

ANNUAL REPORT FOR 2001



**Tucker Mitigation Site
Currituck County
Project No. 6.049009T
TIP No. R-2228WM**



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SUMMARY

The following report summarizes the monitoring activities that have occurred in the past year at the Tucker Tract Mitigation Site. This is the third year the site has been monitored for vegetation and hydrologic success. The site must demonstrate both hydrologic and vegetation success for a minimum of five years to demonstrate successful mitigation.

The Tucker Tract contains one surface gauge and twelve groundwater-monitoring gauges. The site also contains 12 vegetation-monitoring plots. An Infinities tipping bucket rain gauge was installed in August 2000 and was used to record the 2001 daily rainfall data. The State Climatic Office provided historic rainfall data. Hydrologic monitoring indicated that ten of the twelve gauges on site showed saturation for over 12.5% of the growing season. One gauge (TT-2) showed saturation between 8 – 12.5% of the growing season (this gauge, as noted last year, is situated in a local high area) and the remaining gauge (TT-6) showed saturation below 5% of the growing season.

Based on agency comments in 2000 regarding possible soil compaction issues, the Department dispatched the Geo-technical Unit to investigate this situation. The investigations showed that the soil in the restored area of the site and the undisturbed reference ecosystem exhibited similar soil characteristics. The inherent low soil conductivity in both areas still did not prohibit rainfall from entering into the ground, hence saturating the soil.

The third year vegetation monitoring of the planted areas revealed an average density to be 399 trees per acre, which is above the minimum requirement of 320 trees per acre.

Based on the hydrologic and vegetation monitoring, the Tucker Mitigation Site met success criteria across the majority of the site during the 2001-growing season. NCDOT recommends that monitoring continue for a fourth year.

1.0 INTRODUCTION

1.1 Project Description

The Tucker Tract Mitigation Site is located in Currituck County (Figure 1). This site is part of a large property consisting of 68.3 acres in total. Approximately 48.1 acres has been set aside for mitigation. Approximately 28.2 acres of the 48.1 acres was developed and constructed as the Tucker Tract Mitigation Site. The remaining 20.2 acres will be reserved for possible future mitigation projects. The site was built to mitigate for the widening of NC 168 (TIP Project R-2228). The project includes the restoration of 25.1 acres of PC agricultural fields on this property to forested wetland and the preservation of 2.8 acres of forested wetland and 8.7 acres of timbered wetland.

The Final Mitigation Plan for this site was issued on April 1, 1996. Initial construction was completed in late 1997. At that time it was determined that the site had been graded to an unacceptable level. A second contract was issued and the site was re-graded in 1998 with completion in September 1998. The site was planted in early 1999. In March 1999, NCDOT installed monitoring gauges to be used for hydrologic monitoring. In 2000, two additional gauges were installed as a result of field review by resource agencies. The two additional gauges were placed to track groundwater in the vicinity of gauge TT-6. Gauge TT-6 is located at an elevation that ranges from 0.7 to 1.0 foot higher than the adjacent topography. This has produced the less than expected results with gauge TT-6 over the years. This gauge showed lack of success this year as well. The area comprising this locally high area is slightly larger than half an acre. Twelve plots were established to monitor vegetation. This monitoring report presents the third year results of both hydrologic and vegetation monitoring.

1.2 Purpose

In order to demonstrate successful mitigation, hydrologic and vegetative monitoring must be conducted for a minimum of five consecutive years. Success criteria are based on federal guidelines for wetland mitigation. These guidelines stipulate criteria for both hydrologic conditions and vegetation survival. The following report details the results of hydrologic and vegetative monitoring during the year 2001 at the Tucker Tract Mitigation Site as well as local climate conditions throughout the growing season.

1.3 Project History

December 1997	Site Construction Completed (Contract 1)
September 1998	Site Construction Completed (Contract 2)
March 1999	Site Planted, Monitoring Gauges Installed
October 1999	Vegetation Monitoring (1 yr.)
March-November 1999	Hydrologic Monitoring (1 yr.)
August 2000	Vegetation Monitoring (2 yr.)
March-November 2000	Hydrologic Monitoring (2 yr.)
March-November 2001	Hydrologic Monitoring (3 yr.)
July 2001	Vegetation Monitoring (3 yr.)

1.4 Debit Ledger

Tucker Farm	Mit. Plan	Ratios		TIP DEBIT
Currituck County				
Habitat	Acres at Start:	Acres Remaining		R-2228A, BA
SPH Restoration	25.1	0	0.00	25.1
SPH Preservation	2.8	0	0.00	2.8
Upland Mgmt.	8.7	0	0.00	8.7
TOTAL	36.6	0	0.00	

2.0 HYDROLOGY

2.1 Success Criteria

In accordance with Corps guidelines for wetland mitigation, the success criteria for hydrology states that the area must be inundated or saturated (within 12" of the surface) by surface or groundwater for at least a consecutive 12.5% of the growing season. Areas inundated for less than 5% of the growing season are always classified as non-wetlands. Areas inundated between 5% - 12.5% of the growing season can be classified as wetlands depending upon factors such as the presence of wetland vegetation and hydric soils.

The growing season in Currituck County begins March 20 and ends November 13. These dates correspond to a 50% probability that temperatures will drop to 28°F or lower after March 20 and before November 13.¹ The growing season is 239 days; therefore, optimum hydrology requires inundation or saturation 12.5% of this season, or at least 30 consecutive days. Local climate must also represent average conditions for the area.

Based on the Mitigation Plan, hydrologic success is based on soil saturation that is similar to the reference ecosystem and in accordance to Corps guidelines. The reference ecosystem is located on-site in an undisturbed wetland located at a slightly lower elevation in the southern portion of the site, and gauges TT-8 and TT-9 monitor it.

2.2 Hydrologic Description

There are twelve monitoring gauges and one rain gauge installed on-site (Figure 2). The automatic monitoring gauges record daily readings of groundwater depth. This is the third year of hydrologic monitoring for the site.

The principal hydrologic source for this site is precipitation with some input from Buckskin Creek. The Tucker Tract site involved the grading of the field crowns and placing the excess into several drainage ditches to prohibit water from leaving the site. An additional seven to nine inches of fill was brought in to bring the site elevation to its final grade. Several earthen berms were constructed adjacent to the lower areas of the site and adjacent to the residential area. This design will restore wetland hydrology, restrict infiltration losses and surface runoffs, and avoid flooding the adjacent residential area. The hydrologic monitoring should show the reaction of the groundwater level to specific rainfall events.

¹ Natural Resources Conservation Service, Soil Survey of Currituck County, North Carolina, p.71.

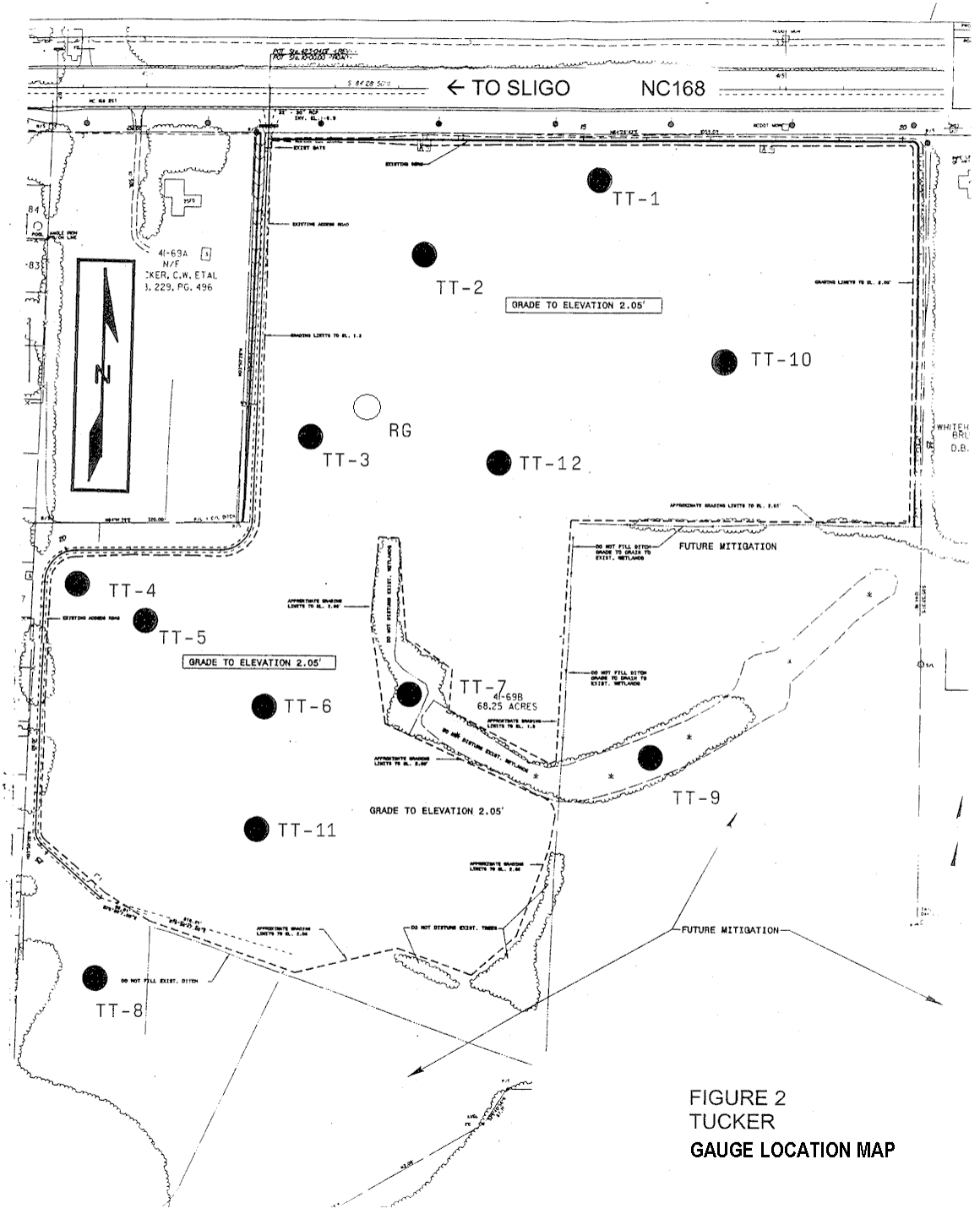


FIGURE 2
 TUCKER
 GAUGE LOCATION MAP

2.3 Results of Hydrologic Monitoring

2.3.1 Site Data

The maximum number of consecutive days that the groundwater was within twelve inches of the surface was determined for each gauge. This number was converted into a percentage of the 239-day growing season. The results are presented in Table 1. Appendix A contains a plot of the groundwater depth for each monitoring gauge and the surface water depth recorded by the surface gauge. The maximum number of consecutive days is noted on each graph. The individual precipitation events, shown on the monitoring gauge graphs as bars, represent data collected from the on-site rain gauge.

