BAILEY FORK WETLAND AND STREAM RESTORATION PROJECT (DRAFT)

ANNUAL MONITORING REPORT FOR 2008 (YEAR 3)

Project Number D04006-3

Submitted to:

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1.0 SUMMARY

This Annual Report details the monitoring activities during the 2008 growing season (Monitoring Year 3) on the Bailey Fork Wetland and Stream Restoration Site ("Site"). Construction of the Site, including planting of trees, was completed in April 2006. In accordance with the Restoration Plan for the Site, 21 vegetation monitoring plots, 13 permanent cross-sections, 3 longitudinal profile surveys, and 8 hydrologic monitoring gauges (4 automated and 4 manual) were installed and/or assessed across the restoration site. The 2008 data represent results from the third year of vegetation and hydrologic monitoring for wetlands and streams.

The design for the Bailey Fork Site involved the restoration of a "Piedmont/ Low Mountain alluvial forest" and associated riverine wetlands described by Schafale and Weakley (1990). Prior to restoration, wetland, stream, and buffer functions on the Site were impaired as a result of agricultural conversion. Streams flowing through the Site were channelized many years ago to reduce flooding and provide drainage for adjacent farm fields. After construction, it was determined that 12.1 acres of riverine wetlands and 6,097 linear feet of stream were restored, and 5.3 acres of riverine wetlands and 9,765 linear feet of stream were enhanced.

Weather station data from the Morganton Weather Station (Morganton, NC UCAN: 14224, COOP: 315838) were used in conjunction with a manual rain gauge located on the Site to document precipitation amounts. The manual gauge is used to validate observations made at the automated station. For the 2008 growing season, total rainfall during the monitoring period was above the normal average (approximately 14 inches mores from January 2008 through October 2008). Much of the rain that fell during the 2008 growing season fell during the months of July, August, and September due to tropical systems that moved through the area.

A total of 21 monitoring plots, each 100 square meters (10m x 10m) in size, were used to document survivability of the woody vegetation planted at the Site. Vegetation monitoring documented the average number of surviving stems per acre on site to be 590, which is a survival rate of greater than 85 percent based on the initial planting count of 698 stems per acre. The data reflects that the majority of the Site has met the interim success criteria of 320 trees per acre by the end of Year 3. A lower survival rate in Plot 9 has been documented and the surrounding area will require replanting in early 2009. Overall, the Site is also on track to meet the final success criteria of 260 trees per acre by the end of Year 5 as specified in the Restoration Plan for the Site.

Stream cross-sectional data document that there has been some adjustment to stream dimension since construction. The Year 3 longitudinal profiles showed that some pools have aggraded slightly due to accumulated sediment. The Site experienced at least one bankfull event on all three reaches during 2008. The bankfull measurements collected during Year 3 and the measurements collected during Year 1 of monitoring show that all three restored reaches have met the success criteria for bankfull events for the project. Overall, monitoring indicates that the site is on track to achieve the stream morphology success criteria specified in the Restoration Plan for the Site.

During 2008, all eight wells recorded a hydroperiod of greater than 7 percent during the growing season. Hydrologic data collected from the reference site, an existing wetland system, indicates that the reference site experienced hydroperiods considerably less than the hydroperiods recorded by all eight wells at the restoration site. The performance of the on-site wells is attributed to the more normal rainfall during the 2008 growing season as compared to previous dry years.

The Site exhibited excellent riffle pool sequencing, pattern, and habitat diversity for benthic macroinvertebrates. It is anticipated that continued improvements in biotic indices and an increase in Dominance in Common (DIC) will be seen in future monitoring reports as communities continue to re-establish.

In summary, the Site remains on track to achieve the hydrologic, vegetative and stream success criteria specified in the Restoration Plan for the Site.

2.0 PROJECT BACKGROUND

The Site is located in Burke County, North Carolina (Figure 1). The project is within cataloging unit 03050101. The Site has recently been used for pasture and hay production. In the past, the Site was used for row crop agriculture and pasture. Ditches were installed to increase arable land and improve drainage when the land was under agricultural production. The streams on the Site were channelized and riparian vegetation was cleared in most locations. Wetland and stream functions on the Site had been severely impacted as a result of these land use changes.

The project involved the restoration of 12.1 acres of riverine wetlands, enhancement of 5.3 acres of riverine wetlands, restoration of 6,097 LF of stream, and enhancement of 9,765 LF of stream. Figures 2(a), 2(b), 2(c), and 2(d) summarize the restoration and enhancement zones on the project site. A total of 61 acres of stream, wetland, and riparian buffer are protected through a permanent conservation easement.

2.1 Project Location

The Site is located approximately two miles southwest of the town of Morganton, along Hopewell Road. The Site is divided into two parts by Hopewell Road and I-40. The monitoring entrance for the northern half of the Site is located at a farm gate on the north side of Hopewell Road immediately east of the Bailey Fork bridge crossing. The monitoring entrance for the southern half of the Site is located south of I-40. The entrance is at the end of Flint Avenue which is accessed from Hopewell Road south of the I-40 overpass.

2.2 Mitigation Goals and Objectives

The specific goals for the Bailey Fork Restoration Project were as follows:

- Restore 6,097 LF of stream channel
- Enhance 9,765 LF of stream channel
- Restore 12.1 acres of riparian wetlands
- Enhance of 5.3 acres of existing, riverine wetlands
- Exclude cattle from stream, wetland and riparian buffer areas
- Develop an ecosystem-based restoration design
- Improve habitat functions
- Realize water quality benefits.

2.3 Project Description and Restoration Approach

For analysis and design purposes, the on-site streams were divided into four reaches. The reaches were numbered sequentially, moving from south to north, with unnamed tributaries carrying a "UT" designation. UT1 is a second order stream that begins offsite, flows into the project area from the southwest, and ends at its confluence with Bailey Fork. UT2 is a first order stream that begins offsite, flows into the project area from the west, and ends at its confluence with UT1. UT3 is a second order stream that begins offsite, flows into the project area from the south, and ends at its confluence with the main stem of Bailey Fork. Bailey Fork flows into the project area from the south and ends at the confluence with Silver Creek. The drainage area of the three tributaries ranges from 0.25 square miles (mi^2) to 0.92 mi^2, while the drainage area at

the downstream end of Bailey Fork is 8.3 mi^2. All four reaches were classified as incised and straightened E5 channels prior to restoration activities. Design information is shown in Table 1.

Table 1. Design Approach for Bailey Fork Restoration Site

Bailey Fork Restoration Site: EEP Contract No. D04006-3			
Project Segment or Reach ID	**Mitigation Type ***	**Approach****	**Linear Footage or Acreage**
Reach UT1	R	P1	1,948 ft
Reach UT2	R	P1	923 ft
Reach UT3	R	P1	3,226 ft
Reach UT3	EII	SS	135 ft
Reach Bailey Fork	EII	SS	9,630 ft
Riverine Wetland	R	-	12.1 ac
Riverine Wetland	E	-	5.3 ac

* R = Restoration; EI = Enhancement I; EII = Enhancement II

** P1 = Priority I; P2 = Priority II; SS = Stabilization

Wetland functions on the Site had been severely impaired by agricultural conversion. Streams flowing through the Site were channelized many years ago to reduce flooding and provide drainage for adjacent farm fields. As a result, nearly all wetland functions within the project area were destroyed.

The design for the restored streams involved the construction of new, meandering channels across the agricultural fields. Reaches UT1, UT2, and UT3 were restored to Rosgen "C5" channels with design dimensions based on nearby reference reaches. The enhancement areas along Bailey Fork and UT3 were accomplished through the use of stabilizing in-stream structures in highly eroded areas and additional buffer planting. Wetland restoration of the prior-converted farm fields on the Site involved grading areas of the farm fields and raising the local water table to restore a natural flooding regime. The streams through the Site were restored to a stable dimension, pattern, and profile, such that riparian wetland functions were restored to the adjacent hydric soil areas. Drainage ditches within the restoration areas were filled to decrease surface and subsurface drainage and raise the local water table. Total stream length across the Bailey Fork Restoration Project was increased from approximately 14,076 LF to 15,862 LF.

The designs allow stream flows larger than bankfull flows to spread onto the floodplain, dissipating flow energies and reducing stress on stream banks. In-stream structures were used to control streambed grade, reduce stream bank stress, and promote bedform sequences and habitat diversity. The in-stream structures consisted of root wads, log vanes, log weirs, and rock vanes, which promote a diversity of habitat features in the restored channel. Where grade control was a consideration, constructed riffles or rock cross vanes were installed to provide long-term stability. Stream banks were stabilized using a combination of erosion control matting, bare-root planting, and transplants. Transplants provide living root mass to increase stream bank stability and create holding areas for fish and aquatic biota. Native vegetation was planted across the Site, and the entire restoration site is protected through a permanent conservation easement.

2.4 Project History and Background

The chronology of the Bailey Fork Mitigation Project is presented in Table 2. The contact information for all designers, contractors, and relevant suppliers is shown in Table 3. Relevant project background information is presented in Table 4.

Table 2. Project Activity and Reporting History

Bailey Fork Wetland and Stream Restoration Project: EEP Contract No. D04006-3

Activity or Report	Scheduled Completion	Data Collection Complete	Actual Completion or Delivery
Restoration Plan Prepared	N/A	N/A	Apr-05
Restoration Plan Amended	N/A	N/A	Apr-05
Restoration Plan Approved	N/A	N/A	Apr-06
Final Design – (at least 90% complete)	N/A	N/A	N/A
Construction Begins	Oct-05	N/A	Nov-05
Temporary S&E mix applied to entire project area	Mar-06	N/A	Apr-06
Permanent seed mix applied to entire project area	Mar-06	N/A	Apr-06
Planting of live stakes	Mar-06	N/A	Apr-06
Planting of bare root trees	Mar-06	N/A	Apr-06
End of Construction	Mar-06	N/A	Apr-06
Survey of As-built conditions (Year 0 Monitoring-baseline)	Mar-06	Apr-06	Apr-06
Year 1 Monitoring	Dec-06	Nov-06	Dec-06
Year 2 Monitoring	Dec-07	Nov-07	Dec-07
Year 3 Monitoring	Oct-08	Nov-08	Dec-08
Year 4 Monitoring	Scheduled Oct-09	Scheduled Nov-09	Scheduled Nov-09
Year 5 Monitoring	Scheduled Oct-10	Scheduled Nov-10	Scheduled Nov-10

Table 3. Project Contacts

Bailey Fork Restoration Site: EEP Contract No. D04006-3	
Full Service Delivery Contractor	
EBX Neuse-I, LLC	909 Capability Drive, Suite 3100 Raleigh, NC 27606 Contact: Norton Webster, Tel. 919-829-9909
Designer	
Michael Baker Engineering, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Eng. Kevin Tweedy, Tel. 919-463-5488
Construction Contractor	
River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Will Pedersen, Tel. 919-459-9001
Planting Contractor	
River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Will Pedersen, Tel. 919-459-9001
Seeding Contractor	
River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Will Pedersen, Tel. 919-459-9001
Seed Mix Sources	Mellow Marsh Farm, 919-742-1200
Nursery Stock Suppliers	International Paper, 1-888-888-7159
Monitoring Performers	
Michael Baker Engineering, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518
Stream Monitoring Point of Contact:	Eng. Kevin Tweedy, Tel. 919-463-5488
Wetland Monitoring Point of Contact:	Eng. Kevin Tweedy, Tel. 919-463-5488
Wetland and Natural Resource Consultants, Inc.	3674 Pine Swamp Rd. Sparta, NC 28675
Vegetation Monitoring Point of Contact:	Chris Huysman, Tel. 336-406-0906

Table 4. Project Background

Bailey Fork Restoration Site: EEP Contract No. D04006-3	
Project County:	Burke County, NC
Drainage Area:	
Reach: Bailey Fork	8.3 mi^2
Reach: UT1	0.81mi^2
Reach: UT2	0.24mi^2
Reach: UT3	0.92 mi^2
Estimated Drainage Percent Impervious Cover:	
Reach: Bailey Fork	> 5%
Reach: UT1	> 5%
Reach: UT2	> 5%
Reach: UT3	> 5%
Stream Order:	
Bailey Fork	2
UT1	1
UT2	1
UT3	1
Physiographic Region	Piedmont
Ecoregion	Northern Inner Piedmont
Rosgen Classification of As-Built	C5
Cowardin Classification	Riverine, Upper Perennial, Unconsolidated Bottom
Dominant Soil Types	Refer to Section 3.1 for Soil Descriptions
Bailey Fork	AaA, CvA
UT1	FaC2, HaA, UnB
UT2	FaC2, HaA, UnB
UT3	FaC2, HaA, UnB
Reference site ID	(Remnant channel - Bailey Fork)
USGS HUC for Project and Reference sites	3050101040020
NCDWQ Sub-basin for Project and Reference	03-08-31
NCDWQ classification for Project and Reference	WS-IV
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor?	N/A
% of project easement fenced	100%

2.5 Project Plan

Plans depicting the as-built conditions of the major project elements, location of permanent monitoring cross-sections, locations of hydrologic monitoring stations, and locations of permanent vegetation monitoring plots are presented in Figure 2(a), 2(b), 2(c) and 2(d) of this report.

3.0 VEGETATION MONITORING

3.1 Soil Data

The soil data for the project site are presented in Table 5.

Table 5. Project Soil Types and Descriptions

Bailey Fork Restoration Site: EEP Contract No. D04006-3

Soil Name	Location	Description
Arkaqua**	Main Channel and Floodplain	Arkaqua series consists of somewhat poorly drained soils that formed in loamy alluvium along nearly level floodplains and creeks. Runoff is slow, and permeability is moderate. Soil texture within the profile ranges from loam to clay loam to sandy loam to sandy clay loam.
Colvard CvA	Main Channel and Floodplain	Colvard series consists of very deep, well drained soils that formed in loamy alluvium on floodplains. These soils are occasionally flooded, well drained, and have slow surface runoff and moderately rapid permeability. The surface layer and subsurface layers are loamy sands in texture.
Fairview FaC2	Floodplain	Fairview soil type occurs on nearly level floodplains along creeks and rivers in pastureland. It has a very deep soil profile and moderate permeability. The surface layer and subsurface layers are clay loams in texture, with an increase in clay content starting at about one foot below the surface.
Hatboro* HaA	Floodplain	Hatboro series consists of a very deep soil profile that is poorly drained with moderate permeability. The series primarily consists of silt loams with underlying layers of sandy clay loam. These soils are generally found on floodplains in pastures and woodlands.
Unison UnB	Floodplain	Unison soil type occurs on mountain foot slopes or stream terraces. It generally has a very deep soil profile, is well drained, and is moderately permeable. Uses include cultivated crops, pasture, orchards, and mixed hardwood forests.

Notes:
Source: From Burke County Soil Survey, USDA-NRCS, http://efotg.nrcs.usda.gov
* Hydric "A" soil type
** Hydric "B" soil type

3.2 Description of Vegetation Monitoring

As a final stage of construction, the stream margins and riparian area of the Bailey Fork stream restoration site were planted with bare root trees, live stakes, and a seed mixture of permanent ground cover for herbaceous vegetation. The woody vegetation was planted randomly six to eight feet apart from the top of the stream banks to the outer edge of the project's re-vegetation limits. The tree species planted at the Site are shown in Table 6. The seed mix of herbaceous species applied to the project's riparian area included Soft rush (*Juncus effusus*), Bentgrass (*Agrostis alba),* Virginia wild rye (*Elymus virginicus),* Switch grass (*Panicum virgatum),* Gamagrass, (*Tripsicum dactyloides),* Smartweed (*Polygonum pennsylvanicum),* Little bluestem (*Schizachyrium scoparium),* Devil's beggars tick (*Bidens frondosa),* Lanceleaf tickseed

(*Coreopsis lanceolata),* Deertounge (*Panicum clandestinum),* Big bluestem (*Andropogon gerardii),* and Indian grass (*Sorghastrum nutans).*

This seed mixture was broadcast on the Site at a rate of 15 pounds per acre. All planting was completed in April 2006.

Table 6. Tree Species Planted in the Bailey Fork Restoration Area

Bailey Fork Restoration Site: EEP Contract No. D04006-3			
ID	**Scientific Name**	**Common Name**	**FAC Status**
1	*Betula nigra*	River Birch	FACW
2	*Fraxinus pennsylvanica*	Green Ash	FACW
3	*Platanus occidentalis*	Sycamore	FACW-
4	*Quercus phellos*	Willow oak	FACW-
5	*Quercus rubra*	Red oak	FACU
6	*Quercus michauxii*	Swamp chestnut oak	FACW-
7	*Liriodendron tulipifera*	Tulip poplar	FACW
8	*Celtis laevigata*	Sugarberry	FACW
9	*Diospyros virginiana*	Persimmon	FAC
10	*Nyssa sylvatica*	Blackgum	FAC

At the time of planting, vegetation plots labeled 1 through 21 were established on-site to monitor survival of the planted woody vegetation. Each vegetation plot is 0.025 acre in size, or 10 meters x 10 meters. All of the planted stems inside the plot were flagged to distinguish them from any colonizing individuals and to facilitate locating them in the future.

3.3 Vegetation Success Criteria

As specified in the approved Restoration Plan for the site, data from vegetation monitoring plots should display a surviving tree density of at least 320 trees per acre at the end of Year 3 of monitoring, and a surviving tree density of at least 260, five-year-old trees per acre at the end of Year 5 of the monitoring period. Although the select native canopy species planted throughout the Site are the target woody vegetation cover, up to 20 percent of the Site's established woody vegetation at the end of the monitoring period may be comprised of invading species.

3.4 Results of Vegetative Monitoring

Table 7 presents stem counts of surviving individuals found at each of the monitoring stations at the end of Year 3 of the post-construction monitoring period. Trees within each monitoring plot are flagged regularly to prevent planted trees from losing their identifying marks due to flag degradation. It is important for trees within the monitoring plots to remain marked to ensure accurate annual stem counts and calculations of tree survivability. Volunteer individuals found within the plots are also flagged during this process. Flags are used to tag trees because they do not interfere with the growth of the tree.

Volunteer woody species were observed in some of the vegetation plots, but were deemed too small to tally. If these trees persist into the next growing season, they will be flagged and added

to the overall stems per acre assessment of the site. Sweetgum (*Liquidambar styraciflua*) is the most common volunteer, though med maple (*Acer rubrum*), river birch (*Betula nigra*), and black walnut (*Juglans nigra*) were also observed.

The data reflects that all of the site with the exception of the area surrounding Plot 9, met the minimum success interim criteria of 320 trees per acre by the end of Year 3. The area surrounding Plot 1 and the area surrounding Plots 12 and 13, which were previously flooded by a beaver impoundment, were replanted in the spring of 2008 and new vegetation monitoring plots were established. The area surrounding Plot 9 will require replanting in the spring of 2009. Assuming normal precipitation during the next growing season and successful supplemental planting in the area surrounding Plot 9, the final success criteria of 260 stems per acre at the end of Year five should be achieved.

3.5 Vegetation Observations

After construction of the mitigation project, a permanent ground cover seed mixture of Virginia wild rye (*Elymus virginicus*), switch grass (*Panicum virgatum*), and fox sedge (*Carex vulpinoidea*) was broadcast on the Site at a rate of 15 pounds per acre. These species are present on the restored site. Hydrophytic herbaceous vegetation, including rush (*Juncus effusus*), spike-rush (*Eleocharis obtusa*), Boxseed (*Ludwigia* sp.), and sedge (*Carex* sp.), are observed across the Site, particularly in areas of periodic inundation. The presence of these herbaceous wetland plants helps to confirm the presence of wetland hydrology on the Site.

There are a number of weed species occurring on the site, though none at present seem to be posing a problem for the seeded woody or herbaceous hydrophytic vegetation. Commonly seen weed species include various pasture grasses, ragweed (*Ambrosia artemisiifolia*), goldenrod (*Solidago spp.*), horseweed (*Conyza spp.*), milkweed, and beggars tick (*Bidens spp.*). Any threatening weed species found in the future will be documented and discussed in trimester reports.

3.6 Vegetation Photos

Photographs of the Site showing the on-site vegetation are included in Appendix A of this Report.

Table 7. 2008 (Year 3) Stem Counts for Each Species Arranged by Plot.

Table 7. 2008 Year 3 Stem Counts for Each Species Arranged by Plot **Bailey Fork Restoration Site: EEP Contract No. D04006-3**																						Initial Totals	Year 1 Totals	Year 2 Totals	Year 3 Totals	Year 3% Survival
	Plots																									
Tree Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21					
Betula nigra	0	0	0	0	0	0	0	0	0	0	0	5	4	1	7	4	5	14	3	6	0	44	50	46	49	N/A
Fraxinus pennsylvanica	0	4	2	2	0	0	0	0	0	0	0	4	5	6	0	8	4	0	5	8	6	48	56	47	54	N/A
Platanus occidentalis	2	0	1	9	10	5	8	0	0	9	0	6	4	0	5	0	0	4	2	2	1	54	59	59	68	N/A
Quercus phellos	4	0	4	0	0	2	0	2	0	0	3	0	2	0	0	0	0	0	0	0	0	10	14	11	17	N/A
Quercus rubra	2	1	4	0	2	1	2	0	0	0	4	1	0	0	0	0	0	0	0	0	2	1	20	18	19	N/A
Quercus michauxii	2	0	0	0	0	0	5	2	0	0	0	1	0	0	0	0	0	0	1	0	0	9	11	8	11	N/A
Liriodendron tulipiferra	3	4	0	2	0	0	0	1	0	6	8	0	0	0	0	0	0	0	0	0	0	38	35	22	24	N/A
Celtis laevigata	0	5	0	0	0	0	0	0	3	0	0	0	0	5	4	5	3	0	3	0	5	49	38	33	33	N/A
Diospyros virginiana	1	0	6	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	15	15	N/A
Nyssa sylvatica	4	0	1	0	2	5	0	5	1	0	0	0	2	0	0	0	0	0	0	0	0	26	38	23	20	N/A
Quercus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	N/A
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74	0	0	0	N/A
Stems per plot	18	14	18	17	16	15	15	10	4	15	15	17	17	12	16	17	12	18	14	16	14	362	328	282	310	85.6
Stems per acre	720	560	720	680	640	600	600	400	160	600	600	680	680	480	640	680	480	720	560	640	560	698	624	537	590	

4.0 STREAM MONITORING

4.1 Description of Stream Monitoring

To document the stated success criteria, the following monitoring program was instituted following construction completion on the Site:

Bankfull Events: Three crest gauges were installed on the Site to document bankfull events. The gauges are checked each month to record the highest out-of-bank flow event that occurred since the last inspection. Crest gauge 1 is located on UT1 near station 25+00 (Figure 2(c)). Crest gauge 2 is located on UT2 near station 17+00 (Figure 2(c)). Crest gauge 3 is located on UT3 near station 31+00 (Figure 2(d)).

Cross-sections: Two permanent cross-sections were installed per 1,000 LF of stream restoration work, with one of the locations being a riffle cross-section and one location being a pool cross-section. A total of 13 permanent cross-sections were established across the Site. Each cross-section was marked on both banks with permanent pins to establish the exact transect used. Permanent cross-section pins were surveyed and located relative to a common benchmark to facilitate easy comparison of year-to-year data. The annual cross-section surveys include points measured at all breaks in slope, including top of bank, bankfull, inner berm, edge of water, and thalweg. Riffle cross-sections are classified using the Rosgen stream classification system. Permanent cross-sections for 2008 (Year 3) were surveyed in October 2008.

Longitudinal Profiles: A complete longitudinal profile was surveyed following construction completion to record as-built conditions. The profile was conducted for the entire length of the restored channels (UT1, UT2, and UT3). Measurements included thalweg, water surface, bankfull, and top of low bank. Each measurement was taken at the head of the feature (e.g., riffle, pool, glide). In addition, maximum pool depths were recorded. All surveys were tied to a single, permanent benchmark. A longitudinal survey of 3,000 LF of restored stream length was completed in November 2007 and in October 2008.

Photograph Reference Stations: Photographs are used to visually document restoration success. A total of 52 reference stations were established to document conditions at the constructed grade control structures across the Site, and additional photograph stations were established at each of the 13 permanent cross-sections and hydrologic monitoring stations. The Global Positioning System (GPS) coordinates of each photograph station were noted as additional references to ensure the same photograph location is used throughout the monitoring period. Reference photographs are taken at least once per year.

