ANNUAL REPORT FOR 2001

ABC WETLAND MITIGATION SITE
BEAUFORT COUNTY
PROJECT NO. 8.T221801
TIP # R-2510WM

Prepared for:

Natural Systems Unit &
Roadside Environmental Unit
North Carolina Department of Transportation

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1.0 INTRODUCTION

1.1 Project Description

The North Carolina Department of Transportation (NCDOT) established the ABC Wetland Mitigation Site (hereinafter referred to as the Site) to provide up-front, wetland replacement for unavoidable highway related wetland impacts in the region. The 75-hectare (184-acre) tract is situated approximately 18 kilometers (11 miles) northeast of Washington and approximately 77 kilometers (48 miles) west of Beaufort County, North Carolina (Figure 1).

The Site had been cleared, ditched, and drained, with wetlands effectively removed to facilitate agricultural production and to convey runoff into Acre Swamp located along the southeastern border of the Site. Wetland mitigation activities were designed to restore wetland features and functions similar to those exhibited by reference wetlands in the region. Site alterations designed to restore characteristic wetland soil features and groundwater wetland hydrology include depression construction (B-horizon contouring), impervious ditch plug construction, ditch backfilling, field crown removal, and harrowing/scarification of wetland soil surfaces. Following construction the Site was planted with native vegetation characteristic of the target ecosystem.

Pre-construction investigations suggested that the Site would support the following communities: 37 hectares (92 acres) of restored non-riverine forested wetlands; 7 hectares (19 acres) of enhanced non-riverine wetland systems; and approximately 1252 meters (4107 feet) of stream enhancement (including streamside plantings and riparian forest buffer restoration). In addition, groundwater recharge was expected to improve within the remaining 31 hectares (76 acres) of uplands and streamside management areas. These areas were estimated based on soil types, local topographic features, elevation and slope, landscape position, and groundwater model forecast (DRAINMOD).

1.2 Purpose

The purpose of this project is to provide mitigation for impacts to forested wetlands caused by Transportation Improvement Projects (TIPs) in the region. A monitoring program must be conducted in order to demonstrate successful mitigation. This program includes installation of groundwater gauges to establish a hydrologic record, placement of permanent vegetation sampling plots to record establishment of woody vegetation, and visual documentation of the Site through development of a photographic record. This document summarizes the results of the monitoring program activities at the ABC Wetland Mitigation Site for the 2001 year.

1.3 Project History

January 1997	Site Identification
June 1999	Detailed Mitigation Design Study
September 2000-January 2001	Site Construction
March 2001	Site Planted
March 2001	Initiated Hydrology Monitoring Stages
August, November 2001	Vegetation Monitoring (1 yr.)

2.0 HYDROLOGY

2.1 Success Criteria

Hydrologic success criteria for the Site is based on federal guidelines for wetlands as described in the 1987 U.S. Army Corp of Engineers (COE) Wetlands Delineation manual. These guidelines suggest that an area must be inundated or saturated (within 12 inches of the surface) by surface or groundwater for 12.5 percent of the growing season (consecutive days). However, areas inundated between 5 and 12.5 percent of the growing season may warrant jurisdictional classification depending upon factors such as the presence of hydrophytic vegetation and hydric soils. For example, reference groundwater models (DRAINMOD) predict that wetland hydroperiod during early successional phases in restoration areas will average 8 percent of the growing season for 55 percent of the years and at least 5 percent of the growing season for 82 percent of the monitoring years. As these sites approach steady state conditions, water storage capacity increases through the improvement of rooting functions, organic material/debris accumulation, and increase in micro-topography. Based on the groundwater model, hydrology success criteria for the five-year monitoring period will include a minimum regulatory criteria, comprising saturation (free water) within one-foot of the soil surface for 5 percent of the growing season.

The average wetland hydroperiod for this Site is expected to exhibit a gradual increase from 8 percent of the growing season, immediately after farm land is

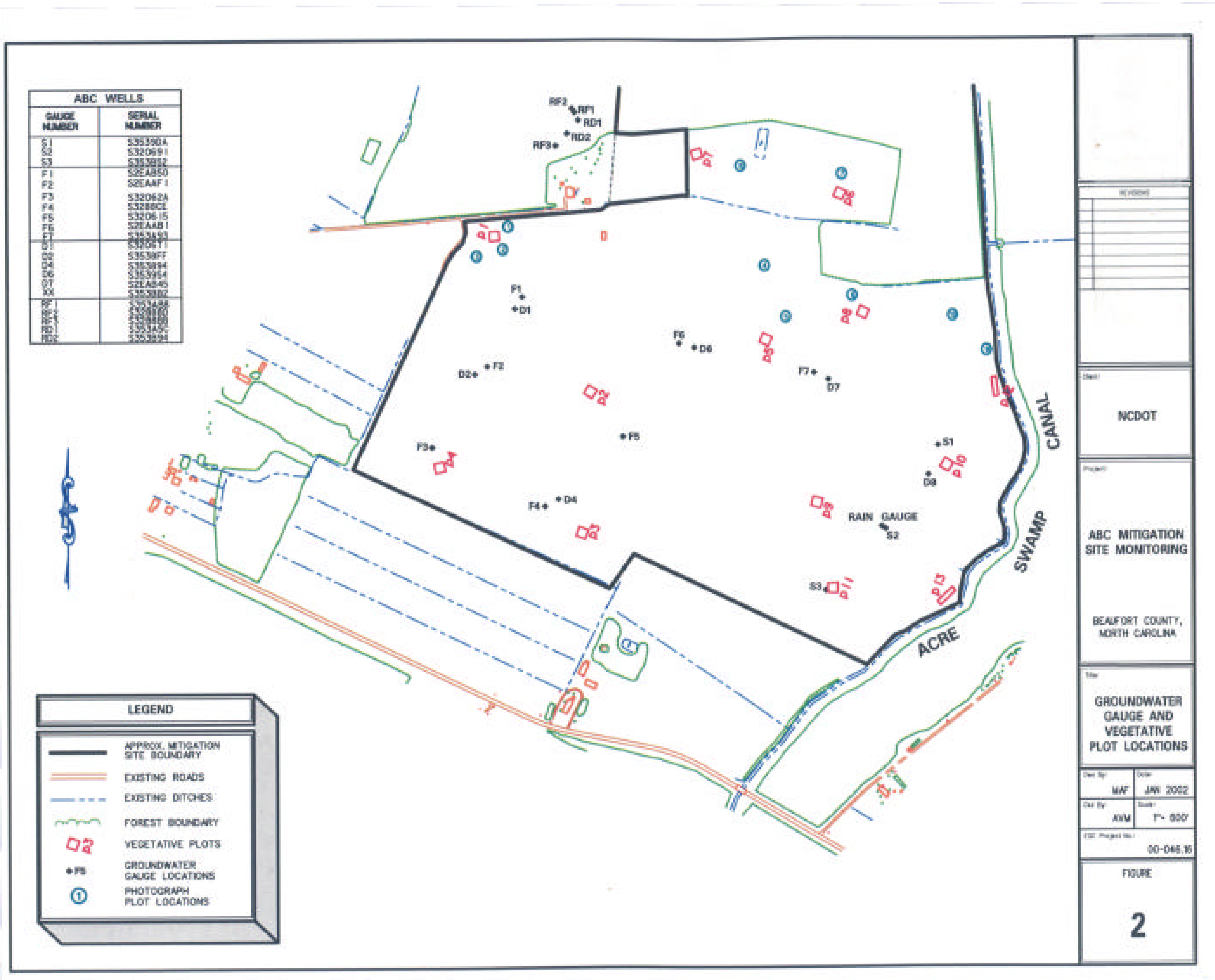
abandoned and drainage structures are removed, to as much as 20 percent under steady state forest conditions. Evaluation of success criteria will be supplemented by sampling and data comparison between reference wetland sites. One reference community was monitored for 2001 and is located approximately 0.20 mile north of the Site. Other reference communities are currently being evaluated for the 2002 monitoring period.

The growing season for Beaufort County is defined in the Beaufort County soil survey as the period between March 13 and November 25 (256 days, USDA 1995). In order to meet minimum hydrologic regulatory success as outlined in the Mitigation Plan (5 percent of the growing season), the groundwater table must remain within 12 inches of the surface for 13 days. Based on the hydrologic forecast average of 8 percent of the growing season for the first year, wetland hydrology will be met if the groundwater table remains within 12 inches of the surface for at least 20 consecutive days during the growing season. As the Site continues to develop, wetland hydroperiods of 32 consecutive days (12.5 percent) and possibly 51 consecutive days (20 percent) are anticipated.

2.2 Hydrologic Description

Following construction, 21 continuously monitored, groundwater gauges were placed in accordance with specifications in U.S. Corps of Engineers', Installing Monitoring Recorders/Piezometers in Wetlands (WRP Technical Note HY-IA-3.1, August 1993). Sixteen monitoring gauges were installed to provide representative coverage within each of the wetland physiographic landscape areas on the Site; in addition, five monitoring gauges were placed within the reference wetland community located approximately 0.20 mile north of the Site (Figure 2).

Micro-topographical features, such as semi-permanently inundated/saturated depressions and swales of various sizes, were created for the purpose of water storage as well as habitat diversity. Nine gauges (D1, D2, D4, D6, D7, D8, S1, S2, and S3,) were placed within saturated depressions, while seven gauges (F1, F2, F3, F4, F5, F6, and F7) were placed in non-depressional areas throughout the Site at base elevation. Five gauges were placed in similar landscape positions within the reference community.


ABC WELLS
GAUGE NUMBER
SERIAL NUMBER
S1
S2
S3
F1
F2
F3
F4
F5
F6
F7
D1
D2
D4
D6
D7
XX
RF1
RF2
RF3
RD1
RD2
RF2
RF1
RD1
RD2
RF3
F1
D1
D2
F2
F6
D6
F7
D7
F3
F5
S1
D8
F4
D4
RAIN GAUGE
S2
S3
CANAL
SWAMP
ACRE
LEGEND
APPROX. MITIGATION SITE BOUNDARY
EXISTING ROADS
EXISTING DITCHES
FOREST BOUNDARY
VEGETATIVE PLOTS
GROUNDWATER GAUGE LOCATIONS
PHOTOGRAPH PLOT LOCATIONS
NCDOT
ABC MITIGATION SITE MONITORING
BEAUFORT COUNTY, NORTH CAROLINA
GROUNDWATER GAUGE AND VEGETATIVE PLOT LOCATIONS
MAF
JAN 2002
AVM
1"= 600'
00-046.16
FIGURE
2

Gauges RD1 and RD2 were placed in depressions while gauges RF1, RF2, and RF3 were placed at base elevation.

2.3 Results of Hydrologic Monitoring

2.3.1 Groundwater Data

Groundwater gauges were placed on March 20 and 21 of this year (7 and 8 days after the growing season began) and were downloaded periodically from March through November 2001. Groundwater data hydrographs for each monitoring gauge are provided in Appendix B.

For the 2001 monitoring year, groundwater data indicate that the average wetland hydroperiod (for consecutive days) of all 21 gauges (on-site and reference) exceeded the minimum regulatory criteria of 5 percent and 20 of the gauges exceeded the 8 percent forecast (Table 1).

Table 1 A comparison between on-site and reference wetland hydroperiod for the 2001 Monitoring

	Monitoring Gauges	<5%	5%-8%	8%-12.5%	> 12.5%	Actual %	Success Dates
Depressions	D1					100%	Mar 22-Nov 25
	D2					100%	Mar 21-Nov 25
	D4					100%	Mar 21-Nov 25
	D6					100%	Mar 22-Nov 25
	D7					100%	Mar 22-Nov 25
	D8					100%	Mar 21-Nov 25
	S1					12.1%	Aug 12-Sep 11
	S2					21.8%	July 19-Sep 12
	S3					28.5%	July 19-Sep 29
Base Elevation	F1					23.8%	July 19-Sep 17
	F2					23.4%	July 19-Sep 16
	F3					8.9%	Aug 14-Sep 5
	F4					26.1%	July 19-Sep 23
	F5					19.1%	July 28-Sep 14
	F6					22.2%	July 19-Sep 13
	F7					20.3%	July 28-Sep 17
Reference	RD1					58.9%	July 18-Nov 16
	RD2					100%	Mar 20-Nov 25
	RF1					14.0%	Mar 20-Apr 23
	RF2					13.2%	Mar 20-Apr 22
	RF3					7.0%	Apr 11-Apr 28

*All data refers to soil saturation within 12 inches of the surface. Gauges were recorded for 247 of the 256 growing season days (March 21 through November 25). Gauge RF3 was replaced and no data were recorded before April 11.

Fourteen of the 16 on-site groundwater gauges (87 percent) indicate that wetland hydroperiod exceeded the 12.5 percent jurisdictional threshold. Four of the five reference groundwater gauges (80 percent) exceeded the 12.5 percent (Figure

3). Overall, on-site gauges exhibit similar results with gauges in the reference community.

