Shepherds Tree Stream and Wetland Restoration
Project No. 333
2009 Monitoring Report: Year 5 of 5

February 2010 (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: KCI Associates of North Carolina, PA
Suite 200 Landmark Center I
4601 Six Forks Rd
Raleigh, NC 27609

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EXECUTIVE SUMMARY

SECTION 1

EXECUTIVE SUMMARY

The Shepherds Tree Stream and Wetland Restoration Project (Site) was developed as a NCDOT project and is located in Iredell County, southeast of Statesville between Triplett Road (SR 2362) and Knox Farm Road (SR 2363) (Appendix 1.1). The Shepherds Tree main channel and its tributary are a first order stream of Third Creek, located within the Yadkin River watershed (HUC 03040102). The site drains approximately 1.06 square miles, occupying approximately 160 acres within the 2, 10, and 100 year floodplain of Third Creek. The stream and wetland enhancement/restoration was designed by KCI Associates of North Carolina, PA. Construction activities were completed in 2004. Monitoring has been conducted annually from 2005 to present.

Beaver have been plentiful and persistent in making use of the channel since construction. As per correspondence with North Carolina Ecosystem Enhancement Program (NCEEP), a wildlife control contractor was dispatched by NCEEP on 5 separate control efforts to remove the beaver and the associated dams so that the stream could be evaluated under a fluvial state as opposed to one of partial impoundment. The intense drought that impacted the area from late 2006 to early 2009 also contributed to the basis for survey delays in that the areas not intermittently impounded by beaver exhibited little to no flow through much of this time period. Due to some remnant dam material left by the contractor and the rapid recolonization by beaver after each control effort, impoundment and backwater conditions were observed to varying degrees in 2007, 2008, and 2009. The small channel size in combination with the extensive acreage and the apparently abundant beaver population make this a particularly challenging site. As such the site has been under constant (monthly) monitoring by EEPs wildlife control contractor for the last year.

This report serves as year five of the five year monitoring plan for the Site.

1.1 Goals and Objectives

Historically, the site was utilized for agricultural activities and improvement projects through the Civilian Conservation Corps, resulting in the re-alignment, ditching and berming of Third Creek. Adjacent floodplains and streams were also cleared, drained, and ditched. These activities are thought to have inhibited stream and wetland function within the site, resulting in a degraded riparian community.

The main goal of the Site was to re-establish an integrated wetland-stream complex that likely existed on the site before its historic disturbance. This wetland-stream complex was proposed to restore ecosystem processes, structure, and composition to mitigate for wetland functions and values that have been lost as a result of human induced disturbances in the Yadkin River Basin. The proposed mitigation plan included stream, wetland, and riparian restoration components.

The project consisted of restoring approximately 10,704 linear feet of stream, 91 acres of forested wetland, and 5 acres of emergent wetland. The stream restoration component consisted of restoring approximately 9,904 linear feet of perennial stream and 800 linear feet of intermittent stream. A sinuous, stable pattern, with riffle-pool bed features was constructed. In-stream structures were installed to provide bank stabilization, habitat, and maintain grade control. Wetland restoration consisted of plugging and filling agricultural ditches and planting vegetation. Riparian areas were planted with native bare root seedlings and herbaceous cover to enhance the riparian areas, improve habitat, and stabilize streambanks.

Appendix 2 provides more detailed project activity, history, contact information, and watershed/site background information for this project.

1.2 Vegetative Assessment

JJG conducted the 2009 (year 5 of 5) vegetative assessment and vegetative plot analysis in September 2009. Vegetation assessments were conducted following the NCEEP 2004 Stem Counting Protocol which consists of counting woody stems within the established vegetation plots. Approximately 91 acres were planted with various native hardwood tree and shrub species for the Site. Previous monitoring reports indicated that ten 50 ft by 50 ft monitoring plots were established by NCDOT for this project. During the 2006 monitoring year conducted by JJG, fourteen vegetative plots were identified and monitored, which is different than the ten originally reported to have been established. The following success goals for vegetation were established for the Site.

- 320 stems per acre years 1 through 3
- 290 stems per acre year 4
- 260 stems per acre year 5

The 2009 vegetation monitoring results indicated that the Site is meeting vegetative success criteria. The average site density is approximately 470 planted stems per acre, which exceeds the year five goal of 260 planted stems per acre with a 94% survival rate for the planted woody vegetation. There is an average of 26 live planted stems per plot. A review of the natural recruits monitored indicates an increase in the average site density of approximately 1242 stems per acre. There is an average of 101 recruitment stems per plot. Some loss of streambank vegetation was evident in previous monitoring years due to beaver activity; however, the overall growth of the streambank vegetation is good and appears to have improved over the past few years. This is most likely due to the resprouting of suspected dead saplings and new volunteer species.

The Site has met the vegetation success criteria requirements for monitoring year 5 (2009). Although all the plots did not individually meet the vegetation success threshold (plots 2, 5, and 10), the results did not affect the Site's average survivability to be considered unsuccessful. Please refer to Appendix 3 for more detailed information on the 2009 vegetation data.

1.3 Stream Assessment

Morphological measurements for the 2009 monitoring year consisted of stream cross-section re-survey and a general stability assessment to comply with the scope of monitoring specified in the permit conditions. The dimensional measurements were not evaluated in 2007 or 2008 as per consultation with EEP due to the aforementioned reasons of partial, periodic impoundment and low flow due to drought. The main channel and its tributary were visually assessed from the upstream point of the project (approximately 285 lf upstream of Triplett Road) to the confluence with Third Creek. Certain areas have been impacted by beaver activity, resulting in inundated, backwater conditions for extended periods. This has most likely attributed to the areas of aggradation and in-stream vegetation that have developed within the Site over the past 5 monitoring years.

Overall, the present stream dimensions along Shepherds Tree appear to be stable with some areas of minor aggradation. The average bankfull width (11.59 ft) of the surveyed cross-sections is higher than the proposed 10.20 ft and the average surveyed mean bankfull depth is 1.46 ft compared to the proposed 1.85 ft. The surveyed bankfull widths and depths lead to an average Width/Depth (W/D) ratio of 8.85, which has increased since the 2006 (6.37) monitoring year. A few of the cross-sections (1, 2, 5, 6, 8, 11, and 16) have shown some level of aggradation from the previous monitoring year (MY-2006). Most likely this change can be attributed to the beaver activity and state wide drought conditions that have occurred over the past five years. The substrate material has also decrease with a median particle size of silt throughout the entire Site. With control of beaver activity and time to allow for higher flow events, the system will flush these finer sediments. It should be noted that although there is some aggradation in the reach, this has not resulted in any significant bank erosion with 98% of the channel banks exhibiting stability. It should also be noted that once the project is closed out and beaver control ceases this site will likely be subject to some level of continuous impoundment.

Four surface gauges are located within the Shepherds Tree project site (three on the main channel and one on the tributary). More than one bankfull or greater event was recorded on the tributary and the main channel during monitoring year 2009. However, not all of the surface gauges recorded bankfull events due to the influenced by beaver activity within the Site.

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 current conditions.

1.4 Wetland Assessment

Seventeen groundwater monitoring gauges and one rain gauge, and four surface water gauges are located on site. The monitoring gauges are programmed to download water levels daily and were downloaded monthly from January to October in order to capture hydrologic data during the growing season. The target wetland hydrology success criterion is saturation or inundation for at least 8 percent (15 days) of the growing season in the lower landscape (floodplain) locations. To achieve the above hydrologic success criterion, groundwater levels need to be

within 12-inches of the ground surface for 15 consecutive days of the April 14 to October 24 growing season.

Groundwater monitoring results from the 2009 monitoring year indicate that thirteen of the seventeen groundwater gauges (1, 2, 3, 4, 6, 7, 8, 11, 12, 13, 14, 16, and 17) achieved the wetland success criteria of saturation for 15 consecutive days (8%) during the growing season. Gauges 5, 10, 15, and 18 did not meet the wetland success criteria. Topographic constraints may be contributing to the lack of wetland hydrological success at these gauges. Beaver impoundments have also created backwater areas, creating higher water levels within the floodplain and riparian areas. As a result, gauges located near the beaver impoundments recorded higher groundwater elevations (typically above surface elevation) during certain periods within the growing season.

Please refer to Appendix 5 for wetland raw data tables and plots and a summary of wetland criteria attainment.

1.5 Annual Monitoring Summary

Overall, the Site is meeting mitigation goals in all proposed areas. Although most of the site is meeting hydrological and vegetative criteria, some zones are exhibiting lower vegetation densities and some gauges are not meeting the hydrologic thresholds. The site will continue to be controlled for beaver activity on a monthly basis and will be monitored again in 2010 and 2011 to further assess the Site's success and to allow the streams and wetlands to return to a more typical flow regime.

The background information provided in this report is referenced from the NCDOT mitigation plan (prepared by KCI) and the previous monitoring report prepared by Soil and Environmental Consultants. 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 NCEEP's website. All raw data supporting the tables and figures in the appendices is available from NCEEP upon request.

SECTION 2
METHODOLOGY

SECTION 2
METHODOLOGY

2.1 Methodology

Methods employed for the Shepherds Tree Stream and Wetland Restoration Project were a combination of those established by standard regulatory guidance and procedures documents (see below), the Shepherds Tree Mitigation Plan (state project no. 6.769001t) submitted by the NCDOT (prepared by KCI) and the Soil and Environmental Consultants monitoring reports. 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 Statesville, NC weather station (the nearest offering daily precipitation data) through the following URL.

http://www.wunderground.com/history/airport/KSVH/2008/1/1/CustomHistory.html?dayend=31&monthend=10&yearend=2008&req_city=NA&req_state=NA&req_statename=NA&MR=1

SECTION 3
REFERENCES

SECTION 3
REFERENCES

Martin, W. and Nunnally, N. 2001. *Air and Water: An Introduction to the Atmosphere and the Hydrosphere*. Kendall/Hunt Publishing Company, Dubuque, Iowa.

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USACOE (2003) *Stream Mitigation Guidelines*. USACOE, USEPA, NCWRC, NCDENR-DWQ

USACOE (1987) *Corps of Engineers Wetlands Delineation Manual.* Tech report Y-87-1. AD/A176

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

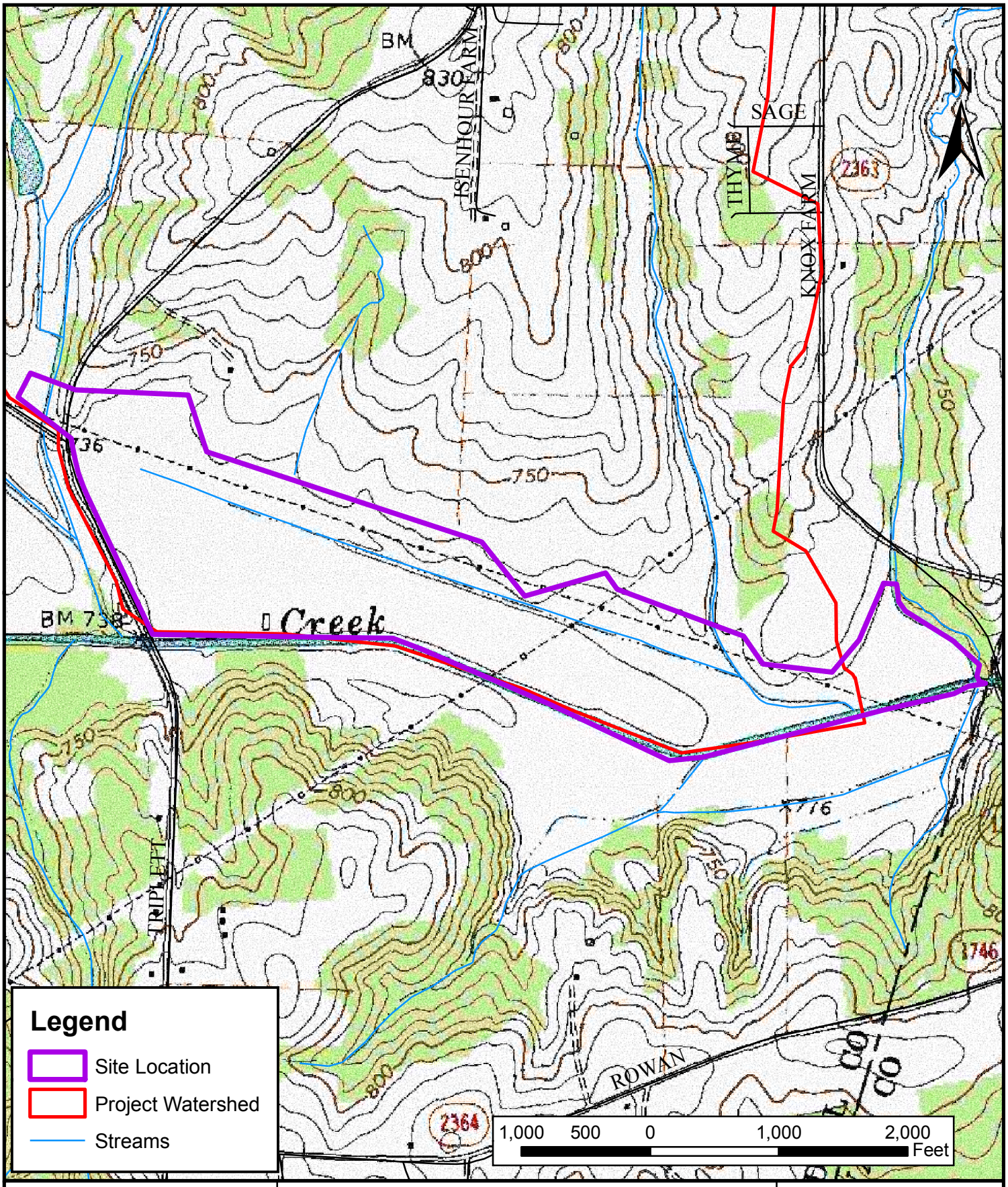
Appendix 4 – Stream Assessment Data

Appendix 5 – Wetland Assessment Data

APPENDIX 1
GENERAL FIGURES AND PLAN VIEWS

1. Project Location Map

2. Current Condition Plan View

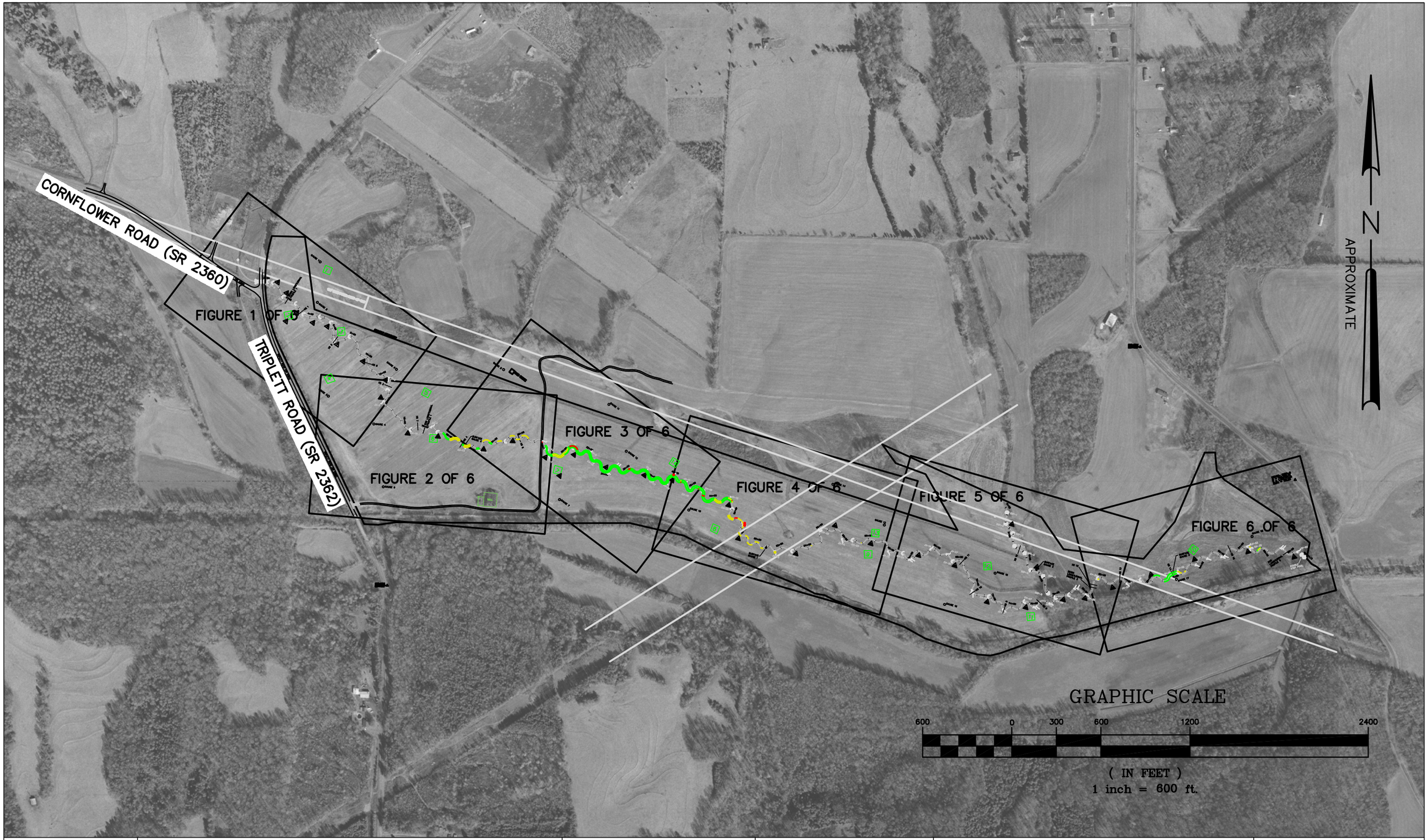


Ecosystem Enhancement Program

JJG

Appendix 1.1 Project Location Map
Shepherds Tree Stream and Wetland Restoration
Iredell County, NC
Year 5 of 5

Project No. 333
February 2010



Ecosystem Enhancement PROGRAM

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

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IREDELL COUNTY
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MONITORING
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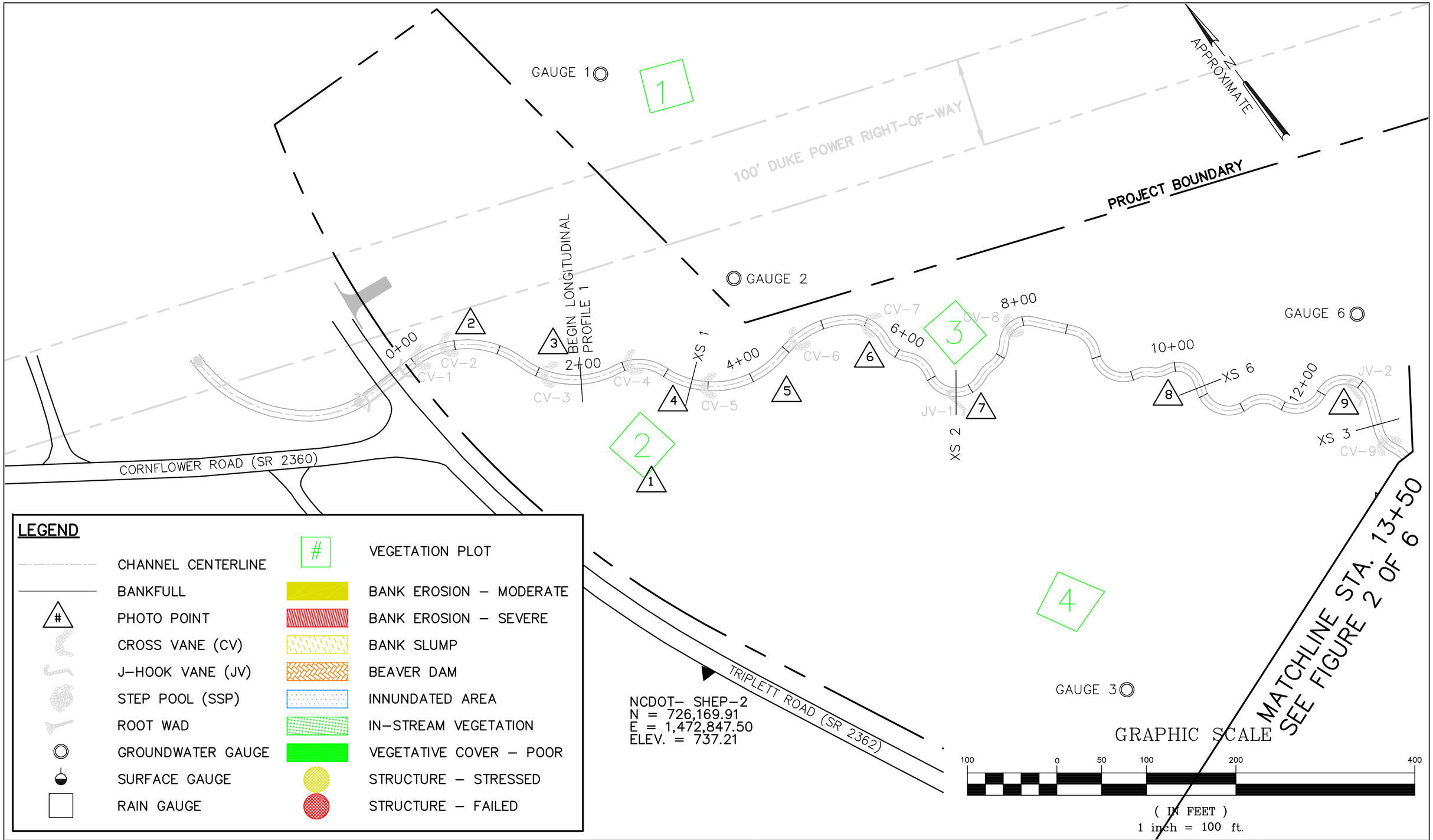
NC ECOSYSTEM ENHANCEMENT PROGRAM
SHEPHERDS TREE STREAM & WETLAND RESTORATION

APPENDIX 1.2
CURRENT CONDITION PLAN VIEW

DATE : FEBRUARY 2010
SCALE : 1"=600'
JOB NO.: 03060005

FIGURE KEY



LEGEND

- CHANNEL CENTERLINE
- BANKFULL
- PHOTO POINT
- CROSS VANE (CV)
- J-HOOK VANE (JV)
- STEP POOL (SSP)
- ROOT WAD
- GROUNDWATER GAUGE
- SURFACE GAUGE
- RAIN GAUGE
- VEGETATION PLOT
- BANK EROSION – MODERATE
- BANK EROSION – SEVERE
- BANK SLUMP
- BEAVER DAM
- INNUNDATED AREA
- IN-STREAM VEGETATION
- VEGETATIVE COVER – POOR
- STRUCTURE – STRESSED
- STRUCTURE – FAILED

Ecosystem Enhancement PROGRAM

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

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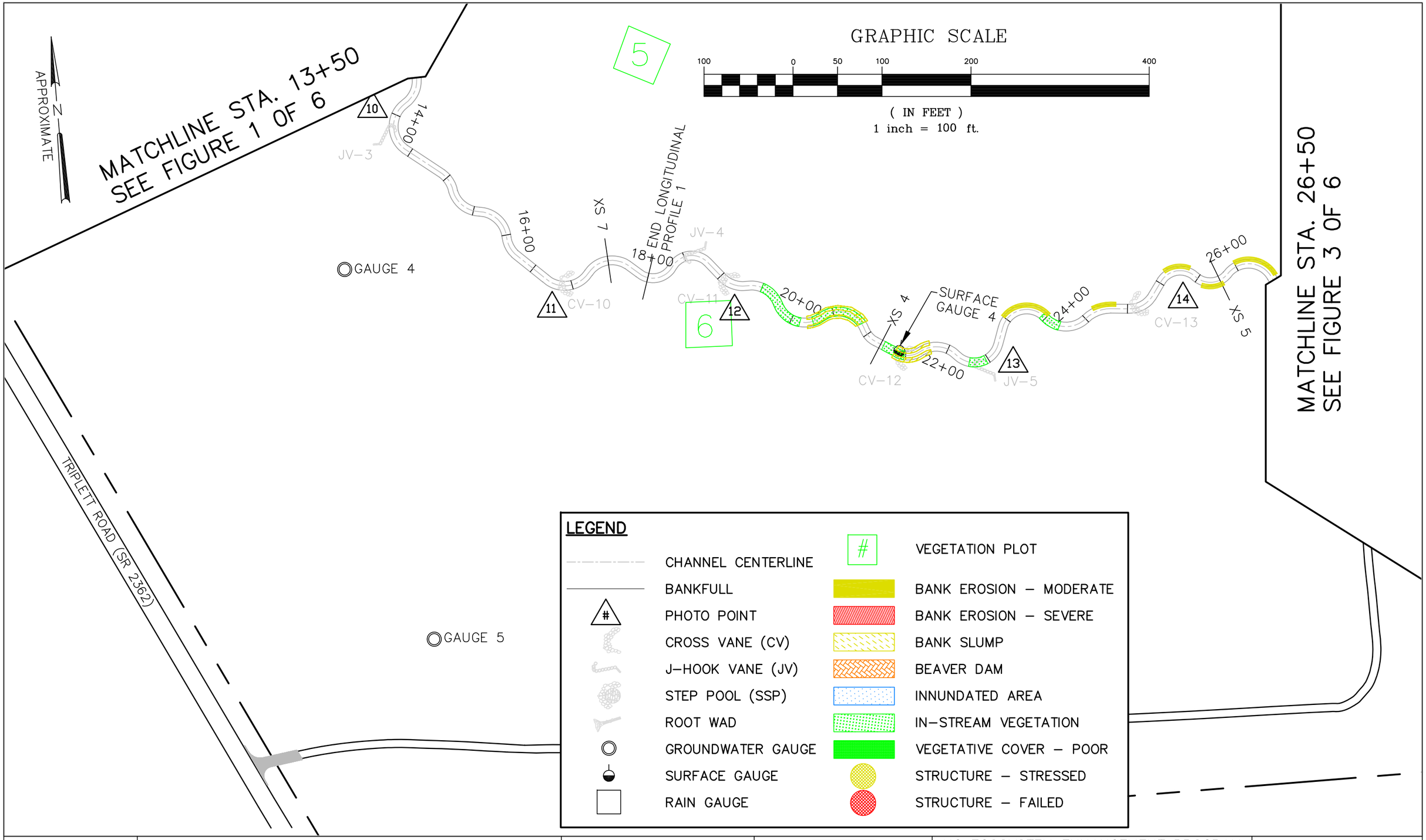
NC ECOSYSTEM ENHANCEMENT PROGRAM
SHEPHERDS TREE STREAM & WETLAND RESTORATION

APPENDIX 1.2
CURRENT CONDITION PLAN VIEW

DATE : FEBRUARY 2010
SCALE : 1"=100'
JOB NO.: 03060005

FIGURE 1 OF 6



Ecosystem Enhancement PROGRAM

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APPENDIX 1.2
CURRENT CONDITION PLAN VIEW

DATE : FEBRUARY 2010
SCALE : 1"=100'
JOB NO.: 03060005

FIGURE 2 OF 6

APPROXIMATE

GAUGE 11

GAUGE 12

GAUGE 7

14

7

MATCHLINE STA. 40+50
SEE FIGURE 4 OF 6

MATCHLINE STA. 26+50
SEE FIGURE 2 OF 6

40+00
38+00
36+00
34+00
32+00
30+00
28+00

20
19
17
16
15
18

JV-9
JV-10
CV-17
JV-8
CV-15
CV-16
JV-6
CV-14
JV-7

LEGEND

- CHANNEL CENTERLINE
- BANKFULL
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- VEGETATIVE COVER – POOR
- STRUCTURE – STRESSED
- STRUCTURE – FAILED

