Kennecott Greens Creek Mining Co.
P.O. Box 32199
Juneau, AK 99803
Phone (907) 790-8460
Fax (907) 790-8478

16 June 2003

Jeff DeFreest
Tongass Minerals Team
Juneau Ranger District
U.S. Forest Service
8465 Old Dairy Road
Juneau, AK 99801

RE: Sixth FWMP Annual Report –Water Year 2002

Dear Jeff:

Attached please find two copies of the Kennecott Greens Creek Mining Company (KGCMC) annual report for the Freshwater Monitoring Program (FWMP). This report has been prepared to satisfy the reporting requirements in the FWMP document. The report presents data for the "Water Year 2002": 1 October 2001 through 30 September 2002. The first section of this report presents information germane to the overall sampling and reporting efforts for Water Year 2002 (Introduction, Interventions, Mid-Year Modifications, Personnel Involved, Proposed Program Modifications, and comprehensive sampling and analyses information). The subsequent sections present data specific to each of the individual sampling sites. The final section, Appendix A, contains the Alaska Department of Fish and Game prepared bio-monitoring report for 2002, Technical Report No. 03-04: April 2003.

This year's FWMP report is the first under the revised FWMP site comparison protocol. Comparisons between sites now employees a non-parametric statistical methodology, replacing the previous visual comparisons of notched-box-plots. Both methods utilize data medians for their comparisons. This change in method did not result in any differing data interpretations. However, it's finer perspective provides a higher definition detail for between-sites comparisons of some elements.

Should you, or your staff, have any questions in reviewing this document, please feel free to contact me here at the mine.

Sincerely,

William F. Oelklaus
Environmental Manager

Attachments
cc. ADEC – Solid Waste

KENNECOTT GREENS CREEK MINING COMPANY

FRESH WATER MONITORING PROGRAM
ANNUAL REPORT

WATER YEAR 2002

(October 1, 2001 through September 30, 2002)

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INTRODUCTION

This annual report for water year 2002 (October 1, 2001 through September 30, 2002) provides the information required by the Fresh Water Monitoring Program (FWMP) for Kennecott Greens Creek Mining Company (KGCMC). It is separated into several sections, the first of which provides general information applicable to the entire program, followed by a comprehensive analysis of the data for each specific site.

To avoid confusion data values reported by the laboratory as being below the Method Detection Limit (MDL) are assigned a value of zero for plotting purposes. This is done so that the values below MDL are visually distinct and thus can be properly interpreted. On several of the graphs presented, changes have occurred in MDL over the period shown. This may lead to the visual impression that an upward trend exists when in fact the older analysis had MDL greater than ambient background levels.
For the current water year's data the actual MDLs for non-detect values are listed in each sites table of results in the interpretative discussion of this report. For prior water year's historic MDLs please refer to GPO Appendix 1, Table 8-2.

The monitoring schedule varies for site to site and was modified under the most recent revision of GPO Appendix 1 that was implemented at the start of the water year 2002. Different sites are monitored for different analytes on different months of the year. At times throughout the year sites scheduled for sampling may not be available due to weather or more rarely operational reasons. Copies of the water year 2002 sampling log are included on page 7 of this section and any variations from scheduled sampling events are noted on each site's table of results presented in the interpretive section.

For all down gradient sites that are paired with an upgradient reference site which are monitored with a frequency greater than 4 times per year, a comparison of medians is presented for each specific site. These down gradient sites (upgradient site in parenthesis) include Site 6 (Site 48), Site 54 (Site 6), Site 46 (Site 49), and Site 58 (Site 57). For each of these sites, the statistical information goals requested a comparison of medians for total alkalinity, pH, conductivity, sulfate and dissolved zinc. Due to limited sulfate data collected, as discussed in the Interventions section, no statistical analysis for sulfate is presented for the current year's data set.

A non-parametric rank-sum test was selected as the method of median comparison. Wilcoxon originally developed the test method in 1945. Mann and Whitney developed an equivalent test at approximately the same time and thus the name Wilcoxon-Mann-Whitney rank-sum test is used. In general terms the rank-sum test is a test for whether one group of data tends to produce larger observations than a second group. The rank-sum test makes no assumptions about the nature of the data distribution and thus is considered more robust when applied to non-normally distributed data sets. The robust nature of the test is critical when applied to the varied distributions typically found in water quality data that commonly include positive skewness, non-normal distributions, censored data due to finite instrument detection limits, seasonality, autocorrelation, and dependence on other uncontrolled variables such as flow rate. All of the aforementioned attributes have been observed in various water-quality data collected under the FWMP.

The rank-sum tests as applied in this report determine if two groups of data come from the same population as measured by the median value. If both groups of data are from the same population, about half of the time an observation from either group could be expected to be greater than a data point from the second data set. In mathematical terms the null hypothesis for the test is:

$$H_0: \quad \text{Prob } [x>y]=0.5$$

and the alternative 2-sided test (x may be larger or smaller than y) is:

$$H_1: \quad \text{Prob } [x>y]\neq 0.5$$

Where x is the data from one group and y are from the second group. The formula states that the probability of an x value being higher than any given y value is one-half.

The computation of the rank-sum test statistic $W_{\Sigma R}$ is straightforward. The combined data are sorted from lowest to highest and assigned rank values from 1 (lowest) to N (highest) where $N=n+m$ and n and m are the number of observation in data sets x and y respectively. For tied ranks the average of the consecutive ranks is applied to each of the values. For large data sets with sample sizes greater than 10 ($n,m>10$) a large-sample approximation may be used and precise probabilities assigned. For smaller data sets an exact test is performed and the calculated $W_{\Sigma R}$ from the data set with the least observations is compared to tabulated values of $W_{\Sigma R}$ for the appropriate α-level (probability of a Type I error), n, and m are consulted.

For larger data sets the rank-sum test statistic can be closely approximated by the normal distribution. It should be noted that the normality of the distribution for the test statistic $W_{\Sigma R}$ does not require that the data from which the ranks are derived is also normally distributed. This is because as the sample size increases there are an increasing number of possible arrangements of data ranks. For example, for $n=m=10$ there are 184,756 possible arrangements. The large-sample approximation compares the computed $W_{\Sigma R}$ to the calculated population parameters μ_w and σ_w that are computed based on the data set sizes from the following formulas:

$$\mathbf{m_w=n*(N+1)/2}$$

$$\mathbf{s_w=[n*m(N+1)/12]^{1/2}}$$

The test statistic $W_{\Sigma R}$ is then standardized based on these population parameters to a value $Z_{\Sigma R}$ based on one of the following formula:

$$
Z_{\Sigma R} = \begin{cases} (W_{\Sigma R}-1/2-\mu_w)/\sigma_w & \text{if } W_{\Sigma R} > \mu_w \\ 0 & \text{if } W_{\Sigma R} = \mu_w \\ (W_{\Sigma R}+1/2-\mu_w)/\sigma_w & \text{if } W_{\Sigma R} < \mu_w \end{cases}
$$

The value of $Z_{\Sigma R}$ is compared to a table of the standard normal distribution to derive the *p*-test value. For a two-tailed test if $\alpha/2<p\text{-test}<\alpha^*/2$ then accept H_0. Summary results presented in the interpretative section for Site 6 and Site 54 list *p*-test values from the large-sample approximation test. The exact test was applied to data from Site 46 and Site 56 and the upper and lower bounds for $\alpha/2=0.025,n,m$ are listed. Further guidance and background can be found in section 3.3.3.1 of the EPA document "Guidance for Data Quality Assessment" EPA/600/R-96/084.

KGCMC utilizes a custom-built Microsoft Access database (WDMS) for the storage, retrieval, and utilization of all data collected under the FWMP, as well as many other environmental monitoring programs being conducted at KGCMC. This database incorporates many different report-generating functions, and several of them have been utilized for the preparation of this report. These individual summary reports have a variety of uses, and the terms used within them are generic. The following explanations clarify the terms used and the information contained in the summary reports utilized for the site-specific data analysis.

Qualified Data by QA Reviewer reports are generated to provide a summary for each site section of data limitations found in the monthly QA reviews. They list all data for that site that was qualified by the QA Reviewer for water year 2002 along with the reason for qualification. These data are all included in the data analyses, unless also identified as an outlier in the WDMS Qualified Data Summary.

Comparison To Standards reports have been generated for each site to list all data for water year 2002 that were greater than the strictest Alaska Water Quality Standard (AWQS). A general list of the AWQS used is in the General Plan of Operations Appendix 1, Revision 5, October 6, 2000, page 3-3. For hardness dependant standards the hardness dependant equation coefficients were taken for 40 CFR Chap. 1 (7-1-00) 131.36. WDMS lists these criteria in the column entitled "Standard" in this summary. The column entitled "Standard Type" is a category assigned directly by WDMS for KGCMC, and has no particular significance for the purposes of this annual report.

INTERVENTIONS

This section addresses any procedural changes, natural phenomena, mine operational changes, or other interventions that could possibly have affected data during water year 2002 are identified below. Results of any visual data analyses to detect evident effects of these interventions are so indicated.

Prior interventions (and negotiated mid-year program modifications such as changes to laboratories, methods, detection limits, and reporting limits), and anything else which may affect data comparability and quality which occurred during previous water years, are documented in the "General History" section of the FWMP and in previous annual reports.

Freezing conditions prohibited sample collected during this water year in the following months at these scheduled sites; December 2001, Site 49; January 2002, Sites 49 and 54.

No flow conditions prohibited sample collection during this water year in the following months at these scheduled sites: December 2001, Site 46; January 2002, Site 46; February 2002, Site 46; March 2002, Site 46; April 2002, Site 46.

No samples were taken at Site 13 during October 2001, November 2001, and April 2002 because of limited site access due to snow cover on the 1350 Road. No sample was collected from Site 56 for the month of September 2002 due to the sample tube falling into the casing and obstructing the hole.

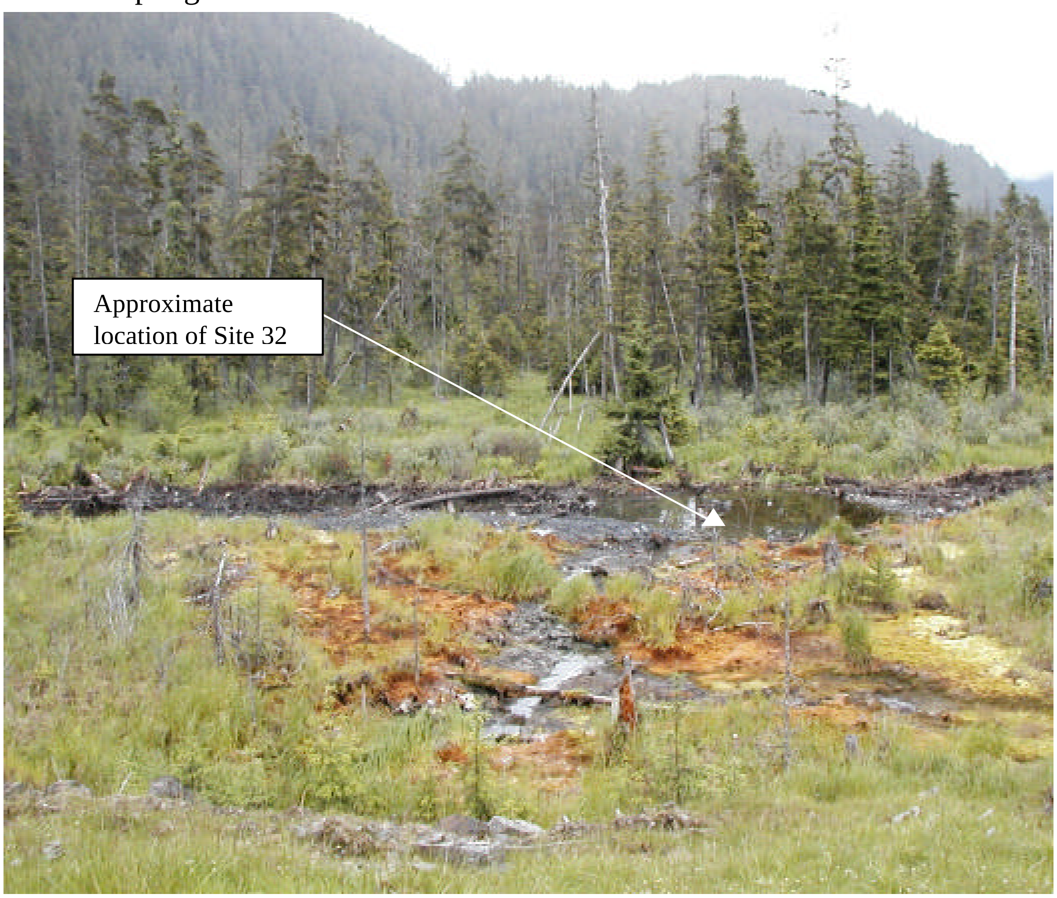
The 2000 FWMP revision changed the suite of analytes to be monitored and added sulfate into the list of analytes. Through an oversight by KGCMC the addition of sulfate into the suite list was not implemented during the 2002 water year. This oversight was identified in February 2003 and immediate remedial action was taken. The samples taken during September 2002 where still available at Battelle Marine Sciences Laboratory that has been the laboratory utilized for sample analyses since October 1996. The samples were sent to Analytica Alaska for sulfate analyses since Battelle does not have the instrumentation necessary. The sulfate concentrations where determined on March 12, 2003 and reported to KGCMC. Sulfate has a twenty-eight day holding time and thus all the data is qualified for expired holding periods. Given the limited amount of data collected during the 2002 water year and the qualified status KGCMC did not include the sulfate values in the normal interpretative analysis except to note any AWQS exceedances. The analysis preformed on the September 2002 samples are reported in the adjacent table. KGCMC has initiated procedures

Site	Sample Date	Analysis Date	Sulfate (mg/L)
48	9/19/02	2/3/03	7.54
06	9/19/02	2/3/03	9.18
54	9/19/02	2/3/03	9.18
49	9/19/02	2/3/03	7.86
46	9/19/02	2/3/03	7.98
57	9/19/02	2/3/03	54.5
58	9/17/02	2/3/03	1.32
27	9/17/02	2/3/03	0.808
29	9/17/02	2/3/03	<0.100
32	9/17/02	2/3/03	0.164
59	9/17/02	2/3/03	3.97
28	9/17/02	2/3/03	10.0
34	9/17/02	2/3/03	360
13	9/19/02	2/3/03	347

starting in February 2003 to incorporated sulfate into the suite P and Q analyses on a permanent basis. In future annual reports the sulfate analyses will be incorporated into each site's interpretive section on a standard basis.

MID-YEAR MODIFICATIONS

The immediate area surrounding Site 32, the Seepage Control Structure site, was modified in June 2002. The access road below the Main Embankment was removed according to the action plan prepared and submitted to the USFS by KGCMC in January 2002. The road material contained pyritic rock, which was likely contributing to the elevated sulfate readings observed in the Seepage Control Pond. The majority of the pyritic material was removed into the Tailings containment area. With the removal of the road material the majority of the water previously retained in the pond now flows as a diffuse surface flow through the natural muskeg that surrounds, or is downgradient from the previous site location. The sampling scheduled for September 2002 was taken at the approximately the same location as the old sample site. It is anticipated that the site will recover and again become like the surrounding muskeg with broad diffuse flow occuring in the sub-surface and through numerous shallow, localized channels. KGCMC plans to discontinue sampling at this site after review with the USFS.



Photograph taken by USFS on July 5, 2002 showing area around Site 34 immediately after removal of access road material.

No other mid-year modifications occurred during water year 2002.

FWMP SAMPLE LOG

Water Year October 2001 Through September 2002
Annual Water Quality Monitoring Schedule-Laboratory Samples

Site	Site Name	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
6	Middle Greens Creek	10-25 P	11-15 P	12-5 Q	1-29 FB P	2-21 Q	3-19 P	4-1 P	5-28 P	6-11 P	7-15 P,R	8-27 P	9-18 P
9	Tributary Creek - Lower										7-15 R		
13	Mine Adit Discharge East	10-25 Q	11-15 Q					4-1 No Access	5-28 Q	6-11 Q	7-15 Q	8-27 FB Q	9-18 Q
27	Monitoring Well 2S								5-7 FB Q				9-17 Q
28	Monitoring Well 2D								5-7 Q				9-17 Q
29	Monitoring Well 3S								5-7 Q				9-17 Q
32	Monitoring Well 5S								5-7 Q				9-17 Q
34	Seepage Control								5-7 Q				9-17 FB Q
46	Lower Bruin Creek	10-25 P	11-15 P	12-5 No Flow Q	1-29 No Flow P	2-21 No Flow Q	3-19 No Flow P	4-1 P	5-28 P	6-11 P	7-15 FB P	8-27 P	9-19 P
48	Upper Greens Creek	10-25 P	11-15 P	12-5 Q	1-29 P	2-21 FB Q	3-19 FB P	4-1 P	5-28 P	6-11 P	7-15 P,R	8-27 P	9-18 P
49	Control Site Upper B.C.	10-25 P	11-15 P	12-5 Frozen Q	1-29 Frozen P	2-21 Q	3-19 P	4-1 FB P	5-28 P	6-11 FB P	7-15 P	8-27 P	9-19 P
54	Greens Cr.below D-pond	10-25 P	11-15 P	12-5 FB Q	1-29 Frozen P	2-21 Q	3-19 P	4-1 P	5-28 P	6-11 P	7-15 P,R	8-27 P	9-19 P
56	Monitoring Well-D-00-1	10-25 F.B. Q	11-15 Q					4-1 Q	5-28 Q	6-11 Q	7-15 Q	8-27 Q	9-19 N/A Q
57	Monitoring Well-23-00-3	10-25 Q	11-15 FB Q					4-1 Q	5-28 Q	6-11 Q	7-15 Q	8-27 Q	9-19 Q
58	Monitoring Well-T-00-1C								5-7 Q				9-17 Q
59	Monitoring Well-T-00-1A								5-7 Q				9-17 Q

SAMPLE SUITES

Suite P
(Surface water only)

Conductivity
pH
Temperature
Hardness
Sulfate
Total Alkalinity
Dissolved Arsenic
Dissolved Cadmium
Dissolved Copper
Dissolved Lead
Dissolved Mercury
Dissolved Zinc

Suite Q
(Groundwater and surface water twice a year)

Conductivity
pH
Temperature
Hardness
Sulfate
Total Alkalinity
Dissolved Arsenic
Dissolved Barium
Dissolved Cadmium
Dissolved Chromium
Dissolved Copper
Dissolved Lead
Dissolved Mercury
Dissolved Nickel
Dissolved Selenium
Dissolved Silver
Dissolved Zinc

PERSONNEL INVOLVED

USFS

Pete Griffen, Monument Manager
USFS
Eric Ouderkirk, Project Manager
USFS
Steve Heppner, Minerals Specialist
USFS
Steve Hohensee
USFS
Steve Paustian
USFS
David Cox
USFS
Pete Schneider
USFS

ADF&G

Phyllis Weber Scannell
ADF&G
David Gregovich
ADF&G Region I
Laura Jacobs
ADF&G
Bill Morris
ADF&G
Jason Harris
ADF&G
Bruce McIntosh
ADF&G
Larry Duffy
University of Alaska
Dan Scannell
University of Alaska

KGCMC

Keith Marshall, General Manager
KGCMC
Bill Oelklaus, Environmental Manager
KGCMC
Kerry Lear, Geologist
KGCMC
Steve Hutson, Environmental Technician
KGCMC
Ted Morales, Environmental Technician
KGCMC
Pete Condon, Geochemist
KGCMC
Tom Zimmer, Environmental Coordinator
KGCMC

Suzan Huges, Project Coordinator
Environmental Synectics, Inc.
Evin McKinney , Senior Scientist
Environmental Synectics, Inc.
Leticia Sangalang, Senior Scientist
Environmental Synectics, Inc.
Linda Bingler, Project Coordinator
Battelle Marine Sciences Laboratory
John Woodward, Consultant
EnviroData Solutions, Inc.
David Wetzel, Project Manager
Analytica Alaska

USF&WS

Deborah Rudis
USFWS

PROPOSED PROGRAM MODIFICATIONS

Discontinue sampling at Site 32 due to the changes discussed in the Mid-Year Modifications section.

Remove Site 13 from the April sampling schedule due to the re-occurring inability to access the site due to snow. Sampling of this site has only been possible once (April 1998) during the month of April during the last 5 water years.

INTERPRETIVE REPORT
SITE 48 “UPPER GREENS CREEK”

All data collected at this site for the past five years are included in the data analyses with the exception of one outlier shown on the table below. During the current year one (1)

Sample Date	Parameter	Value	Qualifier	Notes
12/5/2001	Cond Field, umho	37.0	R	Suspected field instrument malfunction

data point was flagged as an outlier after review by KGCMC. As reported for all sampled sites in December-2001, the value for field specific conductance was flagged and appears to be the result of a malfunction of the field instrument that occurred during the sample run. The dissolved chromium value of 2.55 μg/l from the February-2002 sampling run was reviewed as a potential outlier. All prior analysis for dissolved chromium have returned values less than MDL and thus the value is considered a statistical outlier. Sites 6 and Site 49 also had dissolved chromium values that appeared anomalous and were approximately of the same magnitude. Site 54 was the other site sampled during the same run but returned a value of 0.341 μg/l, which falls within the range of prior measured levels. Internal laboratory quality control sampling that was part of the February-2002 event included a matrix spike of the Site 48 sample and a replicate measurement of the Site 48 sample. Both the matrix spike and duplicate dissolved chromium values appear to confirm the initial value of 2.55 μg/l. The absence of any obvious error by the laboratory and the non-uniform effect on the various sites sampled during the run, which would rule out the possibility of reagent and or sample bottle contamination, leads to retaining the value. Thus, the values for site 48 as well as for Site 6 and Site 49 will be not be flagged as outliers.

The data collected during the current water year are listed in the following “Table of Results for Water Year 2002” report. The table includes all the data, field and lab, collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of zero for the purpose of median calculation.

The data for water year 2002 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified, as listed on the following “Comparison To Standards” report.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious trends were apparent.

Table of Results for Water Year 2002

Site 48 "Control Site Upper Greens Creek"

Sample Date/Parameter	10/25/2001	11/15/2001	12/5/2001	1/29/2002	2/21/2002	3/19/2002	4/1/2002	5/28/2002	6/11/2002	7/15/2002	8/27/2002	9/19/2002	**Median**
Water Temp (°C)	1.8	3.5	1.0	4.6	0.7	0.4	0.0	3.8	4.9	8.0	9.6	6.8	3.7
Conductivity-Field (µmho)	115	104	37	124	153	154	160	53	82	93	96	88	100
Conductivity-Lab (µmho)	118 J	113 J	137	139	138	150	158	61	84	93	100	90	116
pH Lab (standard units)	7.43	7.57 J	7.43	7.35	7.47	7.86	7.22	6.89	7.30	7.90	7.76	7.93	7.45
pH Field (standard units)	7.77	7.90	7.53	7.41	7.90	7.12	7.71	7.30	7.69	7.46	7.79	7.75	7.70
Total Alkalinity (mg/l)	44.5 J	43.4 J	50.2	49.2	50.0	52.2	54.5	23.0	35.0	36.4	39.5	36.5	44.0
Hardness (mg/l)	56.6	54.6	63.1	66.4	35.9	59.0	53.9	29.0	34.1	36.5	47.4	42.6	50.7
Dissolved As (µg/l)	<0.446	<0.264	<0.643 UJ	0.197 J	0.197 J	0.168 J	0.203 J	0.279 J	<0.204 UJ	0.278	0.282 U	0.142 J	0.183
Dissolved Ba (µg/l)			29.5		29.4								29.5
Dissolved Cd (µg/l)	<0.049	0.042	0.034 J	0.042 J	0.030 J	0.033 J	0.025 J	0.049 UJ	<0.034	0.030	0.030	0.029	0.030
Dissolved Cr (µg/l)			<0.275		2.550								1.275
Dissolved Cu (µg/l)	0.354	0.625	0.265	0.642	0.406	0.411	0.269	0.753	0.240 U	0.419 J	0.523	0.521	0.415
Dissolved Pb (µg/l)	0.0685 UJ	0.1100	<0.0330	0.3140 J	<0.0260	<0.0300	<0.0300	0.0510 J	<0.0320 UJ	0.0139 J	0.0158 UJ	0.0810	0.0149
Dissolved Ni (µg/l)			1.64		1.47								1.56
Dissolved Ag (µg/l)			<0.0140		0.0025 J								0.0013
Dissolved Zn (µg/l)	3.11 U	4.05	3.38 J	10.10 J	2.14 UJ	3.61	2.53	3.32	1.69 J	2.21	2.03 U	4.37 J	3.22
Dissolved Se (µg/l)			1.120 J		0.652 J								0.886
Dissolved Hg (µg/l)	0.001300 UJ	0.001510 U	0.000615 UJ	0.000661 UJ	0.000766 UJ	0.000678 J	0.000766 U	0.001460 J	0.000655 U	0.000682 U	0.001180 U	0.001200	0.000766

See "Qualififed Data by QA Reviewer" table for qualifier descriptions.

Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
48	01/29/2002	11:30:00 AM				
			As Diss, ug/l	0.197	J	Below Quantitative Range, L
			Cd Diss, ug/l	0.042	J	Below Quantitative Range, L
			Pb Diss, ug/l	0.314	J	LCS Rec, LCS RPD
			Zn Diss, ug/l	10.1	J	LCS Rec, LCS RPD
			Hg Diss, ug/l	0.000661	UJ	Field Blk, LCS Rec, LCS RPD
48	10/25/2001	3:25:00 PM				
			Cond Lab, umho	118	J	Sample Temp.
			Alk Tot, mg/l	44.5	J	Sample Temp.
			Pb Diss, ug/l	0.0685	UJ	Below Quantitative Range, Fi
			Zn Diss, ug/l	3.11	U	Field Blk.
			Hg Diss, ug/l	0.0013	UJ	Field Blk, LCS RPD
48	11/15/2001	2:15:00 PM				
			Cond Lab, umho	113	J	Sample Temp.
			pH Lab, su	7.57	J	Hold Time
			Alk Tot, mg/l	43.4	J	Sample Temp.
			As Diss, ug/l	-0.264	U	
			Hg Diss, ug/l	0.00151	U	Field Blank Cont.
48	12/05/2001	2:16:00 PM				
			As Diss, ug/l	-0.643	UJ	LCS Rec.
			Cd Diss, ug/l	0.0343	J	Below Quantitative Range
			Zn Diss, ug/l	3.38	J	LCS Rec.
			Se Diss, ug/l	1.12	J	Below Quantitative Range, L
			Hg Diss, ug/l	0.000615	UJ	Field Blk, LCS Rec.
48	02/21/2002	12:19:00 PM				
			As Diss, ug/l	0.197	J	Below Quantitative Range, L
			Cd Diss, ug/l	0.02998	J	Below Quantitative Range, L
			Ag Diss, ug/l	0.0025	J	Below Quantitative Range
			Zn Diss, ug/l	2.14	UJ	Field Blk, LCS Rec.
			Se Diss, ug/l	0.652	J	Below Quantitative Range, L
			Hg Diss, ug/l	0.000766	UJ	Field Blk, LCS Rec, LCS RPD

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
48	03/19/2002	1:55:00 PM				
			As Diss, ug/l	0.168	J	Below Quantitative Range, L
			Cd Diss, ug/l	0.033	J	Below Quantitative Range
			Hg Diss, ug/l	0.000678	J	Below Quantitative Range, L
48	04/01/2002	12:31:00 PM				
			As Diss, ug/l	0.203	J	LCS Rec.
			Cd Diss, ug/l	0.0246	J	Below Quantitative Range
			Hg Diss, ug/l	0.000766	U	Field Blank Cont.
48	05/28/2002	1:45:00 PM				
			As Diss, ug/l	0.279	J	Below Quantitative Range
			Cd Diss, ug/l	0.0491	UJ	CCV Rec.
			Pb Diss, ug/l	0.051	J	Below Quantitative Range
			Hg Diss, ug/l	0.00146	J	CCV Rec, LCS Rec, LCS RP
48	06/11/2002	1:15:00 PM				
			As Diss, ug/l	-0.204	UJ	LCS Rec.
			Cu Diss, ug/l	0.24	U	Field Blank Cont.
			Pb Diss, ug/l	-0.032	UJ	LCS Rec.
			Zn Diss, ug/l	1.69	J	LCS Rec.
			Hg Diss, ug/l	0.000655	U	Field Blank Cont.
48	07/15/2002	1:30:00 PM				
			Cu Diss, ug/l	0.419	J	LCS Rec.
			Pb Diss, ug/l	0.0139	J	Below Quantitative Range
			Hg Diss, ug/l	0.000682	U	Field Blank Cont.
48	08/27/2002	1:39:00 PM				
			As Diss, ug/l	0.282	U	Field Blank Contamination
			Pb Diss, ug/l	0.0158	UJ	Below Quantitative Range, Fi
			Zn Diss, ug/l	2.03	U	Field Blank Contamination
			Hg Diss, ug/l	0.00118	U	Field Blank Contamination
48	09/19/2002	12:55:00 PM				
			As Diss, ug/l	0.142	J	Below Quantitative Range
			Zn Diss, ug/l	4.37	J	LCS Rec.

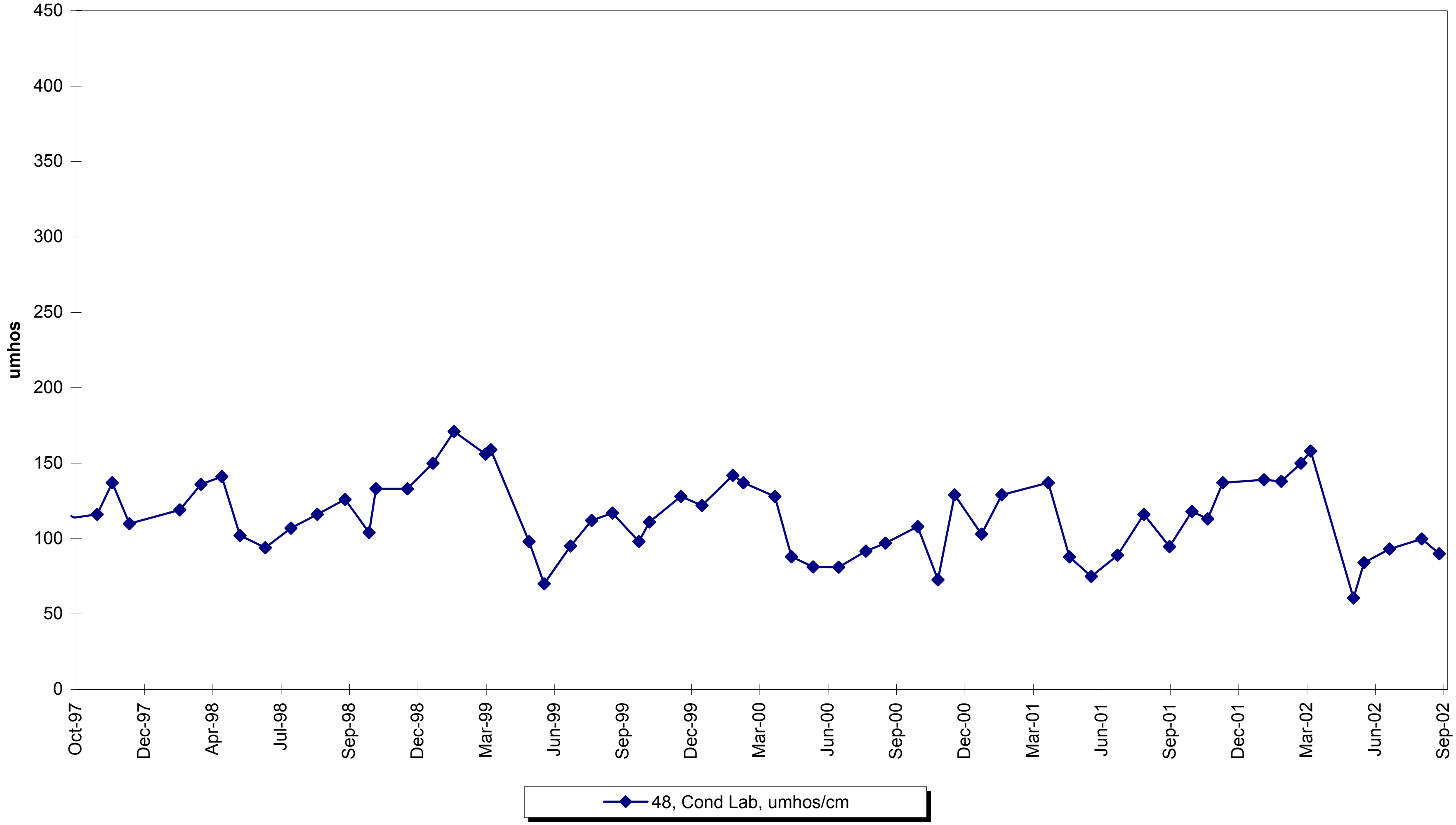
Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

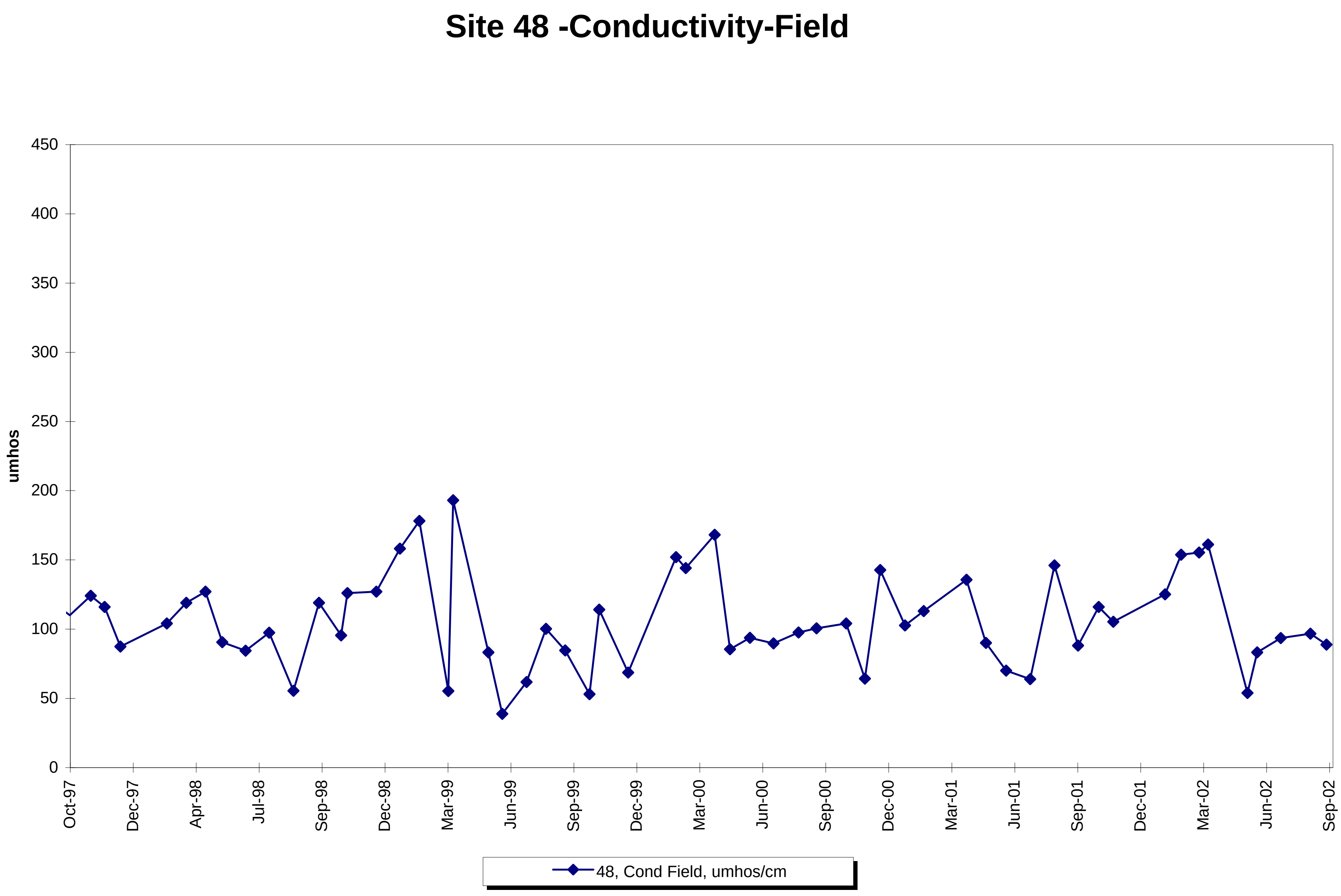
Comparison To Standards

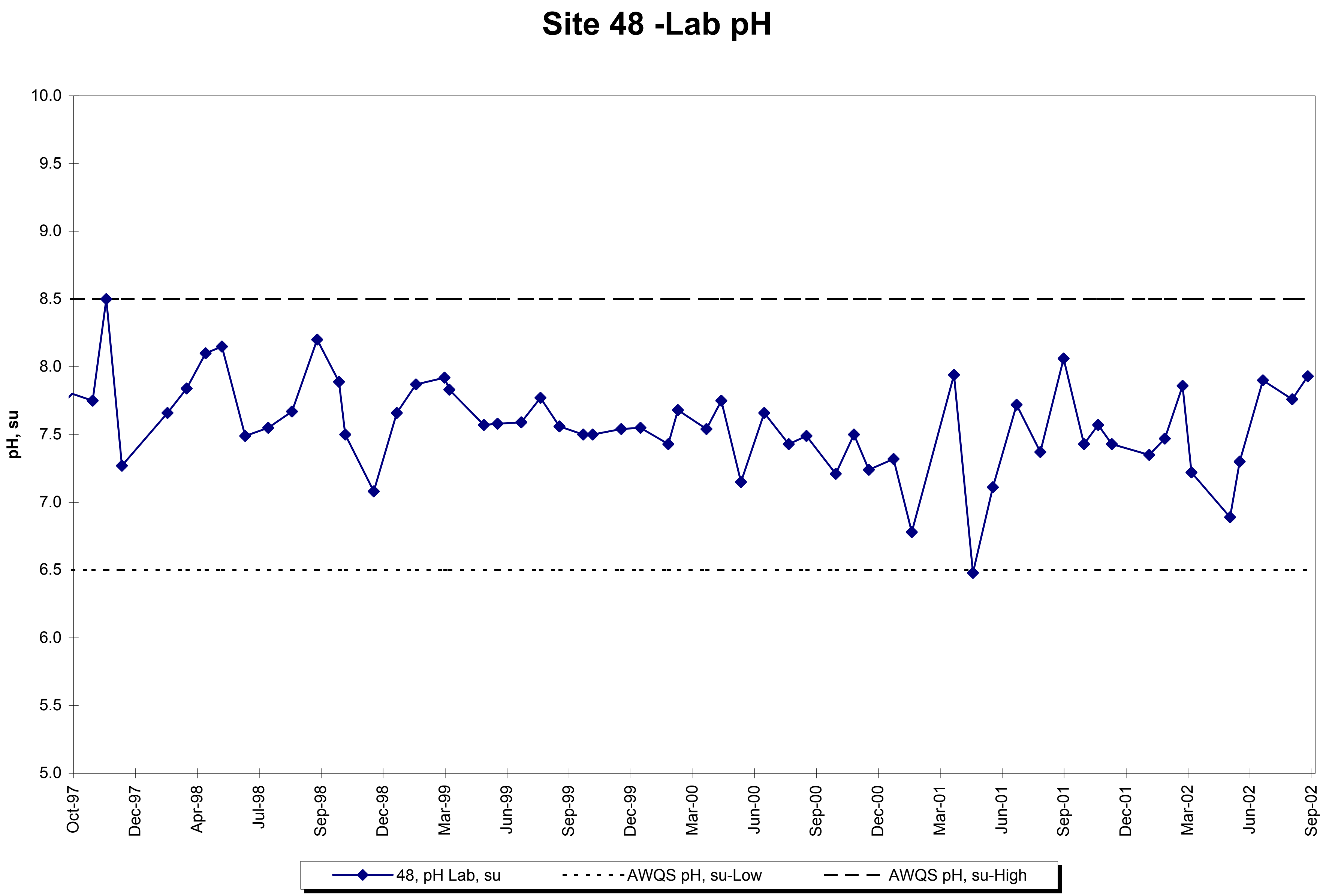
Date Range: 10/01/2001 to 09/30/2002

Site Number	Date	Time	Dup ID	Storet No.	Parameter Description	Value	Standard	Standard Type
							#Error	

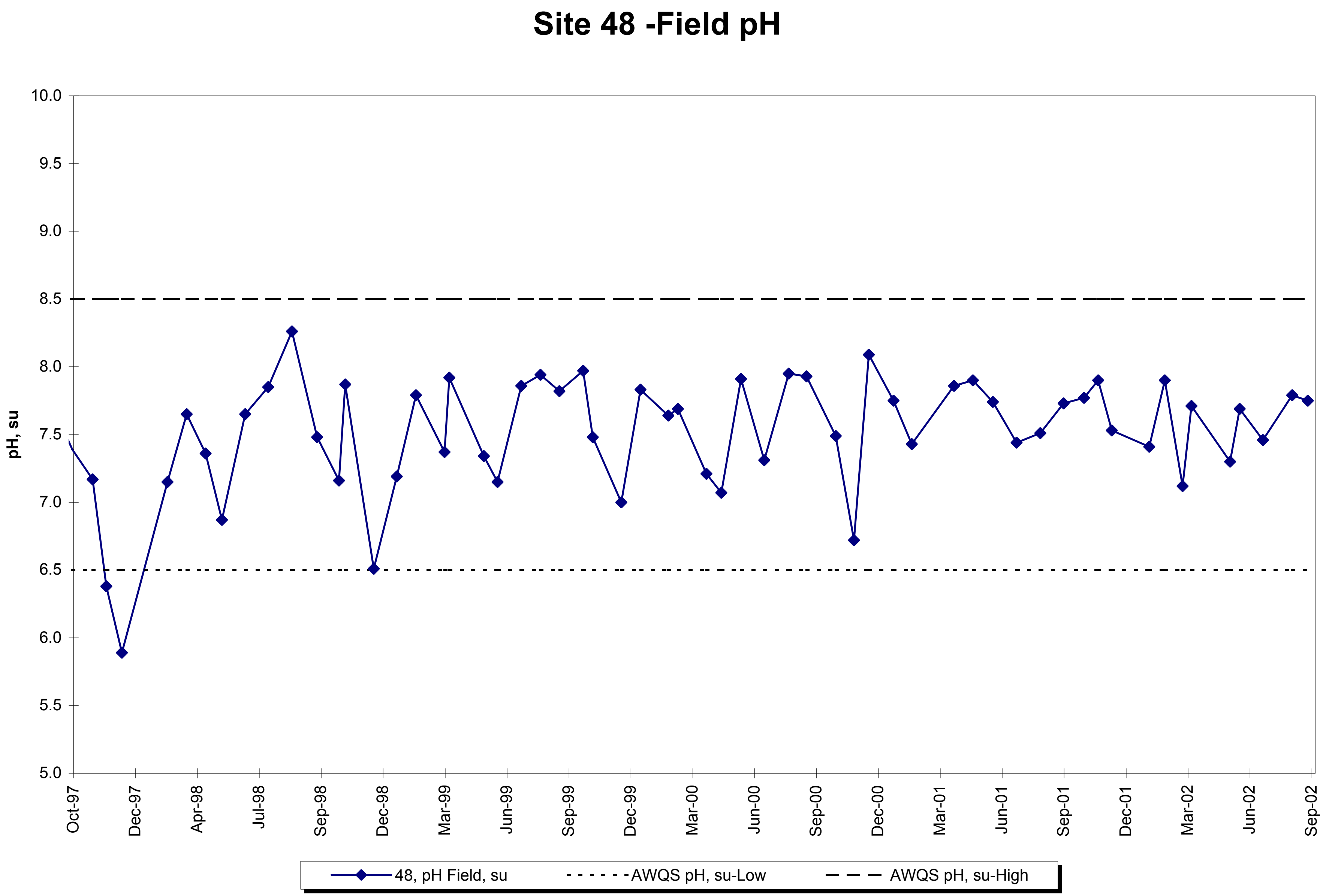
Site 48 -Conductivity-Lab



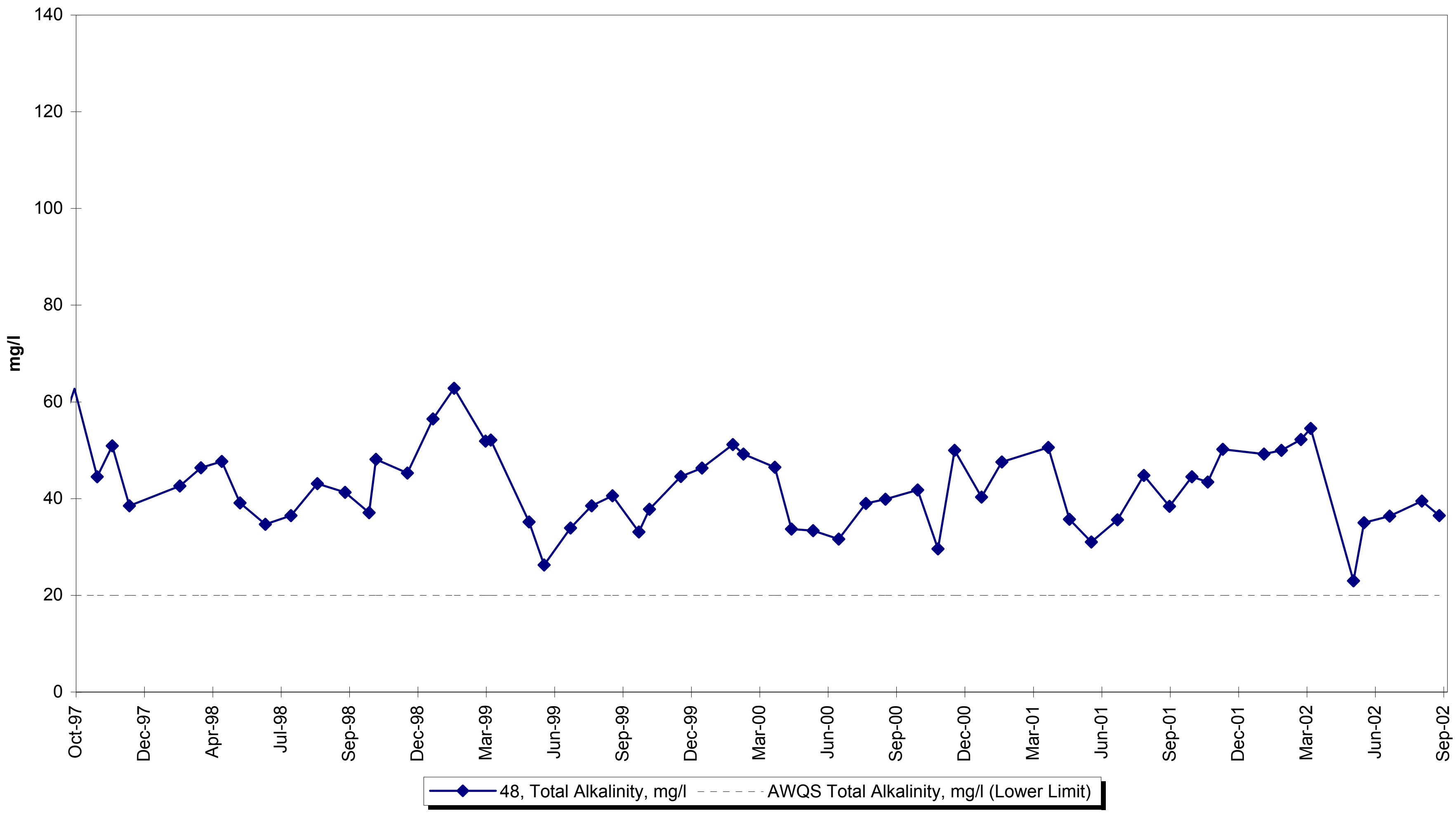

Site 48 -Conductivity-Field
umhos
0
50
100
150
200
250
300
350
400
450
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
48, Cond Field, umhos/cm



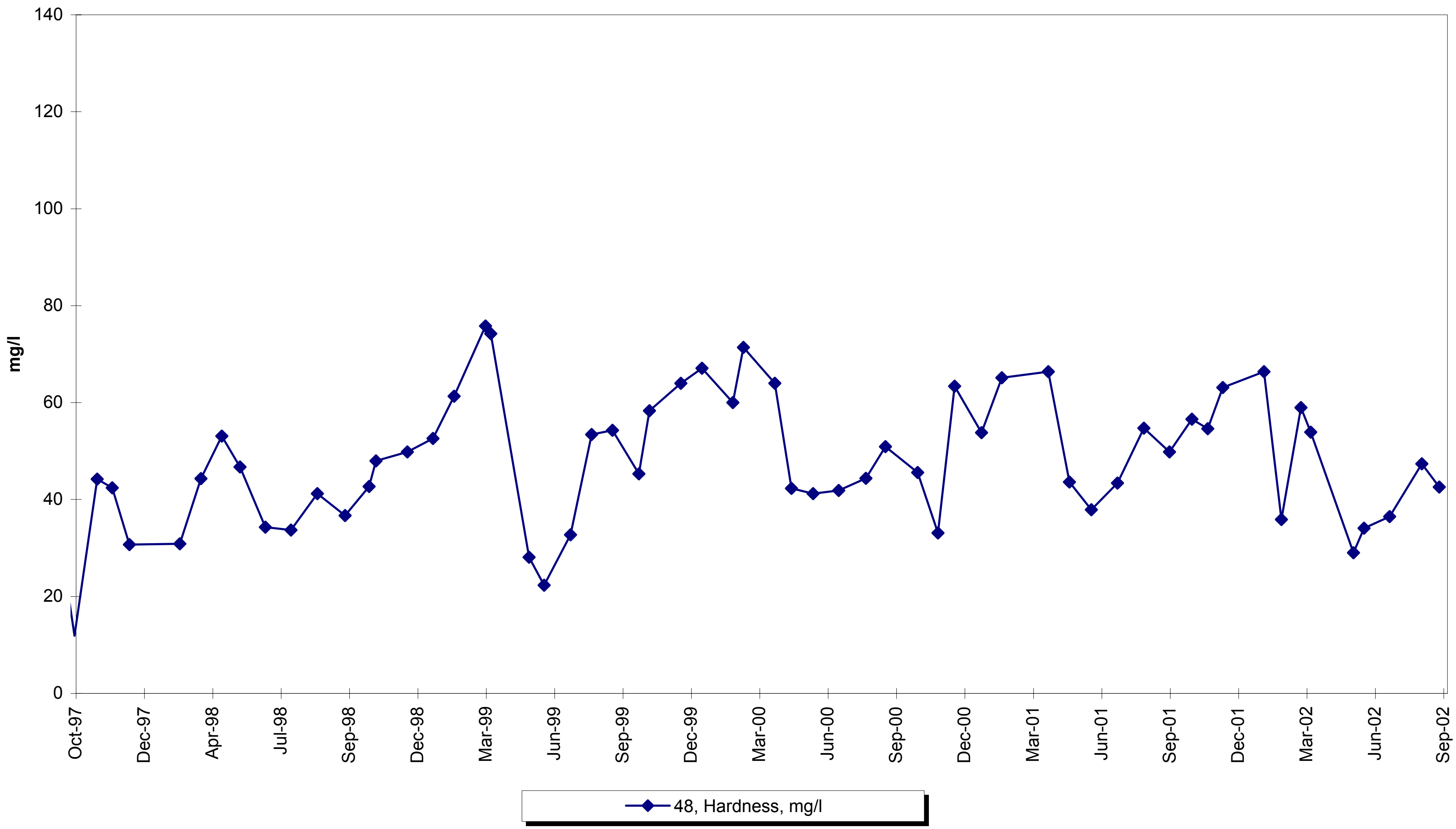
Site 48 -Lab pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
48, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High


Site 48 -Field pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
48, pH Field, su
AWQS pH, su-Low
AWQS pH, su-High

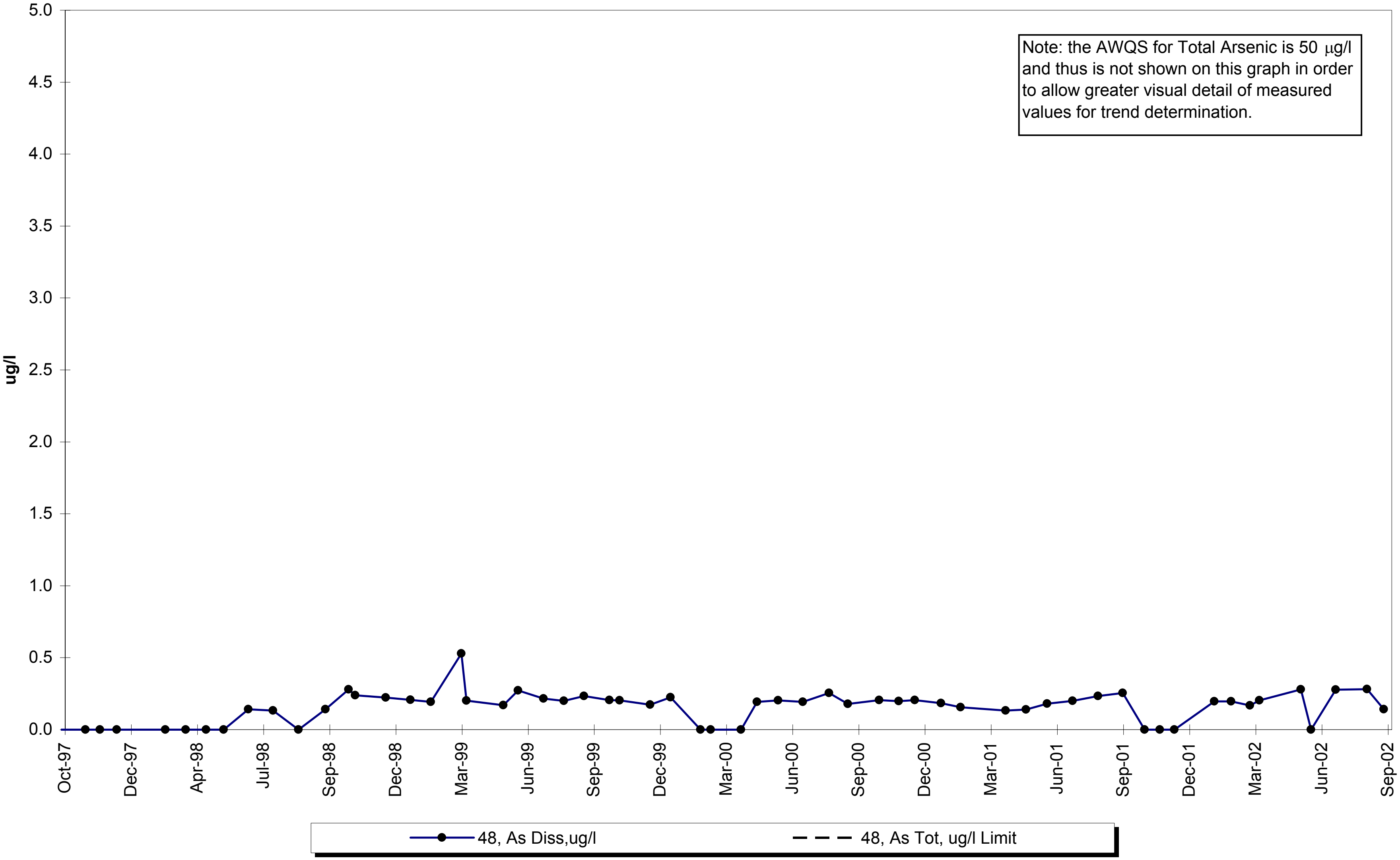
Site 48 -Total Alkalinity



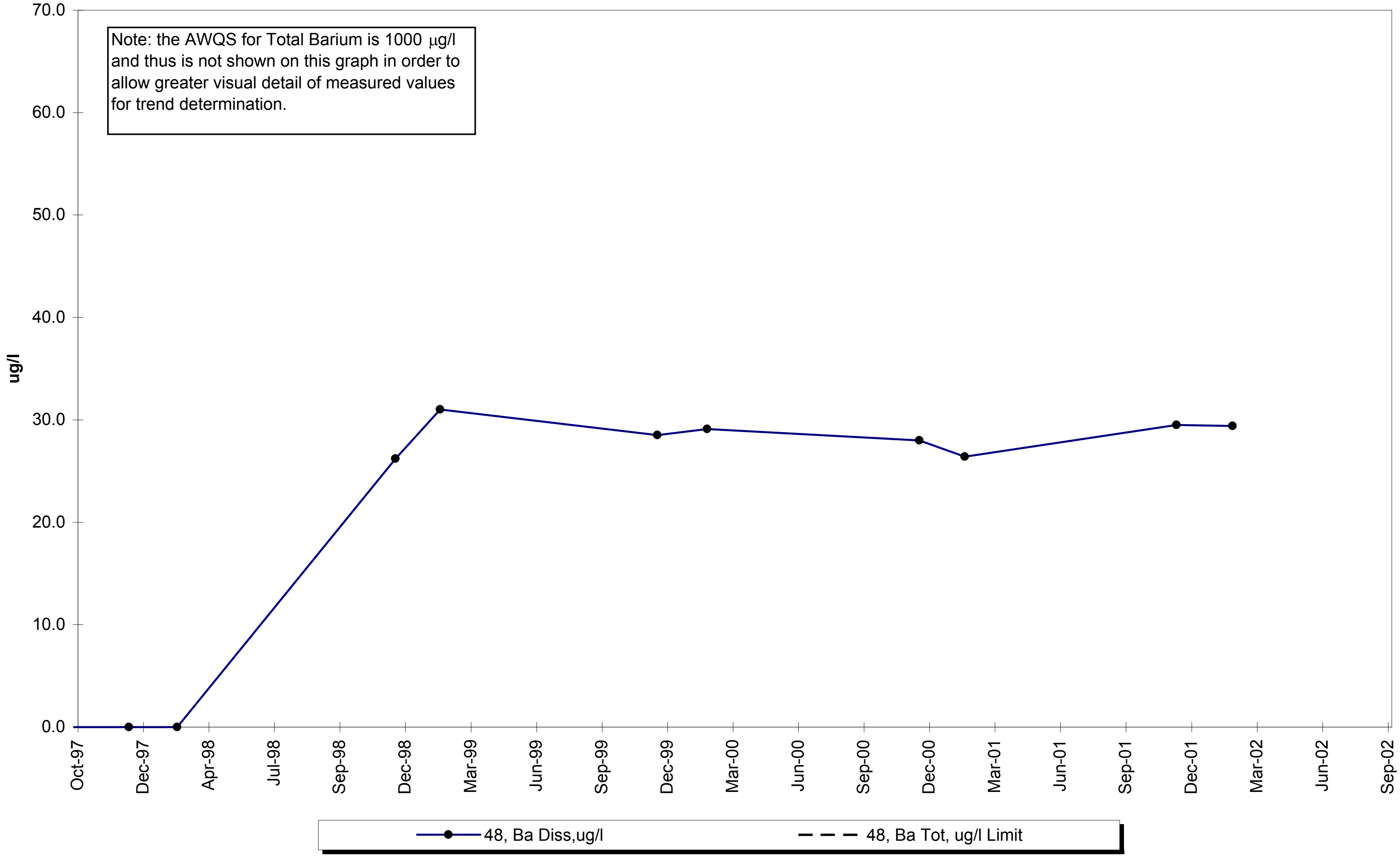
Site 48 -Hardness



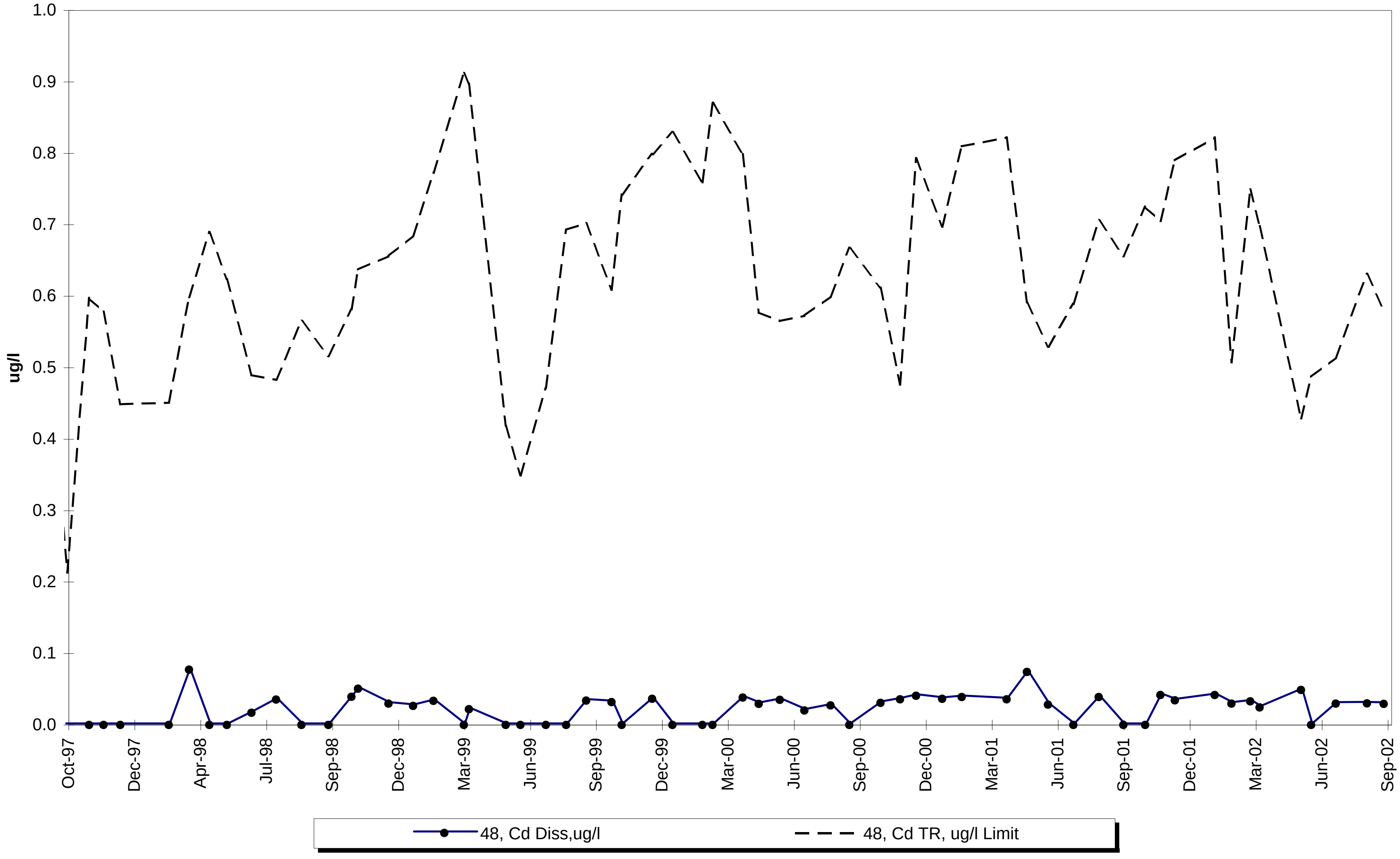
Site 48 -Dissolved Arsenic

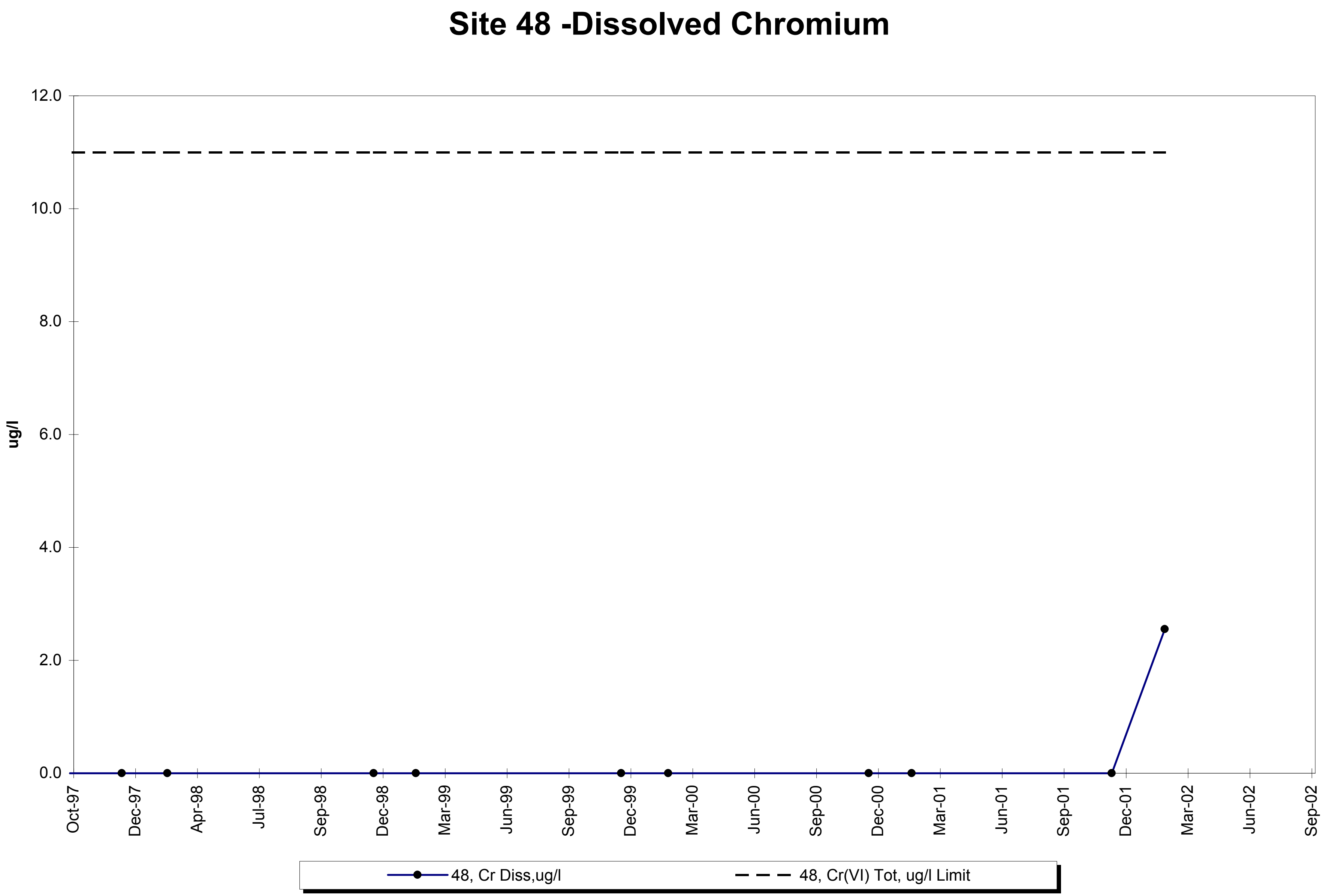


Site 48 -Dissolved Barium

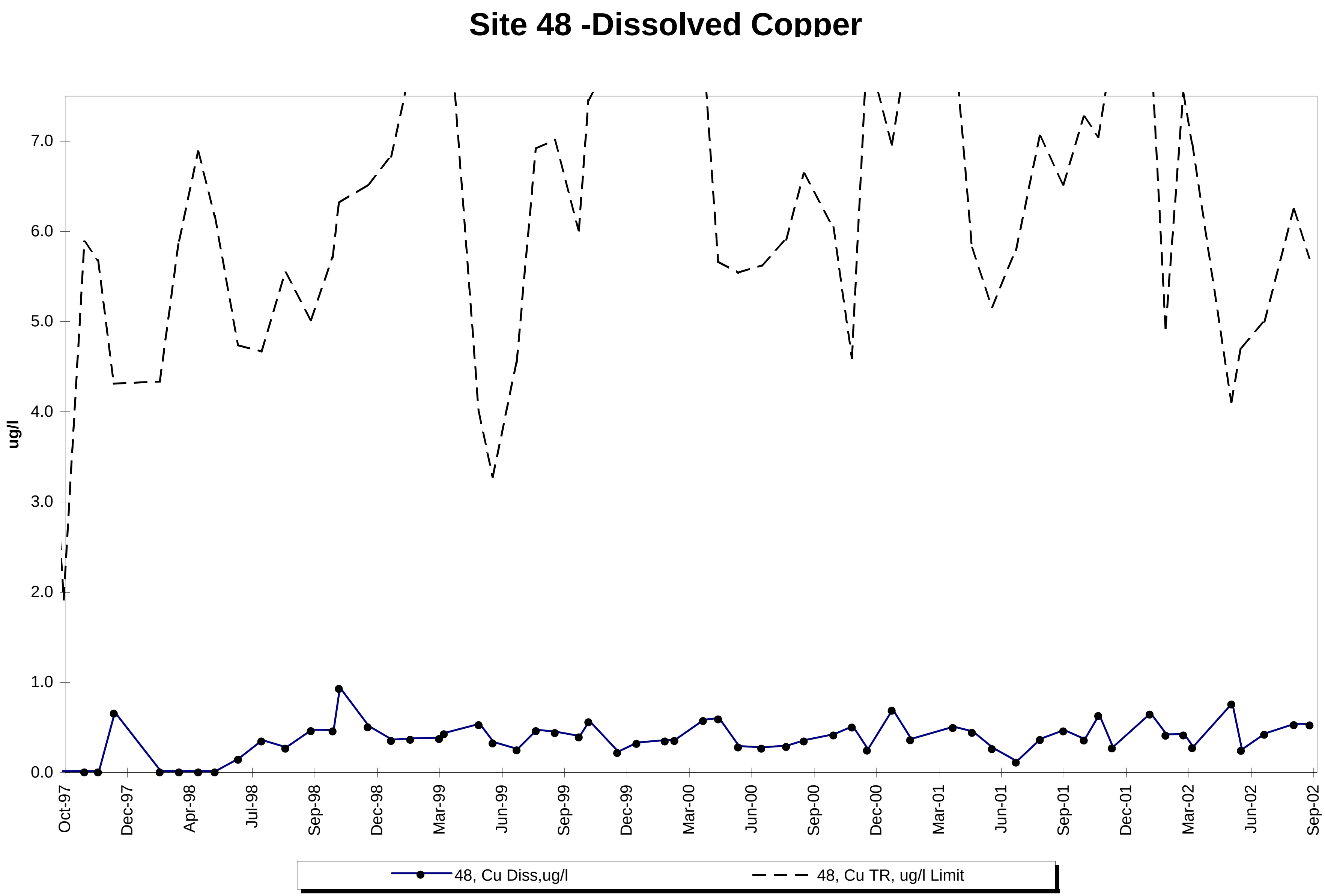


Site 48 -Dissolved Cadmium



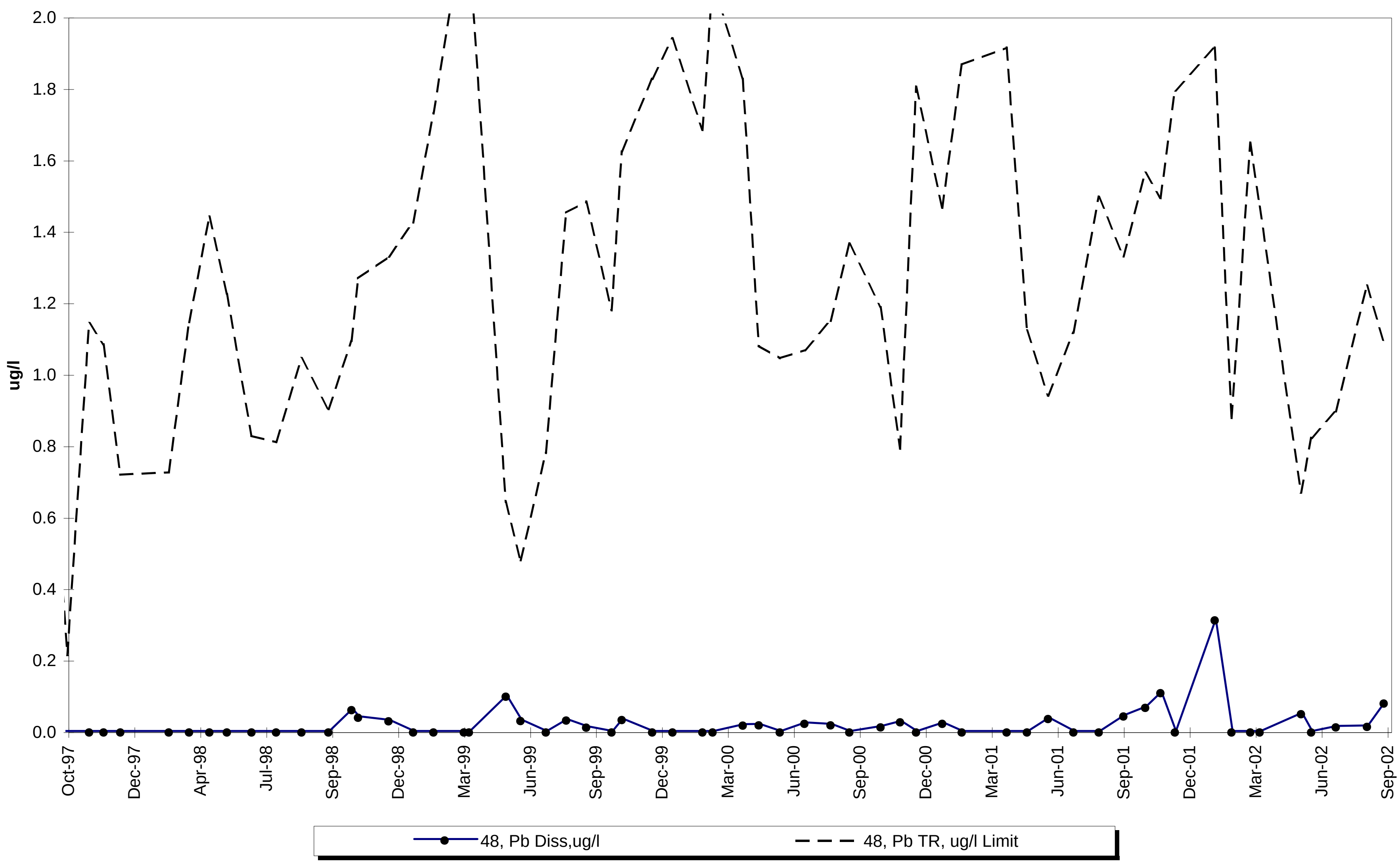


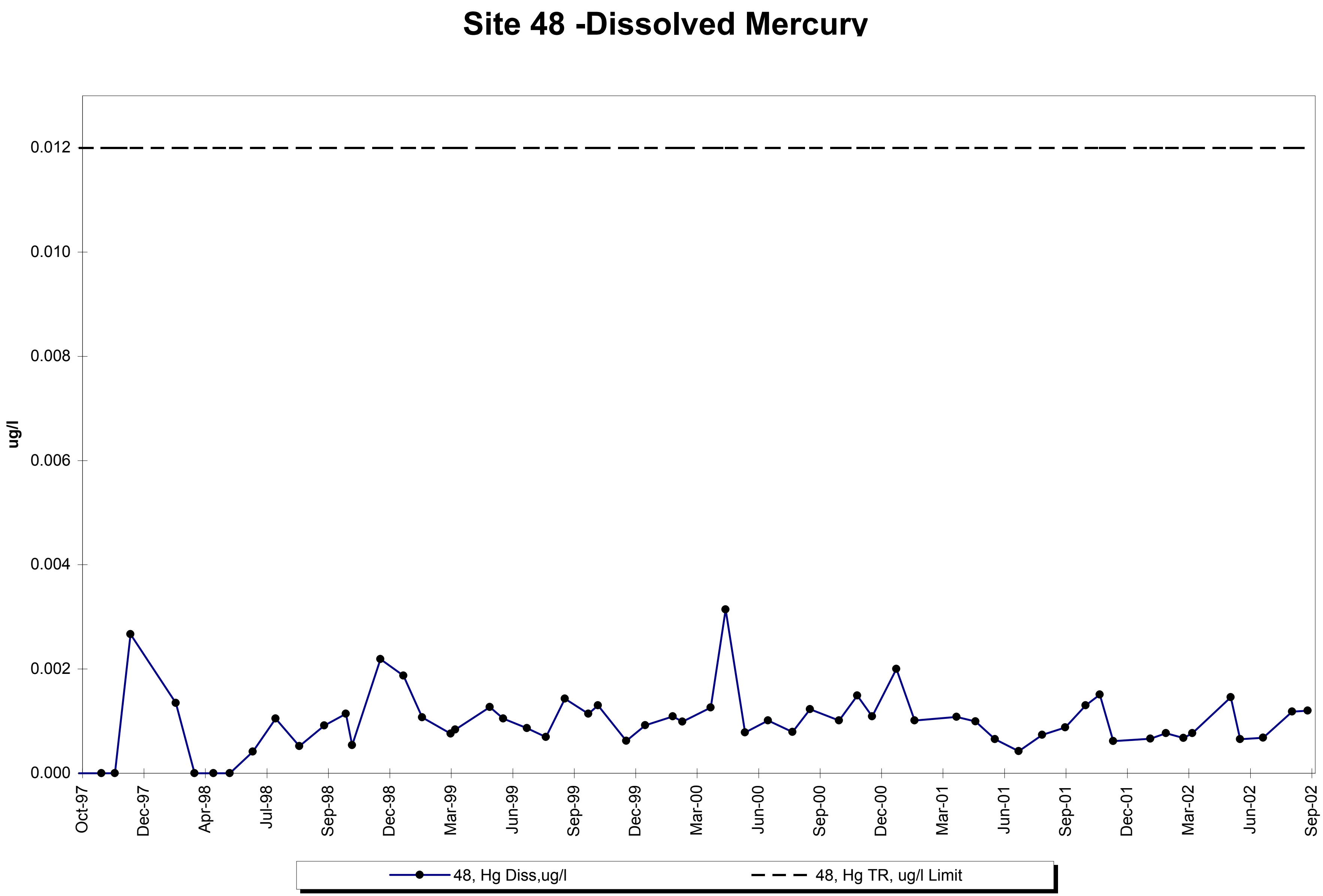
Site 48 -Dissolved Chromium
ug/l
0.0
2.0
4.0
6.0
8.0
10.0
12.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
48, Cr Diss,ug/l
48, Cr(VI) Tot, ug/l Limit



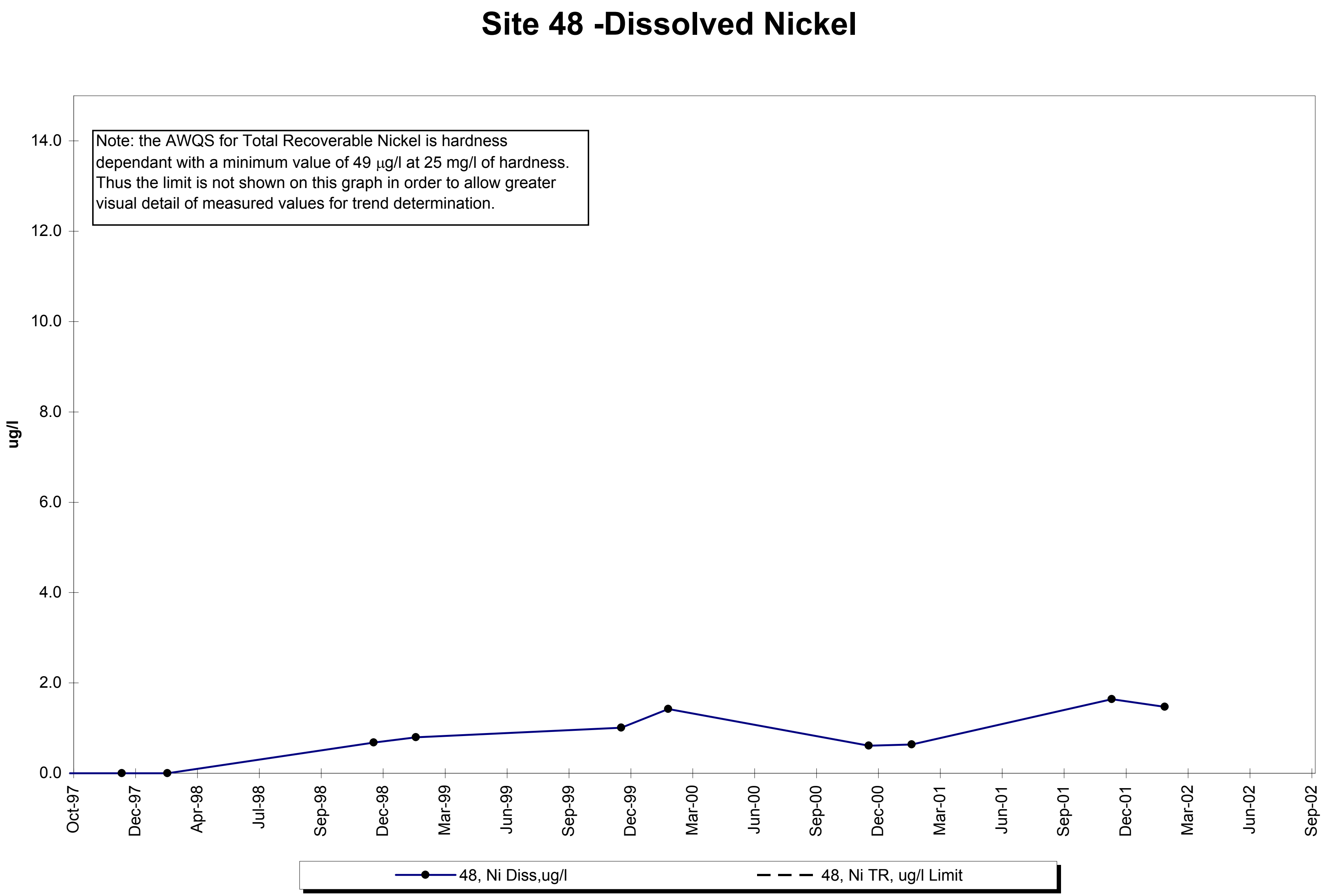
Site 48 -Dissolved Copper
ug/l
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
48, Cu Diss,ug/l
48, Cu TR, ug/l Limit

Site 48 -Dissolved Lead

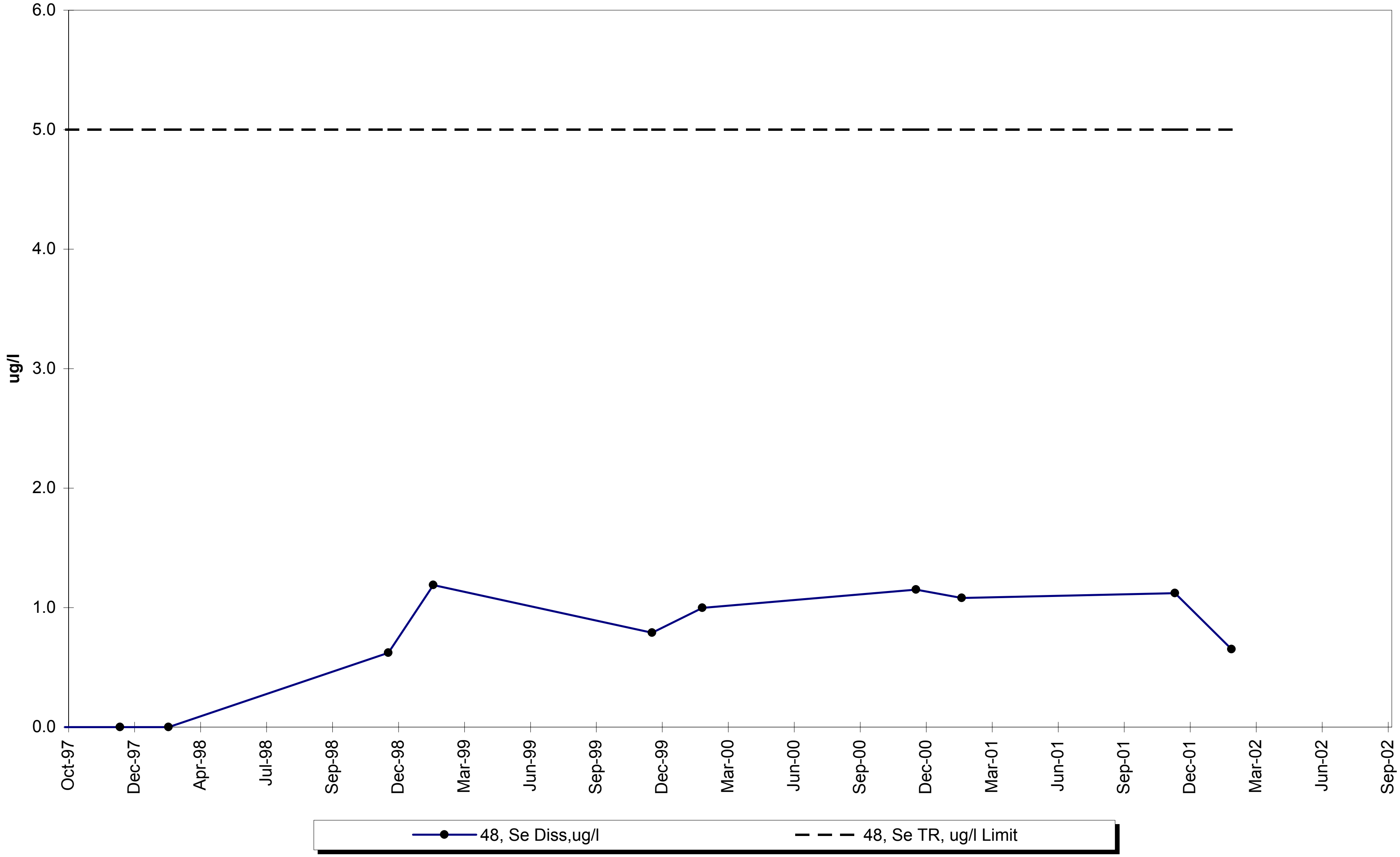




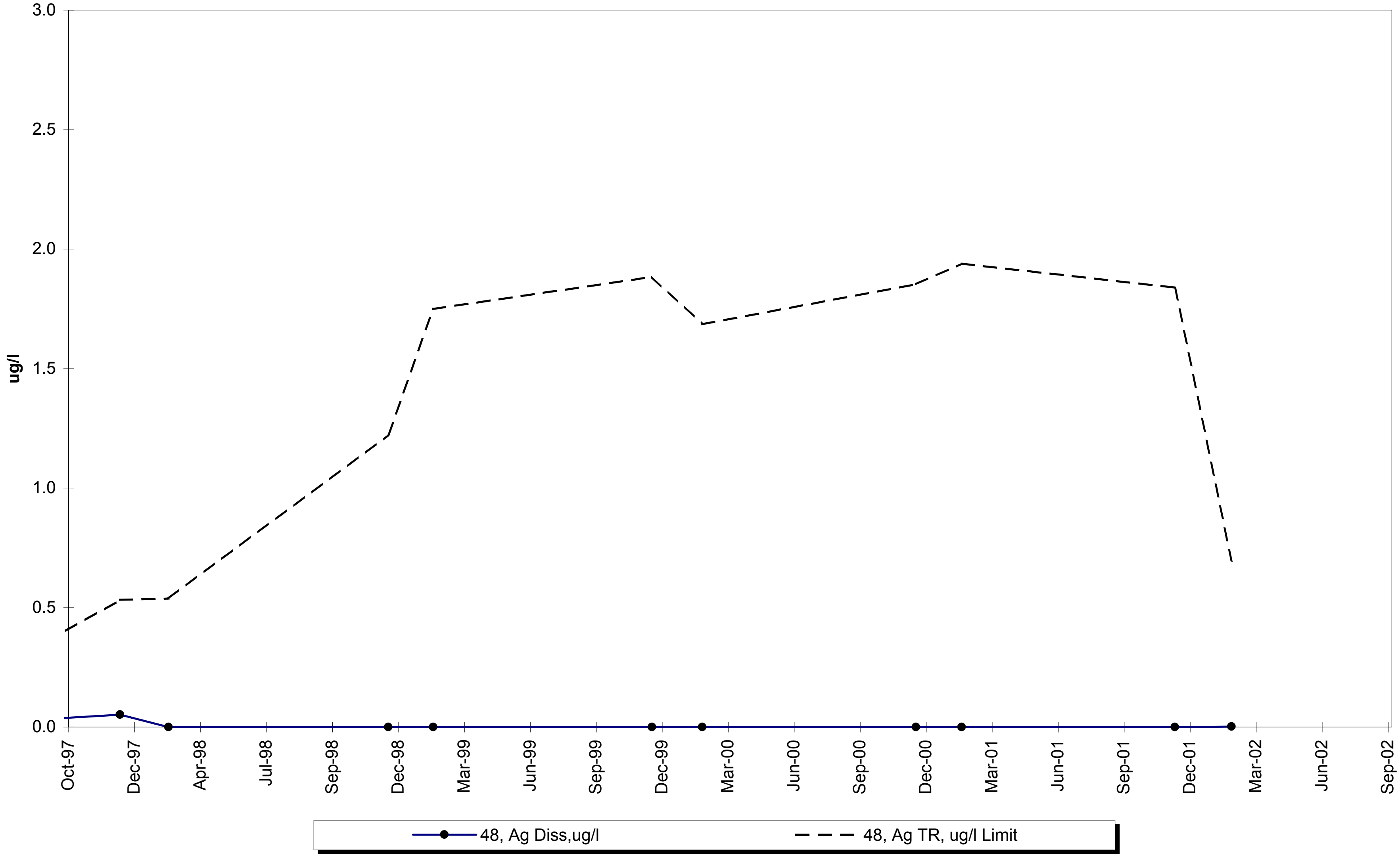
Site 48 -Dissolved Mercury
ug/l
0.012
0.010
0.008
0.006
0.004
0.002
0.000
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
48, Hg Diss,ug/l
48, Hg TR, ug/l Limit


Site 48 -Dissolved Nickel
Note: the AWQS for Total Recoverable Nickel is hardness dependant with a minimum value of 49 μg/l at 25 mg/l of hardness. Thus the limit is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
48, Ni Diss,ug/l
48, Ni TR, ug/l Limit

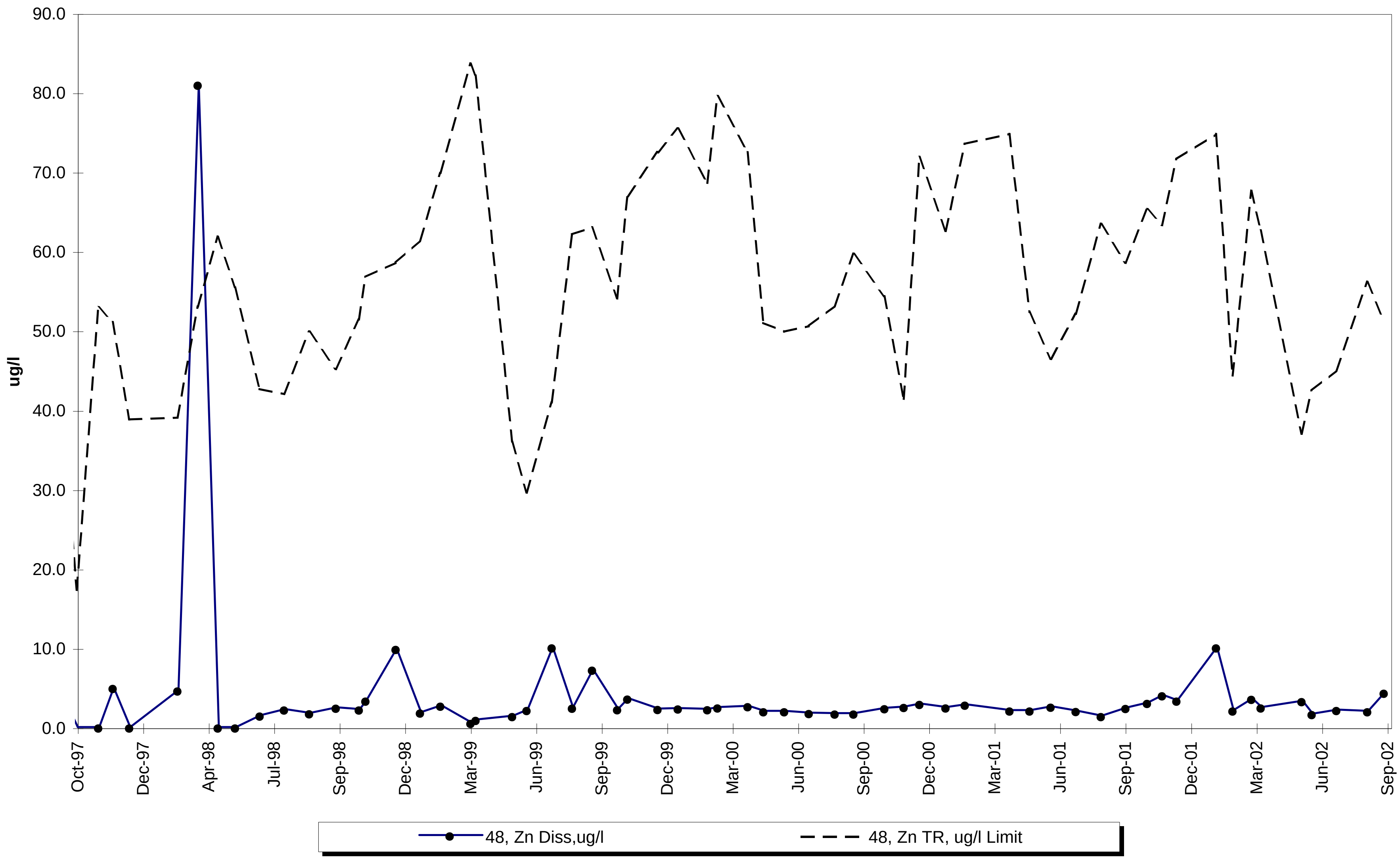
Site 48 -Dissolved Selenium



Site 48 -Dissolved Silver



Site 48 -Dissolved Zinc



INTERPRETIVE REPORT
SITE 6 “MIDDLE GREENS CREEK”

All data collected at this site for the past five years are included in the data analyses with the exception of two outliers shown on the table below. During the current year one (1)

Sample Date	Parameter	Value	Qualifier	Notes
2/16/1999	Cond Lab, umho	408.0	R	Statistical outlier, not collaborated by field measurements.
12/5/2001	Cond Field, umho	37.0	R	Suspected field instrument malfunction

data point was flagged as an outlier after review by KGCMC. As reported for all sampled sites in December-2001, the value for field specific conductance was flagged and appears to be the result of a malfunction of the field instrument that occurred during the sample run. The dissolved chromium value of 1.34 μg/l from the February-2002 sampling run was reviewed as a potential outlier. This value was not flagged as an outlier after a through review as discussed in the section for Site 48, which also returned high values. The dissolved lead value of 2.10 μg/l from the July-2002 sampling run was reviewed as a potential outlier. The result is approximately 35 times the water-year 2002 median value and approximately 4 times greater than the previous maximum value. Review of field notes, laboratory reports, and data limitations listed by the QA reviewer does not indicate the value is an artifact associated with an obvious sampling error. After this analysis the data point was retained with the data set and not flagged as an outlier.

The data collected during the current water year are listed in the following “Table of Results for Water Year 2002” report. The table includes all the data, field and lab, collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of zero for the purpose of median calculation.

The data for water year 2002 have been compared to the strictest fresh water quality criterion for each applicable analyte. Two (2) results exceeding these criteria have been identified, as listed on the following “Comparison To Standards” report. One of these results is a lab pH for which the corresponding field pH was 6.80 which is within AWQS. The second exceedance is for a dissolved lead sample from July-2002 with a value of 2.1 μg/l that exceeds the hardness dependent AWQS standard of 1.0 μg/l. As discussed above this sample was reviewed as a potential outlier but not flagged and represents a new maximum measured value for dissolved lead at this site. The two subsequent sampling events conducted in August and September of 2002 returned values of approximately 0.25 μg/l, which are also well above the median for this site but well below AWQS. The high value recorded in July-2002 appears to be a single event from which the water-quality recovered back below AWQS by the next months sampling run. Subsequent data collected after the period covered by this report indicated that the dissolved lead values have returned to levels measured prior to July-2002.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious trends were apparent. Additional X-Y plots have been generated for alkalinity, pH, conductance, and dissolved zinc that plot Site 6 and Site 48, the upstream control site, to aid in the comparison between those two sites.

A statistical comparison between Site 6 and Site 48 of median values for alkalinity, lab pH, specific conductance, and dissolved zinc have been conducted as specified in the Statistical Information Goals for Site 6. Calculation details of the non-parametric rank sum tests are presented in detail on the pages following this interpretive section. The table below summarizes the results of the large sample approximation to the Wilcoxon-Mann-Whitney rank sum test as performed on the water year 2002 data set.

Analyte	N		Median Value		W (sum of ranks)		p	H_0:μ_{06}=μ_{48}
	#48	#6	#48	#6	#48	#6		
Alkalinity (mg/l)	12	12	44.0	43.5	145	155	0.3975	ACCEPT
Lab pH (su)	12	12	7.45	7.49	145	155	0.3974	ACCEPT
Conductivity (umhos)	12	12	116	123	137	163	0.2352	ACCEPT
Dissolved Zinc (µg/l)	12	12	3.22	5.77	105.5	194.5	**0.0055**	**REJECT**

For alkalinity, pH, and conductivity there is no statistical difference between the measured median values at a significance level of $\alpha/2=0.025$ for a two-tailed test. The dissolved zinc concentrations are statistically different, which has been previously noted for the prior two water years. The median comparison test utilized in prior annual reports was based on a visual comparison of notched-box plots. Additional rank sum tests were performed on the prior year's data to maintain the continuity of the analysis of the dissolved zinc concentration between the two sites. A summary of the rank-sum test results for water years 1998 through 2001 are presented in the table below. The rank-sum tests confirm the prior year's analysis of the difference in median values between the two

Dissolved Zinc (µg/l)	n		Median Value		W (sum of ranks)		p	H_0:μ_{06}=μ_{48}
	#48	#6	#48	#6	#48	#6		
WY 1998	11	12	1.78	6.03	96	180	**0.0141**	**REJECT**
WY 1999	12	12	2.39	4.22	128	172	0.1072	ACCEPT
WY 2000	12	12	2.30	4.30	87	213	**0.0002**	**REJECT**
WY 2001	11	12	2.47	4.89	73	203	**0.0002**	**REJECT**

sites. A visual inspection of a X-Y plot with Site 48 and Site 6 data shows the different trends present at the two sites which becomes apparent with the lower MDL achieved since June-1998. The difference in dissolved zinc concentrations appears to display a distinct seasonal trend where summer flow conditions typically show the smallest difference of approximately 1 µg/l, while winter flow conditions show the largest difference of approximately 3-4 µg/l. The difference is not apparent for data prior to June-1998 due to the higher MDL, 4.7 µg/l, which effectively masks 50% or more of the data from both Site 48 and Site 6. The dissolved zinc data for Site 48 and Site 6 does not visually appear to have any underlying trends based on the post June-1998 data. Median comparisons between separate water year's data-sets since water year 1999 for Site 6 indicate that no statistically significant differences occur between successive years.

Given the consistency of the seasonal differences and lack of any upward trend for Site 6, the determination as to the cause for the difference in median dissolved zinc statistic are inconclusive. Additional analysis for data acquired prior to June-1998 to determine if the dissolved zinc concentrations from Site 48 and Site 6 were previously part of the same population is also inconclusive due to the higher MDL associated with those analyses. The lack of any other collaborative evidence from alkalinity, pH or conductance would indicate the effect is not due to influences from the mine/mill site and could be a natural occurrence.

KGCMC believes that no additional actions are warranted at this time due to the consistent differences in dissolved zinc concentrations between the two sites. The current FWMP program is sufficient to monitor any changes at Site 6 for two reasons. The sampled concentrations for dissolved zinc are typically more than one order of magnitude below the strictest AWQS, currently the level does not approach or endanger water quality values. Second, as documented by the above analysis, differences of as little as 2 μg/l are effectively monitored and documented with the current program. Thus, if an as yet undetected upward trend in dissolved zinc at Site 6, the current program is clearly able to identify the change well before any water quality values are impaired.

Table of Results for Water Year 2002

Site 6 "Middle Greens Creek"

Sample Date/Parameter	10/25/2001	11/15/2001	12/5/2001	1/29/2002	2/21/2002	3/19/2002	4/1/2002	5/28/2002	6/11/2002	7/15/2002	8/27/2002	9/19/2002	**Median**
Water Temp (°C)	1.7	3.4	1.0	4.5	0.7	0.3	6.7	4.2	4.6	7.2	9.5	6.9	4.4
Conductivity-Field (µmho)	128	112	39	136	167	169	161	60	86	94	105	93	112
Conductivity-Lab (µmho)	125 J	121 J	146	148	153	163	175	61	86	98	109	95	123
pH Lab (standard units)	8.35	7.40 J	7.58	7.35	7.36	7.92	7.09	5.78	6.55	7.99	7.86	7.97	7.49
pH Field (standard units)	7.86	7.82	7.55	7.33	7.84	7.45	7.42	6.80	7.39	7.47	7.53	7.64	7.50
Total Alkalinity (mg/l)	45.8 J	41.2 J	50.4	49.8	50.1	53.3	54.4	23.4	35.1	37.5	40.9	36.7	43.5
Hardness (mg/l)	59.7	58.3	68.0	71.4	46.7	57.1	60.1	30.2	35.0	39.9	51.0	44.2	54.1
Dissolved As (µg/l)	<0.446	<0.264	<0.643 UJ	<0.155 UJ	0.127 J	0.175 J	0.183 J	0.275 J	<0.204 UJ	0.294	0.314 U	0.157 J	0.179
Dissolved Ba (µg/l)			29.1		30.2								29.7
Dissolved Cd (µg/l)	0.052 J	0.061	0.041 J	<0.039 UJ	0.043 J	0.050	0.051	0.043 UJ	<0.034	0.050	0.049	0.048	0.048
Dissolved Cr (µg/l)			<0.275		1.340								0.739
Dissolved Cu (µg/l)	0.427	0.646	0.337	0.456	0.410	1.180	0.271	0.495	0.300 U	0.450 J	0.627	0.721	0.453
Dissolved Pb (µg/l)	0.0661 UJ	0.1310 J	<0.0330	0.1370 J	0.0294 J	<0.0300	0.0544 J	0.0418 J	<0.0320 UJ	2.1000	0.2440 U	0.2120	0.0603
Dissolved Ni (µg/l)			1.72		1.49								1.61
Dissolved Ag (µg/l)			<0.0140		<0.0120								0.0065
Dissolved Zn (µg/l)	5.76 U	7.48	6.46 J	7.16 J	5.75 J	5.87	5.77	3.26	2.03 J	4.30	6.09	5.46 J	5.77
Dissolved Se (µg/l)			<0.876 UJ		1.340 J								0.889
Dissolved Hg (µg/l)	0.000769 UJ	0.001550 U	0.000769 J	0.001020 UJ	0.000791 UJ	0.000683 J	0.000793 U	0.002200 J	0.000770 U	0.000560 U	0.002130	<0.000000	0.000781

See "Qualififed Data by QA Reviewer" table for qualifier descriptions.

Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
6	01/29/2002	12:05:00 PM				
			As Diss, ug/l	-0.155	UJ	LCS Rec.
			Cd Diss, ug/l	-0.039	UJ	LCS Rec.
			Pb Diss, ug/l	0.137	J	LCS Rec, LCS RPD
			Zn Diss, ug/l	7.16	J	LCS Rec, LCS RPD
			Hg Diss, ug/l	0.00102	UJ	Field Blk, LCS Rec, LCS RPD
6	10/25/2001	1:25:00 PM				
			Cond Lab, umho	125	J	Sample Temp.
			Alk Tot, mg/l	45.8	J	Sample Temp.
			Cd Diss, ug/l	0.0515	J	Below Quantitative Range, L
			Pb Diss, ug/l	0.0661	UJ	Below Quantitative Range, Fi
			Zn Diss, ug/l	5.76	U	Field Blk.
			Hg Diss, ug/l	0.000769	UJ	Field Blk, LCS RPD
6	11/15/2001	1:07:00 PM				
			Cond Lab, umho	121	J	Sample Temp.
			pH Lab, su	7.4	J	Hold Time
			Alk Tot, mg/l	41.2	J	Sample Temp.
			Pb Diss, ug/l	0.131	J	Below Quantitative Range
			Hg Diss, ug/l	0.00155	U	Field Blank Cont.
6	12/05/2001	1:47:00 PM				
			As Diss, ug/l	-0.643	UJ	LCS Rec.
			Cd Diss, ug/l	0.041	J	Below Quantitative Range
			Zn Diss, ug/l	6.46	J	LCS Rec.
			Se Diss, ug/l	-0.876	UJ	LCS Rec.
			Hg Diss, ug/l	0.000769	J	LCS Rec.
6	02/21/2002	11:32:00 AM				
			As Diss, ug/l	0.127	J	Below Quantitative Range, L
			Cd Diss, ug/l	0.0426	J	Below Quantitative Range, L
			Pb Diss, ug/l	0.0294	J	Below Quantitative Range
			Zn Diss, ug/l	5.75	J	LCS Rec.
			Se Diss, ug/l	1.34	J	Below Quantitative Range, L
			Hg Diss, ug/l	0.000791	UJ	Field Blk, LCS Rec, LCS RPD

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
6	03/19/2002	2:54:00 PM				
			As Diss, ug/l	0.175	J	Below Quantitative Range, L
			Hg Diss, ug/l	0.000683	J	Below Quantitative Range, L
6	04/01/2002	3:00:00 PM				
			As Diss, ug/l	0.183	J	LCS Rec.
			Pb Diss, ug/l	0.0544	J	Below Quantitative Range
			Hg Diss, ug/l	0.000793	U	Field Blank Cont.
6	05/28/2002	12:10:00 PM				
			As Diss, ug/l	0.275	J	Below Quantitative Range
			Cd Diss, ug/l	0.0433	UJ	CCV Rec.
			Pb Diss, ug/l	0.0418	J	Below Quantitative Range
			Hg Diss, ug/l	0.0022	J	CCV Rec, LCS Rec, LCS RP
6	06/11/2002	11:55:00 AM				
			As Diss, ug/l	-0.204	UJ	LCS Rec.
			Cu Diss, ug/l	0.3	U	Field Blank Cont.
			Pb Diss, ug/l	-0.032	UJ	LCS Rec.
			Zn Diss, ug/l	2.03	J	LCS Rec.
			Hg Diss, ug/l	0.00077	U	Field Blank Cont.
6	07/15/2002	12:05:00 PM				
			Cu Diss, ug/l	0.45	J	LCS Rec.
			Hg Diss, ug/l	0.00056	U	Field Blank Cont.
6	08/27/2002	12:11:00 PM				
			As Diss, ug/l	0.314	U	Field Blank Contamination
			Pb Diss, ug/l	0.244	U	Field Blank Contamination
6	09/19/2002	11:45:00 AM				
			As Diss, ug/l	0.157	J	Below Quantitative Range
			Zn Diss, ug/l	5.46	J	LCS Rec.

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Comparison To Standards

Date Range: 10/01/2001 to 09/30/2002

Site Number	Date	Time	Dup ID	Storet No.	Parameter Description	Value	Standard	Standard Type
6	05/28/2002	12:10 PM	0	403	pH Lab, su	5.78	6.5- 8.5	Aquatic
6	07/15/2002	12:05 PM	0	1049	Pb Diss, ug/l	2.1	1.00597	Aquatic

Large Sample Approximation

Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Conductivity Lab, (umhos)**

Site	#48	#6	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	118.0	125.0	12	14
Nov	113.0	121.0	11	13
Dec	137.0	146.0	15	18
Jan	139.0	148.0	17	19
Feb	138.0	153.0	16	21
Mar	150.0	163.0	20	23
Apr	158.0	175.0	22	24
May	60.6	60.9	1	2
Jun	84.1	86.3	3	4
Jul	93.2	97.9	6	8
Aug	99.7	109.0	9	10
Sep	90.0	95.0	5	7
Median	115.5	123.0		

N= 24 $W_{\Sigma R}$ 137 163

n	**m**
12	12

μ_W= 150

σ_W= 17.32

Z_{rs}= 0.72

p-test

0.7648

$\alpha/2$

0.025

H_0

(μ_A=μ_B)

ACCEPT

Large Sample Approximation

Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **pH Lab, (su)**

Site	#48	#6	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	7.43	8.35	11.5	24
Nov	7.57	7.40	14	10
Dec	7.43	7.58	11.5	15
Jan	7.35	7.35	7.5	7.5
Feb	7.47	7.36	13	9
Mar	7.86	7.92	17.5	20
Apr	7.22	7.09	5	4
May	6.89	5.78	3	1
Jun	7.30	6.55	6	2
Jul	7.90	7.99	19	23
Aug	7.76	7.86	16	17.5
Sep	7.93	7.97	21	22
Median	7.45	7.49		

N= 24	$W_{\Sigma R}$		145	155
			n	**m**
			12	12

$\mu_W =$ 150

$\sigma_W =$ 17.31

$Z_{rs} =$ 0.26

p-test	
0.6026	H_0
$\alpha/2$	$(\mu_A = \mu_B)$
0.025	**ACCEPT**

Large Sample Approximation
Wilcoxon-Mann-Whitney Rank Sum Test
Variable: **Total Alkalinity, (mg/l)**

Site	#48	#6	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	44.5	45.8	13	14
Nov	43.4	41.2	12	11
Dec	50.2	50.4	19	20
Jan	49.2	49.8	15	16
Feb	50.0	50.1	17	18
Mar	52.2	53.3	21	22
Apr	54.5	54.4	24	23
May	23.0	23.4	1	2
Jun	35.0	35.1	3	4
Jul	36.4	37.5	5	8
Aug	39.5	40.9	9	10
Sep	36.5	36.7	6	7
Median	44.0	43.5		

N= 24 $W_{\Sigma R}$ 145 155

n	**m**
12	12

μ_W= 150

σ_W= 17.32

Z_{rs}= 0.26

p-test

0.6025

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

ACCEPT

Large Sample Approximation

Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Zn Diss, (ug/l)**

Site	#48	#6	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	3.11	5.76	7	17
Nov	4.05	7.48	12	23
Dec	3.38	6.46	10	21
Jan	10.10	7.16	24	22
Feb	2.14	5.75	4	16
Mar	3.61	5.87	11	19
Apr	2.53	5.77	6	18
May	3.32	3.26	9	8
Jun	1.69	2.03	1	2.5
Jul	2.21	4.30	5	13
Aug	2.03	6.09	2.5	20
Sep	4.37	5.46	14	15
Median	3.22	5.77		

N= 24

ΣR 105.5 194.5

	n	**m**
	12	12

W= 116.5

W_α 18

Upper 126

Lower 18

μ_W= 150

σ_W= 17.32

Z_{rs}= 2.54

p-test

0.9945

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

REJECT

Large Sample Approximation

Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Zn Diss, (ug/l)**

Site	#48	#6	Ranks	
Year	WY1998	WY1998	**A**	**B**
Oct	-4.70	4.89	3	14
Nov	4.98	22.50	15	21
Dec	-4.70	6.66	3	18
Jan		5.76		16
Feb	4.67	11.70	13	20
Mar	81.00	10.00	23	19
Apr	-4.70	44.90	3	22
May	-4.70	-4.70	3	3
Jun	1.50	1.99	6	8
Jul	2.28	4.05	9	12
Aug	1.78	2.31	7	10
Sep	2.50	6.29	11	17
Median	1.78	6.03		

N= 23 $W_{\Sigma R}$ 96 180

n	**m**
11	12

μ_W= 132

σ_W= 16.17

Z_{rs}= -2.20

p-test

0.0141

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

REJECT

Large Sample Approximation

Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Zn Diss, (ug/l)**

Site	#48	#6	Ranks	
Year	WY1999	WY1999	**A**	**B**
Oct	2.28	3.00	8	12
Nov	3.39	3.77	13	14
Dec	9.89	9.73	23	21
Jan	1.88	4.36	6	16
Feb	2.76	4.74	11	18
Mar	0.58	9.82	1	22
Apr	0.97	5.44	2	19
May	1.45	4.62	4	17
Jun	2.19	1.63	7	5
Jul	10.10	2.54	24	10
Aug	2.50	4.07	9	15
Sep	7.27	1.06	20	3
Median	2.39	4.22		

N= 24 $W_{\Sigma R}$ 128 172

n	**m**
12	12

$\mu_W =$ 150

$\sigma_W =$ 17.32

$Z_{rs} =$ 1.24

p-test

0.8928

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

ACCEPT

Large Sample Approximation

Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Zn Diss, (ug/l)**

Site	#48	#6	Ranks	
Year	WY2000	WY2000	**A**	**B**
Oct	2.30	4.48	7	19
Nov	3.65	8.76	17	23
Dec	2.33	4.11	8	18
Jan	2.41	5.36	9	21
Feb	2.29	4.53	6	20
Mar	2.53	5.71	12	22
Apr	2.68	8.79	13	24
May	2.03	3.33	4	16
Jun	2.04	2.44	5	10
Jul	1.82	2.51	3	11
Aug	1.77	2.74	2	14
Sep	1.75	3.17	1	15
Median	2.30	4.30		

N= 24 $W_{\Sigma R}$ 87 213

n	**m**
12	12

μ_W= 150

σ_W= 17.32

Z_{rs}= 3.61

p-test

0.9998

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

REJECT

Large Sample Approximation

Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Zn Diss, (ug/l)**

Site	#48	#6	Ranks	
Year	WY2001	WY2001	**A**	**B**
Oct	2.43	4.90	6	18
Nov	2.59	5.22	9	19
Dec	2.98	7.00	12	22
Jan	2.53	5.86	8	20
Feb	2.89	6.90	11	21
Mar		7.64		23
Apr	2.15	4.87	3.5	17
May	2.15	3.66	3.5	15
Jun	2.61	3.08	10	14
Jul	2.09	3.06	2	13
Aug	1.44	2.35	1	5
Sep	2.47	4.50	7	16
Median	2.47	4.89		

N= 23 $W_{\Sigma R}$ 73 203

	n	**m**
	11	12

μ_W= 132

σ_W= 16.24

Z_{rs}= -3.60

p-test

0.0002

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

REJECT

Large Sample Approximation

Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Zn Diss, (ug/l)**

Site	#6	#6	Ranks	
Year	WY1999	WY2000	**A**	**B**
Oct	3.00	4.48	7	14
Nov	3.77	8.76	10	21
Dec	9.73	4.11	23	12
Jan	4.36	5.36	13	18
Feb	4.74	4.53	17	15
Mar	9.82	5.71	24	20
Apr	5.44	8.79	19	22
May	4.62	3.33	16	9
Jun	1.63	2.44	2	3
Jul	2.54	2.51	5	4
Aug	4.07	2.74	11	6
Sep	1.06	3.17	1	8
Median	4.22	4.30		

N= 24 $W_{\Sigma R}$ 148 152

n	**m**
12	12

μ_W= 150

σ_W= 17.32

Z_{rs}= 0.09

p-test

0.5345

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

ACCEPT

Large Sample Approximation

Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Zn Diss, (ug/l)**

Site	#6	#6	Ranks	
Year	WY2000	WY2001	**A**	**B**
Oct	4.48	4.90	11	15
Nov	8.76	5.22	23	16
Dec	4.11	7.00	10	21
Jan	5.36	5.86	17	19
Feb	4.53	6.90	13	20
Mar	5.71	7.64	18	22
Apr	8.79	4.87	24	14
May	3.33	3.66	8	9
Jun	2.44	3.08	2	6
Jul	2.51	3.06	3	5
Aug	2.74	2.35	4	1
Sep	3.17	4.50	7	12
Median	4.30	4.89		

N= 24

$W_{\Sigma R}$ 140 160

n	**m**
12	12

μ_W= 150

σ_W= 17.32

Z_{rs}= 0.55

p-test

0.7083

$\alpha/2$

0.025

H_0

($\mu_A=\mu_B$)

ACCEPT

Large Sample Approximation

Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Zn Diss, (ug/l)**

Site	#6	#6	Ranks	
Year	WY2001	WY2002	**A**	**B**
Oct	4.90	5.76	10	14
Nov	5.22	7.48	11	23
Dec	7.00	6.46	21	19
Jan	5.86	7.16	16	22
Feb	6.90	5.75	20	13
Mar	7.64	5.87	24	17
Apr	4.87	5.77	9	15
May	3.66	3.26	6	5
Jun	3.08	2.03	4	1
Jul	3.06	4.30	3	7
Aug	2.35	6.09	2	18
Sep	4.50	5.46	8	12
Median	4.89	5.77		

N= 24 $W_{\Sigma R}$ 134 166

n	**m**
12	12

μ_W= 150

σ_W= 17.32

Z_{rs}= 0.89

p-test

0.8146

$\alpha/2$

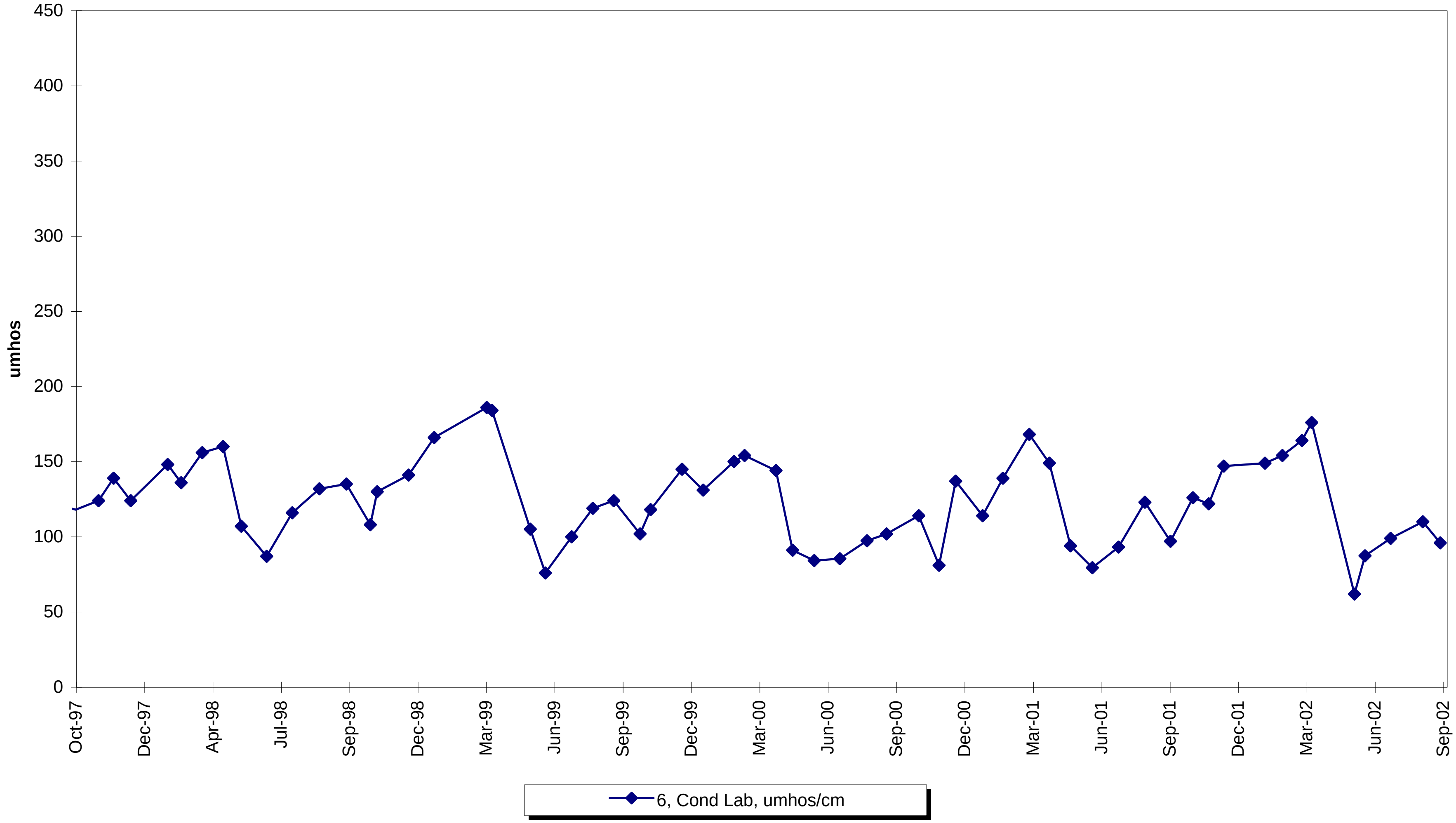
0.025

H_0

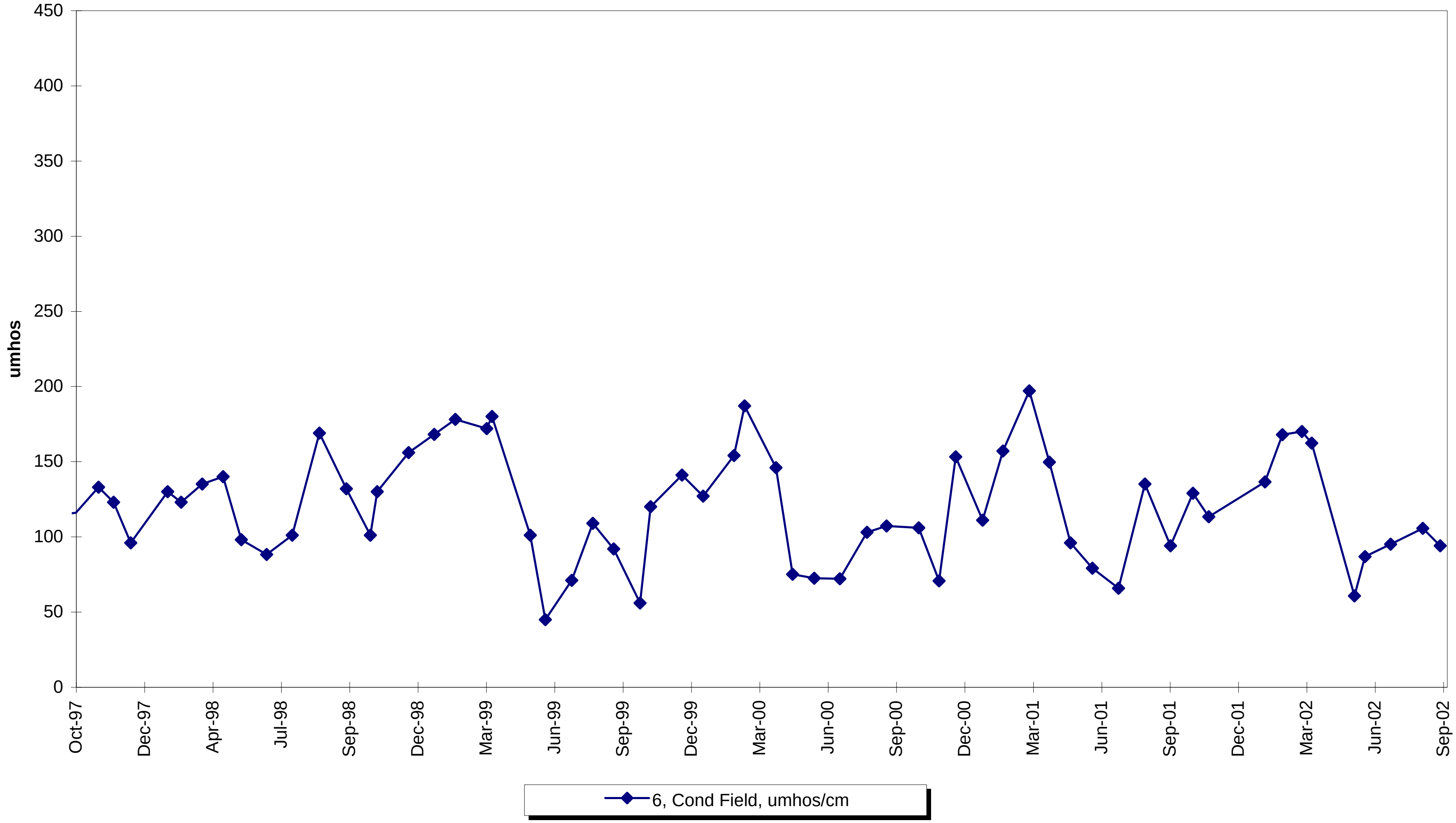
$(\mu_A=\mu_B)$

ACCEPT

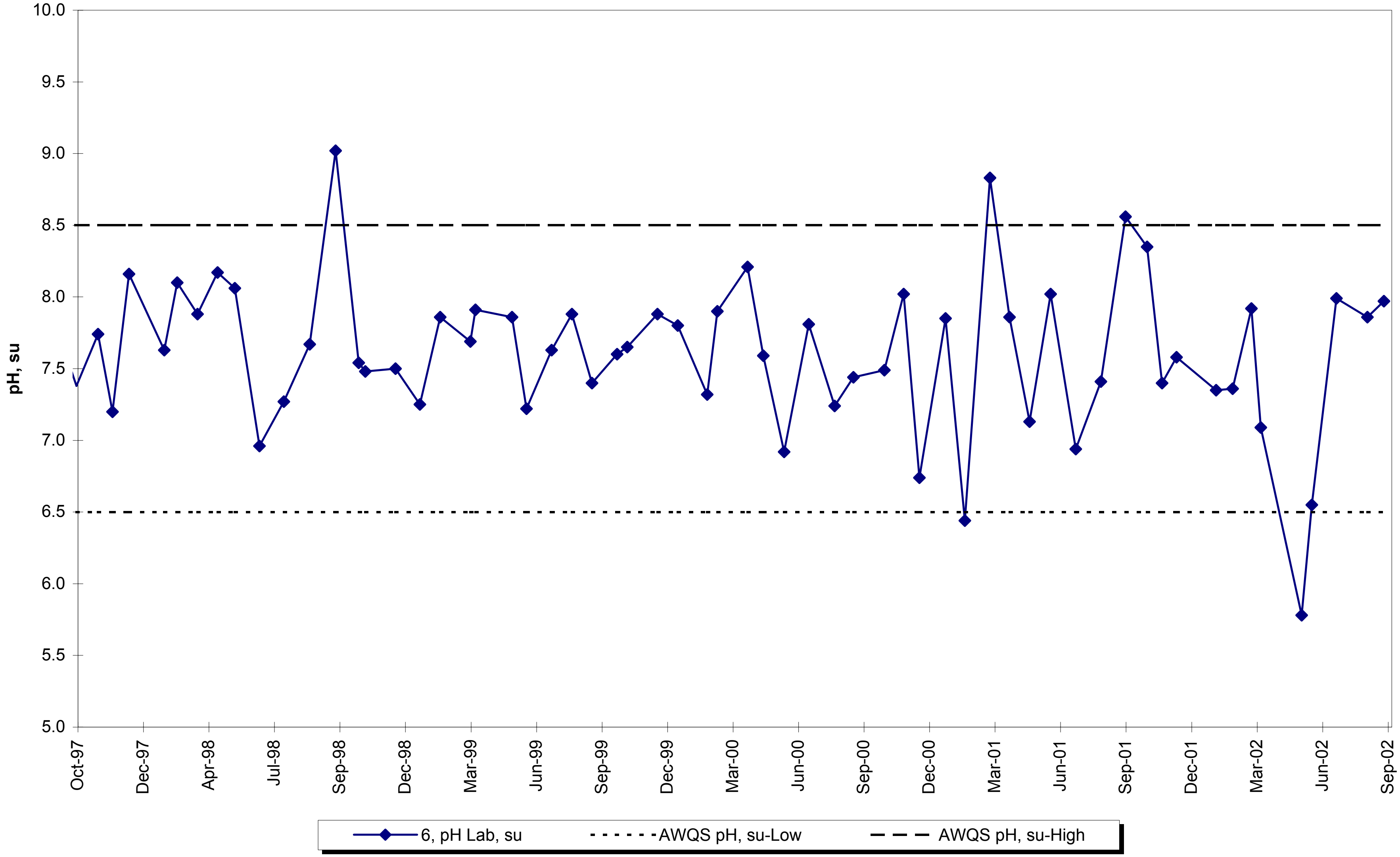
Site 6 -Conductivity-Lab

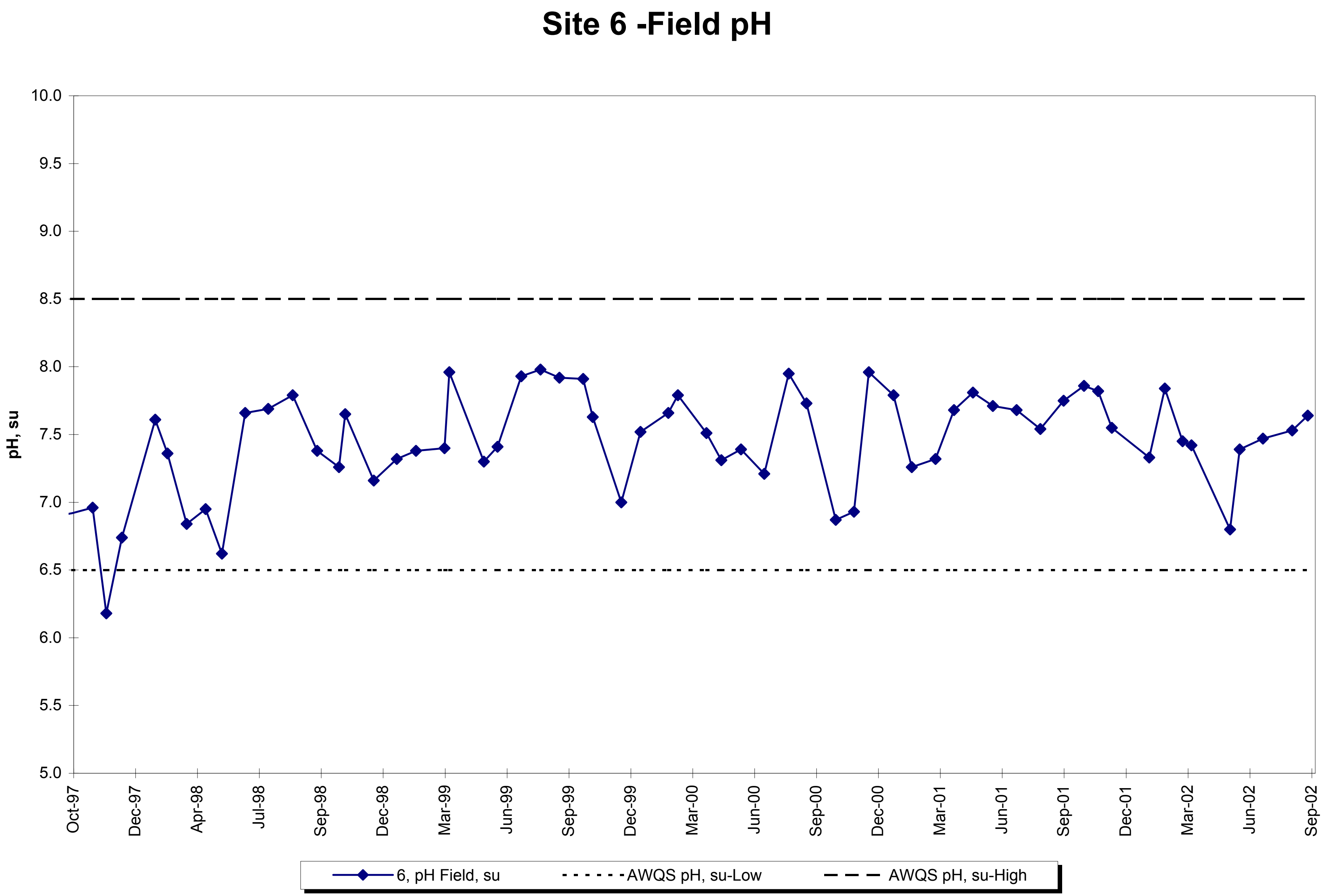


Site 6 -Conductivity-Field



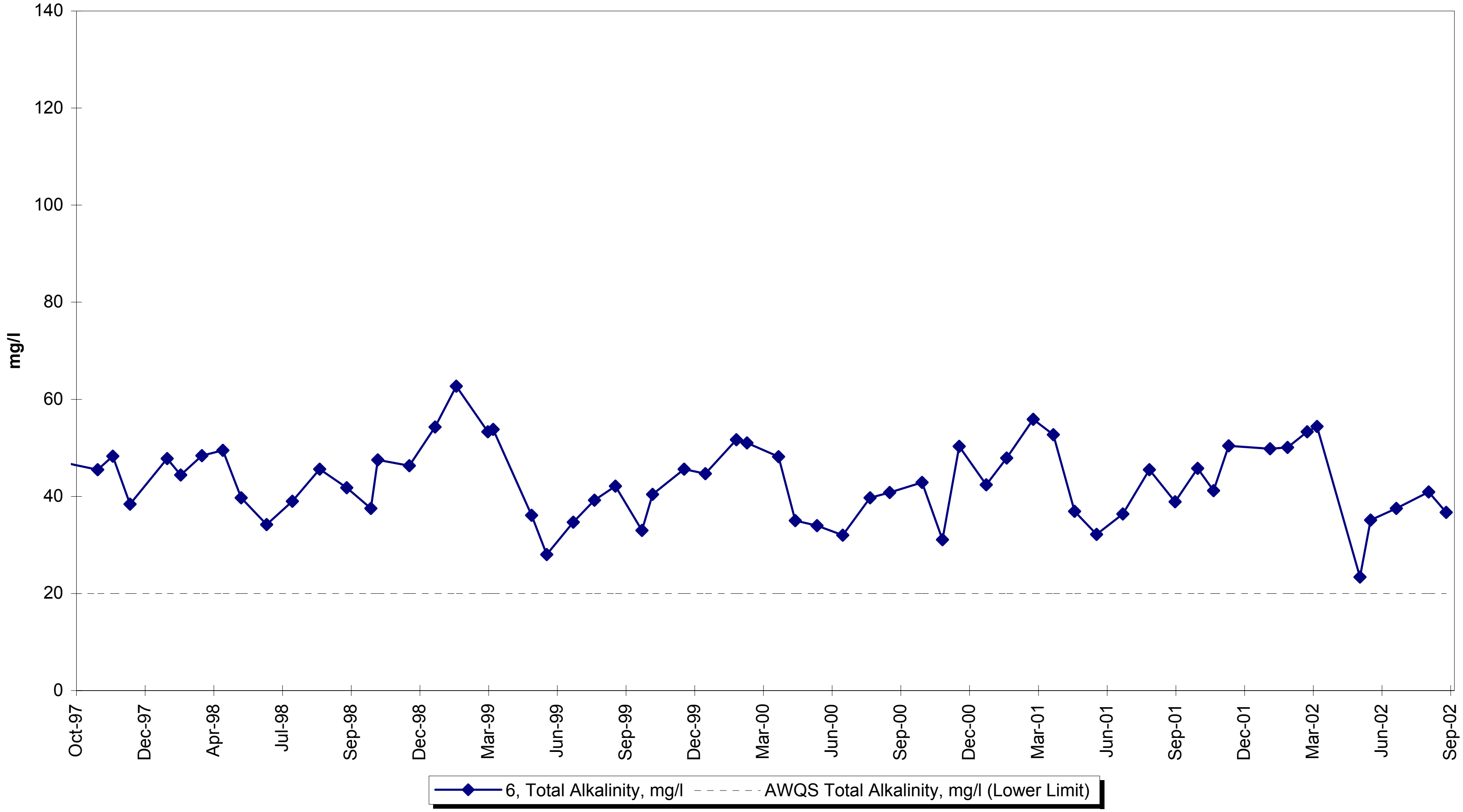
Site 6 -Lab pH


10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
pH, su
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
6, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

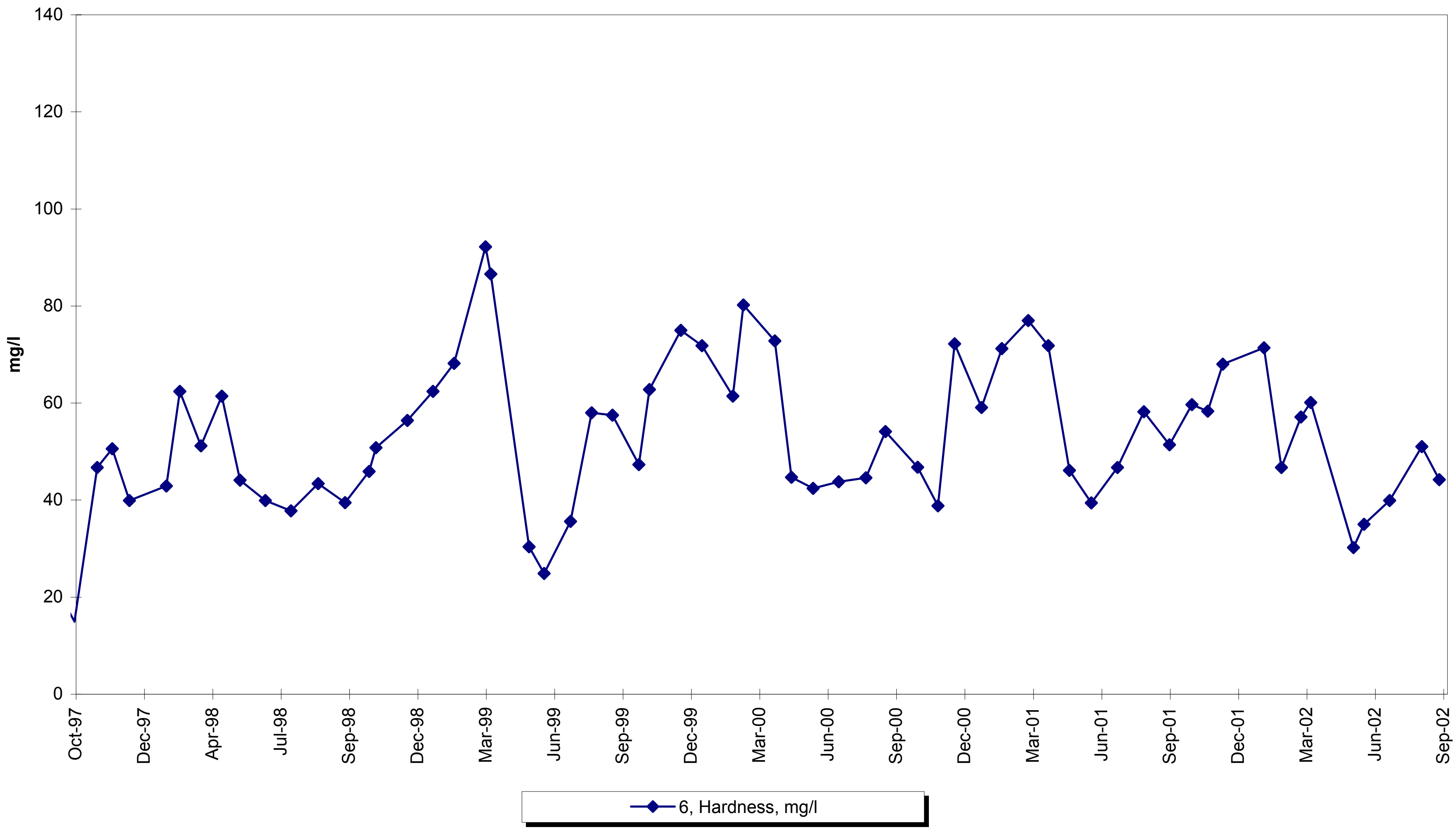


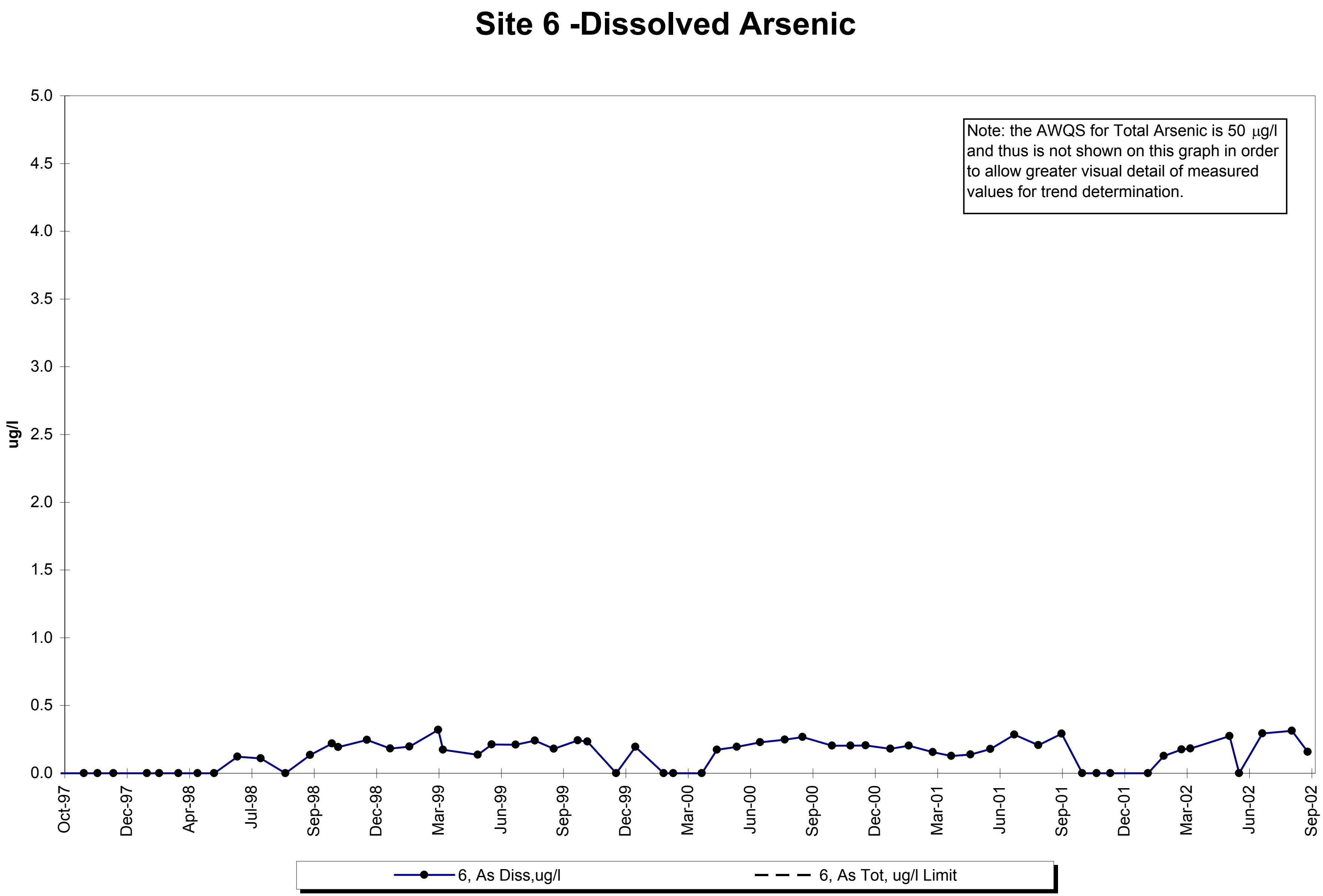
Site 6 -Field pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
6, pH Field, su
AWQS pH, su-Low
AWQS pH, su-High

Site 6 -Total Alkalinity

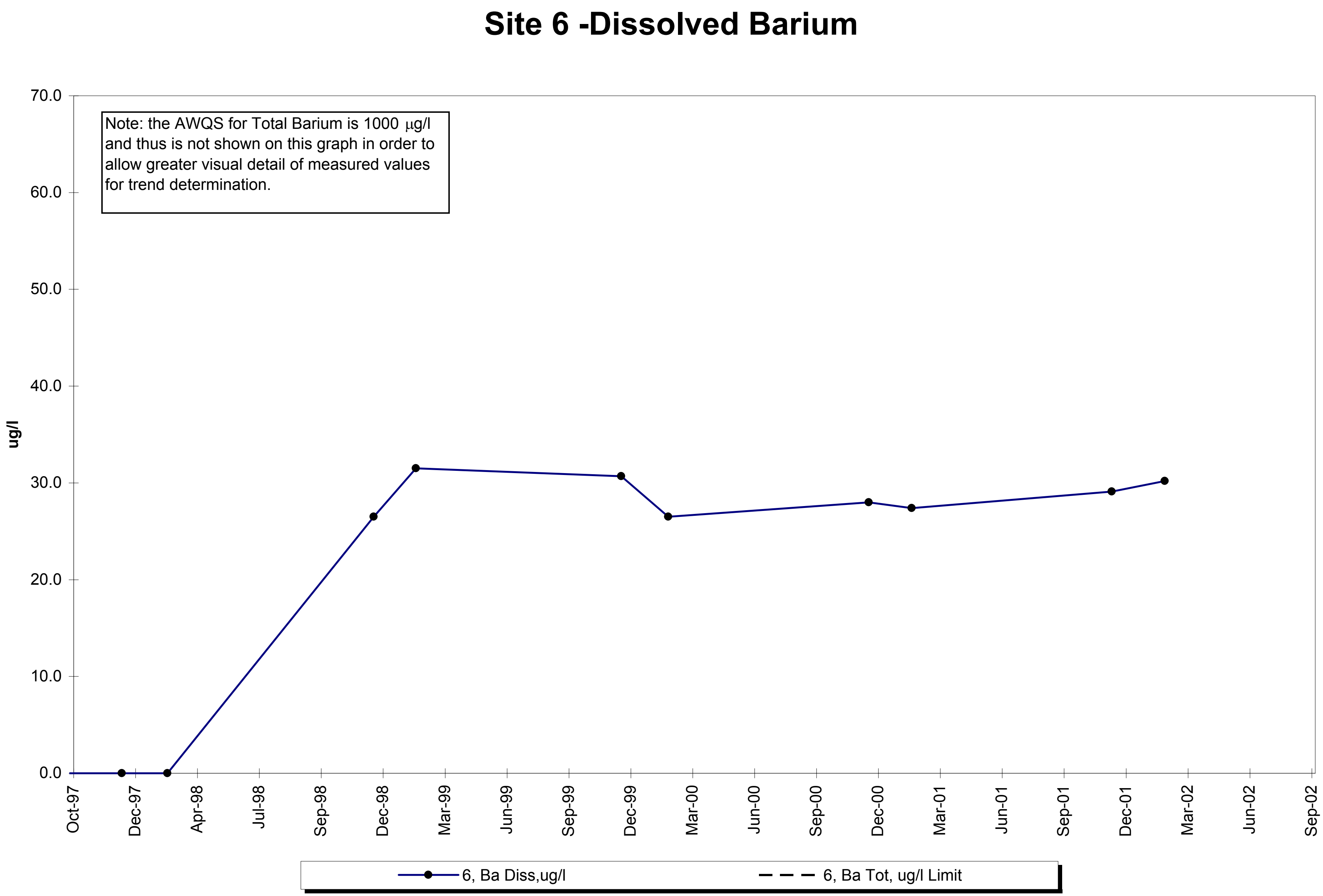


Site 6 -Hardness

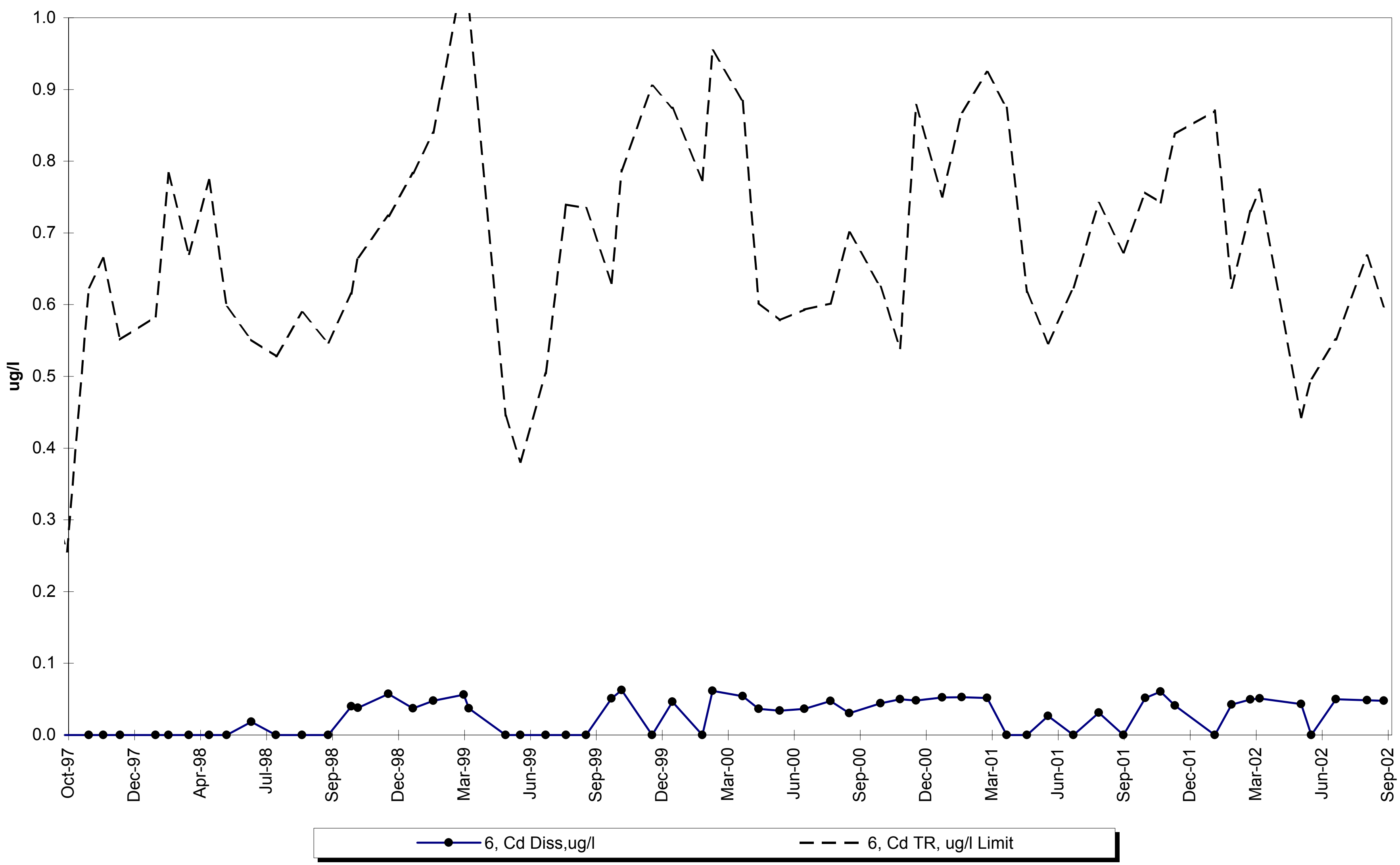


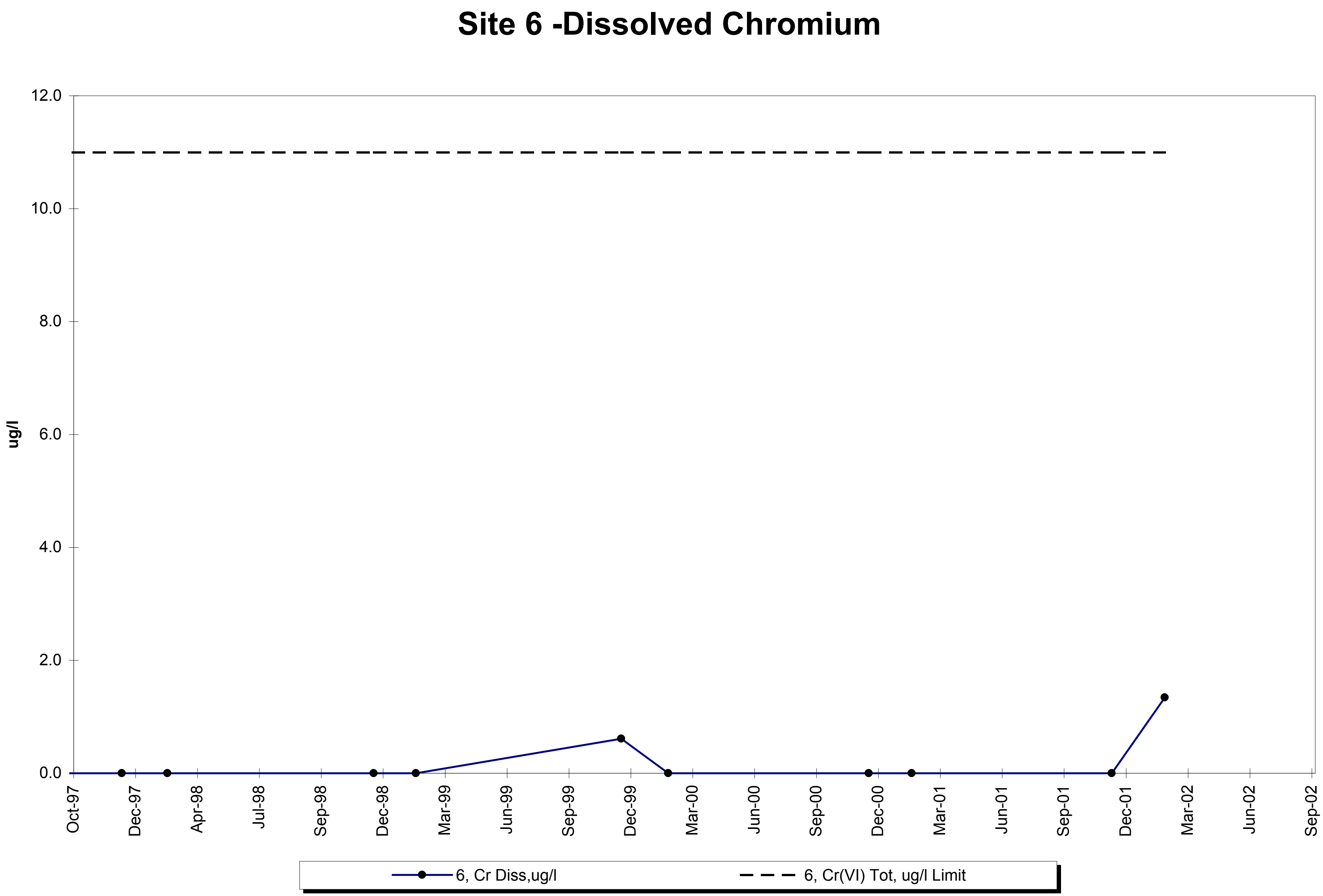


Site 6 -Dissolved Arsenic
Note: the AWQS for Total Arsenic is 50 μg/l and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
6, As Diss,ug/l
6, As Tot, ug/l Limit


Site 6 -Dissolved Barium
Note: the AWQS for Total Barium is 1000 μg/l and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
6, Ba Diss,ug/l
6, Ba Tot, ug/l Limit

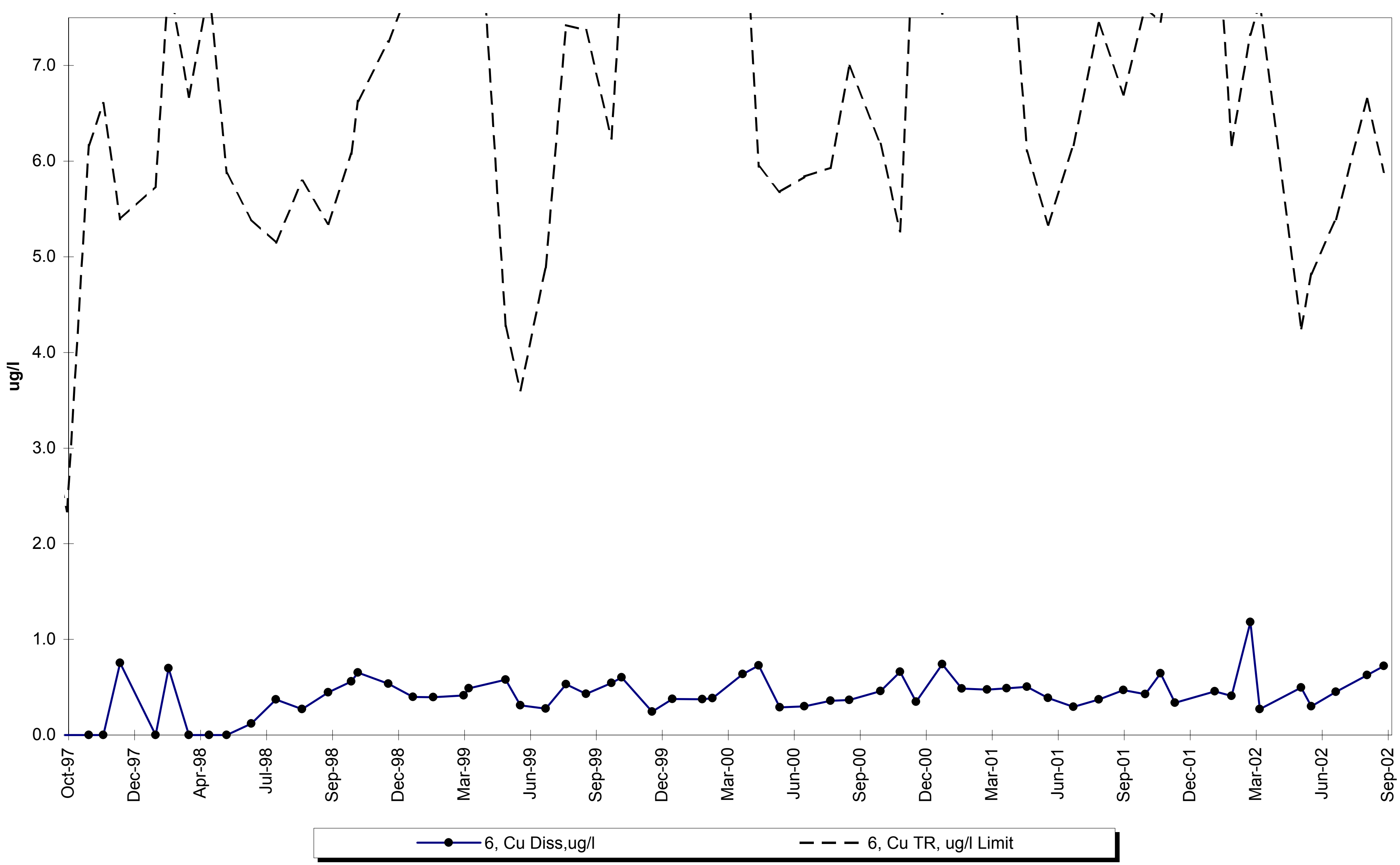
Site 6 -Dissolved Cadmium



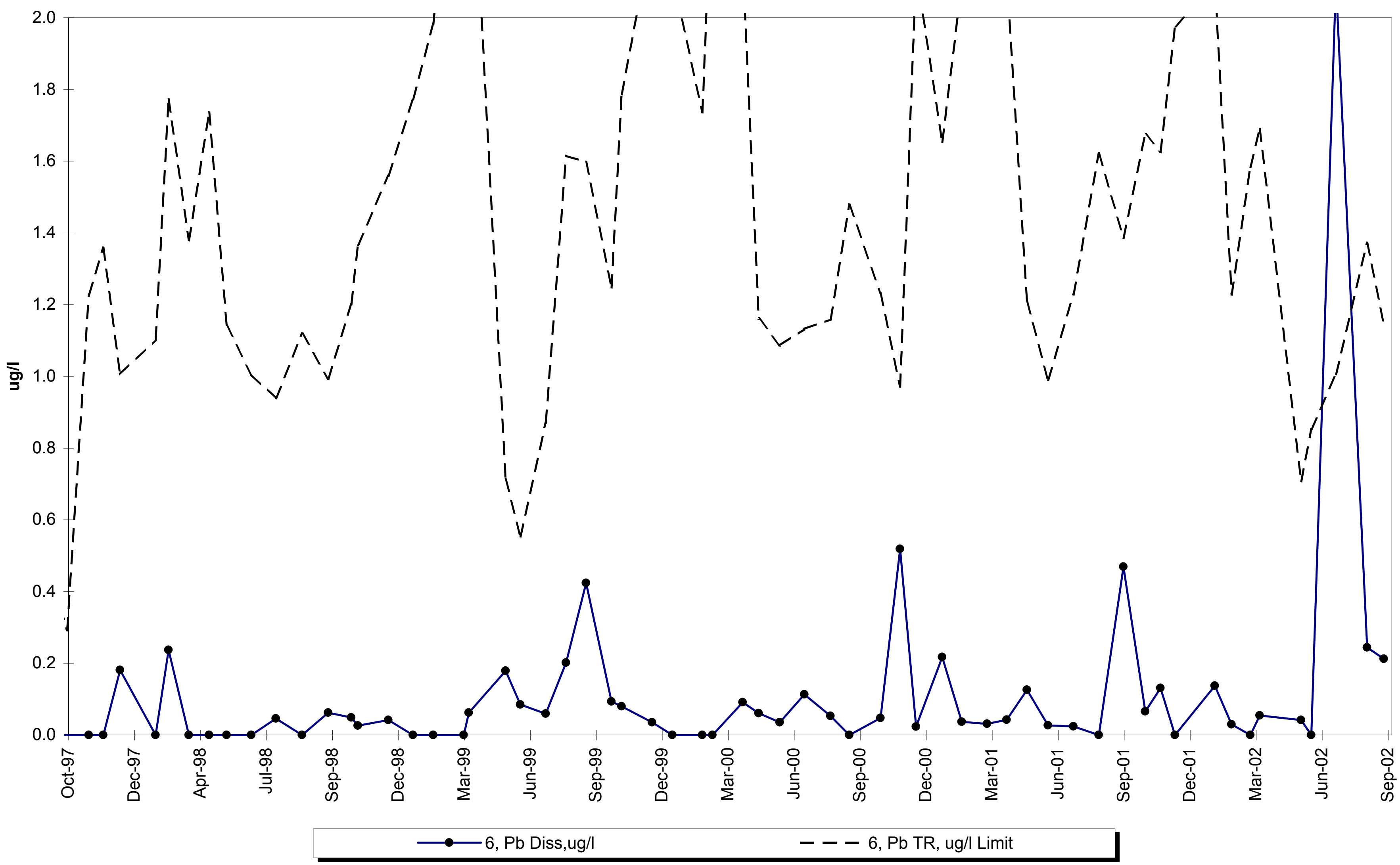


Site 6 -Dissolved Chromium
12.0
10.0
8.0
6.0
4.0
2.0
0.0
ug/l
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
6, Cr Diss,ug/l
6, Cr(VI) Tot, ug/l Limit

