PINCH GUT CREEK STREAM RESTORATION PROJECT

ANNUAL MONITORING REPORT FOR 2010 (YEAR 3)

Contract Number D06043-A

Submitted to: NCDENR - Ecosystem Enhancement Program
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1.0 EXECUTIVE SUMMARY

This Annual Report details the monitoring activities during the 2010 growing season (Monitoring Year 3) on the Pinch Gut Stream Restoration Site ("Site"). As per the approved Restoration Plan for the Site, this Annual Monitoring Report presents data on stream geometry, stem count data from vegetation monitoring stations, and discusses any observed tendencies relating to stream stability and vegetation survival success.

The Site has a recent history of cattle farming and general agricultural usage. Cattle had been allowed to graze on the banks and access the streams in various locations. The streams had been channelized and riparian buffer vegetation was cleared throughout various reaches of the project. A majority of the site had an early successional, narrow buffer that included several invasive species and many channel sections were incised and lacked riparian vegetation. As a result, channel degradation was widespread across the site.

A total of 21 monitoring plots 100 square meters (m^2) (10m x 10m) in size were used to predict survivability of the woody vegetation planted on-site. Data from the Year 3 monitoring event of the 21 vegetation plots exhibited a range of 320 to 800 stems per acre. The data showed that the Site had an average of 547 stems per acre.

The vegetation data demonstrates that all plots on the Site have met the minimum interim success criteria of 320 trees per acre by the end of Year 3.

Cross-section monitoring data for stream stability were collected during Year 3 monitoring. A longitudinal profile survey was completed during Year 3 monitoring for approximately 3,581 linear feet (LF) of stream on the Site. The longitudinal profile was completed for UT1_R2 and UT1_R4 only.

In-stream channel repairs on UT1_R2, UT1_R3, UT1_R4, UT5_R1 and UT3 were completed in 2010, following damage from large consecutive storm events. All repairs were functioning properly after completion and will be closely observed during Year 4 of monitoring.

According to the on-site crest gauges, the Site experienced at least three bankfull flow events during Year 3 of the post-construction monitoring period. The two largest on-site bankfull flow events documented by the UT1 crest gauge during Year 3 of monitoring occurred between January and February of 2010. It was estimated that flows at the UT1_R4 crest gauge during the January 24, 2010 storm event were approximately 3.0 feet (36 inches) above bankfull stage. According to a nearby USGS gauge station, approximately 3.4 inches of rain fell in the Mount Airy region between January 24th and 25th of 2010. Inspection of conditions during site visits revealed visual evidence of out-of-bank flows.

The approved Restoration Plan for the Site identified existing wetlands within the project boundaries, however construction activities sought to avoid these marginal wetland areas and wetland mitigation units were not included as part of the monitoring contract.

In summary, the Site is on track to meet the hydrologic, vegetative, and stream success criteria as specified in the site Restoration Plan.

2.0 PROJECT BACKGROUND

The project involved the restoration and enhancement of unnamed tributaries (UTs) to Pinch Gut Creek. A total of 10,581 LF of stream were restored and 292 LF of stream were enhanced based on the construction as-built survey. Table 1 summarizes the restoration areas on the Site. Selected site photographs are shown in Appendix A and B. The recorded conservation easement totaling 31.8 acres is being revised at the time of this report to include an additional 3.5 acres that will protect the streams and riparian buffers in perpetuity.

2.1 Project Objectives

The specific goals for the Pinch Gut Restoration Project were as follows:

- Restore functional stream channels
- Restore and enhance existing riparian wetlands
- Establish native stream bank and floodplain vegetation in the permanent conservation easement
- Improve water quality in the Pinch Gut Creek watershed by reducing sediment and nutrient inputs by fencing cattle out of the stream and reducing bank erosion
- Improve aquatic and riparian habitat by creating deeper pools with in-stream structures.

2.2 Project Structure, Restoration Type and Approach

After examining the assessment data collected at the Site and exploring the potential for restoration, an approach to the Site was developed that addressed restoration of stream functions within the agricultural field areas. Topography and soils on the Site indicated that the project area most likely functioned in the past as a headwater tributary stream system with associated wetland areas from hill slope seepage, which fed into the larger Pinch Gut Creek system.

Therefore, a design approach was formulated to restore this type of system. First, appropriate stream types for the valley types and slopes were selected and designed to carry bankfull flows. Special consideration was given to minimizing disturbance to existing wetland and wooded areas.

For analysis and design purposes, the on-site streams were divided into 11 reaches (Figure 1). Six tributaries flow directly into a single-thread unnamed tributary (mainstem UT1) from the beginning of the perennial portion of UT1 to Pell Road (SR 1215) and the project limits. The reaches were numbered sequentially from west to east with tributaries carrying a UT designation followed by the reach number. The project watershed boundary is confined within nearby roads and divided into sub-watersheds for each corresponding reach. UT1 flows from west to east and ends at a culvert under Pell Road. UT1 is split into four sub-reaches beginning with UT1_R1 at the headwaters and ending at the UT4 confluence. UT1_R2 continues northeast and ends at the northern property line. UT1_R3 starts at the adjoining property lines, and ends at the UT5_R2 confluence. UT1_R4 continues from the UT5_R2 confluence northeast to the confluence with UT7. UT2 flows from the southwest, and ends at the confluence with UT1_R1. UT3 flows from the northwest and ends after a short distance at the confluence with UT1_R1 just downstream of UT2. UT5_R1 flows into the project from the southwest and ends at the confluence with UT6. UT5_R2 continues from that point

and ends at the confluence with UT1_R3. UT6 flows into the Site from the south and ends at the confluence with UT5_R2. UT7 begins approximately 300 LF upstream of the UT1_R4 confluence.

The overall restoration approach for the Site allows stream flows larger than bankfull flows to spread onto the floodplain, dissipating flow energies and reducing stress on streambanks. In-stream structures were used throughout all reaches to control streambed grade, reduce streambank stress, and promote bedform sequences and habitat diversity. The in-stream structures consist of root wads, log vanes, log weirs, cross vanes, grade control j-hooks, and constructed riffles, which promote a diversity of habitat features in the restored channel. Where grade control was a consideration, constructed riffles were installed to provide long-term stability. Streambanks were stabilized using a combination of erosion control matting, temporary and permanent seeding, bare-root planting, and vegetation transplants. Transplants provide living root mass to increase streambank stability and create holding areas for fish and other aquatic biota

The approved Restoration Plan for the Site identified existing wetlands within the project boundaries, however construction activities sought to avoid these marginal wetland areas and wetland mitigation units were not included. Therefore, no groundwater monitoring stations or rain gauges were installed on the Site. Although, in various locations along the riparian corridor, wetlands were enhanced and/or created as a result of raising the stream profiles which led to higher water table conditions adjacent to the restored channels and has allowed more out-of-bank flooding to occur.

Table 1. Design Approach for the Pinch Gut Creek Stream Restoration Site

Pinch Gut Creek Stream Restoration Site: Project No. D06043-A								
Project Segment or Reach ID	**Existing Feet/Acres**	**Mitigation Type ***	**Approach****	**Linear Footage or Acreage**	**Mitigation Ratio**	**Mitigation Units**	**Stationing**	**Comment**
UT1_R1	1,484	R	P1, P2	1,494	1:1	1,494	10+00 - 29+94	Installed in-stream structures to control grade and reduce bank erosion
UT1_R2	1,952	R	P1, P2	1,506	1:1	1,506	29+94 - 40+30	Installed in-stream structures to control grade and reduce bank erosion
UT1_R3	1,647	R	P1, P2	1,427	1:1	1,427	43+75 - 58+32	Step-pool and riffle-pool sequences were constructed
UT1_R4	2,677	R	P1, P2	2,302	1:1	2,302	58+32 - 82+59	Installed in-stream structures to control grade and reduce bank erosion
UT2	54	R	P2	45	1:1	45	10+00 - 10+45	Step-pool structures installed, stabilized culvert and crossing
UT3	256	R	P1, P2	428	1:1	428	10+00 - 14+39	Dam crossing re-graded and stabilized, step-pool structures and riffles
UT4	96	R	P2	60	1:1	60	10+00 - 10+73	Double drop cross-vane, graded bankfull bench
UT5_R1	969	R	P1, P2	953	1:1	953	10+00 - 19.52	Installed in-stream structures and utilized bedrock knickpoints
UT5_R2	842	R	P1, P2	791	1:1	791	19+52 - 27+70	Installed in-stream structures and utilized bedrock knickpoints
UT6	1,648	R	P1, P2	1,575	1:1	1,575	10+00 - 26+03	Installed in-stream structures and utilized bedrock knickpoints
UT7	299	E	EII	292	2.5:1	117	10+00 - 13+69	Installed in-stream structures to reduce near bank stress and bank erosion

Mitigation Unit Summation

Stream (LF)	Riparian Wetland (Ac)	Non-riparian Wetland (Ac)	Total Wetland (Ac)	Buffer (Ac)	
10,698	0	0	0	35.3	

* R = Restoration
E = Enhancement

** P1 = Priority I
P2 = Priority II
EII = Enhancement II

2.3 Location and Setting

The Site is located in Stokes County, NC (Figure 1), approximately five miles northeast of the Town of Pilot Mountain. The Site lies in the Roanoke River Basin within North Carolina Division of Water Quality sub-basin 03-02-01 and NCEEP targeted local watershed 03010103170030.

2.4 Project History and Background

The Site has a recent history of cattle farming and general agricultural usage. Cattle had been allowed to graze on the banks and access the stream channels in various locations. The streams had been channelized and riparian buffer vegetation was cleared throughout various reaches of the project. A majority of the Site had an early successional, narrow buffer that included several invasive species and many sections were incised and lacked riparian vegetation. As a result, channel degradation was widespread across the Site.

The chronology of the Pinch Gut Creek Project is presented in Table 2. The contact information for the designers, contractors, and relevant suppliers is presented in Table 3. Relevant project background information is provided in Table 4.

2.5 Project Plan

Plans illustrating the as-built conditions of the major project elements, locations of permanent monitoring cross-sections, and locations of permanent vegetation monitoring plots are presented in Figures 2A through 2J of this report.

Table 2. Project Activity and Reporting History

Pinch Gut Creek Stream Restoration Site: Project No. D06043-A			
Activity or Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan Prepared	N/A	N/A	Jul-07
Restoration Plan Amended	N/A	N/A	Jul-07
Restoration Plan Approved	Mar-07	N/A	Jul-07
Final Design – (at least 90% complete)	N/A	N/A	Jun-07
Construction Begins	Oct-07	N/A	Nov-07
Temporary S&E mix applied to entire project area	NA	N/A	Apr-08
Permanent seed mix applied to entire project area	Dec-07	N/A	Apr-08
Planting of live stakes	Dec-07	N/A	Apr-08
Planting of bare root trees	Dec-07	N/A	Apr-08
End of Construction	Dec-07	N/A	Apr-08
Survey of As-built conditions (Year 0 Monitoring-baseline)	Dec-07	Jul-08	Jul-08
Year 1 Monitoring	Dec-08	Nov-08	Dec-08
Year 2 Monitoring	Dec-09	Oct-09	Dec-09
Year 3 Monitoring	Dec-10	Nov-10	Jan-11
Year 4 Monitoring	Scheduled Dec-11	Scheduled Nov-11	Scheduled Dec-11
Year 5 Monitoring	Scheduled Dec-12	Scheduled Nov-12	Scheduled Dec-12

Table 3. Project Contacts

Pinch Gut Creek Stream Restoration Site: Project No. D06043-A	
Designer Michael Baker Engineering, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: 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 Nursery Stock Suppliers	Mellow Marsh Farm, 919-742-1200 International Paper, 1-888-888-7159
Monitoring Performers Michael Baker Engineering, Inc. Stream Monitoring Point of Contact: Vegetation Monitoring Point of Contact:	8000 Regency Parkway, Suite 200 Cary, NC 27518 Dwayne Huneycutt, Tel. 919-463-5488 Dwayne Huneycutt, Tel. 919-463-5488

Table 4. Project Background

Pinch Gut Creek Stream Restoration Site: Project No. D06043-A	
Project County:	Stokes County, NC
Reach:	Drainage Area (sq. mi.):
UT1_R1	0.15
UT1_R2	0.41
UT1_R3	0.48
UT1_R4	1.19
UT2	.02
UT3	.02
UT4	0.10
UT5_R1	0.34
UT5_R2	0.49
UT6	0.12
UT7	0.61
Estimated Drainage % Impervious Cover:	
UT1, UT2, UT3, UT4, UT5, UT6, UT7	<5%
Stream Order:	
UT1_R1, UT2, UT3, UT4, UT5_R1, UT6	1
UT1_R2, UT1_R3, UT5_R2, UT7	2
UT1_R4	3
Physiographic Region	Piedmont
Ecoregion	Northern Inner Piedmont
Rosgen Classification of As-Built:	
UT2, UT3, UT4, UT6, UT7	B
UT1_R3	Bc
UT1_R1, UT5_R1, UT5_R2	B/C
UT1_R2	C
UT1_R4	Cb
Cowardin Classification:	
UT1_R1, UT6, UT5_R1	Riverine, Upper Perennial, Rock Bottom
UT1_R2, UT1_R3, UT1_R4, UT2, UT3, UT4, UT5_R2, UT7	Riverine, Lower Perennial, Unconsolidated Bottom
Dominant Soil Types:	
UT1_R1, UT2, UT3, UT1_R2, UT4, UT1_R3, UT5_R1	PcD2
UT1_R3	PcC2
UT1_R4, UT5_R2, UT6	RpE
UT1_R4, UT7	RtA
Reference site ID	Mickey Reach, Surry County
USGS HUC for Project and Reference sites	03010103170030 (Project); 03040101080010 (Ref.)
NCDWQ Sub-basin for Project and Reference	03-02-01 (Project); 03-07-02 (Ref.)
NCDWQ classification for Project and Reference:	
Reference	B4
UT2, UT3, UT4, UT6, UT7	B
UT1_R3	Bc
UT1_R1, UT5_R1, UT5_R2	B/C

Table 4. Project Background

Pinch Gut Creek Stream Restoration Site: Project No. D06043-A	
Project County:	Stokes County, NC
UT1_R2	C
UT1_R4	B/C
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%

3.0 PROJECT CONDITION AND MONITORING RESULTS

3.1 Vegetation Assessment

3.1.1 Description of Vegetative Monitoring

As a final stage of construction, the stream margins and riparian area of the Site were planted with bare root trees, live stakes, and a seed mixture of temporary and permanent ground cover 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. In general, bare-root vegetation was planted at a target density of 436 stems per acre, in a 10-foot by 10-foot grid pattern. Bare root shrubs were planted at a target density of 258 stems per acre, in a 13-foot by 13-foot grid pattern. The tree species planted at the Site are shown in Table 5. The permanent seed mix of herbaceous species applied to the project's riparian area included Soft rush (*Juncus effusus*), Redtop (*Agrostis alba*), Virginia wild rye (*Elymus virginicus*), Switchgrass (*Panicum virgatum*), Smartweed (*Polygonum pennsylvanicum*), Tick seed (*Bidens frondosa*), Lance leaf coreopsis (*Coreopsis lanceolata*), Eastern gamma grass (*Tripsicum dactyloides*), Little bluestem (*Schizachyrium scoparium*), Deer tongue (*Pancium clandestinum*), Big bluestem (*Andropogon gerardii*) and Indian grass (*Sorgastrum nutans*). This seed mixture was broadcast on the Site at a rate of 15 pounds per acre. All planting was completed in April 2008.

At the time of planting, 21 vegetation plots – labeled 1 through 21 - were delineated 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. The trees also were marked with aluminum metal tags to ensure that the correct identification is made during future monitoring of the vegetation plots.

On a designated corner within each of the 21 vegetation plots, one herbaceous plot was also established. The herbaceous plots measure 1-meter x 1-meter in size. These plots are photographed throughout the growing season. The locations of the vegetation plots are presented in Figures 2B through 2J.

3.1.2 Vegetative Success Criteria

To characterize vegetation success criteria objectively, specific goals for woody vegetation density have been defined. Data from vegetation monitoring plots should display a surviving tree density of at least 320 trees per acre at the end of the third year of monitoring, and a surviving tree density of at least 260 five-year-old trees per acre at the end of the five-year monitoring period.

Table 5. Vegetation Species Planted Across the Restoration Site			
Scientific Name	**Common Name**	**Percent Planted by Species**	**Total Number of Stems**
Bare Root Tree Species			
Betula nigra	River birch	15%	1,962
Liriodendron tulipifera	Tulip poplar	10%	1,308
Quercus phellos	Willow oak	20%	2,616
Quercus rubra	Southern red oak	15%	1,962
Diospyros virginiana	Persimmon	15%	1,962
Juglans nigra	Black walnut	15%	1,962
Platanus occidentalis	Sycamore	10%	1,308
Shrub species			
Alnus serrulata	Tag alder	20%	1,536
Lindera benzoin	Spicebush	25%	1,920
Corylus americana	Hazelnut	20%	1,536
Carpinus caroliniana	Ironwood	15%	1,152
Cornus amomum	Silky dogwood	20%	1,536
Native Herbaceous Species			
Agrostis alba	Redtop	10%	NA
Elymus virginicus	Virginia wildrye	15%	NA
Panicum virgatum	Switch grass	15%	NA
Tripsicum dactyloides	Eastern gamma grass	5%	NA
Polygonum pennsylvanicum	Pennsylvania smartweed	5%	NA
Schizachyrium scoparium	Little bluestem	5%	NA
Juncus effusus	Soft rush	5%	NA
Bidens frondosa (or aristosa)	Beggars tick	5%	NA
Coreopsis lancelota	Lance-leaved tick seed	10%	NA
Panicum clandestinum	Deer tongue	15%	NA
Andropogon gerardii	Big bluestem	5%	NA
Sorgastrum nutans	Indian grass	5%	NA
Woody Vegetation for Live Stakes			
Cornus amomum	Silky dogwood	30%	NA

Table 5. Vegetation Species Planted Across the Restoration Site			
Salix sericia	Silky willow	30%	NA
Sambucus canadensis	Elderberry	20%	NA
Physocarpos orbiculatus	Ninebark	20%	NA

3.1.3 Vegetative Observations and Results

The permanent ground cover seed mixture broadcast on the Site after construction was present during Year 3 monitoring of the Site.

Tables A.1 through A.6 in Appendix A present vegetation metadata, vegetation vigor, vegetation damage and stem count data for the monitoring stations at the end of the Year 3 monitoring period. Data from the Year 3 monitoring event of the 21 vegetation plots exhibited a range of 320 to 800 stems per acre. The data showed that the Site had an average survivability of 547 stems per acre. Based on these results, all plots have met the interim success criteria of 320 stems per acre at the end of monitoring Year 3.

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 they are all accounted for during the annual stem counts and calculation of tree survivability. Aluminum tags with wire hangers are used on surviving stems to aid in relocation during future counts. Flags are also used to mark trees because they do not interfere with the growth of the tree.

Approximately six Tag alders (*Alnus serrulata*), 1 foot to 3 foot in size were observed in vegetation plot 2 following Year 3 monitoring. These volunteer species are native to the area and were also planted as part of the shrub layer for this project. The stems of *Alnus serrulata* did not seem to be posing a threat to the planted stems within the plot. No other significant volunteer woody species were observed in any other vegetation plots. The plots will continue to be assessed during Year 4 monitoring for volunteer species.

3.1.4 Vegetative Problem Areas

It was noted during Year 3 monitoring that vegetation plots 1 and 2 demonstrated densities of 440 and 320 stems per acre, respectively. Although the density of plot 1 shows a density 440 stems per acre, the seven planted stems of spicebush *Lindera benzoin* in plot 1 are very weak and will not likely survive through Year 5. Plot 2 is also of concern due to low stems counts of very weak planted stems of black walnut (*Diospyros virginiana*). Therefore, additional trees will be planted in and around the vicinities of vegetations plots 1 and 2 in winter/spring of 2011.

During Year 3 monitoring, Multiflora rose (*Rosa multiflora*) was observed within vegetation plots 1, 2 and 6. Plots 1 and 2 will have additional stems added in 2011 and plot 6 will be closely observed during Year 4 monitoring. The *rosa mulitiflora* observed in these areas will be treated in the summer/fall of 2011.

There are relatively few weedy species occurring on the Site, and none of the on-site species seem to be posing any problems for the planted woody or herbaceous hydrophytic vegetation

at this time. A significant presence of Blackberry (*Rubus spp*.) was noted within vegetation Plot 1.

3.1.5 Vegetation Photographs

Photographs are used to visually document vegetation plot success. A total of 21 reference stations were established to document tree conditions at each vegetation plot across the Site. Additional photo stations were also established at each of the 21 vegetation plots for herbaceous vegetation monitoring. Reference photos of both tree conditions and herbaceous conditions are taken at least once per year. Photos of the tree plots showing the on-site planted stems are included in Appendix A of this report. Photos of the herbaceous plots are also included in Appendix A.

3.2 Stream Assessment

3.2.1 Morphometric Success Criteria

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

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 22 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. The permanent cross-section pins are 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.

The approved Restoration Plan requires the following criteria be met to achieve stream restoration success. There should be little change in as-built cross-sections. If changes do take place, they will be evaluated to determine if they represent a movement toward a more unstable condition (e.g., down-cutting or erosion) or a movement toward increased stability (e.g., settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio). Cross-sections will be classified using the Rosgen Stream Classification System, and all monitored cross-sections should fall within the quantitative parameters defined for channels of the design stream type.

Longitudinal Profiles: A complete longitudinal profile was surveyed following construction completion to record as-built conditions and to establish a baseline profile. The profile was conducted for the entire length of each restored channel for all reaches. Measurements included thalweg, water surface, inner berm, bankfull, and top of low bank. Each of these measurements was taken at the head of each feature (e.g., riffle, pool, and glide). In addition, maximum pool depth was recorded. All surveys were tied to a single, permanent benchmark.

The approved Restoration Plan requires the following criteria be met to achieve stream restoration success. The longitudinal profiles should show that the bedform features are remaining stable; i.e., they are 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 for channels of the design stream type.

3.2.2 Morphometric Results

Year 3 cross-section monitoring data for stream stability were completed during August and November 2010. The 22 permanent cross-sections along the restored channels (12 located across riffles and 10 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 B.

Cross-sections 3, 5, 7, 9, 11, 13, 16, 18 and 20 are situated across pools which are located at the apex of meander bends. Based on the survey data, cross-sections 3 and 20 have shown relatively little change since as-built conditions. Cross-sections 3, 7, 11, 13, 16, and 18 have demonstrated minor fluctuations in pool dimensions since as-built conditions. Cross-section 9 has deepened significantly since as-built conditions, but remains stable. Based on the data for cross-sections 3, 13 and 16, these pool cross-sections show the slow development of point bar features on the inside bank of the meander bends.

Cross-sections 1, 2, 4, 6, 8, 10, 12, 14, 15, 17, 19, 21 and 22 are situated across riffles which are located between pools. Based on the survey data, cross-sections 1, 14, 15, 17, 19 and 21 showed relatively little change since as-built conditions. Cross-sections 2, 4, 6, 8, 10, 12 and 22 have demonstrated minor fluctuations in riffle dimensions since as-built conditions. Riffle cross-section 6 has a large amount of sediment deposited near the left bank as shown in Appendix B. Pool cross-sections 16 and 18 have minor scour along the right bank (inner berm). These cross-sections do not appear unstable, however, they will be closely observed during the 2011 monitoring season and any significant changes will be reported following Year 4 monitoring.

Riffle cross-sections 10 and 12 underwent repairs during Year 3 by adding Class I/B stone and on-site alluvium to raise the bed elevations. The Year 3 data for cross-sections 10 and 12 provided in Appendix B show a higher bed elevation than was observed in as-built conditions and Year 1 monitoring. According to the Year 3 data, cross-sections 10 and 12 currently appear to be more stable than during Year 1 and as-built conditions due to better connection with the adjacent floodplain.

The longitudinal profile for Year 3 was surveyed in November 2010 and was compared to the data collected during the as-built condition survey in June 2008, Year 1 data collected in November 2008 and Year 2 data surveyed in July 2009. During Year 3 of monitoring, the longitudinal profile survey was only completed for reaches UT1_R2 and UT1_R4. A total stream length of 3,581 LF was surveyed during this time. The longitudinal profiles for these reaches are presented in Appendix B.

Data for the UT1_R2 Year 3 longitudinal profile indicates that the riffles in this reach have maintained relatively the same bed elevations since as-built conditions. Conversely, pools throughout UT1_R2 have continued to increase in depth since as-built conditions. It was noted that increased pool depths were also measured in this reach following Year 1 monitoring. The deeper pools in UT1_R2 are providing increased channel stability while promoting greater habitat diversity. However, two pools at stations 33+18 and 38+38 on UT1_R2 have extended into the downstream riffle sections. These areas have demonstrated deeper thalweg measurements than that which was observed during as-built conditions and previous monitoring years. These two areas will be closely observed during Year 4 monitoring. Any future changes that may demonstrate a movement toward instability within

these areas will be noted and if repairs to these areas are needed, a thorough assessment will be completed before work is initiated. Overall, the longitudinal profile for UT1_R2 demonstrates that the in-stream structures within the reach are stable and functioning as designed.

Data for the UT1_R4 Year 3 longitudinal profile show that the riffles and pools between stations 58+22 to 66+00, have maintained relatively stable riffle elevations and pools have remained deep.

During Year 3 monitoring some of the pools along reaches UT1_R4, UT5_R1, and UT1_R2 experienced moderate bank erosion and floodplain scouring on the outside of the meander bends during large storm events in early winter 2010. It was determined that in-stream repairs were needed to ensure channel stability in the future. In-stream repairs were completed between August and December 2010. In the Year 4 report, all of the repaired areas will be assessed and an analysis of performance will be provided at that time. Further information regarding the repaired areas is provided in Section 3.2.5.