Each stream bank is photographed at each permanent cross-section photograph station. For each stream bank photo, the photograph view line follows a survey tape placed across the channel, perpendicular to flow (representing the cross-section line). The photograph is framed so that the survey tape is centered in the photograph (appears as a vertical line at the center of the photograph), keeping the channel water surface line horizontal and near the lower edge of the frame. A photograph log of the Site is included in Appendix A of this report.

4.2 Stream Restoration Success Criteria

The approved Restoration Plan requires the following criteria be met to achieve stream restoration success:

- *Bankfull Events*: Two bankfull flow events must be documented within the five-year monitoring period. The two bankfull events must occur in separate years.
- *Cross-sections:* There should be little change in as-built cross-sections. If changes to channel cross-sections take place, they should be minor changes representing a move to increasing stability (e.g., settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio). Cross-sections shall be classified using the Rosgen stream classification method and all monitored cross-sections should fall within the quantitative parameters defined for "C" type channels.
- *Longitudinal Profiles:* The longitudinal profiles should show that the bedform features are remaining stable (not aggrading or degrading). The pools should remain deep with flat water surface slopes and the riffles should remain steeper and shallower than the pools. Bedforms observed should be consistent with those observed in "C" type channels.
- *Photograph Reference Stations*: Photographs will be used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation and effectiveness of erosion control measures. Photographs should indicate the absence of developing bars within the channel, no excessive bank erosion or increase in channel depth over time, and maturation of riparian vegetation.

4.3 Bankfull Discharge Monitoring Results

During 2008, the on-site crest gauge documented the occurrence of at least one bankfull flow event at all three crest gauges during Year 3 of the post-construction monitoring period, as shown in Table 8. Inspection of conditions during site visits revealed visual evidence of out-of-bank flows, confirming the crest gauge readings. The largest on-site stream flow documented by the crest gauges during Year 3 of monitoring was approximately 0.39 feet (4.68 inches) at crest gauge 3 on UT3. The bankfull measurements collected during Year 3 and the measurements collected during Year 1 of monitoring show that all three restored reaches have met the success criteria for bankfull events for the project.

Table 8. Verification of Bankfull Events

Bailey Fork Restoration Site: EEP Contract No. D04006-3			
Date of Data Collection	Date of Occurrence of Bankfull Event	Method of Data Collection	Measurement
1/16/2008	Unknown	Crest Gauge 2 UT2	0.08
3/31/2008	Unknown	Crest Gauge 3 UT3	0.16
10/28/2008	Unknown	Crest Gauge 1 UT1	0.39
10/28/2008	Unknown	Crest Gauge 2 UT2	0.25
10/28/2008	Unknown	Crest Gauge 3 UT3	0.20

4.4 Stream Monitoring Data and Photos

A photograph log of the project showing selected photograph point locations and crest gauge photographs are included in Appendix A of this report. Data and photographs from each permanent cross-section are included in Appendix B of this report.

4.5 Stream Stability Assessment

Table 9 presents a summary of the results obtained from the visual inspection of in-stream structures performed during Year 3 of post-construction monitoring. The percentages noted are a general overall field evaluation of the how the features were performing at the time of the photograph point survey. According to the visual assessment, all features of UT2 and UT3 were performing as designed. The step pool at station 29+00 on UT1 has experienced some minor piping and bank stability is becoming a localized concern, and this will require repair in 2009. The two cross vanes on the upstream portion of Bailey Fork on the south side of I-40 have beaver dams built on the boulder inverts. These beaver dams will require removal. However, the noted issues do not represent a threat to overall channel stability.

Table 9. Categorical Stream Feature Visual Stability Assessment

Bailey Fork Mitigation Site: EEP Contract No. D04006-3

Feature	Performance Percentage					
	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
Riffles	100%	100%	95%	95%		
Pools	100%	100%	95%	100%		
Thalweg	100%	100%	100%	100%		
Meanders	100%	100%	100%	100%		
Bed General	100%	100%	100%	100%		
Vanes / J Hooks etc.	100%	100%	100%	95%		
Wads and Boulders	100%	100%	100%	100%		

4.6 Stream Stability Baseline

The quantitative pre-construction, reference reach, and design data used to determine mitigation approach and prepare the construction plans for the project are summarized in Appendix C. The as-built baseline data that determines stream stability during the project's post construction monitoring period are also summarized in Appendix C.

4.7 Longitudinal Profile Monitoring Results

The Year 3 longitudinal profile was completed in October 2008 and was compared to the data collected during the as-built condition survey data. The longitudinal profile is presented in Appendix B. During Year 3 monitoring, approximately 3,400 LF of channel were surveyed.

According to the Year 3 longitudinal profile of UT1, all pools and riffles from stations 17+50 to 29+65 are at relatively the same elevations as the as-built conditions. However, during Year 2 of monitoring, the pools in this section of UT1 had accumulated sediment. The accumulation of sediment did not result in instability of UT1 and was attributed to below normal rainfall conditions during 2007.

The Year 3 longitudinal profile of UT2 shows that most pools and riffles from stations 10+50 to 19+30 have changed slightly since as-built conditions. It was determined that during Year 3 of monitoring, stations 10+00 to 10+50 and 12+00 to 13+00 have filled in with sediment that has apparently originated off site. This sediment has not caused stream instability, but has decreased the depths of some pools. Also on UT2, stations 13+00 to 14+50 have filled in with less sediment than the aforementioned upstream stations. All stations downstream of 14+50 are relatively similar to the as-built conditions.

The Year 3 longitudinal profile of UT3 also shows that some pools have filled slightly since as-built conditions. Stations 10+00 to 15+00 have remained unchanged or have filled slightly. However, stations 15+50 to 22+00 have filled in significantly with sediment. The Year 3 longitudinal profile of UT3 is similar to the Year 2 longitudinal profile. While pool depths have decreased, pools are still prevalent through the reach and channel stability has not been affected by the accumulated sediment.

All of the longitudinal profiles during Year 3 of monitoring showed some changes in the restored reaches. It is our assessment that these changes do not pose a threat to the stability of the channels.

4.8 Cross-Section Monitoring Results

Year 3 cross-section monitoring data for stream stability were collected during September and October of 2008. The data were compared to baseline stream geometry data collected in April 2006 (as-built conditions), Year 1 monitoring data collected in October 2006 and Year 2 monitoring data collected in November 2007.

The 13 permanent cross-sections along the restored channels (7 located across riffles and 6 located across pools) were re-surveyed to document stream dimension at the end of monitoring Year 3. Data from each of these cross-sections are summarized in Appendix D. The cross-sections show that there have been minor adjustments to stream dimension since construction in April 2006.

Cross-sections 2, 4, 6, 8, 10, and 13 are located across pools found at the apex of meander bends. Survey data from the cross-sections indicate that all pools, except the pool in cross-section 4, have experienced moderate dimensional changes in all reaches since as-built conditions. The fluctuations observed are considered typical for meander pools, as pools fill and scour year to year based on sediment loads and rainfall events.

Cross-sections 1, 3, 5, 7, 9, 11 and 12 are located across riffles located between meander bends. Survey data from these cross-sections indicate that all the riffles have remained relatively stable since Year 2. However, the channel dimensions of cross-section 12 have fluctuated each monitoring year since construction, but has never scoured deeper than the as-built condition.

In-stream structures installed within the restored stream include constructed riffles, rock cross vanes, a rock step-pool, log vanes, log weirs, and root wads. A constructed riffle and a rock step-pool installed on the lower end of UT1, and a constructed riffle installed at the lower end of UT3 step

down the elevation of the restored stream beds to match the existing channel inverts at the confluences of the restored channels and Bailey Fork.

Visual observations of these structures throughout the Year 3 growing season have indicated that the rock structures are functioning as designed and holding their elevation grade. However, minor piping has been noted above a rock step within the rock step-pool sequence on UT1. In this same localized area one stream bank is becoming unstable. The area will be require repair in early 2009.

It was also noted that two rock cross vanes on Bailey Fork Creek at approximate stations 17+00 and 28+50 have been impacted by beaver activity. During a site visit in early November 2008, two beaver dams were observed across the rock inverts on top of the cross vanes. The observer noted that water was flowing around the sides of both dams and over the arms of the structures. The dams will require removal during the winter of 2008/2009 and the area will be monitored for further beaver activity going forward.

Log vanes placed in meander pool areas have provided scour to keep pools deep and provide cover for fish. Log weirs placed in riffle areas have maintained riffle elevations and provided downstream scour holes which provide habitat. Root wads placed on the outside of meander bends have provided bank stability and in-stream cover for fish and other aquatic organisms.

Photographs of the channel were taken throughout the monitoring season to document the evolution of the restored stream geometry (see Appendix A). Herbaceous vegetation is dense along the edges of the restored stream, making it difficult in some areas to photograph the stream channel.

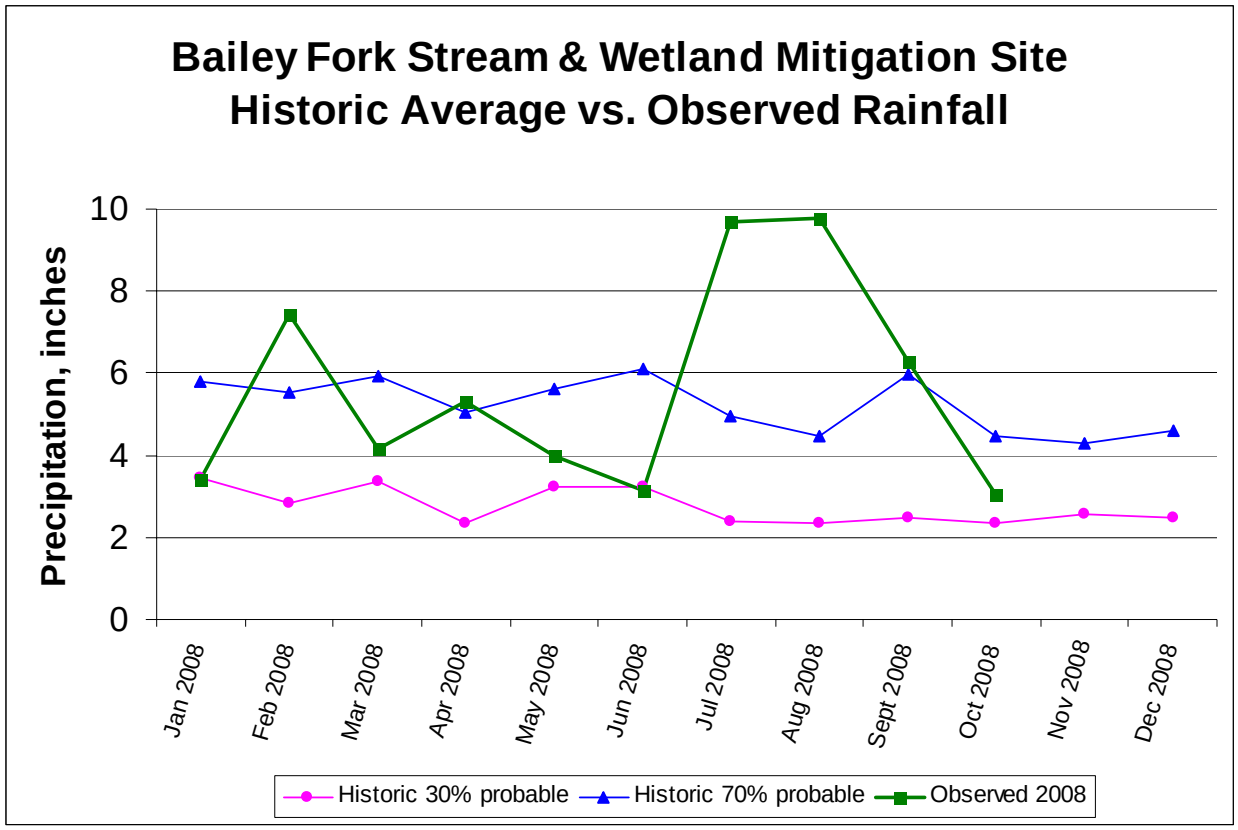
5.0 HYDROLOGY

Weather station data from the Morganton Weather Station (Morganton, NC UCAN: 14224, COOP: 315838) were used in conjunction with a manual rain gauge located on the Site to document precipitation amounts. The manual gauge is used to validate observations made at the automated station. For the 2008 growing season, total rainfall during the monitoring period was above the normal average (from January 2008 through October 2008 rainfall was 14.2 inches above average). Much of the rain that fell during the 2008 growing season fell from July, through September, when evapotranspiration losses were highest (Table 10 and Figure 3).

Table 10. Comparison of Historic Rainfall to Observed Rainfall (inches)
Bailey Fork Mitigation Site: EEP Contract No. D04006-3

Month	Average	30%	70%	Observed 2008 Precipitation
January	4.43	3.45	5.79	3.42
February	4.14	2.83	5.53	7.44
March	4.85	3.36	5.94	4.16
April	3.79	2.36	5.06	5.29
May	4.49	3.22	5.62	4.00
June	4.74	3.25	6.12	3.12
July	3.91	2.38	4.95	9.71
August	3.74	2.36	4.45	9.80
September	4.18	2.48	5.98	6.29
October	3.84	2.03	4.76	3.05
November	3.79	2.55	4.27	NA
December	3.72	2.48	4.59	NA
Total:	49.62	--	--	56.28 (through Sept 08)

Figure 3. Historic Average vs. Observed Rainfall



The Bailey Fork Restoration Plan specified that eight monitoring wells (four automated and four manual) would be established across the restored site. A total of eight wells (four automated and four manual) were installed during early-March 2006 to document water table hydrology in all required monitoring locations. All wells are located in the restored wetland areas adjacent to UT3, and the locations of monitoring wells are shown on the as-built plan sheets. Hydrologic monitoring results are shown in Table 11. A photograph log of the wetland well monitoring stations is included in Appendix A of this report.

During 2008, all eight wells recorded hydroperiods of greater than 7 percent during the growing season. Hydrologic data collected from the reference site, an existing wetland system, indicates that the reference site experienced hydroperiods considerably less than the hydroperiods recorded by all eight wells at the restoration site. The performance of the on-site wells is attributed to more normal rainfall during the 2008 growing season as compared to previous dry years.

Table 11
Hydrologic Monitoring Results for 2008 (Year 3)
Bailey Fork Mitigation Site: EEP Contract No. D04006-3

Monitoring Station	Most Consecutive Days Meeting Criteria[1]	Cumulative Days Meeting Criteria[2]	Number of Instances Meeting Criteria[3]
AW1	22 (10.6%)	35 (16.8%)	3
AW2	21 (10.1%)	33 (15.9%)	3
AW3	39 (18.8%)	45 (21.6%)	2
AW4	52 (25.0%)	65 (31.3%)	3
MW1[4]	21 (10.1%)	33 (15.9%)	3
MW2[4]	21 (10.1%)	33 (15.9%)	3
MW3[5]	39 (18.8%)	45 (21.6%)	2
MW4[6]	52 (25.0%)	65 (31.3%)	3
REF1	7 (3.4%)	9 (4.3%)	2
REF2	3 (1.44%)	4 (1.9%)	2

[1] Indicates the most consecutive number of days within the monitored growing season with a water table less than 12 inches form the soil surface.

[2] Indicates the cumulative number of days within the monitored growing season with a water table less than 12 inches from the soil surface.

[3] Indicates the number of instances within the monitored growing season when the water table rose to less than 12 inches from the soil surface.

[4] Groundwater gauge MW1 and MW2 are manual gauges. Hydrologic parameters are estimated based on data from gauge AW2.

[5] Groundwater gauge MW3 is a manual gauge. Hydrologic parameters are estimated based on data from gauge AW3.

[6] Groundwater gauge MW4 is a manual gauge. Hydrologic parameters are estimated based on data from gauge AW4.

6.0 BENTHIC MACROINVERTEBRATE MONITORING

6.1 Description of Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrate monitoring was conducted in accordance with the Bailey Fork Restoration Plan. Because of seasonal fluctuations in populations, macroinvertebrate sampling must be consistently conducted in the same season. Benthic sampling for the Site was conducted during January 2008. This report summarizes the benthic samples collected during the second year post-construction monitoring phase.

The sampling methodology followed the Qual 4 method listed in NCDWQ's Standard Operating Procedures for Benthic Macroinvertebrates (2006). Field sampling was conducted by Carmen McIntyre and Matthew Reid of Baker. Laboratory identification of collected species was conducted by David Lenat, of Lenat Consulting Services.

Benthic macroinvertebrate samples were collected at Sites 1 and 2 of the Bailey Fork project on January 8, 2008 and Sites 3 and 4 on January 23, 2008. Sites 1 and 3 were located within the restoration area on UT1 to Bailey Fork and UT3 to Bailey Fork, respectively. Site 2 was an offsite reference location upstream of Site 1. Site 4 was an offsite reference location on UT3 south of Hopewell Road upstream of Site 3. Figure 1 illustrates the sampling site locations.

Benthic macroinvertebrates were collected to assess quantity and quality of life in the stream. In particular, specimens belonging to the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) (EPT Species) are useful as an index of water quality. These groups are generally the least tolerant to water pollution and therefore are very useful indicators of water quality. Sampling for these three orders is referred to as EPT sampling.

Habitat assessments using NCDWQ's protocols were also conducted at each site. Physical and chemical measurements including water temperature, percent dissolved oxygen, dissolved oxygen concentration, pH, and specific conductivity were recorded at each site. The habitat assessment field data sheets are presented in Appendix E.

6.2 Benthic Macroinvertebrate Sampling Results

A comparison between the pre- and post-construction monitoring results is presented in Table 12 with complete results presented in Appendix E.

Table 12. Summary of Pre-Restoration vs. Post-Restoration Benthic Macroinvertebrate Sampling Data
Bailey Fork Mitigation Site: EEP Contract No. D04006-3

	Site 1			Site 2			Site 3			Site 4		
	UT1 to Bailey Fork (Restoration)			UT1 to Bailey Fork (Reference)			UT3 to Silver Creek (Restoration)			UT3 to Silver Creek (Reference)		
	Pre	Year 1	Year 2	Pre	Year 1	Year 2	Pre	Year 1	Year 2	Pre	Year 1	Year 2
	1/3/05	1/10/07	1/8/08	1/4/05	1/17/07	1/8/08	1/3/05	1/9/07	1/23/08	1/5/05	1/10/07	1/23/08
Total Taxa Richness	30	35	33	26	34	20	10	26	19	20	14	9
EPT Taxa Richness	14	15	18	16	20	13	1	4	2	9	5	3
Total Biotic Index	4.27	6.33	5.1	4.09	4.3	4.75	7.8	7.87	7.96	4.18	5.75	4.53
EPT Biotic Index	3.71	4.95	4.63	3.41	3.65	4.63	6.2	6.55	6.15	2.74	2.81	3.3
Dominance in Common (%)	n/a	40	86	n/a	n/a	n/a	n/a	50	0	n/a	n/a	n/a
Total Shredder/Scraper Index	6/4	4/3	3/5	7/3	5/3	2/5	0/1	6/3	1/1	3/2	2/2	2/0
EPT Shredder/Scraper Index	3/3	1/2	2/4	4/2	2/2	1/3	0/0	0/1	0/0	1/2	0/1	0/0
Habitat Assessment Rating	51	82	73	65	70	72	37	74	67	53	51	63
Water Temperature (˚C)	n/a	8	10.3	n/a	8.4	7.9	n/a	6.7	6.6	n/a	6.6	7.9
% Dissolved Oxygen (DO)	n/a	42.7	n/a	n/a	32.1	n/a	n/a	n/a	n/a	n/a	51.7	n/a
DO Concentration (mg/l)	n/a	5.05	11.96	n/a	3.76	11.35	n/a	4.7	13.59	n/a	6.35	10.79
pH	n/a	6.04	7.8	n/a	5.97	7.8	n/a	5.93	7.4	n/a	5.95	7.02
Conductivity (µmhos/cm)	n/a	40	50	n/a	50	80	n/a	60	80	n/a	70	80

6.3 Benthic Macroinvertebrate Sampling Discussion

At Site 2, the reference site for Site 1, the Year 2 post-construction community structure and ecological habitat appears to be similar to that observed during the pre-construction monitoring period. Site 2 showed a decrease in both overall and EPT taxa richness and an increase in total and EPT biotic indices. The higher indices could be attributed to the decrease in overall shredder taxa observed during the recent post-construction monitoring. Despite the increase in biotic indices at Site 2, several of the EPT species that were common or abundant in the pre-construction sample, such as *Stenonema pudicum*, *Eccoptera xanthenes*, and *Pycnopsyche spp*. (tolerance values of 2.0, 3.7, and 2.5, respectively) were also common or abundant in the post-construction sample. This suggests that the communities are stable and that water quality is adequate to support intolerant species.

Site 1, which underwent complete restoration, exhibited slight increases in overall and EPT taxa richness, as well as an increased overall biotic index from pre-construction to Year 2 of post-construction. This suggests that although more species were present (assumedly from increase variety of habitat as provided by designed restoration) these species were slightly more tolerant than previous communities. However, from Year 1 to Year 2, overall and EPT biotic indices decreased suggesting that water quality is returning to pre-construction conditions. The EPT biotic indices at both Site 1 the restoration site, and Site 2, the reference site, were 4.63. Year 2 post-construction shredder taxa slightly decreased from the pre-construction conditions. These organisms feed on partially decomposed organic matter such as sticks and leaf packs, a rare habitat (see Habitat Assessments, below). The decrease in sensitive species and lack of shredders are common responses after a major disturbance to habitat such as the in-stream construction techniques implemented on Site 1. It is anticipated that as the project matures shredder populations will increase as more habitat in the form of snags, logs, and leaf packs become available.

Currently Site 1 has 86 percent Dominance in Common (DIC) compared to the reference site, which indicates that 86 percent of the dominant communities at the reference site are dominant at Site 1. In pre-construction conditions, Site 1 had a DIC of 41 percent. This indicates that post-construction recolonization from refugia upstream (represented at Site 2) has taken place. Site 2 is on track for success.

Site 4 was the reference reach for Site 3. The second year of post construction monitoring showed that total taxa and EPT taxa richness are still below the pre-construction values. The decrease in both values may indicate stress on the stream. The overall and EPT biotic index were still above the pre-construction values, indicating that more tolerant species were surviving or colonizing. Extreme drought conditions during 2007 could attribute to the decrease in taxa richness and increase biotic indices if the stream stopped flowing at Site 4.

Site 3 was recovering from backwater conditions caused by a beaver dam during Year 1 of post-construction monitoring. The stagnant water conditions are likely the cause of the decrease in total and EPT taxa richness from Year 1 to Year 2 of post construction monitoring. A dramatic decrease in the shedder population was also observed. The decline in shredder population is likely the result of backwater conditions that appear to have decreased the amount of available organic material between Year 1 and Year 2. An increase in fine sediment deposition was also noted during Year 2 monitoring at Site 3. The increase in fine sediment suggests a likely

decrease in available habitat. Although overall richness values decreased the total and EPT biotic indices stayed relatively the same as in pre-construction conditions. Currently Site 3 has 0 percent DIC with the reference site, down from 50 percent after Year 1 of post construction and 10 percent in pre-construction conditions. The decrease is DIC likely correlates to the prolonged backwater conditions that decreased available riffle habitat at Site 3. It is anticipated that Site 3 will rebound and improvements in biotic indices and an increase in DIC will be seen in future monitoring reports as communities reestablish.

6.4 Habitat Assessment Results and Discussion

Site 1 received a 73 on the Habitat Assessment Field Data Sheet. The site exhibited excellent riffle pool sequencing and pattern. Riffles were mostly gravel and cobbles, moderately embedded with sand, and the pool bottoms were sandy. Site 1has a riparian buffer that is classified as fallow field with immature hardwood saplings scattered throughout. Because there was very little woody vegetation directly adjacent to the channel, organic habitats such as sticks and leaf packs were absent at Site 1. The lack of organic habitats is still likely the cause for the decrease in shredder communities from pre-construction monitoring to post-construction monitoring. It is anticipated that as the riparian buffer grows in, the shredders from the upstream reference site (Site 2) will begin to colonize the restoration reach.

Site 2, the reference reach for Site 1, received a habitat assessment score of 72. The reach exhibited riffle pool sequencing with moderate bank erosion on alternating banks. The riparian buffer was mature and intact along most of the reach. Rocks, sticks, leaf packs, snags and undercut banks were all present along this reach; however large substrate in riffles was often embedded by sand. Bottoms of pools were sandy and filling in. As stated above, the ecological habitat observed during this monitoring cycle appears to be very similar to the pre-construction conditions.

