ANNUAL REPORT FOR 2000

Bryan Boulevard Mitigation Sites
Guilford County
Project No. 8.2491101
TIP No. U-608

Prepared By:
Natural Systems Unit & Roadside Environmental Unit
North Carolina Department of Transportation
December 2000

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

SUMMARY

The following report summarizes the monitoring activities that have occurred in the past year at the Bryan Boulevard Mitigation Sites. Both sites, Horsepen Creek and Oak Ridge Road, were constructed in 1996. Monitoring activities in 2000 represent the fourth year of hydrologic monitoring. Hydrologic monitoring must be conducted until success is demonstrated. Vegetation monitoring for both sites was discontinued after meeting success for the 1999 monitoring year as stated in a letter from the Army Corps of Engineers on June 26, 2000.

Horsepen Creek is monitored by four vegetation plots, ten groundwater gauges, one surface gauge and one rain gauge. Problem gauges at the Horsepen Creek site were replaced at the beginning of the 2000 growing season. Oak Ridge Road is monitored with one vegetation plot, four groundwater gauges, and one rain gauge.

One major change in the hydrologic monitoring process is the installation of an infinity rain gauge on the Horsepen Creek site. This gauge was installed because in the past existing on-site rainfall gauges have proven unreliable. Daily rainfall recorded at a Greensboro rain gauge, maintained by the NC State Climate Office will be obtained to produce the 30-70 percentile graph. On-site rain data from the infinity rain gauge is used for comparison on the groundwater gauge graphs.

Hydrologic monitoring indicates that the entire Oak Ridge Road site and practically the entire Horsepen Creek site have met success criteria during the 2000 monitoring year. Remediation efforts have proven successful at the Oak Ridge Road Site. All but one of the Horsepen Creek groundwater gauges were successful for 12.5% of the growing season. Gauge 6 malfunctioned for several months during the beginning of the growing season. The surface water gauge has not shown appreciable surface water for most of the growing season.

Based on the monitoring results from the 2000 season, NCDOT recommends that hydrologic monitoring be discontinued on both the Horsepen Creek and Oakridge Road sites.

1.0 INTRODUCTION

1.1 Project Description

The Bryan Boulevard Mitigation Sites are located in Guilford County, adjacent to the Bryan Boulevard Extension. Site 1 (Horsepen Creek) is located at the intersection of Bryan Boulevard and Flemming Road; site 2 (Oak Ridge Road) is located near the intersection of Bryan Boulevard and Old Oak Ridge Road (Figure 1). These two sites provide 31.17 acres of mitigation to offset wetland impacts associated with project U-608, the extension of Bryan Boulevard (COE ID # 199100369).

1.2 Purpose

Monitoring for both wetland hydrology and vegetation is required to demonstrate successful mitigation. The following report describes the results of the hydrologic monitoring during 2000 at the Bryan Boulevard Sites. Vegetation monitoring has been discontinued.

1.3 Project History

January 1996	Sites planted
October 1996	Vegetation Monitoring (1 yr.)
March 1997	Monitoring Wells Installed
March – November 1997	Hydrologic Monitoring (1 yr.)
September 1997	Vegetation Monitoring (2 yr.)
March – November 1998	Hydrologic Monitoring - HPC Site (2 yr.)
August 1998	Wells on Oak Ridge Site Removed
October 1998	Vegetation Monitoring (3 yr.)
Winter 1998	Remediation of Oak Ridge Road site
March – November 1999	Hydrologic Monitoring – ORR Site (1 yr.)
	Hydrologic Monitoring – HPC Site (3 yr.)
October 1999	Vegetation Monitoring (4 yr.)
March – November 2000	Hydrologic Monitoring – ORR Site (2 yr.)
	Hydrologic Monitoring – HPC Site (4 yr.)

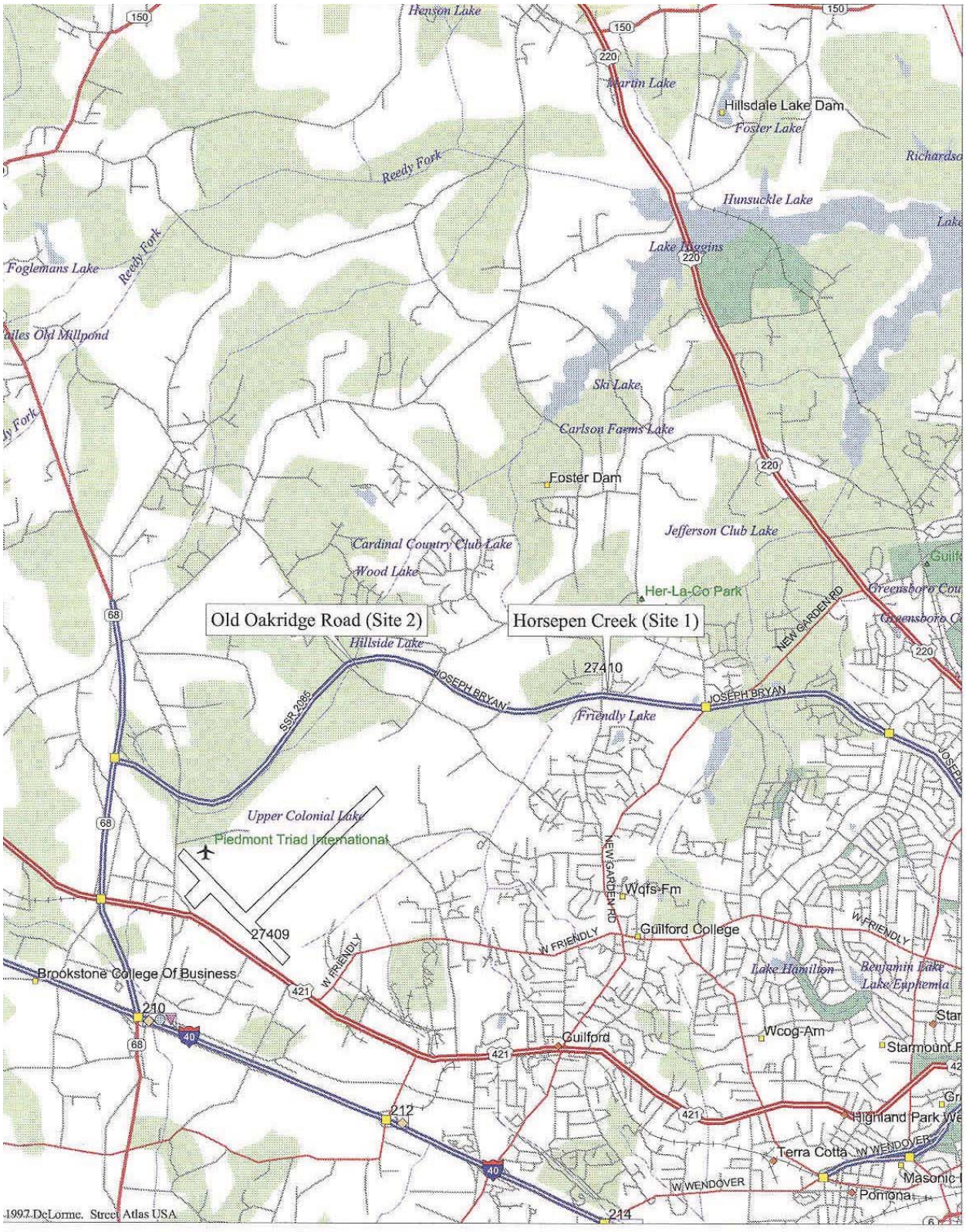


Figure 1. Site Location Map

2.0 HYDROLOGY

2.1 Success Criteria

In accordance with federal 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 ground water for a consecutive 12.5% of the growing season. Areas inundated 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 hydrophytic vegetation and hydric soils.

The growing season in Guilford County begins March 26 and ends on November 6, lasting 226 days. These dates correspond to a 50% probability that air temperatures will drop to 28^{o} or lower after March 26 and before November 6.[1] The optimum duration for wetland hydrology is 29 consecutive days. In the event that the hydrologic success criteria is not met during the first year at either site, hydrologic monitoring will continue in successive years until the success criteria for each site has been met and documented. Also, local climate must reflect average conditions in order for the hydrologic data to be valid.

2.2 Hydrologic Description

Site 1, Horsepen Creek, is equipped with ten groundwater gauges, one rain gauge, and one surface gauge (Figure 2) installed in March 1997. The automatic gauges record daily readings of both depth to groundwater and rainfall throughout the growing season. In the summer of 2000, an Infinity rain gauge was installed on-site to replace the existing gauge. The site will be monitored until hydrologic success criteria is met.

Site 2, Old Oak Ridge Road, is equipped with four groundwater gauges and one rain gauge (Figure 3). These gauges were removed in August of 1998 due to concerns that the site required remediation. The gauges were reinstalled prior to the start of the 1999 growing season, following remediation activities.

Appendix A contains a plot of the water depth for each groundwater gauge and surface gauge in 2000. Precipitation events are included as bars. Daily precipitation events were recorded by the on-site Infinity rain gauge.

[1] Soil Conservation Service, Soil Survey of Guilford County, North Carolina, p.50.