In-stream structures installed within the restored stream included constructed riffles, log weirs, log vanes, grade control rock and log j-hooks, rock and log step-pools, rock and rolls, cross vanes, root wads and stream crossings. Visual observations of these structures throughout Year 3 monitoring, indicated that all structures are functioning as designed and holding their elevation grade. Structures that were installed to develop deep pools such as cross vanes and step pools are performing the designed functions. Log vanes placed in meander pool areas have provided scour to keep pools deep and provide cover for fish. Log weirs and j-hooks placed in riffle areas have maintained riffle elevations and provided a downstream scour hole which provides habitat. Root wads placed on the outside of meander bends have provided bank stability and in-stream cover for fish and other aquatic organisms. Project problem areas relating to in-stream stability and structures are described in Section 3.2.5.

3.2.3 Hydrologic Criteria

Two crest gauges were installed on the Site to document bankfull events. The gauges are checked during each site visit and record the highest out-of-bank flow between site visits. The gauges are located on the downstream portion of UT1_R4 at station 75+50 and UT5_R2 at station 23+50.

The approved Restoration Plan requires the following criteria be met to achieve stream restoration success: Two bankfull flow events must be documented within the five-year monitoring period. The two bankfull events must occur in separate years, otherwise, the stream monitoring will continue until two bankfull events have been documented in separate years.

3.2.4 Hydrologic Monitoring Results

According to the on-site crest gauges, the Site experienced at least three bankfull flow events during Year 3 of the post-construction monitoring period. The two largest on-site bankfull flow event documented by the UT1 crest gauge during Year 3 of monitoring occurred between January and February of 2010. It was estimated that flows at the UT1_R4 crest gauge during the January 24th storm event were approximately 3.0 feet (36 inches) above bankfull stage. To approximate the amount of precipitation that fell on the Site during this

event, rain data from the USGS Ararat river weather station (02113850) in Ararat, NC were used. According to the Ararat station, approximately 3.40 inches of rain fell in the Mount Airy region between January 24 and January 25 of 2010. Photos documenting the impacts of this storm to the restored stream channel are presented in the attached CD that accompanies this report.

Following the January storm the crest gauge on UT5 was not read. However, the UT5 crest did document out of channel bankfull flows during Year 3 monitoring. The largest flow documented by the UT5 crest gauge during Year 2 of monitoring was 0.68 feet above bankfull stage. Inspection of conditions during site visits revealed visual evidence of out-of-bank flows.

Crest gauge readings are presented in Table 6 and photos of the crest gauges and out-of-bank evidence are presented in Appendix B.

Table 6. Verification of Bankfull Events

Pinch Gut Creek Stream Restoration Site: EEP Contract No. D06043-A

Date of Data Collection	Date of Occurrence of Bankfull Event	Method of Data Collection	UT1 Reach 4 - Crest	UT5 Reach 2 - Crest
2/17/2010	January 24, 2010	Crest Gauge	3.0	NA
10/13/2010	Unknown	Crest Gauge	NA	0.68 feet

3.2.5 Stream Problem Areas

During Year 3 monitoring, pools located on UT1_R2, UT1_R4, UT5_R1, and UT5_R2 experienced isolated bank erosion along the outer meander bends. Most problems that occurred during Year 3 of monitoring were due to extensive storm damage in the winter/spring of 2010, primarily due to saturated conditions and poor vegetation establishment in some areas. Repair work to these problem areas was necessary in order to correct the damage incurred from the storm. Repairs to the concerned areas were completed between August and December of 2010. Visual observations of the repaired areas for the remainder of Year 3 monitoring did not reveal any other issues.

As noted in Section 3.2.2, in-stream repairs were mostly concentrated within the pool areas. The work completed between August and December 2010 included adding geolifts to protect the outside of meander bends, adding a cross vane structure for increased bed stability, and adding additional Class I and B stone to constructed riffles and/or problem areas. Other repairs in the UT1_R4 area included re-grading channel bottoms/banks and re-centering of the thalweg. The areas of disturbance were matted and seeded following the repairs.

During Year 3 in-stream repairs on UT5_R1 and UT5_R2 were also completed. On UT5_R1, a brush mattress was installed along the right bank to increase bank stability near station 12+00. In-stream repairs on UT5_R1 were also completed on a J-Hook structure that experienced minor piping at station 18+25.

The planting of 3-year old containerized trees and shrubs, and live stakes is anticipated for winter 2011 in areas that were repaired and/or areas on the floodplain that experienced erosional scour from the large storm event.

The repairs completed during 2010 will be closely observed during Year 4 monitoring. A selection of photos showing some the 2010 repairs are included on the attached photographs CD.

3.2.6 Stream Photographs

Photographs are used to document restoration success visually. A total of 144 reference stations were installed and photographed after construction. Photographs of these reference stations will be continued for at least five years following construction. Reference photos are taken at least twice per year, and are taken in enough locations to document the condition of the restored system. Permanent markers were established to ensure that the same locations (and view directions) on the site are documented in each monitoring period.

The stream systems are photographed longitudinally beginning at the downstream portion of the restoration reaches and moving upstream to the beginning of the reaches. Photographs are taken looking upstream at designated locations. Reference photo locations are marked and described for future reference. Points are spaced sufficiently close enough together to provide an overall view of the reach. The angle of the shot depends on which angle provides the best view and is noted and continued in future shots. When modifications to photo position are made due to obstructions or other reasons, the position is noted along with any landmarks and the same position is used in the future.

Additional photographs are taken to document any observed evidence of flooding patterns such as debris, wrack lines, water marks, channel features, etc.

Both stream banks are photographed at all permanent cross-section photo stations. For each stream bank photo, the photo 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 photo (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 photo log of the restored channel is presented in the attached CD of this report. Photos for each of the 22 permanent cross-sections are included in Appendix B.

Photographs of the restored channel were taken in October 2010 to document the evolution of the stream geometry. Herbaceous vegetation was dense along the banks of UT1_R3, UT3, UT5 and UT6, making the photography of some of the stream channel areas difficult.

3.2.7 Stream Stability Assessment

Table B.1 provides a summary of the results obtained from the visual inspection of in-stream structures performed during Year 1 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 photo point survey. According to the visual stability assessment following Year 3 monitoring and after a visual evaluation of the August 2009 repairs and the fall 2010 repairs, all features on the Site are currently performing as designed.

3.2.8 Quantitative Measures Summary Tables

The quantitative pre-construction, reference reach, and design data used to determine restoration approach, as well as the as-built baseline data used during the project's post construction monitoring period are summarized in Appendix B.

4.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

Stream Monitoring - The total length of stream channel restored on the Site was 10,581 LF. This entire length was inspected during Year 3 of the monitoring period to assess stream performance. Although additional repairs were completed during Year 3, monitoring did not reveal any other significant problem areas within the boundaries of the Site.

A longitudinal profile survey was completed during Year 3 of monitoring for 3,998 LF of stream on the Site.

Data for the UT1_R2 Year 3 longitudinal profile show that the riffles in this reach have maintained relatively the same bed elevations since as-built conditions, with the exceptions of stations 33+18 and 38+38 as stated in Section 3.2.2. The longitudinal profile demonstrates that the in-stream structures within UT1_R4 are stable and functioning as designed.

Data for the UT1_R4 Year 3 longitudinal profile show that riffle and pools between stations 58+22 to 82+53, have maintained relatively stable riffle elevations and pools have remained deep after the 2009 repairs. The visual assessment demonstrated that some of the pools had experienced moderate bank erosion and in-stream structure damage during winter 2010. It was determined that in-stream repairs were needed to ensure channel stability in the future. In-stream repairs within UT1_R4 were completed in August and December 2010. It is expected that the longitudinal profile in Year 3 will more accurately represent the repaired areas.

Year 3 cross-section monitoring data for stream stability were collected during August and November 2010. Based on the survey data, riffle cross-sections 3, 16, 18, 20, and 22 showed relatively little change since as-built conditions. Pool cross-sections 5, 7, and 13 have deepened slightly since as-built conditions. Based on the cross-section data, the pool cross-sections show slow or little development of point bar features on the inside bank of the meander bends. The survey data, for all cross-sections except 10 and 12 showed relatively little change since as-built conditions. Riffle cross-section 10 underwent repairs during Year 2 by adding larger Class 1 and B stone and on-site alluvium to raise the bed elevation. According to the data, cross-section 12 has filled in and appears more stable than during as-built conditions. Riffle cross-sections 10 and 12 will be closely observed during Year 4 monitoring.

In-stream repairs on UT1_R3, UT1_R4, UT5_R1, and UT5_R2 were completed in 2010. All repairs were functioning properly following completion and will be closely observed during Year 4 of monitoring.

According to the on-site crest gauges, the Site experienced at least three bankfull flow events during Year 3 of the post-construction monitoring period. The two largest on-site bankfull flow event documented by the UT1 crest gauge during Year 3 of monitoring occurred between January and February of 2010. It was estimated that flows at the UT1_R4 crest gauge during the January 24th storm event were approximately 3.0 feet (36 inches) above bankfull stage. According to Ararat station, approximately 3.4 inches of rain fell in the Mount Airy region between January 24th and January 25th of 2010.

Vegetation Monitoring - Data from the Year 3 monitoring event of the 21 vegetation plots exhibited a range of 320 to 800 stems per acre. The data showed that the Site had an average of 547 stems per acre. Due a significant number of weak planted stem vegetation plots 1 and 2 will

have additional stems added in the winter/spring of 2011. Density within in plots 1, 2 and 6 will be closely observed during Year 4 monitoring.

The monitoring data demonstrate that all plots on the Site have met the minimum interim success criteria of 320 trees per acre by the end of Year 3.

5.0 WILDLIFE OBSERVATIONS

Observations of deer and raccoon tracks are common on the Site. During the Year 3 of monitoring season, small animals such as snakes and frogs were periodically observed. Various birds were observed on the Site throughout the monitoring season.

6.0 REFERENCES

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. NCDENR. Raleigh, NC.

USDA, NC Agricultural Experiment Station, *Soil Survey of Stokes County, North Carolina*, 1995.

FIGURES

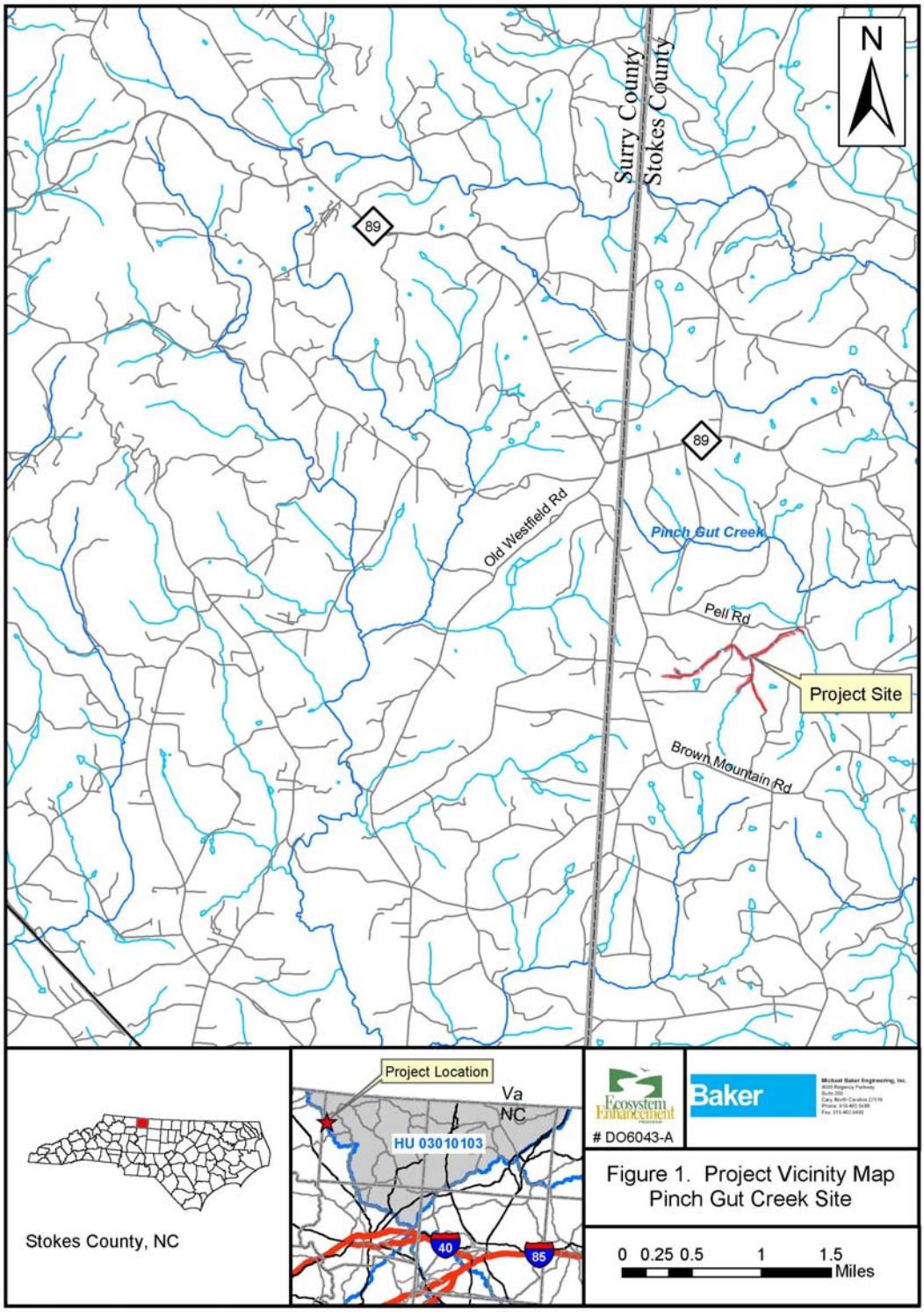


Figure 1. Location of Pinch Gut Creek Stream Restoration Site.

STATE	BAKER PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
NC	109294	1	24

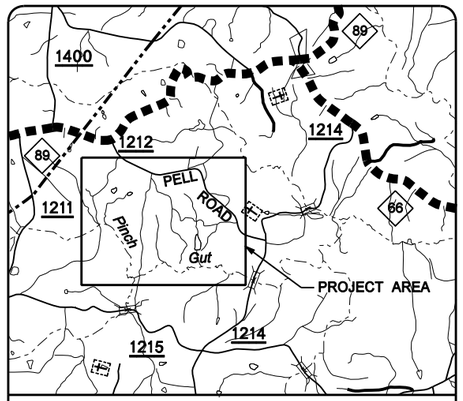
NO.	DATE	CHECKED BY	APPROVED BY
1	06/19/08	KV	KLT

STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

STOKES COUNTY

PINCH GUT CREEK

PROJECT: 109294



VICINITY MAP

LOCATION: 5 MILES NORTHEAST OF PILOT MOUNTAIN
OFF PELL ROAD SR 1215

TYPE OF WORK: AS-BUILT DRAWINGS FOR MITIGATION REPORT
STREAM RESTORATION PROJECT
NCEEP PROJECT# D06043-A

INDEX OF SHEETS

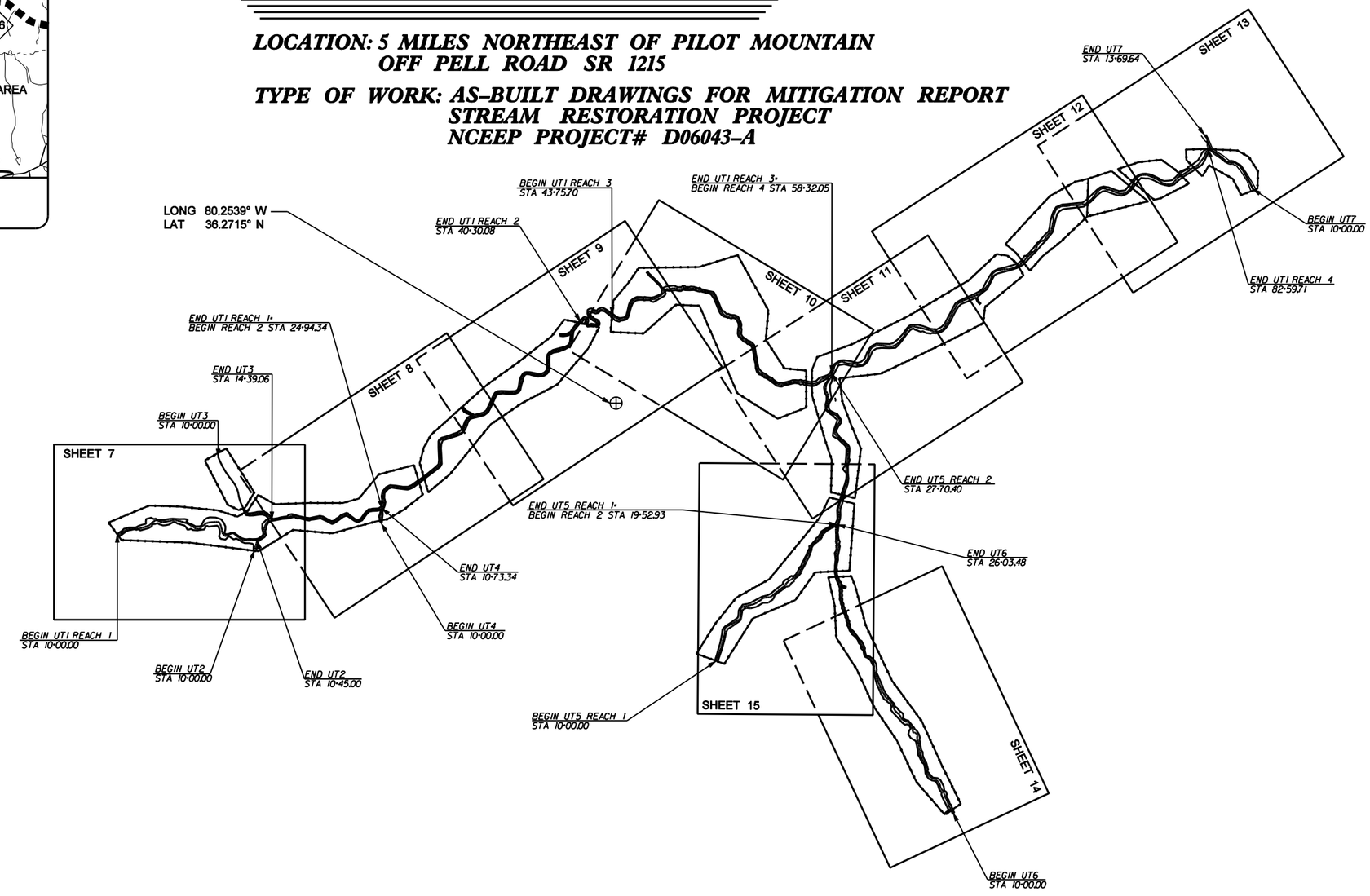
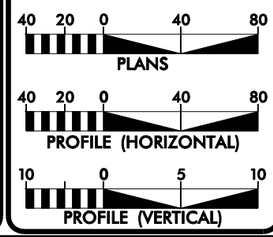


FIGURE 2A

GRAPHIC SCALES



AS-BUILT SUMMARY (YEAR 0-BASELINE DATA)

Project Reach	Existing Length (ft)	As-built Length (ft)	Restoration Approach
UT1_R1	1,484	1,494	Restoration – Priority Level I & II approaches
UT1_R2	1,952	1,506	Restoration – Priority Level I & II approaches
UT1_R3	1,647	1,427	Restoration – Priority Level I & II approaches
UT1_R4	2,677	2,302	Restoration – Priority Level I & II approaches
UT2	54	45	Restoration – Priority Level II approach
UT3	256	428	Restoration – Priority Level I & II approaches
UT4	96	60	Restoration – Priority Level II approach
UT5_R1	969	953	Restoration – Priority Level I & II approaches
UT5_R2	842	791	Restoration – Priority Level I & II approaches
UT6	1,648	1,575	Restoration – Priority Level I & II approaches
UT7	299	292	Enhancement – Level II approach
TOTAL	11,924	10,873	

PREPARED FOR THE OFFICE OF:
NCDENR – ECOSYSTEM ENHANCEMENT PROGRAM
2728 CAPITAL BLVD, SUITE 1H 103
RALEIGH, NC 27604

Ecosystem Enhancement PROGRAM

NCEEP CONTACT: GUY PEARCE
PROJECT CONTACT

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Phone: 919.463.5488
Fax: 919.463.5490

MAY 2008
COMPLETION DATE:

KEVIN TWEEDY, PE
PROJECT ENGINEER

KAYNE VAN STELL
PROJECT MANAGER

PROJECT ENGINEER

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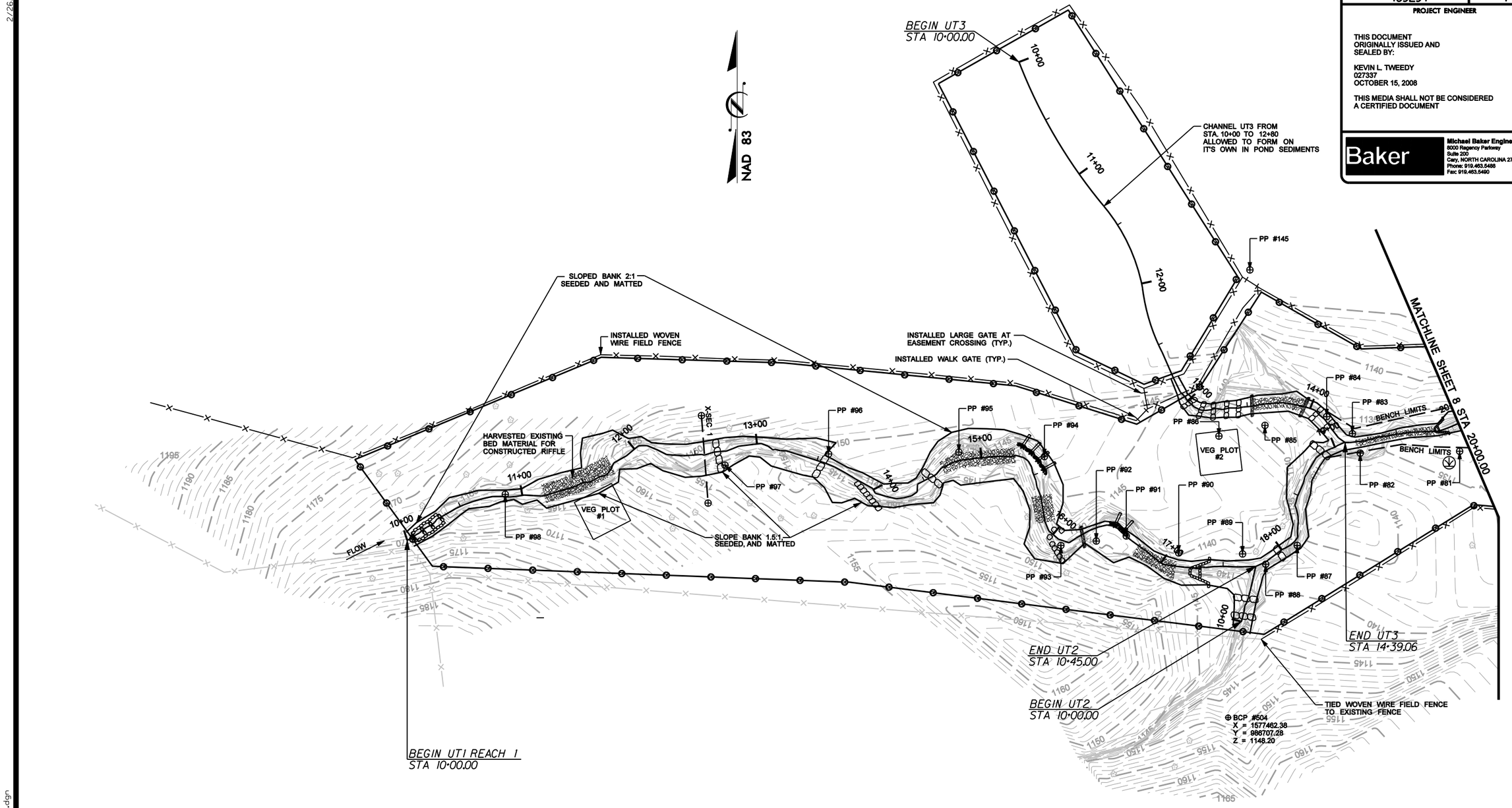

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2. THE RECORDED CONSERVATION EASEMENT TOTALING 31.8 ACRES HAS BEEN REVISED AND SUBMITTED FOR REVIEW AT THE TIME OF THIS AS-BUILT PLAN COMPLETION. THE REVISED CONSERVATION EASEMENT IS SHOWN HEREIN.

