ANNUAL REPORT FOR 2003

Tulula Bog Mitigation Site
Graham County
Project No. 6.939004T
TIP No. A-9WM

Prepared By:
Office of Natural Environment & Roadside Environmental Unit
North Carolina Department of Transportation
December 2003

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SUMMARY

The following report summarizes the monitoring activities that have occurred in the past year at the Tulula Bog Mitigation Site. The site was originally constructed in 2002. The Phase I portion of the site was planted in April 2002, while Phase II was planted in March 2003. The 2003-year represents the first complete year of hydrologic and vegetation monitoring following site construction. The site must demonstrate both hydrologic and vegetation success for a minimum of five years or until the site is deemed successful. It is currently being monitored with thirty groundwater gauges and three vegetation-monitoring plots.

The daily rainfall data depicted on the monitoring gauge graphs was recorded from a local weather station located in Andrews, NC. Historical rainfall data used for the 30th-70th percentile analysis was provided by the Andrews weather station. The NC State Climate Office maintains and provided all of the rainfall data for the Tulula Bog Mitigation Site.

During the 2003 monitoring year, twenty-eight of the thirty-groundwater gauges were downloaded. There is no hydrologic data for gauges D4 and E4. The first year of hydrologic data revealed that eighteen of the twenty-eight groundwater gauges met the success criteria for saturation (within 12" of the surface for 5% of the growing season). Conversely, ten gauges recorded saturation for less than 5% of the growing season. NCDOT will investigate these ten gauges to ascertain whether the gauges are representative of conditions in each respective area.

Vegetation data for the first year of monitoring revealed an average density of 562 trees per acre for the 19.4 acres that were planted. This average is well above the minimum success criteria of 320 trees per acre.

The University of North Carolina at Asheville is performing the stream restoration monitoring, as a part of a grant received from the Department. Upon receipt of this information, the Department will provide appropriate documentation to the resource agencies via the NCDOT website.

NCDOT will continue to monitor the Tulula Bog Mitigation Site for hydrology and vegetation.

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

The Tulula Bog Mitigation Site is a 222-acre tract located in Graham County, NC. The site was developed as a wetland and stream mitigation project designed to assist in replacing highway-related impacts in the mountain region. The mitigation site contains 101 acres of wetland restoration, 121 acres of upland buffer protection, 9,640 feet of stream restoration and 1,400 feet of stream enhancement. It is located off of Highway 129 between Topton and Robbinsville (Figure 1).

1.2 PURPOSE

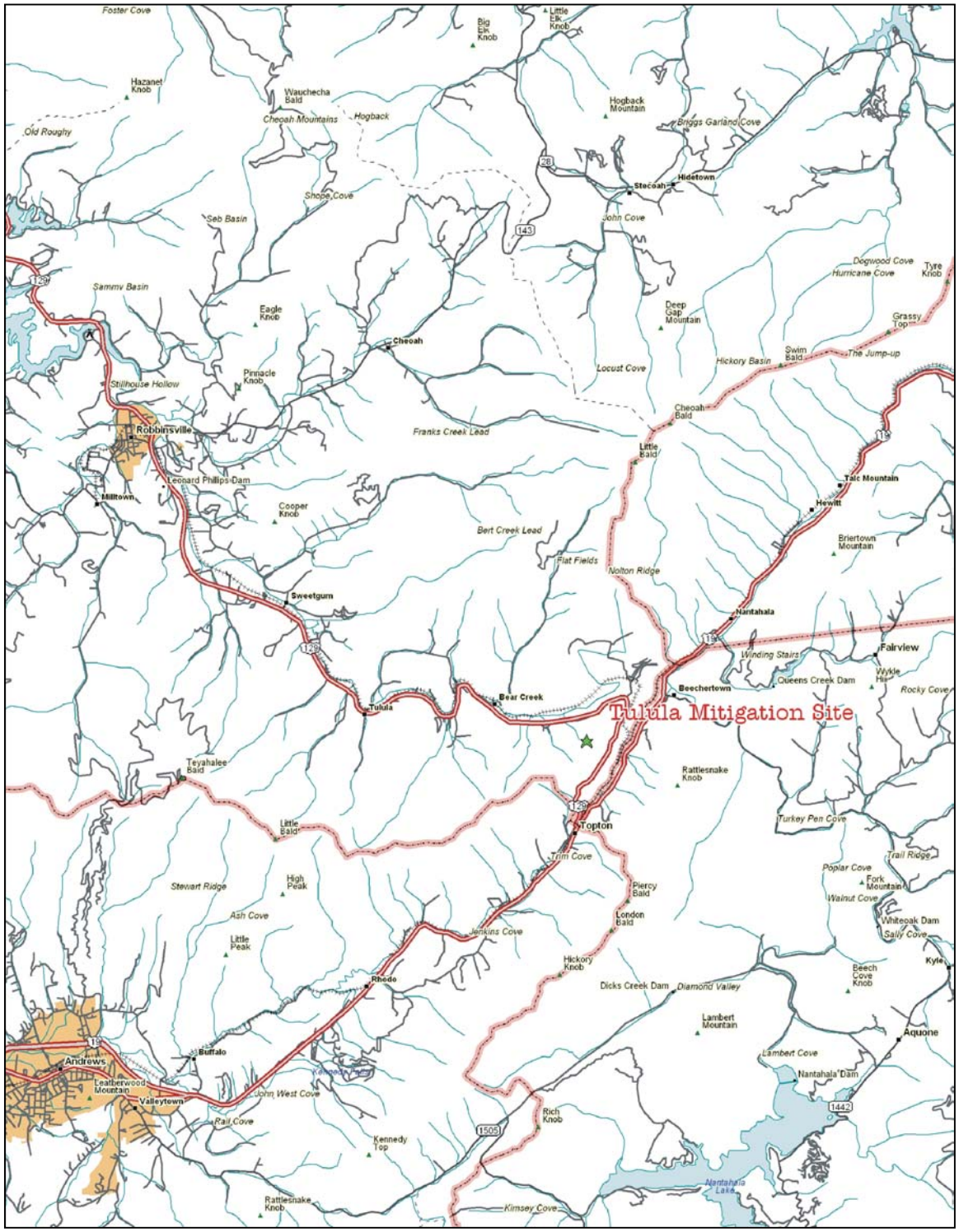
In order to demonstrate successful mitigation, hydrologic and vegetative monitoring must be conducted for a minimum of five consecutive years or until the site is deemed successful. Success criteria are based on federal guidelines for wetland mitigation. These guidelines stipulate criteria for both hydrologic conditions and vegetation survival. The following report details the results of hydrologic and vegetative monitoring during the 2003-growing season at the Tulula Bog Mitigation Site.

Activities in 2003 reflect the first year of monitoring following the restoration efforts. Included in this report are analyses of both hydrologic and vegetative monitoring results, as well as local climate conditions throughout the growing season, and site photographs.

1.3 PROJECT HISTORY: TULULA BOG

July 2000	Monitoring Gauges Installed
April 2002	Phase I Planted
March 2003	Phase II Planted
March - November 2003	Hydrologic Monitoring (1 yr.)
September 2003	Vegetation Monitoring (1 yr.)

Figure 1. Site Location Map



1.4 DEBIT LEDGER

Table 1. Tulula Bog Debit Ledger

Tulula Bog	Mit. Plan			TIP DEBIT	TIP DEBIT	TIP DEBIT	TIP DEBIT	TIP DEBIT
Habitat	Acres At Start:	Acres Remaining	Total Debited	R-2102	A-9DA	A-9DB/DC	A-10BB/C/D	A-9DD
Wetland Functional Restor.	101	47.84	47.4	2.36	0.56	3	30	17.24
Upland Buffer/Protection	121	121	100.00					
Stream Restoration	9,640	3,112	32.3			3,248		3,280
(Linear Feet)								
TOTAL	222	168.84	76.1					

2.0 HYDROLOGY

2.1 SUCCESS CRITERIA

In accordance with federal guidelines for wetland mitigation, the success criteria for hydrology state that the area must be inundated or saturated (within 12" of the surface) by surface or groundwater for at least a consecutive 5% of the growing season during a normal precipitation year. Areas inundated or saturated 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. Areas inundated for less than 5% of the growing season are always classified as non-wetlands.

Stream gauge data will be utilized to substantiate the frequency of the bankfull discharge. The target frequency of the bankfull discharge is a one to two year return interval under normal climatic conditions. Stream gauge monitoring and bankfull calculations will require average climatic conditions including an average distribution of peak storm events. The University of North Carolina at Asheville is performing the stream restoration monitoring, as a part of a grant received from the Department.

The growing season in Graham County begins March 26 and ends November 10. These dates correspond to a 50% probability that temperatures will not drop to 28°F or lower after March 26 and before November 10[1]. Therefore, the growing season consists of 229 days; 5% of the growing season is equal to 12 days. Local climate must also represent average conditions for the area.

[1] Natural Resources Conservation Service, Soil Survey of Graham County, North Carolina.

2.2 HYDROLOGIC DESCRIPTION

In July 2000, thirty groundwater-monitoring gauges were installed along eight transects perpendicular to the stream (Figure 2). The automatic monitoring gauges record daily readings of groundwater and surface water depth.

The Tulula Bog Site was designed to receive hydrologic input from rainfall and water accessing the floodplain. The hydrologic monitoring should show the reaction of the groundwater level to specific rainfall events, as well as the surface water level.

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 well. This number was converted into a percentage of the 229-day growing season (March 16 – November 10). The results are presented in Table 2.

Appendix A contains a plot of the groundwater depth for each monitoring well. The maximum number of consecutive days is noted on each graph. The individual precipitation events are shown on the monitoring well graphs as bars.

Figure 3 provides a graphical representation of the hydrologic results. Gauges highlighted in blue indicate wetland hydrology for more than 12.5% of the growing season. Gauges highlighted in red show hydrology between 8% and 12.5% of the growing season, while those in green indicate hydrology between 5% and 8%. Gauges highlighted in black indicate no wetland hydrology (less than 5% of the growing season).

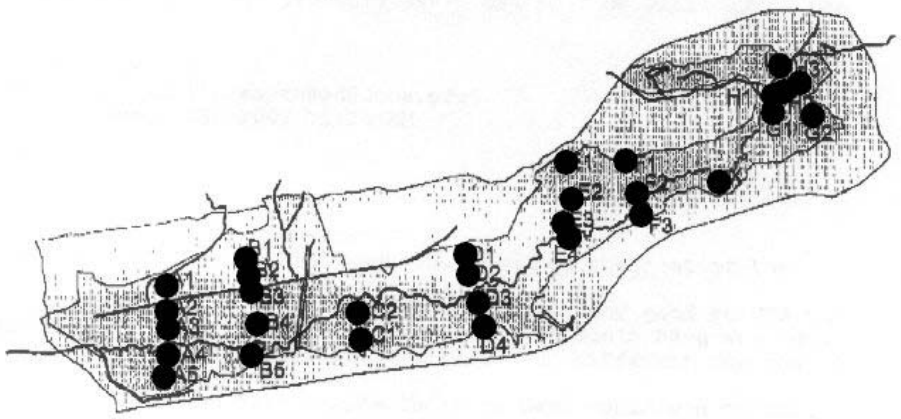


Figure 2. Gauge Location Map

Not to Scale

Table 2. Hydrologic Monitoring Results

Monitoring Well	<5%	5-8%	8-12.5%	>12.5%	Actual %	Success Dates
A1AA S3173D1+				×	27.5	March 26-May 27 June 4-June 21 Oct 27-Nov 10
A2A S31F924	×				0	
A3A S31F776+				×	26.2	June 2-June 17 July 9-Sept 6
A4A S342C87+				×	76.0	March 26-Sept 15
A5A S3167A6	×				0.9	
B1A S3166AA	×				1.3	
B2A S317654+				×	21.8	March 26-May 14 July 1-July 28
B3A S342D51	×				0	
B4A S31F901+				×	58.1	April 24-June 24 July 1-Nov 10
B5A S31F89A+				×	29.3	March 26-May 31 July 30-Sept 18
C1A S494291+				×	100	March 26-Nov 10
C2A S317659+				×	59.8	March 26-Aug 9
D1A S3166FD	×				0.9	
D2A S31F81A	×				1.7	
D3A S31671B+				×	29.3	March 26-May 31 Sept 24-Oct 22
E1A S31F7D3+				×	54.6	March 26-July 28
E2A S342CE0+				×	41.9	March 26-June 29 Sept 23-Nov 9
E3A S31FAA0+				×	60.7	March 26-Aug 11
F1A S31F764+				×	22.3	March 26-May 15
F2A S31F813	×				1.3	

Monitoring Well	<5%	5-8%	8-12.5%	>12.5%	Actual %	Success Dates
F3AA S4CFD03	✕				3.9	
G1A S31F9A1+				✕	40.2	March 26-June 25
G2A S3169EF+				✕	38.9	March 26-June 22
H1AA S494262+			✕		10.9	April 5-April 29 May 1-May 20
H2A S31F93E			✕		9.2	April 22-May 12
H3AA S31F877	✕				3.9	
I1A S3166B4	✕				0	
X1A S316723+				✕	39.3	March 26-June 23

+ Gauge met the success criterion during an average rainfall month (February, April, June, and July).

Specific Gauge Problems:

- Gauge A3A experienced malfunctions and was not downloaded from January 1-May 14.
- Gauge F1A experienced malfunctions and was not downloaded from July 3-November 18.

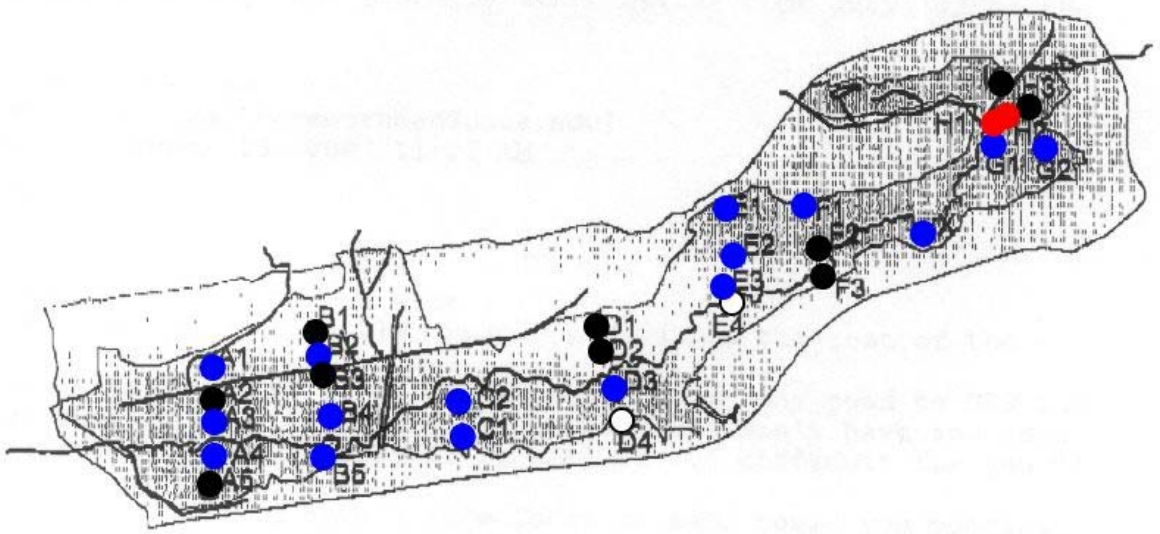


Figure 3. 2003 Hydrologic Monitoring Gauge Results

Hydrology Results
- < 5%
- 5 - 8%
- 8 - 12.5%
- > 12.5%

- Rain Gauge
- Surface Gauge
- Not Applicable

Not to Scale

2.3.2 Climatic Data

Figure 4 is a comparison of monthly rainfall for the period of November 2002 through August 2003 to historical precipitation (collected between 1972 and 2003) for Andrews, North Carolina. There was no rain data provided by the State Climate Office for the months of September-November 2003. This comparison gives an indication of how 2003 relates to historical data in terms of climate conditions. The NC State Climate Office provided all local rainfall information.