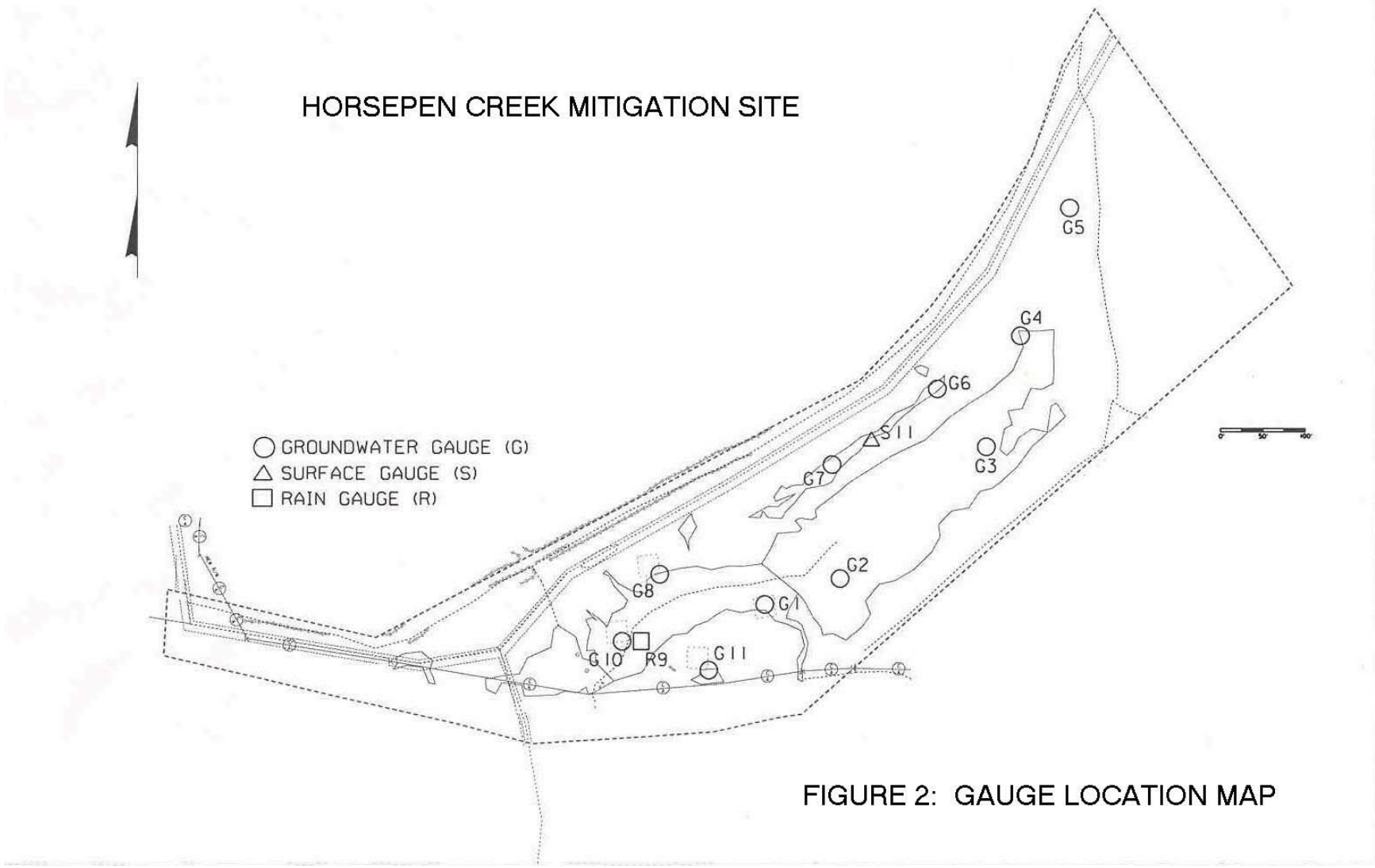


FIGURE 2: GAUGE LOCATION MAP

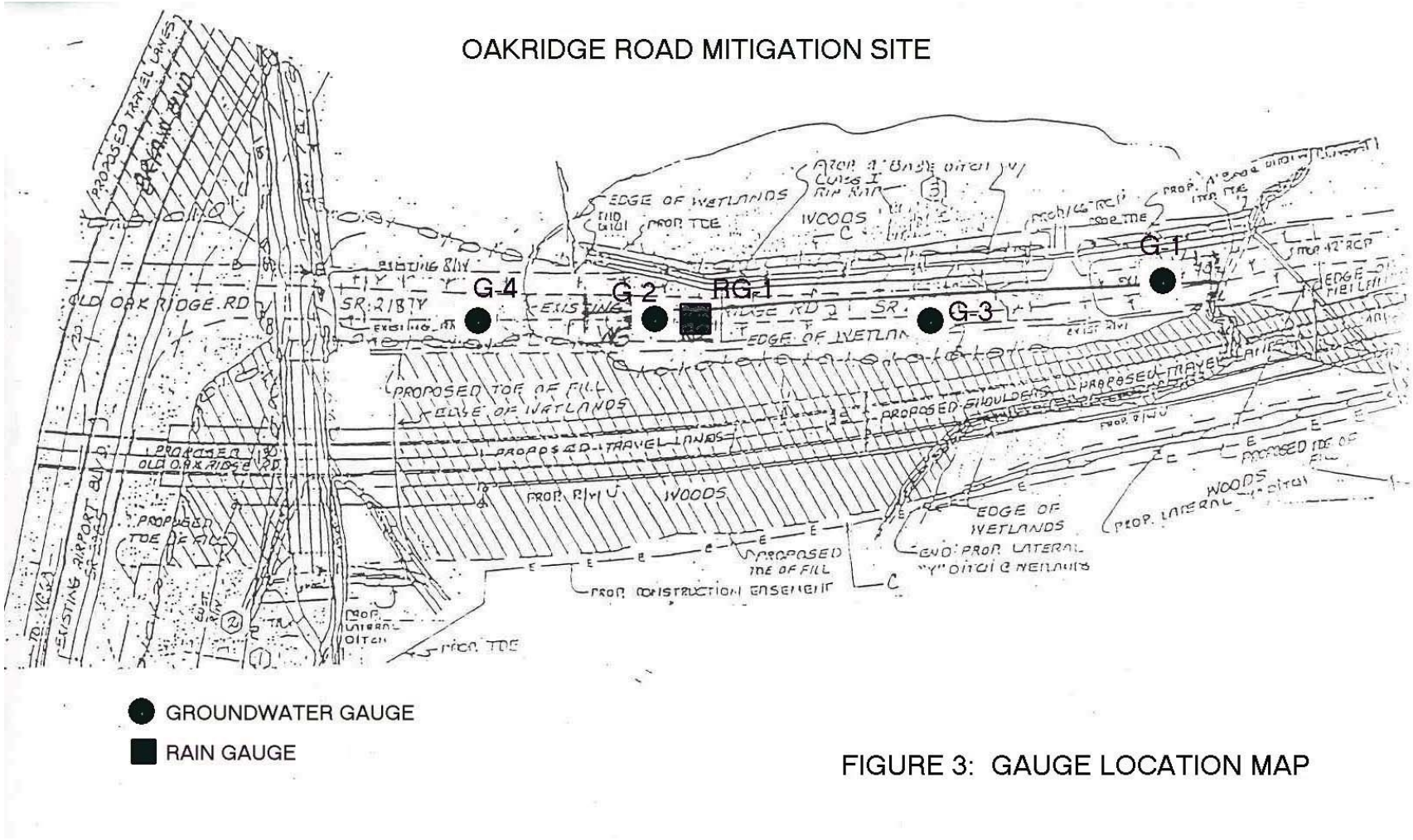


FIGURE 3: GAUGE LOCATION MAP

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 groundwater gauge. This number was converted into a percentage of the 226-day growing season. The 2000 results are presented in Tables 1 and 2.

Table 1

2000 HYDROLOGIC MONITORING RESULTS – Horspen Creek

Monitoring Gauge	< 5%	5% - 8%	8% - 12.5%	> 12.5%	Actual %	Success Dates
H-1				✔	100.0	Mar. 26 – Nov. 11
H-2				✔	100.0	Mar. 26 – Nov. 11
H-3				✔	63.7	Mar. 26 – Aug. 16
H-4				✔	19.5	Mar. 26 – May 8
H-5				✔	31.4	Aug. 28 – Nov. 6
H-6*			✔		9.3	Sept. 15 – Oct. 5
H-7				✔	19.0	Mar. 26 – May 7
H-8*				✔	18.6	Mar. 26 – May 6
H-10				✔	58.0	Jun. 29 – Nov. 6
H-11				✔	19.9	Mar. 26 – May 9

*Represents monitoring wells which were malfunctioning during the growing season.

Groundwater gauge number 6 malfunctioned for several months at the beginning of the growing season. During the months of April and May gauge 6 did not read correctly. The gauge was adjusted at the downloads for both months and the battery reinstalled and seemed to be working again. In June the gauge was still exhibiting problems so its battery was replaced and the download time reset. During the July visit gauge 6 was successfully downloaded. Gauge number 8 malfunctioned at the end of the growing season producing invalid data. It was reprogrammed during the October visit but continued to display problems at the November visit. Difficulties with this well are continuing to be investigated. The surface water gauge on the Horsepen Creek site has not indicated appreciable surface water for most of the 2000 growing season.