PINCH GUT CREEK AS-BUILT PLAN VIEW

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SCALE (FT)

FIGURE 2B

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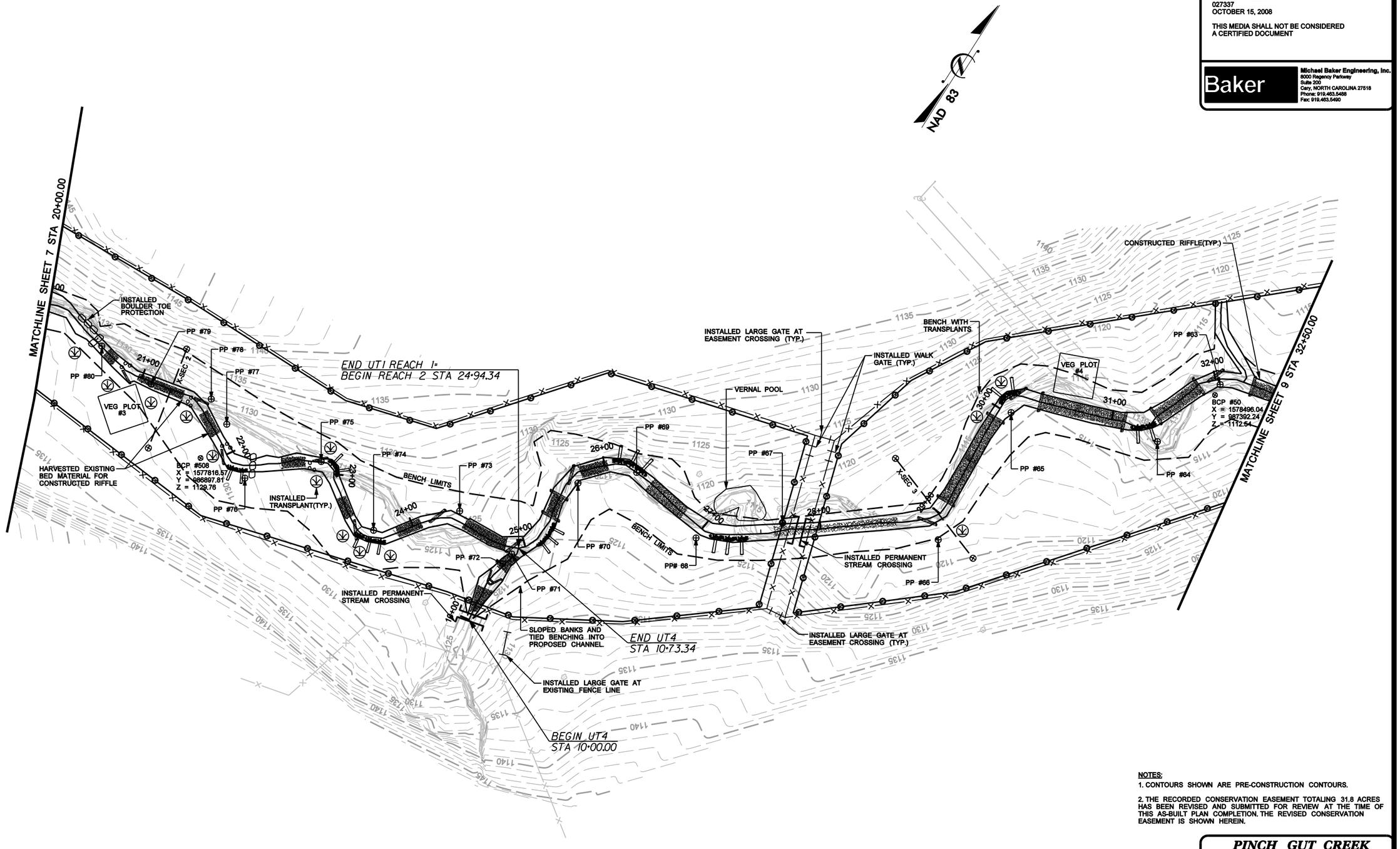

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PINCH GUT CREEK AS-BUILT PLAN VIEW

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FIGURE 2C

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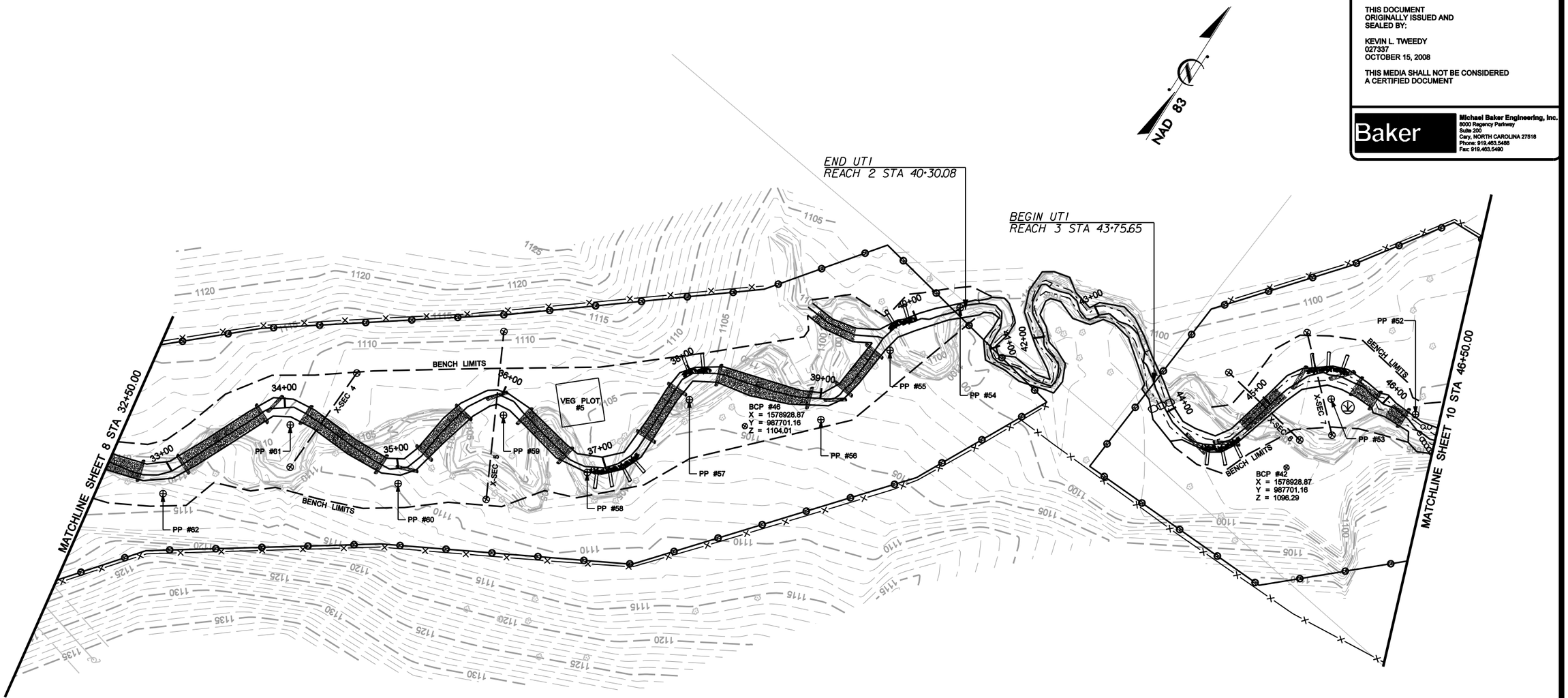

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PINCH GUT CREEK
AS-BUILT
PLAN VIEW

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SCALE (FT)

FIGURE 2D

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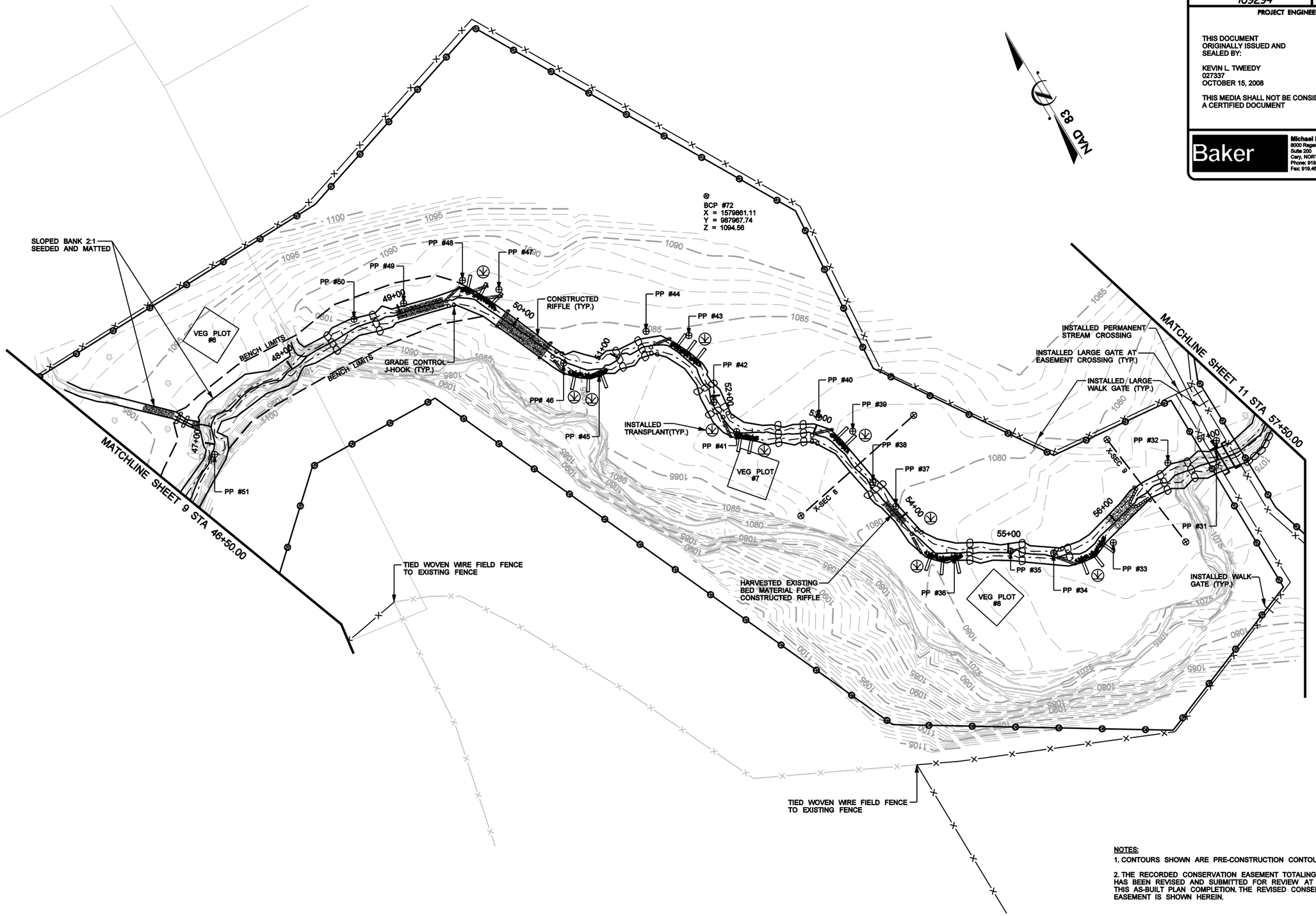

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PINCH GUT CREEK AS-BUILT PLAN VIEW

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FIGURE 2E

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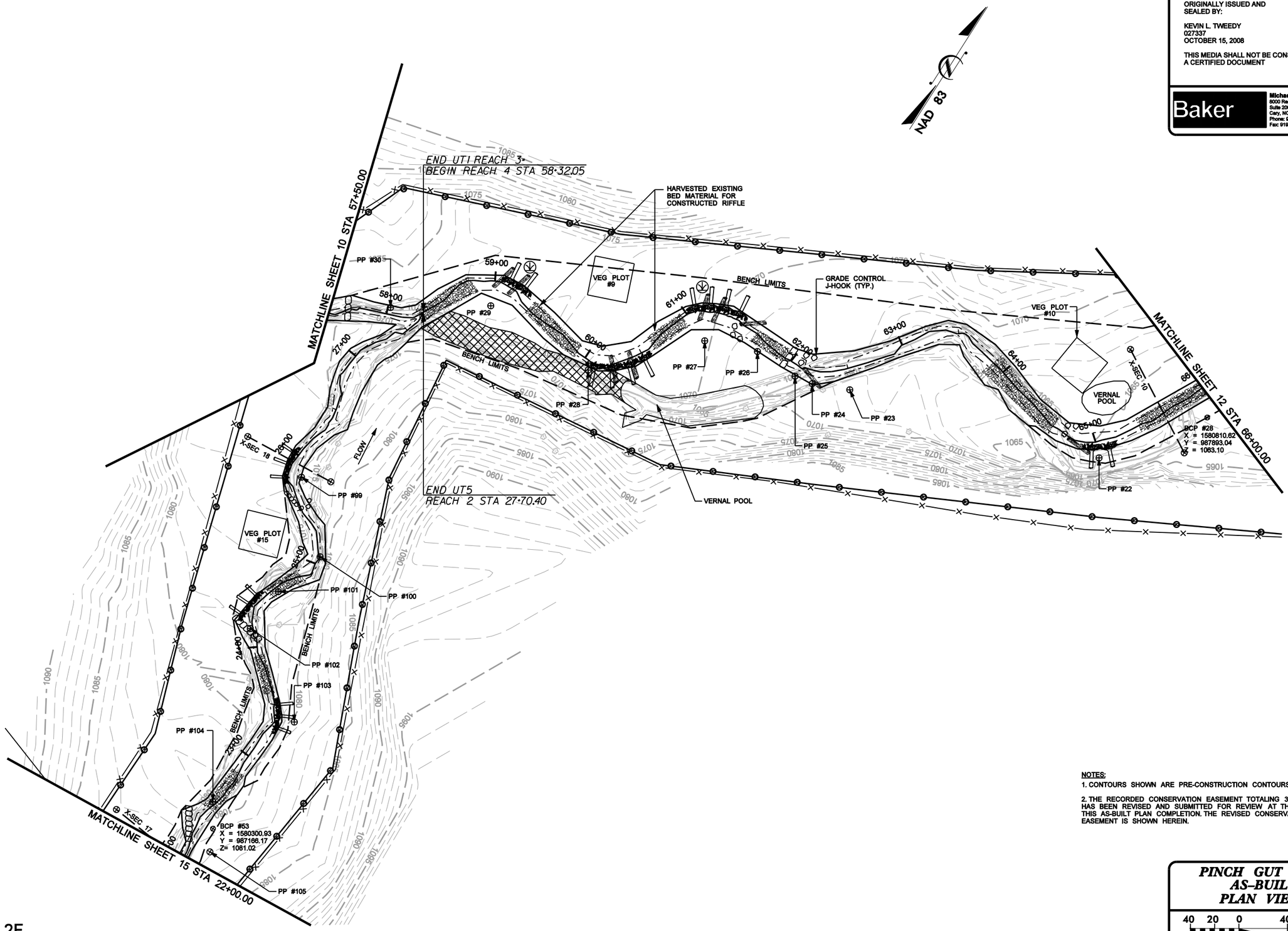

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FIGURE 2F

PINCH GUT CREEK AS-BUILT PLAN VIEW

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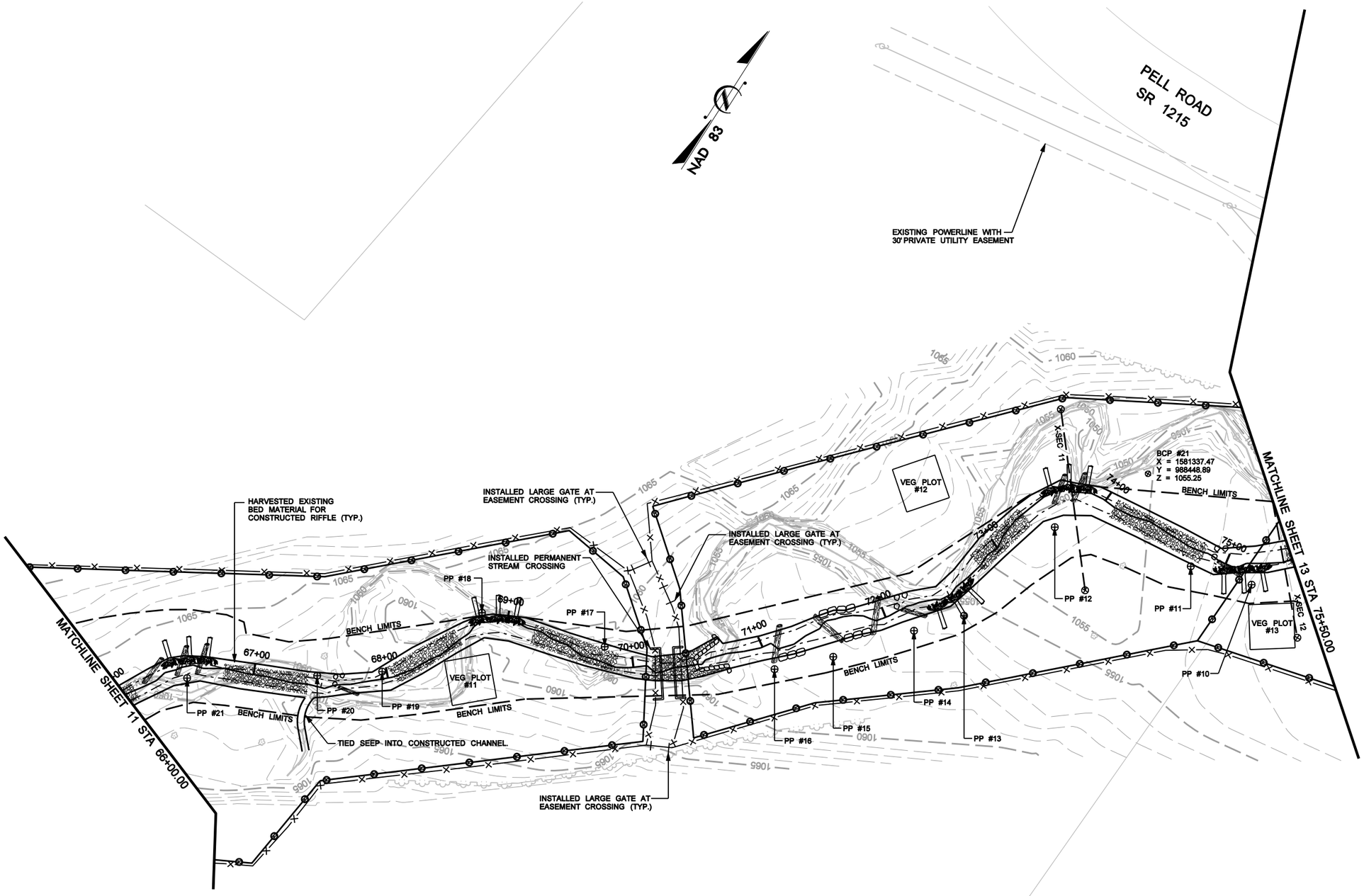

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PINCH GUT CREEK AS-BUILT PLAN VIEW

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SCALE (FT)

FIGURE 2G

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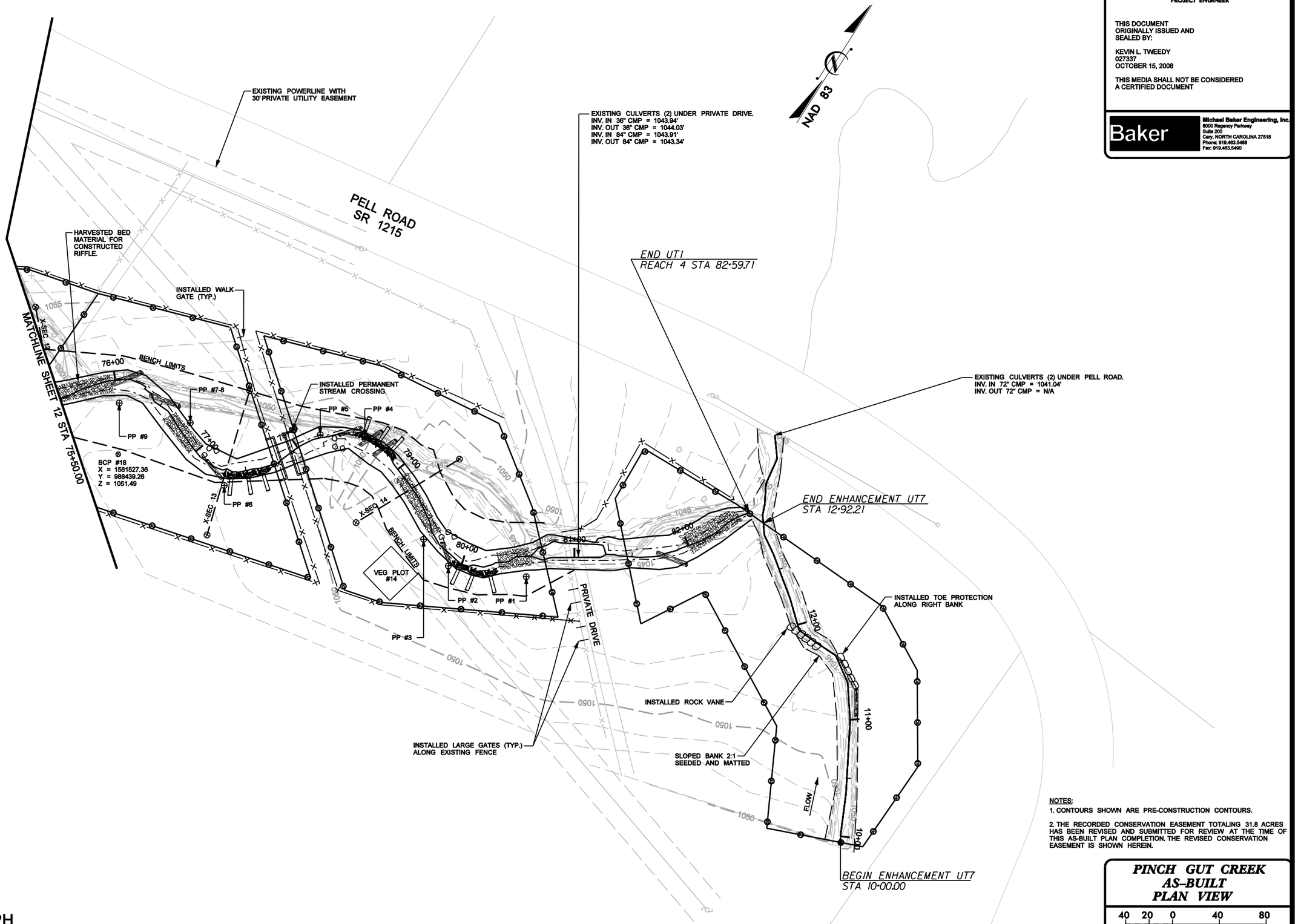

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PINCH GUT CREEK
AS-BUILT
PLAN VIEW

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SCALE (FT)

FIGURE 2H

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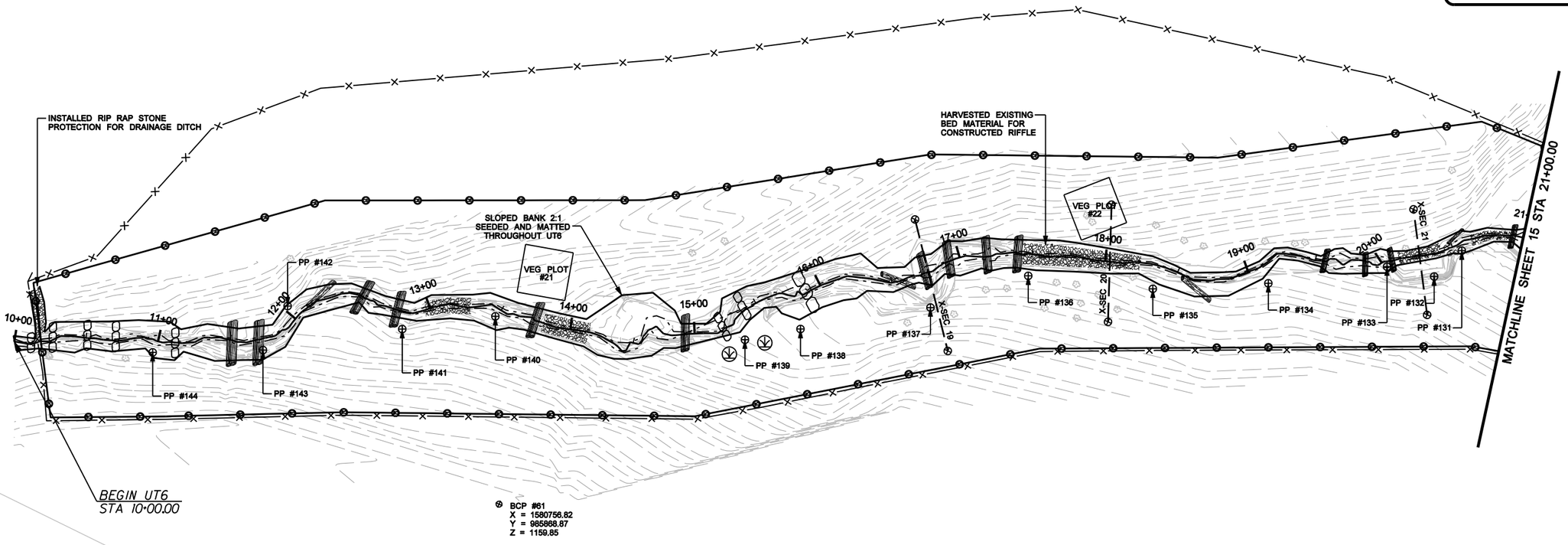

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PINCH GUT CREEK AS-BUILT PLAN VIEW

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SCALE (FT)