Site 3 received a habitat assessment score of 67 during the Year 2 post-construction monitoring period. The site exhibited excellent riffle pool sequencing and pattern. In-stream habitat was diverse but not abundant. Rocks and macrophytes were the common types of habitat. Site 3 experienced backwater conditions throughout much of the Year 2 monitoring period. The stagnant water was a result of a downstream beaver dam. At the time of Year 2 benthic sampling the dam had been removed but left behind fine sediment along the bed and banks in the vicinity of Site 3. The fine sediment covered portions of the riffle substrate. The prolonged backwater also drowned vegetation along the banks. Rocks, sticks, and leaf packs, and root mats from the root wads were present but not common in the sampling area.

Site 4, the reference reach for Site 3, received a habitat assessment score of 63. The riparian zone was mature forest and intact. Rocks, sticks, leaf packs, logs, and undercut banks were present throughout the reach however riffle substrate was embedded with sand. Pool bottoms were sandy. The reach had areas of severe bank erosion. This reach scored a 53 in the pre-construction monitoring report, so it appears that the habitat is similar to pre-construction conditions. Despite the low habitat assessment score, this reach continues to have a very low EPT biotic index, indicating that the water quality is high enough to support fairly intolerant species.

The restoration of pattern and dimension as well as the addition of several root wads, vanes, and armored riffles has enhanced the overall in-stream habitat throughout the restoration Site, while

the reference reaches appeared ecologically stable. The habitat scores at Sites 1 and 3 decreased slightly from the scores collected in Year 1 monitoring. The decrease of the habitat score at Site 1, is likely the result of different evaluators conducting the assessments. The decrease in the habitat score at Site 3 is a result of the prolonged backwater conditions stemming from a downstream beaver dam. The fine sediment covered up available habitat and drowned some of the streambank vegetation. The planted riparian vegetation has had minimal effect on in-stream habitat at Sites 1 and 3; however, future contributions from planted riparian vegetation will be evident as the woody plant species mature. Contributions will include in-stream structures such as sticks and leaf packs.

The physical and chemical measurements of water temperature, percent dissolved oxygen, dissolved oxygen concentration, pH, and specific conductivity at all sites were relatively normal for Piedmont streams with the above noted exceptions.

6.5 Photograph Log

The photograph log is attached as Appendix B. Photos P-1 and P-2 show the stable, well defined riffle pool sequence at Site 1. Site 1 lacks a mature forested canopy; however young woody vegetation is present along the banks. Photos P-3 and P-4 show the mature canopy with breaks for light penetration at Site 2. Site 3 is shown in P-5 and P-6. The lack of vegetation along the streambanks caused by the prolonged backwater conditions is visible is P-5. P-7 and P-8 are upstream and downstream views of Site 4. These photos show the extreme bank erosion affecting the right bank of the stream. Despite the erosion, the varied habitat types are visible, including rocks, logs, undercut banks, and leafpacks.

7.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

Vegetation Monitoring. For the 21 monitoring plots, surviving planted stems ranged from 160 stems per acre to 720 stems per acre with an overall average of 590 stems per acre. The data documents that most of the Site has met the minimum success interim criteria of 320 trees per acre by the end of Year 3 and is on track to meet the final success criteria of 260 trees per acre by the end of Year 5 as specified in the Restoration Plan for the Site. The area surrounding Plot 9 will require replanting in the spring of 2009.

Overall, the Site is on track to achieve the vegetative success criteria specified in the Restoration Plan for the Site.

Stream Monitoring. The entire length of the restored stream channel was inspected during Year 3 of the monitoring period to assess stream performance.

Stream cross-sectional data document that there has been some adjustment to stream dimension since construction, but the adjustments are considered typical for newly restored stream systems and not an indicator of instability. The Year 3 longitudinal profiles showed that some pools have filled slightly due to accumulated sediment. It is likely that these sediments are present in the pools due to the persistent vegetation growth within the restored channels. Therefore, the vegetation is limiting pool scour due to low flow velocities. All of the longitudinal profiles during Year 3 of monitoring showed some changes in the restored reaches. It is our assessment that these changes do not pose a threat to the stability of the channels

It was also noted that two rock cross vanes on Bailey Fork Creek approximately at stations 17+00 and 28+50 have been impacted by beaver activity. During a site visit in early November 2008 two beaver dams were observed across the rock inverts on top of the cross vanes. Water was flowing around the sides of both dams and over on the arms of the structures. The dams will require removal during the winter of 2008/2009.

The Site experienced at least one bankfull event on all 3 reaches during the 2008 growing season. The bankfull measurements collected during Year 3 and the measurements collected during Year 1 of monitoring show that all three restored reaches have met the success criteria for bankfull events for the project.

Overall, the site is on track to achieve the stream morphology success criteria specified in the Restoration Plan for the Site.

Hydrologic Monitoring. During 2008, all eight wells recorded a hydroperiod of greater than 7 percent saturation during the growing season. Hydrologic data collected from the reference site, an existing wetland system, indicates that the reference site experienced hydroperiods considerably less than the hydroperiod recorded by all eight wells at the restoration site. The performance of the on-site wells is attributed to the more normal rainfall during the 2008 growing season as compared to previous dry years.

Overall, the Site is on track to achieve the hydrologic success criteria specified in the Restoration Plan for the Site.

Benthic Monitoring. The Site exhibited excellent riffle pool sequencing, pattern, and habitat diversity. The physical and chemical measurements of water temperature, percent dissolved oxygen, dissolved oxygen concentration, pH, and specific conductivity at all sites were relatively normal for Piedmont streams. It is anticipated that continued improvements in biotic indices and an increase in DIC will be seen in future monitoring reports as communities continue to re-establish.

In summary, the Site remains on track to achieve the hydrologic, vegetative and stream success criteria specified in the Restoration Plan for the Site and monitoring will continue in 2009.

8.0 WILDLIFE OBSERVATIONS

Observations of deer and raccoon tracks are common on the Bailey Fork Site. During certain times of the year, frogs, turtles and fish have been observed.

9.0 REFERENCES

NCDWQ's Standard Operating Procedures for Benthic Macroinvertebrates (2006)

Rosgen, D.L. 1994. *A Classification of Natural Rivers*. Catena 22: 169-199.

Schafale, M.P., and A.S.Weakley. 1990. *Classification of the Natural Communities of North Carolina, Third Approximation*. North Carolina Natural Heritage Program, Division of Parks and Recreation. NCDEHNR. Raleigh, NC.

USDA, NC Agricultural Experiment Station, *Soil Survey of Burke County, North Carolina*, 2006.

FIGURES

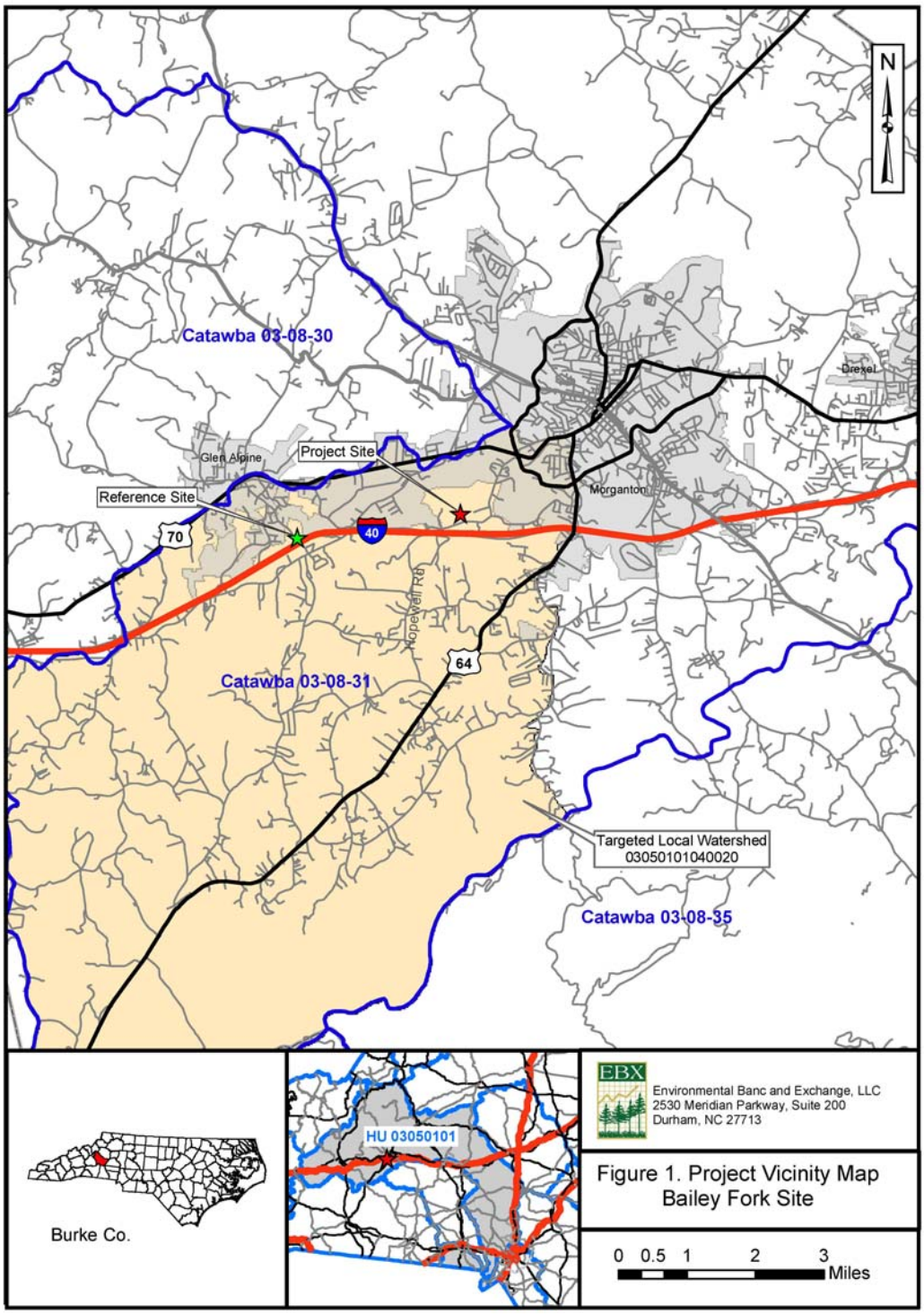


Figure 1. Location of Bailey Fork Stream Mitigation Site.

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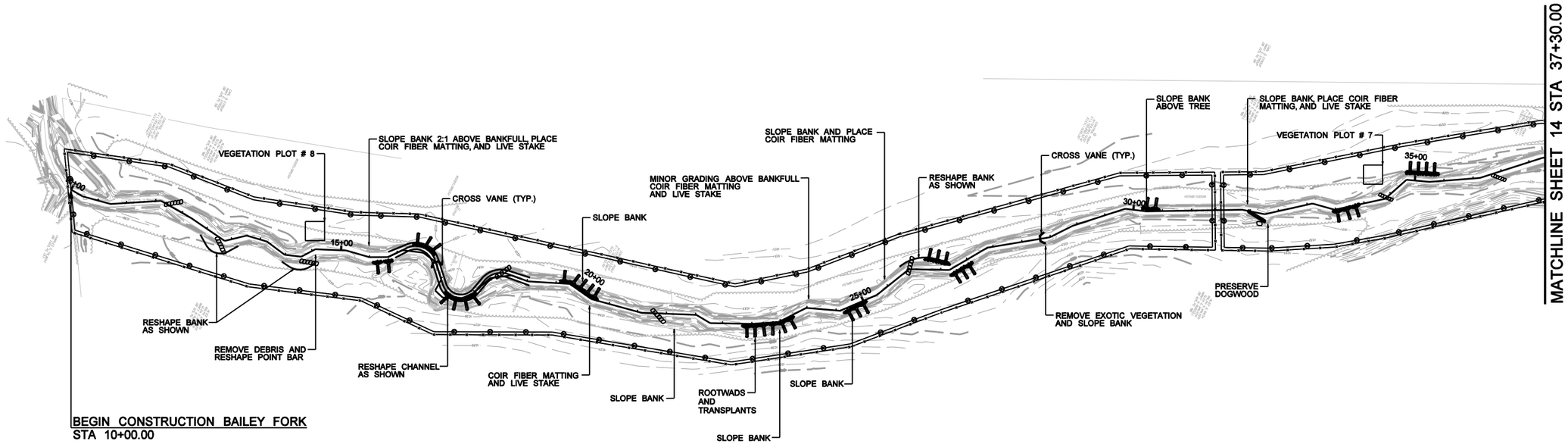

FIGURE: 2A

PLAN VIEW

100 50 0 100 200
SCALE (FT)

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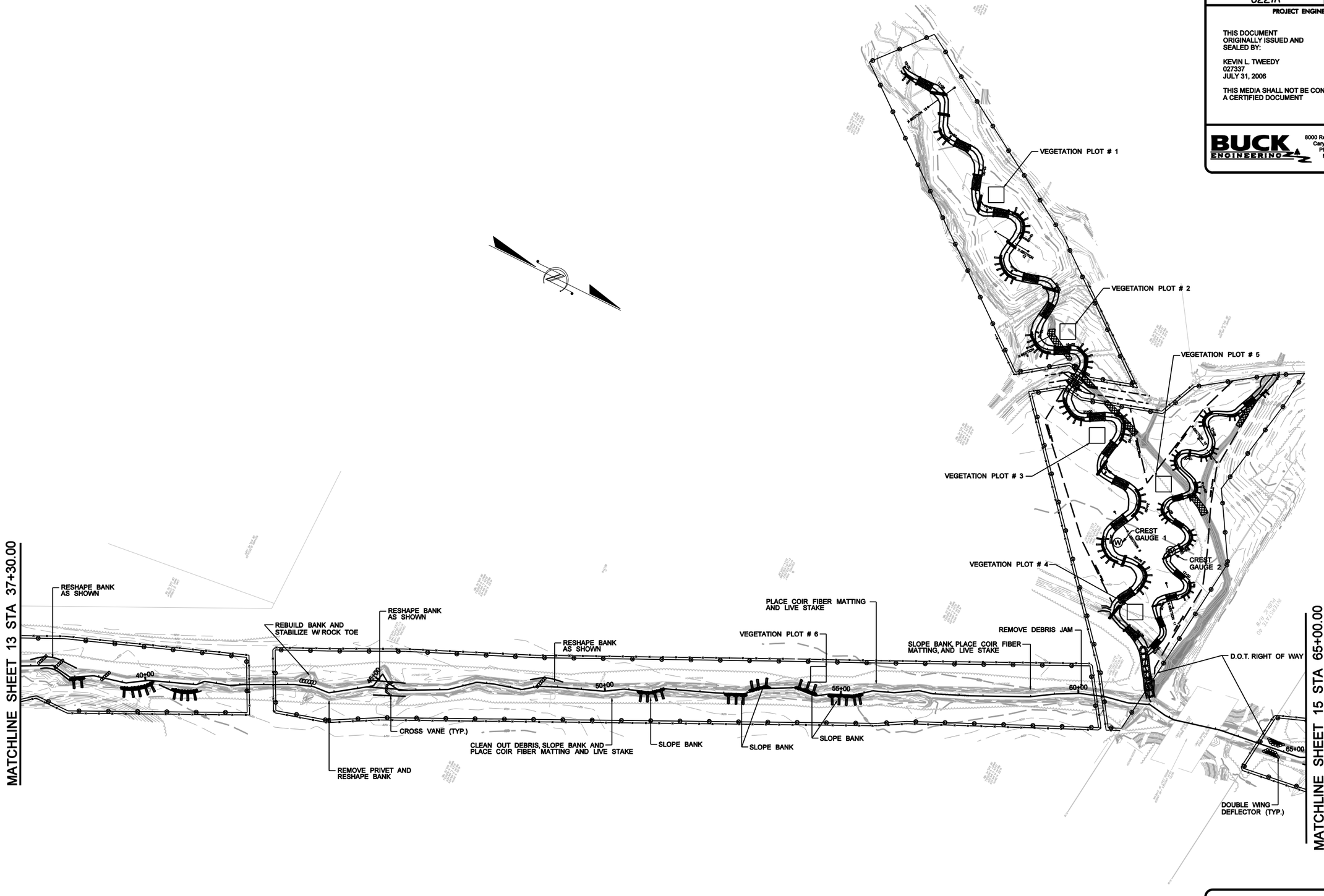

FIGURE: 2B
CROSS SECTION NUMBERING CHANGED 11-20-07

PLAN VIEW

100 50 0 100 200
SCALE (FT)

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Fax: 919-463-5490

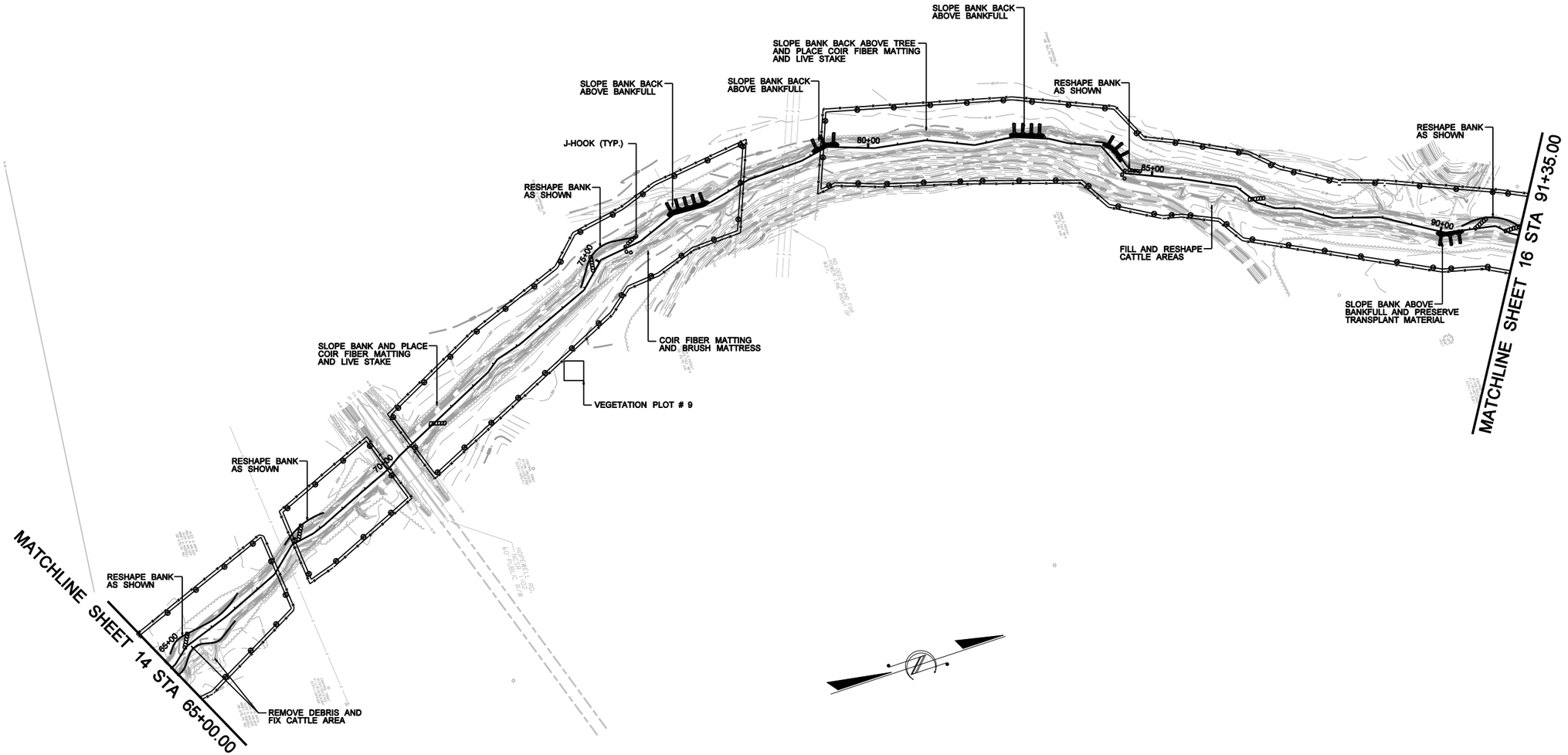

FIGURE: 2C

PLAN VIEW

100 50 0 100 200
SCALE (FT)

2/26/03

BUCK PROJECT REFERENCE NO.	SHEET NO.
0221R	16

PROJECT ENGINEER

THIS DOCUMENT
ORIGINALLY ISSUED AND
SEALED BY:

KEVIN L. TWEEDY
027337
JULY 31, 2006

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BUCK ENGINEERING
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Cary, North Carolina 27511
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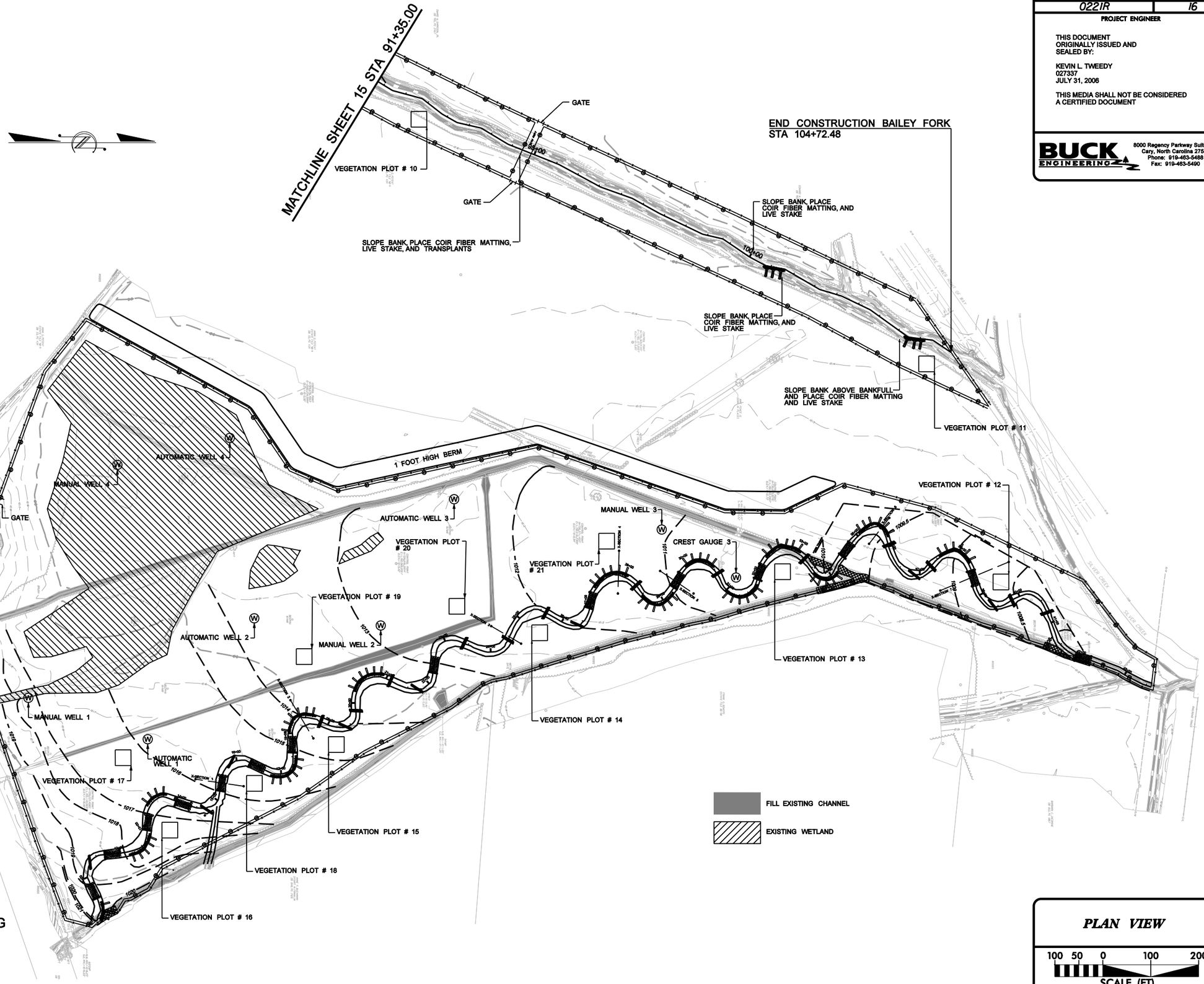


