Tarlton Stream and Wetland Restoration Project

Contract #:	D05013-1
County:	Cumberland
Cataloging Unit:	Cape Fear 03030004
Monitoring Firm POC:	Mid-Atlantic Mitigation, LLC Rich Mogensen (704) 782-4133 Kimley-Horn Associates, Inc. Will Wilhelm (704) 333-5131
Prepared For:	EEP Project Manager, Guy Pearce

Year 5 (2010) Monitoring Report

Kimley-Horn
and Associates, Inc.

Mid-Atlantic
Mitigation, LLC
AN EARTHMARK COMPANY

EarthMark Mitigation Services, LLC

September 15, 2010

NCEEP
1652 Mail Service Center
Raleigh, NC 27699-1652

Attn: Guy Pearce and Tim Baumgartner

RE: Tarlton Wetland and Stream Restoration Project (D05013-1)

Gentlemen:

Enclosed please find three bound copies of the Tarlton Wetland and Stream Restoration Project Monitoring Report Year 5. Also enclosed is a CD which includes a pdf of this Monitoring Report and the associated spreadsheets.

Once you have had a chance to review this report and provide any comments or concerns, and once I have completed all of our Fall 2010 monitoring reports for other projects, I will prepare a Closeout report comparable to the one prepared for the Pott Creek II Project.

Also enclosed is our invoice for this Task in the amount of $60,910. I understand that the invoice will not be approved for payment until the monitoring report has been reviewed and approved by EEP. I also understand that this is the closeout year for this project and while it is our preference to be paid immediately upon approval of this monitoring report, EEP may have constraints regarding closeout and final payment. However, I would like to note that timely payment will facilitate our ability to perform any final maintenance, repair, or planting work EEP may request prior to closeout meetings with the Corp and other agencies.

A note on the Vegetation, the adaptive management approach used on this project was approved in the mitigation plan. While the stem counts of the planted individuals are slightly low, stem counts for species on the planting list (both planted and volunteer) are excellent. It is EarthMark's opinion that any agency, upon seeing the site, will be very pleased with the results of this approach.

If you have any questions please feel free to call our office anytime.

Thank you,

Christine A. Cook

Christine Cook
Environmental Scientist
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INVOICE ENCLOSED

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1.0 EXECUTIVE SUMMARY/PROJECT ABSTRACT

On behalf of the North Carolina Ecosystem Enhancement Program (NCEEP), Mid-Atlantic Mitigation, LLC (MAM) with technical assistance from Kimley-Horn and Associates (KHA) restored, enhanced and preserved 4,402 linear feet of stream, restored 6.6 acres of riverine wetlands and enhanced 2.7 acres of riverine wetlands. Construction of the project began in November 2005 with beaver dam removal and grade-control structure installation, continued into March 2006 with final planting completed in June 2006. The Tarlton Stream and Wetland Restoration Project (Project) will provide NCEEP with 3,930 Stream Mitigation Units (SMUs) and 8.0 Wetland Mitigation Units (WMUs). Contract amounts: 3800 SMU 8 WMU

The objective of the restoration approach is to plan, design, and construct a dynamically stable stream/riparian floodplain and bottomland hardwood riverine wetland community providing an ecological improvement for the entire site and watershed. This project is designed to provide a stream channel that neither aggrades nor degrades while maintaining its dimension, pattern, and profile with the capacity to transport the surface water and sediment load. Also, the Project aims to reestablish the primary stream and wetland functions associated with nutrient removal and transport, provide sediment retention, improve wildlife (both aquatic and terrestrial) habitat, and to provide restoration of riparian zones that historically were an impounded lakebed. The restoration approach, due to the existing condition (fluctuating open water levels caused by beaver activity) and varied historical conditions of the site (lake, dry lake bed, beaver impoundments, etc.), involved an "adaptive" management phased process.

The project was constructed in two phases. The restoration approach established a stable grade control stream section, which maintains the elevation of the entire stream thalweg and the floodplain by controlling the downstream end of the project area. The floodplain elevation below the removed dam was set by installing several rock-cross vanes and a constructed riffle to hold the grade of the existing lake bottom area which is now the floodplain area above the former dam. This design provides both secondary water quality and primary flood storage benefits. The Project (both streams and wetlands) underwent a natural adjustment to a more stable aquatic ecosystem. The streams continued to re-establish natural channel function. This adaptive management approach allowed the streams to naturally seek equilibrium and appropriate dimension, pattern, and profile as the Project stabilizes. The primary restoration approach is to determine whether the stream adjustments trend towards the design criteria and restoration goals based on up-stream reference morphology and vegetation communities.

The riverine wetland and buffer vegetation community will transition as the system seeks hydrologic and biologic equilibrium. After removing the dam, sediments were unconsolidated and mucky with saturation. It was anticipated that settling and subsidence would occur throughout the initial growing season, first through evaporation and then through transpiration as the herbaceous cover (seeded and natural propagation) established. This did occur and continues to progress. Areas that were not

saturated/ponded (i.e. fringe areas and/or headwater wetlands) were initially planted with bare root seedlings and containerized plants to establish a bottomland hardwood riparian wetland community. Later as the site dewatered, thousands of containerized, bottomland hardwood trees & shrubs were planted throughout the stream and wetland areas.

The stream(s) were monitored for stability of dimension, pattern, and profile using standard practices including permanent cross sections, riffle-run-pool analysis, and pebble counts. Wetland hydrology and vegetation success were monitored using self-reading ground water monitoring gages and standardized, randomly placed permanent vegetation plots which were monitored for species diversity and survival. Monitoring data was analyzed to determine what remedial actions if any were required and any remedial actions proposed were detailed in the annual monitoring reports.

The fifth year monitoring was completed on August 25th, 2010. Monitoring success will be discussed in detail in Section 3.

2.0 PROJECT BACKGROUND

2.1 LOCATION AND SETTING

The Project is located in the City of Fayetteville, Cumberland County, North Carolina on the corner of Clearwater Drive and US 401 Bypass (Country Club Drive). A location map is included in Figure 1. The project site is located in the Upper Cape Fear River Watershed (USGS 8-digit Hydrologic Unit 03030004, and NCDWQ River Basin 03-06-15), and is within the NC Ecosystem Enhancement Program (EEP) Cross Creek Targeted Local Watershed (00050). The project site was historically impounded by a dam built in the 1970s, creating Country Club Lake which impounded about 4,500 feet of two perennial prongs of a tributary to Cross Creek. The project drainage area is approximately 2.6 square miles flowing into Cross Creek, a 303(d)-listed stream for impaired biological activity. The eastern prong of the project, which is named UT to Cross Creek East, has a drainage area of 1.0 square miles. The western prong named UT to Cross Creek West has a drainage area of 1.6 square miles. The project area conservation easement consists of 17.8 acres. The restoration project is being managed and monitored by Mid-Atlantic Mitigation, LLC but the property is owned by Greg and Patricia Tarlton and the conservation easement is held by the State of North Carolina.

2.2 STRUCTURE AND OBJECTIVES

The goals and objectives of the Project are to restore a naturally stable stream and riparian wetland community; to restore a bottomland hardwood wetland community; and to provide stormwater management for downstream development. In addition, water quality will be improved, flood storage will be increased, wildlife and aquatic habitat will be restored and the threat of flooding of downstream areas will be significantly reduced.

Phase I (completed Fall 2005): A beaver management plan was implemented to remove all the beavers from the project site. The removal of the old dam debris and spillway was

completed in November and December 2005 making it more difficult for the beavers to re-establish a dam at its existing location. A beaver control program which includes regular site visits to the former dam area has been implemented and will continue throughout the monitoring period. In mid-November 2005, the lake water level was lowered over a 3-5 day period slowly releasing the water downstream to prevent flooding and erosion. In conjunction with removing the beaver dams, the stream section through the area of the historical dam and beaver dams was restored. The channel in this section (approximately 175 feet) was restored using a Priority I (Rosgen) restoration approach. The stream restoration included establishing a bankfull channel and active floodway through the relic spillway/dam and providing a variety of in-stream structures (rock vanes, constructed riffles, and step pool structures) to provide grade control, stability, and improve aquatic habitat diversity. The natural channel design was based on the upstream reference reach. The restoration project was constructed through and under an existing aerial sanitary sewer crossing that is cut out of the easement limits. In addition to the stream restoration, a BMP (level spreader / pre-formed scour hole) was constructed in this area at the outlet of a stormwater drainage pipe. This restoration establishes a stable grade control, which maintains the elevation of the entire stream thalweg and the floodplain by controlling the downstream end of the project area. The floodplain elevation below the dam was set to hold the grade of the existing lake bottom which is now the floodplain area above the former dam area. This also prevented any sediment that was in the old lake from being washed downstream and to provide a natural "pinch-point" corresponding with existing topography. This pinch-point will help re-establish and control natural hydrology in the proposed riparian wetland during events above bankfull and act as a large detention area.

Phase II (completed in July 2006): Once the beavers, beaver dams, and impounded water were removed, and the downstream grade control established, the Project (both streams and wetlands) underwent a natural adjustment to a more stable aquatic ecosystem. The stream segments found their hydrologic equilibrium and re-established bed and bank features. In addition, the site soils gradually dewatered allowing the deposited sediments to consolidate and subside. During the first growing season, the Project soils stabilized through evapotranspiration and subsidence processes. The streams continued to re-establish natural channel function, and were evaluated for necessary adjustments. This adaptive management approach allowed the streams to naturally seek equilibrium and appropriate dimension, pattern, and profile as compared to the upstream reference reach. The primary restoration approach is to determine whether the stream adjustments trend towards the design criteria and restoration goals based on reference morphology and vegetation communities. The eastern and western prongs are designed as Rosgen C5->E5 channels. During monitoring year, the channel slope and/or dimension were found to be stable, structures such as rock cross vanes, log cross vanes, log vanes, log sills, and constructed riffles were not needed to help maintain the channel compared to the reference morphology.

The riparian wetland and buffer vegetation community will transition and stabilize as the system seeks hydrologic equilibrium. The initial planting/seeding of the site was completed in March-April 2006 to establish herbaceous cover of exposed bare soils with

the expectation that the initial growing season would allow for evapotranspiration to dewater lake bottom sediments. These sediments were initially unconsolidated and mucky with saturation. It was anticipated that settling and subsidence would occur throughout the initial growing season, first through evaporation and then through transpiration as the herbaceous cover (seeded and natural propagation) established. This has occurred as proposed. Areas that are not saturated/ponded (i.e. fringe areas and/or floodplain wetlands) were planted with bare root seedlings and containerized plants to establish a bottomland hardwood riparian wetland community.

In order to stabilize the newly constructed stream channel and flood plain areas both temporary and permanent grass seed as well as wetland herbaceous seed were applied to all restored areas. The types of seeds used were: *Leersia oryzoides* (Rice Cut grass); *Panicum clandestinum* (Deertongue grass); *Panicum virgatum* (Switchgrass): *Trisacum dactyloides* (Gama grass), and *Secale cereale* (Annual rye). Also, a Southeast Wildflower mix was applied throughout the project. Five hardwood planting zones were established as follows: Zone 1 – Stream Channel, Zone 2- Stream Bank, Zone 3 – Bottomland Hardwood wetland, Zone 4 – Swamp Wetland, and Zone 5- Upland fringe. Livestakes were installed along the newly constructed channel (approx. 175') within Zone 2. They were planted randomly spaced approximately 3 feet apart and differed in sizes ranging from .25" to 2" in diameter and 2' to 3' in length. Further livestaking may be necessary as the new stream channels stabilize. Zone 3 –5 consists of bareroot seedlings and 1 gallon containerized plants, which were planted randomly 3' to 12' apart throughout the project.

Table I. Project Mitigation Structure and Objectives Table

Project Segment	Mitigation Type	Approach	Linear Footage or Acerage	Stationing	Comment
Stream W Prong	P	-	341	10 + 00 - 14 + 00	Western Prong as it enters the site
Stream W Prong	E1		596	14 + 00 - 19 + 00	Western Prong between Preservation Area and Restoration Area
Stream	R	P1	3465		Remainder of Site is Restoration (88%)
Wetland	R	-	6.6		Project is 83% restoration
Wetland	E	-	2.7		Stream Enhancement Area is bordered by Wetland Enhancement, Several other enhancement areas exist

SMWs
68.2
3973
3465
3930.5

Table II. Project Activity and Reporting History

Activity or Report	Calendar Year of Completion or Planned Completion	Actual Completion Date
Restoration Plan	October 2005	March 2006
Construction	October 2006	March 2006
Temporary /Permanent seeding	October 2006	March 2006
Bareroot Plantings	November 2006	March 2006
Containerized Plantings	November 2006	June 2006
Mitigation Plan	December 2006	August 2006
Year 1 Monitoring	December 2007	October 2006
Year 2 Monitoring	December 2008	December 2007
Year 3 Monitoring	December 2009	November 2008
Year 4 Monitoring	December 2010	November 2009
Year 5 Monitoring	December 2011	September 2010

Table III. Project Contacts

Project Manager Mid-Atlantic Mitigation, LLC	1960 Derita Road Concord, NC 28027 Rich Mogensen (704) 782-4133
Designer Kimley-Horn and Associates Inc.	4651 Charlotte Park Dr Suite 300 Charlotte, NC 28217 Will Wilhelm (704) 333-5131
Construction Contractor Earthwork Inc.	343 Chapman Drive Sanford, NC 27330 Dan Wood (919) 718-6812
Planting & Seeding Contractor Carolina Silvics Seed mixes provided by IKEX Nursery Stock provided by Native Roots Nursery (Formerly Southern Shade)	908 Indian Trail Road Edenton, North Carolina 27932 Dwight McKinney (252) 482-8491
Monitoring Performers Mid-Atlantic Mitigation, LLC	1960 Derita Road Concord, North Carolina 28027 Christine Cook (704) 782-4133 x101

Table IV. Project Background

Project Background Table	
Project County	Cumberland
Drainage Area	2.6 square miles
Drainage Cover Estimate (%)	10%
Physiographic Region	Coastal Plain
Ecoregion	45a Southern Inner Piedmont
Wetland Type	Palustrine, Forested, Broad-leaved Deciduous
Cowardin Classification	PFO1Fh
Dominant soil types	Johnston Loam
Reference site ID	UT to Cross Creek
USGS HUC for Project and Reference	03030004
NCDWQ Sub-basin for Project and Reference	03-06-15
% of project easement fenced	0 – Urban site surrounded by private residence

3.0 PROJECT CONDITION AND MONITORING RESULTS

3.1 VEGETATION ASSESSMENT

3.1.1 Soil Data

Table V. Preliminary Soil Data

Series	Max Depth (in)	% Clay on Surface	K	T	OM %
Johnston Loam	80	25 - 49	.20 - .17	5	3 - 8

3.1.2 Vegetative Problem Areas

At this time, no vegetative problem areas or invasive species problems have been noted. The site has been stabilized and vegetated with native woody and herbaceous species.

3.1.3 Stem Counts

Zones 1 – 3 of the five planting zones were sampled in three 75 ft by 75 ft plots. The prevalent vegetation should consist of macrophytes that typically are adapted for life in saturated soil conditions. These species should have the ability to grow, compete, reproduce, and persist in anaerobic soil conditions. A reduction in the percentage of nuisance vegetation in wetlands areas with existing vegetation to less than 15% will indicate enhancement of wetland vegetation. For the restoration areas, study plots showing that the composition and density of vegetation in the restoration areas that

compares closely to the reference areas will indicate restoration success for vegetation. Stem counts of over 320 trees per acre after 3 years, 288 trees per acre after 4 years, and 260 trees per acre after 5 year will be considered successful. Photos taken at established photo points should indicate maturation of riparian vegetation community.