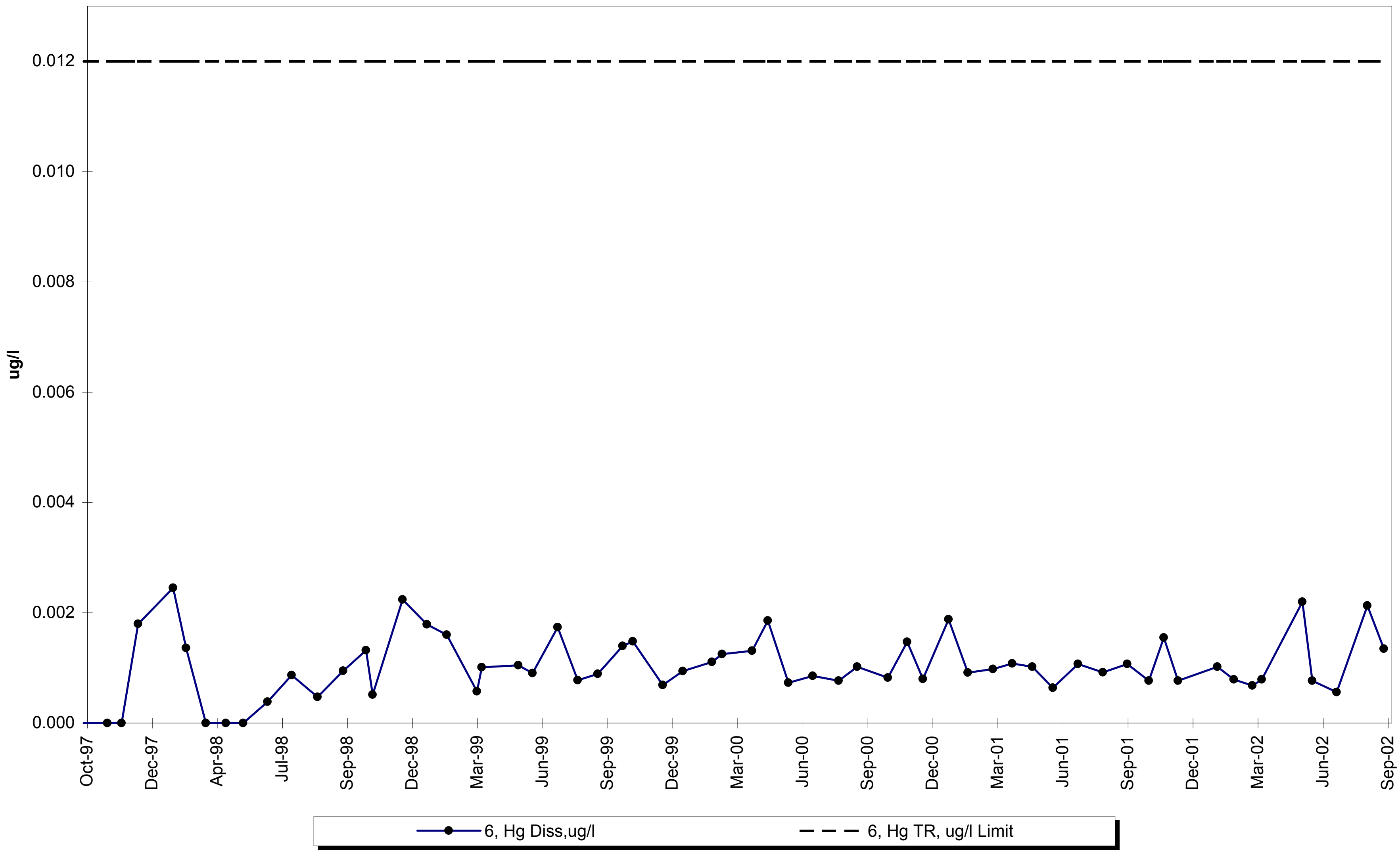
Site 6 -Dissolved Copper



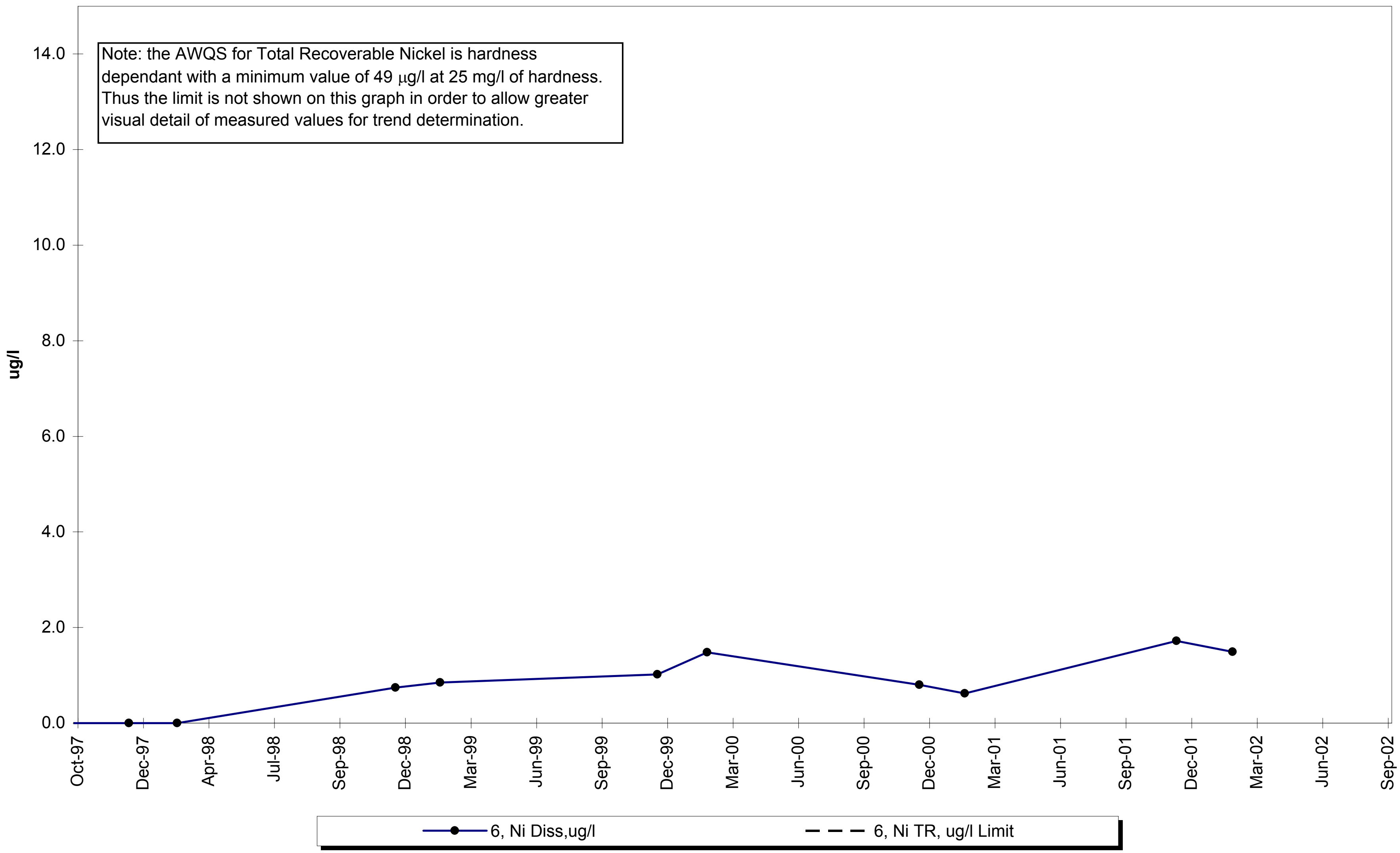
Site 6 -Dissolved Lead



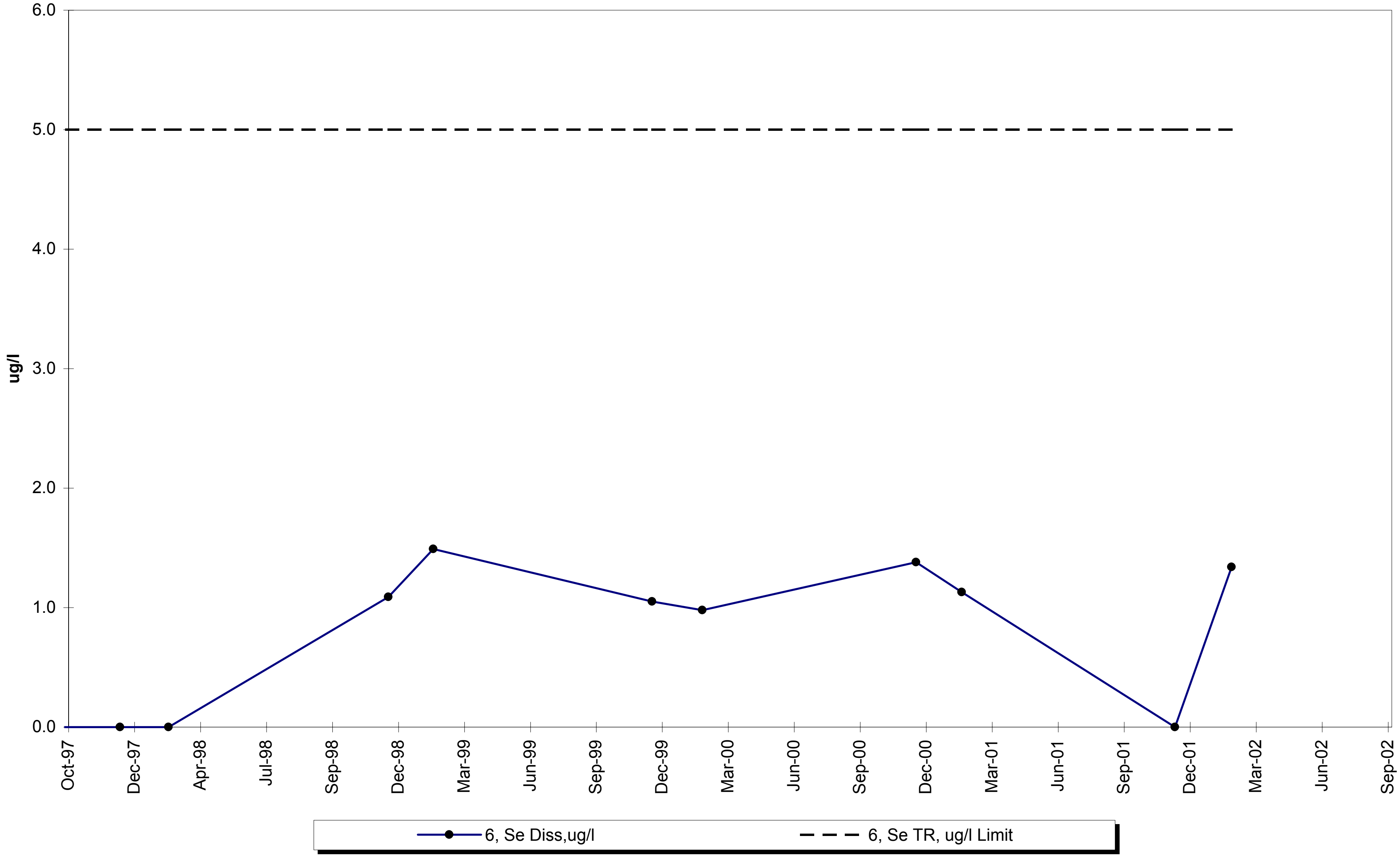
Site 6 -Dissolved Mercury



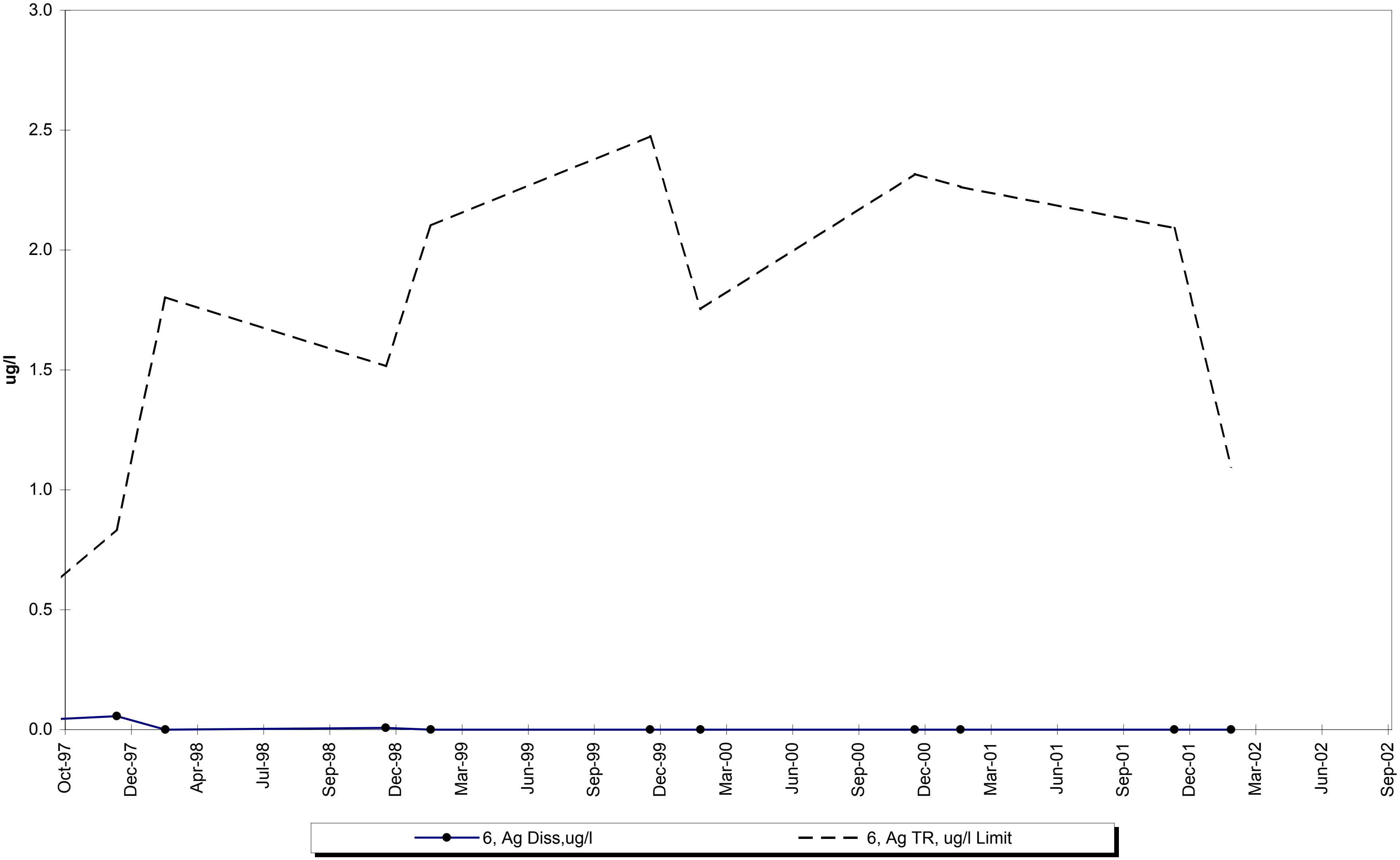
Site 6 -Dissolved Nickel



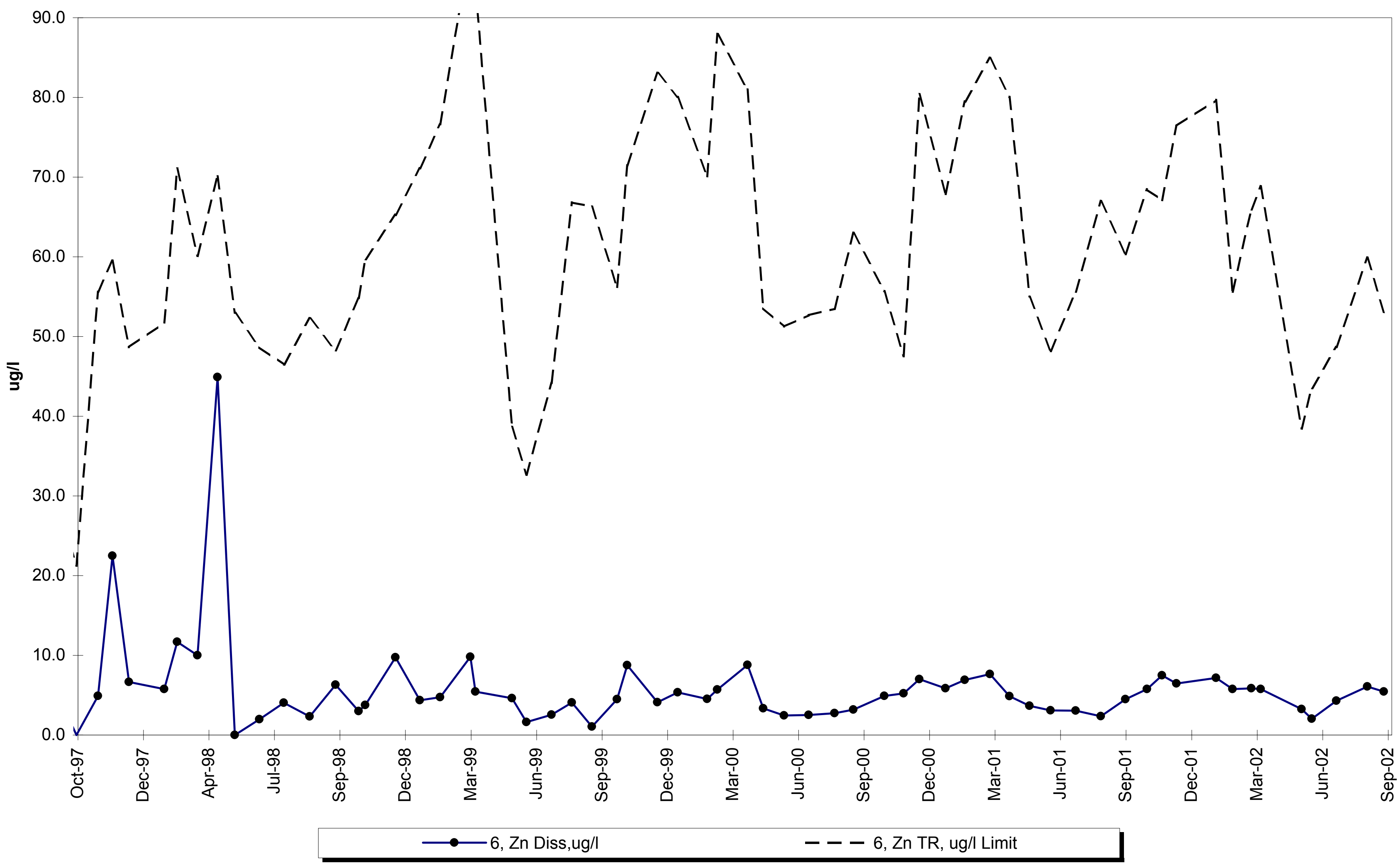
Site 6 -Dissolved Selenium

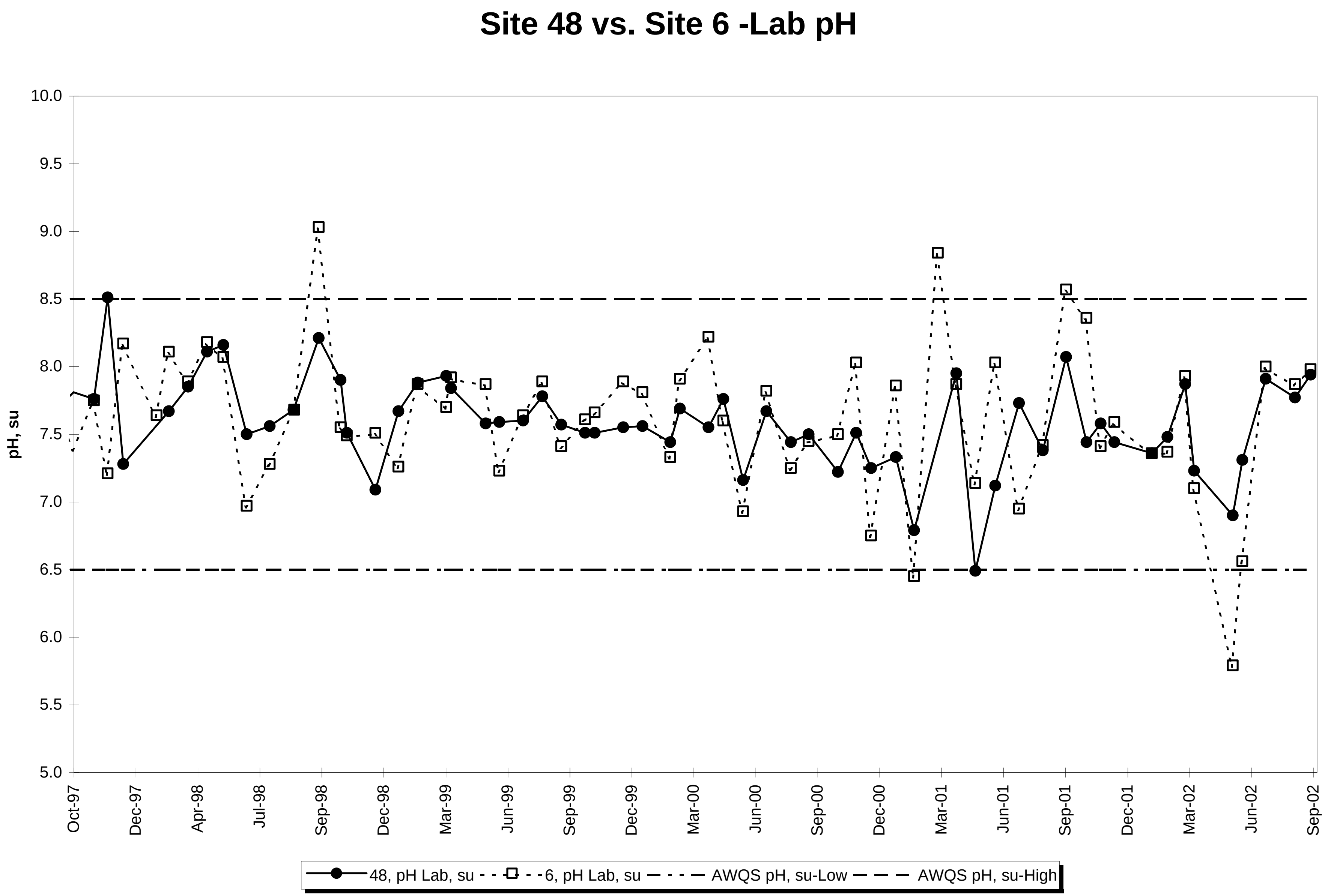


Site 6 -Dissolved Silver



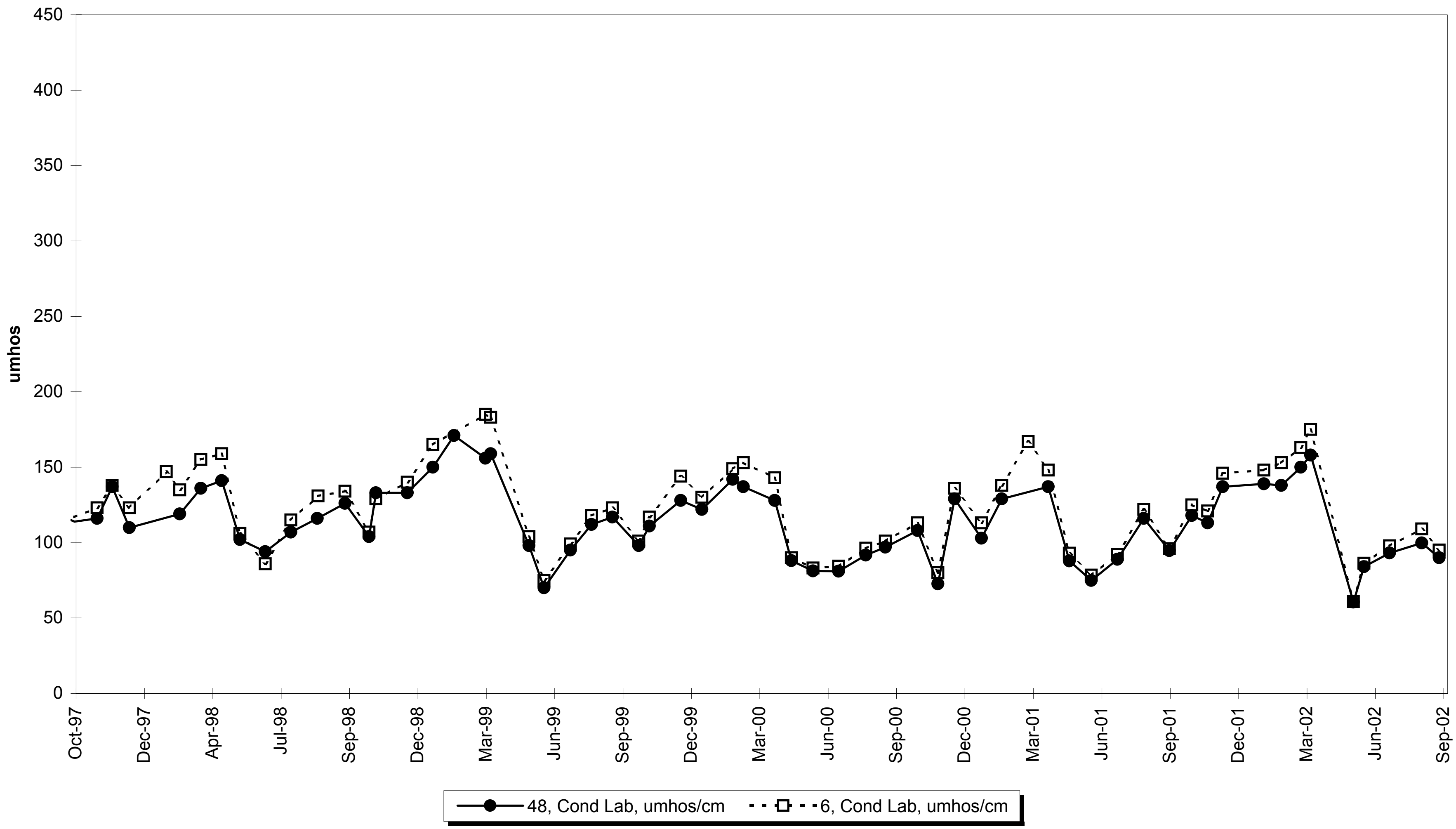
Site 6 -Dissolved Zinc

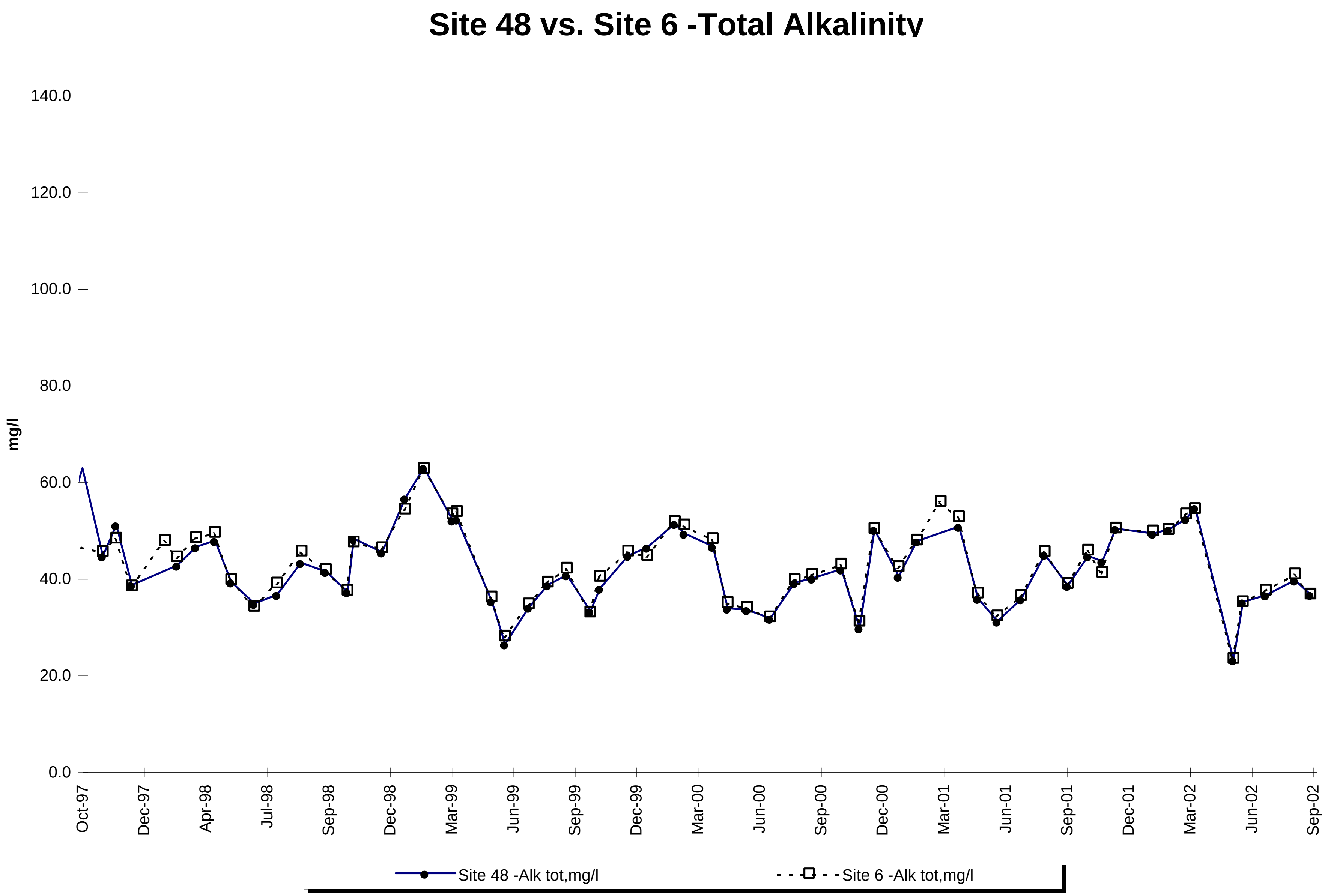




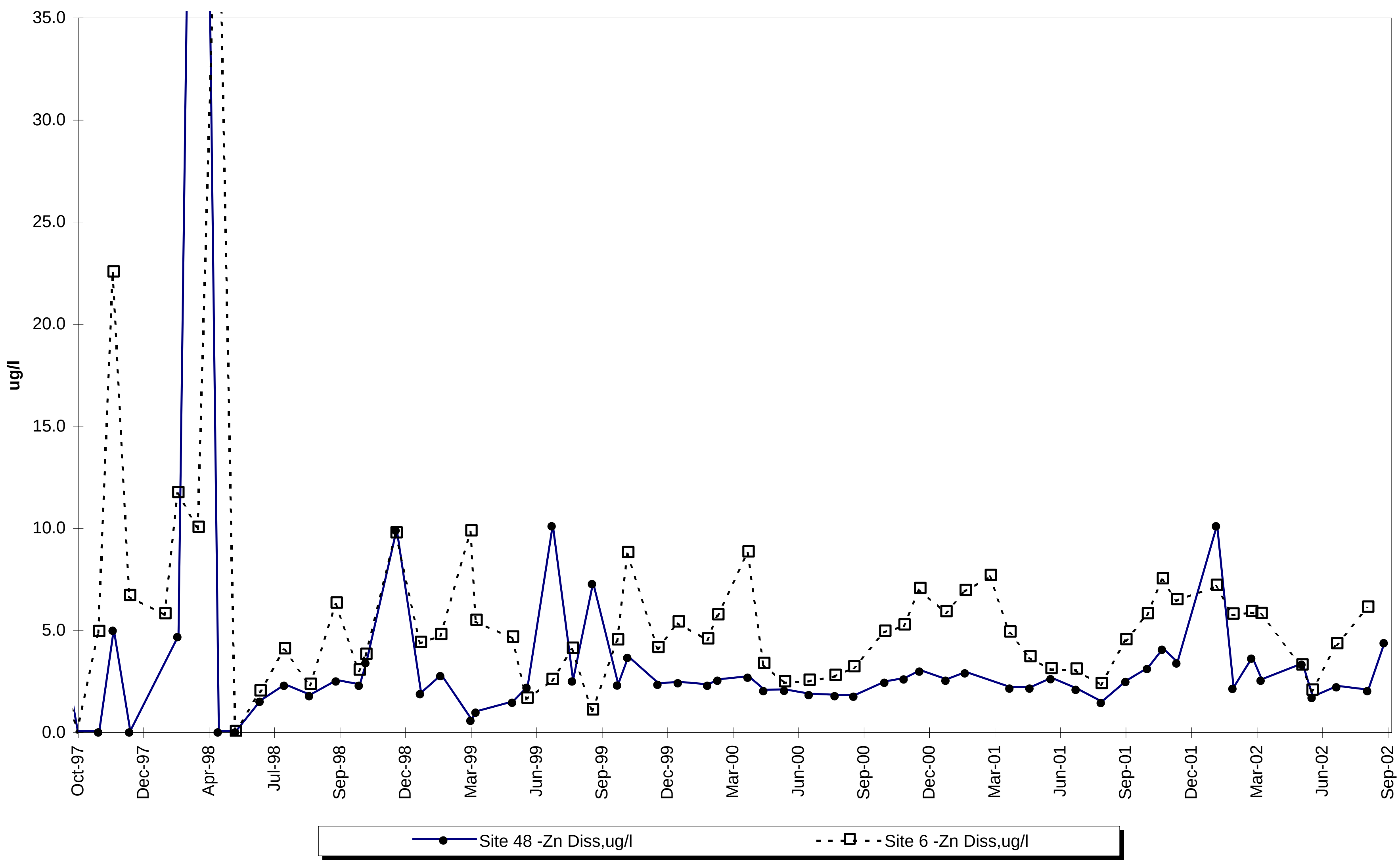
Site 48 vs. Site 6 -Lab pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
48, pH Lab, su
6, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

Site 48 vs Site 6 -Conductivity-Lab




Site 48 vs. Site 6 -Total Alkalinity
mg/l
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Site 48 -Alk tot,mg/l
Site 6 -Alk tot,mg/l

Site 48 vs. Site 6 -Dissolved Zinc



INTERPRETIVE REPORT
SITE 54 "LOWER GREENS CREEK"

All data collected at this site for the past five years are included in the data analyses with the exception of one outlier shown on the table below. During the current year one (1) data point was flagged as an outlier after review by KGCMC. As reported for all sampled sites in December-2001, the value for field specific conductance was flagged and appears to be the result of a malfunction of the field instrument that occurred during the sample run. The hardness value of 129.0 mg/l from the March-2002 sample was reviewed as a potential outlier. The result is over two times the 2002 water year median value and represents a new maximum for the site. The previous maximum was 94 mg/l from the April-1999 sampling period. Review of field notes, laboratory reports, and data limitations listed by the QA reviewer does not indicate the value is an artifact associated with an obvious sampling error. After this analysis the data point was retained with the data set and not flagged as an outlier.

Sample Date	Parameter	Value	Qualifier	Notes
12/5/2001	Cond Field, umho	46.0	R	Suspected field instrument malfunction

The data collected during the current water year are listed in the following "Table of Results for Water Year 2002" report. The table includes all the data, field and lab, collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of zero for the purpose of median calculation.

The data for water year 2002 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified, as listed on the following "Comparison To Standards" report.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious trends were apparent. Additional X-Y plots have been generated for alkalinity, pH, conductance, and dissolved zinc that plot Site 54 and Site 6, the closest upstream site, to aid in the comparison between those two sites.

Median values for alkalinity, pH, specific conductance, and dissolved zinc from site 54 have been compared to those of Site 6. The comparisons were done utilizing a two-tailed, large sample approximation to the Wilcoxon-Mann-Whitney rank sum test with a significance level of $\alpha/2=0.025$. Rank-sum test calculation details can be found in subsequent pages of this section and a summary of the test results is shown in the table below.

Analyte	N		Median Value		W (sum of ranks)		p	$H_0:\mu_{54}=\mu_{06}$
	#06	#54	#06	#54	#06	#54		
Alkalinity (mg/l)	12	11	43.5	43.4	137	139	0.3446	ACCEPT
Lab pH (su)	12	11	7.49	7.49	141	135	0.4389	ACCEPT
Conductivity (umhos)	12	11	123	124	140.5	135.5	0.4267	ACCEPT
Dissolved Zinc (µg/l)	12	11	5.77	5.50	158.5	117.5	0.1944	ACCEPT

For all analytes there are no statistically significant differences between the medians at the $\alpha/2=0.025$ significance level.

Table of Results for Water Year 2002

Site 54 "Lower Greens Creek Control"

Sample Date/Parameter	10/25/2001	11/15/2001	12/5/2001	1/29/2002	2/21/2002	3/19/2002	4/1/2002	5/28/2002	6/11/2002	7/15/2002	8/27/2002	9/19/2002	**Median**
Water Temp (°C)	2.6	4.4	1.0		1.4	0.3	6.5	3.8	4.9	7.8	9.5	7.8	4.4
Conductivity-Field (µmho)	129	112	46		165	171	167	62	86	93	107	93	110
Conductivity-Lab (µmho)	127 J	124 J	148		155	165	176	64	88	100	112	97	124
pH Lab (standard units)	7.37	7.49 J	7.87		7.32	7.63	7.45	6.79	7.16	8.03	7.84	8.08	7.49
pH Field (standard units)	7.80	7.86	7.28		7.62	7.18	7.44	7.10	7.33	7.52	7.63	7.26	7.44
Total Alkalinity (mg/l)	43.9 J	43.4 J	51.8		51.9	55.1	55.8	24.2	35.8	38.2	42.1	37.6	43.4
Hardness (mg/l)	61.1	57.7	69.7		45.4	129.0	56.8	32.0	35.4	38.6	52.4	44.3	52.4
Dissolved As (µg/l)	<0.446	0.269 J	<0.643 UJ		0.098 J	0.166 J	0.167 J	0.281 J	0.213 J	0.274	0.241 U	0.130 J	0.223
Dissolved Ba (µg/l)			30.3		30.5								30.4
Dissolved Cd (µg/l)	<0.049	0.053	<0.029	FROZEN	0.054 J	0.046	0.055	0.043 UJ	<0.034	0.036	0.048	0.041	0.043
Dissolved Cr (µg/l)			<0.275		0.341 J								0.239
Dissolved Cu (µg/l)	0.390	0.662	0.328		0.446	0.349	0.325	0.539	0.323 U	0.434 J	0.636	0.626	0.434
Dissolved Pb (µg/l)	0.0635 UJ	0.1950	<0.0330		<0.0260	<0.0300	0.1390	0.1010	<0.0320 UJ	0.0160 J	0.1440 U	0.0938	0.0635
Dissolved Ni (µg/l)			1.77		1.62								1.70
Dissolved Ag (µg/l)			<0.0140		<0.0120								0.0065
Dissolved Zn (µg/l)	5.25 U	6.27	5.86 J		5.82 J	5.46	6.58	4.18	2.15 J	3.19	5.50	5.52 J	5.50
Dissolved Se (µg/l)			<0.876 UJ		1.170 J								0.804
Dissolved Hg (µg/l)	0.000878 UJ	0.001420 U	0.000636 UJ		0.001220 J	0.000664 J	0.001230 U	0.001840 J	0.000575 U	0.000799 U	0.001260 U	0.001430	0.001220

See "Qualififed Data by QA Reviewer" table for qualifier descriptions.

Shaded data has been qualified as an outlier by KGCMC and removed from any further analysis and is not included into the calculation of the median

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
54	10/25/2001	1:05:00 PM				
			Cond Lab, umho	127	J	Sample Temp.
			Alk Tot, mg/l	43.9	J	Sample Temp.
			Pb Diss, ug/l	0.0635	UJ	Below Quantitative Range, Fi
			Zn Diss, ug/l	5.25	U	Field Blk.
			Hg Diss, ug/l	0.000878	UJ	Field Blk, LCS RPD
54	11/15/2001	12:50:00 PM				
			Cond Lab, umho	124	J	Sample Temp.
			pH Lab, su	7.49	J	Hold Time
			Alk Tot, mg/l	43.4	J	Sample Temp.
			As Diss, ug/l	0.269	J	Below Quantitative Range
			Hg Diss, ug/l	0.00142	U	Field Blank Cont.
54	12/05/2001	1:30:00 PM				
			As Diss, ug/l	-0.643	UJ	LCS Rec.
			Zn Diss, ug/l	5.86	J	LCS Rec.
			Se Diss, ug/l	-0.876	UJ	LCS Rec.
			Hg Diss, ug/l	0.000636	UJ	Field Blk, LCS Rec.
54	02/21/2002	11:11:00 AM				
			As Diss, ug/l	0.0982	J	Below Quantitative Range, L
			Cd Diss, ug/l	0.0537	J	Below Quantitative Range, L
			Cr Diss, ug/l	0.341	J	Below Quantitative Range
			Zn Diss, ug/l	5.82	J	LCS Rec.
			Se Diss, ug/l	1.17	J	Below Quantitative Range, L
			Hg Diss, ug/l	0.00122	J	LCS Rec, LCS RPD
54	03/19/2002	2:30:00 PM				
			As Diss, ug/l	0.166	J	Below Quantitative Range, L
			Hg Diss, ug/l	0.000664	J	Below Quantitative Range, L
54	04/01/2002	2:35:00 PM				
			As Diss, ug/l	0.167	J	Below Quantitative Range, L
			Hg Diss, ug/l	0.00123	U	Field Blank Cont.

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
54	05/28/2002	12:00:00 PM				
			As Diss, ug/l	0.281	J	Below Quantitative Range
			Cd Diss, ug/l	0.0427	UJ	CCV Rec.
			Hg Diss, ug/l	0.00184	J	CCV Rec, LCS Rec, LCS RP
54	06/11/2002	11:25:00 AM				
			As Diss, ug/l	0.213	J	Below Quantitative Range, L
			Cu Diss, ug/l	0.323	U	Field Blank Cont.
			Pb Diss, ug/l	-0.032	UJ	LCS Rec.
			Zn Diss, ug/l	2.15	J	LCS Rec.
			Hg Diss, ug/l	0.000575	U	Field Blank Cont.
54	07/15/2002	11:40:00 AM				
			Cu Diss, ug/l	0.434	J	LCS Rec.
			Pb Diss, ug/l	0.016	J	Below Quantitative Range
			Hg Diss, ug/l	0.000799	U	Field Blank Cont.
54	08/27/2002	11:58:00 AM				
			As Diss, ug/l	0.241	U	Field Blank Contamination
			Pb Diss, ug/l	0.144	U	Field Blank Contamination
			Hg Diss, ug/l	0.00126	U	Field Blank Contamination
54	09/19/2002	11:30:00 AM				
			As Diss, ug/l	0.13	J	Below Quantitative Range
			Zn Diss, ug/l	5.52	J	LCS Rec.

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Comparison To Standards

Date Range: 10/01/2001 to 09/30/2002

Site Number	Date	Time	Dup ID	Storet No.	Parameter Description	Value	Standard	Standard Type
							#Error	

Large Sample Approximation

Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Conductivity Lab, (umhos)**

Site	#6	#54	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	125.0	127.0	13	14
Nov	121.0	124.0	11	12
Dec	146.0	148.0	15	16.5
Jan	148.0		16.5	
Feb	153.0	155.0	18	19
Mar	163.0	165.0	20	21
Apr	175.0	176.0	22	23
May	60.9	64.0	1	2
Jun	86.3	87.8	3	4
Jul	97.9	100.0	7	8
Aug	109.0	112.0	9	10
Sep	95.0	97.1	5	6
Median	123.0	124.0		

N= 23 $W_{\Sigma R}$ 140.5 135.5

n	**m**
12	11

μ_W= 132

σ_W= 16.24

Z_{rs}= 0.18

p-test

0.5733

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

ACCEPT

Large Sample Approximation

Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **pH Lab, (su)**

Site	#6	#54	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	8.35	7.37	23	9
Nov	7.40	7.49	10	12
Dec	7.58	7.87	13	17
Jan	7.35		7	
Feb	7.36	7.32	8	6
Mar	7.92	7.63	18	14
Apr	7.09	7.45	4	11
May	5.78	6.79	1	3
Jun	6.55	7.16	2	5
Jul	7.99	8.03	20	21
Aug	7.86	7.84	16	15
Sep	7.97	8.08	19	22
Median	7.49	7.49		

N= 23 $W_{\Sigma R}$ 141 135

n	**m**
12	11

μ_W= 132

σ_W= 16.25

Z_{rs}= 0.15

p-test

0.5611

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

ACCEPT

Large Sample Approximation

Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Total Alkalinity, (mg/l)**

Site	#6	#54	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	45.8	43.9	14	13
Nov	41.2	43.4	10	12
Dec	50.4	51.8	17	18
Jan	49.8		15	
Feb	50.1	51.9	16	19
Mar	53.3	55.1	20	22
Apr	54.4	55.8	21	23
May	23.4	24.2	1	2
Jun	35.1	35.8	3	4
Jul	37.5	38.2	6	8
Aug	40.9	42.1	9	11
Sep	36.7	37.6	5	7
Median	43.5	43.4		

N= 23 $W_{\Sigma R}$ 137 139

n	**m**
12	11

μ_W= 132

σ_W= 16.25

Z_{rs}= 0.40

p-test

0.6554

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

ACCEPT

Large Sample Approximation

Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Zn Diss, (ug/l)**

Site	#6	#54	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	5.76	5.25	13	7
Nov	7.48	6.27	23	19
Dec	6.46	5.86	20	16
Jan	7.16		22	
Feb	5.75	5.82	12	15
Mar	5.87	5.46	17	8.5
Apr	5.77	6.58	14	21
May	3.26	4.18	4	5
Jun	2.03	2.15	1	2
Jul	4.30	3.19	6	3
Aug	6.09	5.50	18	10
Sep	5.46	5.52	8.5	11
Median	5.77	5.50		

N= 23 ΣR 158.5 117.5

	n	**m**
	12	11

W= 51.5

W_α 18

Upper 114

Lower 18

μ_W= 132

σ_W= 16.24

Z_{rs}= -0.86

p-test

0.1944

$\alpha/2$

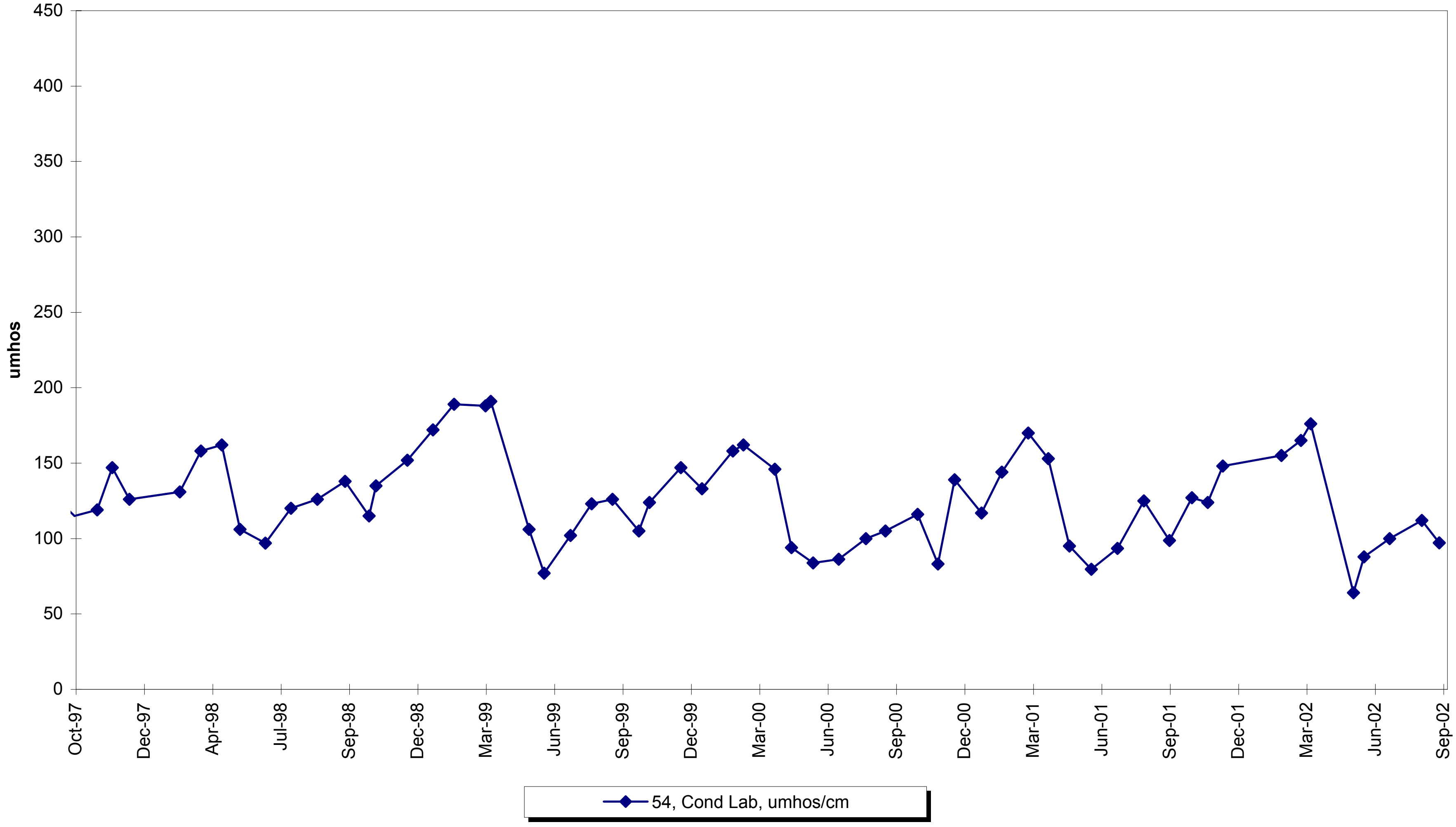
0.025

H_0

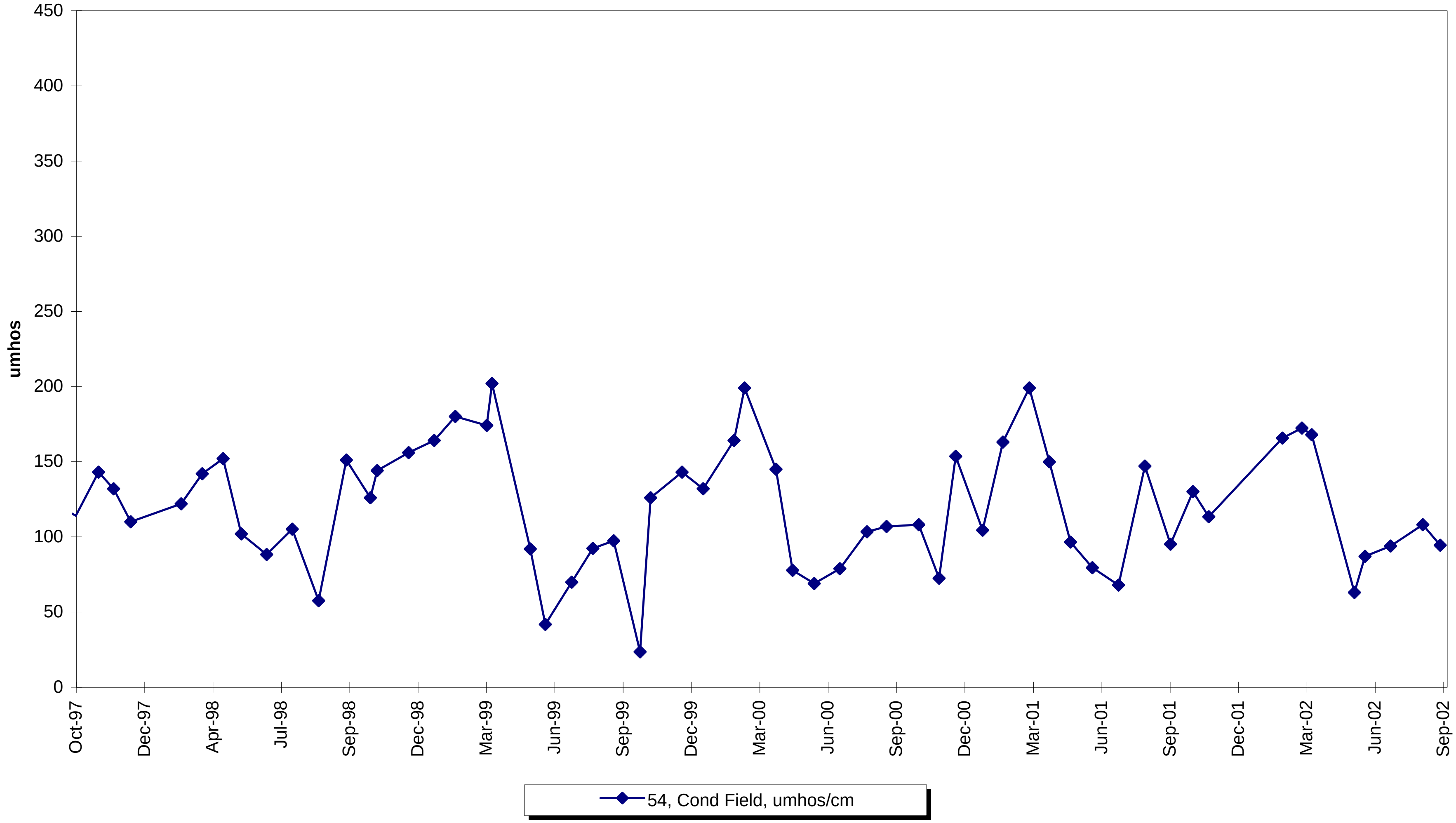
$(\mu_A=\mu_B)$

ACCEPT

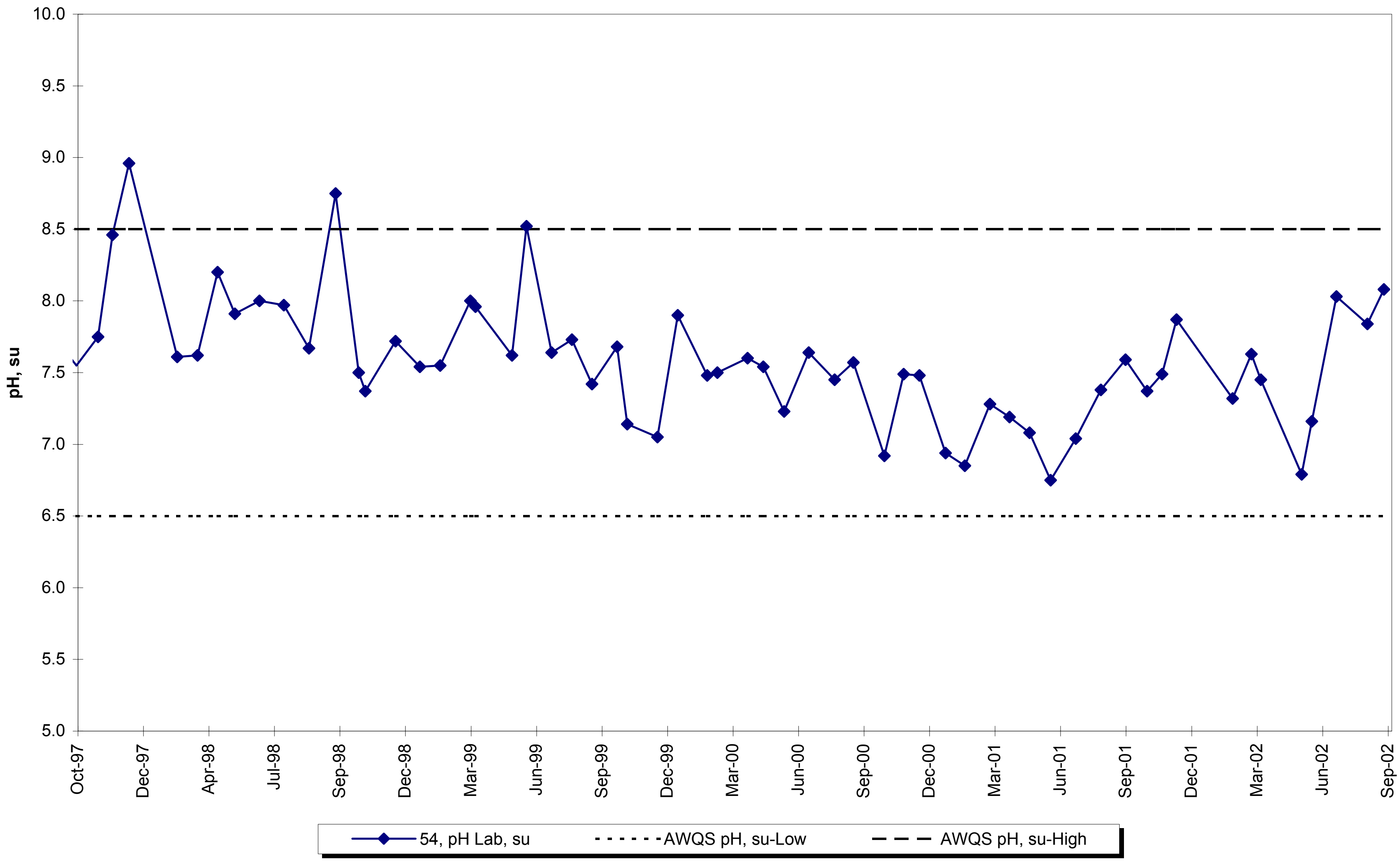
Site 54 -Conductivity-Lab



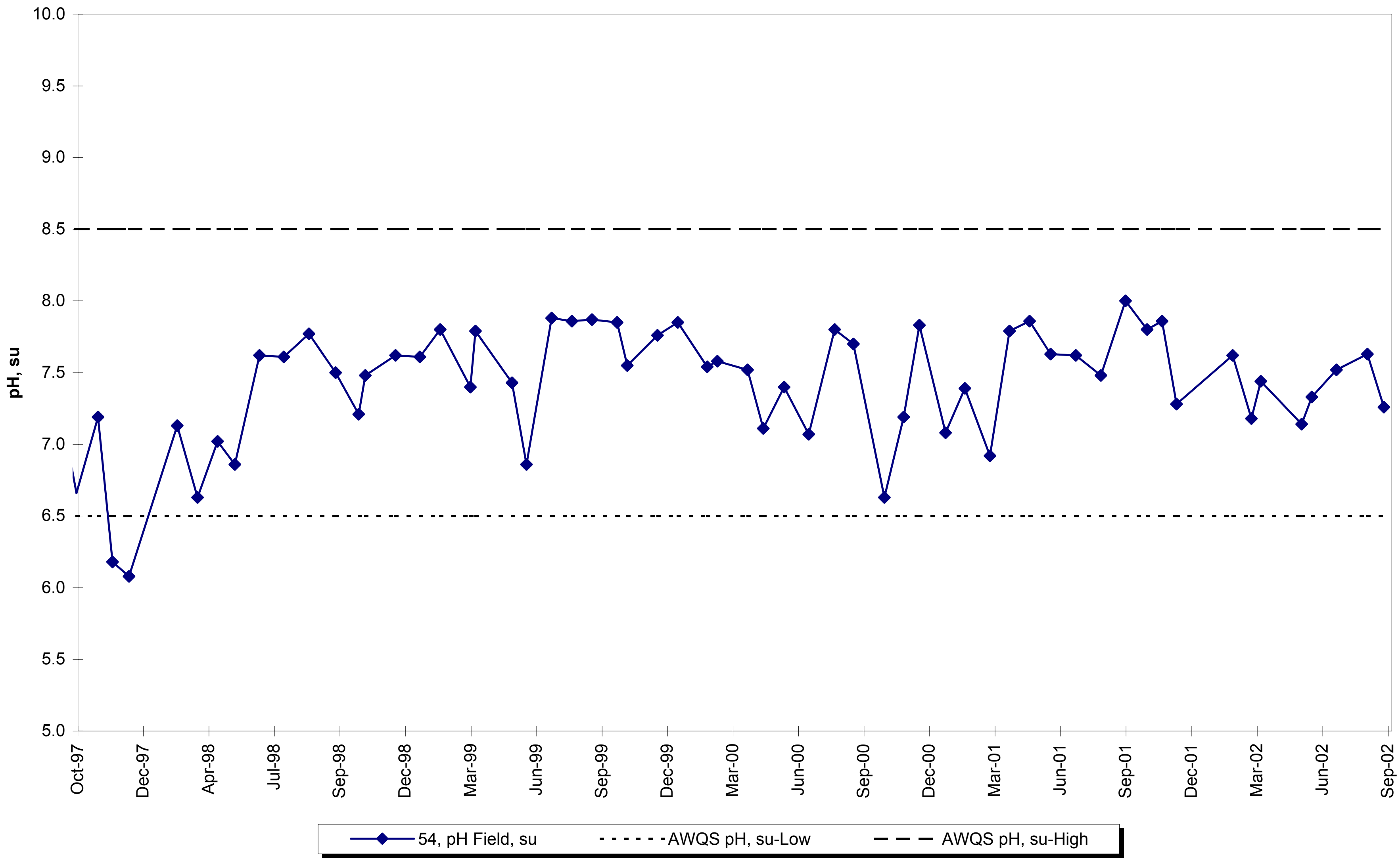
Site 54 -Conductivity-Field



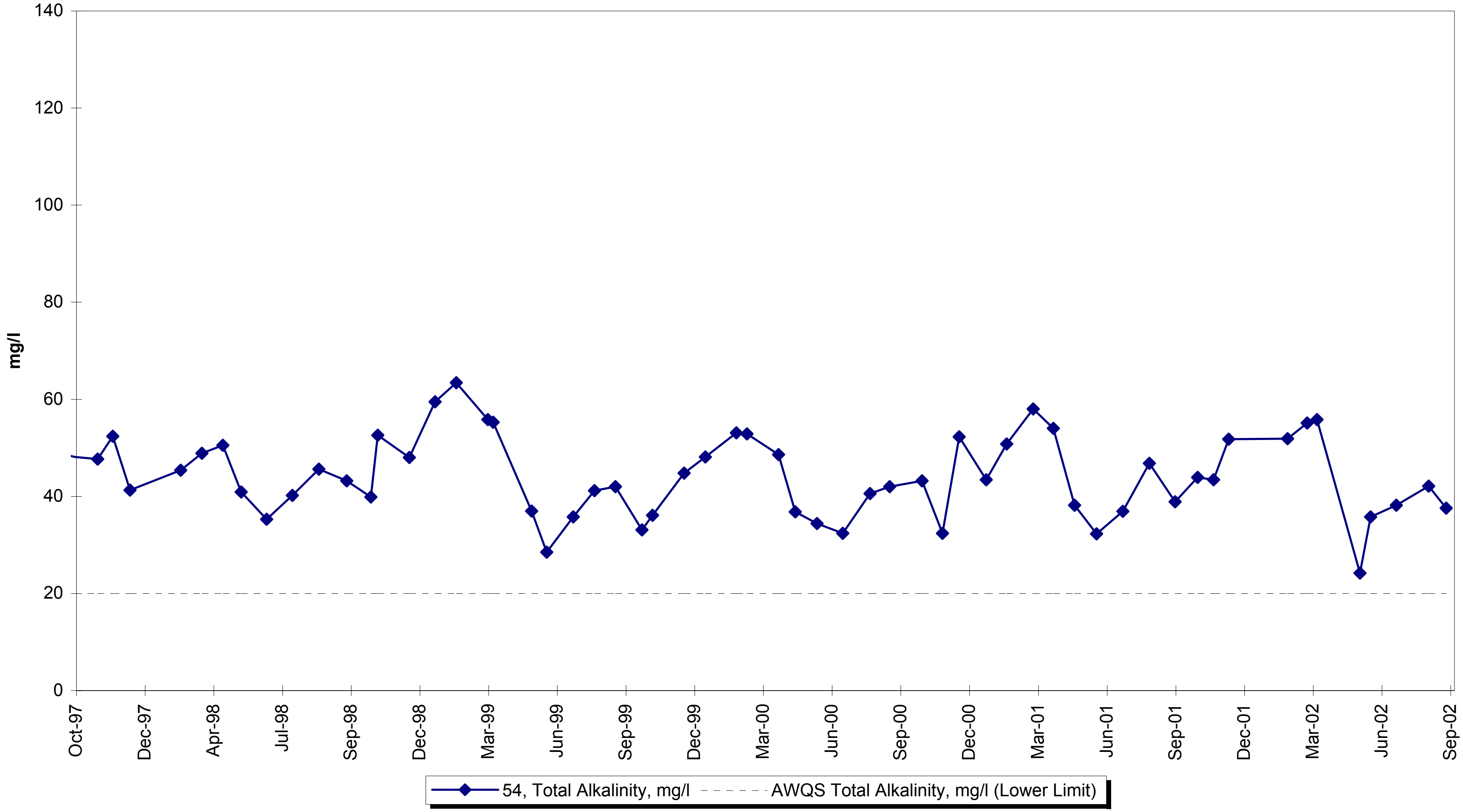
Site 54 -Lab pH

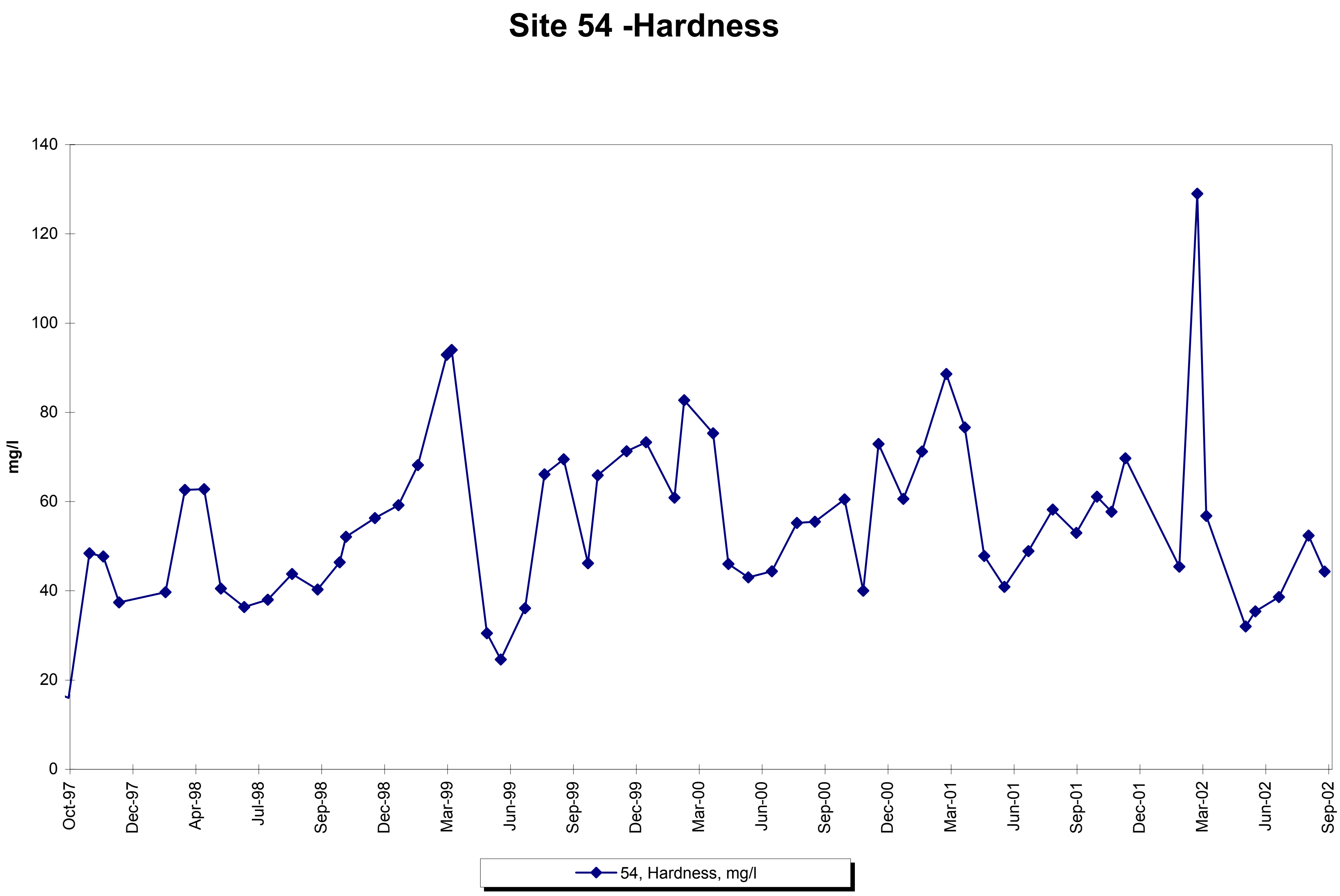


Site 54 -Field pH



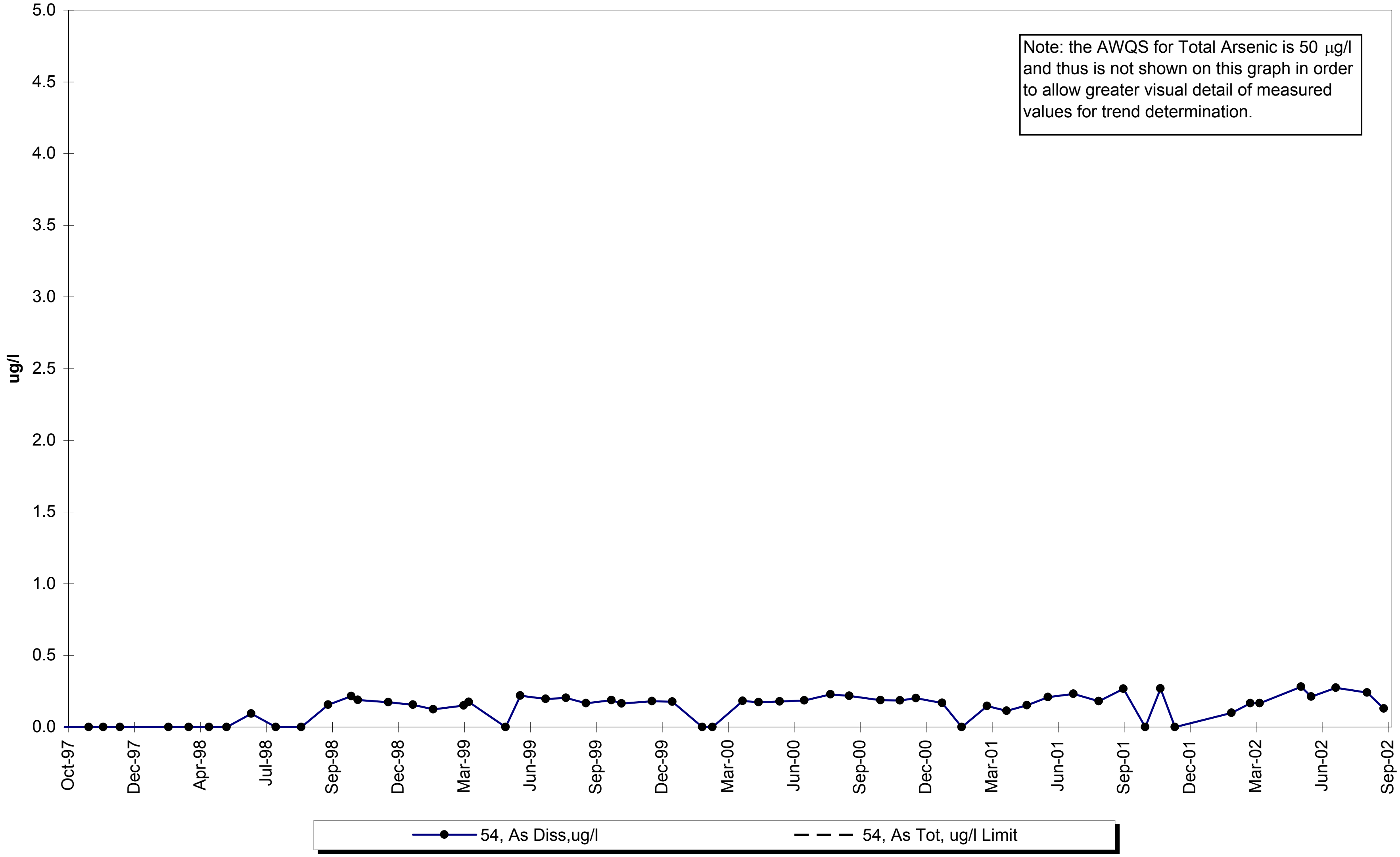
Site 54 -Total Alkalinity



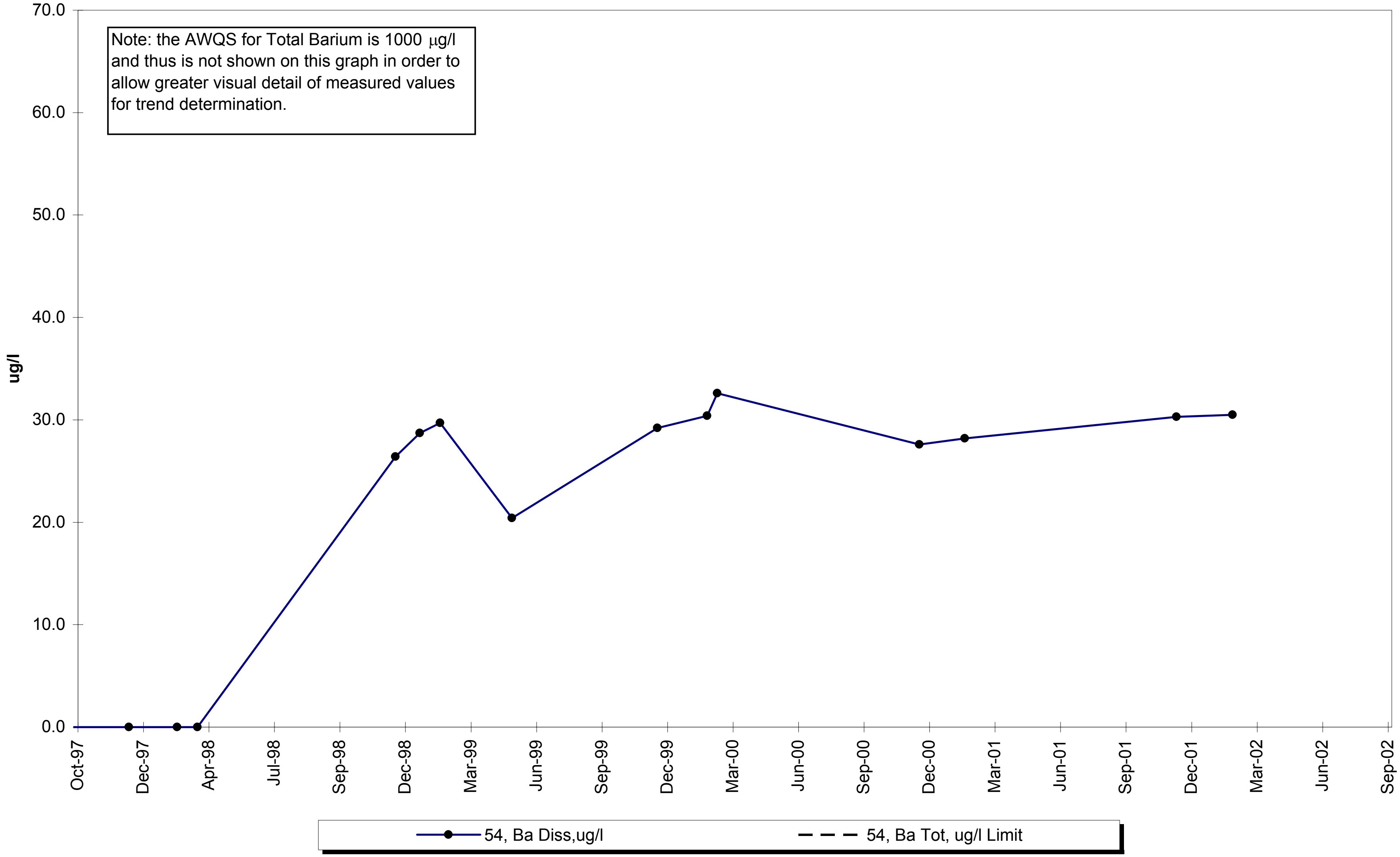


Site 54 -Hardness
mg/l
140
120
100
80
60
40
20
0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
54, Hardness, mg/l

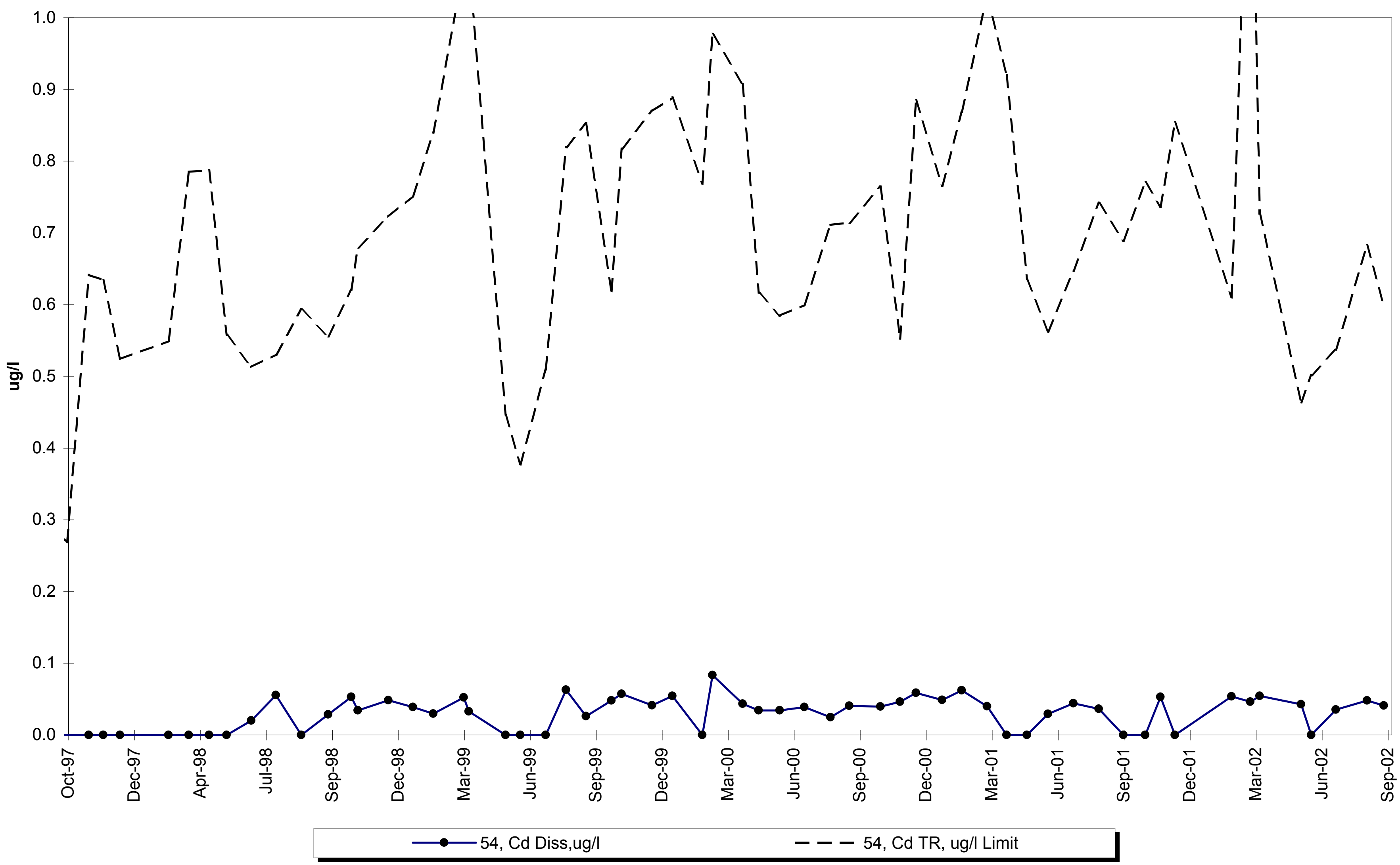
Site 54 -Dissolved Arsenic

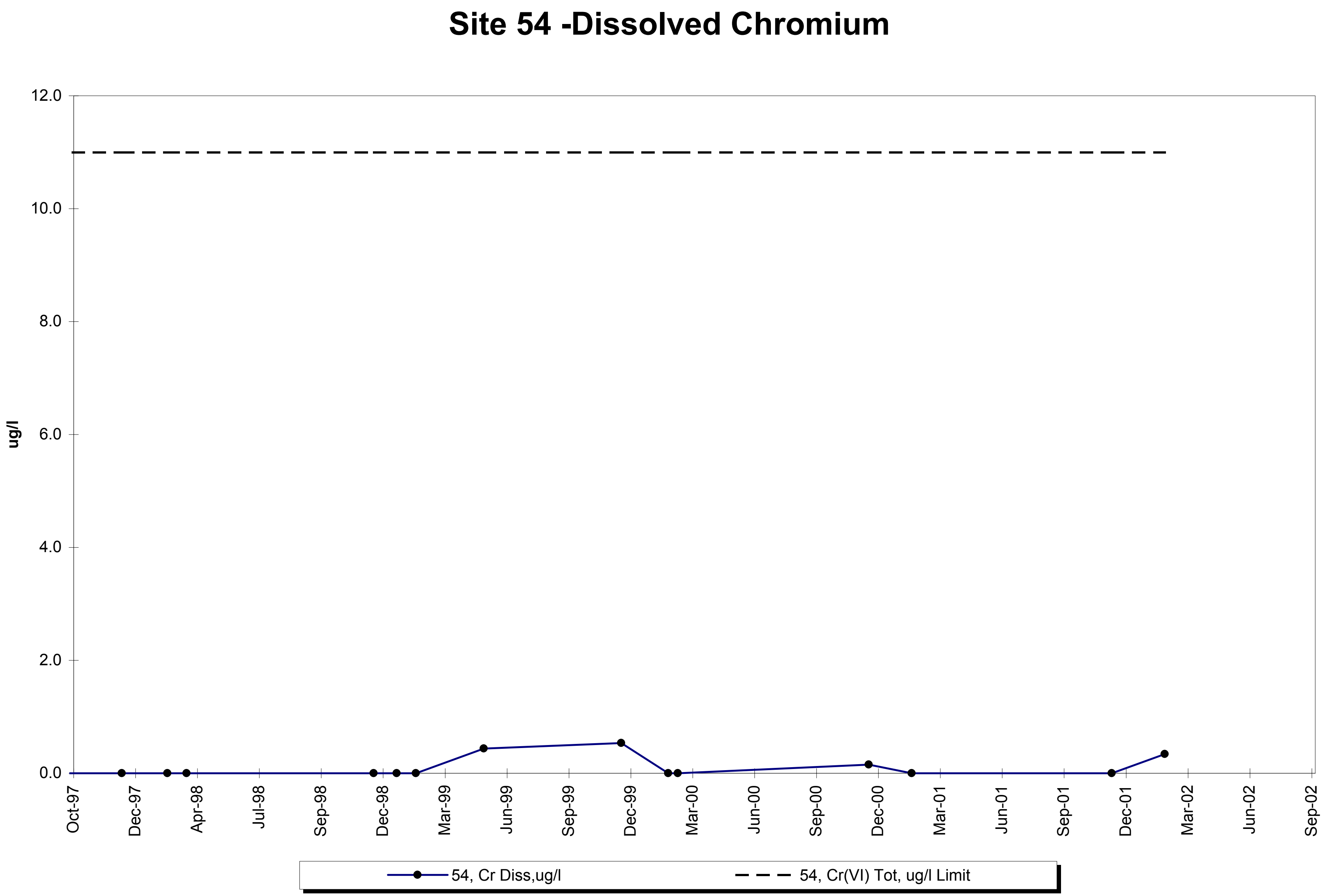


Site 54 -Dissolved Barium



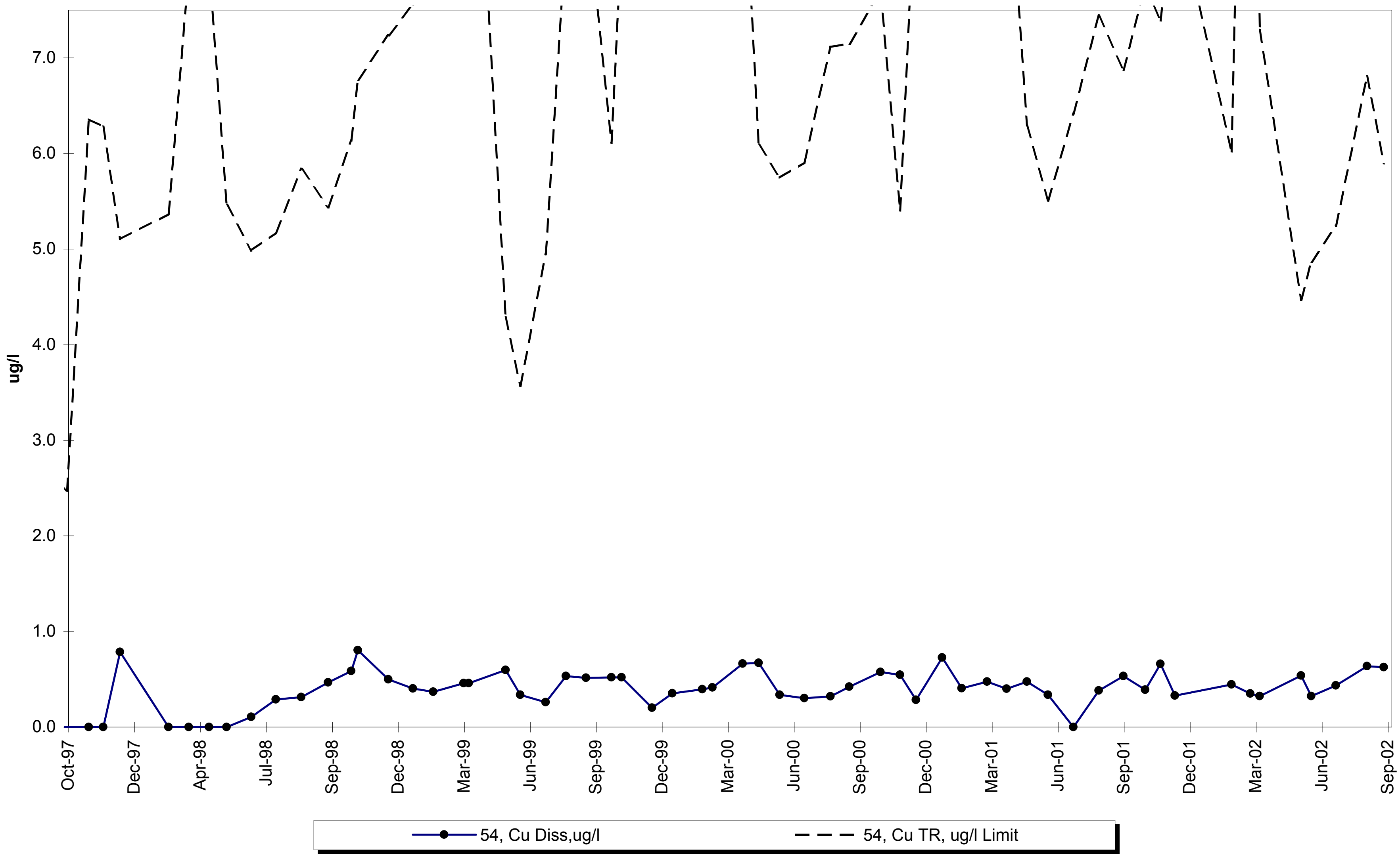
Site 54 -Dissolved Cadmium

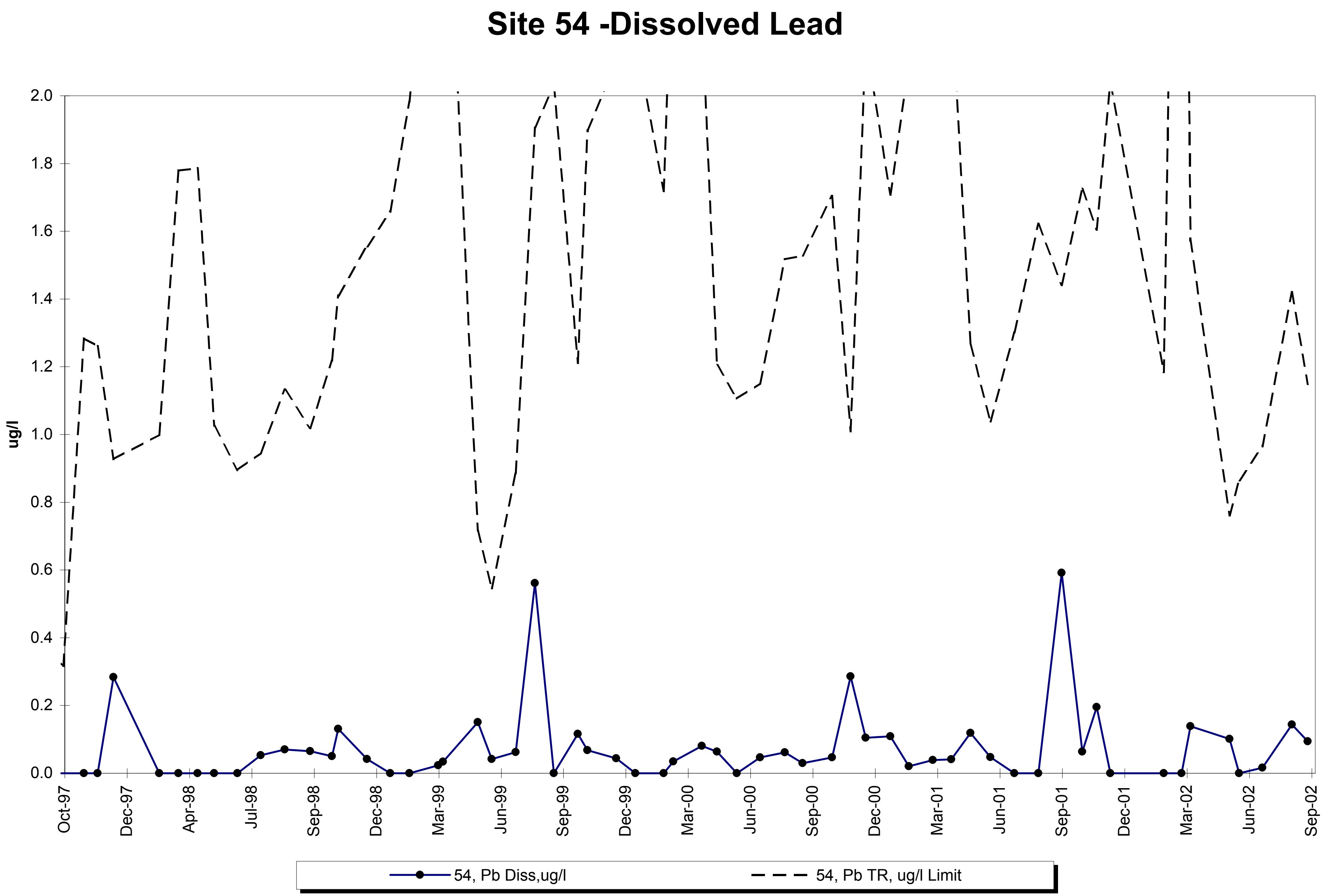




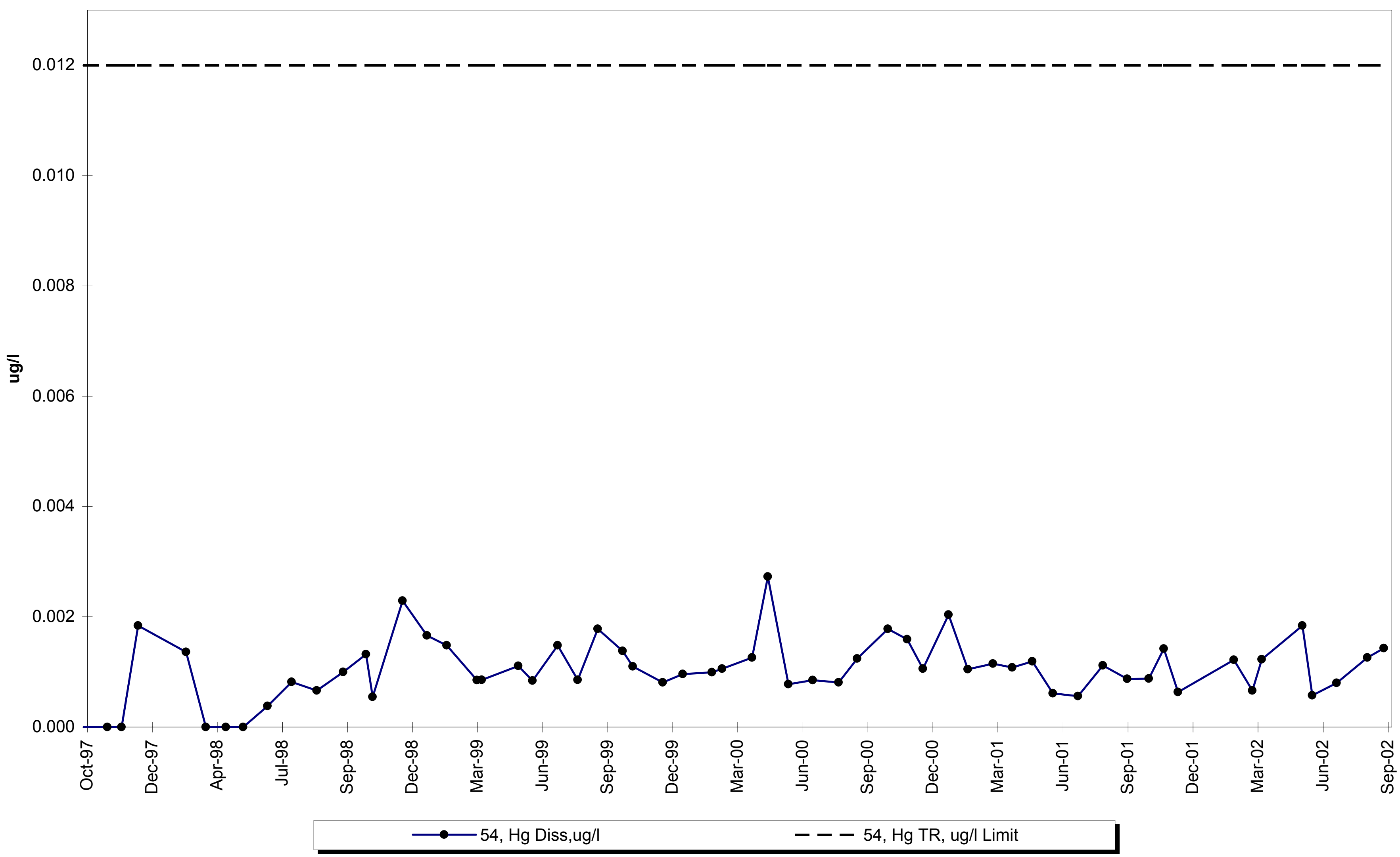
Site 54 -Dissolved Chromium
ug/l
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
54, Cr Diss,ug/l
54, Cr(VI) Tot, ug/l Limit

Site 54 -Dissolved Copper

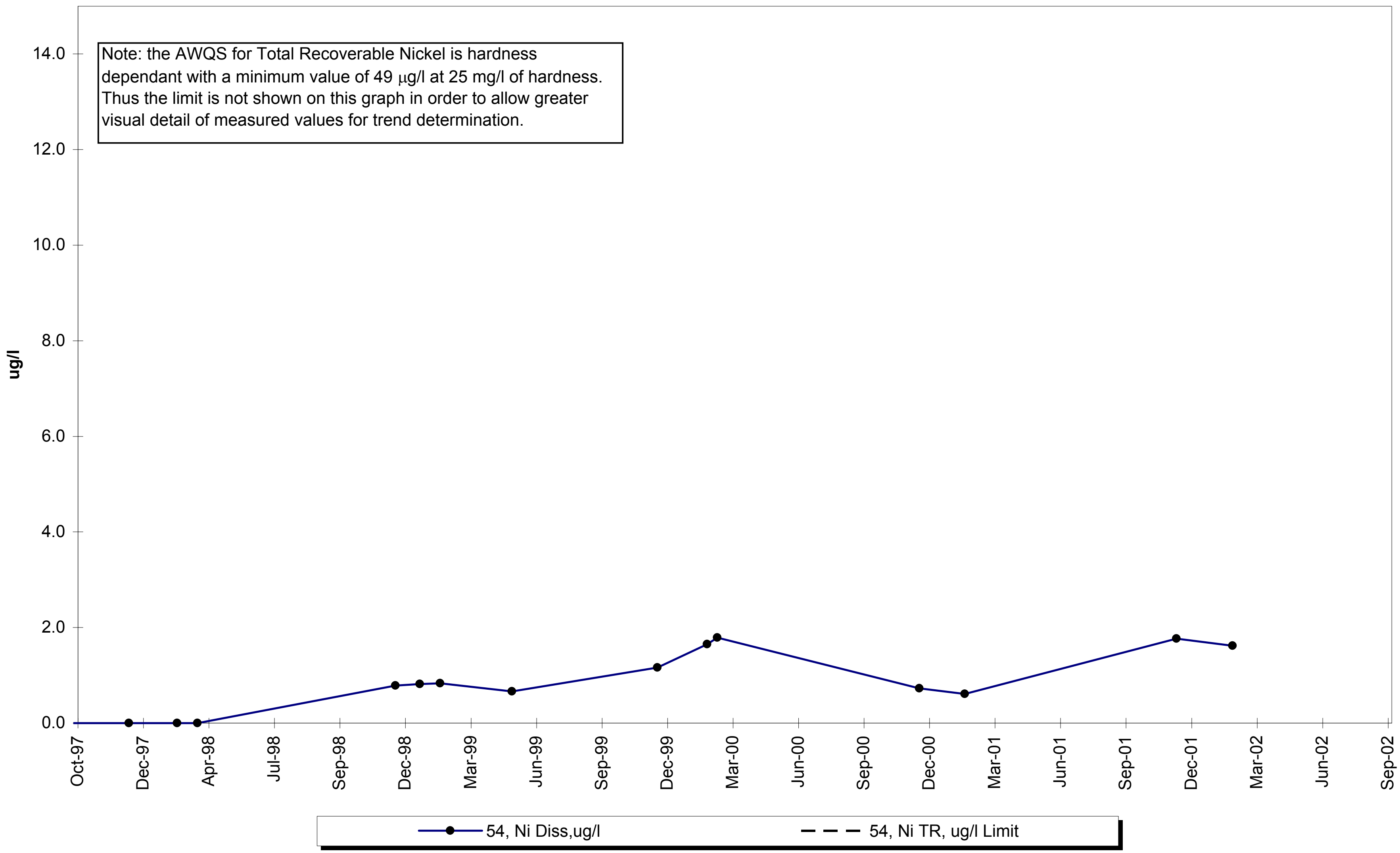



Site 54 -Dissolved Lead
ug/l
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
54, Pb Diss,ug/l
54, Pb TR, ug/l Limit

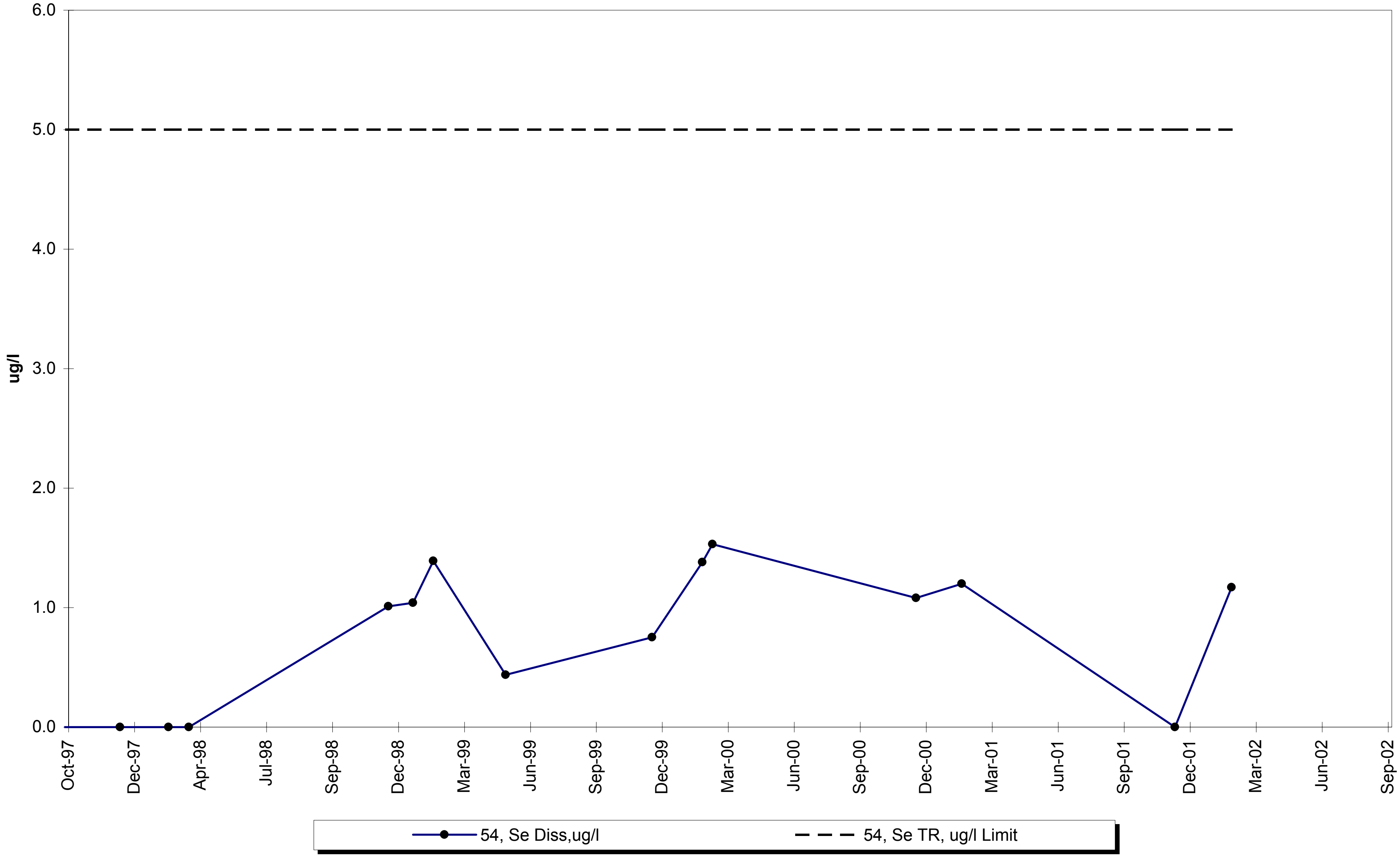
Site 54 -Dissolved Mercury



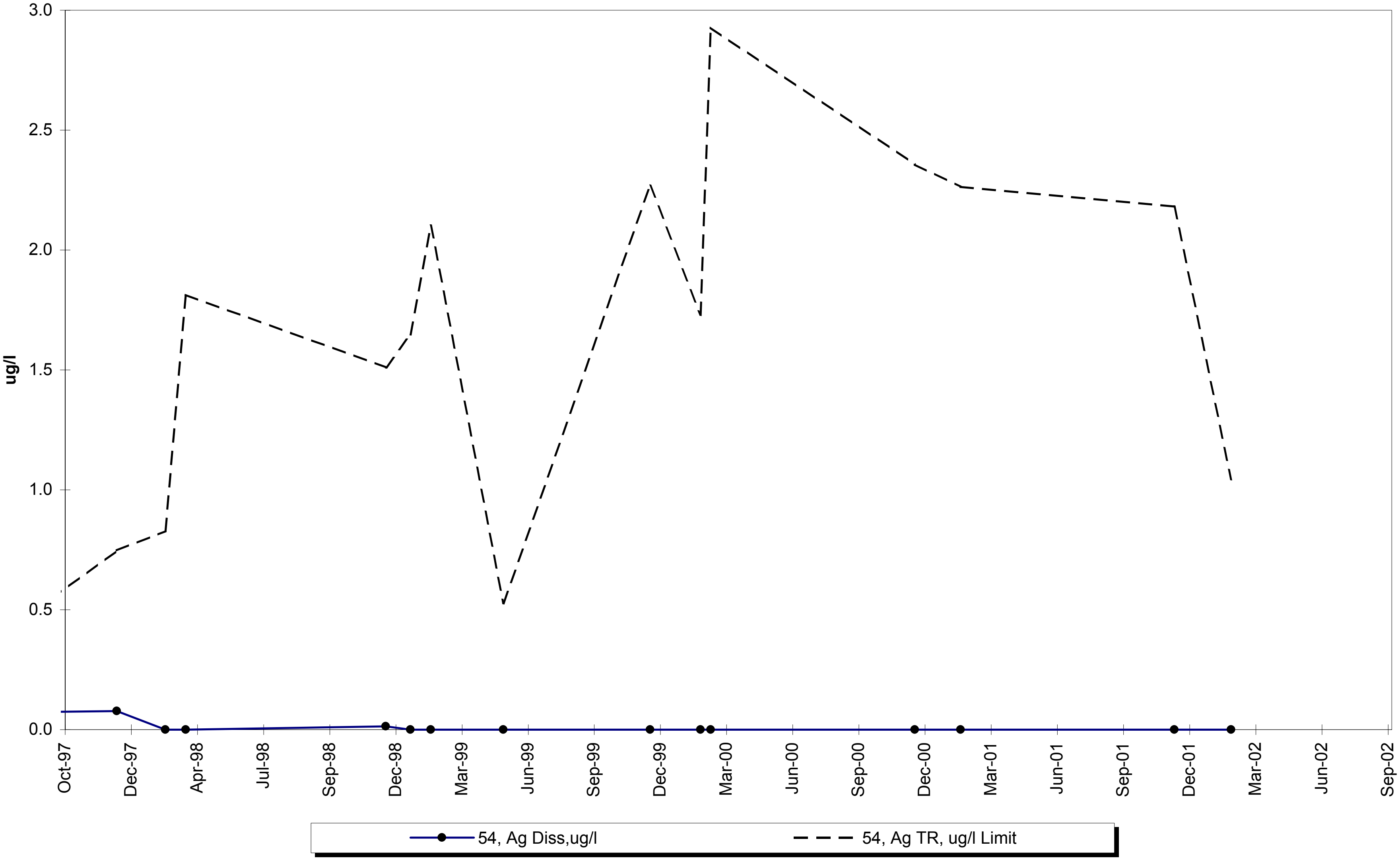
Site 54 -Dissolved Nickel

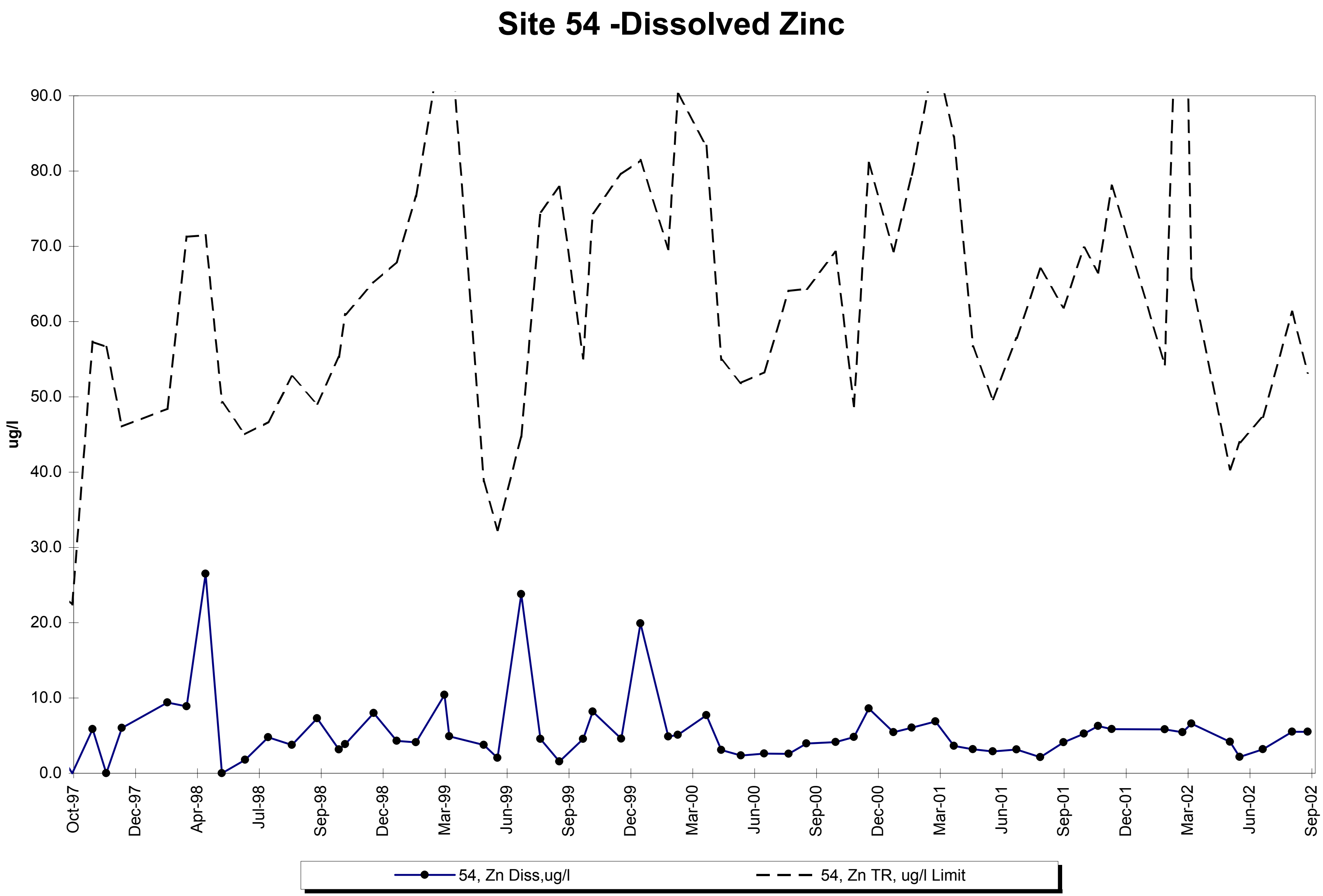


Site 54 -Dissolved Selenium

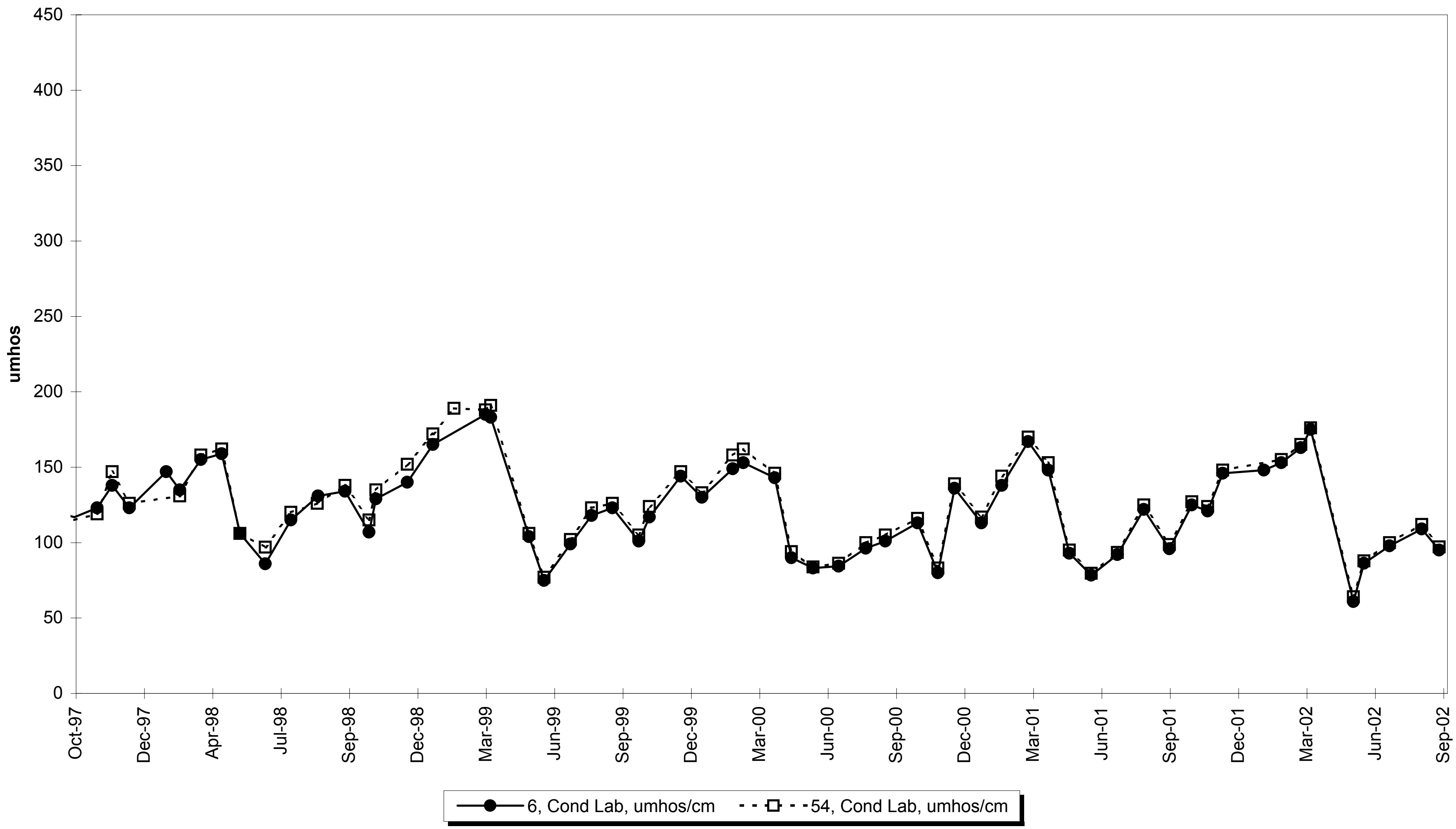


Site 54 -Dissolved Silver

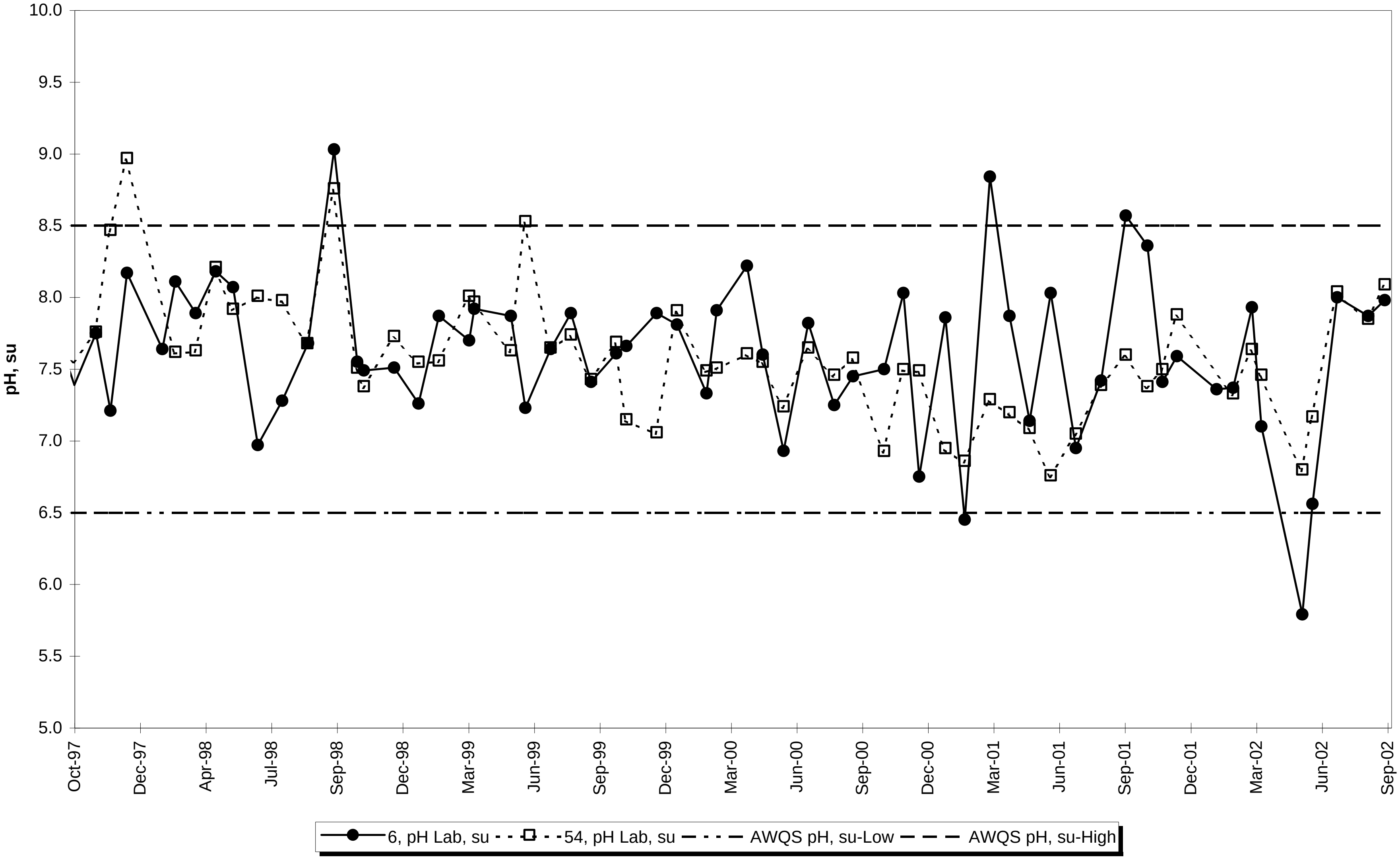


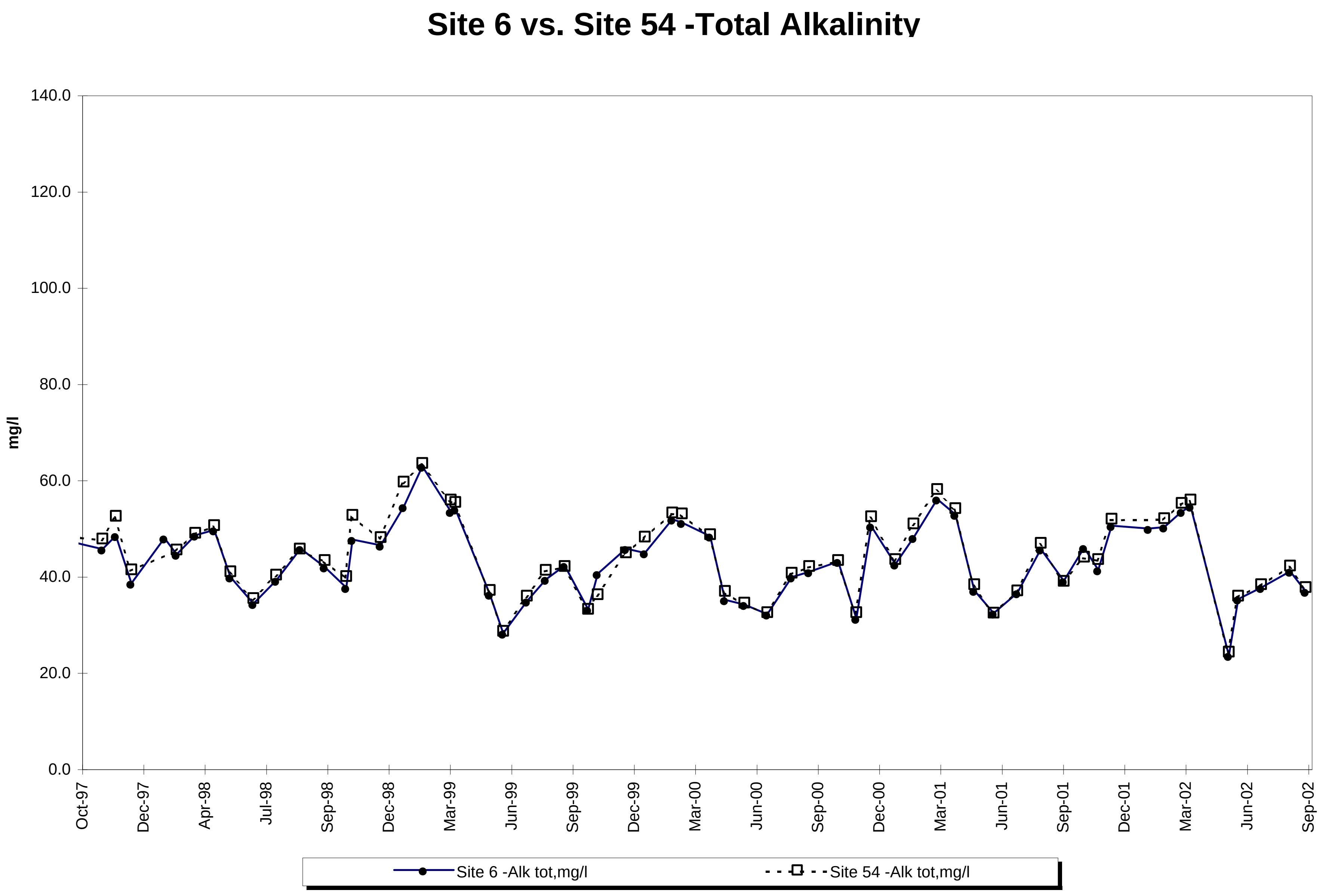

Site 54 -Dissolved Zinc
ug/l
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
54, Zn Diss,ug/l
54, Zn TR, ug/l Limit

Site 6 vs Site 54 -Conductivity-Lab



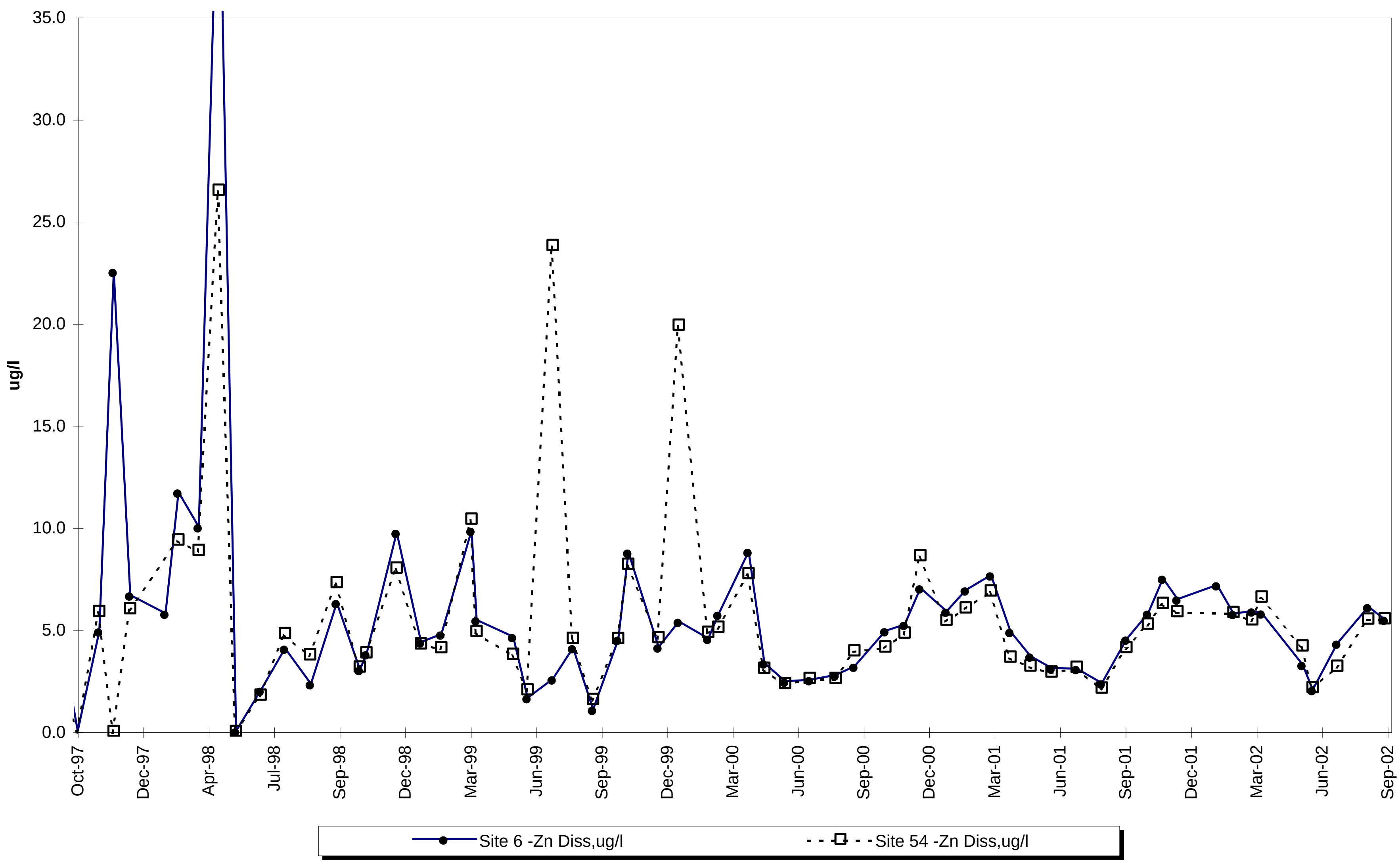
Site 6 vs. Site 54 -Lab pH





Site 6 vs. Site 54 -Total Alkalinity
mg/l
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Site 6 -Alk tot,mg/l
Site 54 -Alk tot,mg/l

Site 6 vs. Site 54 -Dissolved Zinc



INTERPRETIVE REPORT
SITE 49 "UPPER BRUIN CREEK"

All data collected at this site for the past five years are included in the data analyses. The dissolved chromium value of 2.31 µg/l from the February-2002 sampling run was reviewed as a potential outlier. This value was not flagged as an outlier after a through review as discussed in the section for Site 48, which also returned high values. As shown in the table below, there are no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-97 though Sept-02.				

The data collected during the current water year are listed in the following "Table of Results for Water Year 2002" report. The table includes all the data, field and lab, collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of zero for the purpose of median calculation.

The data for water year 2002 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified, as listed on the following "Comparison To Standards" report.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious trends were apparent. As noted above the spike in dissolved chromium from the February-2002 sample occurred at several other sites sampled at the same time and does not appear to be part of any upwards trend.

Table of Results for Water Year 2002

Site 49 "Control Site Upper Bruin Creek"

Sample Date/Parameter	10/25/2001	11/15/2001	12/5/2001	1/29/2002	2/21/2002	3/19/2002	4/1/2002	5/28/2002	6/11/2002	7/15/2002	8/27/2002	9/19/2002	**Median**
Water Temp (°C)	2.0	3.0			0.6	0.9	-0.3	5.8	6.6	9.6	9.9	7.1	4.4
Conductivity-Field (µmho)	153	144			184	196	233	62	101	175	113	125	149
Conductivity-Lab (µmho)	147 J	156 J			169	194	203	66	106	133	119	127	140
pH Lab (standard units)	7.39	7.43 J			7.40	7.75	7.47	6.95	7.26	8.17	7.99	8.10	7.45
pH Field (standard units)	7.78	7.77			7.96	7.62	7.73	7.16	7.80	7.94	7.90	7.78	7.78
Total Alkalinity (mg/l)	61.5 J	64.4 J			67.5	78.3	79.1	27.9	47.1	57.7	51.5	56.0	59.6
Hardness (mg/l)	73.1	80.0			57.4	83.2	86.2	36.2	47.1	58.9	58.9	65.2	62.1
Dissolved As (µg/l)	<0.446	0.206 J			0.120 J	0.161 J	0.153 J	<0.230	<0.204 UJ	0.242	0.186 U	0.103 J	0.157
Dissolved Ba (µg/l)					11.9								11.9
Dissolved Cd (µg/l)	<0.049	0.035 J	FROZEN	FROZEN	0.026 J	0.020 J	0.028 J	0.025 UJ	<0.034	0.033	0.035	0.032	0.027
Dissolved Cr (µg/l)					2.310								2.310
Dissolved Cu (µg/l)	0.391	0.438			0.515	0.417	0.636	0.437	0.467 U	0.627 J	0.783	0.628	0.491
Dissolved Pb (µg/l)	0.0571 UJ	0.0841 J			<0.0260	<0.0300	0.0586 J	<0.0240	<0.0320 UJ	0.0264 J	0.0373 U	0.0892	0.0319
Dissolved Ni (µg/l)					1.62								1.62
Dissolved Ag (µg/l)					<0.0120								0.0060
Dissolved Zn (µg/l)	2.65 U	2.30			1.49 UJ	2.59	2.39	2.31	2.31 J	2.16	2.66 U	2.86 J	2.35
Dissolved Se (µg/l)					1.090 J								1.090
Dissolved Hg (µg/l)	0.001330 UJ	0.001440 U			0.001620 J	0.000791 J	0.000706 U	0.001570 J	0.001360 U	0.001550 U	0.002260	0.002180	0.001495

See "Qualififed Data by QA Reviewer" table for qualifier descriptions.

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
49	10/25/2001	4:00:00 PM				
			Cond Lab, umho	147	J	Sample Temp.
			Alk Tot, mg/l	61.5	J	Sample Temp.
			Pb Diss, ug/l	0.0571	UJ	Below Quantitative Range, Fi
			Zn Diss, ug/l	2.65	U	Field Blk.
			Hg Diss, ug/l	0.00133	UJ	Field Blk, LCS RPD
49	11/15/2001	2:49:00 PM				
			Cond Lab, umho	156	J	Sample Temp.
			pH Lab, su	7.43	J	Hold Time
			Alk Tot, mg/l	64.4	J	Sample Temp.
			As Diss, ug/l	0.206	J	Below Quantitative Range
			Cd Diss, ug/l	0.0345	J	Below Quantitative Range
			Pb Diss, ug/l	0.0841	J	Below Quantitative Range
			Hg Diss, ug/l	0.00144	U	Field Blank Cont.
49	02/21/2002	1:40:00 PM				
			As Diss, ug/l	0.12	J	Below Quantitative Range, L
			Cd Diss, ug/l	0.0259	J	Below Quantitative Range, L
			Zn Diss, ug/l	1.49	UJ	Field Blk, LCS Rec.
			Se Diss, ug/l	1.09	J	Below Quantitative Range, L
			Hg Diss, ug/l	0.00162	J	LCS Rec, LCS RPD
49	03/19/2002	12:55:00 PM				
			As Diss, ug/l	0.161	J	Below Quantitative Range, L
			Cd Diss, ug/l	0.0195	J	Below Quantitative Range
			Hg Diss, ug/l	0.000791	J	Below Quantitative Range, L
49	04/01/2002	1:35:00 PM				
			As Diss, ug/l	0.153	J	Below Quantitative Range, L
			Cd Diss, ug/l	0.0281	J	Below Quantitative Range
			Pb Diss, ug/l	0.0586	J	Below Quantitative Range
			Hg Diss, ug/l	0.000706	U	Field Blank Cont.
49	05/28/2002	2:40:00 PM				
			Cd Diss, ug/l	0.0247	UJ	CCV Rec.
			Hg Diss, ug/l	0.00157	J	CCV Rec, LCS Rec, LCS RP

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
49	06/11/2002	3:15:00 PM				
			As Diss, ug/l	-0.204	UJ	LCS Rec.
			Cu Diss, ug/l	0.467	U	Field Blank Cont.
			Pb Diss, ug/l	-0.032	UJ	LCS Rec.
			Zn Diss, ug/l	2.31	J	LCS Rec.
			Hg Diss, ug/l	0.00136	U	Field Blank Cont.
49	07/15/2002	3:00:00 PM				
			Cu Diss, ug/l	0.627	J	LCS Rec.
			Pb Diss, ug/l	0.0264	J	Below Quantitative Range
			Hg Diss, ug/l	0.00155	U	Field Blank Cont.
49	08/27/2002	2:15:00 PM				
			As Diss, ug/l	0.186	U	Field Blank Contamination
			Pb Diss, ug/l	0.0373	U	Field Blank Contamination
			Zn Diss, ug/l	2.66	U	Field Blank Contamination
49	09/19/2002	11:39:00 AM				
			As Diss, ug/l	0.103	J	Below Quantitative Range
			Zn Diss, ug/l	2.86	J	LCS Rec.

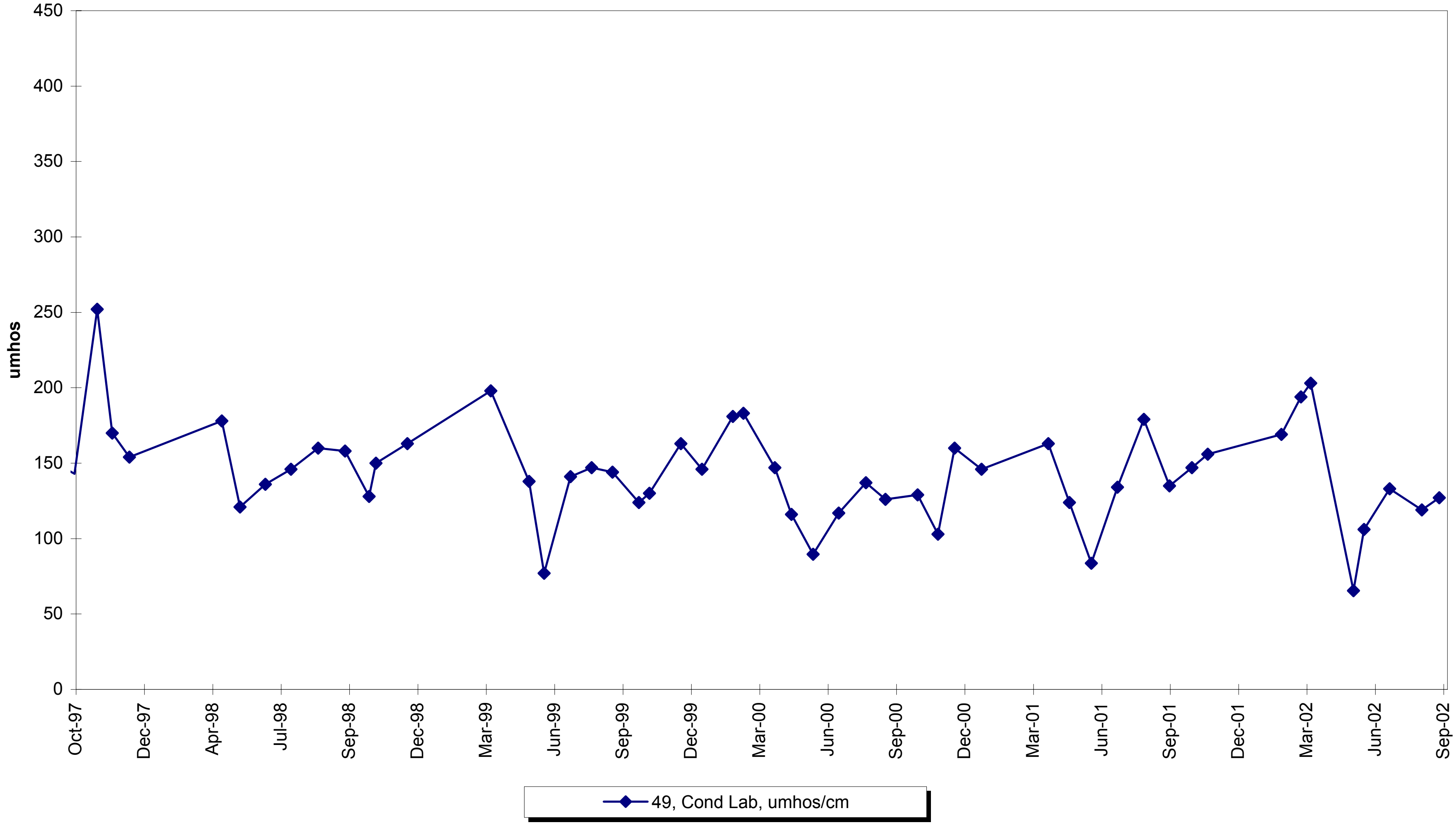
Qualifier	**Description**
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Comparison To Standards

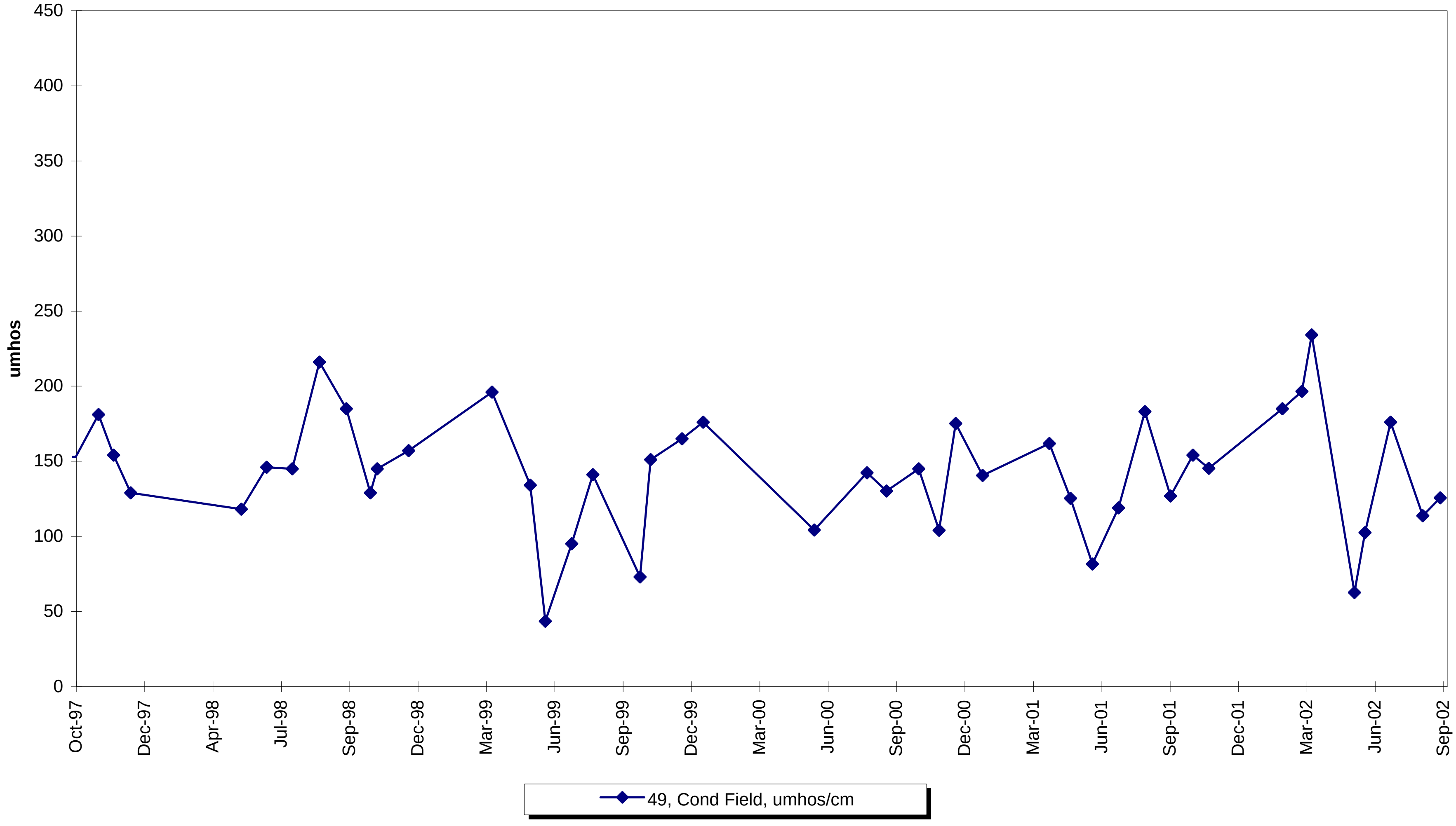
Date Range: 10/01/2001 to 09/30/2002

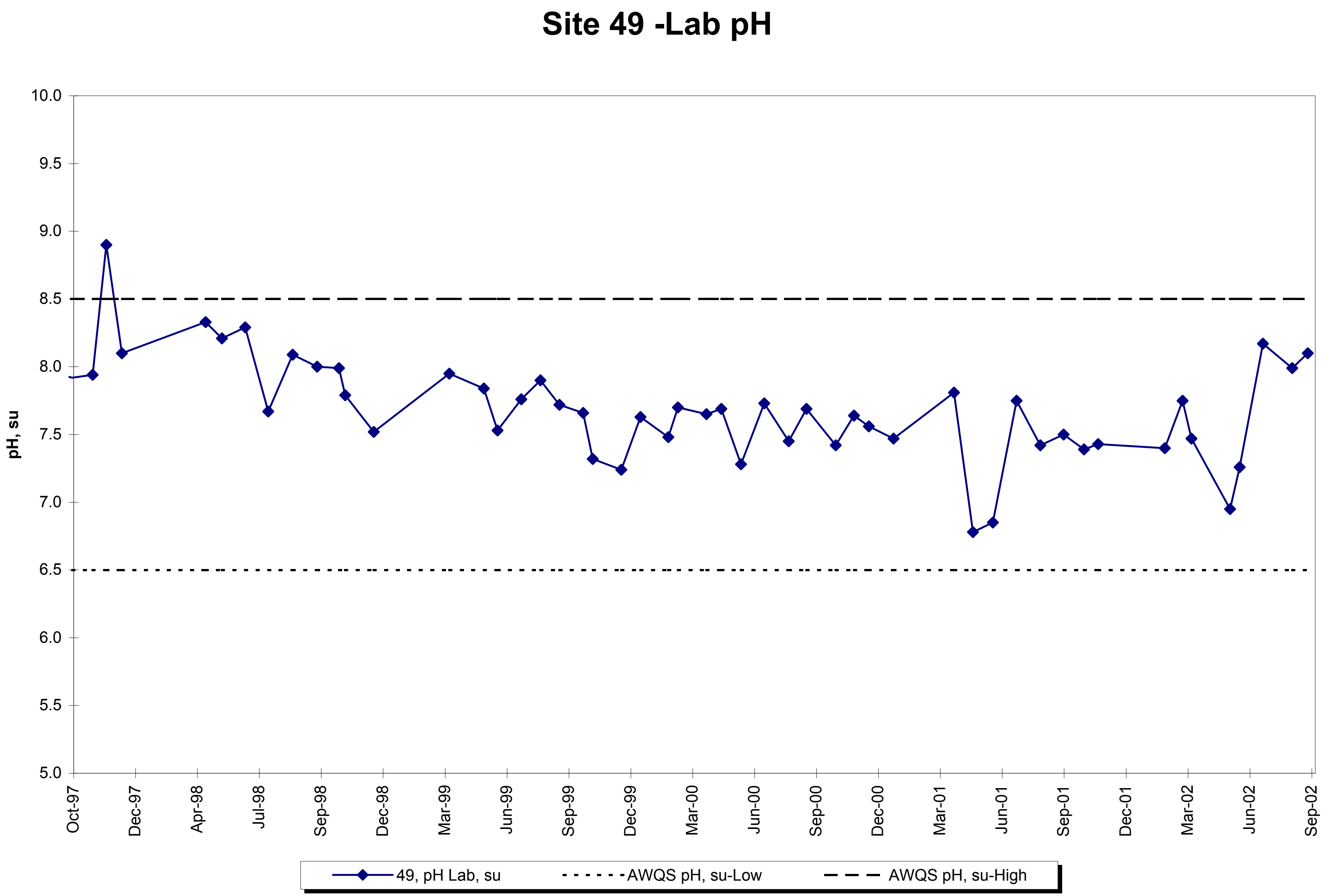
Site Number	Date	Time	Dup ID	Storet No.	Parameter Description	Value	Standard	Standard Type
							#Error	

Site 49 -Conductivity-Lab

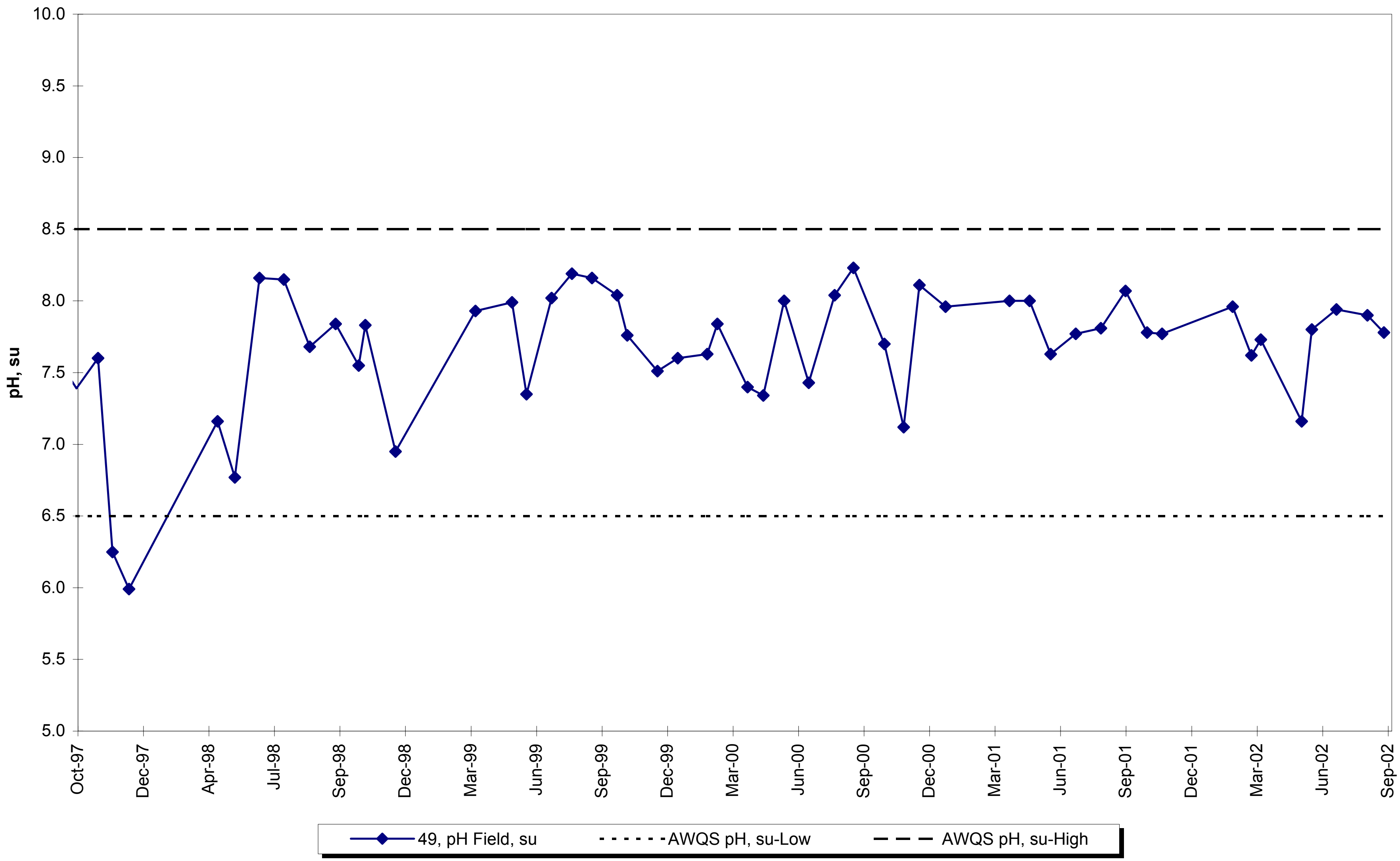


Site 49 -Conductivity-Field

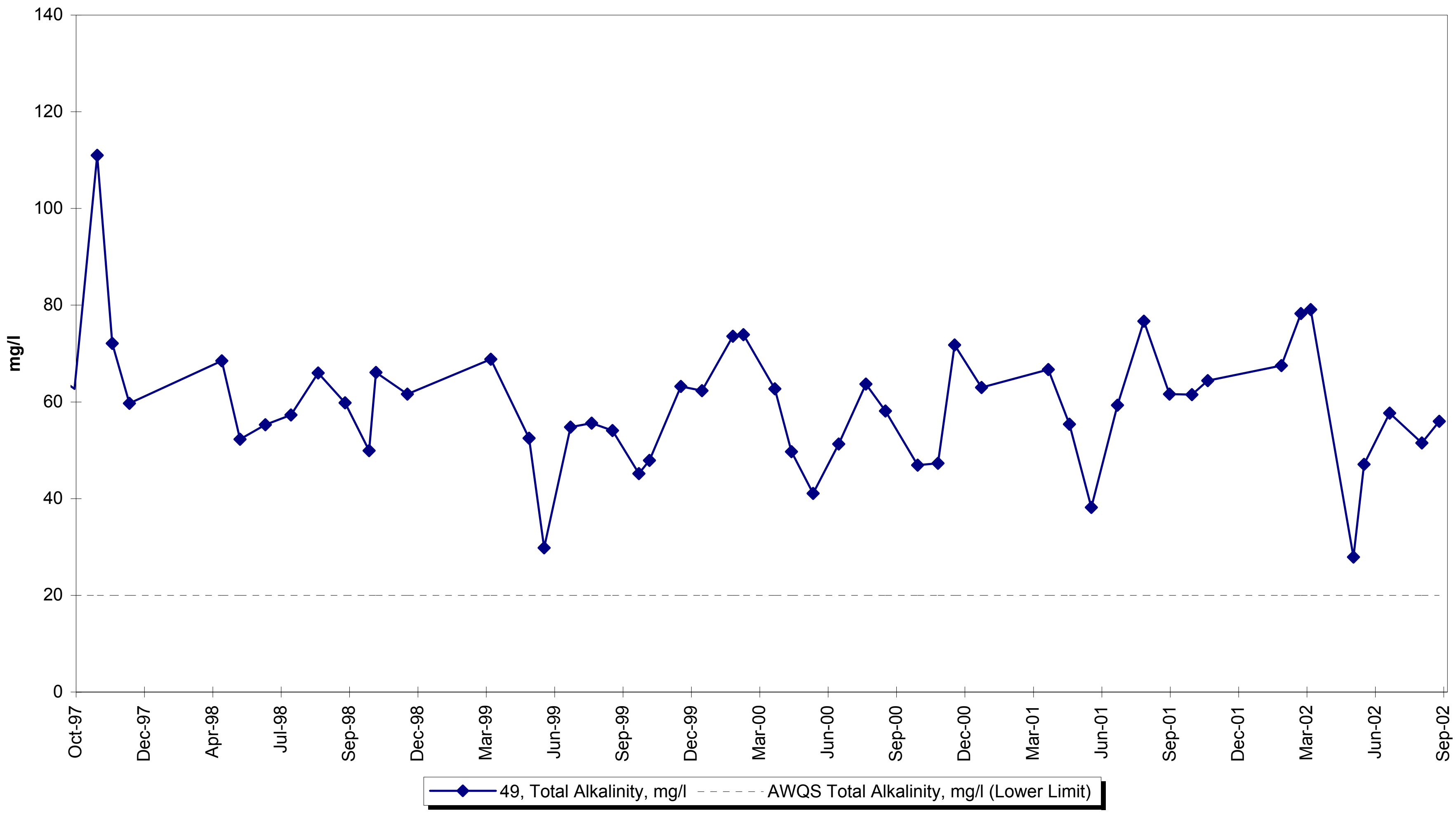



Site 49 -Lab pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
49, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

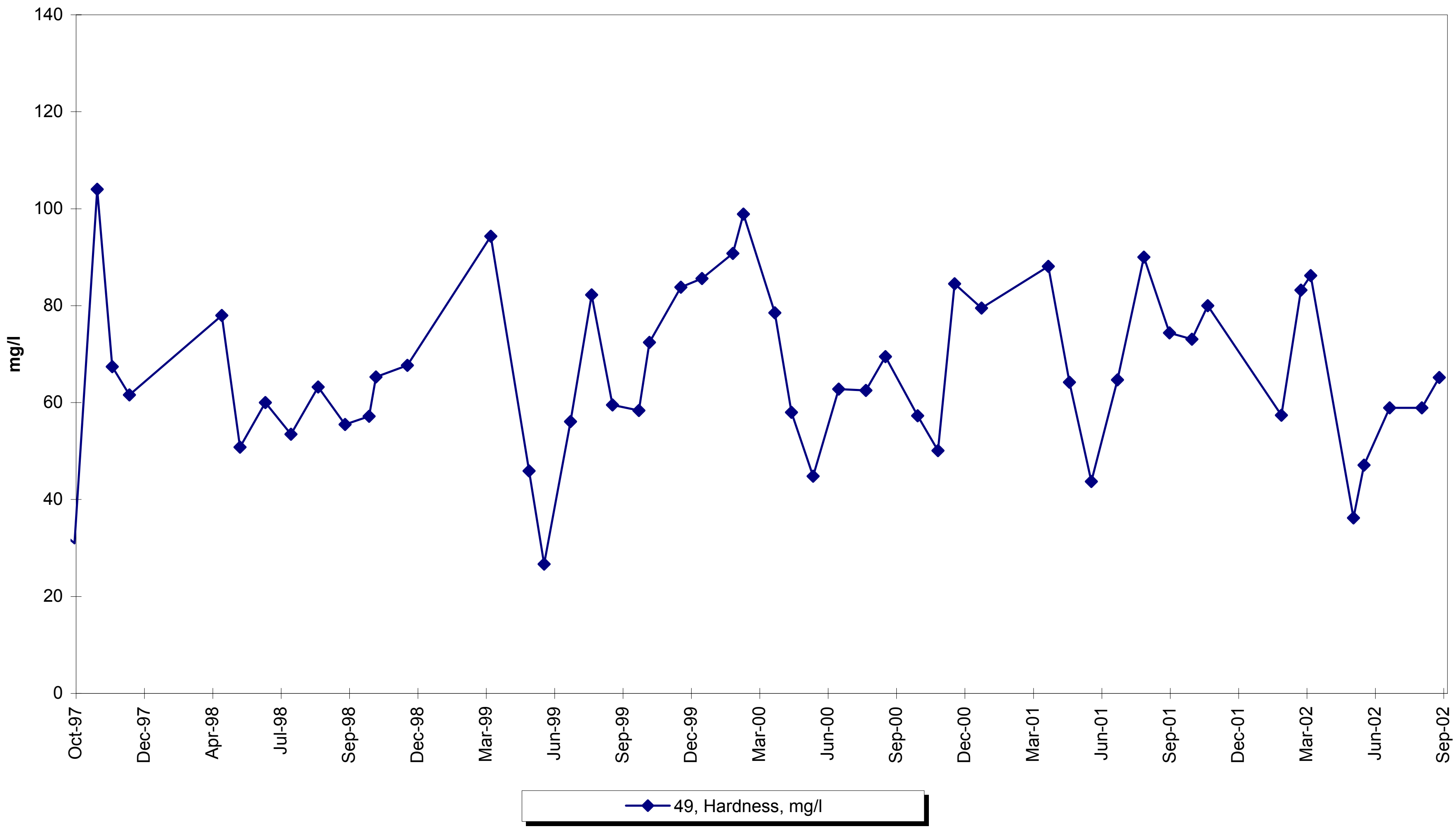
Site 49 -Field pH

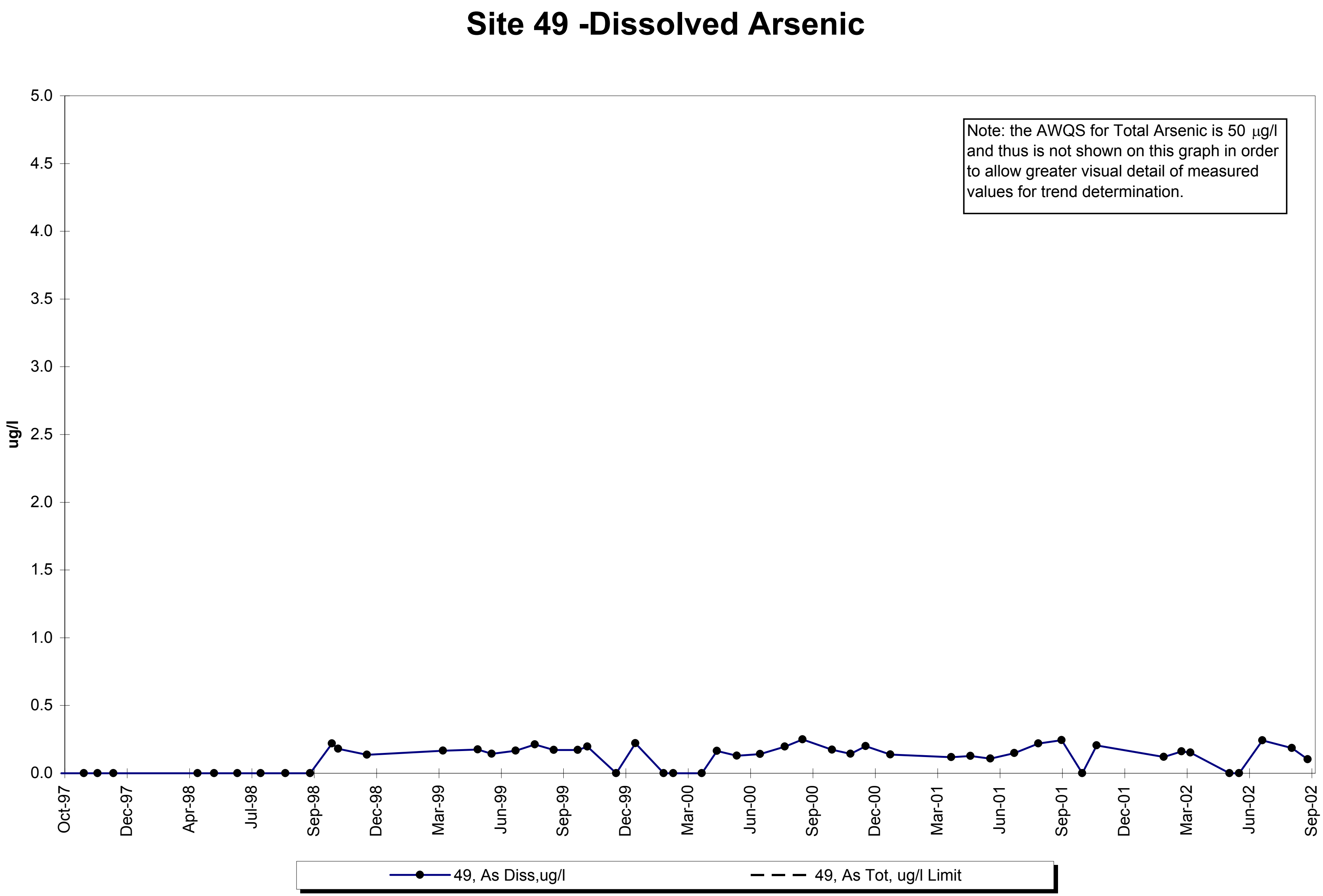


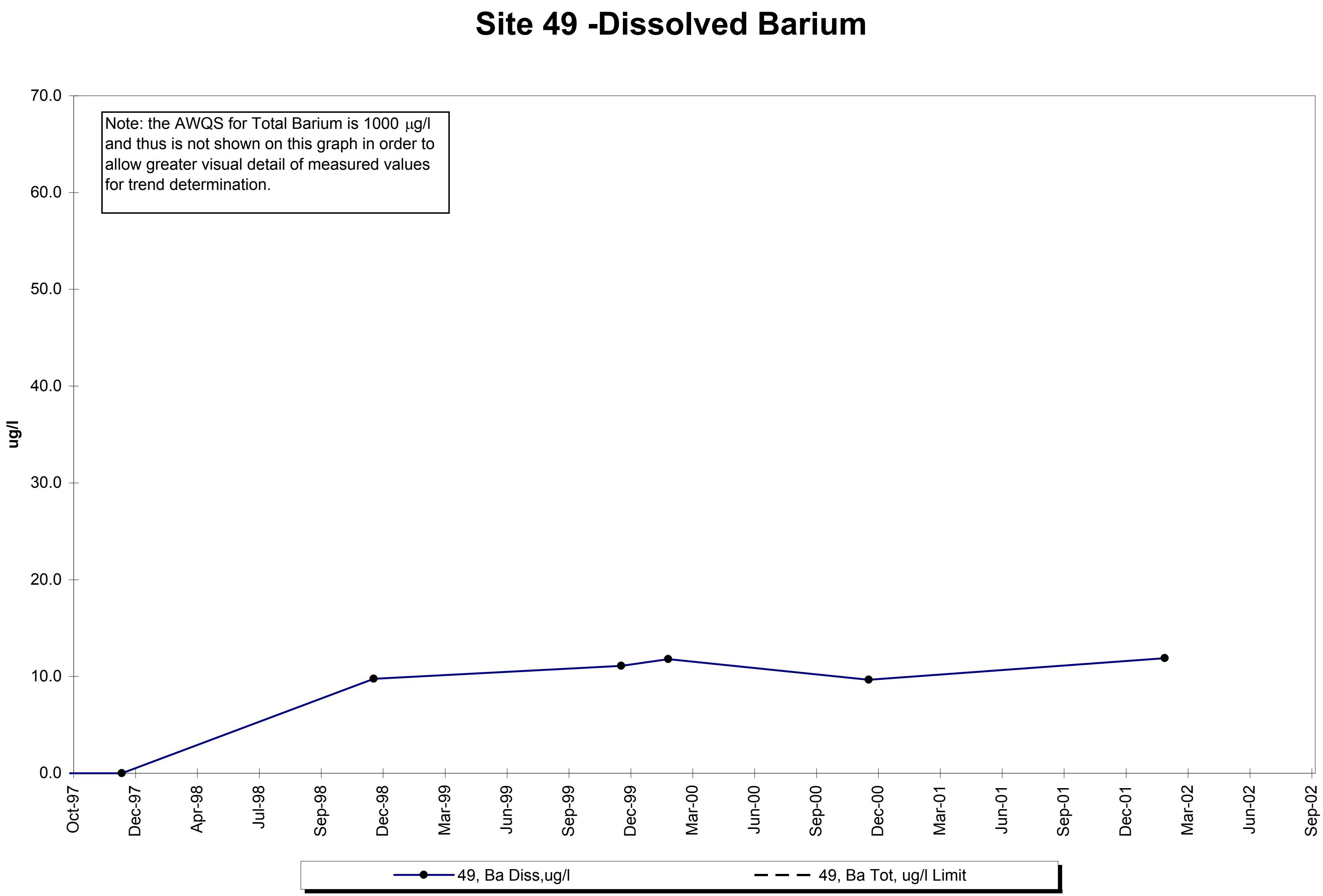
Site 49 -Total Alkalinity



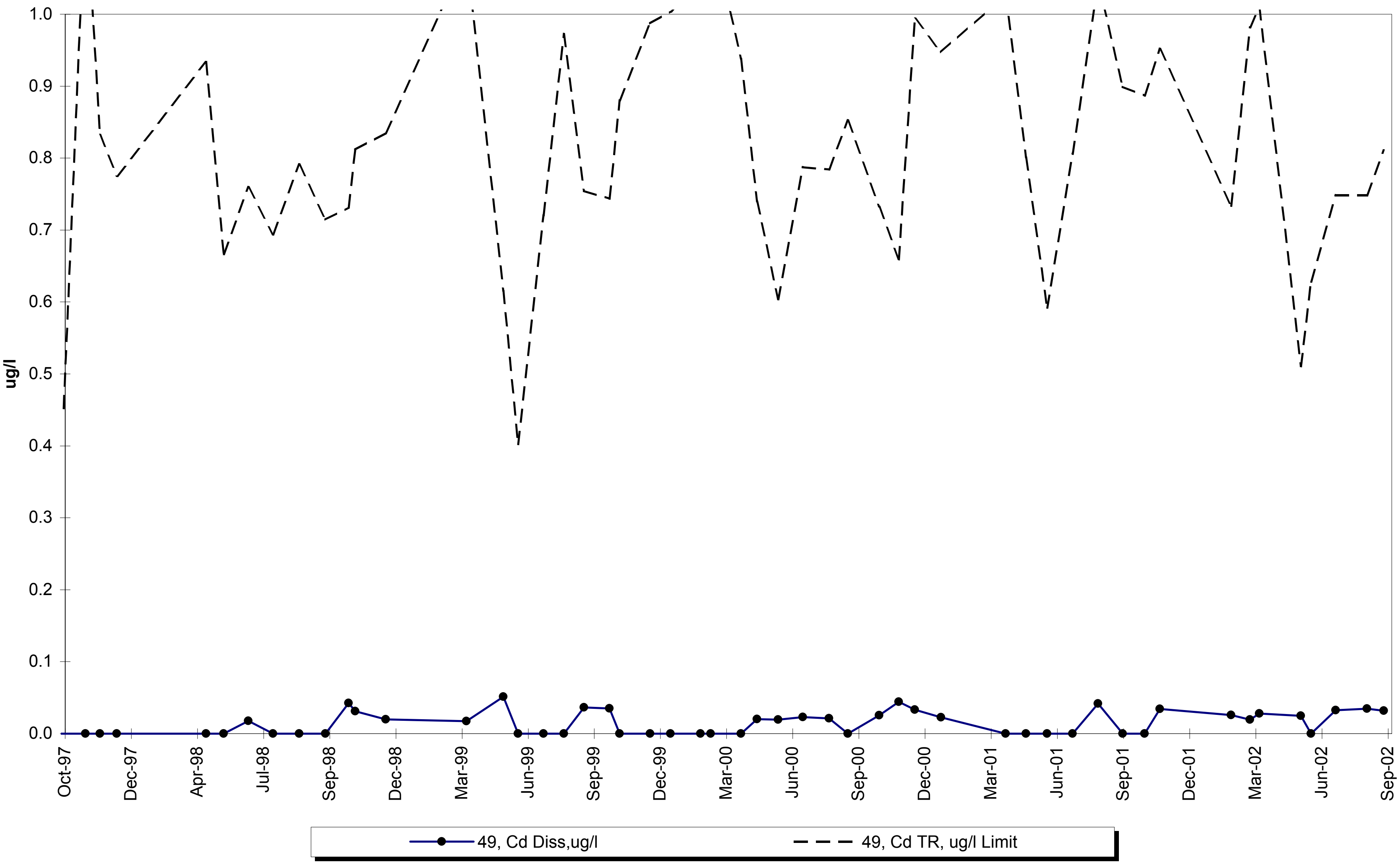
Site 49 -Hardness



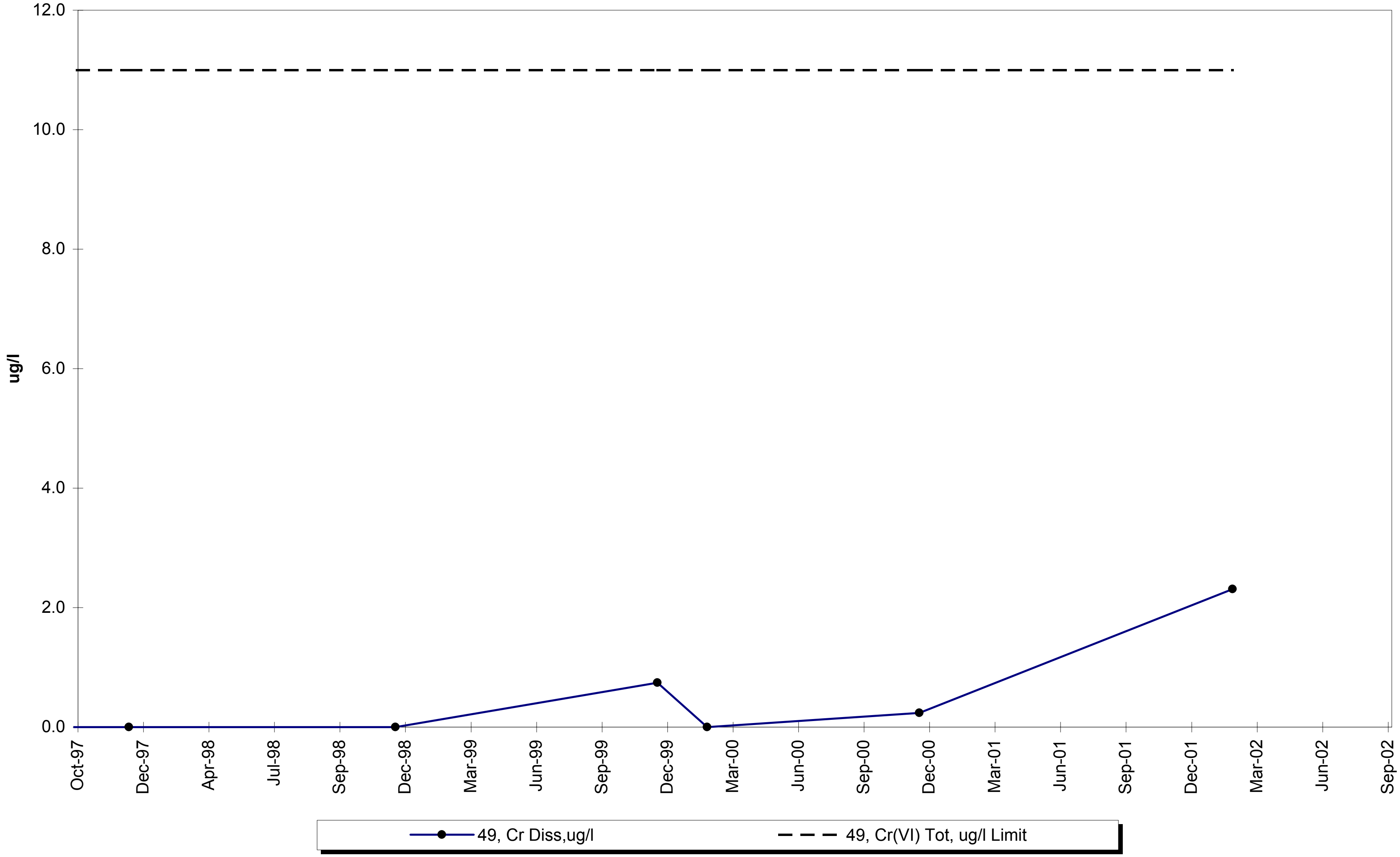

Site 49 -Dissolved Arsenic
Note: the AWQS for Total Arsenic is 50 µg/l and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
49, As Diss,ug/l
49, As Tot, ug/l Limit

