UT to TAR RIVER (Louisburg)
FINAL MONITORING REPORT
YEAR 5 OF 5
2010
EEP Project #234
Franklin County, North Carolina

Submitted to:

Ecosystem Enhancement PROGRAM

NCDENR-EEP
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APPENDICIES

MONITORING SUMMARY

The Unnamed Tributary to Tar River Restoration Site is located within the town of Louisburg, Franklin County, North Carolina. The site was constructed between January 2005 and June 2005. The Priority II restoration involved the conversion of 1,792 linear feet of impaired channel into 1,937 linear feet with improved pattern, dimension, and profile. Rock grade control vanes and root wads were incorporated for aquatic habitat enhancement and bed and bank stability. A variable width riparian buffer was planted on either side of the stream with native vegetation in December 2005. This project has the following goals and objectives:

- Provide a stable stream channel that neither aggrades nor degrades while maintaining its dimension, pattern, and profile with the capacity to transport its watershed's water and sediment load.
- Improve water quality and reduce further property loss by stabilizing eroding stream banks.
- Reconnect the stream to its floodplain and/or establish a new floodplain at a lower elevation.
- Improve aquatic habitat with the use of natural material stabilization structures such as root wads, cross-vanes, woody debris, and a riparian buffer.
- Provide aesthetic value, wildlife habitat, and bank stability through the creation of a riparian zone.
- Stabilize and enhance the tributary and small drainage that enters the site.

During 2009, two areas of bare/eroding terrace were observed along the right side (facing downstream) of the project. The first area (Station 14+45) has fully healed. The second area (Station 16+40) continues to remain bare and does not appear to be stabilizing. Dense loblolly pine (*Pinus taeda*) thickets that are growing in the project corridor are a concern because they are suppressing the growth of more ideal late successional species along the middle sections of the project (see Appendix B Vegetation Problem Area Plan Views). The planted stem densities for all the Vegetation Plots (VP), except VP 1, 2 and 6, were below the Monitoring Year 5 goal of 260 stems/acre. Planted stem density across all vegetation plots in Monitoring Year 5 was 147 stems per acre. It should be noted that there were several species for which 'volunteer' individuals were noted in all vegetation plots. With the inclusion of these 'volunteers,' all of the vegetation plots exceed the Monitoring Year 5 stem density goal. Noted volunteer species include: *Alnus serrulata (VP 6), Baccharis halimifolia (VP 1-9), Betula nigra (VP 2, 7), Cephalanthus occidentalis (VP 6), Fraxinus pennsylvanica (VP 4-9), Liquidambar styraciflua (VP 1,2,6-9), Liriodendron tulipifera (VP 6), Myrica cerifera (VP 9), Platanus occidentalis (VP 7,8), Pinus taeda (VP 1-8), Quercus phellos (VP 6), Quercus pagoda (VP 3,5), Quercus spp. (VP 1-3), Prunus caroliniana (VP 1, 2, 6), Prunus serotina (VP 1,2, 4), and Ulmus rubra (VP 1).*

The site is scheduled for supplemental planting in 2011.

Most of the UT to Tar River project reach appears to have remained stable through Monitoring Year 5. Overall, only 1% of the total bank length exhibited bank instability in the form of mass wasting in 2010. However, two previously mentioned sections of bank instability remain as a concern. At the top of the reach, upslope of the left bank, the terrace has experienced mass wasting just downstream of the culvert outlet. This terrace erosion is encroaching on Burnette Road. Also there is a section of mass wasting on the right bank just downstream of here (Station 10+38). In addition, it was found that the culvert outlet pool, that used to exist as the first channel unit along the profile below the culvert at the upstream end of the reach, is completely filled in with sediment and now exists as riffle habitat. Also there is a section of

mass wasting of the left bank that likely lends to excess sedimentation just downstream of the confluence with the stormwater tributary (Station 24+19) that drains the adjacent shopping center. This tributary probably has very flashy flows during storm events due to the high percentage of impervious area within its watershed, and is presumably the main agent contributing to the problems just downstream. The sedimentation and bank instability areas have been noted as concerns since 2007. The sediment contributing to these areas probably came from a combination of an upstream source and isolated sections of bank instability along the project. It appears that the stream pattern remained consistent between the monitoring years. The profile appears to have remained as stable as can be expected for a sand bed stream, with the exception of some apparent deposition within the first 100 feet of channel and the complete filling in of the culvert outlet pool at the head of the reach, turning it into a riffle (see longitudinal profile overlay). A portion of this region of aggradation has scoured and formed a pool. The overall dimension of the stream appears to have remained consistent with minor enlargement in cross sections 4 and 5. The structures appear to be in good physical condition.

Summary information/data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the mitigation and restoration plan documents available on EEPs website. All raw data supporting the tables and figures in the appendices is available from EEP upon request.

METHODOLOGY

Vegetation Methodology

The following methodology was used for the planted woody stem count. The configuration of the vegetation plots was marked out with tape to measure 10 meters by 10 meters (or equivalent to 100 square meters) depending on buffer width. The planted material in the plot was marked with flagging. The targeted vegetation was then identified by species and a tally of each species was kept and recorded in a field book.

Stream Methodology

The project monitoring for the stream channel included a longitudinal survey, cross-sectional surveys, problem area identification, and photo documentation. The specific methodology for each portion of the stream monitoring is described in detail below.

Longitudinal Profile and Plan View

A longitudinal profile was surveyed with a Nikon DTM-520 Total Station, prism, and a TDS Recon Pocket PC. The heads of features (i.e. riffles, runs, pools, and glides) were surveyed, as well as the point of maximum depth of each pool, boundaries of problem areas, and any other significant slope-breaks or points of interest. At the head of each feature and at the maximum pool depth, thalweg, water surface, edge of water, left and right bankfull, and left and right top of bank (if different than bankfull) were surveyed. All profile measurements were extracted from this survey, including channel and valley length and length of each feature, water surface slope for each reach and feature, bankfull slope for the reach, and pool spacing. This survey also was used to draw plan view figures with Microstation v8 (Bentley Systems, Inc., Exton, PA). Stationing was calculated along the thalweg. All pattern measurements (i.e., meander length, radius of curvature, belt width, meander width ratio, and sinuosity) were extracted from the plan view.

Permanent Cross Sections

Five permanent cross sections (three riffles, one pool, and one run) were surveyed. The beginning and end of each permanent cross section were originally marked with a wooden stake and conduit. Cross sections were installed perpendicular to the stream flow. Each cross section survey noted all changes in slopes, tops of both banks (if different from bankfull), left and right bankfull, edges of water, thalweg and water surface. The cross sections were then plotted and Monitoring Year 5 monitoring data was overlain on data from all previous monitoring years. All dimension measurements (i.e., bankfull width, floodprone width, bankfull mean depth, cross sectional area, width-to-depth ratio, entrenchment ratio, bank height ratio, wetted perimeter, and hydraulic radius) were extracted from these plots and compared to all previous monitoring data.

Pebble Counts

Based on the fact that UT Tar River is a sand bed stream, it was determined that pebble counts were unnecessary as they would fail to detect changes in the amounts of fine sediments in the bed load. Therefore, pebble counts were not performed for Monitoring Year 5.

Photo Documentation

Permanent photo points were established during Monitoring Year 1. Two photographs (facing upstream and facing downstream) were taken at each photo point with a digital camera. A set of three photographs were taken at each cross-section (facing upstream, facing downstream, and facing the channel). A representative photograph of each vegetation plot was taken at the designated corner of the vegetation

plot and in the same direction as the Monitoring Year 1 photograph. Photos were also taken of all significant stream and vegetation problem areas.

REFERENCES

Earth Tech. January 2007. Unnamed Tributary to Tar River Stream Restoration Louisburg, Franklin County, North Carolina Year 1 Monitoring Report.

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Harman, W.H., et al. 1999. Bankfull Hydraulic Geometry Relationships for North Carolina Streams. AWRA Wildland Hydrology Symposium Proceedings. Edited by D.S. Olson and J.P. Potyondy. AWRA Summer Synposium. Bozeman, MT.

North Carolina Ecosystem Enhancement Program. September 2005. Content, Format and Data Requirements for EEP Monitoring Reports.

Rosgen, D.L. 1994. A Classification of Natural River. Catena, Volume 22: 166-169, Elsevier Science, B.V. Amsterdam.

SEPI Engineering Group. 2007. UT to Tar River Final Monitoring Report, Year 2 of 5.

