CHATFIELD BASIN

WATER-QUALITY DATA ASSESSMENT

1999-2001 High-Flow Screening Surveys and

1990-2000 Groundwater-Quality, Plum Creek Alluvial Wells

Prepared for:

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Prepared on Behalf of:

Chatfield Watershed Authority
c/o Denver Regional Council of Governments (DRCOG)
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Prepared by:

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TDS Project No. 9903

November 19, 2001

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595 West Meadow Road
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Mr. Walt Foutz, CPG
Commodore Advanced Sciences, Inc.
4251 Kipling Street, Suite 575
Wheat Ridge, CO 80033-6810

Subject: Chatfield Basin Water-Quality Data Assessment, Task-Order Report
TDS Project No. 9903

Dear Mr. Foutz:

As discussed with you and Mr. Doug Dennison on October 10, I am please to submit to you one original (camera-ready, unbound) and three (3) bound copies of the subject report. I understand that the Chatfield Watershed Authority (CWA) may request that I provide a brief overview presentation of the results of this investigation. Tentatively, the presentation is scheduled for January 22, 2002.

Meanwhile, please let me know if you have questions or need additional information. I have transmitted the spreadsheet files to you separately by e-Mail.

Thank you for contacting TDS Consulting Inc. for execution of this task order.

Yours truly,

Timothy D. Steele, Ph.D.
President, TDS Consulting Inc.

File: 9903

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Introduction

On October 10, 2001, Commodore Advanced Sciences, Inc. (CAS) requested TDS Consulting Inc. (TDS) to perform a water-quality data evaluation on behalf of the Chatfield Watershed Authority (CWA). The assessment focused on (1) screening-survey data collected approximately weekly at 23 streamflow sites throughout the watershed for a 1-to-3 month period for each of calendar years 1999 through 2000 (season for high flows); and (2) groundwater-quality data for up to six alluvial wells collected intermittently since 1990 along Plum Creek. The assessment was conducted during November 2001, and the results are documented herein.

Approaches

Two components of the long-term and ongoing water-quality monitoring program for the Chatfield watershed were considered in this data assessment:

- So-called watershed-wide "screening-survey" data for up to 23 sites along major and small tributaries located throughout the watershed; and
- Groundwater-quality data for up to six alluvial wells along Plum Creek.

For the screening surveys, three watershed-wide surveys were completed during June 1999, and 12 surveys were completed during the April-through-June periods of 2000 and 2001. Focus was on estimating/measuring flows and on field-measured indicator water-quality variables: total suspended solids (TSS), specific conductance (SC), pH, dissolved oxygen (DO), water temperature, nitrate-nitrogen (NO_3-N) concentration, and total-phosphorus (T-P) concentration. For one or two of the surveys during 2000, laboratory analyses of ortho-phosphorus concentrations were made; however, these few data averages were only included in the summary tabulation.

For the groundwater-quality data, up to six Plum Creek alluvial wells were sampled during the 1990-2000 period. The following details are provided of the changing patterns for surveys over this period, providing data results for up to 27 alluvial-well sampling surveys:

- 1990: monthly, for July through September and November through December;
- 1991: quarterly, for the months of April, June, September, and December;
- 1992: quarterly, for the months of February, May, August, and November;
- 1993; bi-annual, for the months of February and November;
- 1995: annually, for the month of June;
- 1998: bimonthly, for the months of April through June; and
- 2000: bimonthly, for the months of April through June.

The groundwater-quality data focused on the following variables: water temperature, specific conductance (SC), dissolved oxygen (DO, intermittent data); total nitrogen (T-N), total phosphorus (T-P), and total ortho-phosphorus. Fewer, more recent analyses of nitrate-nitrogen and nitrite-nitrogen concentrations are included in the data summary but are not further used in the assessment. For alluvial-well 6W, data were available only for the 1990-1993 period of record. Also, for several (approximately seven) of the surveys, alluvial-well 4W was not sampled or could not be accessed.

The appropriate data sets were compiled using both electronic files provided by CAS and completing these with other data included in published CAS annual monitoring reports for the CWA. Some effort was required for this data-compilation phase, due to the following causes: different formats for the electronic files, missing records (found in published data), and occasional data transcriptional errors.

For both data components (screening surveys and groundwater quality), the water-quality data assessment principally relied upon statistical averages for the periods of record and time-series graphics for the principal variables considered. In the results and discussion sections that follow, some of the limitations of the data are specifically provided. Recommendations for future consideration are also provided.

Results

Screening Surveys.—The following observations and watershed conditions were noted (Table 1 and Appendix A):

Total Suspended Solids

- The highest average TSS concentrations (all exceeding 65 mg/L) were found for lower East Plum Creek from Castle Rock to Sedalia (sites CH12, CH13, and CH14), the lowest part of West Plum Creek at Sedalia (site CH24), and the three mainstem Plum Creek sites (CH15, CH16, and CH17).
- Relatively low average TSS concentrations (all less than 10 mg/L) were found for South Platte River sites (CH03, CH04, CH06, and CH07), the Lockheed-Martin tributary (believed to be Brush Creek, site CH05), Massey Draw (site CH08), Cook Creek (site CH09), Bear Creek (site CH21), and upper West Plum Creek (site CH22).
- The remaining seven sites were characterized by intermediate average TSS concentrations (ranging between nearly 14 and over 40 mg/L; sites CH01, CH02 on Deer Creek; sites CH10 and CH11 for upper East Plum Creek; Indian Creek and Jackson Creek (tributaries of West Plum Creek, sites CH18 and CH19), and the mid-reach of Plum Creek (near Dakan Road, site CH23).

Specific Conductance

- The highest average SC value of 1.026 mmhos/cm (or 1026 umhos/cm) was for Massey Draw (site CH08). Two intermediately-high average SC values occurred for lower Deer Creek (site CH02, 0.814 mmhos/cm) and for Brush Creek (site CH05, 0.687 mmhos/cm).

- Relatively low average SC values (0.117 mmhos/cm or less) were noted for five streams (Table 1): (a) Cook Creek (site CH09); (b) upper East Plum Creek (site CH10); Jackson Creek (site CH18); (d) Bear Creek (site CH21); and upper West Plum Creek (site CH22).
- For the remaining 14 stream sites, average SC values remained in the range between 0.211 and 0.393 mmhos/cm, still characterizing good water quality from an overall salinity perspective.
- A number of site averages were affected by a series of high SC measurements recorded for the 4/5/00 survey, indicating a possible field-instrument problem (see below).

Relative Streamflows

- The smaller tributaries were characterized by seasonal streamflows averaging less than 15 cfs: sites CH01, CH02, CH05, CH08, CH09, CH10, CH18, CH20, CH21, and CH22.
- Lower reaches of both East Plum Creek (sites CH14 through CH 17) and West Plum Creek (sites CH 23 and CH24) were characterized by average streamflows of between about 20 and 40 cfs.
- For the mainstem South Platte River, seasonal average streamflows ranged between 253 and 345 cfs (sites CH03, CH04, CH06, and CH07).

Other Physical Variables (pH, DO, and temperature)

- For upper Deer Creek (site CH01), the average pH value was 6.27 (standard units). Otherwise, for all other (22) sites, average pH values remained between 7 and 8, which is considered normal. However, a downward trend in pH values over the period of record was noted for numerous sites (Appendix B).
- The highest average DO (exceeding 8 mg/L) concentrations were noted for upper tributaries (site CH01 on Deer Creek; the mainstem South Platte River at all four sites, Brush Creek at site CH05), Massey Draw at site CH08), Indian Creek at site CH18, and Bear Creek at site CH21). For all other sites, the average DO concentrations all were 8.05 mg/L or lower (but above 7 mg/L).
- Seasonal water temperatures were highly variable for any given site, due in large part to different times of day for measurement. Systematically low water-temperature values were recorded for the 05/03/01 screening survey for a number of sites (Appendix A), indicating a possible instrument-calibration problem.

Nutrient Species (N and P)

- For T-P, the highest average concentrations (ranging between 0.79 and 2.58 mg/L) were associated with the lower segments of East Plum Creek (sites CH12, CH13, and CH14), lower West Plum Creek (site CH24), and the mainstem Plum Creek (sites CH15, CH16, and CH17). A relatively high average T-P concentrations was noted for Indian Creek (0.60 mg/L). For the remaining screening-survey sites (Table 1), average T-P concentrations were 0.40 mg/L or less. The lowest average T-P concentrations were associated with the South Platte River (ranging between 0.13 and 0.19 mg/L; sites CH03, CH04, CH06, and CH07). Due

to detection-limit shifts, 2001 T-P concentrations were consistently higher than for 1999 or 2000; a systematic bias in average T-P concentrations results (Appendix A).

- Average T-N concentrations were contrasted with those for T-P: Relatively low T-N concentrations (1.9 mg/L or less) occurred for East Plum Creek, except for the upper site CH10; lower West Plum Creek (site CH 24), the mainstem Plum Creek (all three sites), and Indian Creek. Otherwise, average T-N concentrations ranged between 2.0 and 2.6 mg/L (Table 1). Some intermittently high T-N concentration anomalies occurred (Appendix A).

Groundwater Quality.—Six alluvial wells were selected for characterization of groundwater quality along Plum Creek. The wells, identified as 1W through 6W, were generally located in an upstream-to-downstream sequence. As was noted above, well 6W was sampled only during 1990-1993, and well 4W was not sampled during several of the surveys. The following observations and alluvial-well conditions were noted (Table 2 and Appendix B):

- Due to the irregular intervals, water temperatures varied greatly and did not depict any seasonal patterns. Average water temperatures ranged between 10.0 and 15.4 degrees C.
- Specific conductances, with two exceptions, were below 600 umhos/cm (Table 2). For wells 2W and 5W, one high SC value for each was noted, which was judged to be anomalous. Average SCs ranged between 252 and 363 umhos/cm. For the five wells with long-term records (1990-2000), some increasing time trends in the data series were noted (Appendix B).
- Dissolved-oxygen concentrations in the wells indicated two distinct patterns. For the upper Plum Creek sites (1W, 2W, and 3W), DO concentrations averaged between 7.01 and 7.34 mg/L; whereas, for the lower Plum Creek sites (4W, 5W, and 6W), DO concentrations averaged between 4.04 and 5.04 mg/L (Table 2). DO concentrations were not reported for the 1995 and 1998 surveys (Appendix B).
- The wells' pH values averaged within a narrow range, between 6.94 and 7.26 standard units.
- Regarding nutrient species, again two distinct patterns were noted (see DO discussion above and Table 2). For the upper-reach wells (1W, 2W, and 3W), average nutrient-species concentrations were higher: T-N, 2.40-3.17 mg/L; T-P, 0.09-0.17 mg.L, and Ortho-P, 0.07-0.16 mg/L. For the lower-reach wells (4W, 5W, and 6W), nutrient concentrations were lower: T-N, 0.24-0.35 mg/L; T-P, 0.01-0.02 mg/L; and Ortho-P, 0.01-0.02 mg/L. Intermittent anomalously high nutrient concentration values were noted (Appendix B).
- Several examples of anomalous values include the following: Well 1W, T-P, 0.75 mg/L; Well 2W, SC, 963 umhos/cm; Well 2W, T-P, 0.514 mg/L; Well 4W, SC, 557 umhos/cm; Well 5W, SC, 925 umhos/cm, and Well 6W, T-N, 1.2 mg/L.

Table 1 -- Chatfield Basin Screening Data, Average Seasonal (April-June) Values, 1999-2001

Site ID	Site	Time	TSS, mg/L	Q, cfs	SC	pH, SU	DO, mg/L	Temp, C	NO3-N, fld	T-P, field	Ortho-P,lab
CH01	UDC	675	17.4	6.04	0.254	6.27	9.71	7.6	2.4	0.24	0.018
CH02	LDC	871	13.9	6.00	0.814	7.25	7.16	10.5	2.1	0.32	0.032
CH03	SPSP	849	3.98	345	0.393	7.31	9.33	8.8	2.5	0.13	0.003
CH04	SPWC	730	5.15	253	0.262	7.03	9.05	8.6	2.0	0.15	0.003
CH05	BCLM	767	9.16	1.94	0.687	7.22	8.67	9.6	2.2	0.25	0.034
CH06	SPCR	920	6.87	263	0.302	7.71	9.20	10.4	2.1	0.18	0.003
CH07	SPPR	921	6.23	259	0.299	7.62	9.11	10.2	2.2	0.19	0.003
CH08	MDCP	884	9.33	3.02	**1.026**	7.90	9.24	12.1	2.6	0.22	0.006
CH09	CCNR	1314	4.96	3.89	0.117	7.44	7.06	15.1	2.0	0.18	0.009
CH10	EPCCC	1284	16.6	13.9	0.102	7.73	7.83	14.8	2.3	0.26	0.003
CH11	EPC25	1247	22.1	21.3	0.192	7.77	7.56	15.9	1.8	0.31	0.012
CH12	EPCCR	1215	**65.9**	25.9	0.217	7.71	7.12	17.0	1.7	**0.79**	0.011
CH13	EPCMB	1151	**80.0**	30.7	0.278	7.72	7.13	16.1	1.5	**0.95**	0.027
CH14	EPC67	1132	**303**	36.1	0.342	7.72	7.35	17.1	1.4	**2.58**	0.043
CH15	PC16	1032	**172**	80.3	0.287	7.67	7.85	14.2	1.5	**1.21**	0.032
CH16	PCTR	921	**94.4**	98.0	0.304	7.36	7.46	11.7	1.8	**1.00**	0.021
CH17	PCCR	943	**93.6**	96.5	0.330	7.44	8.05	11.4	1.6	**0.76**	0.019
CH18	ICRG	1096	40.4	5.20	0.387	7.72	8.33	13.6	1.7	**0.60**	0.019
CH20	JCRD	1454	14.1	14.1	0.098	7.71	7.34	15.9	2.2	0.20	0.016
CH21	BCPP	1369	4.24	1.35	0.092	7.66	9.28	9.9	2.2	0.22	n/a
CH22	WPCRR	1346	6.08	14.4	0.117	7.58	7.42	15.4	2.1	0.29	0.007
CH23	WPCDR	1419	28.5	20.3	0.220	7.77	7.41	17.0	2.3	0.40	0.016
CH24	WPC67	1133	**82.4**	35.1	0.211	7.72	7.71	15.3	1.9	**0.88**	0.010

Table 2 -- Plum Creek Alluvial-Well Data, Average Values, 1990-2000

Item	TIME	TEMPERATURE (DEG C)	SPECIFIC CONDUCTANCE FIELD (US/CM)	OXYGEN, DISSOLVED (MG/L)	pH, FIELD (STANDARD UNITS)	NITROGEN TOTAL (MG/L as N)	PHOSPHORUS, TOTAL (MG/L as P)	PHOSPHORUS ORTHO, TOTAL (MG/L as P)	NITRATE (mg/L as N)	NITRITE (mg/L as N)
Alluvial Well 1W										
Mean	**1101**	**11.3**	**344**	**7.34**	**6.97**	**2.40**	**0.12**	**0.07**	**2.44**	**0.005**
#Values	*27*	*27*	*28*	*19*	*27*	*30*	*30*	*30*	*13*	*13*
Maximum	1400	14.1	475	11.4	8.17	4.7	0.75	0.204	3.51	0.005
Minimum	850	5.0	230	4.8	6.2	0.2	0.01	0.0025	2.08	0.005
Alluvial Well 2W										
Mean	**1085**	**11.9**	**363**	**7.01**	**7.02**	**3.17**	**0.09**	**0.09**	**3.38**	**0.005**
#Values	*27*	*27*	*28*	*19*	*27*	*29*	*29*	*29*	*13*	*13*
Maximum	1415	15.0	963	11.8	8.23	5.1	0.514	0.417	4.07	0.005
Minimum	820	5.0	220	4.76	6.4	0.6	0.02	0.035	2.61	0.005
Alluvial Well 3W										
Mean	**1150**	**11.6**	**362**	**7.32**	**6.97**	**2.75**	**0.17**	**0.16**	**3.58**	**0.005**
#Values	*26*	*26*	*27*	*18*	*26*	*28*	*28*	*28*	*13*	*13*
Maximum	1515	14.8	458	11.4	8.4	4.8	0.5	0.407	4.67	0.005
Minimum	930	5.0	230	4.2	6.1	0.2	0.011	0.0025	2.88	0.005
Alluvial Well 4W										
Mean	**1090**	**15.4**	**252**	**4.04**	**7.26**	**0.35**	**0.01**	**0.01**	**0.02**	**0.005**
#Values	*21*	*20*	*21*	*13*	*20*	*22*	*21*	*22*	*10*	*10*
Maximum	1430	20.9	557	7.6	8.3	3.2	0.052	0.033	0.06	0.005
Minimum	830	9.5	180	2.2	6.5	0.05	0.0025	0.0025	0.01	0.005
Alluvial Well 5W										
Mean	**1078**	**11.4**	**341**	**5.04**	**6.94**	**0.33**	**0.02**	**0.02**	**0.02**	**0.005**
#Values	*26*	*25*	*26*	*17*	*25*	*27*	*26*	*26*	*13*	*13*
Maximum	1550	13.2	925	7.1	8.33	2.3	0.06	0.08	0.04	0.005
Minimum	620	8.0	185	2.8	5.89	0.05	0.0025	0.0025	0.01	0.005
Alluvial Well 6W										
Mean	**1252**	**10.0**	**262**	**4.83**	**7.24**	**0.24**	**0.01**	**0.01**	**n/a**	**n/a**
#Values	*13*	*12*	*12*	*12*	*11*	*13*	*13*	*13*	*0*	*0*
Maximum	1500	19.0	330	6.9	8.2	1.2	0.05	0.05	0	0
Minimum	1030	4.0	170	3.1	6.7	0.05	0.0025	0.0025	0	0

Figure A-1a -- Site CH01, Upper Deer Creek

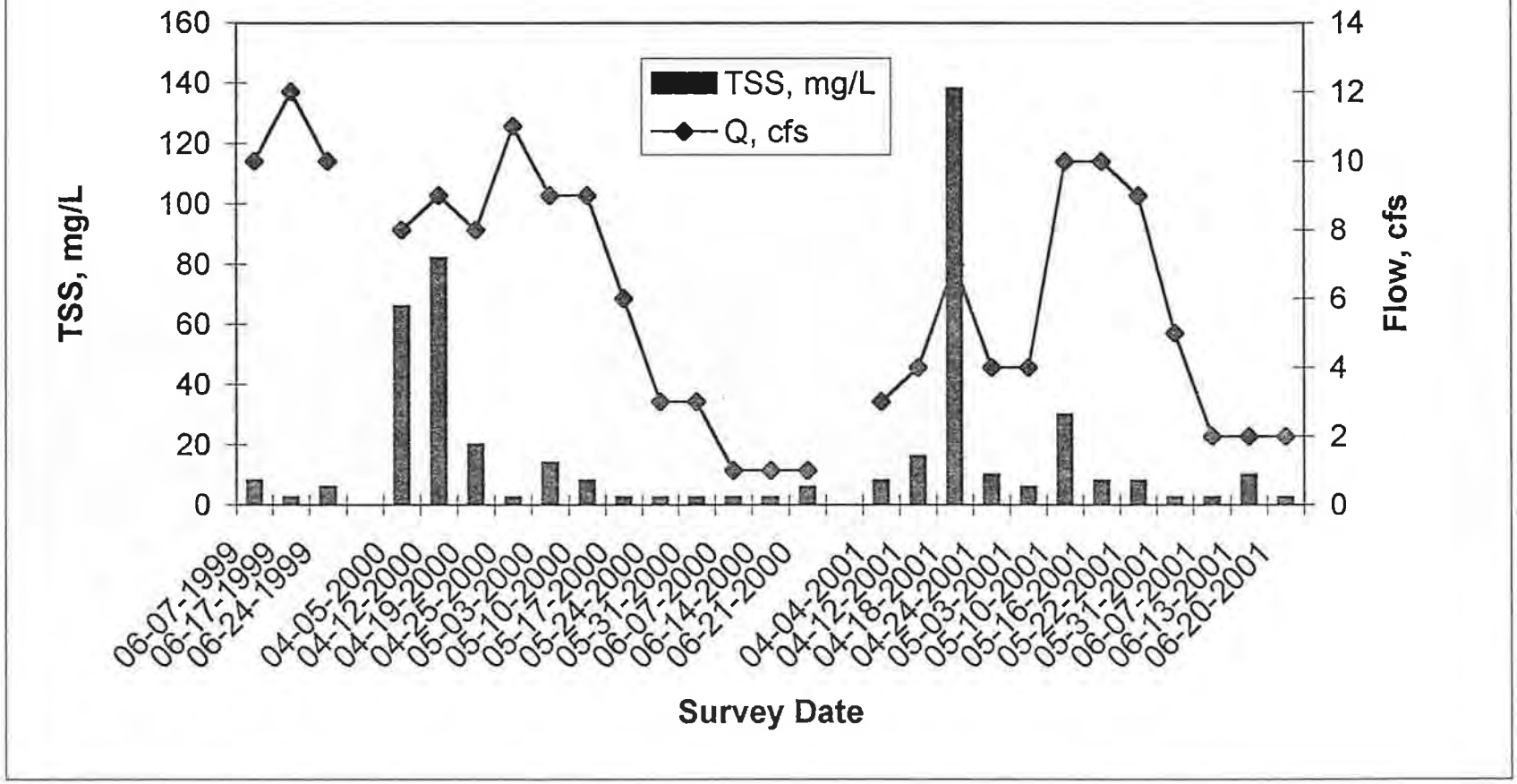


Figure A-1b -- Site CH01, Upper Deer Creek

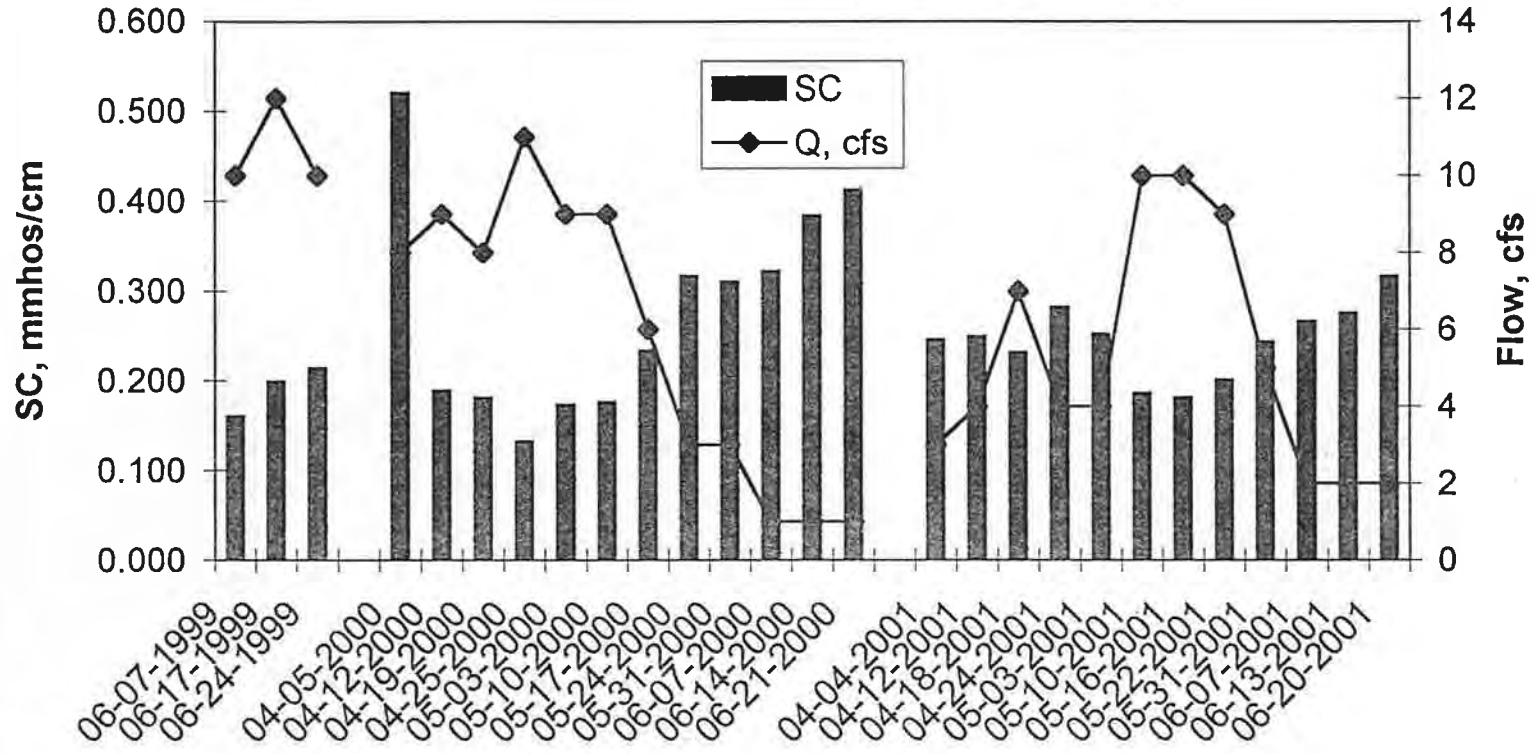
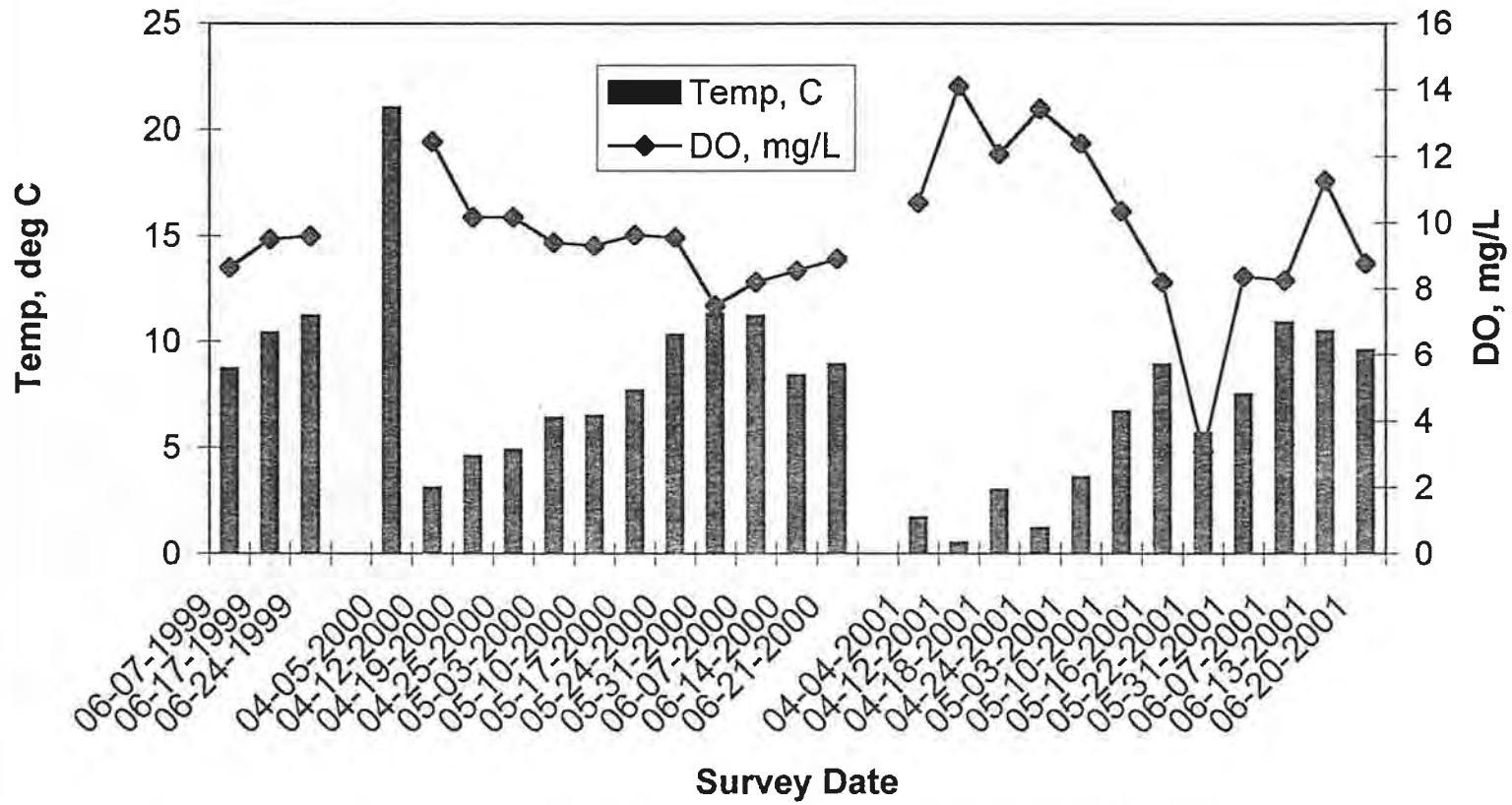


Figure A-1c -- Site CH01, Upper Deer Creek



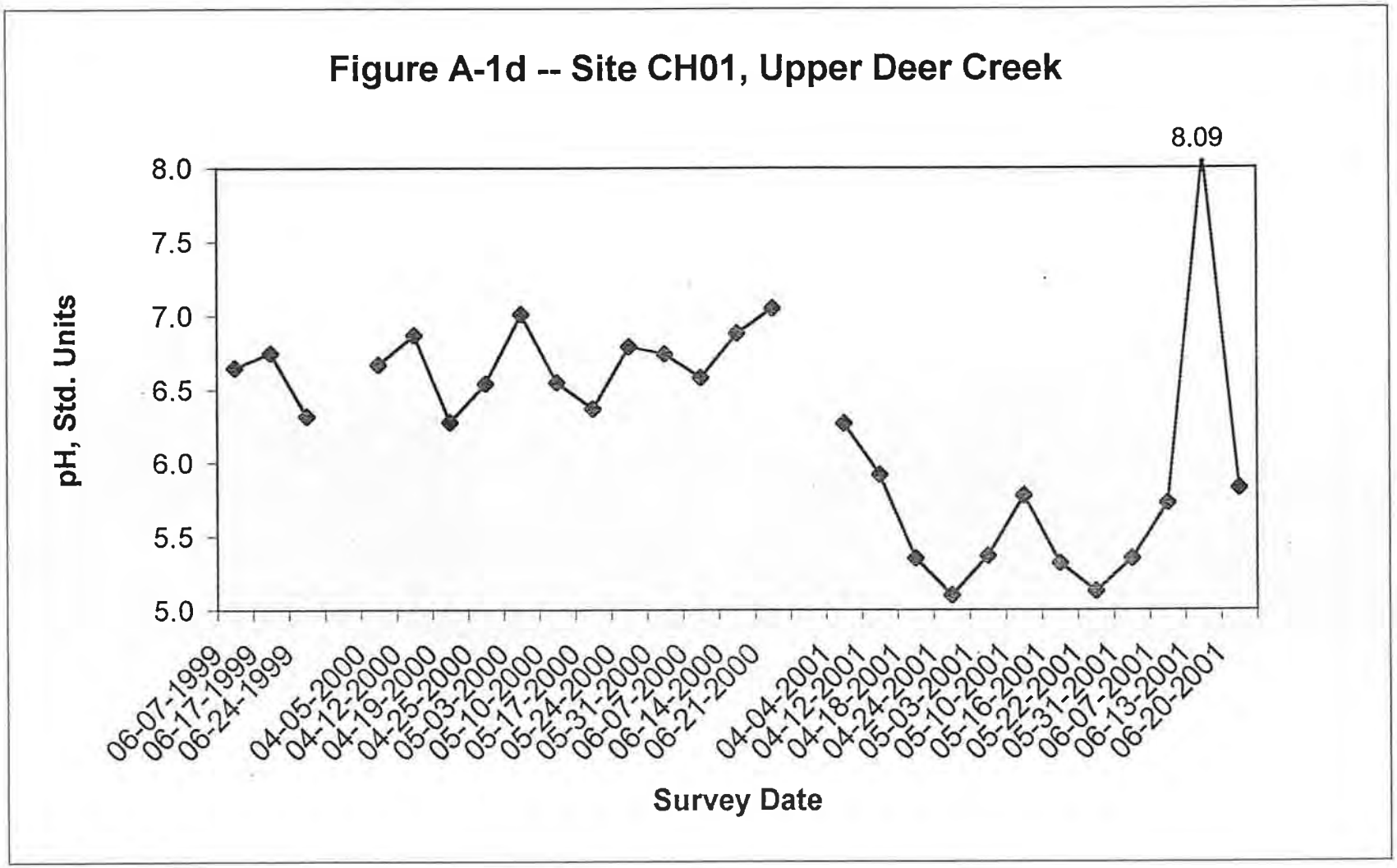


Figure A-1d -- Site CH01, Upper Deer Creek
8.09
8.0
7.5
7.0
6.5
6.0
5.5
5.0
pH, Std. Units
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

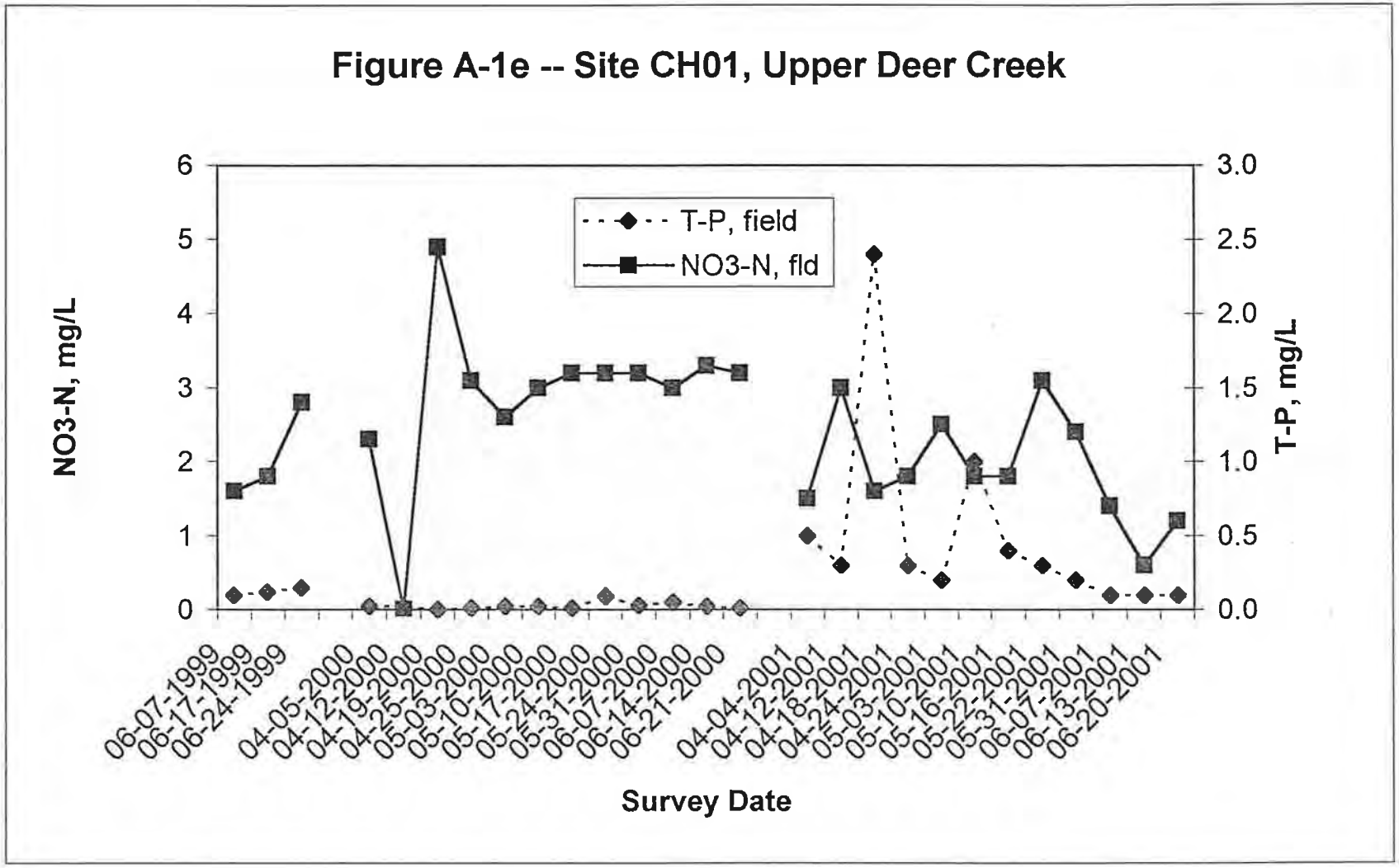


Figure A-1e -- Site CH01, Upper Deer Creek
T-P, field
NO3-N, fld
NO3-N, mg/L
T-P, mg/L
Survey Date
0
1
2
3
4
5
6
0.0
0.5
1.0
1.5
2.0
2.5
3.0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001

Figure A-2a -- Site CH02, Lower Deer Creek

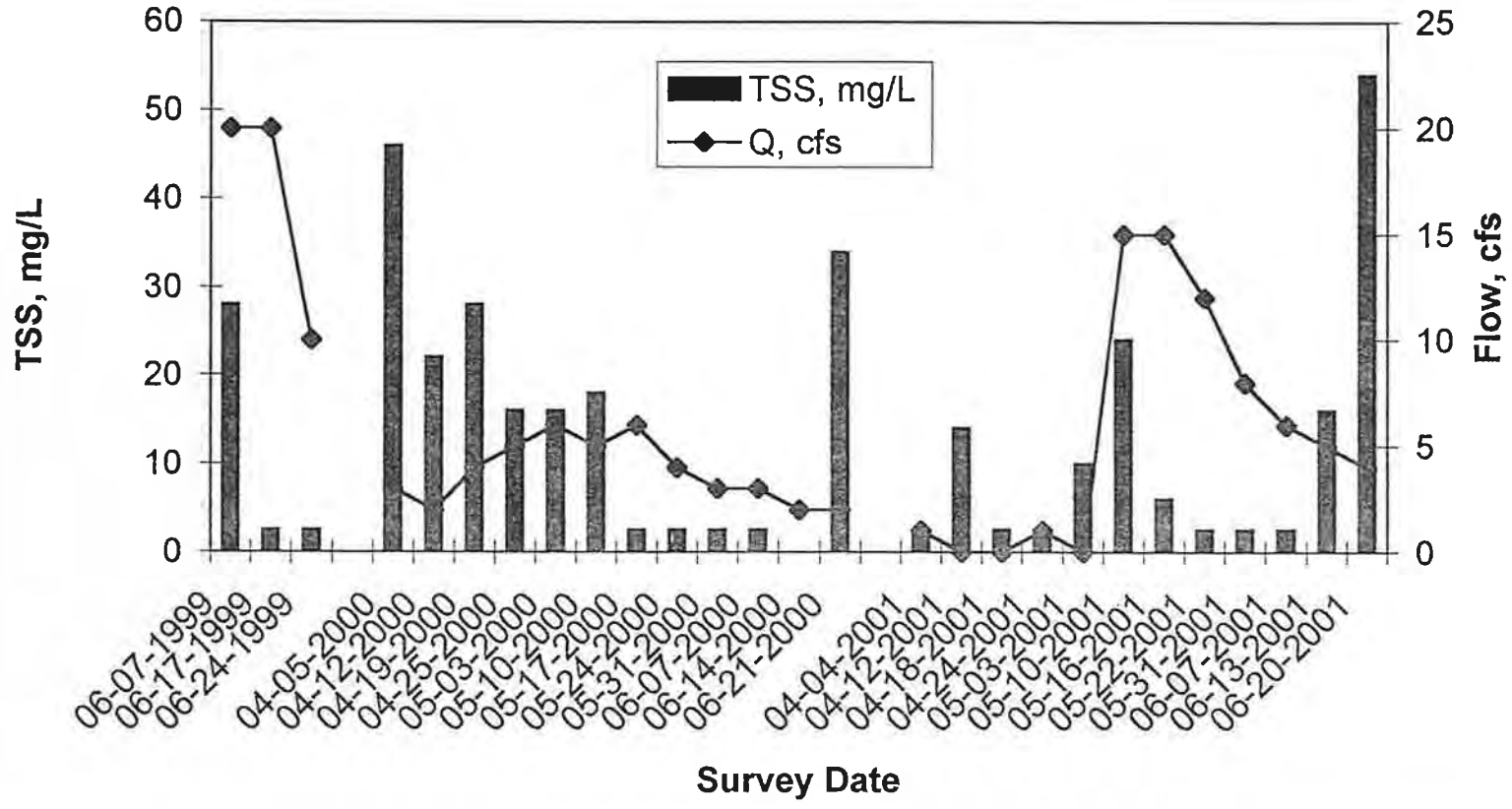


Figure A-2b -- Site CH02, Lower Deer Creek

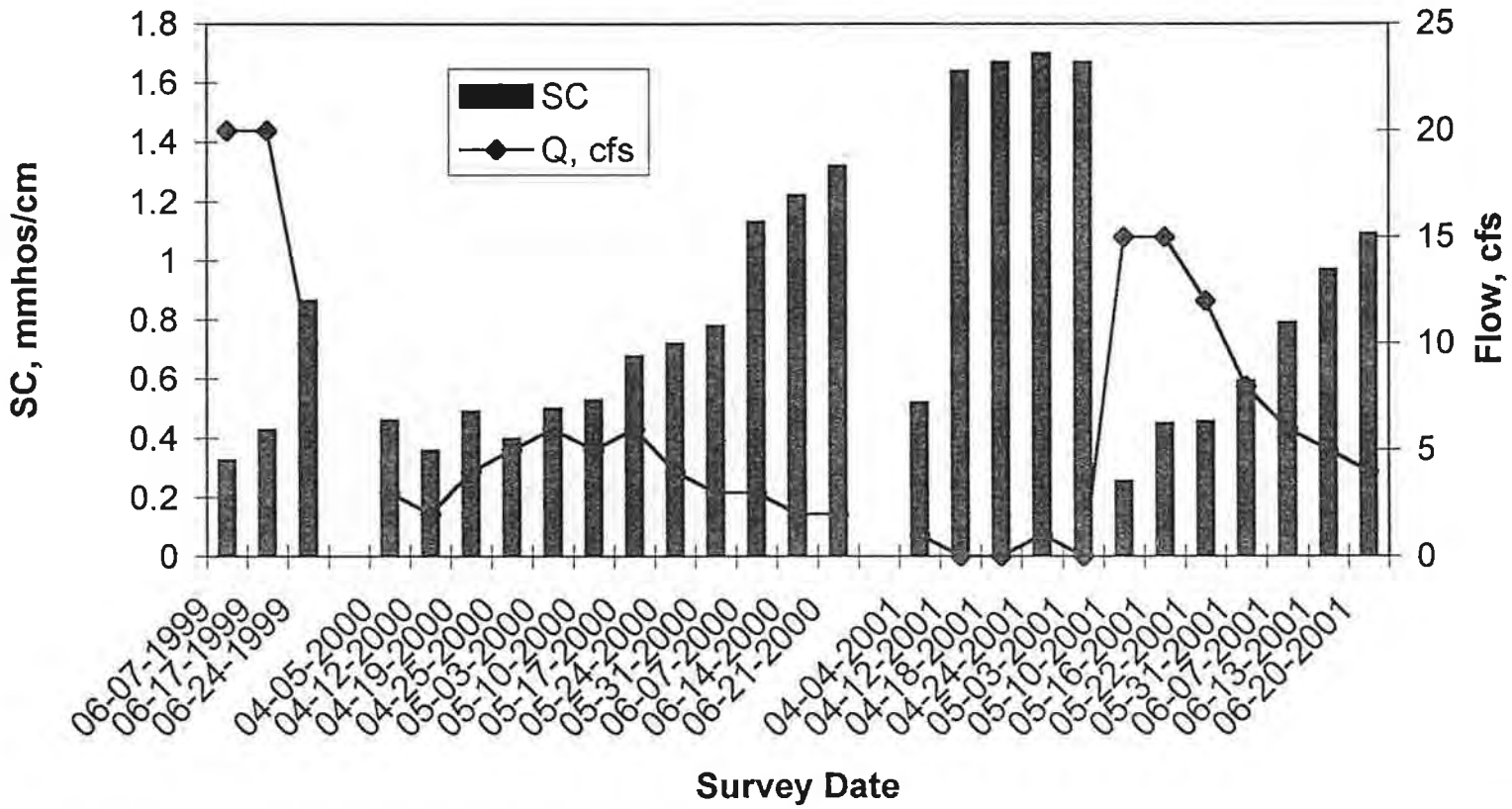


Figure A-2c -- Site CH02, Lower Deer Creek

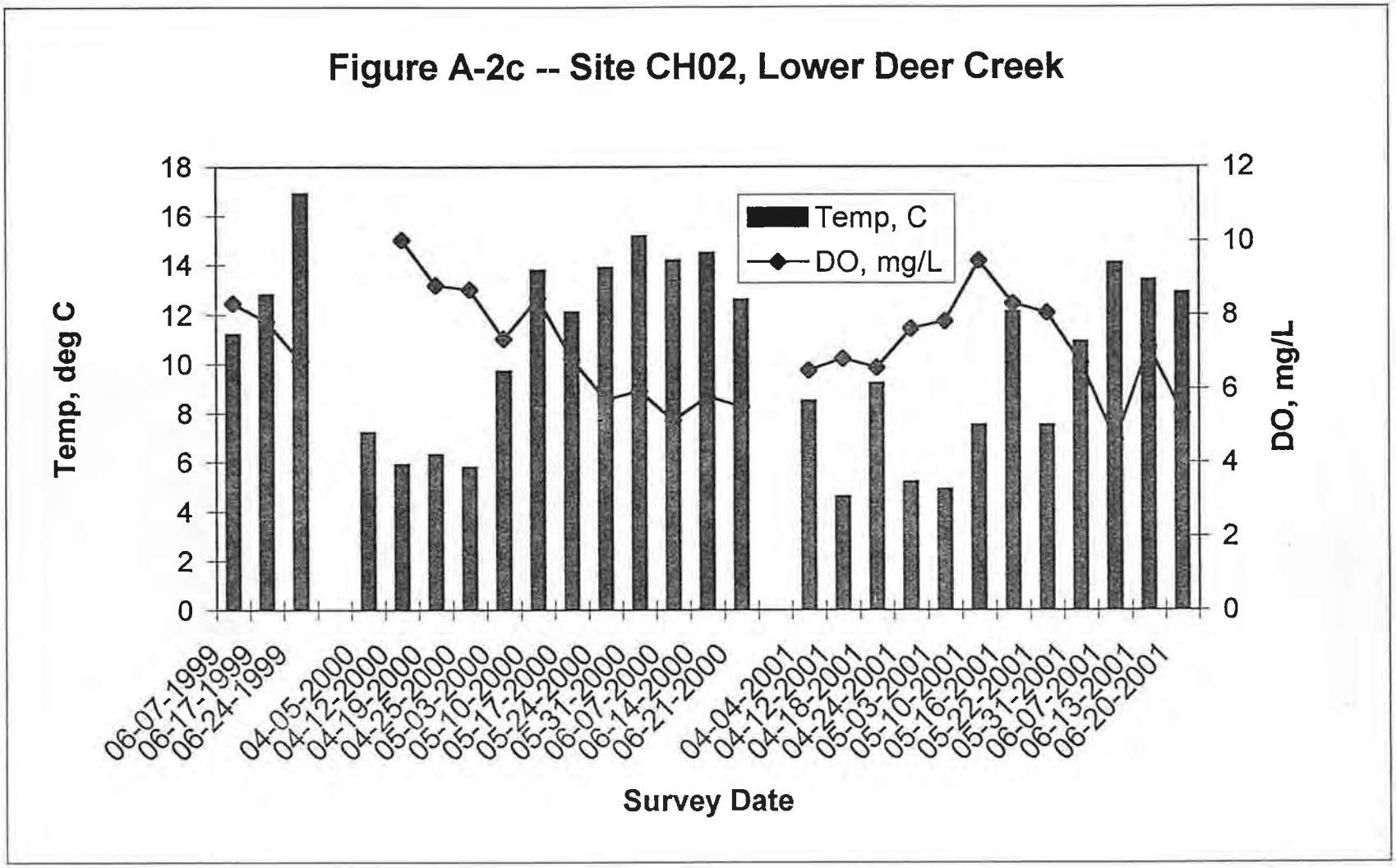


Figure A-2d -- Site CH02, Lower Deer Creek

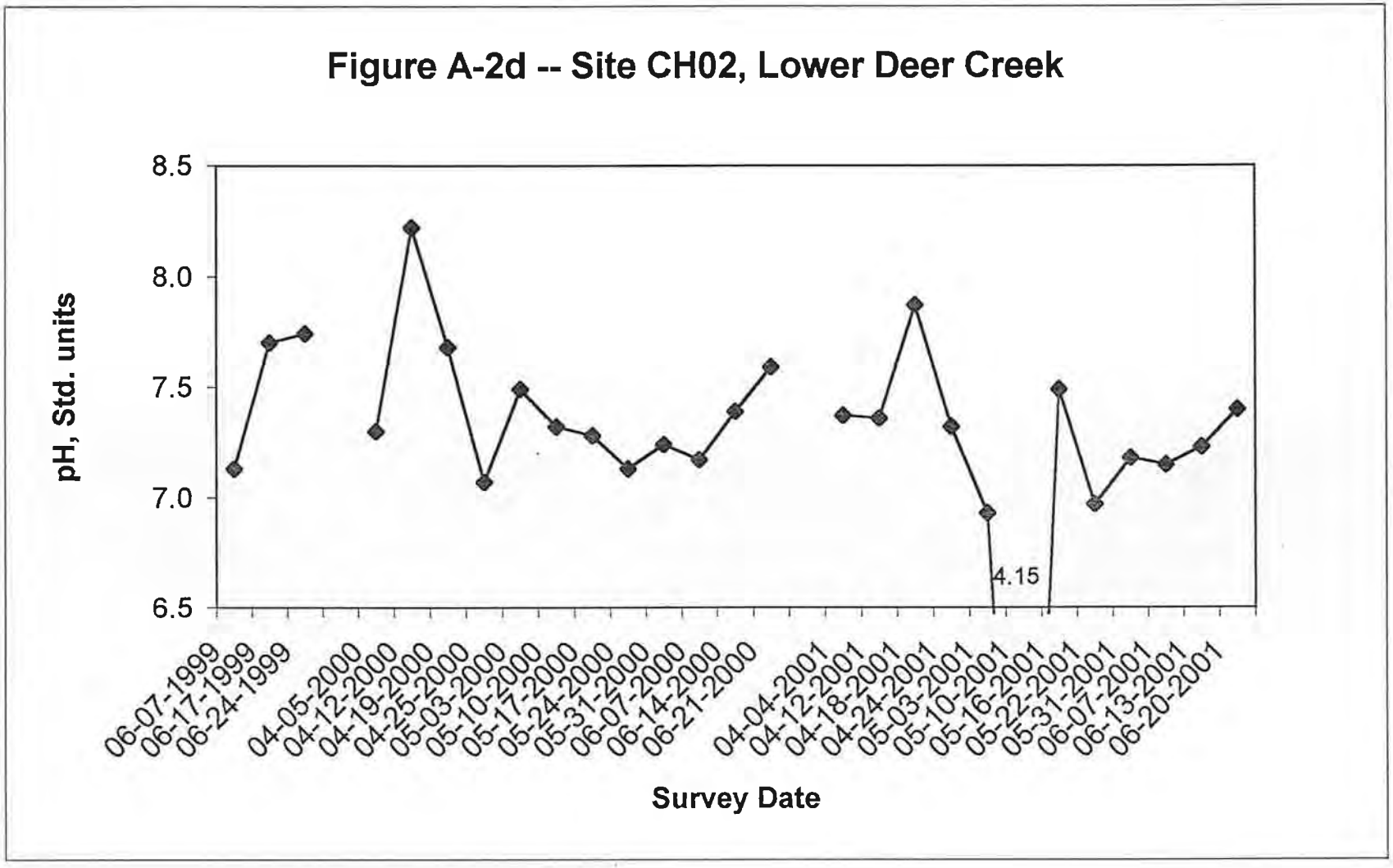
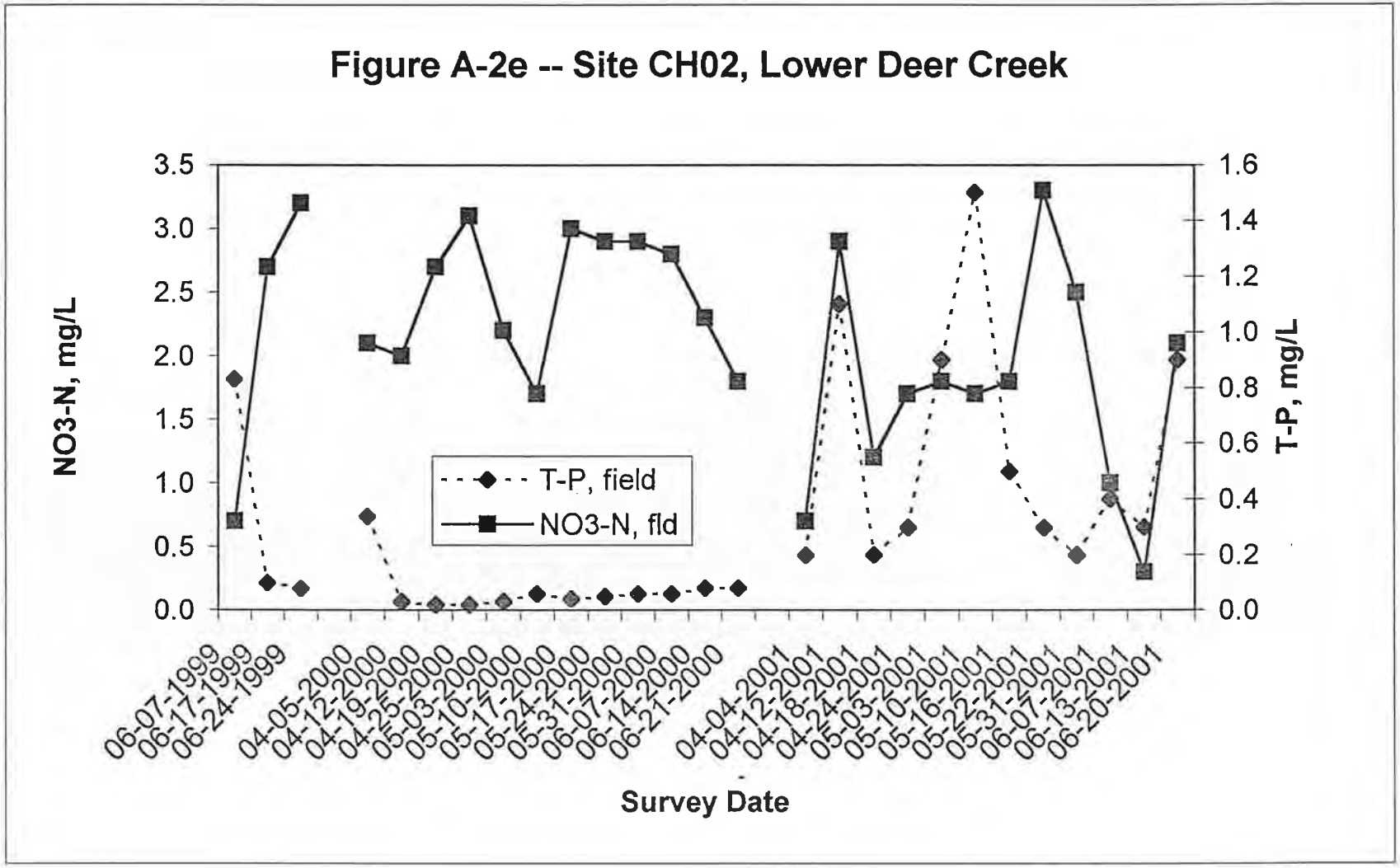


Figure A-2e -- Site CH02, Lower Deer Creek



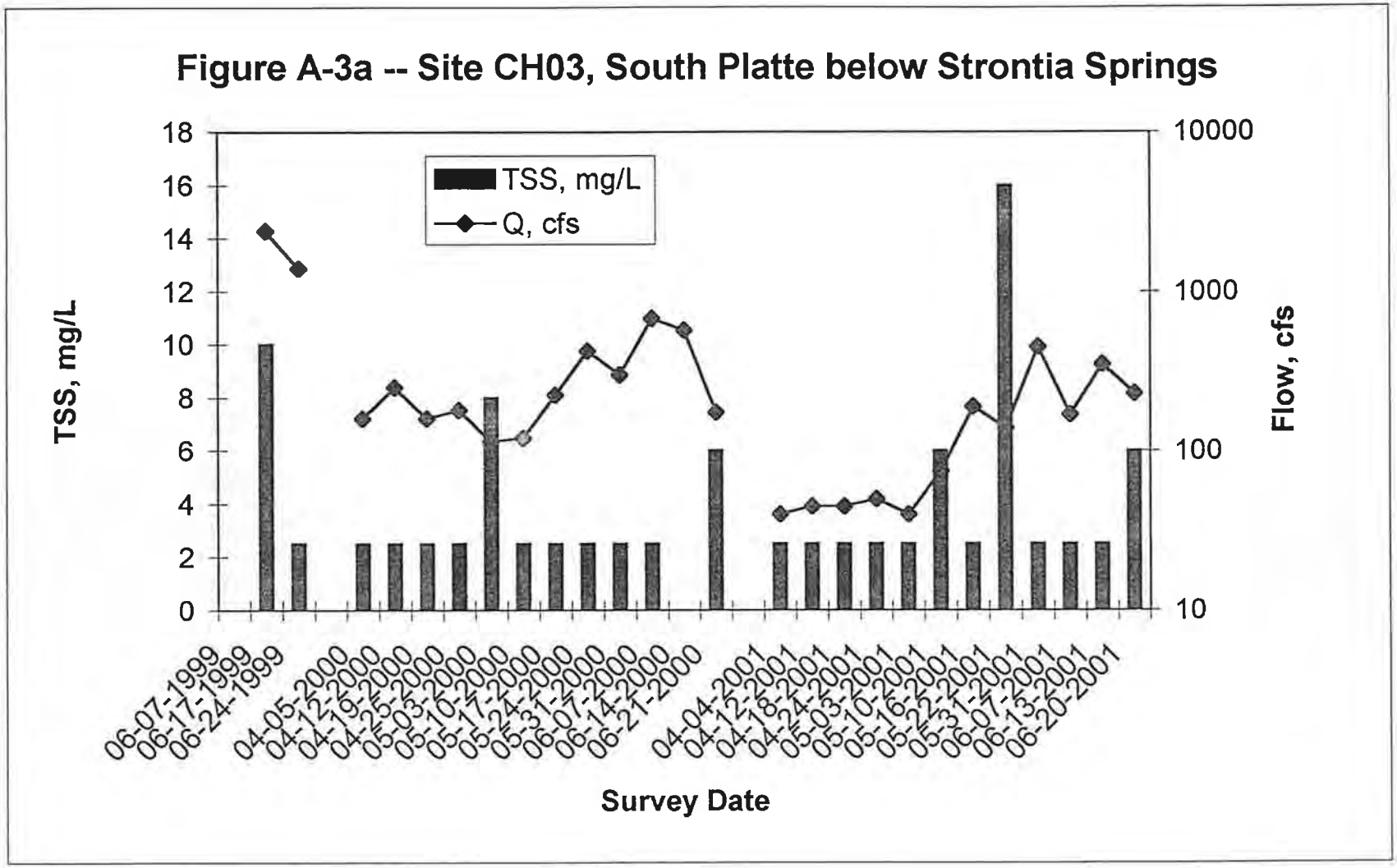


Figure A-3a -- Site CH03, South Platte below Strontia Springs
TSS, mg/L
Q, cfs
TSS, mg/L
Flow, cfs
18
16
14
12
10
8
6
4
2
0
10000
1000
100
10
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

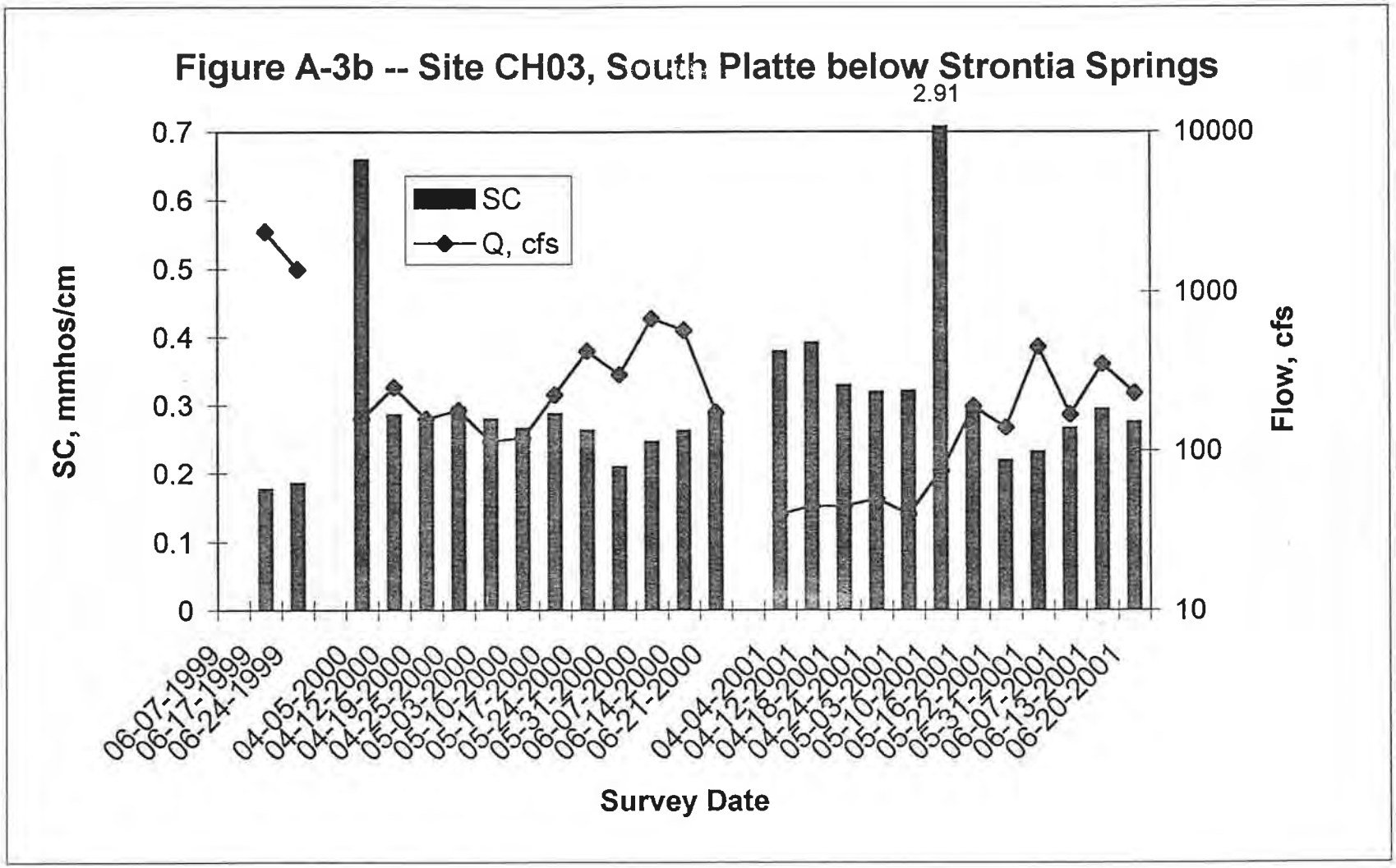
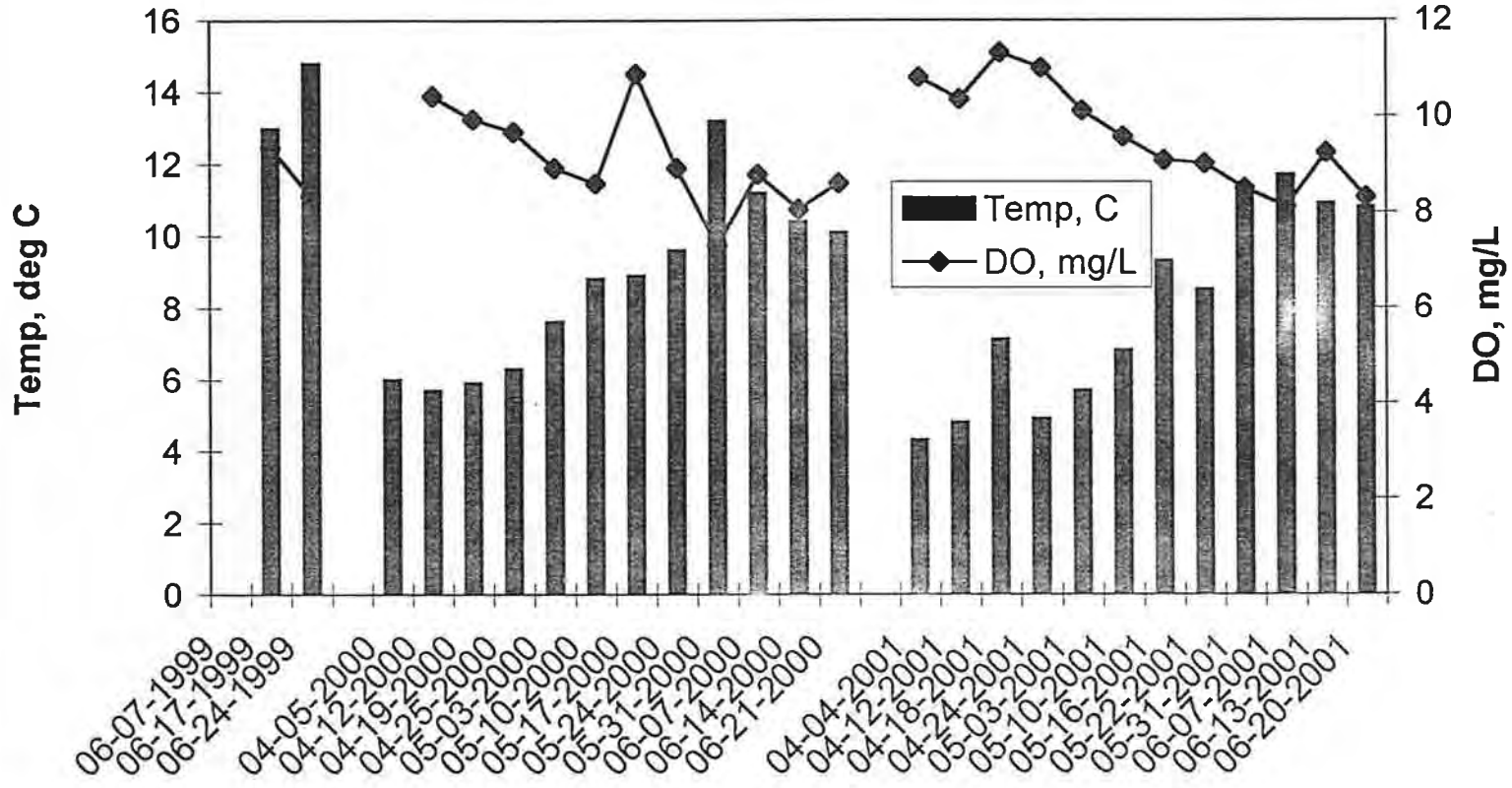