Exhibit Table VI: Stem Counts for Each Species Arranged by Plot

Species	Plots			Initial Totals	Year 1 Totals	Year 2 Totals	2008 Initial	Year 3 Totals	Year 4 Totals	Year 5 Totals	Survival %
	1	2	3								
Betula nigra	5	12		18	18	15	18	16	15	17	94%
Chamaecyparis thyoides				8	2		8		1	0	0%
Cornus ammomum		1	1	10	9	2	10	3	3	2	20%
Fraxinus pennsylvanica	20		14	35	35	43	35	34	33	34	97%
Liriodendron tulipifera				1			1			1	100%
Magnolia virginiana		3					3	3	2	3	100%
Nyssa aquatica	1		2	6	6	8	6	6	6	3	100%
Nyssa biflora	6	4	2	8	8	6	8	5	5	12	150%
Nyssa slyvantica	5	1	1	10	10	10	10	10	6	8	80%
Quercus bicolor		1					3	3	2	1	33%
Quercus nigra			1	2			2		1	1	50%
Quercus phellos				1	1	1	1	1		0	0%
Quercus shumardii				1	1		1			0	0%
Salix nigra					1	1	1	1	1	0	0%
Taxodium distichium	7	10	8	25	21	24	25	25	23	25	100%
Totals	**44**	**32**	**29**	**125**	**112**	**110**	**132**	**106**	**98**	**107**	81%

Table VII. Stems Per Acre

	Year 1 2006		Year 2 2007		Year 3 2008		Year 4 2009		Year 5 2010		
	SPA	SPA w/ vols	SPA	SPA w/ vols	SPA	SPA w/ vols	SPA	SPA w/ vols	SPA	SPA w/ vols	SPA Planted Species Combined
Plot 1	410	441	364	372	356	441	310	465	341	612	403
Plot 2	217	232	217	279	263	332	256	294	248	410	410
Plot 3	240	279	194	248	178	309	186	294	225	712	472
Total	**289**	**317**	**258**	**300**	**266**	**354**	**251**	**351**	**271**	**578**	**428**

3.1.4 Vegetation Assessment Summary

Vegetation success will be defined as tree survival to meet 288 stems per acre (SPA) after 4 years and 260 SPA after 5 years inside the permanent vegetative plots and herbaceous cover evaluated with photos showing 75% coverage, after 5 years.

Survival of several species is above 90% after 5 years with additional volunteers of many desirable species. Volunteer species include *Alnus serrulata, Cephalanthus occidentalis, Platanus occidentalis, Sambucus Canadensis, and Salix nigr.* None of these species were planted because of the large available seed source and excellent growing conditions of the site. Volunteers of planted species include *Betula nigra*, *Cornus amomum*, *Fraxinus pennsylvanica*, *Nyssa sp.*, and *Taxodium distichium.* A large colony of alders still exists in Plot 3. This dense community is typical of alders and has been managed and thinned but continues to flourish. On March 24th, 2008 a small replant, as requested by EEP after the 2007 monitoring report, was done. 55 *Magnolia virginiana*, 45 *Quercus bicolor*, and 35 *Taxodium distichum*, for a total of 135 plants were installed in the areas around and between Plots 2 and 3. Ultimately, this replant did little to bolster the stem counts within the plots. However, visual observation of the site indicates a lush, diverse community of adequate density.

Based on sampling, the site as a whole shows an average of 271 SPA of planted stems and 578 SPA when healthy, desirable volunteers are included, 20 Alder individuals in Plot 3 were used in this calculation. The site demonstrates 81 percent survival of planted stems. When only volunteer individuals of species on the planting list are counted, the site shows an average of 428 SPA. The community is diverse and rich with healthy volunteers. Using the adaptive management approach for this site, the contribution of healthy, desirable volunteers should be considered before any decisions are made on additional plantings. This site was not over planted during initial planting as would typically be done due to a predicted high rate of colonization of desirable volunteer species. While the planted stem count is below the 5 year goal in plots 2 and 3 of 260 stems the contribution of volunteers of species on the planting list places the stems per acre calculation well above this goal. The high survival of volunteer species and individuals indicates that the adaptive management approach has been successful.

In Appendix A, the vegetative survey data tables show the actual counts of each species found per plot. The herbaceous cover plant community was monitored in a 1 m by 1 m square at one corner of each plot. Herbaceous cover for the site is approximately 100%.

3.2 CHANNEL STABILITY ASSESSMENT

3.2.1 Cross Sections

The site as a whole has shown no significant change since as-built documents were submitted. The Cross Section plots are located in Appendix B. Cross Sections 1 and 2 are the only constructed riffle and pool. The banks were graded to the typical designed cross sections. The stream bed is made of stone debris found on site to stabilize the riffle and

to increase bed form diversity/ habitat of the riffle for this section as well as acting as grade control. The stream channels at Cross Sections 3 through 10 are less defined than Cross Sections 1 and 2. MAM and KHA tried to select deep still areas for pools and chose shallower areas of swift running water for the riffle cross sections. Observations for each Cross Section follow.

Cross Section 1 Pool – No significant changes, Thalweg right of center.
Cross Section 2 Riffle– Sand deposits from 2006 and 2009 are completely cleared out, thalweg centered.
Cross Section 3 Pool – Channel appears shallower due to shifting sand bed nature of the stream, left and right bank seem stable as of 2009, thalweg left of center.
Cross Section 4 Riffle – Sand deposits similar to those in 2006 and 2007 are present in 2010, thalweg right of center.
Cross Section 5 Riffle – Seems to have re-aligned with the 2006 channel but has deepened significantly, thalweg left of center.
Cross Section 6 Pool – Right bank and overall channel width continues to fluctuate slightly, thalweg right of center.
Cross Section 7 Riffle – Channel continued to deepened slightly in 2010, right bank and overall channel width continues to fluctuate slightly as well, thalweg left of center.
Cross Section 8 Pool – Sand deposition has continued since 2008, left bank seems to be stabilized while deep section to the right has filled in, thalweg leftt of center.
Cross Section 9 Riffle – Channel depth has been stable as of 2008, scouring or settling of unconsolidated materials may have occurred along right bank in 2008, but has also stabilized, thalweg left of center
Cross Section 10 Pool – Channel indicates a steep slope on the left bank, but appears stable, depth and sand formations continue to fluctuate slightly but appear relatively stable, thalweg left of center.

3.2.2 Bank Full Events

The Crest Stage Gage (CSG) located at the southern end of the site below the confluence of the East and West Prongs was reset and indicated bankfull conditions on April 2nd, 2010. The most likely storm event to trigger the CSG took place on March 29th, 2010 with 1.2 inches of rain registering onsite and the stream gage peaking at 23.75. The CSG was found triggered again on July 8th, 2010. This may have been triggered by an event on June 13th, 2010 where the stream gage registered a peak of 17.32, however this is lower then readings we would normally see for a bankfull event and rainfall did not exceed an inch for that day.

In order for the CSG to indicate bankfull conditions the stream gage north of the site in the reference area must generally register a peak of approximately 24 inches or higher and rainfall onsite as recorded by the raingage near the CSG must be significant (generally, exceeding one inch combined for two consecutive days). Comparison data between the onsite gage and the Fayetteville PWC gage is located in Appendix E.

Rainfall amounts and stream gage peaks are shown in the table below. The stream gage rig was damaged and quit collecting relevant data around 8pm on July 5th, 2010. This was most likely due to an over bank event although it can not be traced to a significant rainfall event on the 5th of July. It is likely that rigging was simply undermined over time by constant ebb and flow and finally failed.

Both the Crest Stage Gage and the Stream Gage have served their five year purpose, with multiple over bank events being documented in 2007, 2008, and 2009 in addition to the past years event.

Table VIII. Potential Bankfull Events

Date	Stream Gage	Onsite Rainfall	Comments
Feb 5 2010	26.34	.09*	1.62" @ KFAY Airport
Mar 29 2010	23.79	1.2	1.65" @ PWC
Jun 13 2010	17.32	.42	
Aug 3 2010			Stream Gage discovered wash out
			Significant rack lines and debris present

* Significant rainfall fell offsite

3.2.3 Pebble Counts and Longitudinal Profiles

There is currently only one constructed riffle on the project, which is located at the site of the original dam and corresponds with Cross Section 2. This riffle was constructed with large cobbles and small boulders found on site. A pebble count was done in 2006 which demonstrated the substantial size of the bed material. In 2009, pebble counts were done on two sections of the same riffle, 2009 and 2009a. Sample 2009a was taken in the same area as the 2006 sample. Only a small representative sample was taken in 2006. Samples for 2009 were slightly larger, but low amounts of smaller bed material make a larger count difficult. The site has shown no significant change since as-built documents were submitted. Pebble count graphs are located in Appendix B with Cross Section 2.

Profiles of the Eastern and Western Prongs show similar trends. While the profiles still appear somewhat inconsistent, several stable pool and riffle features have begun to emerge. Significant sections of each profile match up reasonably with the 2009 survey and several trends have emerged over the full five year period. Riffle areas appear to be becoming more defined with longer stretches of similar elevation followed by pools or series of pools. The UT appears to have developed a stable pattern as of 2008, but its profile continues to be inconsistent, a stable pool appears to have formed at approximately the 70 foot mark followed by a stable riffle-like stretch for approximately 80 feet. The inconsistent nature of the profile in this reach can be attributed to the presence of large amounts of course woody debris and organic material. The current stream morphology is common and typically stable in low-gradient coastal plain systems.

3.2.4 Wetland Assessment

Seven ground water gages are distributed around the project along with one reference gage located upstream of the site on the Western Prong. Graphs showing the 2010 data have been prepared and are included in Appendix E. The average growing season for Cumberland County and the Fayetteville area is 213 days between March and October. Therefore, ten percent of the growing season is approximately 21 days. All gages indicated successful jurisdictional hydrology in 2010. Gage CC2 was found to be malfunctioning on May 11th, 2010. While the area was visually wet, the gage readings didn't reflect site conditions. Program data such as the date and alarm interval were incorrect, also indicating a malfunction. Once this gage was replaced on July 8th it immediately began collecting jurisdictional readings as indicated by the site conditions. Gage CE2 is located within the enhancement area, therefore it was not replaced when it was found to be malfunctioning on July 1st, having already achieved 57 consecutive days of jurisdictional hydrology.

Overall, the site has shown consistent jurisdictional conditions every year. The region experienced moderate to extreme drought according to the Palmer Drought Severity Index from June of 2007 to August of 2008. During this time Gage CEC10 fell below the 10% threshold, but maintained the 5% threshold required for a drought year. Gage CC2 fell slightly below the 5% mark in 2007, but has performed well in all other years. These two gages are located in the driest areas of the site based on the last five years of observation and data.

Table IX. Success Criteria Attainment

Well ID	Well Hydrology Threshold Met?	Mean	Vegetation Plot ID	Vegetation Survival Threshold Met?	Mean
CC2	Y	100%	Plot 1	Y	33% 100% w/ vols
CC3	Y		Plot 2	N (Y w/ vols)	
CEC6	Y		Plot 3	N (Y w/ vols)	
CE2	Y				
CE5	Y				
CEC10	Y				
Tarlton 4	Y				
CC6	Y				

Table Xa. Wetland Criteria Attainment

Well ID	Well Hydrology Threshold Met?	Total days w/ Jurisdictional Hydrology	Percent of Growing Season w/ Jurisdictional Hydrology
CC2	Y	56	26%
CC3	Y	55	26%
CEC6	Y	34	16%
CE2	Y	57	27%
CE5	Y	172	81%
CEC10	Y	55	26%
Tarlton 4	Y	49	23%
CC6	Y	85	40%

Table Xb.:
Percent of Growing Season Meeting Jurisdictional Requirements by Year

Well ID	2006	2007	2008	2009	2010
CC2	43%	4%	14%	29%	26%
CC3	27%	32%	32%	42%	26%
CEC6	40%	22%	18%	21%	16%
CE2	39%	37%	32%	36%	27%
CE5	100%	71%	100%	76%	81%
CEC10	41%	8%	5%	13%	26%
Tarlton 4	22%	21%	24%	20%	23%
CC6	32%	170%	100%	30%	40%

3.2.5 Site Stability Assessment Summary

Overall, the stream channel has developed and stabilized as planned. The herbaceous vegetative cover has also developed a healthy and diverse community. The planted trees and shrubs have also done well and are supplemented by a robust existing buffer community which provides a seed source for volunteers well suited to the current site conditions. Many of the volunteer species are the same as the planted individuals from the approved planting list. Ground water gages demonstrate favorable trends and jurisdictional wetland hydrology. Minor beaver activity was noted on the site this year. One small dam was removed this spring and the beaver control contractor was dispatched immediately to trap any beaver on site and no new beaver activity has been noted since.

APPENDIX A: Vegetation Raw Data

Tarlton- Vegetation plot #1						
	Number of Planted Species/Number of Volunteers					
Trees/ Shrubs	2006	2007	2008	2009	2010	
Acer rubrum				/2	/11	100 % Volunteers
Alnus serrulata	/3	/1	/2	/12	/16	100 % Volunteers
Betula nigra	5	3	4	3	5	
Cephalanthus occidentalis	/1					100 % Volunteers
Chamaecyparis thyoides	1					
Cornus amomum	4					
Fraxinus pennsylvanica	20	20/7	20/9	20/6	20/8	
Liriodendron tulipifera						
Nyssa aquatica	5	5	5	1	1	
Nyssa biflora	6	6	5	6	6	
Nyssa slyvantica	5	5	5	4	5	
Quercus falcata var. pagodafolia						
Quercus michauxii						
Quercus nigra						
Quercus phellos						
Quercus shumardii						
Salix nigra						
Taxodium distichium	7	8	7	6	7	
Total Planted	**53**	**47**	**46**	**40**	**44**	
Voluteers	**4**	**1**	**11**	**20**	**35**	
Total planted species	**53**	**54**	**55**	**46**	**52**	

Plot Size: 5625 ft²

Herbacous Vegetation	2006	2007	2008	2009	2010
Juncus spp.	Dominant	Dominant	Dominant	Common	Dominant
Polygonum* spp. *(tearthumb)	Sub dominant			Dominant	Common
Eupatorium capillifolium	Common				

Stems/plot / Sq ft/plot	=	Stems/ac / Sq ft/acre
44 / 5625	Planted	341 / 43560
79 / 5625	Plus Vols	612 / 43560
52 / 5625	Planting List Species	403 / 43560

Tarlton- Vegetation plot # 2						
Trees/ Shrubs	Number of Species planted/Number of Volunteers					
	2006	2007	2008	2009	2010	
Alnus serrulata						100 % Volunteers
Betula nigra	12	12/4	12/6	12	12/12	
Cephalanthus occidentalis	/2					100 % Volunteers
Chamaecyparis thyoides	1			1	Dead	
Cornus amomum	1	1/2	1/1	1/3	1/3	
Fraxinus pennsylvanica	1					
Liriodendron tulipifera						
Magnolia virginiana			3	2	3	
Nyssa aquatica						
Nyssa biflora	4	4	4/1	4/1	4	
Nyssa slyvantica	1	1/2	1/1	1/1	1	
Quercus bicolor			3	2	1	
Quercus falcata var. pagodafolia						
Quercus michauxii						
Quercus nigra						
Quercus phellos						
Quercus shumardii						
Salix nigra						
Taxodium distichium	8	10	10	10	10/6	
Total Planted	**28**	**28**	**34**	**33**	**32**	
Volunteers	**2**	**8**	**9**	**5**	**21**	
Total planted species	**28**	**36**	**43**	**38**	**53**	