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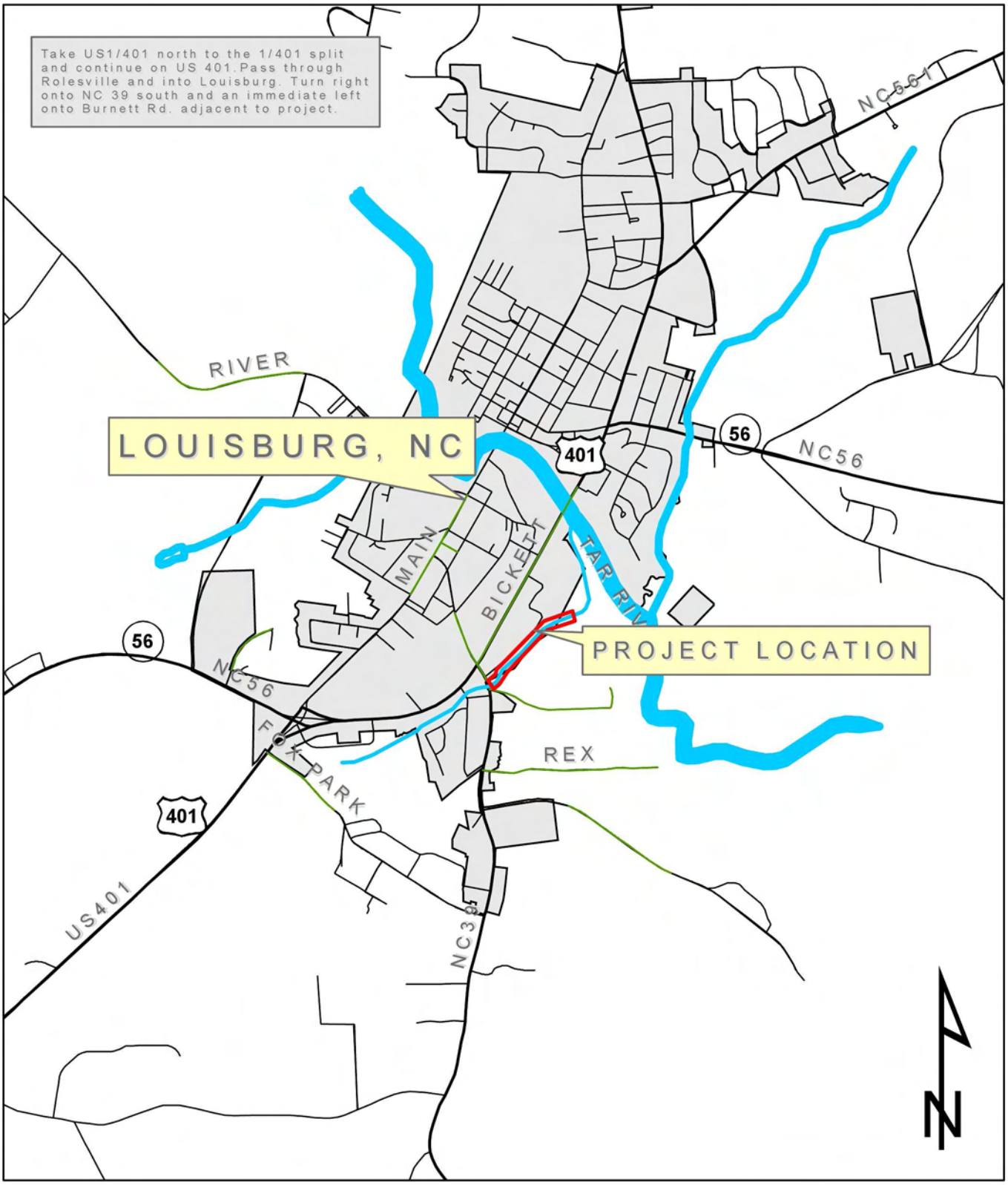
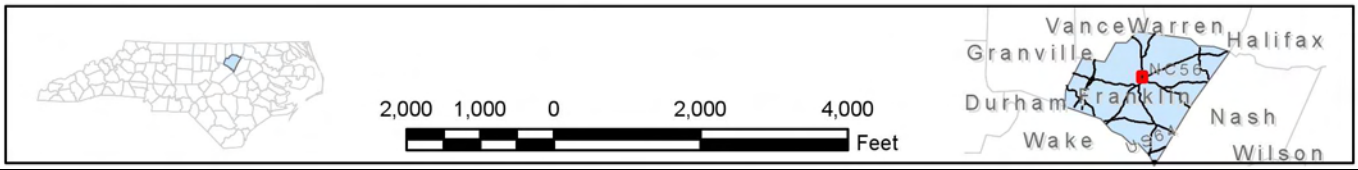
SEPI Engineering Group. 2009. UT to Tar River Final Monitoring Report, Year 4 of 5.

U.S. Department of Army, Corps of Engineers. 2003. Stream Mitigation Guidelines. http://www.saw.usace.army.mil/wetlands/Mitigation/stream_mitigation.html

Appendix A

Project Vicinity Map and Background Files





SEPI	Ecosystem Enhancement	Project: Ut Tar River (EEP #234) Year 5 (2010) Monitoring, Franklin County, North Carolina
		April 2011
		Figure 1. Project Location Map

Table 1. Project Restoration Components UT Tar River Stream Mitigation Site/Project No. 234							
Project Segment or Reach ID	**Pre-Existing Footage**	**Type**	**Approach**	**As-Built Footage**	**As-Built Stationing**	**Monitoring Year 4 Stationing**	**Comments**
UT to Tar River	1,792	Restoration	P II	1,937.13	10+00 – 29+37.13	10+00 – 29+90.65	

Table 2. Project Activity and Reporting History UT to Tar River/EEP Project No. 234			
Activity or Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion Date**
Restoration Plan	NA	NA	June 2003
Final Design - 90%	NA	NA	Unknown
Construction	NA	NA	7/26/2005
Temporary S&E and Permanent seed mix applied	NA	NA	Throughout Construction
Containerized, B&B, livestake planting	NA	NA	12/22/2005
Mitigation Plan / As-built (Year 0 Monitoring - baseline)	April 2006	April 2006	May 2006
Year 1 Monitoring	Fall 2006	January 2007	January 2007
Year 2 Monitoring	Fall 2007	September 2007	December 2007
Year 3 Monitoring	Fall 2008	October 2008	November 15, 2008
Year 4 Monitoring	Fall 2009	October 2009	November 15, 2009
Year 5 Monitoring	Fall 2010	October 2010	November 20, 2010

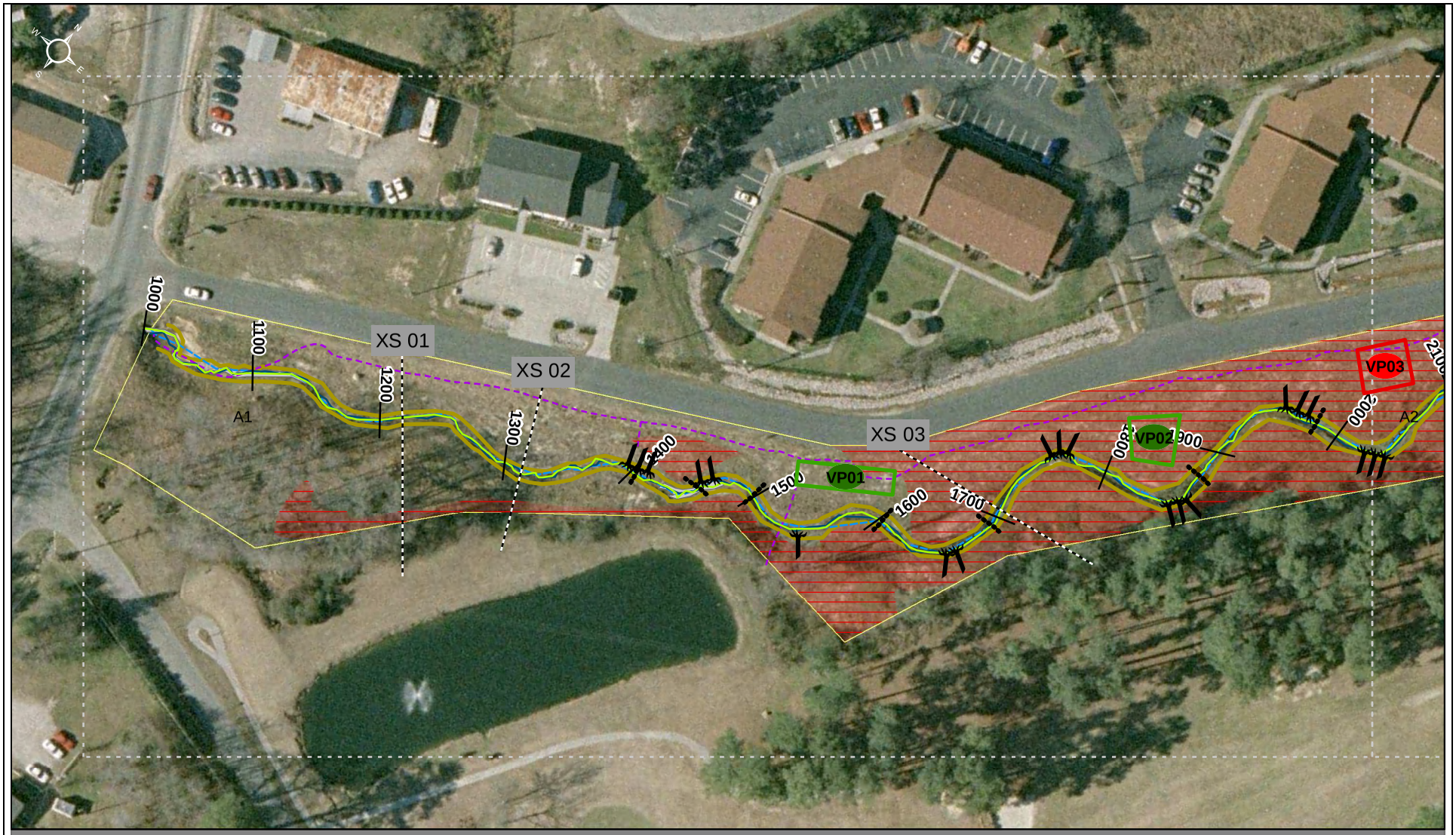
Table 3. Project Contact Table UT to Tar River/EEP Project No. 234	
Designer	Earth Tech 701 Corporate Center Drive Suite 475 Raleigh, NC 27607
Construction Contractor	McQueen Construction 619 Patrick Road Bahama, NC 27503
Planting Contractor	Carolina Environmental Contracting, Inc. P.O. Box 1905 Mount Airy, NC 27030
Seeding Contractor	Erosion Control Solutions 5508 Peakton Dr. Raleigh, NC 27614
2006 Monitoring Performers	Earth Tech 701 Corporation Center Drive, Suite 475 Raleigh, NC 27607
2007-2010 Monitoring Performer	SEPI Engineering Group 1025 Wade Avenue Raleigh, NC 27605 Phillip Todd (919) 789-9977
Stream Monitoring POC	Andy Kiley (919) 573-9914
Vegetation Monitoring POC	Phil Beach (919) 573-9936
Wetland Monitoring POC	N/A

