UT to Barnes Creek
Stream and Wetland Restoration Project
Project No. 397
2009 Monitoring Report: Year 4 of 5

November 2009 (Revised May 2010)

Prepared for: NCDENR-EEP
1652 Mail Service Center
Raleigh, NC 27699-1652

Prepared by: Jordan, Jones & Goulding
9101 Southern Pine Blvd., Suite 160
Charlotte, NC 28273

Design Firm: Baker Engineering
1447 S. Tryon Street, Suite 200
Charlotte, NC 28203

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EXECUTIVE SUMMARY

SECTION 1

EXECUTIVE SUMMARY

The Unnamed Tributray (UT) to Barnes Creek Stream and Wetland Restoration Project (Site) is located north of the Town of Troy in Montgomery County, North Carolina (Appendix 1.1). The Site is located within the Carolina Slate Belt Ecoregion of the Piedmont physiographic region in the Yadkin River Basin (USGS HUC 03040103). The stream enhancement/restoration plan was designed by Baker Engineering and constructed by North State Environmental, Inc. Construction activities were completed in December 2005. The first annual monitoring activities were conducted in October 2006. This report serves as year four of the five year monitoring plan for the Site.

1.1 Goals and Objectives

Prior to restoration, wetland, stream, and buffer functions on the site were impaired as a result of agricultural conversion. Streams flowing through the site were channelized many years ago to reduce flooding and provide drainage for adjacent farm fields. According to the mitigation plan, the Site was restored by relocating 3,916 linear feet (lf) of stream (Priority 1 and 2) and 1.38 acres (ac) of wetlands, and enhancing 3.14 ac of wetlands. The Site's riparian areas were planted to improve habitat and stabilize streambanks. The following specific goals were established for the Site (The lf and ac listed in the project goals below are not the same as the final as-built lf and ac for stream and wetland restoration/enhancement work completed).

1. Restore 4,063 lf of channel dimension, pattern, and profile.
2. Enhance 3.12 ac of existing wetlands by planting vegetation in previous grazed wetland areas.
3. Restore wetland hydrology to 1.38 ac of wetland by raising the water table, restoring over bank flooding, and increasing surface storage.
4. Create 0.39 acres of wetland as ephemeral pools in the existing stream bed after construction for the proposed meandering channel.
5. Improve floodplain functionality by matching floodplain elevations with the bankfull stage.
6. Establish native streambank and floodplain vegetation in the buffer.
7. Improve the water quality in the Barnes Creek watershed by fencing cattle out of the stream and reducing bank erosion.
8. Improve in-stream and riparian habitat by creating deeper pools, areas of re-aeration, planting a riparian buffer, and reducing bank erosion.

UT to Barnes stream channels were designed and constructed as C-type channels. In-stream structures, such as rootwads, log vanes, cross vanes, rock vanes, rock weirs, and log weirs were used to control streambed grade, reduce stress on streambanks, and promote bed form sequences and habitat diversity. Where grade control was a consideration, constructed riffles or rock weirs were installed to provide long-term stability. Streambanks were stabilized using a combination of erosion control matting, bare-root plantings, brush mattresses, and transplants. The Site was planted with native riparian vegetation and the permanent conservation easement was fenced.

Wetland restoration on the Site consisted of raising the local water table and restoring a natural flooding regime. Drainage ditches within the restoration areas were filled to decrease surface and subsurface drainage and raise the local water table.

Beaver were identified along the main channel and its tributary in the 2009 monitoring year. Multiple control efforts have been implemented over the last 2 years to control beaver activity and the site is now under monthly monitoring by the USDA wildlife contractor. At this time, EEP has reported that the beaver dams on the main channel and the tributary have been removed. Appendix 2 provides detailed project activity, history, contact information, and more in-depth watershed/site background for the project.

1.2 Vegetative Assessment

JJG conducted the 2009 (year 4 of 5) vegetative assessment and vegetative plot analysis in September 2009. Four vegetation monitoring plots 100 m^2 (10m x 10m) in size were previously established on site by Baker Engineering. Vegetation assessments were conducted following the NCDOT Stem Counting Protocol which consists of counting woody stems within the established vegetation plots. Vegetation success criteria, as defined in the mitigation plan, specifies that woody planted stems 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.

The 2009 vegetation monitoring indicated an average survivability of 354 stems per acre, which is greater than the required vegetation survival criteria of 320 stems per acre surviving after the third growing season and the required 260 stems per acre at the end of the five year monitoring period. There is not a clearly defined vegetation success goal for year four in the mitigation plan. Therefore, JJG based the success criteria attainment for year four following the goals set for year five. Based on the survival rates illustrated over the years and the number of volunteer species found within the plots, JJG foresees the plant growth to continue to improve and meet the success requirements in year five. Volunteer species improve the average stem per acre from 354 to 516 for monitoring year four. Based on the previous statement, all four plots have met the success criteria for year four. The survival rate for the planted woody vegetation monitored for 2009 is 64%. The monitoring data indicates an average of 18 planted stems per plot.

In conclusion, the riparian restoration project meets the requirements per the vegetative success criterion for the 2009 monitoring year. Refer to Appendix 3 for more detailed vegetation data and photos.

1.3 Stream Assessment

Stream dimension, pattern, profile, and substrate were evaluated within 3,916 linear feet of the Site. Results from the 2009 stream monitoring effort indicate that stream pattern, profile, and dimension of UT Barnes and its tributary are maintaining vertical and lateral stability with minimal problem areas. A few problem areas were observed, such as moderate bank erosion, in-stream vegetation, beaver dams, and inundation/back water areas. A United States Department

of Agriculture (USDA) wildlife unit has been contracted by the Ecosystem Enhancement Program (EEP) to address the beaver activity and the associated dams along the main channel and it's tributary to restore natural hydrologic flow regime. At this time, EEP has reported that the beaver dams on the main channel and the tributary have been removed. In areas where beaver have not impacted the hydrology and the channel was visible, the pattern, profile, and dimension of the restored main channel and its tributary appear stable.

Main Channel

Overall, the present stream dimensions in the main channel appear to be stable. The average bankfull width (18.90 ft) of the surveyed cross-sections is similar to the proposed 18.8 ft, and the average surveyed mean bankfull depth is 1.6 ft compared to the proposed 1.4 ft. The surveyed bankfull widths and depths lead to an average Width/Depth ratio of 13, which typifies a Rosgen C-type stream. The channel appears to be functioning properly in the areas where beaver activity has not impacted the channel hydrology.

The reach appears to be maintaining vertical and lateral stability with minimal bank erosion. The main channel's bank stability rating is 100%. The streambank areas noted with minimal bank erosion do not appear to be impacting the channel's stability. The bank erosion is occurring in small, localized areas and is considered to be normal. Areas with in-stream vegetation growth could potentially result in localized areas of aggradation; therefore leading to lateral and/or vertical shifts in the stream. These areas will continue to be monitored closely for significant adjustments in the bed features and channel thalweg. The thalweg profile appears to be stable, and was characterized by well-defined riffle and pool features. The average water surface slope and the average bankfull slope were very similar for the surveyed reach, 0.0053 ft/ft and 0.0054 ft/ft, respectively. From the 2009 monitoring year, the substrate analysis illustrates minimal shifting in bed materials. Generally the d84 is coarsening in riffle cross-sections, which is indicative of the fines being flushed out that most likely deposited due to the back water conditions occurring from existing beaver activity within the restoration site in the previous monitoring years.

Tributary

Based on current monitoring data and the visual inspection, the channel is impacted by beaver activity. Three beaver dams were located along the channel with inundation levels above the top of bank. Fine sediment deposition is occurring throughout the reach due to the stagnant flow conditions. The average bankfull width (13.70 ft) of the surveyed cross-sections is lower than the proposed 14.40 ft, and the average surveyed mean bankfull depth is 1.0 ft compared to the proposed 0.7 ft. The surveyed bankfull widths and depths lead to an average Width/Depth ratio of 17.6, which typifies a Rosgen C-type stream. The average water surface slope and the average bankfull slope were very slightly different for the surveyed reach, 0.0085 ft/ft and 0.0091 ft/ft, respectively. This is most likely due to the inundated conditions occurring onsite during the longitudinal survey.

The substrate analysis illustrates a significant shift in bed materials, which indicates a high sedimentation rate is occurring throughout the tributary. The current beaver activity, previous in-stream vegetation growth, and drought conditions most likely have attributed to the high silt deposition within the reach. It is expected that these fines will be flushed out of the stream with larger storm events once the beaver activity has ceased and the associated dams have been removed.

Two crest gauges are located within the project site. One bankfull event or greater occurred within the restoration project during the 2009 monitoring year. The on-site crest gauge documented the occurrence of two bankfull events during the first year (2006) of the post-construction monitoring period. No bankfull events were recorded or observed during the 2007 monitoring, which was conducted from August through November 2007. Other indicators such as old wrack lines and staining were observed at the bankfull and greater elevations within the restoration site as well. The Site has met the hydrologic success criteria with two bankfull events occurring in two separate monitoring years.

Overall, the main channel appears to be maintaining grade with stable structures and minimal bank erosion and has met the year four success criteria. The tributary appears to be maintaining vertical and lateral stability; however, beaver activity has impacted normal flow regimes and sediment transport processes. As a result, the 2009 morphological measurement of the cross-sections, longitudinal profile, and the channel's substrate are skewed for the tributary. Time is necessary for this stream to function as a fluvial system under conditions more similar to a normal flow regime before assessing the stream's stability. Therefore, the tributary will not be evaluated as to whether or not it has met the success criteria for monitoring year four. It is expected that with the control of beaver activity, the tributary will obtain a dynamic equilibrium that will allow for assessment in future monitoring years. Please refer to Appendix 4 for more detailed stream data tables and plots and Appendix 1.2 for the location of the longitudinal profile stations, cross-section stations, vegetation plots, photo points, gauges, and problem areas noted.

1.4 Wetland Assessment

Eight groundwater gauges were installed across the restored site during 2006 and 2008 to document water table hydrology in the required monitoring locations. The groundwater gauges are programmed to download groundwater levels daily and were downloaded monthly from March to November in order to capture hydrological data during the growing season. The target wetland hydrological success criterion is saturation or inundation for at least 12.5 percent of the growing season in the lower landscape (floodplain) positions. To achieve the above hydrologic success criterion, groundwater levels must be within 12-inches of the ground surface for 30 consecutive days, which is 12.5 percent of the March 19 to November 16 (243 days) growing season.

The general success of hydrology within the wetland restoration zones is adequate to meet success requirements. All gauges achieved the wetland success criterion of soil saturation within the upper 12 inches for 29 consecutive days. Surface inundation to ground saturation was observed throughout the site; therefore, appropriate hydrological condition for the wetland zones

appears to be present. Although all the gauges achieved the wetland success criteria for the 2009 monitoring year, MW3's success may be attributed to beaver activity observed throughout the 2009 monitoring year.

With the exception of the beaver activity and their impact on the water inundation levels within the wetland areas, no problem areas were observed within the wetland restoration zones for the Site. Hydrophytic vegetation consists of a thick herbaceous layer of sedge species (*Carex sp.*), rush species (*Juncus sp.*), and smartweed species (*Polygonum sp.*). The planted woody stem species throughout the wetland areas are meeting the required success criteria; however, mortality of woody stems was observed due to beaver chews. It is suspected that the mortality of planted stems may also be subject to the planting technique or the soil conditions prior to planting. Please refer to Appendix 5 for wetland raw data tables and plots.

1.5 Annual Monitoring Summary

Overall, the Site appears to be stable and has met stream, vegetation, wetland, and hydrologic mitigation goals for monitoring year 4 with the exception of the tributary. Planted and naturally recruited vegetation is doing well at the site, although some minor vegetation problems were noted due to the severe drought experienced during the 2007 growing season and the on-going beaver activity. The pattern, profile, and dimension of the main channel appear to be maintaining vertical and lateral stability with stable structures and minimal bank erosion. Success criteria achievement was not evaluated for the tributary due to beaver activity. It is expected that with the control of beaver activity, the tributary will obtain a dynamic equilibrium that will allow for assessment in future monitoring years. For the 2009 monitoring year, all gauges achieved the wetland success criterion of soil saturation within the upper 12 inches for 30 consecutive days.

The background information provided in this report is referenced from the mitigation plan and previous monitoring reports prepared by Baker Engineering (2007) and RK&K (2008). 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 EEP's website. All raw data supporting the tables and figures in the appendices is available from EEP upon request.

SECTION 2
METHODOLOGY

SECTION 2
METHODOLOGY

2.1 Methodology

Methods employed for the UT Barnes Stream Restoration Project were a combination of those established by standard regulatory guidance and procedure documents as well as previous monitoring reports completed by Baker Engineering and RK&K, LLP. Geomorphic and stream assessments were performed following guidelines outlined in the Stream Channel Reference Sites: An Illustrated Guide to Field Techniques (Harrelson et al., 1994) and in the Stream Restoration a Natural Channel Design Handbook (Doll et al, 2003). Vegetation assessments were conducted following the NCDOT protocol which consists of counting woody stems within the established vegetation plots. JJG used the *Flora of the Carolinas, Virginia, Georgia, and surrounding areas* by Alan S. Weakley as the taxonomic standard for vegetation nomenclature for this report. Precipitation data for the hydrographs was obtained from both on-site and off-site resources. Off-site daily precipitation was obtained from Weather Underground for the Albemarle, NC weather station (the nearest offering daily precipitation data) through the following URL.

http://waterdata.usgs.gov/nwis/dv?cb_00060=on&cb_00065=on&cb_00045=on&format=html&begin_date=2008-01-01&end_date=2009-12-31&site_no=02118500&referred_module=sw.

SECTION 3
REFERENCES

SECTION 3
REFERENCES

Baker Engineering. 2007. UT Barnes Stream and Wetland Restoration 2007 Annual Monitoring Report (Year 1). Charlotte, NC.

Doll, B.A., Grabow, G.L., Hall, K.A., Halley, J., Harman, W.A., Jennings, G.D., and Wise, D.E., 2003. Stream Restoration A Natural Channel Design Handbook.

Harrelson, Cheryl C; Rawlins, C.L.; Potyondy, John P. 1994. *Stream Channel Reference Sites: An Illustrated Guide to Field Technique.* Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

Rosgen, D L. 1996. Applied River Morphology. Wildland Hydrology Books, Pagosa Springs, CO.

Rummel, Klepper & Kahl, LLP. 2008. UT Barnes Stream and Wetland Restoration 2007 Annual Monitoring Report (Year 2). Raleigh, NC.

Weakley, A.S. 2008. *Flora of the Carolinas, Virginia, Georgia, Northern Florida, and Surrounding Areas* (Draft April 2008). University of North Carolina at Chapel Hill: Chapel Hill, NC.

SECTION 4
APPENDICES

Appendix 1 - General Figures and Plan Views

Appendix 2 - General Project Tables

Appendix 3 - Vegetation Assessment Data

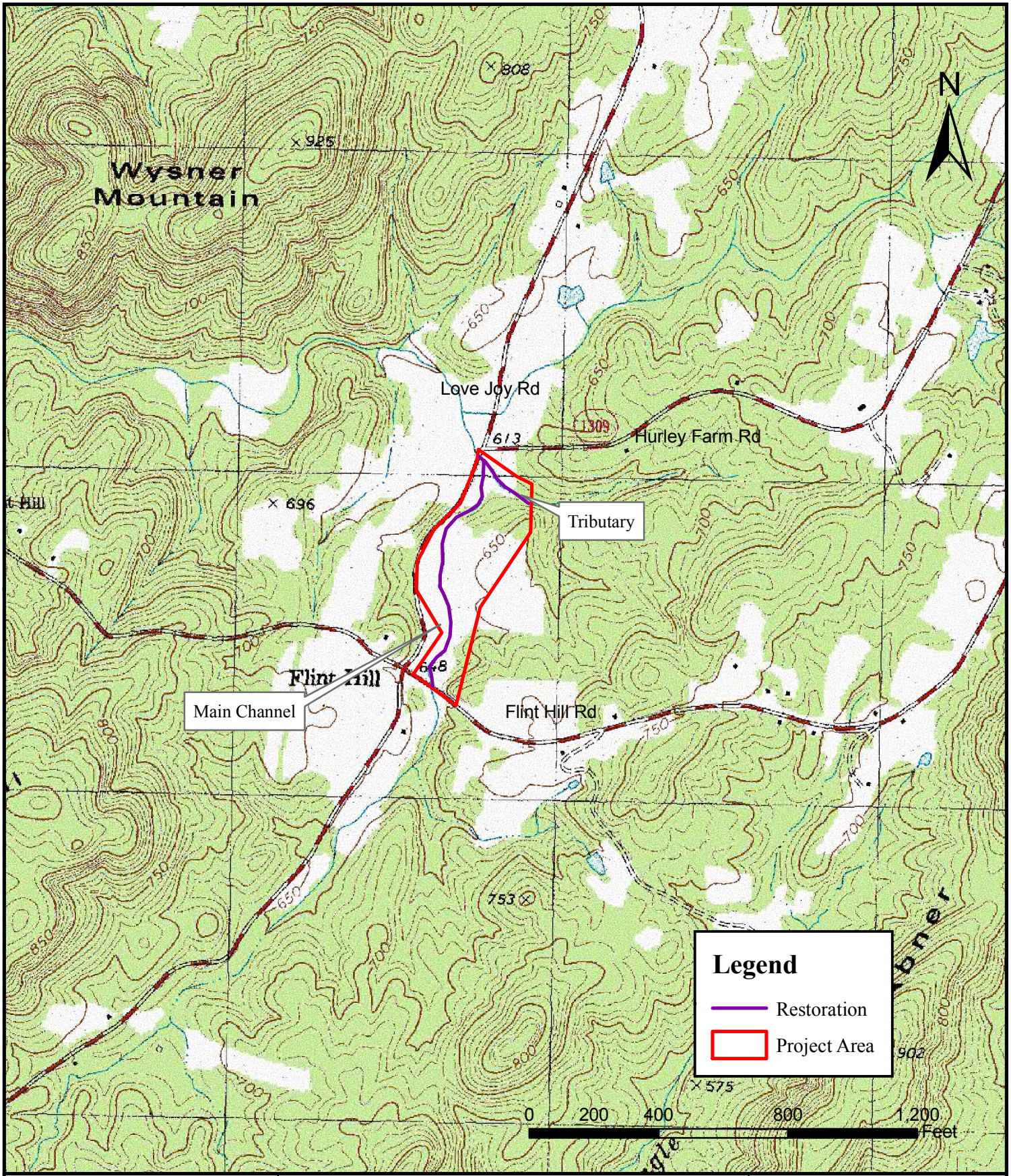
Appendix 4 – Stream Assessment Data

Appendix 5 – Wetland Assessment Data

APPENDIX 1
GENERAL FIGURES AND PLAN VIEWS

1. Project Location Map

2. Current Condition Plan View



Appendix 1.1 Project Location Map
UT to Barnes Stream and Wetland Restoration
Montgomery County, NC
Year 4 of 5

Project No. 397
November 2009

Ecosystem Enhancement PROGRAM

NOTES:
1. GENERAL SITE DATA PROVIDED BY NCEEP.
2. ALL LOCATIONS ARE APPROXIMATE.
3. AERIAL IMAGE FROM NCDOT 1995

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MONTGOMERY COUNTY
NORTH CAROLINA
MONITORING
YEAR 4 of 5

JJG

NC ECOSYSTEM ENHANCEMENT PROGRAM
UT BARNES STREAM AND WETLAND RESTORATION

APPENDIX 1.2
CURRENT CONDITION PLAN VIEW

DATE : NOVEMBER 2009
SCALE : 1"= 200'
JOB NO.: 03060005

FIGURE KEY

CURRENT CONDITIONS LEGEND

- BANK EROSION – MODERATE
- IN–STREAM VEGETATION
- POOR VEGETATION COVER
- BANK SCOUR
- BEAVER DAM
- INUNDATED AREA

EXISTING FEATURES LEGEND

- CONSTRUCTED RIFFLE
- ROCK CROSS–VANE
- ROOT WAD
- LOG WEIR
- COVER LOG
- BRUSH MATTRESS
- STEP POOL
- PHOTO POINT
- GAUGE
- VEGETATION PLOT

EPHEMERAL POOL (Creation)–1
EPHEMERAL POOL (Creation)–2
EPHEMERAL POOL (Creation)–3
MONITORING GAUGE MW–4
BCP–1 REBAR AND CAP N 630447.80 E 1728313.97 ELEV. 639.03
BCP–8236 BRASS DISK N 630430.44 E 1728513.52 ELEV. 628.68
BCP–8229 BRASS DISK N 630236.40 E 1728525.85 ELEV. 630.24
PHOTO POINT M–58
PHOTO POINT M–59
PHOTO POINT M–57
PHOTO POINT M–56
PHOTO POINT M–55
PHOTO POINT M–54
PHOTO POINT M–53
PHOTO POINT M–52
PHOTO POINT M–51
PHOTO POINT M–50
PHOTO POINT M–49
BEGIN LONGITUDINAL PROFILE
WETLAND AREA (Restoration)
VEGETATION PLOT–4
XS 1
XS2
0+00
1+00
2+00
3+00
4+00
5+00
6+00
CE
N
MATCHLINE SHEET 2

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

NOTES:
1. GENERAL SITE DATA PROVIDED BY NCEEP.
2. ALL LOCATIONS ARE APPROXIMATE.

