

ANNUAL MONITORING REPORT FOR 2006 CAMP LEJEUNE



**US MARINE CORPS MITIGATION SITE
ONSLow COUNTY, NORTH CAROLINA
TIP No. U-2107 WM
NCDOT Project No. 6.269010T
(EEP Project Number .00013)
2006 Annual Monitoring Report (Year 5 of 5)**



Submitted to:
North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program
Raleigh, North Carolina

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February 2007

EXECUTIVE SUMMARY

The United States Marine Corps (USMC) Camp Lejeune Wetland Mitigation Site (Site) includes approximately 3.5 acres, located approximately 16 miles south of Jacksonville in Onslow County on the Intracoastal Waterway at Camp Lejeune USMC Base. The Site was designed as a salt marsh to provide compensatory mitigation for the US Highway 17 Bypass of Jacksonville, TIP Project U-2107A, B, BA, C, and D (USACE Action ID No. 199402926). The Site was constructed in 1999 with portions of the Site regraded in 2002. This document serves as the 2006 Fifth Year Annual Monitoring Report.

Groundwater hydrology within 12 inches of the soil surface is occurring for greater than 12.5 percent of the growing season for the year 5 (2006) growing season for the mitigation area gauge (GW2) with 76 consecutive days (35.8 percent) of saturation or inundation; however, the reference area groundwater gauge (GW1: Reference) was slightly low with 22 consecutive days (10.4 percent) of saturation or inundation.

Results from available year 5 (2006) growing season data indicate that surfacewater hydrology is successful and that the Site is adequately flooded to support marsh vegetation.

One 50-foot square shrub plot established within the 0.56-acre shrub area, yielded 737 shrub stems per acre for the 2006 (year 5) monitoring year, which is well-above the required success criteria of 320 stems per acre surviving for 3 years.

For the 2006 (year 5) monitoring year, fifty 1-meter square marsh plots yielded a percent frequency of 89.8 percent and an average scale factor of 4.08. A practical approach would be to average the actual percent cover for the plots and apply the scale factor to that final average percent. When that coverage is greater than or equal to 75 percent, the marsh would be deemed successful. The Site has an average percent cover measured for year 5 (2006) of 64.1 percent.

In summary, the restoration site achieved success criteria for hydrology in the Fifth Monitoring Year (2006). In addition, the shrub zone has been successful, and the marsh grass zone continues to approach success. However, the overall aspect of the Site is that of a successful marsh restoration based on available data over the entire 5-year monitoring, Year 5 (2006) Site evaluation, and professional opinion. Site hydrology and vegetation matches that of the Reference Marsh Ecosystem indicating a successful marsh restoration project.

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1.0 PROJECT BACKGROUND

1.1 Project Description

The United States Marine Corps (USMC) Camp Lejeune Wetland Mitigation Site (Site) is located within the United States Geological Survey (USGS) Hydrologic Unit 03030001 (North Carolina Division of Water Quality [NCDWQ] subbasin 03-05-02) of the White Oak River Basin. The Site includes approximately 3.5 acres, located approximately 16 miles south of Jacksonville in Onslow County on the Intracoastal Waterway at Camp Lejeune USMC Base (Figure 1).

Directions to the Site:

From Raleigh:

- Take I-40 East to Exit 373 (NC24/NC903 East)
- Follow NC 24 East to Jacksonville
- Take US 17 South in Jacksonville for approximately 12 miles
- Turn left onto NC 210 for approximately 4 miles
- Turn left onto NC 172 and follow into Camp Lejeune
- Approximately 7 miles past the entry gate turn right onto TLZ Albatross Road (dirt road)
- At the first open field, veer right and cross the field
- Turn left at the end of the field on the dirt road; follow the road around to the midpoint of the south side of the field
- Turn right onto the final dirt road and follow to a gate at the restoration site

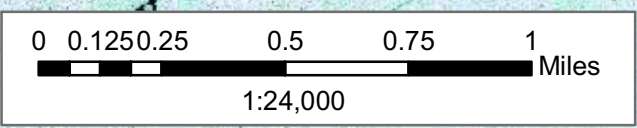
1.2 Purpose

In order to demonstrate successful mitigation, hydrologic and vegetative monitoring must be conducted for five years or until success criteria are achieved. 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 for the 2006 (year 5) growing season at the USMC Mitigation Site.



Site Location

Directions to the Site:
 From Raleigh, North Carolina
 Take Interstate 40 East to exit 373 (NC 24/903 East)
 Follow NC 24 East to Jacksonville
 Take US 17 South in Jacksonville for approximately 12 miles
 Turn left on NC 210 for approximately 4 miles
 Turn left on NC 172 into Camp Lejeune
 Approximately 7 miles past the entry gate to Camp Lejeune turn right onto TLZ Albatross (dirt road)
 At the first open field, veer right and cross field
 Turn left at end of field on dirt road; follow road around to the midpoint of the south side of the field
 Turn right on final dirt road and follow to a locked gate at the restoration site




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SITE LOCATION
CAMP LEJEUNE: USMC MITIGATION SITE
EEP Project Number .00013
2006 Annual Monitoring Year 5 of 5
Onslow County, North Carolina

CLF
 Date:
 January 2007
 Project:
 06-021

FIGURE
1

1.3 Project History

March 1999	Grading Construction
April 1999	Site Planted
May 1999	Monitoring Gauges Installed
May- November 1999	Hydrologic Monitoring (Year 1)
October 1999	Vegetation Monitoring (Year 1)
March-November 2000	Hydrologic Monitoring (Year 2)
August 2000	Vegetation Monitoring (Year 2)
March – November 2001	Hydrologic Monitoring (Year 3)
October 2001	Vegetation Monitoring (Year 3)
April 2002	Site Regraded
May 2002	Site Replanted
August 2002	Vegetation Monitoring (Restart Year 1)
March-November 2002	Hydrologic Monitoring (Restart Year 1)
May 2003	Supplemental Planting
August 2003	Site Treated for Phragmites
August 2003	Vegetation Monitoring (Year 2)
March-November 2003	Hydrologic Monitoring (Year 2)
June 2004	Site Treated for Phragmites
August 2004	Site Visit with Regulatory Agencies
August 2004	Vegetation Monitoring (Year 3)
March-November 2004	Hydrologic Monitoring (Year 3)
September 2005	Vegetation Monitoring (Year 4)
March-November 2005	Hydrologic Monitoring (Year 4)
November 2006	Vegetation Monitoring (Year 5)
March-November 2006	Hydrologic Monitoring (Year 5)

1.4 Permit Related Requirements

The Site was designed as a salt marsh to provide compensatory mitigation for the US Highway 17 Bypass of Jacksonville, TIP Project U-2107A, B, BA, C, and D (USACE Action ID No. 199402926). Special conditions of the permit required that “3.5 acres of *Spartina alterniflora* and *Juncus roemerianus* marsh shall be restored” as described in the Onslow County Marsh Mitigation Plan dated September 1997. The Site was constructed in 1999 with portions of the Site regraded in 2002.

2.0 HYDROLOGY

2.1 Success Criteria

Shrub Area

Success criteria for wetland groundwater hydrology in shrub areas require inundation or saturation within 12 inches of the ground surface for a consecutive period of 12.5 percent of the growing season. The growing season in Onslow County begins April 8 and ends November 5 (212 days). In order to attain hydrologic success in the shrub areas, saturation within 12 inches of the ground surface is required for at least 27 consecutive days (12.5 percent of the growing season).

Marsh Area

Success criteria for surfacewater gauges in the lower marsh areas requires tidal flood, which is defined by the 1997 Mitigation Plan as “the recorded presence of similar water level elevations and flood durations within the mitigation area as compared to the Reference Marsh Ecosystem.”

2.2 Hydrologic Description

Nine gauges were maintained and monitored for the Year 5 (2006) growing season including one rain gauge, 2 groundwater gauges (one reference and one mitigation area gauge), and six surfacewater gauges (two reference gauges, one tidal gauge, and three mitigation area gauges) (Figure 2). Gauges recorded daily readings of groundwater/surfacewater depth. Daily rainfall data recorded from the rain gauge maintained and monitored on the Site was used for seasonal comparison. Graphs of groundwater/surfacewater hydrology and precipitation for Year 5 (2006) are included in Appendix B.

2.3 Results of Hydrologic Monitoring

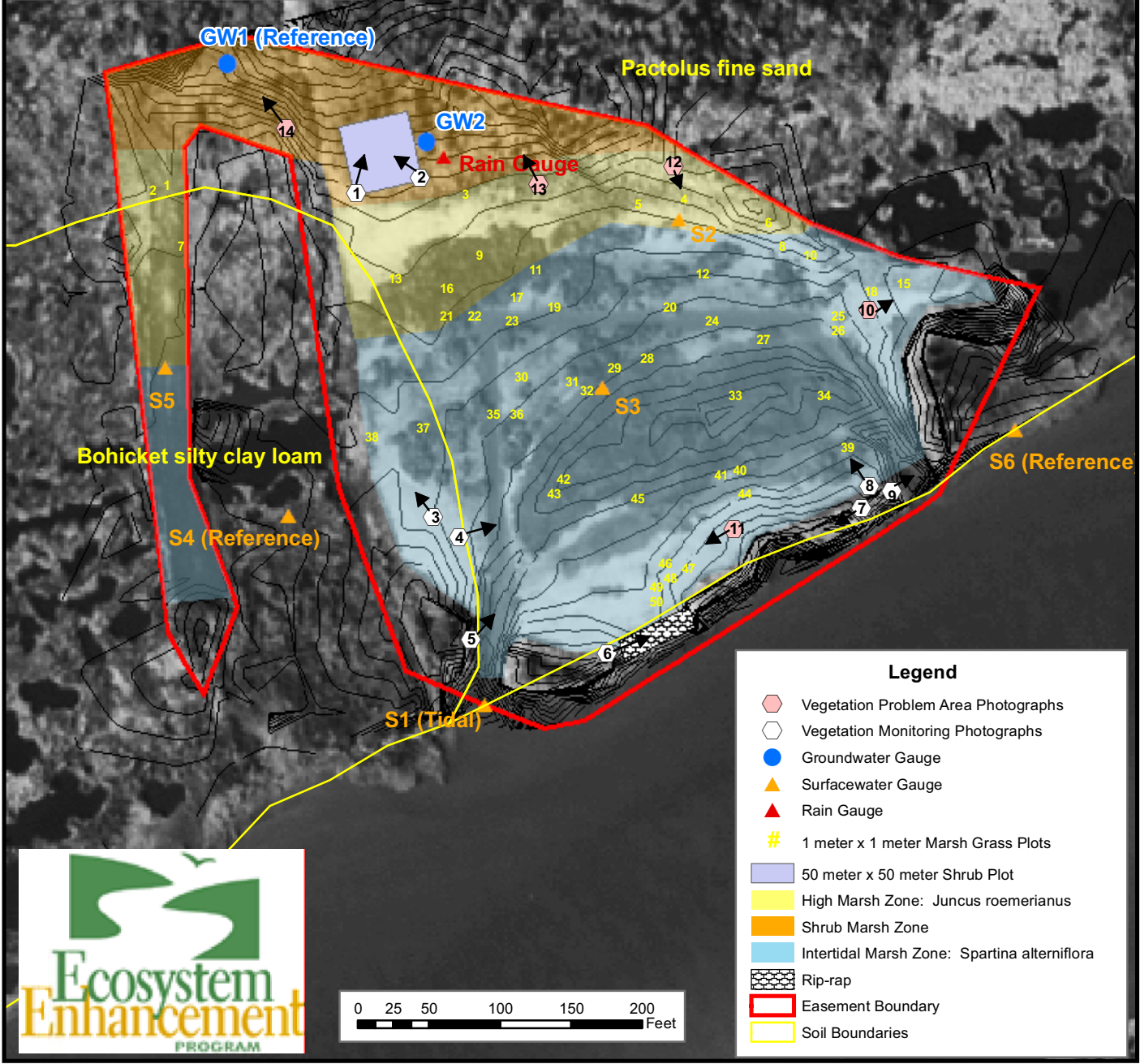
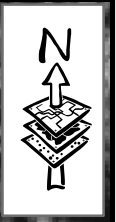
2.3.1 Site Data

The following Table 1 summarizes success criteria achievement for groundwater/surfacewater gauges over the 5-year monitoring period. Groundwater gauge graphs for Year 1 (2002) through year 4 (2005) are included in Appendices C through F.

Groundwater Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)				
	Year 1 (2002)	Year 2 (2003)	Year 3 (2004)	Year 4 (2005)	Year 5 (2006)
GW1 (Reference)	Not reinstalled at time	Yes/50 days (23.6%)	Yes/85 days (40.1%)	Yes/30 days (14.2%)	No/22 days (10.4%)
GW2	Not reinstalled at time	Yes/113 days (53.3%)	Yes/44 days (20.8%)	Yes/121 days (57.1%)	Yes/76 days (35.8%)
Surfacewater Gauge	Success Criteria Achieved/Percentage of Growing Season Inundated				
	Year 1 (2002)	Year 2 (2003)	Year 3 (2004)	Year 4 (2005)	Year 5 (2006)
S1 (Tidal)	Yes (68%)	Yes	Yes	No Data	Yes (75%)
S2	Yes (50%)	Yes	Yes	Yes	Yes (0%)
S3	Yes (82%)	Yes	Yes	Yes	Yes (6.6%)
S4 (Reference)	Not reinstalled at time	Yes	Yes	Yes	Yes (26.9%)
S5	Not reinstalled at time	Yes	Yes	Yes	Yes (74.5%)
S6 (Reference)	Not reinstalled at time	Yes	Yes	Yes	Yes (13.7%)

Groundwater hydrology within 12 inches of the soil surface is occurring for greater than 12.5 percent of the growing season for the year 5 (2006) growing season for the mitigation area gauge (GW2) with 76 consecutive days (35.8 percent) of saturation or inundation; however, the reference area groundwater gauge (GW1: Reference) was slightly low with 22 consecutive days (10.4 percent) of saturation or inundation.

Feature	Latitude	Longitude
GW-1	34.561116302	77.293872864
GW-2	34.560976963	77.293435531
S-1	34.559843150	77.293185852
S-2	34.560764681	77.292814516
S-3	34.560497730	77.293117598
S-4	34.560193230	77.293782745
S-5	34.560550942	77.294033376
S-6	34.560411870	77.292202499
RG	34.560997050	77.293435113
P1	34.561007562	77.293646774
	34.560868732	77.293607809
	34.560897079	77.293446898
	34.561034620	77.293483578



Legend	
	Vegetation Problem Area Photographs
	Vegetation Monitoring Photographs
	Groundwater Gauge
	Surfacewater Gauge
	Rain Gauge
	1 meter x 1 meter Marsh Grass Plots
	50 meter x 50 meter Shrub Plot
	High Marsh Zone: <i>Juncus roemerianus</i>
	Shrub Marsh Zone
	Intertidal Marsh Zone: <i>Spartina alterniflora</i>
	Rip-rap
	Easement Boundary
	Soil Boundaries




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MONITORING PLAN
CAMP LEJEUNE: USMC MITIGATION SITE
EEP Project Number .00013
2006 Annual Monitoring Year 5 of 5
Onslow County, North Carolina

CLF
Date: January 2007
Project: 06-021

FIGURE
2

Results from available year 5 (2006) growing season data indicate that surfacewater hydrology is successful and that the Site is adequately flooded to support marsh vegetation.

2.3.2 Climatic Data

Climatic data for the year 5 (2006) growing season is compared to 30-year historical data from the New Hanover Airport in Wilmington, North Carolina (Figure 3) (NOAA 2004). The Site experienced above normal rainfall for the months of June and November 2006. The remainder of the growing season for year 5 (2006) experienced rainfall totals that fell within the average 30-year historic range.

2.4 Hydrologic Conclusions

Nine gauges were maintained and monitored for the Year 5 (2006) growing season including one rain gauge, 2 groundwater gauges (one reference and one mitigation area gauge), and six surfacewater gauges (two reference gauges, one tidal gauge, and three mitigation area gauges)

The groundwater gauge within the mitigation area (GW2) demonstrated successful hydrologic results, with 76 consecutive days (35.8 percent) of saturation or inundation; however, the reference area groundwater gauge (GW1: Reference) was slightly low with 22 consecutive days (10.4 percent) of saturation or inundation.

Results from all surfacewater gauges indicate that the Site is adequately flooded to support marsh vegetation; which is consistent with success criteria outlined for the marsh restoration area.

3.0 VEGETATION

3.1 Success Criteria

Shrub Area

The shrub area is deemed successful when a minimum mean density of 320 shrubs per acre of approved target species (planted species) survive for at least three years.

Marsh Area

Marsh vegetation success criteria was determined in accordance with NOAA-NMFS guidelines. The assessment involved sampling fifty 1-meter by 1-meter plots and determining a scale factor based on the total number of stems and percent coverage. Monitoring plots found to be located within the open water channel were not evaluated, and did not count in the final count of plots. The vegetation component of the wetland site is deemed successful if the following criteria are met:

1. At year 5, the average of all plots should have a scale value of 5 (75 percent vegetative cover) consisting of wetland herbaceous species, not including any invasive species.
2. A minimum of 70 percent of the plots shall contain the target (planted) species.

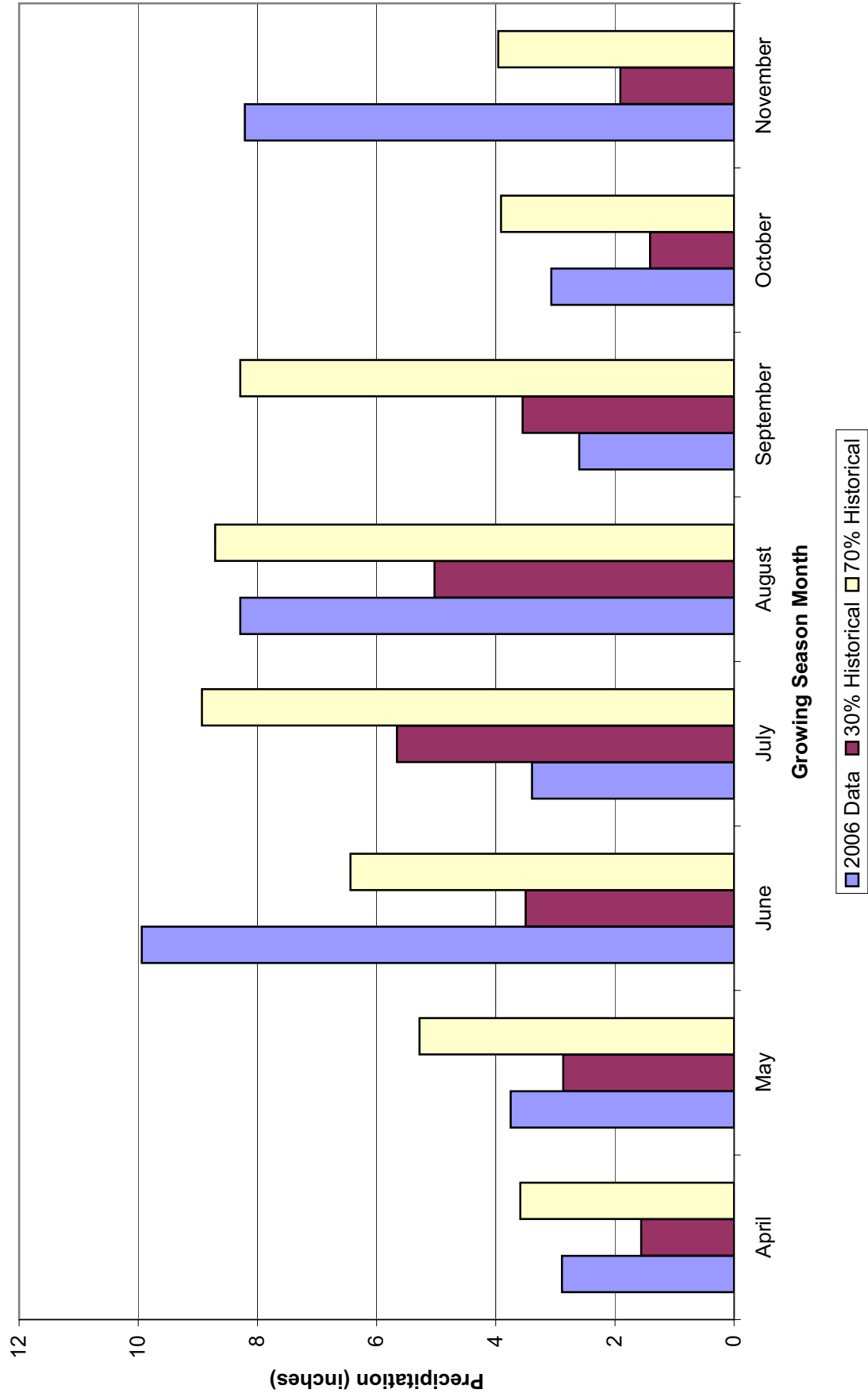
3.2 Description of Planted Areas

Shrub Area

The shrub area consists of 0.56 acre of the 3.5-acre restoration area. Three types of shrubs were planted within the 0.56-acre shrub area:

1. wax myrtle (*Morella* [= *Myrica*] *cerifera*),
2. false willow (*Baccharis halimifolia*), and
3. marsh elder (*Iva frutescens*).