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

Ecosystem Enhancement PROGRAM

NOTES:
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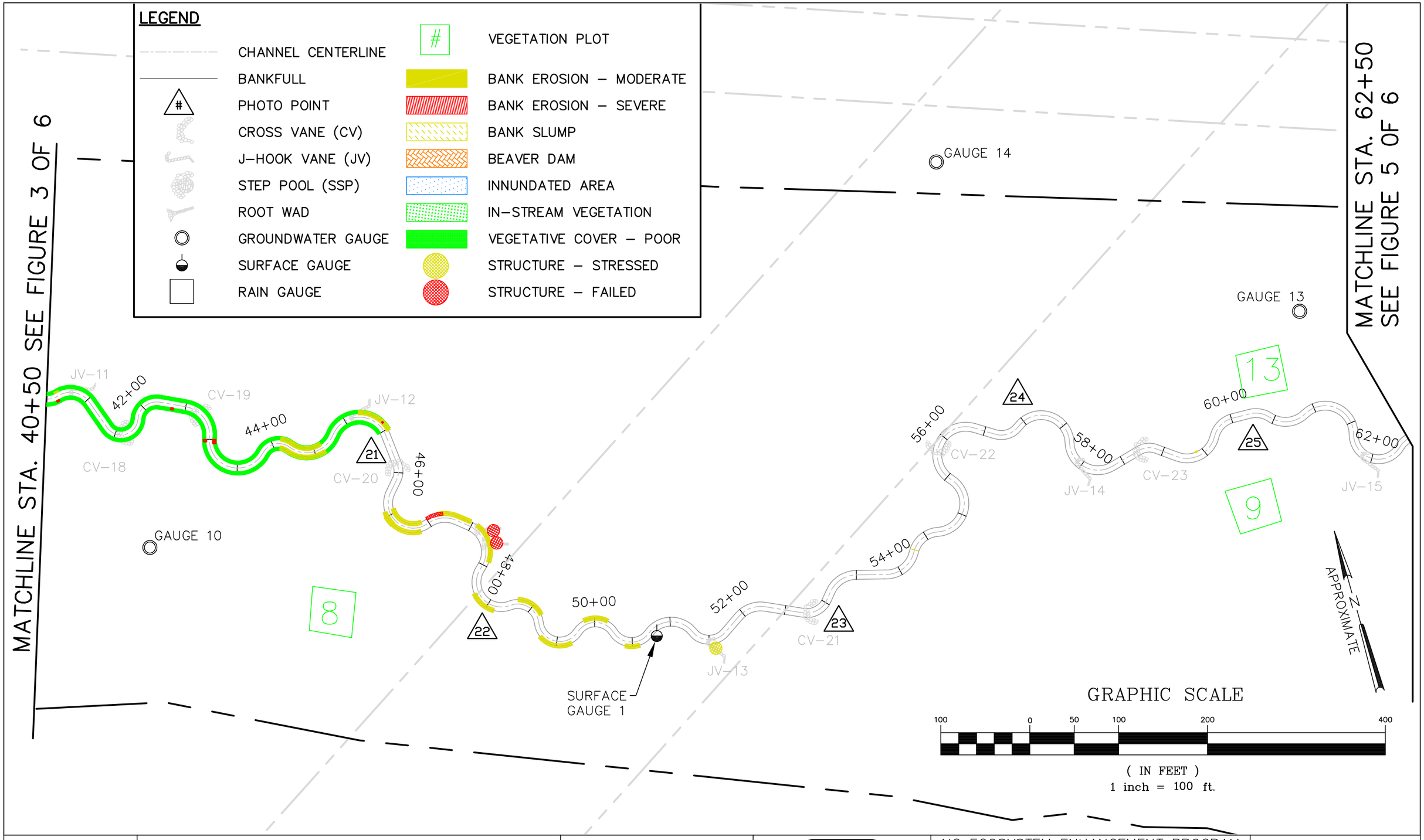
NC ECOSYSTEM ENHANCEMENT PROGRAM
SHEPHERDS TREE STREAM & WETLAND RESTORATION

APPENDIX 1.2
CURRENT CONDITION PLAN VIEW

DATE : FEBRUARY 2010
SCALE : 1"=100'
JOB NO.: 03060005

FIGURE 3 OF 6



NOTES:
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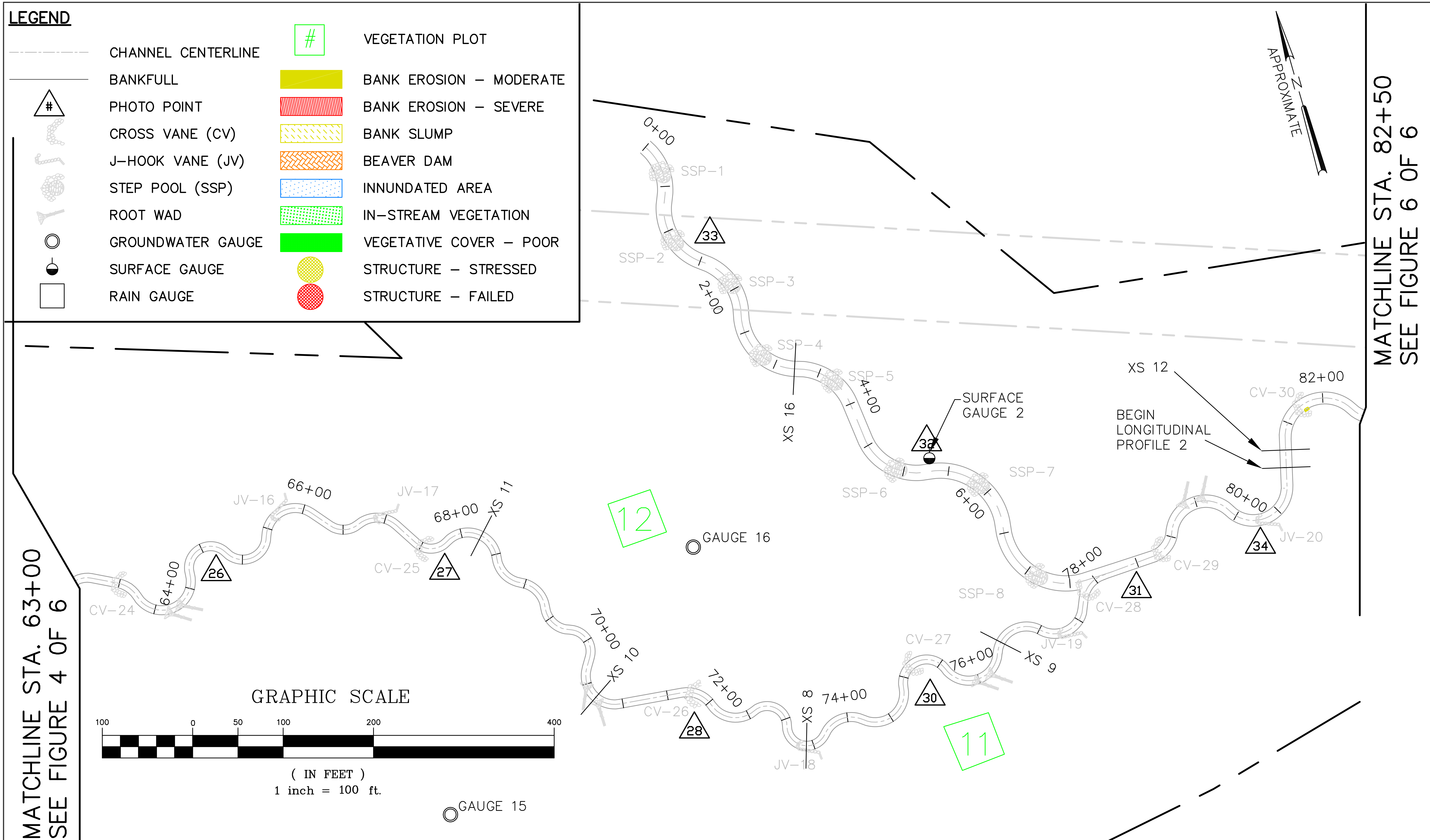
NC ECOSYSTEM ENHANCEMENT PROGRAM
SHEPHERDS TREE STREAM & WETLAND RESTORATION

APPENDIX 1.2
CURRENT CONDITION PLAN VIEW

DATE : FEBRUARY 2010
SCALE : 1"=100'
JOB NO.: 03060005

FIGURE 4 OF 6



LEGEND
CHANNEL CENTERLINE
BANKFULL
PHOTO POINT
CROSS VANE (CV)
J-HOOK VANE (JV)
STEP POOL (SSP)
ROOT WAD
GROUNDWATER GAUGE
SURFACE GAUGE
RAIN GAUGE
VEGETATION PLOT
BANK EROSION – MODERATE
BANK EROSION – SEVERE
BANK SLUMP
BEAVER DAM
INNUNDATED AREA
IN-STREAM VEGETATION
VEGETATIVE COVER – POOR
STRUCTURE – STRESSED
STRUCTURE – FAILED
N APPROXIMATE
MATCHLINE STA. 82+50
SEE FIGURE 6 OF 6
MATCHLINE STA. 63+00
SEE FIGURE 4 OF 6
SURFACE GAUGE 2
XS 12
BEGIN LONGITUDINAL PROFILE 2
GAUGE 16
GAUGE 15
GRAPHIC SCALE
100 0 50 100 200 400
(IN FEET)
1 inch = 100 ft.

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

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MONITORING
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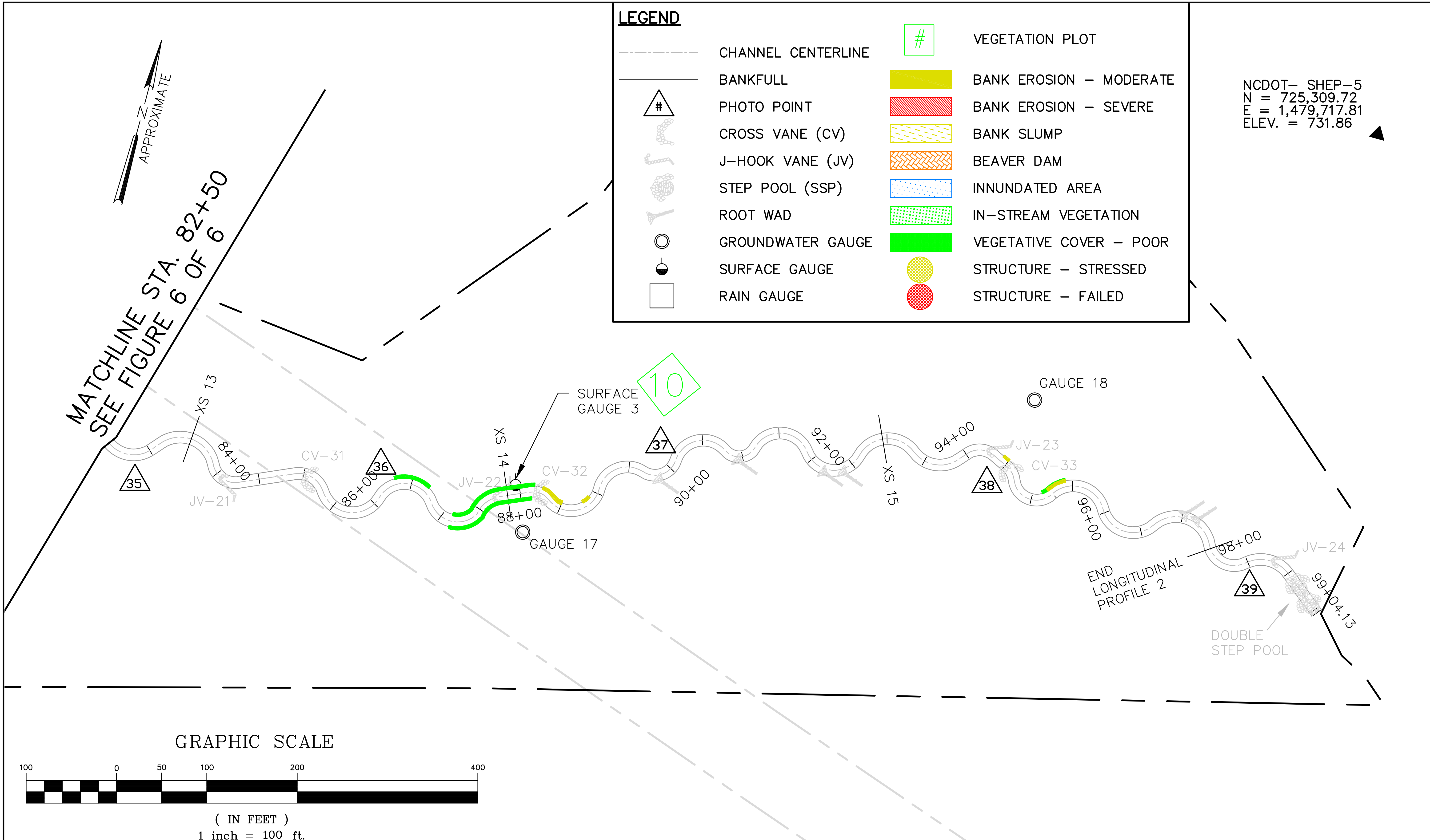
NC ECOSYSTEM ENHANCEMENT PROGRAM
SHEPHERDS TREE STREAM & WETLAND RESTORATION

APPENDIX 1.2
CURRENT CONDITION PLAN VIEW

DATE :	FEBRUARY 2010
SCALE :	1"=100'
JOB NO.:	03060005
FIGURE	5 OF 6



LEGEND
CHANNEL CENTERLINE
BANKFULL
PHOTO POINT
CROSS VANE (CV)
J-HOOK VANE (JV)
STEP POOL (SSP)
ROOT WAD
GROUNDWATER GAUGE
SURFACE GAUGE
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BANK EROSION – MODERATE
BANK EROSION – SEVERE
BANK SLUMP
BEAVER DAM
INNUNDATED AREA
IN-STREAM VEGETATION
VEGETATIVE COVER – POOR
STRUCTURE – STRESSED
STRUCTURE – FAILED
NCDOT- SHEP-5
N = 725,309.72
E = 1,479,717.81
ELEV. = 731.86
N APPROXIMATE
MATCHLINE STA. 82+50
SEE FIGURE 6 OF 6
XS 13
XS 14
XS 15
84+00
86+00
88+00
90+00
92+00
94+00
96+00
98+00
99+04.13
CV-31
CV-32
CV-33
JV-21
JV-22
JV-23
JV-24
SURFACE GAUGE 3
GAUGE 17
GAUGE 18
END LONGITUDINAL PROFILE 2
DOUBLE STEP POOL
35
36
37
38
39
10
GRAPHIC SCALE
100 0 50 100 200 400
(IN FEET)
1 inch = 100 ft.

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SHEPHERDS TREE STREAM & WETLAND RESTORATION

APPENDIX 1.2
CURRENT CONDITION PLAN VIEW

DATE : FEBRUARY 2010
SCALE : 1"=100'
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
Perennial Mainstem Reach	R	P1	9,904 lf	0+00-99+04	Channel restoration, relocation with use of grade control and bank protection structures.
Intermittent Tributary	R	P1	800 lf	0+00-8+00	Channel restoration, relocation with use of grade control and bank protection structures.
Piedmont/Mountain Bottomland Hardwood Forest	R	-	48.56 acres	N/A	Restoration/Enhancement of bottomland hardwood communities by breaching channel berms, plugging drainage ditches and revegetation
	C	-	37.71 acres		
Piedmont/Mountain Swamp Hardwood Forest	R	-	5 acres	N/A	Restoration/Enhancement of swamp hardwood communities by breaching channel berms, plugging drainage ditches and revegetation
Low Elevation Seep	P	-	4.54 acres	N/A	Preservation of an existing levee forest
Phase III	R	P1	284 lf	N/A	Channel Relocation

Component Summations

Restoration Level	Stream (lf)	Wetland (ac)		Upland (ac)	Buffer (ac)	BMP
		Riparian	Non-Riparian			
Restoration (R)	10,988	53.56	N/A	N/A	N/A	N/A
Enhancement (E)	N/A	N/A	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	37.71	N/A	N/A	N/A	N/A
Preservation (P)	N/A	4.54	N/A	N/A	N/A	N/A
HQ Preservation (P)	N/A	N/A	N/A	N/A	N/A	N/A
Totals	**10,988**	**95.61**	**N/A**	**N/A**	**N/A**	**N/A**

Activity or Report	Data Collection Completed	Actual Completion or Delivery
Restoration Plan	N/A	Jun-01
Final Design-90%	N/A	N/A
Construction	N/A	2004
Temporary S&E mix applied to entire project area*	Fall 2001	Fall 2001
Permanent seed mix applied to reach	Spring 2002	Spring 2002
Mitigation Plan/ As-Built (Year 0 Monitoring)	Jun-01	Jun-01
Year 1 Monitoring	Dec-05	Feb-06
Year 2 Monitoring	Sep-06	Jan-07
Year 3 Monitoring	Oct-07	Nov-07
Year 4 Monitoring	Jun-08/Oct-08	Dec-08
Year 5 Monitoring	Jul-09/Jan-10	Jan-10

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

Designer	KCI Associates of North Carolina, PA Suite 200 Landmark Center I 4601 Six Forks Rd Raleigh, NC 27609
Contractor's Name (Phase I)	NCDOT Highway Maintenance
Contractor's Name (Phase II)	Northstate Environmental
Contractor's Name (Phase III)	NCDOT Bridge and Highway Maintenance
Planting Contractor	Unknown
Seeding Contractor	Unknown
Monitoring Performers	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	

Project County	Iredell, North Carolina
Drainage Area	2.17 sq mi
Drainage impervious cover estimate	~10%
Stream Order	First
Physiographic Region	Piedmont
Ecoregion	Outer Piedmont
Rosgen Classification of As-built	E5
Cowardin Classification	R2UB34
Dominant soil types	Chewalca, Conagree
USGS HUC for Project and Reference	3040102
NCDWQ Sub-basin for Project and Reference	03-07-06
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 NCDOT property boundary fenced?	100%

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	N
Plot 3	Y
Plot 4	Y
Plot 5	N
Plot 6	Y
Plot 7	Y
Plot 8	Y
Plot 9	Y
Plot 10	N
Plot 11	Y
Plot 12	Y
Plot 13	Y

Monitoring Plot 1 (9/2009)

Monitoring Plot 2 (9/2009)

Monitoring Plot 3 (9/2009)

Monitoring Plot 4 (9/2009)

Prepared For:

Ecosystem Enhancement Program

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Appendix 3.2 Vegetation Monitoring Plot Photos

JJG

Monitoring Plot 5 (9/2009)

Monitoring Plot 6 (9/2009)

Monitoring Plot 7 (9/2009)

Monitoring Plot 8 (9/2009)

Monitoring Plot 9 (9/2009)

Monitoring Plot 10 (9/2009)

Monitoring Plot 11 (9/2009)

Monitoring Plot 12 (9/2009)

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	Appendix 3.2 Vegetation Monitoring Plot Photos	JJG

Monitoring Plot 13 (9/2009)

Monitoring Plot 14 (9/2009)

Shepherds Tree
Stem Counts for Planted Species Arranged

Species	Common Name	Type	Current Data (MY5-2009)																										Annual Means									
			Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7		Plot 8		Plot 9		Plot 10		Plot 11		Plot 12		Plot 13		Plot 14		Current Mean		MY1 - 2005		MY2 - 2006		MY3 - 2007		MY4 - 2008	
			P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T
Acer negundo	boxelder	T					1	3				2	2	12	2	12			2	2		17	5	5	10	10	8	8			**5**	**7**	**2**	**2**	**7**	**7**	**7**	**8**	**5**	**13**
Acer rubrum	red maple	T		13		32		10		15		11		20		15				7								5		6	**N/A**	**10**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**13**	**N/A**	**13**
Alnus serrulata	tag alder	T/S						5								1												10		1	**N/A**	**4**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**6**	**N/A**	**4**
Betula nigra	river birch	T				16										1		7		2				3		4				2	**N/A**	**3**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**7**	**N/A**	**5**
Cephalanthus occidentalis	button bush	T/S	4	4	2		1	1	1	1	3	8	8	8	1	1	1	1				1	1	1					2	2	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**5**
Cornus amomum	silky dogwood	S														1										2					**N/A**	**2**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**		**N/A**	**2**
Fraxinus pennsylvanica	green ash	T	2	8		6	4	14	15	23	3	6		2	4	4		10	10	16	7	20	17	17	11	11		4	5	5	**7**	**10**	**6**	**6**	**9**	**9**	**9**	**12**	**7**	**14**
Liquidambar styraciflua	sweet gum	T		5		1								3								6						2			**N/A**	**4**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**8**	**N/A**	**4**
Liriodendron tulipifera	tulip poplar	T	1	2		1	1	1	12	13																					**1**	**2**	**5**	**5**	**5**	**5**	**5**	**6**	**5**	**7**
Nyssa sylvatica	black gum	T		3				3								9										1					**N/A**	**4**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**3**	**N/A**	**4**
Platanus occidentalis	sycamore	T				9	9	13		3			2	12	1	51	10	11	6	23		6	4	29	17	17	15	18	20	23	**10**	**21**	**6**	**6**	**10**	**10**	**10**	**11**	**10**	**20**
Populus deltoides	cottonwood	T																		1											**N/A**	**1**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**		**N/A**	**1**
Quercus nigra	water oak	T	1	5				3	2	2				4	3	6						2							3	7	**2**	**5**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**5**
Quercus michauxii	swamp chestnut oak	T		3	2	10	4	6	1	6			2	2		4			4	4		2	3	5	15	15			4	8	**6**	**6**	**3**	**3**	**4**	**4**	**4**	**8**	**5**	**9**
Quercus pagoda	cherrybark oak	T	12	15			3	3	2	7	4	4			3	7	3	5	4	4		3			4	4	10	10	6	6	**5**	**6**	**5**	**5**	**5**	**5**	**5**	**6**	**5**	**8**
Quercus phellos	willow oak	T	2	10	3	7							8	10	1	7					2	5	2	2			7	7	7	7	**4**	**6**	**2**	**2**	**4**	**4**	**3**	**5**	**4**	**9**
Salix nigra	black willow	T				15		4		7		3	1	4	10	10	1	8		8							2	7	4	4	**4**	**6**	**6**	**6**	**4**	**4**	**4**	**6**	**4**	**11**
Ulmus alata	winged elm	T														1		2										1			**N/A**	**1**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**2**	**N/A**	**1**
	Plot Area (acres)		**0.057**																																			
	Species Count		**6**	**10**	**3**	**9**	**7**	**12**	**6**	**9**	**3**	**6**	**6**	**10**	**8**	**15**	**4**	**7**	**5**	**9**	**2**	**9**	**6**	**7**	**5**	**8**	**5**	**10**	**8**	**11**	**10**	**18**	**5**		**5**		**5**	**8**	**5**	**7**
	Stem Count		**22**	**68**	**7**	**97**	**23**	**66**	**33**	**77**	**10**	**34**	**23**	**77**	**25**	**130**	**15**	**44**	**26**	**67**	**9**	**62**	**32**	**62**	**57**	**64**	**42**	**72**	**51**	**71**	**46**	**101**	**19**		**29**		**29**	**64**	**26**	**45**
	Stems per Acre		**386**	**1193**	**123**	**1702**	**404**	**1158**	**579**	**1351**	**175**	**596**	**404**	**1351**	**439**	**2281**	**263**	**772**	**456**	**1175**	**158**	**1088**	**561**	**1088**	**1000**	**1123**	**737**	**1263**	**895**	**1246**	**470**	**1242**	**340**		**528**		**524**	**1174**	**482**	**831**

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***

*Raw data tables have been provided electronically.

Photo Point 1-Vegetation Plot (9/2009)

Photo Point 2-View Upstream
Main Channel (1/2010)

Photo Point 2-View Downstream
Main Channel (1/2010)

Prepared For:	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.1 Stream Station Photos	

Photo Point 3-View Upstream
Main Channel (1/2010)

Photo Point 3-View Downstream
Main Channel (1/2010)

Photo Point 4-View Upstream
Main Channel (1/2010)

Photo Point 4-View Downstream
Main Channel (1/2010)

Prepared For: Ecosystem Enhancement Program	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.1 Stream Station Photos	JJG

Photo Point 5-View Upstream
Main Channel (1/2010)

Photo Point 5-View Downstream
Main Channel (1/2010)

Photo Point 6-View Upstream
Main Channel (1/2010)

Photo Point 6-View Downstream
Main Channel (1/2010)

Prepared For: Ecosystem Enhancement Program	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.1 Stream Station Photos	JJG

Photo Point 7-View Upstream
Main Channel (1/2010)

Photo Point 7-View Downstream
Main Channel (1/2010)

Photo Point 8-View Upstream
Main Channel (1/2010)

Photo Point 8-View Downstream
Main Channel (1/2010)

Prepared For: Ecosystem Enhancement Program	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.1 Stream Station Photos	JJG

Photo Point 9-View Upstream
Main Channel (1/2010)

Photo Point 9-View Downstream
Main Channel (1/2010)

Photo Point 10-View Upstream
Main Channel (1/2010)

Photo Point 10-View Downstream
Main Channel (1/2010)

Prepared For: Ecosystem Enhancement Program	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.1 Stream Station Photos	JJG

Photo Point 11-View Upstream
Main Channel (1/2010)

Photo Point 11-View Downstream
Main Channel (1/2010)

Photo Point 12-View Upstream
Main Channel (1/2010)

Photo Point 12-View Downstream
Main Channel (1/2010)

Prepared For: Ecosystem Enhancement Program	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.1 Stream Station Photos	JJG

Photo Point 14-View Upstream
Main Channel (1/2010)

Photo Point 14-View Downstream
Main Channel (1/2010)

Prepared For:

Ecosystem Enhancement Program

Shepherds Tree Stream and Wetland Restoration
Year 5 of 5

Date: February 2010
Project No.: 333

Appendix 4.1 Stream Station Photos

JJG

Photo Point 15-View Upstream
Main Channel (1/2010)

Photo Point 15-View Downstream
Main Channel (1/2010)

Photo Point 16-View Upstream
Main Channel (1/2010)

Photo Point 16-View Downstream
Main Channel (1/2010)

Prepared For: Ecosystem Enhancement Program	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.1 Stream Station Photos	JJG

Photo Point 17-View Upstream
Main Channel (1/2010)

Photo Point 17-View Downstream
Main Channel (1/2010)

Photo Point 18-Vegetation Plot (9/2009)

Prepared For: Ecosystem Enhancement Program	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.1 Stream Station Photos	JJG

Photo Point 19-View Upstream
Main Channel (1/2010)

Photo Point 19-View Downstream
Main Channel (1/2010)

Photo Point 20-View Upstream
Main Channel (1/2010)

Photo Point 20-View Downstream
Main Channel (1/2010)

Prepared For: Ecosystem Enhancement Program	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.1 Stream Station Photos	JJG

Photo Point 21-View Upstream
Main Channel (1/2010)

Photo Point 21-View Downstream
Main Channel (1/2010)

Photo Point 22-View Upstream
Main Channel (1/2010)

Photo Point 22-View Downstream
Main Channel (1/2010)

Prepared For: Ecosystem Enhancement Program	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.1 Stream Station Photos	JJG

Photo Point 23-View Upstream
Main Channel (1/2010)

Photo Point 23-View Downstream
Main Channel (1/2010)

Photo Point 24-View Upstream
Main Channel (1/2010)

Photo Point 24-View Downstream
Main Channel (1/2010)

Prepared For: Ecosystem Enhancement Program	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.1 Stream Station Photos	JJG

Photo Point 25-View Upstream
Main Channel (1/2010)

Photo Point 25-View Downstream
Main Channel (1/2010)

Photo Point 26-View Upstream
Main Channel (1/2010)

Photo Point 26-View Downstream
Main Channel (1/2010)

Prepared For: Ecosystem Enhancement Program	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.1 Stream Station Photos	JJG

Photo Point 31-View Upstream
Main Channel (1/2010)

Photo Point 31-View Downstream
Main Channel (1/2010)

Photo Point 32-View Upstream
Main Channel (1/2010)

Photo Point 32-View Downstream
Main Channel (1/2010)

