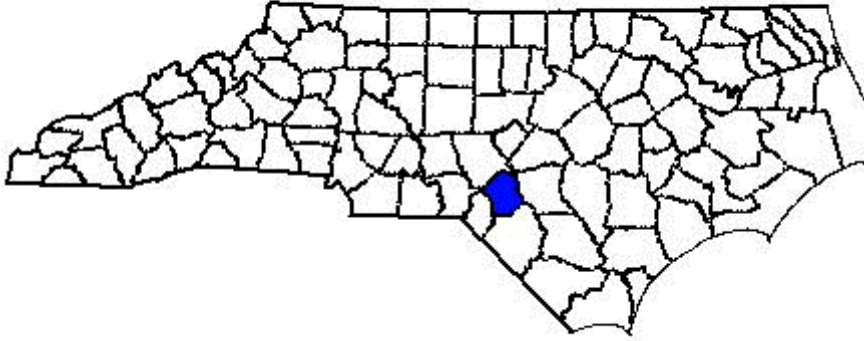


ANNUAL REPORT FOR 2001



**LONG SWAMP MITIGATION SITE
HOKE COUNTY
PROJECT NO. 8.589008T
TIP NO. R-512WM**



Prepared By:
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North Carolina Department of Transportation
December 2001

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LONG SWAMP MITIGATION SITE 2001 REPORT – EXECUTIVE SUMMARY

The following report summarizes the monitoring activities that have occurred in the past year at the Long Swamp Mitigation Site. This site was constructed in 1998. Monitoring activities in 2001 represent the third year of monitoring following construction. The site must demonstrate hydrologic and vegetation success for a minimum of five years or until the project is deemed successful.

The site contains twenty groundwater monitoring gauges (four of which are in reference wetlands), one rain gauge, and eighteen vegetation plots.

This year, rainfall data has been acquired from an onsite rain gauge. Also, daily rainfall data recorded from a rain gauge maintained by the NC State Climate Office in Red Springs (Robeson County) was used for comparison.

Hydrologic monitoring indicated that the northeast portion of the site is consistently not meeting the required success criteria. Of the non-reference monitoring gauges, eight of the sixteen gauges met jurisdictional hydrologic success of at least 12.5% during the growing season (all four reference gauges met the success); conversely, five gauges met hydrology less than 5% of the growing season.

All vegetation monitoring plots but one indicated an average tree density of over 320 trees per acres. The one plot will be replanted in 2002.

As was noted in the 2000 report, NCDOT recommends that the success criteria be revised to current standards. NCDOT will monitor the site for vegetation success for five years. A 320 stems per acre survival criterion for planted seedlings will be used to determine success for the first three years. The required survival criterion will decrease by 10% per year after the third year of vegetation monitoring (i.e., for an expected 290 stems per acre for year 4, and 260 stems per acre for year 5).

Because of the drier conditions in 2001, NCDOT recommends that monitoring continue at least one more year. However, NCDOT is committed to look for alternative replacement mitigation for the areas that are not meeting success (approximately 50 acres in the northeast section), as well the 20 acres of additional mitigation required for TIP Project R-512 that Long Swamp did not compensate. One possibility is the use of a portion of the Key Branch Mitigation Site (R-2231WM). The other avenue that NCDOT is pursuing is to find a site in the same HU as the original impacts to take care of all of these impacts.

1.0 INTRODUCTION

1.1 Project Description

The Long Swamp Wetland Mitigation Site is located approximately 8.7 miles southwest of Raeford in Hoke County (Figure 1). It is bounded by SR 1105 (Wire Road) to the north, SR 1108 (Wilson Road), and SR 1115 (Tom McLaughlin Road) on the west, although portions of the site extends south and west of these secondary roads. The site, located at the head of Long Swamp stream, is characterized as nearly level, encompassing minimal slopes associated with floodplain boundaries of low-energy streams, rims of Carolina bays, and intermittent sand ridges. The area was converted into agricultural use.

The site encompasses approximately 249 acres and is designed as a mitigation site primarily for the US 74 Bypass of Rockingham and Hamlet, TIP Project R-512 (USACE Action ID No. 199301490).

1.2 Purpose

In order to demonstrate successful mitigation, hydrologic and vegetative monitoring must be conducted for a minimum of five years or until success criteria are fulfilled. 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 2001 at the Long Swamp Mitigation Site.

Activities in 2001 reflect the third year of monitoring following the construction. Included in this report are analyses of both hydrologic and vegetative monitoring results as well as local climate conditions throughout the growing season.

1.3 Project History

Summer 1998	Site Construction
March 1999	Installation of Monitoring Gauges
April 1999	Tree Planting
April 1999	Initial Vegetation Monitoring
March-November 1999	Hydrologic Monitoring (Year 1)
October 1999	Vegetation Monitoring (Year 1)
March 2000	Herbicide Treatment (Year 1)
March-November 2000	Hydrologic Monitoring (Year 2)
September 2000	Vegetation Monitoring (Year 2)
March-November 2001	Hydrologic Monitoring (Year 3)
September 2001	Vegetation Monitoring (Year 3)

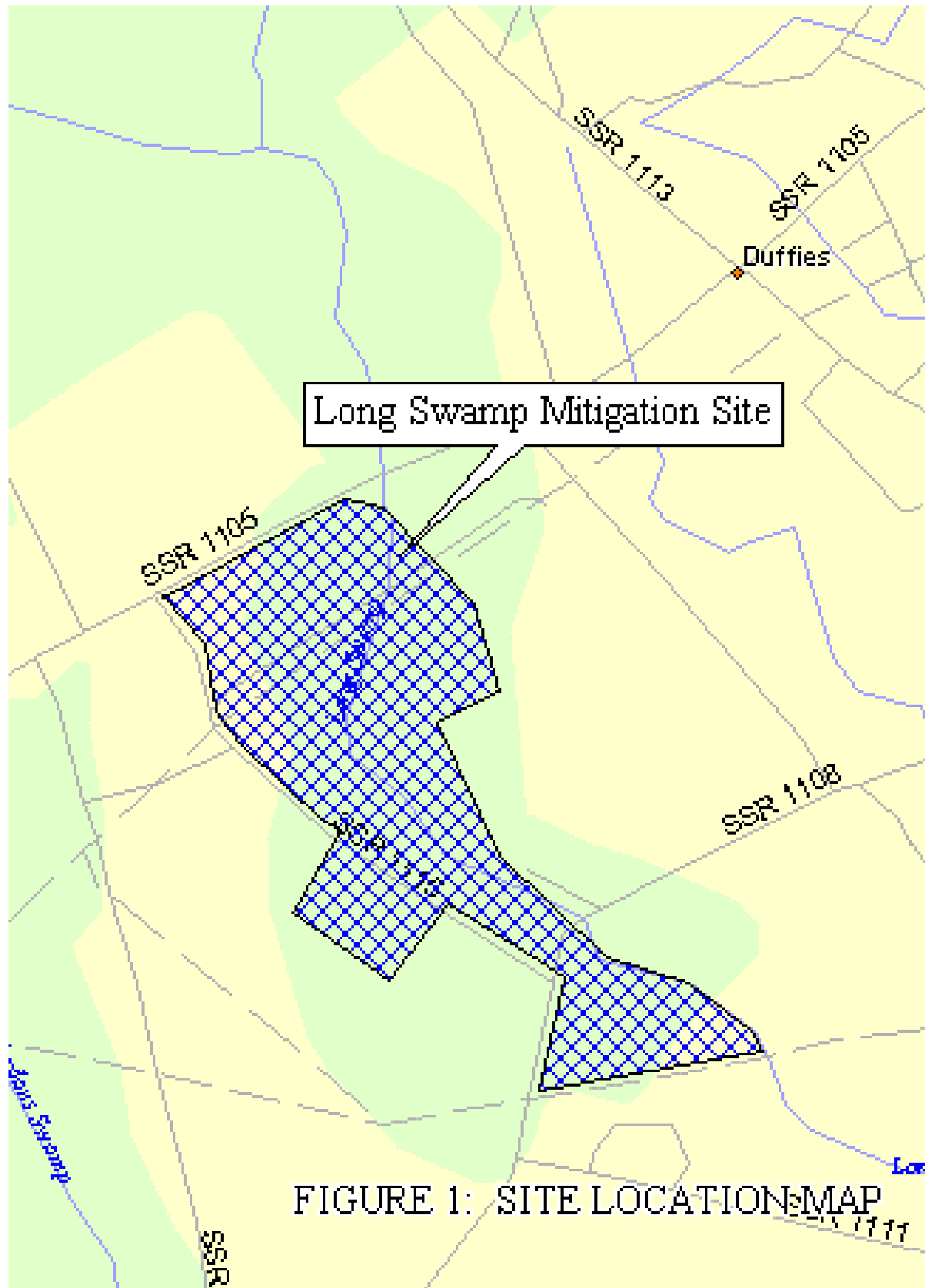


FIGURE 1: SITE LOCATION MAP

1.4 Permit Related Requirements

Special Conditions of the permit for R-512 required that NCDOT:

- purchase or lease the site. The site was purchased in 1997.
- finalize the mitigation planning report for this site. The mitigation planning report was completed in 1997.

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 at least 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 Hoke County begins March 17 and ends November 12. The dates correspond to a 50% probability that temperatures will drop to 28° F or lower after March 17 and before November 12.¹ The growing season is 239 days; therefore the optimum duration for wetland hydrology is 30 days. Local climate must represent average conditions for the area.

2.2 Hydrologic Description

Historically, wetlands on the tract were created by a combination of rainfall, runoff, and groundwater seepage from adjacent interstream areas, and redirected runoff via ditching. Local rainfall was contained within bays or was moved laterally to radially through the soil toward ditches or the remnant Long Swamp stream. After an extensive study of the site's hydrology, it was concluded that placement of impermeable plugs along drainage structures, backfilling of ditches and canals, and diversion of roadside ditches into restored wetlands would elevate the groundwater to a level that would saturate the soil stratum within the required twelve inches. It was predicted that this, in addition to surface water and runoff would be sufficient to restore wetland hydrology.

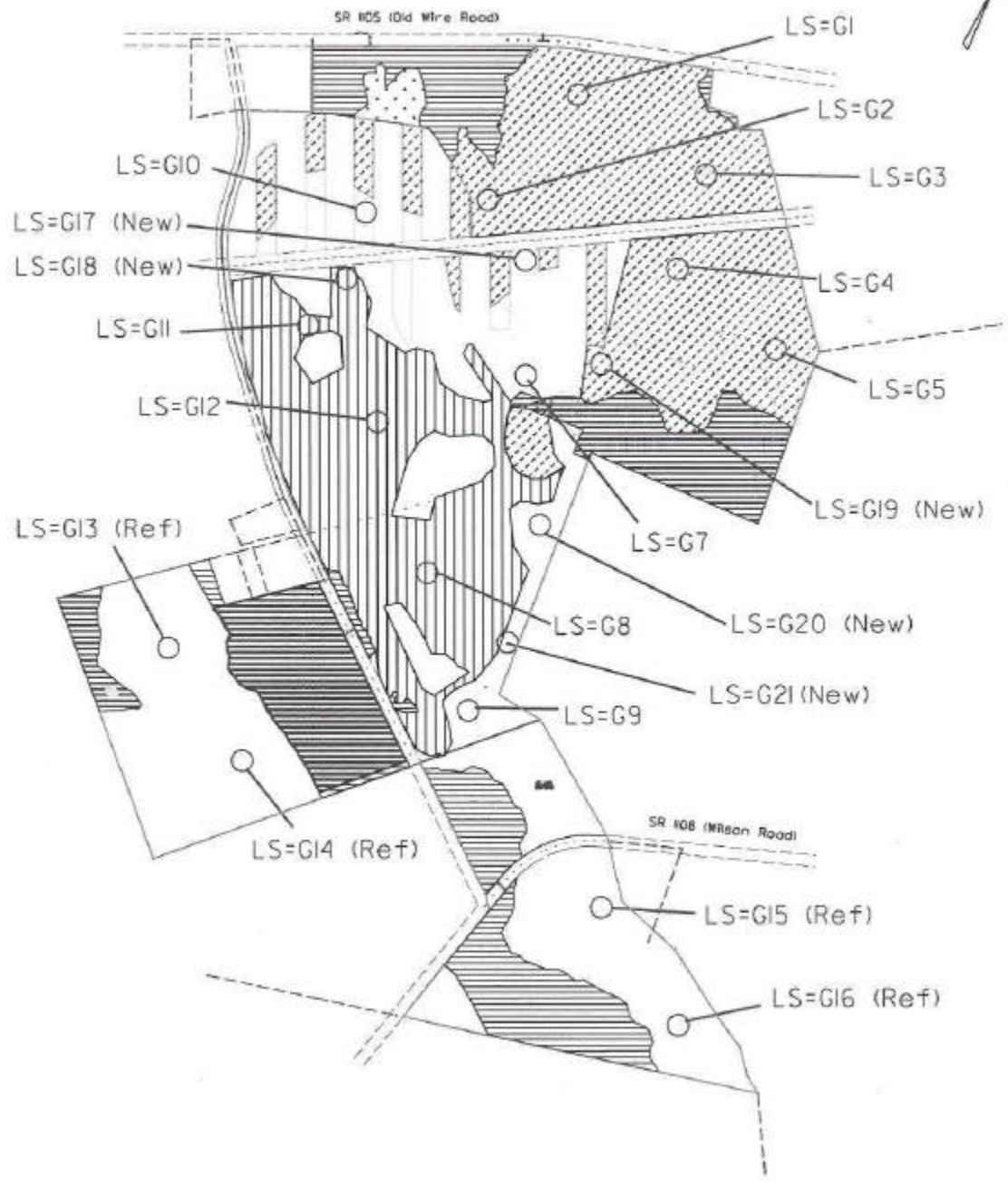
Fifteen groundwater monitoring gauges and one rain gauge were installed in 1999 (Figure 2). The automatic monitoring gauges record daily readings of groundwater depth.

¹ Natural Resources Conservation Service, Soil Survey of Hoke County, North Carolina, p.105.

Five additional gauges (G-17 through G-21) were installed in November 2000 to provide more data in the restoration areas.

This year, rainfall data has been acquired from an onsite rain gauge. Also, daily rainfall data recorded from a rain gauge maintained by the NC State Climate Office in Red Springs (Robeson County) was used for comparison.