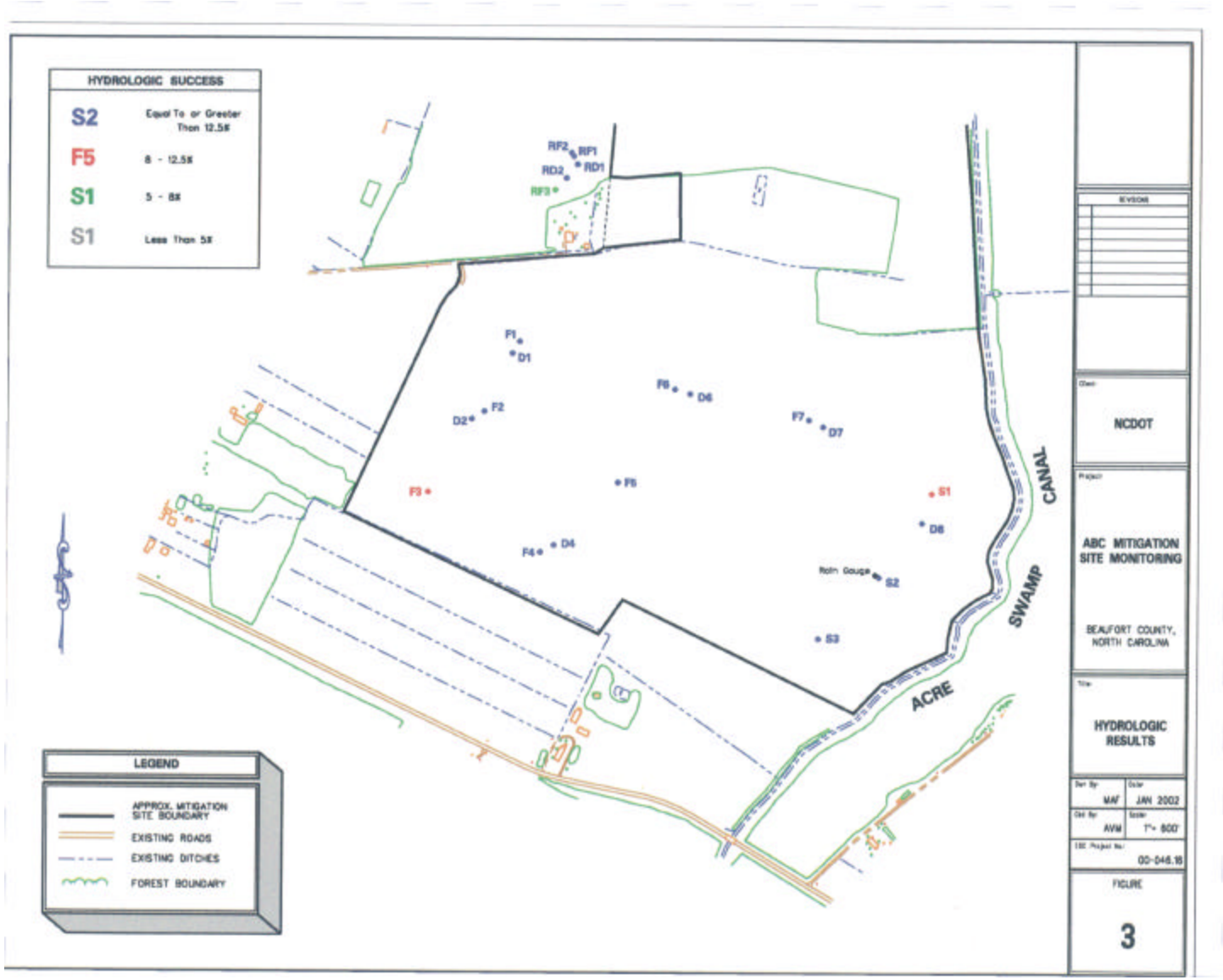
2.3.2 Climatic Data

The majority of this Site is characterized as a precipitation driven system and wetland hydroperiod is completely dependent upon local weather patterns. Climactic data for the local region surrounding the Site were collected from an on-site precipitation gauge and compared to rain station data from Belhaven and Washington, North Carolina (Table 2).

Table 2 A comparison of rainfall data during the growing season for Beaufort County from 4 different sources. Data is listed in monthly rainfall amounts. Differences between monthly amounts of this year and monthly averages during a normal year are given in parentheses.

Month	[1]**Rainfall Data Averages**	**On-Site Rain Gauge**	[2]**2001 Rainfall Belhaven, NC**	[2]**2001 Rainfall Washington, NC**
March	3.59	(Not available)	3.44 (-0.15)	4.97 (+1.38)
April	3.23	1.25 (-1.98)	1.97 (-1.26)	1.56 (-1.67)
May	4.29	2.94 (-1.35)	2.30 (-1.99)	2.93 (-1.36)
June	4.49	9.63 (+5.14)	10.22 (+5.73)	7.81 (+3.32)
July	6.08	5.83 (-0.25)	6.91 (+0.83)	5.18 (-0.90)
August	6.57	4.51 (-2.06)	6.50 (-0.07)	5.95 (-0.62)
September	5.55	0.64 (-4.91)	1.08 (-4.47)	0.77 (-4.47)
October	3.80	0.67 (-3.13)	0.95 (-2.85)	0.58 (-3.22)
November	3.58	0.80 (-2.78)	1.88 (-1.70)	1.07 (-2.51)
Growing Season Total	41.18	[3]26.28 (-11.31)	35.25 (-5.93)	30.82 (-10.32)

1 Based on data received from the Beaufort County Soil Survey
2 Collected by the State Climate Office of North Carolina and the National Climactic Data Center
3 Refers to the total rainfall on-site from April through November. The difference (-11.31) refers to the amount of rainfall below the average from April through November.


HYDROLOGIC SUCCESS
S2 Equal To or Greater Than 12.5%
F5 8 - 12.5%
S1 5 - 8%
S1 Less Than 5%
RF2
RF1
RD2
RD1
RF3
F1
D1
F2
D2
F3
F4
D4
F5
D6
F6
D7
S1
D8
Rain Gauge
S2
S3
SWAMP CANAL
ACRE
LEGEND
APPROX. MITIGATION SITE BOUNDARY
EXISTING ROADS
EXISTING DITCHES
FOREST BOUNDARY
REVISIONS
NCDOT
ABC MITIGATION SITE MONITORING
BEAUFORT COUNTY, NORTH CAROLINA
HYDROLOGIC RESULTS
Dwn By: MAF
Date: JAN 2002
Chk By: AVM
Scale: 1"= 800'
EEE Project No: 00-046.18
FIGURE
3

As depicted in both Table 2 and Figure 4, rainfall for the 2001 year was below average for Beaufort County for the 2001-growing season. Data from the on-site rain gauge illustrates a reduction of 11.32 inches below the average from April through November (the gauge was placed in March so data for that month is not available). In spite of high rainfall for the month of July, early and late season droughts led to an overall decrease for the year. Wetland hydroperiods should increase during average rainfall years.

2.4 Conclusions

Hydrologic data indicate that the Site met or exceeded wetland jurisdictional status for the 2001-monitoring year. Nineteen of the 21 gauges (both on-site and reference) exceeded 12.5 percent of the growing season while the remaining two gauges exceeded the forecast 8 percent of the growing season. All gauges exceed the minimum regulatory success criteria for soil saturation of 5 percent of the growing season. In addition, rainfall amounts were below average for the 2001-growing season. A good indication that the Site should be considered successful is that wetland hydroperiod for the Site duplicated that of reference. As weather patterns approach normal and forested conditions prevail, the duration of wetland hydroperiod is expected to increase.

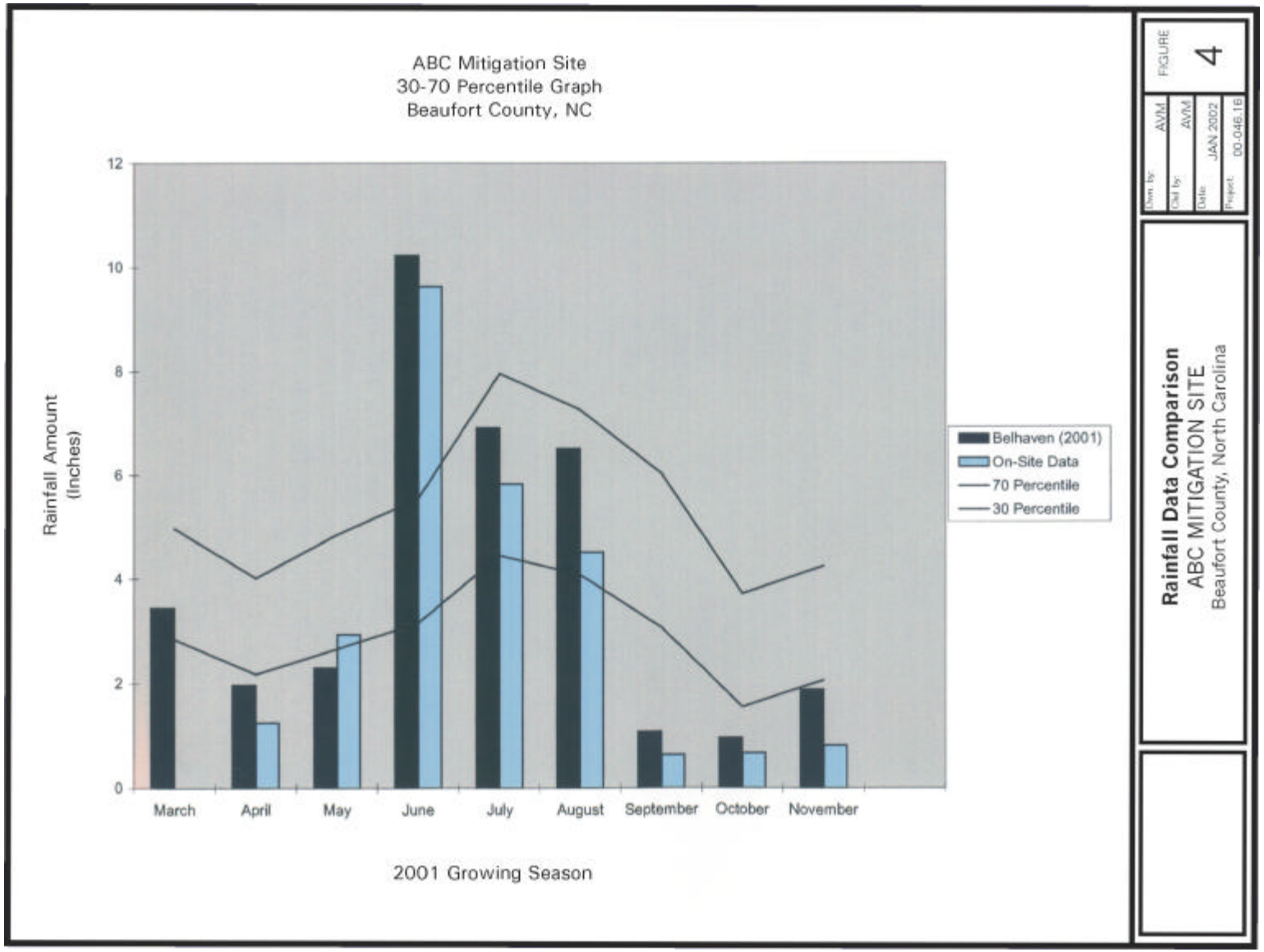
3.0 VEGETATION (YEAR 1 MONITORING)

3.1 Success Criteria

Success Criteria states that there must be a minimum of 320 trees per acre living for at least three consecutive years. A minimum of 290 trees per acre living at year 4 and a minimum of 260 trees per acre living at year 5.

3.2 Community Description

Plant community patterns represent an expression of the variations in hydroperiods exhibited across local reaches of the landscape. Reference Forest Ecosystem (RFE) data, on-site observations, utilization of Schafale and Weakley (1990) classification of natural communities, and a review of the available literature were used to develop the primary plant community associations that have been established during community restoration activities. These community associations include non-riverine swamp forest, non-riverine wet hardwood forest, riverine headwater swamp forest, riverine streambank riparian forest, mesic upland slope forest, and upland dry mesic


ABC Mitigation Site
30-70 Percentile Graph
Beaufort County, NC
Rainfall Amount (Inches)
12
10
8
6
4
2
0
March
April
May
June
July
August
September
October
November
Belhaven (2001)
On-Site Data
70 Percentile
30 Percentile
2001 Growing Season
FIGURE 4
Dwn. by: AVM
Chd by: AVM
Date: JAN 2002
Project: 00.046.16
Rainfall Data Comparison
ABC MITIGATION SITE
Beaufort County, North Carolina

oak-hickory forest. Figure 5 provides a conceptual depiction of potential forest communities to be restored across the Site.

Description of Species

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

Zone 1: Levee/Streambank Forest

Taxodium distichum, Baldcypress
Nyssa sylvatica var. *biflora*, Swamp Blackgum
Quercus laurifolia, Laurel Oak
Quercus lyrata, Overcup Oak
Quercus phellos, Willow Oak
Betula nigra, River Birch

Zone 2: Riverine Swamp Forest

Taxodium distichum, Baldcypress
Quercus laurifolia, Laurel Oak
Quercus lyrata, Overcup Oak
Quercus phellos, Willow Oak
Fraxinus pennsylvanica, Green Ash
Quercus michauxii, Swamp Chestnut Oak

Zone 3: Mesic Hardwood Forest

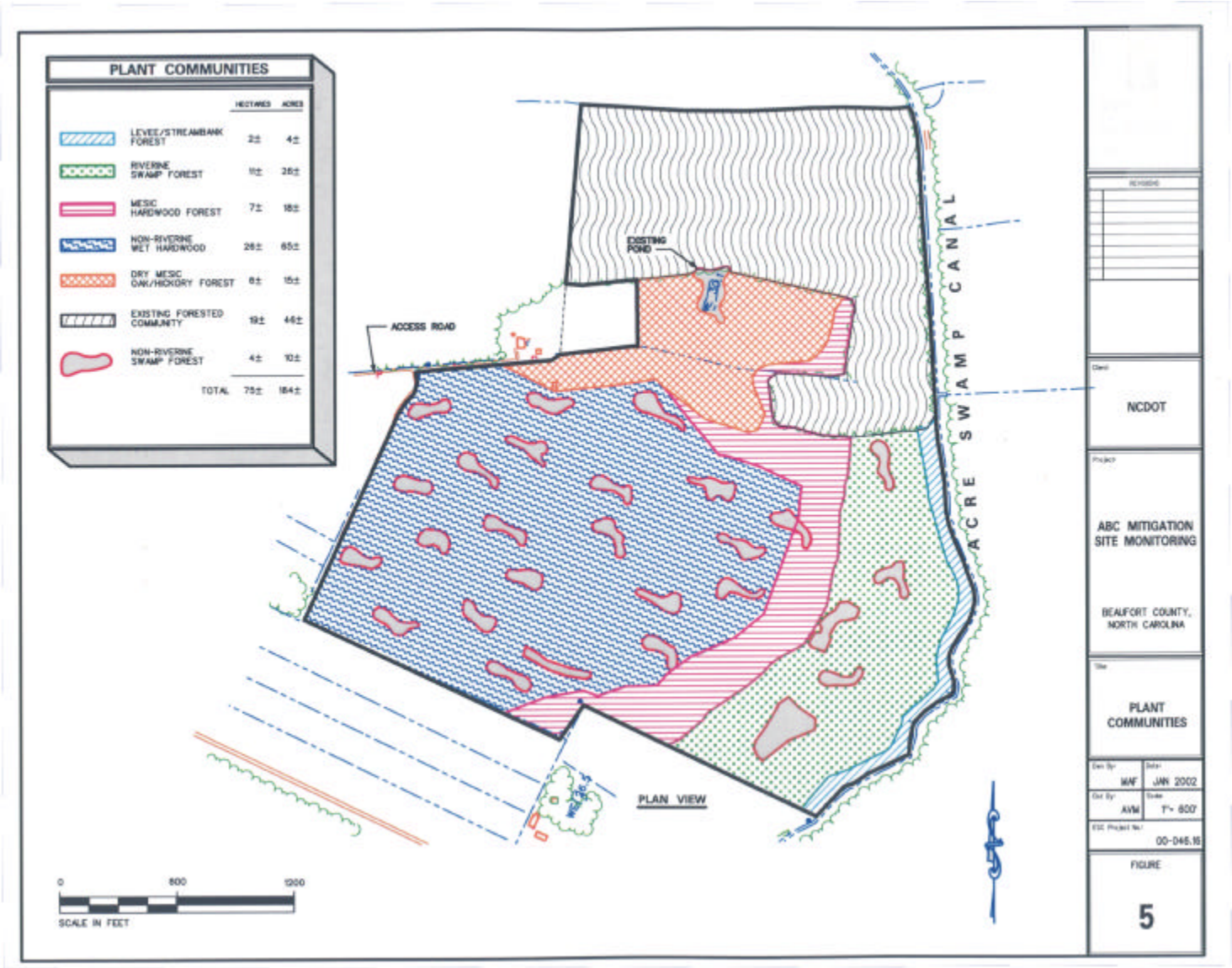
Fraxinus pennsylvanica, Green Ash
Quercus michauxii, Swamp Chestnut Oak
Quercus falcata var. *pagodaefolia*, Cherrybark Oak
Liriodendron tulipifera, Tulip Poplar
Quercus rubra, Northern Red Oak
Quercus alba, White Oak