Figure 3. 2006 Climatic Data vs. 30-year Historic Data



Marsh Area

The marsh grass area consisted of two zones:

- Zone 1. Approximately 0.7 acre of black needle rush (*Juncus roemerianus*) and
- Zone 2. Approximately 2.23 acres of smooth cordgrass (*Spartina alterniflora*).

3.3 Results of Vegetation Monitoring

The following Tables 2 and 3 summarize planted stem counts for shrub and marsh areas of the Site for the year 5 (2006) growing season.

Table 2. Year 5 (2006) Stem Counts (Shrub Area)							
Camp Lejeune Wetland Restoration (EEP Project Number .00013)							
Plot #	Year	Wax Myrtle	False Willow	Marsh Elder	2006 Total Planted Stems in Plot	2001 Total Planted in Plot	2006 Density (Planted Shrubs Stems/Acre)
1	Year 5 (2006)	24	17	1	42	51	737

Table 3. Stem Counts (Marsh Area)						
Camp Lejeune Wetland Restoration (EEP Project Number .00013)						
Plot	Scale Factor	% Cover	<i>Juncus roemerianus</i> Present	<i>Spartina alterniflora</i> Present	Frequency	Notes
1	4	70		X	1	<i>Aster, Phragmites, Distichlis</i>
2	4	70				<i>Juncus effuses, Distichlis, Salicornia, Triglochin, Phragmites,</i>
3	5	95	X		1	<i>Baccharis, Solidago, Chenopodium</i>
4	5	100	X		1	<i>Distichlis</i>
5	5	95		X	1	
6	4	66	X	X	2	<i>Distichlis, Aster tenuifolius</i>
7	5	90	X		1	<i>Distichlis, Aster tenuifolius</i>
8	5	75	X	X	2	<i>Distichlis</i>
9	4	70		X	1	<i>Salicornia</i>
10	5	75	X	X	2	<i>Distichlis, Aster tenuifolius</i>
11	5	90		X	1	
12	4	50		X	1	
13	5	80		X	1	<i>Salicornia</i>
14	5	82				<i>Distichlis, Aster tenuifolius, Borrchia</i>
15	5	76		X	1	<i>Distichlis, Aster tenuifolius, Salicornia</i>
16	5	80		X	1	
17	5	90		X	1	
18	2	21		X	1	<i>Salicornia, 79% bare ground</i>
19	5	80		X	1	
20	5	80		X	1	
21	5	90		X	1	

Plot	Scale Factor	% Cover	<i>Juncus roemerianus</i> Present	<i>Spartina alterniflora</i> Present	Frequency	Notes
22	5	90		X	1	
23	2	20		X	1	80% open water
24	3	30		X	1	70% open water
25	4	51		X	1	<i>Salicornia</i>
26	4	51		X	1	<i>Salicornia</i>
27	4	70		X	1	<i>Salicornia</i>
28	2	11		X	1	<i>Salicornia</i> , 89% bare ground
29	5	80		X	1	
30	4	65		X	1	
31	4	65		X	1	
32	4	70		X	1	<i>Salicornia</i>
33	5	80		X	1	
34	5	80		X	1	
35	4	50		X	1	
36	4	60		X	1	
37	4	70		X	1	
38	5	80		X	1	<i>Salicornia</i>
39	5	80		X	1	
40	5	80		X	1	
41	4	50		X	1	
42	4	50		X	1	<i>Salicornia</i>
43	4	60		X	1	
44	2	30		X	1	<i>Distichlis</i> , <i>Salicornia</i> , 70% bare ground
45	5	80		X	1	
46	-	-	-	-	-	Data lost: most likely bare ground
47	3	30				<i>Distichlis</i> , <i>Salicornia</i> , 70% bare ground
48	0	-				Bare ground
49	0	-				Bare ground
50	3	35		X	1	<i>Distichlis</i> , <i>Salicornia</i>
49	200	3143	6	41	44	TOTALS
Total Number of Plots Counted					49	
Scale Factor Average					4.08	
Percent Cover Average					64.1	
Ave Scale Factor based on % Cover					4.0	
Percent Frequency of Target Species					89.8	

3.4 Conclusions

Shrub Area

One 50-foot by 50-foot (2500 square feet or 0.057-acre) plot was installed following Site planting within the 0.56-acre shrub area of the Site. The shrub density is well-above the success criteria of 320 shrubs per acre with 737 planted shrubs stems per acre for year 5 (2006) monitoring, and has met success criteria for 5 years. The number of wax myrtle and false willow counted within the plot continued to increase due to natural recruitment, while marsh elder continued to decline. Approximately 124 additional volunteer stems of false willow, two wax myrtle, and eight pines (*Pinus* sp.) were counted for year 5 (2006), in

addition to various herbs. The shrub area is anticipated to continue to meet the success criteria beyond the monitoring period.

Marsh Area

Fifty 1-meter by 1-meter plots were installed within the marsh area of the Site, which consists of approximately 0.7 acres of black needle rush (*Juncus roemerianus*) and 2.23 acres of smooth cordgrass (*Spartina alterniflora*).

Using the same methodology from previous monitoring reports, the average scale factor for 49 measured plots was 4.08. A practical approach would be to average the actual percent cover for the plots and apply the scale factor to that final average percent. When that coverage is greater than or equal to 75 percent then the marsh would be deemed successful. Using the average percent cover measured for year 5 (2006), which was 64.1 percent, the marsh has a scale factor of 4.0.

The percentage of plots containing the two target species [black needle rush (*Juncus roemerianus*) or smooth cordgrass (*Spartina alterniflora*)] was 89.8 percent for year 5 (2006) monitoring, which is well-above the success criteria of 70 percent.

The overall aspect of the marsh area is that it is doing well; however, the planted zone of black needle rush (*Juncus roemerianus*) is dominated by smooth cordgrass (*Spartina alterniflora*), pockets of open water, and brackish species. The planted zone of smooth cordgrass (*Spartina alterniflora*) has grown well and is consistent with that of a natural marsh although some bare spots persist. Rhizomes of marsh plants are slowly colonizing these areas as can be seen in the following photographs.



4.0 FIVE-YEAR MONITORING ASSESSMENT

Success has continued for each of the five monitoring years in the shrub area with 737 planted shrub stems per acre tabulated in year 5 (2006), which is well-above the 320 stems per acre success criteria required for three years. The shrub area has met defined success criteria for the entire monitoring period and is anticipated to continue to meet the success criteria beyond the monitoring period. The following Table 4 shows trends for the shrub plot over the five-year monitoring period.

Table 4. Vegetation Trends (Shrub Area Planted Stems)**Camp Lejeune Wetland Restoration (EEP Project Number .00013)**

Monitoring Year	Firm	Total Planted Shrub Stems in Plot	Planted Shrubs Stems/Acre	Success Criteria Met
Year 0 (2001)	NCDOT	51	895	Yes
Year 1 (2002)	NCDOT	48	842	Yes
Year 2 (2003)	NCDOT	48	842	Yes
Year 3 (2004)	NCDOT	42	737	Yes
Year 4 (2005)	BLWI	39	684	Yes
Year 5 (2006)	AXE	42	737	Yes

The percentage of marsh grass plots containing the target species was 89.8 percent for year 5 (2006) monitoring, which is well-above the success criteria of 70 percent. Black needle rush (*Juncus roemerianus*) was only present in approximately 15 percent of its total planted area; other salt marsh species have colonized most of this zone. Using the average percent cover measured for year 5 (2006), which was 64.1 percent, the marsh grass area has a scale factor of 4.0. The bare spots are slowly being colonized, and it is likely that the marsh will reach success criteria based on the percent cover within the next few years. The marsh grass area continues to elude the defined success criteria, but continues to approach that limit. The following Table 5 shows trends for the marsh plots over the five-year monitoring period.

Table 5. Vegetation Trends (Marsh Area)**Camp Lejeune Wetland Restoration (EEP Project Number .00013)**

Monitoring Year	Firm	Average Scale Factor	Scale Factor Success Criteria Met	Percentage of Plots containing Target Species	Target Species Success Criteria Met
Year 1 (2002)	NCDOT	3.16	No	67.3	No
Year 2 (2003)	NCDOT	3.45	No	68.4	No
Year 3 (2004)	NCDOT	4.12	No	76.2	Yes
Year 4 (2005)	BLWI	3.35*	No	89.8	Yes
Year 5 (2006)	AXE	4.08*	No	89.8	Yes

* - This number is the average of scale factors for all plots and is used to compare with previous data. Using the average percent cover yields a scale factor of 4.0

Groundwater hydrology within 12 inches of the soil surface is occurring for greater than 12.5 percent of the growing season for the year 5 (2006) growing season for the mitigation area gauge (GW2) with 76 consecutive days (35.8 percent) of saturation or inundation; however, the reference area groundwater gauge (GW1: Reference) was slightly low with 22 consecutive days (10.4 percent) of saturation or inundation.

Results from all surfacewater gauges indicate that the Site is adequately flooded to support marsh vegetation, which is consistent with success criteria outlined for the marsh restoration area.

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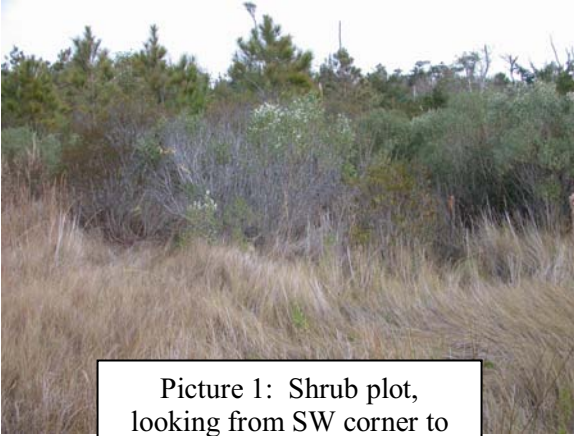
In summary, the restoration site achieved success criteria for hydrology in the Fifth Monitoring Year (2006). In addition, the shrub zone has been successful, and the marsh grass zone continues to approach success. However, the overall aspect of the Site is that of a successful marsh restoration based on available data over the entire 5-year monitoring, year 5 (2006) Site evaluation, and professional opinion. Site hydrology and vegetation matches that of the Reference Marsh Ecosystem indicating a successful marsh restoration project.

5.0. REFERENCES

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APPENDIX A
VEGETATION MONITORING PHOTOGRAPHS

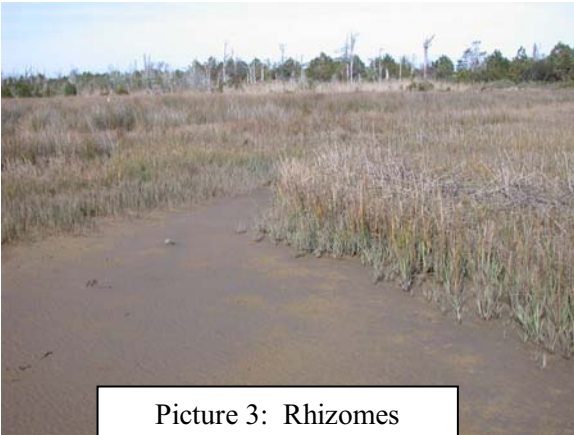
Appendix A
Vegetation Monitoring Photographs
Taken November 2006



Picture 1: Shrub plot,
looking from SW corner to
NE corner



Picture 2: Shrub plot, looking
from plot origin to NW corner



Picture 3: Rhizomes
spreading into bare area



Picture 4



Picture 5



Picture 6: Rip-rap area

Appendix A
Vegetation Monitoring Photographs
Taken November 2006 (continued)