LONG SWAMP MITIGATION SITE
HOKE COUNTY



○ GROUNDWATER MONITORING GAUGE
0' 500' 1000'

FIGURE 2: MONITORING GAUGE LOCATIONS

2.3 Results of Hydrologic Monitoring

2.3.1 Site Data

The maximum number of consecutive days that the groundwater was within twelve inches of the surface was determined for each gauge. This number was converted into a percentage of the 239-day growing season. Table 1 presents the 2001 results.

Appendix A contains a plot of the groundwater depth for each monitoring gauge. The maximum number of consecutive days is noted on each graph. Graph data determined to be erroneous was omitted; therefore, some gaps appear in the plots. Precipitation events are included on each graph as bars.

Table 1
2001 HYDROLOGIC MONITORING RESULTS
(MARCH 17 – NOVEMBER 12)

Monitoring Gauge	< 5% (<12 dy)	5 - 8% (12-18 dy)	8 - 12.5% (19-29 dy)	> 12.5% (>30 dy)	Actual %	Dates Meeting Success
LS-G1			✓		10.9	3/17-4/11
LS-G2			✓		10.9	3/17-4/5
LS-G3	✓				1.7	3/21-3/24
LS-G4	✓				1.7	3/21-3/24
LS-G5	✓				0	none
LS-G7			✓		9.2	3/17-4/7
LS-G8				✓	20.9	3/17-5/5
LS-G9				✓	21.8	3/17-5/7
LS-G10				✓	14.6	3/17-4/20
LS-G11				✓	20.1	3/17-5/3
LS-G12				✓	19.2	3/17-5/1
LS-G13*				✓	20.9	3/17-5/5
LS-G14*				✓	14.6	3/17-4/20
LS-G15*				✓	20.1	3/17-5/3
LS-G16*				✓	20.9	3/17-5/5
LS-G17				✓	13.8	3/17-4/18
LS-G18				✓	10.9	3/17-4/11
LS-G19	✓				0	None
LS-G20				✓	15.1	3/17-4/21
LS-G21^	✓				1.7	None

* Gauges in reference wetlands areas, as was established in the mitigation planning report.

^ Gauge G21 should be in dry area according to the mitigation planning report.

Figure 3 is a graphical representation of the hydrologic monitoring results for this year. A blue dot represents wetland hydrology for more than 12.5% of the season; a red dot indicates hydrology between 8% and 12.5%; a green dot represents hydrology between 5% and 8%. It is this hydrologic data that will indicate success for the site.

For this period from March to November, eight of the sixteen gauges (non-reference gauges) met jurisdictional hydrologic success of at least 12.5% during the growing season. Conversely, five gauges met hydrology less than 5% of the growing season.

Table 2 gives a further comparison between the three years that monitoring has been documented.

Table 2
HYDROLOGIC MONITORING RESULTS FOR 1999-2001
(in Percent of Growing Season)

Monitoring Gauge	Year		
	1999+	2000	2001
LS-G1	6.25	23.4	10.9
LS-G2	0.8	7.5	10.9
LS-G3	0	8.8	1.7
LS-G4	0	5.9	1.7
LS-G5	0	18.8	0
LS-G7	3.3	11.3	9.2
LS-G8	29.2	37.7	20.9
LS-G9	24.6	29.7	21.8
LS-G10	11.7	32.2	14.6
LS-G11	16.7	32.2	20.1
LS-G12	17.1	29.7	19.2
LS-G13*	11.3	24.7	20.9
LS-G14*	5.8	11.3	14.6
LS-G15*	30	29.3	20.1
LS-G16*	30.8	29.7	20.9
LS-G17^	N.A.	N.A.	13.8
LS-G18^	N.A.	N.A.	10.9
LS-G19^	N.A.	N.A.	0
LS-G20^	N.A.	N.A.	15.1
LS-G21^	N.A.	N.A.	1.7

+ Pre-hurricane data

* Reference gauges

^ Gauges installed in 2000

LONG SWAMP MITIGATION SITE HOKE COUNTY

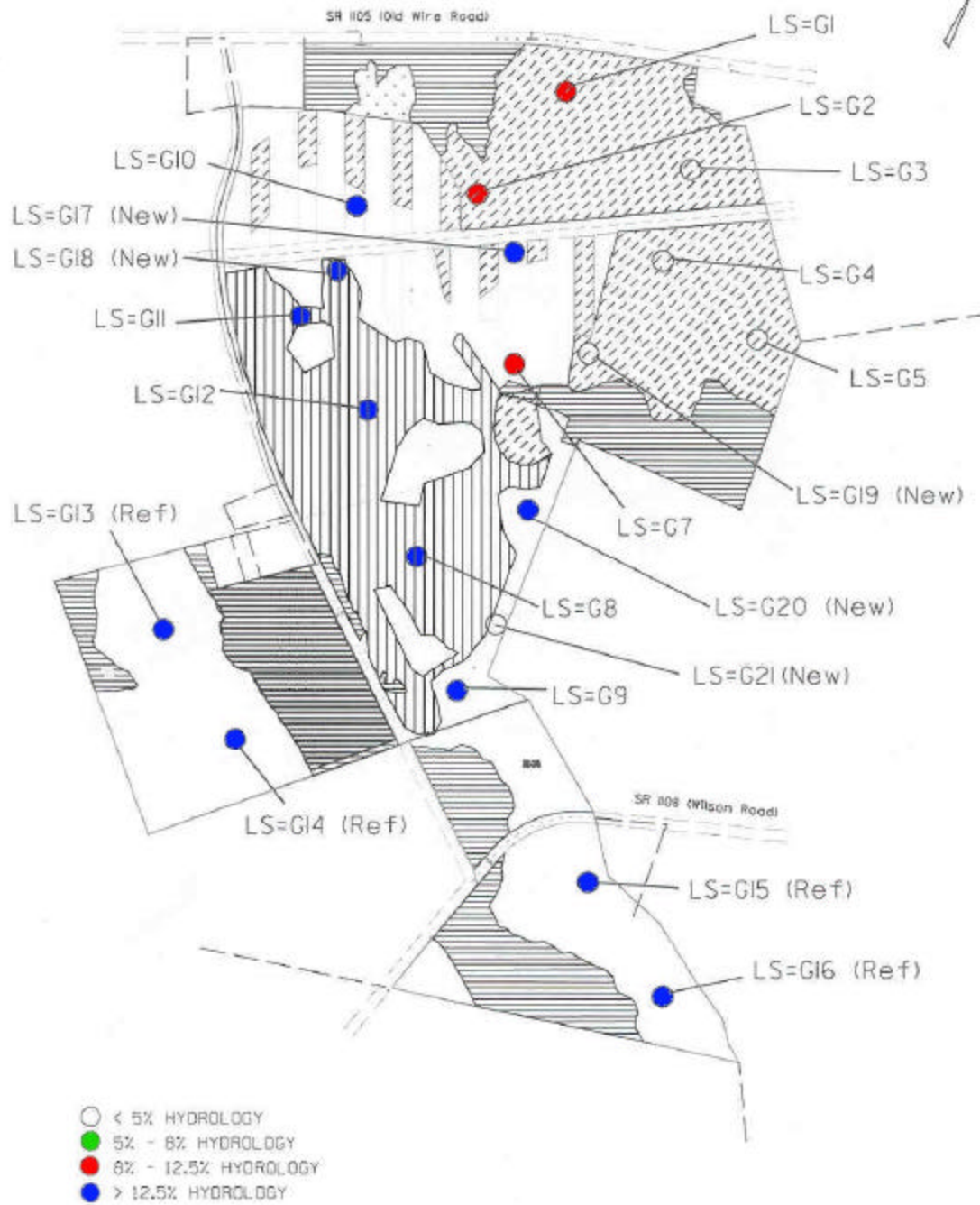


FIGURE 3: 2001 HYDROLOGIC RESULTS

2.3.2 Climatic Data

Figure 4 represents an examination of the local climate in comparison with historical data in order to determine whether 2001 was “average” in terms of climate conditions. The figure compares the rainfall from 2001 with that of historical rainfall (data collected between 1931 and 2001). All rainfall data was collected from the NC State Climate Office. The graph shows 2000 totals from September to December (except for October); the graph also shows 2001 rainfall totals through August 2001. Rainfall data for September through December 2001 will be presented in the 2002 Annual Monitoring Report.

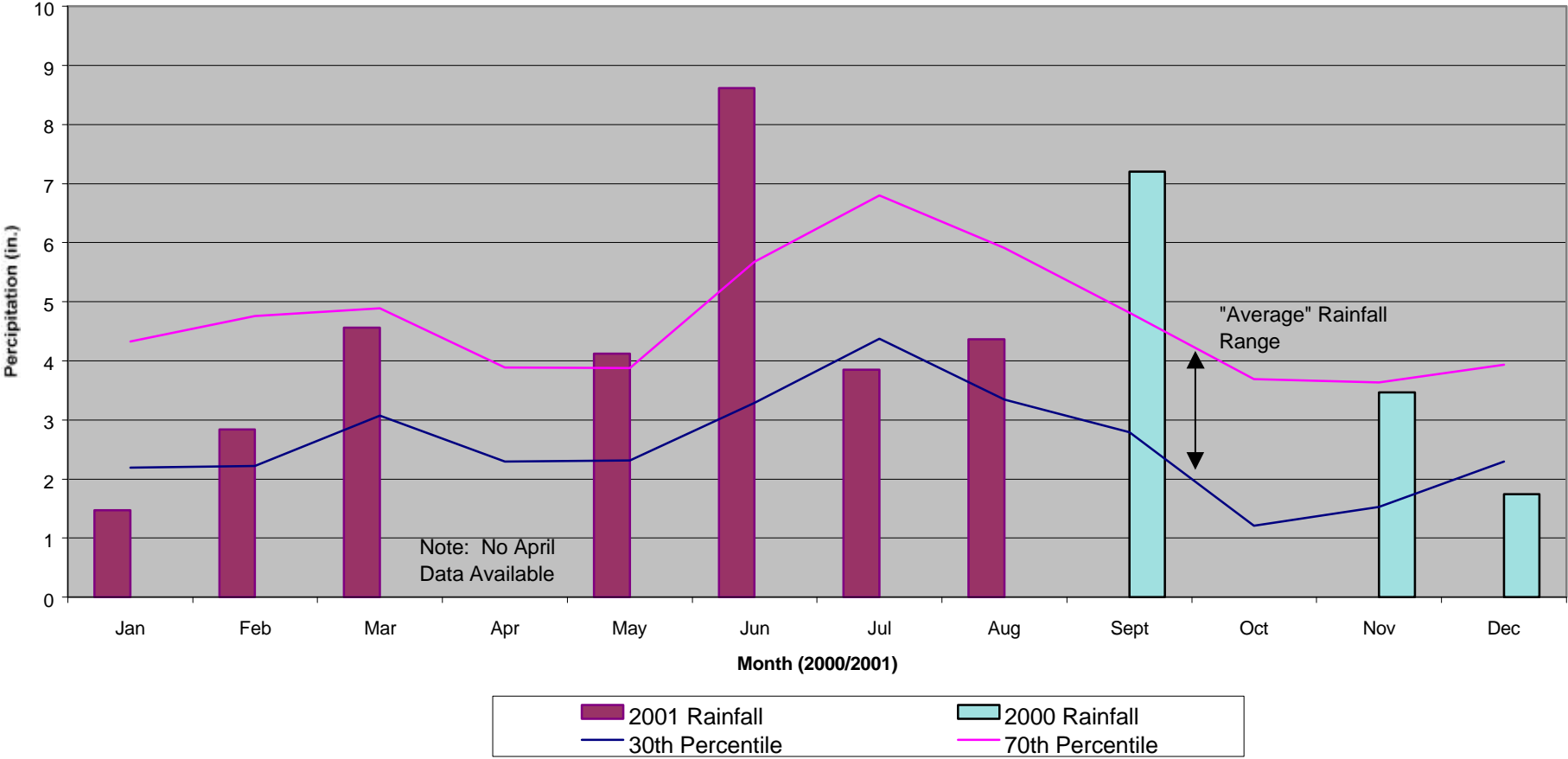
For 2000, September was above average, November was average, and December was below average. For 2001, all but two months had at or below average rainfall. April 2001 data was unavailable from the NC Climate Office.

2.4 Conclusions

2001 represents the third full growing season that the hydrologic data has been examined. Of the non-reference monitoring gauges, eight of sixteen monitoring gauges met the jurisdictional wetland hydrology for 12.5% of the growing season (all four of the reference gauges met the success). Conversely, five of the gauges were successful less than 5% of the growing season.

While 2001 was a drier year than average, hydrologic monitoring has indicated that the northeast portion of the site is consistently not meeting the success criteria. This area is approximately 50 acres in size.

**FIGURE 4: Long Swamp 30-70 Percentile Graph
Hoke County**



3.0 VEGETATION (MONITORING YEAR 3 OF 5)

3.1 Success Criteria

NCDOT will monitor the site for five years or until success criteria is met. A 320 stems per acre survival criterion for planted seedlings will be used to determine success for the first three years. The required survival criterion will decrease by 10% per year after the third year of vegetation monitoring (i.e., for an expected 290 stems per acre for year 4, and 260 stems per acre for year 5). A minimum of 5 character tree species must be present, with no more than 20% of any one species is also required with the exception of Atlantic White Cedar which may comprise up to 75% in swamp forest restoration. Loblolly Pine cannot comprise of more than 10% of the 320 trees per acre requirement.

