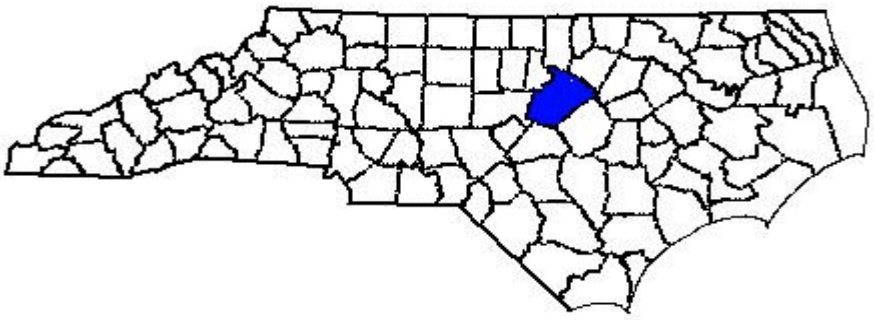
ANNUAL REPORT FOR 2005



Dutchman's Creek Mitigation Site
Wake County
EEP Project No. 121
NCDOT Project No. 8.U401721
TIP No. R-2000 WM

Submitted To:

Ecosystem Enhancement PROGRAM

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January 2006

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Summary

The following report summarizes the monitoring activities that have occurred in the past year at the Dutchman's Creek Mitigation Site. This site was originally constructed in 2000. Monitoring activities in 2005 represent the fifth year of hydrology monitoring and the fourth year of vegetation monitoring for the site. The site must demonstrate both hydrologic and vegetation success for a minimum of five years or until the site is deemed successful.

Currently, eight groundwater gauges and a rain gauge are used to monitor hydrology on the site.

This report utilizes rainfall data from both a local weather station and from an onsite rain gauge. The NC State Climate Office provided historical data from the Raleigh/Durham weather station.

Hydrologic monitoring indicated that three of the eight monitoring gauges met the hydrology success criteria of 5.0% for the 2005-growing season. Five gauges reported saturation for less than 5%. Gauge DC-4 met success criteria during the 2004-year, but failed to meet success criteria in the 2005-year. NCEEP will investigate the gauges that failed to meet the success criteria during the 2005-monitoring year.

During the 2004 monitoring year, an additional plot for shrub planting was established. There are currently four vegetation-monitoring plots established throughout the site. Based on the results of the fourth year of monitoring, an average tree density of 517 stems per acre was reported on the site. This is well above the minimum required by the success criteria.

NCEEP will continue to monitor the Dutchman's Creek Mitigation Site for hydrology and vegetation.

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

The Dutchman's Creek Mitigation Site is located between SR 1386 (Graham Newton Road) and SR 1377 (Blaney Franks Road) immediately above the confluence with Lake Wheeler in Wake County. This site mitigates for wetland impacts associated with the Raleigh Outer Loop (R-2000).

The site, totaling 87 acres in size, consists of scrub-shrub wetland restoration, bottomland hardwood creation, marsh (littoral zone) and open water creation, and floodplain wetland preservation components. The site was constructed in 2000 and planted in 2001.

1.2 PURPOSE

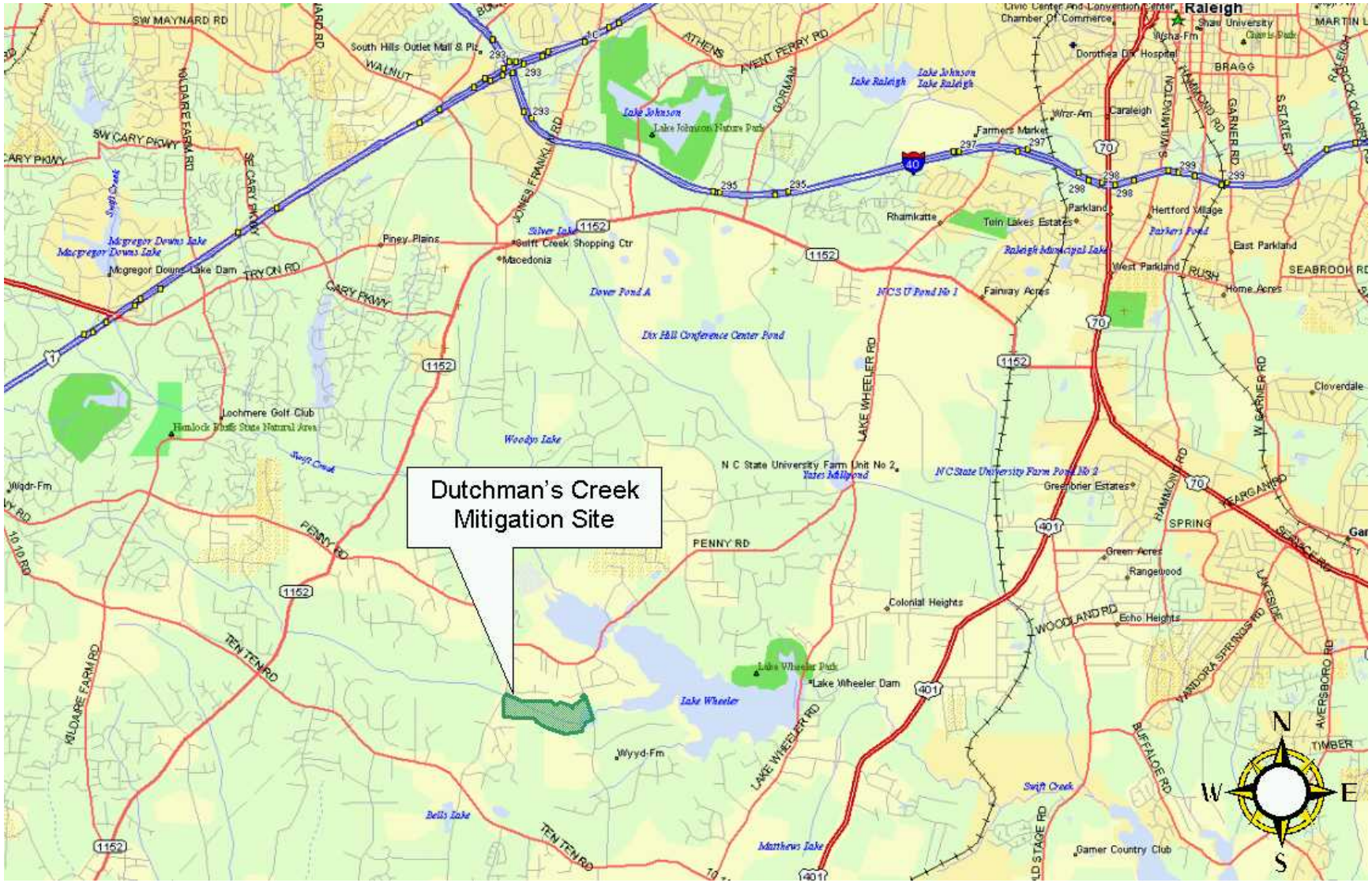
In order to demonstrate successful mitigation, hydrologic and vegetative monitoring must be conducted for a minimum of five consecutive years or until the site is deemed successful. Success criteria are based on federal guidelines for wetland mitigation. These guidelines stipulate criteria for both hydrologic conditions and vegetation survival.

Activities in 2005 reflect the fifth year of hydrology monitoring and the fourth year of vegetation 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

December 2000	Construction Completed
Spring 2001	Site Planted
March 2001	Monitoring Gauges Installed
March- November 2001	Hydrologic Monitoring (1 yr.)
October 2001	Vegetation Monitoring (1 yr.)
March 2002	Replanted Plants and Shrubs
June 2002	Vegetation Monitoring (1 yr. Restart)
March-November 2002	Hydrologic Monitoring (2 yr.)
February 2003	Shrub Area Supplemental Planting
June 2003	Vegetation Monitoring (2 yr.)
March-November 2003	Hydrologic Monitoring (3 yr.)
June 2004	Vegetation Monitoring (3 yr.)
March-November 2004	Hydrologic Monitoring (4 yr.)
July 2005	Vegetation Monitoring (4 yr.)
March-November 2005	Hydrologic Monitoring (5 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 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 for less than 5% of the growing season are always classified as non-wetlands.

A site may be found to meet the hydrology performance criteria on the basis of comparison of monitoring data taken from the site with monitoring data taken from an established reference site approved by the Corps. The Corps retains the discretion to find that the hydrology criteria are met if such monitoring data from the mitigation site and the reference site are substantially the same.

The growing season in Wake 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] The growing season is 229 days; therefore, optimum hydrology requires 5% of this season, or at least 12 consecutive days. Local climate must also represent average conditions for the area.