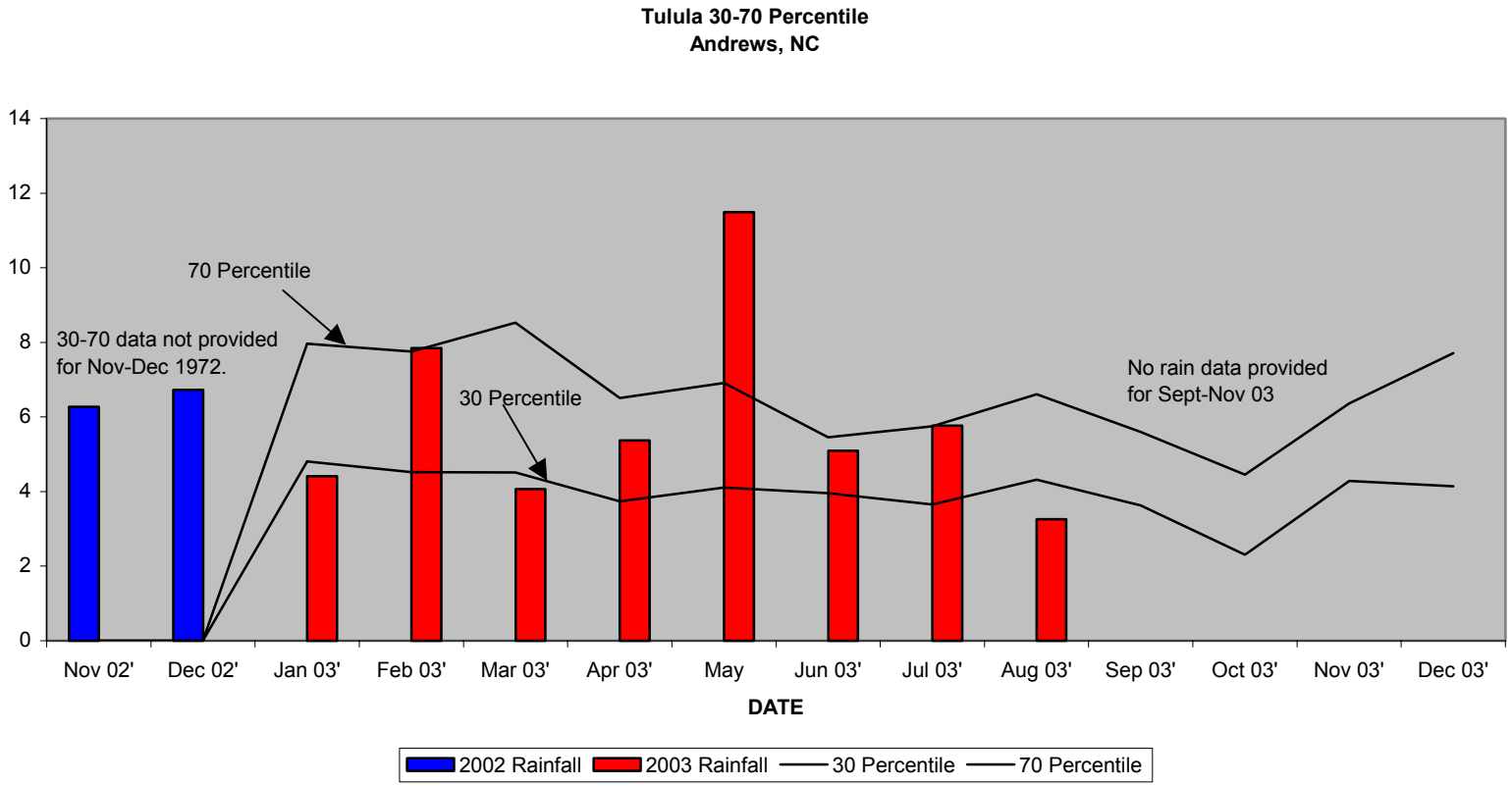
For the 2003-year, the month of May experienced above average rainfall. The months of January, March, and August recorded below average rainfall for the site. February, April, June, and July experienced average rainfall. Overall, 2003 experienced an average rainfall year.

2.4 CONCLUSIONS

The 2003-year represents the first full growing season that hydrologic data has been examined. During the 2003 monitoring year, twenty-eight of the thirty-groundwater gauges were downloaded. There is no hydrologic data for gauges D4 and E4. The first year of hydrologic data revealed that eighteen of the twenty-eight groundwater gauges met the success criteria for saturation (within 12” of the surface for 5% of the growing season). Conversely, ten gauges recorded saturation for less than 5% of the growing season. NCDOT will investigate these ten gauges to ascertain whether the gauges are representative of conditions in each respective area.

NCDOT will continue to monitor the Tulula Bog Mitigation Site for hydrology.

Figure 4. Tulula Bog 30-70 Graph



3.0 VEGETATION: TULULA BOG MITIGATION SITE (YEAR 1 MONITORING)

3.1 SUCCESS CRITERIA

Success criteria state that there must be a minimum of 320 trees per acre surviving for three consecutive years. A minimum of 290 trees per acre must be living at year four and a minimum of 260 trees per acre living at year five.

3.2 DESCRIPTION OF SPECIES

The following species were planted in the restoration area: Approximately 19.4 acres

Nyssa sylvatica var*. sylvatica*, Blackgum

Quercus rubra, Northern Red Oak

Quercus alba, White Oak

Liriodendron tulipifera, Tulip Poplar

3.3 RESULTS OF VEGETATION MONITORING

Table 3. Vegetation Monitoring Statistics

Plot #	Blackgum	Northern Red Oak	White Oak	Tulip Poplar		Total (1 year)	Total (at planting)	Density (Trees/Acre)
1		14	17			31	34	620
2			10	19		29	36	548
3	1	7	5	16		29	38	519
	AVERAGE DENSITY							562

Site Notes: Other species noted: *Panicum* sp., goldenrod, woolgrass, alder, Queen-Anne's-lace, mimosa, briars, and various grasses.

3.4 CONCLUSIONS

Approximately 19.4 acres of the site were planted. There were three vegetation-monitoring plots established throughout the planting areas. The 2003 vegetation monitoring of the site revealed an average density of 562 trees per acre. This average is well above the minimum success criteria of 320 trees per acre.

NCDOT will continue vegetation monitoring on the Tulula Bog Mitigation Site.

4.0 OVERALL CONCLUSIONS/RECOMMENDATIONS

During the 2003 monitoring year, twenty-eight of the thirty-groundwater gauges were downloaded. There is no hydrologic data for gauges D4 and E4. The first year of hydrologic data revealed that eighteen of the twenty-eight groundwater gauges met the success criteria for saturation (within 12" of the surface for 5% of the growing season). Conversely, ten gauges recorded saturation for less than 5% of the growing season. NCDOT will investigate these ten gauges to ascertain whether the gauges are representative of conditions in each respective area.

Vegetation data for the first year of monitoring revealed an average density of 562 trees per acre for the 19.4 acres that were planted. This average is well above the minimum success criteria of 320 trees per acre.

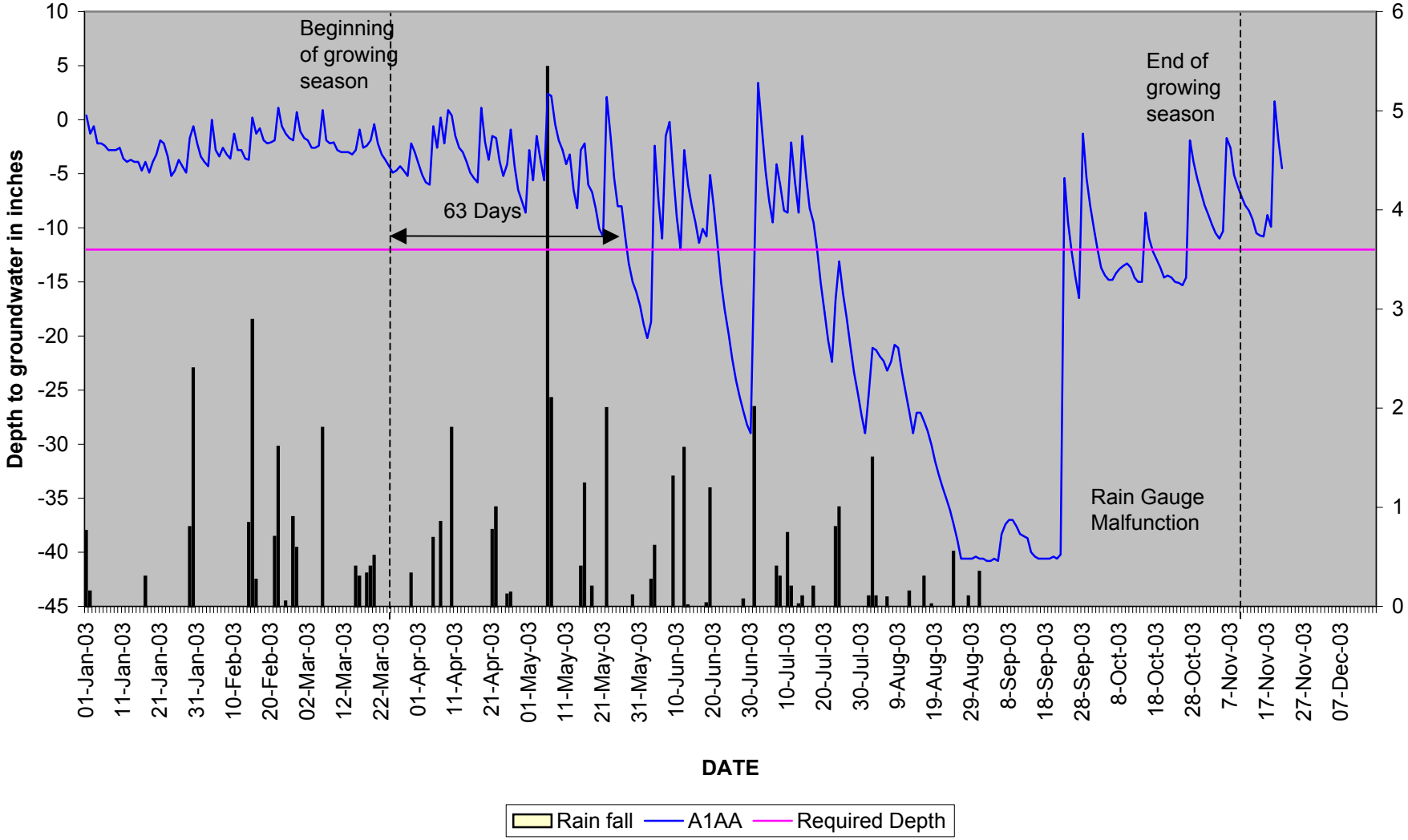
The University of North Carolina at Asheville is performing the stream restoration monitoring, as a part of a grant received from the Department. A portion of this grant is to survey and analyze the geomorphological characteristics of the stream restoration sections of the project. Upon receipt of this information, the Department will provide appropriate documentation to the resource agencies via the Department's website.

NCDOT will continue to monitor the Tulula Bog Mitigation Site for hydrology and vegetation.