Plot Size: 5625 ft²

Herbacous Vegetation	2006	2007	2008	2009	2010
Eupatorium capillifolium	Sparse				
Juncus spp.	Dominant		Dominant	Dominant	Dominant
panicum clandestinum	Common				
polygonum pensylvanicum	Dominant				
polygonum spp. (smartweed)	Common	Common	Common		
Polygonum spp. *(tearthumb)*	Common	Common	Common	Dominant	Common
sedge sp.	Sparse			Common	Common

Stems/plot	=	Stems/ac
Sq ft/plot		Sq ft/acre
32	Planted	248
5625		43560
53	Plus Vols	410
5625		43560
	Planting	
53	List Species	410
5625		43560

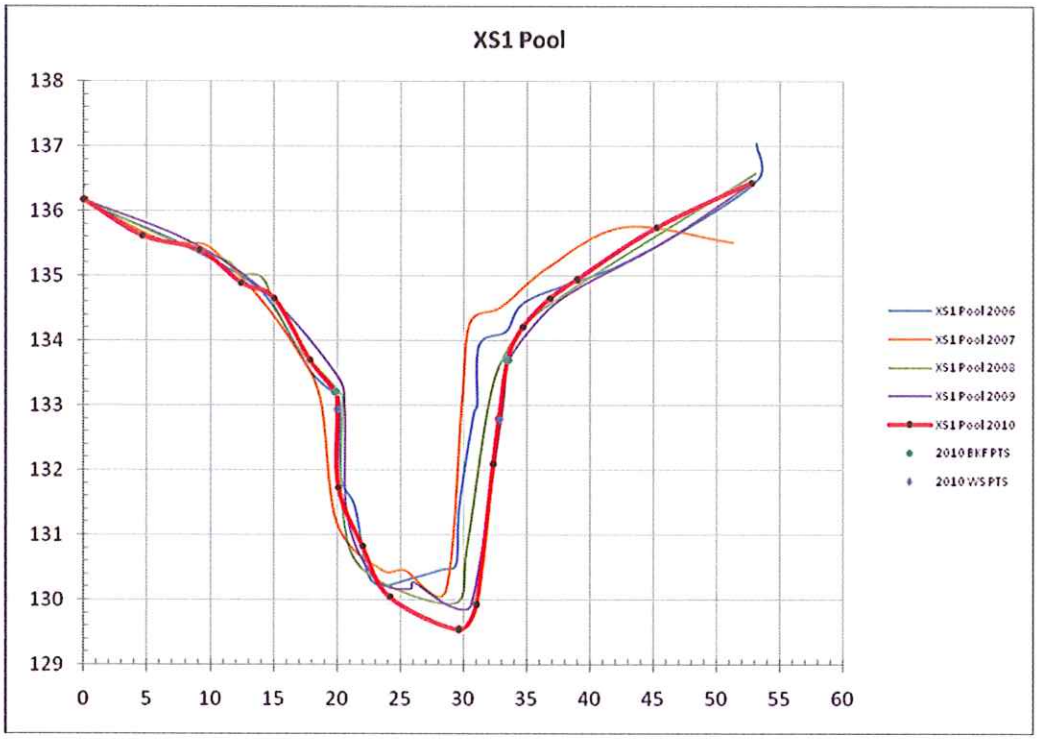
Tarlton- Vegetation plot # 3						
Trees/ Shrubs	Number of Species planted/Number of Volunteers					
	2006	2007	2008	2009	2010	
Acer rubrum				/1	/9	100 % Volunteers
Alnus serrulata	/5+	/5+	/10+	/10+	/20+	100 % Volunteers
Betula nigra	1					
Cephalanthus occidentalis		/1	/1			100 % Volunteers
Chamaecyparis thyoides						
Cornus amomum	4	1	1	1	1	
Fraxinus pennsylvanica	14- (2 Stressed)	16	14	13	14/21	
Liriodendron tulipifera						
Nyssa aquatica					2	
Nyssa biflora	2				2/6	
Nyssa slyvantica	1	1	1	1	1	
Pinus serotina					/3	100 % Volunteers
Platanus occidentalis		/1	/1	/1		100 % Volunteers
Quercus falcata var. pagodafolia						
Quercus michauxii						
Quercus nigra	1	1	1	1	1	
Quercus phellos						
Quercus shumardii	1					
Salix nigra	1	1	1/2	1/2		
Sambucus canadensis					/1	100 % Volunteers
Taxodium distichium	6	6	8	7	8/3	
Total Planted	**31**	**25**	**23**	**24**	**29**	
Volunteers	**5**	**7**	**14**	**14**	**63**	
Total planted species	**31**	**26**	**28**	**26**	**61**	

Plot Size: 5625 ft²

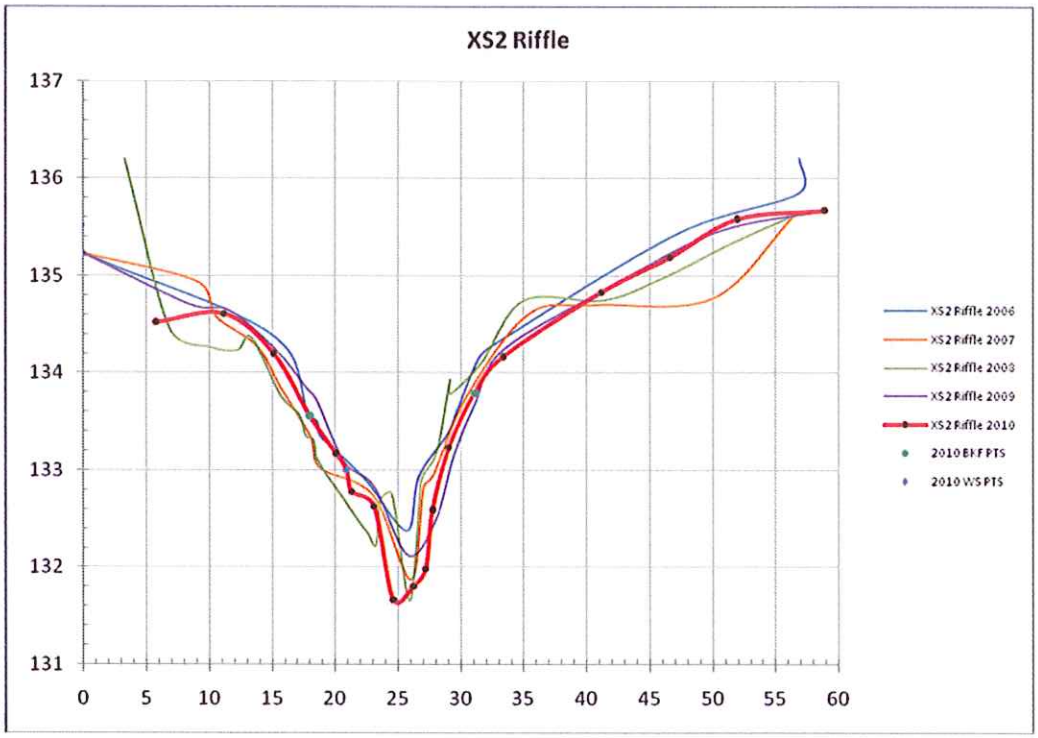
Herbacous Vegetation	2006	2007	2008	2009	2010
Eupatorium capillifolium	Dominant				
Juncus spp.	Dominant	Dominant	Dominant	Dominant	
Lycopus virginicus	Sparse				
Mikania scandens	Sparse				
Polygonum spp. (tearthumb)	Dominant	Dominant	Dominant	Dominant	
unidentified	Sparse				

Stems/plot	=	Stems/ac
Sq ft/plot		Sq ft/acre
29	Planted	225
5625		43560
92	Plus Vols	712
5625		43560
61	Planting List Species	472
5625		43560

APPENDIX B: Cross Sections



Graph 1: Cross Section 1 Pool



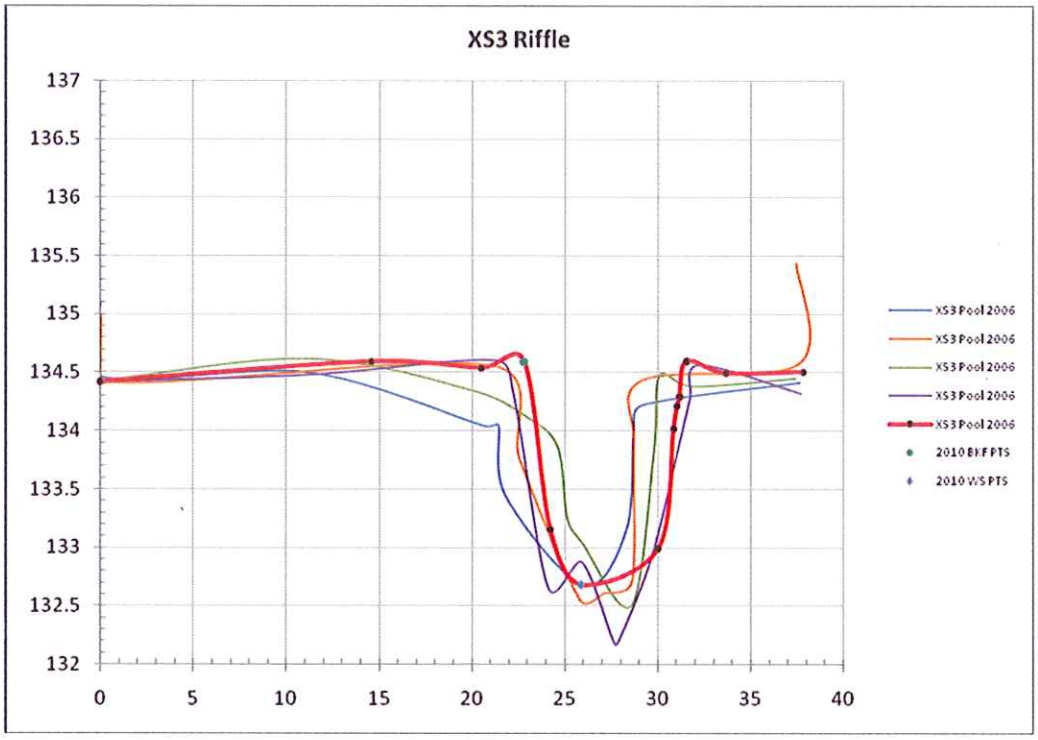
Graph 2: Cross Section 2 Riffle

Title	Cross Section Survey Graphs

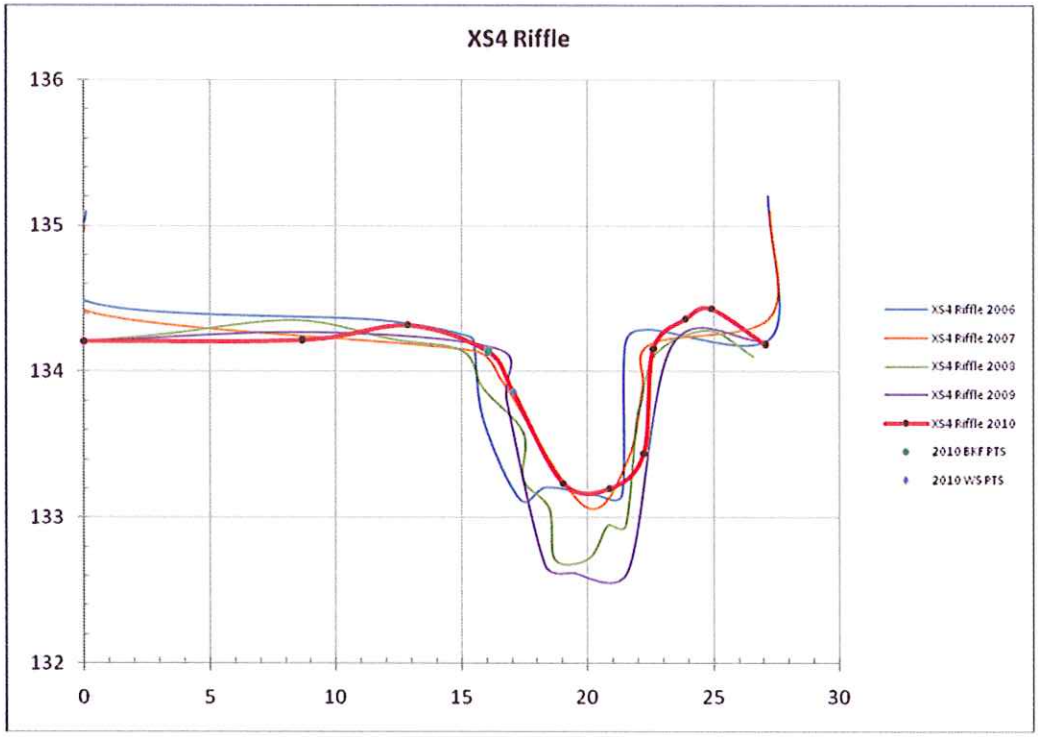
Prepared For:

EarthMark MITIGATION SERVICES

Project	Tarlton Stream and Wetland Restoration Project Cumberland County, North Carolina	
Date	**KHA Project Number**	**Figure**
8/18/10	018285010	4