3.2 Description of Species

The following species were planted in the Wetland Restoration Area:

Zone 1: Streamhead Pocosin (2 acres)

Taxodium distichum, Baldcypress
Chamaecyparis thyoides, Atlantic White Cedar
Liriodendron tulipifera, Tulip Poplar
Pinus serotina, Pond Pine
Quercus laurifolia, Laurel Oak
Fraxinus pennsylvanica, Green Ash
Magnolia virginiana, Sweet Bay
Quercus lyrata, Overcup Oak
Quercus phellos, Willow Oak
Quercus michauxii, Swamp Chestnut Oak
Quercus falcata var. *pagodaefolia*, Cherrybark Oak
Nyssa sylvatica, Blackgum
Quercus alba, White Oak

Zone 2: Streamhead Atlantic White Cedar (4.4 acres)

Chamaecyparis thyoides, Atlantic White Cedar
Liriodendron tulipifera, Tulip Poplar
Pinus serotina, Pond Pine

Fraxinus pennsylvanica, Green Ash
Taxodium distichum, Bald Cypress

Zone 3: Non-riverine Wet Hardwood Forest (74.4 acres)

Quercus michauxii, Swamp Chestnut Oak
Quercus laurifolia, Laurel Oak
Quercus nigra, Water Oak
Quercus lyrata, Overcup Oak
Quercus phellos, Willow Oak
Quercus falcata var. pagodaefolia, Cherrybark Oak
Fraxinus pennsylvanica, Green Ash

Zone 4: Coastal Plain and Small Stream Swamp (42 acres)

Taxodium distichum, Bald Cypress
Quercus phellos, Willow Oak
Quercus laurifolia, Laurel Oak
Quercus lyrata, Overcup Oak
Quercus michauxii, Swamp Chestnut Oak
Liriodendron tulipifera, Tulip Poplar
Fraxinus pennsylvanica, Green Ash
Nyssa sylvatica, Blackgum

**Zone 5: Mesic Mixed Hardwood Forest (Coastal Plain Subtype)
(43.8 acres)**

Quercus lyrata, Overcup Oak
Quercus alba, White Oak
Quercus rubra, Northern Red Oak
Quercus nigra, Water Oak
Quercus falcata var. pagodaefolia, Cherrybark Oak
Quercus michauxii, Swamp Chestnut Oak
Quercus phellos, Willow Oak
Quercus laurifolia, Laurel Oak

3.3 Results of Vegetation Monitoring

Table 3
2001 VEGETATIVE MONITORING RESULTS

	Plot #	Overcup Oak	White Oak	Northern Red Oak	Water Oak	Swamp Chestnut Oak	Cherrybark Oak	Willow Oak	Laurel Oak	Green Ash	Atlantic White Cedar	Pond Pine	Blackgum	Baldypress	Tulip Poplar	Sweet Bay	Total (3 year)	Total (at planting)	Density (Trees/Acre)
Zone 1	9	6	1			2	1	1	1			7	2				21	48	298
ZONE 1 AVERAGE DENSITY																		298	
Zone 2	5				8			1			8	18					35	37	643
ZONE 2 AVERAGE DENSITY																		643	
Zone 3	2	1			2			12	5								20	30	453
	3					14	6	11	3	1							35	35	680
	4	8				4	5		10	2							29	32	616
	6	5				7		3		11							26	26	680
	7	10				6	8		3	4							31	40	527
	17	2			7	9		7	3	7							35	45	529
	18	6				8		1		1							16	26	418
ZONE 3 AVERAGE DENSITY																		558	
Zone 4	10					6				7			10	3			26	35	505
	11	6				7		6		4			3	7			33	37	606
	12	4				6							12	15			37	38	662
	13					11				2			5	5	5		28	31	614
ZONE 4 AVERAGE DENSITY																		597	
Zone 5	1	4		1		14	12		1								32	38	573
	8		2	8		6	3	1	5								25	40	425
	14			4	5	10			6								25	29	586
	15			1		14	14	1	4								34	39	593
	16	14	2	17		1	4	1	5								44	45	665
ZONE 5 AVERAGE DENSITY																		568	
TOTAL AVERAGE DENSITY																		560	

Site Notes:

Zone 1	Other species: Sweetgum.
Zone 2	Other species: Sweetgum, fennel, winged sumac, and briars.
Zone 3	Other species: Pine, sickle pod, red maple, bermuda, broomsedge, smartweed, briars, woolgrass, stinkweed, sweetgum, volunteer blackgum, plume grass, fern, black willow, and fennel.
Zone 4	Other species: Sweetgum, briars, broomsedge, holly, sourwood, bay, volunteer black gum, <i>Baccharis halimifolia</i> , wax myrtle, black willow, volunteer tulip poplar, and pine.
Zone 5	Other species: Ragweed, fennel, morning glory, sickle pod, nutsedge, bermuda grass, goldenrod, mimosa, and hickory.

3.4 Conclusions

Of the 249 acres on this site, approximately 167 involved tree planting. There were 18 monitoring plots established throughout the planting areas, encompassing all plant communities. The 2001 vegetation monitoring revealed an average density of 560 trees per acre with each zone except Zone 1 (Streamhead Pocosin) exceeding the 320 trees per acre requirement. NCDOT will supplementally plant this Zone in 2002.

4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS

Hydrologic monitoring indicated that the enhancement areas are meeting the necessary success criteria. However, the restoration area (northeast portion of the site) is consistently not meeting the success criteria.

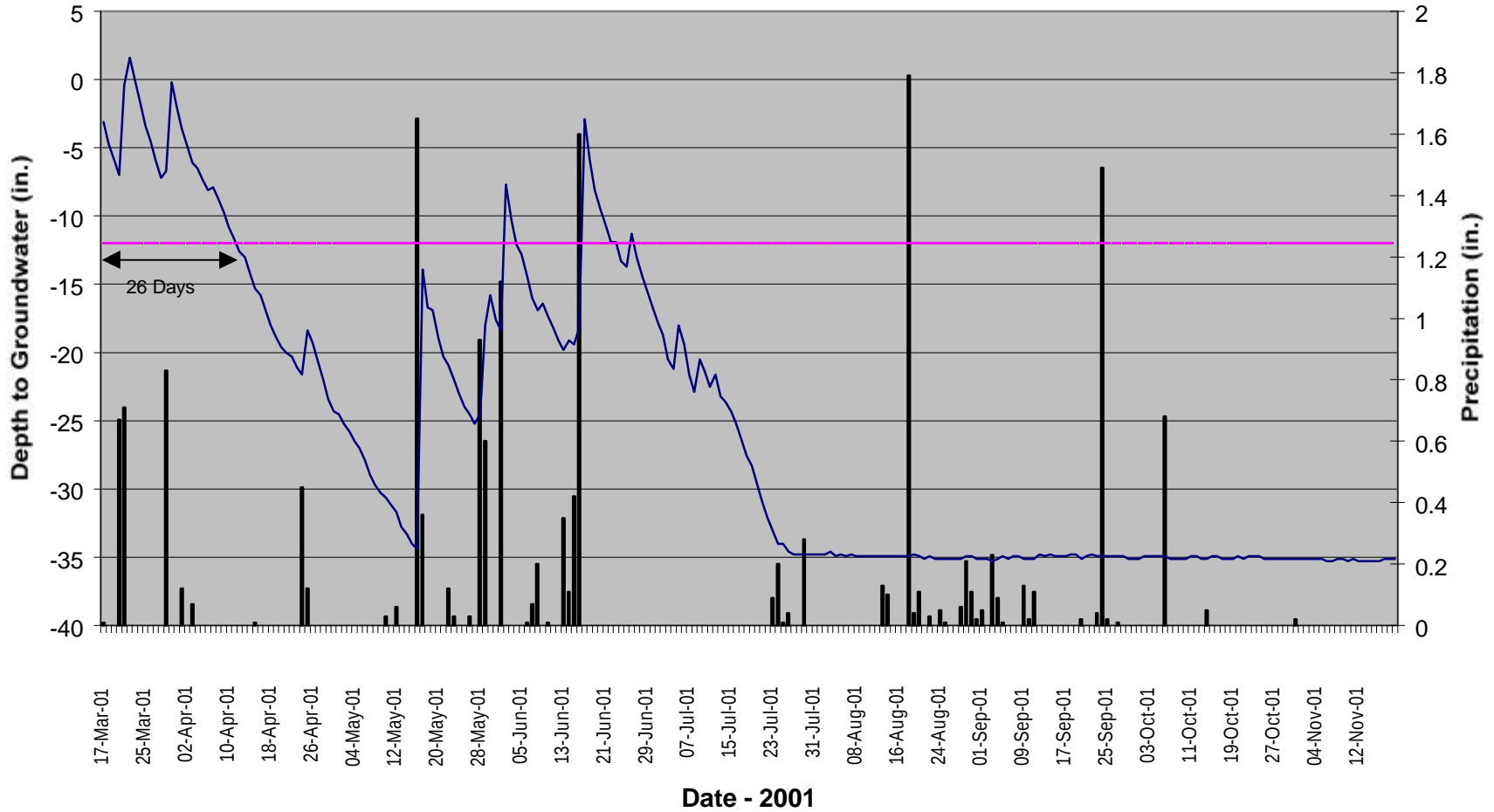
All vegetation monitoring plots but one indicated an average tree density of over 320 trees per acres. The one plot will be replanted in 2002.

Because of the drier conditions in 2001, NCDOT recommends that monitoring continue at least one more year. However, NCDOT is committed to look for alternative replacement mitigation for the areas that are not meeting success (approximately 50 acres in the northeast section), as well the 20 acres of additional mitigation required for TIP Project R-512 that Long Swamp did not compensate. One possibility is the use of a portion of the Key Branch Mitigation Site (R-2231WM). The other avenue that NCDOT is pursuing is to find a site in the same HU as the original impacts to take care of all of these impacts.

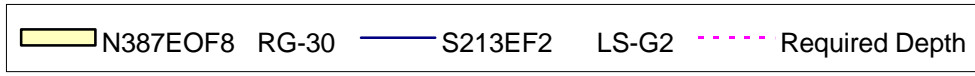
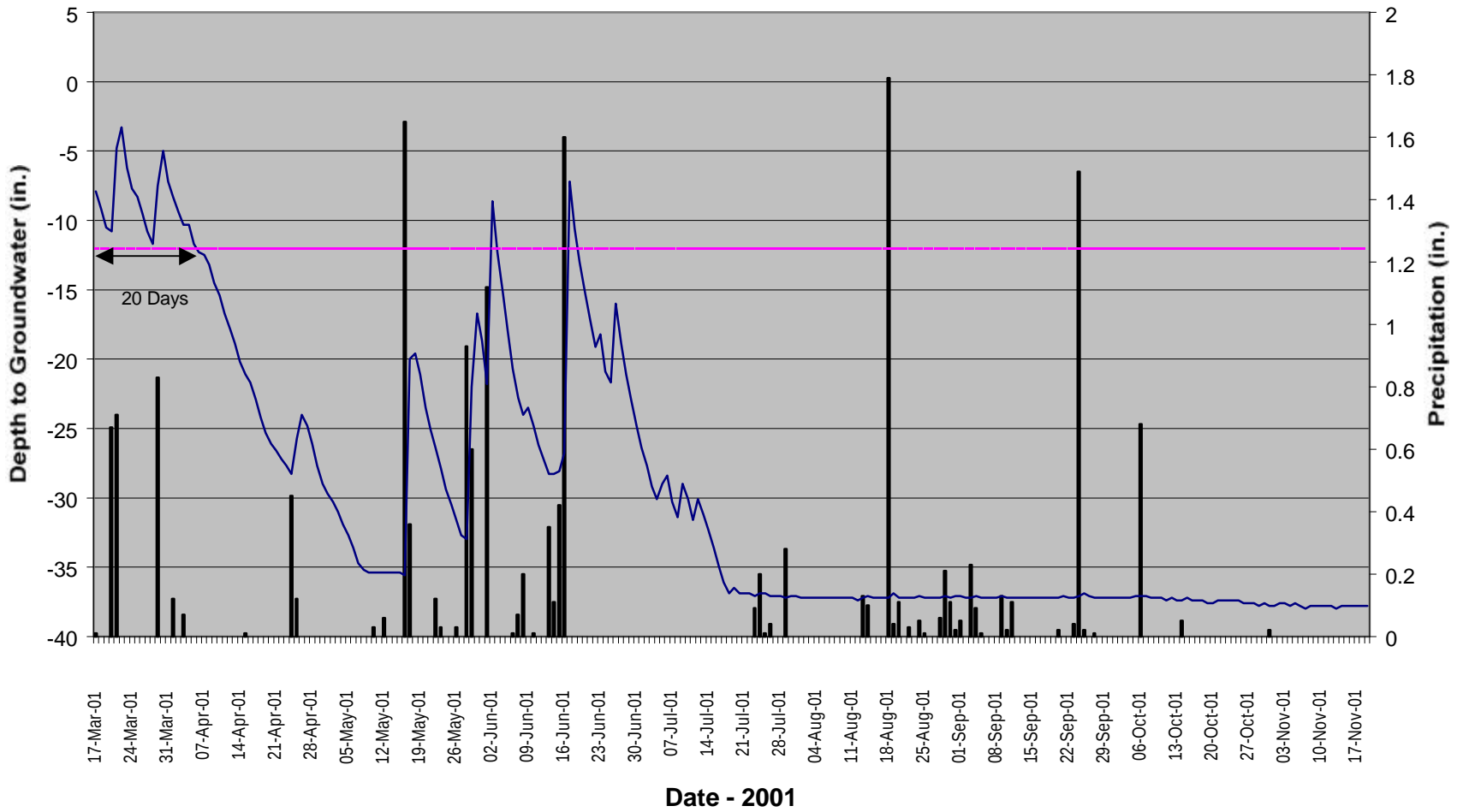
APPENDIX A