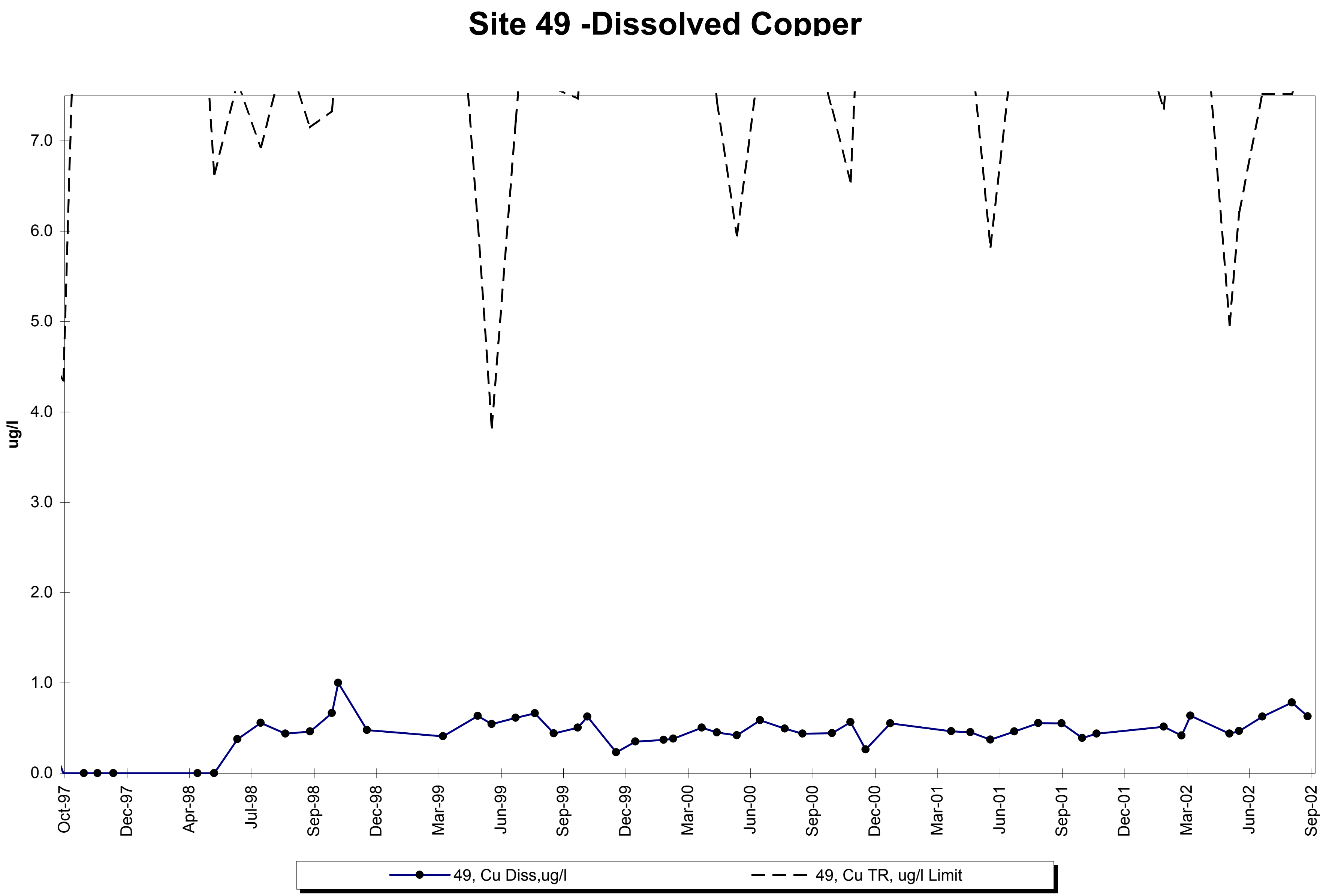

Site 49 -Dissolved Barium
Note: the AWQS for Total Barium is 1000 μg/l and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
49, Ba Diss,ug/l
49, Ba Tot, ug/l Limit

Site 49 -Dissolved Cadmium

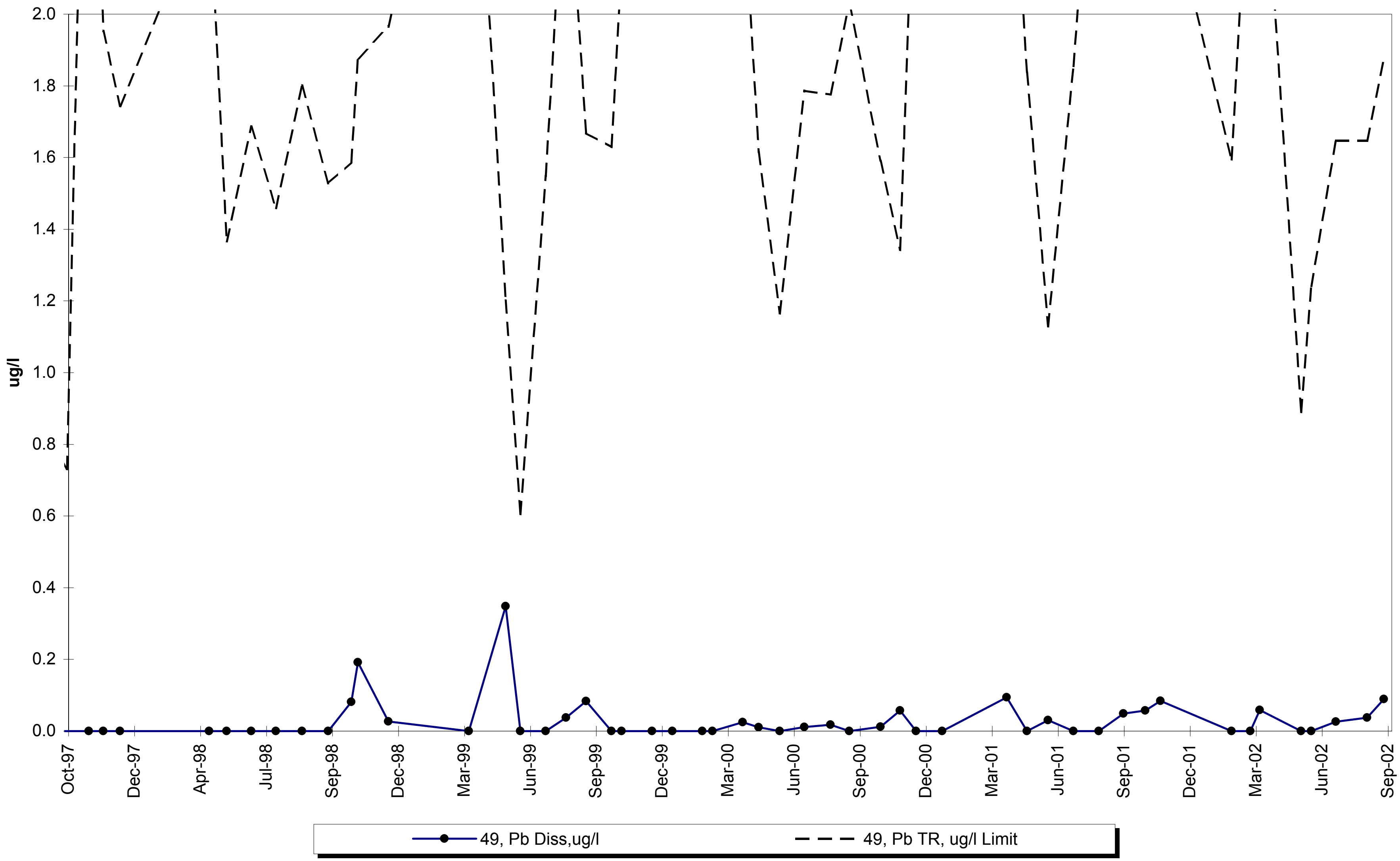


Site 49 -Dissolved Chromium

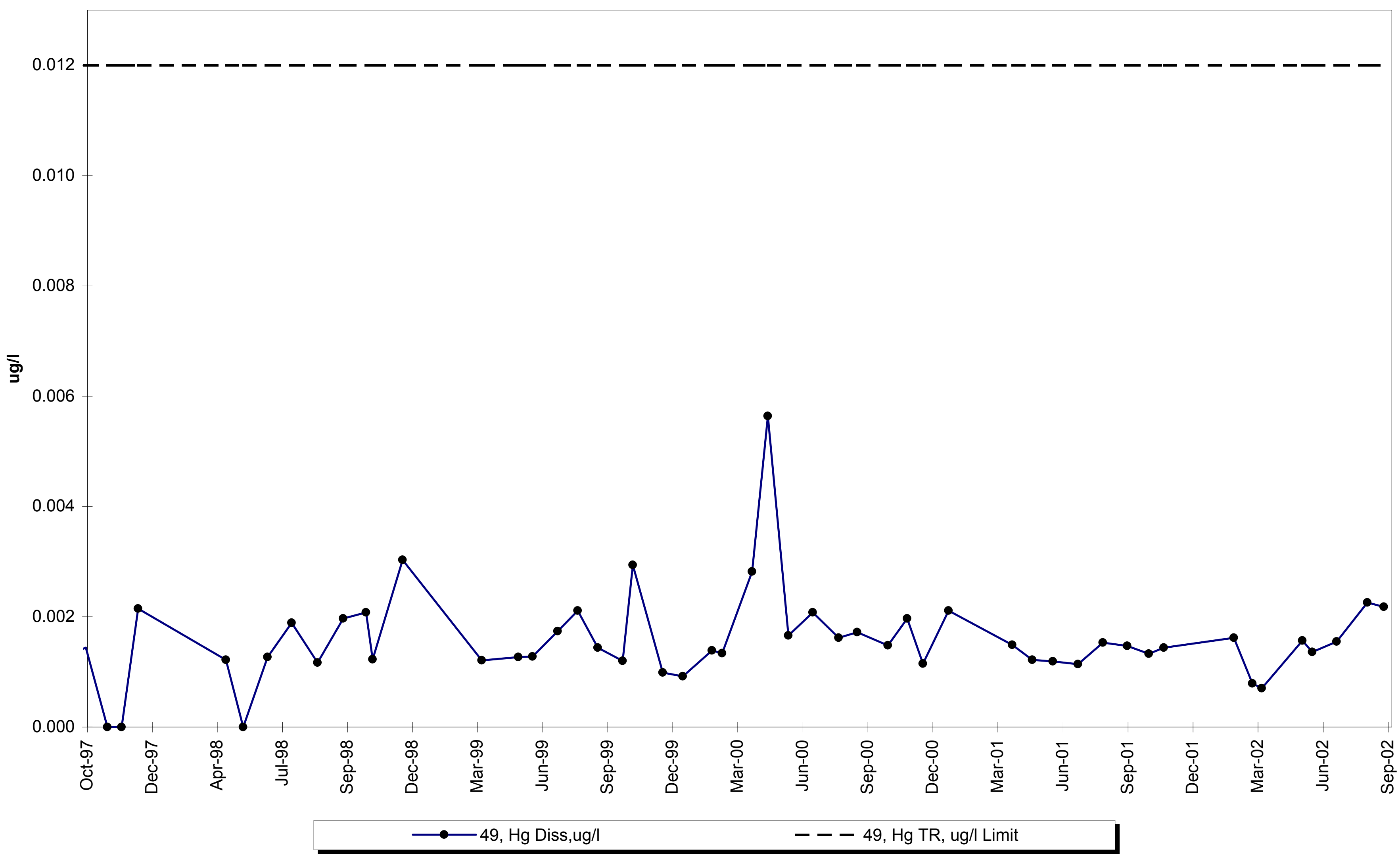



Site 49 -Dissolved Copper
ug/l
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
49, Cu Diss,ug/l
49, Cu TR, ug/l Limit

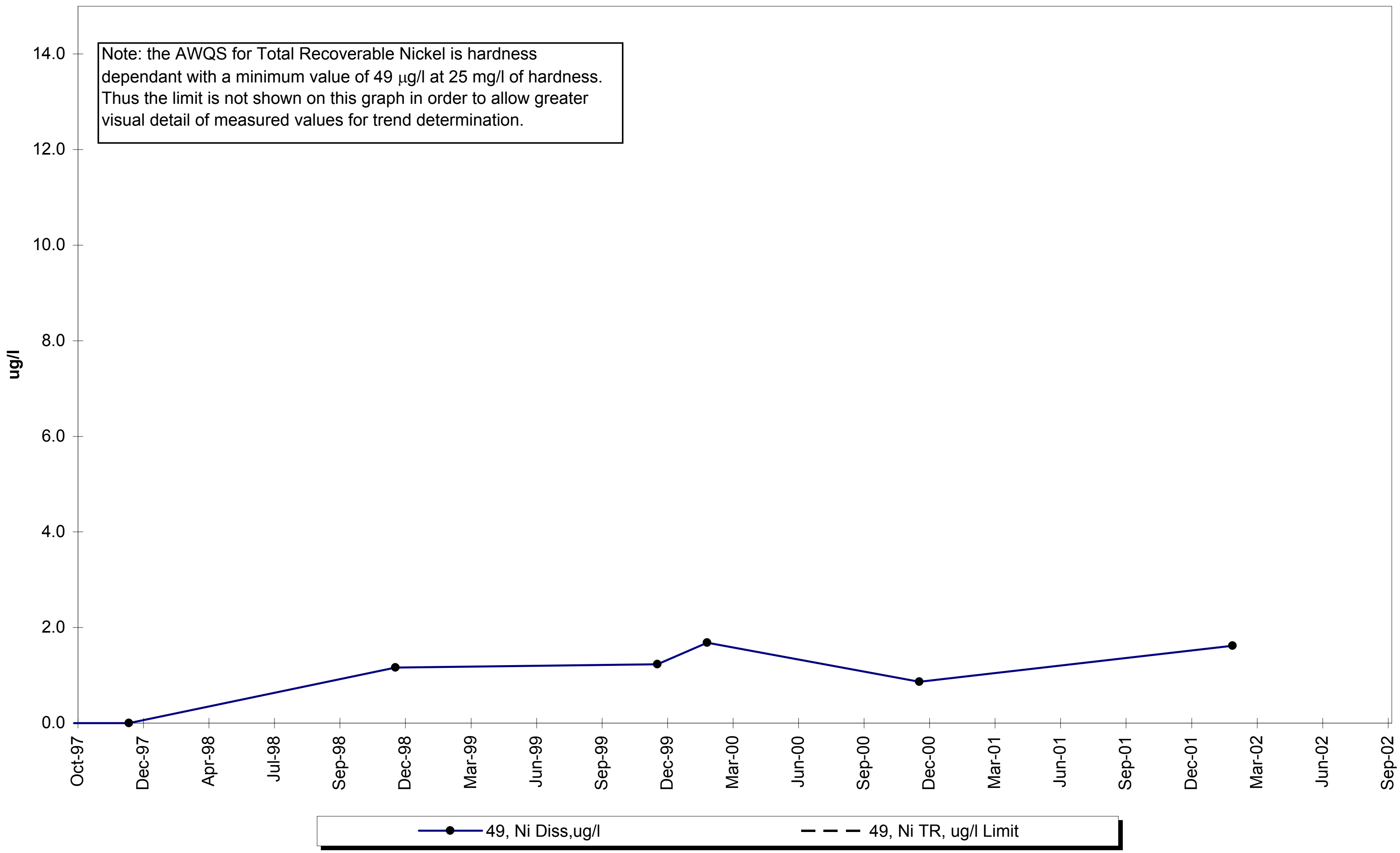
Site 49 -Dissolved Lead



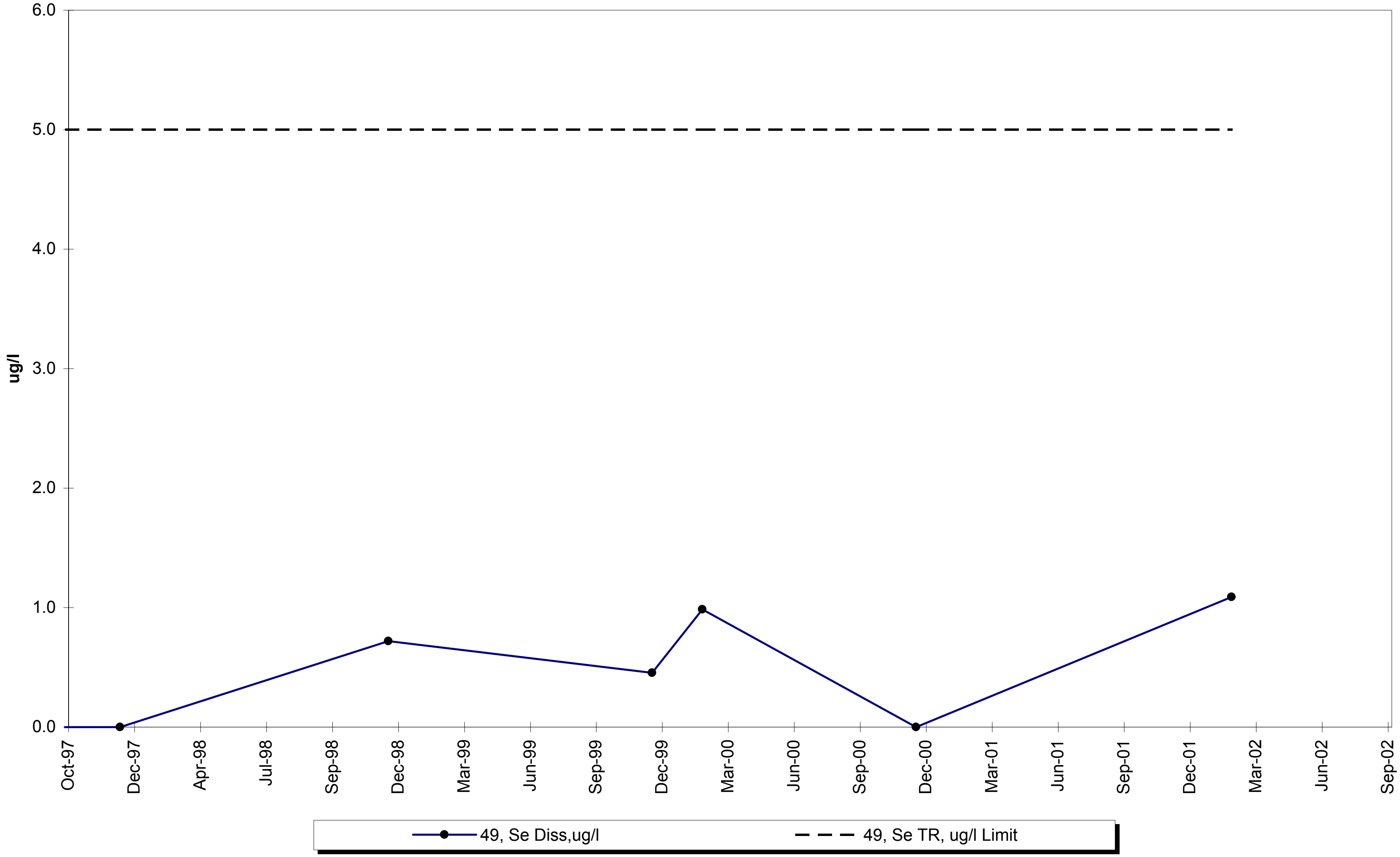
Site 49 -Dissolved Mercury



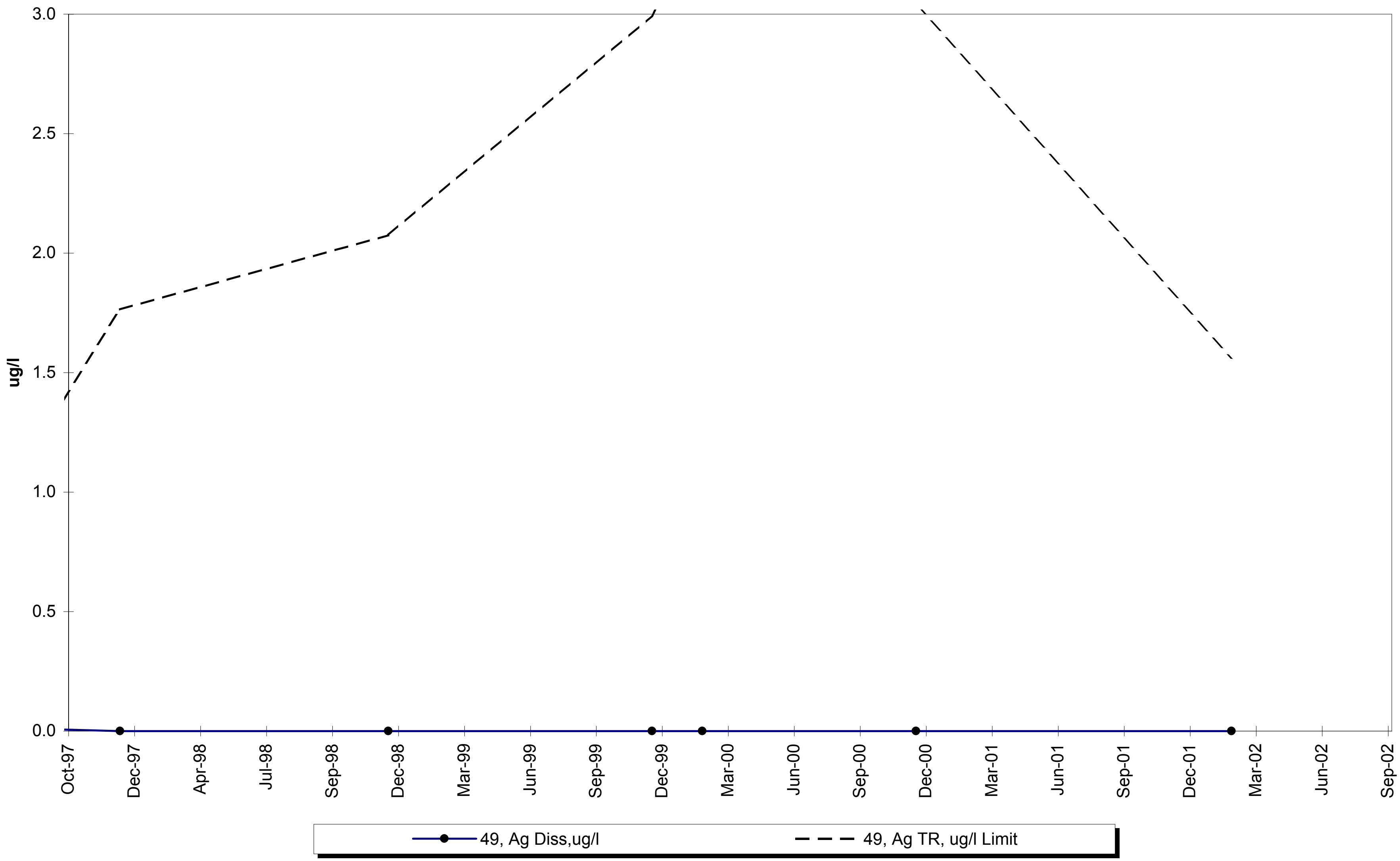
Site 49 -Dissolved Nickel

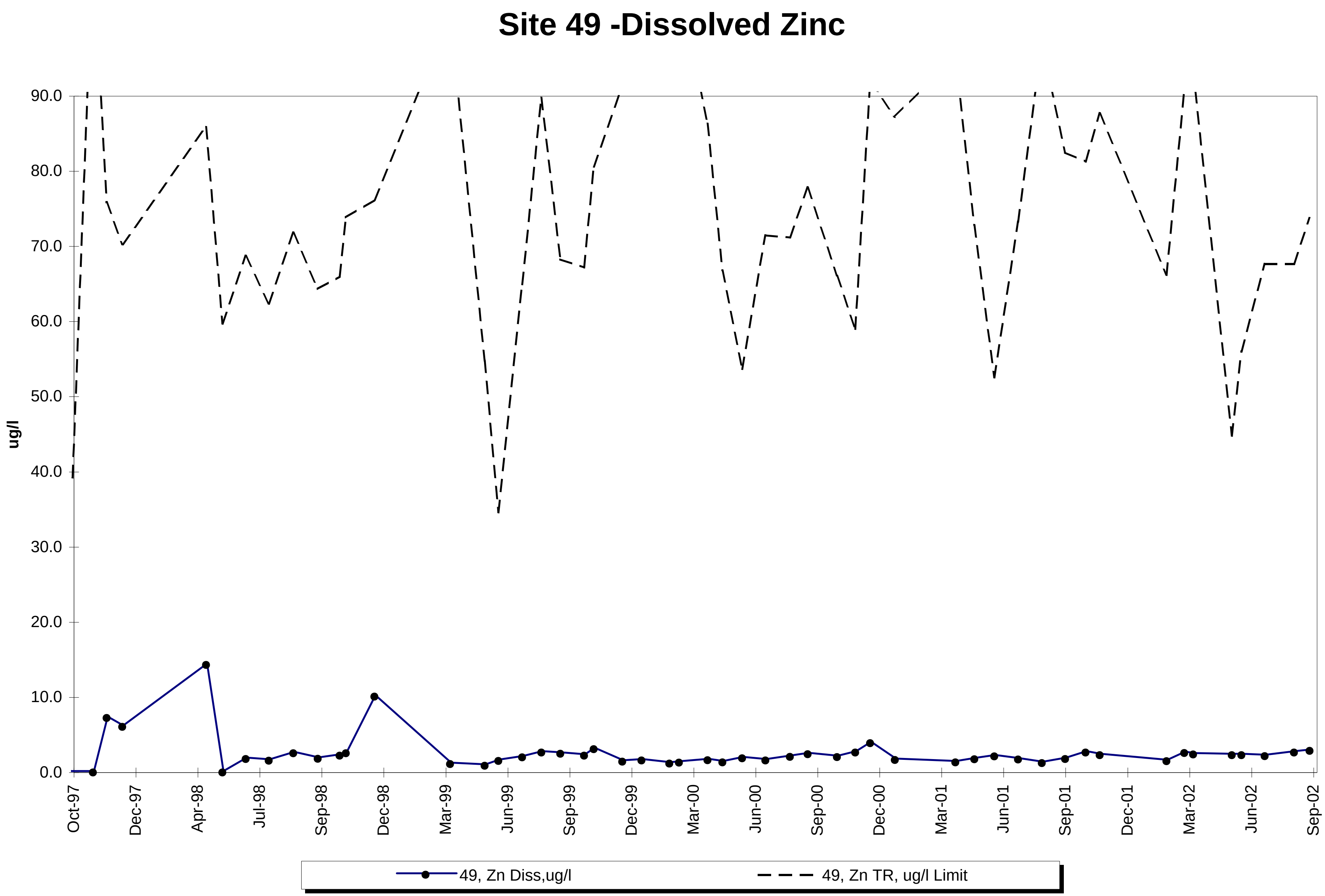


Site 49 -Dissolved Selenium



Site 49 -Dissolved Silver




Site 49 -Dissolved Zinc
ug/l
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
49, Zn Diss,ug/l
49, Zn TR, ug/l Limit

INTERPRETIVE REPORT
SITE 46 "LOWER BRUIN CREEK"

All data collected at this site for the past five years are included in the data analyses. As shown in the table below, there were no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-97 though Sept-02.				

The data collected during the current water year are listed in the following "Table of Results for Water Year 2002" report. The table includes all the data, field and lab, collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of zero for the purpose of median calculation.

The data for water year 2002 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified, as listed on the following "Comparison To Standards" report.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious trends were apparent. Additional X-Y plots have been generated for alkalinity, pH, conductance, and dissolved zinc that plot Site 46 and Site 49, the upstream control site, to aid in the comparison between those two sites.

Median values for alkalinity, pH, specific conductance, and dissolved zinc from site 46 have been compared to those of site 49. The comparisons were done utilizing a two-tailed, exact Wilcoxon-Mann-Whitney rank sum test with a significance level of $\alpha/2=0.025$. Rank-sum test calculation details can be found in subsequent pages of this section and a summary of the test results is shown in the table below.

Analyte	N		Median Value		Σ Ranks		Exact Test Bounds		$H_0:\mu_{46}=\mu_{49}$
	#49	#46	#49	#46	#49	#46	Lower	Upper	
Alkalinity (mg/l)	10	7	59.6	56.7	97.0	**56.0**	42.5	83.5	ACCEPT
Lab pH (su)	10	7	7.45	7.53	86.5	**66.5**	42.5	83.5	ACCEPT
Conductivity (umhos)	10	7	140.0	128.0	97.5	**55.5**	42.5	83.5	ACCEPT
Dissolved Zinc (µg/l)	10	7	2.35	2.28	92.0	**61.0**	42.5	83.5	ACCEPT

For all analytes there are no statistically significant differences between the medians at the $\alpha/2=0.025$ significance level.

Table of Results for Water Year 2002

Site 46 "Lower Bruin Creek"

Sample Date/Parameter	10/25/2001	11/15/2001	12/5/2001	1/29/2002	2/21/2002	3/19/2002	4/1/2002	5/28/2002	6/11/2002	7/15/2002	8/27/2002	9/19/2002	**Median**
Water Temp (°C)	1.8	3.1						5.5	6.3	8.8	9.7	7.9	6.3
Conductivity-Field (µmho)	156	148						67	105	146	121	122	122
Conductivity-Lab (µmho)	146 J	158 J						71	108	134	127	128	128
pH Lab (standard units)	7.39	7.53 J						7.07	7.35	8.17	8.02	8.17	7.53
pH Field (standard units)	8.10	7.99						6.80	7.26	7.74	7.82	7.83	7.82
Total Alkalinity (mg/l)	61.8 J	64.9 J						29.5	47.9	58.3	55.0	56.7	56.7
Hardness (mg/l)	74.6	81.0						38.2	48.5	60.7	62.4	64.0	62.4
Dissolved As (µg/l)	<0.446	0.355 J						<0.230	<0.204 UJ	0.270	0.245 U	0.146 J	0.223
Dissolved Ba (µg/l)													
Dissolved Cd (µg/l)	<0.049	0.020 J	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW	0.023 UJ	<0.034	0.027	0.031	0.028	0.025
Dissolved Cr (µg/l)													
Dissolved Cu (µg/l)	0.404	0.558						0.490	0.417 U	0.665 J	0.694	0.786	0.558
Dissolved Pb (µg/l)	0.0534 UJ	0.1510						0.0345 J	0.0342 J	0.0180 J	0.0663 U	0.0636	0.0534
Dissolved Ni (µg/l)													
Dissolved Ag (µg/l)													
Dissolved Zn (µg/l)	1.78 U	4.80						2.88	1.48 J	2.28	2.09 U	2.72 J	2.28
Dissolved Se (µg/l)													
Dissolved Hg (µg/l)	0.001390 UJ	0.001450 U						0.001640 J	0.001280 U	0.001670	0.003200	0.002520	0.001640

See "Qualififed Data by QA Reviewer" table for qualifier descriptions.

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
46	10/25/2001	1:45:00 PM				
			Cond Lab, umho	146	J	Sample Temp.
			Alk Tot, mg/l	61.8	J	Sample Temp.
			Pb Diss, ug/l	0.0534	UJ	Below Quantitative Range, Fi
			Zn Diss, ug/l	1.78	U	Field Blk.
			Hg Diss, ug/l	0.00139	UJ	Field Blk, LCS RPD
46	11/15/2001	1:15:00 PM				
			Cond Lab, umho	158	J	Sample Temp.
			pH Lab, su	7.53	J	Hold Time
			Alk Tot, mg/l	64.9	J	Sample Temp.
			As Diss, ug/l	0.355	J	Below Quantitative Range
			Cd Diss, ug/l	0.0197	J	Below Quantitative Range
			Hg Diss, ug/l	0.00145	U	Field Blank Cont.
46	05/28/2002	12:05:00 PM				
			Cd Diss, ug/l	0.023	UJ	CCV Rec.
			Pb Diss, ug/l	0.0345	J	Below Quantitative Range
			Hg Diss, ug/l	0.00164	J	CCV Rec, LCS Rec, LCS RP
46	06/11/2002	11:45:00 AM				
			As Diss, ug/l	-0.204	UJ	LCS Rec.
			Cu Diss, ug/l	0.417	U	Field Blank Cont.
			Pb Diss, ug/l	0.0342	J	Below Quantitative Range, C
			Zn Diss, ug/l	1.48	J	LCS Rec.
			Hg Diss, ug/l	0.00128	U	Field Blank Cont.
46	07/15/2002	11:55:00 AM				
			Cu Diss, ug/l	0.665	J	LCS Rec.
			Pb Diss, ug/l	0.018	J	Below Quantitative Range
46	08/27/2002	12:19:00 PM				
			As Diss, ug/l	0.245	U	Field Blank Contamination
			Pb Diss, ug/l	0.0663	U	Field Blank Contamination
			Zn Diss, ug/l	2.09	U	Field Blank Contamination

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
46	09/19/2002	1:55:00 PM				
			As Diss, ug/l	0.146	J	Below Quantitative Range
			Zn Diss, ug/l	2.72	J	LCS Rec.

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Comparison To Standards

Date Range: 10/01/2001 to 09/30/2002

Site Number	Date	Time	Dup ID	Storet No.	Parameter Description	Value	Standard	Standard Type
							#Error	

EXACT Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Conductivity Lab, (umhos)**

Site	#49	#46	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	147.0	146.0	12	11
Nov	156.0	158.0	13	14
Dec				
Jan				
Feb	169.0		15	
Mar	194.0		16	
Apr	203.0		17	
May	65.5	70.6	1	2
Jun	106.0	108.0	3	4
Jul	133.0	134.0	9	10
Aug	119.0	127.0	5	6.5
Sep	127.0	128.0	6.5	8
Median	140.0	128.0		

N= 17		ΣR	97.5	55.5
			n	**m**
			10	7

X(.025,10,7)= 83.5

W_{rs}= **55.5**

X*(.025,10,7)= 42.5

$\alpha/2$	H_0 ($\mu_A=\mu_B$)
0.025	**ACCEPT**

EXACT Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **pH Lab, (su)**

Site	#49	#46	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	7.39	7.39	5.5	5.5
Nov	7.43	7.53	8	10
Dec				
Jan				
Feb	7.40		7	
Mar	7.75		11	
Apr	7.47		9	
May	6.95	7.07	1	2
Jun	7.26	7.35	3	4
Jul	8.17	8.17	16	16
Aug	7.99	8.02	12	13
Sep	8.10	8.17	14	16
Median	7.45	7.53		

N= 17

ΣR	86.5	66.5
	n	**m**
	10	7

X(.025,10,7)= 83.5

W_{rs}= **66.5**

X*(.025,10,7)= 42.5

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

ACCEPT

EXACT Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Total Alkalinity, (mg/l)**

Site	#49	#46	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	61.5	61.8	11	12
Nov	64.4	64.9	13	14
Dec				
Jan				
Feb	67.5		15	
Mar	78.3		16	
Apr	79.1		17	
May	27.9	29.5	1	2
Jun	47.1	47.9	3	4
Jul	57.7	58.3	9	10
Aug	51.5	55.0	5	6
Sep	56.0	56.7	7	8
Median	59.6	56.7		

N= 17 ΣR 97 56

n	**m**
10	7

X(.025,10,7)= 83.5

W_{rs}= **56**

X*(.025,10,7)= 42.5

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

ACCEPT

EXACT Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Zn Diss, (ug/l)**

Site	#49	#46	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	2.65	1.78	12	3
Nov	2.30	4.80	7	17
Dec				
Jan				
Feb	1.49		2	
Mar	2.59		11	
Apr	2.39		10	
May	2.31	2.88	8.5	16
Jun	2.31	1.48	8.5	1
Jul	2.16	2.28	5	6
Aug	2.66	2.09	13	4
Sep	2.86	2.72	15	14
Median	2.35	2.28		

N= 17 ΣR 92 61

	n	**m**
	10	7

X(.025,10,7)= 83.5

W_{rs}= **61**

X*(.025,10,7)= 42.5

$\alpha/2$

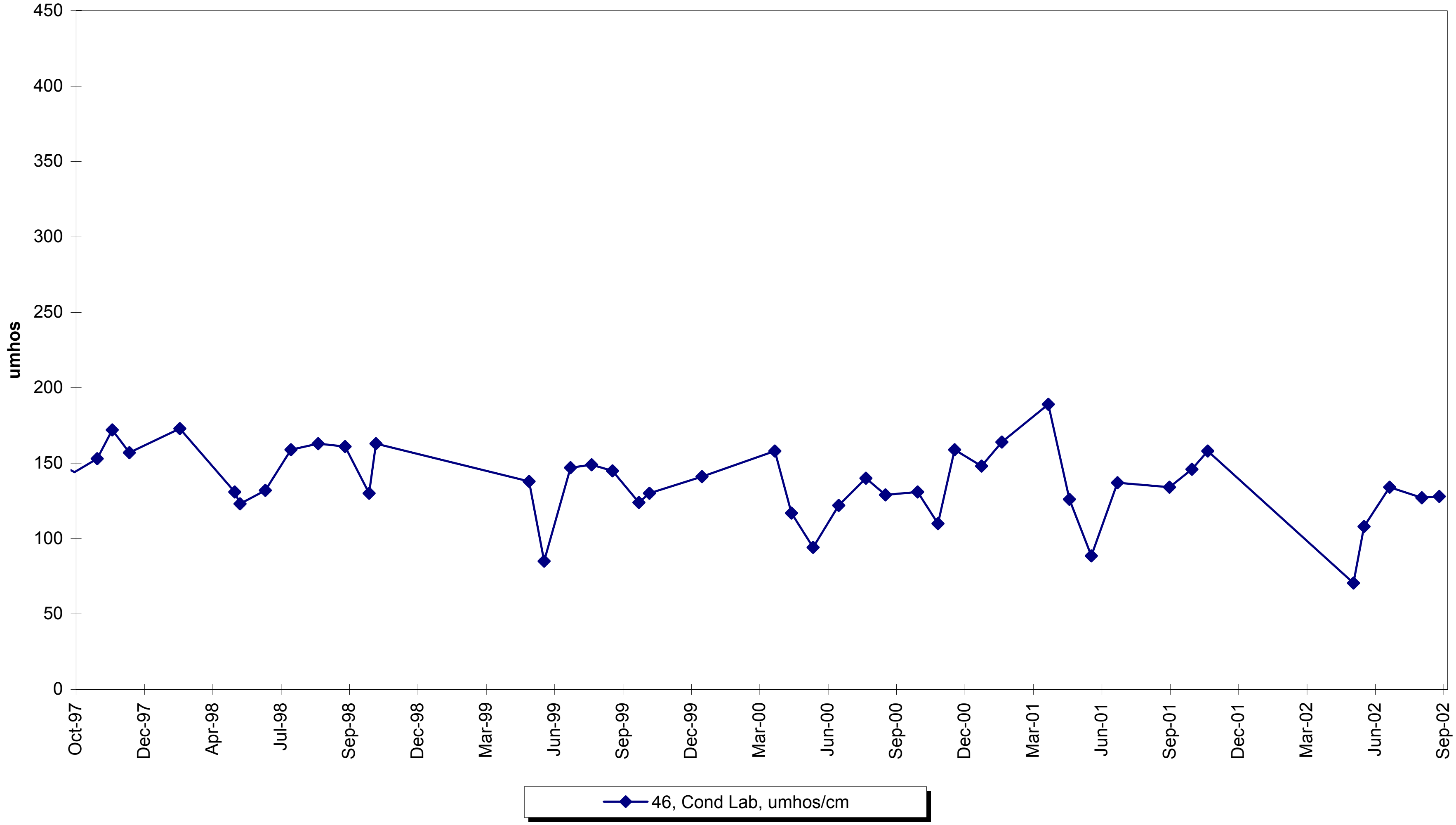
0.025

H_0

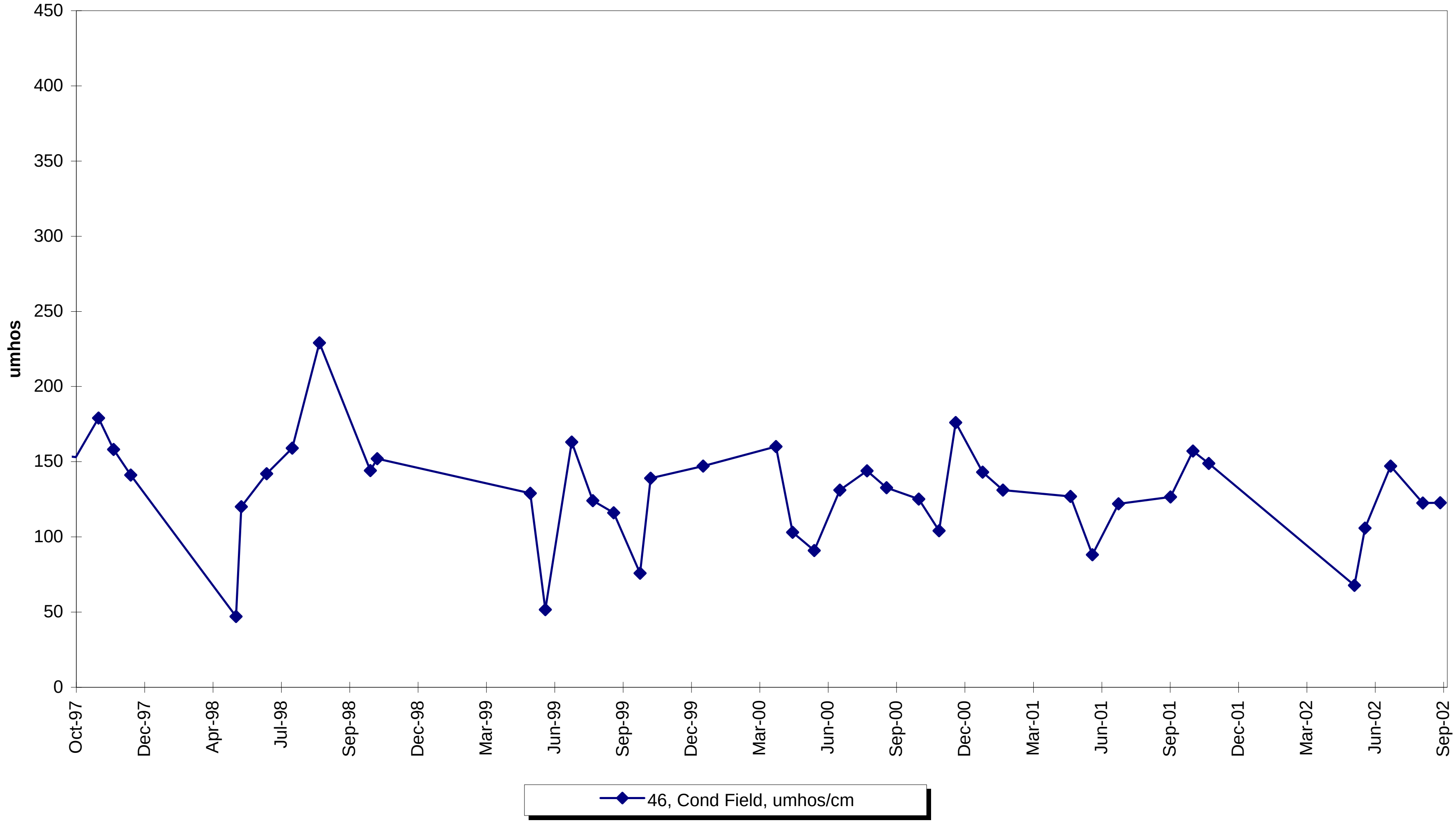
$(\mu_A=\mu_B)$

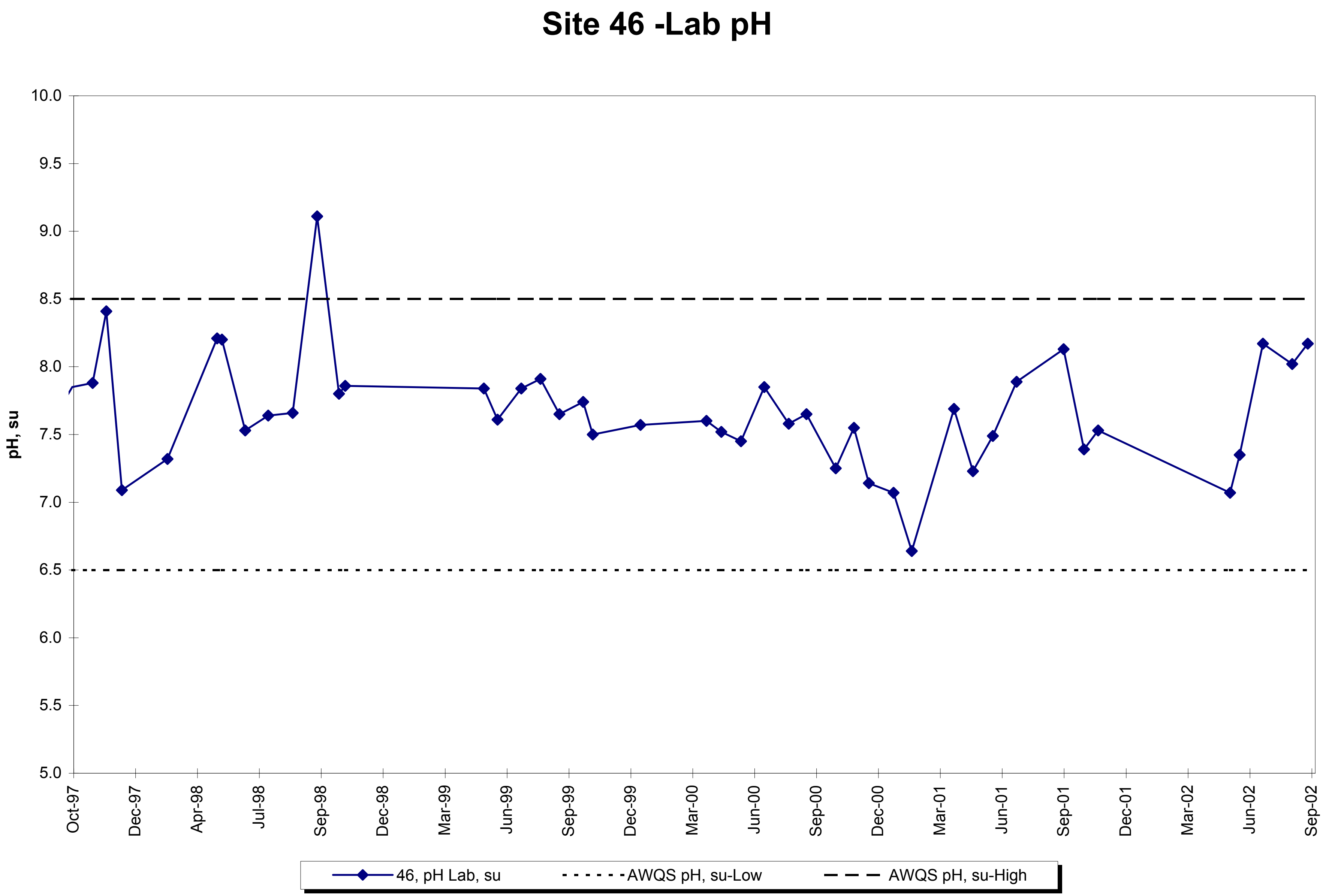
ACCEPT

Site 46 -Conductivity-Lab



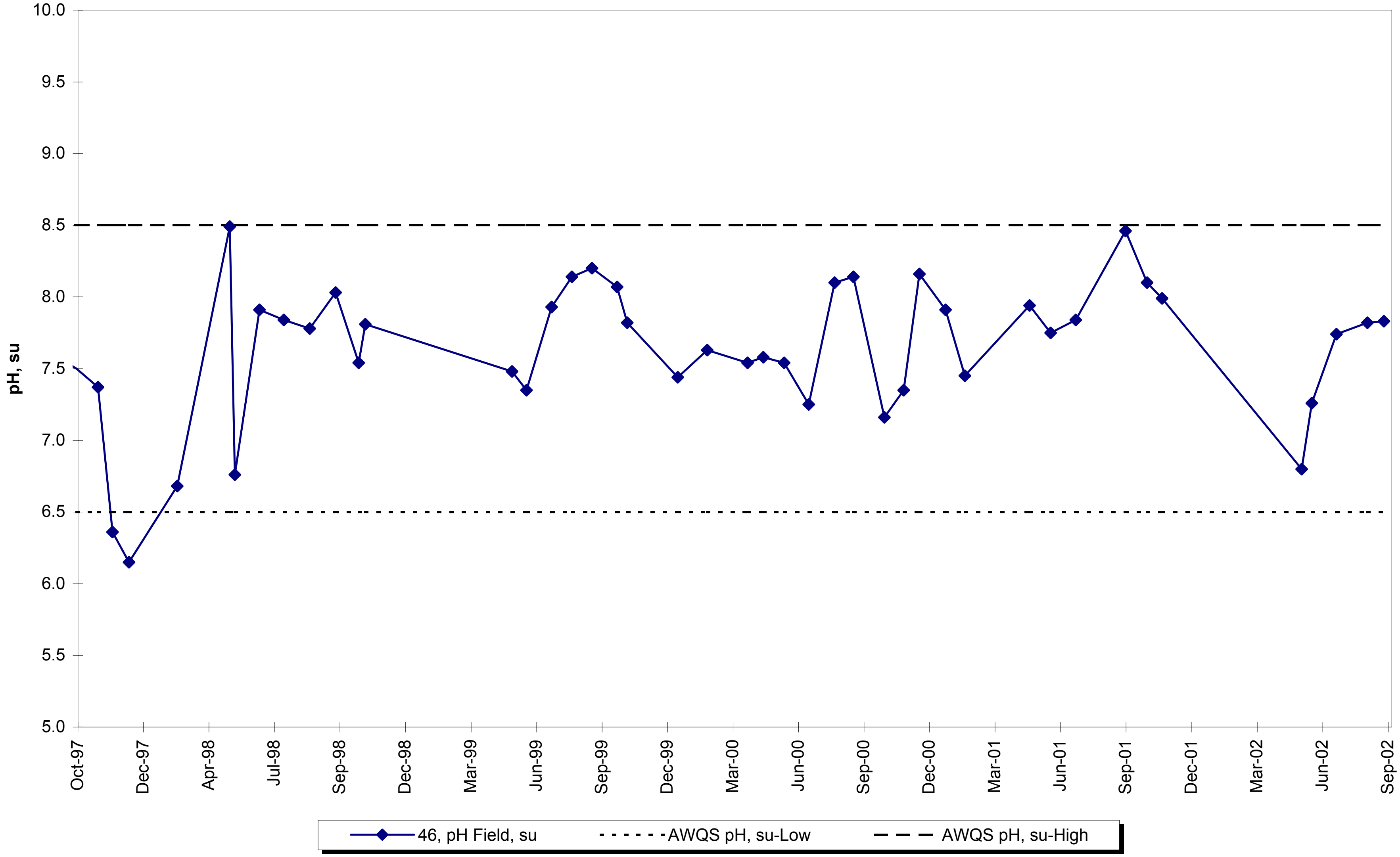
Site 46 -Conductivity-Field



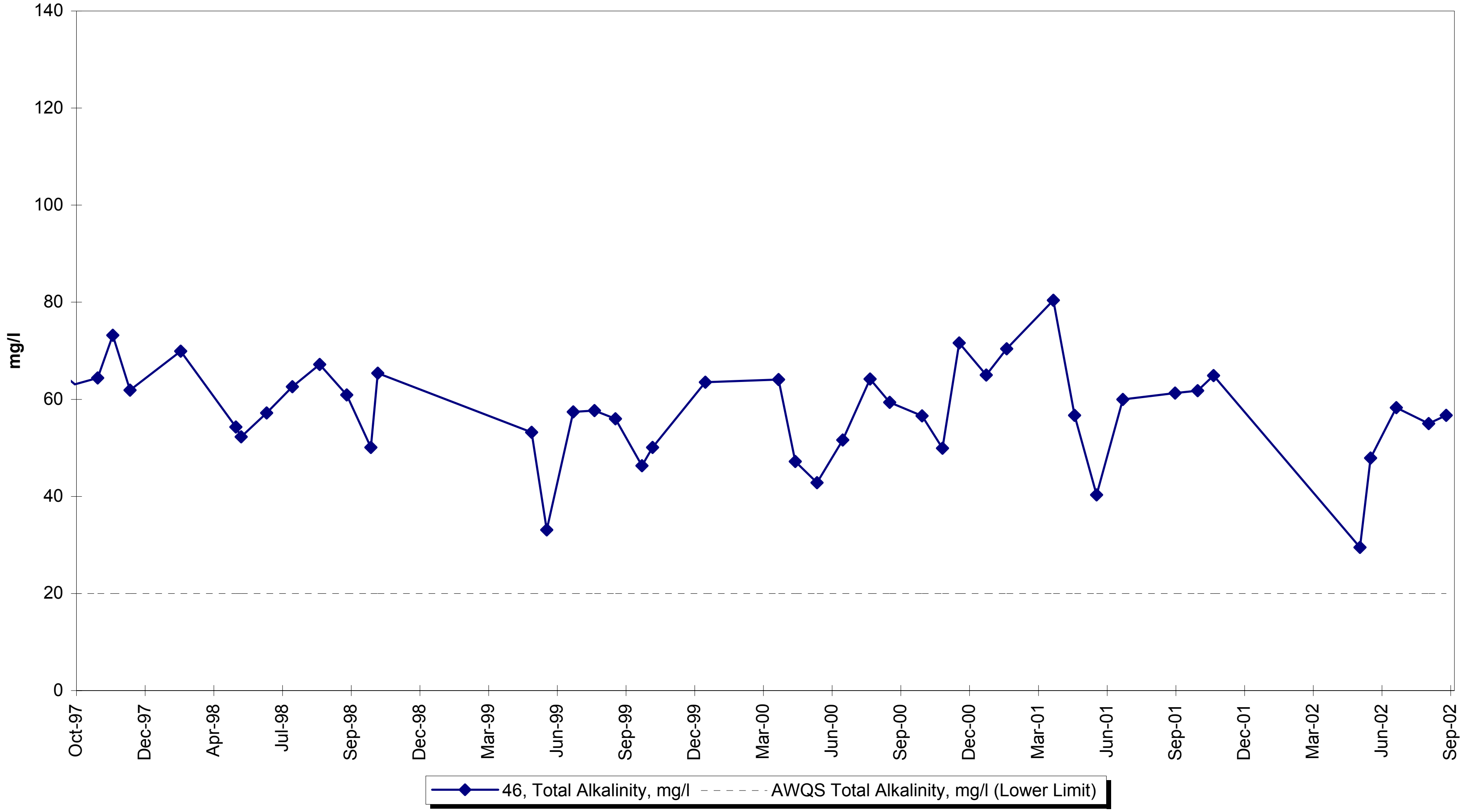


Site 46 -Lab pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
46, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

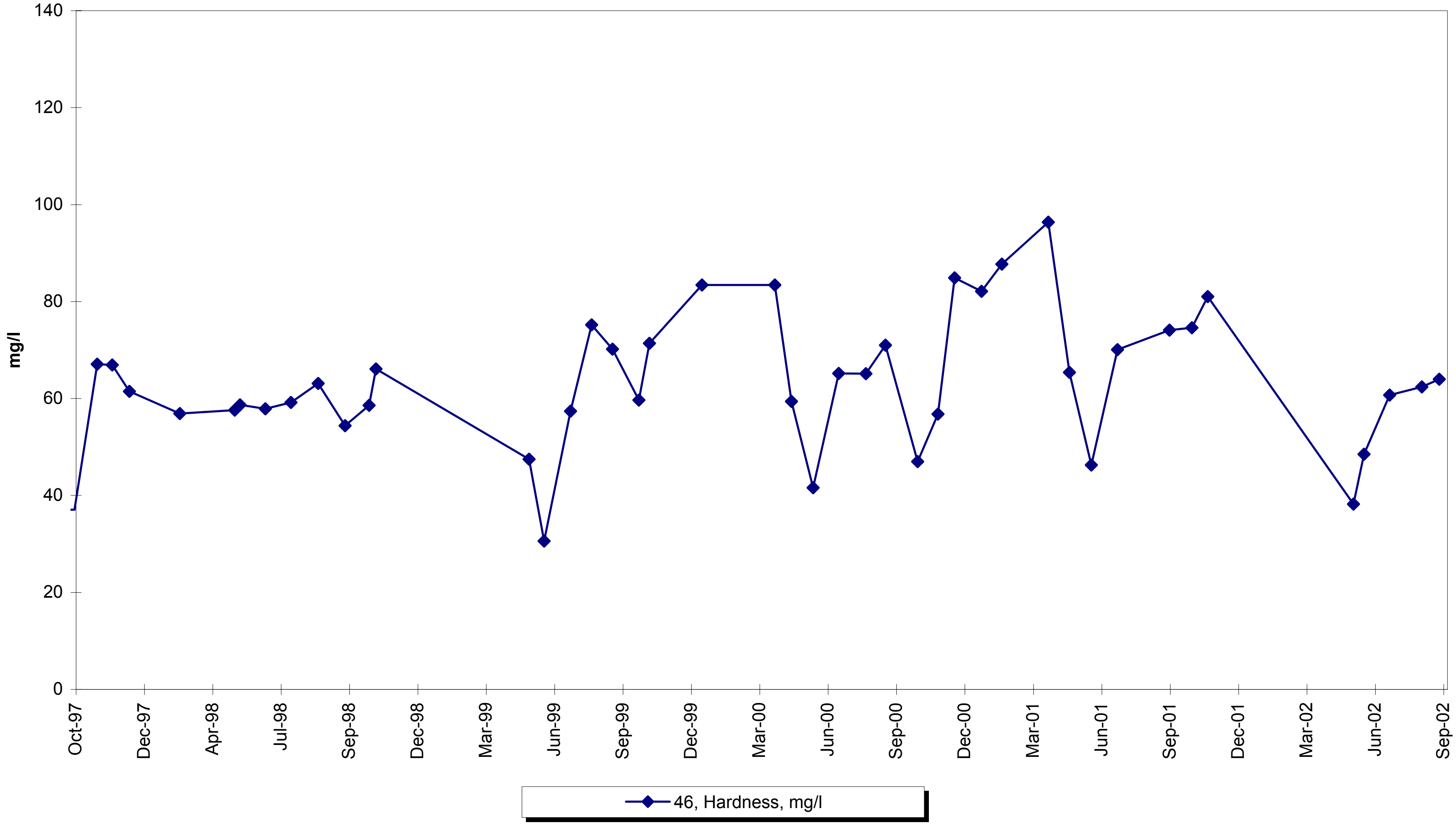
Site 46 -Field pH

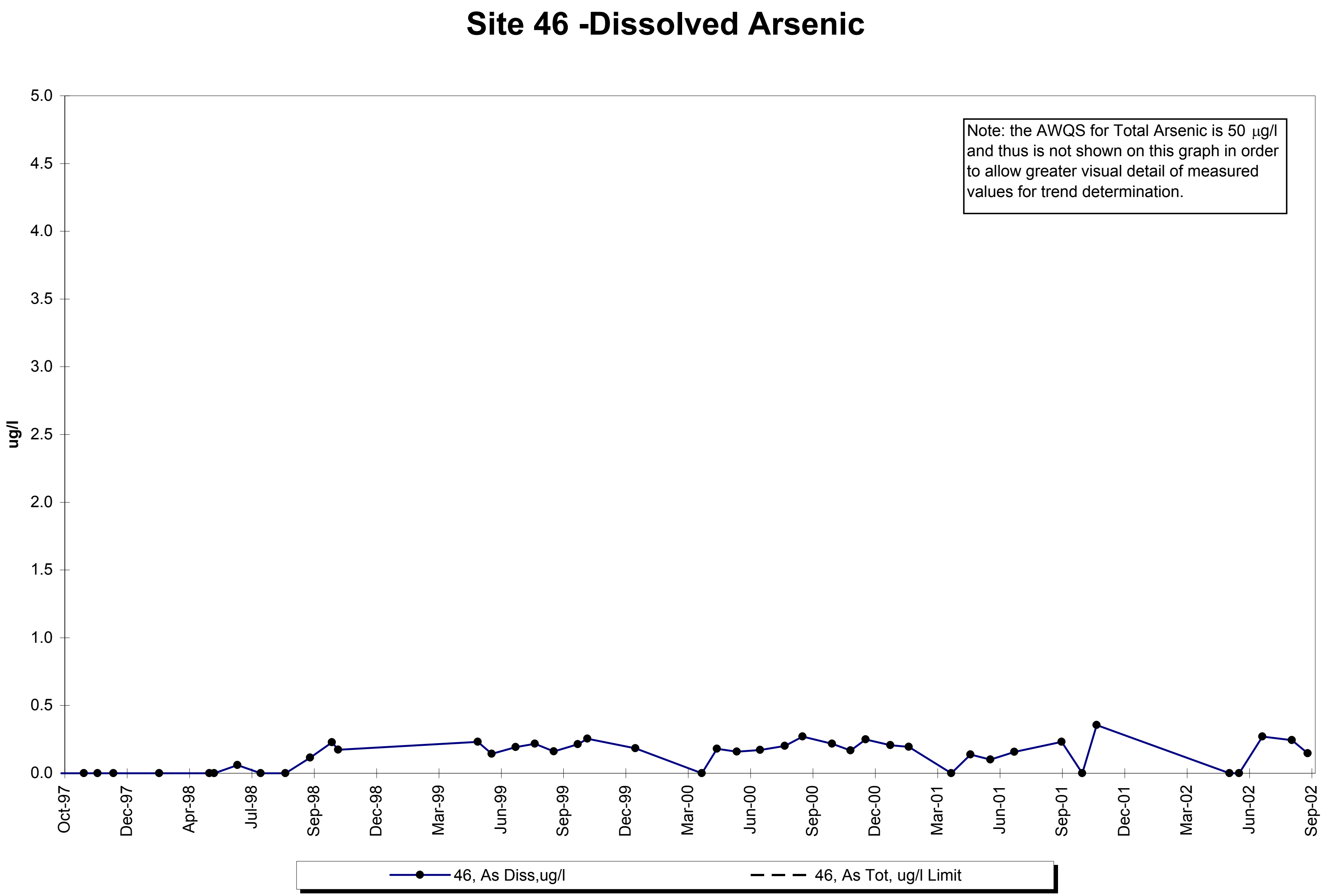


Site 46 -Total Alkalinity

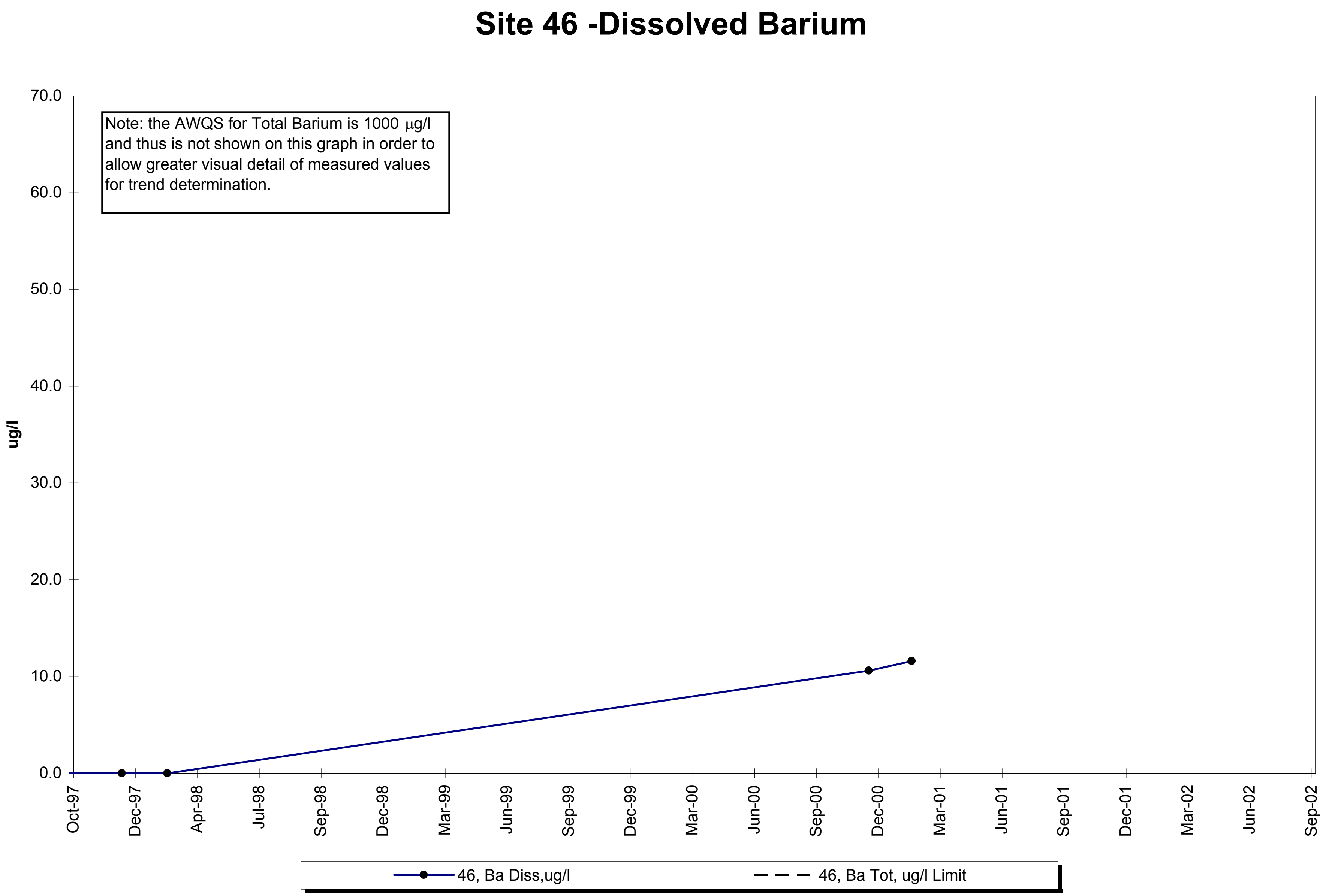


Site 46 -Hardness

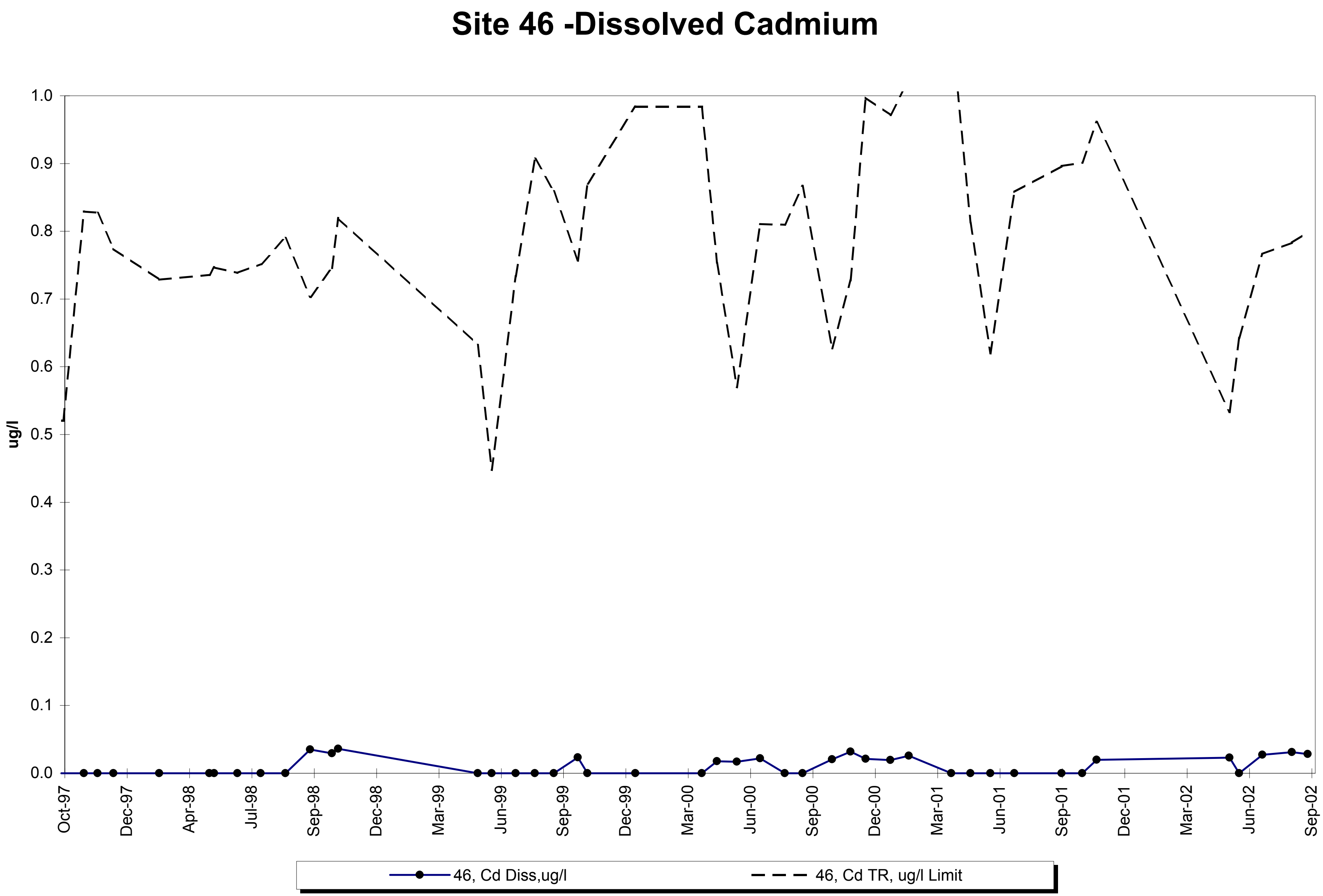


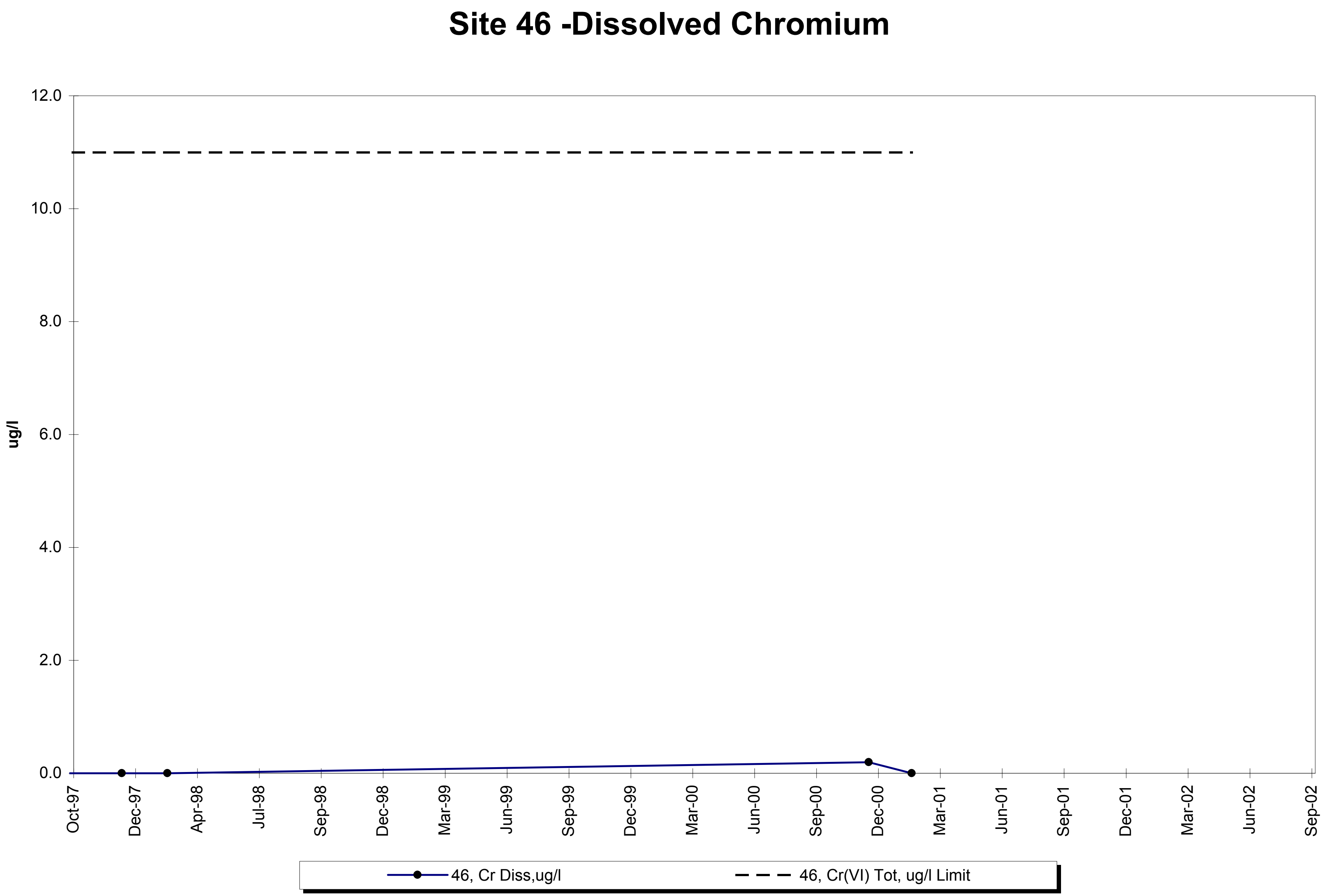


Site 46 -Dissolved Arsenic
Note: the AWQS for Total Arsenic is 50 µg/l and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
46, As Diss,ug/l
46, As Tot, ug/l Limit

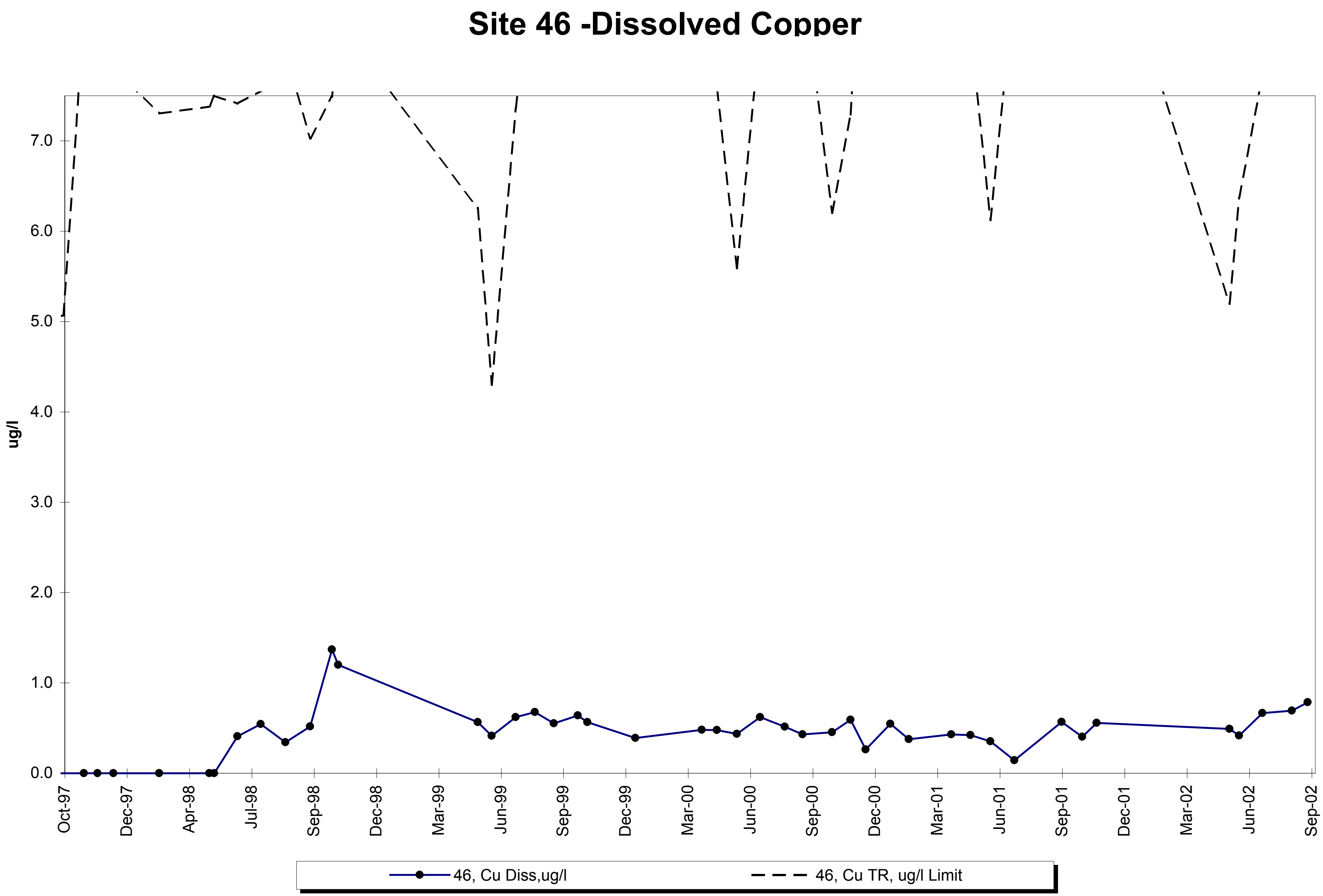


Site 46 -Dissolved Barium
Note: the AWQS for Total Barium is 1000 μg/l and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
46, Ba Diss,ug/l
46, Ba Tot, ug/l Limit

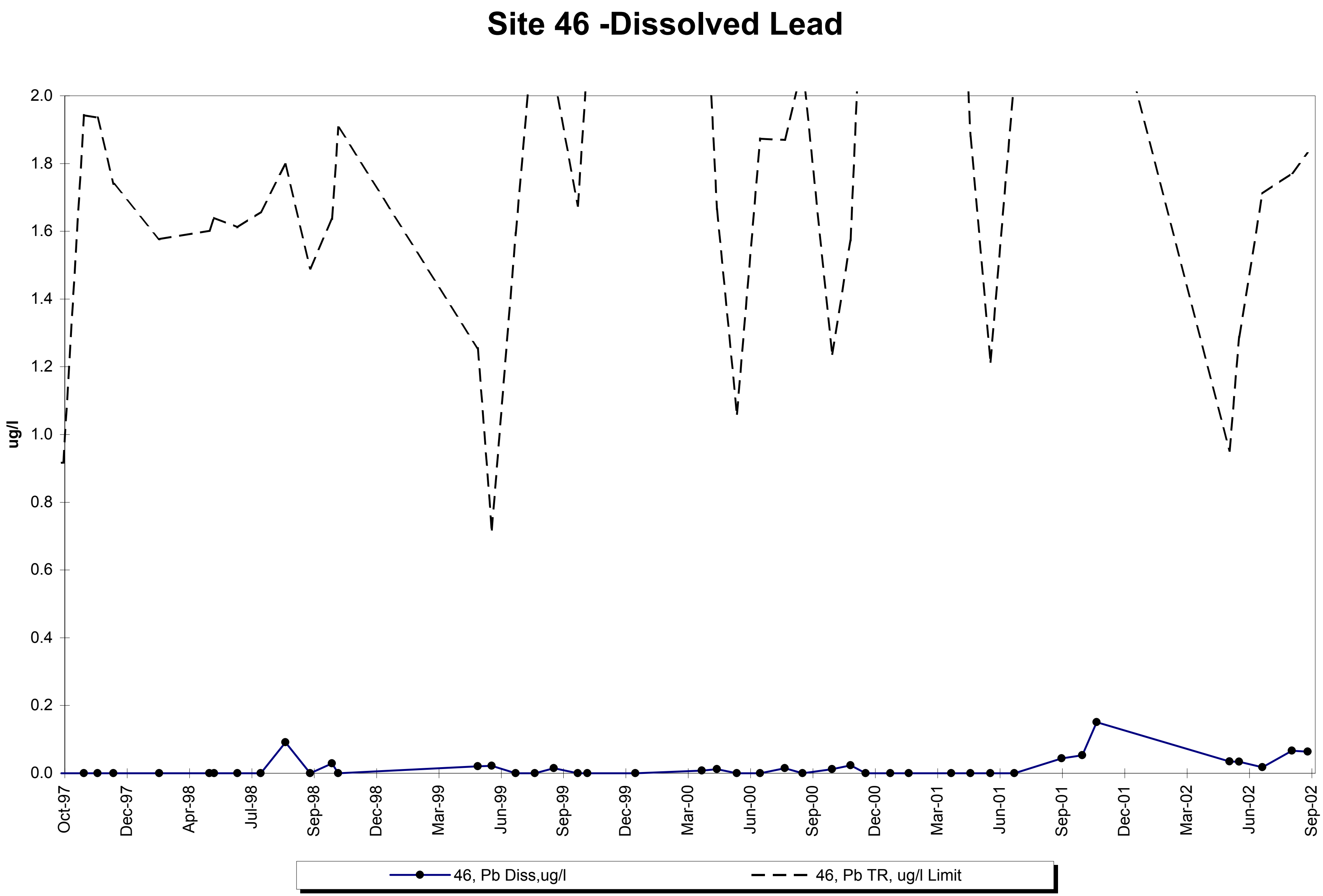

Site 46 -Dissolved Cadmium
ug/l
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
46, Cd Diss,ug/l
46, Cd TR, ug/l Limit



Site 46 -Dissolved Chromium
12.0
10.0
8.0
6.0
4.0
2.0
0.0
ug/l
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
46, Cr Diss,ug/l
46, Cr(VI) Tot, ug/l Limit

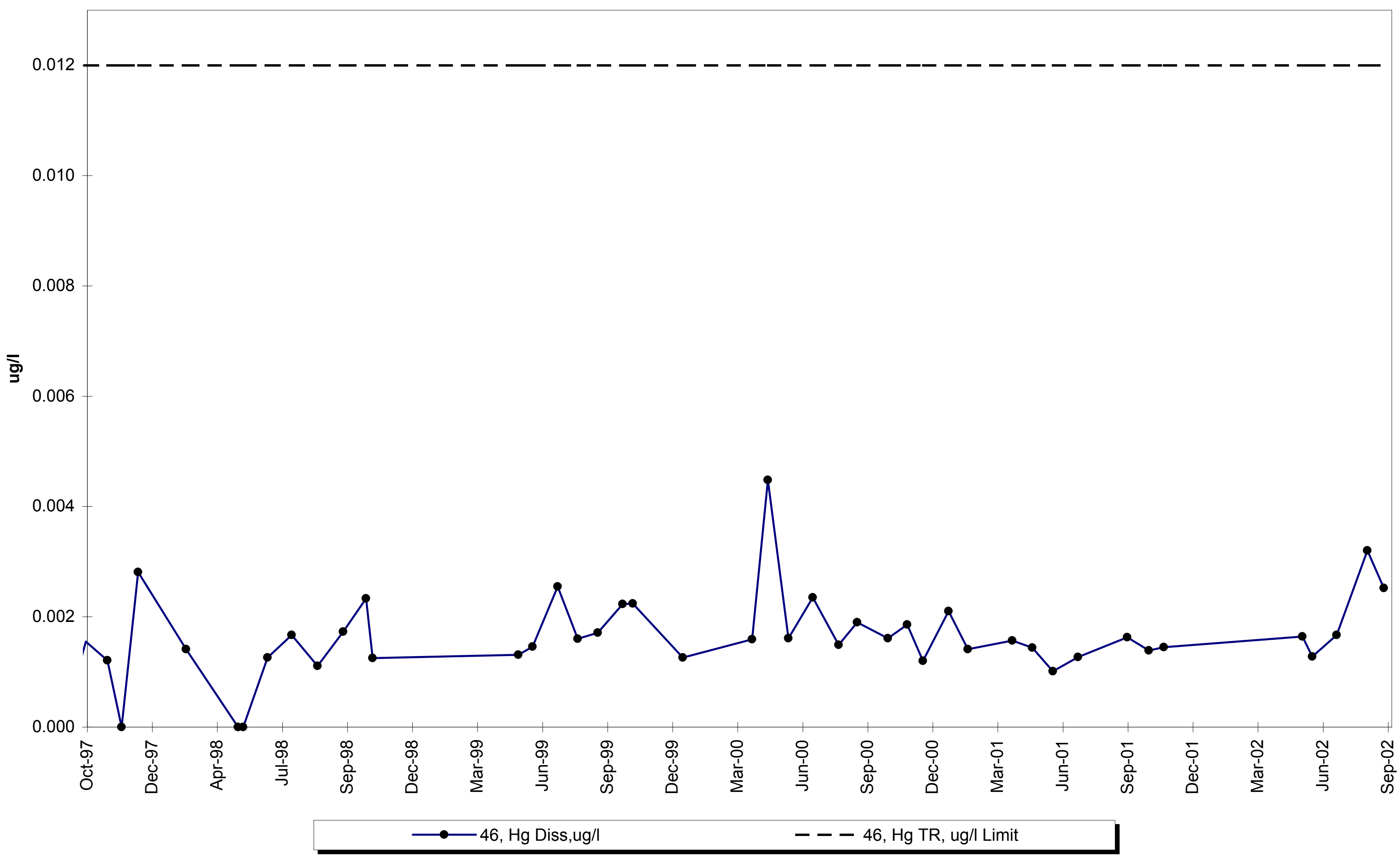


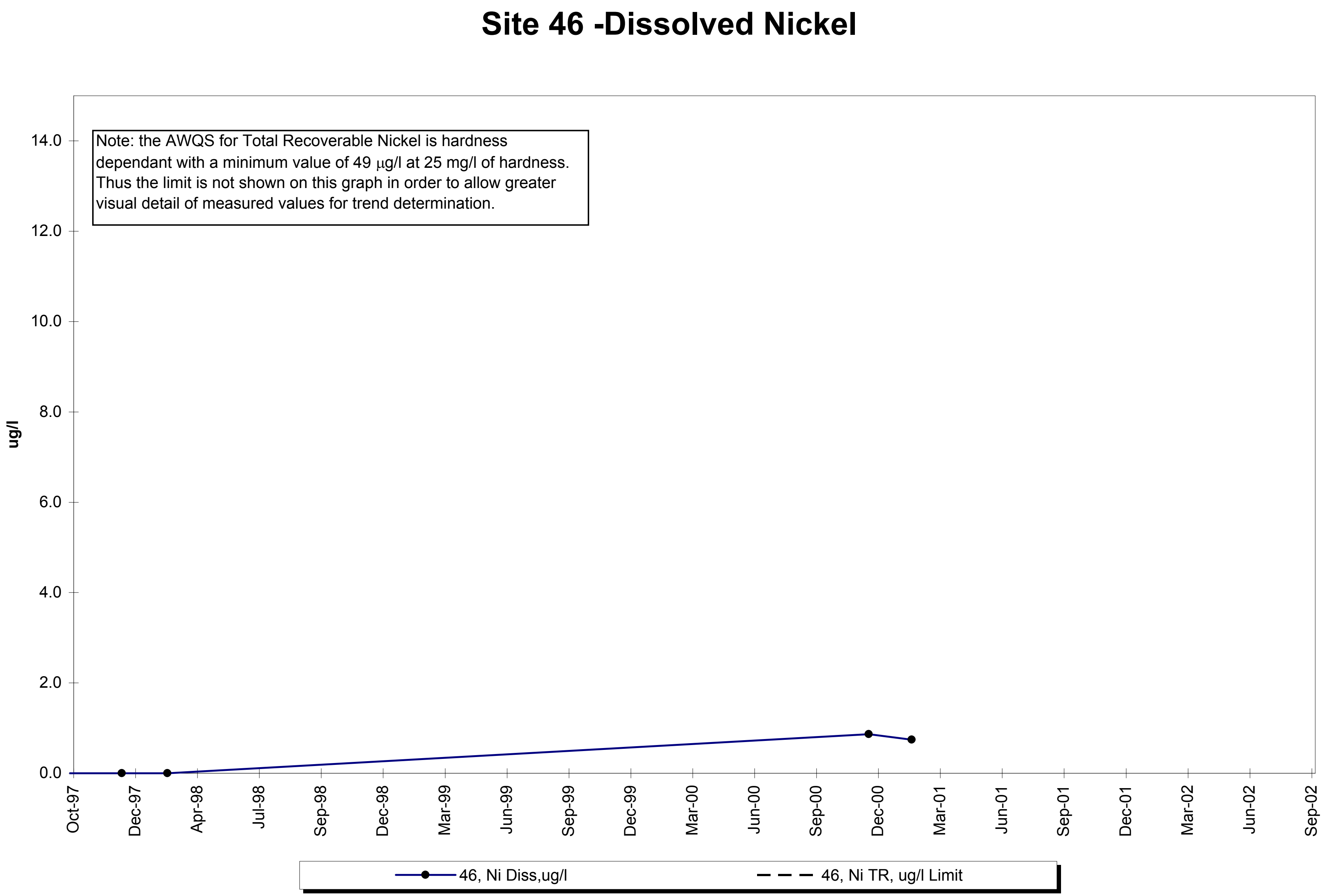
Site 46 -Dissolved Copper
ug/l
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
46, Cu Diss,ug/l
46, Cu TR, ug/l Limit



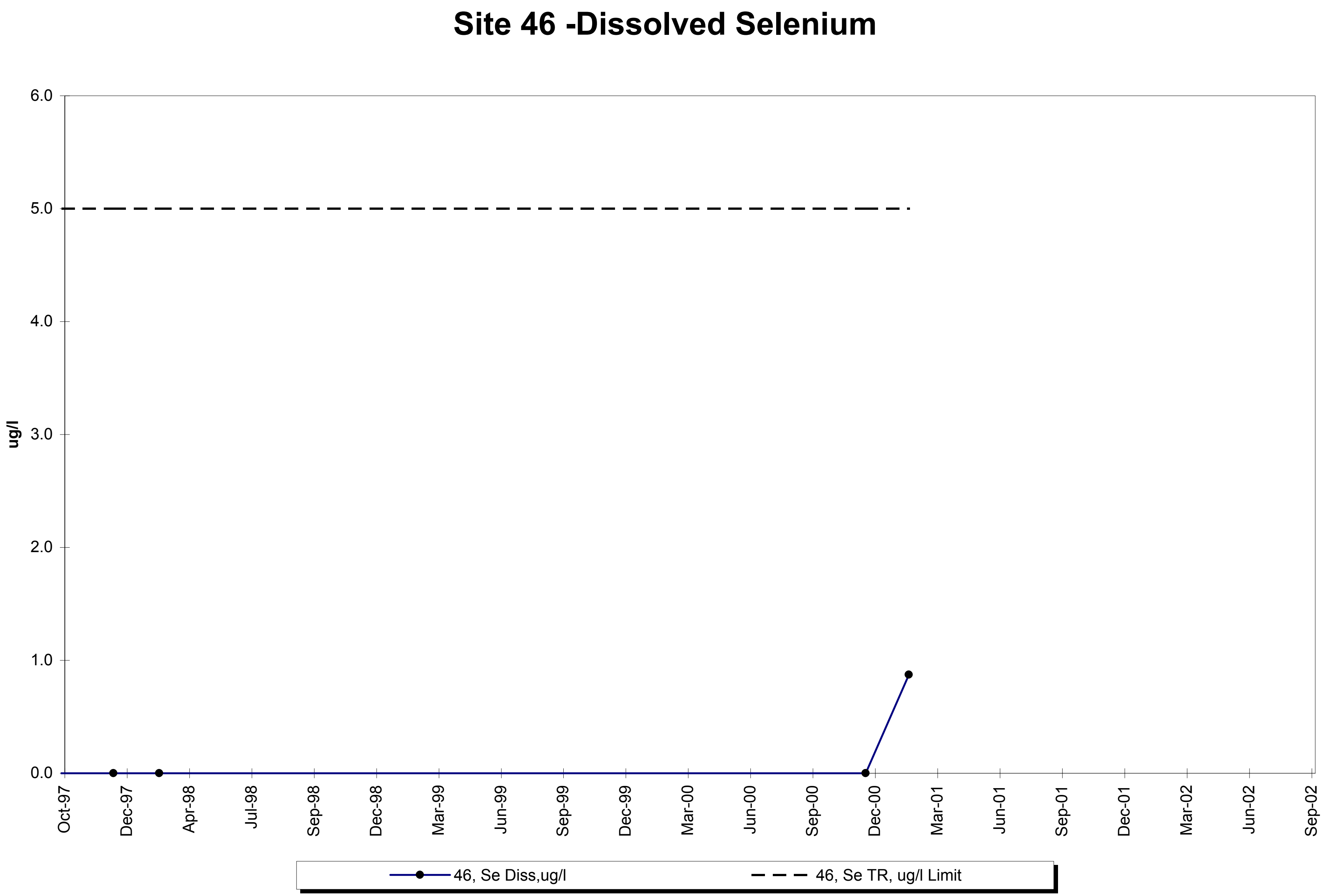
Site 46 -Dissolved Lead
ug/l
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
46, Pb Diss,ug/l
46, Pb TR, ug/l Limit

Site 46 -Dissolved Mercury

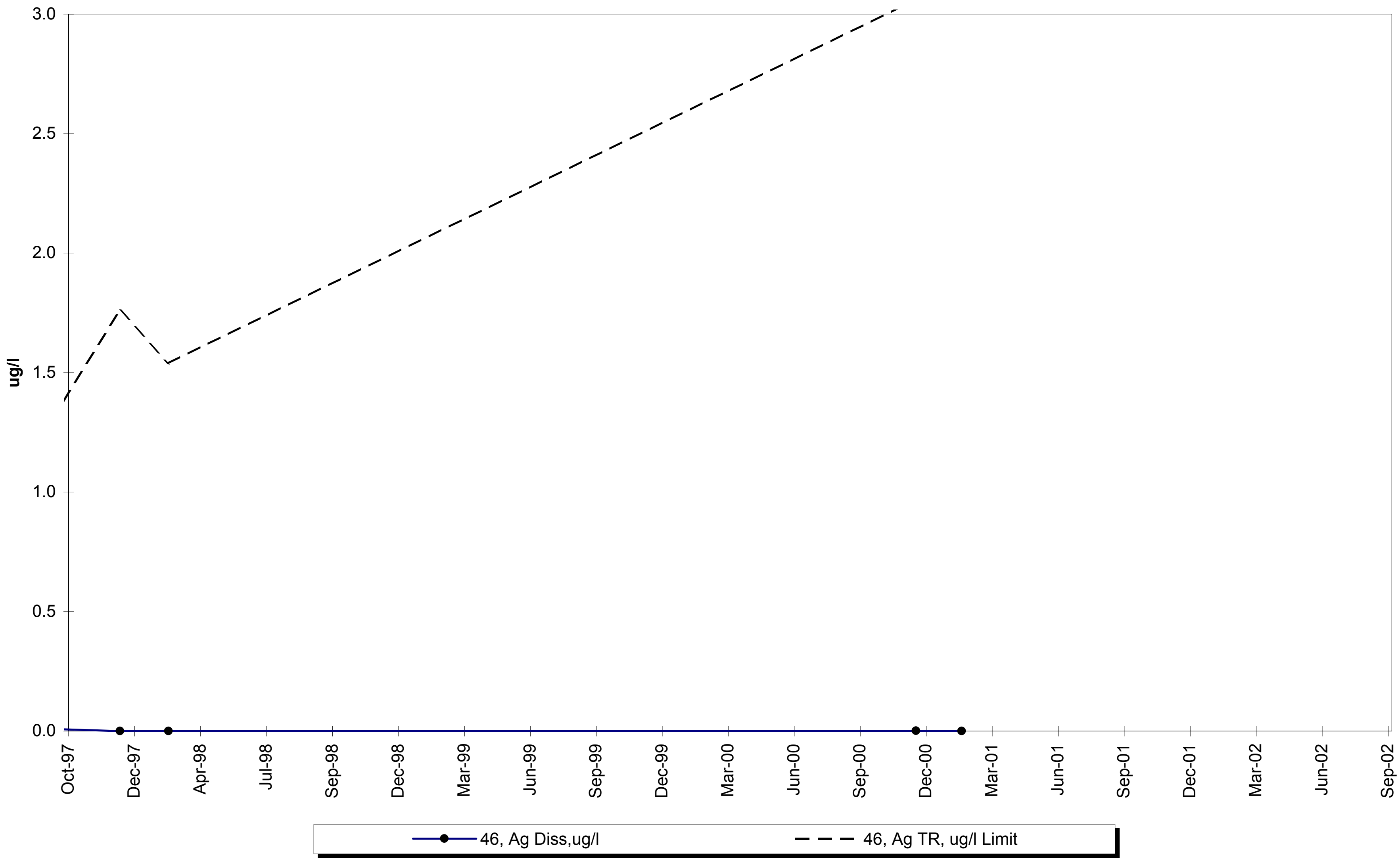


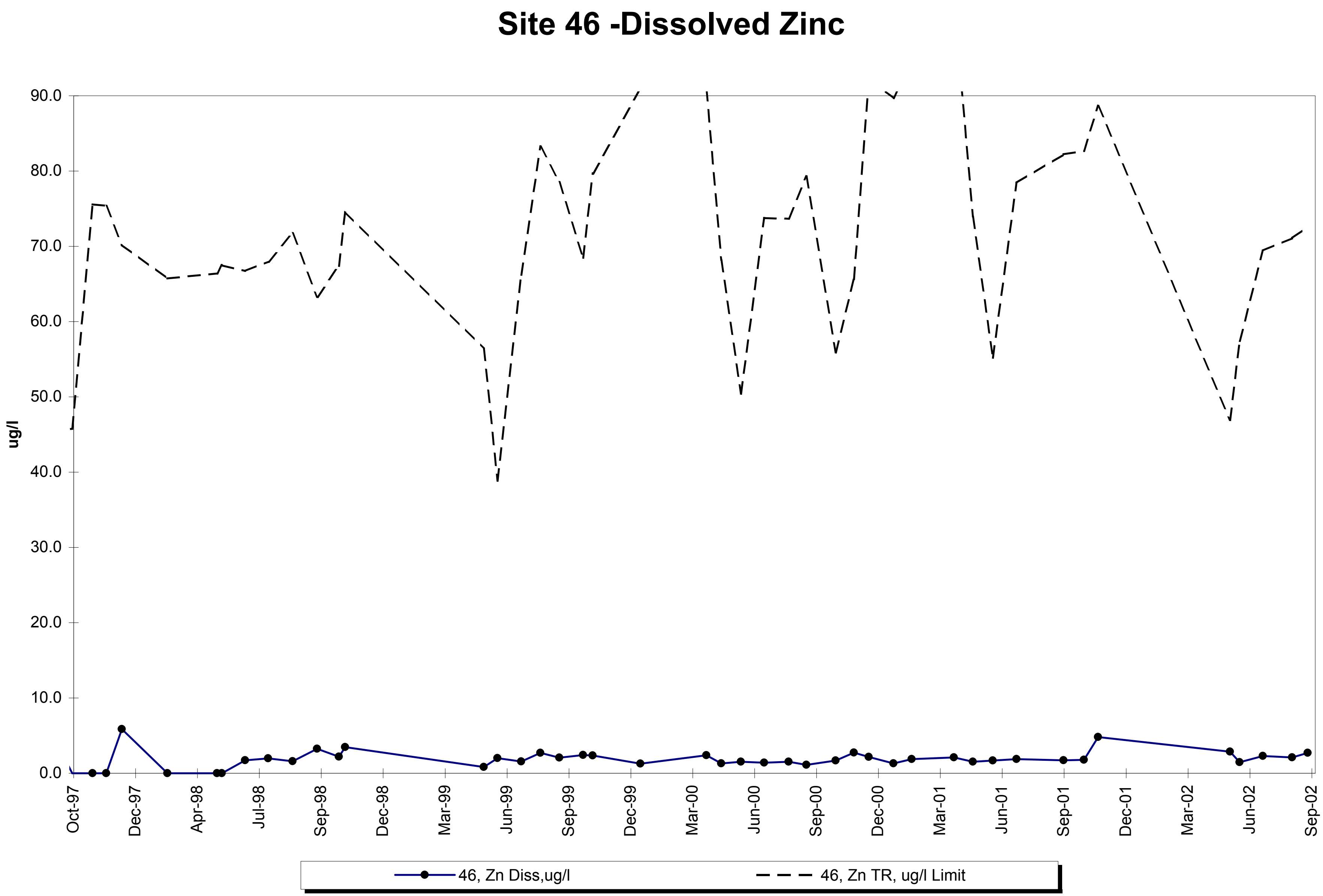


Site 46 -Dissolved Nickel
Note: the AWQS for Total Recoverable Nickel is hardness dependant with a minimum value of 49 µg/l at 25 mg/l of hardness. Thus the limit is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
46, Ni Diss,ug/l
46, Ni TR, ug/l Limit

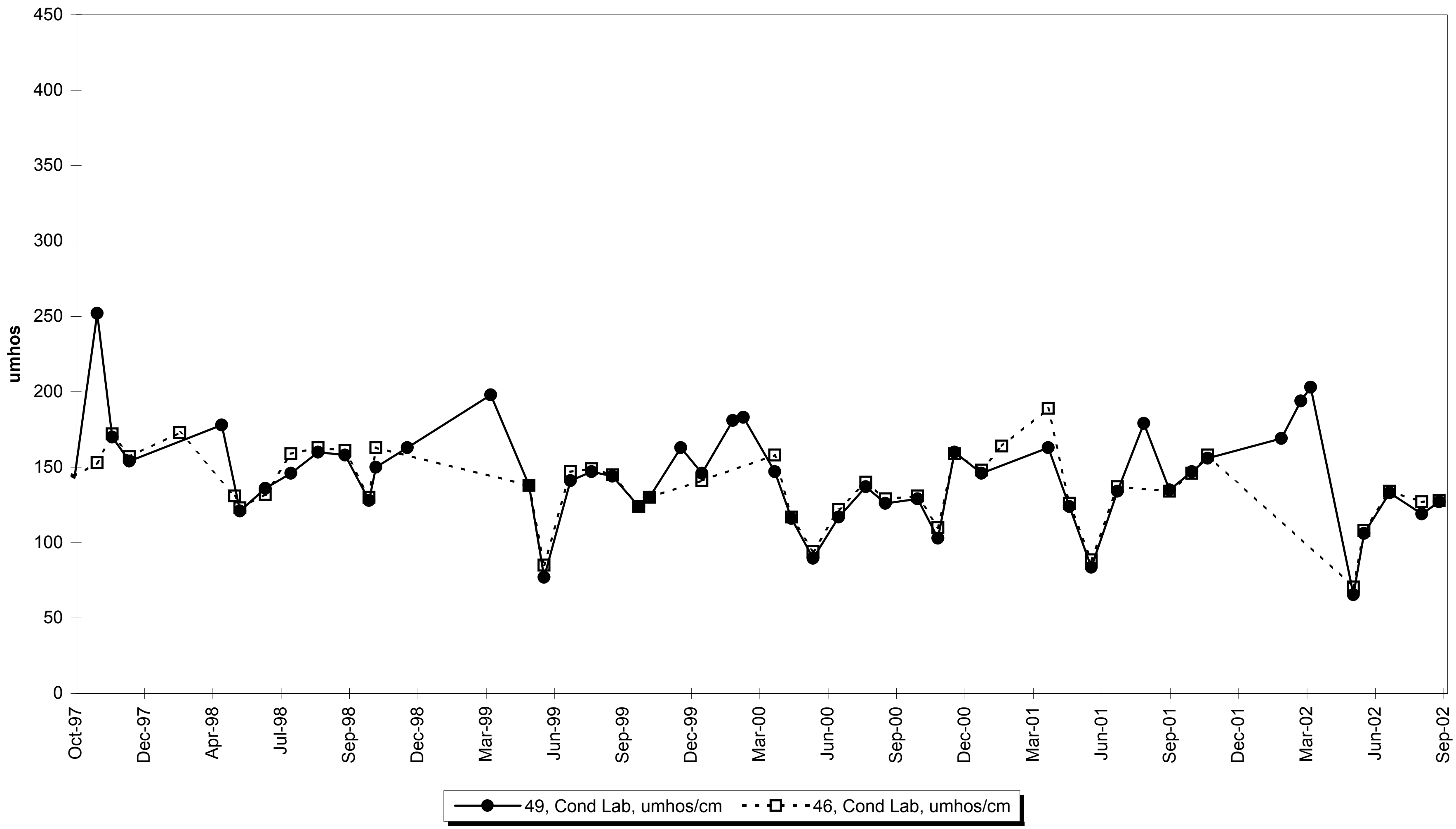

Site 46 -Dissolved Selenium
ug/l
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
46, Se Diss,ug/l
46, Se TR, ug/l Limit

Site 46 -Dissolved Silver

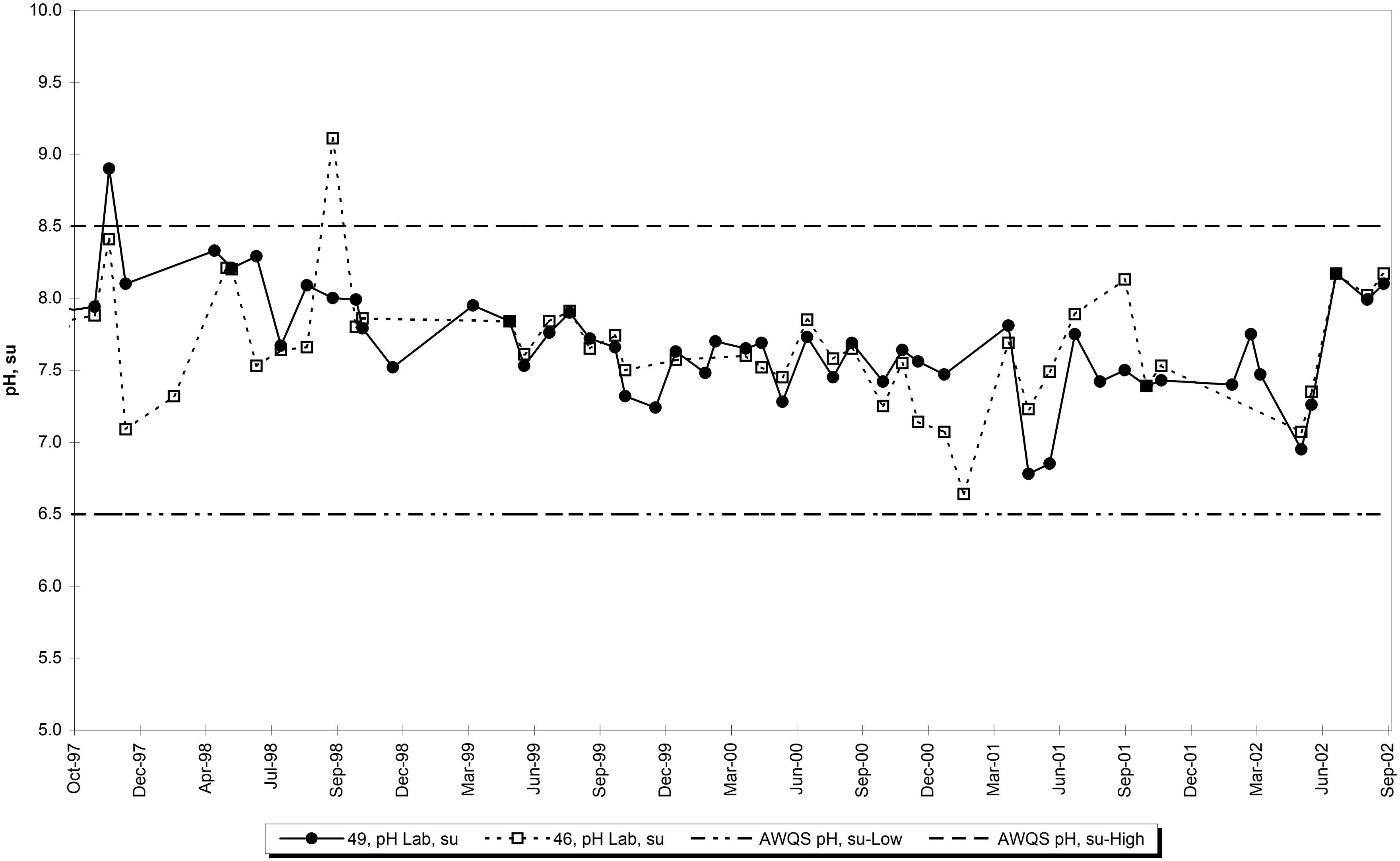



Site 46 -Dissolved Zinc
ug/l
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
46, Zn Diss,ug/l
46, Zn TR, ug/l Limit

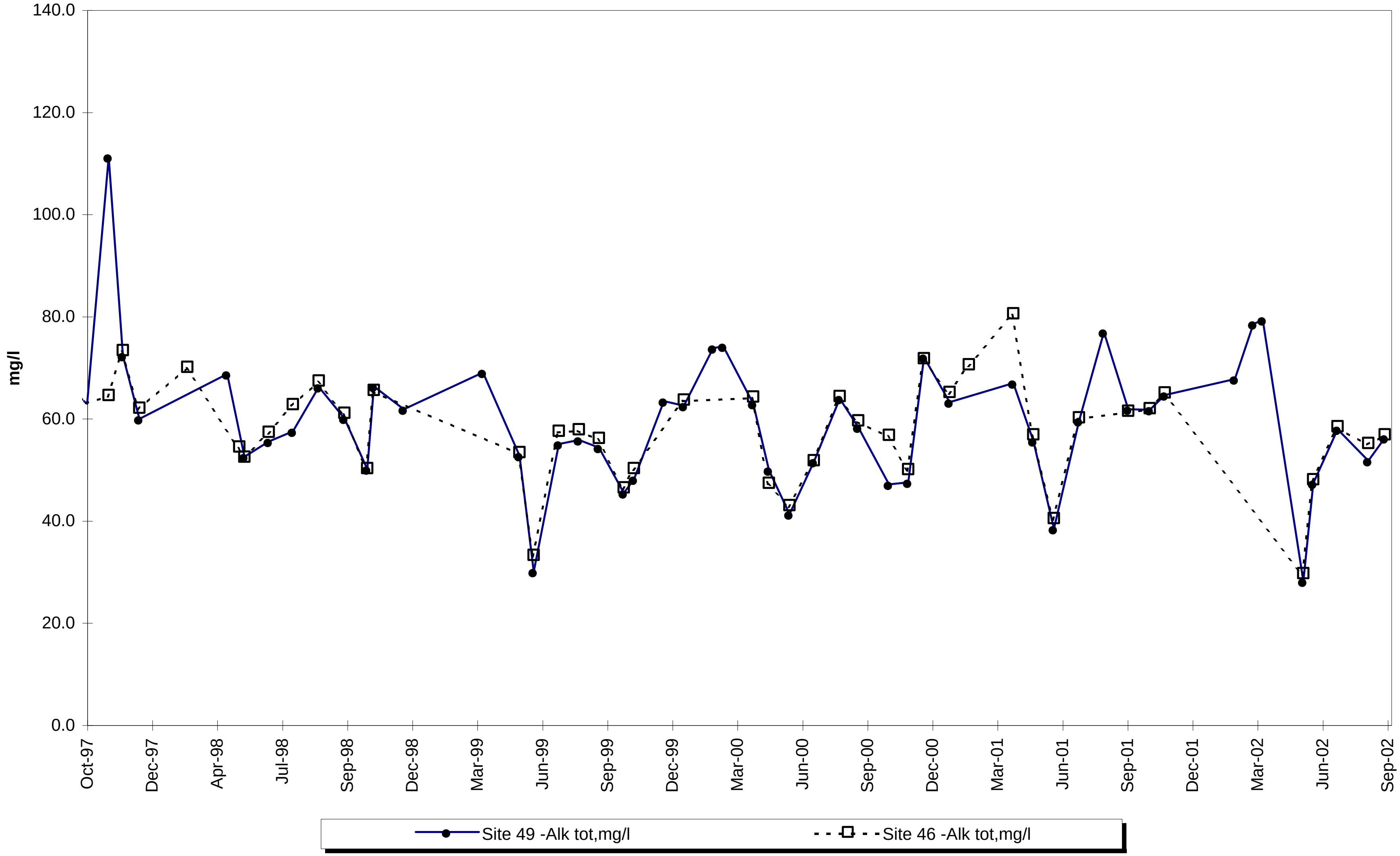
Site 49 vs Site 46 -Conductivity-Lab



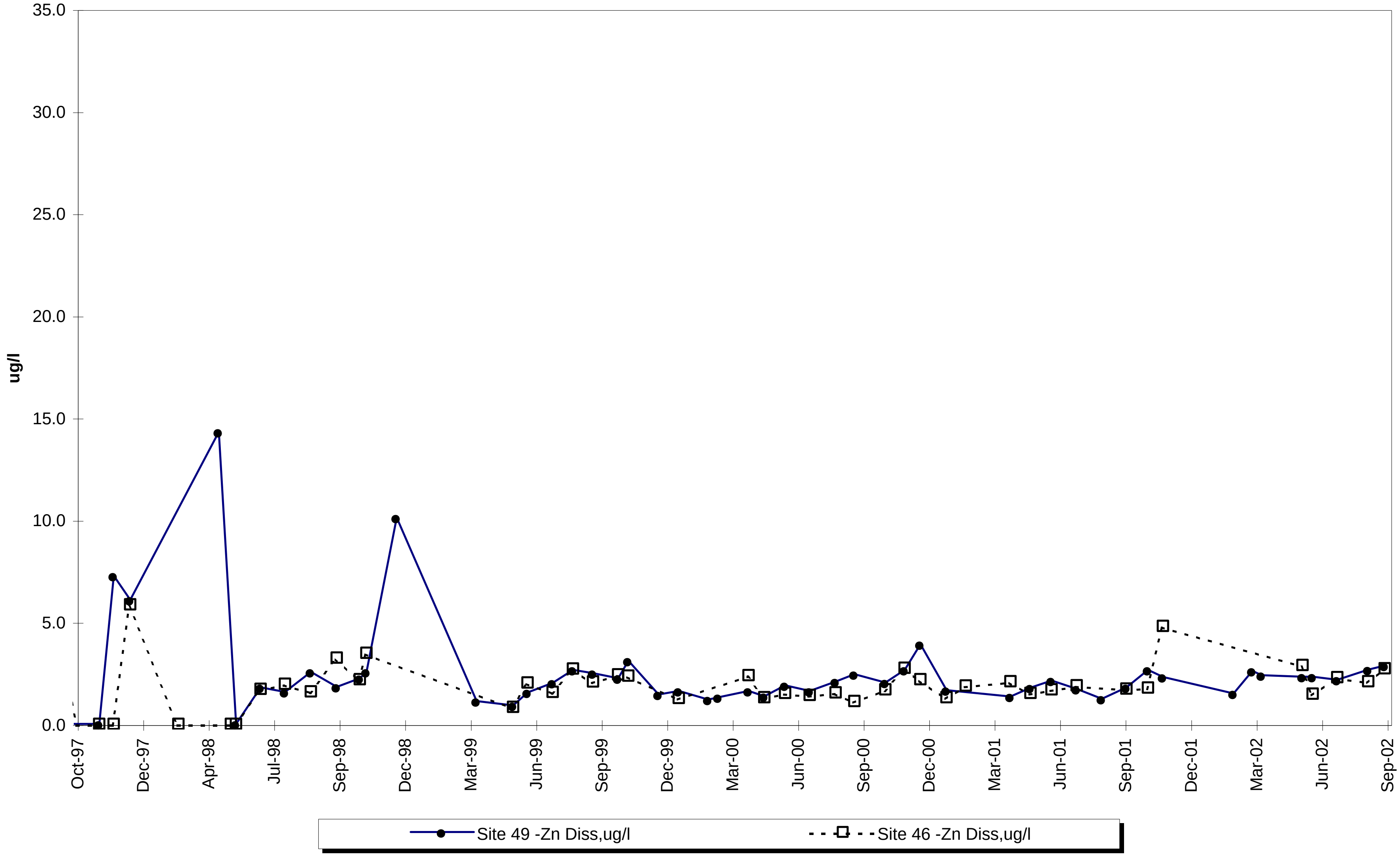
Site 49 vs. Site 46 -Lab pH



Site 49 vs. Site 46 -Total Alkalinity



Site 49 vs. Site 46 -Dissolved Zinc



INTERPRETIVE REPORT
SITE 57 "MONITORING WELL 23-00-03"

Sampling at this site was added to the FWMP in October-2001. All data collected at this site since it's inception into the FWMP are included in the data analyses. Results from the November-2001 sampling run for the dissolved fraction of arsenic, barium, cadmium, chromium, copper, lead, nickel, and zinc appear to be anomalously high when visually compared to data collected during the one pre and six post sampling runs conducted during the 2002 water year. Review of field notes, laboratory reports, and data limitations listed by the QA reviewer does not indicate that the values are an artifact associated with an obvious sampling error. Currently, KGCMC did not feel that enough data had been collected to make a reasonable determination as to if the questionable results in fact represented a true artifact. After continued sampling during the 2003 water year these data points may be reclassified as outliers. Currently as shown in the table below, there are no data outliers for this site.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-97 though Sept-02.				

The data collected during the current water year are listed in the following "Table of Results for Water Year 2002" report. The table includes all the data, field and lab, collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of zero for the purpose of median calculation.

The data for water year 2002 have been compared to the strictest fresh water quality criterion for each applicable analyte. Three (3) results exceeding these criteria have been identified, as listed on the following "Comparison To Standards" report. All three exceedances were associated with the November-2001 sampling event. As previously noted this event appears to be anomalous and may in fact represent a sampling artifact. However, pending further data collection in subsequent water years, the results are interpreted to be part of the natural background variation of ground water up-gradient from Site 23/D.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious trends were apparent. As noted above, the dissolved fraction for arsenic, barium, cadmium, chromium, copper, lead, nickel, and zinc all spike during the sampling done during November-2001. The X-Y graphs for these analytes appear to show the well recovering from an upset event recorded by the spiked values. Values collected since March-2002 appear to have stabilized and further data collection should indicated if the values collected during November-2001 could in fact represent an extreme in the natural variation of this up-gradient well or an artifact of sampling.

Table of Results for Water Year 2002

Site 57 "MW-23-00-03"

Sample Date/Parameter	10/25/2001	11/15/2001	12/5/2001	1/29/2002	2/21/2002	3/19/2002	4/1/2002	5/28/2002	6/11/2002	7/15/2002	8/27/2002	9/19/2002	**Median**
Water Temp (°C)	3.8	4.6	NOT SCHEDULED FOR SAMPLING				8.1	6.8	6.9	8.8	6.6	6.5	6.7
Conductivity-Field (µmho)	415	431					428	437	436	433	427	387	430
Conductivity-Lab (µmho)	401 J	391 J					408	427	435	418	415	398	412
pH Lab (standard units)	7.00	7.36 J					7.43	6.74	7.15	7.60	7.59	7.77	7.40
pH Field (standard units)	7.41	7.68					7.47	7.50	7.47	7.45	7.45	7.70	7.47
Total Alkalinity (mg/l)	160.0 J	153.0 J					152.0	143.0	162.0	154.0	156.0	155.0	154.5
Hardness (mg/l)	210.0	198.0					149.0	301.0	254.0	180.0	209.0	218.0	209.5
Dissolved As (µg/l)	0.464 J	14.100					0.589 J	0.731	0.480 J	0.663	1.230	0.448	0.626
Dissolved Ba (µg/l)	29.0	110.0					29.5	42.2	44.9	29.1	33.2	32.1 J	32.7
Dissolved Cd (µg/l)	0.213 J	3.380					0.219	0.825 J	0.456	0.217	0.083	0.314	0.267
Dissolved Cr (µg/l)	2.080 J	8.800					0.952	0.356 J	0.155 J	3.650	0.368	0.391 J	0.672
Dissolved Cu (µg/l)	0.292	42.300					0.251	1.370	0.644 U	0.449 J	0.318	0.424	0.437
Dissolved Pb (µg/l)	<0.0430	21.9000					<0.0300	0.1120	<0.0320 UJ	0.0571	0.1130 U	0.0558	0.0565
Dissolved Ni (µg/l)	1.96 J	8.96					3.16	3.62	3.11	2.09	2.23	1.96	2.67
Dissolved Ag (µg/l)	<0.0590	0.2170 J					<0.0140	<0.0080 UJ	<0.0220	<0.0120	<0.0220	<0.0330	0.0110
Dissolved Zn (µg/l)	2.18 U	90.80					2.44	11.50	2.44 J	6.06	2.86 U	7.65 J	4.46
Dissolved Se (µg/l)	0.856 J	<1.020 UJ					0.784 J	0.677 J	<0.679 UJ	0.830	0.714	0.797	0.749
Dissolved Hg (µg/l)	0.003590 J	0.000476 U					0.000314 U	0.000517 UJ	0.000553 U	0.000479 U	0.000660 U	0.000649 U	0.000535

See "Qualififed Data by QA Reviewer" table for qualifier descriptions.

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
57	10/25/2001	4:30:00 PM				
			Cond Lab, umho	401	J	Sample Temp.
			Alk Tot, mg/l	160	J	Sample Temp.
			As Diss, ug/l	0.464	J	Below Quantitative Range
			Cd Diss, ug/l	0.213	J	LCS Rec.
			Cr Diss, ug/l	2.08	J	LCS Rec.
			Ni Diss, ug/l	1.96	J	Cont. Calib.
			Zn Diss, ug/l	2.18	U	Field Blk.
			Se Diss, ug/l	0.856	J	LCS Rec.
			Hg Diss, ug/l	0.00359	J	LCS RPD
57	11/15/2001	3:11:00 PM				
			Cond Lab, umho	391	J	Sample Temp.
			pH Lab, su	7.36	J	Hold Time
			Alk Tot, mg/l	153	J	Sample Temp.
			Ag Diss, ug/l	0.217	J	LCS Rec.
			Se Diss, ug/l	-1.02	UJ	LCS Rec.
			Hg Diss, ug/l	0.000476	U	Field Blank Cont.
57	04/01/2002	1:27:00 PM				
			As Diss, ug/l	0.589	J	LCS Rec.
			Se Diss, ug/l	0.784	J	Below Quantitative Range, L
			Hg Diss, ug/l	0.000314	U	Field Blank Cont.
57	05/28/2002	3:00:00 PM				
			Cd Diss, ug/l	0.825	J	CCV Rec.
			Cr Diss, ug/l	0.356	J	Below Quantitative Range
			Ag Diss, ug/l	-0.008	UJ	CCV Rec.
			Se Diss, ug/l	0.677	J	Below Quantitative Range
			Hg Diss, ug/l	0.000517	UJ	CCV Rec., Field Blank Conta

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
57	06/11/2002	2:50:00 PM				
			As Diss, ug/l	0.48	J	Below Quantitative Range, L
			Cr Diss, ug/l	0.155	J	Below Quantitative Range
			Cu Diss, ug/l	0.644	U	Field Blank Cont.
			Pb Diss, ug/l	-0.032	UJ	LCS Rec.
			Zn Diss, ug/l	2.44	J	LCS Rec.
			Se Diss, ug/l	-0.679	UJ	LCS Rec.
			Hg Diss, ug/l	0.000553	U	Field Blank Cont.
57	07/15/2002	3:20:00 PM				
			Cu Diss, ug/l	0.449	J	LCS Rec.
			Hg Diss, ug/l	0.000479	U	Field Blank Cont.
57	08/27/2002	2:32:00 PM				
			Pb Diss, ug/l	0.113	U	Field Blank Contamination
			Zn Diss, ug/l	2.86	U	Field Blank Contamination
			Hg Diss, ug/l	0.00066	U	Field Blank Contamination
57	09/19/2002	2:10:00 PM				
			Ba Diss, ug/l	32.1	J	LCS Rec.
			Cr Diss, ug/l	0.391	J	Below Quantitative Range
			Zn Diss, ug/l	7.65	J	LCS Rec.
			Hg Diss, ug/l	0.000649	U	Field Blank Contamination

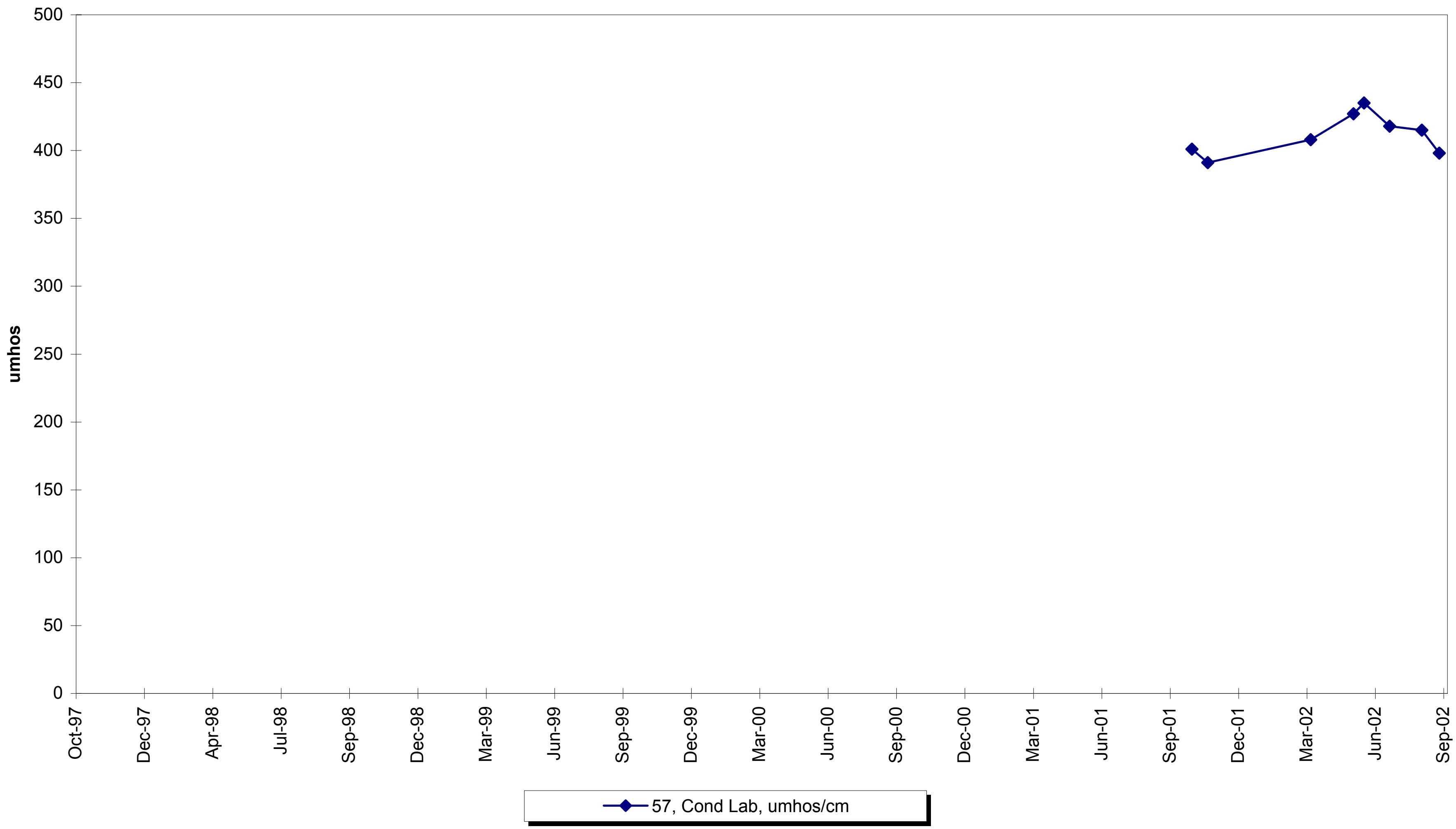
Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Comparison To Standards

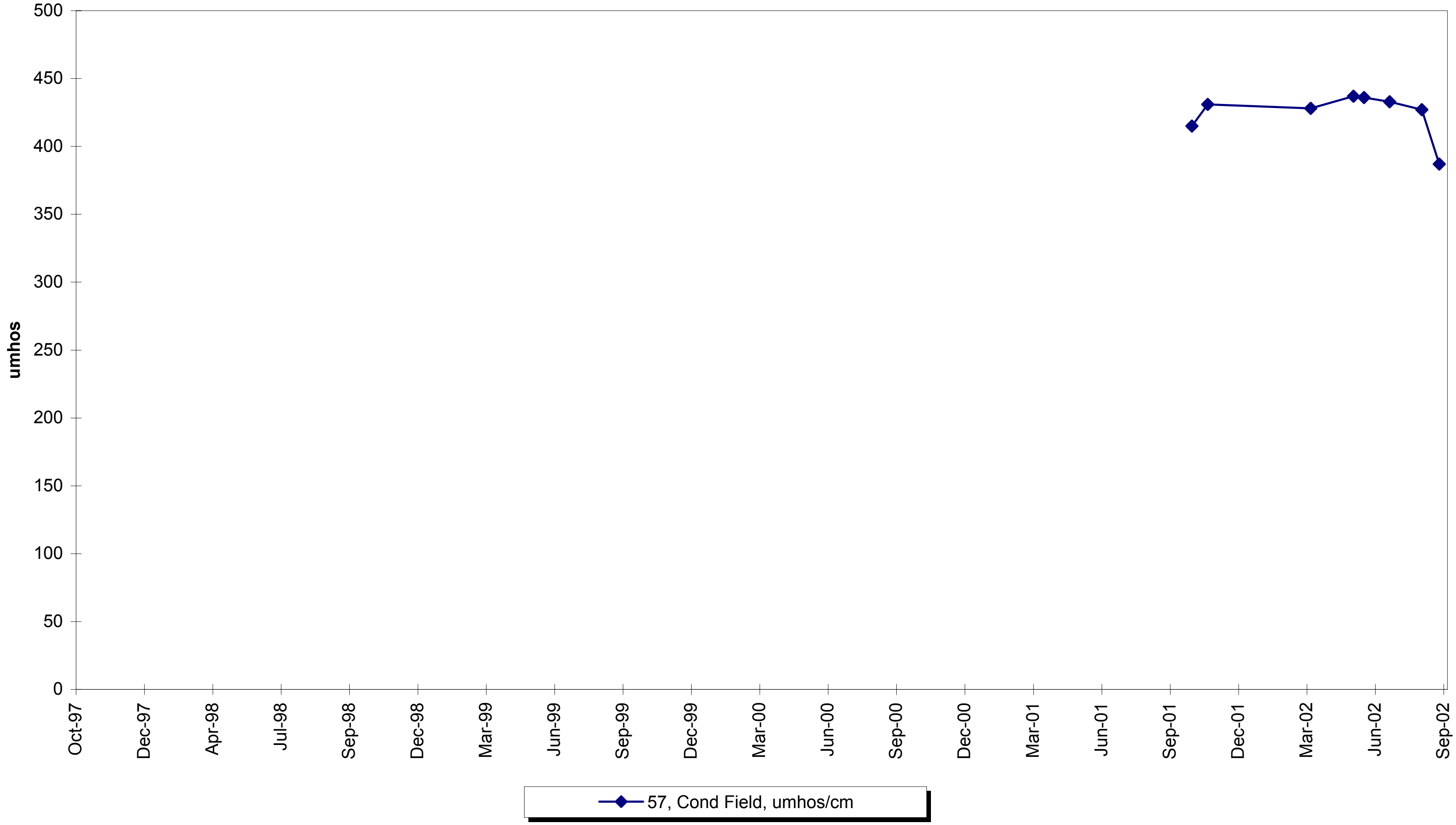
Date Range: 10/01/2001 to 09/30/2002

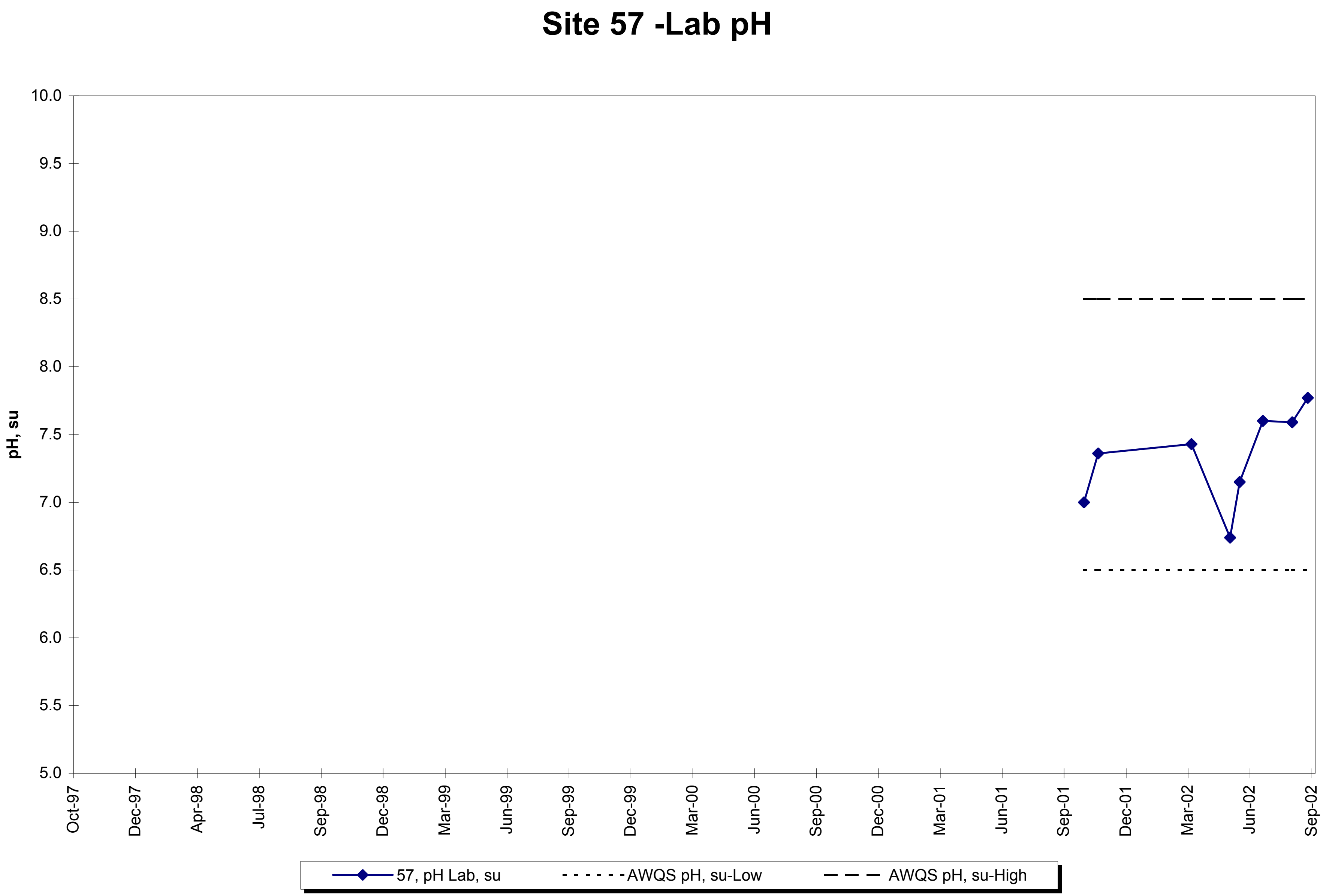
Site Number	Date	Time	Dup ID	Storet No.	Parameter Description	Value	Standard	Standard Type
57	11/15/2001	3:11 PM	0	1025	Cd Diss, ug/l	3.38	1.93934	Aquatic
57	11/15/2001	3:11 PM	0	1040	Cu Diss, ug/l	42.3	21.19625	Aquatic
57	11/15/2001	3:11 PM	0	1049	Pb Diss, ug/l	21.9	7.64419	Aquatic

Site 57 -Conductivity-Lab

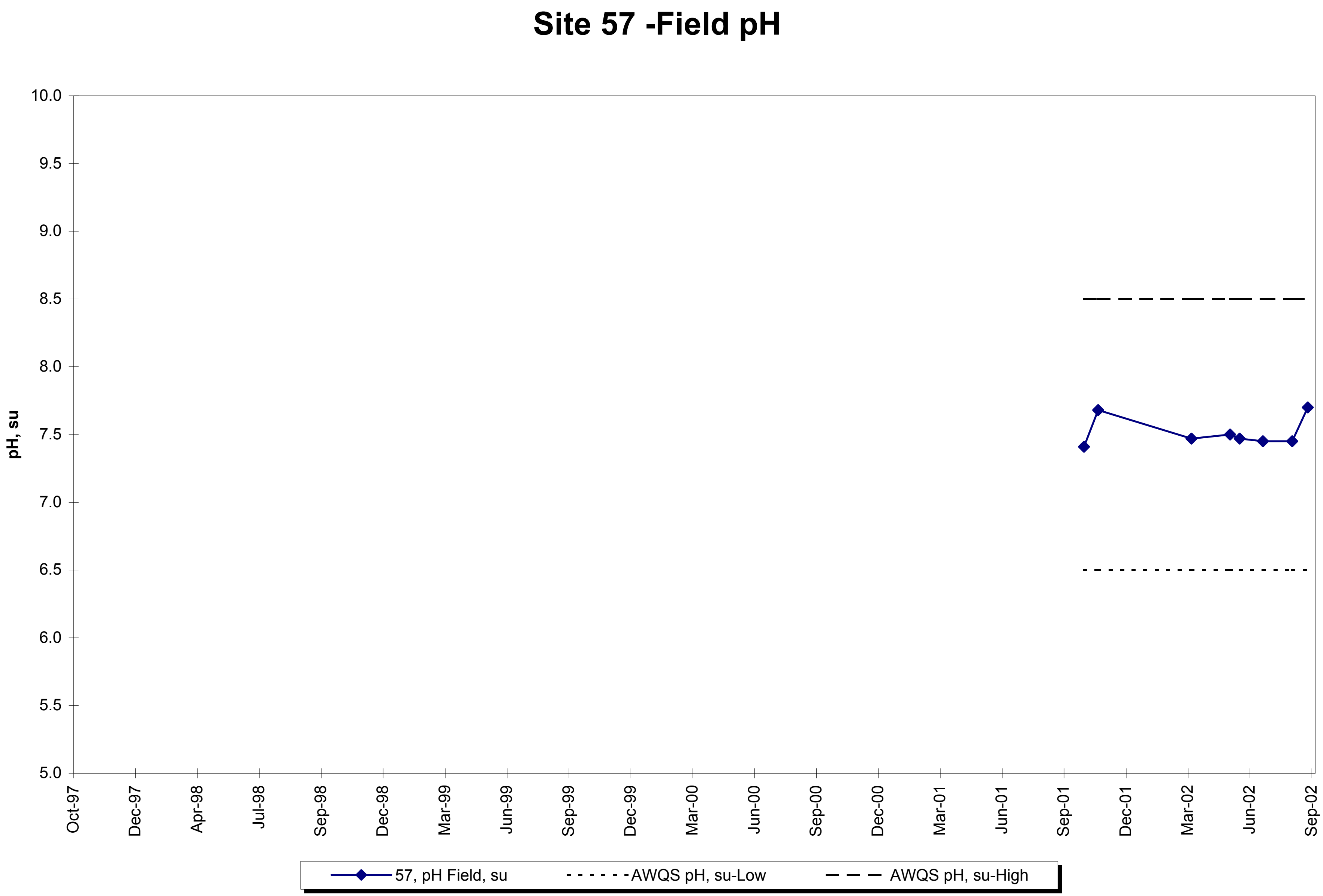


Site 57 -Conductivity-Field



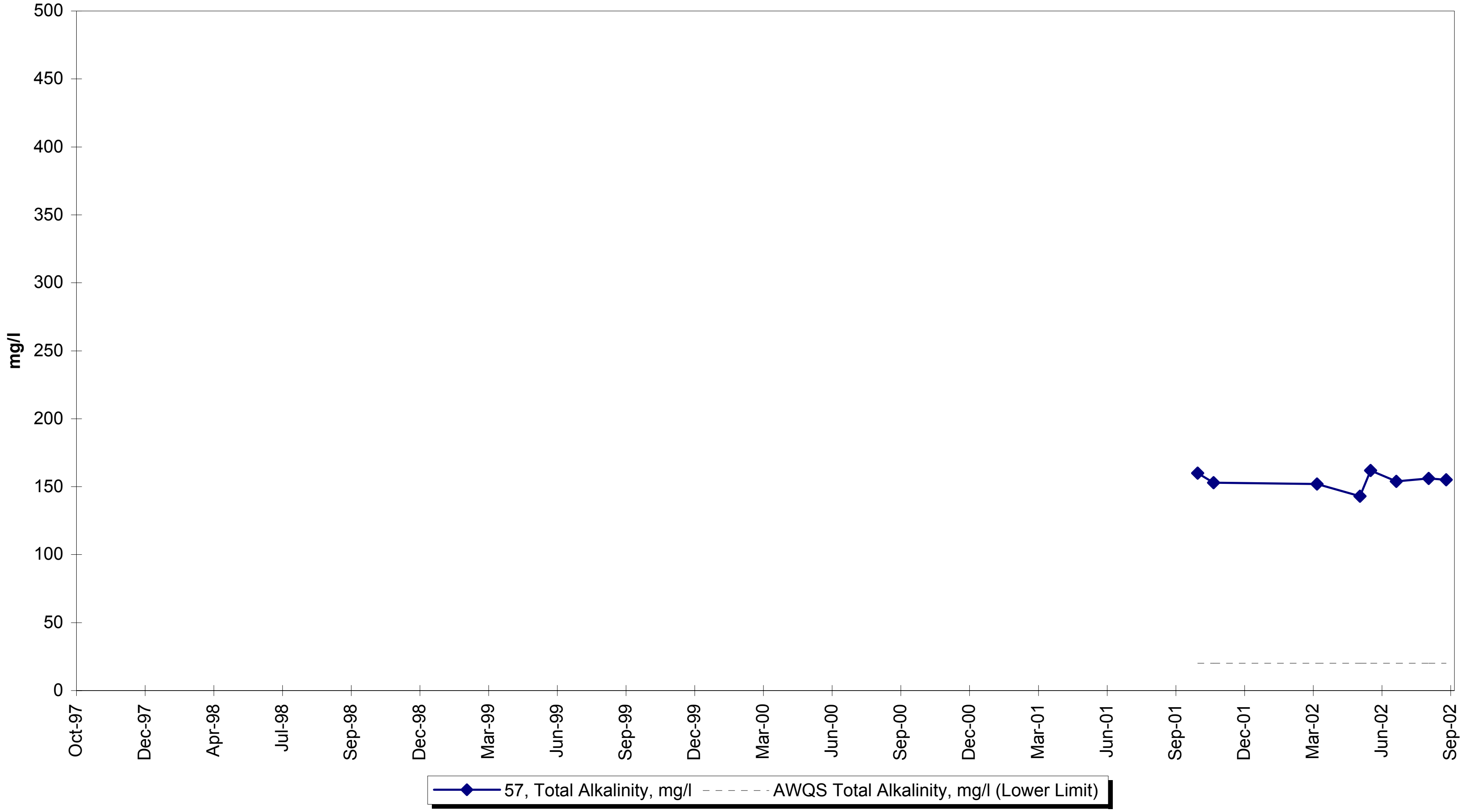


Site 57 -Lab pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
57, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

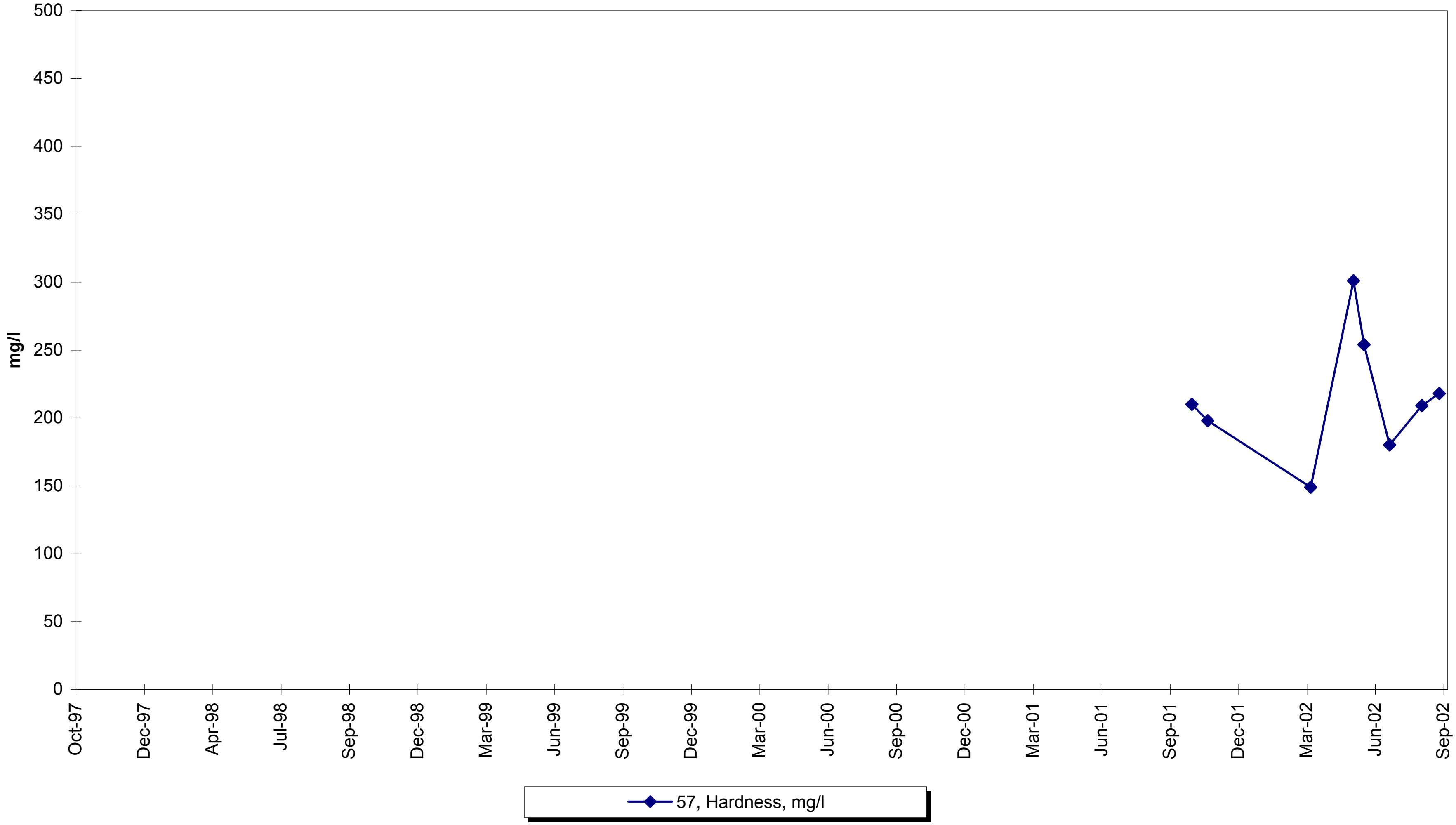


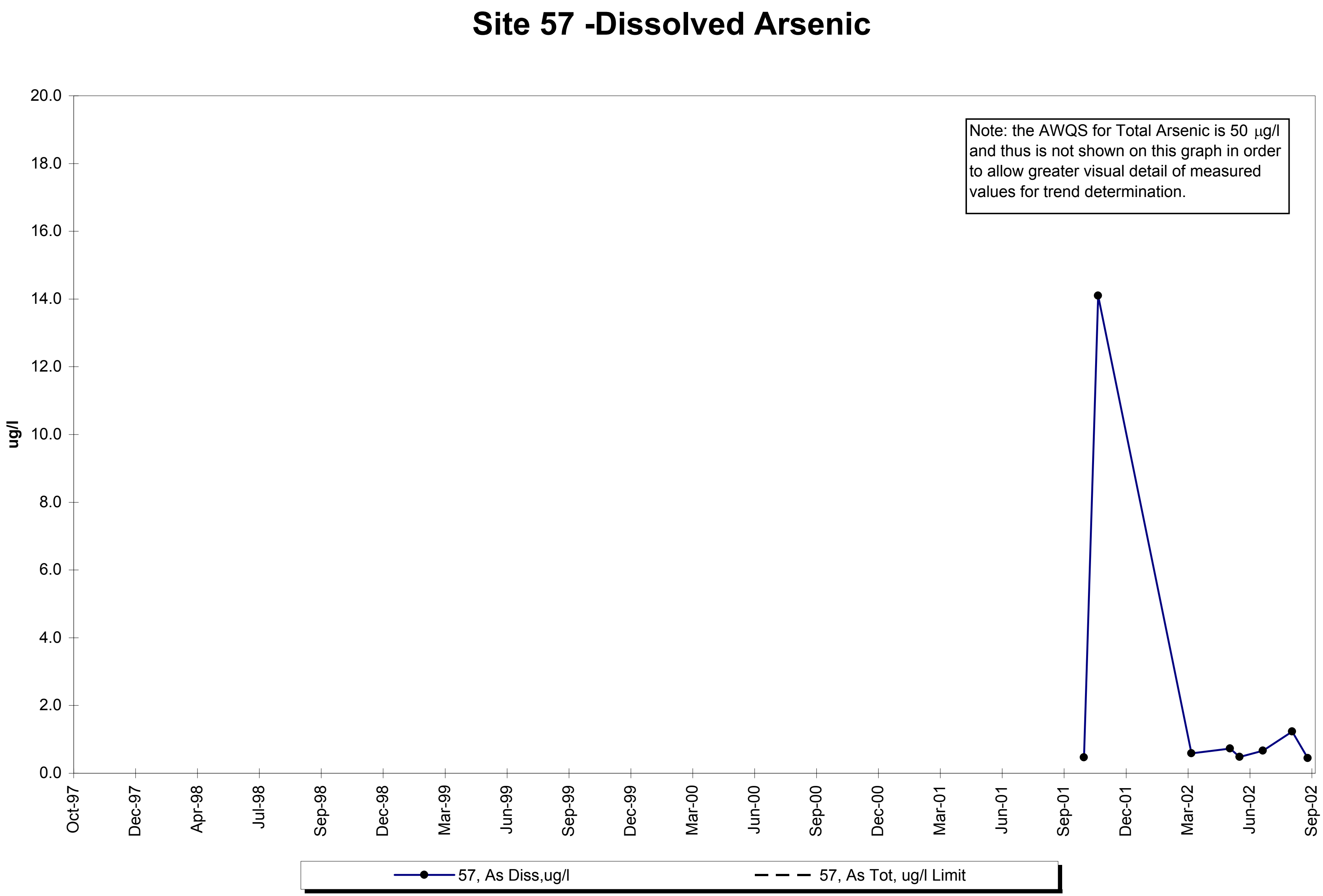
Site 57 -Field pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
57, pH Field, su
AWQS pH, su-Low
AWQS pH, su-High

Site 57 -Total Alkalinity

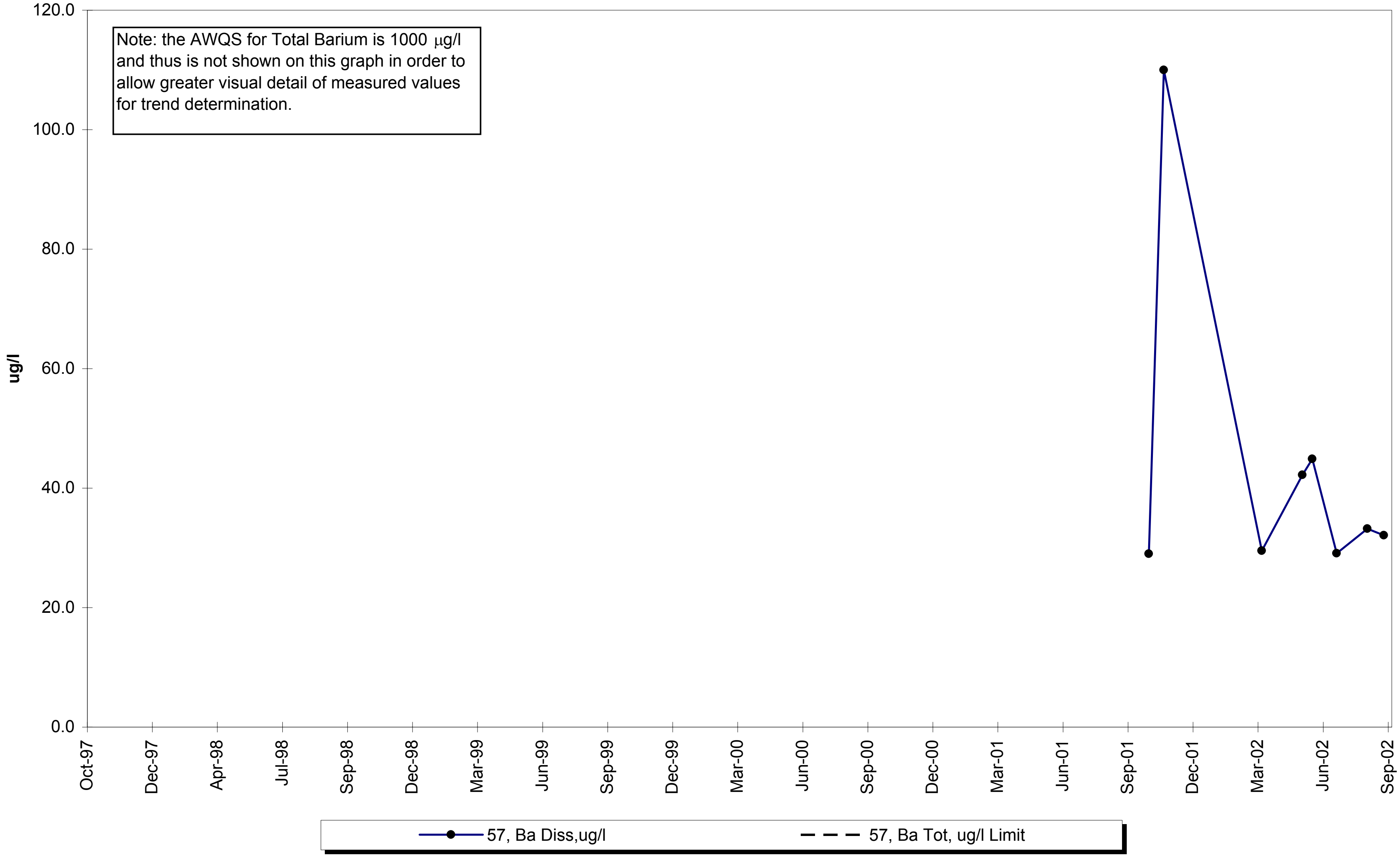


Site 57 -Hardness

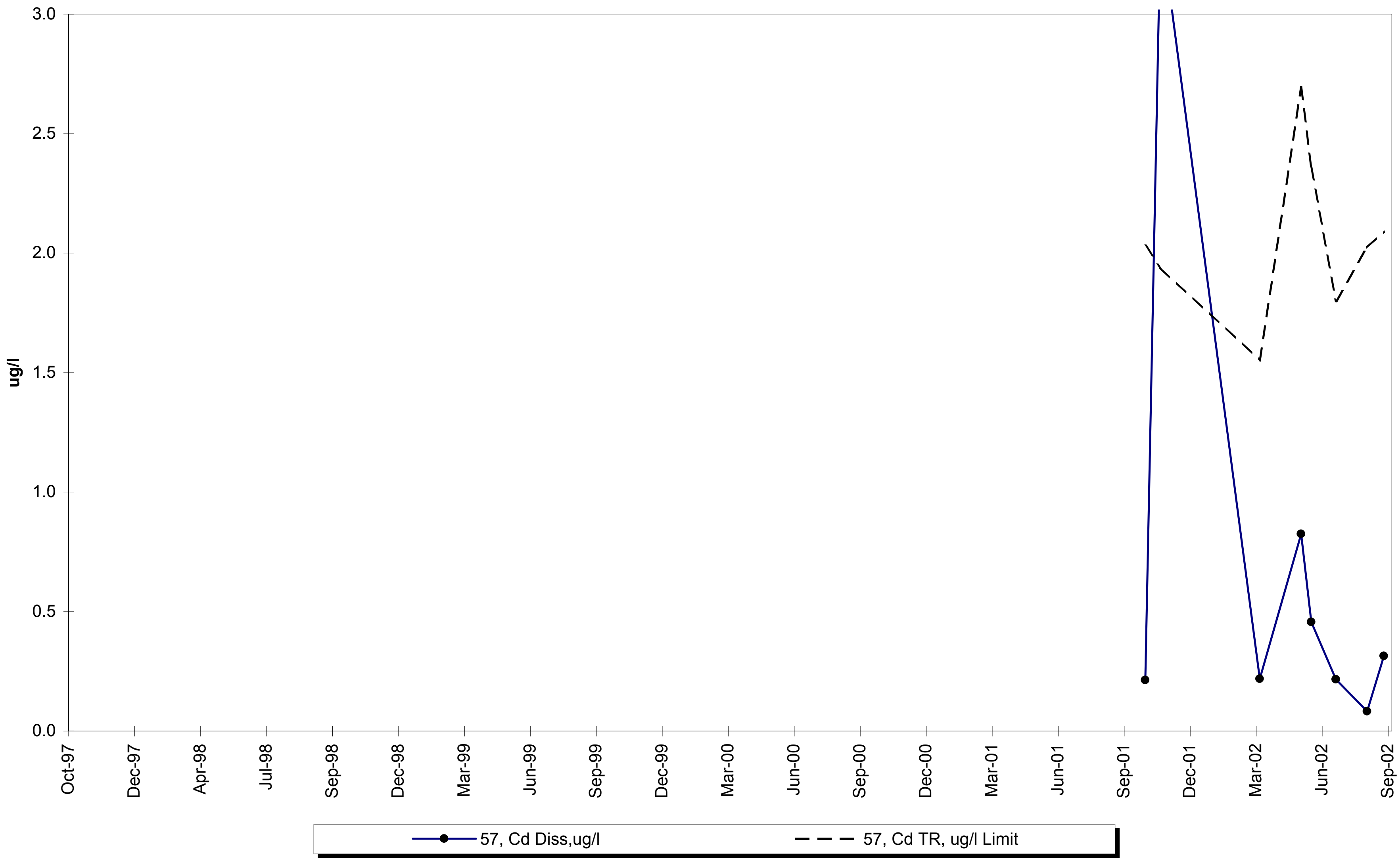



Site 57 -Dissolved Arsenic
Note: the AWQS for Total Arsenic is 50 µg/l and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
57, As Diss,ug/l
57, As Tot, ug/l Limit