Prepared For: Ecosystem Enhancement Program	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.1 Stream Station Photos	JJG

Photo Point 33-View Upstream
Main Channel (1/2010)

Photo Point 33-View Downstream
Main Channel (1/2010)

Photo Point 34-View Upstream
Main Channel (1/2010)

Photo Point 34-View Downstream
Main Channel (1/2010)

Prepared For: Ecosystem Enhancement Program	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.1 Stream Station Photos	JJG

Photo Point 35-View Upstream
Main Channel (1/2010)

Photo Point 35-View Downstream
Main Channel (1/2010)

Photo Point 36-View Upstream
Main Channel (1/2010)

Photo Point 36-View Downstream
Main Channel (1/2010)

Prepared For: Ecosystem Enhancement Program	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.1 Stream Station Photos	JJG

Photo Point 37-View Upstream
Main Channel (1/2010)

Photo Point 37-View Downstream
Main Channel (1/2010)

Photo Point 38-View Upstream
Main Channel (1/2010)

Photo Point 38-View Downstream
Main Channel (1/2010)

Prepared For: Ecosystem Enhancement Program	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.1 Stream Station Photos	JJG

Photo Point 39-View Upstream
Main Channel (1/2010)

Photo Point 39-View Downstream
Main Channel (1/2010)

Prepared For:

Ecosystem Enhancement Program

Shepherds Tree Stream and Wetland Restoration
Year 5 of 5

Date: February 2010
Project No.: 333

Appendix 4.1 Stream Station Photos

JJG

Cross-Section 1-View Upstream
Main Channel (1/2010)

Cross-Section 1-View Downstream
Main Channel (1/2010)

Cross-Section 2-View Upstream
Central Tributary (1/2010)

Cross-Section 2-View Downstream
Central Tributary (1/2010)

Prepared For:	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.2 Stream Cross-Section Photos	

Cross-Section 3-View Upstream
Main Channel (1/2010)

Cross-Section 3-View Downstream
Main Channel (1/2010)

Cross-Section 4-View Upstream
Central Tributary (1/2010)

Cross-Section 4-View Downstream
Central Tributary (1/2010)

Prepared For:	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.2 Stream Cross-Section Photos	

Cross-Section 5-View Upstream
Main Channel (1/2010)

Cross-Section 5-View Downstream
Main Channel (1/2010)

Cross-Section 6-View Upstream
Central Tributary (1/2010)

Cross-Section 6-View Downstream
Central Tributary (1/2010)

Prepared For:	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.2 Stream Cross-Section Photos	

Cross-Section 7-View Upstream
Main Channel (1/2010)

Cross-Section 7-View Downstream
Main Channel (1/2010)

Cross-Section 8-View Upstream
Central Tributary (1/2010)

Cross-Section 8-View Downstream
Central Tributary (1/2010)

Prepared For:	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.2 Stream Cross-Section Photos	

Cross-Section 9-View Upstream
Main Channel (1/2010)

Cross-Section 9-View Downstream
Main Channel (1/2010)

Cross-Section 10-View Upstream
Central Tributary (1/2010)

Cross-Section 10-View Downstream
Central Tributary (1/2010)

Prepared For:	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.2 Stream Cross-Section Photos	

Cross-Section 11-View Upstream
Main Channel (1/2010)

Cross-Section 11-View Downstream
Main Channel (1/2010)

Cross-Section 12-View Upstream
Central Tributary (1/2010)

Cross-Section 12-View Downstream
Central Tributary (1/2010)

Prepared For:	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.2 Stream Cross-Section Photos	

Cross-Section 13-View Upstream
Main Channel (1/2010)

Cross-Section 13-View Downstream
Main Channel (1/2010)

Cross-Section 14-View Upstream
Central Tributary (1/2010)

Cross-Section 14-View Downstream
Central Tributary (1/2010)

Prepared For:	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.2 Stream Cross-Section Photos	

Cross-Section 15-View Upstream
Main Channel (1/2010)

Cross-Section 15-View Downstream
Main Channel (1/2010)

Cross-Section 16-View Upstream
Tributary (1/2010)

Cross-Section 16-View Downstream
Tributary (1/2010)

Prepared For:	Shepherds Tree Stream and Wetland Restoration Year 5 of 5	Date: February 2010 Project No.: 333
	Appendix 4.2 Stream Cross-Section Photos	

Main Channel-9,904.13 linear feet

Feature Category		(# Stable) Number Performing as Intended	Total Number assessed per as-built survey	Total Number/ feet in unstable state	% Perform in Stable Condition	Feature Perform Mean or Total
A. Riffles	1. Present?	N/A				
	2. Armor Stable?					
	3. Facet grade appears stable?					
	4. Minimal evidence of embedding/fining?					
	5. Length appropriate?					
B. Pools	1. Present?	N/A				
	2. Sufficiently deep?					
	3. Length Appropriate?					
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?				N/A	
	4. Sufficient floodplain access and relief?				100%	
E. Bed General	1. General channel bed aggradation areas (bar formation)?*	N/A		6/1377	86%	**93%**
	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		6/105	98%	**98%**
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?					

*In-stream vegetation and beaver activity have impacted areas along the channel that were not noted above

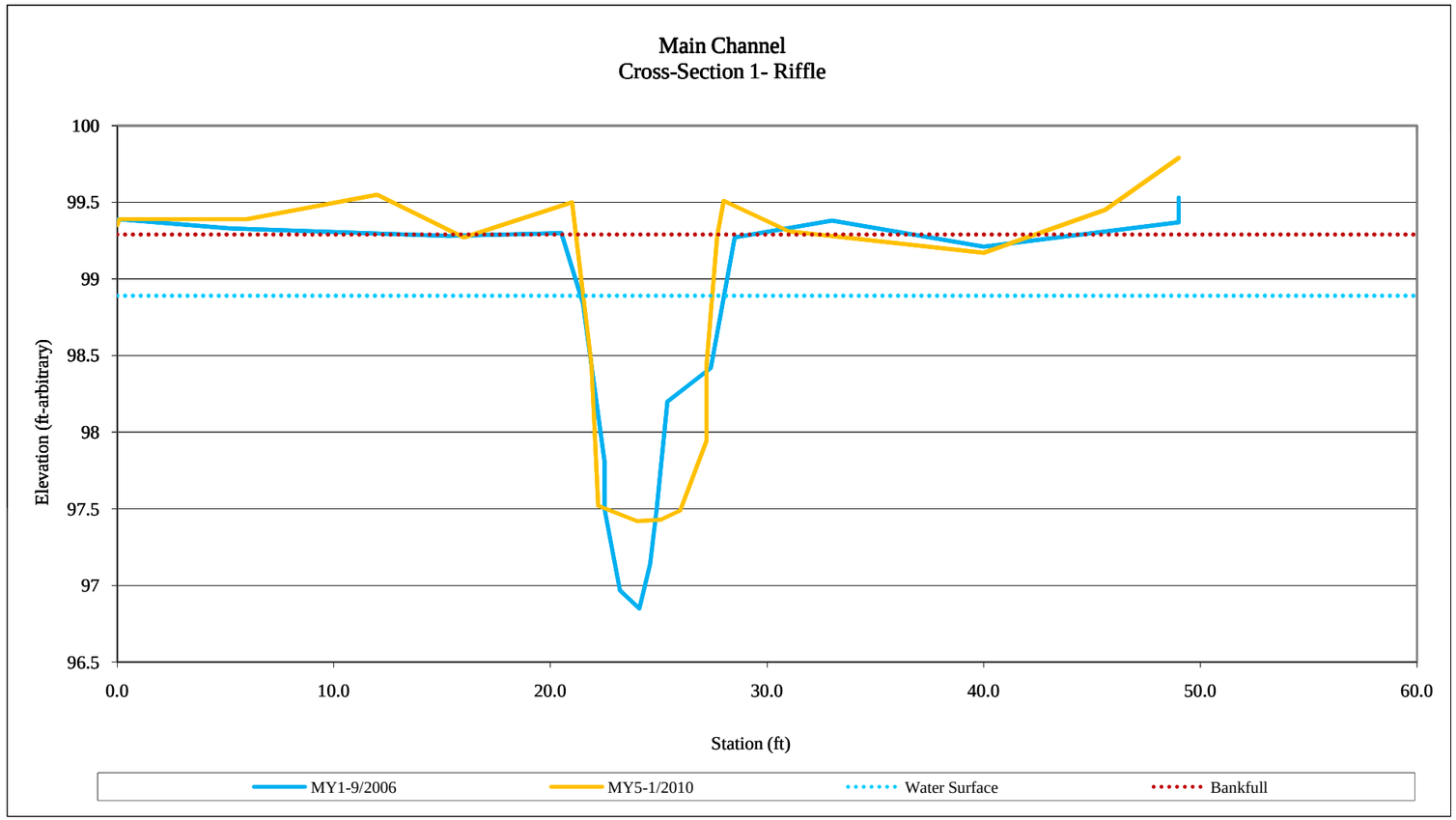
Tributary-800 linear feet

Feature Category		(# Stable) Number	Total Number	Total Number/	% Perform in Stable	Feature Perform
A. Riffles	1. Present?	N/A				
	2. Armor Stable?					
	3. Facet grade appears stable?					
	4. Minimal evidence of embedding/fining?					
	5. Length appropriate?					
B. Pools	1. Present?	N/A				
	2. Sufficiently deep?					
	3. Length Appropriate?					
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?				N/A	
	4. Sufficient floodplain access and relief?				100%	
E. Bed General	1. General channel bed aggradation areas (bar formation)?*	N/A		0	40%	**70%**
	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?	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 have impacted areas along the channel

Date of Collection	Date of Occurrence	Method	Photo # (if available)
N/A	Jun-05	Visual Assessment	N/A
N/A	Aug-05	Surface Gauge 1 and 3-MC	N/A
N/A	Oct-05	Surface Gauge 1-MC	N/A
N/A	Dec-05	Surface Gauge 1-MC	N/A
N/A	Nov-06	Surface Gauge 3-MC	N/A
N/A	Dec-06	Surface Gauge 3-MC	N/A
N/A	Jan-07	Surface Gauge 3-MC	N/A
N/A	Mar-07	Surface Gauge 3-MC	N/A
N/A	Aug-08	Surface Gauge 3-MC	N/A
N/A	Sep-08	Surface Gauge 3-MC	N/A
N/A	Apr-09	Surface Gauge 2-Trib	N/A
N/A	Mar-09	Surface Gauge 3-MC	N/A
N/A	Apr-09	Surface Gauge 3-MC	N/A
N/A	Jun-09	Surface Gauge 3-MC	N/A
N/A	Apr-09	Surface Gauge 2-Trib	N/A
N/A	Jun-09	Surface Gauge 2-Trib	N/A
N/A	Aug-09	Surface Gauge 2-Trib	N/A
N/A	Sep-09	Surface Gauge 2-Trib	N/A

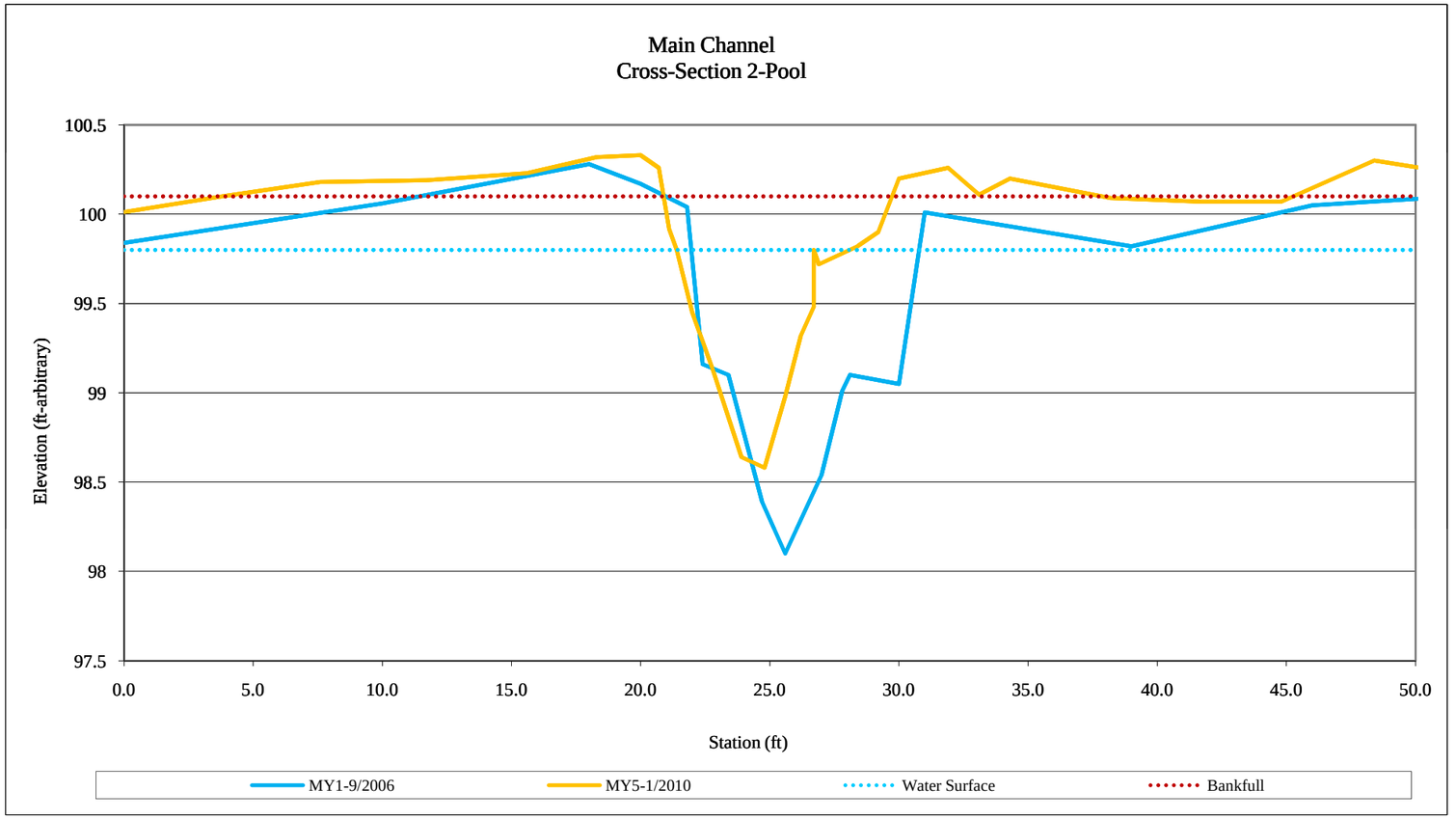
Project Name: Shepherds Tree Main Channel		
Cross-Section: 1		
Feature: Riffle		
1/2010		
Station	**Elevation**	**Notes**
0	99.35	
0.1	99.39	lpt
6	99.39	
12	99.55	
16	99.27	
21	99.5	lbkf
21.9	98.43	lew/ws
22.2	97.52	
24	97.42	
25.1	97.43	
26	97.49	
27.2	97.94	
27.2	98.43	rew/ws
27.7	99.28	
28	99.51	
31	99.31	
40	99.17	
45.6	99.45	
49	99.79	



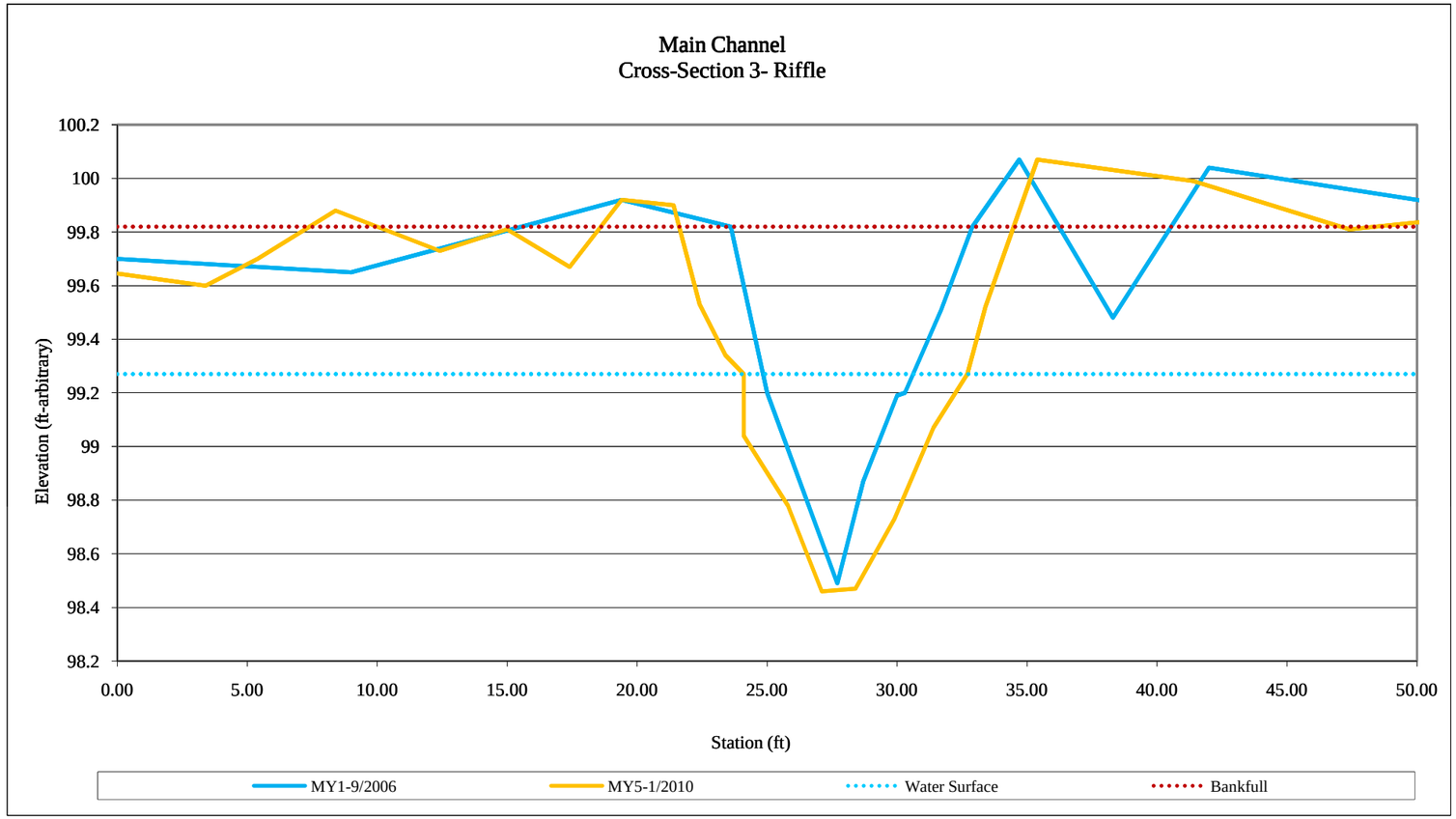
Summary Data	
Bankfull Cross-sectional Area (ft^2)	9.72
Bankfull Width (ft)	6.51
Bankfull Mean Depth (ft)	1.49
Bankfull Max Depth (ft)	1.86
Width/Depth Ratio	4.37
Entrenchment Ratio	>2.2

Project Name: Shepherds Tree-Main Channel					
Cross-Section: 2					
Feature: Pool					
1/2010					
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
-5.50	99.84		29.20	99.90	
-5.50	100.01		30.00	100.20	
-0.50	100.00	lpt	31.90	100.26	
3.80	100.10		33.10	100.11	
7.60	100.18		34.30	100.20	
11.70	100.19		38.20	100.09	
15.60	100.23		41.70	100.07	
18.30	100.32		44.80	100.07	
20.00	100.33		48.40	100.30	
20.70	100.26		51.90	100.22	
21.10	99.92				
21.40	99.80	lew/ws			
22.00	99.45				
22.80	99.13				
23.90	98.64				
24.80	98.58				
25.60	98.98				
26.20	99.32				
26.70	99.48				
26.70	99.80	rew/ws			
26.90	99.72				
28.40	99.82				

Summary Data	
Bankfull Cross-sectional Area (ft^2)	7.39
Bankfull Width (ft)	9.23
Bankfull Mean Depth (ft)	0.80
Bankfull Max Depth (ft)	1.62
Width/Depth Ratio	11.54
Entrenchment Ratio	N/A



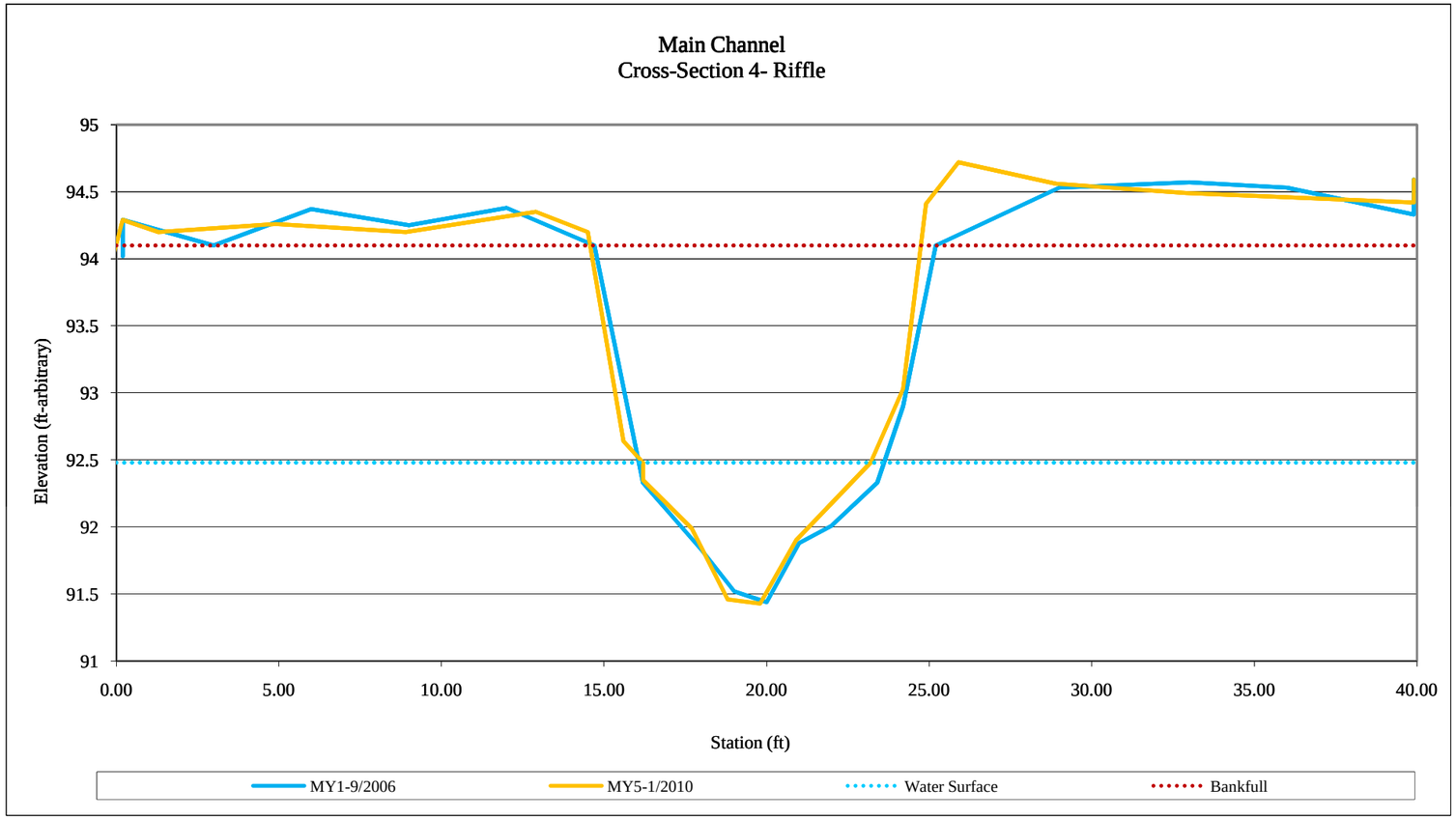
Project Name: Shepherds Tree Main Channel		
Cross-Section: 3		
Feature: Riffle		
1/2010		
-5.6	99.65	
-2.6	99.68	
3.4	99.6	
5.4	99.7	
8.4	99.88	
12.4	99.73	
15	99.81	
17.4	99.67	
19.4	99.92	
21.4	99.9	
22.4	99.53	
23.4	99.34	
24.1	99.27	lew/ws
24.1	99.04	
25.8	98.78	
27.1	98.46	
28.4	98.47	
29.9	98.73	
31.4	99.07	
32.7	99.27	rew/ws
33.40	99.52	
35.40	100.07	
41.40	99.99	
47.40	99.81	
57.40	99.91	



Summary Data	
Bankfull Cross-sectional Area (ft^2)	11.29
Bankfull Width (ft)	13.38
Bankfull Mean Depth (ft)	0.84
Bankfull Max Depth (ft)	1.44
Width/Depth Ratio	15.93
Entrenchment Ratio	>2.2

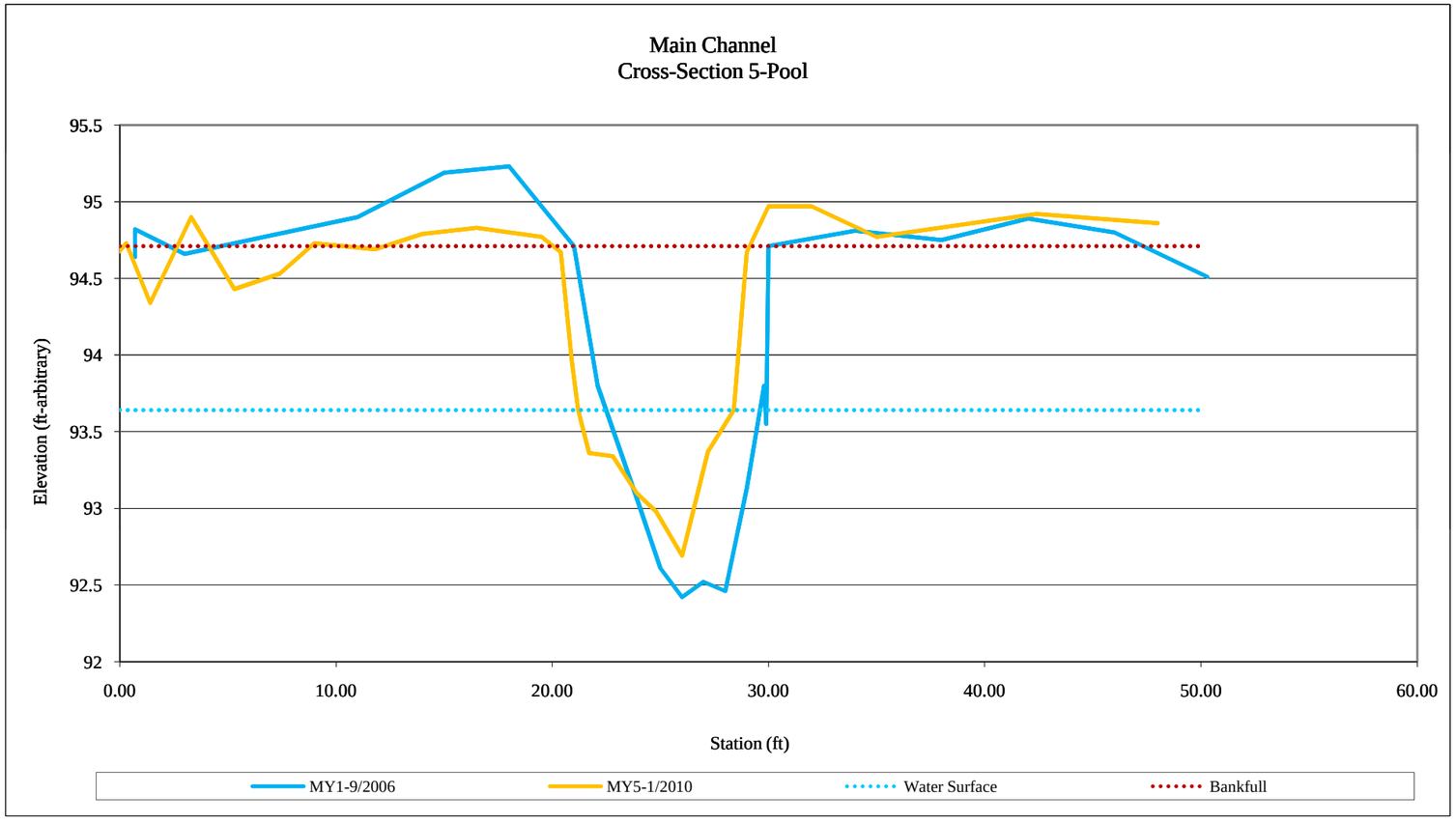
Project Name: Shepherds Tree Main Channel		
Cross-Section: 4		
Feature: Riffle		
1/2010		
-0.1	94.02	
0.2	94.29	lpt
1.3	94.2	
4.9	94.26	
8.9	94.2	
12.9	94.35	
14.5	94.2	
15.6	92.64	
16.2	92.48	lew/ws
16.2	92.35	
17.7	91.99	
18.8	91.46	
19.8	91.43	
20.9	91.9	
23.2	92.48	rew/ws
24.2	93.03	
24.9	94.41	
25.9	94.72	
28.9	94.56	
32.9	94.49	
39.90	94.42	
39.90	94.59	