Table 4. Project Background Table UT to Tar River /EEP Project No. 234	
Project County	Franklin County, NC
Drainage Area	0.61 square miles
Drainage impervious cover estimate (%)	> 30 %
Stream Order	1st order
Physiographic Region	Piedmont
Ecoregion	Northern Outer Piedmont
Rosgen Classification of As-Built	C
Cowardin Classification	NA
Dominant Soil Types	Chewacla and Wehadkee loam; Wedowee-Urbanland_Udorthents complex
Reference site ID	C5 UT Lake Lynn (Wake), C4 UT Hare Snipe Creek (Wake)
USGS HUC for Project	03020101
USGS HUC for References	03020201
NCDWQ Sub-basin for Project	03-03-01
NCDWQ Sub-basin for References	03-04-02
NCDWQ Classification for Project	Not Assigned
NCDWQ Classification for Reference	UT Lake Lynn: B-NSW; UT Hare Snipe Creek: C-NSW
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	<5
% of project easement demarcated with bollards (if fencing absent)	0

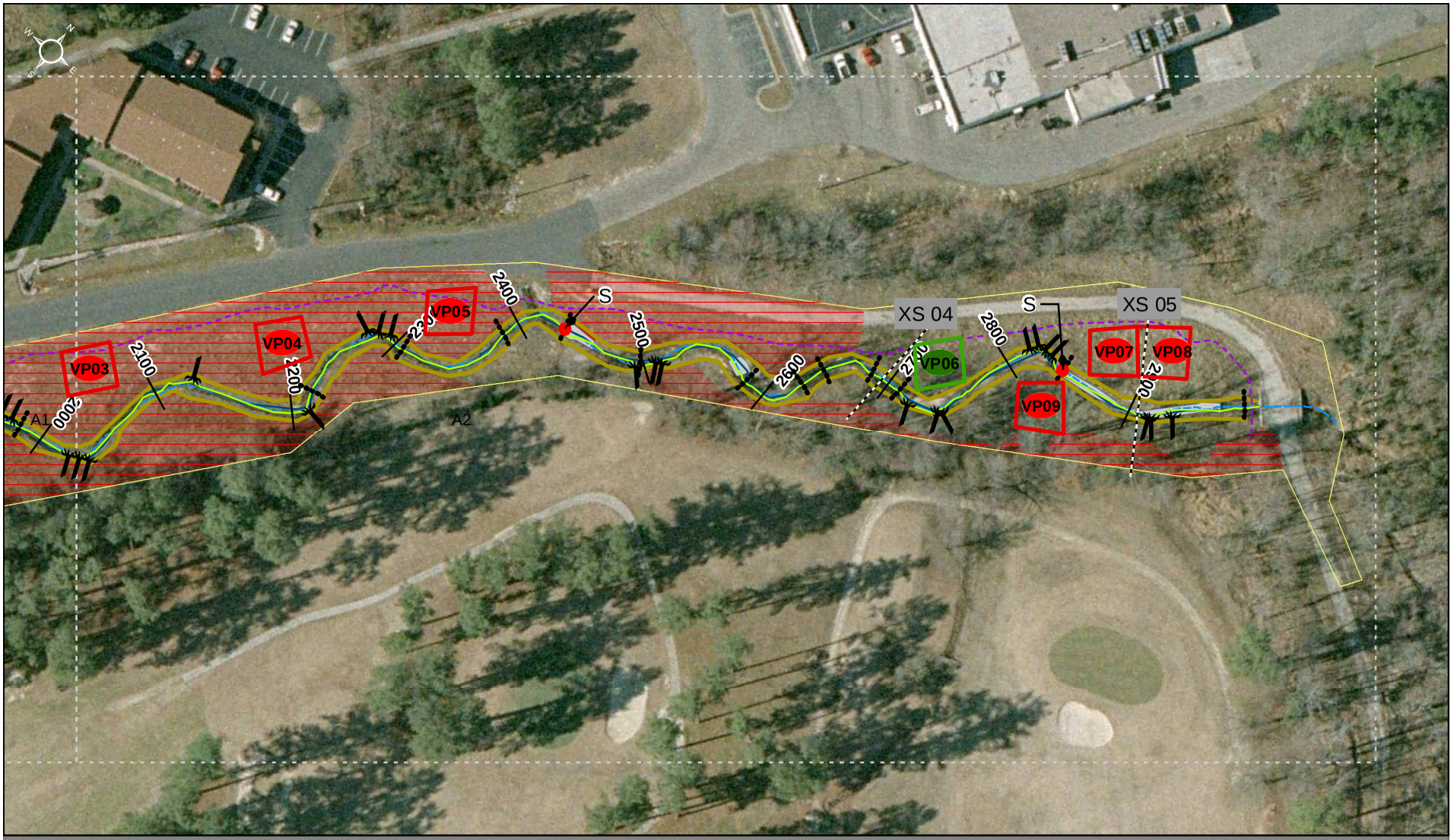
Appendix B

Visual Assessment Data

	Project: Ut Tar River (EEP #234) Year 5 (2010) Monitoring, Franklin County, North Carolina
	April 2011
	Figure 2a: CCPV Index Sheet (Aerials 2007 Franklin County)



Project: Ut Tar River (EEP #234) Year 5 (2010) Monitoring, Franklin County, North Carolina	
April 2011	
Figure 2b: CCPV Sheet 1 (Aerials 2007 Franklin County)	



SEPI	Ecosystem Enhancement	Project: Ut Tar River (EEP #234) Year 5 (2010) Monitoring, Franklin County, North Carolina
		April 2011
		Figure 2c: CCPV Sheet 2 (Aerials 2007 Franklin County)

Table 5 **Visual Stream Morphology Stability Assessment**
Reach ID **Ut Tar River**
Assessed Length **1,960**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			8	343	83%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	12	19			63%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	28	32			88%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	11	32			34%			
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	13	13			100%			
		2. Thalweg centering at downstream of meander (Glide)	13	14			93%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			2	40	99%	2	40	100%
				Totals	2	40	99%	2	40	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	22	24			92%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	24	24			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	24	24			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	24	24			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	24	24			100%			

Table 6 Vegetation Condition Assessment

Planted Acreage[1] **4.1**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres		0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres		0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres		0	0.00	0.0%
			Cumulative Total	0	0.00	0.0%

Easement Acreage[2] **4.1**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern[4]	Areas or points (if too small to render as polygons at map scale).	1000 SF		7	1.80	43.8%
5. Easement Encroachment Areas[3]	Areas or points (if too small to render as polygons at map scale).	none		0	0.00	0.0%

Cross-Section 1: View Upstream (11-10-2010)

Cross-Section 2: View Upstream (11-10-2010)

Cross-Section 1: View Downstream (11-10-2010)

Cross-Section 2: View Downstream (11-10-2010)

Cross-Section 1: Facing Stream (11-10-2010)

Cross-Section 2: Facing Stream (11-10-2010)

Cross-Section 3: View Upstream (11-10-2010)

Cross-Section 4: View Upstream (11-10-2010)

Cross-Section 3: View Downstream (11-10-2010)

Cross-Section 4: View Downstream (11-10-2010)

Cross-Section 3: Facing Stream (11-10-2010)

Cross-Section 4: Facing Stream (11-10-2010)

Cross-Section 5: View Upstream (11-10-2010)

Photo Point 1: View Downstream (11-10-2010)

Cross-Section 5: View Downstream (11-10-2010)

Photo Point 2: View Upstream (11-10-2010)

Cross-Section 5: Facing Stream (11-10-2010)

Photo Point 2: View Downstream (11-10-2010)

Photo Point 3: View Upstream (11-10-2010)

Photo Point 3: View Downstream (11-10-2010)

Photo Point 4: View Upstream (11-10-2010)

Photo Point 4: View Downstream (11-10-2010)

Photo Point 5: View Upstream (11-10-2010)

Photo Point 5: View Downstream (11-10-2010)

Photo Point 6: View Upstream (11-10-2010)

Photo Point 6: View Downstream (11-10-2010)

Photo Point 7: View Upstream (11-10-2010)

Photo Point 7: View Downstream (11-10-2010)

Photo Point 8: View Upstream (11-10-2010)

Photo Point 8: View Downstream (11-10-2010)

Photo Point 9: View Upstream (11-10-2010)

Photo Point 9: View Downstream (11-10-2010)

Photo Point 10: View Upstream (11-10-2010)

Photo Point 10: View Downstream (11-10-2010)

Photo Point 11: View Upstream (11-10-2010)

Photo Point 11: View Downstream (11-10-2010)

Photo Point 12: View Upstream (11-10-2010)

Photo Point 12: View Downstream (11-10-2010)

Photo Point 13: View Upstream (11-10-2010)

Photo Point 13: View Downstream (11-10-2010)

Photo Point 14: View Upstream (11-10-2010)

Photo Point 14: View Downstream (11-10-2010)

Photo 1: Vegetation Plot 1 (9-8-2010)

Photo 2: Vegetation Plot 2 (9-8-2010)

Photo 3: Vegetation Plot 3 (9-8-2010)

Photo 4: Vegetation Plot 4 (9-8-2010)

Photo 5: Vegetation Plot 5 (9-8-2010)