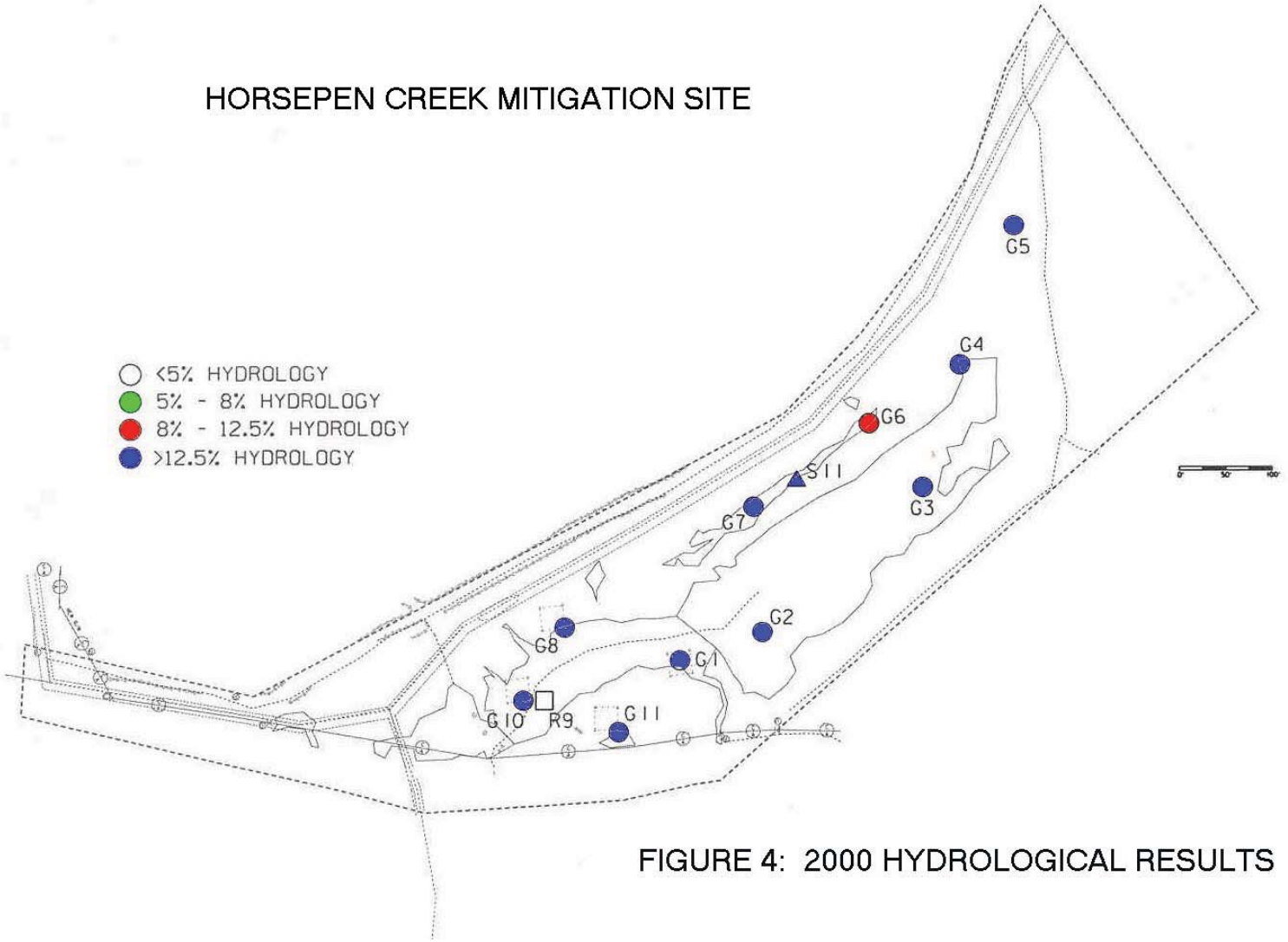


FIGURE 4: 2000 HYDROLOGICAL RESULTS

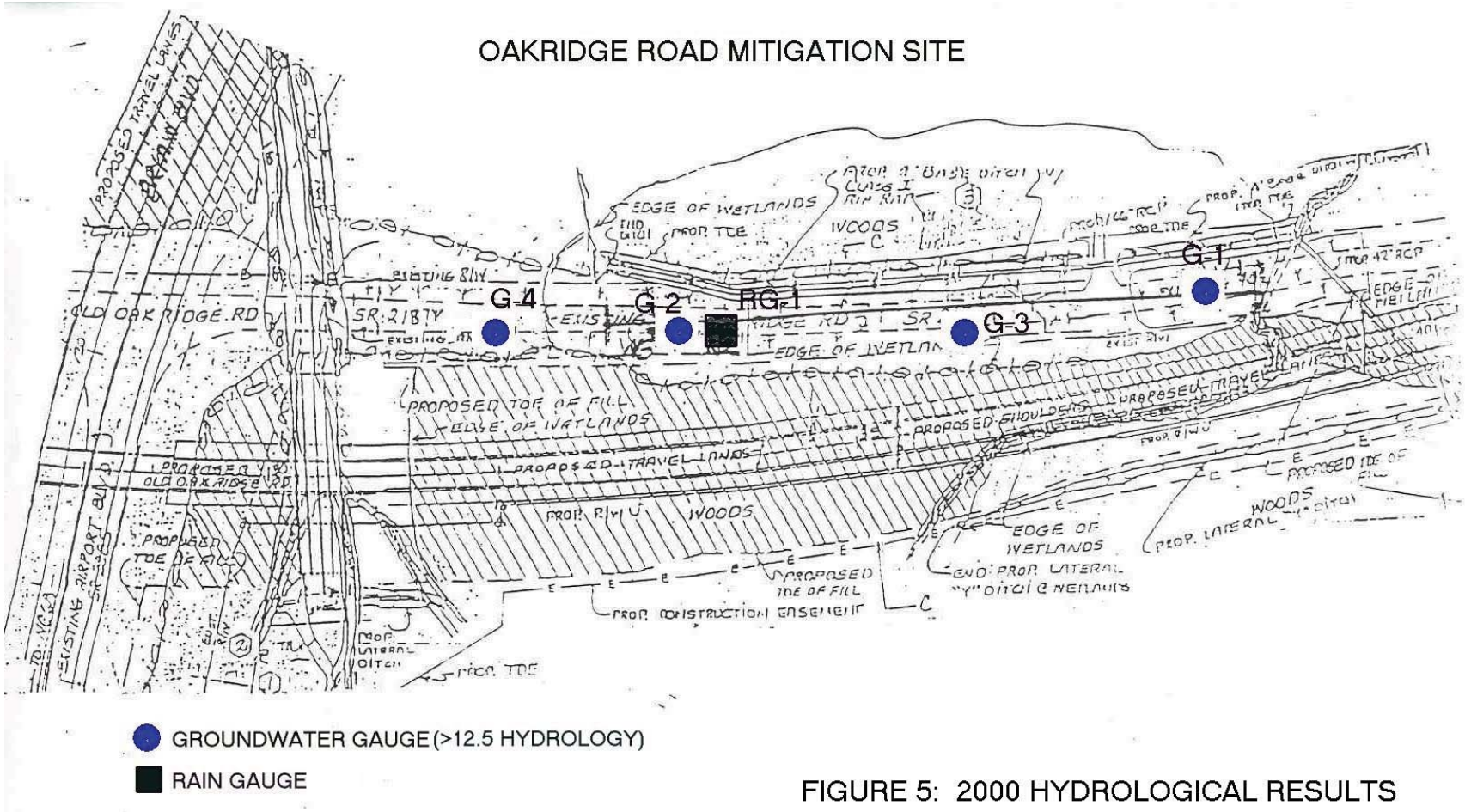


FIGURE 5: 2000 HYDROLOGICAL RESULTS

At the Oak Ridge Road site 3 of the 4 gauges met 100% of the growing season. Gauge number 3 met and exceeded success criteria but displayed some problems during the middle of the growing season. In July gauge 3 was pulled out and replaced. During the August and September visits to the site it was discovered that problems were occurring with the gauge's timing and it was reprogrammed. Gauge 3 was successfully downloaded during the October site visit. When functioning properly the gauge continuously showed water levels above -12 inches and most likely would have met 100% of the growing season as well had it not malfunctioned.

Table 2
2000 HYDROLOGIC MONITORING RESULTS - Oak Ridge Road

Monitoring Gauge	< 5%	5% - 8%	8% - 12.5%	> 12.5%	Actual %	Success Dates
O-1				✔	100.0	Mar. 26 – Nov. 6
O-2				✔	100.0	Mar. 26 – Nov. 6
O-3				✔	32.7	Mar. 26 – Jun. 7
O-4				✔	100.0	Mar. 26 – Nov. 6

Figure 4 and 5 are graphical representations of the 2000 hydrologic data for Bryan Boulevard. Gauges highlighted in blue met wetland hydrology for more than 12.5% of the growing season. Gauges in red met hydrology between 8% and 12.5% of the season while those in green met hydrology between 5% and 8% of the growing season.

2.3.2 Climatic Data

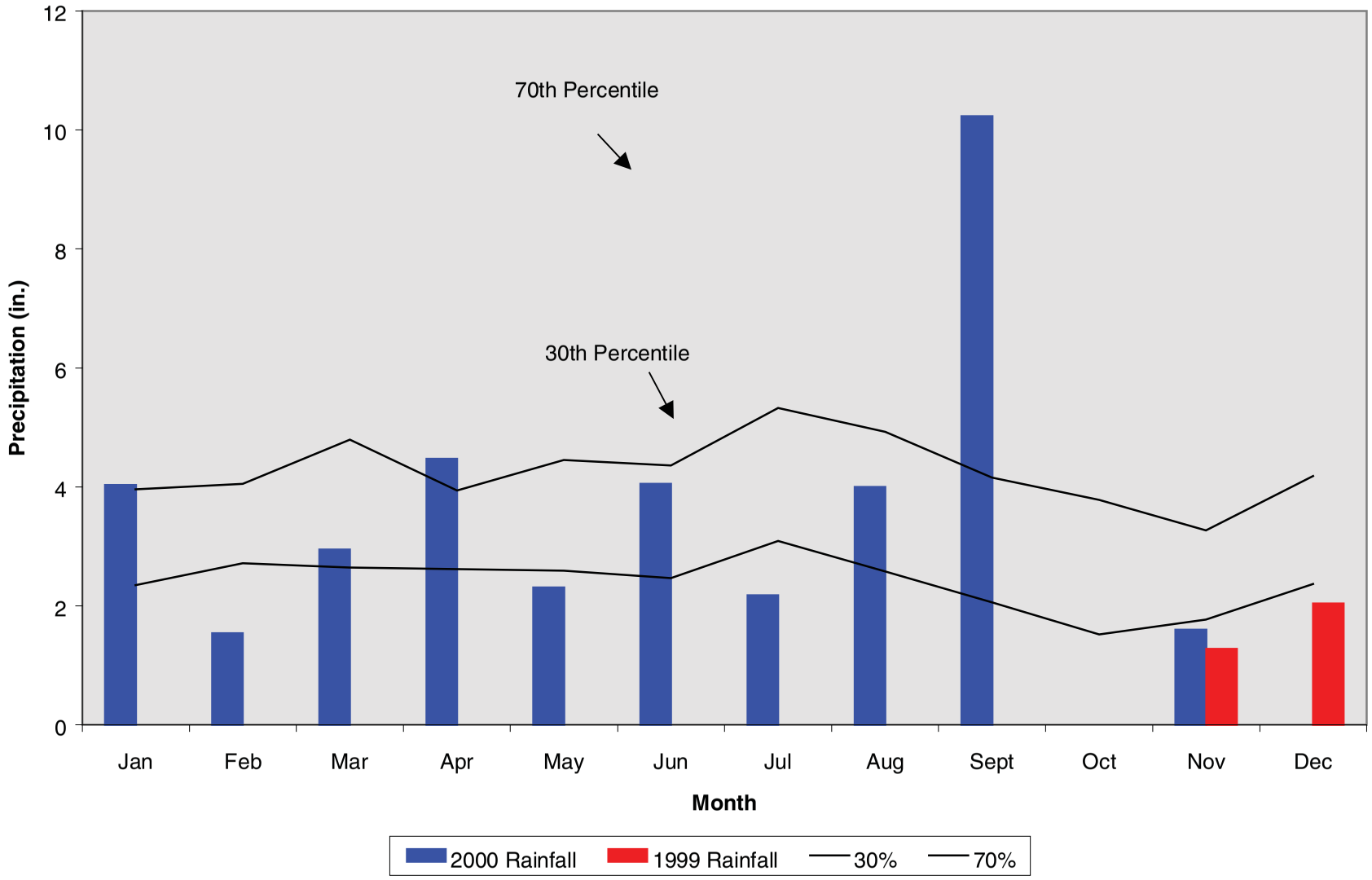
Figure 6 is a comparison of 1999 (winter only) and 2000 monthly rainfall to historical precipitation for the area. The two lines represent the 30th and 70th percentiles of monthly precipitation for Greensboro, NC. The bars are the monthly rainfall totals for 1999 (winter only) and 2000. The data was collected from the National Climatic Data Center rain gauge in Greensboro; because of data availability, the 2000 rainfall encompasses precipitation through November. The 2001 annual monitoring report will include a 30-70 percentile graph with the monthly rainfall from the winter of 2000.

Monthly rainfall totals for 1999 and 2000 at the Greensboro monitoring station were for the most part average or below average.

2.4 Conclusions

The Horsepen Creek site showed improved hydrologic conditions in 2000. Nine of the ten gauges indicated saturation for more than 12.5% of the growing season. Much of the data from gauge number 6, which is the only well that did not demonstrate success, had to be discarded due to a malfunction.

Figure 6: Bryan Blvd. 30-70 Percentile Graph
Greensboro, NC



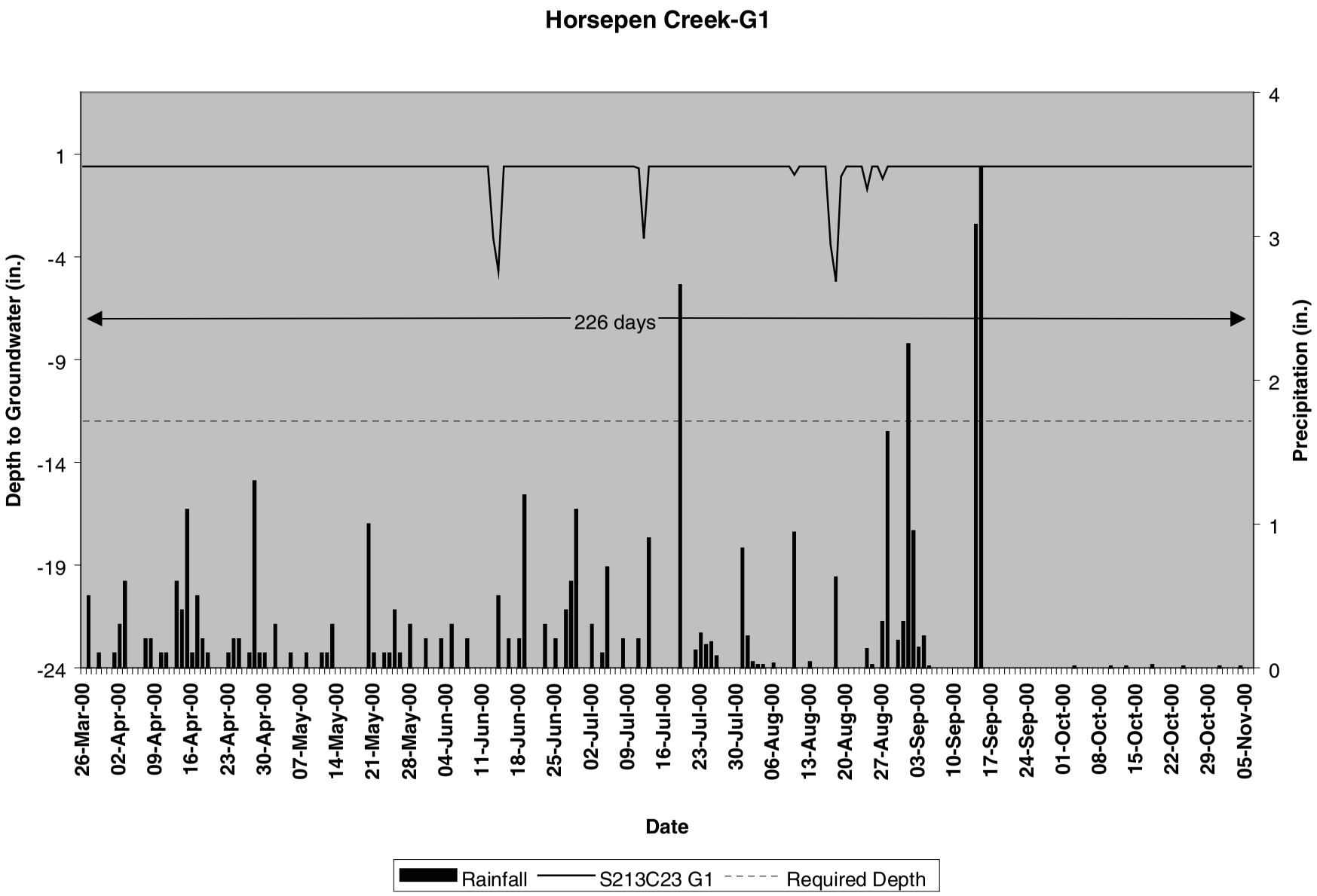
The remediation effort at the Oak Ridge Road site was successful. All four gauges met and far exceeded the hydrologic requirements. Three gauges showed saturation for the entire growing season.

