

**UT to Pembroke Creek Wetland and Stream
Restoration Monitoring Report
EEP Project # 283
Monitoring Year – 02
2009**



Submitted to:



NCDENR-EEP, 1652 Mail Service Center, Raleigh, NC 27699-1652

December 2009

Monitoring Firm



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KCI Project No: 12071067C_PM**

Design Firm



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Durham, NC 27713

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1.0 EXECUTIVE SUMMARY / PROJECT ABSTRACT

The North Carolina Ecosystem Enhancement Program (EEP) restored, enhanced, and preserved wetlands and restored a headwater wetland valley, which is analogous to a stream in this setting at the UT Pembroke Site in Chowan County, North Carolina. The 59 acre site is located within the USGS 8-digit HUC 03010205 of the Pasquotank River Basin. These assets and their acreage totals were revised by the EEP during the summer of 2009, with the revised totals reflected in Table 1 of this report. The project goals and objectives are listed below.

Goal: Modify the channelized water features, based on reference condition, with the intent to restore the sites primary wetland functions such as nutrient cycling, flood storage, and providing wildlife habitat.

Objectives:

- Improve water quality in the basin by filtering nutrients through on-site wetlands.
- Buffer flood flows downstream by increasing infiltration and storage areas.
- Design a waterway through the wetland complex with appropriate cross-section, slope, and pattern as to provide nutrient filtering, flood storage, and wildlife habitat while meeting the appropriate success criteria for the wetland.
- Improve terrestrial and aquatic habitat diversity.
- Establish a contiguous buffer along the project that can serve as a migration corridor for local fauna.

The restored wetlands and headwater wetland valley were planted with one of three different planting zones, each with various species of bare root trees and shrubs. Following the CVS-EEP protocol, sixteen vegetation monitoring plots were established during the baseline data collection immediately after the site was planted. Plot number 14 was damaged during road maintenance and reset in the same location during the second year of monitoring. The second year of monitoring found a site average of 240 planted stems/acre, with nine of the sixteen vegetation monitoring plots having planted stem densities less than the success criteria of 260 stems/acre. Low planted stem densities were also found during the first year of monitoring, but due to the large amount of volunteer woody stems found in the plots, it is likely that volunteer vegetation will successfully vegetate the site throughout the monitoring period. The site's average stem density including volunteers is 1,184 stems/acre, with only four of the sixteen vegetation plots having densities less than 260 stems/acre. The only exotic species identified at the site are parrotfeather (*Myriophyllum aquaticum*), which is present in areas of open standing water, honeysuckle (*Lonicera japonica*), which is scattered throughout the site, and privet (*Ligustrum sinense*), which is predominantly found in the enhancement wetland. Some parts of the site have large cattail (*Typha latifolia*) populations, which may outcompete desirable vegetation and become problematic.

The restored headwater wetland valley is stable. In the parts of the site where there are large areas of standing water the feature becomes less visually defined, but there is still active flow of water across the site. In June 2009, KCI and EEP staff cut two 1.5' wide notches in the top log of the grade transition structure and one notch in the second log. These notches are approximately 6" deep and intended to lower the elevation of the standing water across the site and increase the rate of drainage when there are large rain events. During the December site walk, these notches were being accessed as the water flowed over the grade transition structure and through the notches.

Fifteen groundwater monitoring wells have been established to monitor wetland hydrology. Of these wells, five (4, 5, 6, 9, and 13) were installed in restored wetlands, two (2 and 3) were installed in enhanced wetlands, five (7, 8, 10, 11, and 15) were installed in the headwater wetland valley, and two (12 and 16) were installed in the preserved wetlands as reference wells. A new monitoring well, Monitoring Well 17, was installed in the restored wetland in April 2009. During the site's second growing season 11 of the 14 wells in the restoration areas met the success criteria of having saturated soil conditions occurring within 12 inches of the ground surface for a minimum continuous period of 5% (13 days) of the

263 day growing season (March 10 to November 28) during average climatic conditions. The daily rainfall data obtained from a local weather station shows that the area had average rainfall during the 2009 growing season. The wells that did not meet the success criteria (Wells 2, 3, and 4) each had water above the jurisdictional depth for a maximum of four days. Monitoring Wells 2 and 3 are in the enhanced wetland and Well 4 is in the restored non-riparian wetland. Monitoring Well 4 experienced malfunctions in September and October of 2009, which resulted in lost data for the rest of the growing season. There is the possibility that this well could have met the hydrology success criteria after the large rain event on November 12th, but this is unlikely considering that the other two wells that failed to meet the success criteria did not meet the criteria after this rain event.

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 the EEPs website. All raw data supporting the tables and figures in the appendices are available upon request.

2.0 METHODOLOGY

The Level 2 of the CVS-EEP protocol (<http://cvs.bio.unc.edu/methods.htm>) was used to collect vegetation data from the UT Pembroke site.

3.0 REFERENCES

Lee, M. T., R. K. Peet, S. D. Roberts, and T. R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation, Version 4.0 (<http://cvs.bio.unc.edu/methods.htm>)

Weakley, A. S. 2006. Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas. (http://www.herbarium.unc.edu/FloraArchives/WeakleyFlora_2006-Jan.pdf)

Appendix A

General Figures and Plan Views

Directions to the Project Site:
From Raleigh, travel on US-64 E.
Stay straight on US-17 N. Take
exit 224 and take a left at the top of
the ramp. Then take a left onto
Emperor's Landing Rd. Then take a
right onto Tip Toe Rd. Then take a
right onto Macedonia Rd. The site
will be on your right.

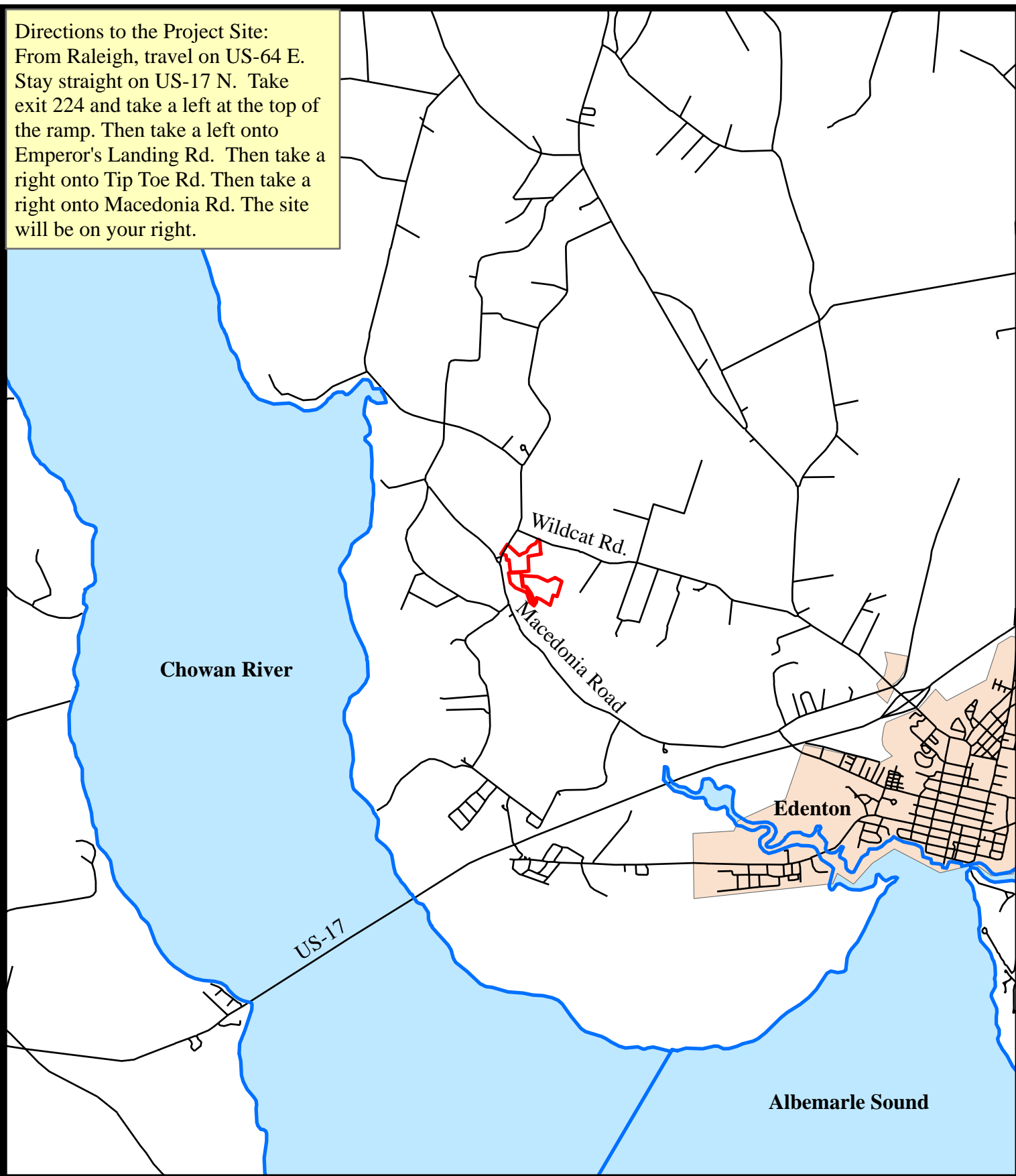
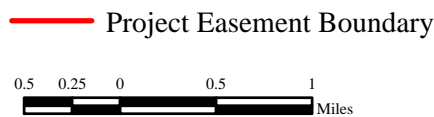