Summary Data	
Bankfull Cross-sectional Area (ft^2)	19.57
Bankfull Width (ft)	10.29
Bankfull Mean Depth (ft)	1.90
Bankfull Max Depth (ft)	2.77
Width/Depth Ratio	5.42
Entrenchment Ratio	>2.2

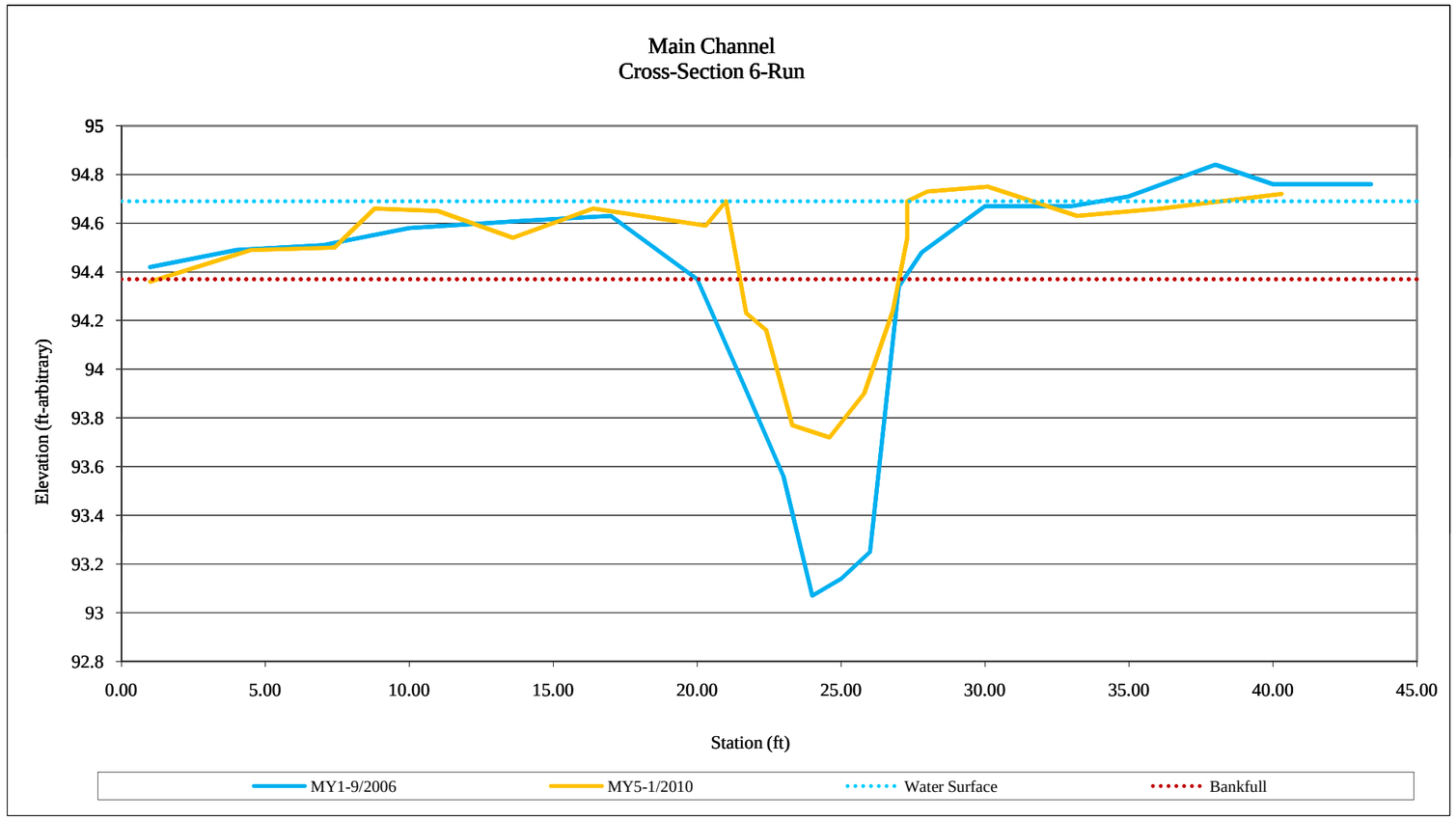


Project Name: Shepherds Tree-Main Channel					
Cross-Section: 5					
Feature: Pool					
1/2010					
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
-4.00	94.82		27.20	93.37	
-2.50	94.80		28.40	93.64	rew/ws
-1.70	94.70		29.00	94.67	
-0.80	94.55		30.00	94.97	
0.30	94.73		32.00	94.97	
1.40	94.34		35.00	94.77	
3.30	94.90		42.40	94.92	
5.30	94.43		48.00	94.86	
7.40	94.53				
9.00	94.73				
11.80	94.69				
14.00	94.79				
16.50	94.83				
19.50	94.77				
20.40	94.67	bkf			
20.90	93.96				
21.20	93.64	lew/ws			
21.70	93.36				
22.80	93.34				
23.90	93.10				
24.80	92.98				
26.00	92.69				

Summary Data	
Bankfull Cross-sectional Area (ft^2)	11.41
Bankfull Width (ft)	8.60
Bankfull Mean Depth (ft)	1.33
Bankfull Max Depth (ft)	1.98
Width/Depth Ratio	6.47
Entrenchment Ratio	N/A



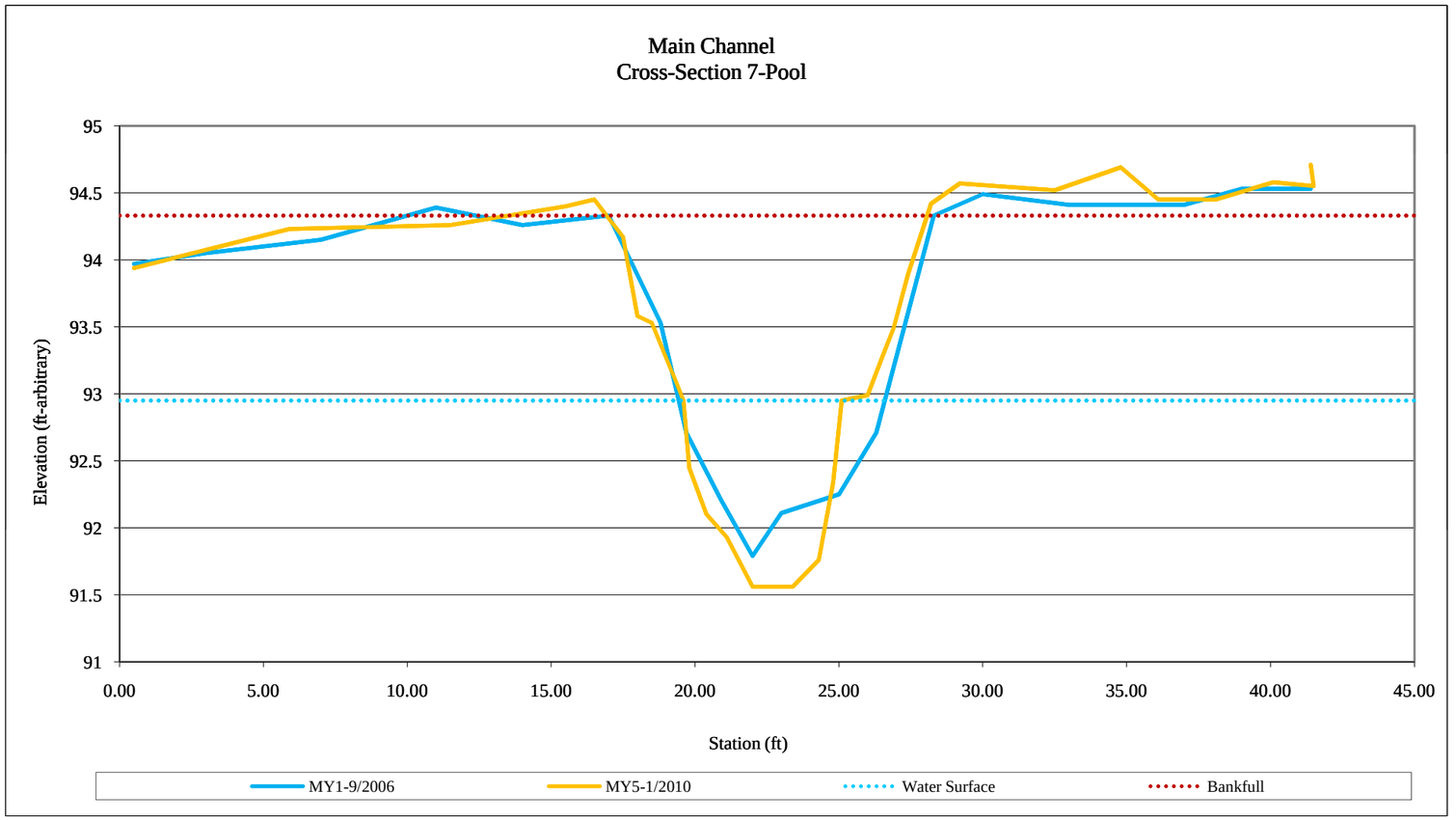
Project Name: Shepherds Tree-Main Channel		
Cross-Section: 6		
Feature: Run		
1/2010		
Station	**Elevation**	**Notes**
1	94.36	
4.5	94.49	
7.4	94.5	
8.8	94.66	
11	94.65	
13.6	94.54	
16.4	94.66	
20.3	94.59	
21	94.69	lew/ws
21.7	94.23	
22.4	94.16	
23.3	93.77	
24.6	93.72	
25.8	93.9	
26.8	94.24	
27.3	94.54	
27.3	94.69	rew/ws
28	94.73	
30.1	94.75	
33.2	94.63	
36.1	94.66	
40.3	94.72	



Summary Data	
Bankfull Cross-sectional Area (ft^2)	3.59
Bankfull Width (ft)	6.15
Bankfull Mean Depth (ft)	0.58
Bankfull Max Depth (ft)	0.87
Width/Depth Ratio	10.60
Entrenchment Ratio	N/A

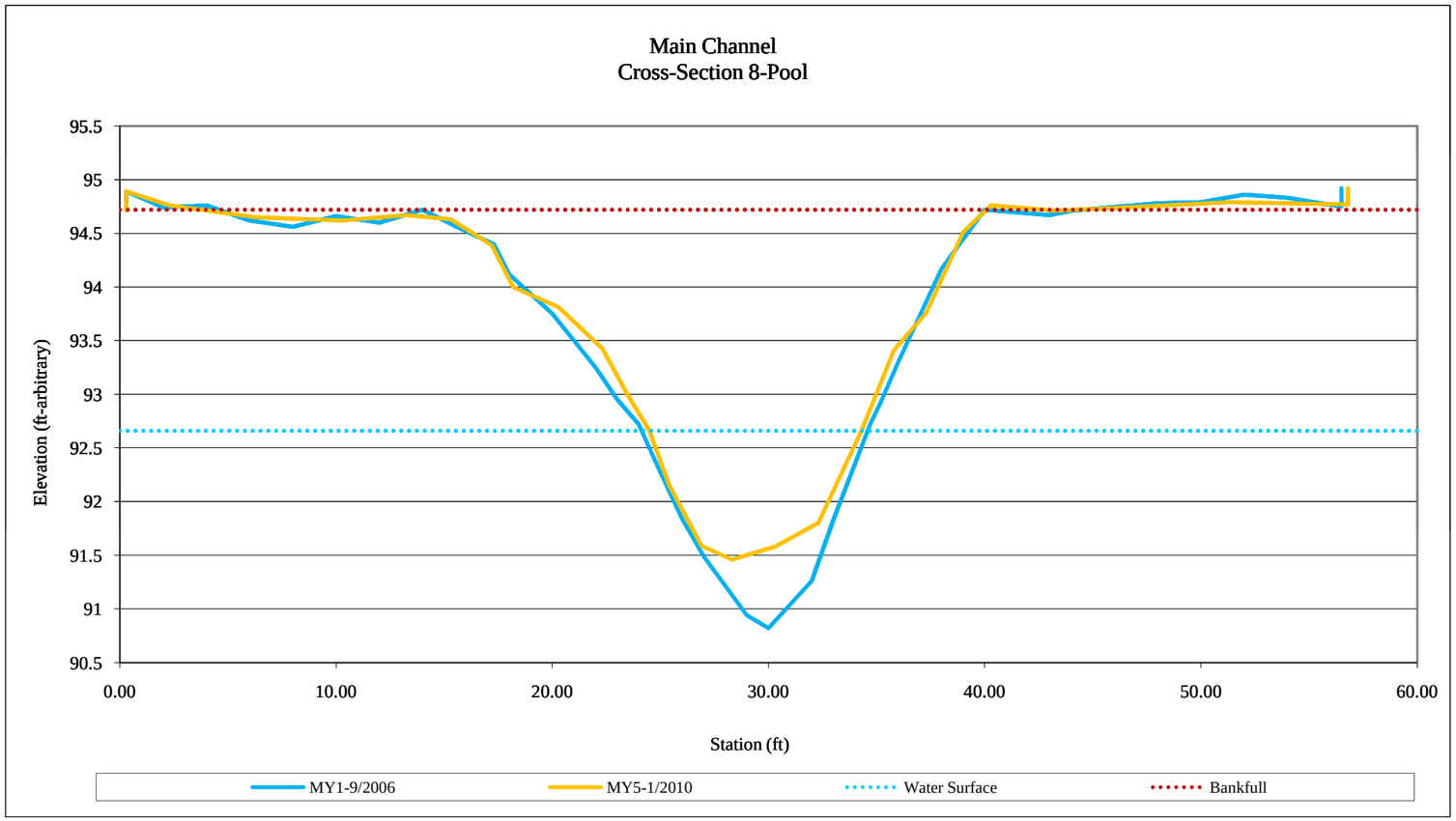
Project Name: Shepherds Tree-Main Channel					
Cross-Section: 7					
Feature: Pool					
1/2010					
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
0.5	93.94		28.2	94.42	
5.9	94.23		29.2	94.57	
11.5	94.26		32.5	94.52	
15.5	94.4	bkf	34.8	94.69	
16.5	94.45		36.1	94.45	
17.5	94.17		38.1	94.45	
18	93.58		40.1	94.58	
18.5	93.53		41.5	94.55	
19.3	93.11		41.4	94.71	
19.6	92.95	lew/ws			
19.8	92.45				
20.4	92.1				
21.1	91.93				
22	91.56				
23.4	91.56				
24.3	91.76				
24.8	92.34				
25.1	92.95	rew/ws			
26	92.99				
26.5	93.27				
26.9	93.49				
27.4	93.89				

Summary Data	
Bankfull Cross-sectional Area (ft^2)	18.75
Bankfull Width (ft)	11.49
Bankfull Mean Depth (ft)	1.63
Bankfull Max Depth (ft)	2.84
Width/Depth Ratio	7.05
Entrenchment Ratio	N/A



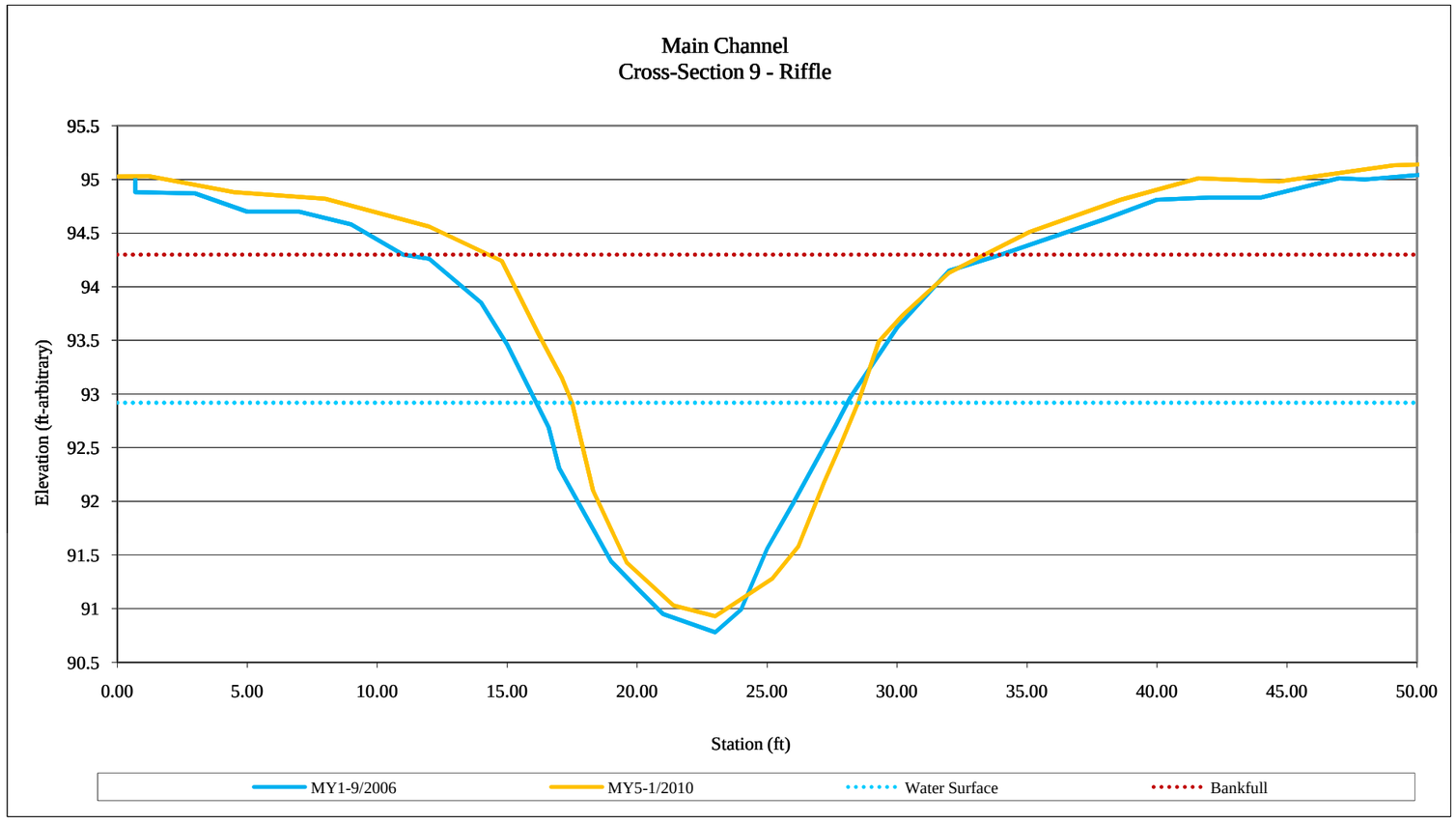
Project Name: Shepherds Tree-Main Channel					
Cross-Section: 8					
Feature: Pool					
1/2010					
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
0.3	94.71		40.3	94.76	
0.3	94.89	lpt	43.3	94.71	
2.3	94.76		51.3	94.79	
6.3	94.65		56.8	94.77	
10.3	94.62		56.8	94.92	rpt
13.3	94.67				
15.3	94.63				
17.2	94.39				
18.2	94				
20.3	93.81				
22.3	93.43				
23.5	92.99				
24.5	92.66	lew/ws			
25.4	92.16				
26.9	91.59				
28.3	91.46				
30.3	91.58				
32.3	91.8				
34.3	92.66	rew/ws			
35.8	93.41				
37.3	93.76				
39	94.51				

Summary Data	
Bankfull Cross-sectional Area (ft^2)	40.95
Bankfull Width (ft)	26.53
Bankfull Mean Depth (ft)	1.54
Bankfull Max Depth (ft)	3.21
Width/Depth Ratio	17.23
Entrenchment Ratio	N/A



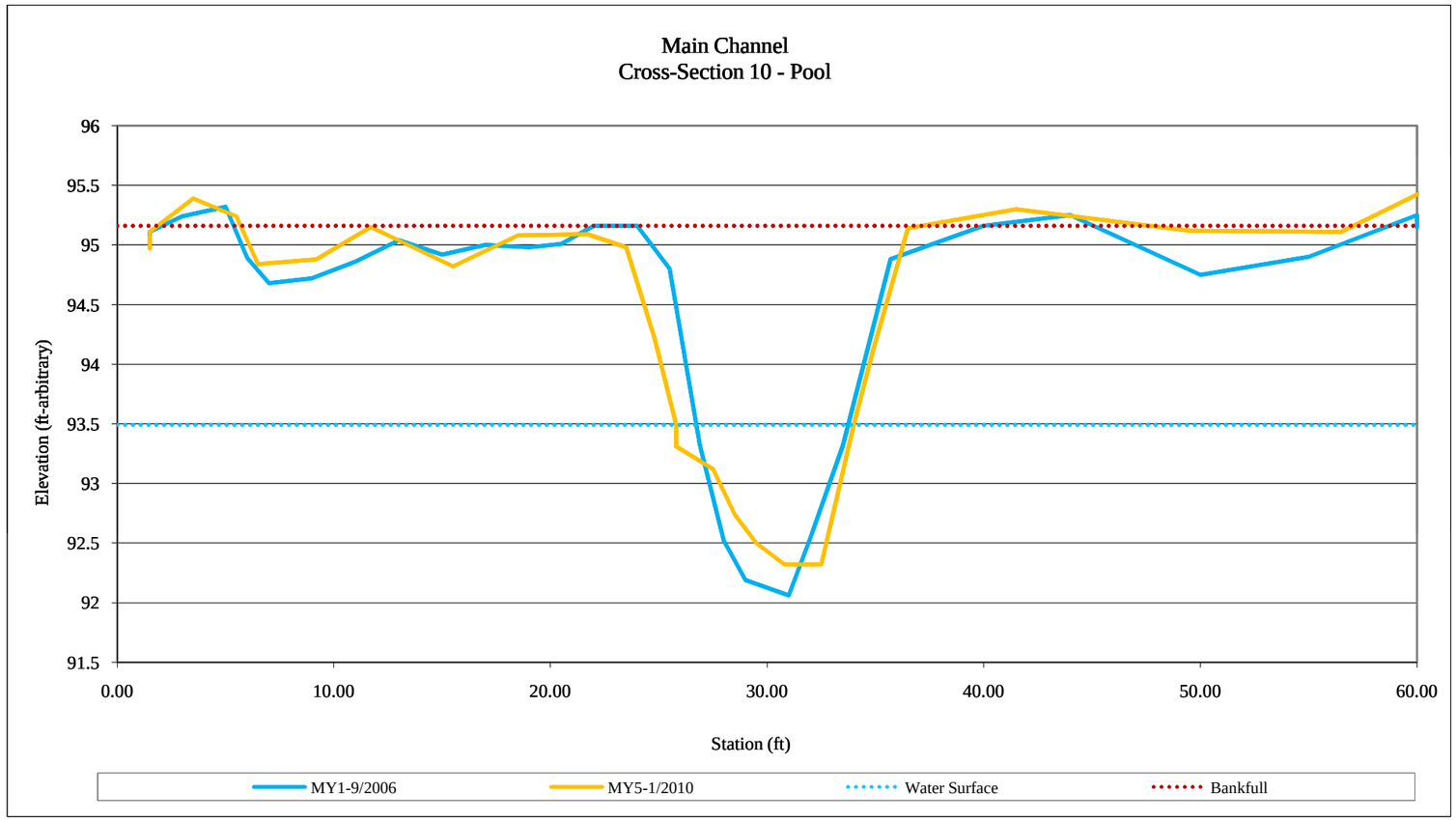
Project Name: Shepherds Tree Main Channel		
Cross-Section: 9		
Feature: Riffle		
1/2010		
-6	94.88	
-2.3	95.02	
1.2	95.03	
4.5	94.88	
8	94.82	
12	94.56	
14.8	94.24	
16.2	93.56	
17.1	93.15	
17.5	92.92	lew/ws
18.3	92.1	
19.6	91.43	
21.4	91.03	
23	90.93	
25.2	91.28	
26.2	91.58	
27.2	92.18	
27.8	92.51	
28.5	92.92	rew/ws
29.3	93.49	
30.20	93.73	
32.00	94.13	
35.10	94.51	
38.60	94.81	
41.60	95.01	
44.70	94.98	
49.1	95.13	
52.7	95.16	
56.8	95.19	
59.6	95.11	
61.8	95.15	

Summary Data	
Bankfull Cross-sectional Area (ft^2)	33.26
Bankfull Width (ft)	18.10
Bankfull Mean Depth (ft)	1.84
Bankfull Max Depth (ft)	3.31
Width/Depth Ratio	9.84
Entrenchment Ratio	>2.20