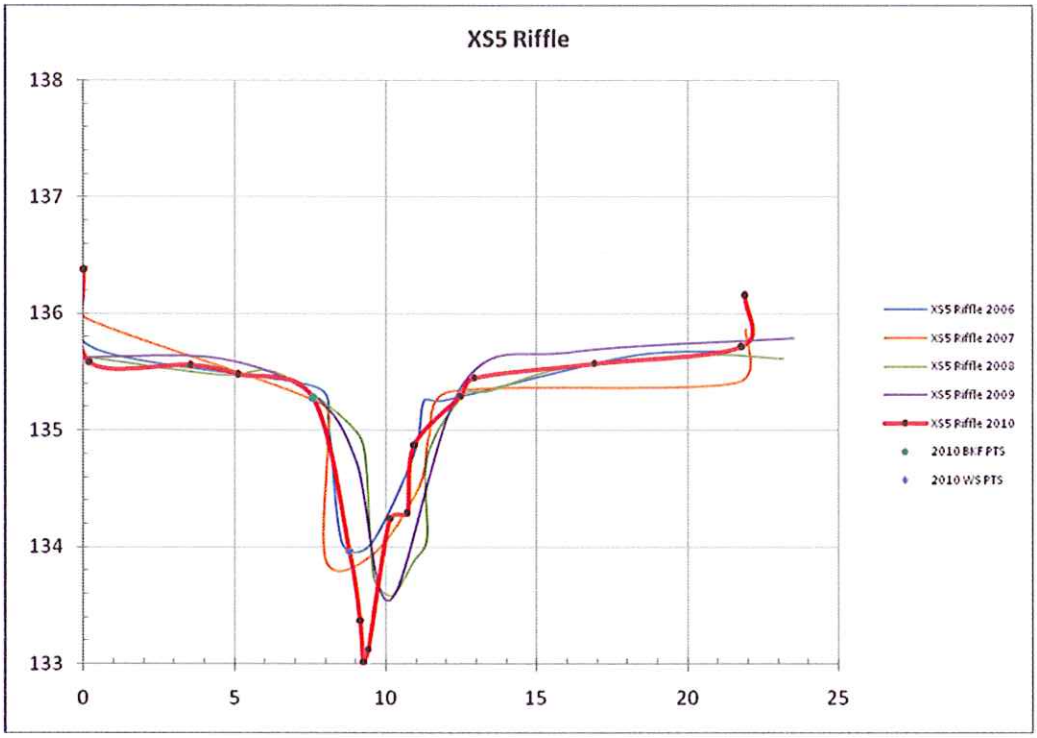
Graph 3: Cross Section 3 Pool



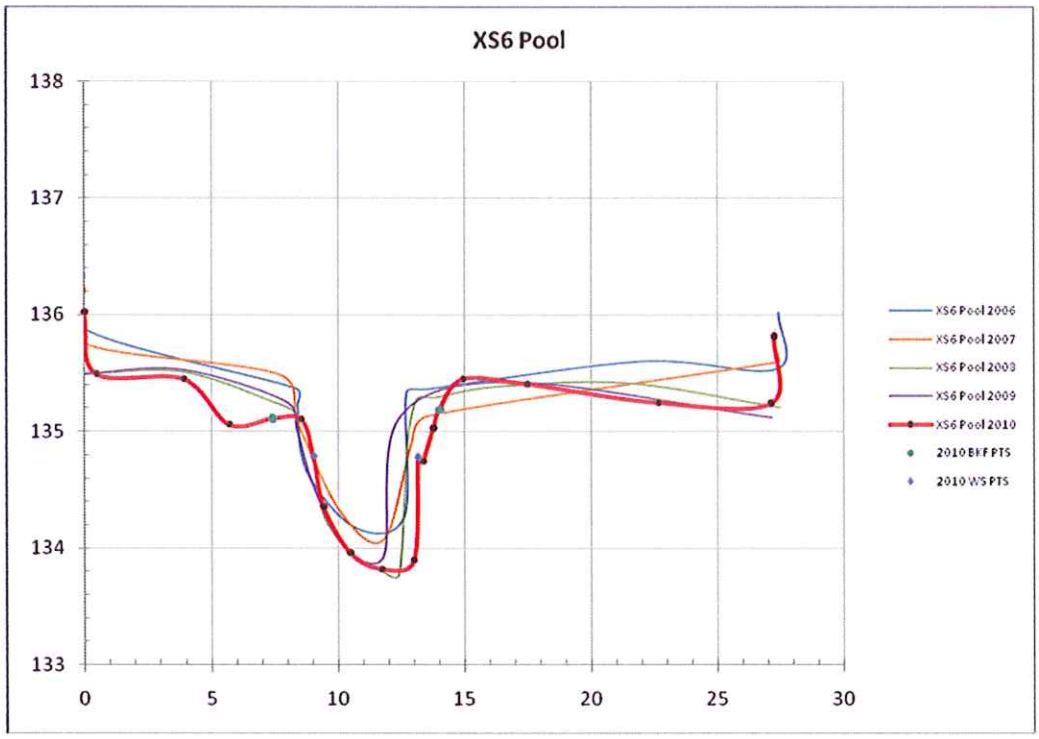
Graph 4: Cross Section 4 Riffle

Title	Cross Section Survey Graphs
Prepared For: EarthMark MITIGATION SERVICES	**Project**: Tarlton Stream and Wetland Restoration Project, Cumberland County, North Carolina

Date	**KHA Project Number**	**Figure**
8/18/10	018285010	4a



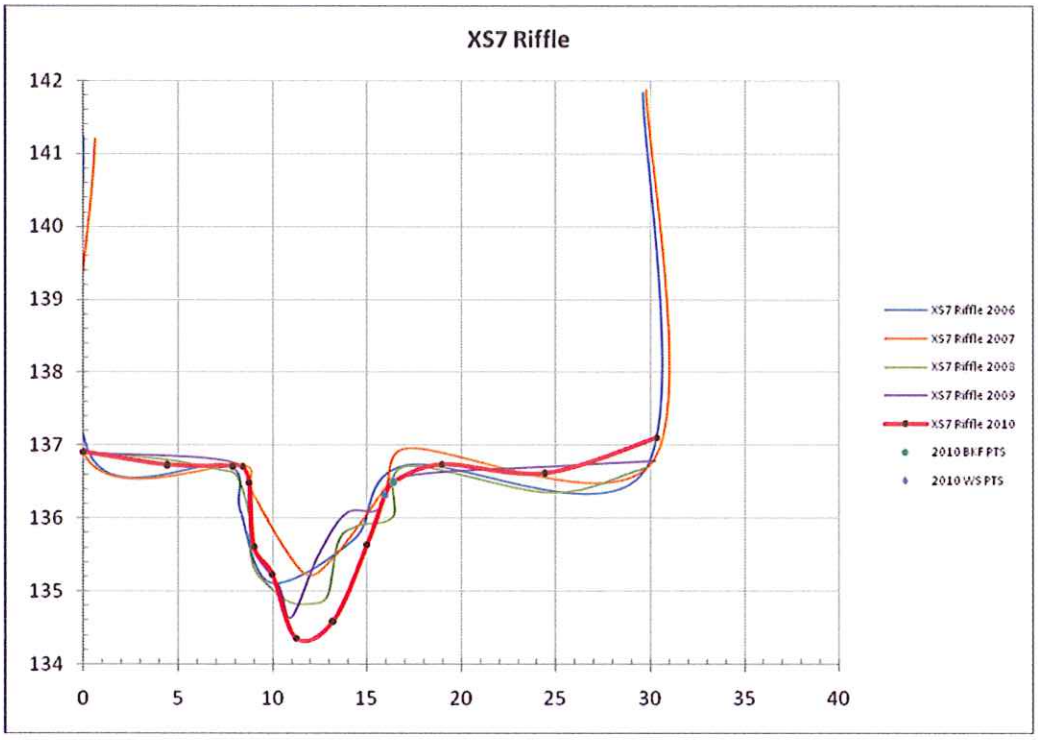
Graph 5: Cross Section 5 Riffle



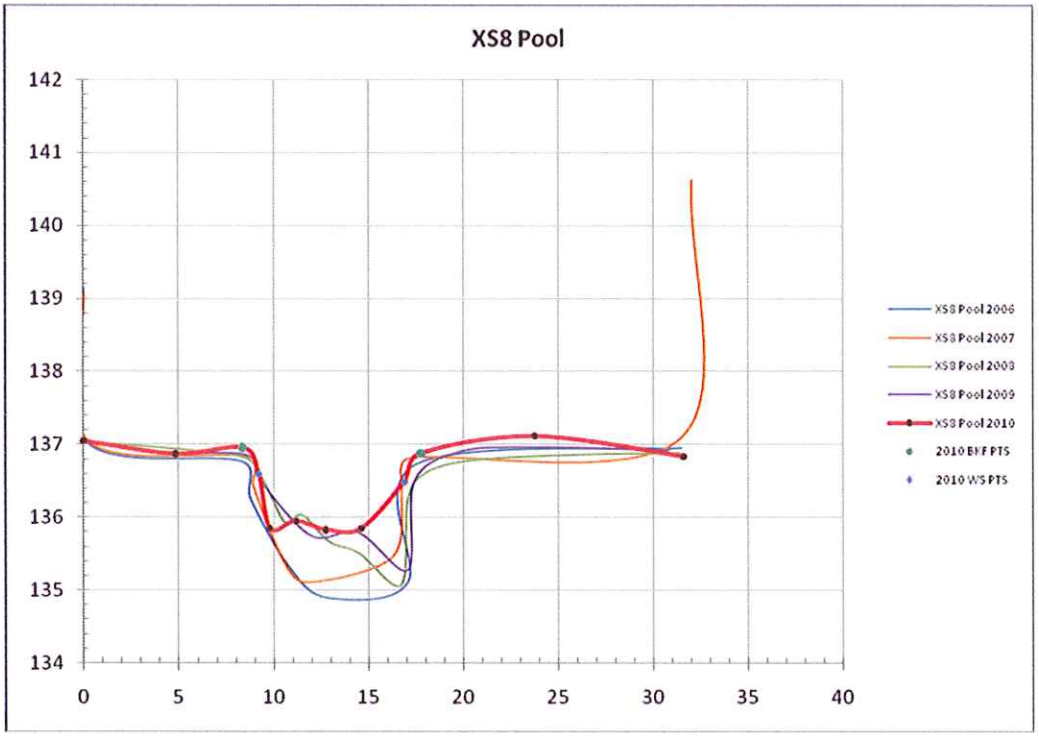
Graph 6: Cross Section 6 Pool

Title	Cross Section Survey Graphs
Prepared For: EarthMark MITIGATION SERVICES	**Project**: Tarlton Stream and Wetland Restoration Project, Cumberland County, North Carolina

Date	**KHA Project Number**	**Figure**
8/18/10	018285010	4b

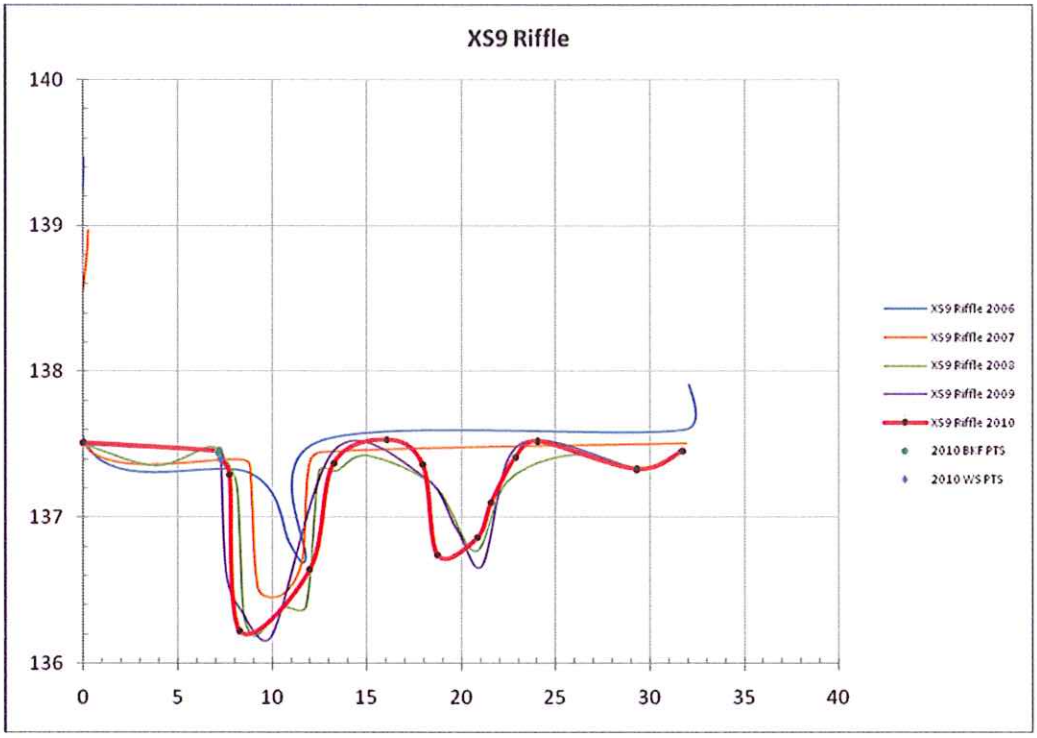


Graph 7: Cross Section 7 Riffle

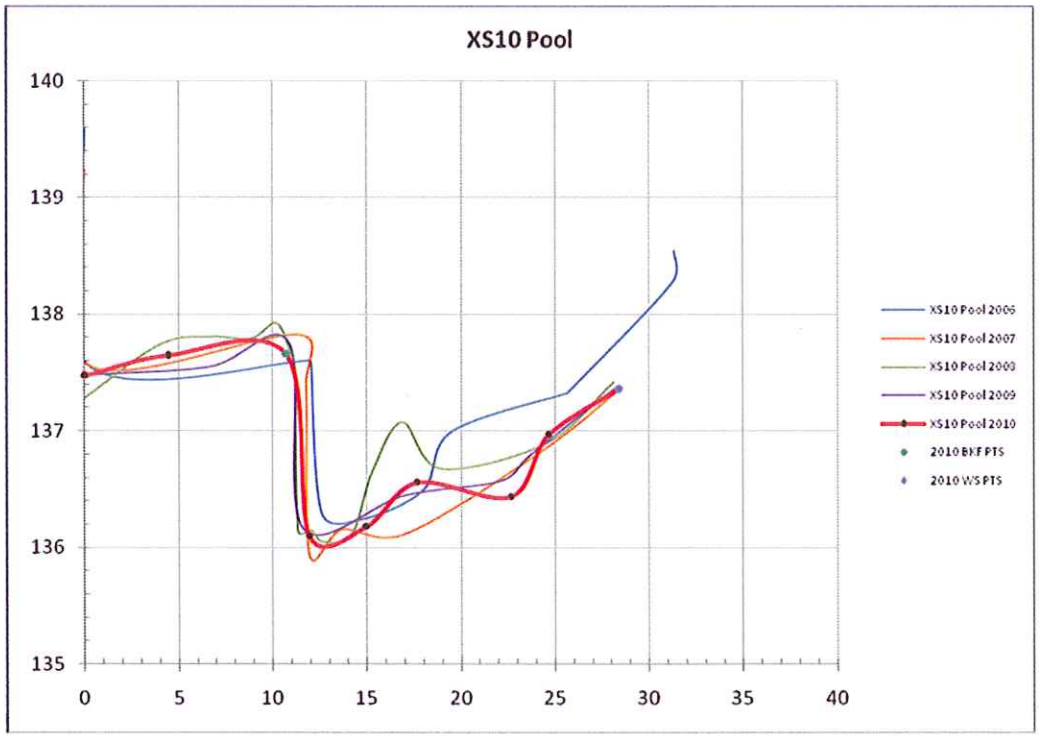


Graph 8: Cross Section 8 Pool

Title	Cross Section Survey Graphs
Prepared For: EarthMark MITIGATION SERVICES	**Project**: Tarlton Stream and Wetland Restoration Project, Cumberland County, North Carolina
Date: 8/18/10	**KHA Project Number**: 018285010
Figure: 4c	