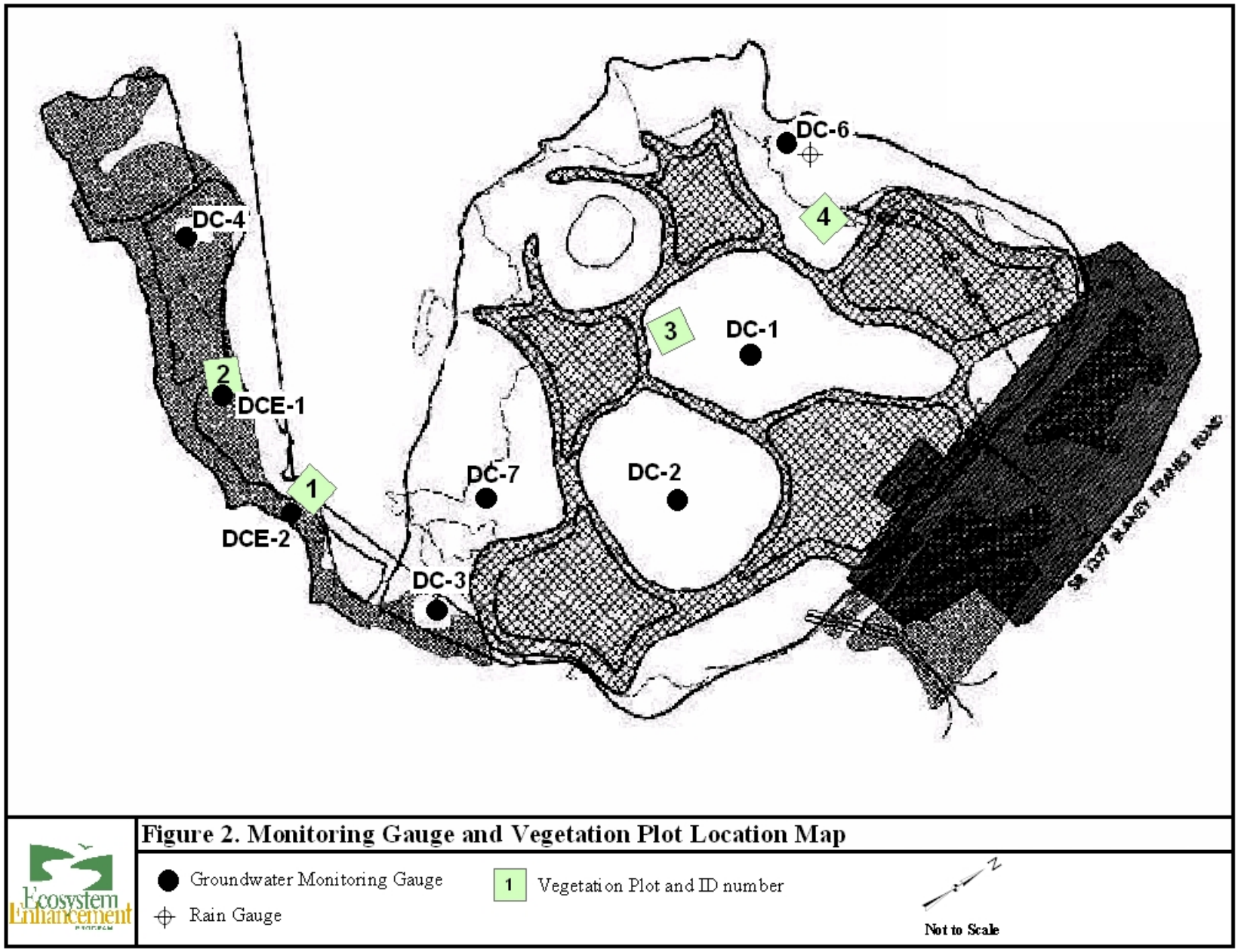
2.2 HYDROLOGIC DESCRIPTION

In March of 2001, six groundwater-monitoring gauges were installed across the site (Figure 2). An additional groundwater gauge was installed in March 2002 based on an onsite agency review meeting. In April of 2003, two additional groundwater gauges were installed between gauges DC-3 and DC-4. After the 2003 monitoring season, the DC-5 gauge was not included in the monitoring results. The 2004 monitoring report fails to indicate why the monitoring of DC-5 was stopped. Currently, eight groundwater gauges and a rain gauge are used to monitor hydrology on the site. The automatic monitoring gauges record daily readings of groundwater depth.

The Dutchman's Creek site was designed to receive hydrologic input from rainfall and surface water accessing the floodplain. The hydrologic monitoring should show the reaction of the groundwater level to specific rainfall events.

[1] Natural Resources Conservation Service, Soil Survey of Wake County, North Carolina, p. 79.

Figure 2. Monitoring Gauge and Vegetation Plot 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 well. This number was converted into a percentage of the 229-day growing season (March 26 – November 10). The results are presented in Table 1.

Appendix A contains a plot of the groundwater depth for each monitoring well. If the gauge shows saturation for greater than 5% of the growing season, 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).

2.3.2 Climatic Data

Figure 4 provides an evaluation of the local climate in comparison with historical data in order to determine whether 2005 was “average” in terms of climate conditions. The two lines represent the 30^{th} and 70^{th} percentiles of monthly precipitation for Raleigh. The bars are the monthly rainfall totals for November 2004 through November 2005. The NC State Climate Office provided historical data from the Raleigh/Durham weather station.

Months with below average rainfall include December (’03), January, February, March, May, June, September, and October. April, August, and November experienced average rainfall. The months November (’04) and July experienced above average rainfall for the year. Overall, the site experienced below average rainfall in 2005.

Table 1. Dutchman's Creek Hydrologic Monitoring Results

Monitoring Well	<5%	5-8%	8-12.5%	>12.5%	Actual %	Success Dates
DC-1+				✕	14.3	March 26-April 27
DC-2+				✕	14.8	April 28-May 18 Oct 8-Nov 10
DC-3	✕				3.5	
DC-4	✕				0.9	
DC-6+				✕	60.9	March 26-June 22 June 24-Nov 10
DC-7	✕				0.0	
DCE-1	✕				0.9	
DCE-2	✕				0.4	

+ Gauge met the success criterion during an average rainfall month (April, August, and November experienced average rainfall).

Specific Gauge Problems:

- Gauge DC-1 malfunctioned during the period from April 28 – July 29. Gauge replaced on July 29. Gauge malfunction during the period of October 30 – November 18. This gauge will be replaced before the 2006 monitoring season.
- Gauge DC-2 malfunctioned during the period from January 1 – April 27. Gauge replaced on April 27.
- Gauge DC-3 malfunctioned during the period from April 6 – April 27. Gauge batteries replaced on April 27.
- Gauge DC-6 malfunctioned on June 23. Gauge DC-6 is a 40" gauge in a 20" well. There is 2.01' of gauge protruding up from the well. To account for this problem, 2.01' was added to all of the readings from gauge DC-6. The NCEEP has been notified of this problem and the gauge will be replaced before the 2006 monitoring season.
- Gauge DC-7 malfunctioned and was replaced on August 24.
- Gauge DCE-1 was replaced on September 22.

2.4 CONCLUSIONS

The 2005-year represents the fifth full growing season that the hydrologic data has been monitored on the Dutchman's Creek Mitigation Site. Three of the eight gauges indicated saturation within 12" of the surface for greater than 5% of the growing season. Five gauges reported saturation for less than 5%. Gauge DC-4 met success criteria during the 2004-year, but failed to meet success criteria in the 2005-year. The monitoring data is not comprehensive enough to provide clear explanations as to why hydrology criteria is not being met on portions of the project. Visual inspections suggest that the elevation differences and proximity to Dutchman's Creek, where there is somewhat better drainage, may have an impact on hydrologic success. NCEEP will investigate the gauges that failed to meet the success criteria during the 2005-monitoring year.

NCEEP will continue to monitor the Dutchman's Creek Mitigation Site for hydrology.