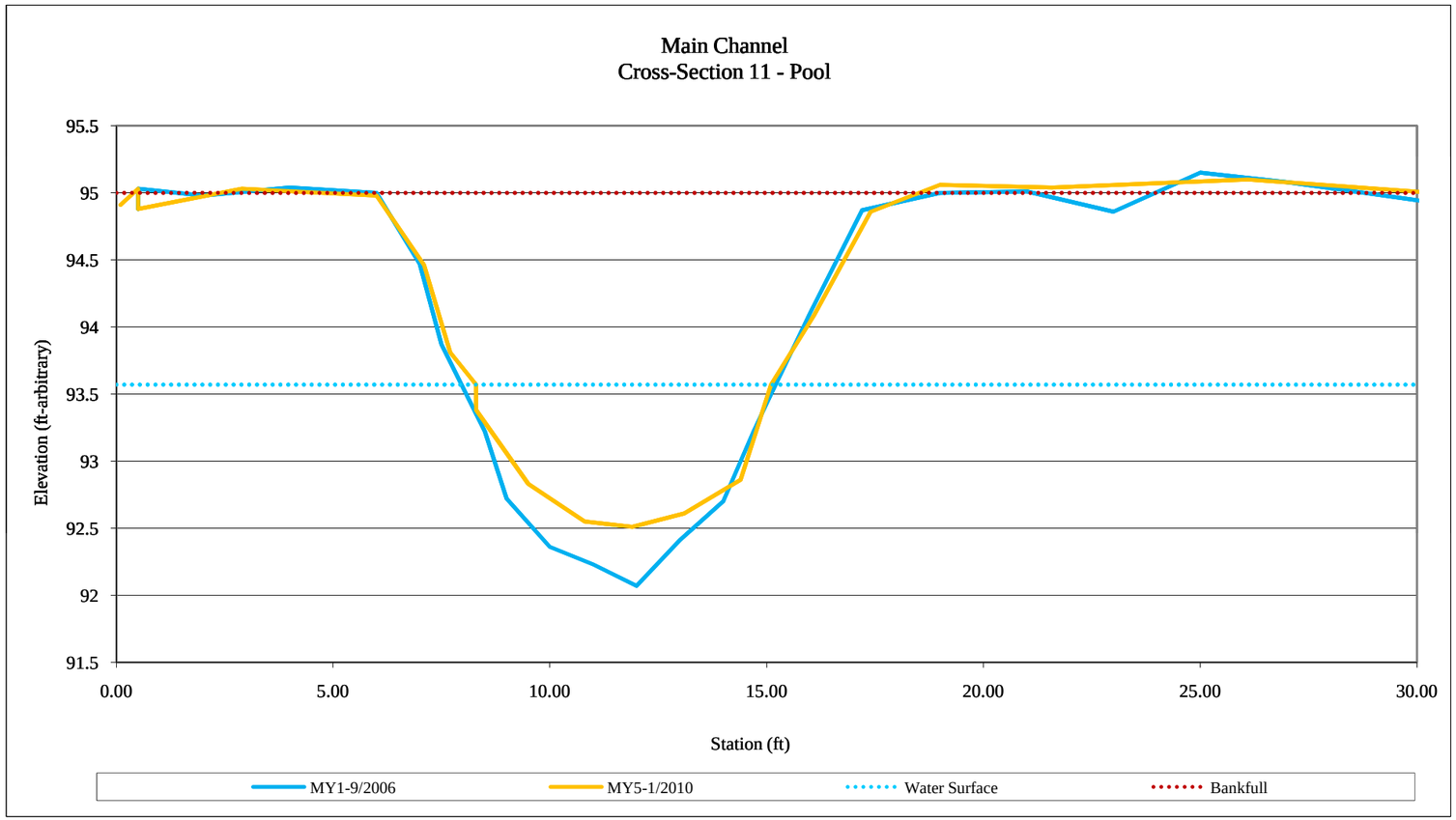


Project Name: Shepherds Tree Main Channel		
Cross-Section: 10		
Feature: Pool		
1/2010		
1.5	94.97	
1.5	95.11	lpt
3.5	95.39	
5.5	95.24	
6.5	94.84	
9.2	94.88	
11.7	95.15	
15.5	94.82	
18.5	95.08	
21.7	95.09	
23.5	94.98	
24.8	94.22	
25.8	93.49	lew/ws
25.8	93.31	
27.5	93.12	
28.5	92.74	
29.5	92.5	
30.8	92.32	
32.5	92.32	
34	93.49	rew/ws
34.90	94.12	
36.50	95.14	
41.50	95.30	
49.50	95.12	
56.50	95.11	
60.20	95.44	

Summary Data	
Bankfull Cross-sectional Area (ft^2)	23.93
Bankfull Width (ft)	15.50
Bankfull Mean Depth (ft)	1.54
Bankfull Max Depth (ft)	2.82
Width/Depth Ratio	10.06
Entrenchment Ratio	N/A



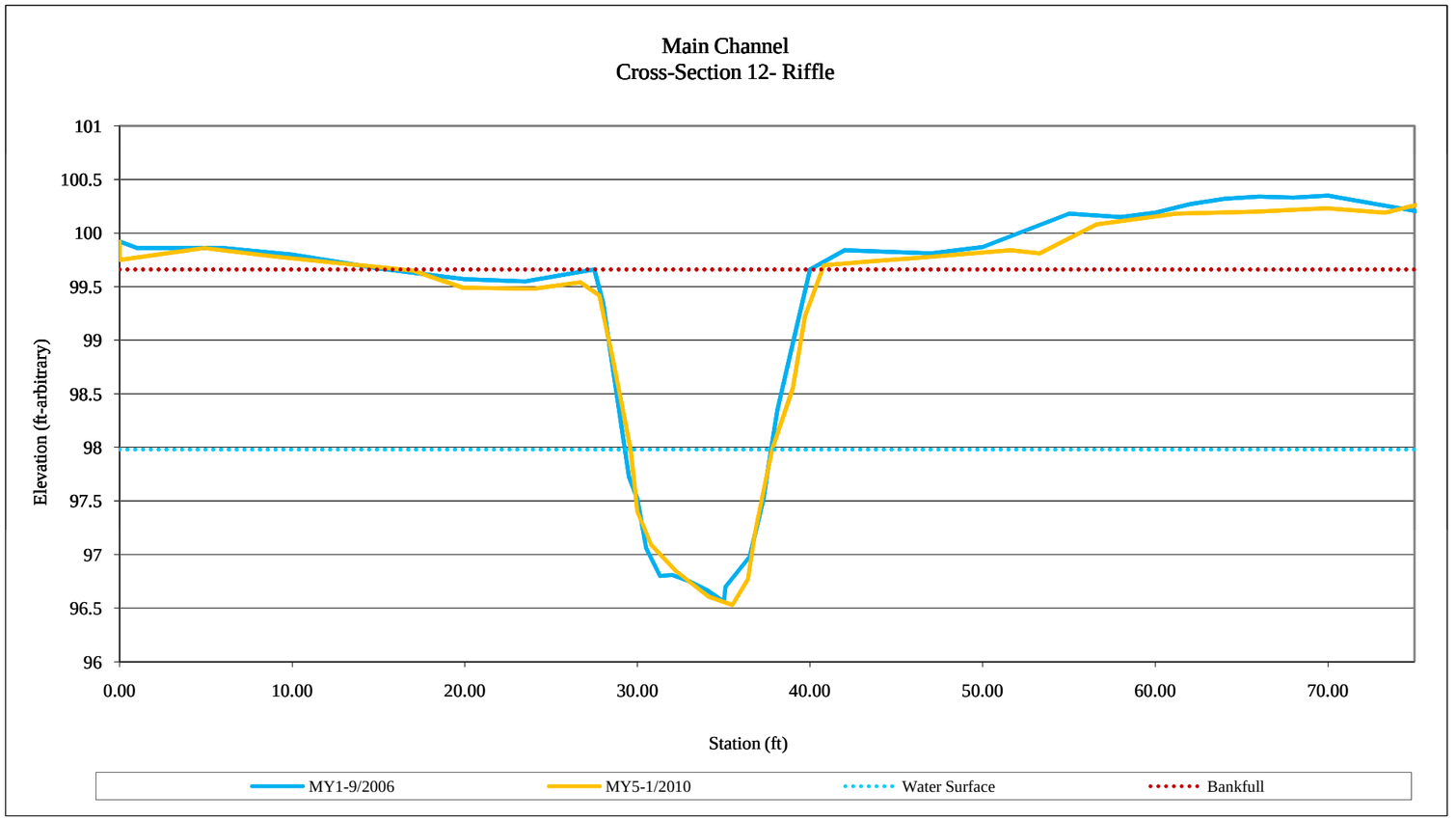
Project Name: Shepherds Tree Main Channel		
Cross-Section: 11		
Feature: Pool		
1/2010		
0.1	94.91	
0.5	95.03	lpt
0.5	94.88	
2.9	95.03	
6	94.98	
7.1	94.46	
7.7	93.81	
8.3	93.57	lew/ws
8.3	93.38	
9.5	92.83	
10.8	92.55	
11.9	92.51	
13.1	92.61	
14.4	92.86	
15.1	93.57	rew/ws
16.1	94.09	
17.4	94.86	
19	95.06	
21.6	95.04	
26.1	95.1	
32.10	94.96	
37.40	94.97	



Summary Data	
Bankfull Cross-sectional Area (ft^2)	19.43
Bankfull Width (ft)	12.92
Bankfull Mean Depth (ft)	1.50
Bankfull Max Depth (ft)	2.55
Width/Depth Ratio	8.61
Entrenchment Ratio	N/A

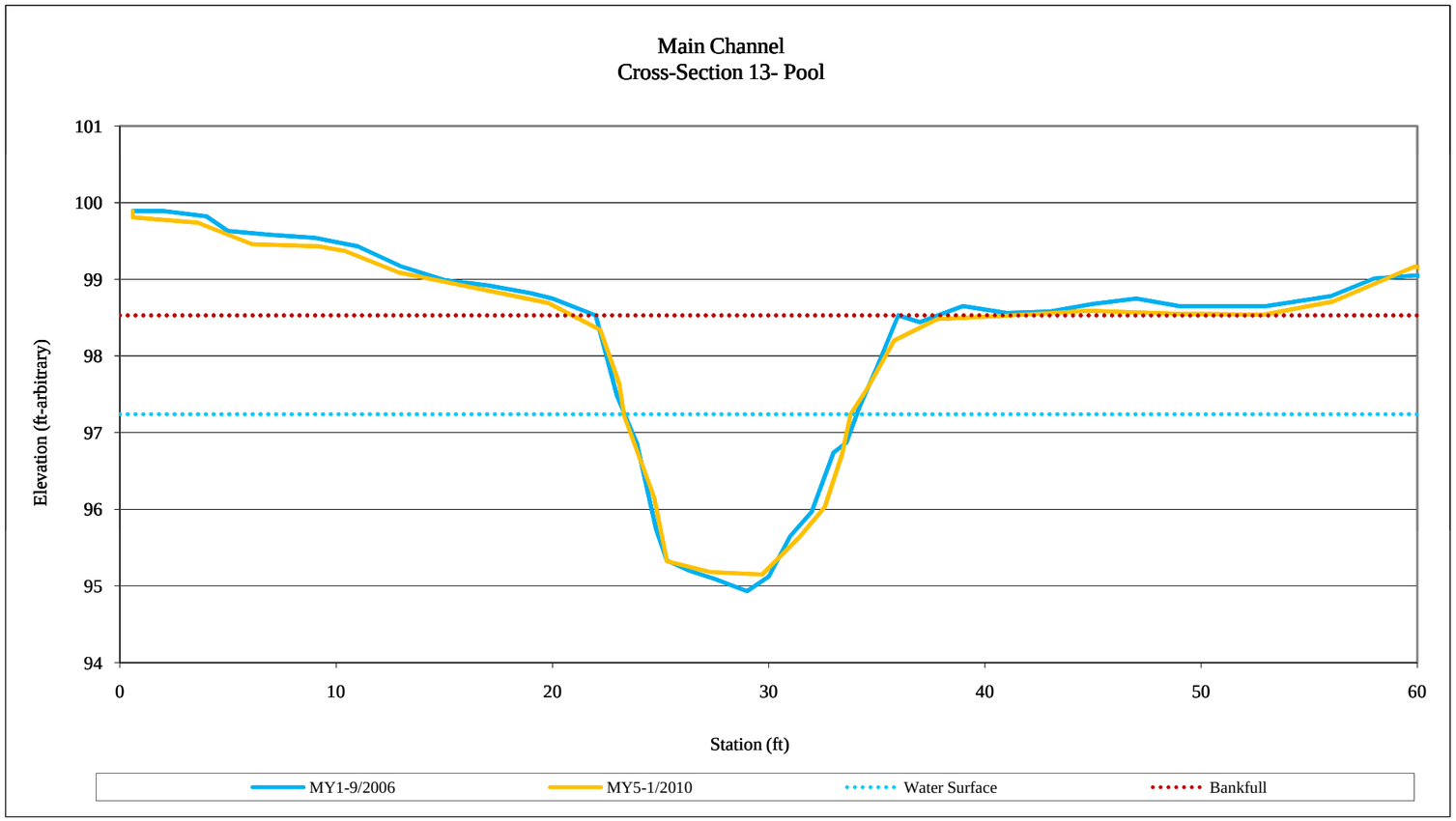
Project Name: Shepherds Tree-Main Channel					
Cross-Section: 12					
Feature: Riffle					
1/2010					
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
0	99.92	lpt	40.8	99.7	
0	99.75		43.1	99.73	
4.9	99.86		46.3	99.77	
9	99.78		51.6	99.84	
12.7	99.72		53.3	99.81	
17	99.65		56.6	100.08	
19.9	99.49		61.2	100.18	
24	99.48		65.8	100.2	
26.7	99.54		69.9	100.23	
27.8	99.42		73.30	100.19	
28.6	98.8		76.6	100.32	
29.6	97.98	lew/ws	76.6	100.08	
30	97.4				
30.8	97.09				
32.2	96.85				
34.1	96.61				
35.5	96.53				
36.4	96.77				
36.8	97.19				
37.8	97.98	rew/ws			
39	98.55				
39.7	99.22				

Summary Data	
Bankfull Cross-sectional Area (ft^2)	26.83
Bankfull Width (ft)	12.80
Bankfull Mean Depth (ft)	2.10
Bankfull Max Depth (ft)	3.17
Width/Depth Ratio	6.10
Entrenchment Ratio	N/A

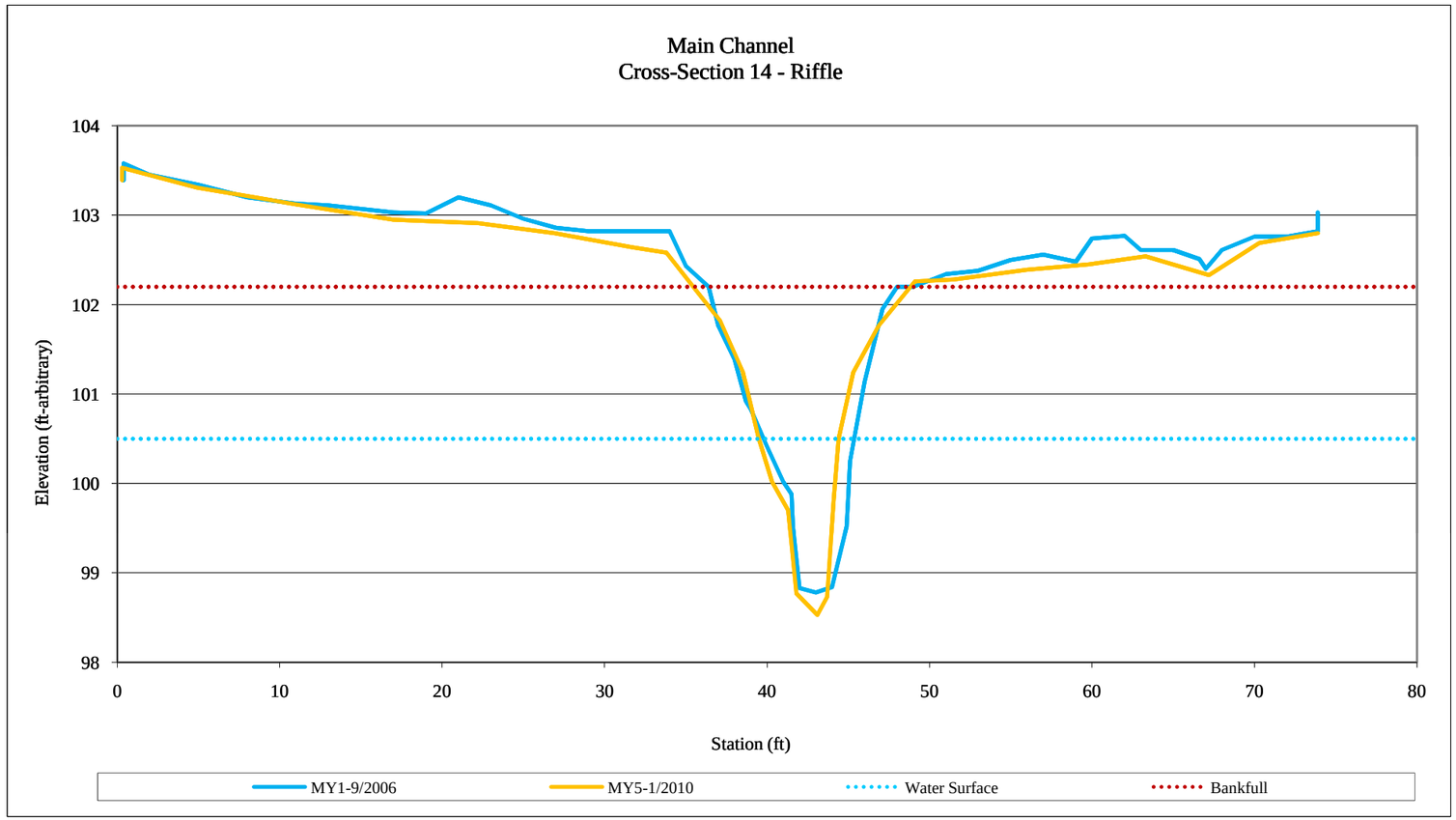


Project Name: Shepherds Tree-Main Channel					
Cross-Section: 13					
Feature: Pool					
1/2010					
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
0.6	99.89	lpt	37.8	98.48	
0.6	99.81		40.6	98.52	
3.6	99.74		44.8	98.59	
6.1	99.46		48.8	98.55	
9.2	99.43		52.9	98.54	
10.4	99.37		56.1	98.71	
12.9	99.09		59.9	99.17	
16.4	98.89		63.2	98.89	
19.8	98.69		68.8	98.88	
22.2	98.34	bkf	71.70	99.00	
23.1	97.63		74.2	99.01	
23.3	97.24	lew/ws			
24.7	96.16				
25.3	95.32				
27.3	95.18				
29.7	95.15				
31.4	95.63				
32.6	96.03				
33.4	96.72				
33.8	97.24	rew/ws			
34.5	97.55				
35.8	98.2				

Summary Data	
Bankfull Cross-sectional Area (ft^2)	31.82
Bankfull Width (ft)	16.56
Bankfull Mean Depth (ft)	1.92
Bankfull Max Depth (ft)	3.33
Width/Depth Ratio	8.63
Entrenchment Ratio	N/A



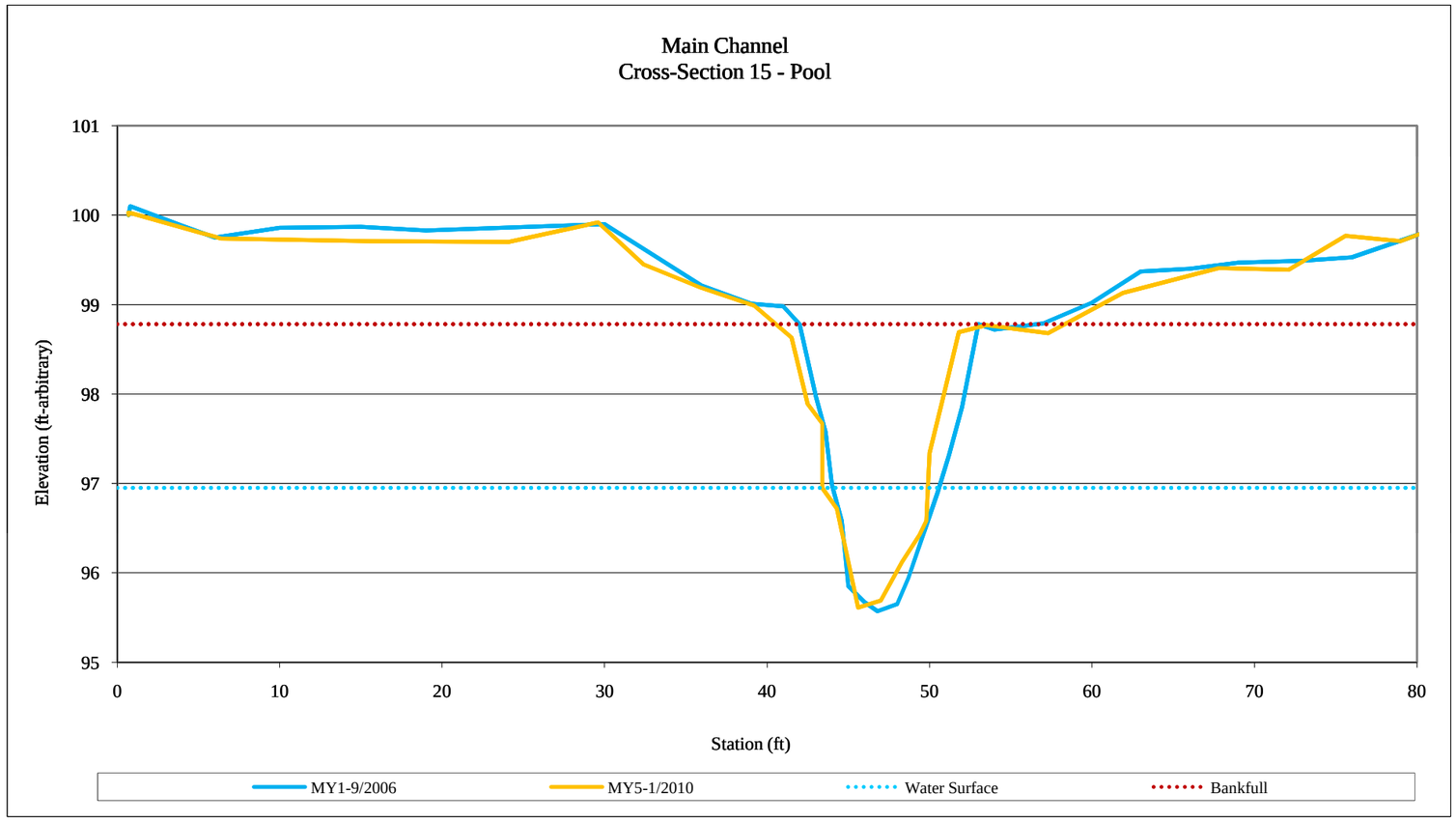
Project Name: Shepherds Tree Main Channel		
Cross-Section: 14		
Feature: Riffle		
1/2010		
0.3	103.39	
0.3	103.53	lpt
4.9	103.31	
11	103.12	
17	102.95	
22.2	102.91	
26.9	102.8	
31.7	102.64	
33.8	102.58	
35.8	102.12	
37.1	101.82	
38.5	101.25	
39.5	100.5	lew/ws
40.3	100.02	
41.3	99.7	
41.8	98.77	
43.1	98.53	
43.7	98.73	
44.1	99.82	
44.4	100.5	rew/ws
45.30	101.24	
46.90	101.77	
49.10	102.26	
51.50	102.28	
56.00	102.39	
59.80	102.45	
63.3	102.54	
67.2	102.33	
70.3	102.69	
73.9	102.8	



Summary Data	
Bankfull Cross-sectional Area (ft^2)	20.03
Bankfull Width (ft)	13.91
Bankfull Mean Depth (ft)	1.44
Bankfull Max Depth (ft)	3.73
Width/Depth Ratio	9.66
Entrenchment Ratio	>2.20

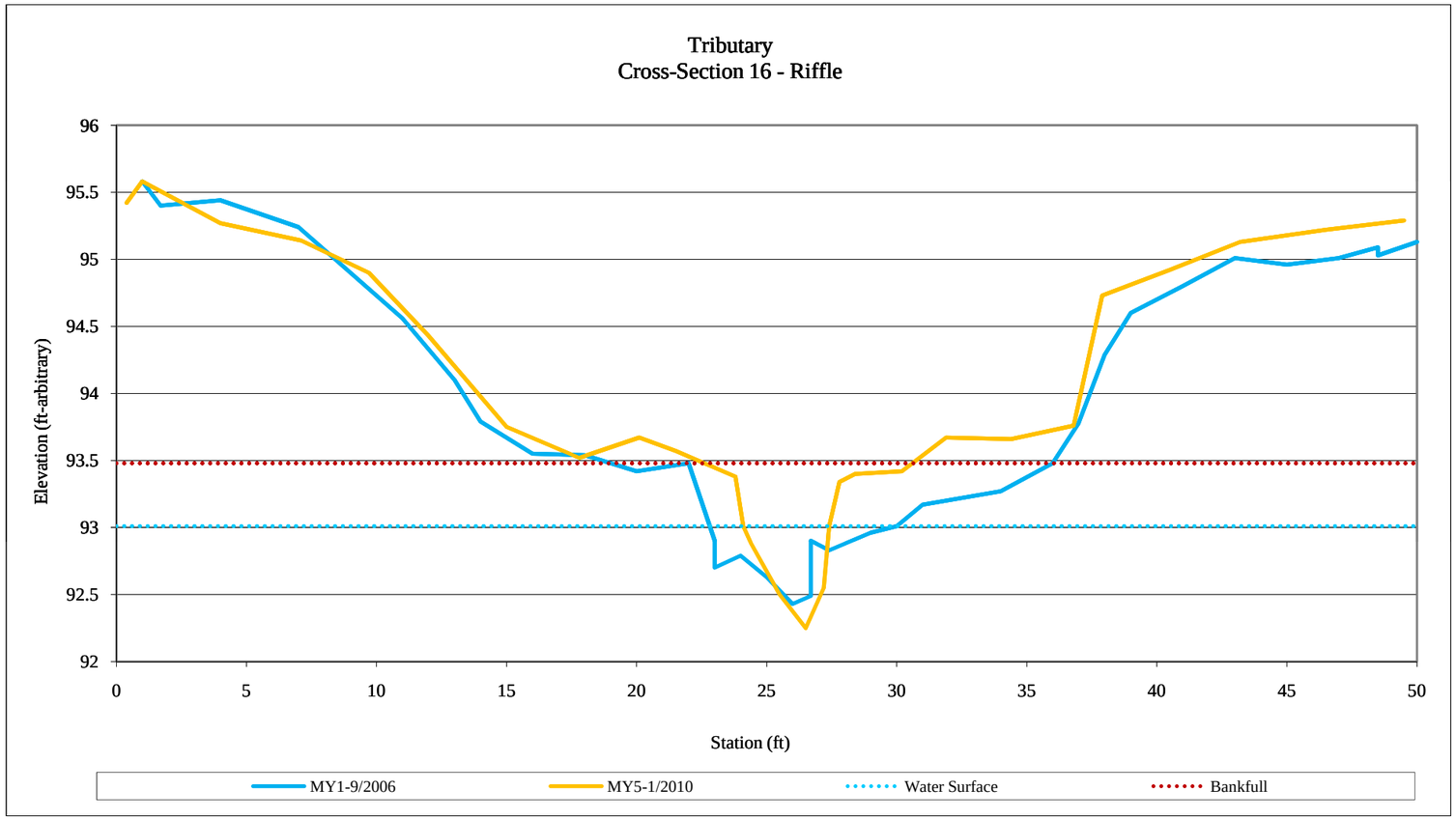
Project Name: Shepherds Tree Main Channel		
Cross-Section: 15		
Feature: Pool		
1/2010		
0.7	100	lpt
0.7	100.03	
6.4	99.74	
15.6	99.71	
24.1	99.7	
29.6	99.92	
32.4	99.45	
35.9	99.19	
39.2	98.99	
41.5	98.63	
42.5	97.89	
43.4	97.67	
43.4	96.95	lew/ws
44.3	96.72	
45.6	95.61	
47	95.69	
48.3	96.12	
49.4	96.43	
49.8	96.58	
49.9	96.95	lrew/ws
50.00	97.34	
50.90	98.01	
51.80	98.69	
53.50	98.77	
57.30	98.68	
61.90	99.13	
67.8	99.41	
72.1	99.39	
75.6	99.77	
79	99.71	
83	99.98	
86.4	100.18	

Summary Data	
Bankfull Cross-sectional Area (ft^2)	20.13
Bankfull Width (ft)	12.89
Bankfull Mean Depth (ft)	1.56
Bankfull Max Depth (ft)	3.16
Width/Depth Ratio	8.26
Entrenchment Ratio	N/A



Project Name: Shepherds Tree Tributary		
Cross-Section: 16		
Feature: Riffle		
1/2010		
0.40	95.42	
1.00	95.58	lpt
4.00	95.27	
7.10	95.14	
9.70	94.9	
12.00	94.43	
15.00	93.75	
17.80	93.52	
20.10	93.67	
21.50	93.57	
23.80	93.38	
24.10	93.01	lew/ws
24.40	92.88	
25.50	92.5	
26.50	92.25	
27.20	92.55	
27.40	93.01	rew/ws
27.80	93.34	
28.40	93.40	
30.20	93.42	
31.90	93.67	
34.40	93.66	
36.80	93.76	
37.90	94.73	
40.50	94.92	
43.20	95.13	
46.50	95.22	
49.50	95.29	