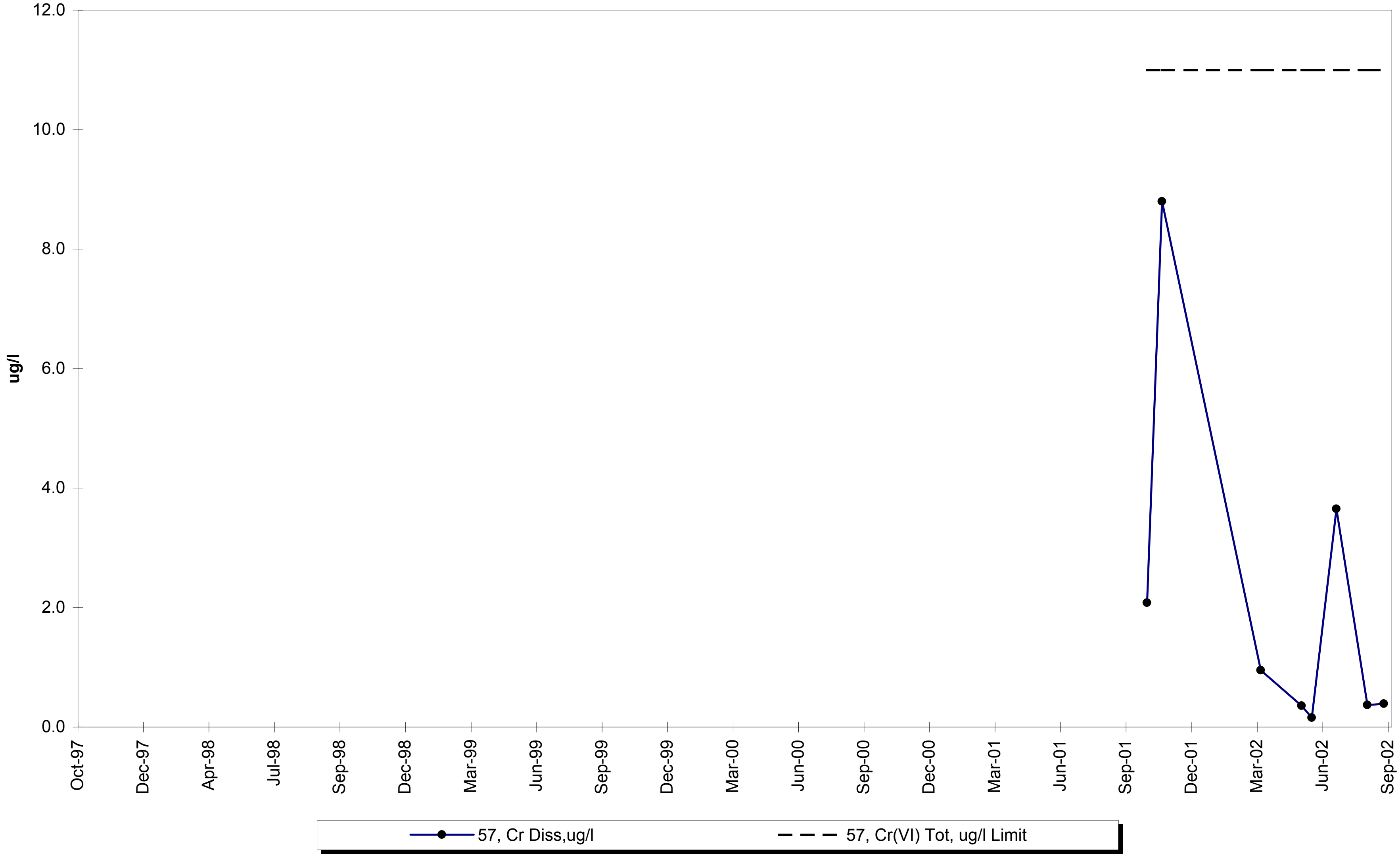
Site 57 -Dissolved Barium



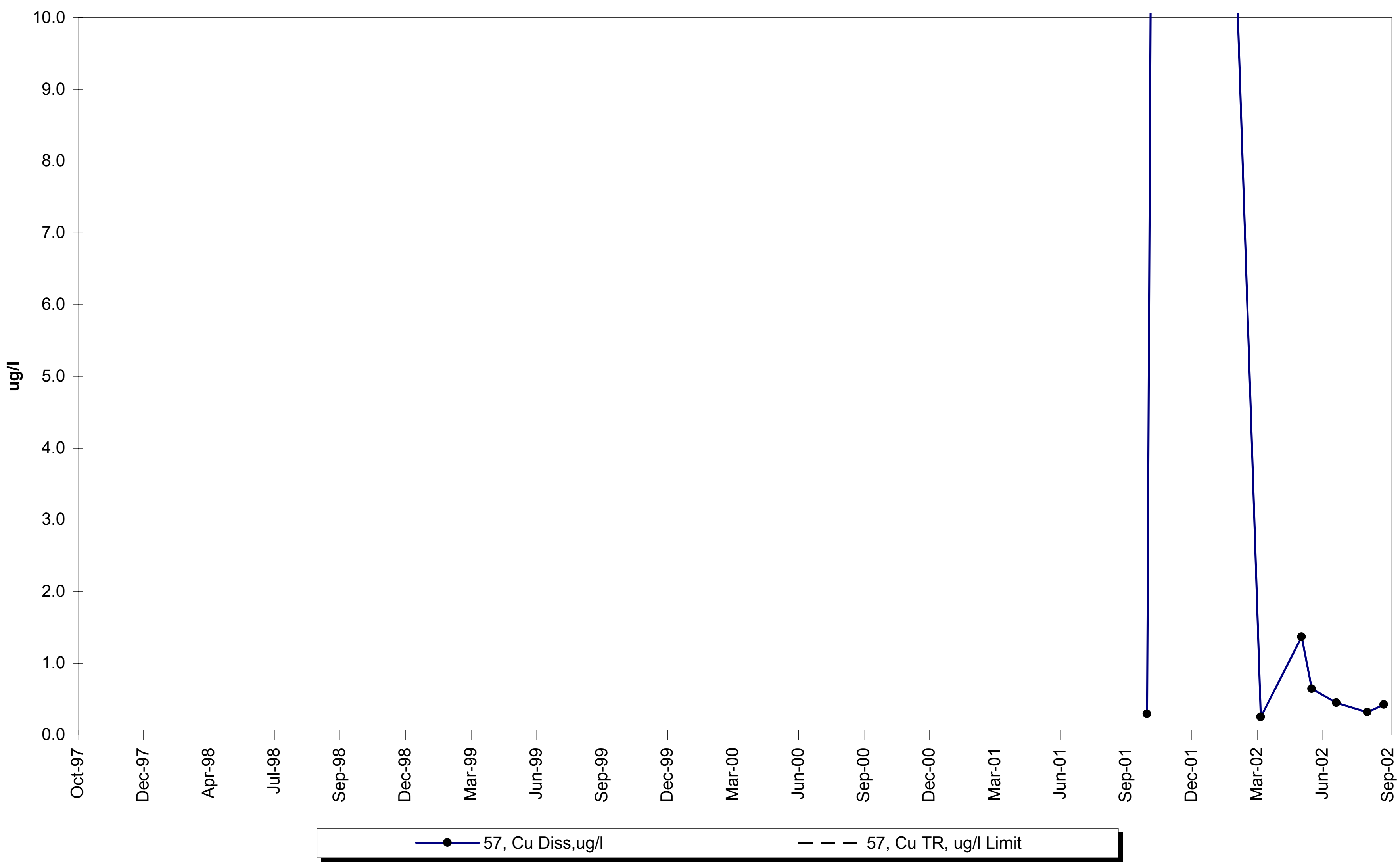
Site 57 -Dissolved Cadmium

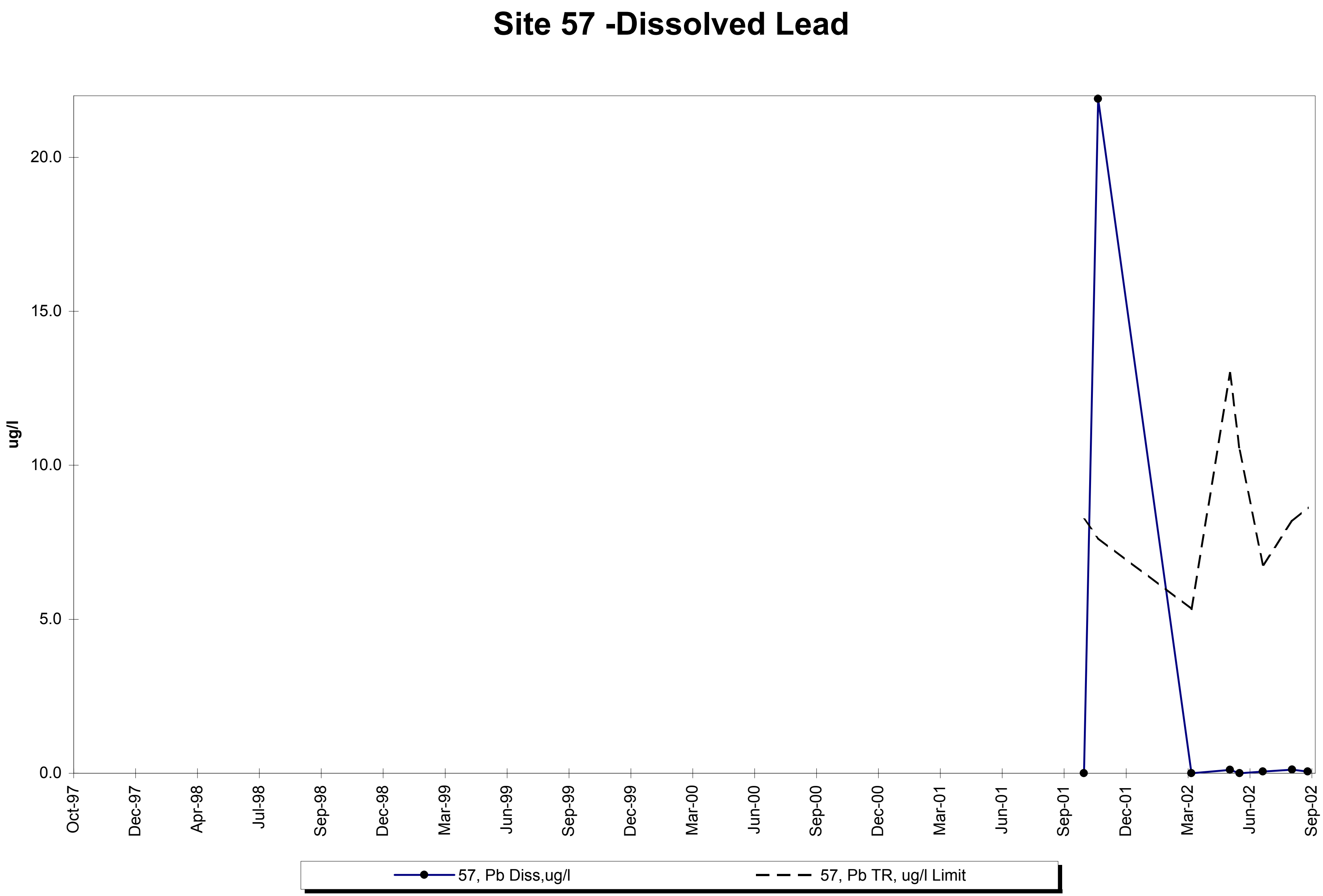


Site 57 -Dissolved Chromium

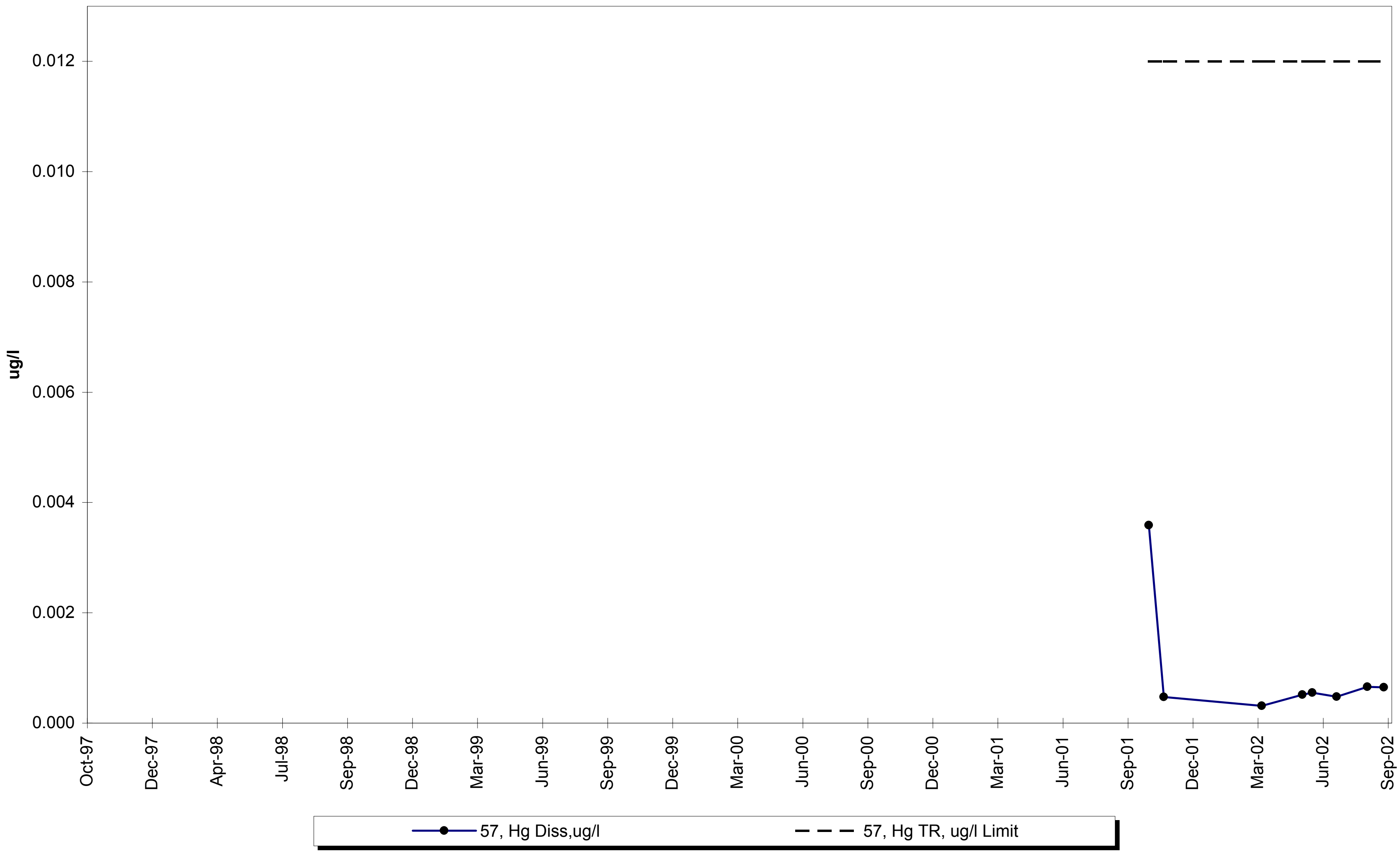


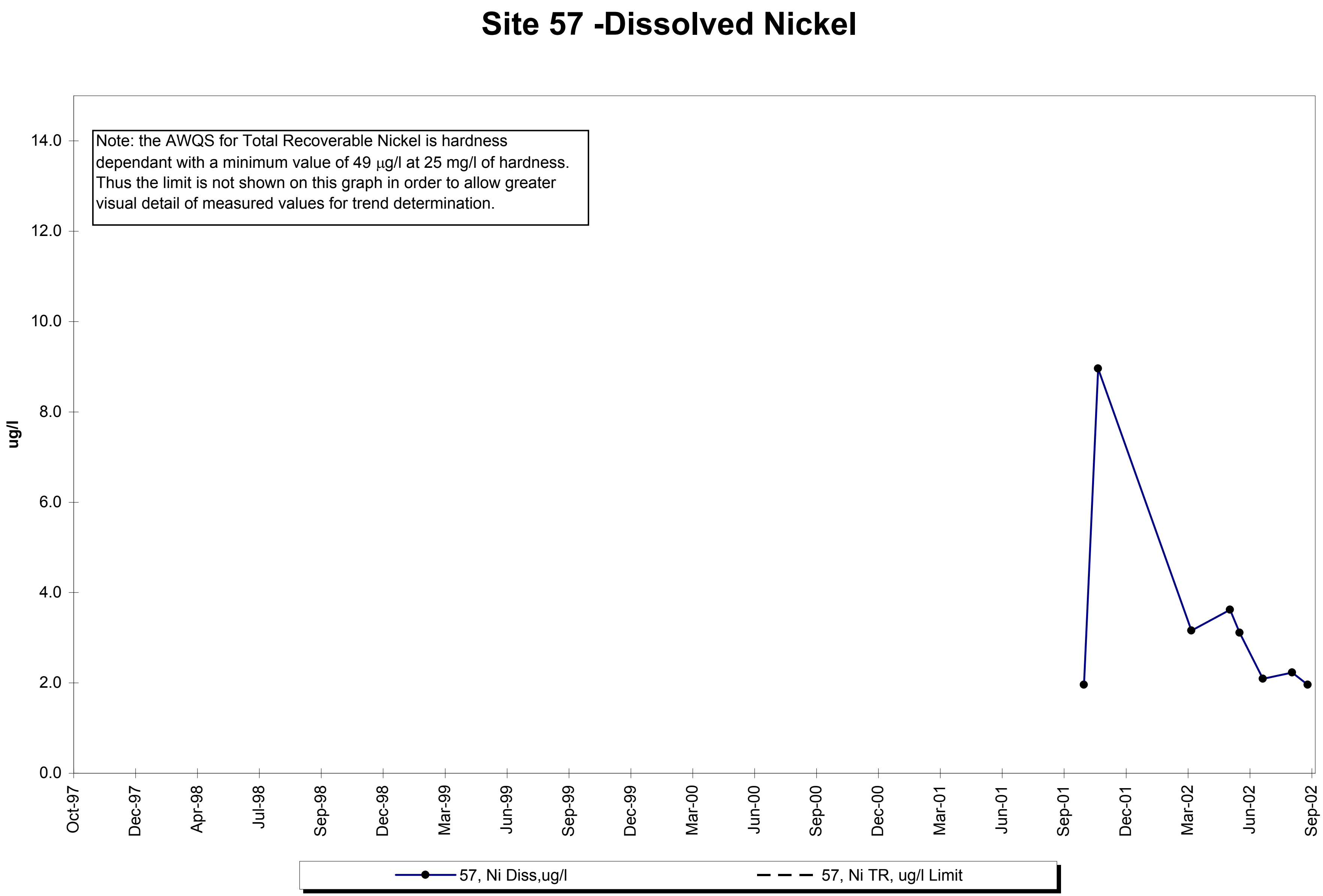
Site 57 -Dissolved Copper

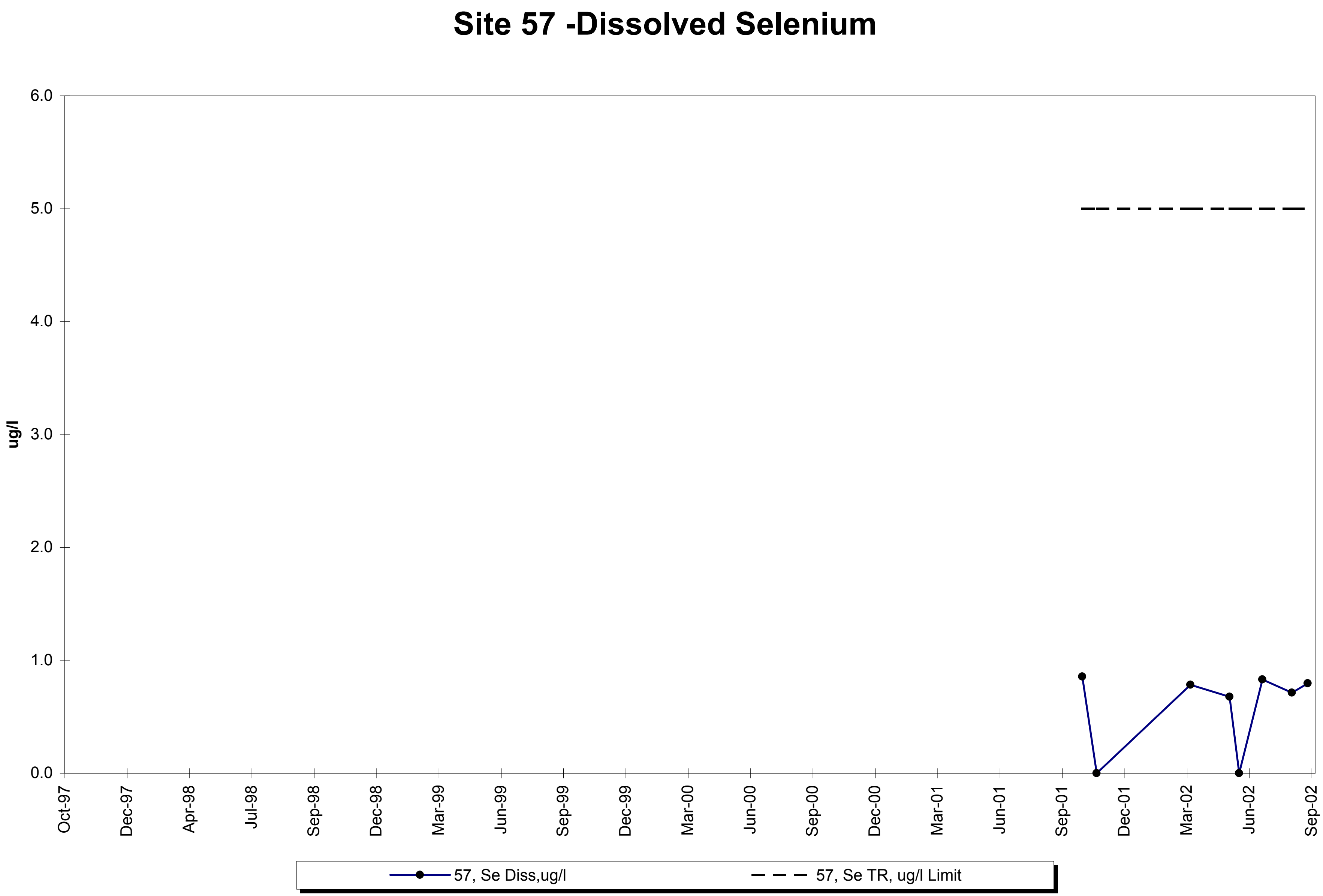



Site 57 -Dissolved Lead
ug/l
20.0
15.0
10.0
5.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
57, Pb Diss,ug/l
57, Pb TR, ug/l Limit

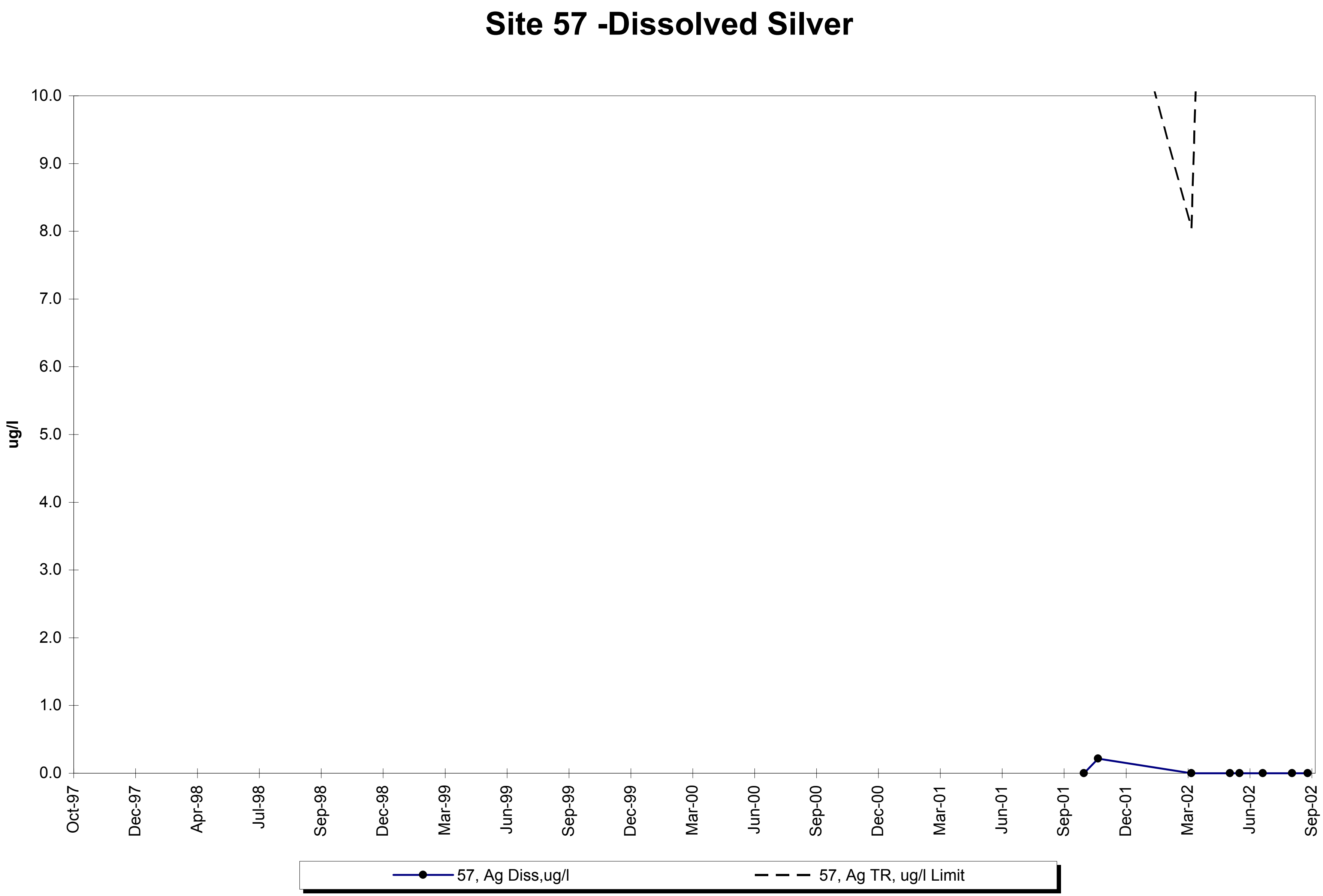
Site 57 -Dissolved Mercury

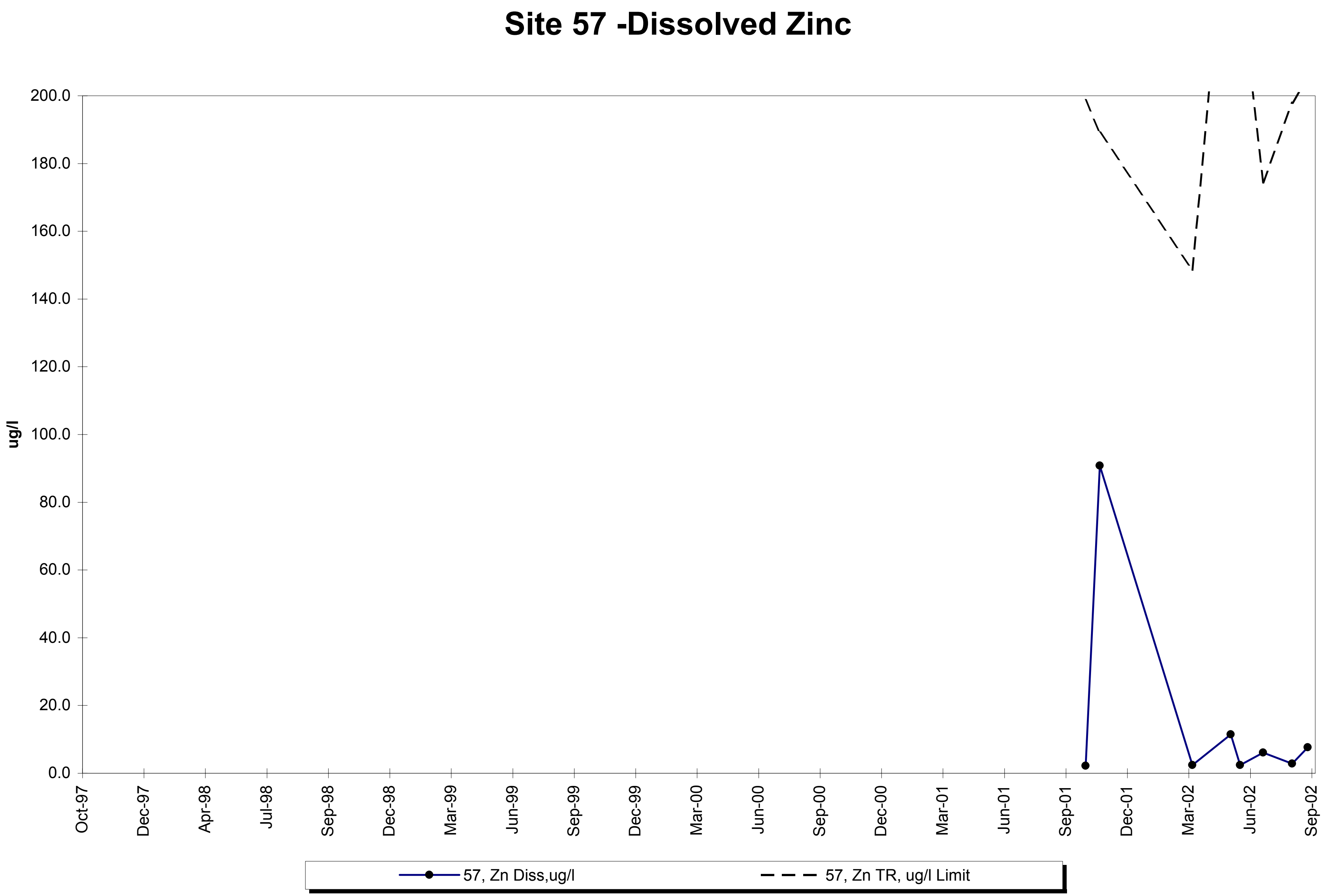



Site 57 -Dissolved Nickel
Note: the AWQS for Total Recoverable Nickel is hardness dependant with a minimum value of 49 µg/l at 25 mg/l of hardness. Thus the limit is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
57, Ni Diss,ug/l
57, Ni TR, ug/l Limit



Site 57 -Dissolved Selenium
ug/l
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
57, Se Diss,ug/l
57, Se TR, ug/l Limit


Site 57 -Dissolved Silver
ug/l
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
57, Ag Diss,ug/l
57, Ag TR, ug/l Limit



Site 57 -Dissolved Zinc
ug/l
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
57, Zn Diss,ug/l
57, Zn TR, ug/l Limit

INTERPRETIVE REPORT
SITE 56 "MONITORING WELL D-00-01"

Sampling at this site was added to the FWMP in October-2001. All data collected at this site since it's inception into the FWMP are included in the data analyses. As shown in the table below, there were no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-97 though Sept-02.				

The data collected during the current water year are listed in the following "Table of Results for Water Year 2002" report. The table includes all the data, field and lab, collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of zero for the purpose of median calculation.

The data for water year 2002 have been compared to the strictest fresh water quality criterion for each applicable analyte. No results exceeding these criteria have been identified, as listed on the following "Comparison To Standards" report.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious trends were apparent. Additional X-Y plots have been generated for alkalinity, pH, conductance, and dissolved zinc that plot Site 56 and Site 57, the up-gradient control site, to aid in the comparison between those two sites.

Median values for alkalinity, pH, specific conductance, and dissolved zinc from Site 56 have been compared to those of Site 57. The comparisons were done utilizing a two-tailed, exact Wilcoxon-Mann-Whitney rank sum test with a significance level of $\alpha/2=0.025$. Rank-sum test calculation details can be found in subsequent pages of this section and a summary of the test results is shown in the table below.

Analyte	N		Median Value		Σ Ranks		Exact Test Bounds		$H_0:\mu_{57}=\mu_{56}$
	#57	#56	#57	#56	#57	#56	Lower	Upper	
Alkalinity (mg/l)	8	7	154.5	57.4	92	**28**	38.7	73.3	**REJECT**
Lab pH (su)	8	7	7.40	7.36	66.5	**53.5**	38.7	73.3	ACCEPT
Conductivity (umhos)	8	7	411.5	133.0	92	**28**	38.7	73.3	**REJECT**
Dissolved Zinc (µg/l)	8	7	4.46	0.80	88	**32**	38.7	73.3	**REJECT**
Dissolved Zinc (µg/l)	7(a)	7	4.46	0.80	73	**32**	36.8	68.3	**REJECT**

(a) Second dissolved zinc rank-sum test doe not include potential Nov-01 outlier value of 90.80 µg/l from Site 57.

For all analytes except pH there was a statistically significant differences between the medians at the $\alpha/2=0.025$ significance level. The statistically significant difference of most of the constituents analyzed in these two wells is likely the result of several inherent differences between the two sites. The up-gradient control site, Site 57, is in an area away from the influence of any major surface flow. The screened interval is in the colluvial unit that underlies most of Site-23 production rock area and samples 63 to 68 feet below the surface. The down-gradient well, Site 56, is to the southeast of the Site-23/D production rock areas and is located approximately 40 ft. west of the lower reaches of Bruin Creek. The screened interval was originally interpreted as the same colluvial unit as Site 57, but recent drilling information suggests the completion is in the alluvial sands which underlie most of Site-D. The sampled interval is at a depth of 14 to 19 feet. The unit of completion is assumed to have the greatest affect on the resulting water quality. The colluvium is characterized as a fine to coarse sand with angular to subrounded, partially weathered chloritic rock with localized residual pyrite. The alluvial sand is characterized as a fine to coarse sand with subangular to rounded gravel and is composed of well-weathered clasts with a more stable mineral assemblage. Thus the colluvial material, being less deeply weathered, would typically generate a higher leachable load of dissolved salts that would be reflected in the chemistry of the associated ground water. Additionally, the proximity of Site 56 to Bruin Creek and it's shallow completion depth suggest there would be a much greater influence of a surface water component relative to Site 57. The surface water recharge to the local aquifer would tend to act as a diluent with respect to the more concentrated dissolved fraction of groundwater. Thus, the combined effects of the difference in completion units and the different hydrological regimes likely explain the disparity in analyte concentrations found at the two sites.

Table of Results for Water Year 2002

Site 56 "MW-D-00-01"

Sample Date/Parameter	10/25/2001	11/15/2001	12/5/2001	1/29/2002	2/21/2002	3/19/2002	4/1/2002	5/28/2002	6/11/2002	7/15/2002	8/27/2002	9/19/2002	**Median**
Water Temp (°C)	4.9	3.1	**NOT SCHEDULED FOR SAMPLING**				0.9	6.0	6.0	9.1	9.8	NOT ACCESSIBLE DUE TO LOST SAMPLE HOSE	6.0
Conductivity-Field (µmho)	146	145					215	98	107	157	123		145
Conductivity-Lab (µmho)	141 J	155 J					186	99	106	133	129		133
pH Lab (standard units)	7.33	7.38 J					7.36	6.76	7.06	7.64	7.49		7.36
pH Field (standard units)	7.42	7.70					7.65	6.80	7.00	7.11	7.40		7.40
Total Alkalinity (mg/l)	57.7 J	63.4 J					73.8	42.1	48.0	57.4	56.2		57.4
Hardness (mg/l)	58.6	70.9					76.3	53.1	47.4	56.4	64.7		58.6
Dissolved As (µg/l)	<0.446	<0.264					0.145 J	0.231 J	<0.204 UJ	0.216	0.202 U		0.202
Dissolved Ba (µg/l)		11.6					11.8	6.2	7.4	9.5	8.9		9.2
Dissolved Cd (µg/l)	<0.049	0.030 J					0.024 J	0.012 J	<0.034	0.015	0.015		0.017
Dissolved Cr (µg/l)		1.810					0.505	1.000	0.568	0.708	0.288		0.638
Dissolved Cu (µg/l)	0.868	0.452					1.020	0.612	0.655 U	0.668 J	0.814		0.668
Dissolved Pb (µg/l)	0.0984 UJ	0.2130					0.0447 J	<0.0240	<0.0320 UJ	<0.0130	0.0116 UJ		0.0160
Dissolved Ni (µg/l)		1.06					1.30	0.64	2.08	0.75	0.74 U		0.90
Dissolved Ag (µg/l)		<0.0320 UJ					<0.0140	<0.0080 UJ	<0.0220	<0.0120	<0.0220		0.0090
Dissolved Zn (µg/l)	3.45 U	1.11 U					1.78	0.58 J	<0.20 UJ	0.80 J	0.27 U		0.80
Dissolved Se (µg/l)		<1.020 UJ					1.040 J	<0.475	<0.679 UJ	0.391	0.292 J		0.365
Dissolved Hg (µg/l)	0.001800 UJ	0.001700 U					0.001180 U	0.002330 J	0.001070 U	0.001400 U	0.001880		0.001700

See "Qualififed Data by QA Reviewer" table for qualifier descriptions.

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
56	10/25/2001	1:55:00 PM				
			Cond Lab, umho	141	J	Sample Temp.
			Alk Tot, mg/l	57.7	J	Sample Temp.
			Pb Diss, ug/l	0.0984	UJ	Below Quantitative Range, Fi
			Zn Diss, ug/l	3.45	U	Field Blk.
			Hg Diss, ug/l	0.0018	UJ	Field Blk., LCS RPD
56	11/15/2001	1:31:00 PM				
			Cond Lab, umho	155	J	Sample Temp.
			pH Lab, su	7.38	J	Hold Time
			Alk Tot, mg/l	63.4	J	Sample Temp.
			Cd Diss, ug/l	0.0304	J	Below Quantitative Range
			Ag Diss, ug/l	-0.032	UJ	LCS Rec.
			Zn Diss, ug/l	1.11	U	Field Blank Cont.
			Se Diss, ug/l	-1.02	UJ	LCS Rec.
			Hg Diss, ug/l	0.0017	U	Field Blank Cont.
56	04/01/2002	2:15:00 PM				
			As Diss, ug/l	0.145	J	Below Quantitative Range, L
			Cd Diss, ug/l	0.024	J	Below Quantitative Range
			Pb Diss, ug/l	0.0447	J	Below Quantitative Range
			Se Diss, ug/l	1.04	J	Below Quantitative Range, L
			Hg Diss, ug/l	0.00118	U	Field Blank Cont.
56	05/28/2002	12:35:00 PM				
			As Diss, ug/l	0.231	J	Below Quantitative Range
			Cd Diss, ug/l	0.012	J	Below Quantitative Range, C
			Ag Diss, ug/l	-0.008	UJ	CCV Rec.
			Zn Diss, ug/l	0.581	J	Below Quantitative Range
			Hg Diss, ug/l	0.00233	J	CCV Rec., LCS Rec., LCS RP

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
56	06/11/2002	12:05:00 PM				
			As Diss, ug/l	-0.204	UJ	LCS Rec.
			Cu Diss, ug/l	0.655	U	Field Blank Cont.
			Pb Diss, ug/l	-0.032	UJ	LCS Rec.
			Zn Diss, ug/l	-0.201	UJ	LCS Rec.
			Se Diss, ug/l	-0.679	UJ	LCS Rec.
			Hg Diss, ug/l	0.00107	U	Field Blank Cont.
56	07/15/2002	12:30:00 PM				
			Cu Diss, ug/l	0.668	J	LCS Rec.
			Zn Diss, ug/l	0.8	J	Below Quantitative Range
			Hg Diss, ug/l	0.0014	U	Field Blank Cont.
56	08/27/2002	12:28:00 PM				
			As Diss, ug/l	0.202	U	Field Blank Contamination
			Pb Diss, ug/l	0.0116	UJ	Below Quantitative Range, Fi
			Ni Diss, ug/l	0.737	U	Field Blank Contamination
			Zn Diss, ug/l	0.274	U	Field Blank Contamination
			Se Diss, ug/l	0.292	J	Below Quantitative Range

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Comparison To Standards

Date Range: 10/01/2001 to 09/30/2002

Site Number	Date	Time	Dup ID	Storet No.	Parameter Description	Value	Standard	Standard Type
							#Error	

EXACT Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Conductivity Lab, (umhos)**

Site	#57	#56	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	401.0	141.0	10	5
Nov	391.0	155.0	8	6
Dec				
Jan				
Feb				
Mar				
Apr	408.0	186.0	11	7
May	427.0	99.1	14	1
Jun	435.0	106.0	15	2
Jul	418.0	133.0	13	4
Aug	415.0	129.0	12	3
Sep	398.0		9	
Median	411.5	133.0		

N= 15 ΣR 92 28

n	**m**
8	7

X(.025,8,7)= 73.3

W_{rs}= **28**

X*(.025,8,7)= 38.7

$\alpha/2$ $\boxed{0.025}$

H_0

$(\mu_A=\mu_B)$

REJECT

EXACT Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **pH Lab, (su)**

Site	#57	#56	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	7.00	7.33	3	6
Nov	7.36	7.38	7.5	9
Dec				
Jan				
Feb				
Mar				
Apr	7.43	7.36	10	7.5
May	6.74	6.76	1	2
Jun	7.15	7.06	5	4
Jul	7.60	7.64	13	14
Aug	7.59	7.49	12	11
Sep	7.77		15	
Median	7.40	7.36		

N= 15 ΣR 66.5 53.5

n	**m**
8	7

X(.025,8,7)= 73.3

W_{rs}= **53.5**

X*(.025,8,7)= 38.7

$\alpha/2$

0.025

H_0

$(\mu_A=\mu_B)$

ACCEPT

EXACT Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Total Alkalinity, (mg/l)**

Site	#57	#56	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	160.0	57.7	14	5
Nov	153.0	63.4	10	6
Dec				
Jan				
Feb				
Mar				
Apr	152.0	73.8	9	7
May	143.0	42.1	8	1
Jun	162.0	48.0	15	2
Jul	154.0	57.4	11	4
Aug	156.0	56.2	13	3
Sep	155.0		12	
Median	154.5	57.4		

N=	15	ΣR	92	28
			n	**m**
			8	7

X(.025,8,7)= 73.3

W_{rs}= **28**

X*(.025,8,7)= 38.7

$\alpha/2$	H_0 ($\mu_A=\mu_B$)
0.025	**REJECT**

EXACT Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Zn Diss, (ug/l)**

Site	#57	#56	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	2.18	3.45	7	11
Nov	90.80	1.11	15	5
Dec				
Jan				
Feb				
Mar				
Apr	2.44	1.78	8.5	6
May	11.50	0.58	14	3
Jun	2.44	-0.20	8.5	1
Jul	6.06	0.80	12	4
Aug	2.86	0.27	10	2
Sep	7.65		13	
Median	4.46	0.80		

N= 15

ΣR	88	32
	n	**m**
	8	7

X(.025,8,7)= 73.3

W_{rs}= **32**

X*(.025,8,7)= 38.7

$\alpha/2$	H_0 ($\mu_A=\mu_B$)
0.025	**REJECT**

EXACT Wilcoxon-Mann-Whitney Rank Sum Test

Variable: **Zn Diss, (ug/l)**

Site	#57	#56	Ranks	
Year	WY2002	WY2002	**A**	**B**
Oct	2.18	3.45	7	11
Nov		1.11		5
Dec				
Jan				
Feb				
Mar				
Apr	2.44	1.78	8.5	6
May	11.50	0.58	14	3
Jun	2.44	-0.20	8.5	1
Jul	6.06	0.80	12	4
Aug	2.86	0.27	10	2
Sep	7.65		13	
Median	4.46	0.80		

N= 14		ΣR	73	32
			n	**m**
			7	7

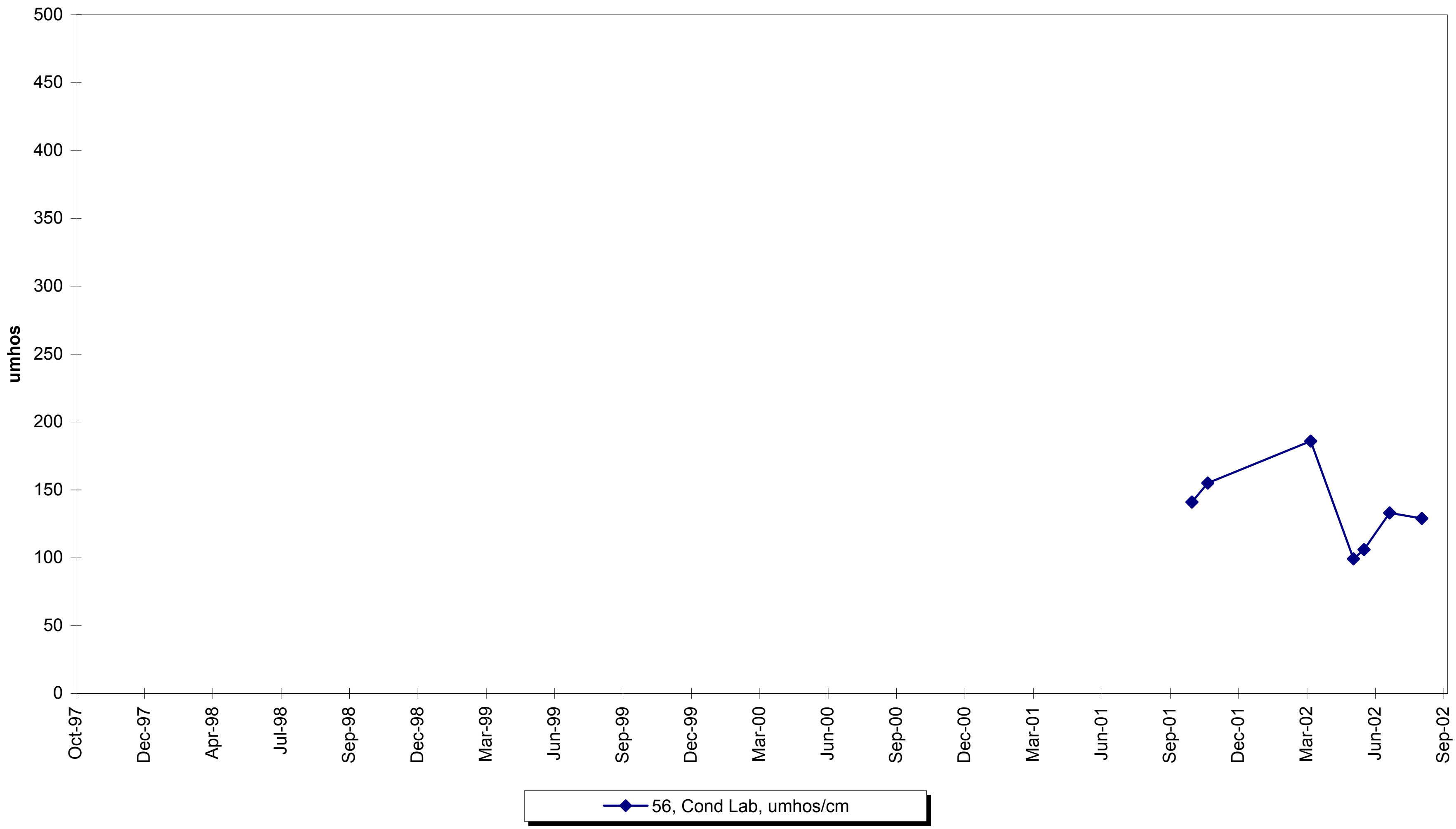
X(.025,7,7)= 68.3

W_{rs}= **73**

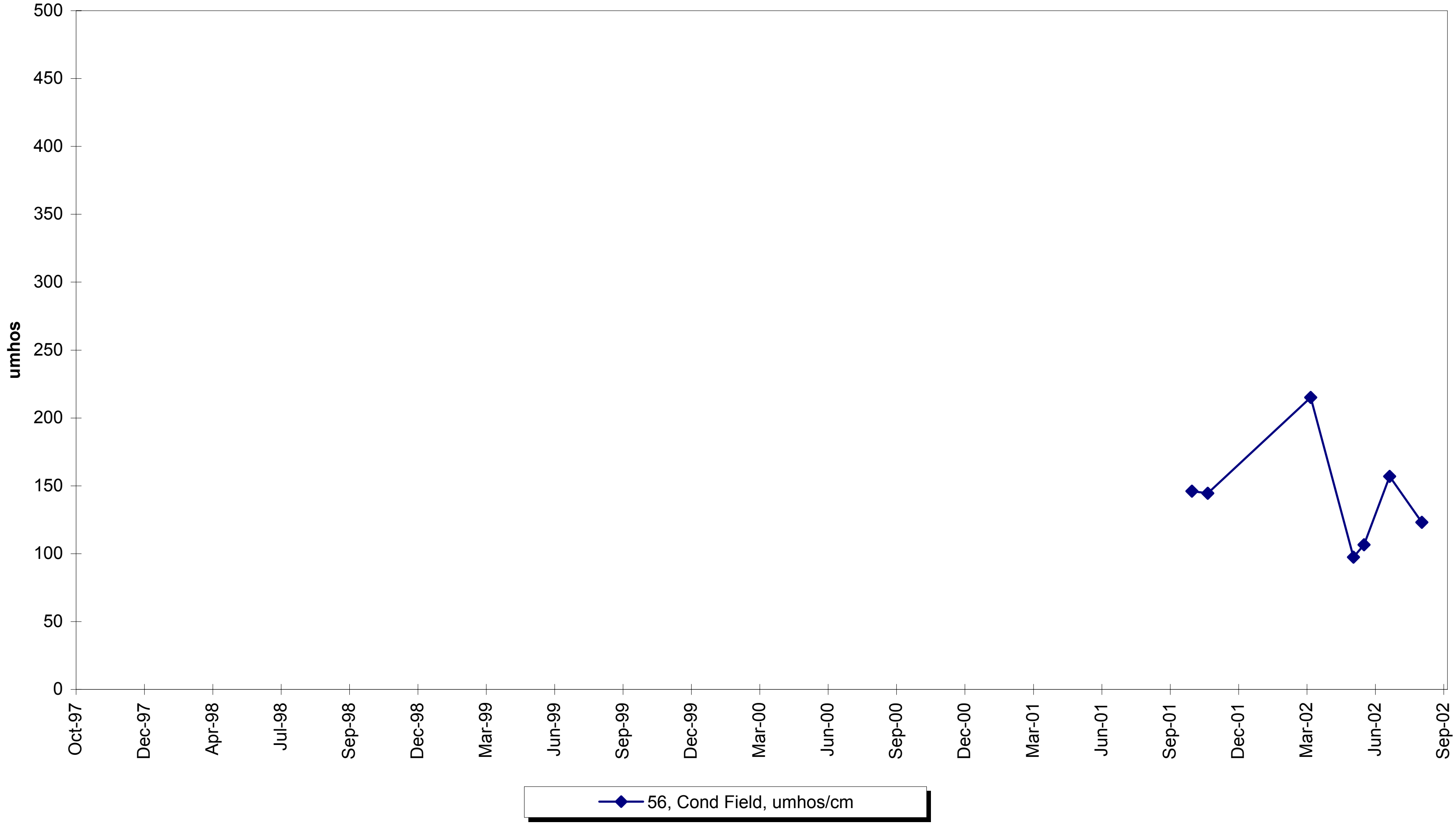
X*(.025,7,7)= 36.8

$\alpha/2$	H_0 ($\mu_A=\mu_B$)
0.025	**REJECT**

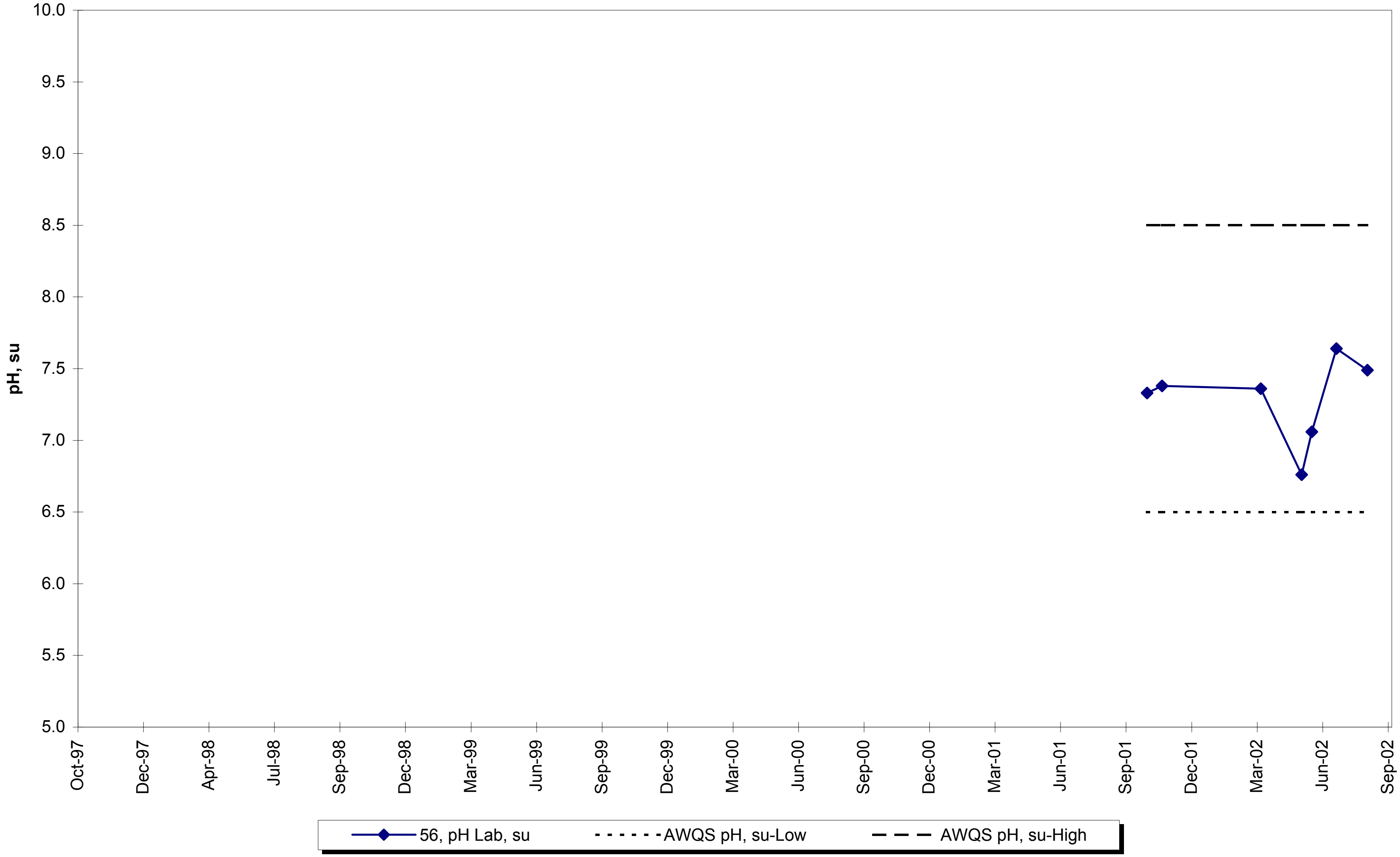
Site 56 -Conductivity-Lab



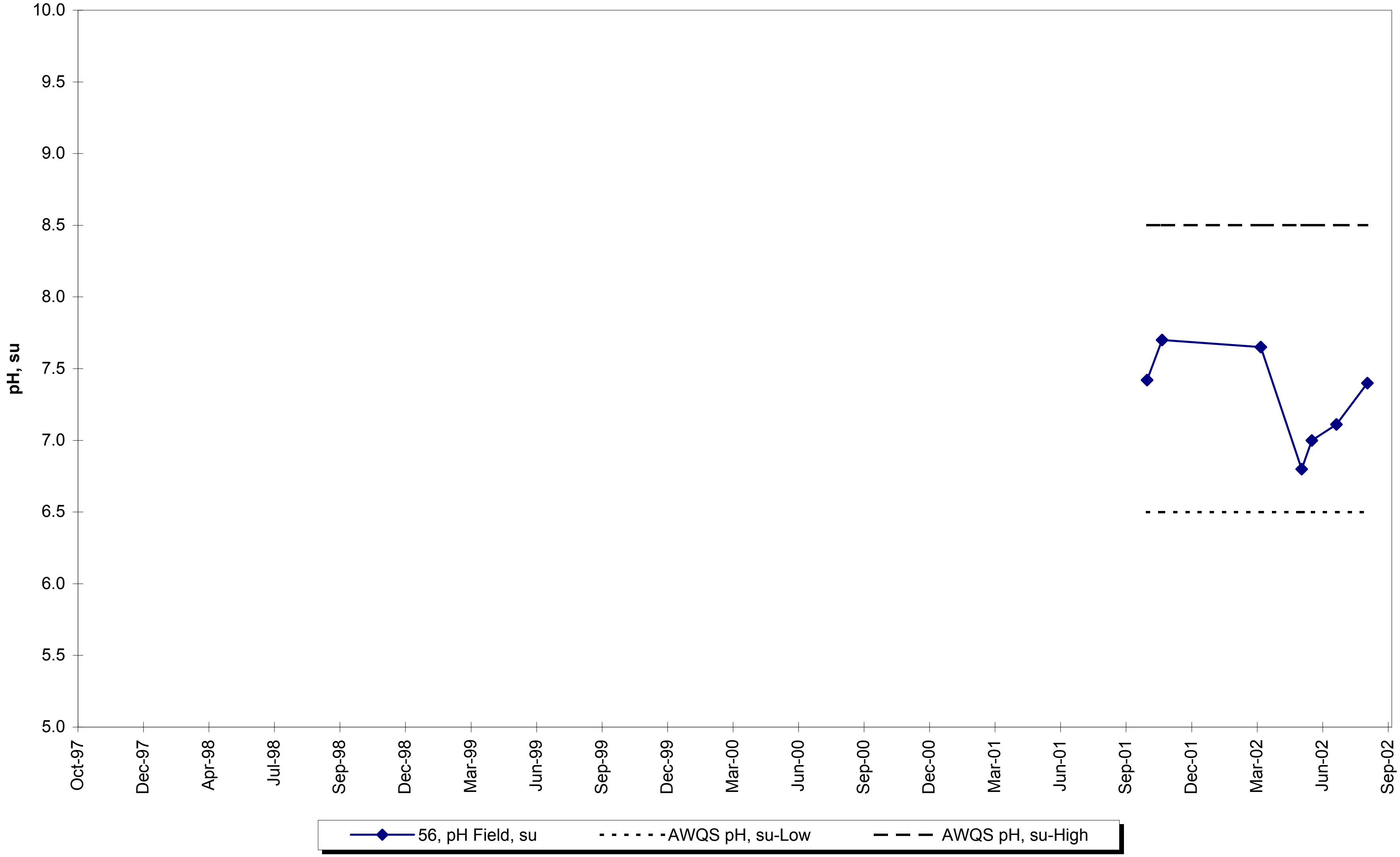
Site 56 -Conductivity-Field

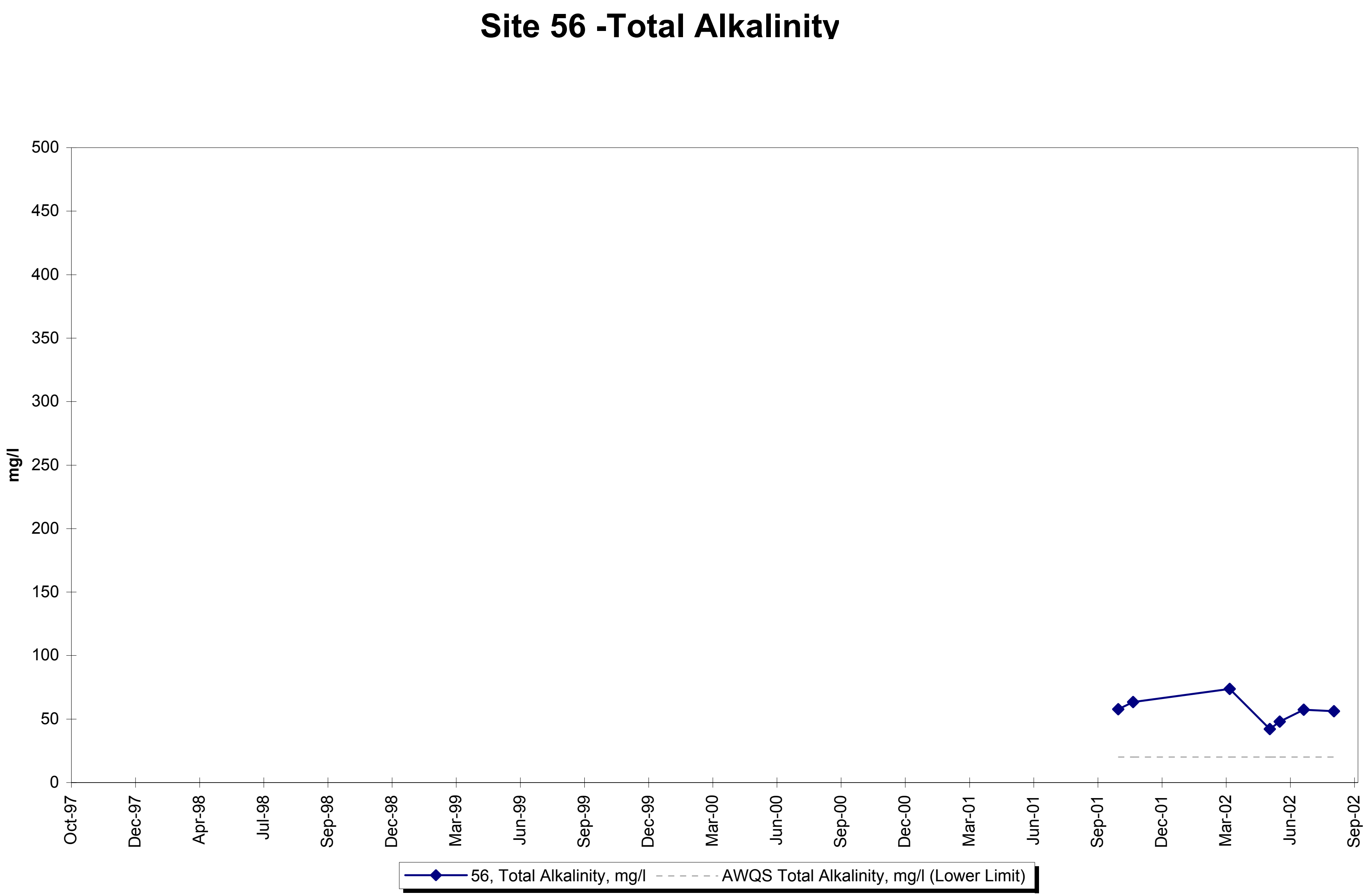


Site 56 -Lab pH

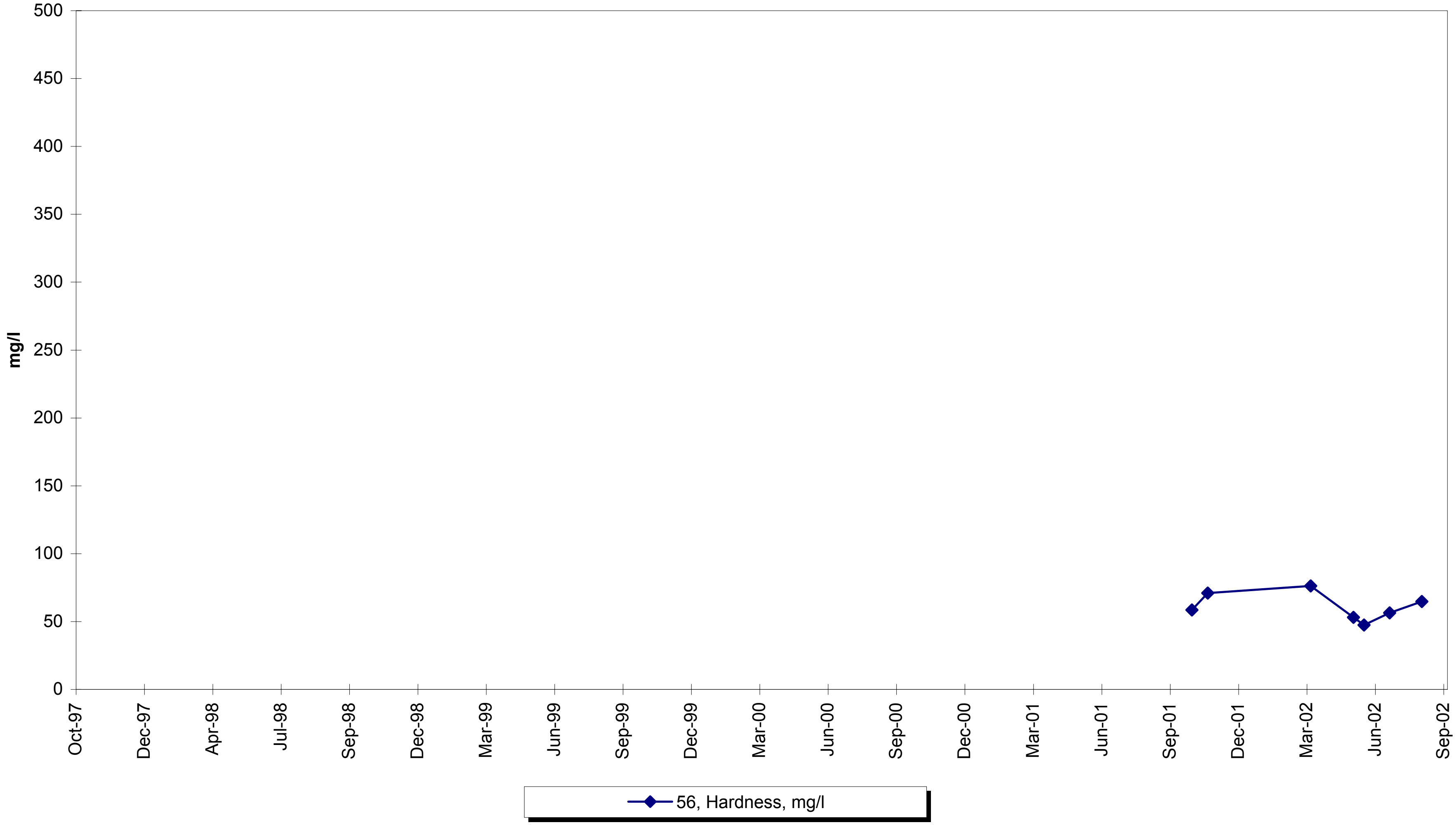


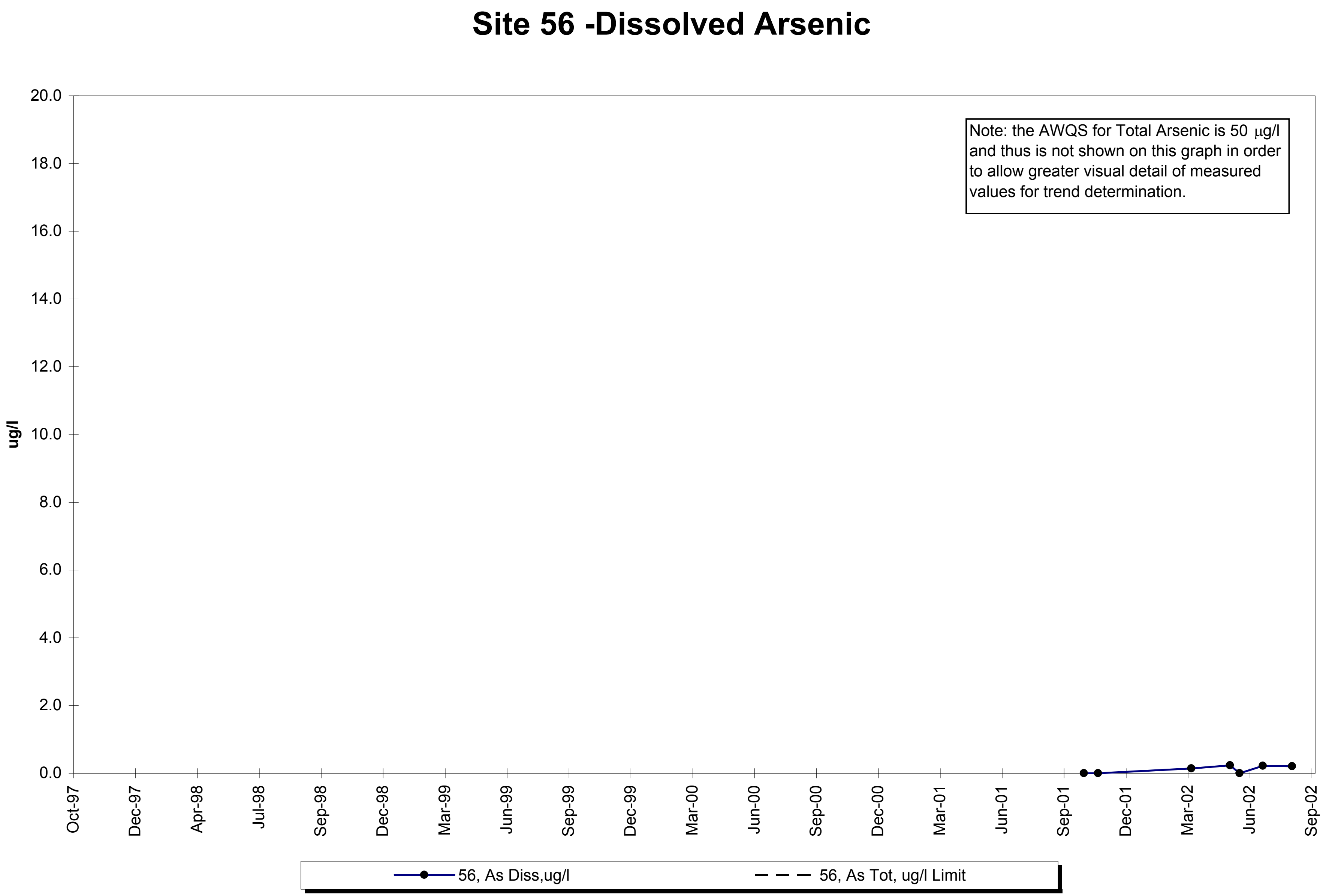
Site 56 -Field pH




Site 56 -Total Alkalinity
mg/l
500
450
400
350
300
250
200
150
100
50
0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
56, Total Alkalinity, mg/l
AWQS Total Alkalinity, mg/l (Lower Limit)

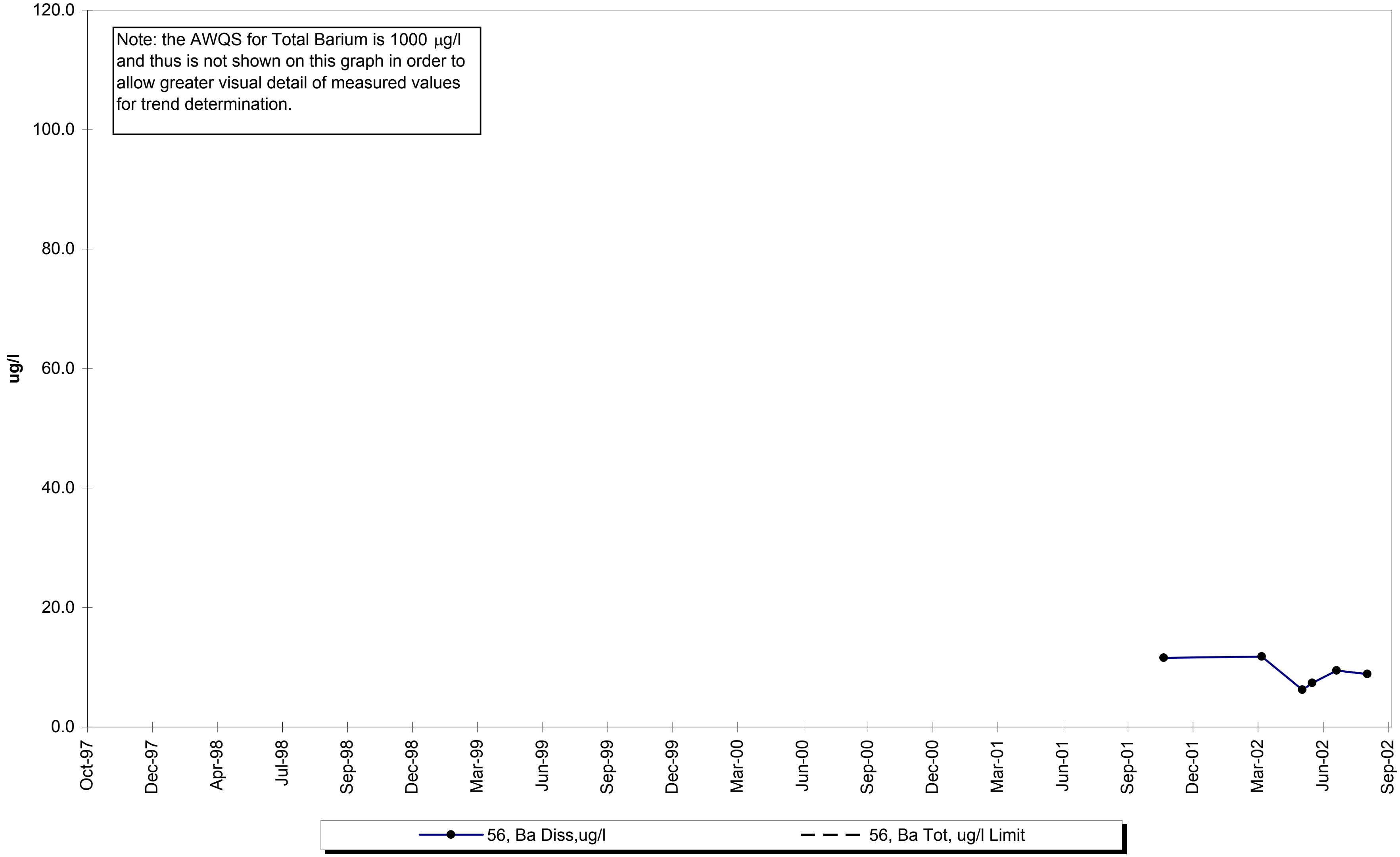
Site 56 -Hardness

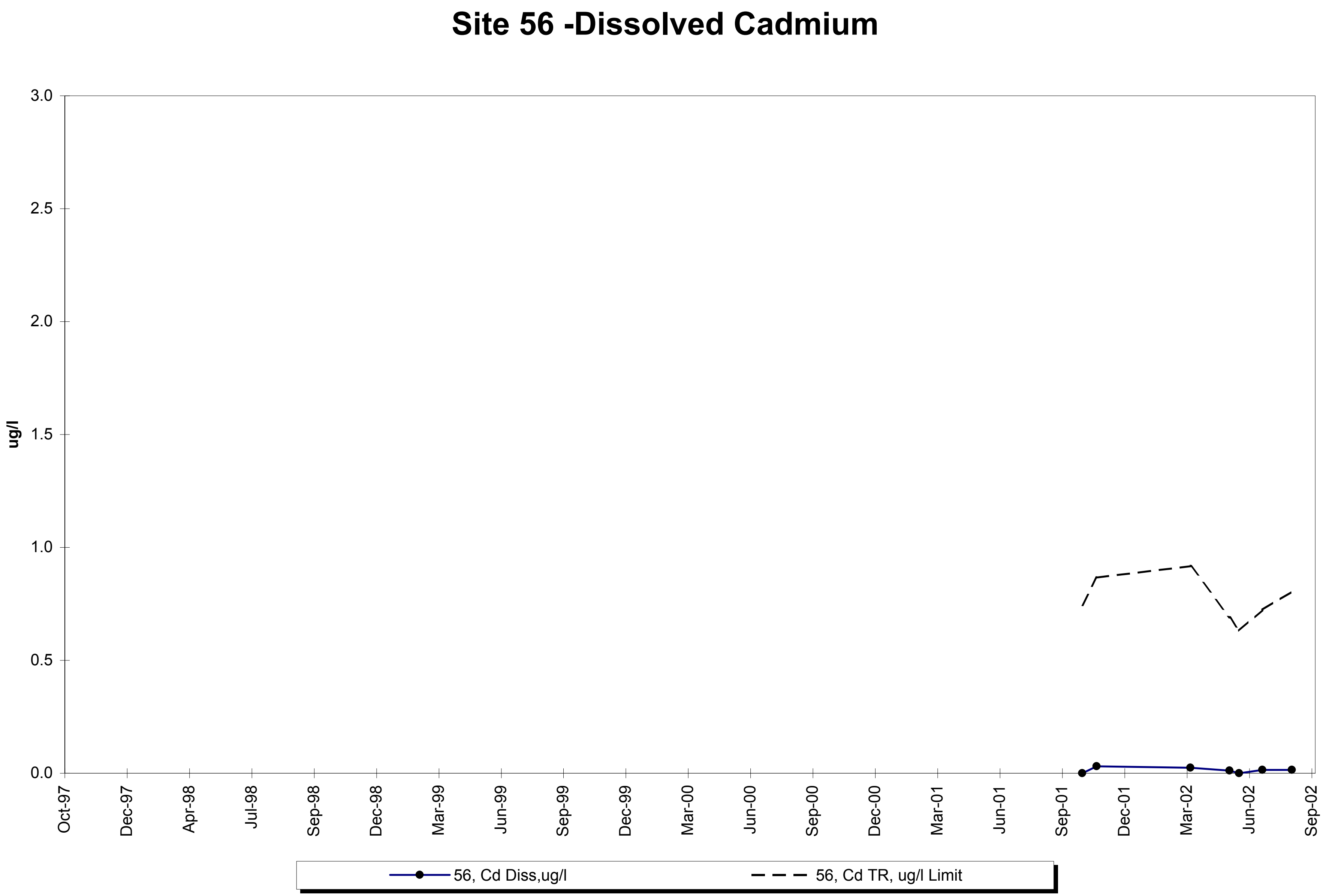


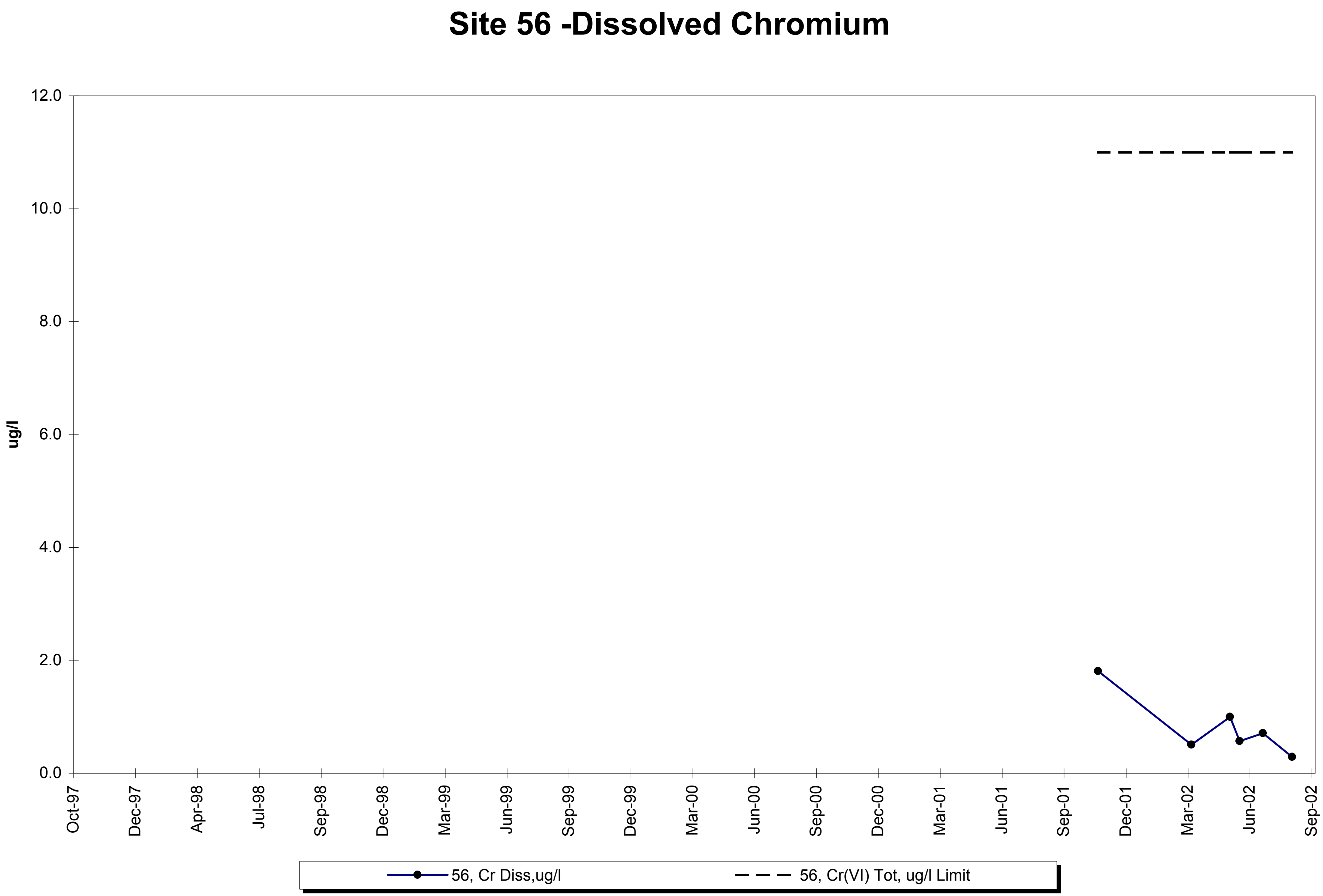


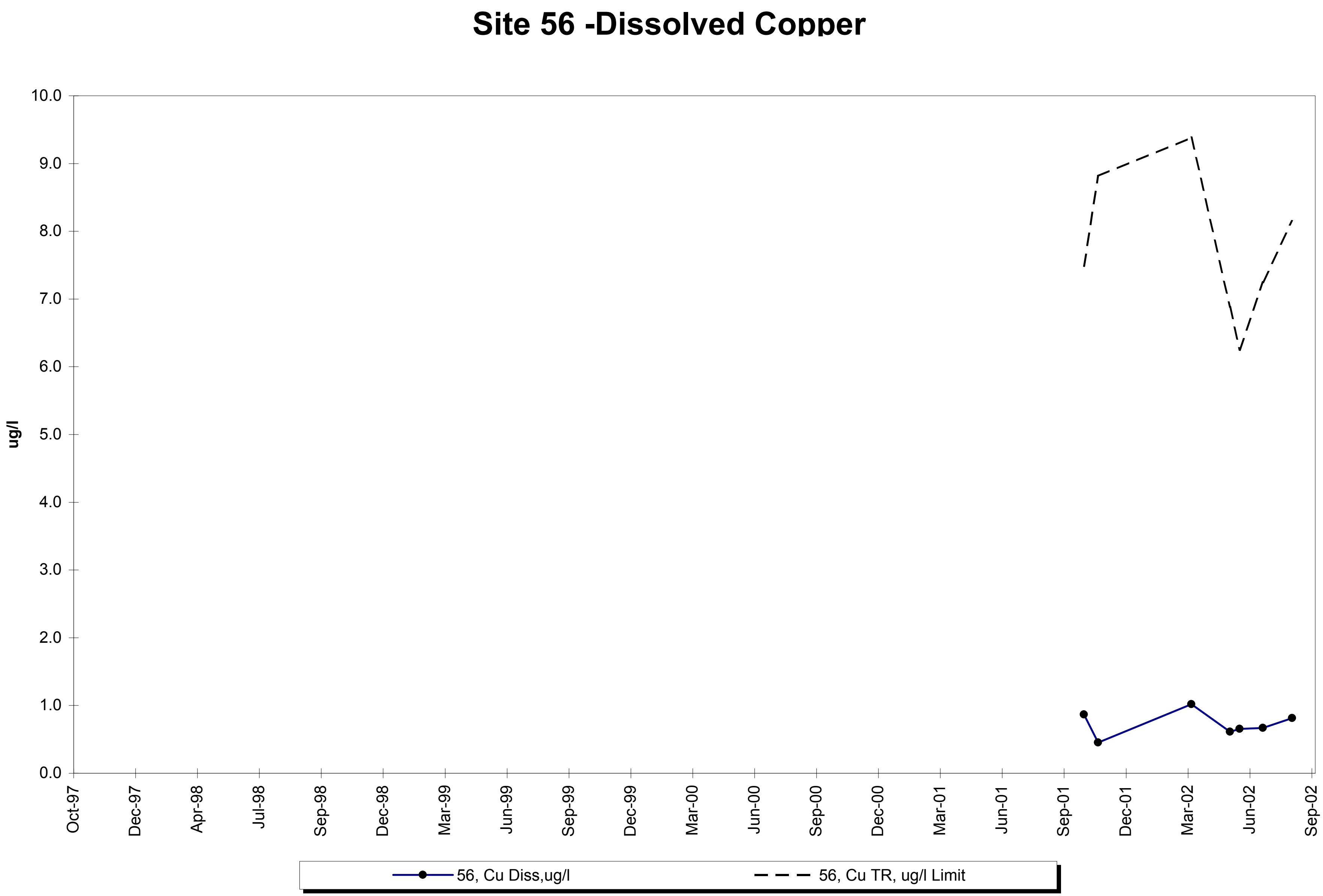
Site 56 -Dissolved Arsenic
ug/l
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Note: the AWQS for Total Arsenic is 50 µg/l and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
56, As Diss,ug/l
56, As Tot, ug/l Limit

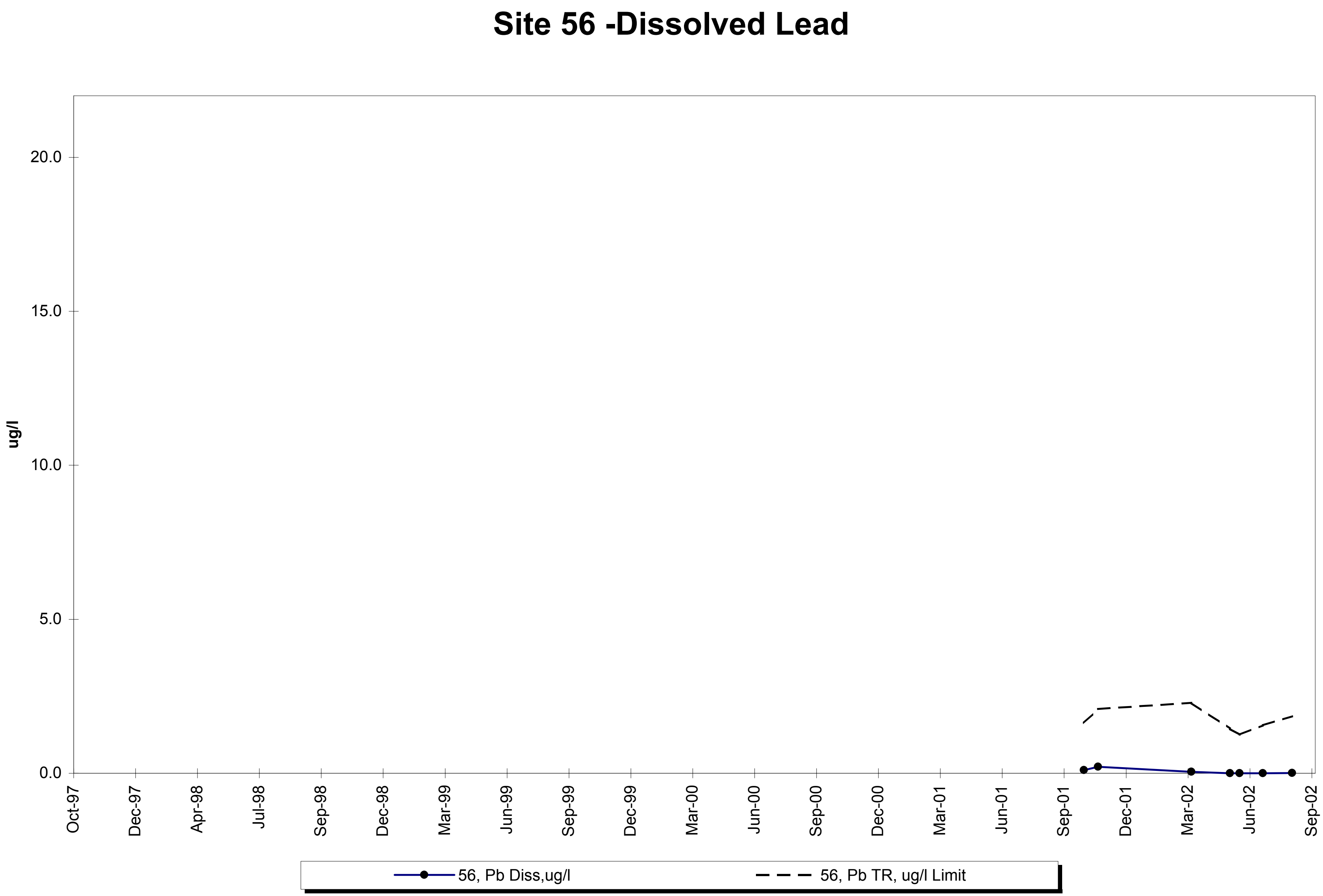
Site 56 -Dissolved Barium




Site 56 -Dissolved Cadmium
ug/l
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
56, Cd Diss,ug/l
56, Cd TR, ug/l Limit

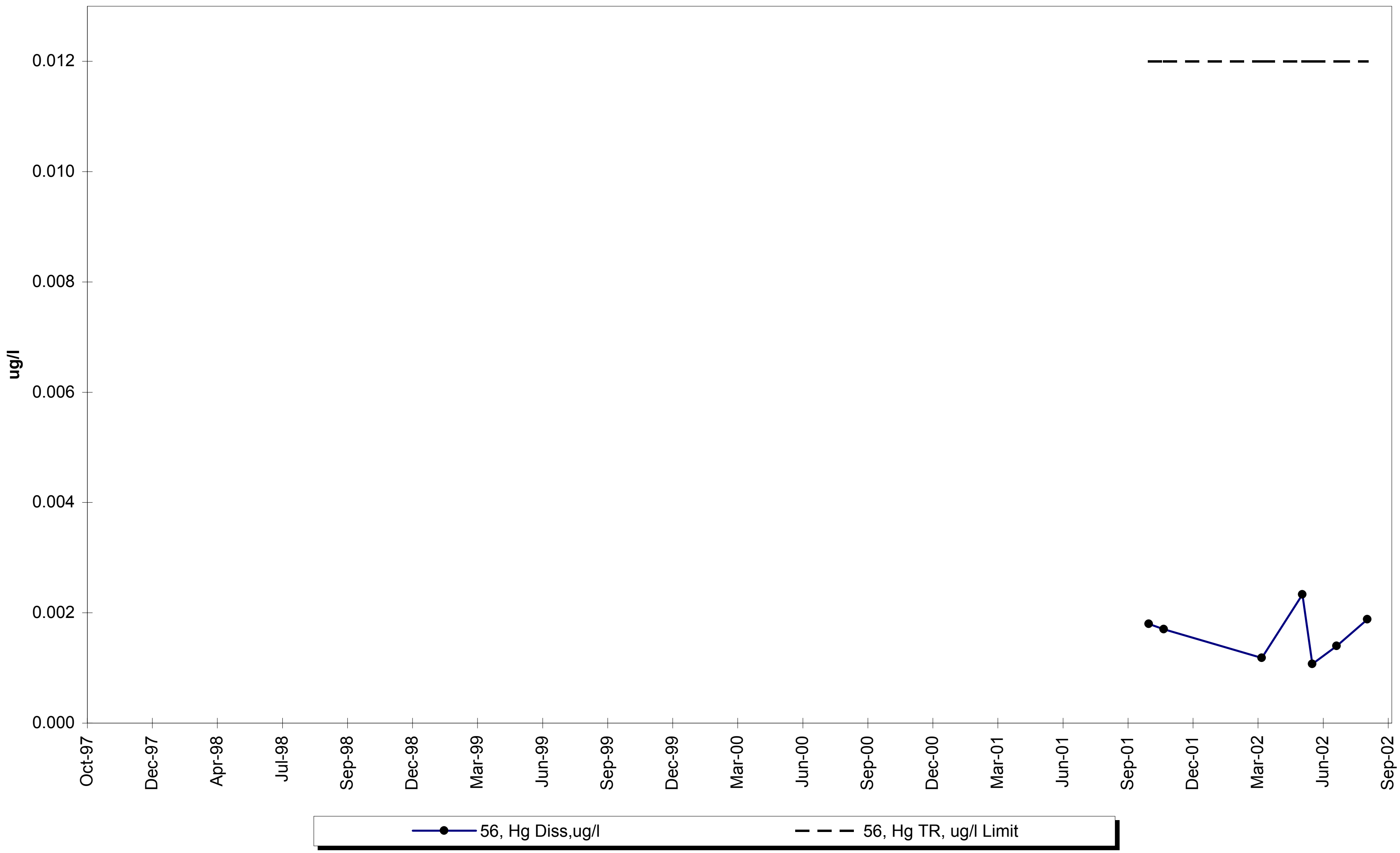

Site 56 -Dissolved Chromium
ug/l
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
56, Cr Diss,ug/l
56, Cr(VI) Tot, ug/l Limit


Site 56 -Dissolved Copper
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ug/l
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
56, Cu Diss,ug/l
56, Cu TR, ug/l Limit

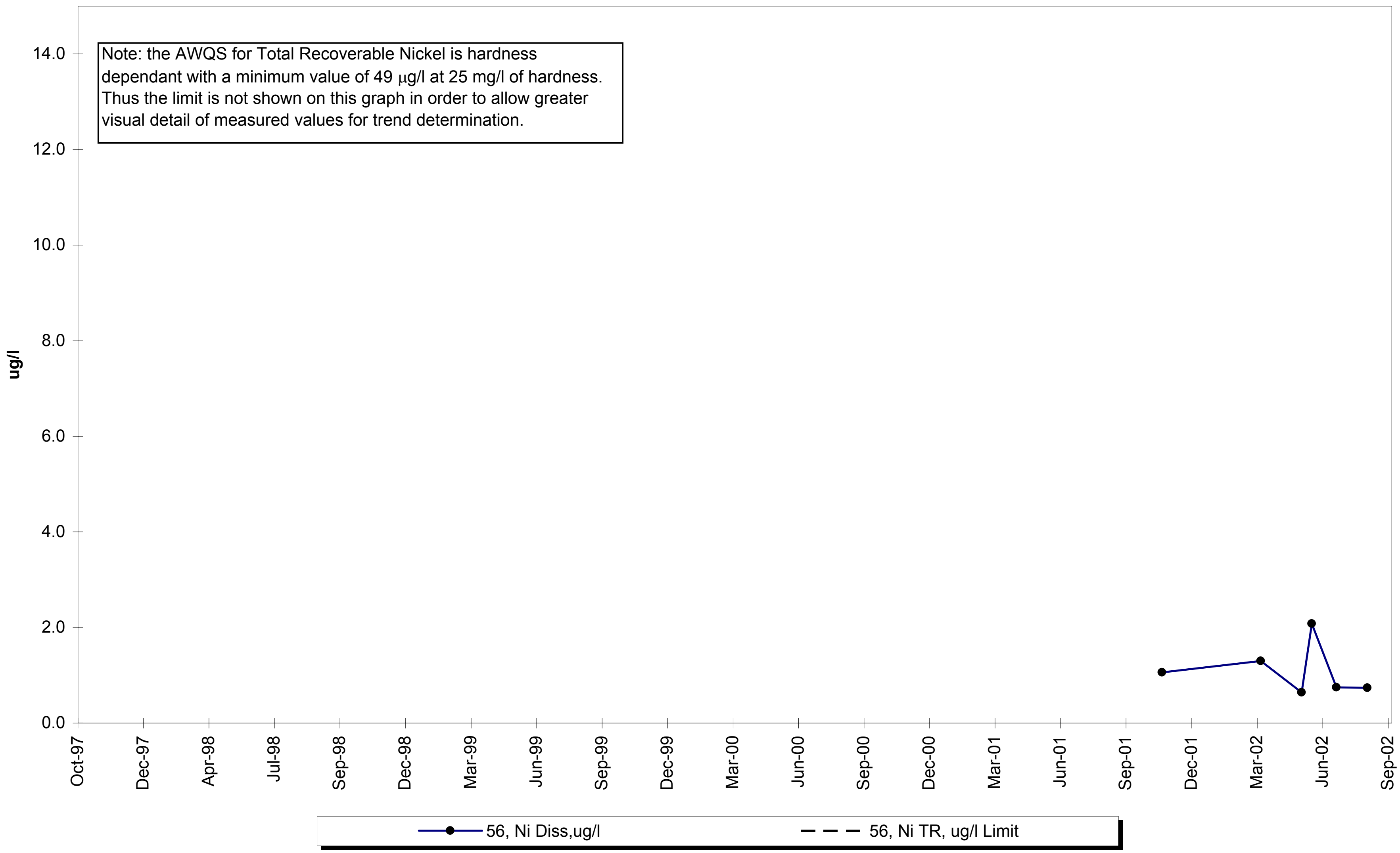


Site 56 -Dissolved Lead
ug/l
20.0
15.0
10.0
5.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
56, Pb Diss,ug/l
56, Pb TR, ug/l Limit

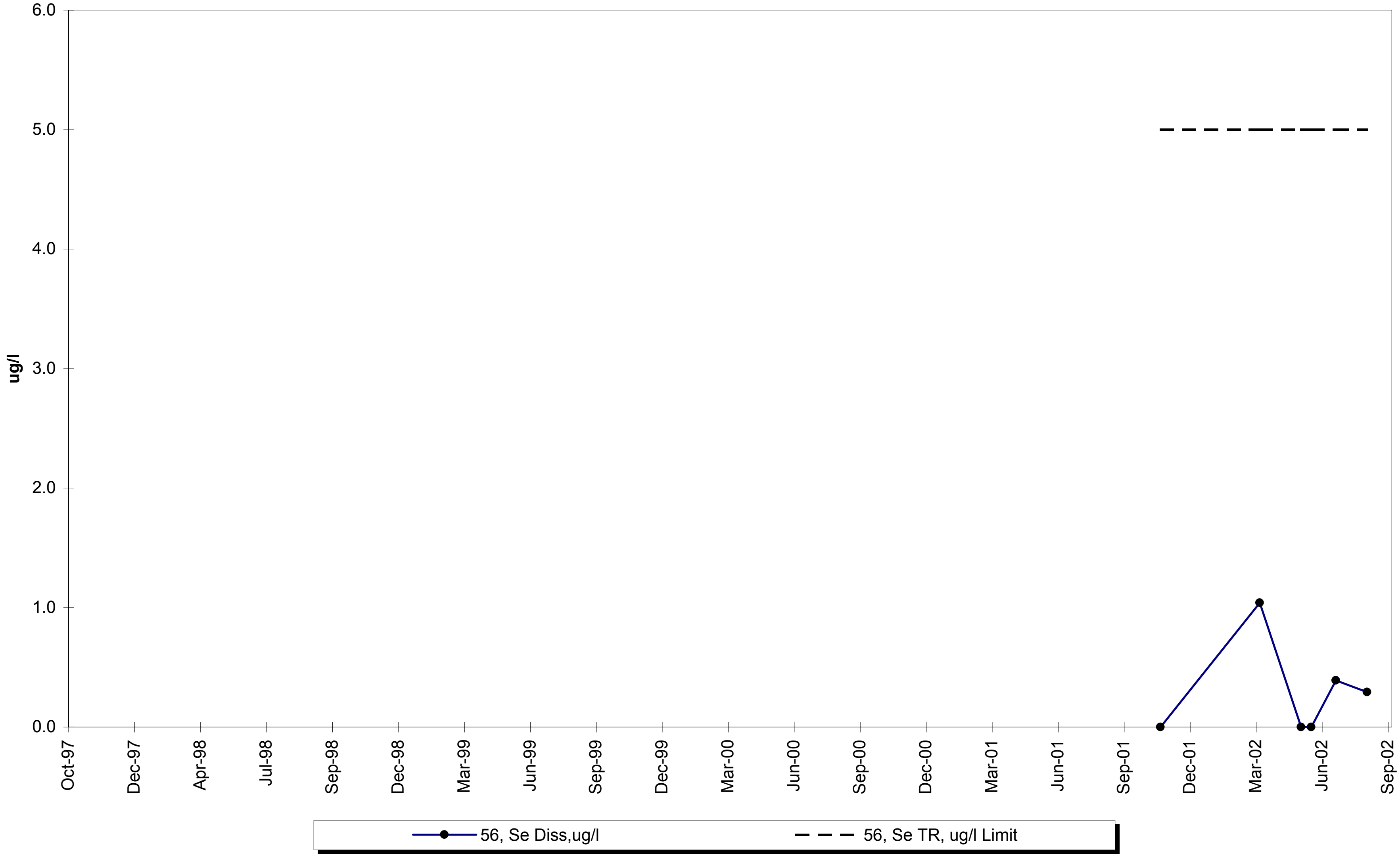
Site 56 -Dissolved Mercury



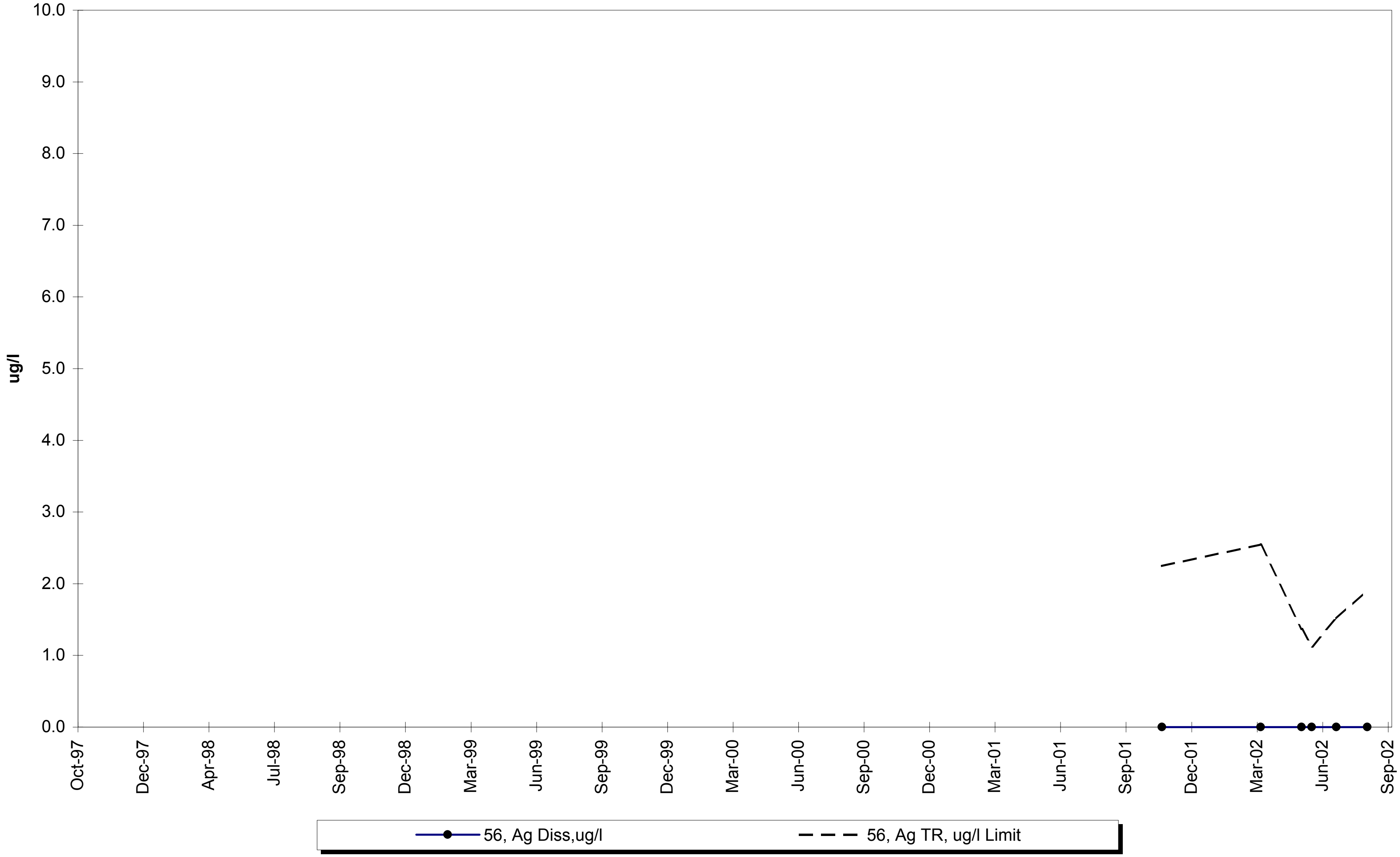
Site 56 -Dissolved Nickel

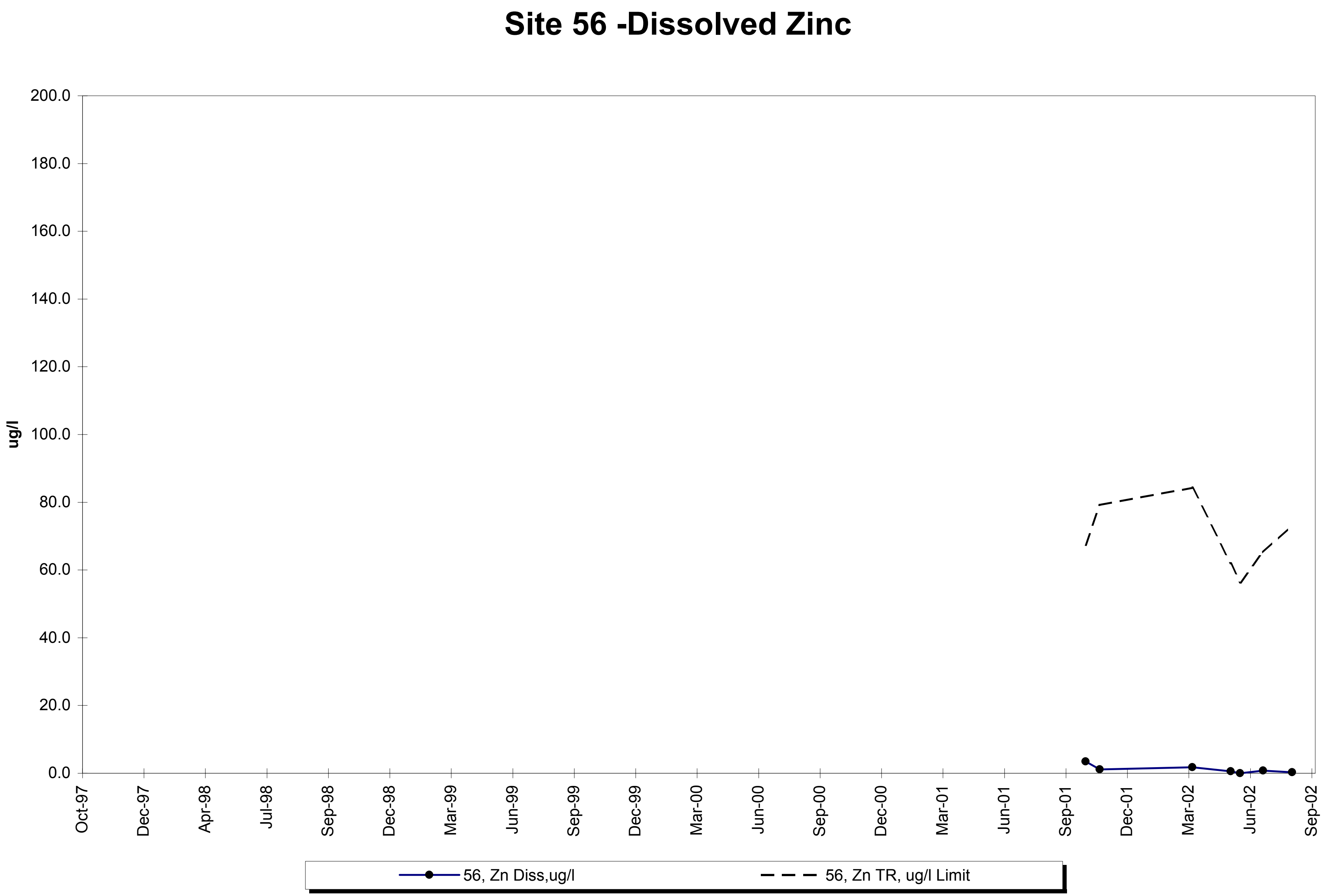


Site 56 -Dissolved Selenium



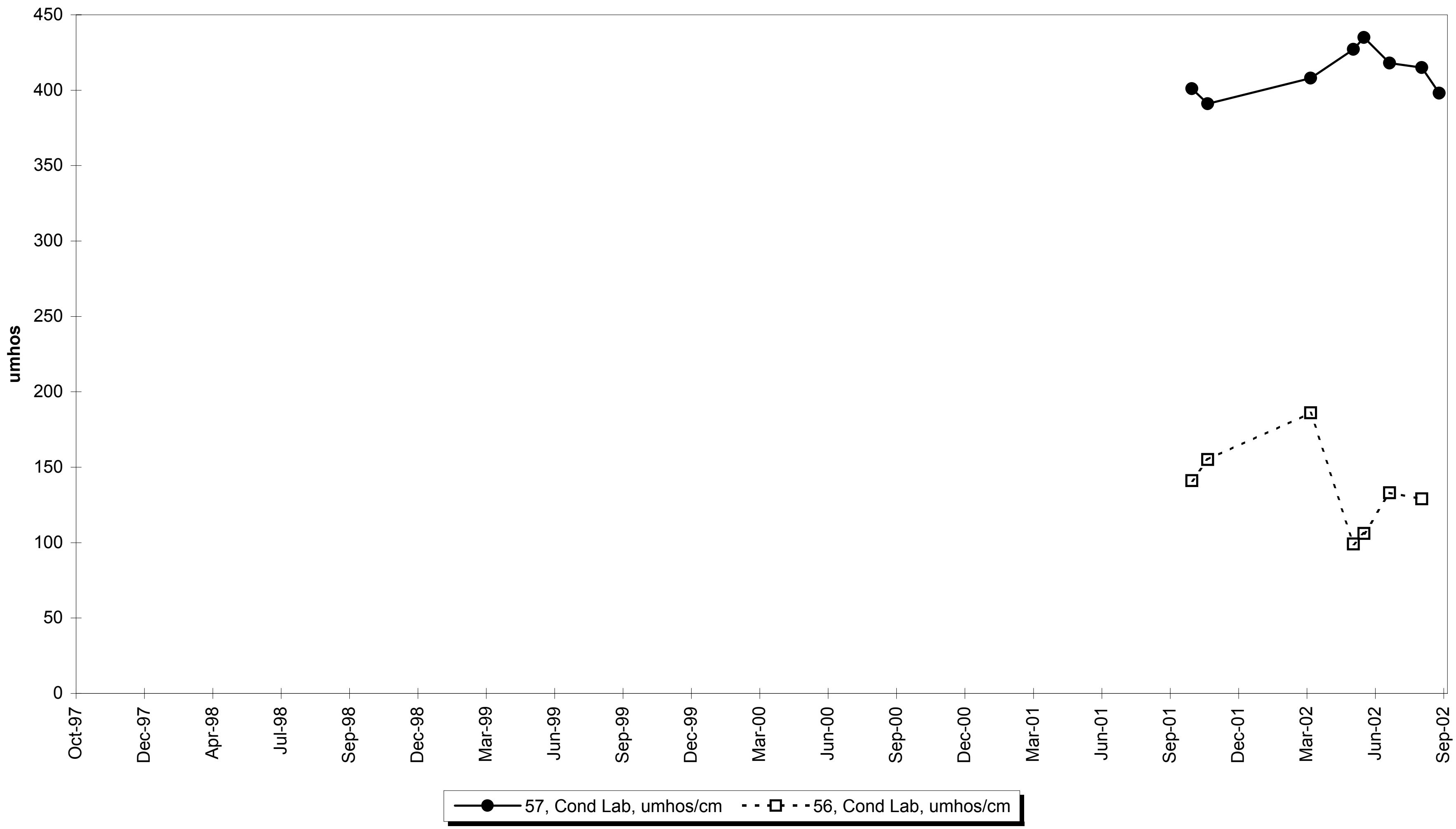
Site 56 -Dissolved Silver



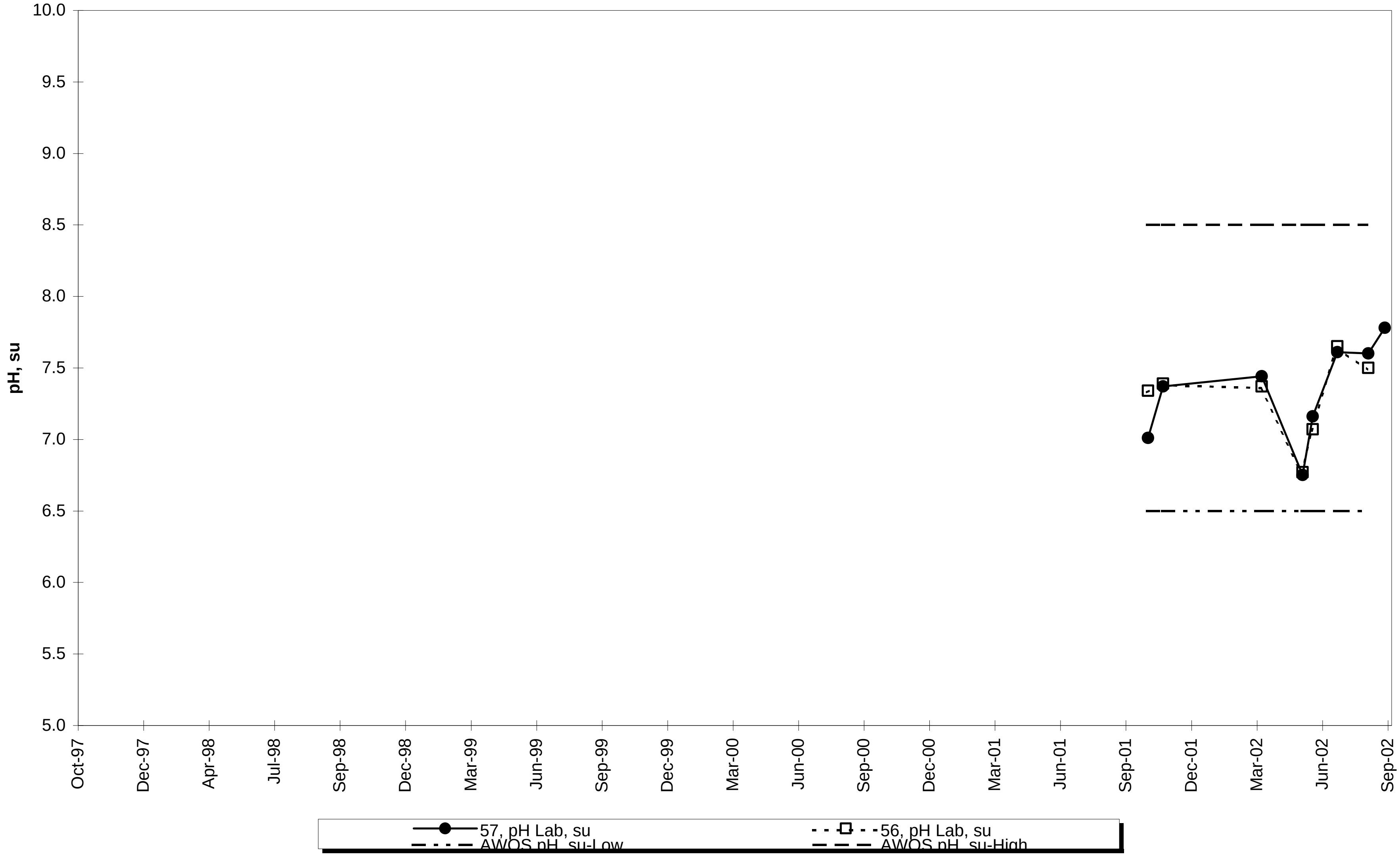


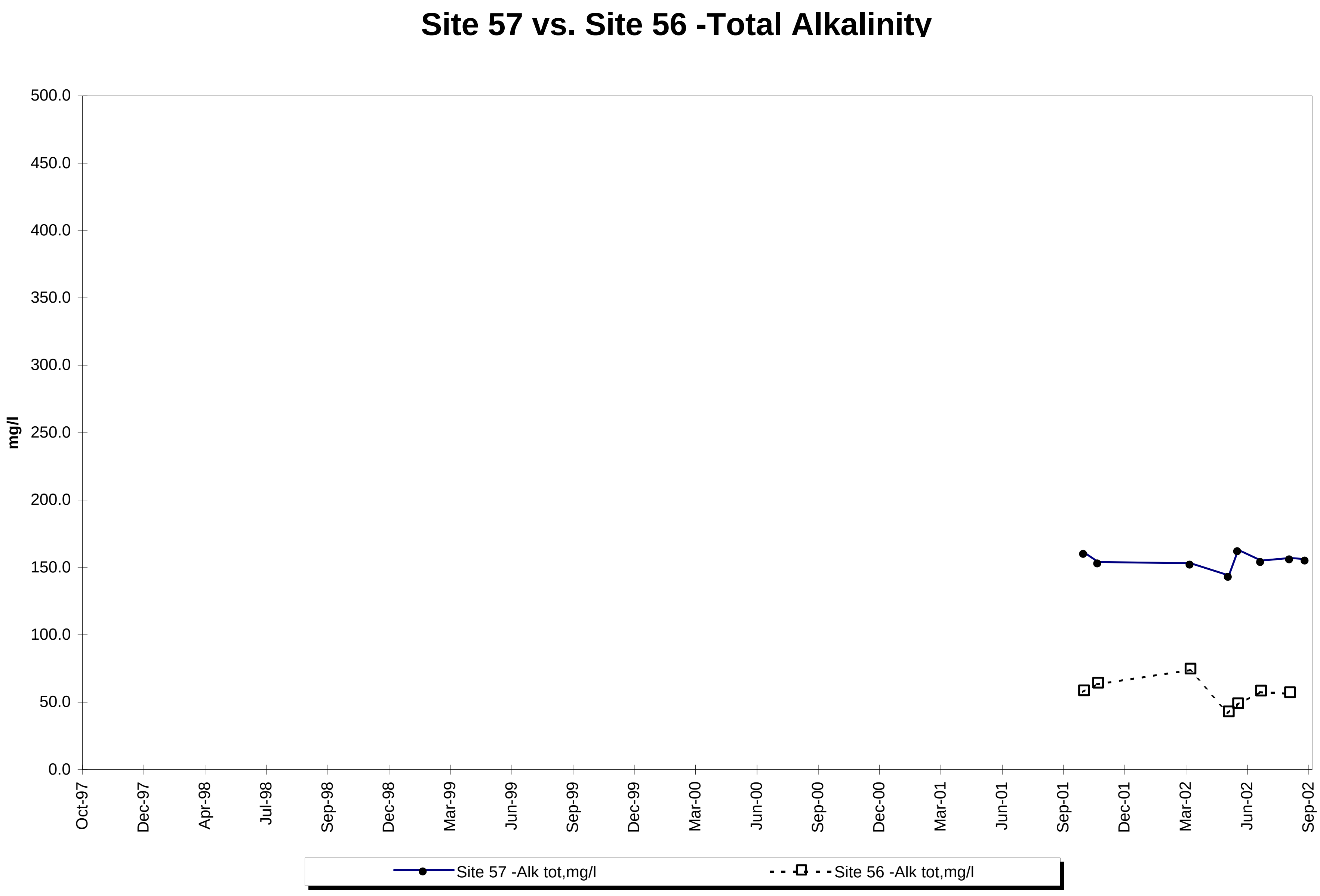
Site 56 -Dissolved Zinc
ug/l
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
56, Zn Diss,ug/l
56, Zn TR, ug/l Limit

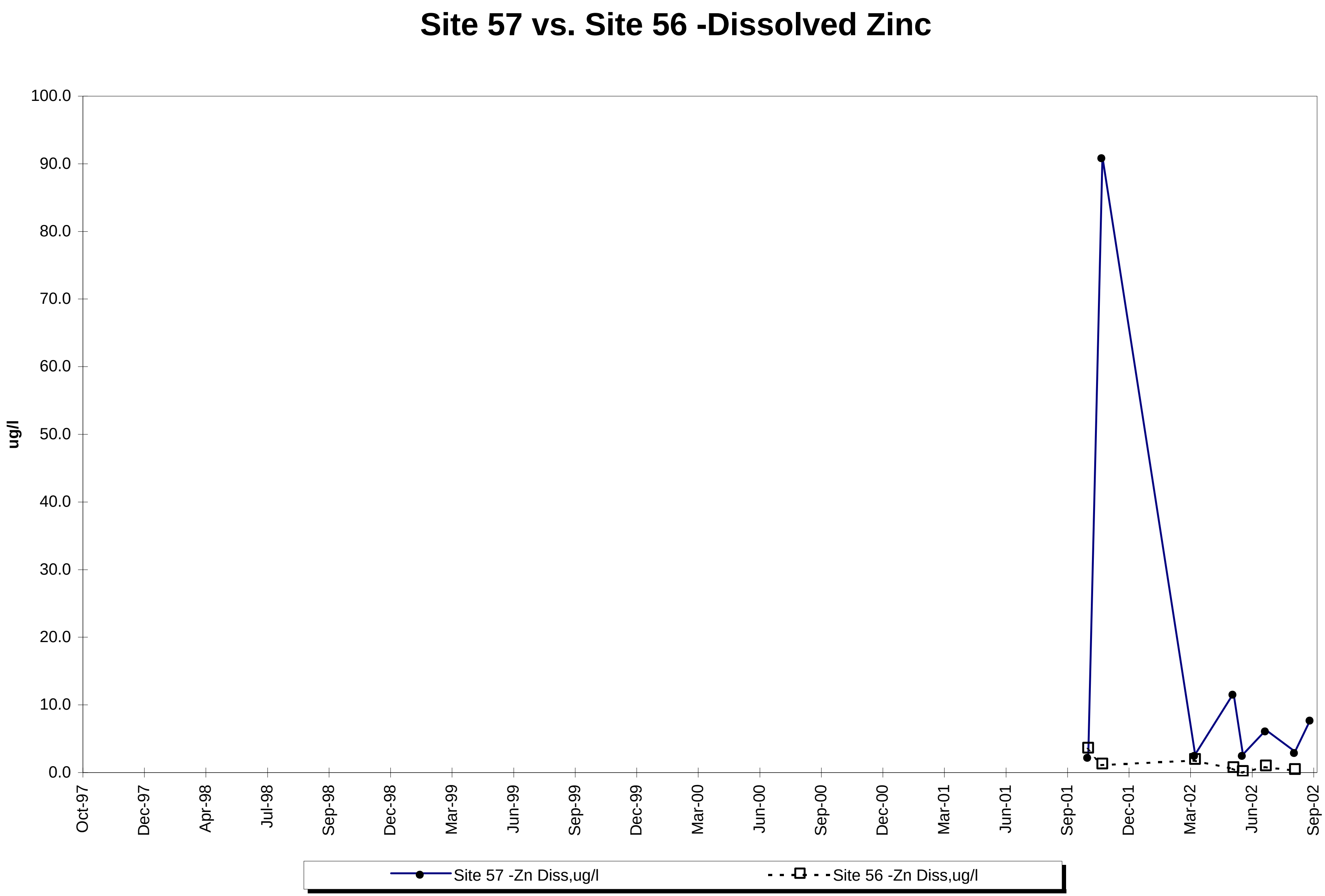
Site 57 vs Site 56 -Conductivity-Lab



Site 57 vs. Site 56 -Lab pH




Site 57 vs. Site 56 -Total Alkalinity
mg/l
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Site 57 -Alk tot,mg/l
Site 56 -Alk tot,mg/l


Site 57 vs. Site 56 -Dissolved Zinc
ug/l
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Site 57 -Zn Diss,ug/l
Site 56 -Zn Diss,ug/l

INTERPRETIVE REPORT
SITE 58 "MONITORING WELL T-00-01C"

Sampling at this site was added to the FWMP in May-2002. All data collected at this site since it's inception into the FWMP are included in the data analyses. As shown in the table below, there were no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-97 though Sept-02.				

The data collected during the current water year are listed in the following "Table of Results for Water Year 2002" report. The table includes all the data, field and lab, collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of zero for the purpose of median calculation.

The data for water year 2002 have been compared to the strictest fresh water quality criterion for each applicable analyte. Two (2) results exceeding these criteria have been identified, as listed on the following "Comparison To Standards" report. These data are both for lab pH. Values for lab pH from other wells completed into organic rich peat sediments similar to Site 58 have historically resulted in pH values ranging from 5 to 6 (e.g. Sites 27, 29, and 32).

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. The inception of sampling at this site commenced in the 2002 water year and thus only two data points are shown on each graph. There are no apparent trends present in the limited data collected to date.

Table of Results for Water Year 2002

Site 58 "MW-T-00-01C"

Sample Date/Parameter	10/25/2001	11/15/2001	12/5/2001	1/29/2002	2/21/2002	3/19/2002	4/1/2002	5/7/2002	6/11/2002	7/15/2002	8/27/2002	9/17/2002	**Median**
Water Temp (°C)								5.4				8.6	7.0
Conductivity-Field (μmho)								67				65	66
Conductivity-Lab (μmho)								69				69	69
pH Lab (standard units)								5.73				6.29	6.01
pH Field (standard units)								6.10				6.00	6.05
Total Alkalinity (mg/l)								22.2				29.3	25.8
Hardness (mg/l)								27.2				25.1	26.2
Dissolved As (μg/l)								<0.230				0.111 J	0.113
Dissolved Ba (μg/l)				**NOT SCHEDULED FOR SAMPLING**				6.0		**NOT SCHEDULED FOR SAMPLING**		6.9 J	6.5
Dissolved Cd (μg/l)								<0.007 UJ				<0.004	0.003
Dissolved Cr (μg/l)								0.958				0.471 J	0.715
Dissolved Cu (μg/l)								0.097				0.154 J	0.125
Dissolved Pb (μg/l)								0.0600 J				0.0267 J	0.0434
Dissolved Ni (μg/l)								0.32				0.23 J	0.27
Dissolved Ag (μg/l)								<0.0080 UJ				0.0421 J	0.0231
Dissolved Zn (μg/l)								0.87 J				0.40 UJ	0.64
Dissolved Se (μg/l)								<0.475				0.214 J	0.226
Dissolved Hg (μg/l)								0.000978 J				0.000606 U	0.000792

See "Qualififed Data by QA Reviewer" table for qualifier descriptions.

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

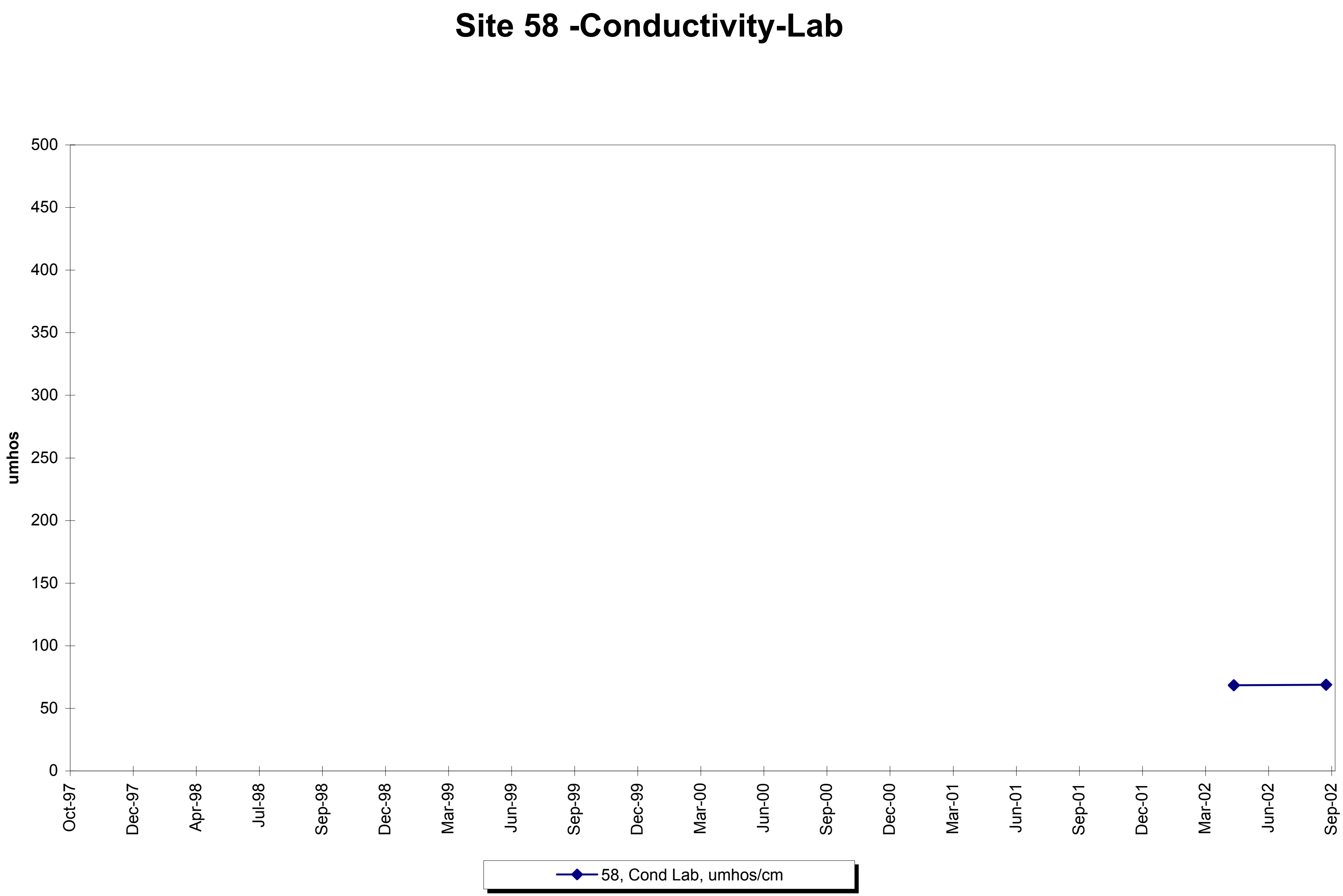
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
58	05/07/2002	1:55:00 PM				
			Cd Diss, ug/l	-0.007	UJ	CCV Rec.
			Pb Diss, ug/l	0.06	J	Below Quantitative Range
			Ag Diss, ug/l	-0.008	UJ	CCV Rec.
			Zn Diss, ug/l	0.87	J	Below Quantitative Range
			Hg Diss, ug/l	0.000978	J	CCV Rec., LCS Rec., LCS RP
58	09/17/2002	12:50:00 PM				
			As Diss, ug/l	0.111	J	Below Quantitative Range
			Ba Diss, ug/l	6.89	J	CCV Rec., LCS Rec.
			Cr Diss, ug/l	0.471	J	Below Quantitative Range
			Cu Diss, ug/l	0.154	J	Below Quantitative Range
			Pb Diss, ug/l	0.0267	J	Below Quantitative Range
			Ni Diss, ug/l	0.233	J	CCV Rec.
			Ag Diss, ug/l	0.0421	J	Below Quantitative Range
			Zn Diss, ug/l	0.404	UJ	Below Quantitative Range, Fi
			Se Diss, ug/l	0.214	J	Below Quantitative Range
			Hg Diss, ug/l	0.000606	U	Field Blank Contamination

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Comparison To Standards

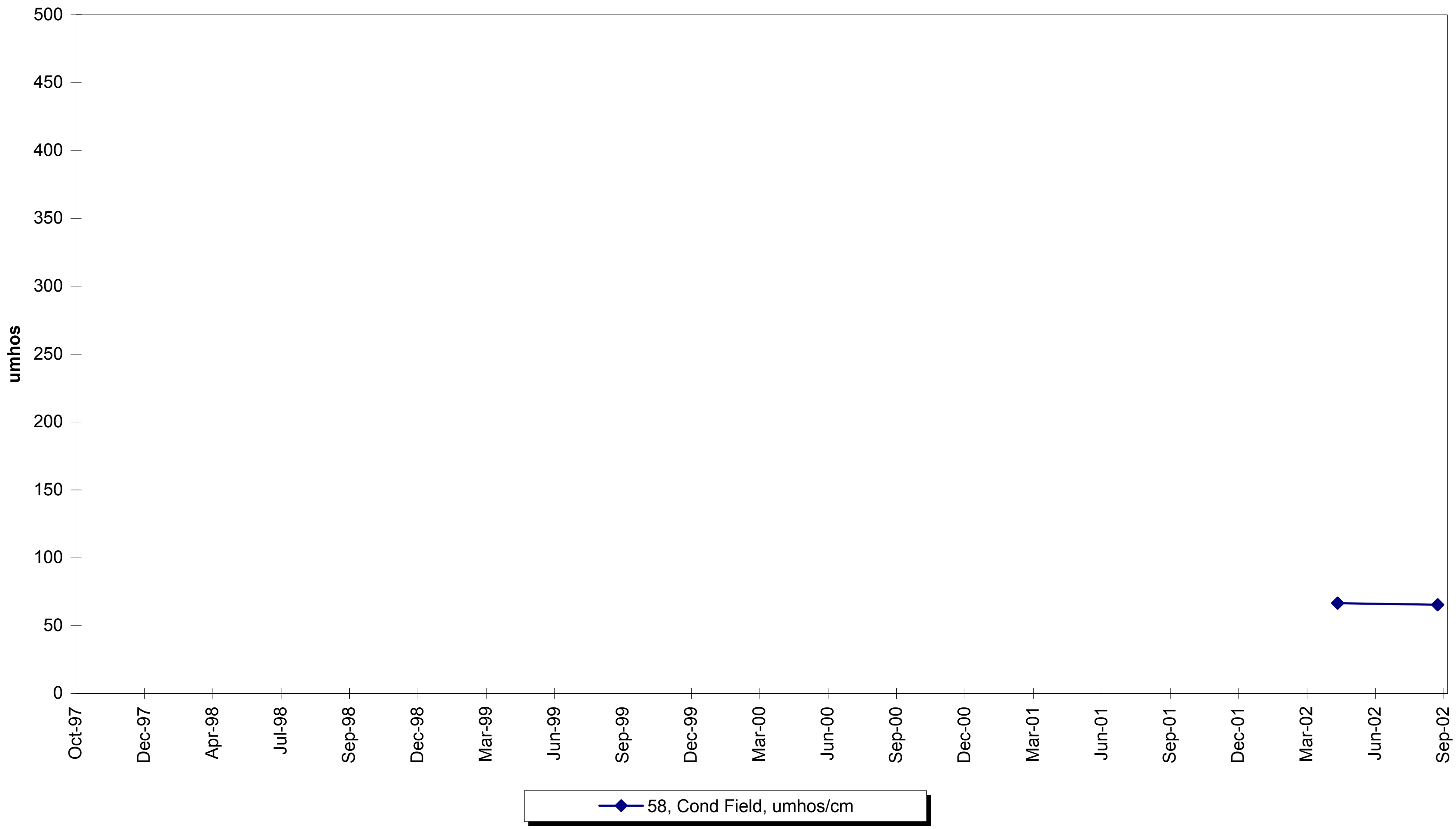
Date Range: 10/01/2001 to 09/30/2002

Site Number	Date	Time	Dup ID	Storet No.	Parameter Description	Value	Standard	Standard Type
58	05/07/2002	1:55 PM	0	403	pH Lab, su	5.73	6.5- 8.5	Aquatic
58	09/17/2002	12:50 PM	0	403	pH Lab, su	6.29	6.5- 8.5	Aquatic

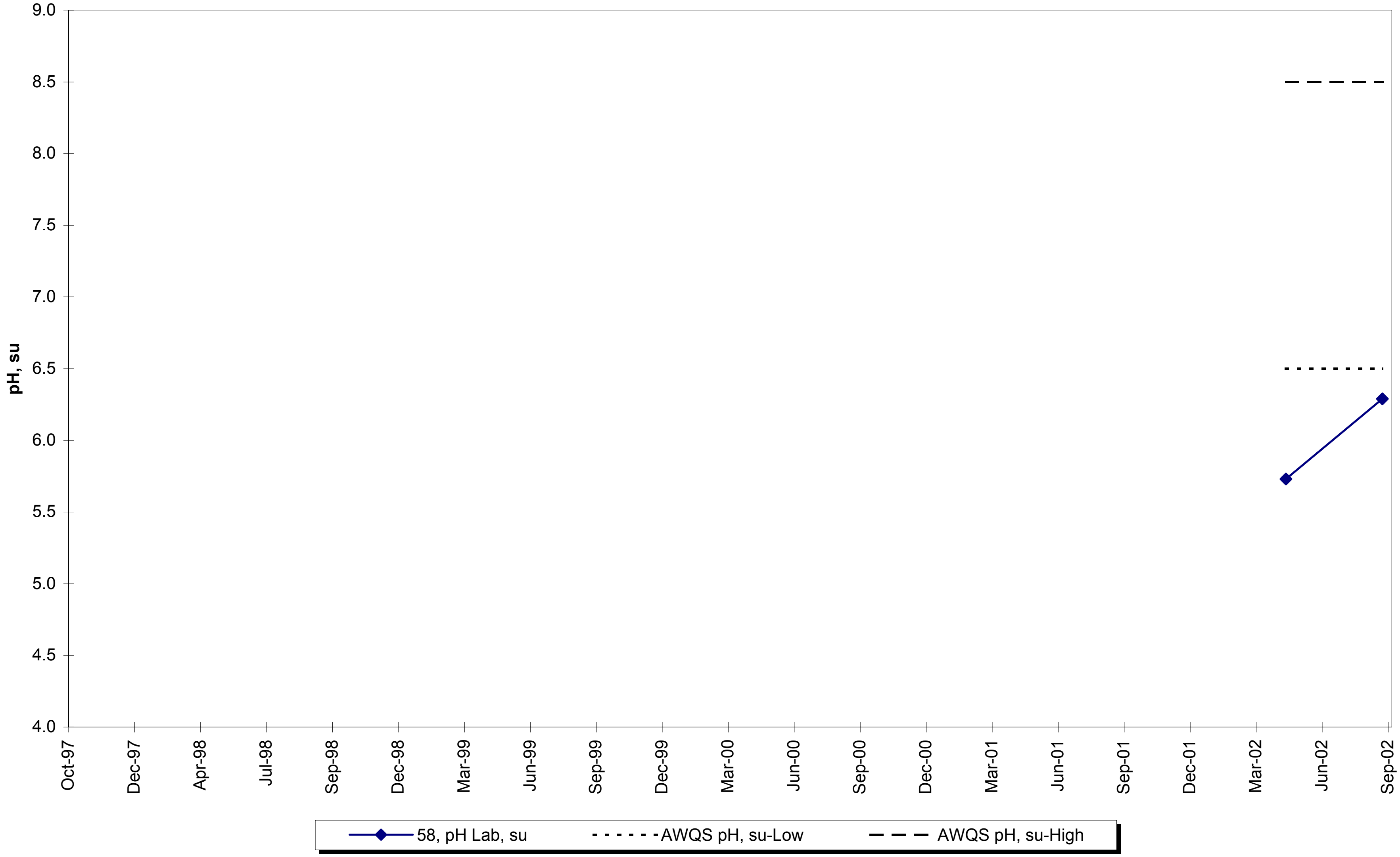


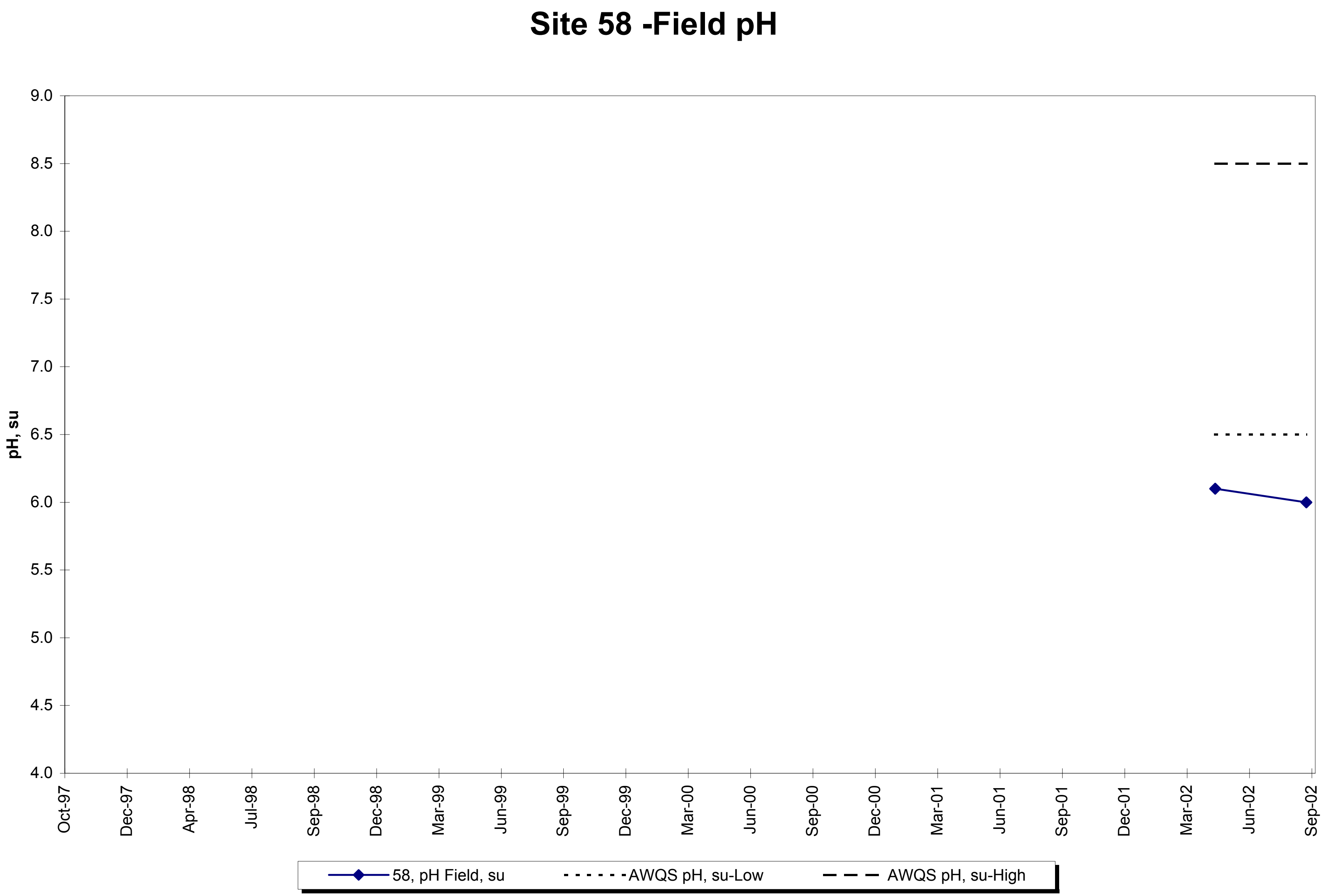
Site 58 -Conductivity-Lab
umhos
500
450
400
350
300
250
200
150
100
50
0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
58, Cond Lab, umhos/cm

Site 58 -Conductivity-Field

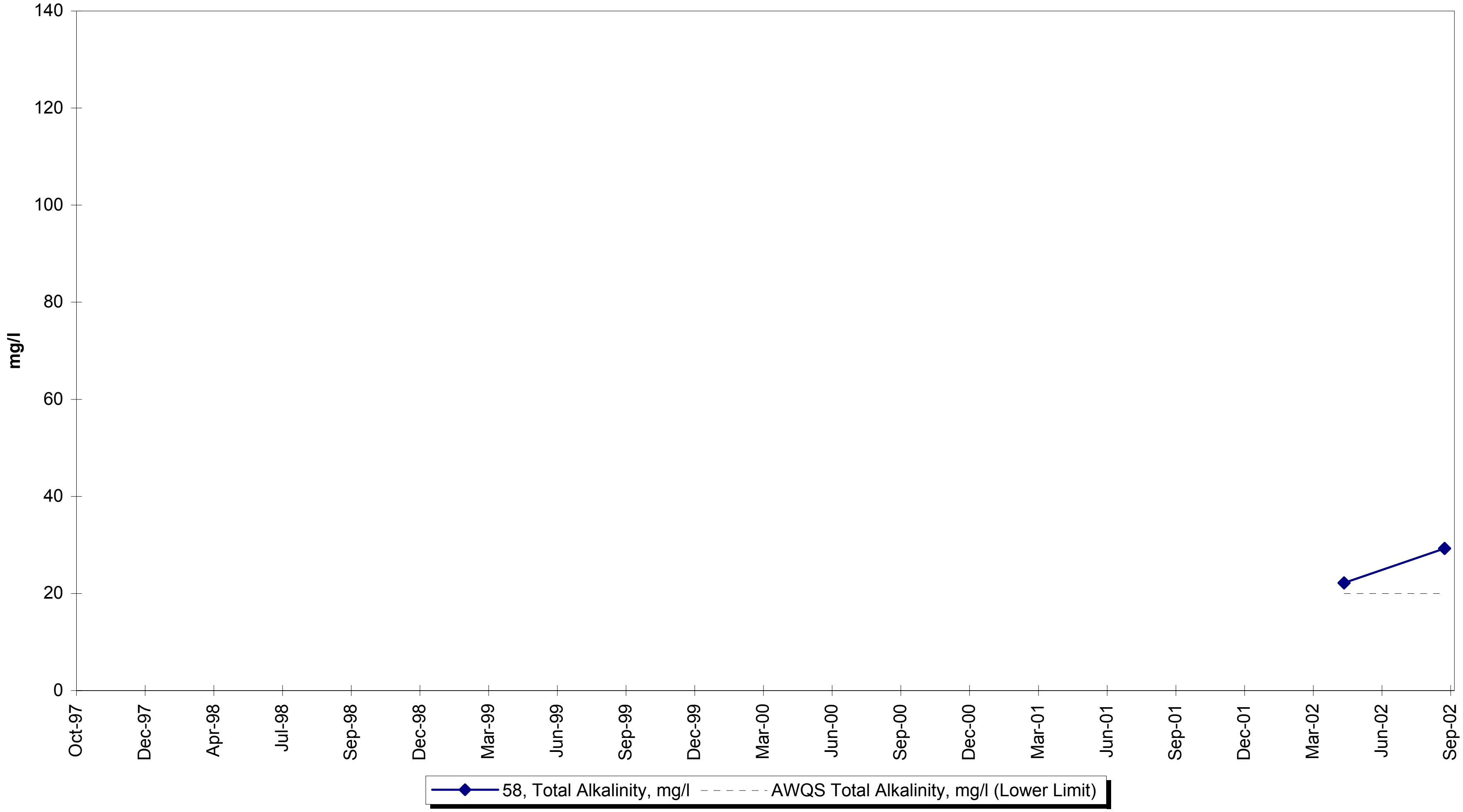


Site 58 -Lab pH

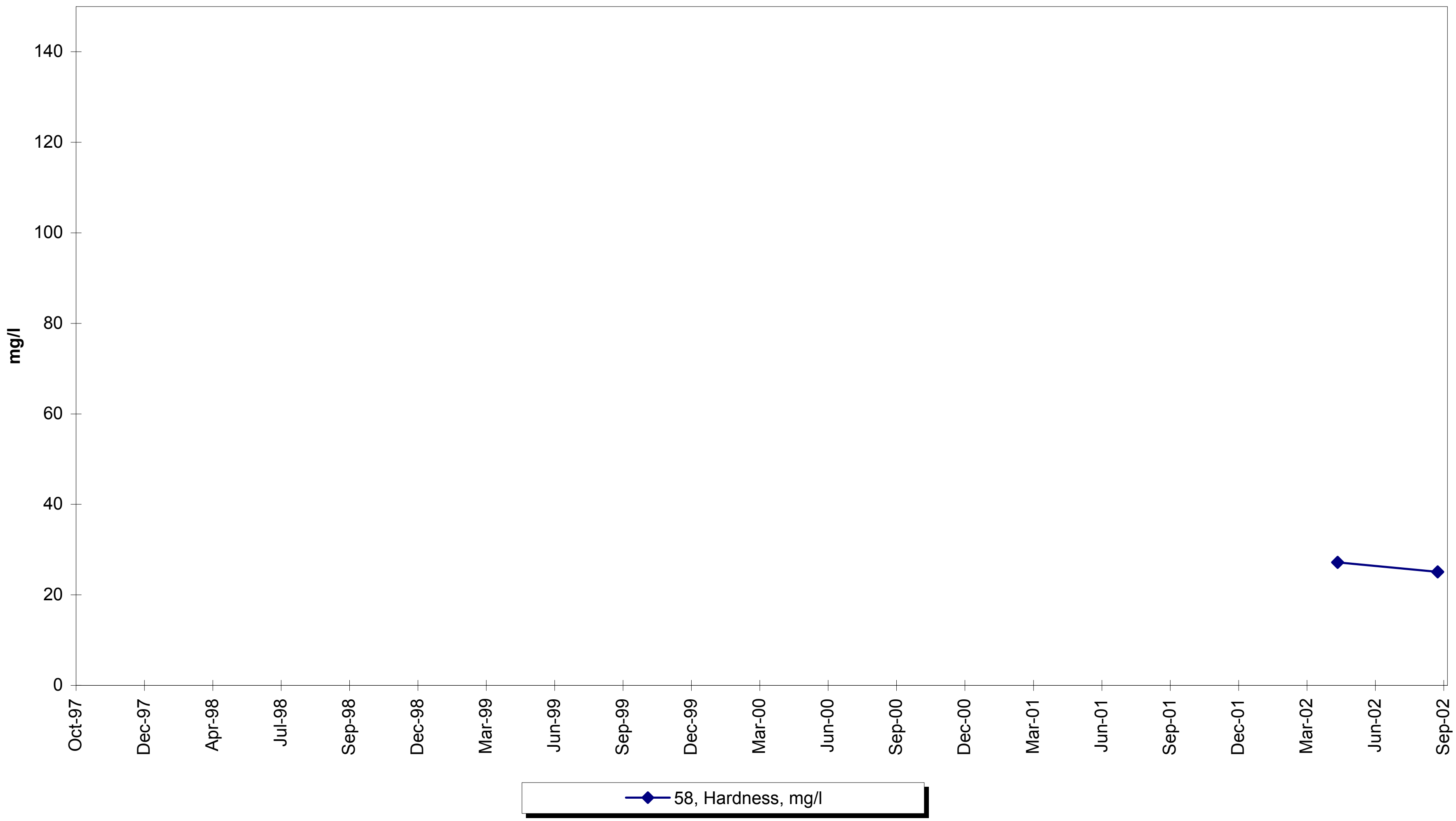



Site 58 -Field pH
pH, su
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
58, pH Field, su
AWQS pH, su-Low
AWQS pH, su-High

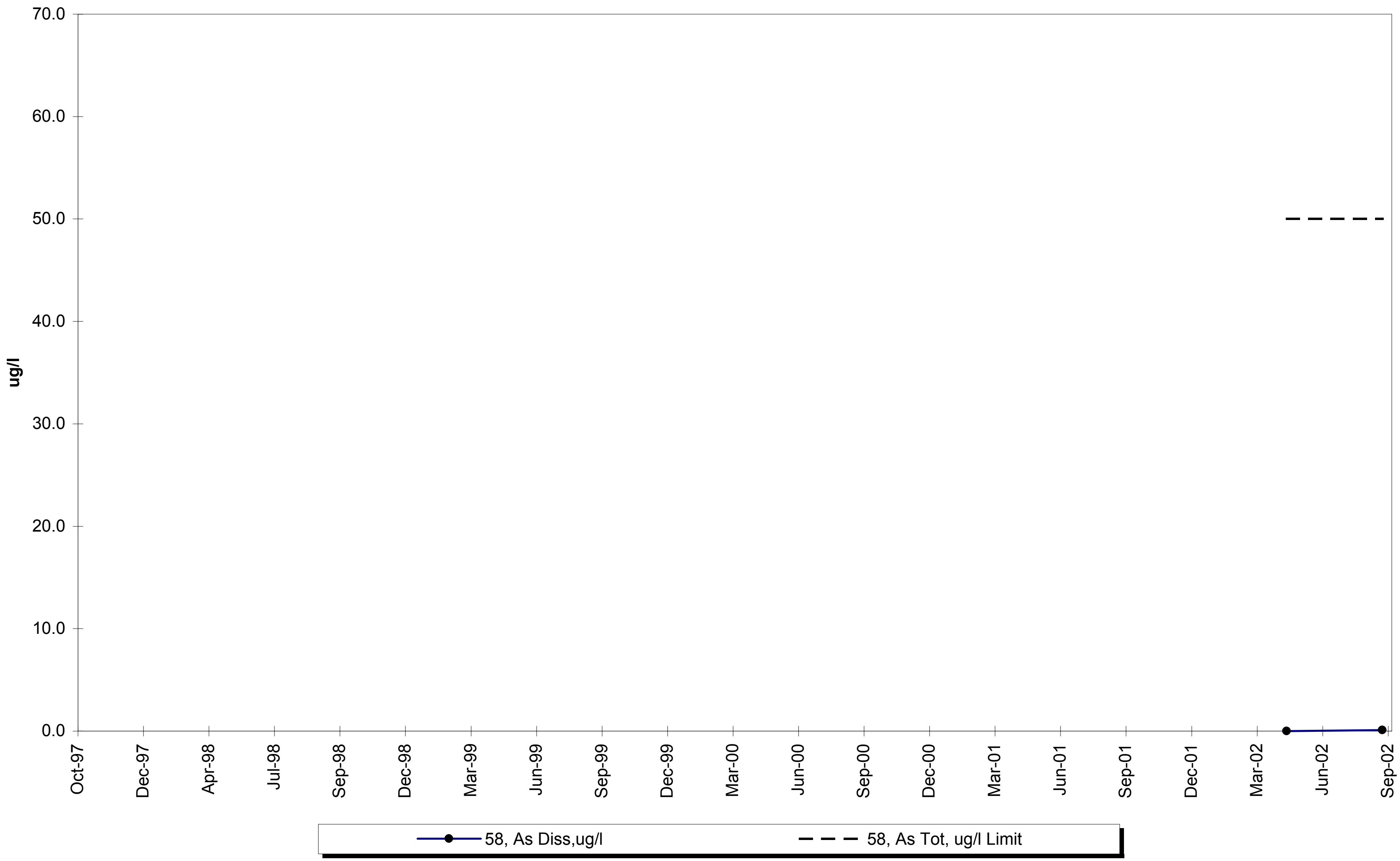
Site 58 -Total Alkalinity

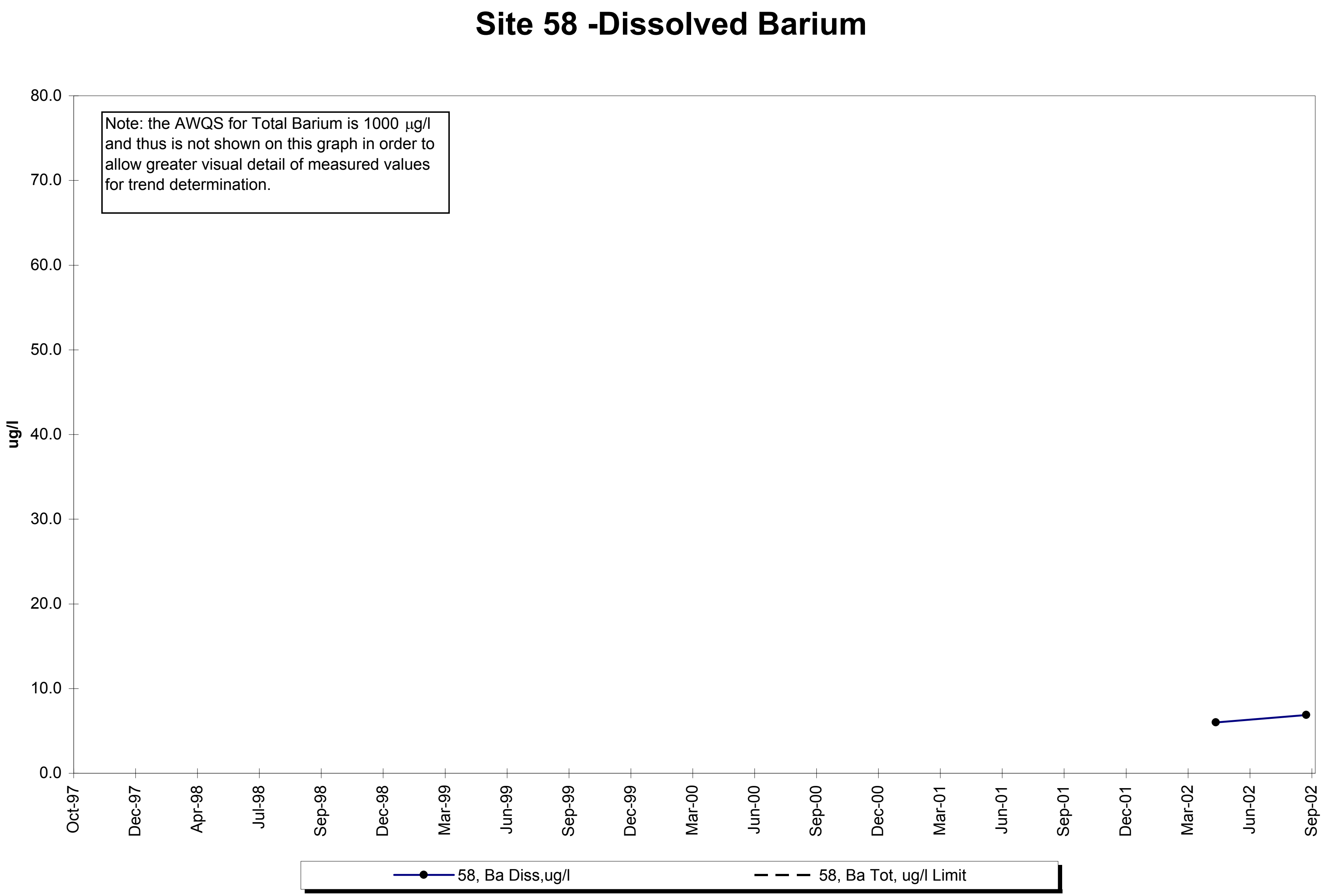


Site 58 -Hardness



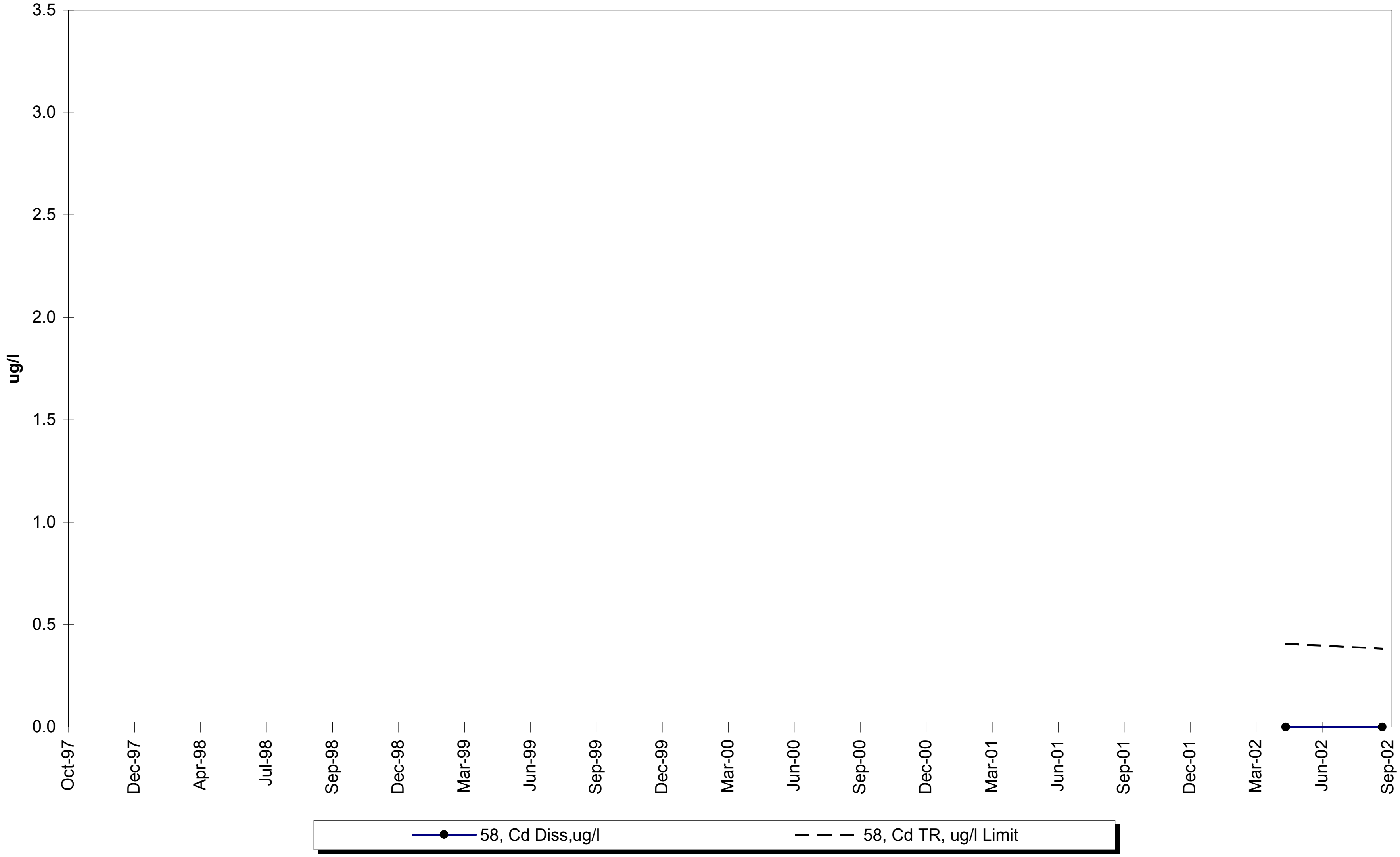
Site 58 -Dissolved Arsenic



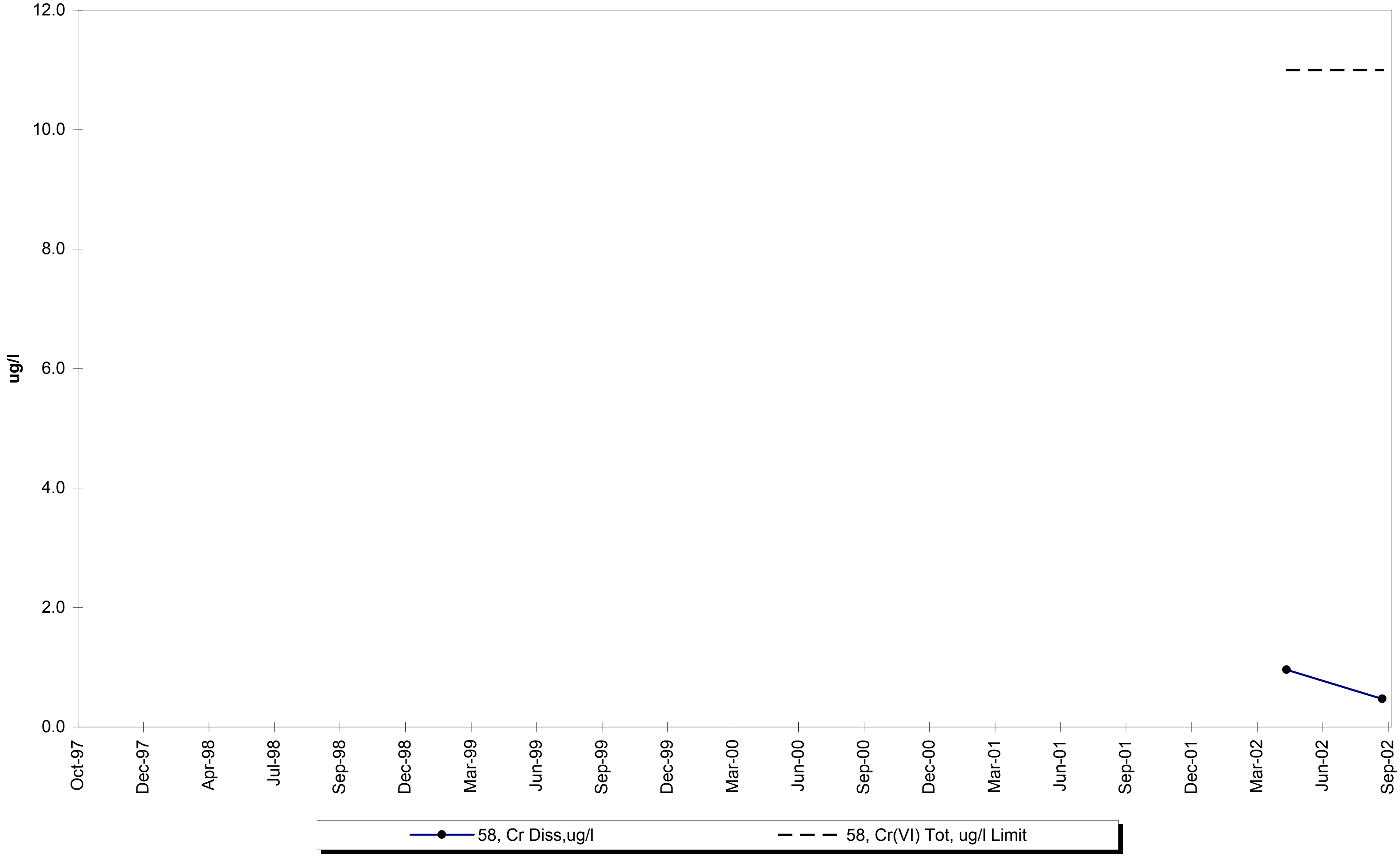


Site 58 -Dissolved Barium
Note: the AWQS for Total Barium is 1000 μg/l and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
58, Ba Diss,ug/l
58, Ba Tot, ug/l Limit

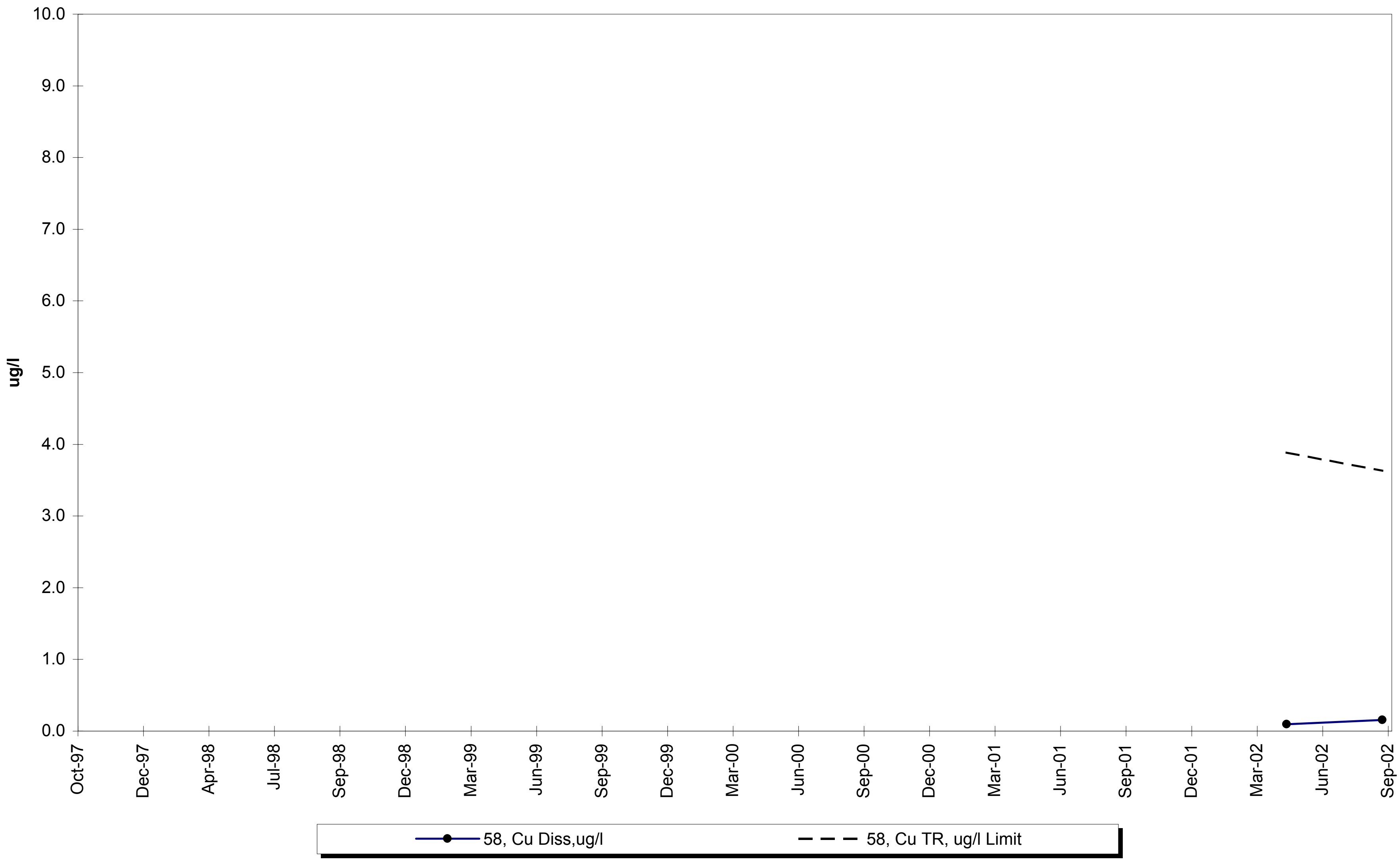
Site 58 -Dissolved Cadmium

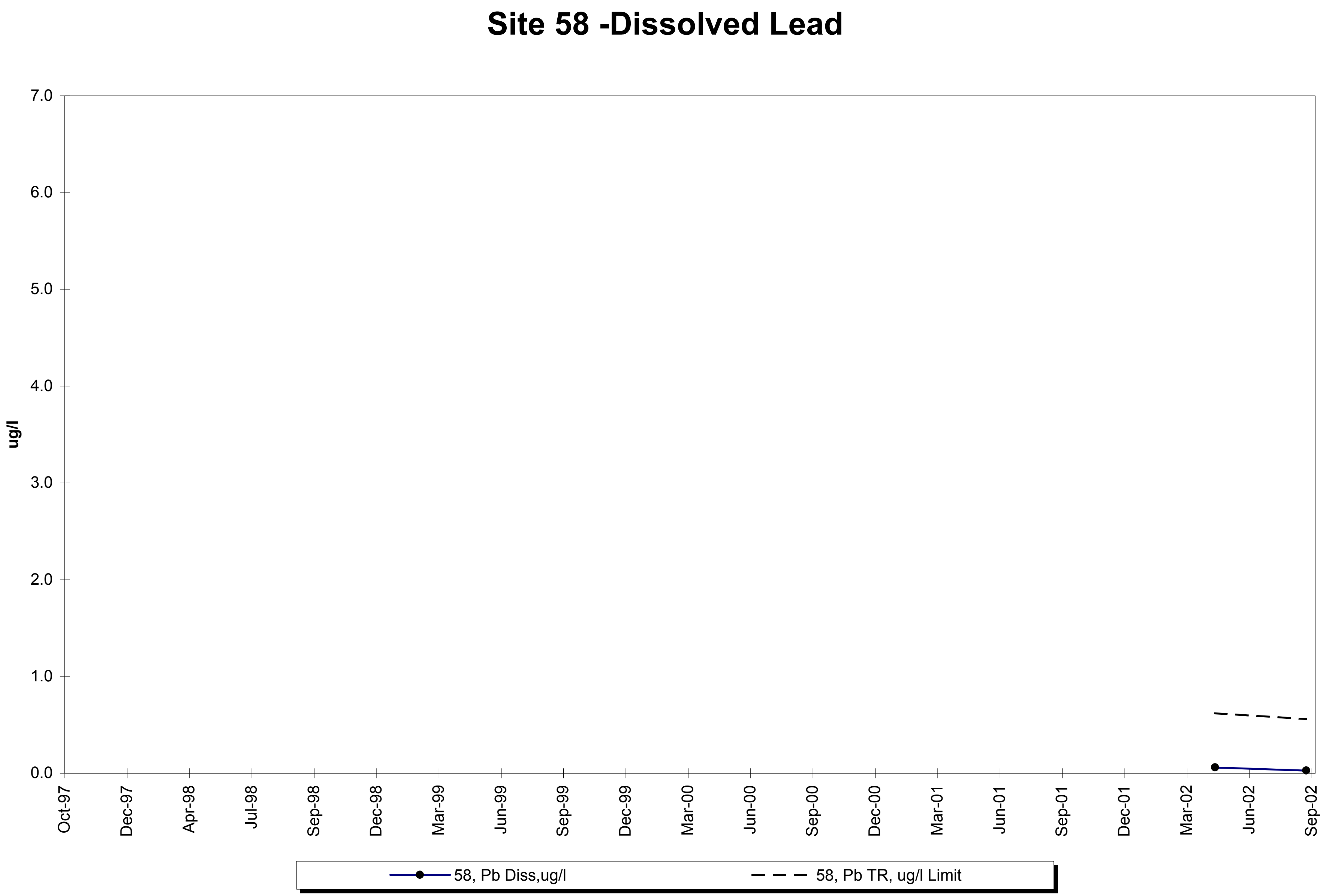


Site 58 -Dissolved Chromium



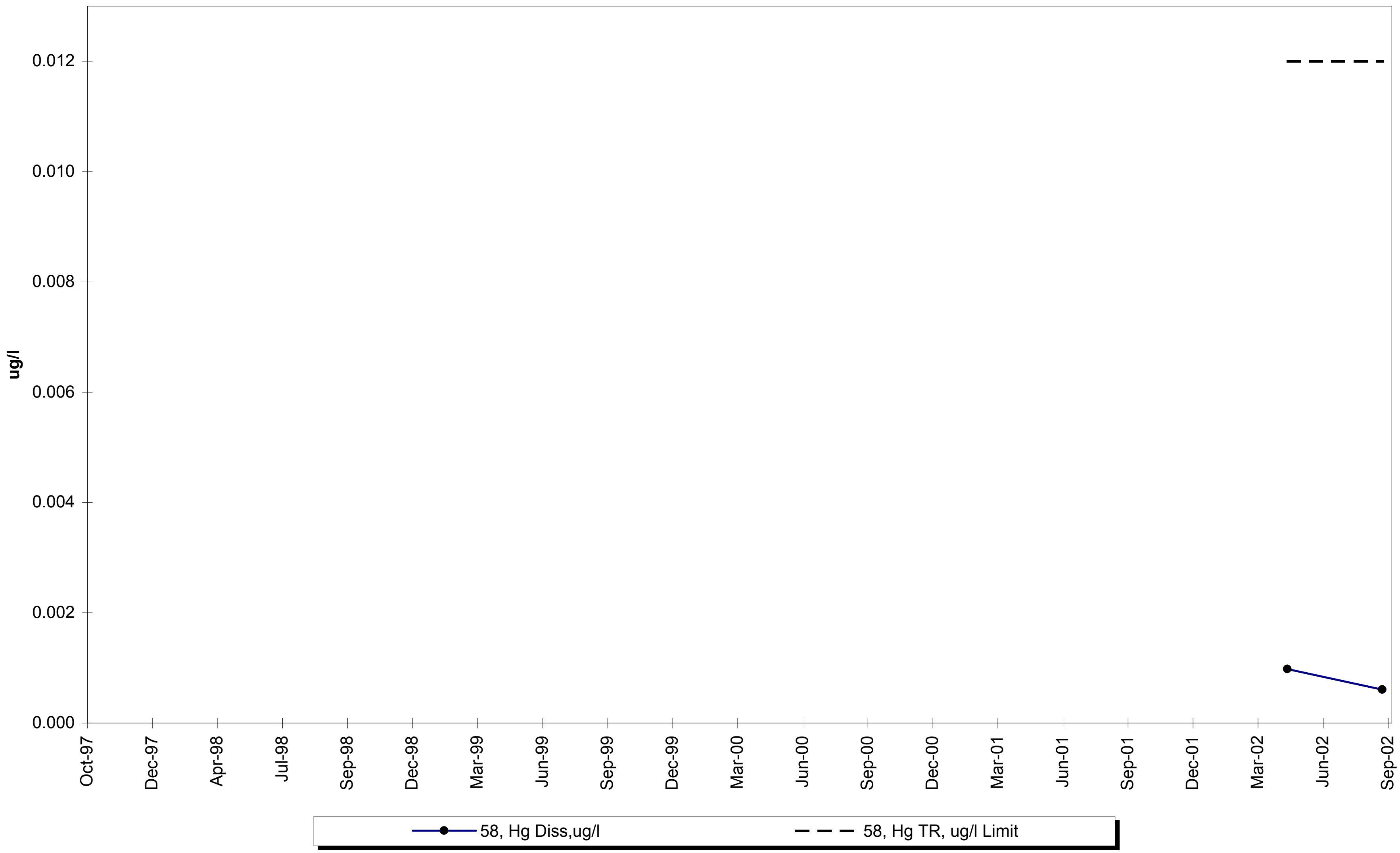
Site 58 -Dissolved Copper



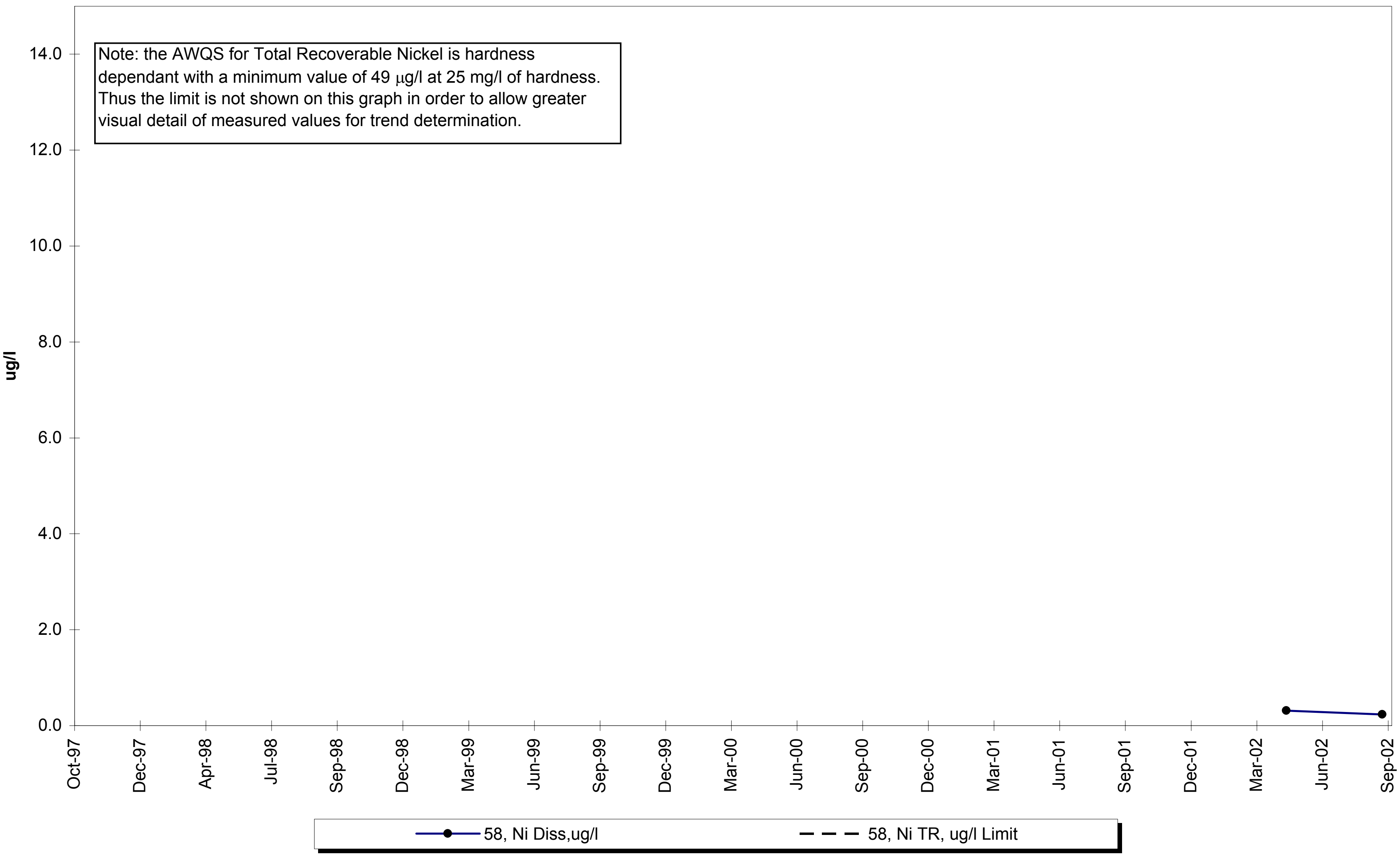


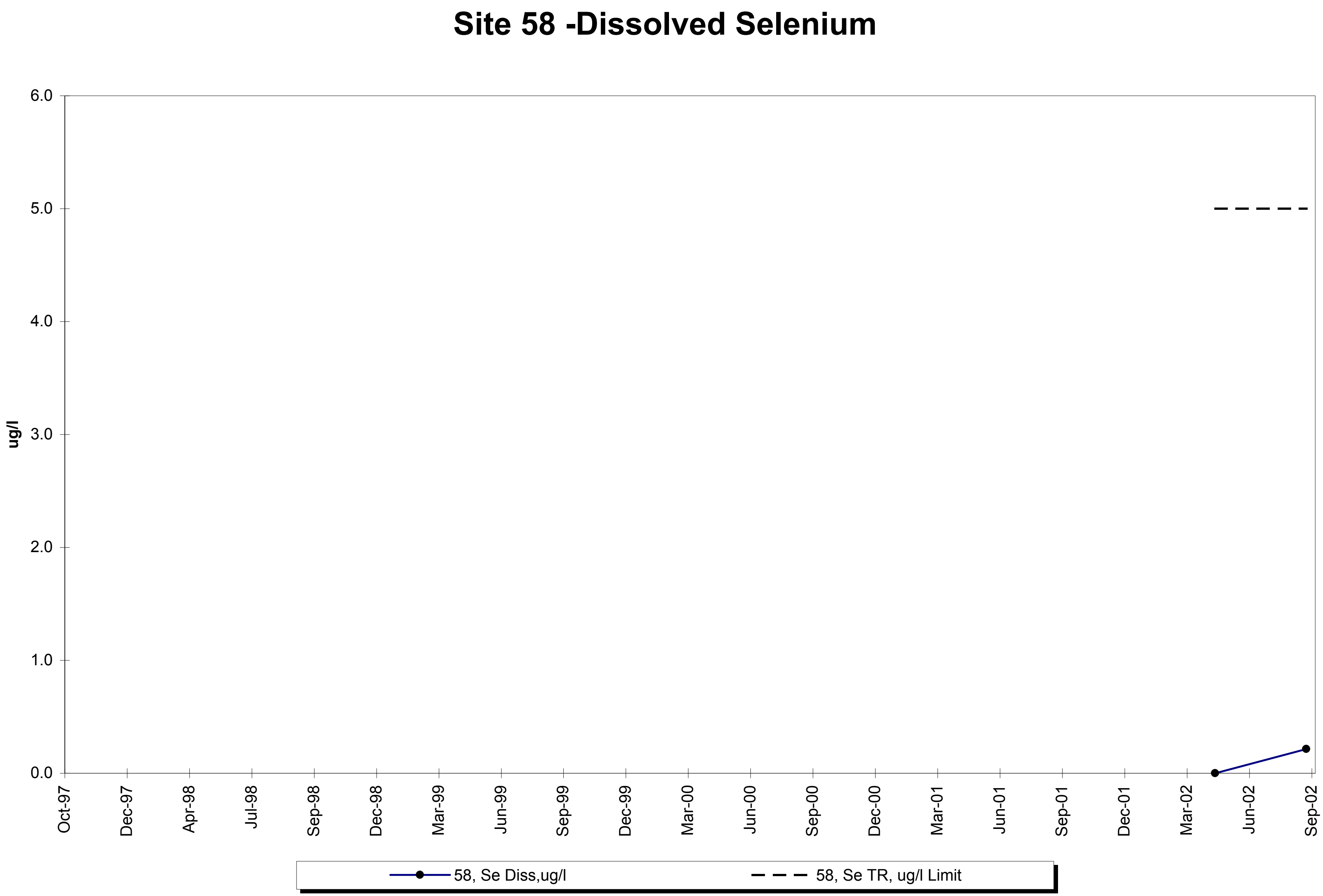
Site 58 -Dissolved Lead
ug/l
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
58, Pb Diss,ug/l
58, Pb TR, ug/l Limit

Site 58 -Dissolved Mercury



Site 58 -Dissolved Nickel

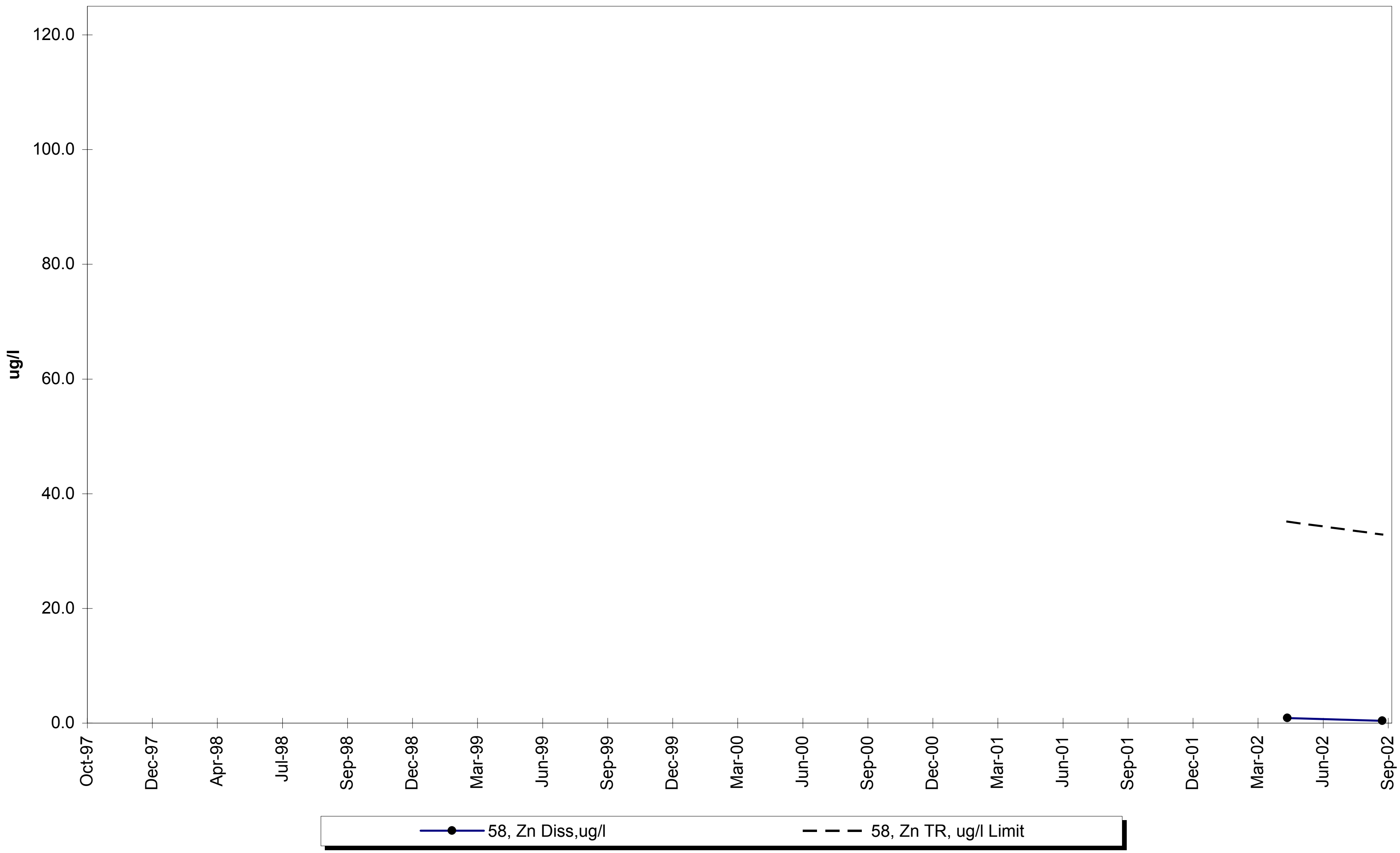




Site 58 -Dissolved Selenium
ug/l
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
58, Se Diss,ug/l
58, Se TR, ug/l Limit


Site 58 -Dissolved Silver
ug/l
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
58, Ag Diss,ug/l
58, Ag TR, ug/l Limit

Site 58 -Dissolved Zinc



INTERPRETIVE REPORT
SITE 27 "MONITORING WELL 2S"

All data collected at this site for the past five years are included in the data analyses. As shown in the table below, there were no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-97 though Sept-02.				