Table 1
HYDROLOGIC MONITORING RESULTS

Monitoring	< 5%	5% - 8%	8% - 12.5%	> 12.5%	Actual %	Success Dates
TT-1				✓	16.3 7.1	May 28 – Jul 5, Aug 19 - Sep 4
TT-2			✓		10.0	Aug 14 - Sept 6
TT-3				✓	28.4 28.4 16.7	May 13 – Jul 19 Jul 27 - Oct 2 Mar 20 - Apr 28
TT-4		✓	✓	✓	23.8 12.5 19.2 6.2	May 14 – Jul 9 Aug 14 - Sep 12 Mar 20 - May 4 Jul 29 - Aug 12
TT-5			✓	✓	15.8 8.3 15.0	Mar 20 – Apr 26 Aug 13 - Sep 1 May 28 - Jul 2
TT-6	✓				4.6	Mar 21 – Apr 8
TT-7				✓	51.0 20.9	Mar 20 – Jul 19 Aug 14 - Oct 2
TT-8				✓	23.0 10.4 7.1 20.5	May 13 – Jul 6 Aug 14 - Sep 7 Jul 25 - Aug 10 Mar 20 - May 7
TT-9				✓	53.5 20.9	Mar 20 – Jul 25 Aug 14 - Oct 2
TT-10				✓	14.6 12.1	Mar 20 – Apr 23 Jun 2 - Jun 30
TT-11				✓	16.3 8.3 10.4	May 27 – Jul 4 Aug 14 - Sep -2 Apr 5 - Apr 29
TT-12				✓	19.6 11.7 12.5	May 22 – Jul 7 Apr 5 - May 2 Aug 14 - Sep 12

Figure 3 is a graphical representation of the hydrologic monitoring results. Based on the Mitigation Plan, hydrologic success is soil saturation that is similar to the reference ecosystem and in accordance to Corps guidelines. The reference ecosystem is located on-site in an undisturbed wetland located at a slightly lower elevation in the southern portion of the site, and gauges TT-8 and TT-9 monitor it. In accordance with Corps guidelines for wetland mitigation, the success criteria for hydrology states that the area must be inundated or saturated (within 12" of the surface) by surface or groundwater for at least a consecutive 12.5% of the growing season. Area inundated for less than 5% of the growing season is always classified as non-wetlands. Areas inundated between 5% and 12.5% of the growing season can be classified as wetlands depending upon factors such as the presence of wetland vegetation and hydric soils.

This year (2001) the majority of the monitoring gauges on site have shown saturation for long periods of time. The two gauges in the reference ecosystem met the success criteria. Eight of the remaining ten gauges in the restored wetland showed similar results and met the success criteria. Two gauges did not show similar results. It is highly unlikely that gauge TT-6 will ever show success during a normal climatic year due to its elevated position (0.7 – 1.0 feet higher) with respect to the rest of the site. This gauge malfunctioned for 2 months during the growing season, but the gauge historically has never met the success criteria. Gauge TT-2 did not meet the success criteria although it did show saturation for 10% of the growing season.

Specific problems: Dead batteries hampered the data acquisition process. Monitoring gauge TT-6 did not record groundwater elevations from August 4 to October 3rd. Several attempts to repair and reset this gauge proved unsuccessful. This gauge will be replaced prior to the next growing season in coordination with the NCDOT Geotechnical Unit. Monitoring gauge TT-5 stopped recording from September 13 until October 3rd as well due to battery problems.

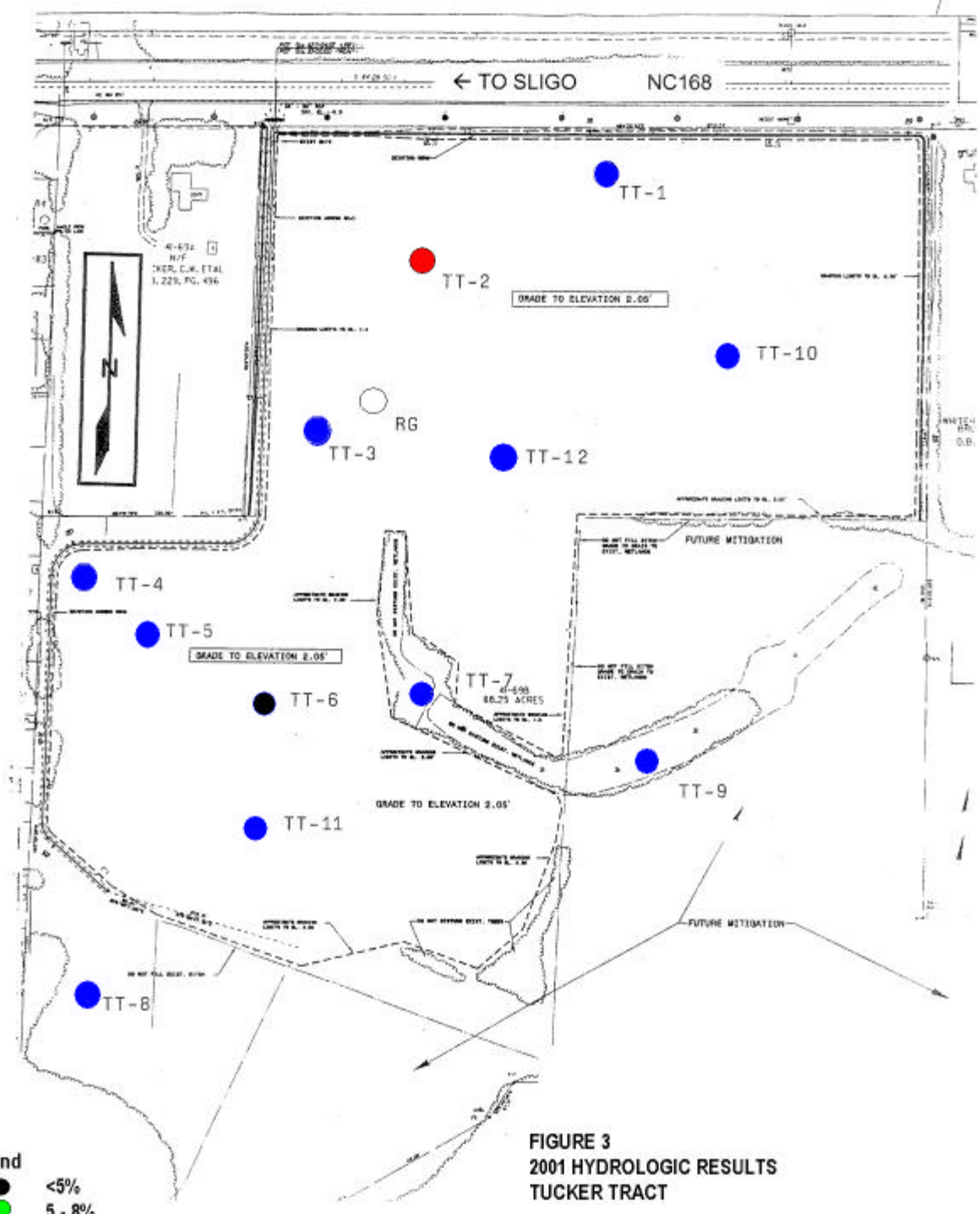
2.3.2 Climatic Data

Figure 4 represents an examination of the local climate in comparison with historical data to determine whether 2001 was “normal” in terms of climate conditions. The figure compares the rainfall from 2001 with that of historical rainfall (data collected between 1948 and 1996). Historical rainfall data was provided by the NC State Climate Office. The 2001 rainfall data was collected by the on-site rain gauge. The graph shows 2001 rainfall totals from January 2001 through the end of November 2001 which includes the growing season for this site. In the year 2001, rainfall was average to below average for the entire growing season. There was no above average rainfall-month in 2001 that skewed the gauge data to show a wetter site. Of the nine months comprising the growing season, five months showed below average rainfall totals. If the yearly rainfall had been more average, one could project that gauge TT-2 could have met the success criteria.

2.3.3 Geotechnical Data

As a result of comments received at the March 2000 monitoring report review meeting, NCDOT conducted several soil tests at Tucker Tract. The tests were conducted in response to concerns expressed at the March meeting that the soil on-site was compacted during construction activities. It was surmised that this compaction effectively sealed the top layer of the soil preventing any surface water from entering into groundwater so that there was no saturation of the soil.

The Geotechnical Unit performed field and laboratory soil tests in several locations in the restored wetland and in the undisturbed reference wetland. The results of the density test showed that the soil compaction at all test locations was within 15% ranging from 82.8% to 97.9% across the site. The 82.8% test result was in the vicinity of Gauge TT-2. The results of the hammer test (a test to measure compaction) showed that the characteristics of the soil across the site to be similar. The soil is sandy clay, which is very dense with a low conductivity rate. Compaction activities on-site during construction had little effect on this very dense soil type. Even with the low soil conductivity rate, all the gauges responded to rainfall events recording soil saturation after rainfall events. The undisturbed reference system exhibited similar characteristics to the restored wetland (see Appendix C).