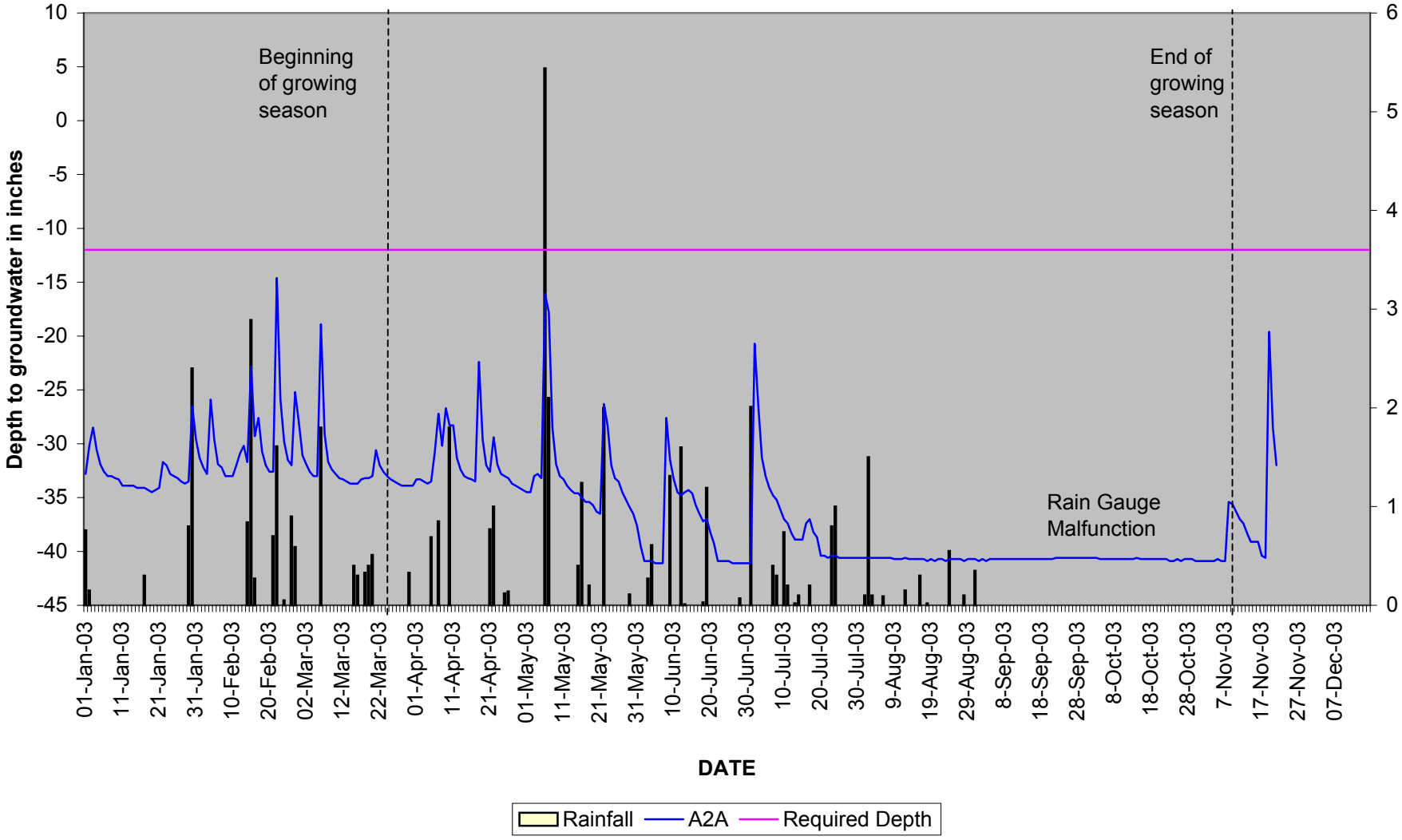
APPENDIX A

GAUGE DATA GRAPHS

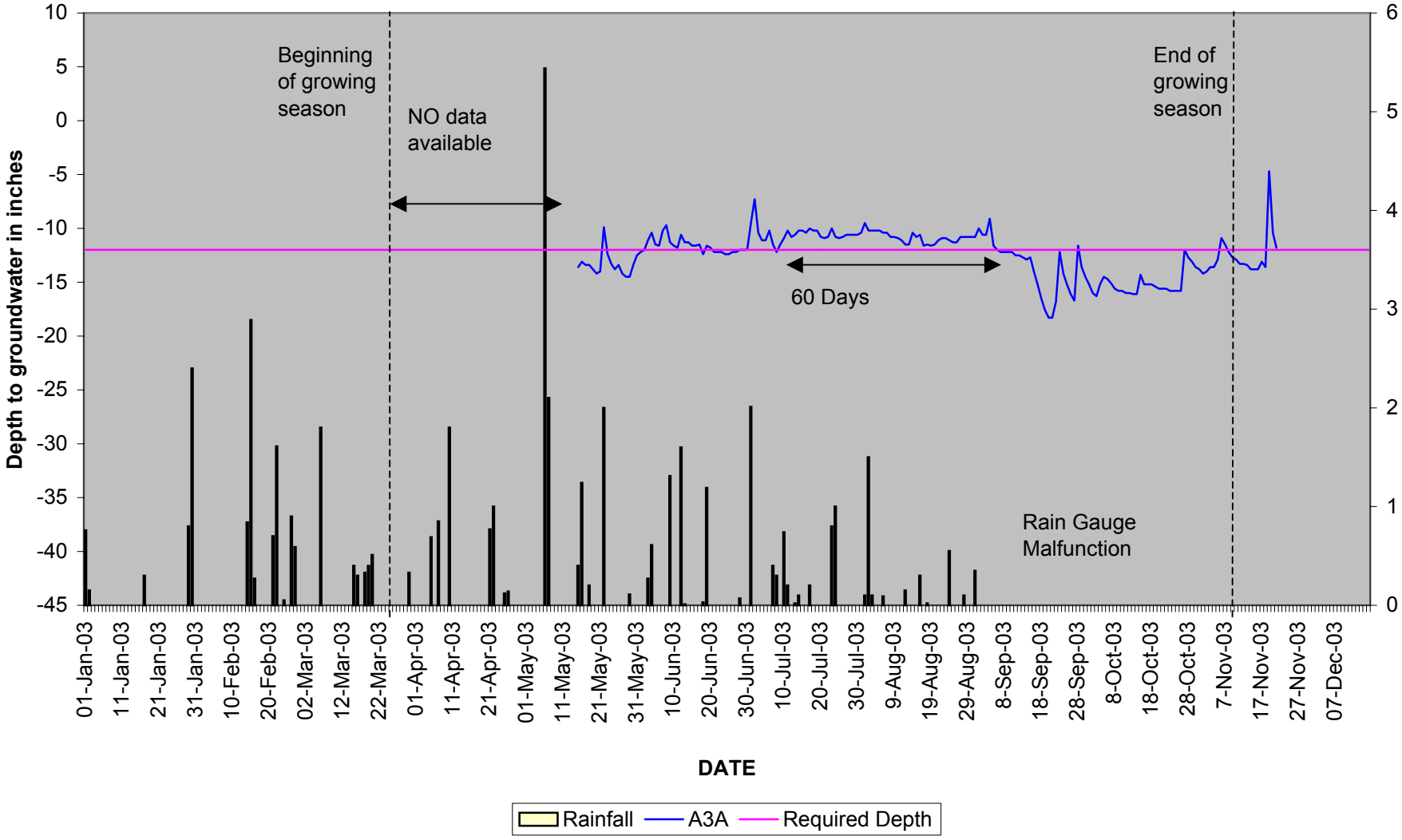
A1AA Tulula Bog

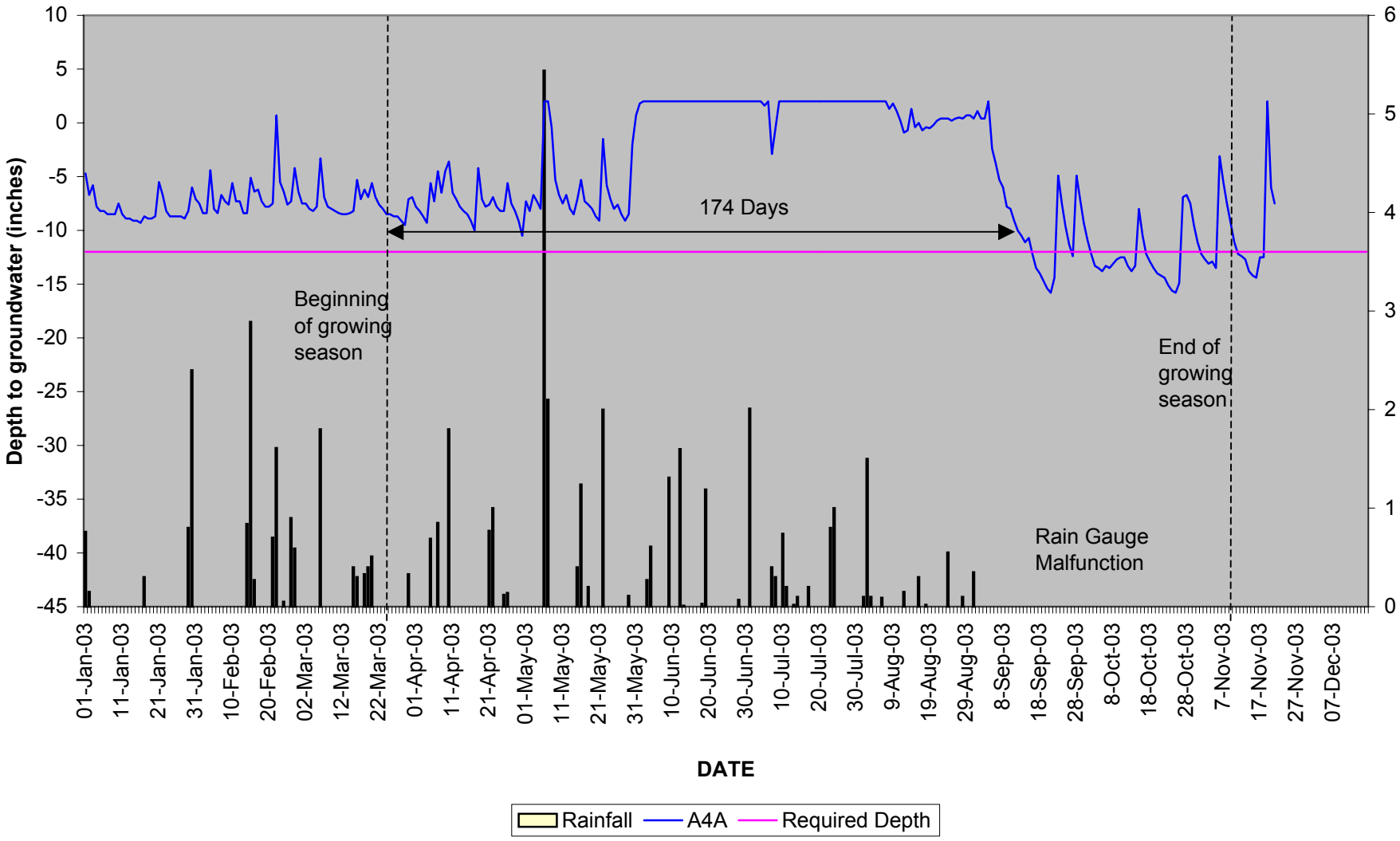


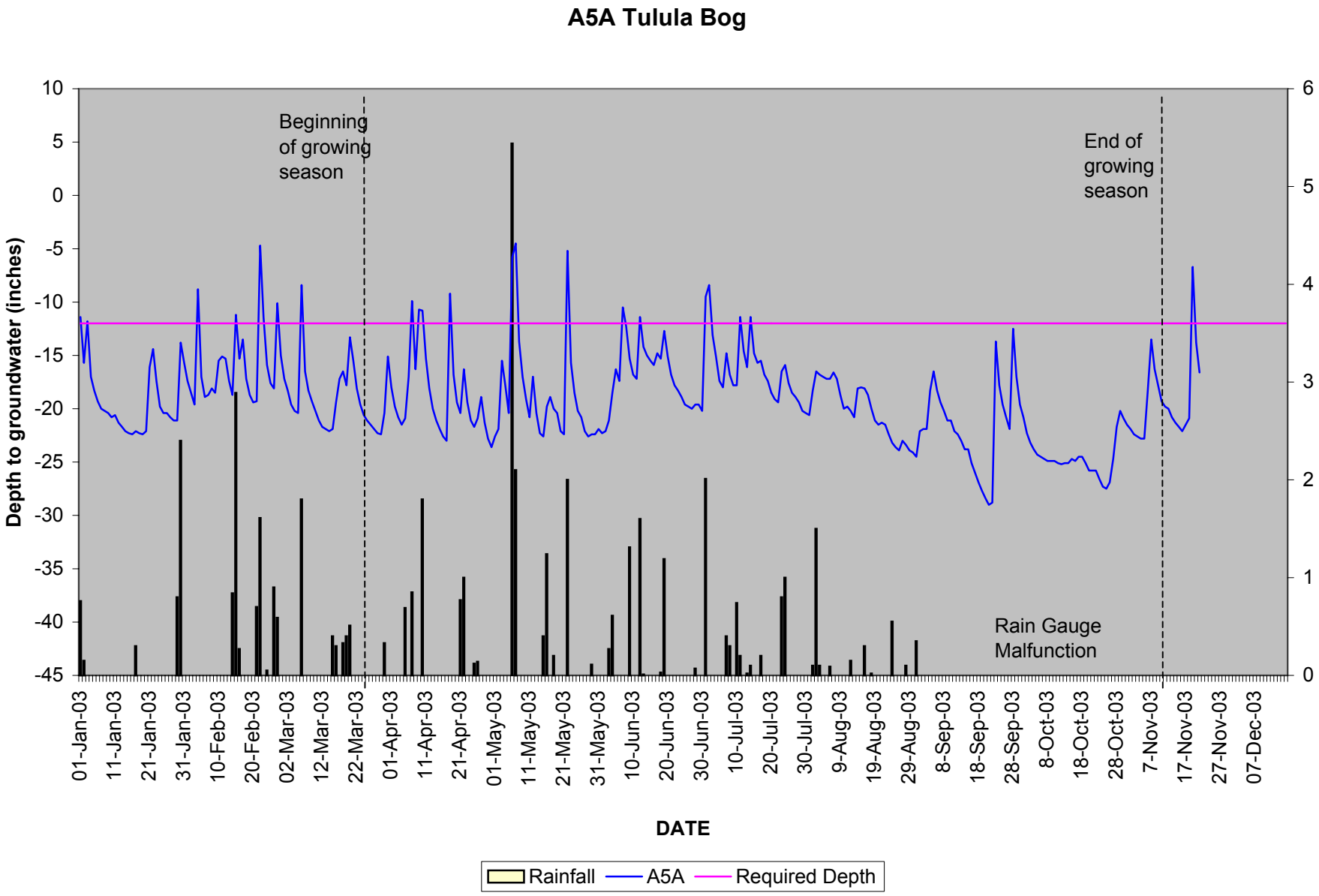
A2A Tulula Bog



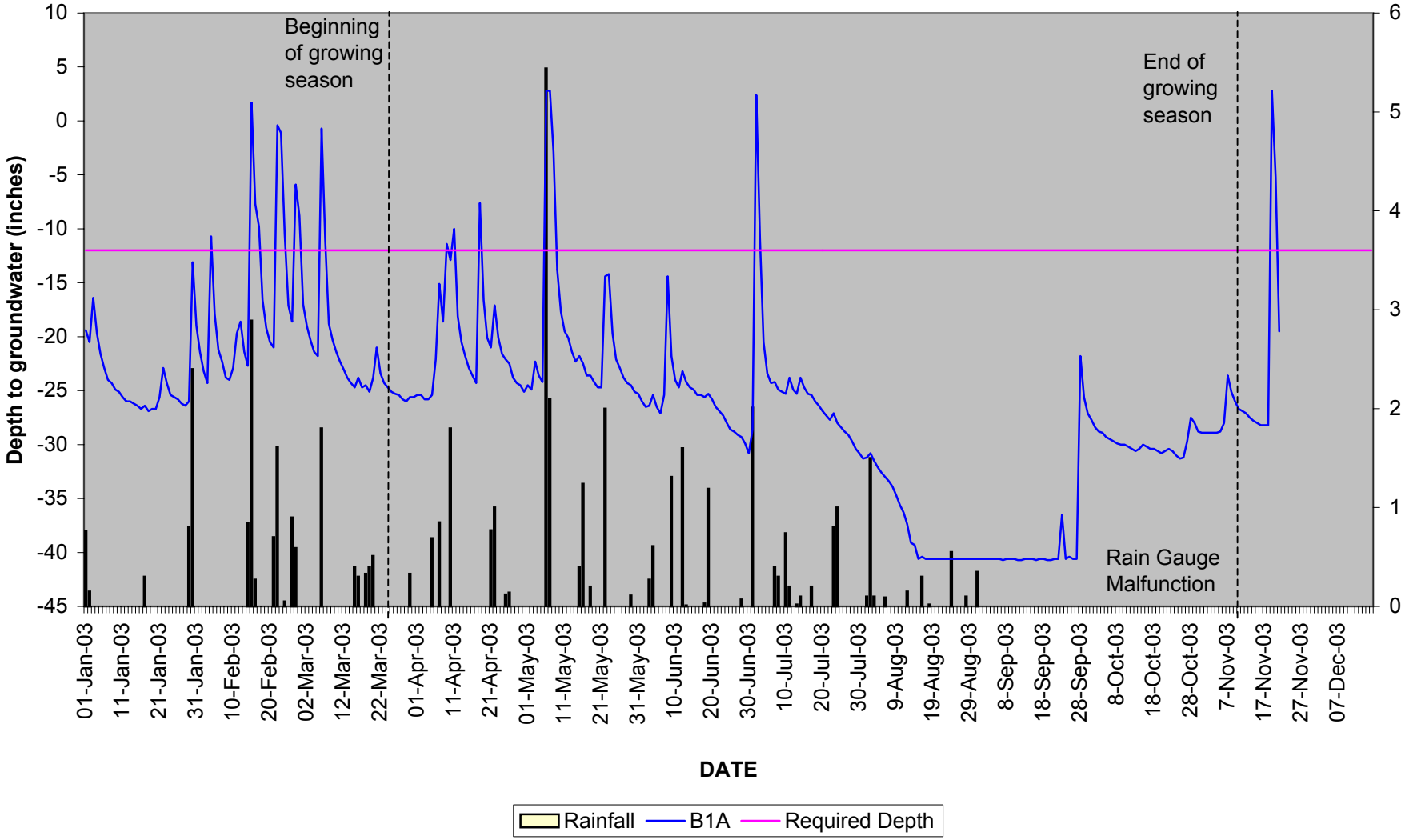
A3A Tulula Bog

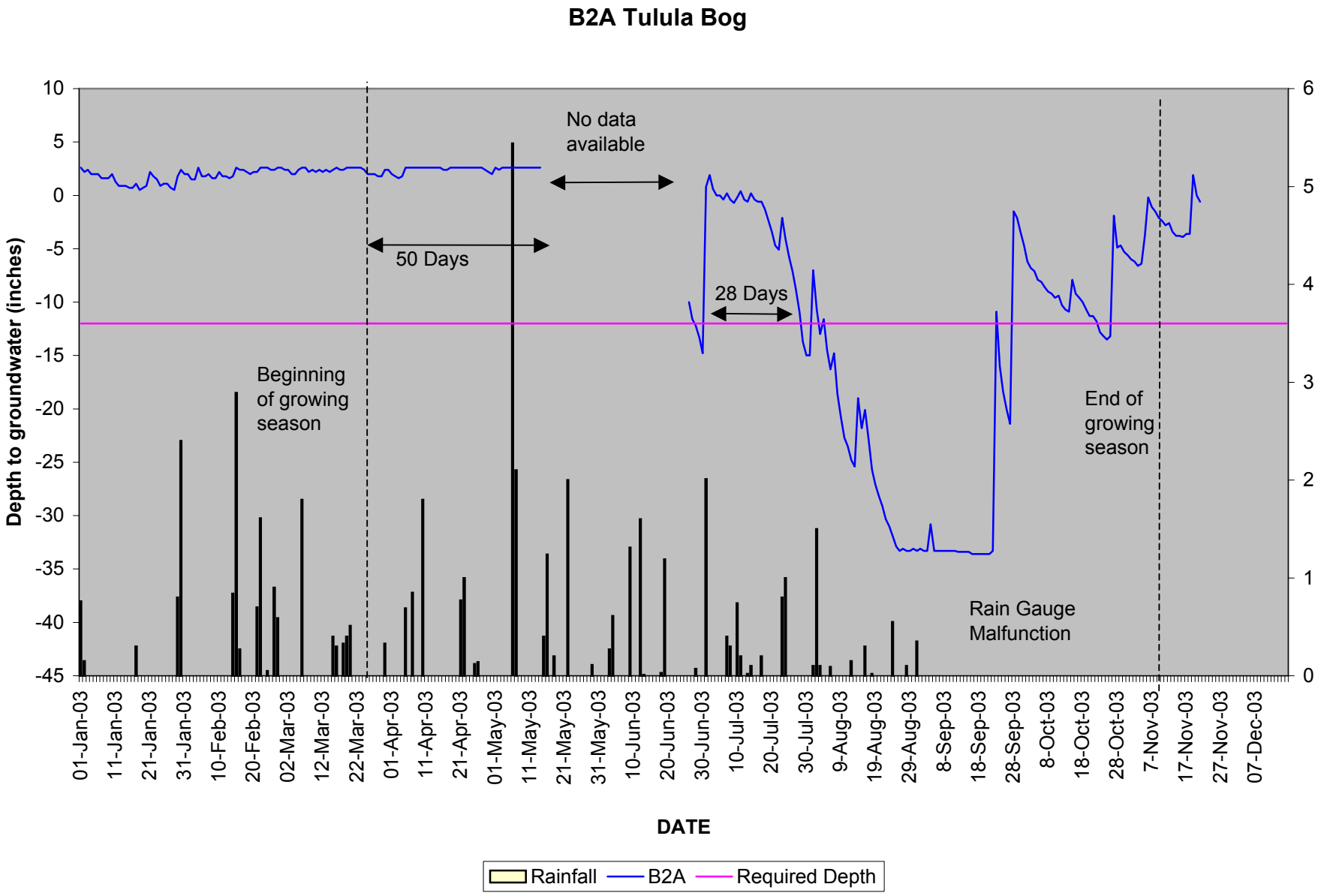


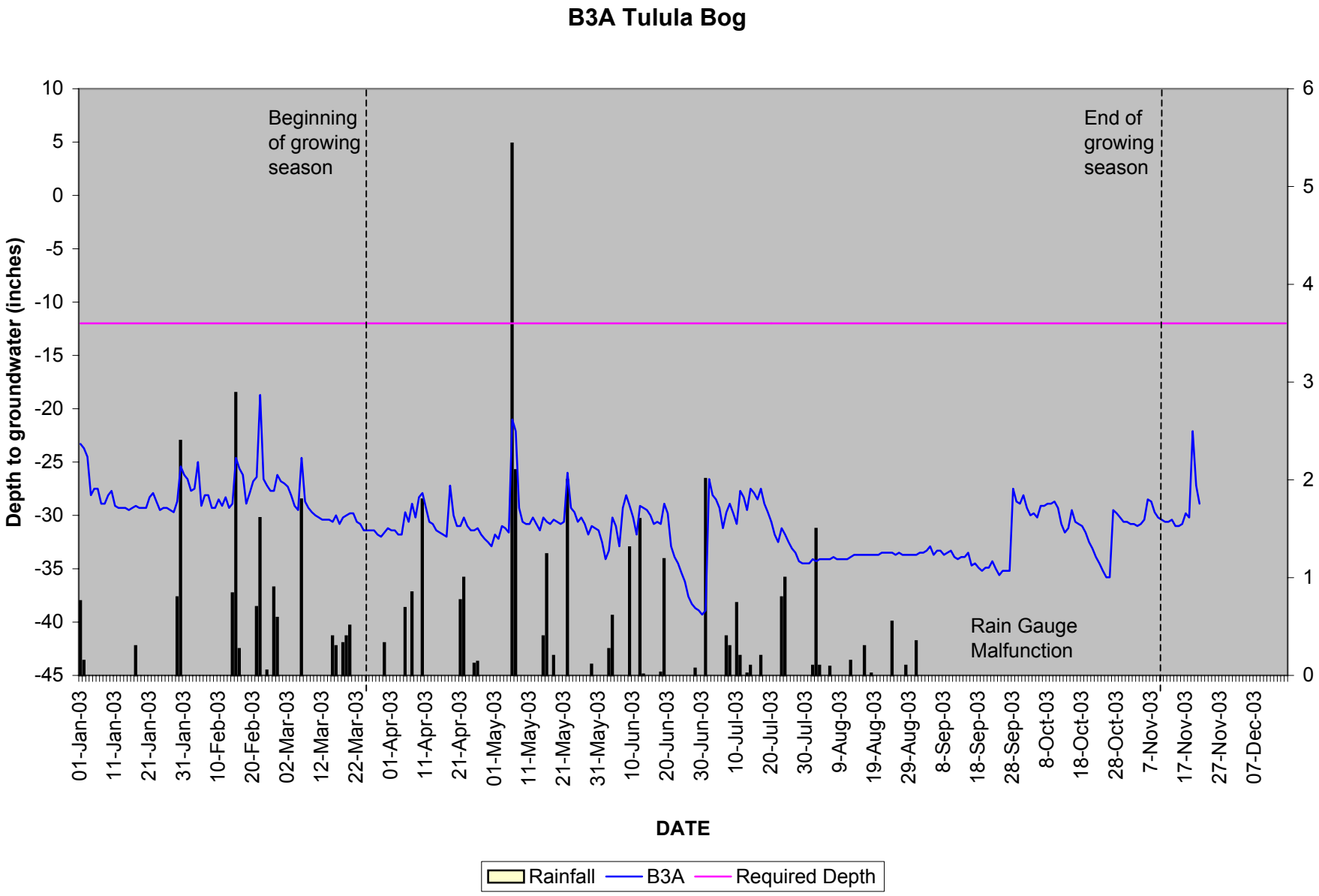

A4A Tulula Bog
Depth to groundwater (inches)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
174 Days
Beginning of growing season
End of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
A4A
Required Depth


A5A Tulula Bog
Depth to groundwater (inches)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