DEPTH TO GROUNDWATER GRAPHS

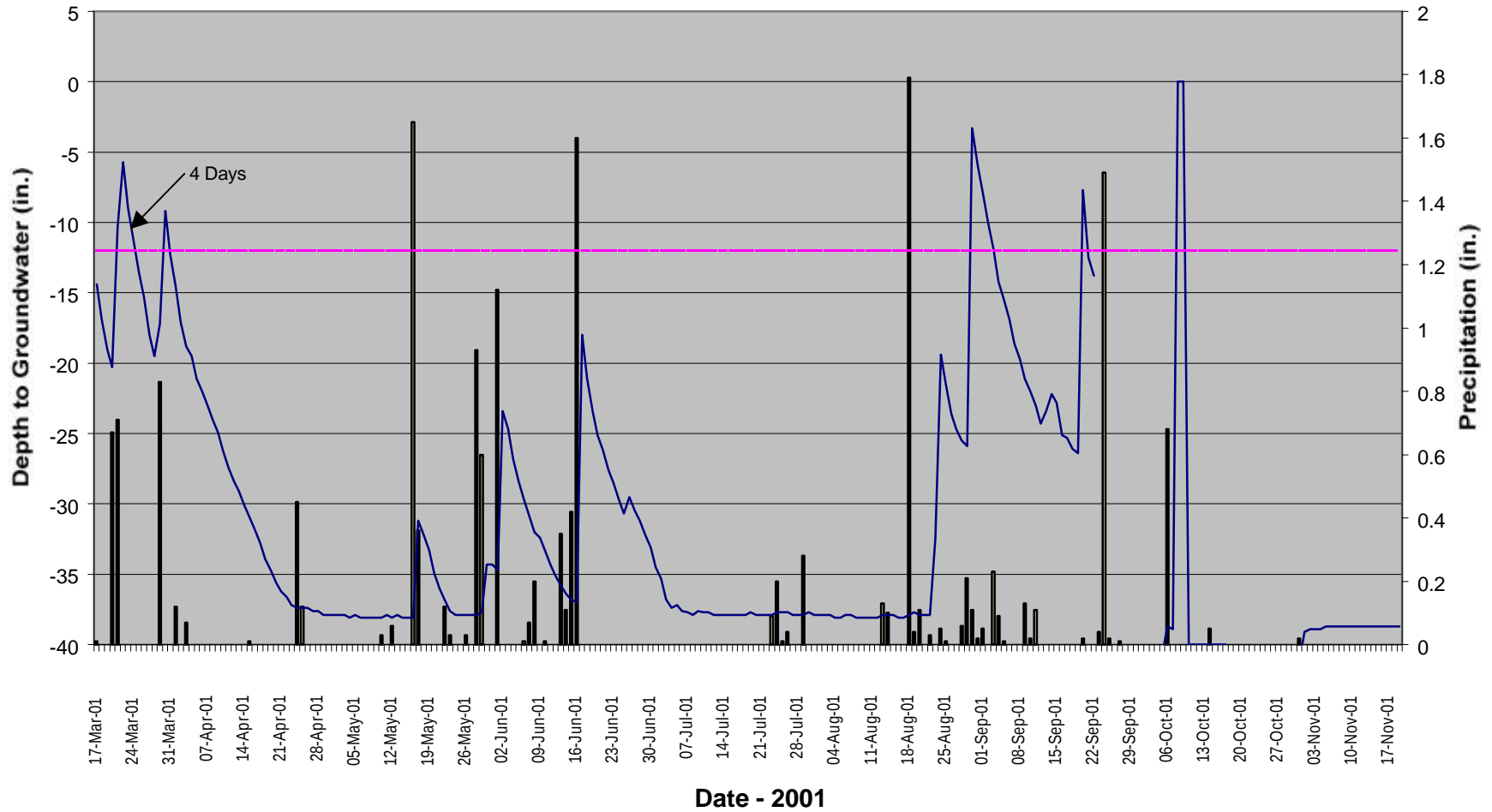
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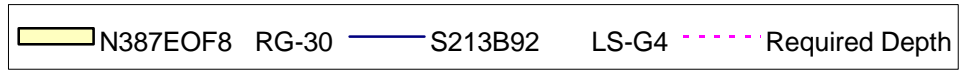
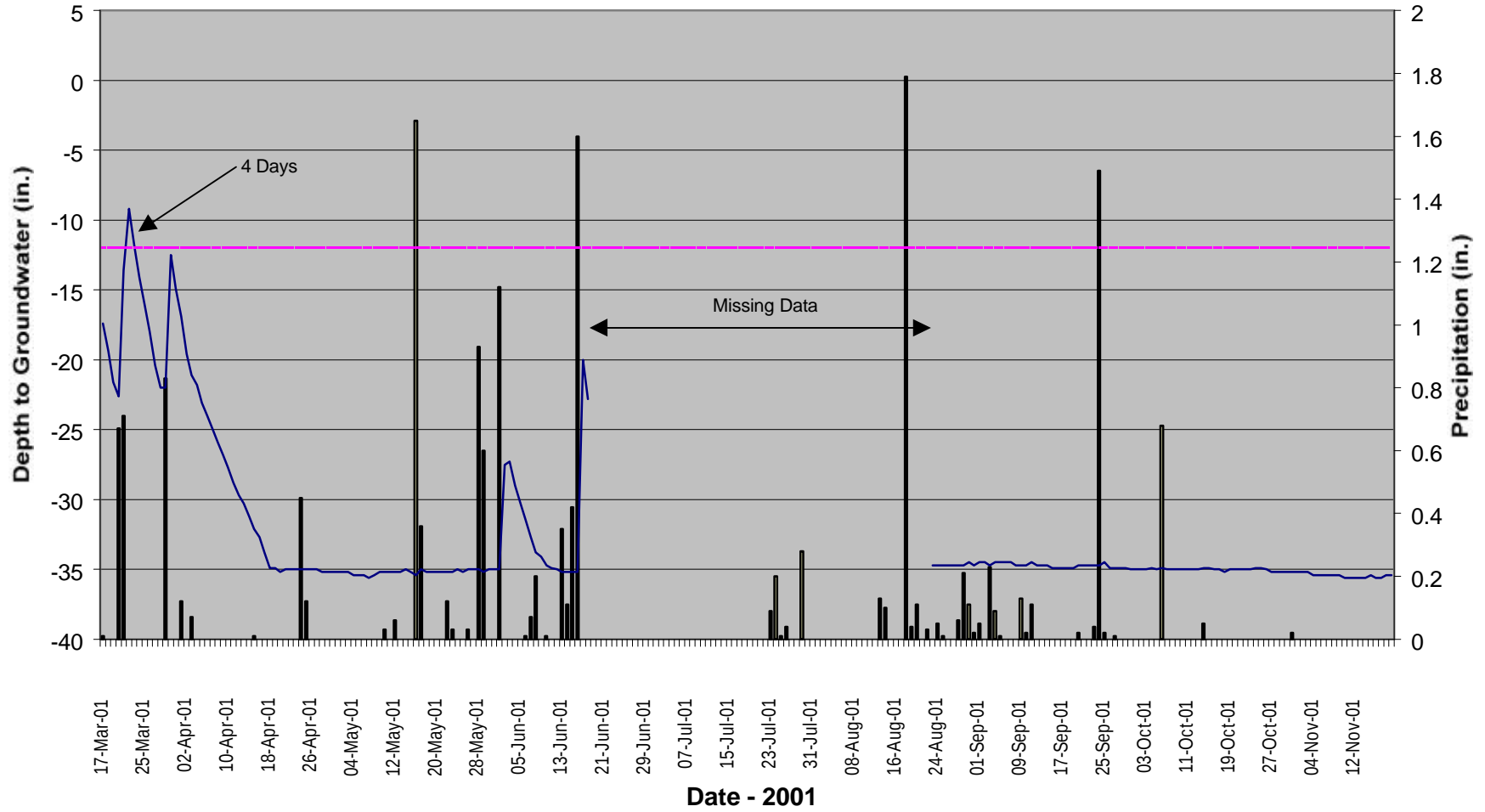
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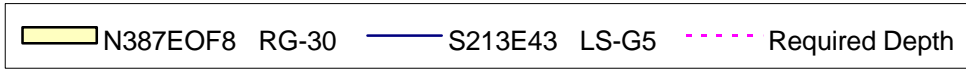
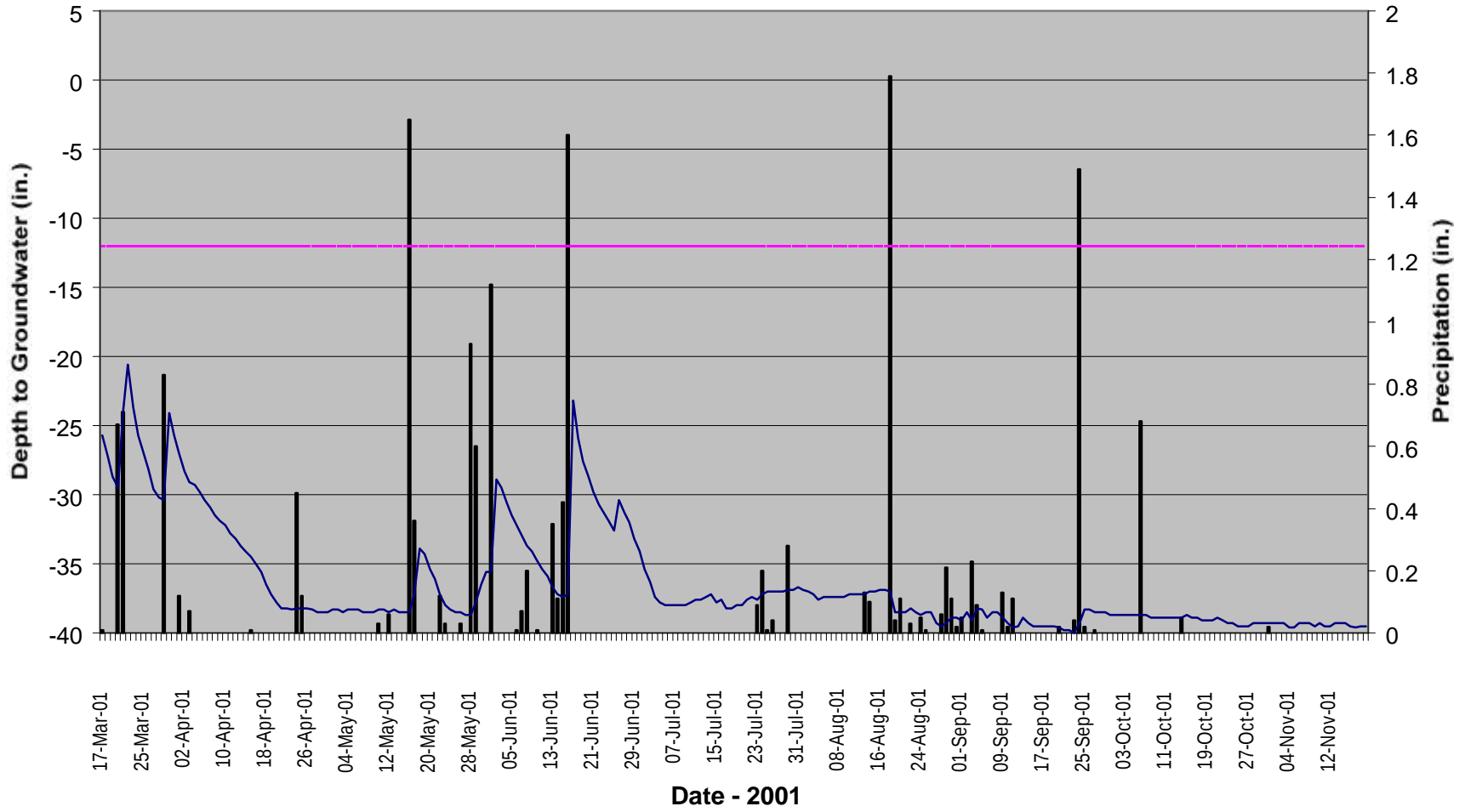
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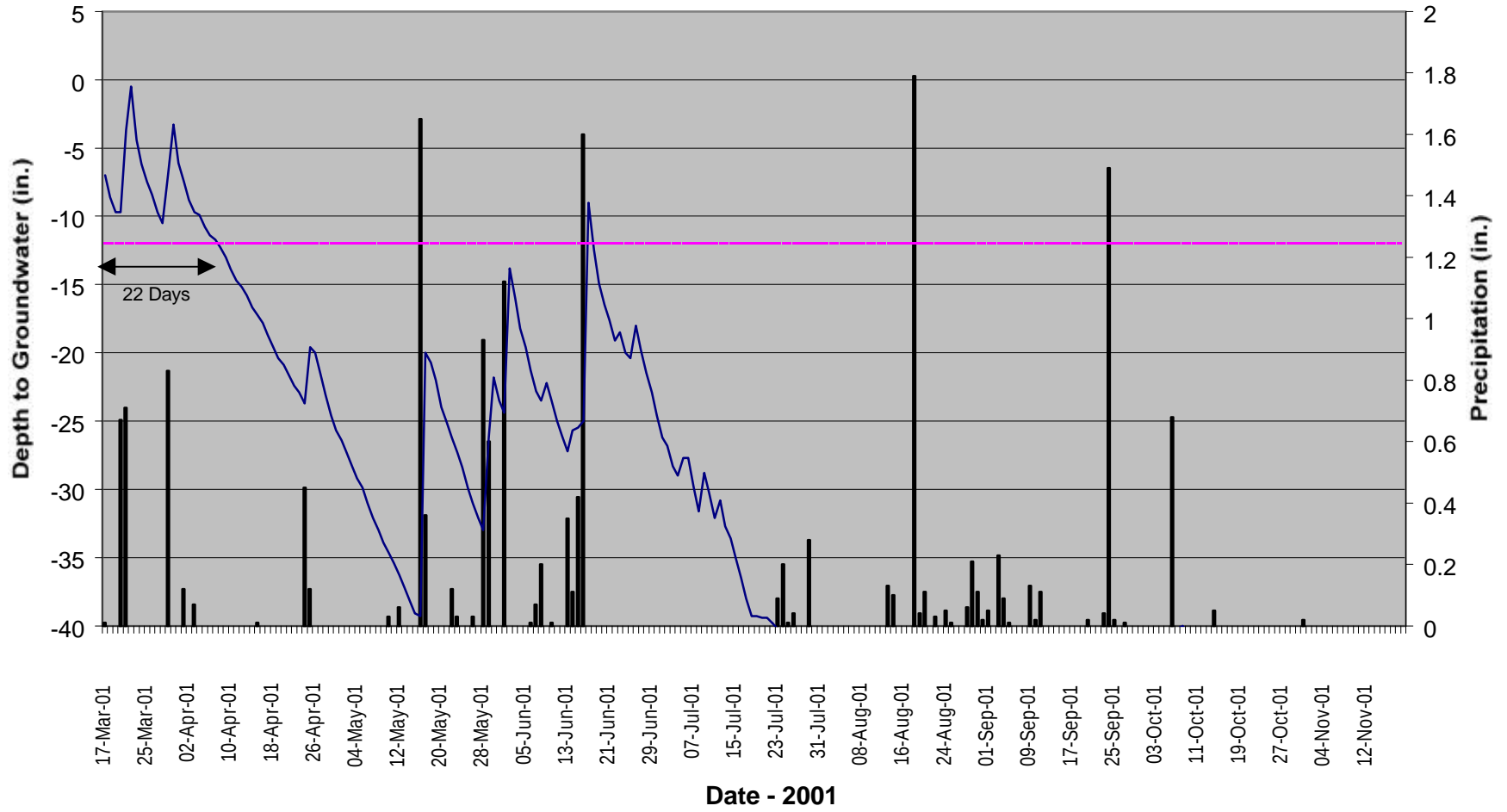
Long Swamp - Gauge G4