FIGURE 2I

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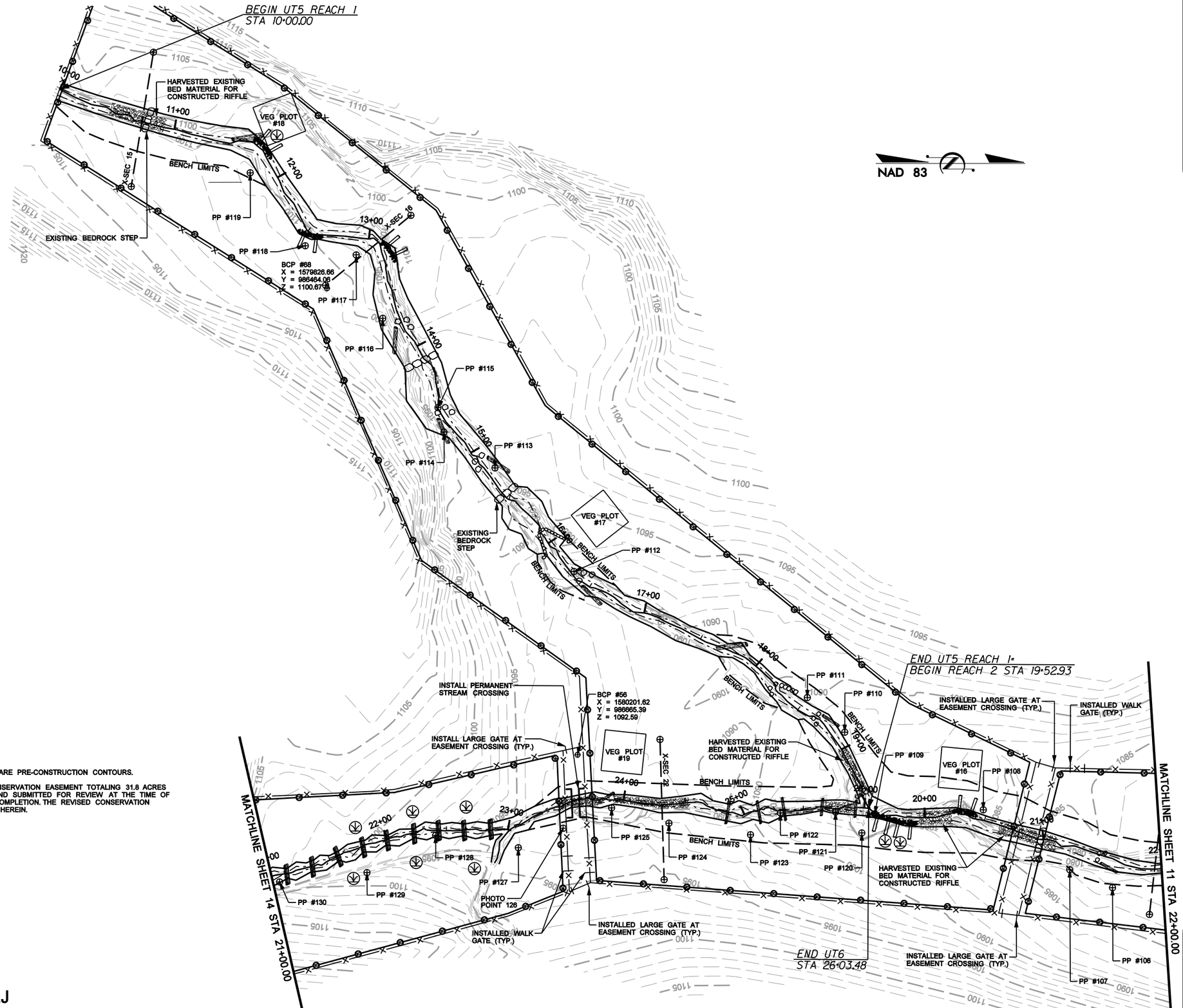

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FIGURE 2J

PINCH GUT CREEK AS-BUILT PLAN VIEW

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SCALE (FT)

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APPENDIX A

VEGETATION DATA

VEGETATION TABLES

Table A.1. Vegetation Metadata

Pinch Gut Restoration Site: Project No. D06043-A

Report Prepared By	Dwayne Huneycutt
Date Prepared	12/7/2010 13:59
database name	cvs-eep-entrytool-v2.2.7_2009 ALL OTHER PR0JECTS_Not Crowns.mdb
database location	L:\Monitoring\Veg Plot Info\CVS Data Tool\PG_LG_DS
computer name	CARYWDHUNEYCU2
file size	96194560
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	PG
project Name	Pinch Gut
Description	The Pinch Gut Creek Restoration Site was restored through a full delivery contract with the North Carolina Ecosystem Enhancement Program (NCEEP).
River Basin	Roanoke
length(ft)	10873
stream-to-edge width (ft)	50
area (sq m)	101003.25
Required Plots (calculated)	20
Sampled Plots	21

Table A.2. Vegetation Vigor by Species

Pinch Gut Restoration Site: Project No. D06043-A									
	Species	**CommonName**	**4**	**3**	**2**	**1**	**0**	**Missing**	**Unknown**
	Alnus serrulata	hazel alder		2			1		
	Betula nigra	river birch	37	22	7		3		
	Cornus amomum	silky dogwood	6	19	3		1		
	Corylus americana	American hazelnut	3	9	11				
	Diospyros virginiana	common persimmon	7	7	13		1		
	Juglans nigra	black walnut			1		1		
	Quercus phellos	willow oak	9	9	4				
	Carpinus caroliniana	American hornbeam	1	8	4		1		
	Quercus rubra	northern red oak	3	11	4	1	1		
	Lindera benzoin	northern spicebush	2	5	9	5	4		
	Liriodendron tulipifera	tuliptree	11	8	8		2		
	Platanus occidentalis	American sycamore	20	12	6		1		
	Unknown						1		
TOT:	**13**	**12**	**99**	**112**	**70**	**6**	**17**		

Table A.3. Vegetation Damage by Species

Pinch Gut Restoration Site: Project No. D06043-A								
	Species	**CommonName**	**Count of Damage Categories**	**No Damage**	**Deer**	**Unknown**	**Vine Strangulation**	
	Alnus serrulata	hazel alder	1	2		1		
	Betula nigra	river birch	2	67	1	1		
	Carpinus caroliniana	American hornbeam	1	13		1		
	Cornus amomum	silky dogwood	4	25	1		3	
	Corylus americana	American hazelnut	1	23	1			
	Diospyros virginiana	common persimmon	1	27		1		
	Juglans nigra	black walnut	1	1			1	
	Lindera benzoin	northern spicebush	3	22		3		
	Liriodendron tulipifera	tuliptree	1	28		1		
	Platanus occidentalis	American sycamore	1	38		1		
	Quercus phellos	willow oak	1	21	1			
	Quercus rubra	northern red oak	1	19		1		
	Unknown		1	1		1		
TOT:	**13**	**12**	**19**	**287**	**4**	**11**	**4**	

Table A.4. Vegetation Damage by Plot

Pinch Gut Restoration Site: Project No. D06043-A							
	Plot	Count of Damage Categories	No Damage	Deer	Unknown	Vine Strangulation	
	PG-01-VP1-year:3	1	11		1		
	PG-01-VP2-year:3	0	8				
	PG-01-VP3-year:3	2	10		2		
	PG-01-VP4-year:3	1	11			1	
	PG-01-VP5-year:3	1	10		1		
	PG-01-VP6-year:3	0	9				
	PG-01-VP7-year:3	0	13				
	PG-01-VP8-year:3	4	10	1		3	
	PG-01-VP9-year:3	0	15				
	PG-01-VP10-year:3	0	17				
	PG-01-VP11-year:3	0	11				
	PG-01-VP12-year:3	0	19				
	PG-01-VP13-year:3	1	20		1		
	PG-01-VP14-year:3	2	14		2		
	PG-01-VP15-year:3	0	18				
	PG-01-VP16-year:3	0	18				
	PG-01-VP17-year:3	0	13				
	PG-01-VP18-year:3	3	13		3		
	PG-01-VP19-year:3	1	18		1		
	PG-01-VP20-year:3	3	15	3			
	PG-01-VP21-year:3	0	14				
TOT:	**21**	**19**	**287**	**4**	**11**	**4**	

Table A.5. Planted Stems by Plot and Species

Pinch Gut Restoration Site: Project No. D06043-A

	Comment	Species	Common Name	Total Planted Stems	Number of Plots	Average Number of Stems	Plot PG-01-VP1-year:3	Plot PG-01-VP2-year:3	Plot PG-01-VP3-year:3	Plot PG-01-VP4-year:3	Plot PG-01-VP5-year:3	Plot PG-01-VP6-year:3	Plot PG-01-VP7-year:3	Plot PG-01-VP8-year:3	Plot PG-01-VP9-year:3	Plot PG-01-VP10-year:3	Plot PG-01-VP11-year:3	Plot PG-01-VP12-year:3	Plot PG-01-VP13-year:3	Plot PG-01-VP14-year:3	Plot PG-01-VP15-year:3	Plot PG-01-VP16-year:3	Plot PG-01-VP17-year:3	Plot PG-01-VP18-year:3	Plot PG-01-VP19-year:3	Plot PG-01-VP20-year:3	Plot PG-01-VP21-year:3
		Alnus serrulata	hazel alder	2	1	2												2									
		Betula nigra	river birch	66	18	3.67		5	3		4	4	3	4	4	2	3	1	4	3	2	2	9	5	3	5	
		Carpinus caroliniana	American hornbeam	13	4	3.25										4		2						5			2
		Cornus amomum	silky dogwood	28	5	5.6			2			4	10	10	2												
		Corylus americana	American hazelnut	23	5	4.6									1			5							3	6	8
		Diospyros virginiana	common persimmon	27	9	3		3	2		3				1		4	2	5	4			3				
		Juglans nigra	black walnut	1	1	1					1																
		Lindera benzoin	northern spicebush	21	9	2.33	7		2			1			1	1		1	3	4				1			
		Liriodendron tulipifera	tuliptree	27	8	3.38				2	2					7		3			5	5		1			2
		Platanus occidentalis	American sycamore	38	9	4.22	4			9					4	2		2	4		5	4			4		
		Quercus phellos	willow oak	22	10	2.2			1							1	2	3		3	4			1	1	5	1
		Quercus rubra	northern red oak	19	5	3.8									1				2		2	7			7		
TOT:	**0**	**12**	**12**	**287**	**12**		**11**	**8**	**10**	**11**	**10**	**9**	**13**	**14**	**14**	**17**	**9**	**19**	**20**	**14**	**18**	**18**	**12**	**13**	**18**	**16**	**13**

Table A.6. Plot Species and Densities

Pinch Gut Restoration Site Contract No. D06043-A

Tree Species	Plots																					Year 3 Totals	Yearly Average Stems/acre
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21		
Betula nigra		5	3		4	4	3	4	4	2	3	1	4	3	2	2	9	5	3	5		66	
Liriodendron tulipifera				2	2					7		3			5	5		1			2	27	
Quercus phellos			1							1	2	3		3	4			1	1	5	1	22	
Quercus rubra									1				2		2	7			7			19	
Diospyros virginiana		3	2		3				1		4	2	5	4			3					27	
Juglans nigra					1																	1	
Platanus occidentalis	4			9					4	2		2	4		5	4			4			38	
Quercus michauxii																						0	
Unknown																						0	
Shrub Species																							
Alnus serrulata													2									2	
Lindera benzoin	7		2			1			1	1		1	3	4				1				21	
Corylus americana									1			5							3	6	8	23	
Capinus caroliniana										4		2						5			2	13	
Cornus amomum			2			4	10	10	2													28	
Stems/plot Year 3	11	8	10	11	10	9	13	14	14	17	9	19	20	14	18	18	12	13	18	16	13	287	
Stems/acre Year 3	440	320	400	440	400	360	520	560	560	680	360	760	800	560	720	720	480	520	720	640	520		547
Stems/acre Year 2	440	320	480	480	400	360	520	560	600	680	400	760	840	640	720	720	520	600	760	680	520		571
Stems/acre Year 1	520	480	480	520	400	520	560	560	720	680	360	720	880	640	760	720	640	640	760	680	600		611
Stems/acre Initial	520	520	560	560	450	600	560	560	720	760	400	800	800	640	760	720	680	680	760	840	680		646

VEGETATION PHOTOS

Vegetation Plot 1

Herbaceous Plot 1

Vegetation Plot 2

Herbaceous Plot 2

Vegetation Plot 3

Herbaceous Plot 3

Vegetation Plot 4

Herbaceous Plot 4

Vegetation Plot 5

Herbaceous Plot 5

Vegetation Plot 6

Herbaceous Plot 6

Vegetation Plot 7

Herbaceous Plot 7

Vegetation Plot 8

Herbaceous Plot 8

Vegetation Plot 9

Herbaceous Plot 9

Vegetation Plot 10

Herbaceous Plot 10

Vegetation Plot 11

Herbaceous Plot 11

Vegetation Plot 12

Herbaceous Plot 12

Vegetation Plot 13

Herbaceous Plot 13

Vegetation Plot 14

Herbaceous Plot 14

Vegetation Plot 15

Herbaceous Plot 15

Vegetation Plot 16

Herbaceous Plot 16

Vegetation Plot 17

Herbaceous Plot 17

Vegetation Plot 18

Herbaceous Plot 18

Vegetation Plot 19

Herbaceous Plot 19

Vegetation Plot 20

Herbaceous Plot 20

Vegetation Plot 21

Herbaceous Plot 21

APPENDIX B

GEOMORPHIC DATA

STREAM TABLES

Table B.1. Categorical Stream Feature Visual Stability Assessment

Pinch Gut Creek Restoration Site: Project No. D06043-A						
Performance Percentage						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles	100%	100%	95%	95%		
B. Pools	100%	95%	95%	95%		
C. Thalweg	100%	100%	95%	95%		
D. Meanders	100%	100%	100%	98%		
E. Bed General	100%	100%	100%	100%		
F. Bank Condition	100%	100%	100%	98%		
G. Wads	100%	100%	100%	100%		

Table B.2. Baseline Stream Summary

Pinch Gut Restoration Site Contract No. D06043-A

Pinch Gut - UT1 Reach 1

Parameter	USGS Gauge		Regional Curve Interval			Pre-Existing Condition			Reference Reach(es) Data			Design			As-built		
Dimension - Riffle			LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max
BF Width (ft)	-----	-----	-----	-----	-----	-----	7.9	-----	8.8	14.25	19.7	9.2	9.2	9.2	9.2	10.3	11.3
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	10.8	-----	35	37.5	40	-----	-----	-----	16.81	28.0	39.13
BF Mean Depth (ft)	-----	-----	-----	-----	-----	-----	1.1	-----	0.5	0.8	1.1	0.7	0.7	0.7	0.7	0.7	0.74
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	1.5	-----	1.1	1.5	1.9	0.8	0.8	0.8	1.1	1.1	1.1
BF Cross Sectional Area (ft^2)	-----	-----	-----	-----	-----	-----	8.9	-----	9.1	10.7	12.2	6.0	6.0	6.0	6.4	7.4	8.4
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	7.0	-----	7.7	21.0	34.3	-----	14.0	-----	13.2	14.2	15.3
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	1.4	-----	2.0	3.0	4.0	-----	-----	-----	1.5	2.9	4.3
Bank Height Ratio	-----	-----	-----	-----	-----	-----	2.0	-----	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.2	5.3
BF Velocity (fps)	-----	-----	-----	-----	-----	-----	3.8	-----	-----	-----	-----	5.7	-----	5.7	-----	-----	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	32	52.5	73	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	28	37.5	47	23	25	27	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	70	175.0	280	73	91.5	110	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	1	2.5	4	3.5	5.75	8	-----	-----	-----
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.0271	0.04435	0.0616	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	8	-----	82	22.9	34.35	45.8	-----	-----	-----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	1.7/12.3/21.4/49.4/65.9			.97/26.72/40.56/87.24/127.72			-----			-----	-----	-----
Reach Shear Stress (competency) lb/f^2	-----	-----	-----	-----	-----	-----	1.29	-----	-----	-----	-----	-----	0.88	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	92.4	-----	-----	-----	-----	-----	83.2	-----	-----	-----	-----
Additional Reach Parameters																	
Channel length (ft)	-----	-----	-----	-----	-----	-----	1,484	-----	-----	-----	-----	-----	1,494	-----	-----	1,494	-----
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	0.15	-----	0.45	-----	0.45	-----	0.15	-----	-----	0.15	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	B4	-----	-----	B4	-----	-----	B4	-----	-----	B4	-----
BF Discharge (cfs)	-----	-----	-----	-----	-----	-----	34.1	-----	-----	-----	-----	-----	34.1	-----	-----	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	1.2	-----	-----	1.13	-----	-----	1.16	-----	-----	1.2	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	0.024	-----	-----	0.0350	-----	-----	0.0247	-----	-----	0.023	-----

Pinch Gut - UT1 Reach 2																	
Parameter	**USGS Gauge**		**Regional Curve Interval**			**Pre-Existing Condition**			**Reference Reach(es) Data**			**Design**			**As-built**		
Dimension - Riffle			LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
BF Width (ft)	-----	-----	-----	-----	-----	-----	11.0	-----	-----	-----	-----	12.4	13	13.5	-----	12.03	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	53.8	-----	-----	-----	-----	54.0	65.0	76.0	-----	82.4	-----
BF Mean Depth (ft)	-----	-----	-----	-----	-----	-----	11.0	-----	-----	-----	-----	0.9	1.0	1.0	-----	0.85	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	2.1	-----	-----	-----	-----	1.1	1.2	1.2	-----	1.39	-----
BF Cross Sectional Area (ft²)	-----	-----	-----	-----	-----	-----	17.4	-----	-----	-----	-----	11.0	12.0	13.0	-----	10.2	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	6.9	-----	-----	-----	-----	-----	14.0	-----	-----	14.6	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	4.9	-----	-----	-----	-----	4.3	5.0	5.6	-----	6.9	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	1.3	-----	-----	-----	-----	1.0	1.0	1.0	-----	1.0	-----
BF Velocity (fps)	-----	-----	-----	-----	-----	-----	3.3	-----	-----	-----	-----	4.5	4.9	5.3	-----	-----	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	45	76.5	108	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	31	35.5	40	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	99	130.5	162	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	3.5	5.75	8	-----	-----	-----
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	31	49	68	-----	-----	-----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	1.5/10.9/21.8/51.6/85.3			-----			-----			-----	-----	-----
Reach Shear Stress (competency) lb/f²	-----	-----	-----	-----	-----	-----	0.88	-----	-----	-----	-----	-----	0.67	-----	-----	-----	-----
Stream Power (transport capacity) W/m²	-----	-----	-----	-----	-----	-----	55.5	-----	-----	-----	-----	-----	54.4	-----	-----	-----	-----
Additional Reach Parameters																	
Channel length (ft)	-----	-----	-----	-----	-----	-----	2242	-----	-----	-----	-----	-----	1519	-----	-----	1569	-----
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	0.4	-----	-----	-----	-----	-----	0.4	-----	-----	0.4	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	C4	-----	-----	C4	-----
BF Discharge (cfs)	-----	-----	-----	-----	-----	-----	58.2	-----	-----	-----	-----	-----	58.2	-----	-----	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	1.40	-----	-----	-----	-----	-----	1.3	-----	-----	1.19	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	0.012	-----	-----	-----	-----	-----	0.013	-----	-----	0.015	-----

Pinch Gut - UT1 Reach 3																		
Parameter	**USGS Gauge**		**Regional Curve Interval**			**Pre-Existing Condition**			**Reference Reach(es) Data**			**Design**			**As-built**		
Dimension - Riffle			LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
BF Width (ft)	-----	-----	-----	-----	-----	-----	14.5	-----	-----	-----	-----	12.4	13	13.5	11.1	11.94	12.8
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	48.6	-----	-----	-----	-----	25.0	32.5	40.0	49.3	85.65	122.0
BF Mean Depth (ft)	-----	-----	-----	-----	-----	-----	1.3	-----	-----	-----	-----	0.9	1.0	1.0	0.9	0.94	1.0
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	2.2	-----	-----	-----	-----	1.1	1.2	1.2	1.4	1.38	1.4
BF Cross Sectional Area (ft²)	-----	-----	-----	-----	-----	-----	48.6	-----	-----	-----	-----	11.0	12.0	13.0	10.2	11.20	12.2
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	11.4	-----	-----	-----	-----	-----	14.0	-----	12.1	12.75	13.4
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	3.4	-----	-----	-----	-----	2.0	2.5	3.0	3.9	7.45	11.0
Bank Height Ratio	-----	-----	-----	-----	-----	-----	1.8	-----	-----	-----	-----	1.0	1.0	1.0	1.0	1.00	1.0
BF Velocity (fps)	-----	-----	-----	-----	-----	-----	3.3	-----	-----	-----	-----	4.1	4.5	4.9	4.4	4.82	5.2
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	43	75.5	108	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	31	35.5	40	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	99	130.5	162	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	3.5	5.75	8	-----	-----	-----
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	25	46	68	-----	-----	-----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	1.59/13.59/25.91/66.78/71.66			-----			-----			-----	-----	-----
Reach Shear Stress (competency) lb/f²	-----	-----	-----	-----	-----	-----	0.81	-----	-----	-----	-----	-----	0.52	-----	-----	-----	-----
Stream Power (transport capacity) W/m²	-----	-----	-----	-----	-----	-----	45.1	-----	-----	-----	-----	-----	37	-----	-----	-----	-----
Additional Reach Parameters																	
Channel length (ft)	-----	-----	-----	-----	-----	-----	1647	-----	-----	-----	-----	-----	1414	-----	-----	1427	-----
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	0.47	-----	-----	-----	-----	-----	0.47	-----	-----	0.47	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	C4	-----	-----	C4	-----
BF Discharge (cfs)	-----	-----	-----	-----	-----	-----	53.5	-----	-----	-----	-----	-----	53.5	-----	-----	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	1.11	-----	-----	-----	-----	1.25	1.3	1.4	-----	1.34	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	0.012	-----	-----	-----	-----	-----	0.098	-----	-----	0.017	-----

Pinch Gut - UT1 Reach 4																	
Parameter	**USGS Gauge**		**Regional Curve Interval**			**Pre-Existing Condition**			**Reference Reach(es) Data**			**Design**			**As-built**		
Dimension - Riffle			LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
BF Width (ft)	-----	-----	-----	-----	-----	-----	16.2	-----	-----	-----	-----	-----	20.8	-----	17.8	18.81	19.6
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	43.0	-----	-----	-----	-----	54.0	65.0	76.0	93.4	107.60	133.3
BF Mean Depth (ft)	-----	-----	-----	-----	-----	-----	1.4	-----	-----	-----	-----	-----	1.5	-----	1.4	1.54	1.7
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	1.9	-----	-----	-----	-----	-----	1.8	-----	2.4	2.58	2.7
BF Cross Sectional Area (ft²)	-----	-----	-----	-----	-----	-----	22.5	-----	-----	-----	-----	-----	31.0	-----	25.3	29.04	31.6
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	11.7	-----	-----	-----	-----	-----	14.0	-----	11.5	12.20	12.7
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	2.7	-----	-----	-----	-----	2.6	3.1	3.6	5.1	5.70	6.8
Bank Height Ratio	-----	-----	-----	-----	-----	-----	1.2	-----	-----	-----	-----	-----	1.0	-----	1.0	1.00	1.0
BF Velocity (fps)	-----	-----	-----	-----	-----	-----	4.2	-----	-----	-----	-----	-----	3.0	-----	-----	-----	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	73	120	167	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	52	57	62	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	167	208.5	250	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	3.5	5.75	8	-----	-----	-----
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.0123	0.0153	0.0183	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	52.1	78.15	104.2	-----	-----	-----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	4.9/12.4/17.4/31.3/49.8			-----			-----			-----	-----	-----
Reach Shear Stress (competency) lb/f²	-----	-----	-----	-----	-----	-----	0.74	-----	-----	-----	-----	-----	0.79	-----	-----	-----	-----
Stream Power (transport capacity) W/m²	-----	-----	-----	-----	-----	-----	52.4	-----	-----	-----	-----	-----	39.6	-----	-----	-----	-----
Additional Reach Parameters																	
Channel length (ft)	-----	-----	-----	-----	-----	-----	2765	-----	-----	-----	-----	-----	2361	-----	-----	2429	-----
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	1.67	-----	-----	-----	-----	-----	1.67	-----	-----	1.67	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	C4	-----	-----	C4	-----
BF Discharge (cfs)	-----	-----	-----	-----	-----	-----	93.7	-----	-----	-----	-----	-----	93.7	-----	-----	93.7	-----
Sinuosity	-----	-----	-----	-----	-----	-----	1.20	-----	-----	-----	-----	1.25	1.325	1.4	-----	1.17	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	0.010	-----	-----	-----	-----	0.012	0.010	0.009	-----	0.011	-----

Pinch Gut - UT5 Reach 1																		
Parameter	**USGS Gauge**		**Regional Curve Interval**			**Pre-Existing Condition**			**Reference Reach(es) Data**			**Design**			**As-built**		
Dimension - Riffle			LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max
BF Width (ft)	-----	-----	-----	-----	-----	-----	9.43	-----	-----	-----	-----	11.8	14.5	13.2	-----	11.7	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	22.39	-----	-----	-----	-----	15	20	25	-----	74.1	-----
BF Mean Depth (ft)	-----	-----	-----	-----	-----	-----	1.28	-----	-----	-----	-----	0.8	0.9	1	-----	1.8	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	1.68	-----	-----	-----	-----	1	1.1	1.2	-----	2.8	-----
BF Cross Sectional Area (ft²)	-----	-----	-----	-----	-----	-----	12.09	-----	-----	-----	-----	10	12.5	15	-----	20.3	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	7.35	-----	-----	-----	-----	-----	14	-----	-----	6.2	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	2.38	-----	-----	-----	-----	1.3	1.5	1.7	-----	6.6	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	1.75	-----	-----	-----	-----	-----	1	-----	-----	1.0	-----
BF Velocity (fps)	-----	-----	-----	-----	-----	-----	4.9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	41	78.5	116	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	30	36.5	43	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	95	134.5	174	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	3.5	8.75	8	-----	-----	-----
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.0167	0.0208	0.0249	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	29.6	51.05	72.5	-----	-----	-----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	1.4/9.4/20.1/45/66			-----			-----			-----	-----	-----
Reach Shear Stress (competency) lb/f²	-----	-----	-----	-----	-----	-----	0.97	-----	-----	-----	-----	-----	0.61	-----	-----	-----	-----
Stream Power (transport capacity) W/m²	-----	-----	-----	-----	-----	-----	83.4	-----	-----	-----	-----	-----	51.1	-----	-----	-----	-----
Additional Reach Parameters																	
Channel length (ft)	-----	-----	-----	-----	-----	-----	980	-----	-----	-----	-----	-----	934	-----	-----	-----	-----
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	0.33	-----	-----	-----	-----	-----	0.33	-----	-----	0.33	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	C4	-----	-----	E4	-----
BF Discharge (cfs)	-----	-----	-----	-----	-----	-----	56.2	-----	-----	-----	-----	-----	56.2	-----	-----	56.2	-----
Sinuosity	-----	-----	-----	-----	-----	-----	1.13	-----	-----	-----	-----	1.25	1.3	1.4	-----	1.2	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	0.015	-----	-----	-----	-----	0.014	0.0130	0.012	-----	0.018	-----