Picture 7



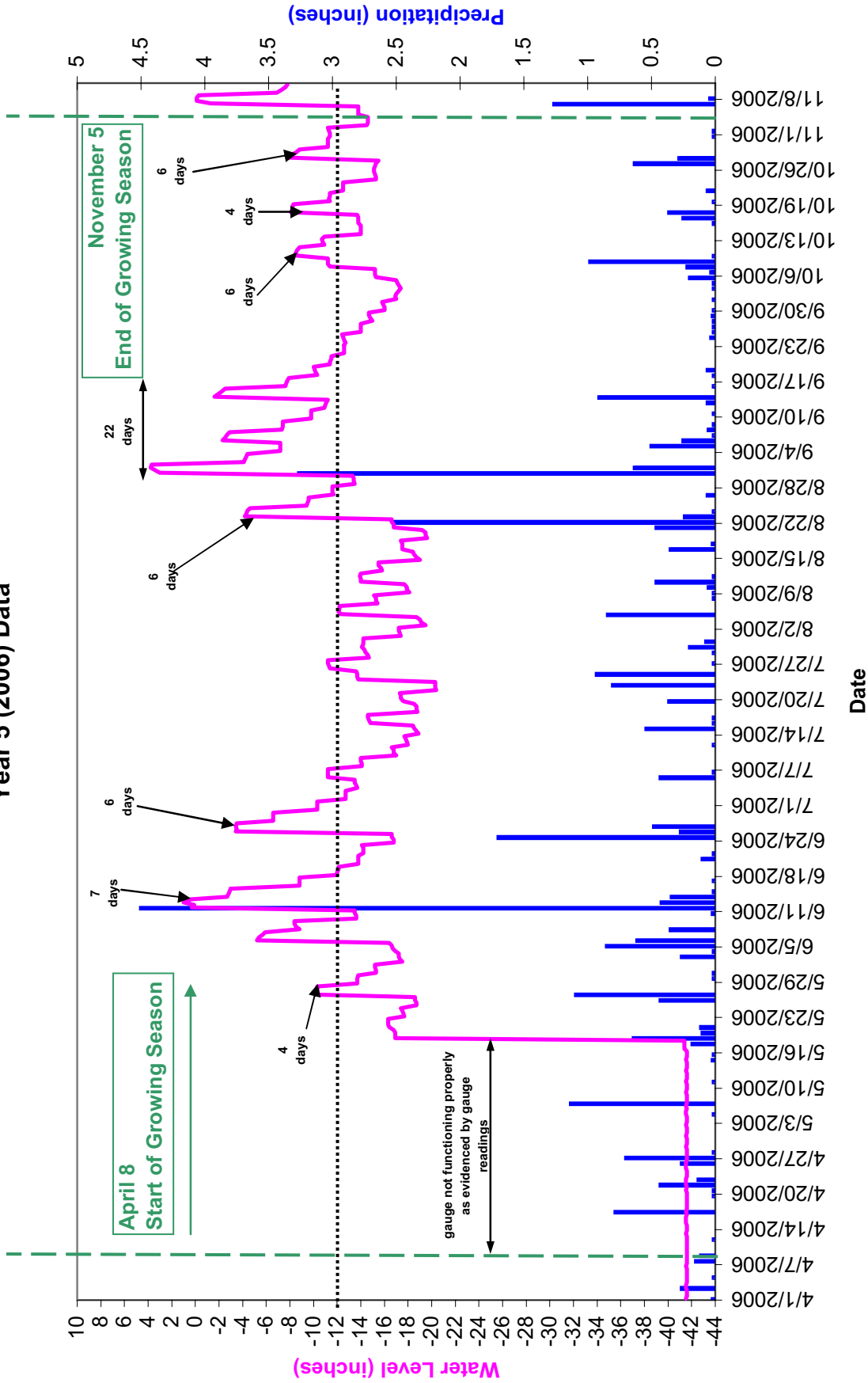
Picture 8: Looking across marsh



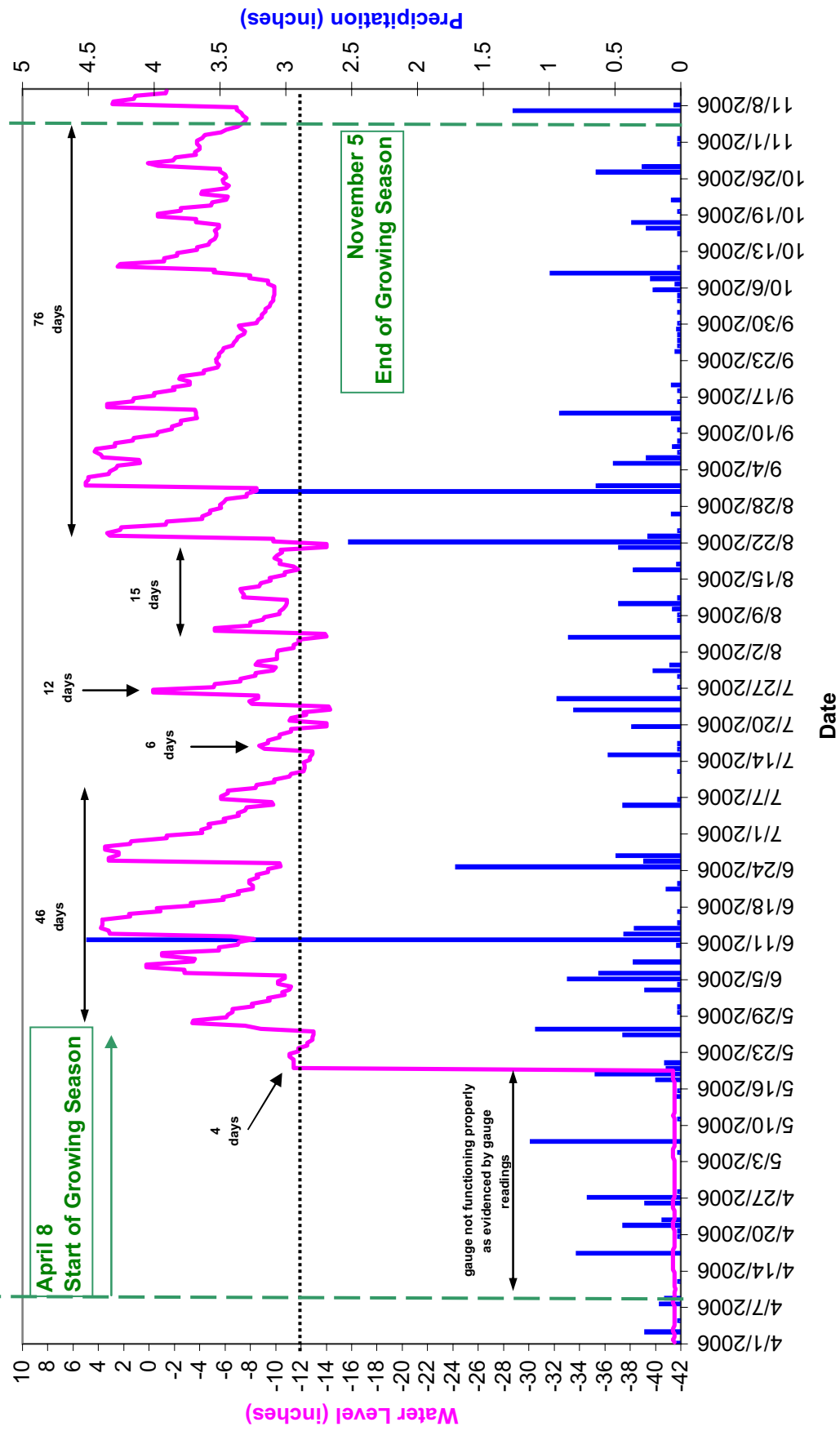
Picture 9

APPENDIX B
YEAR 5 (2006) GROUNDWATER/SURFACEWATER GAUGE GRAPHS

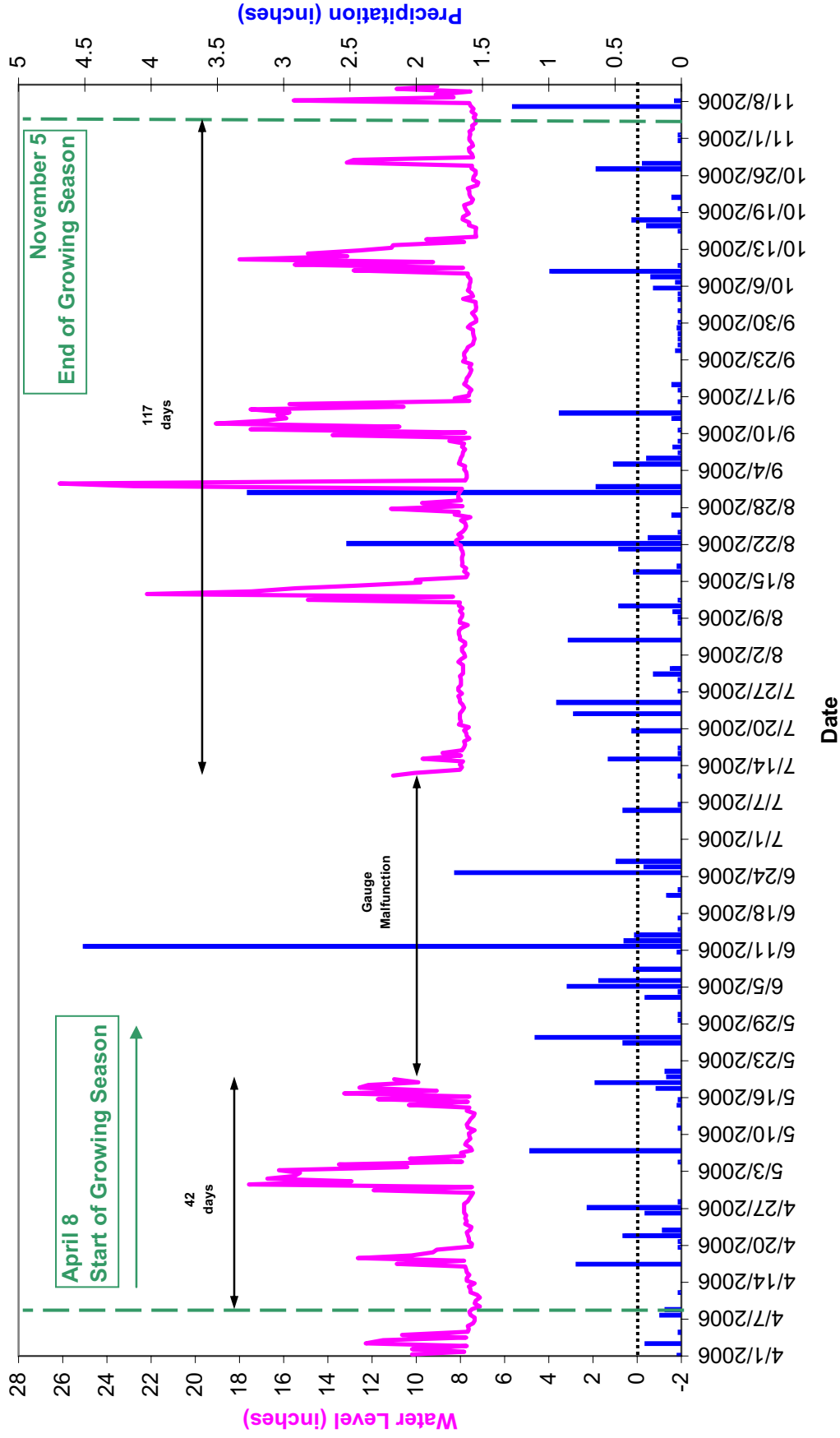
Camp Lejeune Groundwater Gauge 1 (Reference) Year 5 (2006) Data



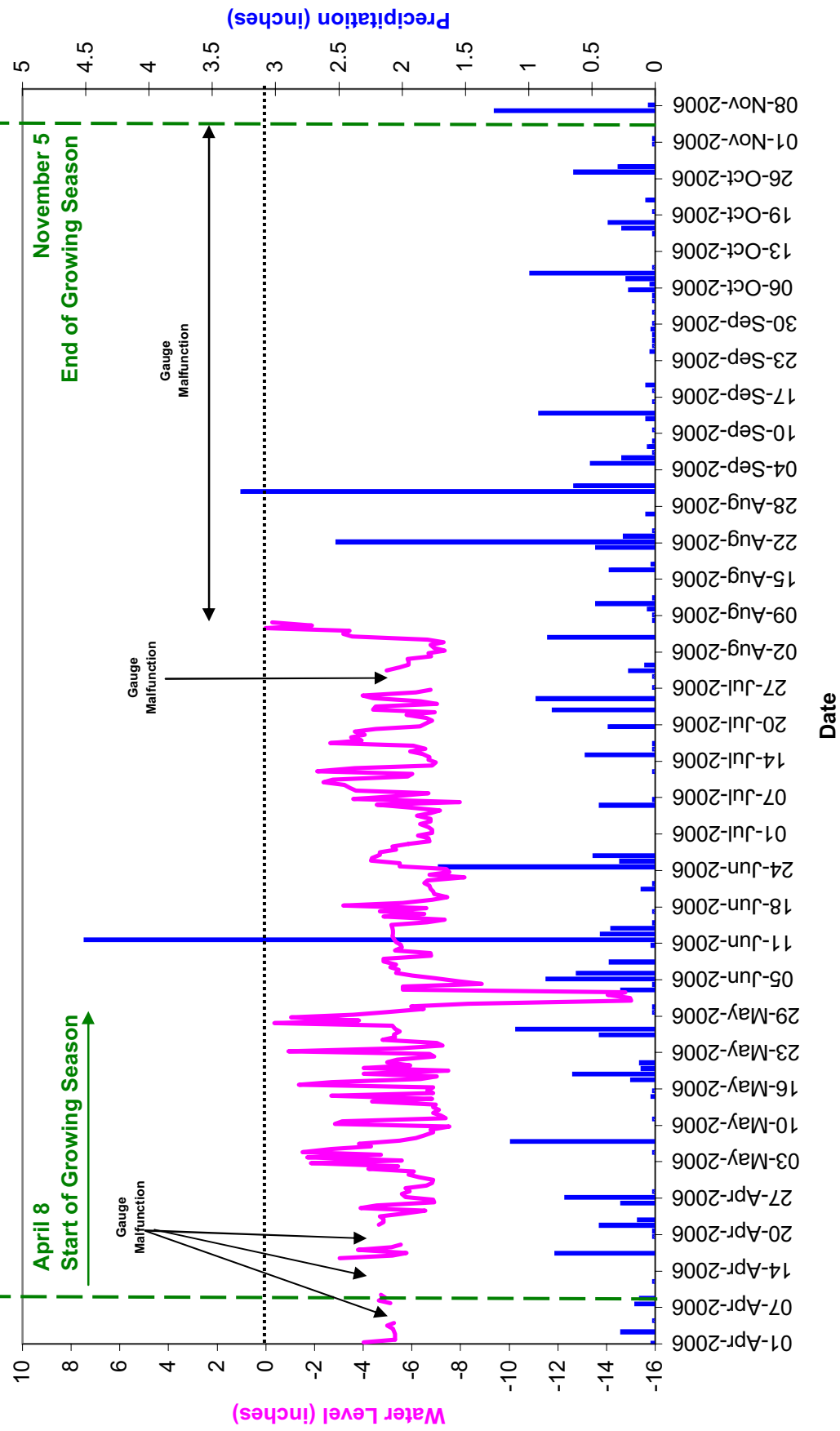
Camp Lejeune Groundwater Gauge 2 Year 5 (2006) Data



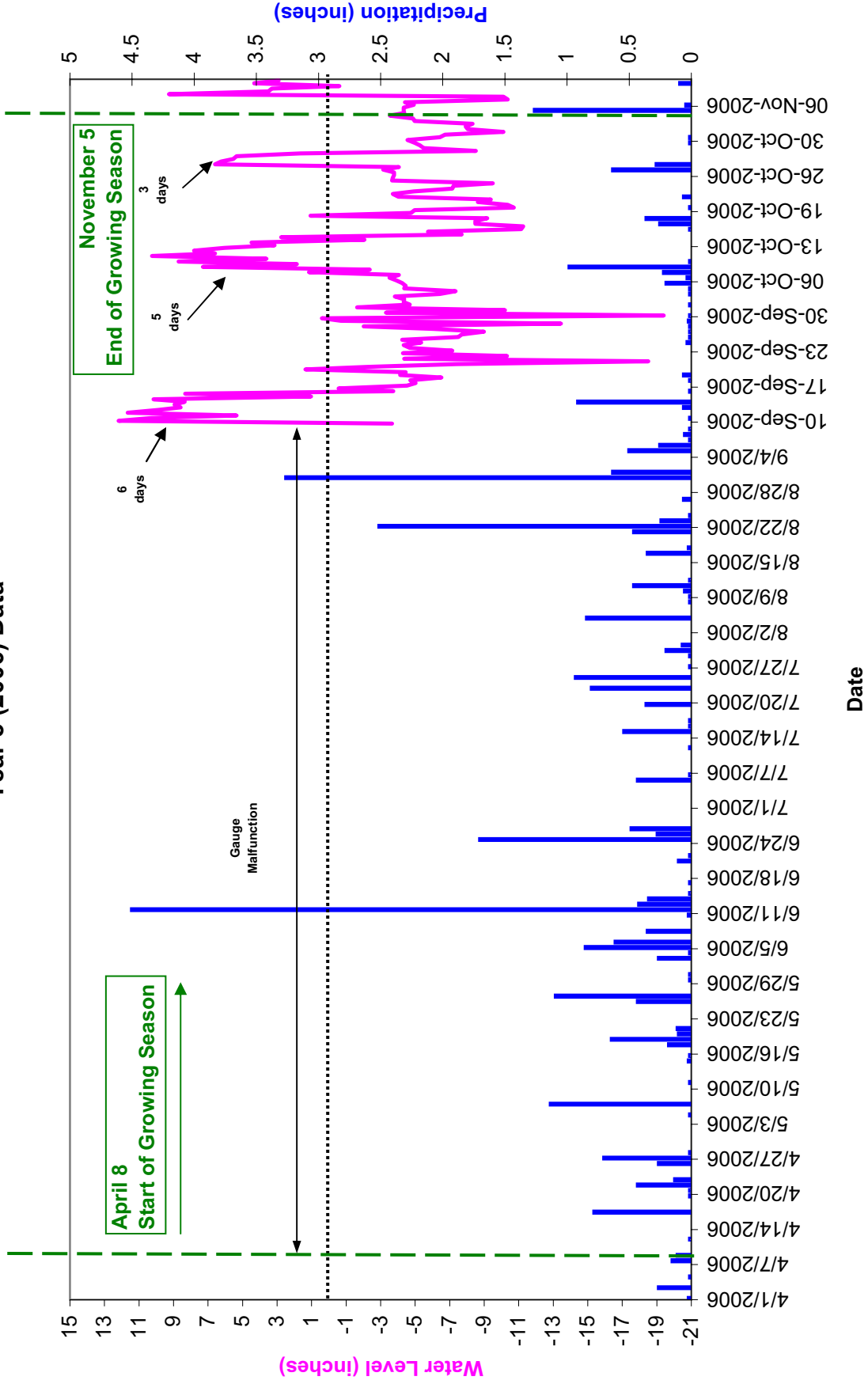
Camp Lejeune Surfacewater Gauge 1 (Tidal) Year 5 (2006) Data



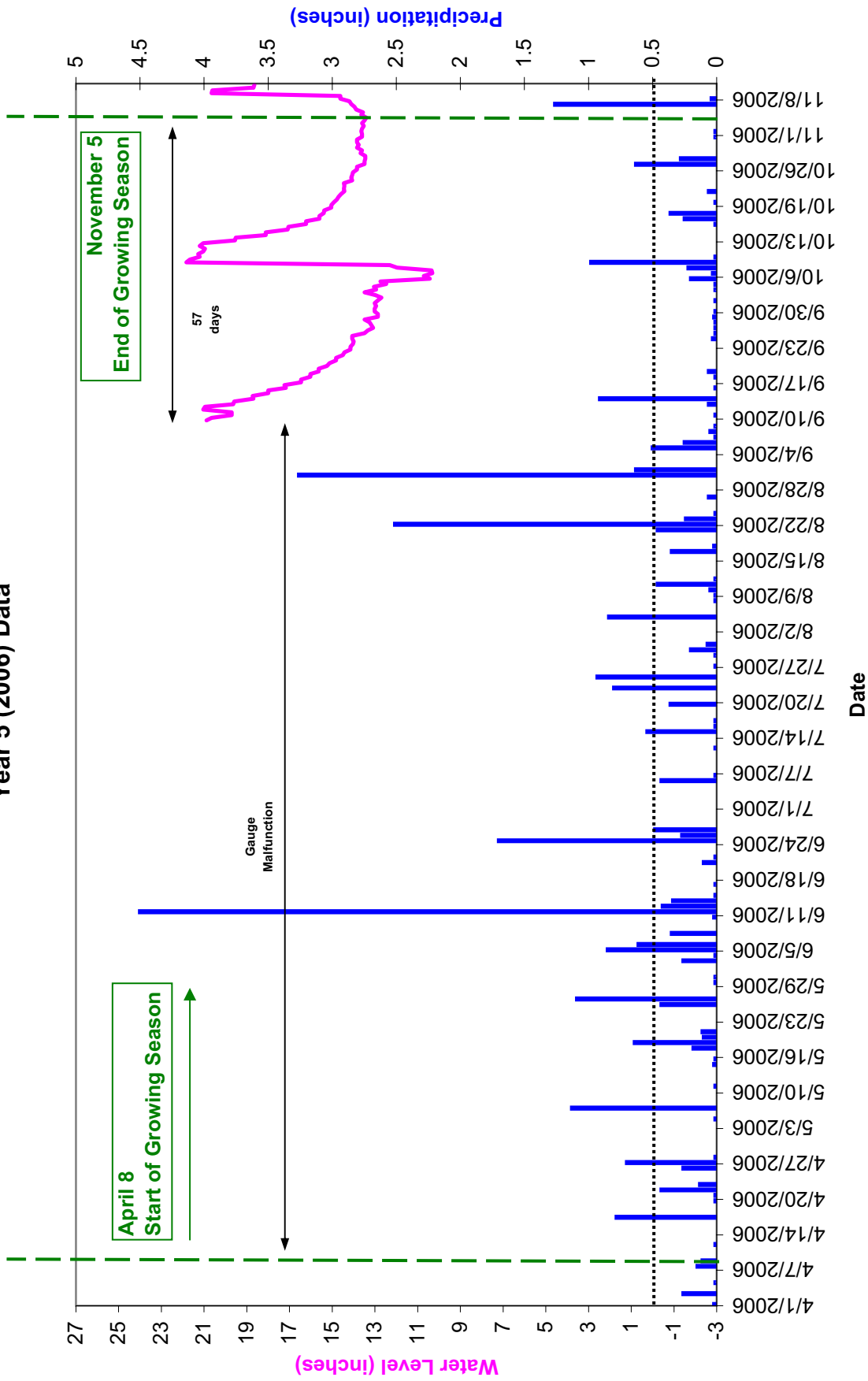
Camp Lejeune Surfacewater Gauge 2 Year 5 (2006) Data



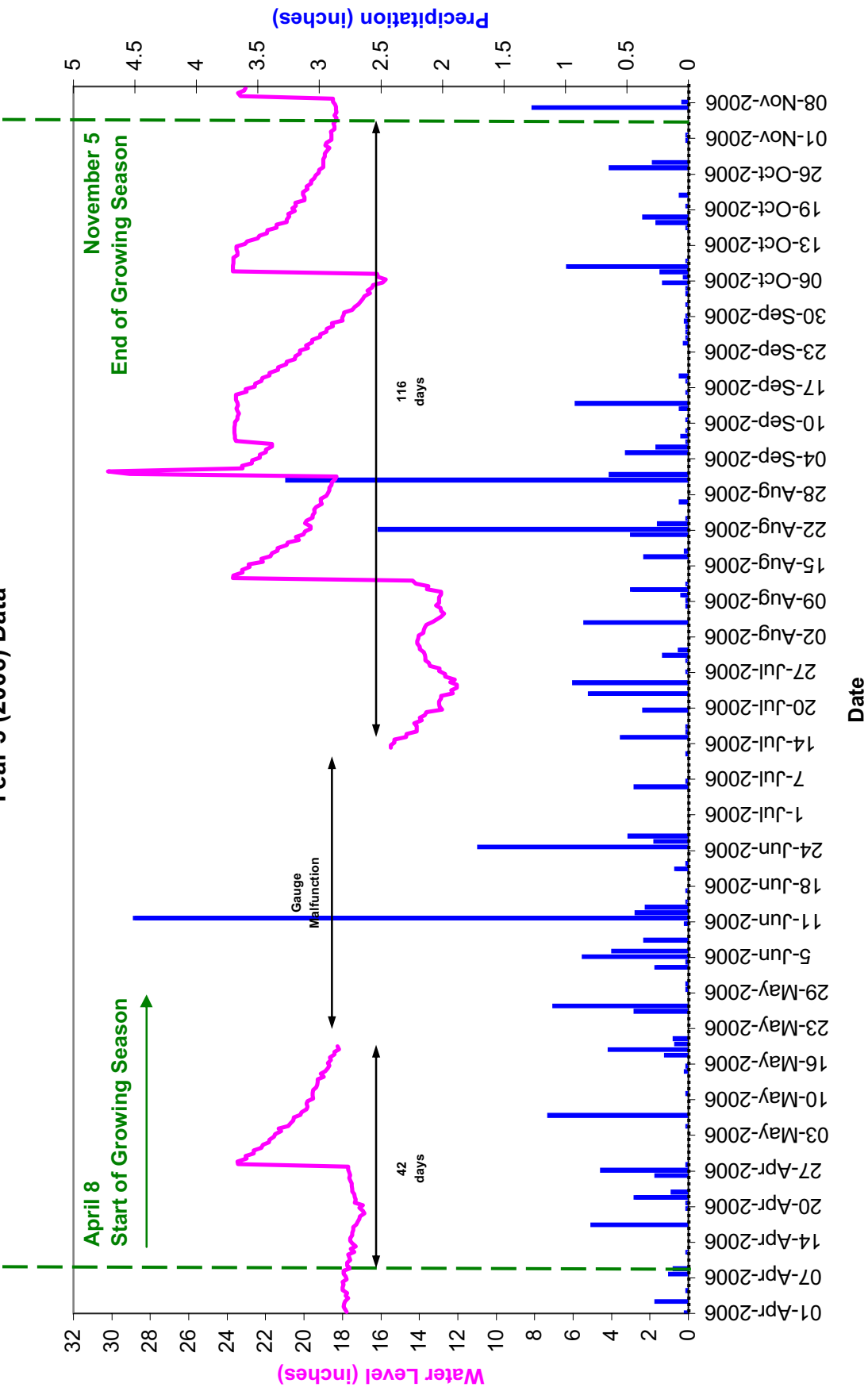
Camp Lejeune Surfacewater Gauge 3 Year 5 (2006) Data