0.76



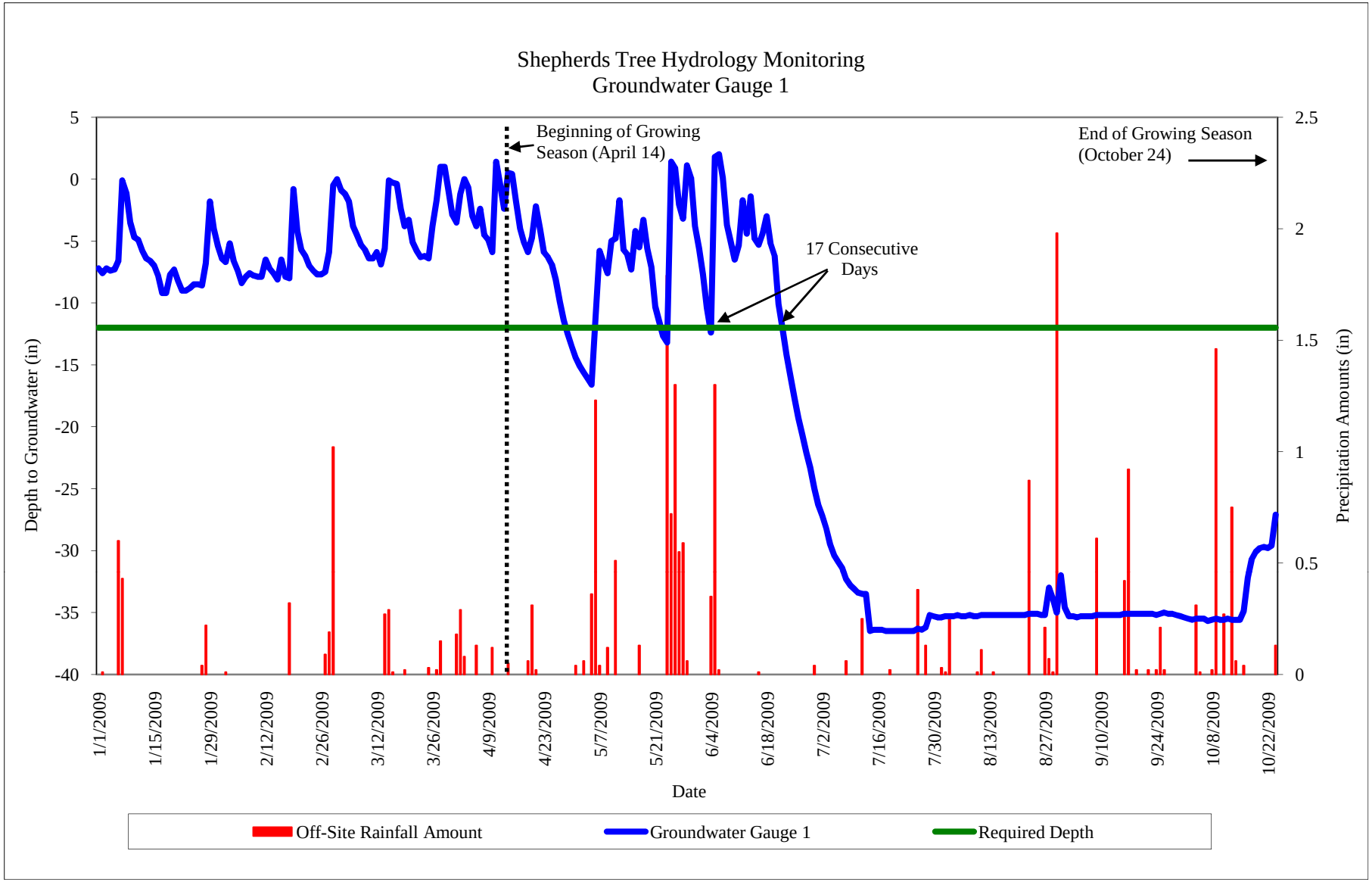
Summary Data	
Bankfull Cross-sectional Area (ft^2)	3.06
Bankfull Width (ft)	6.88
Bankfull Mean Depth (ft)	0.44
Bankfull Max Depth (ft)	1.22
Width/Depth Ratio	17.80
Entrenchment Ratio	>2.20

APPENDIX 5
WETLAND DATA ASSESSMENT

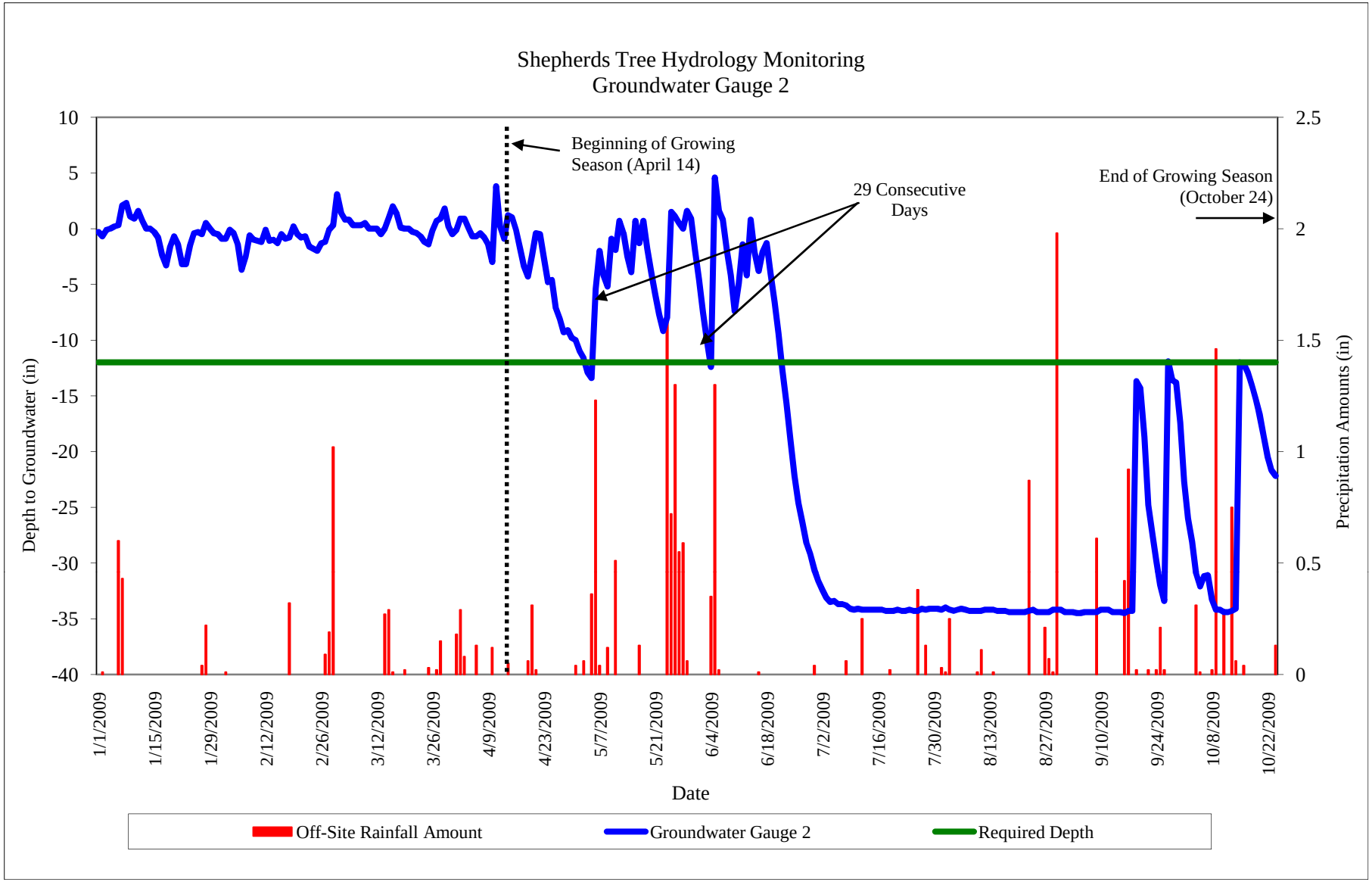
1. Precipitation – Water Level Plots for Gauges*

2. Wetland Criteria Attainment

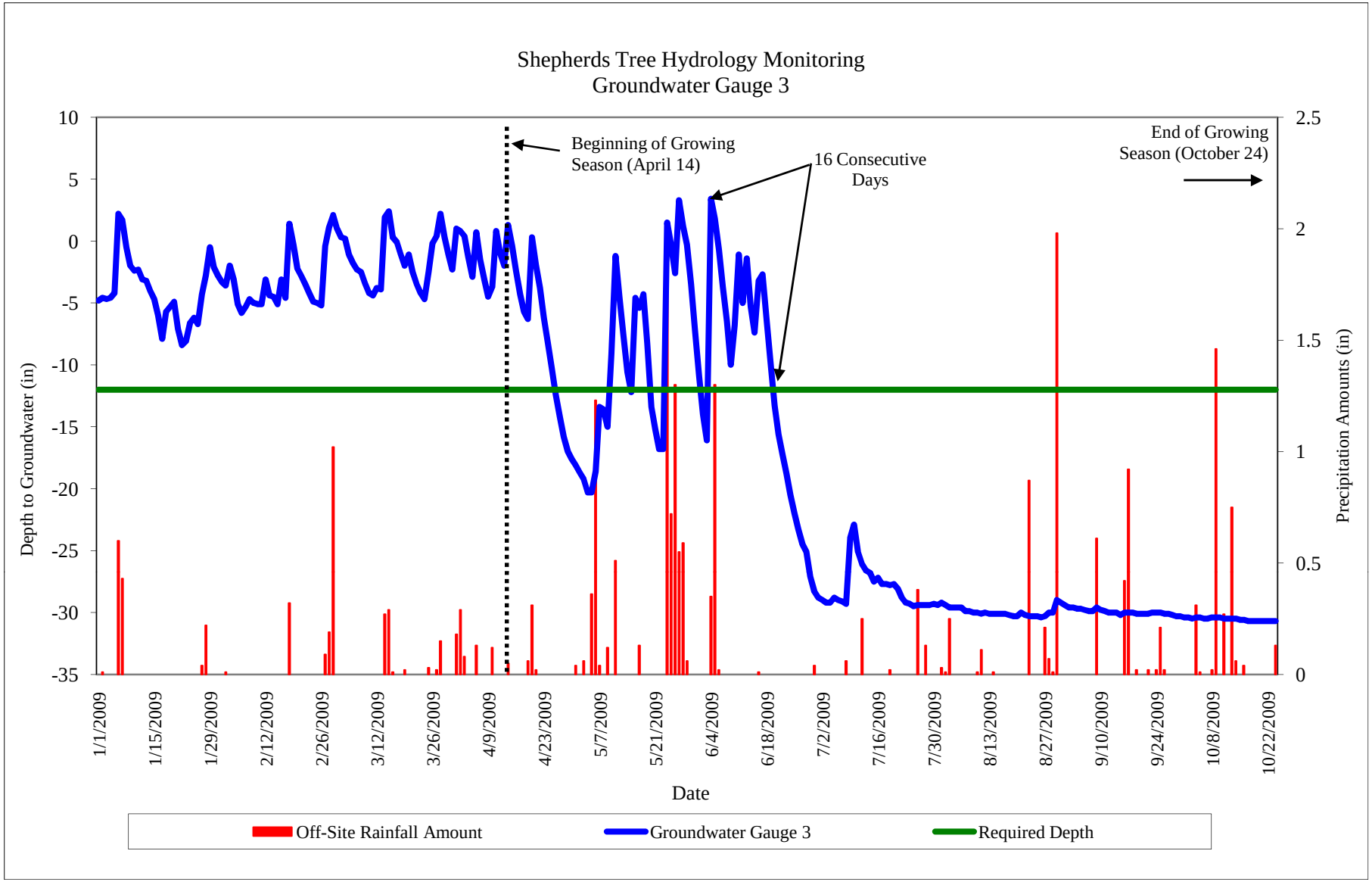
*Raw data tables have been provided electronically.



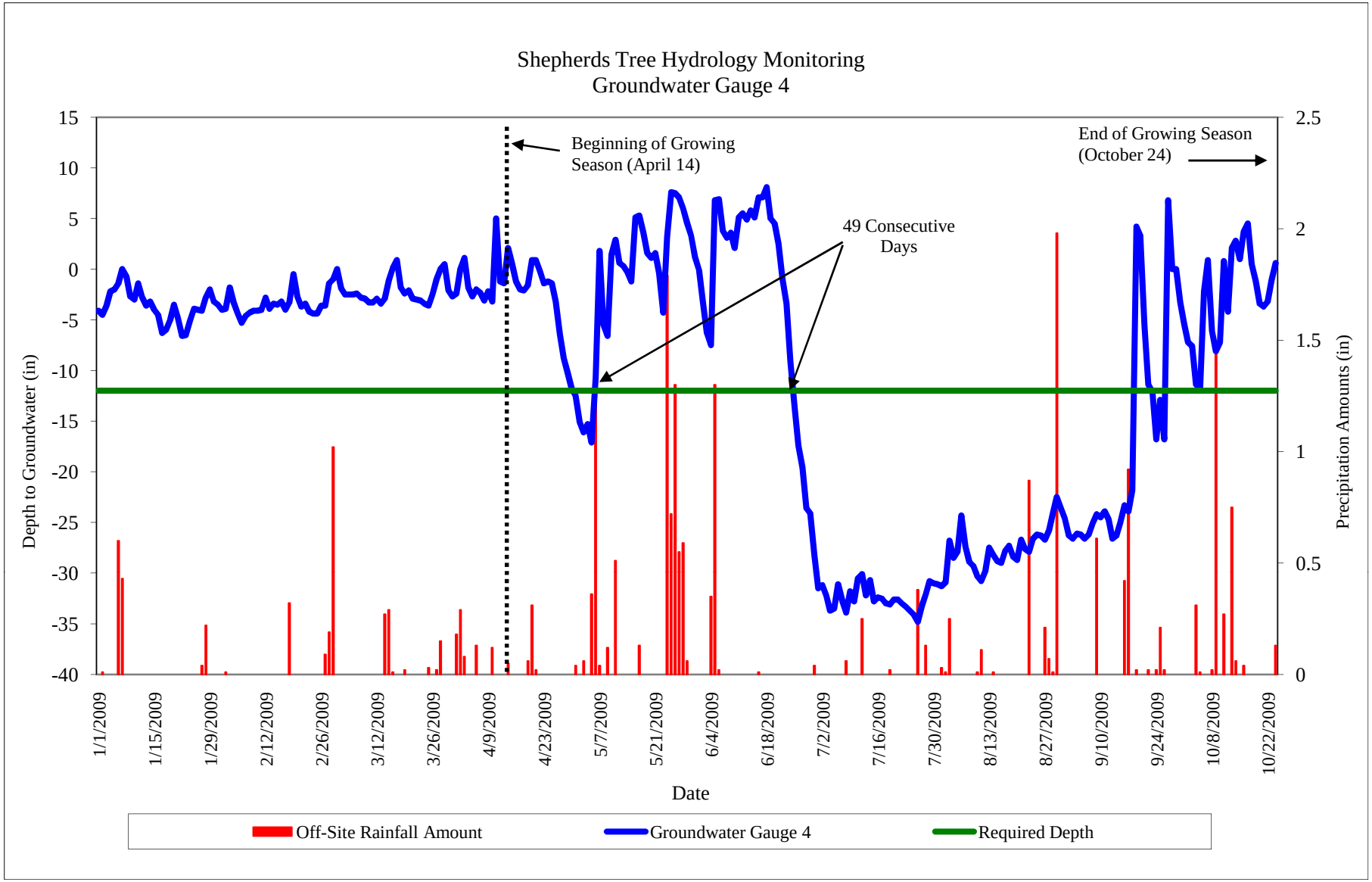
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



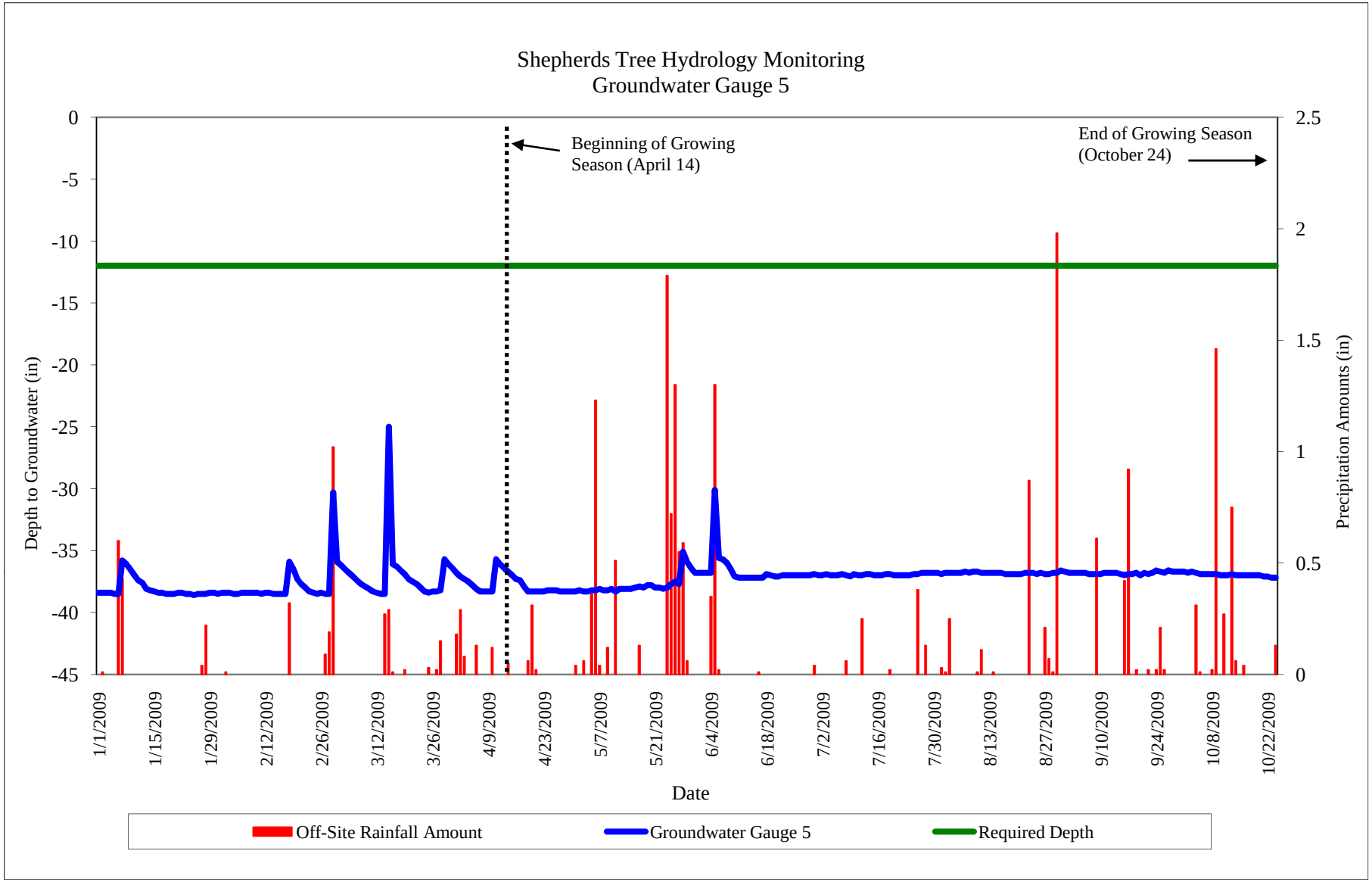
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



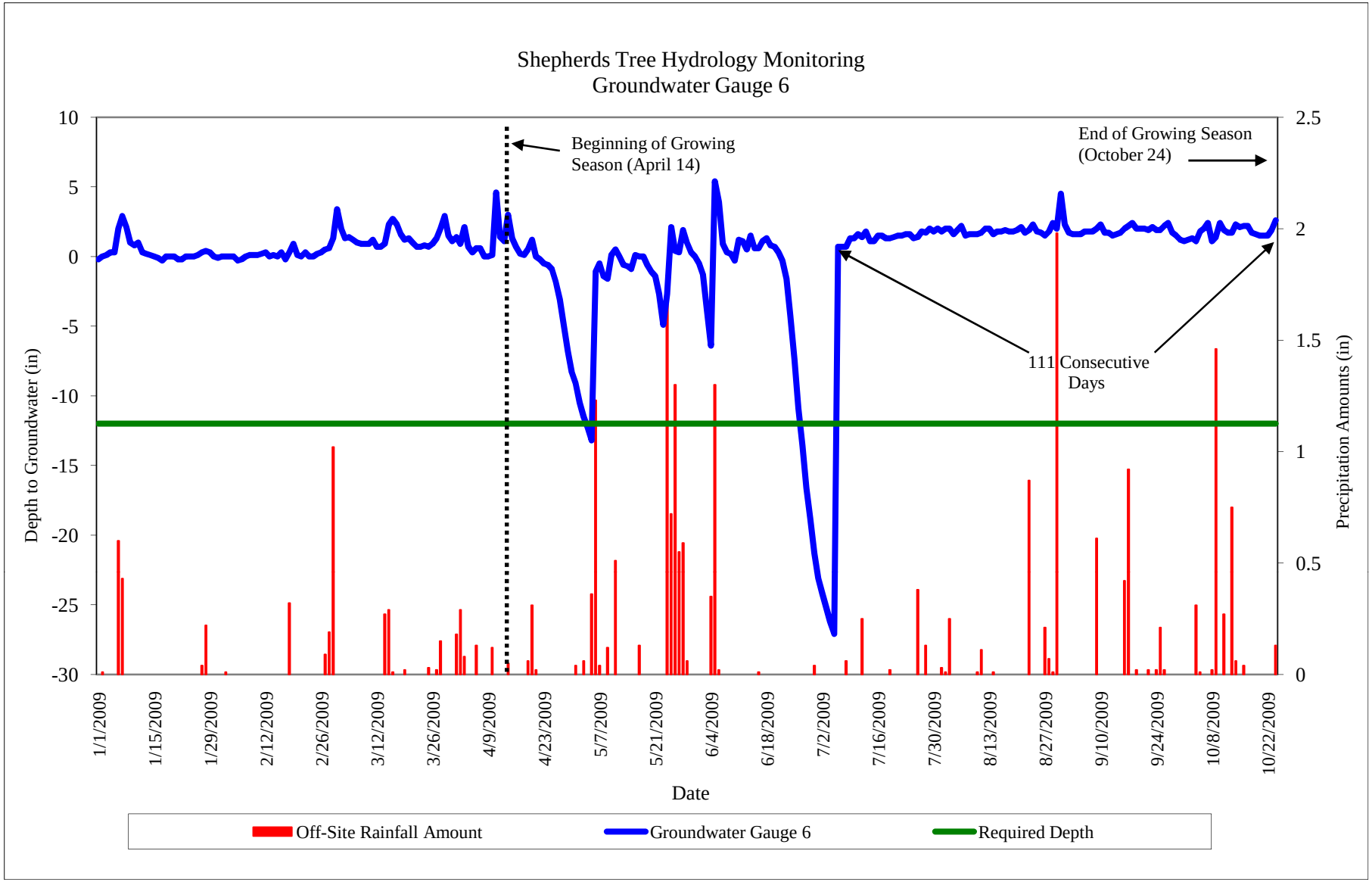
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



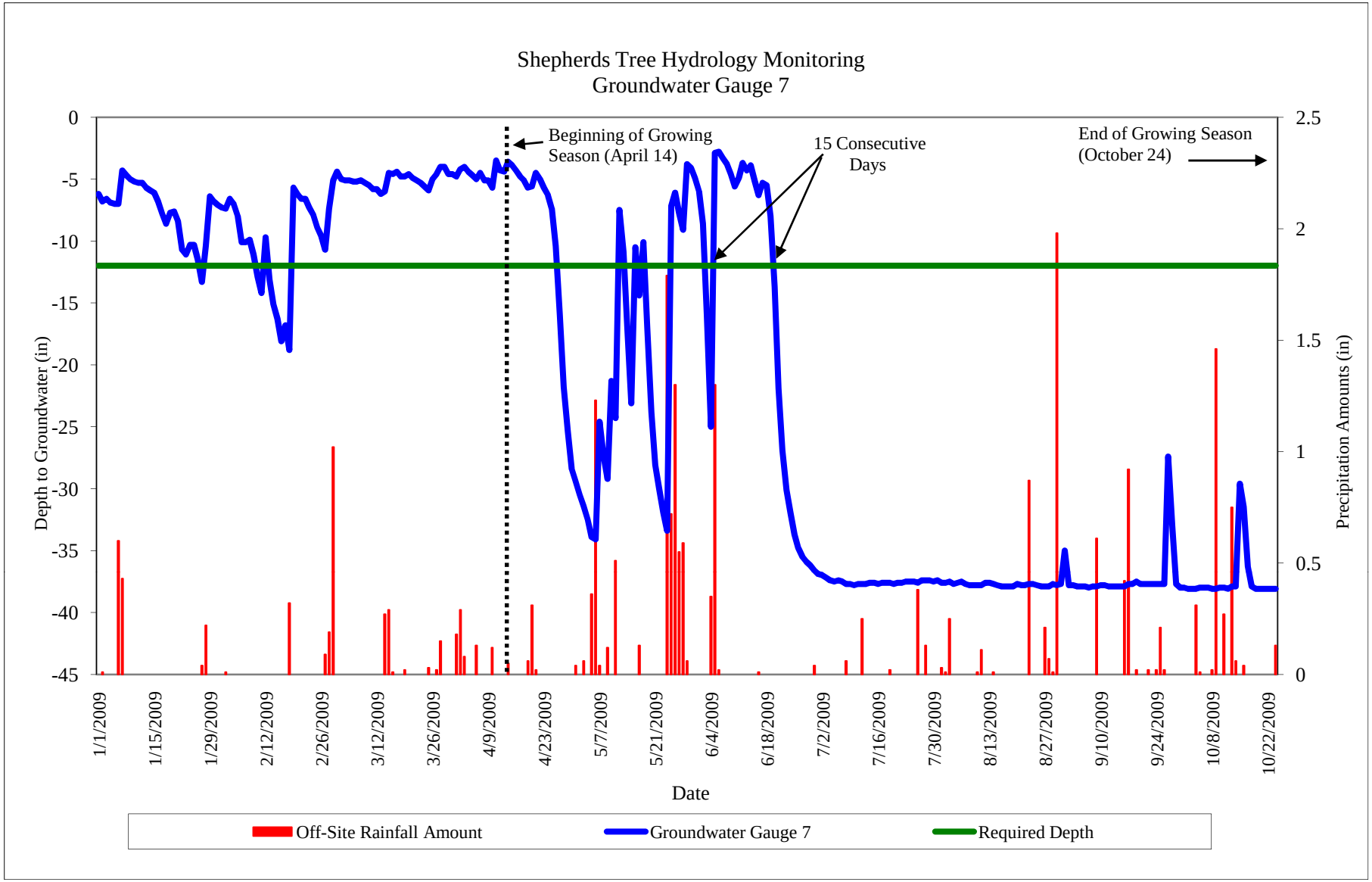
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