Figure A-3b -- Site CH03, South Platte below Strontia Springs
2.91
SC
Q, cfs
SC, mmhos/cm
Flow, cfs
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10000
1000
100
10
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

Figure A-3c -- Site CH03, South Platte below Strontia Springs



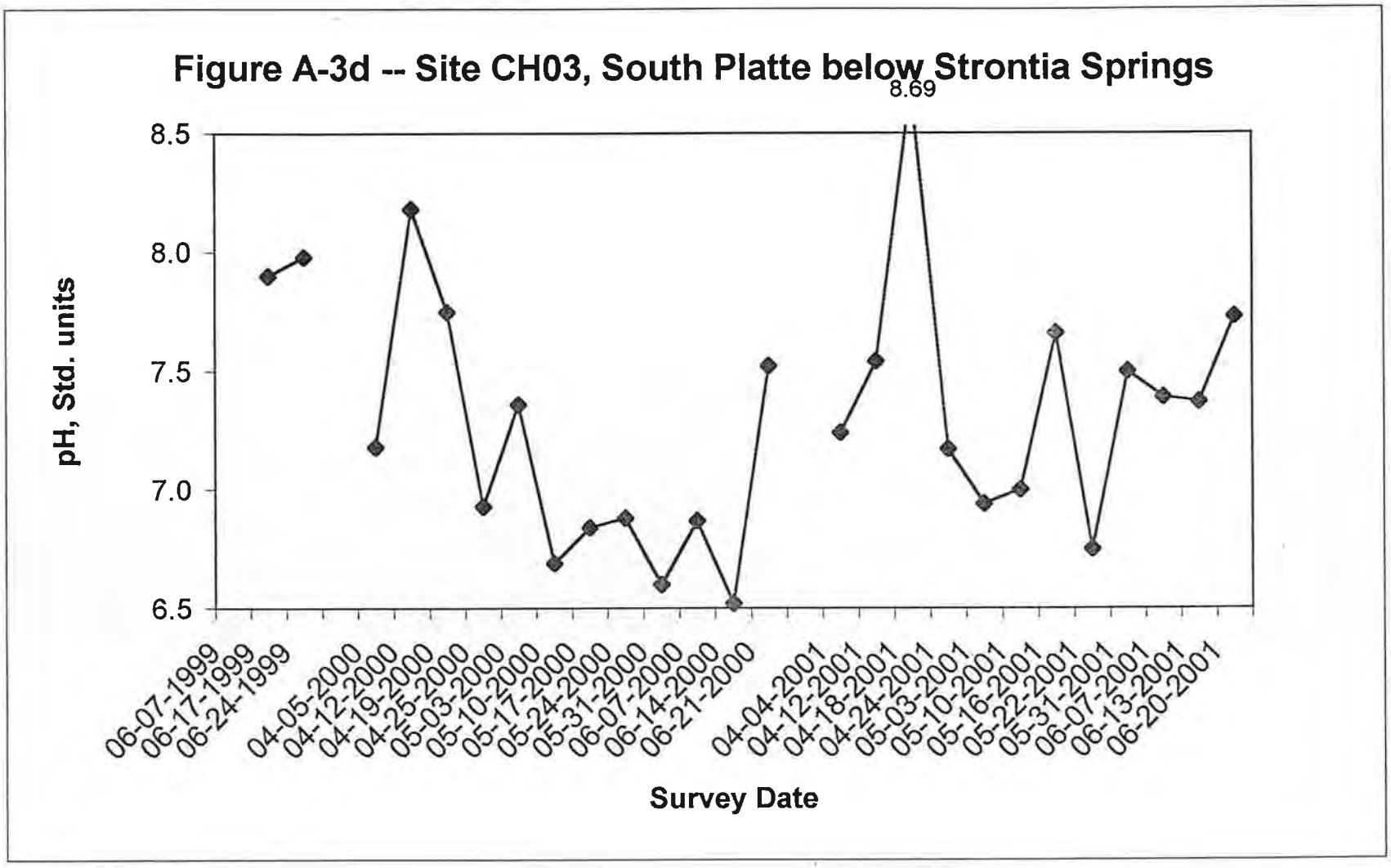


Figure A-3d -- Site CH03, South Platte below Strontia Springs
8.69
8.5
8.0
7.5
7.0
6.5
pH, Std. units
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

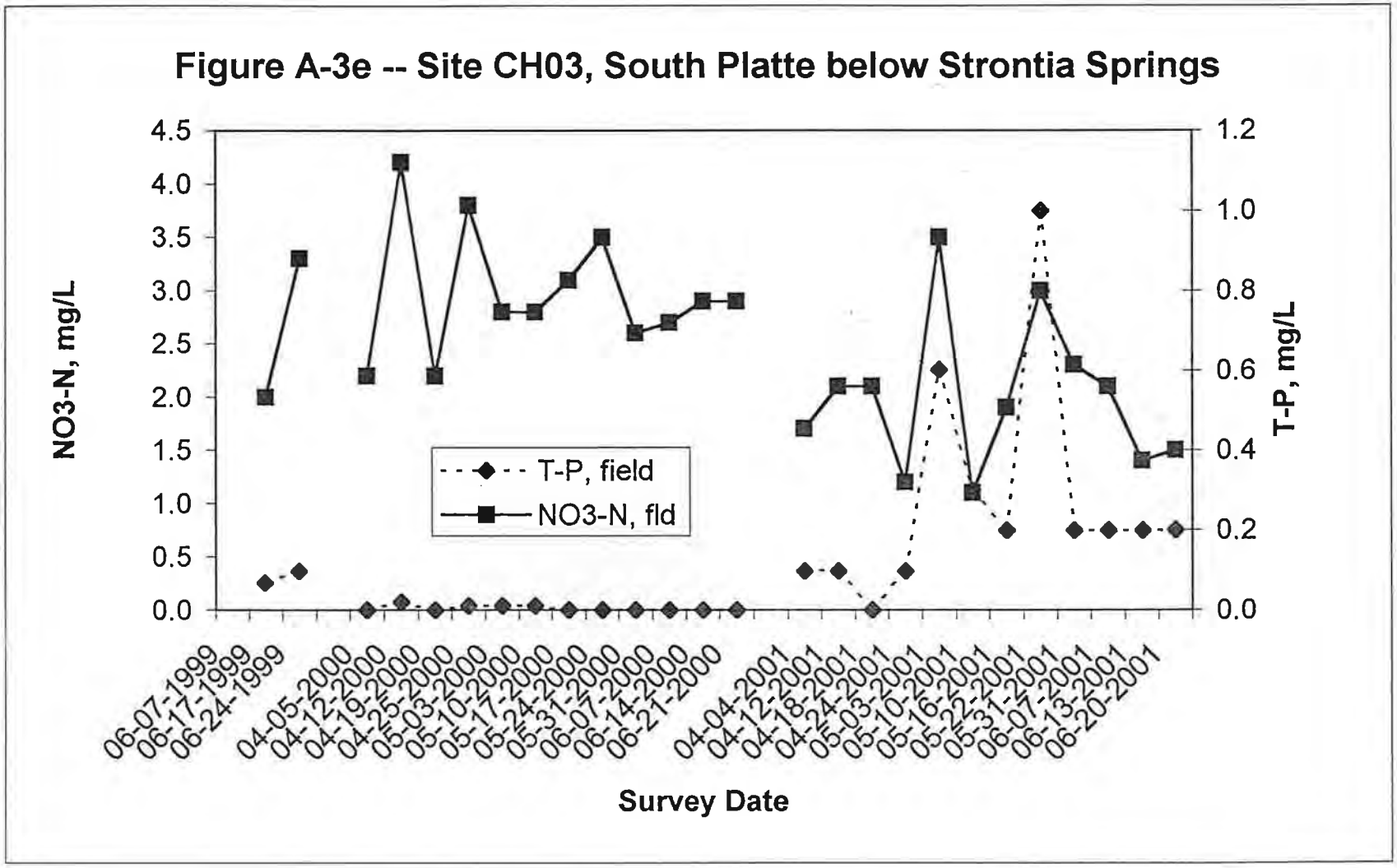


Figure A-3e -- Site CH03, South Platte below Strontia Springs
NO3-N, mg/L
T-P, mg/L
T-P, field
NO3-N, fld
Survey Date
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1.2
1.0
0.8
0.6
0.4
0.2
0.0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001

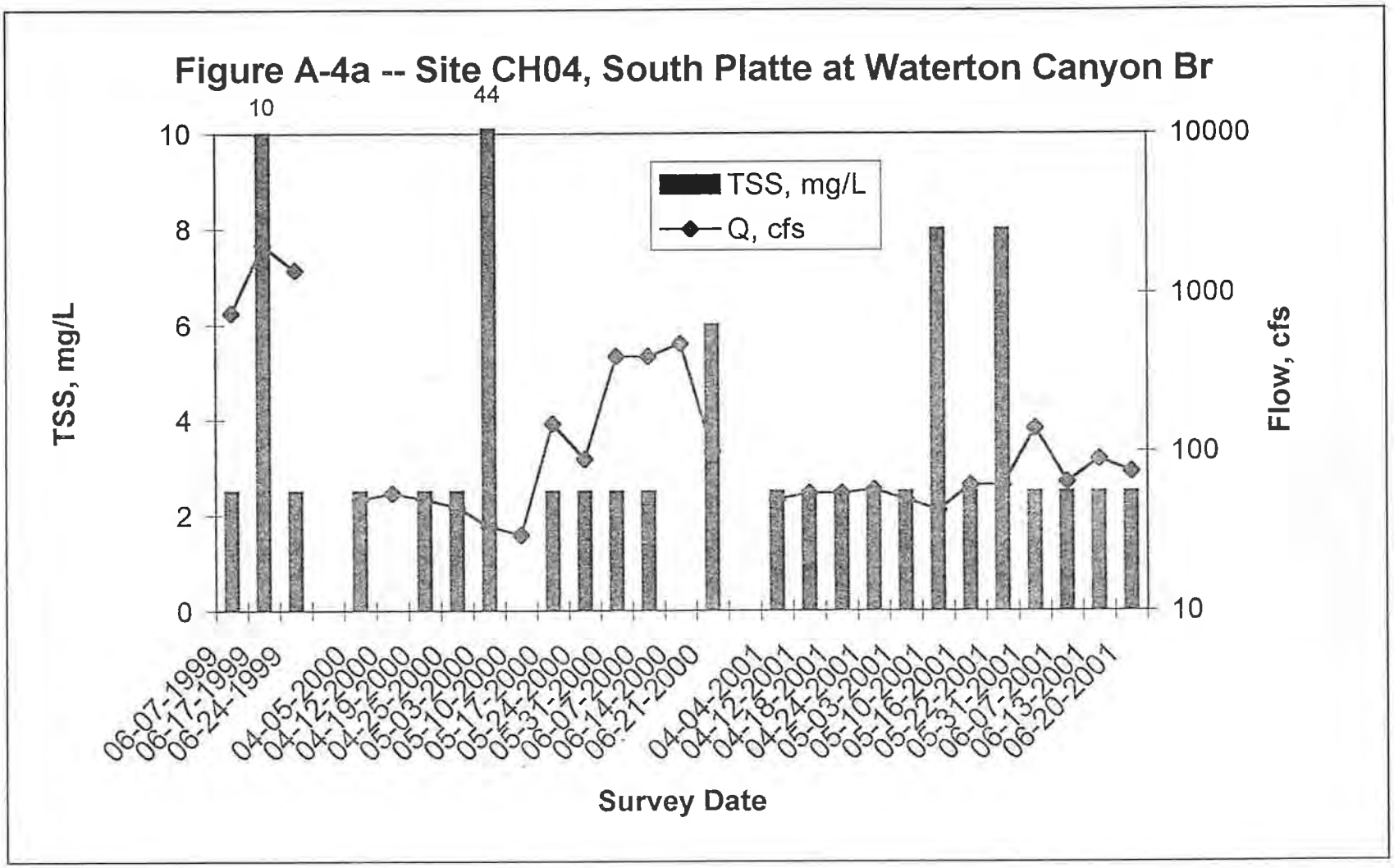


Figure A-4a -- Site CH04, South Platte at Waterton Canyon Br
10
44
TSS, mg/L
Q, cfs
TSS, mg/L
Flow, cfs
0
2
4
6
8
10
10
100
1000
10000
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

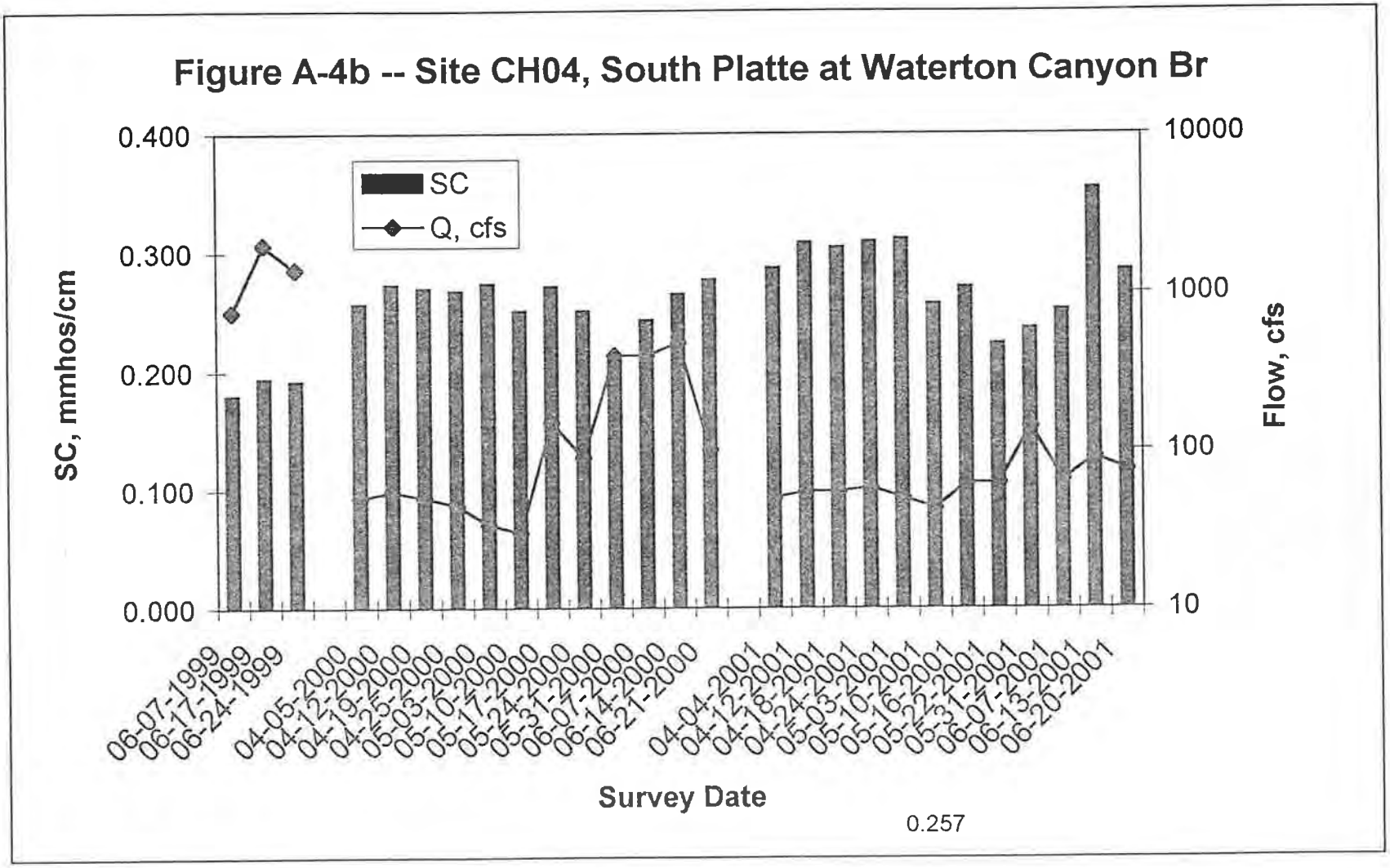


Figure A-4b -- Site CH04, South Platte at Waterton Canyon Br
SC
Q, cfs
SC, mmhos/cm
Flow, cfs
0.400
0.300
0.200
0.100
0.000
10000
1000
100
10
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date
0.257

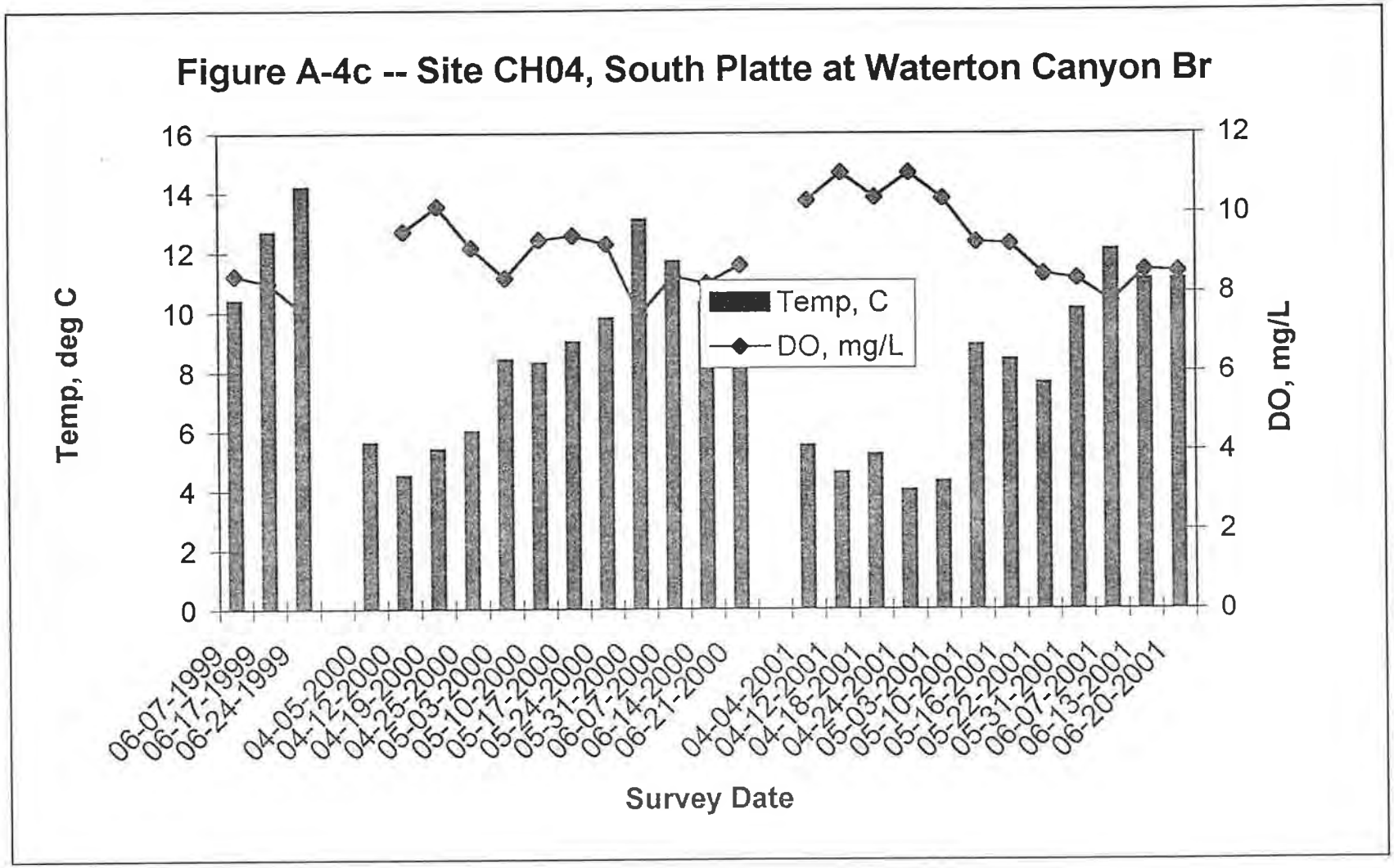


Figure A-4c -- Site CH04, South Platte at Waterton Canyon Br
Temp, deg C
DO, mg/L
Temp, C
DO, mg/L
Survey Date
0
2
4
6
8
10
12
14
16
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001

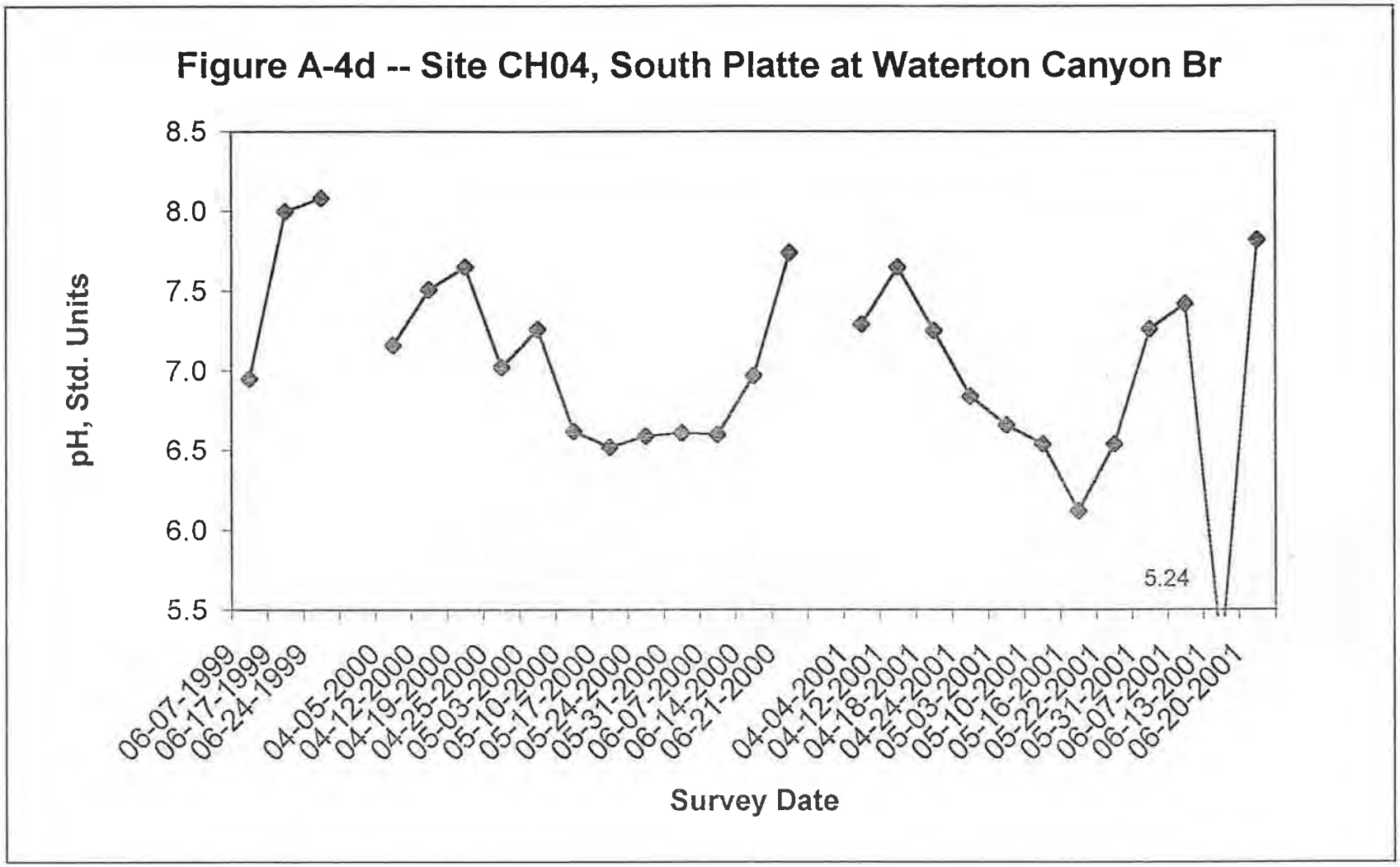


Figure A-4d -- Site CH04, South Platte at Waterton Canyon Br
pH, Std. Units
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.24
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

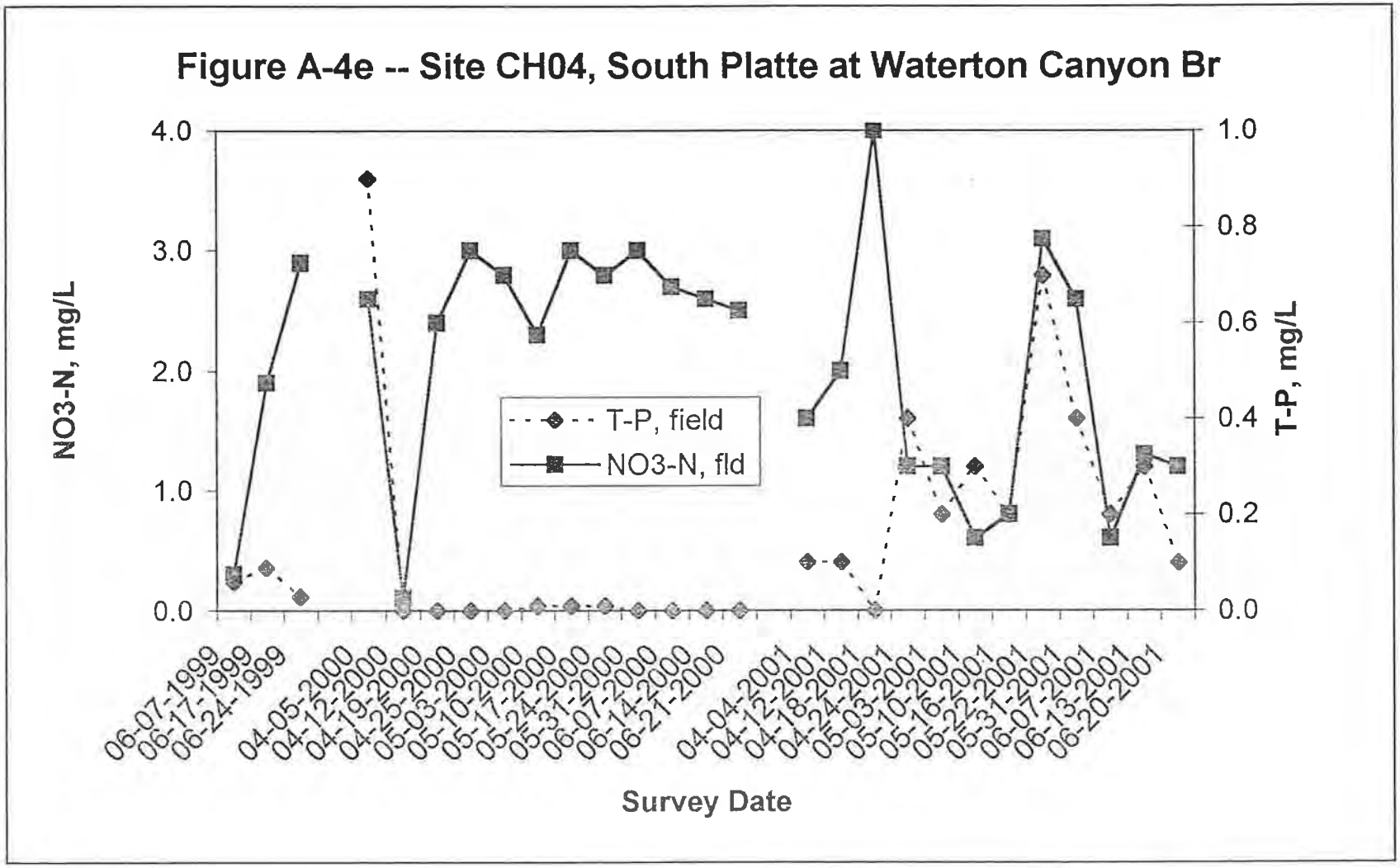


Figure A-4e -- Site CH04, South Platte at Waterton Canyon Br
NO3-N, mg/L
T-P, mg/L
4.0
3.0
2.0
1.0
0.0
1.0
0.8
0.6
0.4
0.2
0.0
T-P, field
NO3-N, fld
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

Figure A-5a -- Site CH05, Brush Creek (Lockhead-Martin)

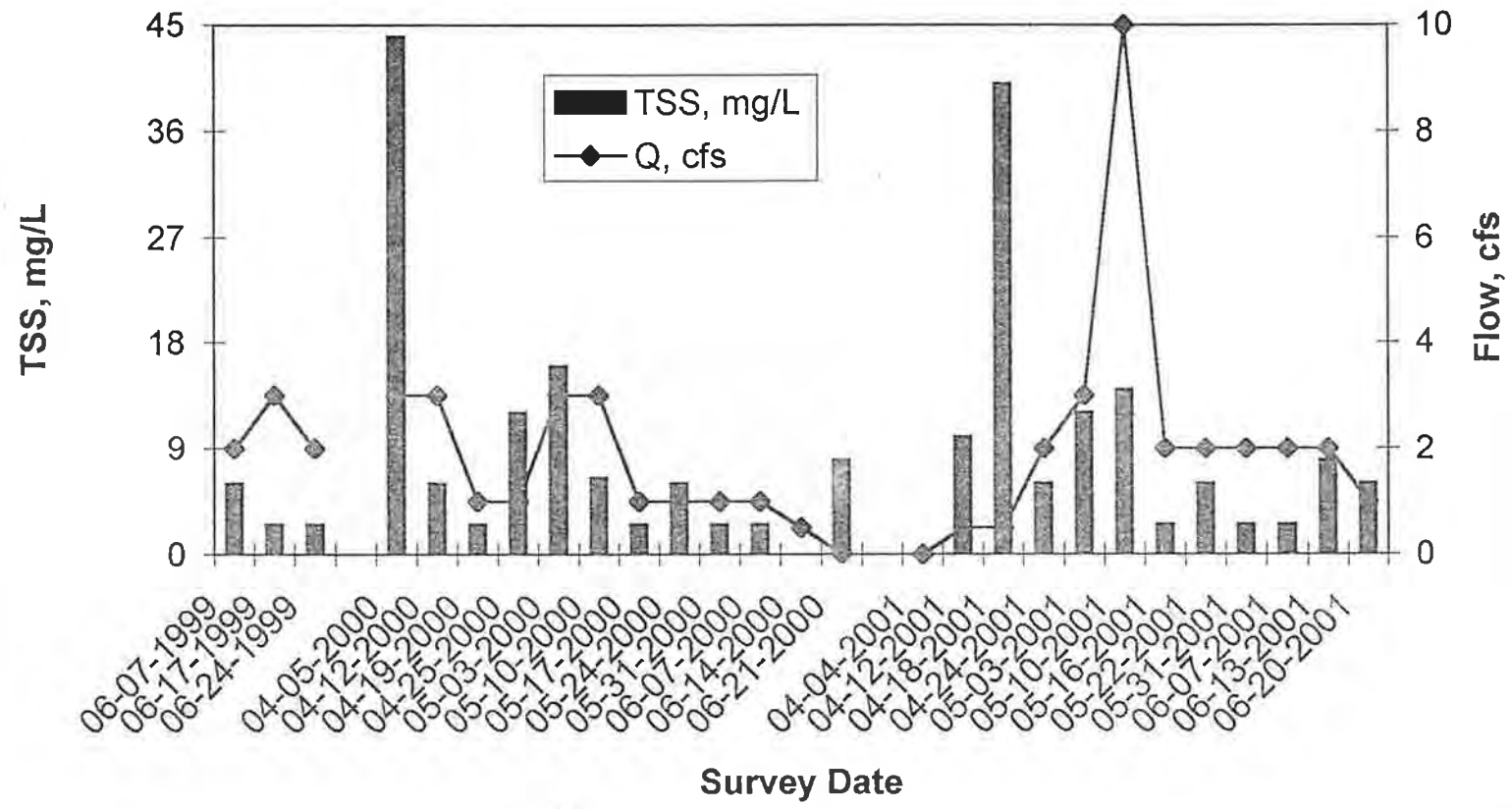


Figure A-5b -- Site CH05, Brush Creek (Lockheed-Martin)

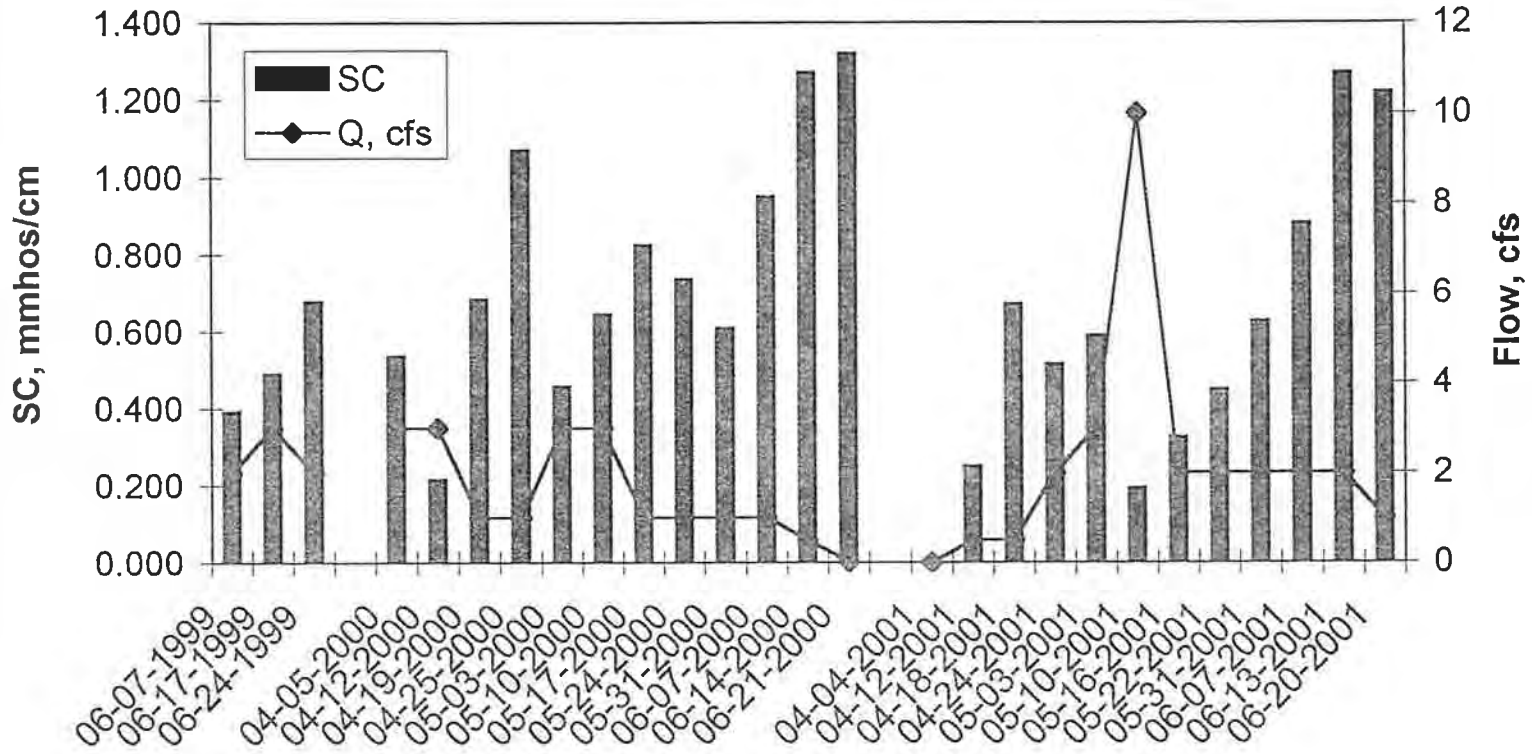


Figure A-5c -- Site CH05, Brush Creek (Lockheed-Martin)

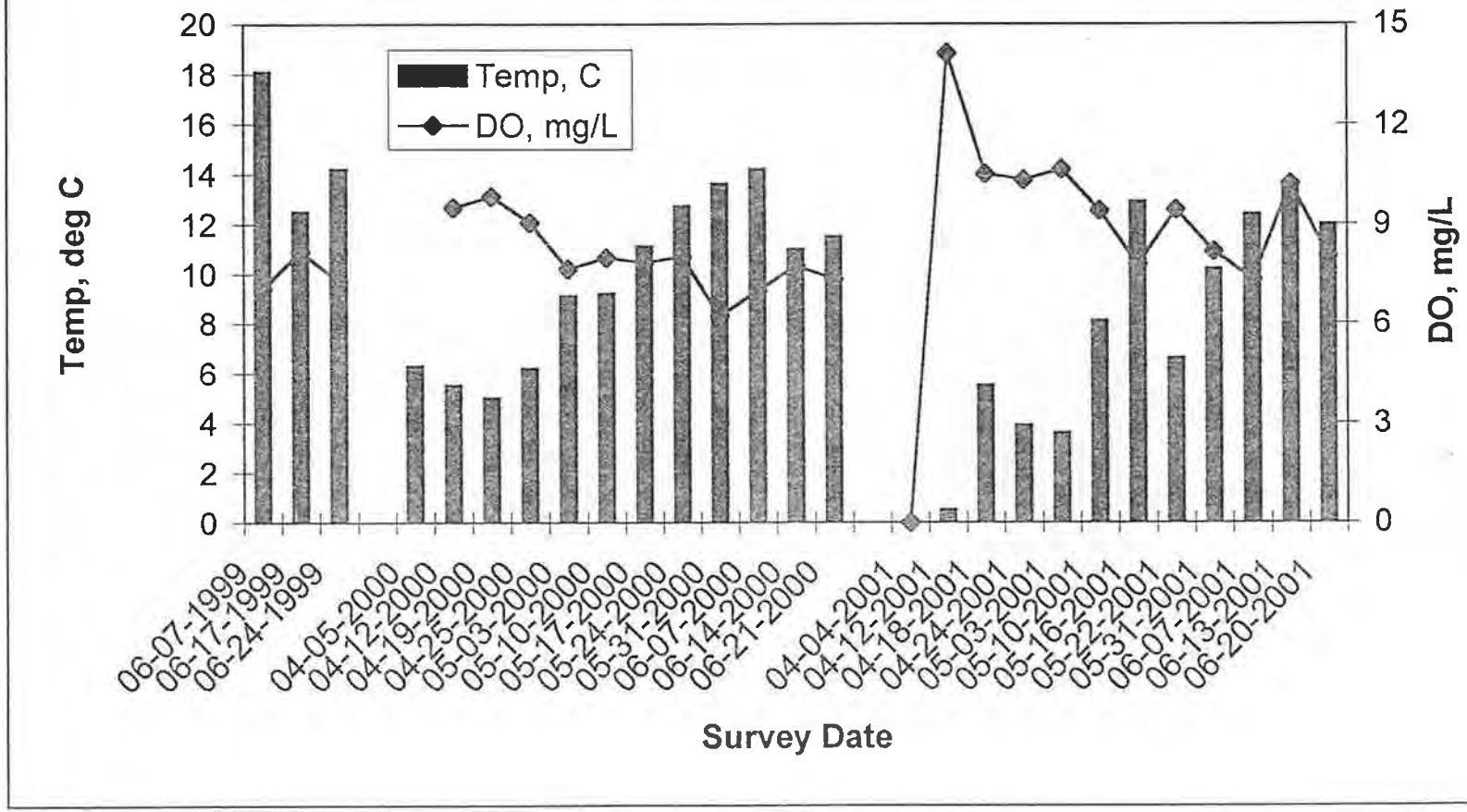


Figure A-5d -- Site CH05, Brush Creek (Lockheed-Martin)

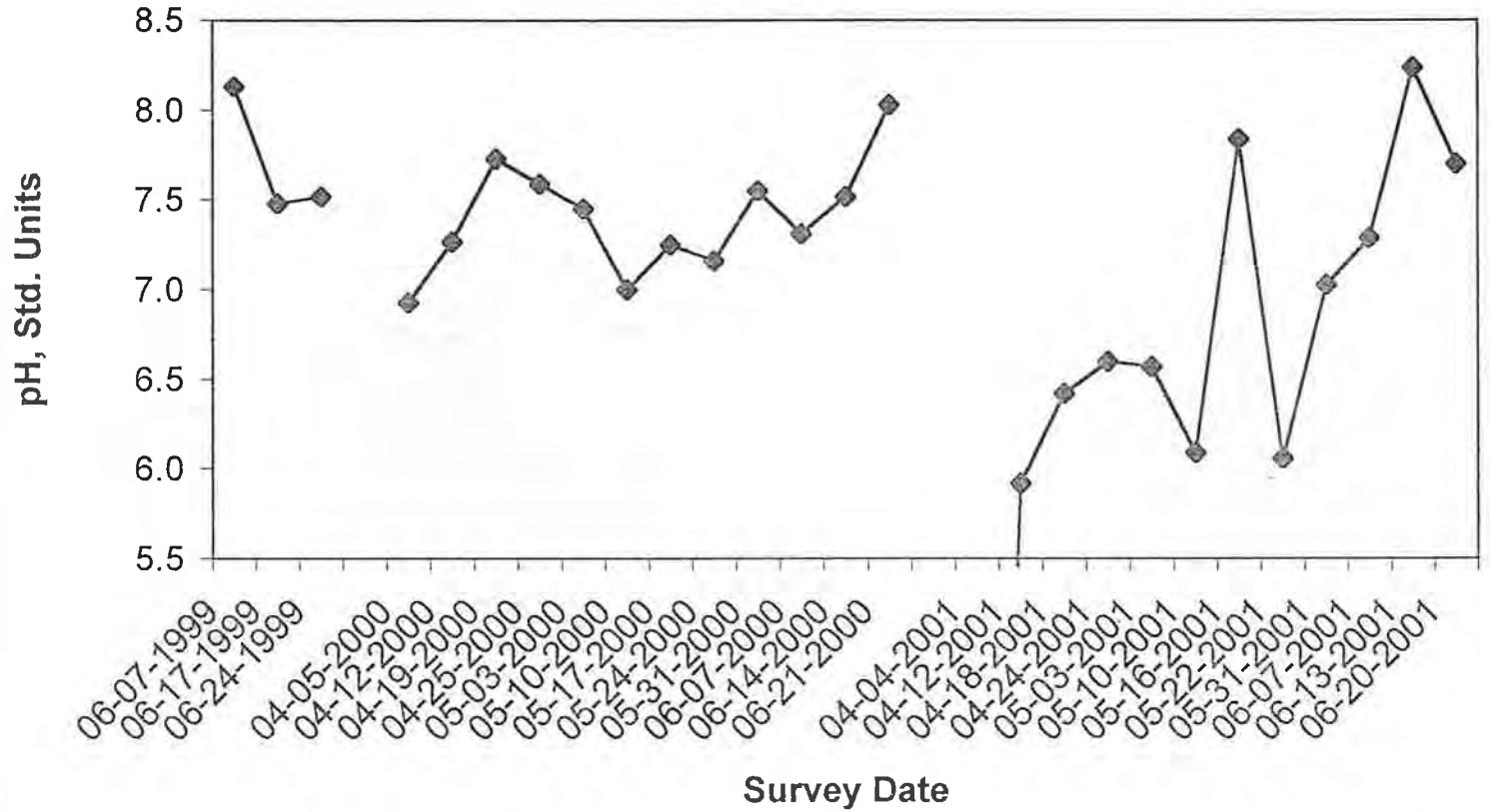
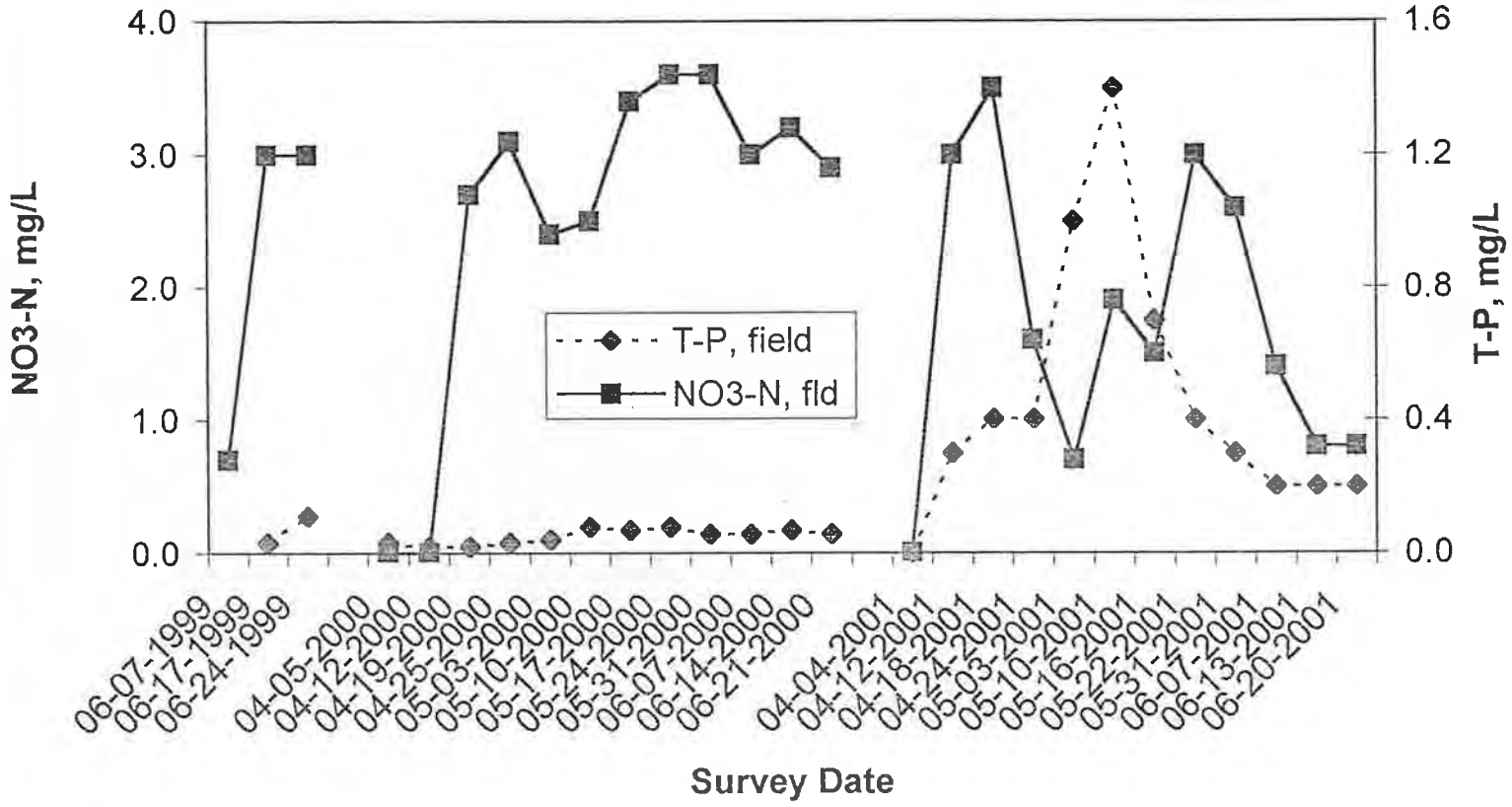


Figure A-5e -- Site CH05, Brush Creek (Lockheed-Martin)



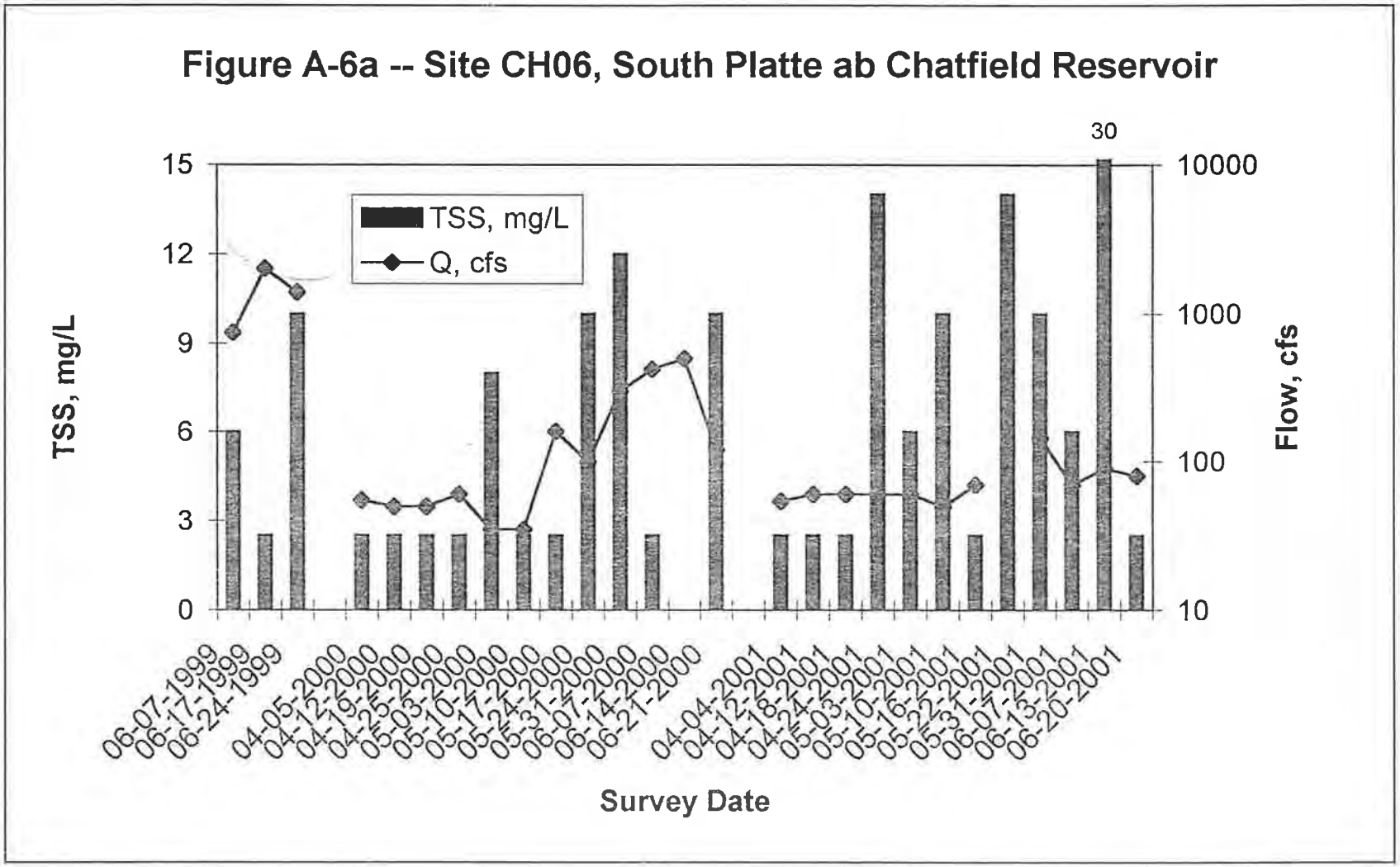


Figure A-6a -- Site CH06, South Platte ab Chatfield Reservoir
TSS, mg/L
Q, cfs
TSS, mg/L
Flow, cfs
Survey Date
0
3
6
9
12
15
10
100
1000
10000
30
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001

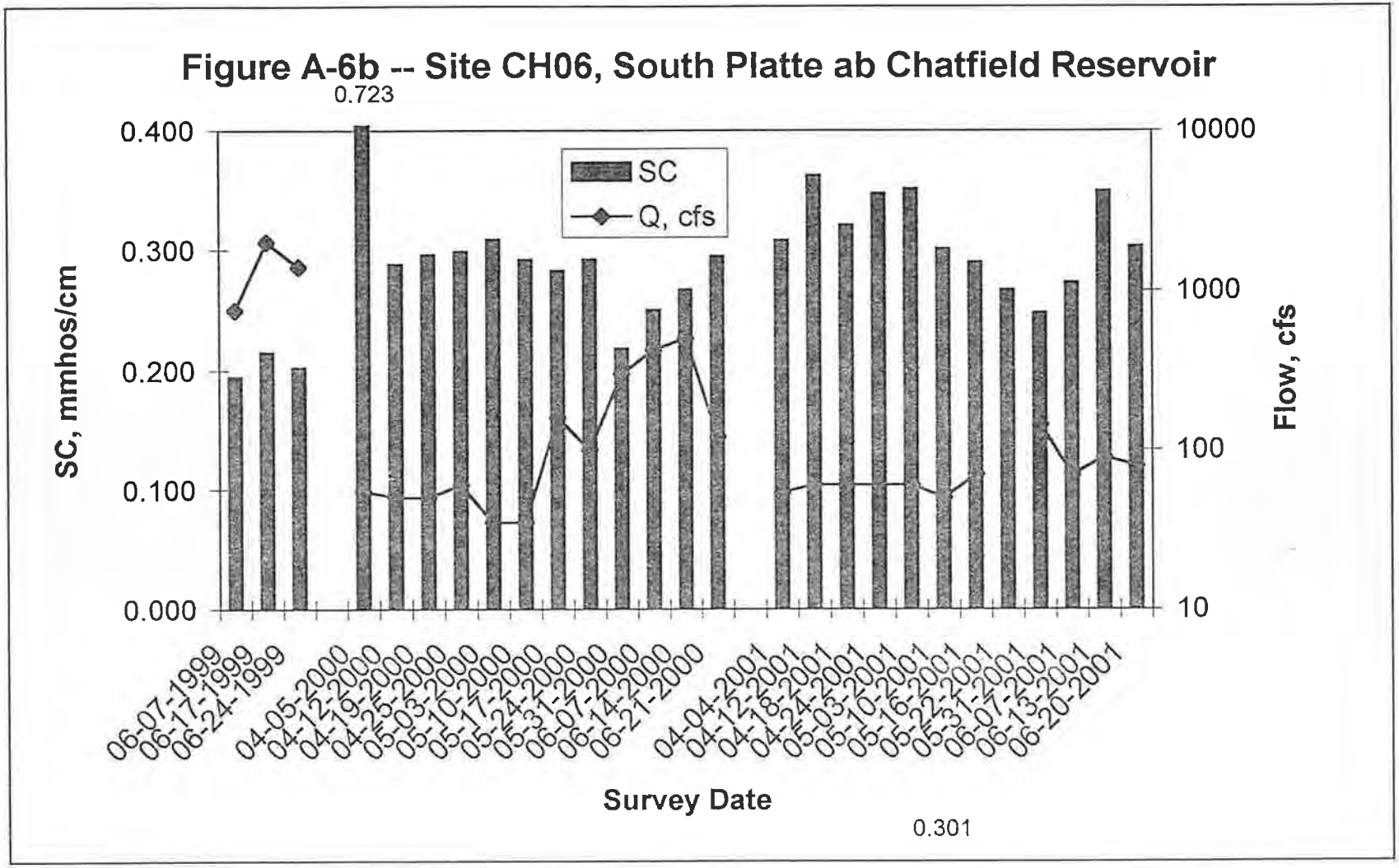
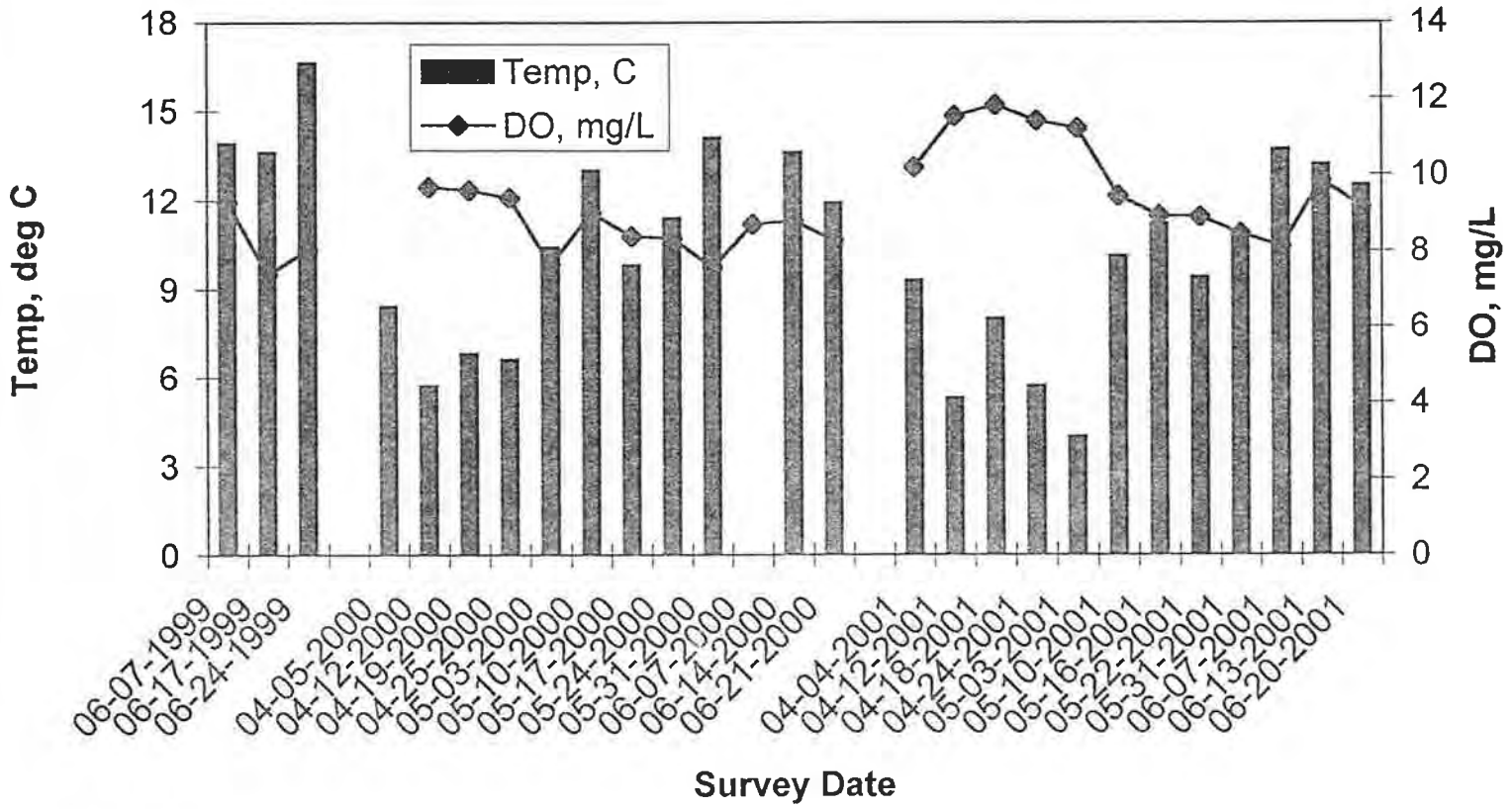


Figure A-6b -- Site CH06, South Platte ab Chatfield Reservoir
0.723
0.400
0.300
0.200
0.100
0.000
SC, mmhos/cm
10000
1000
100
10
Flow, cfs
SC
Q, cfs
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date
0.301

Figure A-6c -- Site CH06, South Platte ab Chatfield Reservoir



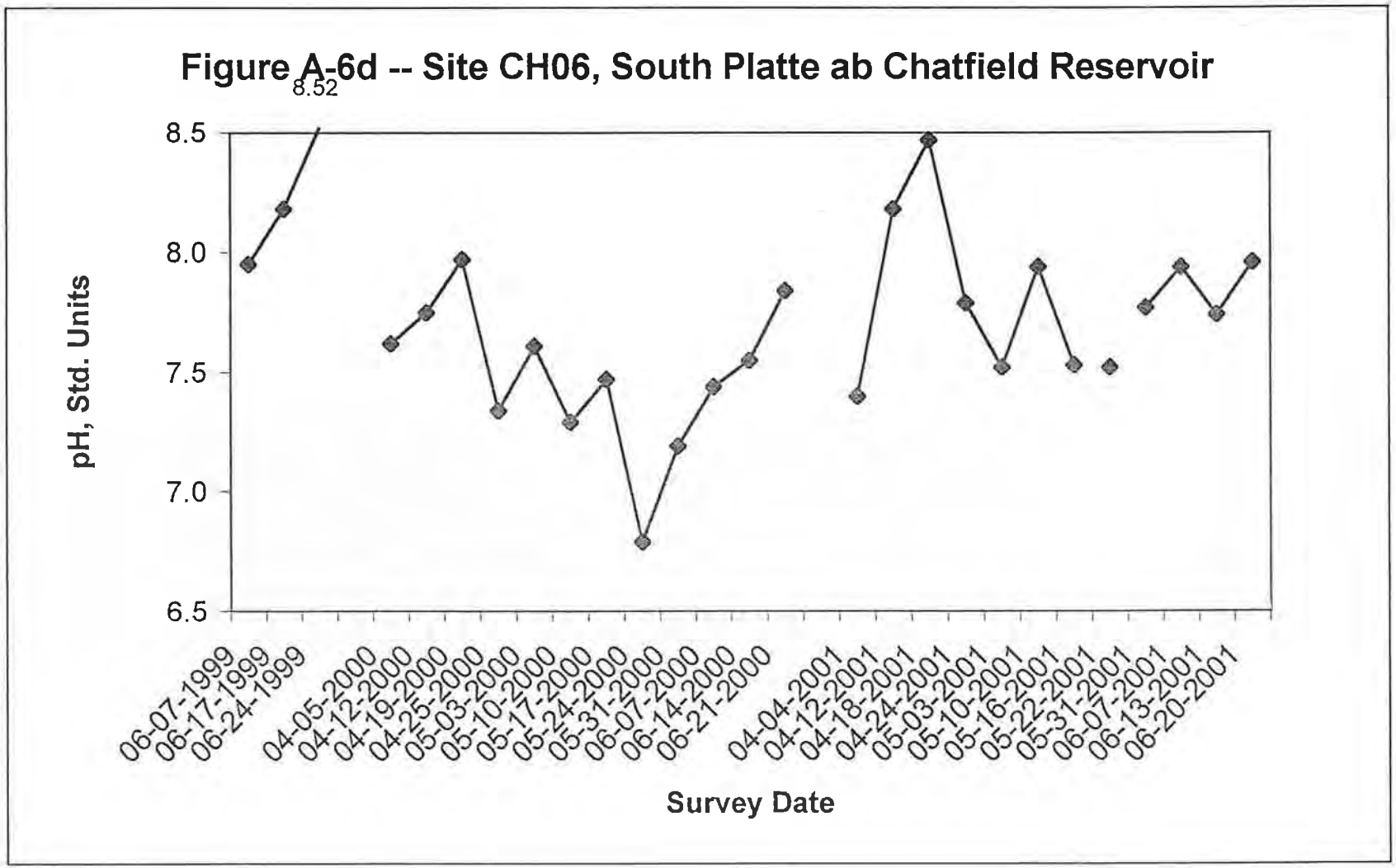
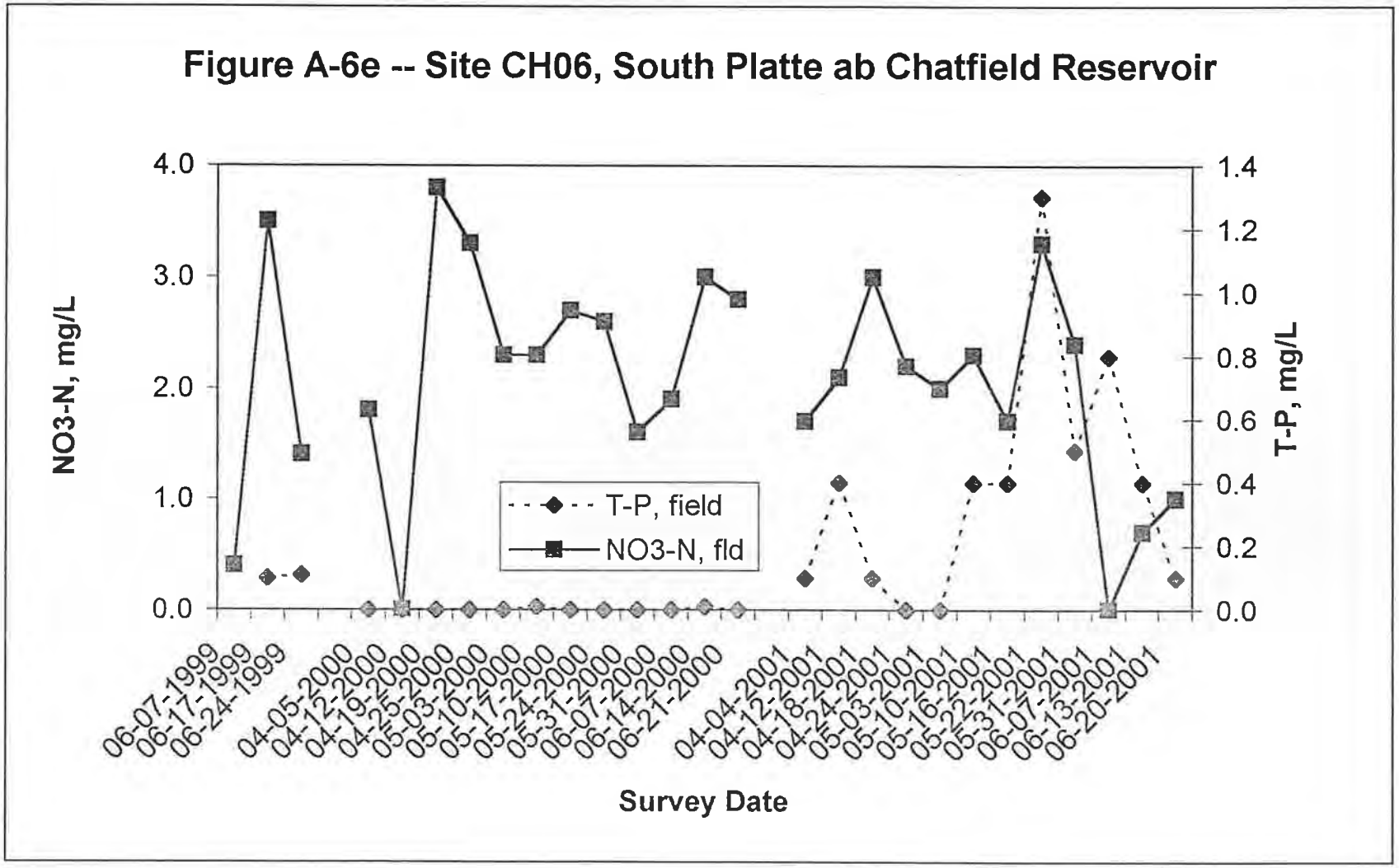