Figure 1. Site Vicinity Map
UT Pembroke Creek, Chowan County, EEP Project # 283



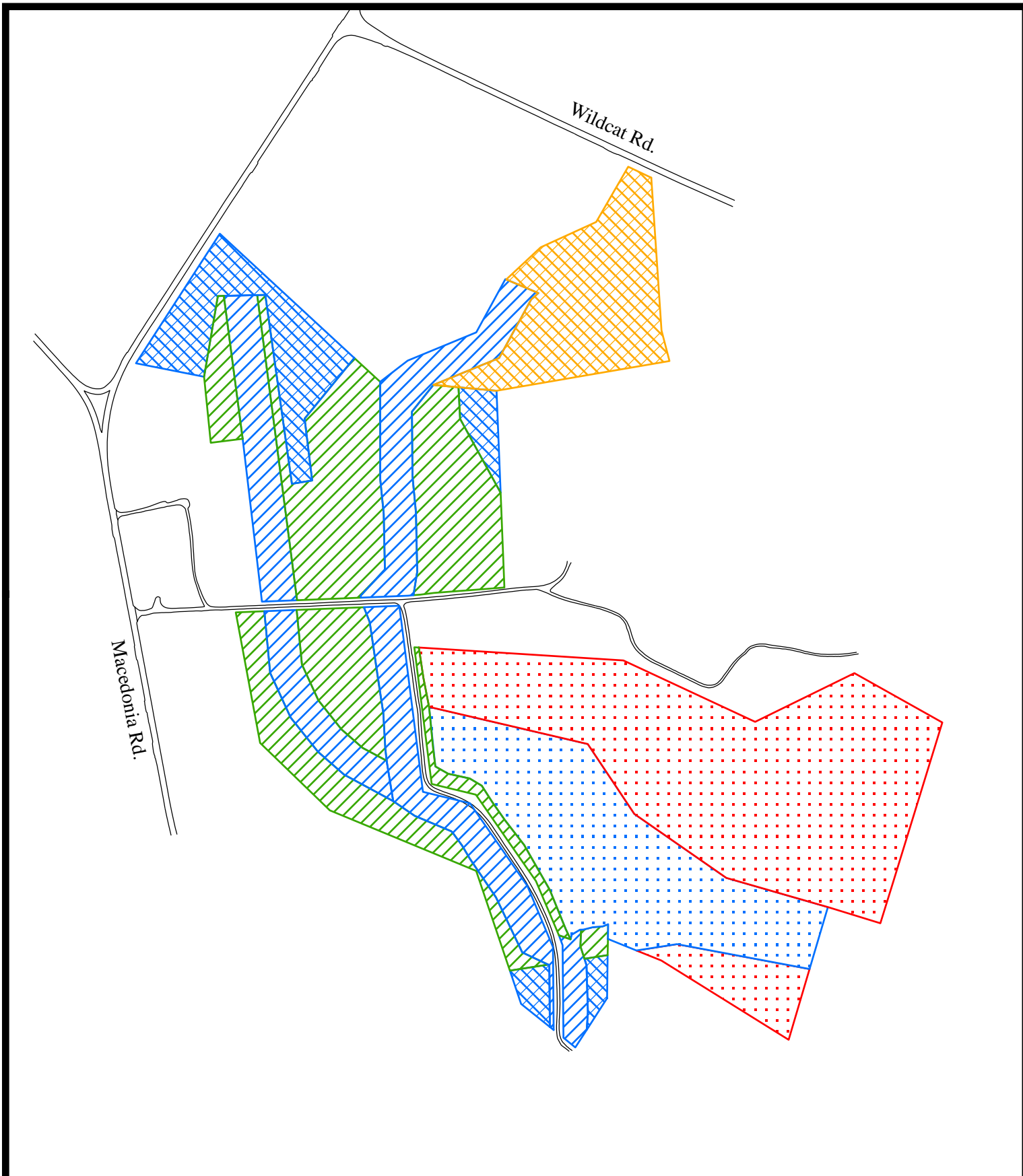








Figure 2. Site Asset Map
UT Pembroke Creek, Chowan County, EEP Project # 283

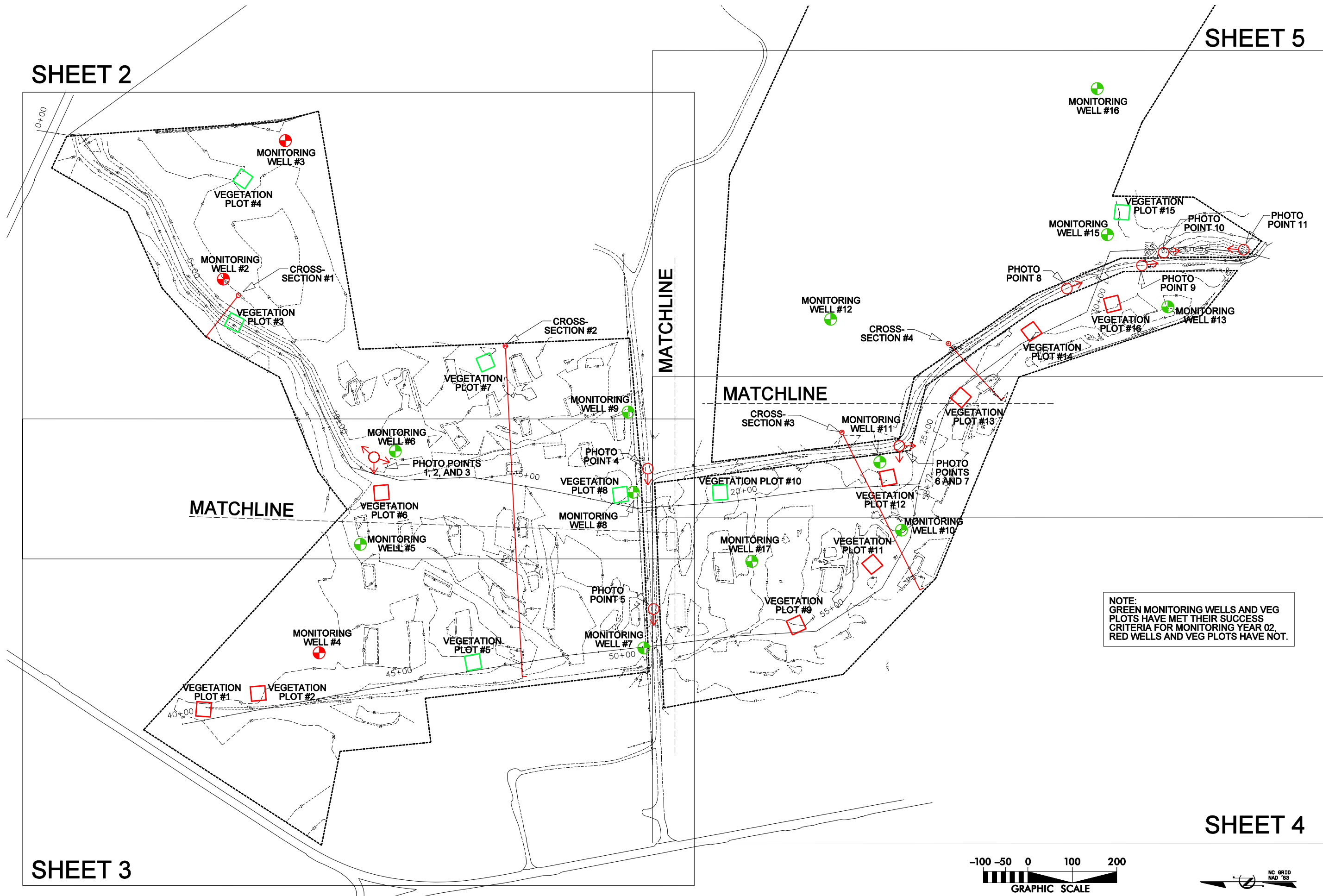
- | | |
|--|--|
|  Headwater Wetland Valley |  Riparian Wetland Restoration |
|  Non-Riparian Wetland Enhancement |  Riparian Wooded Wetland Preservation |
|  Non-Riparian Wetland Restoration | |
|  Non-Riparian Wooded Wetland Preservation | |

260 130 0 260 520 Feet

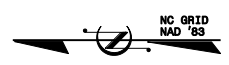
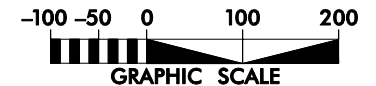


SHEET 2

SHEET 5



NOTE:
 GREEN MONITORING WELLS AND VEG
 PLOTS HAVE MET THEIR SUCCESS
 CRITERIA FOR MONITORING YEAR 02.
 RED WELLS AND VEG PLOTS HAVE NOT.



SHEET 3

SHEET 4

SYL	DESCRIPTION	DATE	APPROVED



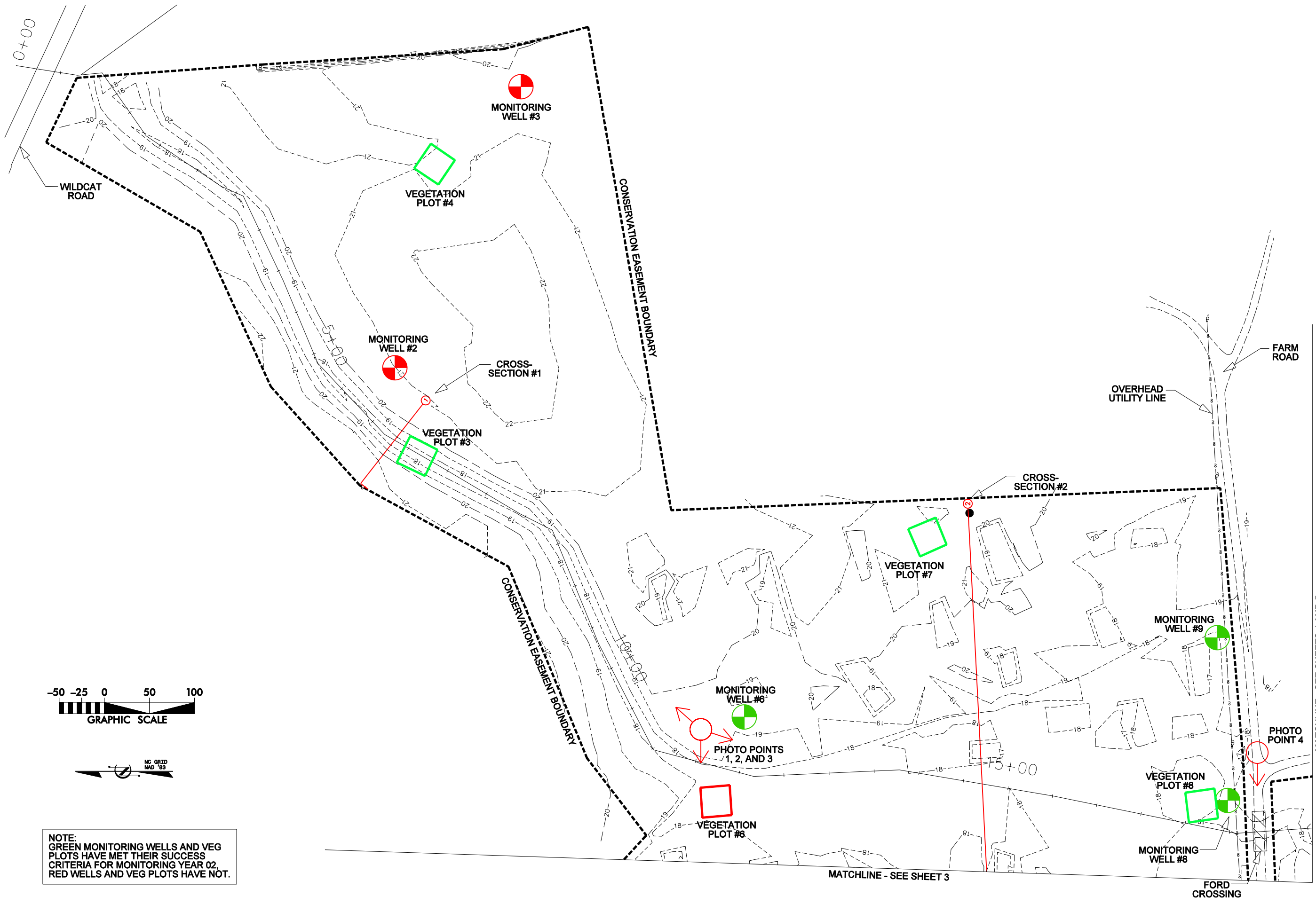
KCI
 ASSOCIATES OF INC.
 ENGINEERS • PLANNERS • SCIENTISTS
 460 SIX FORKS ROAD
 RALEIGH, NORTH CAROLINA 27609

UT PEMBROKE CREEK
 WETLAND AND STREAM RESTORATION
 EEP PROJECT #283
 CHOWAN COUNTY, NORTH CAROLINA
 UT PEMBROKE, MONITORING YEAR 02

DATE: DEC 2009
 SCALE: 1" = 200'

CURRENT
 CONDITION
 PLAN VIEW

SHEET 1 OF 5



NOTE:
 GREEN MONITORING WELLS AND VEG
 PLOTS HAVE MET THEIR SUCCESS
 CRITERIA FOR MONITORING YEAR 02.
 RED WELLS AND VEG PLOTS HAVE NOT.

MATCHLINE - SEE SHEETS 4 AND 5

MATCHLINE - SEE SHEET 3

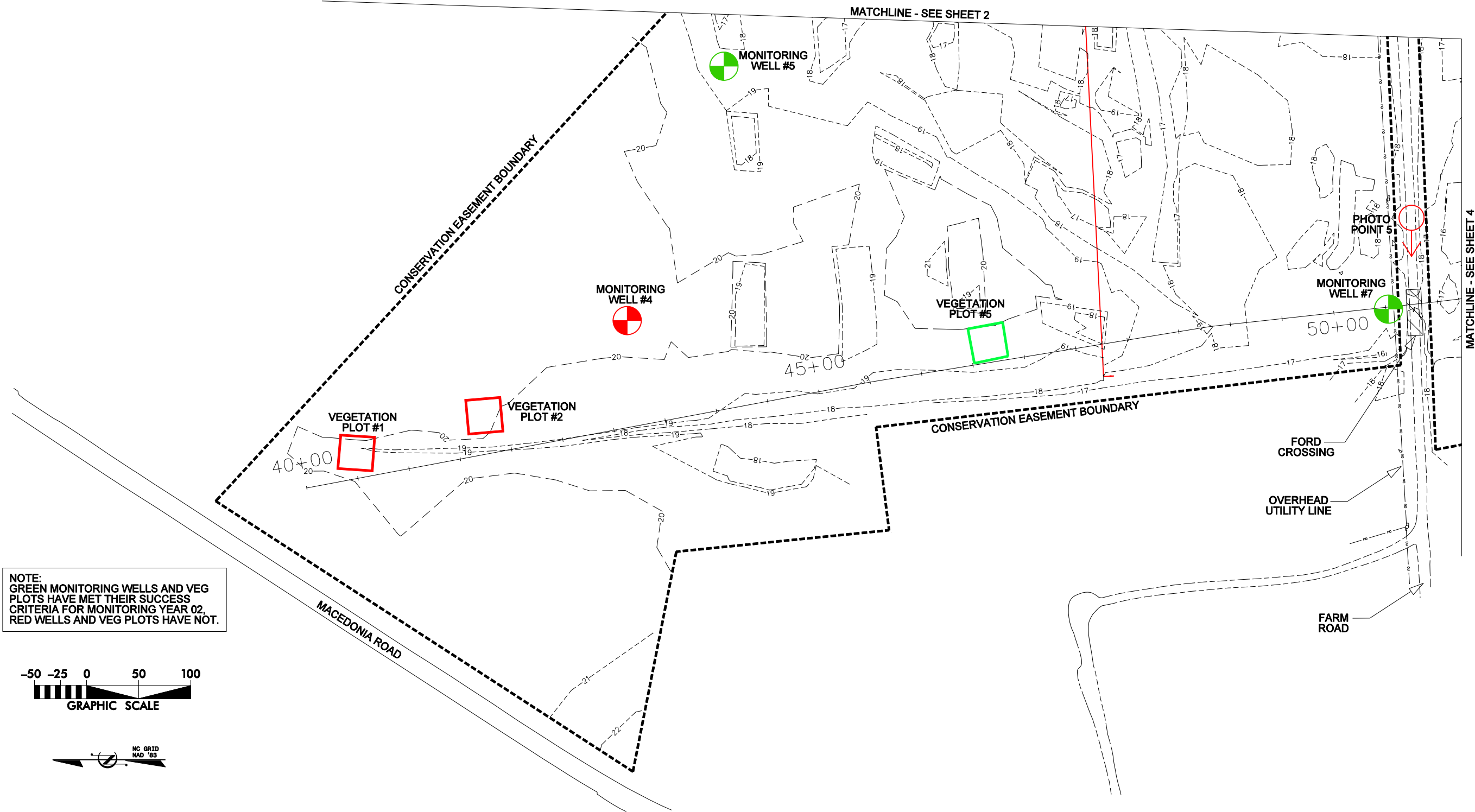
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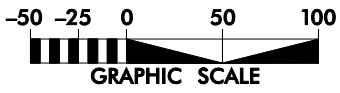
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**UT PEMROKE CREEK
 WETLAND AND STREAM RESTORATION**
 EEP PROJECT #283
 CHOWAN COUNTY, NORTH CAROLINA
 UT PEMROKE, MONITORING YEAR 02

DATE: DEC 2009
 SCALE: 1" = 100'
**CURRENT
 CONDITION
 PLAN VIEW**
 SHEET 2 OF 5



NOTE:
 GREEN MONITORING WELLS AND VEG
 PLOTS HAVE MET THEIR SUCCESS
 CRITERIA FOR MONITORING YEAR 02.
 RED WELLS AND VEG PLOTS HAVE NOT.