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NC ECOSYSTEM ENHANCEMENT PROGRAM
UT BARNES STREAM AND WETLAND RESTORATION

APPENDIX 1.2
CURRENT CONDITION PLAN VIEW

DATE : NOVEMBER 2009
SCALE : 1"=40'
JOB NO.: 03060005

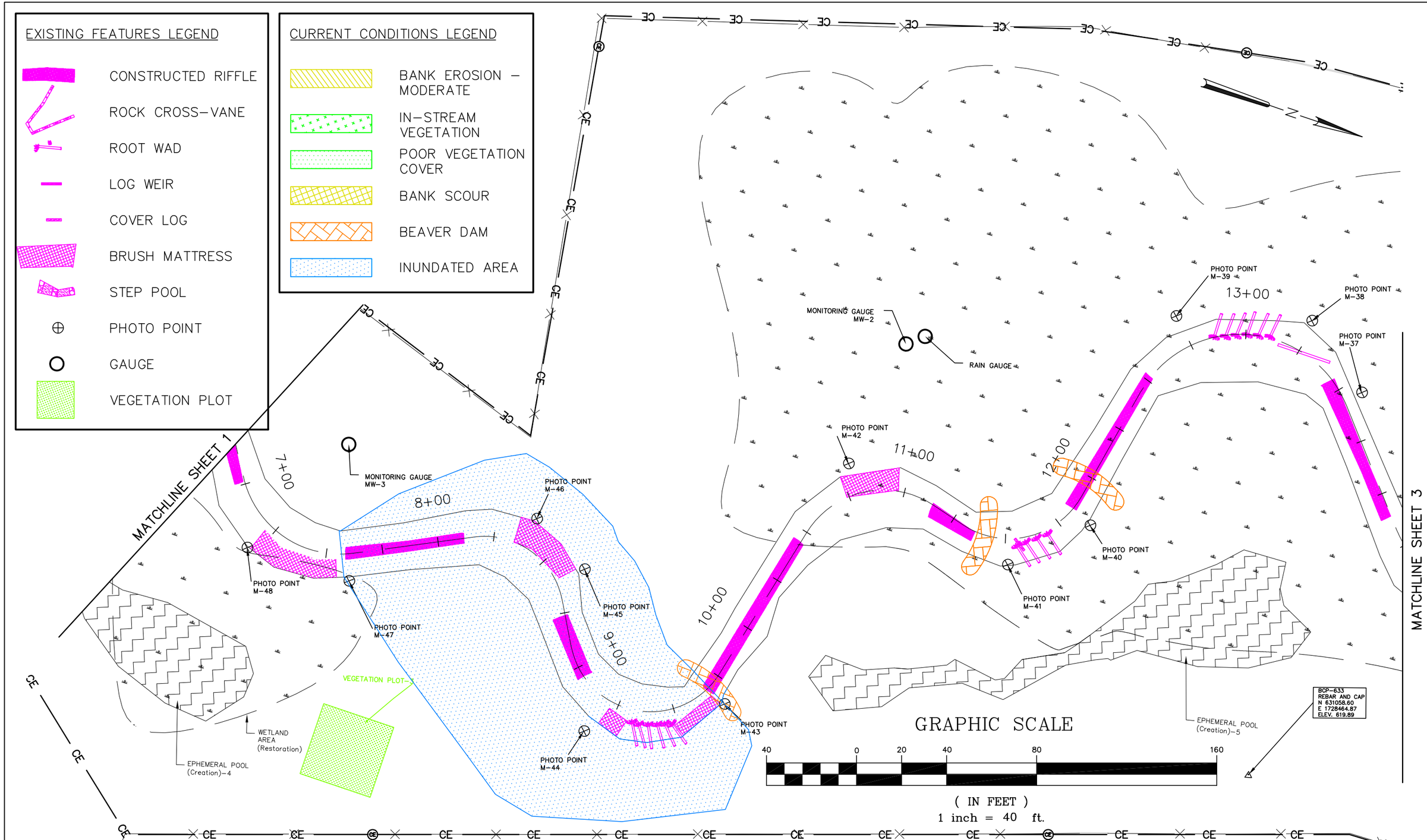
FIGURE 1 OF 6

EXISTING FEATURES LEGEND

- CONSTRUCTED RIFFLE
- ROCK CROSS–VANE
- ROOT WAD
- LOG WEIR
- COVER LOG
- BRUSH MATTRESS
- STEP POOL
- PHOTO POINT
- GAUGE
- VEGETATION PLOT

CURRENT CONDITIONS LEGEND

- BANK EROSION – MODERATE
- IN–STREAM VEGETATION
- POOR VEGETATION COVER
- BANK SCOUR
- BEAVER DAM
- INUNDATED AREA



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PROJECT NO. 397
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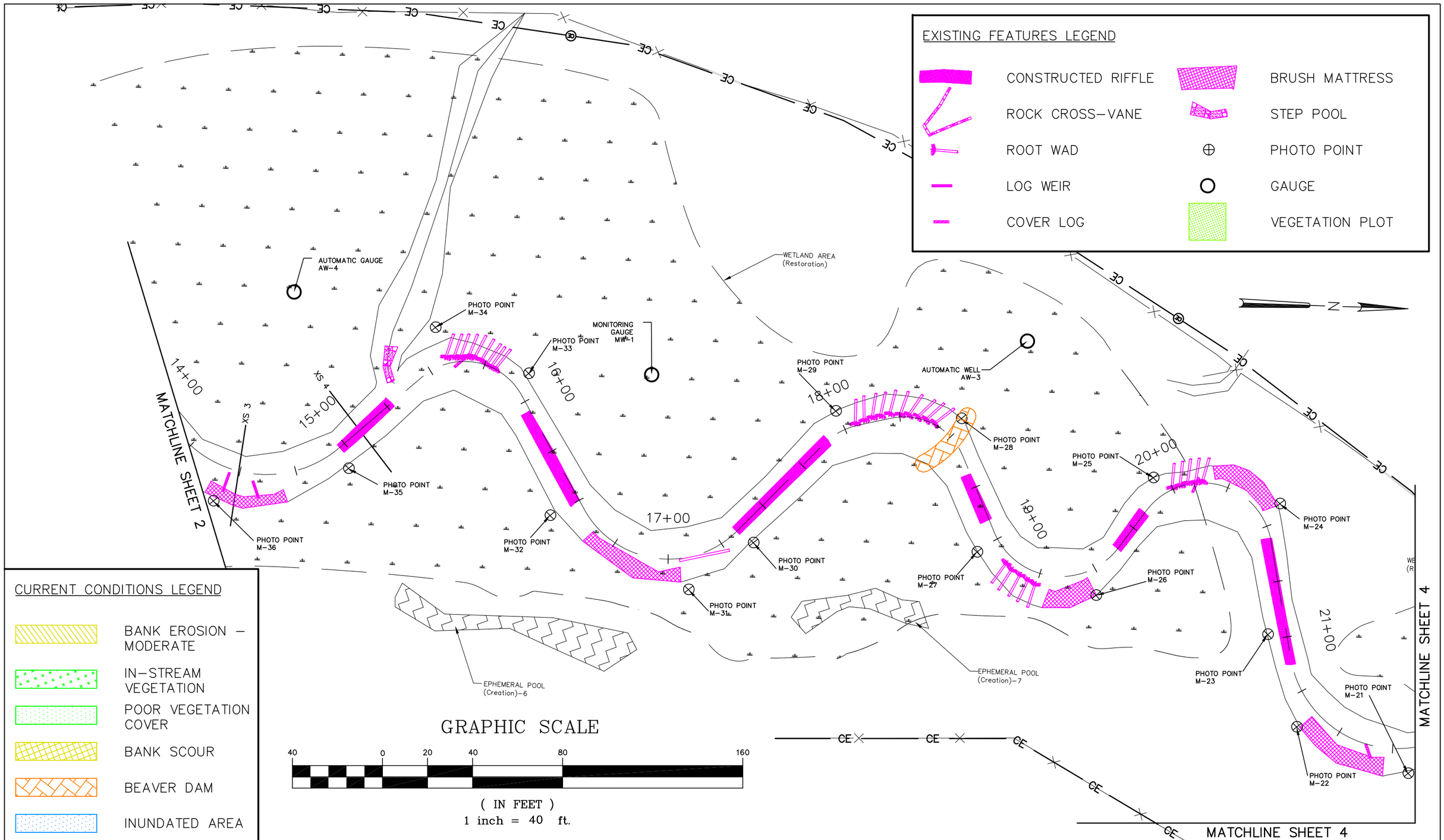
NC ECOSYSTEM ENHANCEMENT PROGRAM
UT BARNES STREAM AND WETLAND RESTORATION

APPENDIX 1.2
CURRENT CONDITION PLAN VIEW

DATE : NOVEMBER 2009
SCALE : 1"=40'
JOB NO.: 03060005

FIGURE 2 OF 6



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NC ECOSYSTEM ENHANCEMENT PROGRAM
UT BARNES STREAM AND WETLAND RESTORATION

APPENDIX 1.2
CURRENT CONDITION PLAN VIEW

DATE : NOVEMBER 2009
SCALE : 1"=40'
JOB NO.: 03060005

FIGURE 3 OF 6

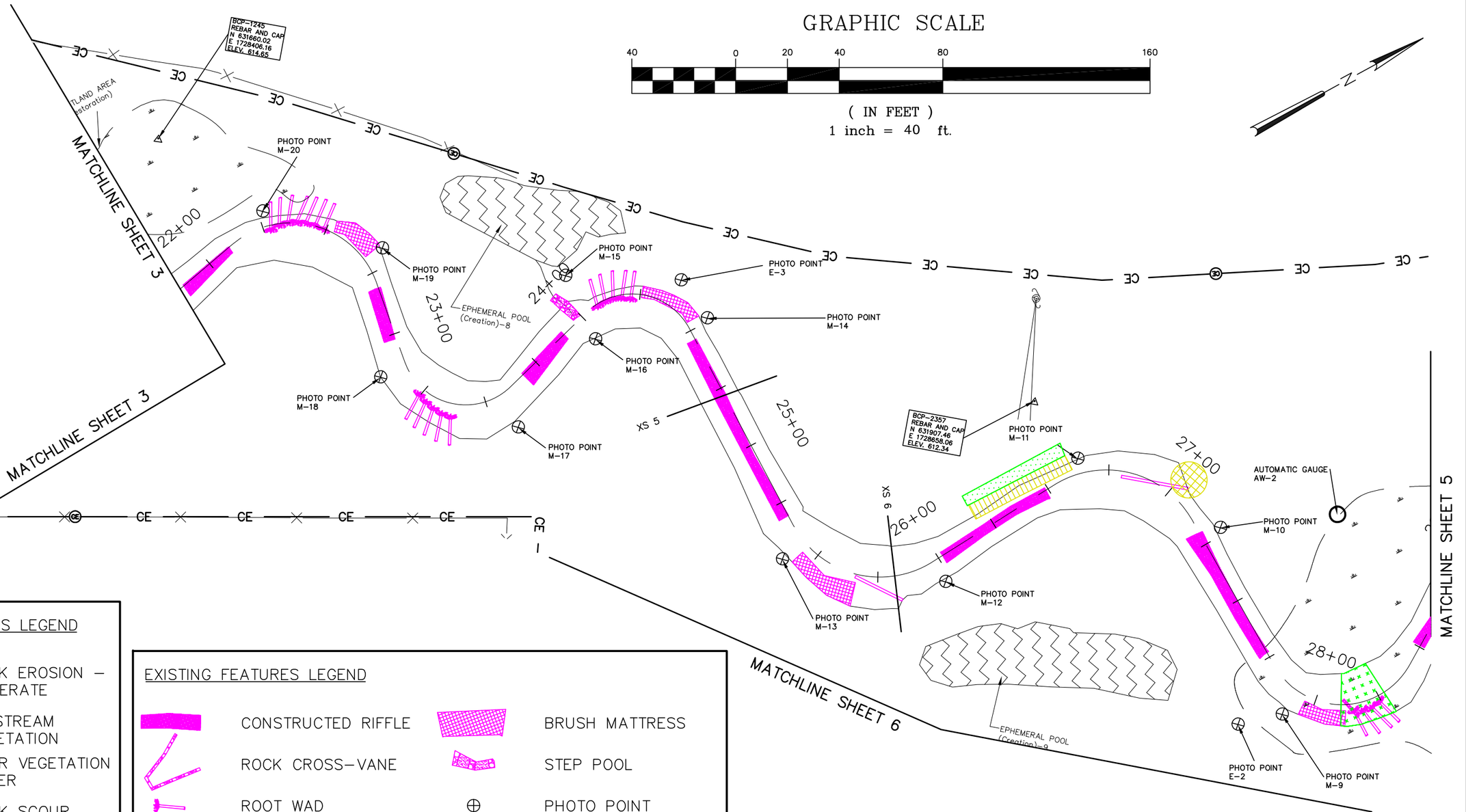
GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)

1 inch = 40 ft.

N



CURRENT CONDITIONS LEGEND

- BANK EROSION – MODERATE
- IN-STREAM VEGETATION
- POOR VEGETATION COVER
- BANK SCOUR
- BEAVER DAM
- INUNDATED AREA

EXISTING FEATURES LEGEND

- CONSTRUCTED RIFFLE
- ROCK CROSS-VANE
- ROOT WAD
- LOG WEIR
- COVER LOG
- BRUSH MATTRESS
- STEP POOL
- PHOTO POINT
- GAUGE
- VEGETATION PLOT

Ecosystem Enhancement PROGRAM

NOTES:
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JJG

NC ECOSYSTEM ENHANCEMENT PROGRAM
UT BARNES STREAM AND WETLAND RESTORATION

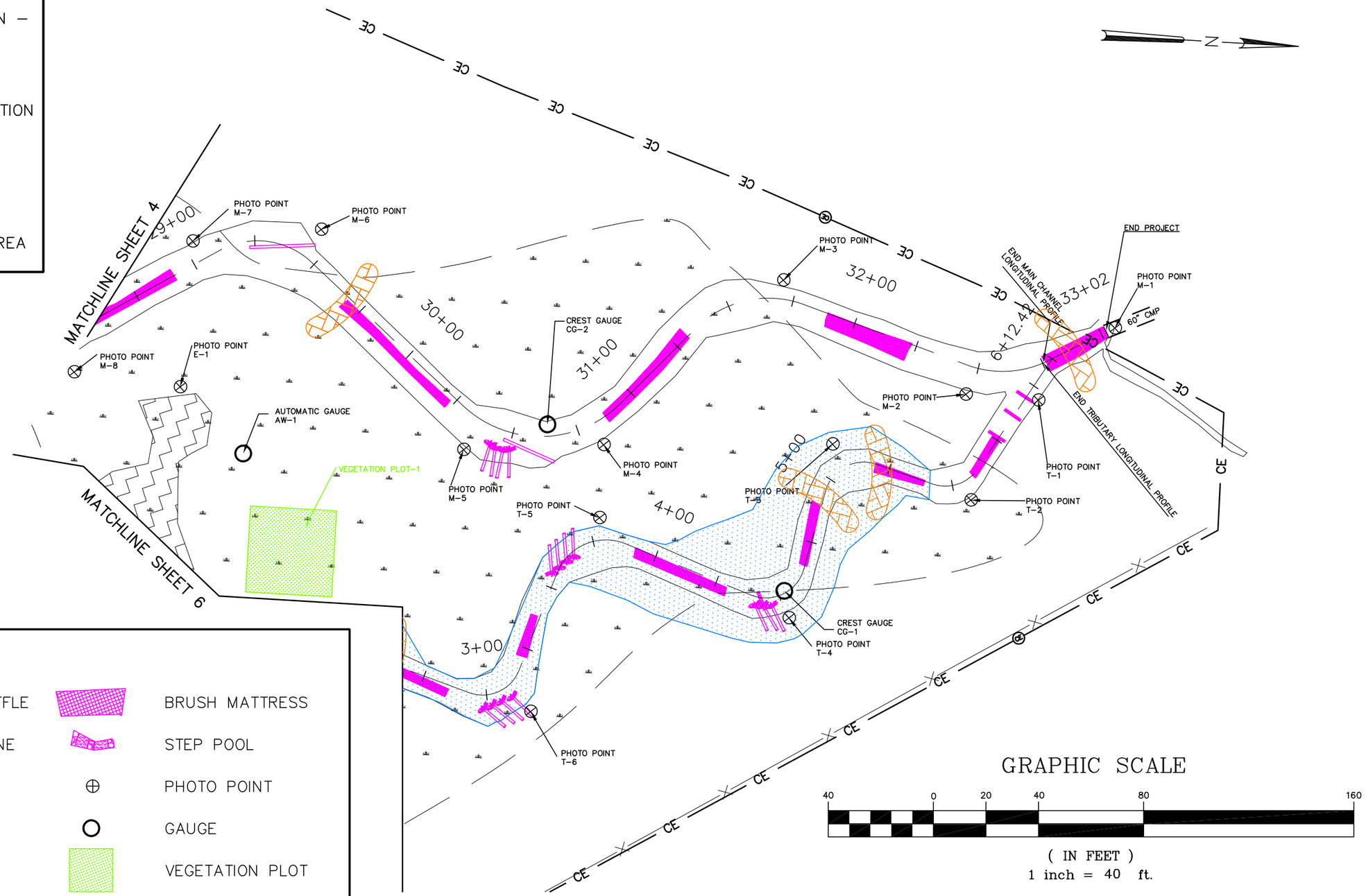
APPENDIX 1.2
CURRENT CONDITION PLAN VIEW

DATE : NOVEMBER 2009
SCALE : 1"=40'
JOB NO.: 03060005

FIGURE 4 OF 6

CURRENT CONDITIONS LEGEND

- BANK EROSION – MODERATE
- IN–STREAM VEGETATION
- POOR VEGETATION COVER
- BANK SCOUR
- BEAVER DAM
- INUNDATED AREA



EXISTING FEATURES LEGEND

- CONSTRUCTED RIFFLE
- ROCK CROSS–VANE
- ROOT WAD
- LOG WEIR
- COVER LOG
- BRUSH MATTRESS
- STEP POOL
- PHOTO POINT
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- VEGETATION PLOT

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)

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Ecosystem Enhancement PROGRAM

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PROJECT NO. 397
MONTGOMERY COUNTY
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NC ECOSYSTEM ENHANCEMENT PROGRAM
UT BARNES STREAM AND WETLAND RESTORATION

APPENDIX 1.2
CURRENT CONDITION PLAN VIEW

DATE : NOVEMBER 2009
SCALE : 1"=40'
JOB NO.: 03060005

FIGURE 5 OF 6

CURRENT CONDITIONS LEGEND

- BANK EROSION – MODERATE
- IN–STREAM VEGETATION
- POOR VEGETATION COVER
- BANK SCOUR
- BEAVER DAM
- INUNDATED AREA

MATCHLINE SHEET 4

MATCHLINE SHEET 5

EPHEMERAL POOL (Creation)–10

WETLAND AREA (Restoration)

PHOTO POINT T–7

PHOTO POINT T–8

PHOTO POINT T–9

PHOTO POINT T–10

PHOTO POINT T–11

XS 8

XS 7

1+00

0+00

BEGIN TRIBUTARY LONGITUDINAL PROFILE

VEGETATION PLOT–2

BCP–16ST
REBAR AND CAP
E 532722.39
N 1729074.96
ELEV. 616.18

CE

EXISTING FEATURES LEGEND

- CONSTRUCTED RIFFLE
- ROCK CROSS–VANE
- ROOT WAD
- LOG WEIR
- COVER LOG
- BRUSH MATTRESS
- STEP POOL
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- GAUGE
- VEGETATION PLOT

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(IN FEET)
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Ecosystem Enhancement PROGRAM

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NC ECOSYSTEM ENHANCEMENT PROGRAM
UT BARNES STREAM AND WETLAND RESTORATION

APPENDIX 1.2
CURRENT CONDITION PLAN VIEW

DATE : NOVEMBER 2009
SCALE : 1"=40'
JOB NO.: 03060005

FIGURE 6 OF 6

APPENDIX 2
GENERAL PROJECT TABLES

1. **Project Mitigation Structure and Objectives**
2. **Project Activity and Reporting History**
3. **Project Contacts**
4. **Project Background**

Segment/Reach	Mitigation Type	Approach	Linear Footage or Acres	Stationing (ft)	Comments
Main Channel	R	P1/ P2	3,305 lf	0+00-33+05	Channel restoration, relocation with use of grade control and bank protection structures.
Tributary	R	P2	611 lf	0+00-6+11	Channel restoration, relocation with use of grade control and bank protection structures.
Wetland Enhancement	E	---	3.14 ac	---	Enhancement of jurisdictional wetland.
Wetland Restoration	R	---	1.38 ac	---	Restoration of wetlands.

Component Summations

Restoration Level	Stream (lf)	Wetland (ac)		Upland (ac)	Buffer (ac)	BMP
		Riparian	Non-Riparian			
Restoration (R)	3,916	1.38	N/A	N/A	N/A	N/A
Enhancement (E)	N/A	3.14	N/A	N/A	N/A	N/A
Enahncement I (E)	N/A	N/A	N/A	N/A	N/A	N/A
Enhancement II (E)	N/A	N/A	N/A	N/A	N/A	N/A
Creation (C)	N/A	N/A	N/A	N/A	N/A	N/A
Preservation (P)	N/A	N/A	N/A	N/A	N/A	N/A
HQ Preservation (P)	N/A	N/A	N/A	N/A	N/A	N/A
Totals	**3,916**	**4.52**	**N/A**	**N/A**	**N/A**	**N/A**

*The final linear footage and acreage listed above is based on the as-built values constructed on-site.