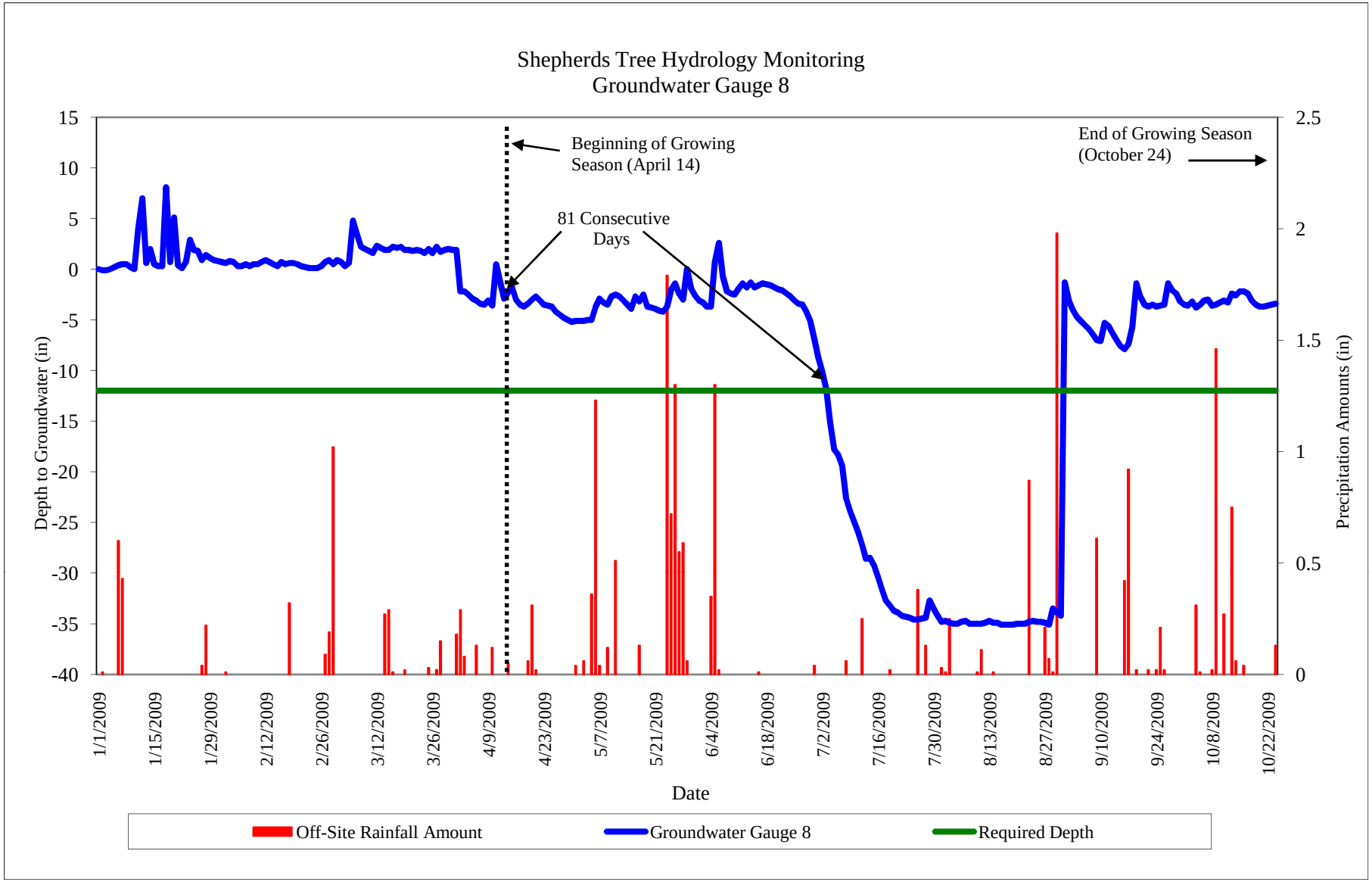
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



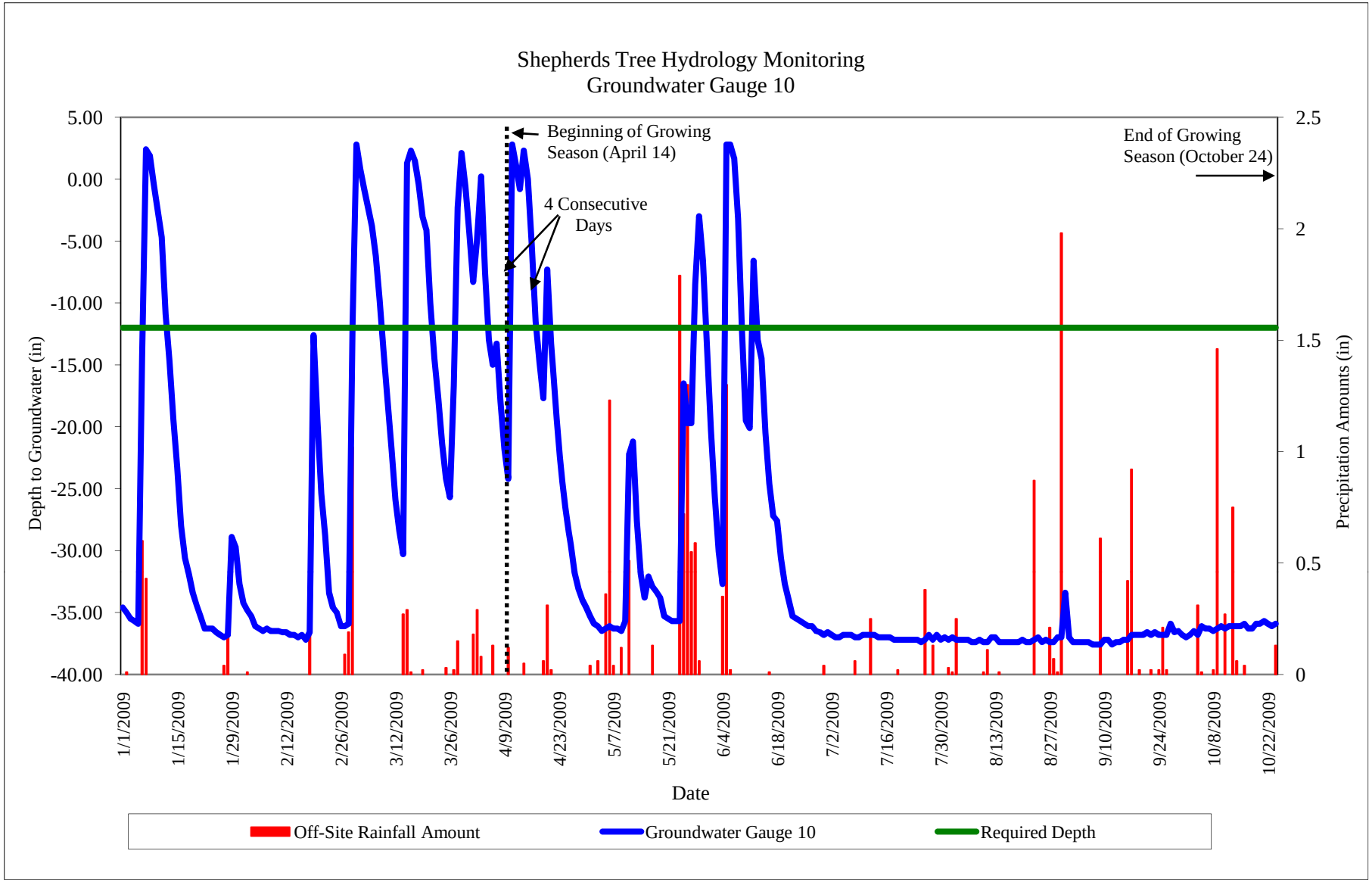
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



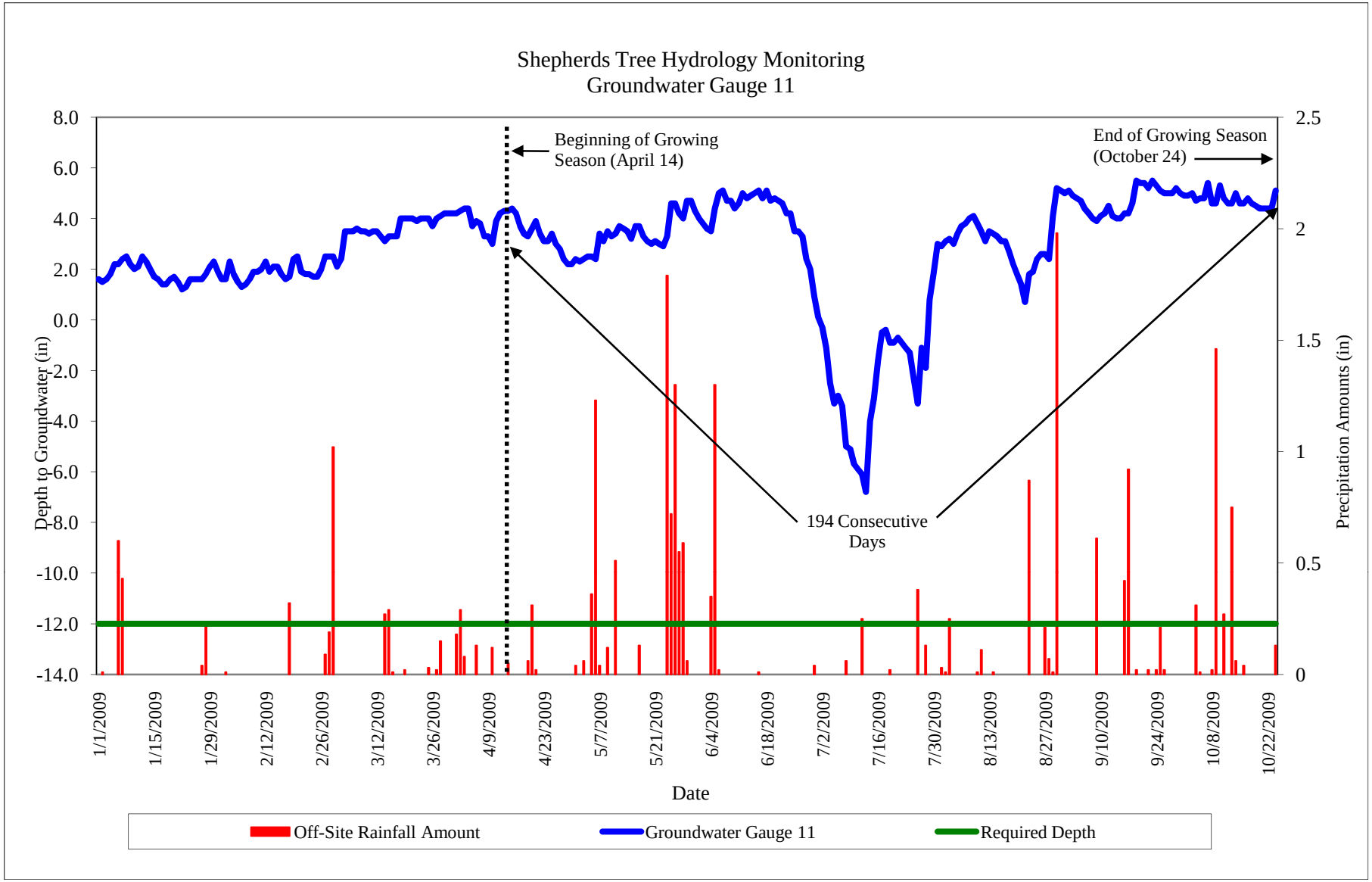
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



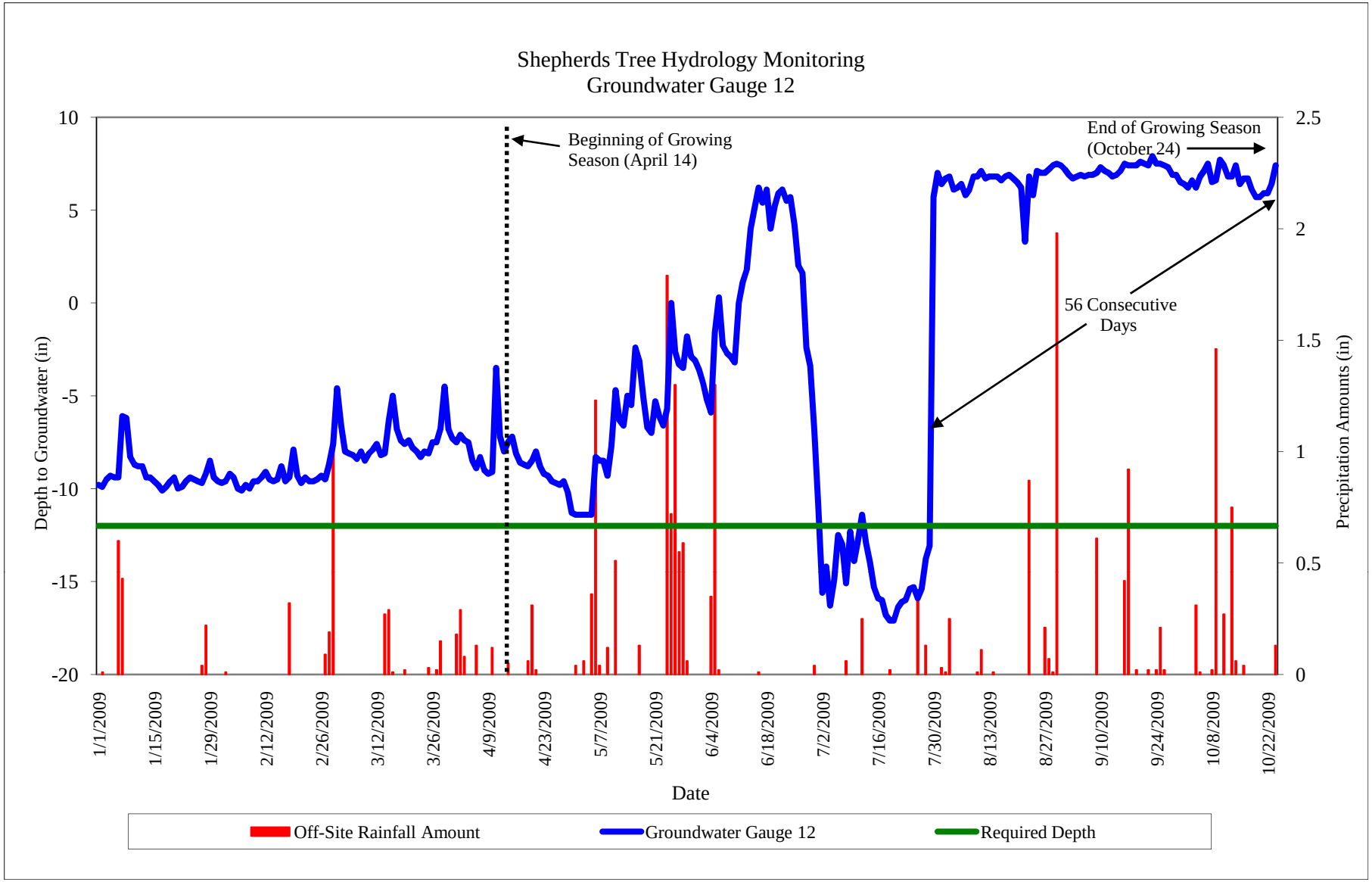
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



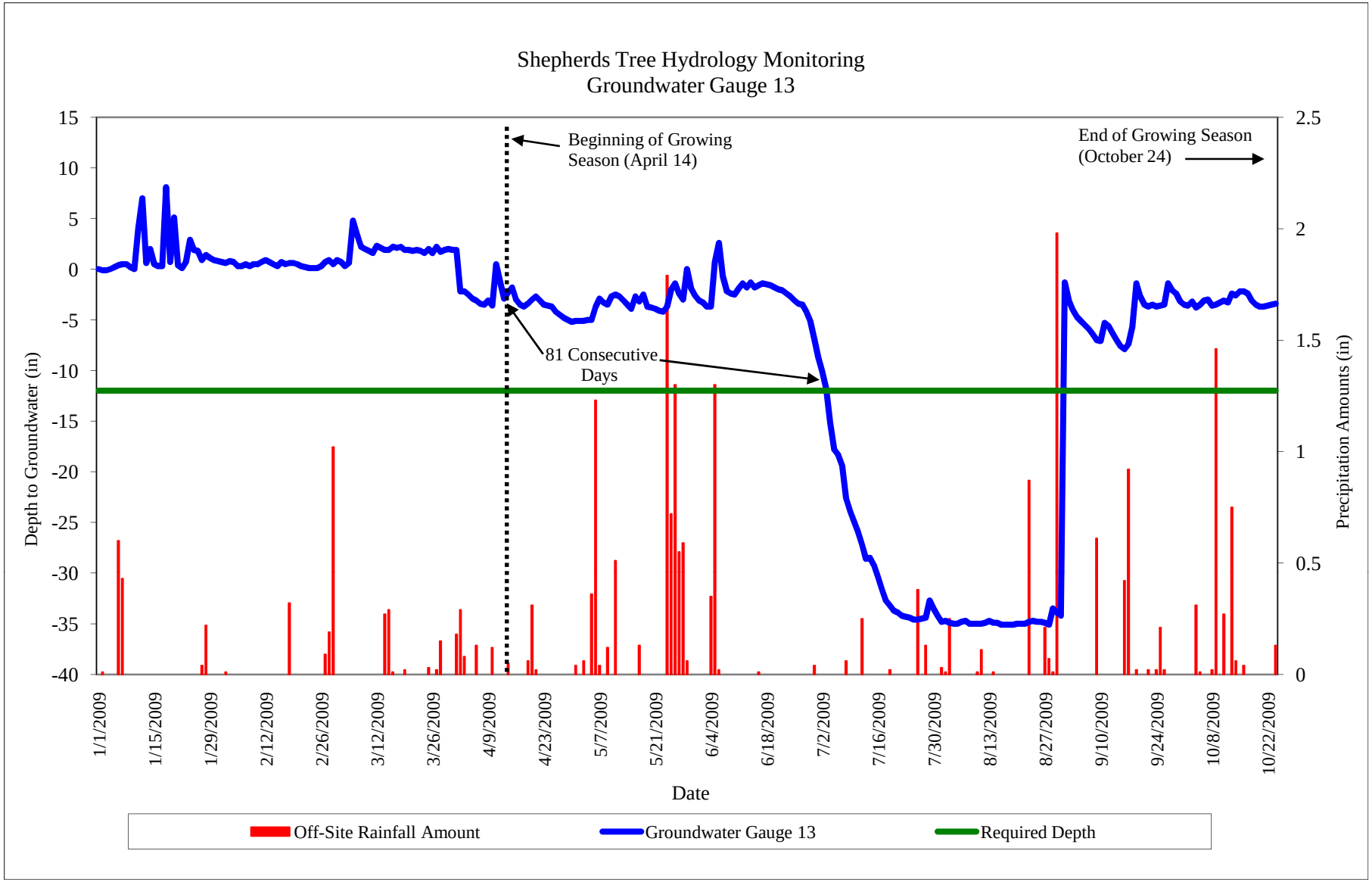
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



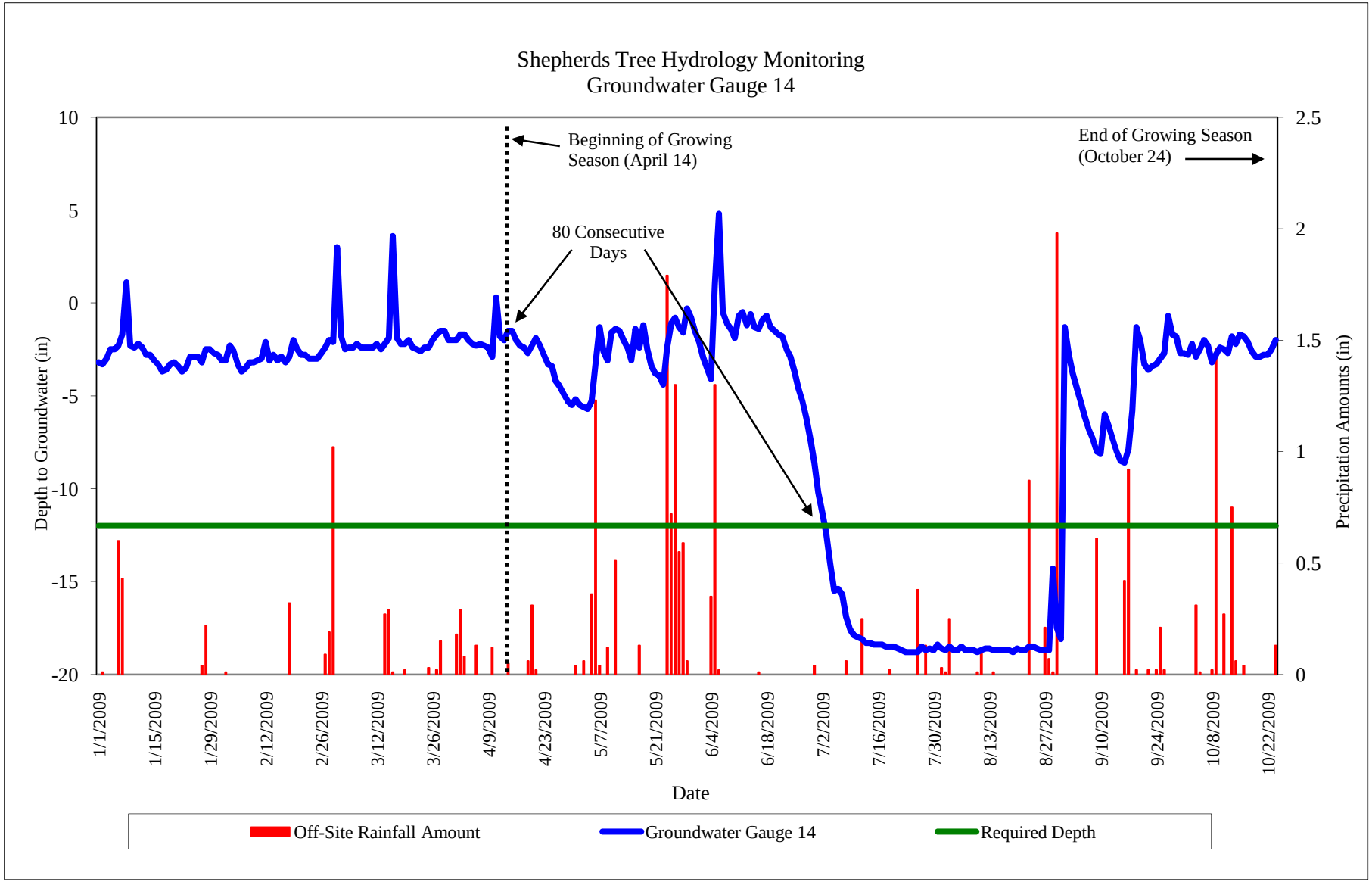
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



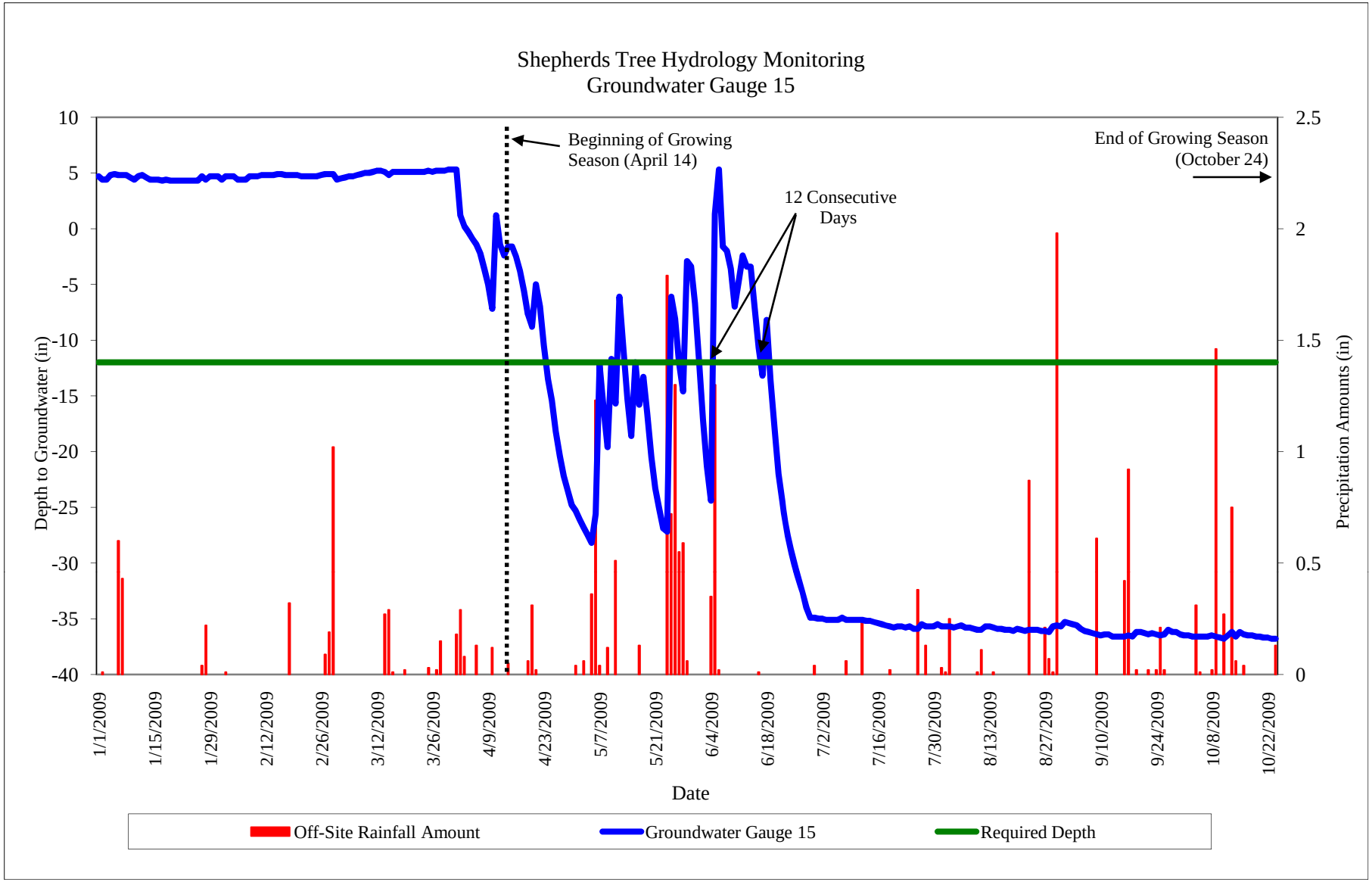
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



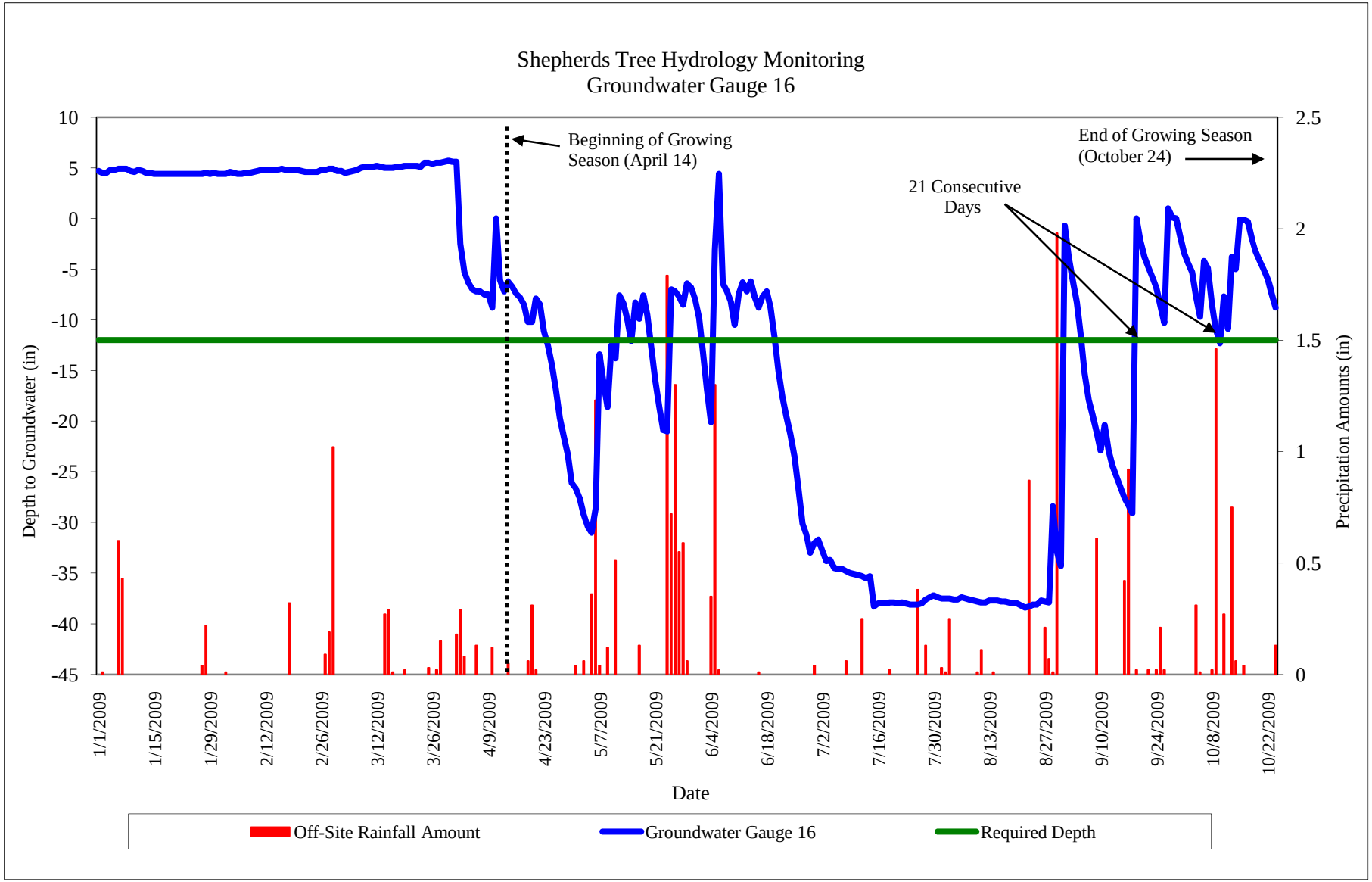
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