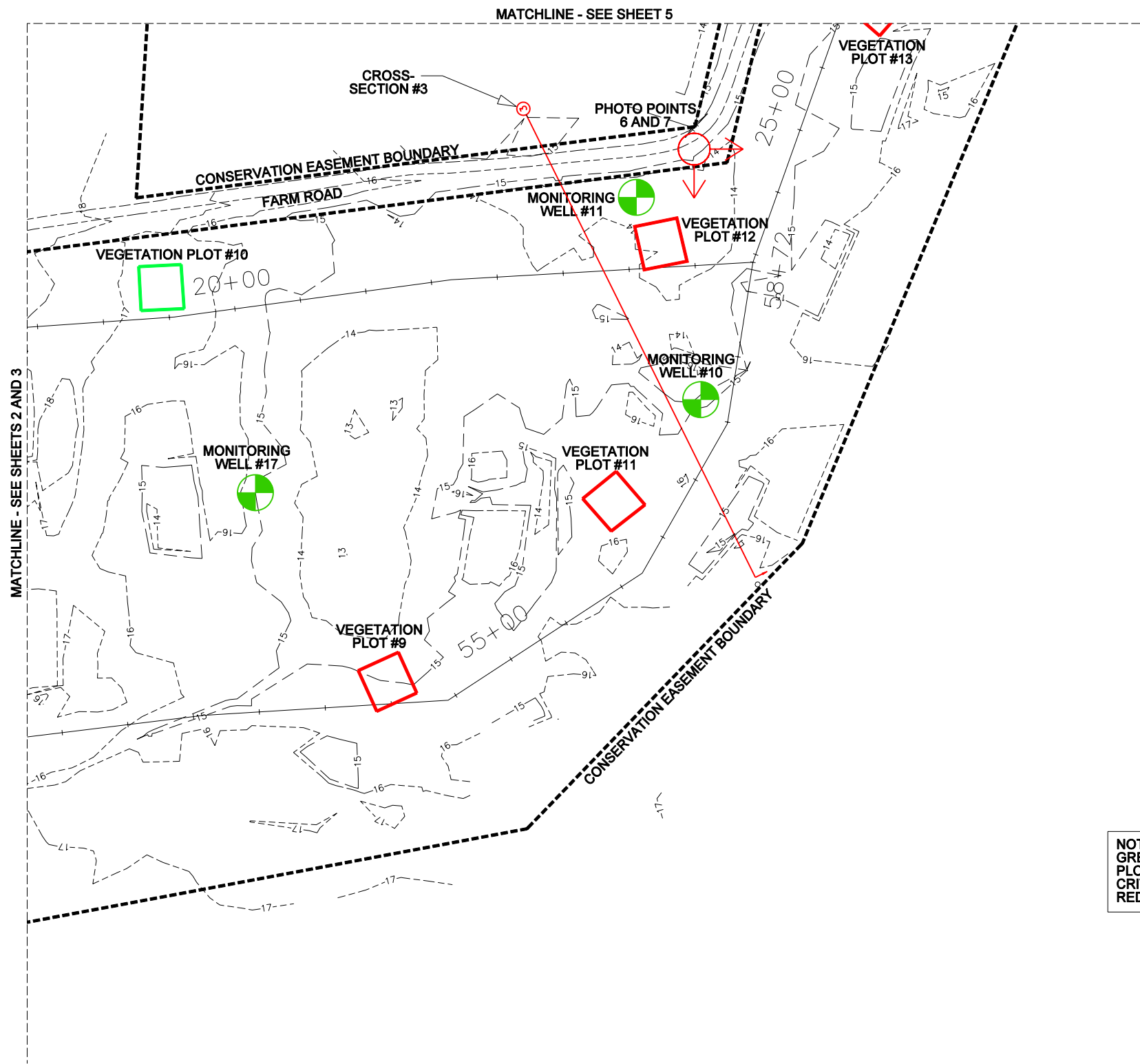
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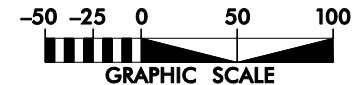
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UT PEMBROKE CREEK
 WETLAND AND STREAM RESTORATION
 EEP PROJECT #283
 CHOWAN COUNTY, NORTH CAROLINA
 UT PEMBROKE, MONITORING YEAR 02

DATE: DEC 2009
 SCALE: 1" = 100'
 CURRENT
 CONDITION
 PLAN VIEW
 SHEET 3 OF 5



NOTE:
 GREEN MONITORING WELLS AND VEG
 PLOTS HAVE MET THEIR SUCCESS
 CRITERIA FOR MONITORING YEAR 02,
 RED WELLS AND VEG PLOTS HAVE NOT.



SYL	DESCRIPTION	DATE	APPROVED



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**UT PEMBROKE CREEK
 WETLAND AND STREAM RESTORATION**
 EEP PROJECT #283
 CHOWAN COUNTY, NORTH CAROLINA
 UT PEMBROKE, MONITORING YEAR 02

DATE: DEC 2009
 SCALE: 1" = 100'
**CURRENT
 CONDITION
 PLAN VIEW**
 SHEET 4 OF 5

MATCHLINE - SEE SHEET 2

CONSERVATION EASEMENT BOUNDARY

MONITORING WELL #12

MATCHLINE - SEE SHEET 4

CROSS-SECTION #4

VEGETATION PLOT #13

VEGETATION PLOT #14

PHOTO POINT 8

FORD CROSSING

MONITORING WELL #15

VEGETATION PLOT #16

PHOTO POINT 9

FORD CROSSING

VEGETATION PLOT #15

PHOTO POINT 10

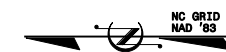
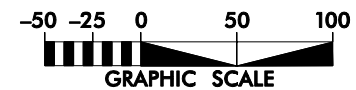
PHOTO POINT 11

MONITORING WELL #13

CONSERVATION EASEMENT BOUNDARY

MONITORING WELL #16

NOTE:
GREEN MONITORING WELLS AND VEG PLOTS HAVE MET THEIR SUCCESS CRITERIA FOR MONITORING YEAR 02, RED WELLS AND VEG PLOTS HAVE NOT.



SYL	DESCRIPTION	DATE	APPROVED



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UT PEMBROKE CREEK
WETLAND AND STREAM RESTORATION
EEP PROJECT #283
CHOWAN COUNTY, NORTH CAROLINA
UT PEMBROKE, MONITORING YEAR 02

DATE: DEC 2009
SCALE: 1" = 100'
CURRENT CONDITION
PLAN VIEW
SHEET 5 OF 5

Appendix B

General Project Tables

Table 1. Project Restoration Components				
Project Number and Name: 283 - UT Pembroke				
Project Component	Type	Acreege / Linear Feet	Stationing	Comment
Headwater Wetland Valley	Restoration	4,488 lf	00+00 to 34+73 and 40+00 to 58+72	This feature is 100 feet wide for its entire length, encompassing 9.96 acres.
Riparian Wetlands	Restoration	13.81 ac	N/A	
Non-Riparian Wetlands	Restoration	4.46 ac	N/A	
Non-Riparian Wetlands	Enhancement	5.26 ac	N/A	
Riparian Wooded Wetlands	Preservation	8.95 ac	N/A	
Non-Riparian Wooded Wetlands	Preservation	25.92 ac	N/A	

Table 2. Project Activity and Reporting History		
Project Number and Name: 283 - UT Pembroke		
Activity or Report	Data Collection Complete	Actual Completion or Delivery
Restoration Plan	2006	Sep 06
Final Design - 90%	N/A	Mar 07
Construction	N/A	Feb 08
Bare-Root Planting	N/A	Dec 07
Mitigation Plan	N/A	Oct 08
Year 1 Monitoring	Nov 08	Mar 09
Year 2 Monitoring	Nov 09	Dec 09

Table 3. Project Contacts Table	
Project Number and Name: 283 - UT Pembroke	
Design Firm	EcoEngineering, A Division of the John R. McAdams Company Inc. 2905 Meridian Parkway Durham, North Carolina 27713 Contact: Mr. James M. Halley, P.E. Phone: (919) 287-4262 Fax: (919) 361-2269
Construction Contractor	Backwater Environmental PO Box 1654 119 Ilex Court Pittsboro, North Carolina 27312 Contact: Mr. Adam McIntyre Phone: (919) 482-8491
Planting Contractor	Carolina Silvics, Inc. 908 Indian Trail Road Edenton, North Carolina 27932 Phone: (252) 482-8491
Monitoring Performers	
Mitigation Plan and MY-01	EcoEngineering, A Division of the John R. McAdams Company Inc. 2905 Meridian Parkway Durham, North Carolina 27713 Contact: Mr. James M. Halley, P.E. Phone: (919) 287-4262 Fax: (919) 361-2269
MY-02	KCI Associates of NC Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514 Fax: (919) 783-9266

Table 4. Project Attribute Table	
Project Number and Name: 283 - UT Pembroke	
Project County	Chowan County
Drainage Area	0.4 mi ²
Drainage Impervious Cover Estimate (%)	<5%
Physiographic Region	Outer Coastal Plain
Ecoregion	Chesapeake-Pamlico Lowlands and Tidal Marshes
Plant Communities	Coastal Plain Small Stream Swamp, Nonriverine Wet Hardwood Forest, and Mesic Mixed Hardwood Forest
Dominant Soil Types	Cape Fear, Conetoe, Dragston, Portsmouth, Roanoke, and Tomotley
Reference Site ID	Reference Sites 1, 2, 3, and 4
USGS HUC for Project and References	03010205
Any portion of the project segment 303d listed?	No
Any portion of the project segment upstream of a 303d listed segment?	No
Reasons for 303d Listing or Stressor	N/A
% of Project Fenced	0%

Appendix C

Vegetation Assessment Data

Table 5. Vegetation Plot Mitigation Success Summary Table		
Project Number and Name: 283 - UT Pembroke		
Vegetation Plot ID	Monitoring Year 02 Planted Stem Density (stems/acre)	Vegetation Survival Threshold Met?
1	202	No
2	40	No
3	486	Yes
4	486	Yes
5	486	Yes
6	0	No
7	445	Yes
8	405	Yes
9	0	No
10	364	Yes
11	162	No
12	0	No
13	40	No
14	81	No
15	445	Yes
16	202	No

Table 6. Vegetation Metadata Table							
Project Number and Name: 283 – UT Pembroke							
Report Prepared By		Brian Roberts					
Date Prepared		11/5/2009 13:10					
Database Name		KCI-2008-cvs-eep-entrytool-v2.2.7-MTL.mdb					
Database Location		C:\Users\broberts\Desktop\KCI_2008-entrytool-v2.2.7					
PROJECT SUMMARY-----							
Project Code	Project Name	Description	Length (ft)	Stream-to-Edge Width (ft)	Area (sq m)	Required Plots (calculated)	Sampled Plots
283	UT Pembroke	Stream and wetland restoration site in Chowan County, NC.	4,488	50	41,691	11	16

Vegetation Monitoring Plot Photos



Plot 1 – 10/7/09 - MY 02 - Facing Macedonia Road on the northwestern portion of the site



Plot 2 – 10/7/09 - MY 02 - Facing Macedonia Road on the northwestern portion of the site



Plot 3 – 10/7/09 - MY 02 - Facing intersection of Macedonia Road and Wildcat Road



Plot 4 – 10/7/09 - MY 02 - Facing Macedonia Road and Wildcat Road on the northeastern portion of the site



Plot 5 – 10/7/09 - MY 02 - Facing Macedonia Road on western portion of the site



Plot 6 – 10/7/09 - MY 02 - Facing Macedonia Road on the central portion of the site



Plot 7 – 10/7/09 - MY 02 - Facing intersection of Macedonia Road on the western portion of the site



Plot 8 – 10/7/09 - MY 02 - Facing Macedonia Road on central portion of the site just north of the main road



Plot 9 – 10/8/09 - MY 02 - Facing Macedonia Road on western portion of the site near the pond



Plot 10 – 10/7/09 - MY 02 - Facing Macedonia Road just southwest of the intersection of the main road and the dirt access road



Plot 11 – 10/7/09 - MY 02 - Facing Macedonia Road just south of Plot 9 near the pond



Plot 12 – 10/7/09 - MY 02 - Facing Macedonia Road just south of the pond



Plot 13 – 10/8/09 - MY 02 - Facing Macedonia Road on southwestern portion of the site



Plot 14 – 10/8/09 - MY 02 - Facing Macedonia Road on southwestern portion of the site



Plot 15 – 10/8/09 - MY 02 - Facing east on the southeastern portion of the site



Plot 16 – 10/8/09 - MY 02 - Facing Macedonia Road on the southwestern portion of the site

Appendix D

Wetland Assessment Data

Wetland Photos



Photo Point 1 – 12/2/09 - MY 02 – Facing northwest toward Wildcat Road.



Photo Point 2 – 12/2/09 - MY 02 – Facing west toward Macedonia Road.



Photo Point 3 – 12/2/09 - MY 02 – Facing south toward the downstream end of the project.



Photo Point 4 – 12/2/09 - MY 02 – Road Crossing Type A – Station 17+75 – Facing west toward Macedonia Road.



Photo Point 5 – 12/2/09 - MY 02 – Road Crossing Type A – Station 50+75 – Facing west toward Macedonia Road.



Photo Point 6 – 12/2/09 - MY 02 –Facing northwest toward Macedonia Road.



Photo Point 7 – 12/2/09 - MY 02 – Facing south.



Photo Point 8 – 12/2/09 - MY 02 – Road Crossing Type B – Station 30+50



Photo Point 9 – 12/2/09 - MY 02 – Road Crossing Type C – Station 32+50



Photo Point 10 – 12/2/09 - MY 02 – Grade transition, facing downstream.



Photo Point 11 – 12/2/09 - MY 02 – Grade transition, facing upstream.

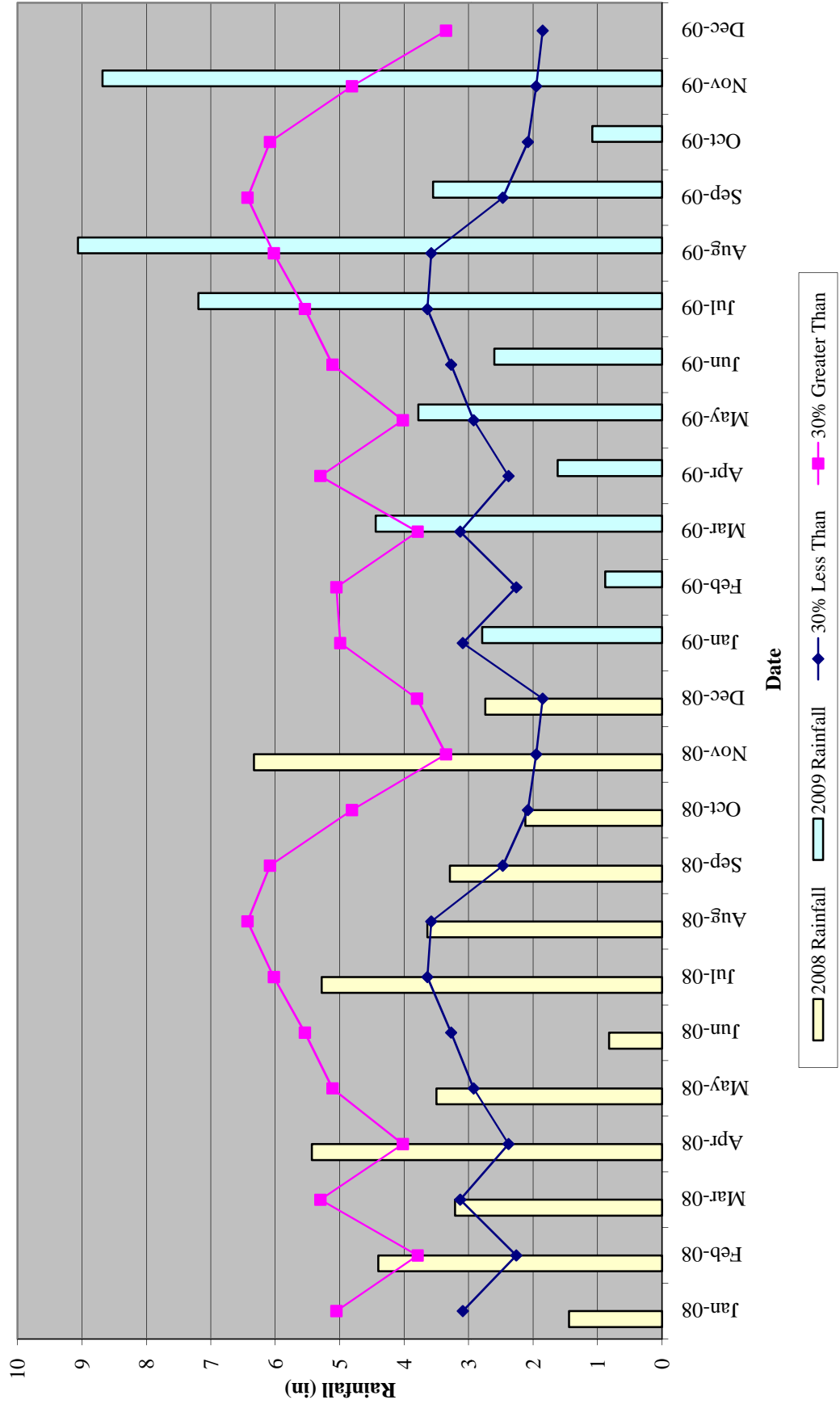


Maintenance Photo – 12/2/09 - MY 02 – Water flowing through notch in second log of grade transition.