FIGURE: 2D
CROSS SECTION NUMBERING
CHANGED 11-20-07

PLAN VIEW

100 50 0 100 200
SCALE (FT)

IK/26/2007
R:\0221R\Design\As-built\0221R_AB_EBX_psh_16.dgn

APPENDIX A

PHOTO LOG

VEGETATION PHOTOS

Bailey Fork Vegetation Plot 1

Bailey Fork Vegetation Plot 2

Bailey Fork Vegetation Plot 3

Bailey Fork Vegetation Plot 4

Bailey Fork Vegetation Plot 5

Bailey Fork Vegetation Plot 6

Bailey Fork Vegetation Plot 7

Bailey Fork Vegetation Plot 8

Bailey Fork Vegetation Plot 9

Bailey Fork Vegetation Plot 10

Bailey Fork Vegetation Plot 11

Bailey Fork Vegetation Plot 12

Bailey Fork Vegetation Plot 13

Bailey Fork Vegetation Plot 14

Bailey Fork Vegetation Plot 15

Bailey Fork Vegetation Plot 16

Bailey Fork Plot Vegetation 17

Bailey Fork Vegetation Plot 18

Bailey Fork Vegetation Plot 19

Bailey Fork Vegetation Plot 20

Bailey Fork Vegetation Plot 21

STREAM PHOTOS AND WETLAND PHOTOS

UT1 Photo Point 1

UT1 Photo Point 2

UT1 Photo Point 3

UT1 Photo Point 5

UT1 Photo Point 7

UT1 Photo Point 10

UT1 Photo Point 13

UT1 Photo Point 17

UT1 Photo Point 19

UT2 Photo Point 1

UT2 Photo Point 3

UT2 Photo Point 6

UT2 Photo Point 8

UT2 Photo Point 12

UT3 Photo Point 1

UT3 Photo Point 4

UT3 Photo Point 7

UT3 Photo Point 10

UT3 Photo Point 12

UT3 Photo Point 15

UT3 Photo Point 18

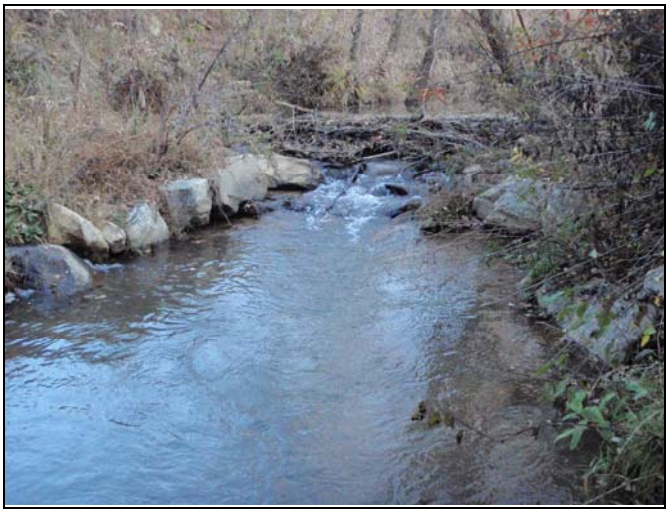
UT3 Photo Point 19

UT3 Photo Point 22

UT3 Photo Point 24

UT3 Photo Point 25

UT3 Photo Point 26



Bailey Fork Cross Vane 1, beaver dam across invert

Bailey Fork Cross Vane 2, beaver dam across invert

Crest Gauge UT3 10/28/08

Crest Gauge UT2 10/28/08

Crest Gauge UT1 10/28/08

Auto Well 1 - East

Auto Well 1 - North

Auto Well 1 – South

Auto Well 1 - West

Auto Well 2 - East

Auto Well 2 - North

Auto Well 2 - South

Auto Well 2 - West

Auto Well 3 - East

Auto Well 3 - North

Auto Well 3 - South

Auto Well 3 - West

Auto Well 4 - East

Auto Well 4 - North

Auto Well 4 - South

Auto Well 4 - West

Manual Well 1 - East

Manual Well 1 - North

Manual Well 1 - South

Manual Well 1 - West

Manual Well 2 - East

Manual Well 2 - North

Manual Well 2 - South

Manual Well 2 - West

Manual Well 3 - East

Manual Well 3 - North

Manual Well 3 - South

Manual Well 3 - West

Manual Well 4 - East

Manual Well 4 - North

Manual Well 4 - South

Manual Well 4 - West

Bailey Fork Reference Well 1 - East

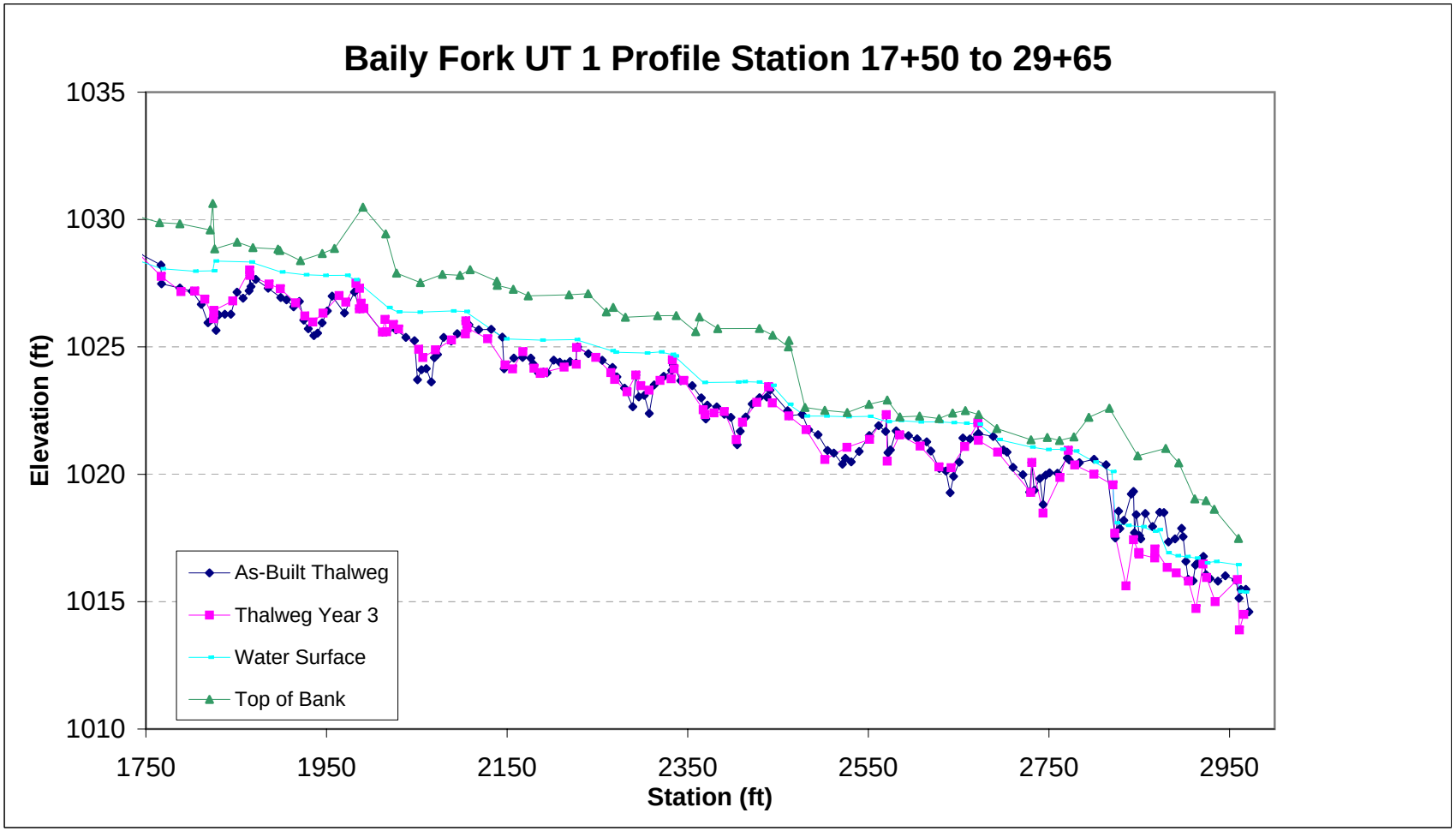
Bailey Fork Reference Well 1 - North

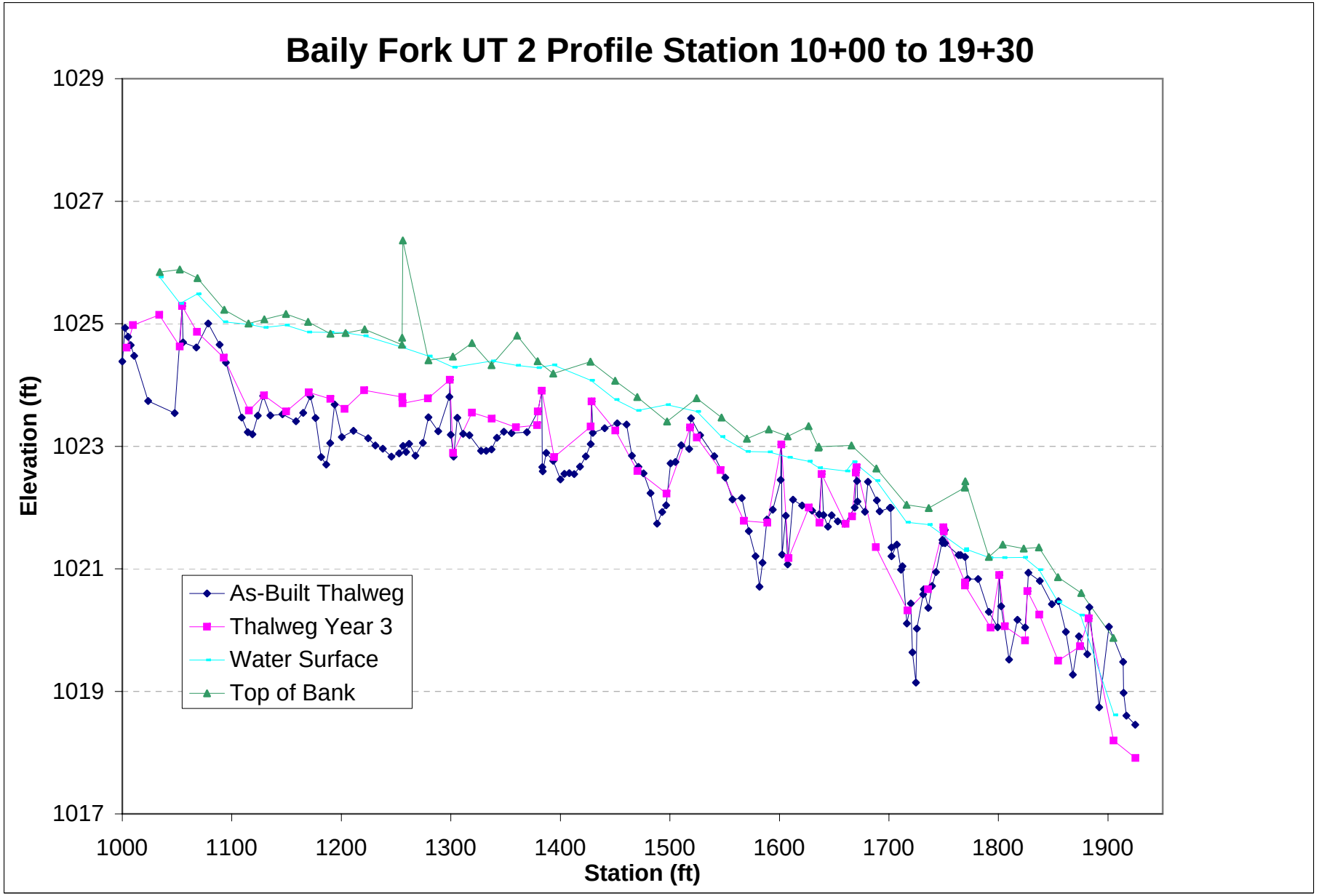
Bailey Fork Reference Well 1 - South

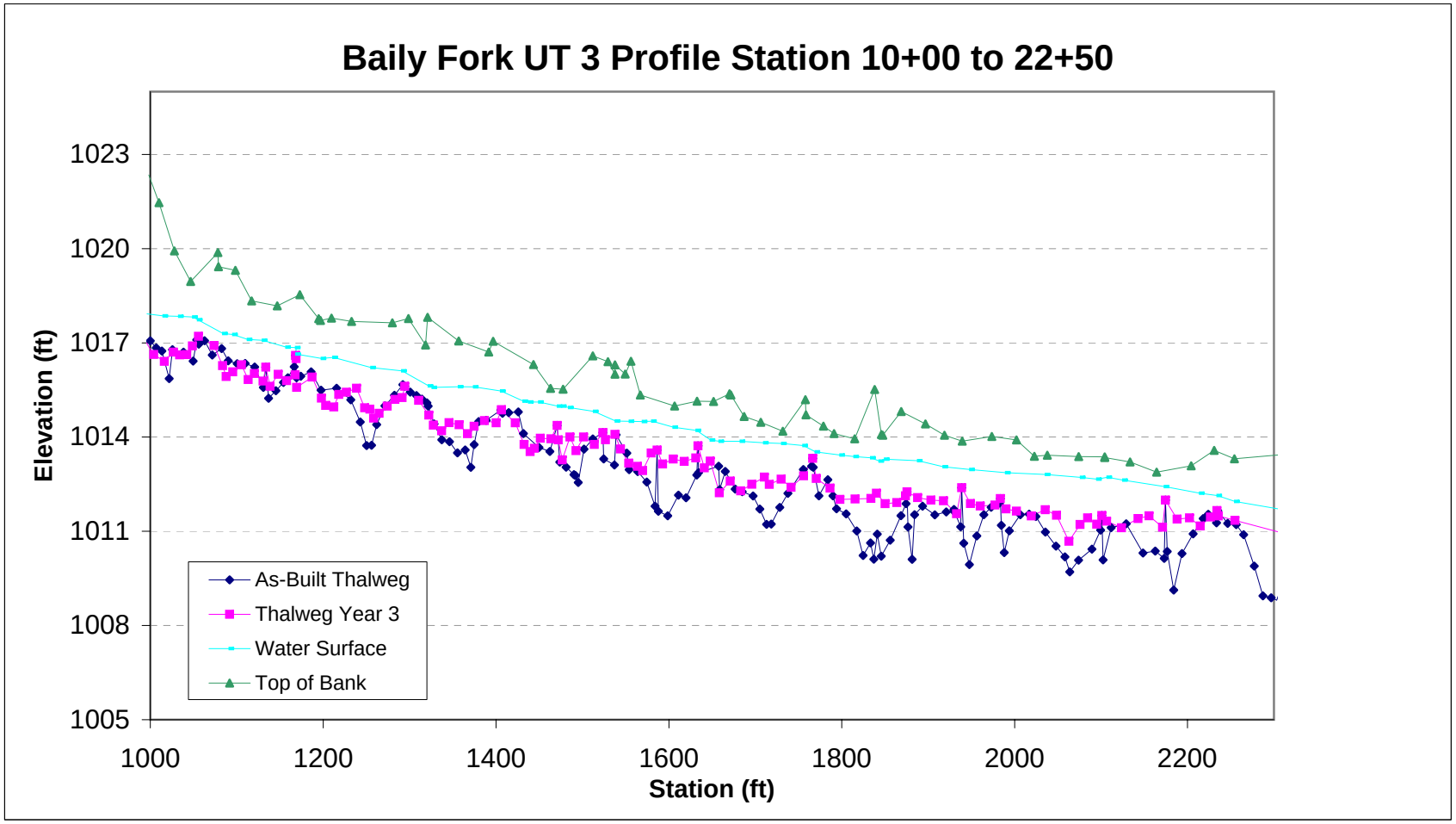
Bailey Fork Reference Well 1 - West

APPENDIX B

STREAM MONITORING DATA


Baily Fork UT 1 Profile Station 17+50 to 29+65
1035
1030
1025
1020
1015
1010
Elevation (ft)
1750
1950
2150
2350
2550
2750
2950
Station (ft)
As-Built Thalweg
Thalweg Year 3
Water Surface
Top of Bank


Baily Fork UT 2 Profile Station 10+00 to 19+30
Elevation (ft)
1029
1027
1025
1023
1021
1019
1017
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
Station (ft)
As-Built Thalweg
Thalweg Year 3
Water Surface
Top of Bank


Baily Fork UT 3 Profile Station 10+00 to 22+50
Elevation (ft)
1023
1020
1017
1014
1011
1008
1005
1000
1200
1400
1600
1800
2000
2200
Station (ft)
As-Built Thalweg
Thalweg Year 3
Water Surface
Top of Bank

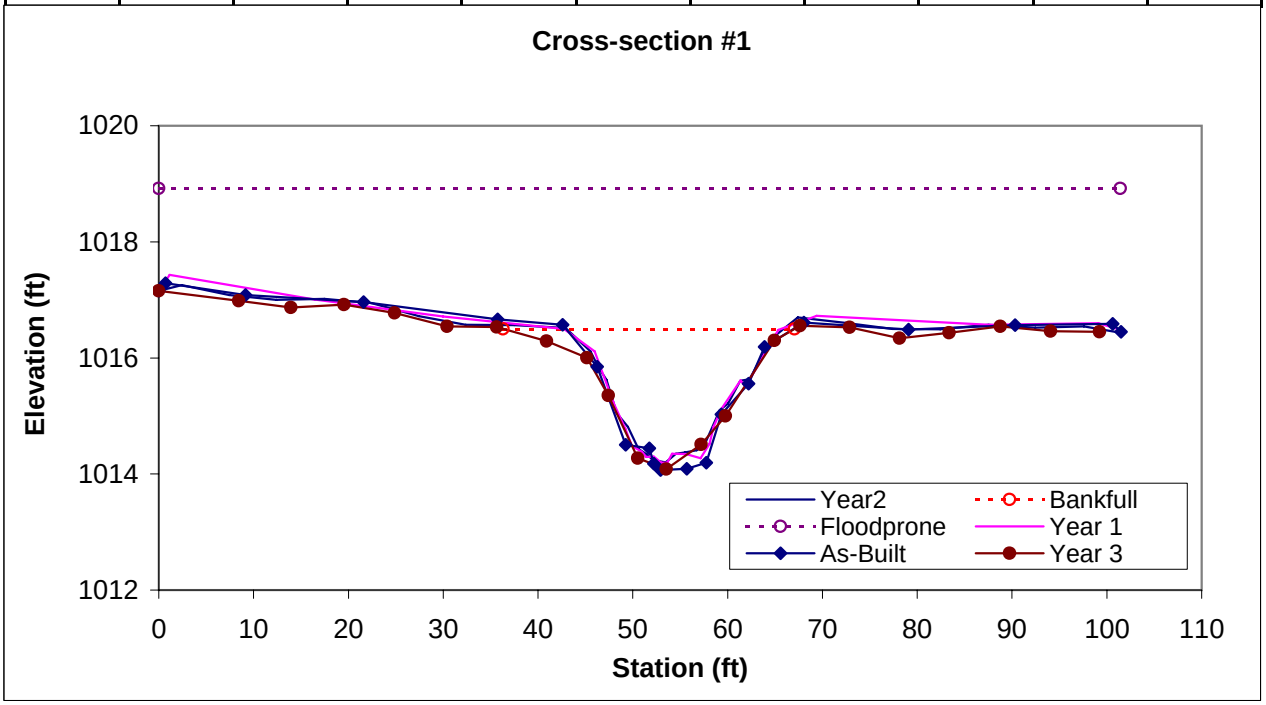
Permanent Cross-section #1 UT3

(Year 3 Data - Collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	33.3	30.72	1.08	2.42	28.37	1	3.3	1016.5	1016.53



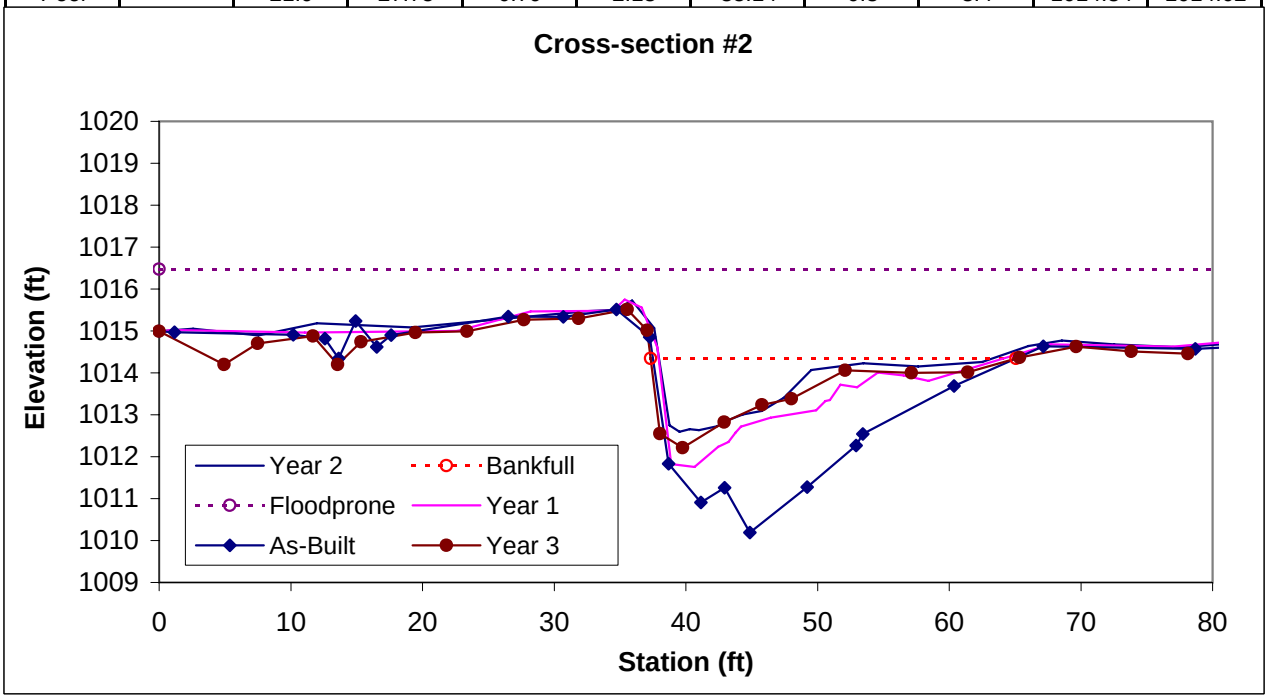
Permanent Cross-section #2 UT3

(Year 3 Data - Collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		21.9	27.75	0.79	2.13	35.14	0.8	3.4	1014.34	1014.02