Photo 6: Vegetation Plot 6 (9-8-2010)

	
Photo 7: Vegetation Plot 7 (9-8-2010)	Photo 8: Vegetation Plot 8 (9-8-2010)
	
Photo 9: Vegetation Plot 9 (9-8-2010)	

Appendix C
Vegetation Plot Data

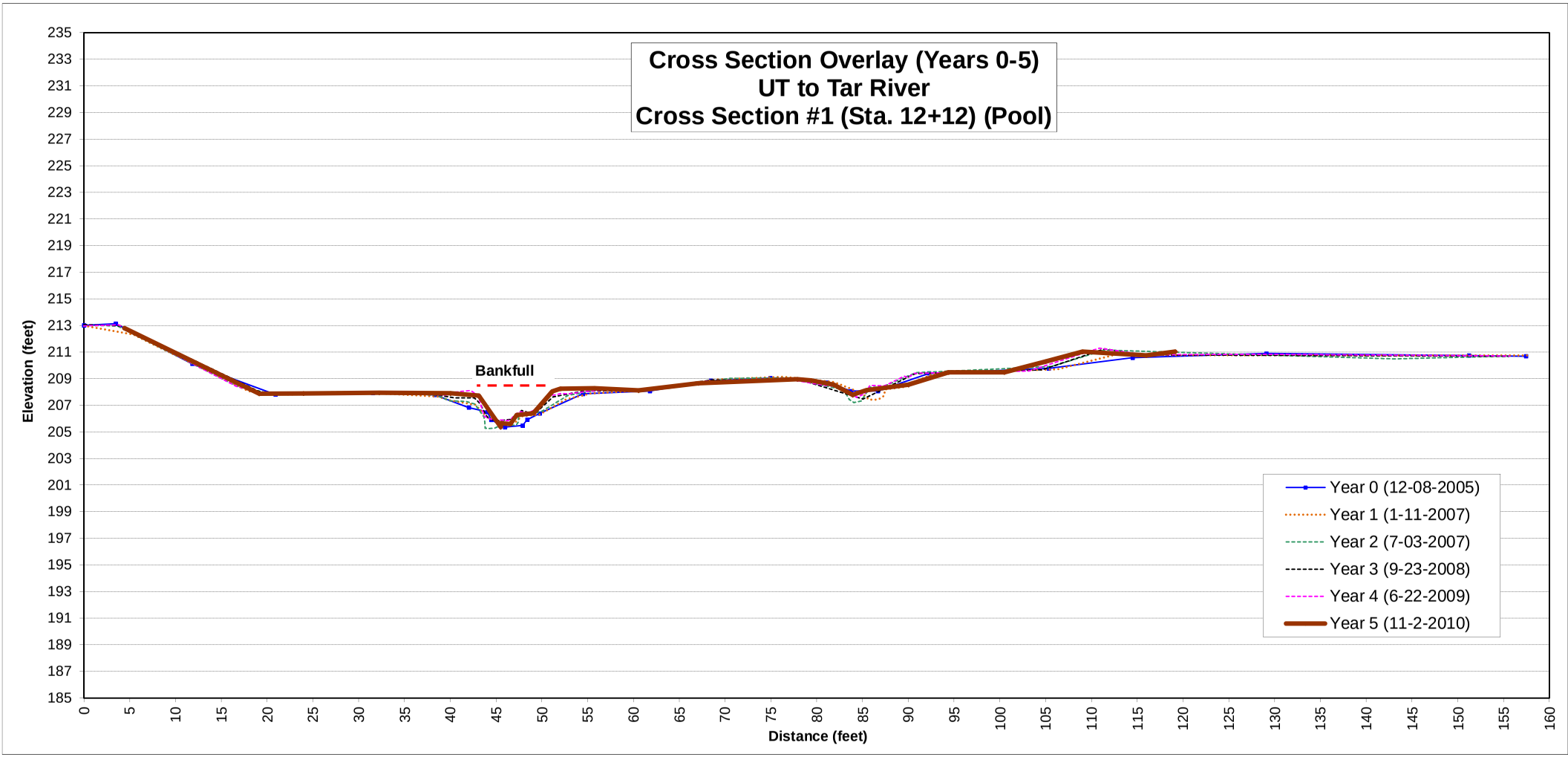
Table 7. Stem counts for each species arranged by plot for UT Tar River

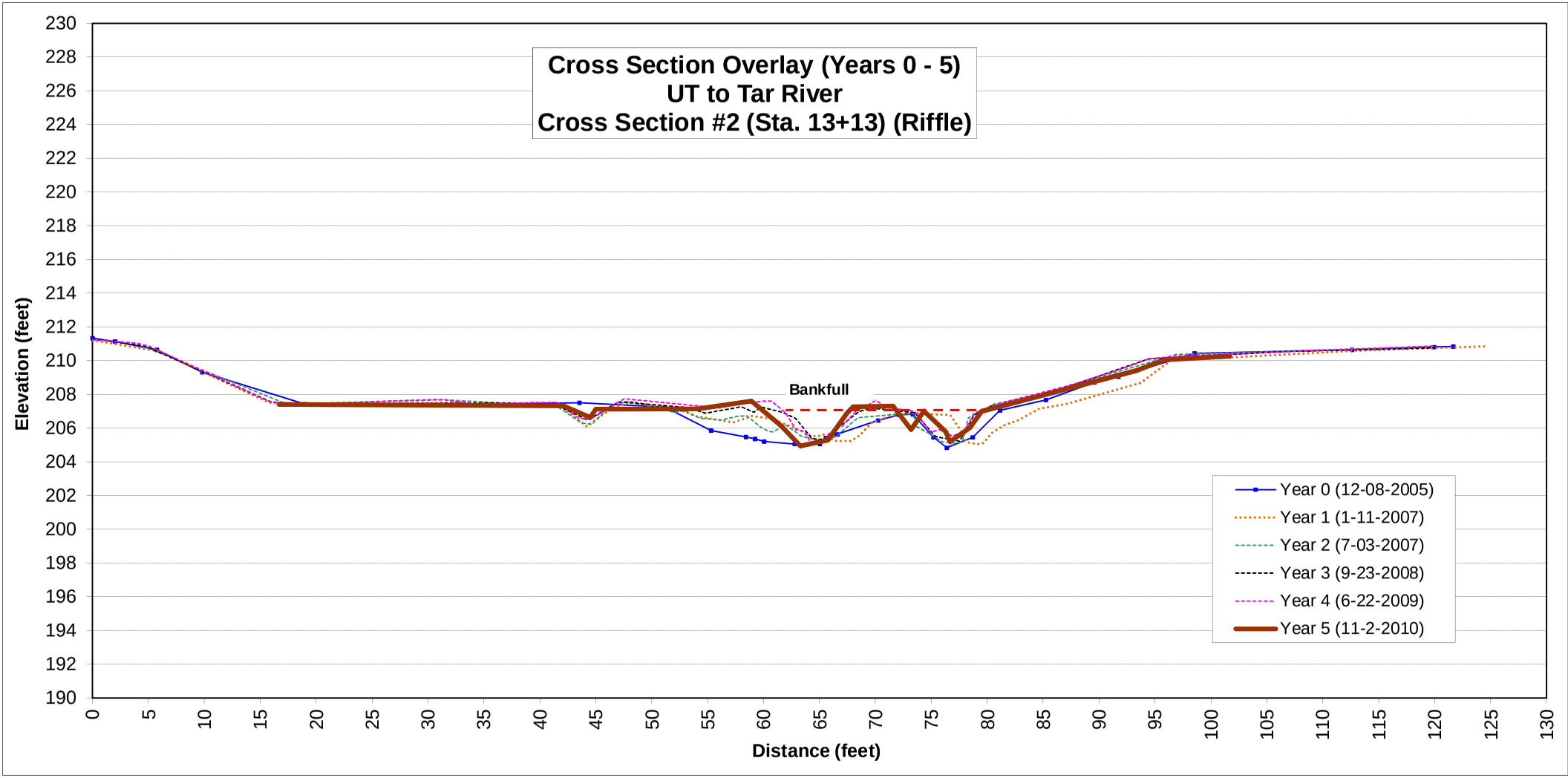
Species	Plots									Initial Totals	Year 1 Totals	Year 2 Totals	Year 3 Totals	Year 4 Totals	Year 5 Totals	Survival %
	1	2	3	4	5	6	7	8	9							
Shrubs																
Myrica cerifera	1					1				5	2	2	1	0	2	40.0%
Alnus serrulata										3	3	0	0	0	0	0.0%
Sambucus canadensis										2	1	0	0	0	0	0.0%
Clematis virginiana										4	0	0	0	0	0	0.0%
Viburnum nudum			1			1				5	1	0	0	0	2	40.0%
Trees																
Fraxinus pennsylvanica	2				1	1	1	1		7	8	8	8	8	6	85.7%
Betula nigra	2	4				1			1	17	11	8	6	6	8	47.1%
Quercus phellos	2	1				1				8	4	3	3	3	4	50.0%
Quercus pagoda						1	1		1	10	6	5	5	3	3	30.0%
Quercus nigra	1								1	8	6	1	1	1	2	25.0%
Nyssa sylvatica										13	5	0	0	0	0	0.0%
Platanus occidentalis	1	2				1			2	9	9	5	5	5	6	66.7%
Celtis laevigata										10	1	1	1	1	0	0.0%
Total per plot	9	7	1	0	1	7	2	1	5	101	57	33	37	27	33	26.7%
Stems per acre	360	280	40	0	40	280	80	40	200	466	263	189	189	120.0	146.7	