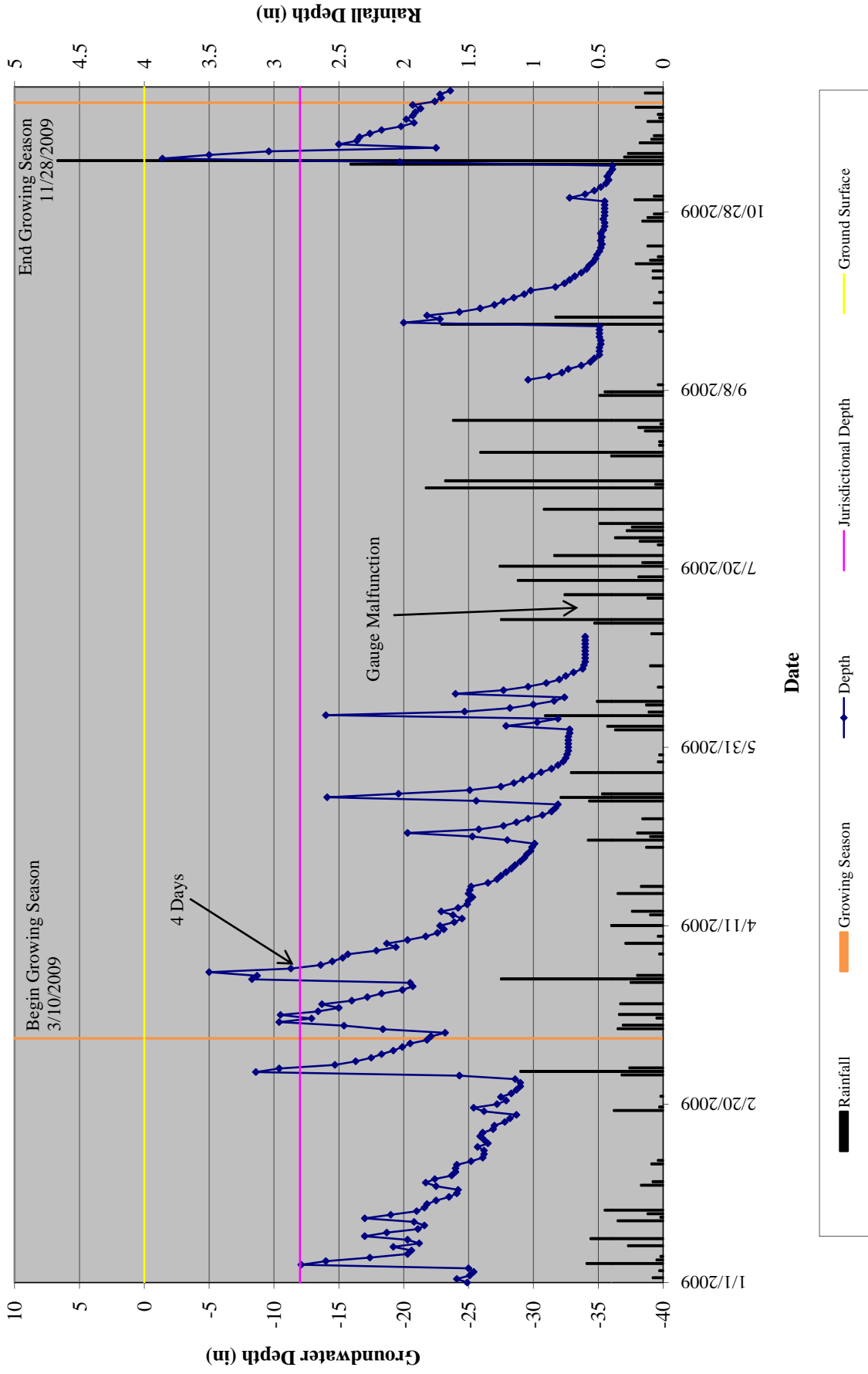
Table 8. Wetland Hydrology Criteria Attainment Table**Project Number and Name: 283 - UT Pembroke**

Gauge	Success Criteria Achieved / Max Consecutive Days During Growing Season (Percentage)	
	Year 1 (2008)	Year 2 (2009)
Well 2	No/0 (0%)	No/4 (1.5%)
Well 3	No/0 (0%)	No/4 (1.5%)
Well 4	No/0 (0%)	No/4 (1.5%)
Well 5	No/11 (4.2%)	Yes/49 (18.6%)
Well 6	No/12 (4.6%)	Yes/46 (17.5%)
Well 7	Yes/87 (33.1%)	Yes/108 (41.1%)
Well 8	No/11 (4.8%)	Yes/45 (17.1%)
Well 9	Yes/51 (19.4%)	Yes/49 (18.6%)
Well10	Yes/207 (78.7%)	Yes/110 (41.8%)
Well 11	Yes/107 (40.7%)	Yes/263 (100%)
Well 12 <i>Reference</i>	Yes/77 (29.3%)	Yes/53 (20.2%)
Well 13	No/10 (3.8%)	Yes/31 (11.8%)
Well 15	Yes/174 (66.2%)	Yes/107 (40.7%)
Well 16 <i>Reference</i>	Yes/112 (43%)	Yes/87 (33.1%)
Well 17	N/A	Yes/108 (41.1%)

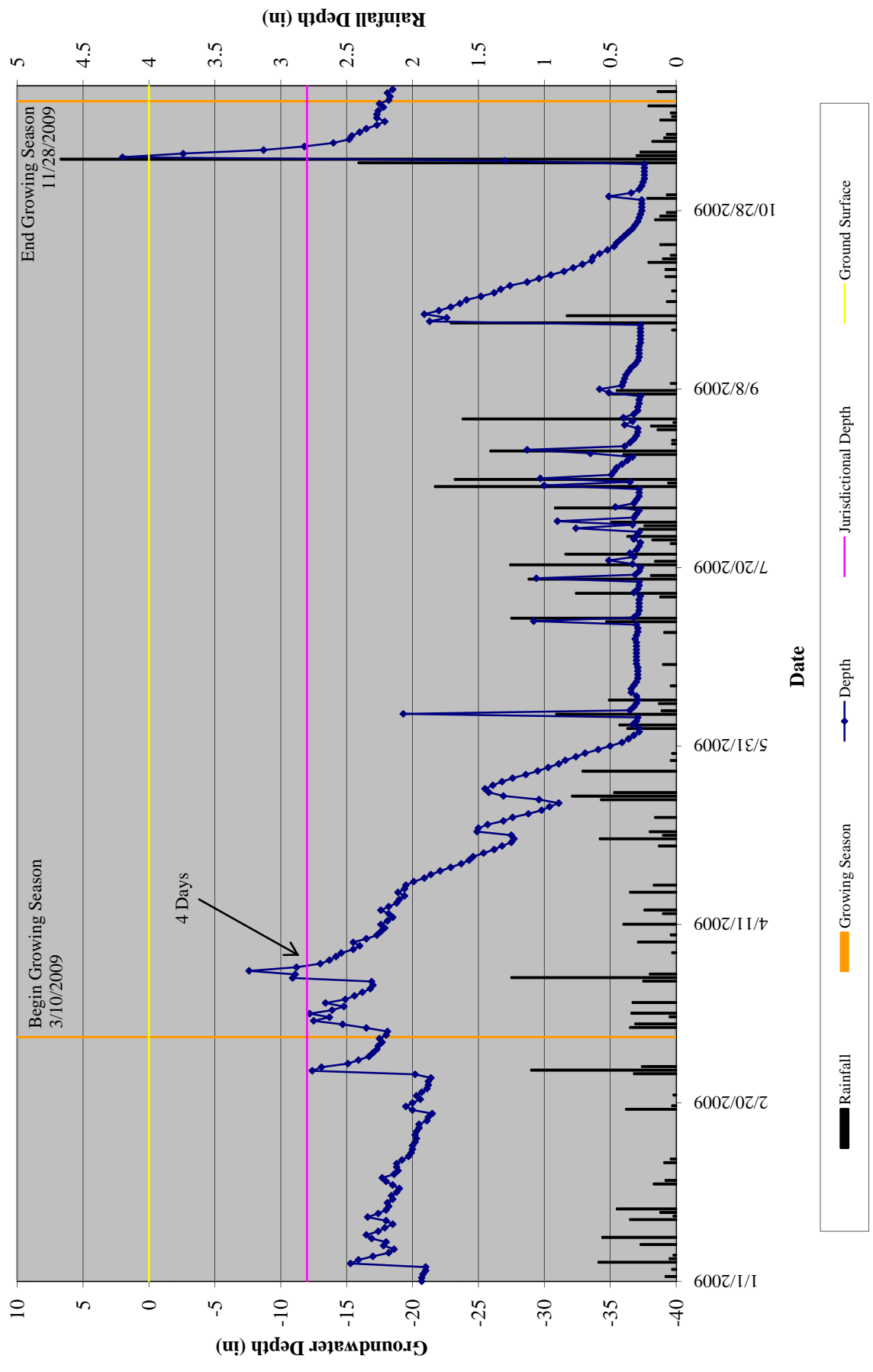
UT Pembroke 30-70 Percentile Graph 2008-2009
Edenton, NC Monthly Rainfall



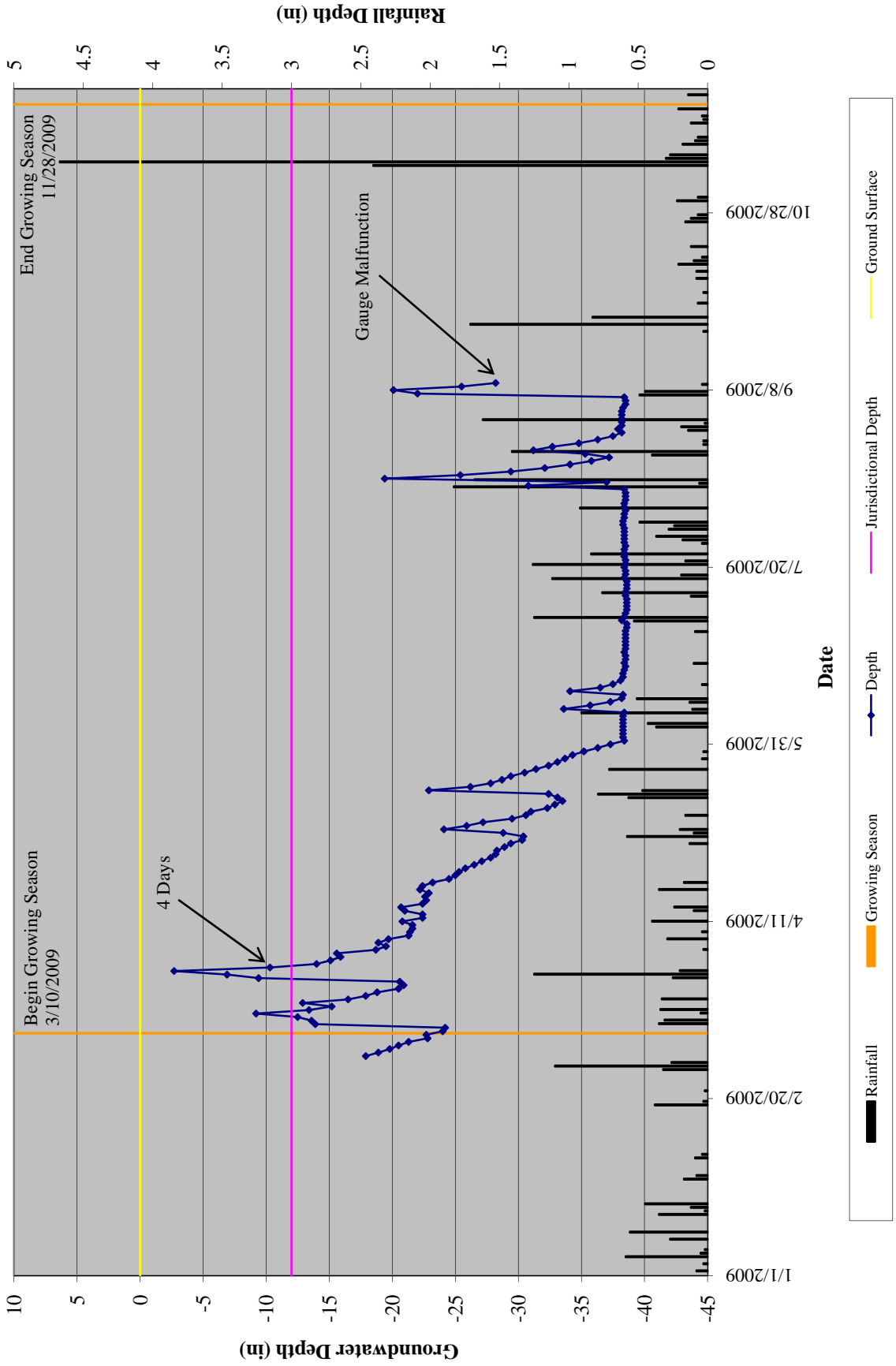
UT Pembroke MY02 Ground Water Monitoring Well #2