Figure 3. Monitoring Gauge Results Map

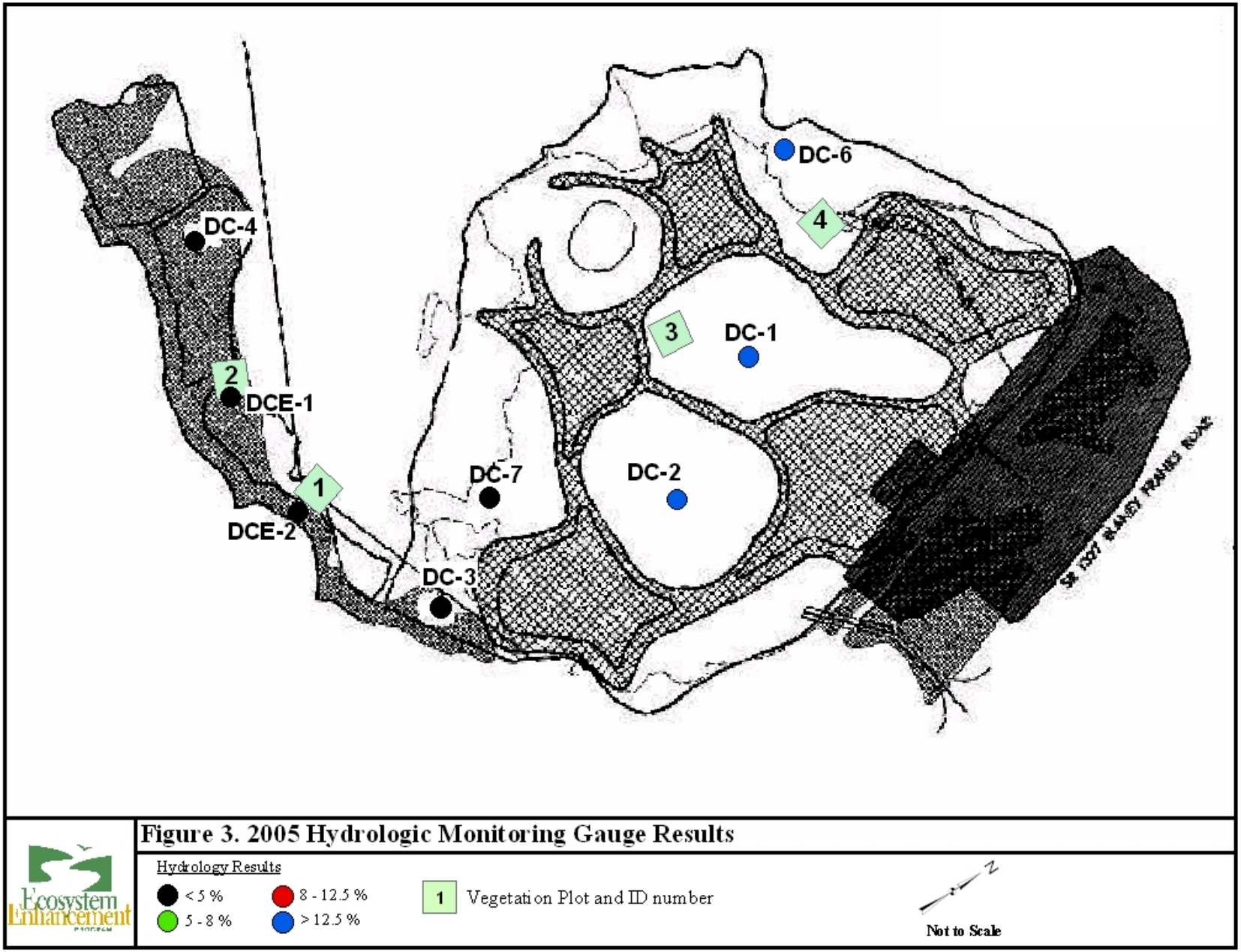
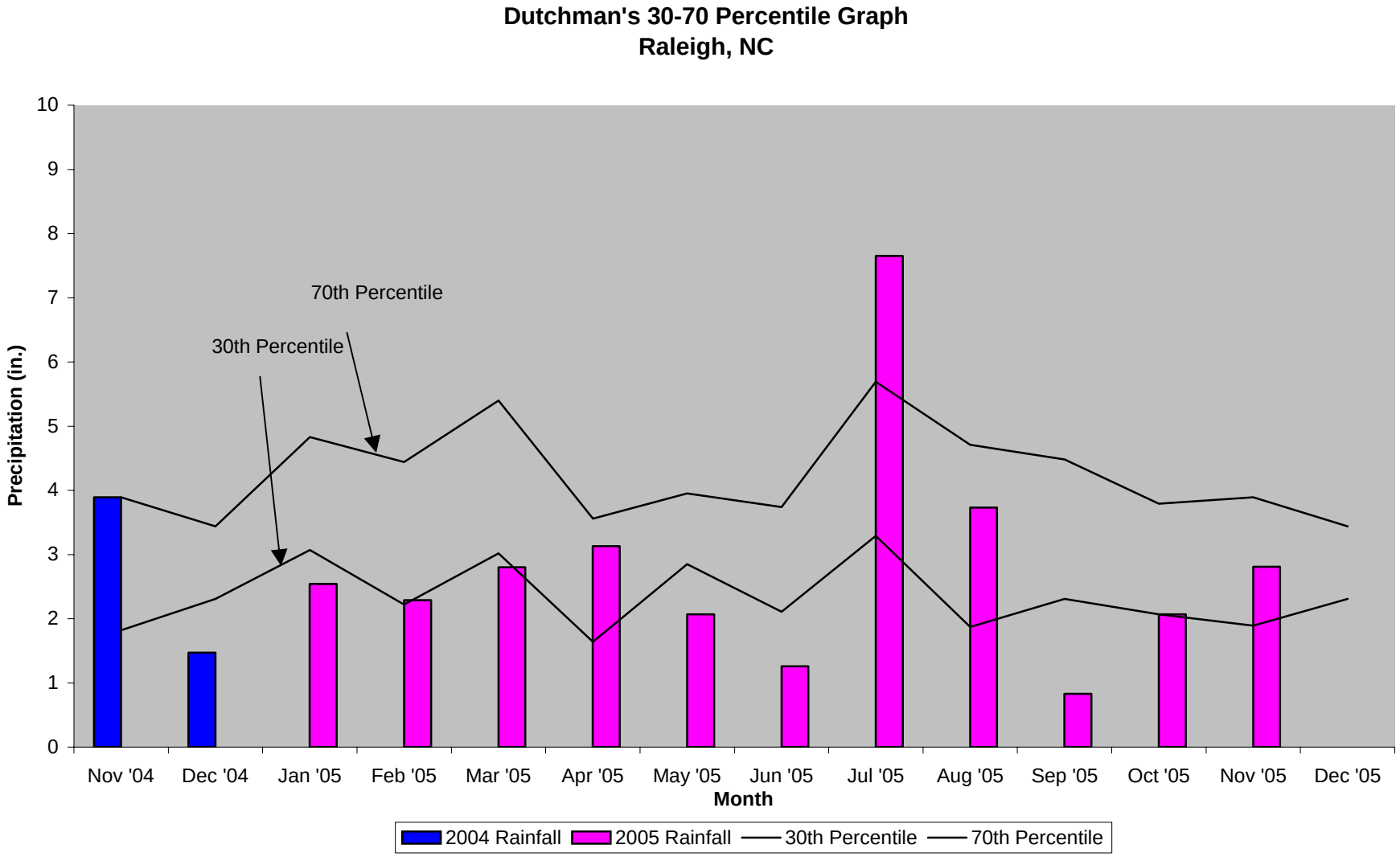


Figure 4. 30-70 Percentile Graph



3.0 VEGETATION: DUTCHMANS CREEK MITIGATION SITE (YEAR 4 MONITORING)

3.1 SUCCESS CRITERIA

As stated in the July 1999 Mitigation Plan, the success criteria for vegetation within the scrub-shrub areas and bottomland hardwood forest will be met if a minimum mean density of 320 characteristic species/acre are surviving after 3 years and a minimum mean density of 260 characteristic species/acre are surviving after 5 years from initial planting. Supplemental plantings will be performed as needed to achieve the vegetation success criteria.

3.2 DESCRIPTION OF SPECIES

The following tree species were planted in the Wetland Restoration Area: (Bottomland Hardwood Area)

Quercus falcata var. *pagodaefolia*, Cherrybark Oak
Quercus falcata var. *falcata*, Southern Red Oak
Fraxinus pennsylvanica, Green Ash
Quercus phellos, Willow Oak
Nyssa sylvatica var. *sylvatica*, Blackgum
Quercus lyrata, Overcup Oak
Quercus nigra, Water Oak

The following shrub species were planted in the Wetland Restoration Area: (Shrub Area)

Cornus amomum, Silky Dogwood
Cornus stricta, Swamp Dogwood
Cornus sericea, Redosier Dogwood
Alnus serrulata, Tag Alder
Cephalanthus occidentalis, Buttonbush
Celtis laevigata, Sugarberry

3.3 RESULTS OF VEGETATION MONITORING

Table 2. Vegetation Monitoring Statistics

Plot #	Cherrybark Oak	Green Ash	Overcup Oak	Southern Red Oak	Water Oak	Willow Oak	Blackgum	Dogwood Species	Tag Alder	Buttonbush	Sugarberry	Total (4 Year)	Total (at planting)	Density (Stems/Acre
1	1	9					1					11	39	192
2	4	21	14	1		1	3					44	44	680
3(Shrub)								21	5	9	7	42	66	433
4(Shrub)								49	3	2	2	56	50	762
				AVERAGE TREE DENSITY										517

Site Notes: Species noted: alder, arrow-arum, elderberry, microstegium, *Juncus* sp., silky dogwood, switch grass, black willow, *Baccharis* sp., pokeberry, cattail, river birch, sedge, multi-flora rose, tulip poplar, sweetgum, red maple, and fennel.
Plot 4 contains more stems at year four than at planting because many planted stems of silky dogwood were indistinguishable from volunteer stems.