Beginning of growing season
End of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
A5A
Required Depth

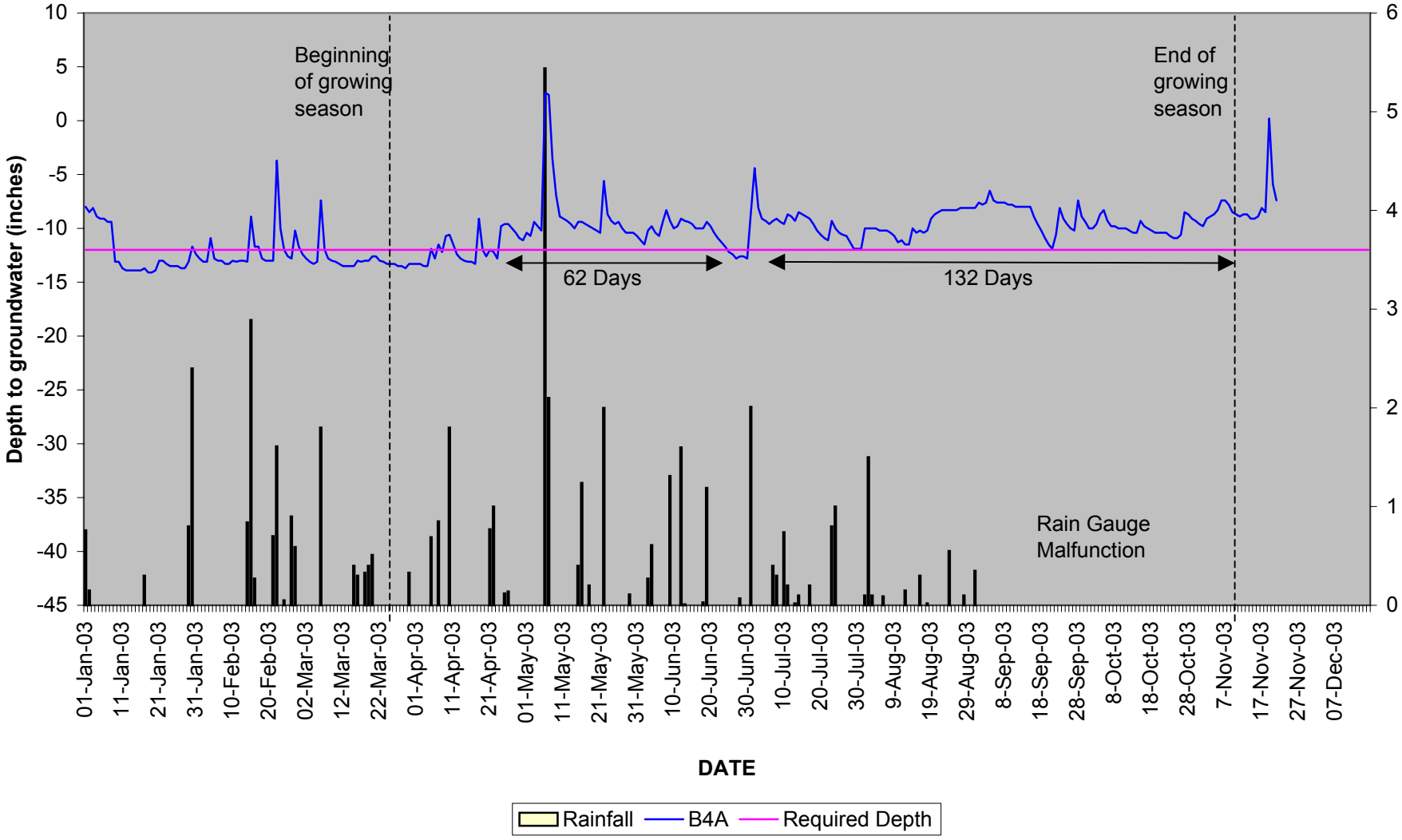
B1A Tulula Bog

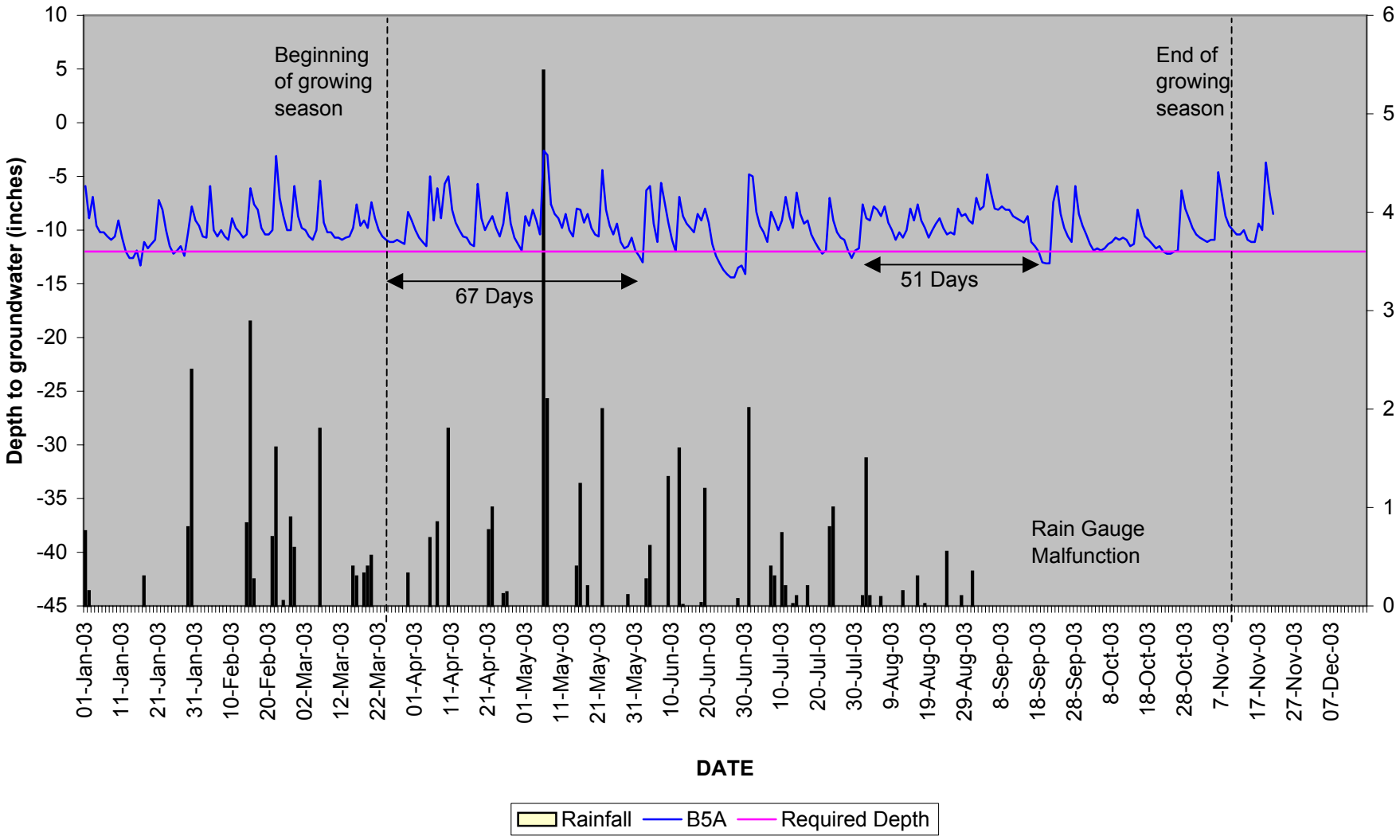



B2A Tulula Bog
Depth to groundwater (inches)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
No data available
50 Days
28 Days
Beginning of growing season
End of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
B2A
Required Depth


B3A Tulula Bog
Depth to groundwater (inches)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
Beginning of growing season
End of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
B3A
Required Depth