Tucker 30 - 70 Percentile Graph

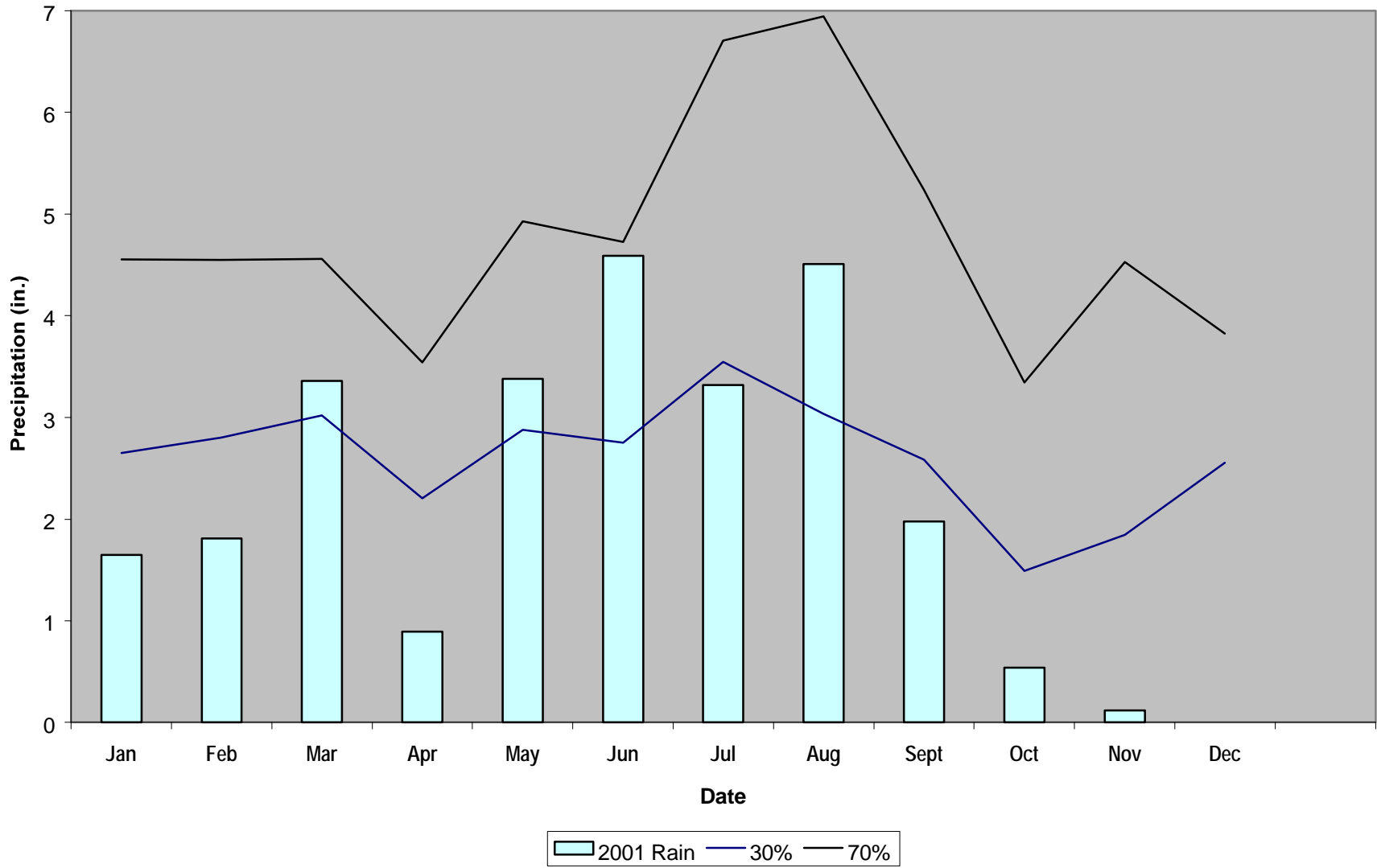


FIGURE 4

2.4 Conclusions

The year 2001 represents the third growing season that the hydrologic data has been examined. The majority of the monitoring gauges on site have shown saturation for long periods of time during an average to below average rainfall monitoring period. Two gauges did not meet hydrologic success criteria, however one gauge is located in an area that is 0.7 to 1.0 foot higher than the surrounding mitigation site. The other gauge showed 10% hydrology. Hydrologic monitoring data in 2001 met or exceeded the success criteria for jurisdictional wetland hydrology for the majority of the site. Gauges will continue to be closely monitored during subsequent field trips.

Geotechnical investigations showed the soil in the restored area and the undisturbed reference ecosystem exhibit similar soil characteristics. The inherent low soil conductivity in both areas still did not prohibit rainfall from entering into the ground saturating the soil.

3.0 VEGETATION: TUCKER TRACT MITIGATION SITE (YEAR 3 MONITORING)

3.1 Success Criteria

NCDOT will monitor the site for five years or until success criteria is met. 320 stems per acre survival criterion for planted seedlings will be used to determine success for the first three years. The required survival criterion will decrease by 10% per year after the third year of vegetation monitoring (i.e., for an expected 290 stems per acre for year 4, and 260 stems per acre for year 5). The number of plants of one species will not exceed 20% of the total number of plants of all species planted.

3.2 Description of Species

The following tree species were planted in the Wetland Restoration Area:

Zone 1: Wetland Reforestation (14.05 Acres)

Fraxinus pennsylvanica, Green Ash

Quercus falcata var. *pagodaefolia*, Cherrybark Oak

Quercus michauxii, Swamp Chestnut Oak

Quercus phellos, Willow Oak

Quercus nigra, Water Oak

Quercus lyrata, Overcup Oak

Nyssa aquatica, Tupelo Gum

Zone 2: Wetland Reforestation (9.04 Acres)

Taxodium distichum, Baldcypress

Fraxinus pennsylvanica, Green Ash

Quercus falcata var. *pagodaefolia*, Cherrybark Oak

Quercus michauxii, Swamp Chestnut Oak

Quercus phellos, Willow Oak

Quercus lyrata, Overcup Oak

Zone 3: Wetland Reforestation (1.89 Acres)

Quercus phellos, Willow Oak

Quercus nigra, Water Oak

Fraxinus pennsylvanica, Green Ash

Taxodium distichum, Baldcypress

Quercus lyrata, Overcup Oak

Nyssa aquatica, Tupelo Gum

Quercus michauxii, Swamp Chestnut Oak

3.3 Results of Vegetation Monitoring

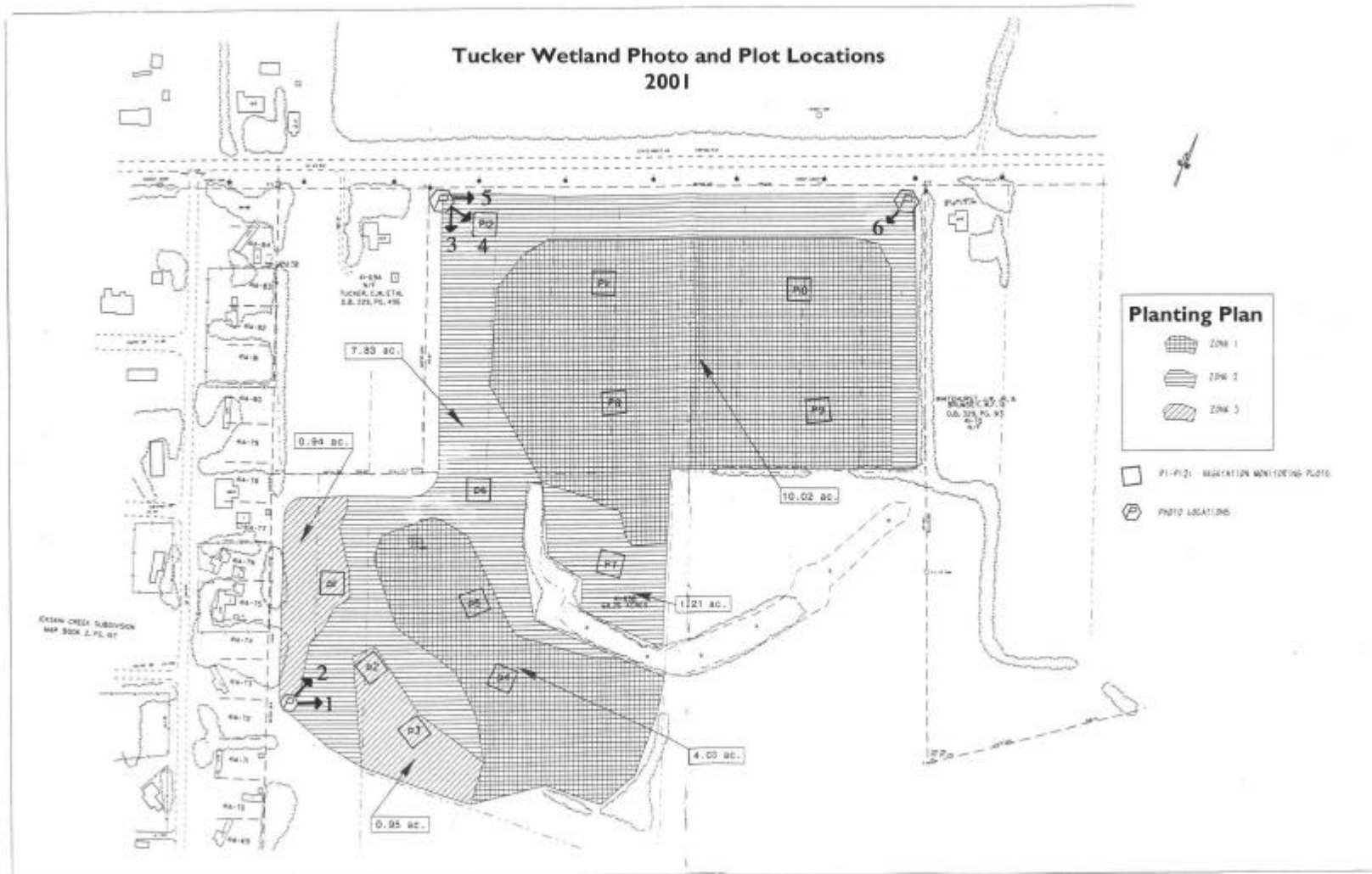
ZONE	Plot #	Overcup Oak	Tupelo Gum	Green Ash	Baldcypress	Water Oak	Willow Oak	Sw. Chestnut Oak	Cherrybark Oak	Total (3 year)	Total (at planting)	Density (Tree/Acre)
1	4		1	12		2	10	7	7	39	55	482
	5	1		10			10	11	2	34	48	482
	8			18			6	5		29	52	379
	9			9			12	3	5	29	40	493
	10			8		1	4	1		14	39	244
	11			6			1	5		12	48	170
ZONE 1 AVERAGE DENSITY											375	
2	6	5			13		10	2	3	33	50	449
	7	8		3	13		1	1	3	29	62	318
	12	5		7	10		4		1	27	48	383
ZONE 2 AVERAGE DENSITY											383	
3	1	11	4	11	11		2			39	53	500
	2	17					1	4		22	51	293
	3	6	17	9	9		4		4	49	56	595
ZONE 3 AVERAGE DENSITY											463	
TOTAL AVERAGE DENSITY											399	

Site Notes: Site is well vegetated with various grasses, a variety of *Juncus* sp., and sedges. Deer and raccoon tracks noted throughout site. 2 inches of standing water noted in a small area of plot 7. Other species noted: volunteer pines, *Scirpus* sp., *Aster* sp., cattails, *Baccharis halimifolia*, foxtail, woolgrass, fennel, pickerel-weed, and *Sesbania* sp.