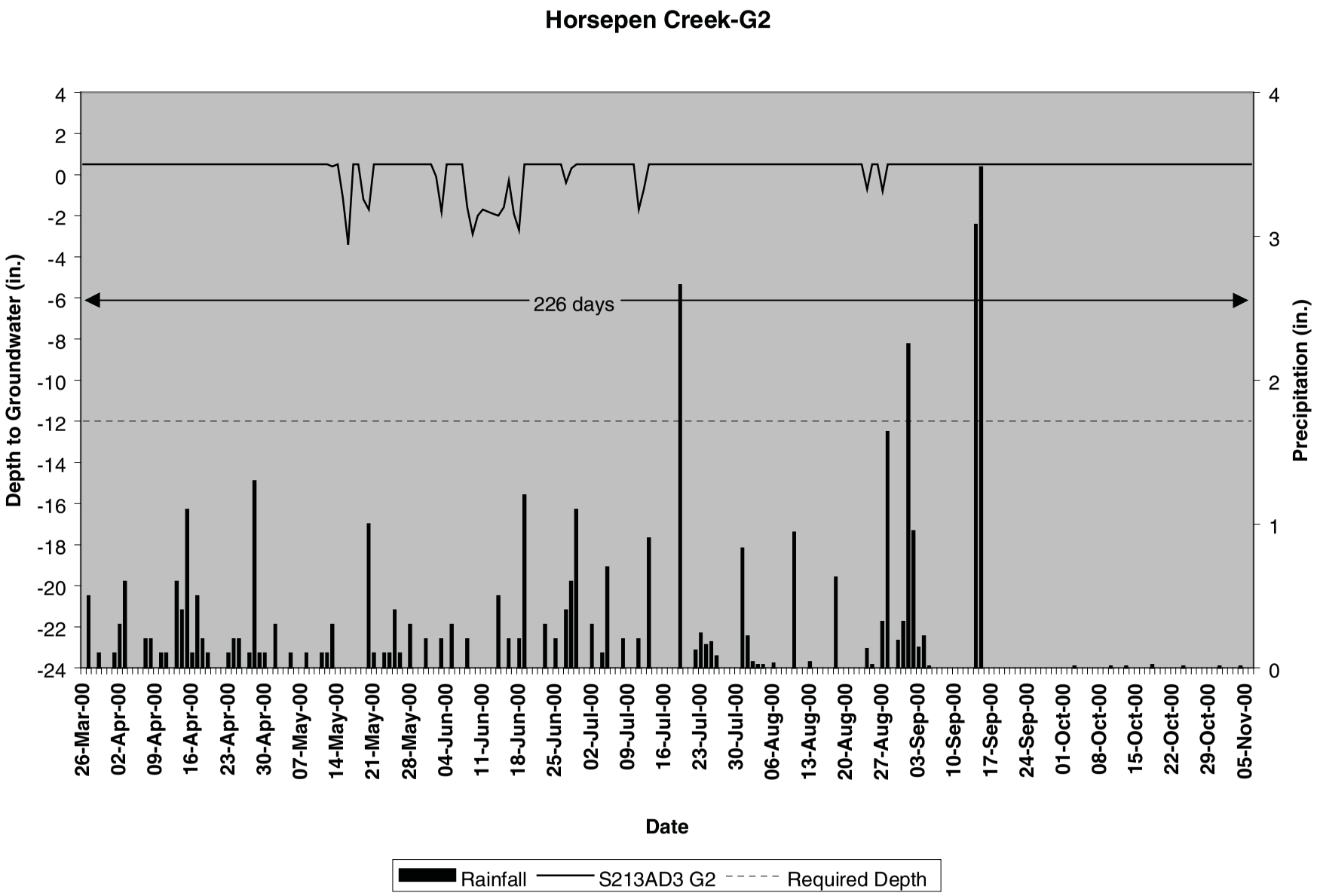
4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS

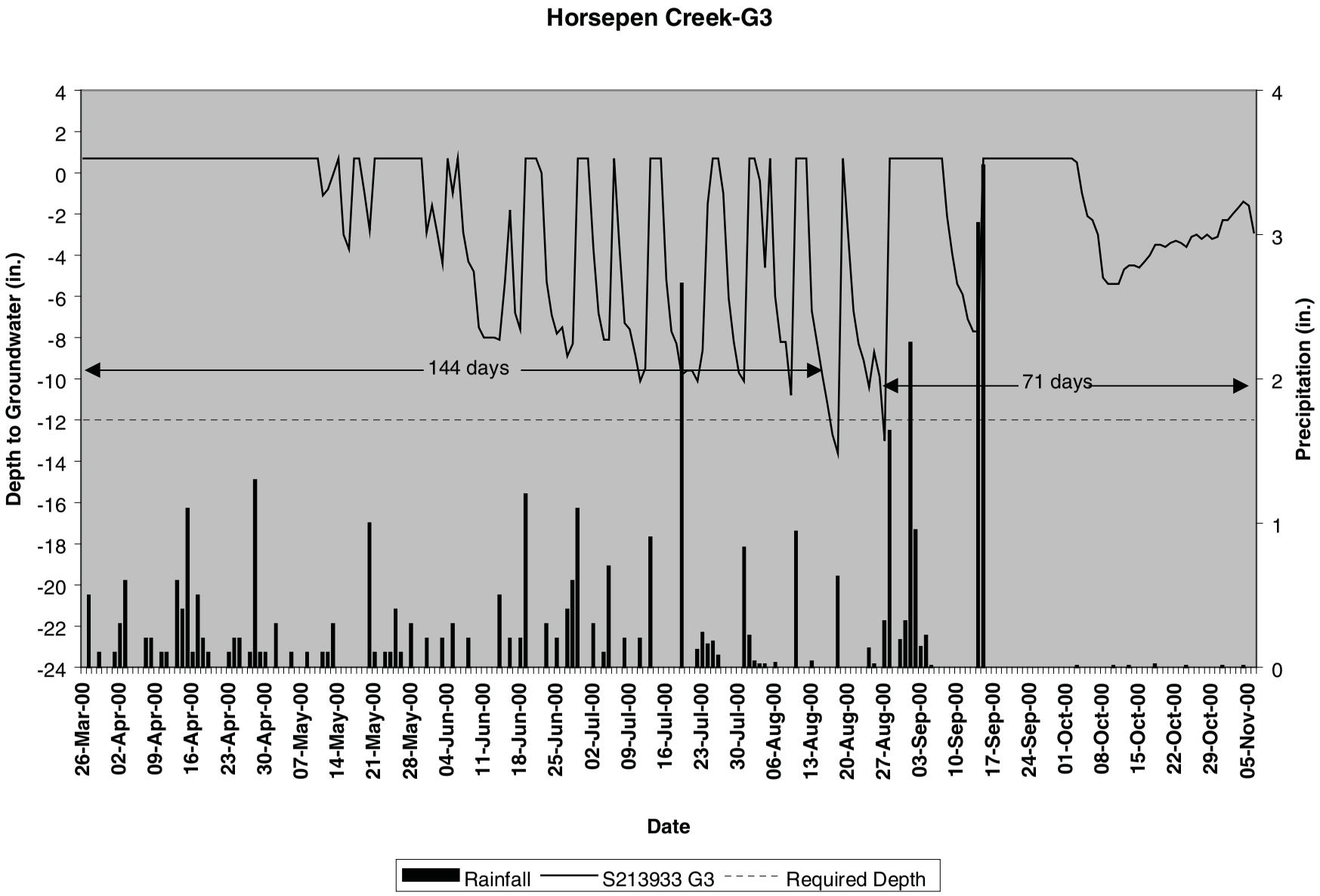
Both sites met hydrologic criteria in 2000. Due to the huge success of the Oak Ridge Road site and vast improvement of the Horsepen Creek site throughout the entire growing season NCDOT recommends discontinuing hydrological monitoring.