B4A Tulula Bog




B5A Tulula Bog
Depth to groundwater (inches)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
Beginning of growing season
End of growing season
67 Days
51 Days
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
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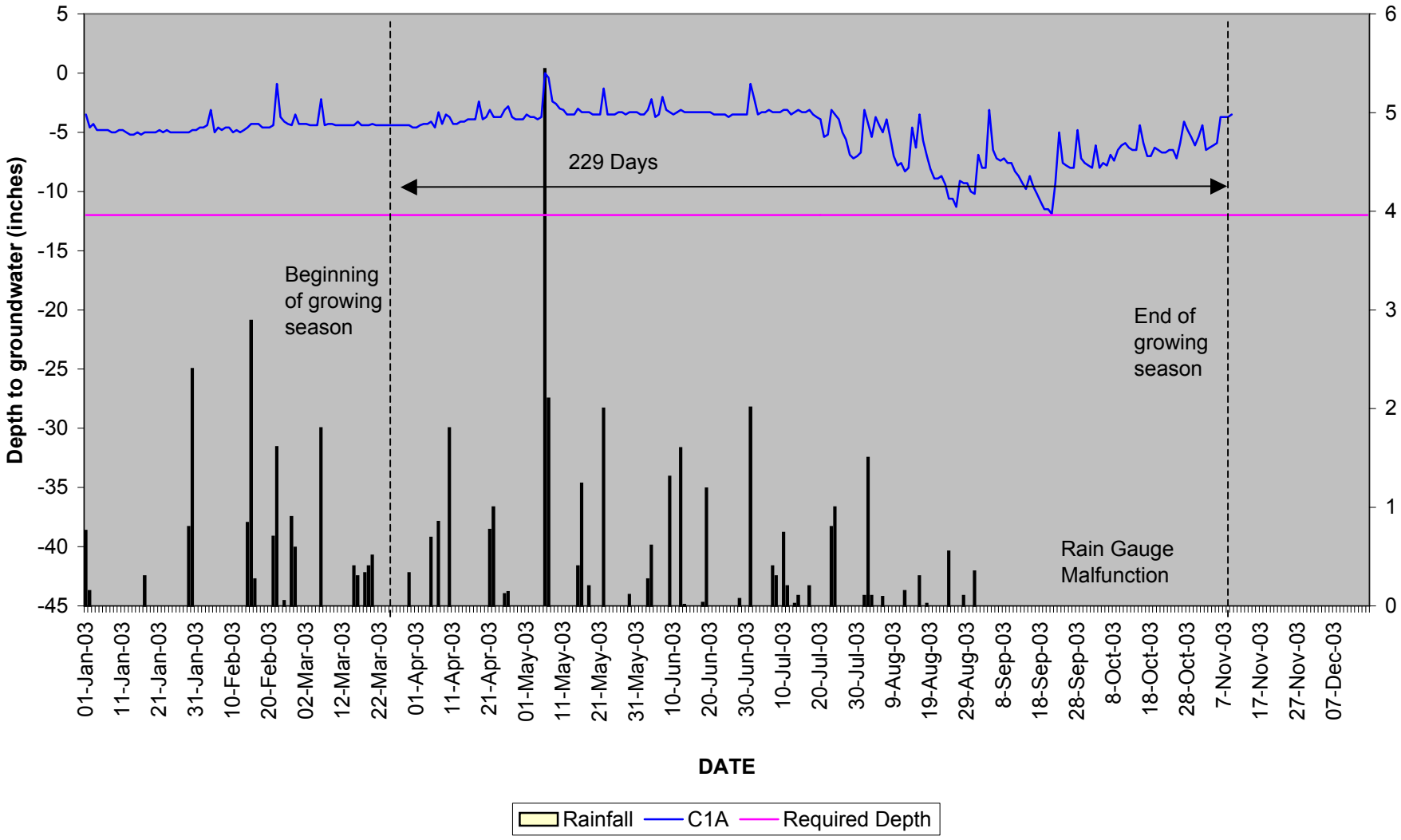
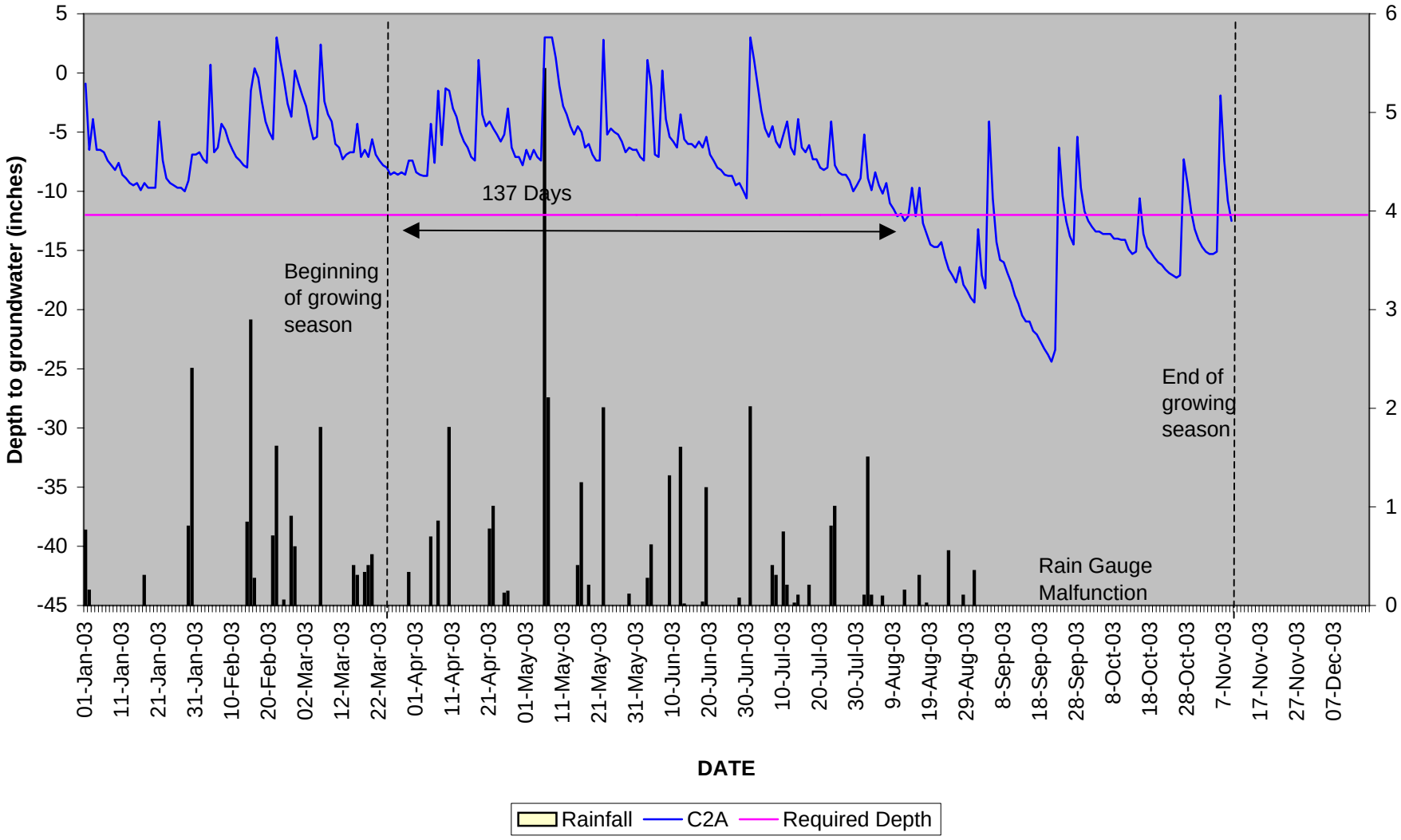
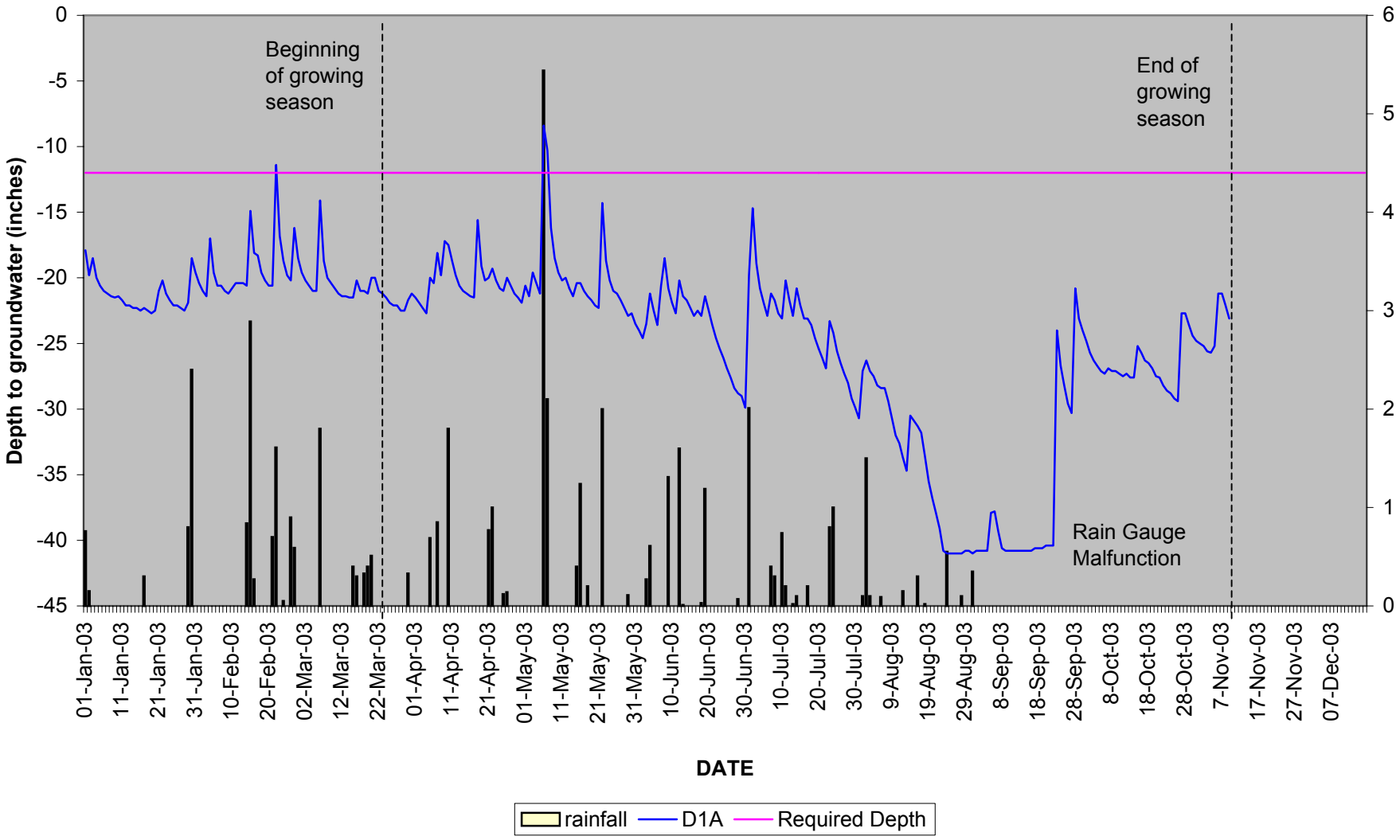
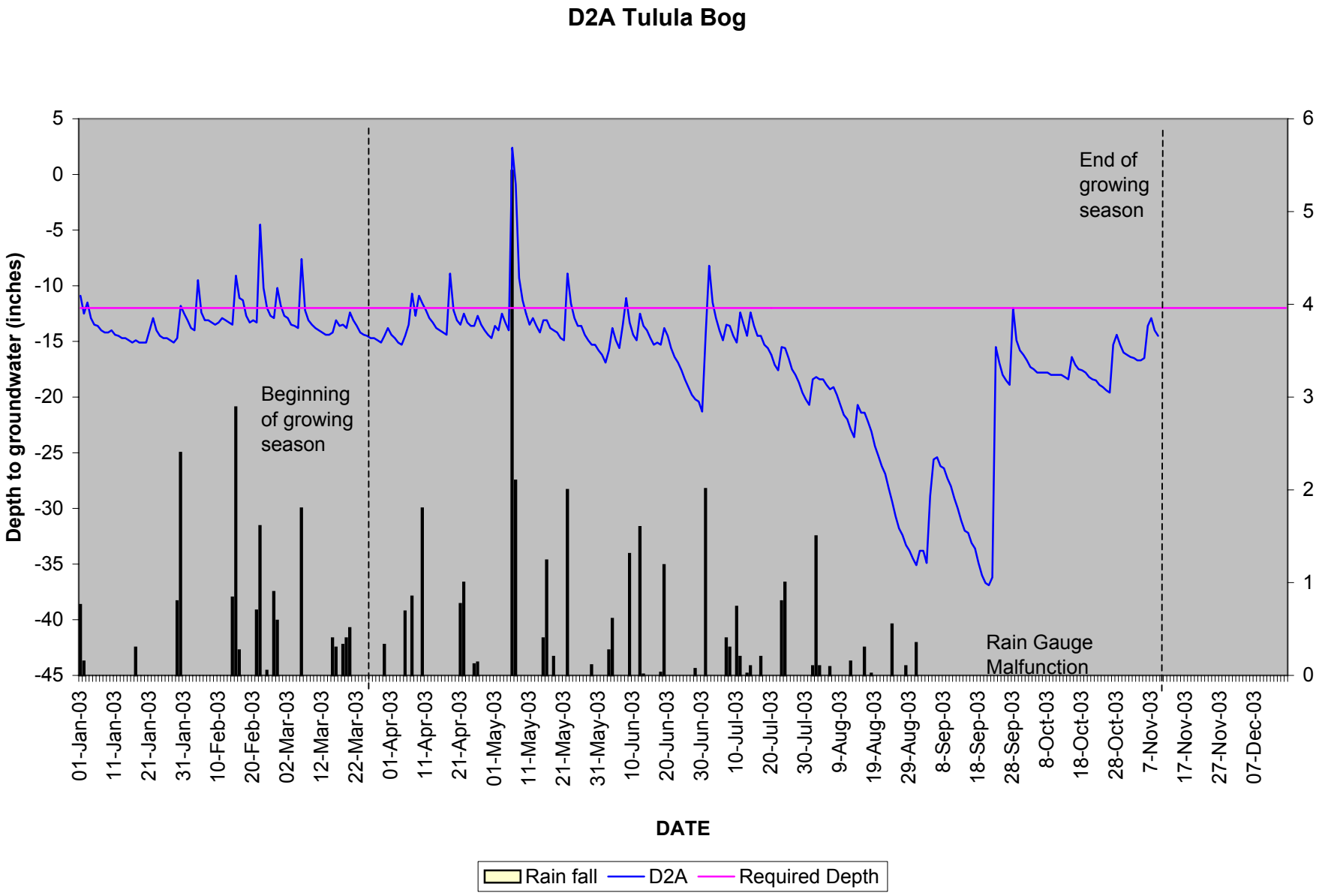
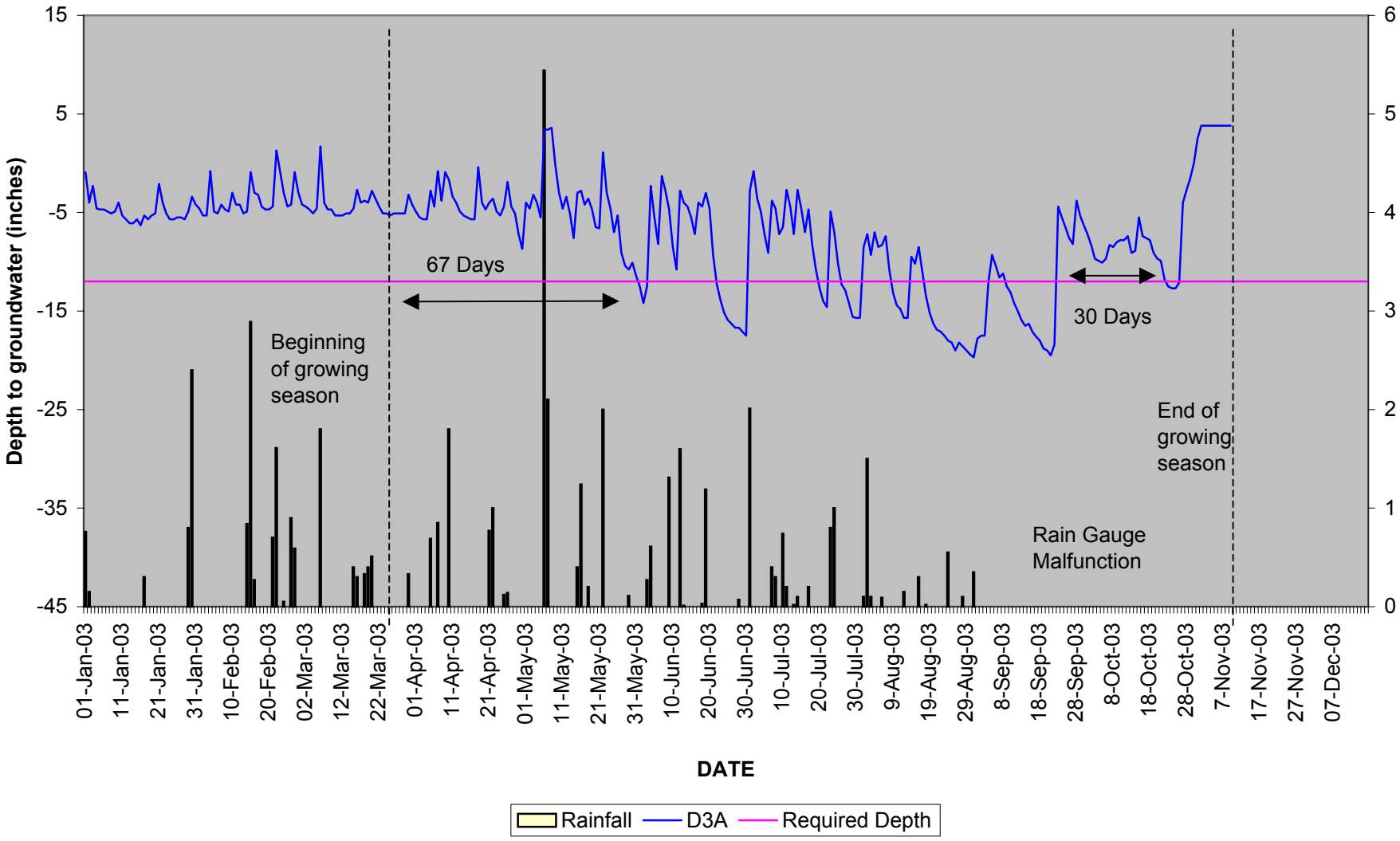
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
B5A
Required Depth

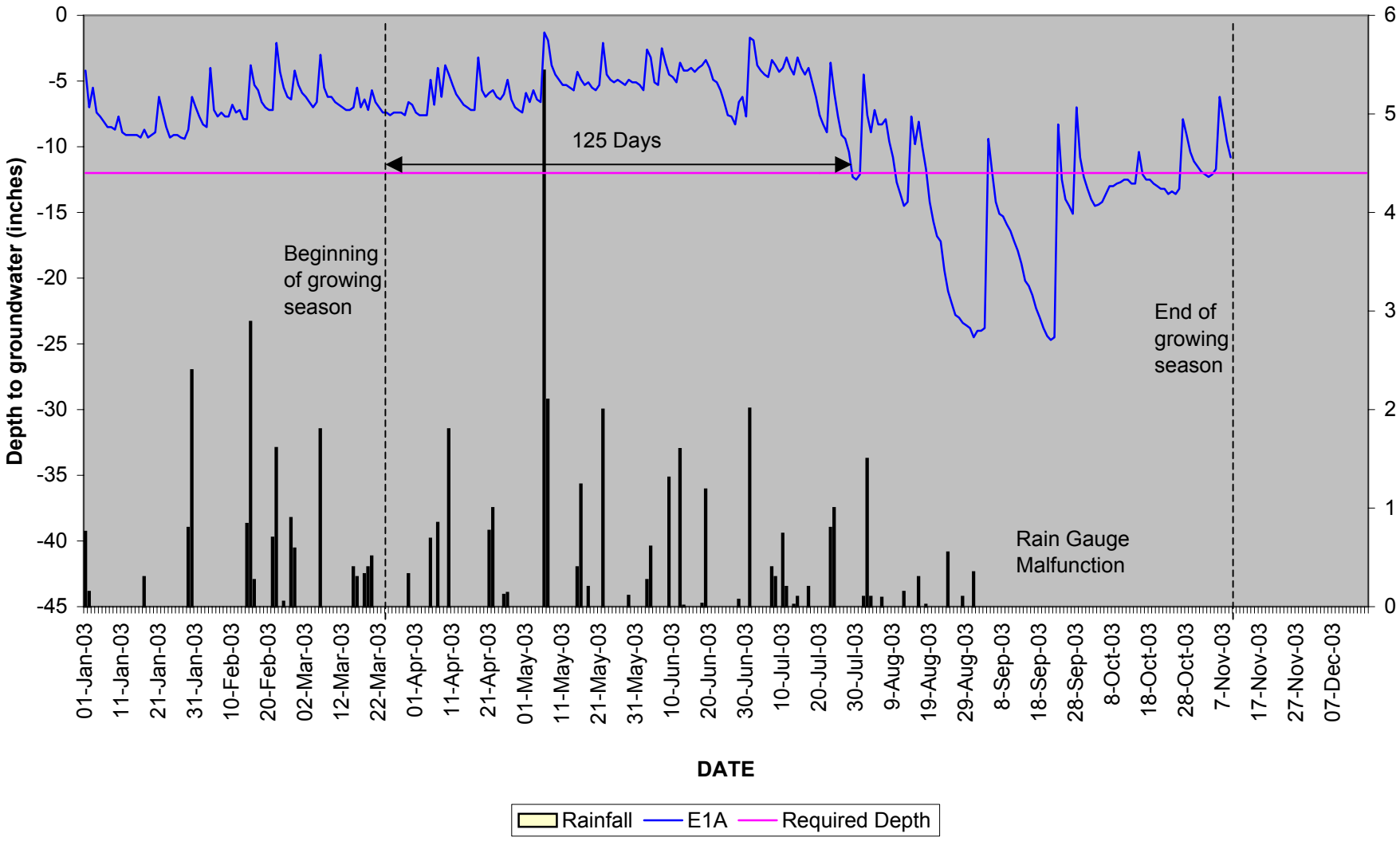

C1A Tulula Bog
Depth to groundwater (inches)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
229 Days
Beginning of growing season
End of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
C1A
Required Depth