Long Swamp - Gauge G5

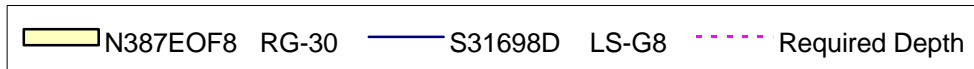
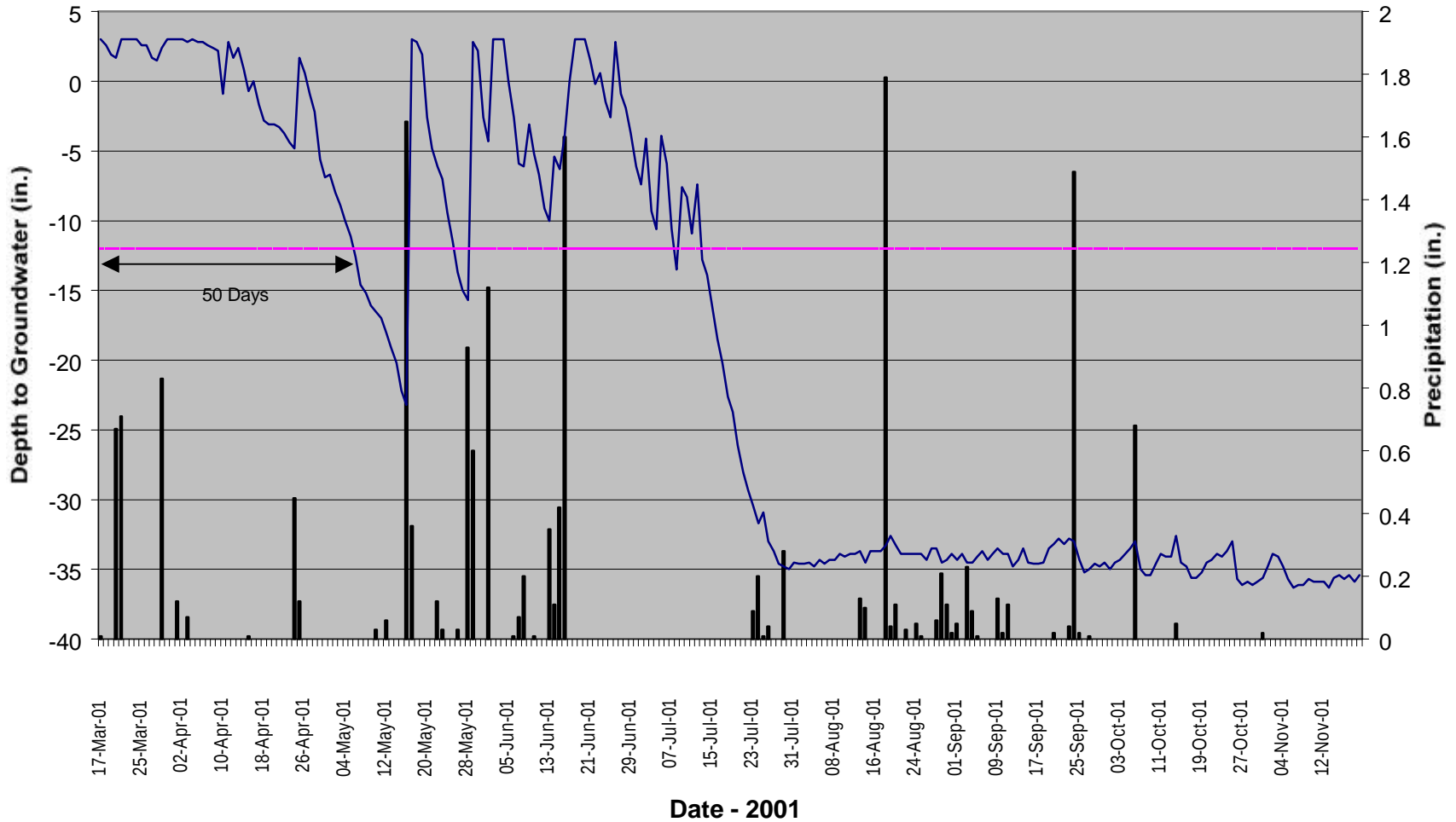


Long Swamp - Gauge G7

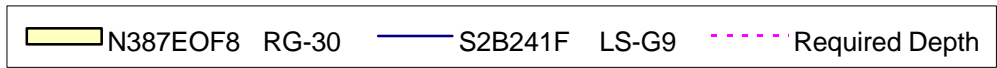
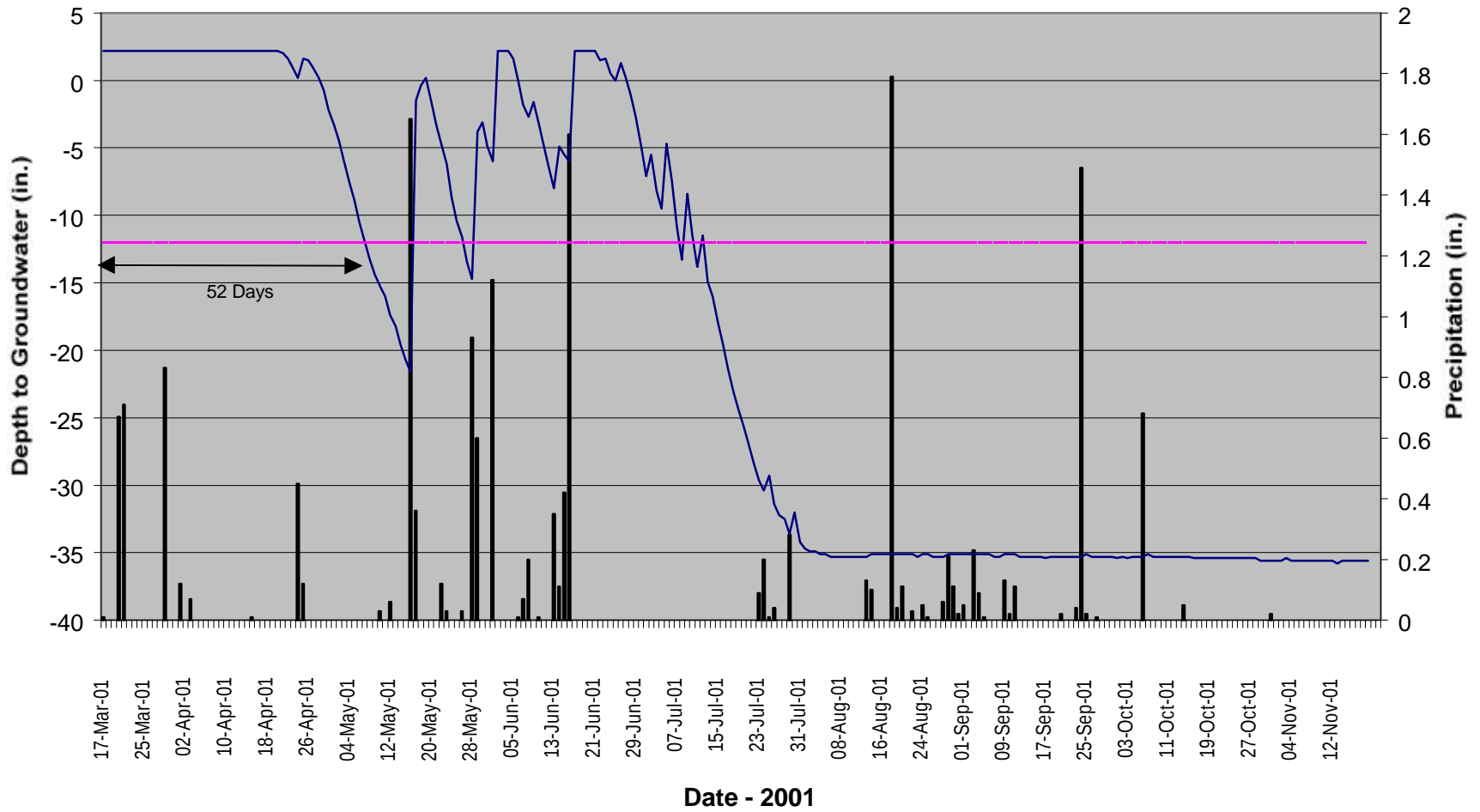