Zone 4: Non-Riverine Wet Hardwood Forest

Nyssa sylvatica var. *biflora*, Swamp Blackgum
Quercus laurifolia, Laurel Oak
Quercus lyrata, Overcup Oak
Quercus phellos, Willow Oak
Fraxinus pennsylvanica, Green Ash
Quercus michauxii, Swamp Chestnut Oak

Zone 5: Dry Mesic Oak/Hickory Forest

Quercus rubra, Northern Red Oak
Quercus alba, White Oak
Carya tomentosa, Mockernut Hickory
Nyssa sylvatica, Blackgum
Carya glabra, Pignut Hickory
Quercus falcata, Southern Red Oak


PLANT COMMUNITIES
HECTARES
ACRES
LEVEE/STREAMBANK FOREST 2± 4±
RIVERINE SWAMP FOREST 11± 26±
MESIC HARDWOOD FOREST 7± 18±
NON-RIVERINE WET HARDWOOD 26± 65±
DRY MESIC OAK/HICKORY FOREST 6± 15±
EXISTING FORESTED COMMUNITY 19± 46±
NON-RIVERINE SWAMP FOREST 4± 10±
TOTAL 75± 184±
EXISTING POND
ACCESS ROAD
ACRE SWAMP CANAL
PLAN VIEW
0
600
1200
SCALE IN FEET
NCDOT
ABC MITIGATION SITE MONITORING
BEAUFORT COUNTY, NORTH CAROLINA
PLANT COMMUNITIES
WAF
JAN 2002
AWM
1"= 600'
00-046.16
FIGURE
5

3.3 Results of Vegetation Monitoring

ZONE	Plot #	Baldcypress	Swp. Blackgum	Laurel Oak	Overcup Oak	Willow Oak	River Birch	Green Ash	Swp. Chestnut Oak	Cherrybark Oak	Tulip Poplar	Northern Red Oak	White Oak	Mockernut Hickory	Blackgum	Pignut Hickory	Southern Red Oak	Total	Total (at planting)	Density (Tree/Acre)
1	12	13			2				16	1								32	32	680
	13			8	14	5			4	1								32	35	622
									ZONE 1 AVERAGE DENSITY											651
2	10	1		3	12	5				3								24	32	510
	11	17		2	6			4										29	33	598
									ZONE 2 AVERAGE DENSITY											554
3	8							9	1	7	1	3	8					29	33	598
	9							3	3	14	1	5						26	31	570
									ZONE 3 AVERAGE DENSITY											584
4	1		2	2	6	20		1										31	31	680
	2		2			6		2	17									27	34	540
	3	5			8	5		1	7									26	31	570
	4	1			18	2		17	1									39	39	680
	5		1		9	1		19										30	35	583
									ZONE 4 AVERAGE DENSITY											611
5	6							1				5		2	5			13	31	285
	7				4	4						9	2				6	25	32	531
									ZONE 5 AVERAGE DENSITY											408
									TOTAL AVERAGE DENSITY											573

Zone 1: Other species noted: *Aster* sp. and fennel. Plots 12 and 13 are 100' x 25' due to the size of the zone.
Zone 2: Other species noted: foxtail, fennel, *Aster* sp., ragweed, *Juncus* sp., and *Scirpus* sp. Cattails and standing water were noted in the pockets.
Zone 3: Other species noted: volunteer pine, fennel, foxtail, briars, and broomsedge.
Zone 4: Other species noted: foxtail, smartweed, fennel, ragweed, *Juncus* sp., *Carex* sp., and *Eleocharis* sp.
Zone 5: Other species noted: volunteer overcup oak and heavy 5 feet tall fennel and ragweed. Plot 6 had some standing water and the soil was too saturated for the species planted in this zone.

3.4 Conclusions

Of the 187 acres of this site, approximately 140.7 acres involved tree planting. There were 13 vegetation monitoring plots established throughout the planting areas. The vegetation monitoring of this site was conducted on two different occasions, one in August and one in November. The 2001 vegetation monitoring of the planted areas revealed an average density to be 573 trees per acre. This is above the minimum 320 trees per acre.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the initial mitigation design plan, expectations were that the Site would support 37 hectares (92 acres) of restored non-riverine forested wetlands and 7 hectares (19 acres) of enhanced non-riverine wetland systems. Groundwater recharge potential was proposed for restoration or enhancement within the remaining 31 hectares (76 acres) of uplands and stream-side management areas. These estimates were based on landscape position and soil types.

Following the 2001 monitoring year however, data indicate that additional wetland restoration credit is expected. In spite of a decrease in precipitation, eighteen of the 21 gauges (both on-site and reference) exceeded 12.5 percent of the growing season. Of the remaining three gauges, two on-site gauges exceeded the forecast 8 percent of the growing season and one reference gauge exceeded 5 percent of the growing season. Vegetative data also indicate that the entire Site may support species typical of mesic and bottomland hardwood communities, which meets jurisdictional standards. All soils within the Site were mapped as either Type A (hydric soils) or Type B (containing inclusions of hydric soils) which meet jurisdictional standards for soils.

Installation of additional monitoring gauges in areas presumed to be upland or marginal sites has been planned for the 2002 monitoring year. Also, supplemental plantings will occur in order to establish bottomland hardwood communities in areas that can support this community. Monitoring is expected to continue for the next four years. Additional off-site reference wetlands have been identified and are expected to be monitored in 2002.

In summary, the Site met success criteria for hydrology and vegetation in the 2001 Monitoring Year and more importantly, the Site exhibits wetland characteristics similar to reference. In addition, jurisdictional wetland criteria have been met throughout a much greater area than originally predicted. Continued monitoring and additional supplemental data will continue for the next four years and allow for an accurate estimation of restoration potential for the Site.

5.0 REFERENCE PAGE

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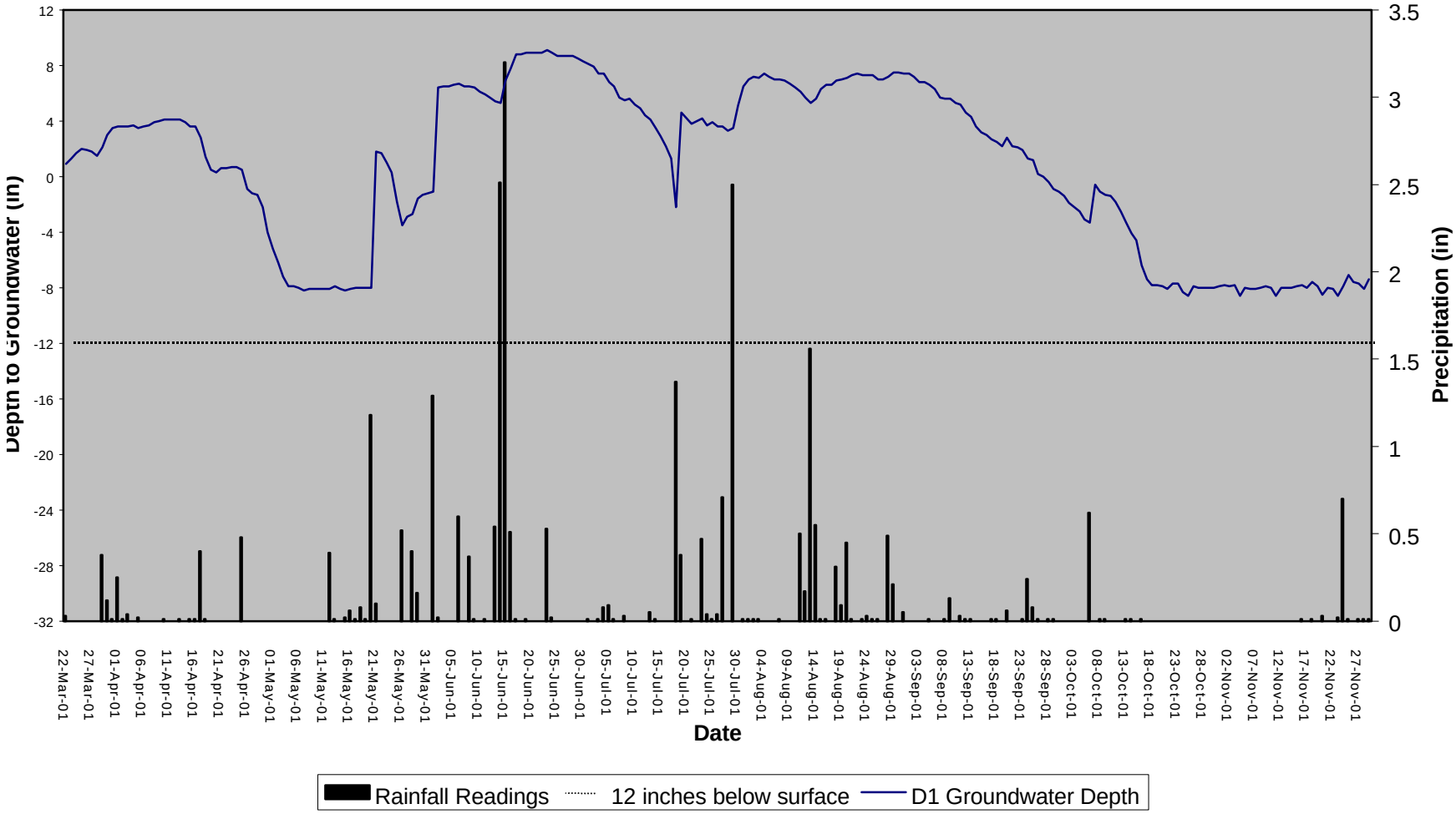
Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina: Third Approximation. Natural Heritage Program, Division of Parks and Recreation, N.C. Department of Environment, Health, and Natural Resources. Raleigh. 325 pp.

U.S. Department of Agriculture (USDA). 1995. Soil Survey of Beaufort County, NorthCarolina. Natural Resource Conservation Service.