Pinch Gut - UT5 Reach 2																		
Parameter	**USGS Gauge**		**Regional Curve Interval**			**Pre-Existing Condition**			**Reference Reach(es) Data**			**Design**			**As-built**		
Dimension - Riffle			LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max
BF Width (ft)	-----	-----	-----	-----	-----	-----	15.66	-----	-----	-----	-----	-----	-----	-----	-----	8.7	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	18.4	-----	-----	-----	-----	-----	-----	-----	-----	24.1	-----
BF Mean Depth (ft)	-----	-----	-----	-----	-----	-----	1.24	-----	-----	-----	-----	-----	-----	-----	-----	0.9	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	1.82	-----	-----	-----	-----	-----	-----	-----	-----	1.7	-----
BF Cross Sectional Area (ft²)	-----	-----	-----	-----	-----	-----	19.47	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	12.6	-----	-----	-----	-----	-----	-----	-----	-----	10.2	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	1.2	-----	-----	-----	-----	-----	-----	-----	-----	2.8	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	2.2	-----	-----	-----	-----	-----	-----	-----	-----	1.0	-----
BF Velocity (fps)	-----	-----	-----	-----	-----	-----	4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	3.5/11/23.1/96.3/118.9			-----			-----			-----	-----	-----
Reach Shear Stress (competency) lb/f²	-----	-----	-----	-----	-----	-----	1.11	-----	-----	-----	-----	-----	0.81	-----	-----	-----	-----
Stream Power (transport capacity) W/m²	-----	-----	-----	-----	-----	-----	81.4	-----	-----	-----	-----	-----	72.8	-----	-----	-----	-----
Additional Reach Parameters																	
Channel length (ft)	-----	-----	-----	-----	-----	-----	842	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	0.48	-----	-----	-----	-----	-----	-----	-----	-----	0.33	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	-----	-----	-----	E4	-----
BF Discharge (cfs)	-----	-----	-----	-----	-----	-----	77.1	-----	-----	-----	-----	-----	-----	-----	-----	77.1	-----
Sinuosity	-----	-----	-----	-----	-----	-----	1.3	-----	-----	-----	-----	-----	-----	-----	-----	1.2	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	0.015	-----	-----	-----	-----	-----	-----	-----	-----	0.018	-----

Pinch Gut - UT6																		
Parameter	**USGS Gauge**		**Regional Curve Interval**			**Pre-Existing Condition**			**Reference Reach(es) Data**			**Design**			**As-built**		
Dimension - Riffle			LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max
BF Width (ft)	-----	-----	-----	-----	-----	-----	10.15	-----	8.8	14.25	19.7	-----	8.5	-----	-----	8.9	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	13.06	-----	35	37.5	40	-----	18	-----	-----	33.0	-----
BF Mean Depth (ft)	-----	-----	-----	-----	-----	-----	0.7	-----	0.5	0.8	1.1	-----	0.7	-----	-----	0.8	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	0.98	-----	1.1	1.5	1.9	-----	1	-----	-----	1.6	-----
BF Cross Sectional Area (ft²)	-----	-----	-----	-----	-----	-----	7.06	-----	9.1	10.7	12.2	-----	6	-----	-----	7.0	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	14.6	-----	7.7	21.0	34.3	-----	12	-----	-----	11.4	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	1.29	-----	2.0	3.0	4.0	-----	2.1	-----	-----	3.6	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	3.06	-----	1.0	1.0	1.0	-----	1	-----	-----	1.8	-----
BF Velocity (fps)	-----	-----	-----	-----	-----	-----	2.9	-----	-----	-----	-----	-----	4.5	-----	-----	-----	-----
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	30	49	68	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	28	37.5	47	21	23	25	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	70	175.0	280	68	85	102	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	1	2.5	4	3.5	5.75	8	-----	-----	-----
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.0409	0.0669	0.0929	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	8	-----	82	21.2	31.8	42.4	-----	-----	-----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	1.2/5.6/12.2/32.6/55.1/76.2			.97/26.72/40.56/87.24/127.72			-----			-----	-----	-----
Reach Shear Stress (competency) lb/f²	-----	-----	-----	-----	-----		1.46		-----	-----	-----	-----	1.28	-----	-----		-----
Stream Power (transport capacity) W/m²	-----	-----	-----	-----	-----		92.4		-----	-----	-----	-----	107.3	-----	-----	-----	-----
Additional Reach Parameters																	
Channel length (ft)	-----	-----	-----	-----	-----	-----	1,650	-----	-----	-----	-----	-----	1,250	-----	-----	1,604	-----
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	0.12	-----	0.45	-----	0.45	-----	0.12	-----	-----	0.12	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	B4	-----	-----	B4	-----	-----	B4	-----	-----	B4a	-----
BF Discharge (cfs)	-----	-----	-----	-----	-----	-----	27	-----	-----	-----	-----	-----	27	-----	-----	27	-----
Sinuosity	-----	-----	-----	-----	-----	-----	1.1	-----	-----	1.13	-----	-----	1.16	-----	-----	1.1	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	0.038	-----	-----	0.0350	-----	-----	0.0372	-----	-----	0.040	-----

Table B.3. Morphology and Hydraulic Monitoring Summary

Pinch Gut Creek Restoration Site: Project No. D06043-A																	
Reach: UT1_R1																	
Parameter	Cross-section 1 Riffle					Cross-section 2 Riffle											
	MY1	**MY2**	**MY3**	**MY4**	**MY5**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**							
Dimension																	
BF Width (ft)	12.18	11.88	12.10			12.21	14.96	9.80									
BF Mean Depth (ft)	0.83	0.89	0.73			0.57	0.41	0.42									
Width/Depth Ratio	14.64	13.35	16.57			21.56	36.45	23.26									
BF Cross-sectional Area (ft²)	10.10	10.60	8.80			6.90	6.10	4.10									
BF Max Depth (ft)	1.46	1.39	1.15			1.40	0.97	0.80									
Width of Floodprone Area (ft)	40.00	40.04	39.12			66.49	63.14	61.14									
Entrenchment Ratio	1.50	1.50	1.40			3.90	2.90	4.10									
Bank Height Ratio	2.40	2.50	2.90			1.00	0.80	1.10									
Wetted Perimeter (ft)	13.84	13.66	13.56			13.35	15.78	10.64									
Hydraulic Radius (ft)	0.73	0.78	0.65			0.52	0.39	0.39									
Substrate																	
d50 (mm)																	
d84 (mm)																	

Parameter	MY-1 (2008)			MY-2 (2009)			MY-3 (2010)			MY-4 (2011)			MY-5 (2012)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern															
Channel Beltwidth (ft)															
Radius of Curvature (ft)															
Meander Wavelength (ft)															
Meander Width Ratio															
Profile															
Riffle length (ft)															
Riffle Slope (ft/ft)															
Pool Length (ft)															
Pool Spacing (ft)															
Additional Reach Parameters															
Valley Length (ft)			No			No									
Channel Length (ft)			Data			Data									
Sinuosity			Collected			Collected									
Water Surface Slope (ft/ft)															
BF Slope (ft/ft)															
Rosgen Classification															

Reach: UT1_R2																
Parameter	Cross-section 3 Pool					Cross-section 4 Riffle					Cross-section 5 Pool					
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	
Dimension																
BF Width (ft)	18.41	19.09	18.01			12.05	14.71	11.66			23.25	23.82	25.87			
BF Mean Depth (ft)	3.02	0.98	1.17			0.86	0.65	0.64			0.87	1.17	1.04			
Width/Depth Ratio	16.66	19.40	15.40			14.03	22.72	18.15			26.65	20.29	24.94			
BF Cross-sectional Area (ft²)	20.30	18.80	21.10			10.40	9.50	7.50			20.30	28.00	26.80			
BF Max Depth (ft)	3.02	2.92	3.06			1.51	1.32	1.29			2.77	4.03	4.01			
Width of Floodprone Area (ft)	97.00	96.47	98.04			87.57	87.60	87.62			125.10	128.11	128.14			
Entrenchment Ratio	4.60	4.20	4.70			6.90	5.50	7.00			4.30	4.60	4.20			
Bank Height Ratio	1.00	0.90	1.00			1.00	1.00	1.00			0.90	0.90	1.00			
Wetted Perimeter (ft)	24.45	21.05	20.35			13.77	16.01	12.94			24.99	26.16	27.95			
Hydraulic Radius (ft)	0.83	0.89	1.04			0.76	0.59	0.58			0.81	1.07	0.96			
Substrate																
d50 (mm)																
d84 (mm)																

Parameter	MY-1 (2008)			MY-2 (2009)			MY-3 (2010)			MY-4 (2011)			MY-5 (2012)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern															
Channel Beltwidth (ft)															
Radius of Curvature (ft)															
Meander Wavelength (ft)															
Meander Width Ratio															
Profile															
Riffle length (ft)															
Riffle Slope (ft/ft)															
Pool Length (ft)															
Pool Spacing (ft)															
Additional Reach Parameters															
Valley Length (ft)			1320.42			1320.42			1320.42						
Channel Length (ft)			1569			1569			1569						
Sinuosity			1.19			1.19			1.19						
Water Surface Slope (ft/ft)			0.0154			0.0156			0.0158						
BF Slope (ft/ft)			0.0184			0.0184			0.0188						
Rosgen Classification															

Reach: UT1_R3																				
Parameter	Cross-section 6 Riffle					Cross-section 7 Pool					Cross-section 8 Riffle					Cross-section 9 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)	13.16	14.55	11.81			15.36	18.65	19.58			13.64	13.37	13.32			17.94	20.46	19.58		
BF Mean Depth (ft)	0.96	0.79	0.72			1.18	1.03	1.41			0.80	0.84	0.85			1.34	1.56	1.41		
Width/Depth Ratio	13.76	18.48	16.31			13.02	18.05	13.90			16.98	15.88	15.70			13.40	13.13	13.90		
BF Cross-sectional Area (ft²)	12.60	11.50	8.50			18.10	19.30	27.60			11.00	11.30	11.30			17.94	31.90	27.60		
BF Max Depth (ft)	1.56	1.41	1.06			2.94	2.89	3.36			1.50	1.70	1.93			3.07	4.56	3.36		
Width of Floodprone Area (ft)	71.30	68.83	64.10			80.15	80.14	104.26			121.98	121.99	122.00			104.30	104.27	104.26		
Entrenchment Ratio	3.90	3.40	3.70			5.00	4.20	5.30			8.90	9.10	9.20			5.80	5.10	5.30		
Bank Height Ratio	1.00	1.00	1.10			1.00	1.00	1.00			1.00	1.00	1.00			1.00	1.00	1.00		
Wetted Perimeter (ft)	15.08	16.13	13.25			17.72	20.71	22.40			15.24	15.05	15.02			20.62	23.58	22.40		
Hydraulic Radius (ft)	0.84	0.71	0.64			1.02	0.93	1.23			0.72	0.75	0.75			0.87	1.35	1.23		
Substrate																				
d50 (mm)																				
d84 (mm)																				

Parameter	MY-1 (2008)			MY-2 (2009)			MY-3 (2010)			MY-4 (2011)			MY-5 (2012)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern															
Channel Beltwidth (ft)															
Radius of Curvature (ft)															
Meander Wavelength (ft)															
Meander Width Ratio															
Profile															
Riffle length (ft)															
Riffle Slope (ft/ft)															
Pool Length (ft)															
Pool Spacing (ft)															
Additional Reach Parameters															
Valley Length (ft)			No			No									
Channel Length (ft)			Data			Data									
Sinuosity			Collected			Collected									
Water Surface Slope (ft/ft)															
BF Slope (ft/ft)															
Rosgen Classification															

Reach: UT1_R4																				
Parameter	Cross-section 10 Riffle					Cross-section 11 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)	23.27	19.28	18.21			44.84	44.61	43.79			19.31	20.40	20.10			37.32	37.86	34.59		
BF Mean Depth (ft)	1.36	1.32	1.44			1.57	1.55	1.52			1.51	1.24	1.20			1.25	1.09	0.99		
Width/Depth Ratio	17.14	14.58	12.67			28.57	28.87	28.90			12.75	16.49	16.76			29.95	34.80	35.04		
BF Cross-sectional Area (ft²)	31.60	25.50	26.20			70.40	68.90	66.40			29.20	25.20	24.11			46.50	41.20	34.15		
BF Max Depth (ft)	2.70	2.02	2.25			4.25	4.70	4.84			2.18	1.83	1.89			3.87	4.02	3.26		
Width of Floodprone Area (ft)	96.18	96.25	96.22			133.42	133.36	133.46			137.73	137.73	137.75			128.61	128.59	128.65		
Entrenchment Ratio	4.10	5.00	5.30			3.00	3.00	3.00			6.60	5.70	5.84			3.40	3.40	3.72		
Bank Height Ratio	1.00	1.00	1.00			1.00	1.00	1.00			1.00	1.00	1.04			1.00	1.00	0.93		
Wetted Perimeter (ft)	25.99	21.92	21.09			47.98	47.71	46.83			22.33	22.88	22.50			39.82	40.04	36.57		
Hydraulic Radius (ft)	1.22	1.16	1.24			1.47	1.44	1.42			1.31	1.10	1.07			1.17	1.03	0.93		
Substrate																				
d50 (mm)																				
d84 (mm)																				

Parameter	Cross-section 14 Riffle				
	MY1	MY2	MY3	MY4	MY5
Dimension					
BF Width (ft)	21.86	21.82	17.58		
BF Mean Depth (ft)	1.31	1.29	1.54		
Width/Depth Ratio	16.69	16.88	11.43		
BF Cross-sectional Area (ft²)	28.60	28.20	27.02		
BF Max Depth (ft)	2.47	2.51	2.60		
Width of Floodprone Area (ft)	103.62	103.63	103.68		
Entrenchment Ratio	4.70	4.70	5.90		
Bank Height Ratio	1.00	1.00	1.14		
Wetted Perimeter (ft)	24.48	24.40	20.66		
Hydraulic Radius (ft)	1.17	1.16	1.31		
Substrate					
d50 (mm)					
d84 (mm)					

Parameter	MY-1 (2008)			MY-2 (2009)			MY-3 (2010)			MY-4 (2011)			MY-5 (2012)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern															
Channel Beltwidth (ft)															
Radius of Curvature (ft)															
Meander Wavelength (ft)															
Meander Width Ratio															
Profile															
Riffle length (ft)															
Riffle Slope (ft/ft)															
Pool Length (ft)															
Pool Spacing (ft)															
Additional Reach Parameters															
Valley Length (ft)			2076.71			2076.71			2076.71						
Channel Length (ft)			2428.94			2428.94			2428.94						
Sinuosity			1.17			1.17			1.17						
Water Surface Slope (ft/ft)			0.0111			0.0111			0.011						
BF Slope (ft/ft)			0.0129			0.0129			0.0129						
Rosgen Classification															

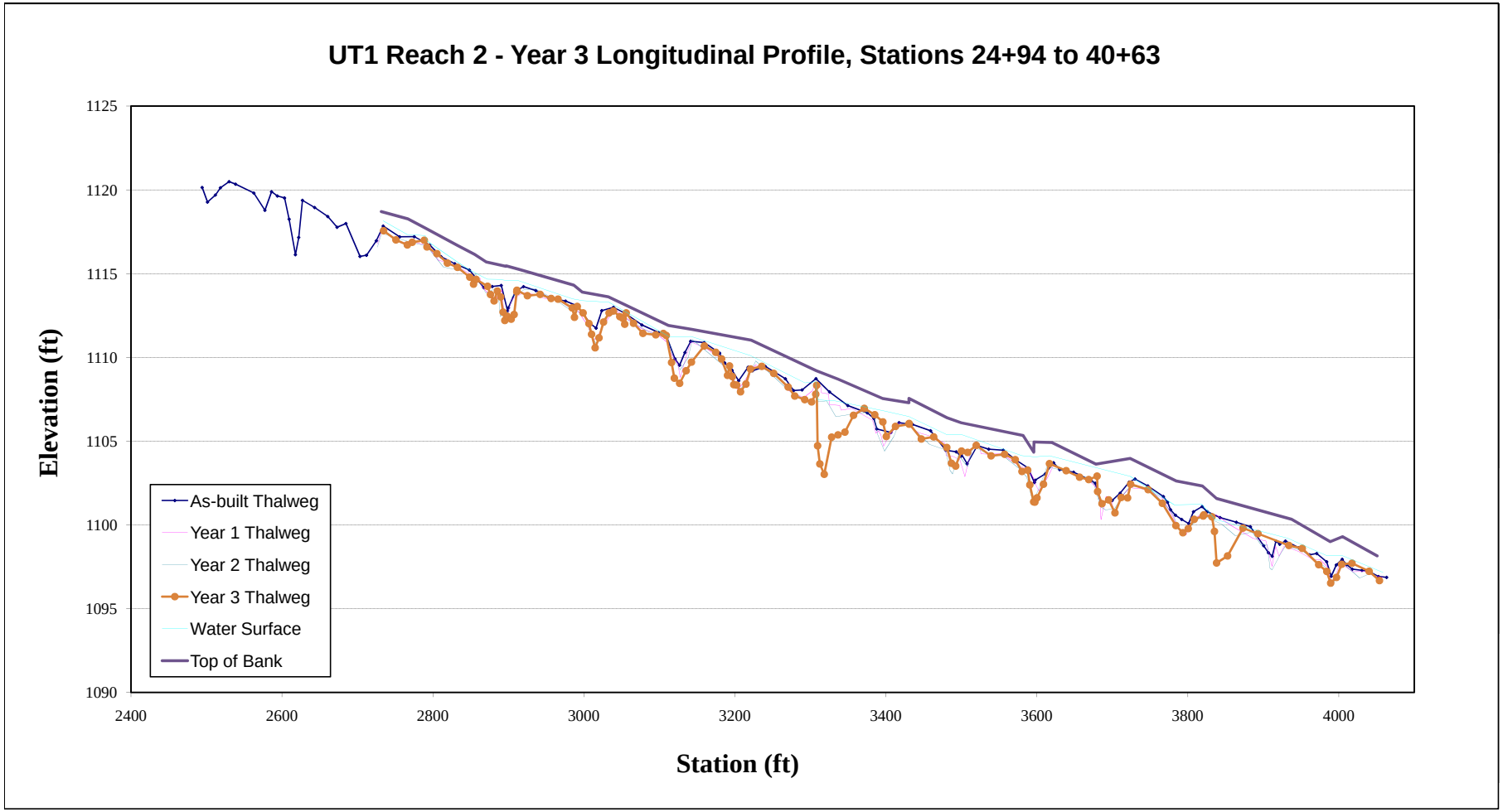
Reach: UT5																				
Parameter	Cross-section 15 Riffle					Cross-section 16 Pool					Cross-section 17 Riffle					Cross-section 18 Pool				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension																				
BF Width (ft)	11.37	11.88	12.10			15.86	15.57	17.53			15.66	15.94	15.16			13.32	12.05	17.03		
BF Mean Depth (ft)	1.75	1.89	1.95			1.67	1.26	1.03			0.86	0.82	0.95			1.93	1.62	1.28		
Width/Depth Ratio	6.51	6.28	6.20			9.52	12.32	17.08			18.24	19.48	16.02			6.90	7.42	13.28		
BF Cross-sectional Area (ft²)	19.90	22.50	23.60			26.40	19.70	18			13.40	13.10	14.35			25.70	19.60	21.83		
BF Max Depth (ft)	2.88	3.10	3.18			3.63	3.26	2.35			2.13	2.45	2.49			3.75	3.73	2.87		
Width of Floodprone Area (ft)	107.78	109.39	109.44			81.21	81.21	81.21			80.52	81.00	81.97			68.36	68.75	66.23		
Entrenchment Ratio	7.40	8.10	8.10			5.10	5.00	3.2			1.90	1.90	2.11			5.10	5.70	3.24		
Bank Height Ratio	1.00	1.00	1.00			1.00	1.00	0.97			0.80	0.80	0.88			1.00	1.10	1.22		
Wetted Perimeter (ft)	14.87	15.66	16.00			19.20	18.09	19.59			17.38	17.58	17.06			17.18	15.29	19.59		
Hydraulic Radius (ft)	1.34	1.44	1.48			1.38	1.09	0.92			0.77	0.75	0.84			1.50	1.28	1.11		
Substrate																				
d50 (mm)																				
d84 (mm)																				

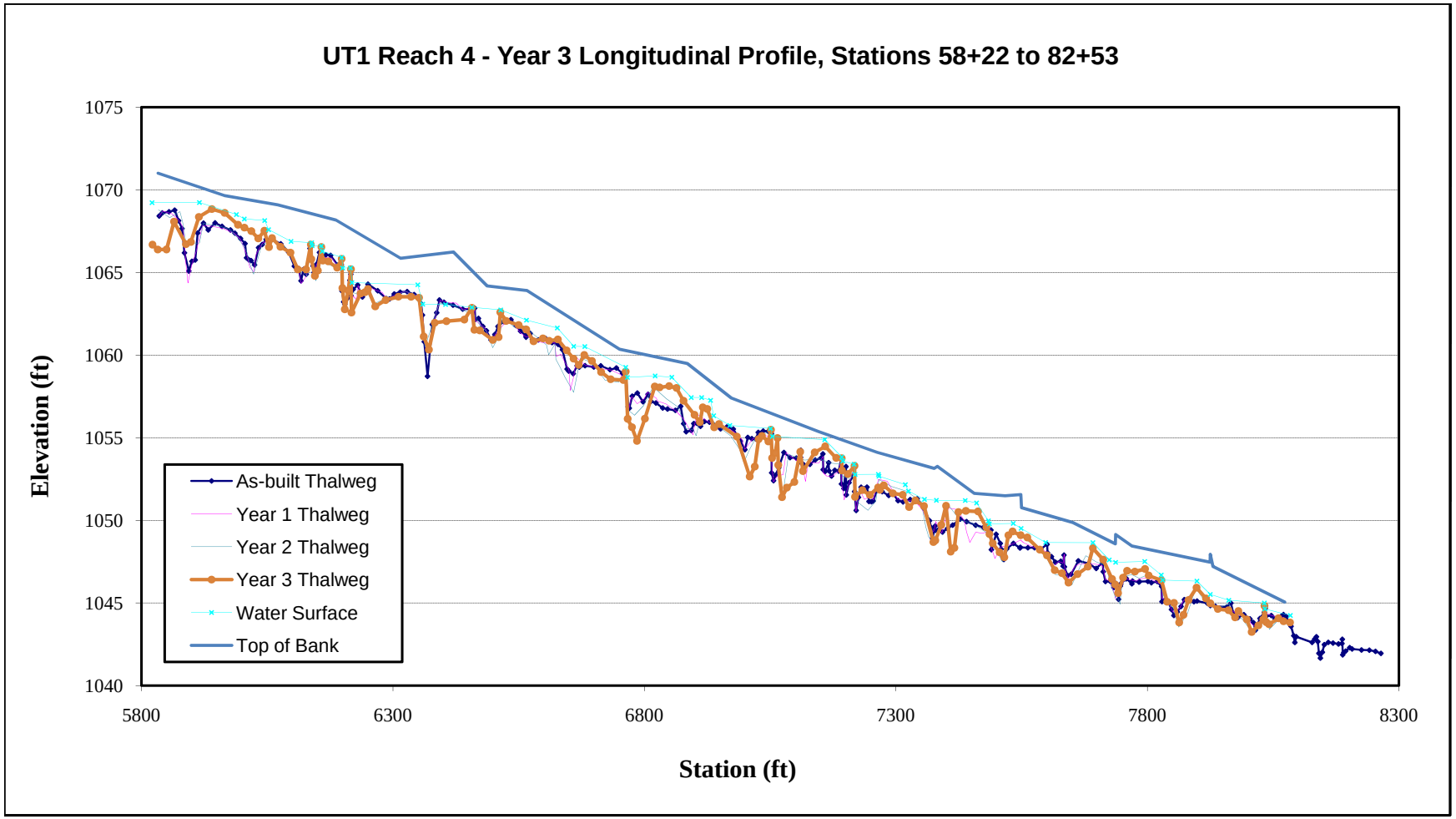
Parameter	MY-1 (2008)			MY-2 (2009)			MY-3 (2010)			MY-4 (2011)			MY-5 (2012)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern															
Channel Beltwidth (ft)															
Radius of Curvature (ft)															
Meander Wavelength (ft)															
Meander Width Ratio															
Profile															
Riffle length (ft)															
Riffle Slope (ft/ft)															
Pool Length (ft)															
Pool Spacing (ft)															
Additional Reach Parameters															
Valley Length (ft)			No			No									
Channel Length (ft)			Data			Data									
Sinuosity			Collected			Collected									
Water Surface Slope (ft/ft)															
BF Slope (ft/ft)															
Rosgen Classification															