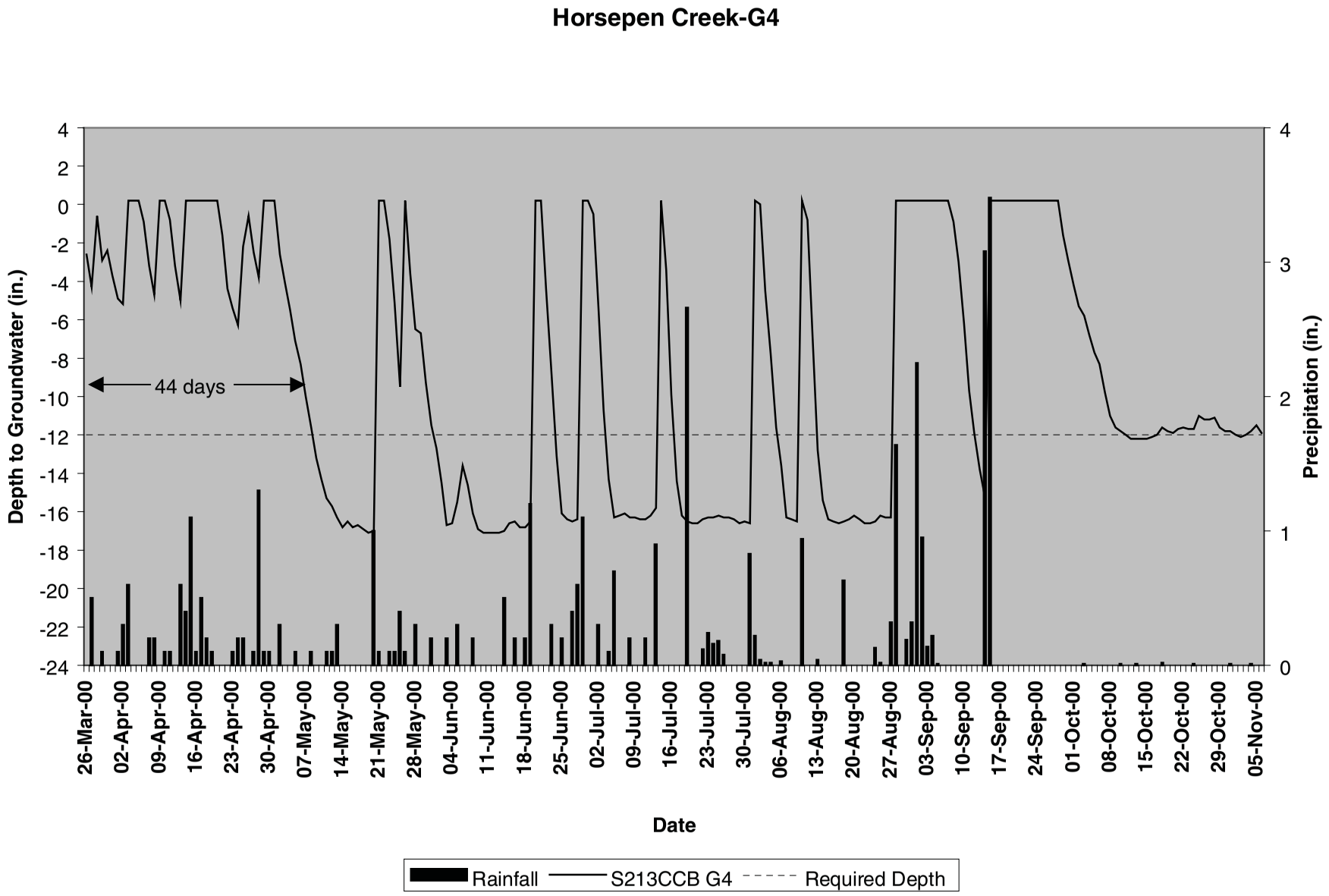
APPENDIX A

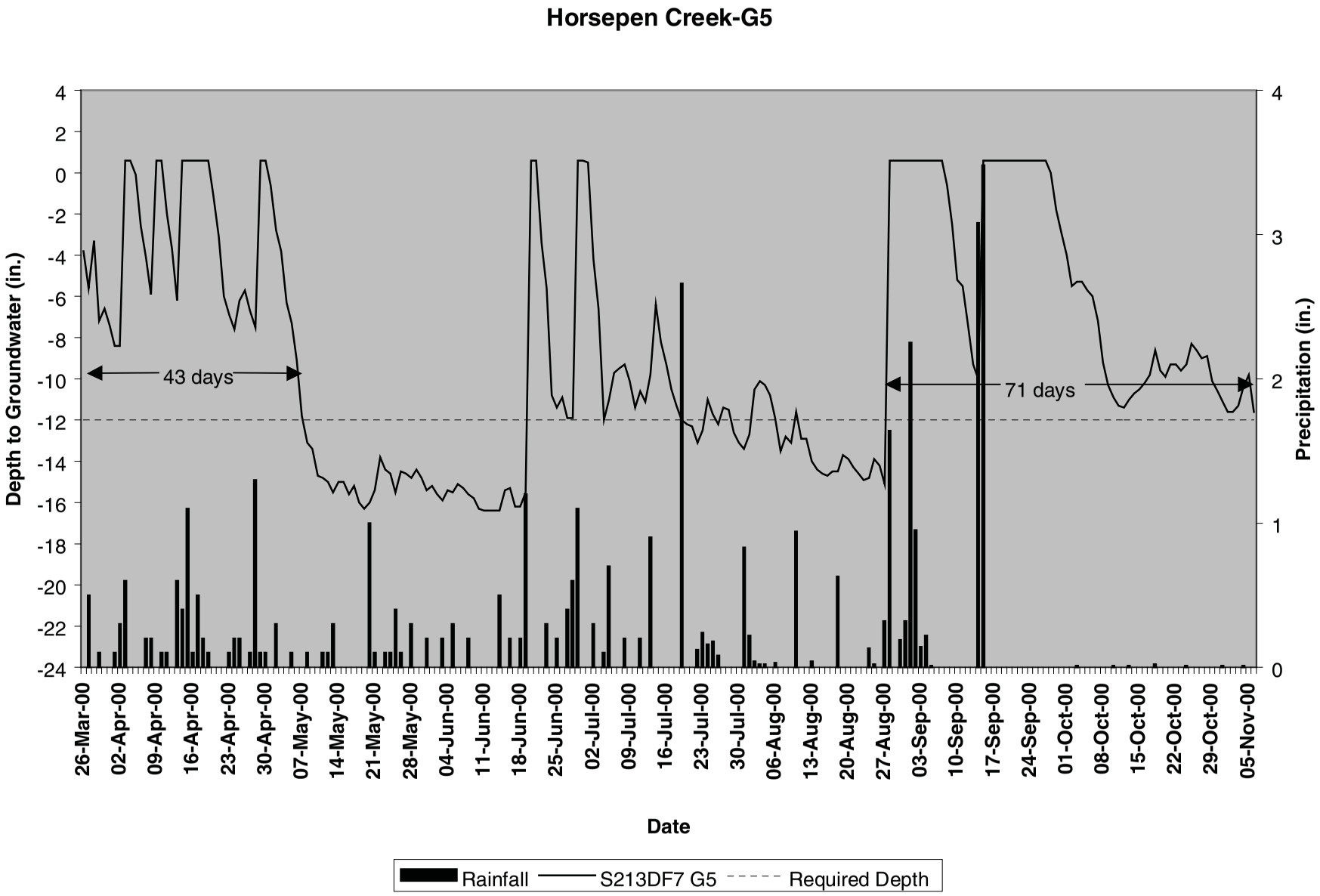
DEPTH TO GROUNDWATER PLOTS

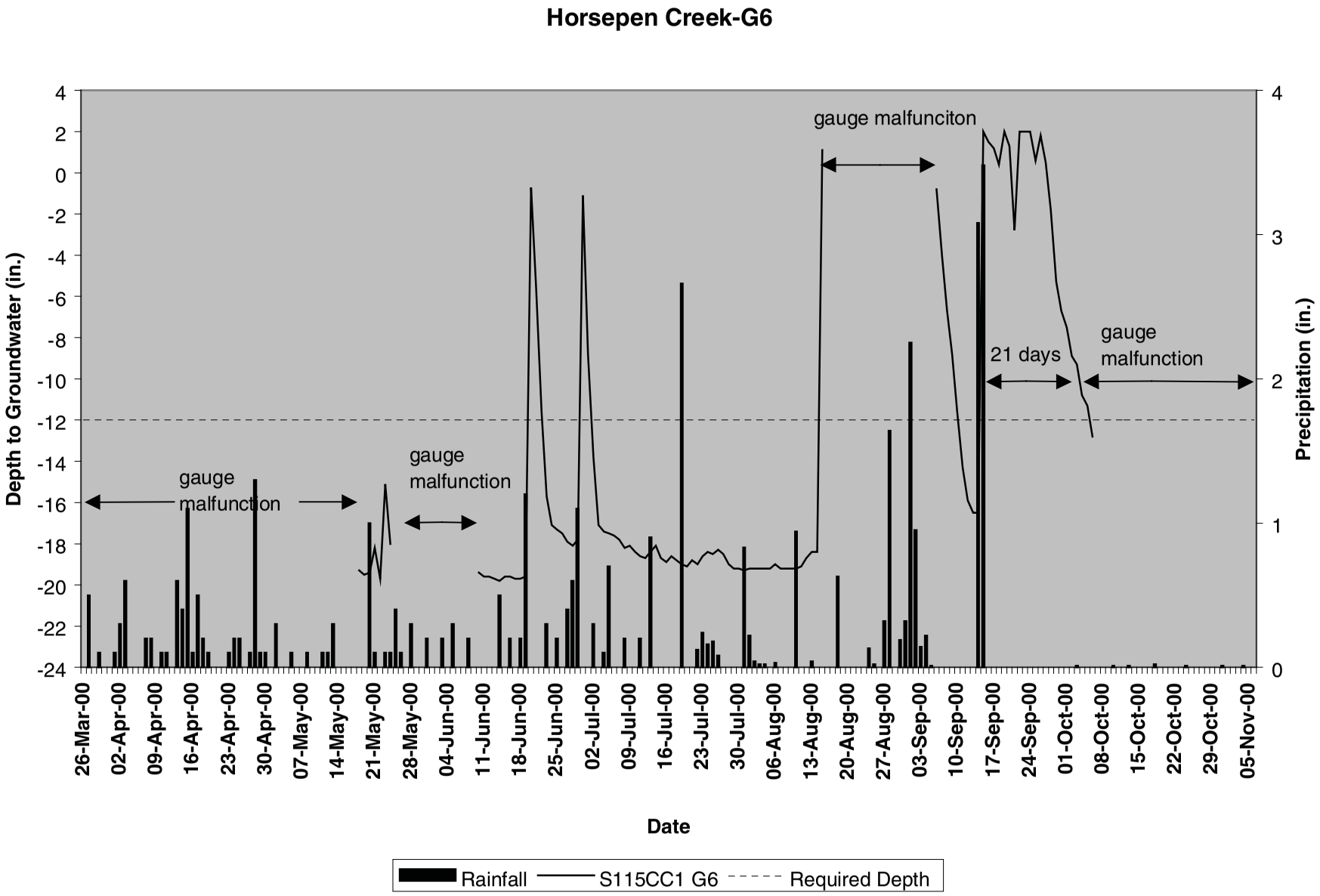

Horsepen Creek-G1
Depth to Groundwater (in.)
1
-4
-9
-14
-19
-24
Precipitation (in.)
4
3
2
1
0
226 days
26-Mar-00
02-Apr-00
09-Apr-00
16-Apr-00
23-Apr-00
30-Apr-00
07-May-00
14-May-00
21-May-00
28-May-00
04-Jun-00
11-Jun-00
18-Jun-00
25-Jun-00
02-Jul-00
09-Jul-00
16-Jul-00
23-Jul-00
30-Jul-00
06-Aug-00
13-Aug-00
20-Aug-00
27-Aug-00
03-Sep-00
10-Sep-00
17-Sep-00
24-Sep-00
01-Oct-00
08-Oct-00
15-Oct-00
22-Oct-00
29-Oct-00
05-Nov-00
Date
Rainfall
S213C23 G1
Required Depth