Figure A-6d -- Site CH06, South Platte ab Chatfield Reservoir
8.52
8.5
8.0
7.5
7.0
6.5
pH, Std. Units
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

Figure A-6e -- Site CH06, South Platte ab Chatfield Reservoir



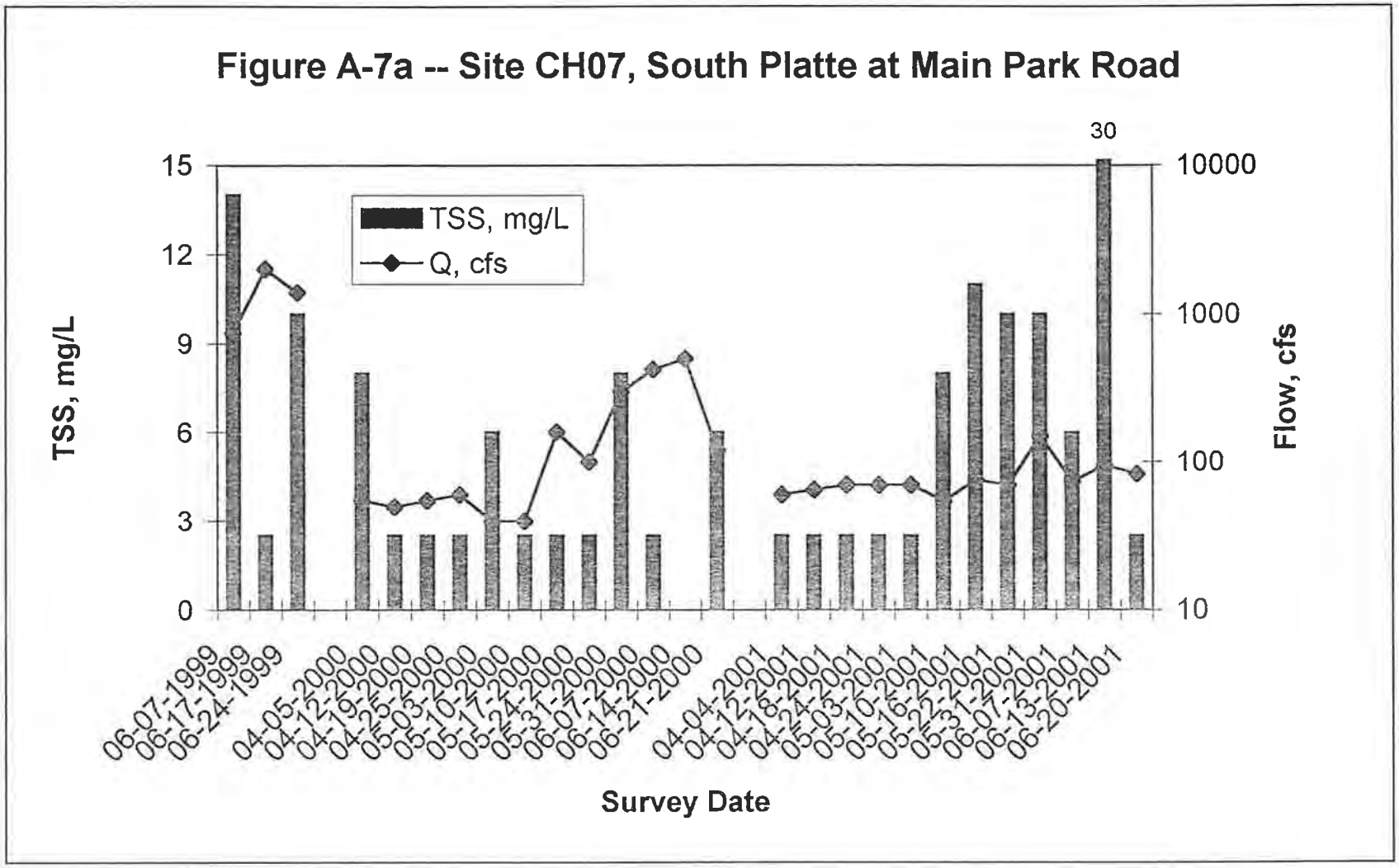


Figure A-7a -- Site CH07, South Platte at Main Park Road
TSS, mg/L
Q, cfs
TSS, mg/L
Flow, cfs
Survey Date
0
3
6
9
12
15
10
100
1000
10000
30
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001

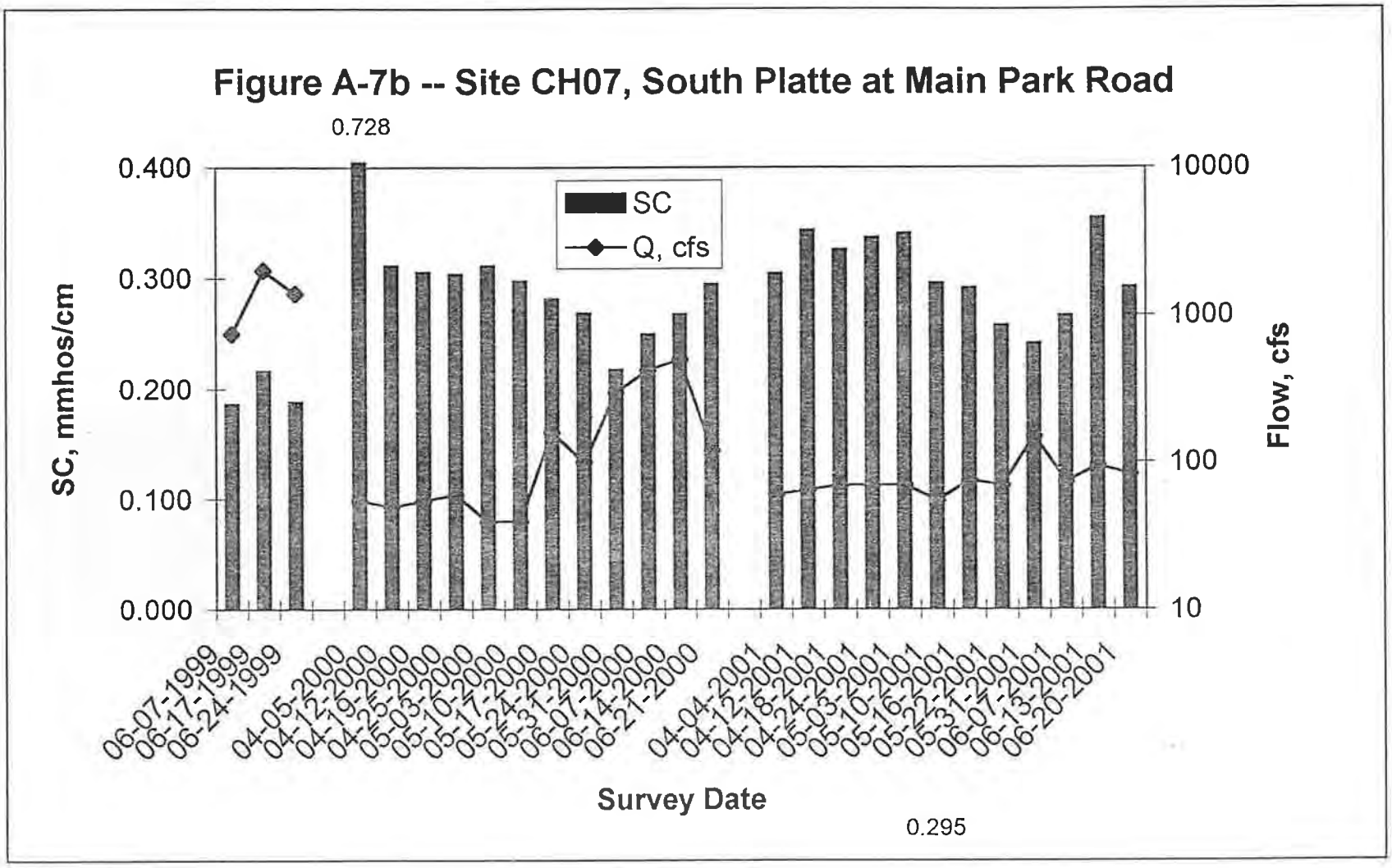
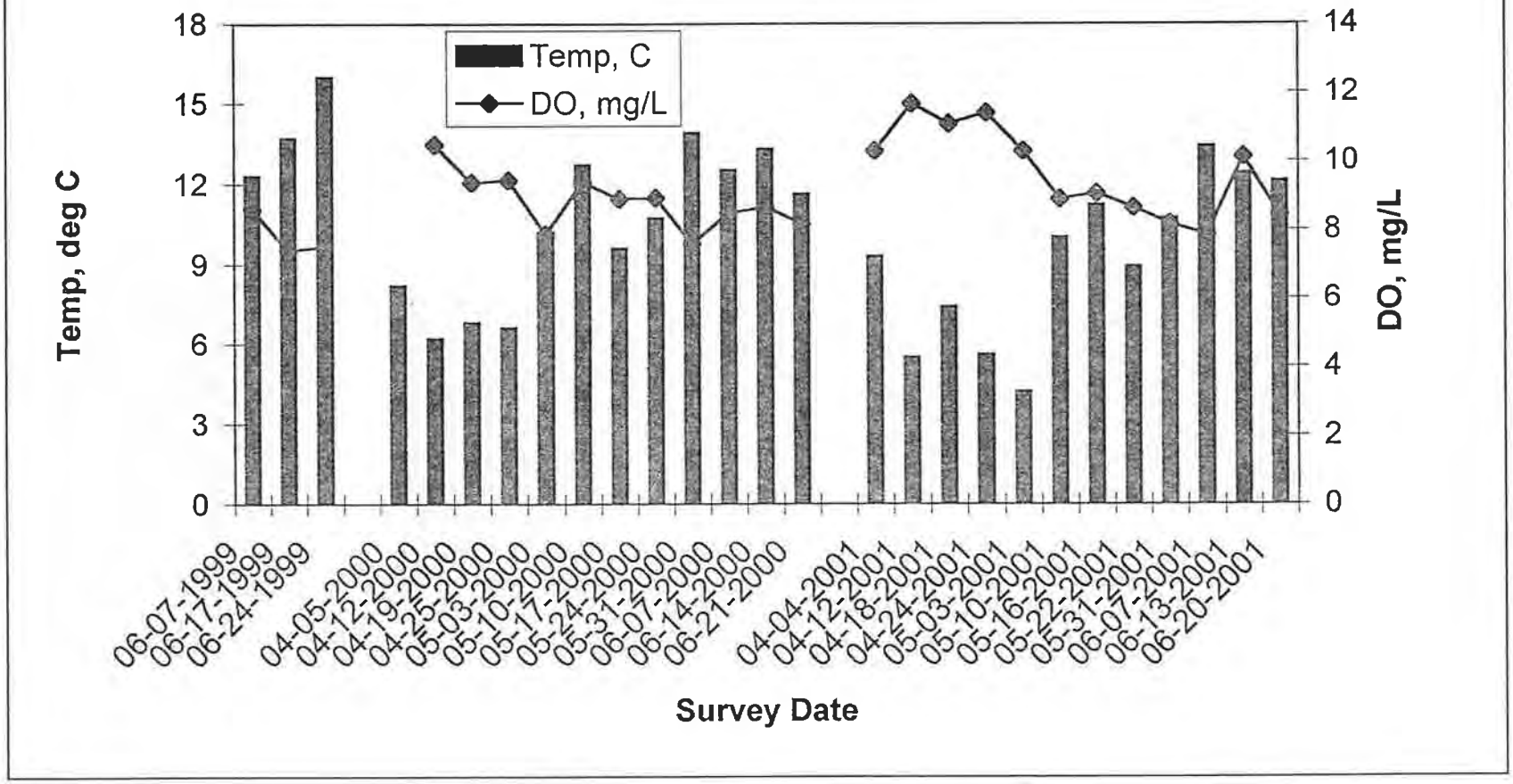


Figure A-7b -- Site CH07, South Platte at Main Park Road
0.728
0.400
0.300
0.200
0.100
0.000
SC
Q, cfs
SC, mmhos/cm
10000
1000
100
10
Flow, cfs
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date
0.295

Figure A-7c -- Site CH07, South Platte at Main Park Road



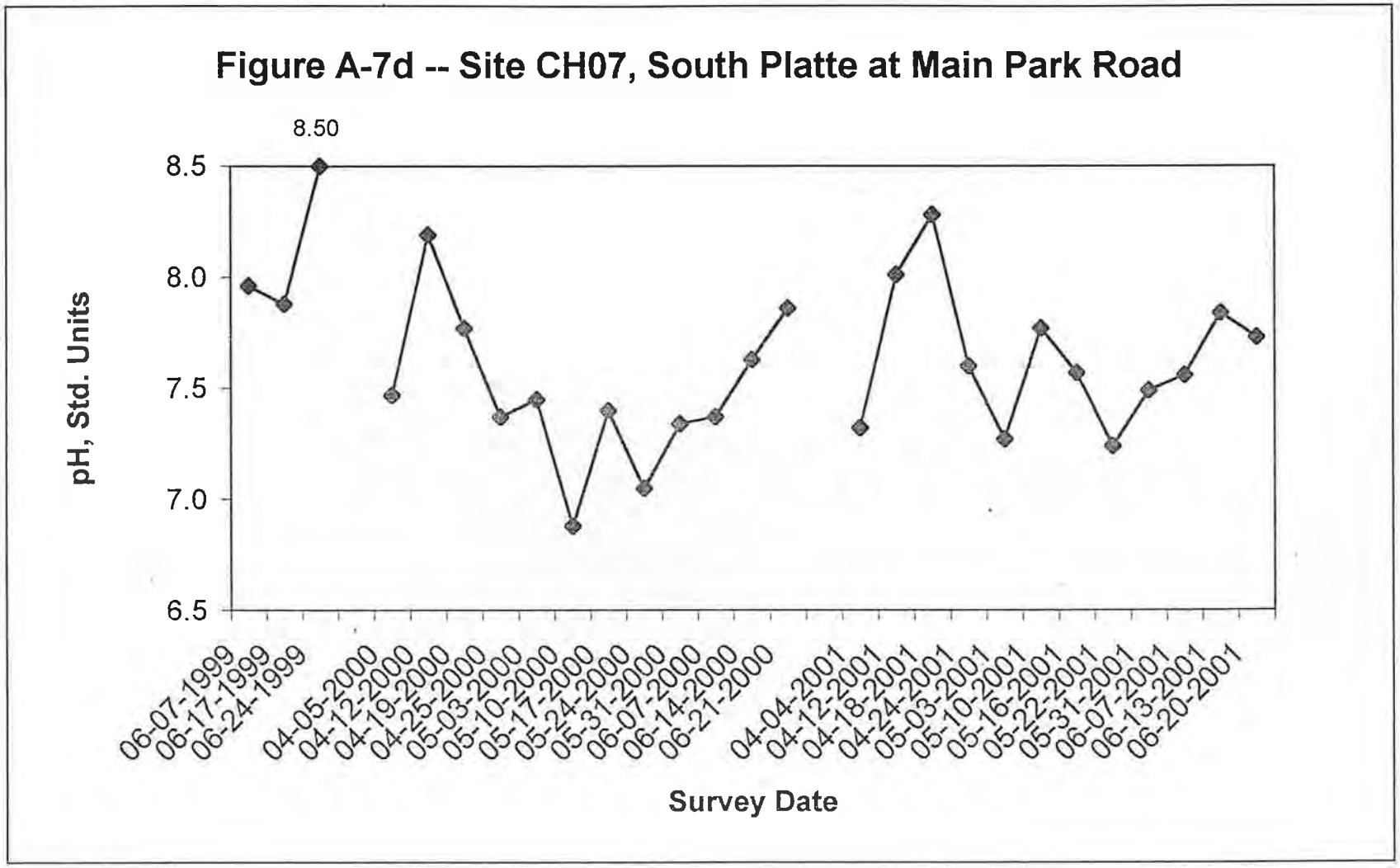


Figure A-7d -- Site CH07, South Platte at Main Park Road
8.50
8.5
8.0
7.5
7.0
6.5
pH, Std. Units
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

Figure A-7e -- Site CH07, South Platte at Main Park Road

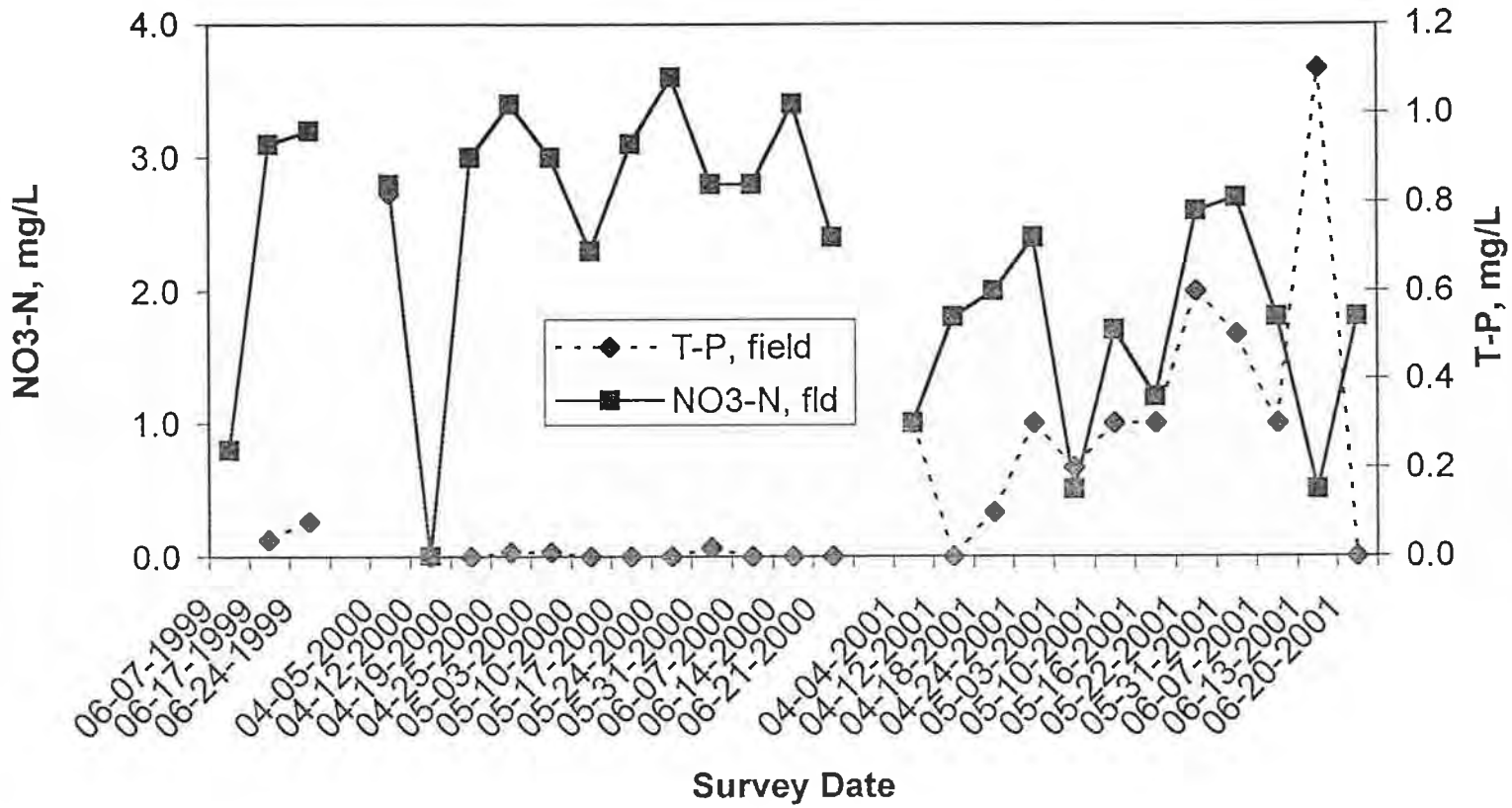


Figure A-8a -- Site CH08, Massey Draw near Perimeter Road

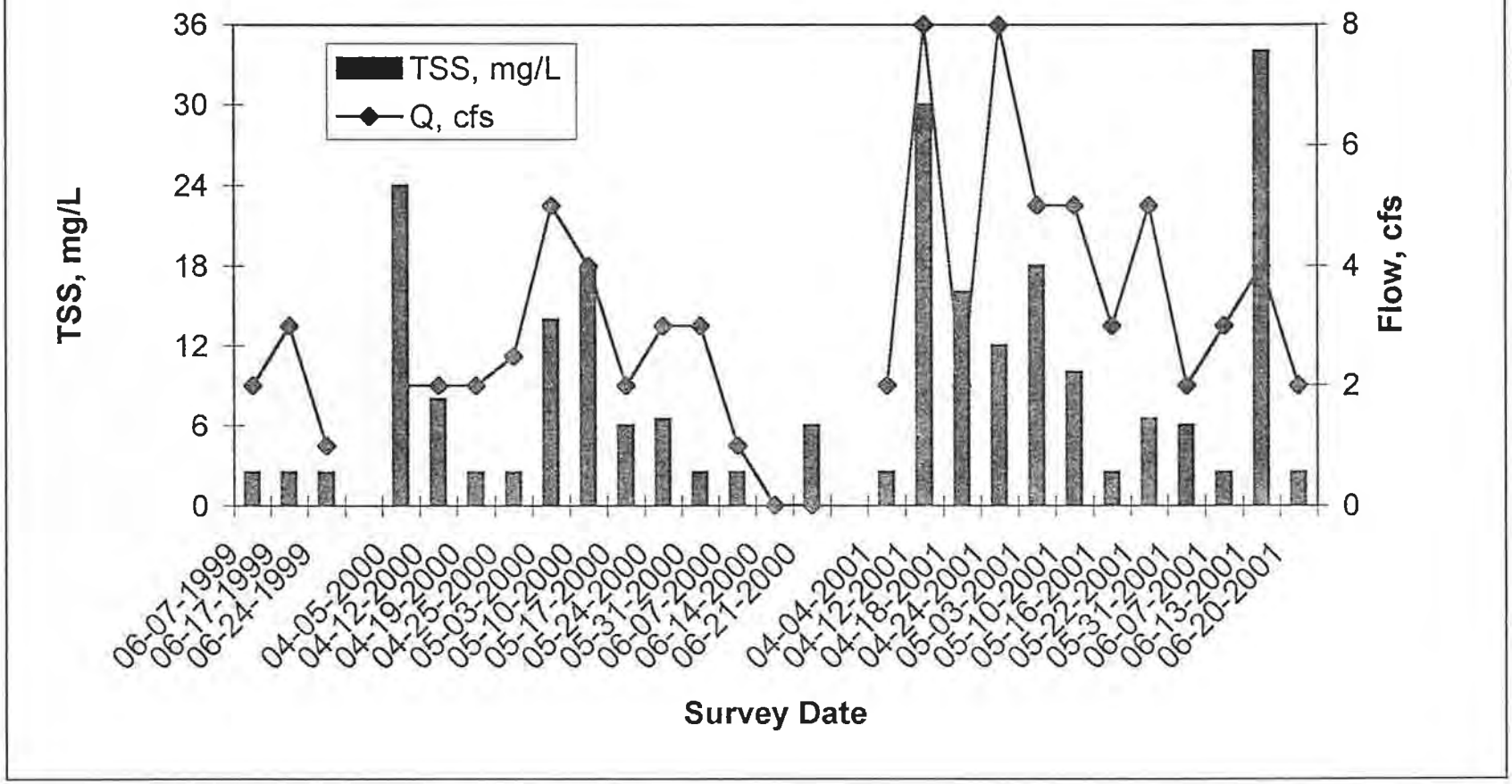


Figure A-8b -- Site CH08, Massey Draw near Perimeter Road

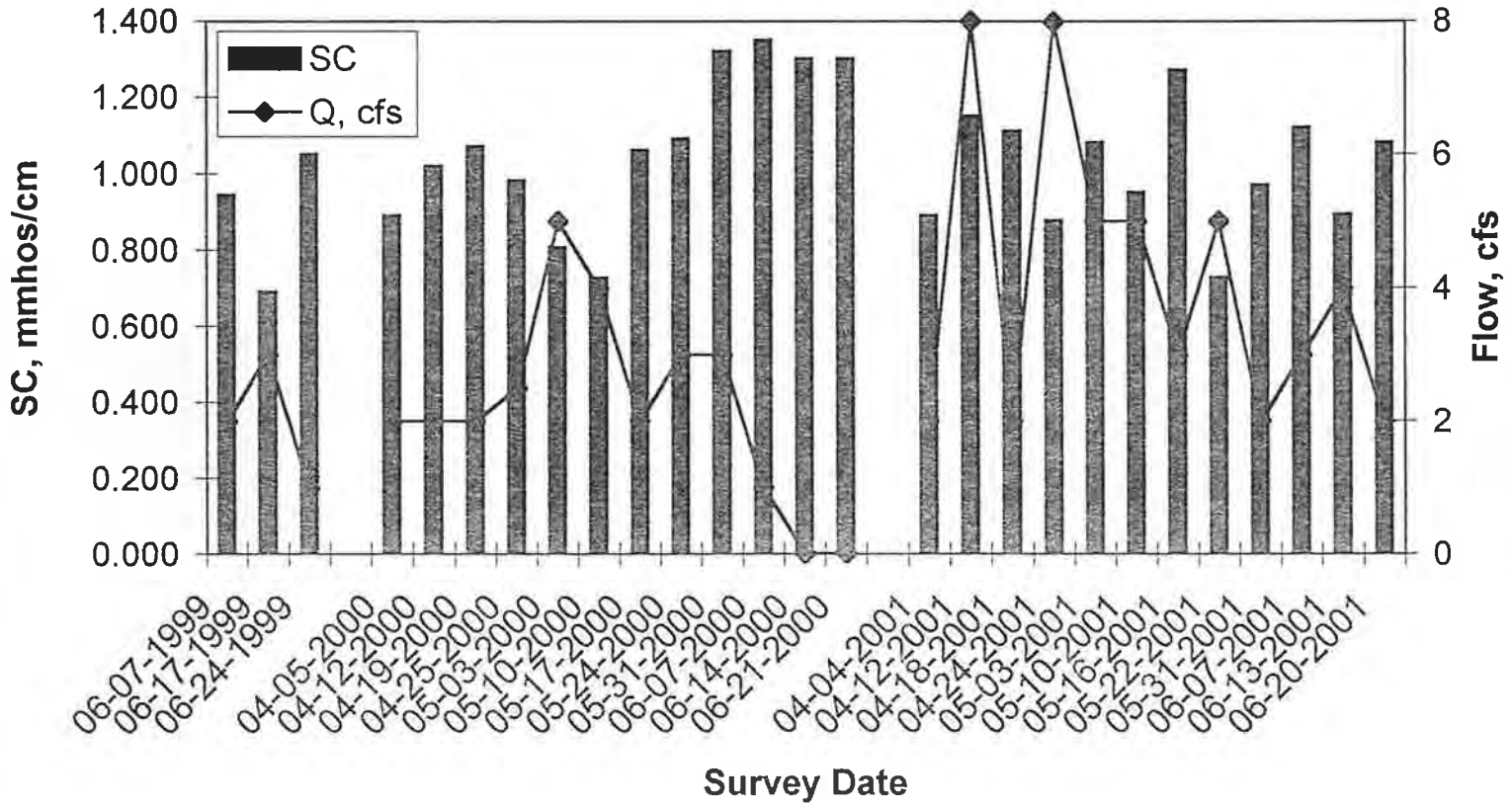


Figure A-8c -- Site CH08, Massey Draw near Perimeter Road

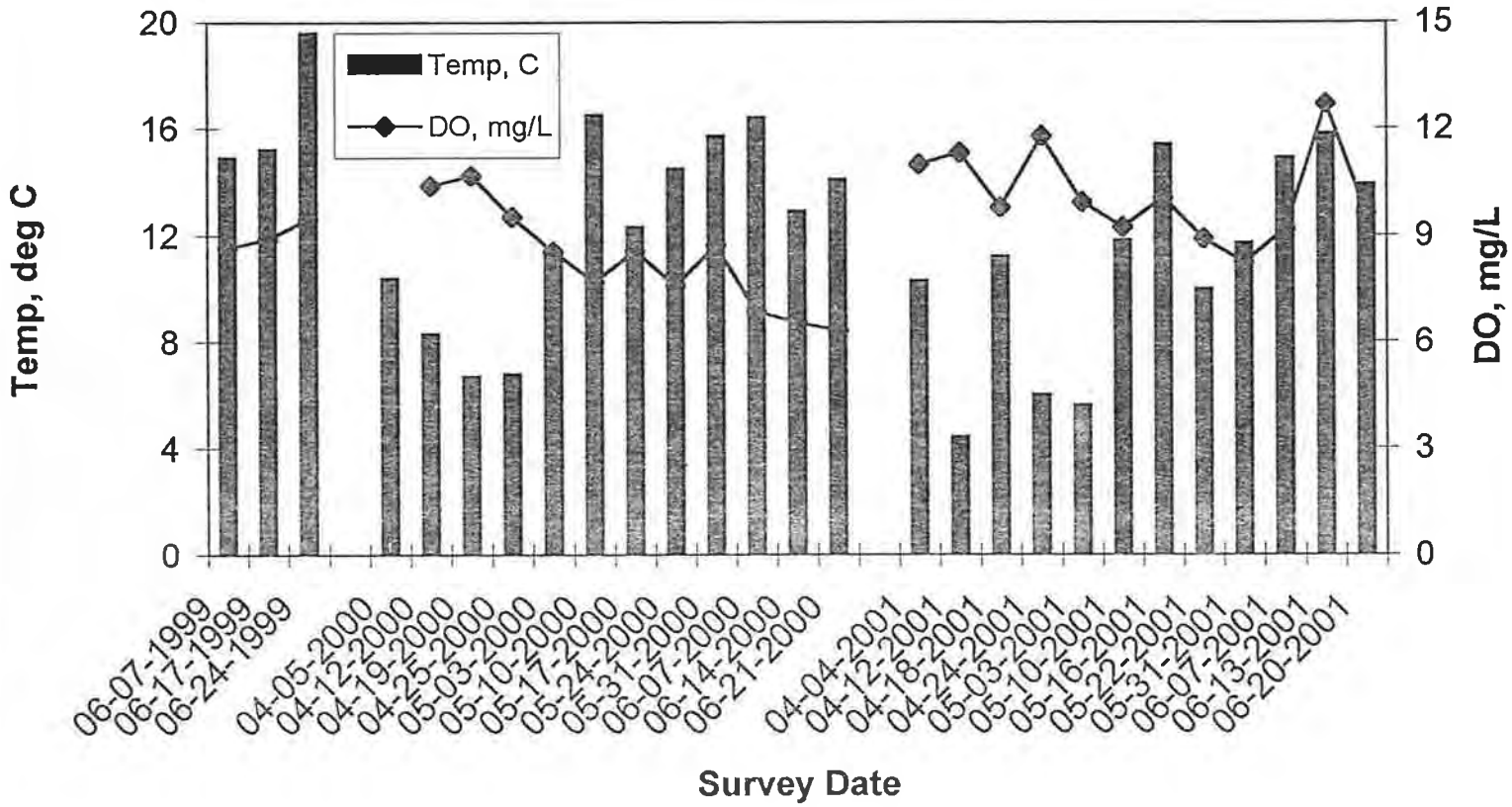


Figure A-8d -- Site CH08, Massey Draw near Perimeter Road

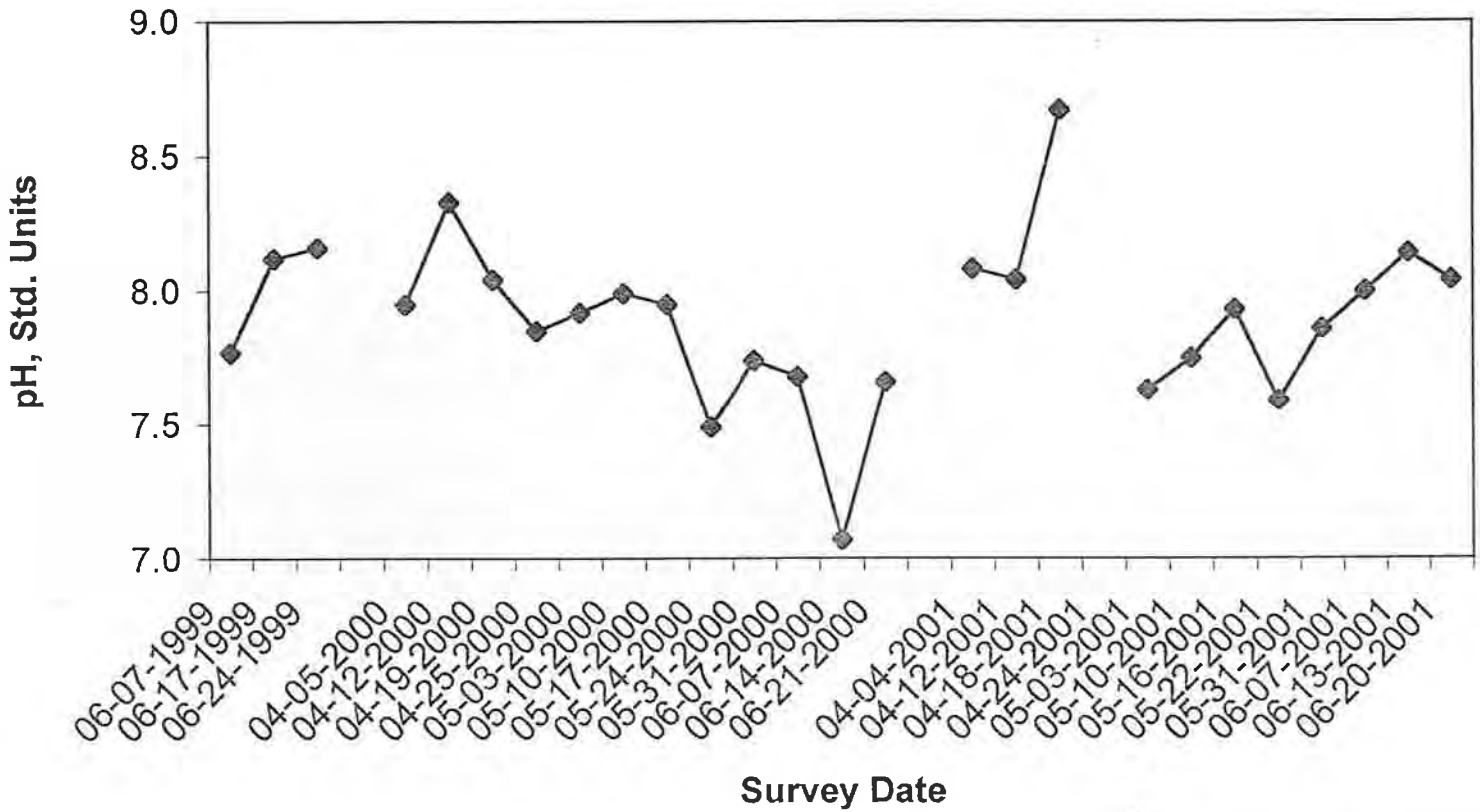


Figure A-8e -- Site CH08, Massey Draw near Perimeter Road

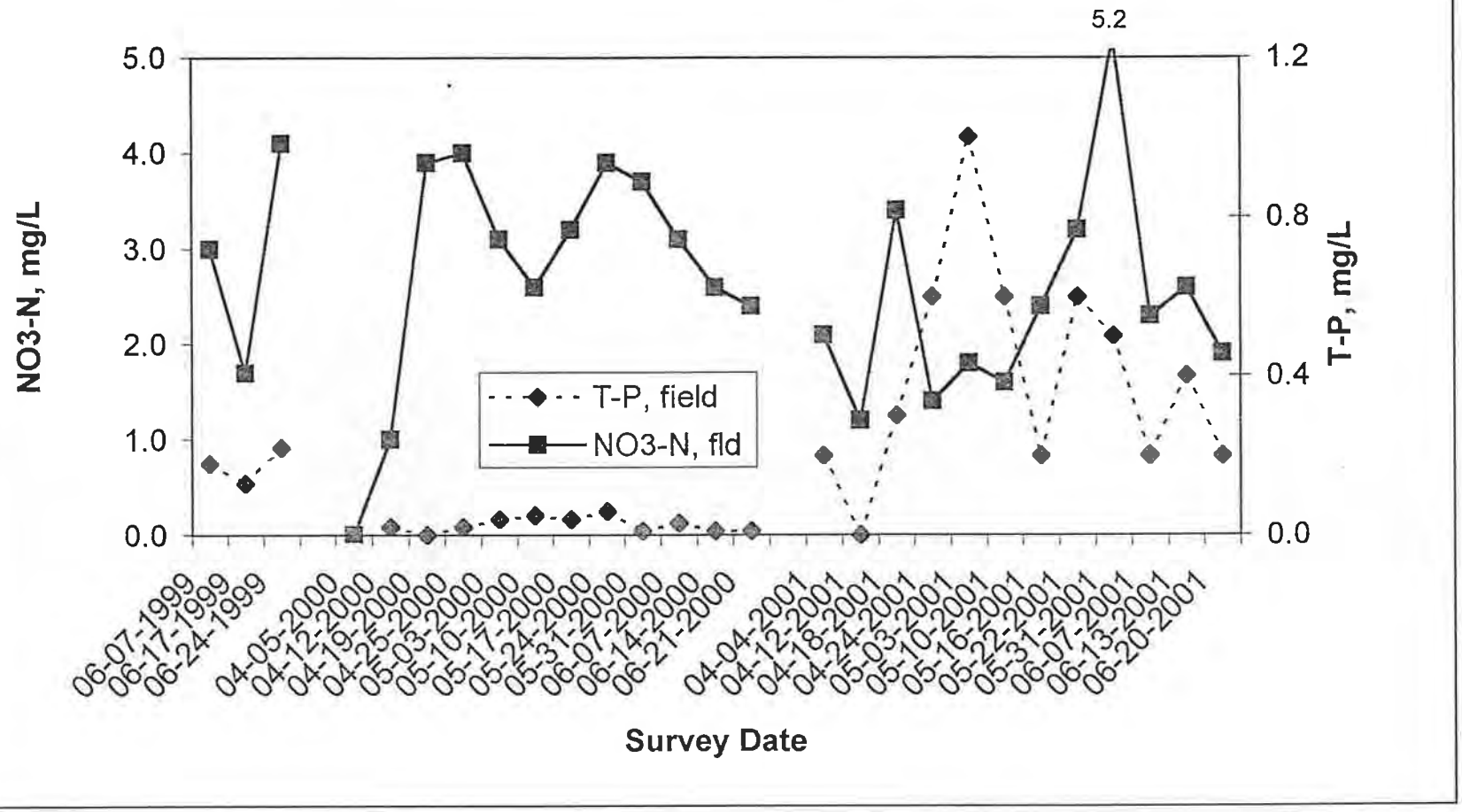
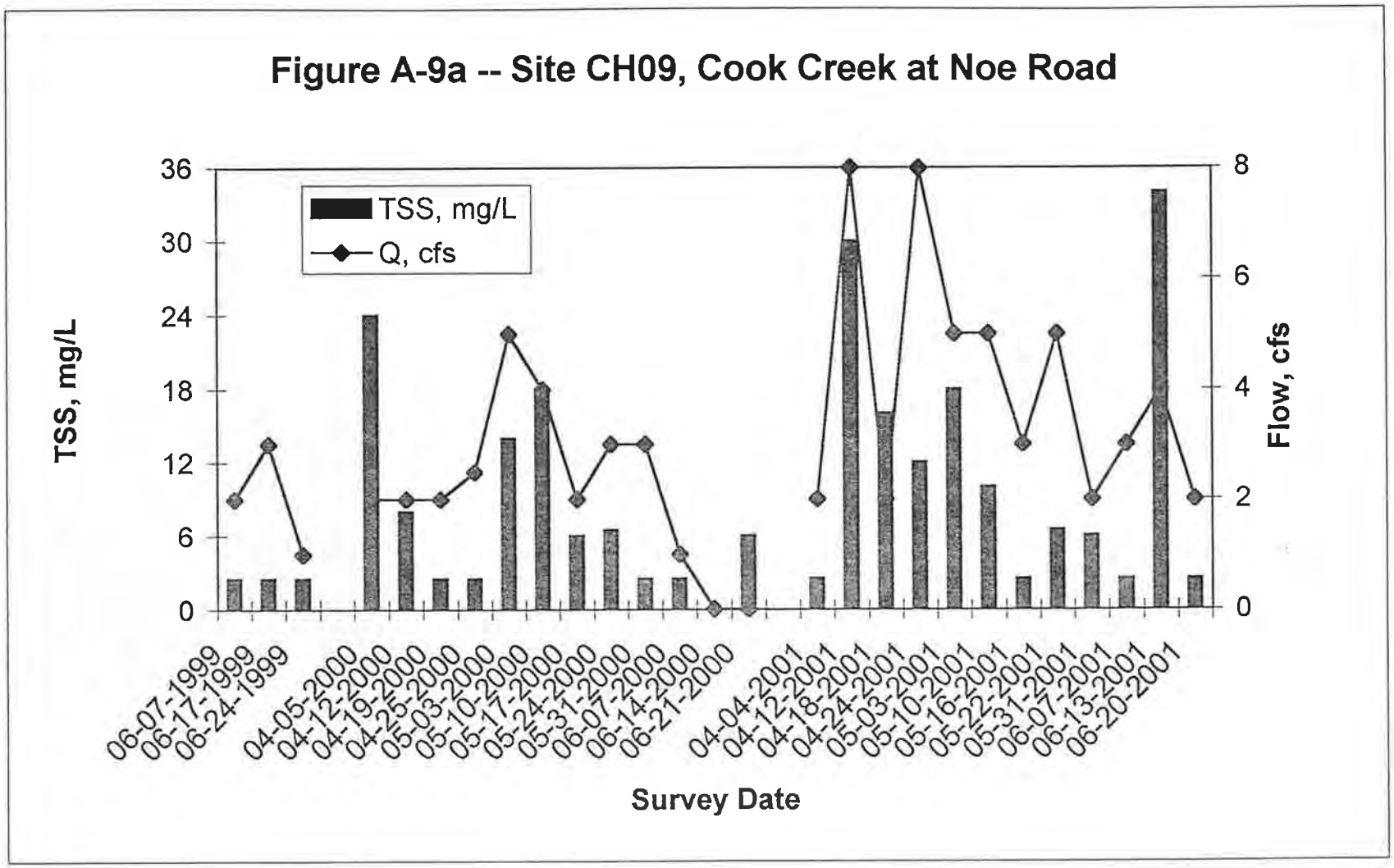


Figure A-9a -- Site CH09, Cook Creek at Noe Road



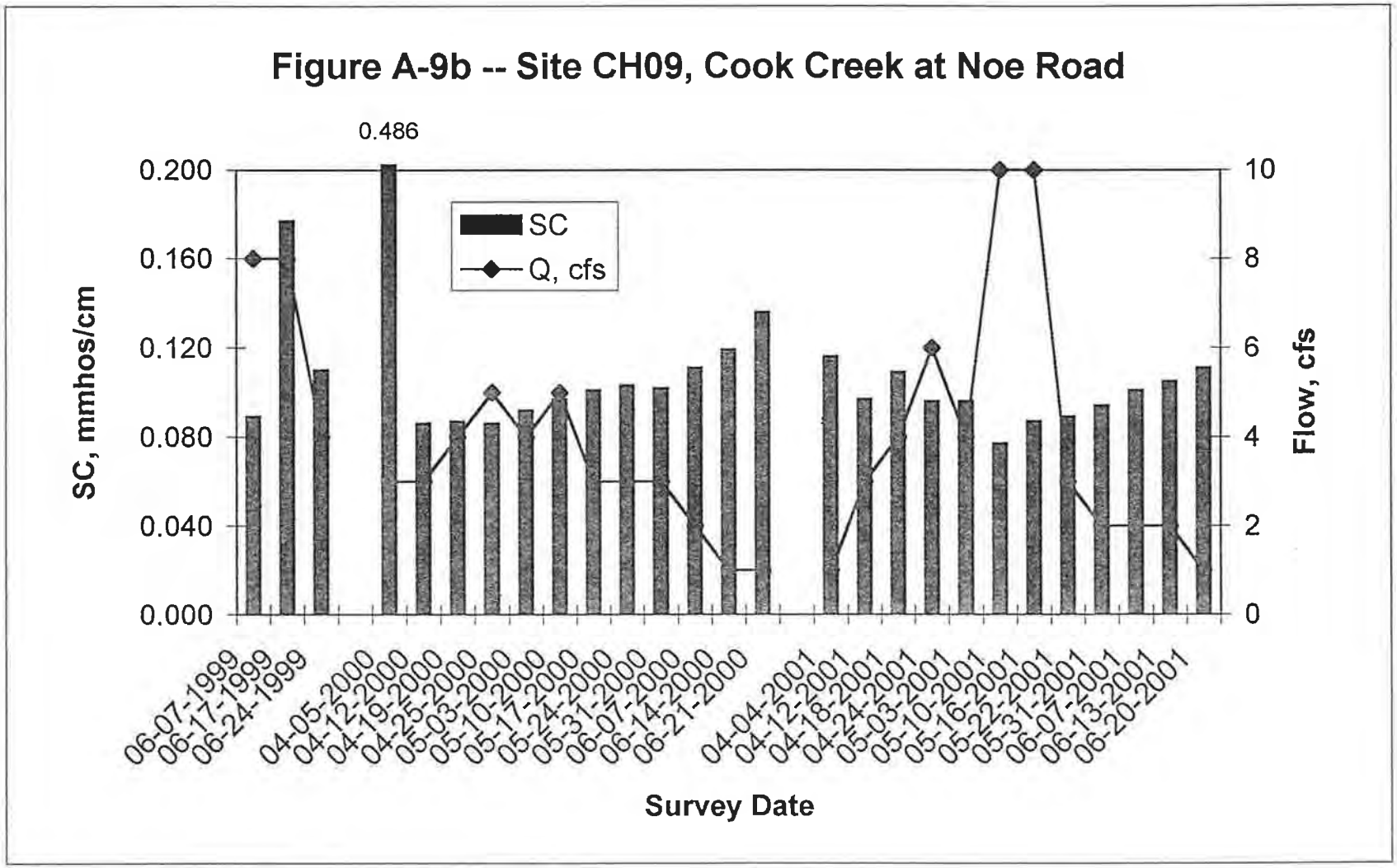


Figure A-9b -- Site CH09, Cook Creek at Noe Road
0.486
0.200
0.160
0.120
0.080
0.040
0.000
SC, mmhos/cm
10
8
6
4
2
0
Flow, cfs
SC
Q, cfs
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

Figure A-9c -- Site CH09, Cook Creek at Noe Road

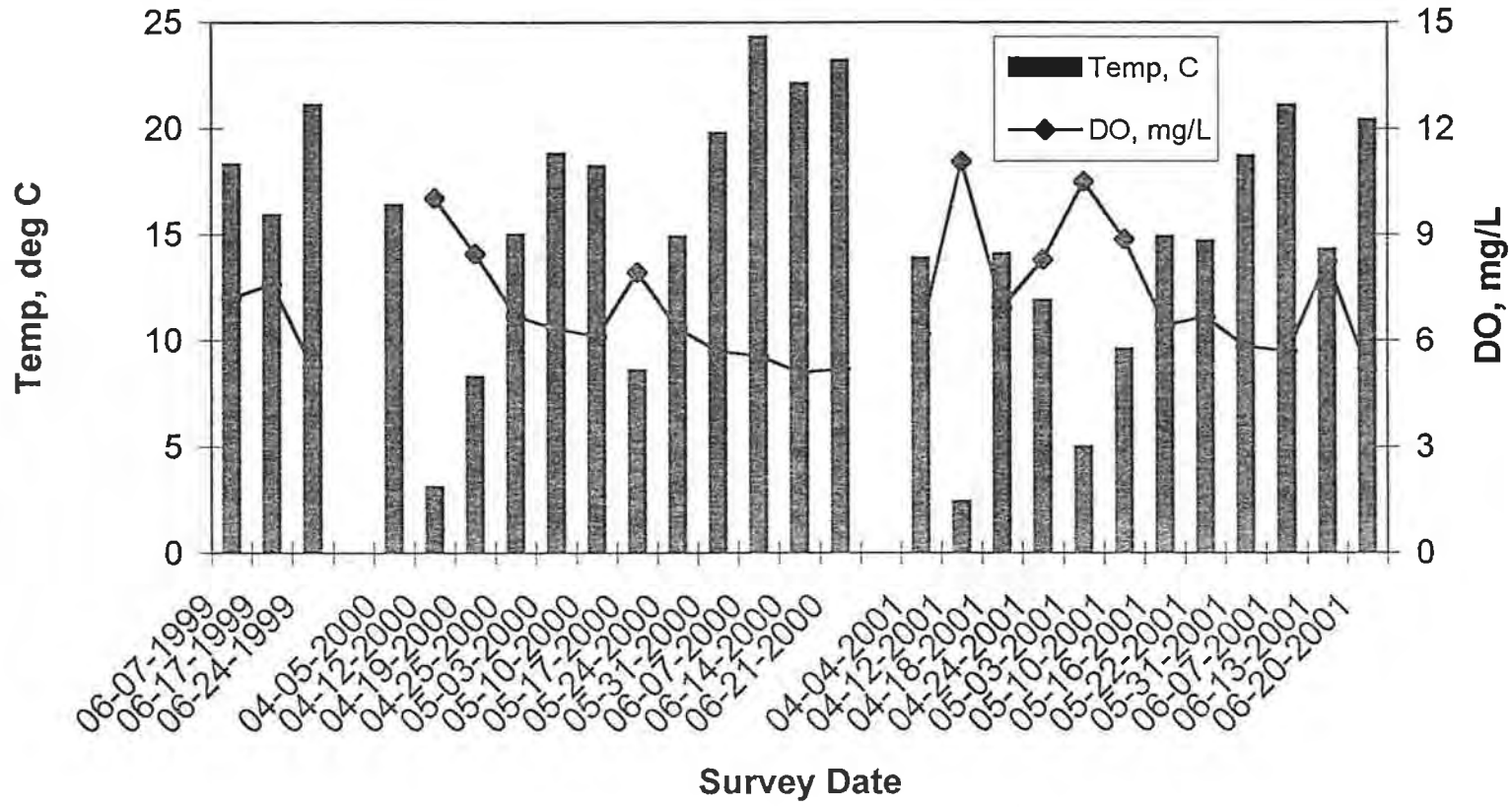


Figure A-9d -- Site CH09, Cook Creek at Noe Road

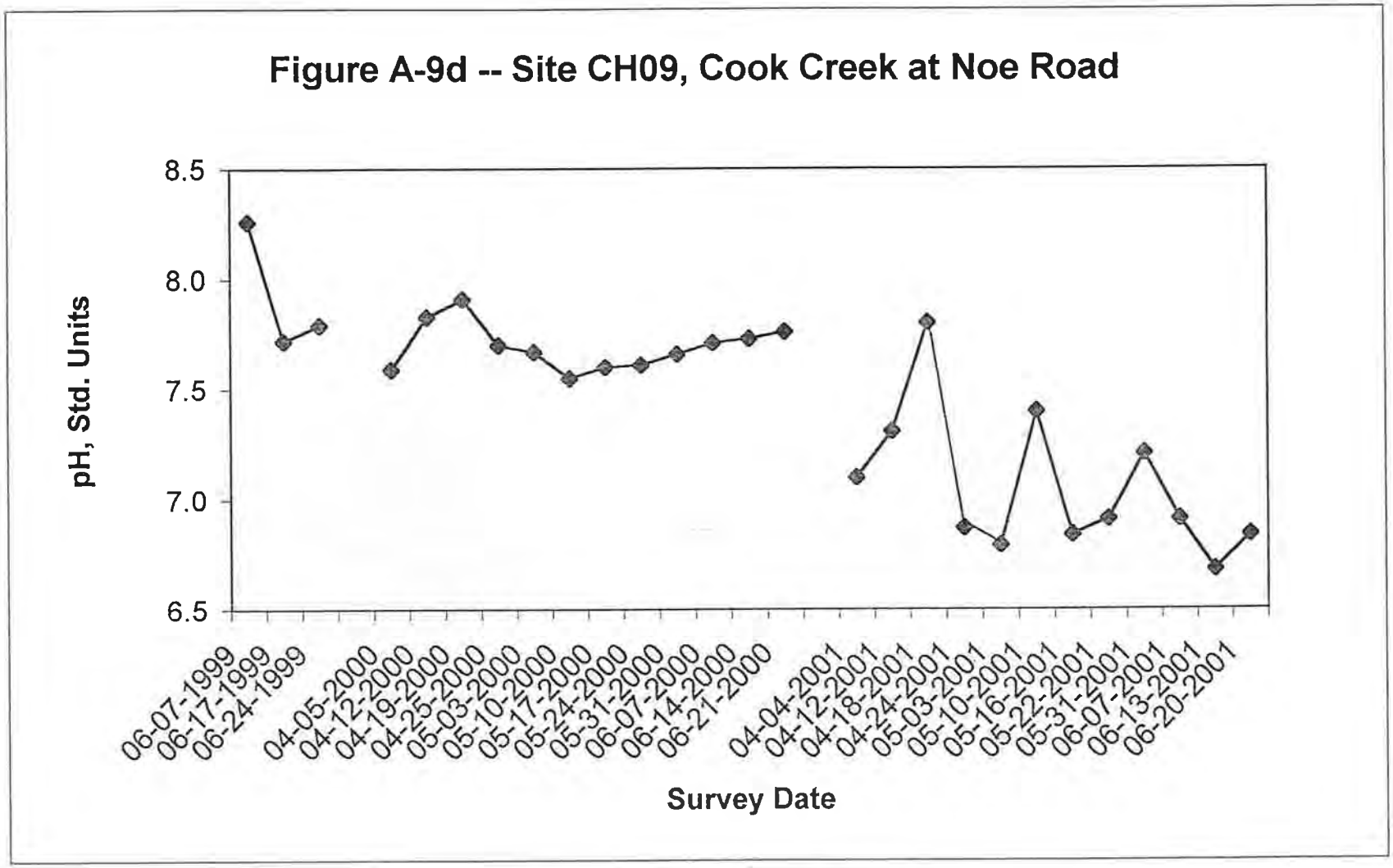
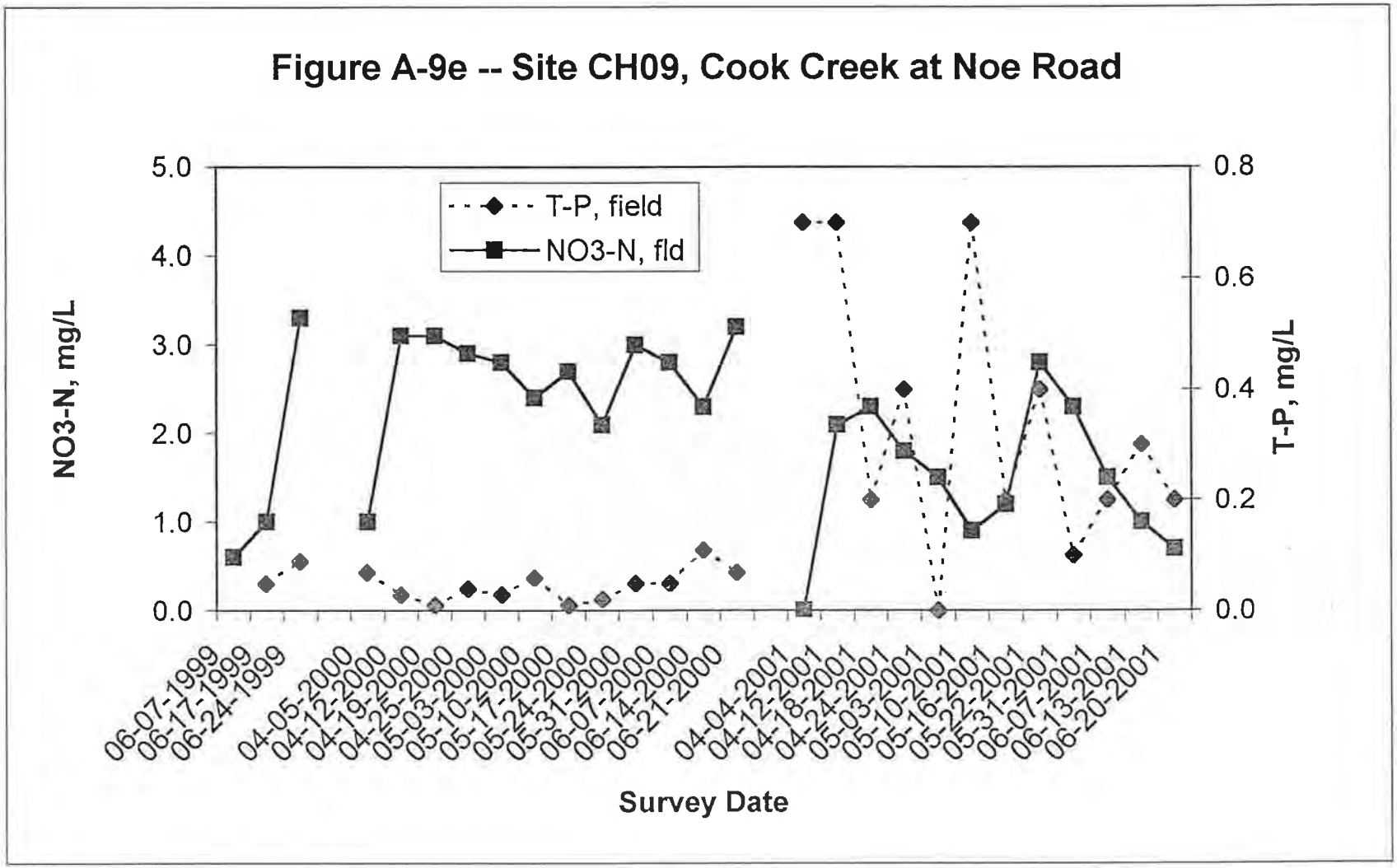


Figure A-9e -- Site CH09, Cook Creek at Noe Road



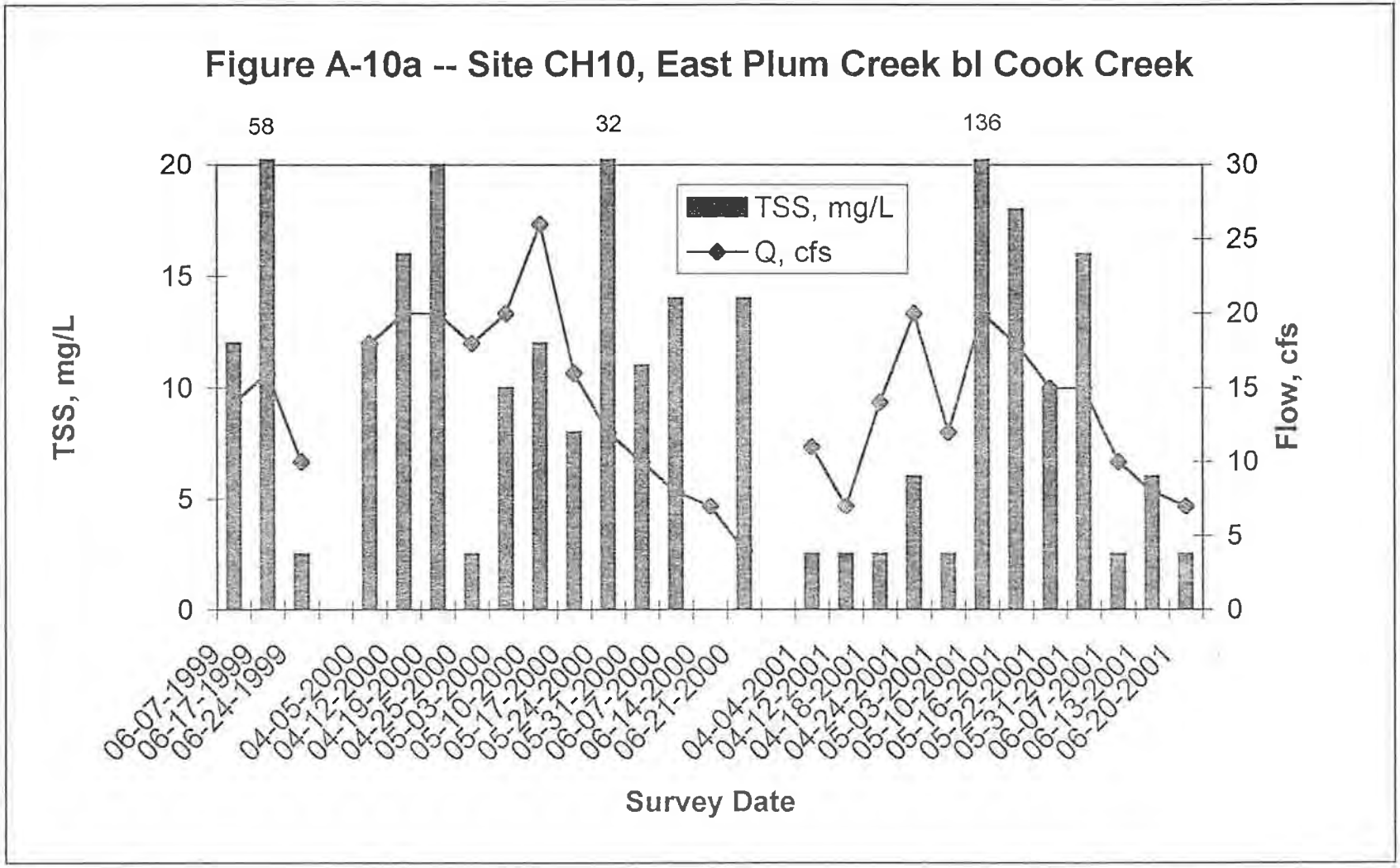


Figure A-10a -- Site CH10, East Plum Creek bl Cook Creek
58
32
136
TSS, mg/L
Q, cfs
TSS, mg/L
Flow, cfs
Survey Date
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001