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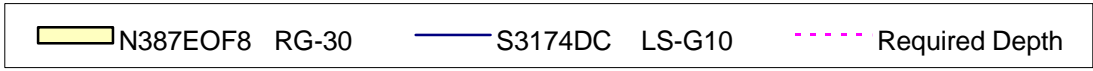
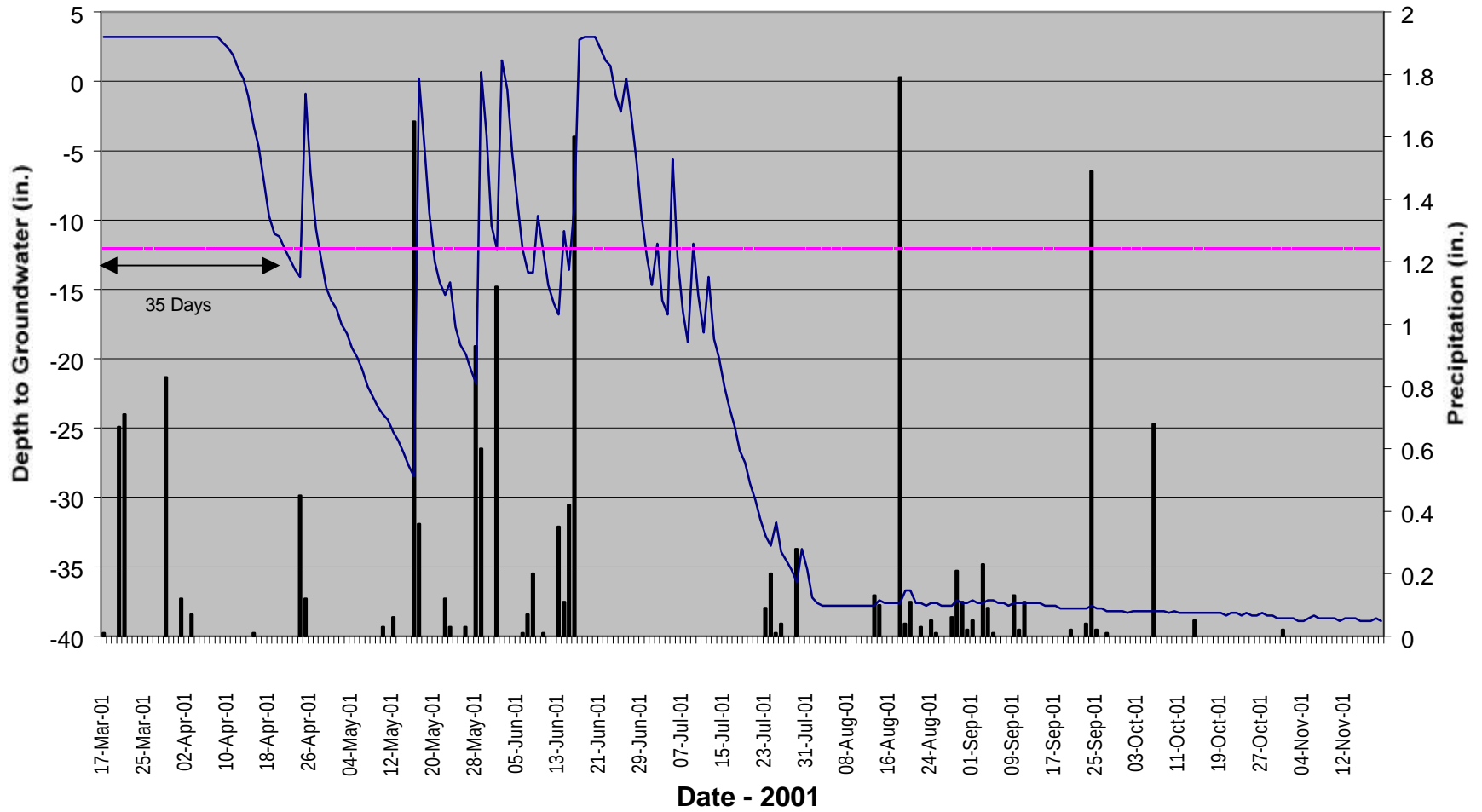
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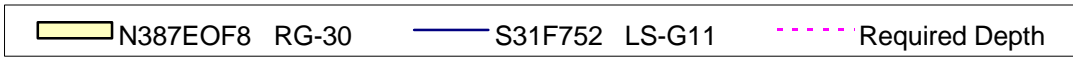
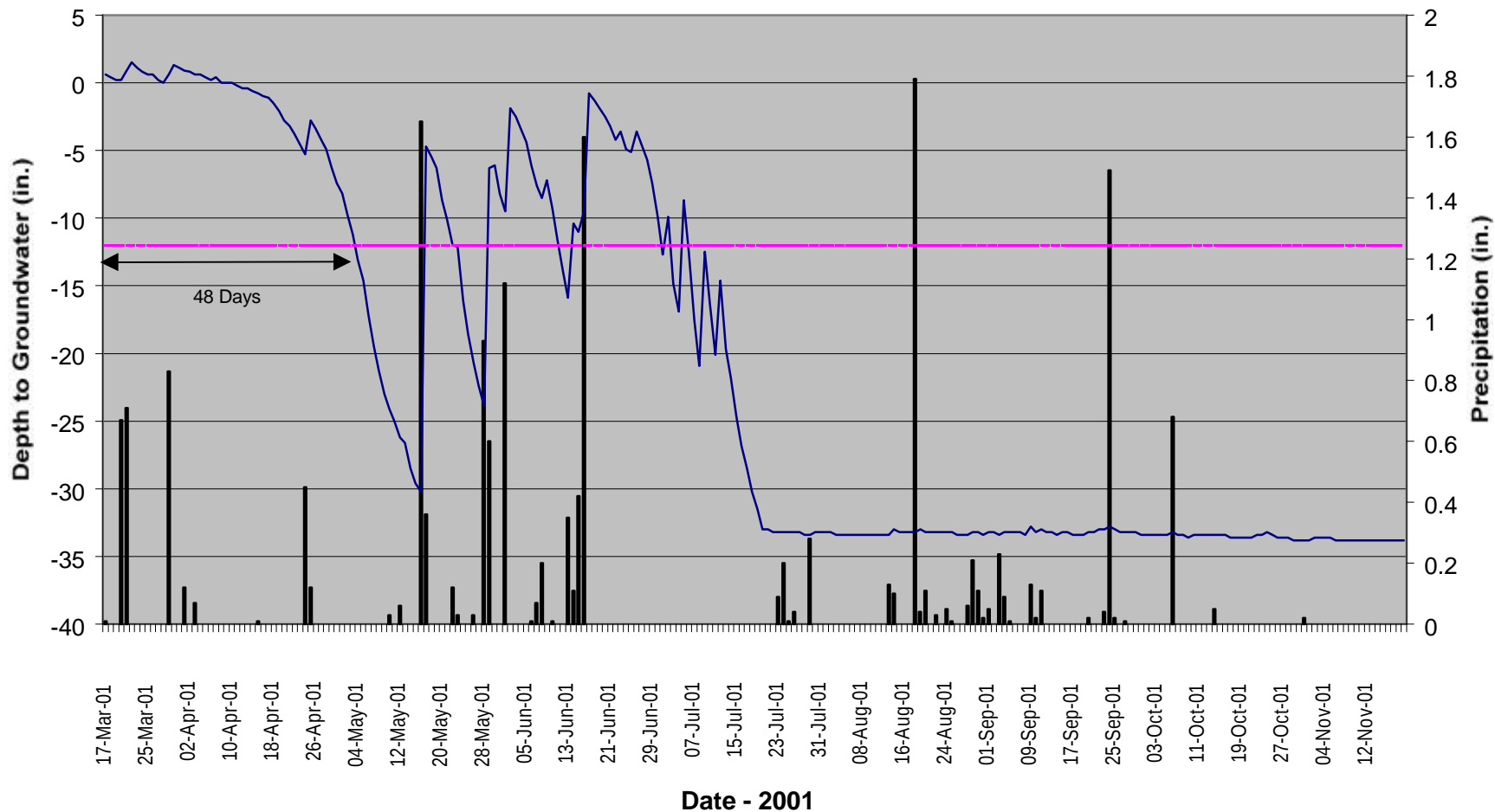
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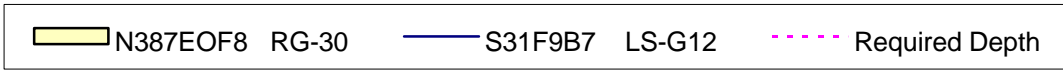
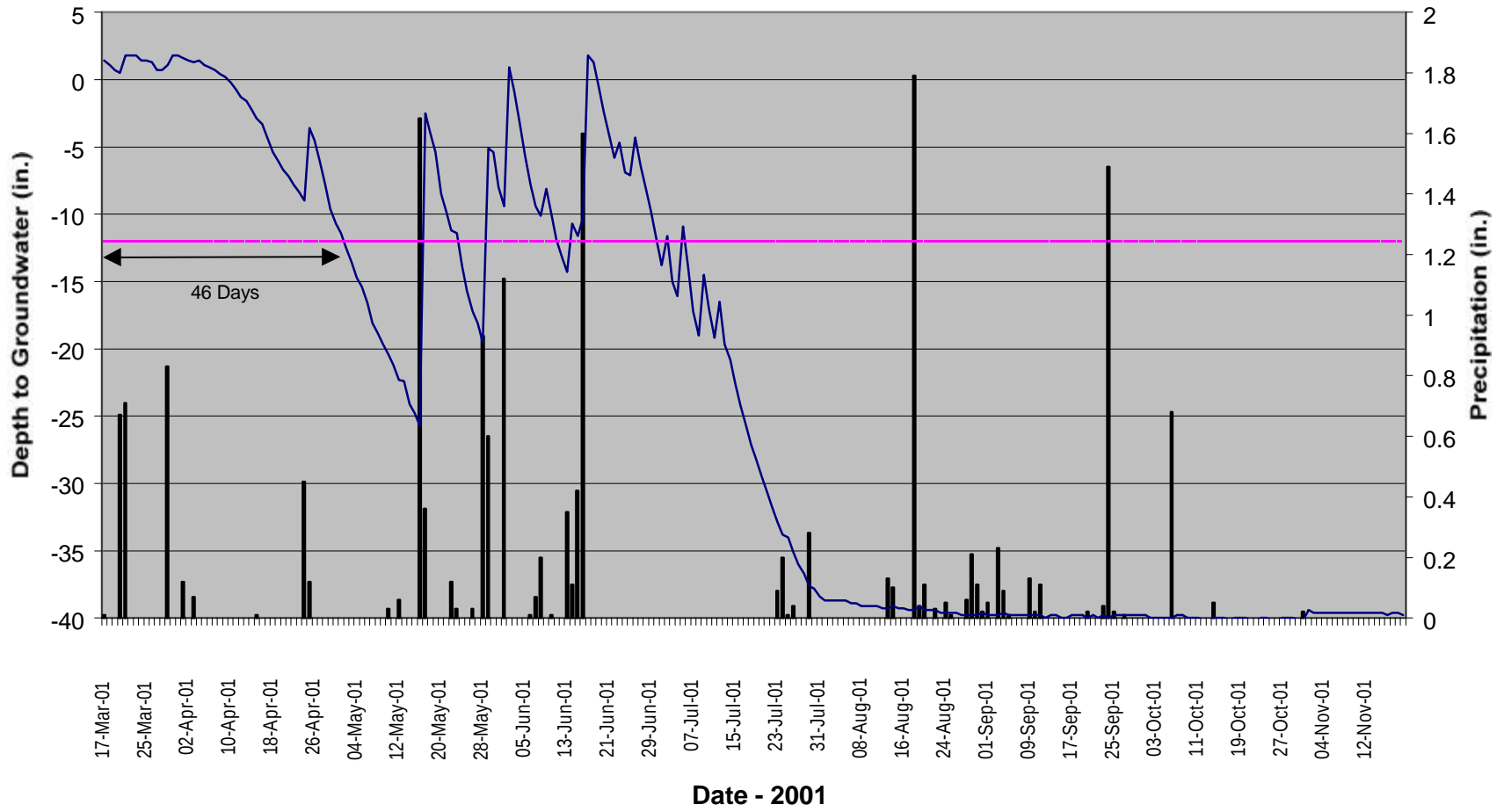
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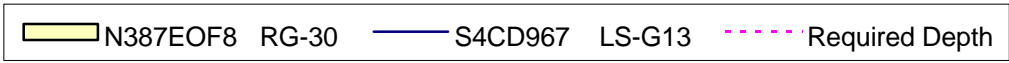
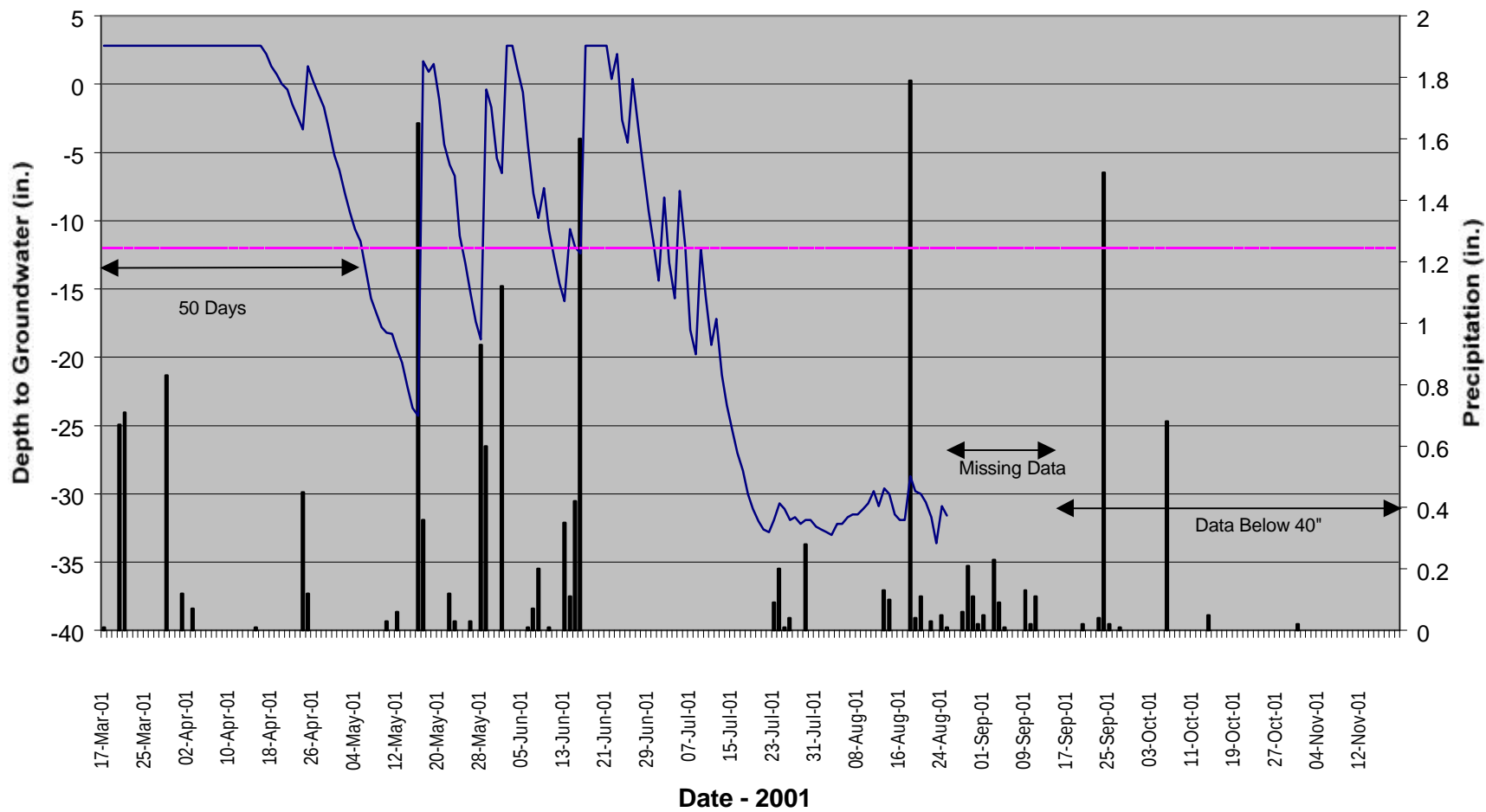
Long Swamp - Gauge G11



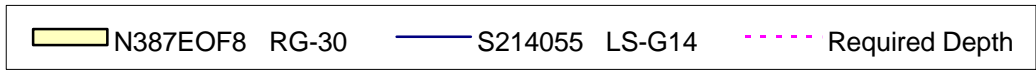
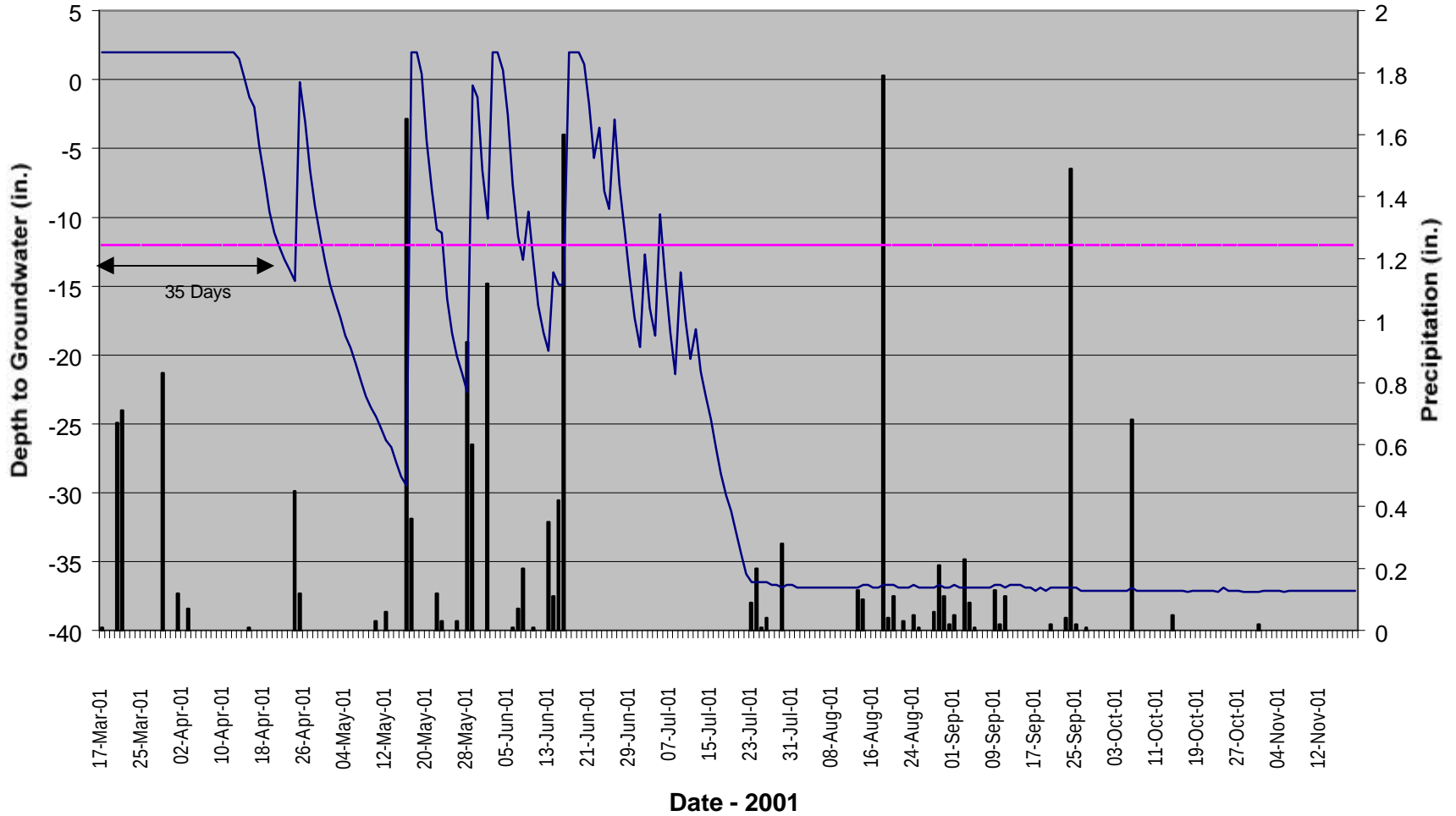
Long Swamp - Gauge G12