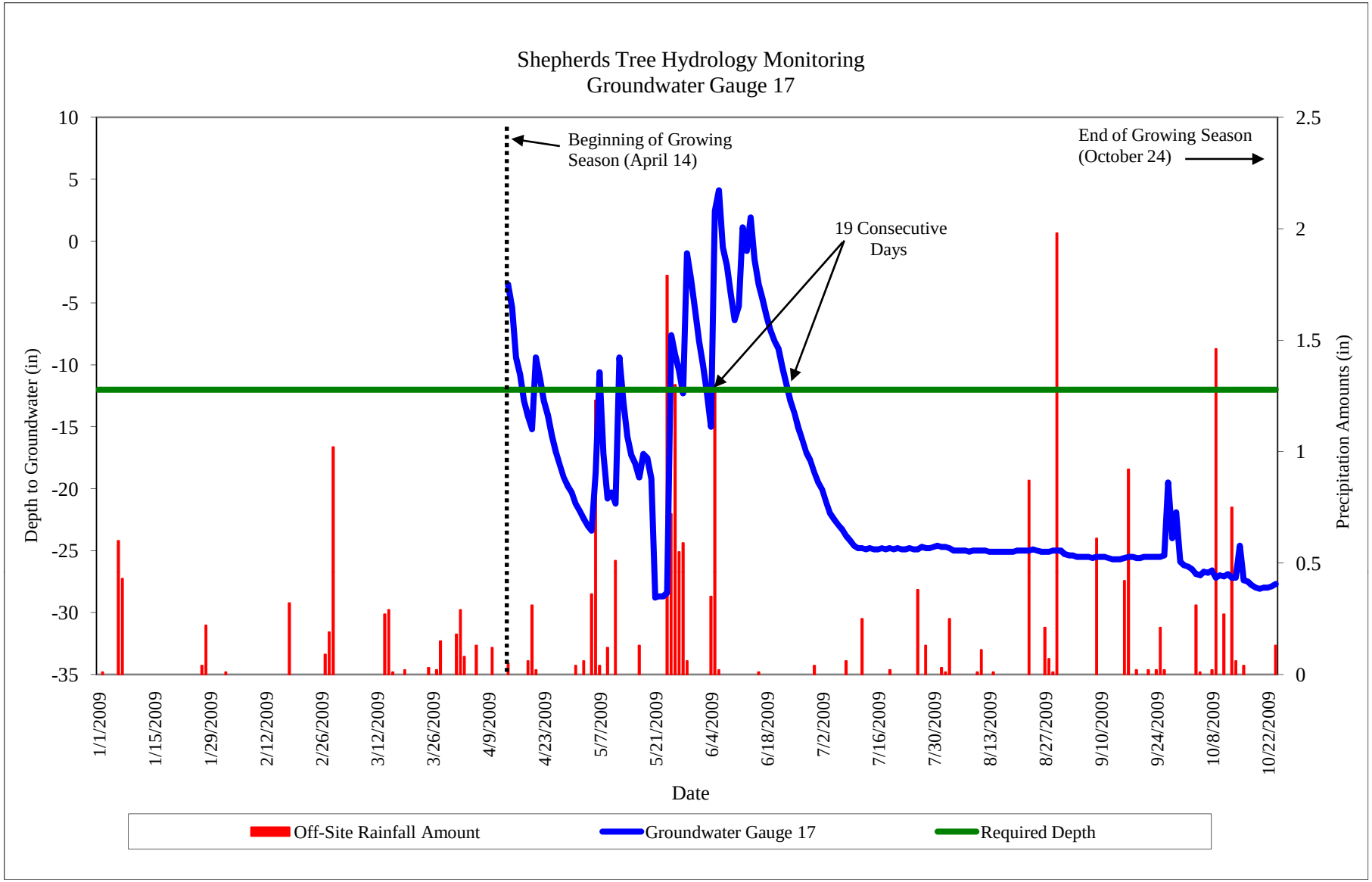
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



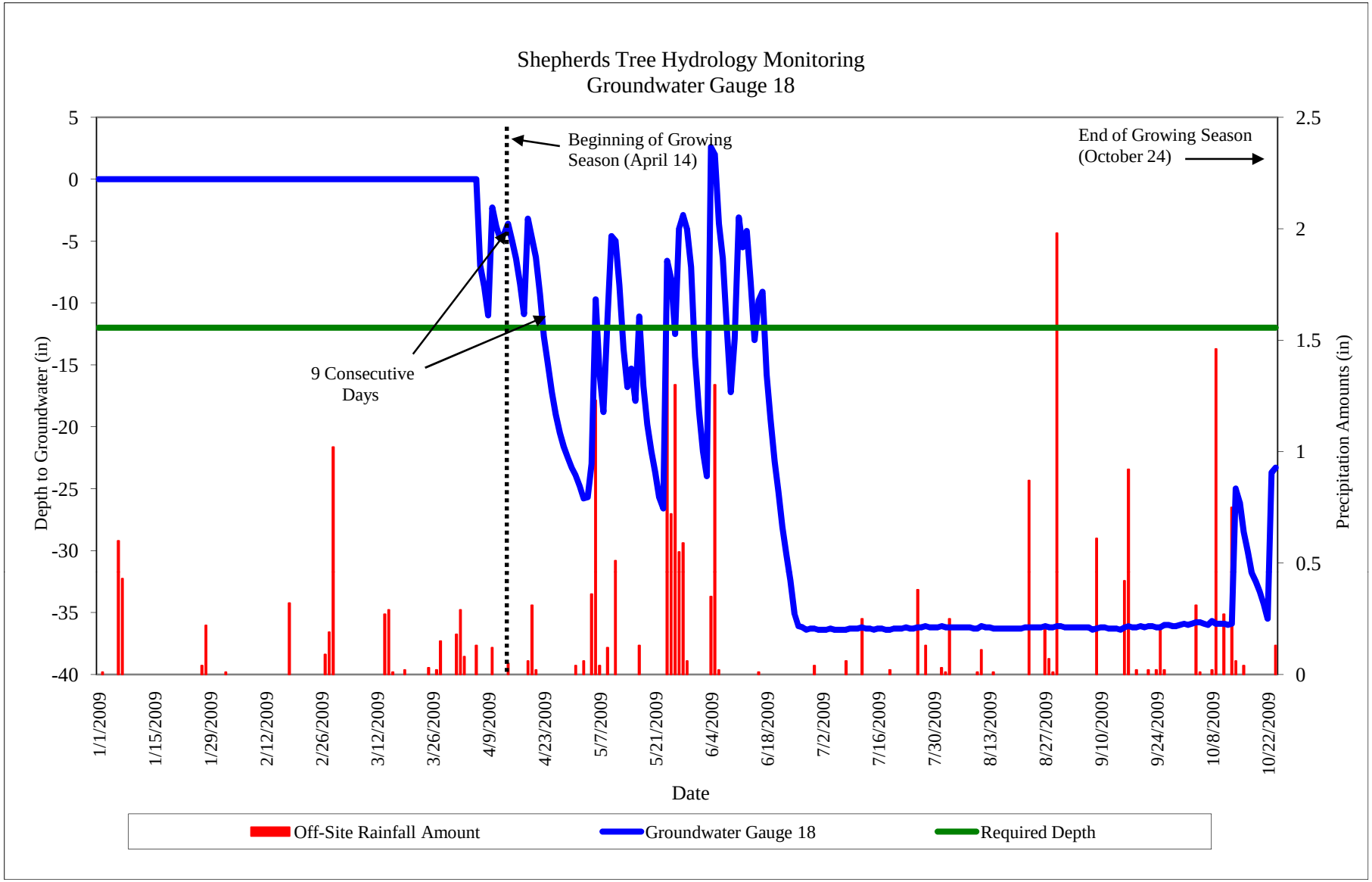
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



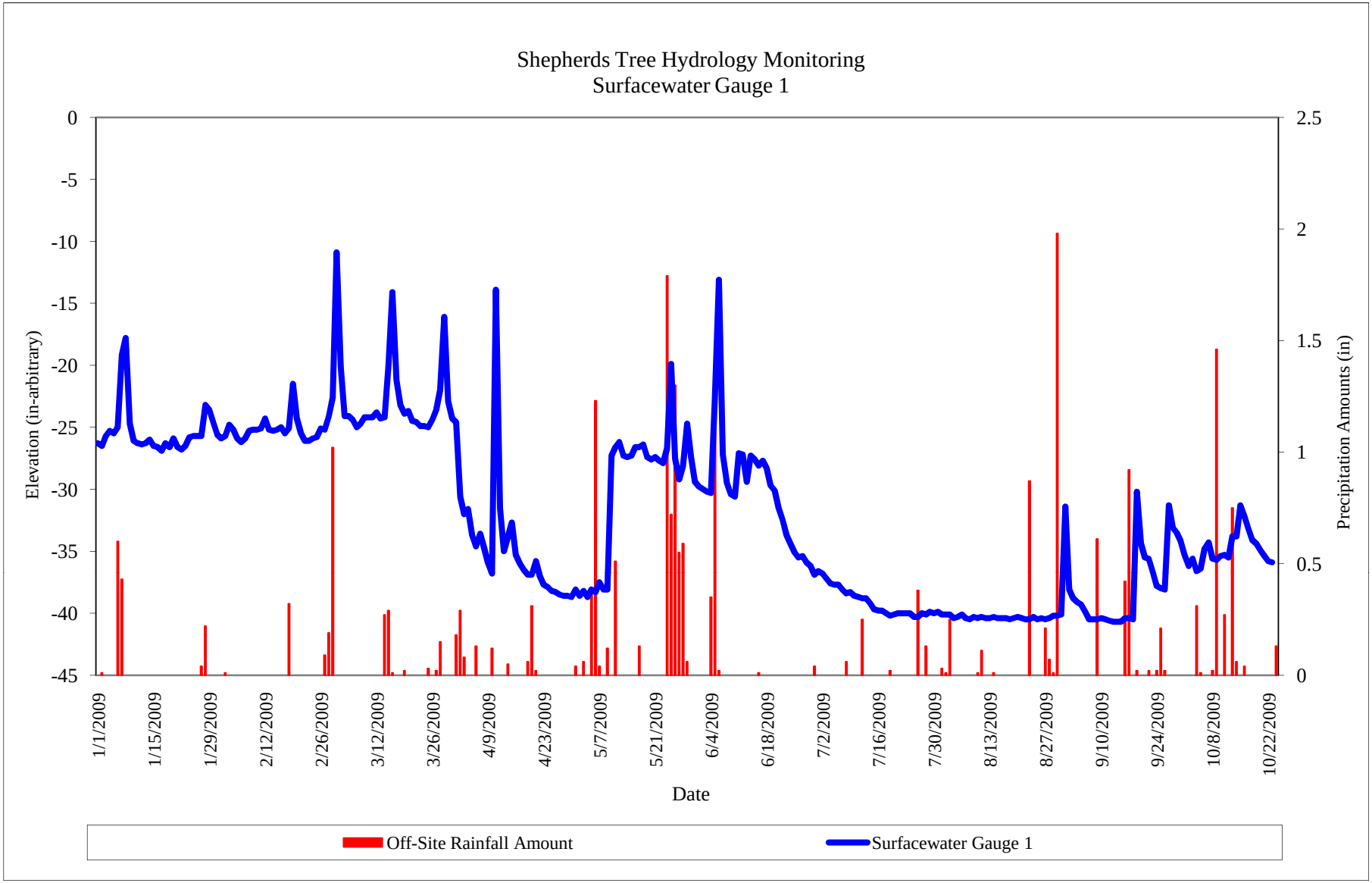
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



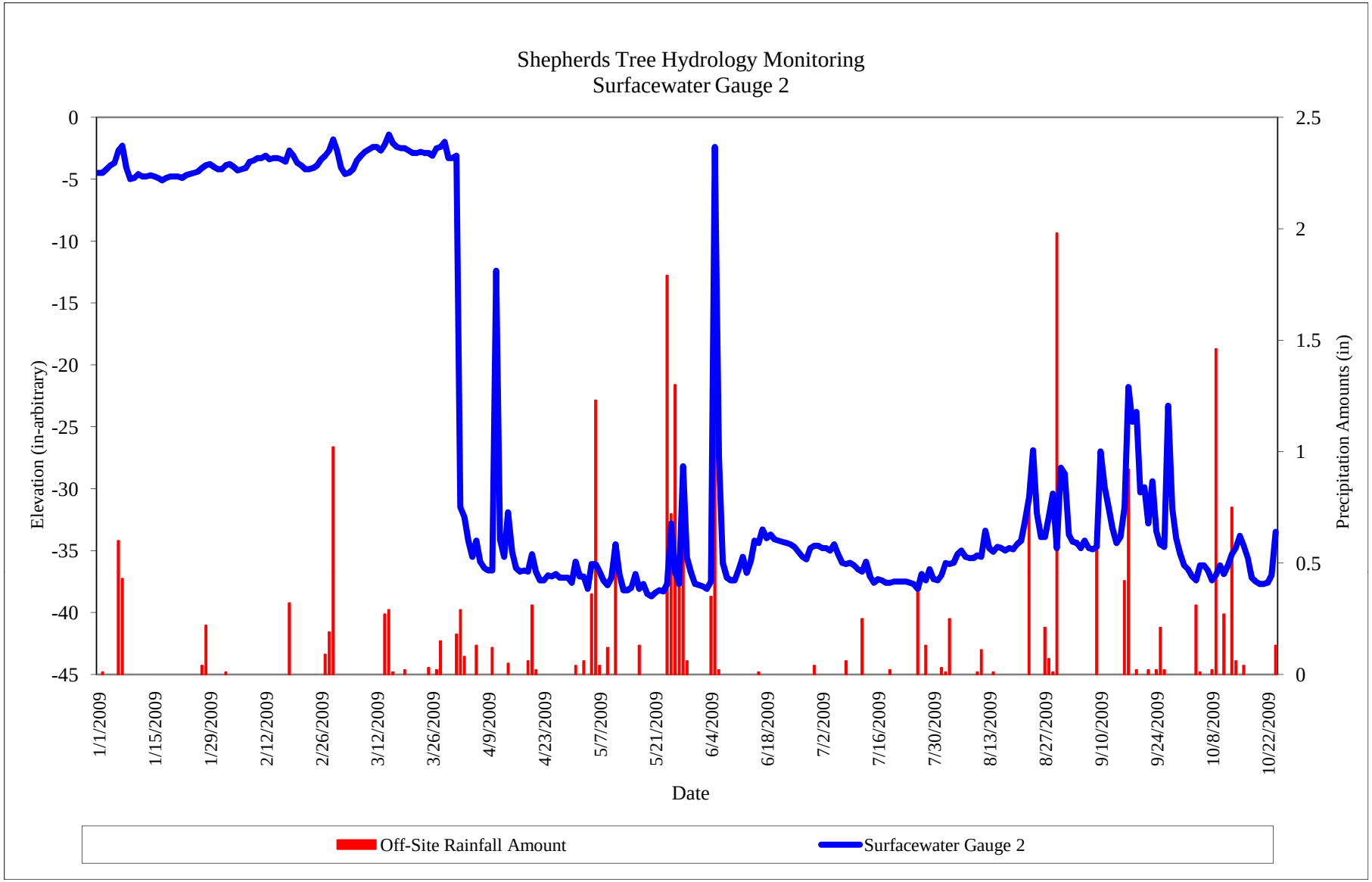
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



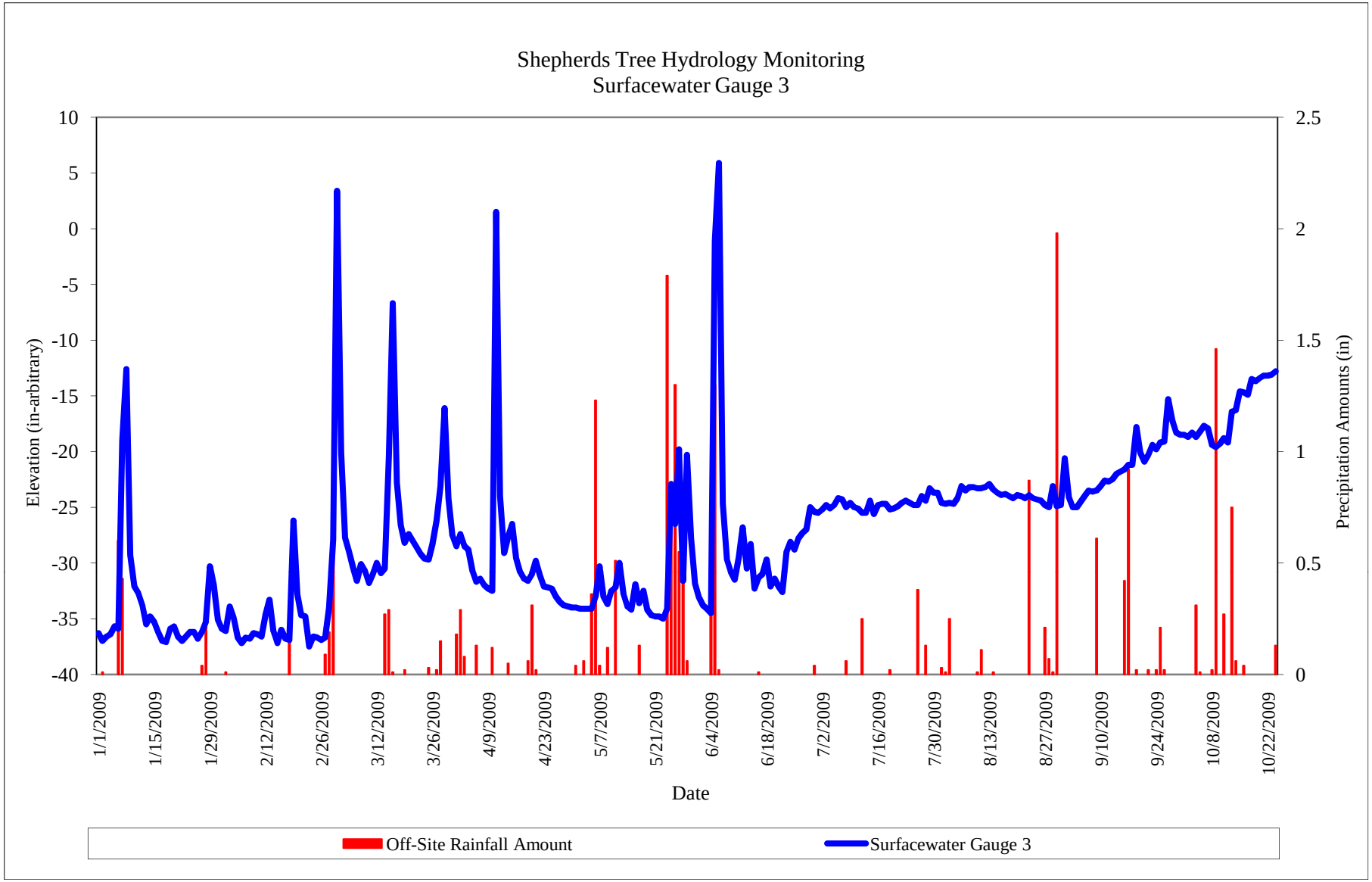
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Shepherds Tree Stream and Wetland Restoration
Year 5 of 5



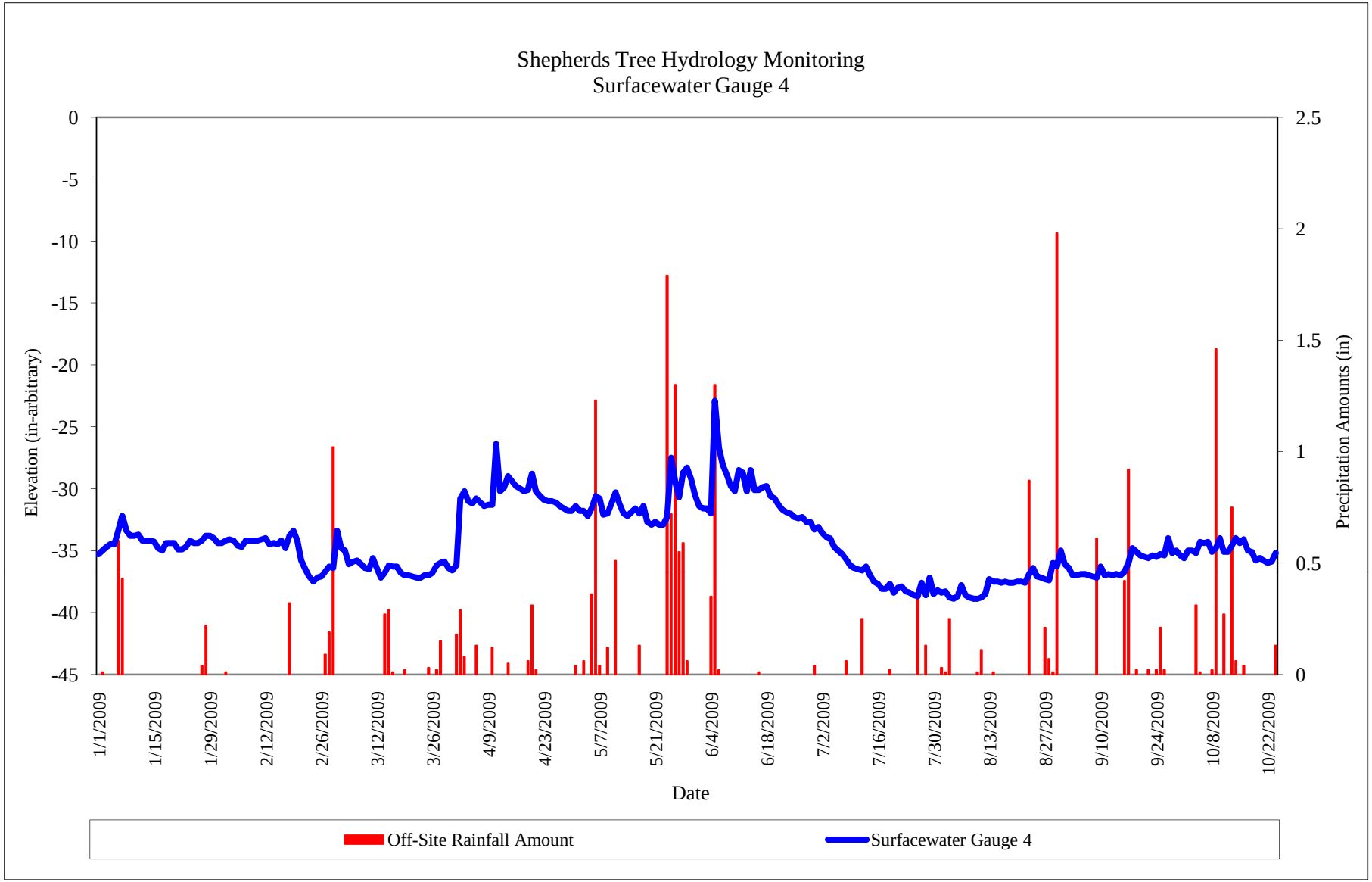
Appendix 5.1 Precipitation - Water Level Plots for Gauges
Back Creek Stream and Wetland Restoration
Year 5 of 5



Appendix 5.1 Precipitation - Water Level Plots for Gauges
Back Creek Stream and Wetland Restoration
Year 5 of 5



Appendix 5.1 Precipitation - Water Level Plots for Gauges
Back Creek Stream and Wetland Restoration
Year 5 of 5



Appendix 5.1 Precipitation - Water Level Plots for Gauges
Back Creek Stream and Wetland Restoration
Year 5 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 (2005)*	**Year 2 (2006)**	**Year 3 (2007)**	**Year 4 (2008)**	**Year 5 (2009)**	**Year 6 (2010)**	**Year 7 (2011)**
GW1	Yes	Yes/35 Days (44%)	Yes/17 Days (9%)	Yes/18 Days (25%)	Yes/17 Days (30%)		
GW2	No	No/1 Days (1%)	No/0 Days (0%)	Yes/194 Days (100%)	Yes/29 Days (35%)		
GW3	No	**	No/8 Days (4%)	Yes/20 Days (29%)	Yes/16 Days (24%)		
GW4	Yes	Yes/25 Days (37%)	No/11 Days (6%)	Yes/46 Days (37%)	Yes/49 Days (51%)		
GW5	No	No/0 Days (0%)	No/0 Days (0%)	No/0 Days (0%)	No/0 Days (0%)		
GW6	No	Yes/76 Days (72%)	Yes/76 Days (74%)	Yes/59 Days (83%)	Yes/111 Days (94%)		
GW7	No	Yes/22 Days (32%)	No/11 Days (6%)	No/5 Days (12%)	Yes/15 Days (21%)		
GW8	Yes	Yes/54 Days (78%)	Yes/33 Days (30%)	Yes/46 Days (66%)	Yes/81 Days (70%)		
GW10	Yes	Yes/109 Days (86%)	No/4 Days (2%)	No/5 Days (8%)	No/4 Days (7%)		
GW11	Yes	Yes/194 Days (100%)	Yes/150 Days (77%)	Yes/194 Days (100%)	Yes/194 Days (100%)		
GW12	Yes	Yes/94 Days (88%)	Yes/61 Days (49%)	Yes/61 Days (85%)^	Yes/87 Days (86%)		
GW13	No	Yes/194 Days (100%)	Yes/47 Days (45%)	Yes/80 Days (90%)	Yes/81 Days (70%)		
GW14	Yes	Yes/194 Days (100%)	Yes/46 Days (44%)	Yes/67 Days (89%)	Yes/80 Days (60%)		
GW15	No	Yes/194 Days (100%)	No/9 Days (5%)	Yes/161 Days (87%)	No/12 Days (16%)		
GW16	No	Yes/194 Days (100%)	No/3 Days (3%)	Yes/160 Days (86%)	Yes/21 Days (42%)		
GW17	N/A	No/4 Days (8%)	No/3 Days (2%)	No/5 Days (8%)	Yes/19 Days (18%)		
GW18	N/A	No/11 Days (18%)	No/8 Days (4%)	No/13 Days (16%)	No/9 Days (16%)		

*Raw data was not provided, results from KCI 2005 monitoring report

**Gauge Malfunctioned and was not Replaced Until After the Growing Season and Beaver Removal

^Gauge failed 10/7/2008, replaced 11/2008