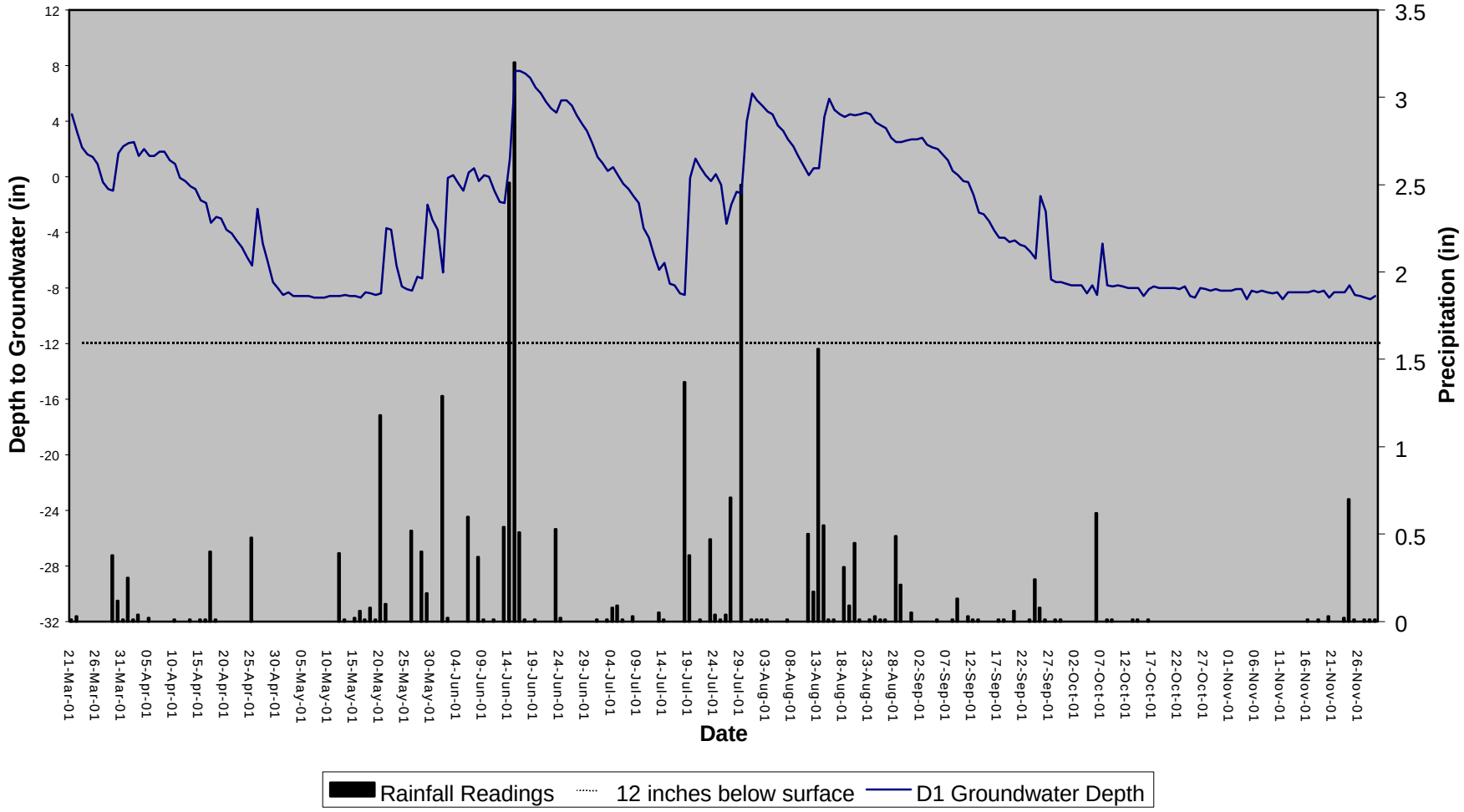
APPENDIX A

Monitoring Gauge Hydrographs

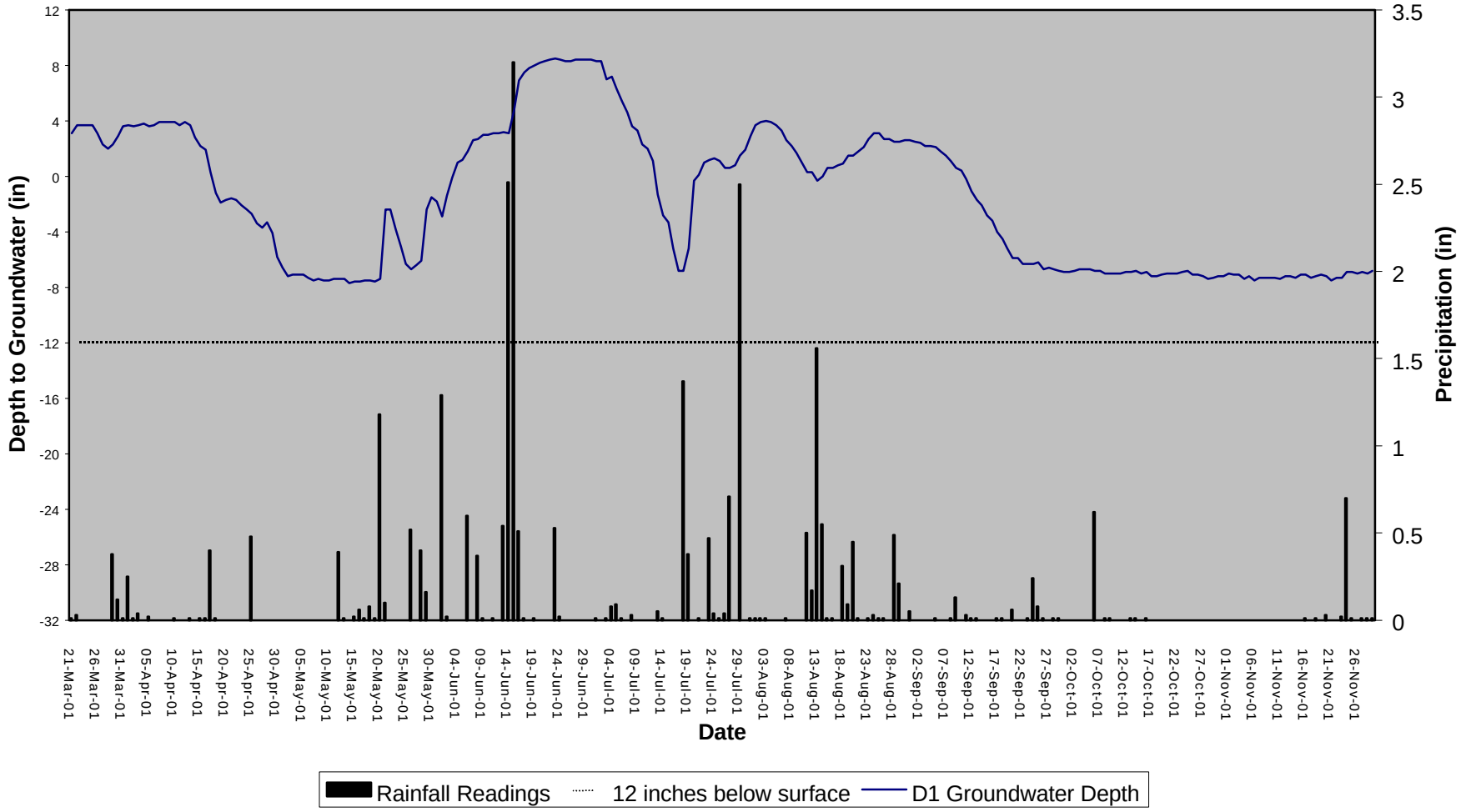
ABC Mitigation Site
Gauge D1



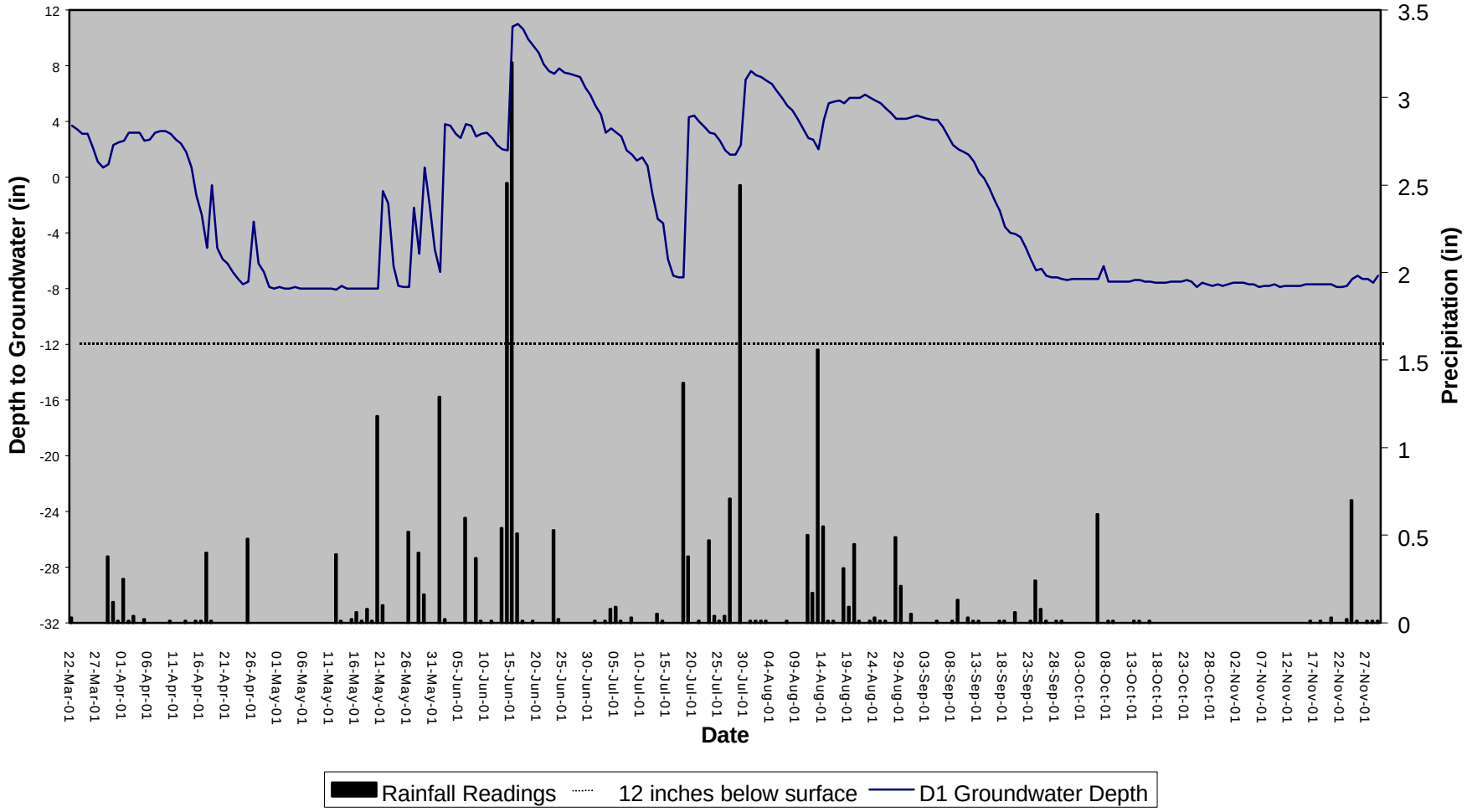
ABC Mitigation Site
Gauge D2



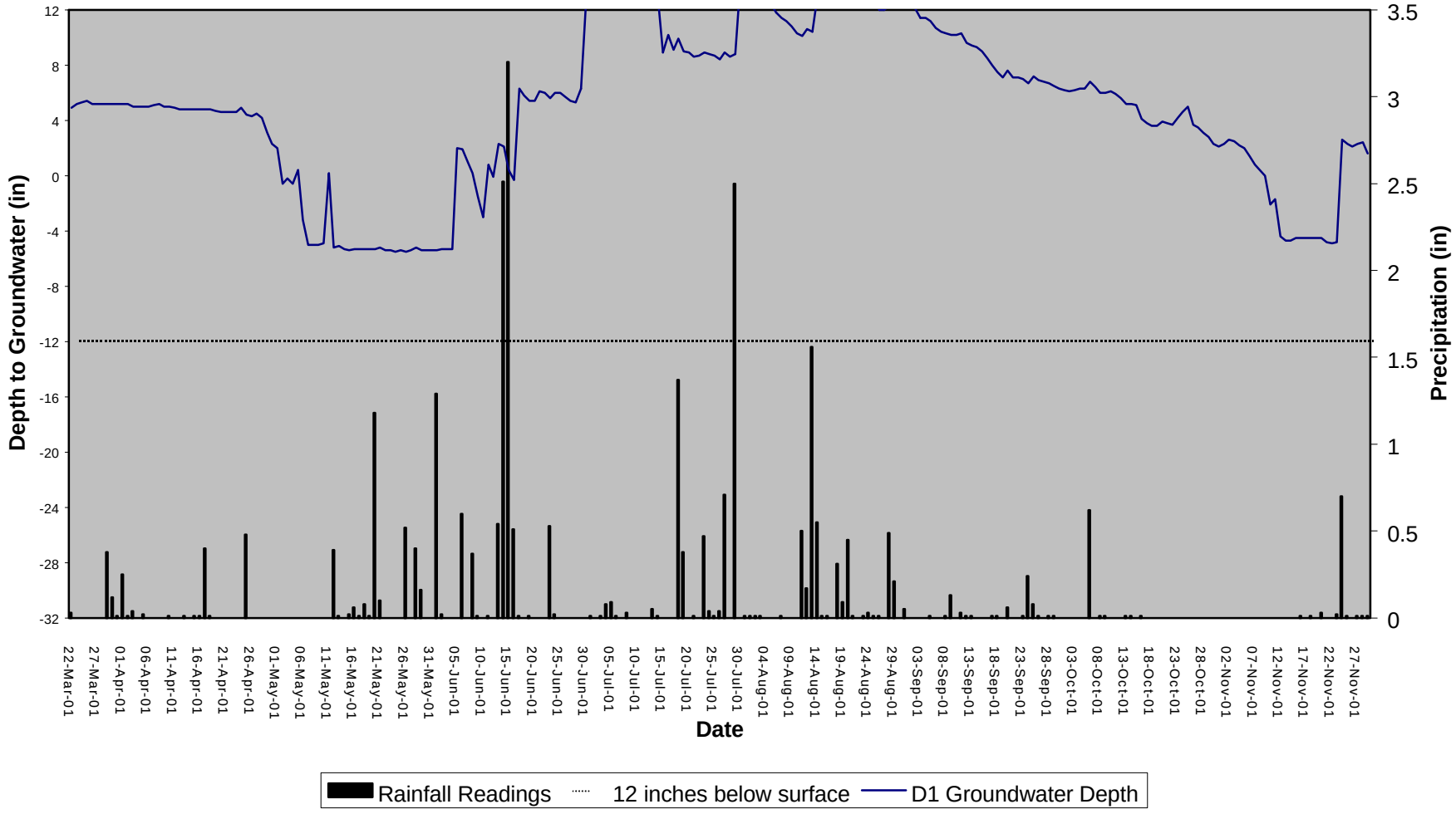
ABC Mitigation Site
Gauge D4



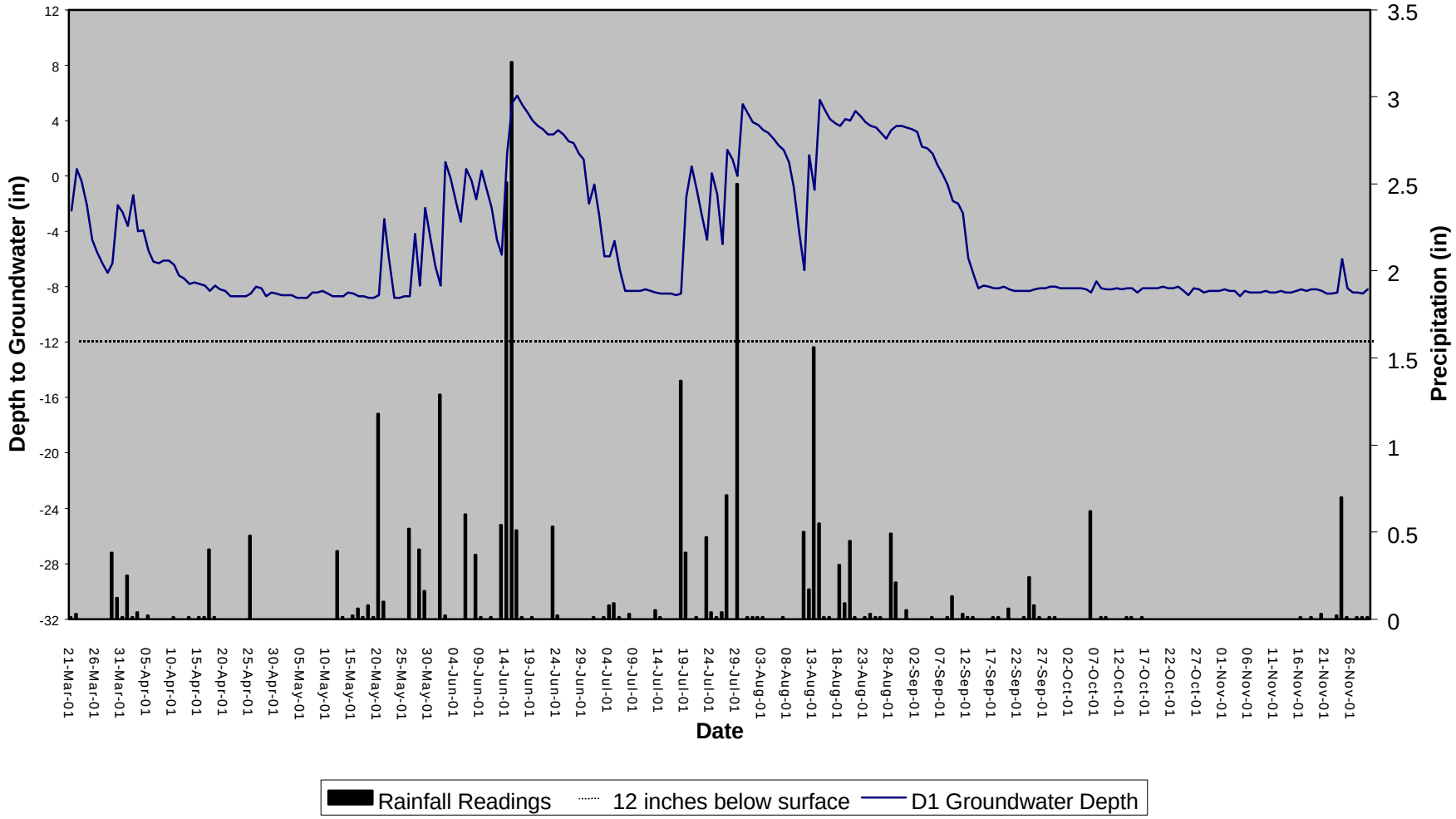