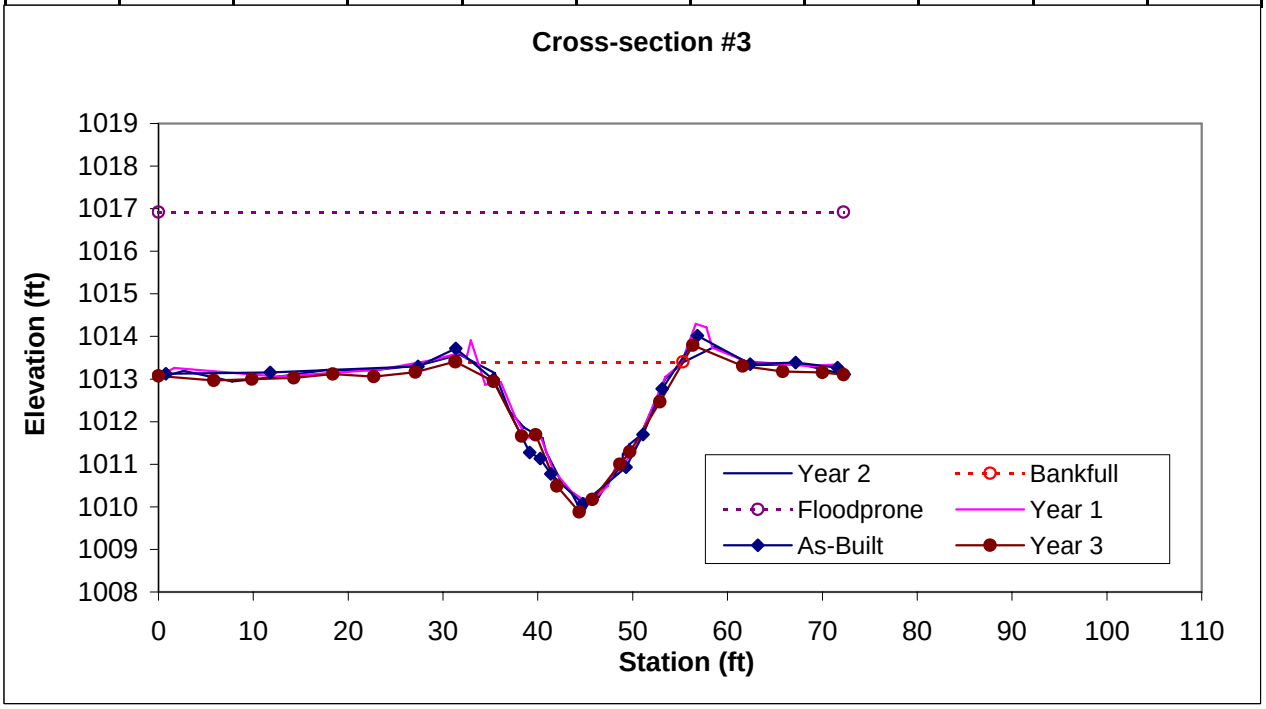
Permanent Cross-section #3 UT3

(Year 3 Data - Collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

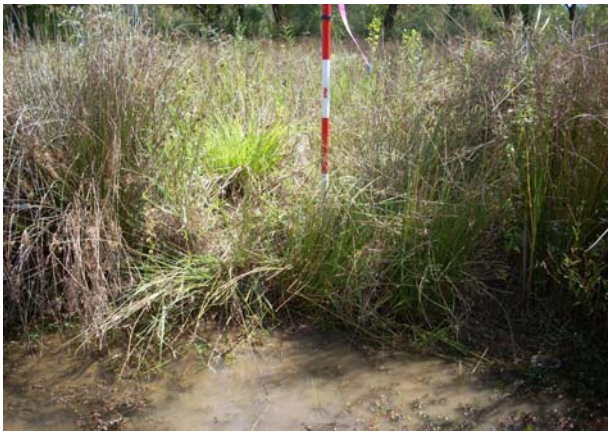
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	40.6	23.99	1.69	3.52	14.16	1	3	1013.4	1013.41



Permanent Cross-section #4 UT3

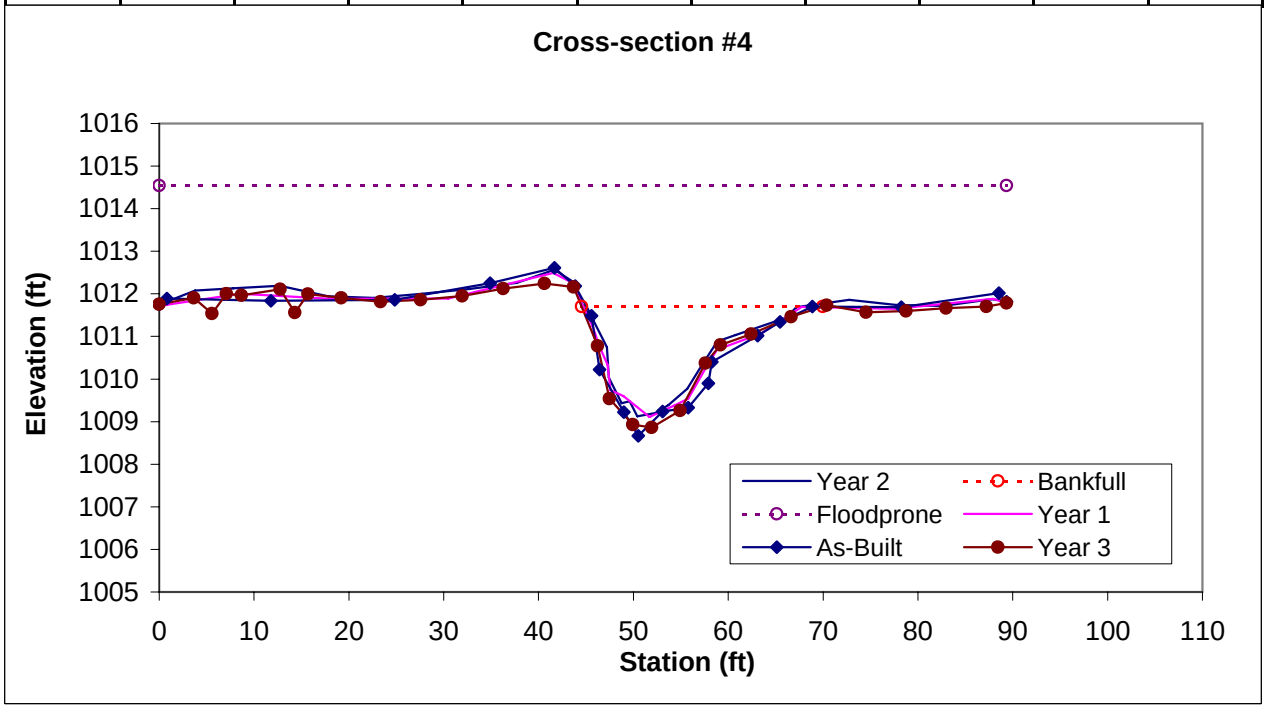
(Year 3 Data - Collected October 2008)

Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		33.8	25.46	1.33	2.84	19.16	1	3.5	1011.7	1011.73



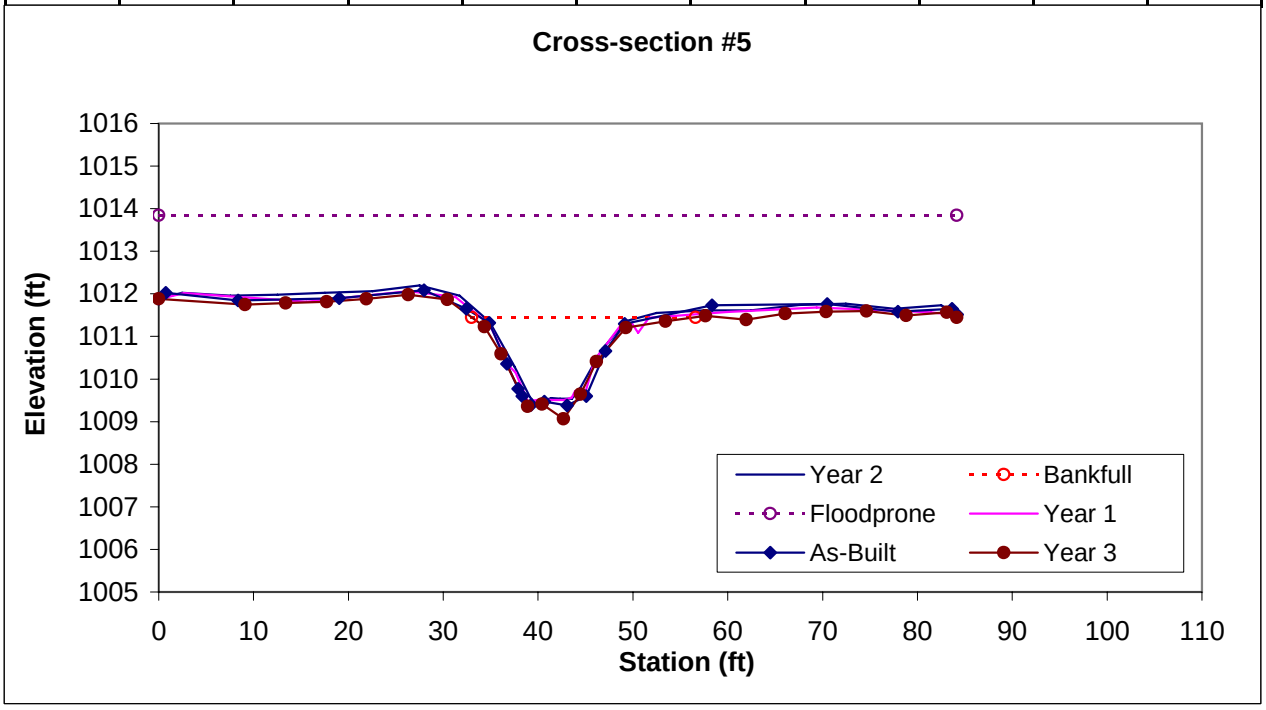
Permanent Cross-section #5 UT3

(Year 3 Data - Collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	22.4	23.63	0.95	2.39	24.96	1	3.6	1011.45	1011.36



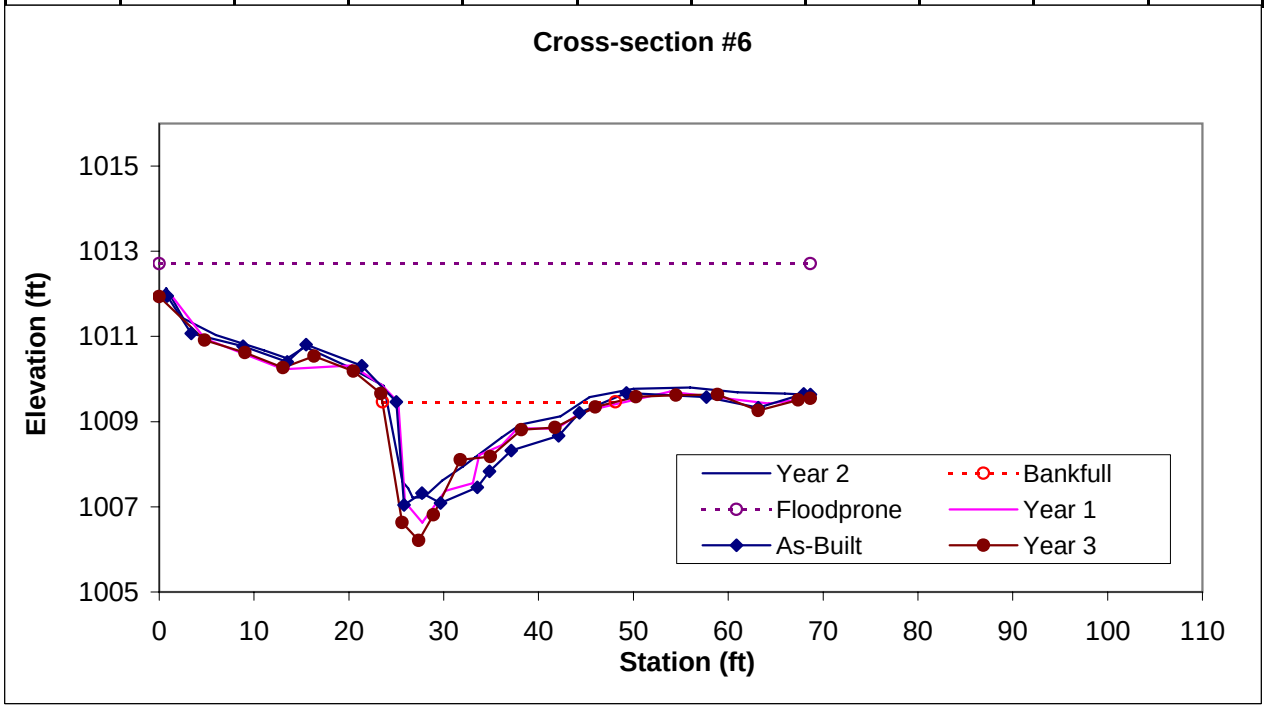
Permanent Cross-section #6 UT3

(Year 3 Data - Collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		29.8	24.56	1.21	3.25	20.27	1	2.8	1009.46	1009.34



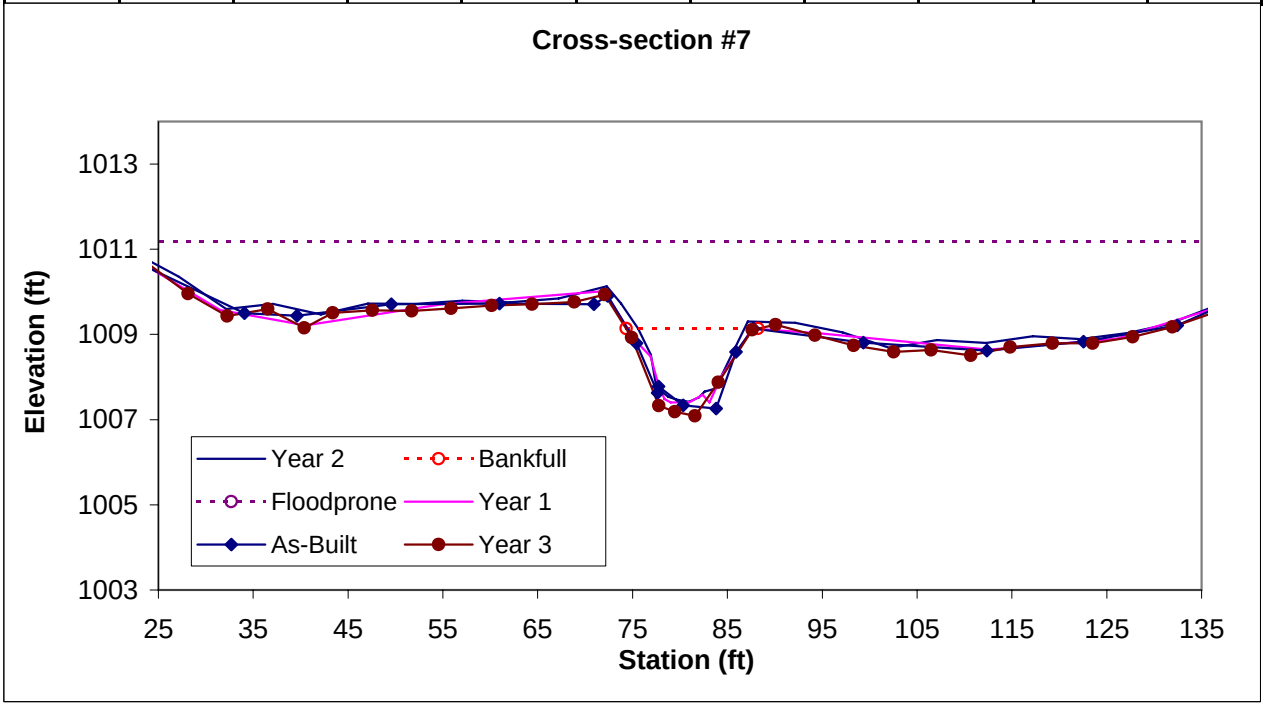
Permanent Cross-section #7 UT3

(Year 3 Data - Collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	16.8	13.9	1.21	2.05	11.49	1	9.5	1009.14	1009.11



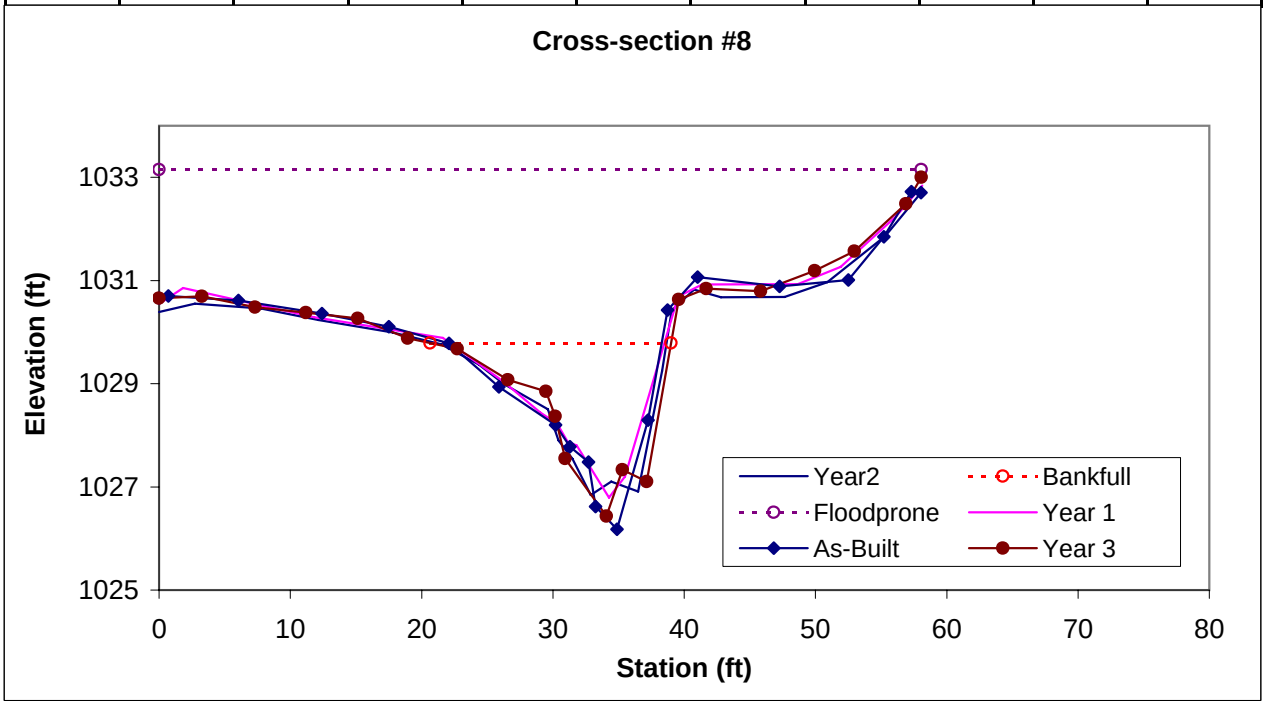
Permanent Cross-section #8 UT1

(Year 3 Data - Collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		25.9	18.35	1.41	3.36	13.01	1	3.2	1029.79	1029.68



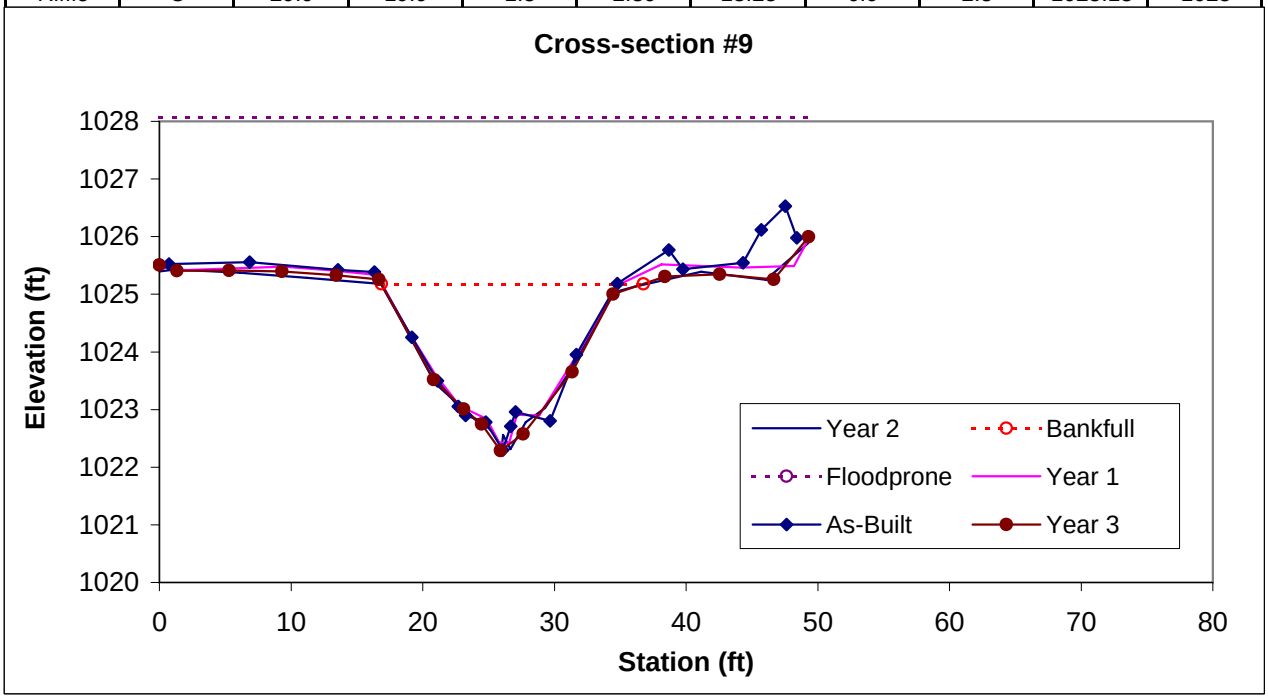
Permanent Cross-section #9 UT1

(Year 3 Data - Collected Sept. 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	29.9	19.9	1.5	2.89	13.25	0.9	2.5	1025.18	1025



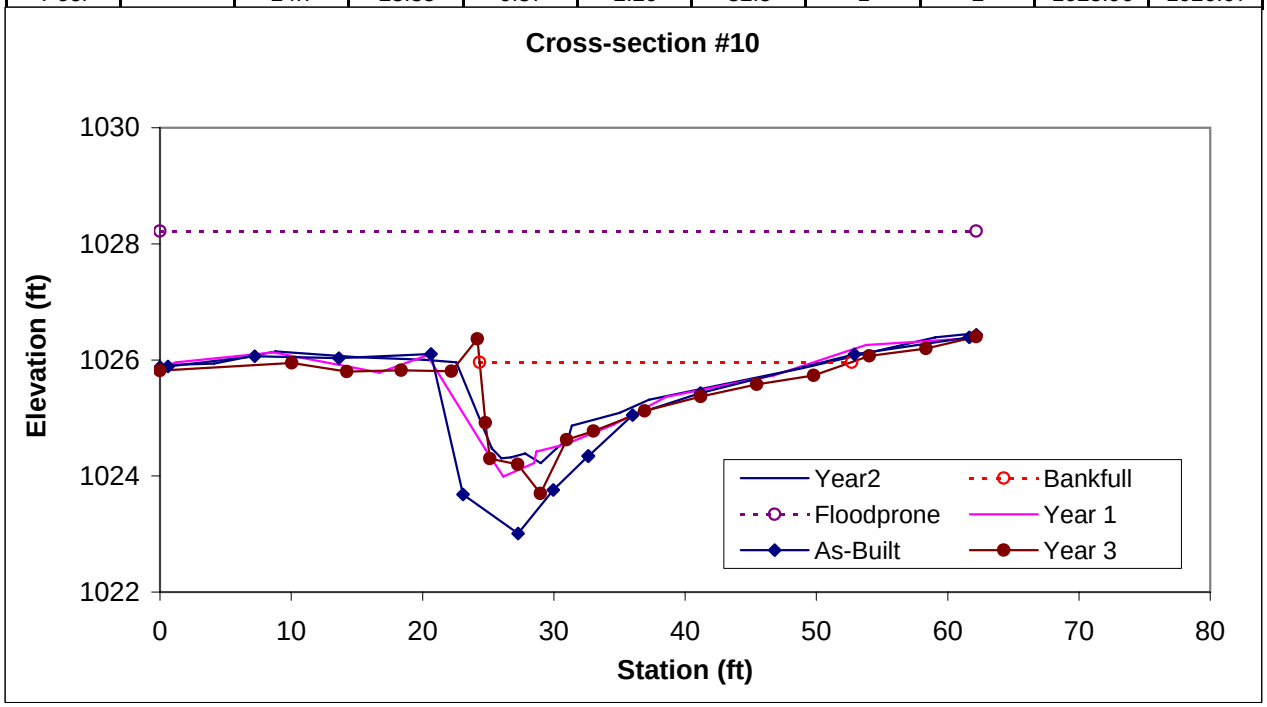
Permanent Cross-section #10 UT2

(Year 3 Data - Collected September 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		24.7	28.35	0.87	2.26	32.5	1	2	1025.96	1026.07