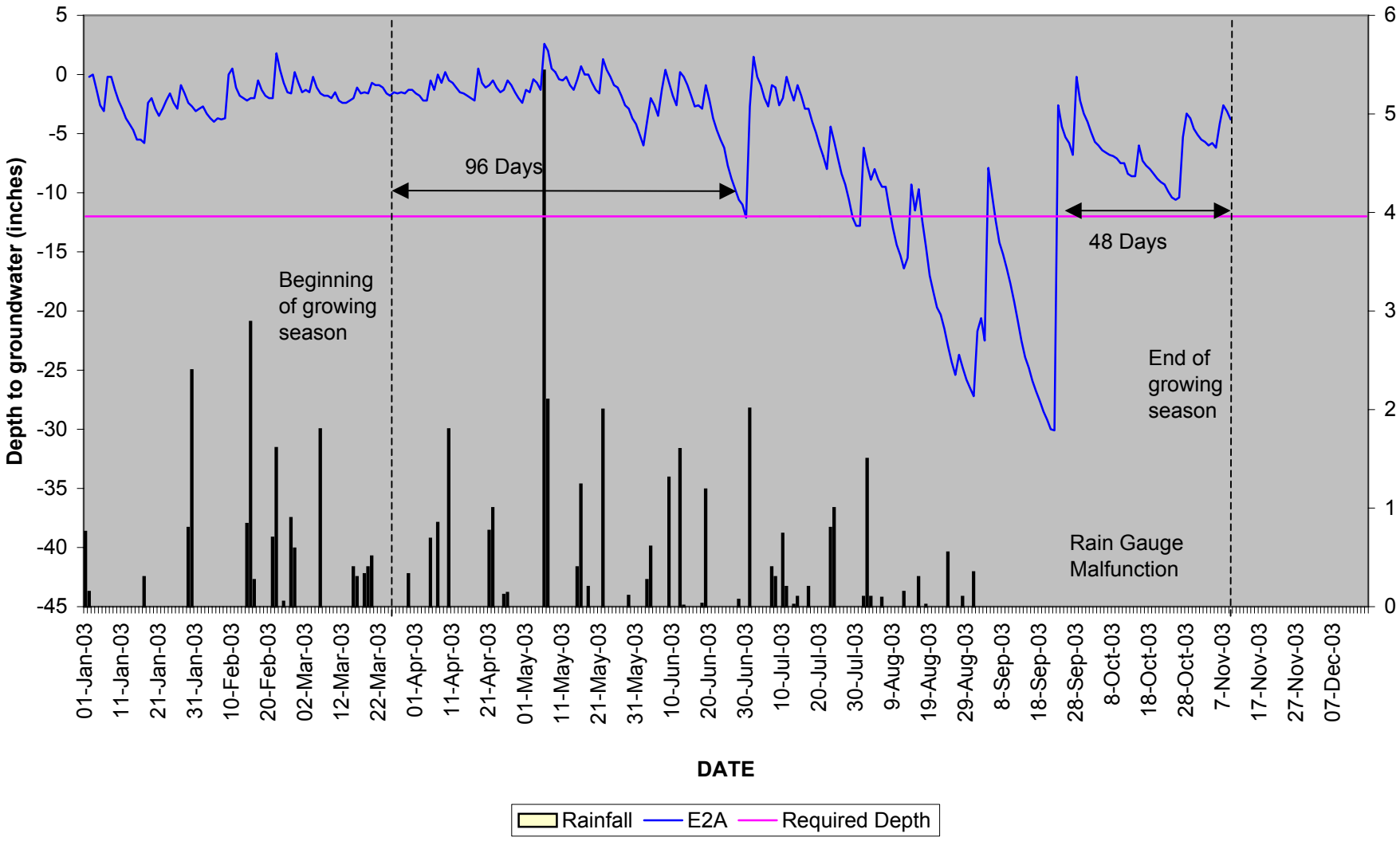

C2A Tulula Bog
Depth to groundwater (inches)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
137 Days
Beginning of growing season
End of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
C2A
Required Depth

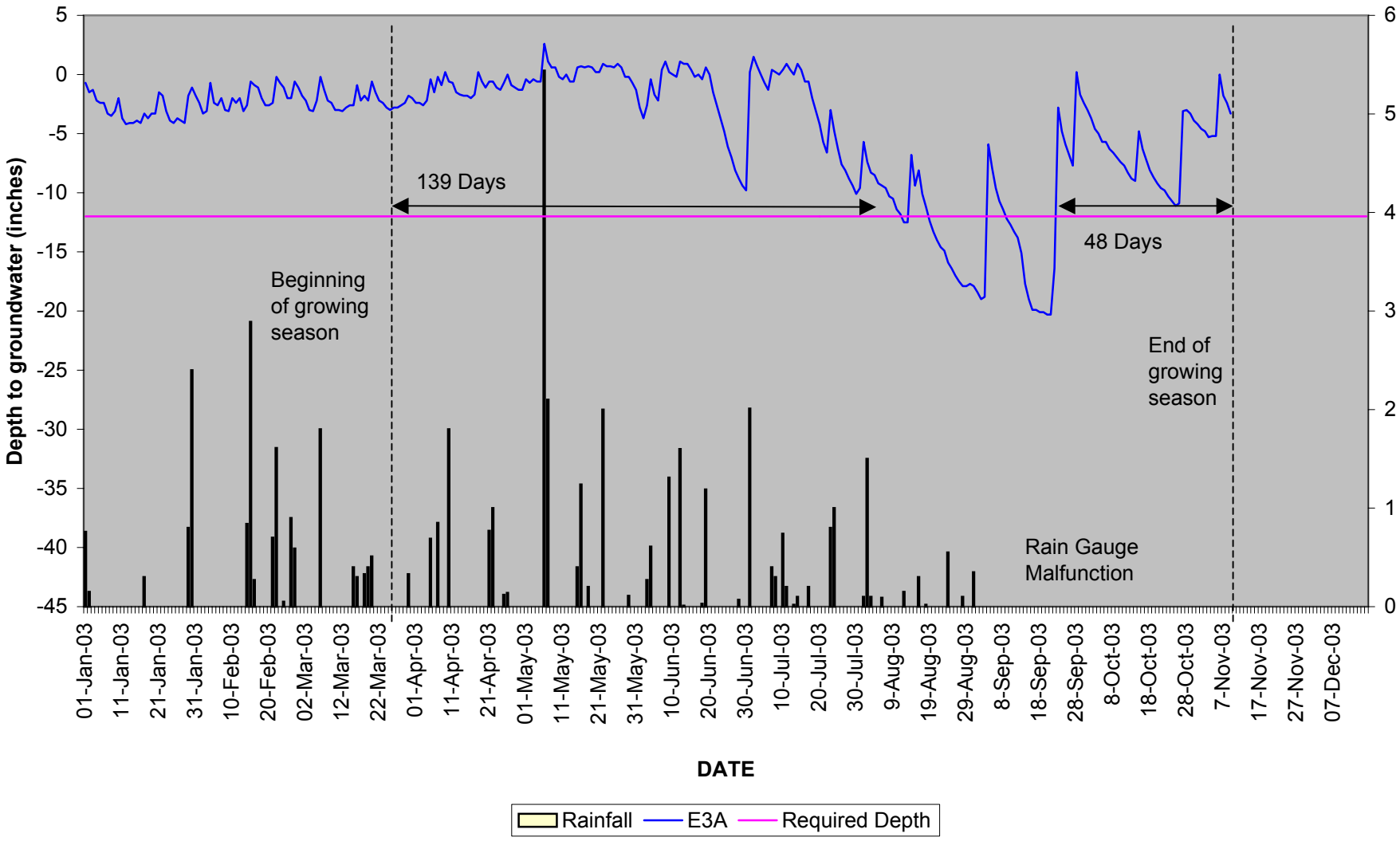

D1A Tulula Bog
Depth to groundwater (inches)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
Beginning of growing season
End of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
rainfall
D1A
Required Depth


D2A Tulula Bog
Depth to groundwater (inches)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
End of growing season
Beginning of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rain fall
D2A
Required Depth

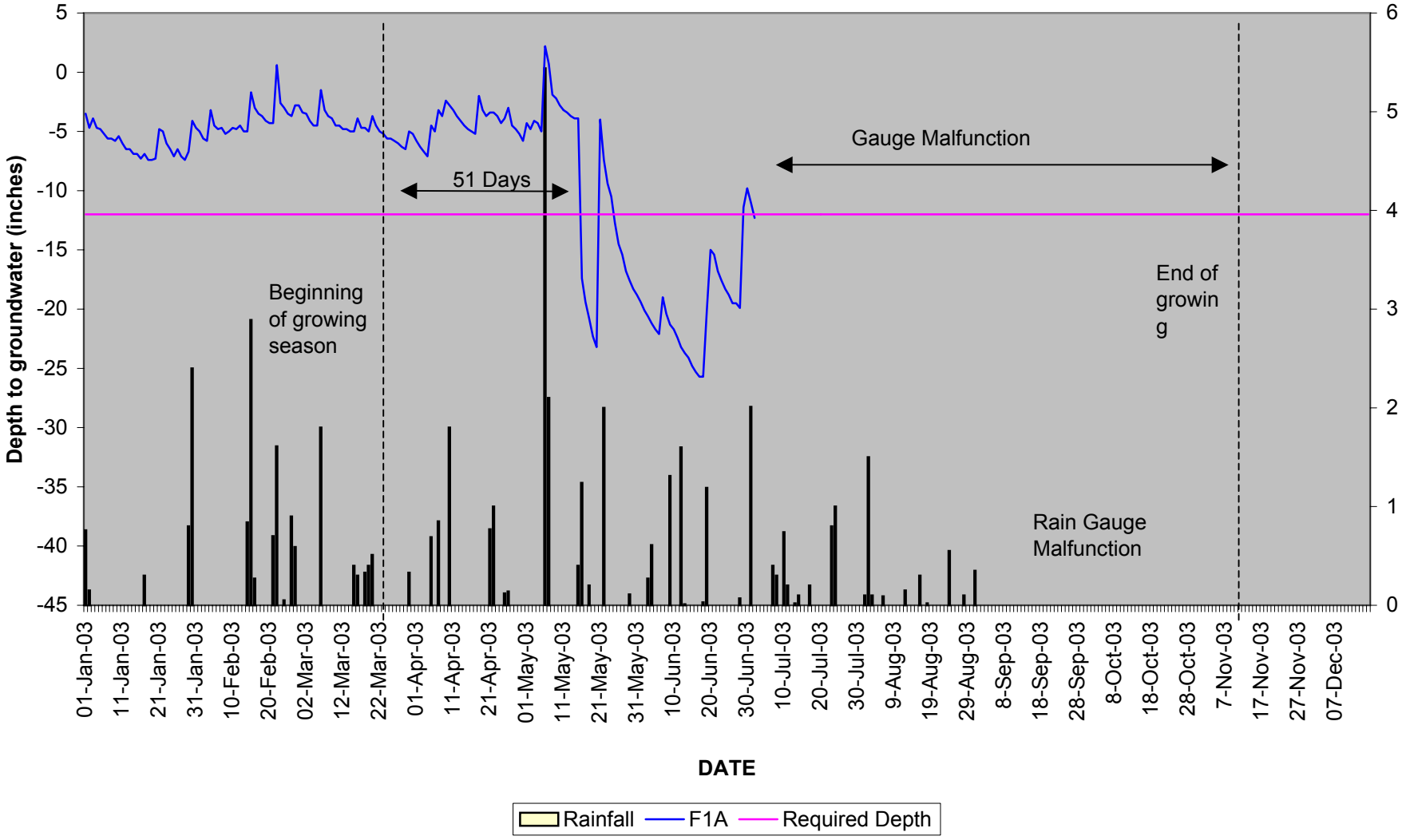

D3A Tulula Bog
Depth to groundwater (inches)
15
5
-5
-15
-25
-35
-45
6
5
4
3
2
1
0
67 Days
30 Days
Beginning of growing season
End of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
D3A
Required Depth

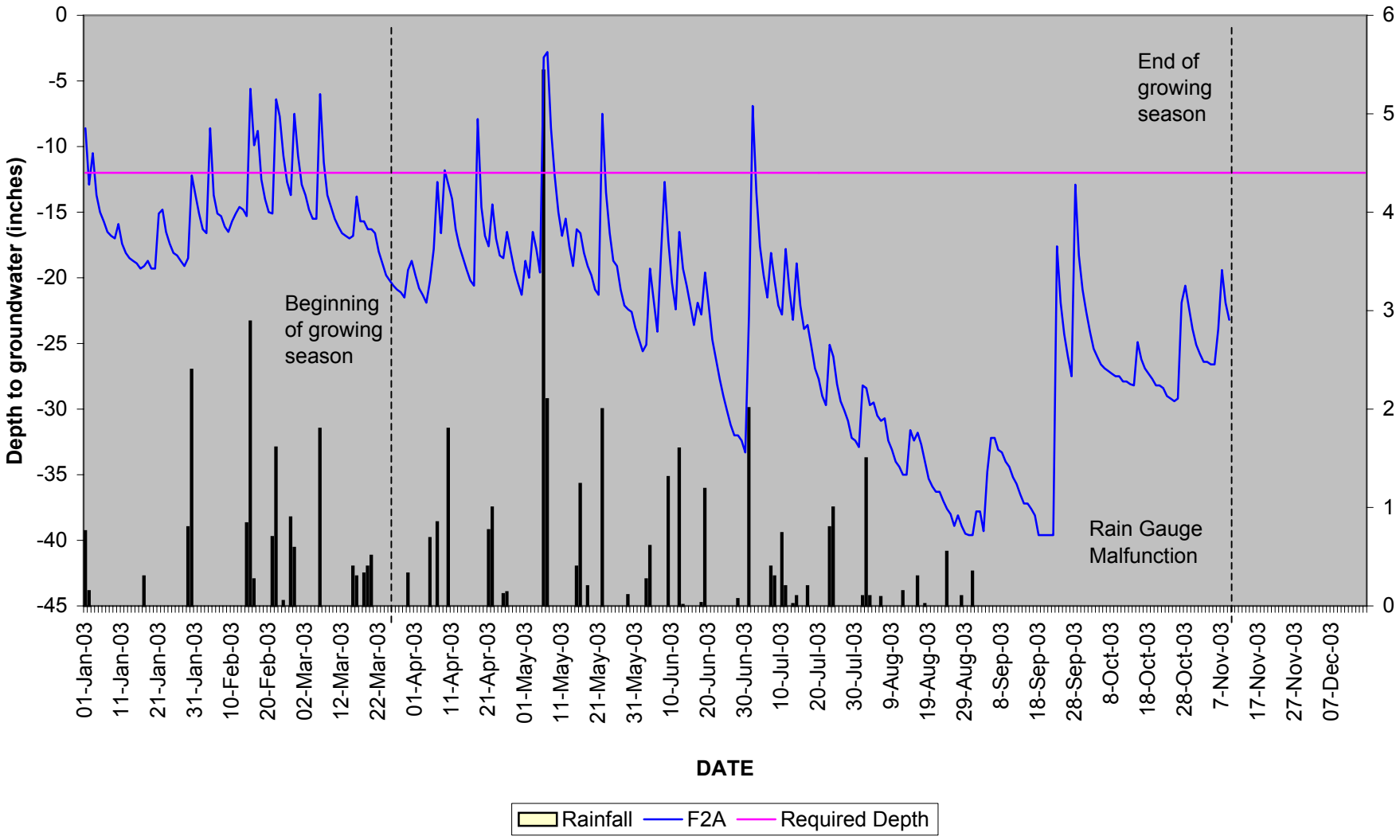

E1A Tulula Bog
Depth to groundwater (inches)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
125 Days
Beginning of growing season
End of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
E1A
Required Depth


E2A Tulula Bog
Depth to groundwater (inches)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
96 Days
48 Days
Beginning of growing season
End of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
E2A
Required Depth