3.4 Conclusions

Of the 48 acres of this site, approximately 25 acres involved tree planting. There were 12 test plots established throughout the planting areas. The 2001 vegetation monitoring of the planted areas revealed an average density of 399 trees per acre, which is above the minimum requirement of 320 trees per acre. All zones remain above the minimum requirement of 320 trees per acre.

FIGURE 5 – PLOT LOCATIONS AND PHOTO POINTS



4.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

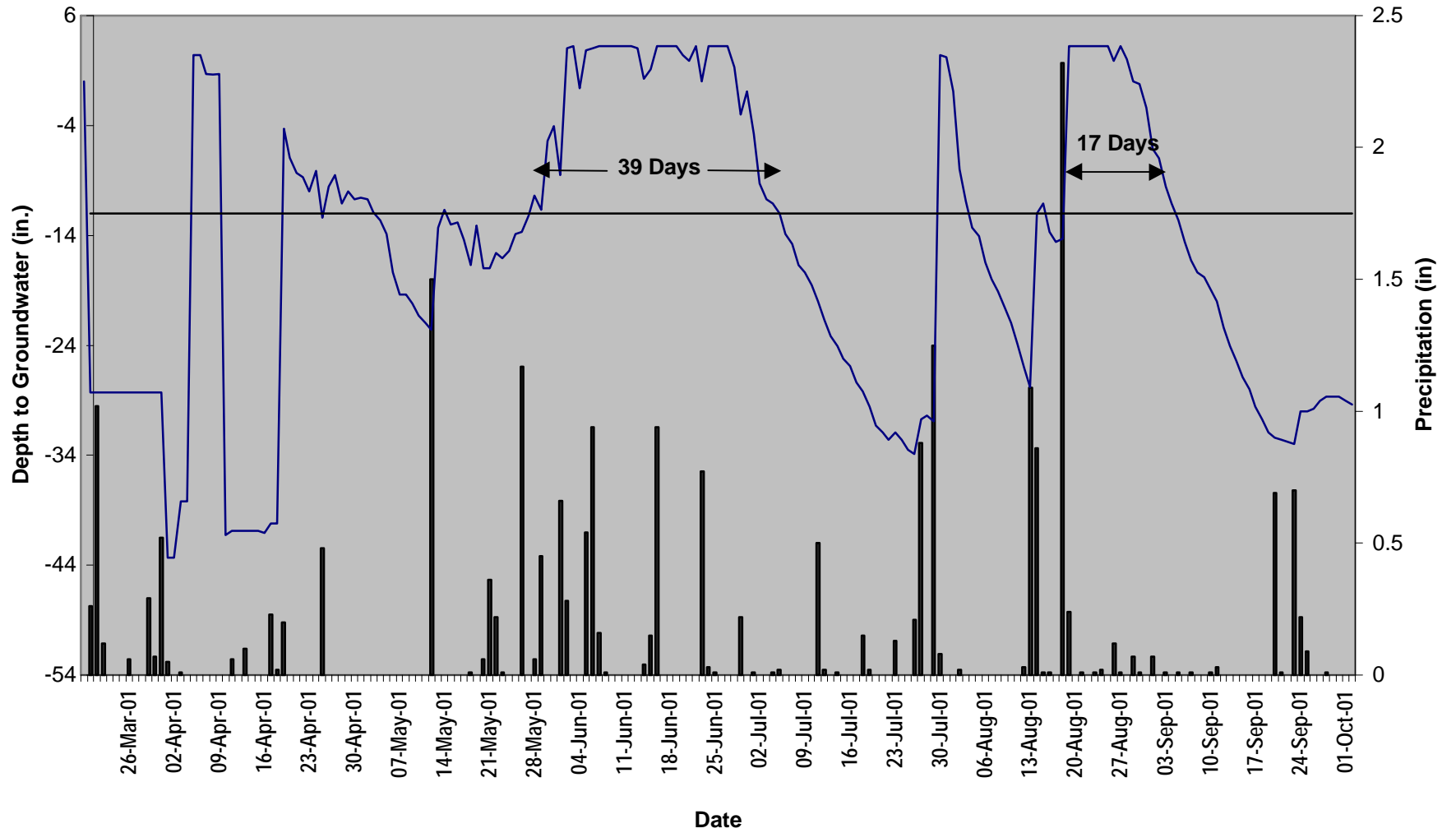
The results of the third year of monitoring indicate this site was successful. The majority of the groundwater gauges met the hydrologic success criteria. Based upon a previous field investigation, gauge TT-6 is situated in a locally high hummock rising approximately 8 inches above the surrounding area. Gauge TT-2 was the other gauge that came close to meeting saturation requirements as well.

Geotechnical analysis of soil in the restored wetland and the reference wetland showed that they are similar and share similar soil conductivity rates. Vegetation data also met success criteria. The average plot density was above the required 320 stems/acre showing a rate of 399 stems per acre. Densities within each zone were above the 320 stems per acre as well.

Vegetation and hydrologic monitoring will continue for a fourth year in 2002 at the Tucker Tract Mitigation Site.