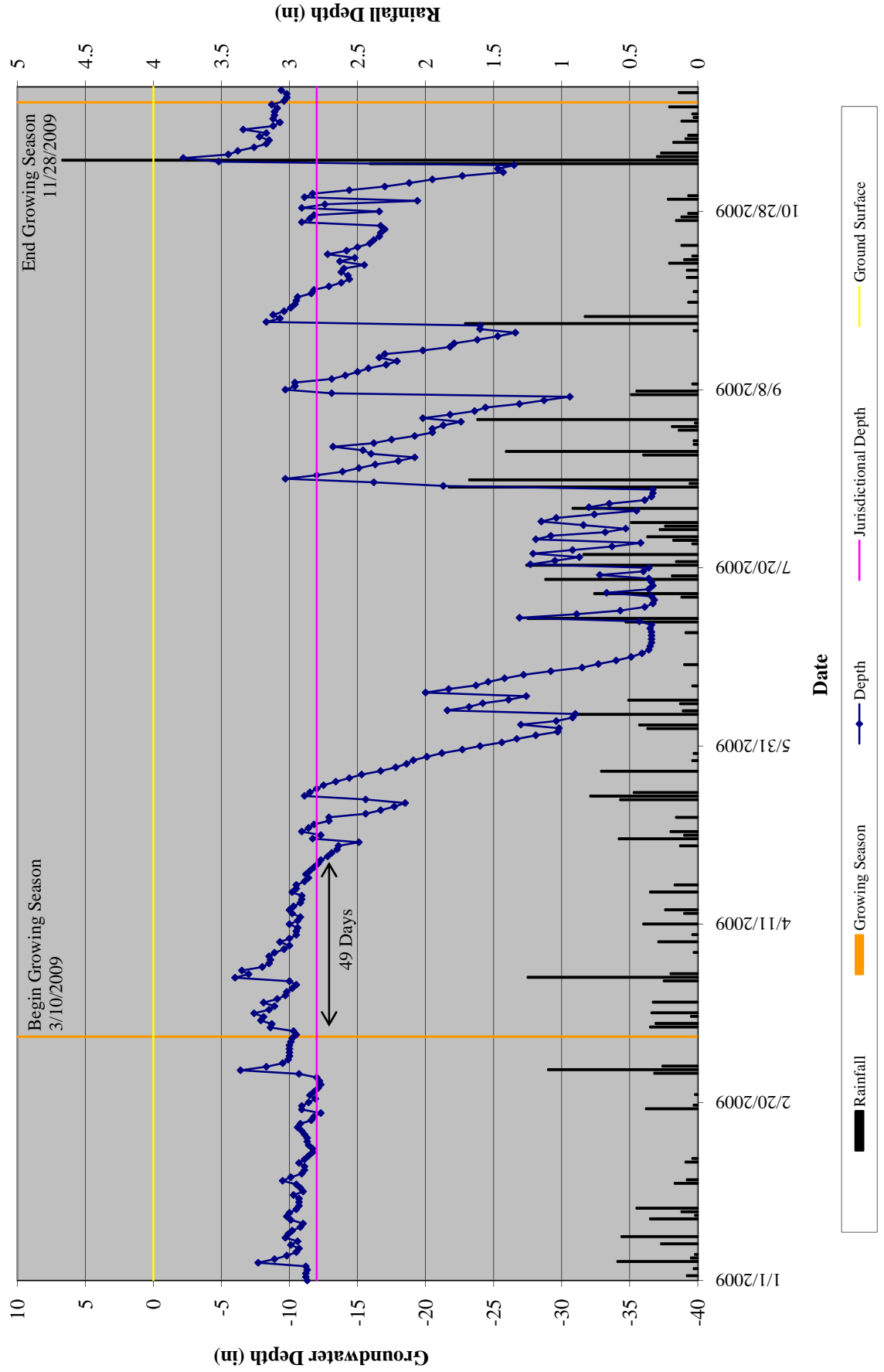
UT Pembroke MY02 Ground Water Monitoring Well #3



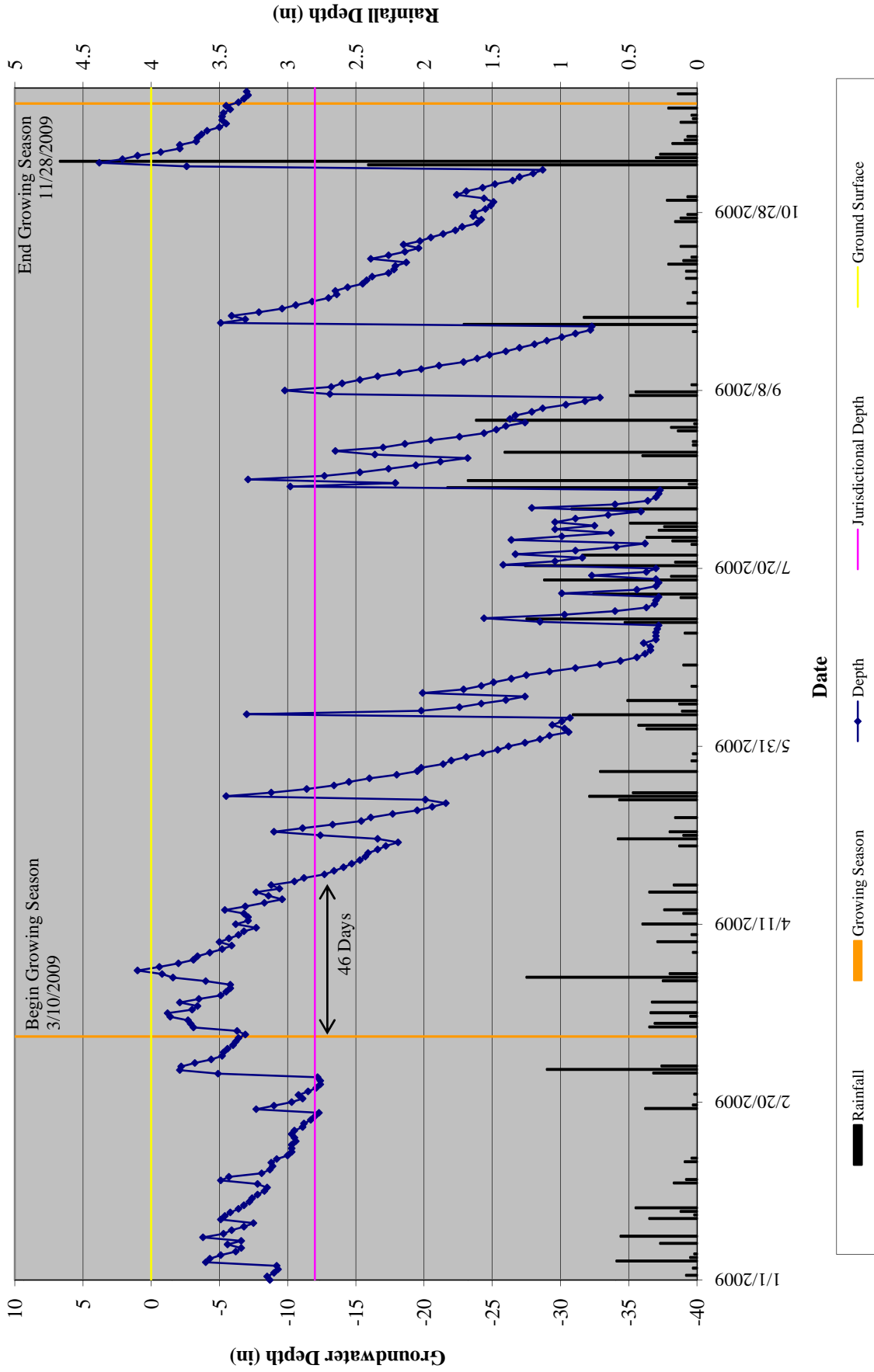
UT Pembroke MY02 Ground Water Monitoring Well #4



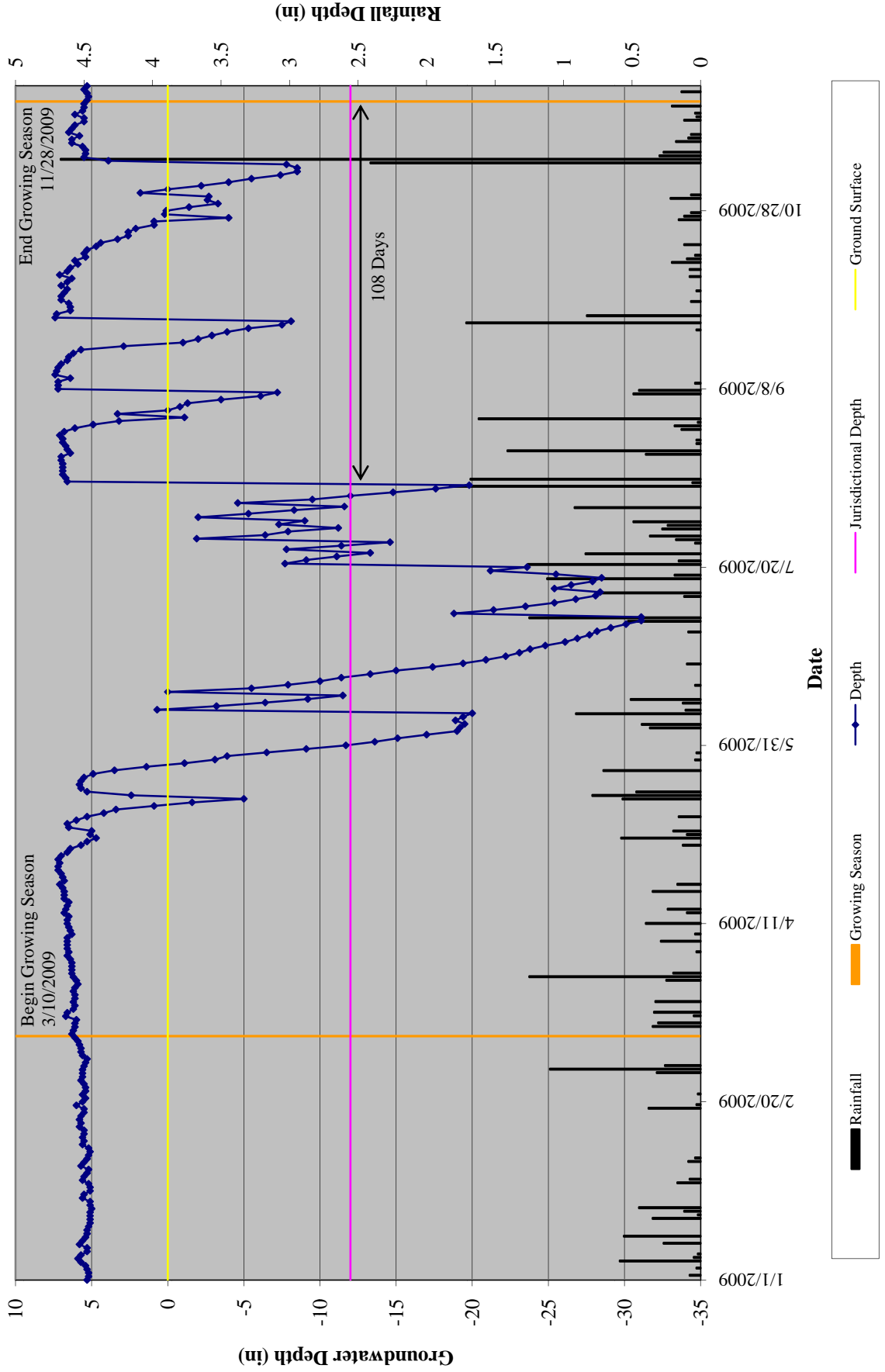
UT Pembroke MY02 Ground Water Monitoring Well #5



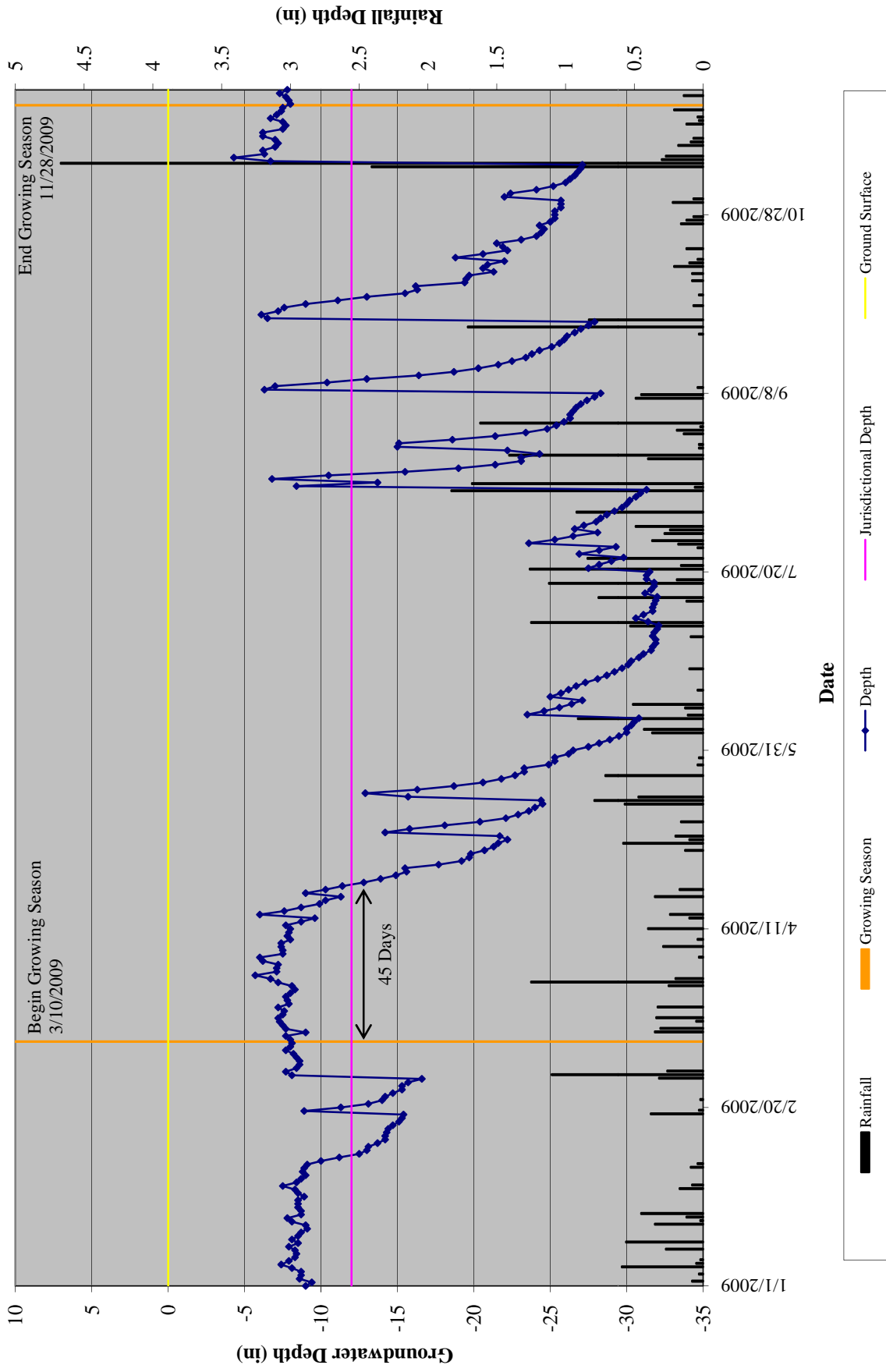
UT Pembroke MY02 Ground Water Monitoring Well #6