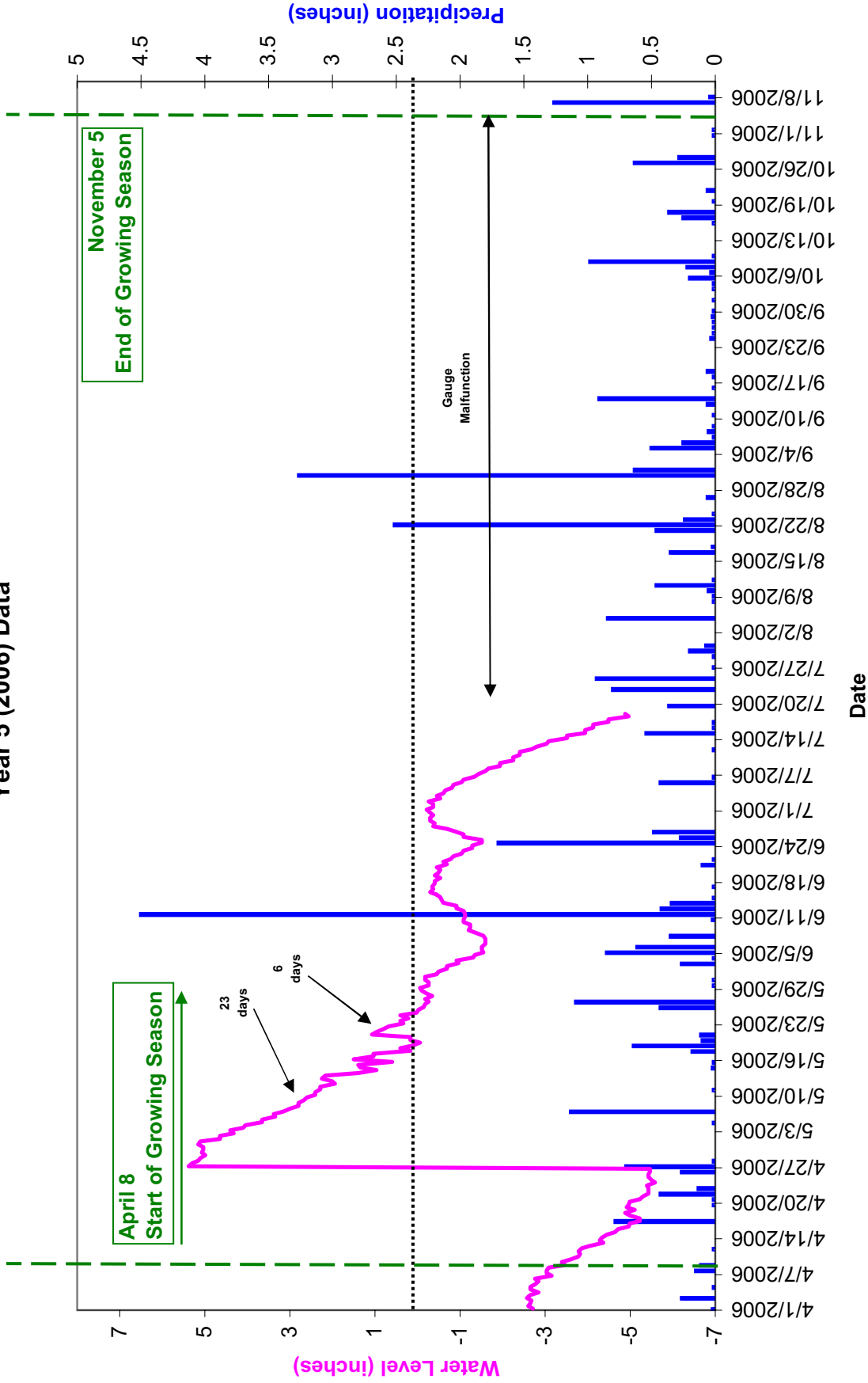
Camp Lejeune Surfacewater Gauge 4 (Reference) Year 5 (2006) Data



Camp Lejeune Surfacewater Gauge 5 Year 5 (2006) Data



Camp Lejeune Surfacewater Gauge 6 (Reference) Year 5 (2006) Data



APPENDIX C
YEAR 4 (2005) GROUNDWATER/SURFACEWATER GAUGE GRAPHS

Figure 5
Camp Lejeune - GW1 (Reference)
40" Groundwater (S517094 / S517186)

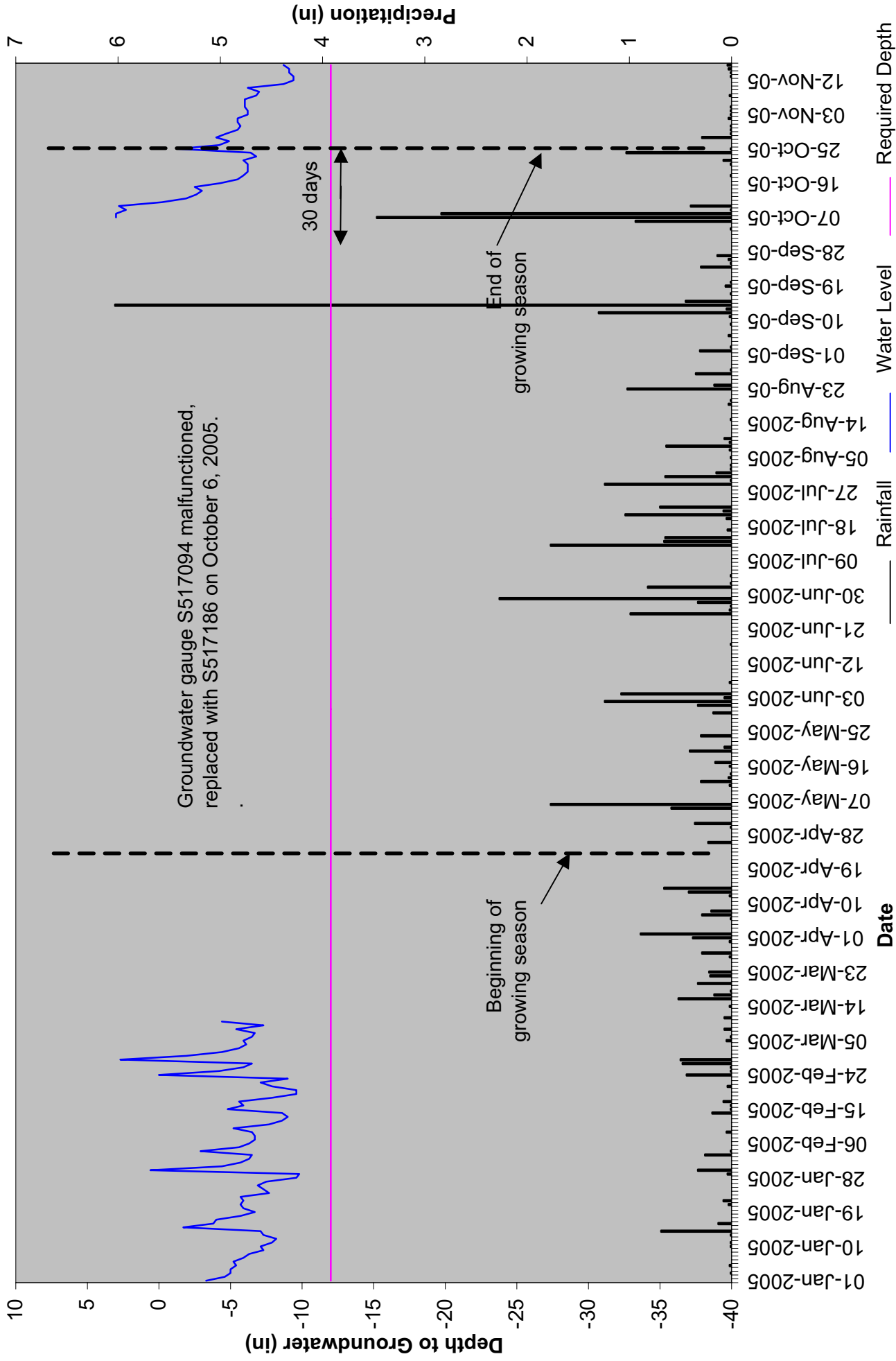


Figure 6
Camp Lejeune - GW2
40" Groundwater (S517186 / S51BE0A)

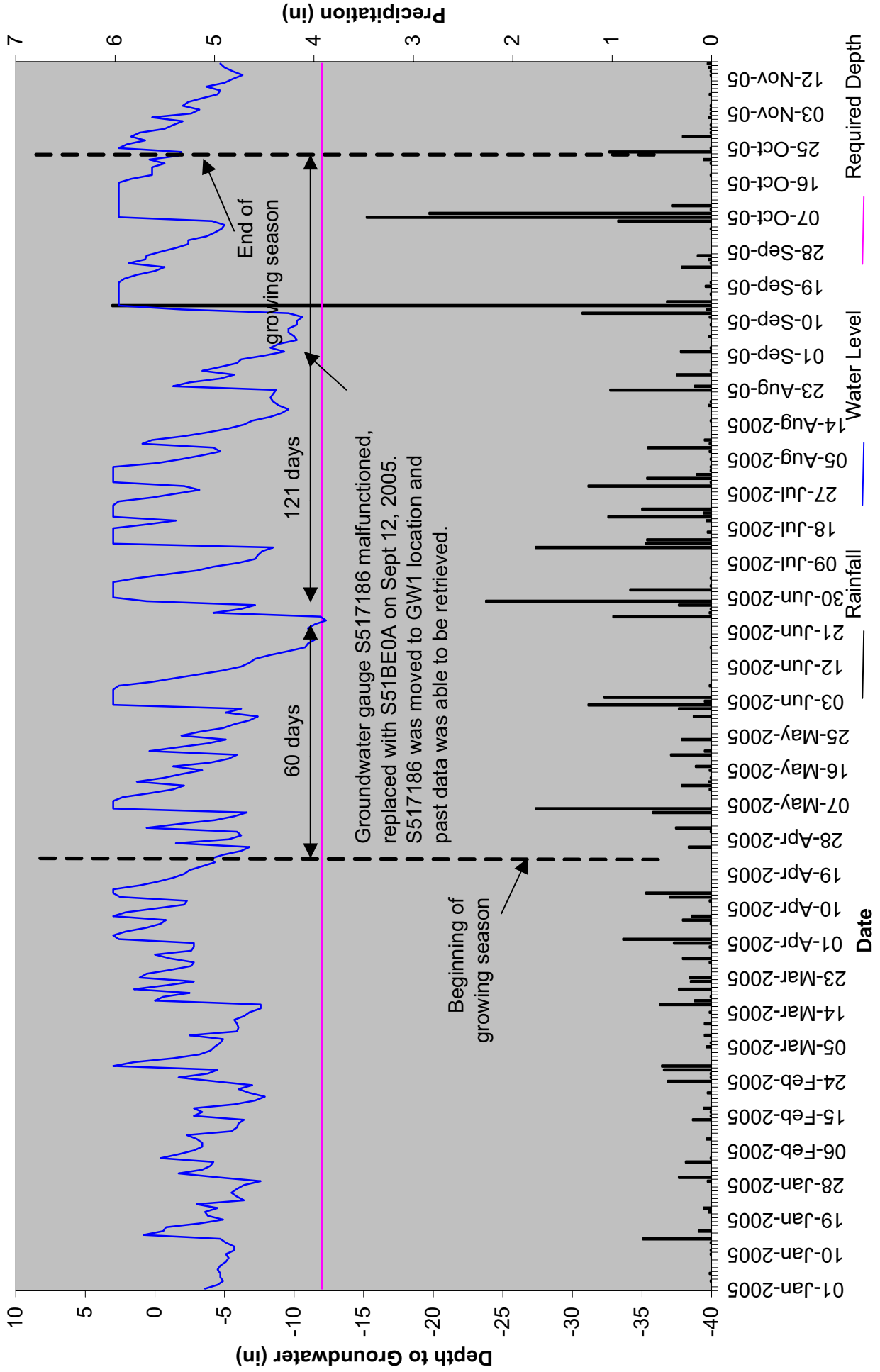


Figure 7
Camp Lejeune SG-2
Infinity - (N3C72C6C)

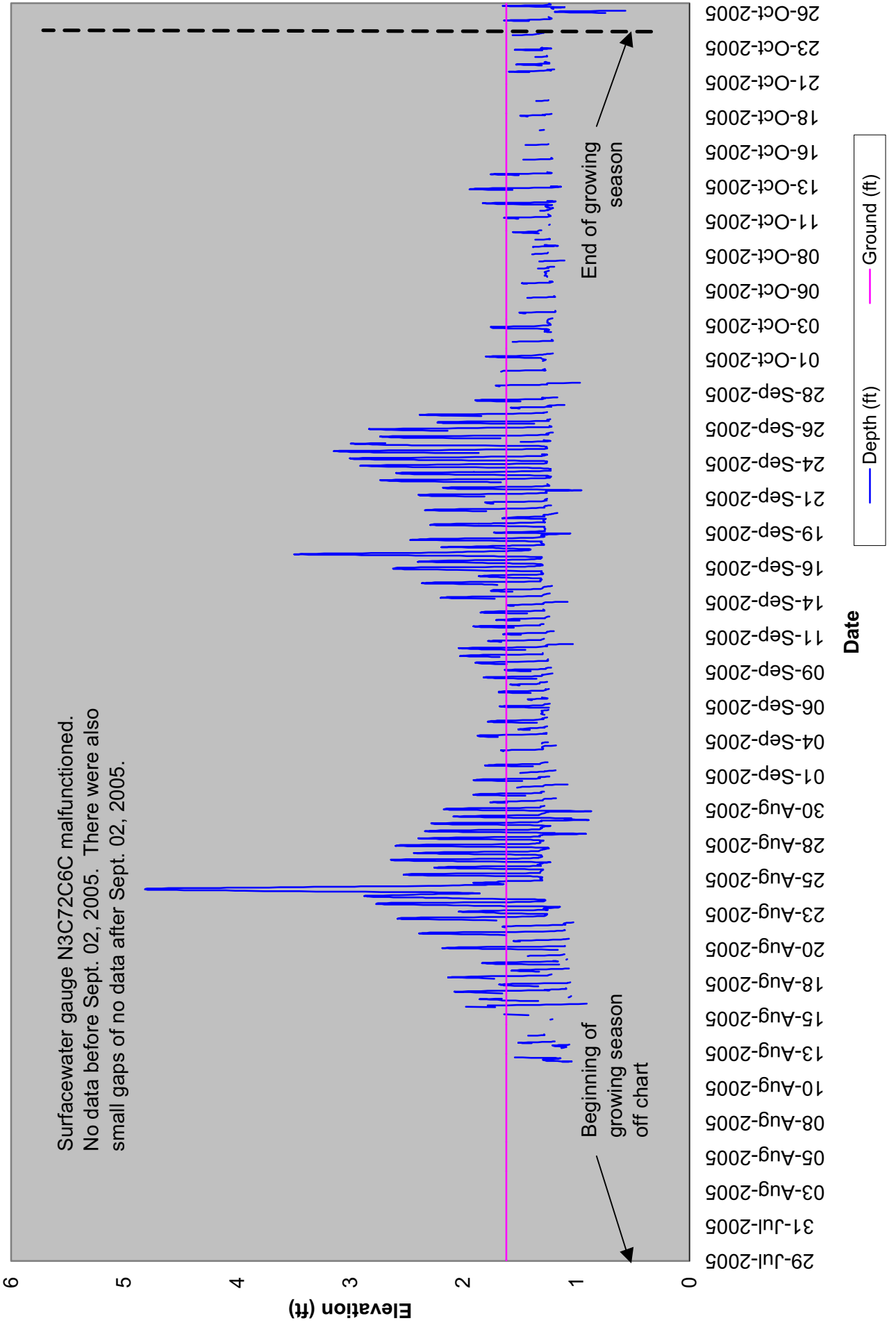


Figure 8
Camp Lejeune SG-3
Infinity - (N3C72A17)

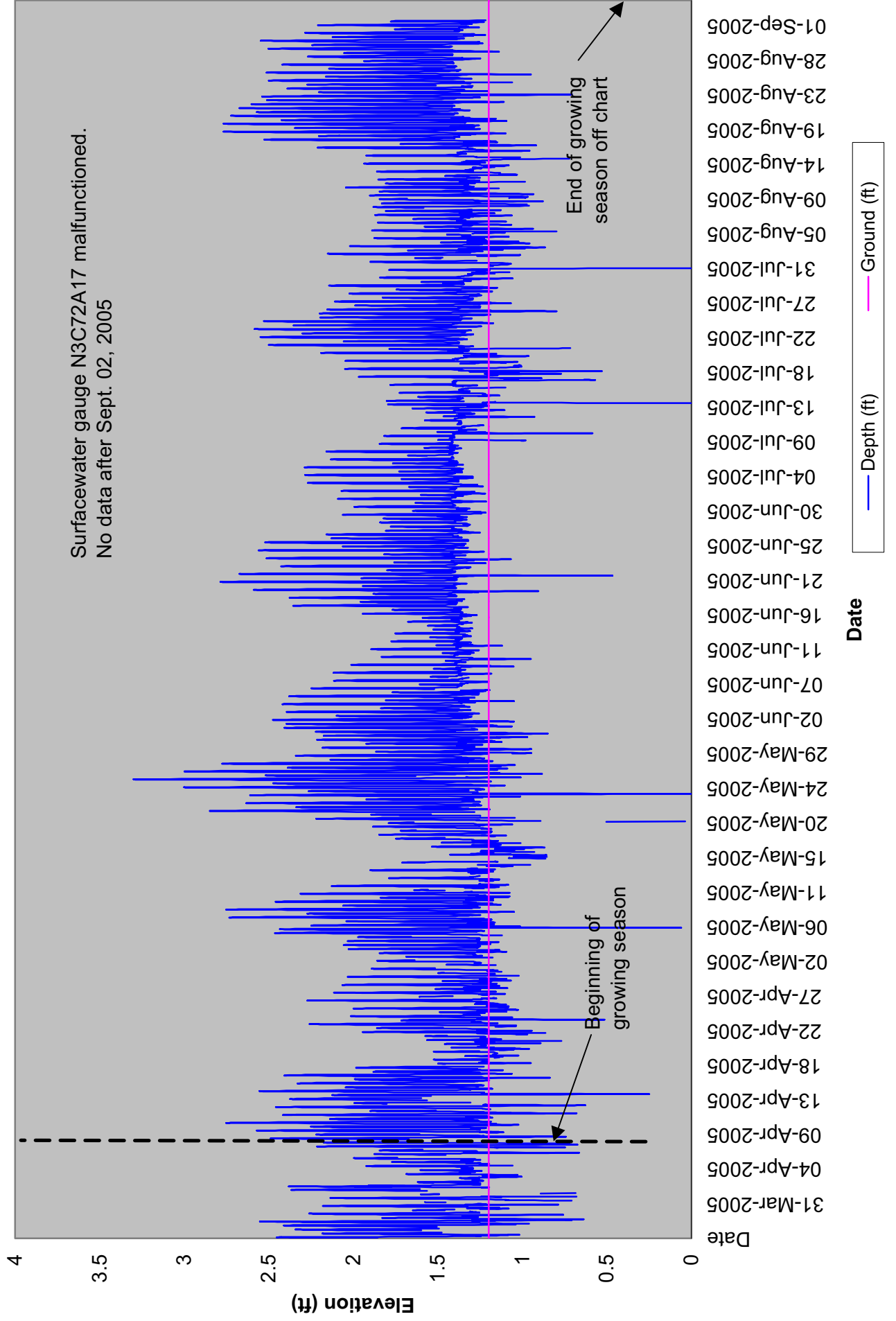


Figure 9
Camp Lejeune SG-4
Infinity - (N3C72D25)