3.4 CONCLUSIONS

The shrub and the bottomland hardwood areas have been planted with the species listed above. An additional shrub-monitoring plot (plot 4) was established in 2004. The 2005 vegetation monitoring of the site revealed an average density of 517 stems per acre, which is well above the minimum success criteria of 320 stems per acre.

4.0 OVERALL CONCLUSIONS/RECOMMENDATIONS

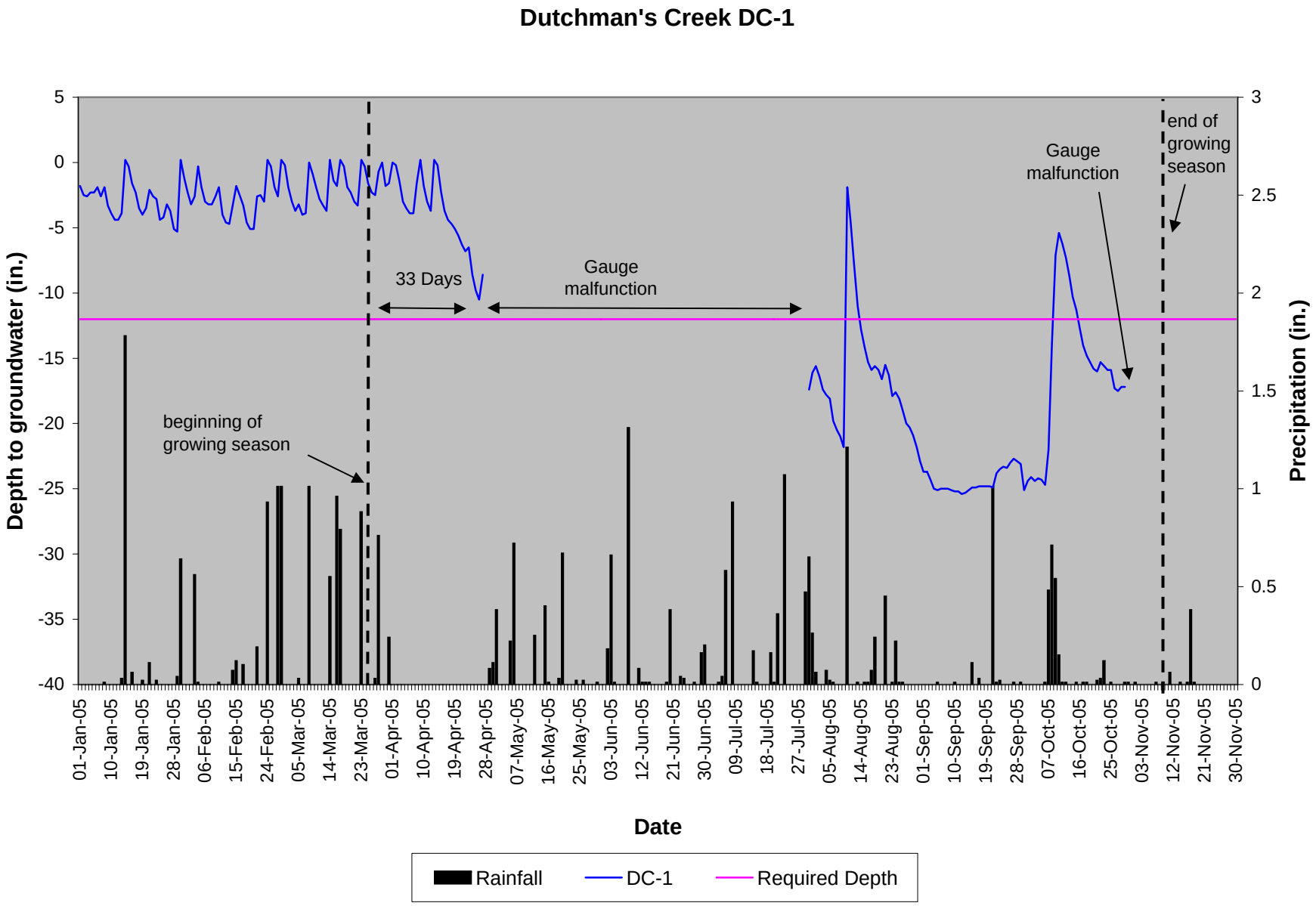
Three of the eight gauges indicated saturation within 12" of the surface for greater than 5% of the growing season during a below average rainfall year. Five gauges reported saturation for less than 5%. Gauge DC-4 met success criteria during the 2004-year, but failed to meet success criteria in the 2005-year. NCEEP will investigate the gauges that failed to meet the success criteria during the 2005-monitoring year.

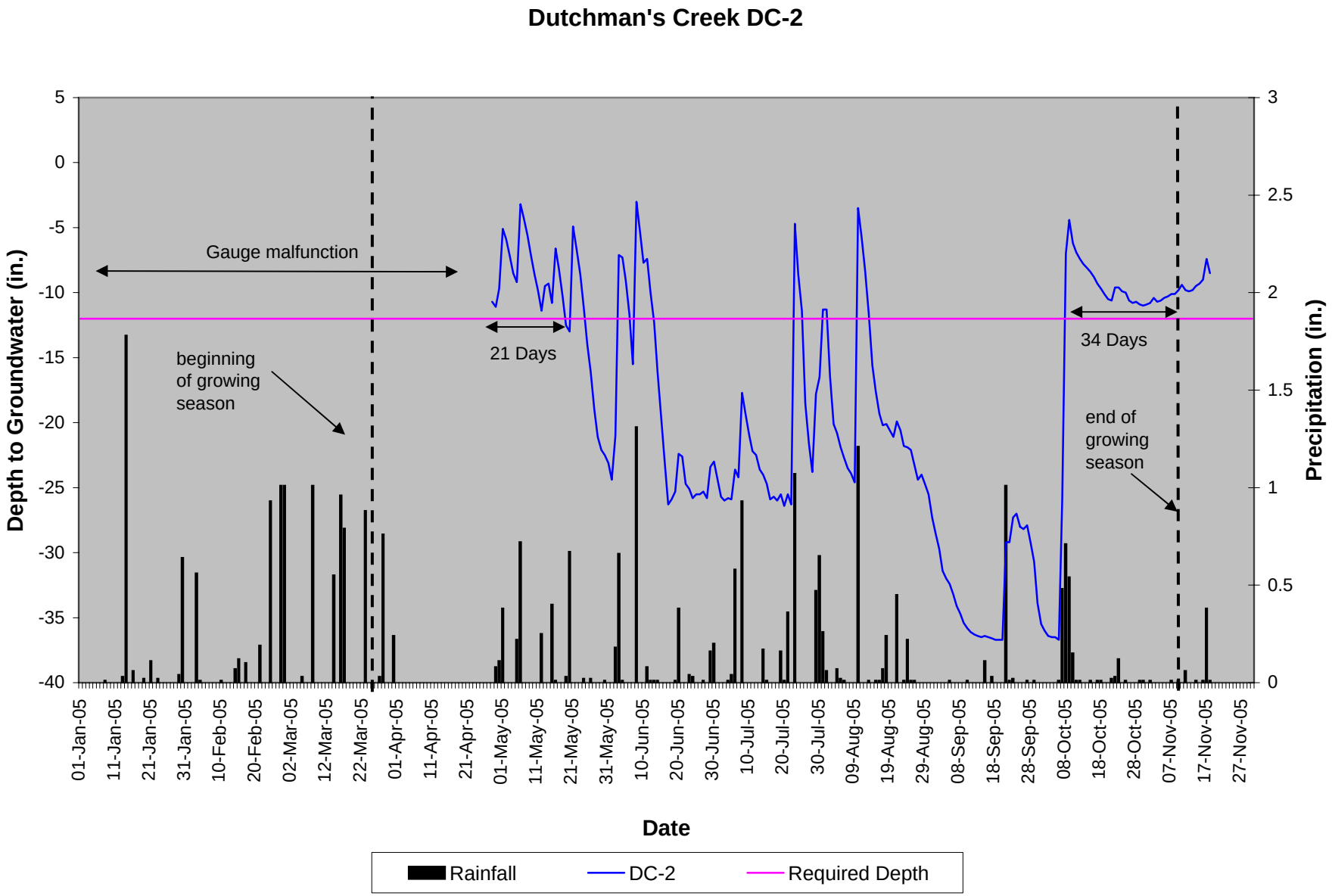
The 2005 vegetation monitoring of the site revealed an average density of 517 stems per acre. This is well above the minimum required by the success criteria.