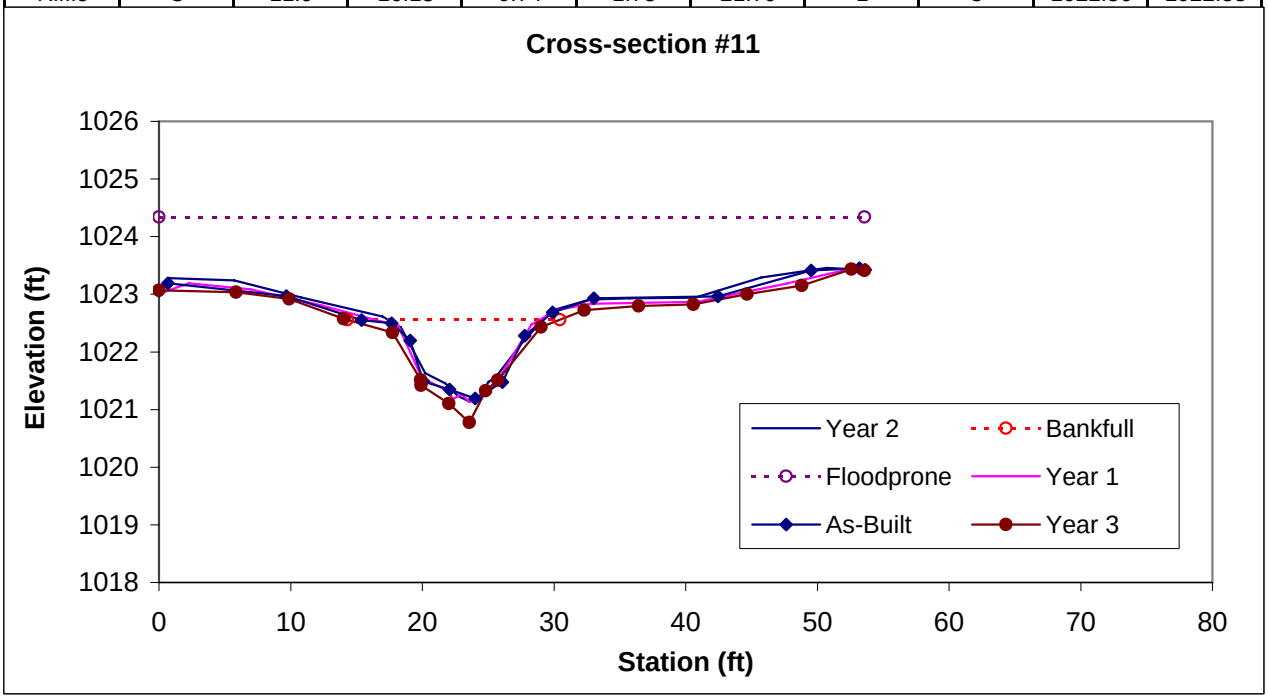
Permanent Cross-section #11 UT2

(Year 3 Data - Collected September 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	11.9	16.13	0.74	1.78	21.79	1	3	1022.56	1022.58



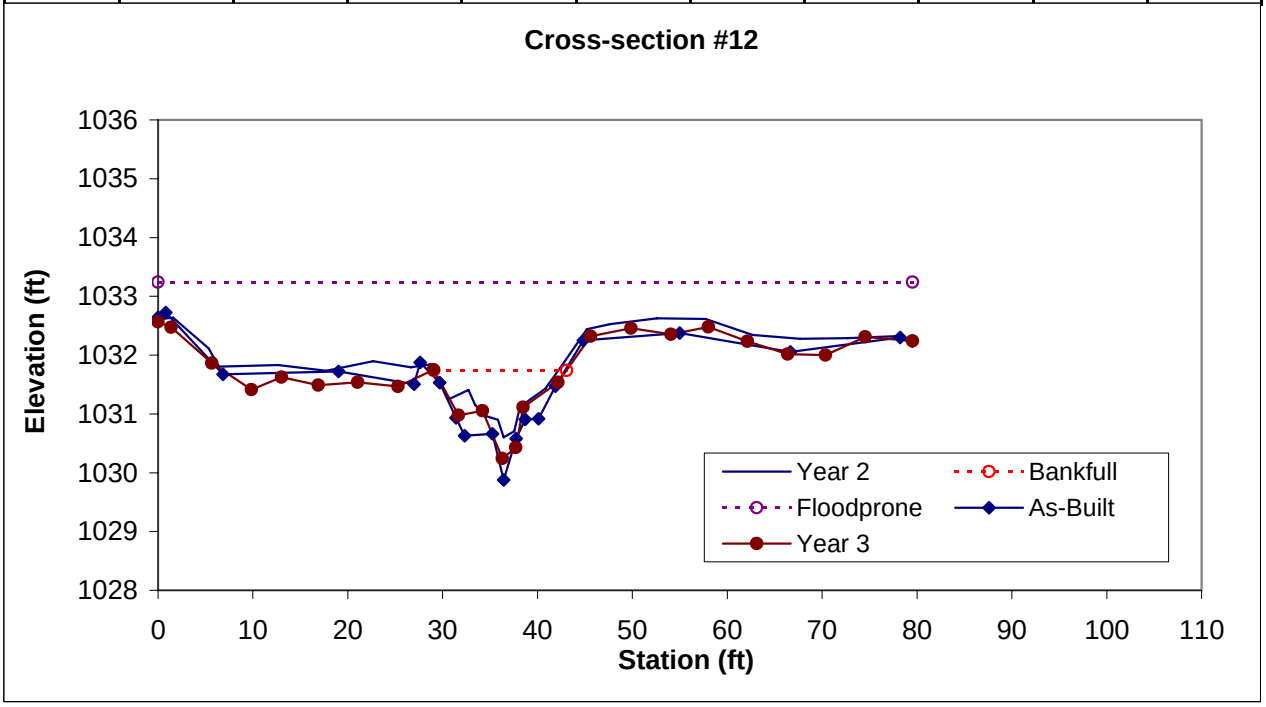
Permanent Cross-section #12 UT1

(Year 3 Data - Collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	9.5	13.99	0.68	1.5	20.67	1	5.7	1031.74	1031.75



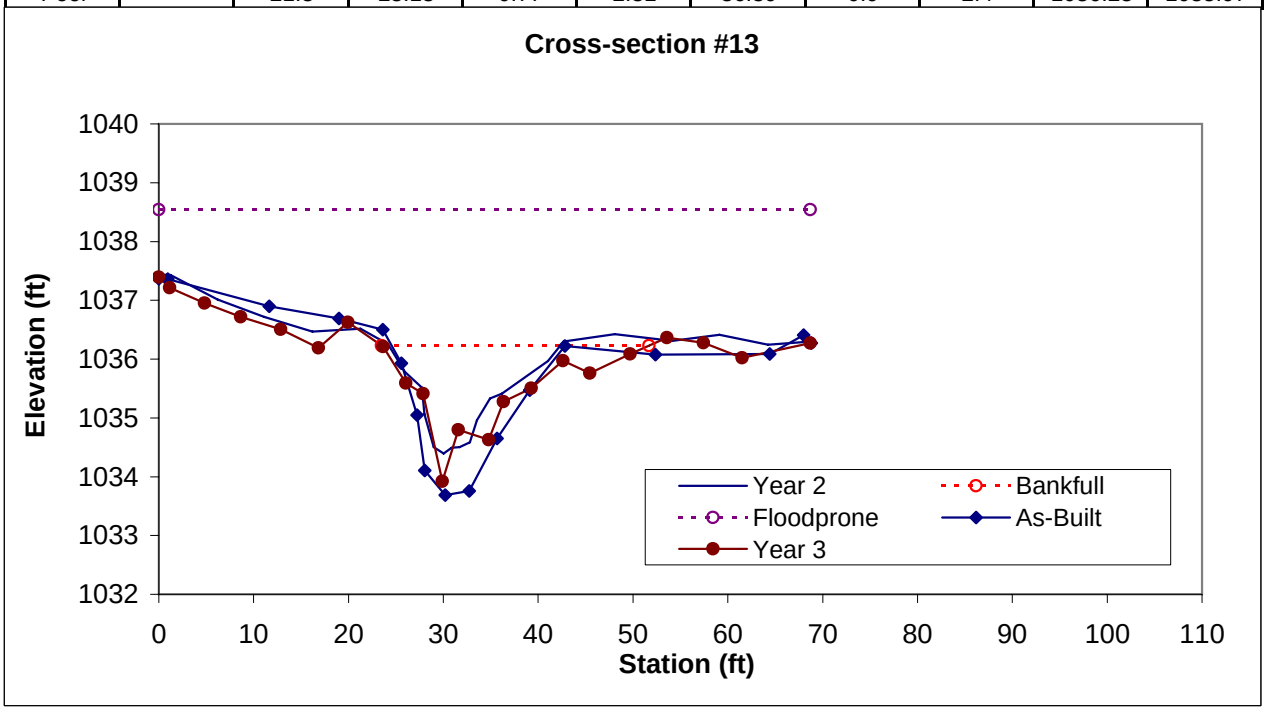
Permanent Cross-section #13 UT1

(Year 3 Data - Collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		21.8	28.18	0.77	2.31	36.39	0.9	2.4	1036.23	1035.97



APPENDIX C

BASELINE STREAM SUMMARY FOR RESTORATION REACHES

Baseline Stream Summary for Restoration Reaches

Bailey Fork Creek Mitigation Site: EEP Contract No. D04006-3																	
Reach UT1																	
Parameter	**USGS Gauge**		**Regional Curve Interval**			**Pre-Existing Condition**			**Reference Reach(es) Data**			**Design**			**As-Built**		
Dimension - Riffle	Jacob	Norwood	LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max
Bankfull Width (ft)	61.3	32	6.7	25	10.9	9.2	10.0	10.9	-----	-----	-----	-----	14.9	-----	15.7	17.7	19.8
Floodprone Width (ft)	96.3	-----	-----	-----	-----	12.9	35.9	58.9	-----	-----	-----	130.0	185.0	240.0	80.0	105.4	130.7
Bankfull Mean Depth (ft)	4.7	3.1	0.9	2.4	1.4	1.2	1.6	2.0	-----	-----	-----	-----	1.2	-----	0.9	1.3	1.7
Bankfull Max Depth (ft)	5.8	-----	-----	-----	-----	2.0	2.4	2.9	-----	-----	-----	-----	1.8	-----	2.0	2.5	3.1
Bankfull Cross-sectional Area (ft2)	290	99	9	37	18.6	10.9	16.3	21.6	-----	-----	-----	-----	18.5	-----	14.0	23.3	32.7
Width/Depth Ratio	13	10.3	-----	-----	-----	5.5	6.6	7.8	5.1	7.1	9.1	-----	12.0	-----	17.0	17.4	17.7
Entrenchment Ratio	1.6	-----	-----	-----	-----	1.4	3.4	5.4	-----	23.5	-----	8.7	12.4	16.1	5.1	5.9	6.6
Bank Height Ratio	1.3	-----	-----	-----	-----	1.0	1.5	2.0	-----	1.2	-----	-----	1.0	-----	1.0	1.1	1.3
Bankfull Velocity (fps)	3.9	2.6	-----	-----	-----	-----	4.8	-----	-----	5.8	-----	-----	3.9	-----	-----	3.9	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	52	85.5	119	51	67	84
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	30	37.5	45	28	32	37
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	104	134	164	130	150	162
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	2.42	5.46	8.5	3.5	5.75	8	2.9	3.8	4.7
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	18	45	59	10	45	60
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.016	0.0235	0.031	0.016	0.0235	0.031
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	19	50.8	69.7	19	40	63
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	52	67	82	65	75	80
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	0.25 / 0.46 / 0.86 / 9.05 / 14.98			-----	-----	-----		N/A			Not Collected	
Reach Shear Stress (competency) lb/f2	-----	-----	-----	-----	-----	-----	0.98	-----	-----	-----	-----	-----	0.66	-----	-----	0.64	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	93.5	-----	-----	-----	-----	-----	43.7	-----	-----	39.6	-----
Additional Reach Parameters																	
Channel length (ft)	850	-----	-----	-----	-----	-----	1,638	-----	-----	-----	-----	-----	1,920	-----	-----	1,948	-----
Drainage Area (SM)	25.7	7.2	-----	-----	-----	-----	0.8	-----	0.39	0.945	1.5	-----	0.8	-----	-----	0.8	-----
Rosgen Classification	C4	E	-----	-----	-----	-----	E5/G5	-----	E5	-----	E4/5	-----	C5	-----	-----	C5	-----
Bankfull Discharge (cfs)	1140	254	18	220	76.47	-----	72	-----	-----	119	-----	-----	72	-----	-----	72	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	1.1	-----	1.24	1.52	1.8	-----	1.3	-----	-----	1.4	-----
BF slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	0.013	-----	-----	-----	-----	-----	0.010	-----	-----	0.010	-----

Reach UT2																	
Parameter	**USGS Gauge**		**Regional Curve Interval**			**Pre-Existing Condition**			**Reference Reach(es) Data**			**Design**			**As-built**		
Dimension - Riffle	Jacob	Norwood	LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	61.3	32.0	4.0	17.0	6.4	-----	5.1	-----	-----	-----	-----	-----	9.9	-----	-----	13.8	-----
Floodprone Width (ft)	96.3	-----	-----	-----	-----	-----	10.0	-----	-----	-----	-----	60.0	140.0	220.0	-----	53.6	-----
Bankfull Mean Depth (ft)	4.7	3.1	0.5	1.7	1.0	-----	1.6	-----	-----	-----	-----	-----	0.8	-----	-----	0.7	-----
Bankfull Max Depth (ft)	5.8	-----	-----	-----	-----	-----	1.9	-----	-----	-----	-----	-----	1.2	-----	-----	1.4	-----
Bankfull Cross-sectional Area (ft2)	290.0	99.0	3.8	17.0	8.2	-----	8.0	-----	-----	-----	-----	-----	8.2	-----	-----	9.7	-----
Width/Depth Ratio	13.0	10.3	-----	-----	-----	-----	3.3	-----	5.1	7.1	9.1	-----	12.0	-----	-----	19.7	-----
Entrenchment Ratio	1.6	-----	-----	-----	-----	-----	2.0	-----	-----	23.5	-----	6.1	14.2	22.2	-----	3.9	-----
Bank Height Ratio	1.3	-----	-----	-----	-----	-----	2.5	-----	-----	1.2	-----	-----	1.0	-----	-----	1.0	-----
Bankfull Velocity (fps)	3.9	2.6	-----	-----	-----	-----	2.2	-----	-----	5.8	-----	-----	2.2	-----	-----	1.9	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	35	57	79	54	64	72
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	20	25	30	19	21	24
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	69	89	109	83	99	111
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	2.42	5.46	8.5	3.5	5.75	8	3.9	4.6	5.2
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	22	27	36	22	27	32
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.003	0.013	0.022	0.003	0.013	0.022
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	21	44	58	21	47	64
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	35	45	55	41.6	49.285	55.73
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	0.23 / 0.39 / 0.61 / 2.67 / 5.90			-----	-----	-----		N/A			Not Collected	
Reach Shear Stress (competency) lb/f2	-----	-----	-----	-----	-----	-----	0.32	-----	-----	-----	-----	-----	0.25	-----	-----	0.21	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	19.3	-----	-----	-----	-----	-----	9.6	-----	-----	6.6	-----
Additional Reach Parameters																	
Channel length (ft)	850	-----	-----	-----	-----	-----	270	-----	-----	-----	-----	-----	870	-----	-----	923	-----
Drainage Area (SM)	25.7	7.2	-----	-----	-----	-----	0.24	-----	0.39	0.945	1.5	-----	0.24	-----	-----	0.24	-----
Rosgen Classification	C4	E	-----	-----	-----	-----	E5	-----	E5		E4/5	-----	C5	-----	-----	C5	-----
Bankfull Discharge (cfs)	1140	254	10	100	32	-----	18	-----		119		-----	18	-----	-----	18	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	1.0	-----	1.2	1.5	1.8	-----	1.4	-----	-----	1.4	-----
BF slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	0.005	-----	-----	-----	-----	-----	0.006	-----	-----	0.005	-----

Reach UT3																	
Parameter	**USGS Gauge**		**Regional Curve Interval**			**Pre-Existing Condition**			**Reference Reach(es) Data**			**Design**			**As-built**		
Dimension - Riffle	Jacob	Norwood	LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max
Bankfull Width (ft)	61.3	32.0	6.8	26.0	11.5	9.2	10.0	10.8	-----	-----	-----	-----	16.7	-----	13.3	24.4	26.8
Floodprone Width (ft)	96.3	-----	-----	-----	-----	40.0	60.0	80.0	-----	-----	-----	80.0	280.0	480.0	72.3	96.9	129.7
Bankfull Mean Depth (ft)	4.7	3.1	0.9	2.5	1.5	1.9	2.1	2.2	-----	-----	-----	-----	1.2	-----	1.0	1.2	1.4
Bankfull Max Depth (ft)	5.8	-----	-----	-----	-----	2.9	3.0	3.1	-----	-----	-----	-----	1.7	-----	1.9	2.2	2.5
Bankfull Cross-sectional Area (ft2)	290.0	99.0	10.0	40.0	20.3	19.8	20.3	20.7	-----	-----	-----	-----	20.0	-----	15.9	24.5	34.1
Width/Depth Ratio	13.0	10.3	-----	-----	-----	4.3	5.0	5.6	5.1	7.1	9.1	-----	14.0	-----	11.1	17.2	26.6
Entrenchment Ratio	1.6	-----	-----	-----	-----	3.4	5.1	6.8	-----	23.5	-----	4.8	16.8	28.7	3.2	6.5	9.8
Bank Height Ratio	1.3	-----	-----	-----	-----	1.3	1.6	1.9	-----	1.2	-----	-----	1.0	-----	-----	1.0	-----
Bankfull Velocity (fps)	3.9	2.6	-----	-----	-----	2.7	2.7	2.6	-----	5.8	-----	-----	2.7	-----	3.4	2.2	1.6
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	59	96.5	134	85	91	120
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	33	41.5	50	27	37	43
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	117	150.5	184	172	179	200
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	2.42	5.46	8.5	3.5	5.75	8	3.5	3.7	4.9
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	26	75	91	26	50	63
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.004	-----	-----	0.004	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	26	49	69	26	75	98
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	59	75.5	92	86	90	100
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	0.24 / 0.34 / 0.44 / 1.38 / 3.40			-----	-----	-----		N/A			Not Collected	
Reach Shear Stress (competency) lb/f2	-----	-----	-----	-----	-----	-----	0.4	-----	-----	-----	-----	-----	0.3	-----	-----	0.3	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	25.0	-----	-----	-----	-----	-----	14.7	-----	-----	9.5	-----
Additional Reach Parameters																	
Channel length (ft)	850	-----	-----	-----	-----	-----	2,513	-----	-----	-----	-----	-----	3,227	-----	-----	3,226	-----
Drainage Area (SM)	25.7	7.2	-----	-----	-----	-----	0.92	-----	0.39	0.945	1.5	-----	0.92	-----	-----	0.92	-----
Rosgen Classification	C4	E	-----	-----	-----	-----	E5	-----	E5	-----	E4/5	-----	C5	-----	-----	C5	-----
Bankfull Discharge (cfs)	1140	254	29	250	83.83	-----	54	-----	-----	119	-----	-----	54	-----	-----	54	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	1.1	-----	1.24	1.52	1.8	-----	1.4	-----	-----	1.4	-----
BF slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	0.002	-----	-----	-----	-----	-----	0.004	-----	-----	0.004	-----

APPENDIX D

MORPHOLOGY AND HYDRAULIC MONITORING SUMMARY - YEAR 2 MONITORING

Morphology and Hydraulic Monitoring Summary - Year 3 Monitoring

Bailey Fork Restoration Site: EEP Contract No. D04006-3

Reach: UT1

I. Cross-Section Parameters	Cross-section 8 Riffle					Cross-section 9 Pool					Cross-section 12 Riffle					Cross-section 13 Pool				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension																				
BF Width (ft)	16.29	17.55	18.35			22.25	20.2	19.9			15.25	13.9	13.99			20.19	18.07	28.18		
Floodprone Width (ft)	5.98	-	-			5.92	-	-			3.58	-	-			5.12	-	-		
BF Cross-sectional Area (ft2)	22.4	25.7	25.9			32	29.5	29.9			12.0	8.5	9.5			21.3	16.2	21.8		
BF Mean Depth (ft)	1.37	1.47	1.41			1.44	1.46	1.5			.79	0.61	1.5			1.06	0.9	0.77		
BF Max Depth (ft)	2.99	2.94	3.36			2.96	2.87	2.89			1.79	1.24	20.67			2.56	1.84	2.31		
Width/Depth Ratio	11.87	11.97	13.01			15.48	13.83	13.25			19.32	22.81	20.67			19.1	20.15	36.39		
Entrenchment Ratio	3.6	3.3	3.2			2.2	2.4	2.5			5.2	5.7	5.7			3.4	3.8	2.4		
Wetted Perimeter (ft)	-	-	-			-	-	-			-	-	-			-	-	-		
Hydraulic Radius (ft)	-	-	-			-	-	-			-	-	-			-	-	-		
Substrate																				
d50 (mm)																				
d84 (mm)																				

II. Reachwide Parameters	MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)			MY-5 (2010)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern															
Channel Beltwidth (ft)			-	52	85	-			-						
Radius of Curvature (ft)			-	33	41	-			-						
Meander Wavelength (ft)			-	130	136	-			-						
Meander Width Ratio			-	7.40	9.78	-			-						
Profile															
Riffle Length (ft)			-			-			-						
Riffle Slope (ft/ft)			-			-			-						
Pool Length (ft)			-			-			-						
Pool Spacing (ft)			-			-			-						
Additional Reach Parameters															
Valley Length (ft)			-												
Channel Length (ft)			1,948			1,948			1,948						
Sinuosity			1.4			1.4			1.38						
Water Surface Slope (ft/ft)			-			-			0.0108						
BF Slope (ft/ft)			0.0142			0.0142			0.0149						
Rosgen Classification			C5			C5			C5						

Reach: UT2																					
I. Cross-Section Parameters	Cross-section 10 Pool					Cross-section 11 Riffle															
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5											
Dimension																					
BF Width (ft)	29.75	28.26	28.35			12.41	11.69	16.13													
Floodprone Width (ft)	4.02	-	-			2.84	-	-													
BF Cross-sectional Area (ft2)	26.2	21.3	24.7			9.6	9.0	11.9													
BF Mean Depth (ft)	0.88	0.75	0.87			0.78	0.77	0.74													
BF Max Depth (ft)	2.01	1.74	2.26			1.42	1.4	1.78													
Width/Depth Ratio	33.81	37.57	32.5			15.98	15.13	21.79													
Entrenchment Ratio	2.1	2.2	2			4.3	4.6	3													
Wetted Perimeter (ft)	-	-	-			-	-	-													
Hydraulic Radius (ft)	-	-	-			-	-	-													
Substrate																					
d50 (mm)																					
d84 (mm)																					

II. Reachwide Parameters	MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)			MY-5 (2010)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern															
Channel Beltwidth (ft)			-	50	55	-			-						
Radius of Curvature (ft)			-	22	26	-			-						
Meander Wavelength (ft)			-	90	100	-			-						
Meander Width Ratio			-	7.69	8.55	-			-						
Profile															
Riffle length (ft)			-			-			-						
Riffle Slope (ft/ft)			-			-			-						
Pool Length (ft)			-			-			-						
Pool Spacing (ft)			-			-			-						
Additional Reach Parameters															
Valley Length (ft)			-			-			-						
Channel Length (ft)			923			923			923						
Sinuosity			1.4			1.4			1.46						
Water Surface Slope (ft/ft)			-			-			.0082						
BF Slope (ft/ft)			0.005			0.005			0.005						
Rosgen Classification			C5			C5			C5						

Reach: UT3				
I. Cross-Section Parameters	Cross-section 1	Cross-section 2	Cross-section 3	Cross-section 4

	Riffle					Pool					Riffle					Pool				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension																				
BF Width (ft)	22.4	22.89	30.72			26.14	25.27	27.5			22.48	23.88	23.99			22.62	22.84	25.46		
Floodprone Width (ft)	4.58	-	-			5.16	-	-			-	-	-			-	-	-		
BF Cross-sectional Area (ft2)	29.40	29.3	33.3			27.7	16.5	21.9			45.1	40.1	40.6			30	28.5	33.8		
BF Mean Depth (ft)	1.31	1.28	1.08			1.06	0.65	0.79			2.01	1.68	1.69			1.32	1.25	1.33		
BF Max Depth (ft)	2.29	2.3	2.42			2.58	1.75	2.13			3.54	3.66	3.52			2.54	2.57	2.84		
Width/Depth Ratio	17.1	17.2	28.37			24.65	38.62	35.14			11.21	14.24	14.16			17.08	18.27	19.16		
Entrenchment Ratio	>4.5	>4.4	3.3			>3.6	>3.7	3.4			>3.2	>3.0	3			3.9	3.9	3.5		
Wetted Perimeter (ft)	-	-	-			-	-	-			-	-	-			-	-	-		
Hydraulic Radius (ft)	-	-	-			-	-	-			-	-	-			-	-	-		
Substrate																				
d50 (mm)																				
d84 (mm)																				