The data collected during the current water year are listed in the following "Table of Results for Water Year 2002" report. The table includes all the data, field and lab, collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of zero for the purpose of median calculation.

The data for water year 2002 have been compared to the strictest fresh water quality criterion for each applicable analyte. Two (2) results exceeding these criteria have been identified, as listed on the following "Comparison To Standards" report. The two datum are for lab pH values below the lower limit of 6.5 listed in AWQS. Lab pH for Site 27 has historically resulted in values ranging from a pH of 5.5 to 7.0 which are characteristic for wells completed in organic rich peat sediments.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. Dissolved barium, hardness, lab conductivity, and total alkalinity show increases of varying magnitudes starting with the Septmeber-2001 sample and continuing through both samples taken during 2002. Additionally, dissolved chromium and arsenic yielded new maximum values but do not show consistent trends. The remaining analytes did not show any obvious trends.

Of the increases noted above, the most dramatic occurred with dissolved barium and hardness. Dissolved barium concentrations increased from a median of 21.4 µg/l for the six samples taken from September-1998 through May-2001 up to approximately 60 µg/l. Prior to the increase, the maximum dissolved barium concentration measured at Site 27 was 22.1 µg/l in the May-2000 sample. Changes to the MDL for dissolved barium effectively mask any trends of similar magnitude prior to June-1998. Hardness values show a similar style of increase from median of 24.7 mg/l for the 9 samples taken between November-1996 and May-2001 up to values between 75 to 143 mg/l. Sampling prior to 1993 for Site 27 shows a reverse of the current trend. This prior trend starts with the inception of sampling at this site in 1998. The initial hardness values averaged around 150 mg/l and decrease in a inconsistent manner to 19 mg/l in late 1993. It should be noted that sampling done prior to October-1996 occurred at various laboratories and direct comparisons with current values should be viewed with caution. Nevertheless, the overall range in variability of hardness at his site is documented over the historical sampling period and encompasses the current trend in hardness values. With regard to dissolved barium, due to changes in analytical techniques it is uncertain if variations of similar magnitude to the current trend have occurred in the past.

The other analytes listed show less dramatic trends but ones that are distinct nonetheless. Sampling since September-2002 shows moderate but consistent increases in lab conductivity and total alkalinity. Prior sampling has shown variations of similar range and the current interpretation is that the trends are within the norm for Site 27. A new maximum was noted for dissolved chromium with a value of 5.28 μg/l for the May-2002 sample. Prior sampling averaged approximately 1 μg/l. However, the September-2002 valued was just slightly above the trend established prior to the May-2002 and thus the upward trend was not consistent as was case with the previously discussed analytes. Changes in the MDL that occurred in June-1998 may have the effect of masking previous trends of approximately the same magnitude. Dissolved arsenic shows a slightly different trend with the 6 samples taken between September-1996 and May-2001 having a median of 1.9 μg/l and the 3 most recent samples having concentrations ranging from 6.9 to 7.6 μg/l. However, the relative magnitude of the increase with respect to the MDL of 5 μg/l, which was effective prior to June-1998, may be masking previous trends with concentrations of similar magnitude.

The combined increase in the listed analytes suggests a change in the relative proportion between dilute surface water derived from precipitation and a groundwater higher in total dissolved solids in equilibrium with bedrock and/or unconsolidated mineral soils typical of the area. As noted above, samples at Site 27, from it's inception in July-1988 through the early 1990's, show higher concentrations of alkalinity, hardness and higher conductance readings that are similar in magnitude to the most recent trend. Changes in MDL for arsenic, barium, and chromium likely mask similar values to those recorded during the recent increase. Thus, the upward trends may be due to the relative increase in the proportion of deeper-seated groundwater being sampled at the site. The notable absence of an increase in dissolved zinc indicates that tailings contact water is not involved with the upward trend of the other analytes.

Additional X-Y plots have been generated for alkalinity, pH, conductance, and dissolved zinc that plot Site 27 and Site 58, the upgradient control site, to aid in the comparison between those two sites. Total alkalinity, lab conductivity and dissolved zinc are all approximately twice the concentration at Site 27 than at Site 58. Lab pH is slightly lower at Site 27 than Site 58. The variation in the two site's water chemistries is a direct result of the inherent differences between the site's hydrogeologies and the affect this has upon the hydrologic conditions at the two sites. Site 58 is located in close proximity to the large bedrock ridge, which defines the eastern geologic and hydrologic boundary of the tails area. The upslope portion of the ridge acts as the major recharge zone to the area aquifer. Along this ridge it is likely that groundwater flow is dominated by shallow or near surface flows due to the steep gradient and thin mineral soil. Thus, the groundwater at Site 58 is typically a mixture of surficial recharge from the immediate area with a component of relatively juvenile groundwater originating from the ridge to the east. In contrast, Site 27 is located in an area of gently sloping muskeg that forms part of the upper Tributary Creek drainage area. The area's groundwater is characterized by diffuse flow through the peat/sand strata that make up the upper portion of the unconsolidated sediment fill in the Tributary Creek valley. Additionally, Site 27 is located in an area identified as a groundwater discharge site into Tributary Creek. Thus, Site 27 samples groundwater that is relatively mature in comparison to Site 58 and may have a higher component of groundwater that has been in contact with a larger variety of strata for a longer period of time. Therefore the groundwater would be expected to have a higher dissolved load. The lower pH would be a due to the greater interaction with organic matter in the muskeg and would promote greater solubility for naturally occurring dissolved metals sampled at this site.

Table of Results for Water Year 2002

Site 27 "MW-2S"													
Sample Date/Parameter	10/25/2001	11/15/2001	12/5/2001	1/29/2002	2/21/2002	3/19/2002	4/1/2002	5/7/2002	6/11/2002	7/15/2002	8/27/2002	9/17/2002	**Median**
Water Temp (°C)								5.8				8.7	7.3
Conductivity-Field (μmho)								98				101	99
Conductivity-Lab (μmho)								116				133	125
pH Lab (standard units)								5.41				6.16	5.79
pH Field (standard units)								5.74				5.80	5.77
Total Alkalinity (mg/l)								51.6				68.5	60.1
Hardness (mg/l)								143.0				116.0	129.5
Dissolved As (μg/l)								6.980				7.590	7.285
Dissolved Ba (μg/l)	**NOT SCHEDULED FOR SAMPLING**							64.1	**NOT SCHEDULED FOR SAMPLING**			56.1 J	60.1
Dissolved Cd (μg/l)								<0.007 J				<0.004	0.003
Dissolved Cr (μg/l)								5.280				1.720	3.500
Dissolved Cu (μg/l)								0.079 J				0.225	0.152
Dissolved Pb (μg/l)								0.0515 J				0.0525	0.0520
Dissolved Ni (μg/l)								3.07				3.16 J	3.12
Dissolved Ag (μg/l)								<0.0080 J				0.1720	0.0880
Dissolved Zn (μg/l)								1.12				4.36 J	2.74
Dissolved Se (μg/l)								<0.475				0.219 J	0.228
Dissolved Hg (μg/l)								0.001190 UJ				0.000633 U	0.000912

See "Qualififed Data by QA Reviewer" table for qualifier descriptions.

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
27	05/07/2002	1:15:00 PM				
			Cd Diss, ug/l	0.00968	J	Below Quantitative Range, C
			Cu Diss, ug/l	0.0691	J	Below Quantitative Range
			Pb Diss, ug/l	0.0316	J	Below Quantitative Range
			Ag Diss, ug/l	0.016	J	Below Quantitative Range, C
			Hg Diss, ug/l	0.000293	UJ	Below Quantitative Range, C
27	09/17/2002	1:36:00 PM				
			Ba Diss, ug/l	56.1	J	CCV Rec, LCS Rec.
			Ni Diss, ug/l	3.16	J	CCV Rec.
			Zn Diss, ug/l	4.36	J	LCS Rec.
			Se Diss, ug/l	0.219	J	Below Quantitative Range
			Hg Diss, ug/l	0.000633	U	Field Blank Contamination

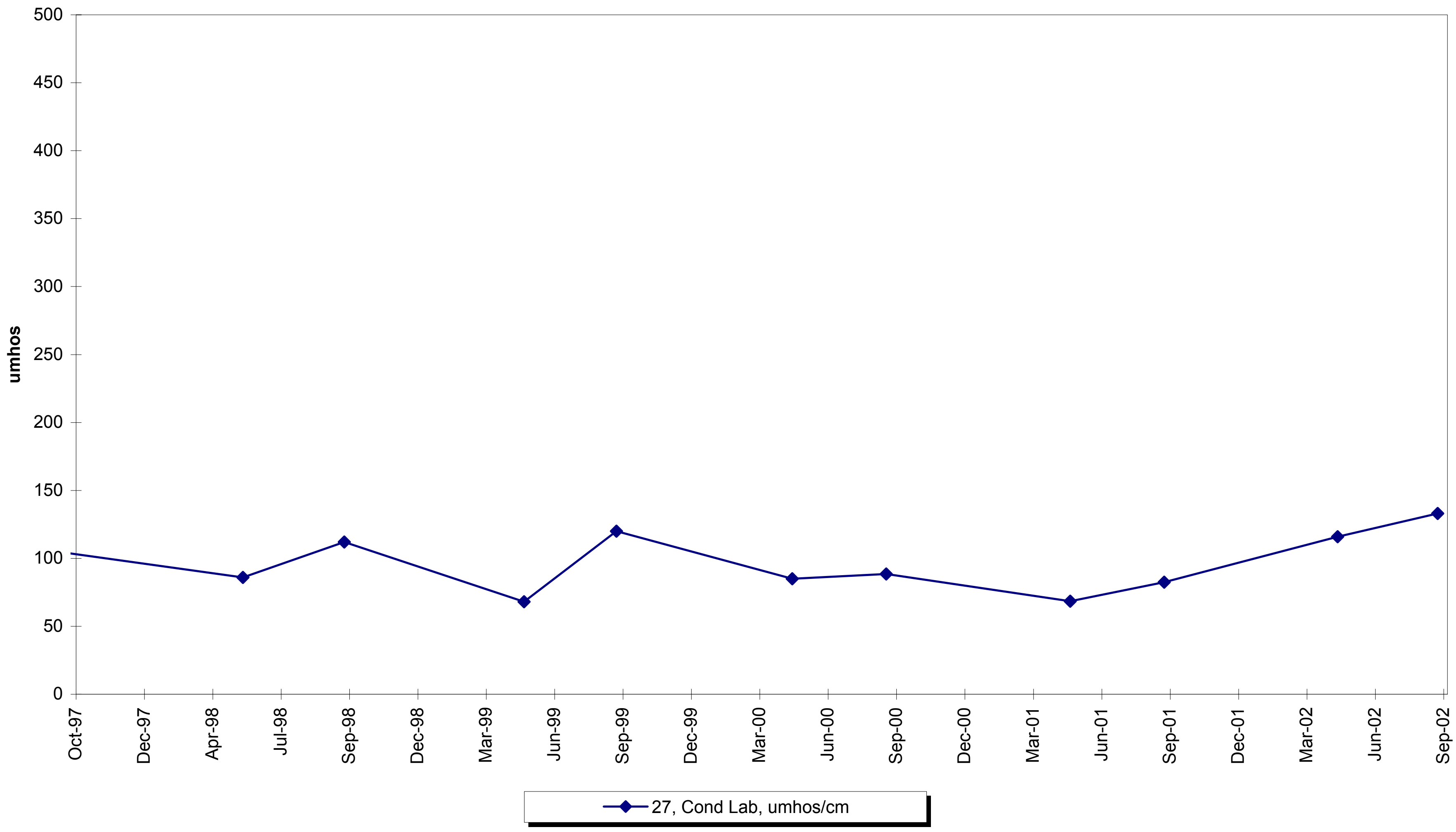
Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

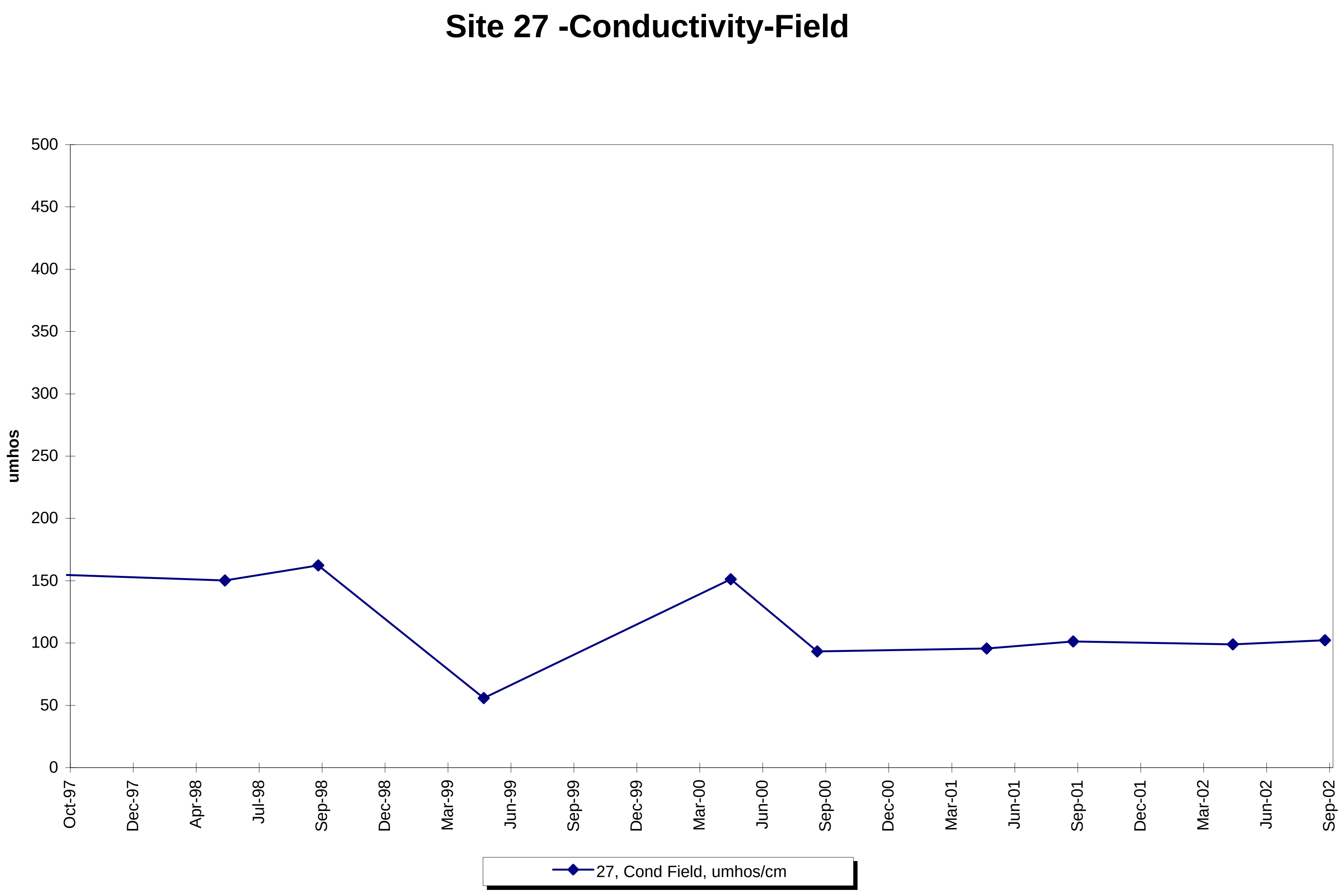
Comparison To Standards

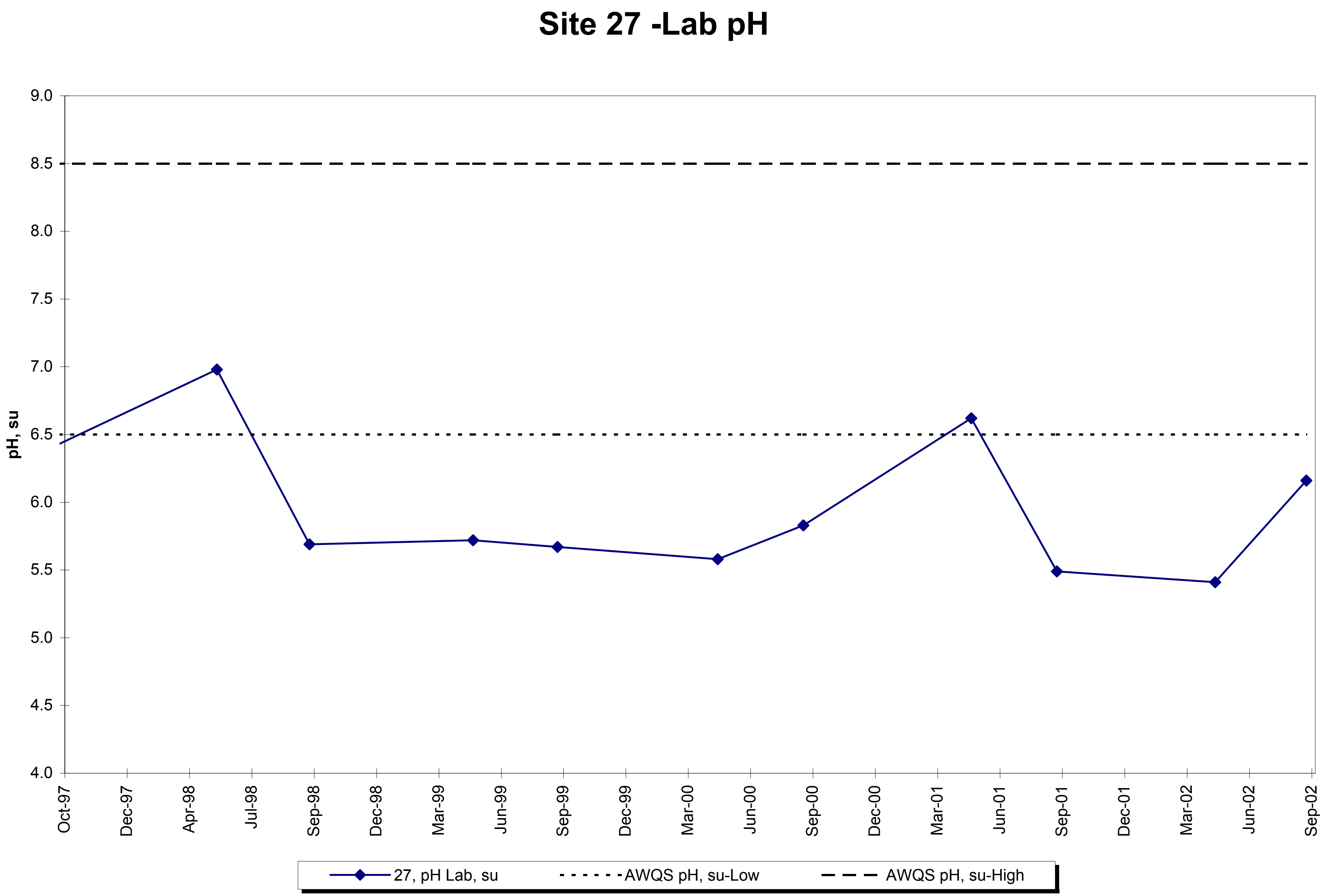
Date Range: 10/01/2001 to 09/30/2002

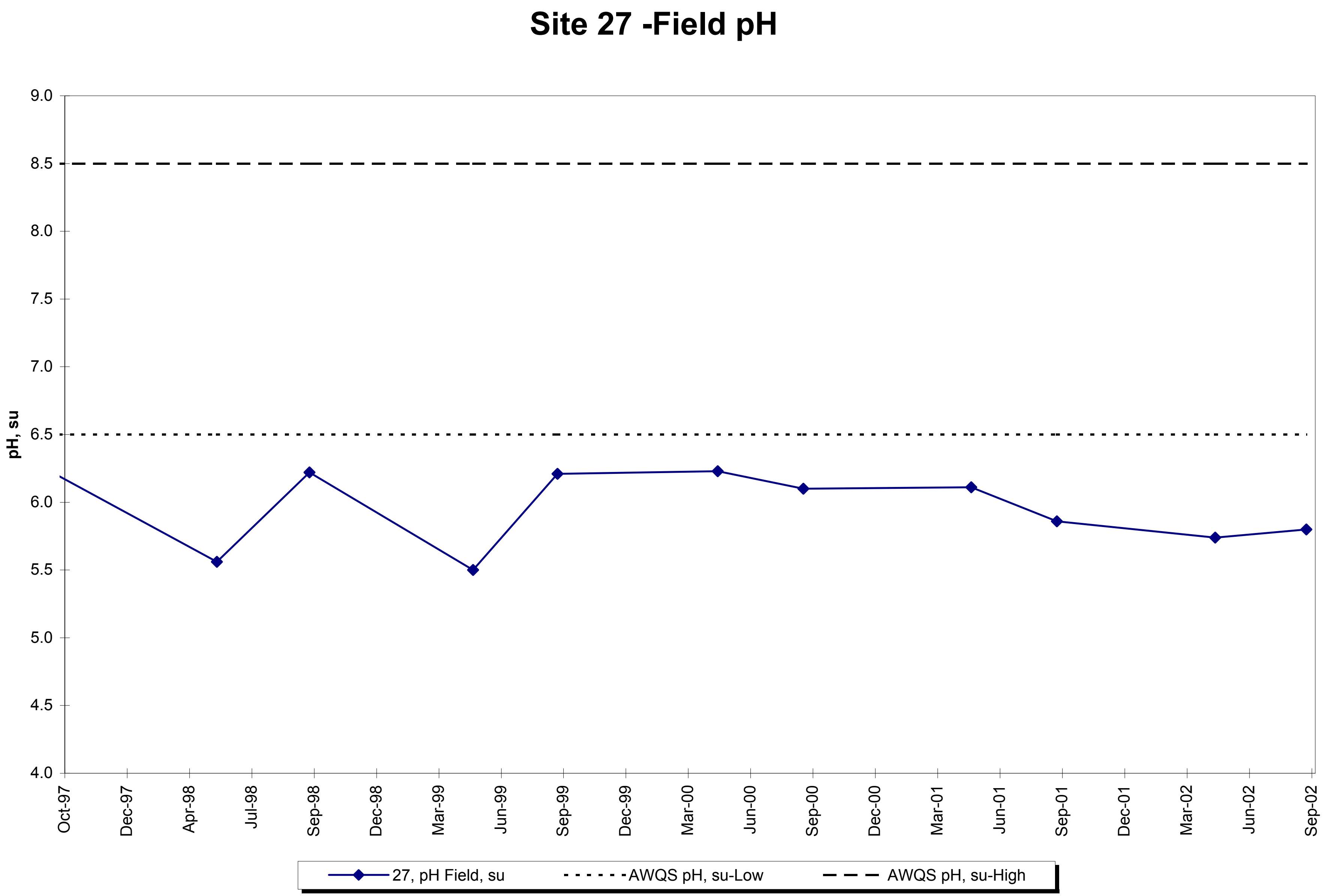
Site Number	Date	Time	Dup ID	Storet No.	Parameter Description	Value	Standard	Standard Type
27	05/07/2002	1:15 PM	0	403	pH Lab, su	5.41	6.5- 8.5	Aquatic
27	09/17/2002	1:36 PM	0	403	pH Lab, su	6.16	6.5- 8.5	Aquatic

Site 27 -Conductivity-Lab



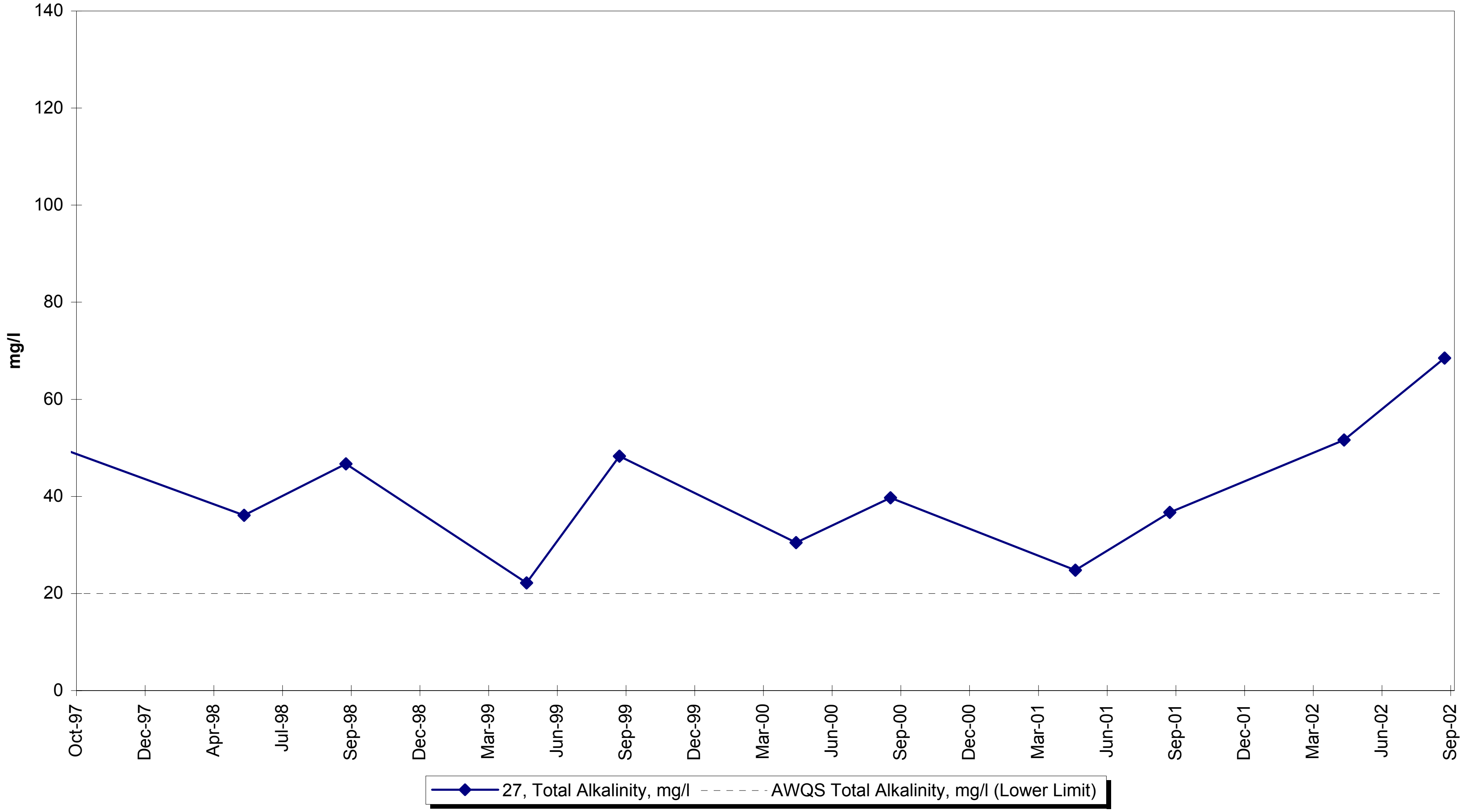

Site 27 -Conductivity-Field
umhos
500
450
400
350
300
250
200
150
100
50
0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
27, Cond Field, umhos/cm


Site 27 -Lab pH
pH, su
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
27, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

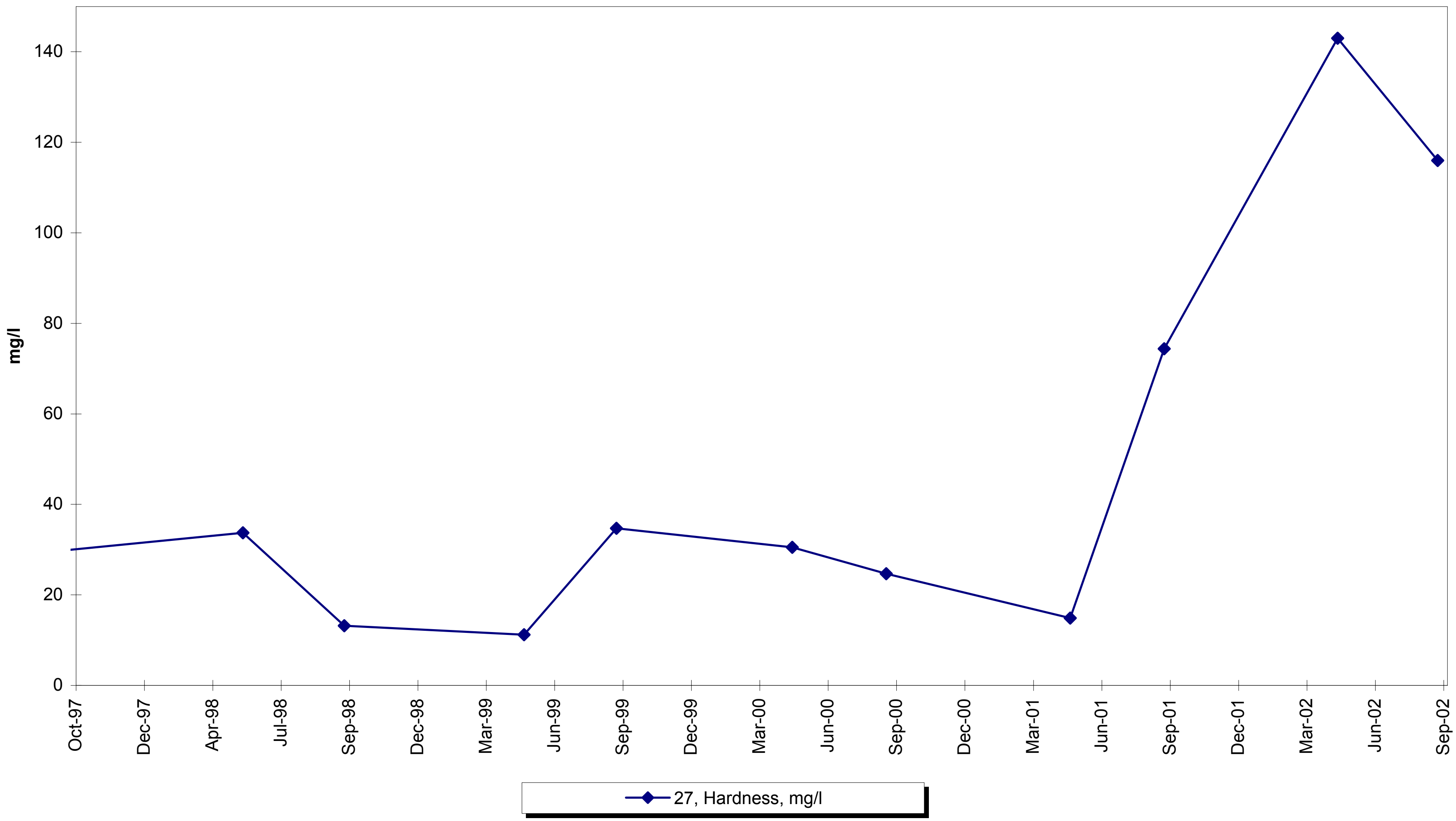


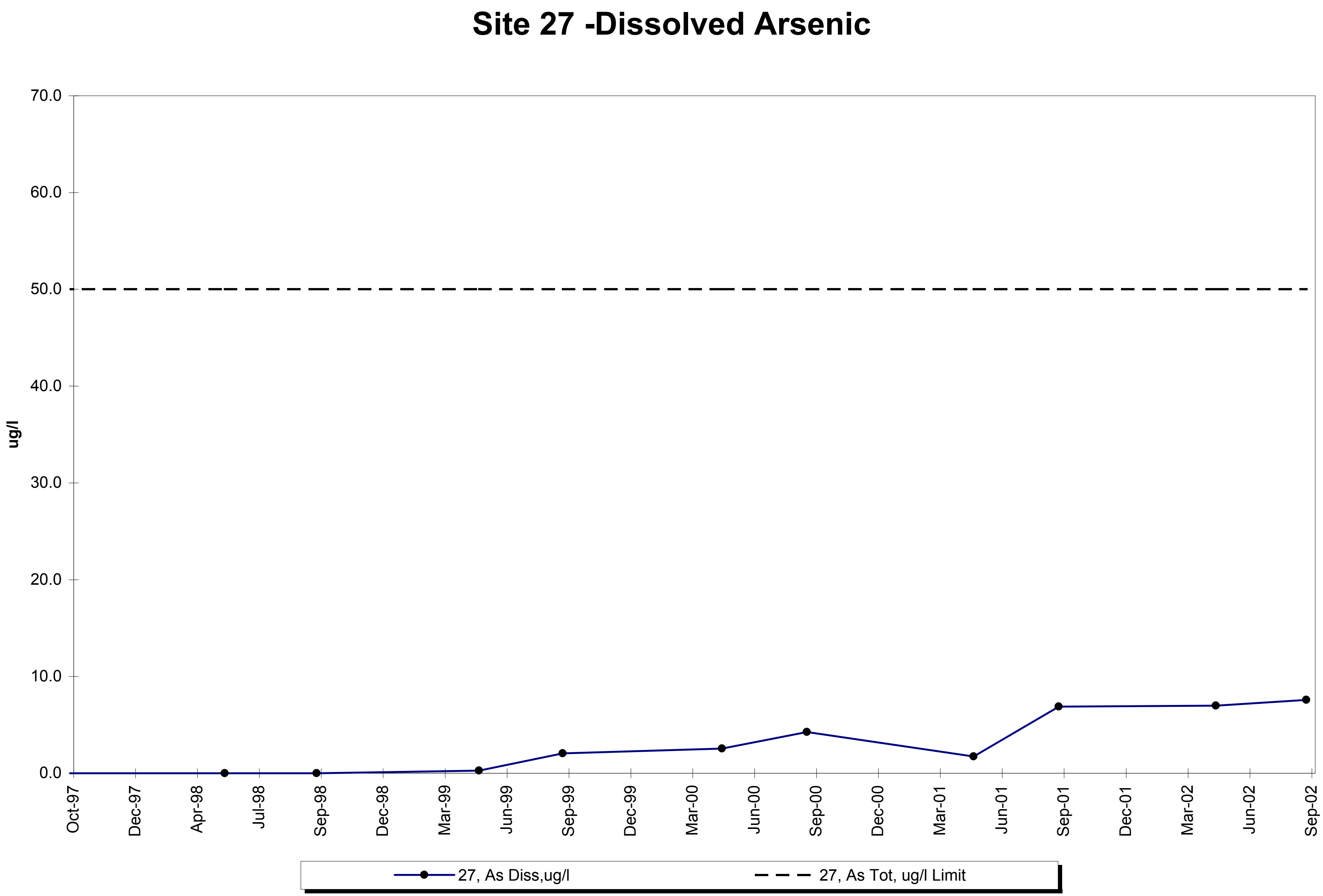
Site 27 -Field pH
pH, su
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
27, pH Field, su
AWQS pH, su-Low
AWQS pH, su-High

Site 27 -Total Alkalinity



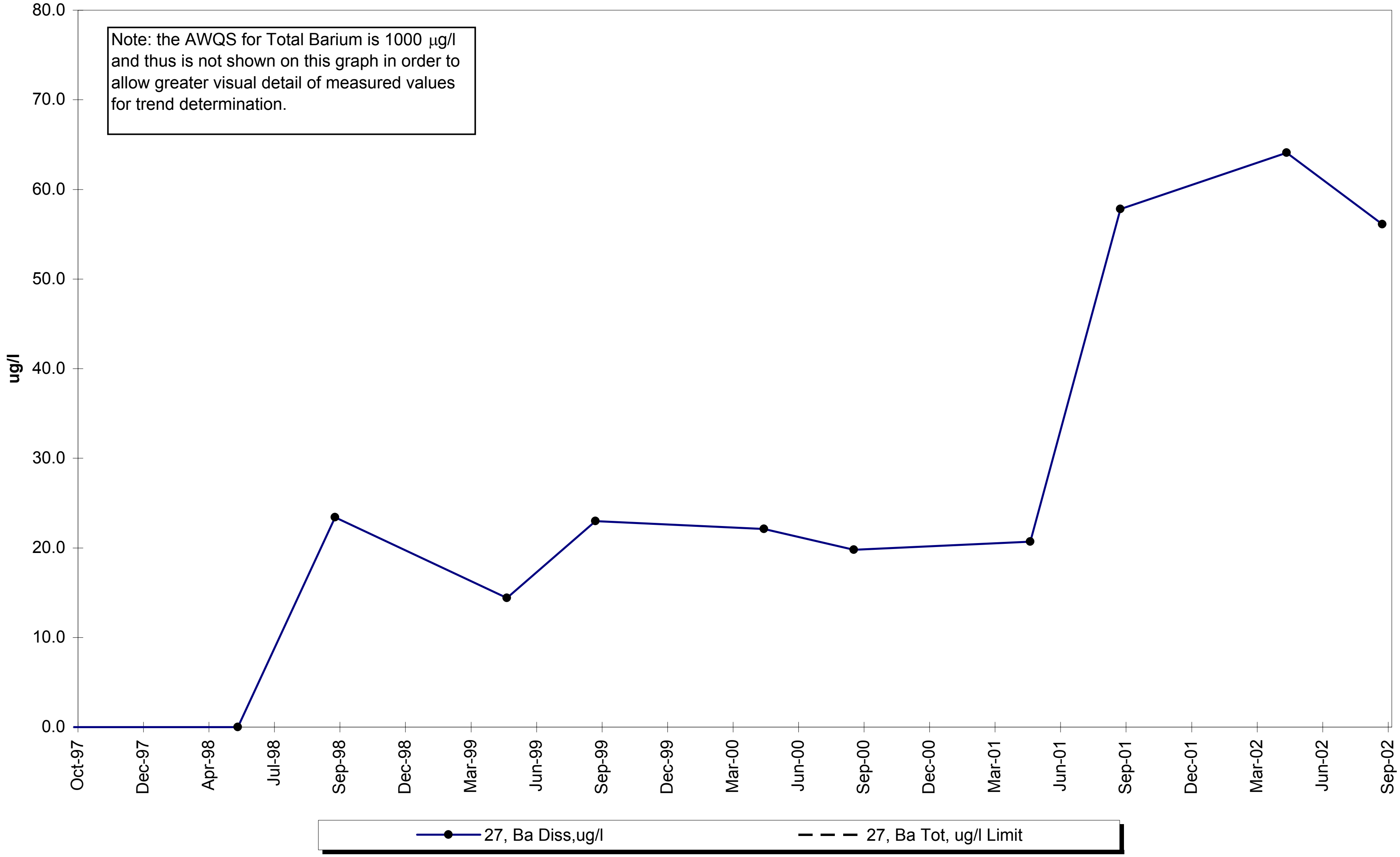
Site 27 -Hardness



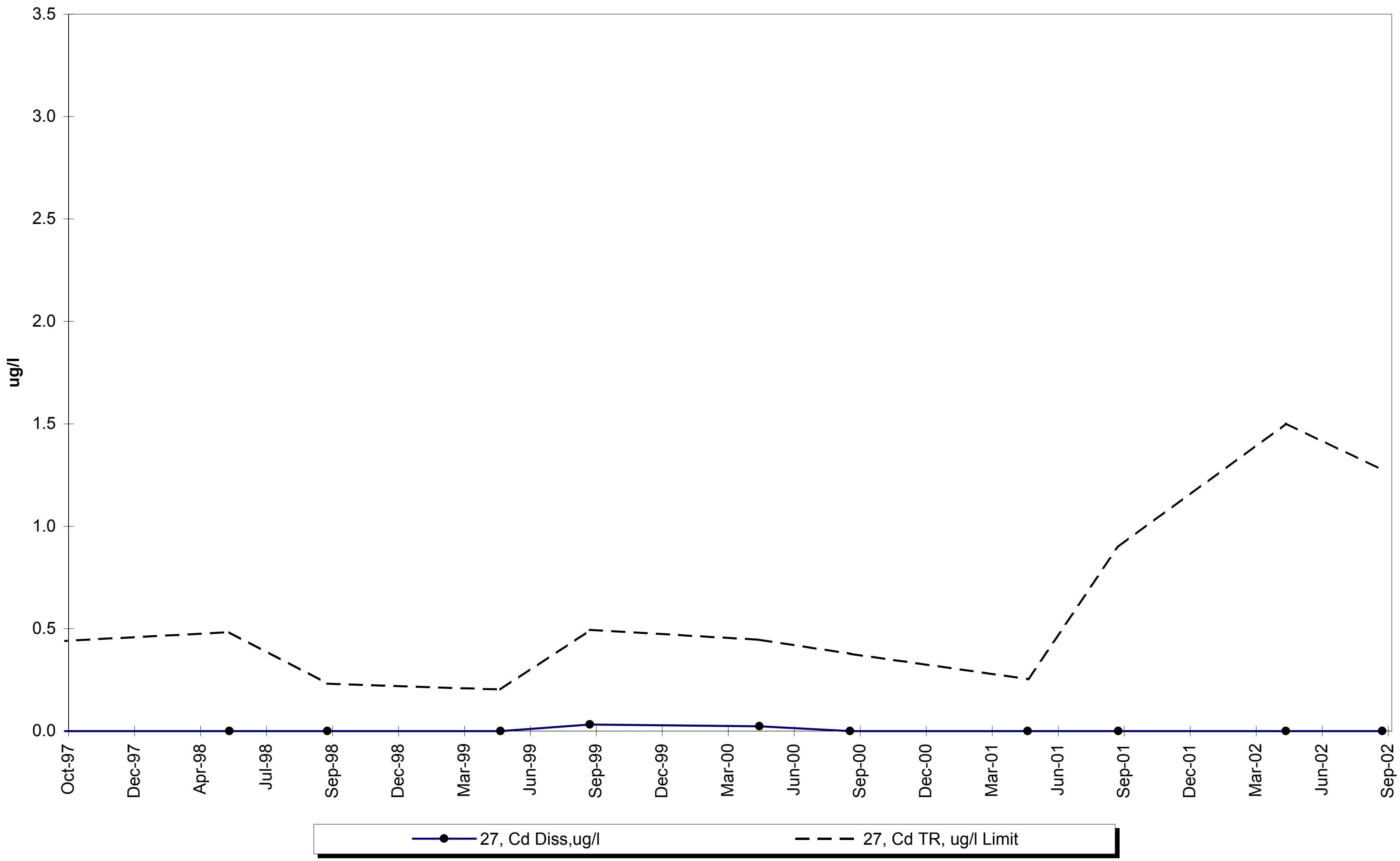


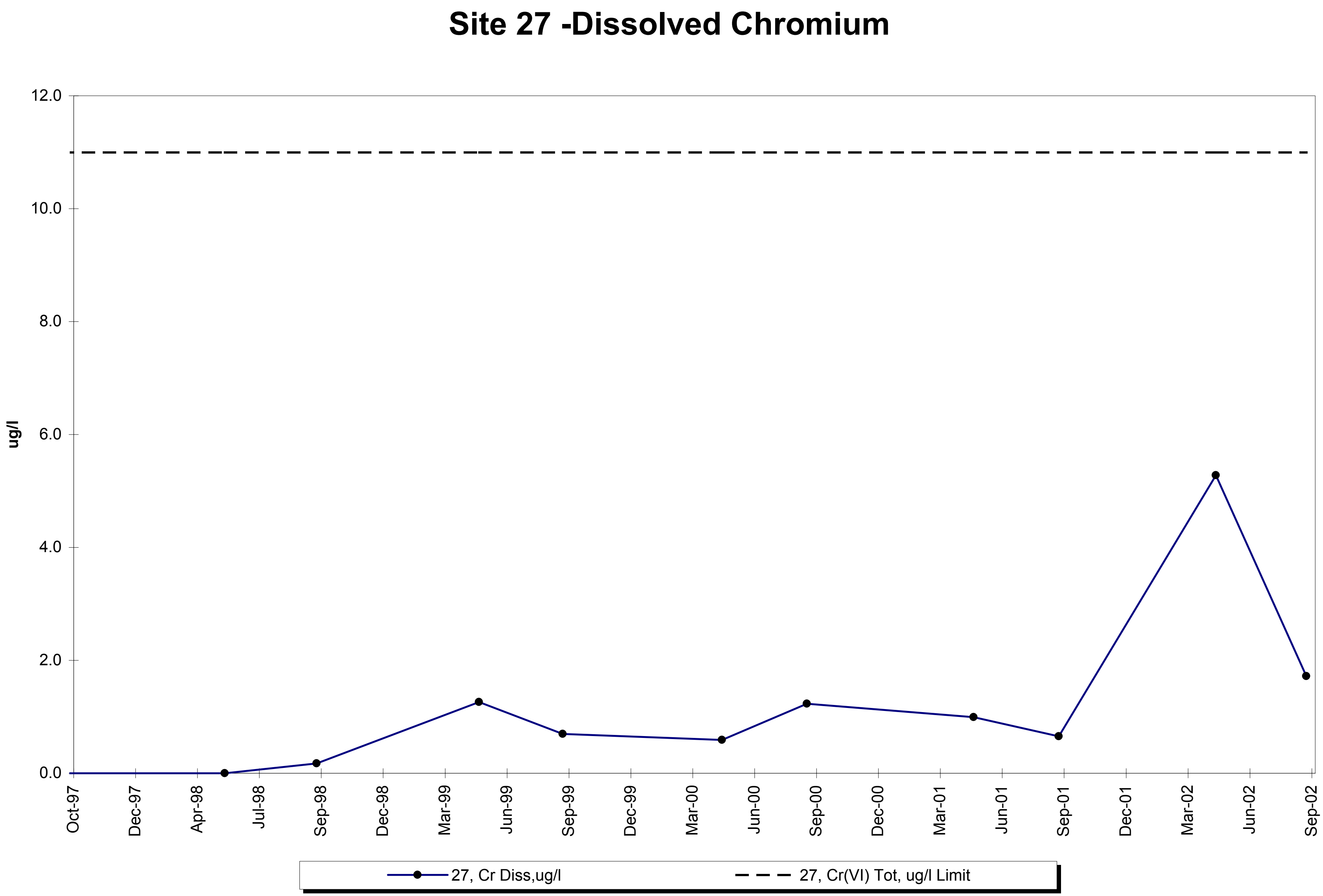
Site 27 -Dissolved Arsenic
ug/l
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
27, As Diss,ug/l
27, As Tot, ug/l Limit

Site 27 -Dissolved Barium

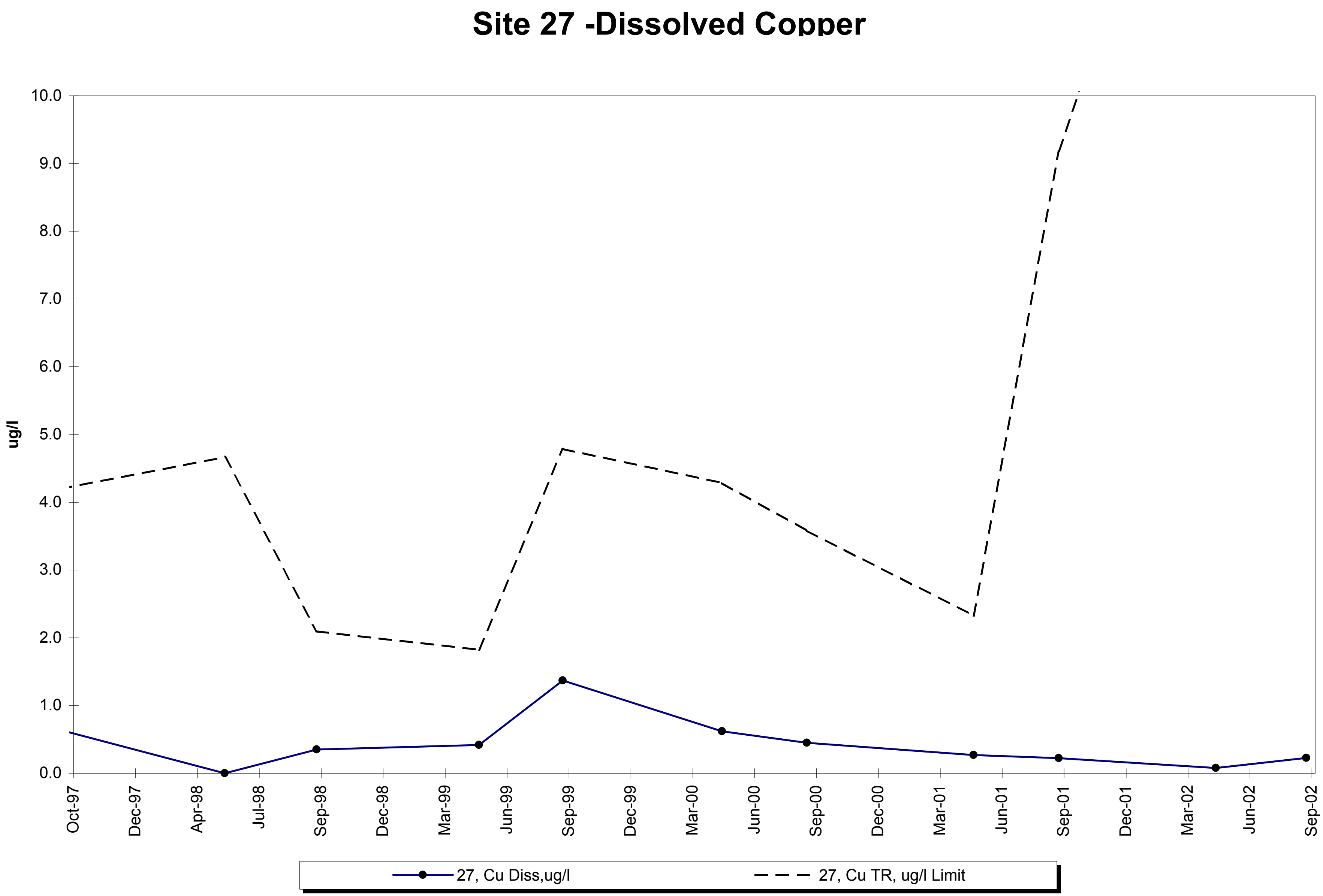


Site 27 -Dissolved Cadmium

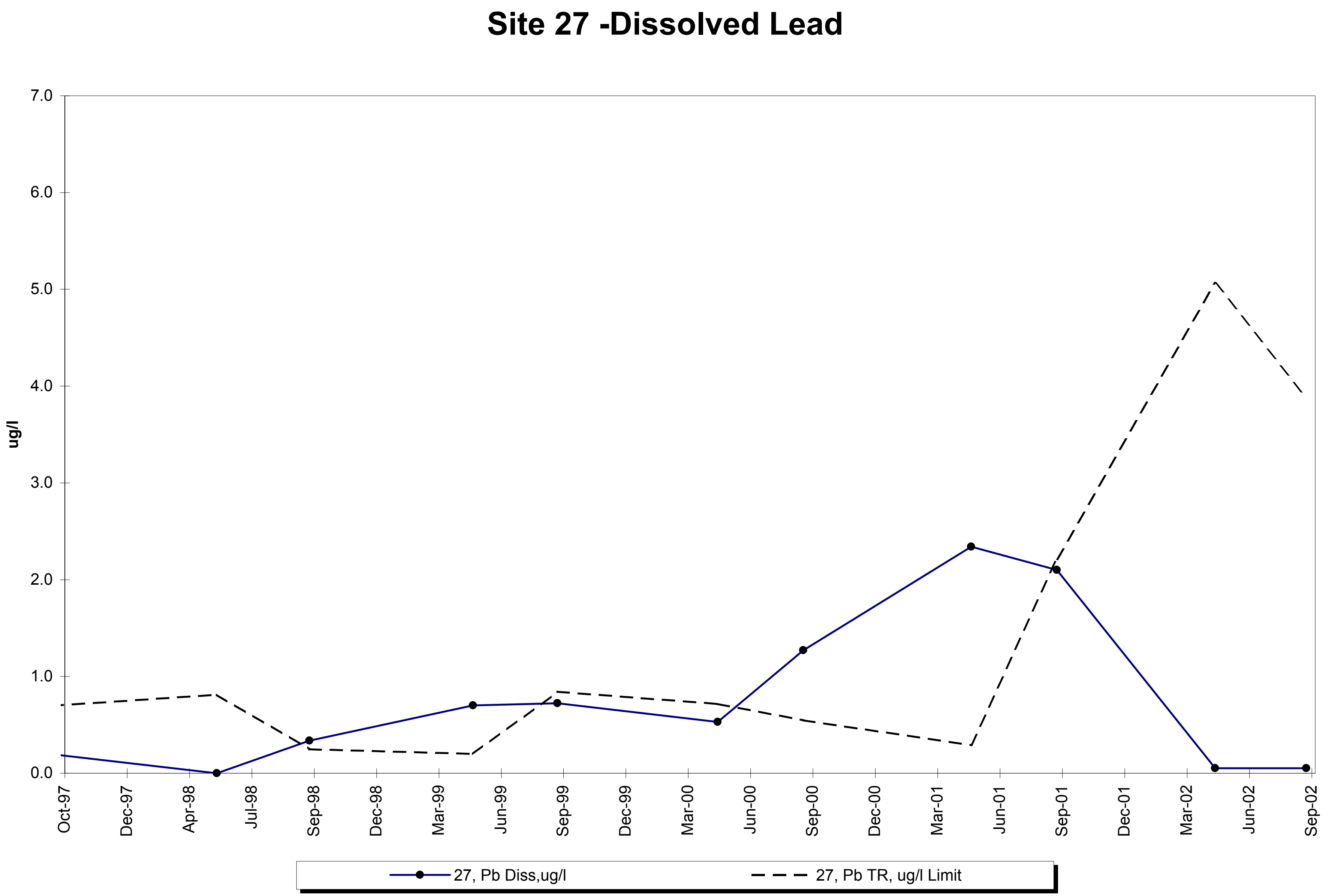




Site 27 -Dissolved Chromium
ug/l
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
27, Cr Diss,ug/l
27, Cr(VI) Tot, ug/l Limit

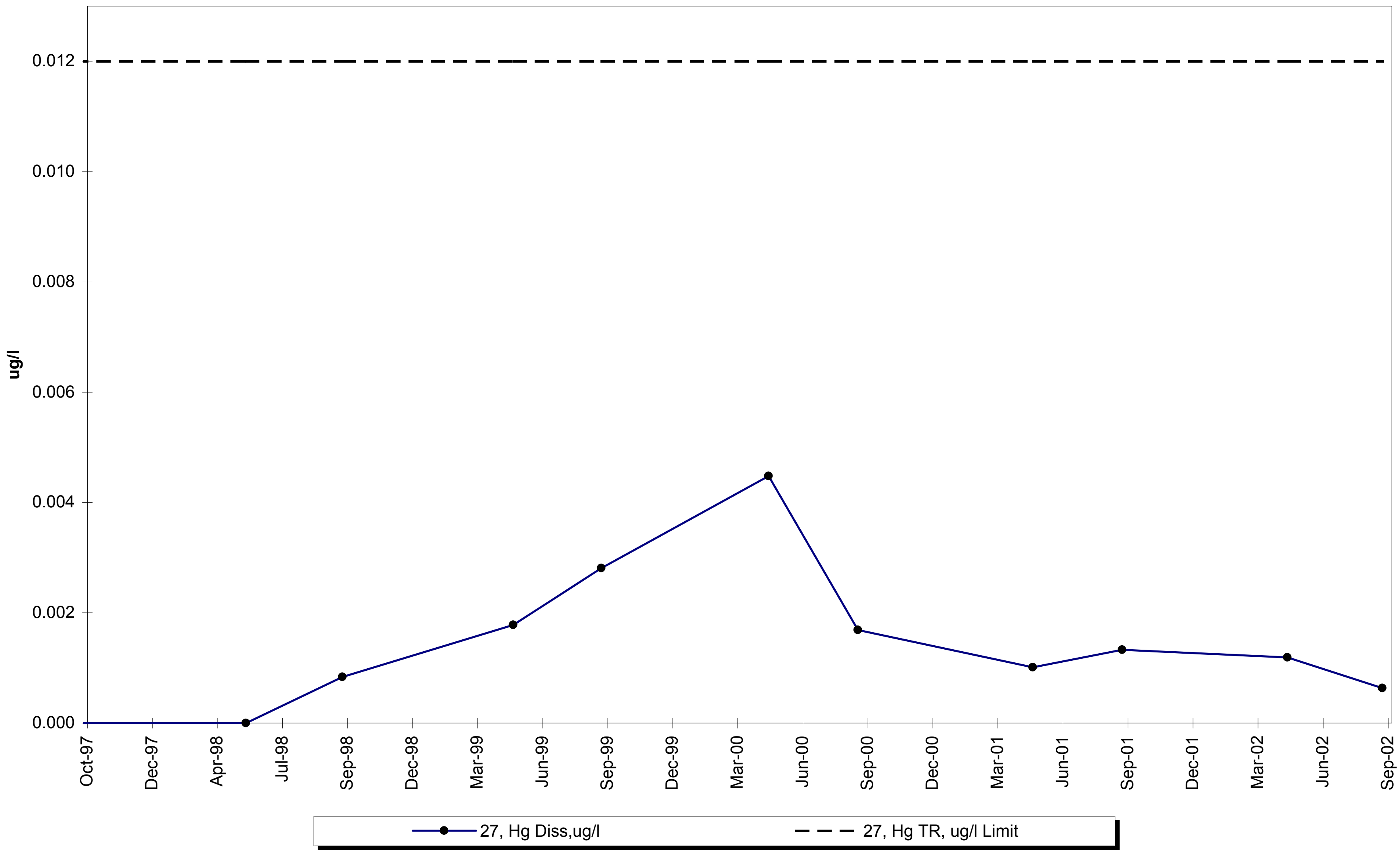


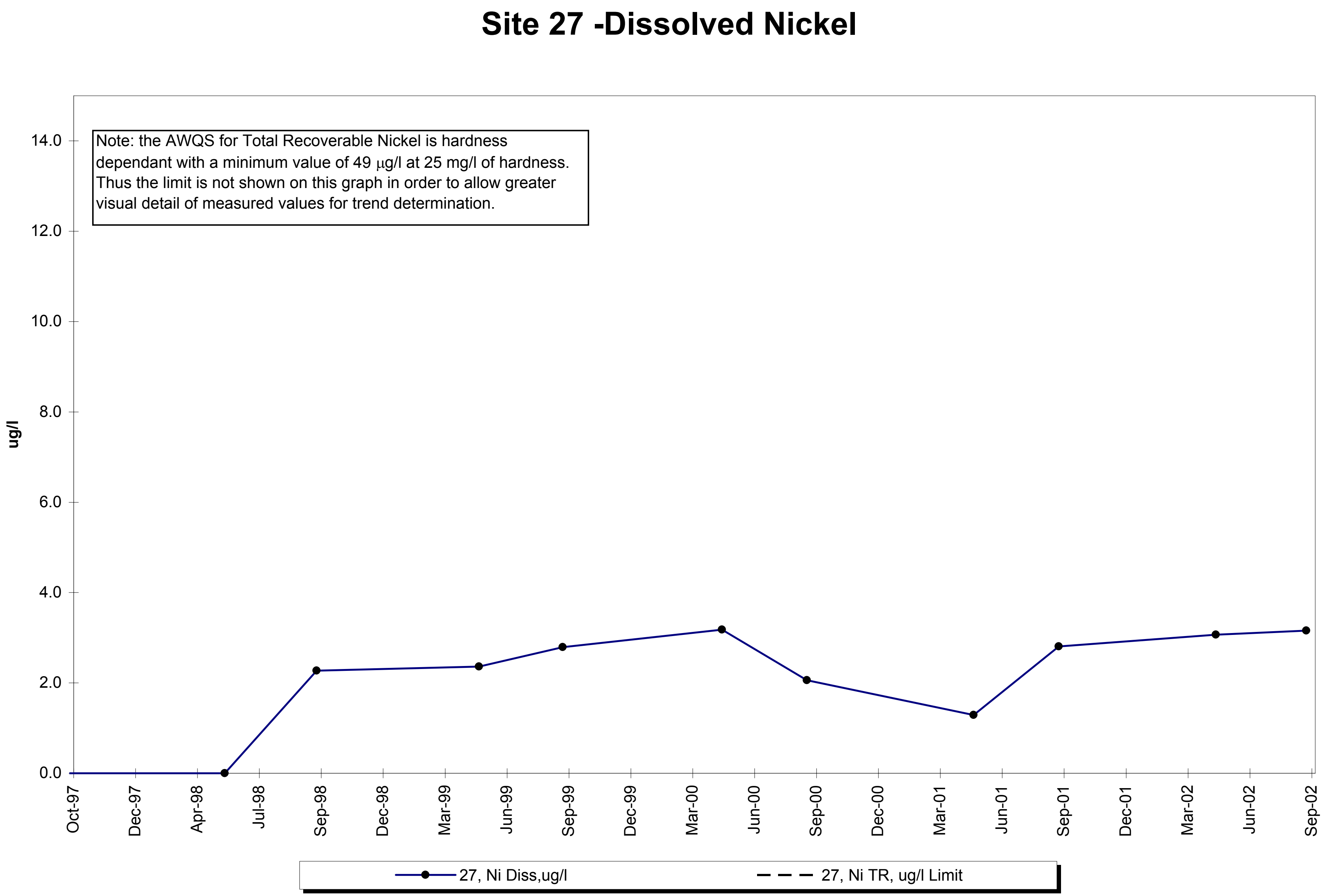
Site 27 -Dissolved Copper
ug/l
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
27, Cu Diss,ug/l
27, Cu TR, ug/l Limit



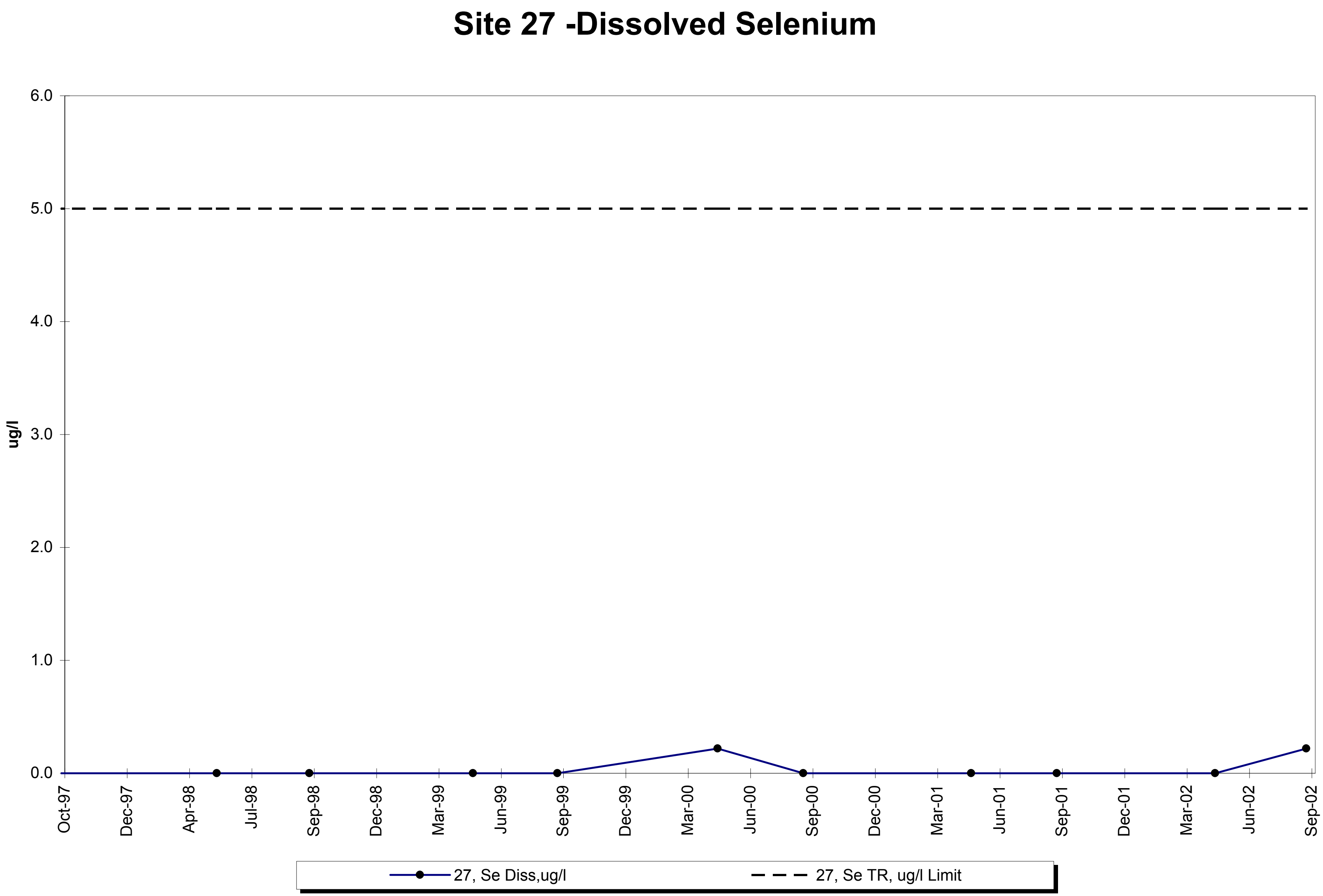
Site 27 -Dissolved Lead
ug/l
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
27, Pb Diss,ug/l
27, Pb TR, ug/l Limit

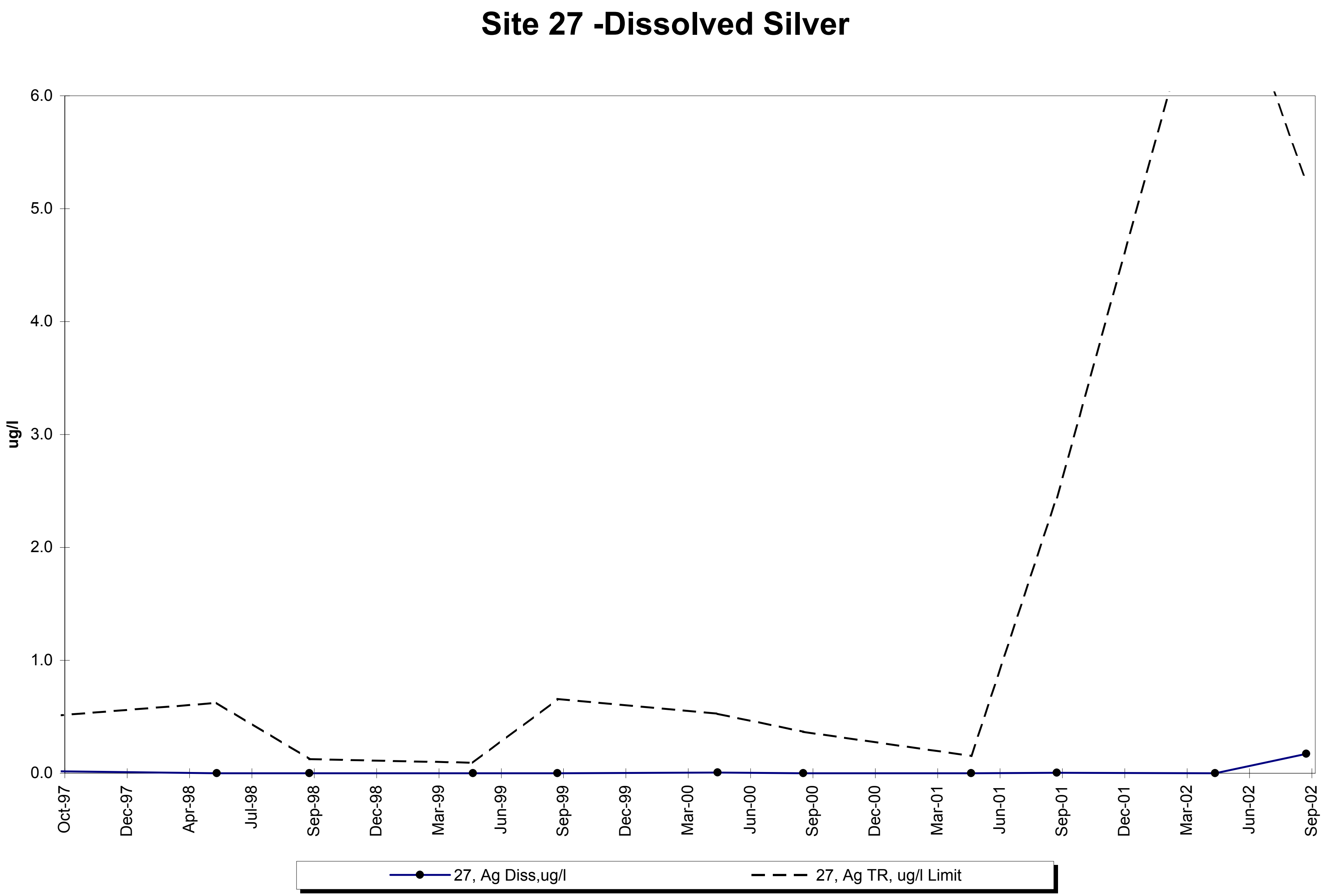
Site 27 -Dissolved Mercury





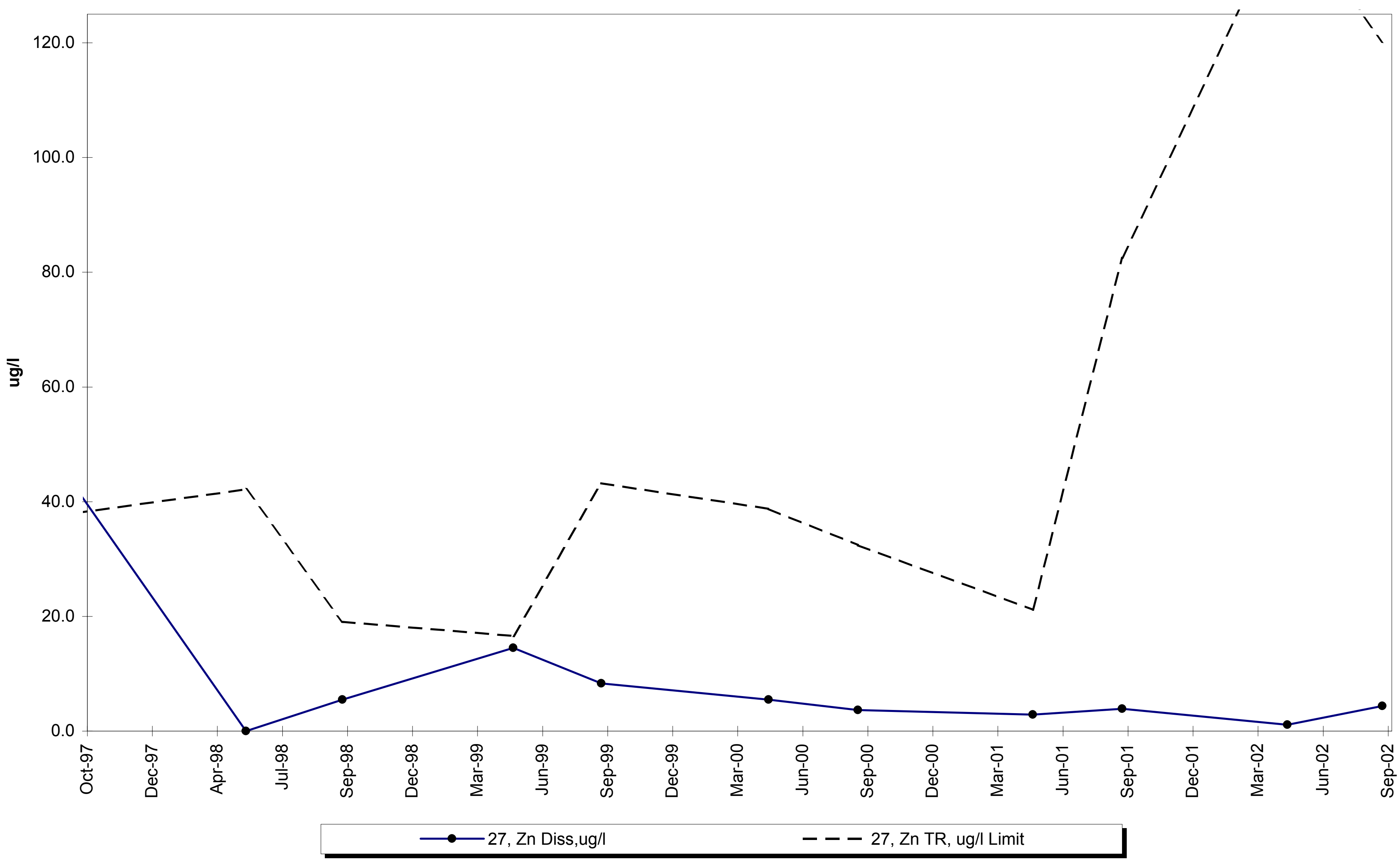
Site 27 -Dissolved Nickel
Note: the AWQS for Total Recoverable Nickel is hardness dependant with a minimum value of 49 μg/l at 25 mg/l of hardness. Thus the limit is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
27, Ni Diss,ug/l
27, Ni TR, ug/l Limit


Site 27 -Dissolved Selenium
ug/l
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
27, Se Diss,ug/l
27, Se TR, ug/l Limit

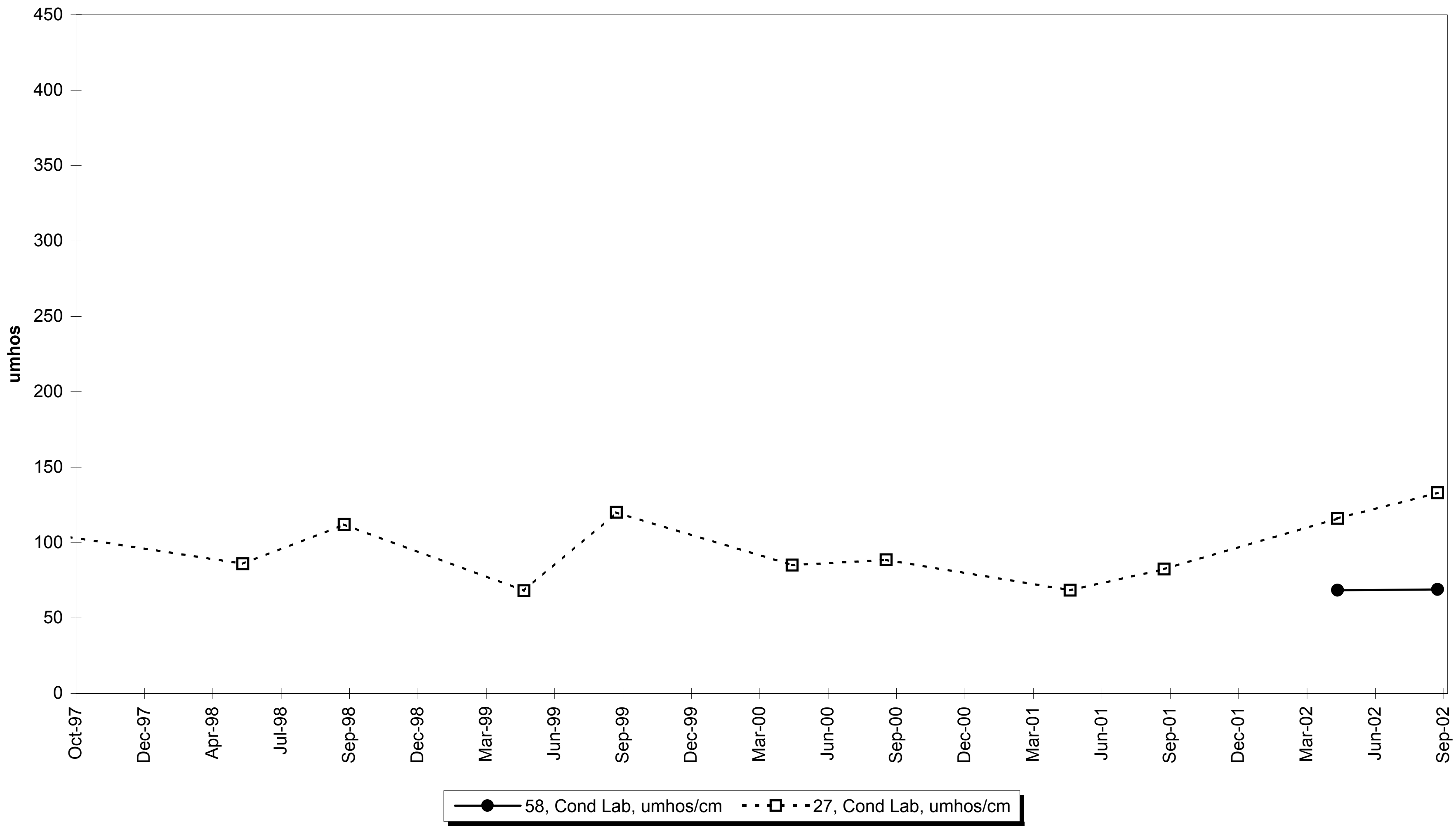


Site 27 -Dissolved Silver
ug/l
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
27, Ag Diss,ug/l
27, Ag TR, ug/l Limit

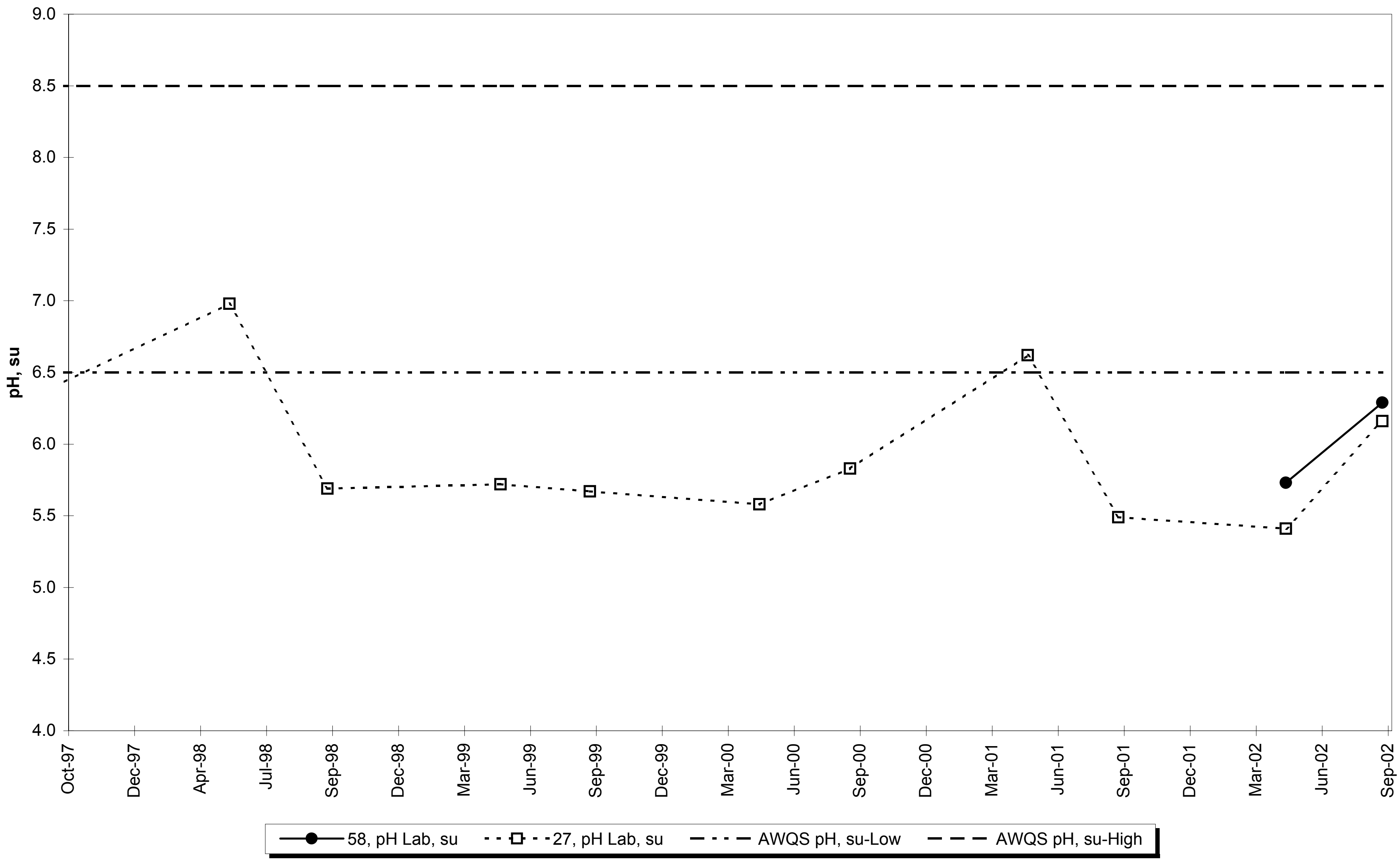
Site 27 -Dissolved Zinc

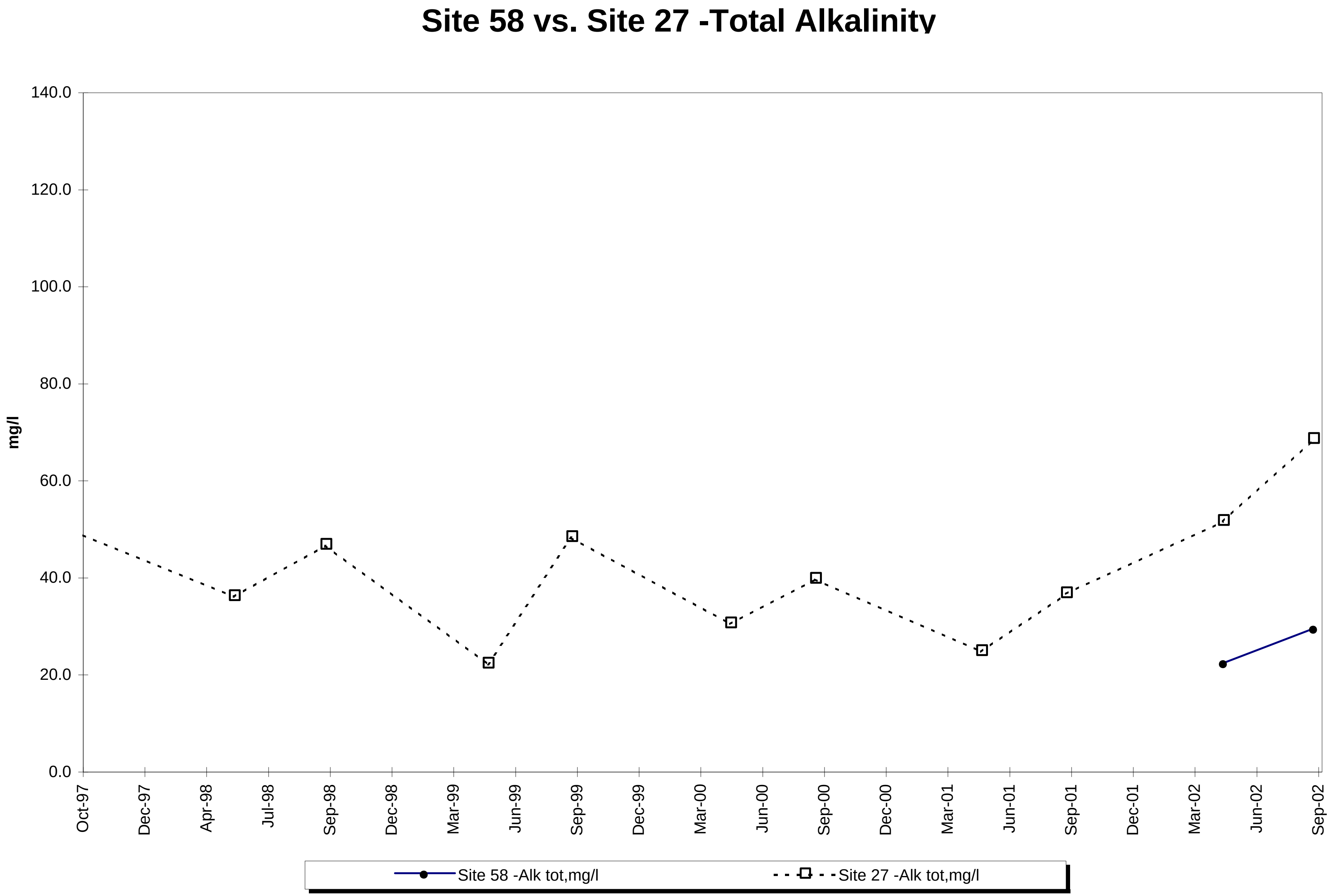


Site 58 vs Site 27 -Conductivity-Lab

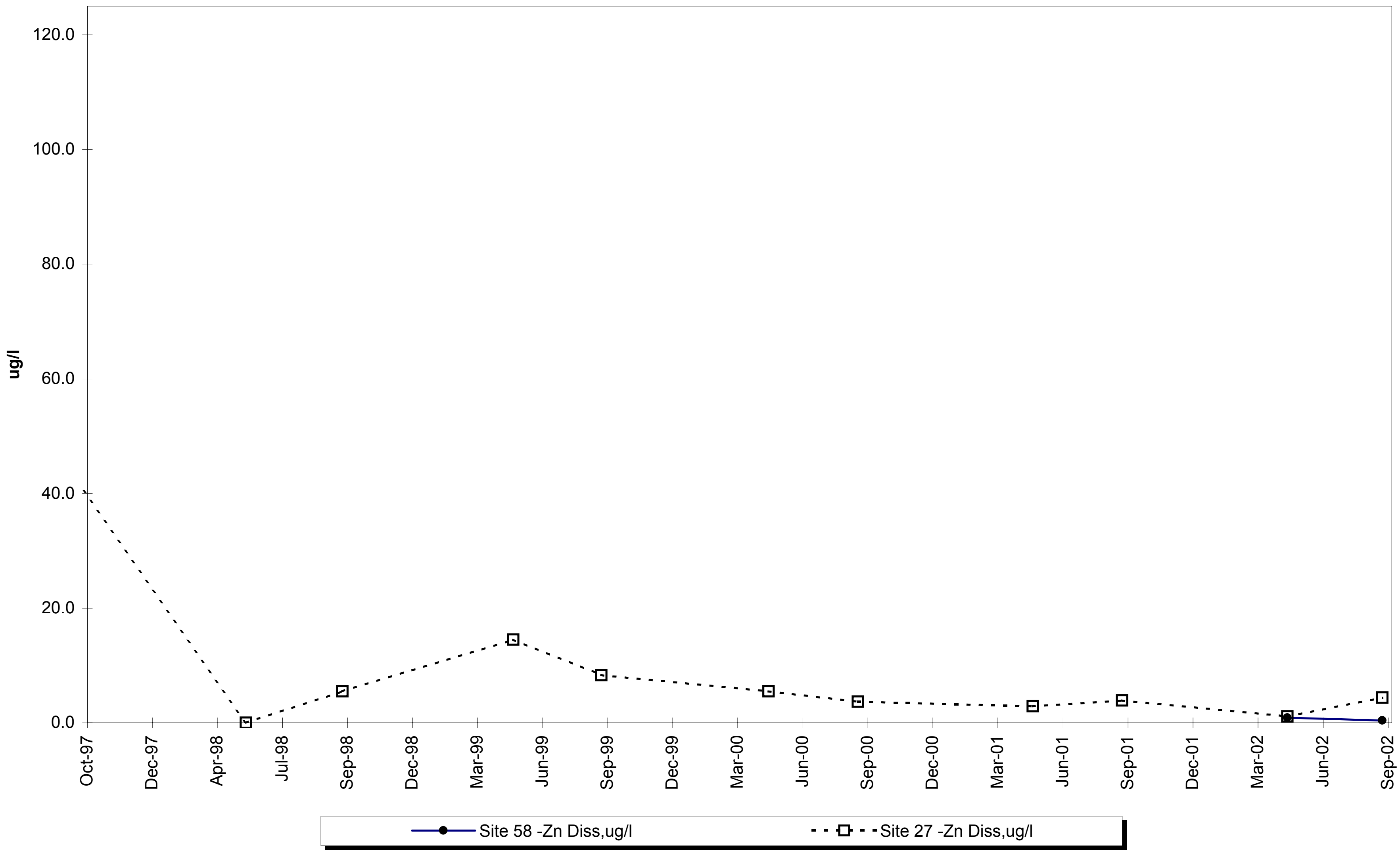


Site 58 vs. Site 27 -Lab pH




Site 58 vs. Site 27 -Total Alkalinity
mg/l
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Site 58 -Alk tot,mg/l
Site 27 -Alk tot,mg/l

Site 58 vs. Site 27 -Dissolved Zinc



INTERPRETIVE REPORT
SITE 29 “MONITORING WELL 3S”

All data collected at this site for the past five years are included in the data analyses. As shown in the table below, there were no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-97 though Sept-02.				

The data collected during the current water year are listed in the following “Table of Results for Water Year 2002” report. The table includes all the data, field and lab, collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of zero for the purpose of median calculation.

The data for water year 2002 have been compared to the strictest fresh water quality criterion for each applicable analyte. Three (3) results exceeding these criteria have been identified, as listed on the following “Comparison To Standards” report. The two of these data are for lab pH values below the lower limit of 6.5 listed in AWQS. Lab pH for Site 29 has historically resulted in values ranging from a pH of 4.9 to 6.5 which are characteristic for wells completed in organic rich peat sediments. The third exceedance is for a dissolved lead sample from May-2002 with a value of 0.722 µg/l that exceeds the hardness dependent AWQS standard of 0.719 µg/l. Lead concentrations for Site 29 have historically been at or near the hardness dependent AWQS due to the low hardness of the samples.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious trends were apparent.

Additional X-Y plots have been generated for alkalinity, pH, conductance, and dissolved zinc that plot Site 29 and Site 58, the up-gradient control site, to aid in the comparison between those two sites. Total alkalinity, lab conductivity and dissolved zinc are all higher at Site 29 than at Site 58. Lab pH is slightly lower at Site 29 than Site 58. These differences are similar to what was noted previously for Site 27 with respect to Site 58. The hydrogeologic conditions that exist at Site 29 are similar to Site 27 with the exception that Site 29 is in the headwater region of Further Creek, which drains westward into Hawk Inlet, and is not typically in an active surface discharge zone. Nevertheless, the same reasons for the differences that occur between Site 58 and Site 27 should apply to Site 29 with respect to Site 58.

Table of Results for Water Year 2002

Site 29 "MW-3S"

Sample Date/Parameter	10/25/2001	11/15/2001	12/5/2001	1/29/2002	2/21/2002	3/19/2002	4/1/2002	5/7/2002	6/11/2002	7/15/2002	8/27/2002	9/17/2002	**Median**
Water Temp (°C)								8.3				8.8	8.6
Conductivity-Field (μmho)								99				174	136
Conductivity-Lab (μmho)								90				128	109
pH Lab (standard units)								4.88				5.75	5.32
pH Field (standard units)								5.12				5.77	5.45
Total Alkalinity (mg/l)								35.5				60.5	48.0
Hardness (mg/l)								30.6				49.9	40.3
Dissolved As (μg/l)								10.300				13.100	11.700
Dissolved Ba (μg/l)				NOT SCHEDULED FOR SAMPLING				16.0		NOT SCHEDULED FOR SAMPLING		18.2 J	17.1
Dissolved Cd (μg/l)								<0.007 UJ				<0.004	0.003
Dissolved Cr (μg/l)								2.190				1.400	1.795
Dissolved Cu (μg/l)								0.236				0.147 J	0.192
Dissolved Pb (μg/l)								0.7220				0.1730	0.4475
Dissolved Ni (μg/l)								1.70				1.41 J	1.56
Dissolved Ag (μg/l)								<0.0080 UJ				0.1620	0.0830
Dissolved Zn (μg/l)								3.68				2.91 J	3.30
Dissolved Se (μg/l)								<0.475				0.228 J	0.233
Dissolved Hg (μg/l)								0.000736 J				0.000569 U	0.000653

See "Qualififed Data by QA Reviewer" table for qualifier descriptions.

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
29	05/07/2002	12:10:00 PM				
			Cd Diss, ug/l	-0.007	UJ	CCV Rec.
			Ag Diss, ug/l	-0.008	UJ	CCV Rec.
			Hg Diss, ug/l	0.000736	J	CCV Rec, LCS Rec, LCS RP
29	09/17/2002	2:42:00 PM				
			Ba Diss, ug/l	18.2	J	CCV Rec, LCS Rec.
			Cu Diss, ug/l	0.147	J	Below Quantitative Range
			Ni Diss, ug/l	1.41	J	CCV Rec.
			Zn Diss, ug/l	2.91	J	LCS Rec.
			Se Diss, ug/l	0.228	J	Below Quantitative Range
			Hg Diss, ug/l	0.000569	U	Field Blank Contamination

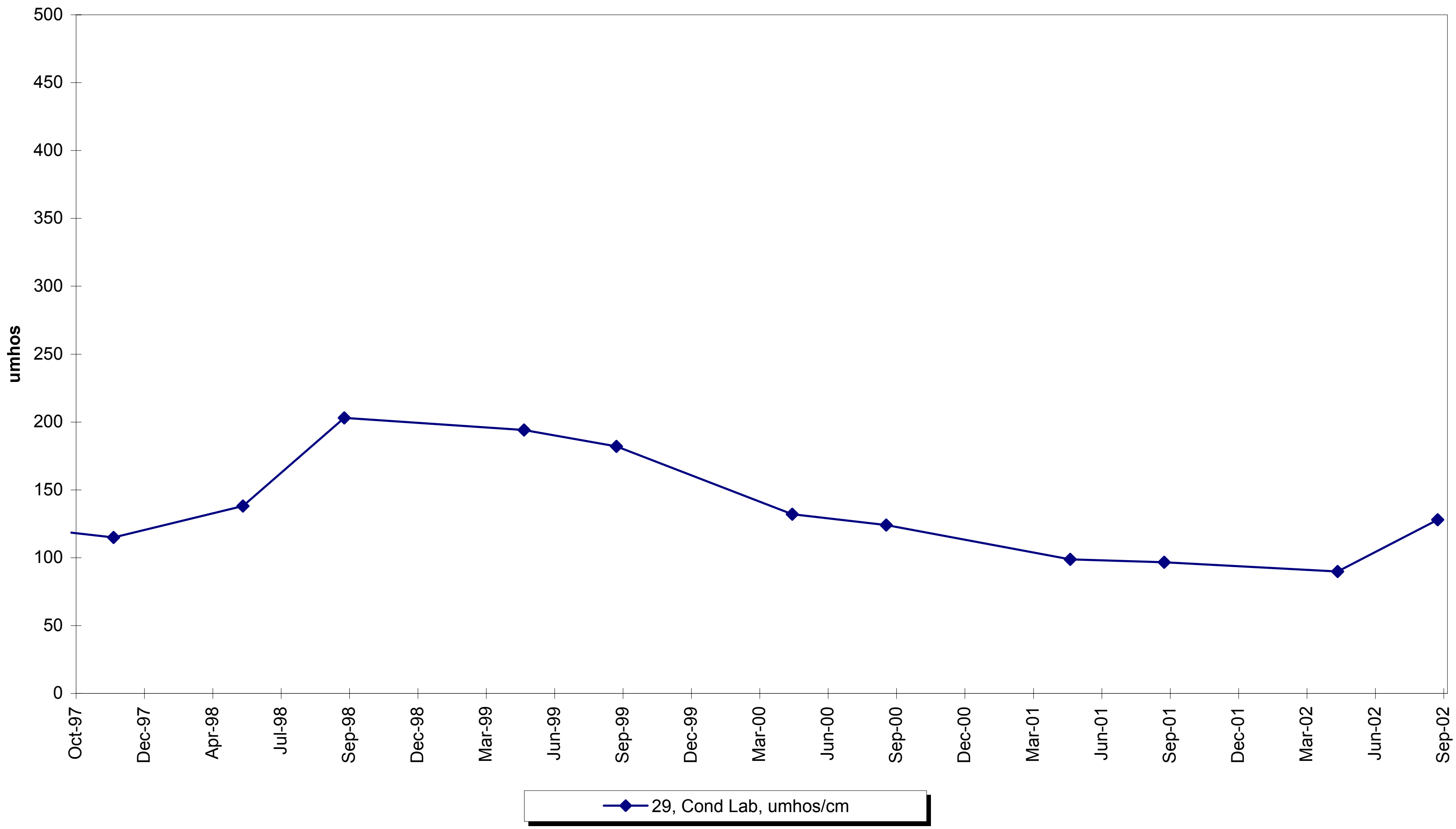
Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Comparison To Standards

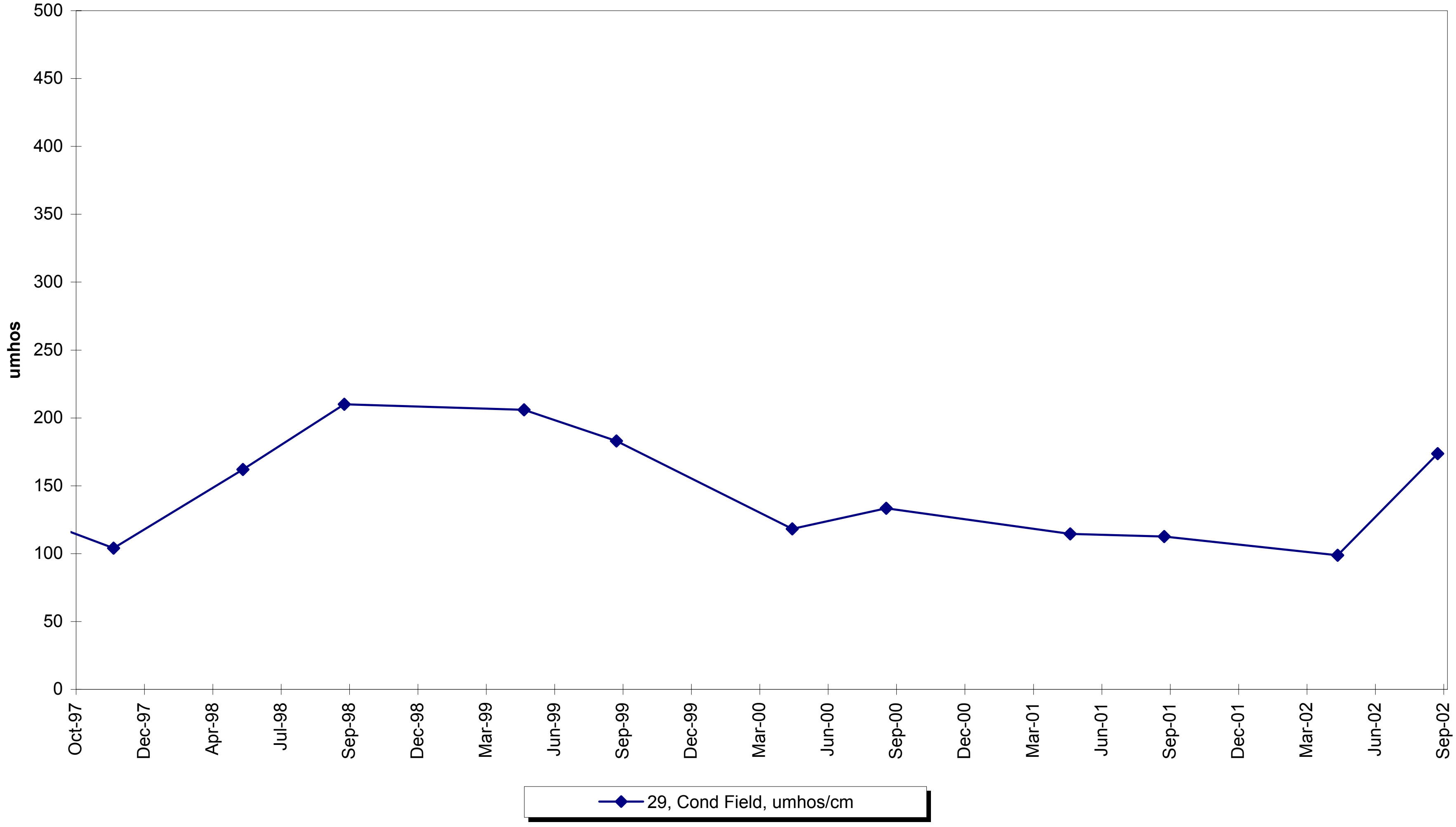
Date Range: 10/01/2001 to 09/30/2002

Site Number	Date	Time	Dup ID	Storet No.	Parameter Description	Value	Standard	Standard Type
29	05/07/2002	12:10 PM	0	1049	Pb Diss, ug/l	0.722	0.71891	Aquatic
29	05/07/2002	12:10 PM	0	403	pH Lab, su	4.88	6.5- 8.5	Aquatic
29	09/17/2002	2:42 PM	0	403	pH Lab, su	5.75	6.5- 8.5	Aquatic

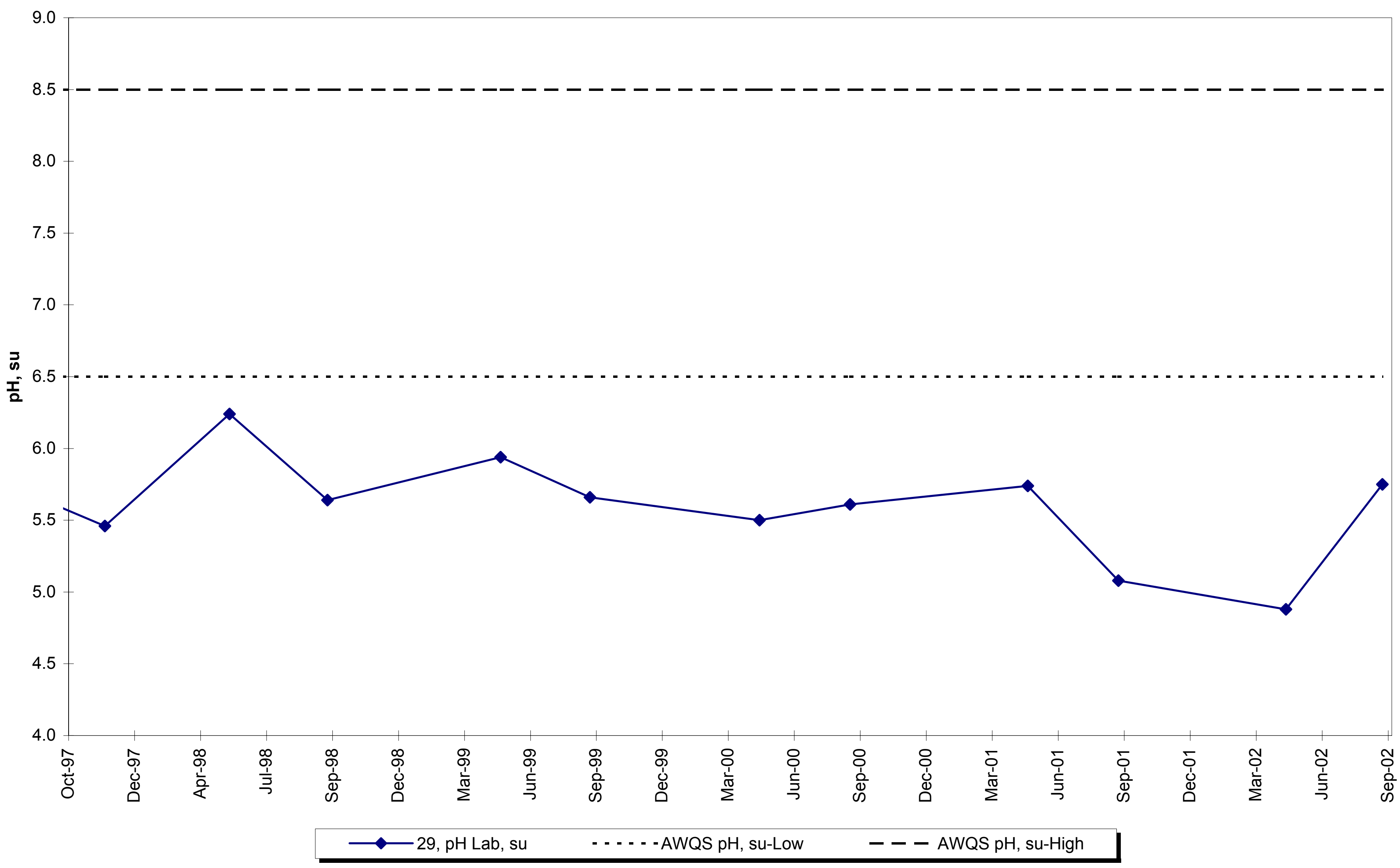
Site 29 -Conductivity-Lab

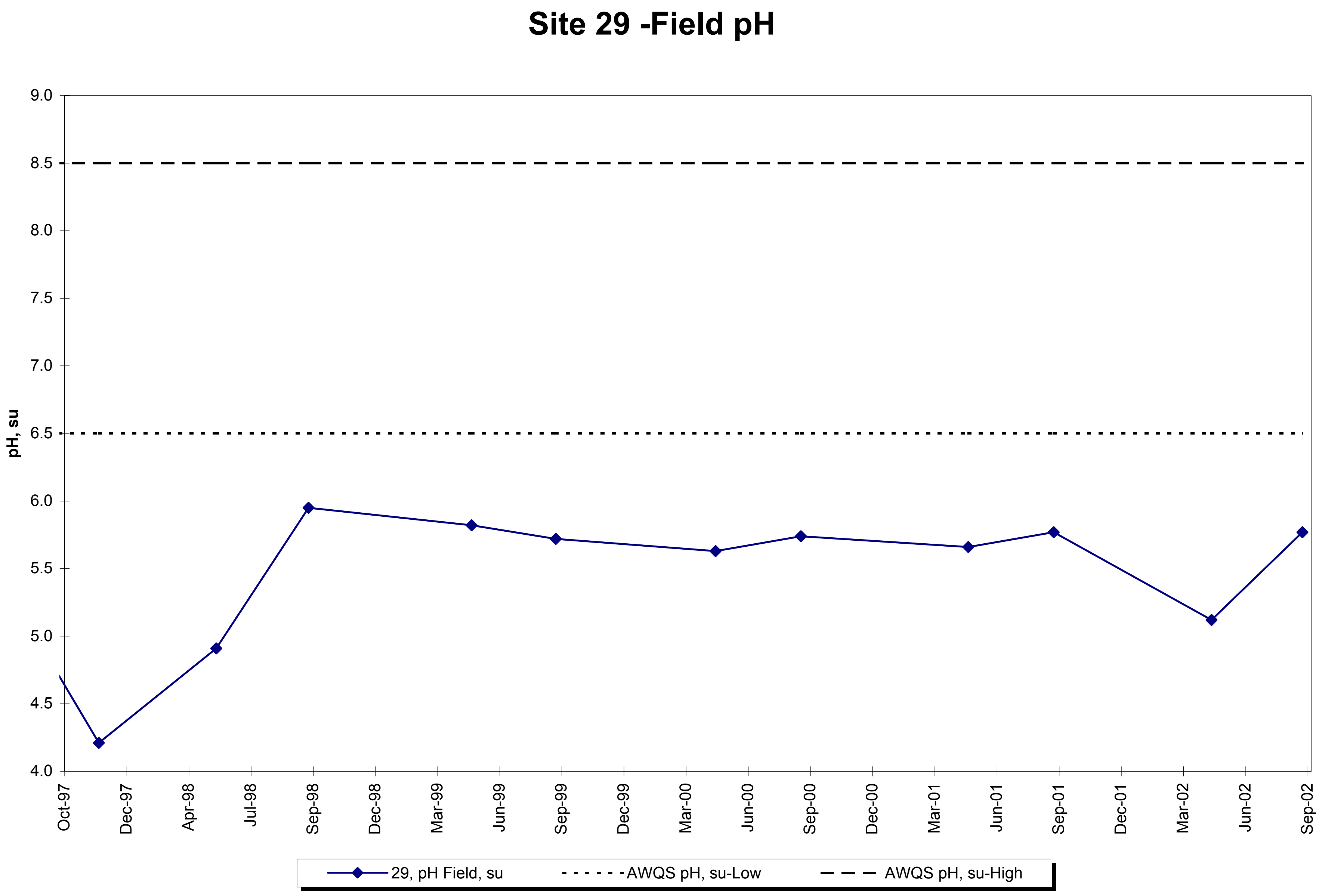


Site 29 -Conductivity-Field

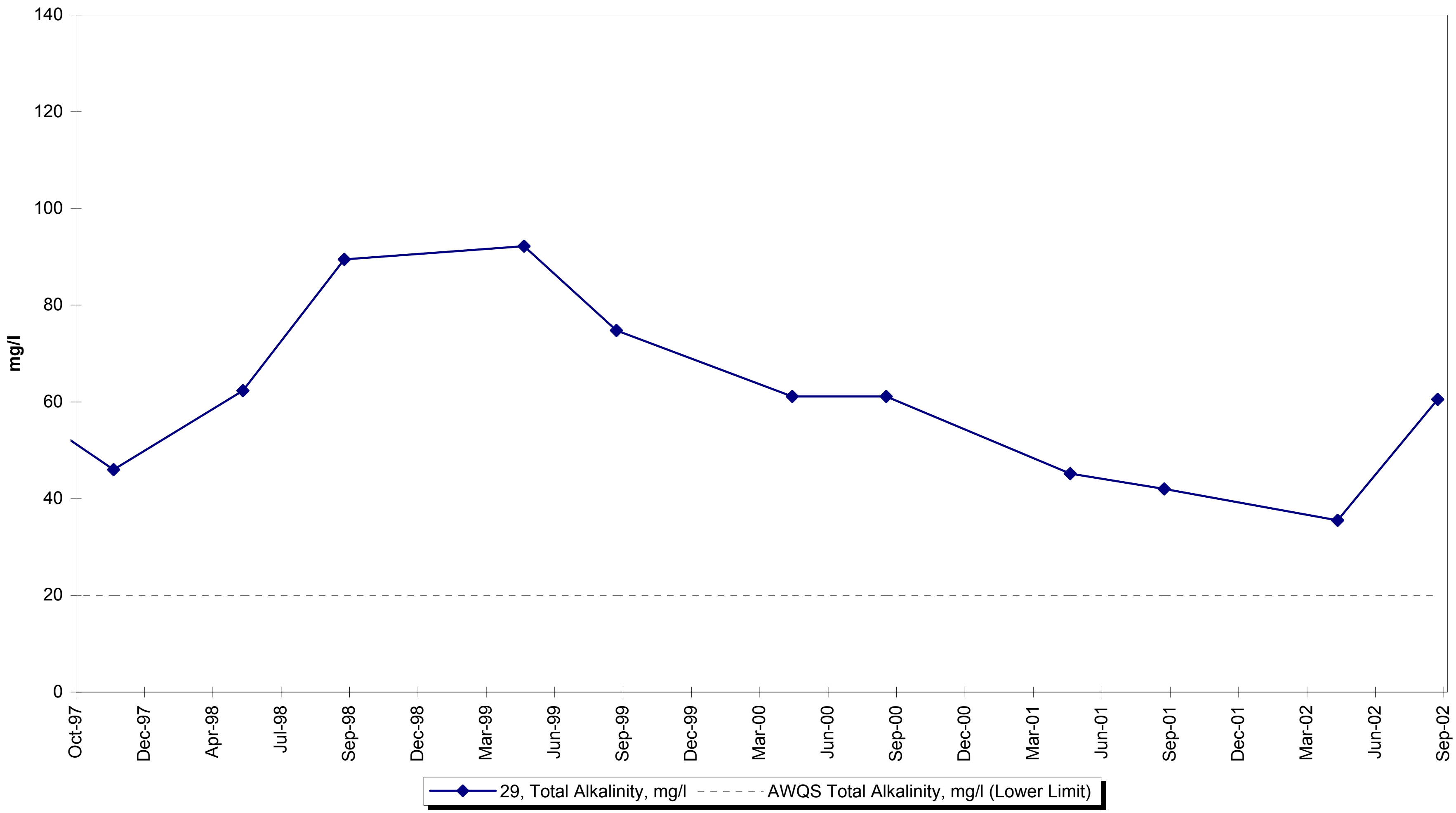


Site 29 -Lab pH

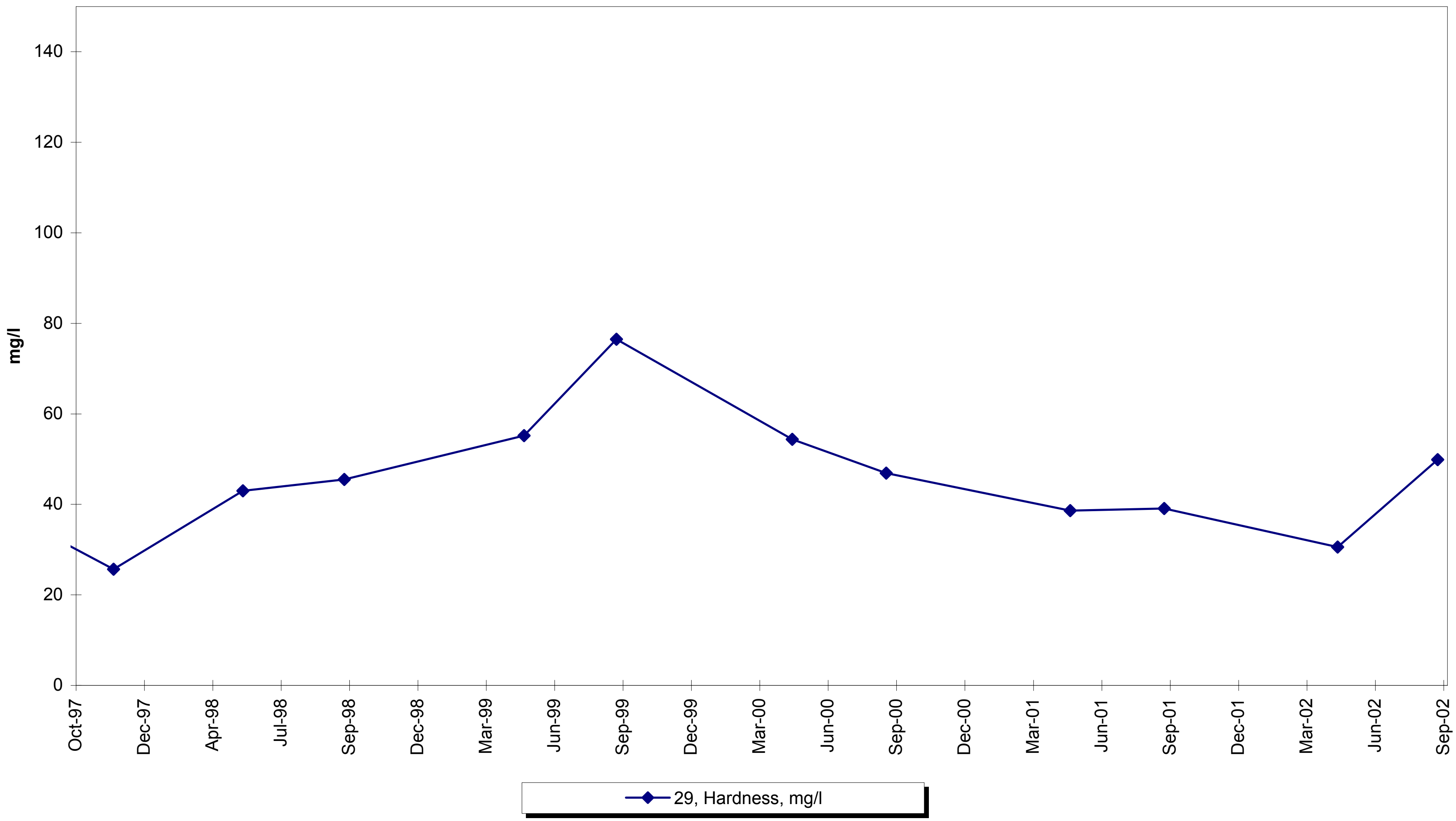


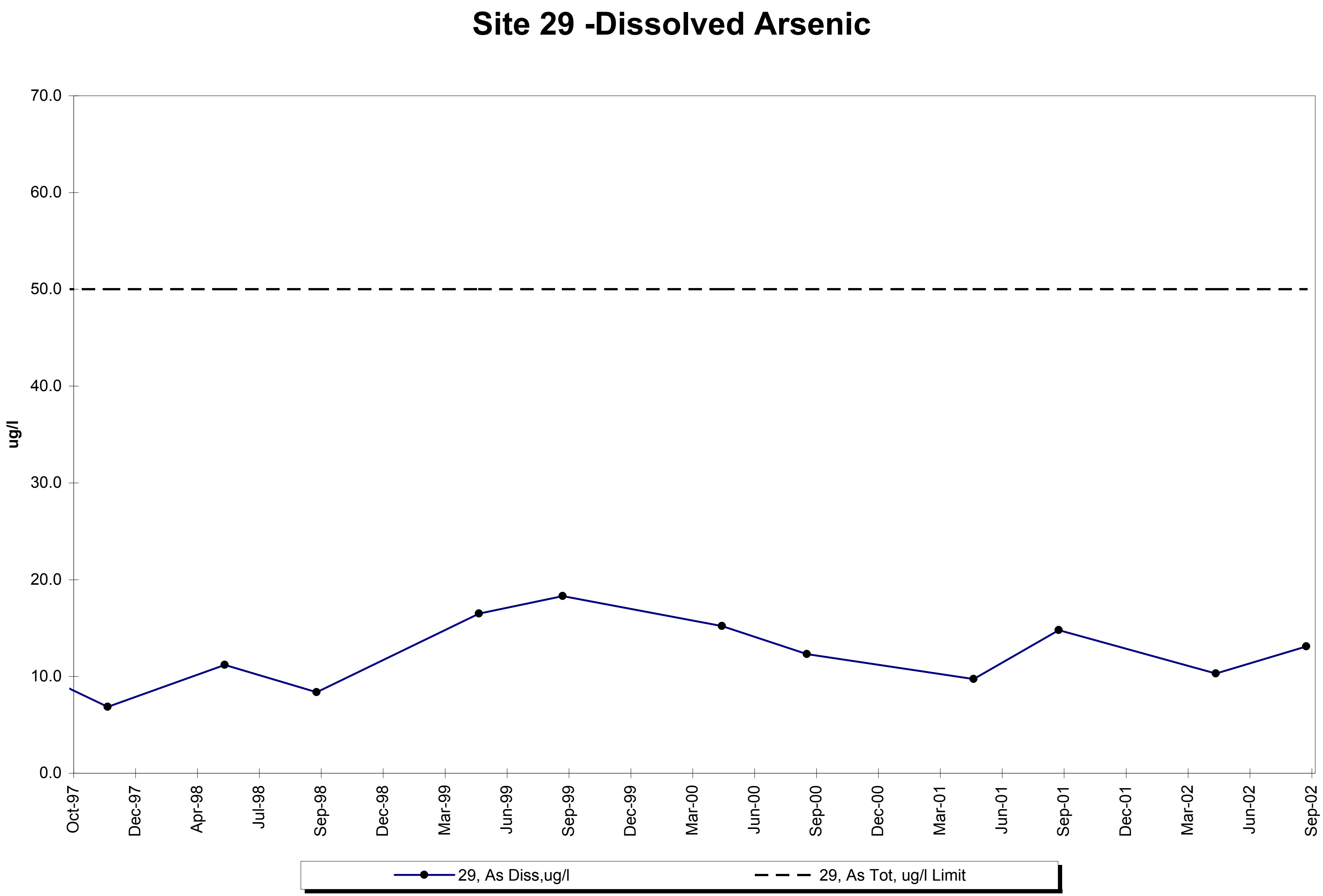

Site 29 -Field pH
pH, su
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
29, pH Field, su
AWQS pH, su-Low
AWQS pH, su-High

Site 29 -Total Alkalinity

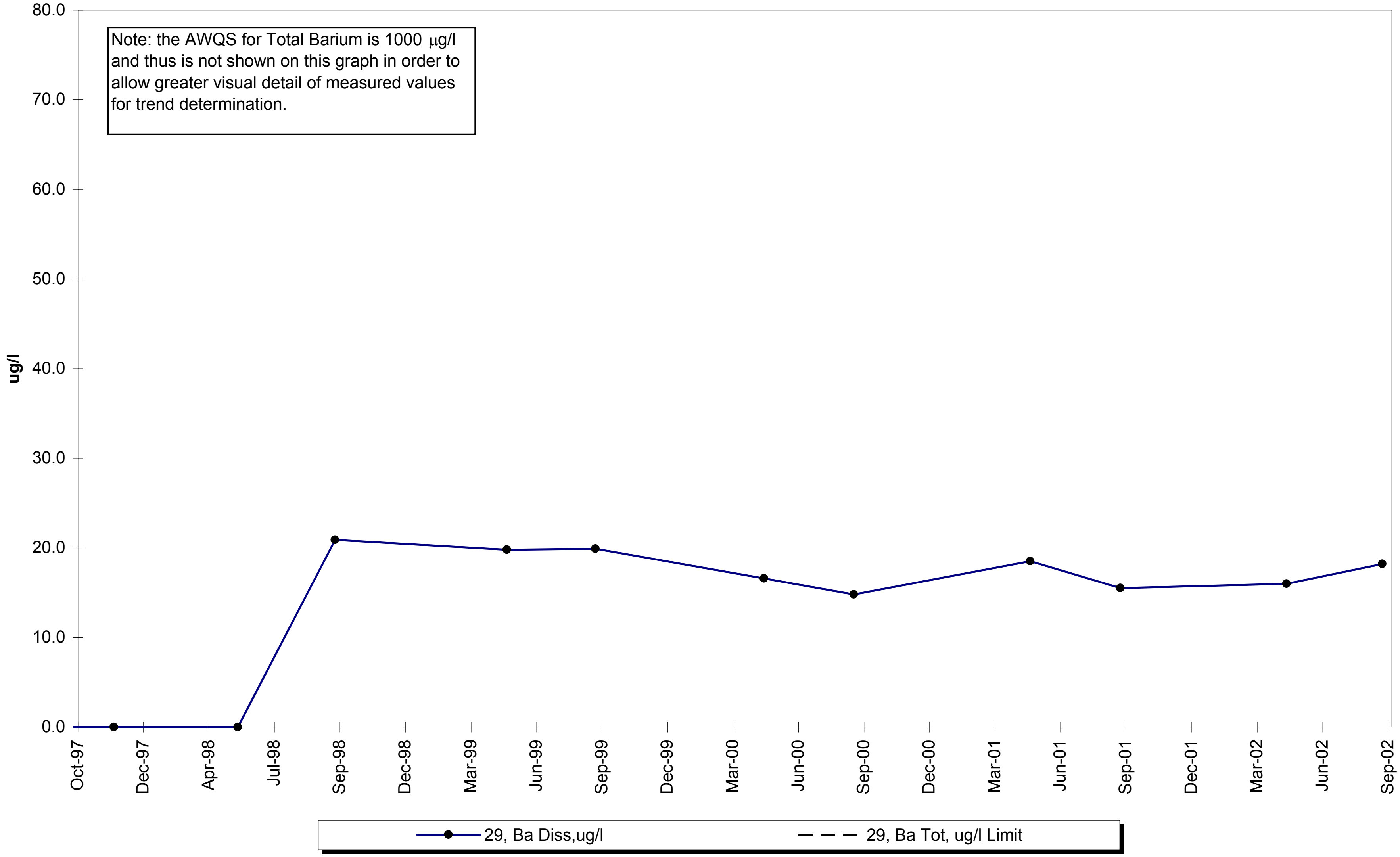


Site 29 -Hardness

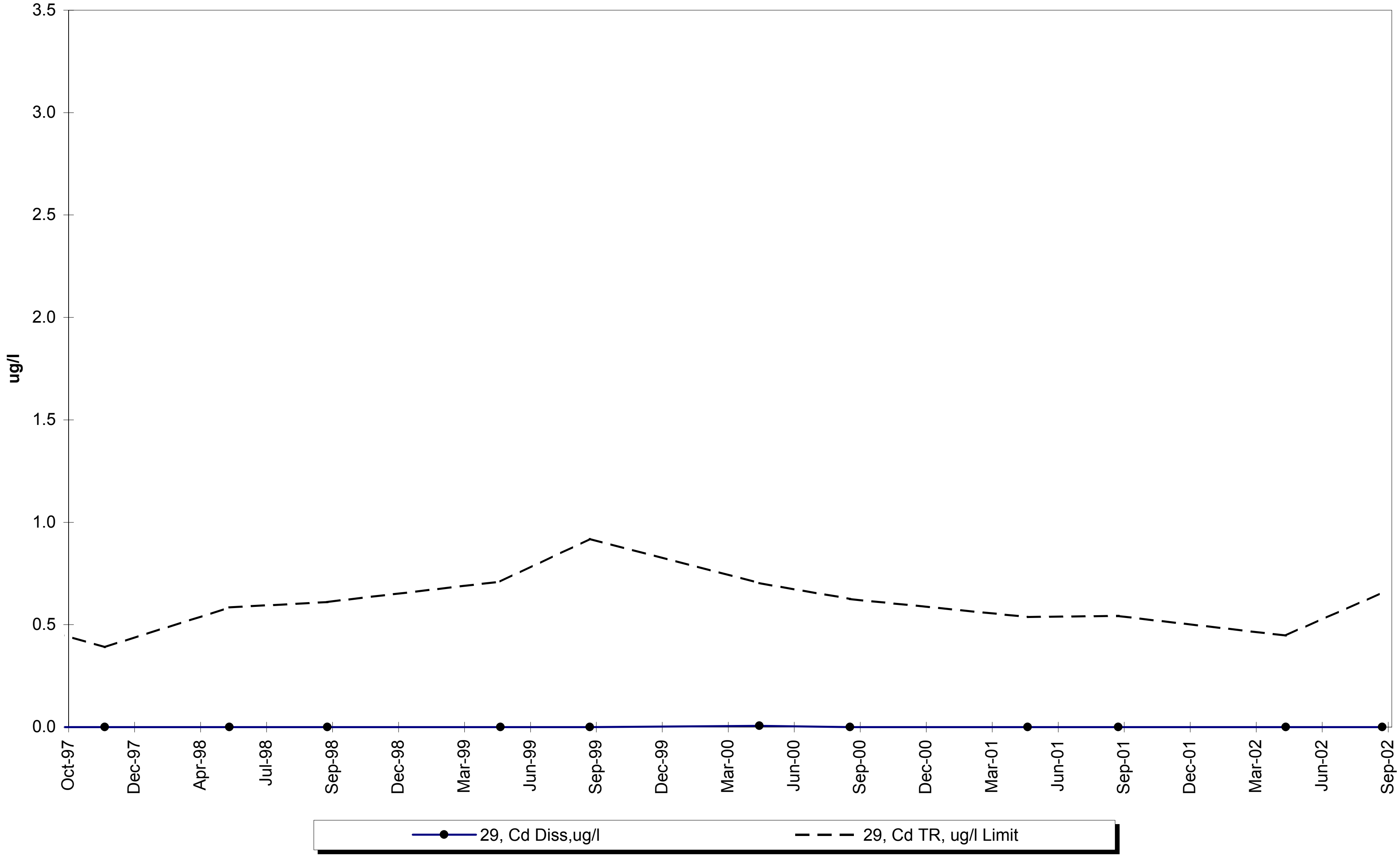


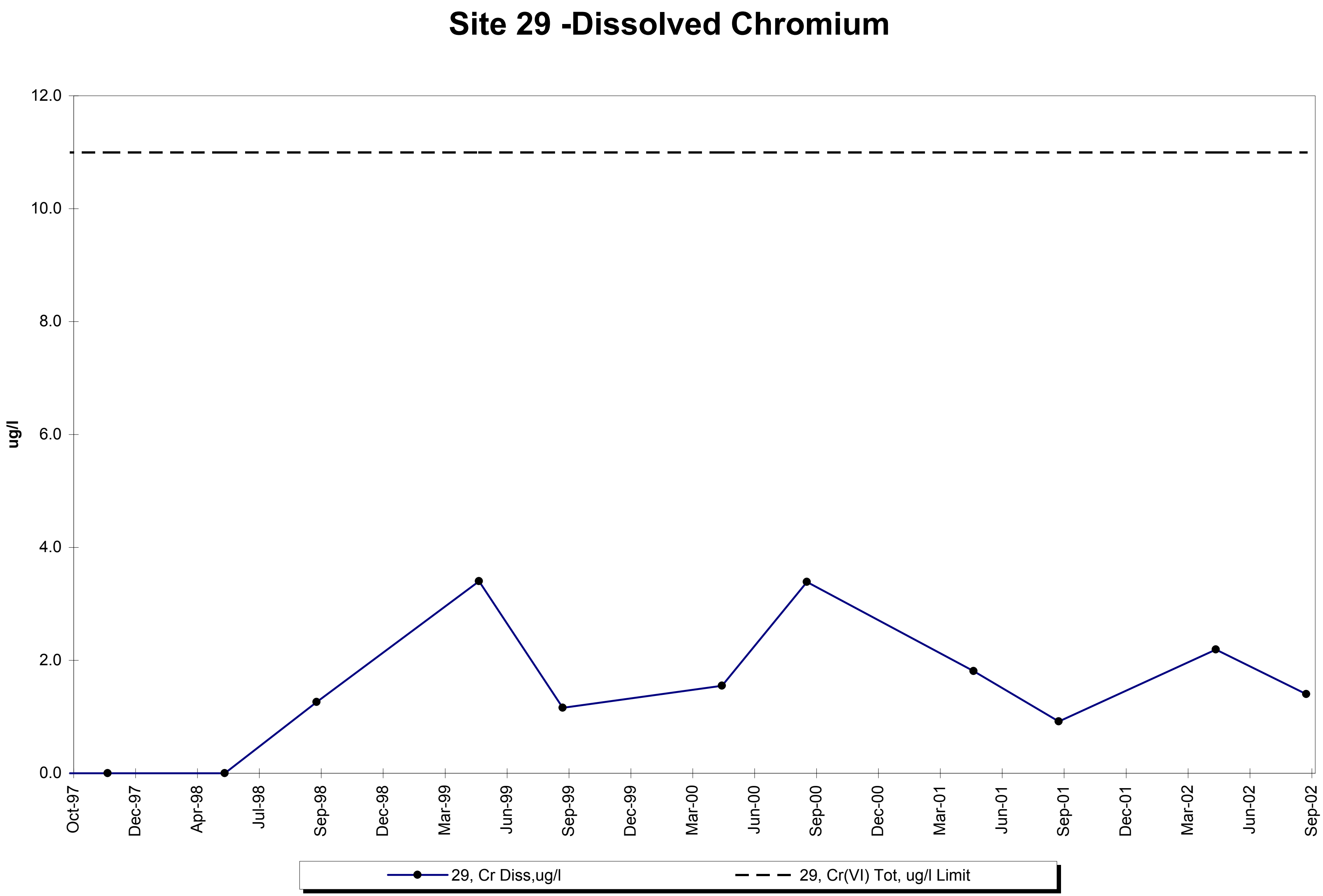

Site 29 -Dissolved Arsenic
ug/l
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
29, As Diss,ug/l
29, As Tot, ug/l Limit

Site 29 -Dissolved Barium

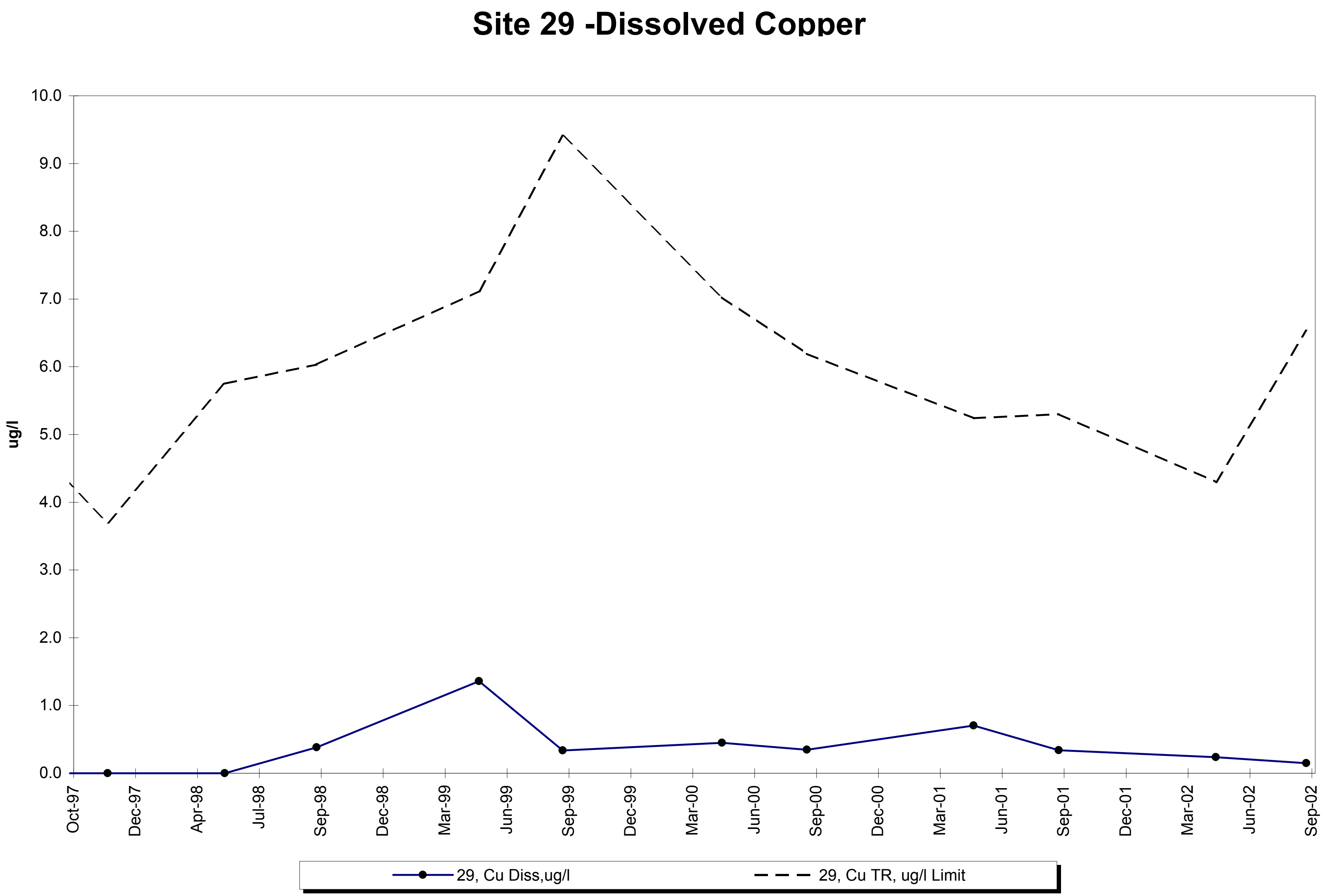


Site 29 -Dissolved Cadmium

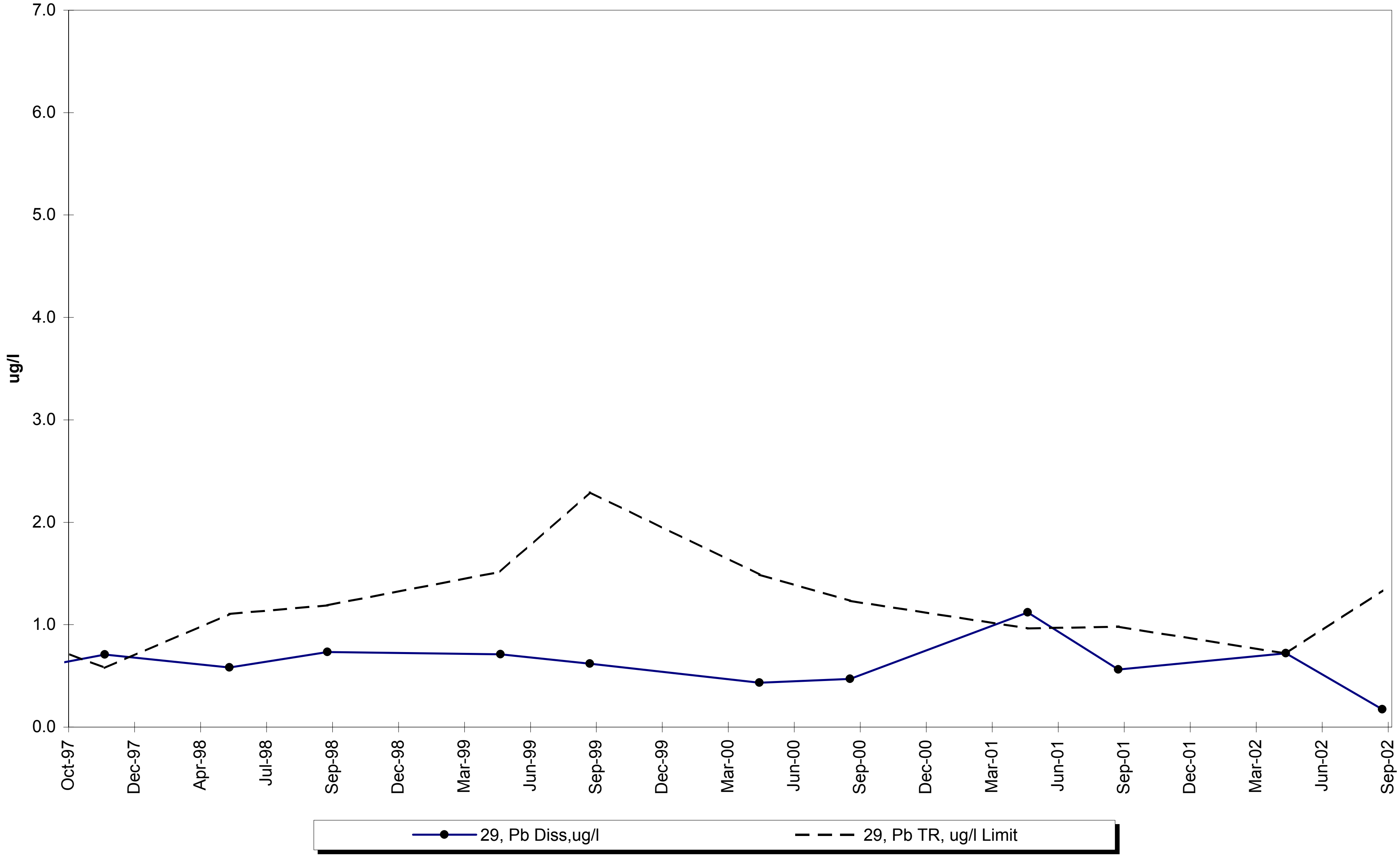




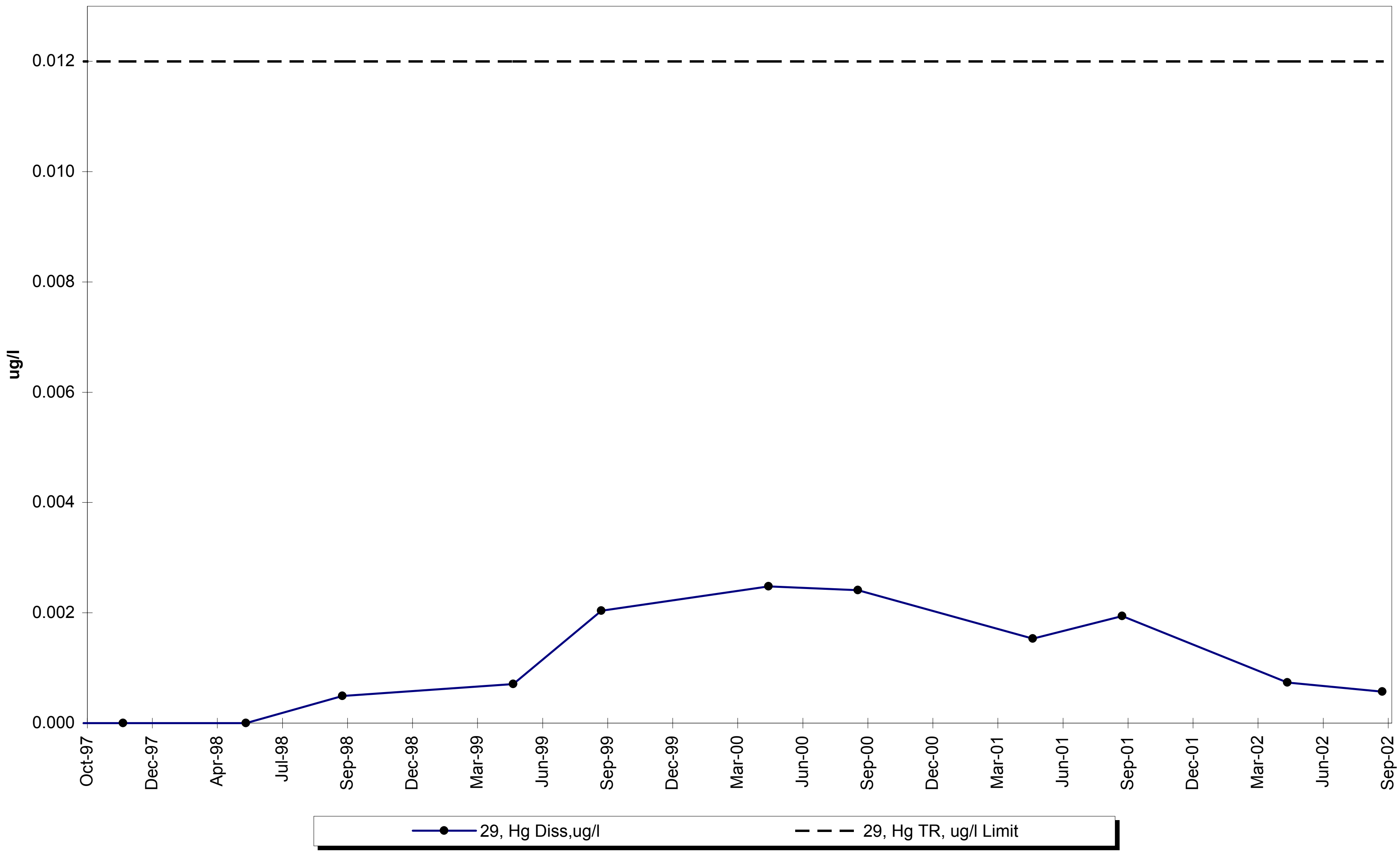
Site 29 -Dissolved Chromium
ug/l
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
29, Cr Diss,ug/l
29, Cr(VI) Tot, ug/l Limit


Site 29 -Dissolved Copper
ug/l
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
29, Cu Diss,ug/l
29, Cu TR, ug/l Limit