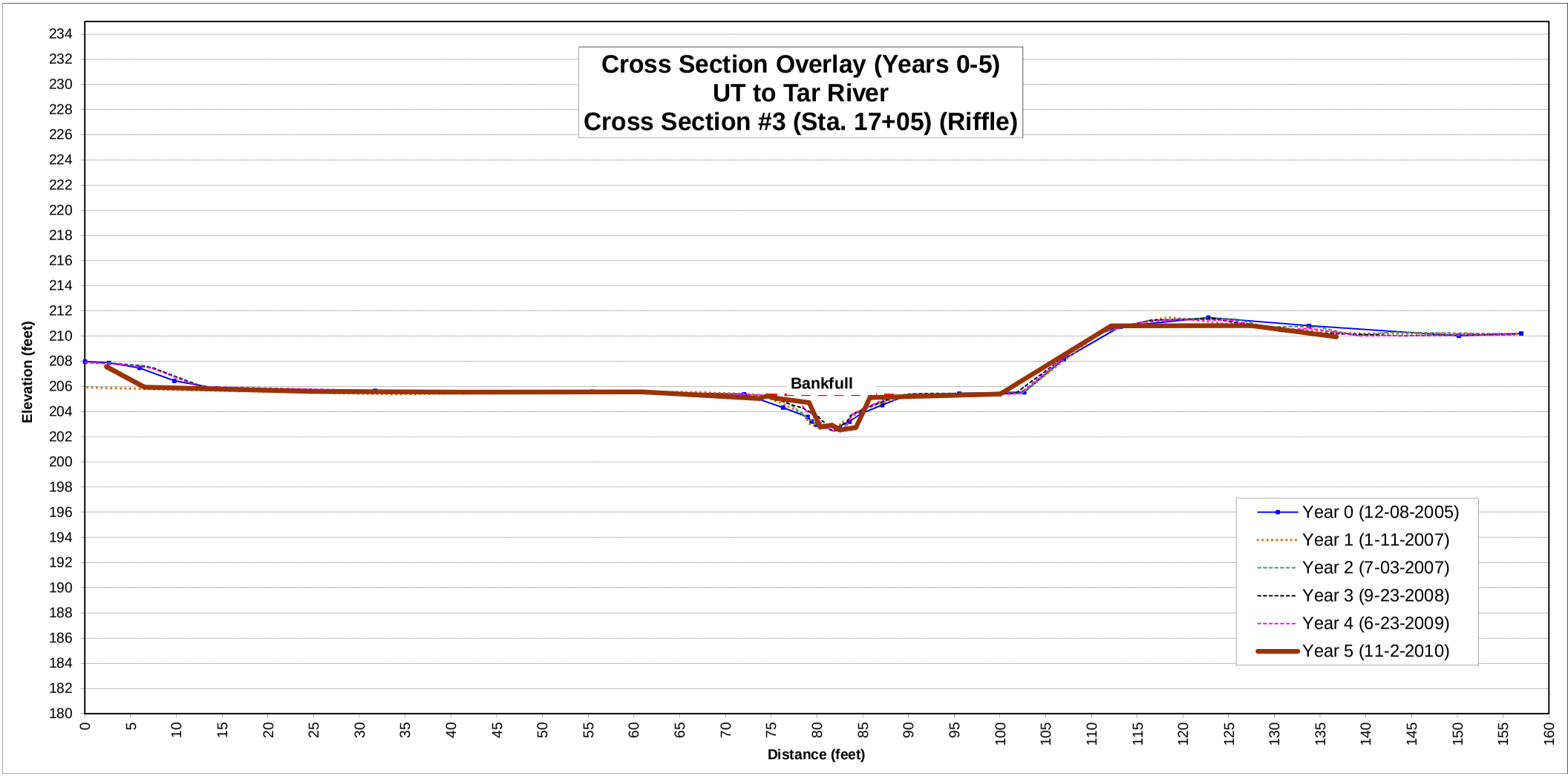
**Volunteers of the following species, not initially recorded as planted, were counted: Alnus serrulata (VP 6), Baccharis halimifolia (VP 1-9), Betula nigra (VP 2, 7), Cephalanthus occidentalis (VP 6), Fraxinus pennsylvanica (VP 4-9), Liquidambar styraciflua (VP 1,2,6-9), Liriodendron tulipifera (VP 6), Myrica cerifera (VP 9), Platanus occidentalis (VP 7,8), Pinus taeda (VP 1-8), Quercus phellos (VP 6), Quercus pagoda (VP 3,5), Quercus spp. (VP 1-3), Prunus caroliniana (VP 1, 2, 6), Prunus serotina (VP 1,2, 4), and Ulmus rubra (VP 1).*

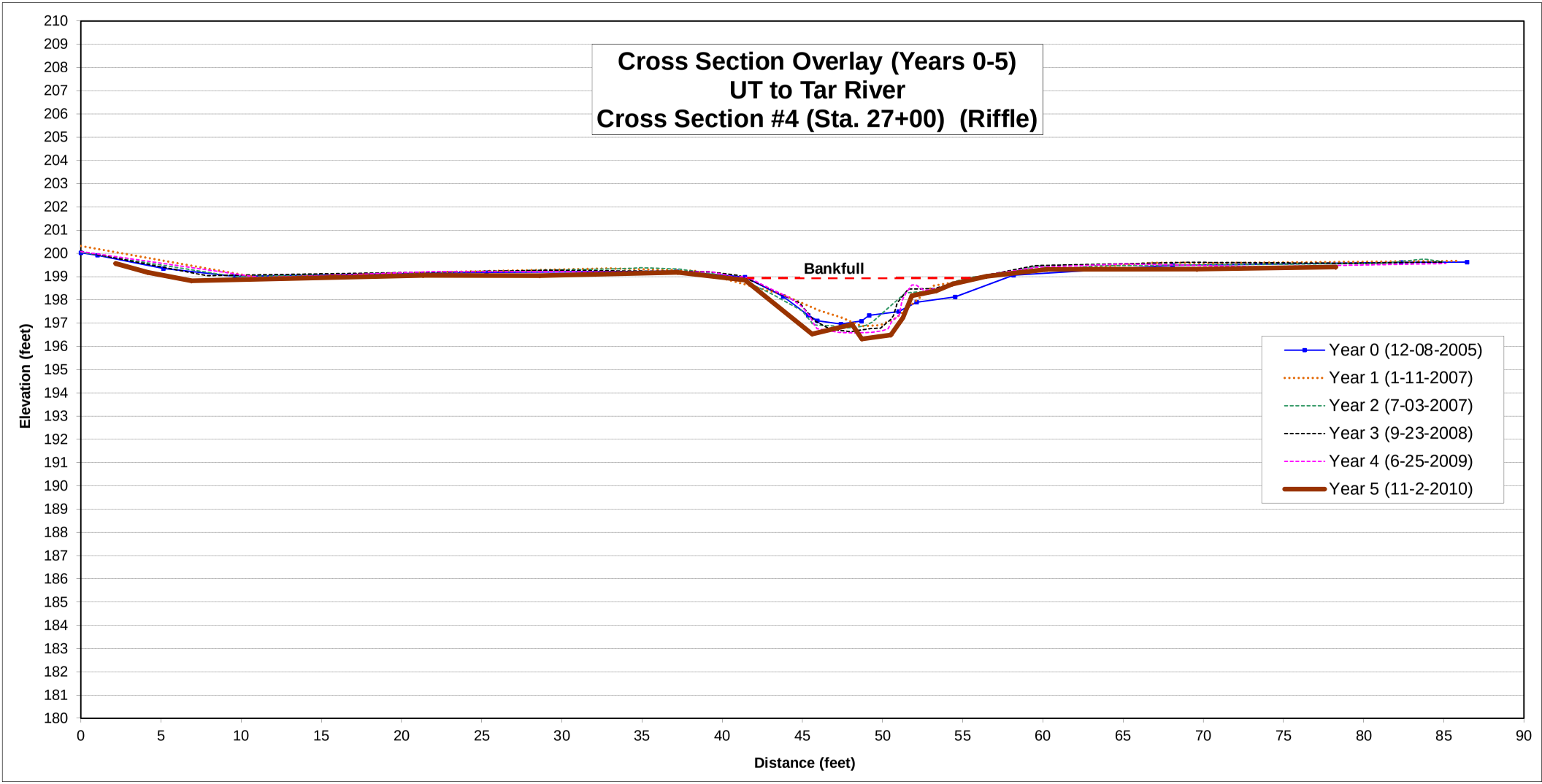
**Fraxinus pennsylvanica, Liquidambar styraciflua,* and *Baccharis halimifolia* were too numerous to count in VP 7 and 8. *Pinus taeda* were too numerous to count in VP 2, 3, and 5.