Figure A-10b -- Site CH10, East Plum Creek bl Cook Creek

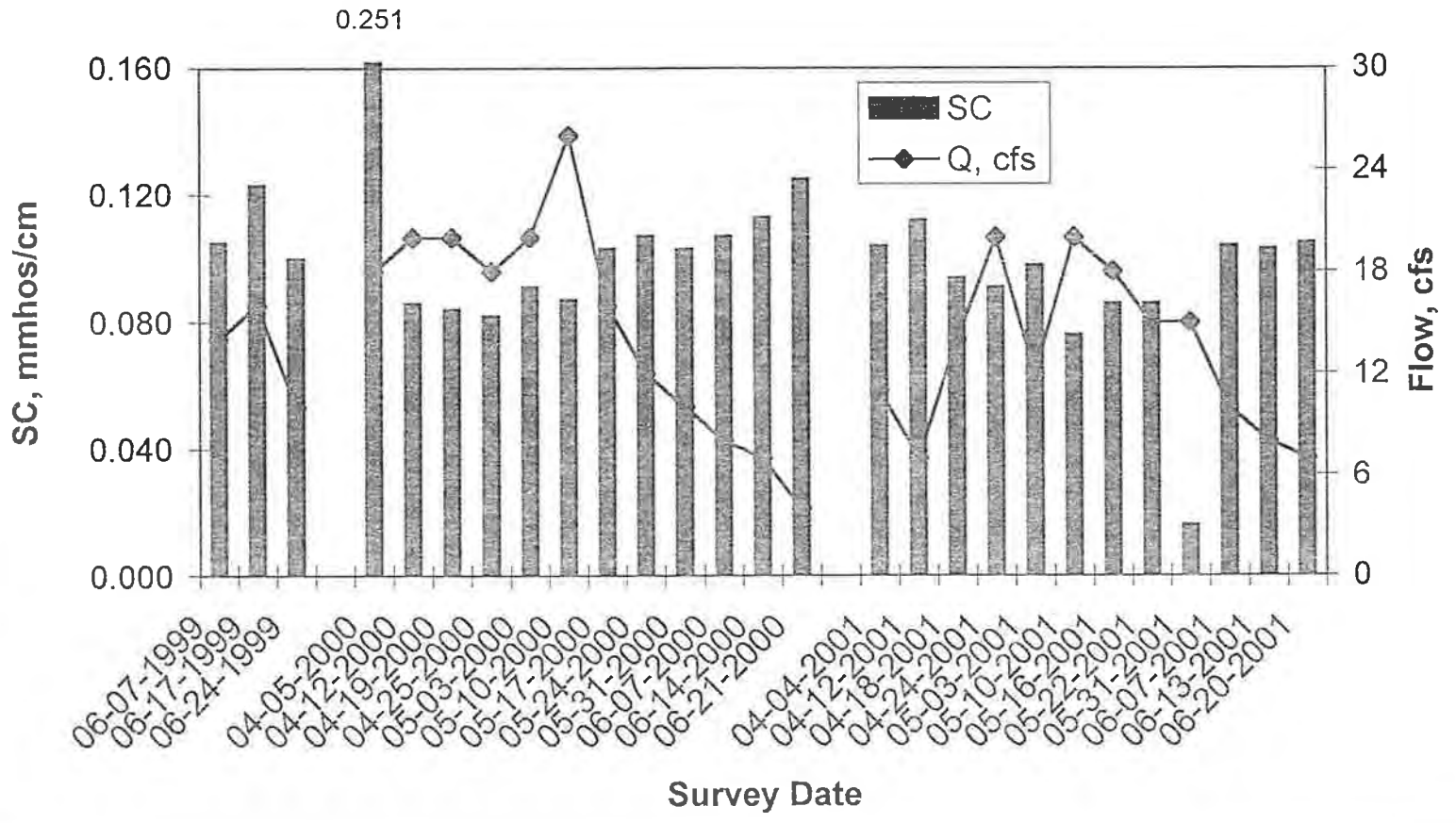


Figure A-10c -- Site CH10, East Plum Creek bl Cook Creek

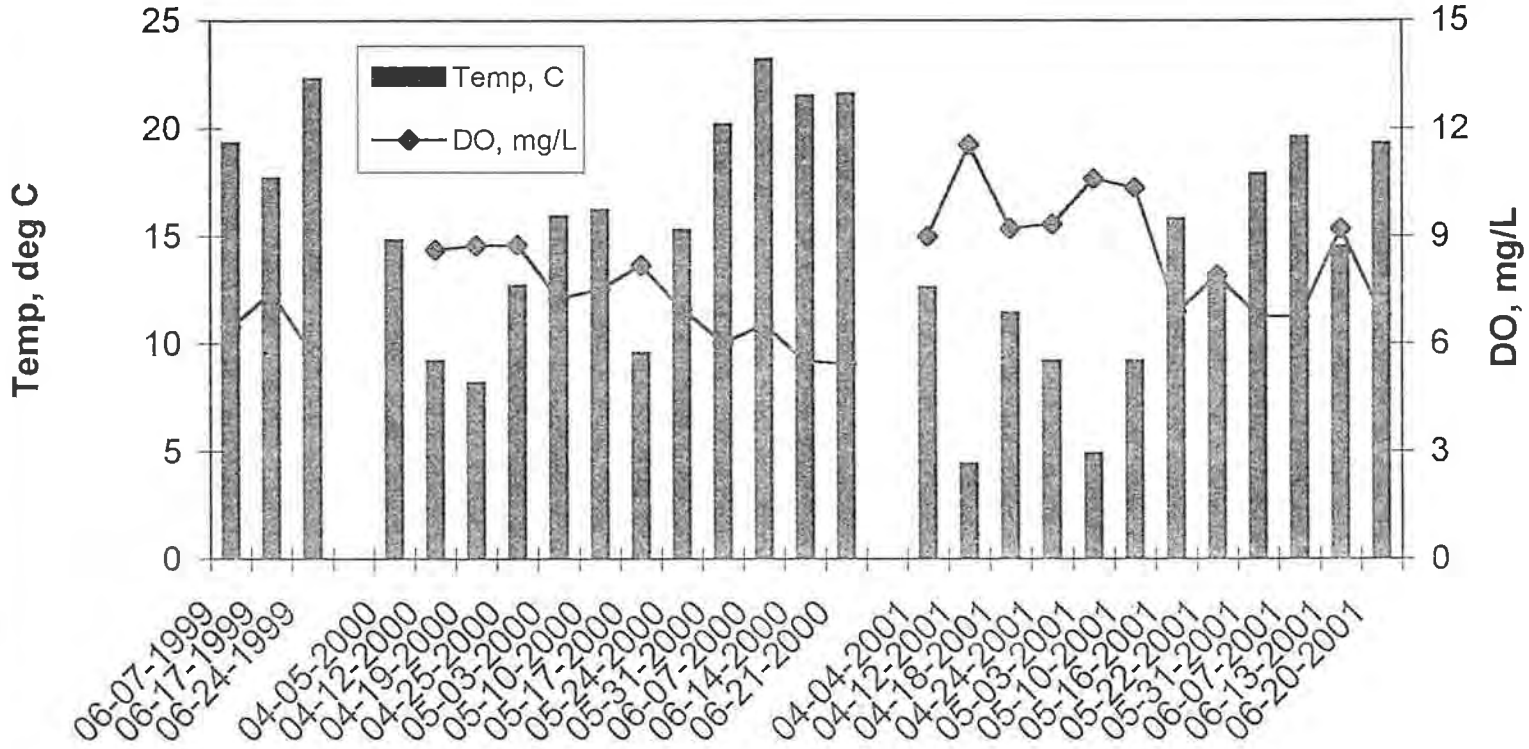


Figure A-10d -- Site CH10, East Plum Creek bl Cook Creek

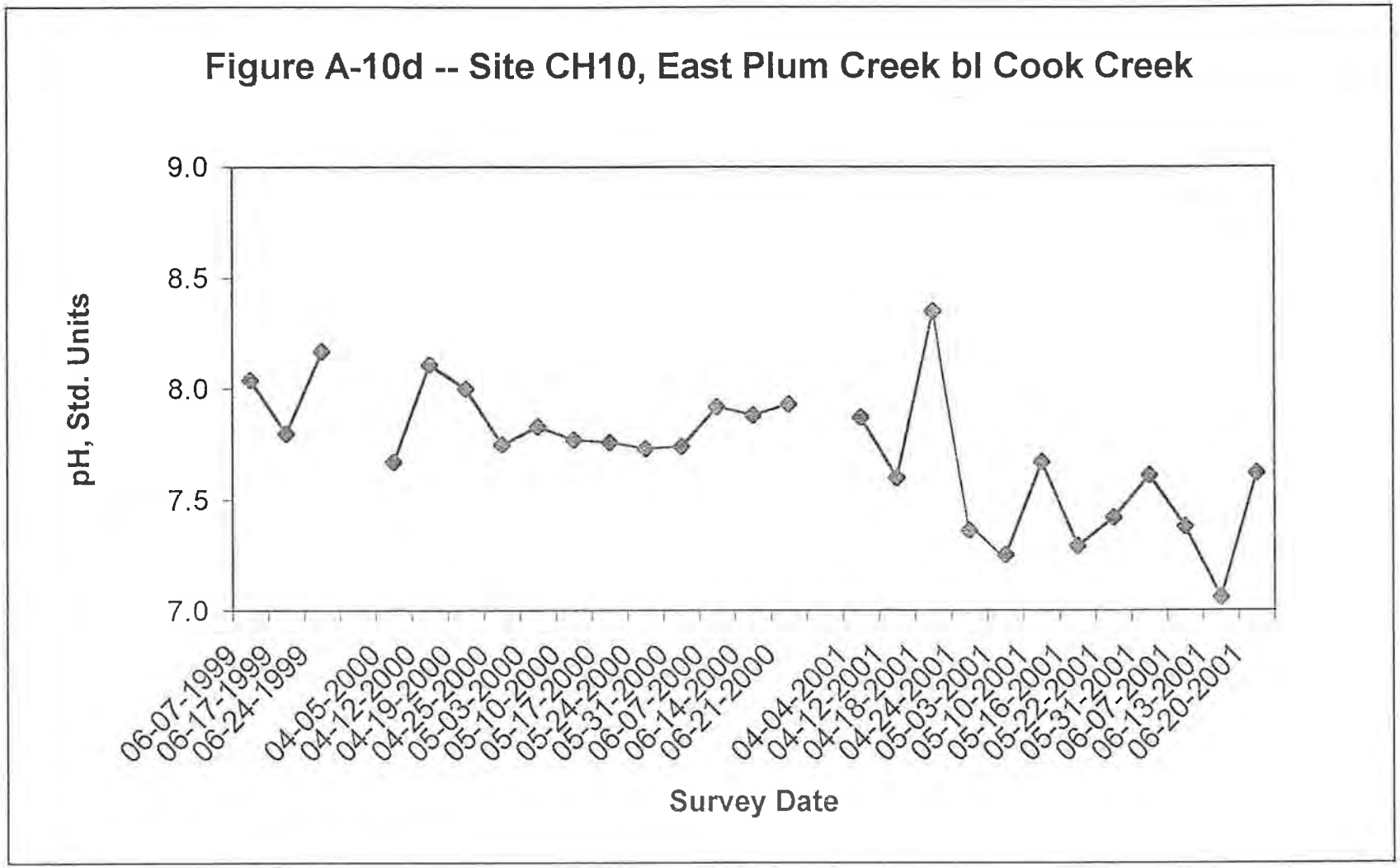


Figure A-10e -- Site CH10, East Plum Creek bl Cook Creek

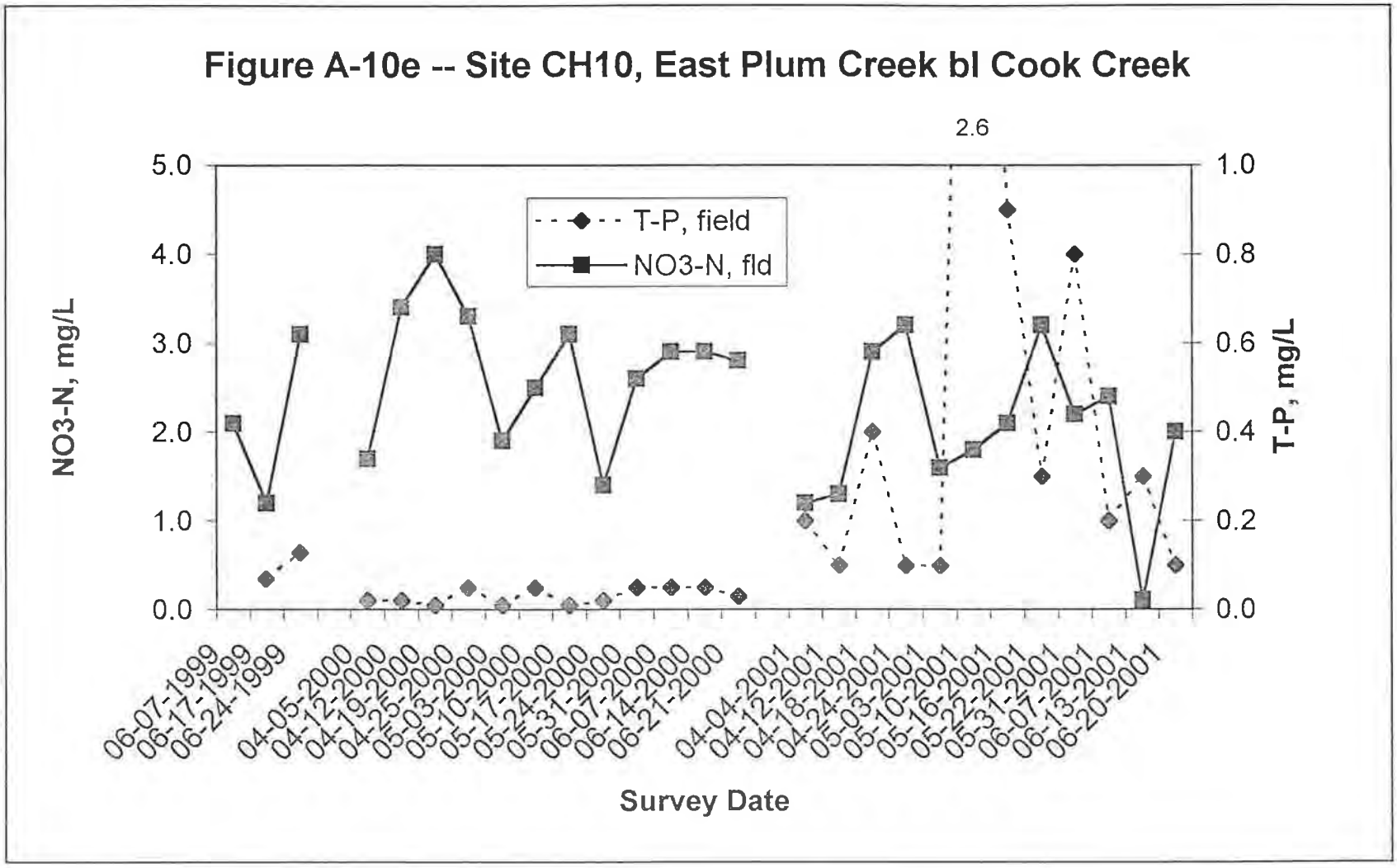


Figure A-11a -- Site CH11, East Plum Creek at I-25 Bridge

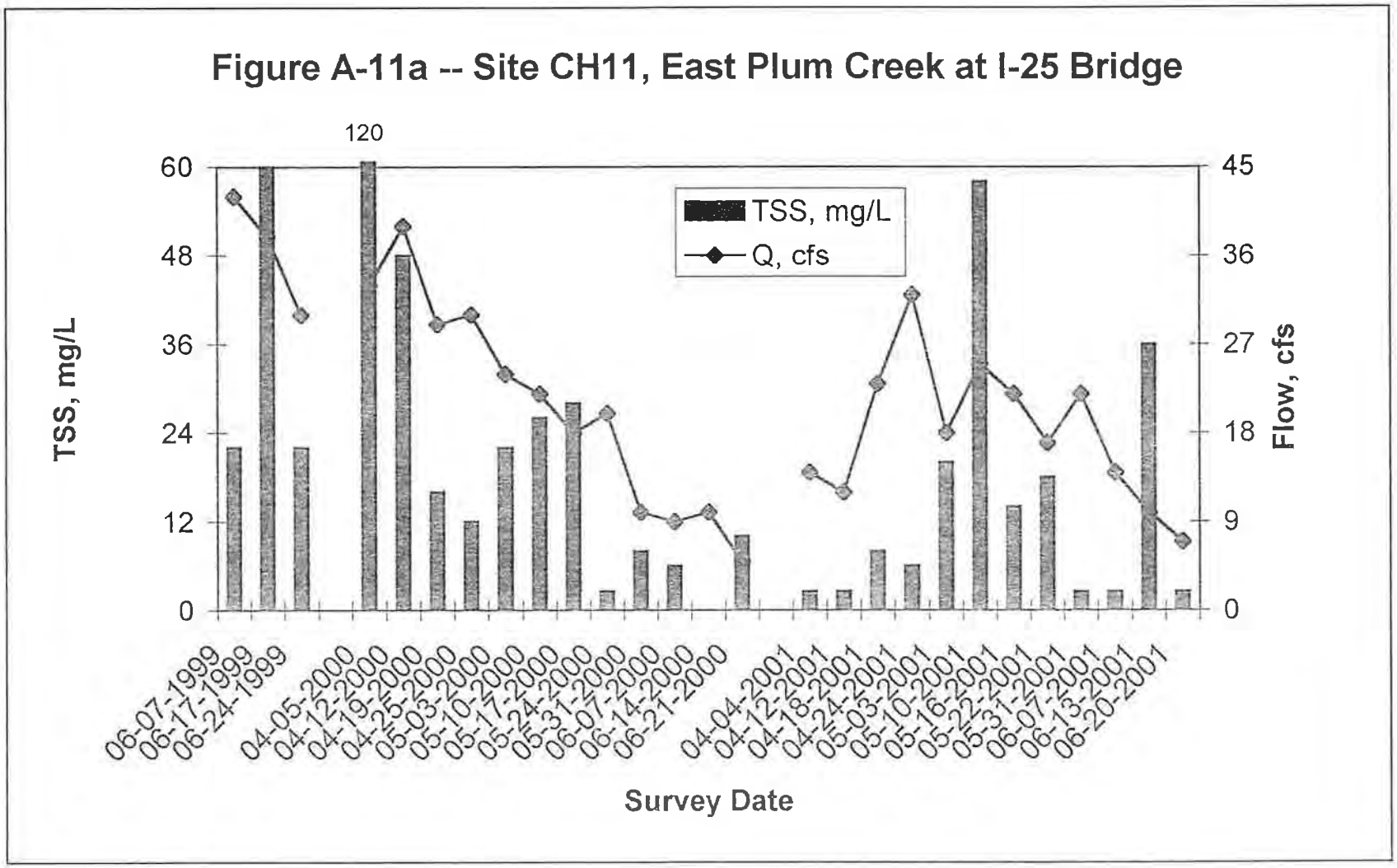


Figure A-11b -- Site CH11, East Plum Creek at I-25 Bridge

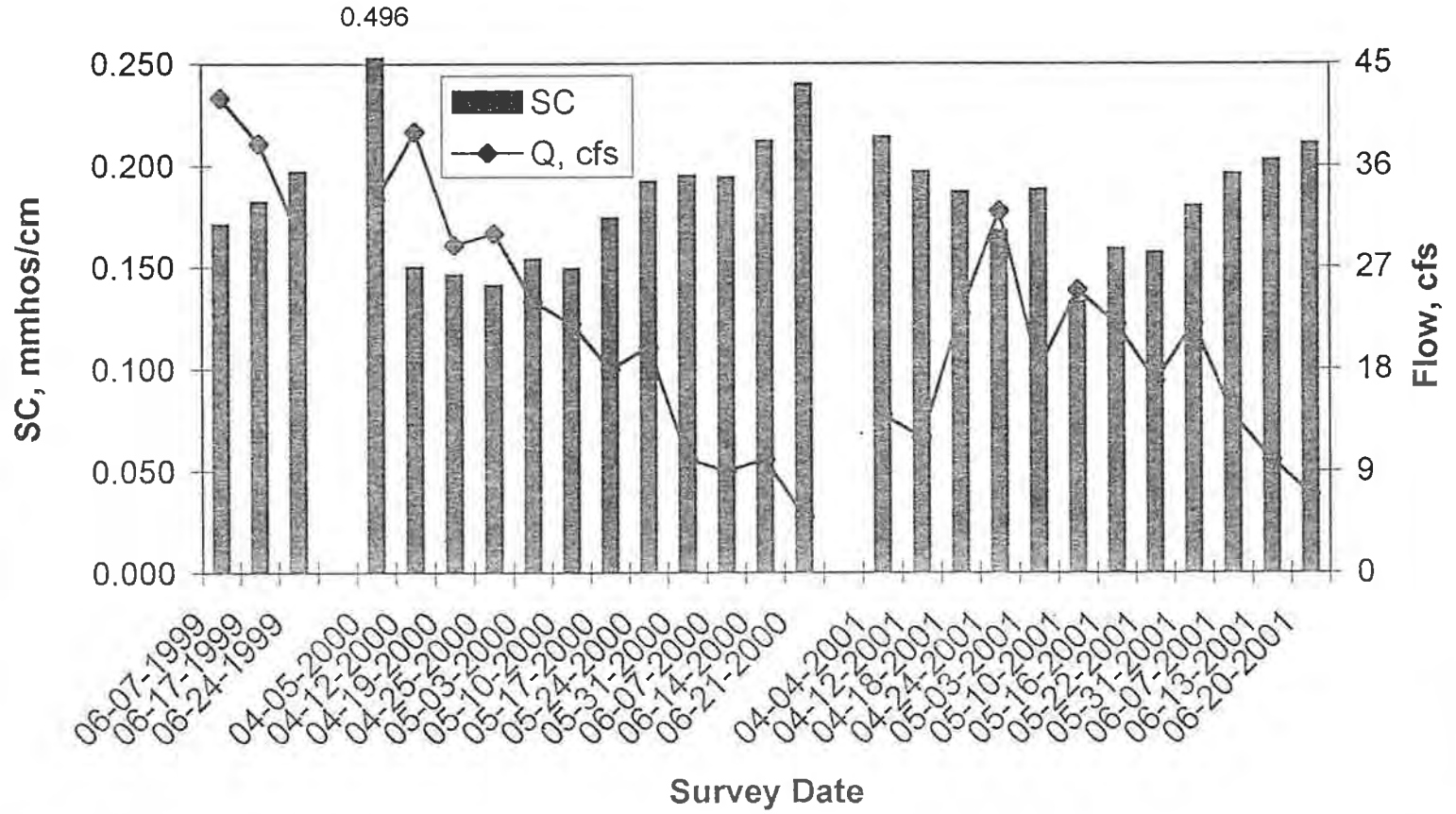


Figure A-11c -- Site CH11, East Plum Creek at I-25 Bridge

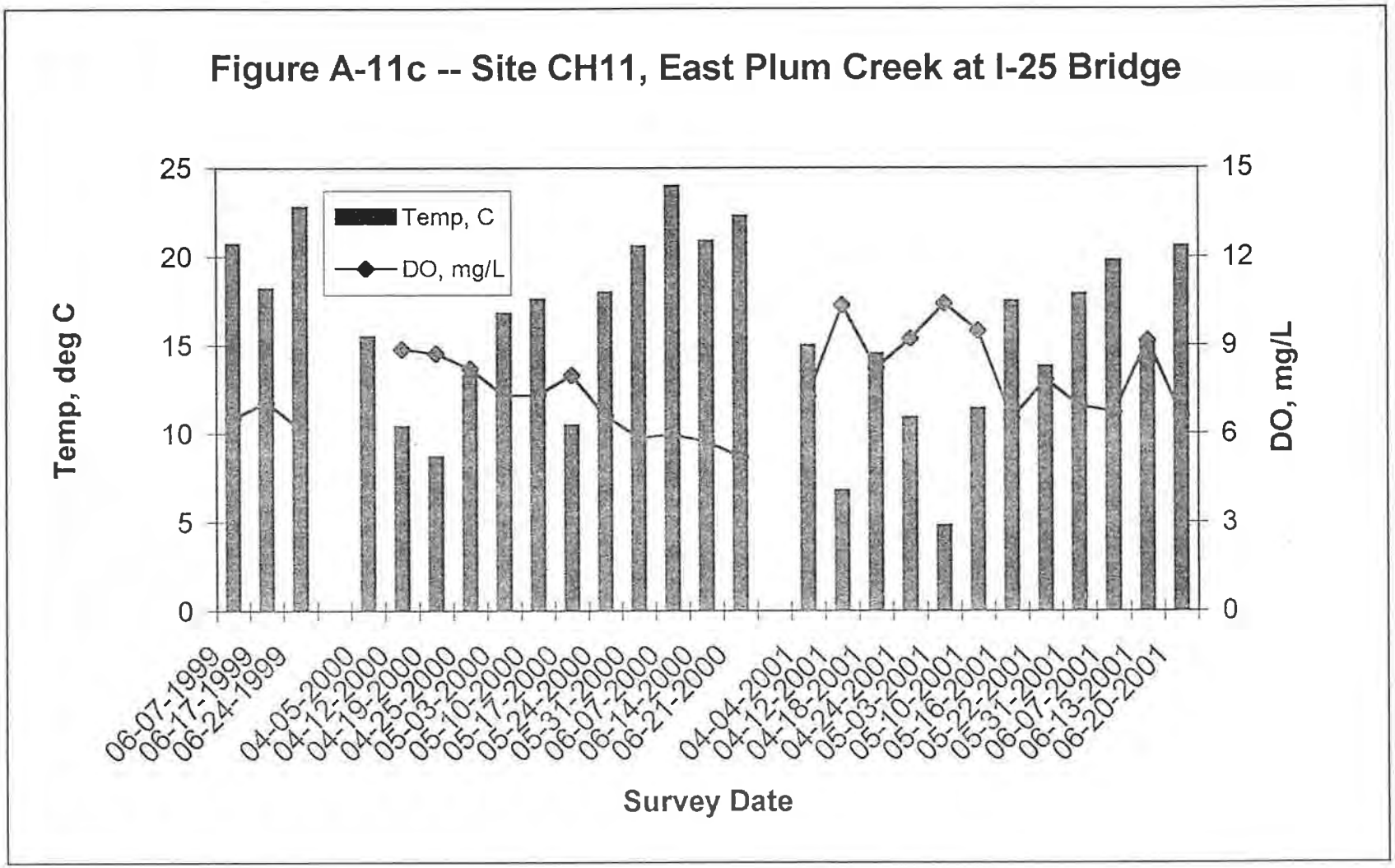
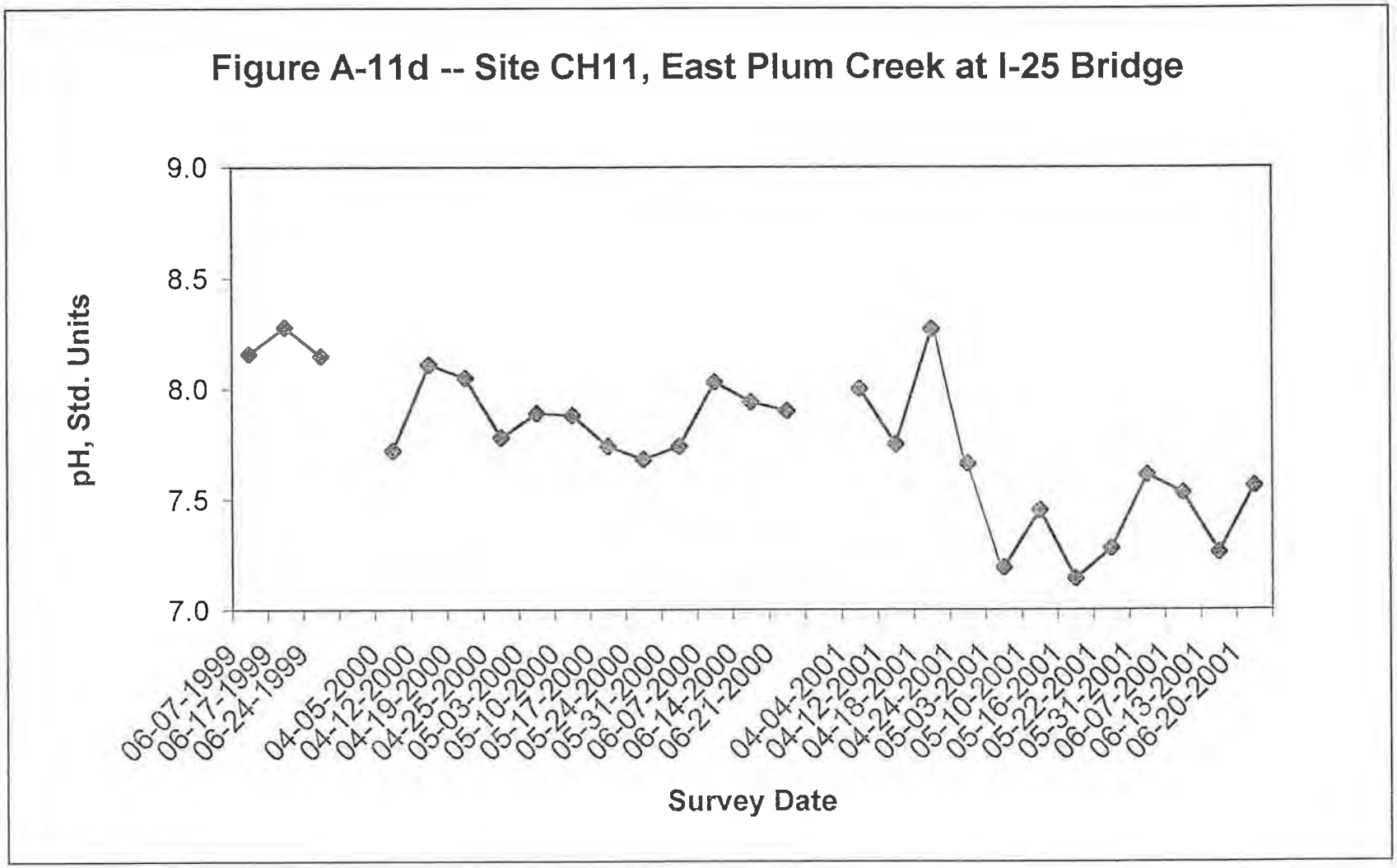


Figure A-11d -- Site CH11, East Plum Creek at I-25 Bridge



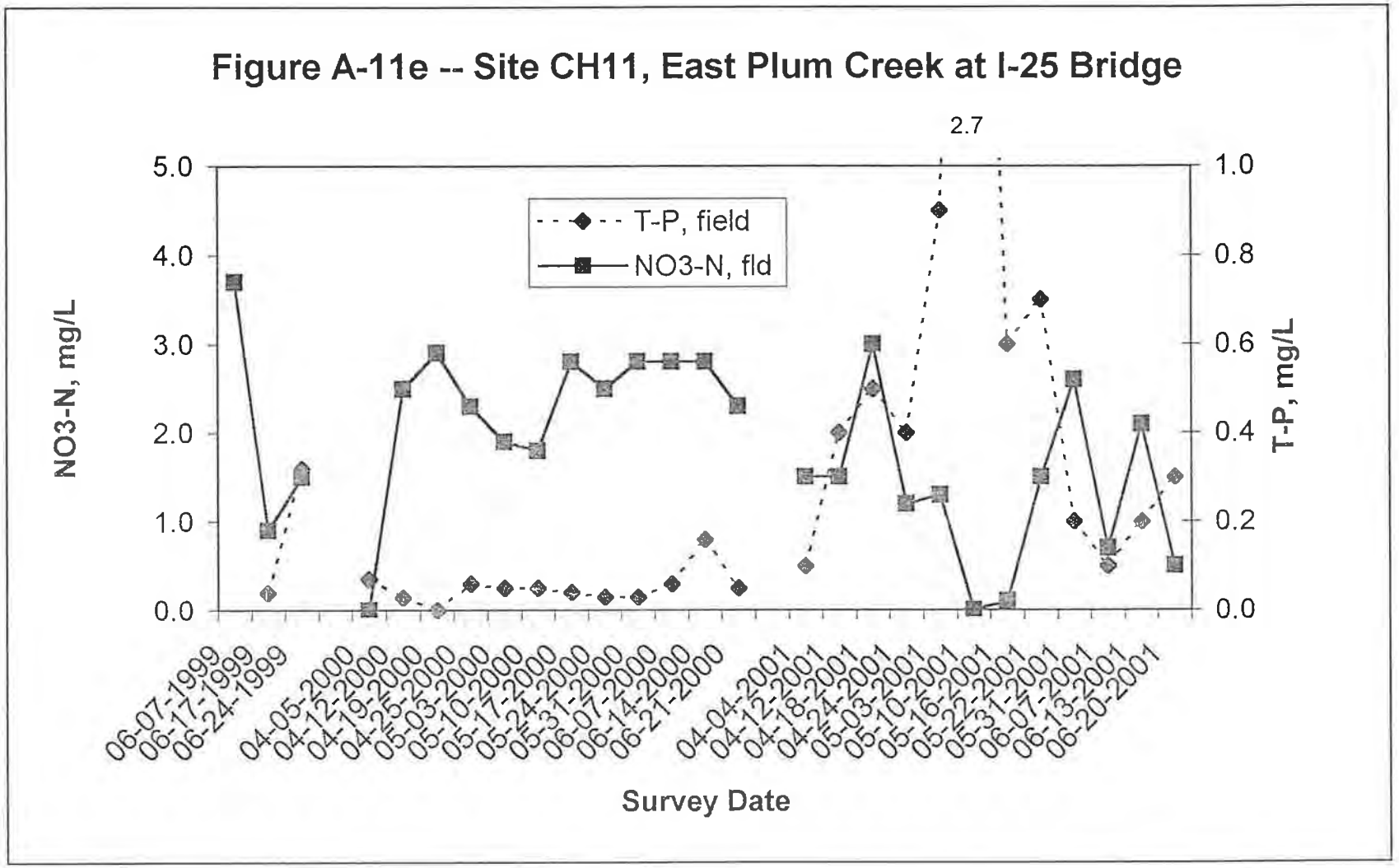


Figure A-11e -- Site CH11, East Plum Creek at I-25 Bridge
2.7
5.0
4.0
3.0
2.0
1.0
0.0
1.0
0.8
0.6
0.4
0.2
0.0
T-P, field
NO3-N, fld
NO3-N, mg/L
T-P, mg/L
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

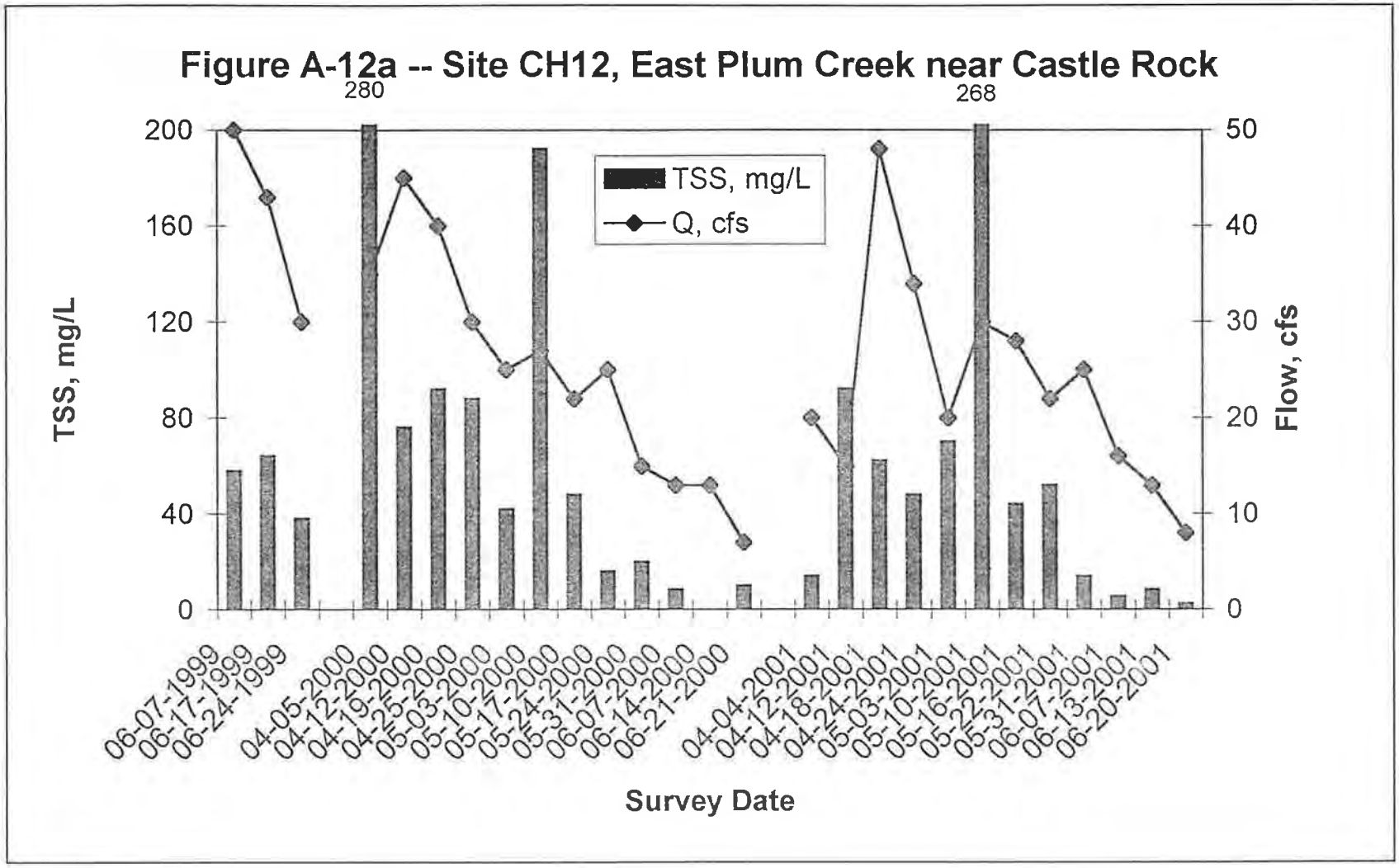


Figure A-12a -- Site CH12, East Plum Creek near Castle Rock
280
268
TSS, mg/L
Q, cfs
TSS, mg/L
Flow, cfs
200
160
120
80
40
0
50
40
30
20
10
0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

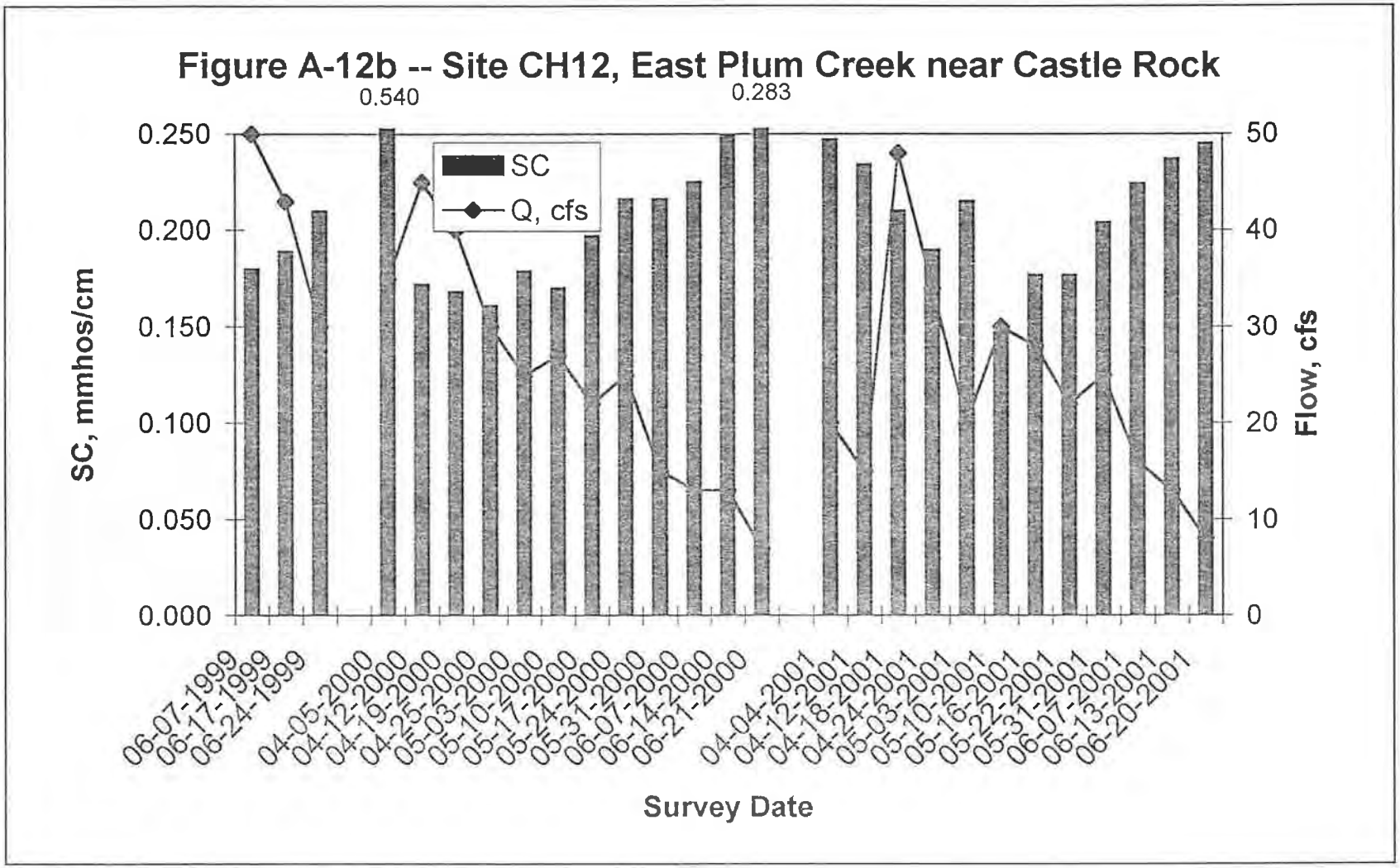


Figure A-12b -- Site CH12, East Plum Creek near Castle Rock
0.540
0.283
SC
Q, cfs
SC, mmhos/cm
Flow, cfs
0.250
0.200
0.150
0.100
0.050
0.000
50
40
30
20
10
0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

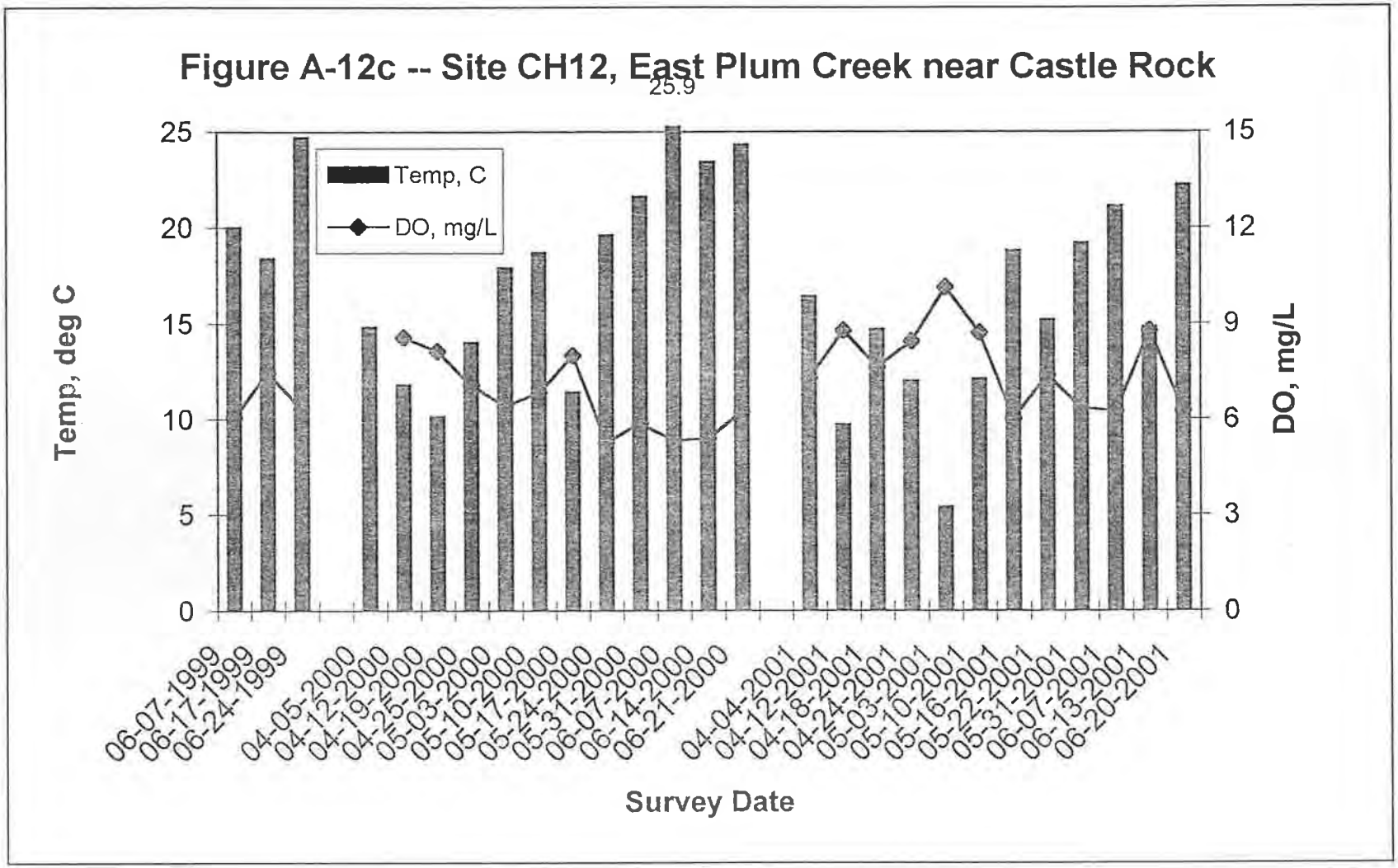
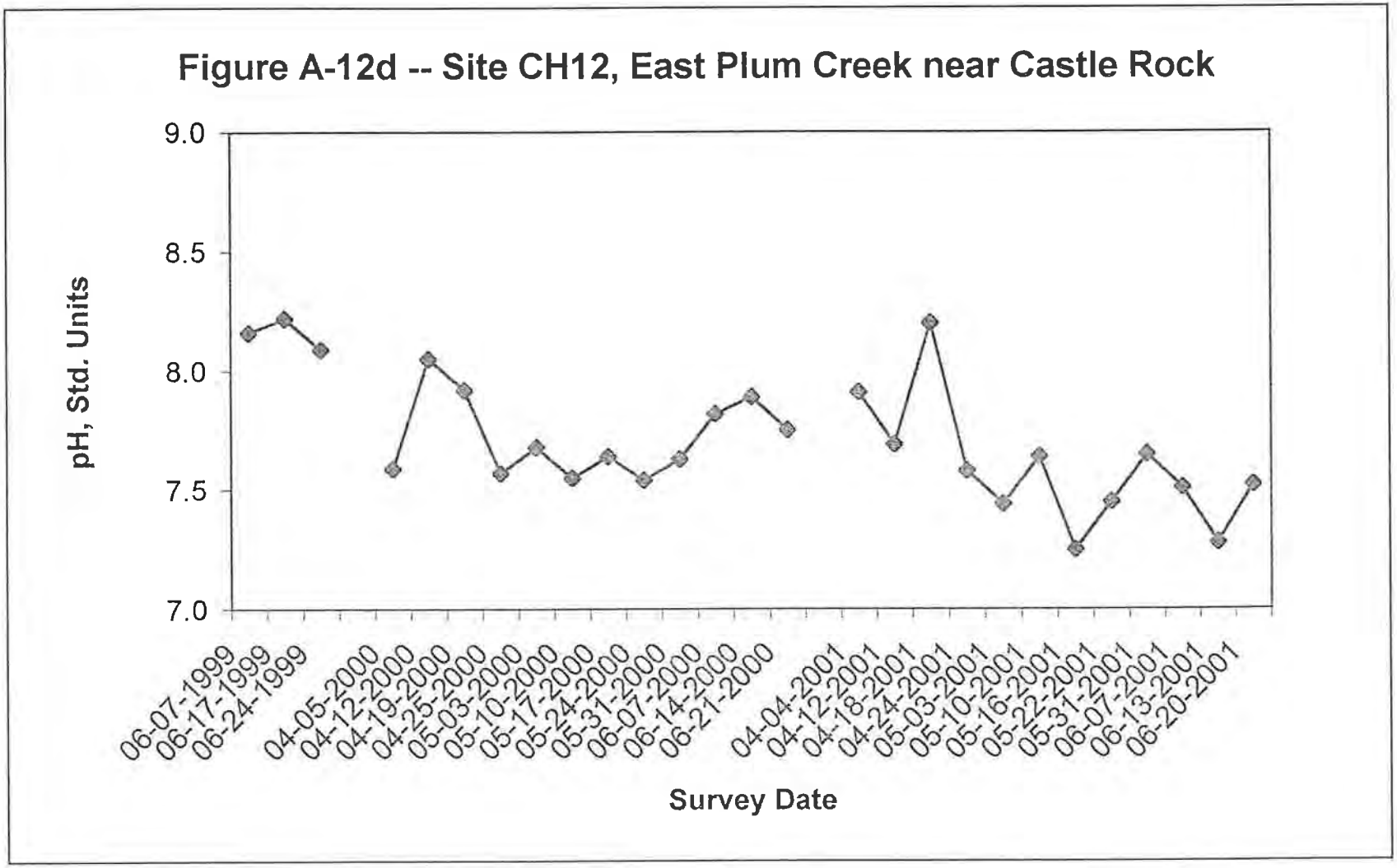


Figure A-12c -- Site CH12, East Plum Creek near Castle Rock
25.9
Temp, C
DO, mg/L
Temp, deg C
DO, mg/L
Survey Date
0
5
10
15
20
25
0
3
6
9
12
15
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001

Figure A-12d -- Site CH12, East Plum Creek near Castle Rock



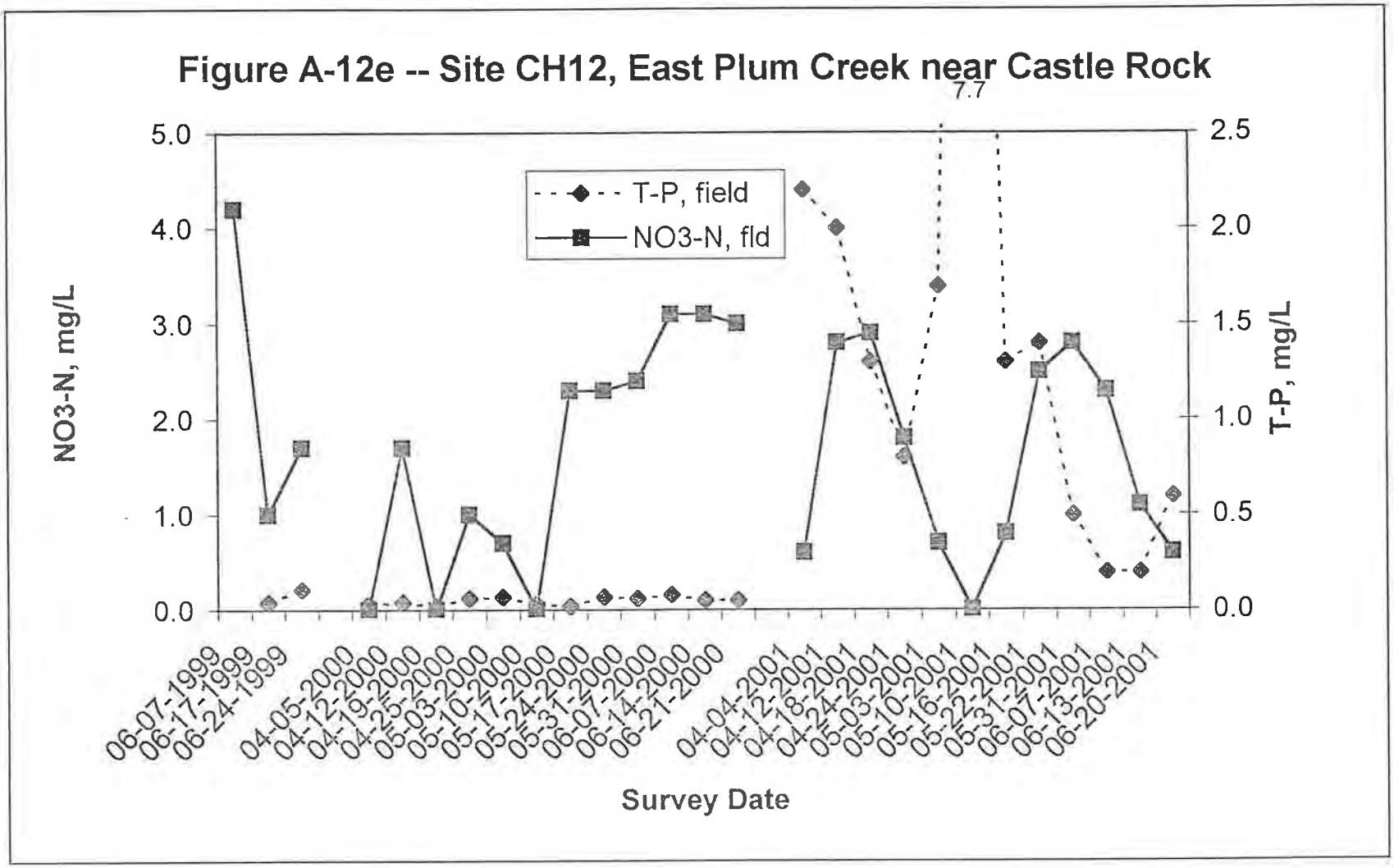


Figure A-12e -- Site CH12, East Plum Creek near Castle Rock
7.7
T-P, field
NO3-N, fld
NO3-N, mg/L
T-P, mg/L
5.0
4.0
3.0
2.0
1.0
0.0
2.5
2.0
1.5
1.0
0.5
0.0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

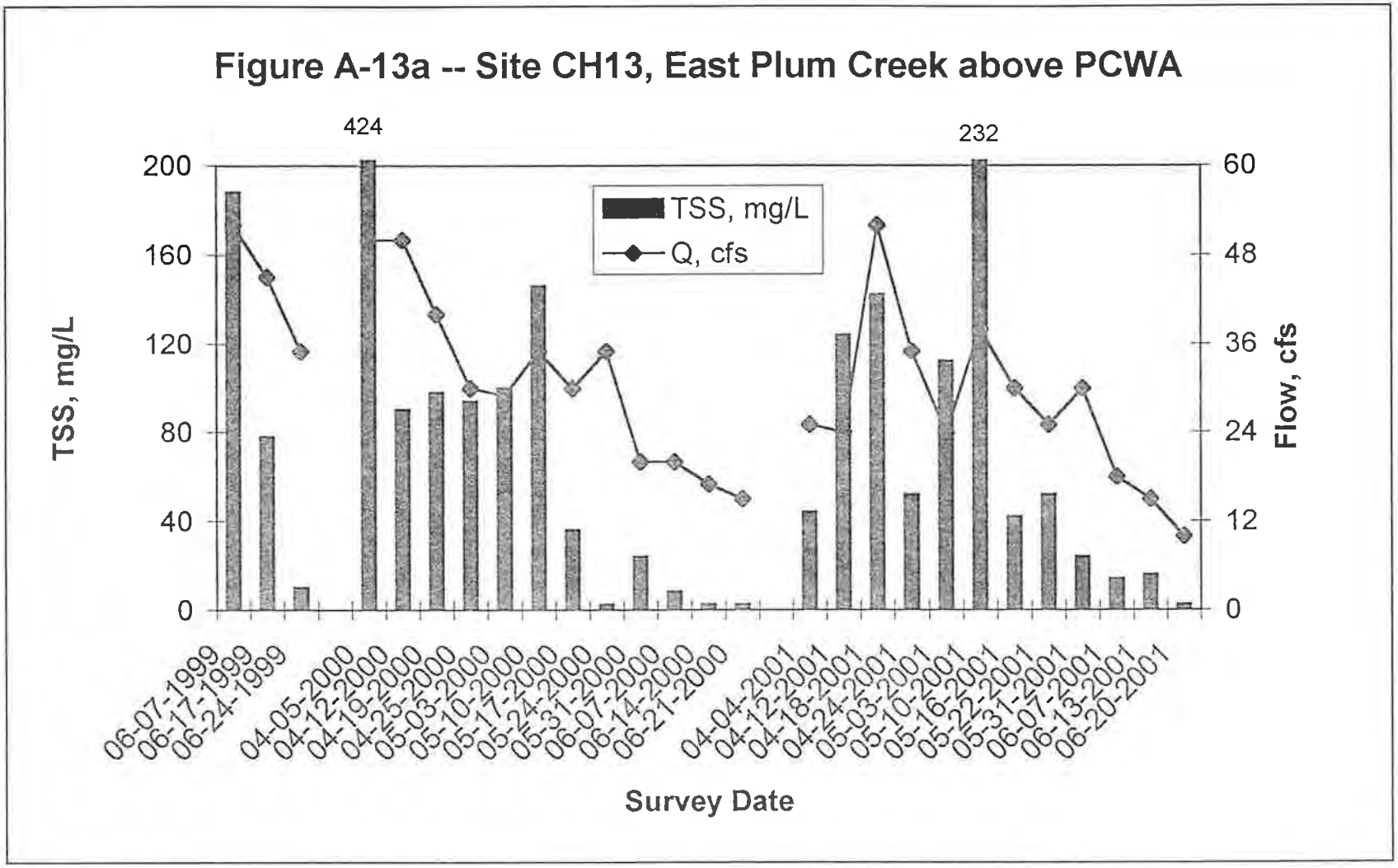


Figure A-13a -- Site CH13, East Plum Creek above PCWA
424
232
200
160
120
80
40
0
60
48
36
24
12
0
TSS, mg/L
Q, cfs
TSS, mg/L
Flow, cfs
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

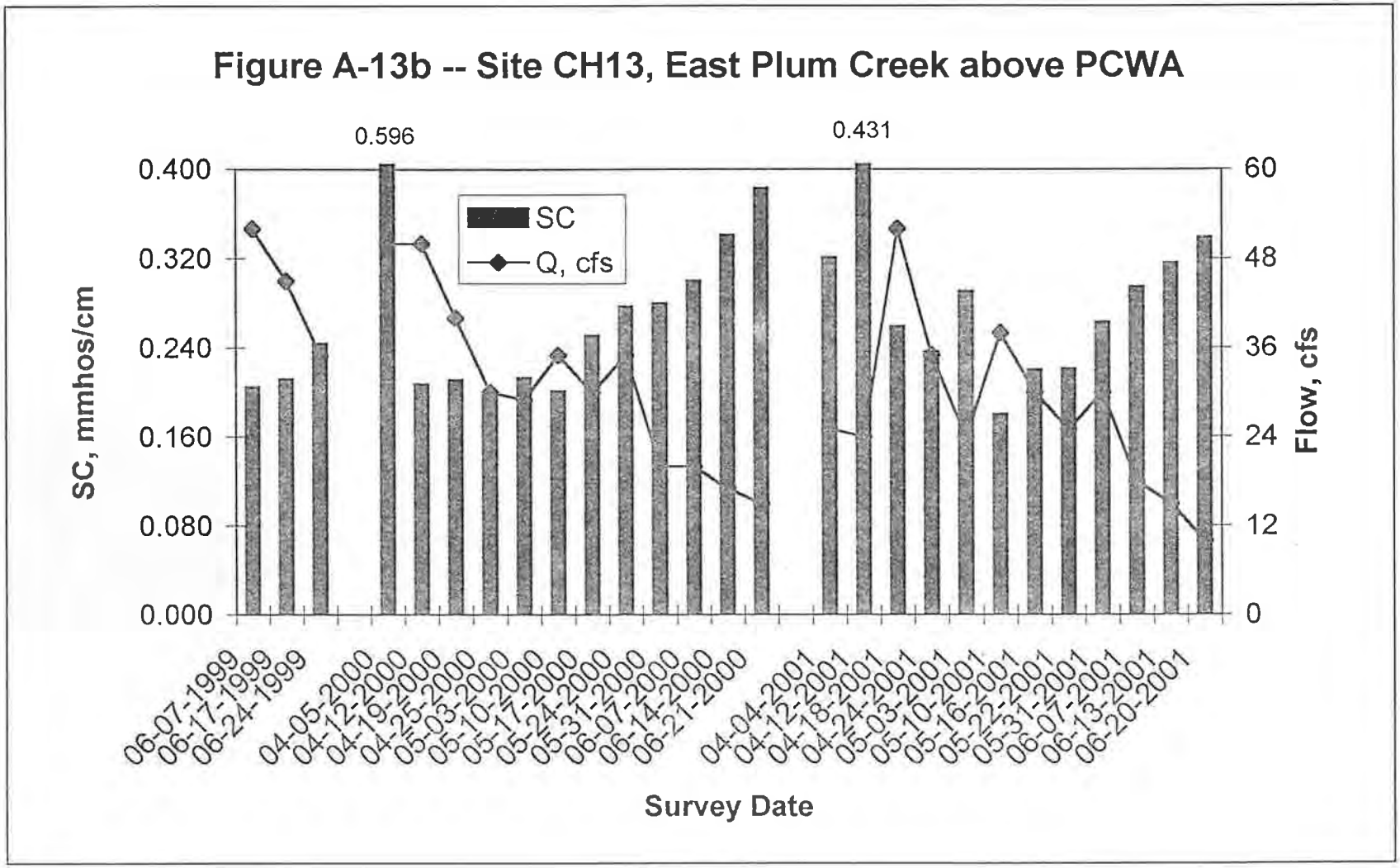


Figure A-13b -- Site CH13, East Plum Creek above PCWA
0.596
0.431
SC
Q, cfs
SC, mmhos/cm
Flow, cfs
0.400
0.320
0.240
0.160
0.080
0.000
60
48
36
24
12
0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

Figure A-13c -- Site CH13, East Plum Creek above PCWA

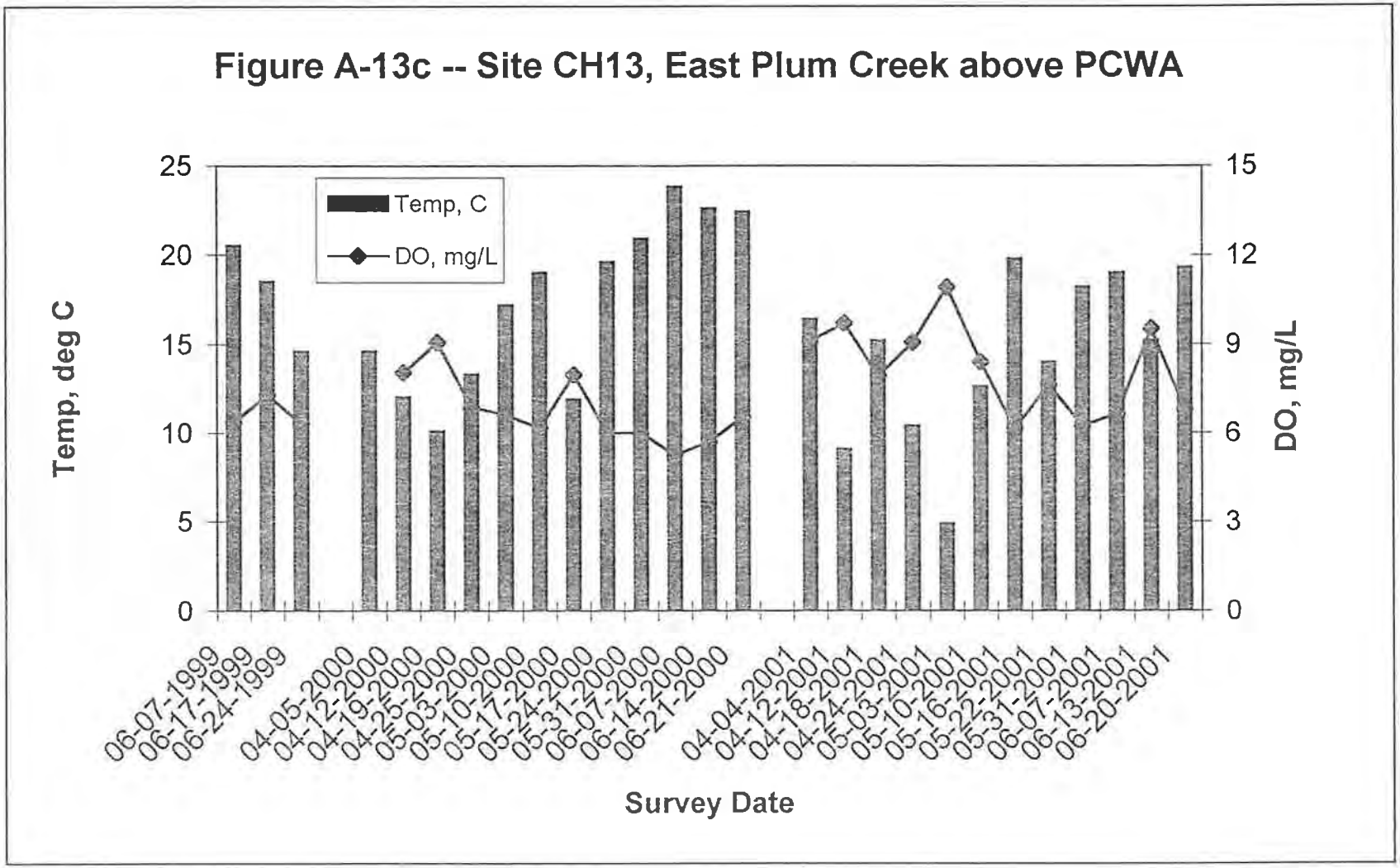
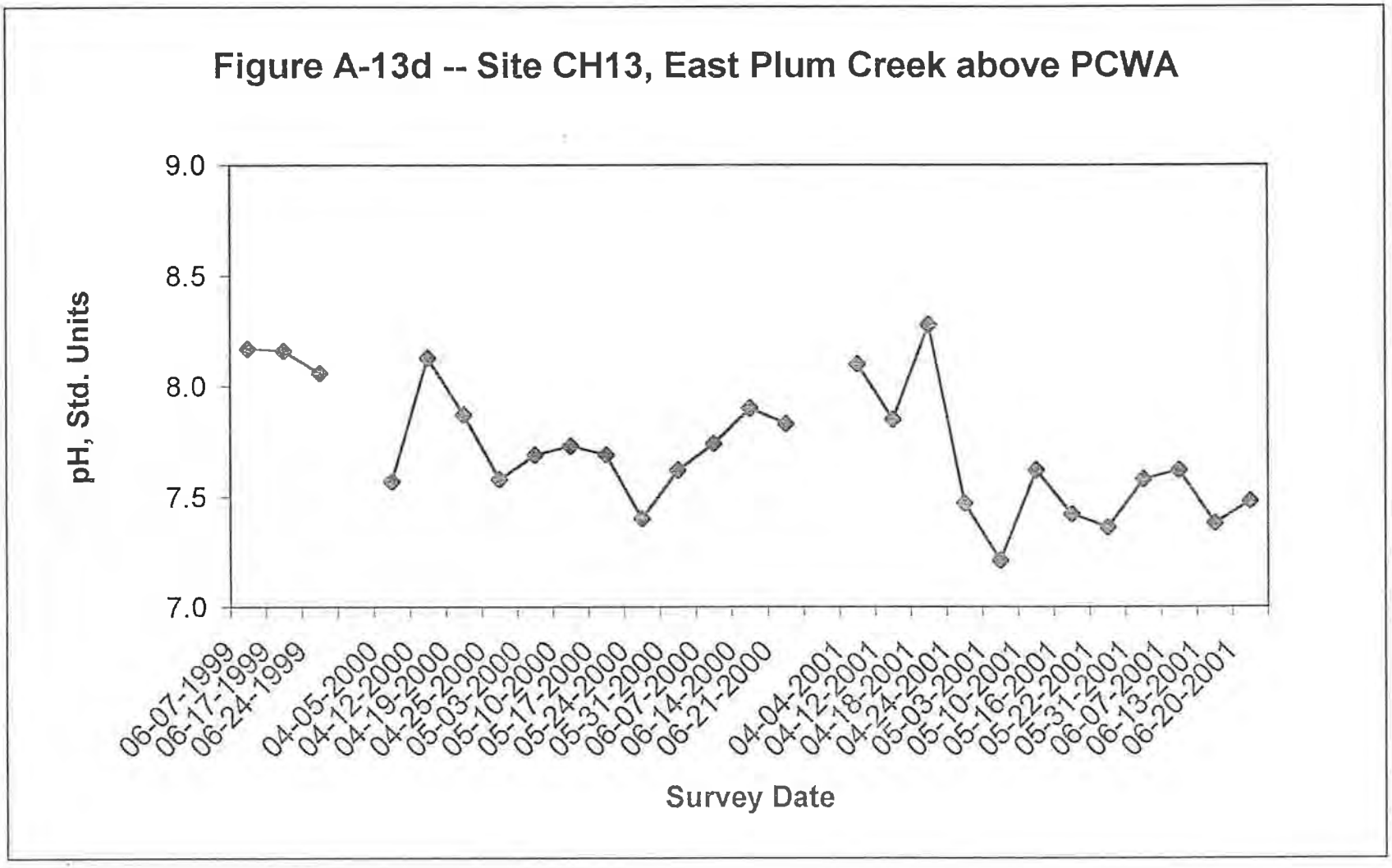