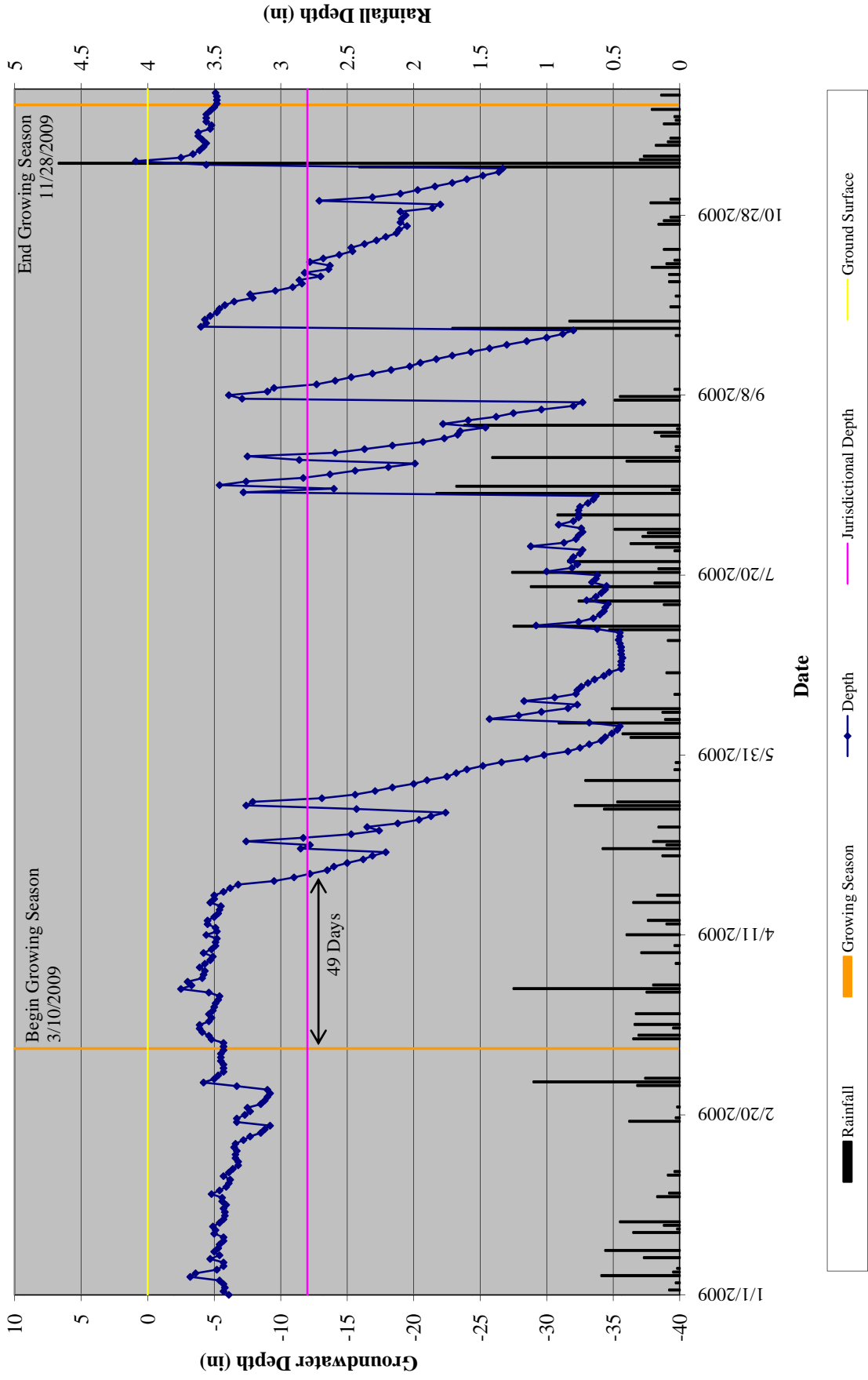
UT Pembroke MY02 Ground Water Monitoring Well #7



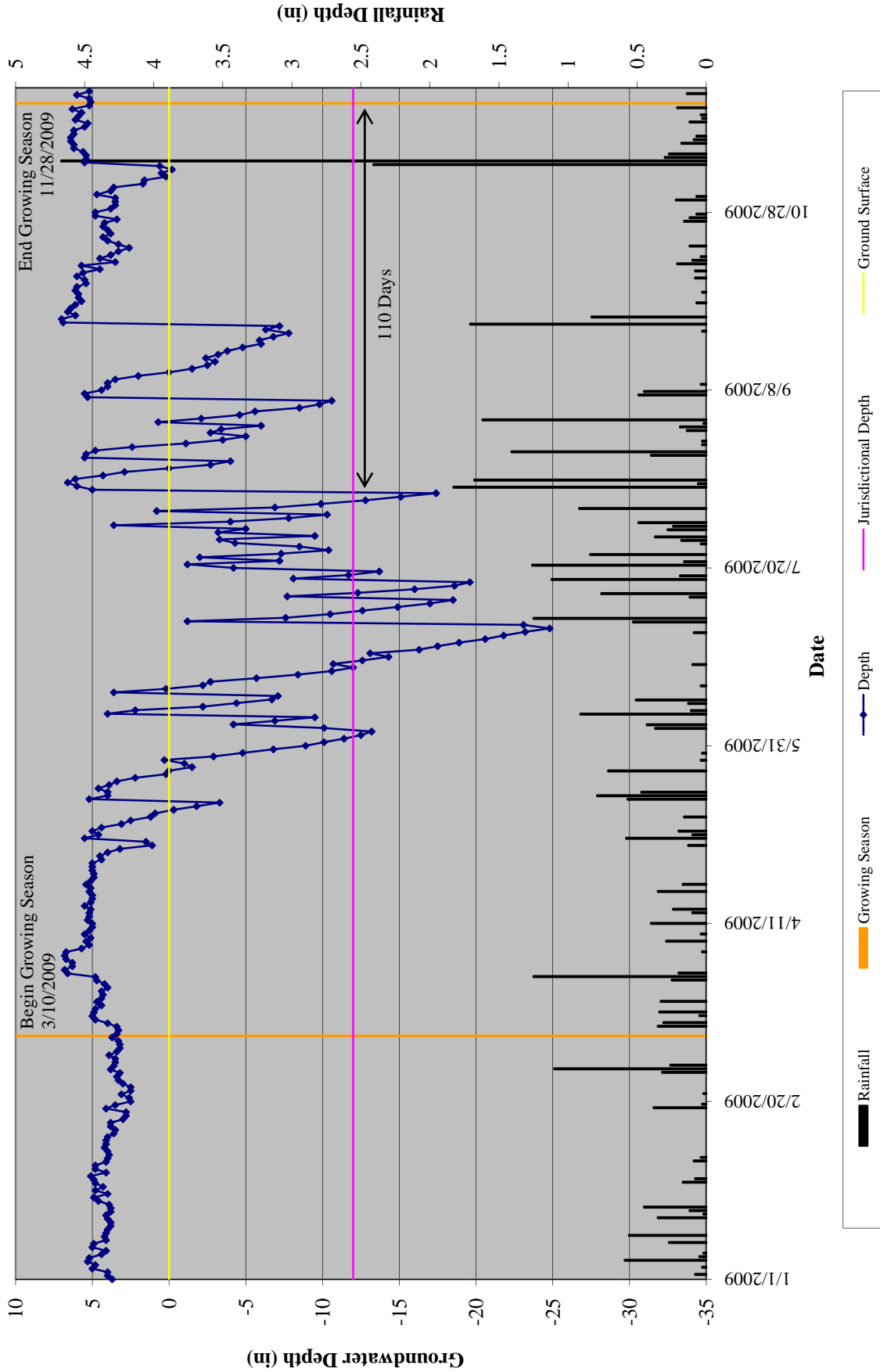
UT Pembroke MY02 Ground Water Monitoring Well #8



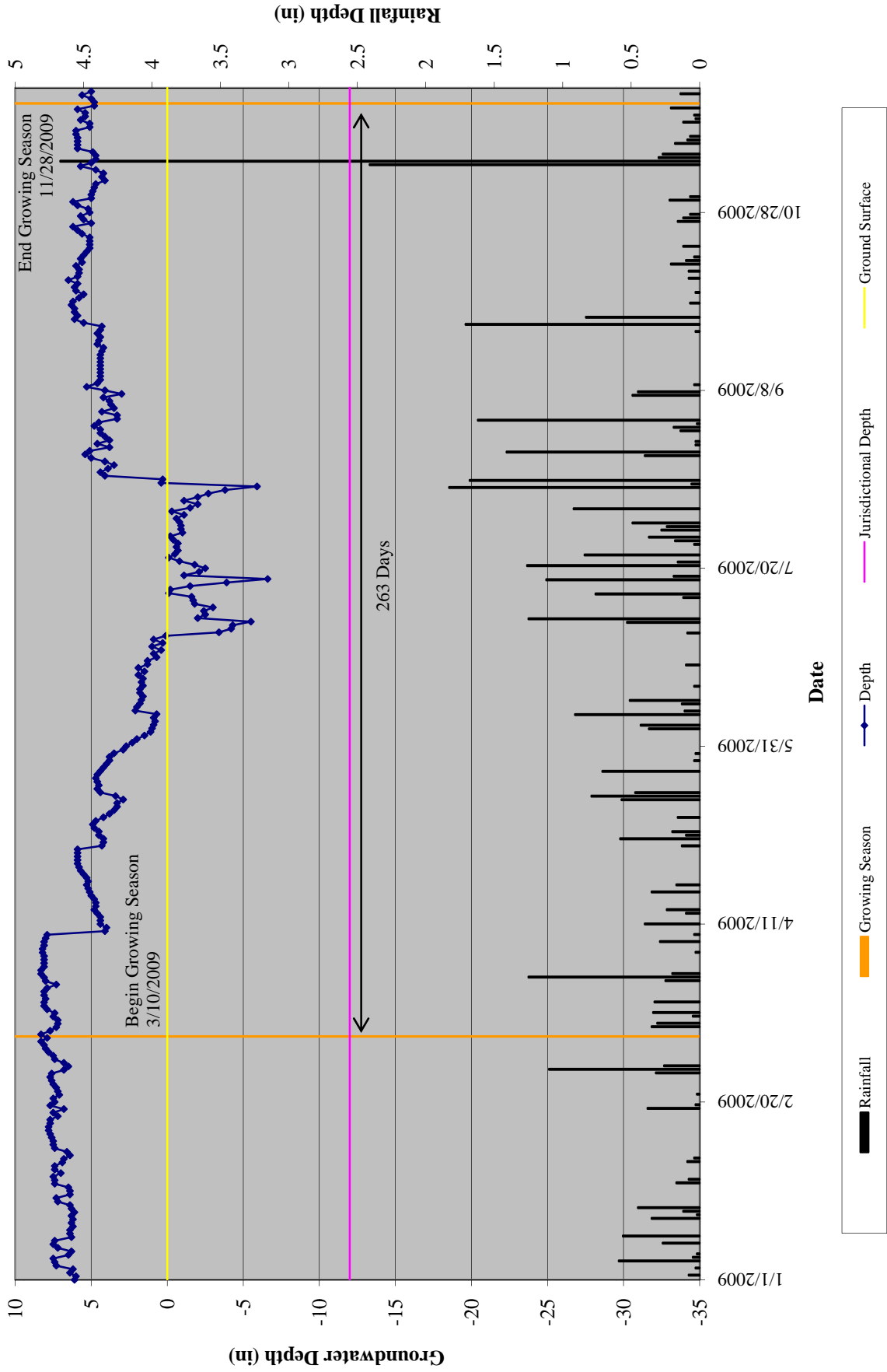
UT Pembroke MY02 Ground Water Monitoring Well #9



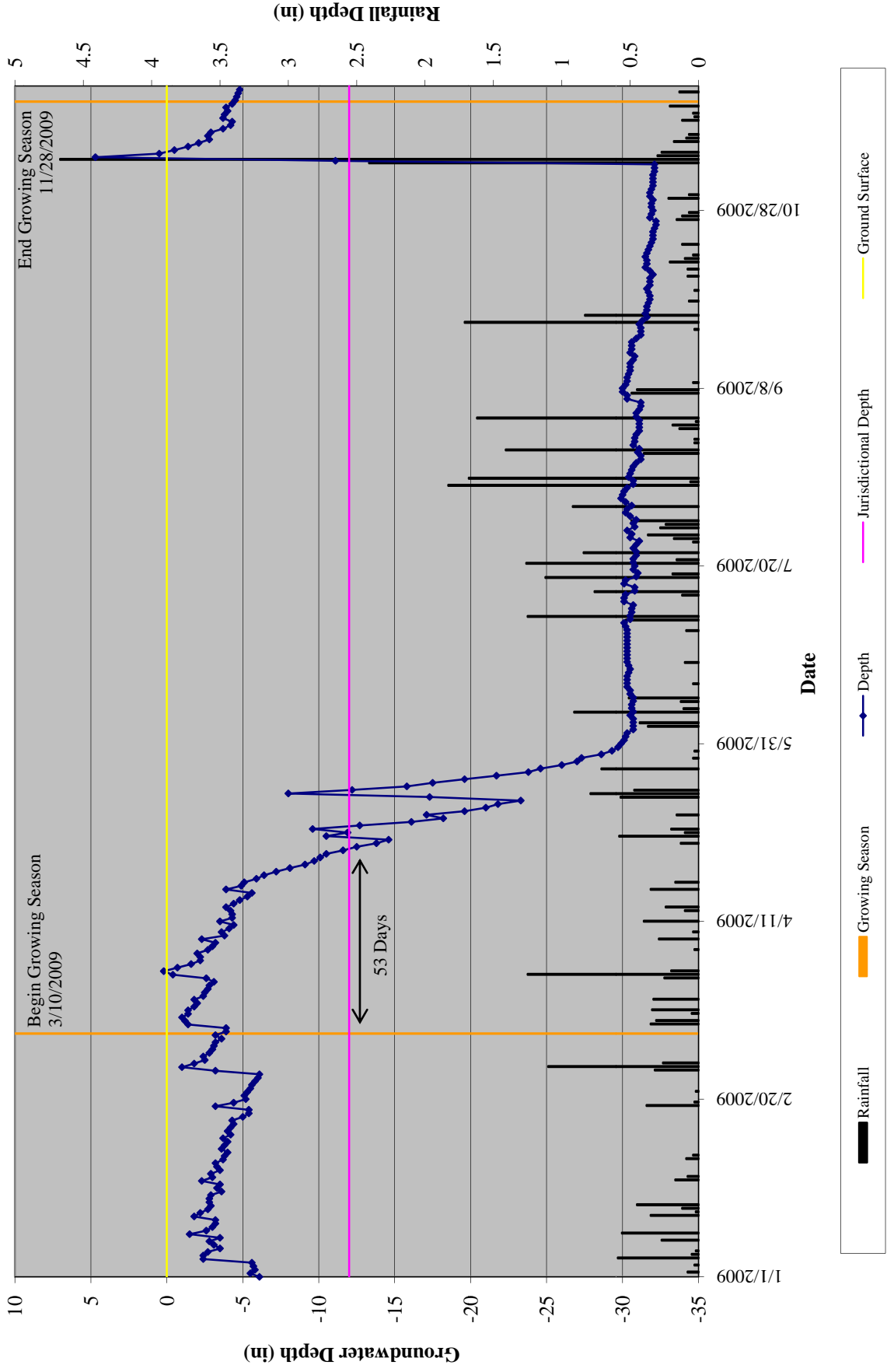
UT Pembroke MY02 Ground Water Monitoring Well #10