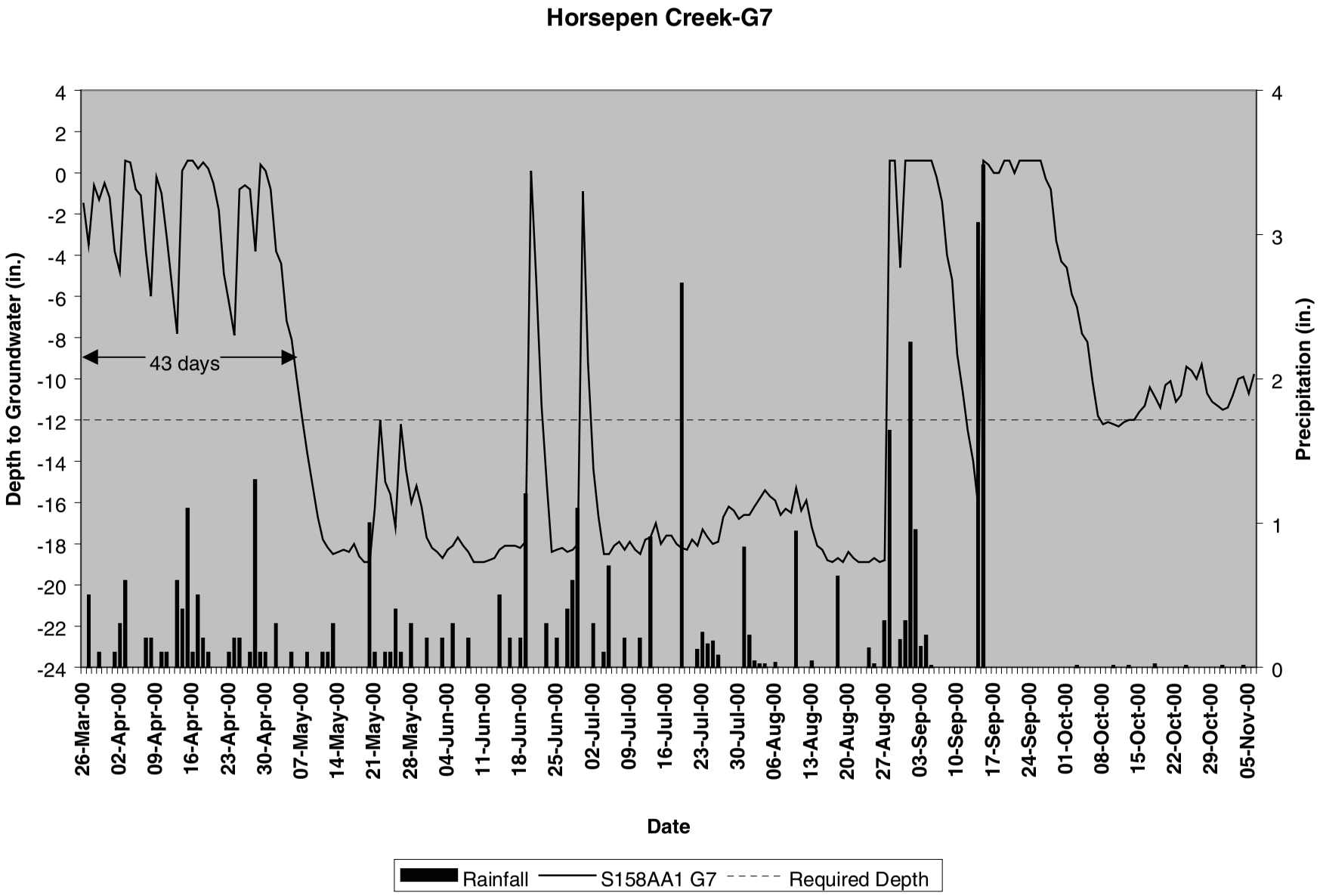

Horsepen Creek-G2
Depth to Groundwater (in.)
Precipitation (in.)
226 days
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
3
1
26-Mar-00
02-Apr-00
09-Apr-00
16-Apr-00
23-Apr-00
30-Apr-00
07-May-00
14-May-00
21-May-00
28-May-00
04-Jun-00
11-Jun-00
18-Jun-00
25-Jun-00
02-Jul-00
09-Jul-00
16-Jul-00
23-Jul-00
30-Jul-00
06-Aug-00
13-Aug-00
20-Aug-00
27-Aug-00
03-Sep-00
10-Sep-00
17-Sep-00
24-Sep-00
01-Oct-00
08-Oct-00
15-Oct-00
22-Oct-00
29-Oct-00
05-Nov-00
Date
Rainfall
S213AD3 G2
Required Depth

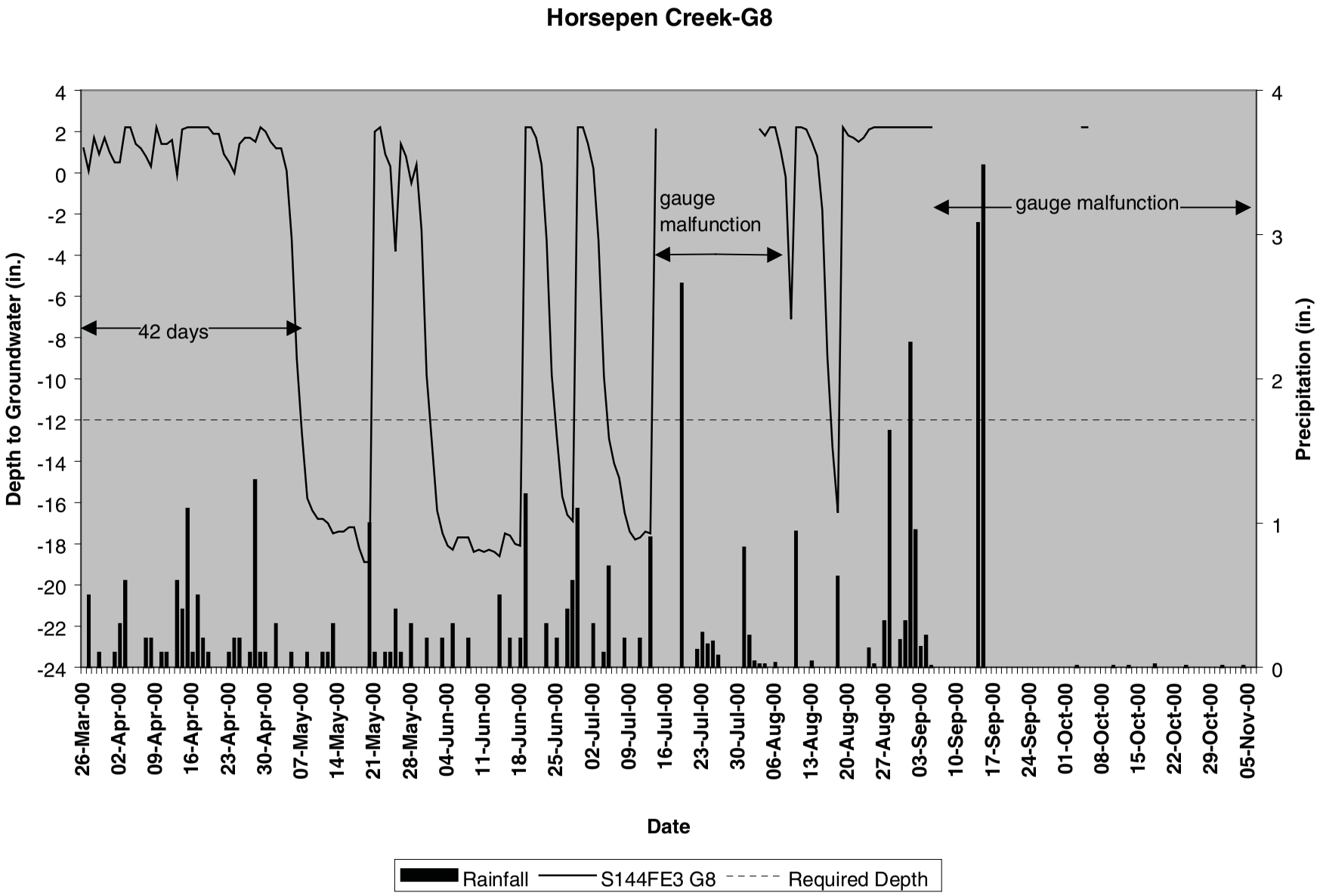

Horsepen Creek-G3
Depth to Groundwater (in.)
Precipitation (in.)
144 days
71 days
Date
Rainfall
S213933 G3
Required Depth

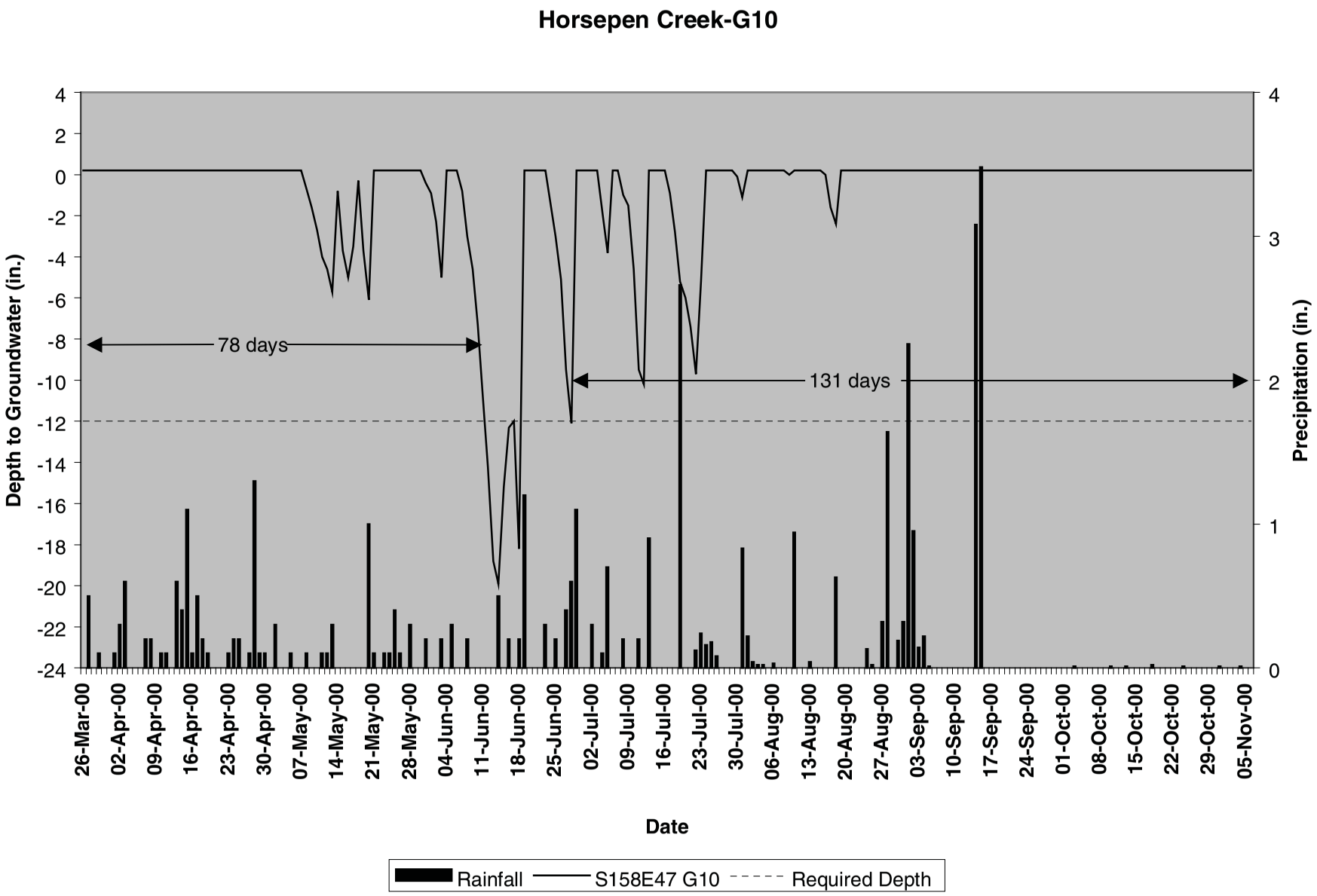

Horsepen Creek-G4
Depth to Groundwater (in.)
Precipitation (in.)
44 days
Date
Rainfall
S213CCB G4
Required Depth