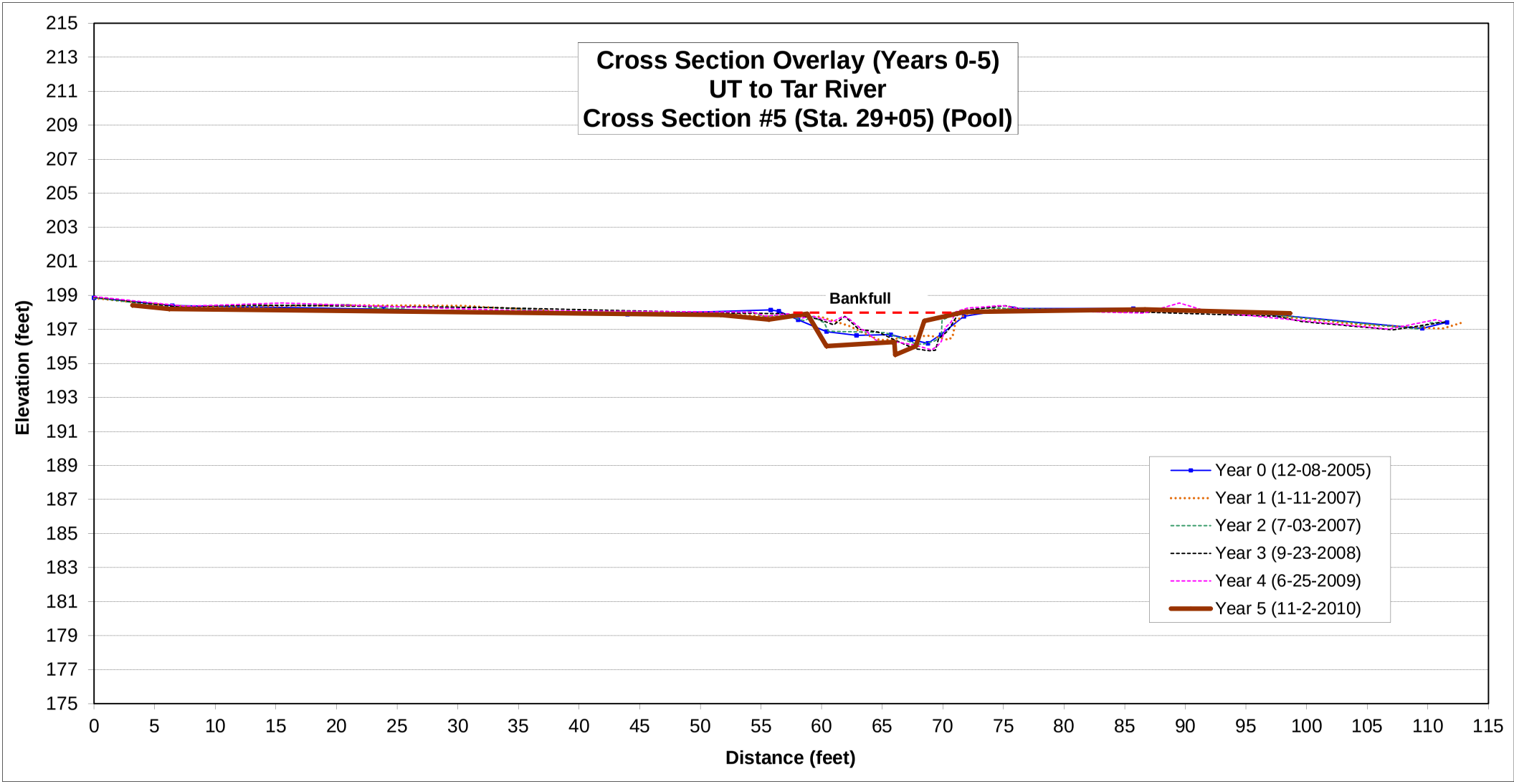
Appendix D
Stream Survey Data

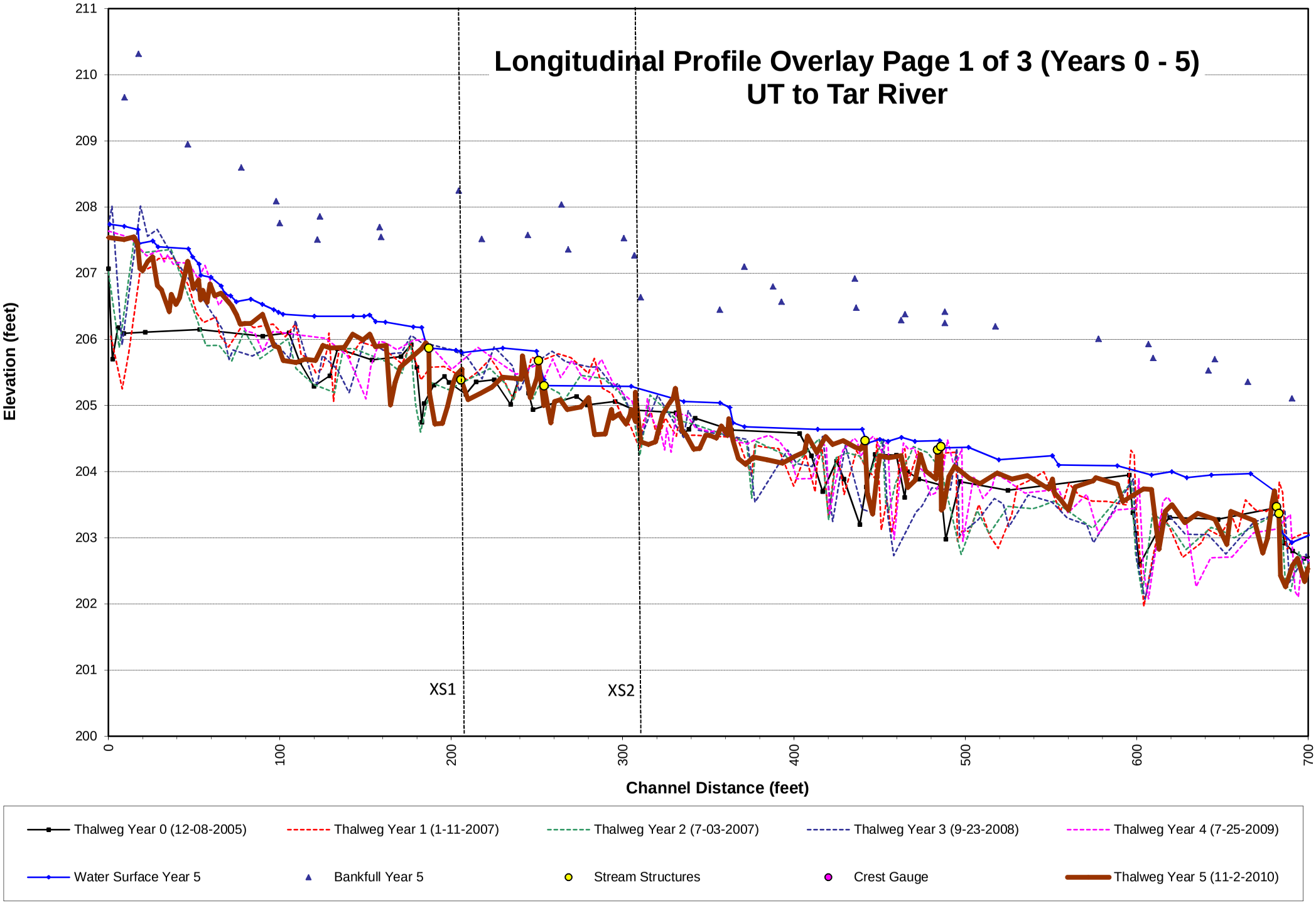

Cross Section Overlay (Years 0-5)
UT to Tar River
Cross Section #1 (Sta. 12+12) (Pool)
Bankfull
Elevation (feet)
Distance (feet)
Year 0 (12-08-2005)
Year 1 (1-11-2007)
Year 2 (7-03-2007)
Year 3 (9-23-2008)
Year 4 (6-22-2009)
Year 5 (11-2-2010)