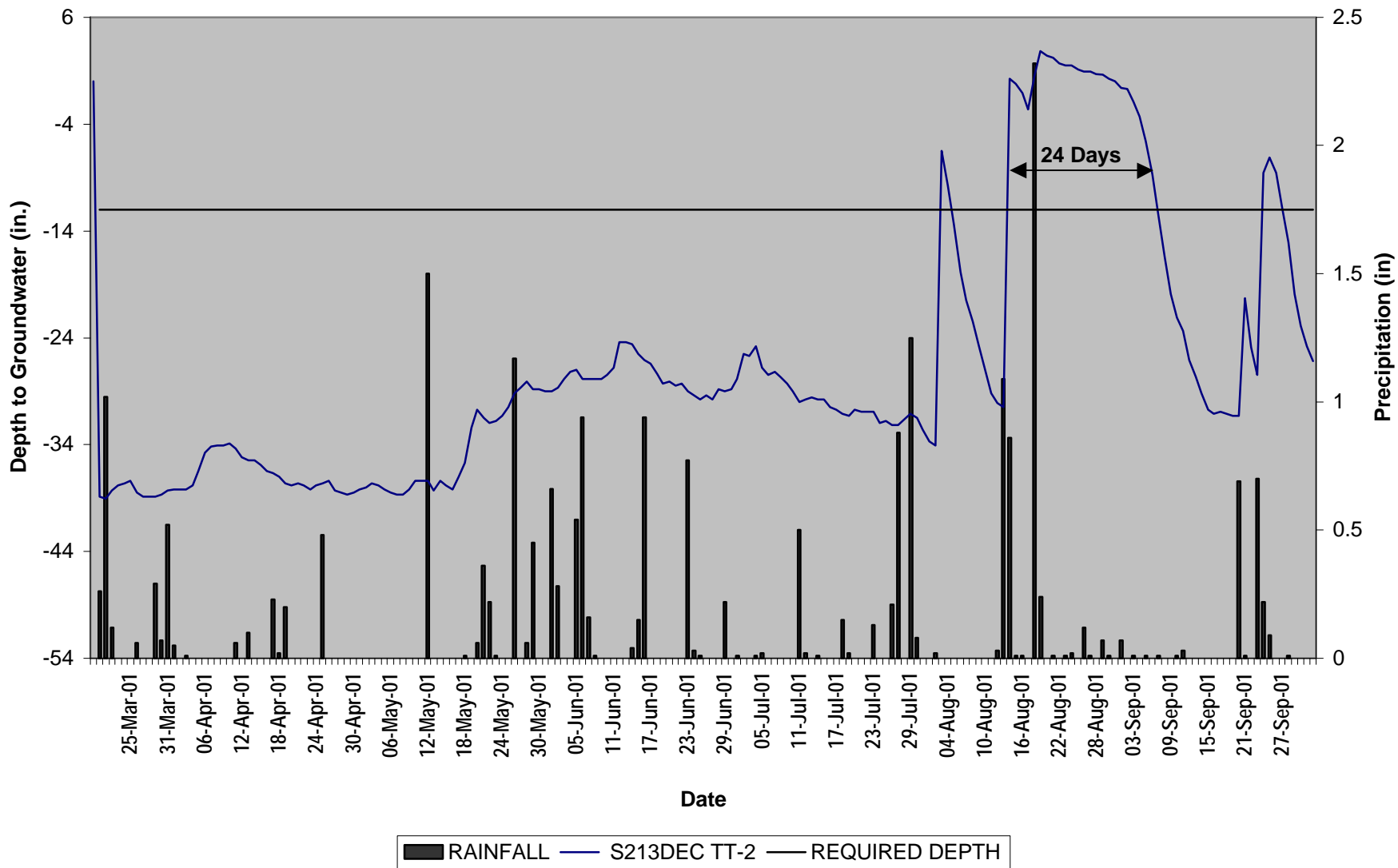
APPENDIX A
DEPTH TO GROUNDWATER PLOTS

2001 Tucker TT-1

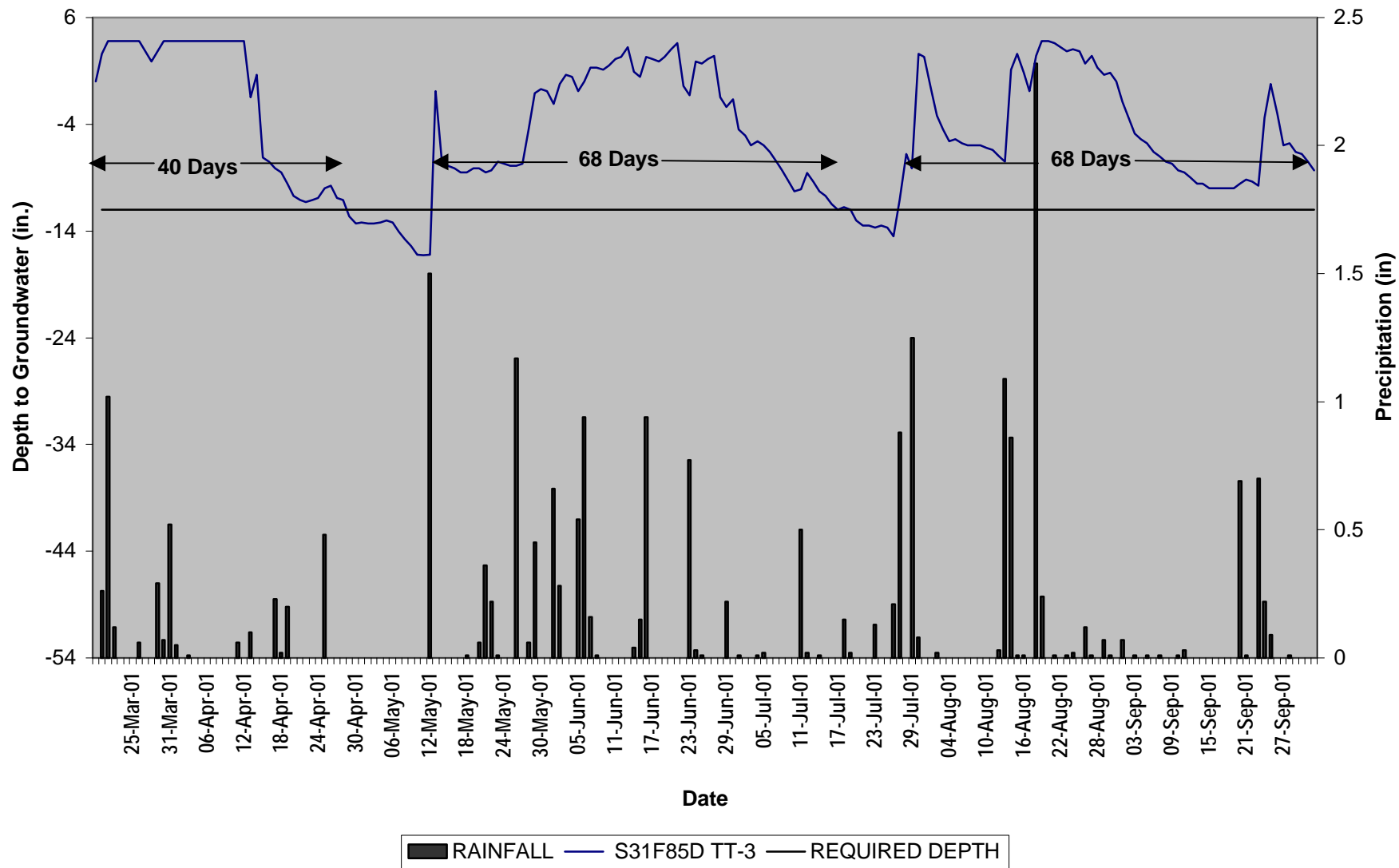


■ RAINFALL — S316A2A TT-1 — REQUIRED DEPTH

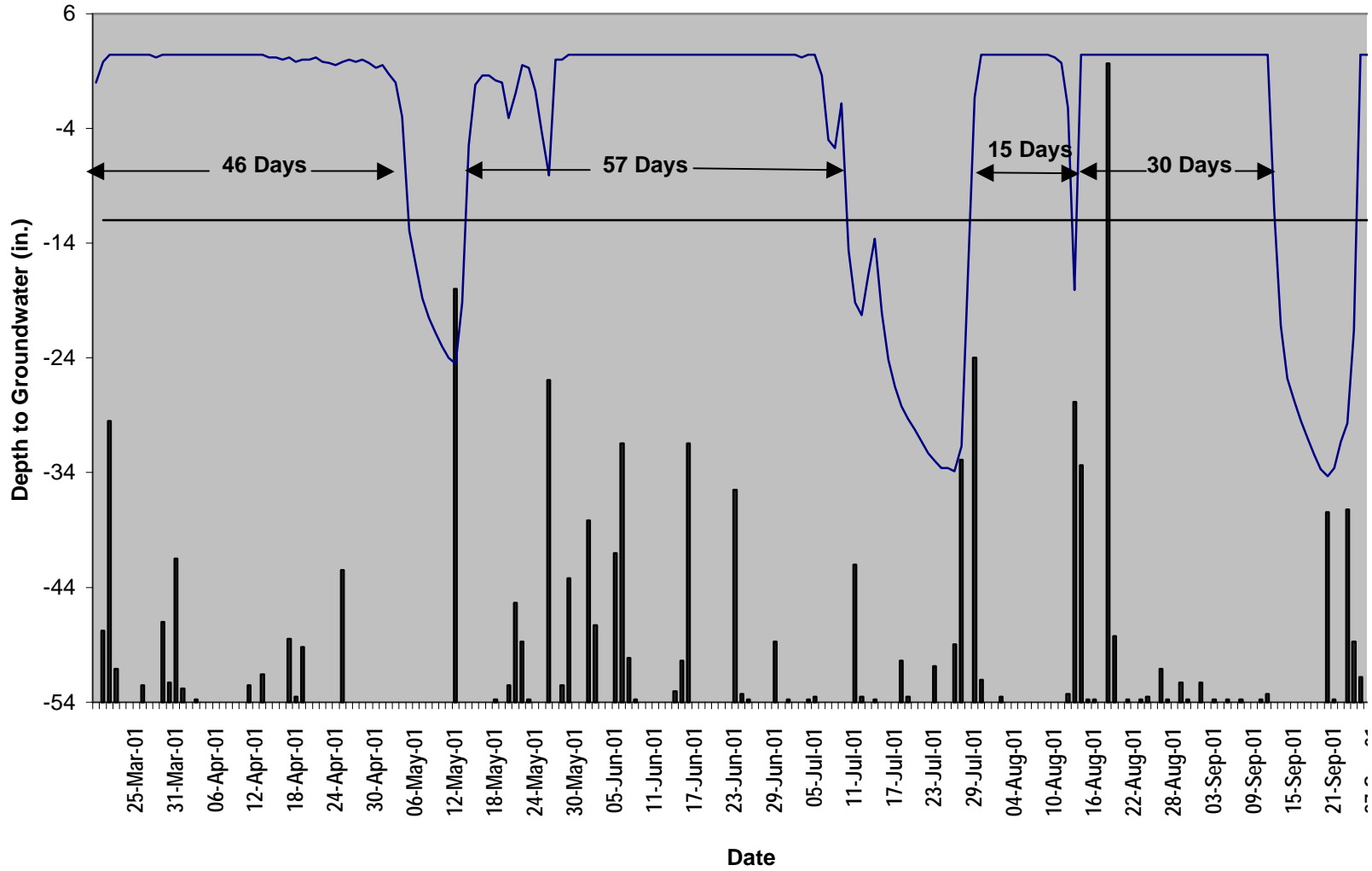
2001 Tucker TT-2



2001 Tucker TT-3

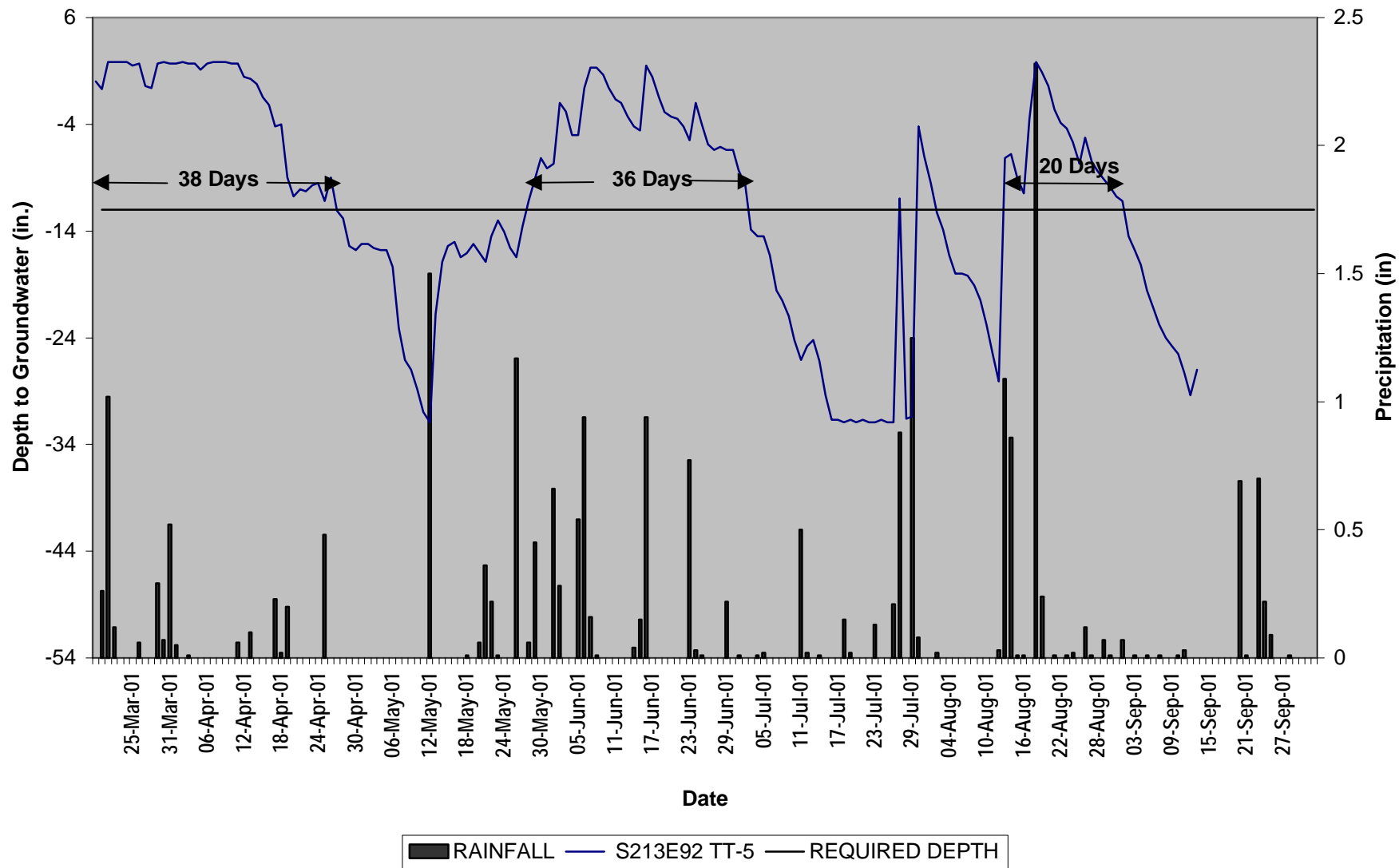


2001 Tucker TT-4

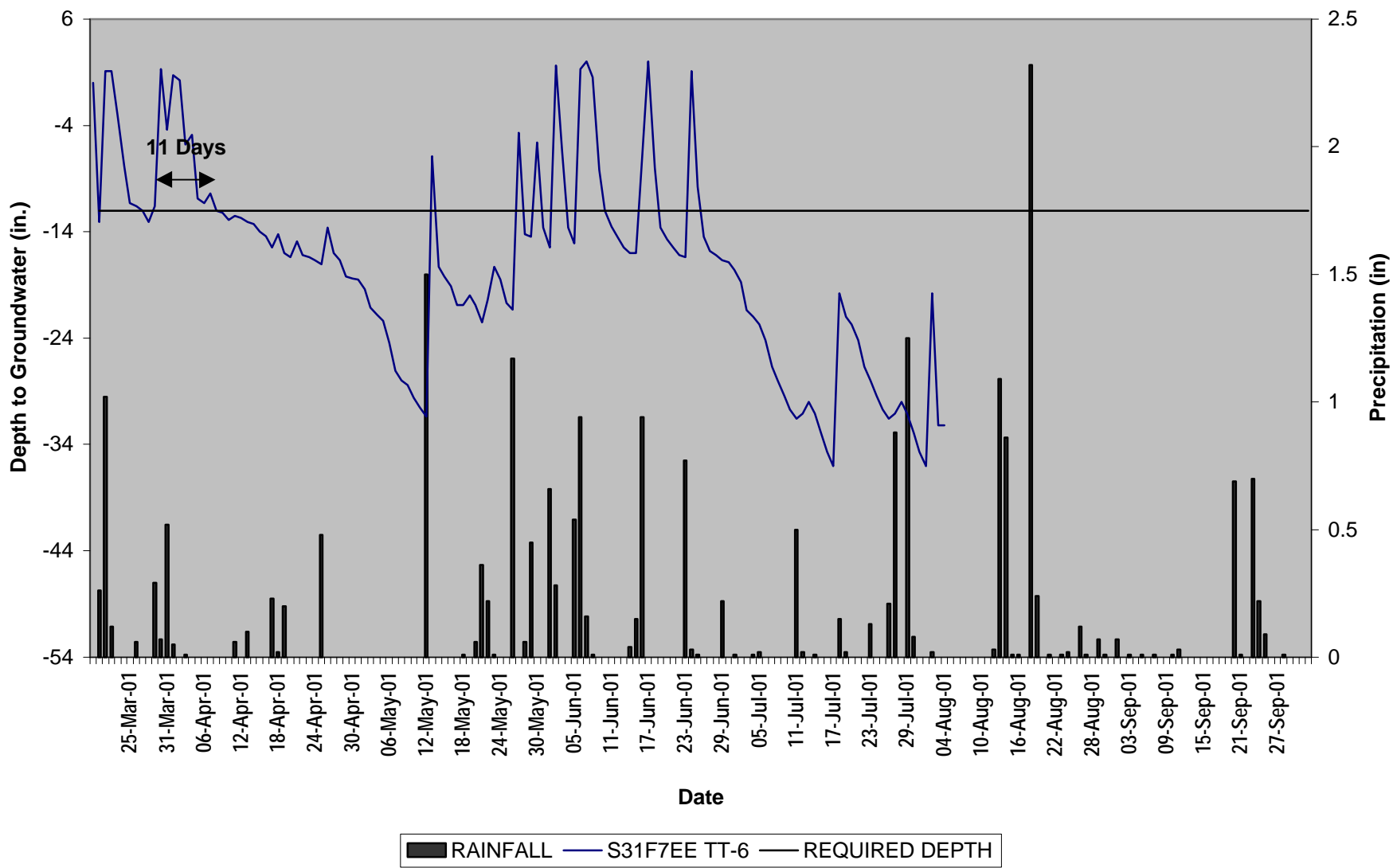


■ RAINFALL — S31F9EF TT-4 — REQUIRED DEPTH

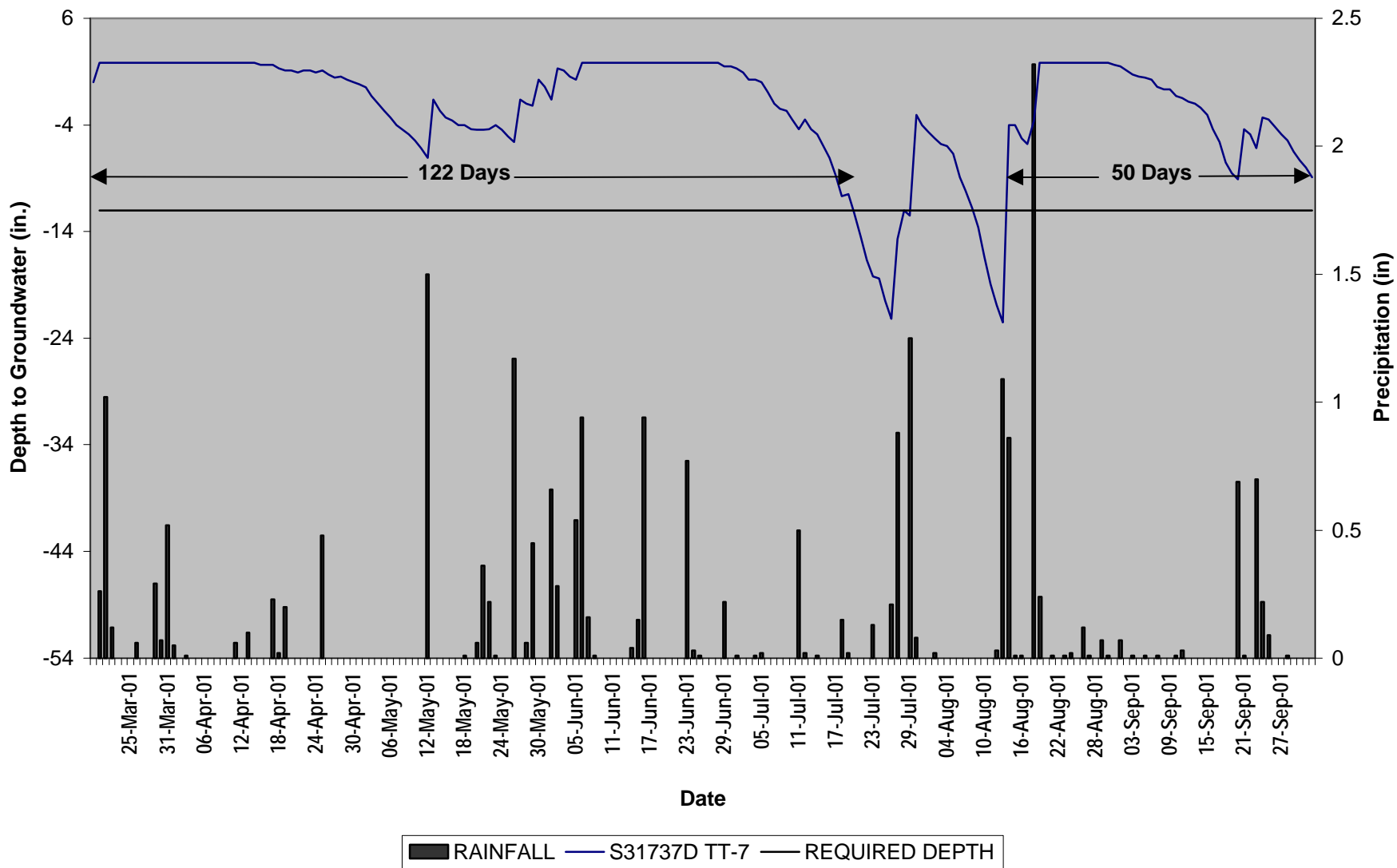
2001 Tucker TT-5



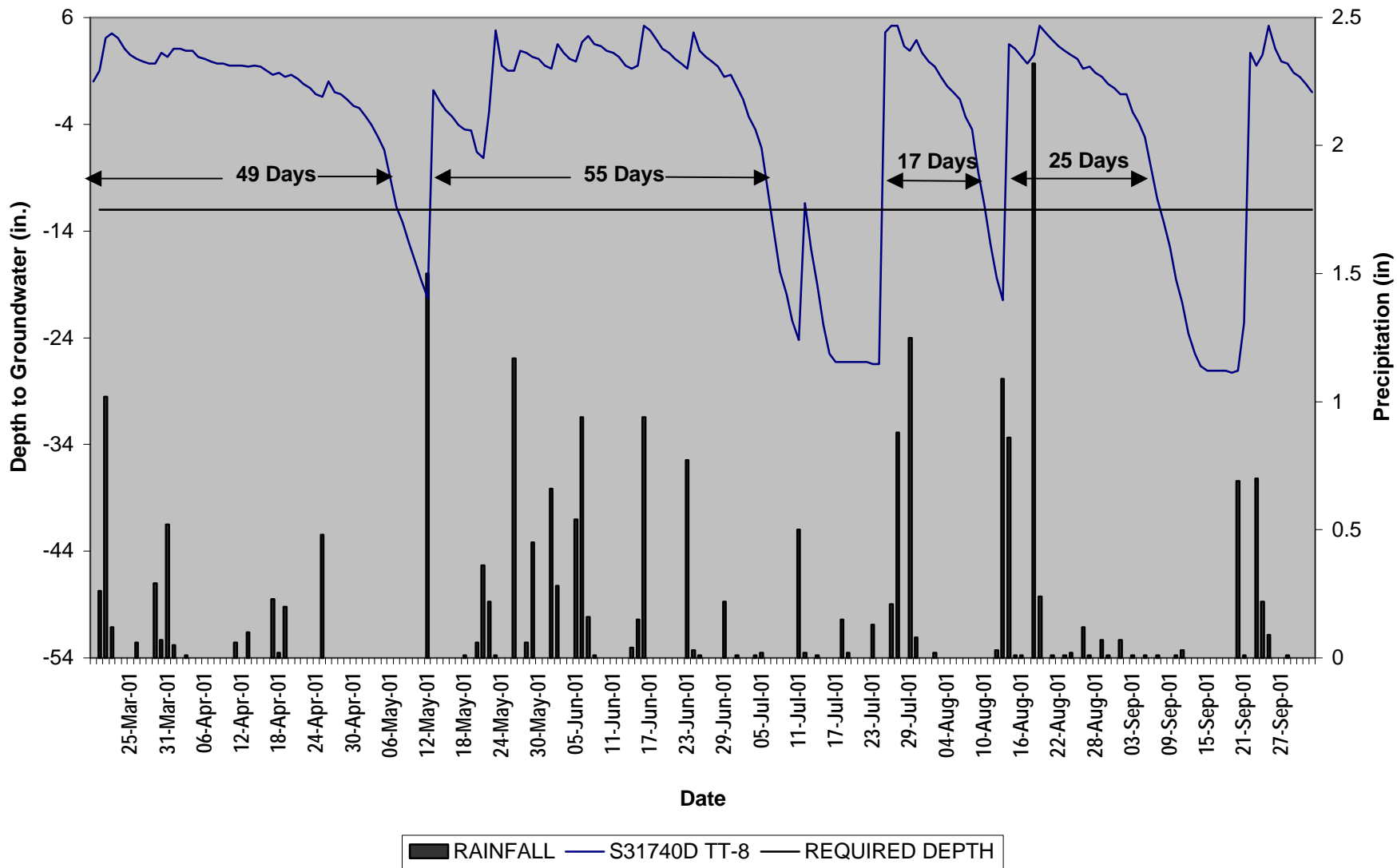
2001 Tucker TT-6