Activity or Report	Data Collection Completed	Actual Completion or Delivery
Restoration Plan	NA	N/A
Final Design-90%	NA	Jul-05
Construction	NA	Mar-06
Temporary S&E mix applied to entire project area*	NA	Mar-06
Permanent seed mix applied to entire project area	NA	Mar-06
Planting of live stakes and bare root trees	NA	Mar-06
Mitigation Plan/ As-Built (Year 0 Monitoring)	Jun-06	Jul-06
Year 1 Monitoring	Oct-06	Mar-07
Year 2 Monitoring	Nov-07	Mar-08
Year 3 Monitoring	May-08	Mar-09
Year 4 Monitoring	Aug-09	Dec-09
Year 5 Monitoring	TBD	TBD

*Seed and mulch is added as each section of construction is completed.

Designer	Baker Engineering 1447 South Tryon, Suite 200 Charlotte, NC 28203
Construction	North State Environmental, Inc. 2889 Lowery Street Winston-Salem, NC 27101
Planting Contractor	North State Environmental, Inc.
Seeding Contractor	
Monitoring Performers	
Year 1	Baker Engineering 1447 South Tryon, Suite 200 Charlotte, NC 28203
Year 2	Rummel, Klepper & Kahl, LLP 900 Ridgefield Drive Suite 350 Raleigh, NC 27609
Year 3-Present	Jordan, Jones & Goulding 9101 Southern Pine Blvd., Suite 160 Charlotte, NC 28273
Stream Monitoring, POC	Kirsten Young, 704-527-4106 ext.246
Vegetation Monitoring, POC	
Wetland Monitoring, POC	

Project County	Montgomery County, North Carolina
Drainage Area:	
UT to Barnes (Main Channel)	2.0 sq.mi.
Tributary	0.18 sq.mi.
Drainage impervious cover estimate:	
UT to Barnes (Main Channel)	<5%
Tributary	<5%
Stream Order:	
UT to Barnes (Main Channel)	2nd
Tributary	1st
Physiographic Region	Piedmont
Ecoregion	Carolina Slate Belt
Rosgen Classification of As-built:	
UT to Barnes (Main Channel)	C
Tributary	C
Cowardin Classification	Riverine, Lower Perennial, Unconsolidated Bottom, Cobble-Gravel
Dominant Soil Types:	
UT to Barnes (Main Channel)	Chenneby Silt Loam and Herndon Silt Loam
Tributary	Chenneby Silt Loam
Reference site ID	Spencer Creek and UT to Spencer Creek
USGS HUC for Project	304010305
NCDWQ Sub-basin for Project and Reference	03-07-09
NCDWQ classification for Project and Reference	C
Any portion of any project segment 303d list?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reason for 303d listing or stressor?	N/A
% of project easement fenced?	1

APPENDIX 3
VEGETATION ASSESSMENT DATA

1. **Vegetation Plot Mitigation Success**

2. **Vegetation Monitoring Plot Photos**

3. **Vegetation Plot Summary Data Table**

Vegetation Plot ID	Vegetation Survival Threshold Met (Y/N)
Plot 1	Y
Plot 2	Y
Plot 3	Y
Plot 4	Y

Monitoring Plot 1 (9/2009)

Monitoring Plot 2 (9/2009)

Monitoring Plot 3 (9/2009)

Monitoring Plot 4 (9/2009)

Prepared For:	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 3.2 Vegetation Monitoring Plot Photos	

UT to Barnes Creek
Stem Counts for Planted Species

			Current Data (MY4-2009)								Annual Means							
			Plot 1		Plot 2		Plot 3		Plot 4		Current Mean		MY1 - 2006		MY2 - 2007		MY3 - 2008	
Species	**Common Name**	**Type**	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T
Acer rubrum	Red maple	T			2	2	1	1			**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
Betula nigra	River birch	T	1	1	2	2	2	2	4	5	**2**	**3**	**5**	**5**	**2**	**2**	**2**	**2**
Carya cordiformis	Bitternut hickory	T				2												
Cornus amomum	Silky dogwood	S	1	1						2	**1**	**2**	**2**	**2**	**3**	**3**	**1**	**1**
Carpinus caroliniana	Ironwood	T/S							1	1	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**1**
Lindera benzoin	Spicebush	T/S							1	1	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**1**
Liquidambar styraciflua	Sweetgum	T				7												
Nyssa sylvatica	Blackgum	T					1	1			**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Platanus occidentalis	Sycamore	T	3	3			2	2	4	4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Quercus falcata	Southern red oak	T			3	3					**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**
Quercus lyrata	Overcup oak	T					1	1			**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Quercus sp	Oak species	T	1	2	1	1			1	3	**1**	**2**	**4**	**4**	**3**	**3**	**1**	**1**
Salix nigra	Black willow	T		1		1					**N/A**	**1**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Sambucus canadensis	Elderberry	T/S				1												
Unknown	unknown species	T	2	1	1						**2**	**1**	**1**	**1**	**3**	**3**	**2**	**2**
		Plot Area (acres)	**0.0247**															
		Species Count	**5**	**6**	**5**	**8**	**5**	**5**	**5**	**6**	**11**	**12**	**6**		**5**		**5**	**6**
		Stem Count	**8**	**9**	**9**	**19**	**7**	**7**	**11**	**16**	**17**	**20**	**14**		**11**		**9**	**12**
		Stems per Acre	**324**	**364**	**364**	**769**	**283**	**283**	**445**	**648**	**354**	**516**	**567**		**445**		**354**	**486**

Type=**S**hrub or **T**ree
P = Planted
T = Total

APPENDIX 4
STREAM ASSESSMENT DATA

1. **Stream Station Photos**
2. **Stream Cross-Section Photos**
3. **Qualitative Visual Stability Assessment**
4. **Verification of Bankfull Events**
5. **Cross-Section Plots and Raw Data Tables***
6. **Longitudinal Plots and Raw Data Tables***
7. **Pebble Count Plots and Raw Data Tables***

*Raw data tables have been provided electronically.

M-1 View Upstream
Main Channel (8/2009)

M-2 View Downstream
Main Channel (8/2009)

M-3 View Upstream
Main Channel (8/2009)

M-4 View Upstream
Main Channel (8/2009)

M-5 View Upstream
Main Channel (8/2009)

M-6 View Upstream
Main Channel (8/2009)

M-7 View Upstream
Main Channel (8/2009)

M-8 View Upstream
Main Channel (8/2009)

Prepared For:	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.1 Stream Station Photos	

M-9 View Upstream
Main Channel (8/2009)

M-10 View Upstream
Main Channel (8/2009)

M-11 View Downstream
Main Channel (8/2009)

M-12 View Upstream
Main Channel (8/2009)

M-13 View Upstream
Main Channel (8/2009)

M-14 View Upstream
Main Channel (8/2009)

M-15 View Upstream
Main Channel (8/2009)

M-16 View Upstream
Main Channel (8/2009)

Prepared For:	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.1 Stream Station Photos	

M-17 View Upstream
Main Channel (8/2009)

M-18 View Upstream
Main Channel (8/2009)

M-19 View Upstream
Main Channel (8/2009)

M-20 View Upstream
Main Channel (8/2009)

M-21 View Downstream
Main Channel (8/2009)

M-22 View Upstream
Main Channel (8/2009)

M-23 View Upstream
Main Channel (8/2009)

M-24 View Upstream
Main Channel (8/2009)

Prepared For:	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.1 Stream Station Photos	

M-25 View Downstream
Main Channel (8/2009)

M-26 View Upstream
Main Channel (8/2009)

M-27 View Upstream
Main Channel (8/2009)

M-28 View Upstream
Main Channel (8/2009)

Prepared For:	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.1 Stream Station Photos	

M-29 View Downstream
Main Channel (8/2009)

M-30 View Upstream
Main Channel (8/2009)

M-31 View Upstream
Main Channel (8/2009)

M-32 View Upstream
Main Channel (8/2009)

Prepared For:	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.1 Stream Station Photos	

M-33 View Downstream
Main Channel (8/2009)

M-34 View Upstream
Main Channel (8/2009)

M-35 View Upstream
Main Channel (8/2009)

M-36 View Upstream
Main Channel (8/2009)

M-37 View Downstream
Main Channel (8/2009)

M-38 View Upstream
Main Channel (8/2009)

M-39 View Upstream
Main Channel (8/2009)

M-40 View Downstream
Main Channel (8/2009)

Prepared For: Ecosystem Enhancement Program	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.1 Stream Station Photos	JJG

M-41 View Upstream
Main Channel (8/2009)

M-42 View Downstream
Main Channel (8/2009)

M-43 View Upstream
Main Channel (8/2009)

M-44 View Downstream
Main Channel (8/2009)

Prepared For:	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.1 Stream Station Photos	

M-45 View Upstream
Main Channel (8/2009)

M-46 View Upstream
Main Channel (8/2009)

M-47 View Upstream
Main Channel (8/2009)

M-48 View Upstream
Main Channel (8/2009)

Prepared For: Ecosystem Enhancement Program	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.1 Stream Station Photos	JJG

M-49 View Downstream
Main Channel (8/2009)

M-50 View Downstream
Main Channel (8/2009)

M-51 View Upstream
Main Channel (8/2009)

M-52 View Upstream
Main Channel (8/2009)

Prepared For: Ecosystem Enhancement Program	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.1 Stream Station Photos	JJG

M-53 View Upstream
Main Channel (8/2009)

M-54 View Downstream
Main Channel (8/2009)

M-55 View Upstream
Main Channel (8/2009)

M-56 View Downstream
Main Channel (8/2009)

M-57 View Upstream
Main Channel (8/2009)

M-58 View Downstream
Main Channel (8/2009)

M-59 View Upstream
Tributary (8/2009)

Prepared For:	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.1 Stream Station Photos	

T-1 View Downstream
Tributary (11/2009)

T-2 View Upstream
Tributary (11/2009)

T-3 View Downstream
Tributary (8/2009)

T-4 View Upstream
Tributary (8/2009)

Prepared For:	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.1 Stream Station Photos	

T-5 View Downstream
Tributary (11/2009)

T-6 View Upstream
Tributary (11/2009)

T-7/8 View Downstream
Tributary (11/2009)

Prepared For:	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.1 Stream Station Photos	

T-9 View Upstream
Tributary (11/2009)

T-10 View Downstream
Tributary (11/2009)

T-11 View Downstream
Tributary (11/2009)

Prepared For:	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.1 Stream Station Photos	

E-1 View East (8/2009)

E-2 View West (8/2009)

E-3 View Southwest (8/2009)

Prepared For: Ecosystem Enhancement Program	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.1 Stream Station Photos	JJG

Cross-Section 1-View Upstream (8/2009)

Cross-Section 1-View Downstream (8/2009)

Cross-Section 2-View Upstream (8/2009)

Cross-Section 2-View Downstream (8/2009)

Prepared For: Ecosystem Enhancement Program	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.2 Stream Cross-Section Photos	JJG

Cross-Section 3-View Upstream (8/2009)

Cross-Section 3-View Downstream (8/2009)

Cross-Section 4-View Upstream (8/2009)

Cross-Section 4-View Downstream (8/2009)

Prepared For: Ecosystem Enhancement Program	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.2 Stream Cross-Section Photos	JJG

Cross-Section 5-View Upstream (8/2009)

Cross-Section 5-View Downstream (8/2009)

Cross-Section 6-View Upstream (8/2009)

Cross-Section 6-View Downstream (8/2009)

Prepared For: Ecosystem Enhancement Program	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.2 Stream Cross-Section Photos	JJG

Cross-Section 7-View Upstream (11/2009)

Cross-Section 7-View Downstream (11/2009)

Cross-Section 8-View Upstream (11/2009)

Cross-Section 8-View Downstream (11/2009)

Prepared For: Ecosystem Enhancement Program	UT to Barnes Stream and Wetland Restoration Year 4 of 5	Date: November 2009 Project No.: 397
	Appendix 4.2 Stream Cross-Section Photos	JJG

UT to Barnes-Main Channel (3,305 lf)

Feature Category		(# Stable) Number Performing as Intended	Total Number assessed per As-Built	Total Number/ feet in unstable state	% Perform in Stable Condition	Feature Perform Mean or Total
A. Riffles	1. Present?	30	30	N/A	100%	**100%**
	2. Armor Stable?	30			100%	
	3. Facet grade appears stable?	30			100%	
	4. Minimal evidence of embedding/fining?	30			100%	
	5. Length appropriate?	30			100%	
B. Pools	1. Present?	29	29	N/A	100%	**100%**
	2. Sufficiently deep?	29			100%	
	3. Length Appropriate?	29			100%	
C. Thalweg	1. Upstream of meander bend centering?	N/A			100%	**100%**
	2. Downstream of meander centering?				100%	
D. Meanders	1. Outer bend in state of limited/controlled erosion?	N/A			100%	**100%**
	2. Of those eroding, # w/concomitant point bar formation?				100%	
	3. Apparent Rc within spec?				100%	
	4. Sufficient floodplain access and relief?				100%	
E. Bed General	1. General channel bed aggradation areas (bar formation)?	N/A		0	100%	**100%**
	2. Channel bed degradation - areas of increasing down-cutting or head cutting?			0	100%	
F. Bank	1. Actively eroding, wasting, or slumping bank	N/A		0	100%	**100%**
G. Vanes	1. Free of back or arm scour?	1	1	N/A	100%	**100%**
	2. Height appropriate?	1			100%	
	3. Angle and geometry appear appropriate?	1			100%	
	4. Free of piping or other structural failures?	1			100%	
H. Wads/ Boulders	1. Free of scour?	20	21	N/A	95%	**95%**
	2. Footing stable?	20			95%	

UT to Barnes-Tributary (611 lf)

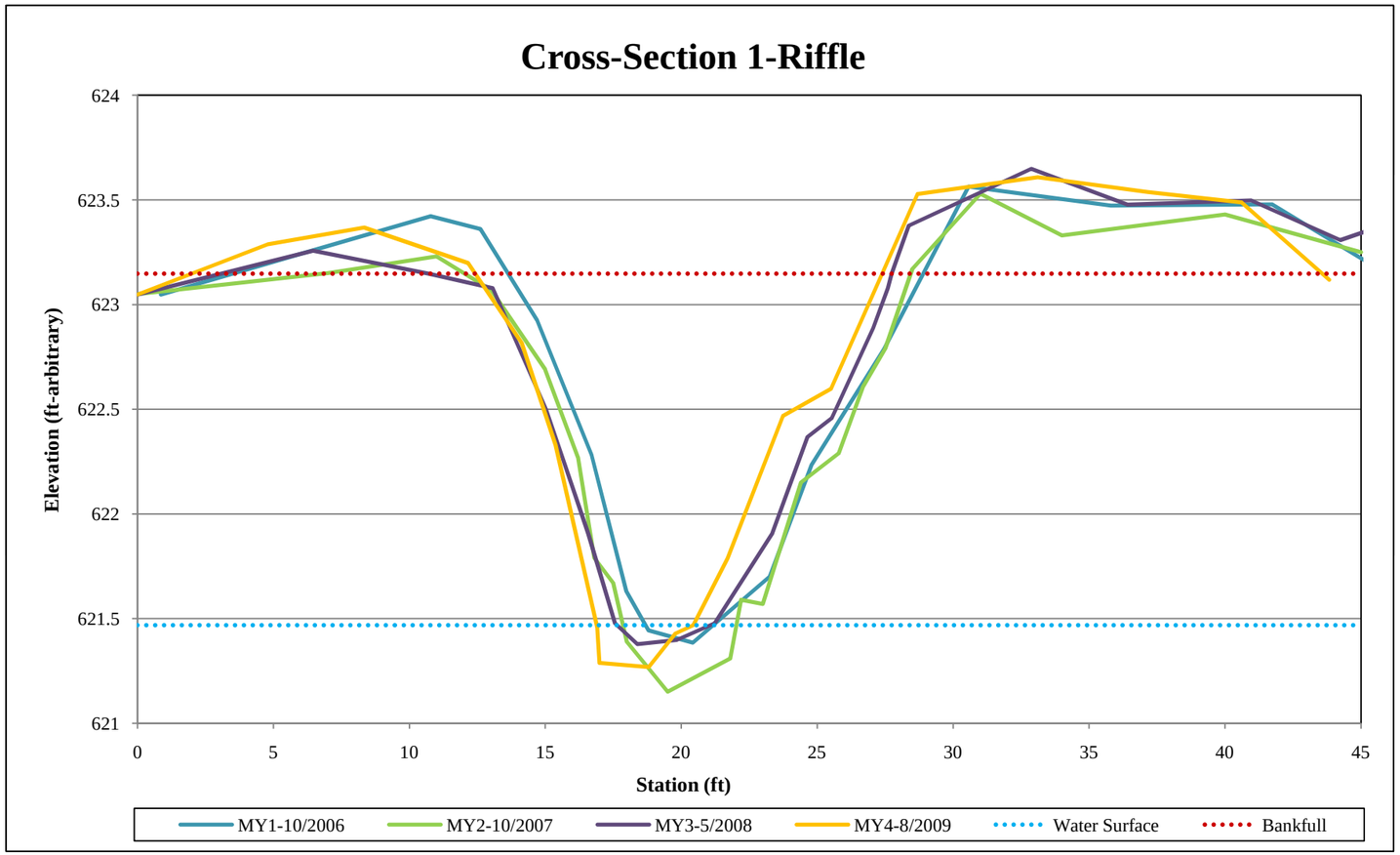
Feature Category		(# Stable) Number Performing as Intended	Total Number assessed per As-Built	Total Number/ feet in unstable state	% Perform in Stable Condition	Feature Perform Mean or Total
A. Riffles	1. Present?	10	10	N/A	100%	**80%**
	2. Armor Stable?	10			100%	
	3. Facet grade appears stable?	10			100%	
	4. Minimal evidence of embedding/fining?	0			0%	
	5. Length appropriate?	10			100%	
B. Pools	1. Present?	9	9	N/A	100%	**100%**
	2. Sufficiently deep?	9			100%	
	3. Length Appropriate?	9			100%	
C. Thalweg	1. Upstream of meander bend centering?	N/A			100%	**100%**
	2. Downstream of meander centering?				100%	
D. Meanders	1. Outer bend in state of limited/controlled erosion?	N/A			100%	**100%**
	2. Of those eroding, # w/concomitant point bar formation?				100%	
	3. Apparent Rc within spec?				100%	
	4. Sufficient floodplain access and relief?				100%	
E. Bed General*	1. General channel bed aggradation areas (bar formation)?	N/A				
	2. Channel bed degradation - areas of increasing down-cutting or head cutting?					
F. Bank*	1. Actively eroding, wasting, or slumping bank	N/A				
G. Vanes	1. Free of back or arm scour?	N/A				
	2. Height appropriate?					
	3. Angle and geometry appear appropriate?					
	4. Free of piping or other structural failures?					
H. Wads/ Boulders	1. Free of scour?	N/A				
	2. Footing stable?					

*Beaver Activity has impacted the stream reach in several areas. Sediment deposition is occurring throughout the reach. Water levels are above the top of bank in some areas making it difficult to determine bank stability.