Figure A-13d -- Site CH13, East Plum Creek above PCWA



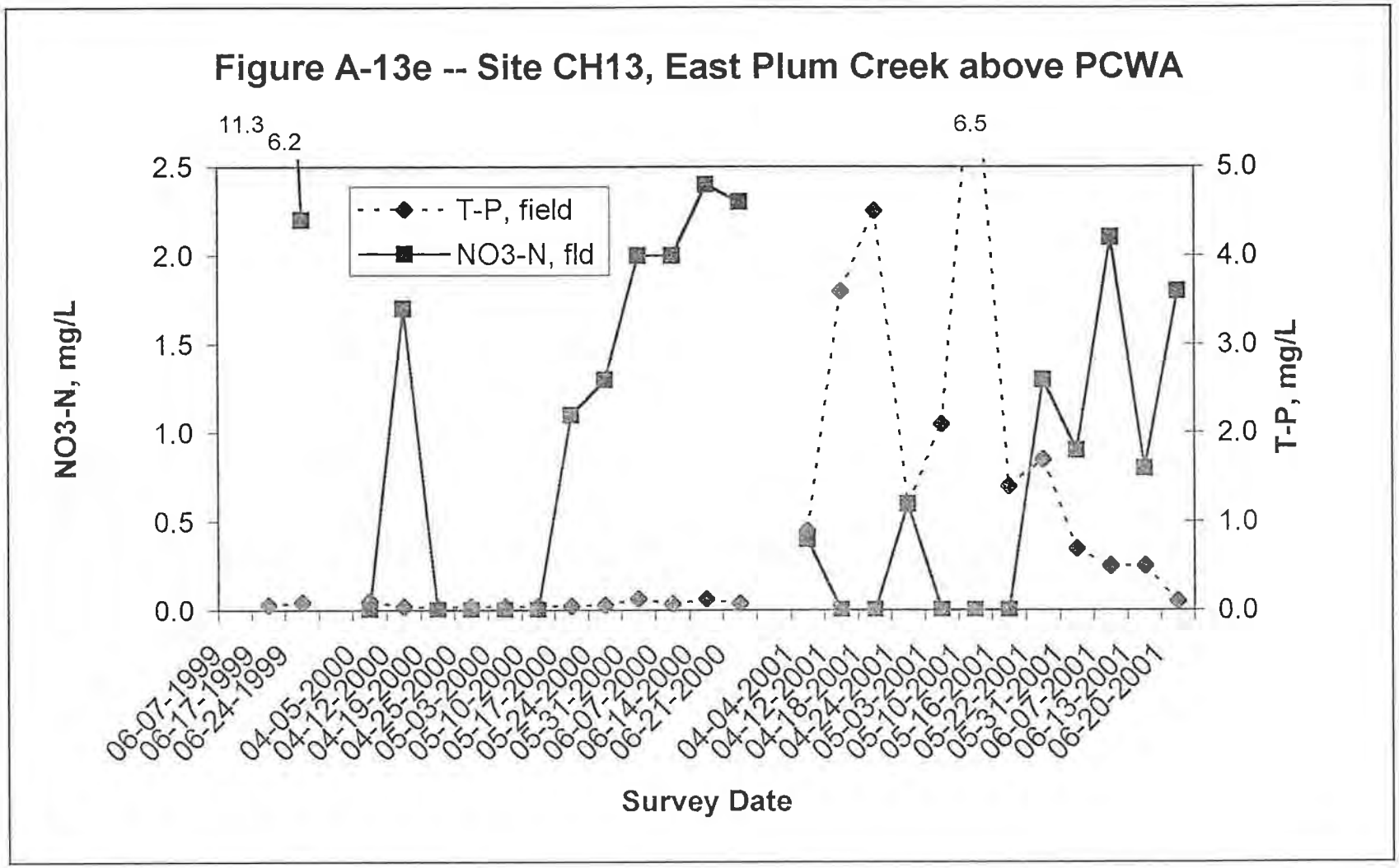


Figure A-13e -- Site CH13, East Plum Creek above PCWA
11.3
6.2
6.5
T-P, field
NO3-N, fld
NO3-N, mg/L
T-P, mg/L
2.5
2.0
1.5
1.0
0.5
0.0
5.0
4.0
3.0
2.0
1.0
0.0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

Figure A-14a -- Site CH14, East Plum Creek at Sedalia

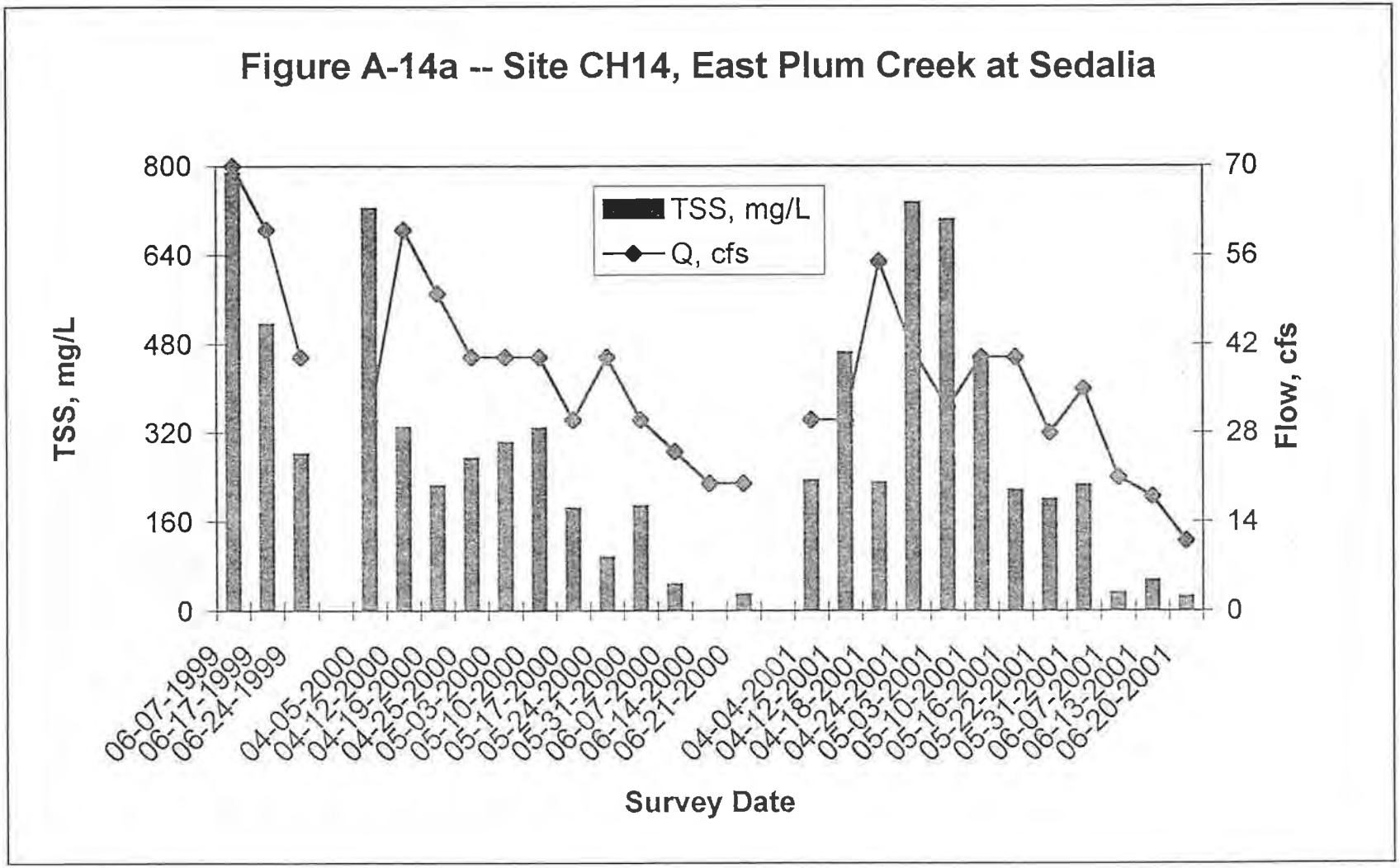


Figure A-15b -- Site CH15, Plum Creek at County Road 16

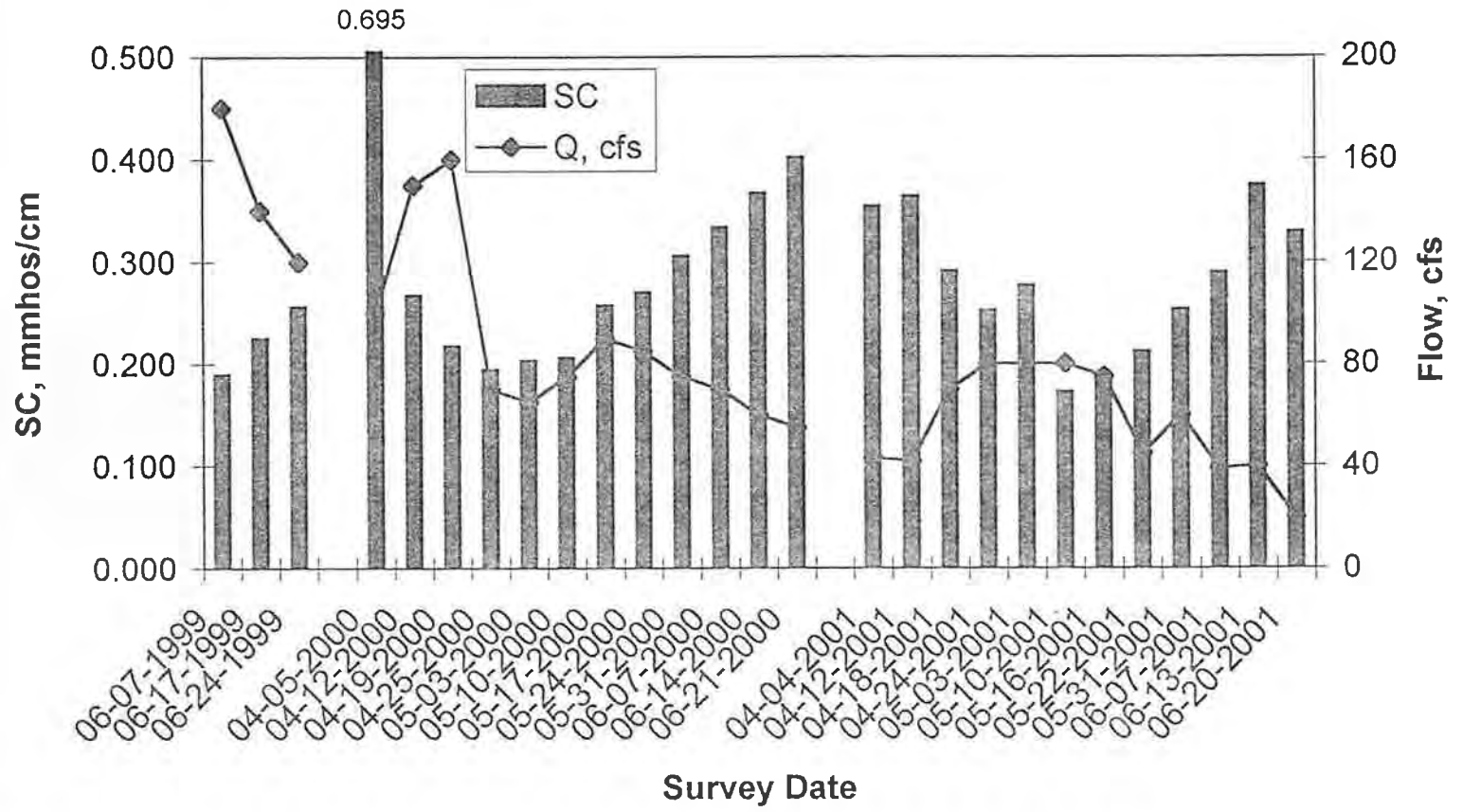


Figure A-15c -- Site CH15, Plum Creek at County Road 16

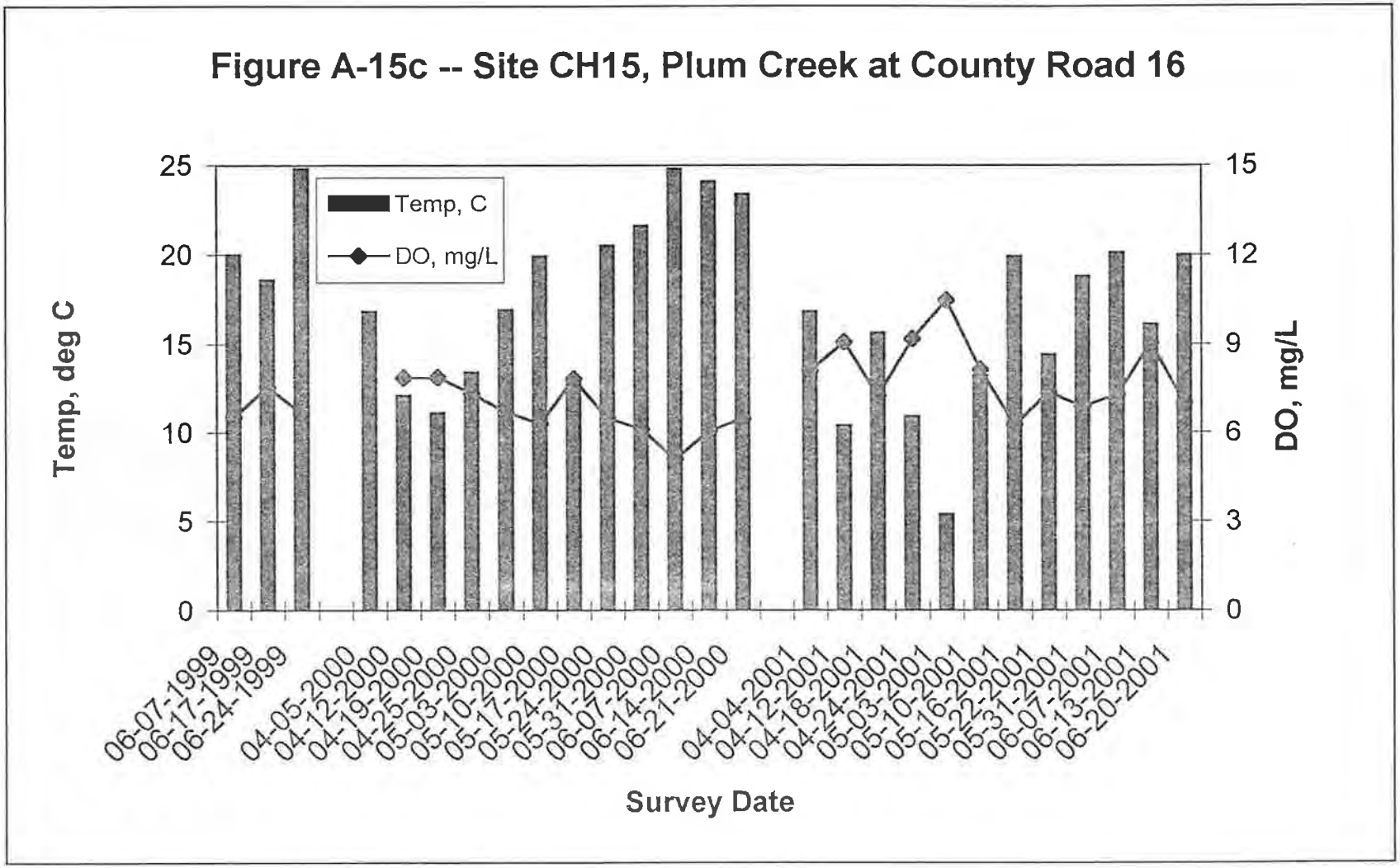


Figure A-14b -- Site CH14, East Plum Creek at Sedalia

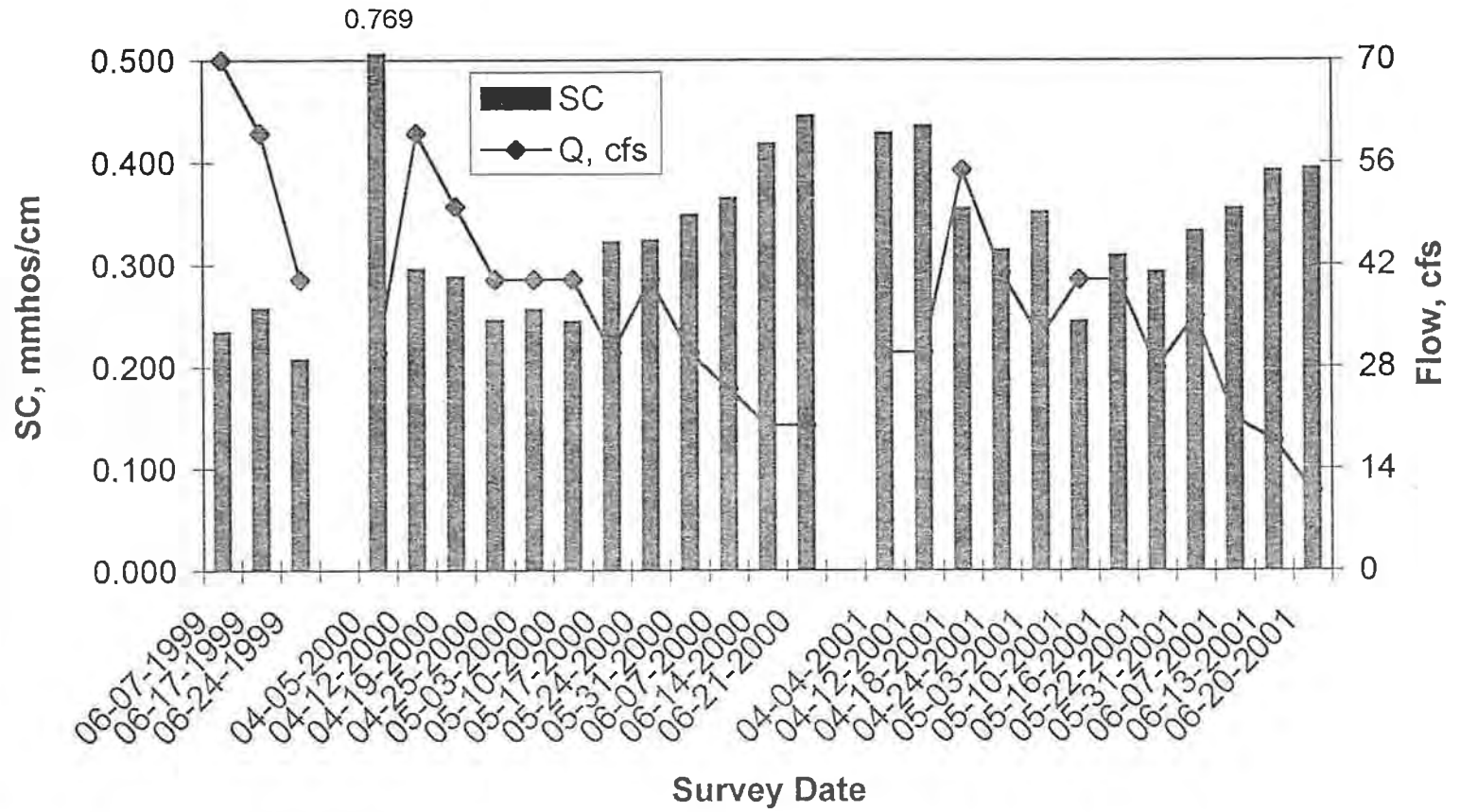


Figure A-14c -- Site CH14, East Plum Creek at Sedalia

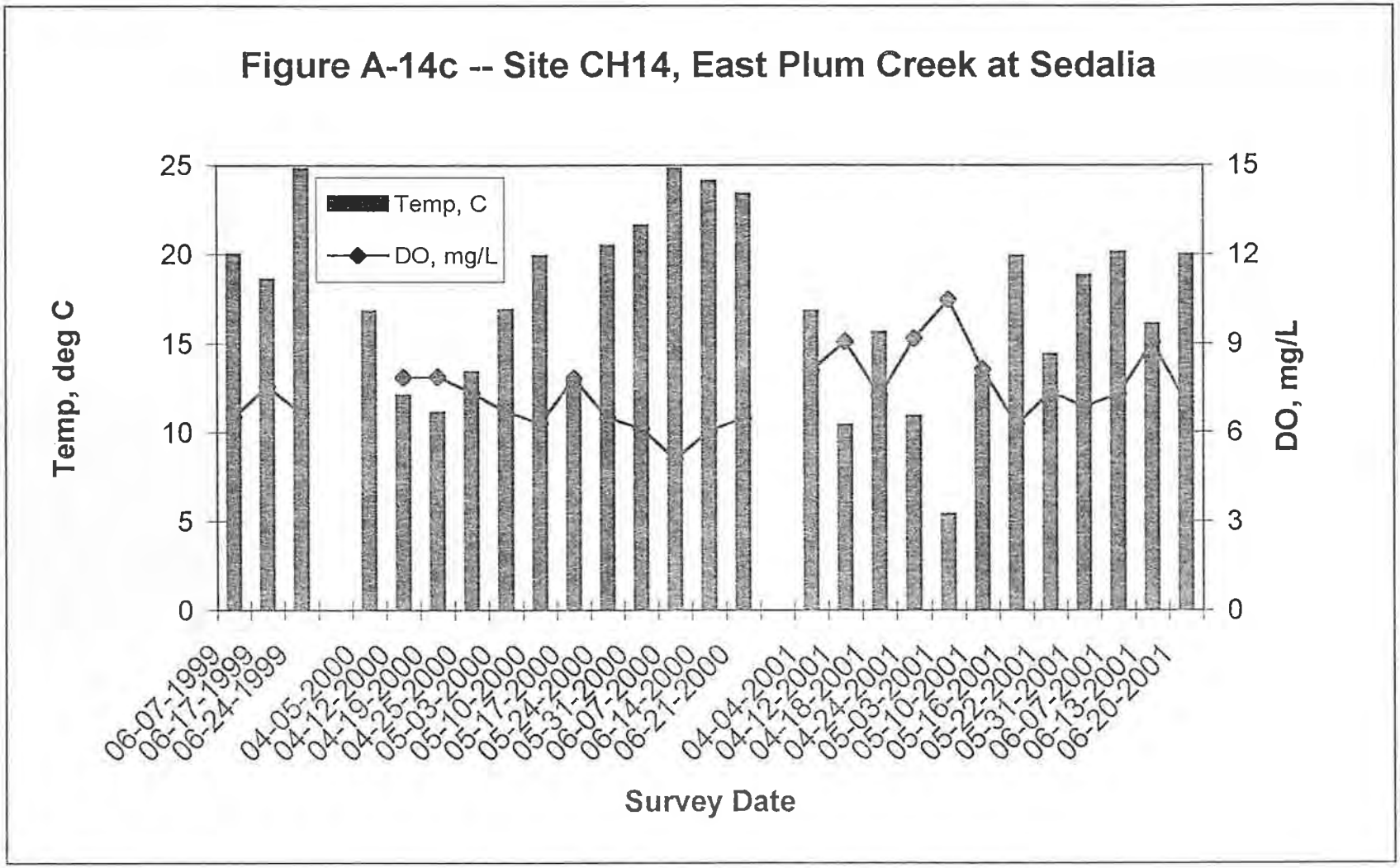


Figure A-14d -- Site CH14, East Plum Creek at Sedalia

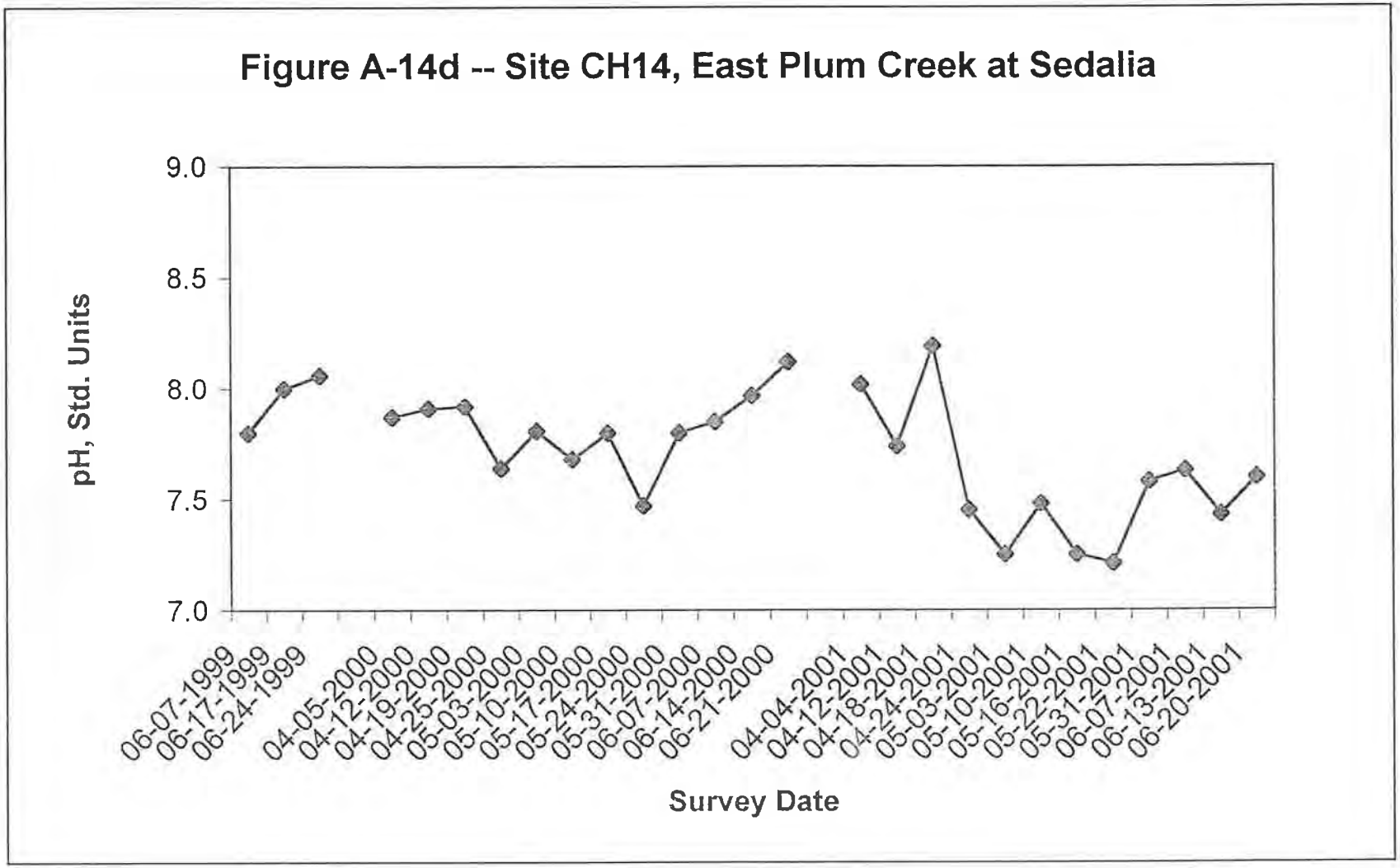
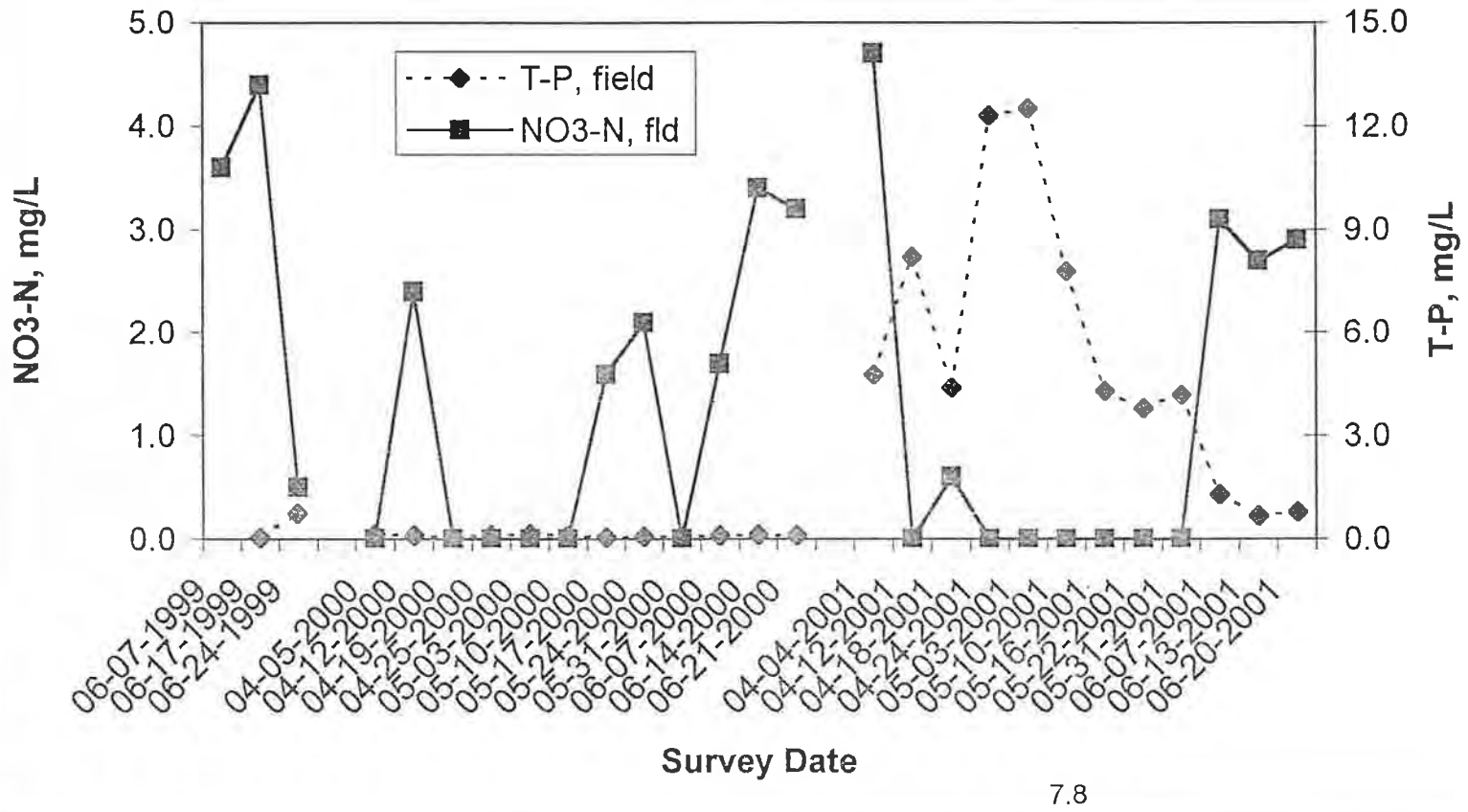


Figure A-14e -- Site CH14, East Plum Creek at Sedalia



7.8

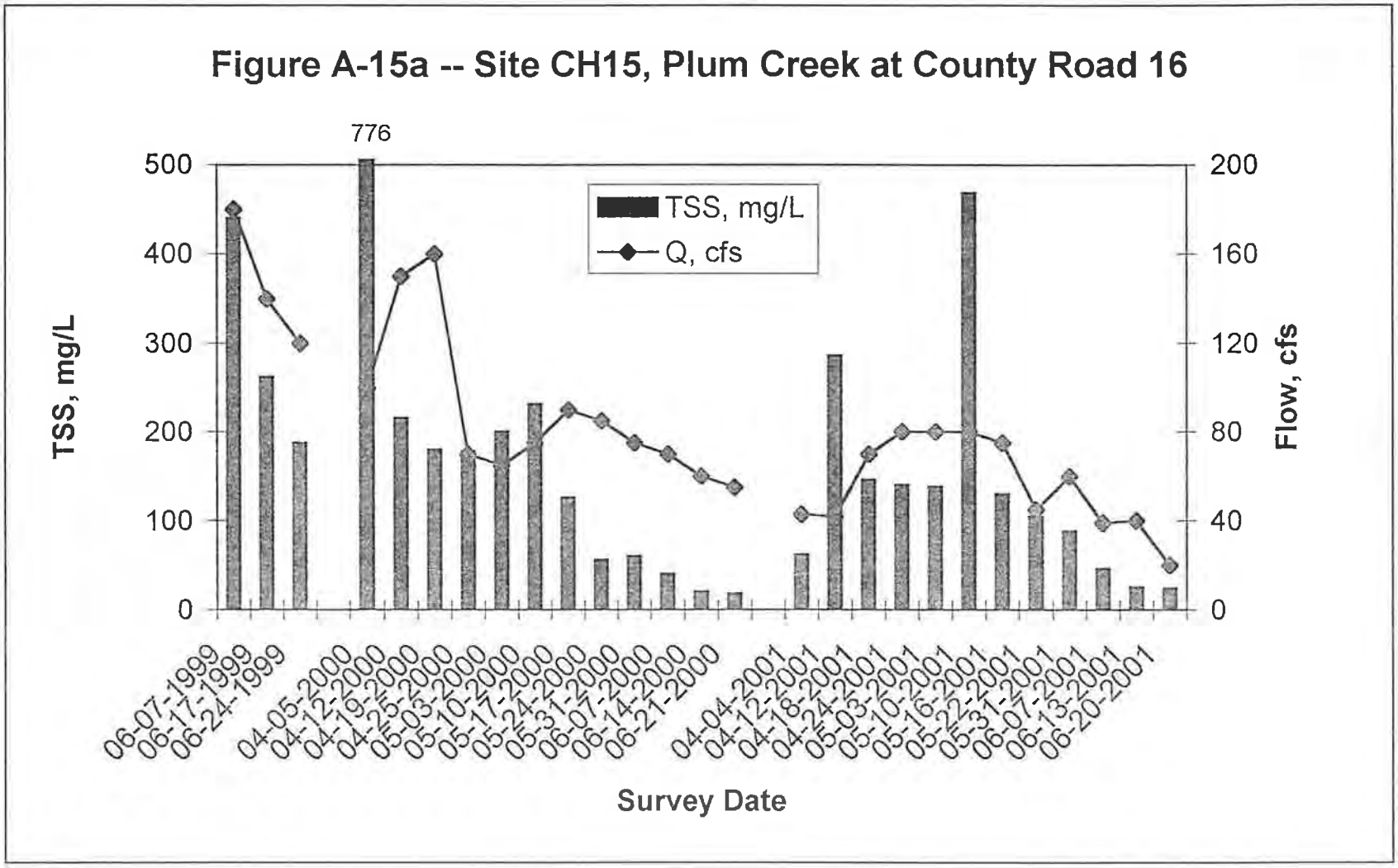
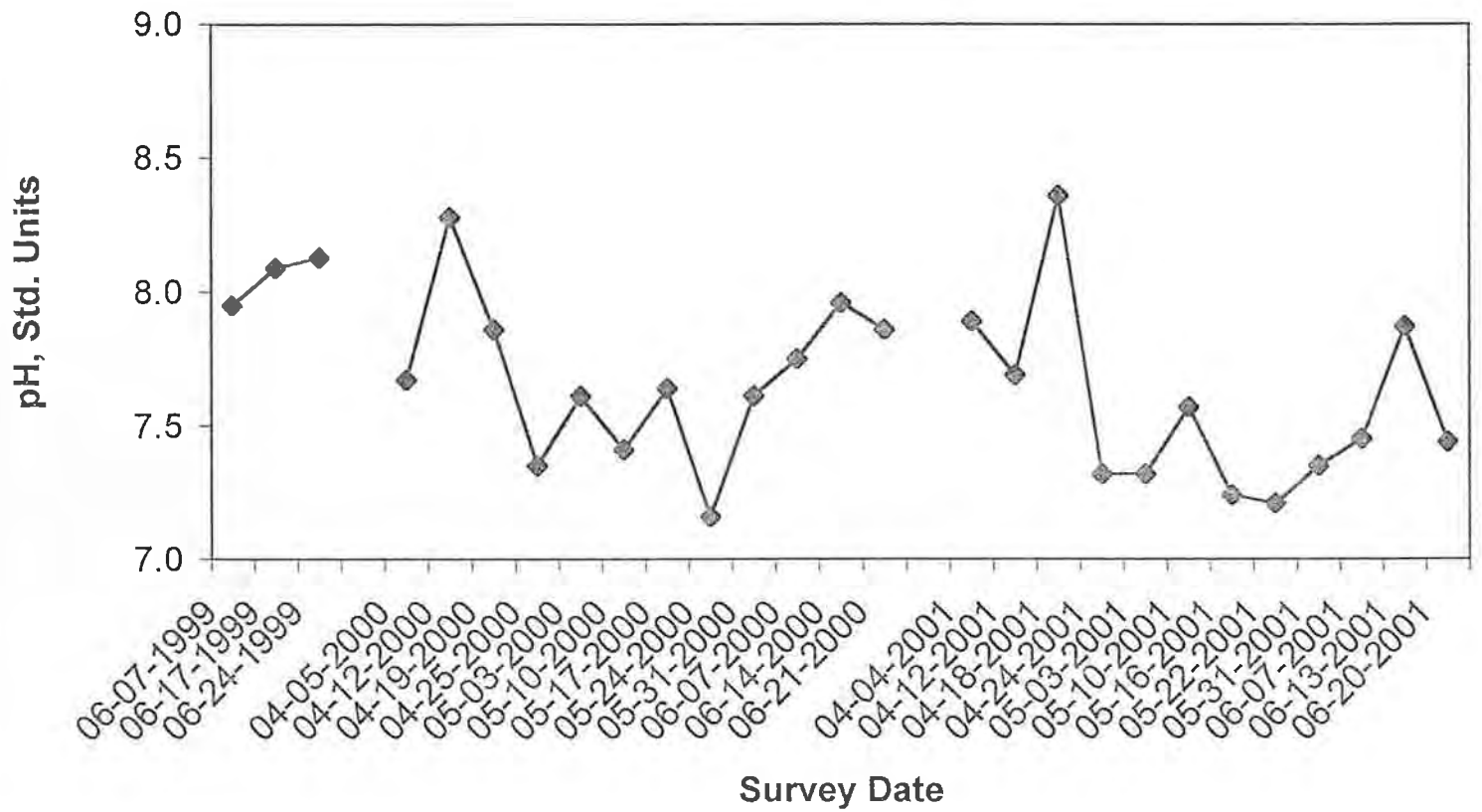


Figure A-15a -- Site CH15, Plum Creek at County Road 16
776
500
400
300
200
100
0
200
160
120
80
40
0
TSS, mg/L
Q, cfs
TSS, mg/L
Flow, cfs
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

Figure A-15d -- Site CH15, Plum Creek at County Road 16



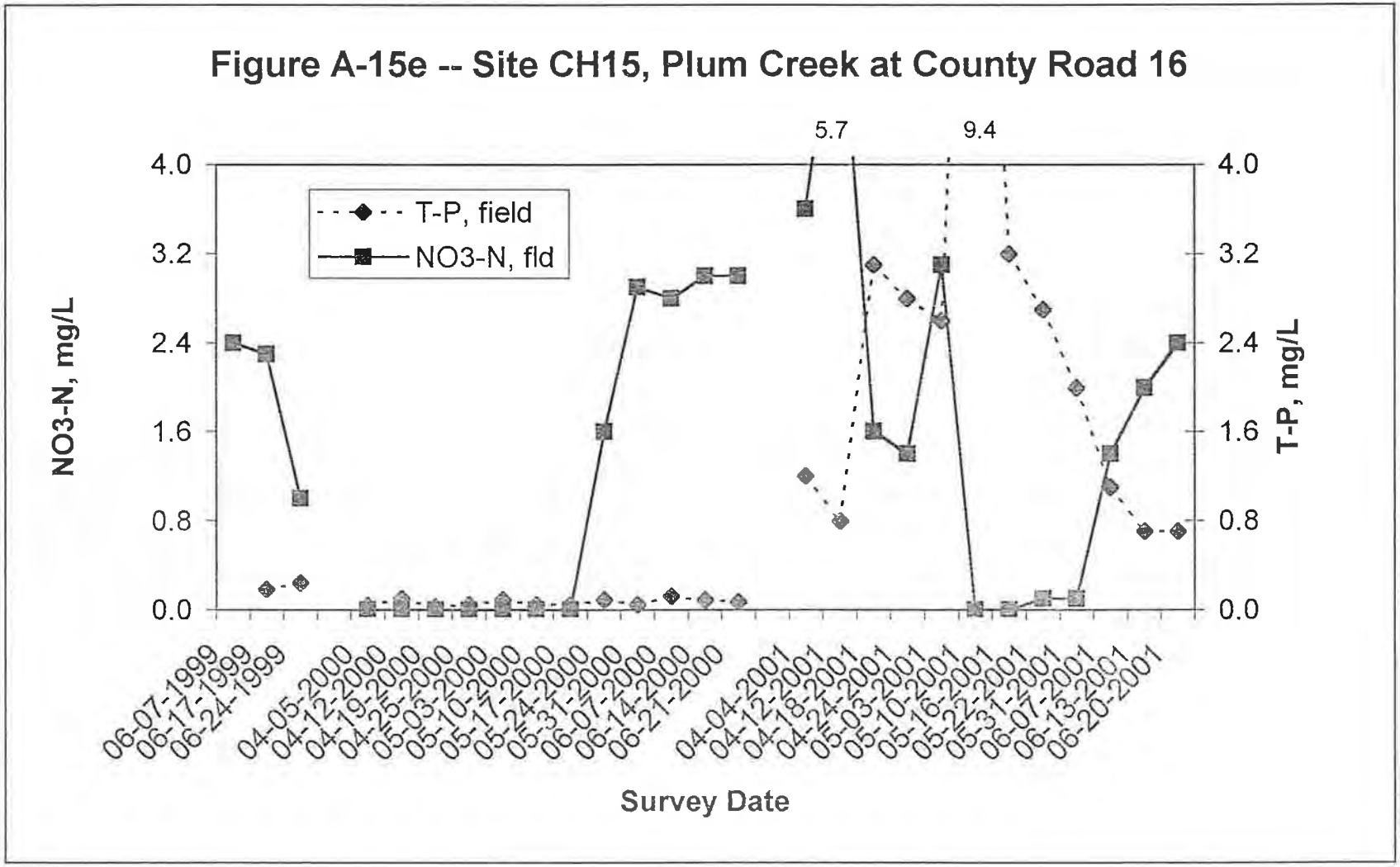


Figure A-15e -- Site CH15, Plum Creek at County Road 16
5.7
9.4
4.0
3.2
2.4
1.6
0.8
0.0
T-P, field
NO3-N, fld
NO3-N, mg/L
T-P, mg/L
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

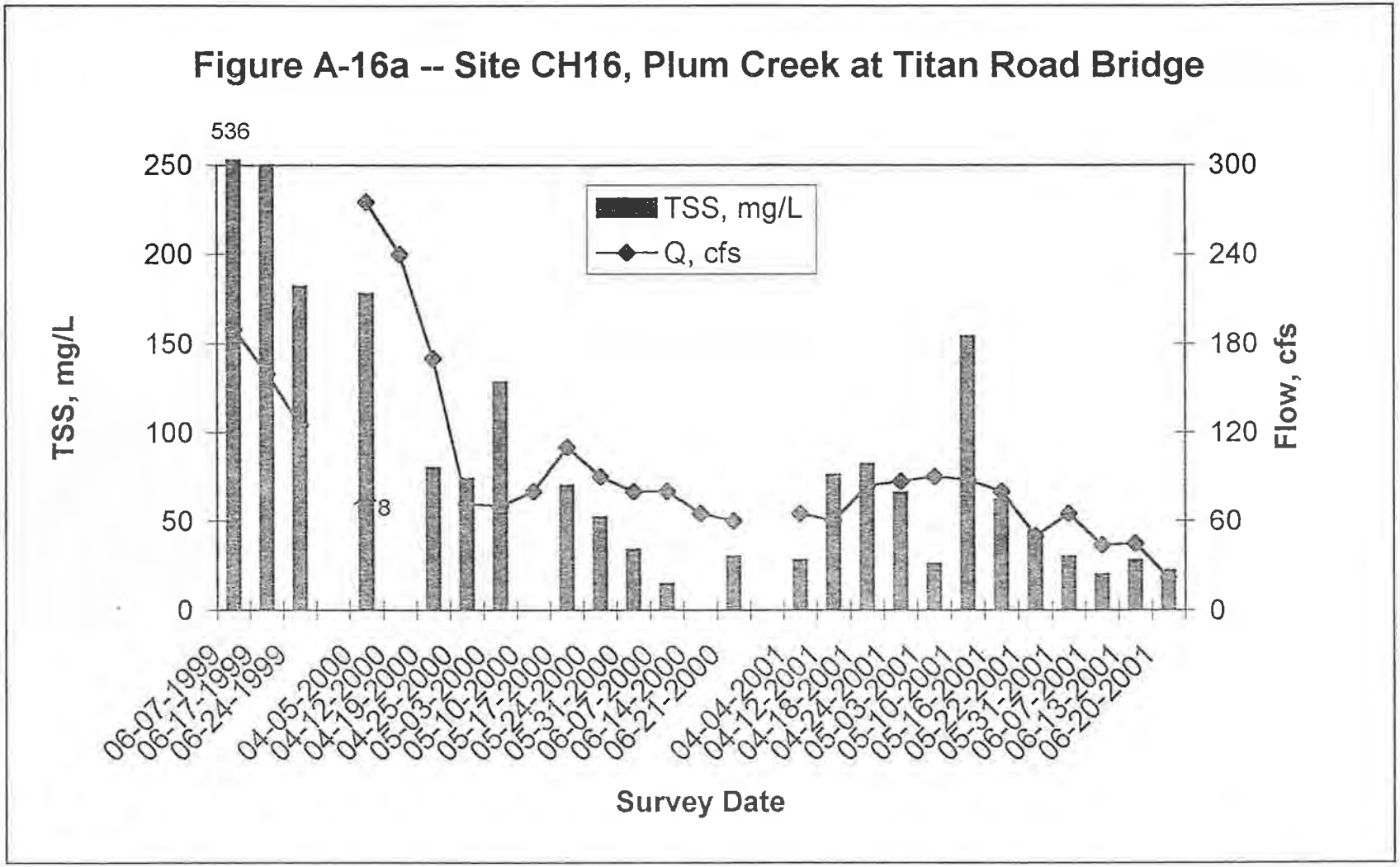


Figure A-16a -- Site CH16, Plum Creek at Titan Road Bridge
536
8
TSS, mg/L
Q, cfs
TSS, mg/L
Flow, cfs
250
200
150
100
50
0
300
240
180
120
60
0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

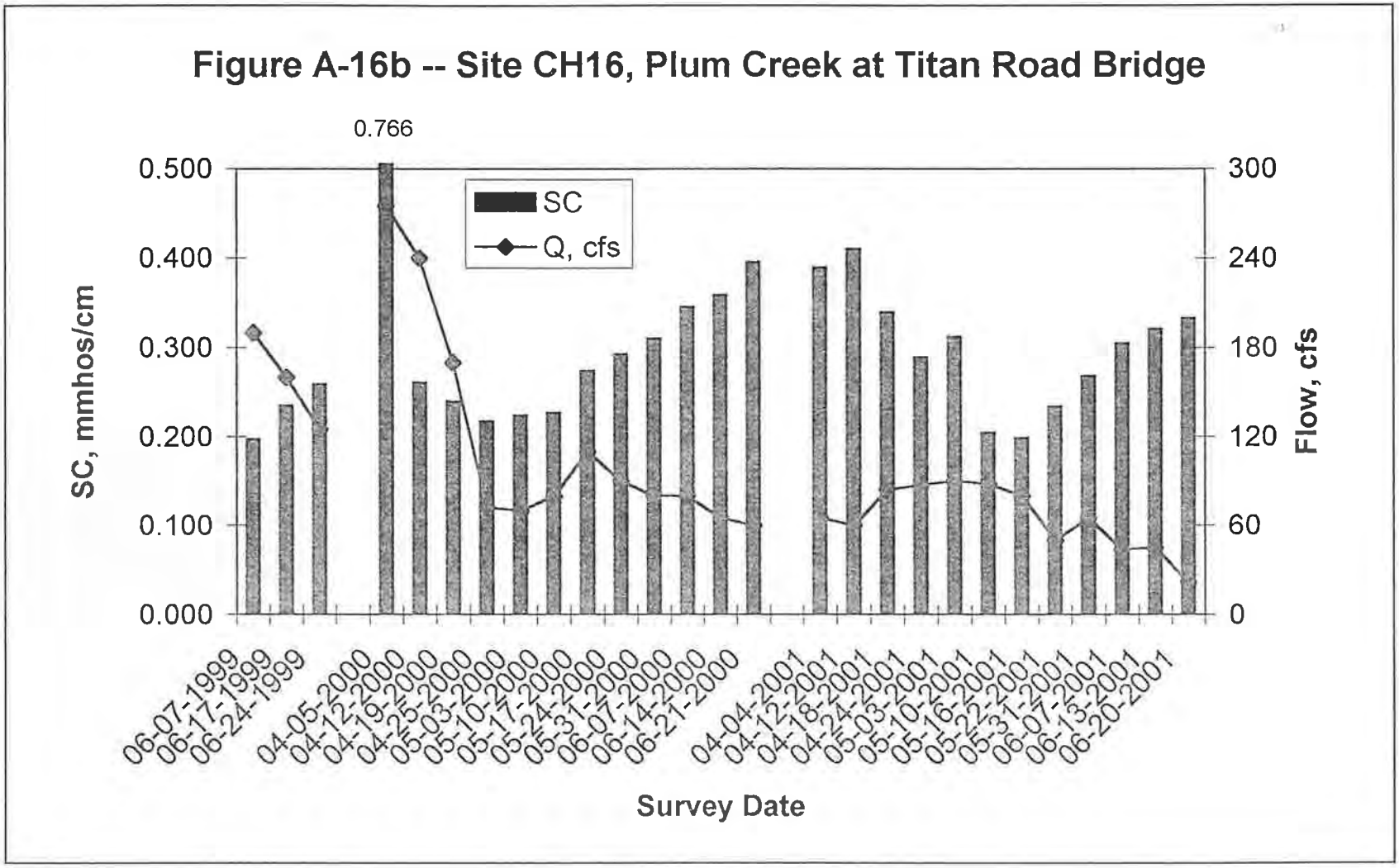


Figure A-16b -- Site CH16, Plum Creek at Titan Road Bridge
0.766
SC
Q, cfs
SC, mmhos/cm
Flow, cfs
0.500
0.400
0.300
0.200
0.100
0.000
300
240
180
120
60
0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

Figure A-16c -- Site CH16, Plum Creek at Titan Road Bridge

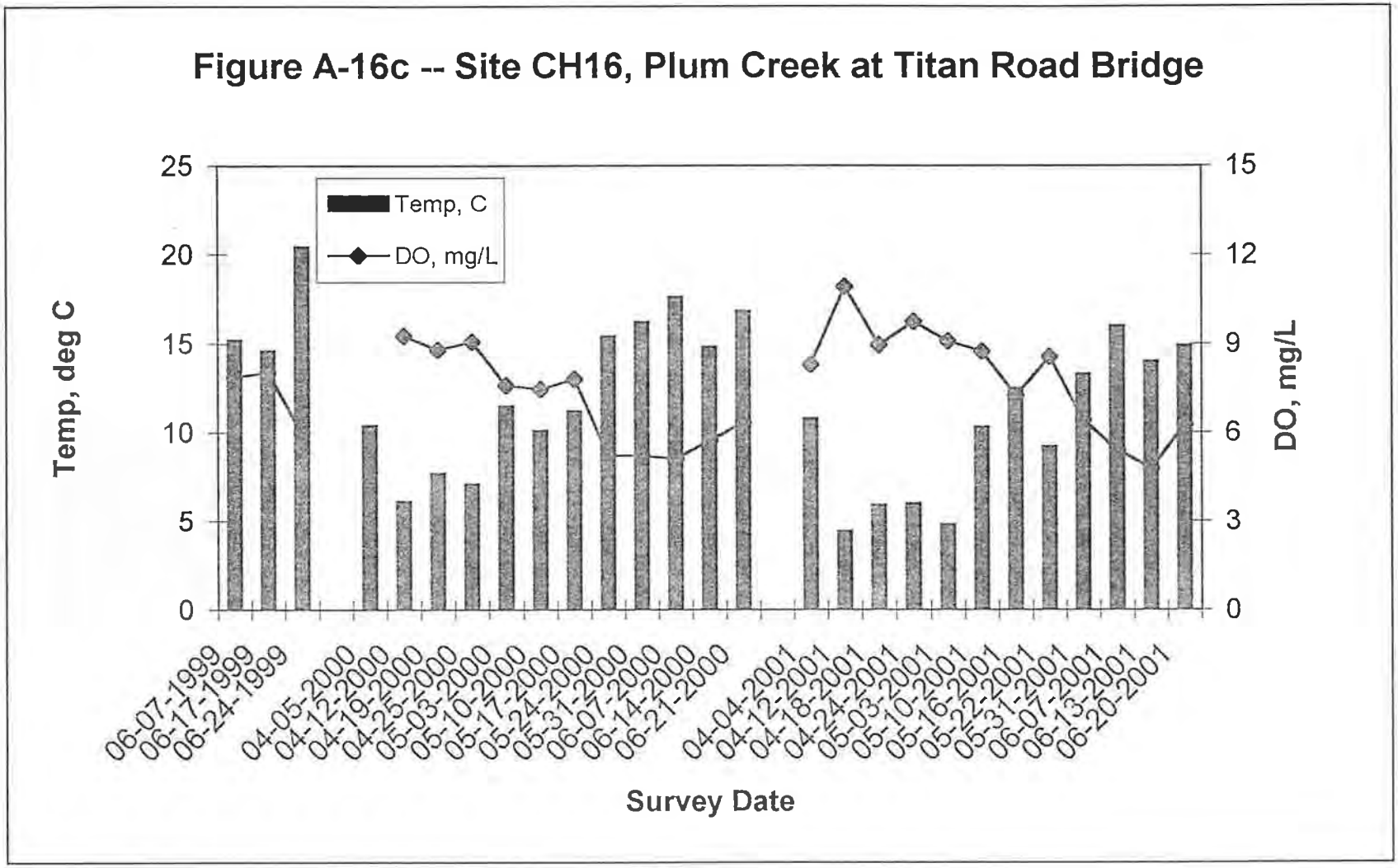


Figure A-16d -- Site CH16, Plum Creek at Titan Road Bridge

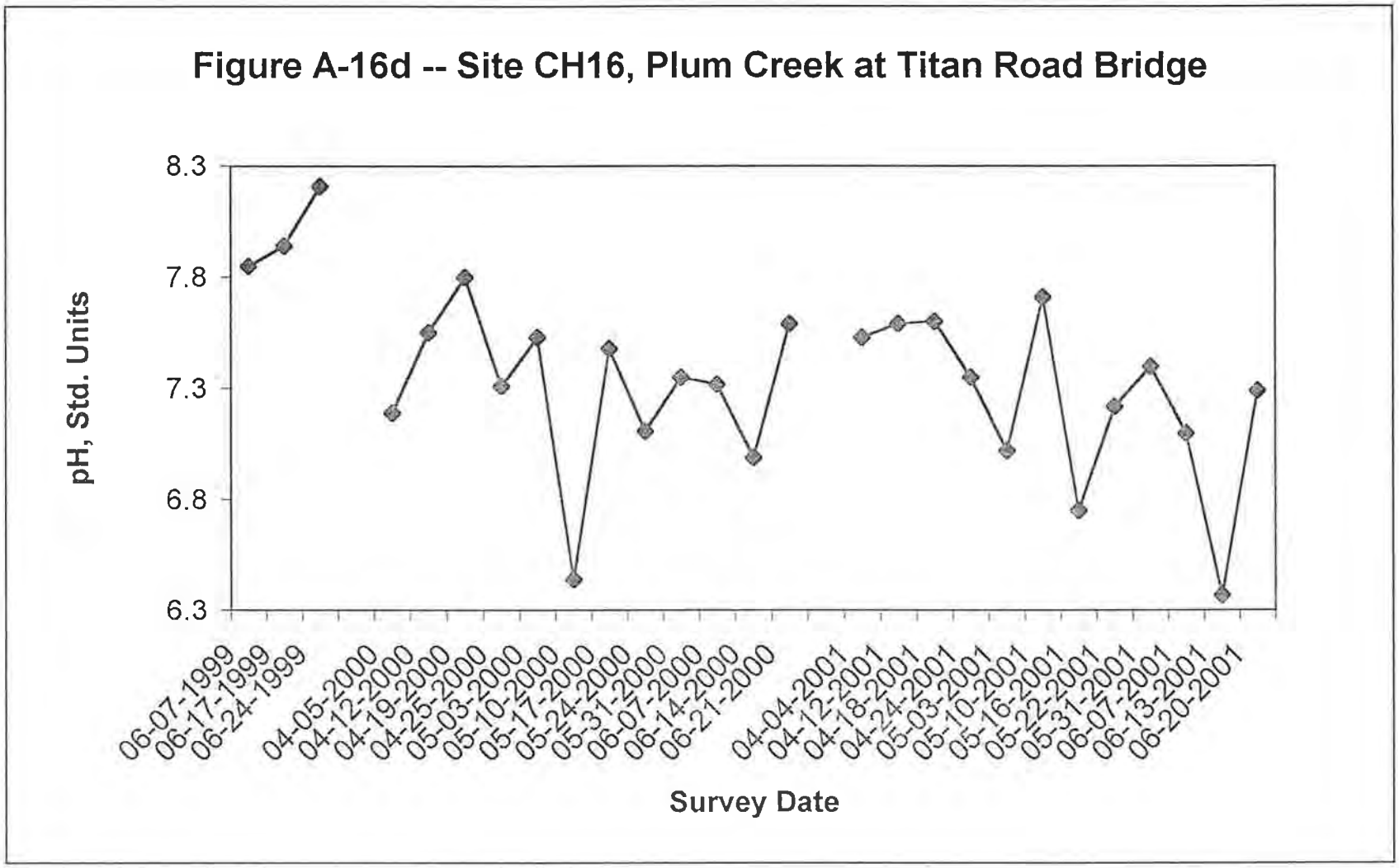
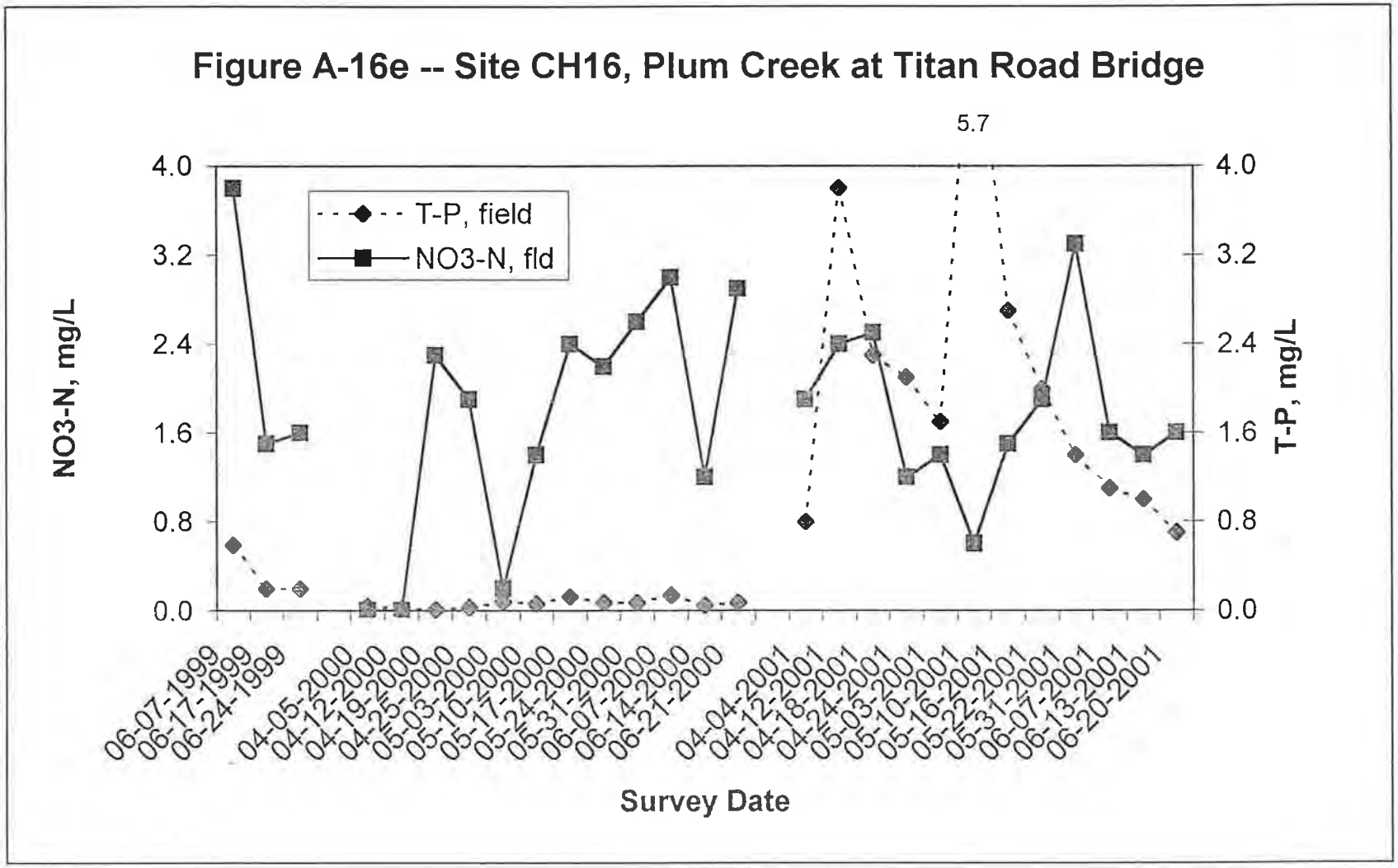


Figure A-16e -- Site CH16, Plum Creek at Titan Road Bridge



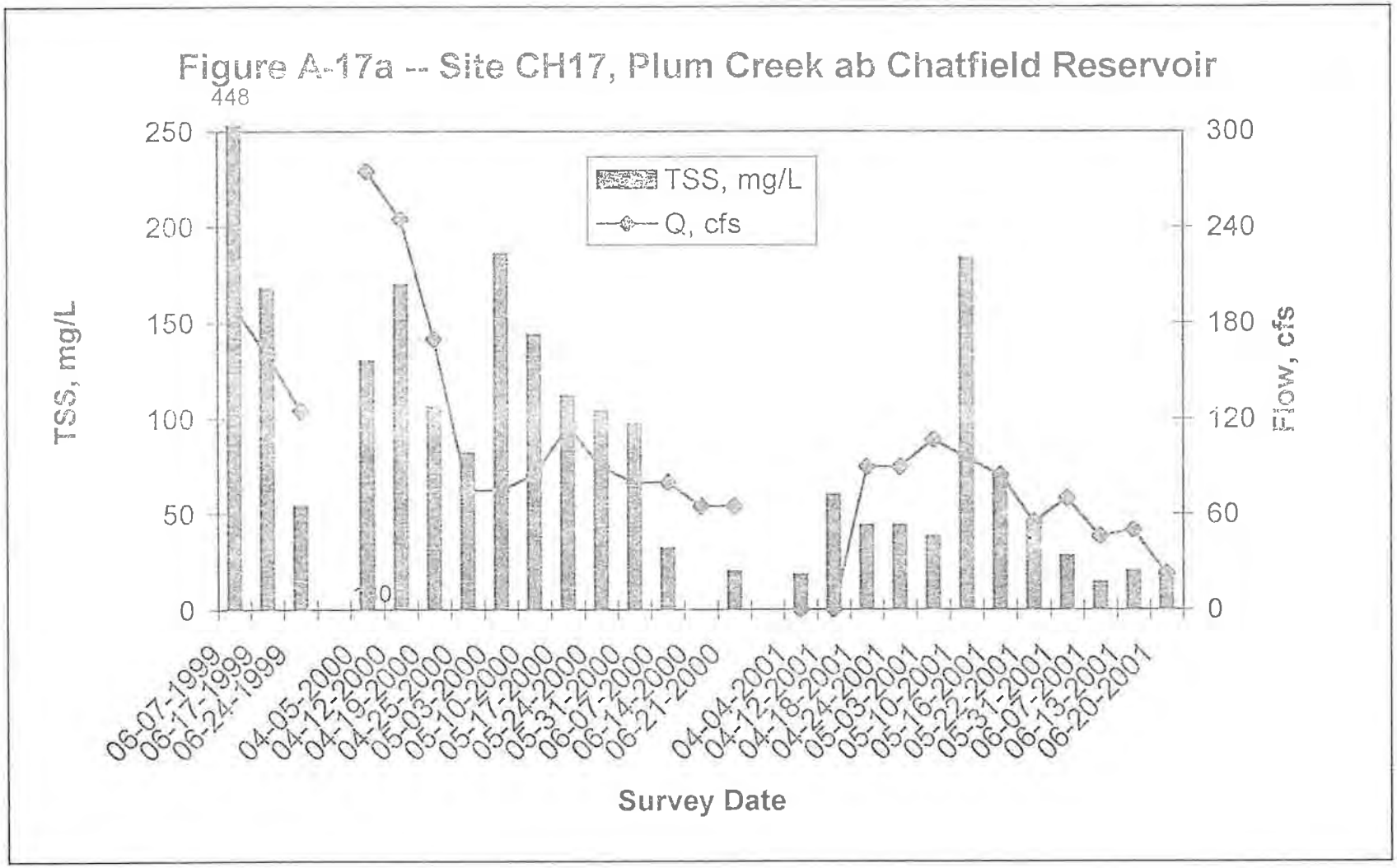


Figure A-17a -- Site CH17, Plum Creek ab Chatfield Reservoir
448
250
200
150
100
50
0
300
240
180
120
60
0
TSS, mg/L
Q, cfs
TSS, mg/L
Flow, cfs
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

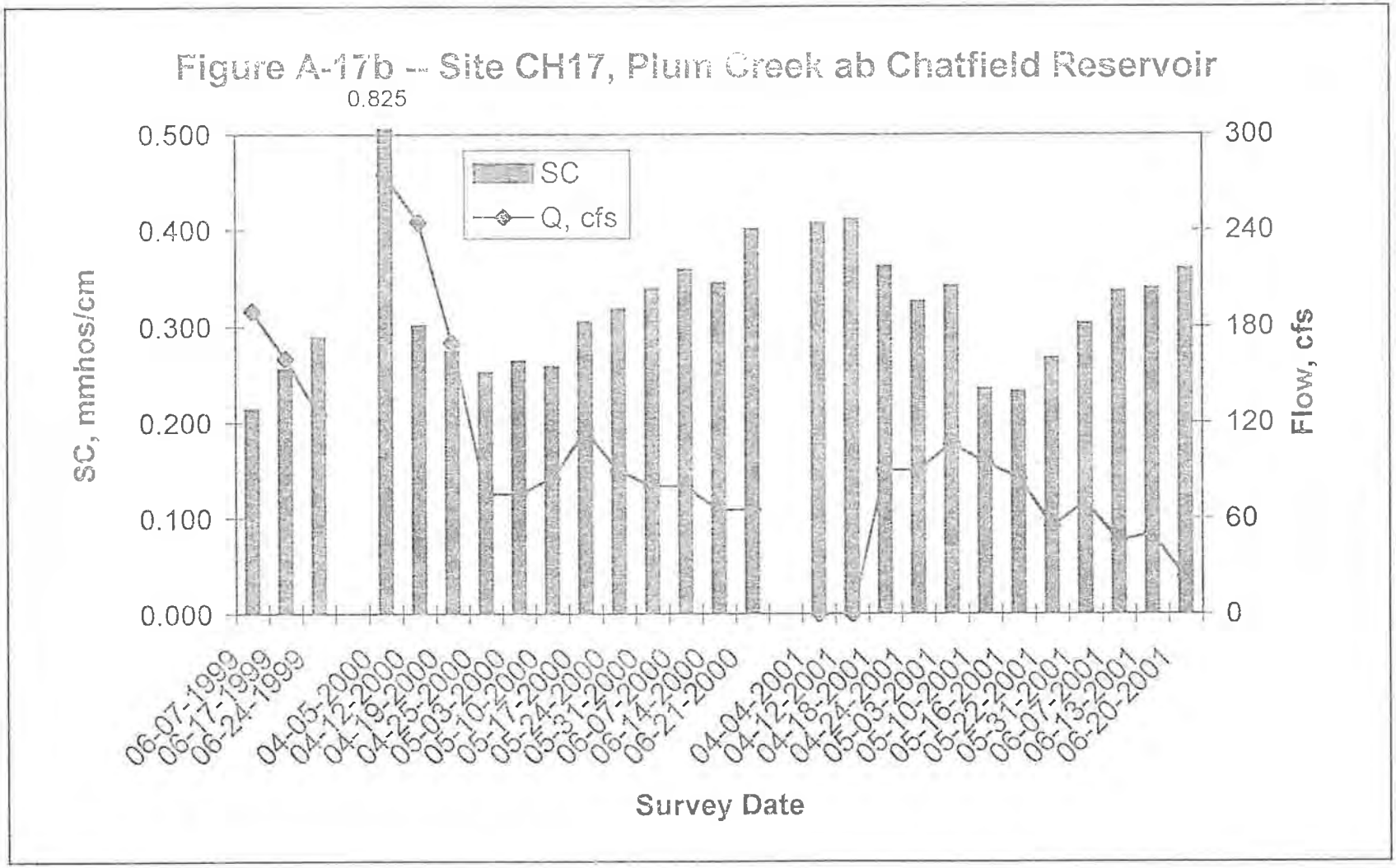


Figure A-17b -- Site CH17, Plum Creek ab Chatfield Reservoir
0.825
SC
Q, cfs
SC, mmhos/cm
Flow, cfs
0.500
0.400
0.300
0.200
0.100
0.000
300
240
180
120
60
0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