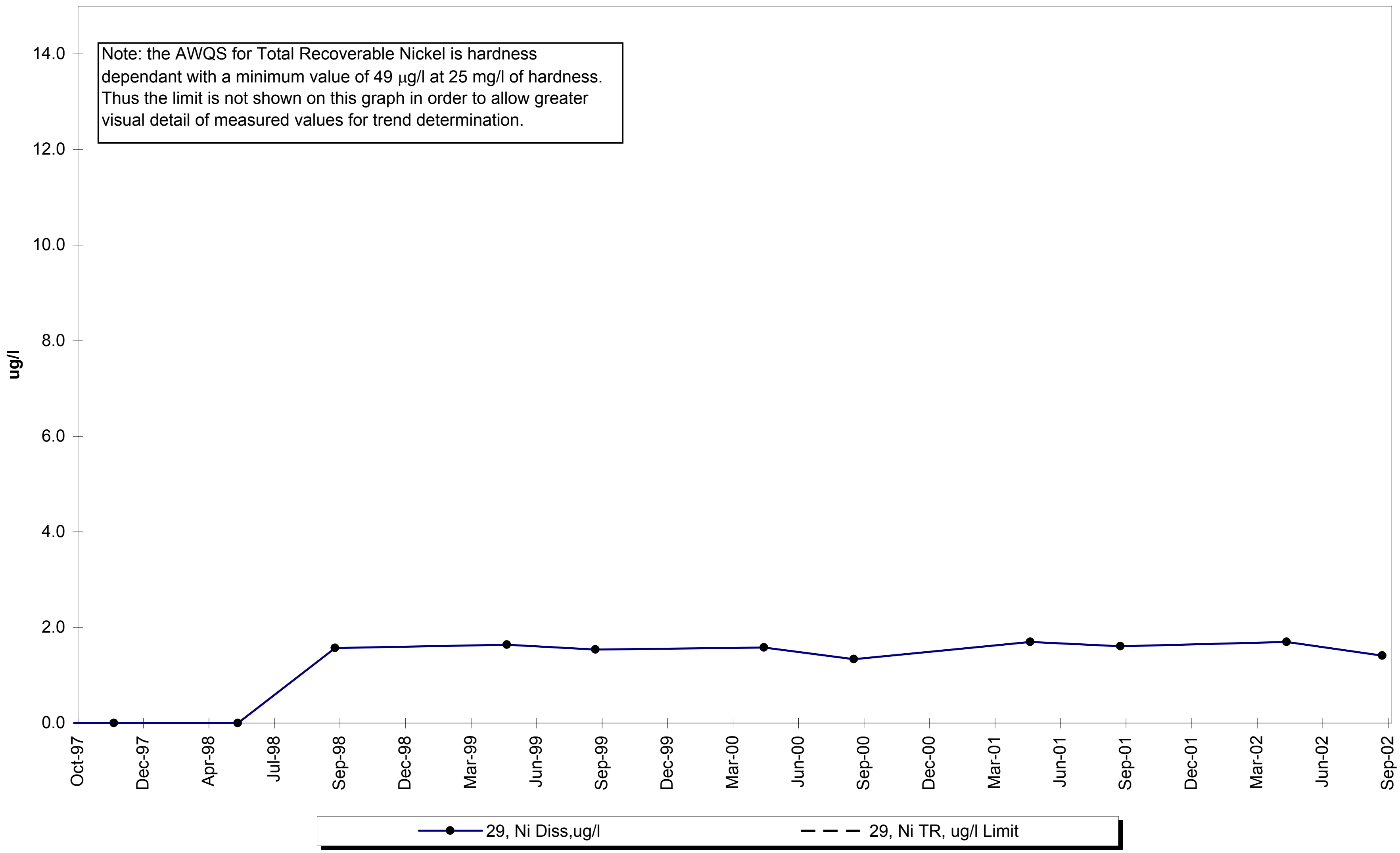
Site 29 -Dissolved Lead



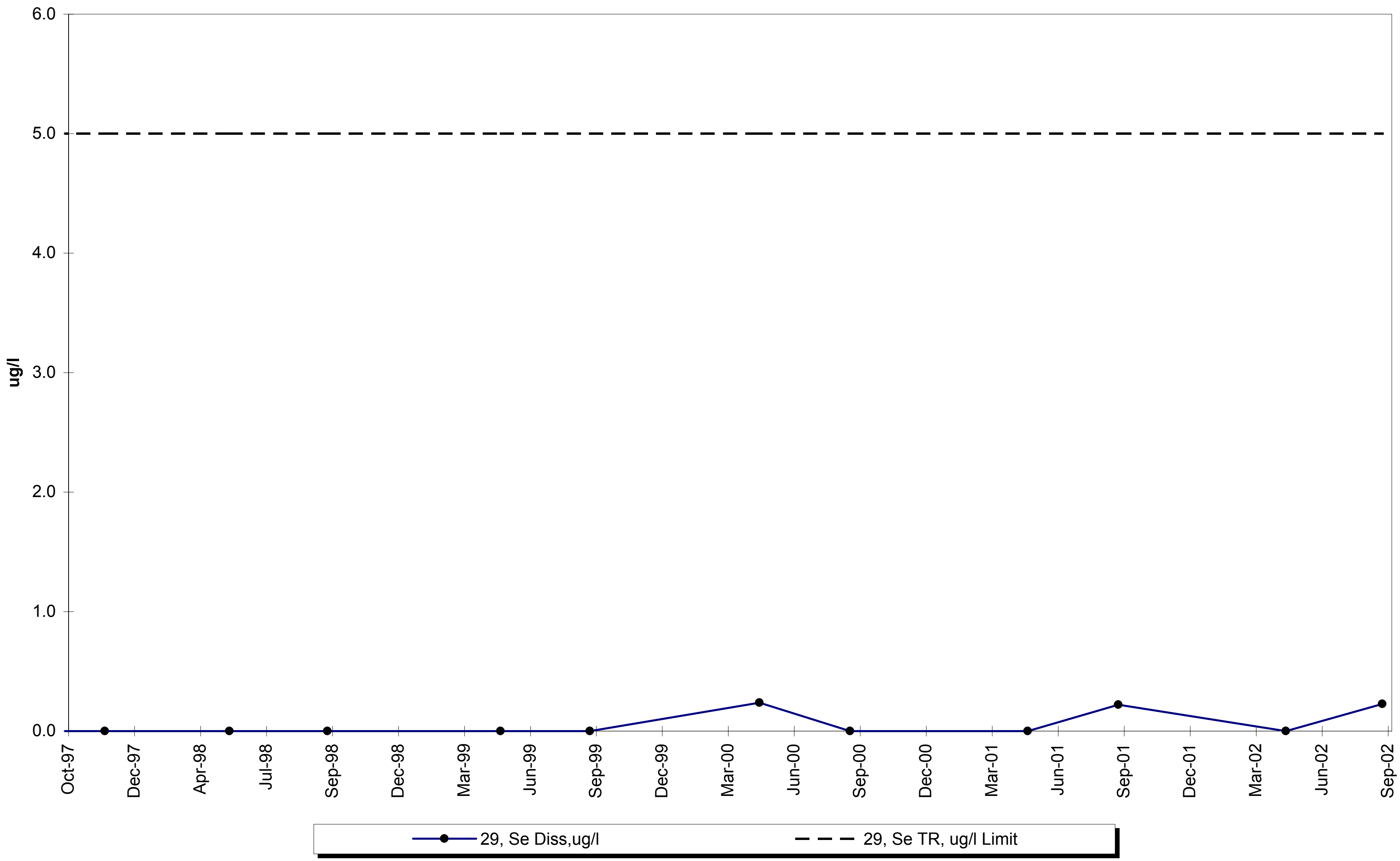
Site 29 -Dissolved Mercury

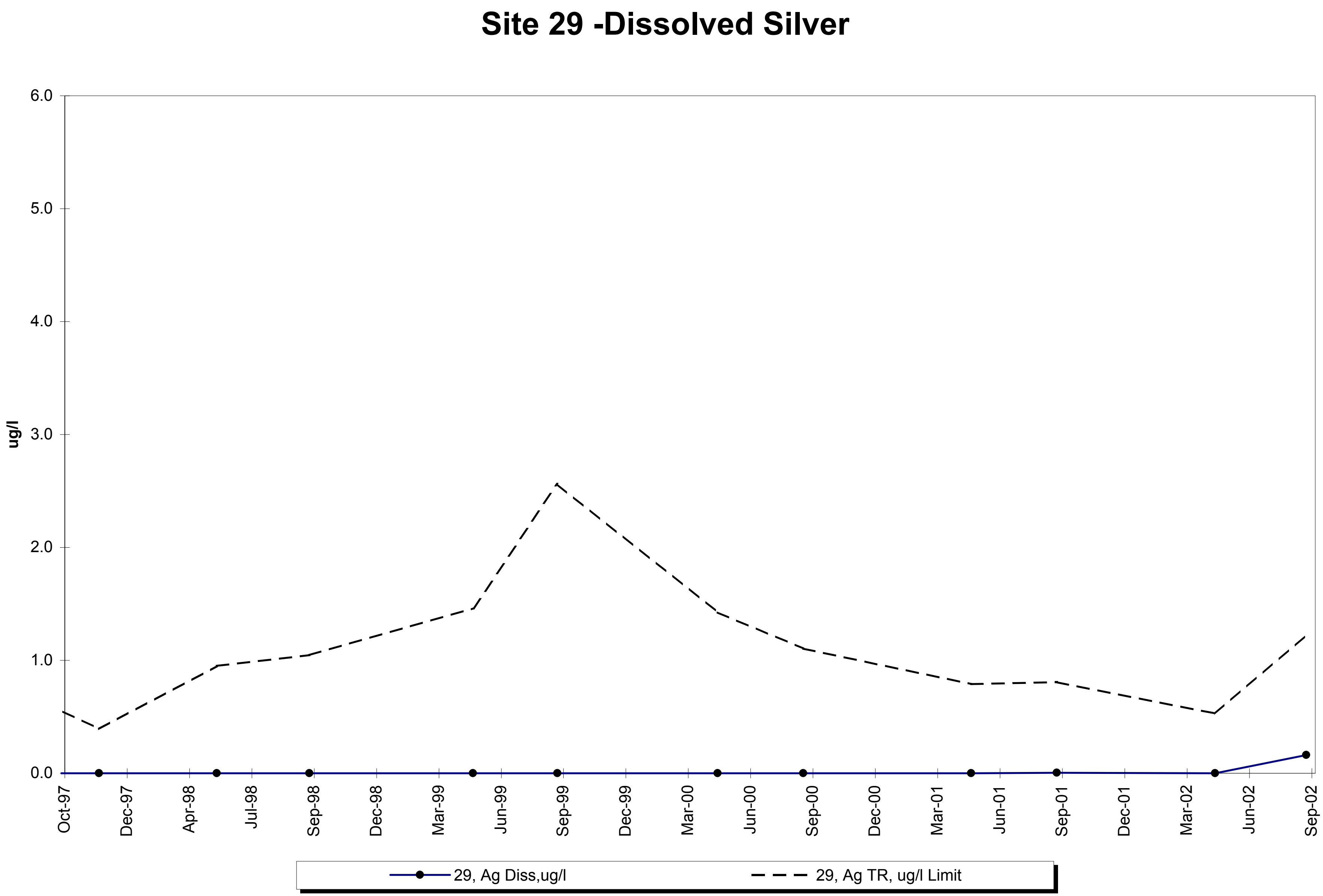


Site 29 -Dissolved Nickel

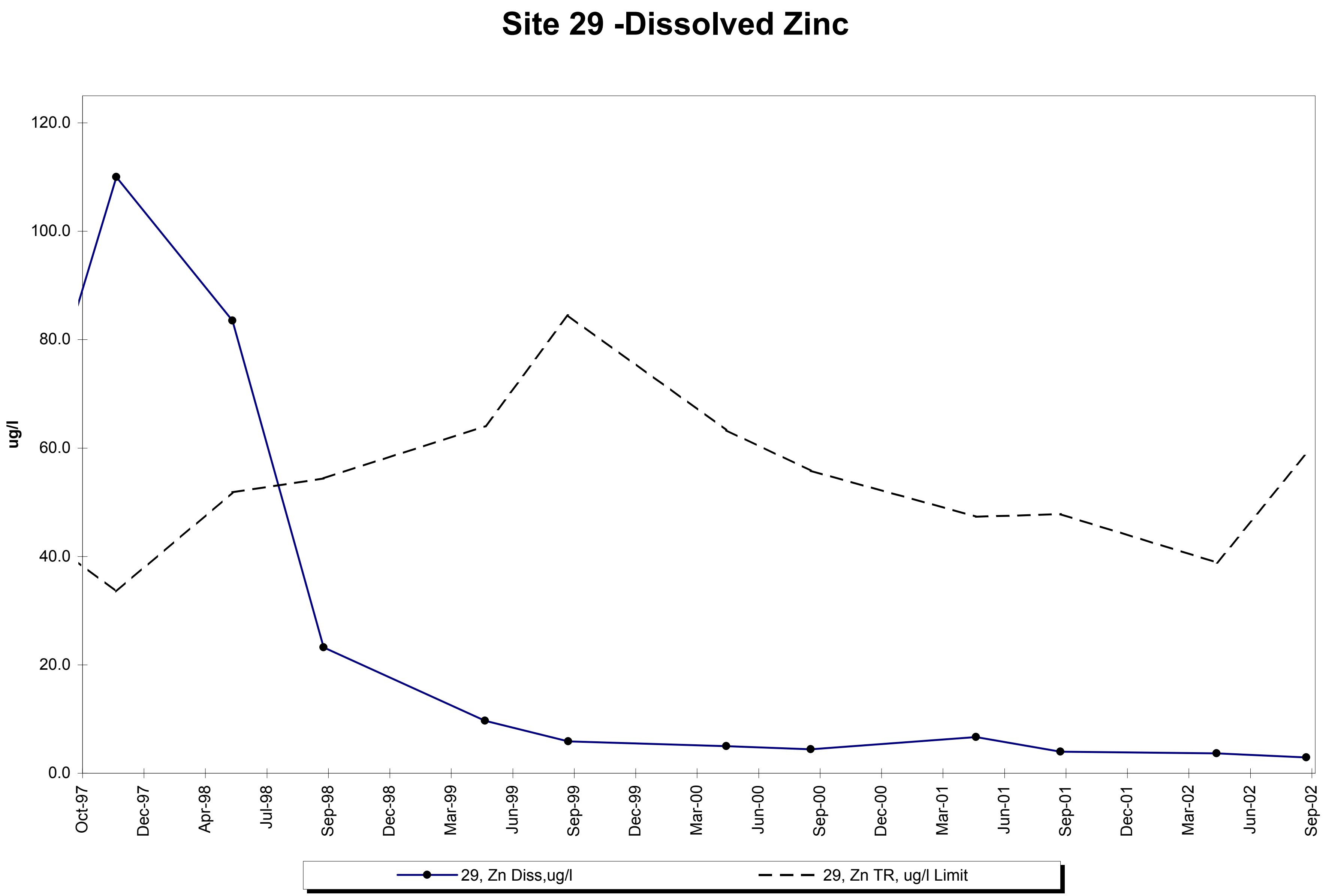


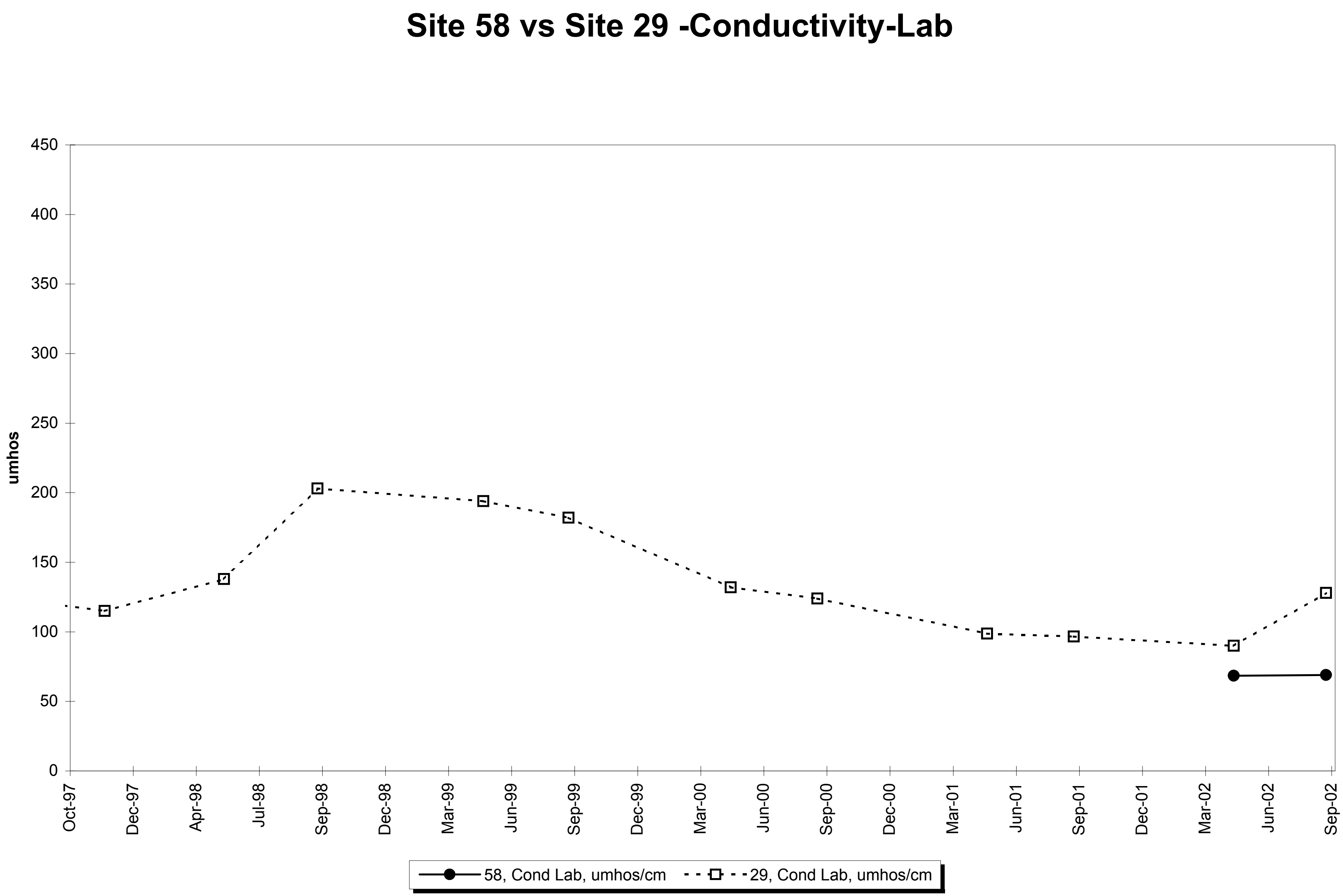
Site 29 -Dissolved Selenium

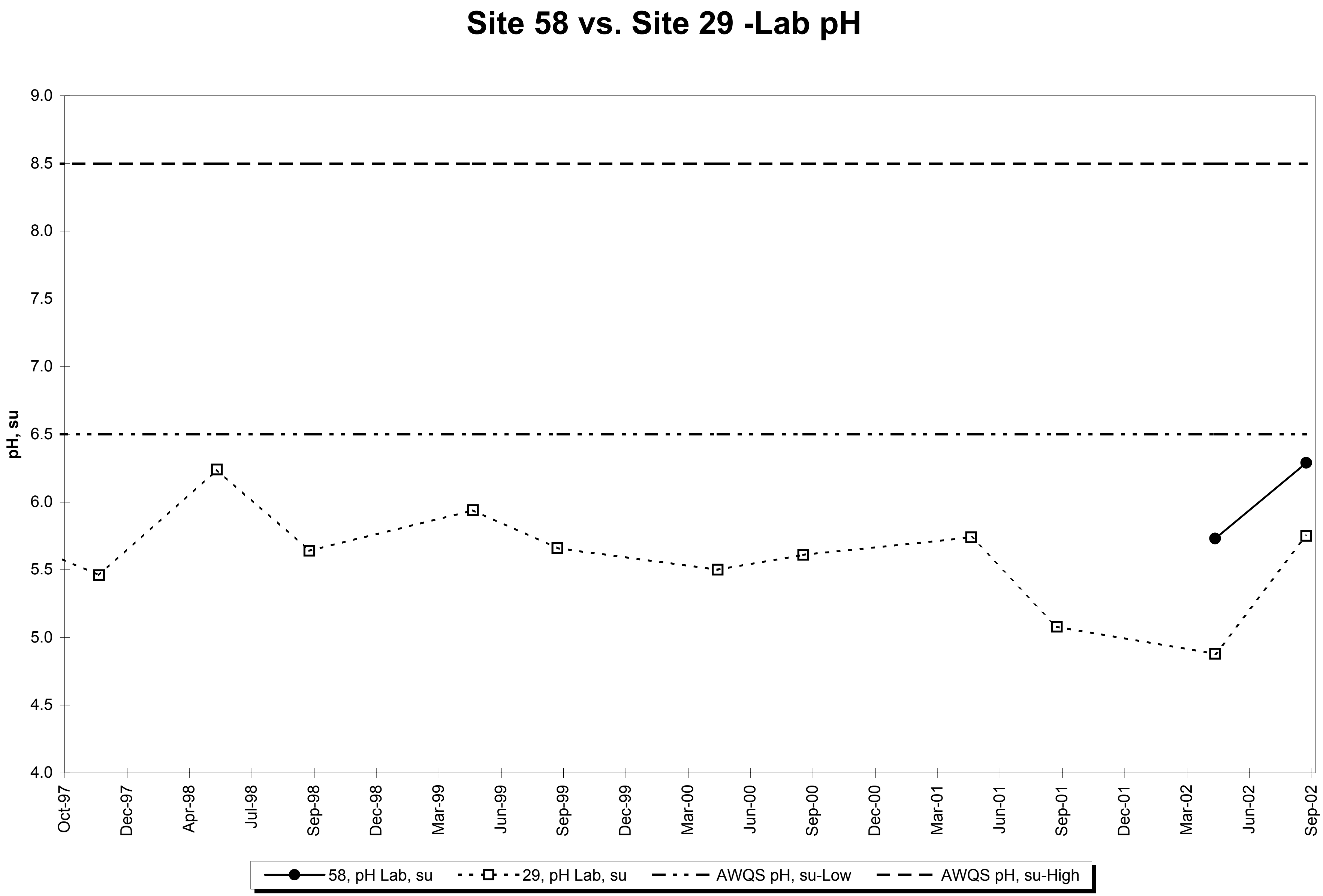




Site 29 -Dissolved Silver
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ug/l
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
29, Ag Diss,ug/l
29, Ag TR, ug/l Limit

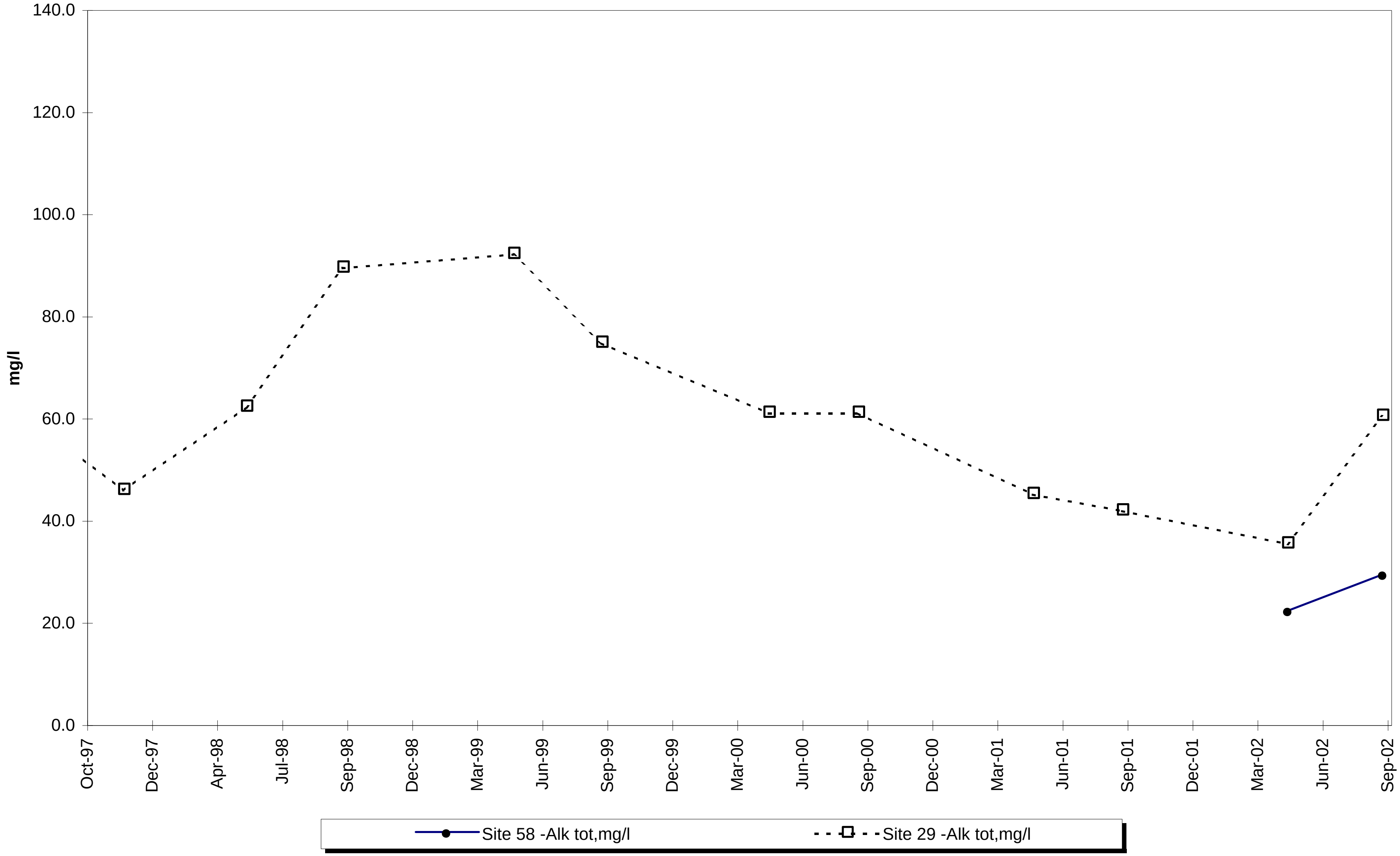

Site 29 -Dissolved Zinc
ug/l
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
29, Zn Diss,ug/l
29, Zn TR, ug/l Limit


Site 58 vs Site 29 -Conductivity-Lab
umhos
450
400
350
300
250
200
150
100
50
0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
58, Cond Lab, umhos/cm
29, Cond Lab, umhos/cm

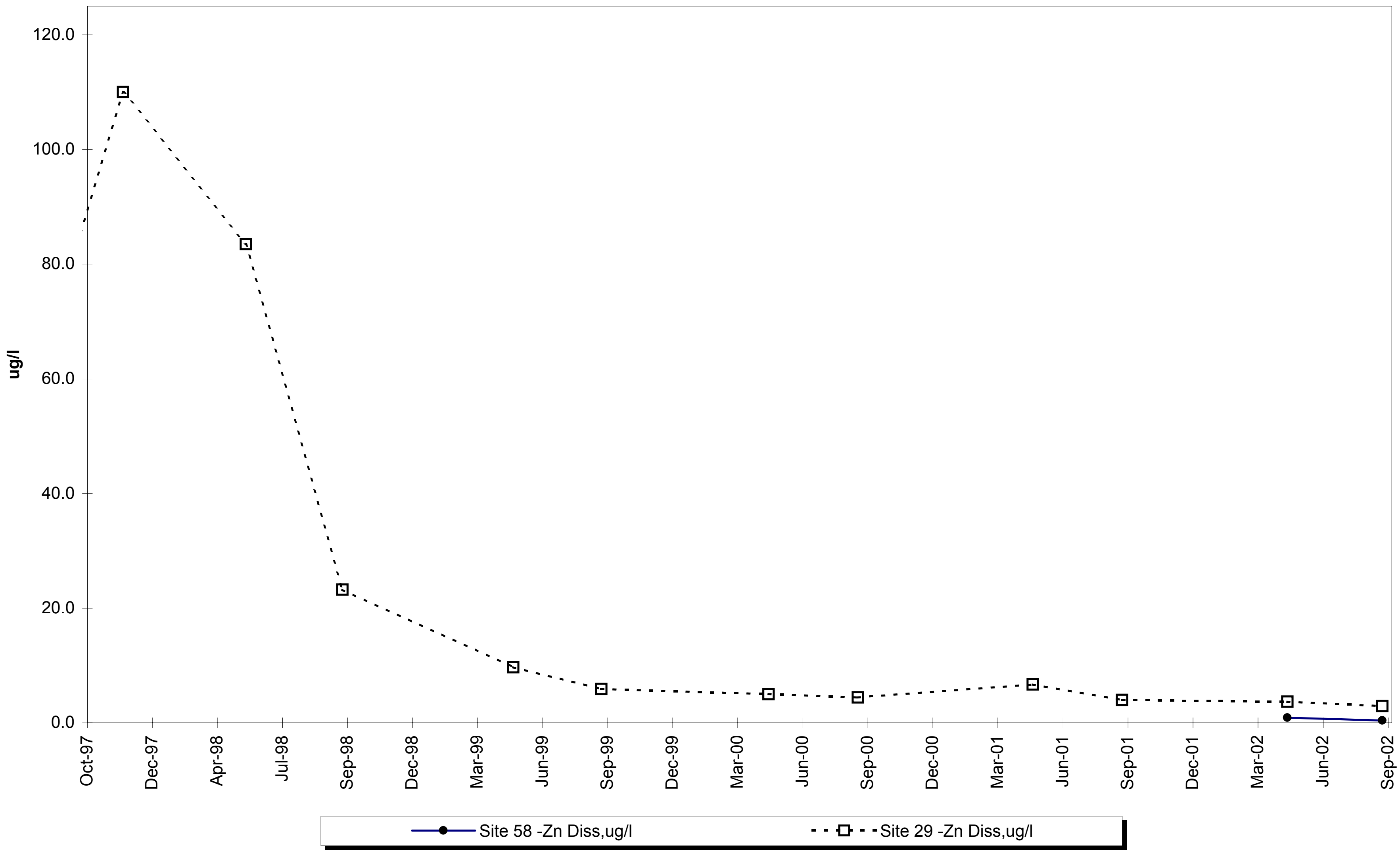


Site 58 vs. Site 29 -Lab pH
pH, su
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
58, pH Lab, su
29, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

Site 58 vs. Site 29 -Total Alkalinity



Site 58 vs. Site 29 -Dissolved Zinc



INTERPRETIVE REPORT
SITE 32 "MONITORING WELL 5S"

All data collected at this site for the past five years are included in the data analyses. As shown in the table below, there were no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-97 though Sept-02.				

The data collected during the current water year are listed in the following "Table of Results for Water Year 2002" report. The table includes all the data, field and lab, collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of zero for the purpose of median calculation.

The data for water year 2002 have been compared to the strictest fresh water quality criterion for each applicable analyte. Six (6) results exceeding these criteria have been identified, as listed on the following "Comparison To Standards" report. Two (2) of these datum are for lab pH values below the lower limit of 6.5 listed in AWQS. Lab pH for Site 32 has historically resulted in values ranging from a pH of 4.5 to 5.5 which are characteristic for wells completed in organic rich peat sediments. A second group of two exceedances are for total alkalinity for which Site 32 has a five-year average value of 18.0 mg/l, which is below AWQS of 20 mg/l. The final two exceedances are for dissolved lead concentrations. The May-2002 sample had a dissolved lead concentration of 2.63 µg/l that exceeds the minimum hardness dependent AWQS standard of 0.557 µg/l. The September-2002 sample had a dissolved lead concentration of 2.01 µg/l that exceeds the hardness dependent AWQS standard of 0.921 µg/l. Due to the low hardness for this site 12 of the past 14 samples have returned lead values higher than AWQS but within the same general range of 1.5-3.5µg/l of dissolved lead. The fourteen samples represent all the samples taken since the inception of a lower MDL for lead determinations in June-1998.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No consistent trends are present, but hardness, dissolved chromium, mercury and silver show new maximum values during the 2002 water year. In all cases the new maximums typically appear as single-point excursions from the trends established by prior sampling.

The September-2002 hardness sample of 37.2 mg/l appears as a marked upturn from the recent average of approximately 10mg/l. However, hardness values for sampling prior to 1994 range from 5 to 80 mg/l concentration. Thus, the upturn is a visual artifact of the period shown on the graph and is within the normal variation of water chemistry for the site. Dissolved silver returned a new maximum value of 0.176 μg/l for the September-2002 sample. Sampling prior to June-1998 was done with higher MDL, which may effectively mask any previous values of similar magnitude. The increase recorded by this single determination is currently not interpreted to be an upward trend due to its single point nature. Finally, dissolved mercury also returned a new maximum value of 0.00699 μg/l for the May-2002 sample. Currently this is also appears to be a one-point excursion with the subsequent sample taken in September-2002 returning to within the range established by prior sampling. Finally, dissolved chromium established and new maximum value of 8.1 μg/l for the May-2002 sample. The subsequent sample taken in September-2002 returned to within the range established by prior sampling and the maximum does not appear to form an upward trend.

Additional X-Y plots have been generated for alkalinity, pH, conductance, and dissolved zinc that plot Site 32 and Site 58, the upgradient control site, to aid in comparison between those two sites. Total alkalinity and lab conductivity are slightly higher at Site 58 while lab pH is more alkaline at Site 58, median pH of 6.0, than at Site 32 with a median pH of 4.9. Dissolved zinc levels are higher at Site 32 than at Site 58. However, the median value of dissolved zinc for Site 32 may be skewed positively by the May 2002 sample, which returned a value of 19.4 μg/l. This value is the largest recorded since the change in MDL and the associated increase in precision at lower analytical levels that occurred in June 1998. The long-term median value for dissolved zinc since June 1998 is 9.2 μg/l, which is still elevated with respect to Site 58 and the other shallow wells completed into peat (e.g. Site 27 and Site 29). The lower pH at Site 32 with respect to the other shallow wells may account for the elevated zinc concentration found there due to the higher zinc solubility at a lower pH.

Table of Results for Water Year 2002

Site 32 "MW-5S"

Sample Date/Parameter	10/25/2001	11/15/2001	12/5/2001	1/29/2002	2/21/2002	3/19/2002	4/1/2002	5/7/2002	6/11/2002	7/15/2002	8/27/2002	9/17/2002	**Median**
Water Temp (°C)								8.0				8.6	8.3
Conductivity-Field (µmho)								64				64	64
Conductivity-Lab (µmho)								58				61	59
pH Lab (standard units)								4.53				5.30	4.92
pH Field (standard units)								4.73				5.25	4.99
Total Alkalinity (mg/l)								14.6				17.6	16.1
Hardness (mg/l)								10.1				37.2	23.7
Dissolved As (µg/l)								5.030				4.510	4.770
Dissolved Ba (µg/l)	**NOT SCHEDULED FOR SAMPLING**							22.3	**NOT SCHEDULED FOR SAMPLING**			24.9 J	23.6
Dissolved Cd (µg/l)								0.016 J				0.026	0.021
Dissolved Cr (µg/l)								8.100				2.280	5.190
Dissolved Cu (µg/l)								2.340				1.950	2.145
Dissolved Pb (µg/l)								2.6300				2.0100	2.3200
Dissolved Ni (µg/l)								4.28				4.13 J	4.21
Dissolved Ag (µg/l)								0.0212 J				0.1760	0.0986
Dissolved Zn (µg/l)								19.40				9.34 J	14.37
Dissolved Se (µg/l)								<0.475				0.348 J	0.293
Dissolved Hg (µg/l)								0.006990 J				0.003210	0.005100

See "Qualififed Data by QA Reviewer" table for qualifier descriptions.

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

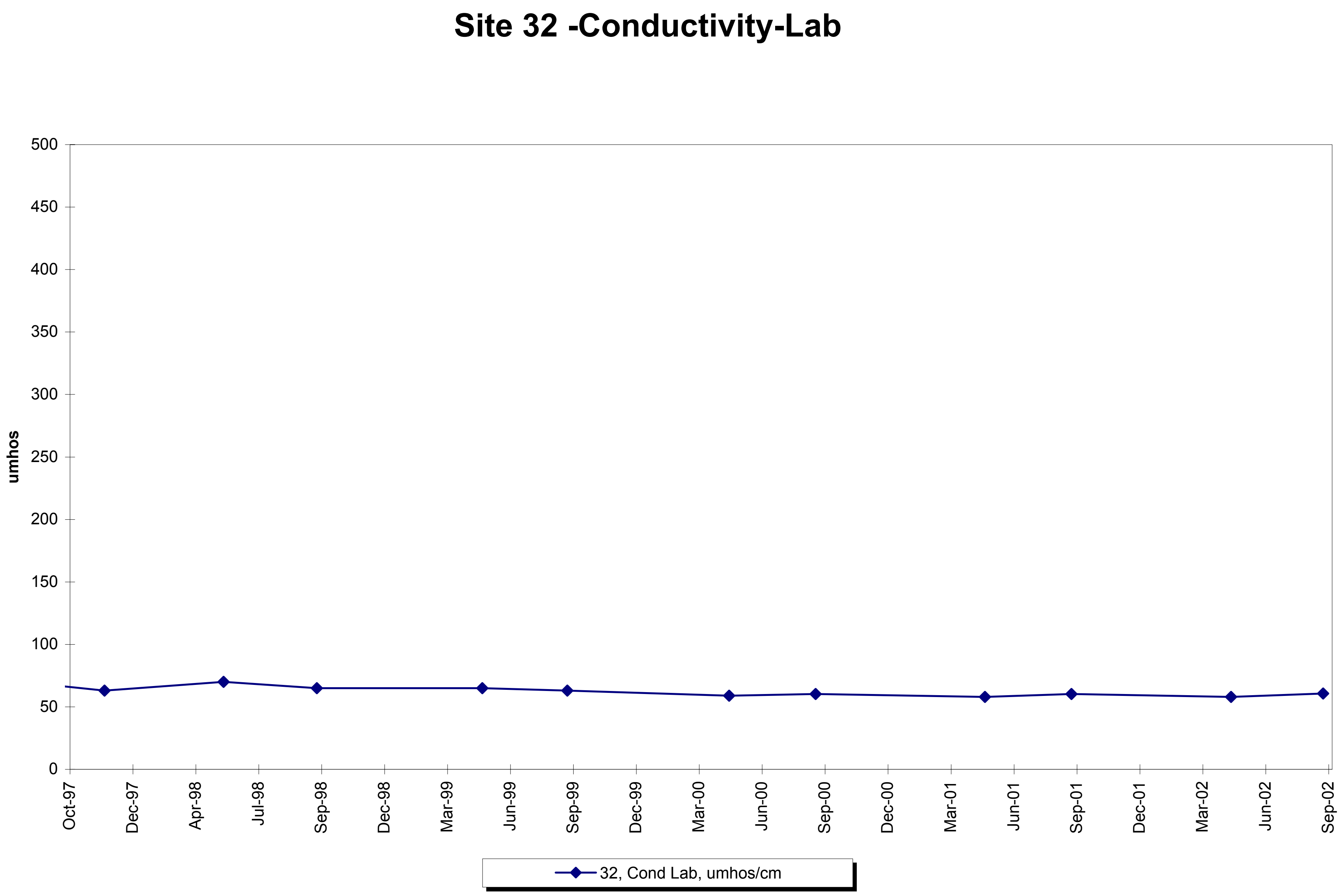
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
32	05/07/2002	12:30:00 PM				
			Cd Diss, ug/l	0.0156	J	Below Quantitative Range, C
			Ag Diss, ug/l	0.0212	J	Below Quantitative Range, C
			Hg Diss, ug/l	0.00699	J	CCV Rec, LCS Rec, LCS RP
32	09/17/2002	2:35:00 PM				
			Ba Diss, ug/l	24.9	J	CCV Rec, LCS Rec.
			Ni Diss, ug/l	4.13	J	CCV Rec.
			Zn Diss, ug/l	9.34	J	LCS Rec.
			Se Diss, ug/l	0.348	J	Below Quantitative Range

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Comparison To Standards

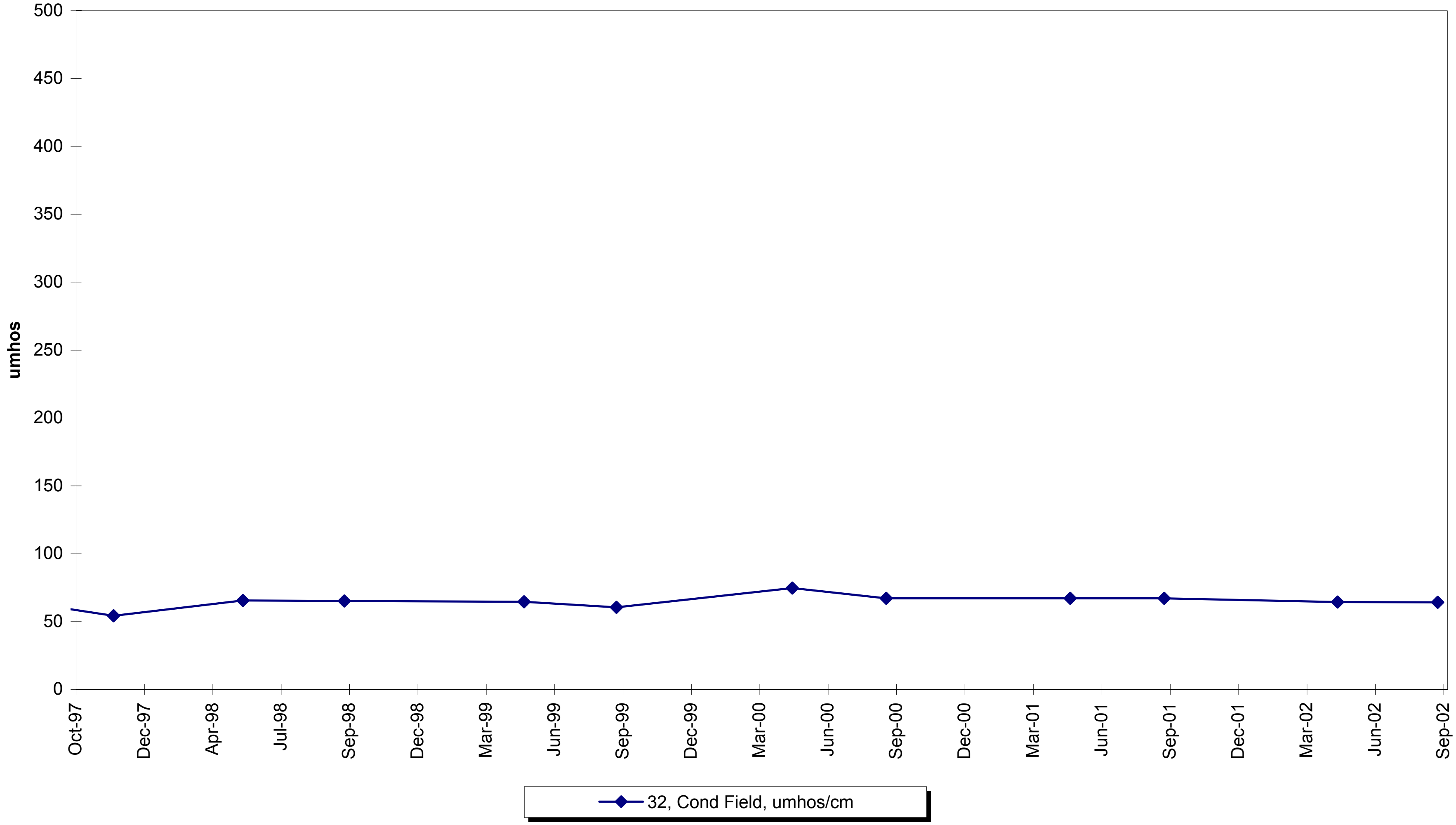
Date Range: 10/01/2001 to 09/30/2002

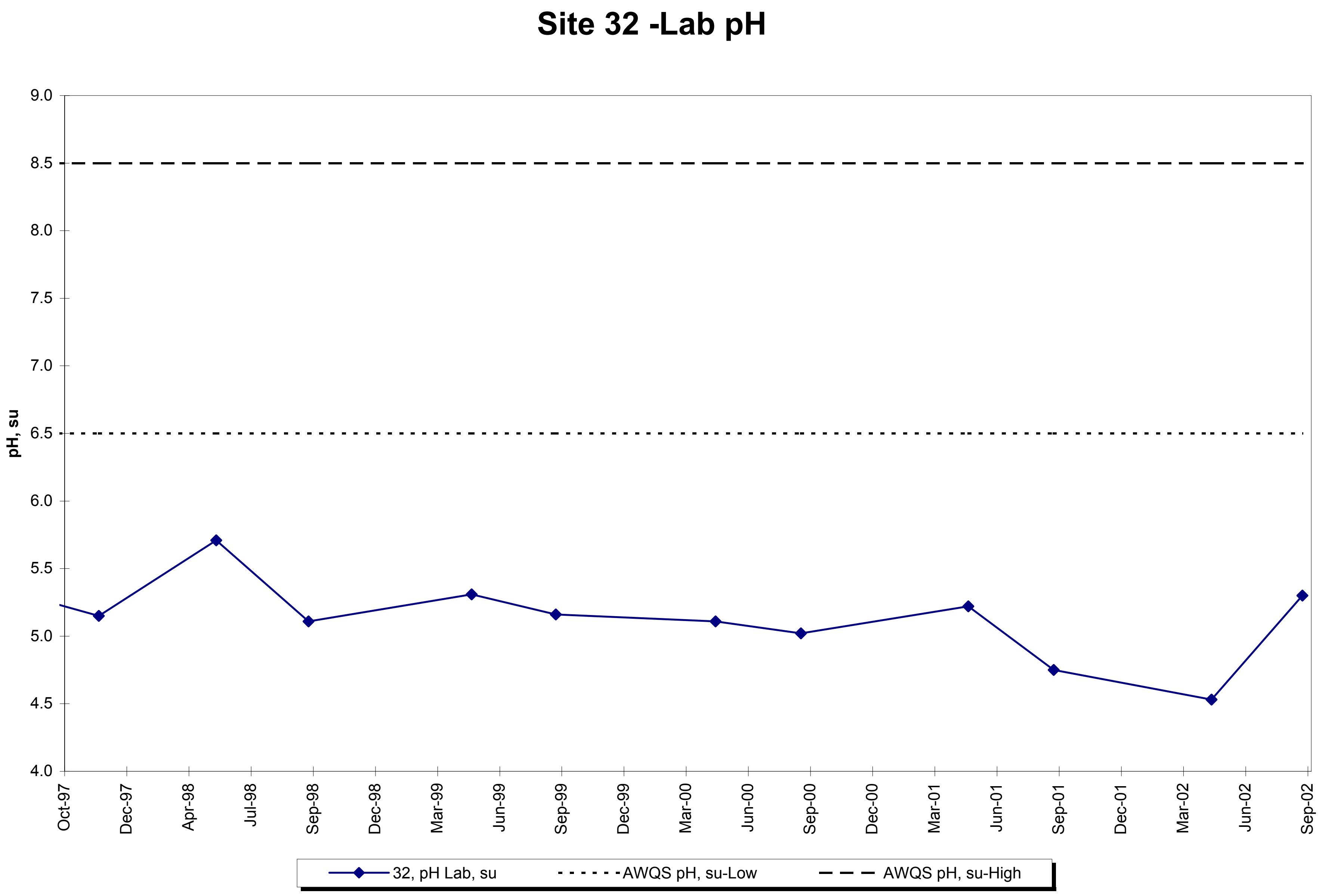
Site Number	Date	Time	Dup ID	Storet No.	Parameter Description	Value	Standard	Standard Type
32	05/07/2002	12:30 PM	0	410	Alk Tot, mg/l	14.6	20.	Aquatic
32	05/07/2002	12:30 PM	0	1049	Pb Diss, ug/l	2.63	0.1767	Aquatic
32	05/07/2002	12:30 PM	0	403	pH Lab, su	4.53	6.5- 8.5	Aquatic
32	09/17/2002	2:35 PM	0	410	Alk Tot, mg/l	17.6	20.	Aquatic
32	09/17/2002	2:35 PM	0	1049	Pb Diss, ug/l	2.01	0.92058	Aquatic
32	09/17/2002	2:35 PM	0	403	pH Lab, su	5.3	6.5- 8.5	Aquatic



Site 32 -Conductivity-Lab
umhos
500
450
400
350
300
250
200
150
100
50
0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
32, Cond Lab, umhos/cm

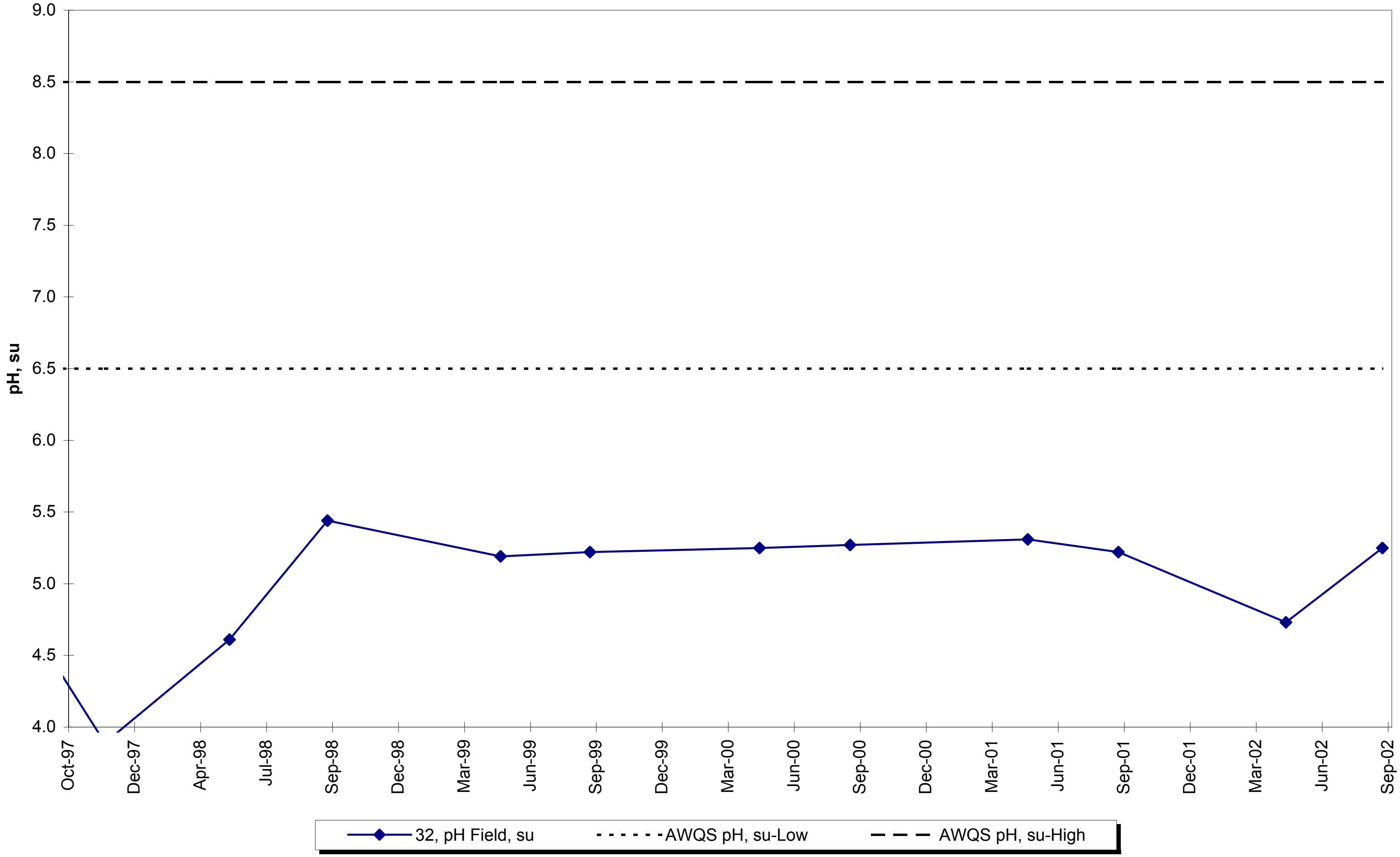
Site 32 -Conductivity-Field



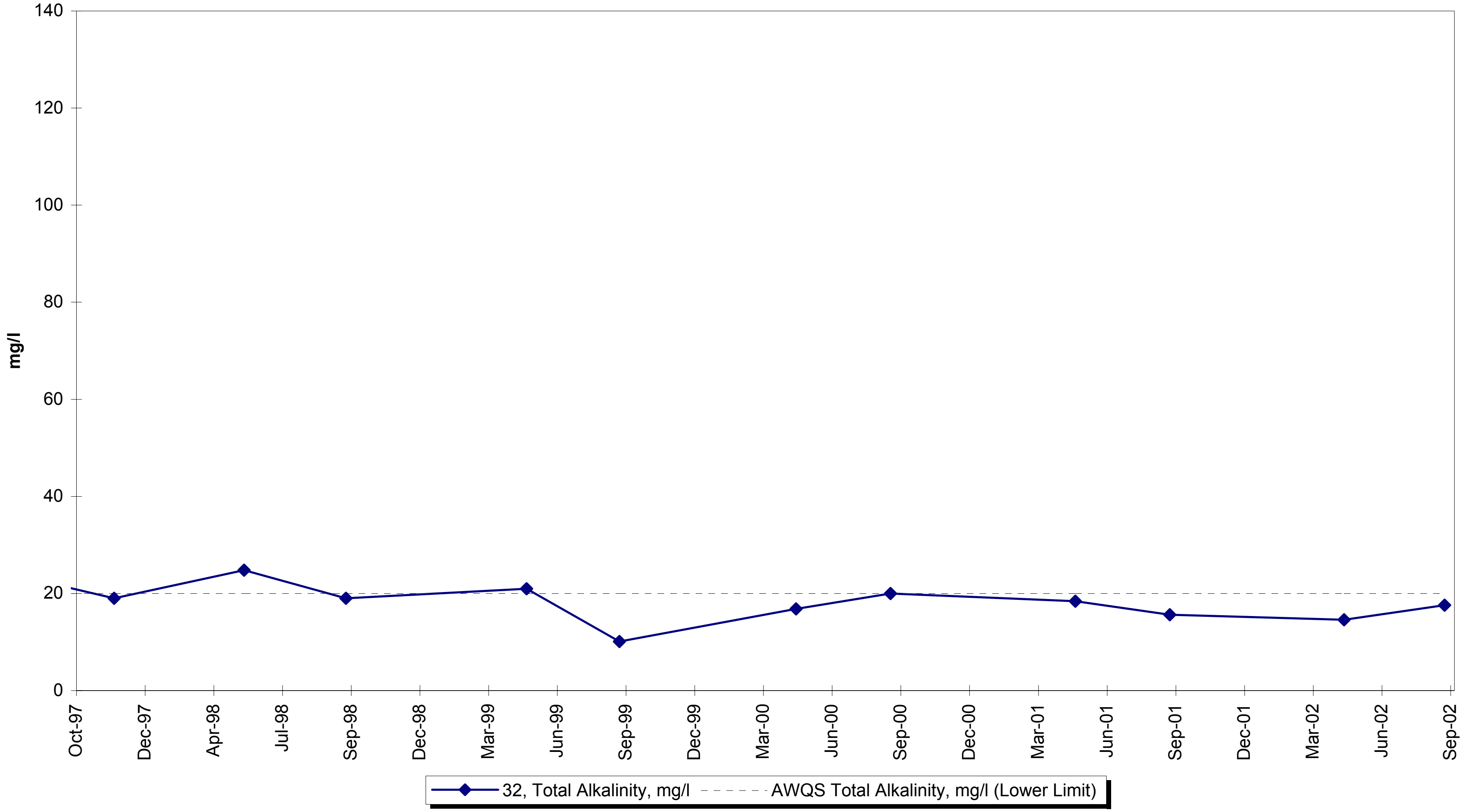


Site 32 -Lab pH
pH, su
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
32, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

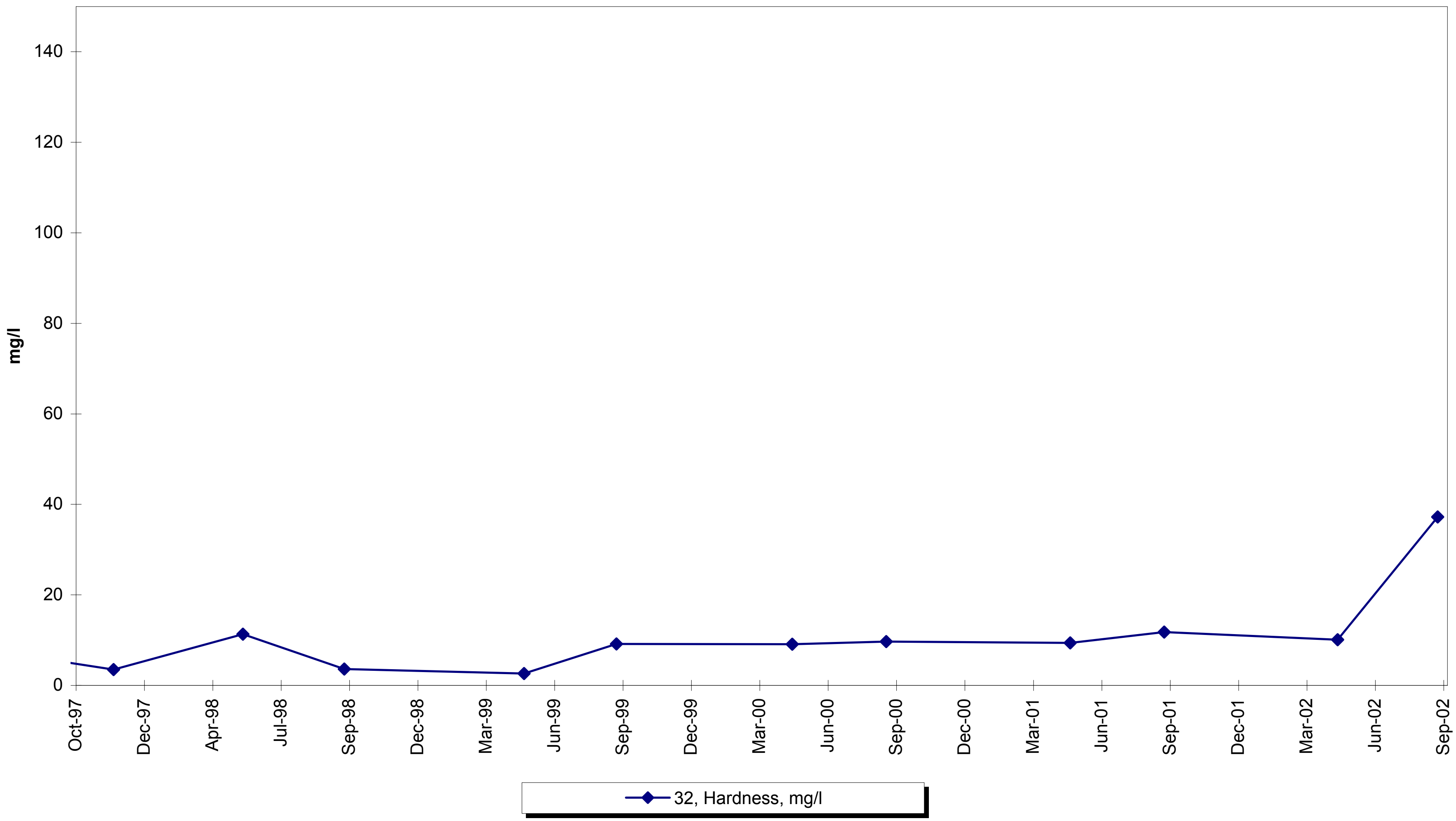
Site 32 -Field pH

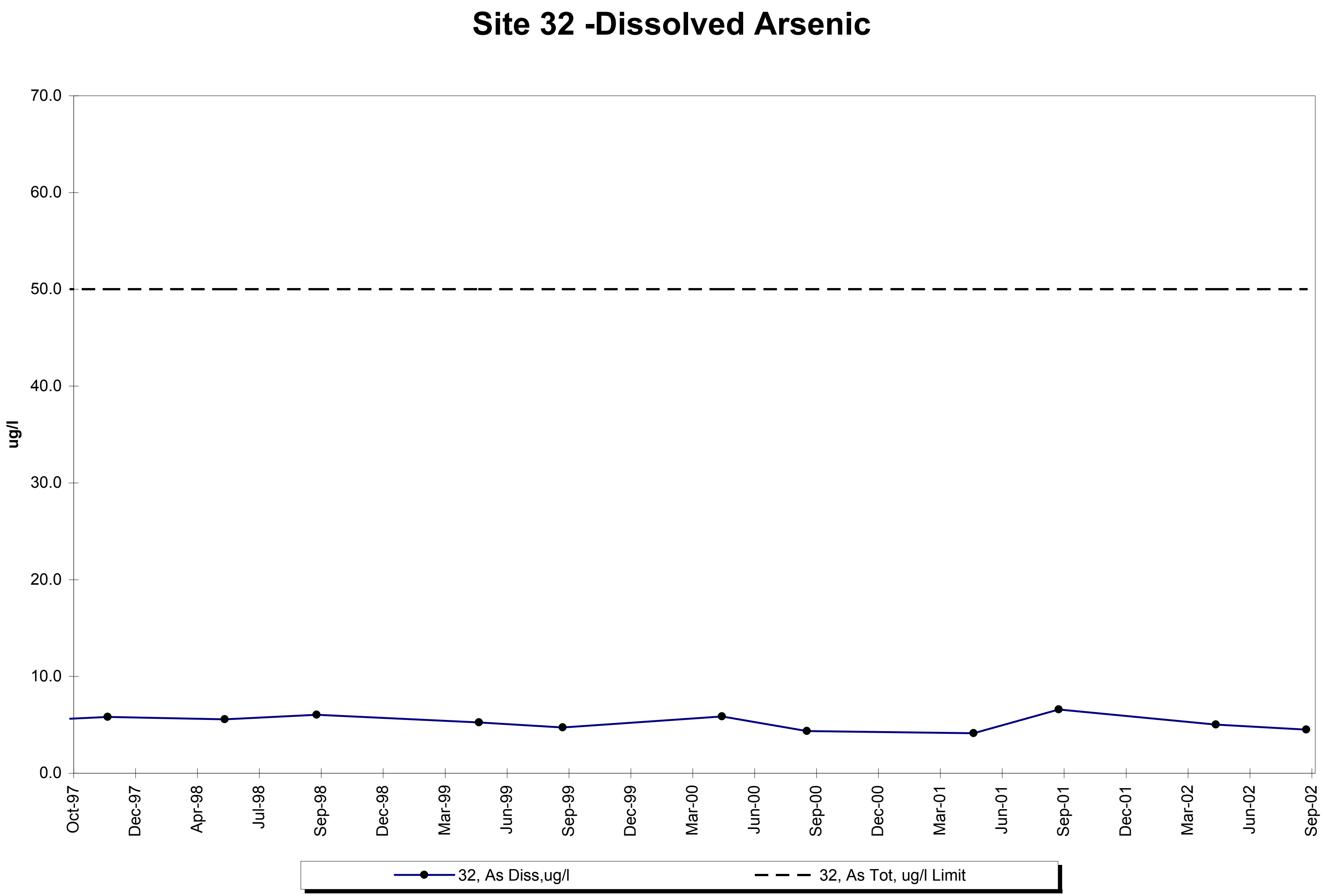


Site 32 -Total Alkalinity



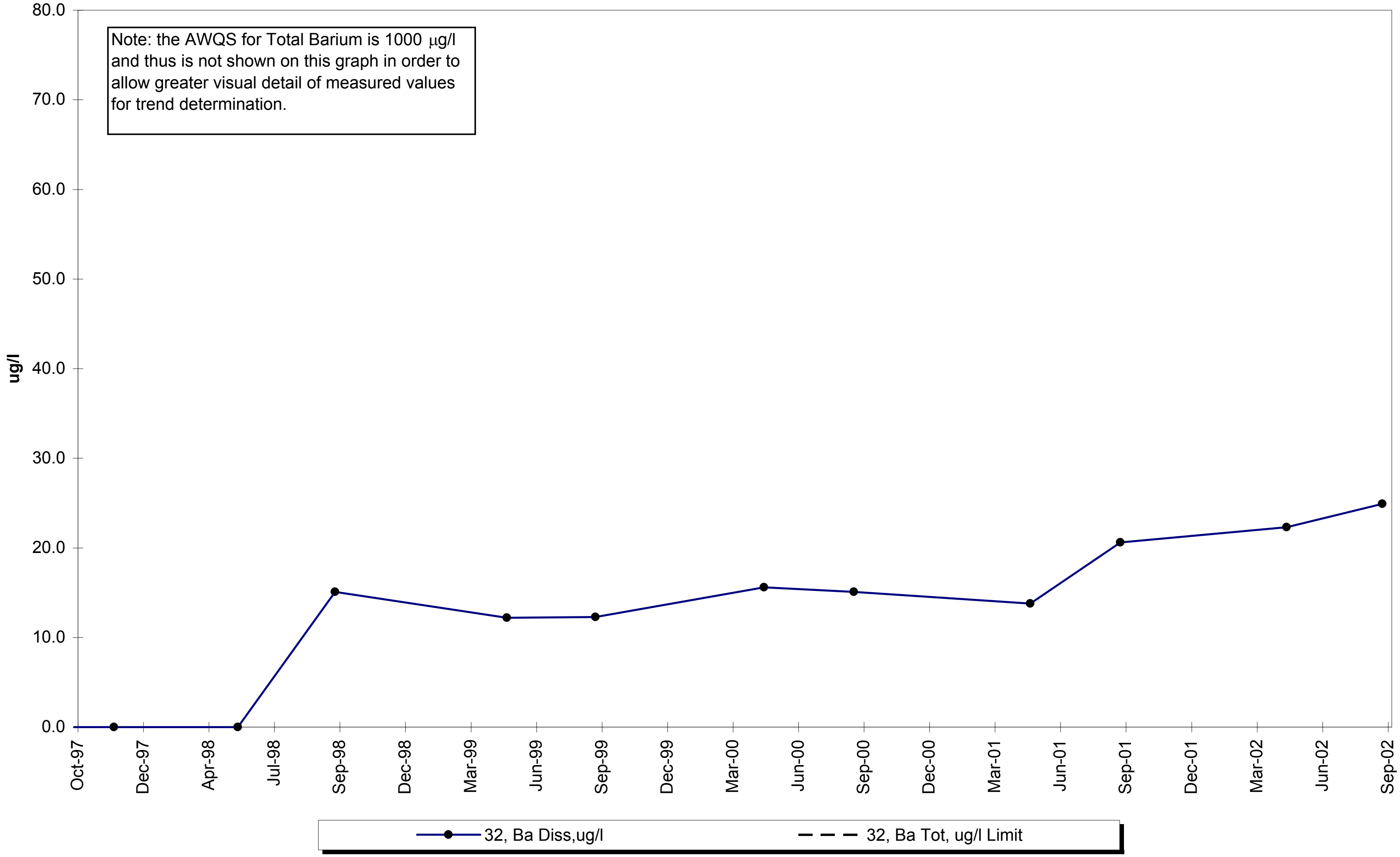
Site 32 -Hardness

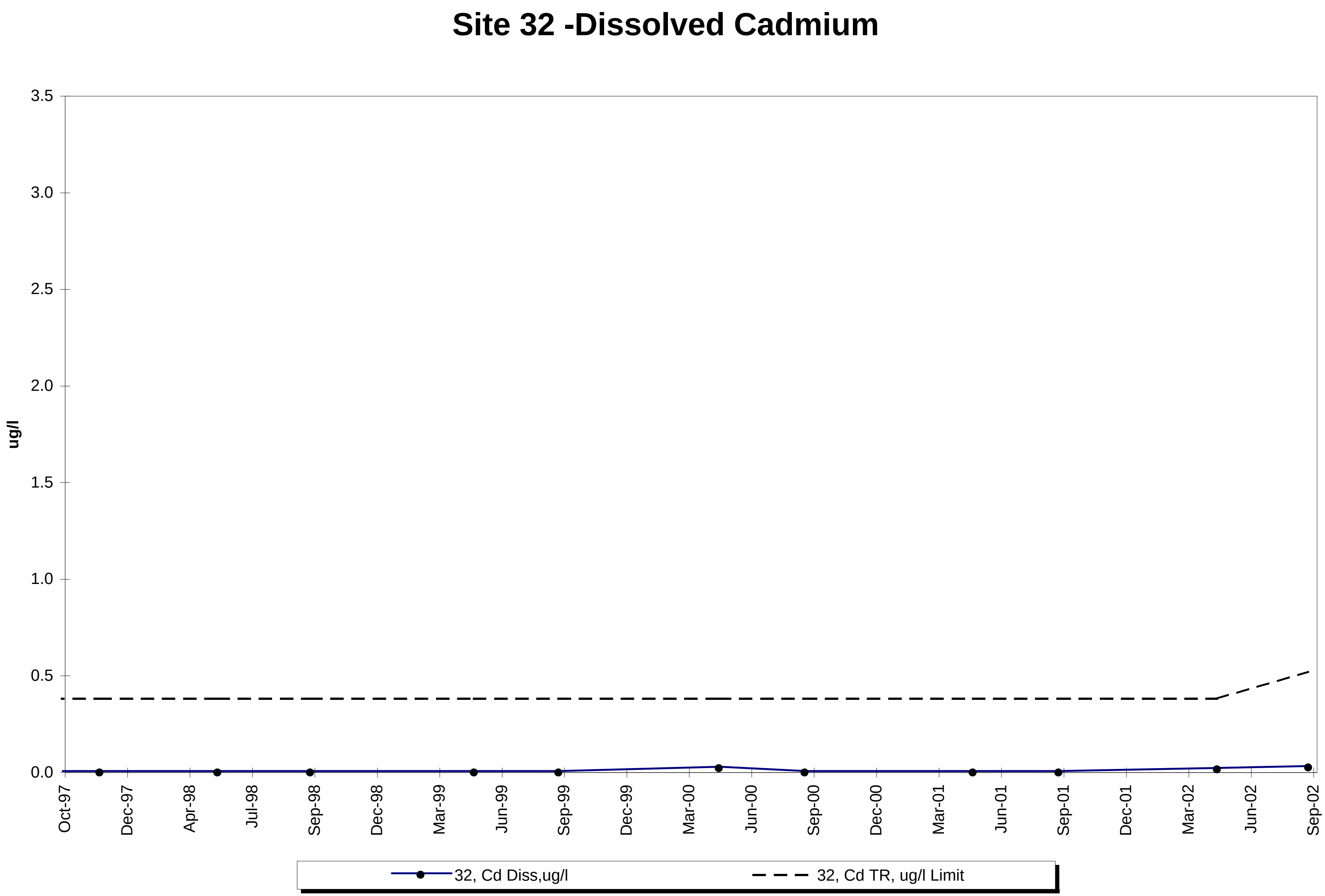




Site 32 -Dissolved Arsenic
ug/l
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
32, As Diss,ug/l
32, As Tot, ug/l Limit

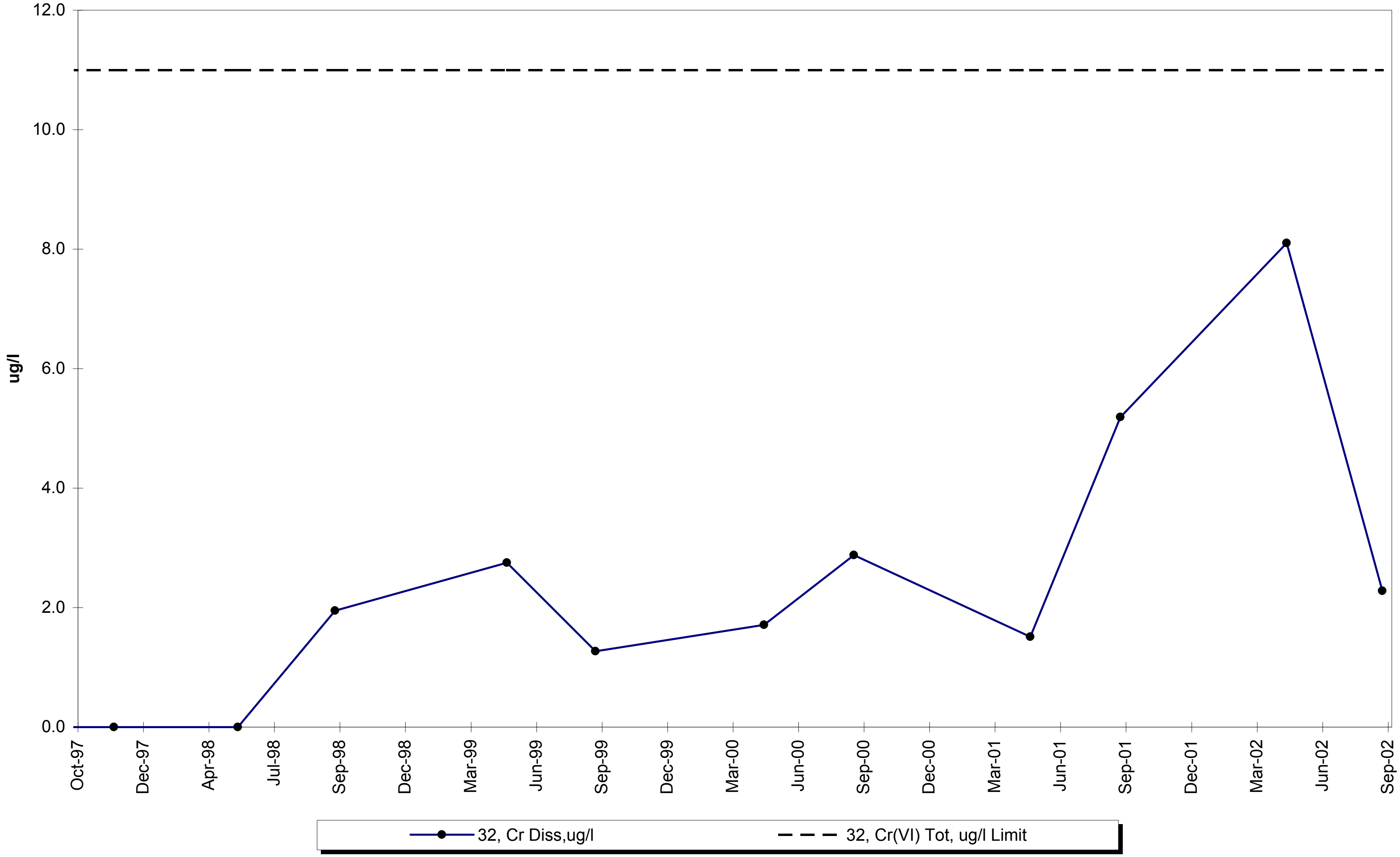
Site 32 -Dissolved Barium



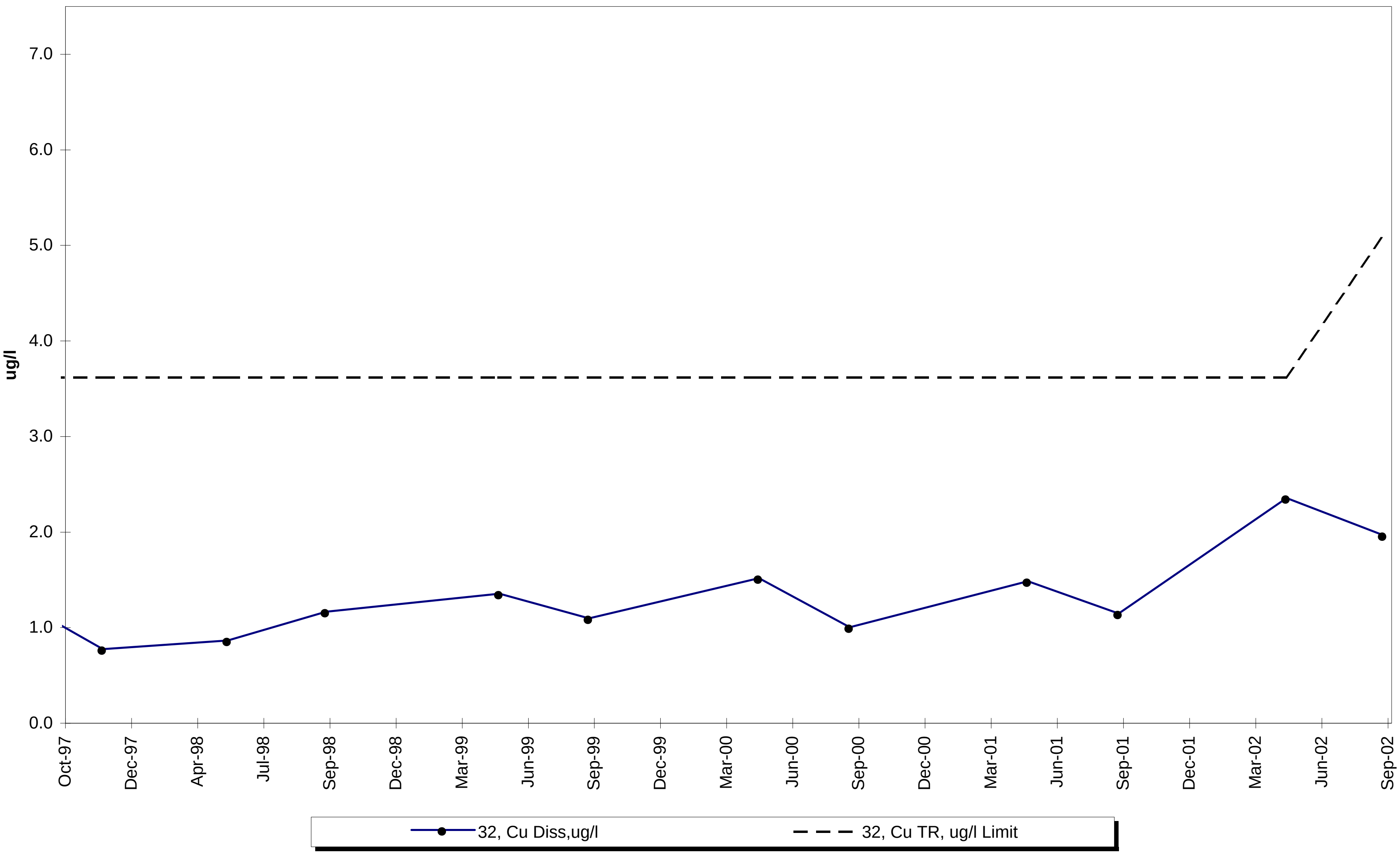


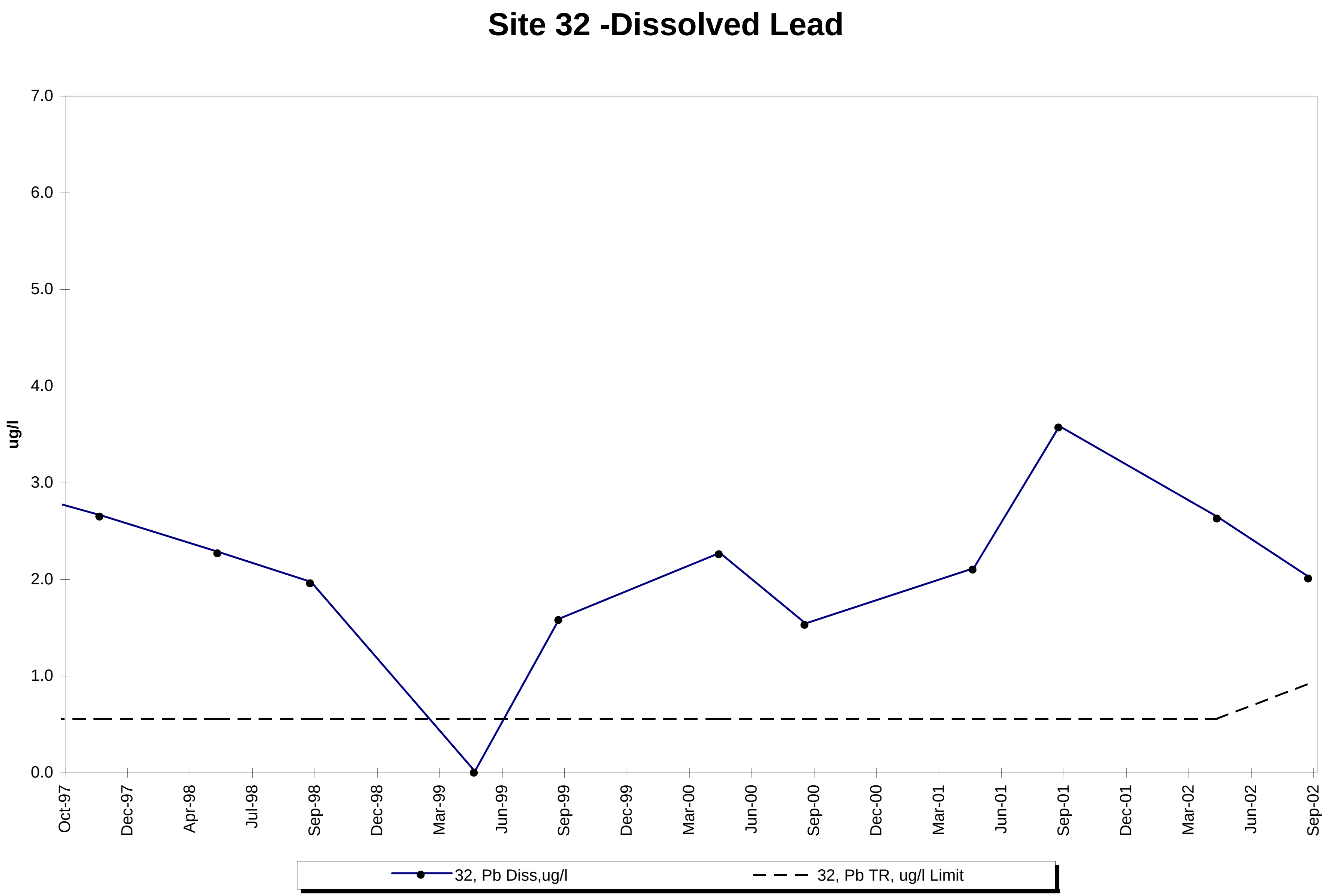
Site 32 -Dissolved Cadmium
ug/l
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
32, Cd Diss,ug/l
32, Cd TR, ug/l Limit

Site 32 -Dissolved Chromium

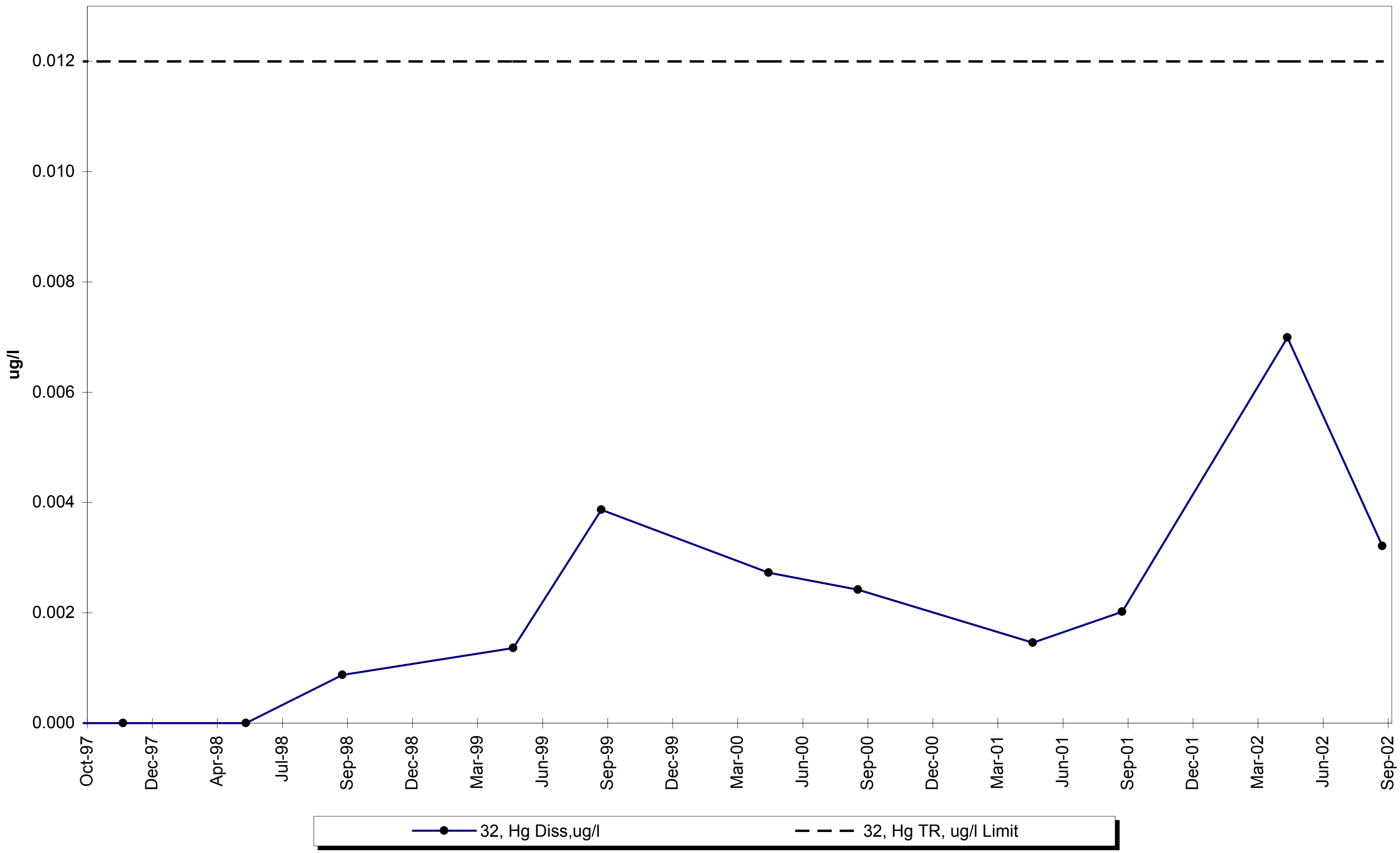


Site 32 -Dissolved Copper

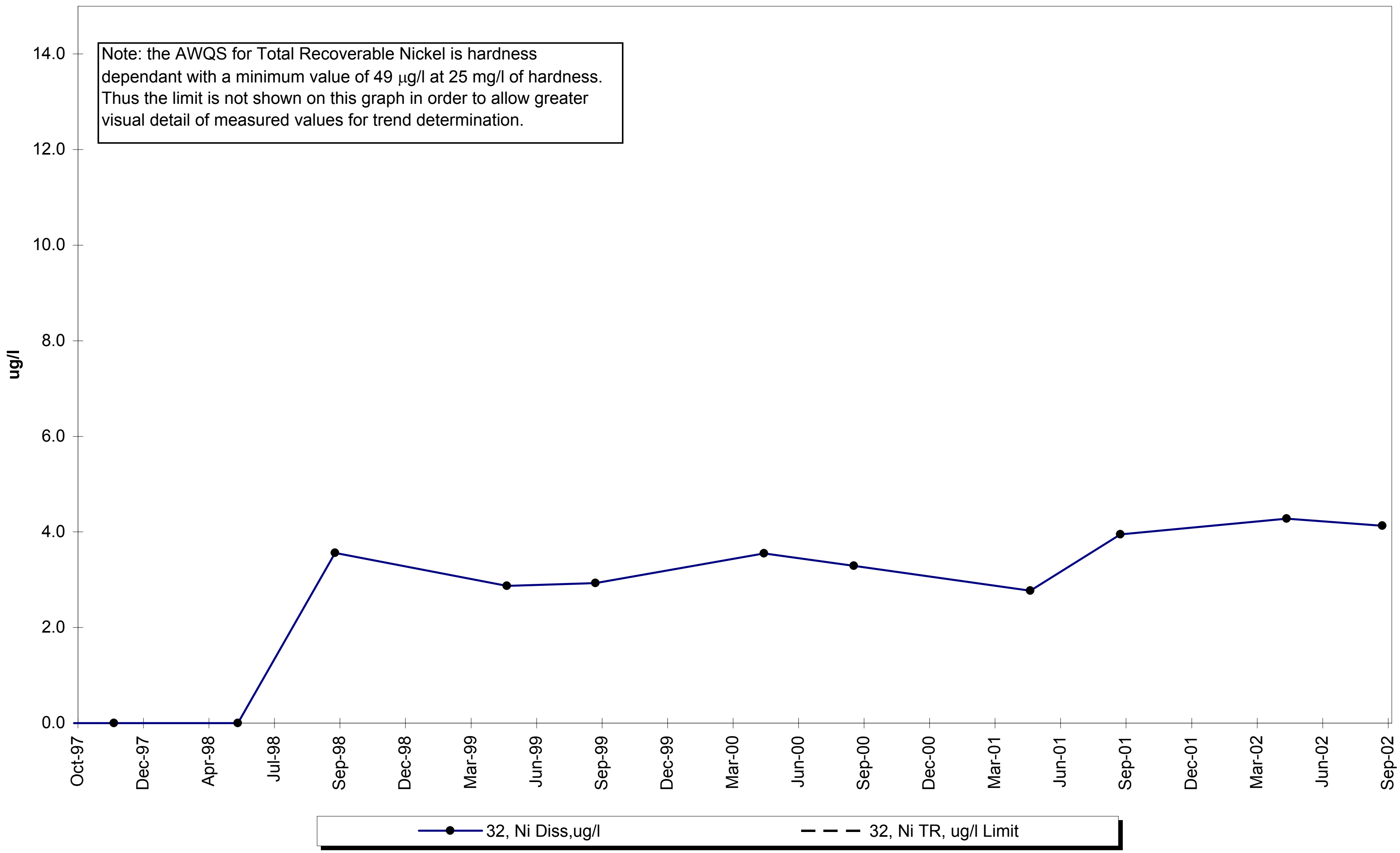


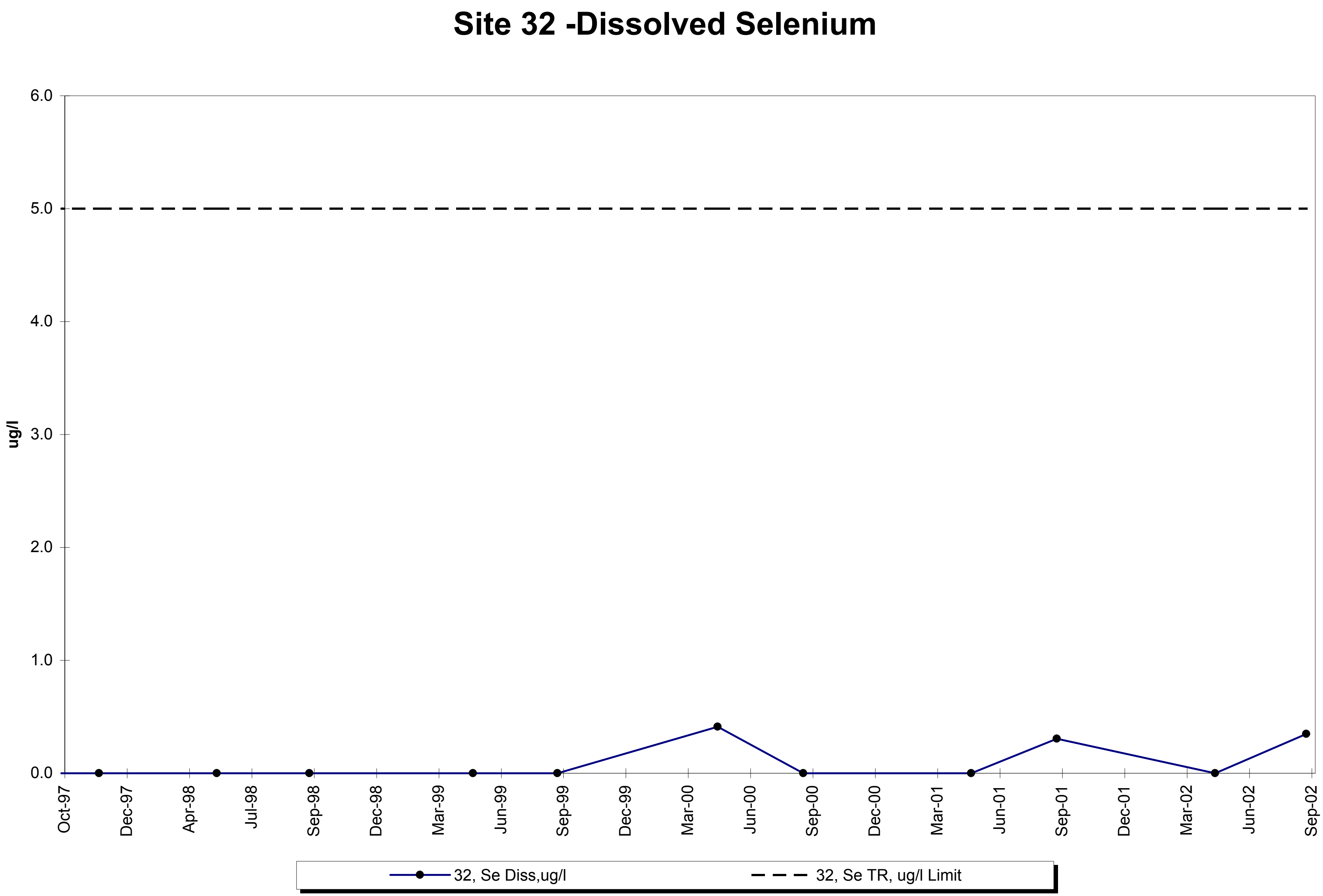

Site 32 -Dissolved Lead
ug/l
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
32, Pb Diss,ug/l
32, Pb TR, ug/l Limit

Site 32 -Dissolved Mercury

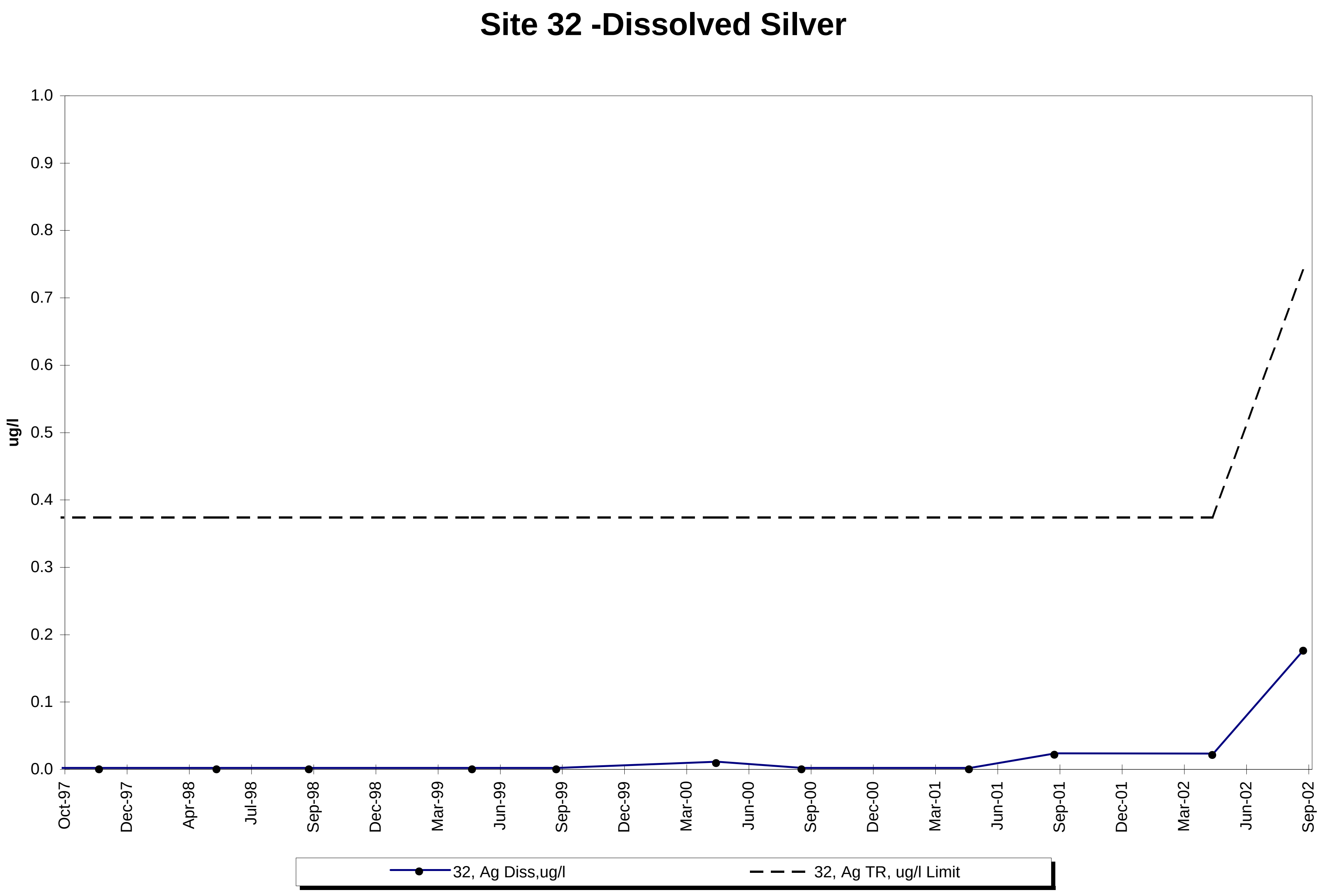


Site 32 -Dissolved Nickel



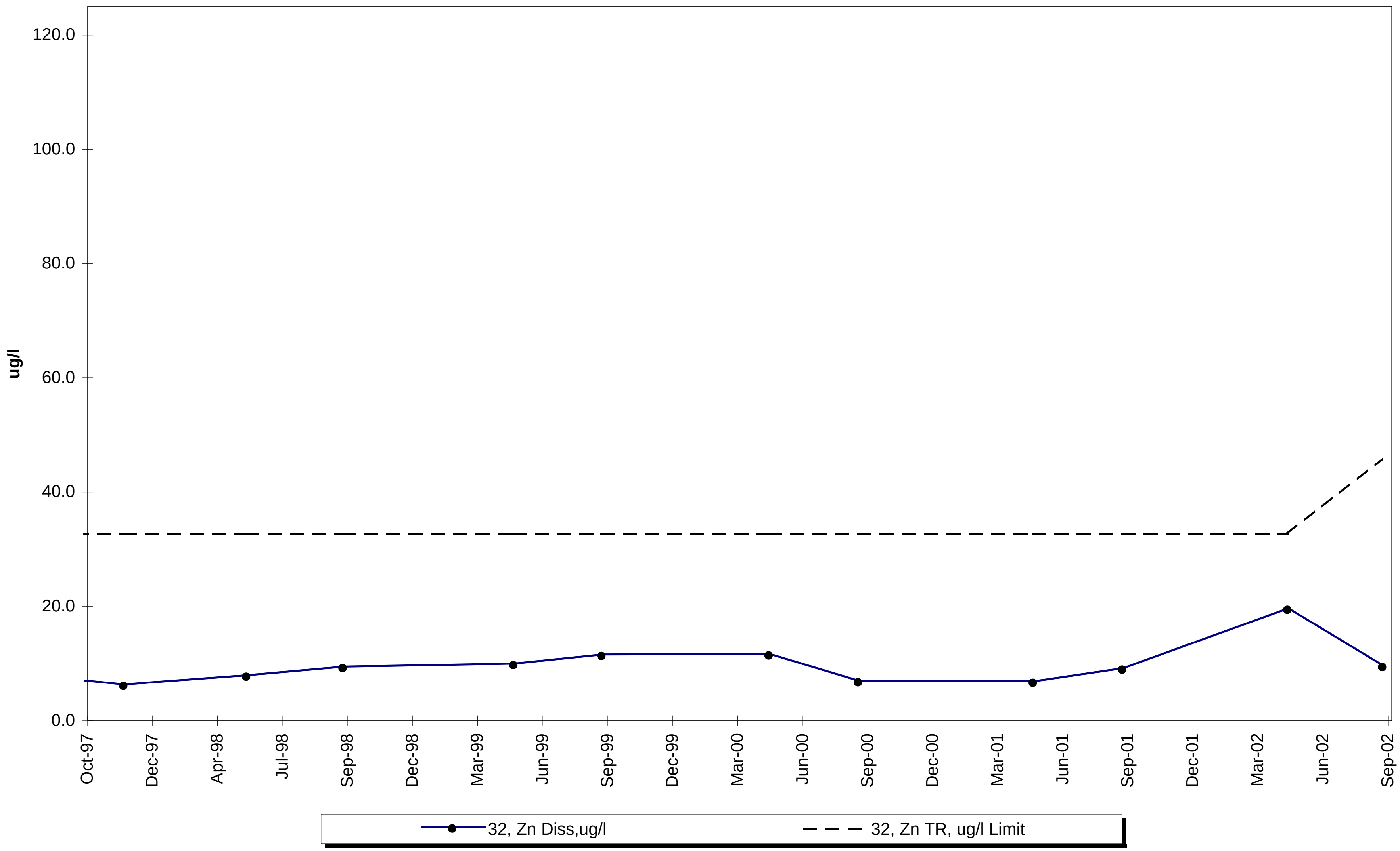


Site 32 -Dissolved Selenium
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ug/l
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
32, Se Diss,ug/l
32, Se TR, ug/l Limit

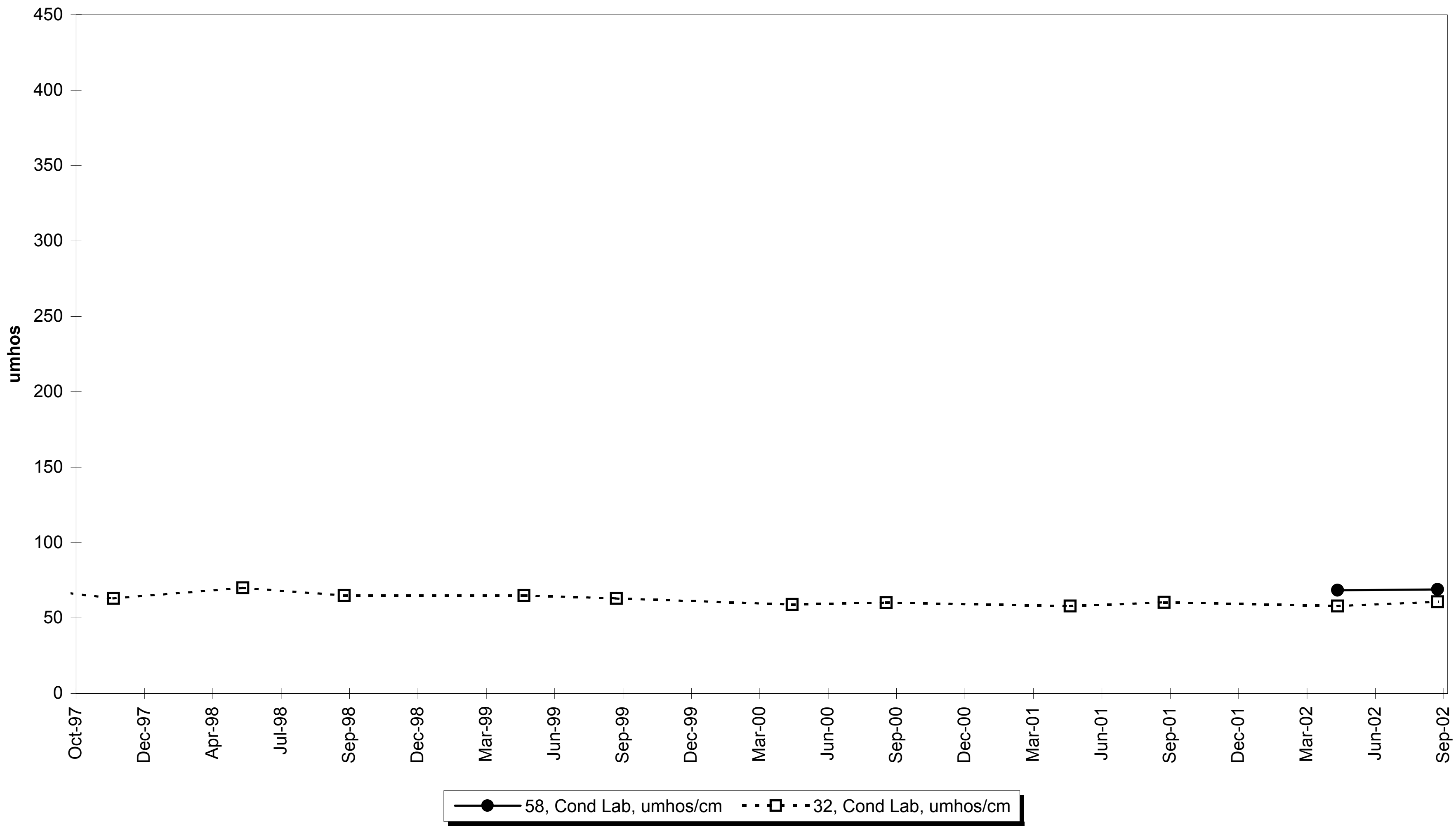


Site 32 -Dissolved Silver
ug/l
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
32, Ag Diss,ug/l
32, Ag TR, ug/l Limit

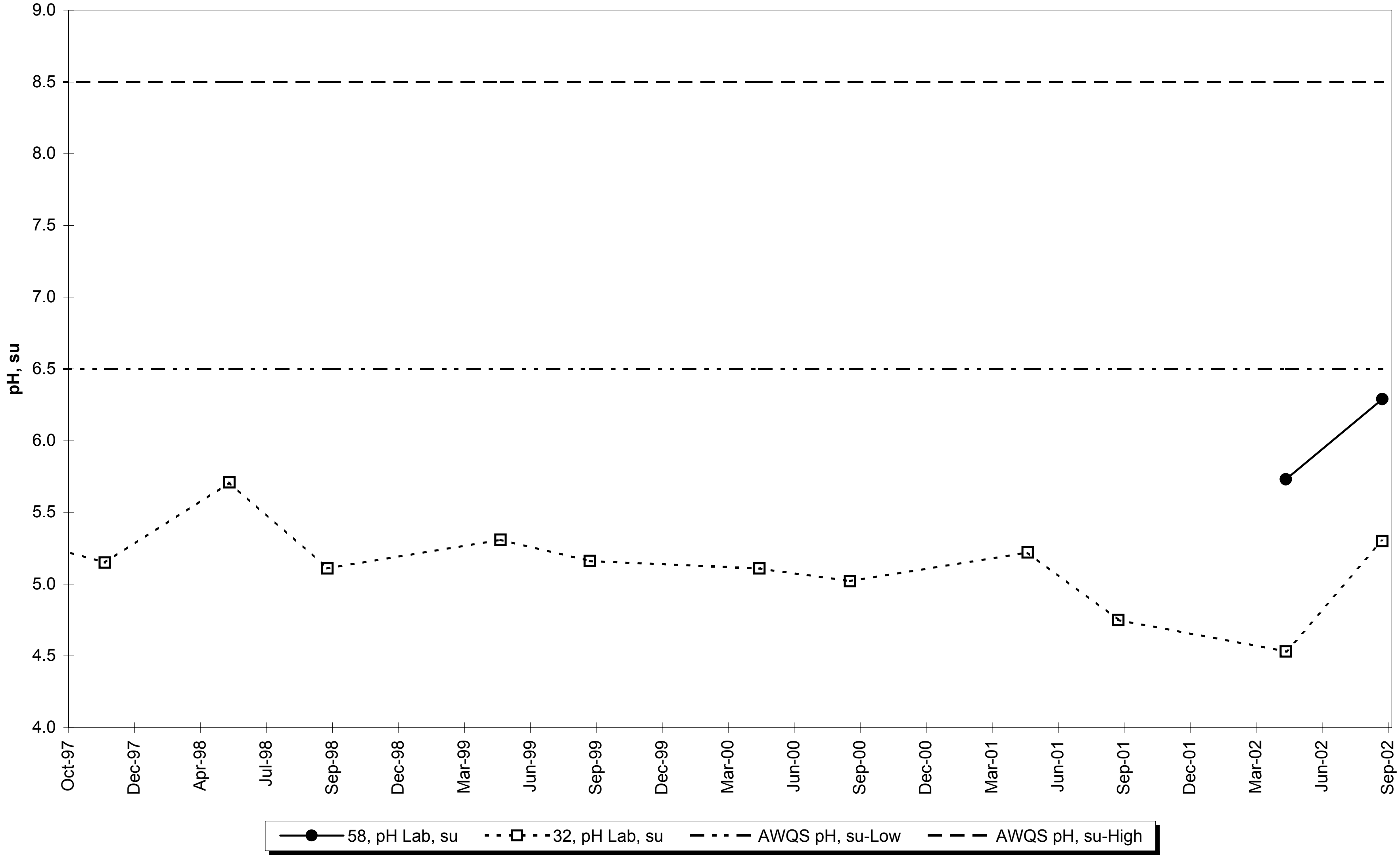
Site 32 -Dissolved Zinc

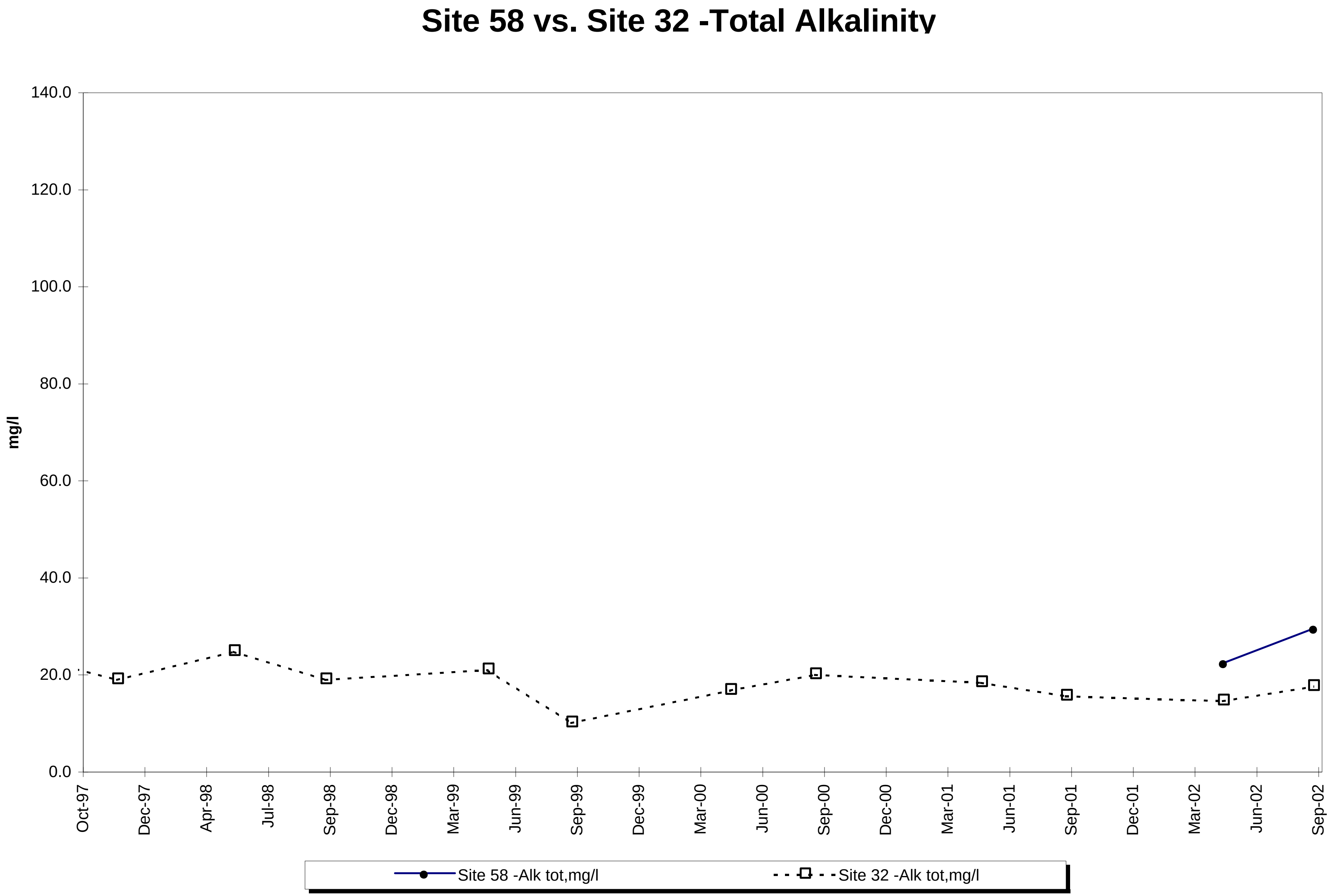


Site 58 vs Site 32 -Conductivity-Lab



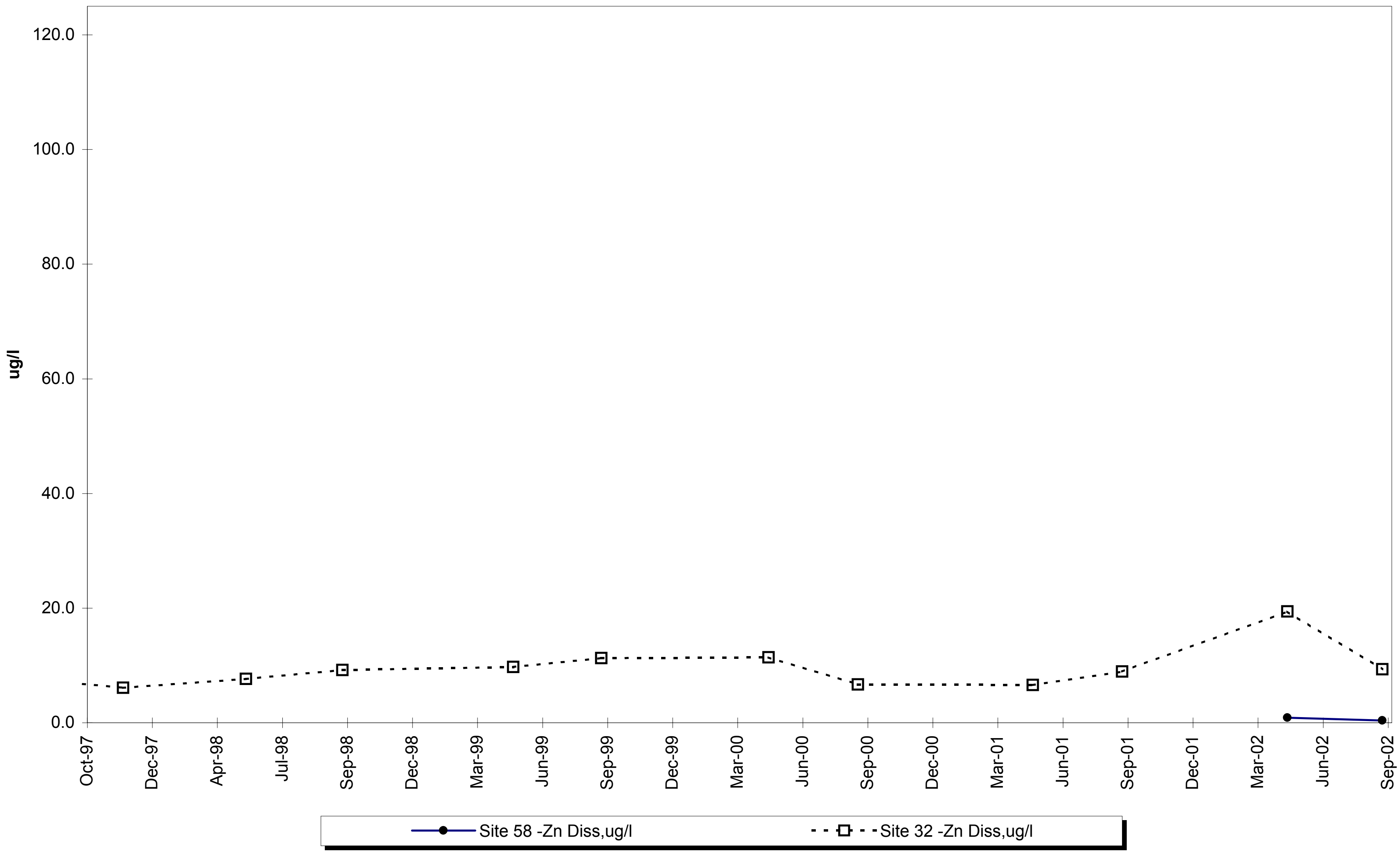
Site 58 vs. Site 32 -Lab pH





Site 58 vs. Site 32 -Total Alkalinity
mg/l
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Site 58 -Alk tot,mg/l
Site 32 -Alk tot,mg/l

Site 58 vs. Site 32 -Dissolved Zinc



INTERPRETIVE REPORT
SITE 59 “MONITORING WELL T-00-01A”

Sampling at this site was added to the FWMP in May-2002. All data collected at this site since it’s inception into the FWMP are included in the data analyses. As shown in the table below, there were no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-97 though Sept-02.				

The data collected during the current water year are listed in the following “Table of Results for Water Year 2002” report. The table includes all the data, field and lab, collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of zero for the purpose of median calculation.

The data for water year 2002 have been compared to the strictest fresh water quality criterion for each applicable analyte. One (1) result exceeding these criteria has been identified, as listed on the following “Comparison To Standards” report. This datum is a lab pH for which the corresponding field pH was 7.55 which is within AWQS.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. The inception of sampling at this site commenced in the 2002 water year and thus only two data points are shown on each graph. There are no apparent trends present in the limited data collected to data.

Table of Results for Water Year 2002

Site 59 "MW-T-00-01A"													
Sample Date/Parameter	10/25/2001	11/15/2001	12/5/2001	1/29/2002	2/21/2002	3/19/2002	4/1/2002	5/7/2002	6/11/2002	7/15/2002	8/27/2002	9/17/2002	**Median**
Water Temp (°C)	NOT SCHEDULED FOR SAMPLING							7.6	NOT SCHEDULED FOR SAMPLING			7.9	7.8
Conductivity-Field (μmho)								105				109	107
Conductivity-Lab (μmho)								111				111	111
pH Lab (standard units)								5.92				6.82	6.37
pH Field (standard units)								6.55				6.57	6.56
Total Alkalinity (mg/l)								43.6				47.7	45.7
Hardness (mg/l)								48.8				42.9	45.9
Dissolved As (μg/l)								0.235 J				0.120 J	0.178
Dissolved Ba (μg/l)								7.1				7.9 J	7.5
Dissolved Cd (μg/l)								0.011 J				0.013	0.012
Dissolved Cr (μg/l)								4.110				5.040	4.575
Dissolved Cu (μg/l)								0.094 J				0.279	0.186
Dissolved Pb (μg/l)								0.0243 J				0.0871	0.0557
Dissolved Ni (μg/l)								1.04				0.80 J	0.92
Dissolved Ag (μg/l)								<0.0080 UJ				<0.0330	0.0103
Dissolved Zn (μg/l)								3.42				1.30 U	2.36
Dissolved Se (μg/l)								<0.475				0.367 J	0.302
Dissolved Hg (μg/l)								0.000304 UJ				0.000385 U	0.000345

See "Qualififed Data by QA Reviewer" table for qualifier descriptions.

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

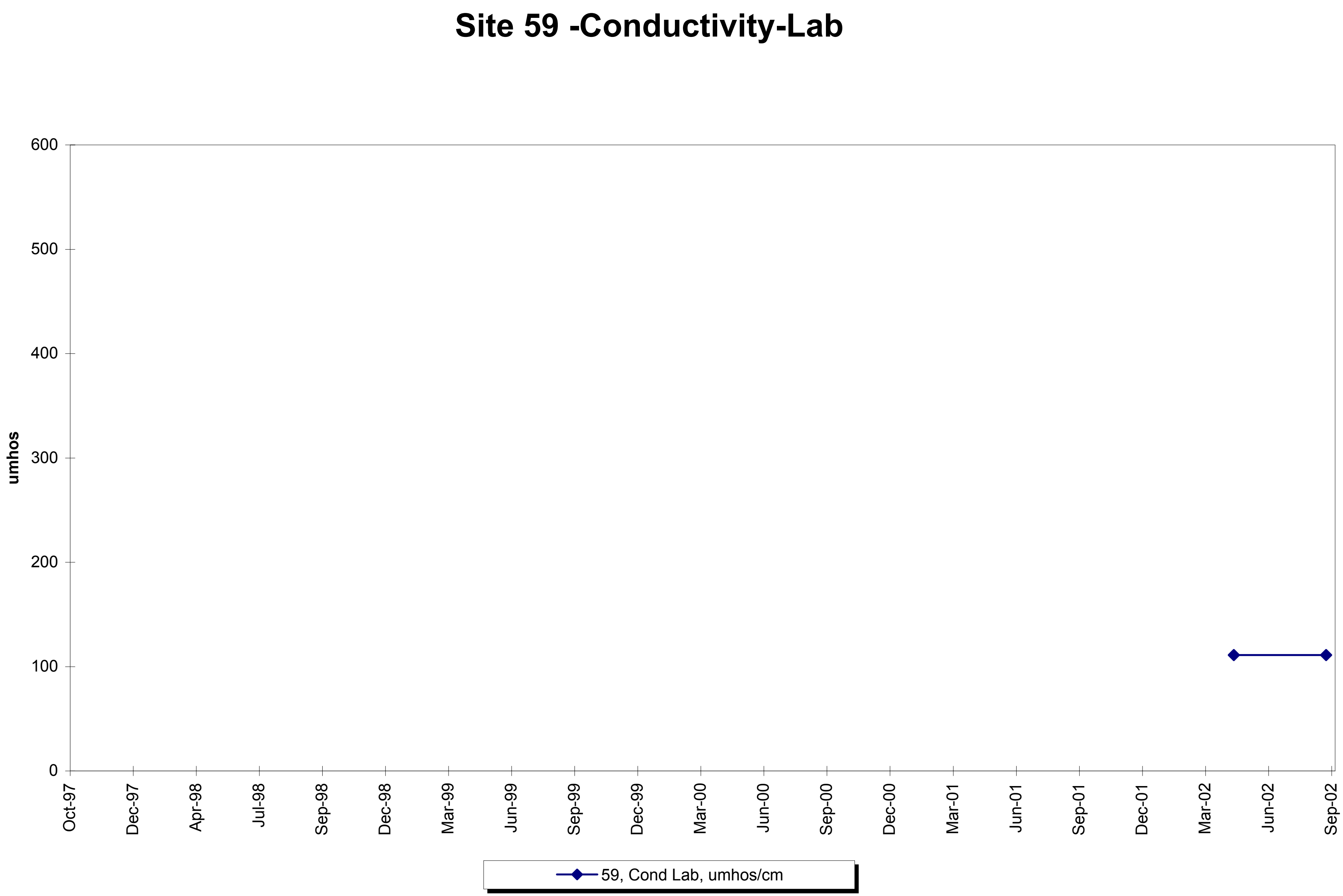
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
59	05/07/2002	1:45:00 PM				
			As Diss, ug/l	0.235	J	Below Quantitative Range
			Cd Diss, ug/l	0.0112	J	Below Quantitative Range, C
			Cu Diss, ug/l	0.0937	J	Below Quantitative Range
			Pb Diss, ug/l	0.0243	J	Below Quantitative Range
			Ag Diss, ug/l	-0.008	UJ	CCV Rec.
			Hg Diss, ug/l	0.000304	UJ	Below Quantitative Range, C
59	09/17/2002	12:35:00 PM				
			As Diss, ug/l	0.12	J	Below Quantitative Range
			Ba Diss, ug/l	7.86	J	CCV Rec., LCS Rec.
			Ni Diss, ug/l	0.804	J	CCV Rec.
			Zn Diss, ug/l	1.3	U	Field Blank Contamination
			Se Diss, ug/l	0.367	J	Below Quantitative Range
			Hg Diss, ug/l	0.000385	U	Field Blank Contamination

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

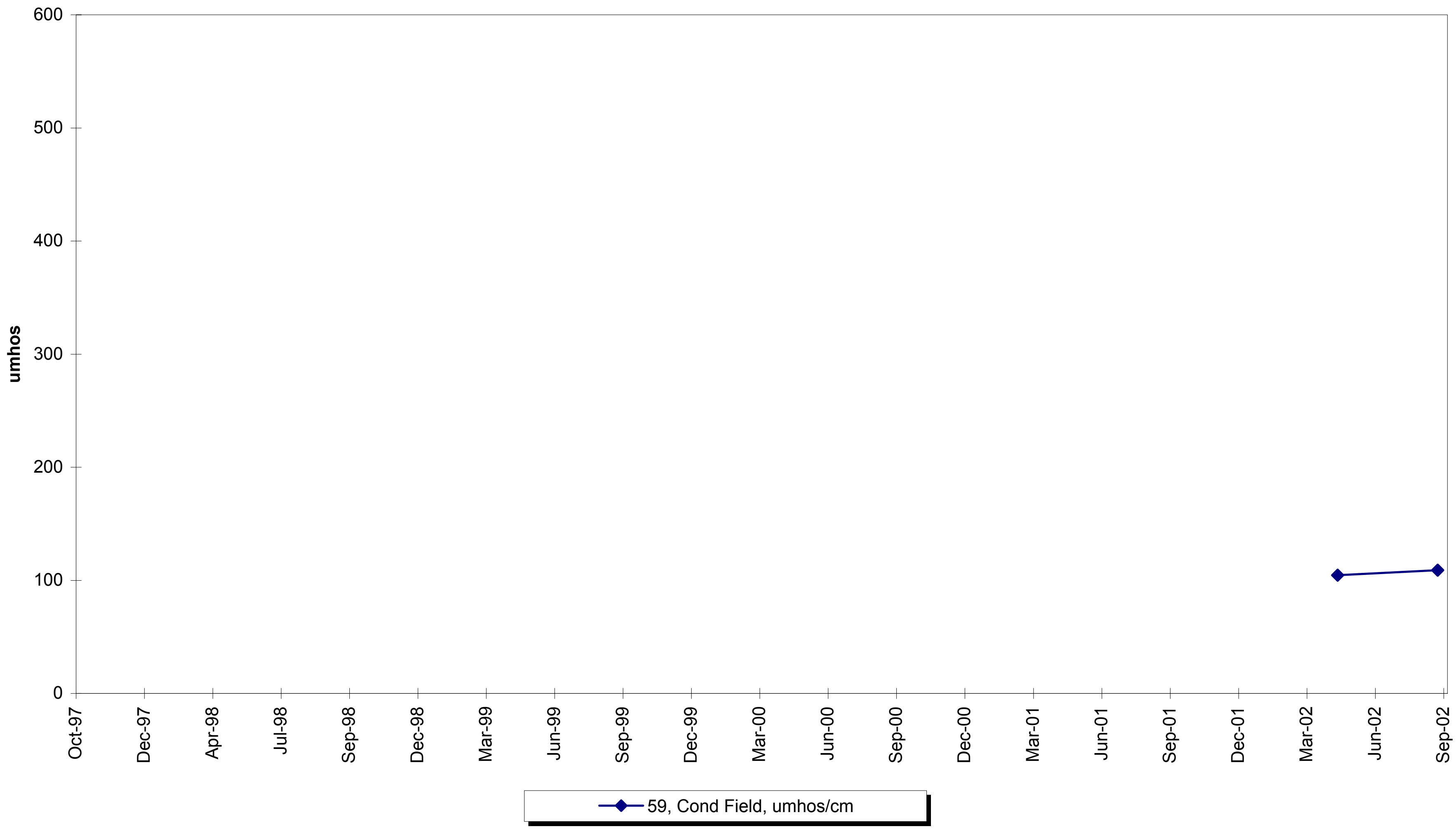
Comparison To Standards

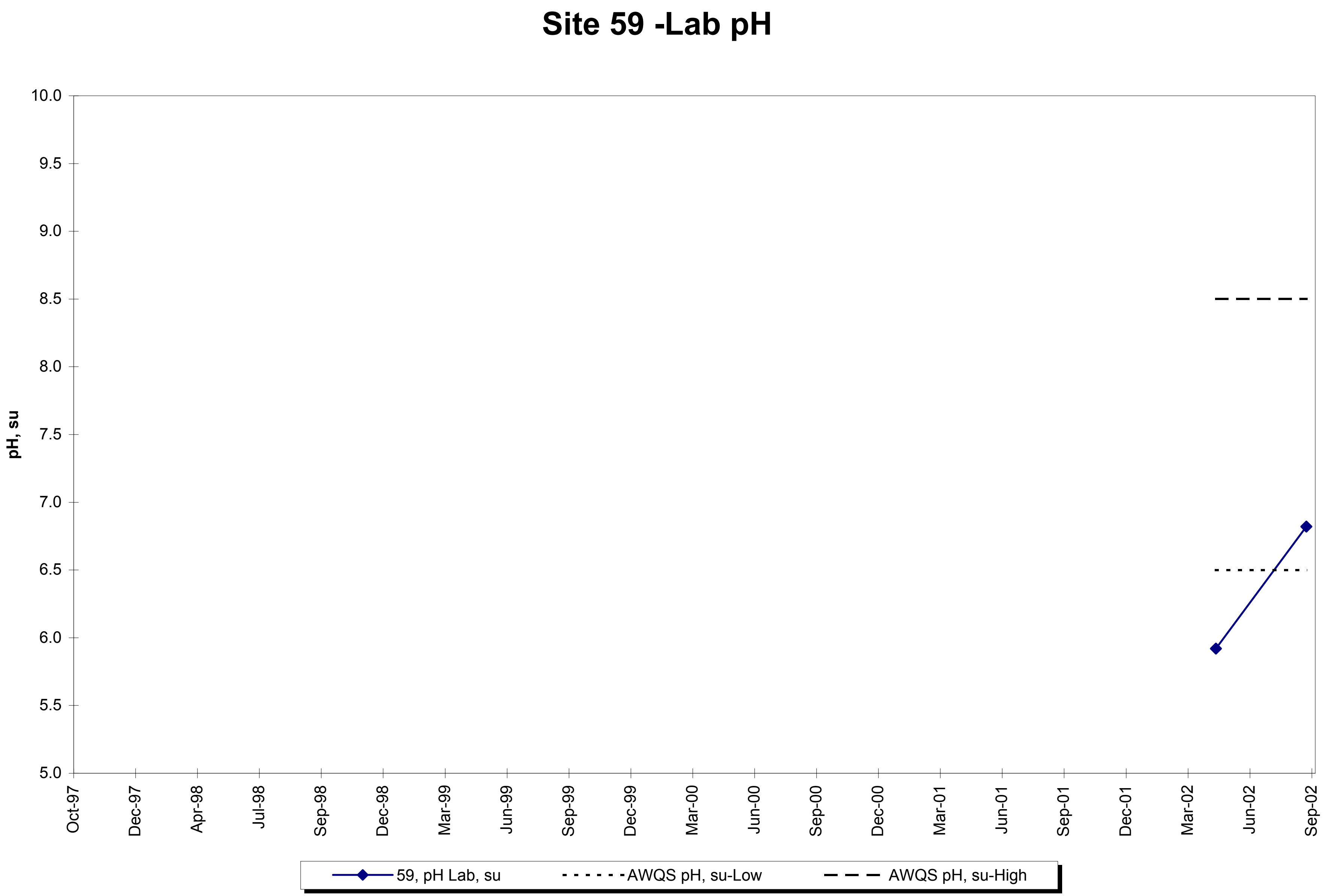
Date Range: 10/01/2001 to 09/30/2002

Site Number	Date	Time	Dup ID	Storet No.	Parameter Description	Value	Standard	Standard Type
59	05/07/2002	1:45 PM	0	403	pH Lab, su	5.92	6.5- 8.5	Aquatic

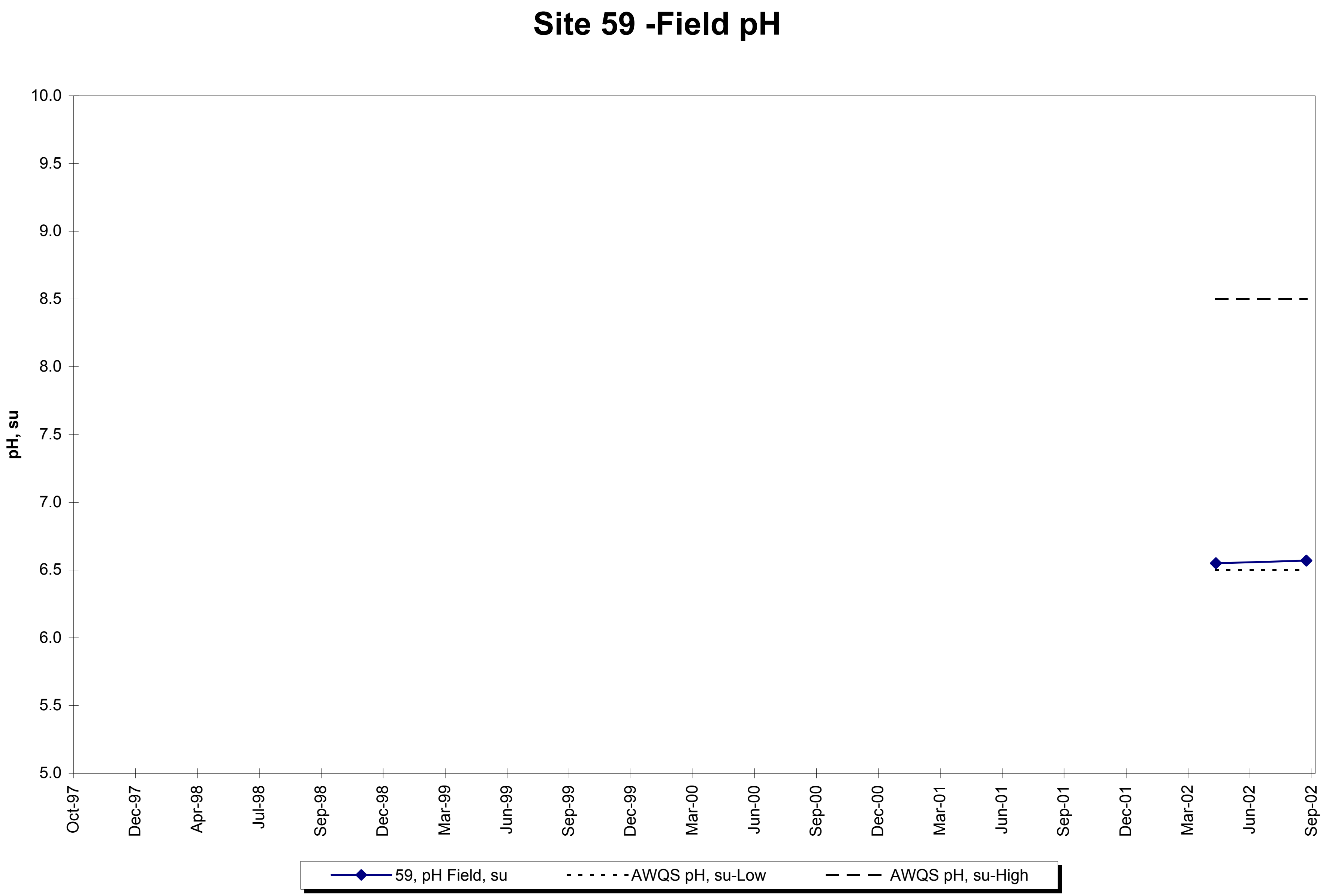

Site 59 -Conductivity-Lab
umhos
600
500
400
300
200
100
0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
59, Cond Lab, umhos/cm

Site 59 -Conductivity-Field



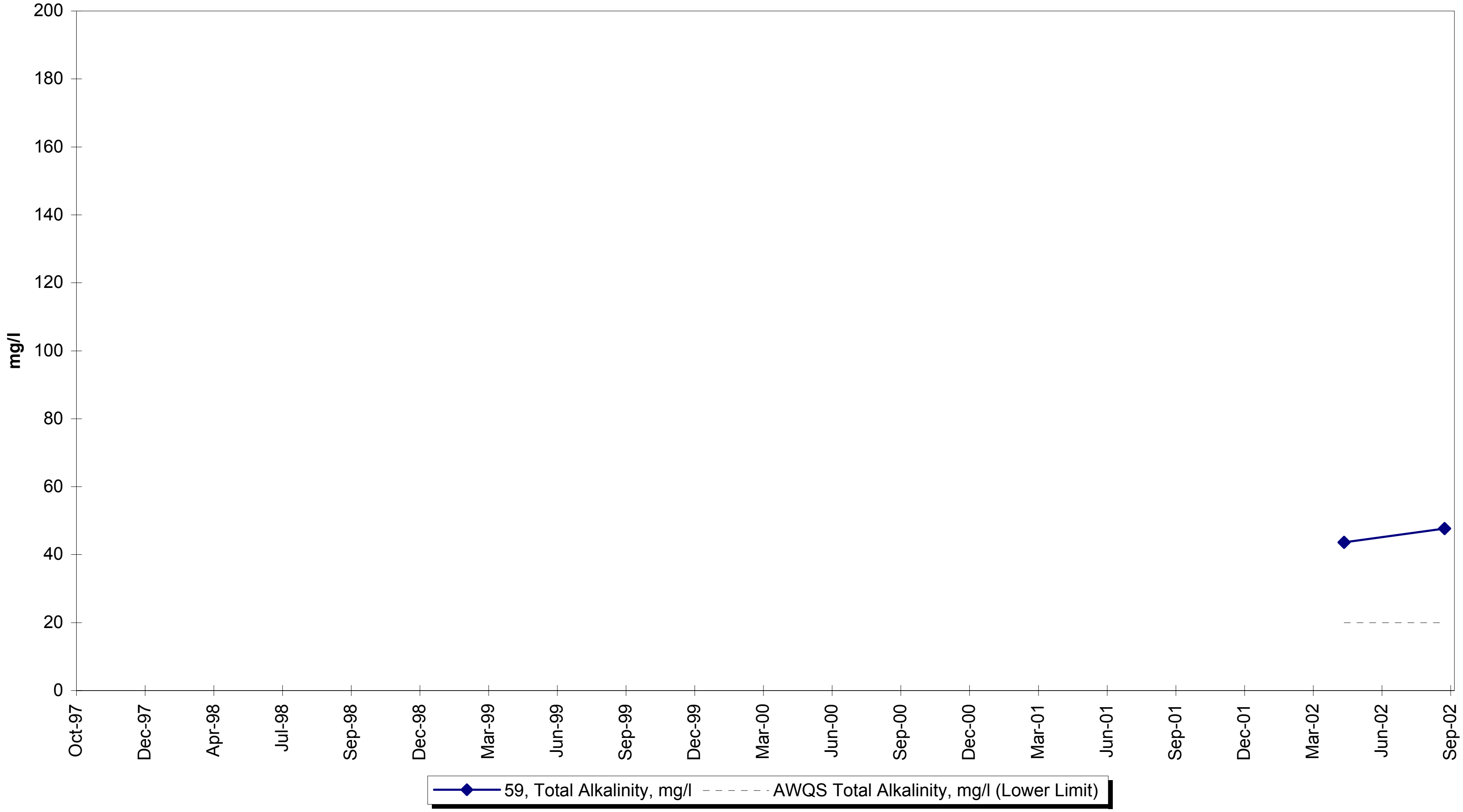


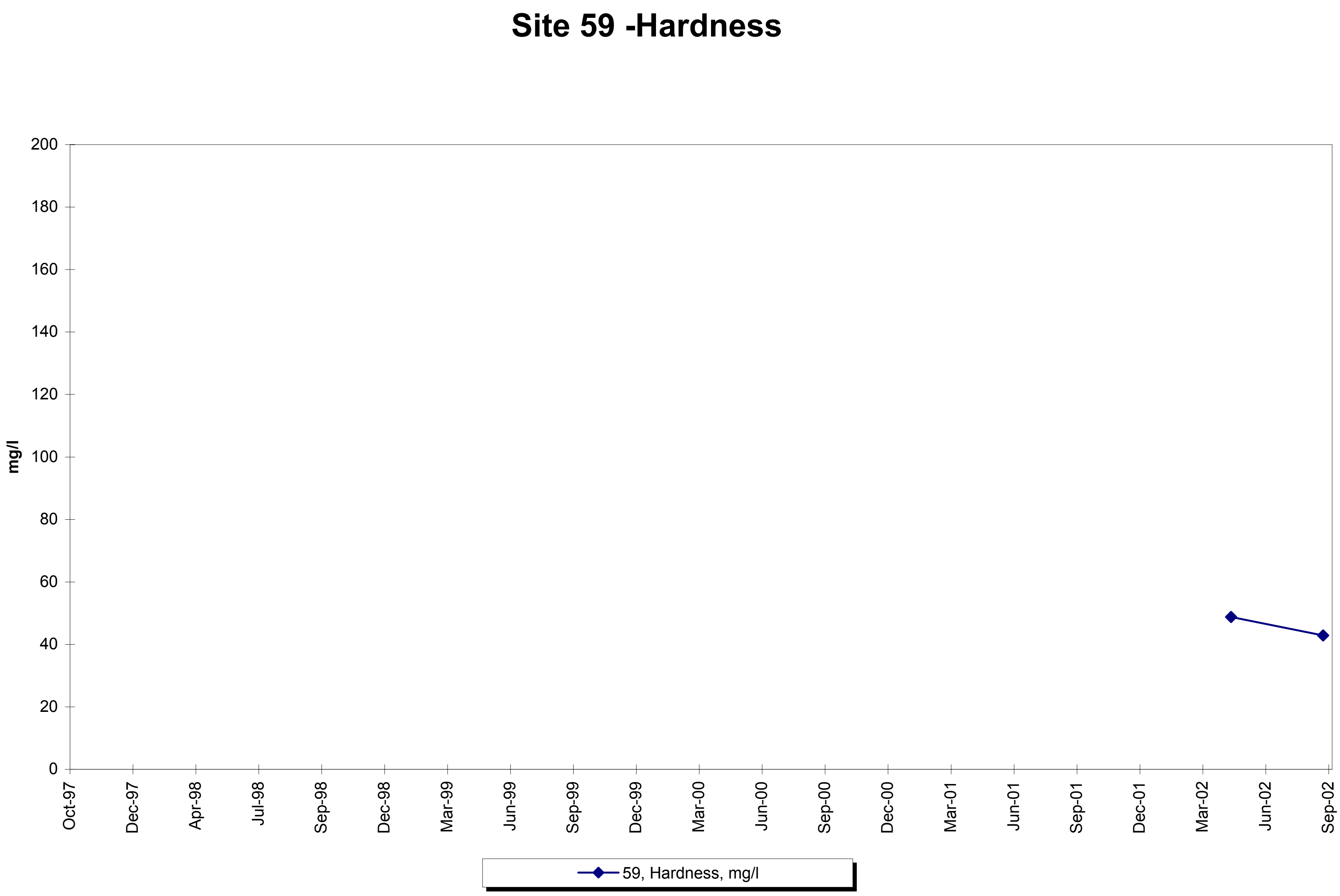
Site 59 -Lab pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
59, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

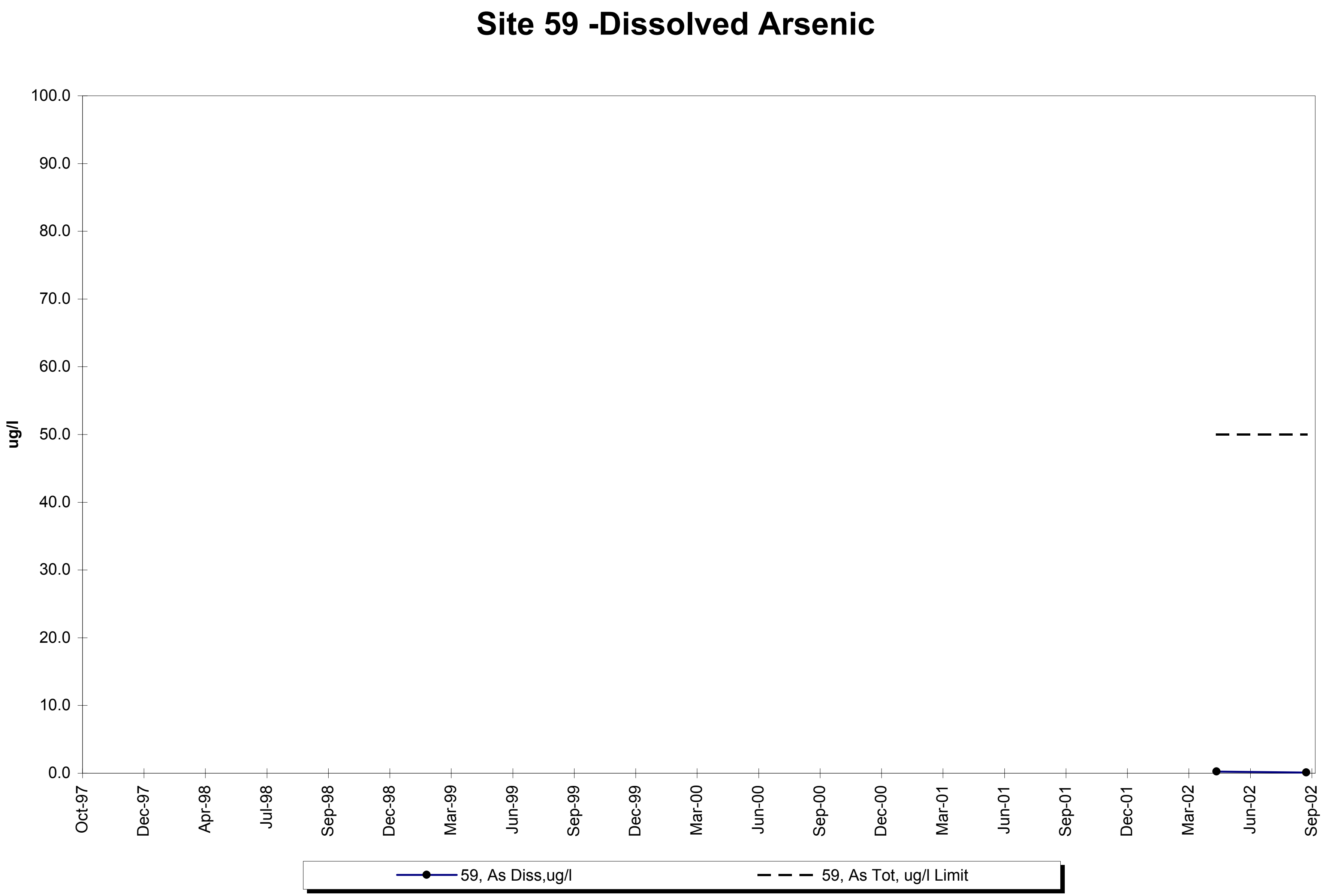


Site 59 -Field pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
59, pH Field, su
AWQS pH, su-Low
AWQS pH, su-High

Site 59 -Total Alkalinity

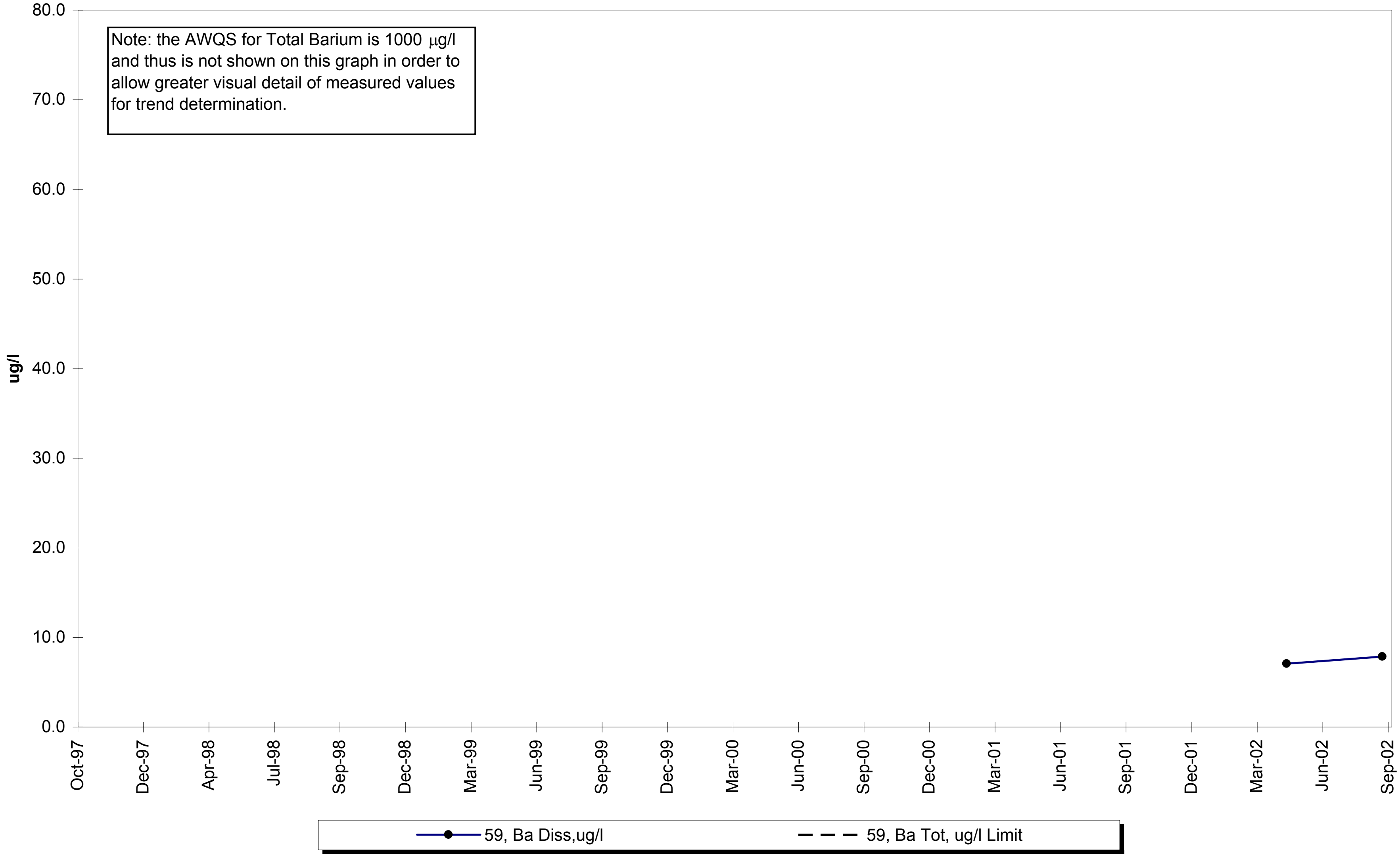


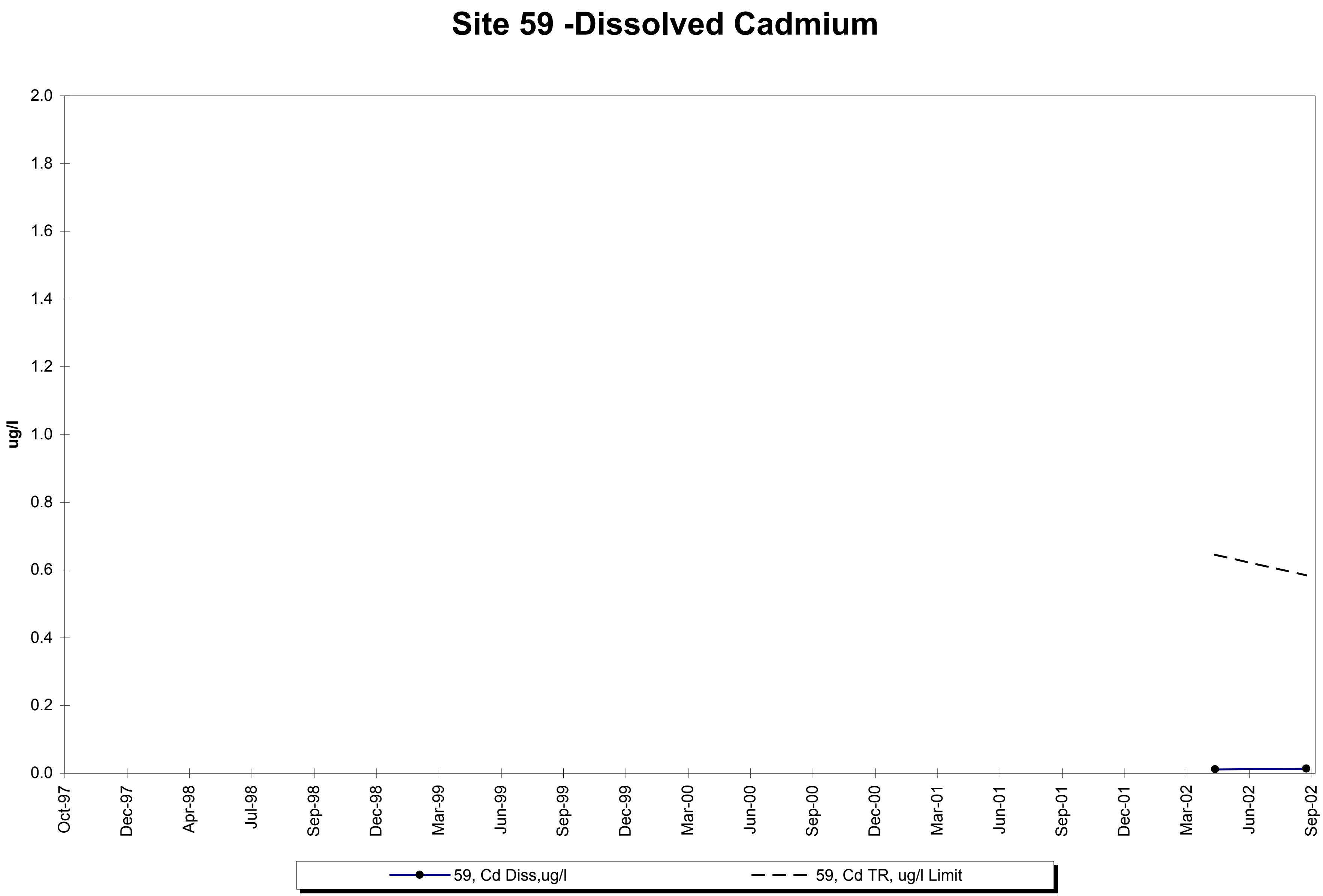

Site 59 -Hardness
mg/l
200
180
160
140
120
100
80
60
40
20
0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
59, Hardness, mg/l

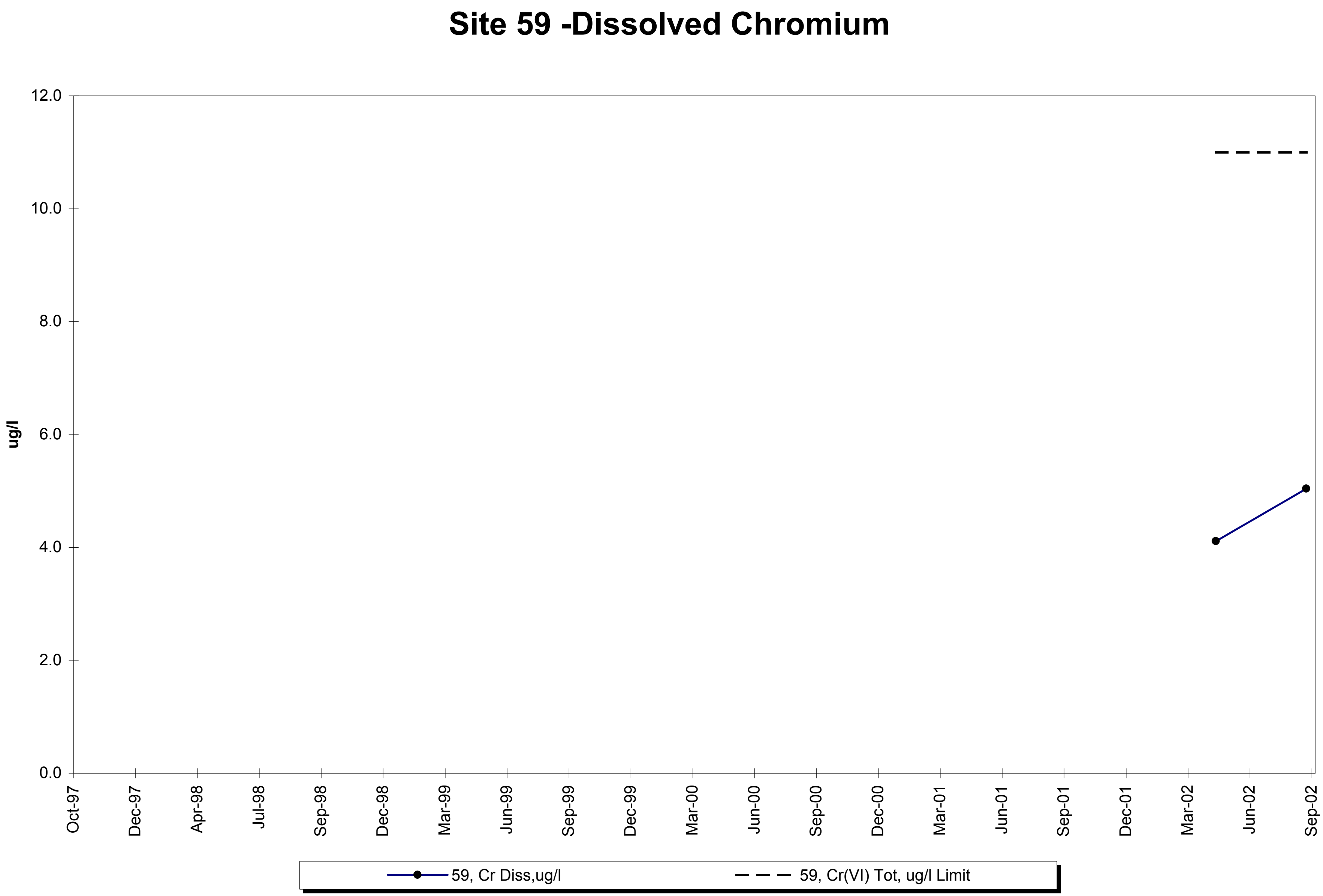


Site 59 -Dissolved Arsenic
ug/l
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
59, As Diss,ug/l
59, As Tot, ug/l Limit

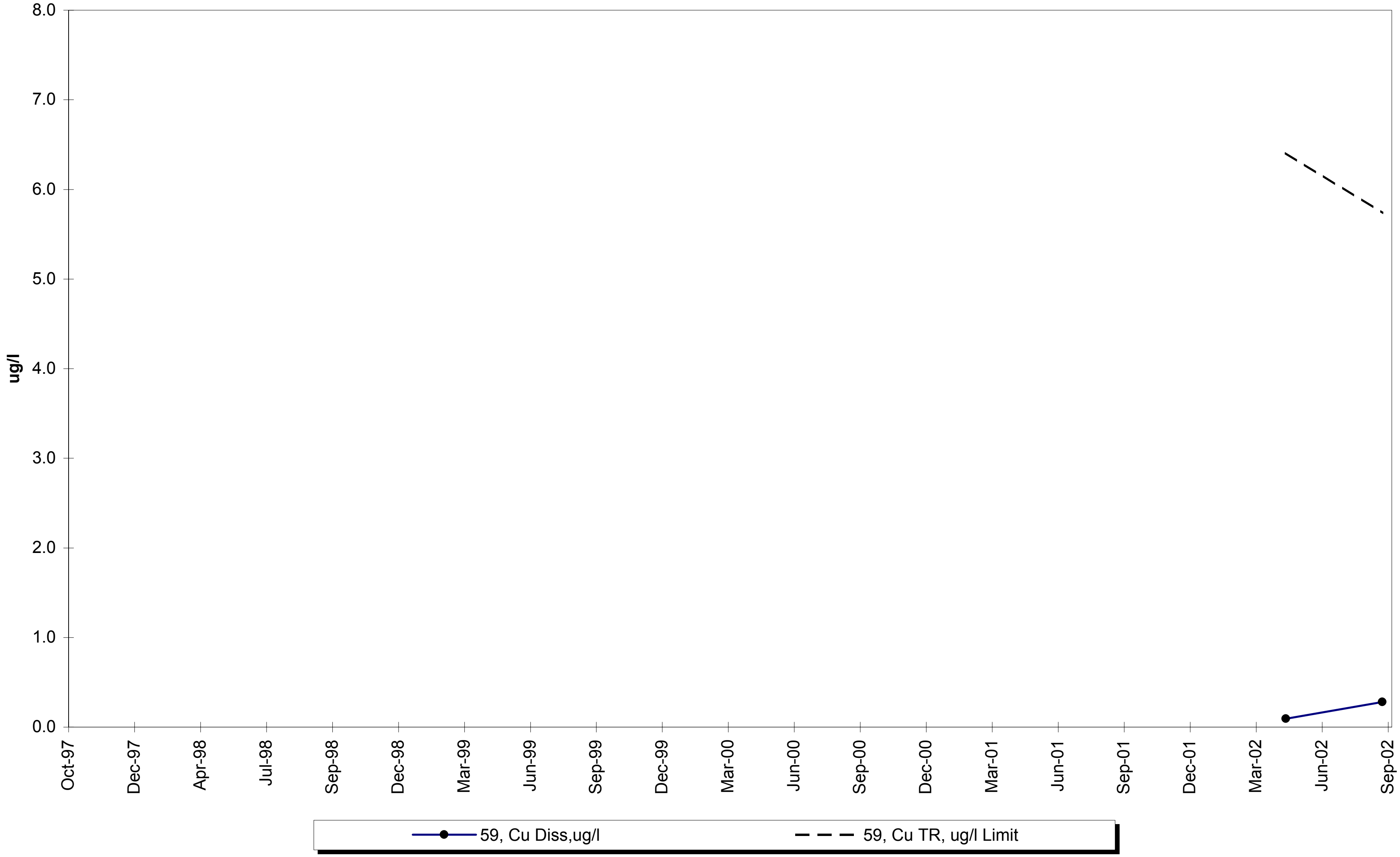
Site 59 -Dissolved Barium

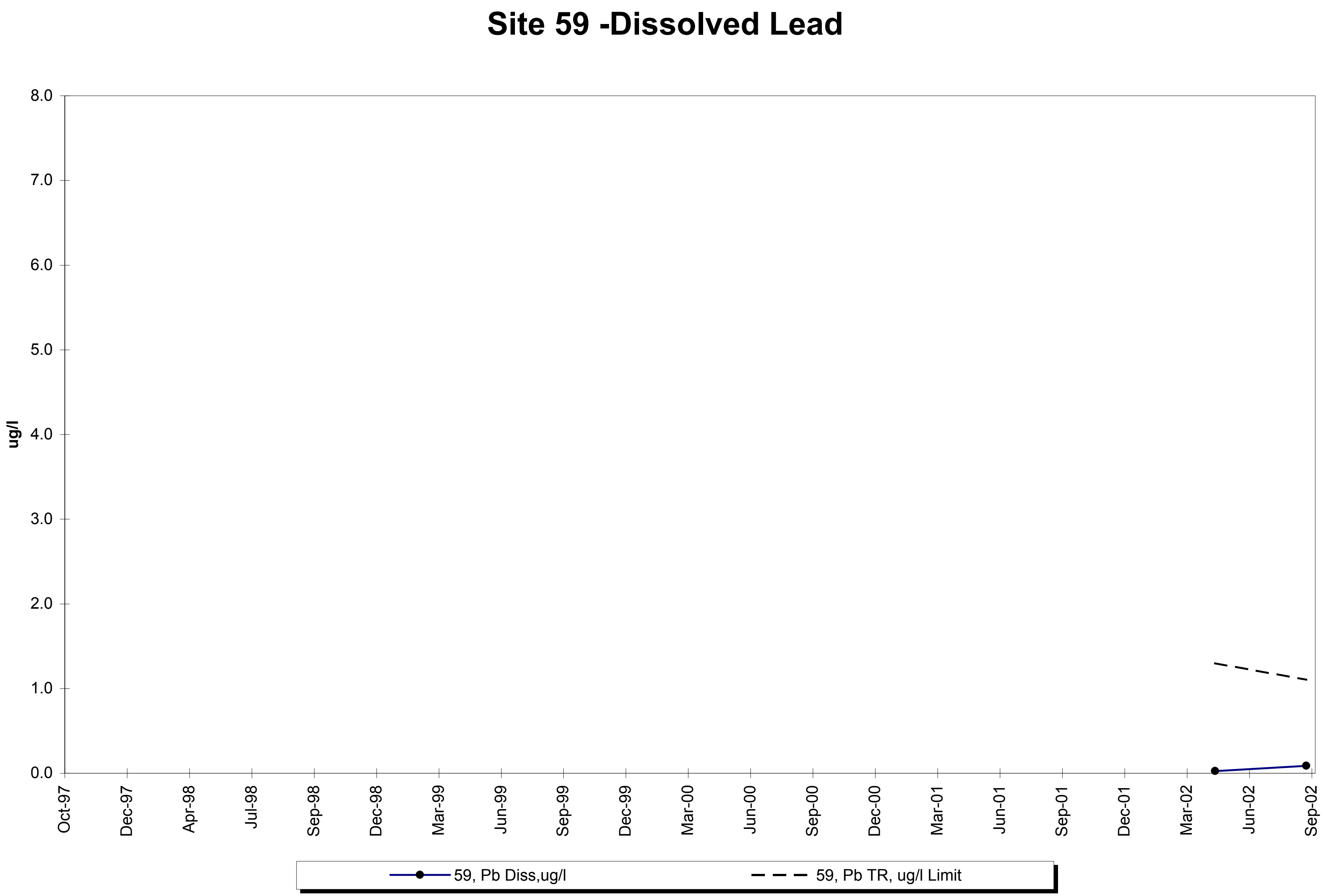



Site 59 -Dissolved Cadmium
ug/l
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
59, Cd Diss,ug/l
59, Cd TR, ug/l Limit

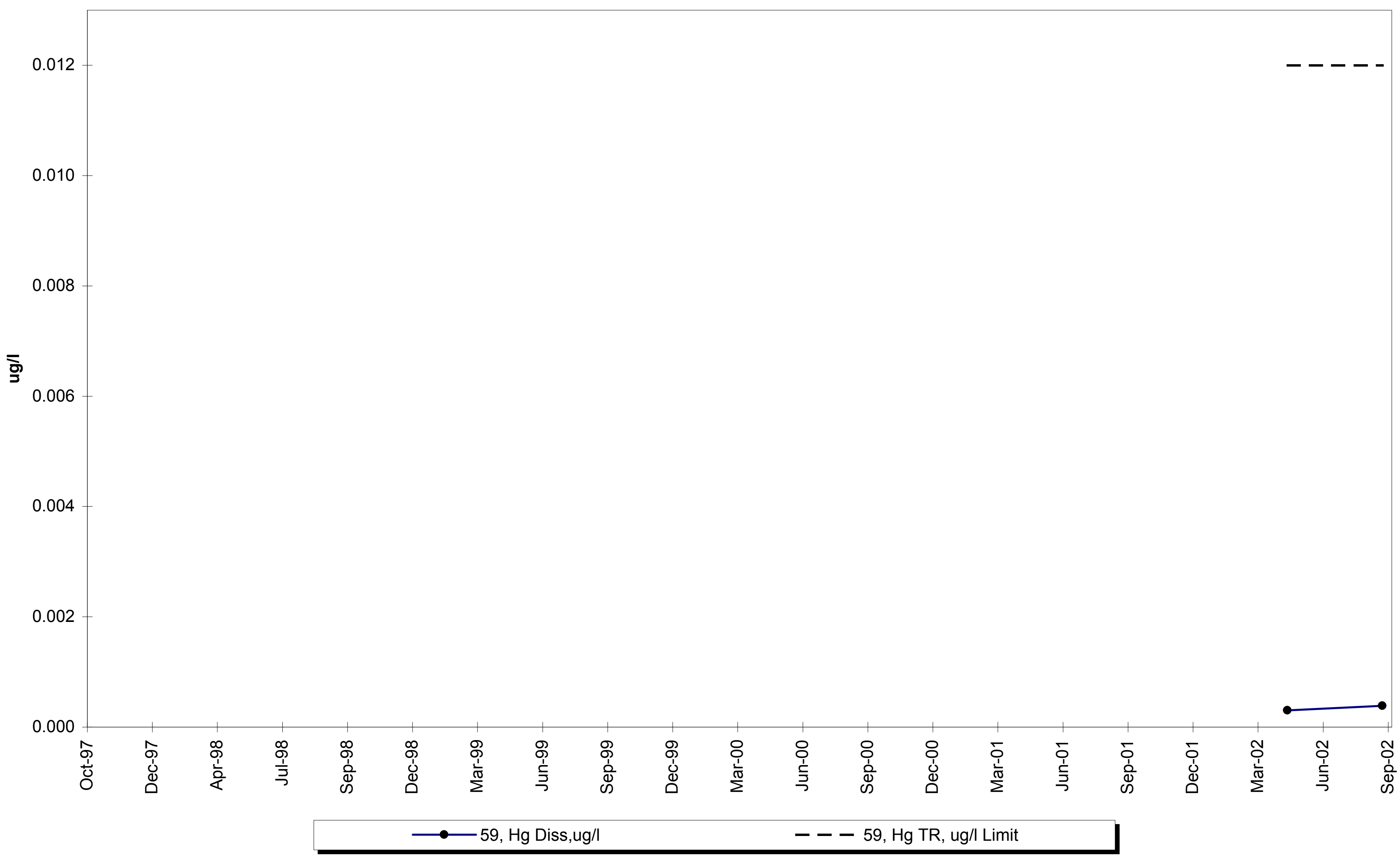

Site 59 -Dissolved Chromium
ug/l
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
59, Cr Diss,ug/l
59, Cr(VI) Tot, ug/l Limit

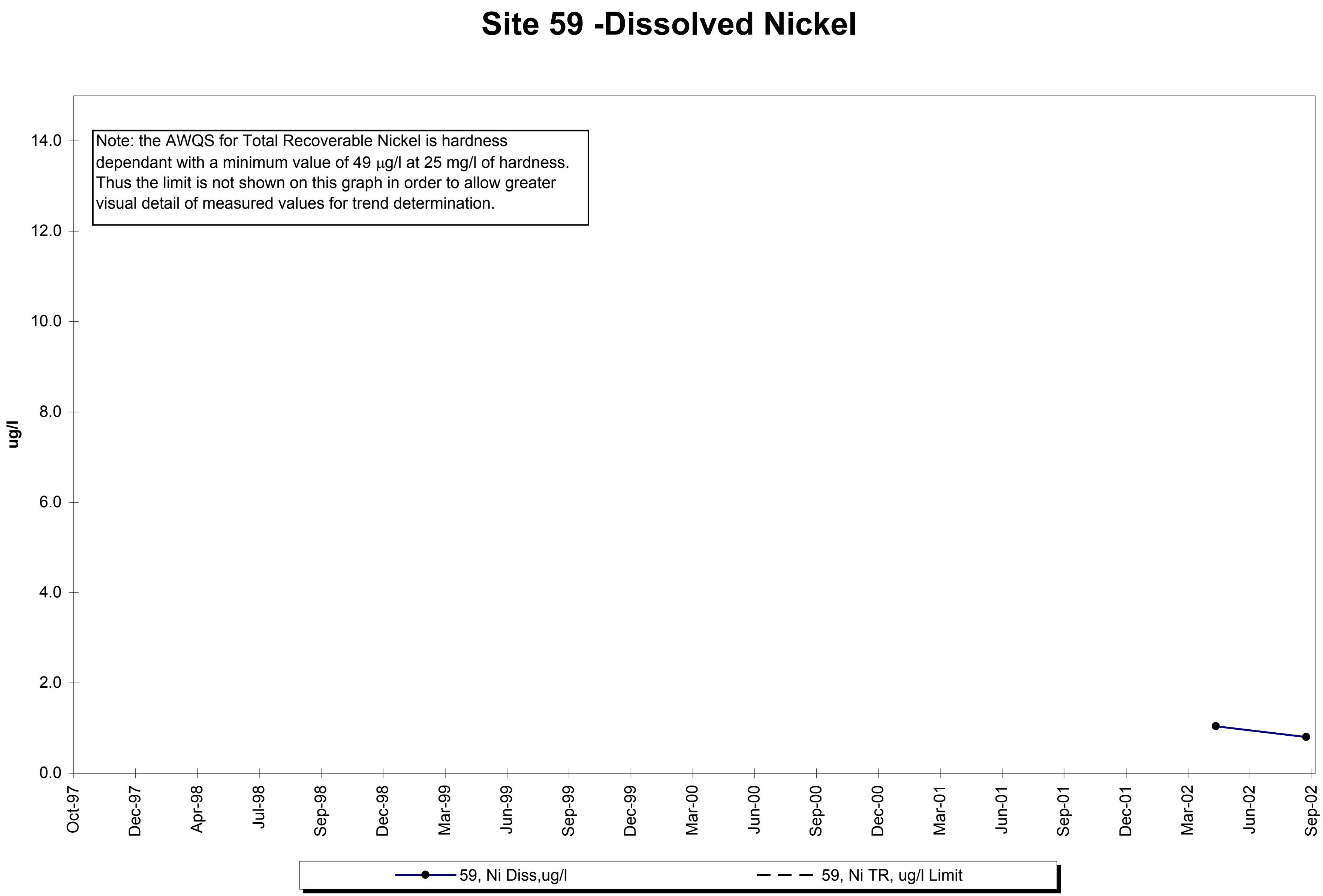
Site 59 -Dissolved Copper



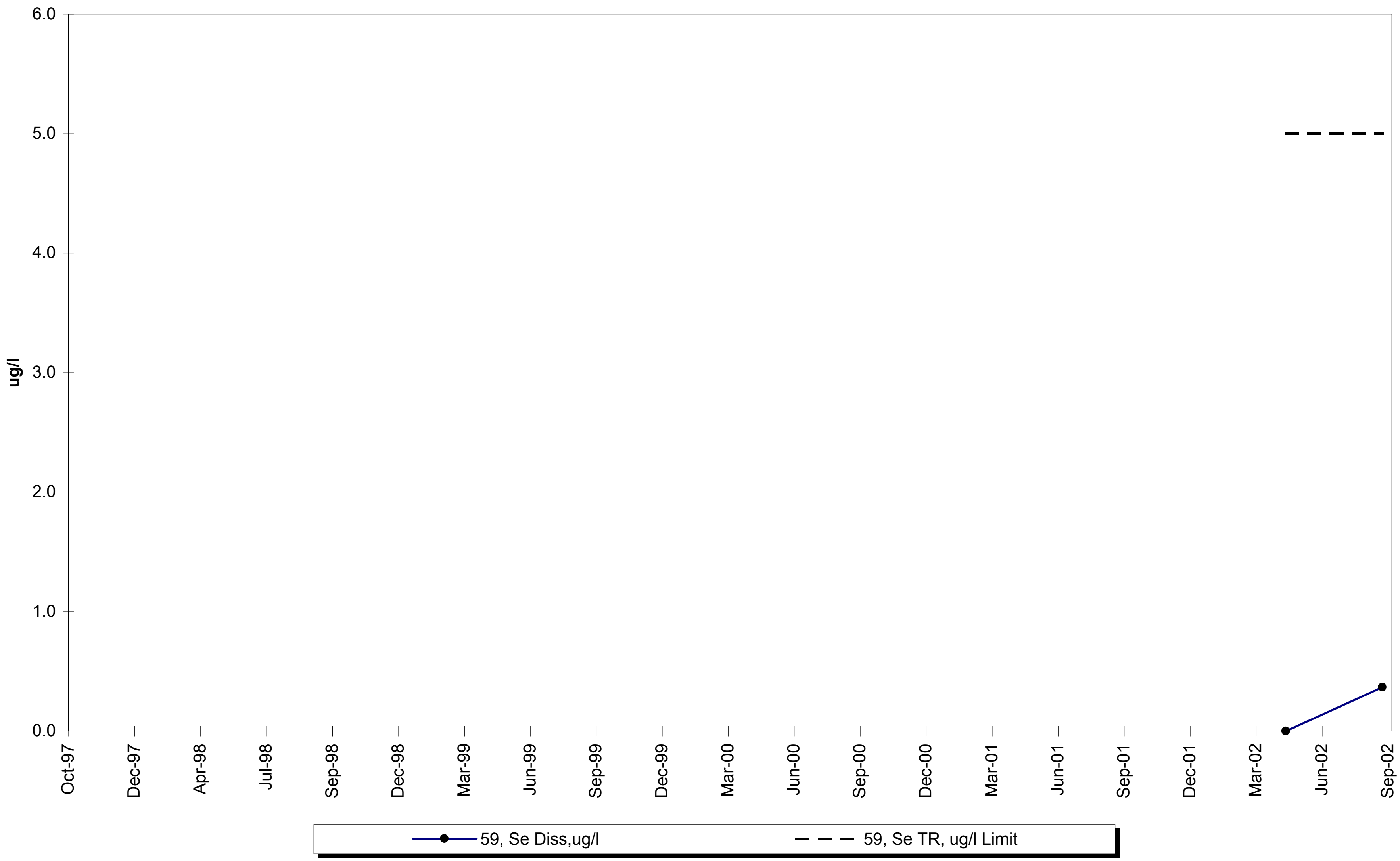

Site 59 -Dissolved Lead
ug/l
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
59, Pb Diss,ug/l
59, Pb TR, ug/l Limit

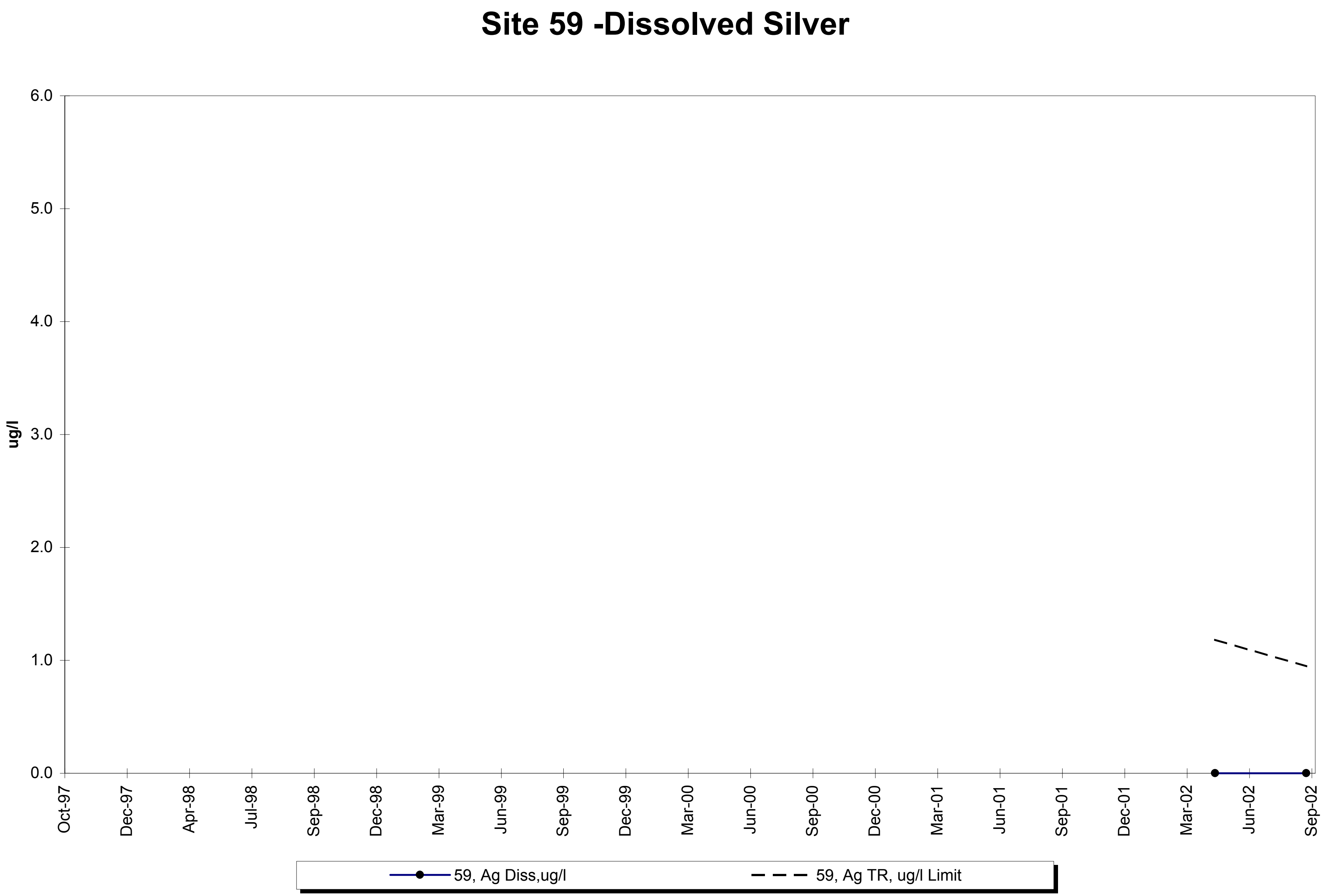
Site 59 -Dissolved Mercury

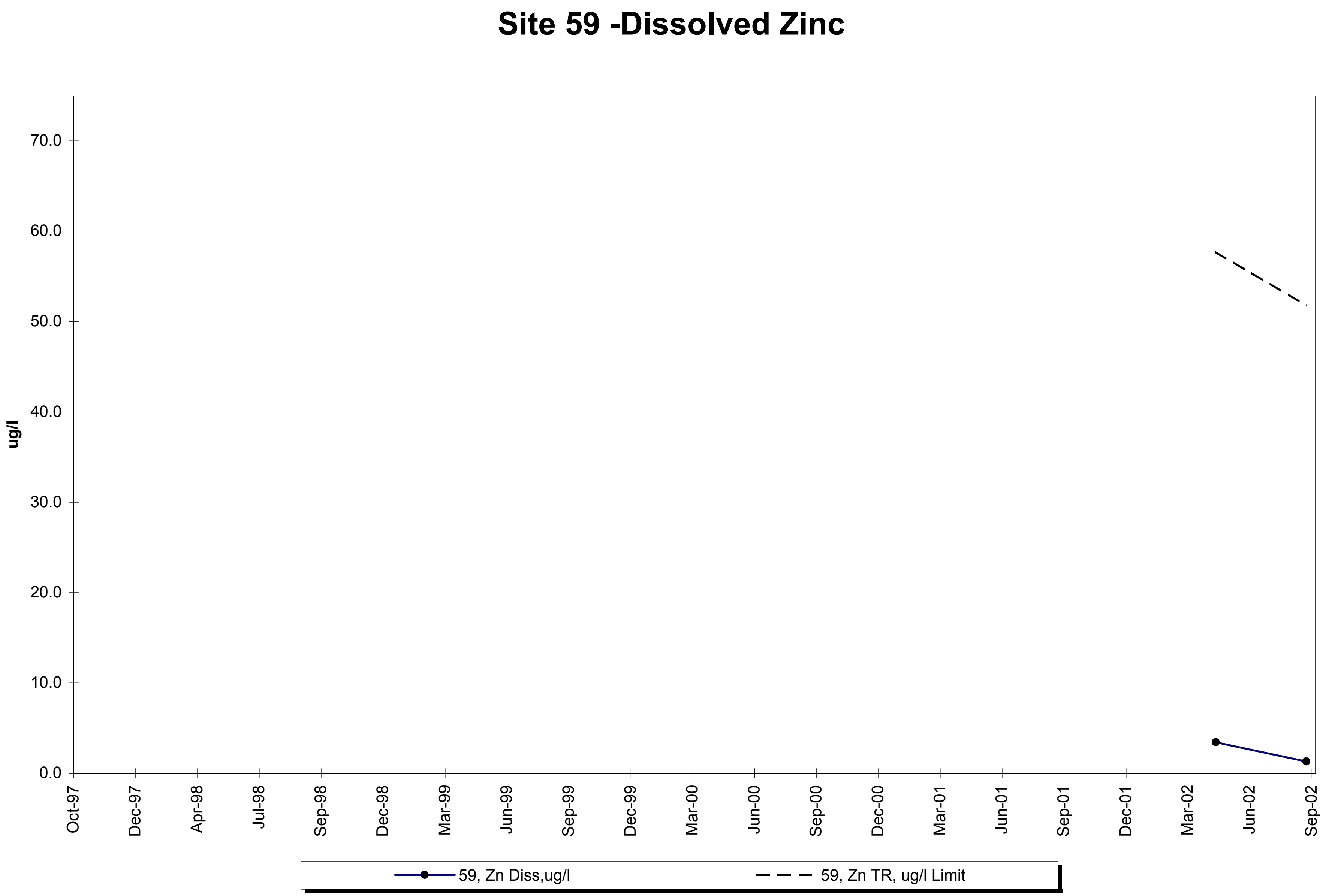



Site 59 -Dissolved Nickel
Note: the AWQS for Total Recoverable Nickel is hardness dependant with a minimum value of 49 µg/l at 25 mg/l of hardness. Thus the limit is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
59, Ni Diss,ug/l
59, Ni TR, ug/l Limit

Site 59 -Dissolved Selenium




Site 59 -Dissolved Silver
ug/l
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
59, Ag Diss,ug/l
59, Ag TR, ug/l Limit


Site 59 -Dissolved Zinc
ug/l
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
59, Zn Diss,ug/l
59, Zn TR, ug/l Limit

INTERPRETIVE REPORT
SITE 28 "MONITORING WELL 2D"

All data collected at this site for the past five years are included in the data analyses. As shown in the table below, there were no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-97 though Sept-02.				