Date of Collection	Date of Occurrence	Method	Photo # (if available)
7/13/2006	6/24/2006	CG 1	N/A
7/13/2006	6/24/2006	CG 2	N/A
9/29/2006	8/31/2006	CG 1	N/A
9/29/2006	8/31/2006	CG2	N/A
8/2008	Unknown	CG1/CG2	N/A
11/18/2009	11/11/2009- 11/12/2009	CG1/CG2	N/A

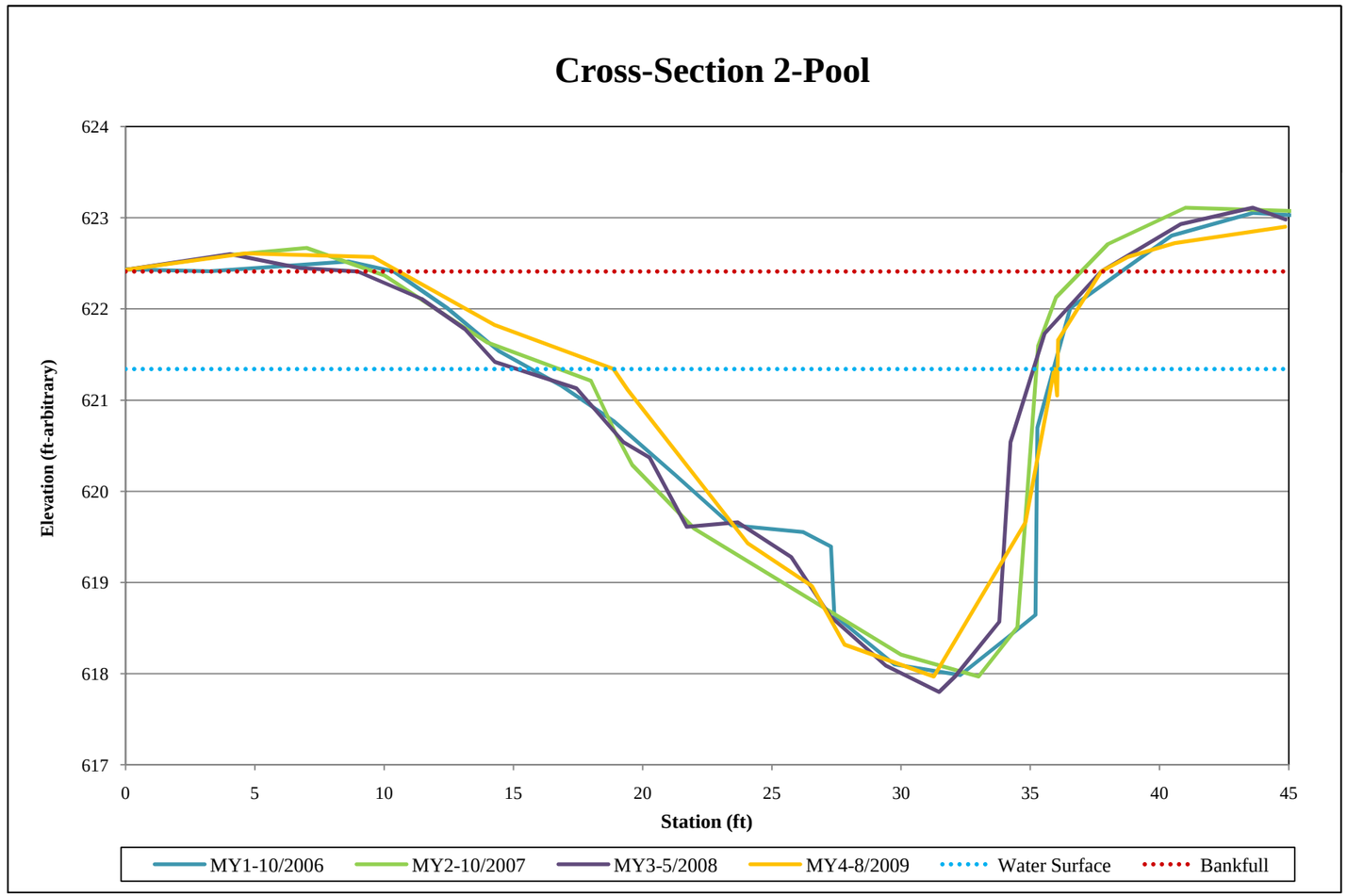
Project Name: UT to Barnes Creek		
Cross-Section: 1		
Feature: Riffle		
8/2009		
Station	**Elevation**	**Notes**
0.00	623.05	x1-lpt
4.79	623.29	x1
8.34	623.37	x1
12.16	623.20	x1-b
14.13	622.82	x1
15.38	622.33	x1
16.91	621.47	x1-lw
16.99	621.29	x1
18.80	621.27	x1
19.78	621.43	x1
20.44	621.47	x1-rw
21.70	621.79	x1
23.74	622.47	x1
25.51	622.60	x1
28.69	623.53	x1
33.11	623.61	x1
37.16	623.54	x1
40.61	623.49	x1
43.83	623.12	x1-rpt

Summary Data	
Bankfull Cross-sectional Area (ft^2)	15.69
Bankfull Width (ft)	15.40
Bankfull Mean Depth (ft)	1.02
Bankfull Max Depth (ft)	1.93
Width/Depth Ratio	15.10
Entrenchment Ratio	8+



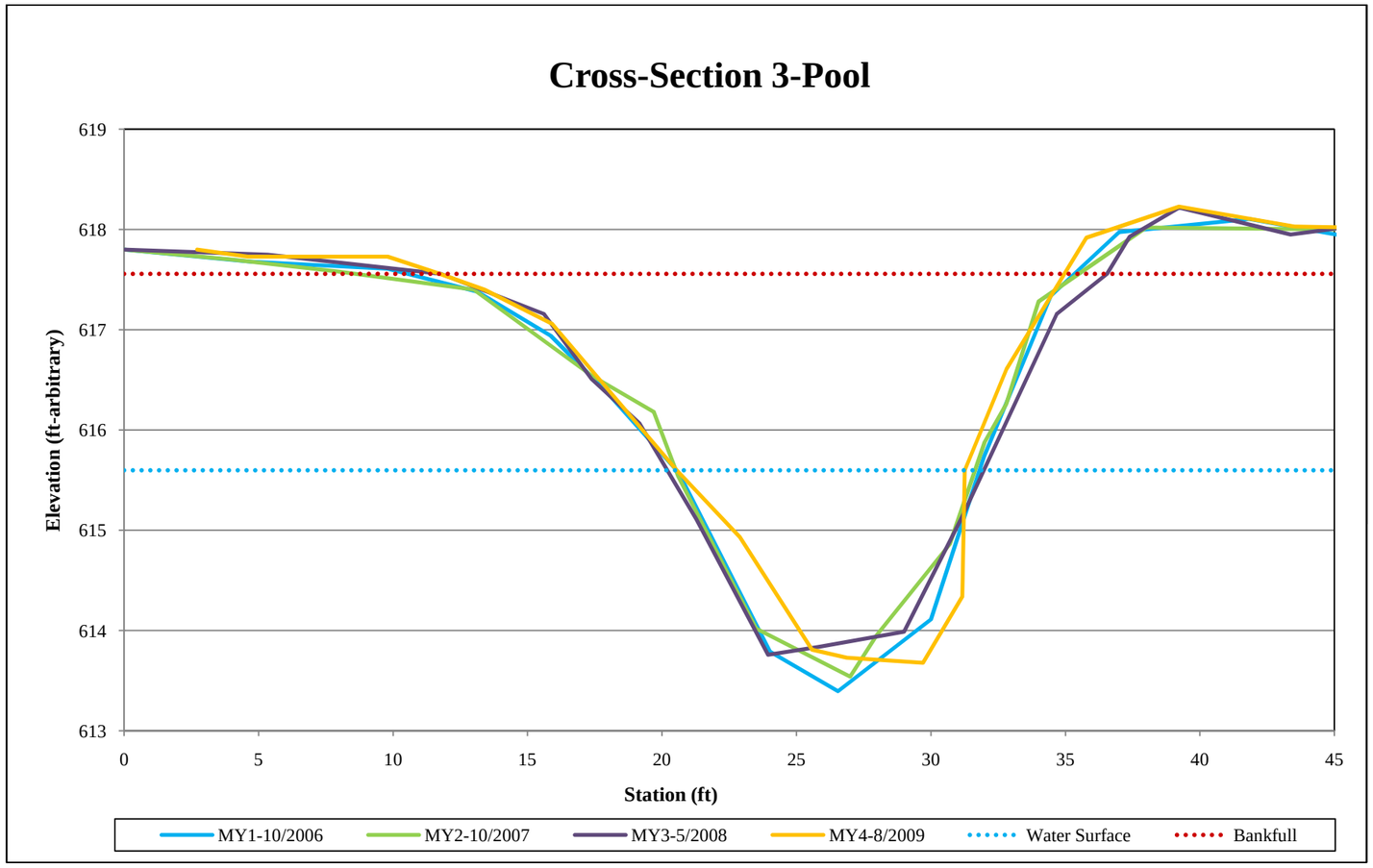
Project Name: UT to Barnes Creek		
Cross-Section: 2		
Feature: Pool		
8/2009		
Station	**Elevation**	**Notes**
0.00	622.43	x2-lpt
4.64	622.61	x2
9.57	622.57	x2
14.29	621.82	x2
18.87	621.34	x2-lw
19.42	621.11	x2
24.06	619.43	x2
26.55	618.96	x2
27.81	618.32	x2
31.27	617.97	x2
35.93	621.34	x2-rw
34.81	619.66	x2
36.04	621.05	x2
36.07	621.66	x2
37.74	622.41	x2-b
38.77	622.57	x2
40.58	622.72	x2
44.86	622.90	x2-rpt

Summary Data	
Bankfull Cross-sectional Area (ft^2)	58.90
Bankfull Width (ft)	27.16
Bankfull Mean Depth (ft)	2.17
Bankfull Max Depth (ft)	4.44
Width/Depth Ratio	12.52
Entrenchment Ratio	4.02+



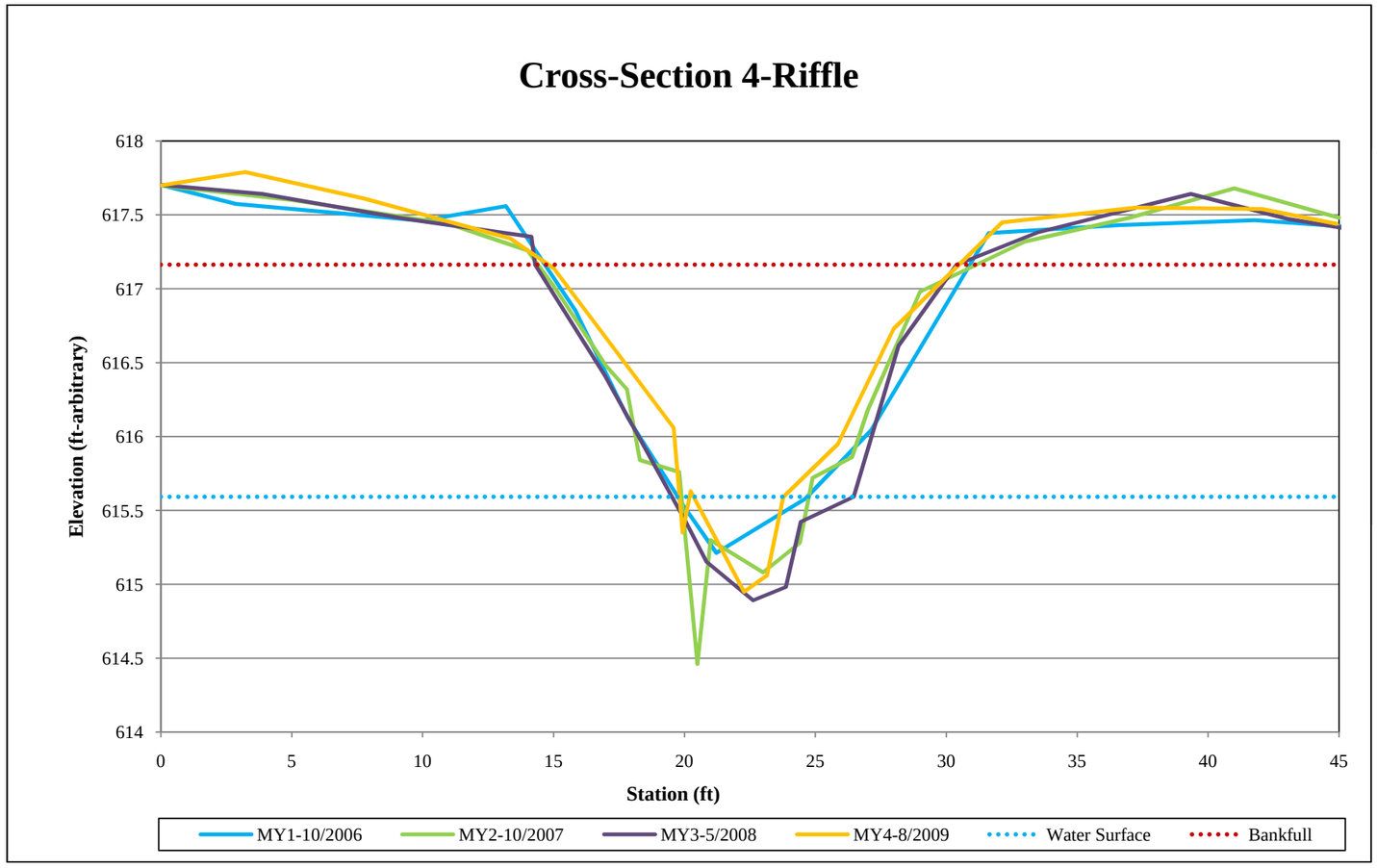
Project Name: UT to Barnes Creek		
Cross-Section: 3		
Feature: Pool		
8/2009		
Station	**Elevation**	**Notes**
2.72	617.80	x3-lpt
4.60	617.73	x3
9.81	617.73	x3
11.75	617.56	x3-b
13.42	617.40	x3
15.92	617.06	x3
20.55	615.60	x3-lw
22.91	614.93	x3
25.58	613.81	x3
26.87	613.73	x3
29.70	613.68	x3
31.17	614.34	x3
31.26	615.60	x3-rw
32.81	616.61	x3
35.78	617.92	x3
39.23	618.23	x3
43.51	618.03	x3
48.12	618.01	x3-rpt

Summary Data	
Bankfull Cross-sectional Area (ft^2)	45.12
Bankfull Width (ft)	23.21
Bankfull Mean Depth (ft)	1.94
Bankfull Max Depth (ft)	3.88
Width/Depth Ratio	11.96
Entrenchment Ratio	1.96



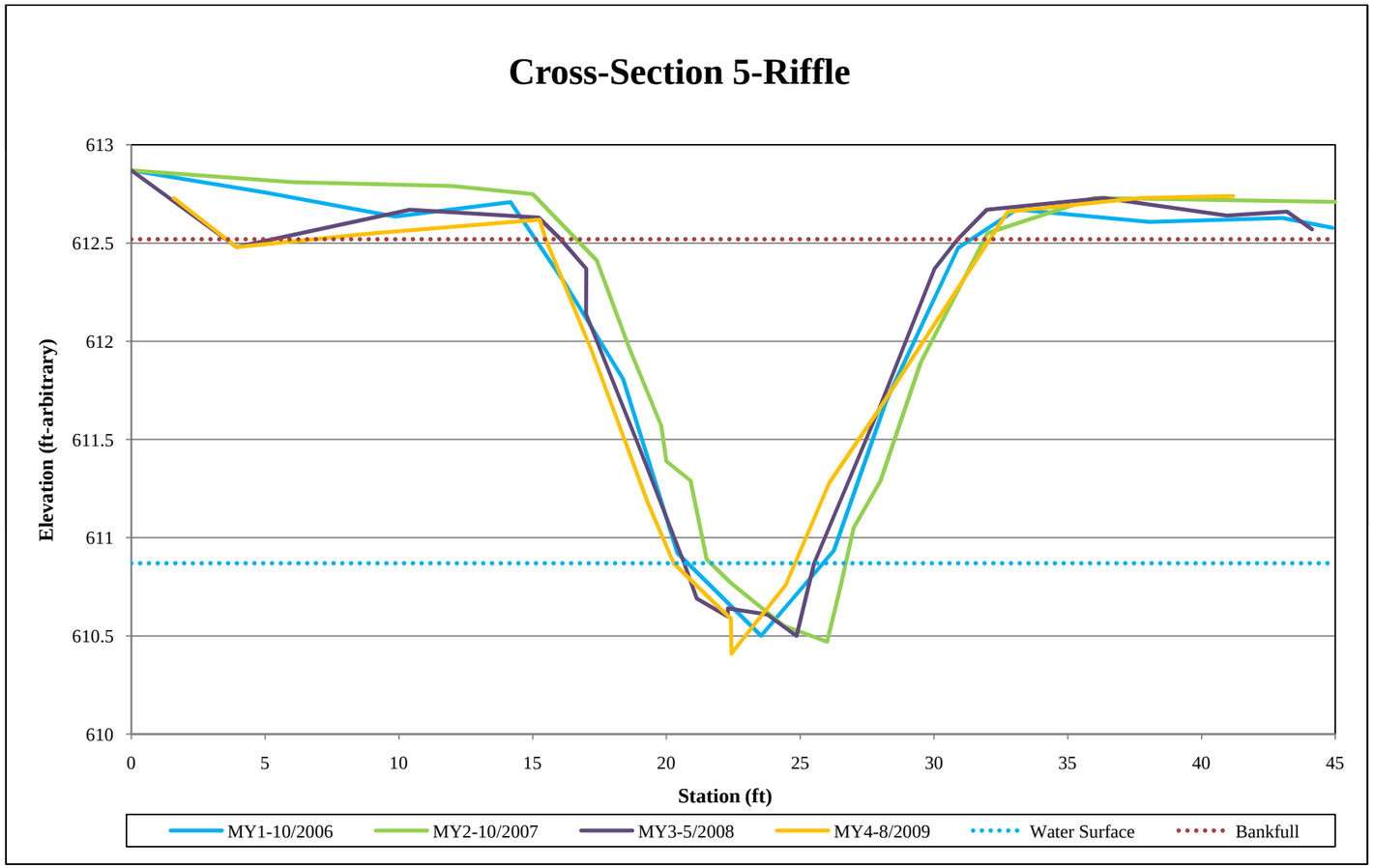
Project Name: UT to Barnes Creek		
Cross-Section: 4		
Feature: Riffle		
8/2009		
Station	**Elevation**	**Notes**
0.00	617.70	x4-lpt
3.22	617.79	x4
7.77	617.61	x4
13.35	617.34	x4
15.00	617.14	x4-b
19.59	616.06	x4
19.93	615.35	x4
20.24	615.63	x4-lw
22.28	614.95	x4
23.15	615.06	x4
23.77	615.59	x4-rw
25.86	615.95	x4
28.00	616.73	x4
32.14	617.45	x4
37.25	617.55	x4
42.06	617.54	x4
44.92	617.44	x4-rpt

Summary Data	
Bankfull Cross-sectional Area (ft^2)	15.29
Bankfull Width (ft)	15.36
Bankfull Mean Depth (ft)	1.00
Bankfull Max Depth (ft)	2.19
Width/Depth Ratio	15.36
Entrenchment Ratio	2.55+



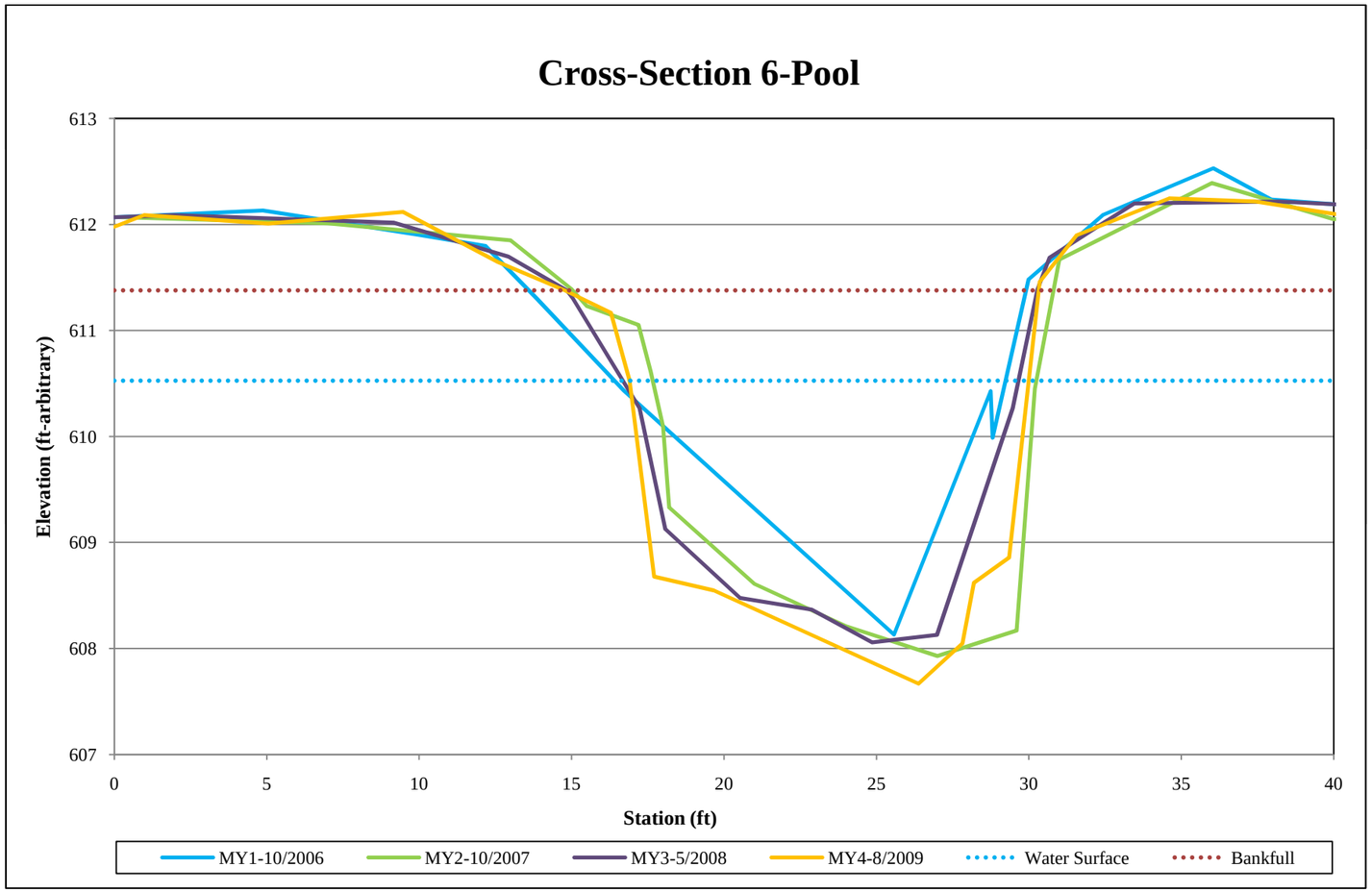
Project Name: UT to Barnes Creek		
Cross-Section: 5		
Feature: Riffle		
8/2009		
Station	**Elevation**	**Notes**
1.58	612.73	x5-lpt
3.93	612.48	x5
8.99	612.55	x5
15.26	612.62	x5-b
15.49	612.52	x5
17.21	611.95	x5
19.30	611.18	x5
20.27	610.87	x5-lw
21.55	610.70	x5
22.41	610.59	x5
22.43	610.41	x5
22.60	610.44	x5-rw
24.46	610.76	x5
26.08	611.28	x5
27.88	611.64	x5
32.76	612.66	x5
37.73	612.73	x5
41.18	612.74	x5-rpt
46.44	612.73	x5