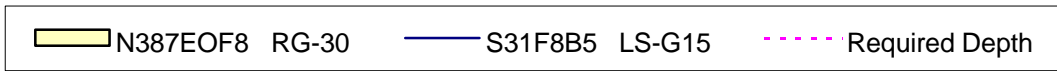
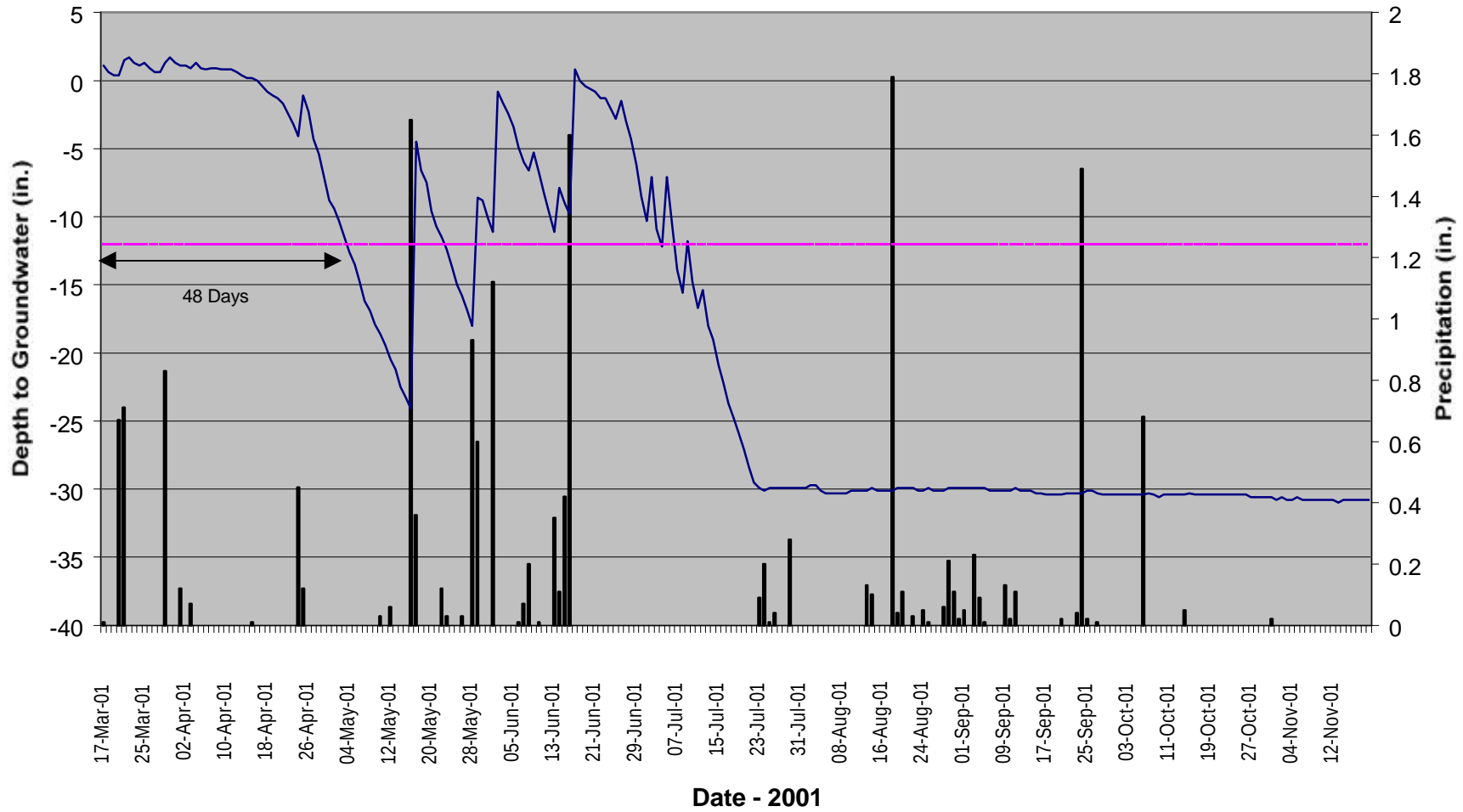
Long Swamp - Gauge G13



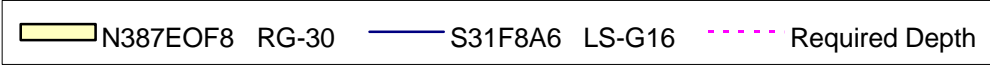
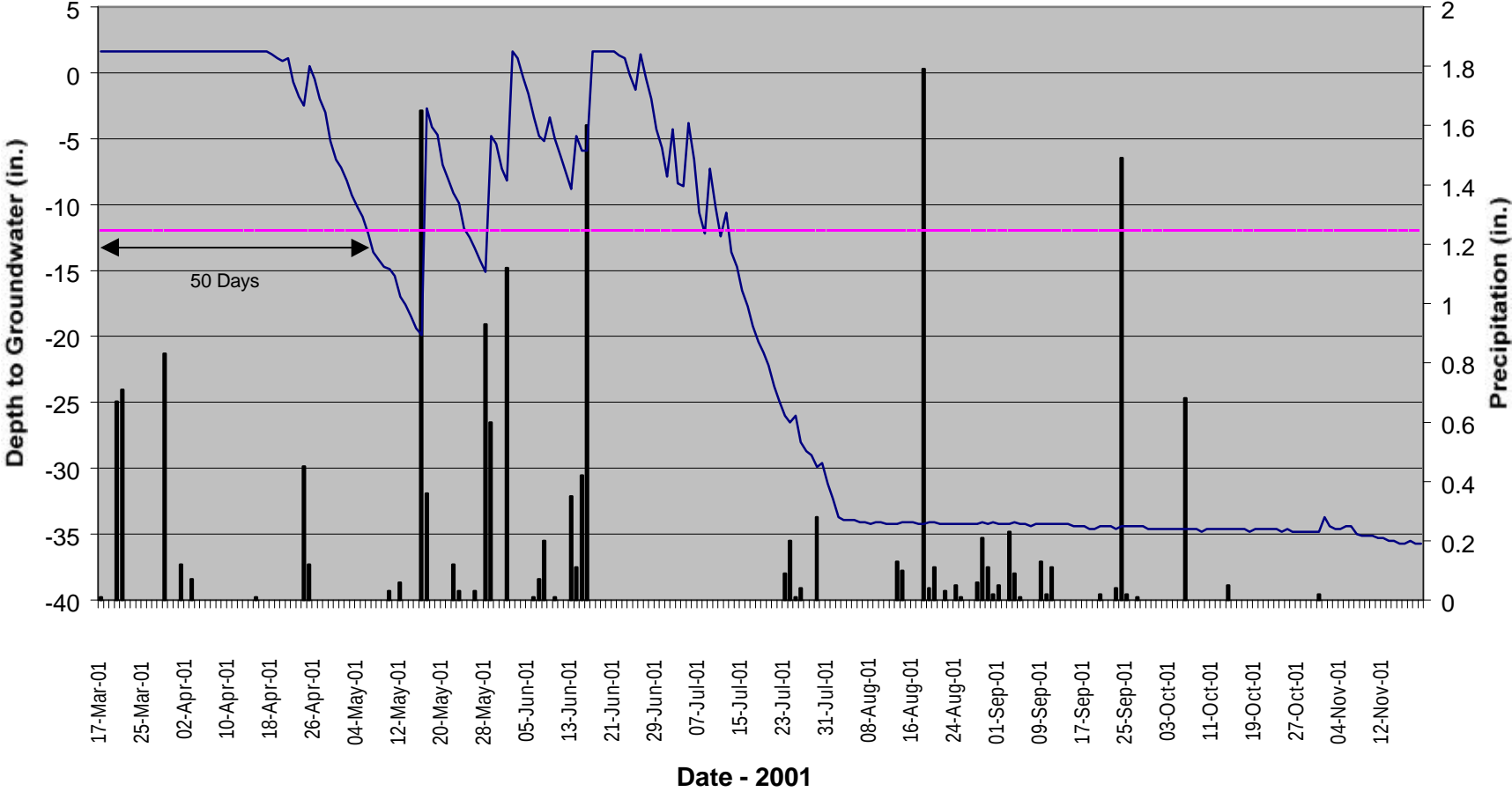
Long Swamp - Gauge G14



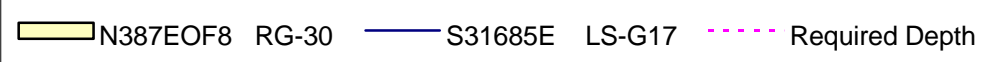
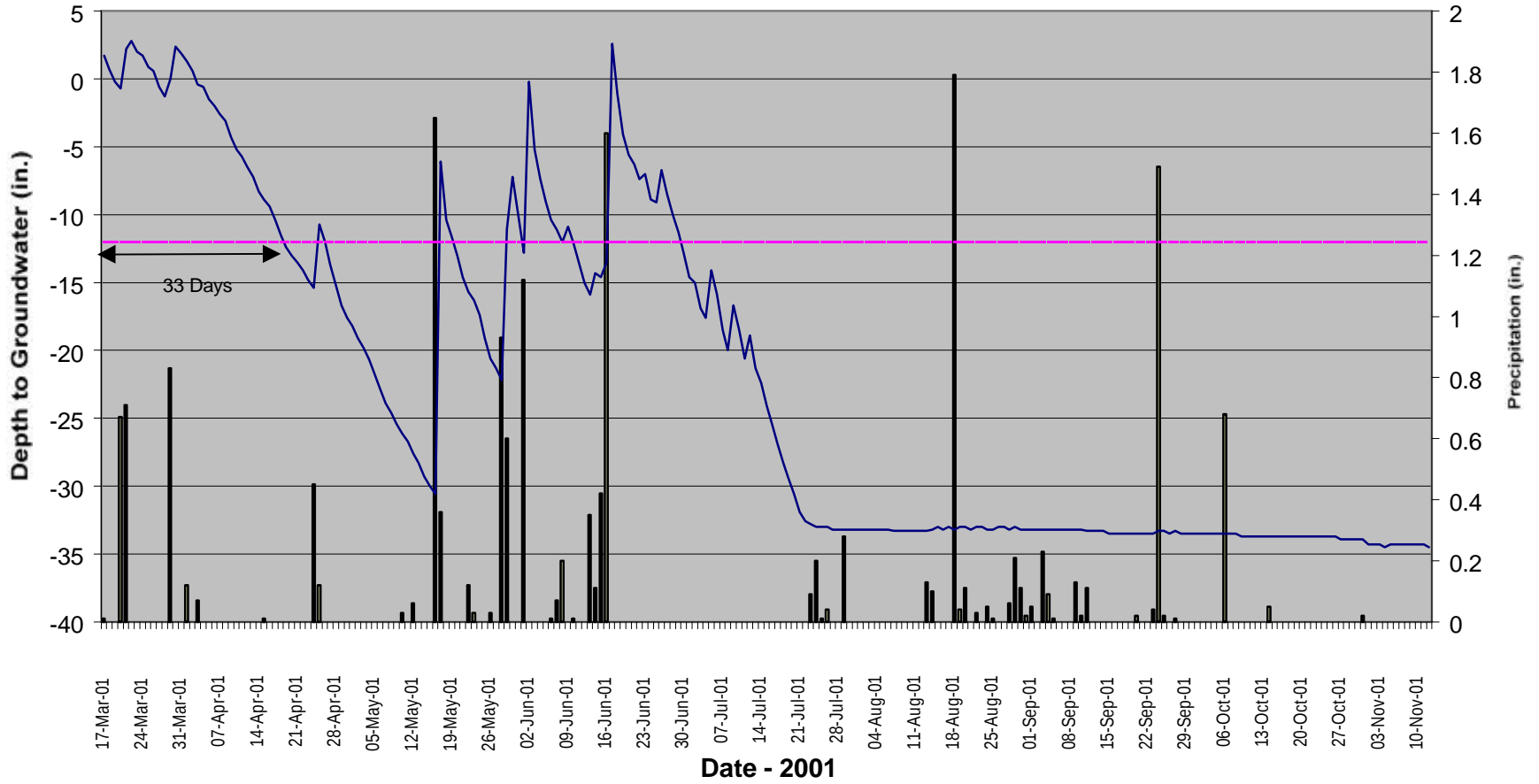
Long Swamp - Gauge G15



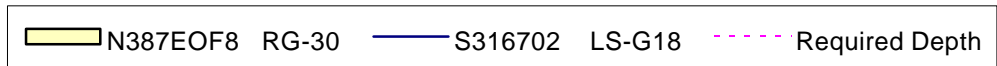
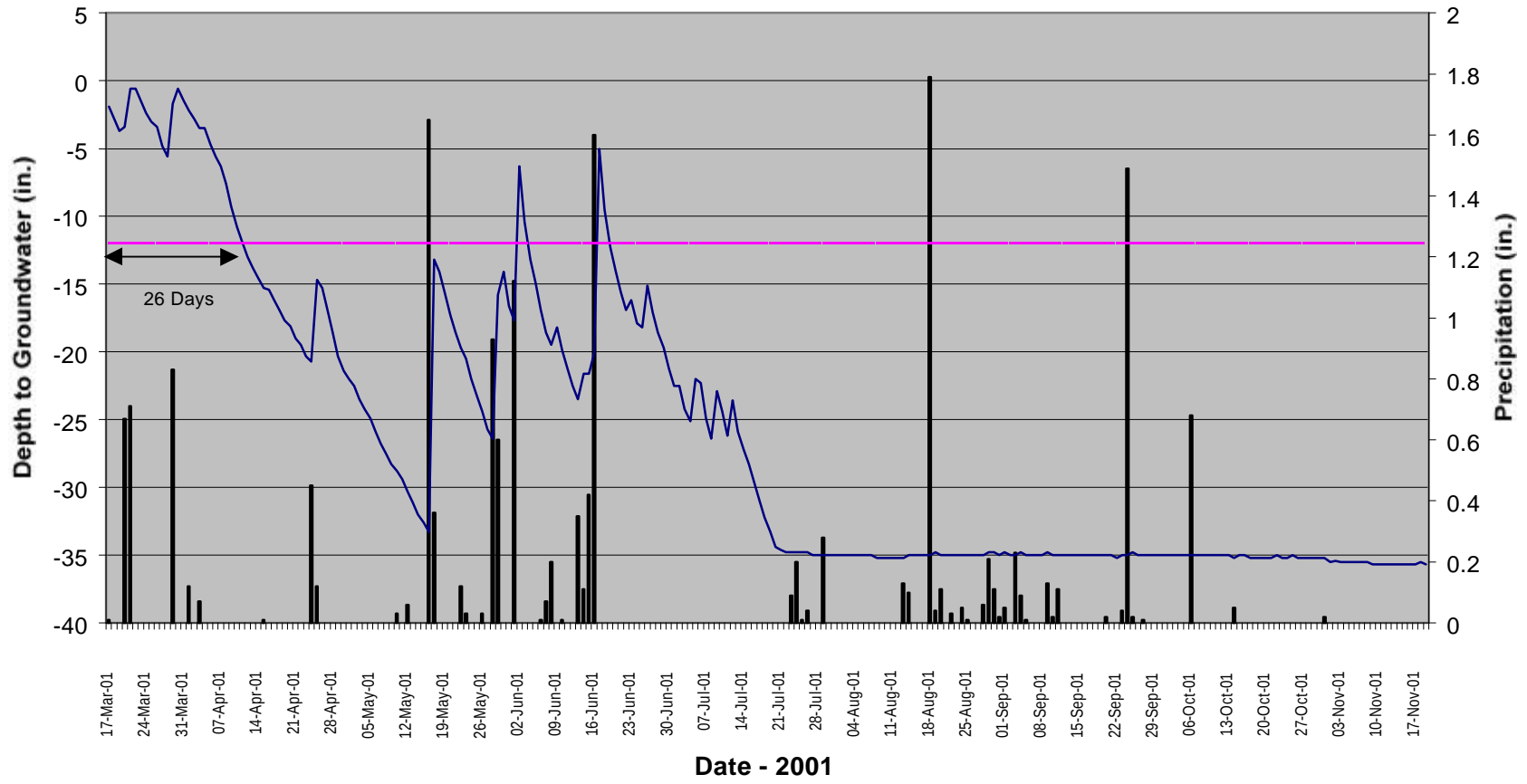
Long Swamp -Gauge G16