The data collected during the current water year are listed in the following "Table of Results for Water Year 2002" report. The table includes all the data, field and lab, collected for the current water year and a series of flags keyed to the summary report "Qualified Data by QA Reviewer". The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of zero for the purpose of median calculation.

The data for water year 2002 have been compared to the strictest fresh water quality criterion for each applicable analyte. Three (3) results exceeding these criteria have been identified, as listed on the following "Comparison To Standards" report. One of the exceedances is a lab pH for which the corresponding field pH was 8.34 which is within AWQS. The remaining two datum are for dissolved arsenic values of 68.1 µg/l and 62.8 µg/l for May-2002 and September-2002 respectively which exceed the AWQS of 50 µg/l. This site has routinely returned arsenic values above the AWQS and has a median value of 74.0 µg/l based on sampling since October-1988.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious trends were apparent. Additional X-Y plots have been generated for alkalinity, pH, conductance, and dissolved zinc that plot Site 28 and Site 59, the up-gradient control site, to aid in comparison between those two sites. Total alkalinity, lab pH, and lab conductivity are all higher at Site 28 than at Site 59 while the dissolved zinc concentrations are similar. Site 59 and Site 28 are deep completion wells that are each respectively colocated with Site 58 and Site 27. A similar line of reasoning discussed in the section for Site 28 can be applied to explaining the differences in water chemistry between Site 59 and Site 28. Thus, the generally higher concentrations at Site 28 reflect the more mature nature of the groundwater sampled at this site and the similar values for dissolved zinc are a strong indication of the lack of any influence from tailings contact water.

Table of Results for Water Year 2002

Site 28 "MW-2D"

Sample Date/Parameter	10/25/2001	11/15/2001	12/5/2001	1/29/2002	2/21/2002	3/19/2002	4/1/2002	5/7/2002	6/11/2002	7/15/2002	8/27/2002	9/17/2002	**Median**
Water Temp (°C)								8.2				8.7	8.5
Conductivity-Field (μmho)								248				214	231
Conductivity-Lab (μmho)								240				210	225
pH Lab (standard units)								6.84				8.52	7.68
pH Field (standard units)								8.29				8.34	8.32
Total Alkalinity (mg/l)								93.1				92.9	93.0
Hardness (mg/l)								68.4				73.3	70.9
Dissolved As (μg/l)								68.100				62.800	65.450
Dissolved Ba (μg/l)	**NOT SCHEDULED FOR SAMPLING**							6.3	**NOT SCHEDULED FOR SAMPLING**			8.4 J	7.4
Dissolved Cd (μg/l)								0.010 UJ				<0.004	0.006
Dissolved Cr (μg/l)								<0.149				<0.273	0.106
Dissolved Cu (μg/l)								0.069 J				0.114 J	0.092
Dissolved Pb (μg/l)								0.0316 J				0.0532	0.0424
Dissolved Ni (μg/l)								0.59				0.52 J	0.55
Dissolved Ag (μg/l)								0.0160 UJ				0.0532 J	0.0346
Dissolved Zn (μg/l)								1.57 J				1.03 U	1.30
Dissolved Se (μg/l)								<0.475				<0.162	0.159
Dissolved Hg (μg/l)								0.000293 J				0.000285 UJ	0.000289

See "Qualified Data by QA Reviewer" table for qualifier descriptions.

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
28	05/07/2002	12:55:00 PM				
			Cd Diss, ug/l	-0.007	UJ	CCV Rec.
			Cu Diss, ug/l	0.0793	J	Below Quantitative Range
			Pb Diss, ug/l	0.0515	J	Below Quantitative Range
			Ag Diss, ug/l	-0.008	UJ	CCV Rec.
			Zn Diss, ug/l	1.12	J	Below Quantitative Range
			Hg Diss, ug/l	0.00119	J	CCV Rec, LCS Rec, LCS RP
28	09/17/2002	1:25:00 PM				
			Ba Diss, ug/l	8.39	J	CCV Rec, LCS Rec.
			Cu Diss, ug/l	0.114	J	Below Quantitative Range
			Ni Diss, ug/l	0.518	J	CCV Rec.
			Ag Diss, ug/l	0.0532	J	Below Quantitative Range
			Zn Diss, ug/l	1.03	U	Field Blank Contamination
			Hg Diss, ug/l	0.000285	UJ	Below Quantitative Range, Fi

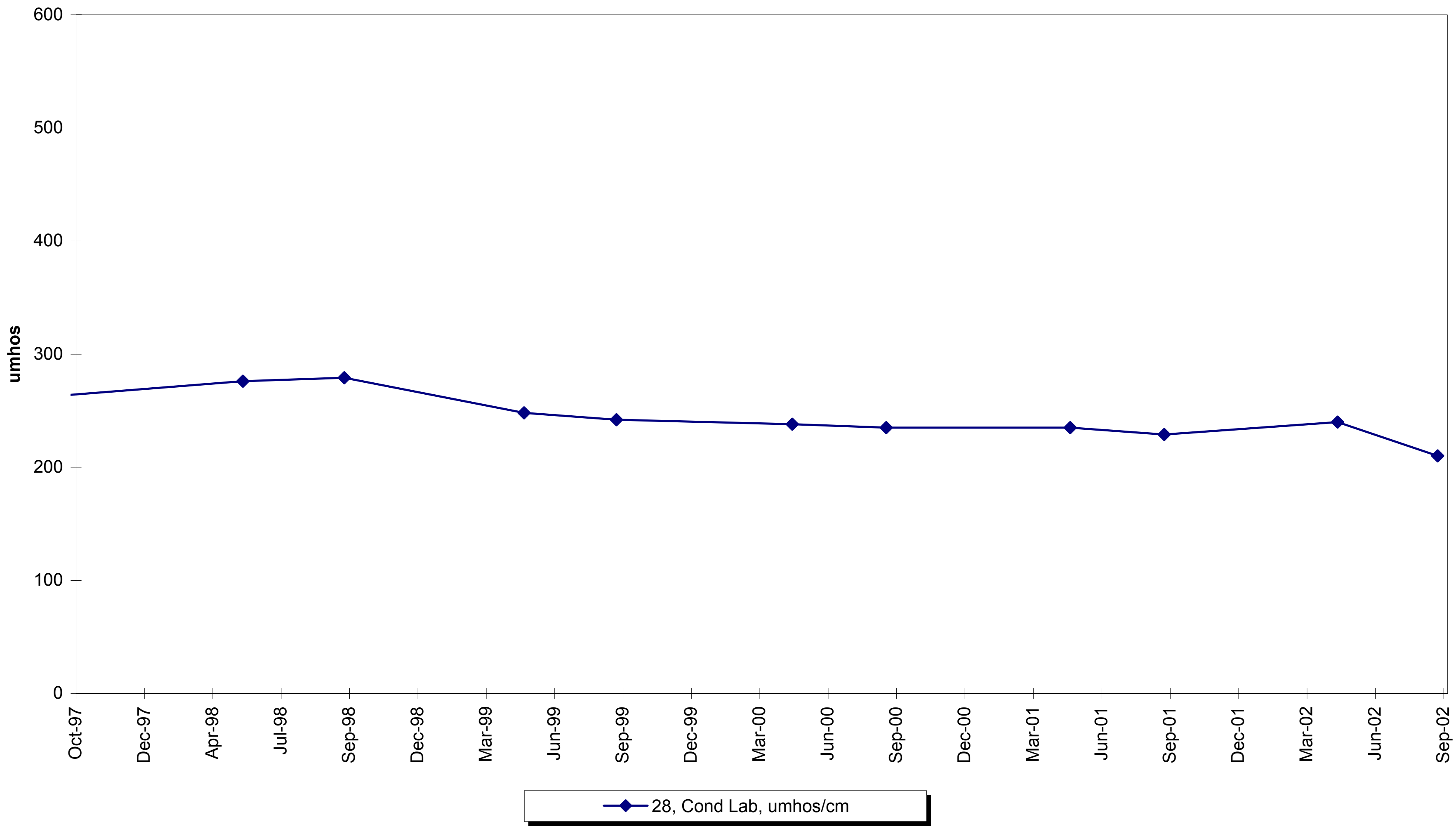
Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Comparison To Standards

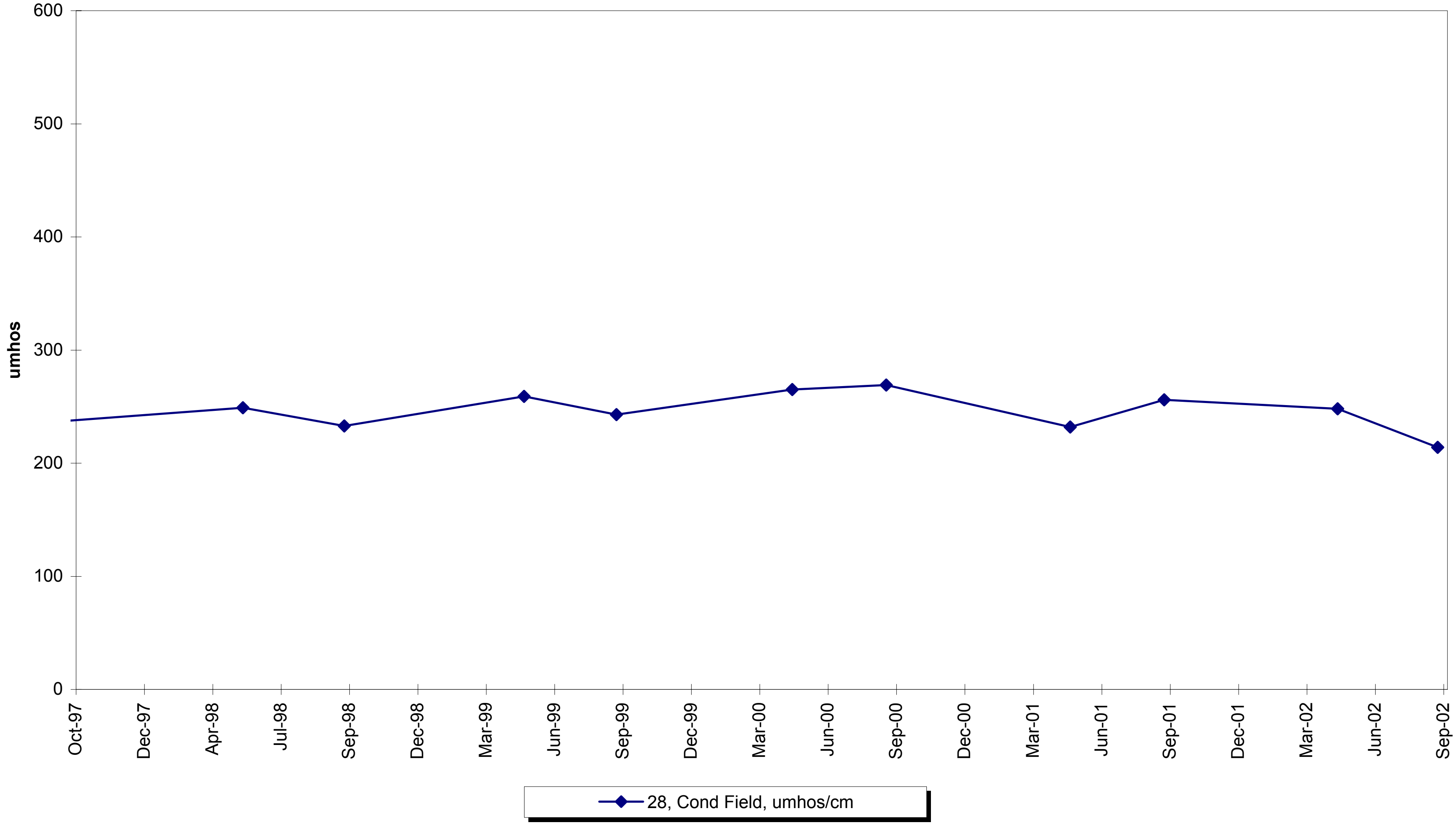
Date Range: 10/01/2001 to 09/30/2002

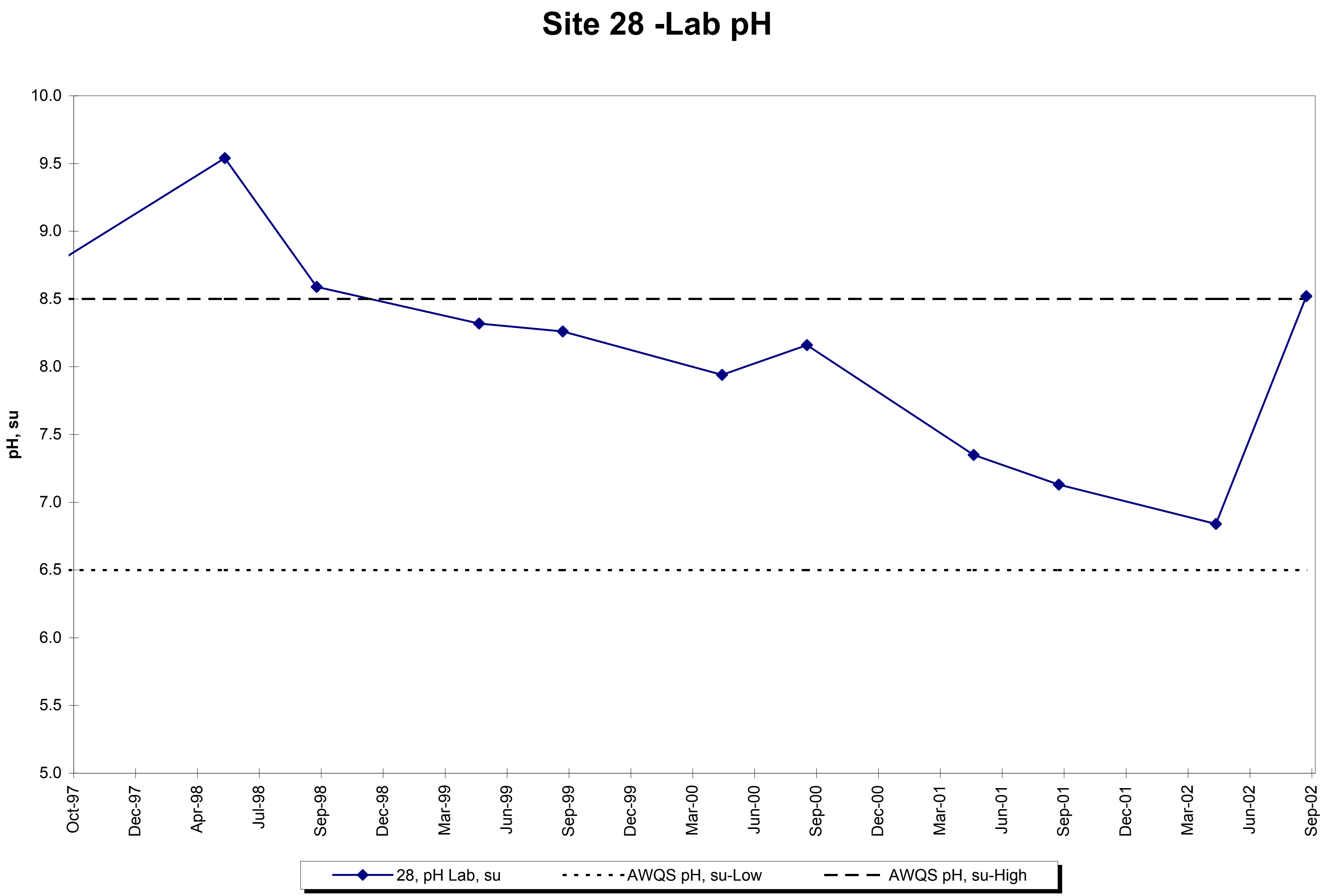
Site Number	Date	Time	Dup ID	Storet No.	Parameter Description	Value	Standard	Standard Type
28	05/07/2002	12:55 PM	0	1000	As Diss, ug/l	68.1	50.	Aquatic
28	09/17/2002	1:25 PM	0	1000	As Diss, ug/l	62.8	50.	Aquatic
28	09/17/2002	1:25 PM	0	403	pH Lab, su	8.52	6.5- 8.5	Aquatic

Site 28 -Conductivity-Lab

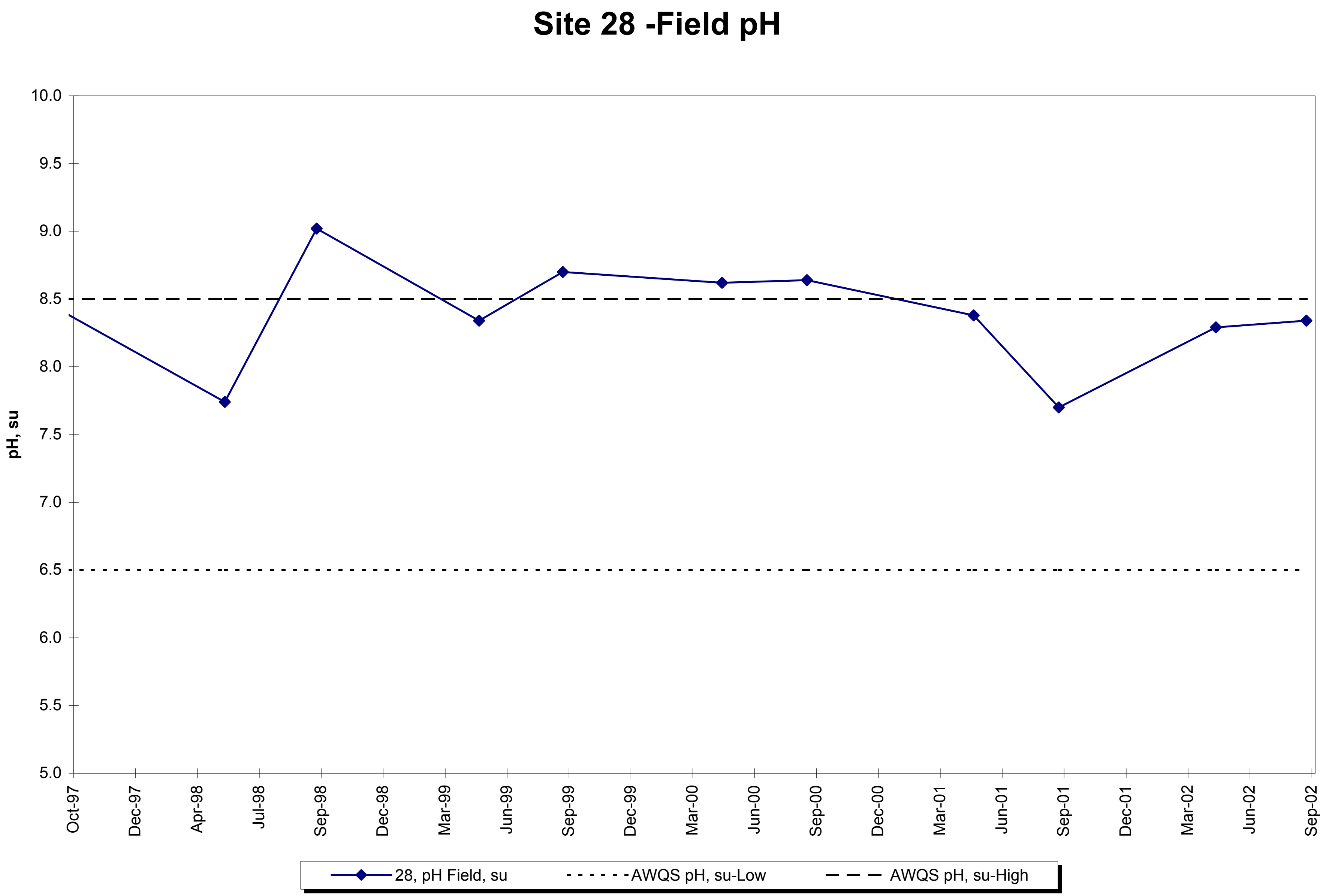


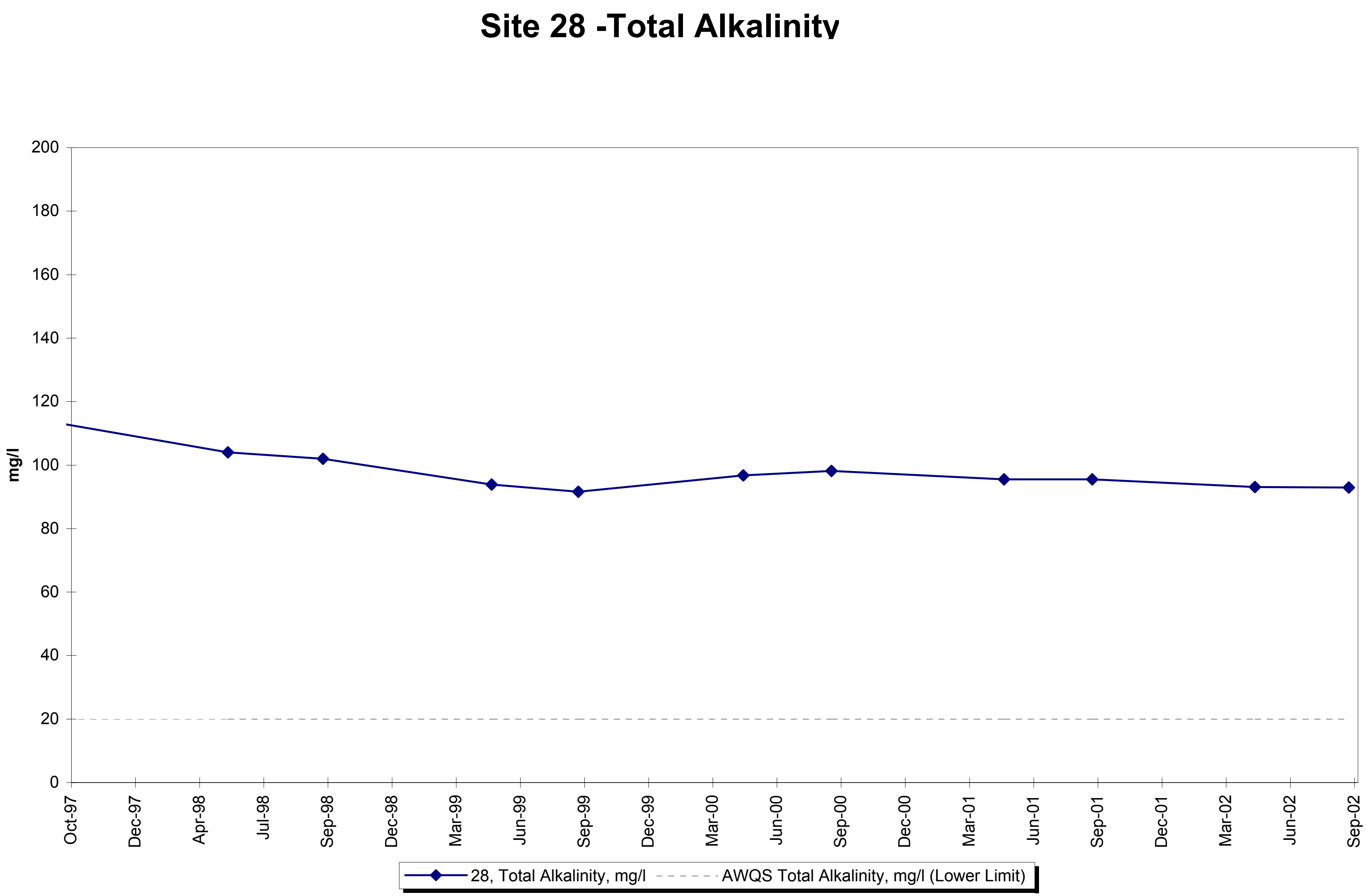
Site 28 -Conductivity-Field



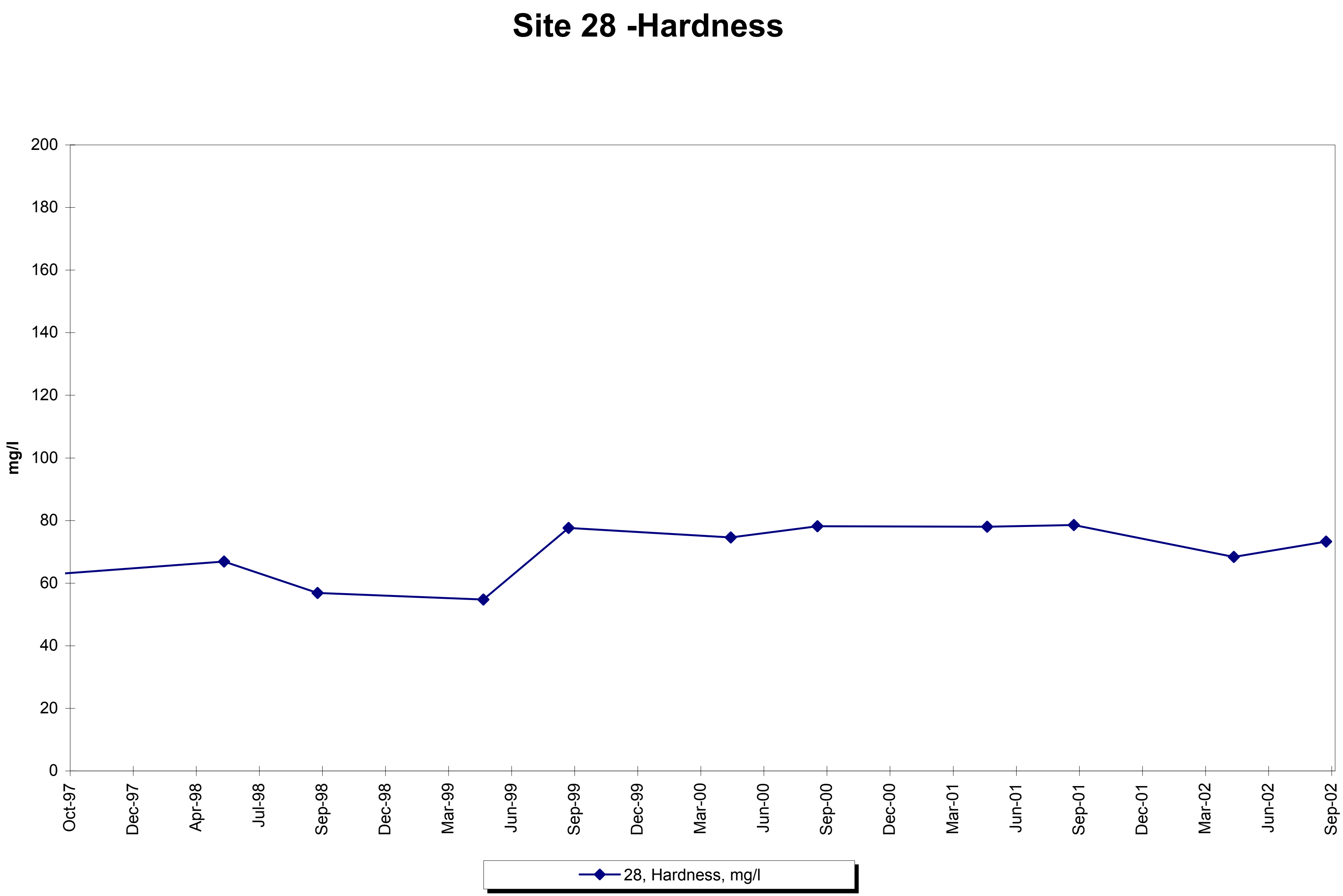


Site 28 -Lab pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
28, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

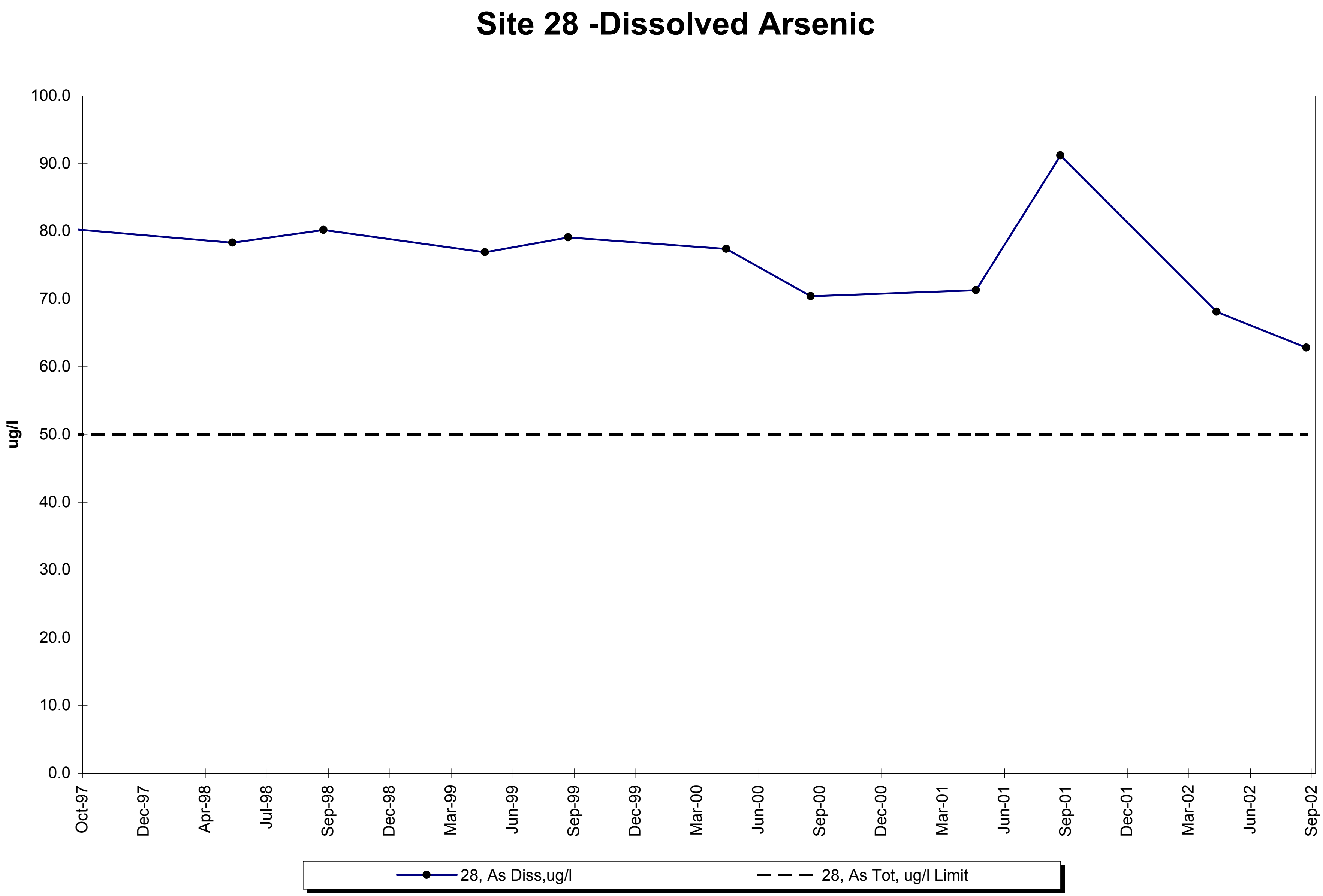

Site 28 -Field pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
28, pH Field, su
AWQS pH, su-Low
AWQS pH, su-High



Site 28 -Total Alkalinity
mg/l
200
180
160
140
120
100
80
60
40
20
0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
28, Total Alkalinity, mg/l
AWQS Total Alkalinity, mg/l (Lower Limit)

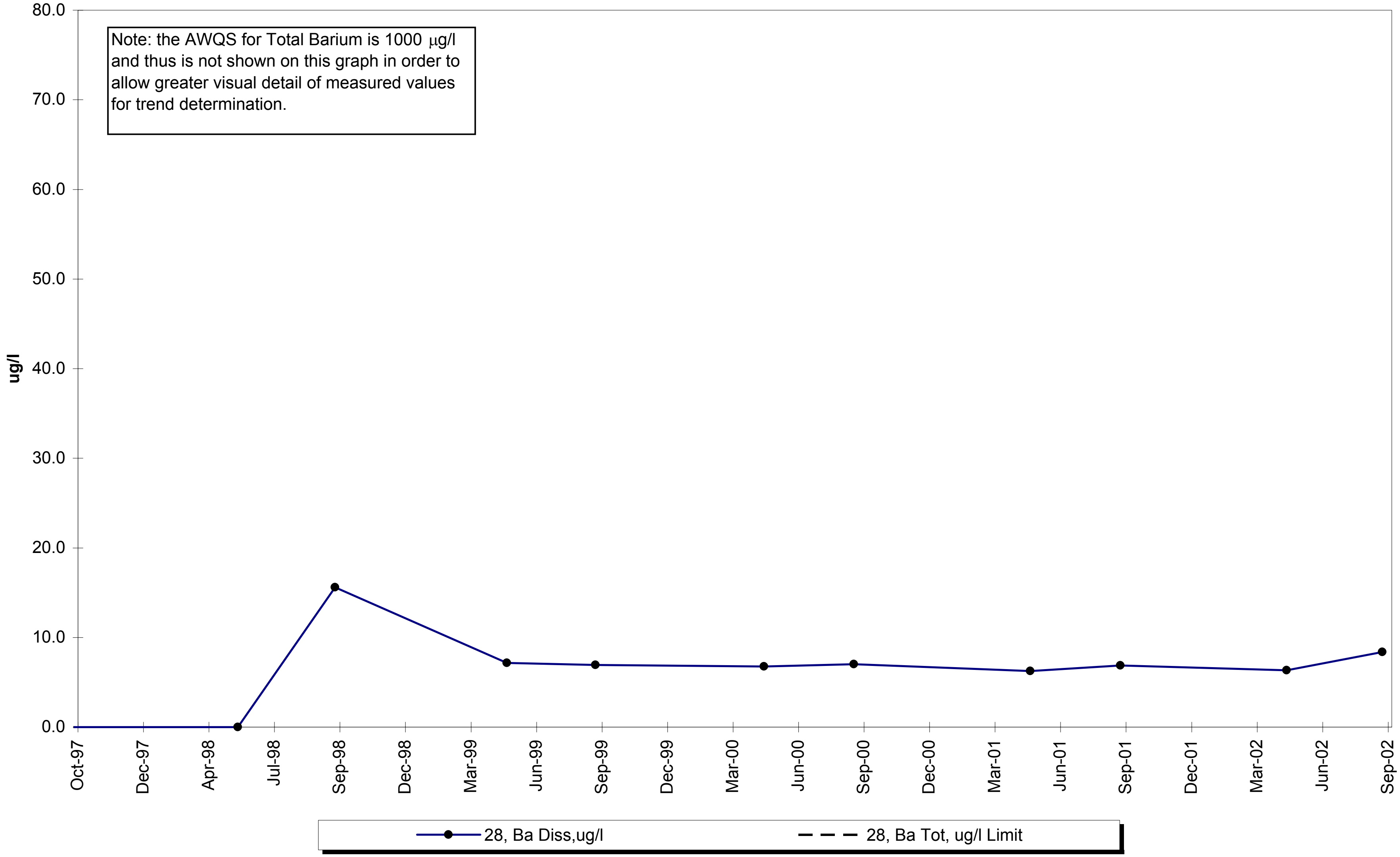


Site 28 -Hardness
mg/l
200
180
160
140
120
100
80
60
40
20
0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
28, Hardness, mg/l

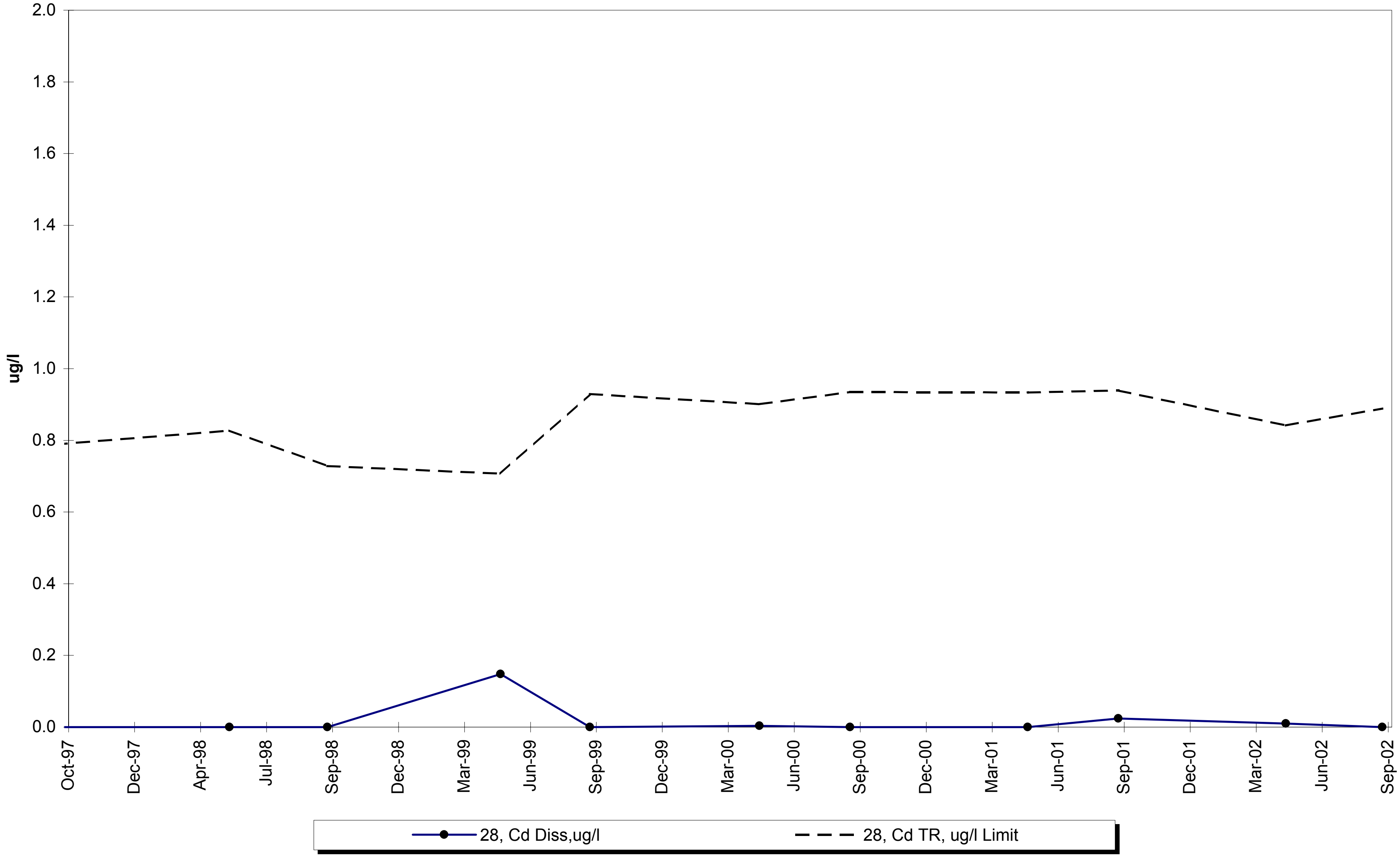

Site 28 -Dissolved Arsenic
ug/l
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
28, As Diss,ug/l
28, As Tot, ug/l Limit

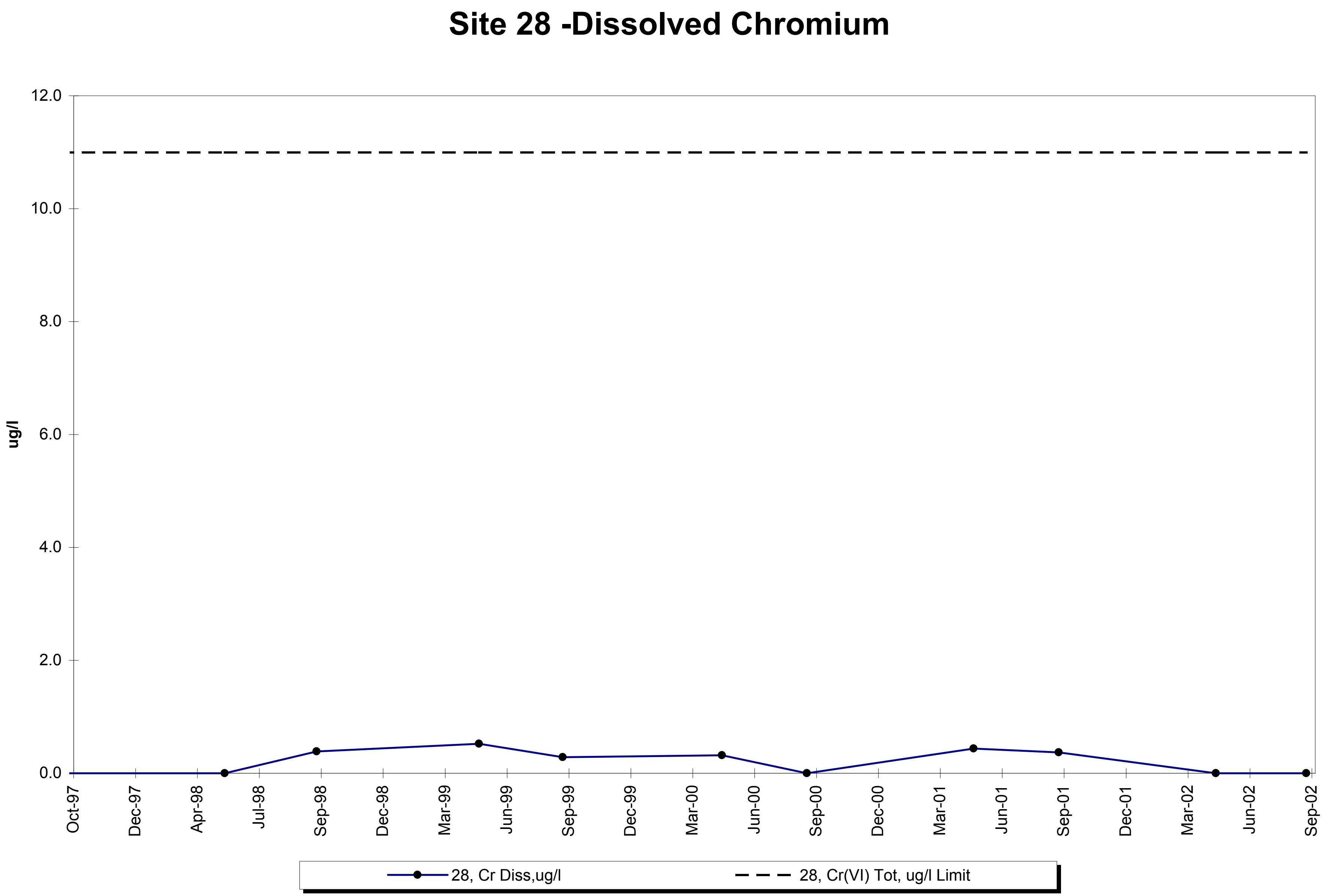
Site 28 -Dissolved Barium

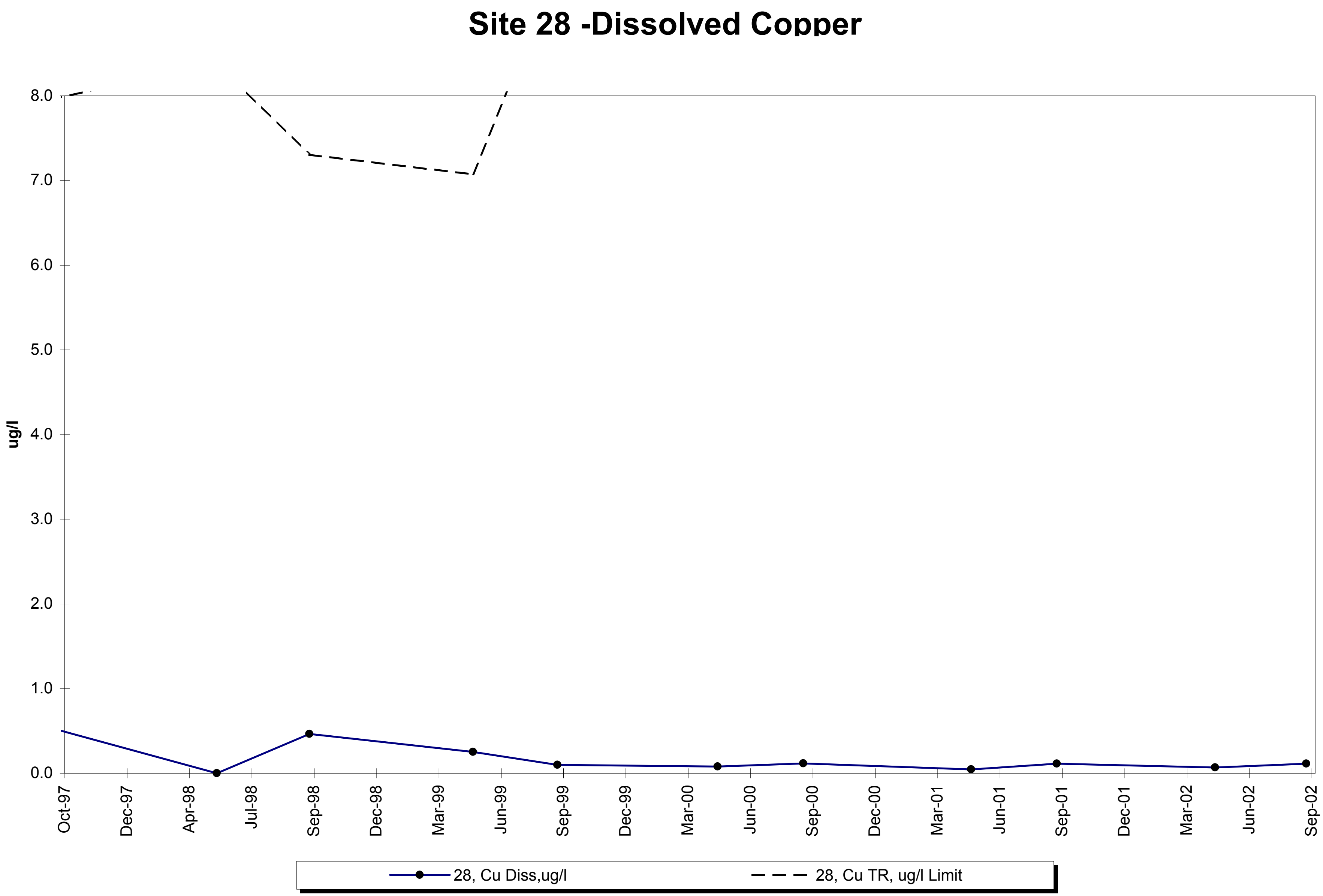
Note: the AWQS for Total Barium is 1000 μg/l and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination.



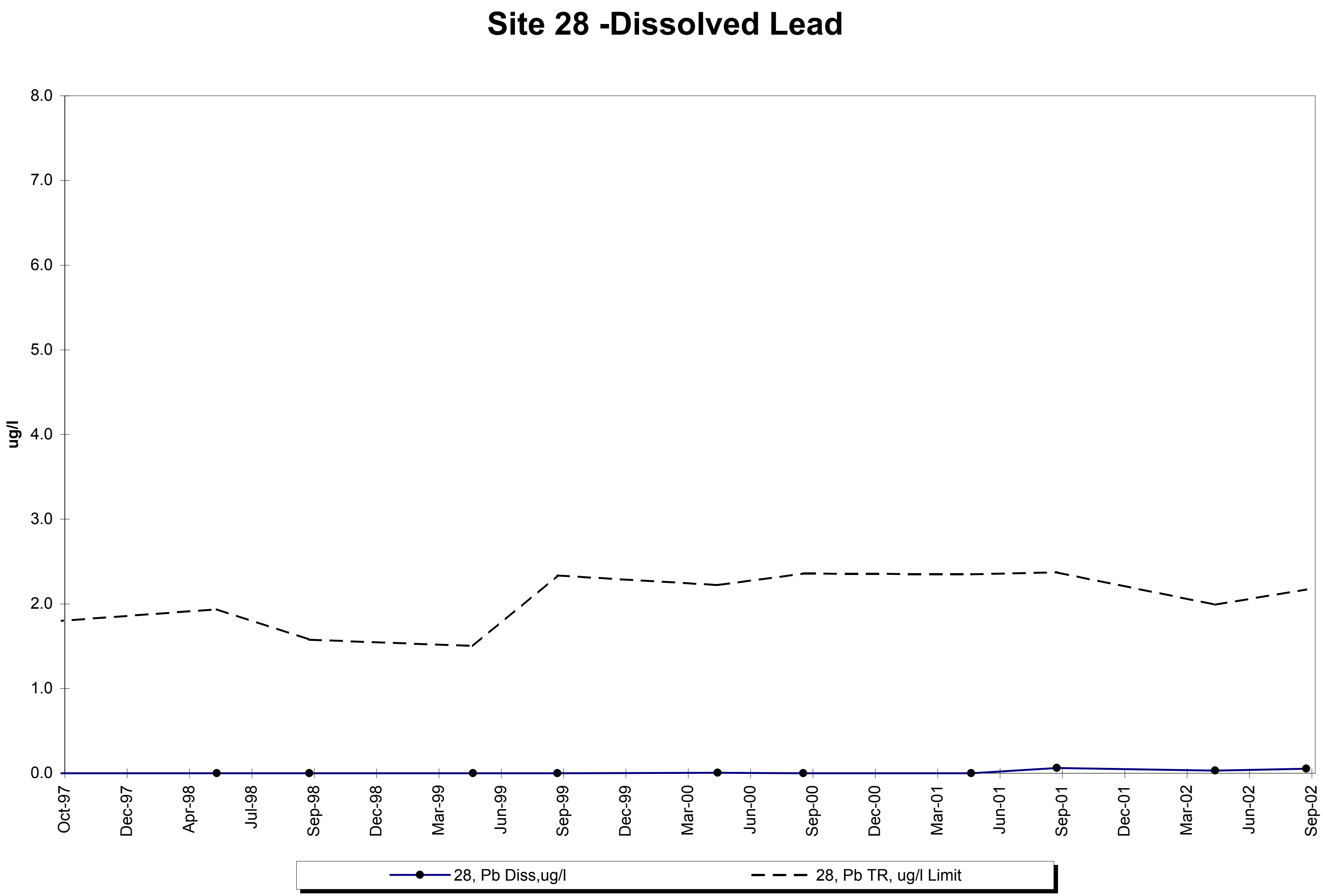
Site 28 -Dissolved Cadmium

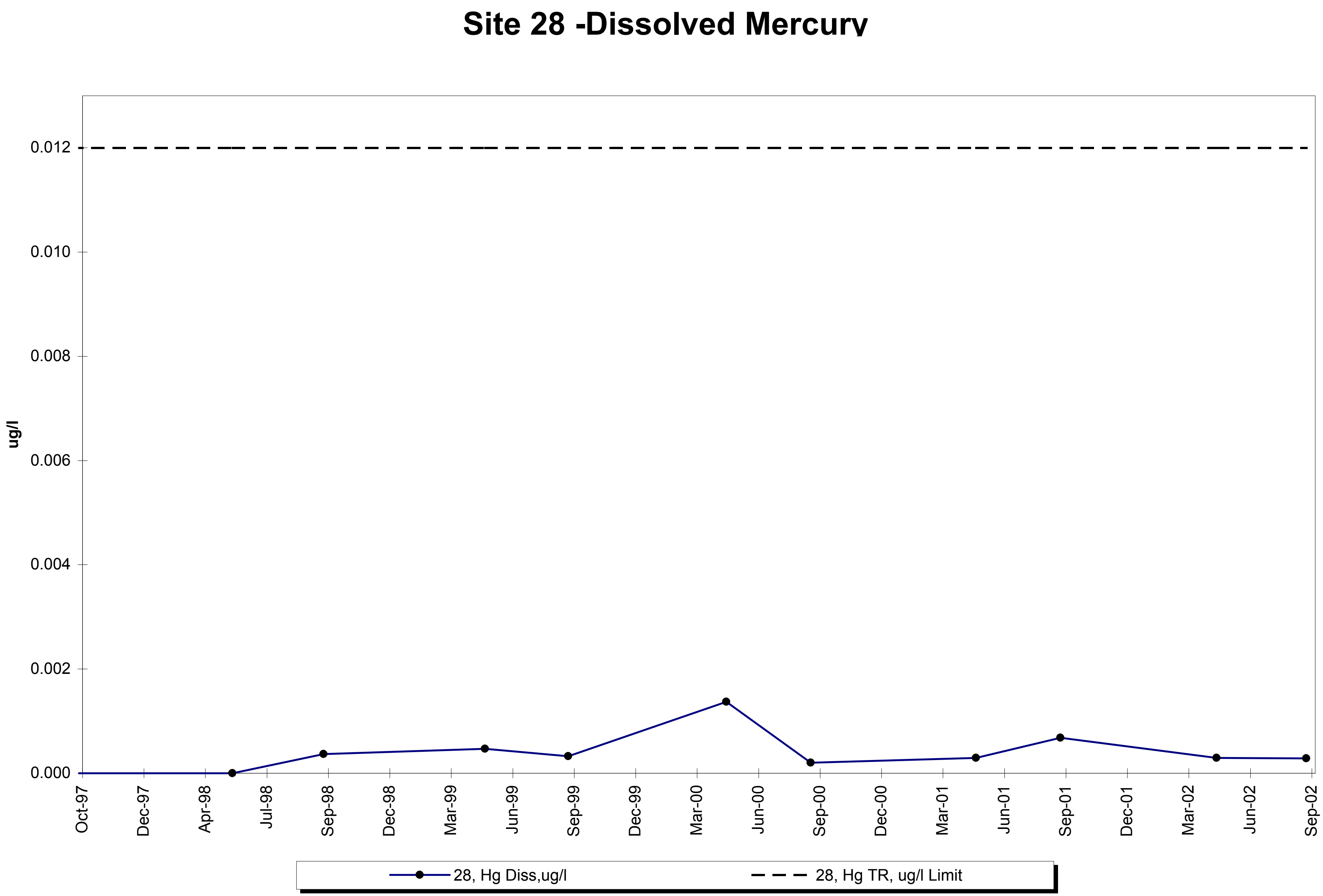



Site 28 -Dissolved Chromium
ug/l
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
28, Cr Diss,ug/l
28, Cr(VI) Tot, ug/l Limit

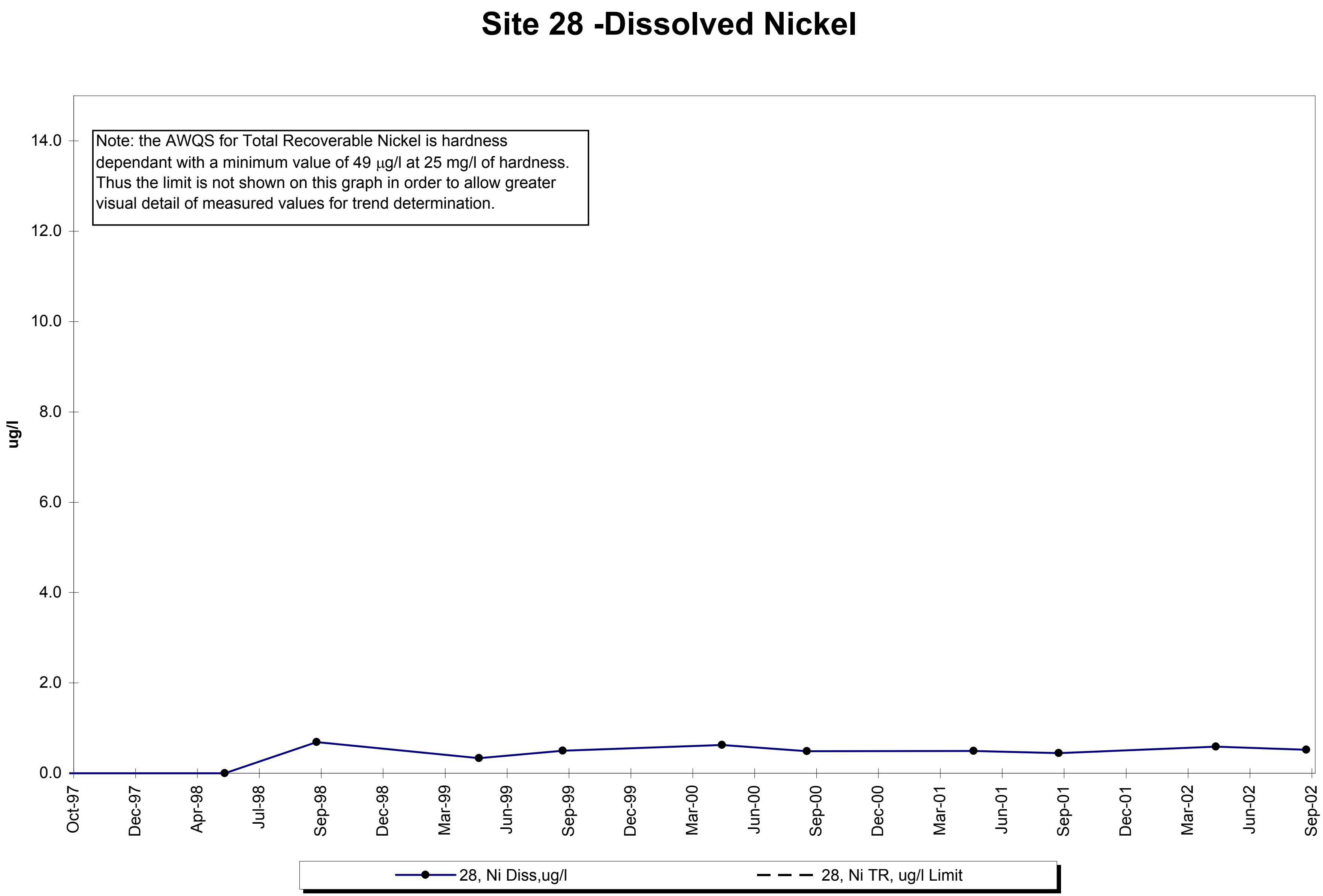


Site 28 -Dissolved Copper
ug/l
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
28, Cu Diss,ug/l
28, Cu TR, ug/l Limit

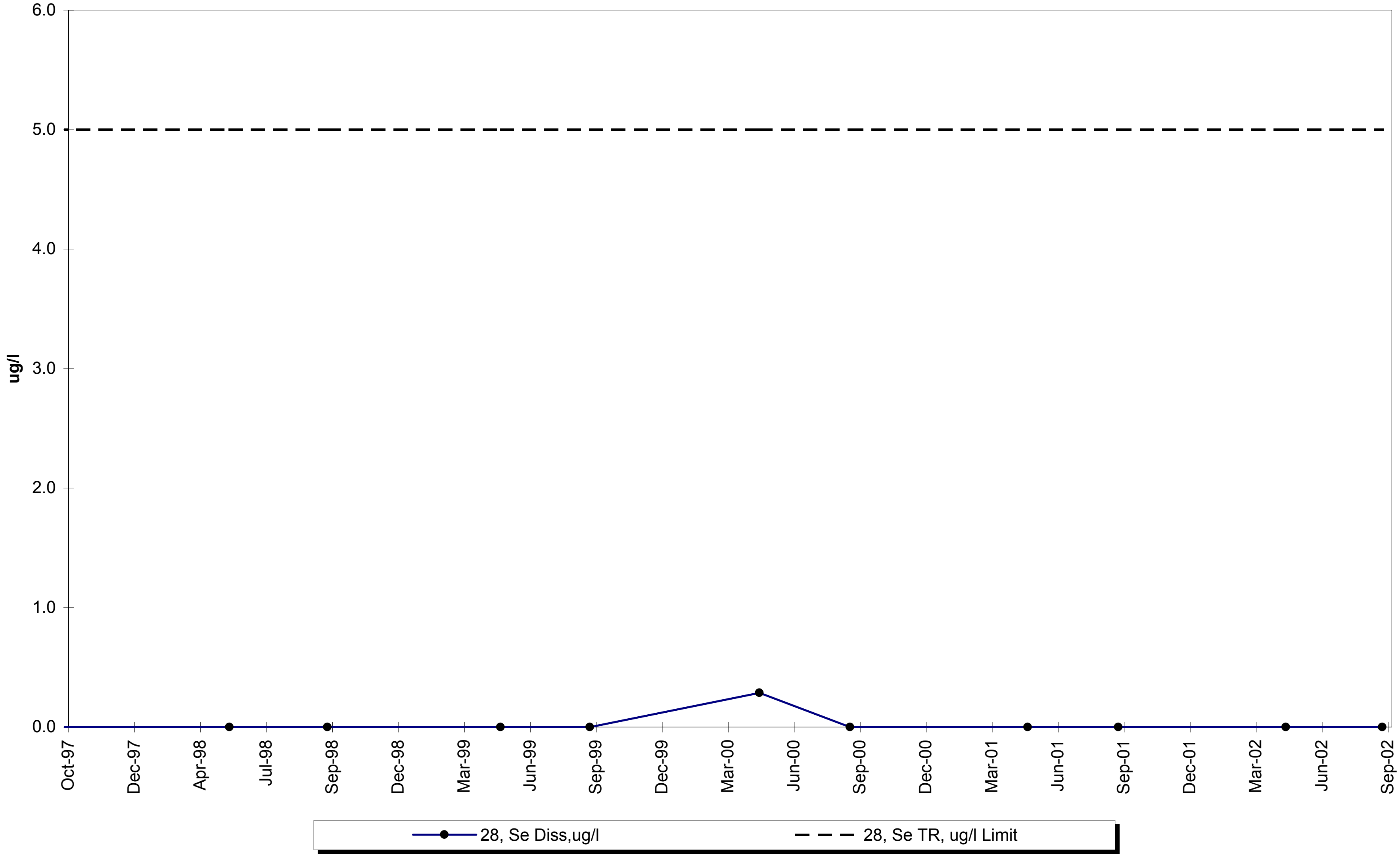

Site 28 -Dissolved Lead
ug/l
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
28, Pb Diss,ug/l
28, Pb TR, ug/l Limit

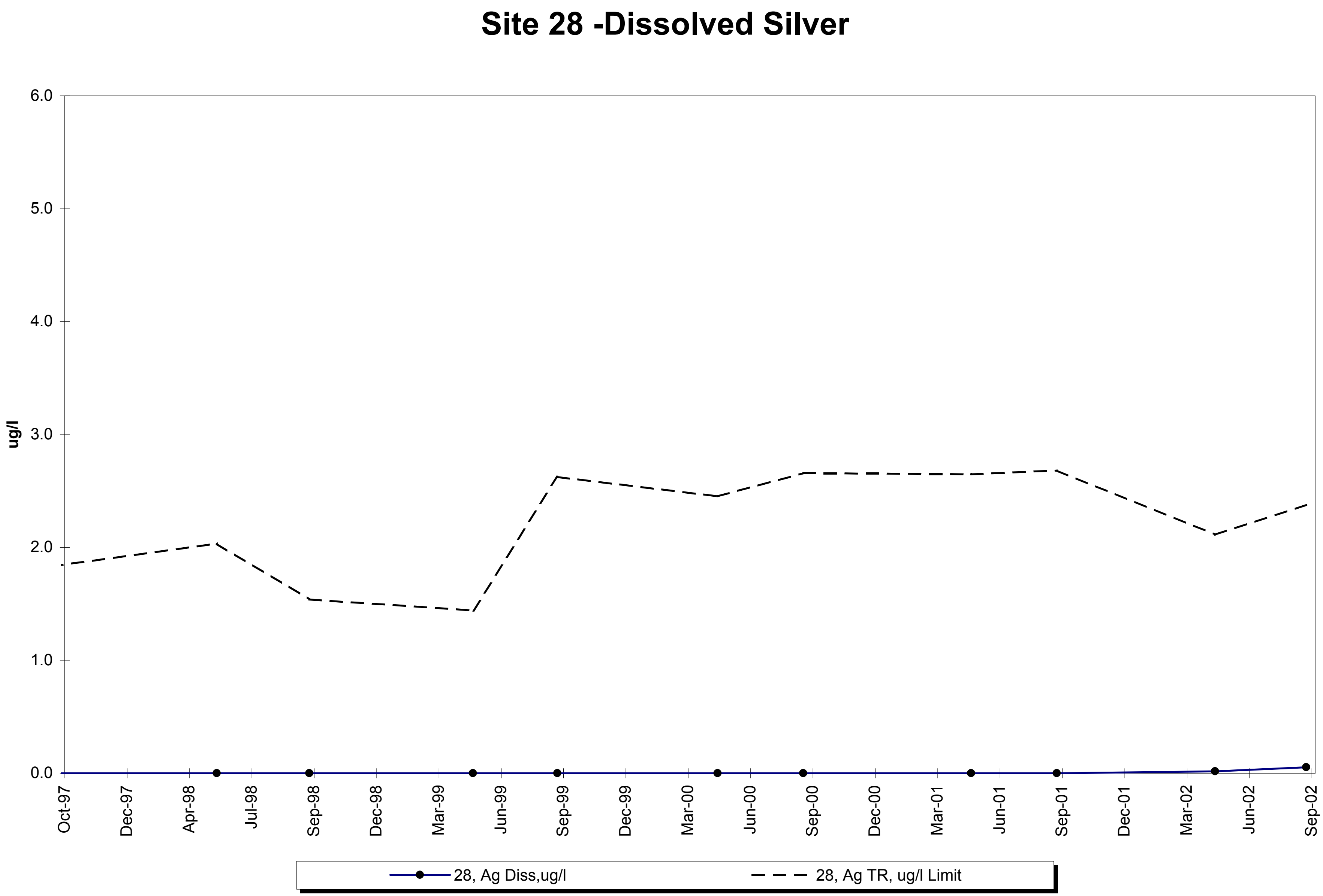


Site 28 -Dissolved Mercury
ug/l
0.012
0.010
0.008
0.006
0.004
0.002
0.000
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
28, Hg Diss,ug/l
28, Hg TR, ug/l Limit


Site 28 -Dissolved Nickel
Note: the AWQS for Total Recoverable Nickel is hardness dependant with a minimum value of 49 μg/l at 25 mg/l of hardness. Thus the limit is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
28, Ni Diss,ug/l
28, Ni TR, ug/l Limit

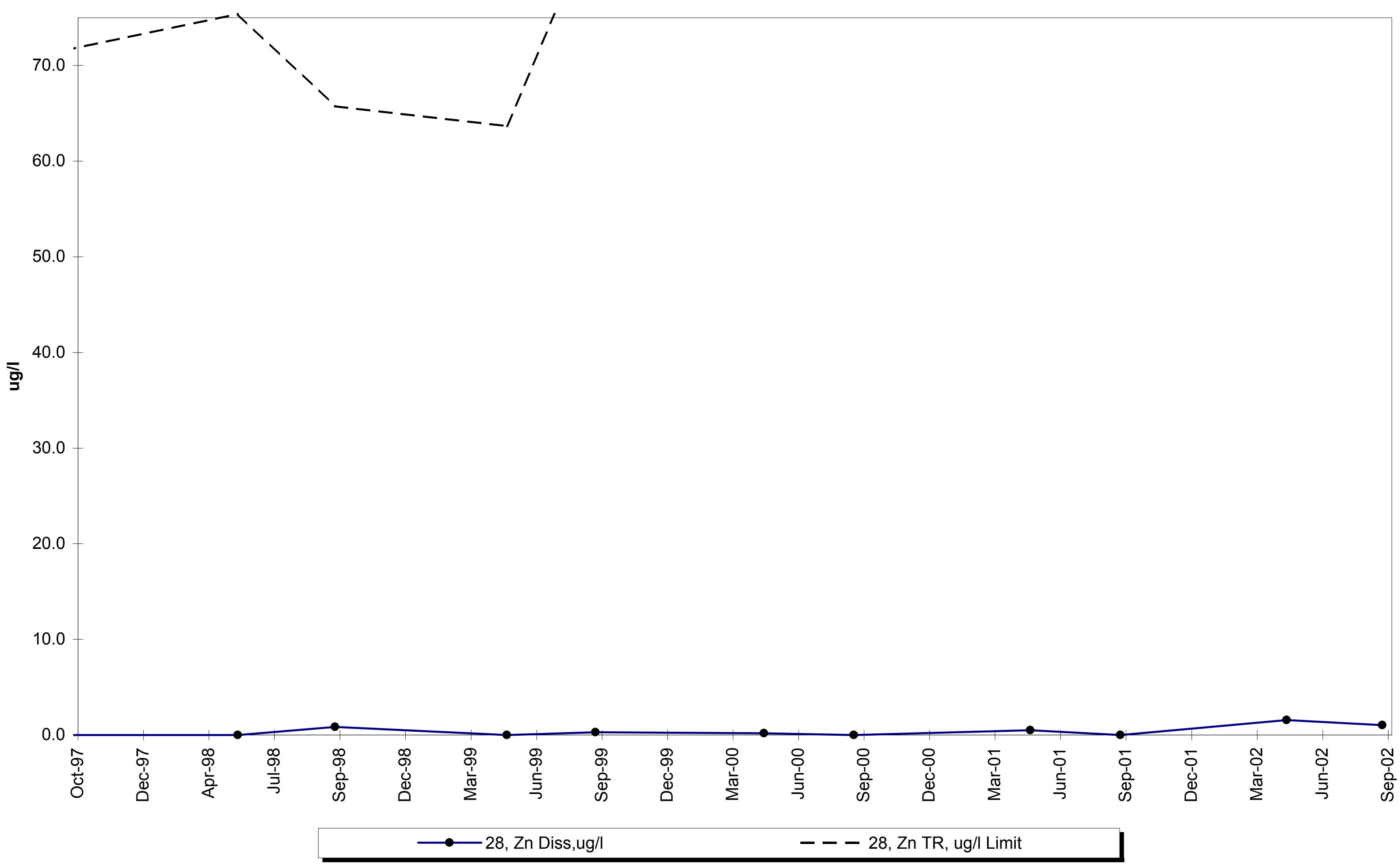
Site 28 -Dissolved Selenium



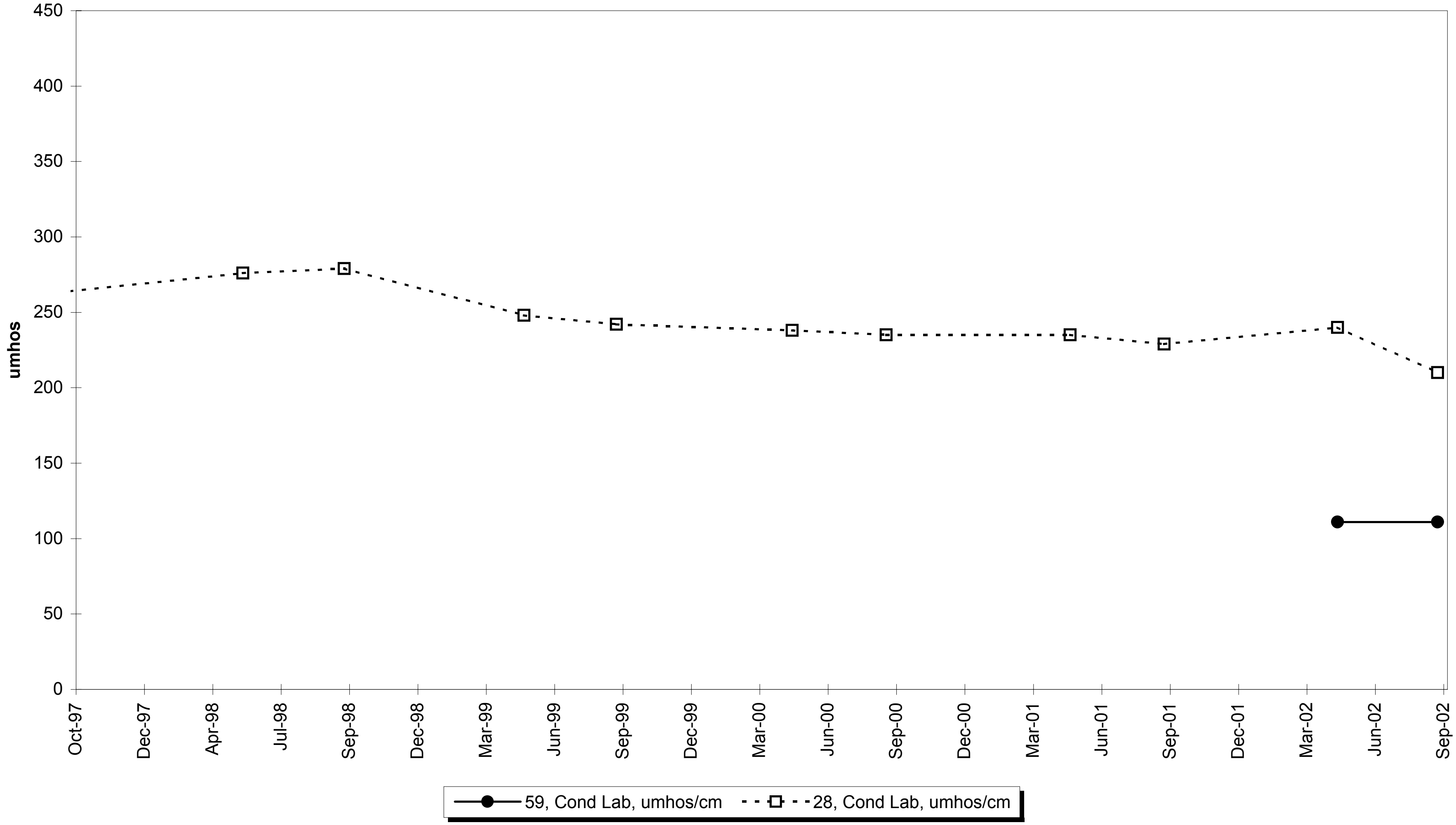


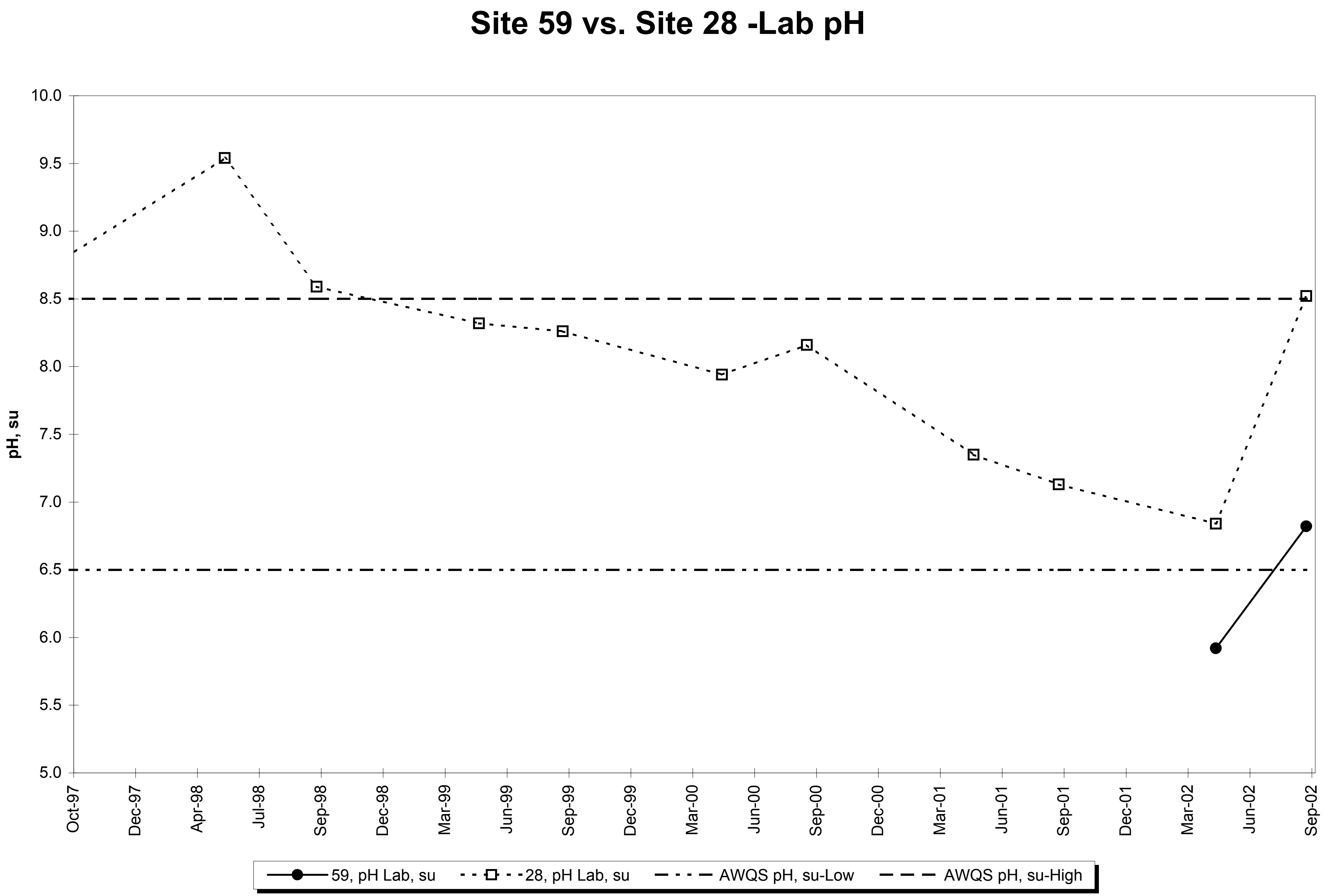
Site 28 -Dissolved Silver
ug/l
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
28, Ag Diss,ug/l
28, Ag TR, ug/l Limit

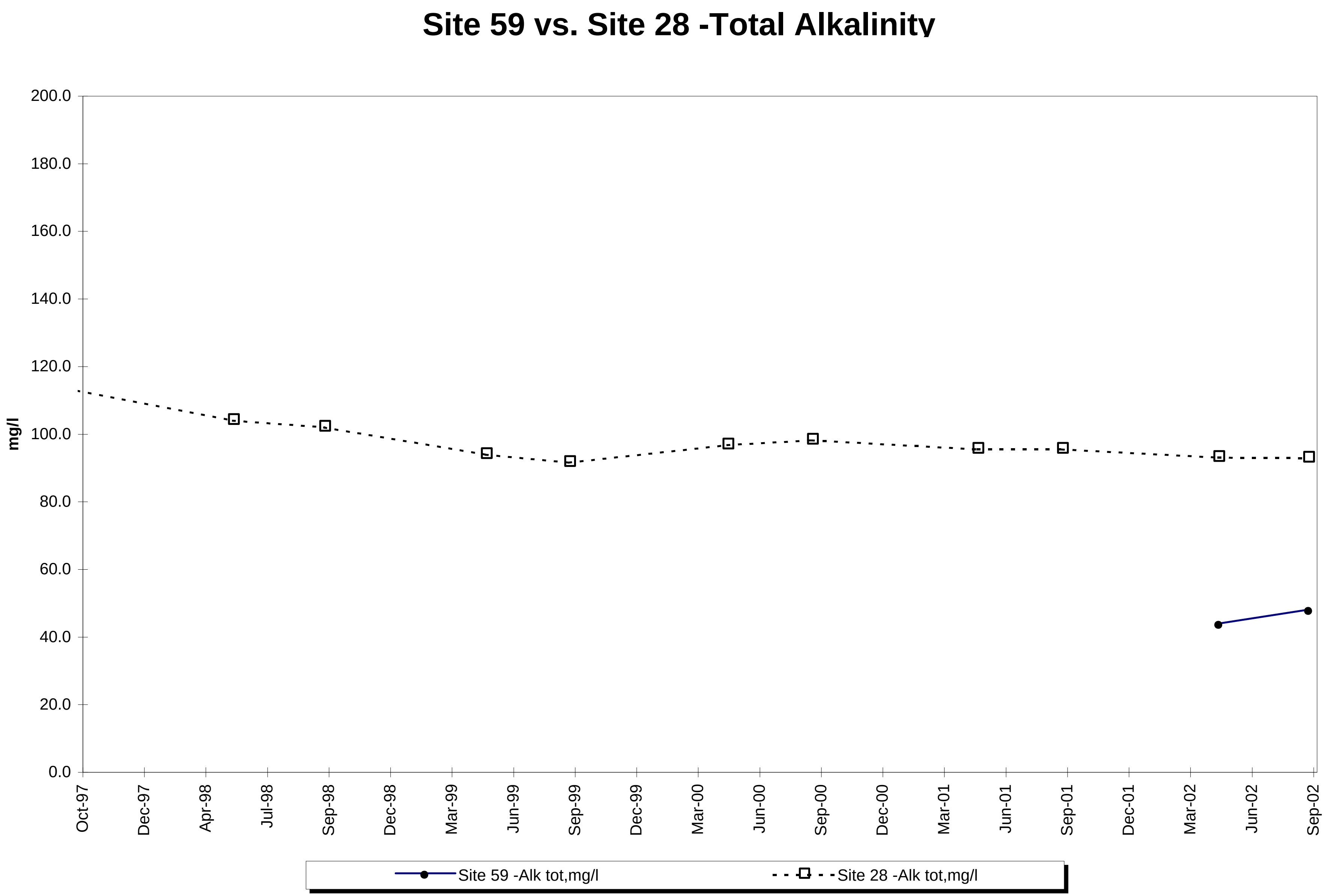
Site 28 -Dissolved Zinc

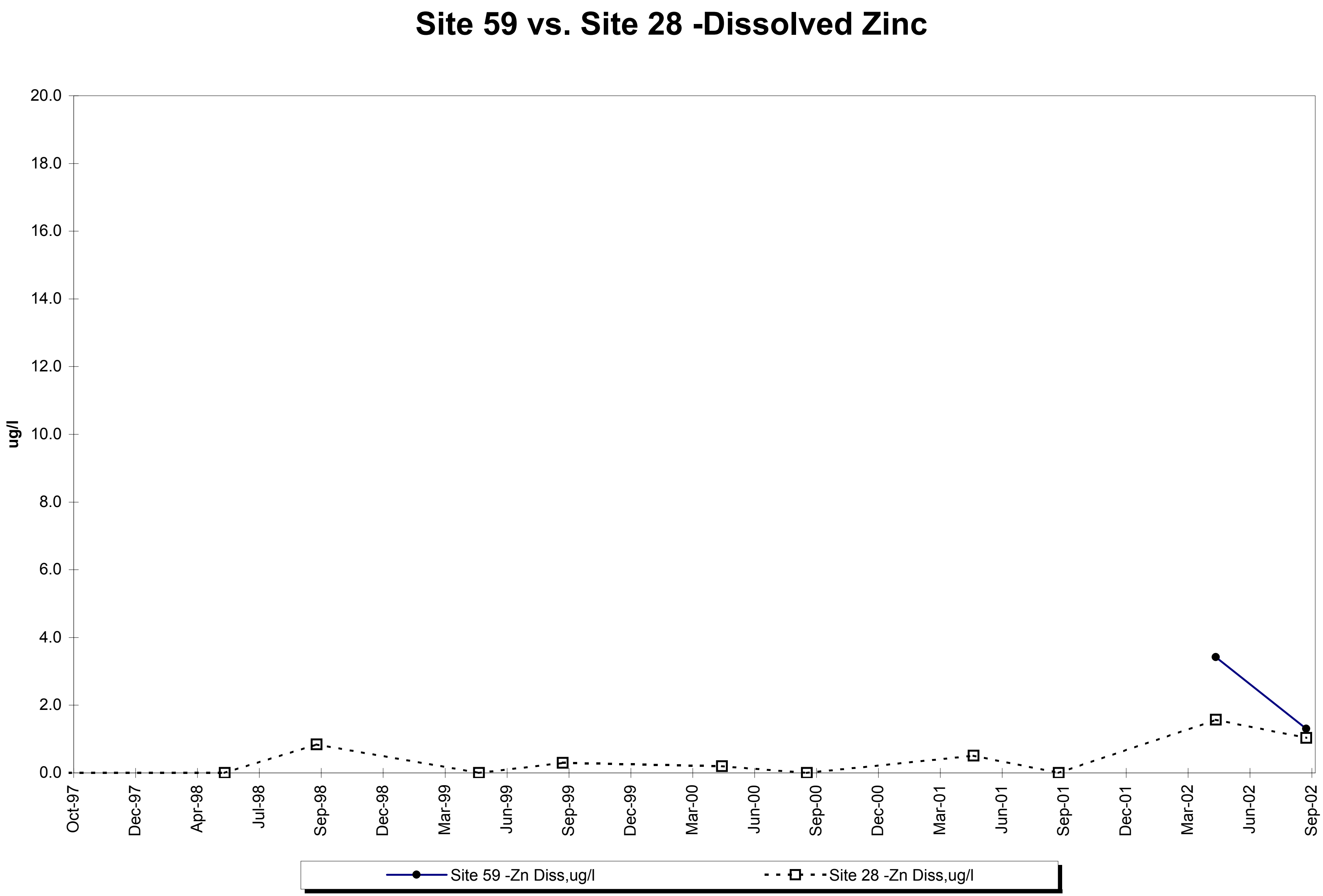


Site 59 vs Site 28 -Conductivity-Lab




Site 59 vs. Site 28 -Lab pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
59, pH Lab, su
28, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High


Site 59 vs. Site 28 -Total Alkalinity
mg/l
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Site 59 -Alk tot,mg/l
Site 28 -Alk tot,mg/l



Site 59 vs. Site 28 -Dissolved Zinc
ug/l
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Site 59 -Zn Diss,ug/l
Site 28 -Zn Diss,ug/l

INTERPRETIVE REPORT
SITE 34 “SEEPAGE CONTROL”

All data collected at this site for the past five years are included in the data analyses. As shown in the table below, there were no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-97 though Sept-02.				

The data collected during the current water year are listed in the following “Table of Results for Water Year 2002” report. The table includes all the data, field and lab, collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of zero for the purpose of median calculation.

The data for water year 2002 have been compared to the strictest fresh water quality criterion for each applicable analyte. Two (2) results exceeding these criteria has been identified, as listed on the following “Comparison To Standards” report. One datum is a lab pH for which the corresponding field pH was 7.22 which is within AWQS. The second datum is for a September 2002 sulfate value of 360 mg/l that exceeds the AWQS of 250 mg/l. As discussed in the Mid-year Modifications section, an access road built of pyritic road rock that was likely contributing to the known sulfate loading of the Seepage Control Pond was removed in June 2002.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious trends were apparent.

As noted in the Mid-Year Modification’s discussion at the front of this report, KGCMC plans to discontinue sampling at the Seepage Control Pond that was effectively eliminated by the removal of the road/dam structure in June 2002.

Table of Results for Water Year 2002

Site 34 "Seepage Control"													
Sample Date/Parameter	10/25/2001	11/15/2001	12/5/2001	1/29/2002	2/21/2002	3/19/2002	4/1/2002	5/7/2002	6/11/2002	7/15/2002	8/27/2002	9/17/2002	**Median**
Water Temp (°C)	NOT SCHEDULED FOR SAMPLING							12.4	NOT SCHEDULED FOR SAMPLING			10.9	11.7
Conductivity-Field (μmho)								776				1,039	908
Conductivity-Lab (μmho)								744				999	872
pH Lab (standard units)								6.36				6.97	6.67
pH Field (standard units)								7.22				6.88	7.05
Total Alkalinity (mg/l)								145.0				192.0	168.5
Hardness (mg/l)								486.0				577.0	531.5
Dissolved As (μg/l)								1.230				0.842	1.036
Dissolved Ba (μg/l)								58.7				93.6	76.2
Dissolved Cd (μg/l)								0.025				0.012	0.019
Dissolved Cr (μg/l)								0.425				<0.273	0.281
Dissolved Cu (μg/l)								1.240				0.969	1.105
Dissolved Pb (μg/l)								0.3580				0.2210	0.2895
Dissolved Ni (μg/l)								6.46				7.54	7.00
Dissolved Ag (μg/l)								<0.0080				0.0589	0.0315
Dissolved Zn (μg/l)								20.50				7.50	14.00
Dissolved Se (μg/l)								<0.475				0.339	0.288
Dissolved Hg (μg/l)								0.001400				0.000502	0.000951

See "Qualififed Data by QA Reviewer" table for qualifier descriptions.

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

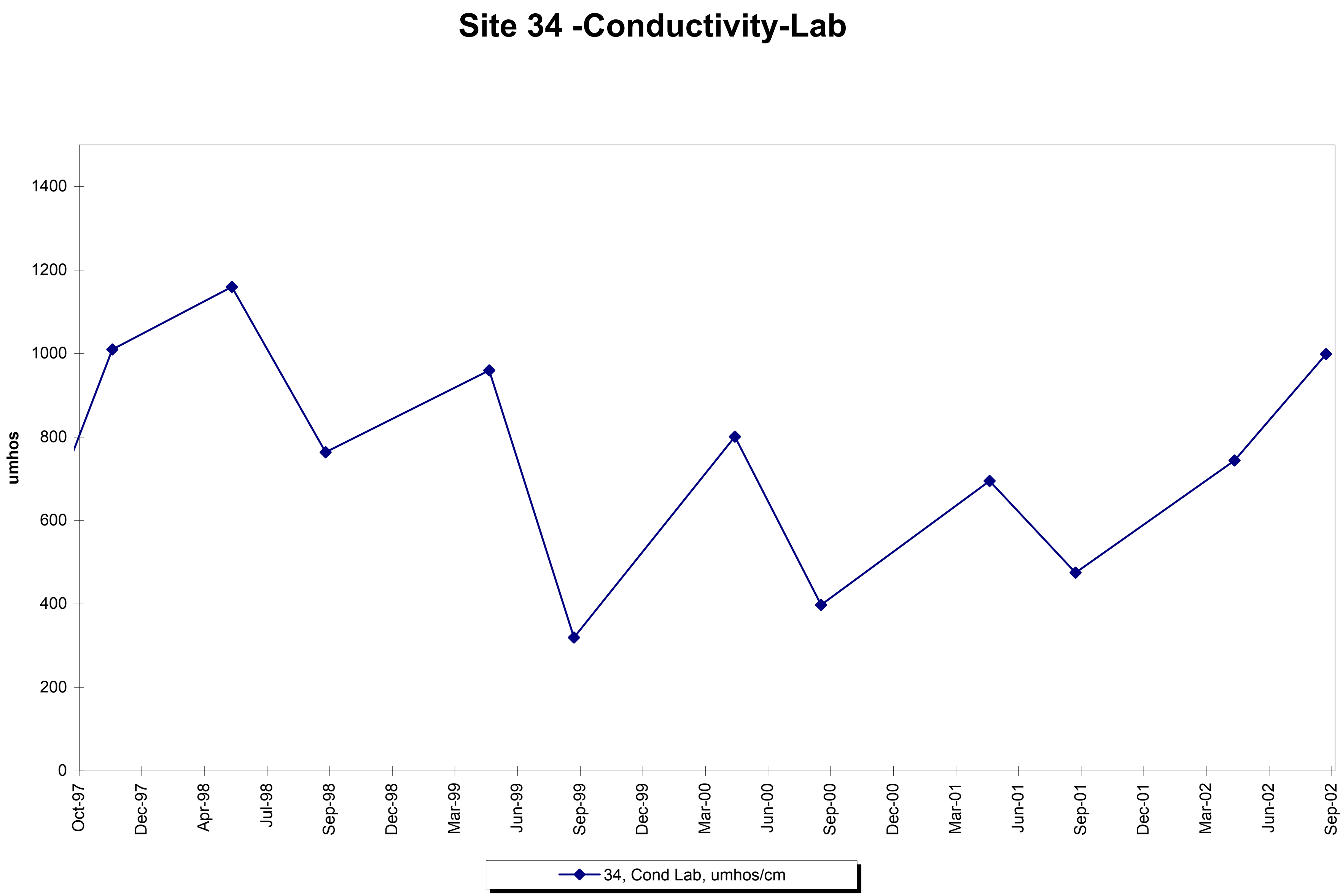
Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
			#Error			

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

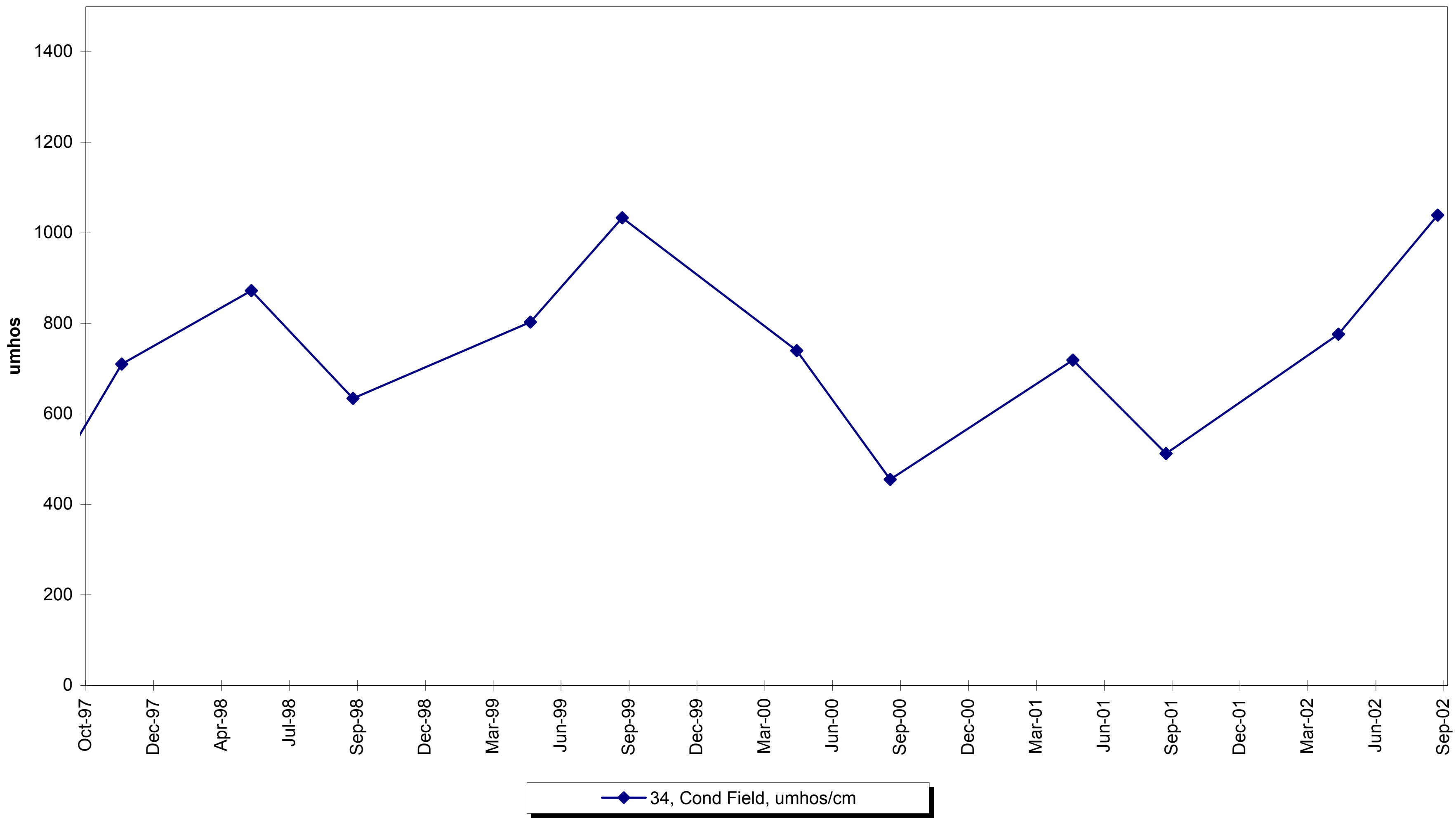
Comparison To Standards

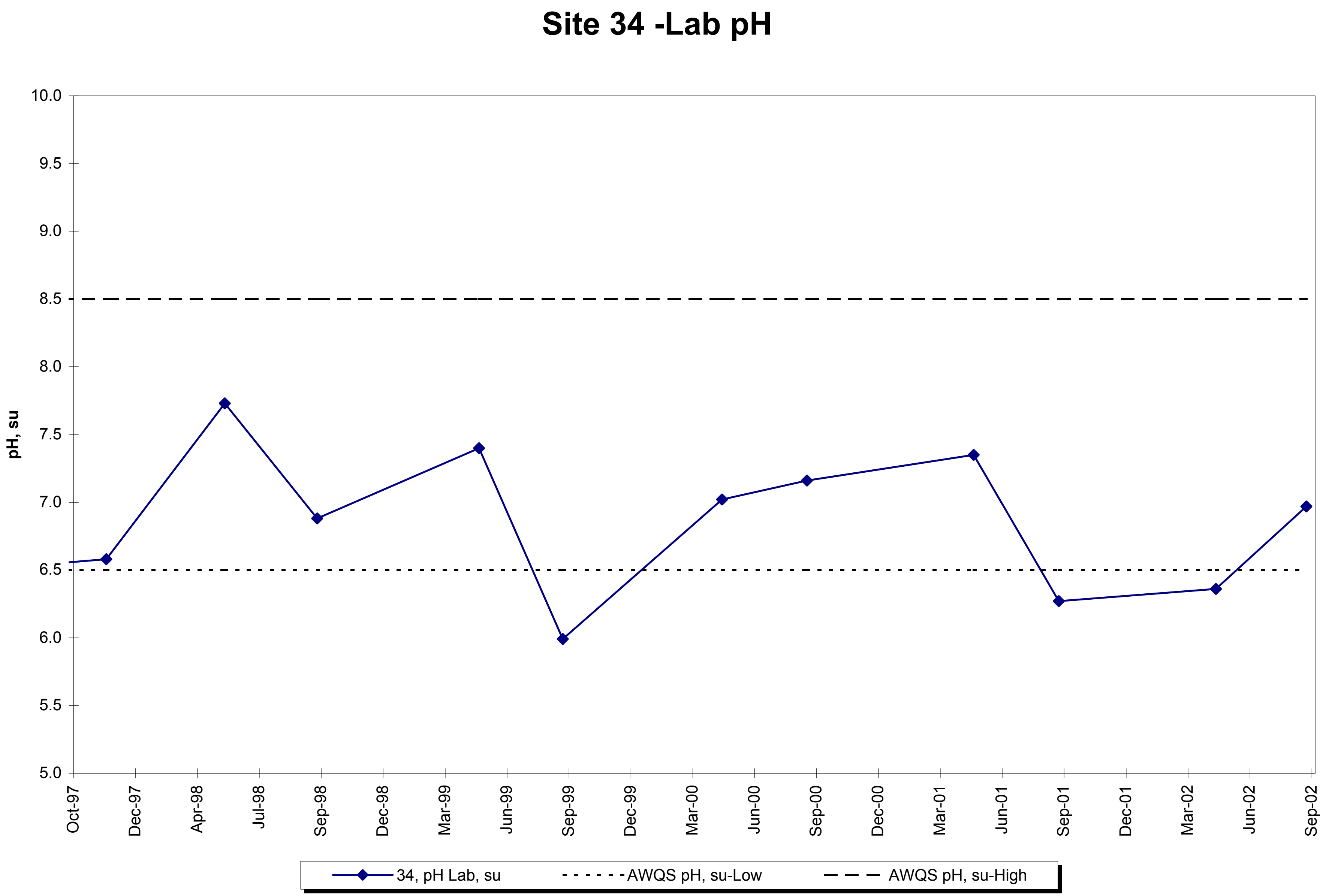
Date Range: 10/01/2001 to 09/30/2002

Site Number	Date	Time	Dup ID	Storet No.	Parameter Description	Value	Standard	Standard Type
34	05/07/2002	1:30 PM	0	403	pH Lab, su	6.36	6.5- 8.5	Aquatic
34	09/17/2002	2:00 PM	0	945	SO4 Tot, mg/l	360	250.	Aquatic

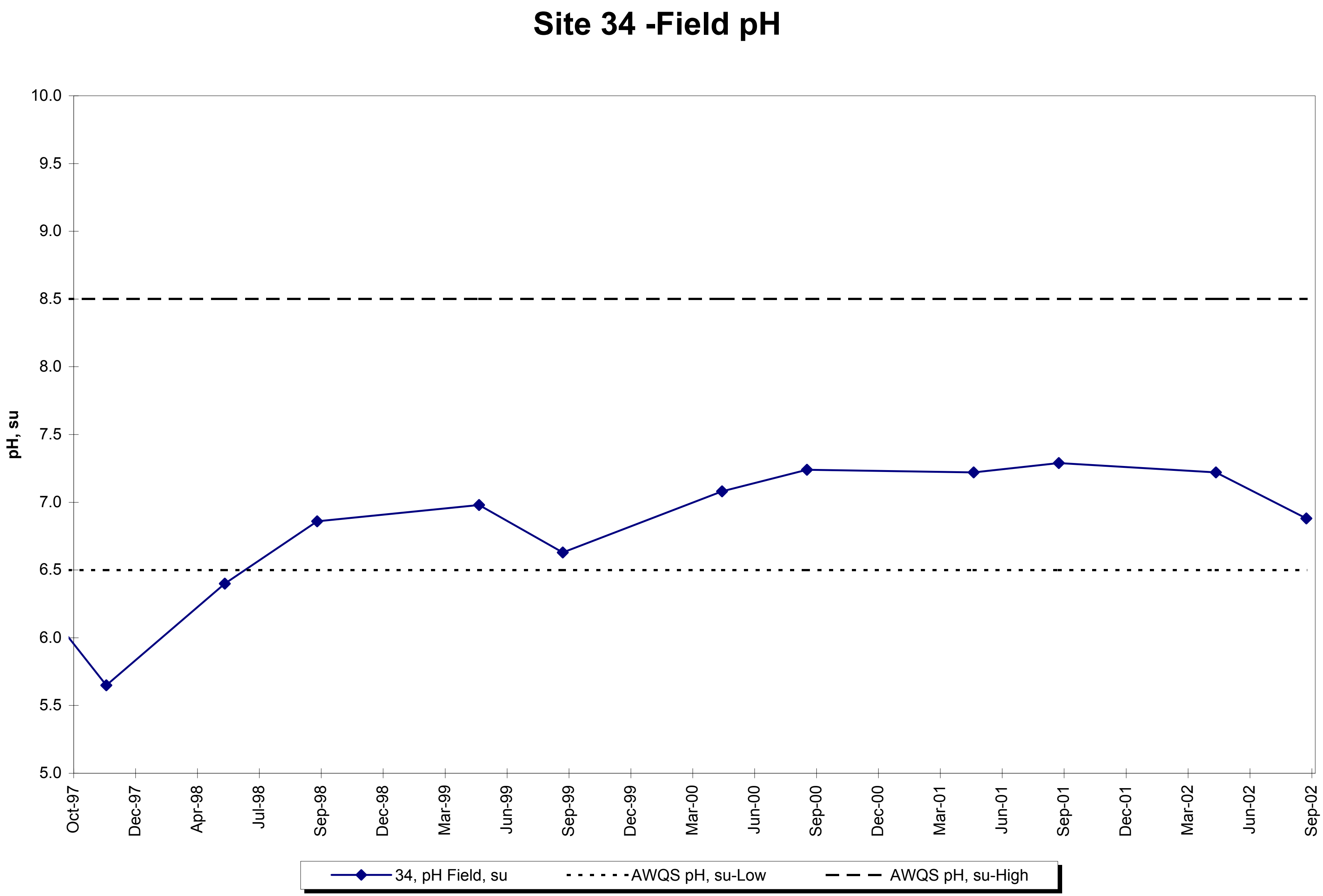

Site 34 -Conductivity-Lab
umhos
0
200
400
600
800
1000
1200
1400
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
34, Cond Lab, umhos/cm

Site 34 -Conductivity-Field

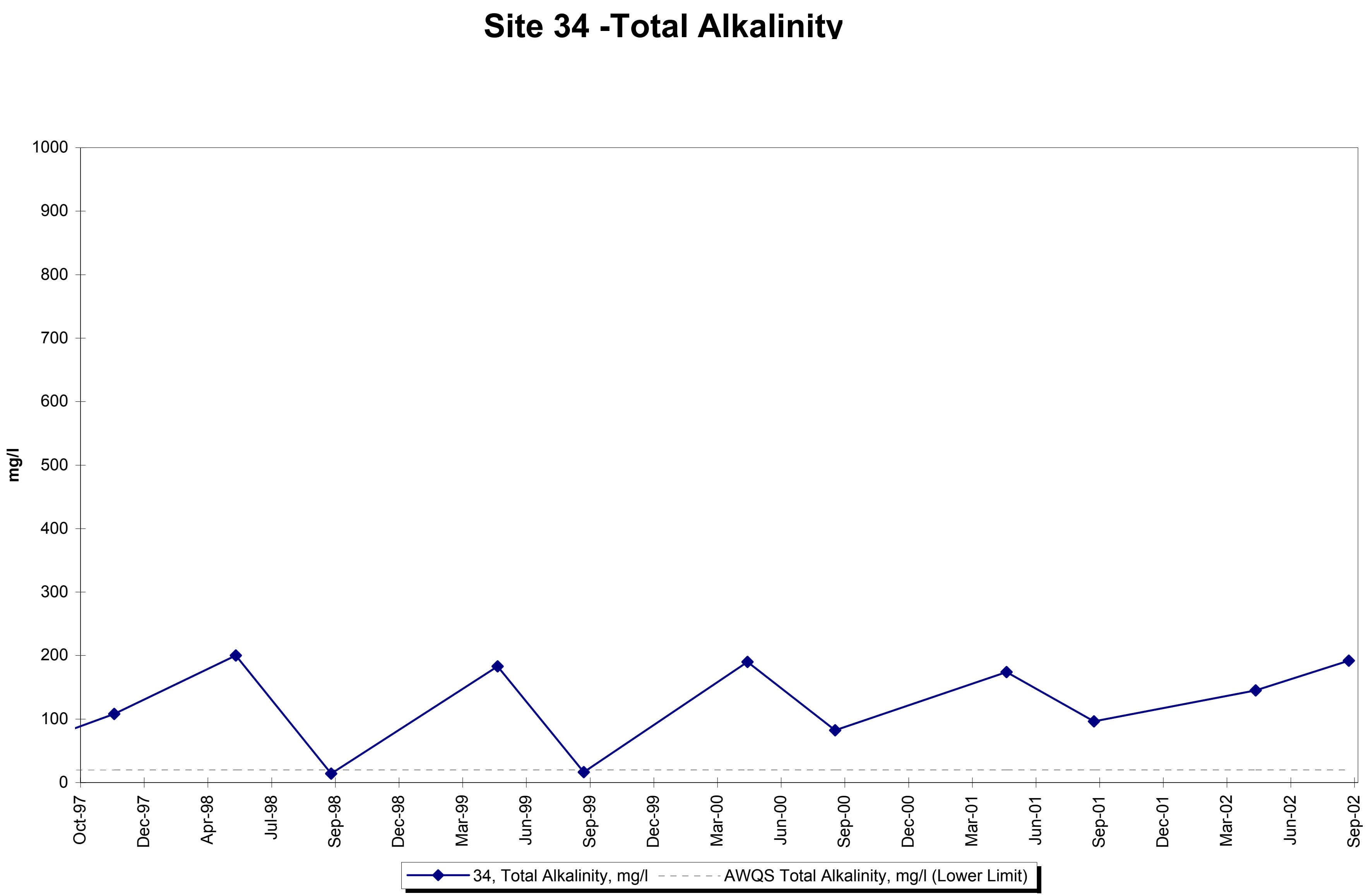




Site 34 -Lab pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
34, pH Lab, su
AWQS pH, su-Low
AWQS pH, su-High

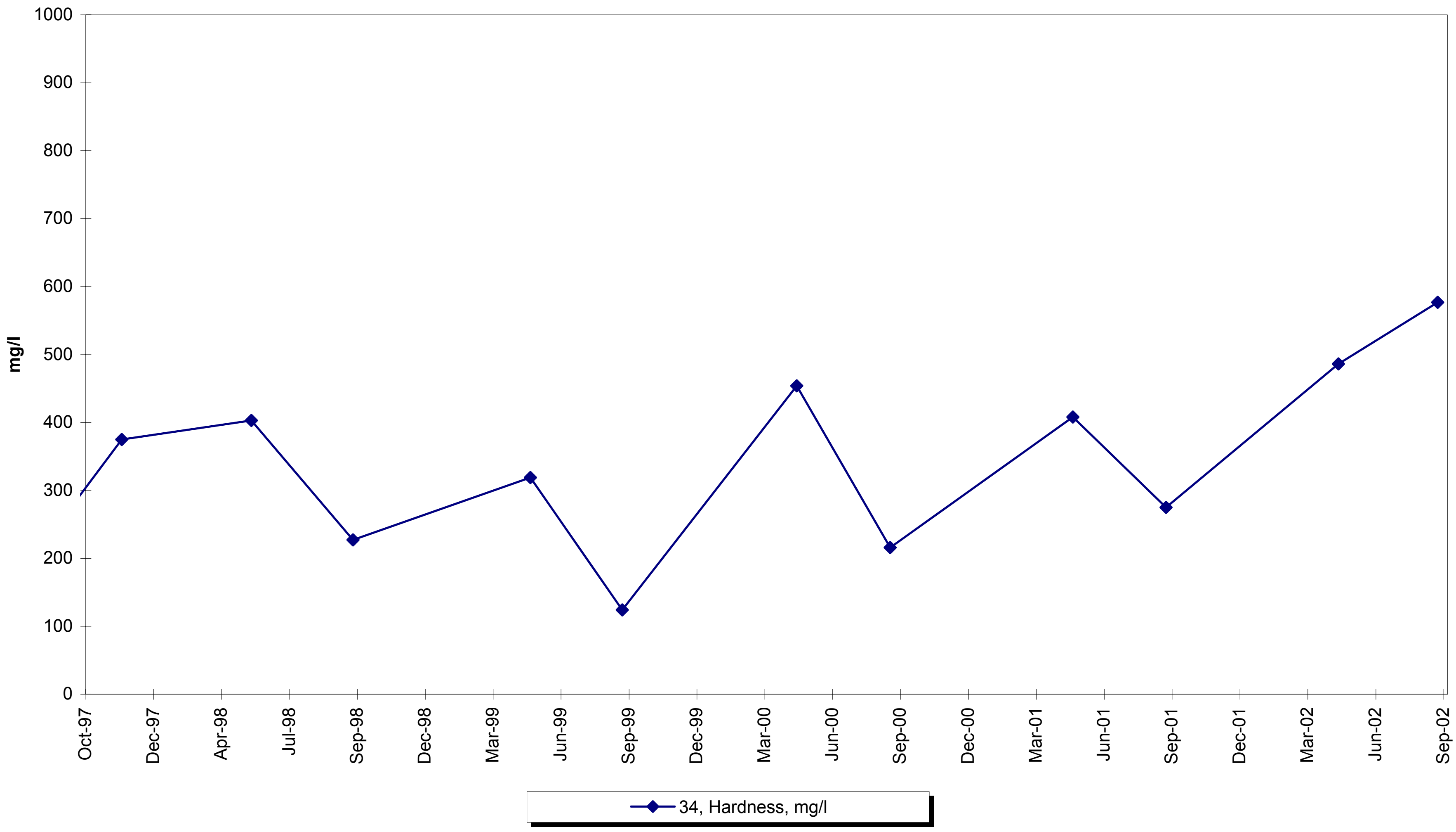


Site 34 -Field pH
pH, su
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
34, pH Field, su
AWQS pH, su-Low
AWQS pH, su-High

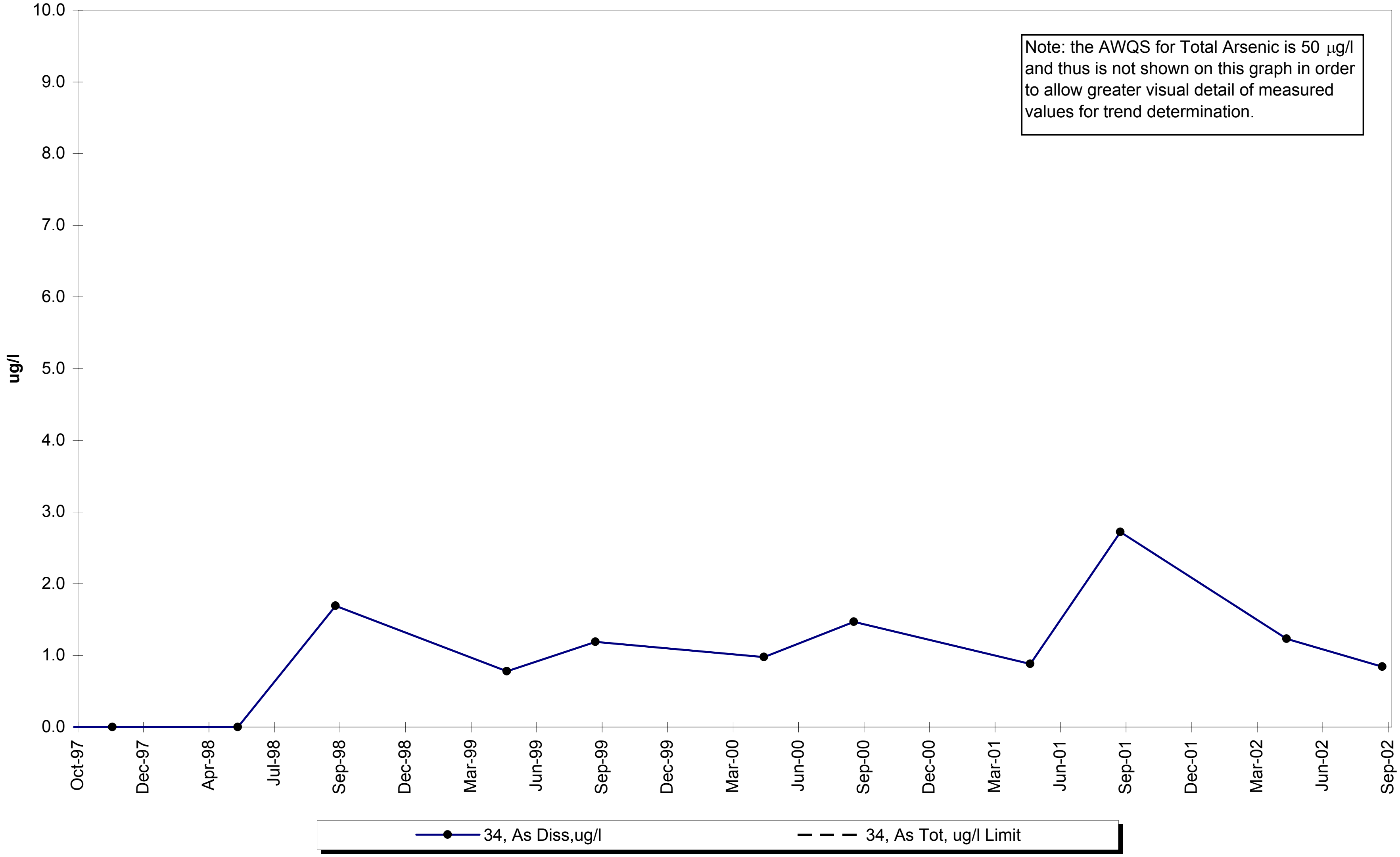


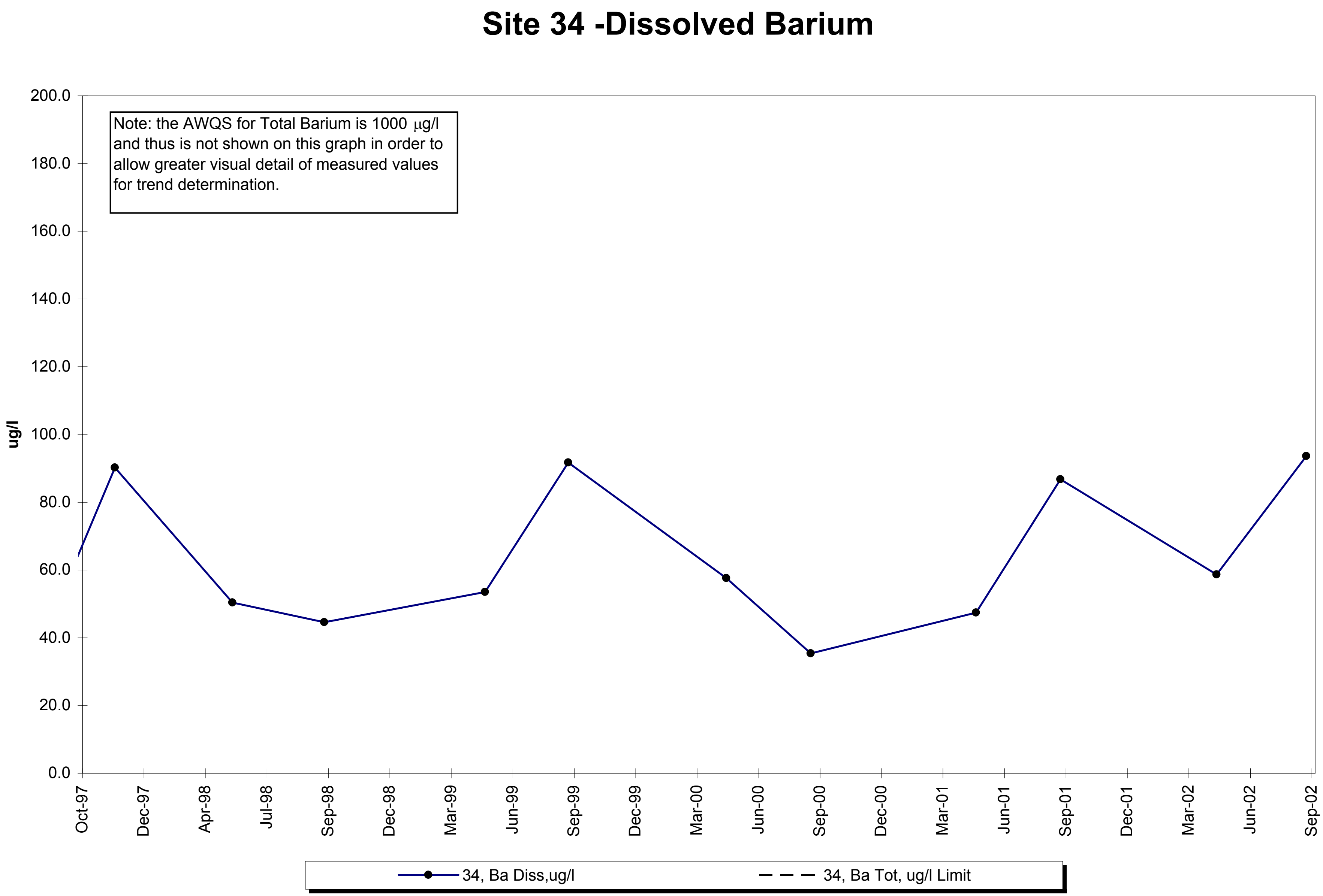
Site 34 -Total Alkalinity
mg/l
1000
900
800
700
600
500
400
300
200
100
0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
34, Total Alkalinity, mg/l
AWQS Total Alkalinity, mg/l (Lower Limit)

Site 34 -Hardness

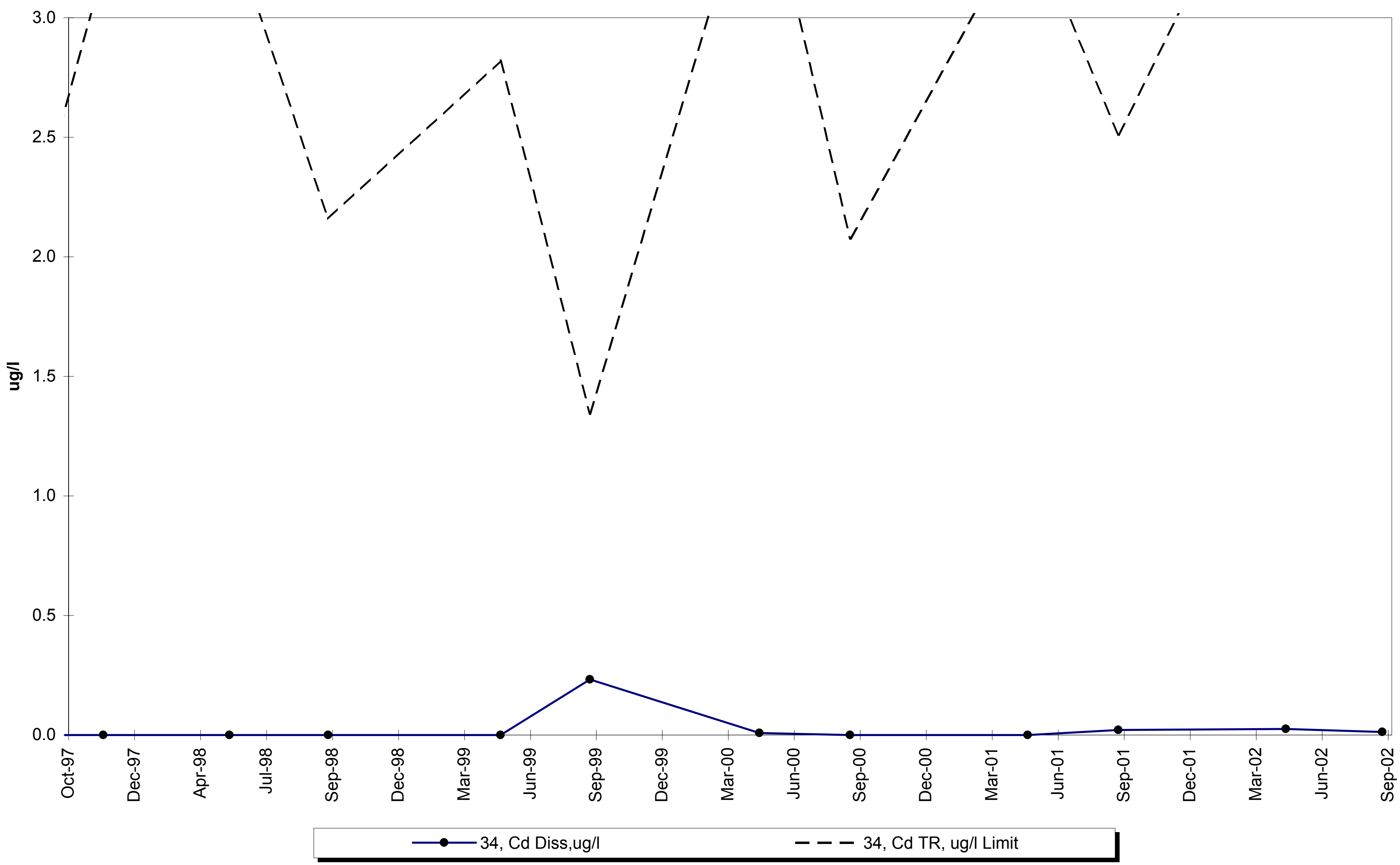


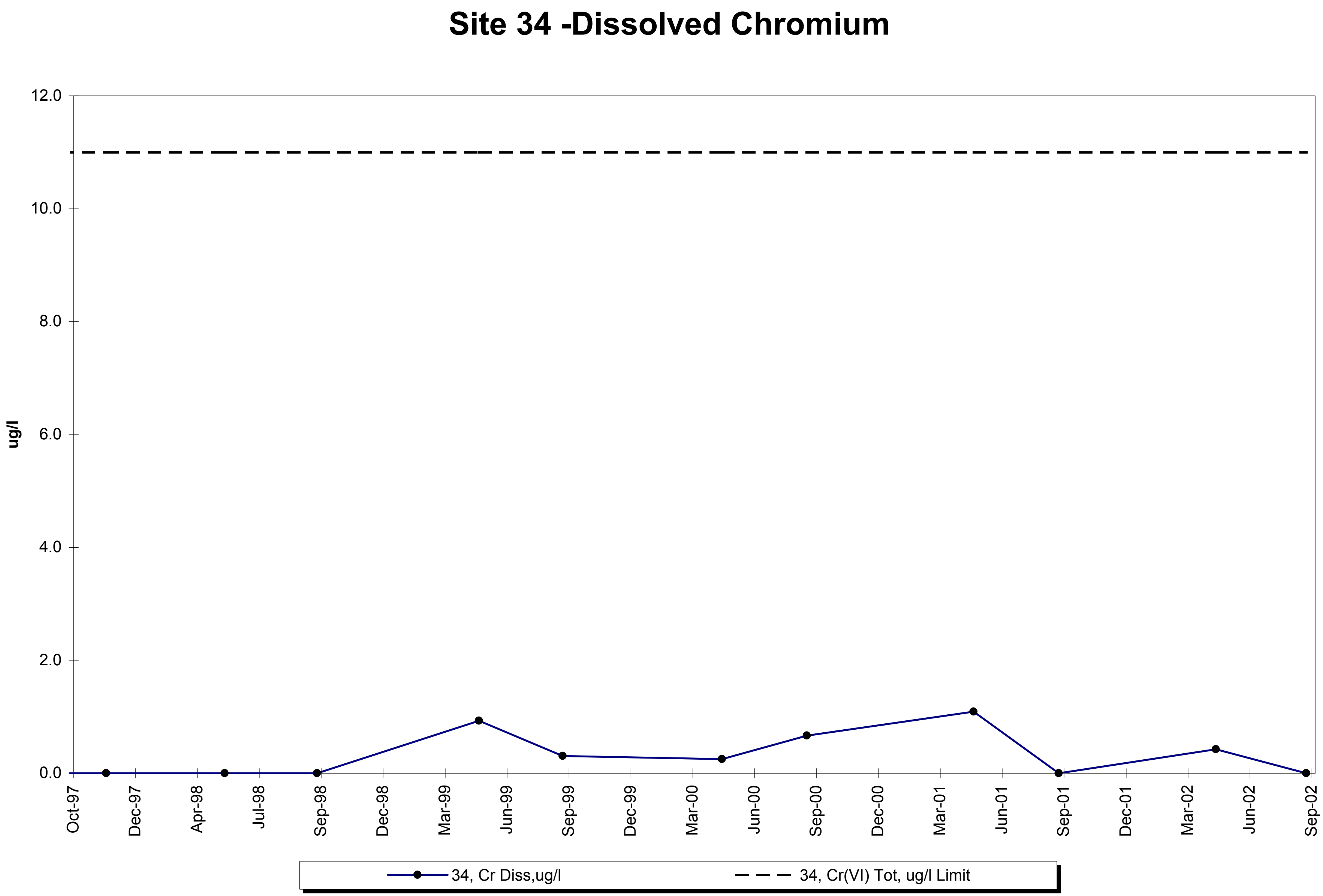
Site 34 -Dissolved Arsenic

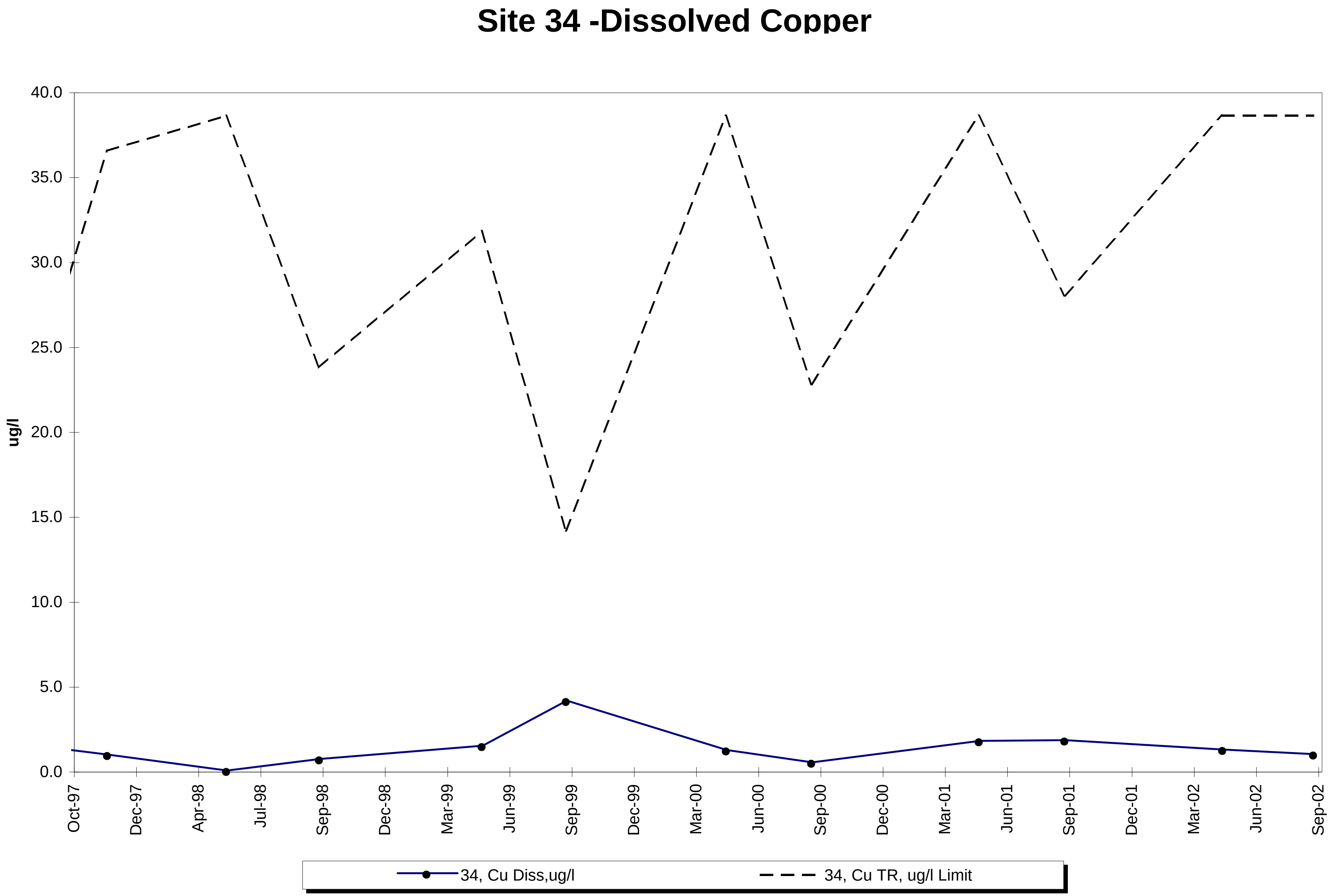



Site 34 -Dissolved Barium
Note: the AWQS for Total Barium is 1000 µg/l and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
34, Ba Diss,ug/l
34, Ba Tot, ug/l Limit

Site 34 -Dissolved Cadmium

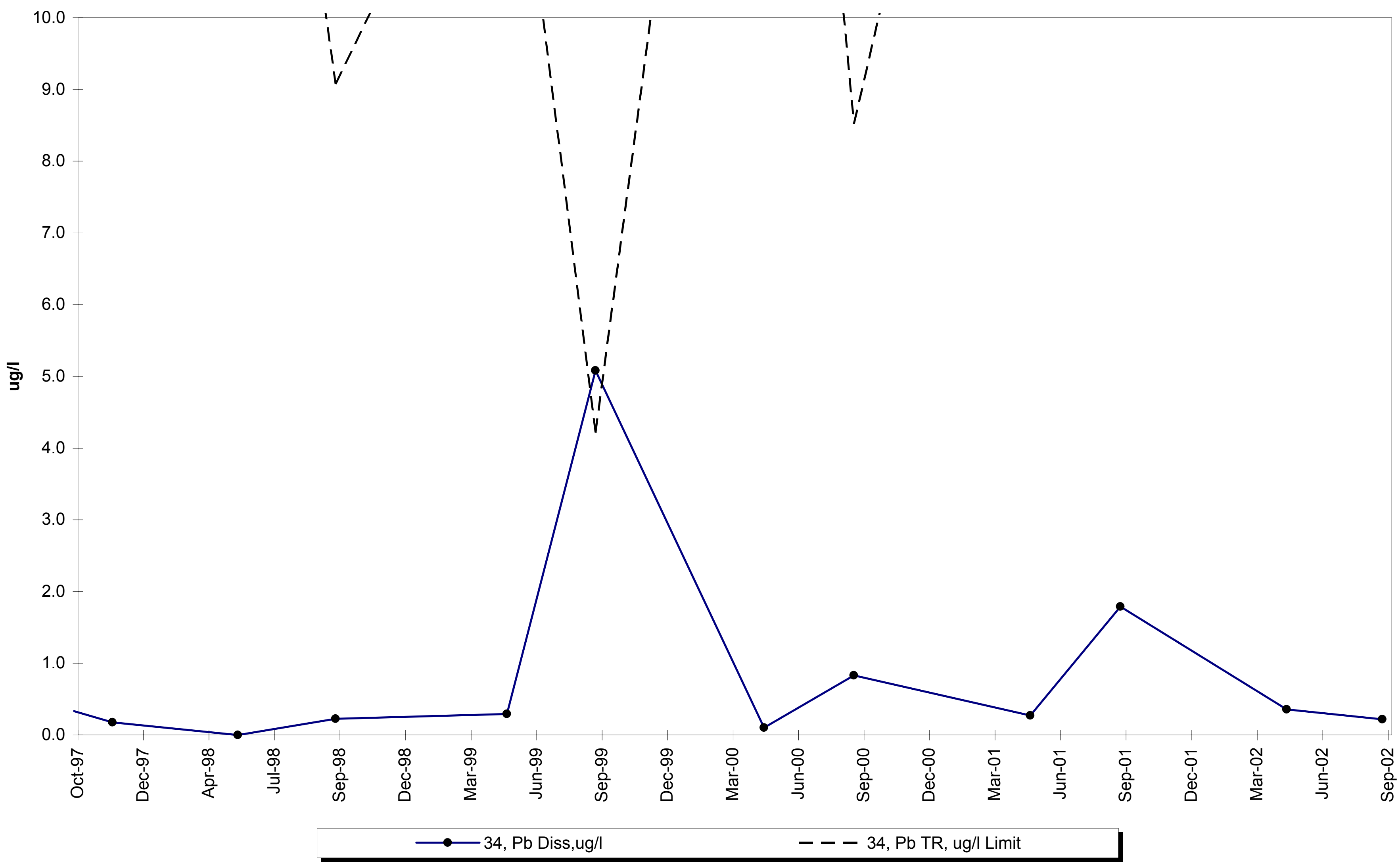



Site 34 -Dissolved Chromium
ug/l
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
34, Cr Diss,ug/l
34, Cr(VI) Tot, ug/l Limit

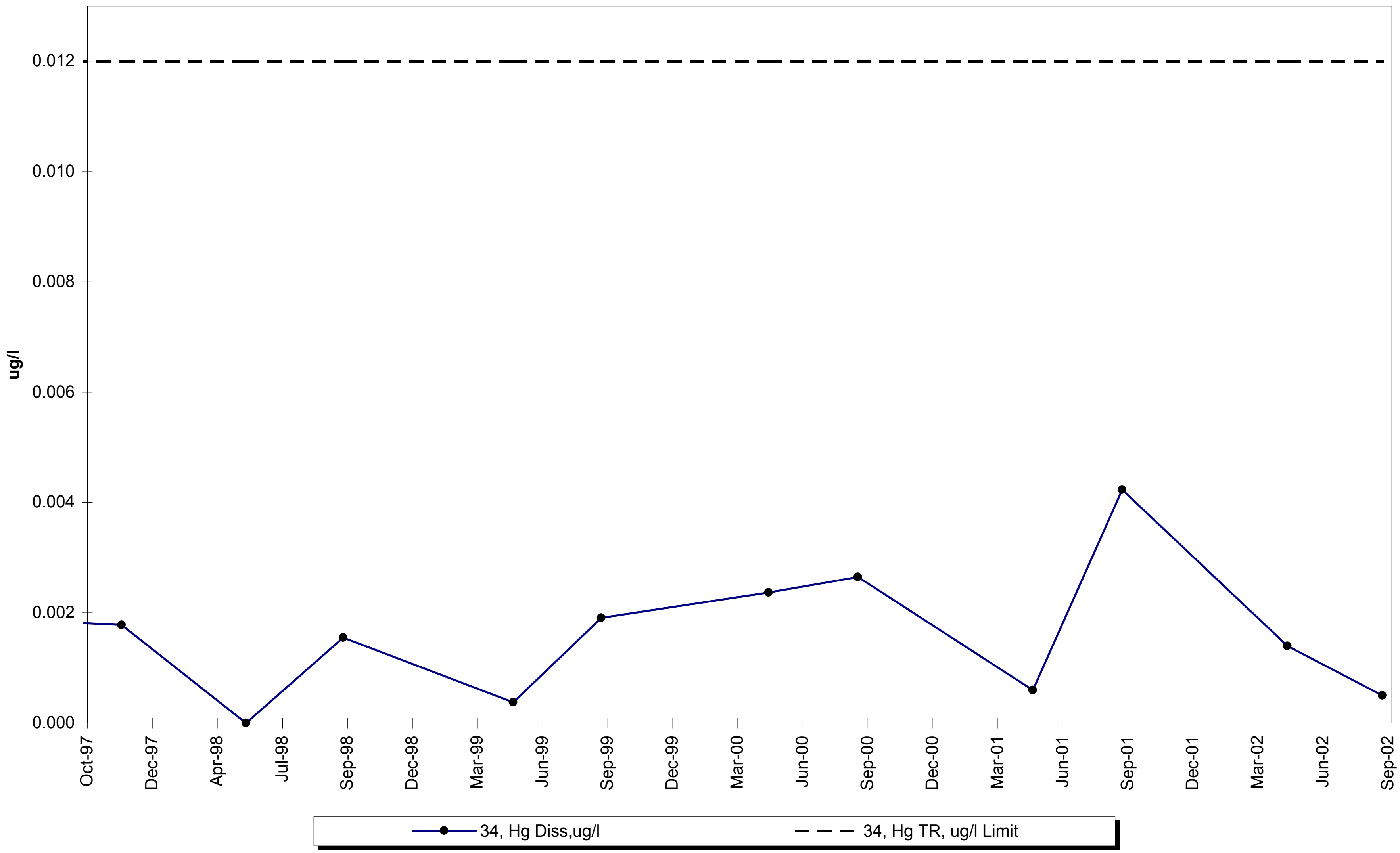


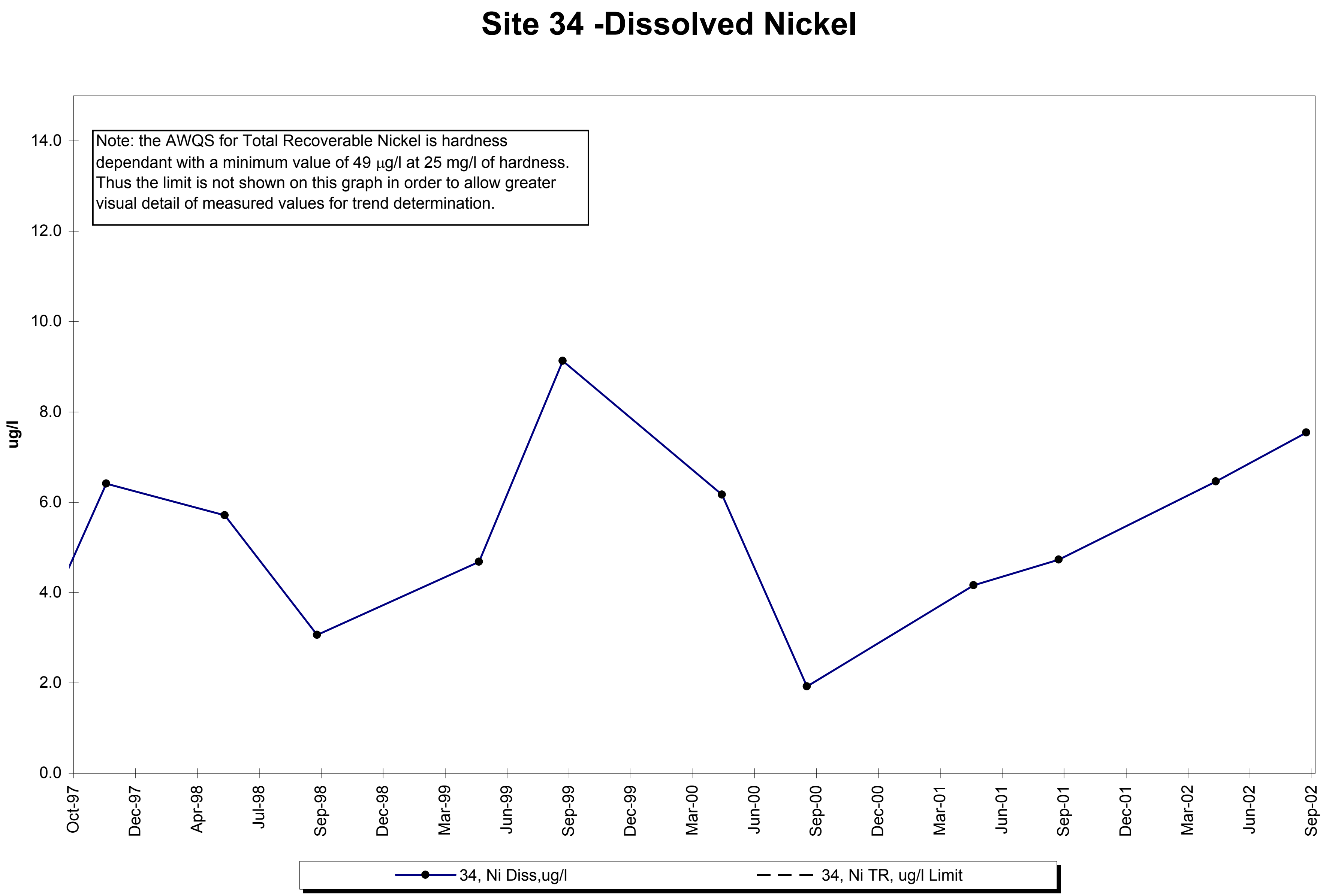
Site 34 -Dissolved Copper
ug/l
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
34, Cu Diss,ug/l
34, Cu TR, ug/l Limit

Site 34 -Dissolved Lead

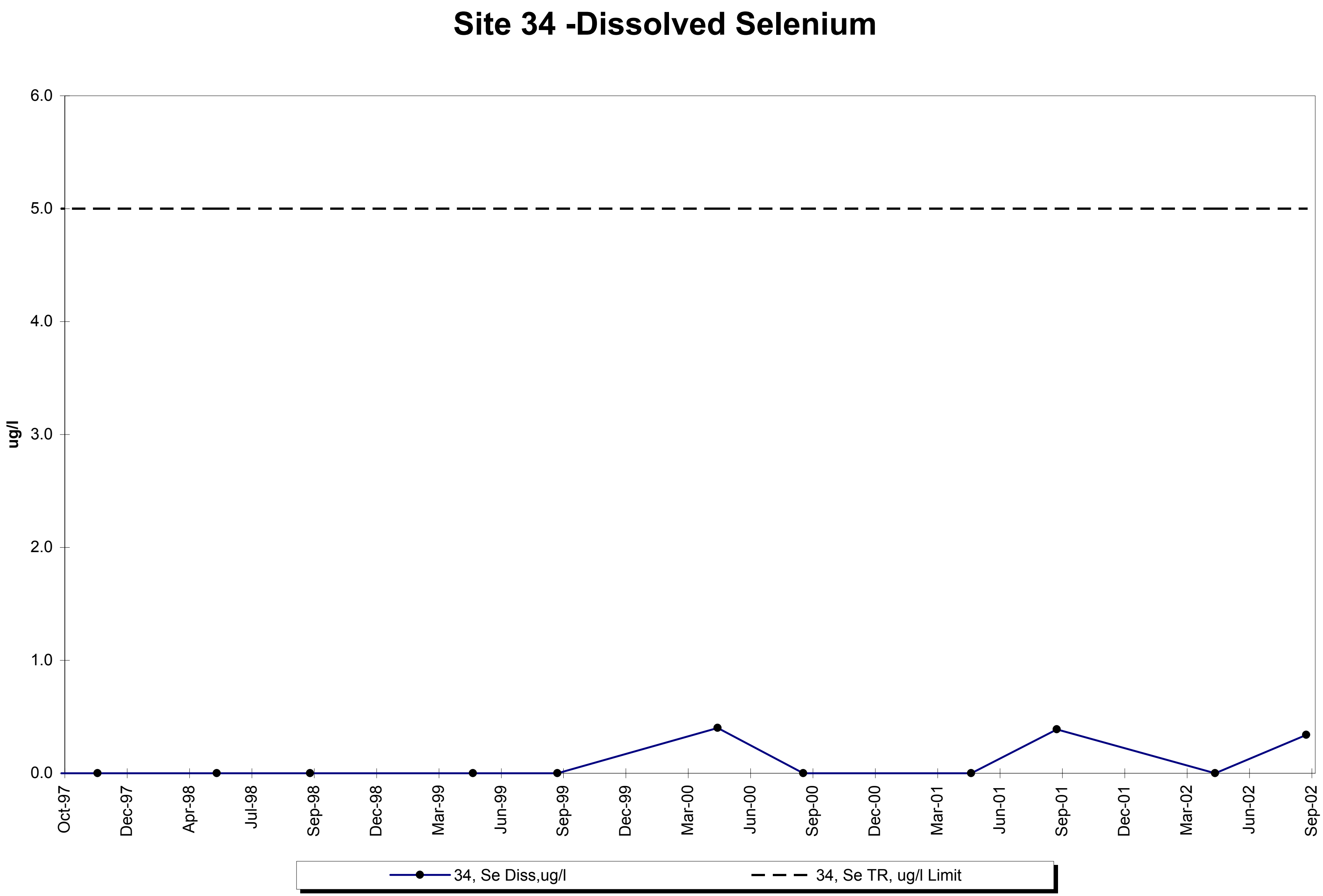


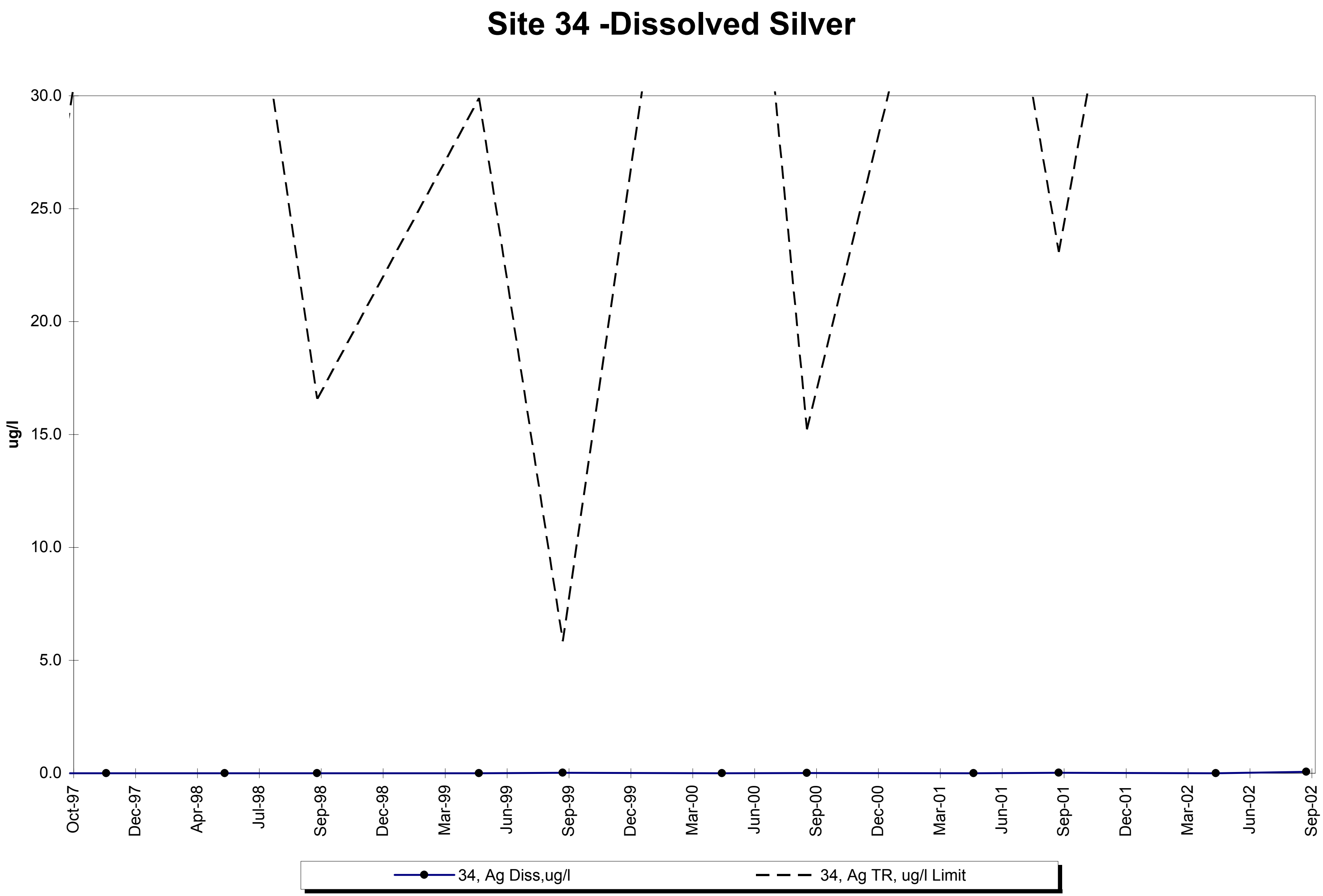
Site 34 -Dissolved Mercury



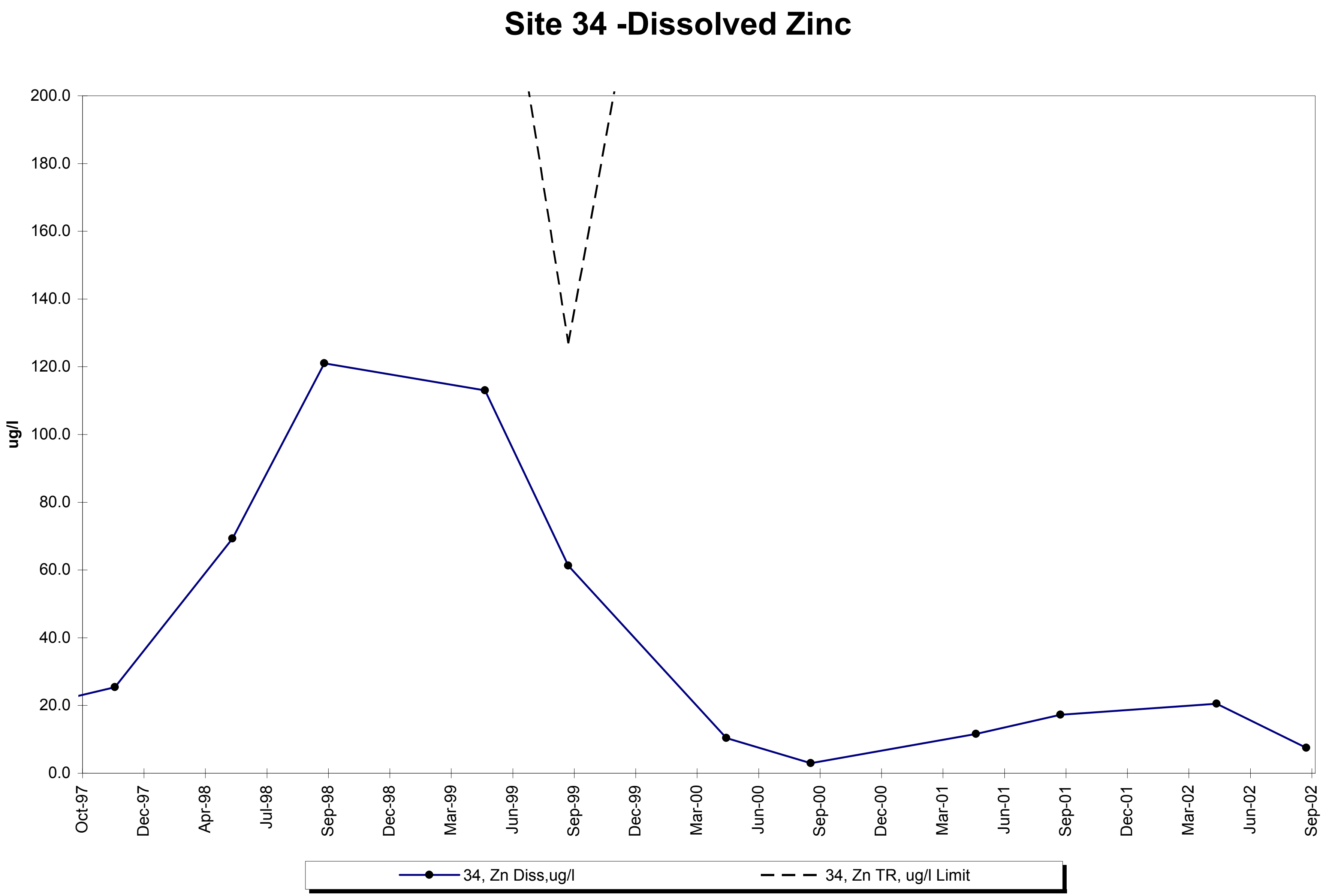


Site 34 -Dissolved Nickel
Note: the AWQS for Total Recoverable Nickel is hardness dependant with a minimum value of 49 μg/l at 25 mg/l of hardness. Thus the limit is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
34, Ni Diss,ug/l
34, Ni TR, ug/l Limit


Site 34 -Dissolved Selenium
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ug/l
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
34, Se Diss,ug/l
34, Se TR, ug/l Limit



Site 34 -Dissolved Silver
ug/l
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
34, Ag Diss,ug/l
34, Ag TR, ug/l Limit



Site 34 -Dissolved Zinc
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
ug/l
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
34, Zn Diss,ug/l
34, Zn TR, ug/l Limit

INTERPRETIVE REPORT
SITE 13 “MINE ADIT DISCHARGE EAST”

All data collected at this site for the past five years are included in the data analyses. As shown in the table below, there were no data outliers.