Reach: UT6																				
Parameter	Cross-section 19 Riffle					Cross-section 20 Pool					Cross-section 21 Riffle					Cross-section 22 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)	8.54	8.25	8.66			8.35	8.85	8.60			8.88	9.17	10.07			11.21	12.08	13.56		
BF Mean Depth (ft)	0.80	0.84	0.73			0.88	0.86	0.84			0.70	0.70	69.00			0.90	0.85	0.98		
Width/Depth Ratio	10.74	9.81	11.90			9.47	10.34	10.28			12.74	13.15	14.66			12.52	14.13	13.86		
BF Cross-sectional Area (ft²)	6.80	6.90	6.30			7.40	7.60	7.20			6.20	6.40	6.90			10.00	10.30	13.30		
BF Max Depth (ft)	1.80	1.50	1.08			1.32	1.36	1.26			1.45	1.51	1.50			1.77	2.05	2.67		
Width of Floodprone Area (ft)	15.88	14.31	14.31			13.54	13.33	13.32			49.95	51.04	49.78			70.08	75.34	85.48		
Entrenchment Ratio	1.90	1.70	1.50			1.60	1.50	1.50			5.60	5.60	4.90			6.30	6.20	6.30		
Bank Height Ratio	2.30	2.90	3.40			2.20	2.20	2.30			1.00	1.00	1.00			1.00	1.00	1.00		
Wetted Perimeter (ft)	10.14	9.93	10.12			10.11	10.57	10.28			10.28	10.57	148.07			13.01	13.78	15.52		
Hydraulic Radius (ft)	0.67	0.69	0.62			0.73	0.72	0.70			0.60	0.61	0.05			0.77	0.75	0.86		
Substrate																				
d50 (mm)																				
d84 (mm)																				

Parameter	MY-1 (2008)			MY-2 (2009)			MY-3 (2010)			MY-4 (2011)			MY-5 (2012)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern															
Channel Beltwidth (ft)															
Radius of Curvature (ft)															
Meander Wavelength (ft)															
Meander Width Ratio															
Profile															
Riffle length (ft)															
Riffle Slope (ft/ft)															
Pool Length (ft)															
Pool Spacing (ft)															
Additional Reach Parameters															
Valley Length (ft)			No			No									
Channel Length (ft)			Data			Data									
Sinuosity			Collected			Collected									
Water Surface Slope (ft/ft)															
BF Slope (ft/ft)															
Rosgen Classification															

STREAM DATA


UT1 Reach 2 - Year 3 Longitudinal Profile, Stations 24+94 to 40+63
Elevation (ft)
1125
1120
1115
1110
1105
1100
1095
1090
2400
2600
2800
3000
3200
3400
3600
3800
4000
Station (ft)
As-built Thalweg
Year 1 Thalweg
Year 2 Thalweg
Year 3 Thalweg
Water Surface
Top of Bank


UT1 Reach 4 - Year 3 Longitudinal Profile, Stations 58+22 to 82+53
Elevation (ft)
1075
1070
1065
1060
1055
1050
1045
1040
5800
6300
6800
7300
7800
8300
Station (ft)
As-built Thalweg
Year 1 Thalweg
Year 2 Thalweg
Year 3 Thalweg
Water Surface
Top of Bank

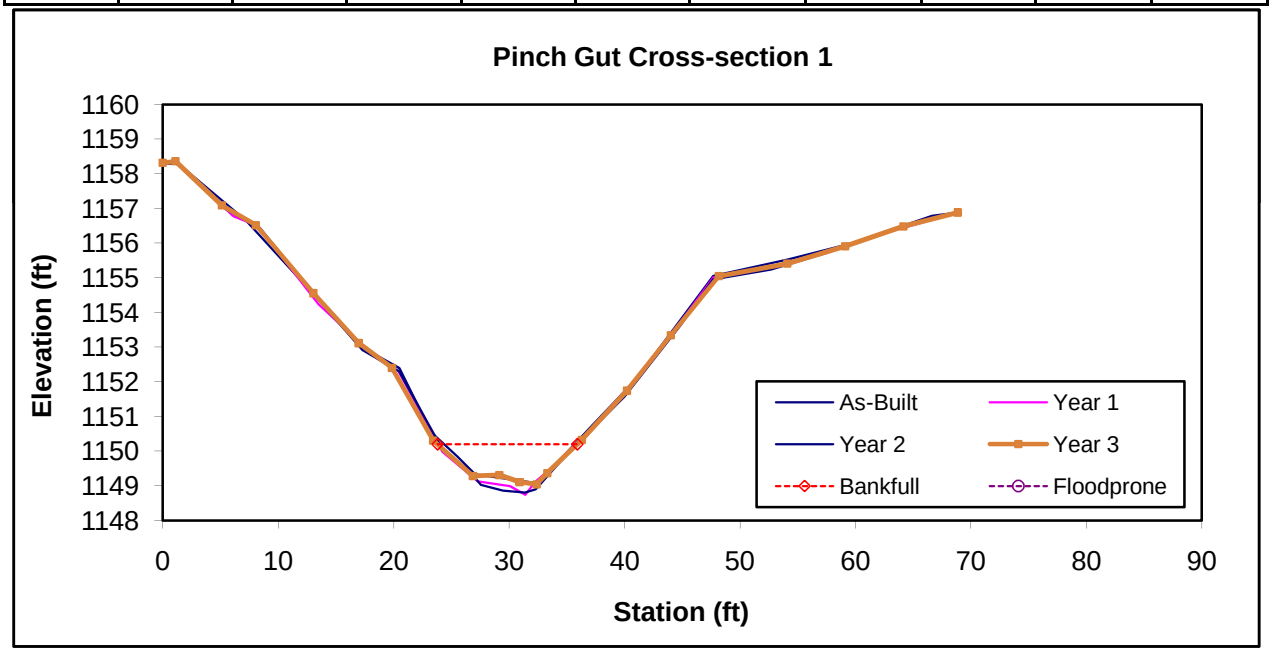
Permanent Cross-section 1, Station 12+57

(Year 3 Data - Collected November 2010)

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	Bc	8.8	12.1	0.73	1.15	16.57	2.9	1.4	1150.2	1152.41



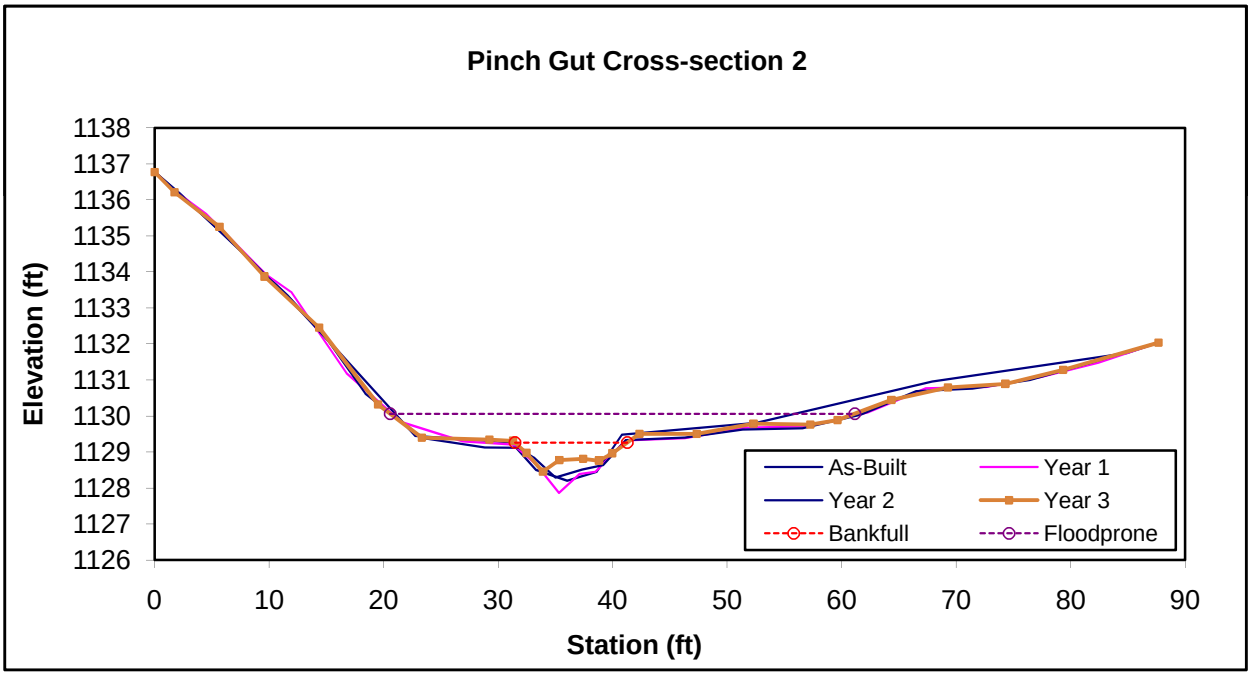
Permanent Cross-section 2, Station 21+26

(Year 3 Data - Collected November 2010)

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	Cc	4.1	9.8	0.42	0.8	23.26	1.1	4.1	1129.26	1129.31



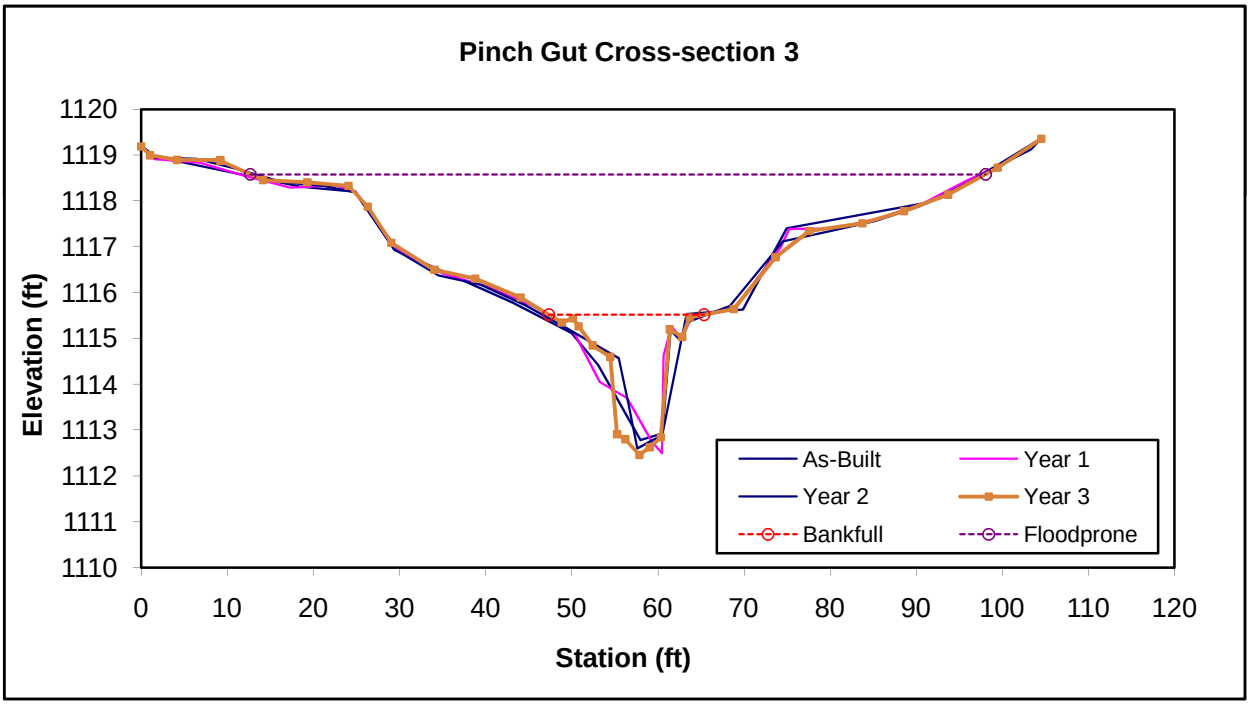
Permanent Cross-section 3, Station 28+99

(Year 3 Data - Collected November 2010)

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		21.1	18.01	1.17	3.06	15.4	1	4.7	1115.52	1115.44



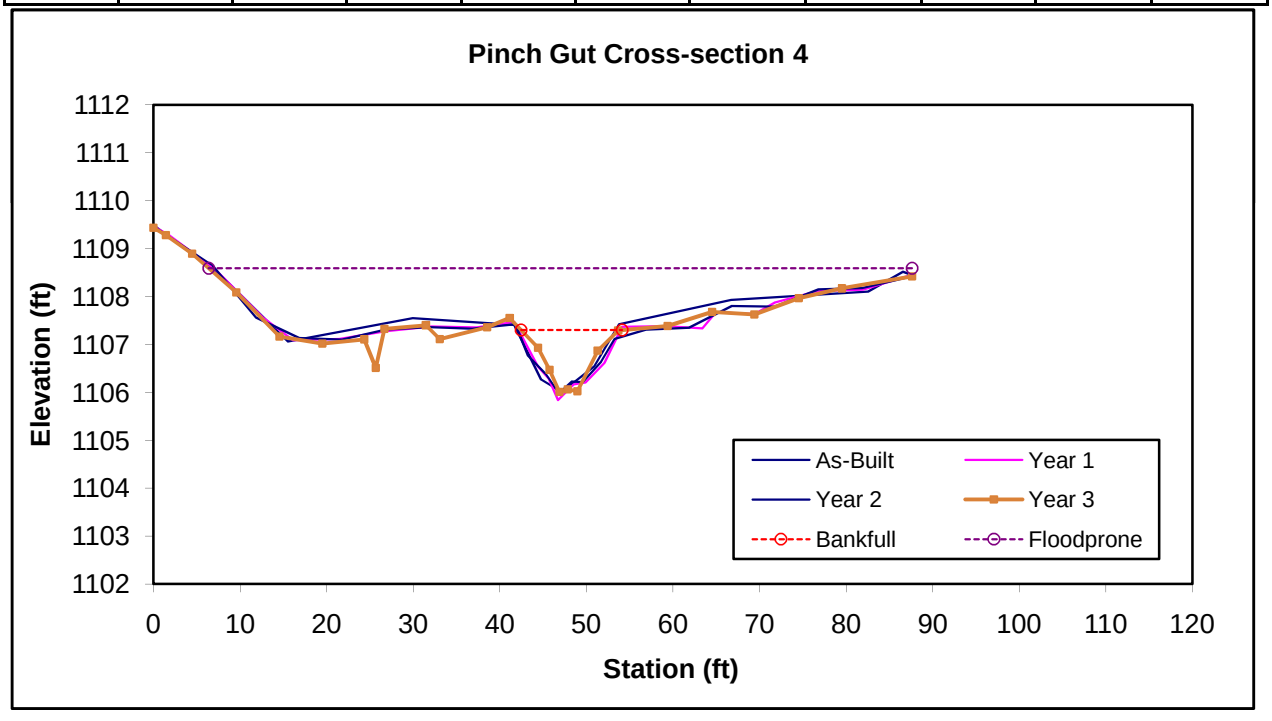
Permanent Cross-section 4, Station 31+34

(Year 3 Data - Collected November 2010)

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	7.5	11.66	0.64	1.29	18.15	1	7	1107.3	1107.29



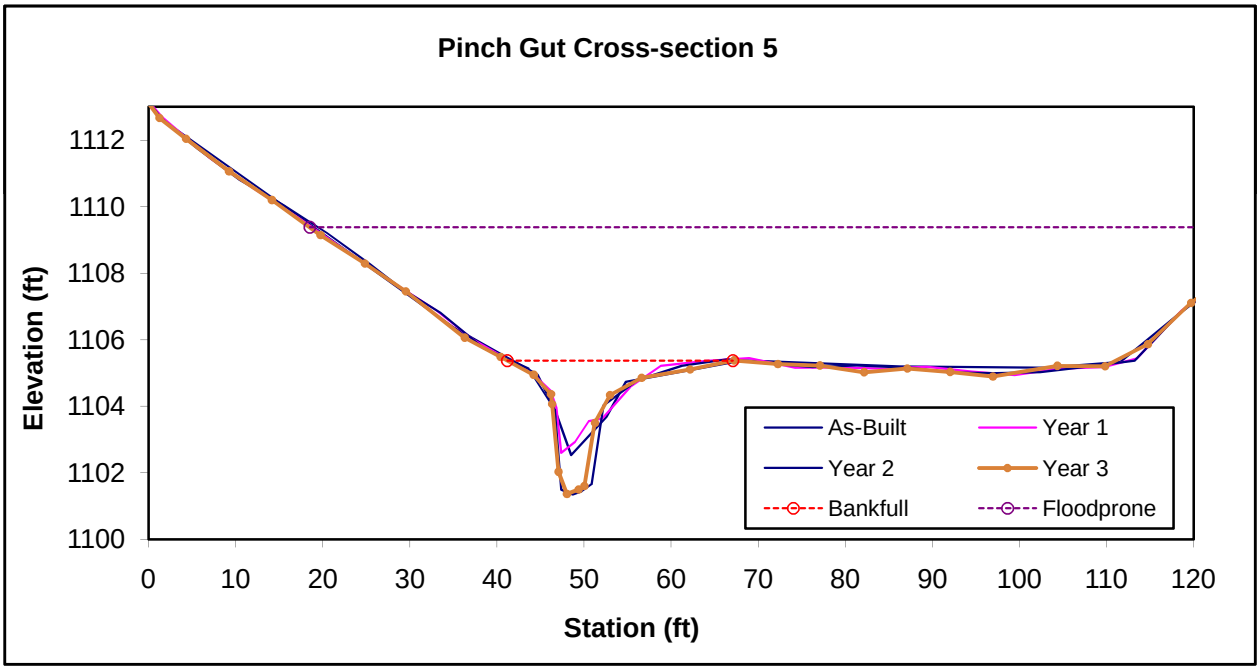
Permanent Cross-section 5, Station 35+97

(Year 3 Data - Collected November 2010)

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		26.8	25.87	1.04	4.01	24.94	1	4.2	1105.37	1105.38



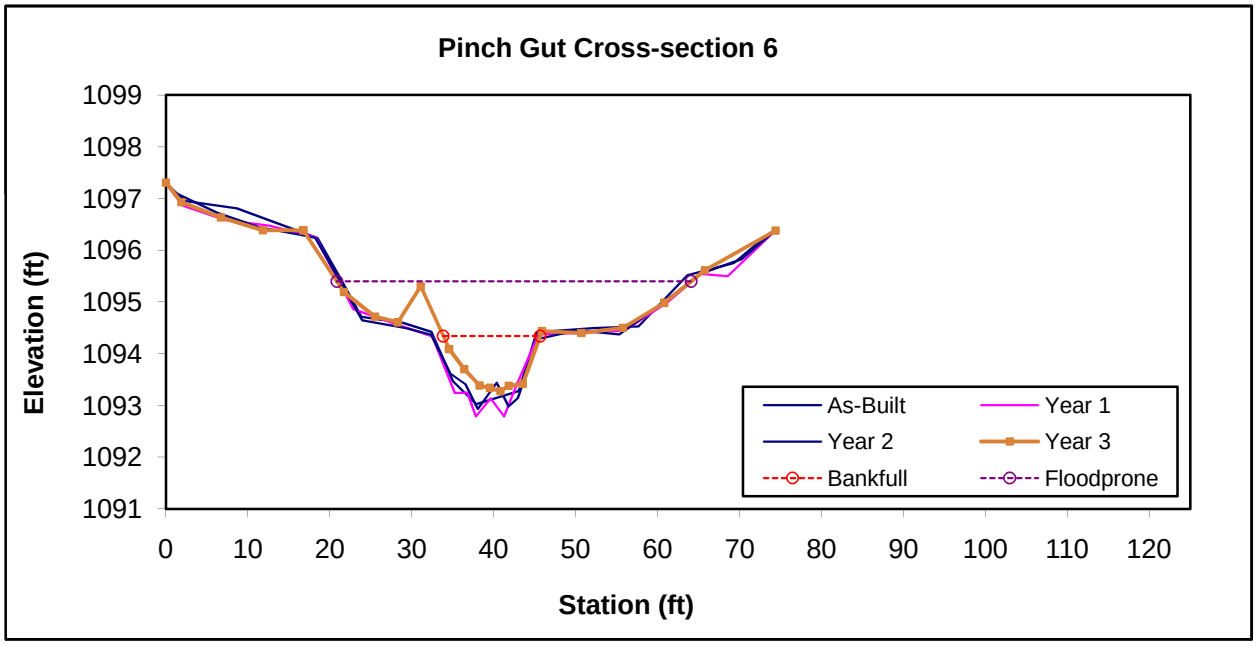
Permanent Cross-section 6, Station 44+97

(Year 3 Data - Collected November 2010)

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	Cc	8.5	11.81	0.72	1.06	16.31	1.1	3.7	1094.34	1094.44



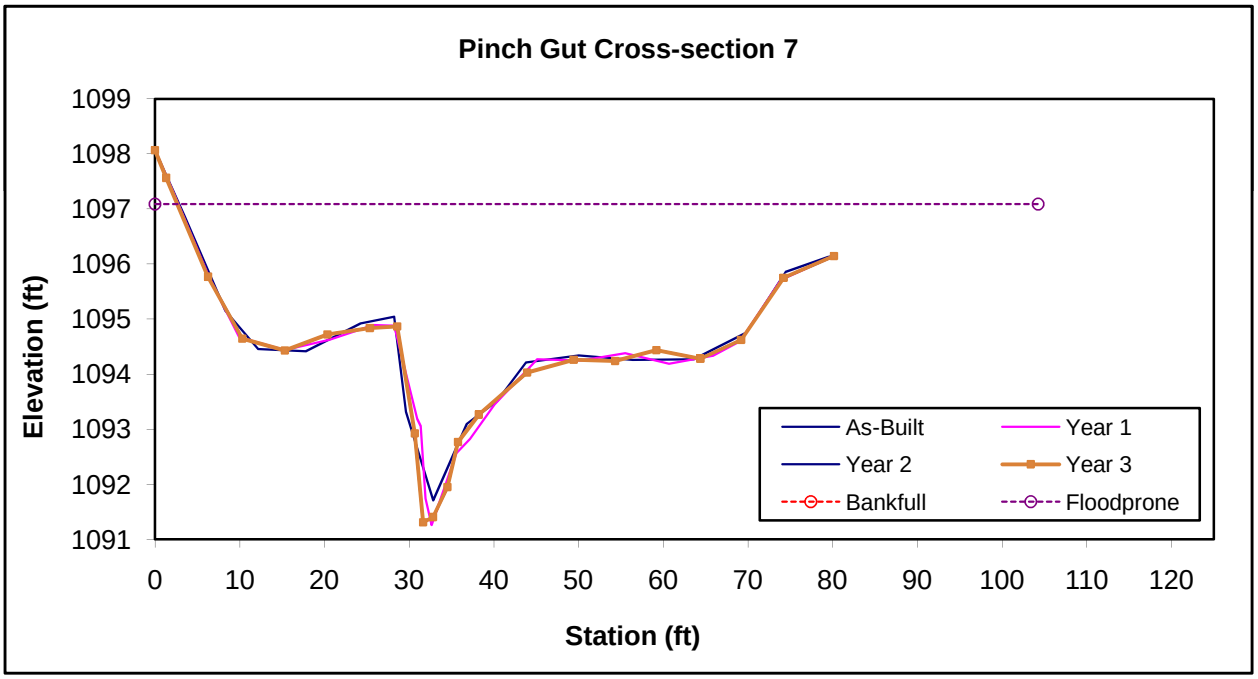
Permanent Cross-section 7, Station 45+44

(Year 3 Data - Collected November 2010)

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		27.6	19.58	1.41	3.36	13.9	1	5.3	1074.92	1074.93



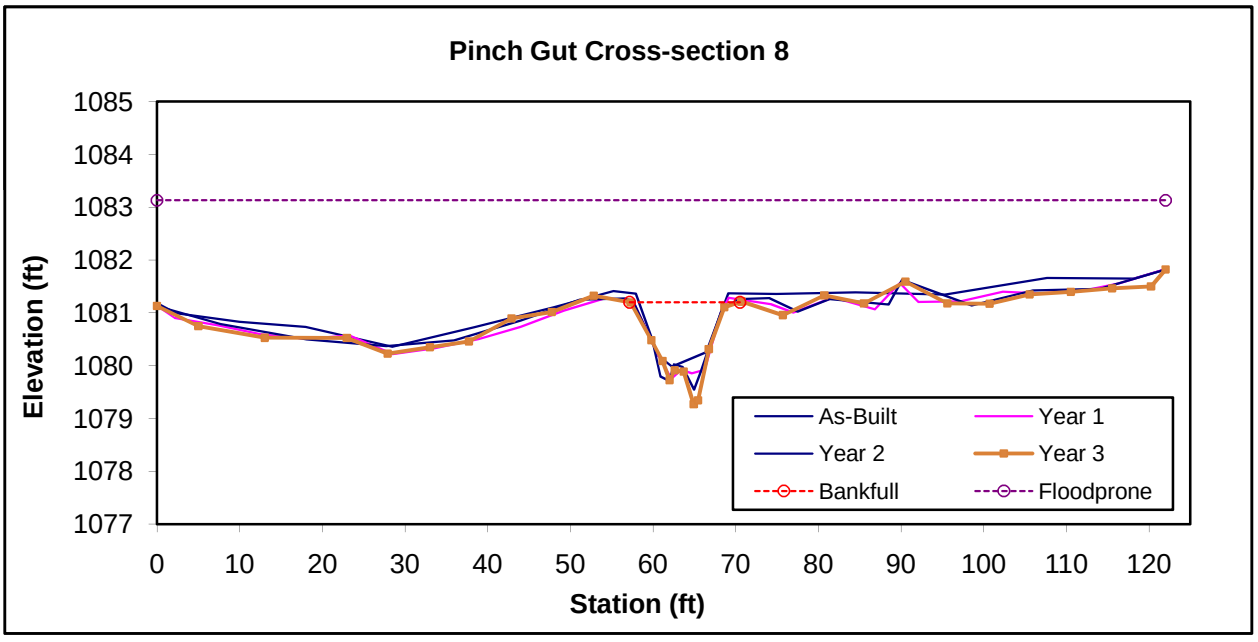
Permanent Cross-section 8, Station 53+47