Summary Data	
Bankfull Cross-sectional Area (ft^2)	17.94
Bankfull Width (ft)	16.60
Bankfull Mean Depth (ft)	1.08
Bankfull Max Depth (ft)	2.11
Width/Depth Ratio	15.37
Entrenchment Ratio	2.95+



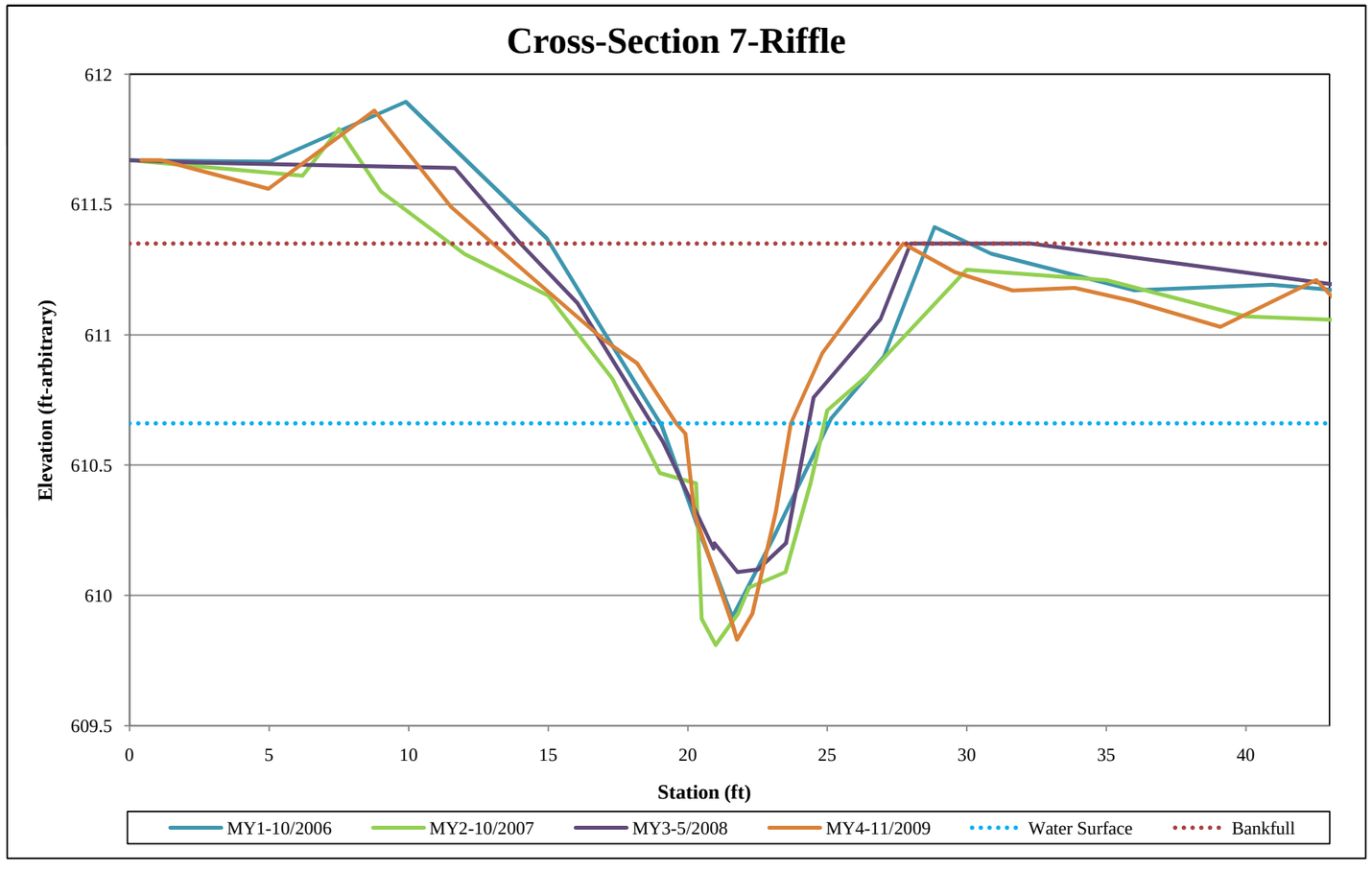
Project Name: UT to Barnes Creek		
Cross-Section: 6		
Feature: Pool		
8/2009		
Station	**Elevation**	**Notes**
0.00	611.98	x6-lpt
0.98	612.09	x6
5.05	612.01	x6
9.47	612.12	x6
12.58	611.65	x6
14.78	611.38	x6-b
16.29	611.17	x6
16.90	610.53	x6-lw
17.71	608.68	x6
19.67	608.55	x6
26.38	607.67	x6
27.82	608.05	x6
28.20	608.62	x6-rw
29.35	608.86	x6
30.36	611.46	x6
31.57	611.90	x6
34.61	612.25	x6
37.44	612.22	x6
41.37	612.04	x6
44.97	611.89	x6-rpt

Summary Data	
Bankfull Cross-sectional Area (ft^2)	39.82
Bankfull Width (ft)	15.57
Bankfull Mean Depth (ft)	2.56
Bankfull Max Depth (ft)	3.71
Width/Depth Ratio	6.08
Entrenchment Ratio	2.35+



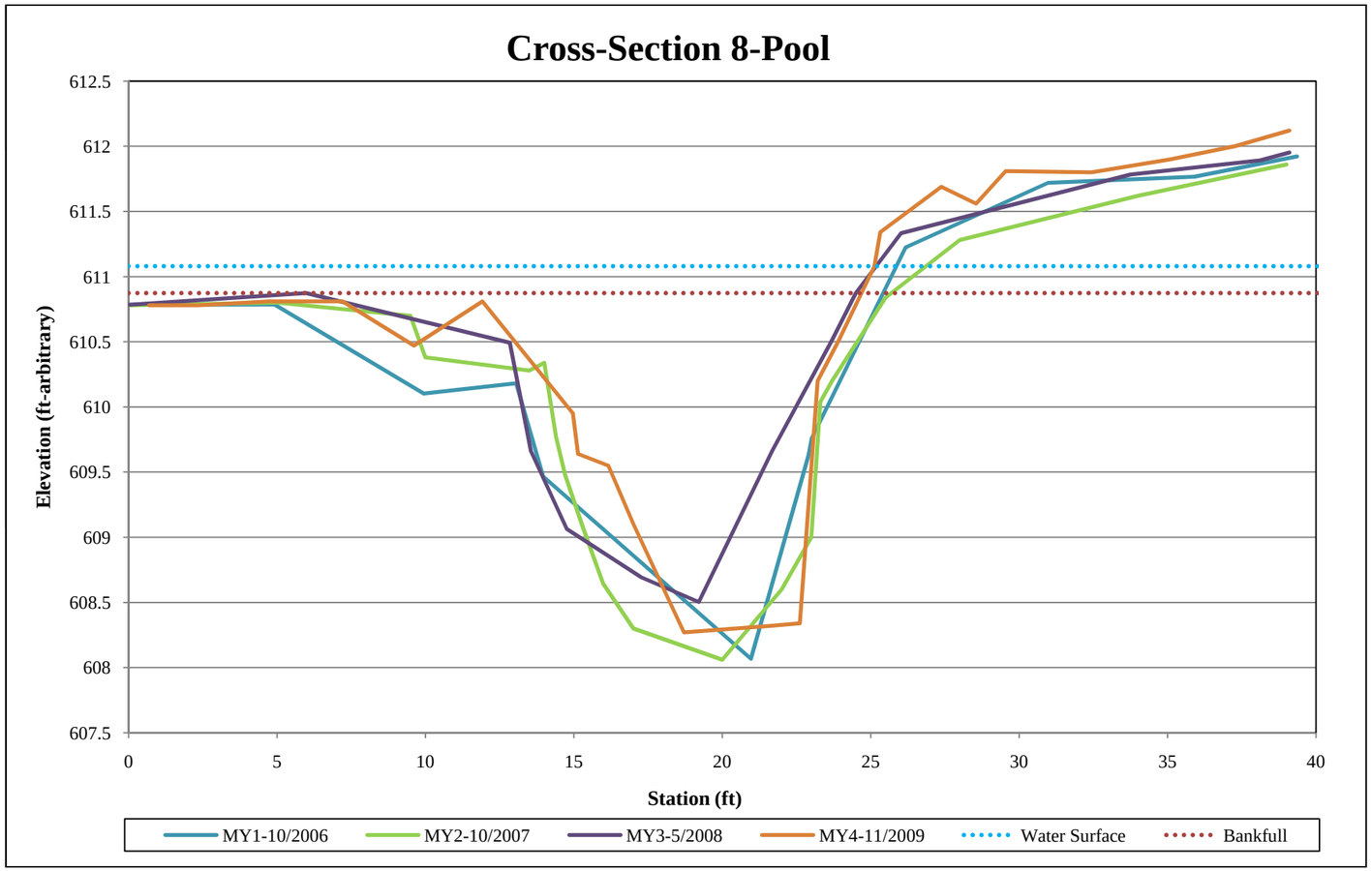
Project Name: UT to Barnes Creek		
Cross-Section: 7		
Feature: Riffle		
11/2009		
Station	**Elevation**	**Notes**
0.42	611.67	x7-lpt
1.13	611.67	x7
4.97	611.56	x7
8.77	611.86	x7
11.52	611.49	x7
14.30	611.23	x7
17.00	610.98	x7
18.19	610.89	x7
19.59	610.66	x7-lw
19.92	610.62	x7
20.25	610.31	x7
21.63	609.88	x7
21.77	609.83	x7
22.31	609.93	x7
23.16	610.32	x7
23.69	610.66	x7-rw
24.82	610.93	x7
27.72	611.35	x7-b
29.57	611.24	x7
31.65	611.17	x7
33.86	611.18	x7
35.92	611.13	x7
39.09	611.03	x7
42.52	611.21	x7
44.75	610.96	x7-rpt

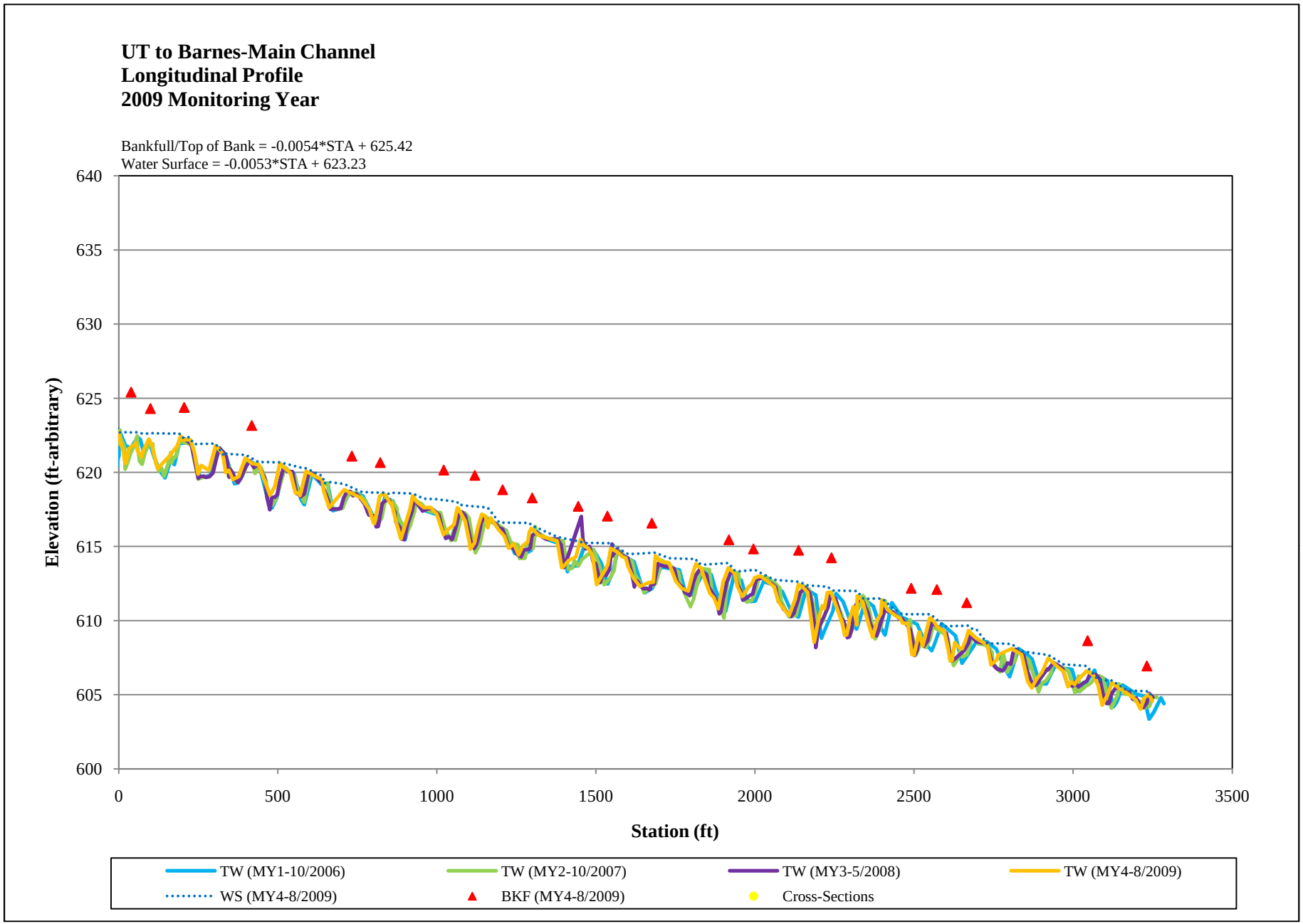
Summary Data	
Bankfull Cross-sectional Area (ft^2)	8.02
Bankfull Width (ft)	14.70
Bankfull Mean Depth (ft)	0.55
Bankfull Max Depth (ft)	1.52
Width/Depth Ratio	26.73
Entrenchment Ratio	3.2+

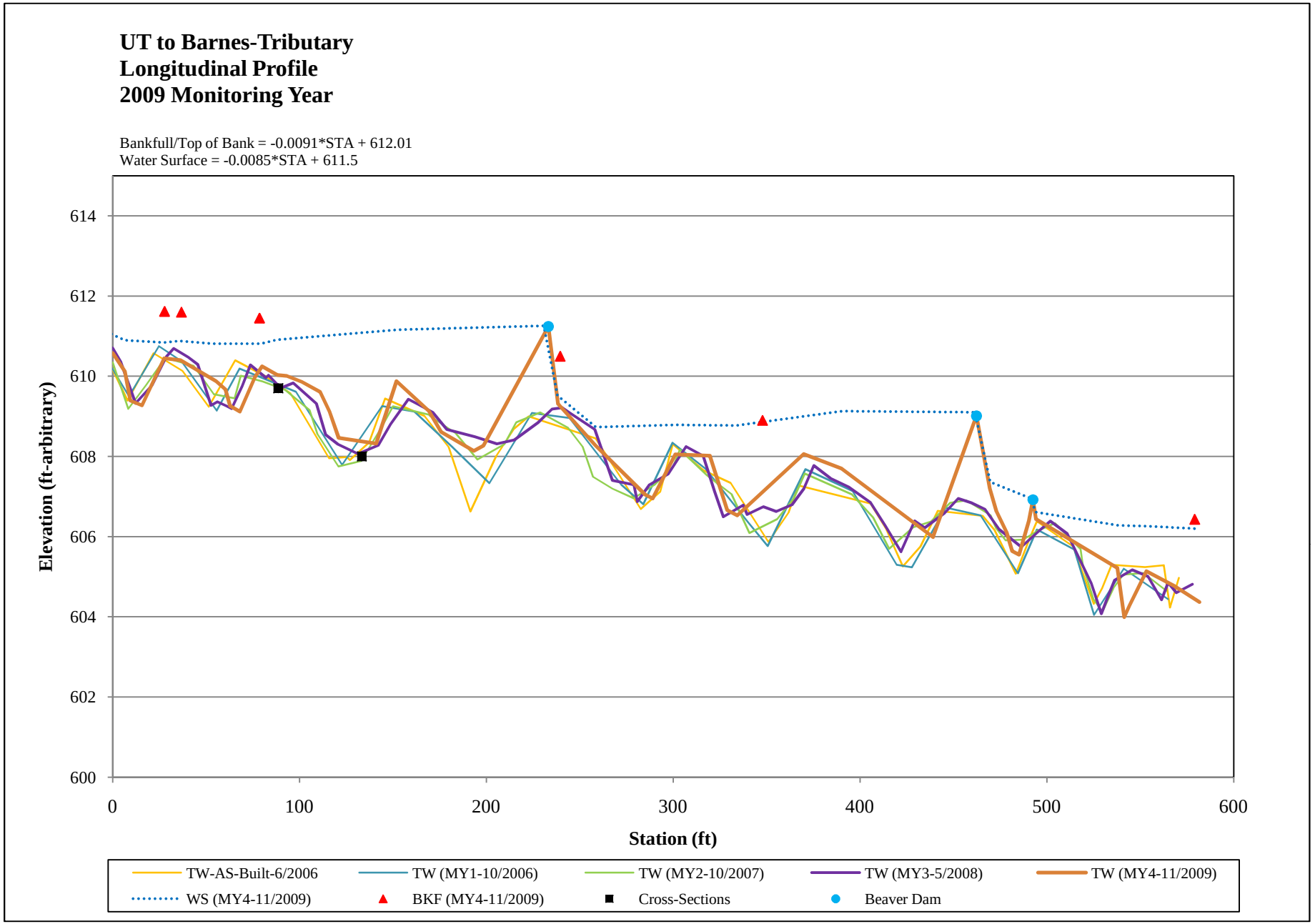


Project Name: UT to Barnes Creek		
Cross-Section: 8		
Feature: Pool		
11/2009		
Station	**Elevation**	**Notes**
0.69	610.78	x8-lpt
2.35	610.78	x8
4.74	610.81	x8
7.21	610.81	x8
9.61	610.47	x8
11.92	610.81	x8
14.97	609.95	x8
15.14	609.64	x8
16.16	609.55	x8
17.01	609.10	x8
18.71	608.27	x8
21.57	608.32	x8
22.61	608.34	x8
23.21	610.20	x8
23.92	610.51	x8
25.12	611.08	x8-rw
25.32	611.34	x8
27.38	611.69	x8
28.55	611.56	x8
29.55	611.81	x8-b
32.44	611.80	x8
35.09	611.90	x8
37.27	612.00	x8
39.10	612.12	x8-rpt

Summary Data	
Bankfull Cross-sectional Area (ft^2)	18.71
Bankfull Width (ft)	12.63
Bankfull Mean Depth (ft)	1.48
Bankfull Max Depth (ft)	2.54
Width/Depth Ratio	8.53
Entrenchment Ratio	2.11+

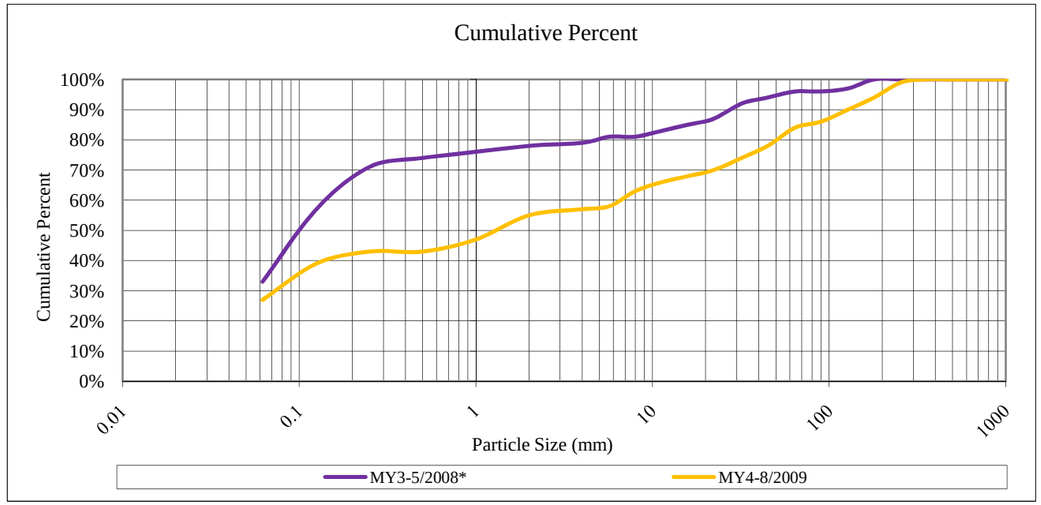


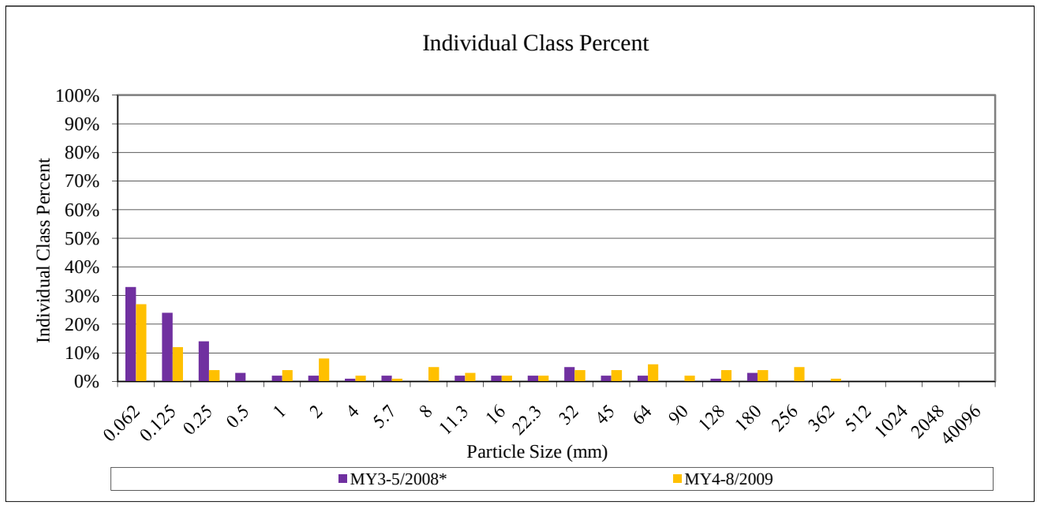

UT to Barnes-Main Channel
Longitudinal Profile
2009 Monitoring Year
Bankfull/Top of Bank = -0.0054*STA + 625.42
Water Surface = -0.0053*STA + 623.23
Elevation (ft-arbitrary)
640
635
630
625
620
615
610
605
600
0
500
1000
1500
2000
2500
3000
3500
Station (ft)
TW (MY1-10/2006)
TW (MY2-10/2007)
TW (MY3-5/2008)
TW (MY4-8/2009)
WS (MY4-8/2009)
BKF (MY4-8/2009)
Cross-Sections