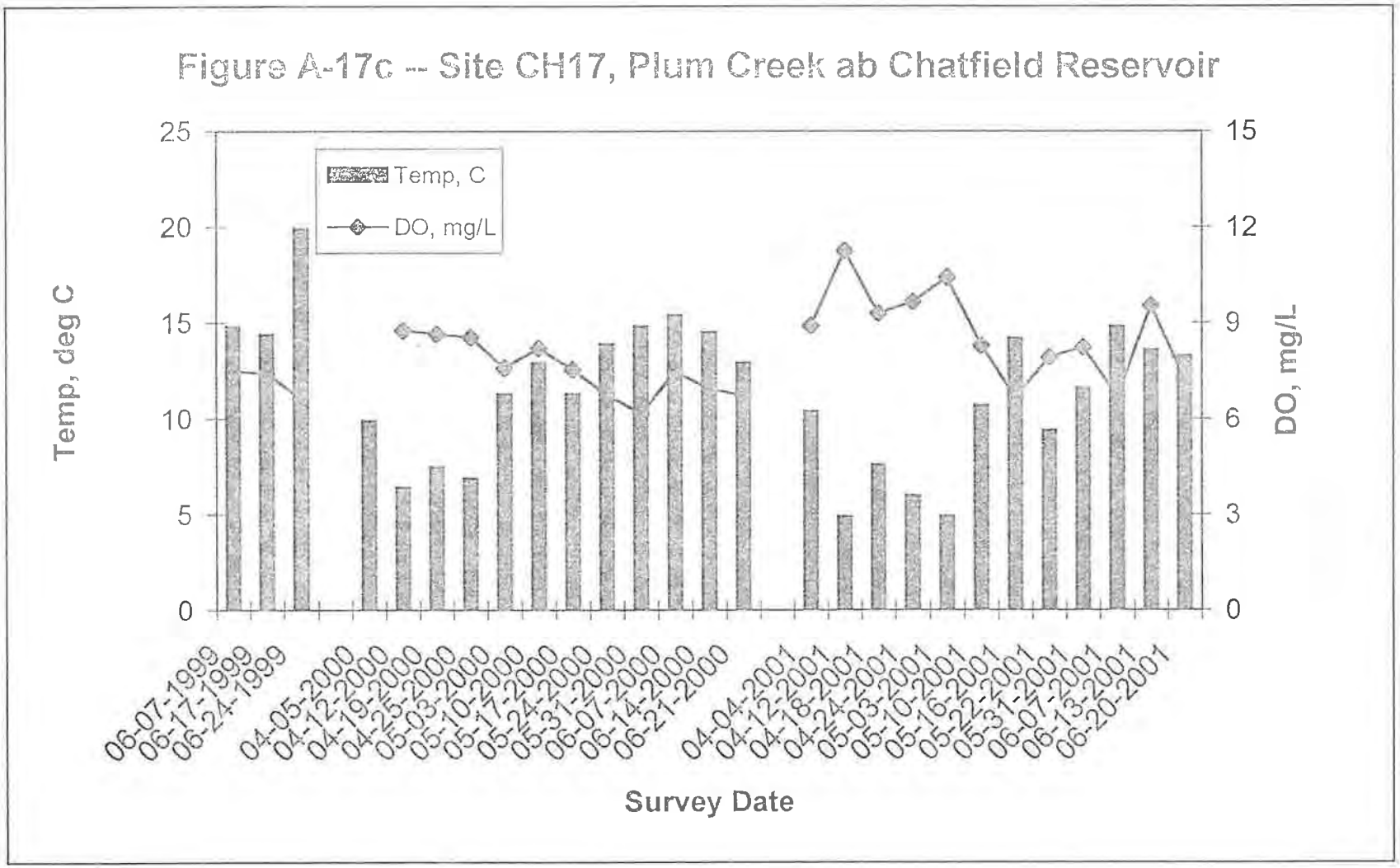


Figure A-17c -- Site CH17, Plum Creek ab Chatfield Reservoir
Temp, C
DO, mg/L
Temp, deg C
DO, mg/L
25
20
15
10
5
0
15
12
9
6
3
0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

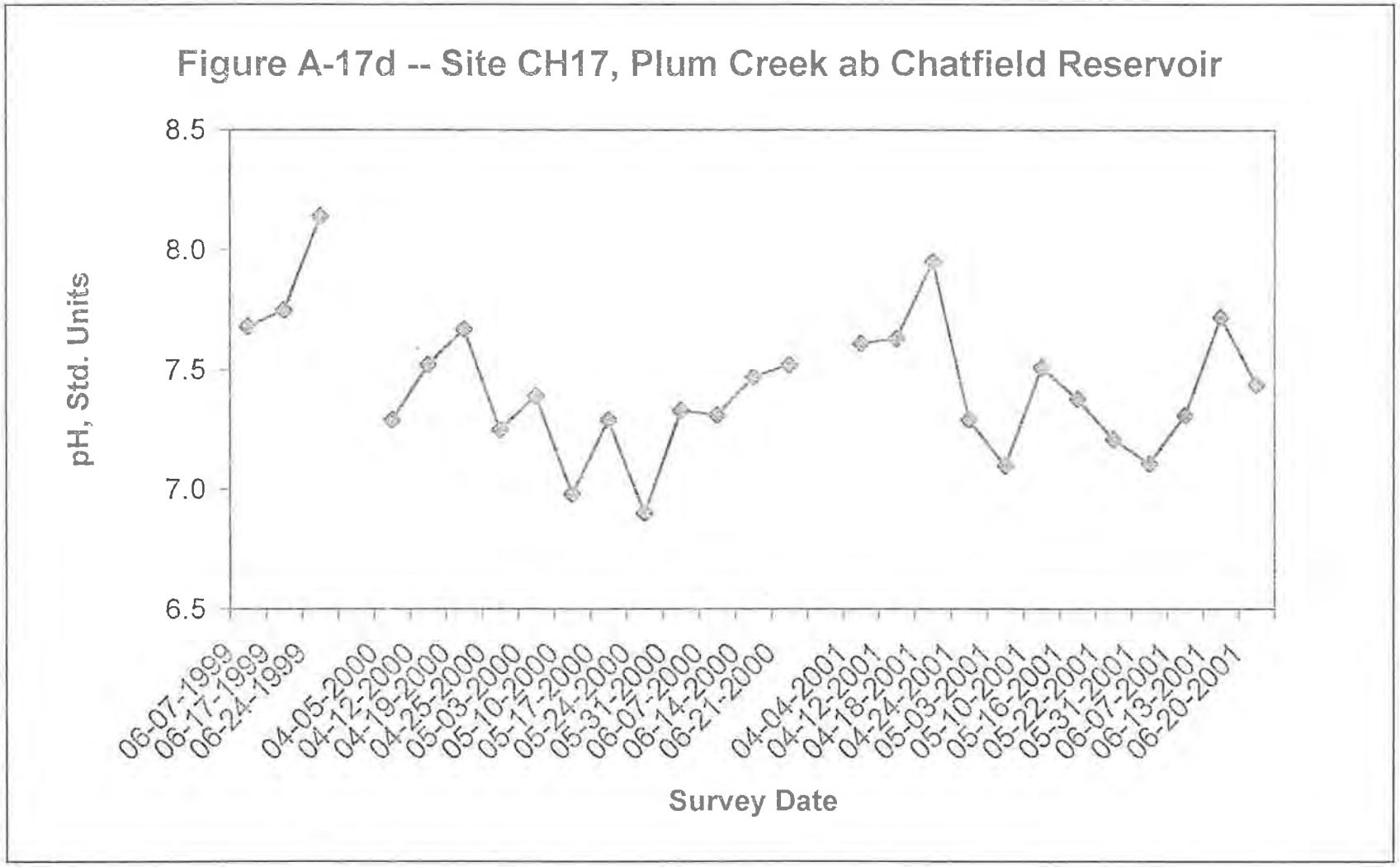


Figure A-17d -- Site CH17, Plum Creek ab Chatfield Reservoir
pH, Std. Units
8.5
8.0
7.5
7.0
6.5
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

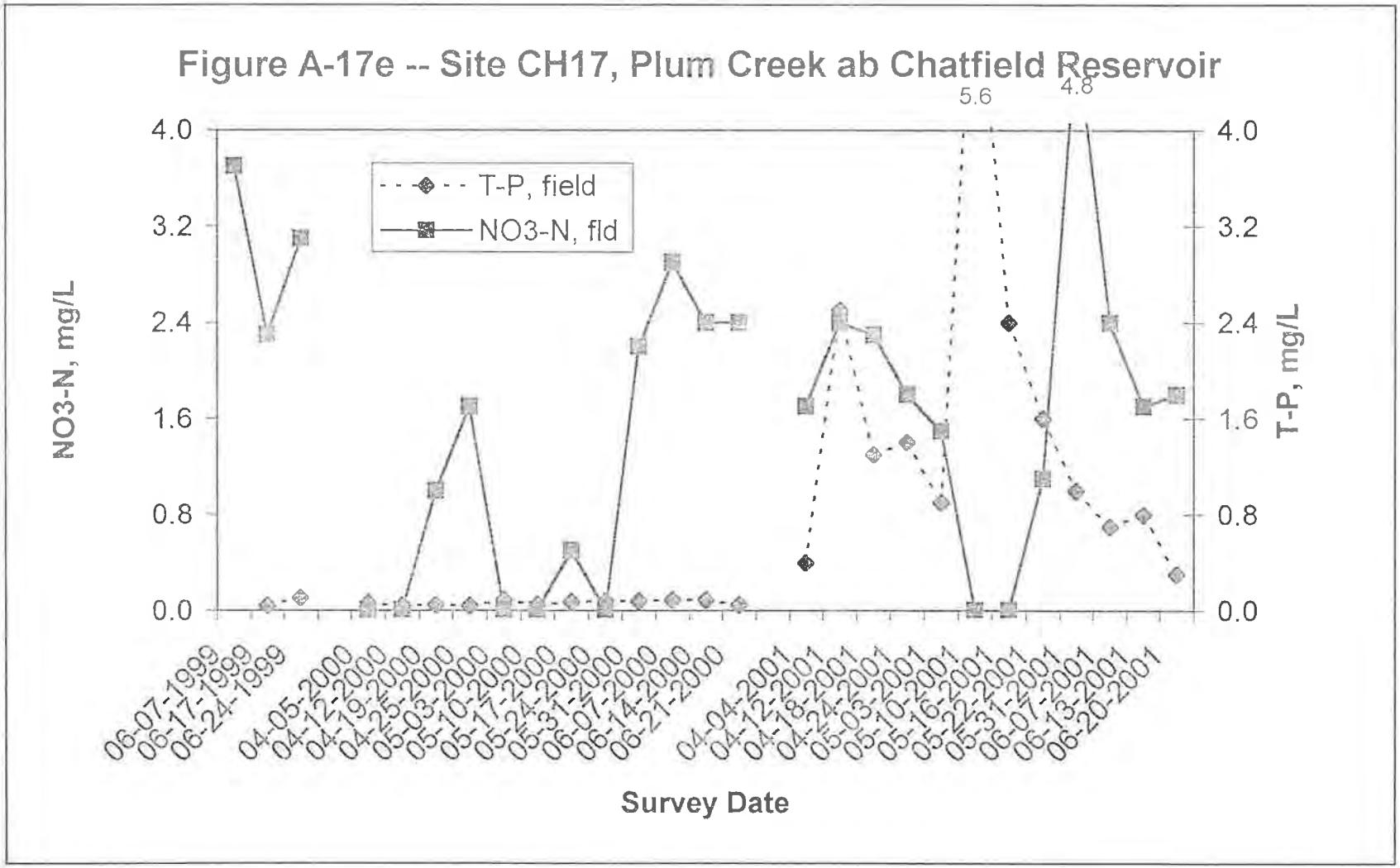


Figure A-17e -- Site CH17, Plum Creek ab Chatfield Reservoir
5.6
4.8
4.0
3.2
2.4
1.6
0.8
0.0
T-P, field
NO3-N, fld
NO3-N, mg/L
T-P, mg/L
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

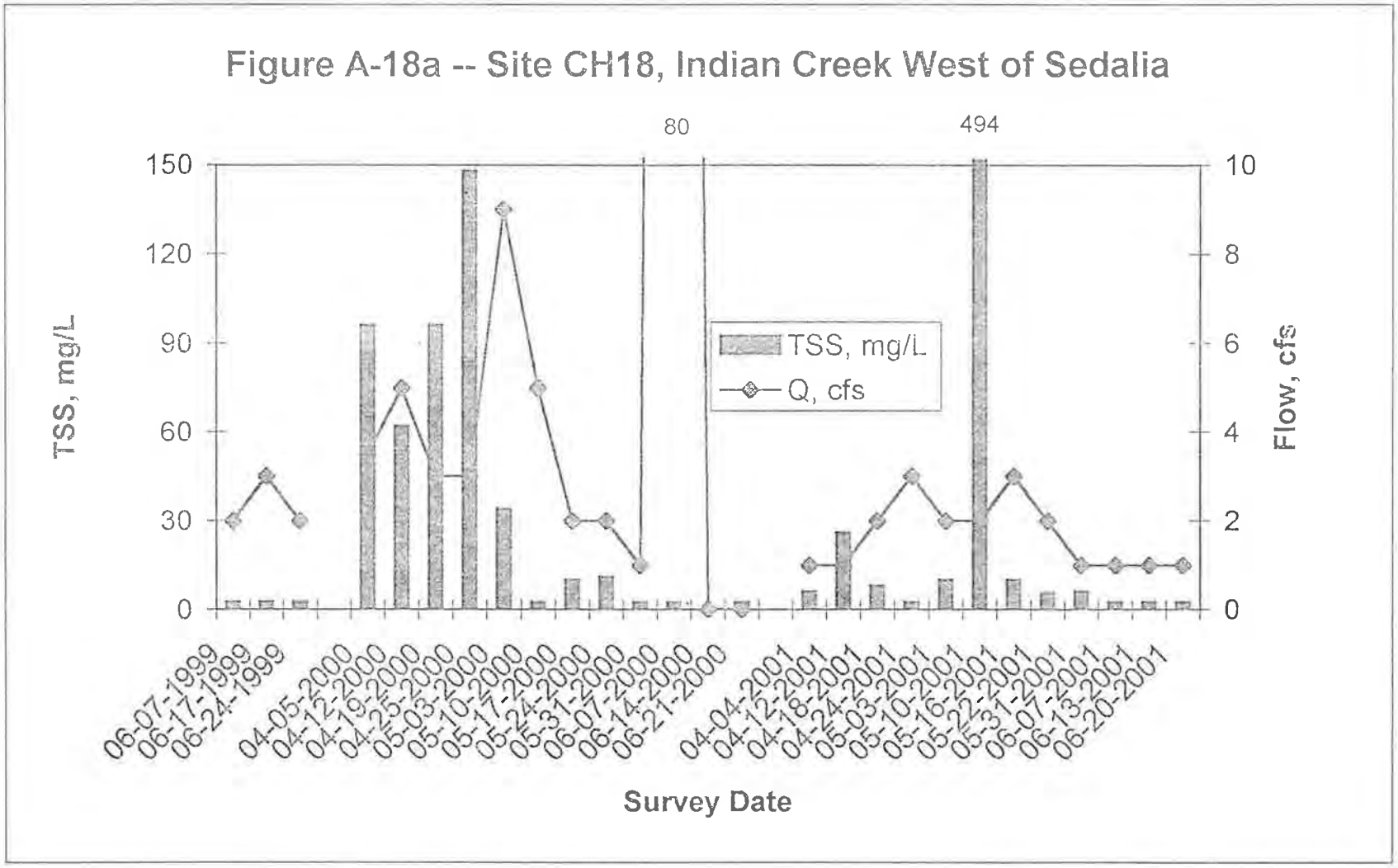


Figure A-18a -- Site CH18, Indian Creek West of Sedalia
80
494
150
120
90
60
30
0
10
8
6
4
2
0
TSS, mg/L
Flow, cfs
TSS, mg/L
Q, cfs
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

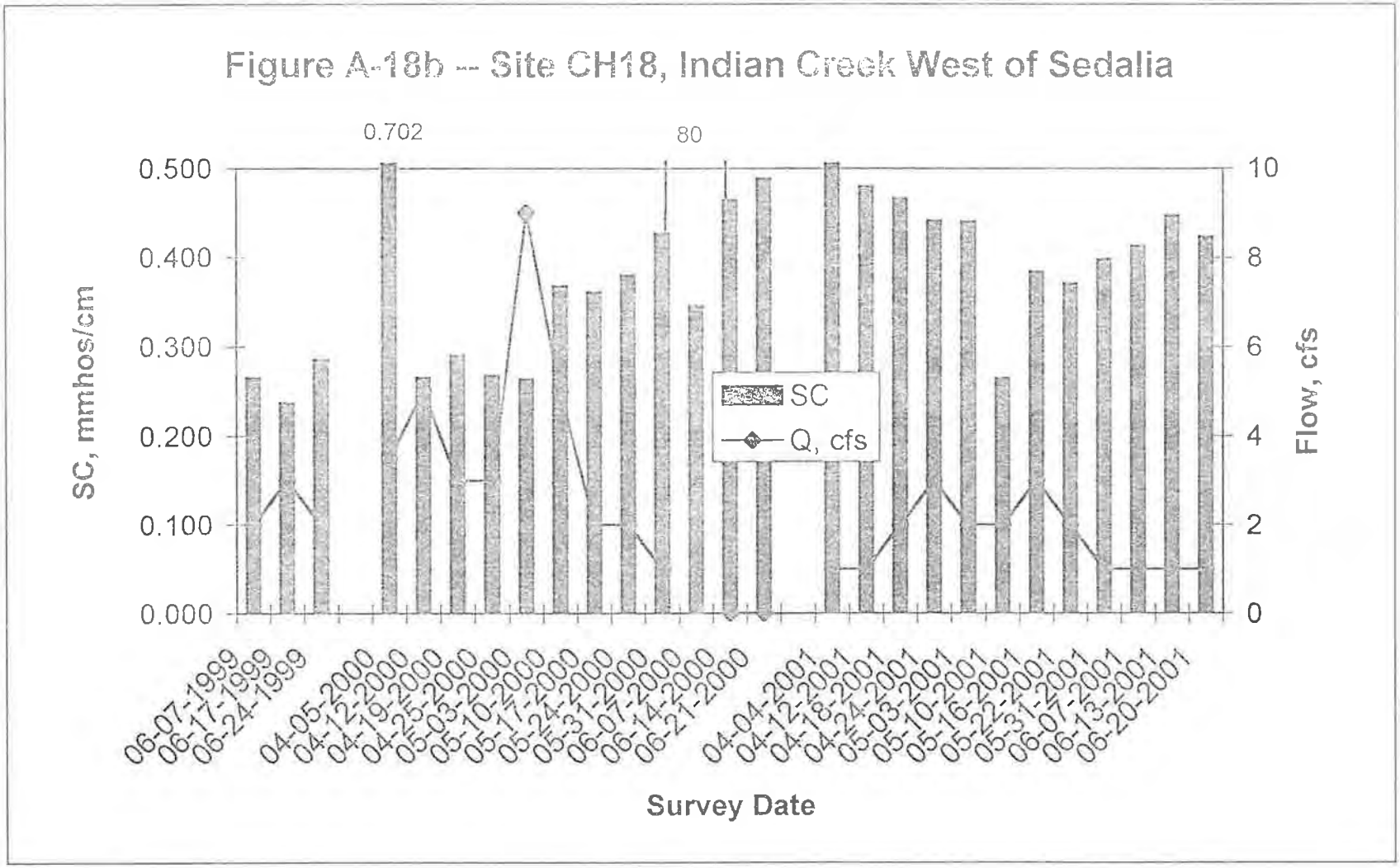


Figure A-18b -- Site CH18, Indian Creek West of Sedalia
0.702
80
0.500
0.400
0.300
0.200
0.100
0.000
SC, mmhos/cm
10
8
6
4
2
0
Flow, cfs
SC
Q, cfs
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

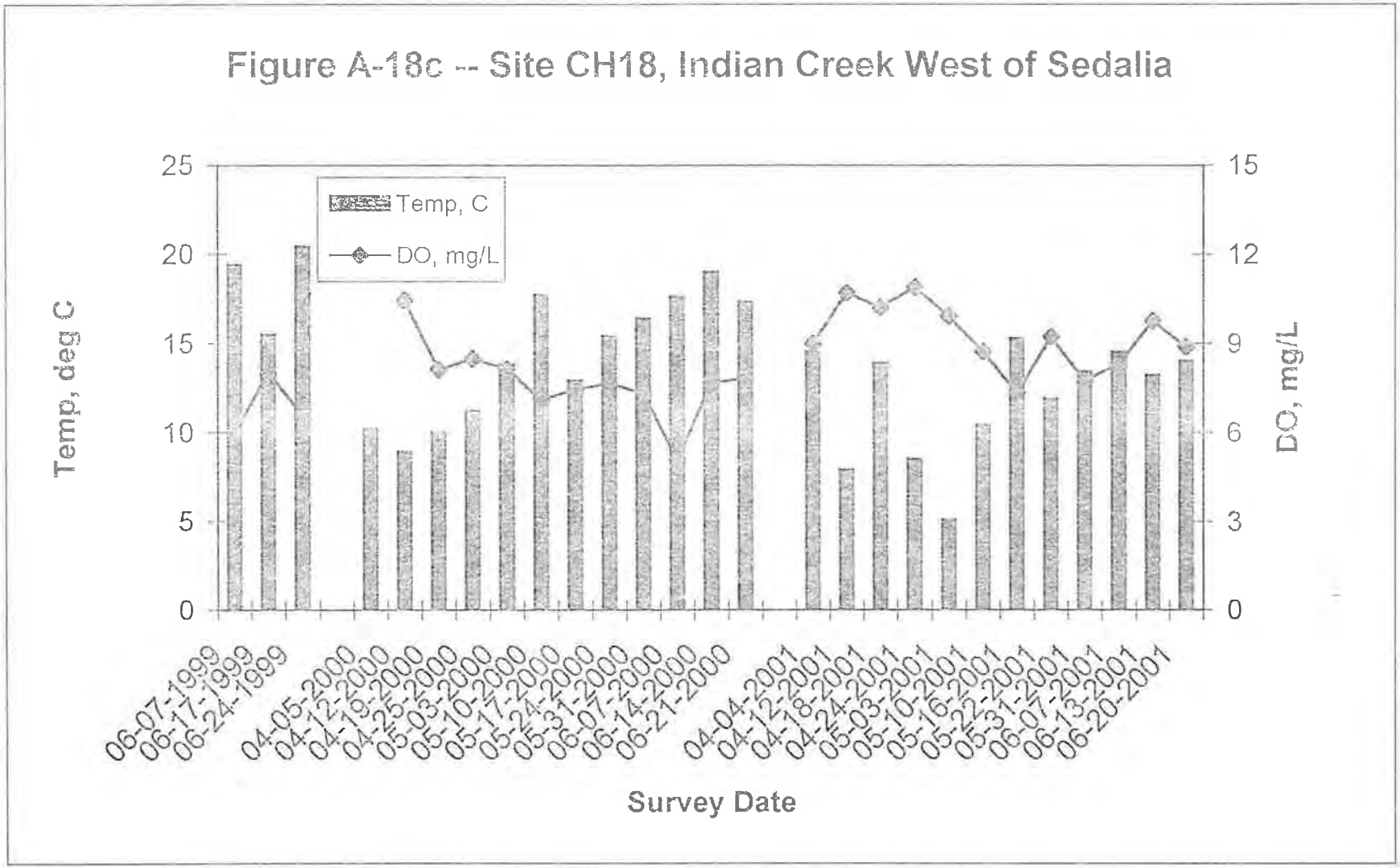


Figure A-18c -- Site CH18, Indian Creek West of Sedalia
Temp, C
DO, mg/L
Temp, deg C
DO, mg/L
25
20
15
10
5
0
15
12
9
6
3
0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

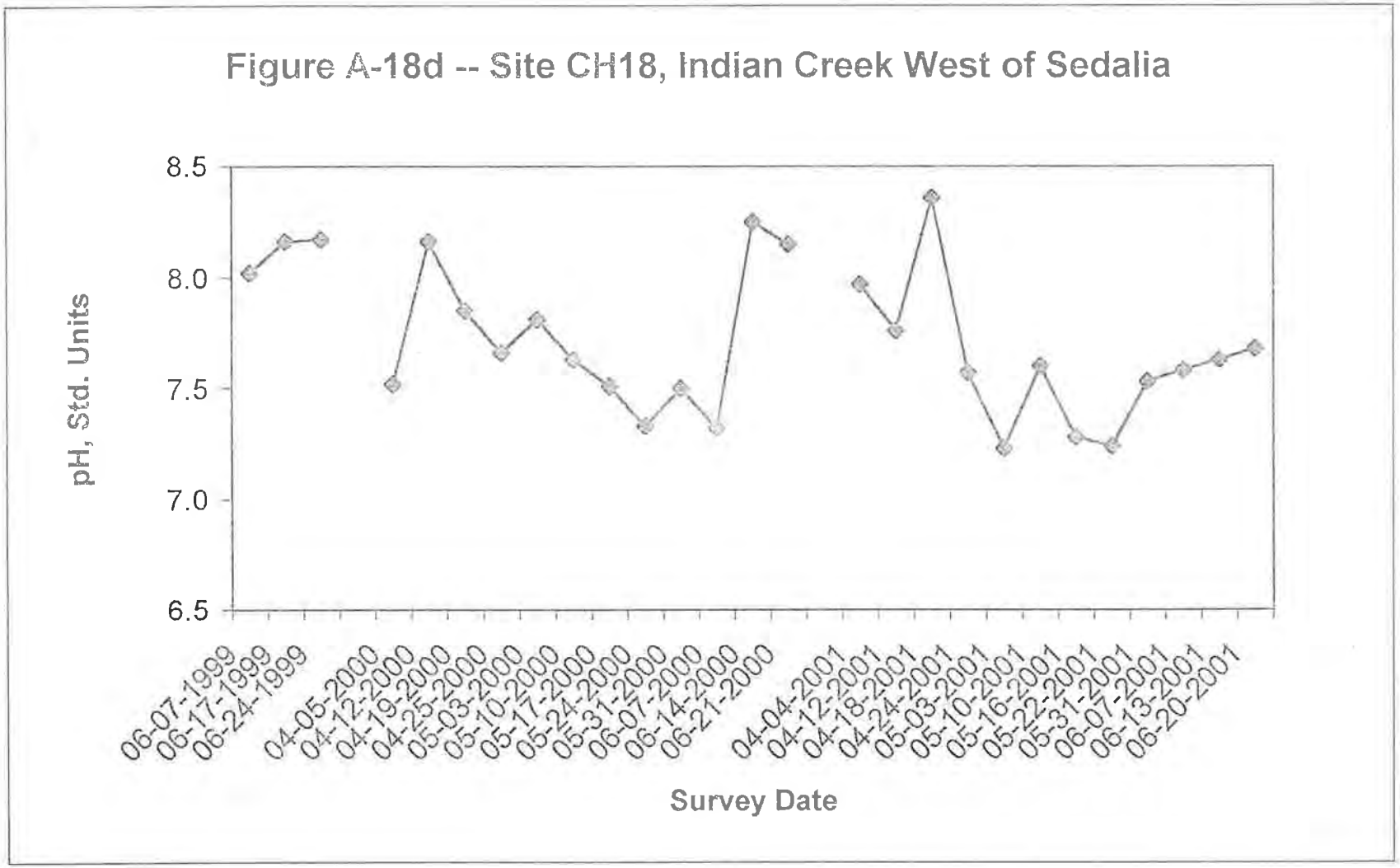


Figure A-18d -- Site CH18, Indian Creek West of Sedalia
pH, Std. Units
8.5
8.0
7.5
7.0
6.5
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

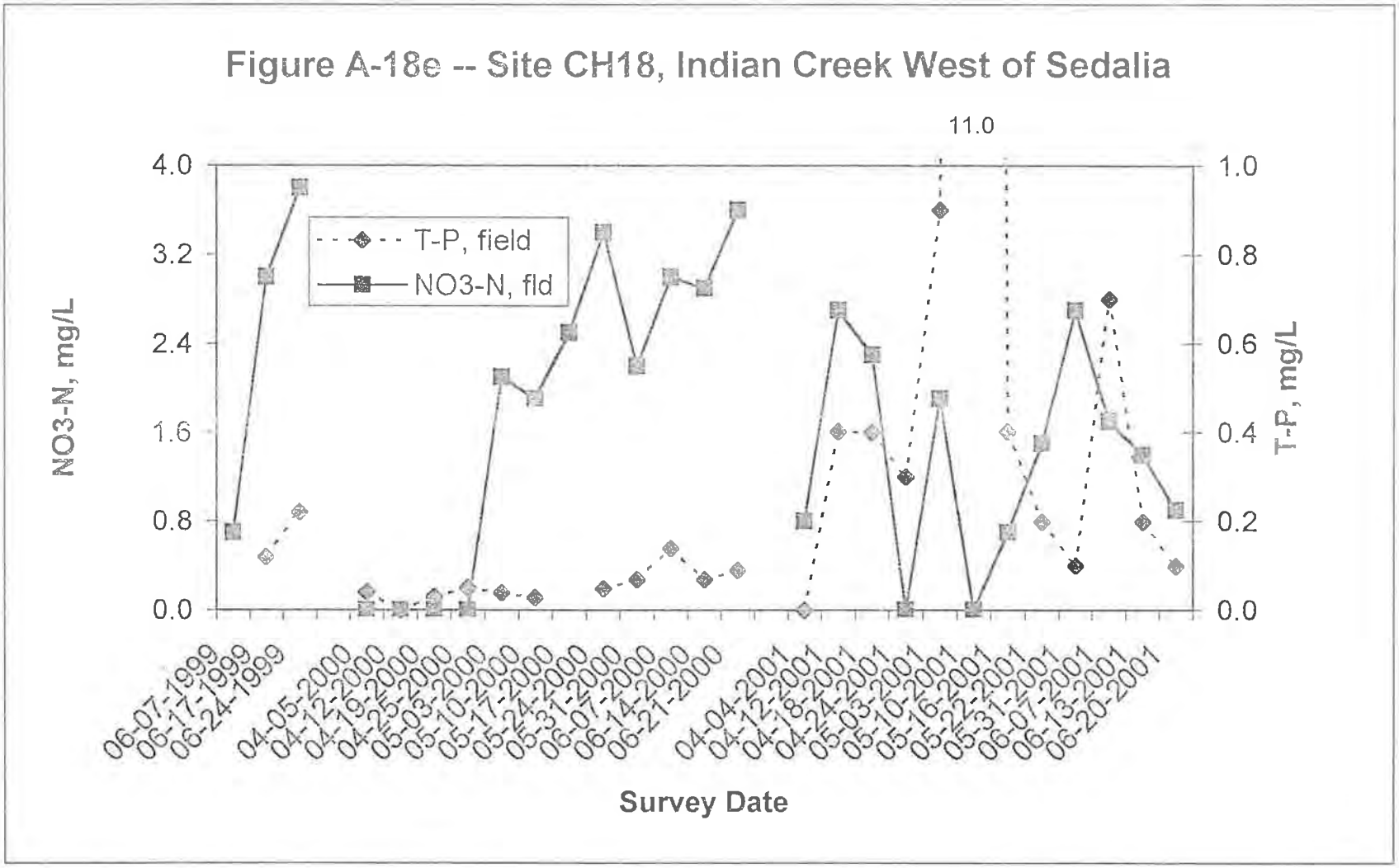


Figure A-18e -- Site CH18, Indian Creek West of Sedalia
11.0
4.0
3.2
2.4
1.6
0.8
0.0
1.0
0.8
0.6
0.4
0.2
0.0
T-P, field
NO3-N, fld
NO3-N, mg/L
T-P, mg/L
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

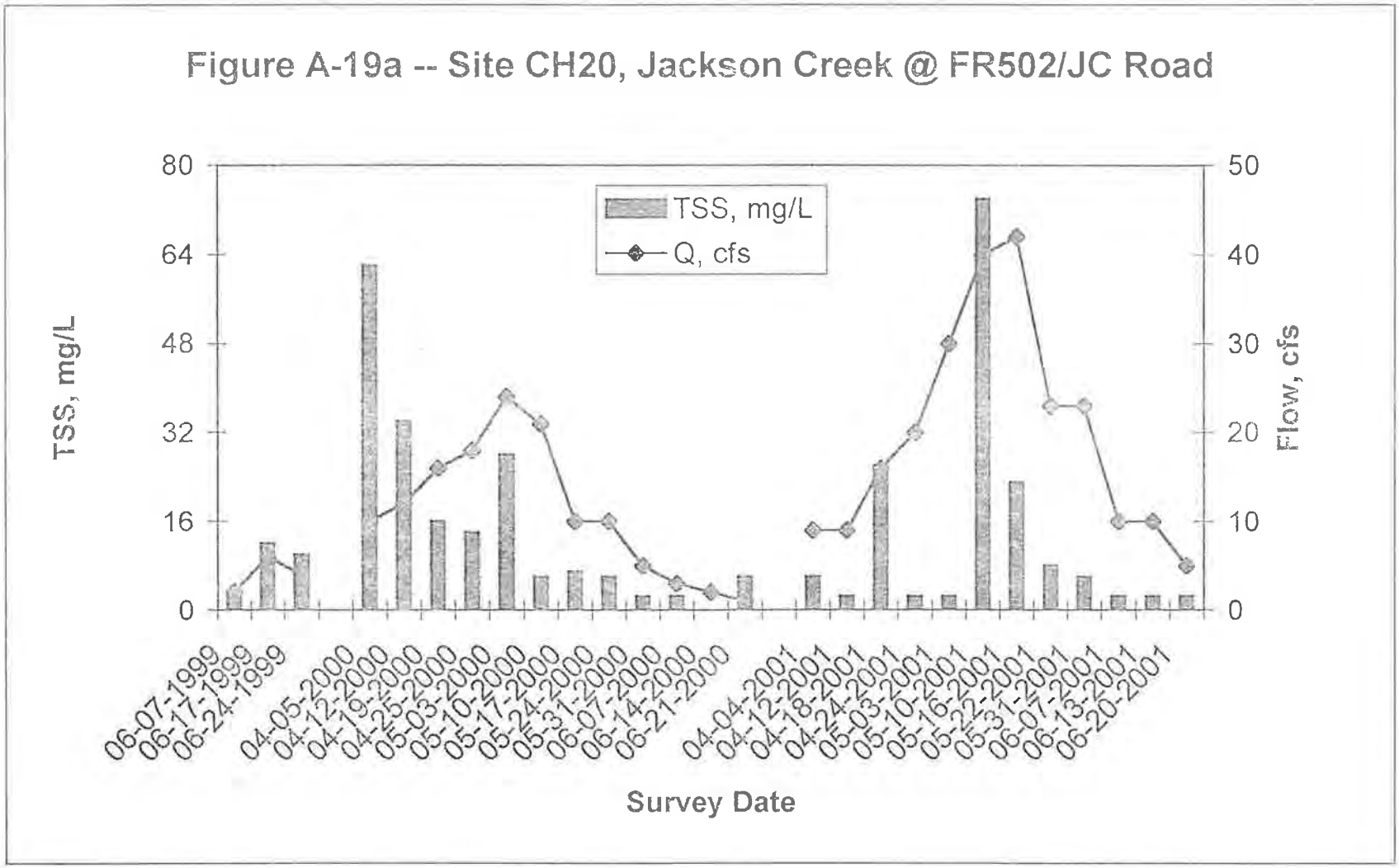


Figure A-19a -- Site CH20, Jackson Creek @ FR502/JC Road
TSS, mg/L
Q, cfs
TSS, mg/L
Flow, cfs
80
64
48
32
16
0
50
40
30
20
10
0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

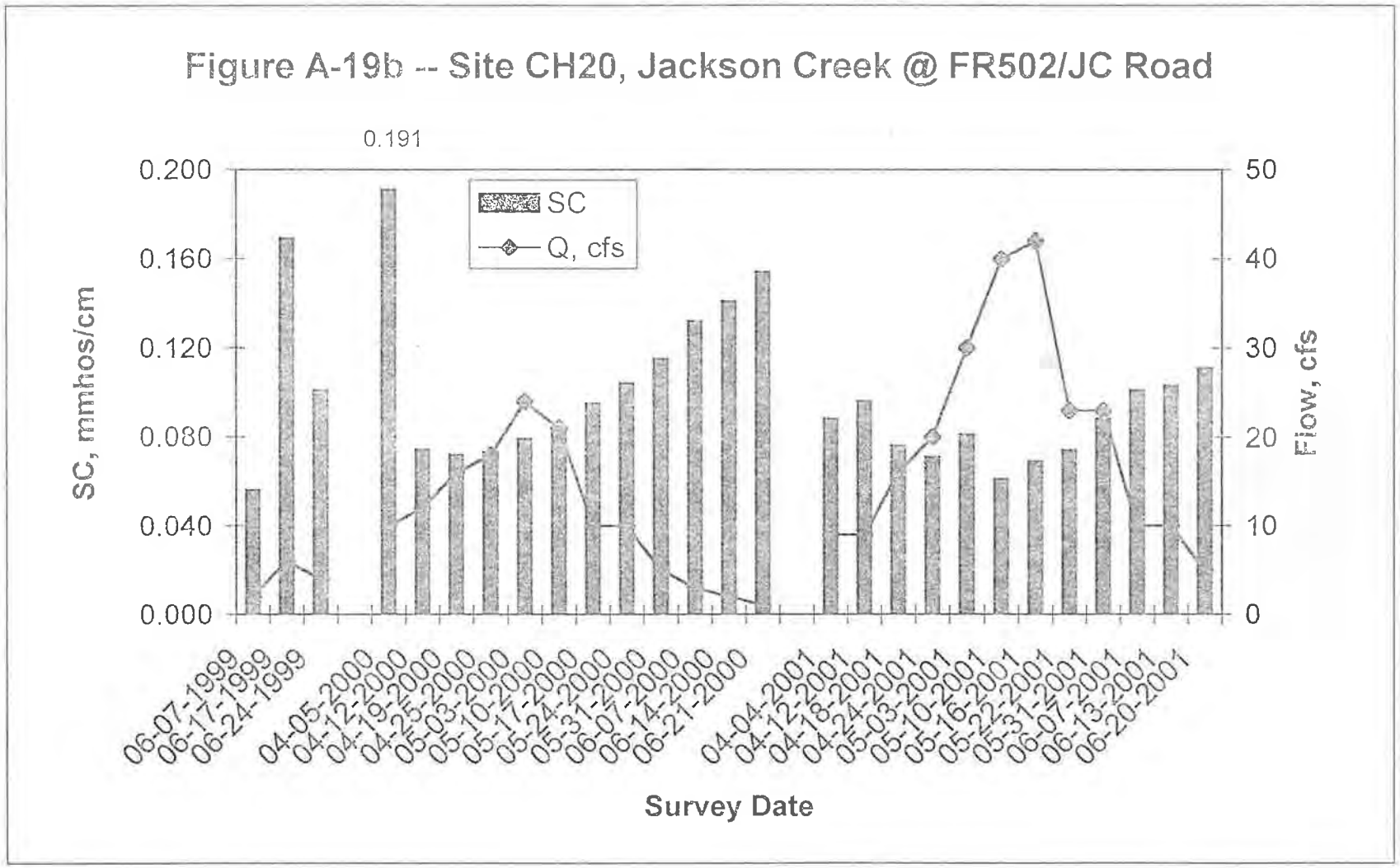


Figure A-19b -- Site CH20, Jackson Creek @ FR502/JC Road
0.191
SC
Q, cfs
SC, mmhos/cm
Flow, cfs
0.200
0.160
0.120
0.080
0.040
0.000
50
40
30
20
10
0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

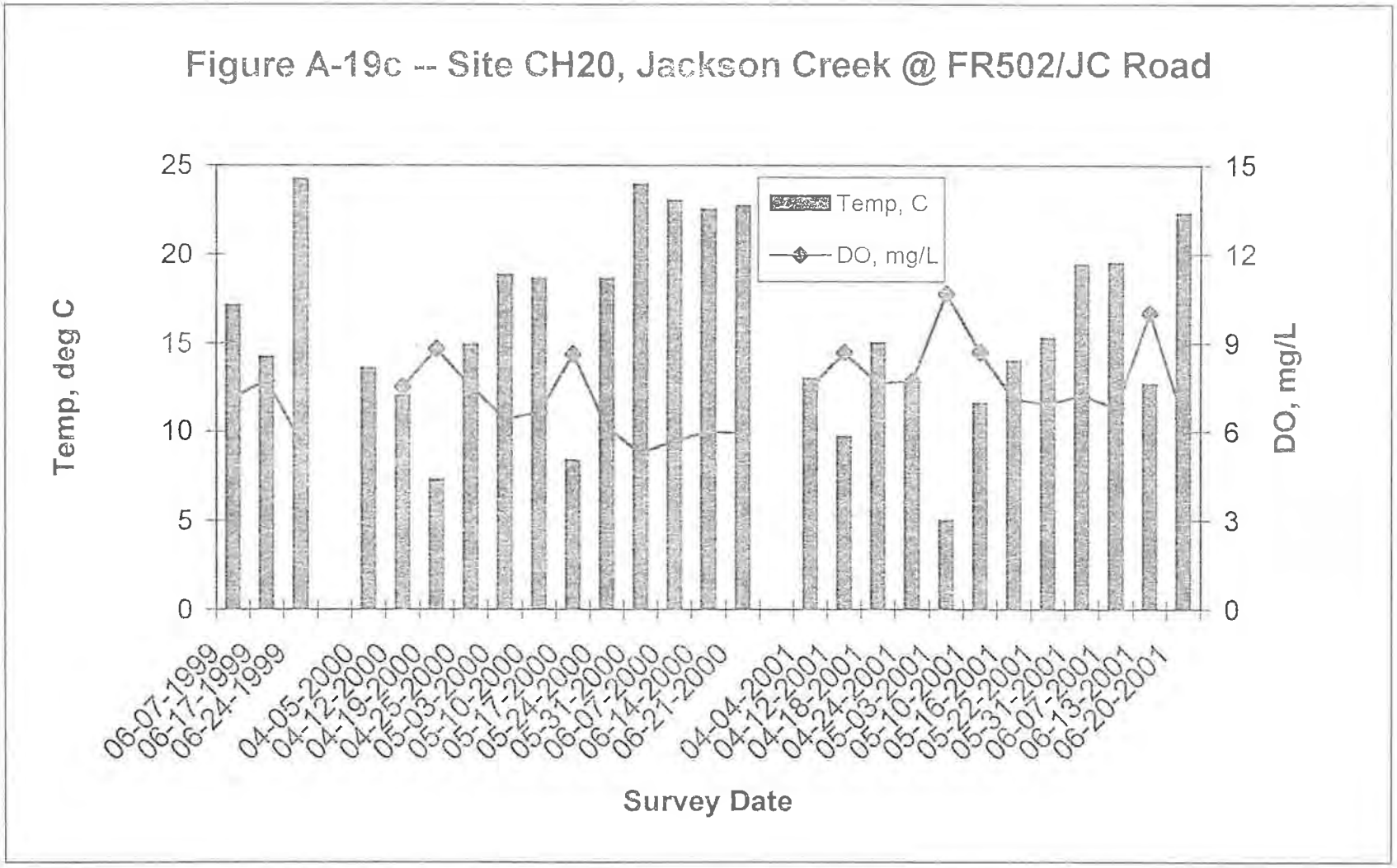


Figure A-19c -- Site CH20, Jackson Creek @ FR502/JC Road
Temp, deg C
DO, mg/L
Temp, C
DO, mg/L
25
20
15
10
5
0
15
12
9
6
3
0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

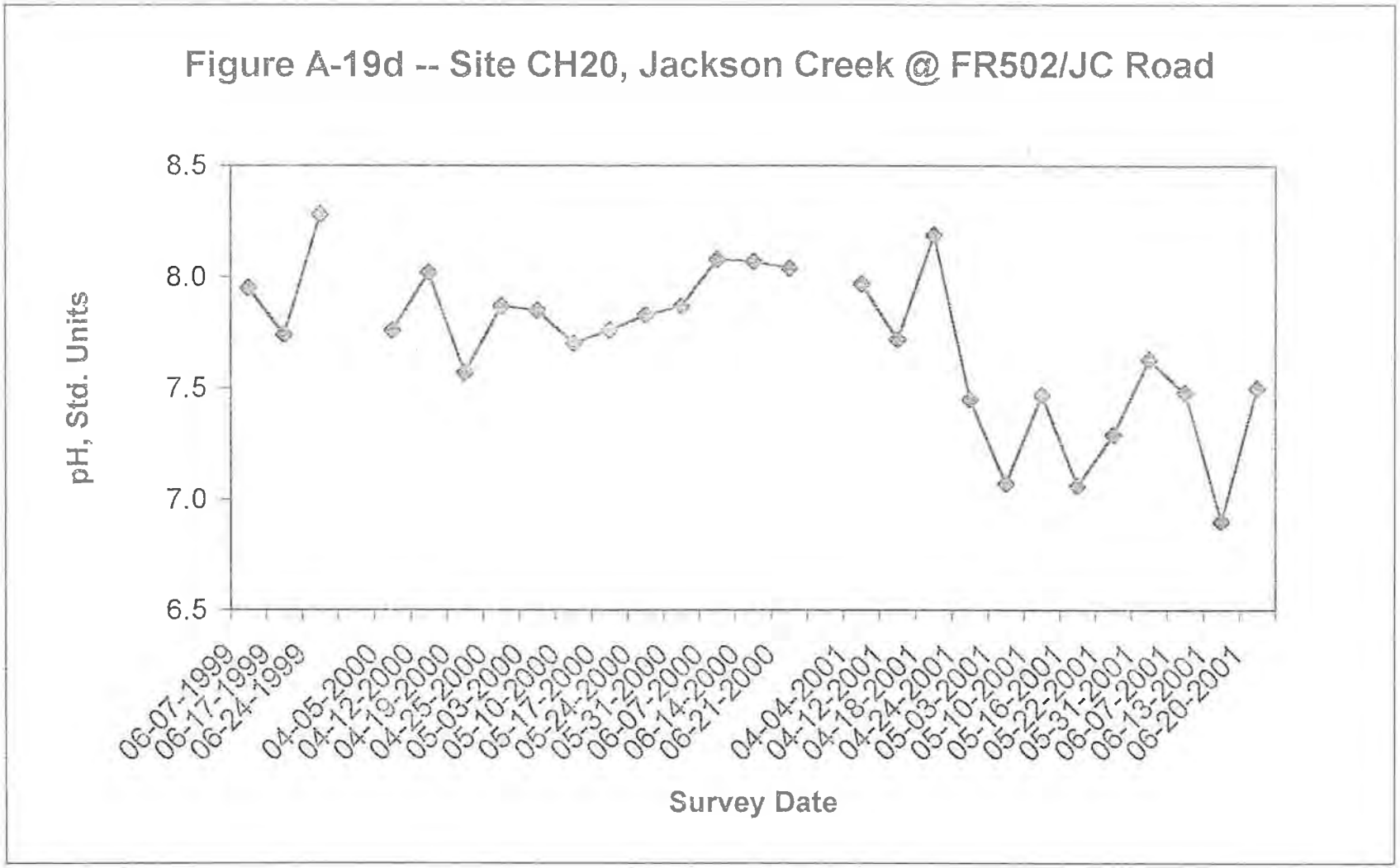


Figure A-19d -- Site CH20, Jackson Creek @ FR502/JC Road
pH, Std. Units
8.5
8.0
7.5
7.0
6.5
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

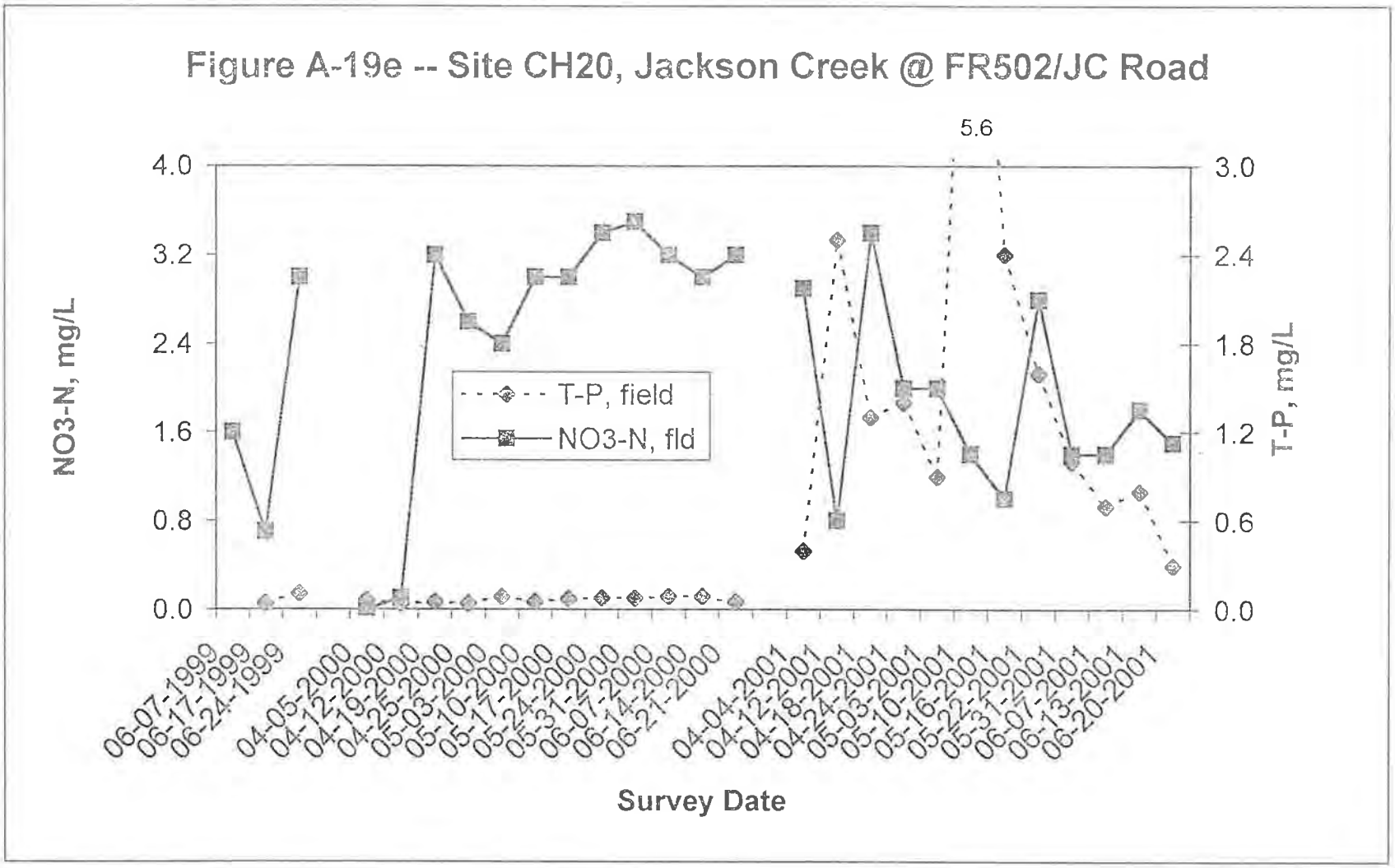


Figure A-19e -- Site CH20, Jackson Creek @ FR502/JC Road
5.6
4.0
3.2
2.4
1.6
0.8
0.0
3.0
2.4
1.8
1.2
0.6
0.0
NO3-N, mg/L
T-P, mg/L
T-P, field
NO3-N, fld
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

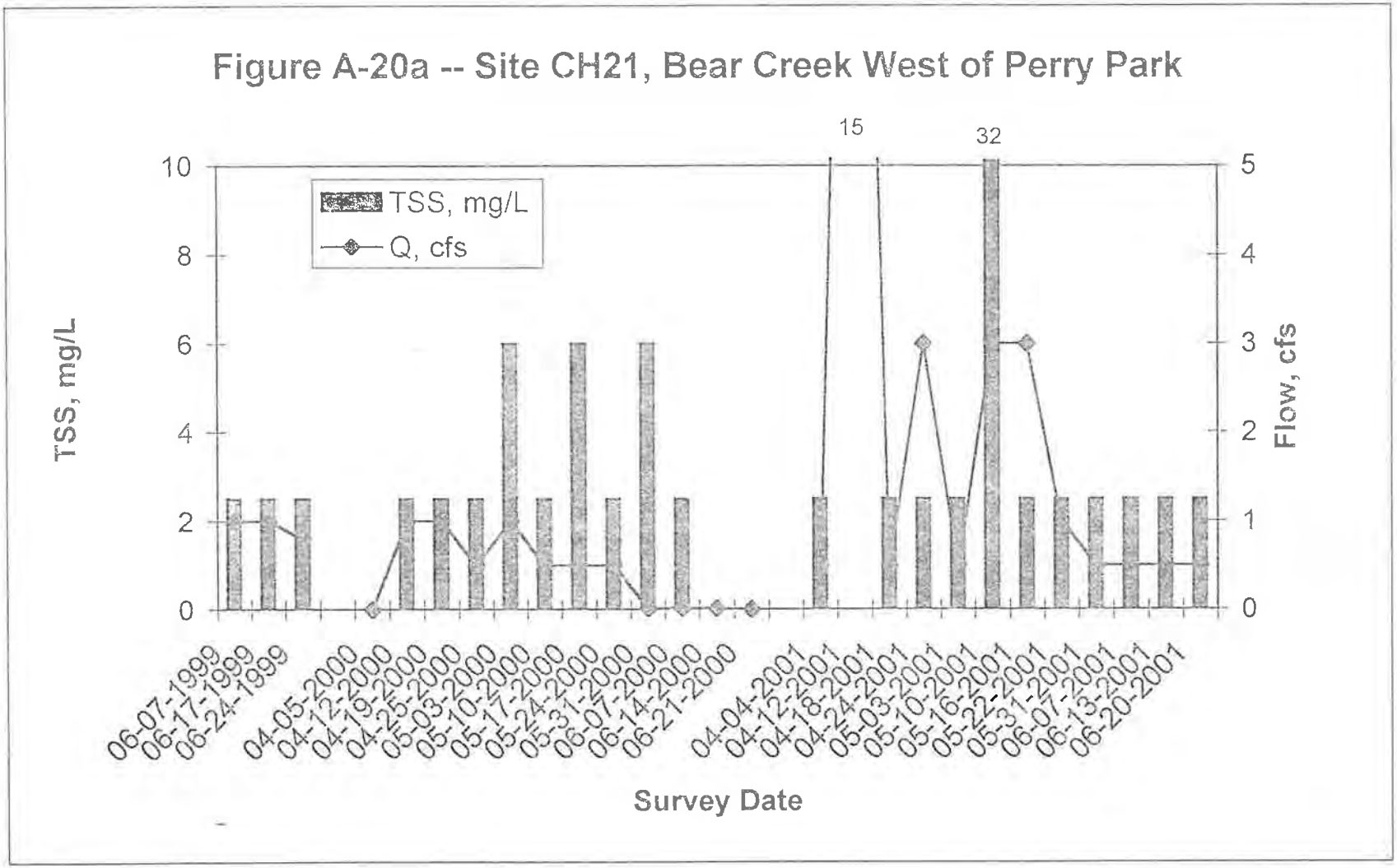
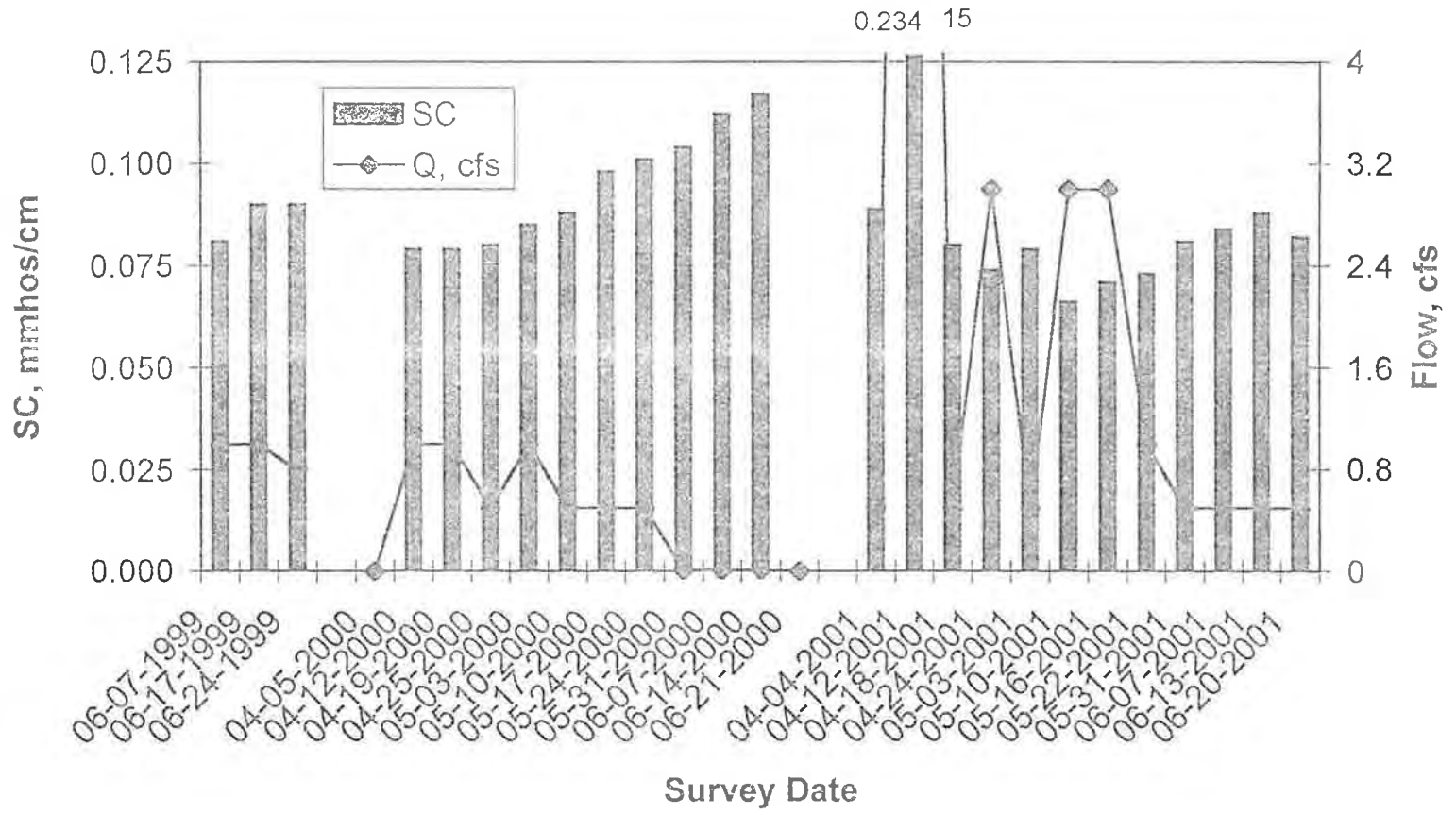


Figure A-20a -- Site CH21, Bear Creek West of Perry Park
15
32
TSS, mg/L
Q, cfs
TSS, mg/L
Flow, cfs
Survey Date
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001

Figure A-20b -- Site CH21, Bear Creek West of Perry Park



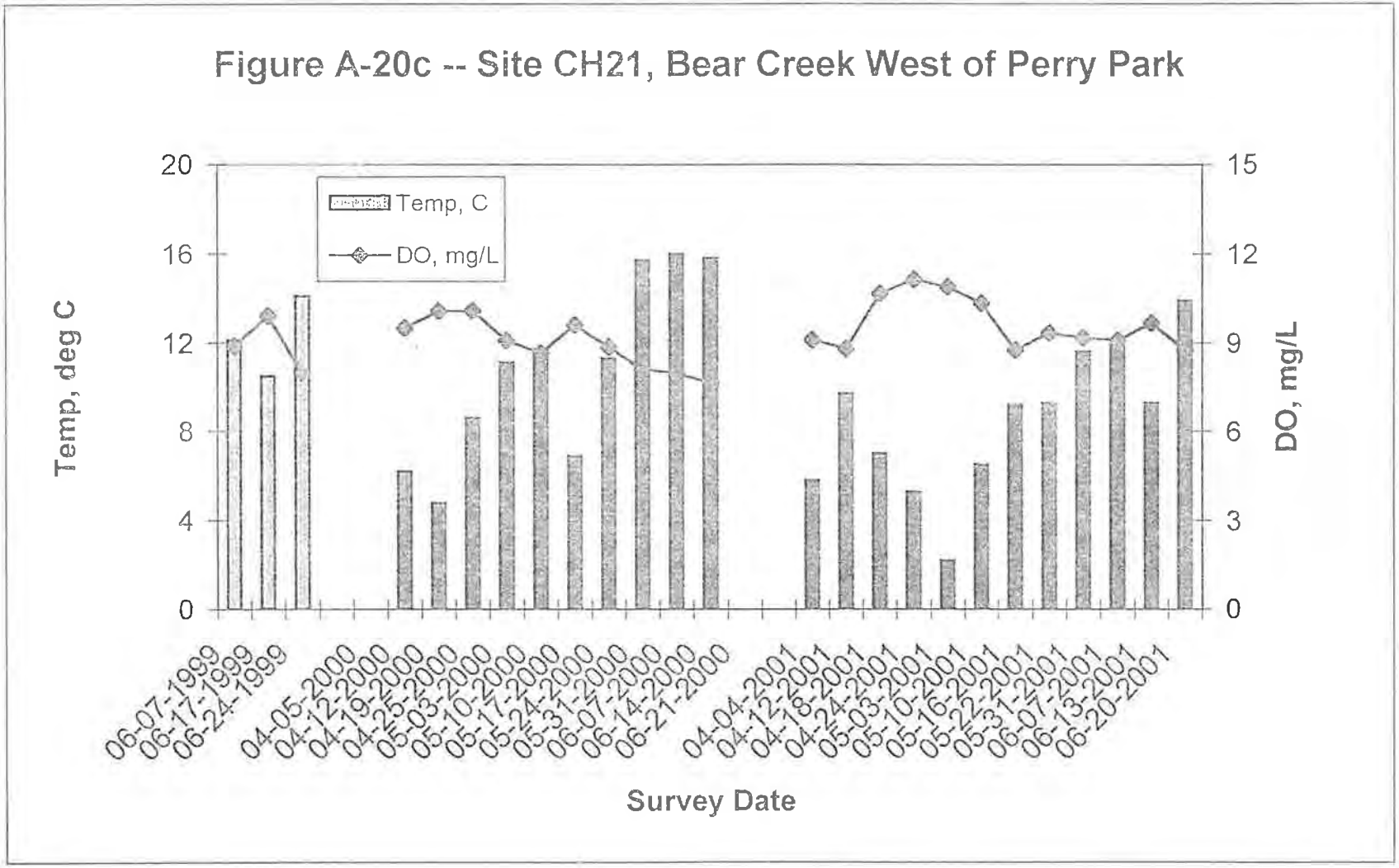


Figure A-20c -- Site CH21, Bear Creek West of Perry Park
Temp, C
DO, mg/L
Temp, deg C
DO, mg/L
20
16
12
8
4
0
15
12
9
6
3
0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