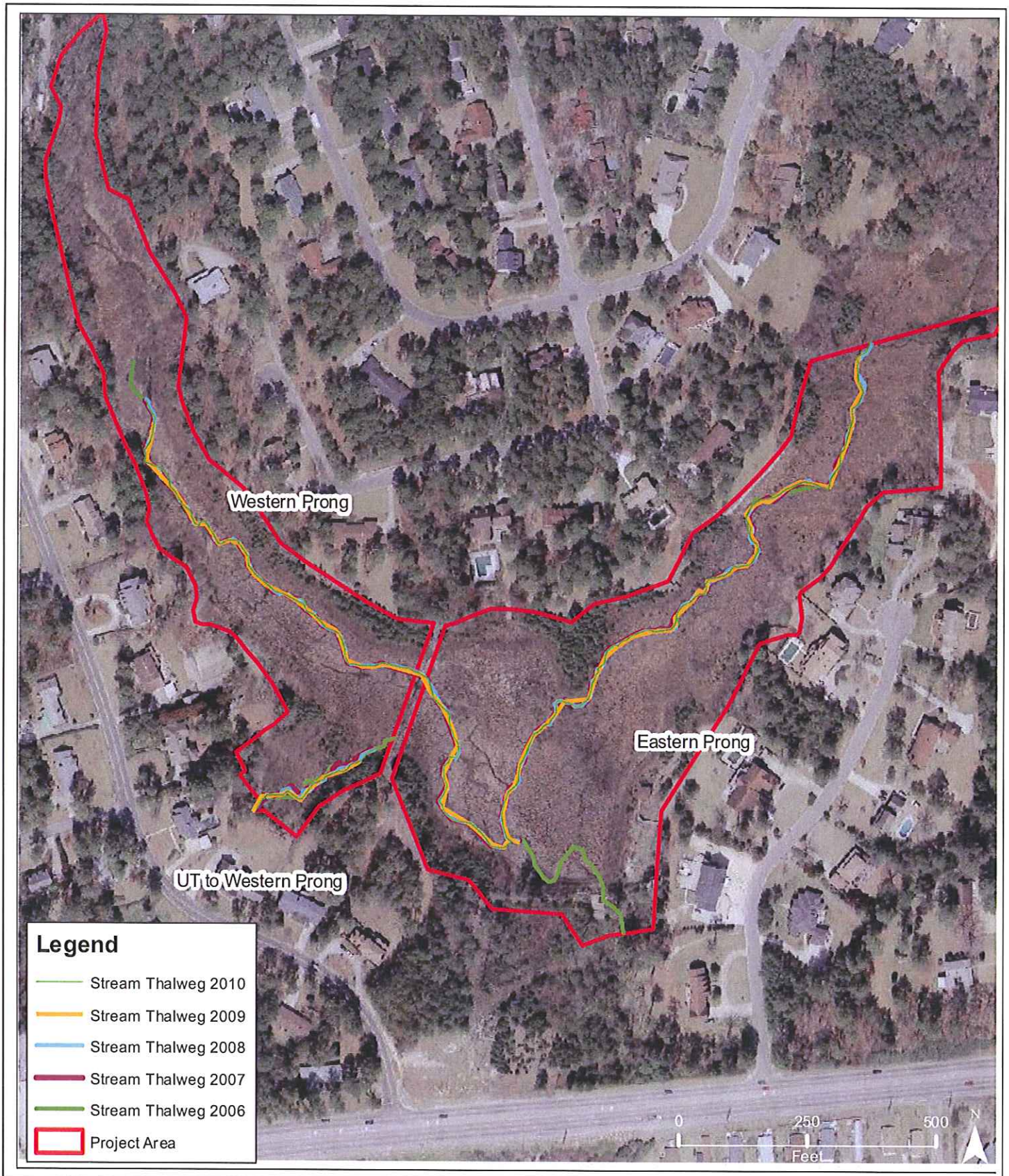
Graph 9: Cross Section 9 Riffle



Graph 10: Cross Section 10 Pool

Title	Cross Section Survey Graphs		
Prepared For: EarthMark MITIGATION SERVICES	**Project**	Tarlton Stream and Wetland Restoration Project Cumberland County, North Carolina	
	Date 8/18/10	**KHA Project Number** 018285010	**Figure** 4d

APPENDIX C: Profile Survey

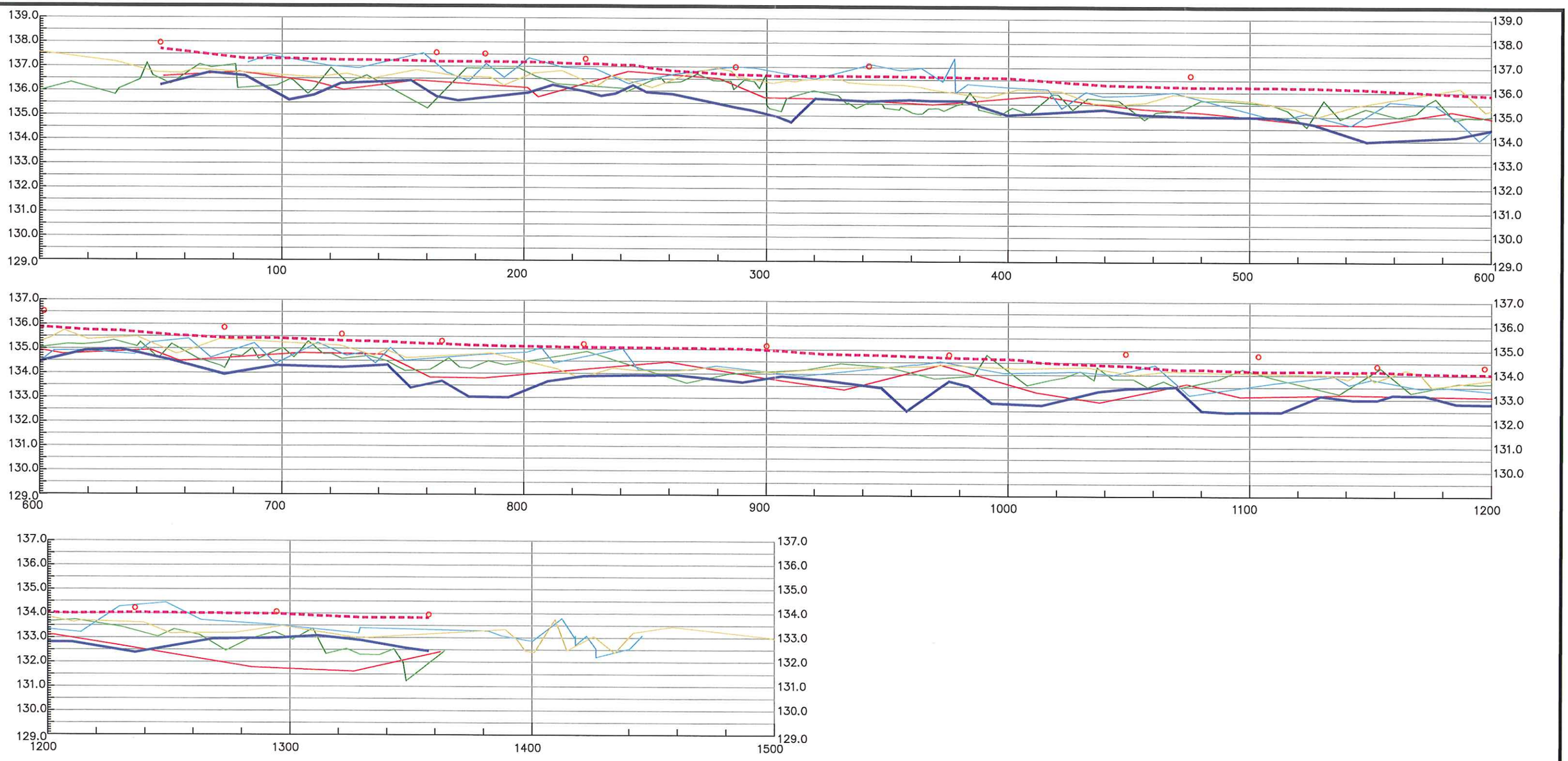


Title	Survey Site Thalweg Map
Prepared For: EarthMark Mitigation Services	**Project**: Tarlton Stream and Wetland Restoration Project, Cumberland County, North Carolina
Date: 7/21/10	**KHA Project Number**: 018285010
	Figure: 3

P:\012857 Mid-Atlantic Mitigation\Survey\RIVERMorph

Prepared by Jason Diaz

Kimley-Horn and Associates, Inc.



REV. No:	REVISION:	DATE:	DRAWN BY:	CHECKED BY:

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CLIENT: EARTHMARK MITIGATION SERVICES

TITLE: WESTERN PRONG PROFILES

SEAL:

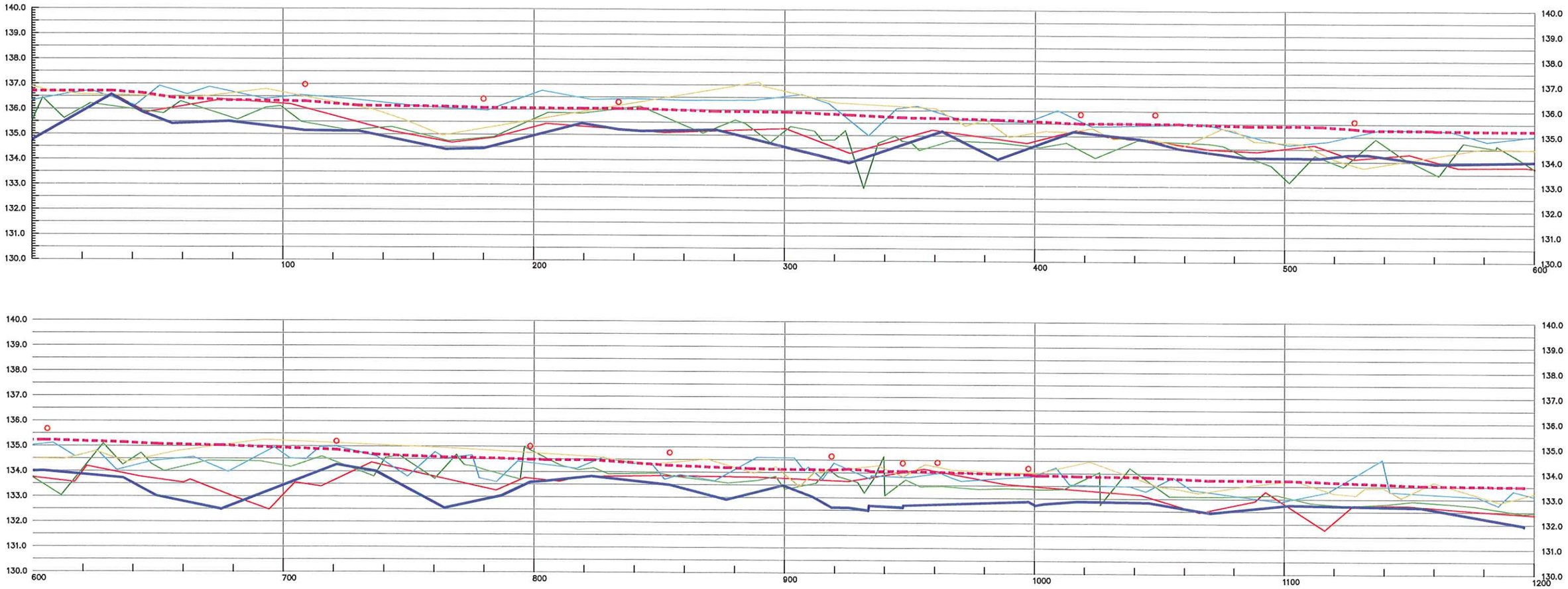
DATE: 07/22/2010
HORIZONTAL SCALE: 1":200'
VERTICAL SCALE: 1":200'
DRAWN BY: NJM
DESIGNED BY: JCD
CHECKED BY: WRW

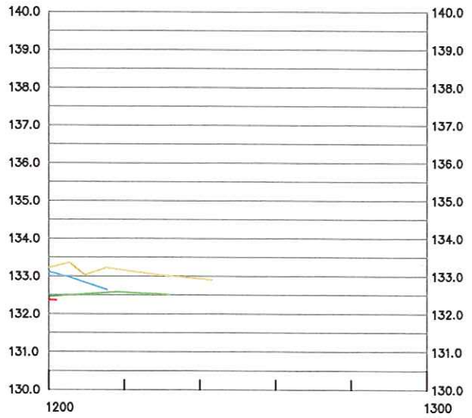
PROJECT: TARLTON STREAM AND WETLAND RESTORATION
CUMBERLAND COUNTY

ATTACHED REFERENCE FILES:

S.C.O. NUMBER: D05013-1

FIGURE NUMBER: 5A





2006 THALWEG
2007 THALWEG
2008 THALWEG
2009 THALWEG
2010 THALWEG
2010 WATER SURFACE
2010 BANKFULL

REV. No.	REVISION	DATE	DRAWN BY:	CHECKED BY:

PREPARED IN THE OFFICE OF:
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CLIENT: EARTHMARK MITIGATION SERVICES

TITLE: EASTERN PRONG PROFILES

SEAL:

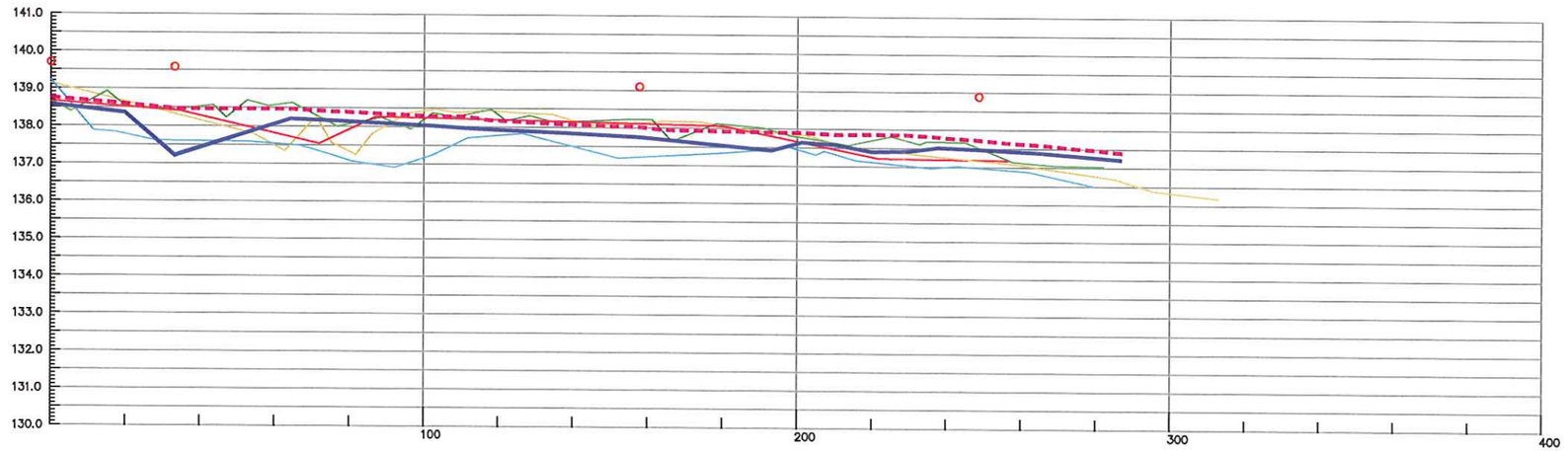
DATE: 07/22/2010
HORIZONTAL SCALE: 1":200'
VERTICAL SCALE: 1":200'
DRAWN BY: NJM
DESIGNED BY: JCD
CHECKED BY: WRW

PROJECT: TARLTON STREAM AND WETLAND RESTORATION
CUMBERLAND COUNTY

ATTACHED REFERENCE FILES:

S.C.O. NUMBER: D05013-1

FIGURE NUMBER: 5



2006 THALWEG
2007 THALWEG
2008 THALWEG
2009 THALWEG
2010 THALWEG
2010 WATER SURFACE
2010 BANKFULL

REV. No.:	REVISION:	DATE:	DRAWN BY:	CHECKED BY:

PREPARED IN THE OFFICE OF:
Kimley-Horn and Associates, Inc.
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PHONE: (919) 677-2000 FAX: (919) 677-2050

CLIENT: EARTHMARK MITIGATION SERVICES

TITLE: UT TO WESTERN PRONG PROFILES

SEAL:

DATE: 07/22/2010
HORIZONTAL SCALE: 1":200'
VERTICAL SCALE: 1":200'
DRAWN BY: NJM
DESIGNED BY: JCD
CHECKED BY: WRW

PROJECT: TARLTON STREAM AND WETLAND RESTORATION
CUMBERLAND COUNTY

ATTACHED REFERENCE FILES:

S.C.O. NUMBER: D05013-1

FIGURE NUMBER: 5B

APPENDIX D: Photo Log

Photo Points
Storm Water Outfalls

Photo Point 1

Photo Point 2

Photo Point 3

Photo Point 4

Photo Point 5

Photo Point 6

Photo Point 7

Photo Point 9

Photo Point 10

Photo Point 11

Photo Point 12 – Veg Plot 2

Photo Point 13

Photo Point 14 – Veg Plot 1

Photo Point 15

Photo Point 16

Photo Point 17

Photo Point 18

Photo Point 19

Photo Point 20 – Veg Plot 3

Photo Point 21

Photo Point 24

Photo Point 25

Photo Point 26

Photo Point 29

Photo Point 30

Photo Point 31

Outfall NW of well CE2

Outfall NE of well CC3

Outfall W of well TARLTON4

Outfall near Photo Point 1

Outfall N of well CEC10

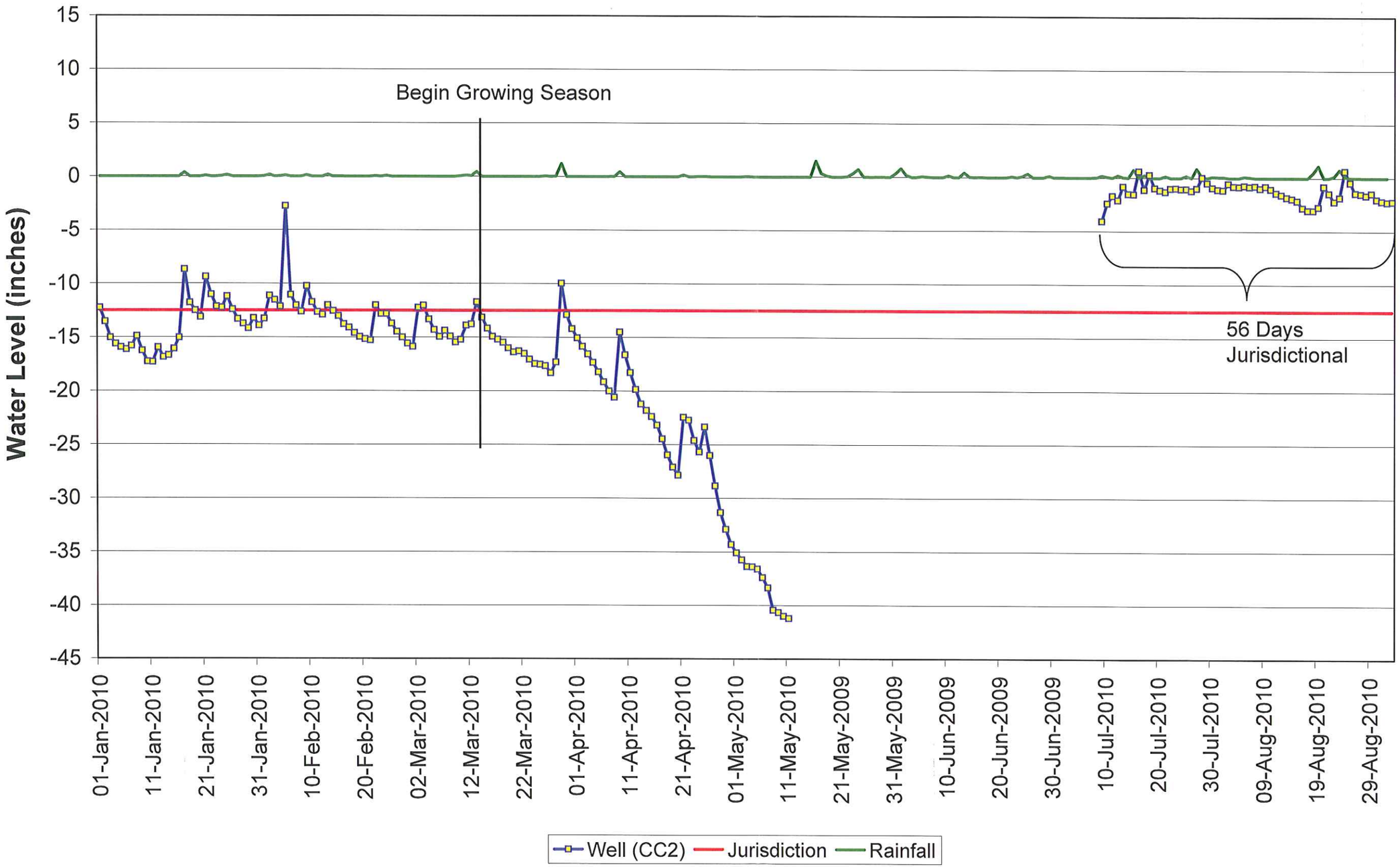
Outfall S of well CEC10

Outfall SE of well CEC10

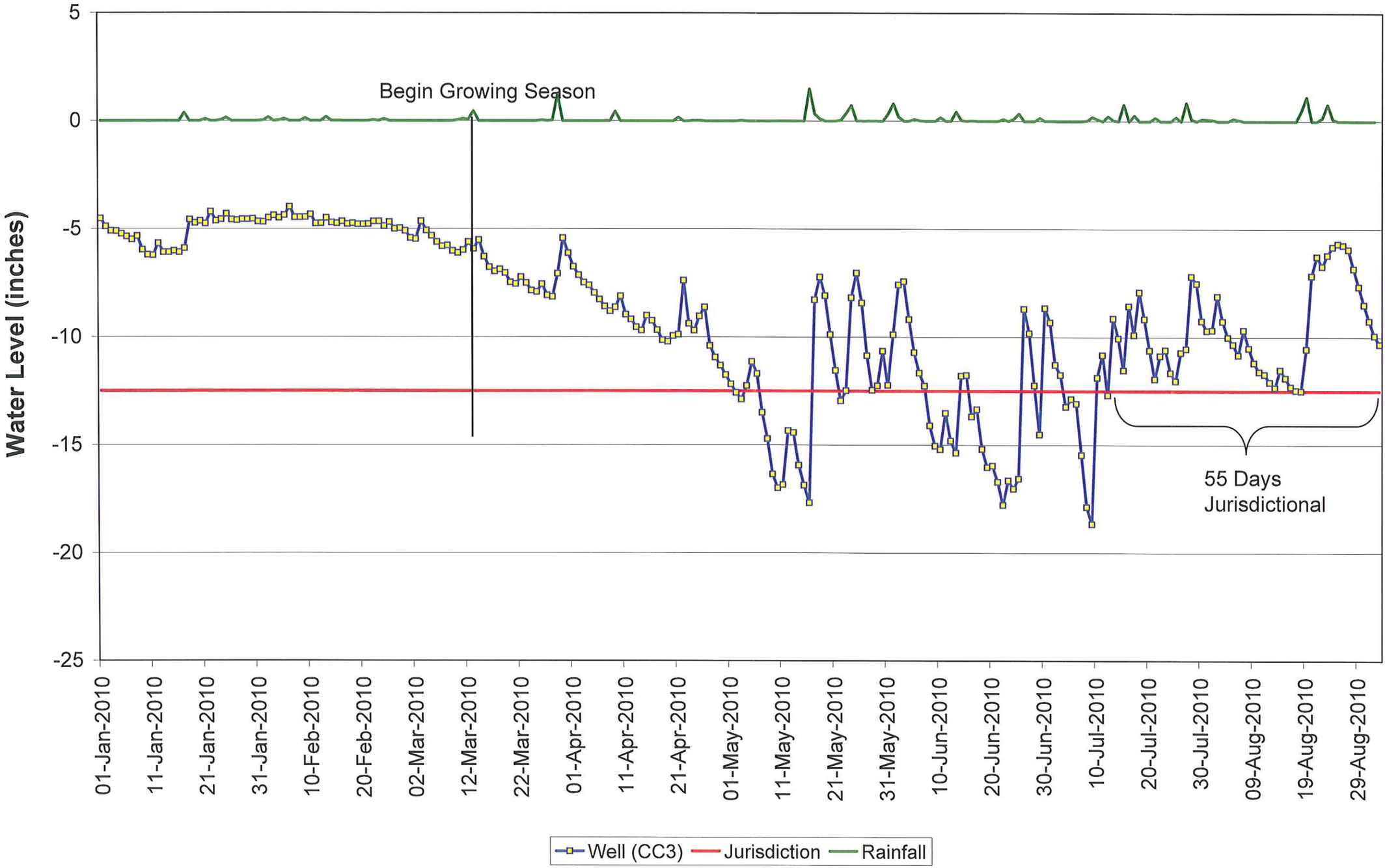
APPENDIX E: Ground and Surface Water Data

Ground Water Gage Graphs
Bank Full Events Photo Log
Rainfall and Stream Gage Graphs

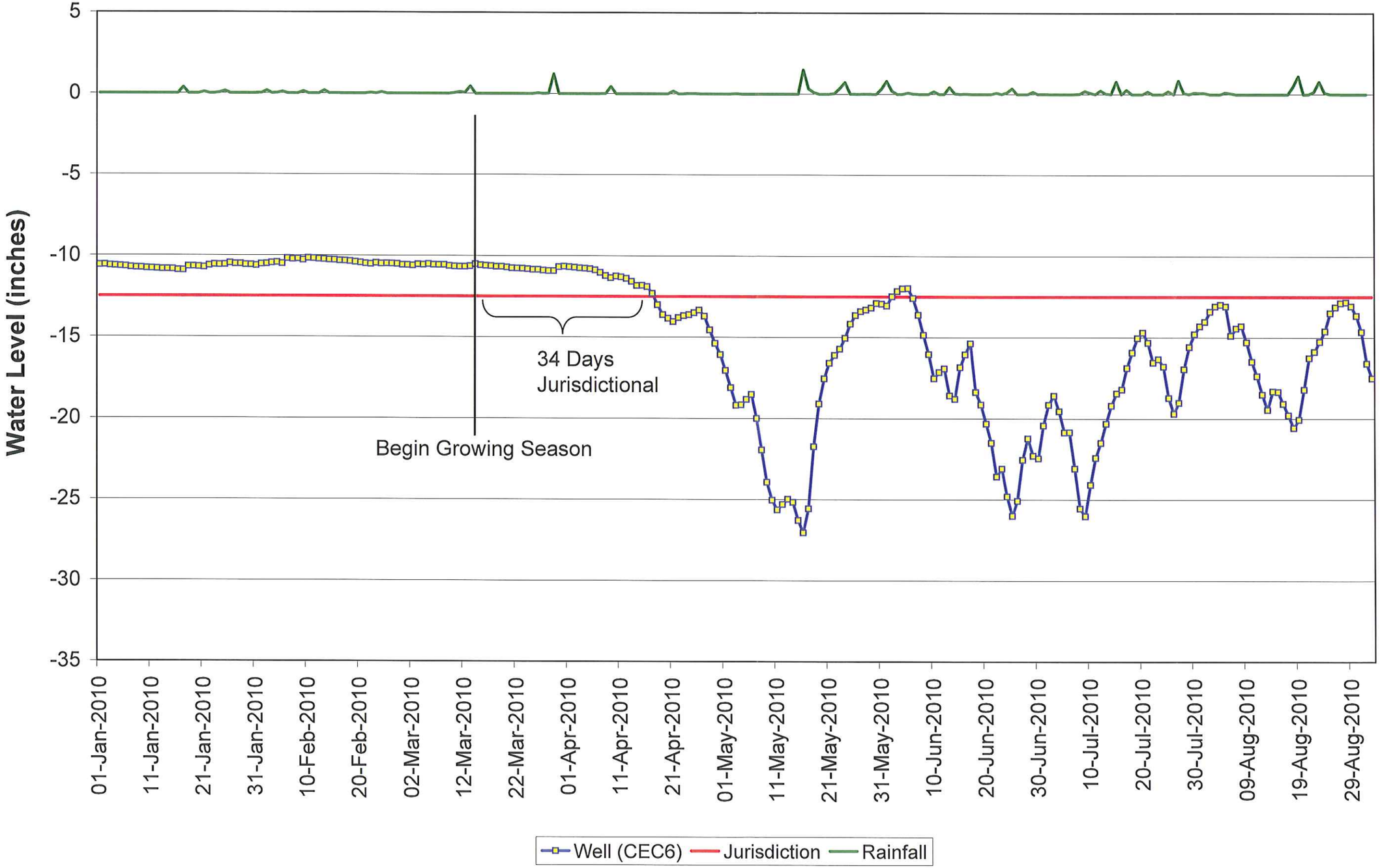
Water Level for Tarlton Well CC2 with Rainfall Data



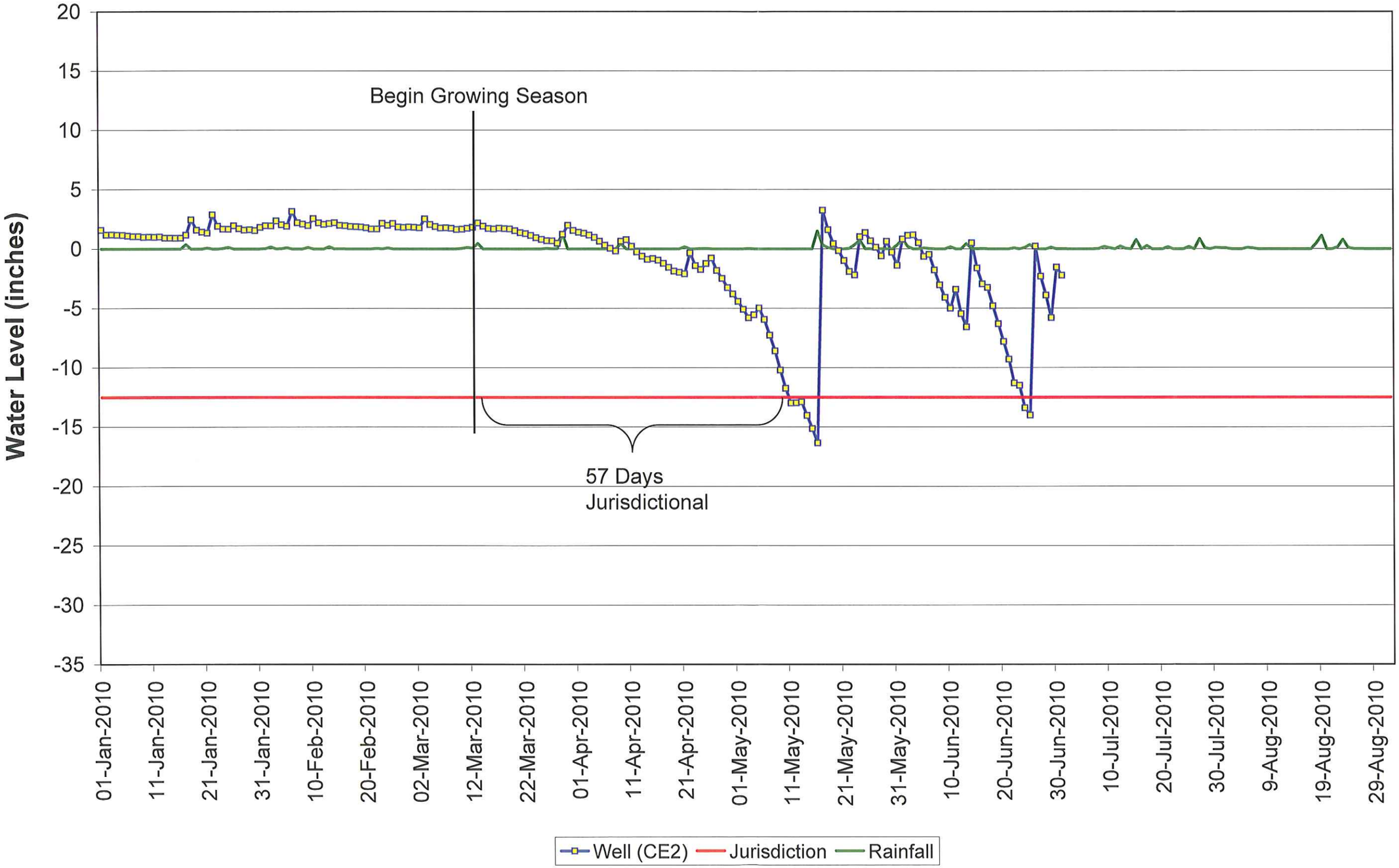
Water Level for Tarlton Well CC3 with Rainfall Data