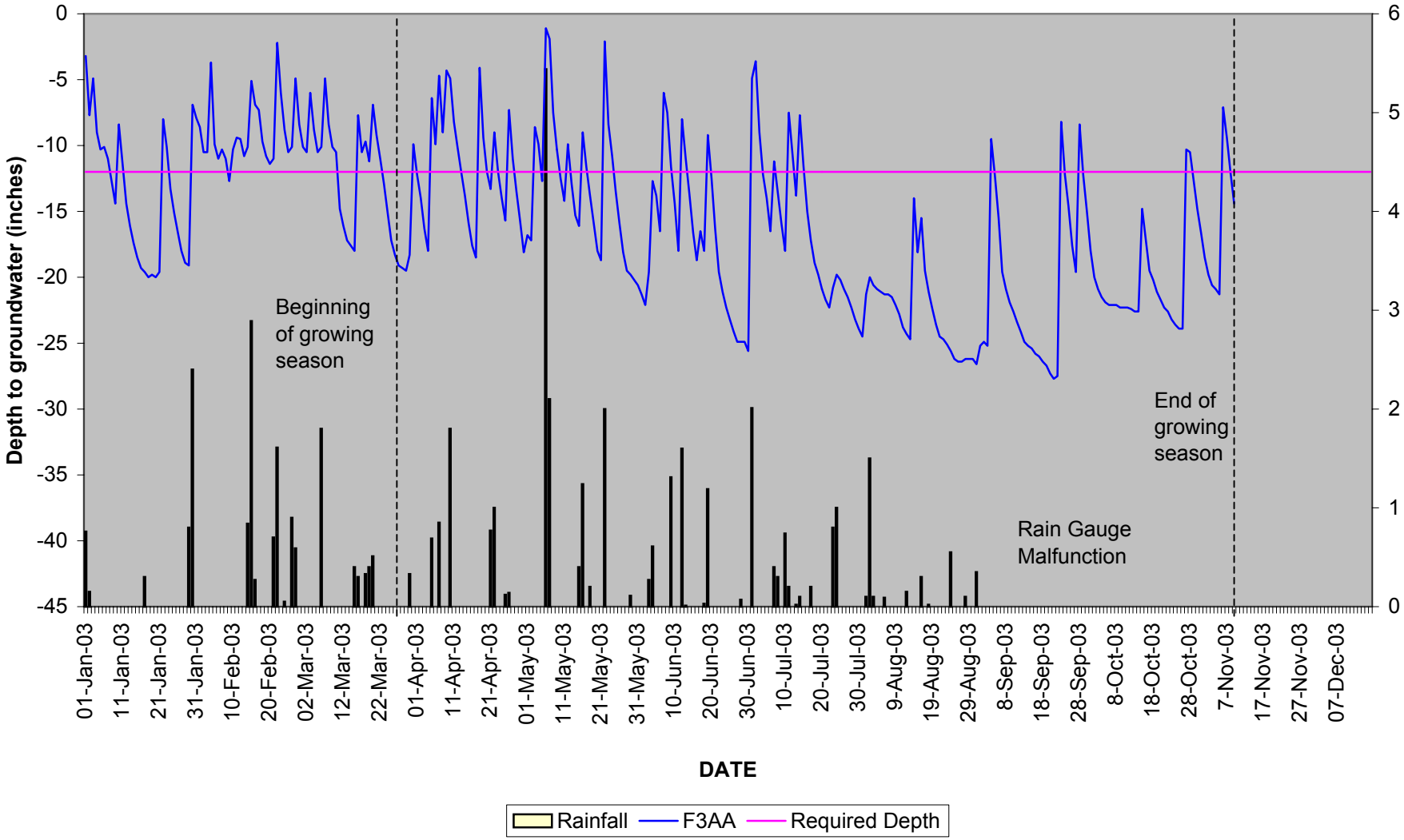

E3A Tulula Bog
Depth to groundwater (inches)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
139 Days
48 Days
Beginning of growing season
End of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
E3A
Required Depth

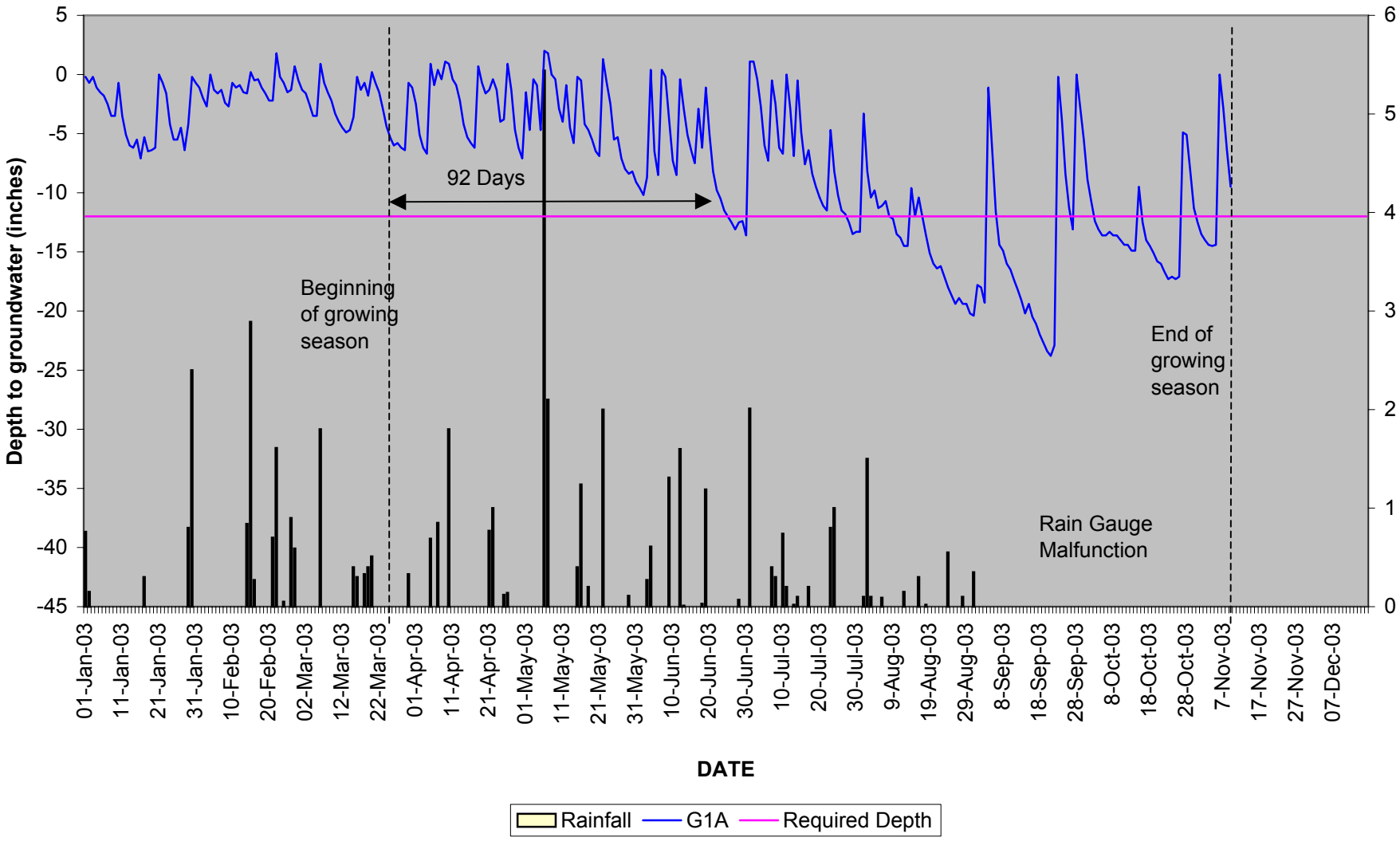
F1A Tulula Bog

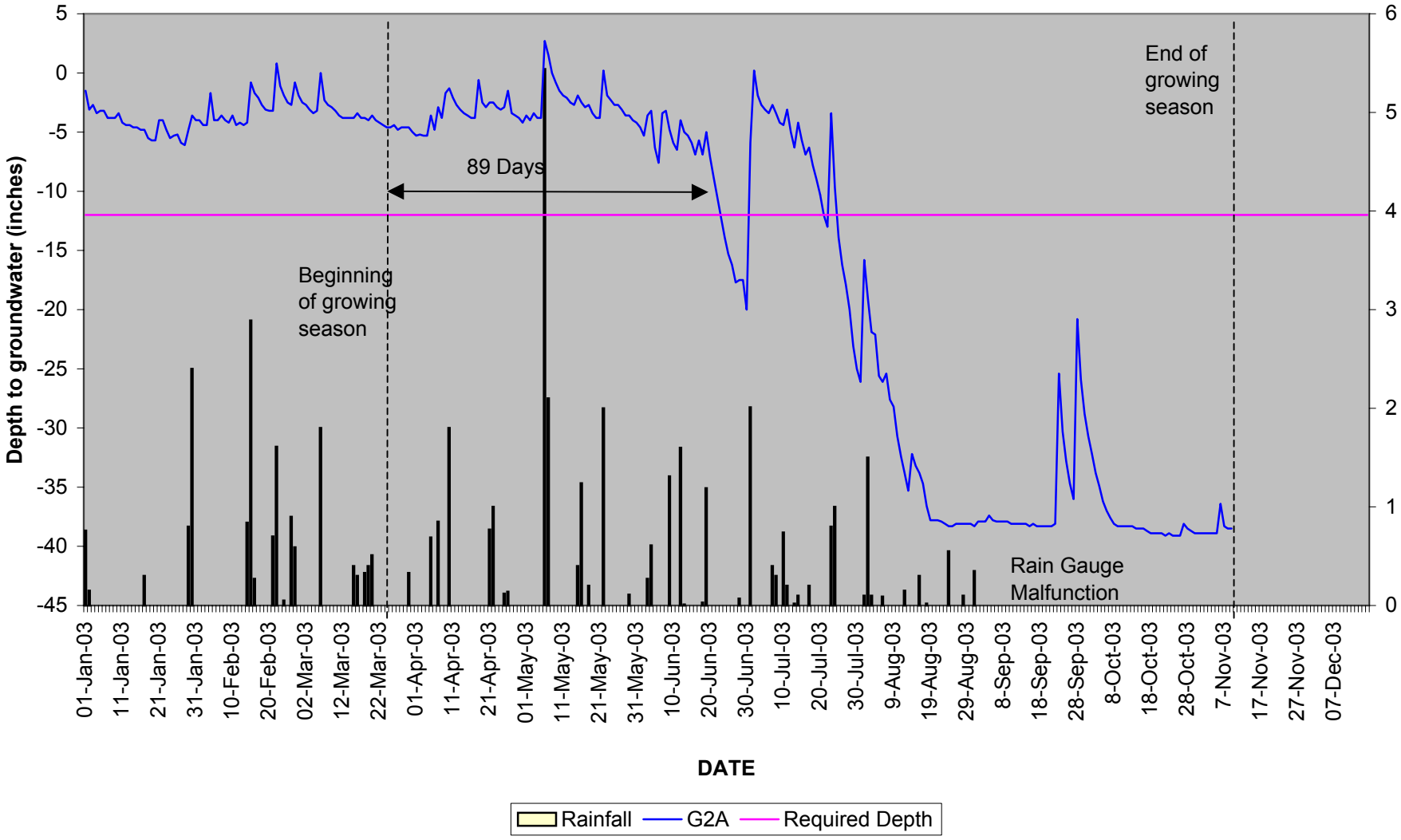



F2A Tulula Bog
Depth to groundwater (inches)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
End of growing season
Beginning of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
F2A
Required Depth