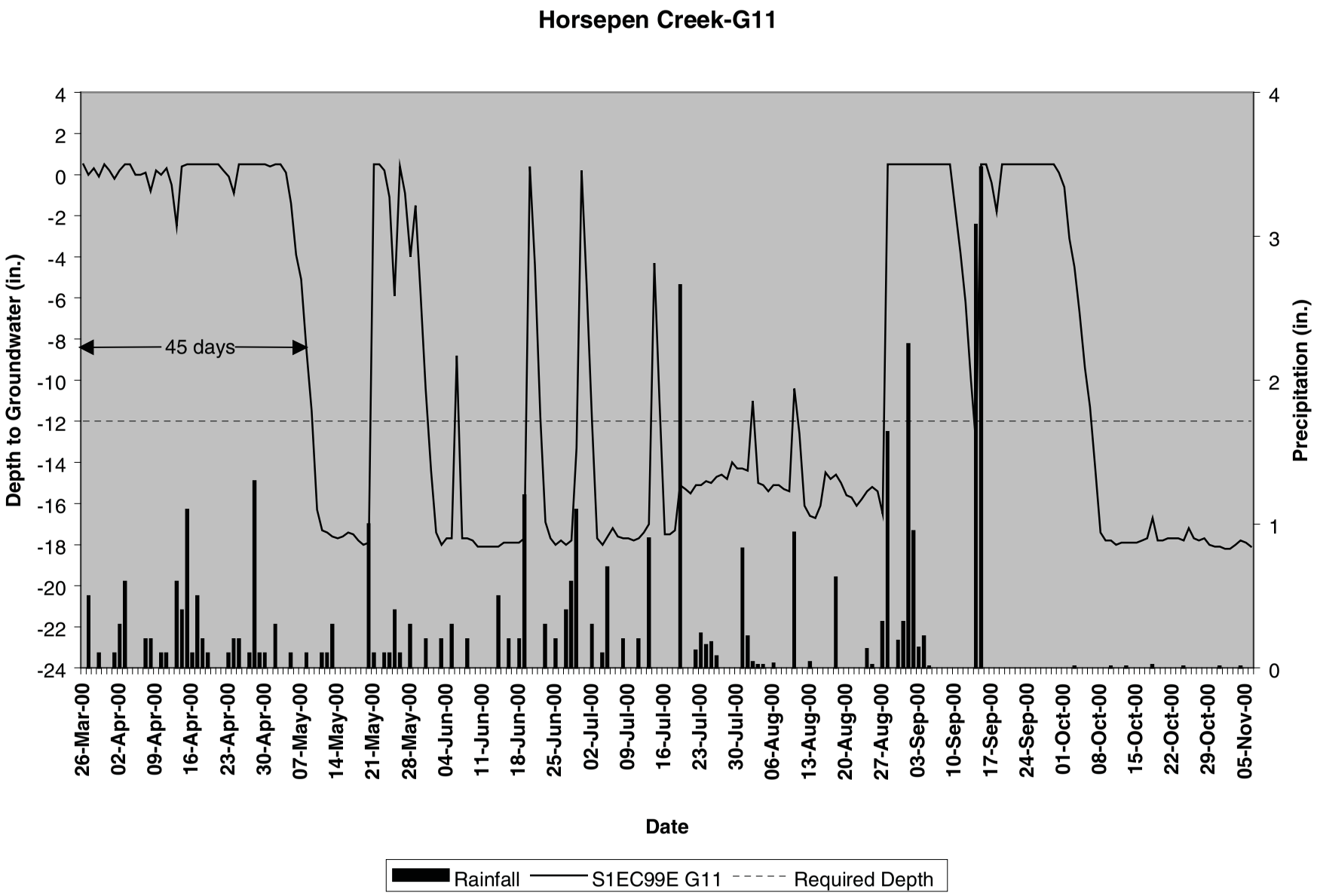

Horsepen Creek-G5
Depth to Groundwater (in.)
Precipitation (in.)
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
3
1
43 days
71 days
26-Mar-00
02-Apr-00
09-Apr-00
16-Apr-00
23-Apr-00
30-Apr-00
07-May-00
14-May-00
21-May-00
28-May-00
04-Jun-00
11-Jun-00
18-Jun-00
25-Jun-00
02-Jul-00
09-Jul-00
16-Jul-00
23-Jul-00
30-Jul-00
06-Aug-00
13-Aug-00
20-Aug-00
27-Aug-00
03-Sep-00
10-Sep-00
17-Sep-00
24-Sep-00
01-Oct-00
08-Oct-00
15-Oct-00
22-Oct-00
29-Oct-00
05-Nov-00
Date
Rainfall
S213DF7 G5
Required Depth

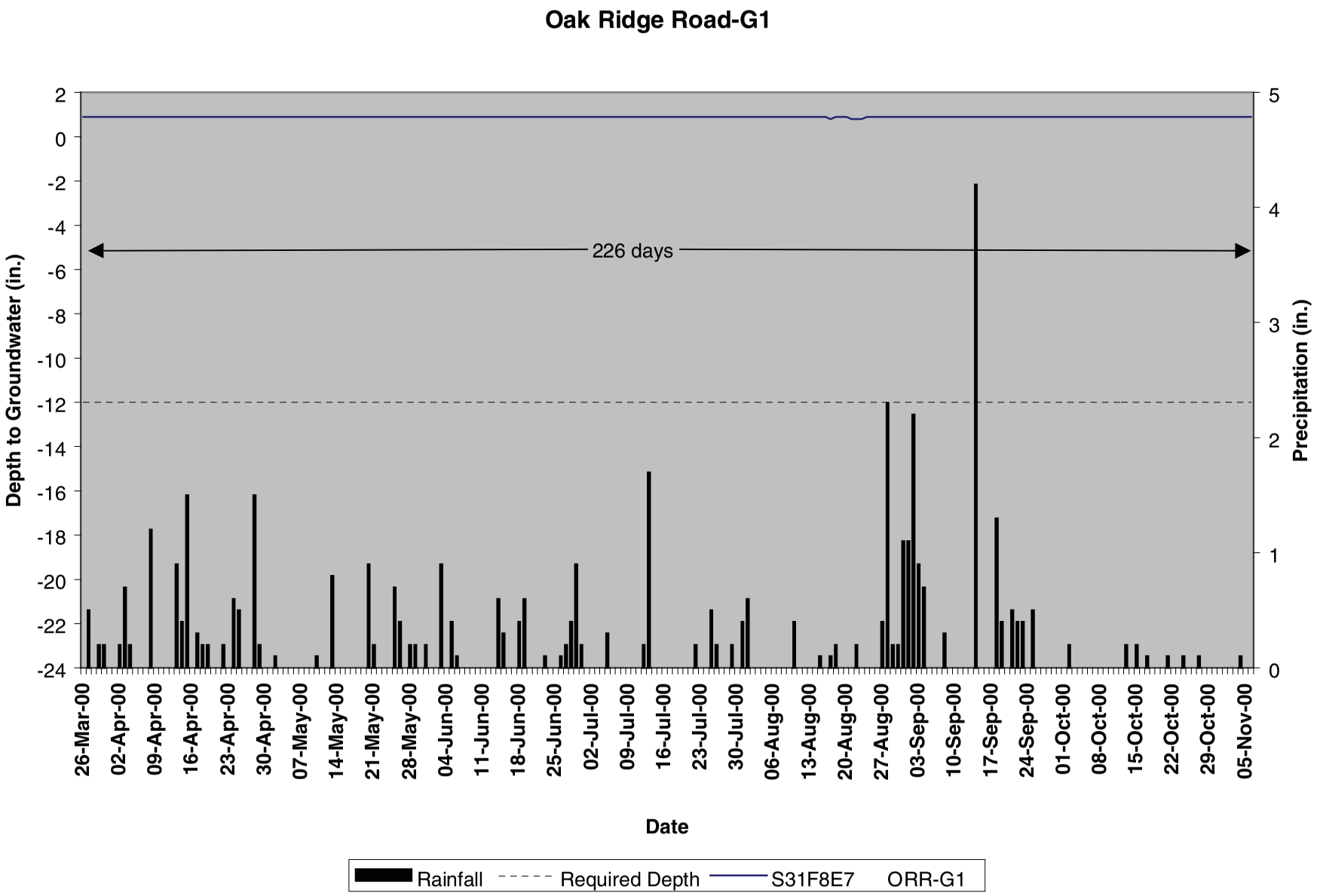

Horsepen Creek-G6
Depth to Groundwater (in.)
Precipitation (in.)
gauge malfunciton
gauge malfunction
gauge malfunction
21 days
gauge malfunction
Date
Rainfall
S115CC1 G6
Required Depth

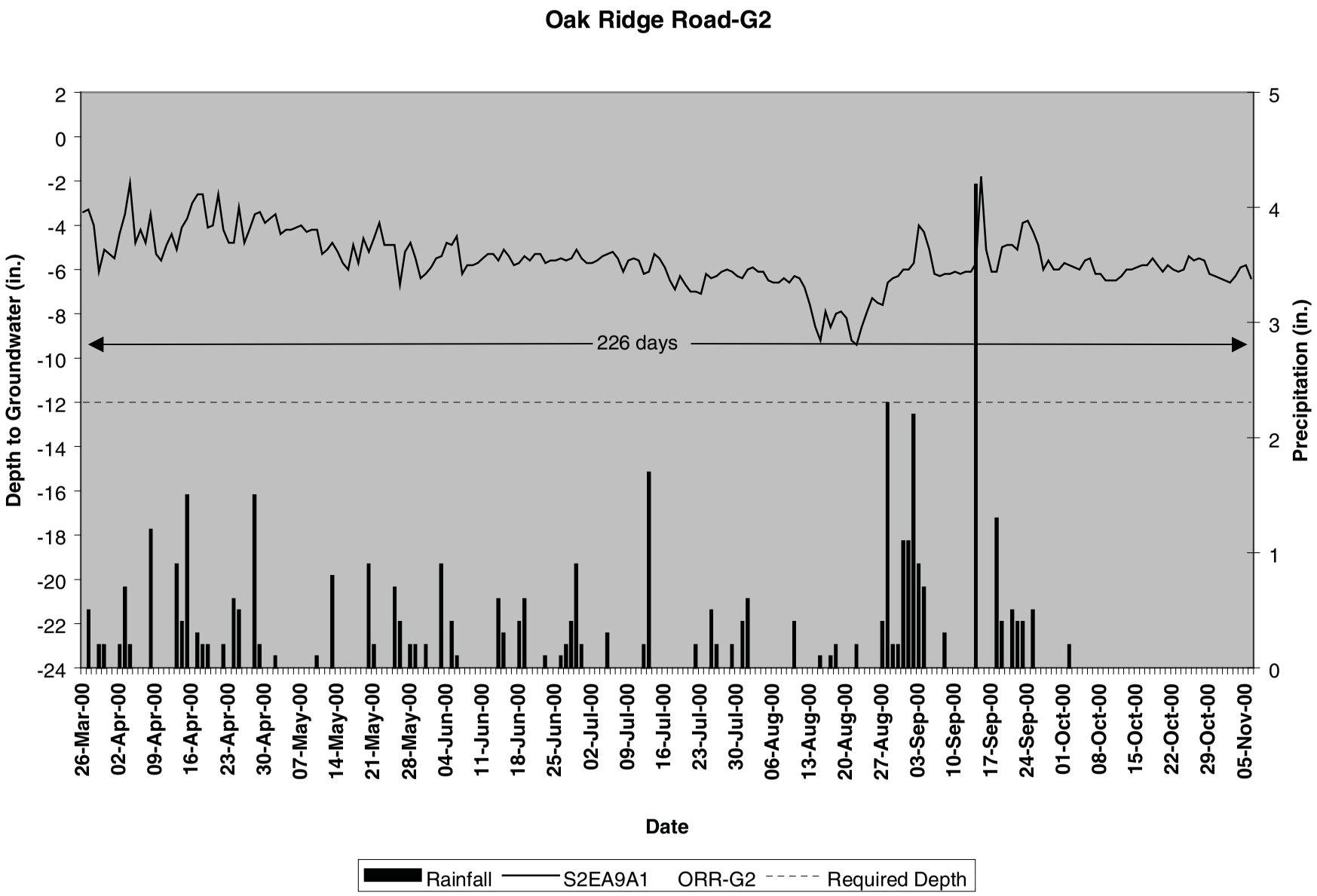

Horsepen Creek-G7
Depth to Groundwater (in.)
Precipitation (in.)
43 days
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
4
3
2
1
0
26-Mar-00
02-Apr-00
09-Apr-00
16-Apr-00
23-Apr-00
30-Apr-00
07-May-00
14-May-00
21-May-00
28-May-00
04-Jun-00
11-Jun-00
18-Jun-00
25-Jun-00
02-Jul-00
09-Jul-00
16-Jul-00
23-Jul-00
30-Jul-00
06-Aug-00
13-Aug-00
20-Aug-00
27-Aug-00
03-Sep-00
10-Sep-00
17-Sep-00
24-Sep-00
01-Oct-00
08-Oct-00
15-Oct-00
22-Oct-00
29-Oct-00
05-Nov-00
Date
Rainfall
S158AA1 G7
Required Depth