(Year 3 Data - Collected November 2010)

Looking at the Left Bank

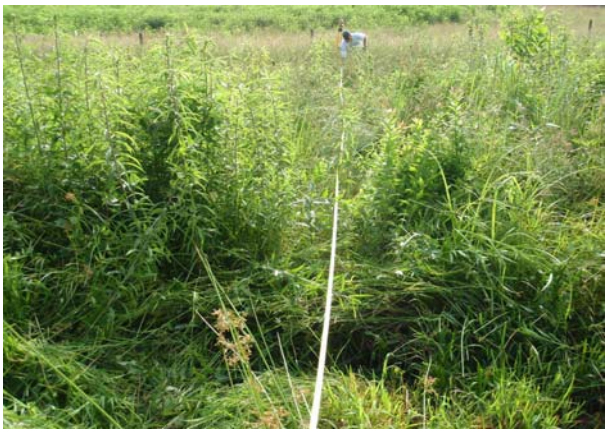
Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Cc	11.3	13.32	0.85	1.93	15.7	1	9.2	1081.2	1081.2



Permanent Cross-section 9, Station 56+39

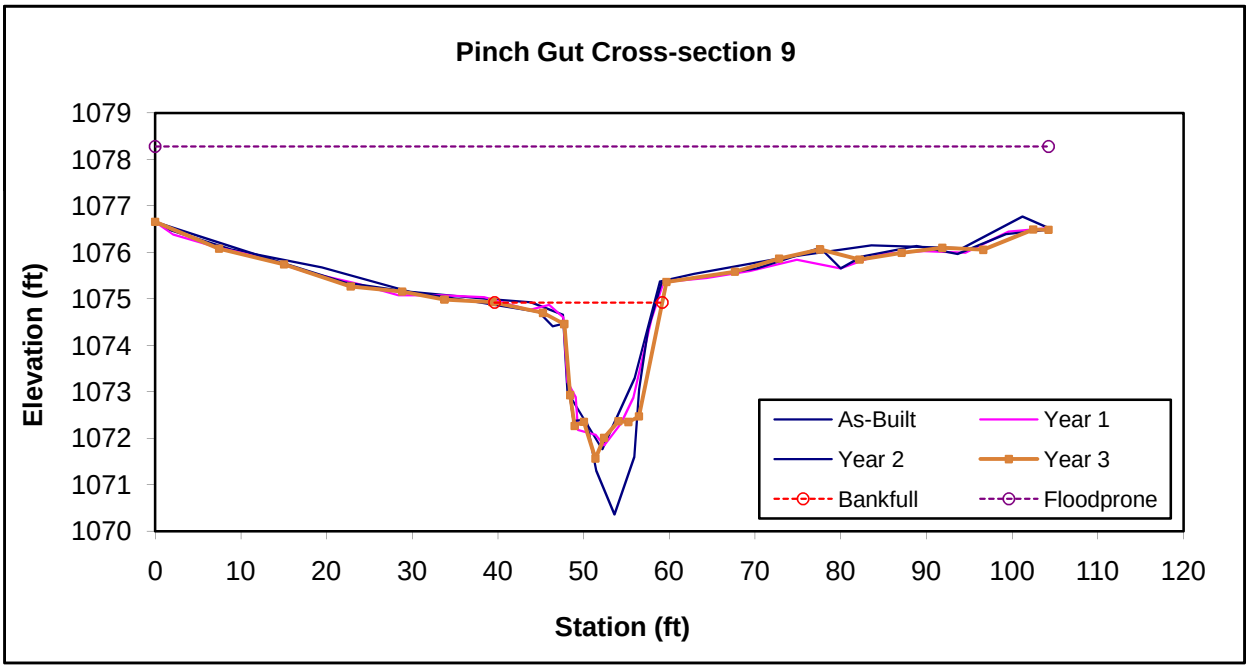
(Year 3 Data - Collected November 2010)



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		27.6	19.58	1.41	3.36	13.9	1	5.3	1074.92	1074.93



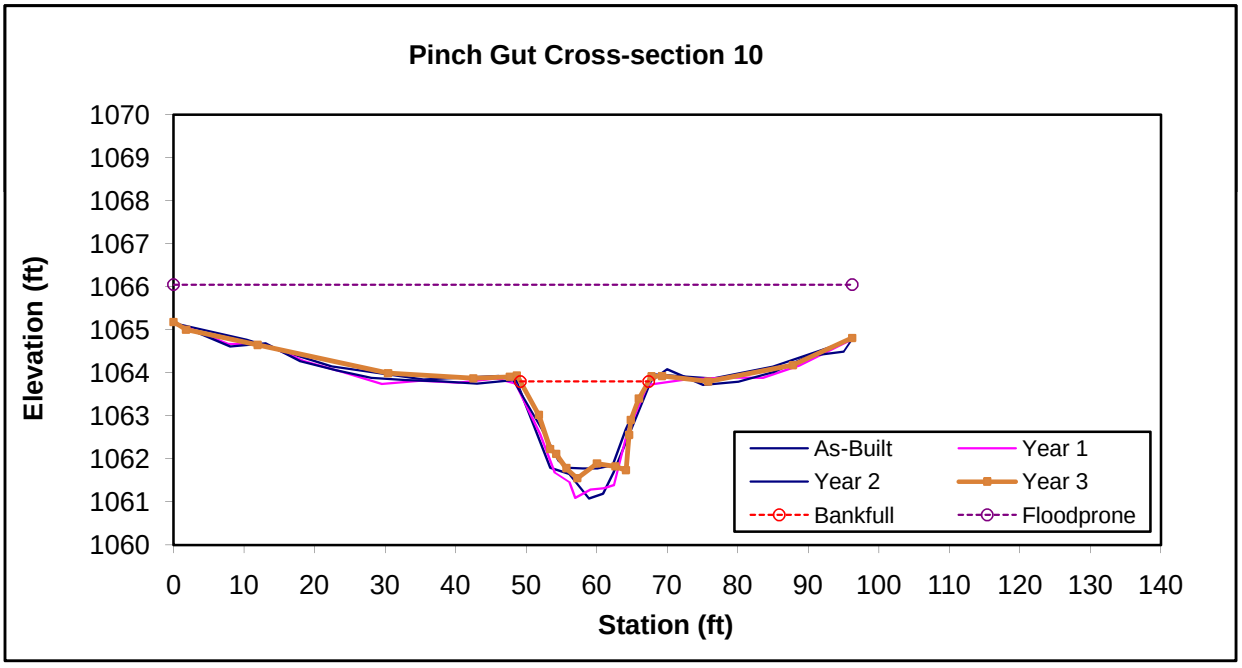
Permanent Cross-section 10, Station 65+55

(Year 3 Data - Collected November 2010)

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	26.2	18.21	1.44	2.25	12.67	1	5.3	1063.8	1063.91



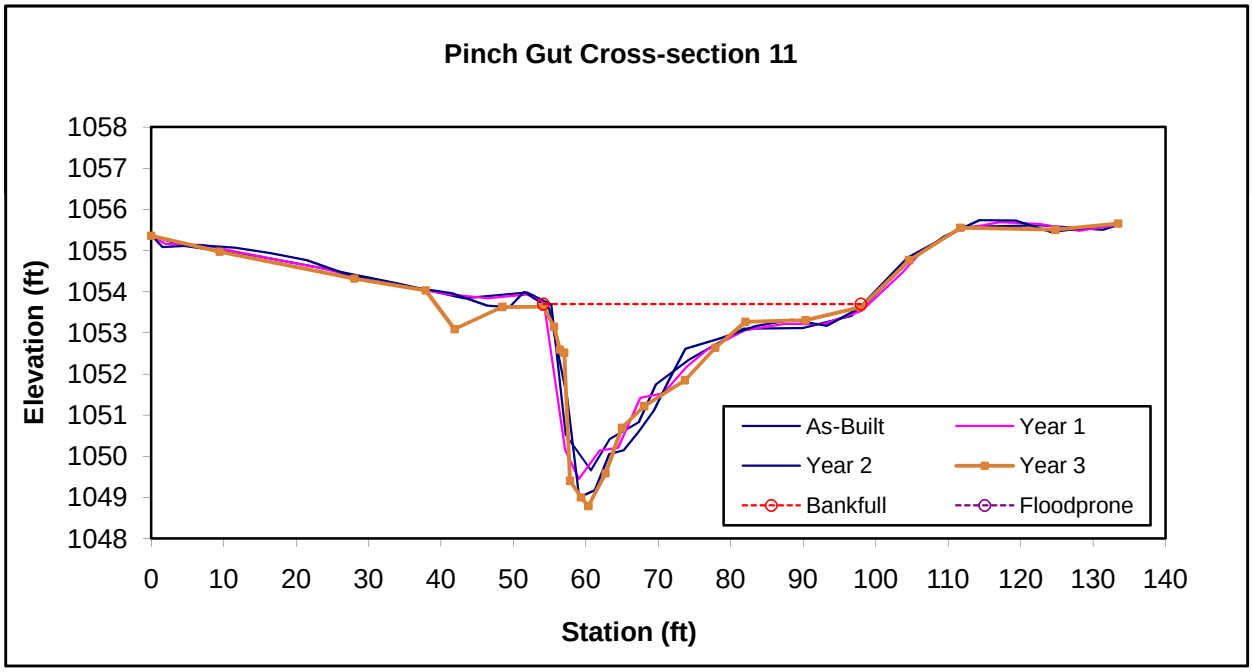
Permanent Cross-section 11, Station 73+68

(Year 3 Data - Collected November 2010)

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		66.4	43.79	1.52	4.84	28.9	1	3	1053.63	1053.62



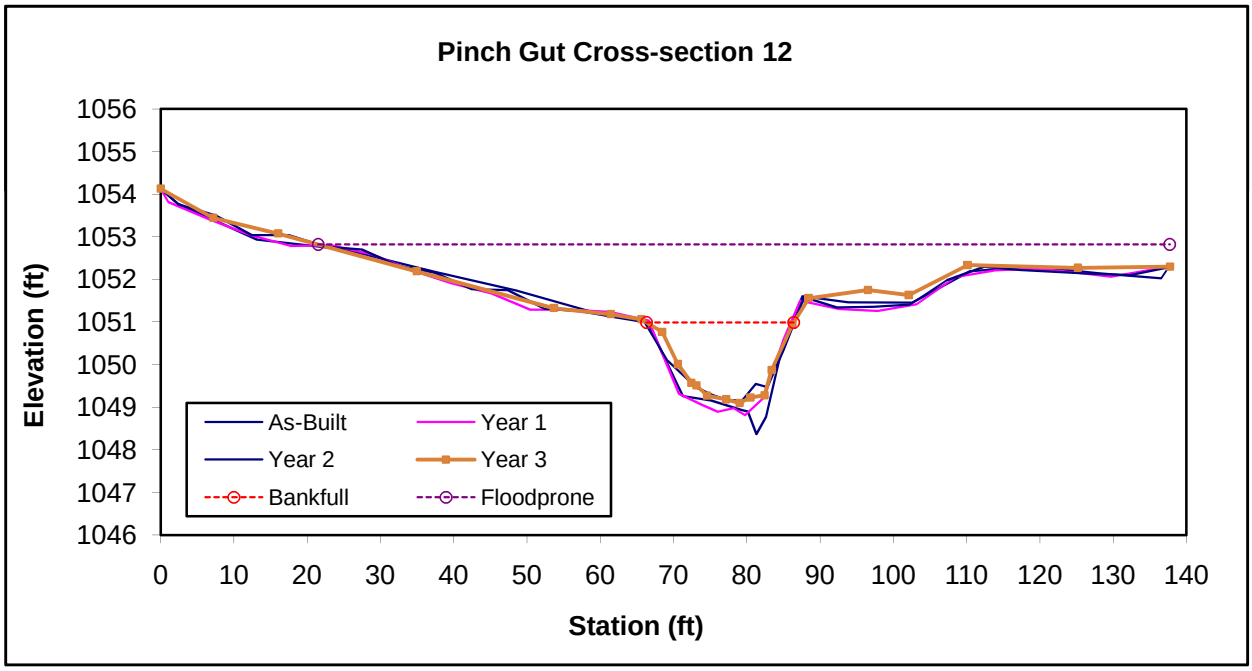
Permanent Cross-section 12, Station 75+37

(Year 3 Data - Collected November 2010)

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	24.1	20.1	1.2	1.89	16.76	1	5.8	1050.99	1051.06



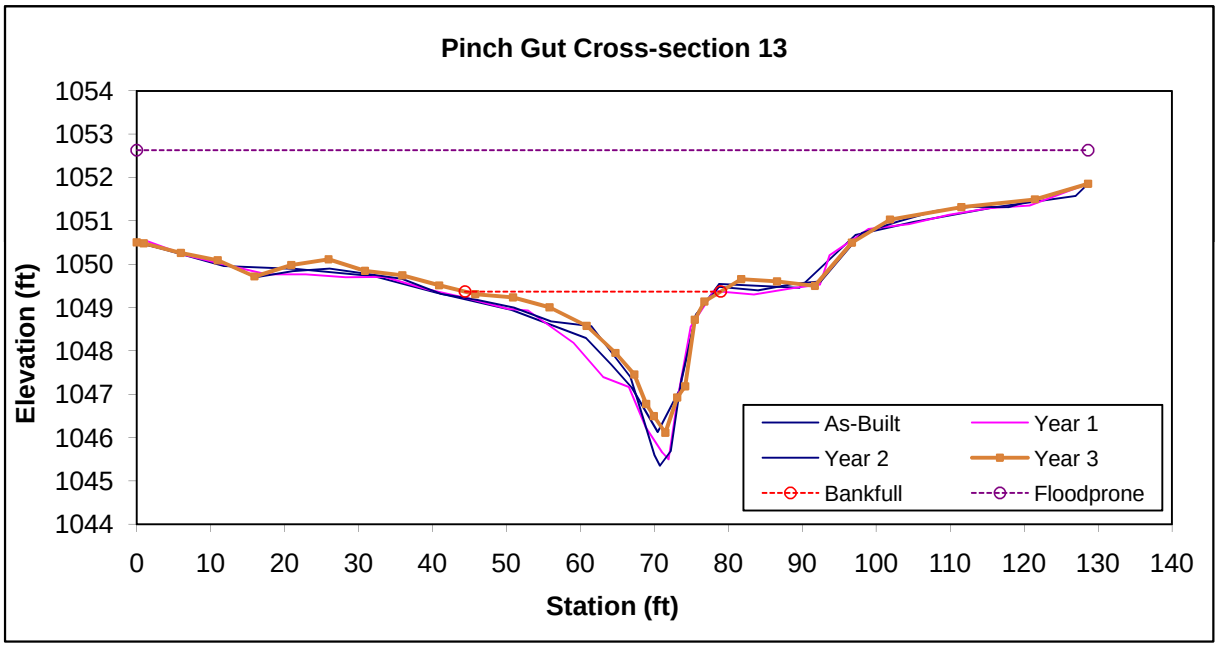
Permanent Cross-section 13, Station 77+25

(Year 3 Data - Collected November 2010)

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		34.1	34.59	0.99	3.26	35.04	0.9	3.7	1049.37	1049.14



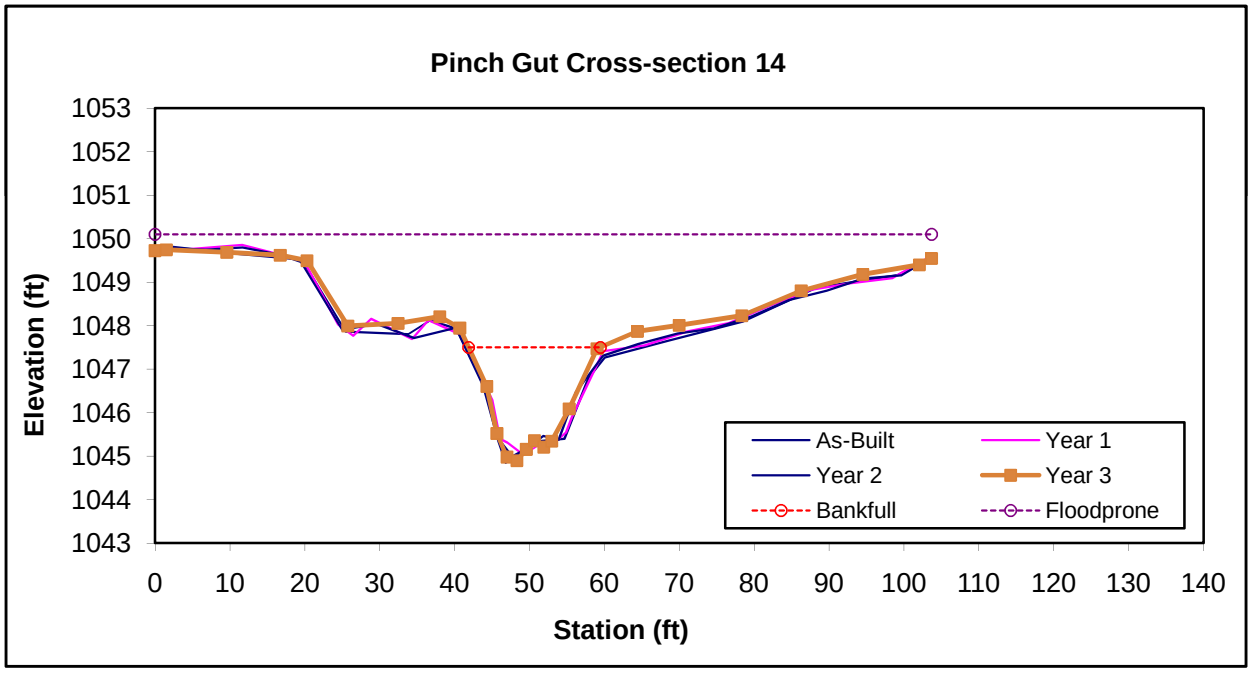
Permanent Cross-section 14, Station 79+15

(Year 3 Data - Collected November 2010)

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	27	17.58	1.54	2.6	11.43	1.1	5.9	1047.5	1047.87



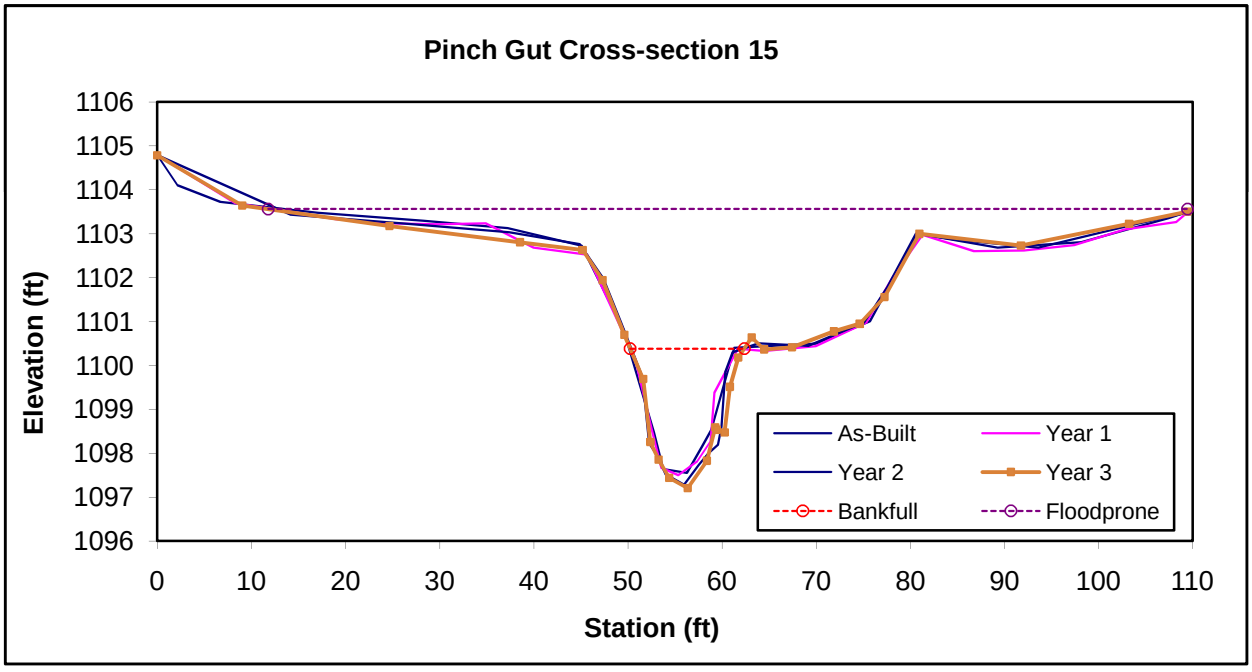
Permanent Cross-section 15, Station 10+73

(Year 3 Data - Collected November 2010)

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	23.6	12.1	1.95	3.18	6.2	1.1	8.1	1100.38	1100.63



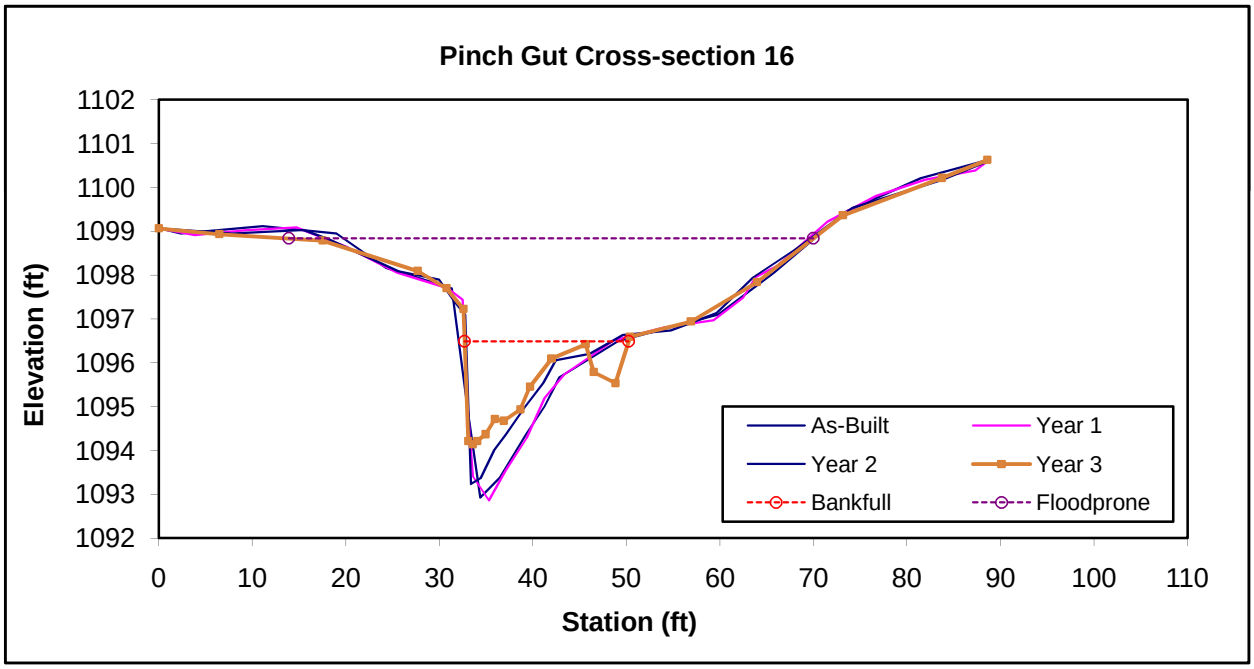
Permanent Cross-section 16, Station 13+08

(Year 3 Data - Collected November 2010)

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		18	17.53	1.03	2.35	17.08	1	3.2	1096.49	1096.42



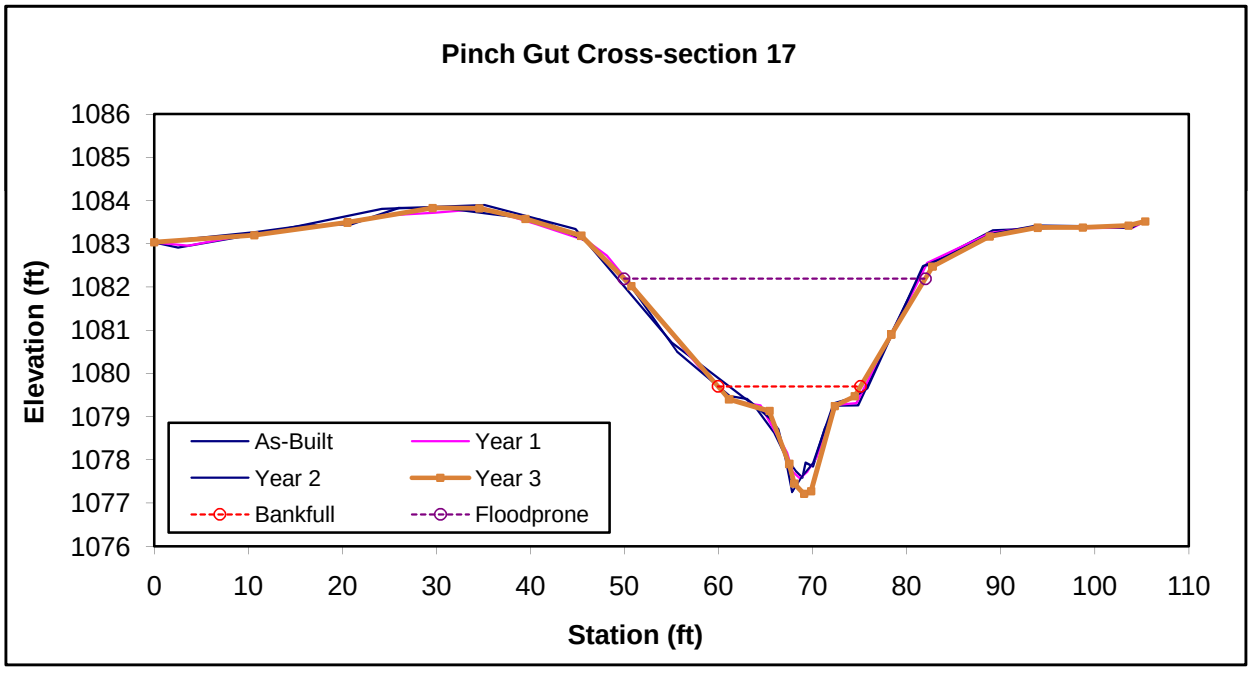
Permanent Cross-section 17, Station 21+96