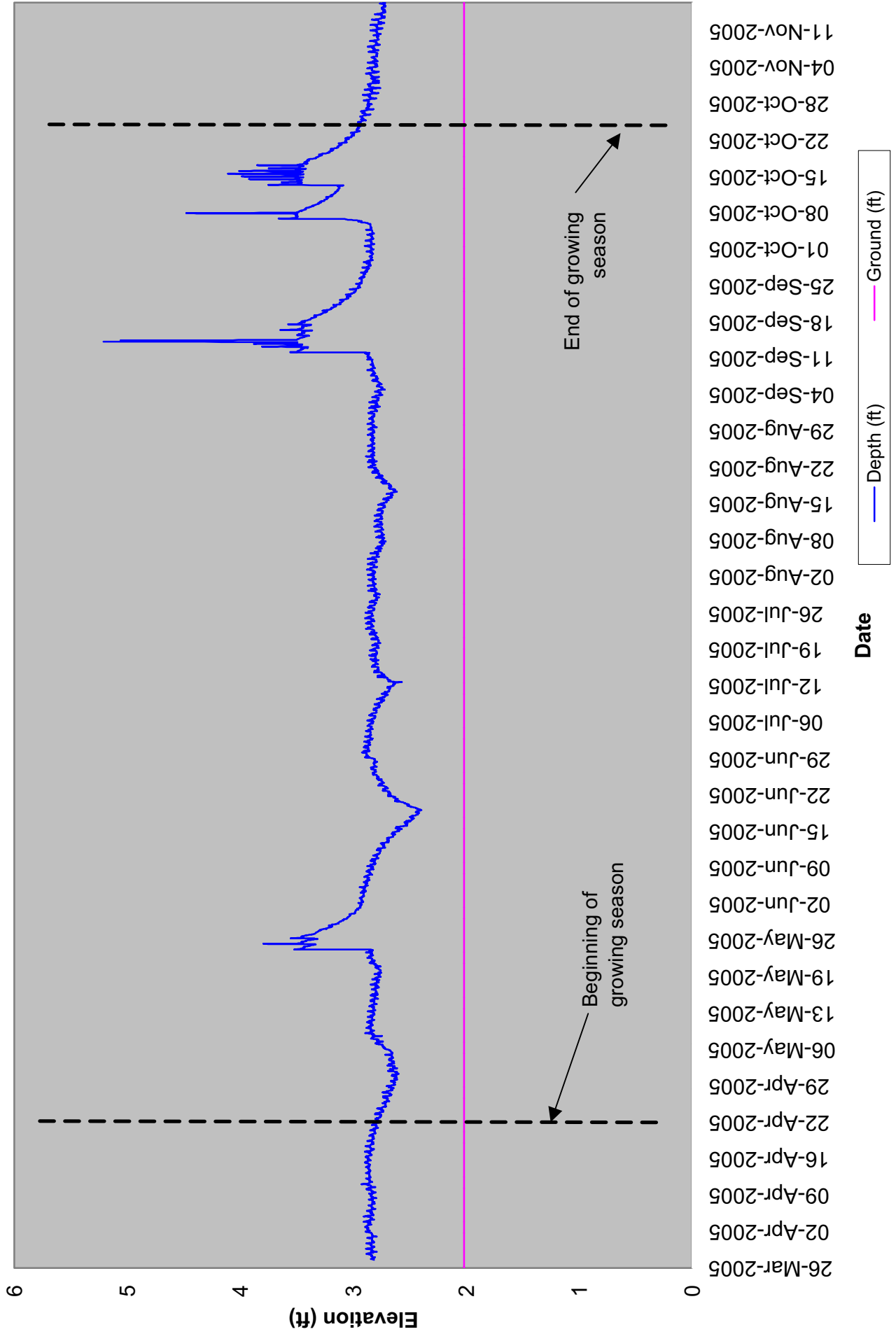


Figure 10
Camp Lejeune SG-5
Infinity - (N3C691A9)

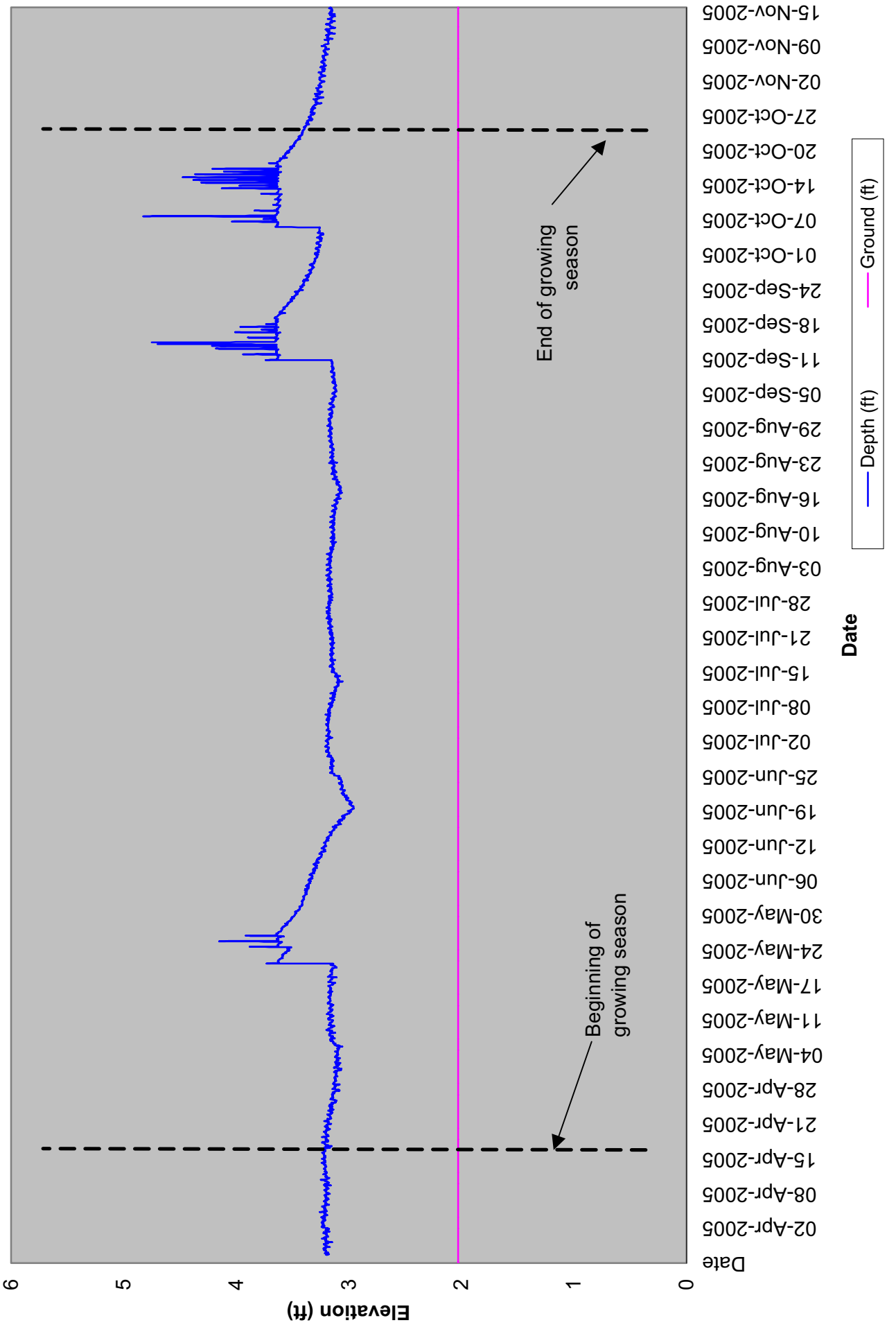
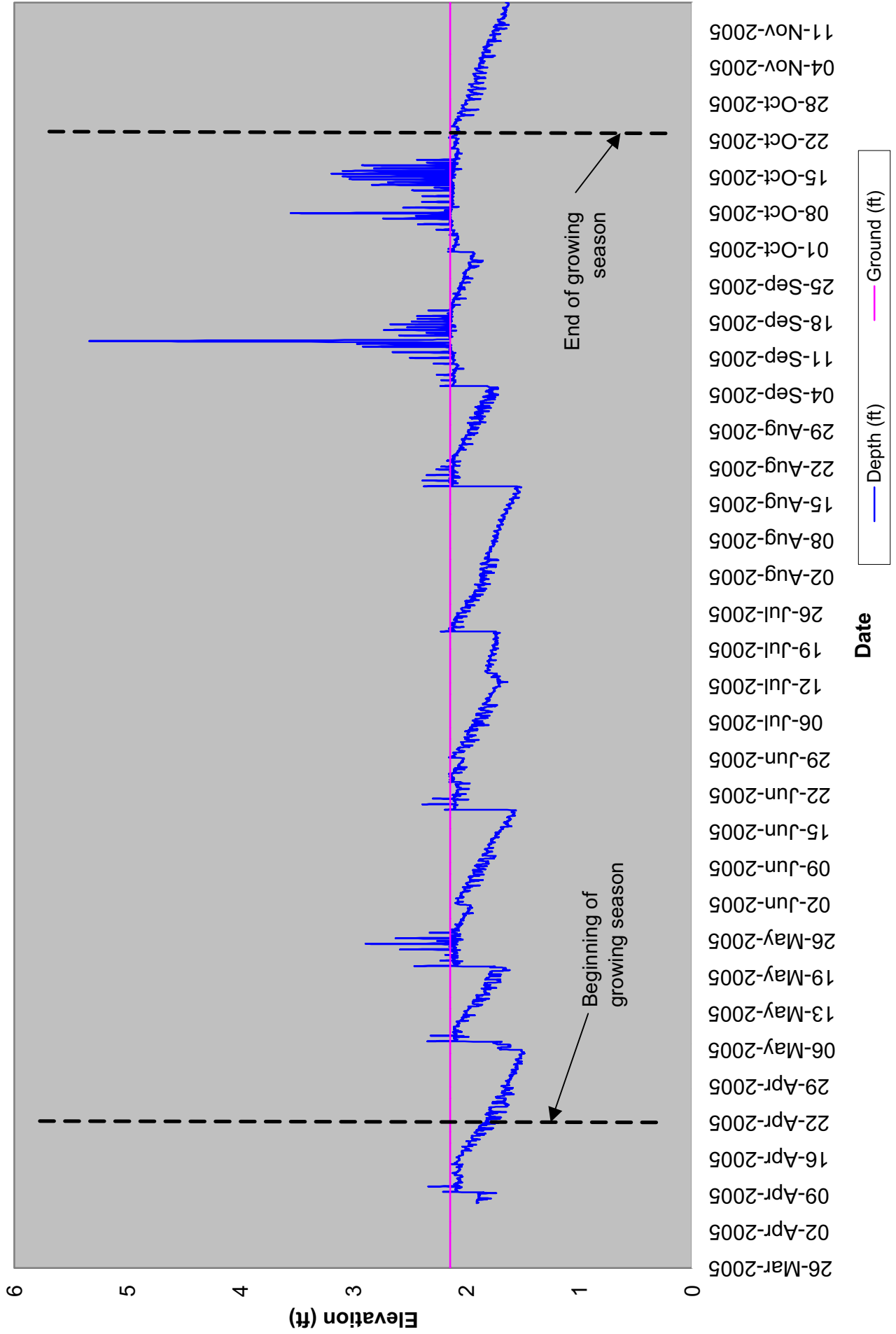
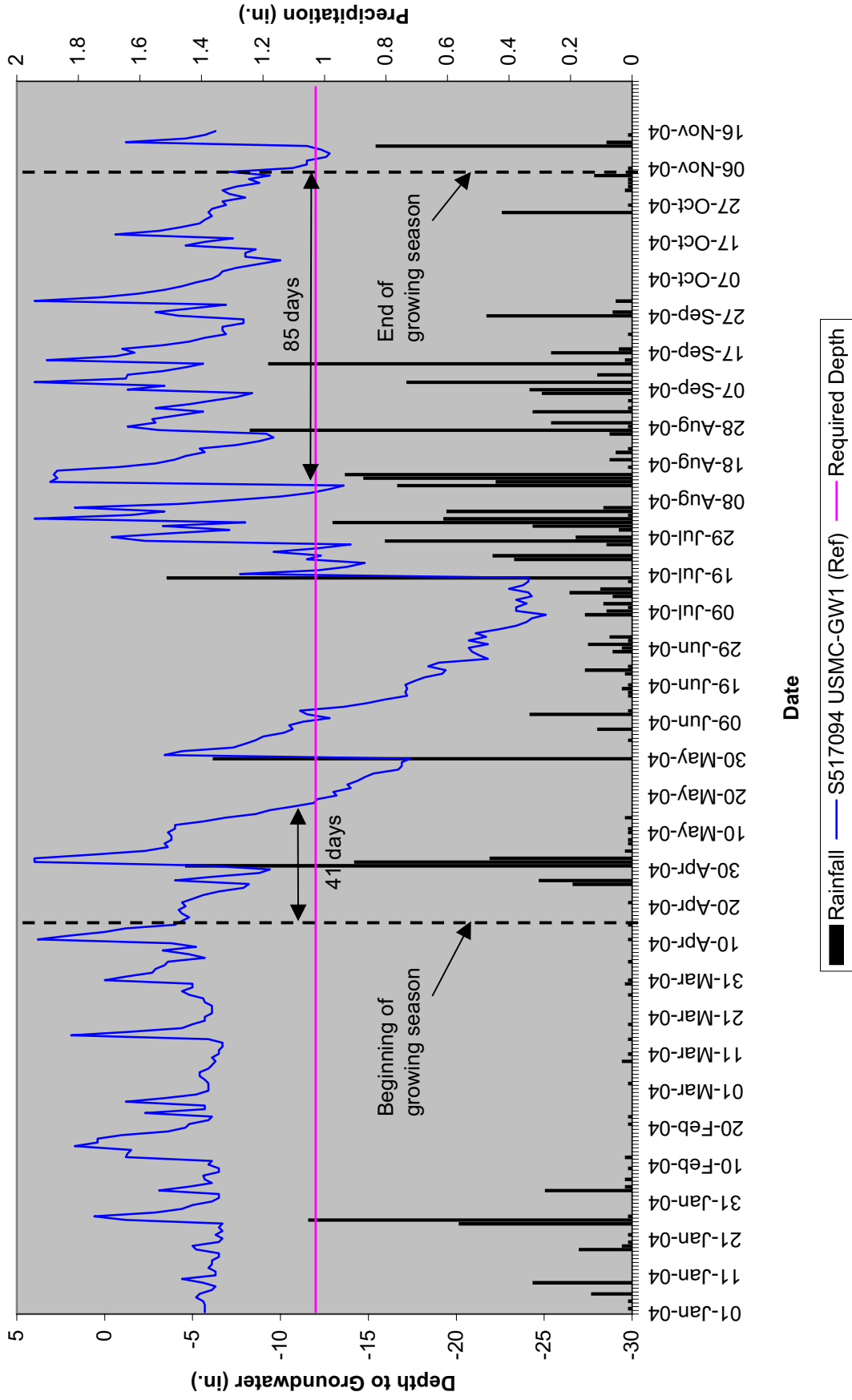


Figure 11
Camp Lejeune SG-6 (ref)
Infinity - (N3C6920E)