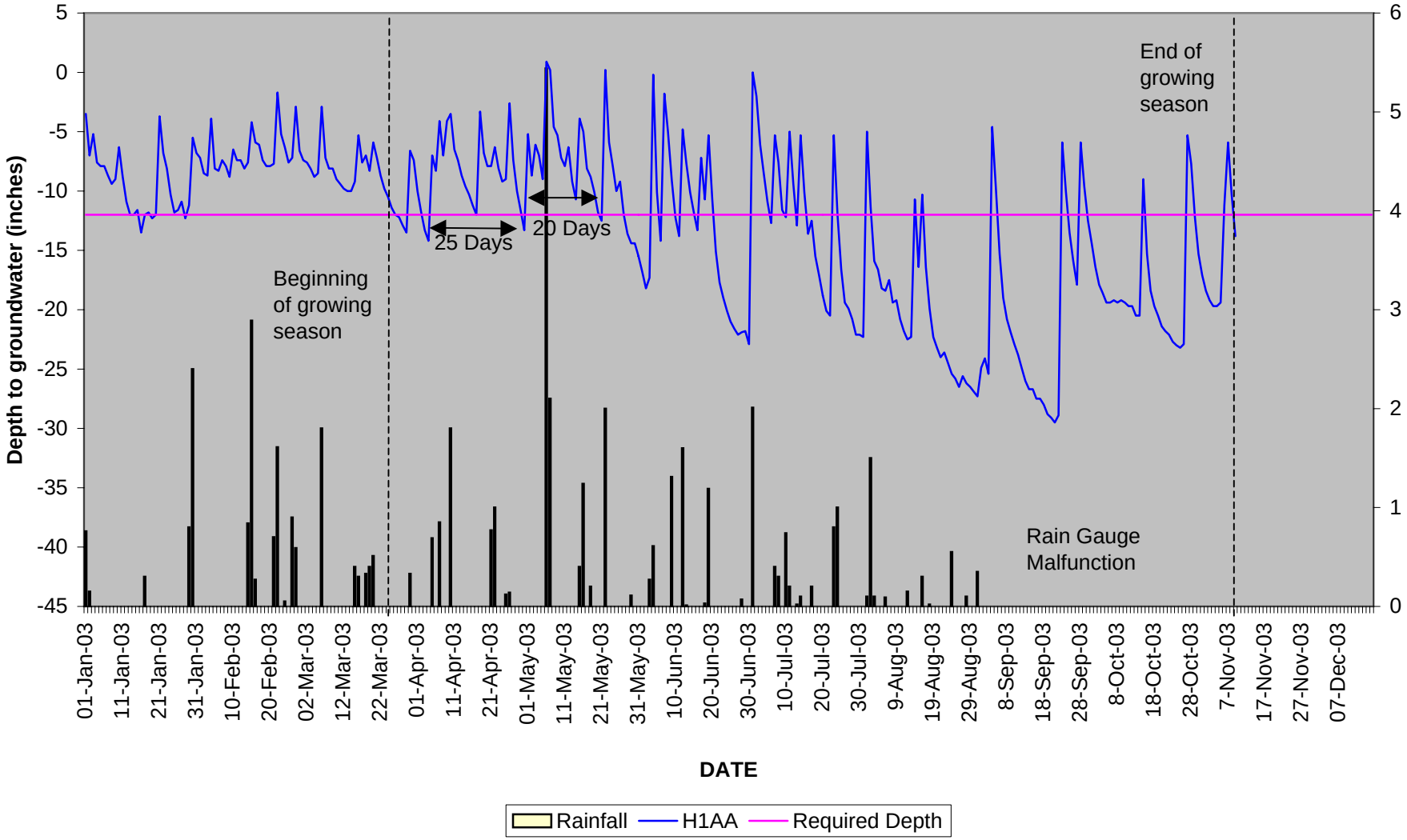
F3AA Tulula Bog

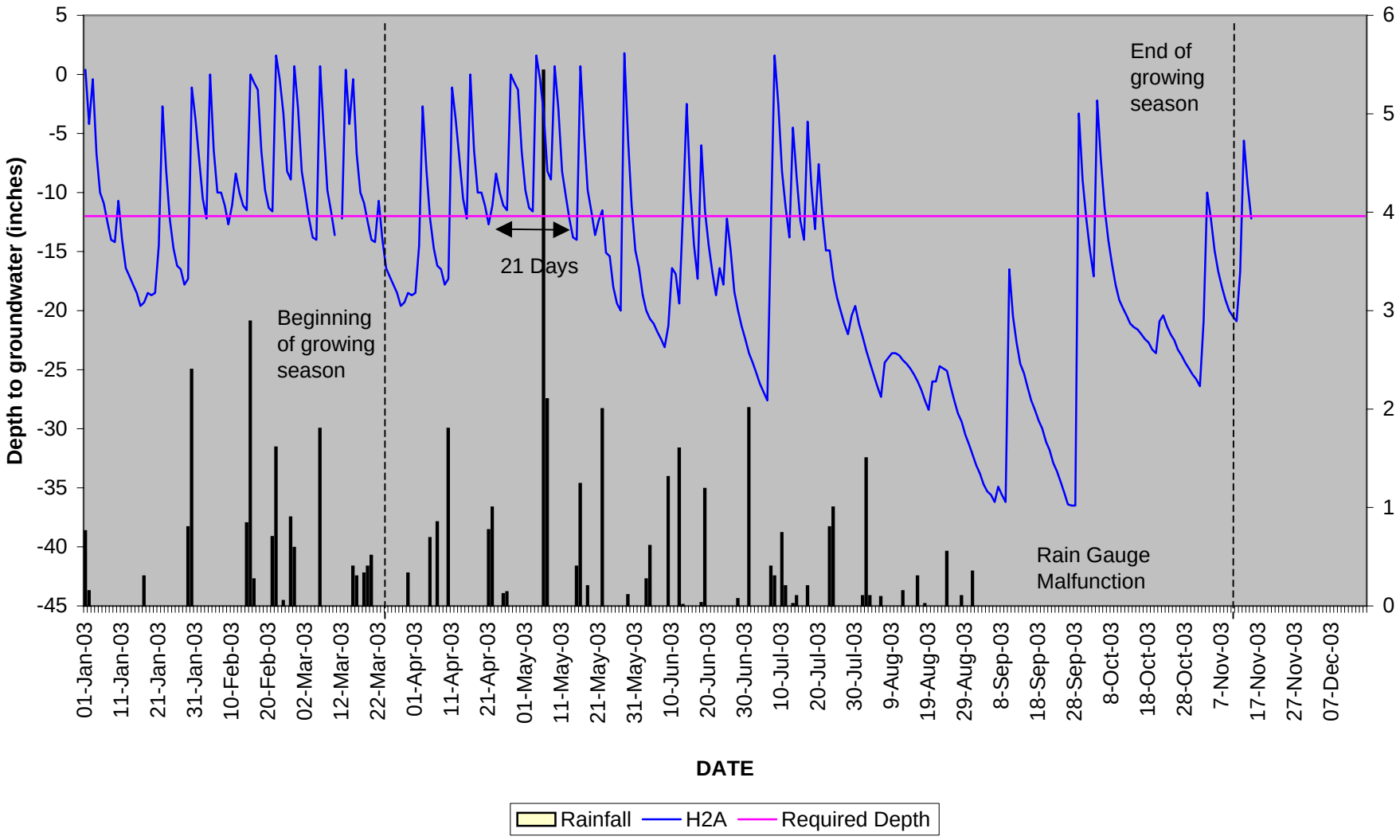


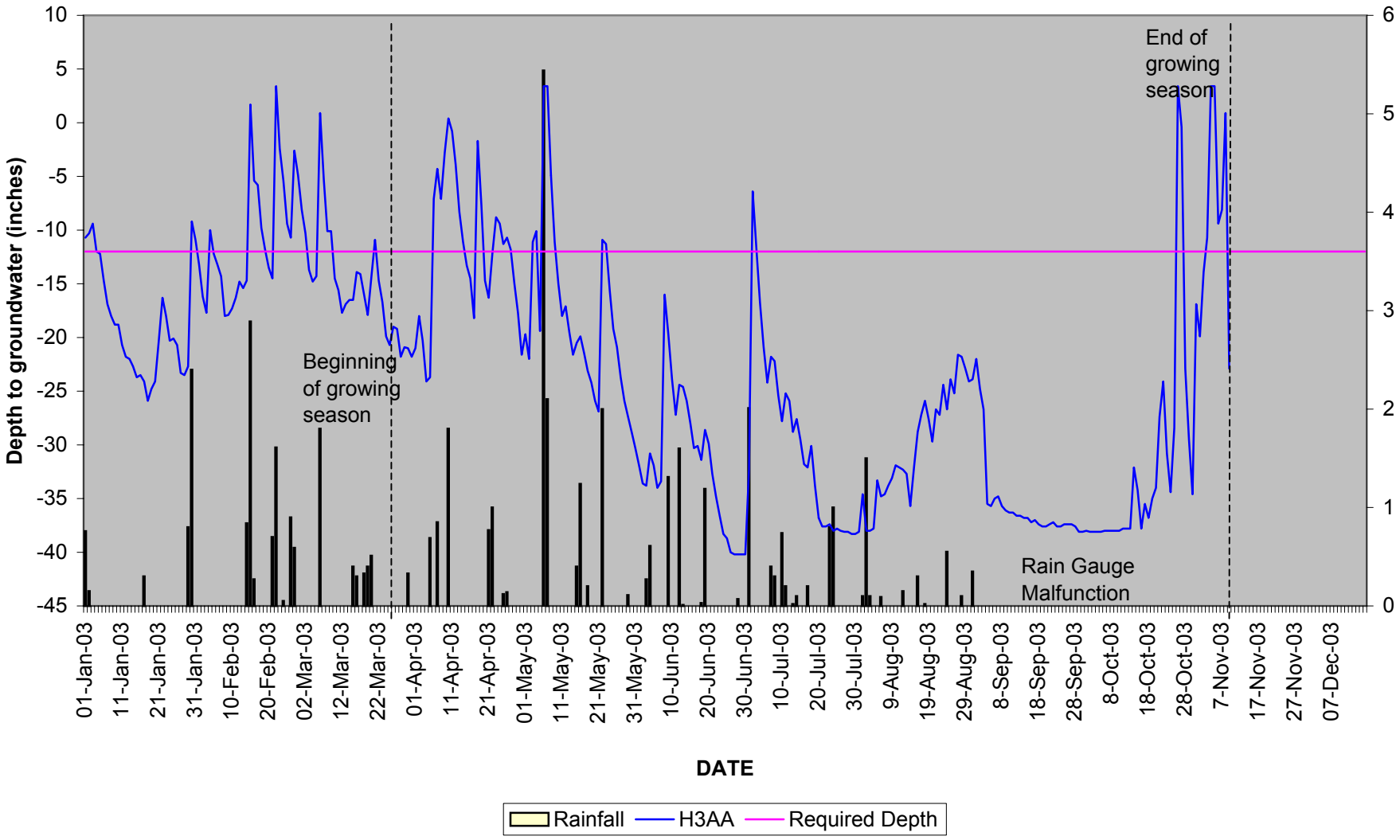

G1A Tulula Bog
Depth to groundwater (inches)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
92 Days
Beginning of growing season
End of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
G1A
Required Depth

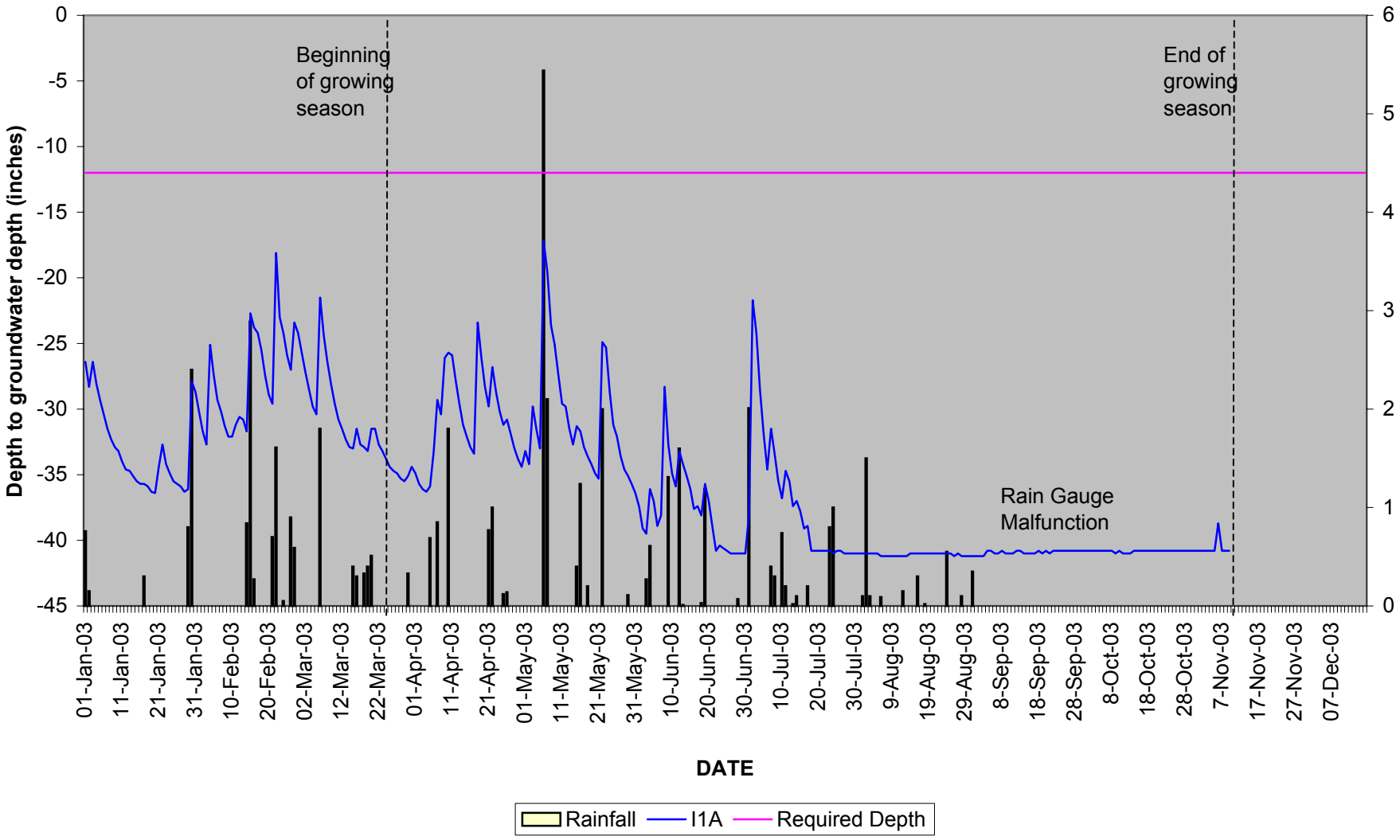

G2A Tulula Bog
Depth to groundwater (inches)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
89 Days
Beginning of growing season
End of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
G2A
Required Depth

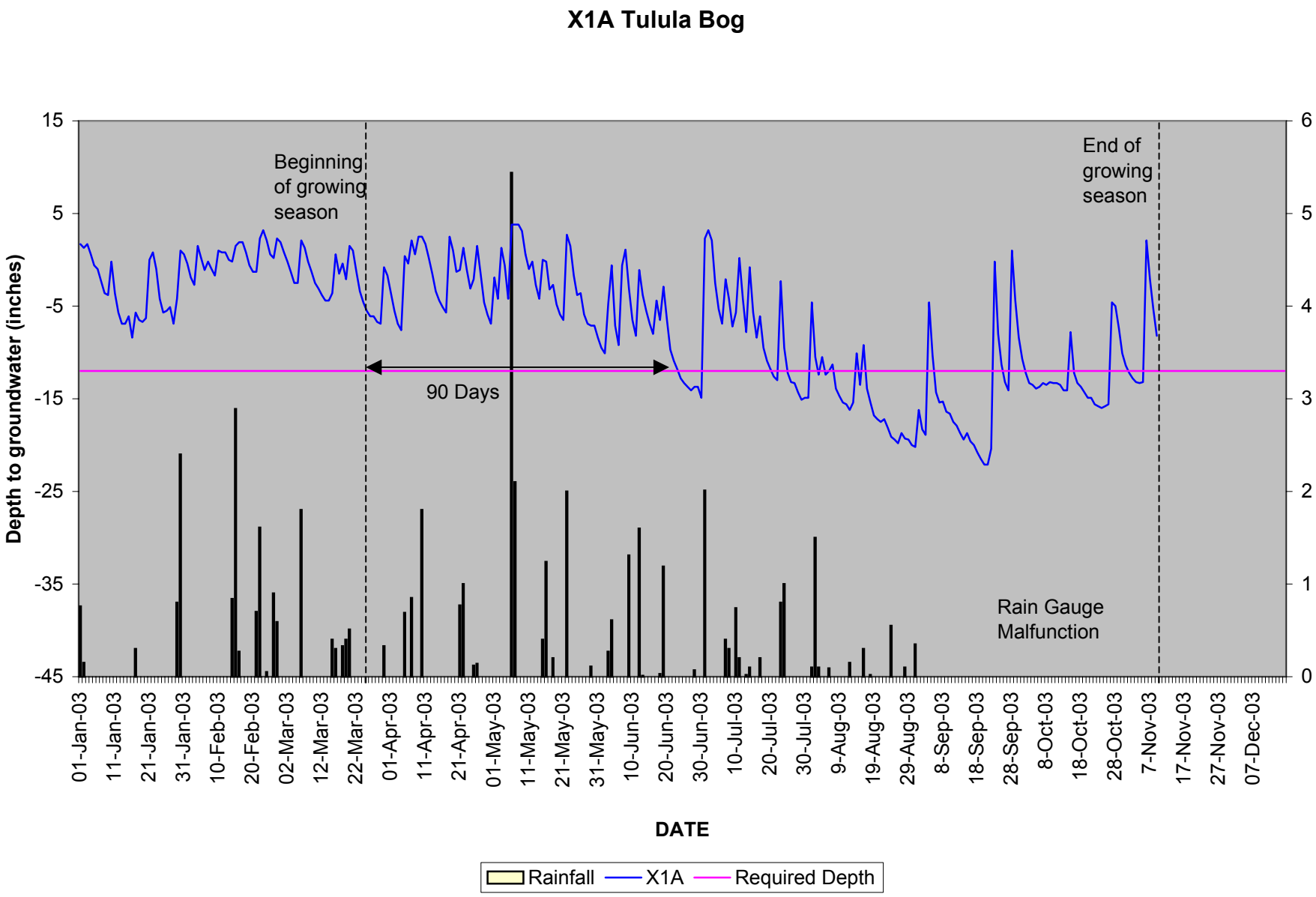
H1AA Tulula Bog




H2A Tulula Bog
Depth to groundwater (inches)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
End of growing season
21 Days
Beginning of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
H2A
Required Depth


H3AA Tulula Bog
Depth to groundwater (inches)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
Beginning of growing season
End of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
H3AA
Required Depth


I1A Tulula Bog
Depth to groundwater depth (inches)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
6
5
4
3
2
1
0
Beginning of growing season
End of growing season
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
I1A
Required Depth


X1A Tulula Bog
Depth to groundwater (inches)
15
5
-5
-15
-25
-35
-45
6
5
4
3
2
1
0
Beginning of growing season
End of growing season
90 Days
Rain Gauge Malfunction
01-Jan-03
11-Jan-03
21-Jan-03
31-Jan-03
10-Feb-03
20-Feb-03
02-Mar-03
12-Mar-03
22-Mar-03
01-Apr-03
11-Apr-03
21-Apr-03
01-May-03
11-May-03
21-May-03
31-May-03
10-Jun-03
20-Jun-03
30-Jun-03
10-Jul-03
20-Jul-03
30-Jul-03
9-Aug-03
19-Aug-03
29-Aug-03
8-Sep-03
18-Sep-03
28-Sep-03
8-Oct-03
18-Oct-03
28-Oct-03
7-Nov-03
17-Nov-03
27-Nov-03
07-Dec-03
DATE
Rainfall
X1A
Required Depth

APPENDIX B

SITE PHOTOS & PLANTING PLAN

Tulula Bog

PHOTO 1

PHOTO 2

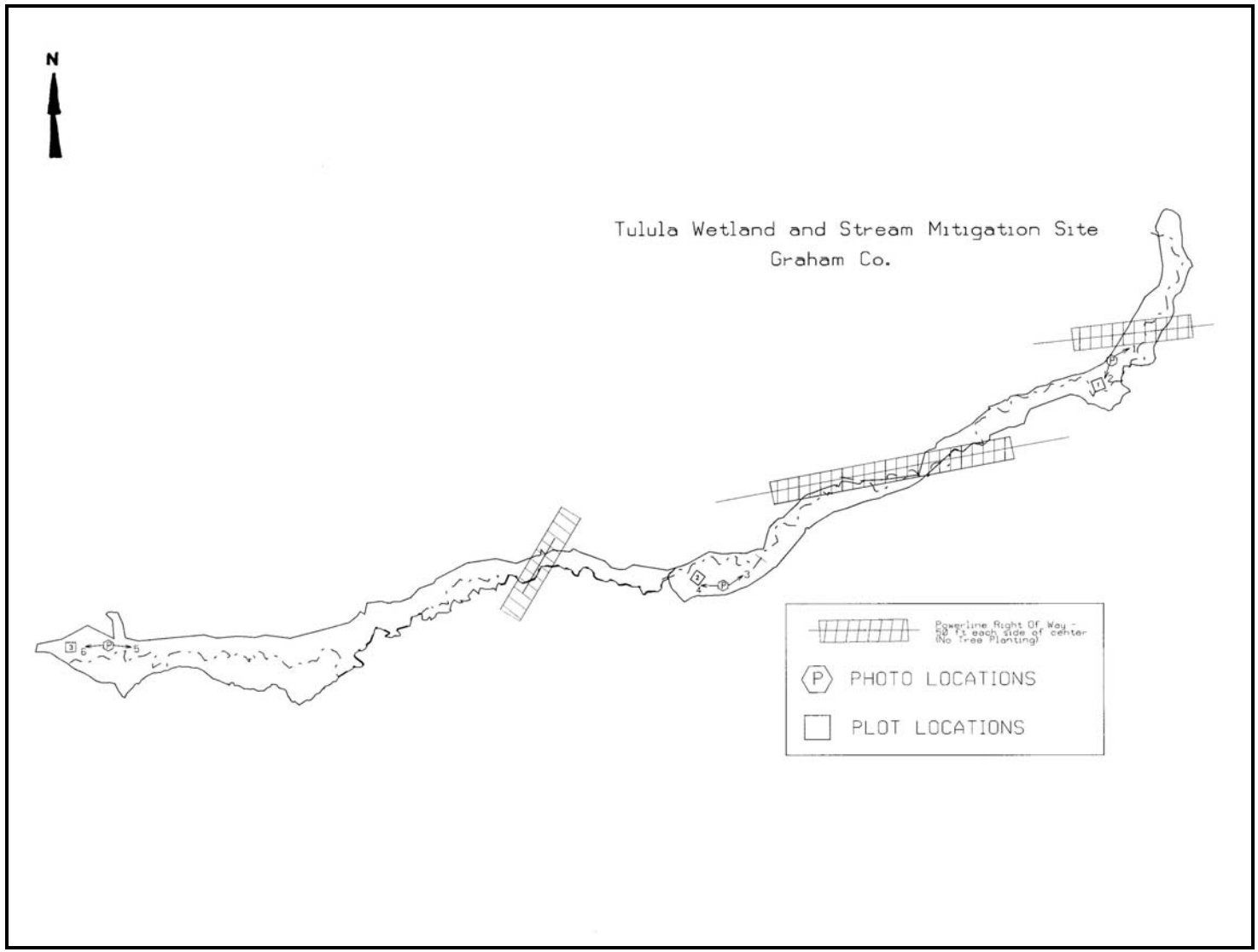
PHOTO 3

PHOTO 4

PHOTO 5

PHOTO 6

2003


N
Tulula Wetland and Stream Mitigation Site
Graham Co.
Powerline Right Of Way -
50 ft each side of center
(No Tree Planting)
PHOTO LOCATIONS
PLOT LOCATIONS