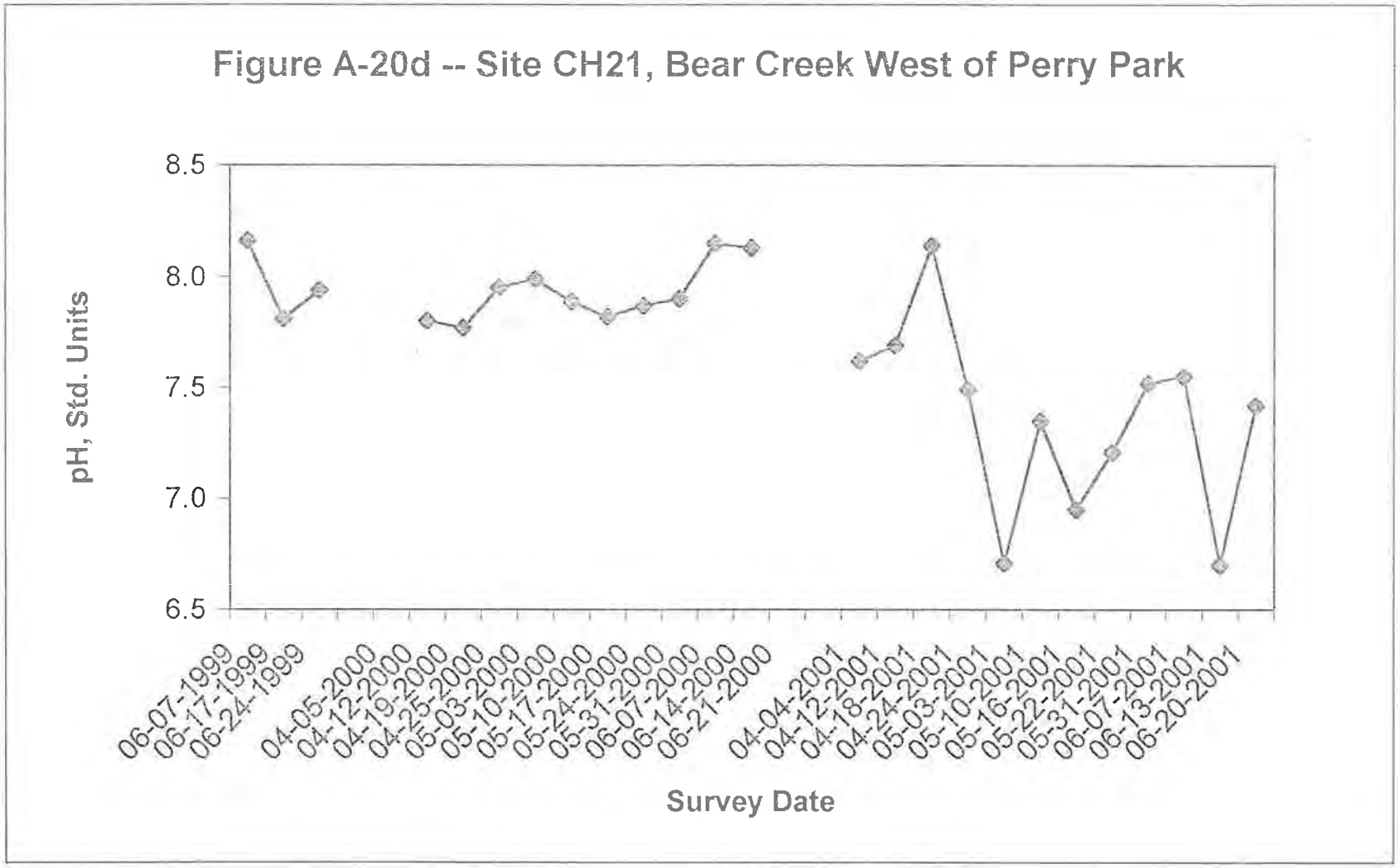


Figure A-20d -- Site CH21, Bear Creek West of Perry Park
pH, Std. Units
8.5
8.0
7.5
7.0
6.5
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

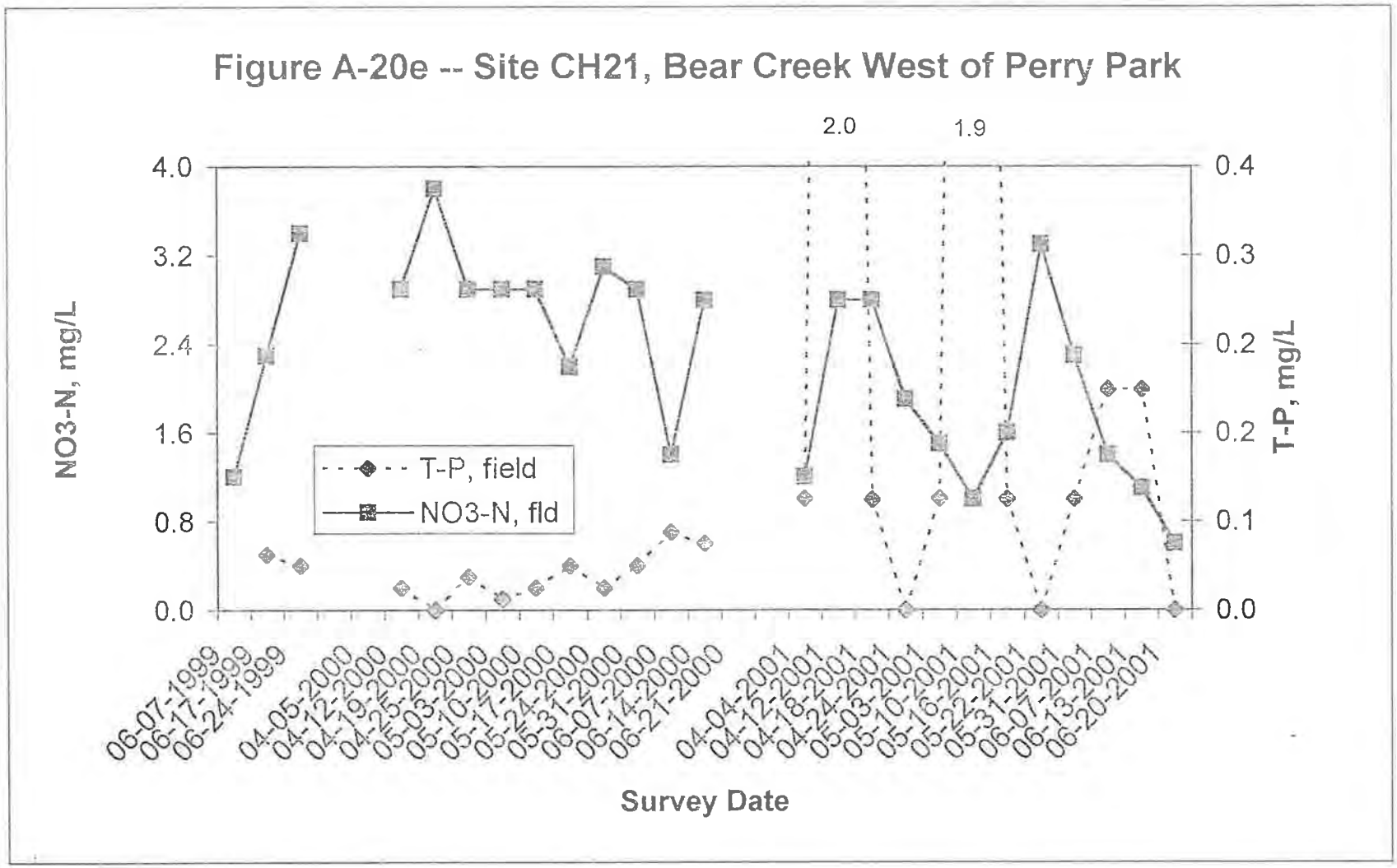
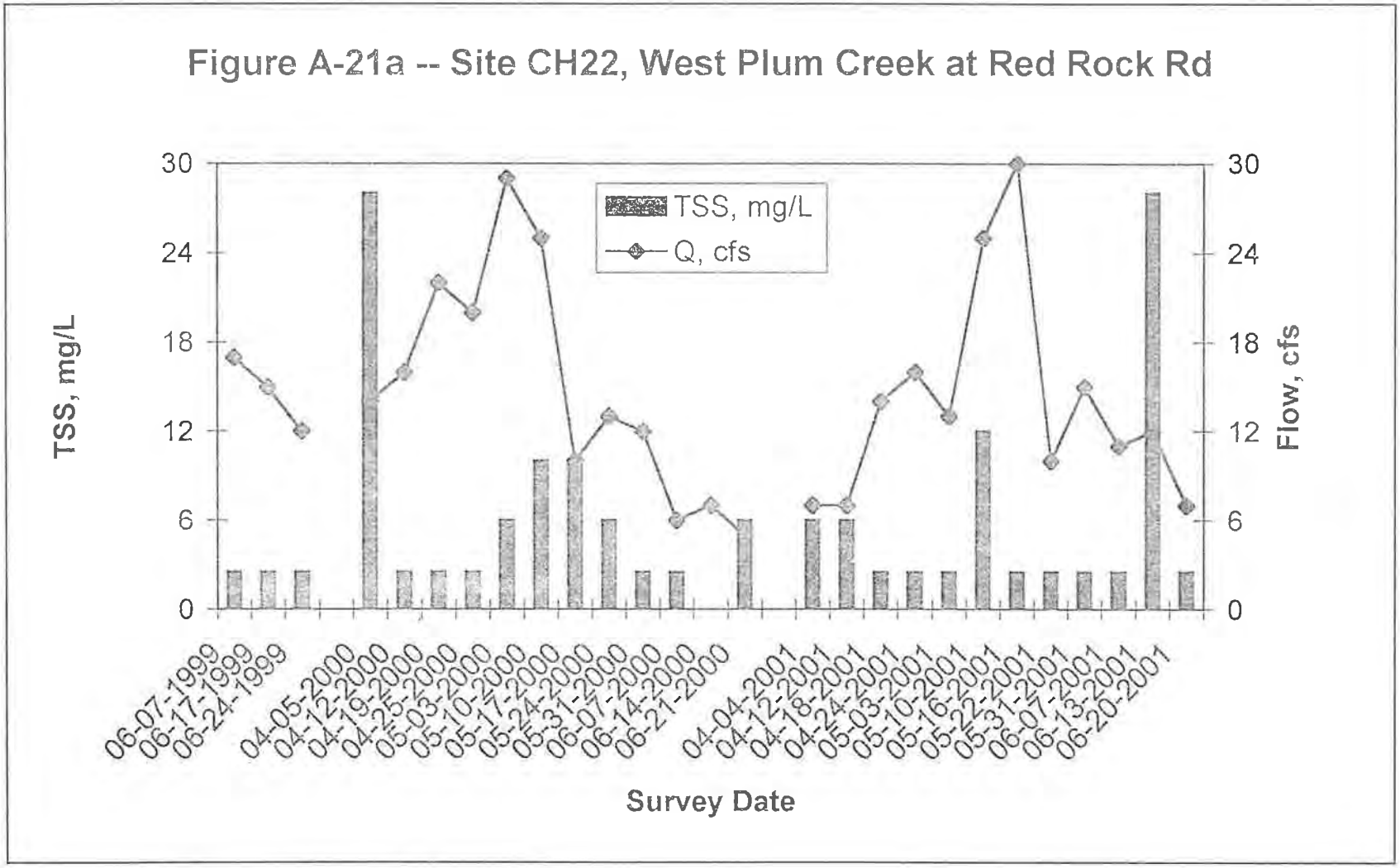


Figure A-20e -- Site CH21, Bear Creek West of Perry Park
2.0
1.9
4.0
3.2
2.4
1.6
0.8
0.0
0.4
0.3
0.2
0.2
0.1
0.0
NO3-N, mg/L
T-P, mg/L
T-P, field
NO3-N, fld
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

Figure A-21a -- Site CH22, West Plum Creek at Red Rock Rd



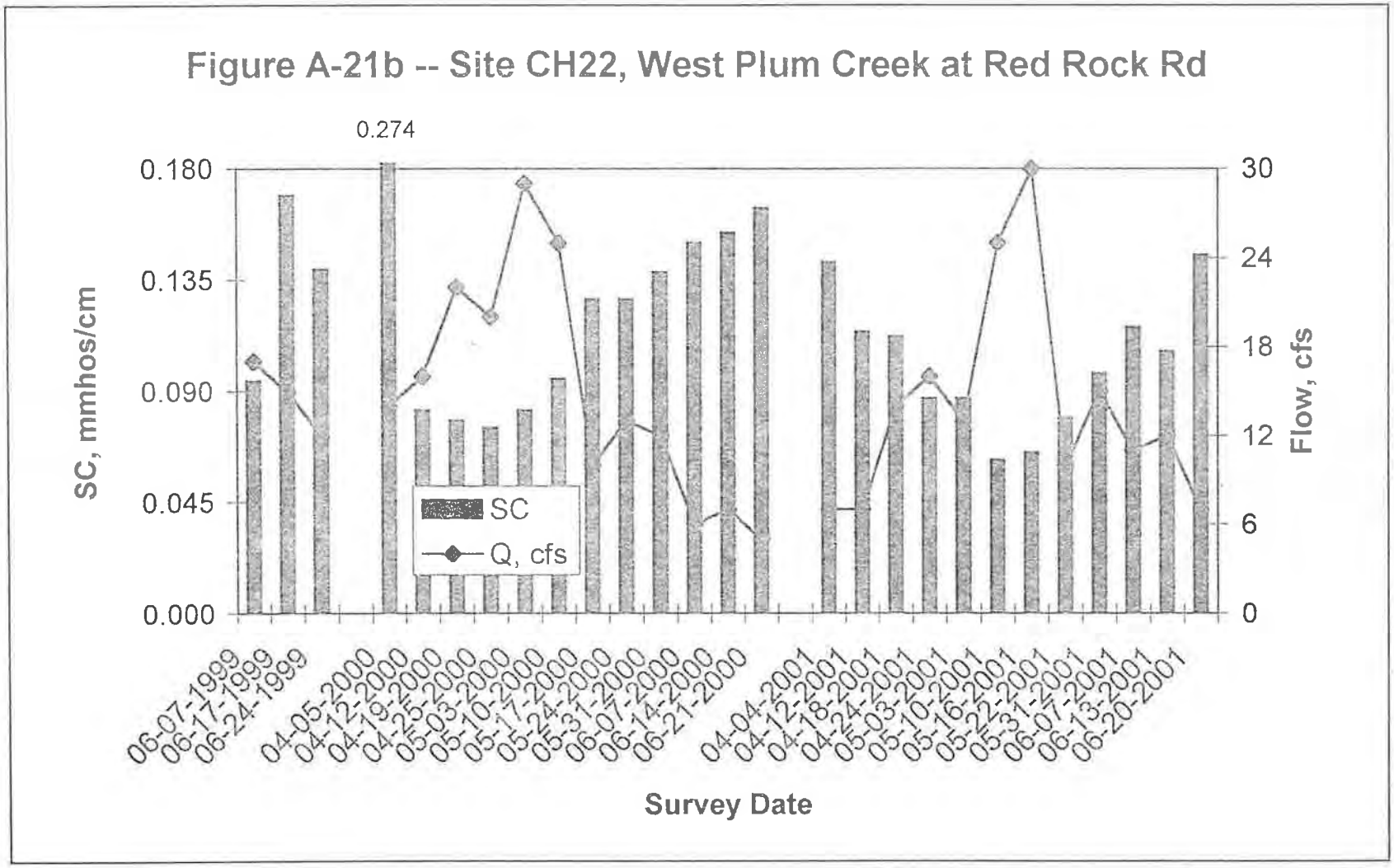
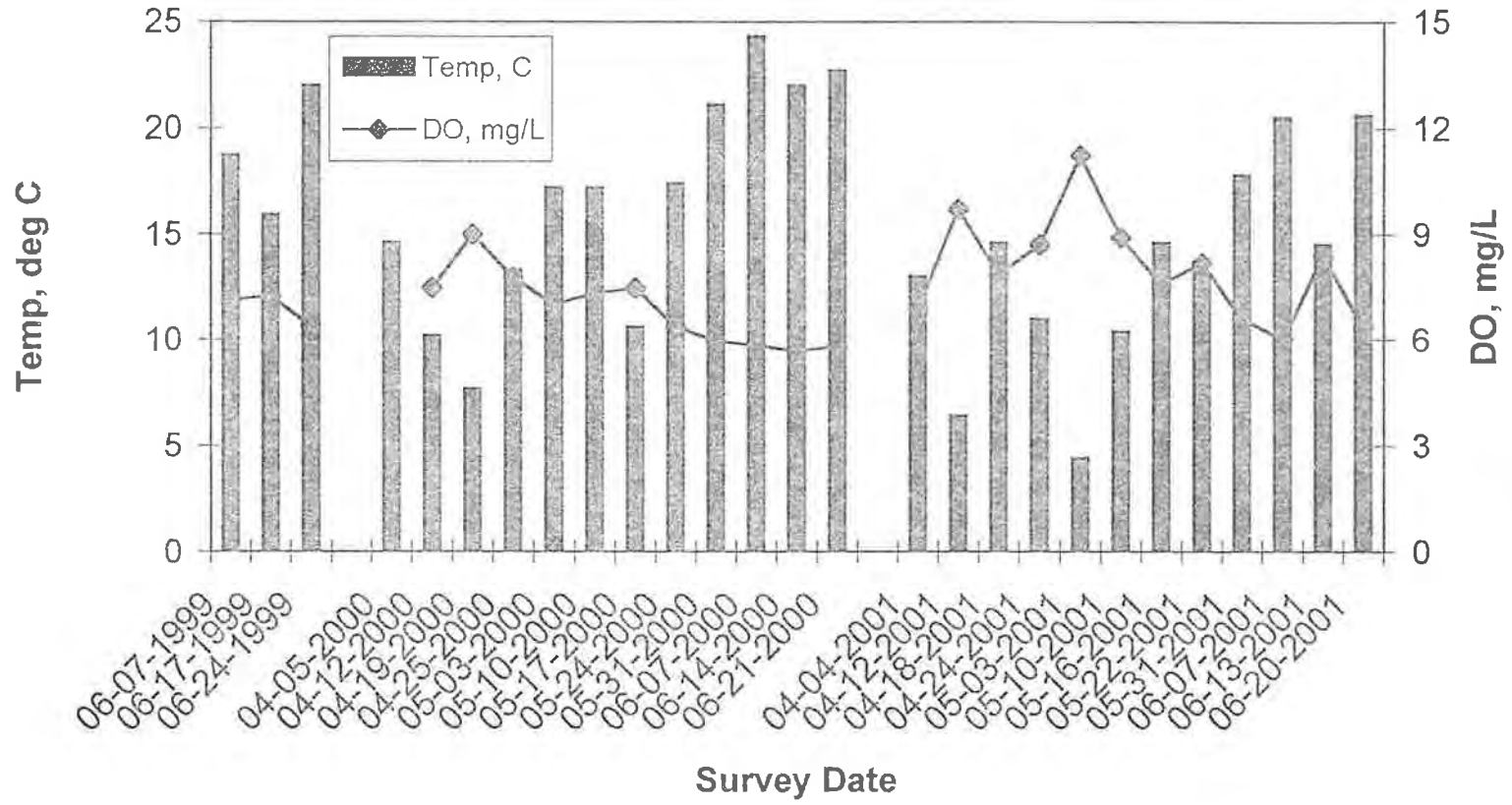


Figure A-21b -- Site CH22, West Plum Creek at Red Rock Rd
0.274
0.180
0.135
0.090
0.045
0.000
SC, mmhos/cm
30
24
18
12
6
0
Flow, cfs
SC
Q, cfs
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

Figure A-21c -- Site CH22, West Plum Creek at Red Rock Rd



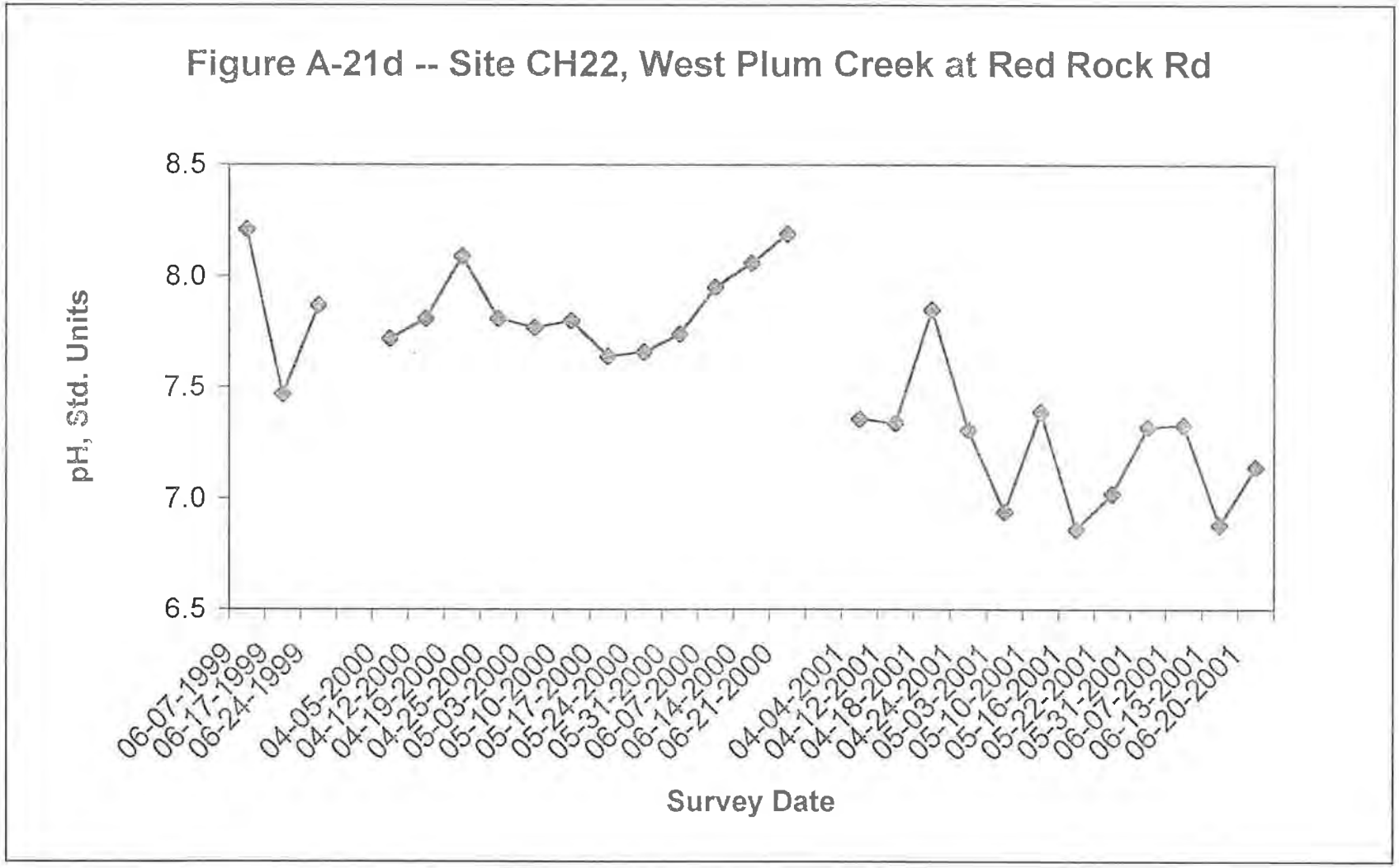


Figure A-21d -- Site CH22, West Plum Creek at Red Rock Rd
pH, Std. Units
8.5
8.0
7.5
7.0
6.5
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

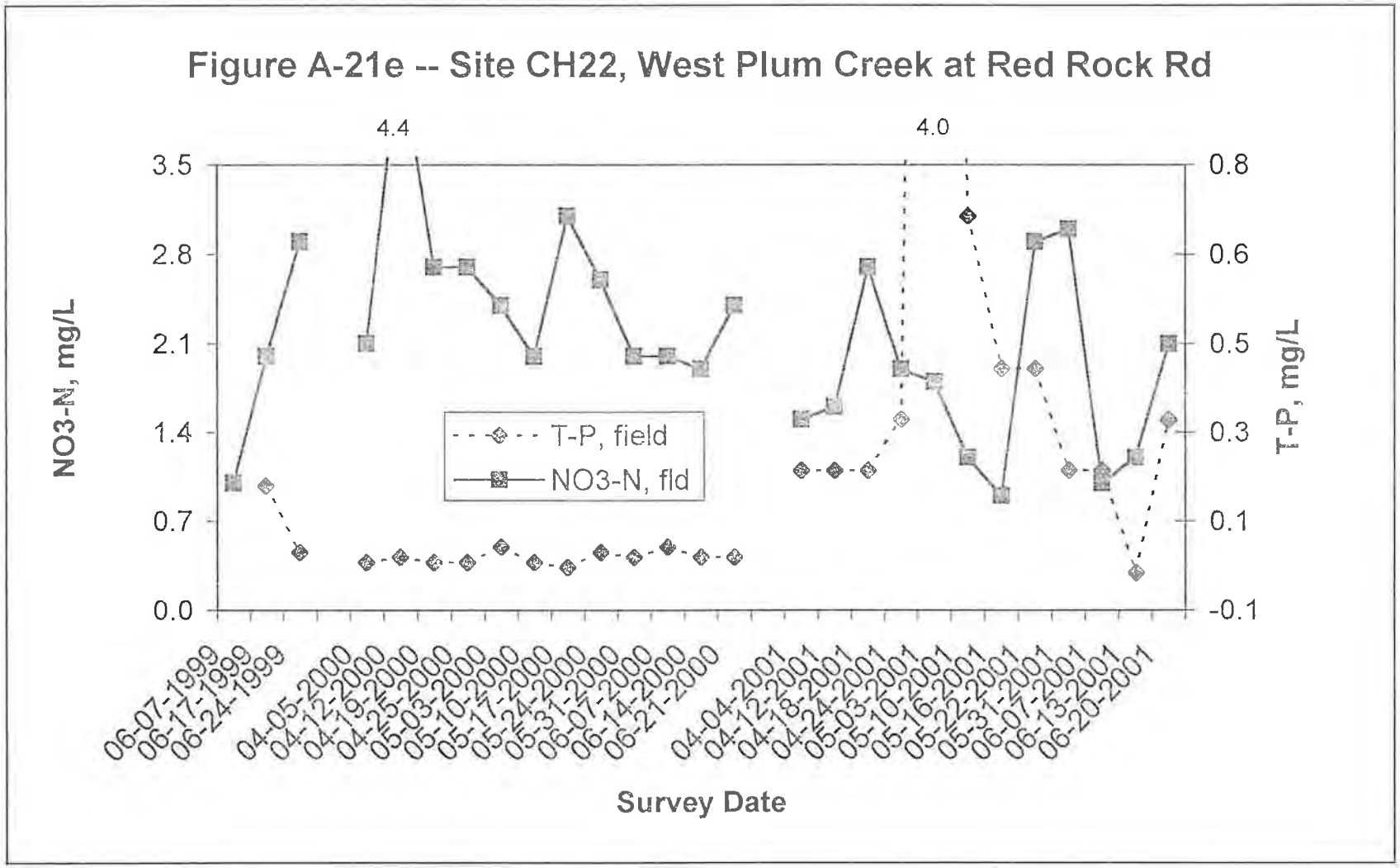


Figure A-21e -- Site CH22, West Plum Creek at Red Rock Rd
4.4
4.0
3.5
2.8
2.1
1.4
0.7
0.0
0.8
0.6
0.5
0.3
0.1
-0.1
NO3-N, mg/L
T-P, mg/L
T-P, field
NO3-N, fld
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

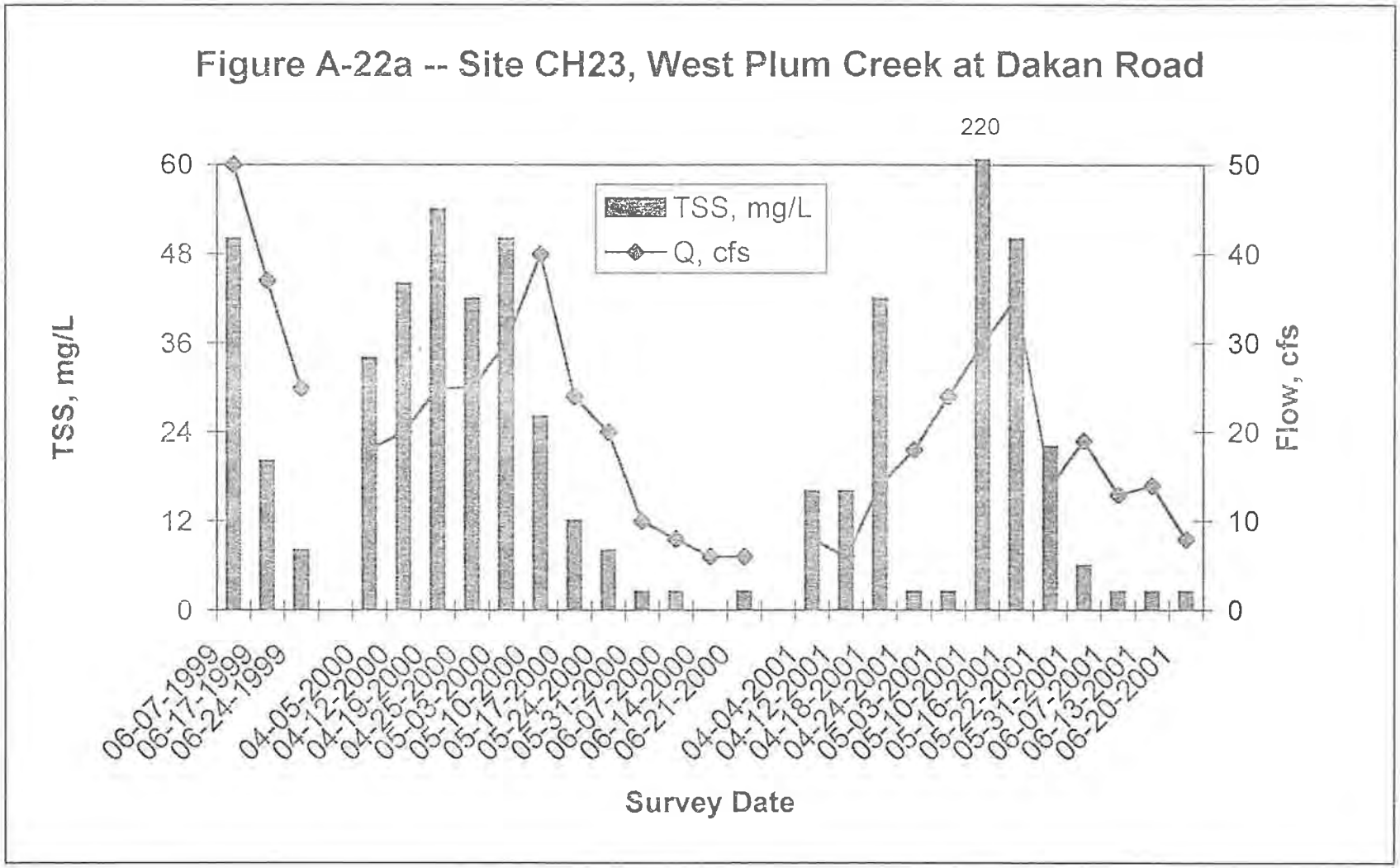


Figure A-22a -- Site CH23, West Plum Creek at Dakan Road
220
60
48
36
24
12
0
50
40
30
20
10
0
TSS, mg/L
Flow, cfs
TSS, mg/L
Q, cfs
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

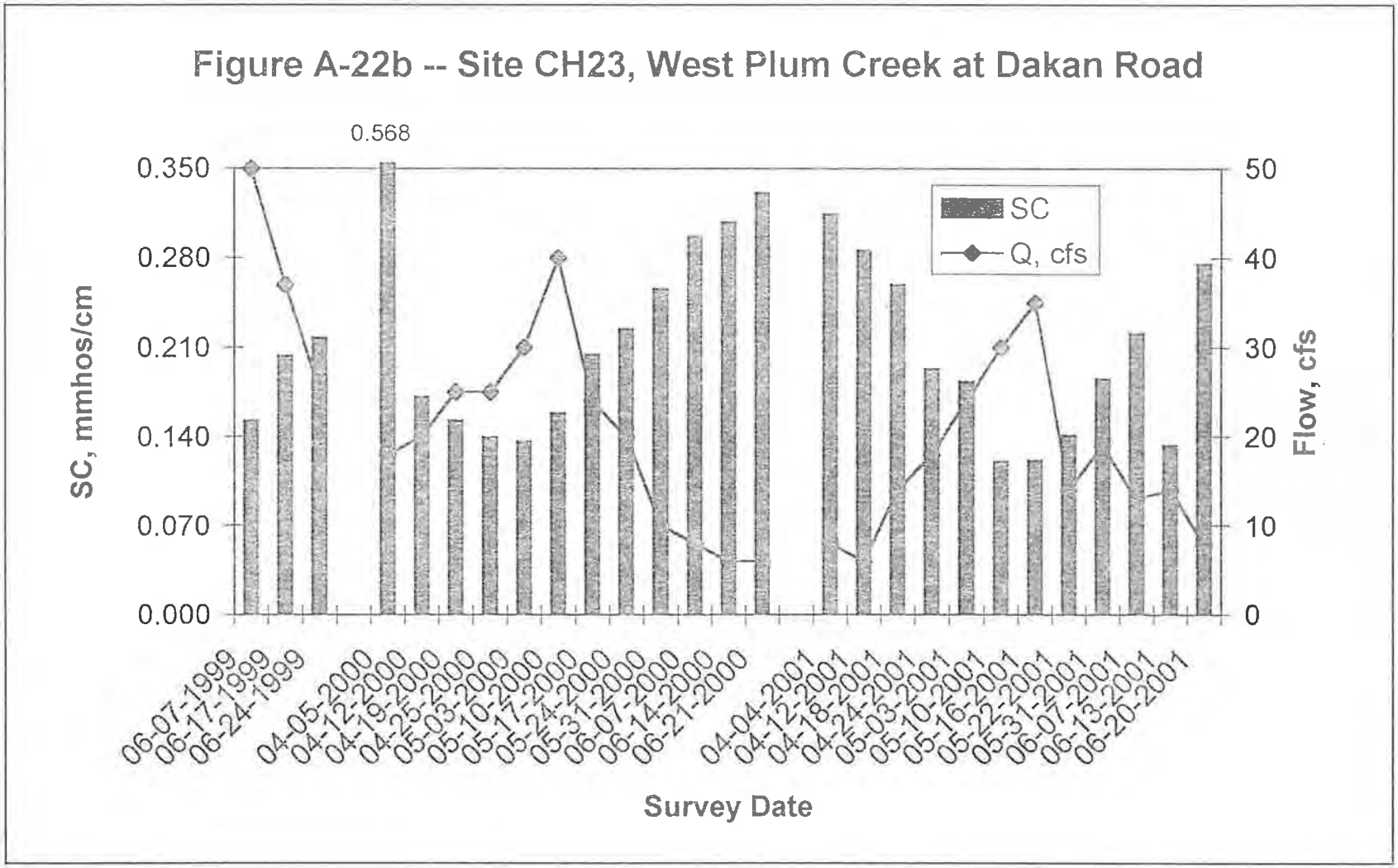


Figure A-22b -- Site CH23, West Plum Creek at Dakan Road
0.568
0.350
0.280
0.210
0.140
0.070
0.000
SC, mmhos/cm
50
40
30
20
10
0
Flow, cfs
SC
Q, cfs
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

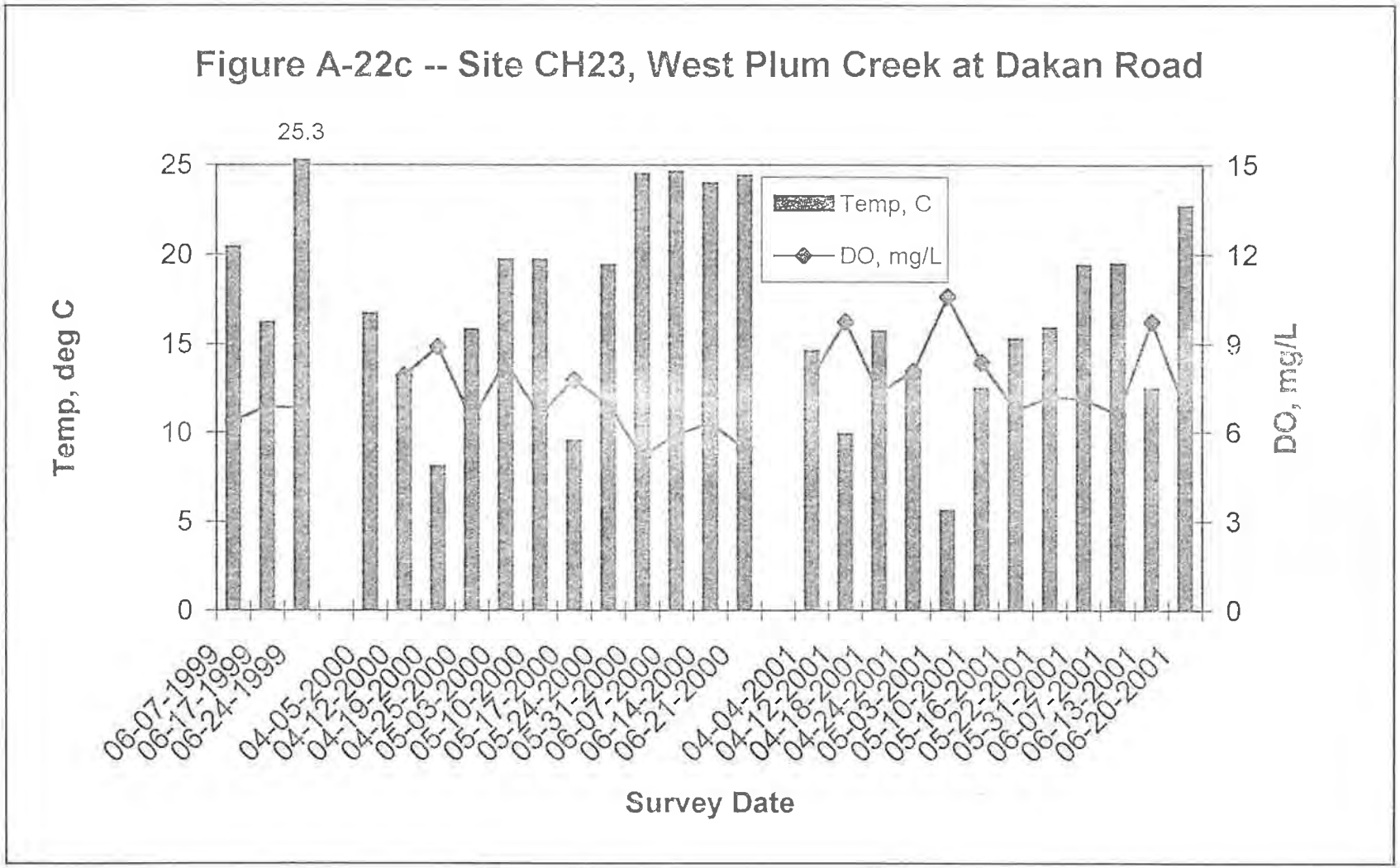
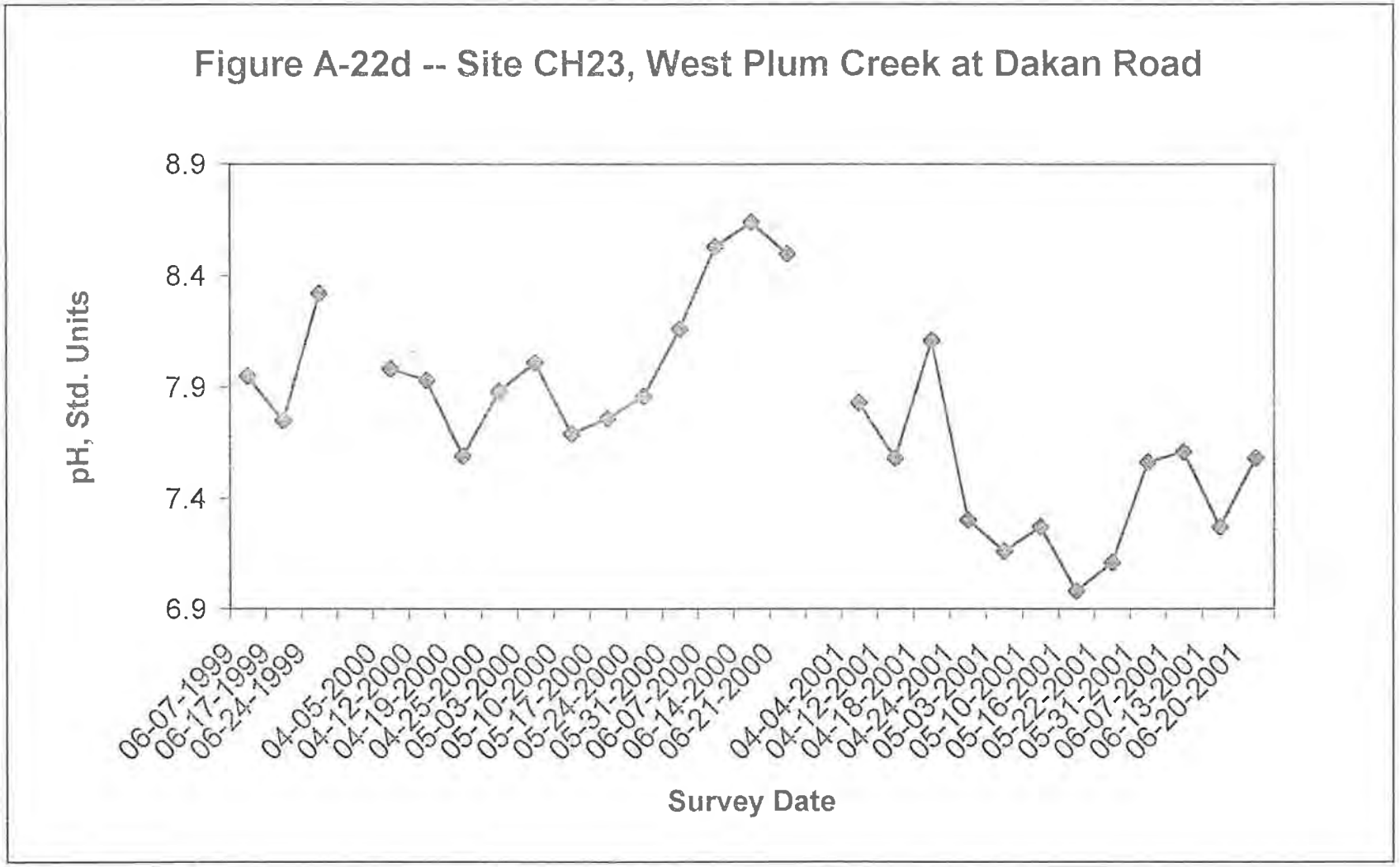


Figure A-22c -- Site CH23, West Plum Creek at Dakan Road
25.3
Temp, C
DO, mg/L
Temp, deg C
DO, mg/L
0
5
10
15
20
25
0
3
6
9
12
15
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

Figure A-22d -- Site CH23, West Plum Creek at Dakan Road



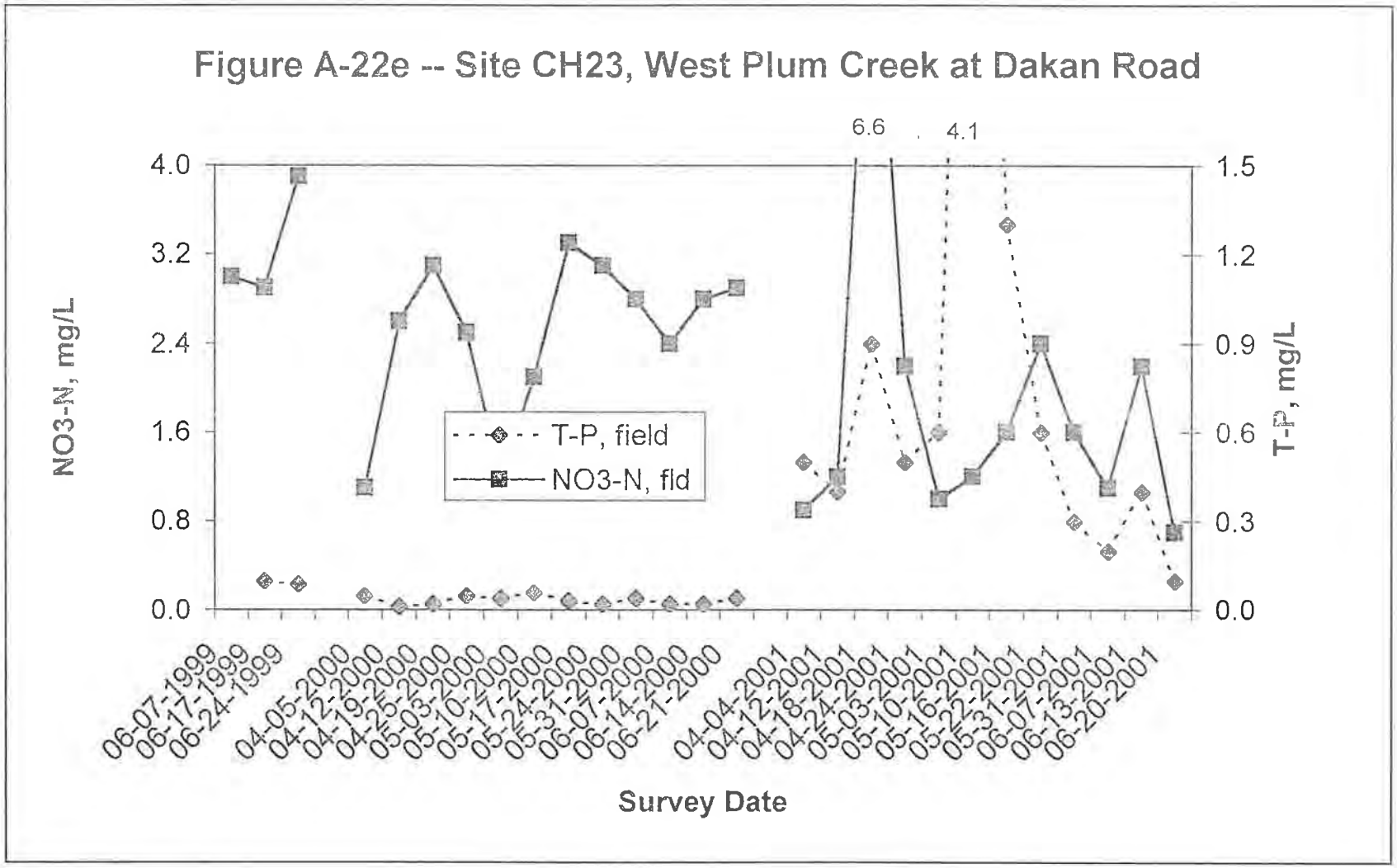


Figure A-22e -- Site CH23, West Plum Creek at Dakan Road
6.6
4.1
4.0
3.2
2.4
1.6
0.8
0.0
1.5
1.2
0.9
0.6
0.3
0.0
NO3-N, mg/L
T-P, mg/L
T-P, field
NO3-N, fld
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

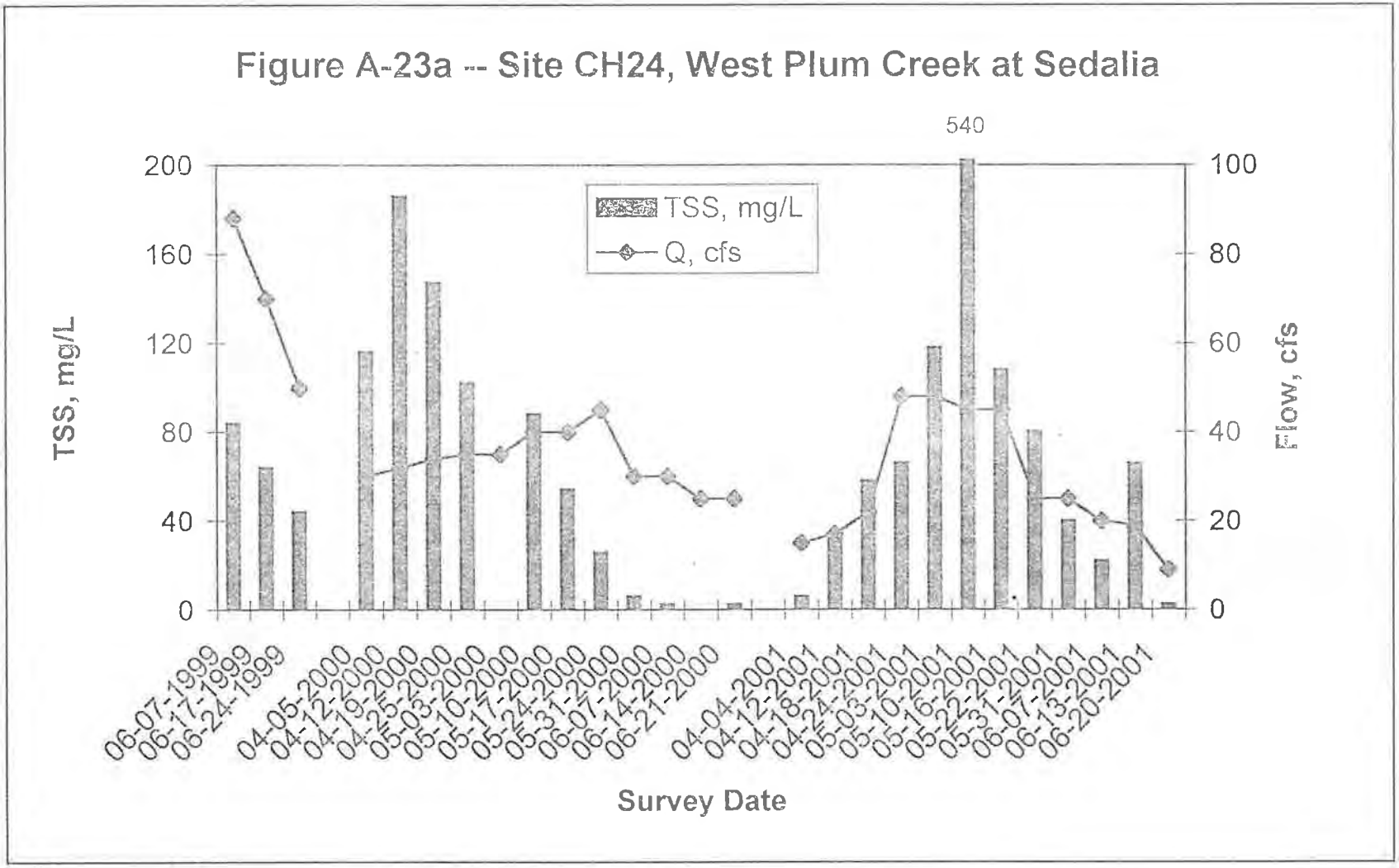


Figure A-23a -- Site CH24, West Plum Creek at Sedalia
540
200
160
120
80
40
0
100
80
60
40
20
0
TSS, mg/L
Flow, cfs
TSS, mg/L
Q, cfs
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

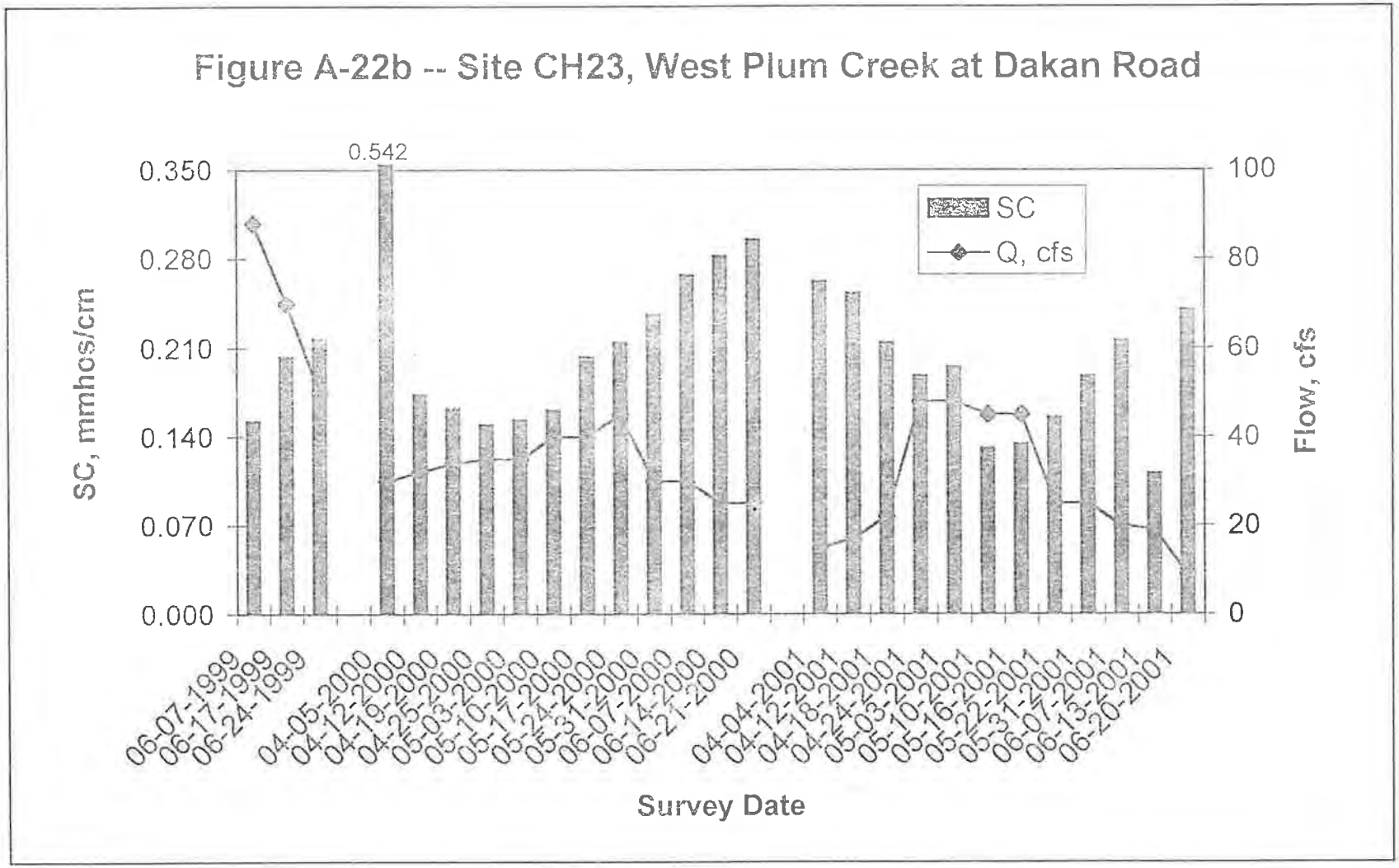


Figure A-22b -- Site CH23, West Plum Creek at Dakan Road
0.542
0.350
0.280
0.210
0.140
0.070
0.000
SC, mmhos/cm
100
80
60
40
20
0
Flow, cfs
SC
Q, cfs
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

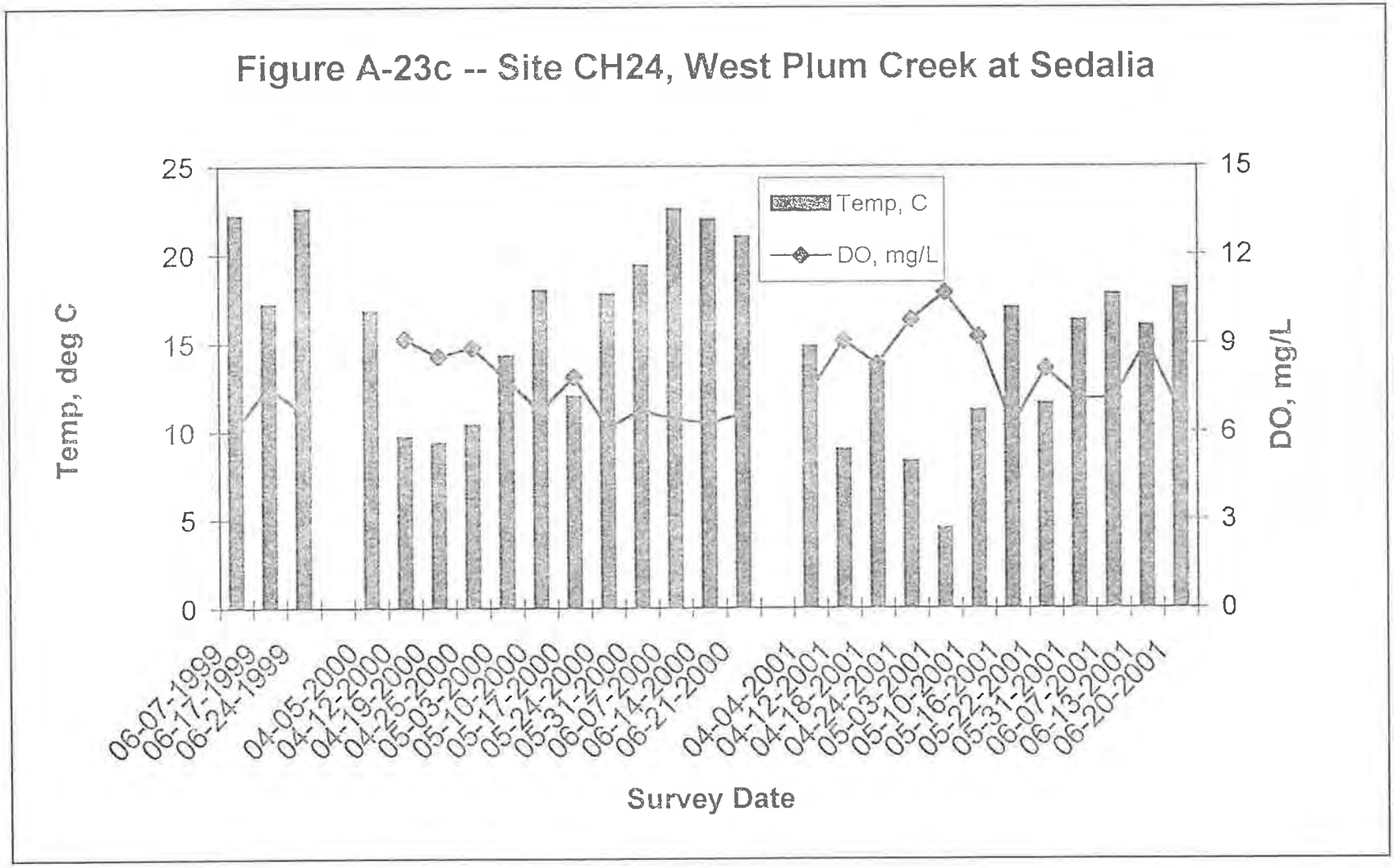


Figure A-23c -- Site CH24, West Plum Creek at Sedalia
Temp, C
DO, mg/L
Temp, deg C
DO, mg/L
25
20
15
10
5
0
15
12
9
6
3
0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

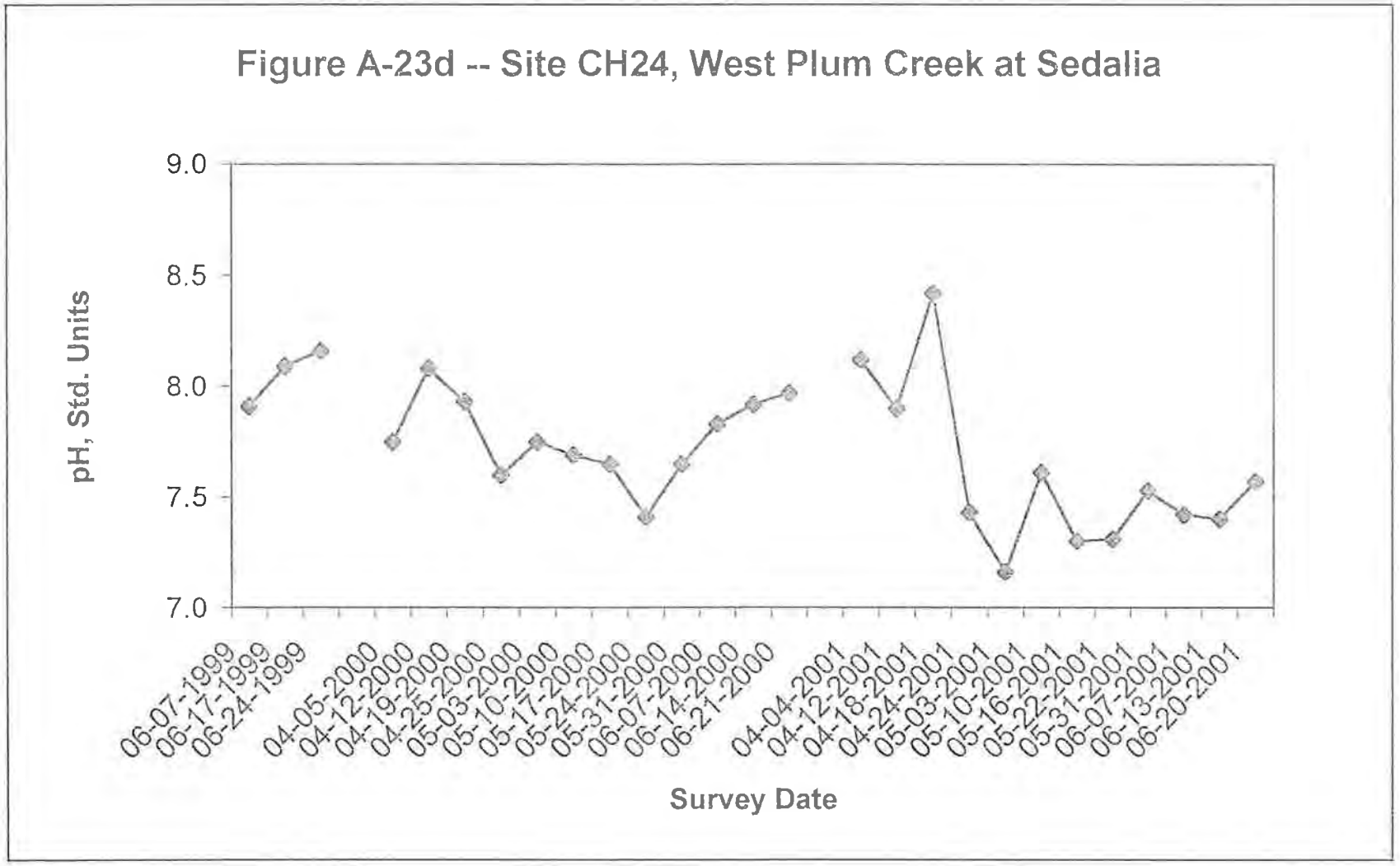


Figure A-23d -- Site CH24, West Plum Creek at Sedalia
pH, Std. Units
9.0
8.5
8.0
7.5
7.0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

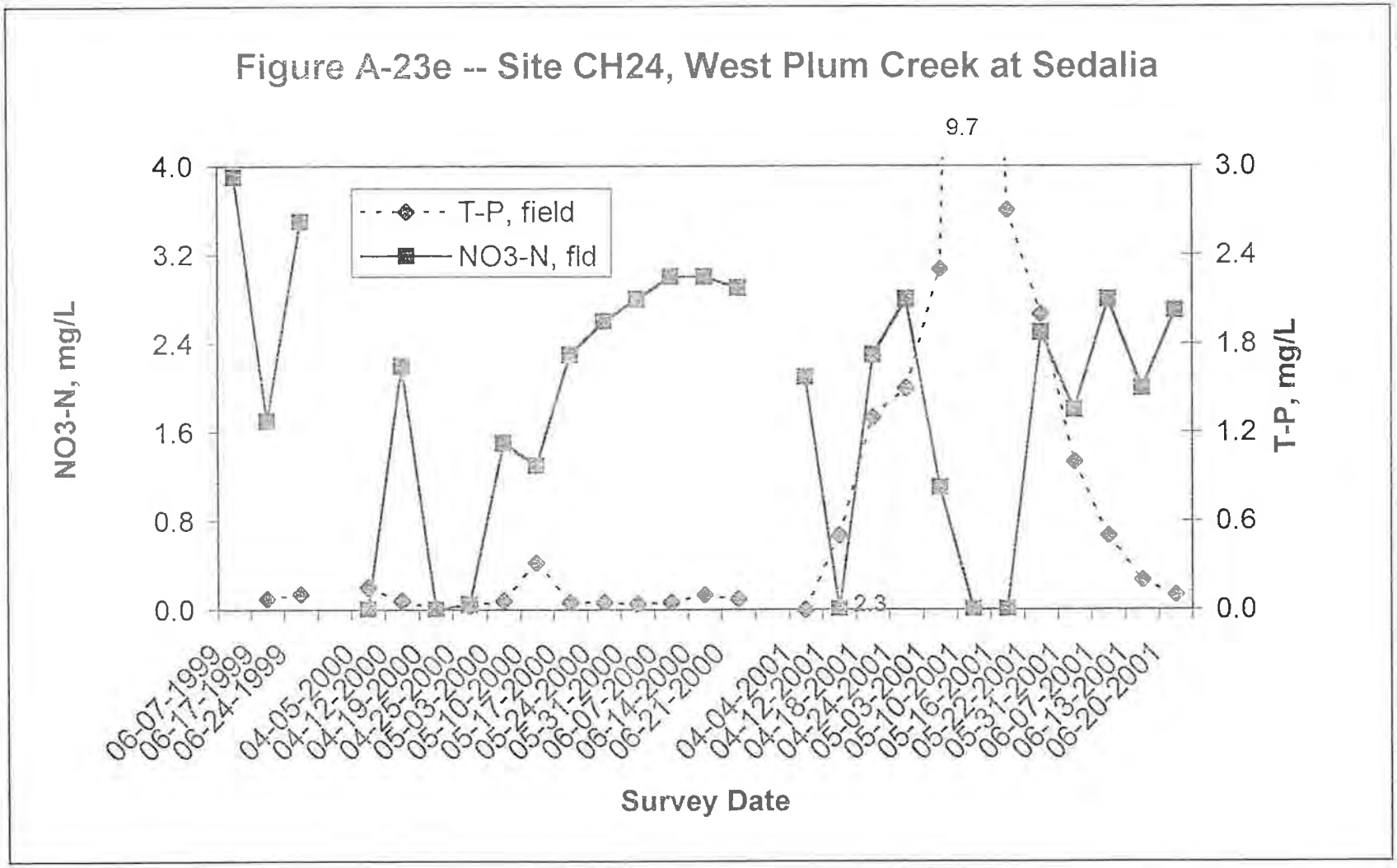


Figure A-23e -- Site CH24, West Plum Creek at Sedalia
9.7
2.3
T-P, field
NO3-N, fld
NO3-N, mg/L
T-P, mg/L
4.0
3.2
2.4
1.6
0.8
0.0
3.0
2.4
1.8
1.2
0.6
0.0
06-07-1999
06-17-1999
06-24-1999
04-05-2000
04-12-2000
04-19-2000
04-25-2000
05-03-2000
05-10-2000
05-17-2000
05-24-2000
05-31-2000
06-07-2000
06-14-2000
06-21-2000
04-04-2001
04-12-2001
04-18-2001
04-24-2001
05-03-2001
05-10-2001
05-16-2001
05-22-2001
05-31-2001
06-07-2001
06-13-2001
06-20-2001
Survey Date