UT to Barnes-Tributary
Longitudinal Profile
2009 Monitoring Year
Bankfull/Top of Bank = -0.0091*STA + 612.01
Water Surface = -0.0085*STA + 611.5
Elevation (ft-arbitrary)
614
612
610
608
606
604
602
600
0
100
200
300
400
500
600
Station (ft)
TW-AS-Built-6/2006
TW (MY1-10/2006)
TW (MY2-10/2007)
TW (MY3-5/2008)
TW (MY4-11/2009)
WS (MY4-11/2009)
BKF (MY4-11/2009)
Cross-Sections
Beaver Dam

Project Name: UT to Barnes Creek					
Cross-Section: 1					
Feature: Riffle					
			2009		
Description	**Material**	**Size (mm)**	**Total #**	**Item %**	**Cum %**
Silt/Clay	silt/clay	0.062	27	27%	27%
Sand	very fine sand	0.125	12	12%	39%
	fine sand	0.250	4	4%	43%
	medium sand	0.50	0	0%	43%
	coarse sand	1.00	4	4%	47%
	very coarse sand	2.0	8	8%	55%
Gravel	very fine gravel	4.0	2	2%	57%
	fine gravel	5.7	1	1%	58%
	fine gravel	8.0	5	5%	63%
	medium gravel	11.3	3	3%	66%
	medium gravel	16.0	2	2%	68%
	course gravel	22.3	2	2%	70%
	course gravel	32.0	4	4%	74%
	very coarse gravel	45	4	4%	78%
	very coarse gravel	64	6	6%	84%
Cobble	small cobble	90	2	2%	86%
	medium cobble	128	4	4%	90%
	large cobble	180	4	4%	94%
	very large cobble	256	5	5%	99%
Boulder	small boulder	362	1	1%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	1.38
D84	64
D95	195.2

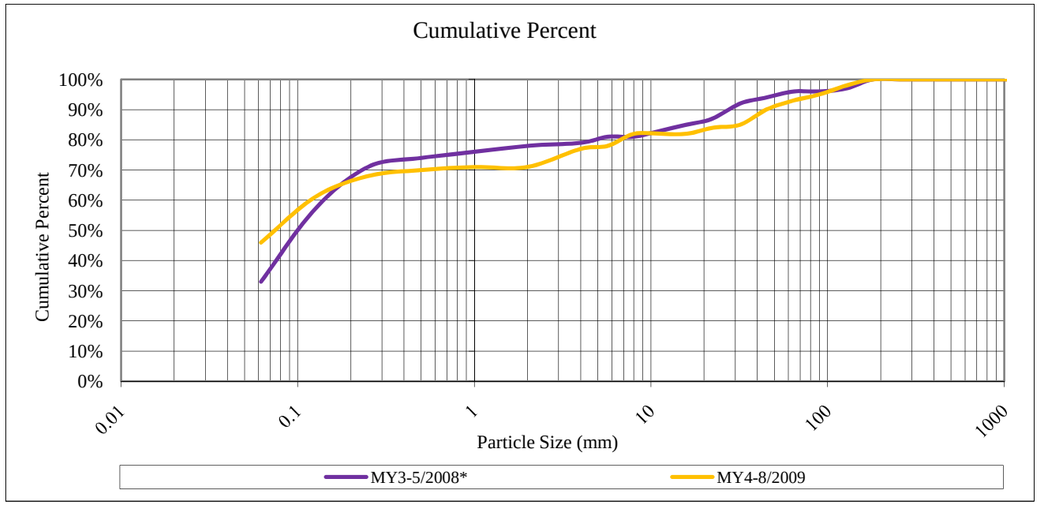


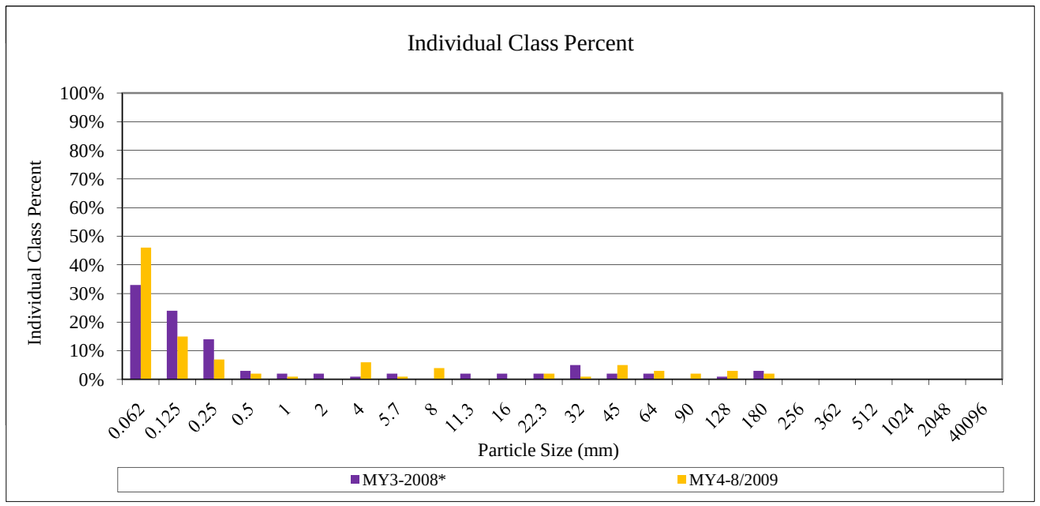


*Data reported based on reachwide pebble count

Project Name: UT to Barnes Creek					
Cross-Section: 2					
Feature: Pool					
			2009		
Description	**Material**	**Size (mm)**	**Total #**	**Item %**	**Cum %**
Silt/Clay	silt/clay	0.062	46	46%	46%
Sand	very fine sand	0.125	15	15%	61%
	fine sand	0.250	7	7%	68%
	medium sand	0.50	2	2%	70%
	coarse sand	1.00	1	1%	71%
	very coarse sand	2.0	0	0%	71%
Gravel	very fine gravel	4.0	6	6%	77%
	fine gravel	5.7	1	1%	78%
	fine gravel	8.0	4	4%	82%
	medium gravel	11.3	0	0%	82%
	medium gravel	16.0	0	0%	82%
	course gravel	22.3	2	2%	84%
	course gravel	32.0	1	1%	85%
	very coarse gravel	45	5	5%	90%
	very coarse gravel	64	3	3%	93%
Cobble	small cobble	90	2	2%	95%
	medium cobble	128	3	3%	98%
	large cobble	180	2	2%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	0.08
D84	22.6
D95	90

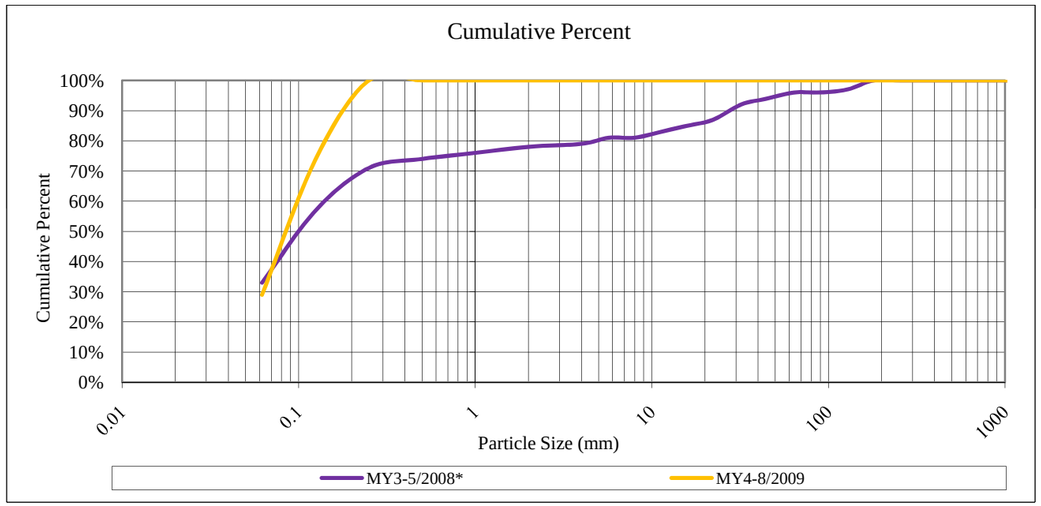


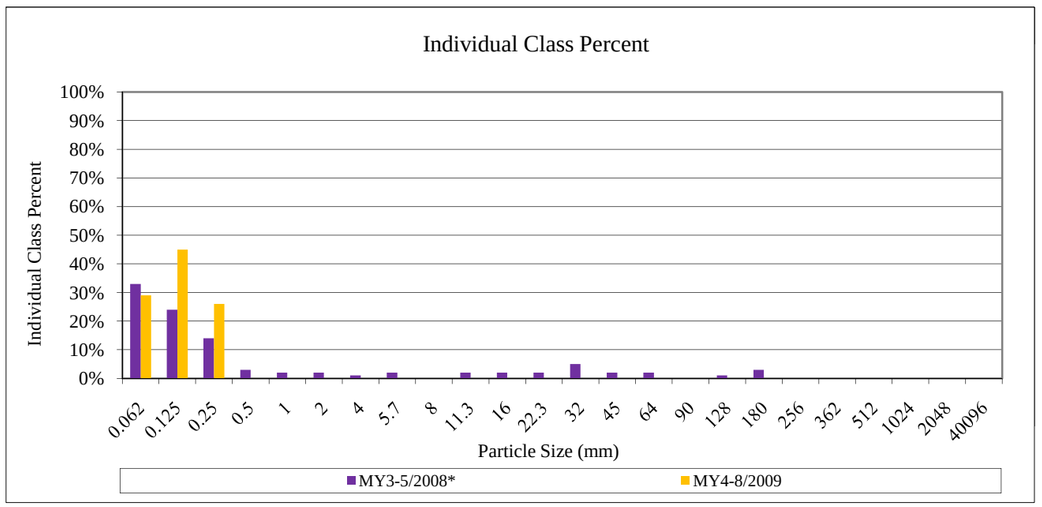


*Data reported based on reachwide pebble count

Project Name: UT to Barnes Creek					
Cross-Section: 3					
Feature: Pool					
			2009		
Description	**Material**	**Size (mm)**	**Total #**	**Item %**	**Cum %**
Silt/Clay	silt/clay	0.062	29	29%	29%
Sand	very fine sand	0.125	45	45%	74%
	fine sand	0.250	26	26%	100%
	medium sand	0.50	0	0%	100%
	coarse sand	1.00	0	0%	100%
	very coarse sand	2.0	0	0%	100%
Gravel	very fine gravel	4.0	0	0%	100%
	fine gravel	5.7	0	0%	100%
	fine gravel	8.0	0	0%	100%
	medium gravel	11.3	0	0%	100%
	medium gravel	16.0	0	0%	100%
	course gravel	22.3	0	0%	100%
	course gravel	32.0	0	0%	100%
	very coarse gravel	45	0	0%	100%
	very coarse gravel	64	0	0%	100%
Cobble	small cobble	90	0	0%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	0.09
D84	0.17
D95	0.23

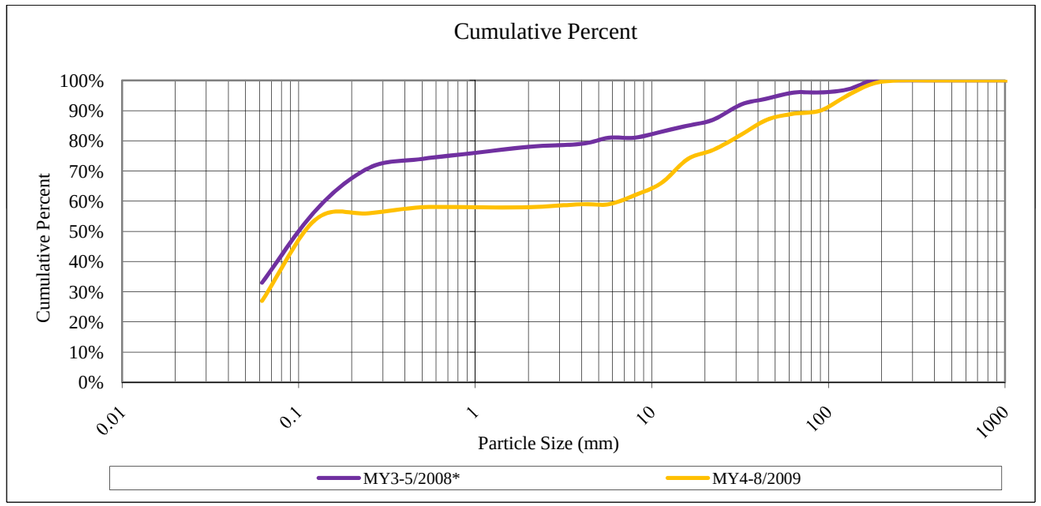


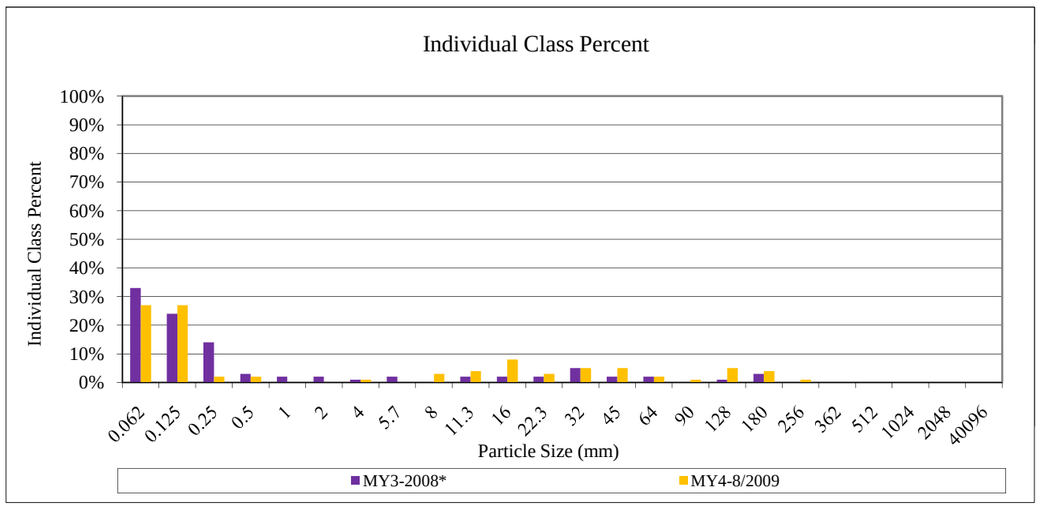


*Data reported based on reachwide pebble count

Project Name: UT to Barnes Creek					
Cross-Section: 4					
Feature: Riffle					
			2009		
Description	**Material**	**Size (mm)**	**Total #**	**Item %**	**Cum %**
Silt/Clay	silt/clay	0.062	27	27%	27%
Sand	very fine sand	0.125	27	27%	54%
	fine sand	0.250	2	2%	56%
	medium sand	0.50	2	2%	58%
	coarse sand	1.00	0	0%	58%
	very coarse sand	2.0	0	0%	58%
Gravel	very fine gravel	4.0	1	1%	59%
	fine gravel	5.7	0	0%	59%
	fine gravel	8.0	3	3%	62%
	medium gravel	11.3	4	4%	66%
	medium gravel	16.0	8	8%	74%
	course gravel	22.3	3	3%	77%
	course gravel	32.0	5	5%	82%
	very coarse gravel	45	5	5%	87%
	very coarse gravel	64	2	2%	89%
Cobble	small cobble	90	1	1%	90%
	medium cobble	128	5	5%	95%
	large cobble	180	4	4%	99%
	very large cobble	256	1	1%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	0.12
D84	37.2
D95	128

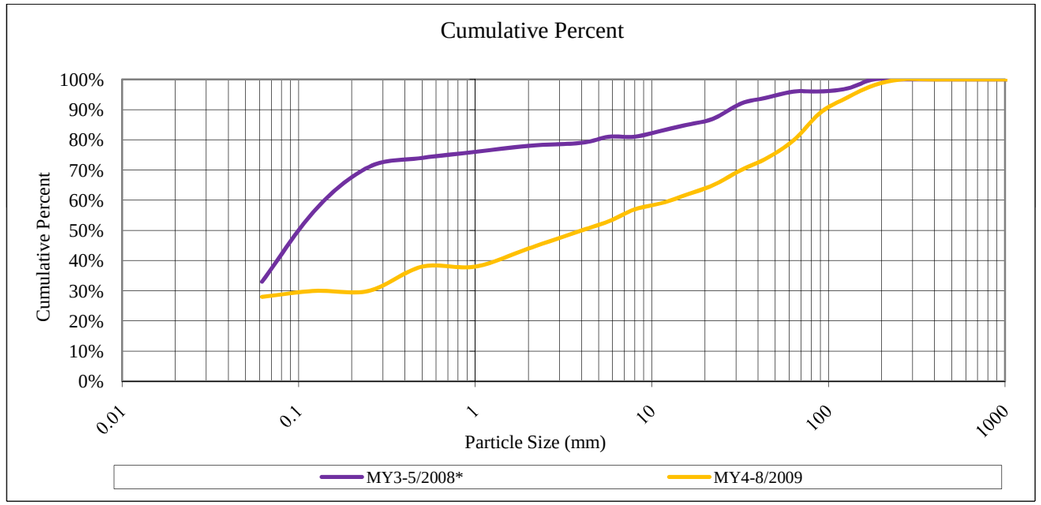


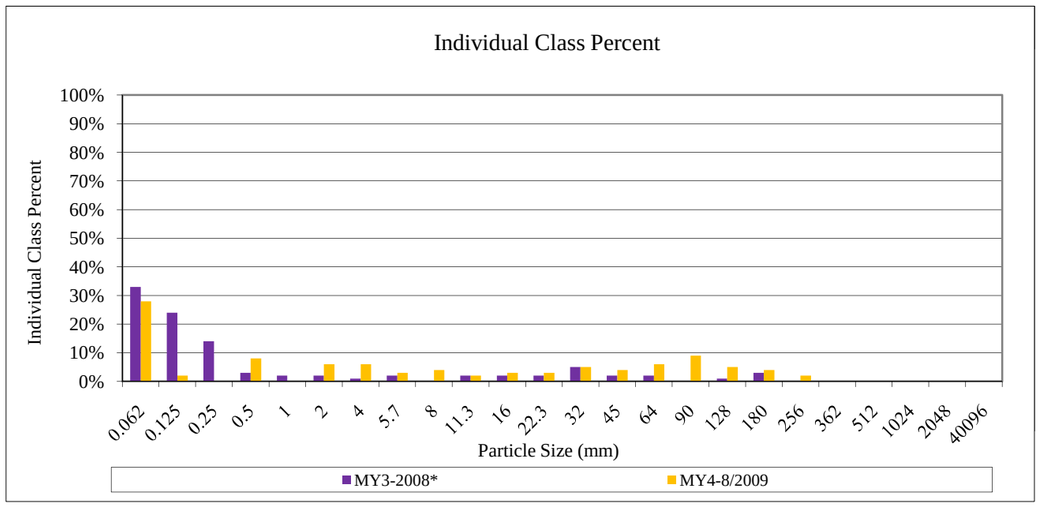


*Data reported based on reachwide pebble count

Project Name: UT to Barnes Creek					
Cross-Section: 5					
Feature: Riffle					
			2009		
Description	**Material**	**Size (mm)**	**Total #**	**Item %**	**Cum %**
Silt/Clay	silt/clay	0.062	28	28%	28%
Sand	very fine sand	0.125	2	2%	30%
	fine sand	0.250	0	0%	30%
	medium sand	0.50	8	8%	38%
	coarse sand	1.00	0	0%	38%
	very coarse sand	2.0	6	6%	44%
Gravel	very fine gravel	4.0	6	6%	50%
	fine gravel	5.7	3	3%	53%
	fine gravel	8.0	4	4%	57%
	medium gravel	11.3	2	2%	59%
	medium gravel	16.0	3	3%	62%
	course gravel	22.3	3	3%	65%
	course gravel	32.0	5	5%	70%
	very coarse gravel	45	4	4%	74%
	very coarse gravel	64	6	6%	80%
Cobble	small cobble	90	9	9%	89%
	medium cobble	128	5	5%	94%
	large cobble	180	4	4%	98%
	very large cobble	256	2	2%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	4
D84	75.56
D95	141