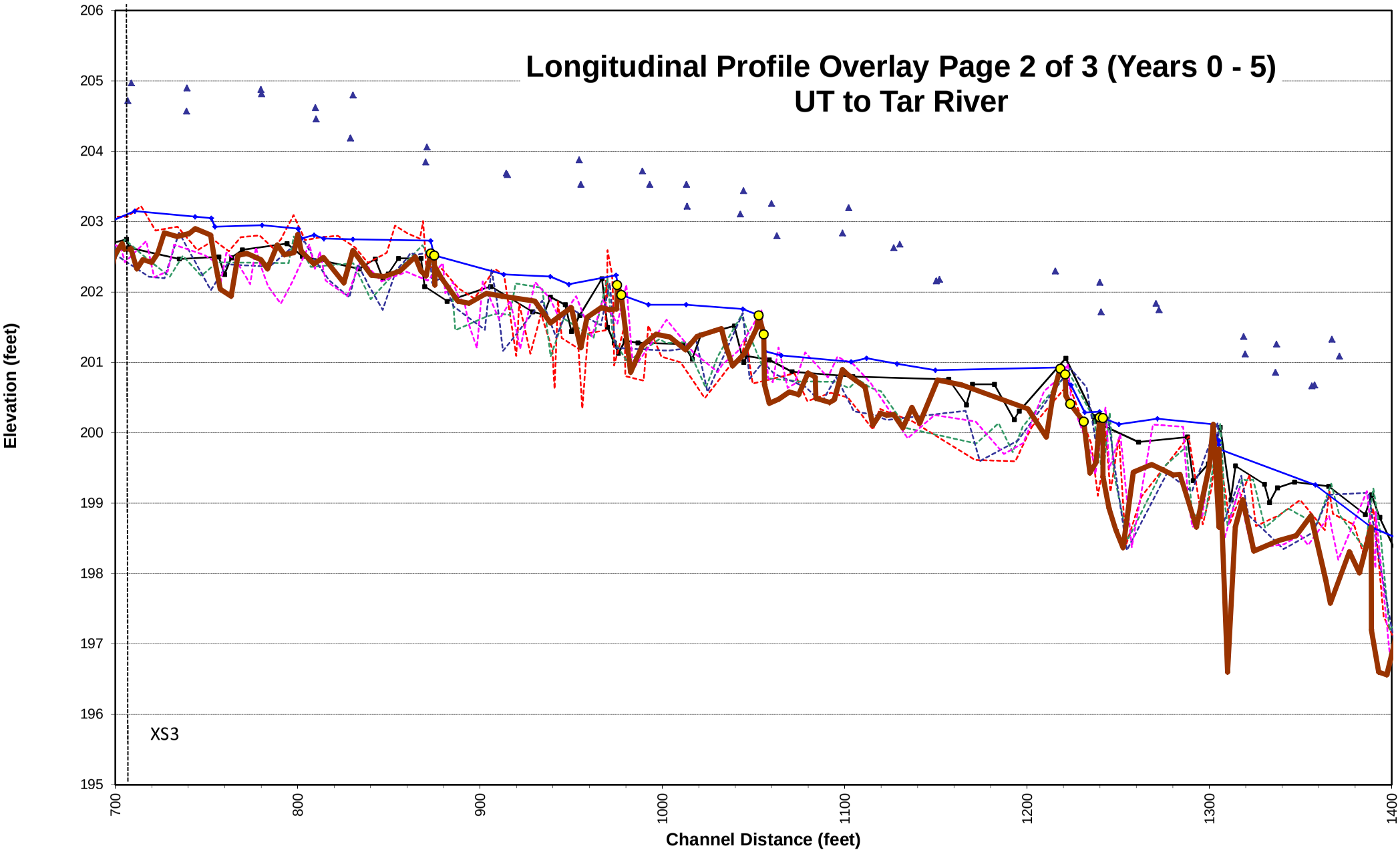

Cross Section Overlay (Years 0 - 5)
UT to Tar River
Cross Section #2 (Sta. 13+13) (Riffle)
Bankfull
Elevation (feet)
Distance (feet)
230
228
226
224
222
220
218
216
214
212
210
208
206
204
202
200
198
196
194
192
190
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125
130
Year 0 (12-08-2005)
Year 1 (1-11-2007)
Year 2 (7-03-2007)
Year 3 (9-23-2008)
Year 4 (6-22-2009)
Year 5 (11-2-2010)

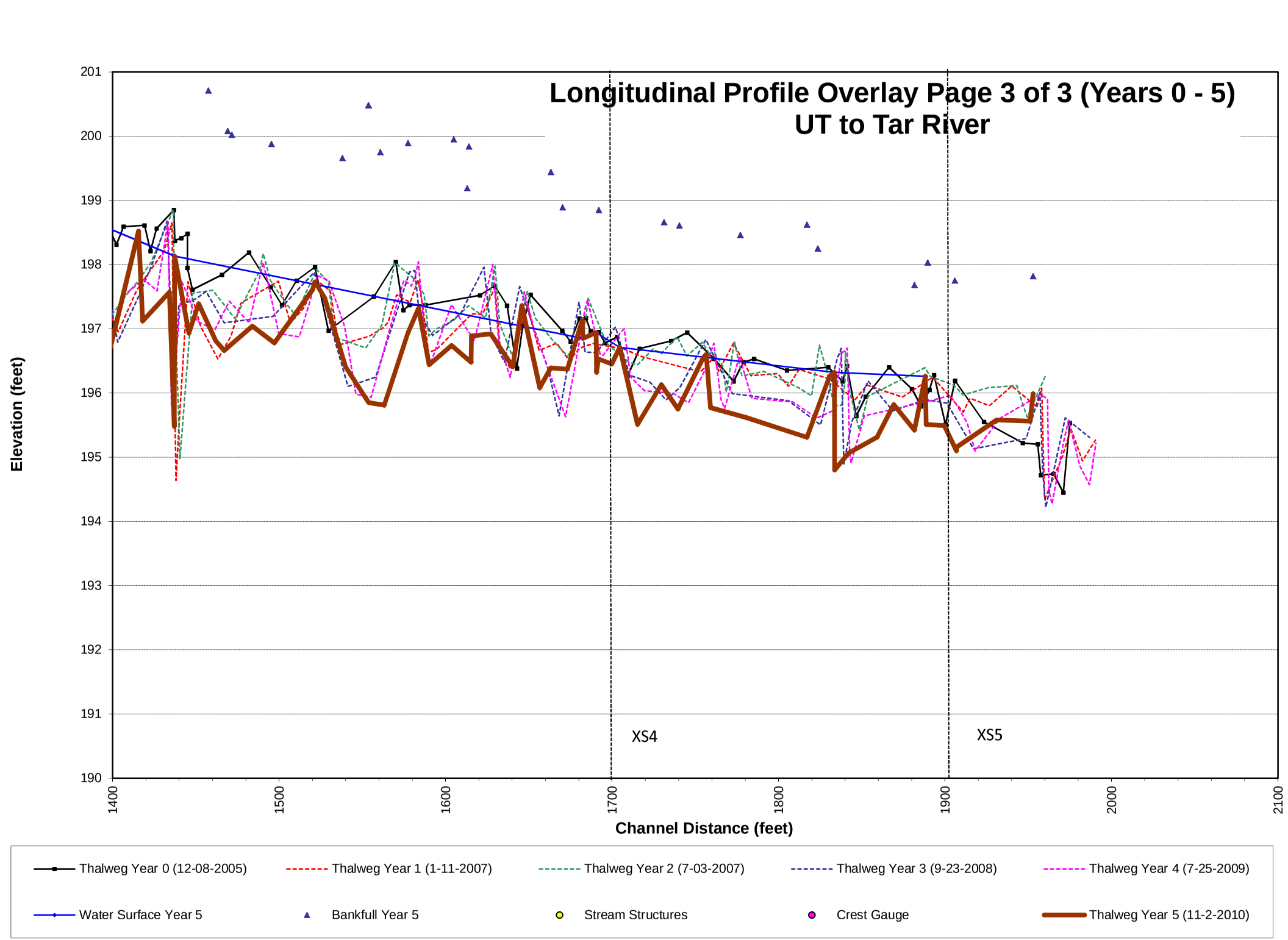

Cross Section Overlay (Years 0-5)
UT to Tar River
Cross Section #3 (Sta. 17+05) (Riffle)
Bankfull
Elevation (feet)
Distance (feet)
Year 0 (12-08-2005)
Year 1 (1-11-2007)
Year 2 (7-03-2007)
Year 3 (9-23-2008)
Year 4 (6-23-2009)
Year 5 (11-2-2010)


Cross Section Overlay (Years 0-5)
UT to Tar River
Cross Section #4 (Sta. 27+00) (Riffle)
Bankfull
Elevation (feet)
Distance (feet)
Year 0 (12-08-2005)
Year 1 (1-11-2007)
Year 2 (7-03-2007)
Year 3 (9-23-2008)
Year 4 (6-25-2009)
Year 5 (11-2-2010)


Cross Section Overlay (Years 0-5)
UT to Tar River
Cross Section #5 (Sta. 29+05) (Pool)
Bankfull
Elevation (feet)
Distance (feet)
215
213
211
209
207
205
203
201
199
197
195
193
191
189
187
185
183
181
179
177
175
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
Year 0 (12-08-2005)
Year 1 (1-11-2007)
Year 2 (7-03-2007)
Year 3 (9-23-2008)
Year 4 (6-25-2009)
Year 5 (11-2-2010)


Longitudinal Profile Overlay Page 1 of 3 (Years 0 - 5)
UT to Tar River
Elevation (feet)
211
210
209
208
207
206
205
204
203
202
201
200
0
100
200
300
400
500
600
700
Channel Distance (feet)
XS1
XS2
Thalweg Year 0 (12-08-2005)
Thalweg Year 1 (1-11-2007)
Thalweg Year 2 (7-03-2007)
Thalweg Year 3 (9-23-2008)
Thalweg Year 4 (7-25-2009)
Water Surface Year 5
Bankfull Year 5
Stream Structures
Crest Gauge
Thalweg Year 5 (11-2-2010)


Longitudinal Profile Overlay Page 2 of 3 (Years 0 - 5)
UT to Tar River
Elevation (feet)
206
205
204
203
202
201
200
199
198
197
196
195
XS3
700
800
900
1000
1100
1200
1300
1400
Channel Distance (feet)
Thalweg Year 0 (12-08-2005)
Thalweg Year 1 (1-11-2007)
Thalweg Year 2 (7-03-2007)
Thalweg Year 3 (9-23-2008)
Thalweg Year 4 (7-25-2009)
Water Surface Year 5
Bankfull Year 5
Stream Structures
Crest Gauge
Thalweg Year 5 (11-2-2010)


Longitudinal Profile Overlay Page 3 of 3 (Years 0 - 5)
UT to Tar River
Elevation (feet)
201
200
199
198
197
196
195
194
193
192
191
190
1400
1500
1600
1700
1800
1900
2000
2100
Channel Distance (feet)
XS4
XS5
Thalweg Year 0 (12-08-2005)
Thalweg Year 1 (1-11-2007)
Thalweg Year 2 (7-03-2007)
Thalweg Year 3 (9-23-2008)
Thalweg Year 4 (7-25-2009)
Water Surface Year 5
Bankfull Year 5
Stream Structures
Crest Gauge
Thalweg Year 5 (11-2-2010)

Pebble counts were not performed for UT Tar River during Monitoring Year 5 because it is a sand bed stream and the counts would not successfully detect changes in the amounts of fine sediments in the channel bed.