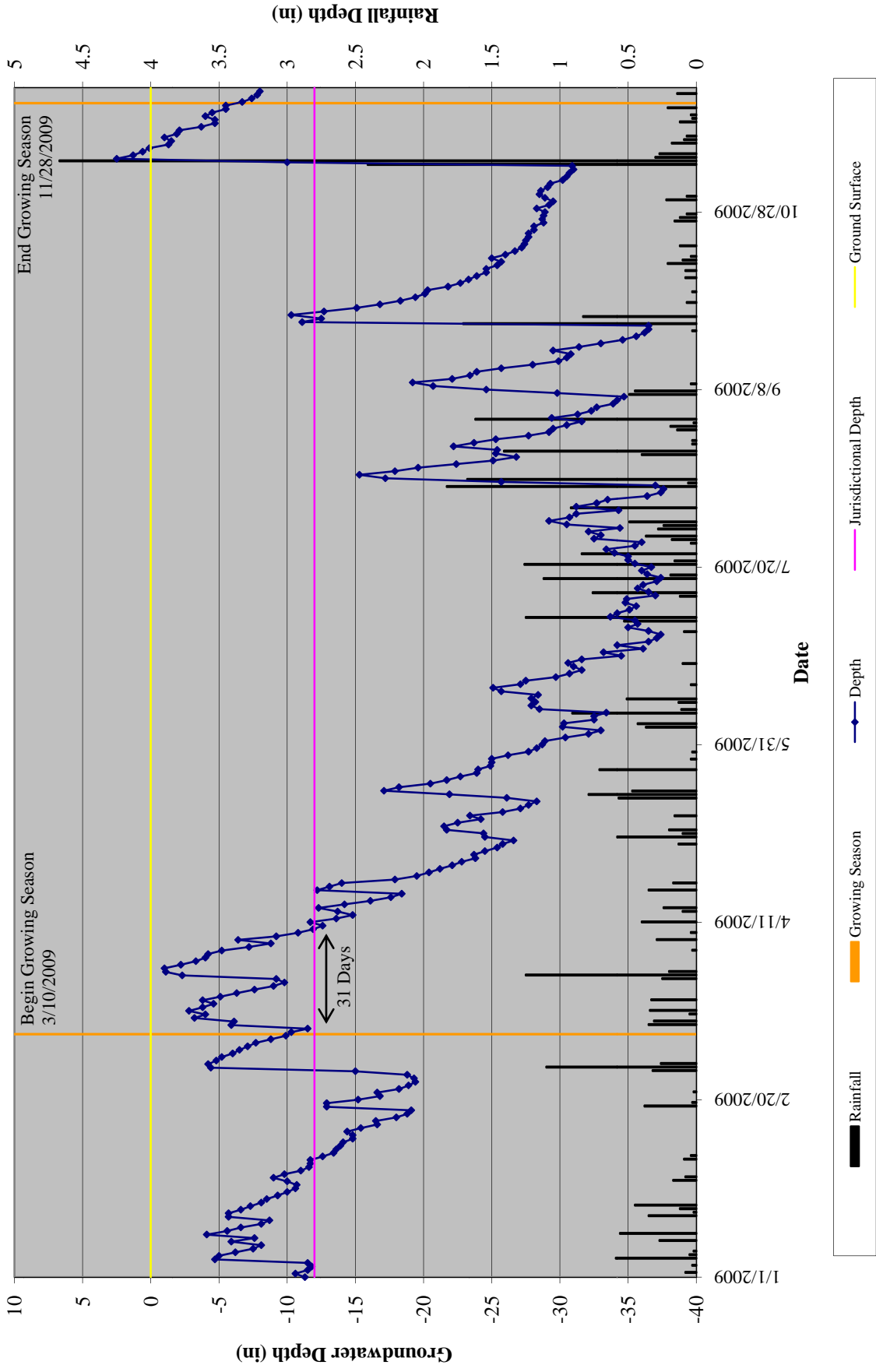
UT Pembroke MY02 Ground Water Monitoring Well #11



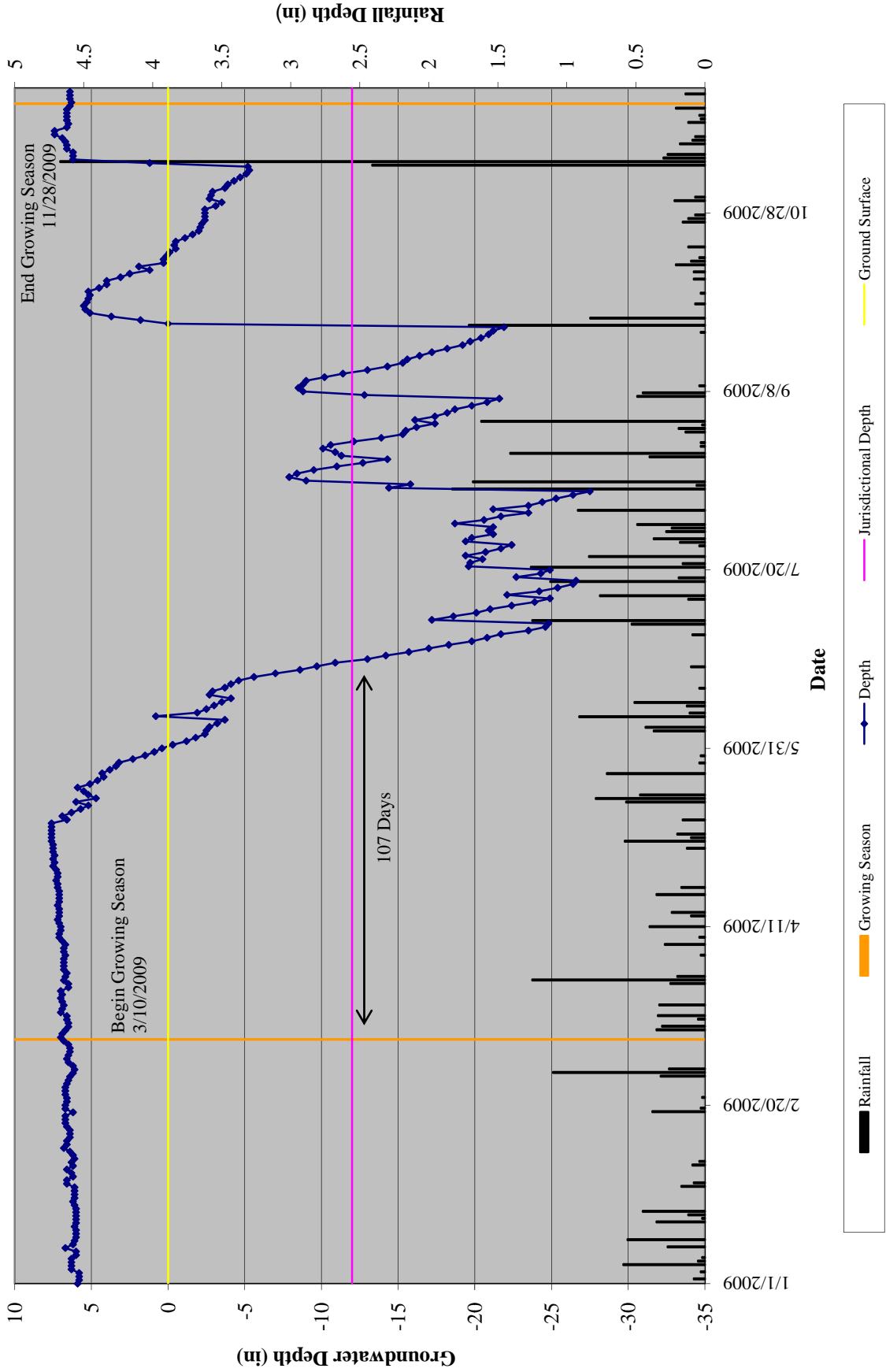
UT Pembroke MY02 Ground Water Monitoring Reference Well #12



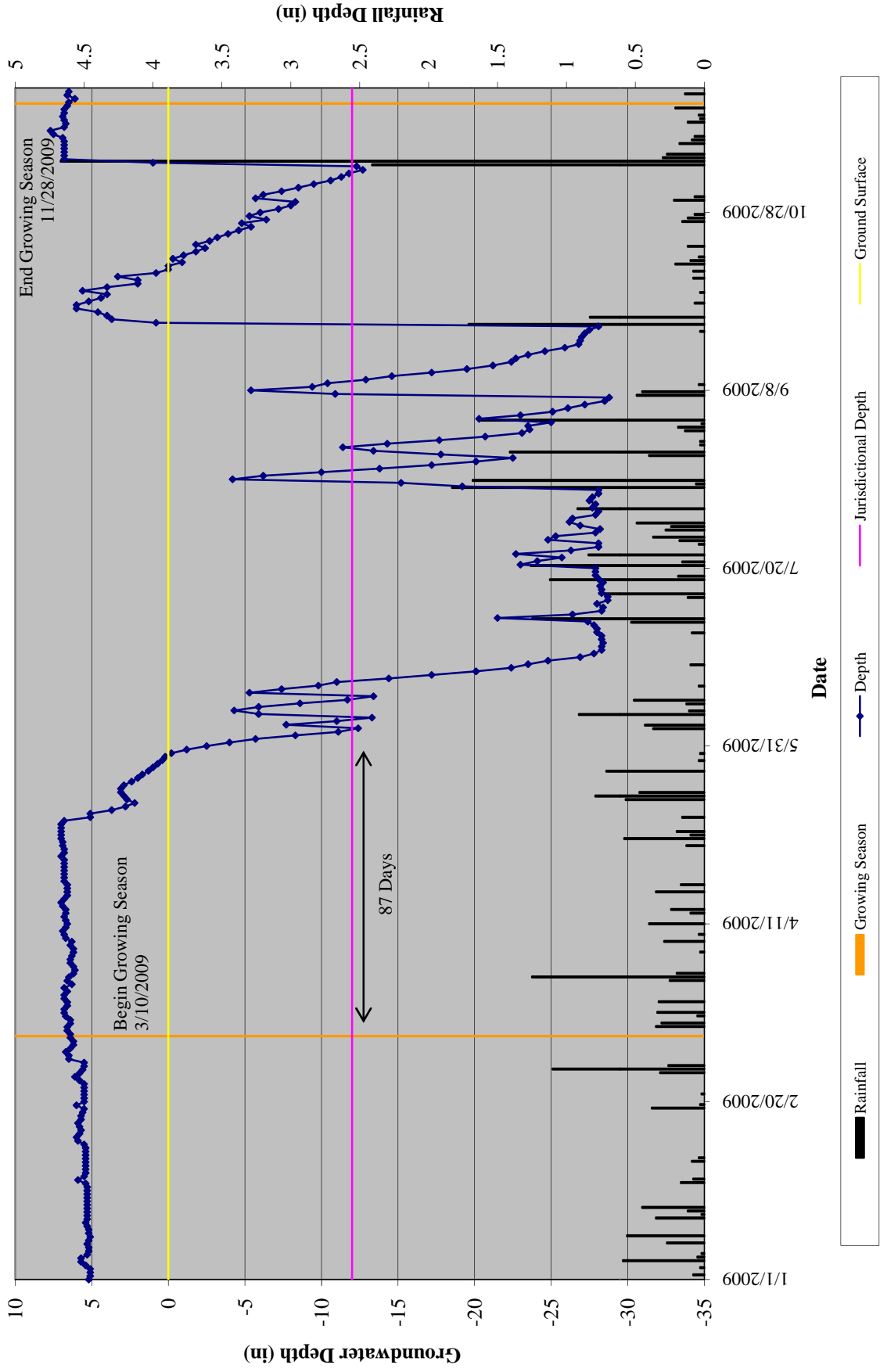
UT Pembroke MY02 Ground Water Monitoring Well #13