ABC Mitigation Site
Gauge D6



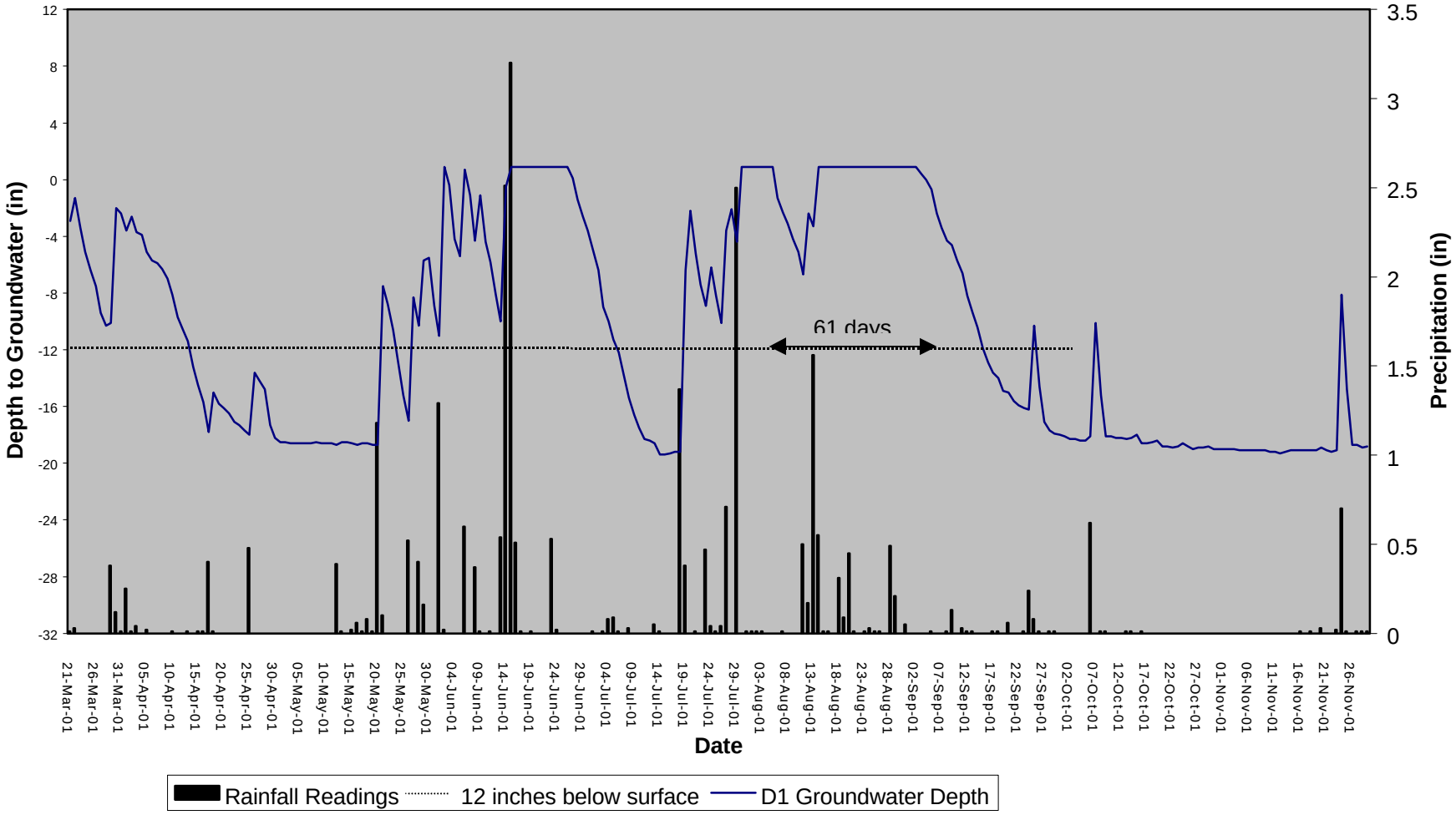
ABC Mitigation Site
Gauge D7



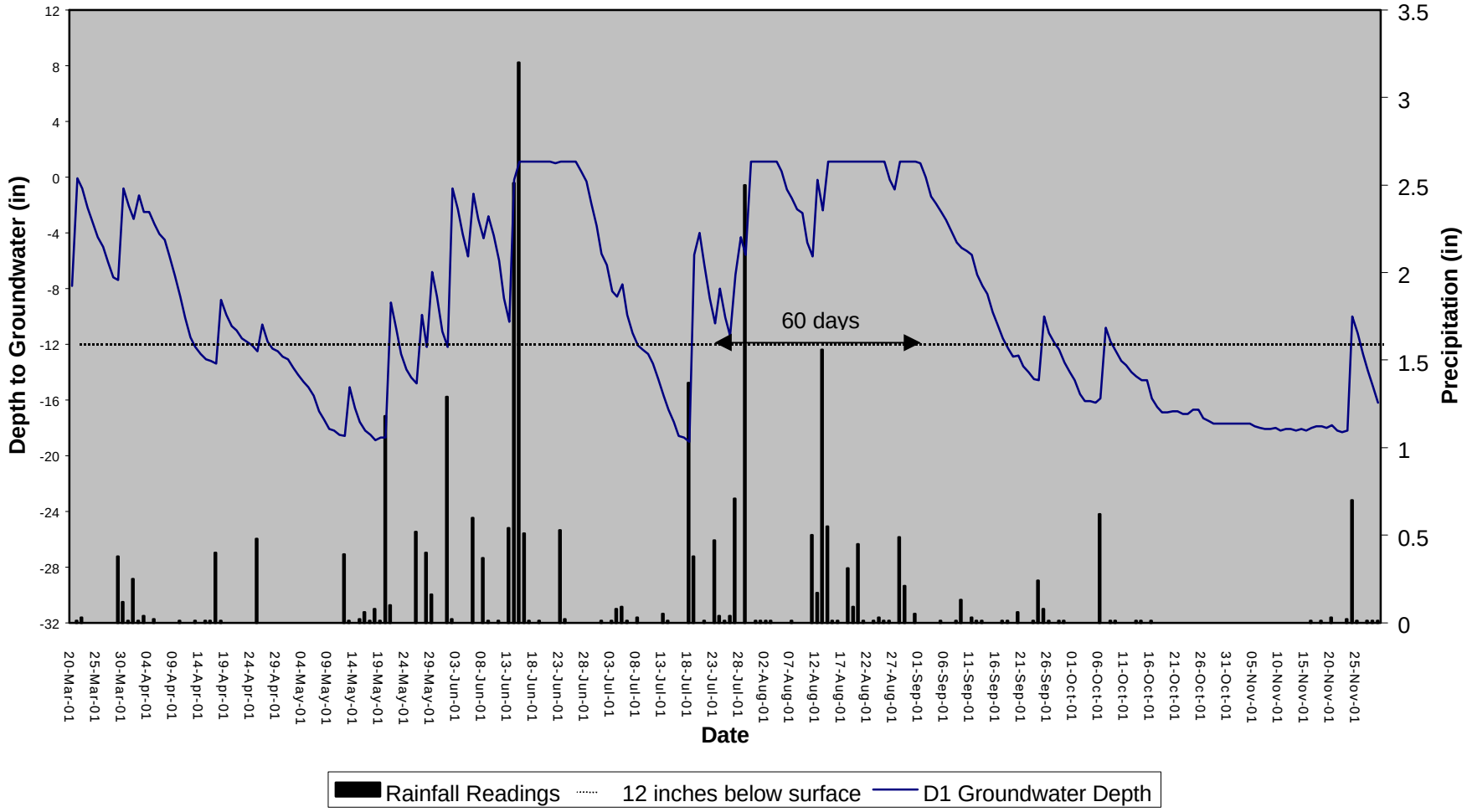
ABC Mitigation Site
Gauge D8



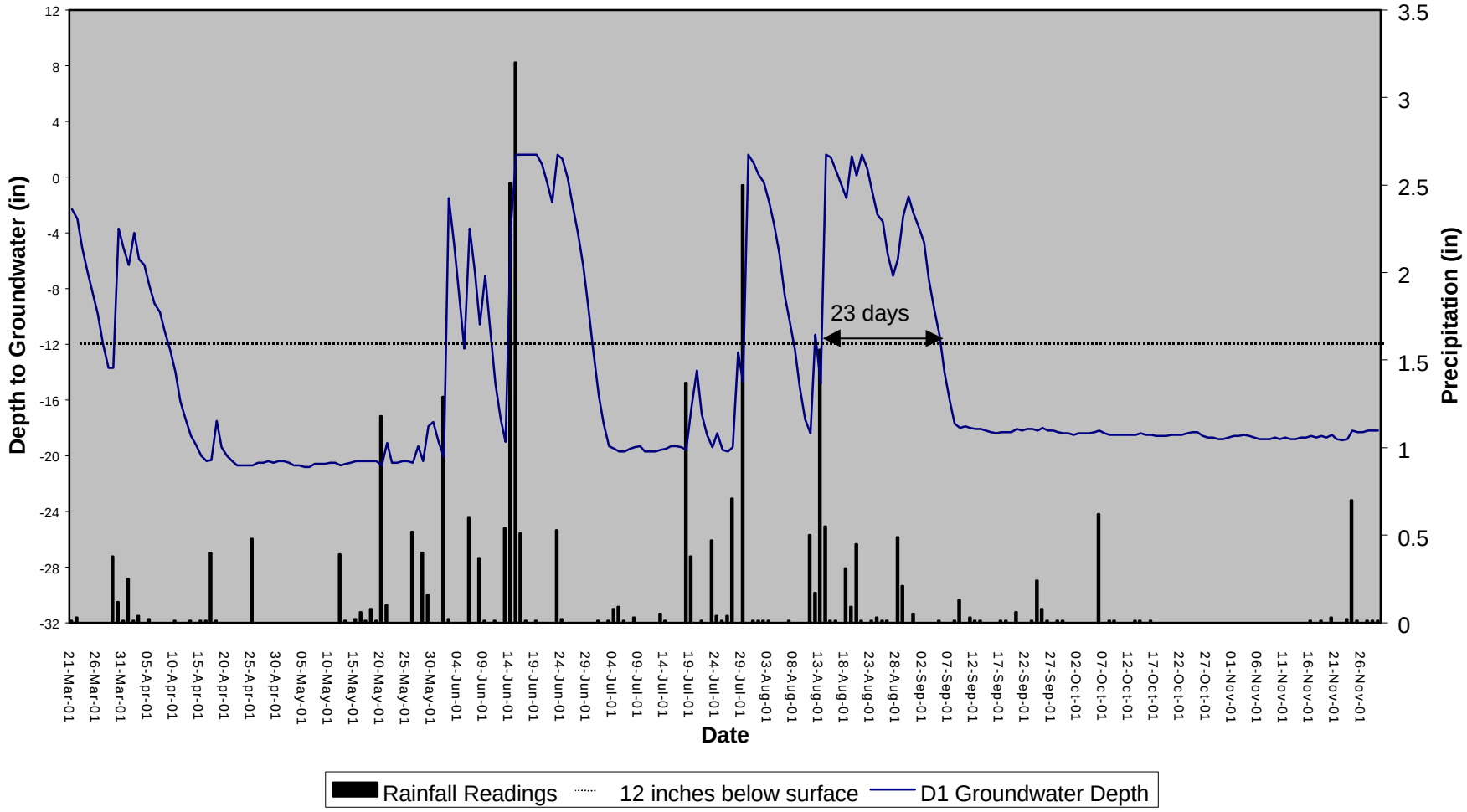
ABC Mitigation Site
Gauge F1



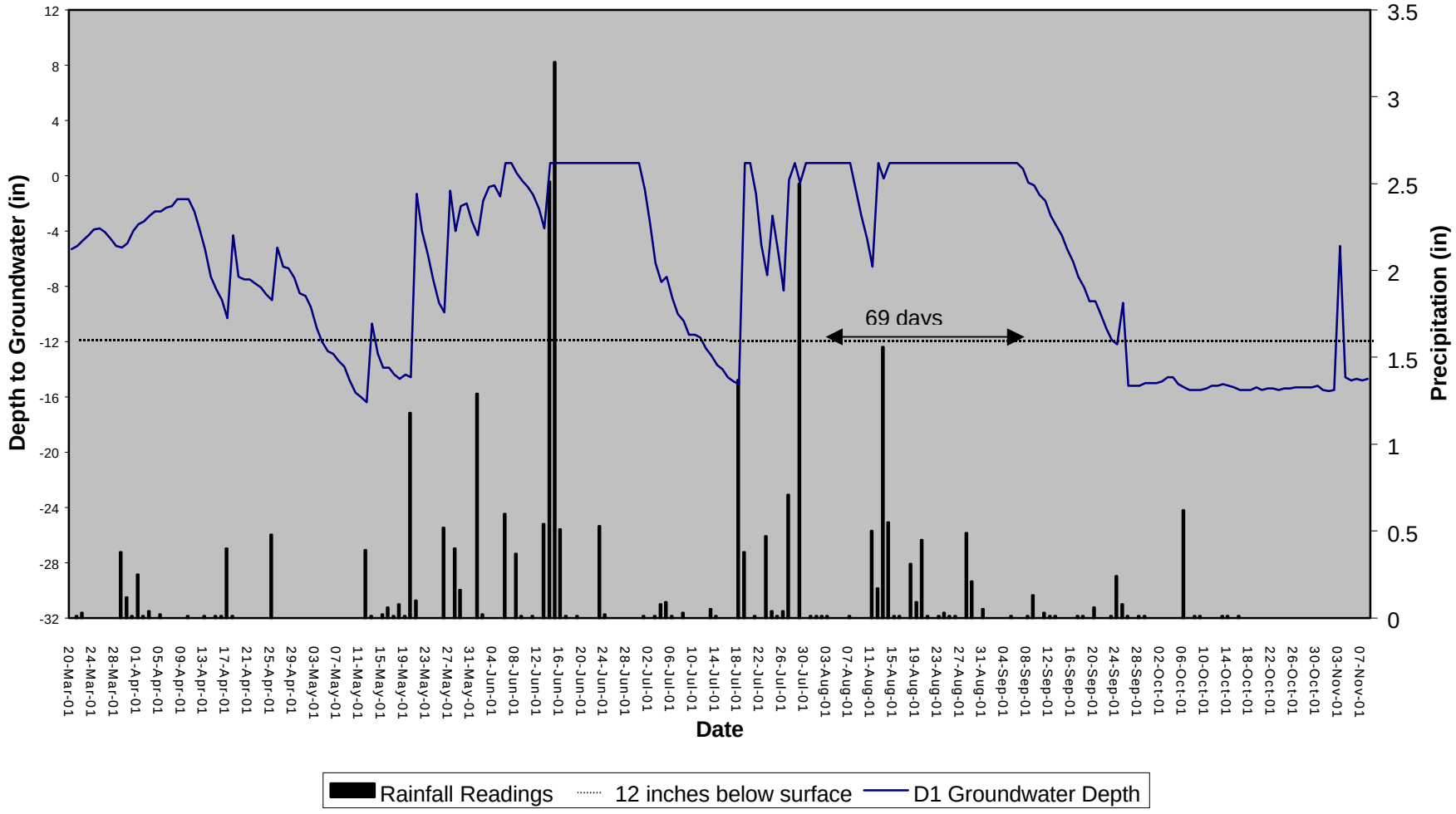
ABC Mitigation Site