Table 8. Baseline Morphologyand Hydraulic Summary
UT Tar River/EEP Number 234

Parameter	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Reference Stream			Design (SR#1)			As-built (SR#1)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Dimension																		
BF Width (ft)				5.5	21.0	11.30	10.20	13.80		10.00	19.10				18.00	17.60	25.20	20.50
Floodprone Width (ft)																		
BFCross Sectional Area (ft)				6.2	28.0	15.30	20.80	28.10		5.50	23.40				24.50	19.80	35.10	23.30
BF Mean Depth (ft)				0.8	2.1	1.40			2.00	0.55	1.22				1.38	1.00	1.40	1.25
Max Depth (ft)							2.80	3.30		1.00	2.26				2.20	2.00	2.70	2.35
Width/Depth Ratio							5.00	6.80		10.30	20.60				13.20	13.00	20.20	18.70
Entrenchment Ratio							3.90	4.00		1.90	6.60				2.20	2.40	5.00	3.40
Wetted Perimeter (ft)																20.30	28.00	22.60
Hydraulic radius (ft)																0.90	1.30	1.08
Pattern																		
Channel Beltwidth (ft)							8.00	30.00		17.00	41.00		23.00	58.00		29.00	66.00	43.00
Radius of Curvature (ft)							10.00	60.00		12.00	81.00		36.00	72.00		28.00	58.00	34.50
Meander Wavelenght (ft)							265.00	470.00		42.00	59.00		59.00	84.00		80.00	165.00	121.00
Meander Width Ratio							0.70	2.50		1.30	3.20		1.30	3.20		1.64	2.61	2.20
Profile																		
Riffle length (ft)							14.00	316.00	83.00							1.50	51.70	13.10
Riffle slope (ft/ft)							0.002	0.017	0.012	0.009	0.075		0.009	0.033		0.000	0.040	0.010
Pool length (ft)							10.00	102.00	42.00							3.30	20.70	9.80
Pool spacing (ft)							33.00	379.00	226.00	32.00	75.00		32.00	75.00		13.60	158.30	57.93
Substrate																		
d50 (mm)							0.50	1.00		0.25	0.50					0.06	0.25	
d84 (mm)							5.70	8.00		11.30	16.00					0.25	0.50	
Additional Reach Parameters																		
Valley Length (ft)									1662.00									1662.00
Channel Length (ft)									1792.00									1937.00
Sinuosity									1.07	1.25	1.70				1.25			1.17
Water Surface Slope (ft/ft)									0.01	0.01	0.02				0.00			0.01
BF slope (ft/ft)									0.01									0.01
Rosgen Classification									E5	C4	C5				C5			
*Habitat Index																		
*Macrobenthos																		

Table 9. Morphology and Hydraulic Monitoring Summary
UT Tar River
Segment/Reach: 1

Parameter	Cross Section 1 Pool						Cross Section 2 Riffle						Cross Section 3 Riffle						Cross Section 4 Riffle						Cross Section 5 Pool					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	22.9	13.0	14.8	12.5	7.8	7.6	25.2	31.3	26.6	19.3	18.5	15.8	17.6	17.7	14.9	19.3	15.7	20.7	21.0	11.5	14.2	14.1	13.7	15.6	20.0	15.7	16.2	13.9	13.9	18.9
Floodporne Width (ft)	N/A	77.6	N/A	N/A	N/A	N/A	91.0	83.1	87.0	77.5	79.5	79.5	100+	128.1	103+	106.5+	106.2+	106.2+	90.0	85.9	85+	85+	85+	85+	>100	112.8	110+	N/A	N/A	N/A
BFCross Sectional Area (ft)	21.7	11.8	16.0	11.2	9.9	9.8	35.1	23.9	23.7	13.6	13.3	16.3	23.7	20.5	18.7	16.9	16.5	16.3	22.9	10.9	15.6	15.7	16.6	20.5	19.8	10.8	13.2	13.3	13.3	17.3
BF Mean Depth (ft)	0.90	0.90	1.10	0.90	1.27	1.29	1.40	0.76	0.89	0.71	0.72	1.04	1.40	1.16	1.26	0.88	1.05	0.78	1.10	0.95	1.10	1.12	1.22	1.32	1.00	0.69	0.81	0.96	0.96	0.92
Width/Depth Ratio	N/A	14.4	13.7	N/A	N/A	5.9	18.0	41.2	30.0	27.3	25.8	15.2	13.0	15.2	11.8	22.0	14.9	26.6	19.3	12.1	12.9	12.6	11.2	11.8	20.2	22.7	20.0	N/A	N/A	20.5
Entrenchment Ratio	N/A	6.0	N/A	N/A	N/A	N/A	3.6	2.7	3.3	4.0	4.3	4.3	5.6	7.3	7.0+	5.5+	6.75+	6.75+	4.3	7.5	6.0+	6.0+	6.2+	6.2+	5.0	7.2	6.8+	N/A	N/A	N/A
Bank Height Ratio	N/A	N/A	1.1	N/A	N/A	N/A	N/A	N/A	1.3	1.1	1.3	1.3	N/A	N/A	1.0	1.0	1.0	1.0	N/A	N/A	1.2	1.1	1.1	1.1	N/A	N/A	1.1	N/A	N/A	N/A
Wetted Perimeter (ft)	N/A	13.7	16.3	13.9	9.4	9.6	28.0	33.2	27.9	18.8	19.8	19.2	20.3	19.0	16.2	20.6	17.3	23.3	23.2	12.2	15.1	15.4	15.4	17.4	22.0	16.7	17.2	15.5	15.4	21.5
Hydraulic radius (ft)	N/A	0.86	0.98	0.81	1.06	1.03	1.30	0.72	0.84	1.03	0.67	0.85	1.17	1.08	1.16	0.93	0.95	0.70	1.00	0.90	1.00	0.91	1.08	1.18	0.90	0.64	0.77	0.86	0.86	0.81
Substrate						2.35						2.12						2.73						2.61						2.37
d50 (mm)	.125-.25	1.13	1.3	NA	NA	NA	.125-.25	1.05	2.9	NA	NA	NA	.125-.25	0.36	2.0	NA	NA	NA	.125-.25	0.33	0.7	NA	NA	NA	.062-.12	0.44	4.3	NA	NA	NA
d84 (mm)	.25-.5	8.41	5.4	NA	NA	NA	.25-.5	6.27	7.9	NA	NA	NA	.25-.5	3.33	7.0	NA	NA	NA	.25-.5	1.46	3.7	NA	NA	NA	.25-.5	0.96	15.0	NA	NA	NA

Parameter	MY0			MY1			MY2			MY3			MY4			MY5		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	29	66	43	8.9	46.2	26.9	26.4	64.9	43.2	22.6	58.0	39.6	23.2	56.2	39.0	23.2	56.2	39.0
Radius of Curvature (ft)	28	58	35	13.5	68.9	29.7	20.3	50.6	34.6	24.7	57.3	37.6	21.5	56.8	34.1	21.5	56.8	34.1
Meander Wavelenght (ft)	80	165	121	77.2	160.9	121.0	77.5	156.3	117.8	81.7	160.8	117.1	86.2	161.5	119.9	86.2	161.5	119.9
Meander Width Ratio	1.64	2.61	2.20				1.40	3.45	2.30	1.60	4.11	2.81	1.70	4.11	2.86	1.70	4.11	2.86
Profile																		
Riffle length (ft)	1.5	51.7	13.1	21.1	60.0	33.0	2.0	57.4	15.4	1.6	71.4	16.7	2.1	139.5	8.9	5.0	105.0	29.8
Riffle slope (ft/ft)	0.000	0.040	0.010	0.005	0.043	0.010	0.000	0.050	0.013	0.000	0.100	0.017	0.000	0.357	0.020	0.000	0.076	0.014
Pool length (ft)	3.3	20.7	9.8	7.3	90.1	25.7	7.0	100.8	19.4	6.4	117.8	38.9	4.2	114.8	14.8	5.4	83.0	30.7
Pool spacing (ft)	13.6	158.3	57.9	6.0	69.0	30.8	10.8	146.9	45.7	22.4	136.8	65.1	9.2	121.7	33.9	11.0	176.0	51.9
Additional Reach Parameters																		
Valley Length (ft)	1662			1662			1656			1656			1656			1656		
Channel Length (ft)	1937			1937			1960			1952			1991			1991		
Sinuosity	1.2			1.2			1.2			1.2			1.2			1.2		
Water Surface Slope (ft/ft)	0.01			0.01			0.0059			0.0063			0.0062			0.0062		
BF slope (ft/ft)	0.01			0.01			0.0059			0.0061			0.0060			0.0060		
Rosgen Classification	C5			C5			C5			C5			C5			C5		
*Habitat Index	NA			NA			NA			NA			NA			NA		
*Macrobenthos	NA			NA			NA			NA			NA			NA		

Appendix E
Hydrologic Data

Table 10. Verification of Bankfull Events			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo # (if available)**
1/3/2007	Unknown date in 2006	Photographic – Near Bankfull; wrack lines observed	See Monitoring Year 1 Report
6/4/2007	6/3/2007	Result of 1.5' rainfall event; wrack lines observed.	None
10/1/2008	6/30/2008	According to NCDC Station Coop ID 315123 - Louisburg NC , 2.0 inches of precipitation fell over this 24 hour period. It was assumed, but not verified, that this rainfall produced a bankfull event.	None
10/1/2008	9/6/2008	According to NCDC Station Coop ID 315123 - Louisburg NC , 3.27 inches of precipitation fell over this 24 hour period. It was assumed, but not verified, that this rainfall produced a bankfull event.	None
6/23/2009	Uknown date after January 27, 2009 and before June 22, 2009.	Crest gauge reading of 1 foot 10 inches on gauge stick (bankfull datum set at 11 inches). Date of over-bankfull flow is unknown, but most likely occurred during or just after the dates of March 1-3, 2009 when 5.2 inches of snow, ice, and rainfall fell according to NCDC Station Coop ID 315123 - Louisburg NC.	Photo 5 in 'Stream Problem Area' photolog (digital submission only)
11/2/2010	Likely May 17, 2010	Crest gauge reading indicated bankfull event since 6/23/2009. Weather station data indicates storm event exceeding 2.5 inches on May 17, 2010	