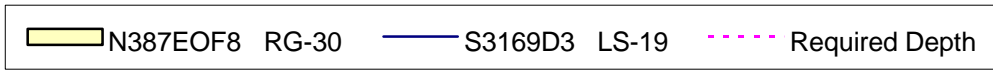
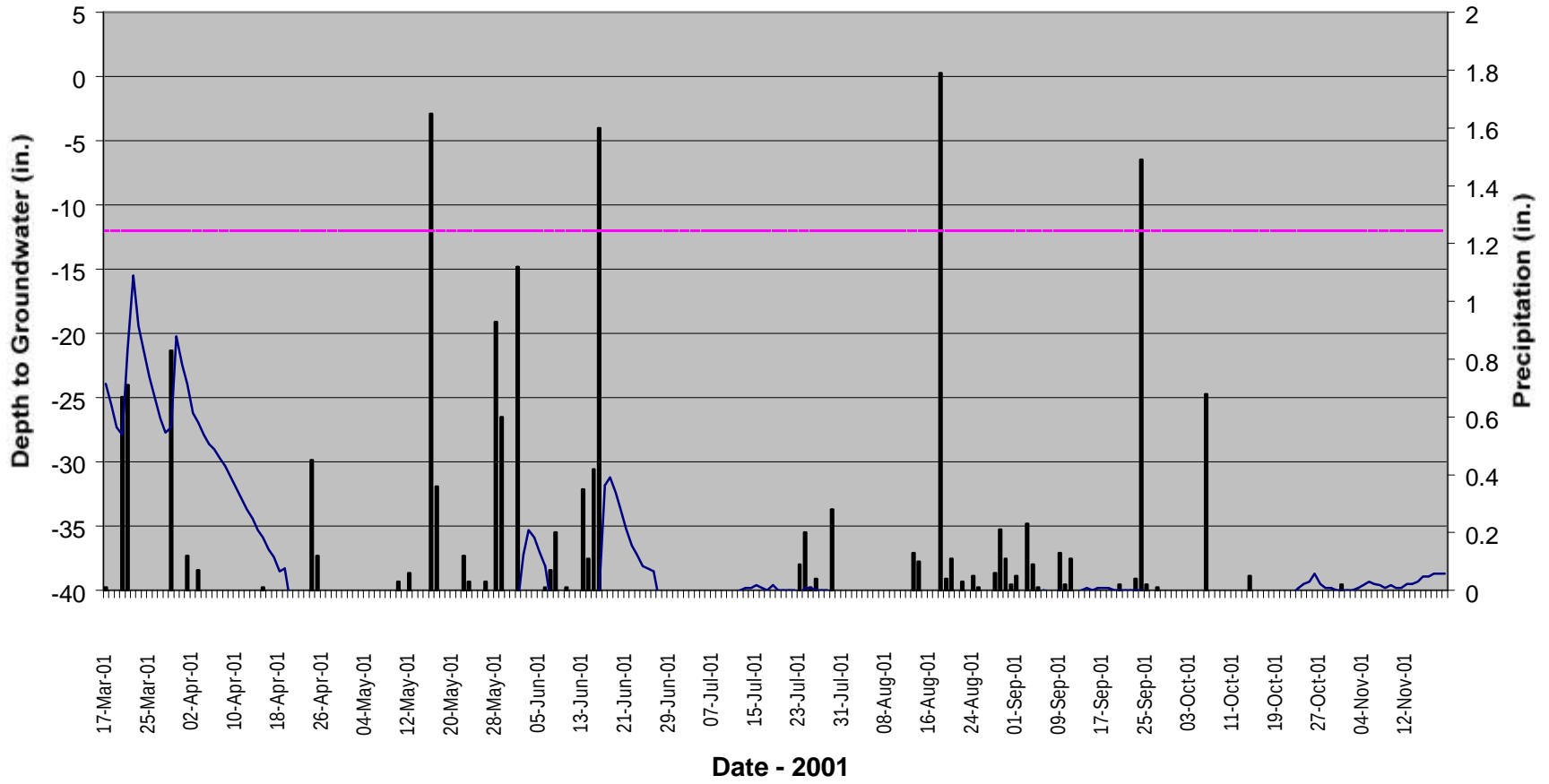
Long Swamp -Gauge G17



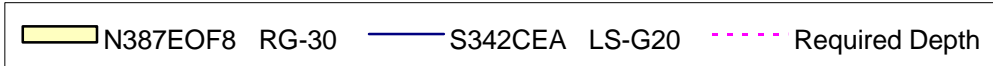
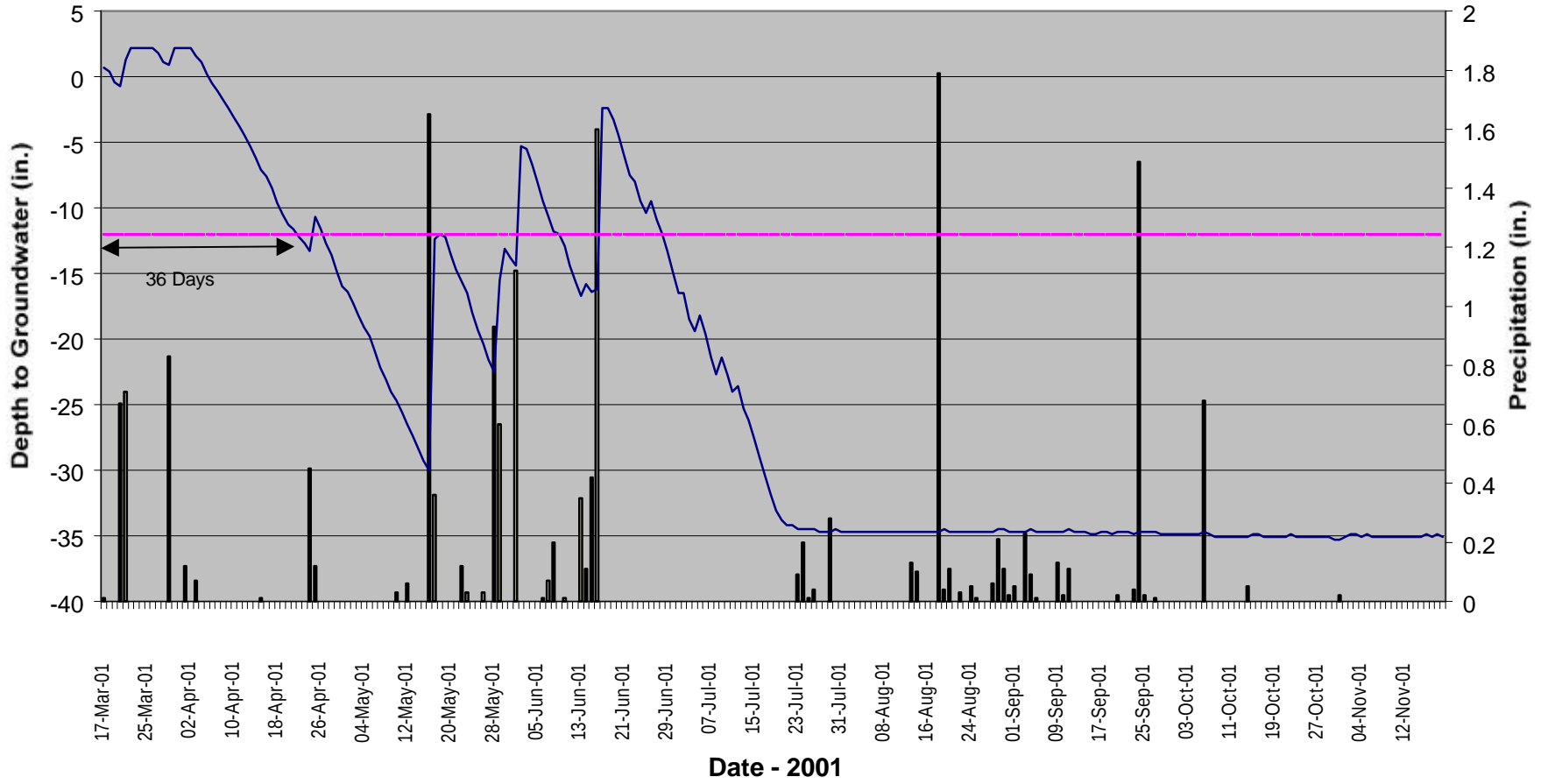
Long Swamp -Gauge G18



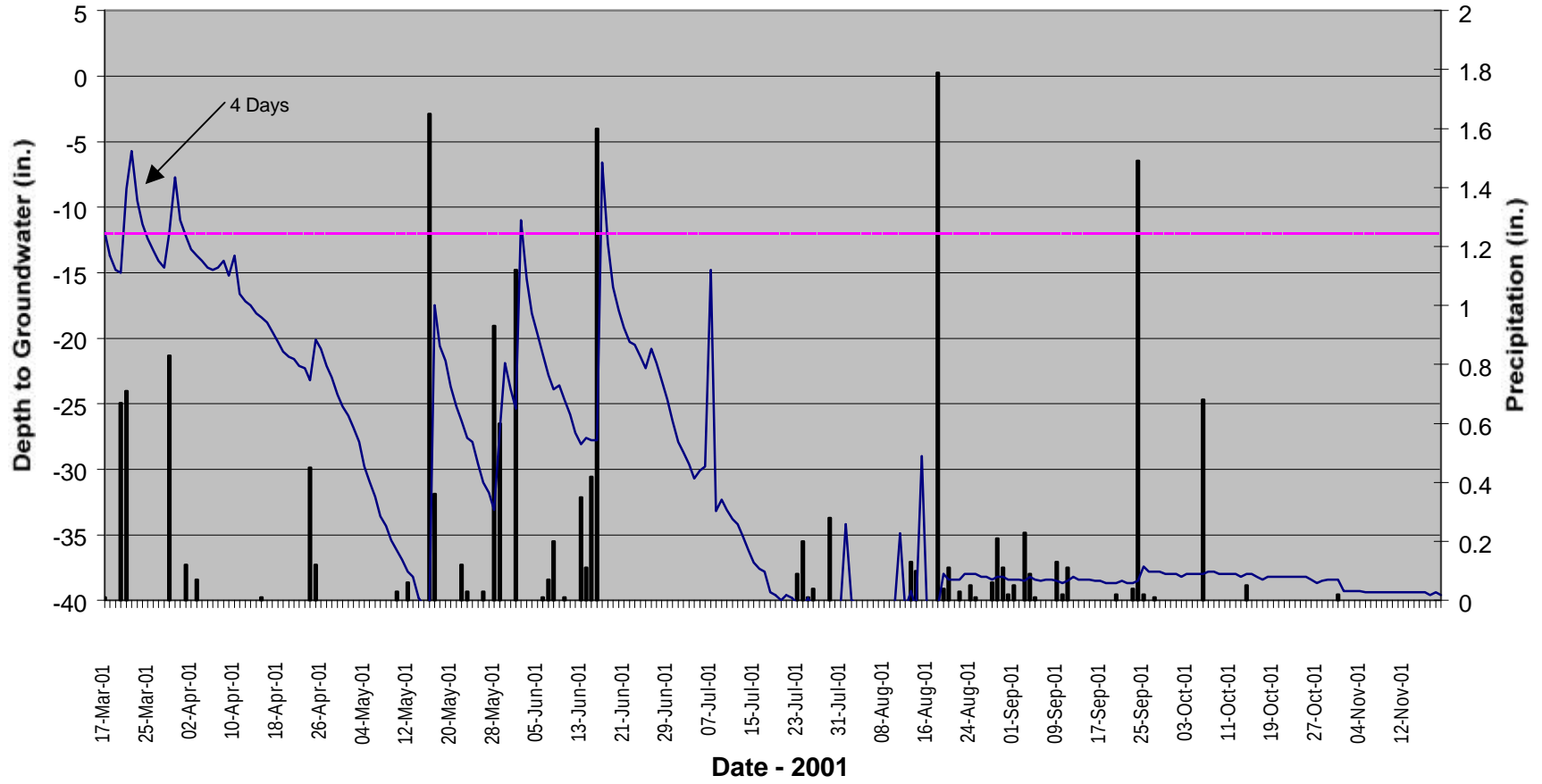
Long Swamp -Gauge G19



Long Swamp -Gauge G20



Long Swamp -Gauge G21



APPENDIX B

PHOTO AND VEGETATION PLOT LOCATIONS, SITE PHOTOS

LONG SWAMP MITIGATION SITE
 PHOTO AND PLOT LOCATIONS
 2001 MONITORING



-  NO PLANTING
-  STREAMHEAD POCOSIN
-  STREAMHEAD ATLANTIC WHITE CEDAR
-  NON RIVERINE WET HARDWOOD FOREST
-  COASTAL PLAIN AND SMALL STREAM SWAMP
-  MIXED MESIC HARDWOODS

-  MONITORING PLOTS
-  PHOTO LOCATIONS

DATE: 10/2001
 DRAWN BY: J. W. HARRIS
 CHECKED BY: J. W. HARRIS
 APPROVED BY: J. W. HARRIS

Scale: 1" = 100'
 0 10 20 30 40 50 60 70 80 90 100
 FEET

DATE: 10/2001
 DRAWN BY: J. W. HARRIS
 CHECKED BY: J. W. HARRIS
 APPROVED BY: J. W. HARRIS

Long Swamp



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6

Long Swamp



Photo 7



Photo 8



Photo 9



Photo 10



Photo 11



Photo 12

Long Swamp



Photo 13



Photo 14