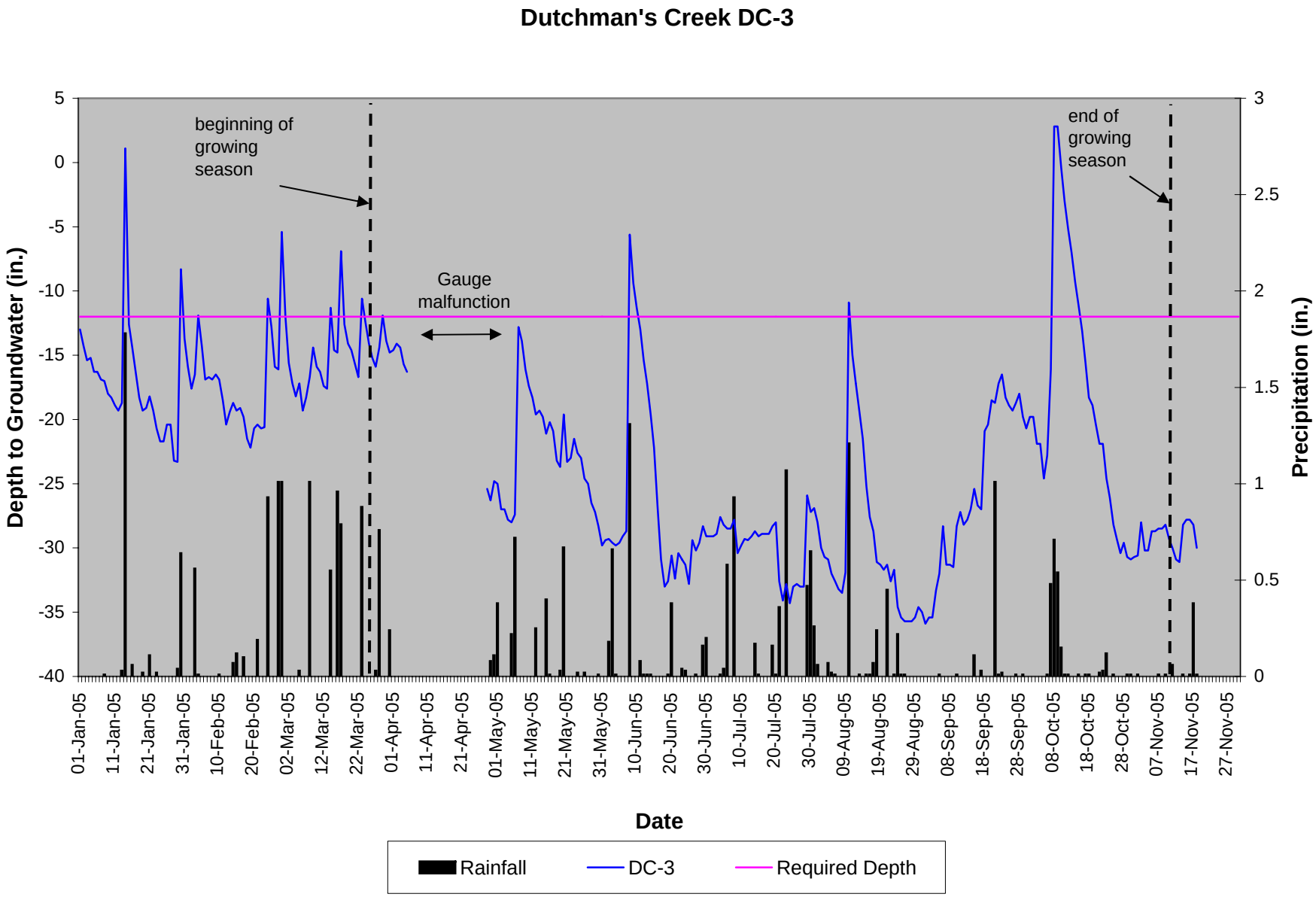
NCEEP will continue to monitor the Dutchman's Creek Mitigation Site for hydrology and vegetation.