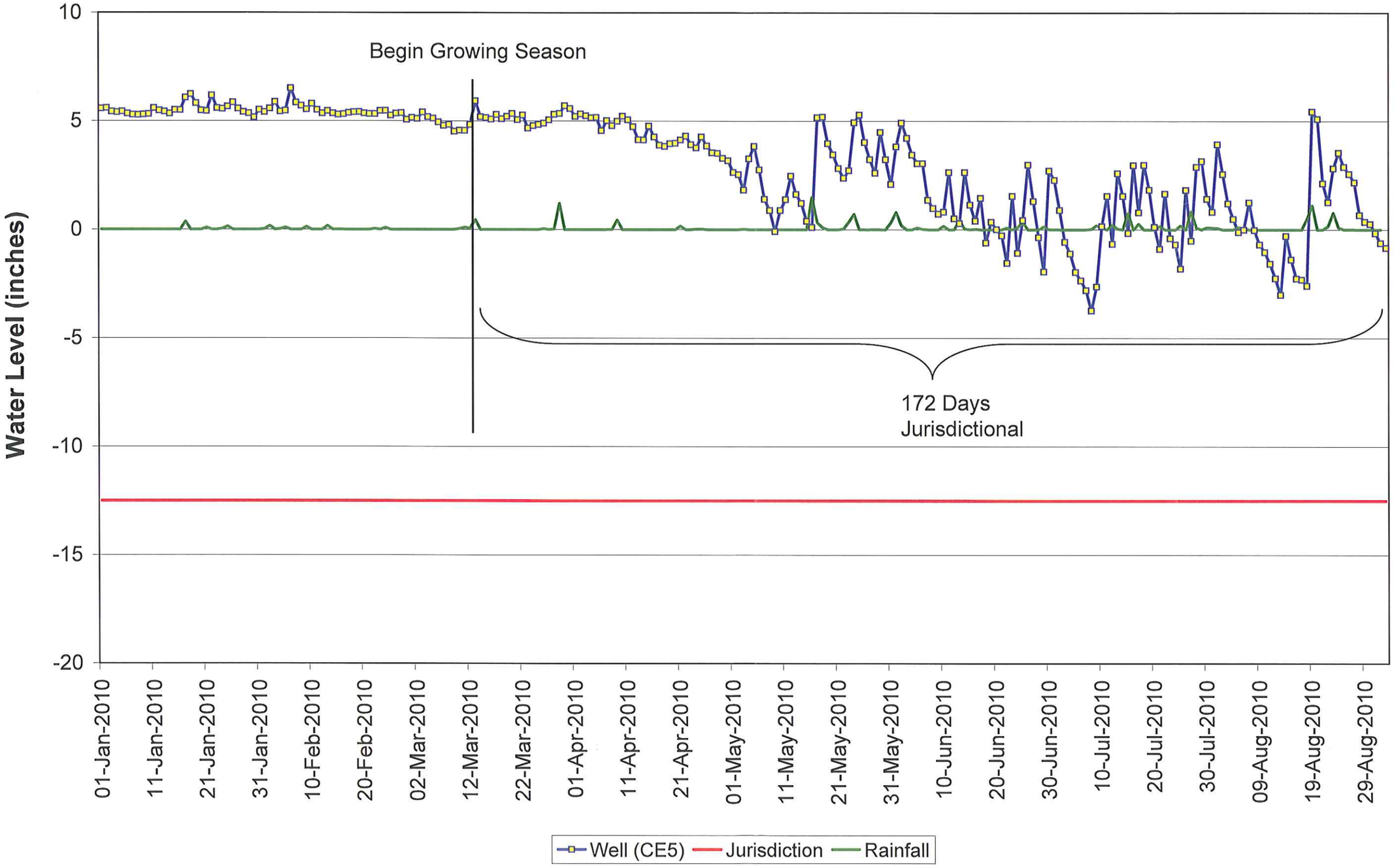
Water Level for Tarlton Well CEC6 with Rainfall Data



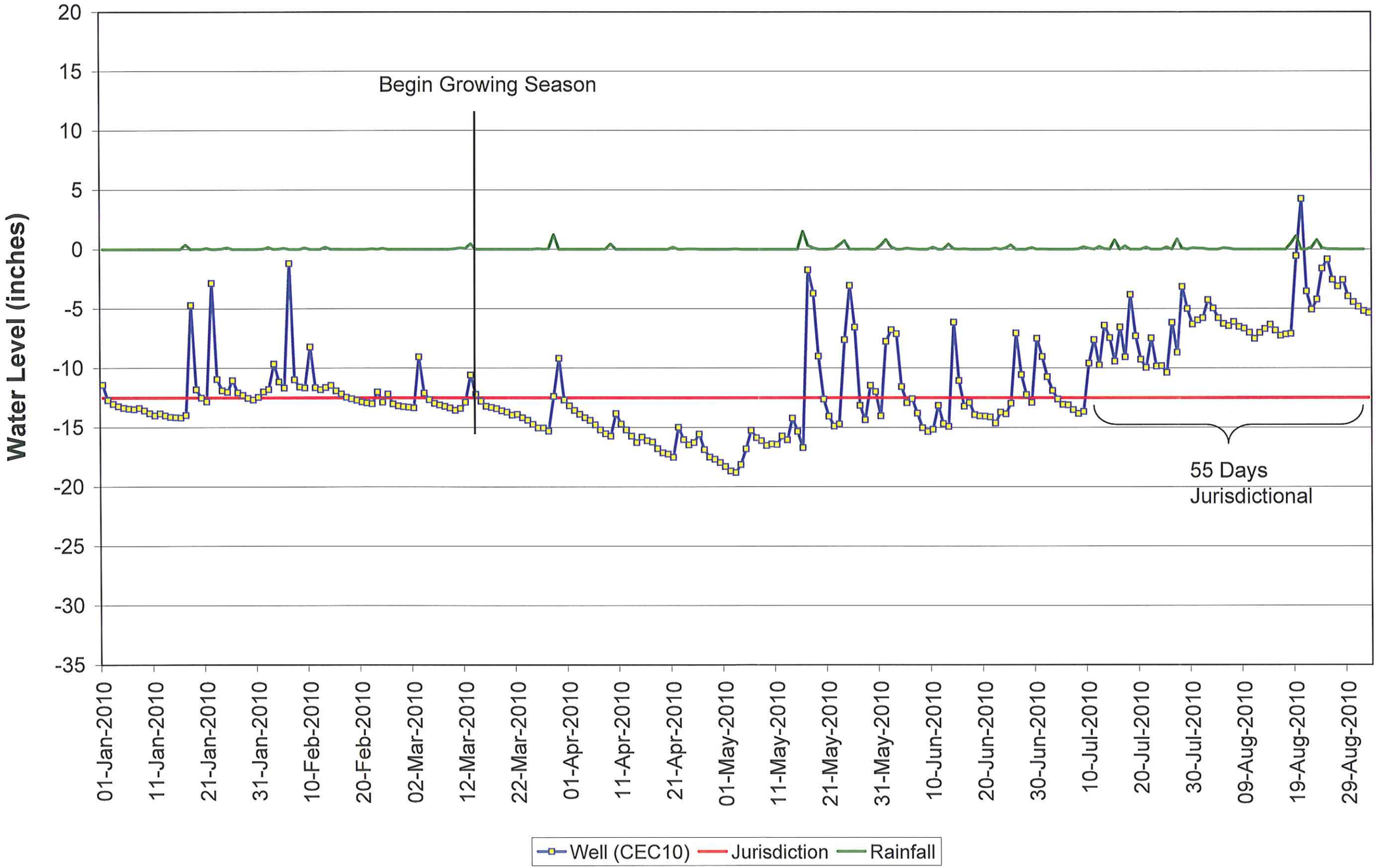
Water Level for Tarlton Well CE2 with Rainfall Data



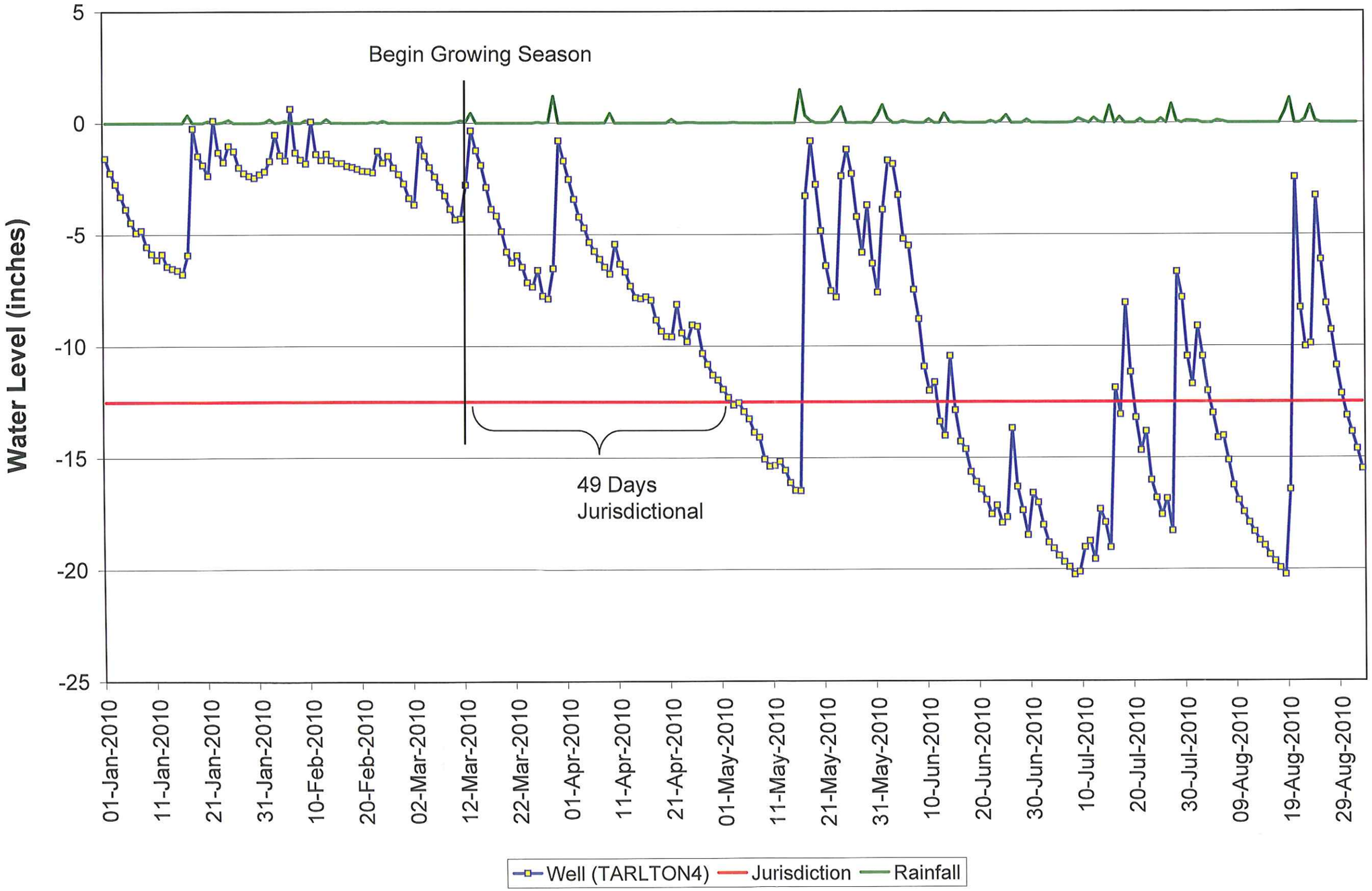
Water Level for Tarlton Well CE5 with Rainfall Data



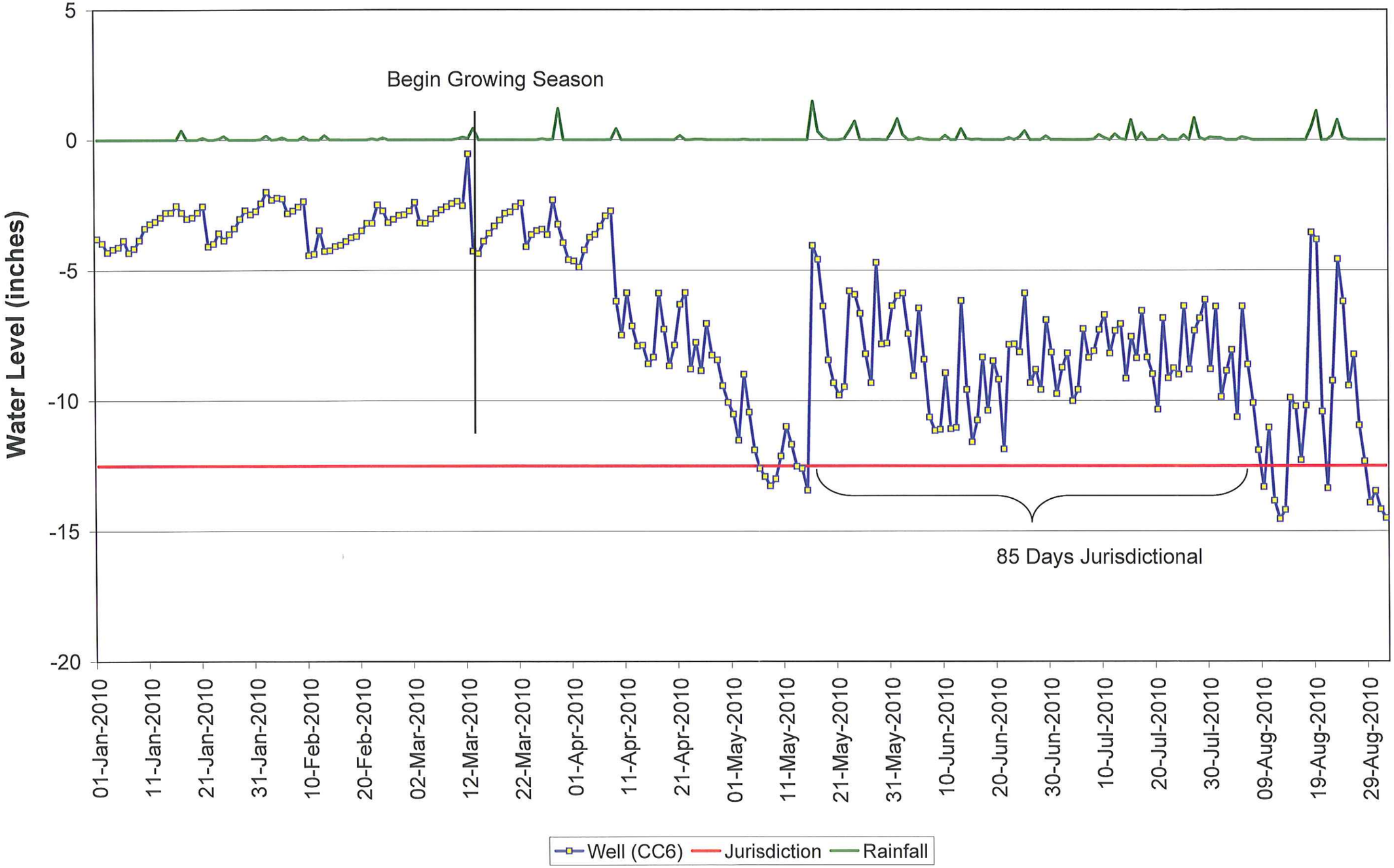
Water Level for Tarlton Well CEC10 with Rainfall Data