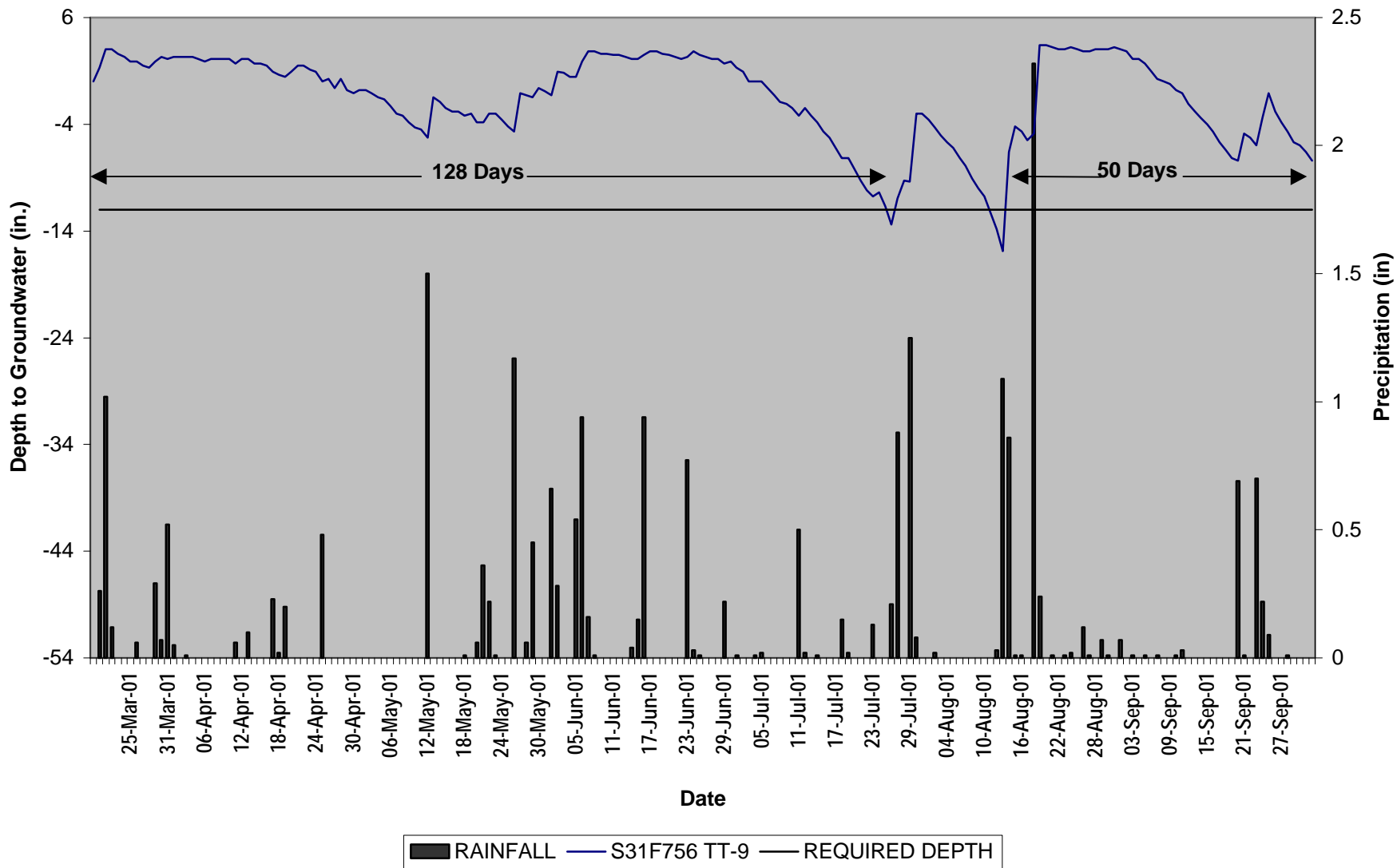
2001 Tucker TT-7



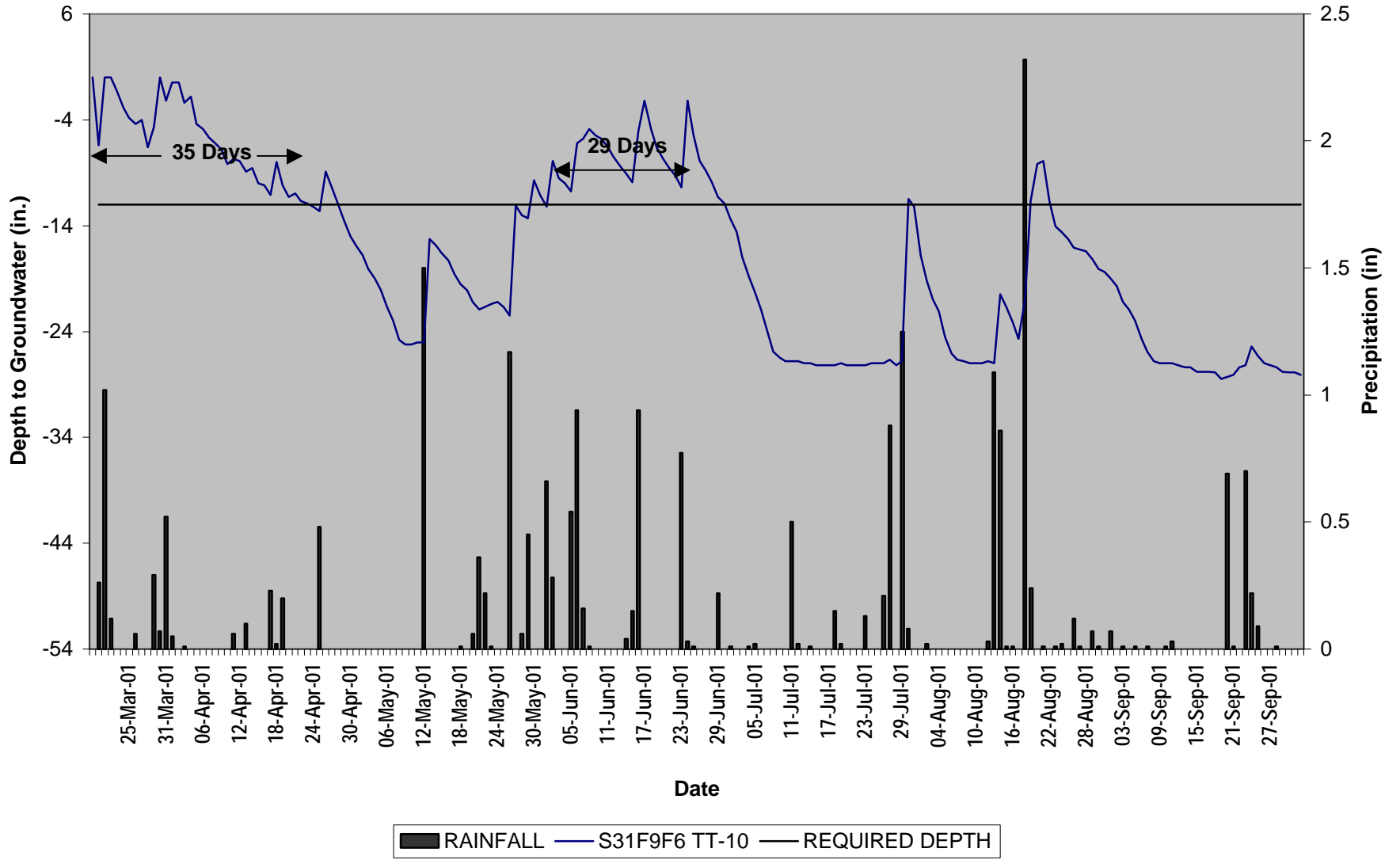
2001 Tucker TT-8



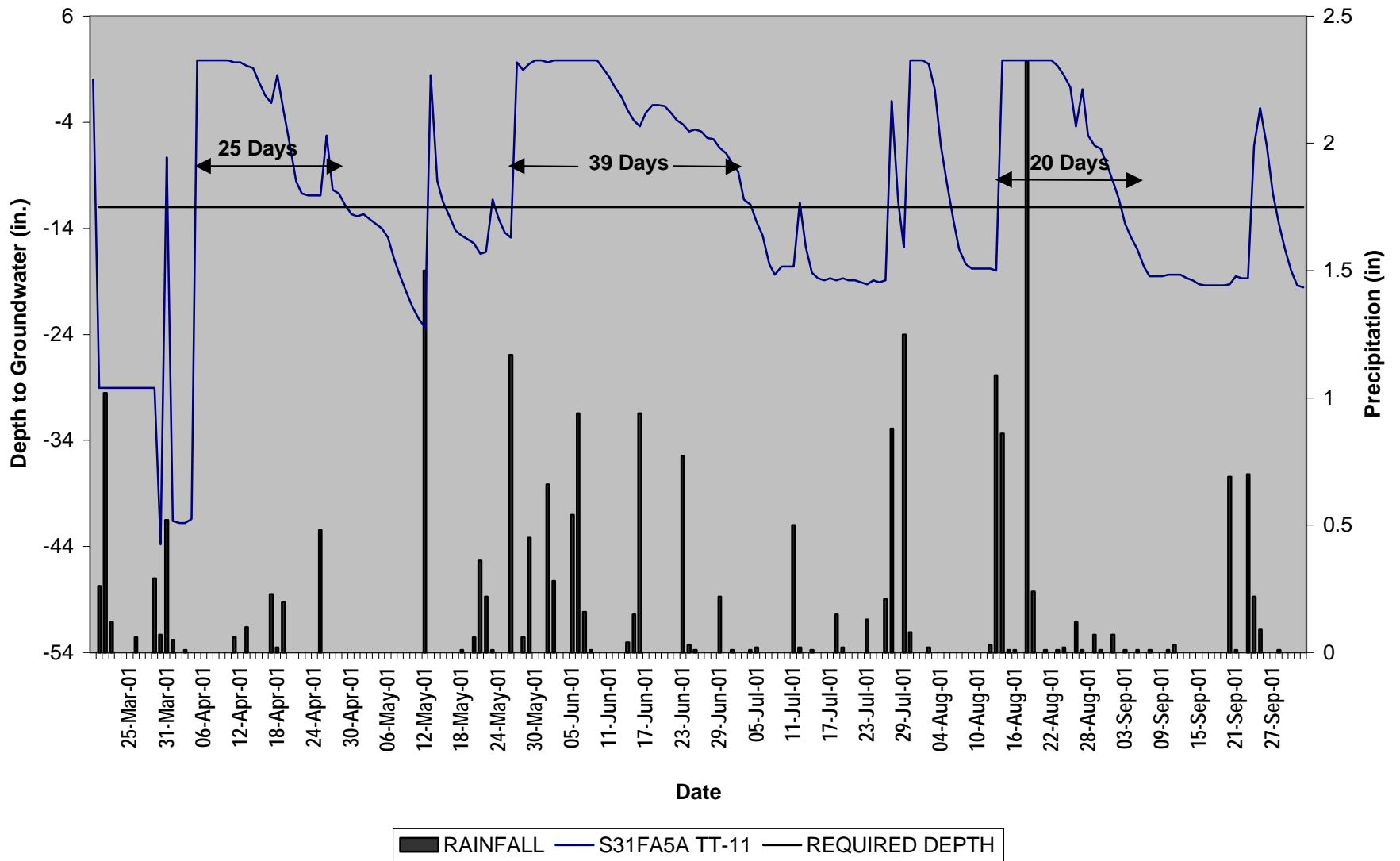
2001 Tucker TT-9



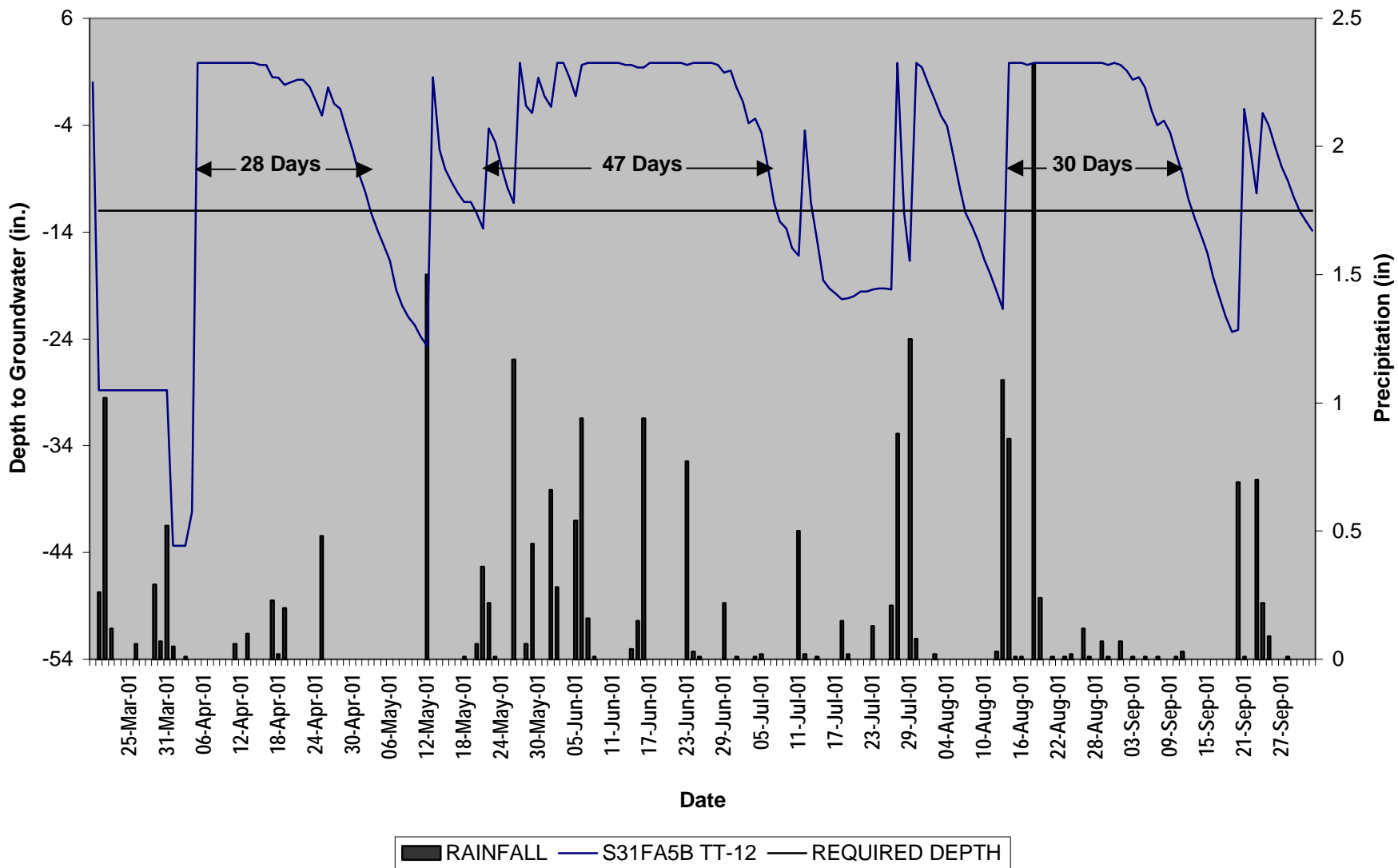
2001 Tucker TT-10



2001 Tucker TT-11



2001 Tucker TT-12



APPENDIX B

SITE PHOTOS



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6

APPENDIX C

GEOTECHNICAL DATA



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY
GOVERNOR

LYNDO TIPPETT
SECRETARY

December 21, 2001

Memorandum To: Mr Ed Lewis
PD & EA

From: W.L. Moore, III
State Engineering Geologist

Subject: Tucker Wetland Mitigation Site

The Geotechnical Unit investigated the site in June, 2001, and have the following comments concerning subsurface conditions at the site.

The surface soil layer consists of brown sandy clay approximately 1-foot thick. This layer was added to the site to raise the surface elevation. It is similar to the surface soils in the nearby undisturbed areas except that the added material is less plastic than the natural soil layer and there is no root mat cover.

A layer of stiff grey fine sandy clay soil occurs to an average depth of 3 feet. This soil has a very low hydraulic conductivity as demonstrated by a laboratory test that yielded a value of 0.8 ft./day in a soft soil condition.

The soils from the site do exhibit a lower moisture content than the soil from an undisturbed location. This indicates a slightly higher density of these soils; however, the very low hydraulic conductivity of the clay would change very little.