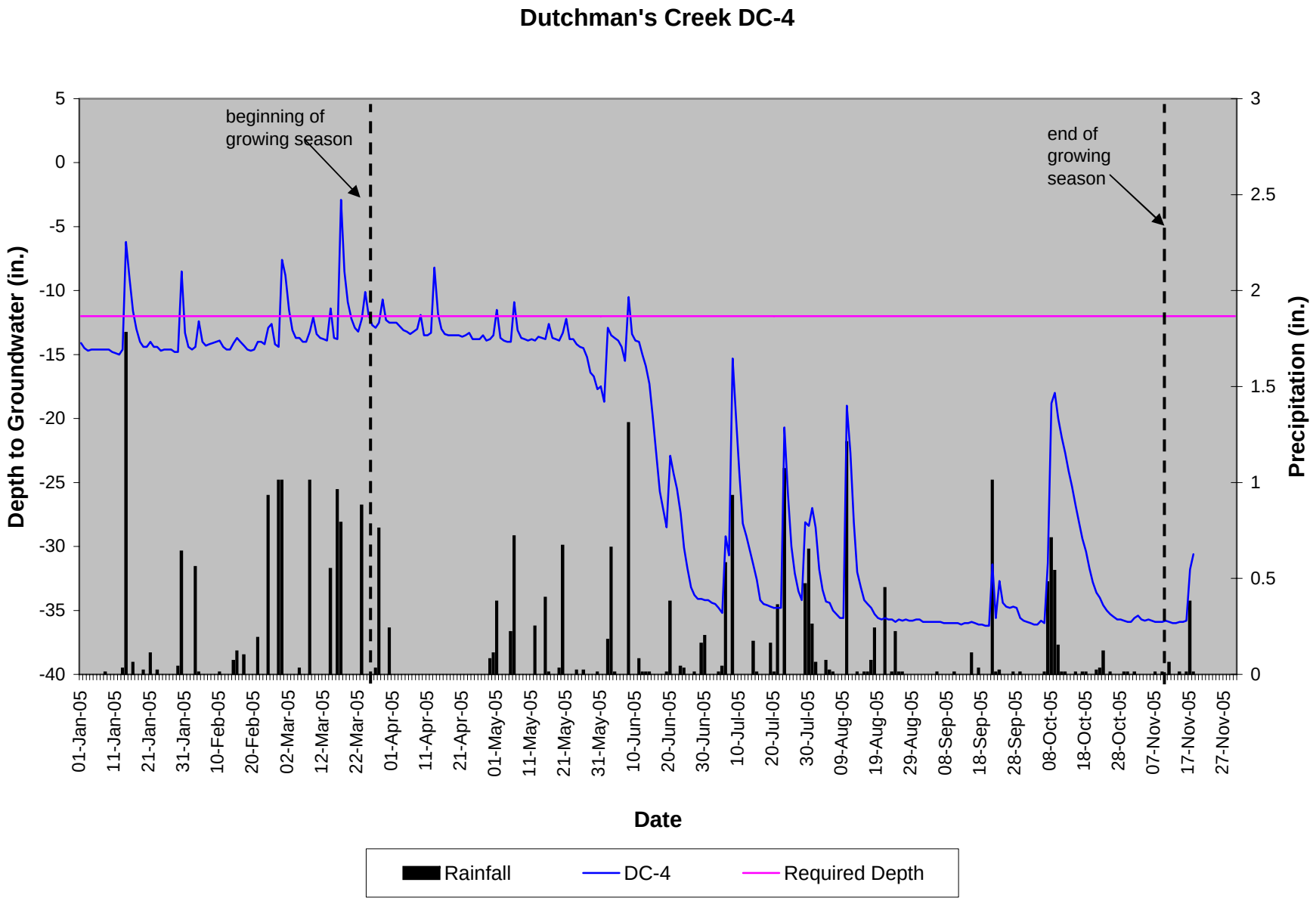
APPENDIX A

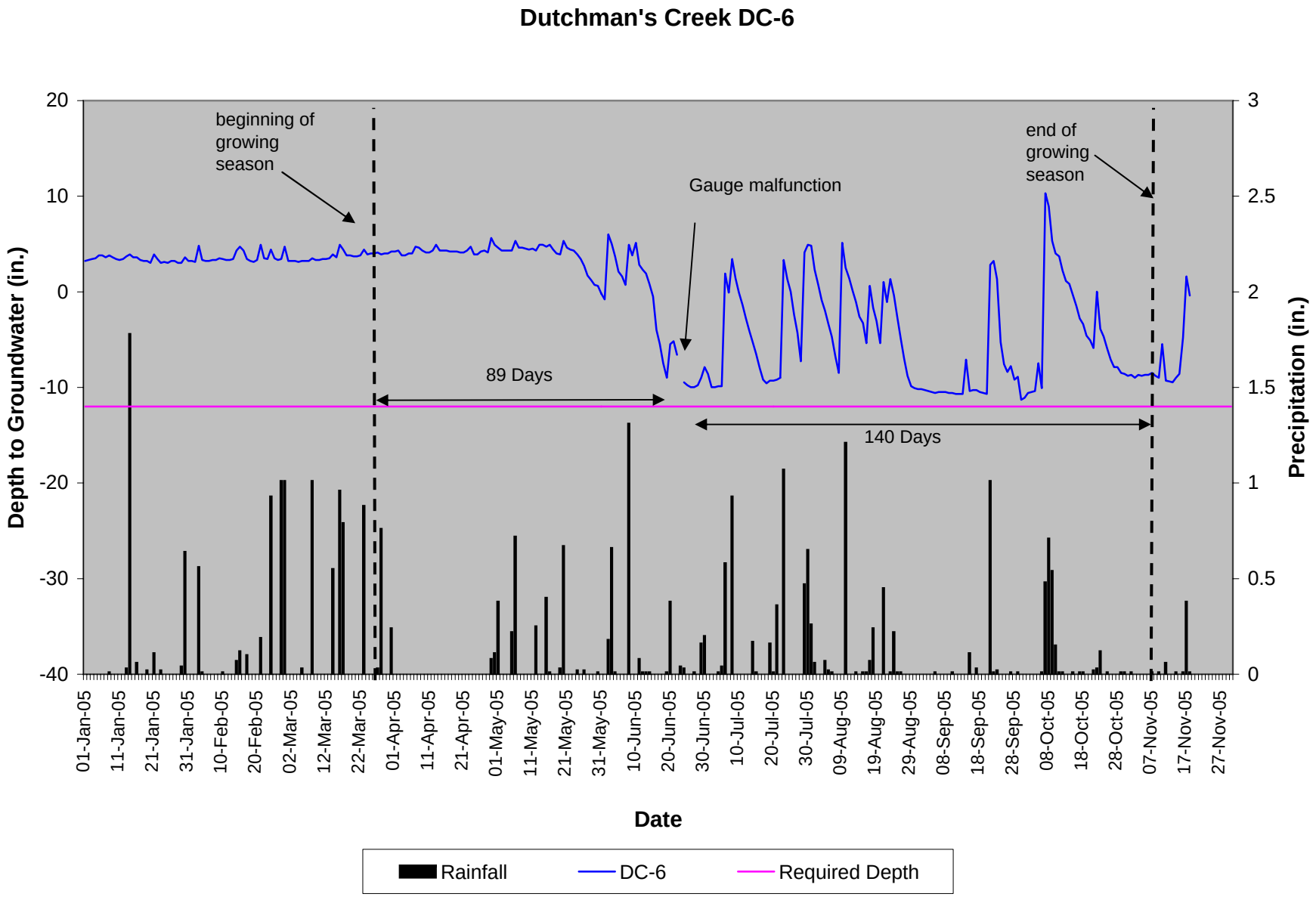
GAUGE DATA GRAPHS


Dutchman's Creek DC-1
Depth to groundwater (in.)
Precipitation (in.)
Date
beginning of growing season
33 Days
Gauge malfunction
Gauge malfunction
end of growing season
Rainfall
DC-1
Required Depth


Dutchman's Creek DC-2
Depth to Groundwater (in.)
Precipitation (in.)
Gauge malfunction
beginning of growing season
21 Days
34 Days
end of growing season
Date
Rainfall
DC-2
Required Depth


Dutchman's Creek DC-3
beginning of growing season
Gauge malfunction
end of growing season
Depth to Groundwater (in.)
Precipitation (in.)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
3
2.5
2
1.5
1
0.5
0
01-Jan-05
11-Jan-05
21-Jan-05
31-Jan-05
10-Feb-05
20-Feb-05
02-Mar-05
12-Mar-05
22-Mar-05
01-Apr-05
11-Apr-05
21-Apr-05
01-May-05
11-May-05
21-May-05
31-May-05
10-Jun-05
20-Jun-05
30-Jun-05
10-Jul-05
20-Jul-05
30-Jul-05
09-Aug-05
19-Aug-05
29-Aug-05
08-Sep-05
18-Sep-05
28-Sep-05
08-Oct-05
18-Oct-05
28-Oct-05
07-Nov-05
17-Nov-05
27-Nov-05
Date
Rainfall
DC-3
Required Depth


Dutchman's Creek DC-4
beginning of growing season
end of growing season
Depth to Groundwater (in.)
Precipitation (in.)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
3
2.5
2
1.5
1
0.5
0
01-Jan-05
11-Jan-05
21-Jan-05
31-Jan-05
10-Feb-05
20-Feb-05
02-Mar-05
12-Mar-05
22-Mar-05
01-Apr-05
11-Apr-05
21-Apr-05
01-May-05
11-May-05
21-May-05
31-May-05
10-Jun-05
20-Jun-05
30-Jun-05
10-Jul-05
20-Jul-05
30-Jul-05
09-Aug-05
19-Aug-05
29-Aug-05
08-Sep-05
18-Sep-05
28-Sep-05
08-Oct-05
18-Oct-05
28-Oct-05
07-Nov-05
17-Nov-05
27-Nov-05
Date
Rainfall
DC-4
Required Depth


Dutchman's Creek DC-6
beginning of growing season
Gauge malfunction
end of growing season
89 Days
140 Days
Depth to Groundwater (in.)
Precipitation (in.)
Date
Rainfall
DC-6
Required Depth
20
10
0
-10
-20
-30
-40
3
2.5
2
1.5
1
0.5
0
01-Jan-05
11-Jan-05
21-Jan-05
31-Jan-05
10-Feb-05
20-Feb-05
02-Mar-05
12-Mar-05
22-Mar-05
01-Apr-05
11-Apr-05
21-Apr-05
01-May-05
11-May-05
21-May-05
31-May-05
10-Jun-05
20-Jun-05
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20-Jul-05
30-Jul-05
09-Aug-05
19-Aug-05
29-Aug-05
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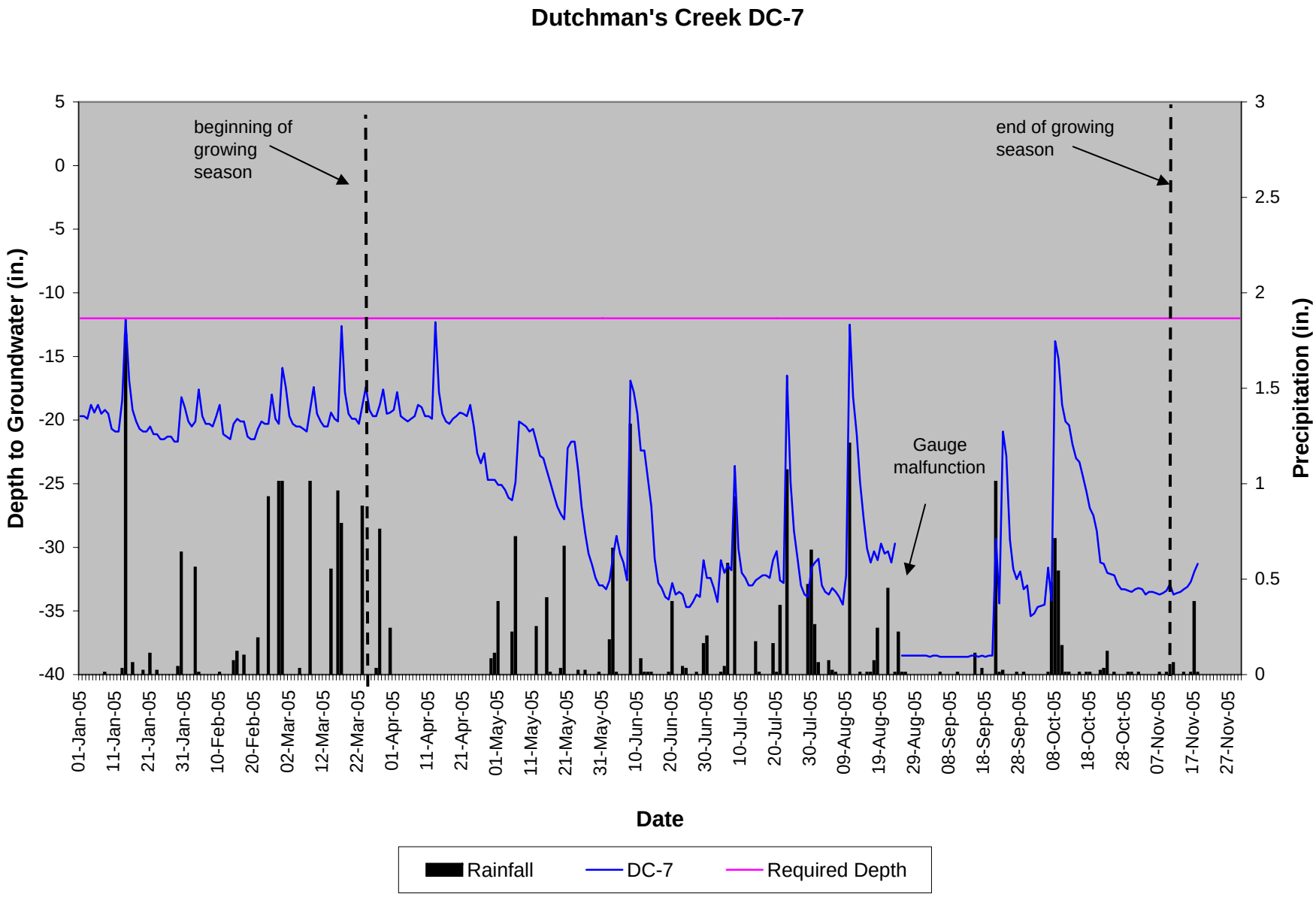
17-Nov-05
27-Nov-05