(Year 3 Data - Collected November 2010)

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	Bc	14.3	15.16	0.95	2.49	16.02	0.9	2.1	1079.7	1079.4



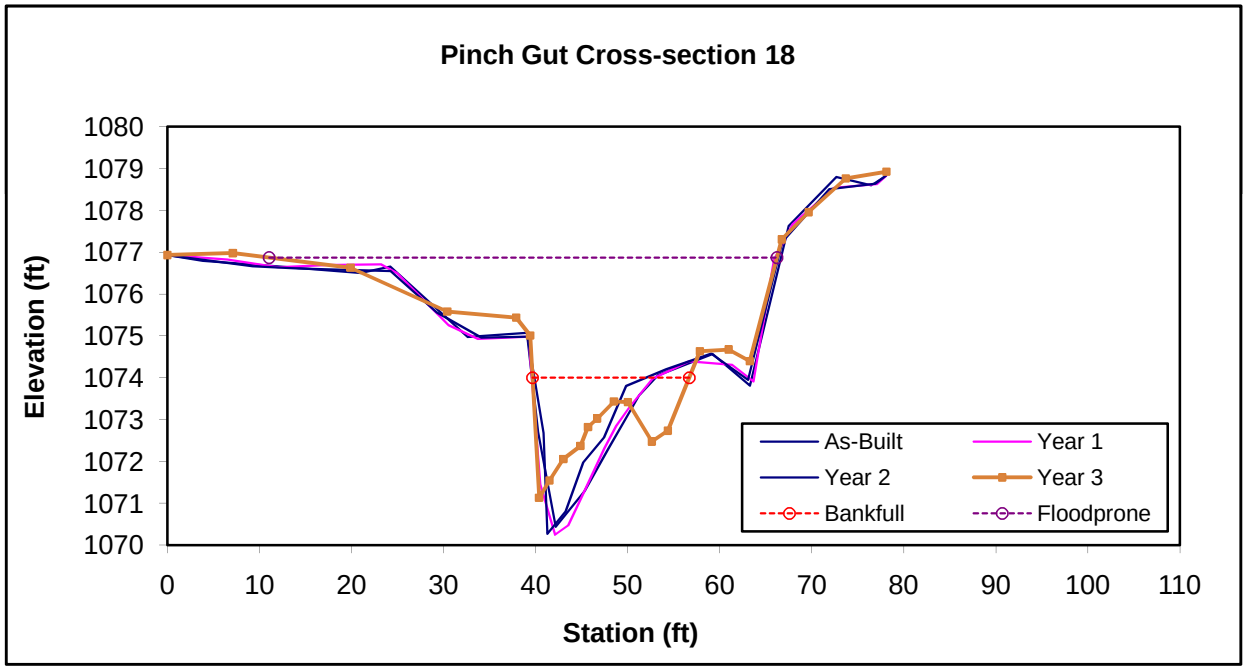
Permanent Cross-section 18, Station 25+95

(Year 3 Data - Collected November 2010)

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	17.03	1.28	2.87	13.28	1.2	3.2	1074	1074.63



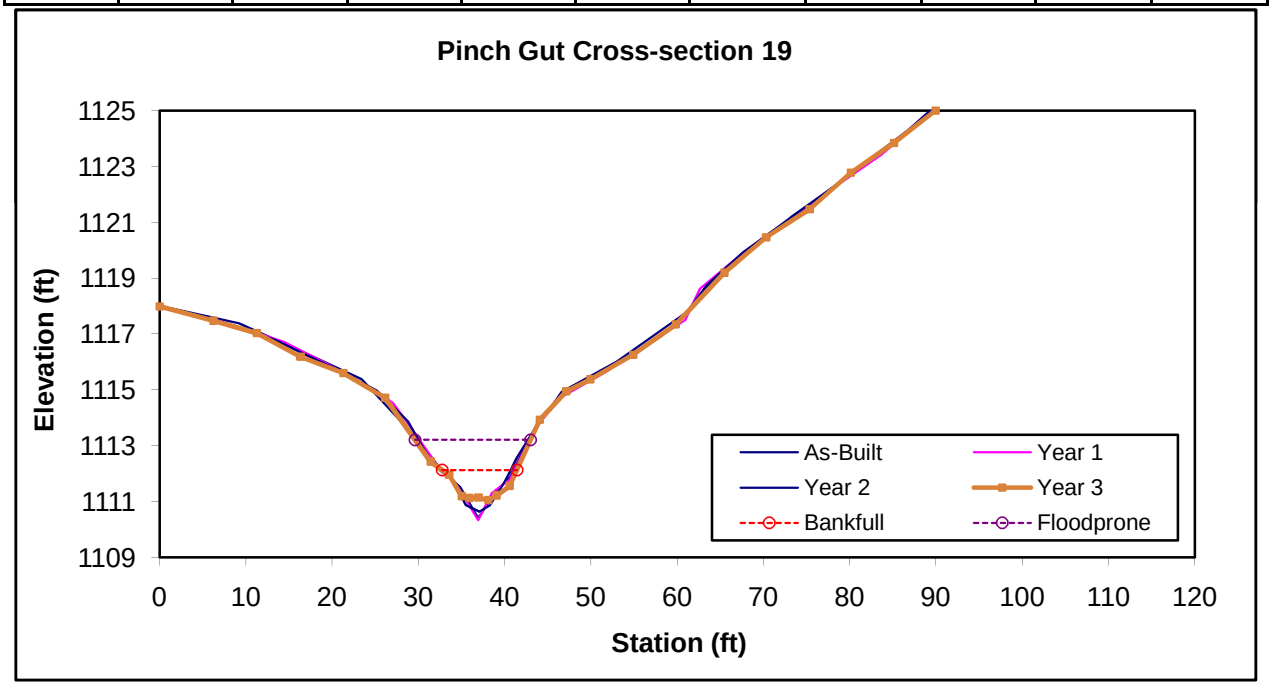
Permanent Cross-section 19, Station 16+76

(Year 3 Data - Collected November 2010)

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	Bc	6.3	8.66	0.73	1.08	11.9	3.4	1.5	1112.13	1114.72



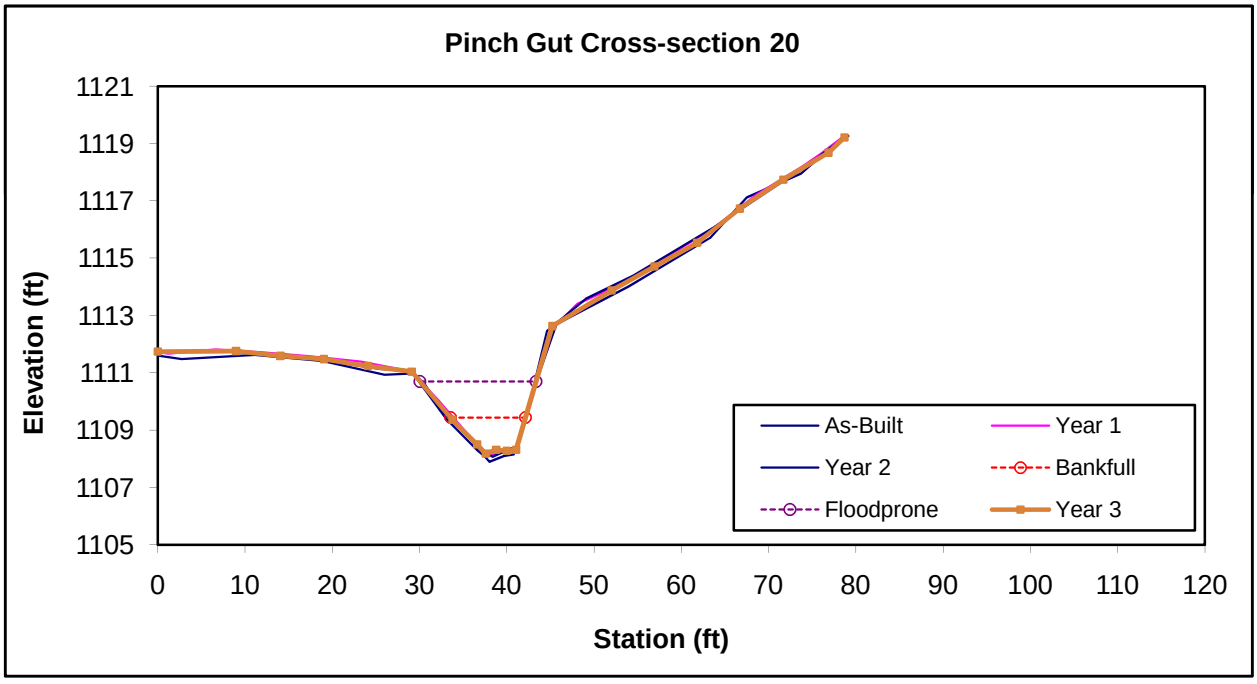
Permanent Cross-section 20, Station 18+03

(Year 3 Data - Collected November 2010)

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		7.2	8.6	0.84	1.26	10.28	2.3	1.5	1109.44	1111.04



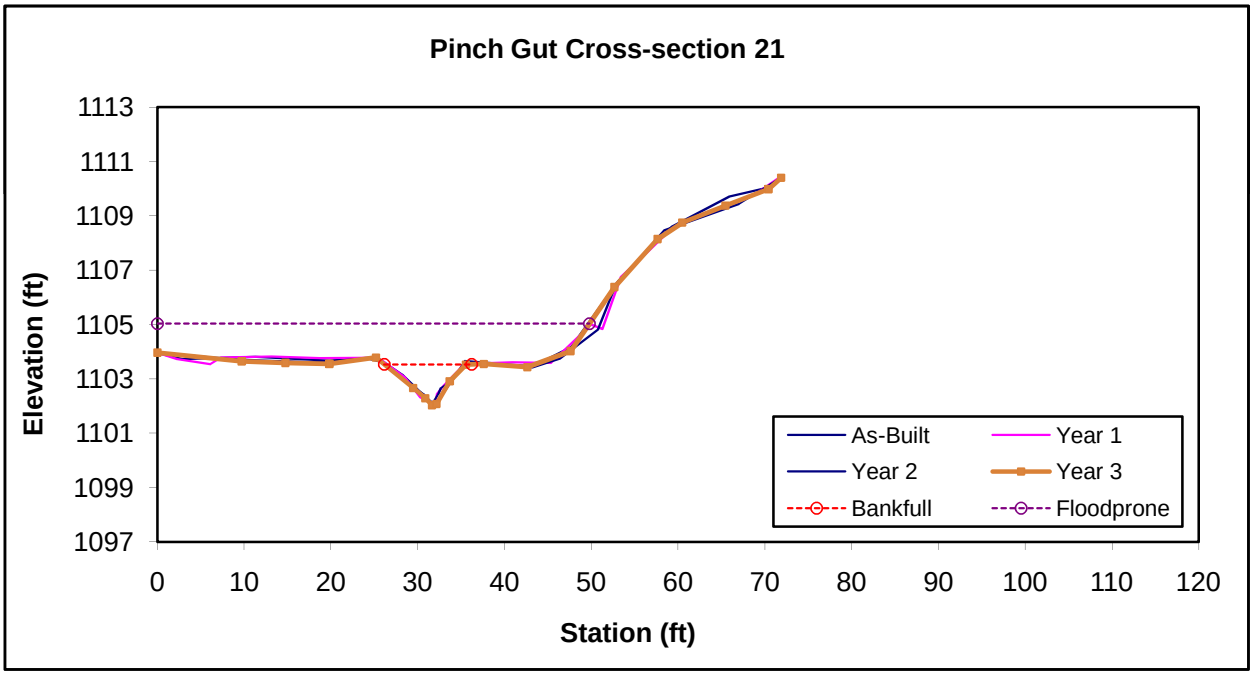
Permanent Cross-section 21, Station 20+27

(Year 3 Data - Collected November 2010)

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	Cc	6.9	10.07	0.69	1.5	14.66	1	4.9	1103.53	1103.52



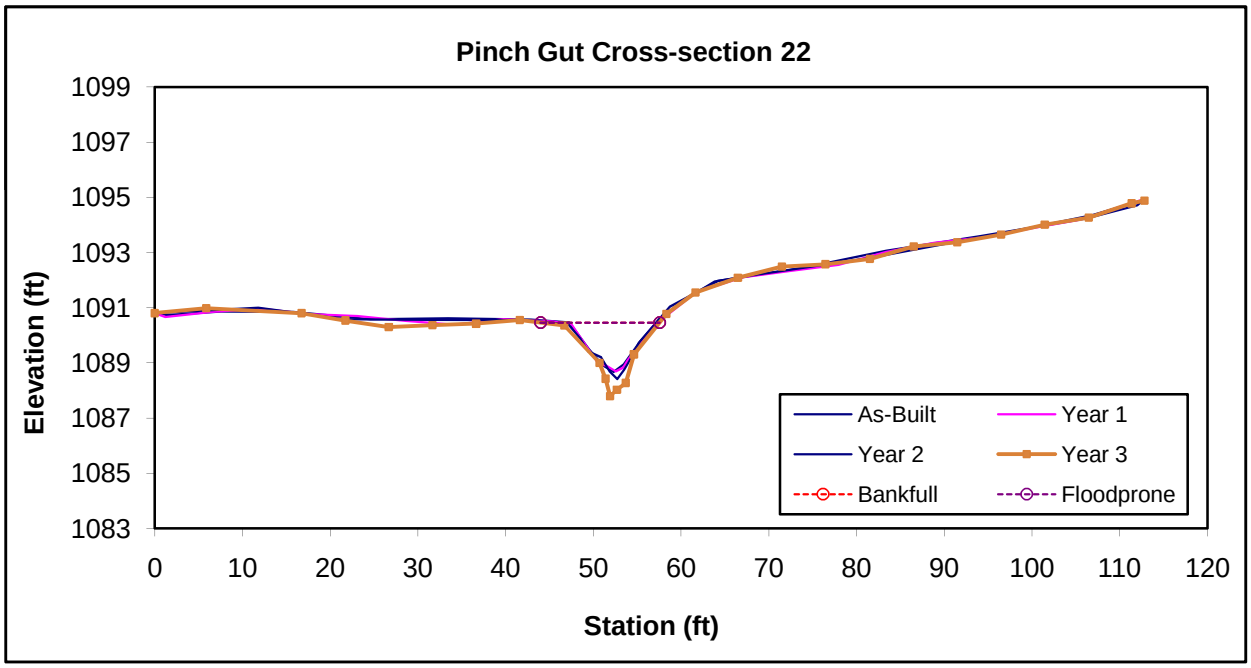
Permanent Cross-section 22, Station 24+32

(Year 3 Data - collected November 2010)

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	Cc	13.3	13.56	0.98	2.67	13.86	1	6.3	1090.46	1090.55



Constructed Riffle, Downstream of Culvert, UT1 Reach 4 End

Photo Point 1 – Constructed Riffle, UT1 Reach 4

Photo Point 2 – J-Hook, UT1 Reach 4

Photo Point 3 – Constructed Riffle, UT1 Reach 4

Photo Point 4 – J-Hook, UT1 Reach 4

Photo Point 5 – Stream Crossing, UT1 Reach 4

Photo Point 6 – J-Hook, UT1 Reach 4

Photo Point 7 – Constructed Riffle, UT1 Reach 4

Photo Point 8 – J-Hook, UT1 Reach 4

Photo Point 9 – Constructed Riffle, UT1 Reach 4

Photo Point 10 – J-Hook, UT1 Reach 4

Photo Point 11 – Constructed Riffle, UT1 Reach 4

Photo Point 12 – Constructed Riffle, UT1 Reach 4

Photo Point 13 – Cross Vane, UT1 Reach 4

Photo Point 14 – Rock and Roll, UT1 Reach 4

Photo Point 15 – Rock and Roll, UT1 Reach 4

Photo Point 16 – Cross Vane/Stream Crossing, UT1 Reach 4

Photo Point 17 – Constructed Riffle, UT1 Reach 4

Photo Point 18 – Constructed Riffle, UT1 Reach 4

Photo Point 19 – Log J-Hook, UT1 Reach 4

Photo Point 20 – Constructed Riffle, UT1 Reach 4

Photo Point 21 – J-Hook/Riffle, UT1 Reach 4

Photo Point 22 – Constructed Riffle, UT1 Reach 4

Photo Point 23 – Cross Vane, UT1 Reach 4

Photo Point 24 – Step Pool, UT1 Reach 4

Photo Point 25 – Constructed Riffle, UT1 Reach 4

Photo Point 26 – J-Hook, UT1 Reach 4

Photo Point 27 – Constructed Riffle, UT1 Reach 4

Photo Point 28 – Constructed Riffle, UT1 Reach 4

Photo Point 29 – Constructed Riffle, Begin UT1 Reach 4

Photo Point 30 – Cross Vane, UT1 Reach 4 End

Photo Point 31 – Stream Crossing, UT1 Reach 3

Photo Point 32 – Step Pool, UT1 Reach 3

Photo Point 33 – Step Pool, UT1 Reach 3

Photo Point 34 – Step Pool, UT1 Reach 3

Photo Point 35 – Step Pool, UT1 Reach 3

Photo Point 36 – J-Hook, UT1 Reach 3

Photo Point 37 – Constructed Riffle, UT1 Reach 3

Photo Point 38 – Step Pool, UT1 Reach 3

Photo Point 39 –Step Pool, UT1 Reach 3

Photo Point 40 – Step Pools, UT1 Reach 3

Photo Point 41 – Step Pools, UT1 Reach 3

Photo Point 42 – Step Pools, UT1 Reach 3

Photo Point 43 – J-Hook, UT1 Reach 3

Photo Point 44 – Step Pools, UT1 Reach 3

Photo Point 45 – J-Hook, UT1 Reach 3

Photo Point 46 – Constructed Riffle, UT1 Reach 3

Photo Point 47 – J-Hook, UT1 Reach 3

Photo Point 48 – Constructed Riffle, UT1 Reach 3

Photo Point 49 – Step Pool, UT1 Reach 3

Photo Point 50 – Step Pool, UT1 Reach 3

Photo Point 51 – J-Hook, UT1 Reach 3

Photo Point 52 – Log Weir, UT1 Reach 3

Photo Point 53 – Constructed Riffle, UT1 Reach 3 Begin

Photo Point 54 – Constructed Riffle, UT1 Reach 2 End

Photo Point 55 – Constructed Riffle, UT1 Reach 2

Photo Point 56 – Constructed Riffle, UT1 Reach 2

Photo Point 57 – Constructed Riffle, UT1 Reach 2

Photo Point 58 – Constructed Riffle, UT1 Reach 2

Photo Point 59 – Constructed Riffle, UT1 Reach 2

Photo Point 60 – Constructed Riffle, UT1 Reach 2

Photo Point 61 – Constructed Riffle, UT1 Reach 2

Photo Point 62 – Constructed Riffle, UT1 Reach 2

Photo Point 63 – Constructed Riffle, UT1 Reach 2

Photo Point 64 – Constructed Riffle, UT1 Reach 2

Photo Point 65 – Constructed Riffle, UT1 Reach 2

Photo Point 66 – Constructed Riffle, UT1 Reach 2

Photo Point 67 – Constructed Riffle, UT1 Reach 2

Photo Point 68 – Constructed Riffle, UT1 Reach 2

Photo Point 69 – Constructed Riffle, UT1 Reach 2

Photo Point 70 – Constructed Riffle, UT1 Reach 2 Begin

Photo Point 71 – Constructed Riffle, UT1 Reach 1 End

Photo Point 72 – X-Vane, UT4

Photo Point 73 – Constructed Riffle, UT1 Reach 1

Photo Point 74 – Constructed Riffle, UT1 Reach 1

Photo Point 75 – Constructed Riffle, UT1 Reach 1

Photo Point 76 – J-Hook, UT1 Reach 1

Photo Point 77 – Constructed Riffle, UT1 Reach 1

Photo Point 78 – J-Hook, UT1 Reach 1

Photo Point 79 – J-Hook/Constructed Riffle, UT1 Reach 1

Photo Point 80 – Step Pool, UT1 Reach 1

Photo Point 81 – Cross Vane, UT1 Reach 1

Photo Point 82 – Step Pool, UT3 End

Photo Point 83 – Step, UT1 End

Photo Point 84 – Step, UT3

Photo Point 85 – Step, UT3

Photo Point 86 – Step Pool, UT3 Begin

Photo Point 87 – Step Pool, UT1 Reach 1

Photo Point 88 – Step Pool, UT2

Photo Point 89 – CrossVane, UT1 Reach 1

Photo Point 90 – Constructed Riffle, UT1 Reach 1

Photo Point 91 – Constructed Riffle, UT1 Reach 1

Photo Point 92 – J-Hook, UT1 Reach 1

Photo Point 93 – Constructed Riffle, UT1 Reach 1

Photo Point 94 – Constructed Riffle, UT1 Reach 1

Photo Point 95 – Step Pool, UT1 Reach 1

Photo Point 96 – Step Pool, UT1 Reach 1

Photo Point 97 – Step Pool, UT1 Reach 1

Photo Point 98 – Cascade, UT1 Begin

Photo Point 99 – Constructed Riffle, UT5 Reach 2 End

Photo Point 100 – Constructed Riffle, UT5 Reach 2

Photo Point 101 – Constructed Riffle, UT5 Reach 2

Photo Point 102 – J-Hook, UT5 Reach 2

Photo Point 103 – Constructed Riffle, UT5 Reach 2

Photo Point 104 – J-Hook, UT5 Reach 2

Photo Point 105 – Constructed Riffle, UT5 Reach 2

Photo Point 106 – Constructed Riffle, UT5 Reach 2

Photo Point 107 – Stream Crossing, UT5 Reach 2

Photo Point 107 – Stream Crossing, UT5 Reach 2

Photo Point 108 – Constructed Riffle, UT5

Photo Point 109 – Step Pool, UT5 Reach 1 End

Photo Point 110 – J-Hook, UT5 Reach 1

Photo Point 111 – Cross Vane, UT5 Reach 1

Photo Point 112 – Cross Vane, UT5 Reach 1

Photo Point 113 – Constructed Riffle, UT5 Reach 1

Photo Point 114 – J-Hook, UT5 Reach 1

Photo Point 115 – Constructed Riffle, UT5 Reach 1

Photo Point 116 – Constructed Riffle, UT5 Reach 1

Photo Point 117 – Constructed Riffle, UT5 Reach 1

Photo Point 118 – Constructed Riffle, UT5 Reach 1

Photo Point 119 – Constructed Riffle, UT5 Reach 1 Begin

Photo Point 120 – Step Pool, UT6 End

Photo Point 121 – Step Pool, UT6

Photo Point 122 – Step Pool, UT6

Photo Point 123 – Step Pool, UT6

Photo Point 124 – Constructed Riffle, UT6

Photo Point 131 – J-Hook, UT6

Photo Point 132 – Constructed Riffle, UT6

Photo Point 133 – Log Step, UT6

Photo Point 134 – Constructed Riffle, UT6

Photo Point 135 – Constructed Riffle, UT6

Photo Point 136 – Log Steps, UT6

Photo Point 137 – Step Pool, UT6

Photo Point 138 – Step Cascade, UT6

Photo Point 139 – Constructed Riffle/Step Pool, UT6

Photo Point 140 – Constructed Riffle, UT6

Photo Point 141 – Constructed Riffle, UT6

Photo Point 142 – Step Pool, UT6

Photo Point 143 – Step Pool, UT6

Photo Point 144 – Steps, UT6 Begin

BEFORE: UT1_R3 stream crossing after storm damage near station 57+00

AFTER: UT1_R3 repaired stream crossing by adding Class I/B stone and installed a grade control J-Hook

BEFORE: Observed right bank erosion and structure failure along UT1_R3 near station 57+75

AFTER: Installed cross vane to increase bed/bank stability and improve habitat

BEFORE: Looking downstream at left bank erosion from January 2010 storm damage

AFTER: Repaired left bank and installed geolift at UT1_R4 near station 74+00, view is downstream

BEFORE: Repaired cross vane piping and right bank erosion along UT5_R1 near station 18+25

AFTER: Cross vane immediately after repair, view is downstream

AFTER: Repaired left bank and installed geolift at UT1_R4 station 67+00, view is upstream

AFTER: Installed geolift, view is upstream immediately after bank repair

Looking at debris line on crest gauge at UT5_R2 after January 2010 storm event

AFTER: Re-shaped riffle along UT1_R4 near station 59+50