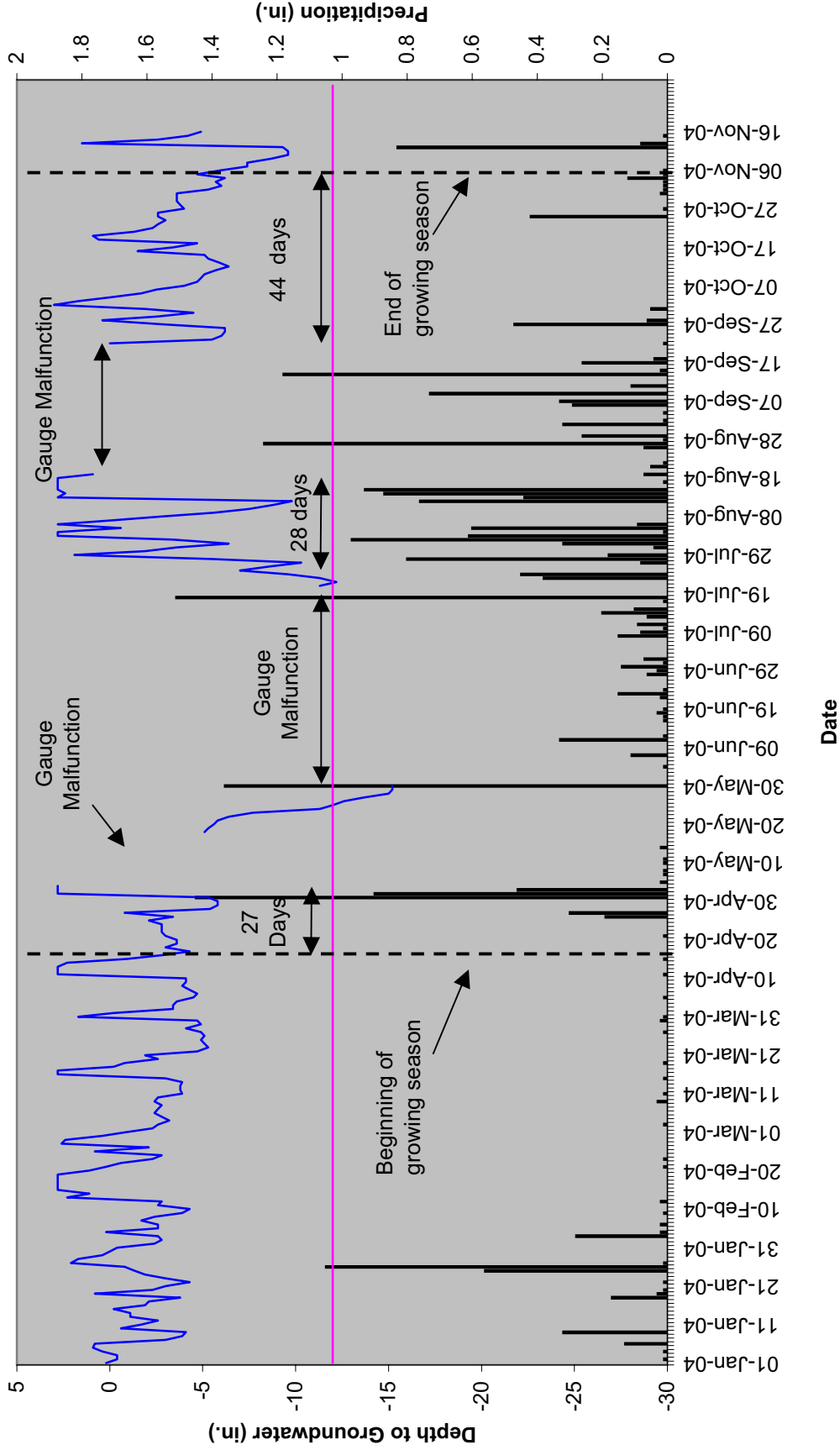


APPENDIX D
YEAR 3 (2004) GROUNDWATER/SURFACEWATER GAUGE GRAPHS

**USMC-GW1
Reference
40" Groundwater**

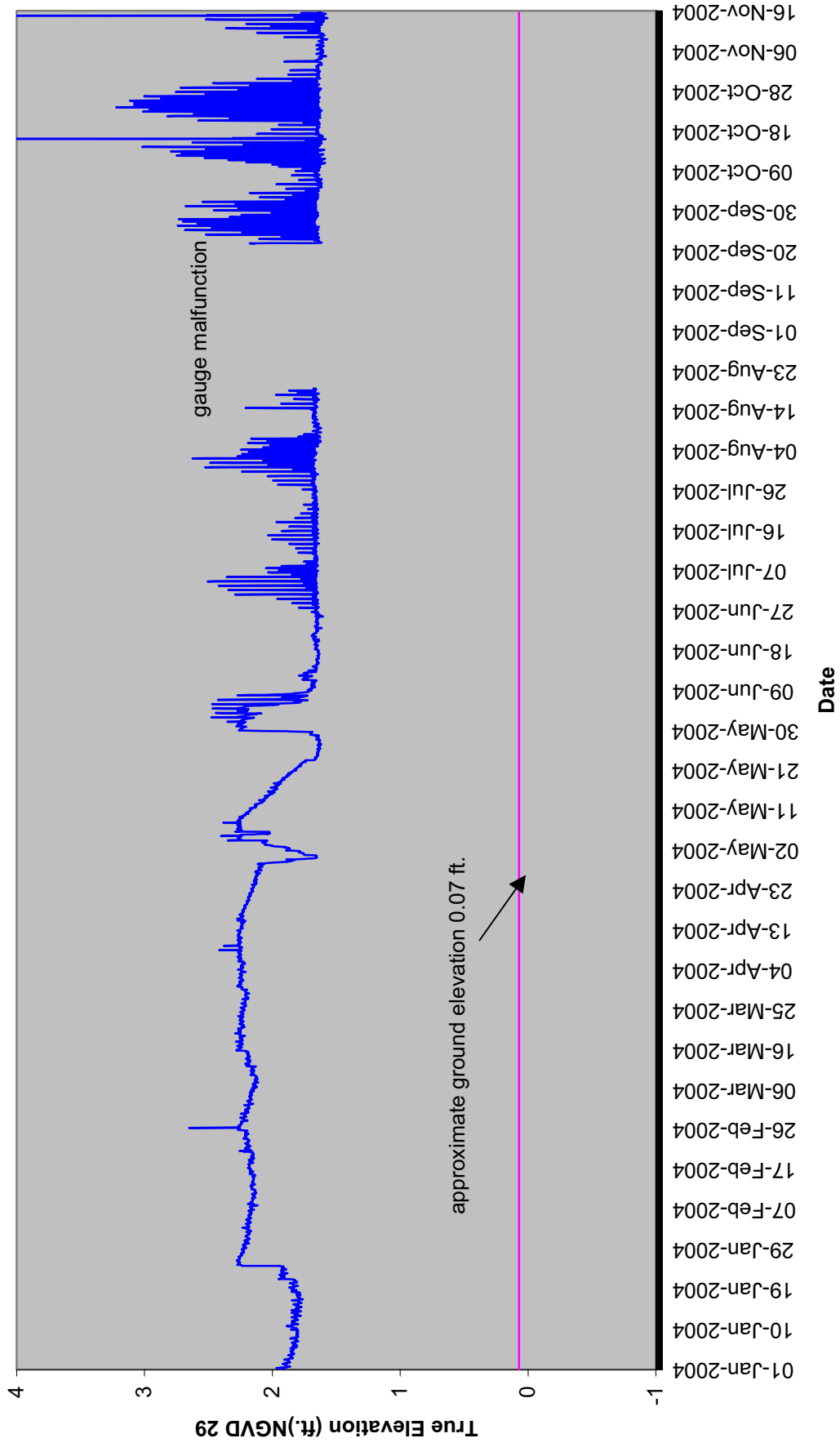


USMC-GW2 40" Groundwater

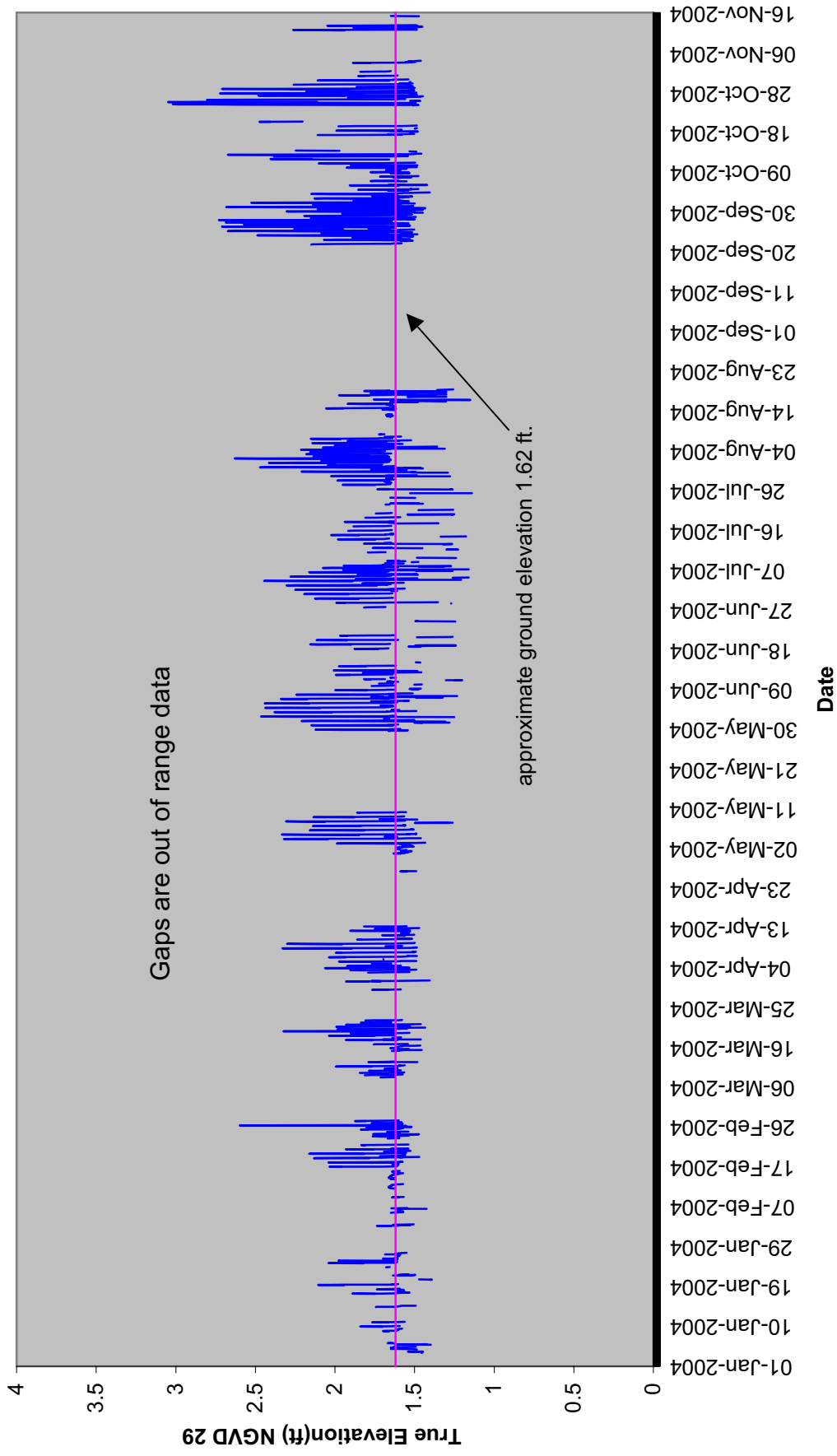


Rainfall
 S517186 USMC-GW2
 Required Depth

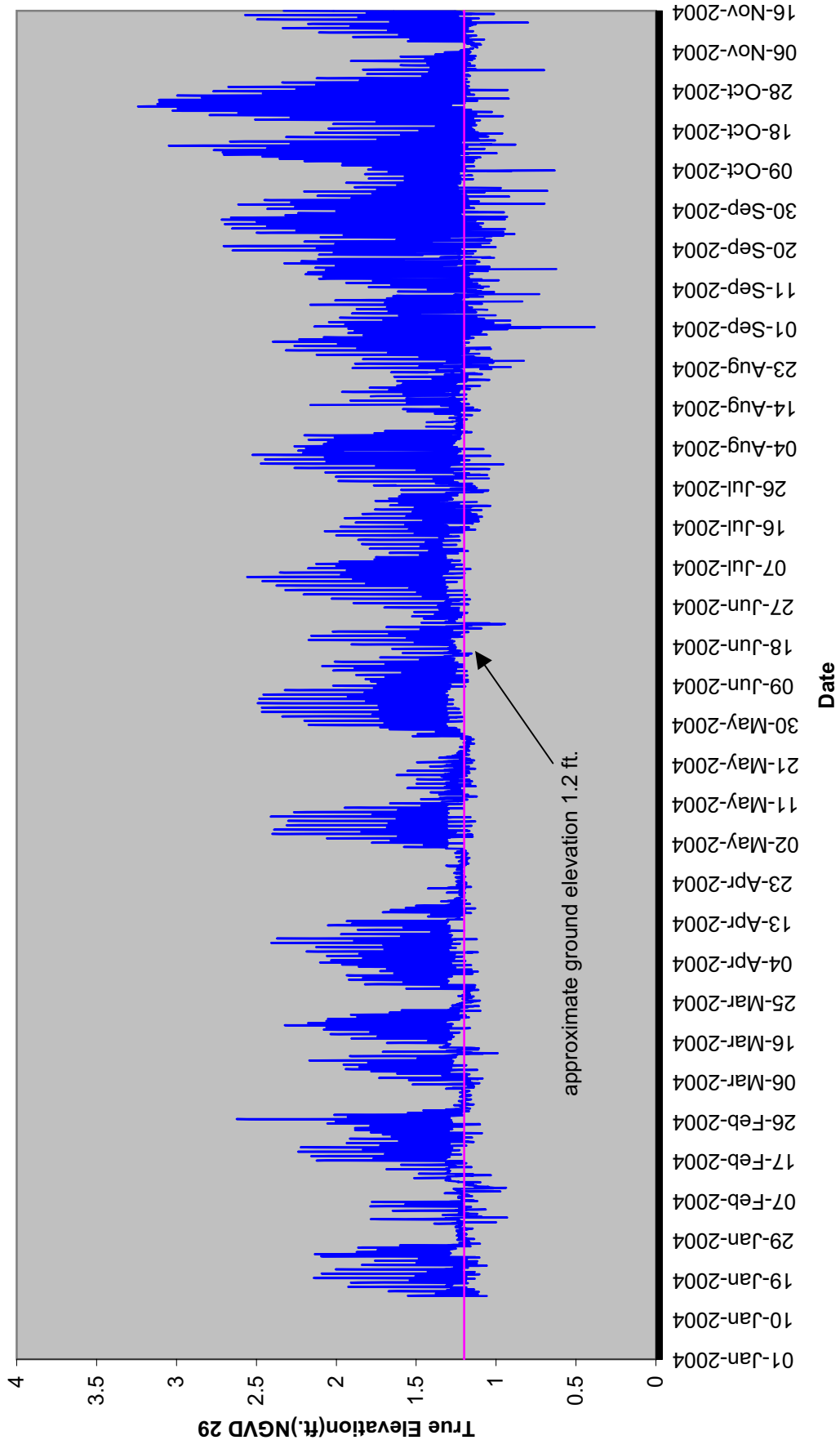
USMC-SG1 Tide Gauge



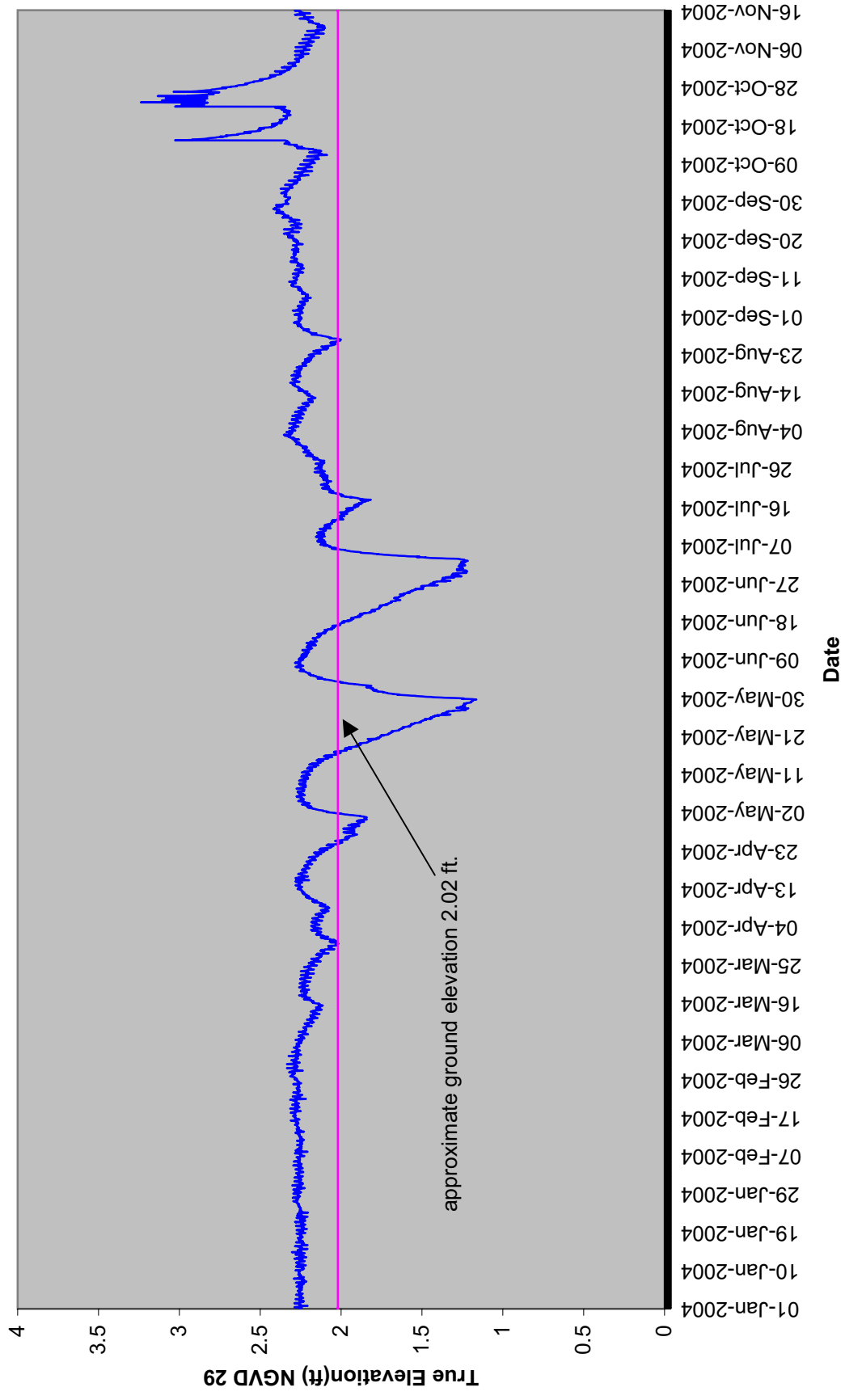
**USMC-SG2
Surface Gauge**



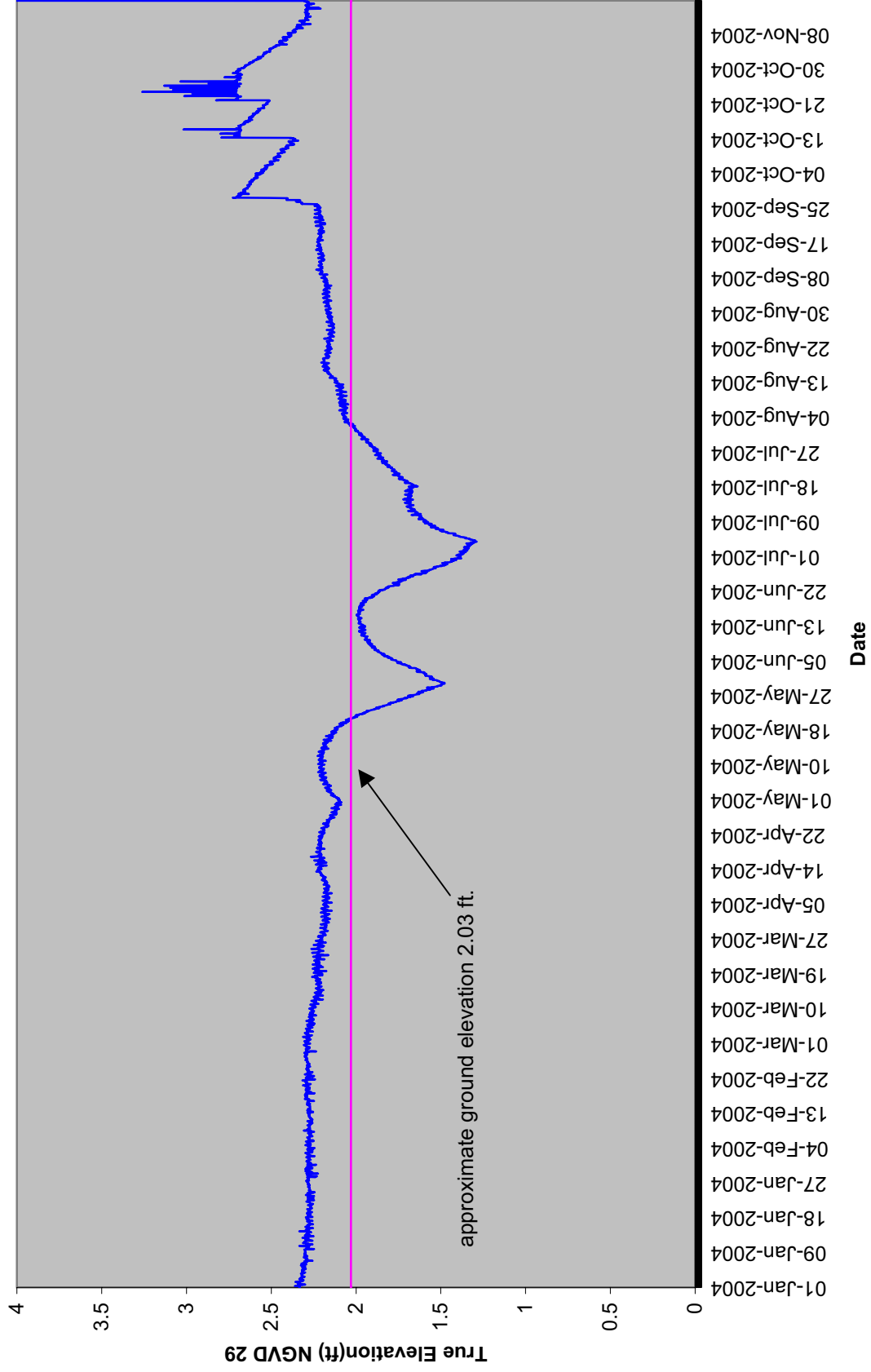
**USMC-SG3
Surface Gauge**



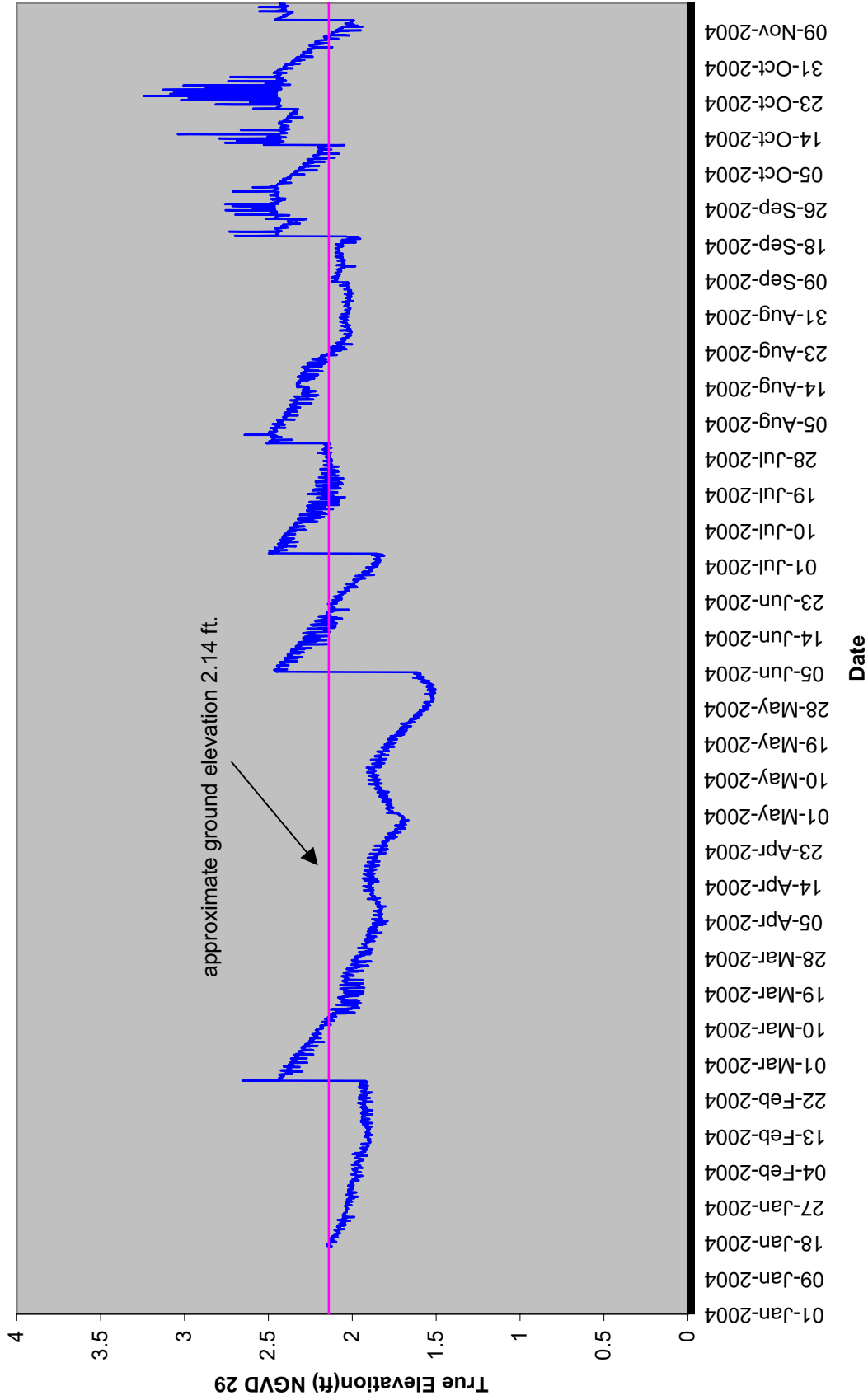
USMC-SG4 Reference Surface Gauge



USMC-SG5 Surface Gauge

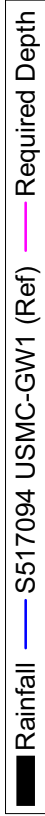
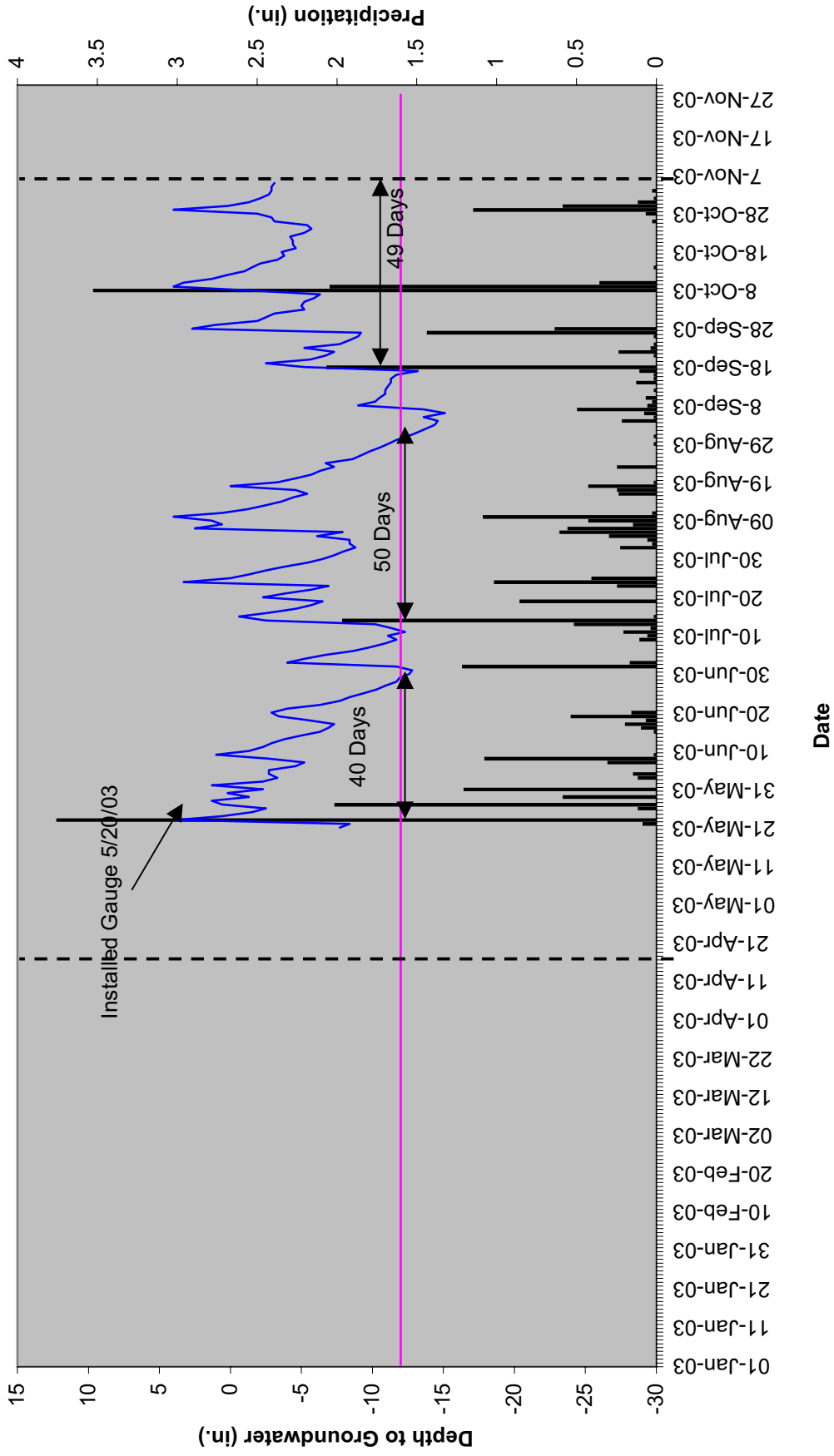