Dutchman's Creek DC-7
beginning of growing season
end of growing season
Gauge malfunction
Depth to Groundwater (in.)
Precipitation (in.)
Date
Rainfall
DC-7
Required Depth
5
0
-5
-10
-15
-20
-25
-30
-35
-40
3
2.5
2
1.5
1
0.5
0
01-Jan-05
11-Jan-05
21-Jan-05
31-Jan-05
10-Feb-05
20-Feb-05
02-Mar-05
12-Mar-05
22-Mar-05
01-Apr-05
11-Apr-05
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01-May-05
11-May-05
21-May-05
31-May-05
10-Jun-05
20-Jun-05
30-Jun-05
10-Jul-05
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30-Jul-05
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19-Aug-05
29-Aug-05
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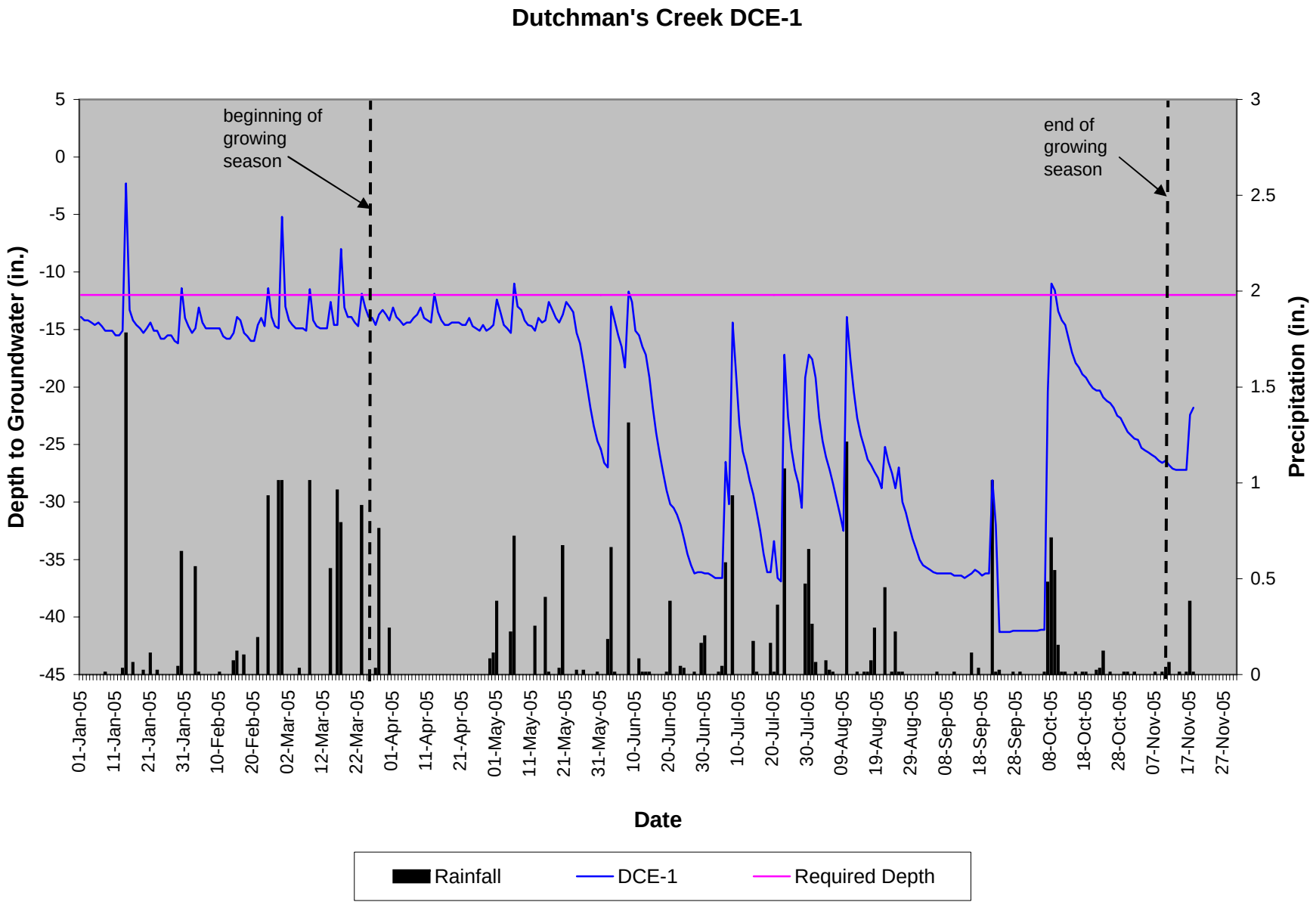
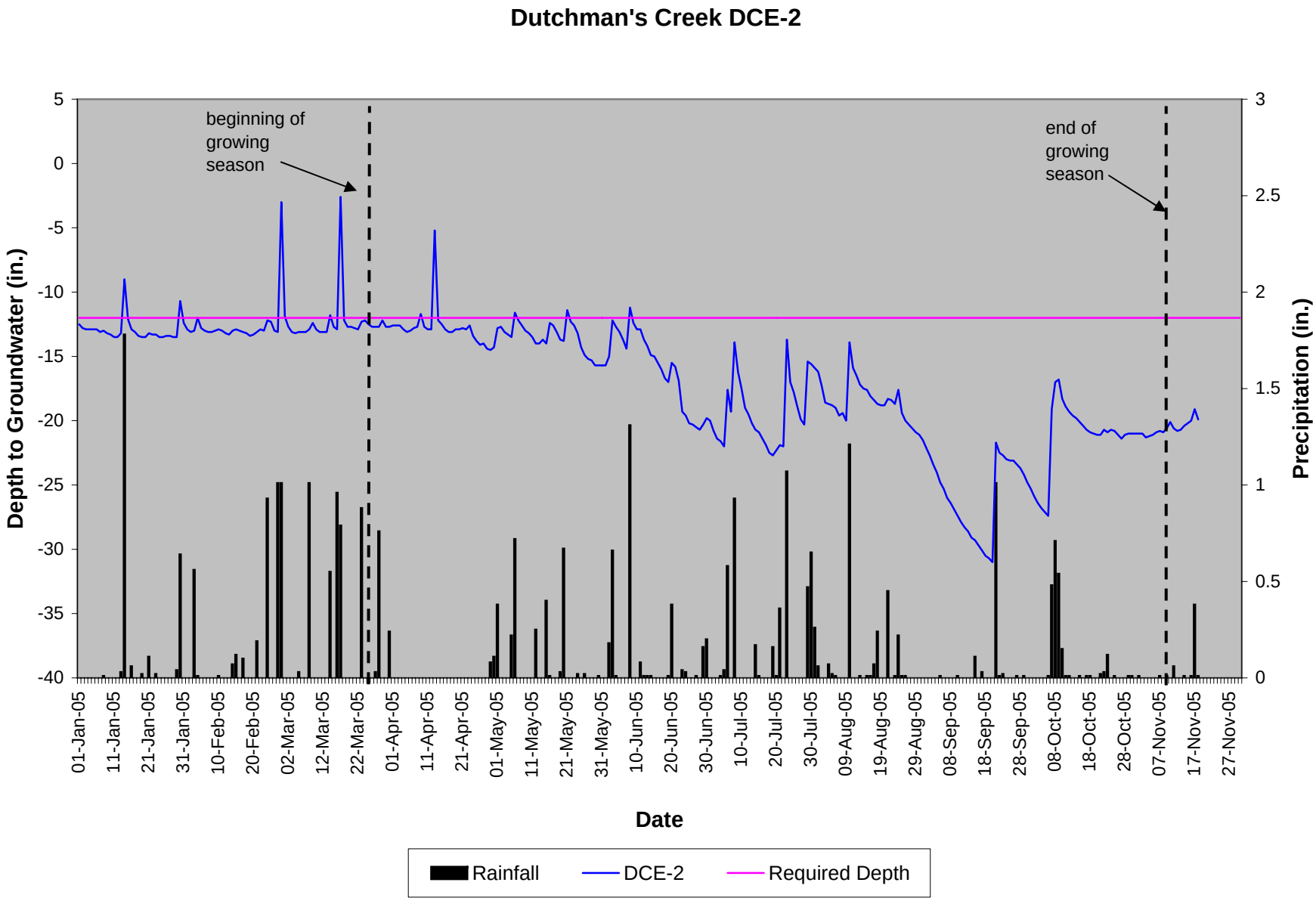
17-Nov-05
27-Nov-05