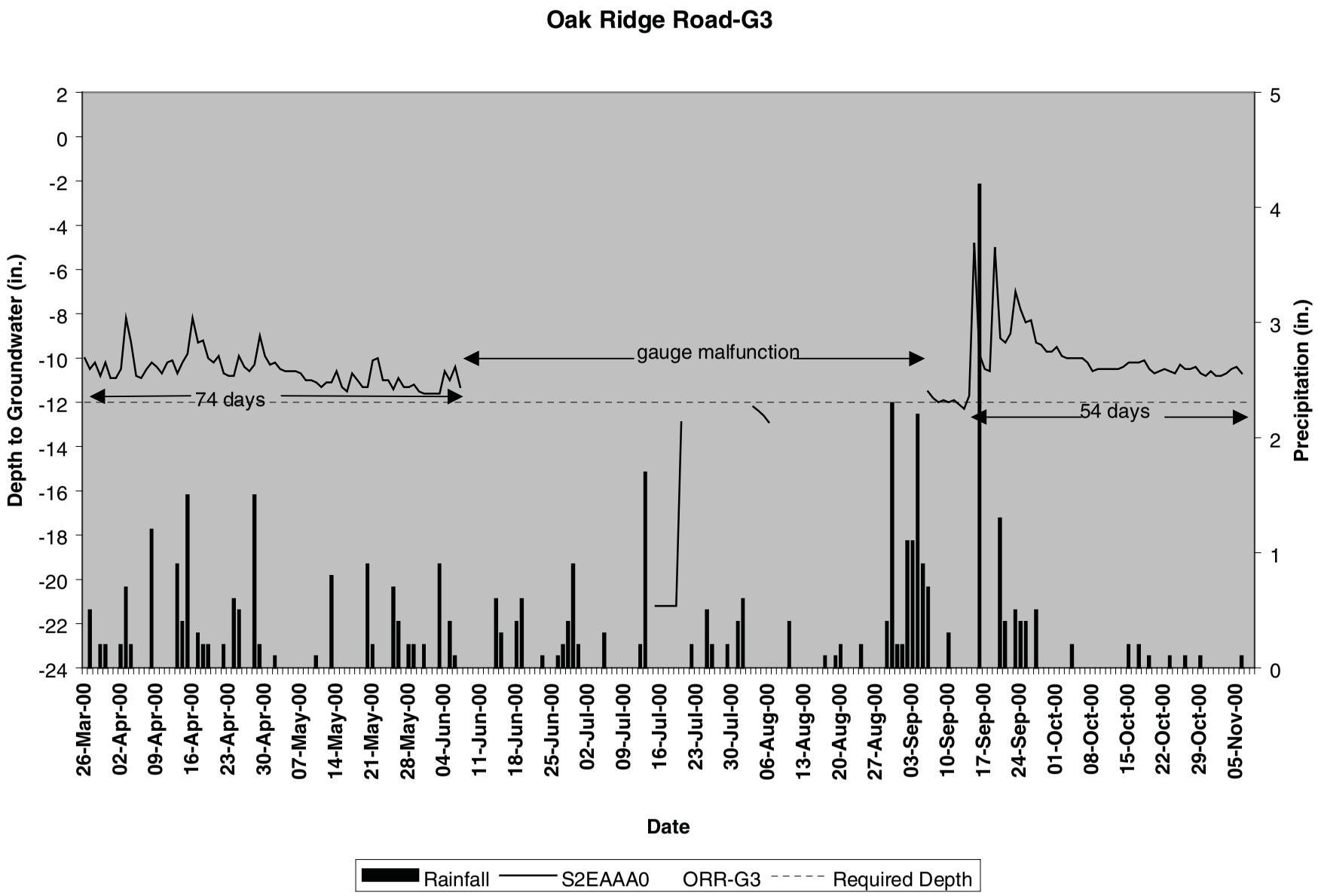

Horsepen Creek-G8
Depth to Groundwater (in.)
Precipitation (in.)
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
4
3
2
1
0
42 days
gauge malfunction
gauge malfunction
26-Mar-00
02-Apr-00
09-Apr-00
16-Apr-00
23-Apr-00
30-Apr-00
07-May-00
14-May-00
21-May-00
28-May-00
04-Jun-00
11-Jun-00
18-Jun-00
25-Jun-00
02-Jul-00
09-Jul-00
16-Jul-00
23-Jul-00
30-Jul-00
06-Aug-00
13-Aug-00
20-Aug-00
27-Aug-00
03-Sep-00
10-Sep-00
17-Sep-00
24-Sep-00
01-Oct-00
08-Oct-00
15-Oct-00
22-Oct-00
29-Oct-00
05-Nov-00
Date
Rainfall
S144FE3 G8
Required Depth

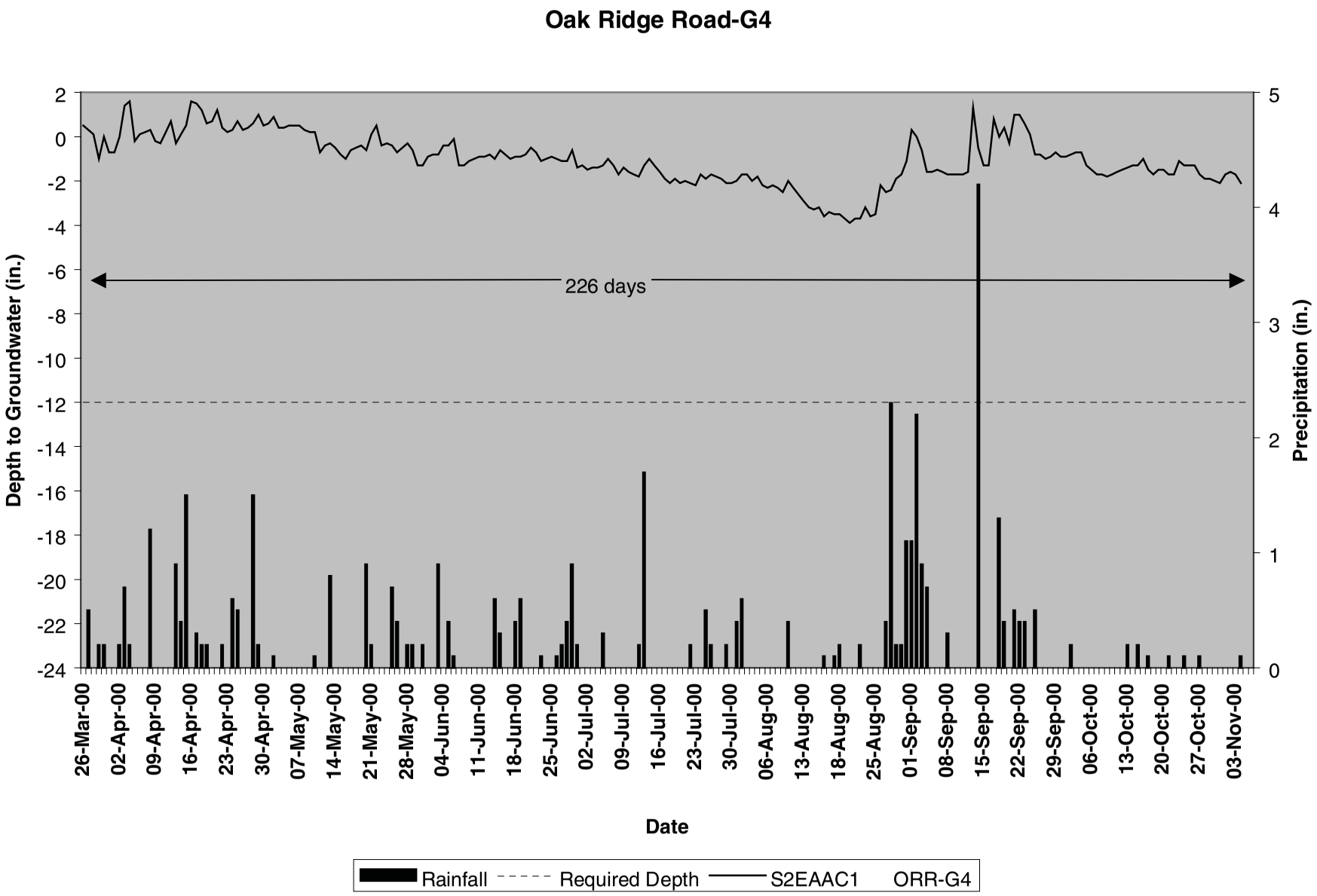

Horsepen Creek-G10
Depth to Groundwater (in.)
Precipitation (in.)
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
3
1
78 days
131 days
26-Mar-00
02-Apr-00
09-Apr-00
16-Apr-00
23-Apr-00
30-Apr-00
07-May-00
14-May-00
21-May-00
28-May-00
04-Jun-00
11-Jun-00
18-Jun-00
25-Jun-00
02-Jul-00
09-Jul-00
16-Jul-00
23-Jul-00
30-Jul-00
06-Aug-00
13-Aug-00
20-Aug-00
27-Aug-00
03-Sep-00
10-Sep-00
17-Sep-00
24-Sep-00
01-Oct-00
08-Oct-00
15-Oct-00
22-Oct-00
29-Oct-00
05-Nov-00
Date
Rainfall
S158E47 G10
Required Depth


Horsepen Creek-G11
Depth to Groundwater (in.)
Precipitation (in.)
45 days
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
3
1
26-Mar-00
02-Apr-00
09-Apr-00
16-Apr-00
23-Apr-00
30-Apr-00
07-May-00
14-May-00
21-May-00
28-May-00
04-Jun-00
11-Jun-00
18-Jun-00
25-Jun-00
02-Jul-00
09-Jul-00
16-Jul-00
23-Jul-00
30-Jul-00
06-Aug-00
13-Aug-00
20-Aug-00
27-Aug-00
03-Sep-00
10-Sep-00
17-Sep-00
24-Sep-00
01-Oct-00
08-Oct-00
15-Oct-00
22-Oct-00
29-Oct-00
05-Nov-00
Date
Rainfall
S1EC99E G11
Required Depth


Oak Ridge Road-G1
Depth to Groundwater (in.)
Precipitation (in.)
226 days
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
5
4
3
2
1
0
26-Mar-00
02-Apr-00
09-Apr-00
16-Apr-00
23-Apr-00
30-Apr-00
07-May-00
14-May-00
21-May-00
28-May-00
04-Jun-00
11-Jun-00
18-Jun-00
25-Jun-00
02-Jul-00
09-Jul-00
16-Jul-00
23-Jul-00
30-Jul-00
06-Aug-00
13-Aug-00
20-Aug-00
27-Aug-00
03-Sep-00
10-Sep-00
17-Sep-00
24-Sep-00
01-Oct-00
08-Oct-00
15-Oct-00
22-Oct-00
29-Oct-00
05-Nov-00
Date
Rainfall
Required Depth
S31F8E7
ORR-G1


Oak Ridge Road-G2
Depth to Groundwater (in.)
Precipitation (in.)
226 days
Date
Rainfall
S2EA9A1
ORR-G2
Required Depth


Oak Ridge Road-G3
Depth to Groundwater (in.)
Precipitation (in.)
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
5
4
3
2
1
0
74 days
gauge malfunction
54 days
26-Mar-00
02-Apr-00
09-Apr-00
16-Apr-00
23-Apr-00
30-Apr-00
07-May-00
14-May-00
21-May-00
28-May-00
04-Jun-00
11-Jun-00
18-Jun-00
25-Jun-00
02-Jul-00
09-Jul-00
16-Jul-00
23-Jul-00
30-Jul-00
06-Aug-00
13-Aug-00
20-Aug-00
27-Aug-00
03-Sep-00
10-Sep-00
17-Sep-00
24-Sep-00
01-Oct-00
08-Oct-00
15-Oct-00
22-Oct-00
29-Oct-00
05-Nov-00
Date
Rainfall
S2EAAA0
ORR-G3
Required Depth


Oak Ridge Road-G4
Depth to Groundwater (in.)
Precipitation (in.)
226 days
Date
Rainfall
Required Depth
S2EAAC1
ORR-G4