Water Level for Tarlton Well TARLTON4 with Rainfall Data



Water Level for Tarlton Well CC6 (Wetland Reference) with Rainfall Data



Bankfull Events Photo Log

Most likely triggered on 3-29-2010

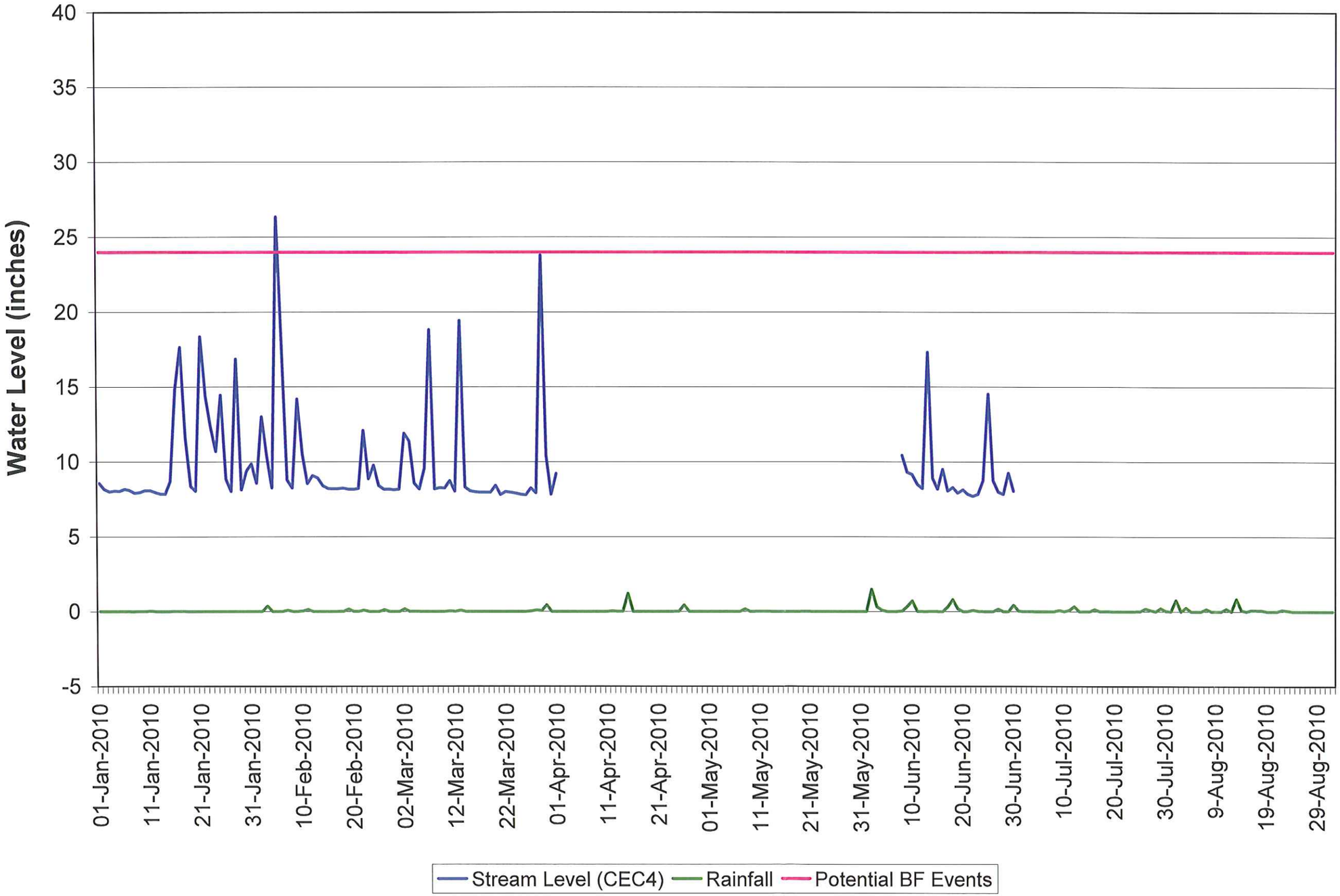
May have been Triggered on June 13th, 2010.

Table VIII. Potential Bankfull Events

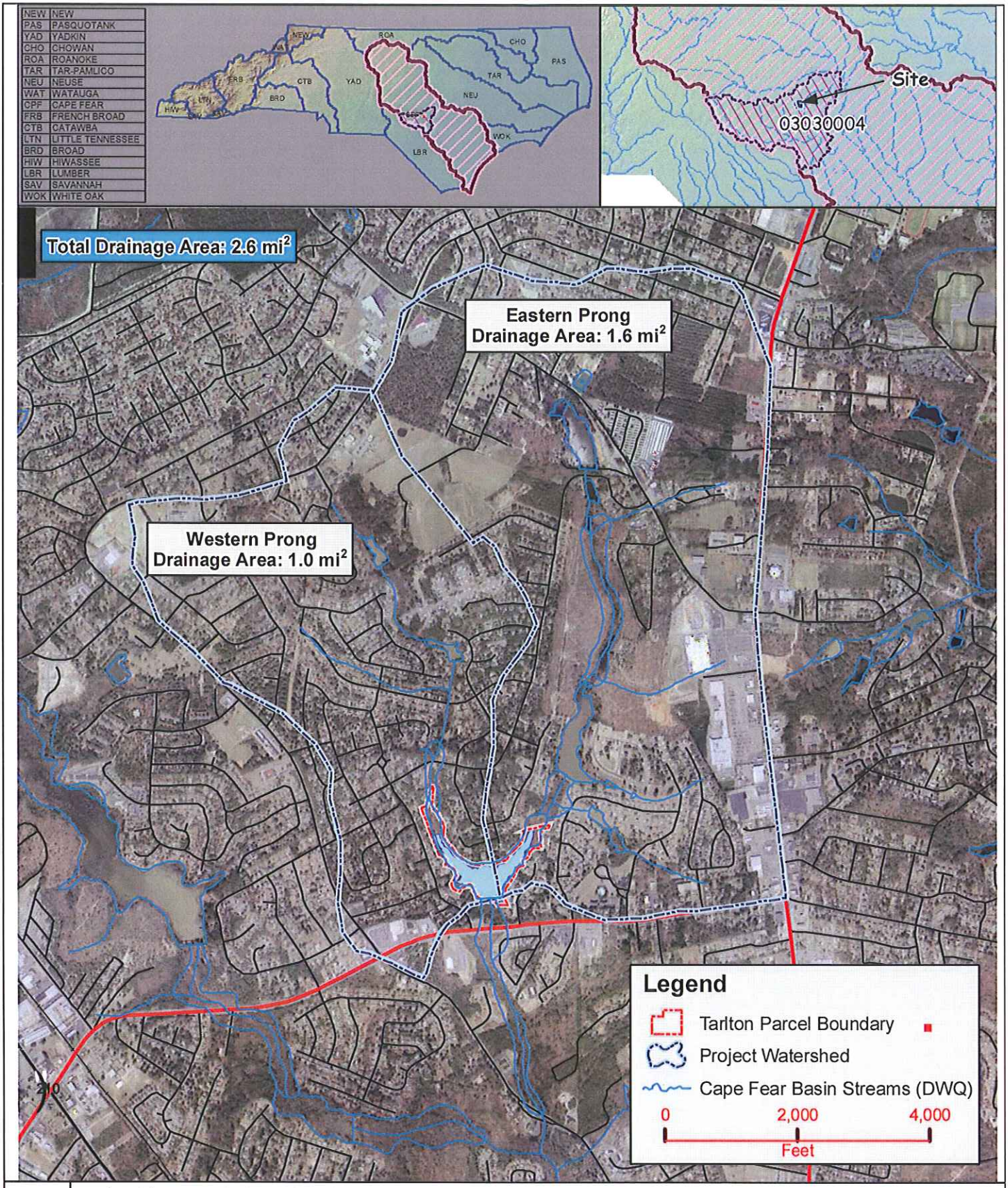
Date	Stream Gage	Onsite Rainfall	Comments
Feb 5 2010	26.34	.09*	1.62" @ KFAY Airport
Mar 29 2010	23.79	1.2	1.65" @ PWC
Jun 13 2010	17.32	.42	
Aug 3 2010			Stream Gage discovered wash out
			Significant rack lines and debris present

* Significant rainfall fell offsite

Stream Water Level vs. Rainfall

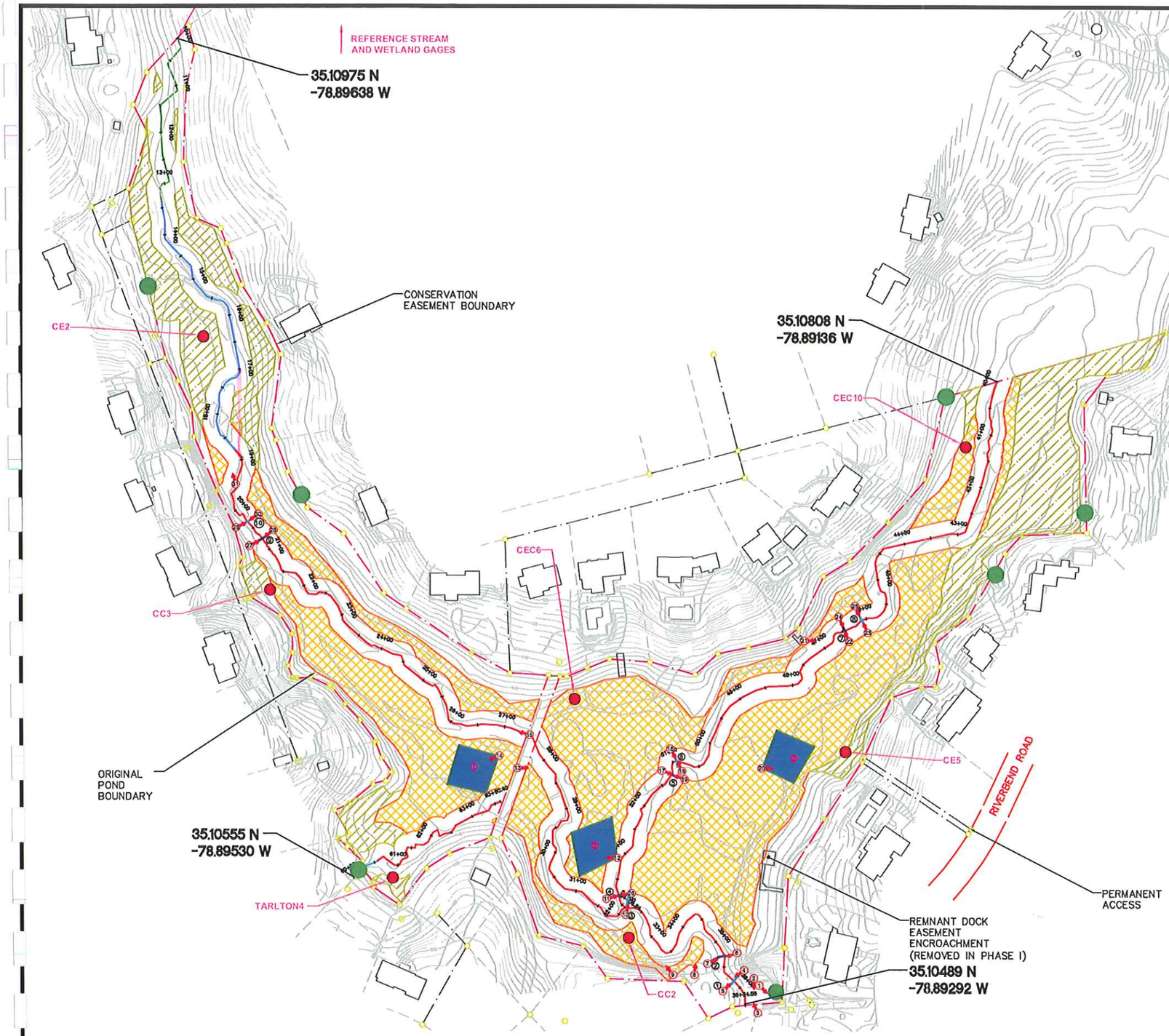


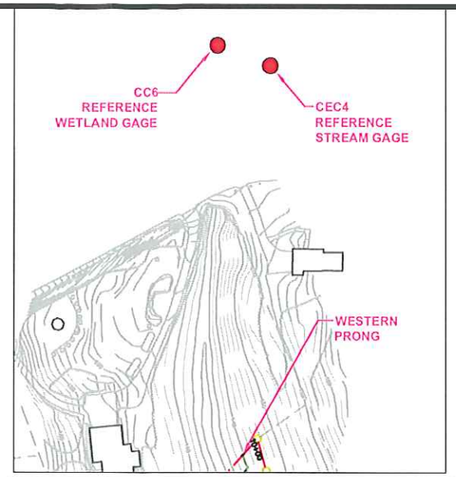
FIGURES



Title	Project Site Watershed Map (Cumberland County 2001 Aerial)

Prepared For: Mid-Atlantic Mitigation, LLC	**Project**	Tarlton Stream and Wetland Restoration Cumberland County, North Carolina	
	Date	**Project Number**	**Figure**
	11/28/07	012857003	1





CU: 03030004

SITE LEGEND

- MAJOR CONTOUR
- MINOR CONTOUR
- PROPERTY BOUNDARY
- WETLAND ENHANCEMENT
- WETLAND RESTORATION
- STREAM RESTORATION
- STREAM ENHANCEMENT
- STREAM PRESERVATION
- PERMANENT RIFFLE CROSS SECTION
- PERMANENT POOL CROSS SECTION
- VEGETATION MONITORING QUAD
- MONITORING GAGE
- STORM WATER OUTFALL
- 20 PHOTOGRAPH LOCATIONS

GRAPHIC SCALE

200 0 100 200 400 800

(IN FEET)

1 inch = 200 ft.

REV. No.	REVISION	DATE	DRAWN BY	CHECKED BY

PREPARED IN THE OFFICE OF:
Kimley-Horn and Associates, Inc.
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PHONE: (919) 677-2000 FAX: (919) 677-2050

CLIENT: MID-ATLANTIC MITIGATION

TITLE: MONITORING PLAN MAP

SEAL:

DATE: 11/30/07
HORIZONTAL SCALE: 1":200'
VERTICAL SCALE: 1":200'
DRAWN BY: JLD
DESIGNED BY: JLD
CHECKED BY: WRW

PROJECT: TARLTON STREAM AND WETLAND RESTORATION
CUMBERLAND COUNTY

ATTACHED REFERENCE FILES:

S.C.O. NUMBER: D05013-1

FIGURE NUMBER: 2