Dutchman's Creek DCE-1
beginning of growing season
end of growing season
Depth to Groundwater (in.)
Precipitation (in.)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
3
2.5
2
1.5
1
0.5
0
01-Jan-05
11-Jan-05
21-Jan-05
31-Jan-05
10-Feb-05
20-Feb-05
02-Mar-05
12-Mar-05
22-Mar-05
01-Apr-05
11-Apr-05
21-Apr-05
01-May-05
11-May-05
21-May-05
31-May-05
10-Jun-05
20-Jun-05
30-Jun-05
10-Jul-05
20-Jul-05
30-Jul-05
09-Aug-05
19-Aug-05
29-Aug-05
08-Sep-05
18-Sep-05
28-Sep-05
08-Oct-05
18-Oct-05
28-Oct-05
07-Nov-05
17-Nov-05
27-Nov-05
Date
Rainfall
DCE-1
Required Depth


Dutchman's Creek DCE-2
beginning of growing season
end of growing season
Depth to Groundwater (in.)
Precipitation (in.)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
3
2.5
2
1.5
1
0.5
0
01-Jan-05
11-Jan-05
21-Jan-05
31-Jan-05
10-Feb-05
20-Feb-05
02-Mar-05
12-Mar-05
22-Mar-05
01-Apr-05
11-Apr-05
21-Apr-05
01-May-05
11-May-05
21-May-05
31-May-05
10-Jun-05
20-Jun-05
30-Jun-05
10-Jul-05
20-Jul-05
30-Jul-05
09-Aug-05
19-Aug-05
29-Aug-05
08-Sep-05
18-Sep-05
28-Sep-05
08-Oct-05
18-Oct-05
28-Oct-05
07-Nov-05
17-Nov-05
27-Nov-05
Date
Rainfall
DCE-2
Required Depth

APPENDIX B

SITE PHOTOS, PLANTING PLAN, & VEGETATION PLOT COORDINATES

Dutchman's Creek

Appendix B1. Site Photos

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

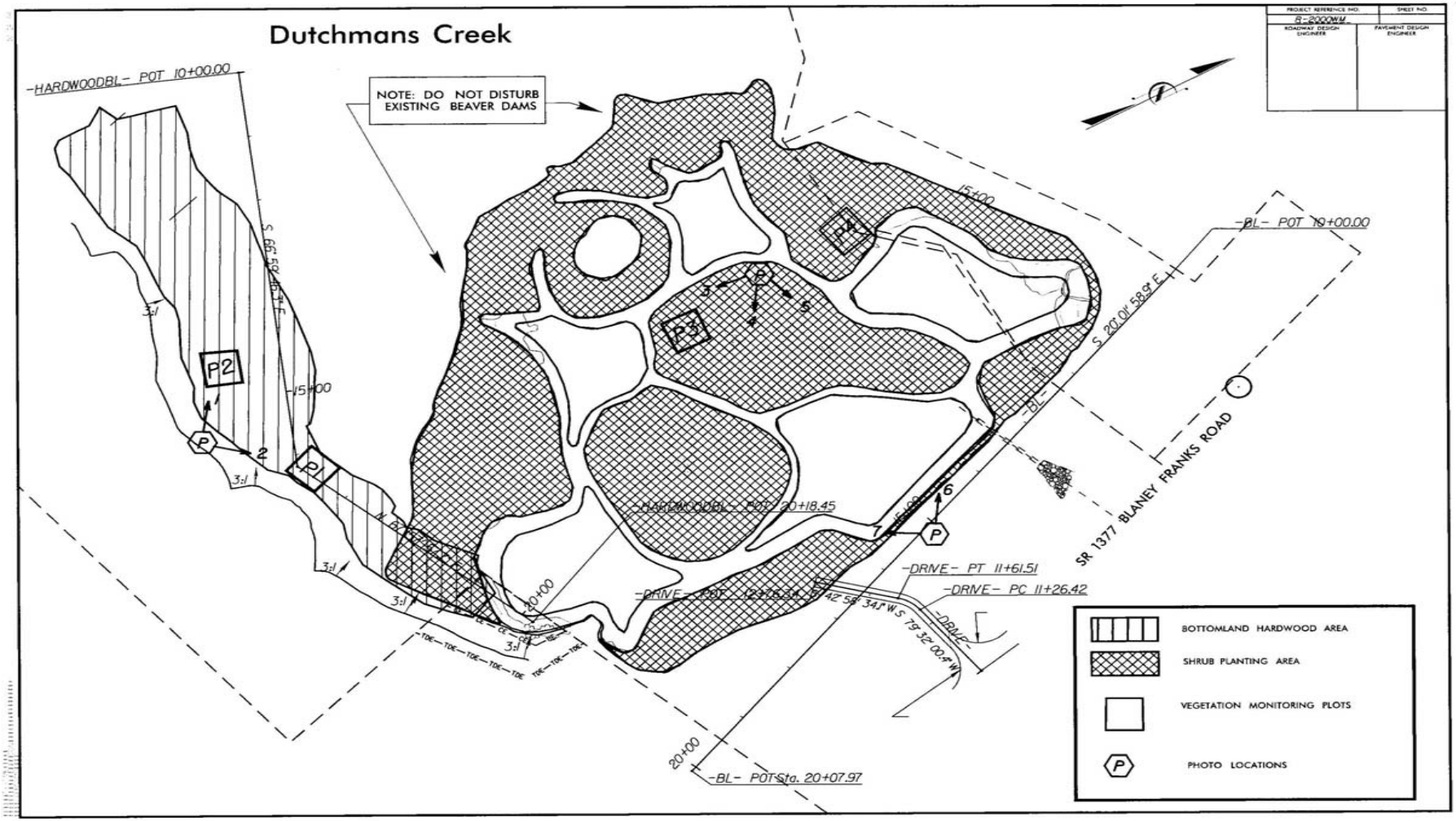
2005

Dutchman’s Creek

Photo 7

2005

Appendix B2. Planting Plan



Appendix B3. Vegetation Plot Coordinates

Vegetation Plot Number	Northing	Easting
1	705757.57	2081193.37
	705772.84	2081241.87
	705724.81	2081257.10
	705708.71	2081209.93
2	705747.04	2081013.61
	705728.47	2081060.24
	705683.96	2081042.15
	705702.64	2080993.09
3	706311.69	2081269.62
	706306.09	2081318.33
	706256.98	2081315.94
	706260.59	2081266.16
4	706567.75	2081236.61
	706577.06	2081287.68
	706528.54	2081298.61
	706518.31	2081248.49

Coordinates are based on North Carolina State Plane,
North American Datum of 1983, feet.