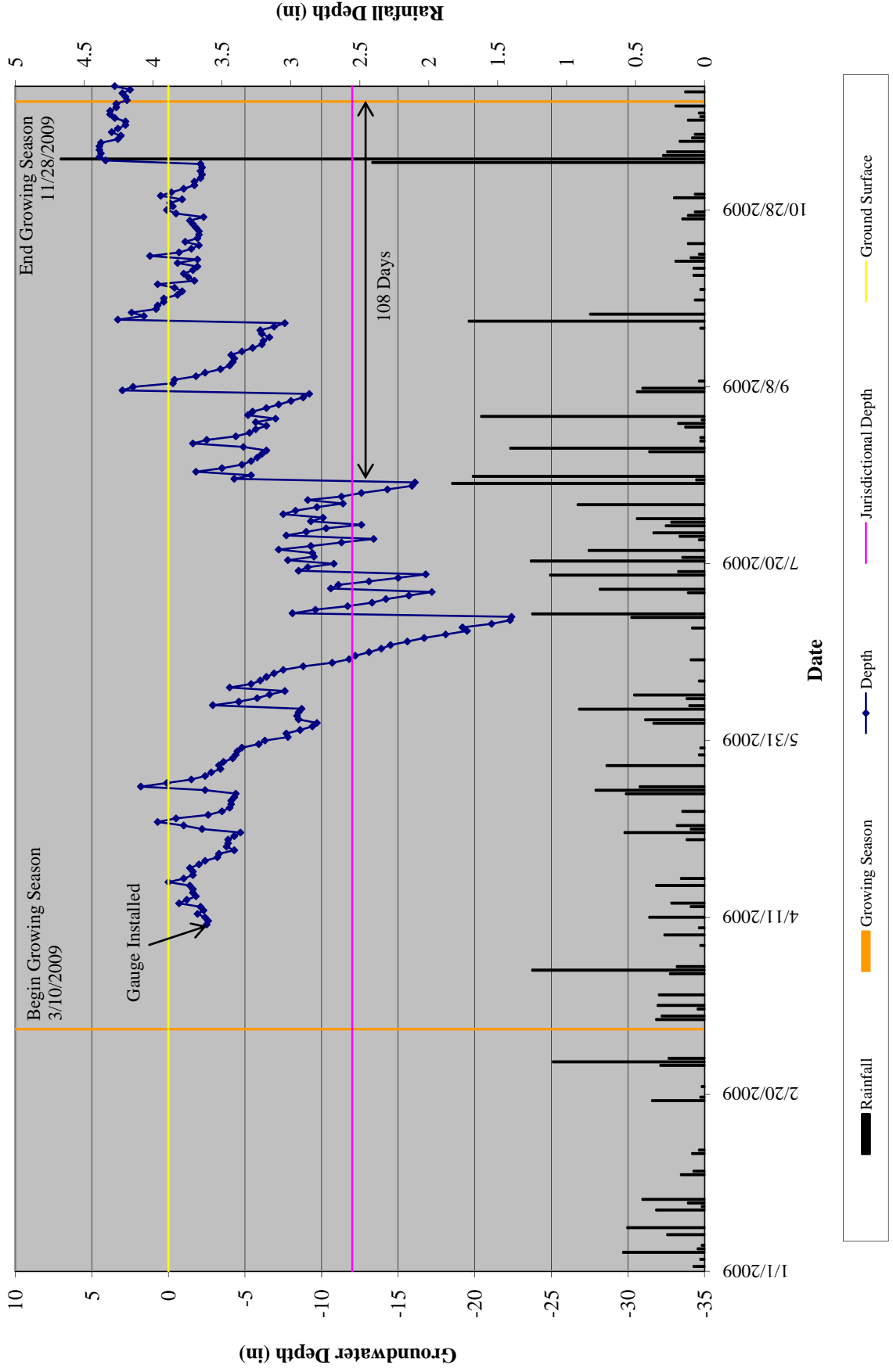
UT Pembroke MY02 Ground Water Monitoring Well #15



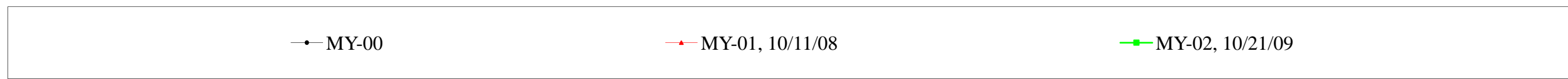
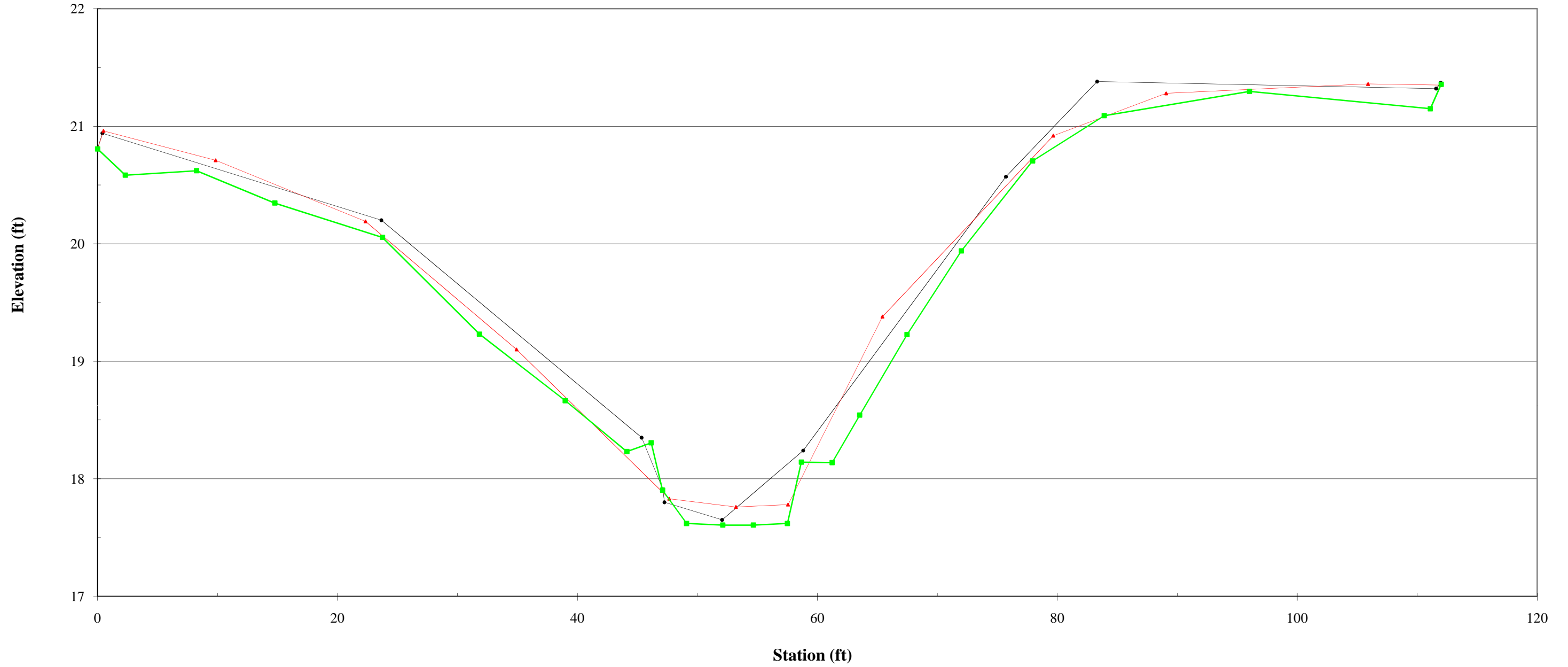
**UT Pembroke MY02
Ground Water Monitoring Reference Well #16**



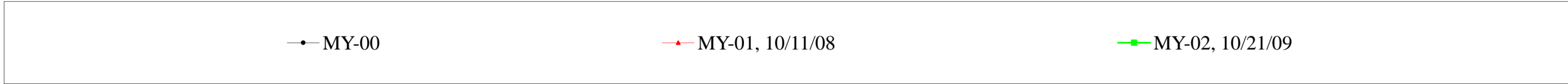
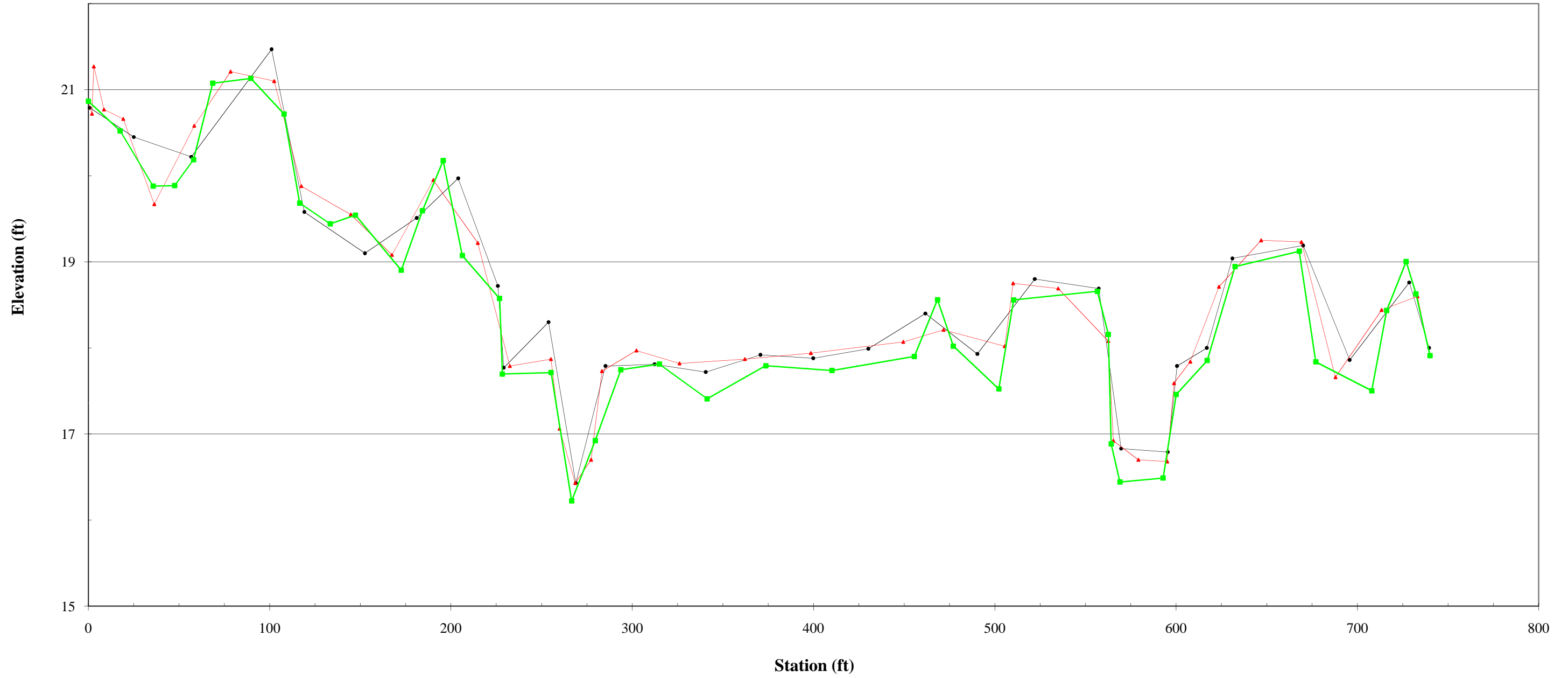
UT Pembroke MY02 Ground Water Monitoring Well #17



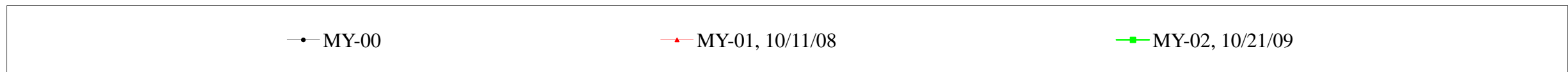
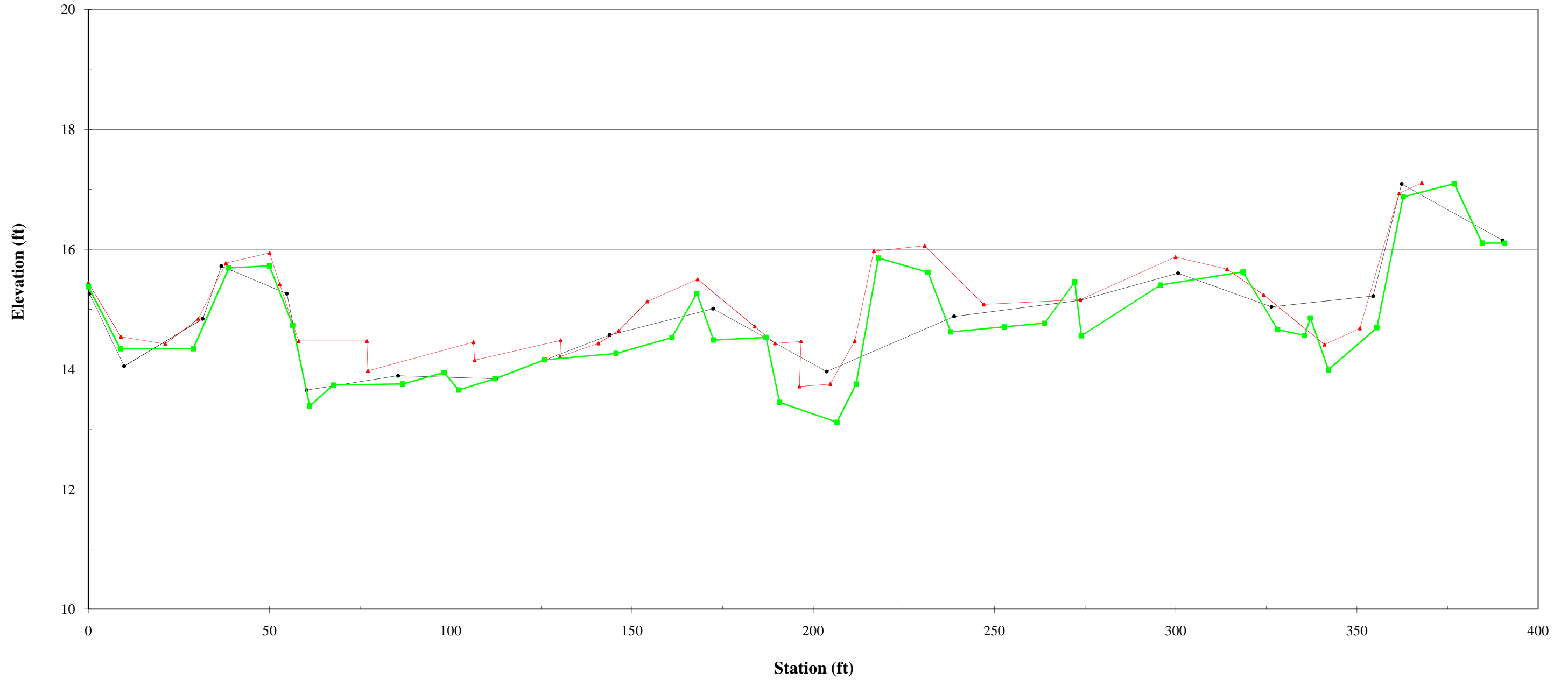
Cross-Section 1
UT Pembroke
EEP Project Number 283- MY02



**Cross-Section 2
UT Pembroke
EEP Project Number 283- MY02**



**Cross-Section 3
UT Pembroke
EEP Project Number 283- MY02**



**Cross-Section 4
UT Pembroke
EEP Project Number 283- MY02**