II. Reachwide Parameters	MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)			MY-5 (2010)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern															
Channel Beltwidth (ft)			-	70	90	-			-						
Radius of Curvature (ft)			-	28	45	-			-						
Meander Wavelength (ft)			-	160	180	-			-						
Meander Width Ratio			-	6.70	16	-			-						
Profile															
Riffle length (ft)			-			-			-						
Riffle Slope (ft/ft)			-			-			-						
Pool Length (ft)			-			-			-						
Pool Spacing (ft)			-			-			-						
Additional Reach Parameters															
Valley Length (ft)			-			-									
Channel Length (ft)			3226			3226			3226						
Sinuosity			1.4			1.4			1.51						
Water Surface Slope (ft/ft)			-			-			.0035						
BF Slope (ft/ft)			0.0049			0.0049			.0053						
Rosgen Classification			C5			C5			C5						

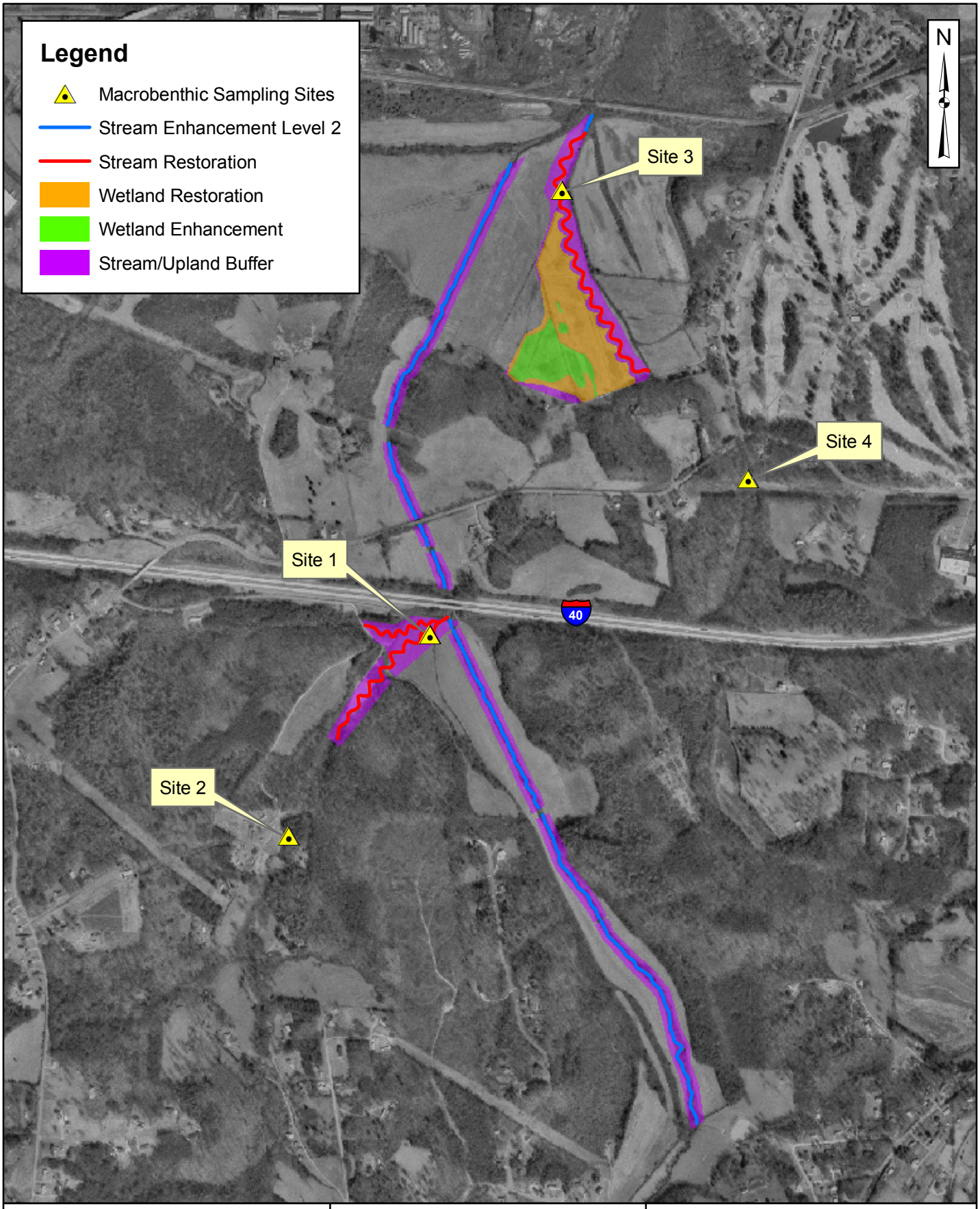
Reach: UT3 Continued

I. Cross-Section Parameters	Cross-section 5 Riffle					Cross-section 6 Pool					Cross-section 7 Riffle					
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	

Dimension											
BF Width (ft)	33.77	17.59	23.63		23.85	20.57	24.56		13.09	11.25	13.9
Floodprone Width (ft)	4.34	-	-		5.66	-	-		3.48	-	-
BF Cross-sectional Area (ft2)	24.6	19	22.4		26.6	22.3	29.8		14.3	13.0	16.8
BF Mean Depth (ft)	0.73	1.08	0.95		1.12	1.09	1.21		1.09	1.16	1.21
BF Max Depth (ft)	2.17	2.07	2.39		2.83	2.24	3.25		1.74	1.73	2.05
Width/Depth Ratio	46.36	16.28	24.96		21.36	18.95	20.27		12	9.72	11.49
Entrenchment Ratio	2.5	4.8	3.6		2.9	3.2	2.8		9.7	11	9.5
Wetted Perimeter (ft)	-	-	-		-	-	-		-	-	-
Hydraulic Radius (ft)	-	-	-		-	-	-		-	-	-
Substrate											
d50 (mm)											
d84 (mm)											

APPENDIX E

BENTHIC MACROINVERTEBRATE MONITORING DATA



Environmental Banc and Exchange, LLC
2530 Meridian Parkway, Suite 200
Durham, NC 27713

0 500 1,000 2,000 Feet

Figure 1.
Benthic Macroinvertebrate Sampling Sites
Bailey Fork Site

P1 Site 1 – Facing upstream

P2 Site 1 – Facing downstream

P3 Site 2 – Facing upstream

P4 Site 2 – Facing downstream

P5 Site 3 – Facing upstream

P6 Site 3 – Facing downstream

P7 Site 4 – Facing upstream

P8 Site 4 – Facing downstream

Appendix A. Benthos Data for Bailey Fork Project Collected on January 7 & 23, 2008

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 UT1 to Bailey Fork 1/8/08	Site 2 UT1 to Bailey Fork Reference 1/8/08	Site 3 UT3 to Silver Creek 1/23/08	Site 4 UT3 to Silver Creek Reference 1/23/08
ANNELIDA						
Oligchaeta						
Naididae						
Dero spp.	**10.0**	**GC**			**R**	
Nais spp.	**8.9**				**R**	
Tubificidae						
Ilyodrilus templetoni	**9.3**	**GC**			**R**	
Limnodrilus spp.	**9.5**	**GC**			**R**	
ARTHROPODA						
Insecta						
Coleoptera						
Elmidae						
Stenelmis crenata.	**7.0**	**OM**				**R**
Ptilodactylidae						
Anchytarsus bicolor	**3.6**	**SH**	**R**			**R**
Diptera						
Chironomidae						
Brillia spp.	**5.2**	**SH**	**R**	**R**		
Conchapelopia grp	**8.4**	**PR**	**R**		**R**	
Corynoneura spp.	**6.0**	**GC**	**C**	**R**		
Cricotopus bicinctus	**8.5**	**OM**			**R**	
Dicrotendipes fumidus	**N/A**	**N/A**			**R**	
Diplocladius cultriger	**7.4**	**GC**			**R**	
Limnophyes spp.	**7.4**	**GC**	**R**			
Nanocladius spp.	**7.1**	**GC**			**C**	
Orthocladius obumbratus	**8.5**	**GC**	**A**		**VA**	
Parametricnemus lundbecki	**3.7**	**GC**	**C**	**R**	**R**	
Paraphaenocladius spp.	**3.3**	**GC**		**R**		
Polypedilum halterale grp	**7.3**	**SH**			**R**	
Dixidae						
Dixa spp.	**2.6**	**GC**	**A**			
Simulidae						
Simulium spp.	**6.0**	**FC**	**C**			
Tipulidae						
Dicronata spp.	**0.0**	**PR**	**R**			**R**
Hexatoma spp.	**4.3**	**PR**				**R**
Tipula spp.	**7.3**	**SH**				**C**
Ephemeroptera						
Caenidae						
Caenis spp.	**7.4**	**GC**			**C**	
Ephmeridae						
Ephemera spp.	**2.0**	**GC**	**R**	**R**		
Hexagenia spp.	**4.9**	**GC**	**R**			

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 UT1 to Bailey Fork 1/8/08	Site 2 UT1 to Bailey Fork Reference 1/8/08	Site 3 UT3 to Silver Creek 1/23/08	Site 4 UT3 to Silver Creek Reference 1/23/08
Ephemerellidae						
Ephemerella dorothea	**6.0**	**N//A**	**C**	**C**		
Eurylophella funeralis	**2.1**	**GC**	**R**	**R**		
Eurylophella spp.	**4.3**	**SC**	**C**			
Heptageniidae						
Stenonema modestum	**5.5**	**SC**	**A**	**C**		
Stenonema pudicum	**2.0**	**SC**	**C**	**C**		
Siphlonuridae						
Ameletus lineatus	**2.4**	**N/A**			**R**	
Megaloptera						
Corydalidae						
Nigronia fasciatus	**5.6**					**R**
Odonata						
Aeshnidae						
Boyeria vinosa	**5.9**	**PR**	**R**			
Calopterygidae						
Calopteryx spp.	**7.8**	**PR**	**C**	**R**	**C**	
Coenagrionidae						
Argia spp.	**8.2**	**PR**			**R**	
Enallagma spp.	**8.9**	**PR**			**R**	
Gomphidae						
Ophiogomphus spp.	**5.5**	**PR**	**R**			
Stylogomphus albistylus	**4.7**	**N/A**	**R**			
Libellulidae						
Libellula spp.	**9.6**	**PR**			**R**	
Plecoptera						
Capnidae						
Allocapnia spp.	**2.5**	**SH**	**R**	**R**		
Perlidae						
Eccoptura xanthenes	**3.7**	**N/A**	**R**	**C**		**R**
Perlodidae						
Diploperla duplicata	**2.7**	**N/A**	**R**	**R**		
Isoperla bilineata	**5.4**	**N/A**	**R**			
Peltoperlidae						
Tallaperla spp.	**1.2**		**C**			
Trichoptera						
Hydropsychidae						
Cheumatopsyche spp.	**6.2**	**FC**	**C**	**C**		**R**
Diplectrona modesta	**2.2**	**FC**	**C**	**R**		**C**
Hydropsyche betteni	**7.8**	**FC**	**A**	**A**		
Limnephilidae						
Pycnopsyche spp.	**2.5**	**SH**	**C**	**C**		
Rhyacophildae						
Rhyacophila carolina grp.	**0.0**	**R**				

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 UT1 to Bailey Fork 1/8/08	Site 2 UT1 to Bailey Fork Reference 1/8/08	Site 3 UT3 to Silver Creek 1/23/08	Site 4 UT3 to Silver Creek Reference 1/23/08
Uenoidae						
Neophylax spp.	**2.2**	**SC**	**R**	**R**		
MOLLUSCA						
Gastropoda						
Physidae						
Physella spp.	**8.8**	**SC**	**R**	**R**	**R**	
Pleuroceridae						
Elimia spp.	**2.5**	**SC**		**R**		
Total Taxa Richness			**33**	**20**	**19**	**9**
EPT Taxa Richness			**18**	**13**	**2**	**3**
Total Biotic Index			**4.9**	**5.1**	**8.2**	**4.5**
EPT Biotic Index			**4.6**	**4.6**	**6.2**	**3.3**
Dominant in Common Taxa (%)			**86**	**N/A**	**0**	**N/A**

Notes: Tolerance Values: ranges from 0 (least tolerant to pollution) to 10 (most tolerant to pollution).
Functional Feeding Group: CG = Collector-Gatherer, FC = Filterer-Collector, OM = Omnivore, PR = Predator, SC = Scraper, SH = Shredder.
Abundance: R = Rare (1-2 individuals); C = Common (3-9 individuals); A = Abundant (10 or more individuals).

BAILEY'S FORK - Deducted 10 pts to rescore as a 73.
- 10 pts taken off Section VIII "Channel Flow Status"

7/00 Revision 5

Habitat Assessment Field Data Sheet Not on Revision 6 forms.
Mountain/ Piedmont Streams

Biological Assessment Unit, DWQ TOTAL SCORE 73

Directions for use: The observer is to survey a minimum of 100 meters of stream, preferably in an upstream direction starting abov bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a pro habitat evaluation the observer needs to get into the stream. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habi score is determined by adding the results from the different metrics.

Stream UT 1, SITE 1 BAILEY'S FORK Location/road: HOPEWELL + I-40 (Road Name HOPEWELL) County BURKE

Date 1/2/09 CC# _____ Basin CATAWBA Subbasin 11-34-8-3

Observer(s) _____ Type of Study: ☐ Fish ☒ Benthos ☐ Basinwide ☐ Special Study (Describe) _____

~~Latitude~~ NORTHING 726970.6 ~~Longitude~~ EASTING 1191435.9 Ecoregion: ☐ MT ☒ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature 10.3 °C DO 11.96 mg/l Conductivity (corr.) 50. µmhos/cm pH 7.8 (% SAT. 106.6)

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what estimate driving thru the watershed in watershed land use.

Visible Land Use: 15 %Forest ____ %Residential ____ %Active Pasture ____ % Active Crops
80 %Fallow Fields ____ % Commercial ____ %Industrial 5 %Other - Describe: HIGHWAY

Watershed land use (est): ____ %Forest ____ %Agriculture ____ %Urban ☐ Animal operations upstream

Width: (meters) Stream 1.2 Channel (at top of bank) 2.2 Stream Depth: (m) Avg .15 Max 8"
☐ Width variable

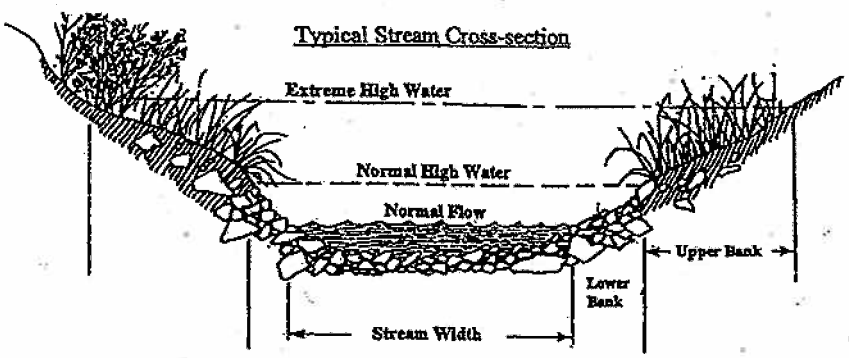
Bank Height (from deepest part of channel (in riffle or run) to top of bank): (m) .75

Bank Angle: 30 ° or ☐ NA (Vertical is 90°, horizontal is 0°. Angles > 90° indicate slope is towards mid-channel, < 90° indicate slope is away from channel. NA if bank is too low for bank angle to matter.)

☐Deeply incised-steep,straight banks ☐Both banks undercut at bend ☐Channel filled in with sediment
☐ Recent overbank deposits ☐Bar development ☐Buried structures ☐Exposed bedrock
☐ Excessive periphyton growth ☐ Heavy filamentous algae growth ☐Green tinge ☐ Sewage smell
Manmade Stabilization: ☐N ☒Y: ☐Rip-rap, cement, gabions ☐ Sediment/grade-control structure ☐Berm/levee
Flow conditions : ☐High ☒Normal ☐Low
Turbidity: ☒Clear ☐ Slightly Turbid ☐Turbid ☐Tannic ☐Milky ☐Colored (from dyes)

Weather Conditions: 70° CLEAR Photos: ☐N ☒Y ☒Digital ☐35mm

Remarks: W/IN RESTORATION REACH



This side is 45° bank angle.

BAILEYS FORK SITE 1 RT1

I. Channel Modification

	Score
A. channel natural, frequent bends	(5)
B. channel natural, infrequent bends (channelization could be old)	4
C. some channelization present	3
D. more extensive channelization, >40% of stream disrupted	2
E. no bends, completely channelized or rip rapped or gabioned, etc	0

☐ Evidence of dredging ☐Evidence of desnagging=no large woody debris in stream ☒Banks of uniform shape/height

Subtotal 5

Remarks

II. Instream Habitat: Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >70% of the reacl is rocks, 1 type is present, circle the score of 17. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as Rare, Common, or Abundant.

R Rocks C Macrophytes ____Sticks and leafpacks ____Snags and logs ____Undercut banks or root mats

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

	>70% Score	40-70% Score	20-40% Score	<20% Score
4 or 5 types present	20	16	12	8
3 types present	19	15	11	7
2 types present	18	(14)	10	6
1 type present	17	13	9	5
No types present	0			

☐ No woody vegetation in riparian zone Remarks exposed root mass from grasses

Subtotal 14

III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder) look at entire reach for substrate scoring, but only look at ri for embeddedness.

	Score
A. substrate with good mix of gravel cobble and boulders	
1. embeddedness <20% (very little sand, usually only behind large boulders)	15
2. embeddedness 20-40%	12
3. embeddedness 40-80%	8
4. embeddedness >80%	3
B. substrate gravel and cobble	
1. embeddedness <20%	14
2. embeddedness 20-40%	11
3. embeddedness 40-80%	(6)
4. embeddedness >80%	2
C. substrate mostly gravel	
1. embeddedness <50%	8
2. embeddedness >50%	4
D. substrate homogeneous	
1. substrate nearly all bedrock	3
2. substrate nearly all sand	3
3. substrate nearly all detritus	2
4. substrate nearly all silt/ clay	1

Subtotal 6

Remarks

IV. Pool Variety Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in la high gradient streams.

	Score
A. Pools present	
1. Pools Frequent (>30% of 100m area surveyed)	
a. variety of pool sizes	10
b. pools same size (indicates pools filling in)	(8)
2. Pools Infrequent (<30% of the 100m area surveyed)	
a. variety of pool sizes	6
b. pools same size	4
B. Pools absent	0

Subtotal 8

☐ Pool bottom boulder-cobble=hard ☒ Bottom sandy-sink as you walk ☐ Silt bottom ☐ Some pools over wader depth

Remarks

Page Total 33

BAILEY'S FORK SITE 1 471

V. Riffle Habitats

Definition: Riffle is area of reaeration-can be debris dam, or narrow channel area.

	Riffles Frequent Score	Riffles Infrequent Score
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream....	(16)	12
B. riffle as wide as stream but riffle length is not 2X stream width	14	7
C. riffle not as wide as stream and riffle length is not 2X stream width	10	3
D. riffles absent.....	0	

Channel Slope: ☒Typical for area ☐Steep=fast flow ☐Low=like a coastal stream

Subtotal 16

VI. Bank Stability and Vegetation

FACE UPSTREAM

	Left Bank Score	Rt. Bank Score
A. Banks stable		
1. no evidence of erosion or bank failure(except outside of bends), little potential for erosion....	(7)	(7)
B. Erosion areas present		
1. diverse trees, shrubs, grass; plants healthy with good root systems.....	6	6
2. few trees or small trees and shrubs; vegetation appears generally healthy.....	5	5
3. sparse mixed vegetation; plant types and conditions suggest poorer soil binding.....	3	3
4. mostly grasses, few if any trees and shrubs, high erosion and failure potential at high flow..	2	2
5. no bank vegetation, mass erosion and bank failure evident.....	0	0

Total 14

Remarks

VII. Light Penetration (Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block sunlight when the sun is directly overhead).

	Score
A. Stream with good shading with some breaks for light penetration	10
B. Stream with full canopy - breaks for light penetration absent.....	8
C. Stream with partial shading - sunlight and shading are essentially equa.....	7
D. Stream with minimal shading - full sun in all but a few areas.....	2
E. No shading.....	(0)

Remarks

Subtotal 0

VIII. Riparian Vegetative Zone Width

Definition: Riparian zone for this form is area of natural vegetation adjacent to stream (can go beyond floodplain). Definition: A the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths stream, storm drains, uprooted trees, otter slides, etc.

FACE UPSTREAM

Dominant vegetation: ☐ Trees ☐ Shrubs ☐ Grasses ☒ Weeds/old field ☐ Exotics (kudzu,etc)

	Lft. Bank Score	Rt. Bank Score
A. Riparian zone intact (no breaks)		
1. width > 18 meters.....	(5)	(5)
2. width 12-18 meters.....	4	4
3. width 6-12 meters.....	3	3
4. width < 6 meters.....	2	2
B. Riparian zone not intact (breaks)		
1. breaks rare		
a. width > 18 meters.....	4	4
b. width 12-18 meters.....	3	3
c. width 6-12 meters.....	2	2
d. width < 6 meters.....	1	1
2. breaks common		
a. width > 18 meters.....	3	3
b. width 12-18 meters.....	2	2
c. width 6-12 meters.....	1	1
d. width < 6 meters.....	0	0

Total 10

Remarks

Page Total 40

☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream.

TOTAL SCORE 73

7/00 Revision 5

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

72

Biological Assessment Unit, DWQ TOTAL SCORE 79

Directions for use: The observer is to survey a minimum of 100 meters of stream, preferably in an upstream direction starting abo bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a pro habitat evaluation the observer needs to get into the stream. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habi score is determined by adding the results from the different metrics.

Stream BAILEY'S FORK (SITE 2) Location/road: HOPEWELL (SITE 2) (Road Name HOPEWELL) County BURKE

Date 1/2/08 CC# _____ Basin CATAWBA Subbasin 11-34-8-3

Observer(s)_____ Type of Study: ☐ Fish ☒ Benthos ☐ Basinwide ☐ Special Study (Describe) _____

~~Latitude~~ NORTHING 725231.4 ~~Longitude~~ EASTING 1190216.6 Ecoregion: ☐ MT ☒ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature 7.9 °C DO 11.35 mg/l Conductivity (corr.) 50 µmhos/cm pH 7.8

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what estimate driving thru the watershed in watershed land use.

Visible Land Use: 75 %Forest 25 %Residential _____ %Active Pasture _____ % Active Crops
_____ %Fallow Fields _____ % Commercial _____ %Industrial _____ %Other - Describe: _____

Watershed land use (est): 40 %Forest 60 %Agriculture _____ %Urban ☐ Animal operations upstream

Width: (meters) Stream 2.25 Channel (at top of bank) 4.0 Stream Depth: (m) Avg .11 Max .17
☐ Width variable

Bank Height (from deepest part of channel (in riffle or run) to top of bank): (m) 1 (RB), 3.1 (LB)

Bank Angle: 60 ° or ☐ NA (Vertical is 90°, horizontal is 0°. Angles > 90° indicate slope is towards mid-channel, < 90° indicate slope is away from channel. NA if bank is too low for bank angle to matter.)