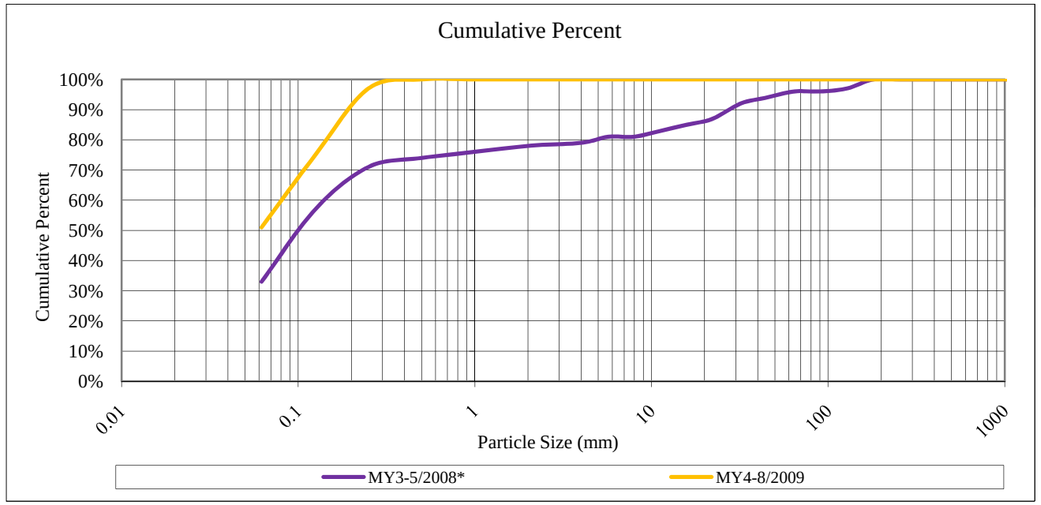


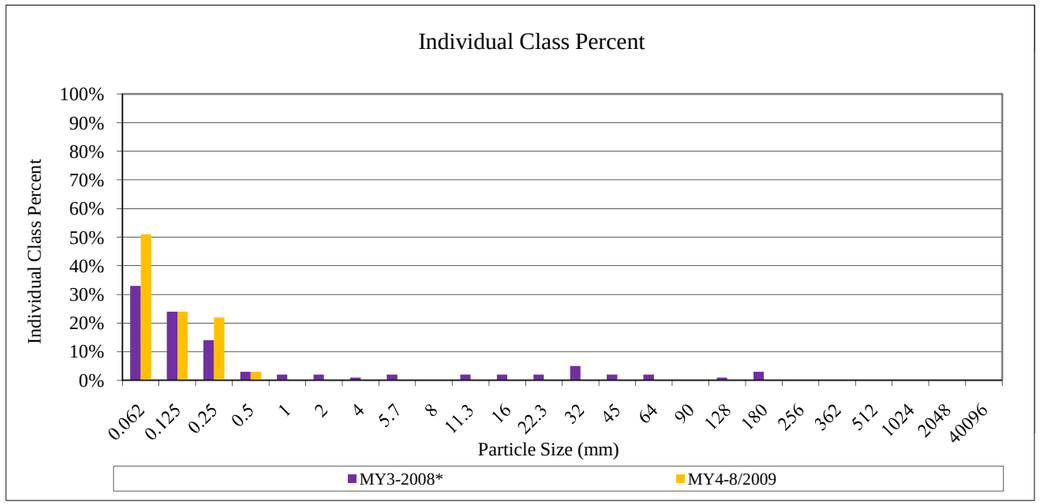


*Data reported based on reachwide pebble count

Project Name: UT to Barnes Creek					
Cross-Section: 6					
Feature: Pool					
			2009		
Description	**Material**	**Size (mm)**	**Total #**	**Item %**	**Cum %**
Silt/Clay	silt/clay	0.062	51	51%	51%
Sand	very fine sand	0.125	24	24%	75%
	fine sand	0.250	22	22%	97%
	medium sand	0.50	3	3%	100%
	coarse sand	1.00	0	0%	100%
	very coarse sand	2.0	0	0%	100%
Gravel	very fine gravel	4.0	0	0%	100%
	fine gravel	5.7	0	0%	100%
	fine gravel	8.0	0	0%	100%
	medium gravel	11.3	0	0%	100%
	medium gravel	16.0	0	0%	100%
	course gravel	22.3	0	0%	100%
	course gravel	32.0	0	0%	100%
	very coarse gravel	45	0	0%	100%
	very coarse gravel	64	0	0%	100%
Cobble	small cobble	90	0	0%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	0.06
D84	0.18
D95	0.24

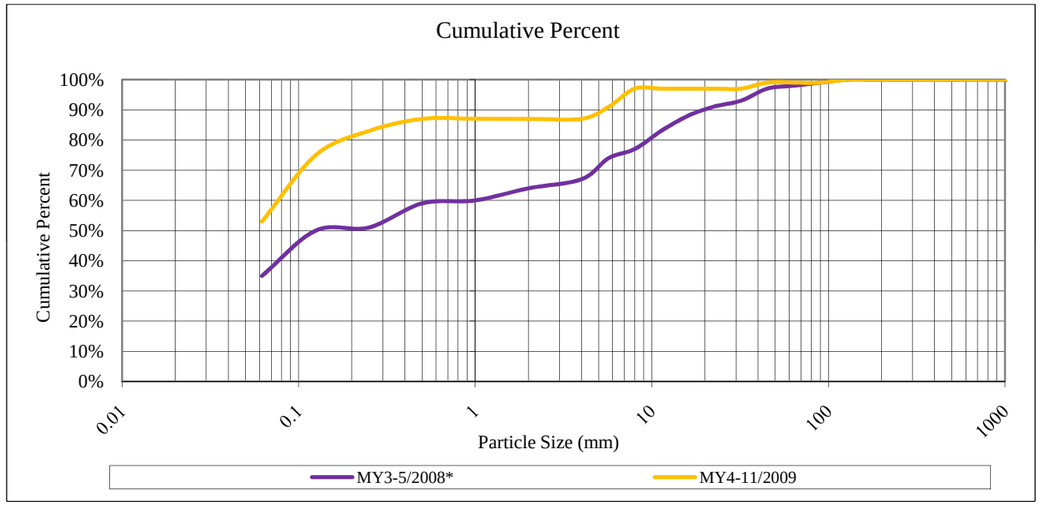


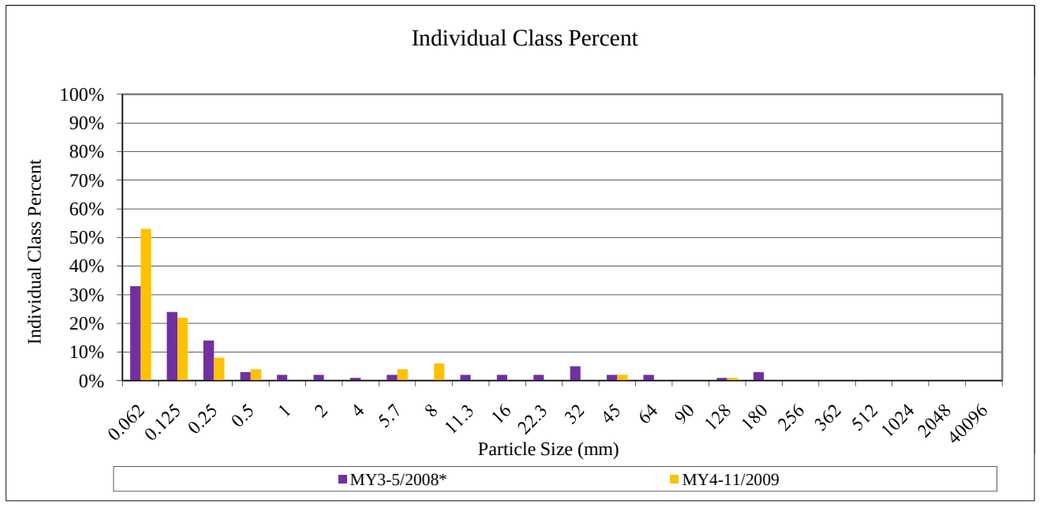


*Data reported based on reachwide pebble count

Project Name: UT to Barnes Creek					
Cross-Section: 7					
Feature: Riffle					
			2009		
Description	**Material**	**Size (mm)**	**Total #**	**Item %**	**Cum %**
Silt/Clay	silt/clay	0.062	53	53%	53%
Sand	very fine sand	0.125	22	22%	75%
	fine sand	0.250	8	8%	83%
	medium sand	0.50	4	4%	87%
	coarse sand	1.00	0	0%	87%
	very coarse sand	2.0	0	0%	87%
Gravel	very fine gravel	4.0	0	0%	87%
	fine gravel	5.7	4	4%	91%
	fine gravel	8.0	6	6%	97%
	medium gravel	11.3	0	0%	97%
	medium gravel	16.0	0	0%	97%
	course gravel	22.3	0	0%	97%
	course gravel	32.0	0	0%	97%
	very coarse gravel	45	2	2%	99%
	very coarse gravel	64	0	0%	99%
Cobble	small cobble	90	0	0%	99%
	medium cobble	128	1	1%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	0.06
D84	0.31
D95	7.23





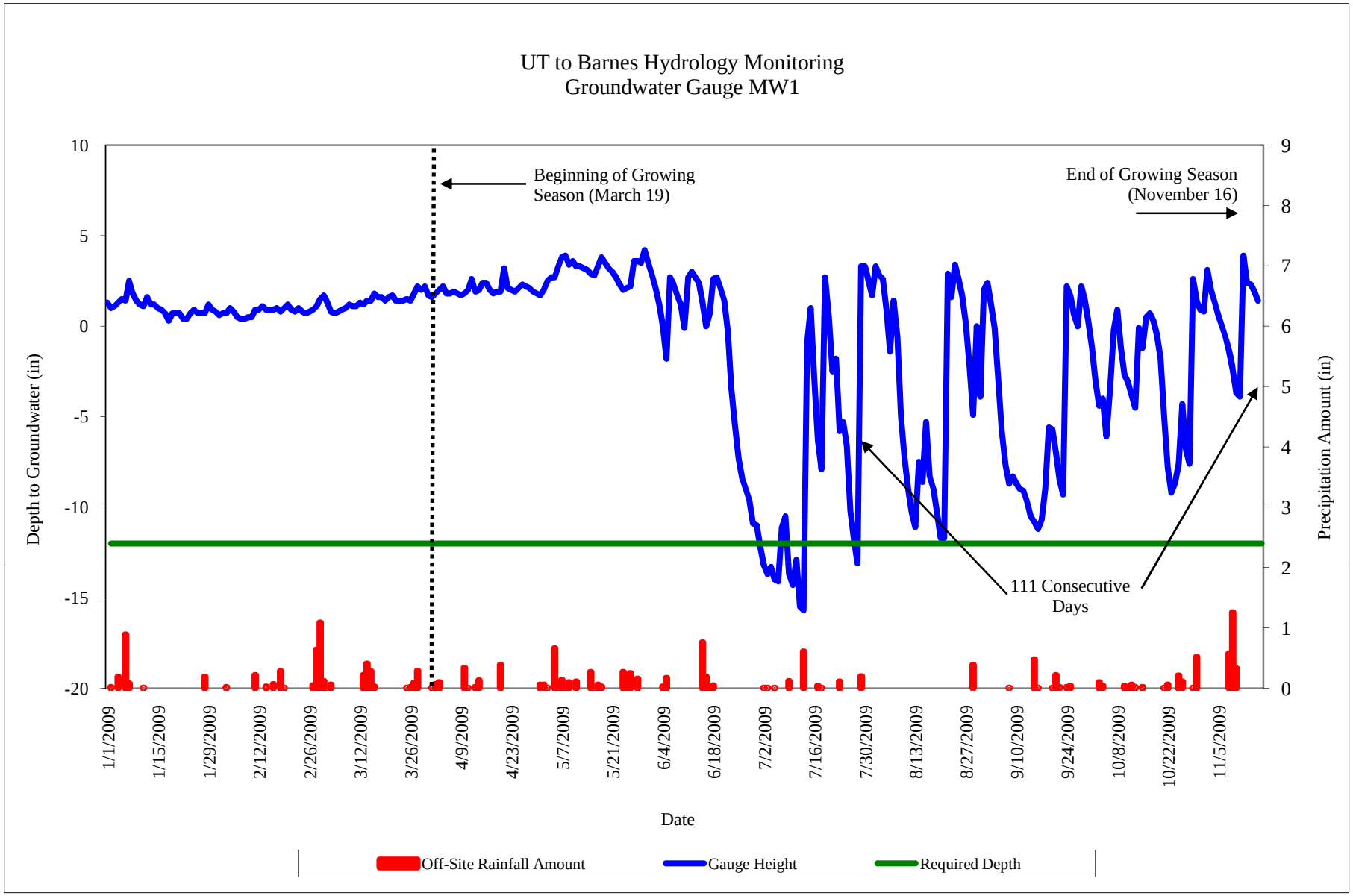
*Data reported based on reachwide pebble count

APPENDIX 5
WETLAND DATA ASSESSMENT

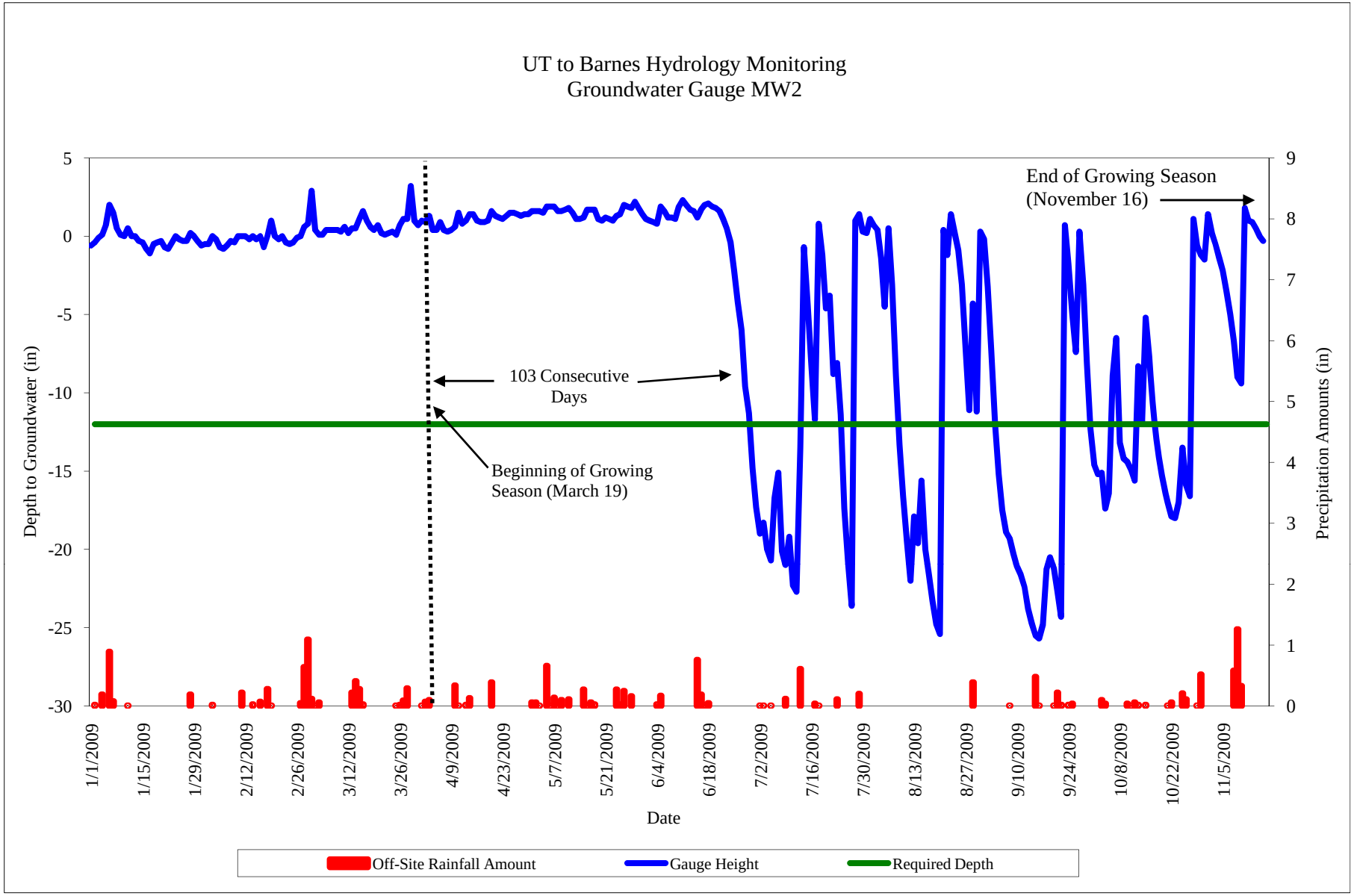
1. Precipitation – Water Level Plots for Gauges*

2. Wetland Criteria Attainment

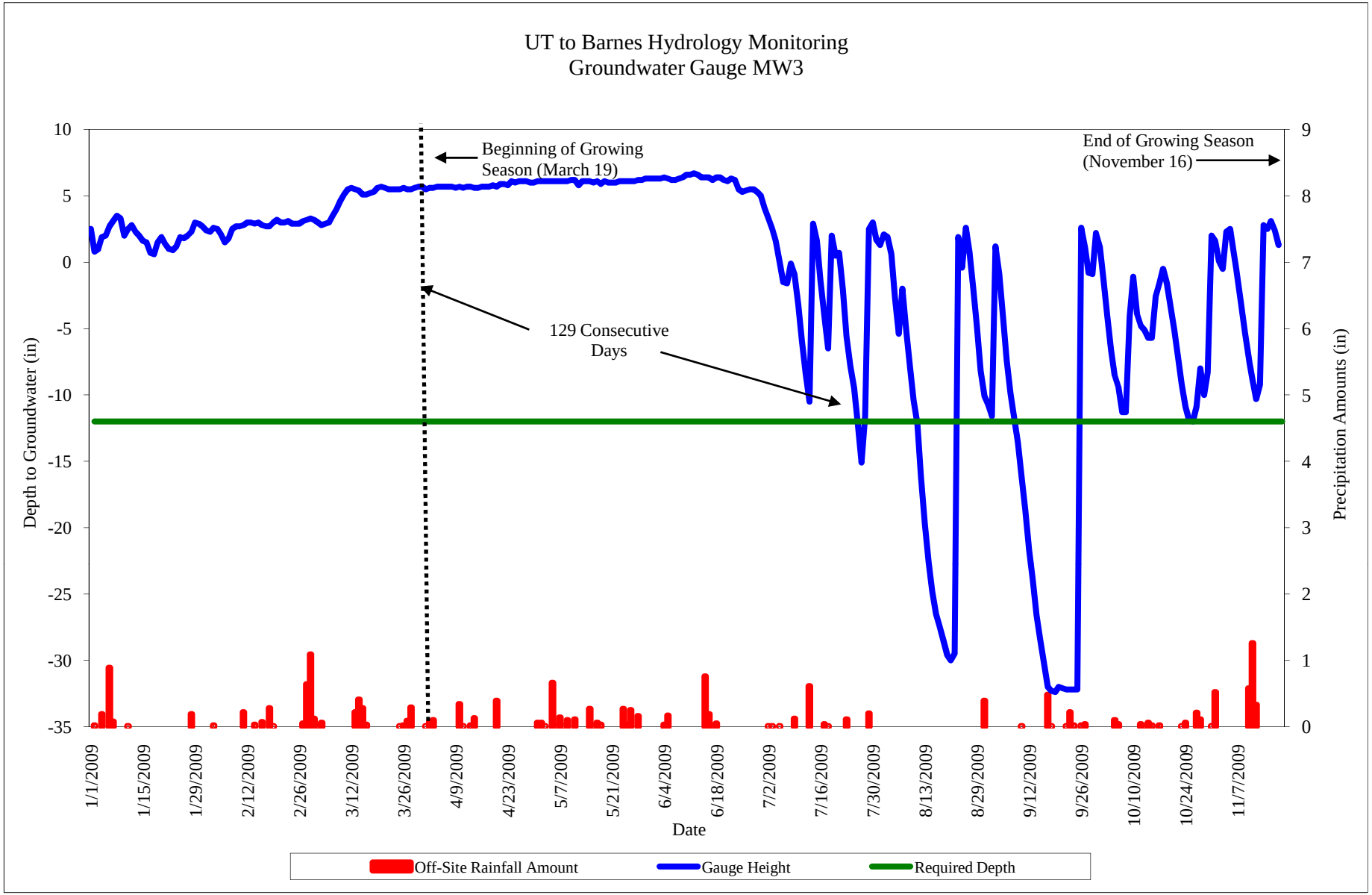
*Raw data tables have been provided electronically.