USMC-SG6 Reference Surface Gauge

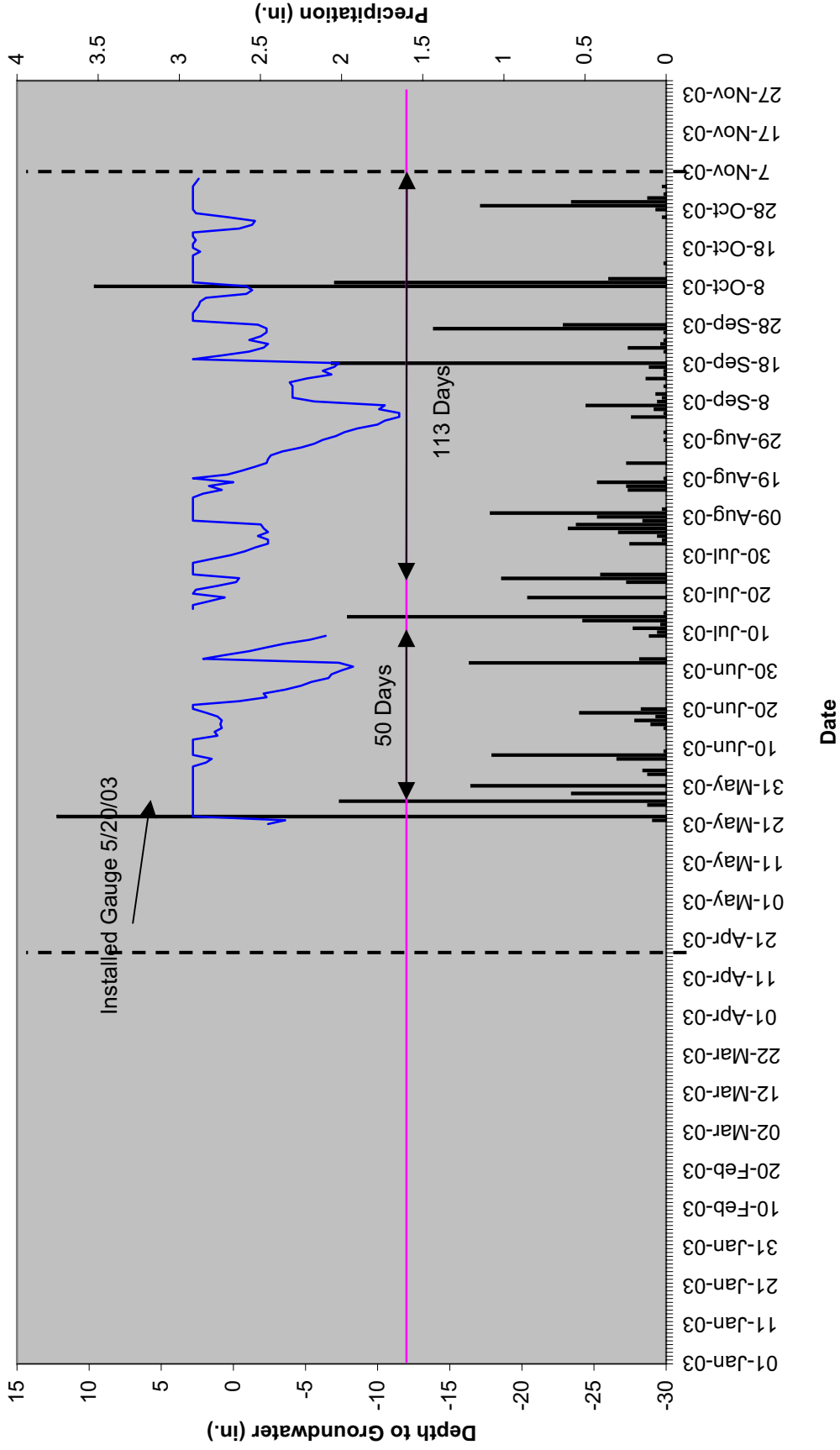


APPENDIX E
YEAR 2 (2003) GROUNDWATER/SURFACEWATER GAUGE GRAPHS

**USMC-GW1
Reference
40" Groundwater**

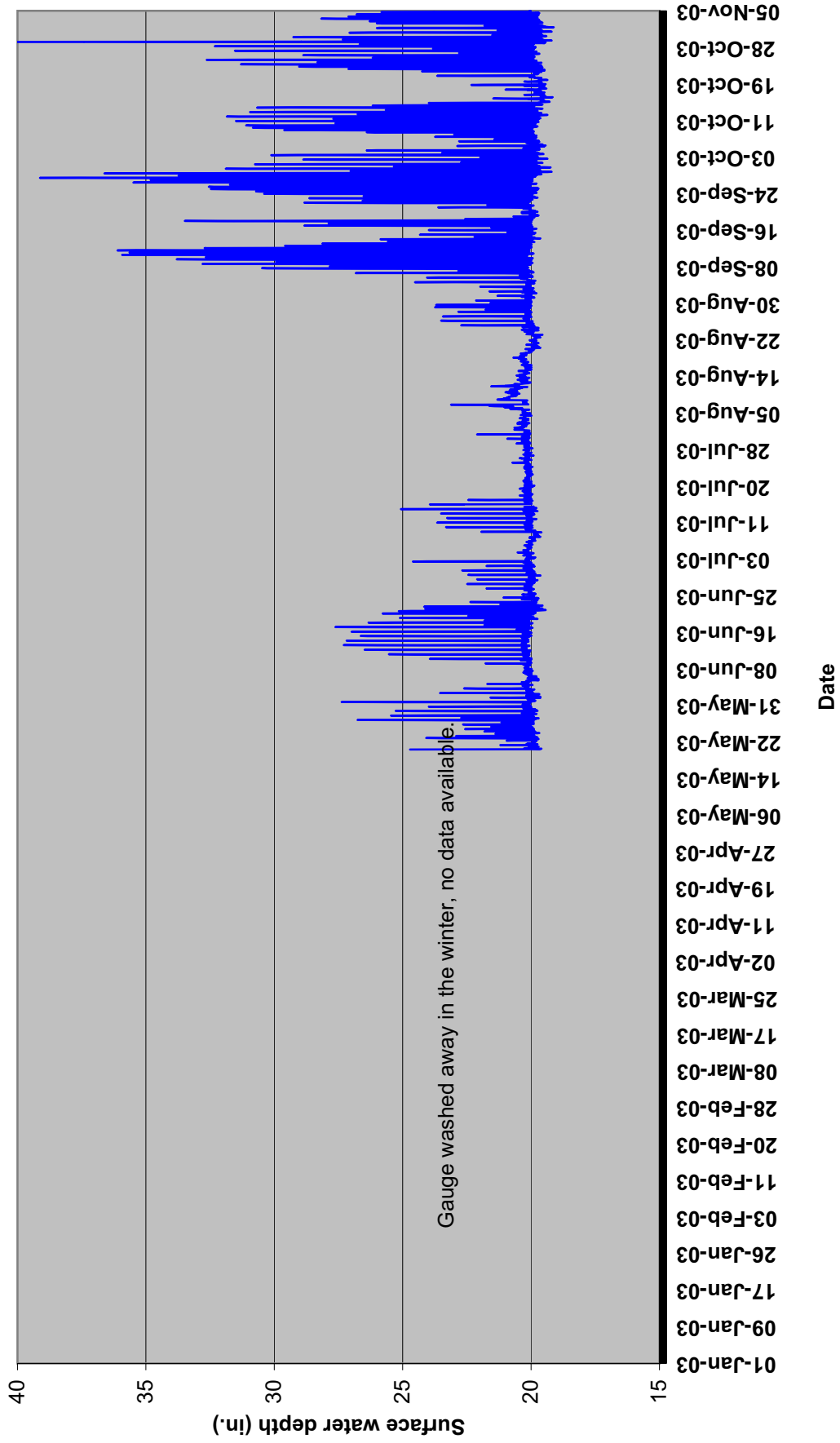


USMC-GW2 40" Groundwater

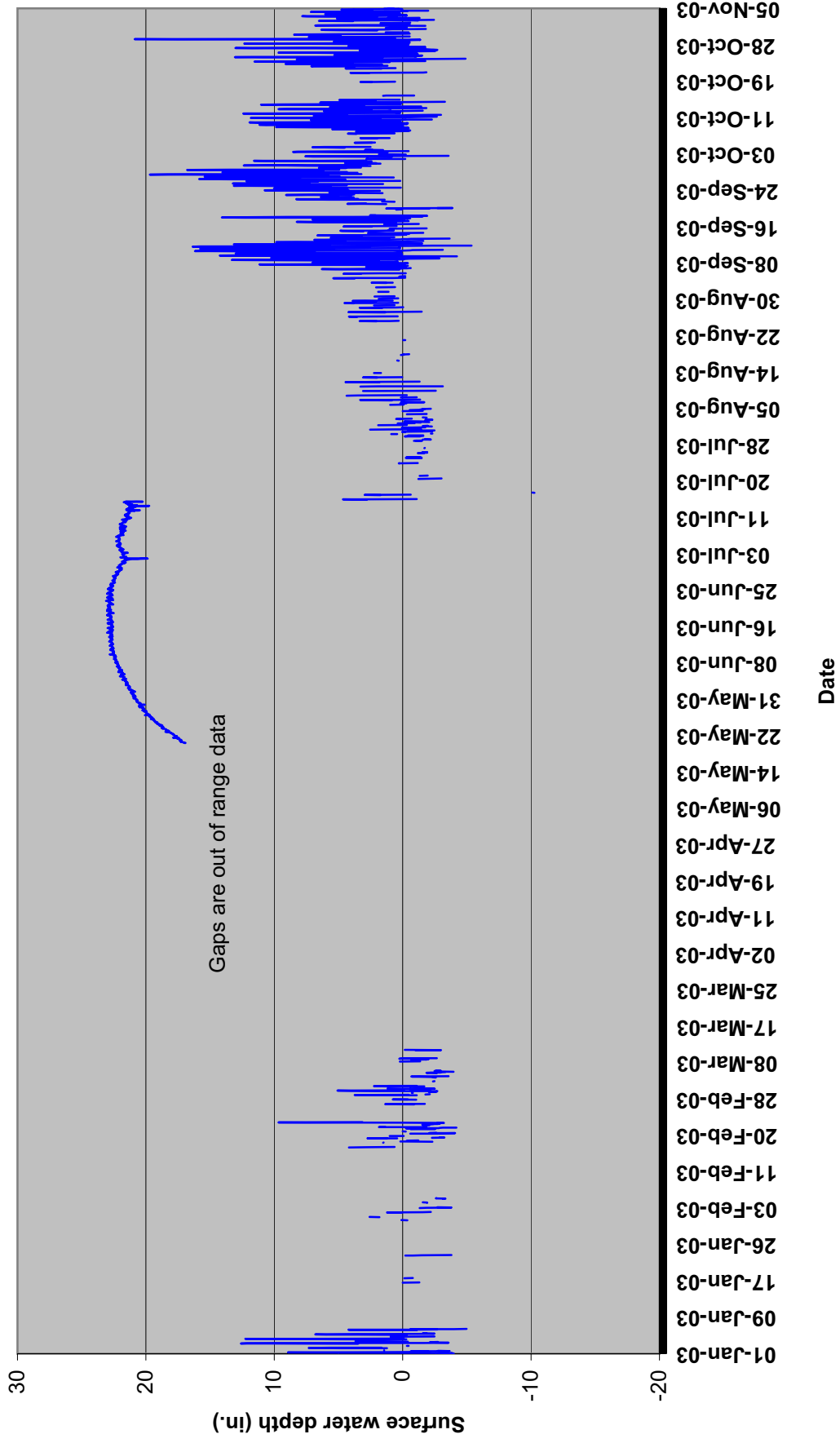


■ Rainfall — S5175AA USMC-GW2 — Required Depth

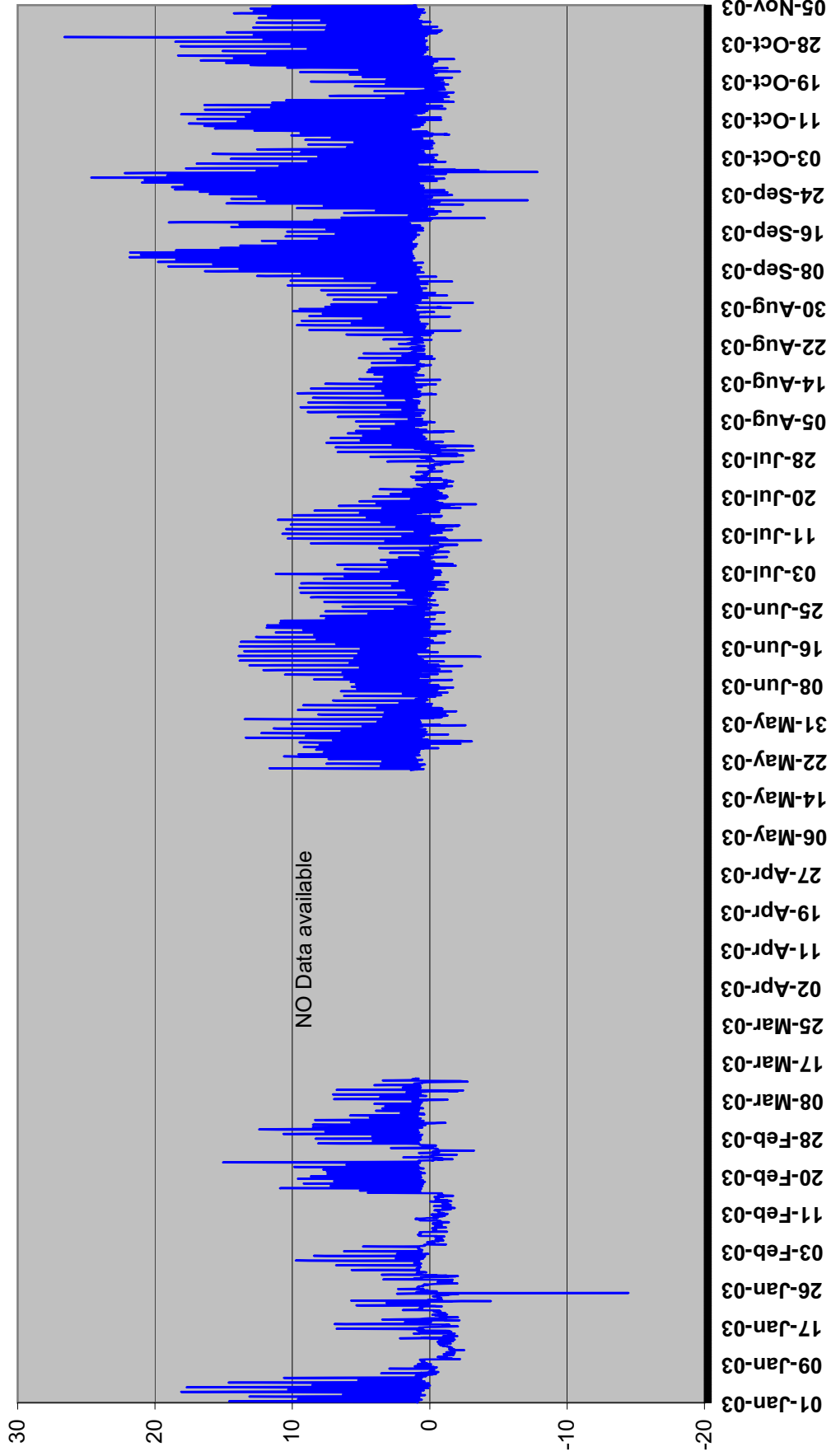
USMC-SG1 Tide Gauge



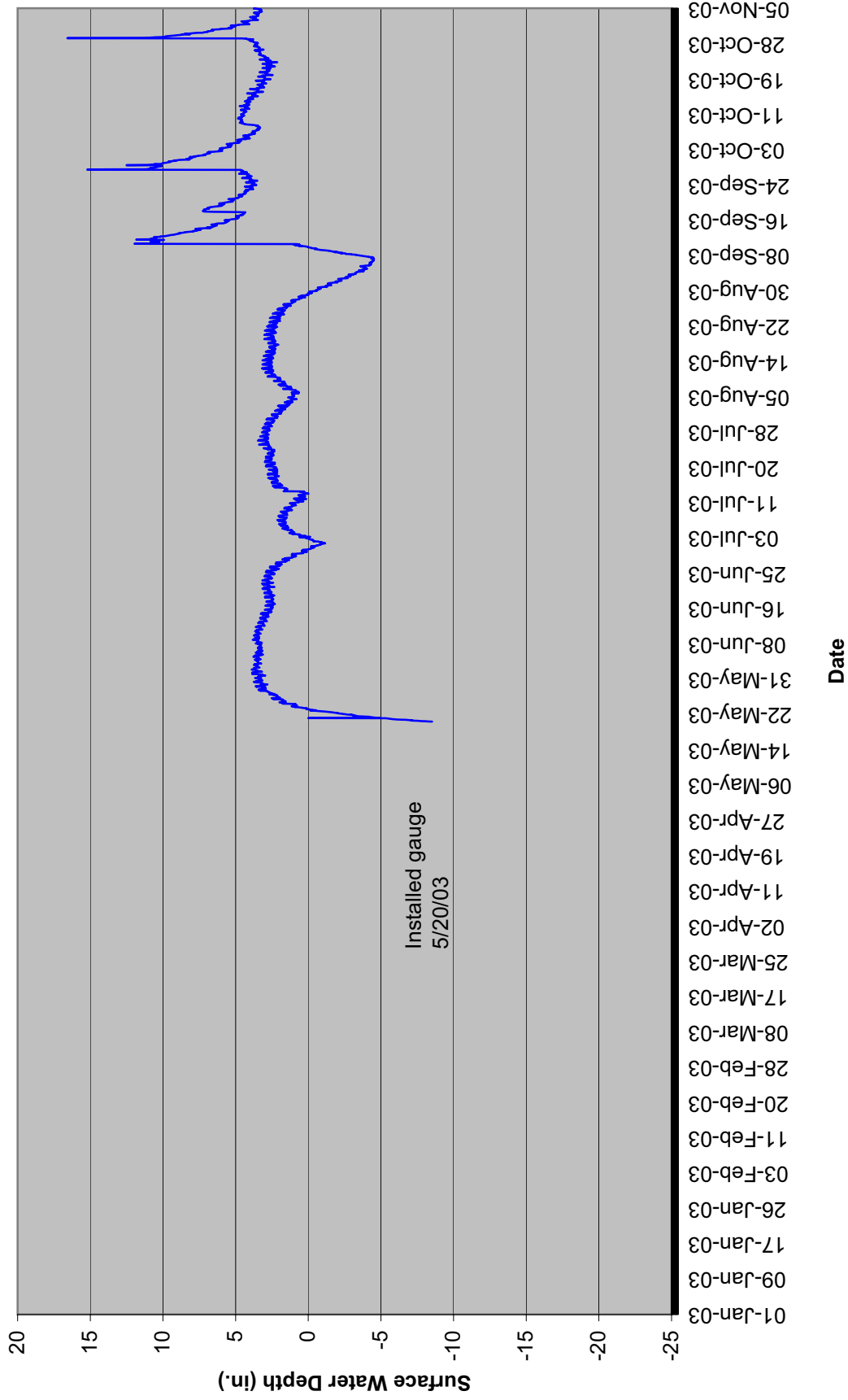