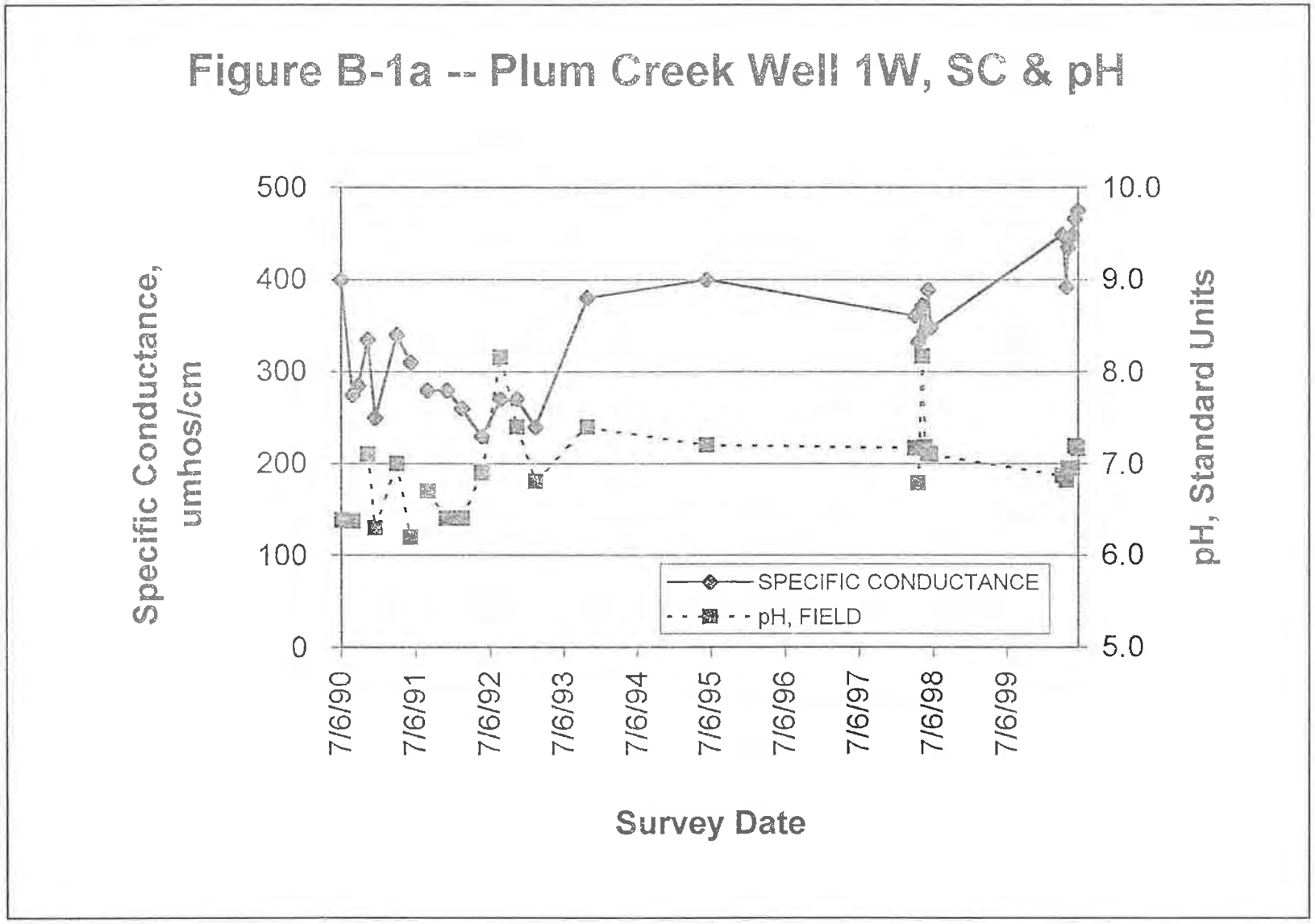
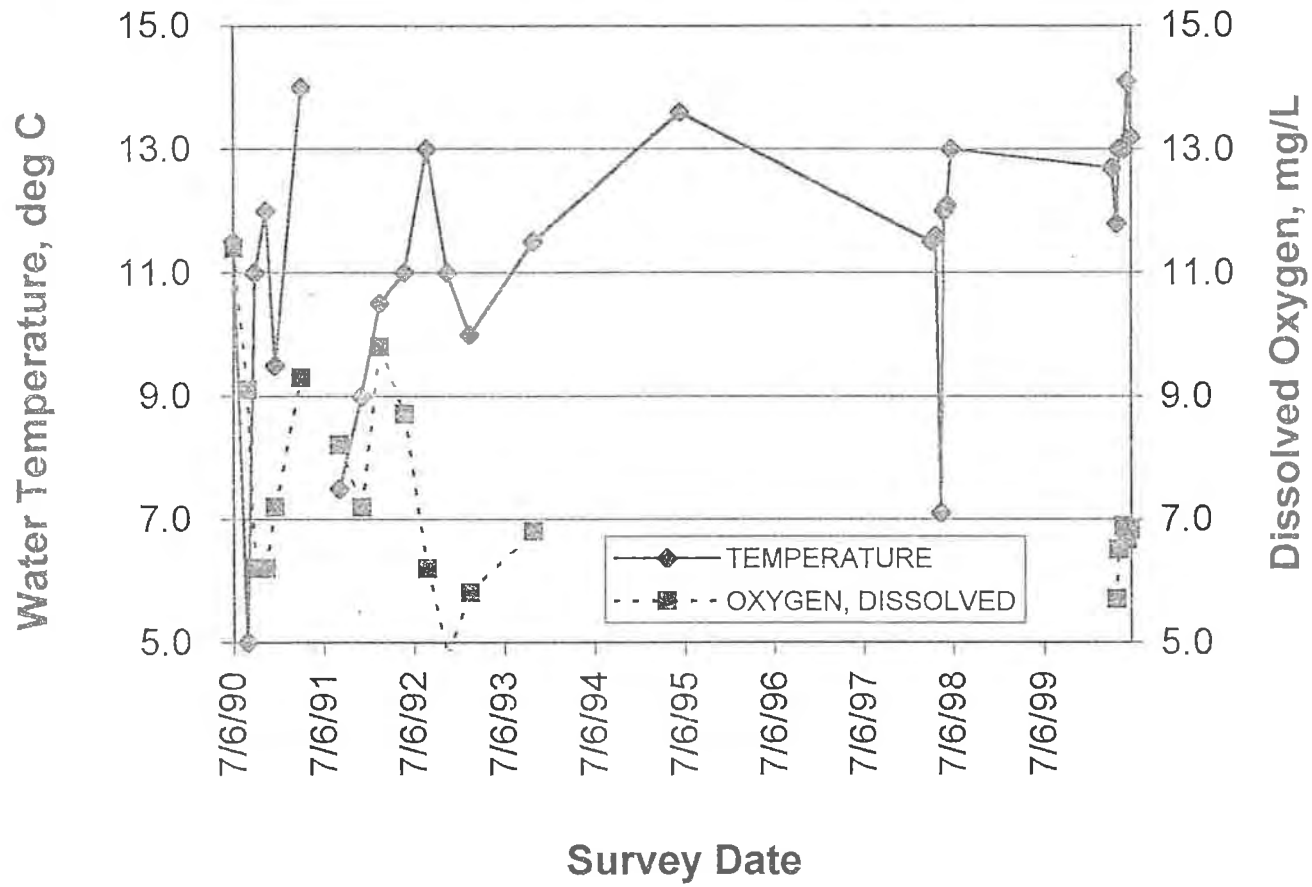


Figure B-1a -- Plum Creek Well 1W, SC & pH
Specific Conductance, umhos/cm
pH, Standard Units
500
400
300
200
100
0
10.0
9.0
8.0
7.0
6.0
5.0
SPECIFIC CONDUCTANCE
pH, FIELD
7/6/90
7/6/91
7/6/92
7/6/93
7/6/94
7/6/95
7/6/96
7/6/97
7/6/98
7/6/99
Survey Date

Figure B-1b -- Plum Creek Well 1W, DO & Temperature



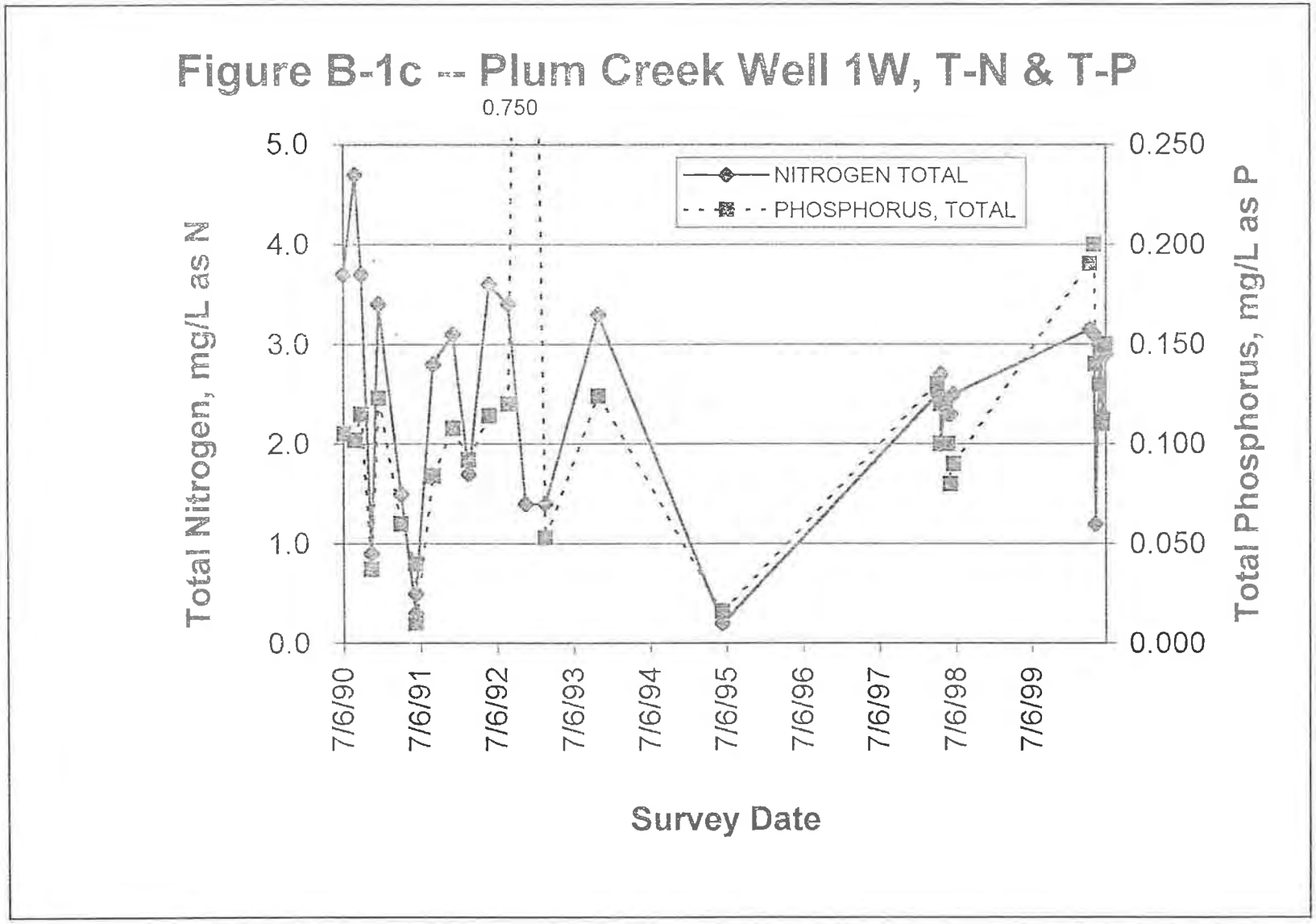


Figure B-1c -- Plum Creek Well 1W, T-N & T-P
0.750
5.0
4.0
3.0
2.0
1.0
0.0
0.250
0.200
0.150
0.100
0.050
0.000
NITROGEN TOTAL
PHOSPHORUS, TOTAL
Total Nitrogen, mg/L as N
Total Phosphorus, mg/L as P
7/6/90
7/6/91
7/6/92
7/6/93
7/6/94
7/6/95
7/6/96
7/6/97
7/6/98
7/6/99
Survey Date

Figure B-2a -- Plum Creek Well 2W, SC & pH

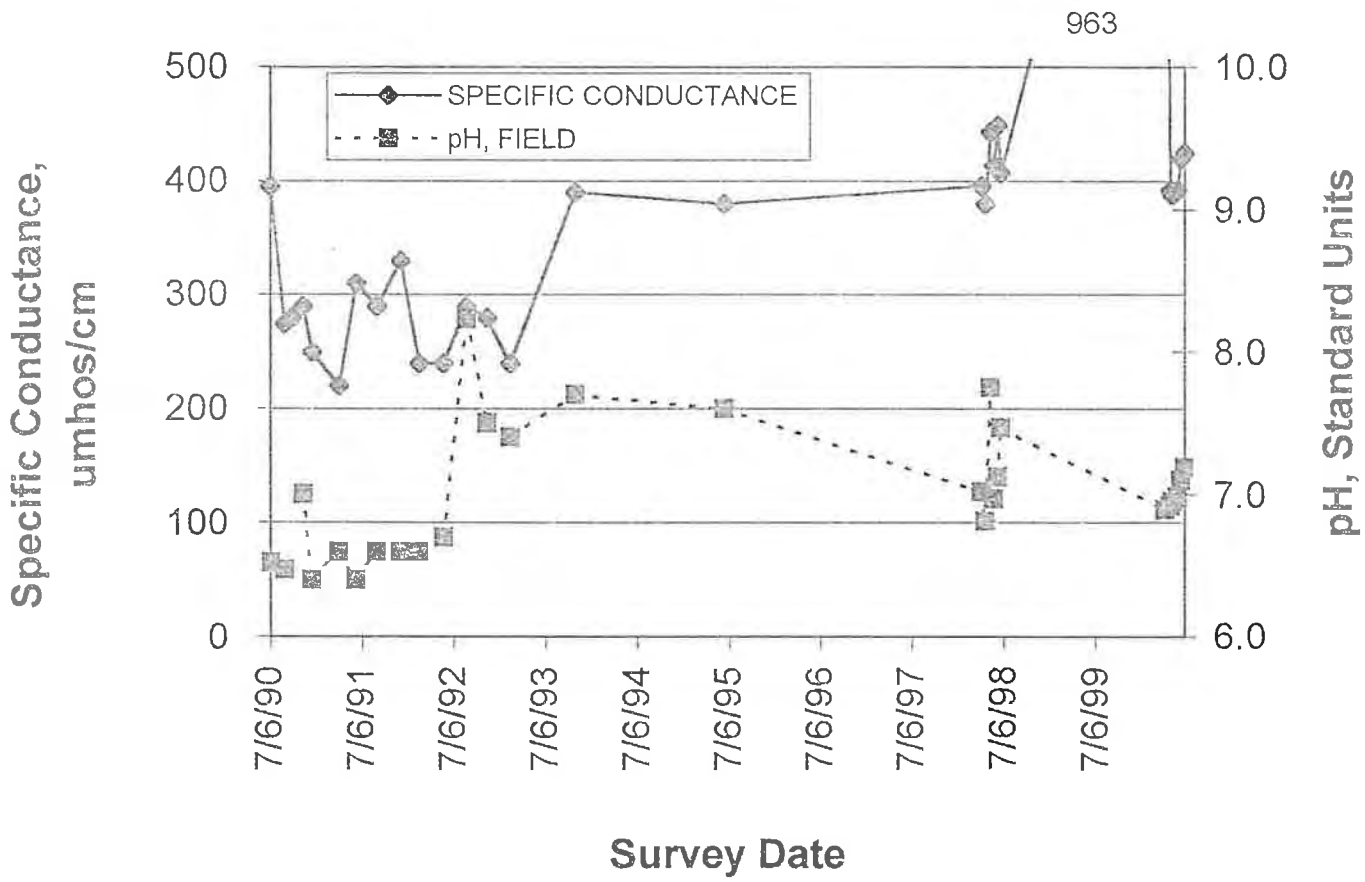
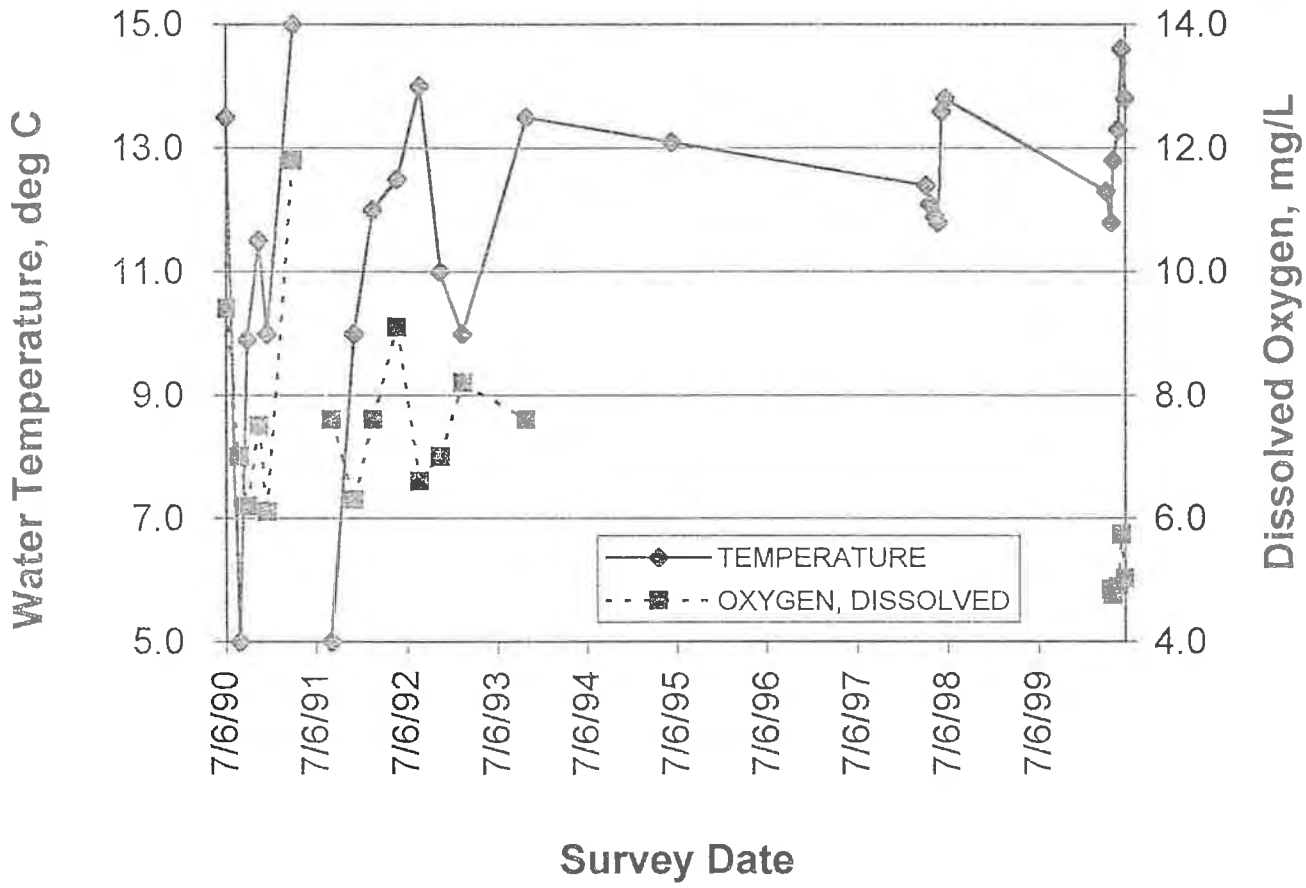


Figure B-2b -- Plum Creek Well 2W, DO & Temperature



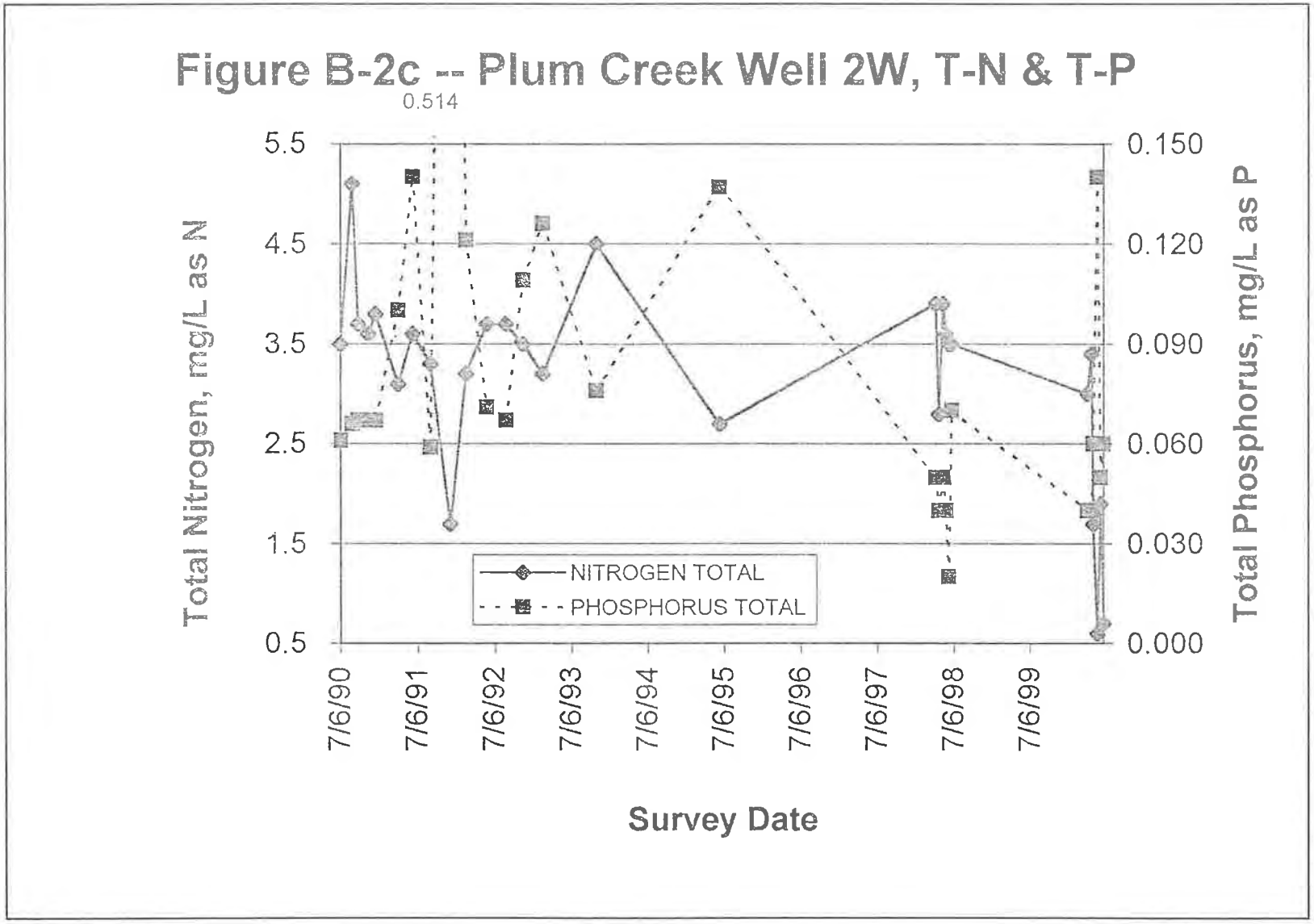


Figure B-2c -- Plum Creek Well 2W, T-N & T-P
0.514
5.5
4.5
3.5
2.5
1.5
0.5
0.150
0.120
0.090
0.060
0.030
0.000
Total Nitrogen, mg/L as N
Total Phosphorus, mg/L as P
NITROGEN TOTAL
PHOSPHORUS TOTAL
7/6/90
7/6/91
7/6/92
7/6/93
7/6/94
7/6/95
7/6/96
7/6/97
7/6/98
7/6/99
Survey Date

Figure B-3a -- Plum Creek Well 3W, SC & pH

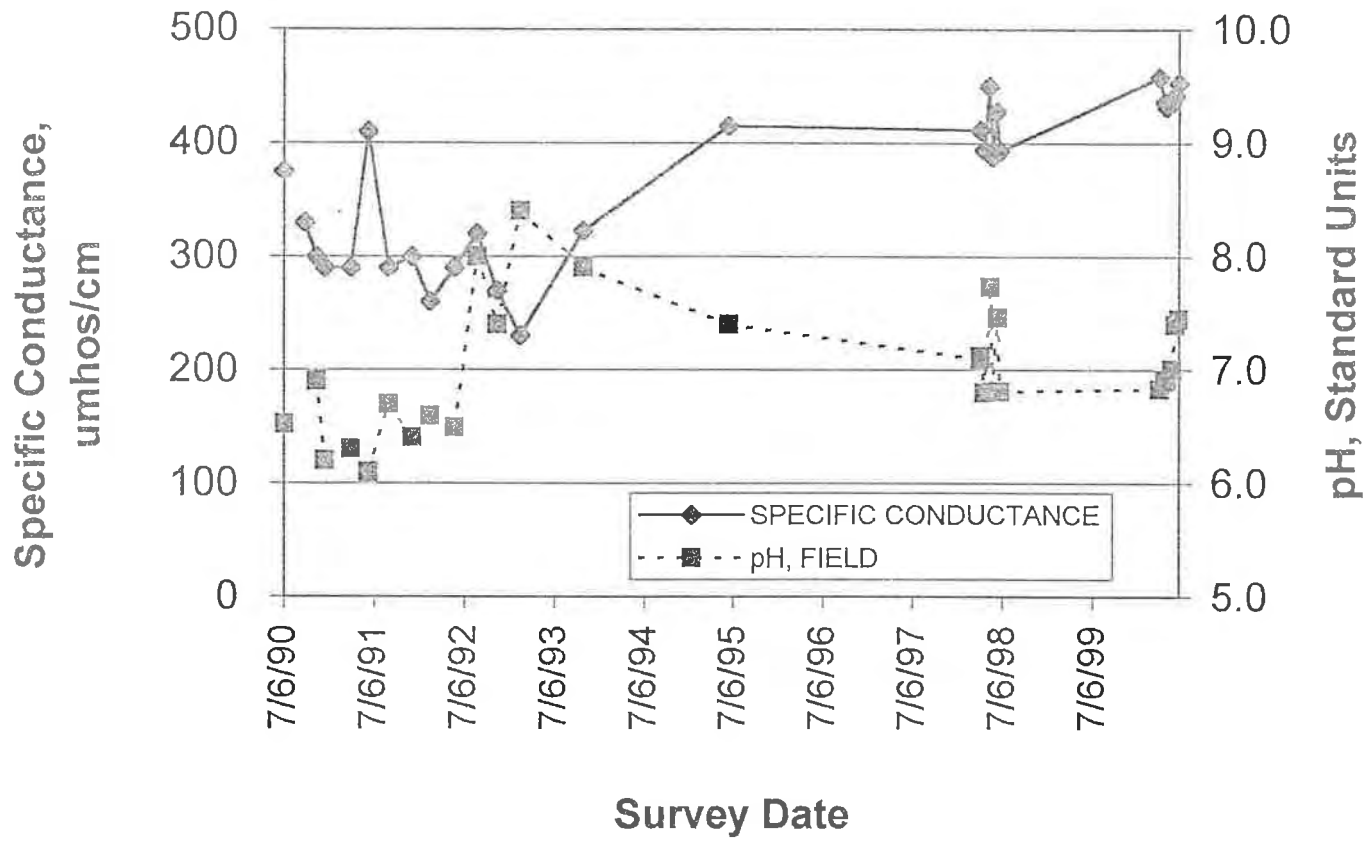
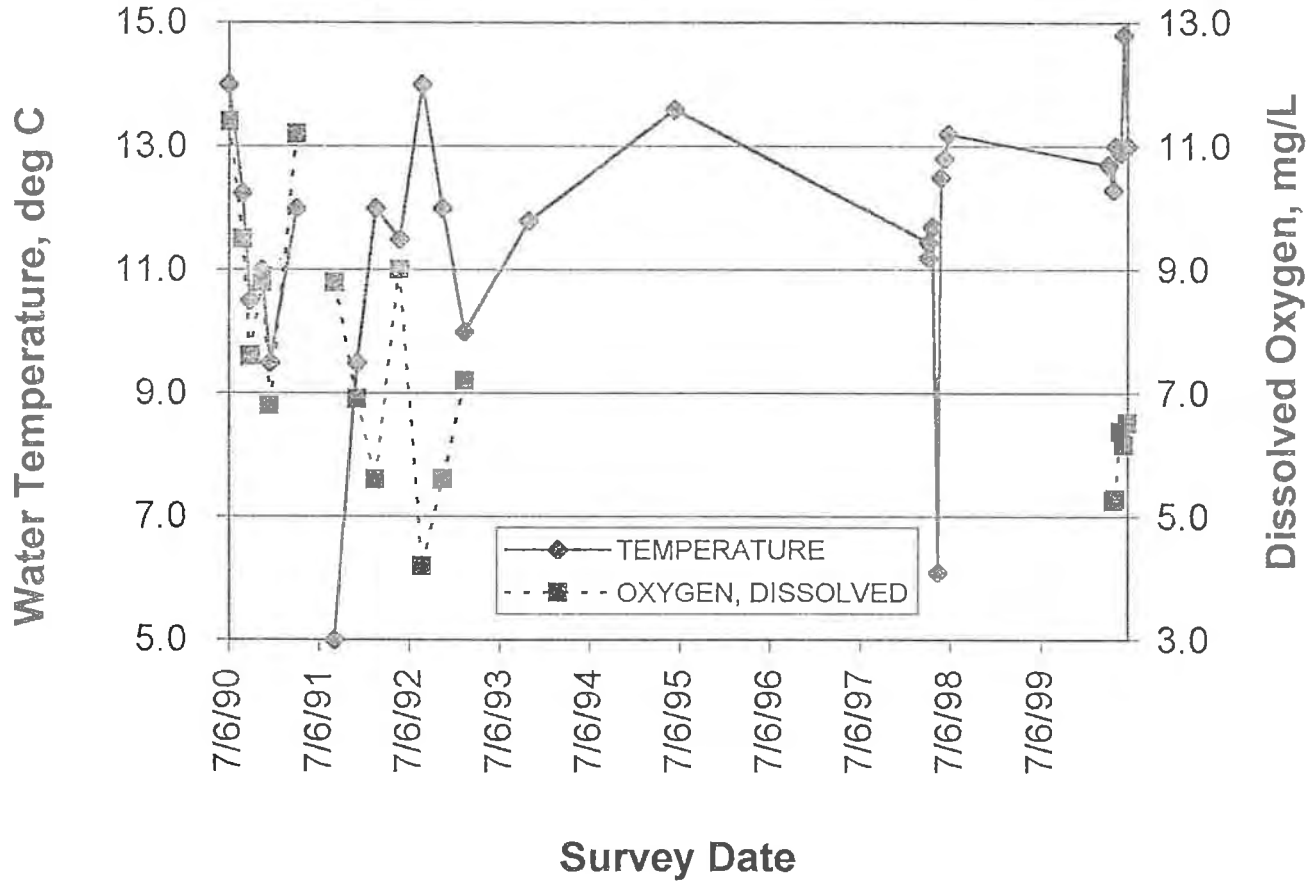


Figure B-3b -- Plum Creek Well 3W, DO & Temperature



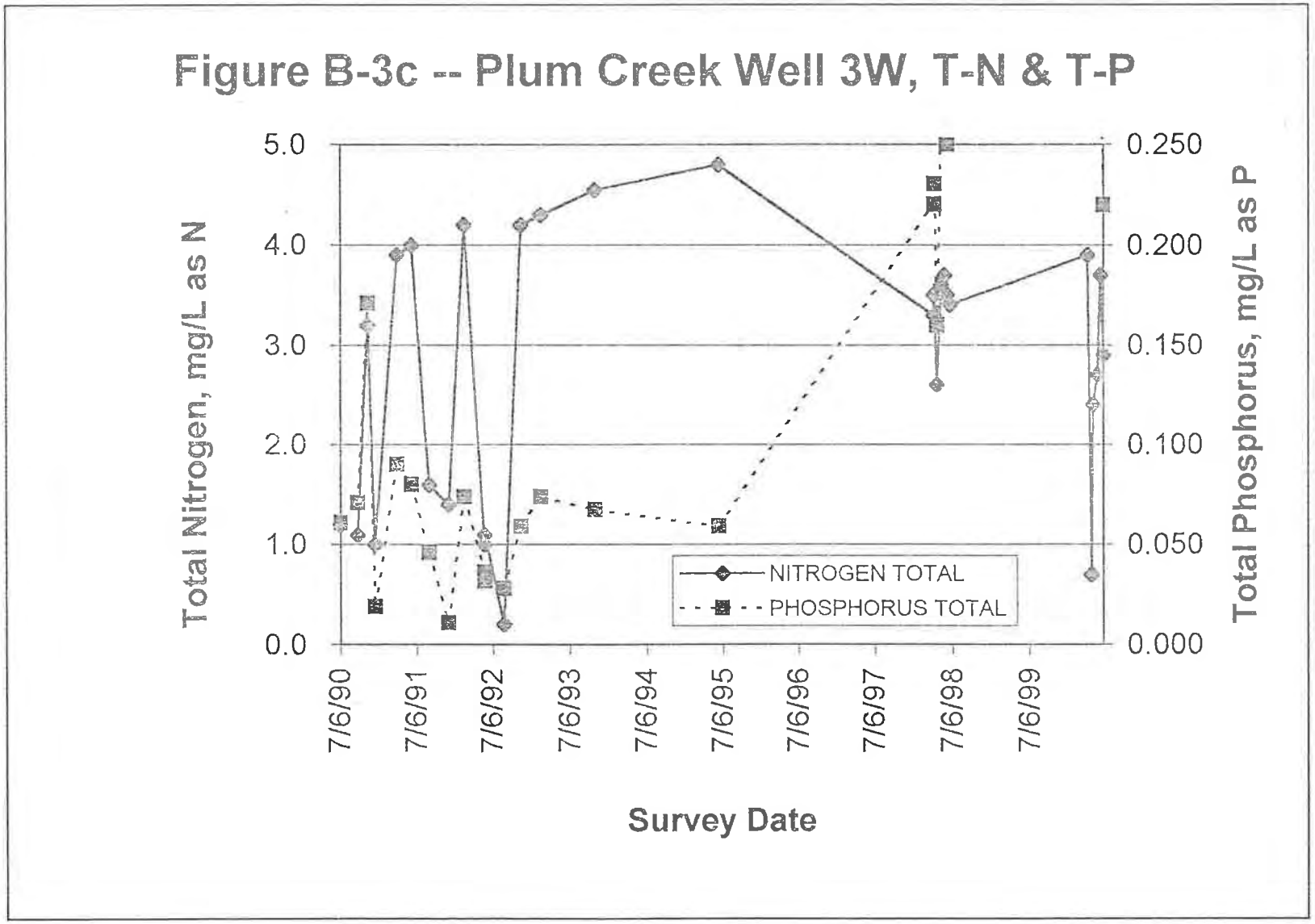


Figure B-3c -- Plum Creek Well 3W, T-N & T-P
Total Nitrogen, mg/L as N
Total Phosphorus, mg/L as P
5.0
4.0
3.0
2.0
1.0
0.0
0.250
0.200
0.150
0.100
0.050
0.000
NITROGEN TOTAL
PHOSPHORUS TOTAL
7/6/90
7/6/91
7/6/92
7/6/93
7/6/94
7/6/95
7/6/96
7/6/97
7/6/98
7/6/99
Survey Date

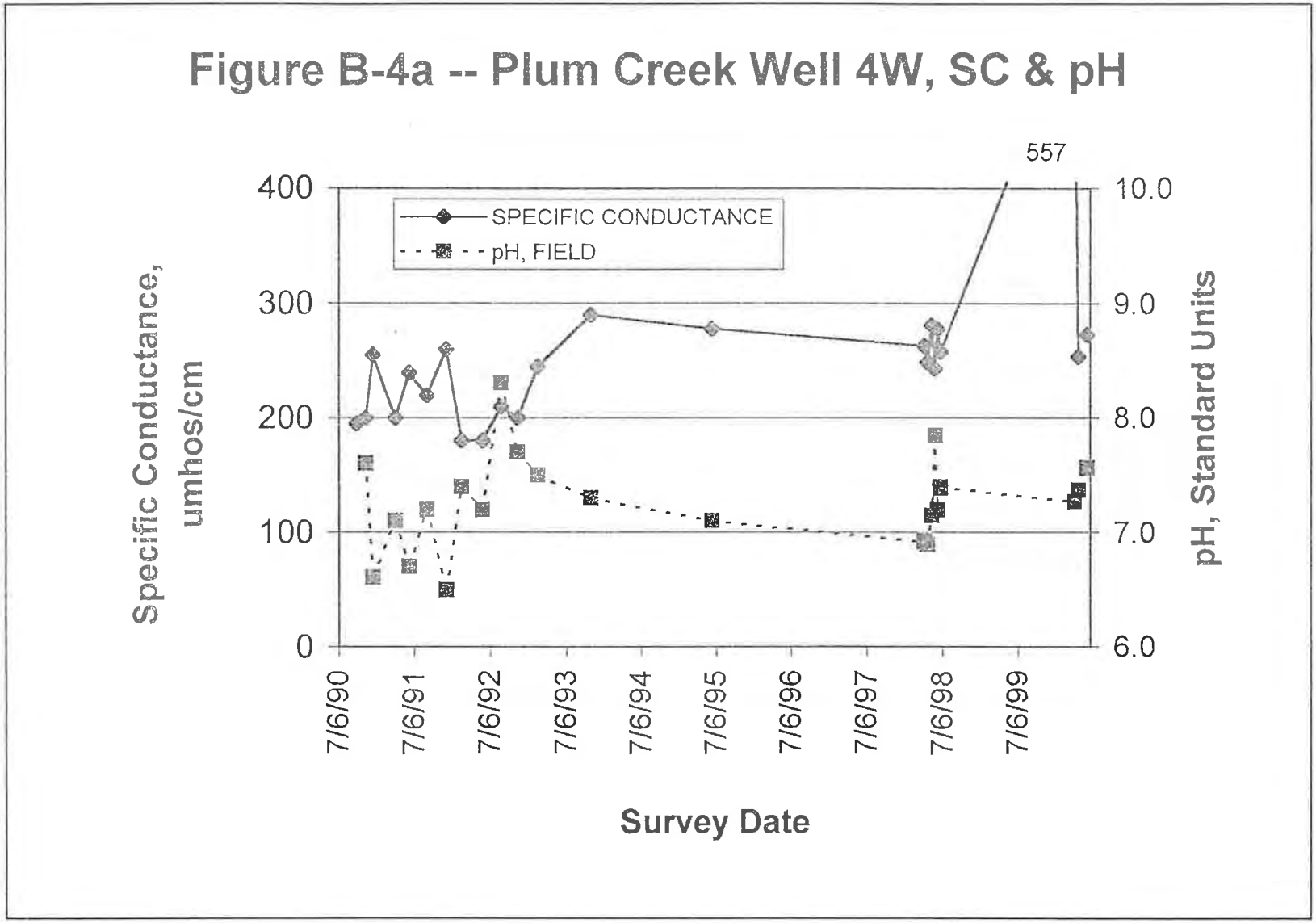
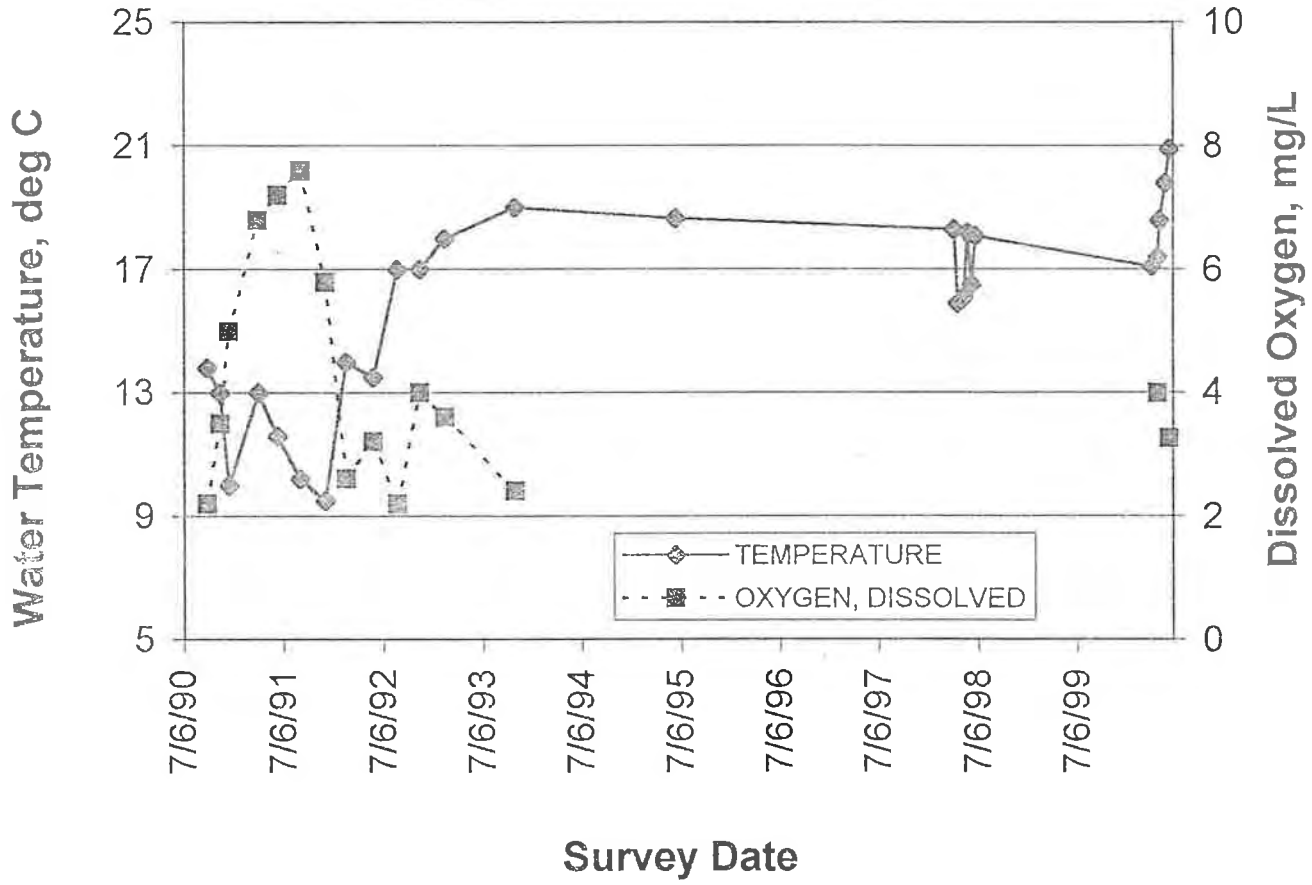


Figure B-4a -- Plum Creek Well 4W, SC & pH
557
400
300
200
100
0
10.0
9.0
8.0
7.0
6.0
SPECIFIC CONDUCTANCE
pH, FIELD
Specific Conductance, umhos/cm
pH, Standard Units
7/6/90
7/6/91
7/6/92
7/6/93
7/6/94
7/6/95
7/6/96
7/6/97
7/6/98
7/6/99
Survey Date

Figure B-4b -- Plum Creek Well 4W, DO & Temperature



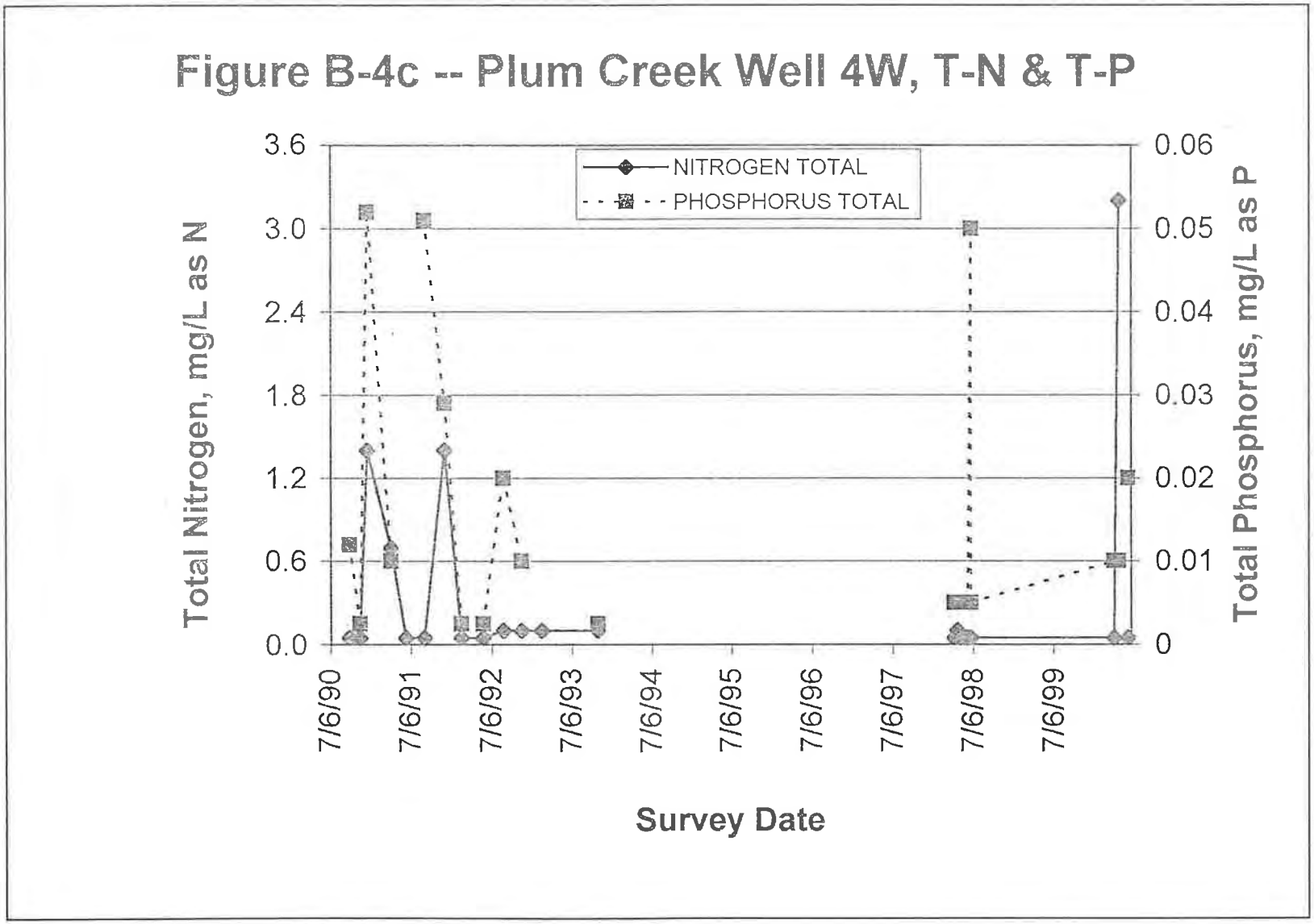
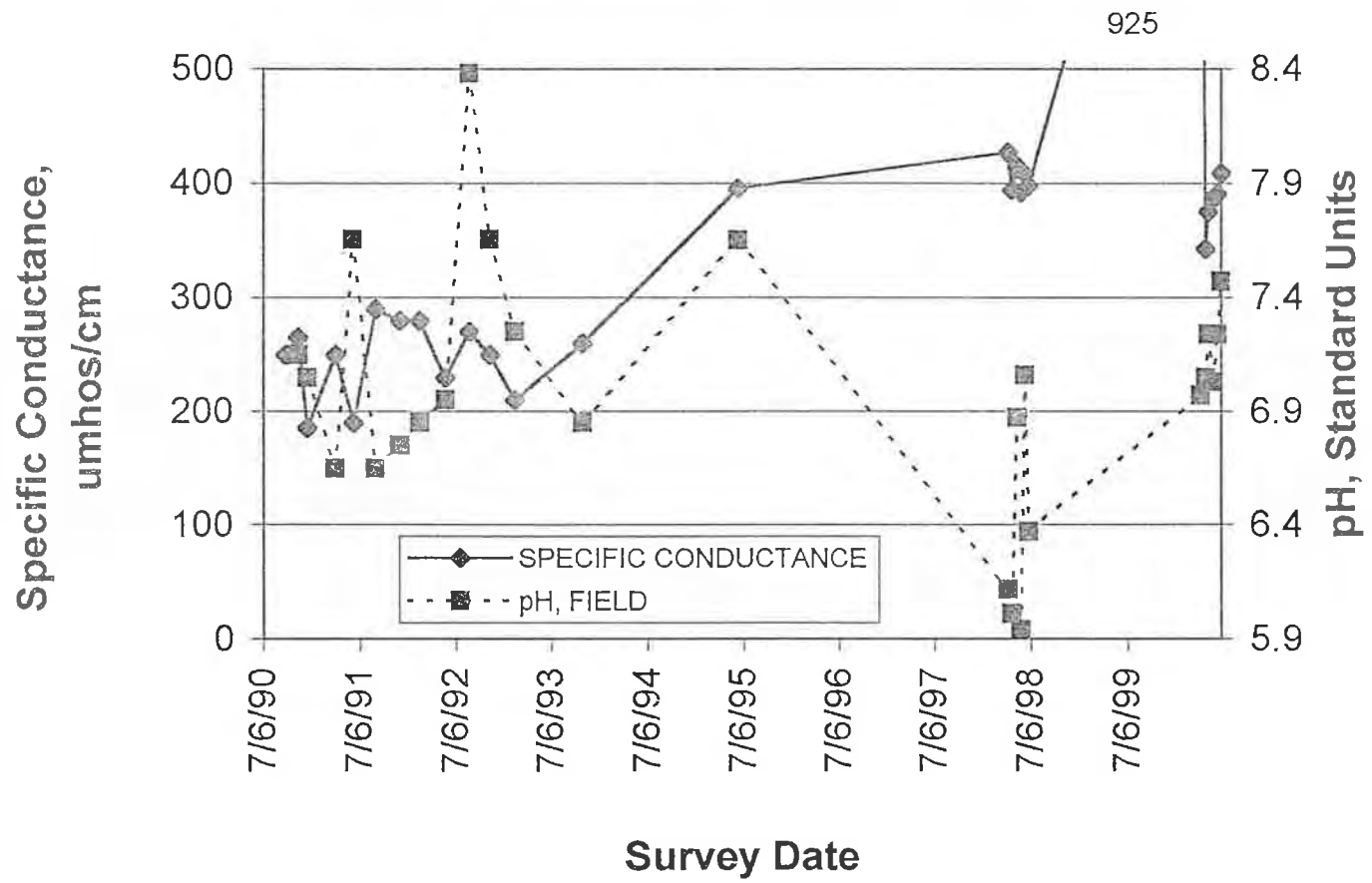


Figure B-4c -- Plum Creek Well 4W, T-N & T-P
NITROGEN TOTAL
PHOSPHORUS TOTAL
Total Nitrogen, mg/L as N
Total Phosphorus, mg/L as P
3.6
3.0
2.4
1.8
1.2
0.6
0.0
0.06
0.05
0.04
0.03
0.02
0.01
0
7/6/90
7/6/91
7/6/92
7/6/93
7/6/94
7/6/95
7/6/96
7/6/97
7/6/98
7/6/99
Survey Date

Figure B-5a -- Plum Creek Well 5W, SC & pH



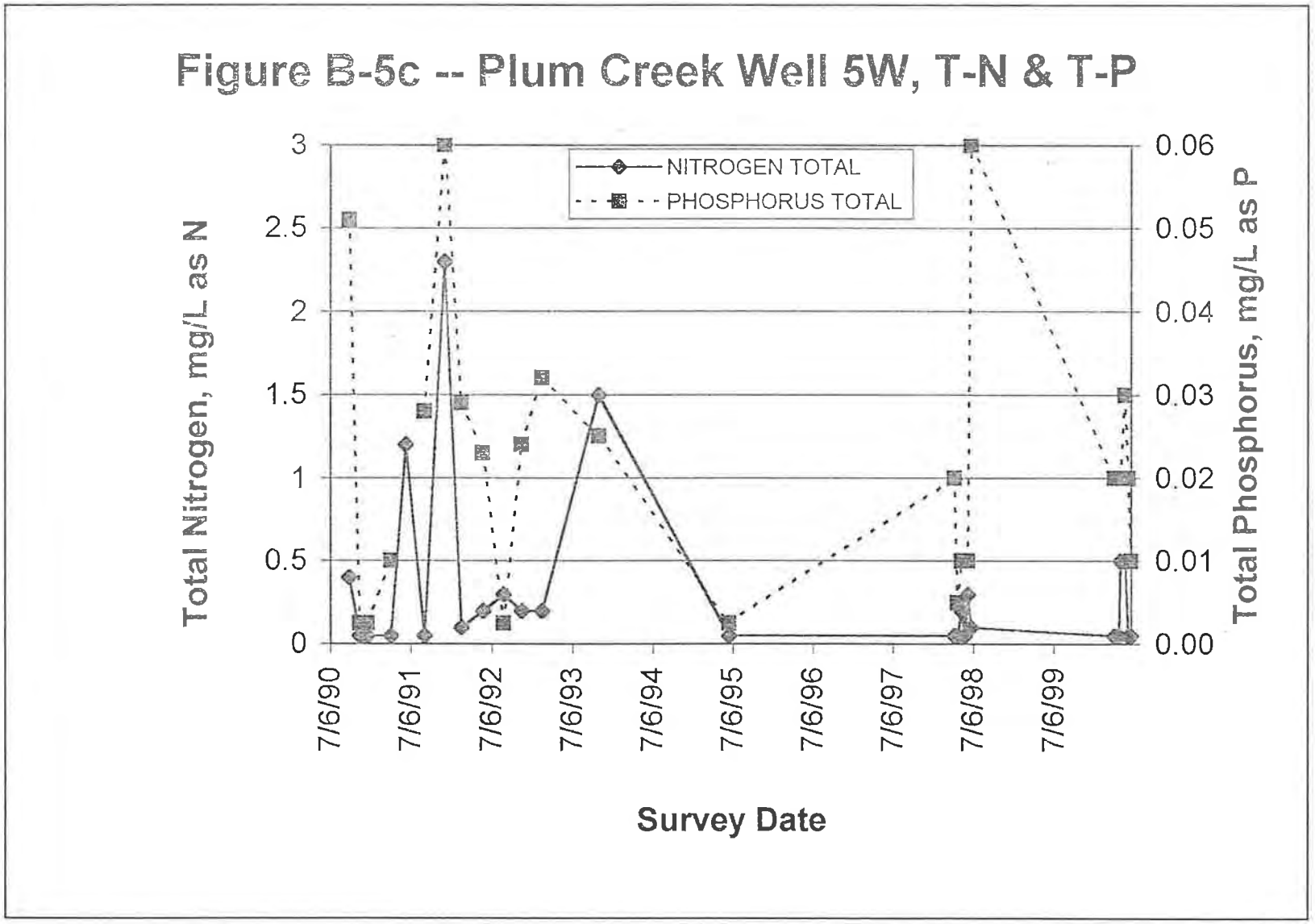


Figure B-5c -- Plum Creek Well 5W, T-N & T-P
NITROGEN TOTAL
PHOSPHORUS TOTAL
Total Nitrogen, mg/L as N
Total Phosphorus, mg/L as P
3
2.5
2
1.5
1
0.5
0
0.06
0.05
0.04
0.03
0.02
0.01
0.00
7/6/90
7/6/91
7/6/92
7/6/93
7/6/94
7/6/95
7/6/96
7/6/97
7/6/98
7/6/99
Survey Date

Figure B-6a -- Plum Creek Well 6W, SC & pH

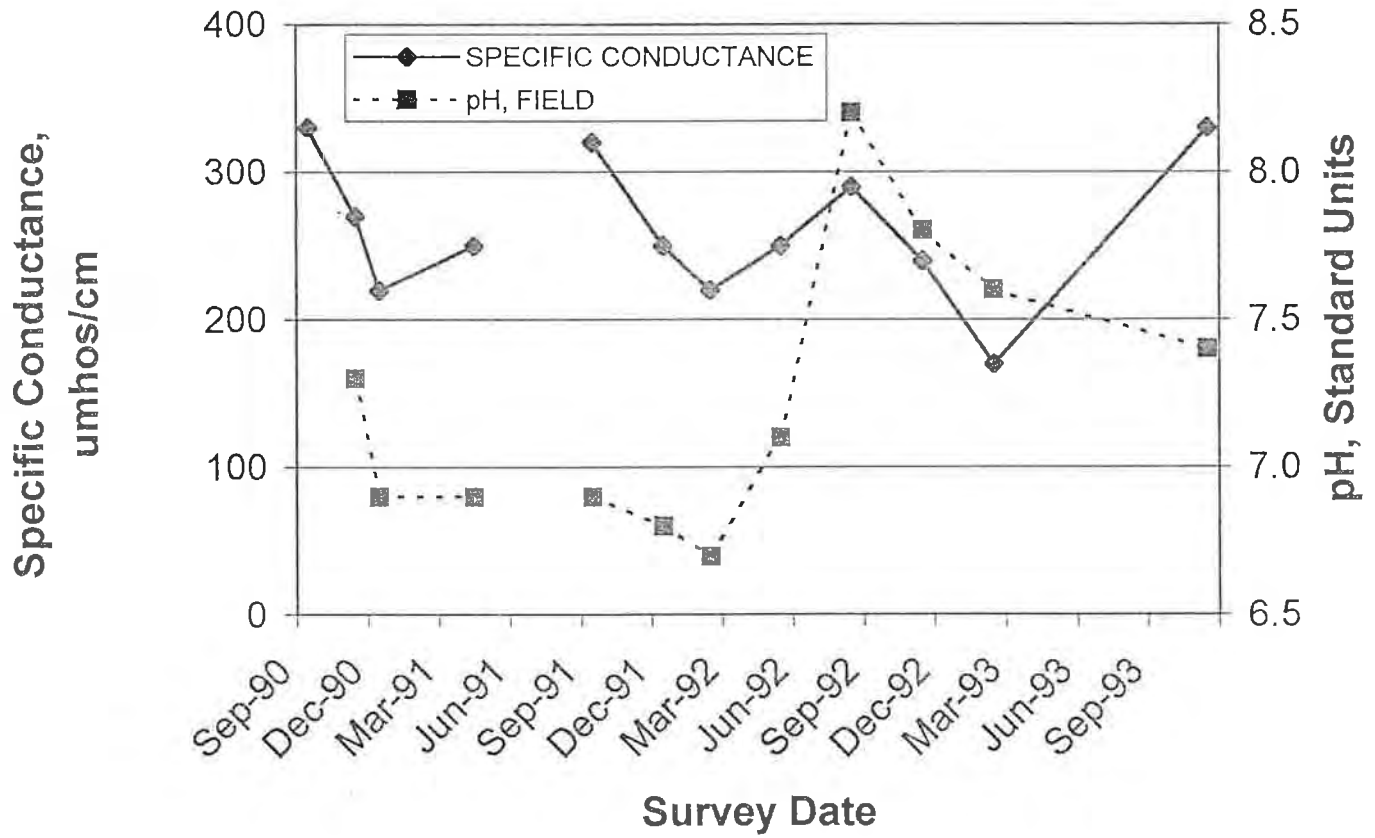
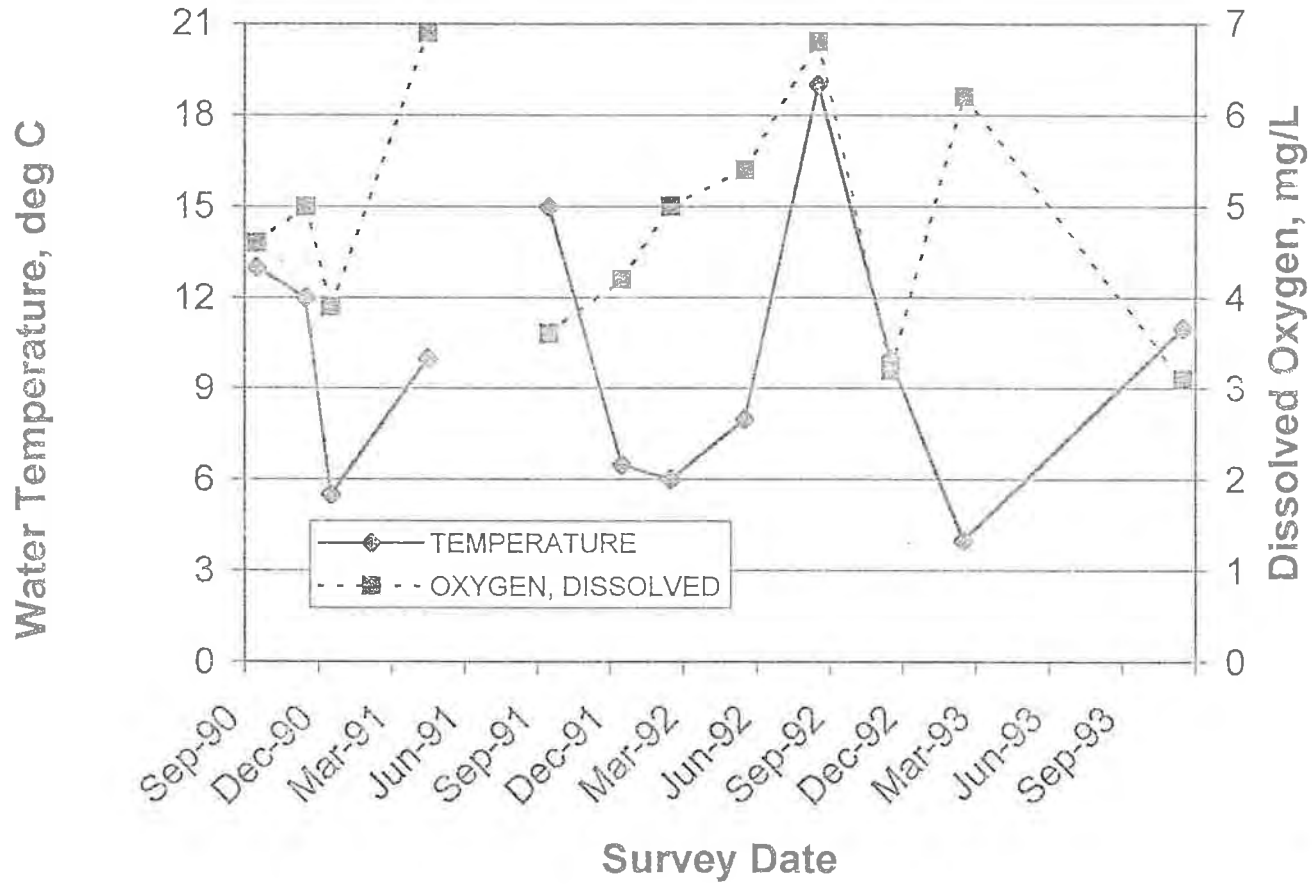


Figure B-6b -- Plum Creek Well 6W, DO & Temperature



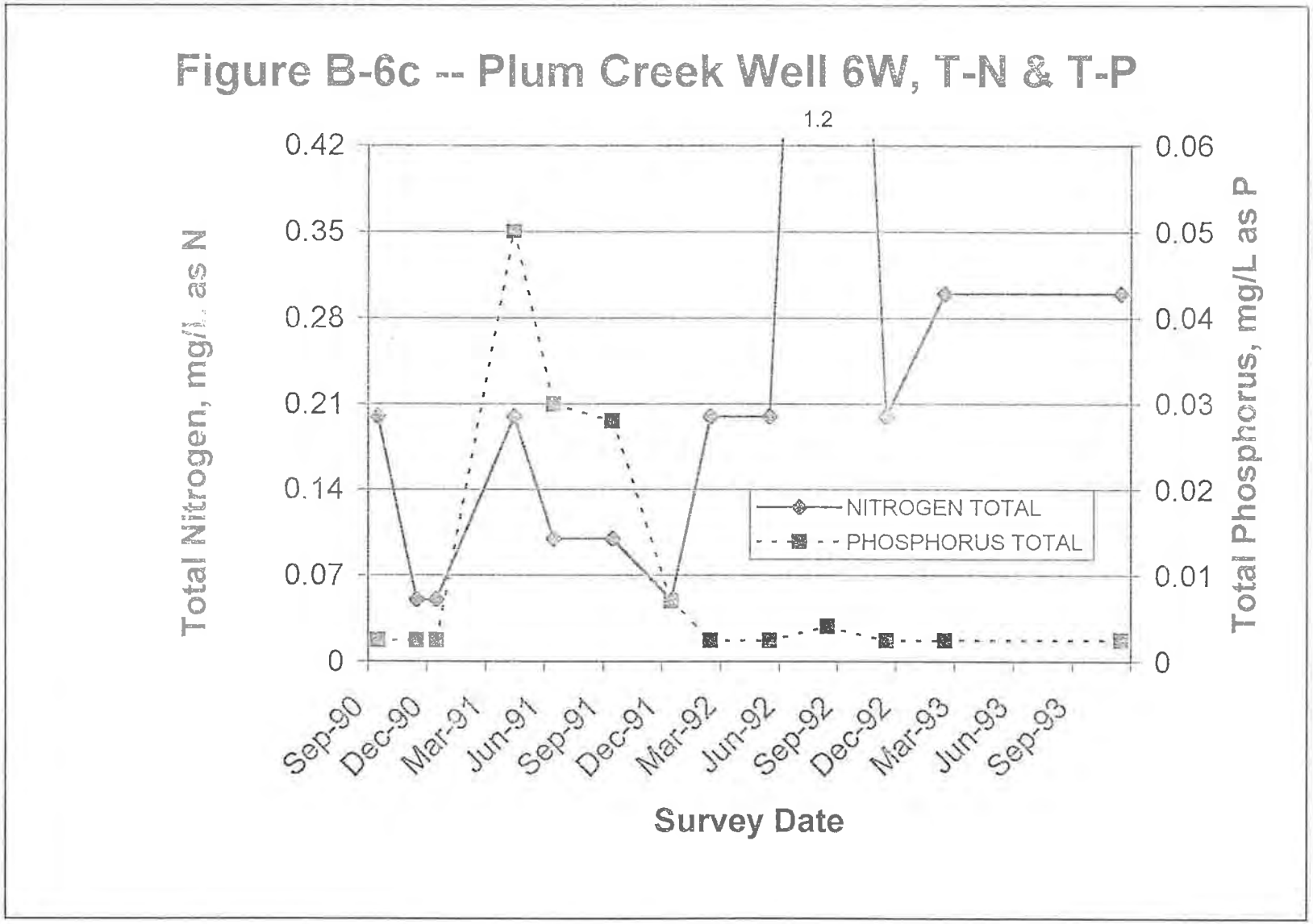


Figure B-6c -- Plum Creek Well 6W, T-N & T-P
1.2
0.42
0.35
0.28
0.21
0.14
0.07
0
0.06
0.05
0.04
0.03
0.02
0.01
0
Total Nitrogen, mg/L as N
Total Phosphorus, mg/L as P
NITROGEN TOTAL
PHOSPHORUS TOTAL
Sep-90
Dec-90
Mar-91
Jun-91
Sep-91
Dec-91
Mar-92
Jun-92
Sep-92
Dec-92
Mar-93
Jun-93
Sep-93
Survey Date