Gauge F2



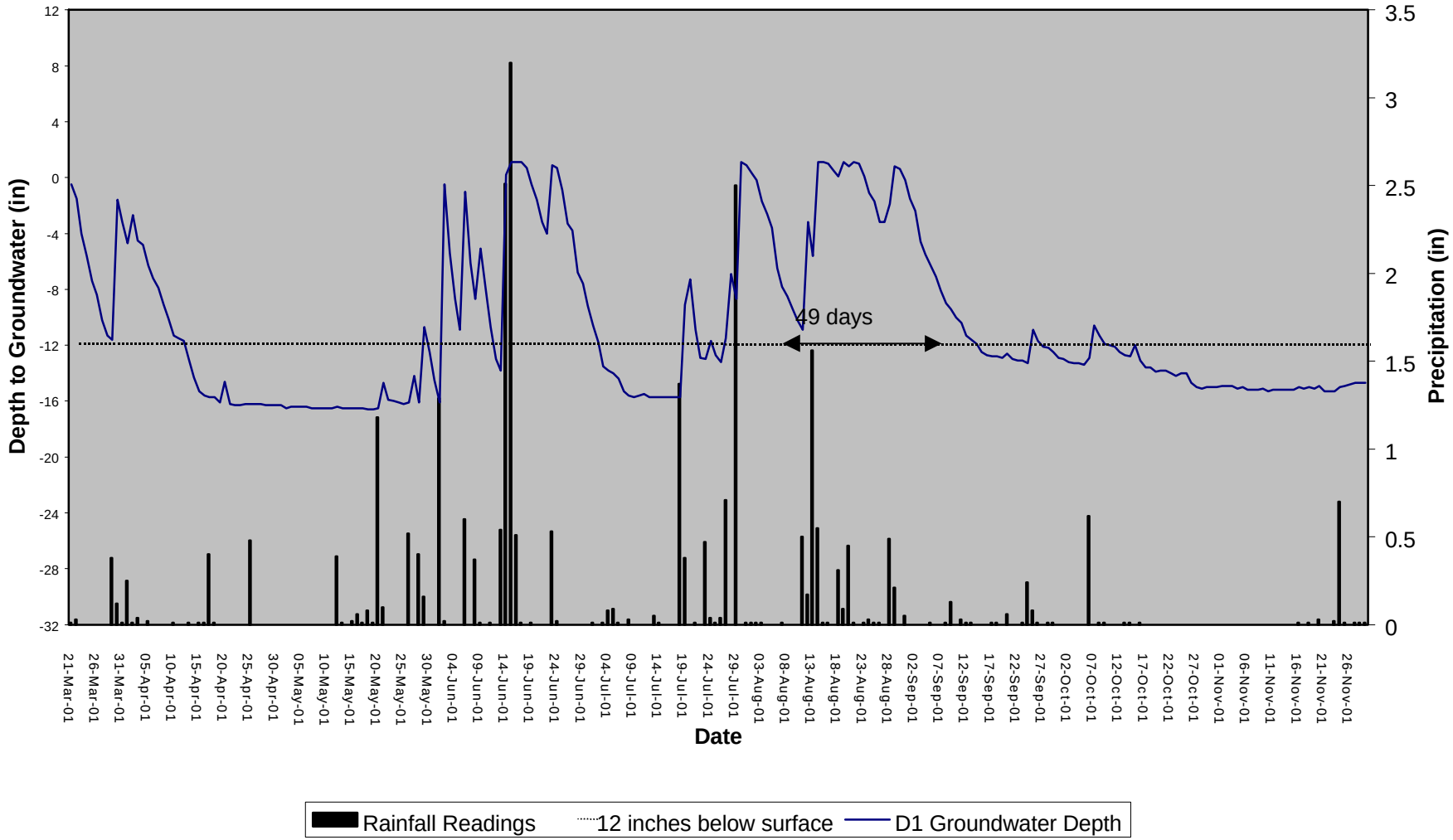
ABC Mitigation Site
Gauge F3



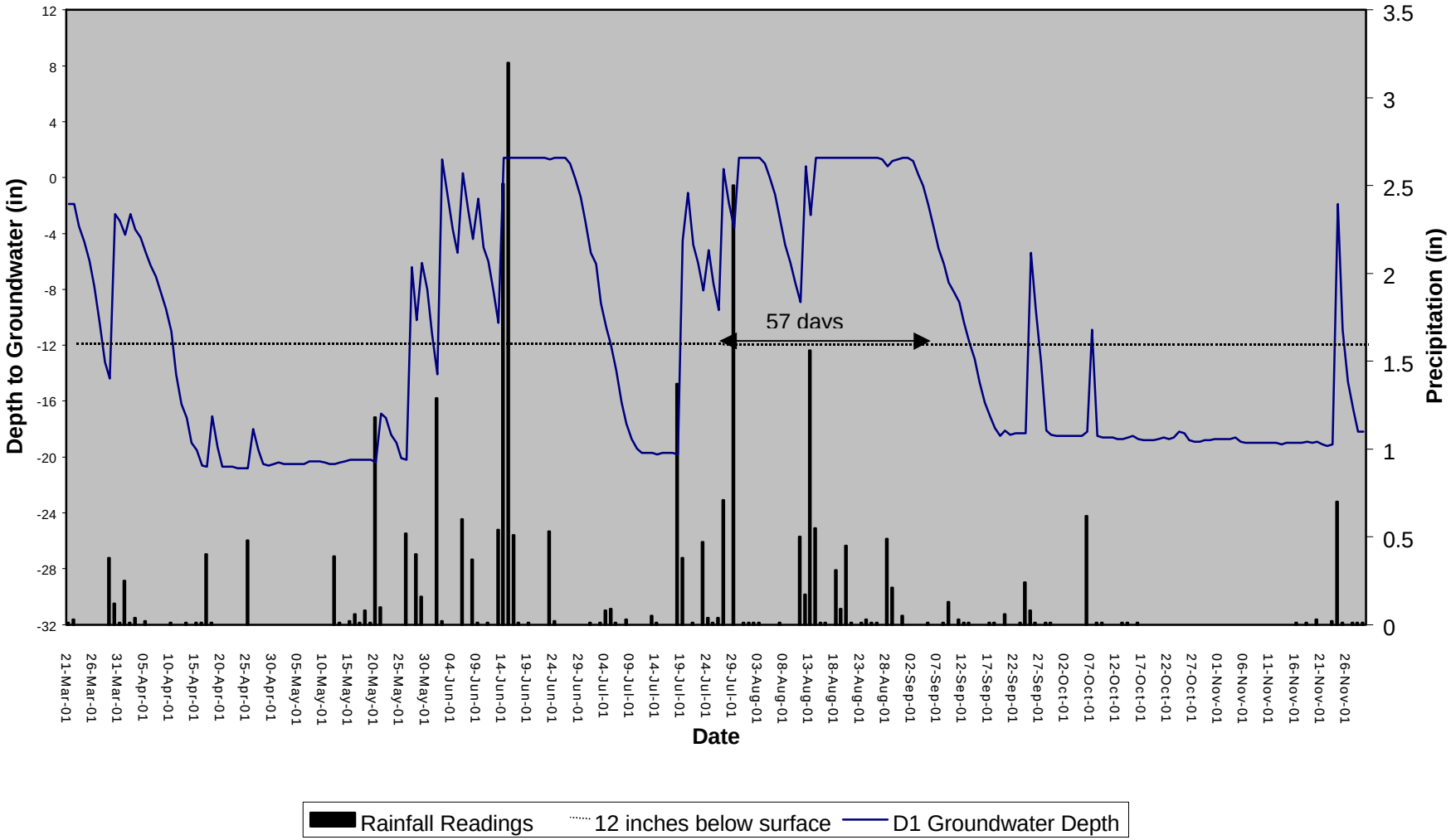
ABC Mitigation Site
Gauge F4



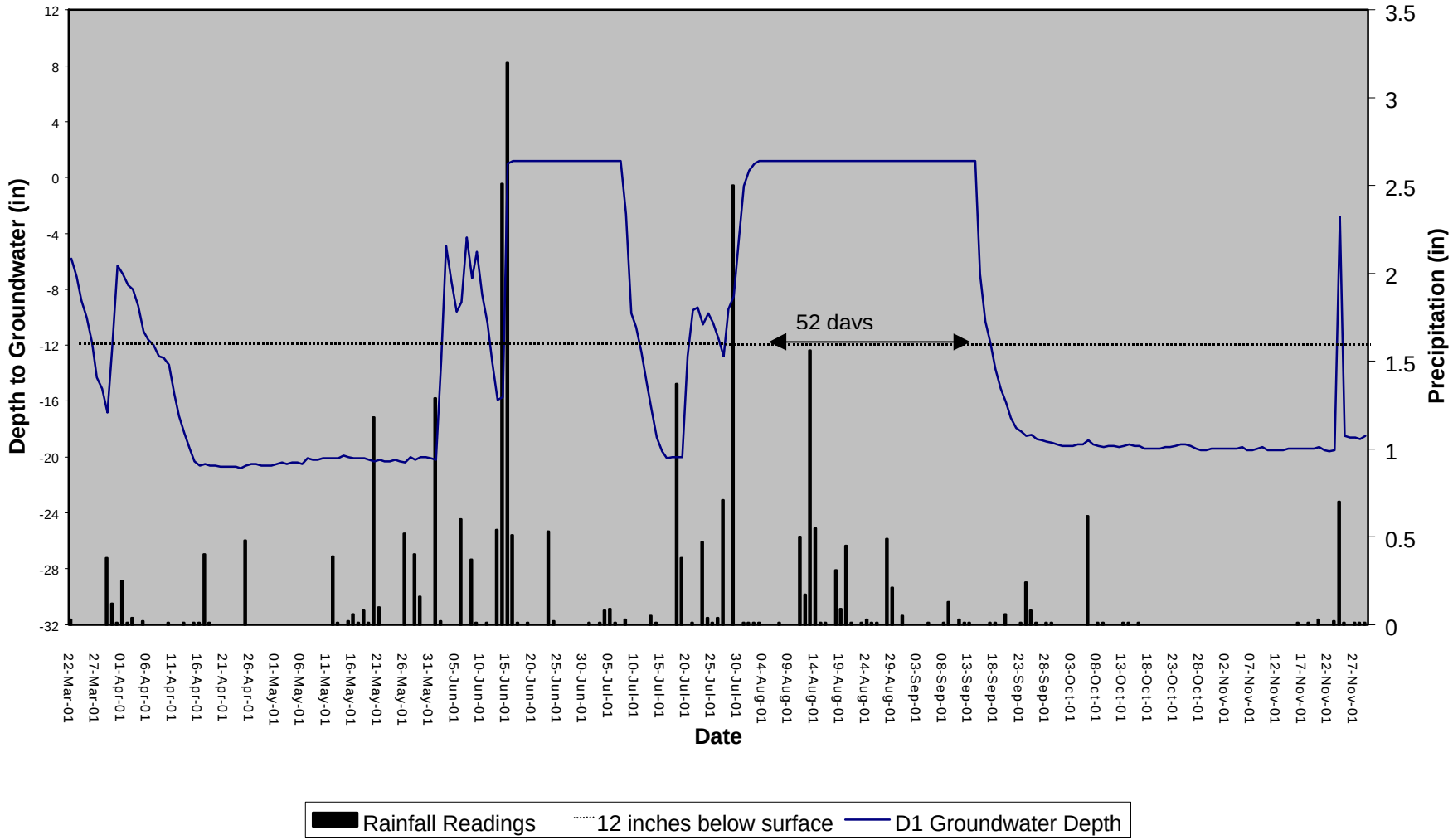
ABC Mitigation Site
Gauge F5



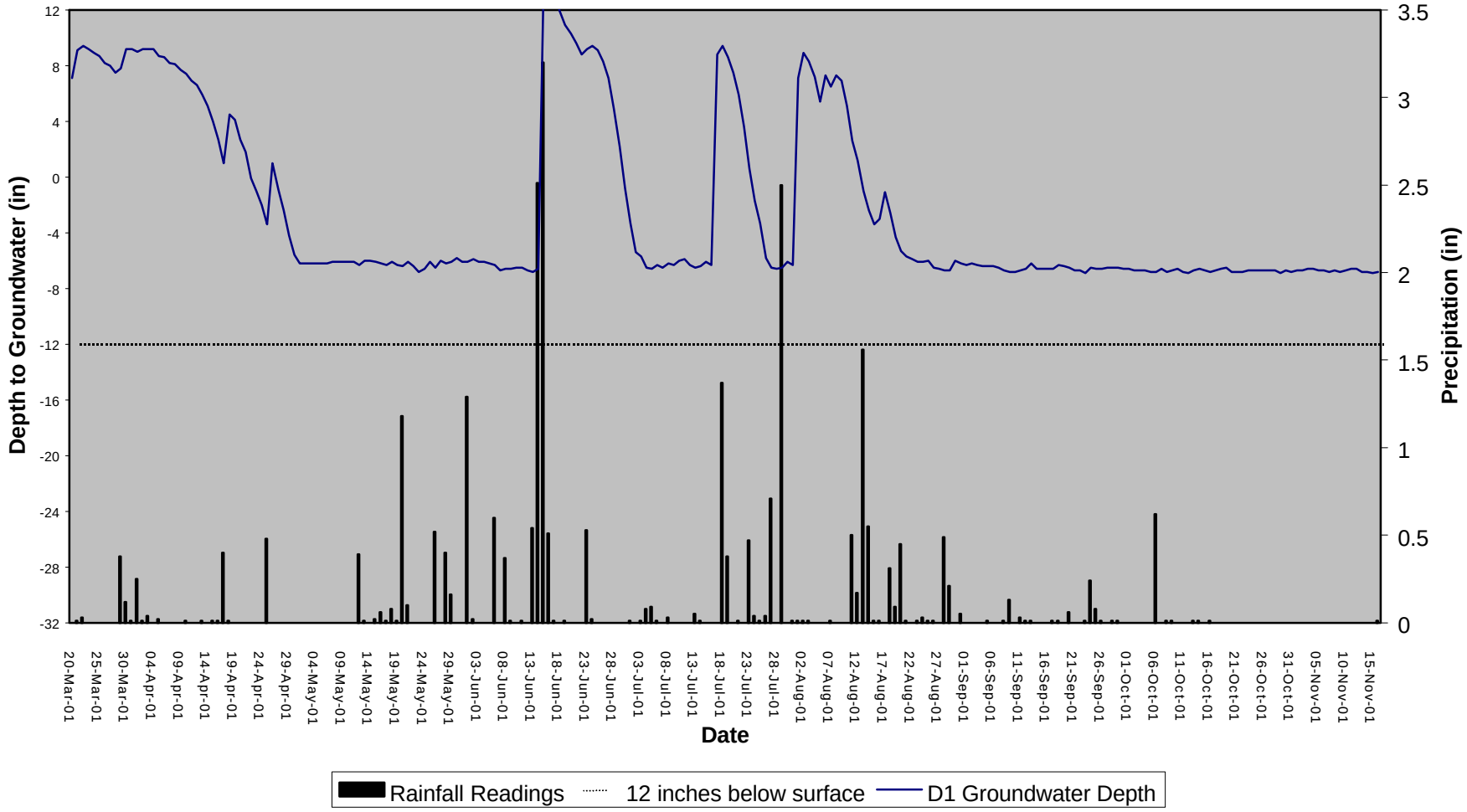
ABC Mitigation Site
Gauge F6