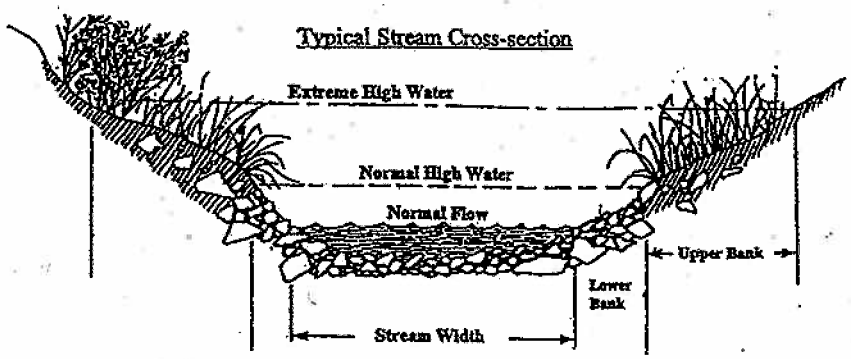
☒ Deeply incised-steep, straight banks ☒ Both banks undercut at bend ☒ Channel filled in with sediment
☐ Recent overbank deposits ☐ Bar development ☐ Buried structures ☐ Exposed bedrock
☐ Excessive periphyton growth ☐ Heavy filamentous algae growth ☐ Green tinge ☐ Sewage smell
Manmade Stabilization: ☒ N ☐ Y: ☐ Rip-rap, cement, gabions ☐ Sediment/grade-control structure ☐ Berm/levee
Flow conditions: ☐ High ☒ Normal ☐ Low
Turbidity: ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Tannic ☐ Milky ☐ Colored (from dyes)

Weather Conditions: SUNNY 42.0 Photos: ☐ N ☒ Y ☒ Digital ☐ 35mm

Remarks: REFERENCE REACH UPSTREAM OF SITE 1.

7.9C

Typical Stream Cross-section



This side is 45° bank angle.

BAILEY'S FORK SITE 2

I. Channel Modification — Score

A. channel natural, frequent bends 5
B. channel natural, infrequent bends (channelization could be old) 4
C. some channelization present 3
D. more extensive channelization, >40% of stream disrupted 2
E. no bends, completely channelized or rip rapped or gabioned, etc 0

☐ Evidence of dredging ☐ Evidence of desnagging=no large woody debris in stream ☐ Banks of uniform shape/height

Subtotal 5

Remarks _____

II. Instream Habitat: Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >70% of the reach is rocks, 1 type is present, circle the score of 17. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as Rare, Common, or Abundant.

C ✓ Rocks ___ R Macrophytes ✓ C Sticks and leafpacks ___ R Snags and logs ✓ A Undercut banks or root mats

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

	>70% Score	40-70% Score	20-40% Score	<20% Score
4 or 5 types present	20	16	12	8
3 types present	19	15	(11)	7
2 types present	18	14	10	6
1 type present	17	13	9	5
No types present	0			

☐ No woody vegetation in riparian zone Remarks _____

Subtotal 11

III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder) look at entire reach for substrate scoring, but only look at rif for embeddedness.

Score

A. substrate with good mix of gravel cobble and boulders
1. embeddedness <20% (very little sand, usually only behind large boulders) 15
2. embeddedness 20-40% 12
3. embeddedness 40-80% 8
4. embeddedness >80% 3

B. substrate gravel and cobble
1. embeddedness <20% 14
2. embeddedness 20-40% 11
3. embeddedness 40-80% ..... (8)
4. embeddedness >80% 2

C. substrate mostly gravel
1. embeddedness <50% 8
2. embeddedness >50% 4

D. substrate homogeneous
1. substrate nearly all bedrock 3
2. substrate nearly all sand 3
3. substrate nearly all detritus 2
4. substrate nearly all silt/ clay 1

Subtotal 6

Remarks _____

IV. Pool Variety Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in la high gradient streams.

Score

A. Pools present
1. Pools Frequent (>30% of 100m area surveyed)
a. variety of pool sizes 10
b. pools same size (indicates pools filling in) ..... (8)
2. Pools Infrequent (<30% of the 100m area surveyed)
a. variety of pool sizes 6
b. pools same size 4

B. Pools absent 0

Subtotal 8

☐ Pool bottom boulder-cobble=hard ☒ Bottom sandy-sink as you walk ☐ Silt bottom ☐ Some pools over wader depth

Remarks _____

Page Total 30

BAILEY'S FORK SITE 2

V. Riffle Habitats

Definition: Riffle is area of reaeration-can be debris dam, or narrow channel area.

	Riffles Frequent Score	Riffles Infrequent Score
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream....	(16)	12
B. riffle as wide as stream but riffle length is not 2X stream width	14	7
C. riffle not as wide as stream and riffle length is not 2X stream width	10	3
D. riffles absent.....	0	

Channel Slope: ☒Typical for area ☐Steep=fast flow ☐Low=like a coastal stream

Subtotal 16

VI. Bank Stability and Vegetation

FACE UPSTREAM

	Left Bank Score	Rt. Bank Score
A. Banks stable		
1. no evidence of erosion or bank failure(except outside of bends), little potential for erosion....	7	7
B. Erosion areas present		
1. diverse trees, shrubs, grass; plants healthy with good root systems.....	(6)	6
2. few trees or small trees and shrubs; vegetation appears generally healthy.....	5	(5)
3. sparse mixed vegetation; plant types and conditions suggest poorer soil binding.....	3	3
4. mostly grasses, few if any trees and shrubs, high erosion and failure potential at high flow..	2	2
5. no bank vegetation, mass erosion and bank failure evident.....	0	0
		Total 11

Remarks _____

VII. Light Penetration (Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block sunlight when the sun is directly overhead).

	Score
A. Stream with good shading with some breaks for light penetration	(10)
B. Stream with full canopy - breaks for light penetration absent.....	8
C. Stream with partial shading - sunlight and shading are essentially equa.....	7
D. Stream with minimal shading - full sun in all but a few areas.....	2
E. No shading.....	0

Remarks _____ Subtotal 10

VIII. Riparian Vegetative Zone Width

Definition: Riparian zone for this form is area of natural vegetation adjacent to stream (can go beyond floodplain). Definition: A the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream; such as paths stream, storm drains, uprooted trees, otter slides, etc.

FACE UPSTREAM

Dominant vegetation: ☑ Trees ☑ Shrubs ☑ Grasses ☐ Weeds/old field ☐ Exotics (kudzu,etc)

	Lft. Bank Score	Rt. Bank Score
A. Riparian zone intact (no breaks)		
1. width > 18 meters.....	5	5
2. width 12-18 meters.....	4	4
3. width 6-12 meters.....	3	3
4. width < 6 meters.....	2	2
B. Riparian zone not intact (breaks)		
1. breaks rare		
a: width > 18 meters.....	(4)	4
b. width 12-18 meters.....	3	3
c. width 6-12 meters.....	2	2
d. width < 6 meters.....	1	1
2. breaks common		
a. width > 18 meters.....	3	3
b. width 12-18 meters.....	2	2
c. width 6-12 meters.....	1	(1)
d. width < 6 meters.....	0	0
		Total 5

Remarks _____

Page Total 42

☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream.

TOTAL SCORE 72

7/00 Revision 5

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

Biological Assessment Unit, DWQ TOTAL SCORE 67

Directions for use: The observer is to survey a minimum of 100 meters of stream, preferably in an upstream direction starting abo bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a pro habitat evaluation the observer needs to get into the stream. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habi score is determined by adding the results from the different metrics.

Stream BAILEY'S FORK Location/road: SITE 3 (Road Name HOPEWELL) County BURKE

Date 1/23/08 CC# _____ Basin CATAWBA Subbasin 11-34-8-3

Observer(s) CHM + MR Type of Study: ☐ Fish ☒ Benthos ☐ Basinwide ☐ Special Study (Describe) _____

NORTHING EASTING
~~Latitude~~ 730808.0 ~~Longitude~~ 1192576.6 Ecoregion: ☐ MT ☒ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature 6.6 °C DO 13.59 (111%) mg/l Conductivity (corr.) 80 µmhos/cm pH 7.4

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what estimate driving thru the watershed in watershed land use.

Visible Land Use: _____%Forest _____%Residential _____%Active Pasture _____% Active Crops
98 %Fallow Fields _____% Commercial _____%Industrial 2 %Other - Describe: RAILROAD

Watershed land use (est): _____%Forest 90 %Agriculture 10 %Urban (Residential) ☐ Animal operations upstream

Width: (meters) Stream 1.75 Channel (at top of bank) 3 Stream Depth: (m) Avg 6" Max .67
☐ Width variable

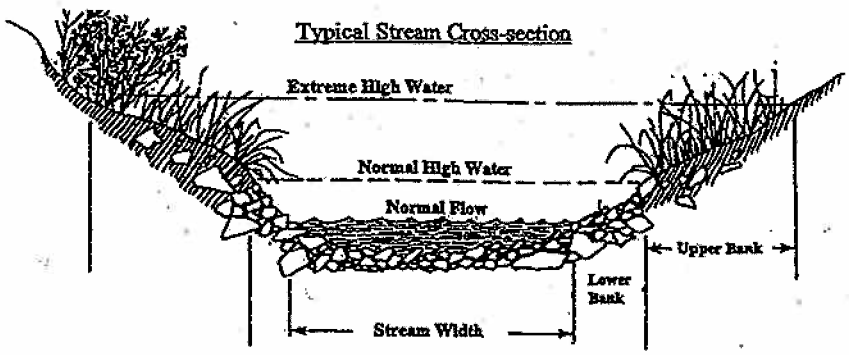
Bank Height (from deepest part of channel (in riffle or run) to top of bank): (m) 1

Bank Angle: 45 ° or ☐ NA (Vertical is 90°, horizontal is 0°. Angles > 90° indicate slope is towards mid-channel, < 90° indicate slope is away from channel. NA if bank is too low for bank angle to matter.)

☐Deeply incised-steep,straight banks ☐Both banks undercut at bend ☑Channel filled in with sediment
☐ Recent overbank deposits ☐Bar development ☐Buried structures ☐Exposed bedrock
☐ Excessive periphyton growth ☐ Heavy filamentous algae growth ☐Green tinge ☐ Sewage smell
Manmade Stabilization: ☐N ☒Y: ☐Rip-rap, cement, gabions ☐ Sediment/grade-control structure ☐Berm/levee
Flow conditions : ☐High ☐Normal ☑Low
Turbidity: ☑Clear ☐ Slightly Turbid ☐Turbid ☐Tannic ☐Milky ☐Colored (from dyes)

Weather Conditions: SUNNY 45 Photos: ☐N ☒Y ☒Digital ☐35mm

Remarks: W/IN RESTORATION REACH



This side is 45° bank angle.

BAILEYS FORK SITE 3

I. Channel Modification — Score

A. channel natural, frequent bends	(5)
B. channel natural, infrequent bends (channelization could be old)	4
C. some channelization present	3
D. more extensive channelization, >40% of stream disrupted	2
E. no bends, completely channelized or rip rapped or gabioned, etc	0

☐ Evidence of dredging ☐ Evidence of desnagging=no large woody debris in stream ☒ Banks of uniform shape/height

Subtotal 5

Remarks _____

II. Instream Habitat: Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >70% of the reacl is rocks, 1 type is present, circle the score of 17. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as Rare, Common, or Abundant.

C Rocks A Macrophytes R Sticks and leafpacks R Snags and logs R Undercut banks or root mats

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

	>70% Score	40-70% Score		20-40% Score	<20% Score
4 or 5 types present	20	16		12	8
3 types present	19	15		11	7
2 types present	18	14	12	10	6
1 type present	17	13		9	5
No types present	0				

☐ No woody vegetation in riparian zone Remarks _____

Subtotal 12

III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder) look at entire reach for substrate scoring, but only look at ri for embeddedness.

	Score
A. substrate with good mix of gravel cobble and boulders	
1. embeddedness <20% (very little sand, usually only behind large boulders)	15
2. embeddedness 20-40%	12
3. embeddedness 40-80%	8
4. embeddedness >80%	3
B. substrate gravel and cobble	
1. embeddedness <20%	14
2. embeddedness 20-40%	11
3. embeddedness 40-80%	6
4. embeddedness >80%	2
C. substrate mostly gravel	
1. embeddedness <50%	8
2. embeddedness >50%	(4)
D. substrate homogeneous	
1. substrate nearly all bedrock	3
2. substrate nearly all sand	3
3. substrate nearly all detritus	2
4. substrate nearly all silt/ clay	1

Remarks heavily silted

Subtotal 4

IV. Pool Variety Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in la high gradient streams.

	Score
A. Pools present	
1. Pools Frequent (>30% of 100m area surveyed)	
a. variety of pool sizes	10
b. pools same size (indicates pools filling in)	(8)
2. Pools Infrequent (<30% of the 100m area surveyed)	
a. variety of pool sizes	6
b. pools same size	4
B. Pools absent	0

Subtotal 8

☐ Pool bottom boulder-cobble=hard ☐ Bottom sandy-sink as you walk ☐ Silt bottom ☐ Some pools over wader depth

Remarks _____

Page Total 29

BAILEYS FORK SITE 5

V. Riffle Habitats

Definition: Riffle is area of reaeration-can be debris dam, or narrow channel area.

	Riffles Frequent Score	Riffles Infrequent Score
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream....	(16)	12
B. riffle as wide as stream but riffle length is not 2X stream width	14	7
C. riffle not as wide as stream and riffle length is not 2X stream width	10	3
D. riffles absent.....	0	

Channel Slope: ☐Typical for area ☐Steep=fast flow ☐Low=like a coastal stream

Subtotal 16

VI. Bank Stability and Vegetation

FACE UPSTREAM

	Left Bank Score	Rt. Bank Score
A. Banks stable		
1. no evidence of erosion or bank failure(except outside of bends), little potential for erosion....	(7)	(9)
B. Erosion areas present		
1. diverse trees, shrubs, grass; plants healthy with good root systems.....	6	6
2. few trees or small trees and shrubs; vegetation appears generally healthy.....	5	5
3. sparse mixed vegetation; plant types and conditions suggest poorer soil binding.....	3	3
4. mostly grasses, few if any trees and shrubs, high erosion and failure potential at high flow..	2	2
5. no bank vegetation, mass erosion and bank failure evident.....	0	0

Total 14

Remarks SOME DEPOSITION PRESENT IN REACH.

VII. Light Penetration (Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block sunlight when the sun is directly overhead).

	Score
A. Stream with good shading with some breaks for light penetration	10
B. Stream with full canopy - breaks for light penetration absent.....	8
C. Stream with partial shading - sunlight and shading are essentially equa.....	7
D. Stream with minimal shading - full sun in all but a few areas.....	2
E. No shading.....	(0)

Remarks _____ Subtotal 0

VIII. Riparian Vegetative Zone Width

Definition: Riparian zone for this form is area of natural vegetation adjacent to stream (can go beyond floodplain). Definition: A the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths stream, storm drains, uprooted trees, otter slides, etc.

FACE UPSTREAM

Dominant vegetation: ☐ Trees ☐ Shrubs ☒ Grasses ☐ Weeds/old field ☐Exotics (kudzu,etc)

	Lft. Bank Score	Rt. Bank Score
A. Riparian zone intact (no breaks)		
1. width > 18 meters.....	5	5
2. width 12-18 meters.....	(4)	(4)
3. width 6-12 meters.....	3	3
4. width < 6 meters.....	2	2
B. Riparian zone not intact (breaks)		
1. breaks rare		
a. width > 18 meters.....	4	4
b. width 12-18 meters.....	3	3
c. width 6-12 meters.....	2	2
d. width < 6 meters.....	1	1
2. breaks common		
a. width > 18 meters.....	3	3
b. width 12-18 meters.....	2	2
c. width 6-12 meters.....	1	1
d. width < 6 meters.....	0	0

Total 8

Remarks Juncus. RIPARIAN BUFFER PLANTED LOOKS HEALTHY BUT STILL YOUNG- NO SHADING AT PRESENT

Page Total 38

☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream.

TOTAL SCORE 67

7/00 Revision 5

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

Biological Assessment Unit, DWQ TOTAL SCORE 63

Directions for use: The observer is to survey a minimum of 100 meters of stream, preferably in an upstream direction starting abov bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a pro habitat evaluation the observer needs to get into the stream. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habi score is determined by adding the results from the different metrics.

Stream BAILEY'S FORK UT3 Location/road: SITE 4 (Road Name HOPEWELL (HOPEWELL GOLF CLUB) County BURKE

Date 1/23/08 CC# _____ Basin CATAWBA Subbasin 11-34-8-3

Observer(s) MR + CHM Type of Study: ☐ Fish ☒ Benthos ☐ Basinwide ☐ Special Study (Describe) _____

~~Latitude~~ NORTHING 728313.9 ~~Longitude~~ EASTING 1194186.3 Ecoregion: ☐ MT ☒ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature 7.9 °C DO 10.79 mg/l Conductivity (corr.) 80 µmhos/cm pH 7.02

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what estimate driving thru the watershed in watershed land use.

Visible Land Use: 65 %Forest 20 %Residential _____ %Active Pasture _____ % Active Crops
_____ %Fallow Fields _____ % Commercial _____ %Industrial 15 %Other - Describe: CLEARED FOREST

Watershed land use (est): 35 %Forest 50 %Agriculture 15 %Urban (Residential / Hwys) ☐ Animal operations upstream

Width: (meters) Stream 1.5 Channel (at top of bank) 4.5 Stream Depth: (m) Avg .25 Max 1
☐ Width variable

Bank Height (from deepest part of channel (in riffle or run) to top of bank): (m) 2.5

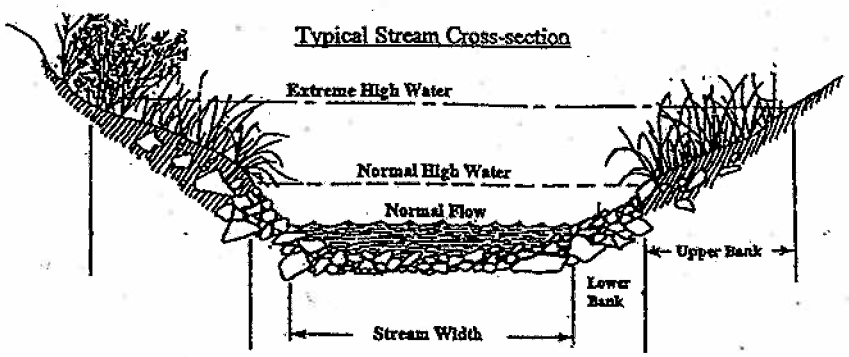
Bank Angle: 90 ° or ☐ NA (Vertical is 90°, horizontal is 0°. Angles > 90° indicate slope is towards mid-channel, < 90° indicate slope is away from channel. NA if bank is too low for bank angle to matter.)

☑ Deeply incised-steep, straight banks ☐ Both banks undercut at bend ☑ Channel filled in with sediment
☐ Recent overbank deposits ☒ Bar development ☐ Buried structures ☐ Exposed bedrock
☐ Excessive periphyton growth ☐ Heavy filamentous algae growth ☐ Green tinge ☐ Sewage smell
Manmade Stabilization: ☑ N ☐ Y: ☐ Rip-rap, cement, gabions ☐ Sediment/grade-control structure ☐ Berm/levee
Flow conditions: ☐ High ☐ Normal ☑ Low
Turbidity: ☑ Clear ☐ Slightly Turbid ☐ Turbid ☐ Tannic ☐ Milky ☐ Colored (from dyes)

Weather Conditions: SUNNY 50° Photos: ☐ N ☒ Y ☒ Digital ☐ 35mm

Remarks: REFERENCE SITE UPSTREAM OF SITE 3 ON UT3 SOUTH OF HOPEWELL RD.

Typical Stream Cross-section



This side is 45° bank angle.

BAILEY'S FORK WTS SITE 4

I. Channel Modification — Score

- A. channel natural, frequent bends — 5
- B. channel natural, infrequent bends (channelization could be old) — 4
- C. some channelization present — 3
- D. more extensive channelization, >40% of stream disrupted — 2
- E. no bends, completely channelized or rip rapped or gabioned, etc — 0

☐ Evidence of dredging ☐ Evidence of desnagging=no large woody debris in stream ☐ Banks of uniform shape/height

Subtotal 4

Remarks _____

II. Instream Habitat: Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >70% of the reach is rocks, 1 type is present, circle the score of 17. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as Rare, Common, or Abundant.

C Rocks A Macrophytes C Sticks and leafpacks R Snags and logs C Undercut banks or root mats

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

	>70% Score	40-70% Score		20-40% Score	<20% Score
4 or 5 types present	20	(16)	13	12	8
3 types present	19	15		11	7
2 types present	18	14		10	6
1 type present	17	13		9	5
No types present	0				

☐ No woody vegetation in riparian zone Remarks ROOT MATS NOT CURRENTLY IN CONTACT W/ WATER - LOW FLOW

Subtotal 13

III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder) look at entire reach for substrate scoring, but only look at ri for embeddedness.

	Score
A. substrate with good mix of gravel cobble and boulders	
1. embeddedness <20% (very little sand, usually only behind large boulders)	15
2. embeddedness 20-40%	12
3. embeddedness 40-80%	8
4. embeddedness >80%	3
B. substrate gravel and cobble	
1. embeddedness <20%	14
2. embeddedness 20-40%	11
3. embeddedness 40-80%	(6)
4. embeddedness >80%	2
C. substrate mostly gravel	
1. embeddedness <50%	8
2. embeddedness >50%	4
D. substrate homogeneous	
1. substrate nearly all bedrock	3
2. substrate nearly all sand	3
3. substrate nearly all detritus	2
4. substrate nearly all silt/ clay	1

Subtotal 6

Remarks _____

IV. Pool Variety Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in la high gradient streams.

	Score
A. Pools present	
1. Pools Frequent (>30% of 100m area surveyed)	
a. variety of pool sizes	(10)
b. pools same size (indicates pools filling in)	8
2. Pools Infrequent (<30% of the 100m area surveyed)	
a. variety of pool sizes	6
b. pools same size	4
B. Pools absent	0

Subtotal (8) 8

☐ Pool bottom boulder-cobble=hard ☑ Bottom sandy-sink as you walk ☐ Silt bottom ☐ Some pools over wader depth

Remarks POOLS HEAVILY SILTED

Page Total (31) 31

BAILEY'S FORK UT3 SITE4

V. Riffle Habitats

Definition: Riffle is area of reaeration-can be debris dam, or narrow channel area.

	Riffles Frequent Score	Riffles Infrequent Score
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream....	~~16~~ (10)	12
B. riffle as wide as stream but riffle length is not 2X stream width	14	7
C. riffle not as wide as stream and riffle length is not 2X stream width	10	3
D. riffles absent.....	0	

Channel Slope: ☐Typical for area ☐Steep=fast flow ☐Low=like a coastal stream

Subtotal ~~16~~ 10

VI. Bank Stability and Vegetation

FACE UPSTREAM

	Left Bank Score	Rt. Bank Score
A. Banks stable		
1. no evidence of erosion or bank failure(except outside of bends), little potential for erosion....	7	7
B. Erosion areas present		
1. diverse trees, shrubs, grass; plants healthy with good root systems.....	~~8~~	6
2. few trees or small trees and shrubs; vegetation appears generally healthy.....	5	~~6~~
3. sparse mixed vegetation; plant types and conditions suggest poorer soil binding.....	3	3
4. mostly grasses, few if any trees and shrubs, high erosion and failure potential at high flow..	(2)	(2)
5. no bank vegetation, mass erosion and bank failure evident.....	0	0
		Total ~~13~~ 14

Remarks POWER LINE CUT

VII. Light Penetration (Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block sunlight when the sun is directly overhead).

	Score
A. Stream with good shading with some breaks for light penetration	~~10~~
B. Stream with full canopy - breaks for light penetration absent.....	8
C. Stream with partial shading - sunlight and shading are essentially equa.....	7
D. Stream with minimal shading - full sun in all but a few areas.....	2
E. No shading.....	0

Remarks _____ Subtotal 10

VIII. Riparian Vegetative Zone Width

Definition: Riparian zone for this form is area of natural vegetation adjacent to stream (can go beyond floodplain). Definition: A the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths stream, storm drains, uprooted trees, otter slides, etc.

FACE UPSTREAM

Dominant vegetation: ☑ Trees ☑ Shrubs ☑ Grasses ☐ Weeds/old field ☐ Exotics (kudzu,etc)

	Lft. Bank Score	Rt. Bank Score
A. Riparian zone intact (no breaks)		
1. width > 18 meters.....	5	5
2. width 12-18 meters.....	4	4
3. width 6-12 meters.....	3	3
4. width < 6 meters.....	2	2
B. Riparian zone not intact (breaks)		
1. breaks rare		
a. width > 18 meters.....	~~4~~	~~4~~
b. width 12-18 meters.....	3	3
c. width 6-12 meters.....	2	2
d. width < 6 meters.....	1	1
2. breaks common		
a. width > 18 meters.....	3	3
b. width 12-18 meters.....	2	2
c. width 6-12 meters.....	1	1
d. width < 6 meters.....	0	0
		Total 8

Remarks _____

Page Total ~~35~~ 32

☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream.

TOTAL SCORE ~~68~~ 63