USMC-SG2 Surface Gauge



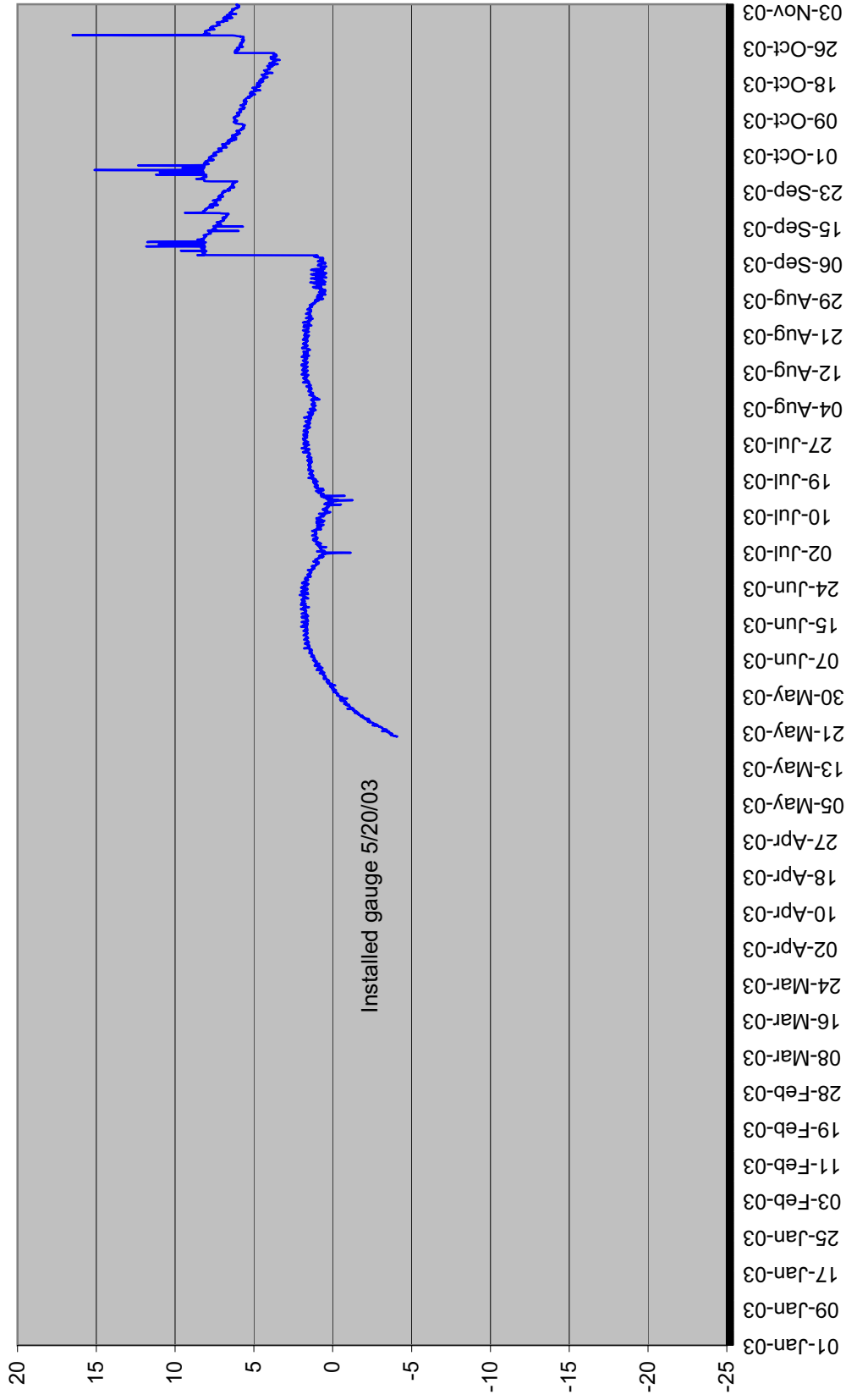
**USMC-SG3
Surface Gauge**



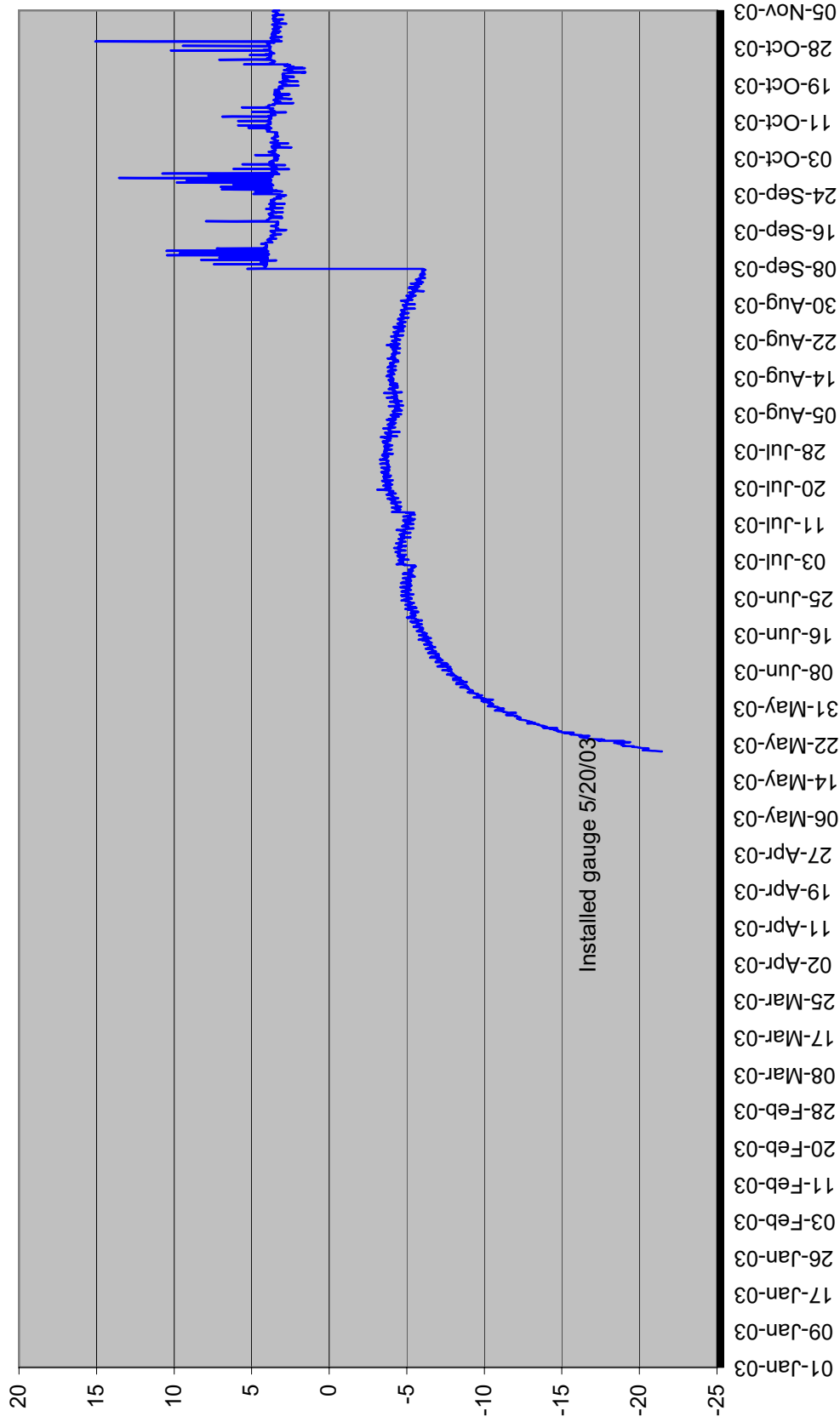
USMC-SG4 Reference Surface Gauge



USMC-SG5 Surface Gauge

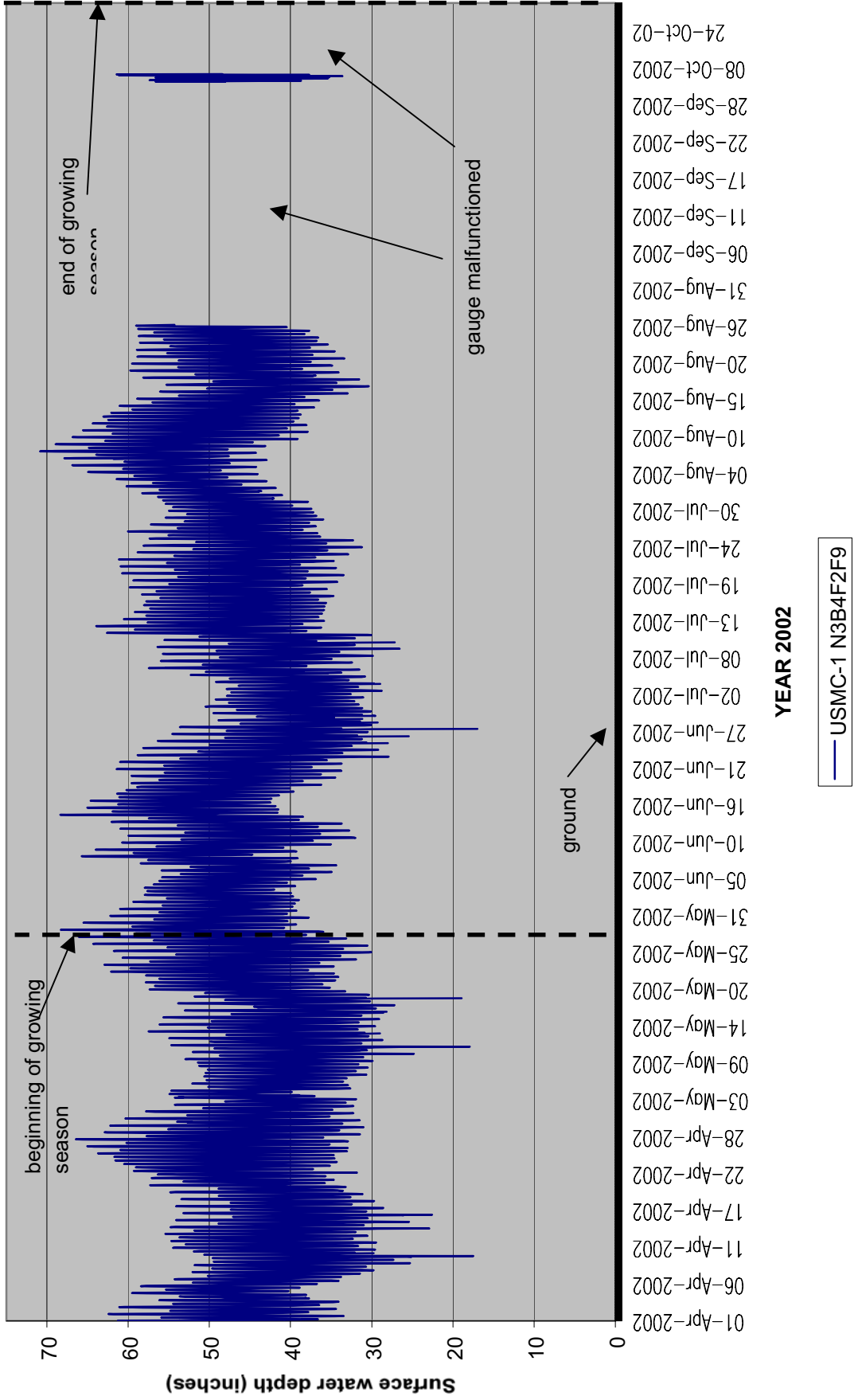


USMC-SG6 Reference Surface Gauge

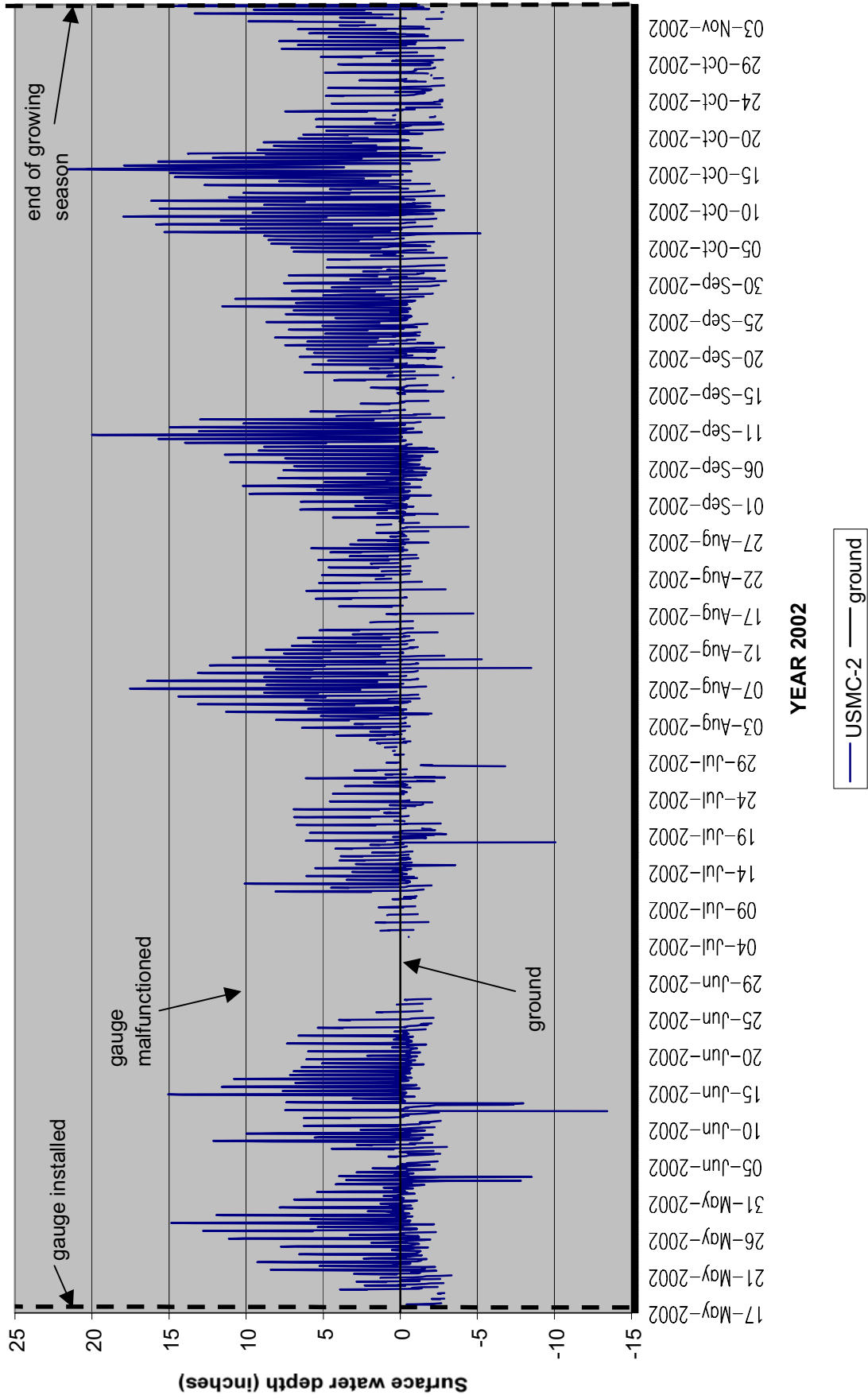


APPENDIX F
YEAR 1 (2002) GROUNDWATER/SURFACEWATER GAUGE GRAPHS

USMC-1 Tidal Gauge



USMC-2 N3C72C6C



USMC-3 N3C72A17