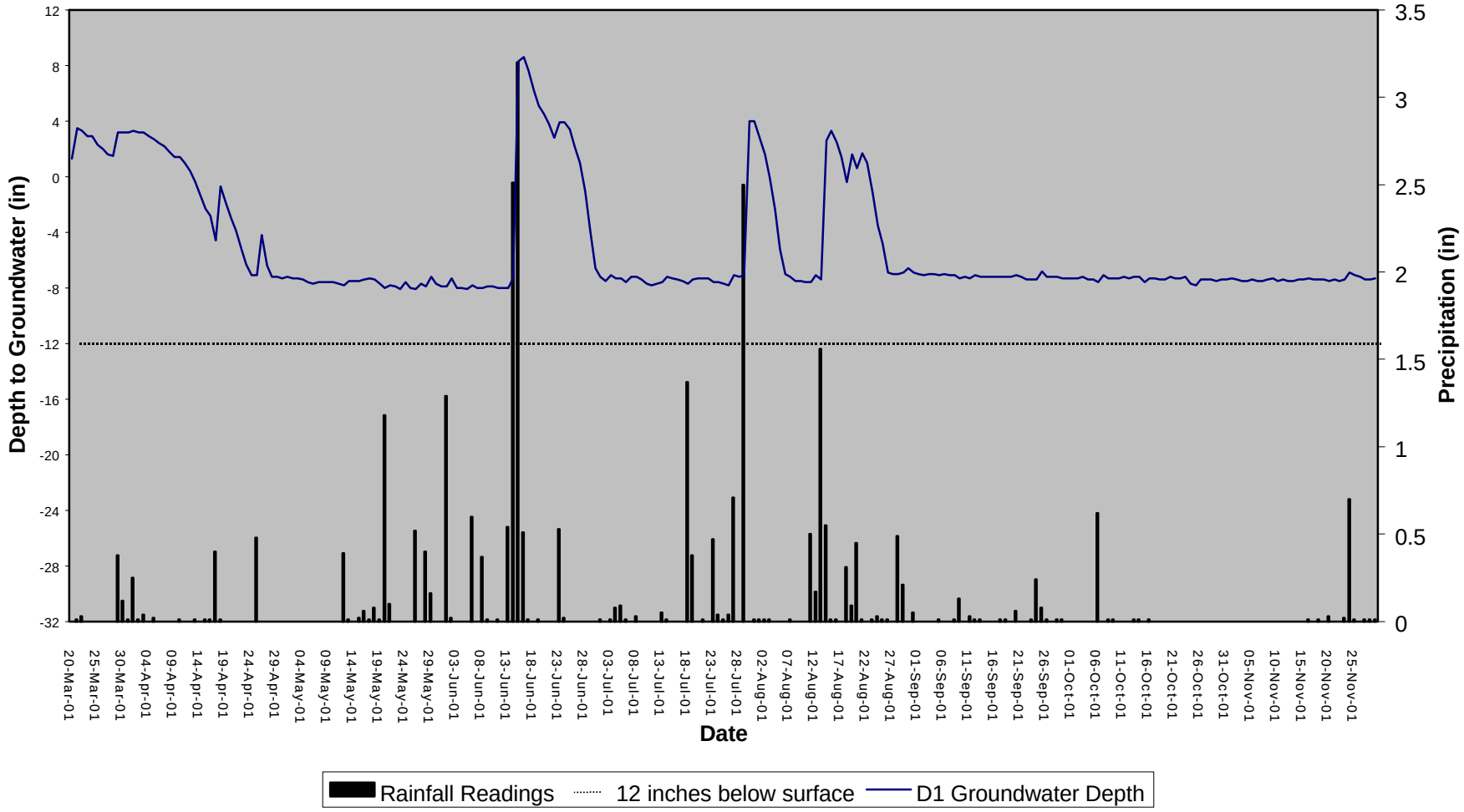
ABC Mitigation Site
Gauge F7



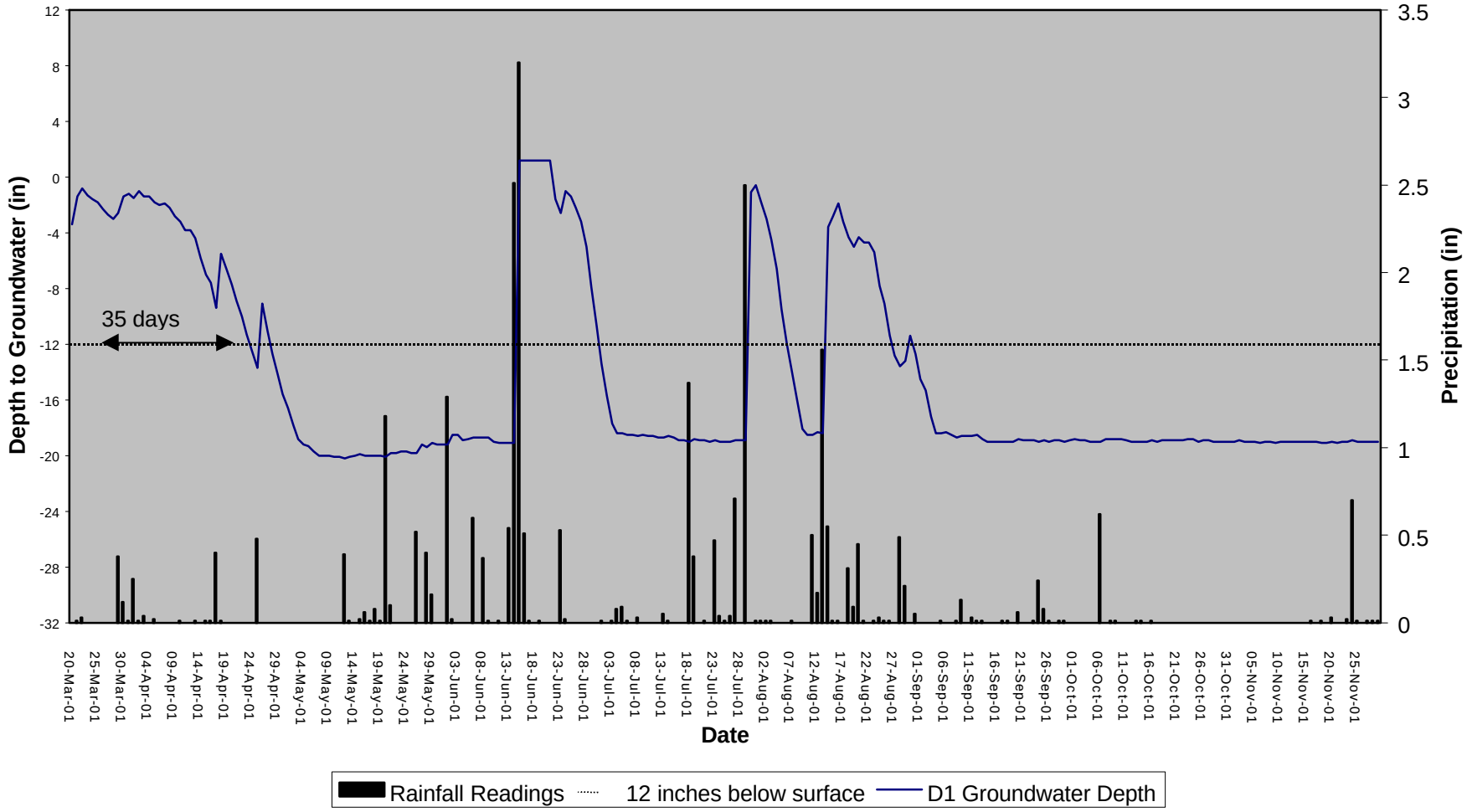
ABC Mitigation Site
Gauge RD1



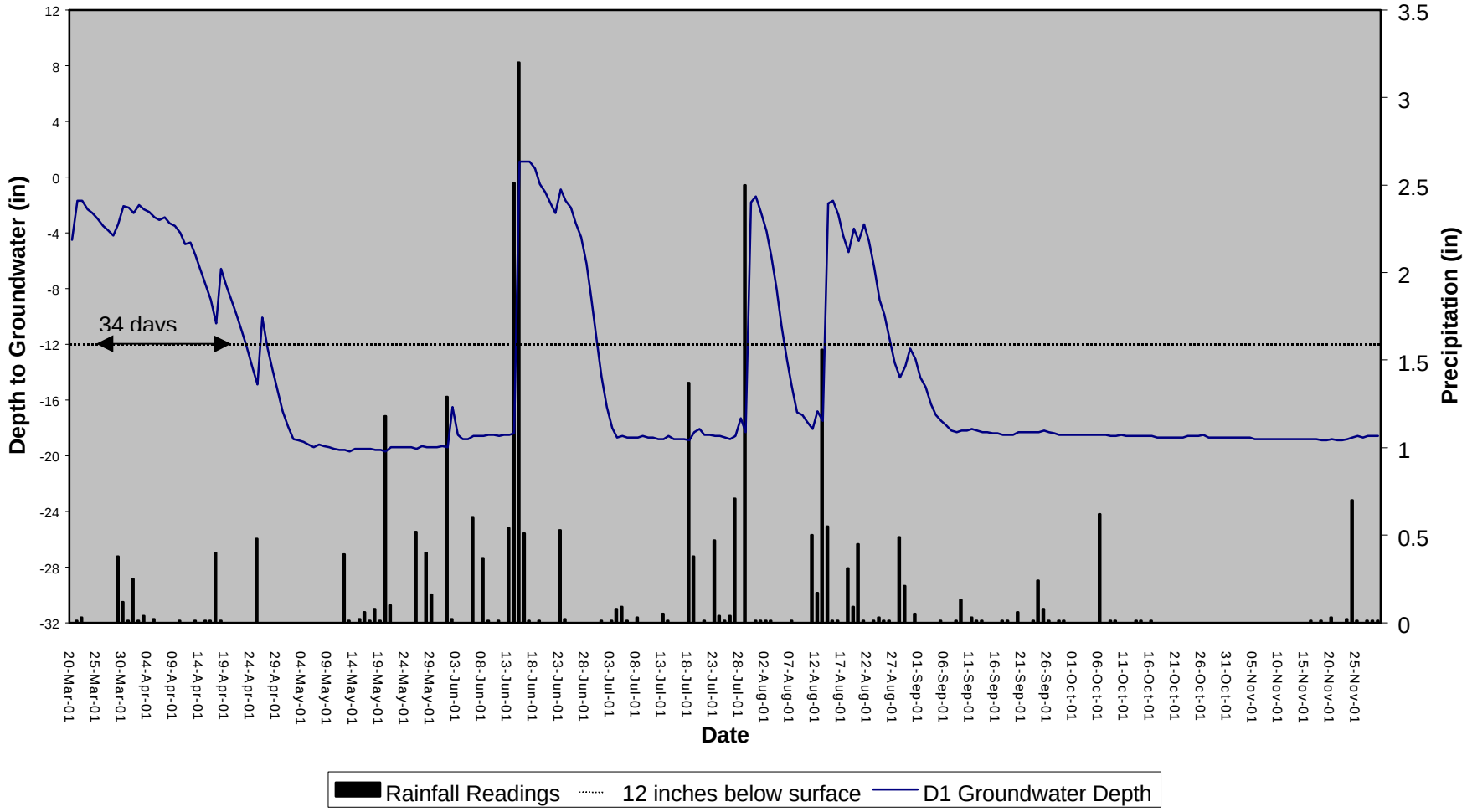
ABC Mitigation Site
Gauge RD2



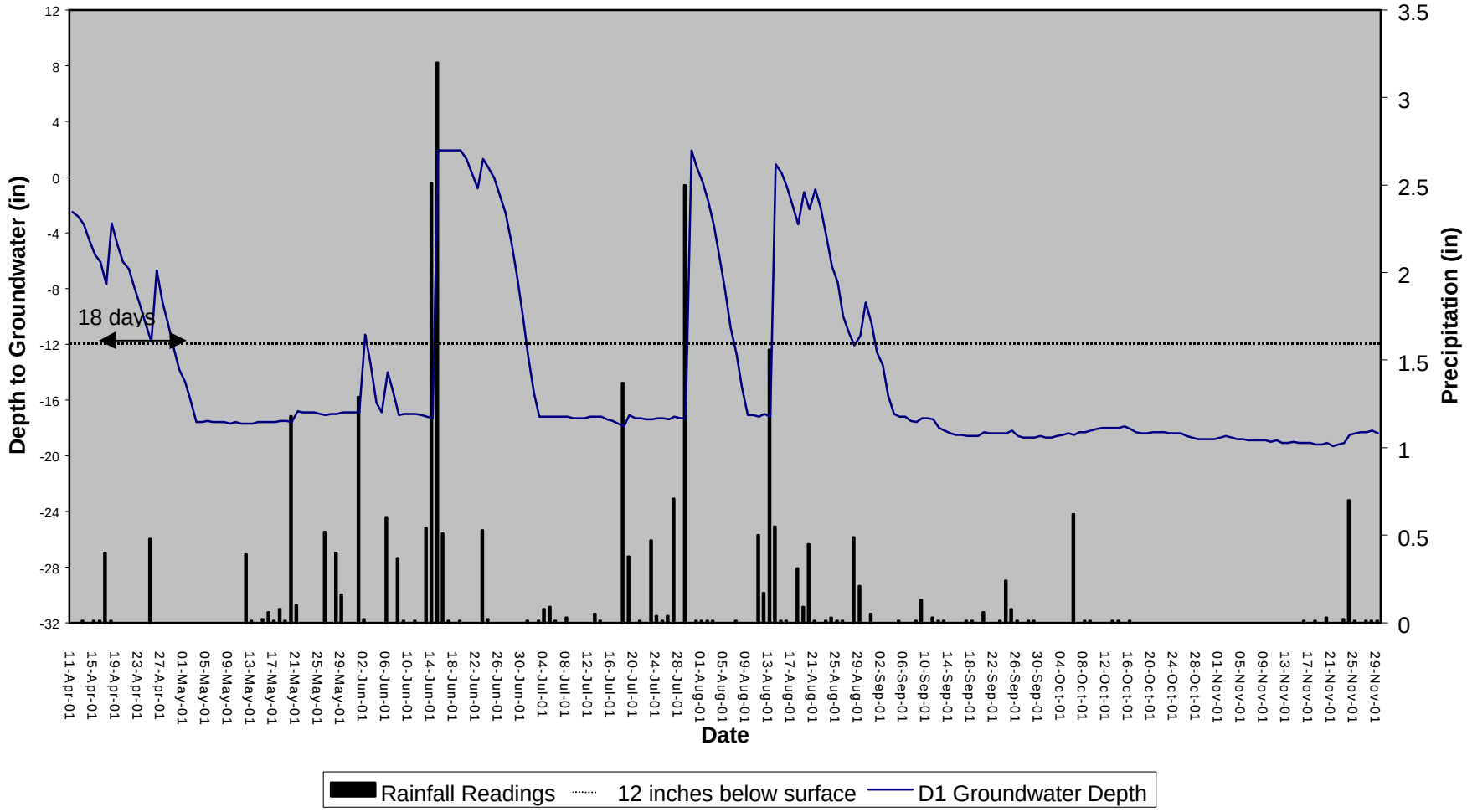
ABC Mitigation Site
Gauge RF1



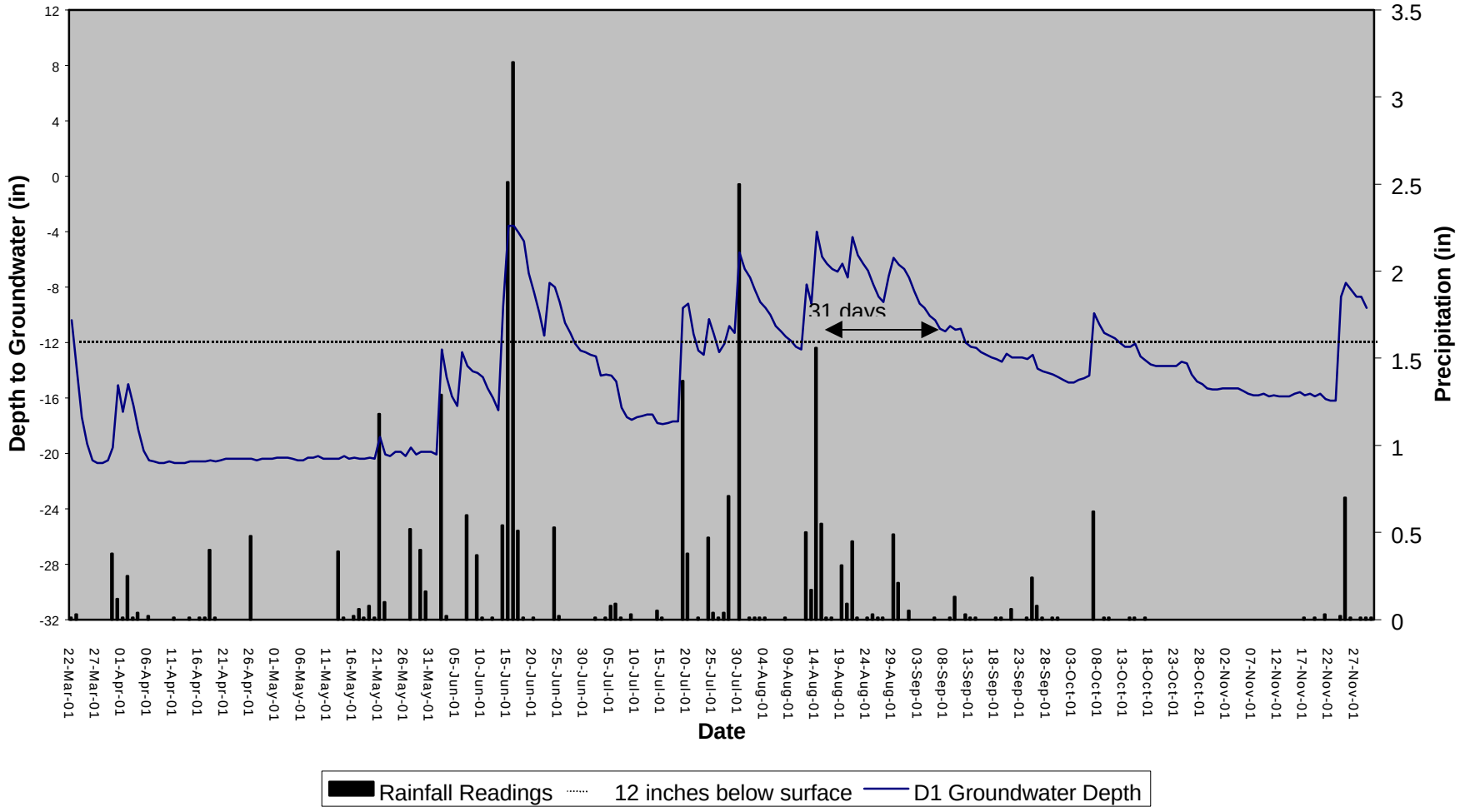