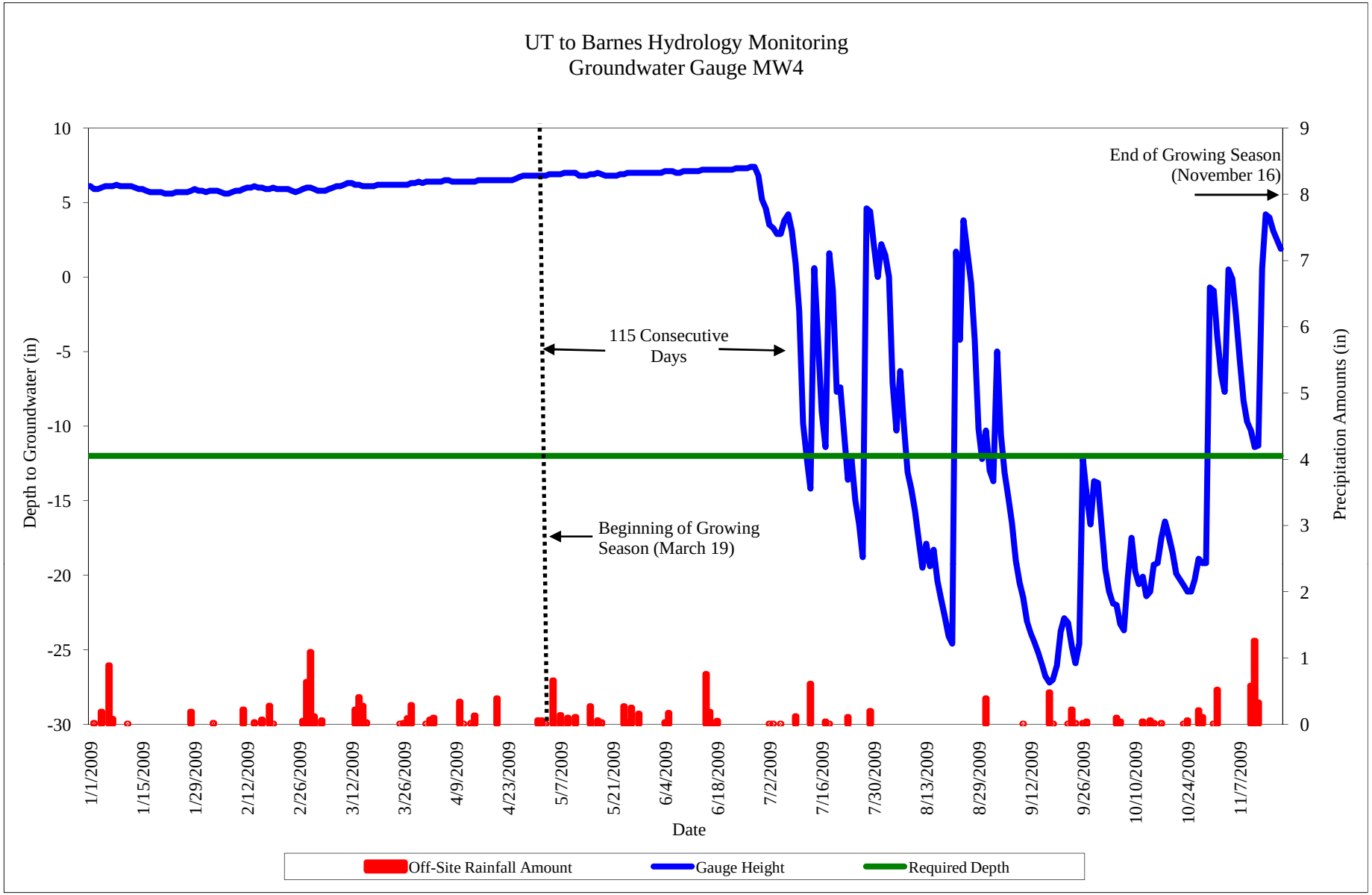
Appendix 5.1 Precipitation - Water Level Plots for Gauges
UT to Barnes Stream and Wetland Restoration
Year 4 of 5



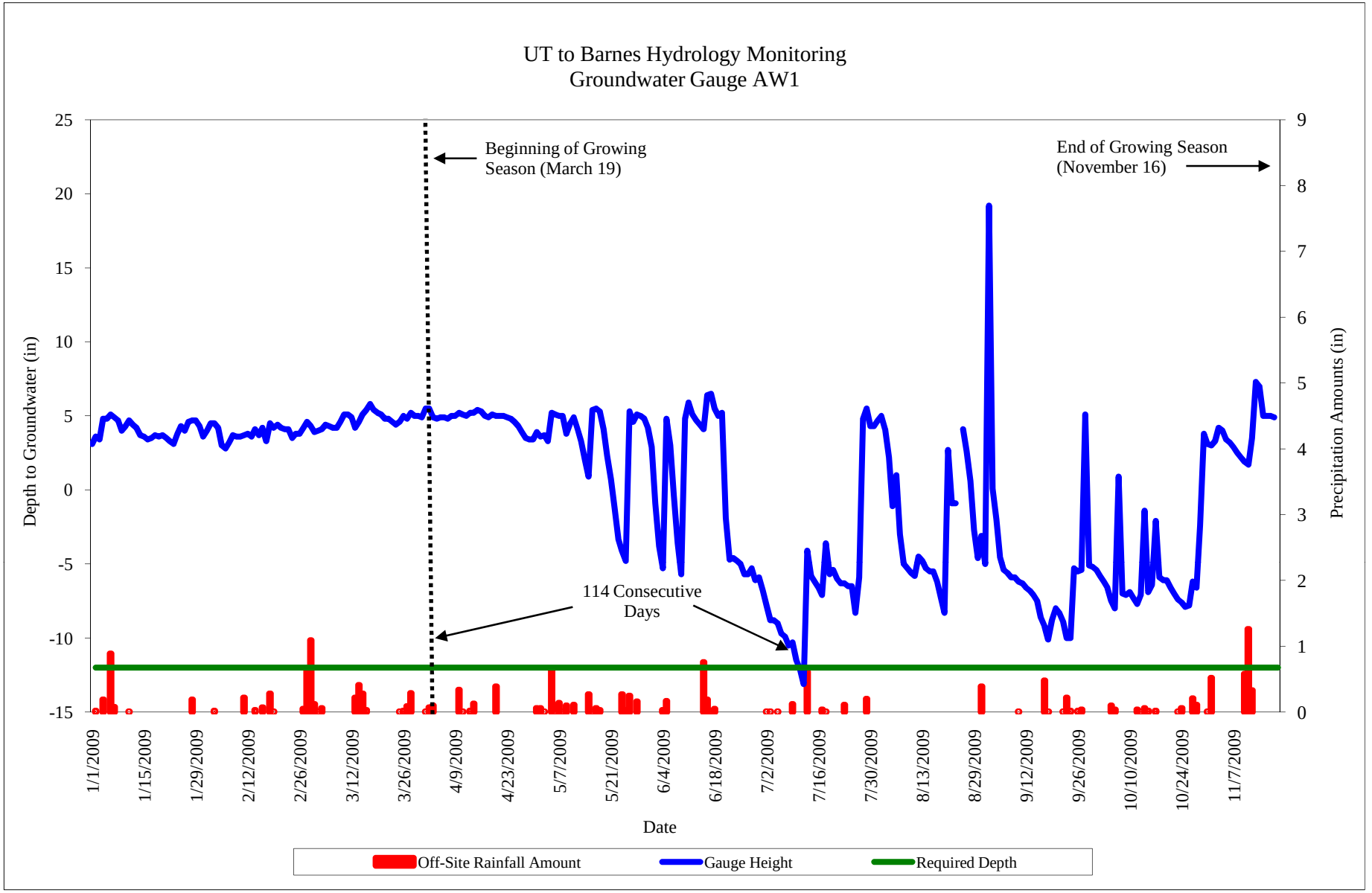
Appendix 5.1 Precipitation - Water Level Plots for Gauges
UT to Barnes Stream and Wetland Restoration
Year 4 of 5



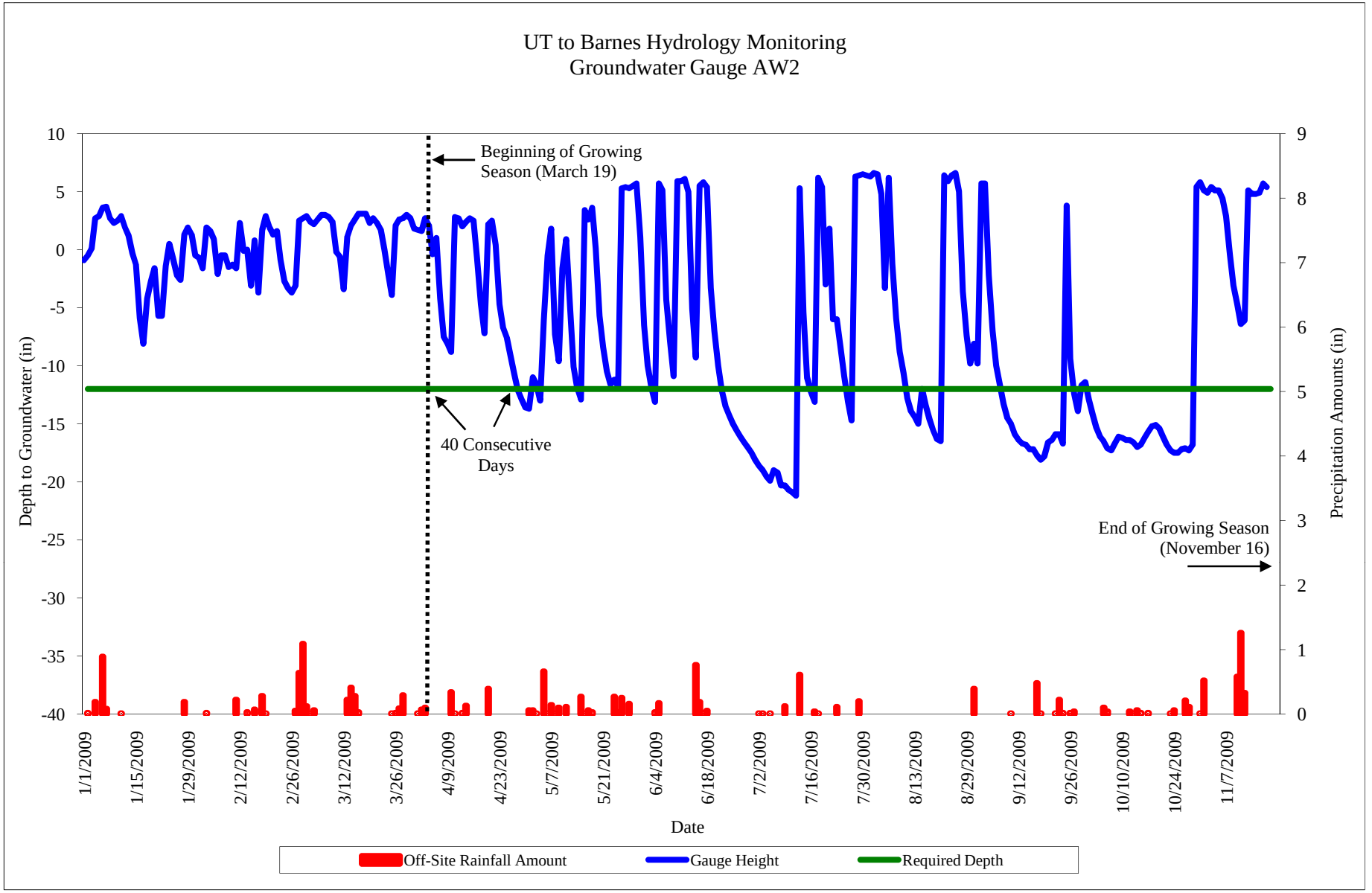
Appendix 5.1 Precipitation - Water Level Plots for Gauges
UT to Barnes Stream and Wetland Restoration
Year 4 of 5



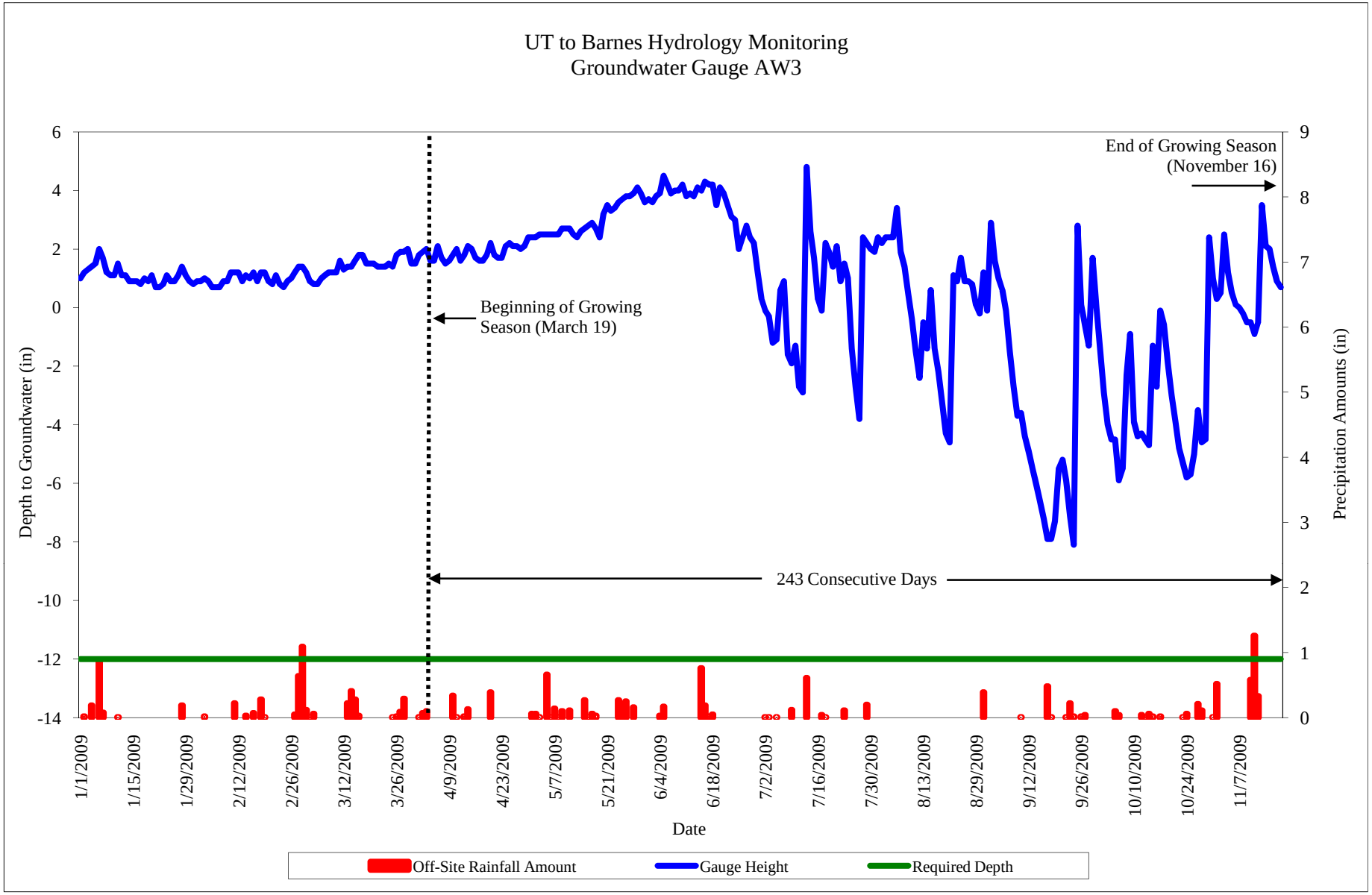
Appendix 5.1 Precipitation - Water Level Plots for Gauges
UT to Barnes Stream and Wetland Restoration
Year 4 of 5



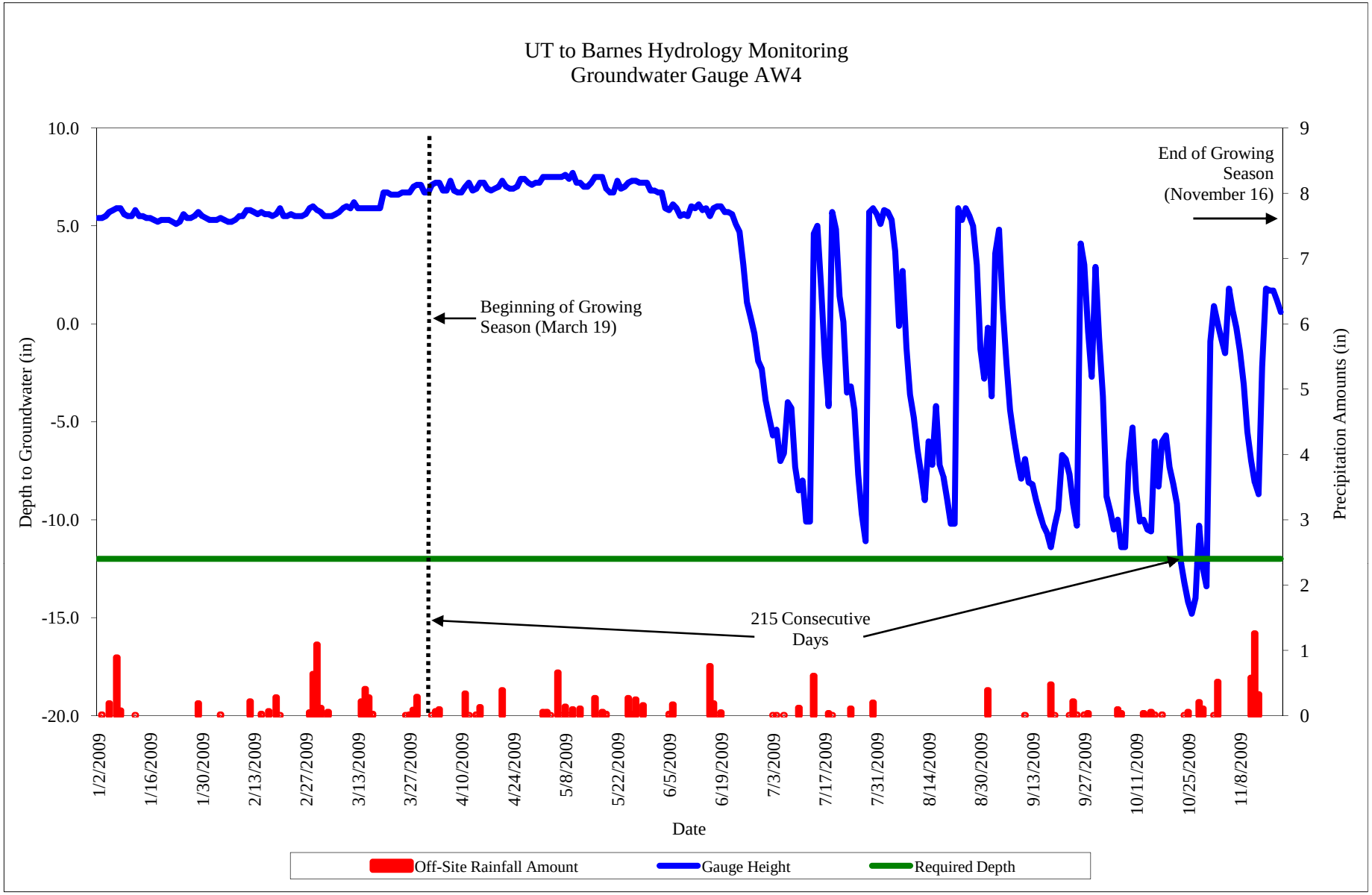
Appendix 5.1 Precipitation - Water Level Plots for Gauges
UT to Barnes Stream and Wetland Restoration
Year 4 of 5



Appendix 5.1 Precipitation - Water Level Plots for Gauges
UT to Barnes Stream and Wetland Restoration
Year 4 of 5



Appendix 5.1 Precipitation - Water Level Plots for Gauges
UT to Barnes Stream and Wetland Restoration
Year 4 of 5



Appendix 5.1 Precipitation - Water Level Plots for Gauges
UT to Barnes Stream and Wetland Restoration
Year 4 of 5

Summary of Groundwater Gauge Results for Years 1 through 5					
Gauge	**Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)**				
	Year 1 (2006)	**Year 2 (2007)^**	**Year 3 (2008)**	**Year 4 (2009)**	**Year 5 (2010)**
AW1	Yes/10 Days (4%)	Yes/93 Days (38%)	Yes/75 Days (31%)	Yes/114 Days (47%)	
AW2	Yes/13 Days (5%)	Yes/166 Days (68%)	Yes/77 Days (33%)	Yes/40 Days (17%)	
AW3	Yes/202 Days (83%)	Yes/12 Days (5%)	Yes/143 Days (59%)	Yes/243 Days (100%)	
AW4	Yes/130 Days (53%)	Yes/37 Days (15%)	Yes/108 Days (44%)	Yes/215 Days (89%)	
MW1*	> 75%	N/A	Yes/89 Days (37%)	Yes/111 Days (46%)	
MW2*	< 50%	N/A	Yes/77 Days (32%)	Yes/103 Days (42%)	
MW3*	< 50%	N/A	No/14 Days (58%)	Yes/129 Days (53%)	
MW4*	< 30%	N/A	Yes/138 Days (57%)	Yes/115 Days (47%)	

*Four Ecotone monitoring gauges were installed to replace the original manual gauges for the 2008 monitoring year

N/A-2007 monitoring did not commence until August 2007

^Percentages were not calculated by previous monitoring firm