ABC Mitigation Site
Gauge RF2



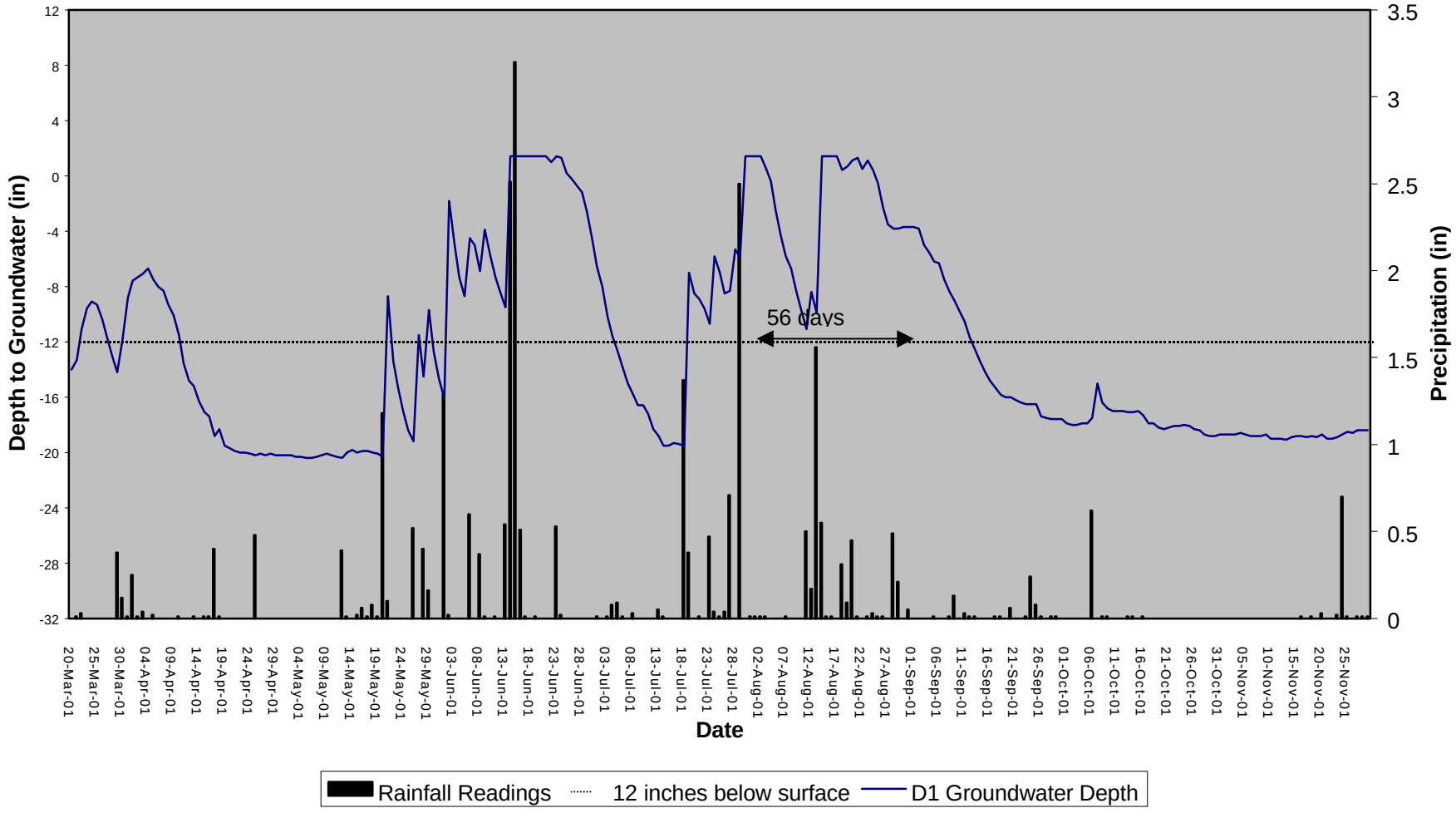
ABC Mitigation Site
Gauge RF3



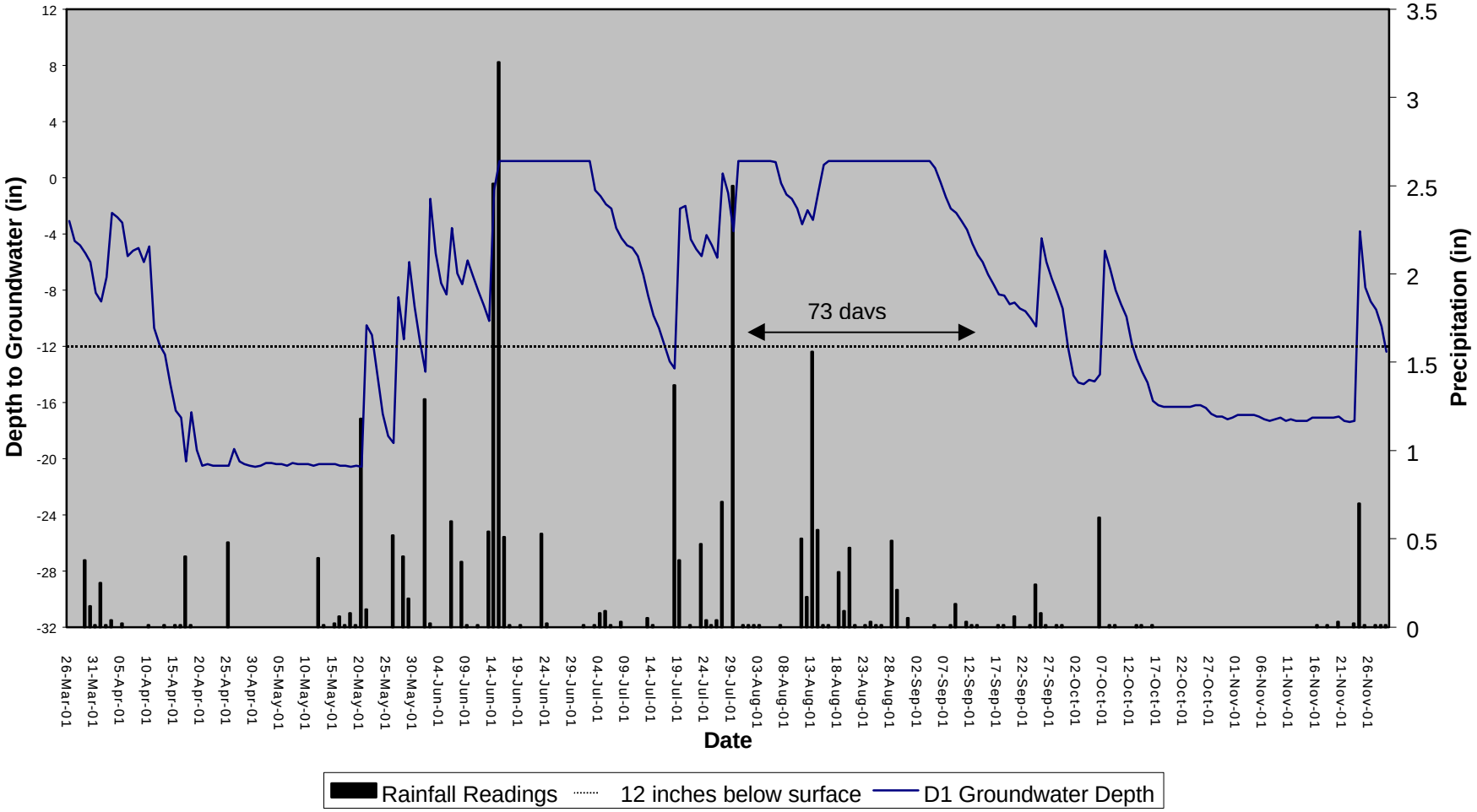
ABC Mitigation Site
Gauge S1



ABC Mitigation Site
Gauge S2



ABC Mitigation Site
Gauge S3



APPENDIX B

Photographic Record

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10