Sample Date	Parameter	Value	Qualifier	Notes
No outliers have been identified by KGCMC for the period of Oct-97 though Sept-02.				

The data collected during the current water year are listed in the following “Table of Results for Water Year 2002” report. The table includes all the data, field and lab, collected for the current water year and a series of flags keyed to the summary report “Qualified Data by QA Reviewer”. The QA report lists any associated data limitations found during the monthly QA reviews of laboratory data for this site. Median values for all analytes have been calculated and are shown in the right-most column of the table of results. Any value reported as less than MDL has been replaced with a value of zero for the purpose of median calculation.

The data for water year 2002 have been compared to the strictest fresh water quality criterion for each applicable analyte. One (1) result exceeding these criteria has been identified, as listed on the following “Comparison To Standards” report. The datum is for a September 2002 sulfate value of 347 mg/l that exceeds the AWQS of 250 mg/l. The elevated sulfate is likely the result of oxidation of pyrite contained in the production rock storage area located immediately upstream from Site 13. KGCMC plans for the removal of this material are listed in the General Plan of Operation, Appendix 14 –Attachment A, November 2001. It is anticipated that the removal of the waste rock will lower the sulfate concentrations to below AWQS.

X-Y plots have been generated to graphically present the data for each of the analytes requested in the Statistical Information Goals for this site. These plots have been visually analyzed for the appearance of any trend in concentration. No obvious trends were apparent.

Table of Results for Water Year 2002

Site 13 "Mine Adit Discharge East"

Sample Date/Parameter	10/25/2001	11/15/2001	12/5/2001	1/29/2002	2/21/2002	3/19/2002	4/1/2002	5/28/2002	6/11/2002	7/15/2002	8/27/2002	9/19/2002	**Median**
Water Temp (°C)	4.0	INACCESSIBLE DUE TO SNOW	NOT SCHEDULED FOR SAMPLING				INACCESSIBLE DUE TO SNOW	8.8	8.2	10.5	10.2	8.9	8.9
Conductivity-Field (μmho)	812							674	737	855	741	843	777
Conductivity-Lab (μmho)	791 J							646	724	832	717	857	758
pH Lab (standard units)	7.10							6.76	7.15	8.00	7.85	7.50	7.33
pH Field (standard units)	7.12							7.60	7.65	7.82	7.75	7.42	7.63
Total Alkalinity (mg/l)	166.0 J							107.0	126.0	144.0	111.0	147.0	135.0
Hardness (mg/l)	456.0							449.0	396.0	480.0	411.0	531.0	452.5
Dissolved As (μg/l)	<0.446							0.295 J	-0.204 UJ	0.227	0.212 U	-0.074	0.218
Dissolved Ba (μg/l)	32.8							20.4	22.3	23.8	23.9	34.2 J	23.9
Dissolved Cd (μg/l)	<0.049							0.022 UJ	-0.034	0.024	0.040	0.053	0.024
Dissolved Cr (μg/l)	2.950 J							1.150	0.157 J	2.750	0.356	-0.273	0.753
Dissolved Cu (μg/l)	0.284							1.410	1.210 U	1.500 J	1.620	1.560	1.455
Dissolved Pb (μg/l)	0.0910 UJ							0.0737	-0.0320 UJ	0.0147 J	0.0375 U	0.5240	0.0556
Dissolved Ni (μg/l)	2.90 J							2.35	2.08	2.52	2.35	2.70	2.44
Dissolved Ag (μg/l)	<0.0590							-0.0080 UJ	-0.0220	-0.0120	-0.0220	-0.0330	0.0110
Dissolved Zn (μg/l)	15.20							18.50	7.30 J	17.70	19.50	25.60 J	18.10
Dissolved Se (μg/l)	0.382 J							-0.475	-0.679 UJ	0.386	-0.210	0.277 J	0.308
Dissolved Hg (μg/l)	0.002120 J							0.000655 UJ	0.001010 U	0.000665 U	0.001160 U	0.000751 U	0.000881

See "Qualififed Data by QA Reviewer" table for qualifier descriptions.

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
13	10/25/2001	3:10:00 PM				
			Cond Lab, umho	791	J	Sample Temp.
			Alk Tot, mg/l	166	J	Sample Temp.
			Cr Diss, ug/l	2.95	J	LCS Rec.
			Pb Diss, ug/l	0.091	UJ	Below Quantitative Range, Fi
			Ni Diss, ug/l	2.9	J	Cont. Calib.
			Se Diss, ug/l	0.382	J	LCS Rec.
			Hg Diss, ug/l	0.00212	J	LCS RPD
13	05/28/2002	1:05:00 PM				
			As Diss, ug/l	0.295	J	Below Quantitative Range
			Cd Diss, ug/l	0.0222	UJ	CCV Rec.
			Ag Diss, ug/l	-0.008	UJ	CCV Rec.
			Hg Diss, ug/l	0.000655	UJ	CCV Rec, Field Blank Contam
13	06/11/2002	12:56:00 PM				
			As Diss, ug/l	-0.204	UJ	LCS Rec.
			Cr Diss, ug/l	0.157	J	Below Quantitative Range
			Cu Diss, ug/l	1.21	U	Field Blank Cont.
			Pb Diss, ug/l	-0.032	UJ	LCS Rec.
			Zn Diss, ug/l	7.3	J	LCS Rec.
			Se Diss, ug/l	-0.679	UJ	LCS Rec.
			Hg Diss, ug/l	0.00101	U	Field Blank Cont.
13	07/15/2002	1:00:00 PM				
			Cu Diss, ug/l	1.5	J	LCS Rec.
			Pb Diss, ug/l	0.0147	J	Below Quantitative Range
			Hg Diss, ug/l	0.000665	U	Field Blank Cont.
13	08/27/2002	12:57:00 PM				
			As Diss, ug/l	0.212	U	Field Blank Contamination
			Pb Diss, ug/l	0.0375	U	Field Blank Contamination
			Hg Diss, ug/l	0.00116	U	Field Blank Contamination

Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Qualified Data by QA Reviewer

Date Range: 10/01/2001 to 09/30/2002

Site No.	Sample Date	Sample Time	Parameter	Value	Qualifier	Reason for Qualifier
13	09/19/2002	12:25:00 PM				
			Ba Diss, ug/l	34.2	J	LCS Rec.
			Zn Diss, ug/l	25.6	J	LCS Rec.
			Se Diss, ug/l	0.277	J	Below Quantitative Range
			Hg Diss, ug/l	0.000751	U	Field Blank Contamination

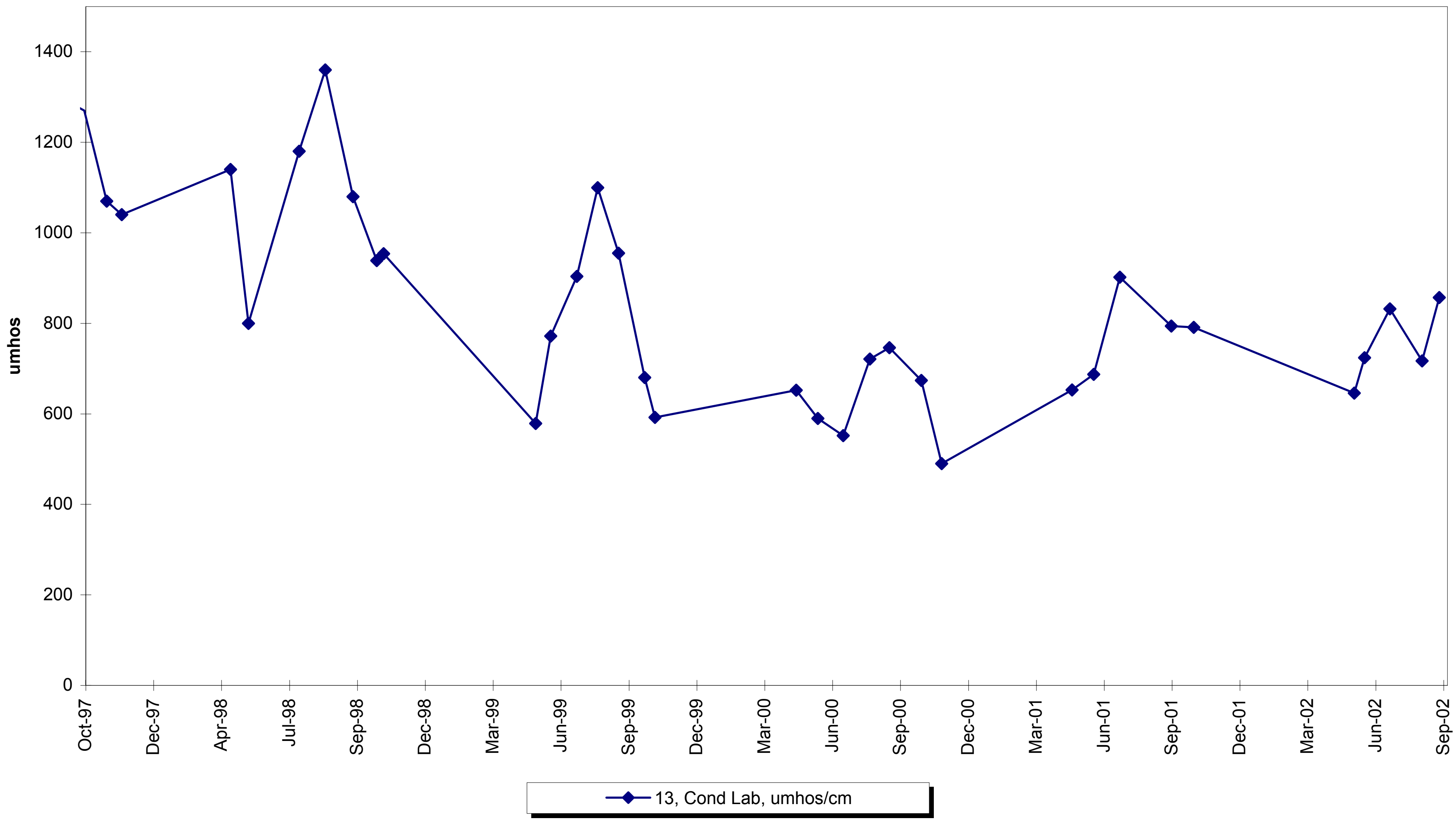
Qualifier	Description
J	Positively Identified - Approximate Concentration
N	Presumptive Evidence For Tentative Identification
NJ	Tentatively Identified - Approximate Concentration
R	Rejected - Cannot Be Verified
U	Not Detected Above Quantitation Limit
UJ	Not Detected Above Approximate Quantitation Limit

Comparison To Standards

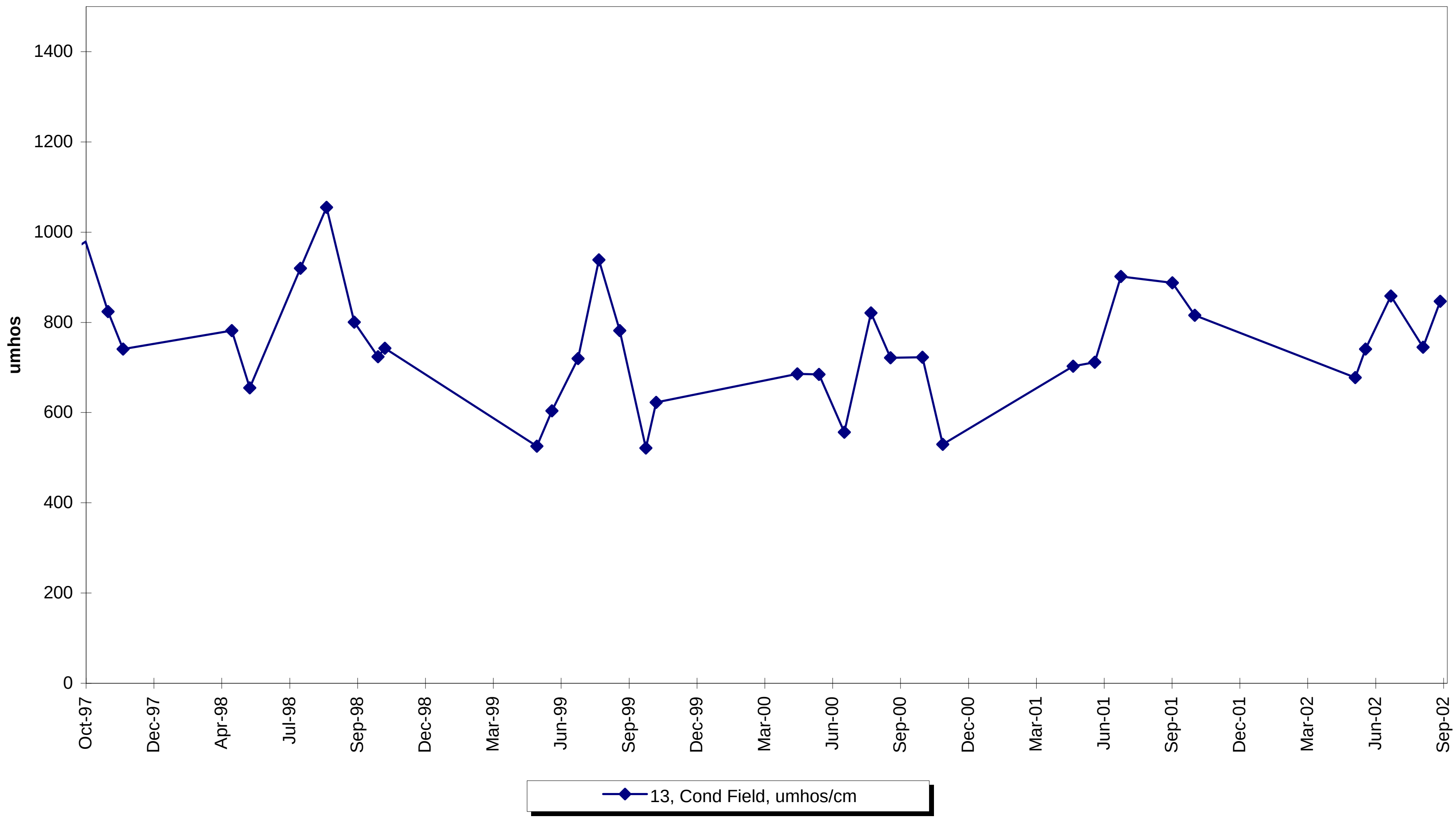
Date Range: 10/01/2001 to 09/30/2002

Site Number	Date	Time	Dup ID	Storet No.	Parameter Description	Value	Standard	Standard Type
13	09/19/2002	12:25 PM	0	945	SO4 Tot, mg/l	347	250.	Aquatic

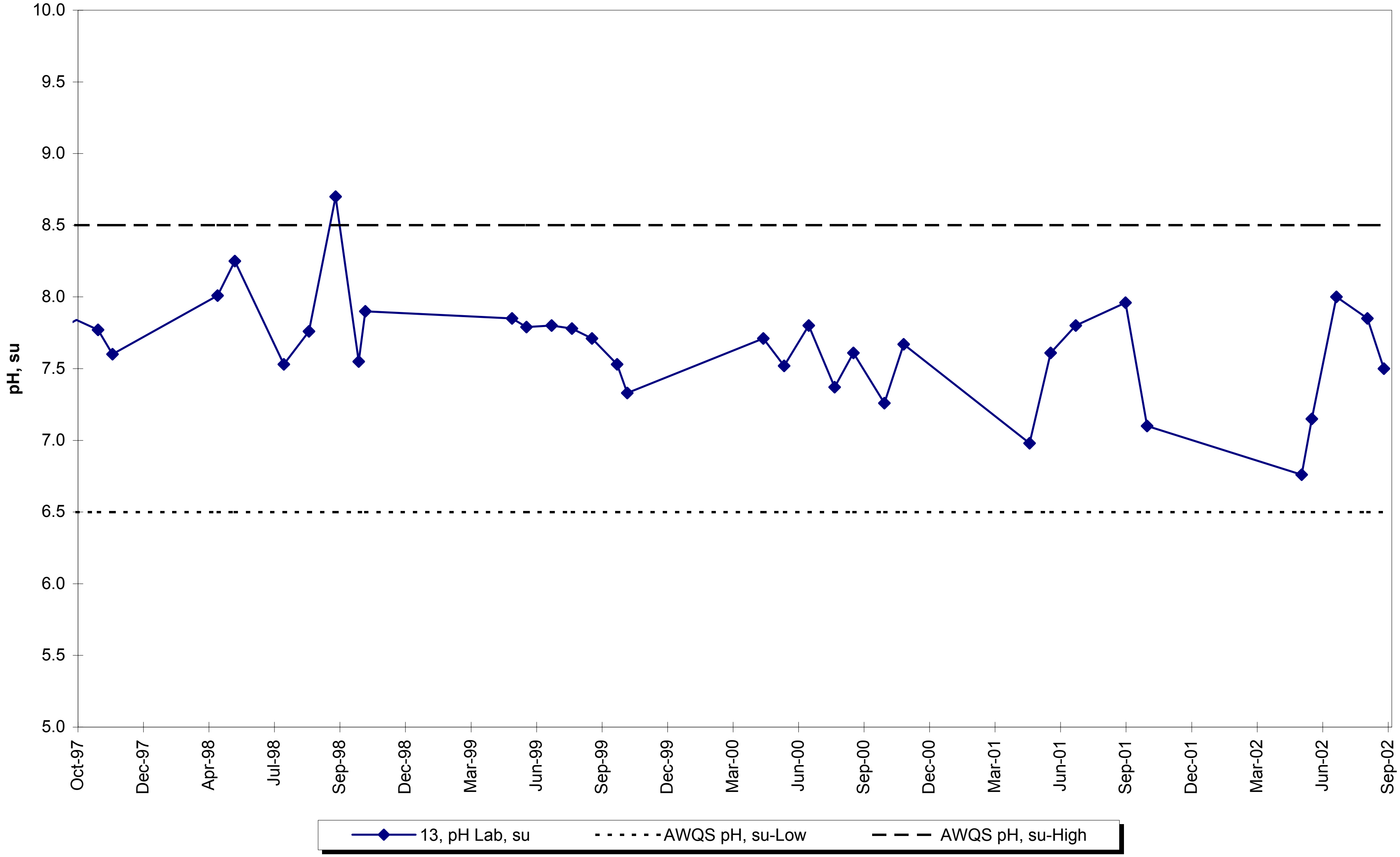
Site 13 -Conductivity-Lab



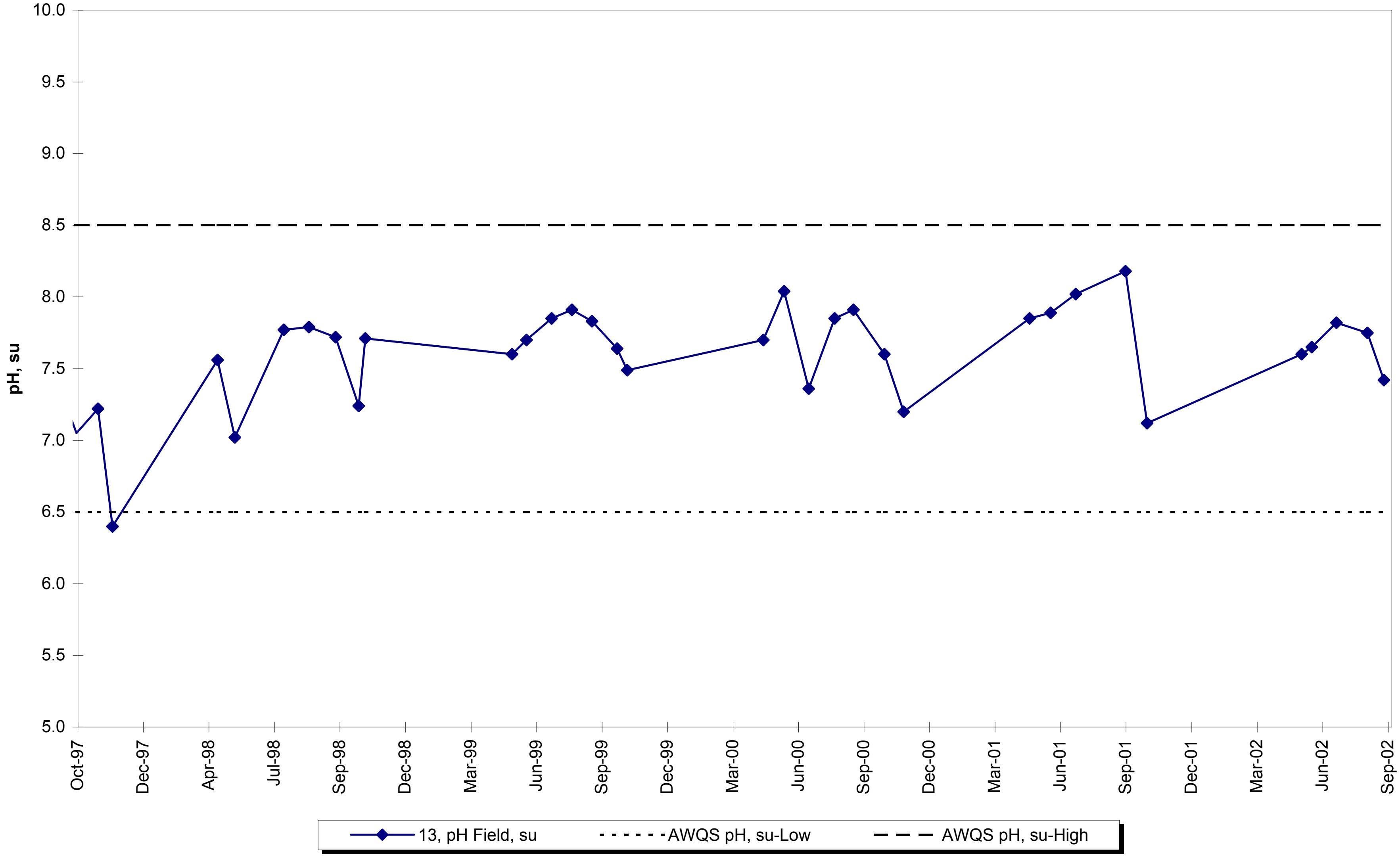
Site 13 -Conductivity-Field



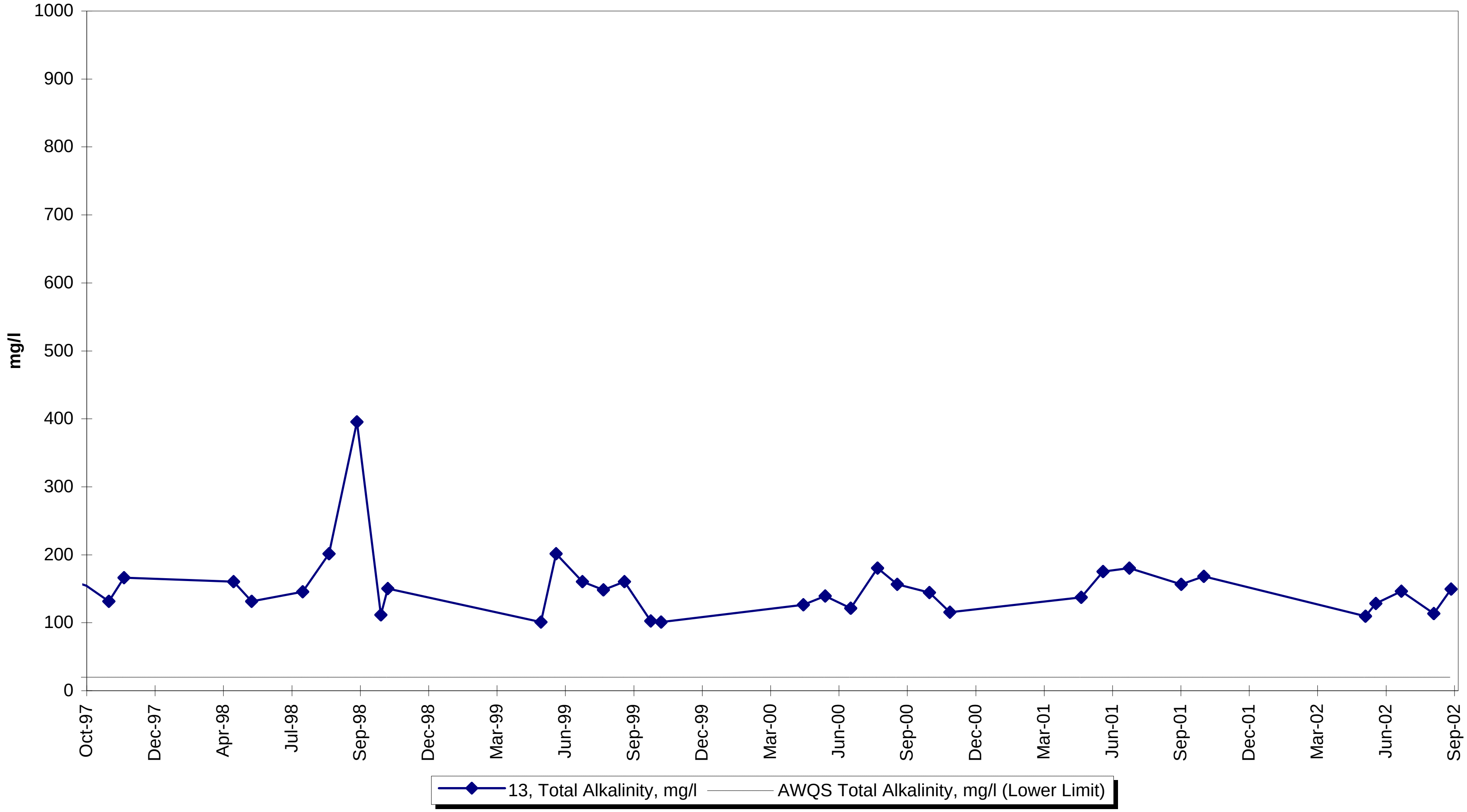
Site 13 -Lab pH



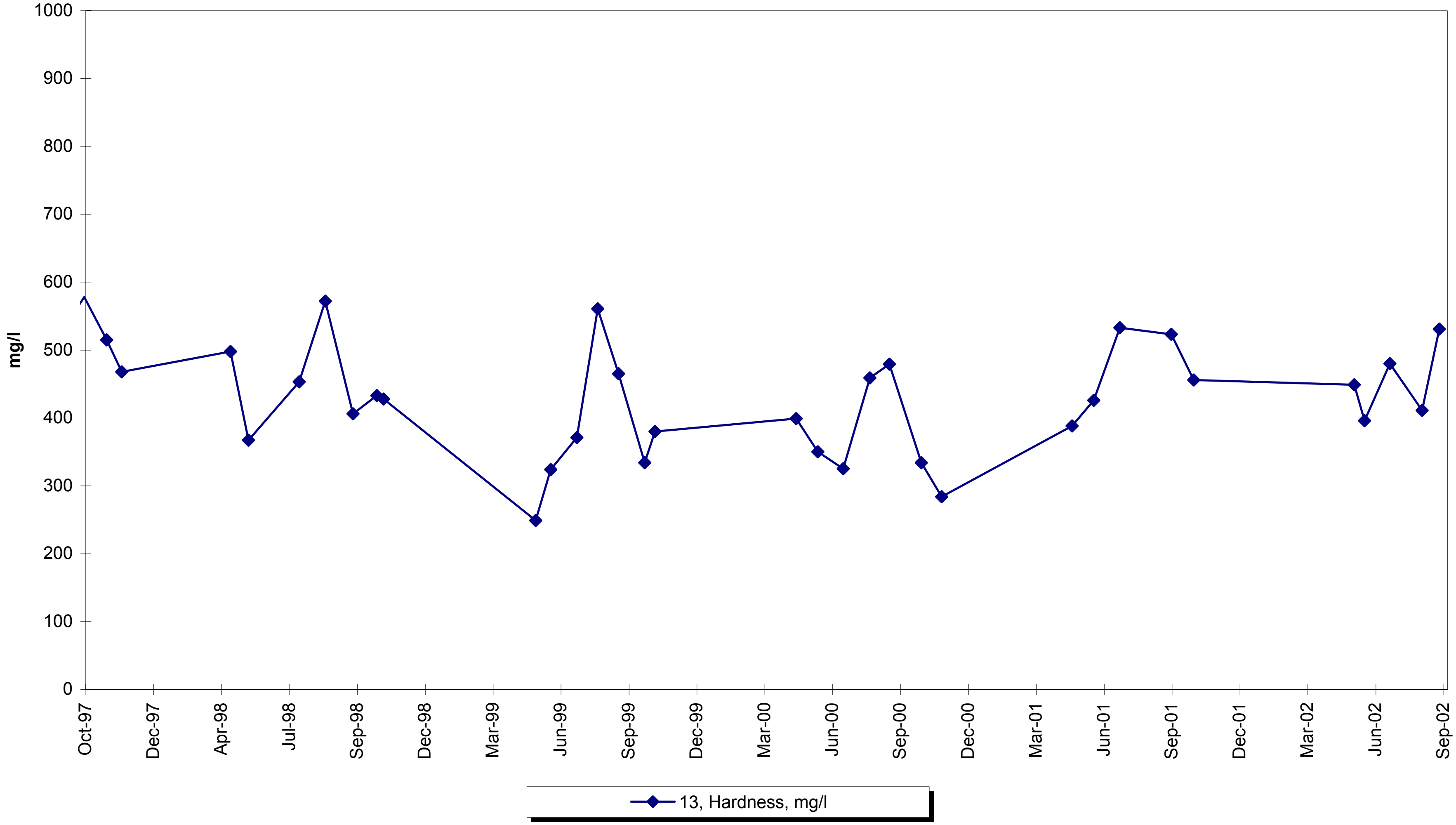
Site 13 -Field pH

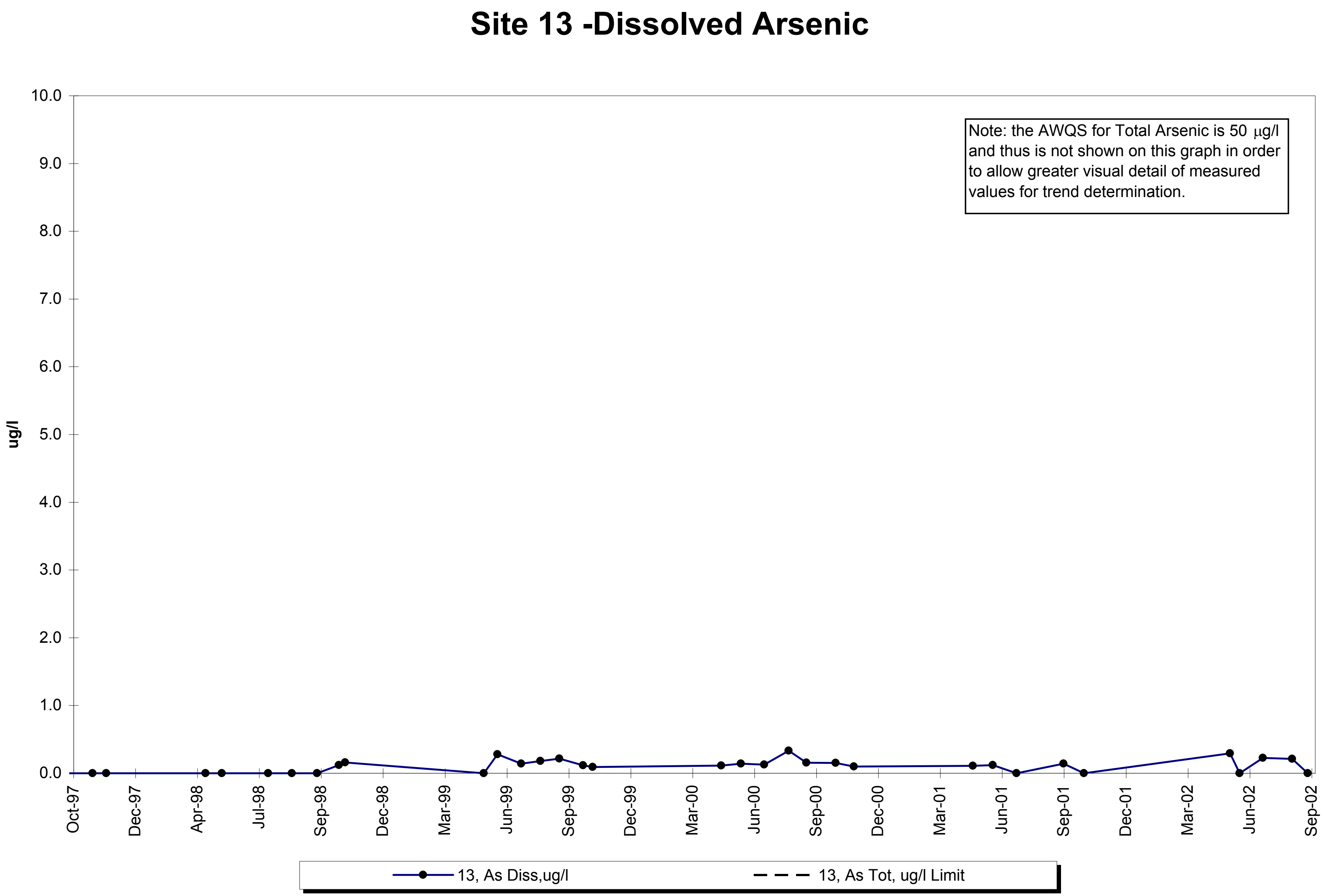


Site 13 -Total Alkalinity



Site 13 -Hardness




Site 13 -Dissolved Arsenic
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ug/l
Note: the AWQS for Total Arsenic is 50 µg/l and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
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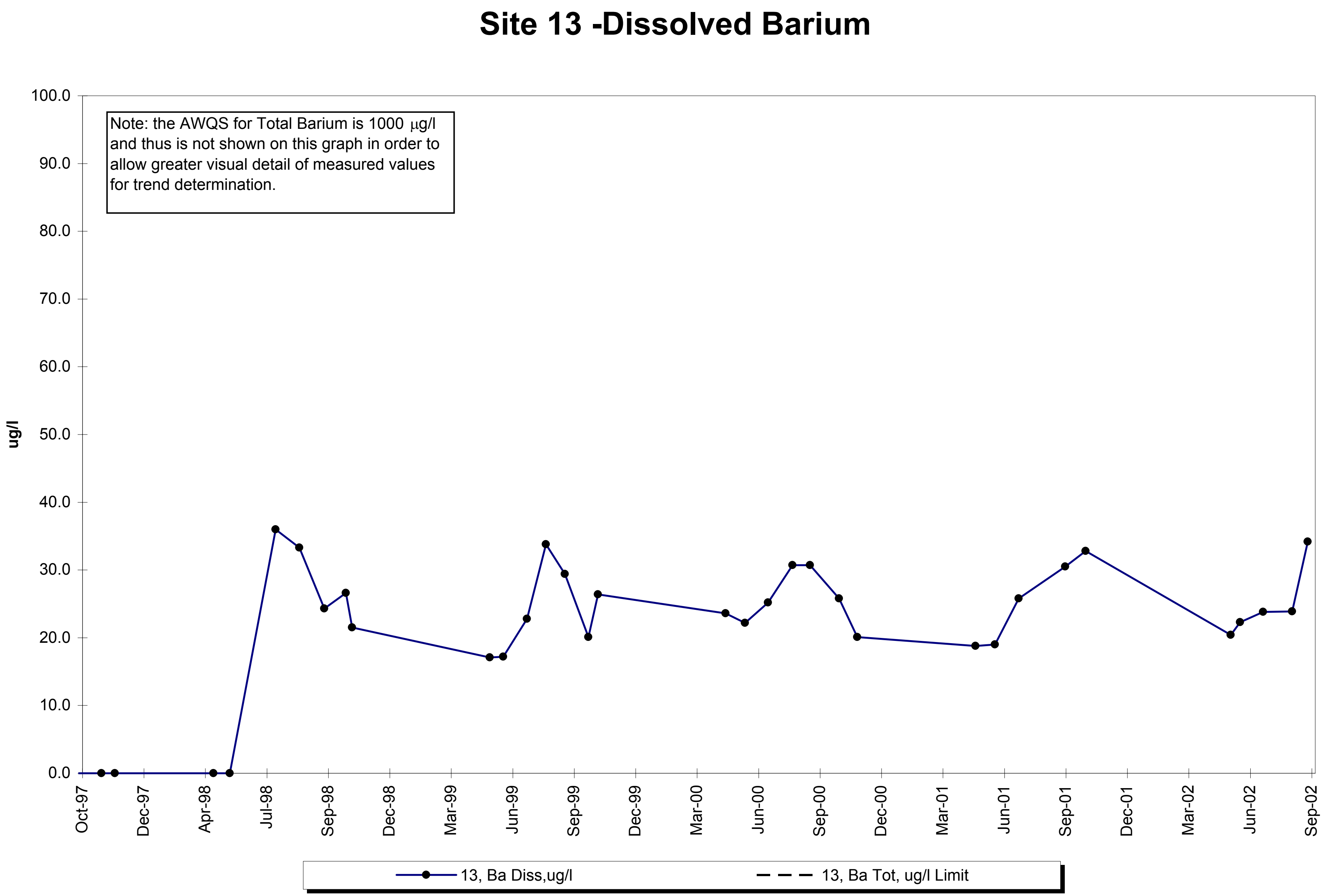
Dec-01
Mar-02
Jun-02
Sep-02
13, As Diss,ug/l
13, As Tot, ug/l Limit



Site 13 -Dissolved Barium
Note: the AWQS for Total Barium is 1000 µg/l and thus is not shown on this graph in order to allow greater visual detail of measured values for trend determination.
ug/l
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90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Oct-97
Dec-97
Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
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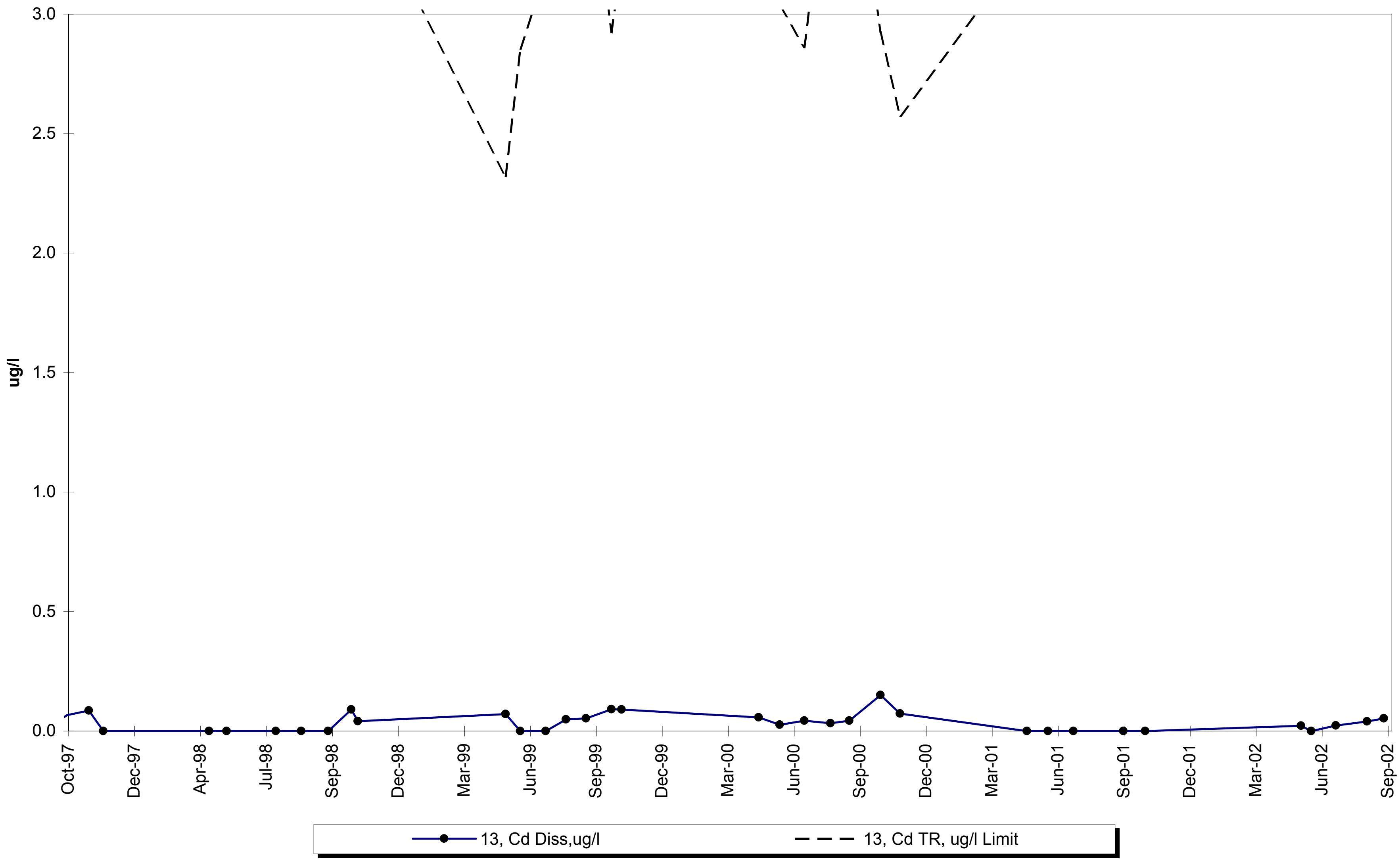
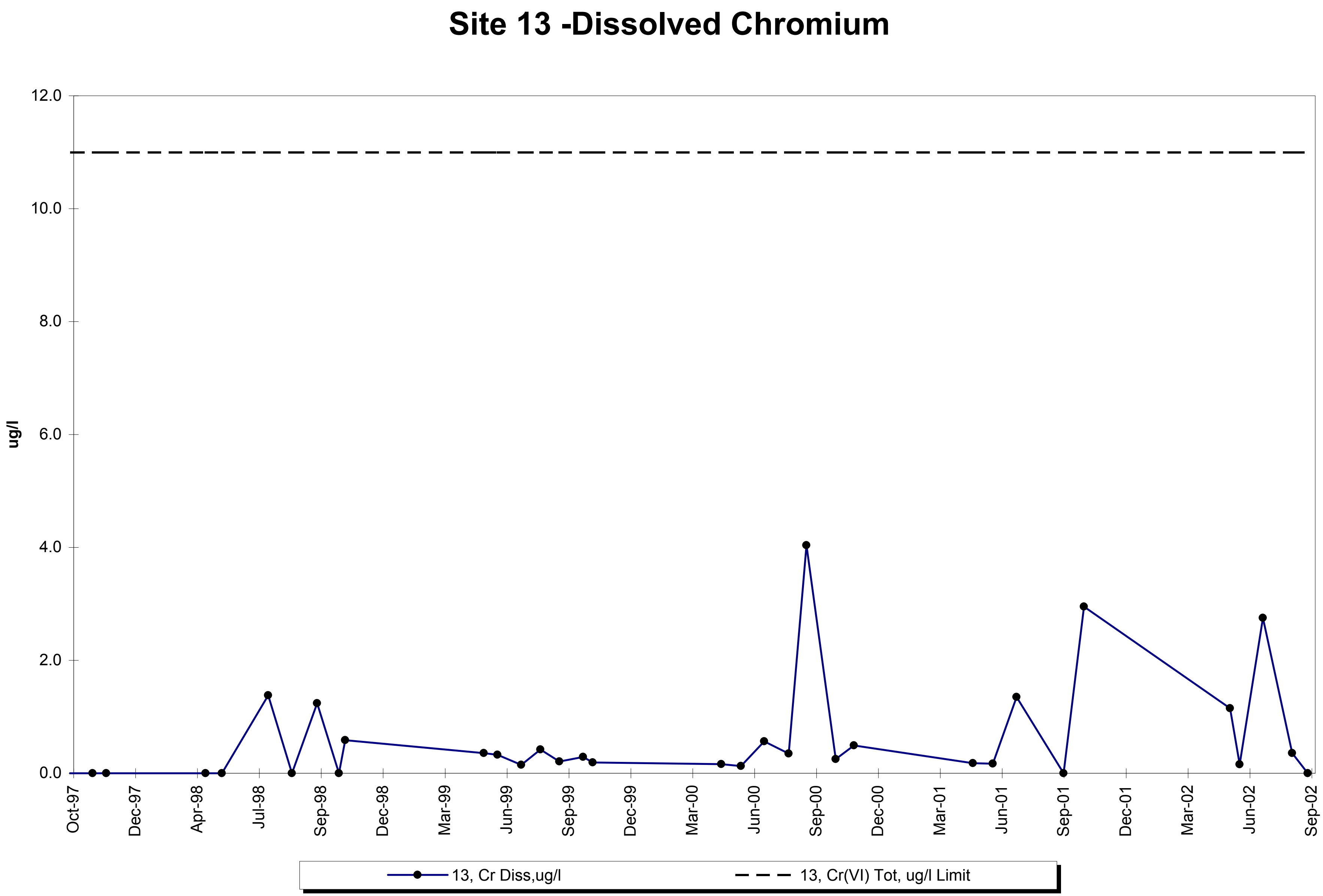
Jun-02
Sep-02
13, Ba Diss,ug/l
13, Ba Tot, ug/l Limit

Site 13 -Dissolved Cadmium

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8.0
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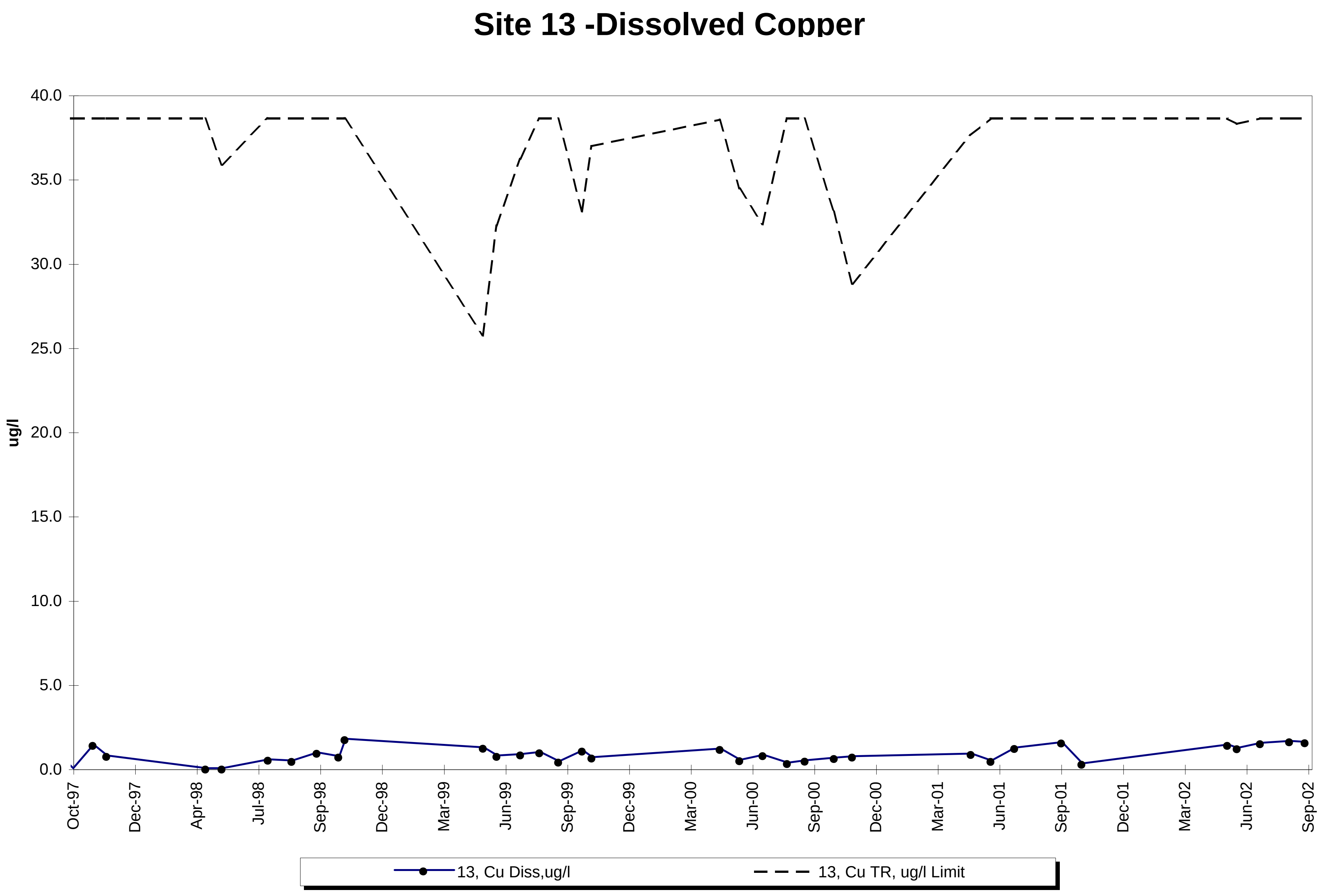
13, Cr(VI) Tot, ug/l Limit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Jul-98
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Jun-00
Sep-00
Dec-00
Mar-01
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13, Cu TR, ug/l Limit

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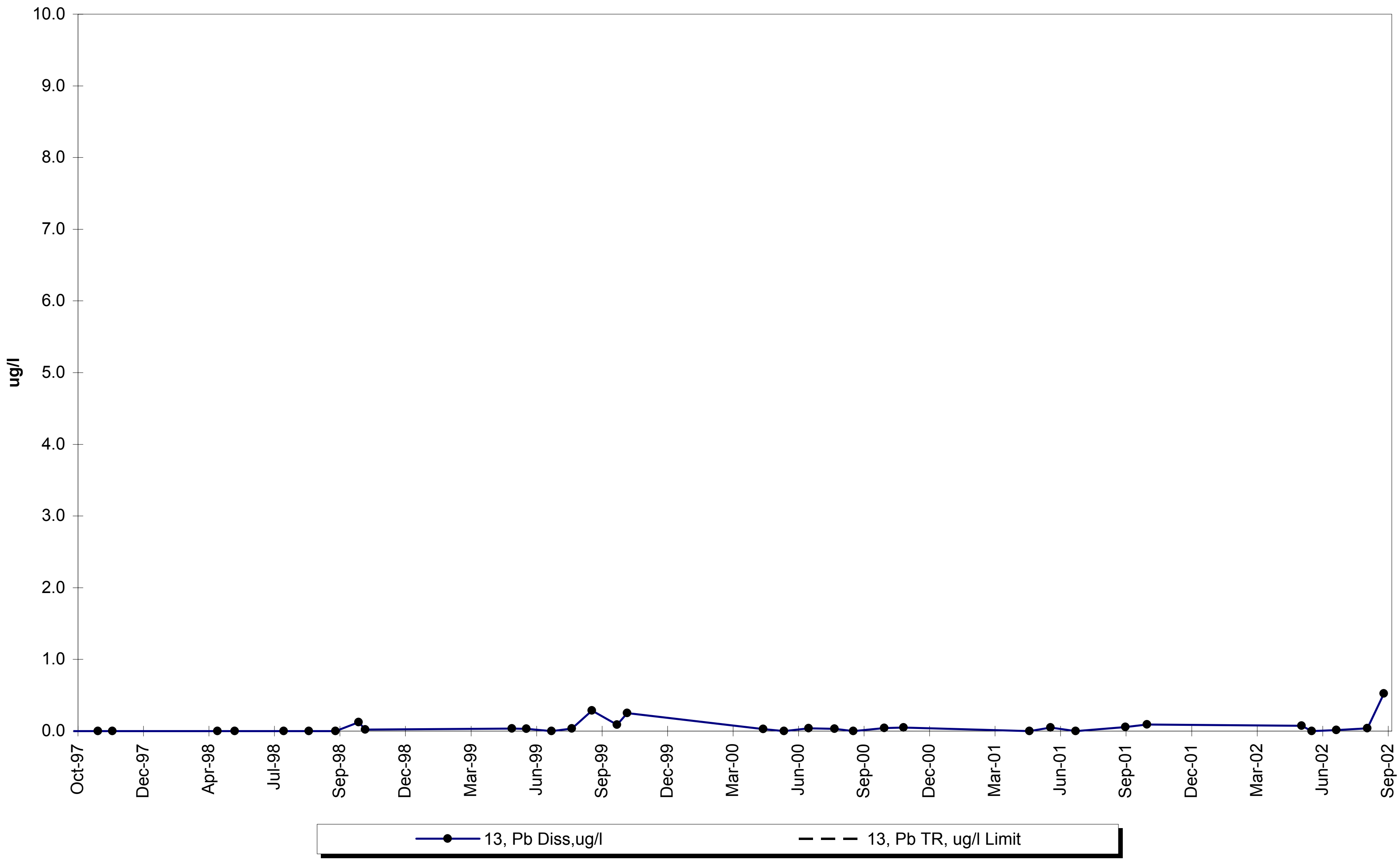

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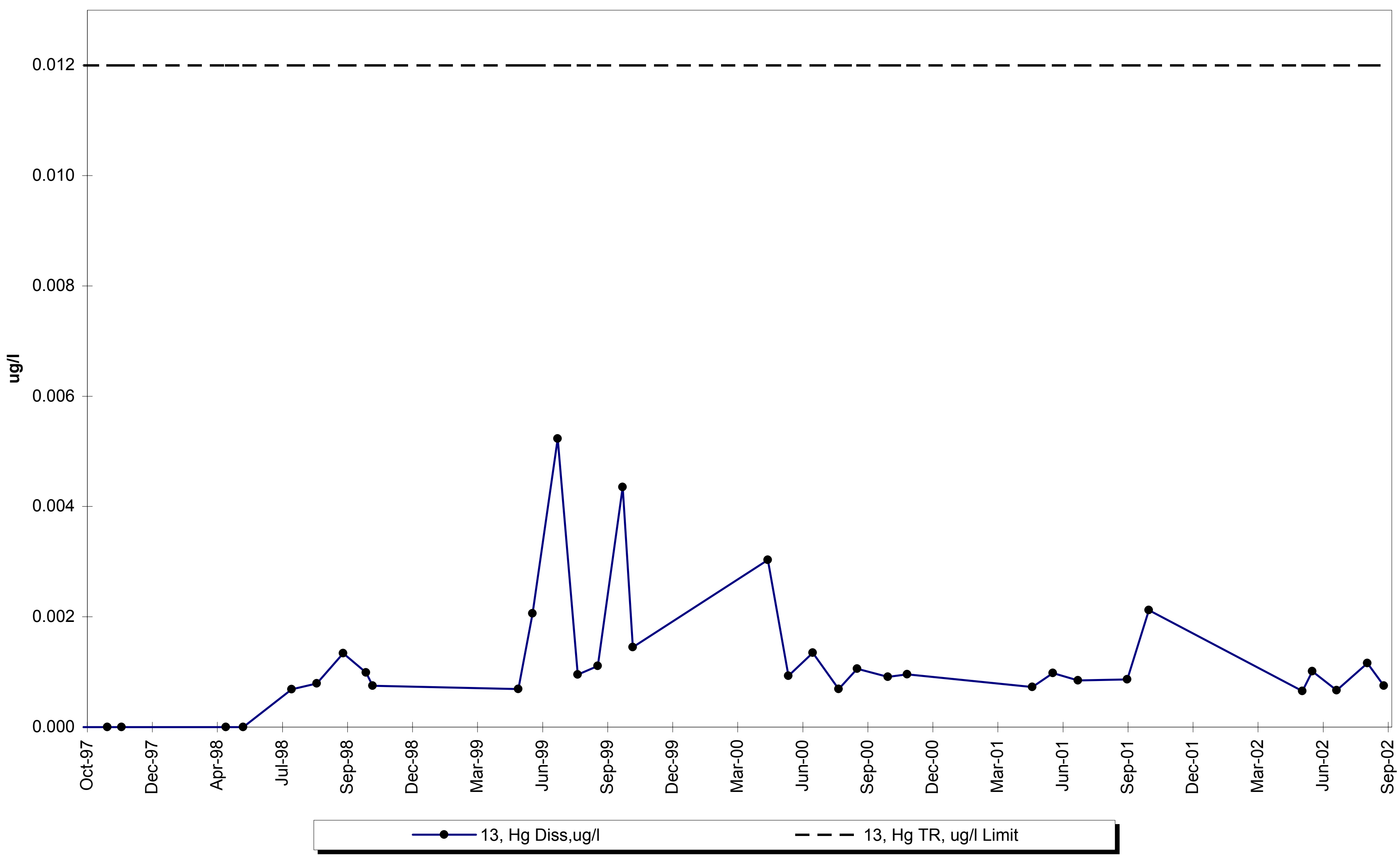

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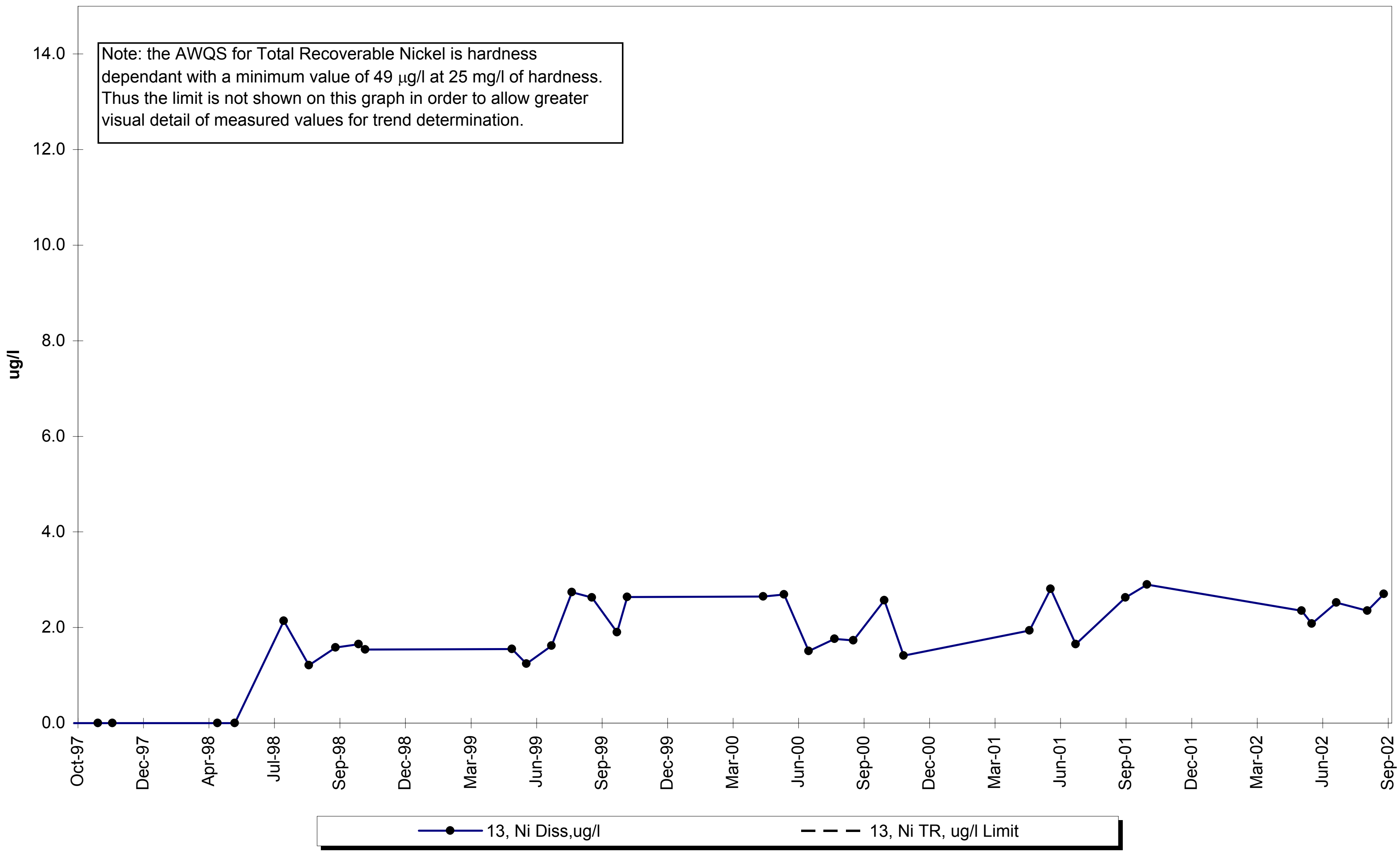

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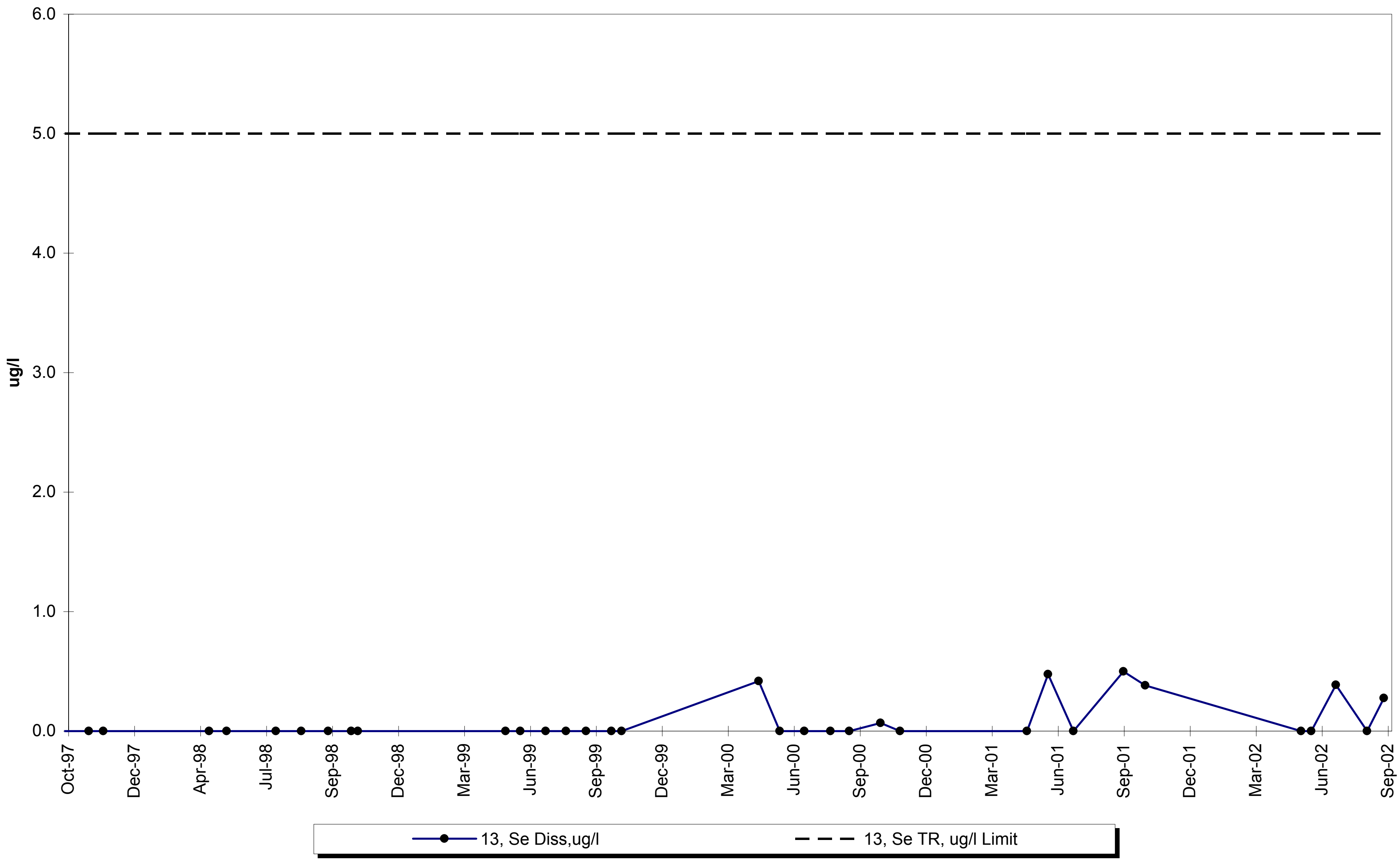

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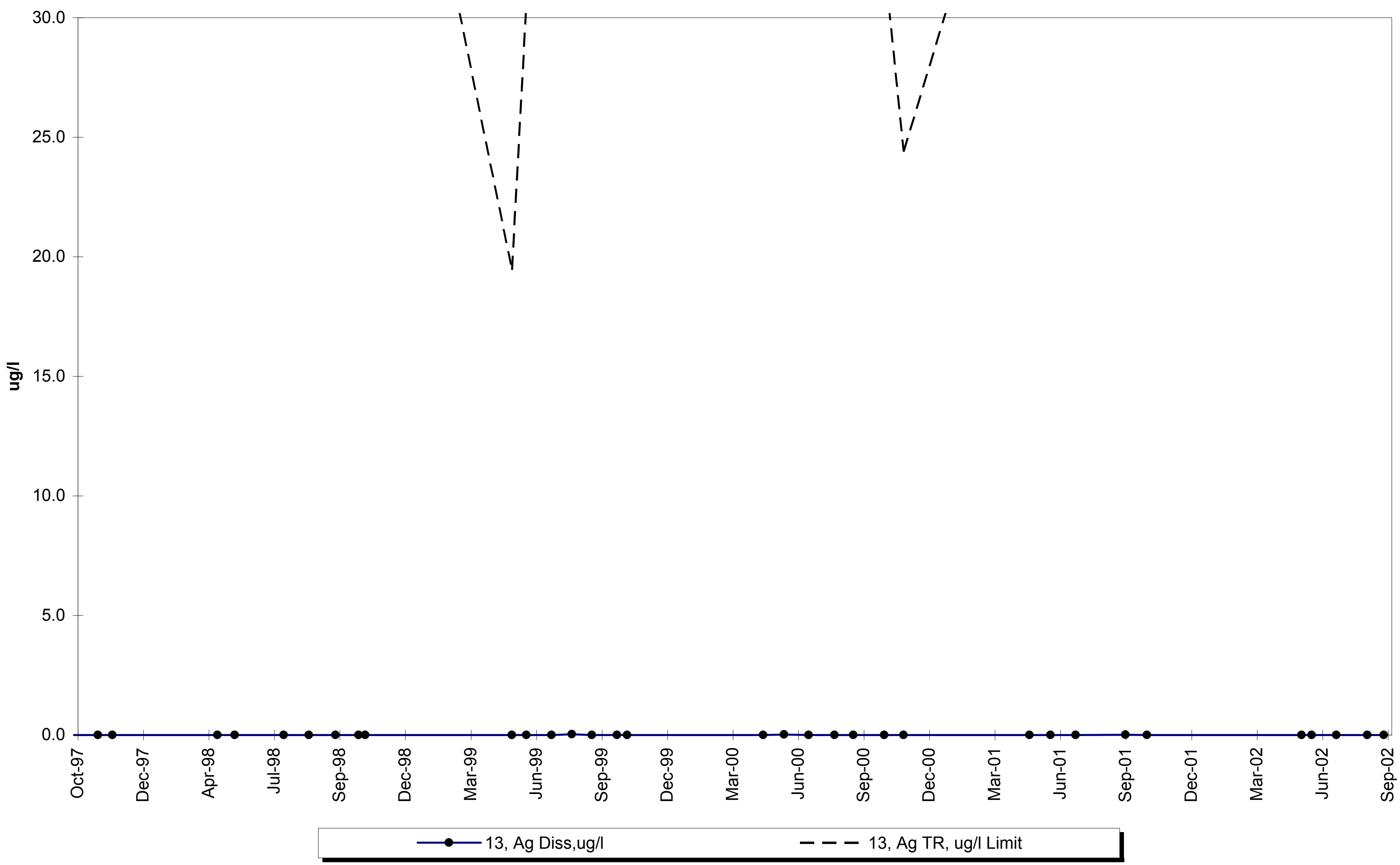

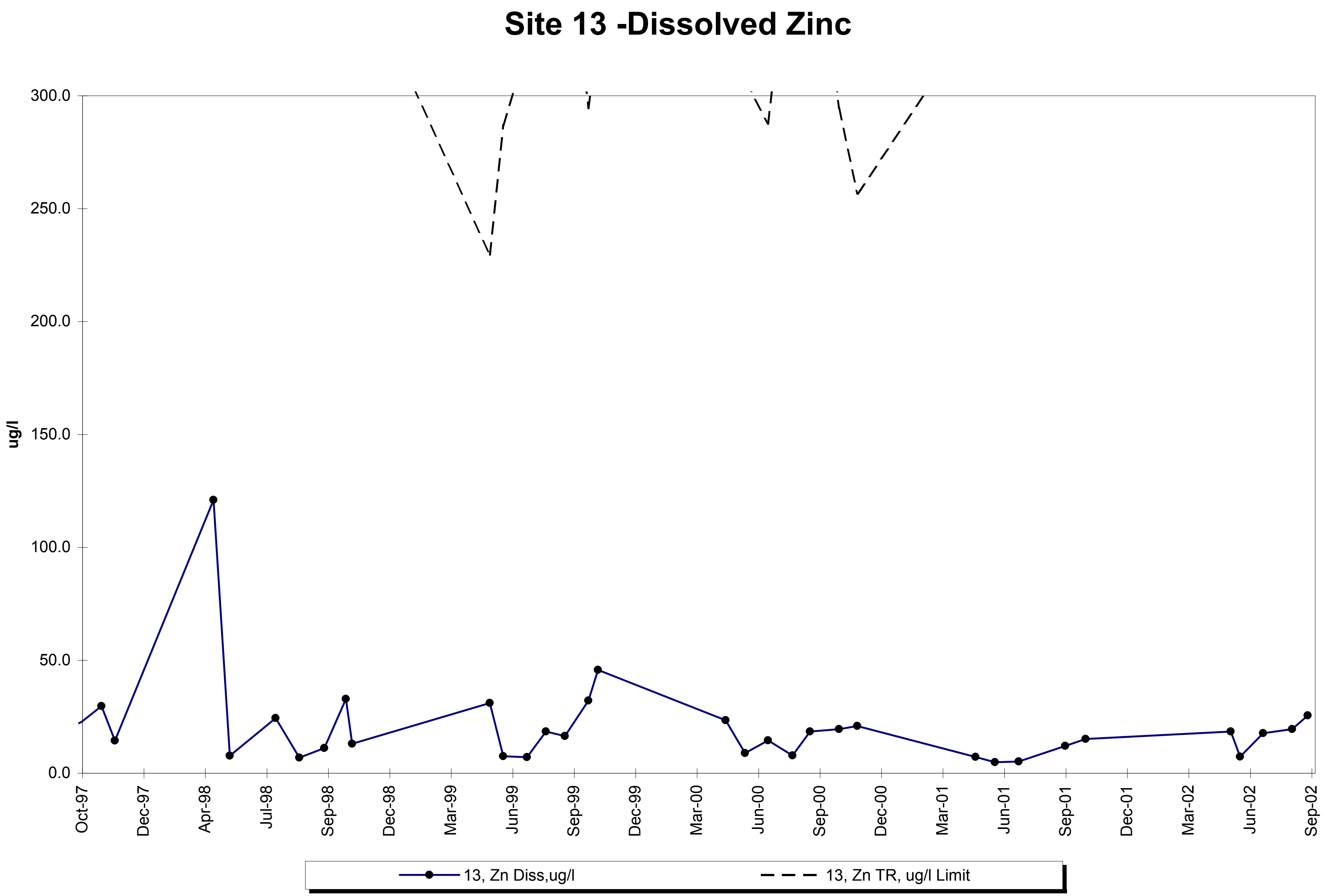
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Apr-98
Jul-98
Sep-98
Dec-98
Mar-99
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
13, Zn Diss,ug/l
13, Zn TR, ug/l Limit

APPENDIX A

Technical Report No. 03-04

Aquatic Biomonitoring At Greens Creek Mine, 2002

by Laura Jacobs
Phyllis Weber Scannell
Bill Morris

April 2003

Alaska Department of Fish and Game   Habitat and Restoration Division

Aquatic Biomonitoring
at Greens Creek Mine

Technical Report No. 03-04

By

Laura Jacobs
Phyllis Weber Scannell
Bill Morris

Kerry Howard
Director
Habitat and Restoration Division
Alaska Department of Fish and Game
Juneau, AK

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ACKNOWLEDGEMENTS

We thank Kennecott Greens Creek Mining Company for their continued financial and logistical support for this biomonitoring project. In particular, we acknowledge the support given by Bill Oelklaus, Steve Hutson, and Kerry Lear of Kennecott Greens Creek Mining. Steve Paustian, K. Brownlee, Steve Hohensee, J. Laker, and Pete Schneider of US Forest Service were instrumental in sampling fish and providing population estimates. April Behr, Al Townsend, Shannon Spring, and David Kwasinski of Alaska Department of Fish and Game (ADF&G) conducted laboratory analysis. Lisa Ingalls, ADF&G, provided final technical editing of this document, although any errors are the responsibility of the authors. We appreciate the support of Dr. Joe Margraf and Ms. Kathy Pierce of The University of Alaska, Cooperative Fish and Wildlife Research Unit for allowing us to use their laboratory facilities for chlorophyll analysis.

EXECUTIVE SUMMARY

The Alaska Department of Fish and Game and the US Forest Service, in cooperation with the US Fish and Wildlife Service, began an aquatic biomonitoring program in Greens Creek and Tributary Creek in 2001. The purpose of the program has been to document the health of aquatic communities and to establish abundance and taxonomic richness of existing aquatic habitats so comparisons can be made with future conditions of the monitored sites. Both years of the biomonitoring program have included surveys of periphyton abundance, aquatic invertebrate density and community structure, juvenile fish abundance and distribution, concentrations of select elements in fish tissues, and toxicity testing.

The biomonitoring sites in Greens Creek Site 54 and Tributary Creek Site 9 continued to sustain complex, diverse aquatic communities at population levels similar to the reference site, Greens Creek Site 48. Periphyton biomass and community composition continue to appear robust, particularly in Tributary Creek where stream flows are low, scouring flood events are rare, and annual variations in flow appear to be buffered by numerous wetlands in the watershed. Estimates of periphyton biomass in Greens Creek Site 54 were similar to the reference site, Greens Creek Site 48.

Aquatic invertebrate communities are taxonomically rich and abundant. The number of taxa, or taxonomic richness, was similar among Greens Creek Sites 48 and 54, and Tributary Creek Site 9 during both years. Aquatic invertebrate densities were highest in Greens Creek Site 54 during both years of monitoring, and lowest in Tributary Creek Site 9.

Populations of the many pollution-sensitive taxa remain intact. Aquatic communities at both Greens Creek Sites 48 and 54 were dominated by mayflies (Ephemeroptera), with small contributions by stoneflies (Plecoptera) and true flies (aquatic Diptera). In Tributary Creek Site 9, however, the community composition was only slightly dominated by mayflies, and non-insect invertebrates formed a large component of the community. Aquatic Diptera, and Plecoptera also were identified as important components of the aquatic community in Tributary Creek and were found in larger proportions there than at Greens Creek Sites 48 and 54. These differences are likely influenced by differences in physical features, including gradient, water velocity, and scour patterns in the different sites.

Juvenile fish populations continue to thrive, with many age classes present at each site. In 2001, the highest fish density (Dolly Varden and coho salmon combined) was found in Tributary Creek Site 9, and in 2002, the highest density was in Greens Creek Site 54.

Metals concentrations in Dolly Varden tissues do not appear to be any higher in Greens Creek Site 54 or Tributary Creek Site 9 than in the reference site, Greens Creek Site 48. The median values for each of the six measured metals in this year's biomonitoring study were similar among Greens Creek Sites 48 and 54 and Tributary Creek Site 9.

We found no indication of acute toxicity in water from the three biomonitoring sites.

Overall, the aquatic communities in Greens Creek Sites 48 and 54 and Tributary Creek Site 9 have remained abundant and diverse. We found no indication of acute toxicity in water from the three biomonitoring sites.

INTRODUCTION

In 2000, an interagency regulatory team made up of representatives from Kennecott Greens Creek Mining Company (KGCMC), Alaska Department of Natural Resources (ADNR), United States Environmental Protection Agency (USEPA), United States Forest Service (USFS), United States Fish and Wildlife Service (USFWS), Alaska Department of Fish and Game (ADF&G), Alaska Department of Law (DOL), and Alaska Department of Environmental Conservation (ADEC) were invited by KGCMC to conduct an environmental audit of the Greens Creek Mining operation within the Admiralty Island National Monument. From findings of that review, the KGCMC Fresh Water Monitoring plan was updated, including specifications for biomonitoring in areas adjacent to the KGCMC surface facilities associated with the mine and mill. This document presents results of the second year (2002) of biological monitoring of the Greens Creek Mining operation.

The intent of biological monitoring is to document the continued use of Greens Creek and Tributary Creek by fish and other aquatic species, and to document the continued health of the aquatic communities. Biomonitoring will detect early changes to the aquatic community that may result from changes in water chemistry, either through surface or groundwater inputs to the system.

Results from biomonitoring usually are compared to baseline conditions, or if baseline data are unavailable, to a reference site that is unaffected. Few baseline biomonitoring studies as intensive as this current program were conducted before development of the Greens Creek Mine. The existing biomonitoring program is designed to compare present to future conditions at the mine, with consideration given to any previous monitoring. All biological monitoring follows standard protocols acceptable to USEPA, ADEC, USFS, ADF&G, and American Public Health Association (1992).

PURPOSE

The objective of the biomonitoring program is to establish existing conditions of the biological communities in selected reaches of Greens Creek and Tributary Creek near the KGCMC surface facilities. Future sampling during the mine life or during reclamation and closure can be compared to the conditions defined under the current biomonitoring program to detect any changes that may have occurred in aquatic communities.

The biological monitoring program for the Greens Creek mining and milling operations addresses the following factors:

1. Distribution and abundance of juvenile fish;
2. Whole body concentrations of Cd, Cu, Pb, Se, Ag, and Zn in juvenile fish;
3. Periphyton biomass, estimated by chlorophyll concentrations;
4. Abundance and community structure of benthic macroinvertebrate populations;
5. Standardized laboratory toxicity testing.

LOCATION AND SCHEDULE OF MONITORING

Three sites were selected for routine biomonitoring: Greens Creek Site 48 (Greens Creek upstream of mining activities), Greens Creek Site 54 (Greens Creek below Pond D), and Site 9 (Tributary Creek). Greens Creek Site 6 (Middle Greens Creek) was sampled one time in 2001 to provide information on baseline conditions (in this instance, baseline is meant to describe the conditions at the beginning of the biomonitoring program). KGCMC routinely monitors the ambient water quality at these sites on a monthly basis. Water quality samples were collected at each of the biomonitoring sites within the month of that biomonitoring effort. Table 1 summarizes the biomonitoring factors that were sampled at each site; Figure 1 shows the location of the Greens Creek Mine.

Table 1. Sample sites and schedule for biomonitoring sites at the Greens Creek mine.

Site Name	Monitoring Objective	Compare to:	Frequency	Factors	Time to Sample
Upper Greens Creek (Site 48)	Routine, Control		Annually for 5 years, then review	FA, FM, P, MI, TOX	mid-late July
Middle Greens Creek (Site 6)	Baseline		Baseline Sample on 5-year schedule, unless indication of WQ exceedance	FA, FM, P, MI, TOX	mid-late July
Greens Creek below Pond D (Site 54)	Routine, treatment	Control	Annually for 5 years, then review	FA, FM, P, MI, TOX	mid-late July
Tributary Creek (Site 9)	Baseline	Change over time	Annually for 5 years, then review	FA, FM, P, MI, TOX	mid-late July

WQ: water quality
FA: fish abundance and distribution
MI: macroinvertebrate abundance, community structure
P periphyton biomass
TOX: micro-toxicity tests
FM: fish metals content

Figure 1. Location of the Greens Creek Mine, Admiralty Island, Alaska.

METHODS

Periphyton Biomass

Rationale

Periphyton, or attached algae, is sensitive to changes in water quality. Their abundance confirms that productivity is occurring at specific locations within a water body.

Sample Collection and Analysis

The protocol for collecting stream periphyton follows the protocol from the ADF&G (1998) and Barbour et al. (1997). Periphyton was sampled during a period of stable flow. Ten rocks were collected from the stream benthos in each study reach. A 5-cm x 5-cm square of high-density foam was placed on the rock. Using a small toothbrush, all material around the foam square was removed and rinsed away with clean water. The foam was removed from the rock, the rock was brushed with a clean toothbrush, and then the periphyton was rinsed onto a 0.45 µm glass fiber filter, attached to a vacuum pump. After extracting as much water as possible, approximately 1 ml saturated $MgCO_3$ was added to the filter to prevent acidification and conversion of chlorophyll to phaeophytin. The filter was wrapped in a large filter (to absorb any additional water), labeled, placed in a sealed plastic bag, and packed over desiccant. Filters were frozen on site in a lightproof container with desiccant, and then transported to Fairbanks where they were kept frozen until laboratory analysis.

Methods for extraction and measurement of chlorophyll followed USEPA protocol (USEPA 1997). Filters were removed from the freezer, cut into small pieces, and placed in a centrifuge tube with 10 ml of 90% buffered acetone. Centrifuge tubes were placed in a metal rack, covered with aluminum foil, and held in a dark refrigerator for 24 hr. After extraction, samples were centrifuged for 20 minutes at 1600 rpm, and then read on a Shimadzu Spectrophotometer UV-601 at optical densities (OD) 664 nm, OD 647 nm, and OD 630 nm. In addition, a reading was taken at OD 750 nm to correct for turbidity. An acetone blank was used to correct for the solvent. Samples were then treated with 0.1 ml of 0.1 N hydrochloric acid to convert chlorophyll to phaeophytin, and read at OD 665 nm and OD 750 nm. Based upon these readings, amounts of chlorophylls *a*, *b*, *c* and phaeophytin were determined according to Standard Methods (APHA 1992).

BENTHIC MACROINVERTEBRATES

Rationale

The primary objective of sampling benthic macroinvertebrates was to characterize community structure and abundance of benthic macroinvertebrates at sample sites. Benthic macroinvertebrate abundance and taxonomic richness are useful measures of stream health.

Sample Collection and Analysis

Five benthic samples were collected from each sample site with a modified Hess sampler. We used a stratified random sample design, modified from Barbour et al. (1997). Samples were collected exclusively from riffle areas where the greatest taxonomic richness and densities are typically found. This sample design eliminated variability from sampling pools or other marginal habitats where pollution-sensitive macroinvertebrates are less likely to occur. For each sample, the substrate was first manually disturbed, and then rocks were brushed and removed. After the larger substrate was removed, the fine gravels were disturbed to a depth of approximately 10-15 cm. Macroinvertebrates disturbed from the stream bottom were collected in a 1-m, 300 μm mesh net, attached to the sampler. The sample was removed, placed in pre-labeled, 500 ml Nalgene bottles. Samples were then preserved in 70% denatured ethanol.

Macroinvertebrate samples were later sorted from all debris and identified to the lowest practical taxonomic level. Larger samples were sub-sampled using a gridded tray. Randomly selected grids were sorted and identified until a minimum of 300 macroinvertebrates was found. Four samples were re-sorted to determine the accuracy in recovering macroinvertebrates. We found that recovery was approximately 98%.

ABUNDANCE OF REARING FISH

Rationale

The purpose of monitoring juvenile fish populations was to determine potential trends in the numbers of Dolly Varden (*Salvelinus malma*) and coho salmon (*Oncorhynchus kisutch*) in stream segments near the surface mine facilities in the Greens Creek and Tributary Creek drainages. Sample design and methods followed procedures in the " Fresh Water Monitoring Program" (KGCMC 2000). Precise GPS coordinates were measured at the upstream end of four stream reaches (28 m to 135 m in length). A complete set of digital photos was taken to document site conditions at each survey reach.

Sample Collection and Analysis

Fish population estimates were made with a three-pass removal method by the USFS, using 0.65 cm mesh minnow traps baited with salmon eggs that had been treated with an iodine solution

(Betadyne) (Bryant 2000). During the first season of biomonitoring (in 2001), a sample reach was identified and marked with aluminum tree tags and metal stakes driven into the stream bank. Approximately 25 minnow traps were deployed for each sampling event at each sample site. Sample reaches varied in length among sites because of the limited availability of suitable habitat to set traps. At Greens Creek Site 48, we sampled a reach 75 m in length in 2001 and 50 m in 2002; in Greens Creek Site 54, a sample reach of 28 m was sampled both in 2001 and 2002; and in Tributary Creek Site 9, we sampled a 44-m reach in 2001 and 50 m in 2002.

Traps were placed throughout the sample section focusing on pools, undercut banks, bank alcoves, and under root-wads or logjams. Where possible, natural obstructions, like shallow riffles or small waterfalls over log steps, defined upper and lower section boundaries to minimize fish movement into the sample section during sampling.

Minnow traps were set for about 1.5 hr, at which time all captured fish were transferred to plastic buckets with holes drilled in the sides. Buckets were placed in the stream to keep water aerated and the captured fish in less stressful conditions. The traps were re-baited and reset for another 1.5 hr period. While the second set was fishing, fish captured during the first set were identified to species, counted, and measured to fork length.

A subset of the fish population sample was retained for whole body analysis of metals. Fish not retained for the metals analyses were returned to the stream immediately after sampling was completed.

METALS CONCENTRATIONS IN WHOLE BODY JUVENILE FISH

Rationale

The response time for juvenile fish to accumulate metals is rapid; for example, ADF&G has documented metals accumulation in juvenile Dolly Varden within five to six weeks after dispersing from their overwintering grounds to mineralized and unmineralized tributaries (Weber Scannell and Ott 2001). Should changes occur at the Greens Creek Mine that result in higher concentrations of metals in the creek, tissue sampling of juvenile fish should reflect these changes.

Sample Collection and Analysis

Six juvenile Dolly Varden were caught in baited minnow traps at each sample site and measured to fork length. The fish were individually packed in clean, pre-labeled bags, placed in an acid-washed cooler, and frozen on-site until transport to Fairbanks. We followed the techniques of

Crawford and Luoma (1993) for minimizing contamination of the samples. In Fairbanks, the fish were weighed without removal from the bags (we corrected for the weight of the sample bag). The fish were submitted to a private analytical laboratory, where they were digested, dried, and analyzed for Ag, Cd, Cu, Pb, Se, and Zn on a dry-weight basis, with percent moisture reported. In 2001 and 2002, all fish retained for metals analysis were Dolly Varden, although samples from Sites 48, and 54 (Greens Creek Site 6 in 2001) contained a mixture of resident and anadromous forms. In 2000, samples from Greens Creek Site 54 and Tributary Creek Site 9 both contained a mixture of coho salmon and Dolly Varden.

Samples were numbered following the convention used by ADF&G:

Date/Stream Code/Species Code/Age Code/Sample Number

An example fish label would read: 071201GC54DVJ01, where 070201 represents July 2, 2001; GC54 represents Greens Creek Site 54; DV represents Dolly Varden; J represents juvenile; and 01 represents sample replicate #1.

Quality Control / Quality Assurance of Laboratory Analysis

The analytical laboratory provided Level III quality assurance/quality control information for each analyte, including matrix spikes, standard reference materials, laboratory calibration data, sample blanks, and sample duplicates.

TOXICITY TESTING

Rationale

Toxicity tests measure the combined toxic effects of all constituents in a particular sample, because some substances can be toxic in amounts that are below detection limits. This is especially true when multiple toxic components synergistically cause toxicity, although each component may be below a detection limit. A commonly available test is the Microtox test, which uses the luminescent bacteria *Vibrio fischeri*. When grown under optimum conditions, the bacteria produce light as a by-product of their cellular respiration. Bacterial bioluminescence is directly related to cell respiration, and any inhibition of cellular activity results in a decreased rate of respiration and a corresponding decrease in the rate of luminescence (Azur 1999).

Sample Collection and Analysis

Water samples were collected at the same time other biomonitoring sampling was done. Samples were kept refrigerated until they were analyzed for acute (1 hr) Microtox toxicity. Solutions of 0% to 45% of the test (creek) water were mixed with reagent water and tested for acute toxicity.

The percent of the population affected by the toxicant was determined for each dilution. The IC-20 represents the estimated toxicant concentration that would cause a 20 percent reduction in a non-lethal biological measurement of the test organism. In the case of the tests conducted in this study, the non-lethal biological measurement was growth of the test species, *Vibrio fischeri*.

RESULTS AND DISCUSSION

GREENS CREEK SITE 48

Greens Creek Site 48 (Figure 2) was selected as an upstream reference site for comparison to "treatment" sites adjacent to and downstream from the KGCMC facilities. This site lies approximately 1 km upstream of the weir that blocks access to anadromous fish. Therefore, the only salmonid species at this site are resident Dolly Varden.

The Greens Creek Site 48 sample reach has been characterized as a MM2 Channel Type (Appendix 1) with an average width of 10 m and a gradient of 2-4 percent (Paustian et al. 1999, Weber Scannell and Paustian 2001). Cobble was the dominant substrate and large woody material was a key factor in pool formation and fish habitat cover. A stream reach of 50 m was sampled for fish populations.

Figure 2. Greens Creek Site 48.

Periphyton Biomass
Median concentrations of chlorophyll *a*, an estimate of periphyton biomass, were significantly higher in 2002 (Wilcoxin Rank Sum Test, p = 0.04) than in 2001 (Figure 3).

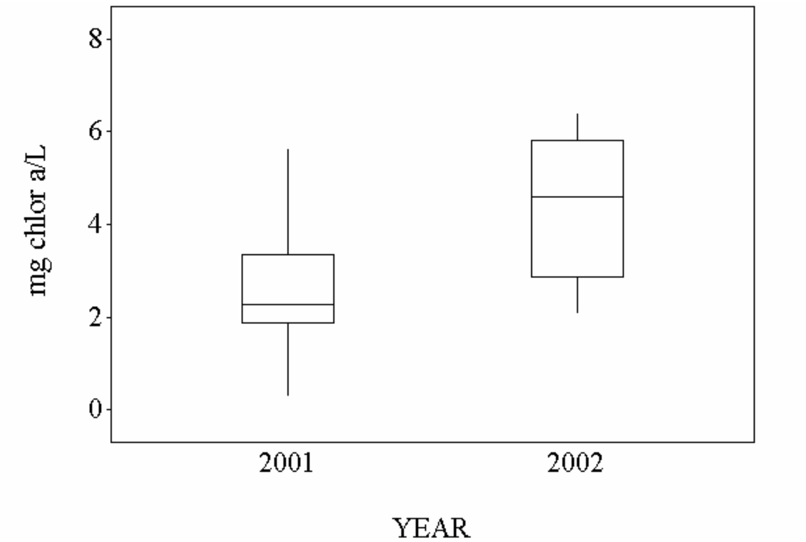

Figure 3. Estimated periphyton biomass in Greens Creek Site 48, 2001 and 2002. The box in the Box and Whisker graph shows the middle half of the data, the intersecting line is the median and the vertical lines at the top and the bottom of the box indicate the range of "typical" data values.

Algal communities contained higher proportions of chlorophyll *c* than chlorophyll *b* (Figure 4) in both years sampled, indicating an algal community dominated by diatoms. Low to undetectable concentrations of chlorophyll *b* indicate minimal amounts of filamentous green algae or blue-green bacteria.

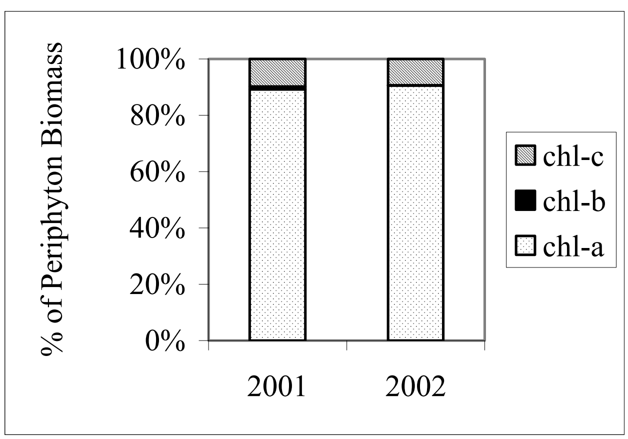

Figure 4. Proportions of chlorophyll *a*, *b*, and *c* in Greens Creek Site 48, 2001 and 2002.

Aquatic Invertebrate Community

The average density of aquatic invertebrates in upper Greens Creek Site 48 was somewhat lower in 2002 (1408/m^2) than in 2001 (2368/m^2), although differences were not significant (Wilcoxin Rank Sum Test, P = 0.09, Figure 5).

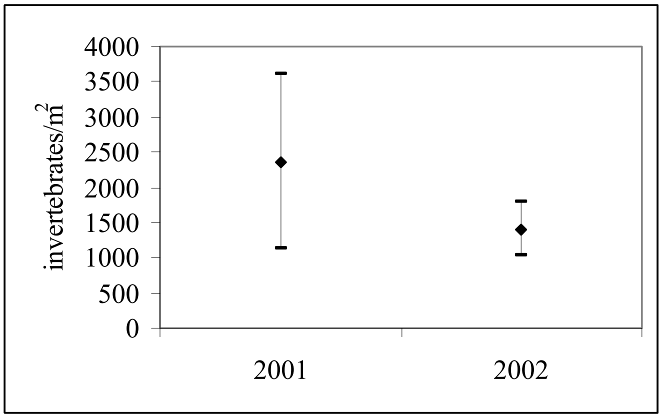

Figure 5. Density of aquatic invertebrates (average, plus and minus 1 standard deviation) in Greens Creek Site 48, 2001 and 2002.

Taxonomic richness was similar between the two years sampled. In 2001, we collected a total of 25 distinct taxa with an average of 12 taxa per sample. In 2002, we identified 24 distinct taxa and an average of 13 taxa per sample.

Invertebrate communities were somewhat different between the years sampled, with slightly higher proportions of Chironomidae in 2002 than 2001 (Figure 6). In both years, the EPT taxa (Ephemeroptera, Plecoptera, and Trichoptera) were most prevalent. Given that most of the EPT taxa are sensitive to water quality, especially metals, the high proportion found at this site signifies excellent water quality conditions for aquatic life.

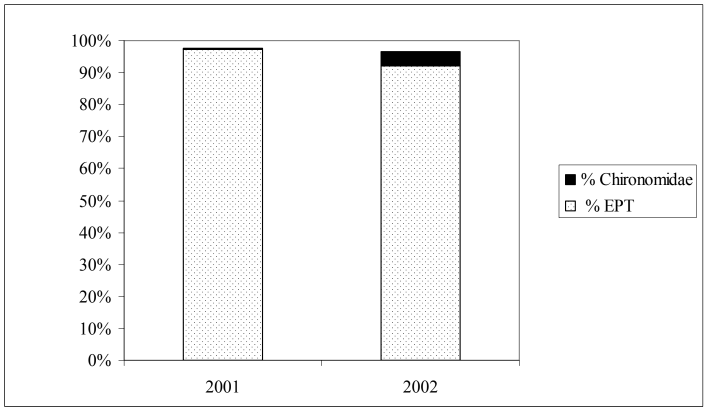

Figure 6. Proportions of EPT taxa and Chironomidae in Greens Creek Site 48, 2001 and 2002.

The aquatic invertebrate community was dominated by mayflies (Ephemeroptera, primarily Baetidae: *Baetis;* Ephemerellidae: *Drunella;* and Heptageniidae: *Cinygmula, Epeorus* and *Rhithrogena)* in both 2001 and 2002 (Figure 7). Appendix 2 lists the macroinvertebrate taxa found in Greens Creek Site 48.

Figure 7. Community composition of aquatic invertebrates in Greens Creek Site 48, 2001 and 2002.

Percent Dominant Taxon is a metric that usually identifies the absence of environmentally sensitive species or dominance of a less-sensitive taxa. In Greens Creek Site 48, the mayfly Heptegeniidae: *Epeorus* comprised 38% of the invertebrate community in 2001 and 27% in 2002. Other, almost equally common taxa in both years were the mayflies Baetidae: *Baetis* and Heptgeniidae: *Rhithrogena. Baetis* are rated as "moderately sensitive," *Epeorus* are "sensitive," and *Rhithrogena* are "very sensitive" (Barbour et al. 1997). In both years, pollution sensitive taxa dominated the invertebrate community in Greens Creek Site 48 and the mixture of numerous taxa represents a complex community.

Juvenile Fish Community

The 2002 fish population survey, conducted within a 50-m reach, resulted in capture of 126 Dolly Varden with an estimated population size for the reach, based on a 3-pass removal, of 145 Dolly Varden. Population estimates in 2001 were similar with 144 fish per 72-m reach (Table 2). Density estimates also were similar, with an estimated 0.20 fish/m^2 in 2001 and 0.23 fish/m^2 in 2002.

Table 2. Juvenile fish population estimates for Greens Creek Site 48, 2001 and 2002.

Year Sampled	Fish Species	Total Fish Caught	Population Estimate, Fish/reach	Sample Reach, m	Density, fish/m^2
2001	DV	68	144	72	0.20
2002	DV	126	145	50	0.23

The fork length of captured fish ranged from 50 mm to 140 mm in 2001 (Figure 8) and from 45 mm to 160 mm in 2002 (Figure 9). Because growth rates of resident Dolly Varden populations are highly variable, no estimates of the number of age classes present were made; however, the presence of small fish in both years and lack of access from downstream reaches suggest successful spawning in this site.

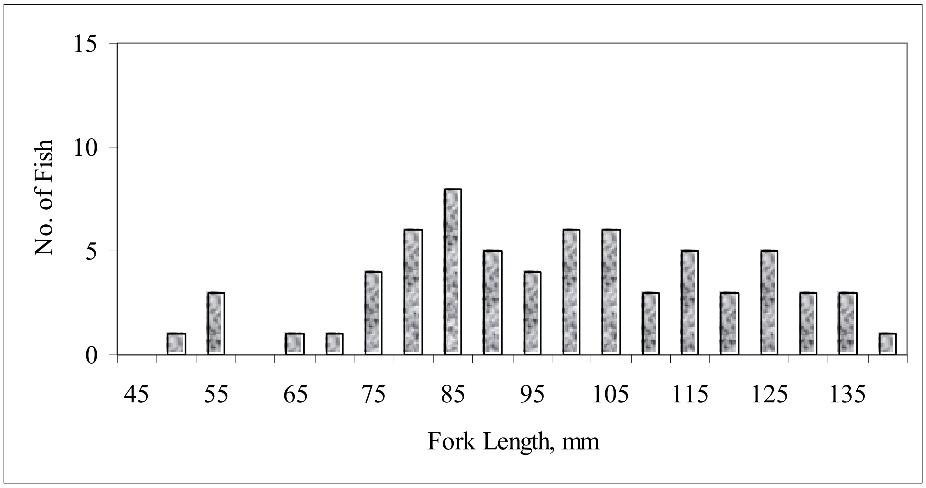

Figure 8. Dolly Varden captured at Greens Creek Site 48, 2001.

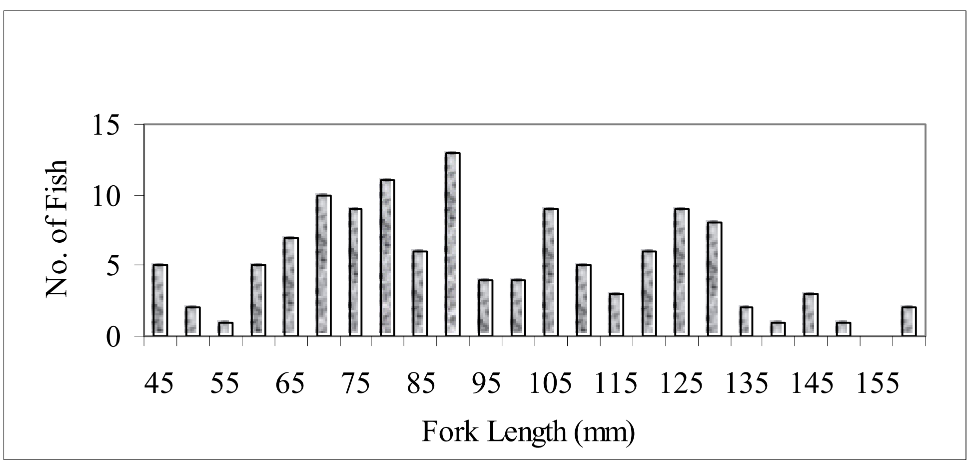

Figure 9. Dolly Varden captured in Greens Creek Site 48, 2002.

Concentrations of metals in juvenile fish were similar in 2001 and 2002, with slightly higher median concentrations of Ag and Zn in 2002 (Figure 10, Appendix 3).

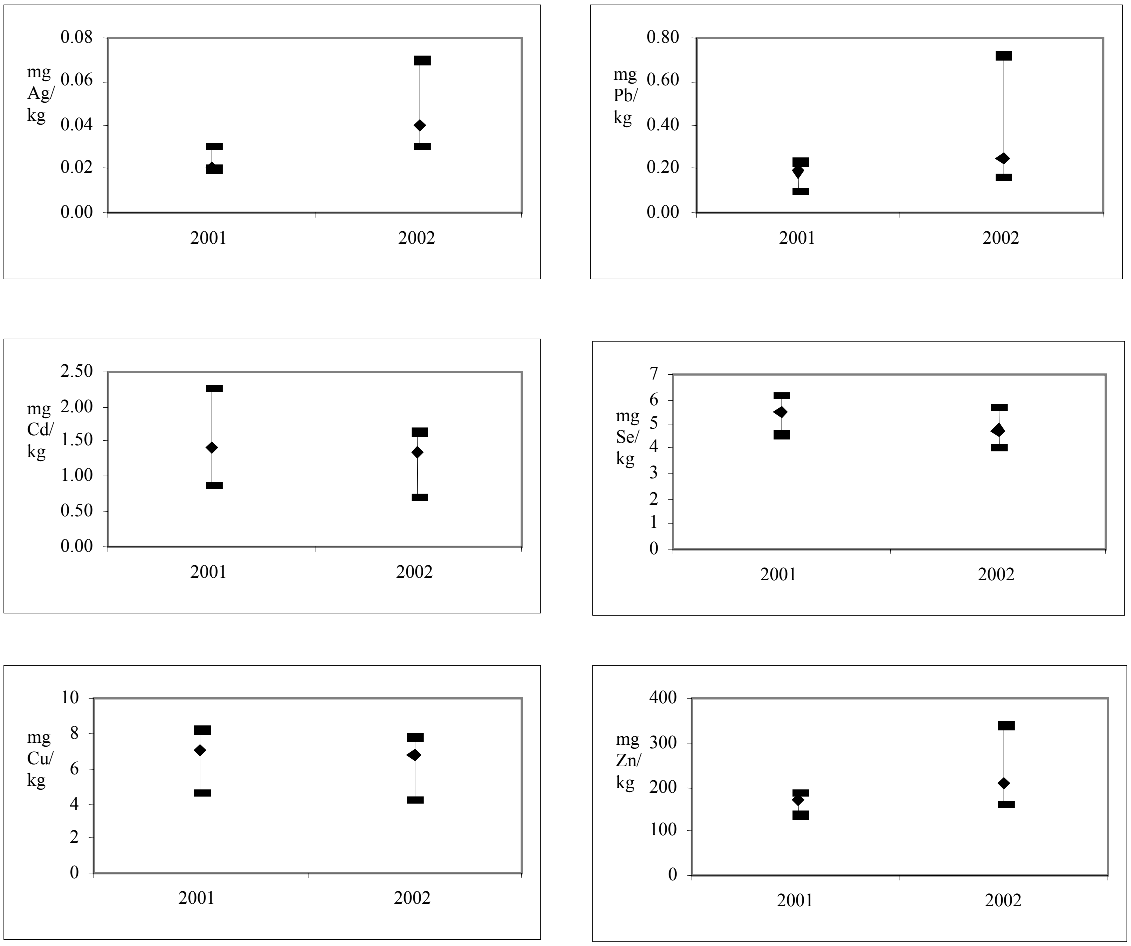

Figure 10. Metals (median, maximum, and minimum) in whole body fish captured in Greens Creek Site 48, 2001 and 2002.

Toxicity Testing

We did not find toxic effects from any of the dilutions of Greens Creek Site 48 water in the acute Microtox toxicity tests (test dilutions ranged from 5% to 45% of Greens Creek Site 48 waters). The growth of the test species, *Vibrio fischeri*, was the same for the control as well as all test dilutions. As a result, the calculated IC-20 value was >100%.

Summary

The high aquatic invertebrate density and prevalence of pollution-sensitive invertebrate species in Greens Creek Site 48 signify a functioning and healthy aquatic community. The population of fish, although limited to resident species, is of a size and age distribution that is expected for this type of stream channel.

MIDDLE GREENS CREEK

Greens Creek Site 6 (below the confluence of Bruin Creek) has been monitored continuously under the FWMP since 1978. The site was located to detect potential effects on Greens Creek from activities in the KGCMC mine, mill, and shop areas. Access of anadromous fish to this stream reach was created by KGCMC in 1989 by installing a fish pass in a waterfall about 5 km downstream. This site is near the upper limit of anadromous fish, defined by a weir located about 1 km upstream. Both Dolly Varden and coho salmon have been found in this reach. Biomonitoring information from this site will be used to detect possible changes in aquatic communities that occur from natural causes or as a result of mine activities. Data were collected in 2001 for baseline information (Weber Scannell and Paustian 2002), and the site will not be sampled again until 2006.

GREENS CREEK SITE 54

Greens Creek Site 54 (Figure 11) is located about 0.5 km downstream of Site 6 (Middle Greens Creek) and about 1 km downstream of the weir that limits the upstream migration of anadromous fish. Anadromous fish access to this stream reach was created by KGCMC in 1989 by installing a fish pass in a waterfall area about 5 km downstream. Both Dolly Varden and coho salmon have been documented in this reach.

The Greens Creek Site 54 sample reach was characterized as a MM2 Channel Type (Appendix 1), with an average channel width of 10 m and a stream gradient of 2-4 percent (Weber Scannell and Paustian 2001, Paustian et al. 1999). Cobble was the dominant streambed material and large woody debris has been integral to pool formation and fish habitat cover.

Figure 11. Greens Creek Site 54.

Periphyton Biomass

Median quantities of periphyton biomass in Greens Creek Site 54 were significantly higher in 2002 than in 2001 (Wilcoxin Rank Sum Test, $p = 0.002$, Figure 12). Differences between the two years were similar to those found in Greens Creek Site 48, and are likely a result of climatic conditions, including water temperature and flow rates during the month before sampling.

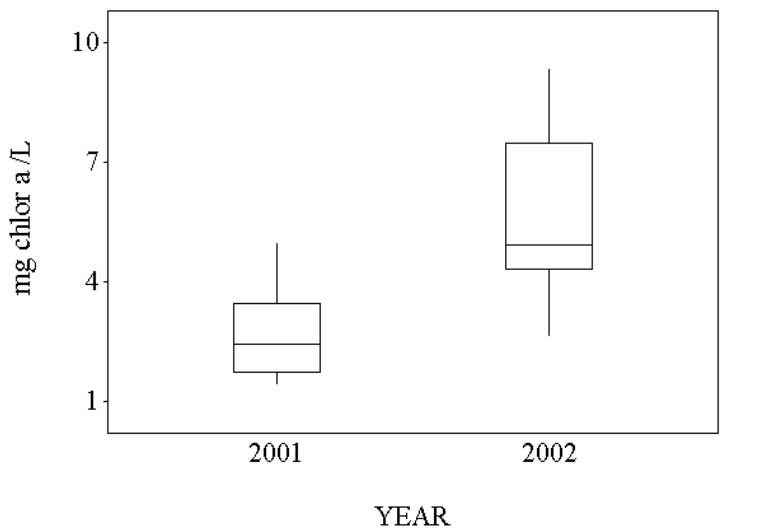

Figure 12. Periphyton biomass in Greens Creek Site 54, 2001 and 2002.

The periphyton community was similar to that found in Greens Creek Site 48, with chlorophyll *a* the dominant pigment and a higher proportion of chlorophyll *c* than chlorophyll *b* (Figure 13). As in Greens Creek Site 48, the higher proportions of chlorophyll *c* indicate an algal community dominated by diatoms while low concentrations of chlorophyll *b* correspond to low populations of filamentous green algae and blue-green bacteria.

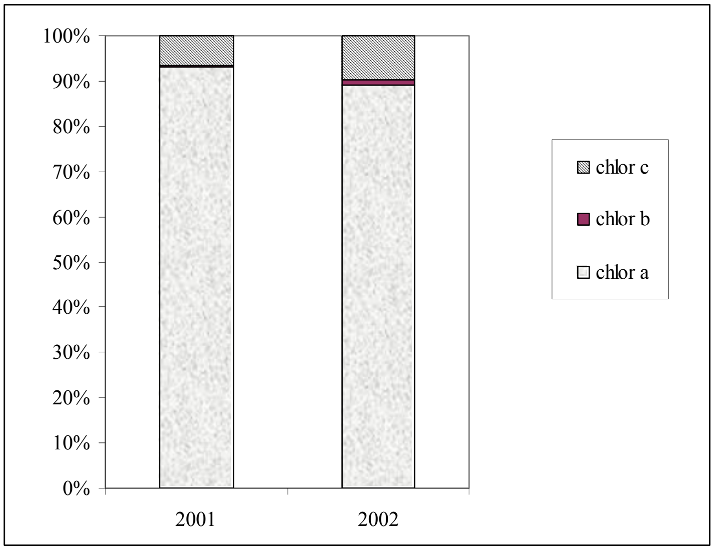

Figure 13. Proportions of chlorophylls *a, b* and *c* in Greens Creek Site 54, 2001 and 2002.

Aquatic Invertebrate Community

The average density of aquatic invertebrates in Greens Creek Site 54 was slightly lower in 2002 than in 2001; although differences were not significant (Wilcoxin Rank Sum Test, P = 0.42, Figure 14). Taxonomic richness was similar between the two years sampled. In 2001, we collected a total of 28 distinct aquatic taxa with an average of 15.2 taxa per sample and in 2002 we collected a total of 30 distinct taxa with an average of 13.8 taxa per sample (Appendix 2).

Invertebrate communities in Greens Creek Site 54 were dominated by EPT taxa with few Chironomidae (Figure 15). In both years, Ephemeroptera were the most commonly collected order (Figure 16). In 2001, we found that 52.5% of the total invertebrates collected were the mayfly Heptageniidae: *Epeorus*, 17.9% were Heptageniidae:*Cinygumula,* and 14% were Baetidae: *Baetis*. Communities were similar in 2002, when 42.6% of the total invertebrates were Heptageniidae: *Epeorus*, 5.1% were Heptageniidae:*Cinygumula*, and 15.3% were Baetidae: *Baetis*. The dominance of the aquatic invertebrate community by pollution-sensitive taxa (Figure 16), combined with the mixture of many species of mayflies, stoneflies, caddiesflies, and true flies indicates a complex and healthy aquatic ecosystem.

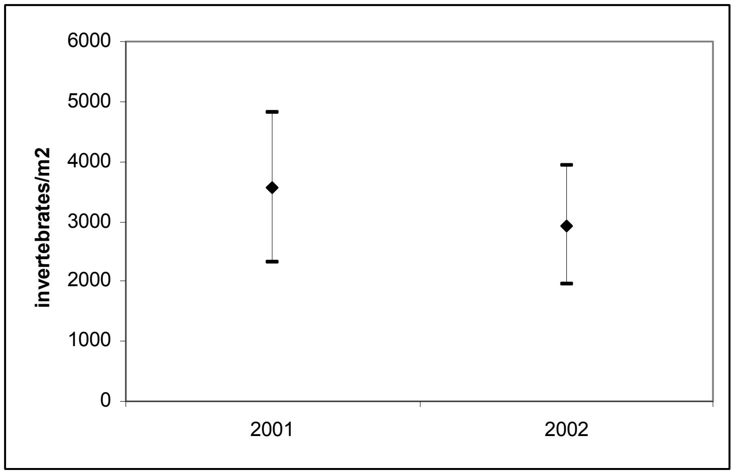

Figure 14. Density of aquatic invertebrates (average plus and minus 1 standard deviation) in Greens Creel Site 54, 2001 and 2002.

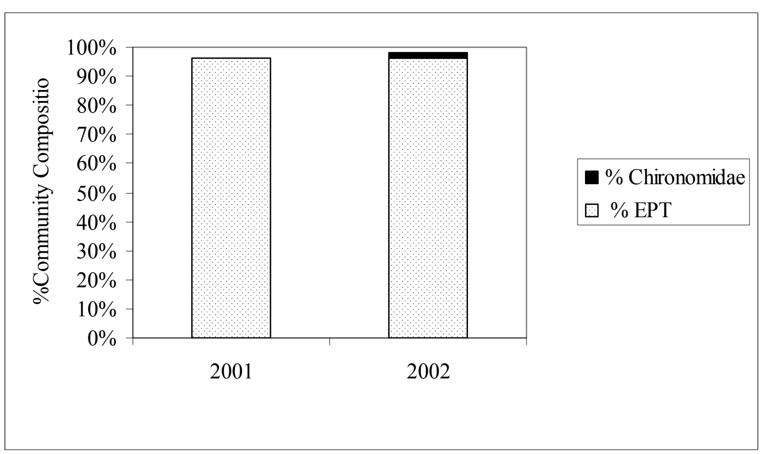

Figure 15. Proportions of EPT taxa and Chironomidae in Greens Creek Site 54, 2001 and 2002.

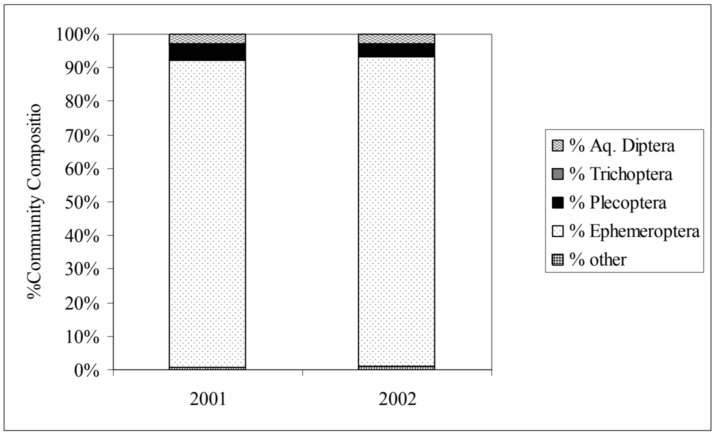

Figure 16. Community composition of aquatic invertebrates in Greens Creek Site 54, 2001 and 2002.

Juvenile Fish Community

Juvenile coho salmon and Dolly Varden were sampled in the same 28-m reach during both sample events in 2001 and 2002. In 2001, the USFS reported catching too few juvenile coho salmon in Greens Creek Site 54 to estimate the population (Table 3). During 2002, however, juvenile coho salmon were caught in sufficient quantities to estimate a population of 21 fish for the 28-m reach, or approximately 0.07 fish/m^2. Juvenile Dolly Varden were found in greater abundance, with population estimates of 164 fish in 2001 and 293 fish in 2002. The estimated density of juvenile Dolly Varden was higher in 2002 (1.0 fish/m^2) than in 2001 (0.6 fish/m^2).

Table 3. Juvenile fish population estimates for Greens Creek Site 54, 2001 and 2002.

Year	Fish Species	Total Fish Collected	Population Estimate, fish/reach	Sample Reach, m	Density, fish/m^2
2001	DV	138	164	28	0.6
2002	DV	271	293	28	1.0
2001	CO		Too few fish	28	Not calculated
2002	CO	21	21	28	0.07

The size distribution of juvenile Dolly Varden in 2001 caught within the Greens Creek Site 54 sample reach suggested the presence of four age classes: from age 0 to age 3 plus a possible age-4 fish at 165 mm (Armstrong and Morrow 1980, Figure 17). Length-frequency information of juvenile Dolly Varden caught in 2002 suggests the presence of the same age classes as in 2001, but with a slightly different distribution (Figure 18). The age 2 and age 3 fish were caught with the highest frequency. The larger estimated population size within the same size sample reach may indicate movement into the area by age 2 and age 3 fish possibly after older fish migrated out, usually by age 3 or 4 (Armstrong and Morrow 1980).

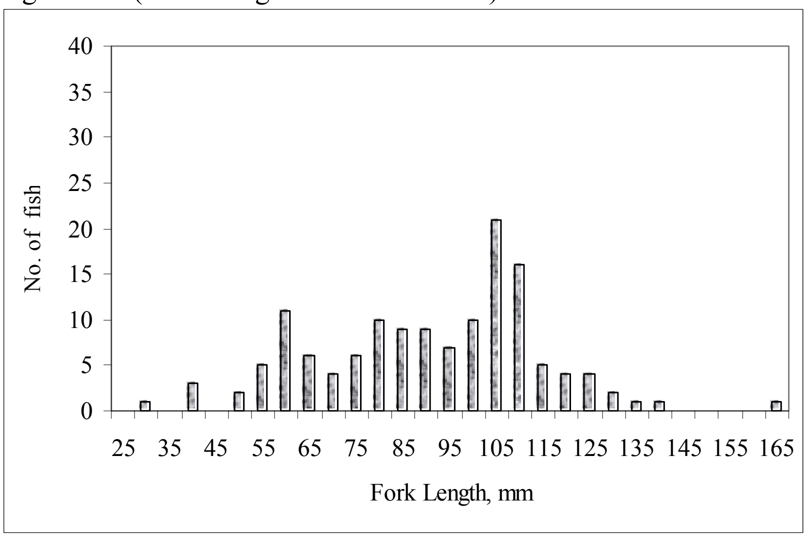

Figure 17. Juvenile Dolly Varden captured in Greens Creek Site 54, 2001.

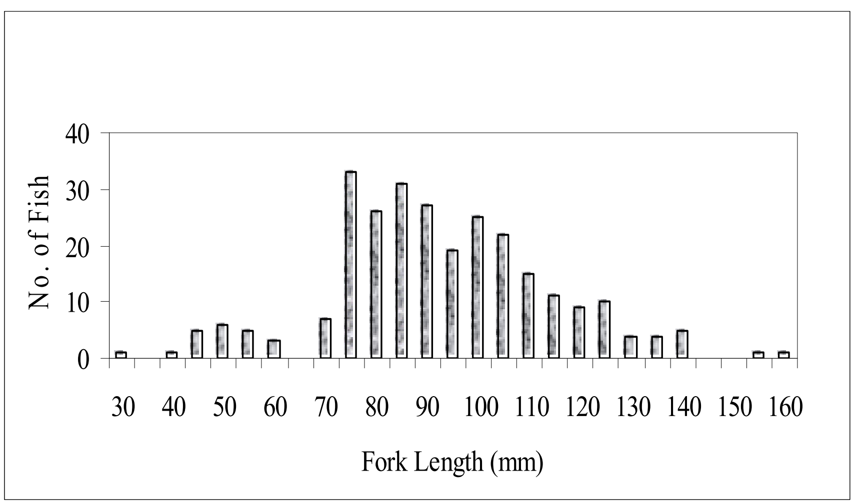

Figure 18. Juvenile Dolly Varden captured in Greens Creek Site 54, 2002.

Juvenile coho salmon caught within the Greens Creek Site 54 sample reach during 2002 probably represent age 0 fish (Figure 19). The low numbers of juvenile coho salmon during the 2001 sample event may indicate displacement or low survival of fry from that cohort.

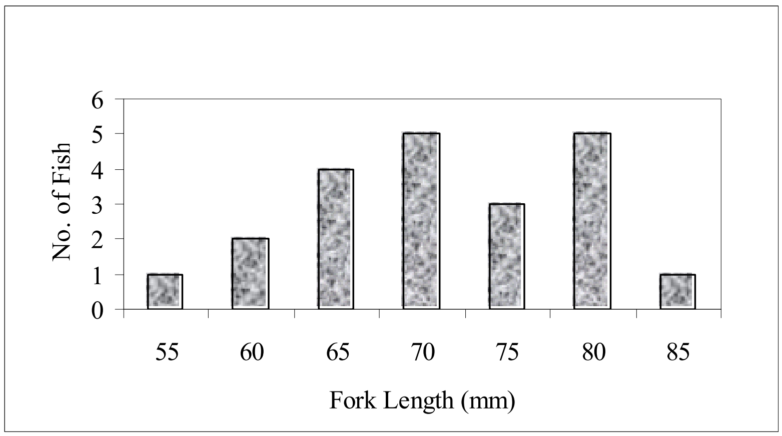

Figure 19. Juvenile coho salmon captured in Greens Creek Site 54, 2002.

Metals in Juvenile Fish

Concentrations of most metals in juvenile fish were similar among the years 2000 through 2002 (Figure 20, Appendix 3), although copper was lower in both 2001 and 2002.

Toxicity Testing

We did not find toxic effects from any of the dilutions of Greens Creek Site 54 water in the acute Microtox toxicity tests (test dilutions ranged from 5% to 45% of Greens Creek Site 54 waters). The growth of the test species, *Vibrio fischeri*, was the same for the control and all test dilutions. As a result, the calculated IC-20 value was >100%.

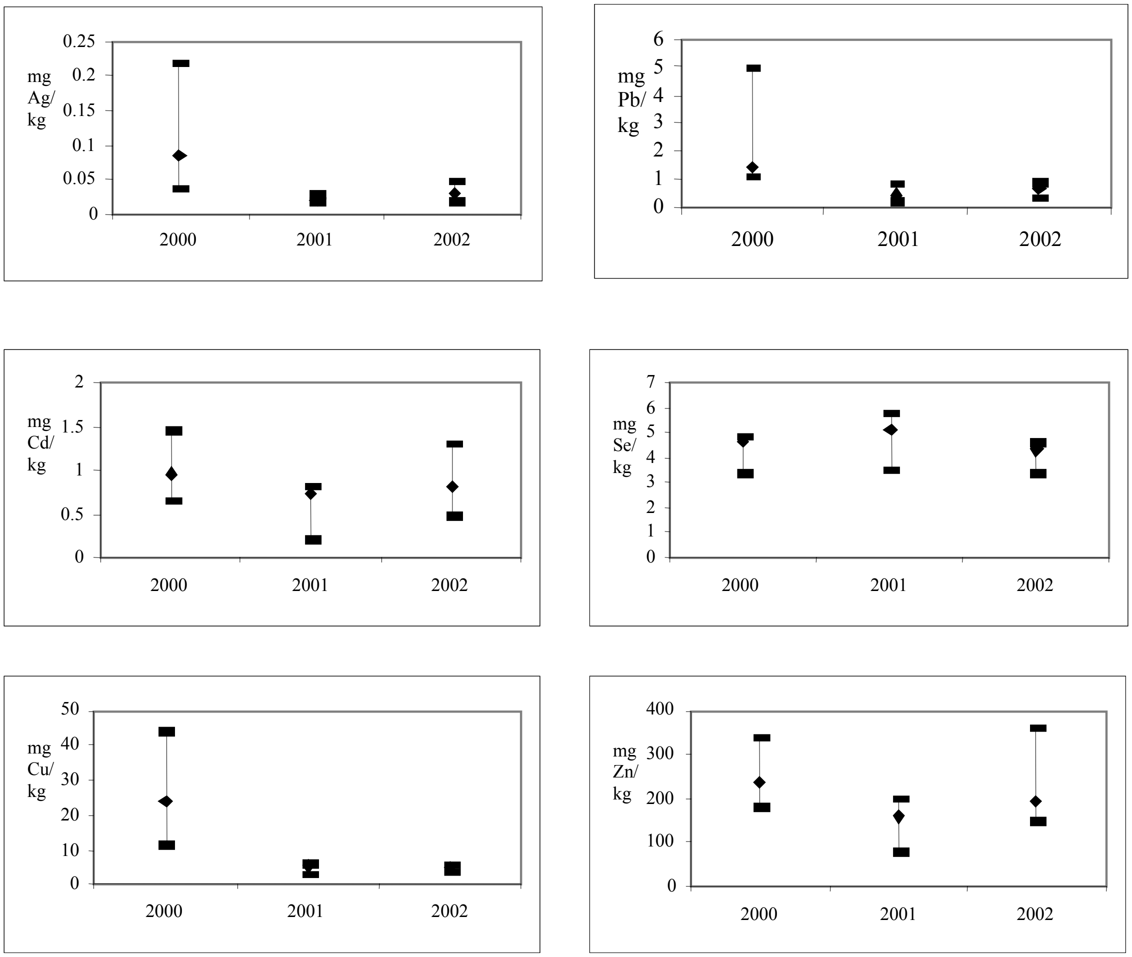

Figure 20. Metals in whole body fish in Greens Creek Site 54, 2000, 2001 and 2002.

TRIBUTARY CREEK SITE 9

Tributary Creek is a small stream with a dense canopy (Figure 21). This site was previously monitored under the FWMP from 1981 through 1993 and is included in the current biomonitoring program because it is located downstream from the KGCMC dry tailings placement facilities. This creek has populations of pink (*Oncorhynchus gorbuscha*), chum (*O. keta*), and coho salmon, cutthroat trout (*O. clarki*), Dolly Varden char and sculpin (no species given).

The sample reach in Tributary Creek Site 9 was characterized as a FP3 Channel Type (Appendix 1), typical of a valley bottom or flat lowlands. The creek is 2 m wide with a 1% stream gradient, and fine gravel as the dominant substrate (Weber Scannell 2001, Paustian et al. 1999). During the 2001 sampling event, the reach was 44 m in length, while in 2002 it was 50 m in length.

Figure 21. Tributary Creek Site 9.

Periphyton Biomass

Periphyton biomass, expressed as mg/L chlorophyll *a*, was similar in 2001 and 2002 (Wilcoxin Rank Sum Test, p = 0.44, Figure 22). Algal communities contained higher proportions of chlorophyll *c* than chlorophyll *b* in 2001 and nearly equal proportions in 2002 (Figure 23). Unlike Greens Creek Sites 54 and 48, diatoms, filamentous green algae and blue-green bacteria are important components of the algal communities in Tributary Creek.

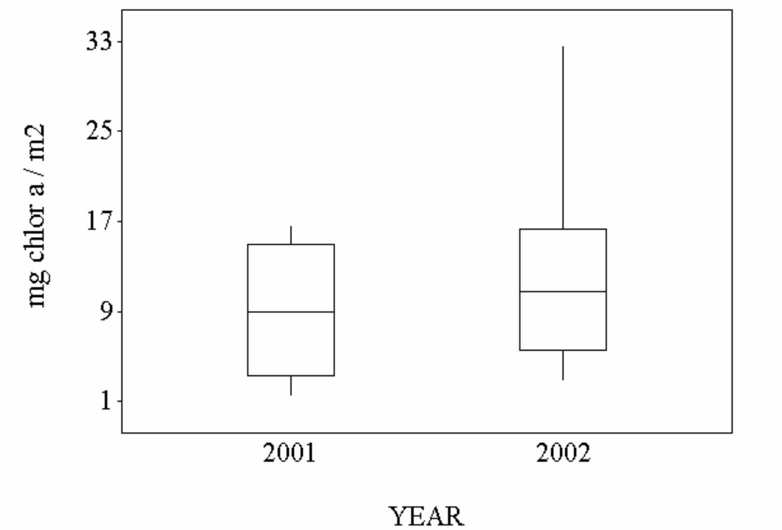

Figure 22. Periphyton biomass in Tributary Creek Site 9, 2001 and 2002.

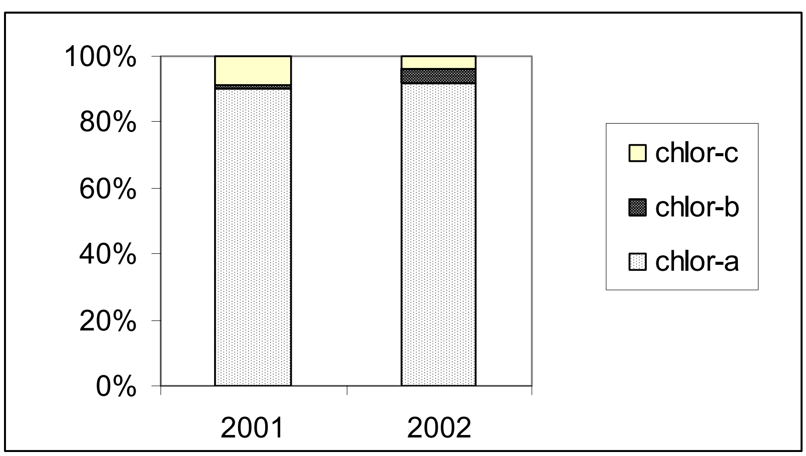

Figure 23. Proportions of chlorophyll *a*, *b* and *c* in Tributary Creek Site 9, 2001 and 2002.

Aquatic Invertebrate Community

As in Greens Creek Sites 48 and 54, the density of aquatic invertebrates in Tributary Creek was similar in 2001 and 2002 (Wilcoxin Rank Sum Test, p = 0.15, Figure 24). Taxonomic richness, as expressed by number of taxa sampled in Tributary Creek Site 9, also was similar in 2001 and 2002. In 2001, we identified 21 distinct aquatic taxa and an average of 13.6 taxa per sample. In 2002, we found 24 distinct taxa and an average of 15.2 taxa per sample.

Figure 24. Density of aquatic invertebrates in Tributary Creek Site 9, 2001 and 2002.

Invertebrate communities in Tributary Creek Site 9 have a large component of non-insects, which are not as commonly found in the Greens Creek sites (Figure 25). The presence of these orders reflects the stream channel characteristics of a small, valley-bottom stream with attached wetland areas. As in the Greens Creek sites, the EPT taxa are the major component.

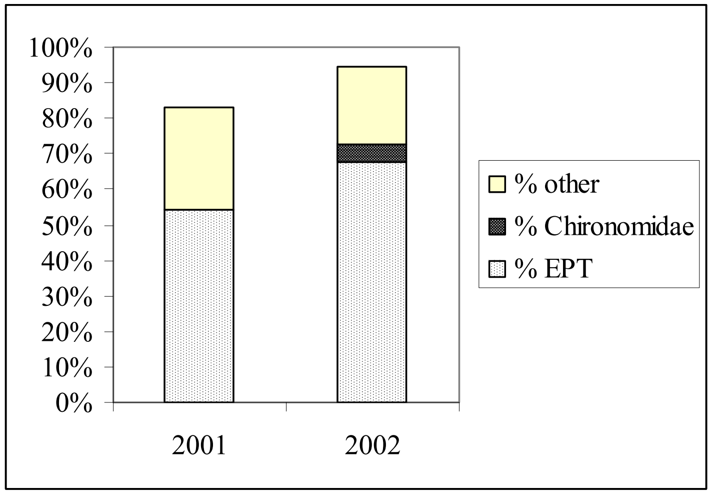

Figure 25. Proportions of EPT taxa and Chironomidae in Tributary Creek Site 9, 2001 and 2002.

Tributary Creek Site 9 has a complex invertebrate community of mayflies, stoneflies, caddisflies, true flies, and non-insect groups (Figure 26). The non-insect group included springtails (Collembola), worms (Oligochaeta), mites (Acarina), and seed shrimp (Ostracoda). Unlike Greens Creek Sites 54 and 48 where one or two invertebrate taxa comprise more than half of the community, the invertebrate population in Tributary Creek Site 9 contains lower proportions of many taxa (Table 4). Pollution-sensitive taxa, such as the mayflies *Baetis*, *Ephemerella*, *Cinygmula*, and *Paraleptophlebia* were prevalent.

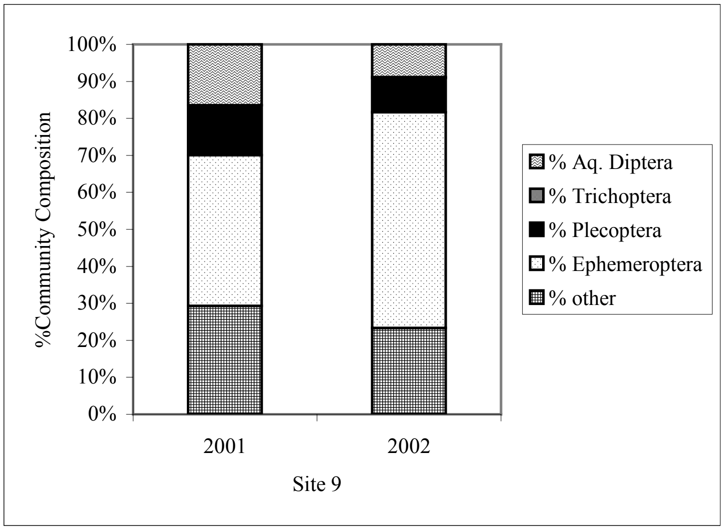

Figure 26. Community composition of aquatic invertebrates in Tributary Creek Site 9, 2001 and 2002.

Table 4. Most commonly found taxa in Tributary Creek Site 9.

Order	Family	Genus	2001	2002
Ephemeroptera	Baetidae	*Baetis*	8%	16%
	Heptageniidae	*Cinygmula*	17%	24%
	Leptophlebiidae	*Paraleptophlebia*	13%	13%
Plecoptera	Chloroperlidae	*Sweltsa*		6%
	Chloroperlidae	*Suwallia*	7%	
Acarina				6%
Oligochaeta			8%	
Ostracoda			18%	
Isopoda	Gammaride	*Gammarus*		14%

Juvenile Fish Community

A variety of fish rear in Tributary Creek, including coho salmon, Dolly Varden, cutthroat trout, and sculpin. Coho, pink, and chum salmon spawn in the creek. Cutthroat trout and sculpin (4 total collected) are minor components of the fish community in Tributary Creek.

Fewer fish were caught in 2002 than in 2001 (Table 5). Age 0 juvenile Dolly Varden were found in 2002 (Figure 28) but not in 2001 (Figure 27). The length-frequency of Dolly Varden collected in both years suggests the presence of several age groups, possibly age 0 (2002 only), age 1 and age 2 and a few age 3. The presence of age 0 fish indicates successful recruitment to this creek; however, their absence suggests only that they were not trapped in the short period this creek was sampled.

Table 5. Juvenile fish population estimates for Tributary Creek Site 9, 2001 and 2002.

Year	**Fish**	**Total fish caught**	**Population Estimate, fish/reach**	**Sample Reach, m**	**Density, fish/m^2**
2001	DV	81	81	50	0.65
2002	DV	51	57	50	0.46
2001	CO	118	120	50	0.94
2002	CO	44	46	50	0.35

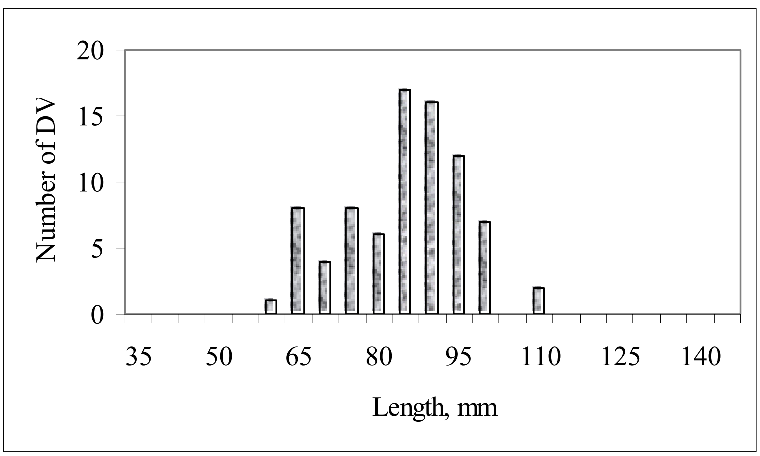

Figure 27. Juvenile Dolly Varden captured in Tributary Creek Site 9, 2001.

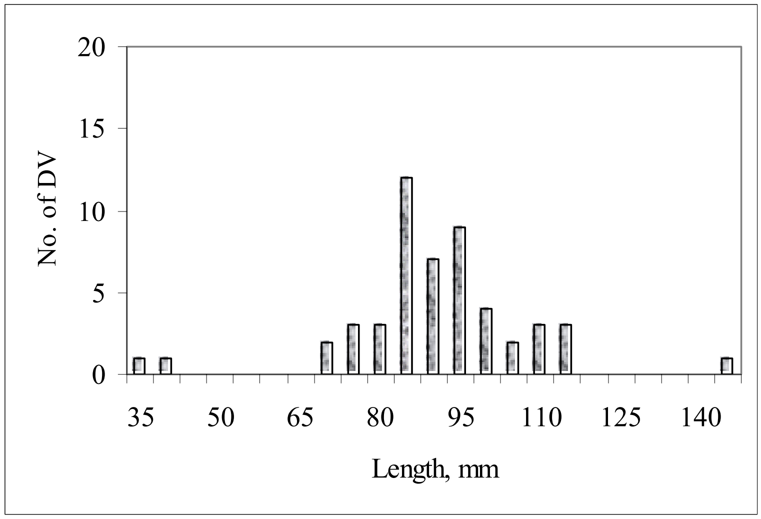

Figure 28. Juvenile Dolly Varden captured in Tributary Creek Site 9, 2002.

In 2001, we caught 118 juvenile coho salmon in Tributary Creek Site 9. Catches were substantially lower in 2002 when only 44 juvenile coho salmon were caught. The juvenile coho salmon at this site are likely a mixture of age classes, from age 0 to age 3 (Figures 29 and 30). Likely this species lives in Tributary Creek for one to two years before migrating to sea (Morrow 1980).

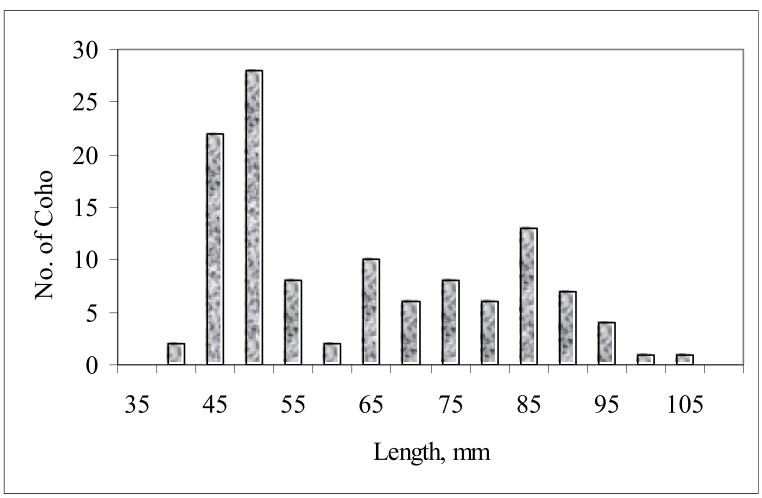

Figure 29. Juvenile coho salmon captured in Tributary Creek Site 9, 2001.

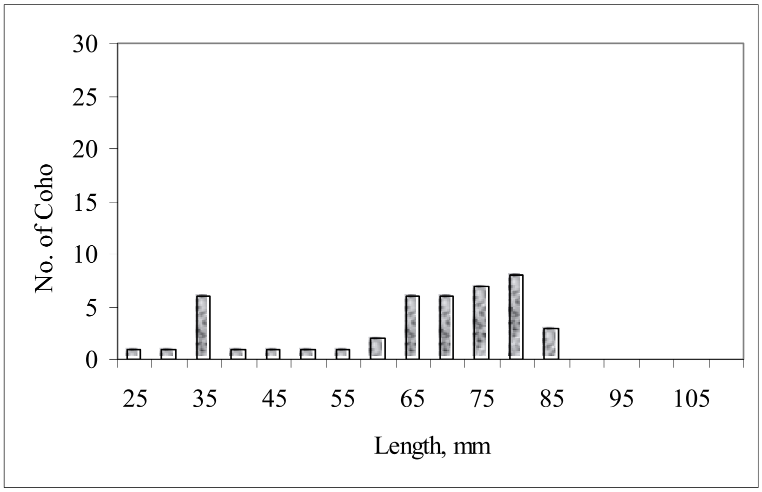

Figure 30. Juvenile coho salmon captured in Tributary Creek Site 9, 2002.

Metals in Juvenile Fish

There were slight fluctuations in all metals concentrations in juvenile fish tissues between the three years of measurements (Figure 31, Appendix 3). Levels of cadmium steadily increased from a median value of 0.53 mg/kg levels measured in 2000 to 1.11 mg/kg measured in 2002, although they remain within the range of values measured in Greens Creek Site 6, our reference site.

Toxicity Testing

We did not find toxic effects from any of the dilutions of Tributary Creek Site 9 water in the acute Microtox toxicity tests (test dilutions ranged from 5 to 45% of Tributary Creek Site 9 waters). The growth of the test species, *Vibrio fischeri*, was the same for the control as well as all test dilutions. As a result, the calculated IC-20 value was >100%.

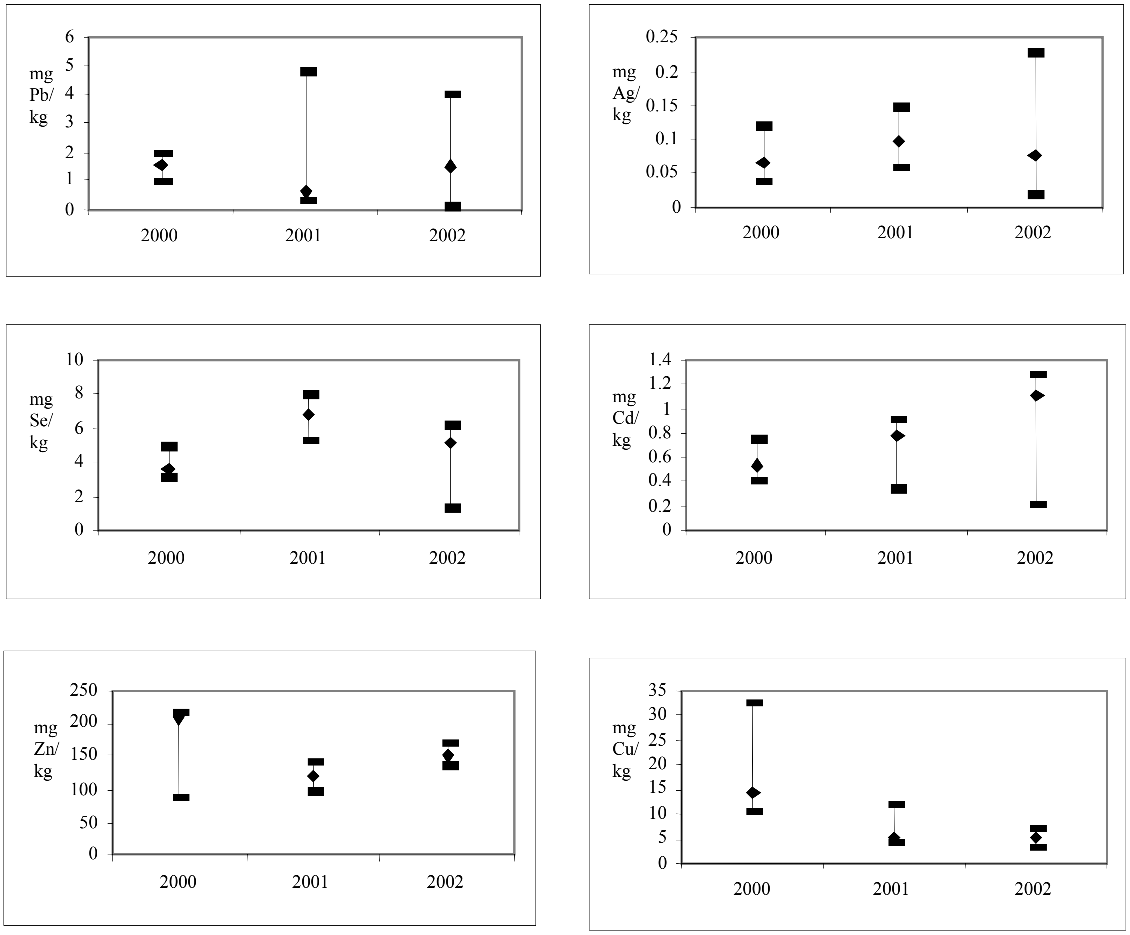

Figure 31. Metals in whole body fish in Tributary Creek Site 9, 2000, 2001 and 2002.

COMPARISONS AMONG SITES

Periphyton Biomass

Periphyton biomass was similar among the three Greens Creek sample sites and similar among the years sampled (Figure 32). Tributary Creek, a warmer, slow-flowing system had substantially higher amounts of periphyton.

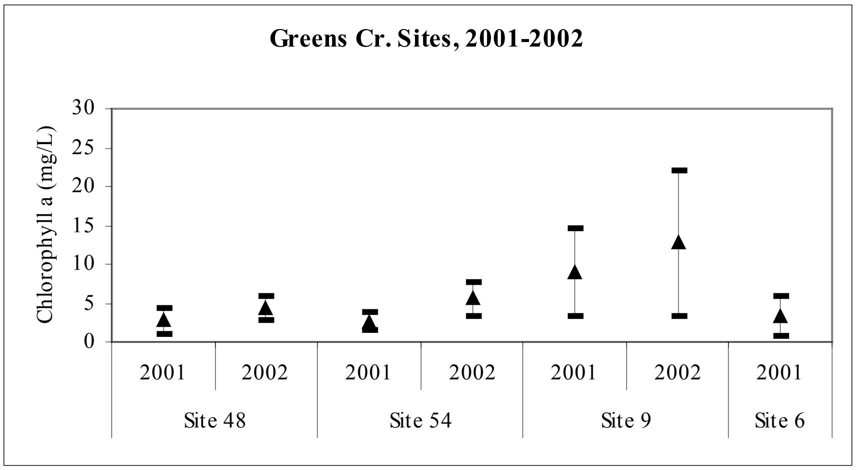

Figure 32. Comparisons of estimated periphyton biomass among sites, 2001 and 2002.

There were slight differences in community composition of the periphyton sampled at the Greens Creek and Tributary Creek sites (Figure 33). Chlorophyll *a* is the primary photosynthetic pigment, is present in all algae, and is a useful indicator of a healthy algal community (Wetzel 1983). The low concentrations of chlorophyll *b,* sometimes below detection limits, is not unusual. Chlorophyll *b* is an accessory pigment and is usually found in combination with other photosynthetic pigments. When measured above detection limits, Chlorophyll *b* is an indication of the presence of green algae and euglenophytes. Chlorophyll *c* is also an accessory pigment, and is only found in the photosynthetic Chromista and dinoflagellates (Waggoner and Speer 2000), of which diatoms form a major group in the periphyton community. Measurable quantities of chlorophyll *c* indicate the importance of diatoms in the community.

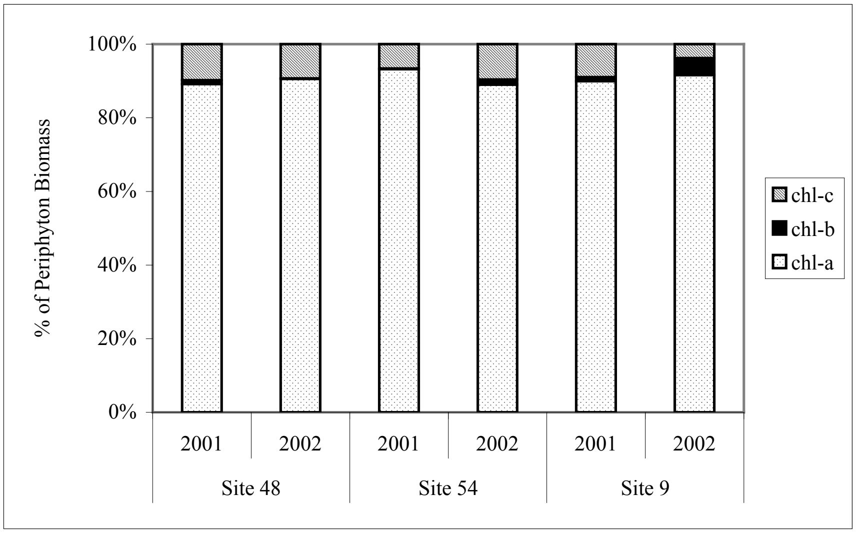

Figure 33. Comparison of proportions of chlorophylls *a*, *b*, *c* among sites, 2001 and 2002.

The contribution by chlorophylls *b* and *c* are different in Tributary Creek than the Greens Creek sites. In Tributary Creek, chlorophyll *b* was nearly equal to chlorophyll *c,* suggesting that at the time of sampling in 2002, there was a large percentage of green and blue-green algae in the periphyton community (Wetzel 1983). Given the differences in channel morphology, flow regimes and streamside vegetation between Greens Creek and Tributary Creek, the differences in algal communities are not unexpected.

Despite the lower periphyton biomass and slight difference in community composition in Tributary Creek Site 9 compared to the rest of the biomonitoring sites (Sites 48, 54, and 6), the periphyton communities in all biomonitoring sites are well within ranges of healthy aquatic systems (Wetzel 1983).

Aquatic Invertebrate Community

Aquatic invertebrate densities were highest in Greens Creek Site 54 during both years of monitoring, and lowest in Site 9 (Figure 34). Although invertebrate density was lowest in Tributary Creek Site 9, the density at this site is considered to be typical of a healthy community (Barber et al 1997).

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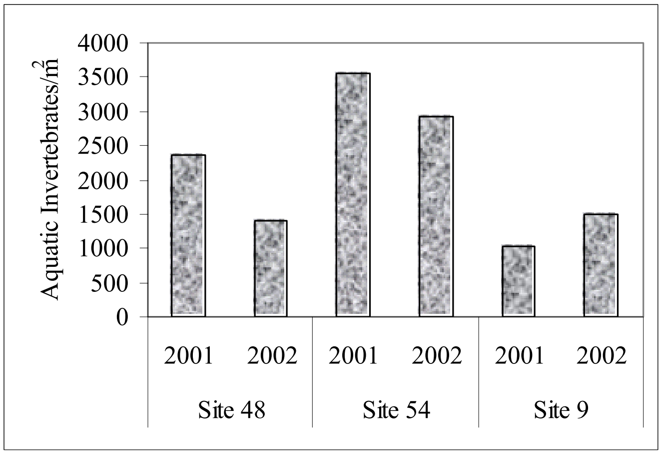

Figure 34. Comparison of aquatic invertebrate density among sites, 2001 and 2002.

All of the biomonitoring sites had complex invertebrate communities with fairly large numbers of distinct taxa per sample (Figure 35). More than 50% of the invertebrates in Greens Creek Sites 54 and 48 were one or two taxa; however, communities in Tributary Creek Site 9 contained lower proportions of many taxonomic groups (Figure 36). Differences in the structure of these communities reflect differences in channel morphology, frequency of flood events, streamside vegetation, and flow rates. Aquatic habitats with fairly even stream flows, such as Tributary Creek Site 9, usually do not have communities dominated by a few taxa (Hynes 1970). The predominance of one or two taxa is likely a result to perturbation, in Greens Creek the dominant taxa are sensitive to pollution. Therefore, the community is likely responding to high streamflows and exhibiting rapid re-colonization.

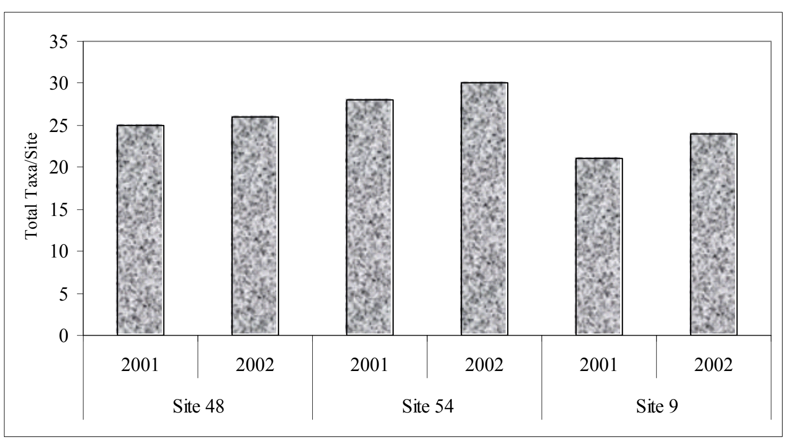

Figure 35. Comparison of taxonomic richness among sites, 2001 and 2002.

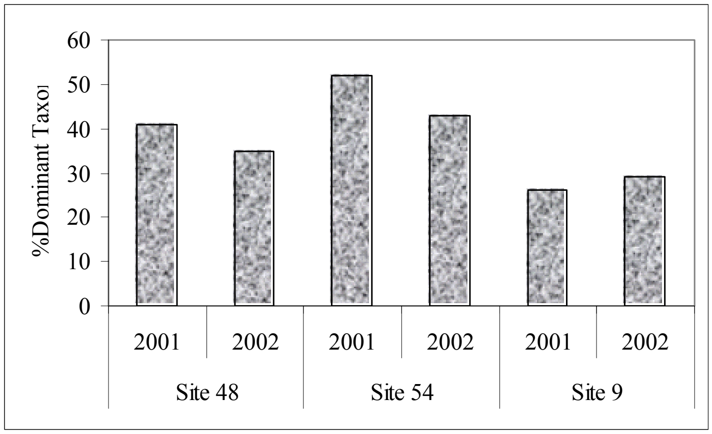

Figure 36. Comparison of percent dominant taxa among sites, 2001 and 2002.

Percent EPT, which is based on the concept that most Ephemeroptera – Plecoptera – Trichoptera taxa are sensitive to pollutants (Merritt and Cummins 1996) was high in all of the biomonitoring sites (Figure 37).

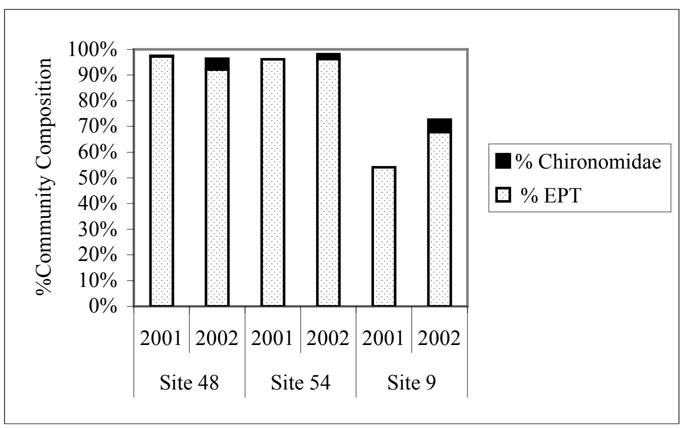

Figure 37. Comparisons of proportions of EPT taxa and Chironomidae among sites, 2001 and 2002.

Aquatic invertebrate communities in Greens Creek Sites 48 and 54 were more similar to one another than to those in Tributary Creek Site 9 (Figure 38). Aquatic communities at both Sites 48 and 54 were dominated by mayflies (Ephemeroptera), with small contributions by stoneflies (Plecoptera) and true flies (aquatic Diptera). In Tributary Creek Site 9, however, the community was only slightly dominated by mayflies with numerous non-insect invertebrates. Aquatic Diptera, and Plecoptera also were more important components of the aquatic community in

Tributary Creek Site 9 than in Greens Creek Sites 48 and 54. This difference is likely due to differences in physical characteristics of the stream systems.

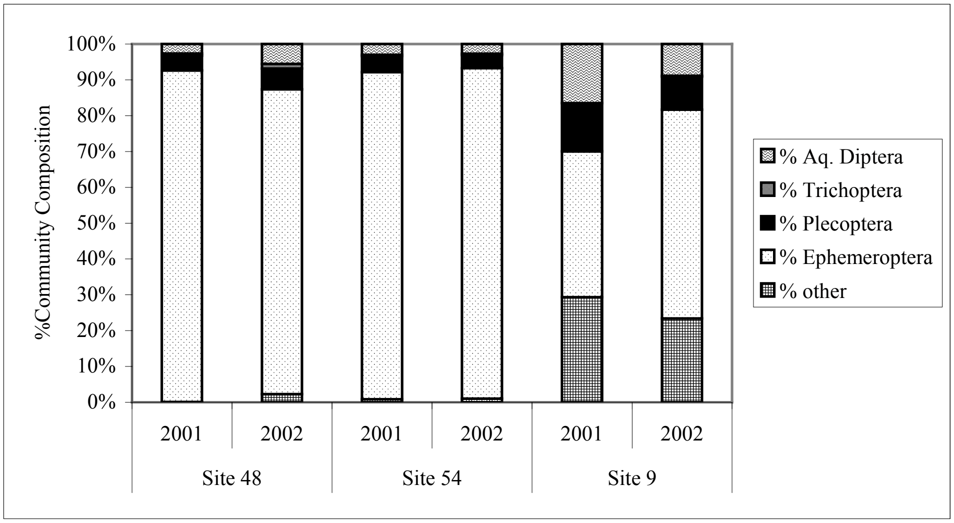

Figure 38. Comparison of community composition of aquatic invertebrates among sites, 2001 and 2002.

We used a number of different metrics to detect any responses of aquatic invertebrate communities to possible metals pollution. Density and taxonomic richness showed all three communities to be well-developed, complex communities with high invertebrate abundance. The percent dominant taxa showed the communities to have high proportions of pollution-sensitive invertebrates, and where a community was dominated by one or two groups, those groups were sensitive to pollution. Because all three communities show a prevalence of pollution-sensitive species, we believe that any future perturbations by pollution or natural stressors will cause a substantial change in the abundance or diversity of aquatic invertebrates.

Juvenile Fish Community

In 2001, the total fish density (Dolly Varden and coho combined) was highest in Tributary Creek Site 9 when we caught an estimated 1.59 fish/m^2 of stream habitat. In 2002, the estimated fish density was highest in Greens Creek Site 54 where we caught an estimated 1.07 fish/m^2 (Table 6). Densities were lowest in Greens Creek Site 48, where fish access is limited by a weir and the stream only contains resident Dolly Varden (Weber Scannell and Paustian 2002). All three biomonitoring sites support healthy fish communities.

Table 6. Estimated fish densities in the biomonitoring sites.

	Greens Creek Site 48		Greens Creek Site 54		Tributary Creek Site 9	
2001						
Fish species	Coho salmon	Dolly Varden	Coho salmon	Dolly Varden	Coho salmon	Dolly Varden
Total fish caught	0	68		138	118	81
Sample Reach, m	72	72	28	28	50	50
Population Estimate, fish/reach	0	144	few fish	164	120	81
Density, fish/m^2	0	0.2	Not calculated	0.6	0.94	0.65
2002						
Total fish caught	0	126	21	271	44	51
Sample Reach, m	50	50	28	28	50	50
Population Estimate, fish/reach	0	145	21	293	46	57
Density, fish/m^2	0	0.23	0.07	1.0	0.35	0.46

Metals in Juvenile Fish

The median values for each of the six measured metals in this year's biomonitoring study were similar among the two sites on Greens Creek Sites 48 and 54 and Tributary Creek Site 9 (Figure 39). We could not detect any evidence that metals in fish tissues from Greens Creek Site 54, near the mine, or Tributary Creek Site 9, below the tailings facility, were elevated above the reference site, Greens Creek Site 48.

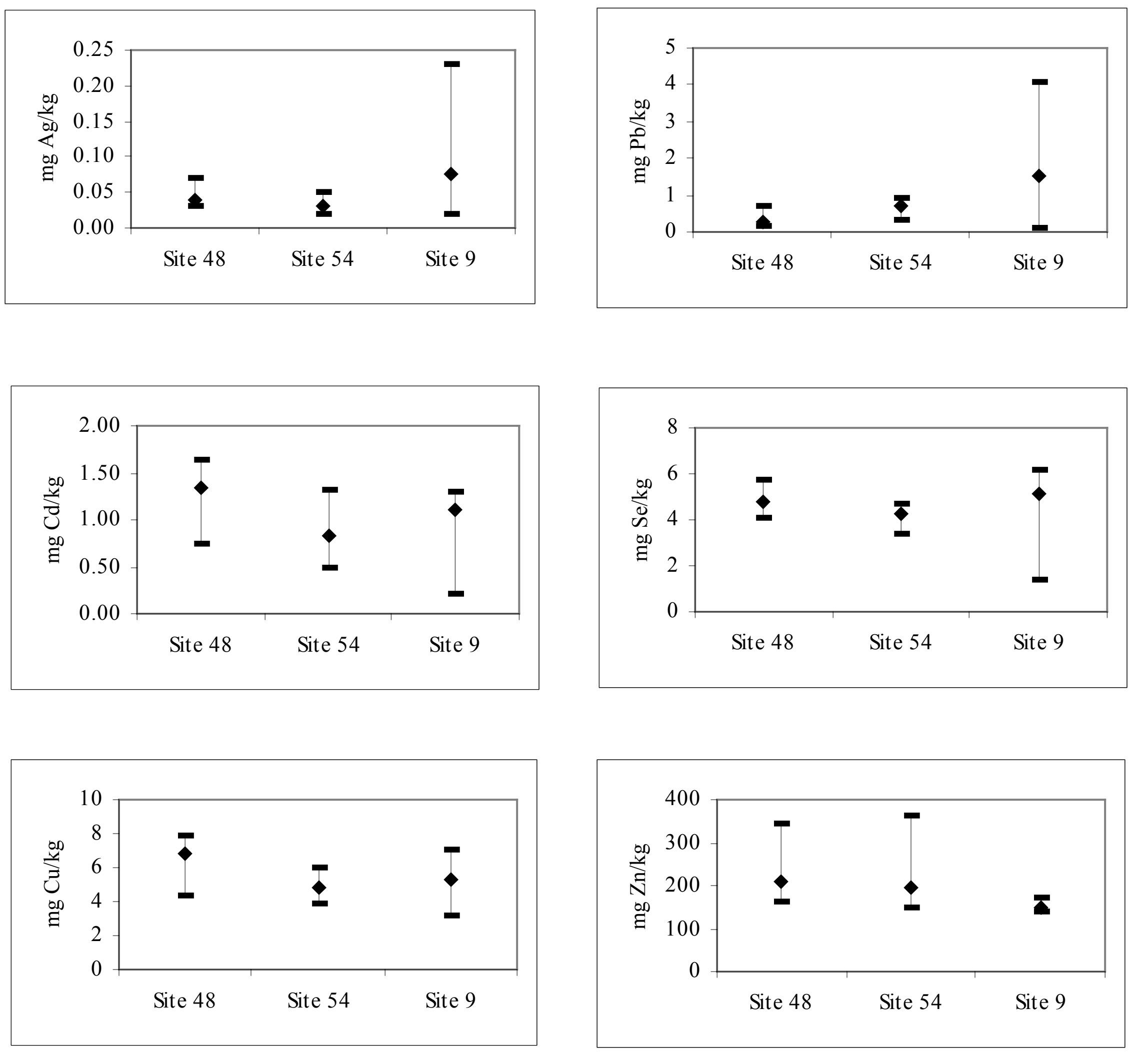

Figure 39. Comparison of metals in whole body fish among sites, 2002.

Toxicity Testing

Acute toxicity testing of water from each the three sample sites was conducted during 2002. No toxicity was detected during any of the tests, and growth of *Vibrio fischeri* was similar to the control for all dilutions. Because there was no toxic response, the IC-20 value for each site was >100%.

The results from testing for chronic toxicity are not presented here because of difficulties with test procedures. Quality control of the test reagent turned out to be unacceptable for each of the four shipments we made during 2002. Several attempts were made to conduct the testing, with each attempt ending in failure because of faulty test reagent.

CONCLUSIONS

The two biomonitoring sites on Greens Creek Sites 48 and 54 and one inTributary Creek Site 9 continued to sustain complex, diverse aquatic communities at population levels similar to other systems in the area. Periphyton biomass and community composition continue to appear robust, particularly in Tributary Creek where stream flows are low, scouring flood events are rare, and annual variations in flow appear to be buffered by the ubiquitous wetlands in the watershed. The aquatic invertebrate communities are taxonomically rich with high densities. In addition, the populations of the many pollution-sensitive taxa remain intact. Juvenile fish populations continue to thrive, with many age classes present at each site. Metals in juvenile fish tissues do not appear to be any greater than that measured in the reference site, and concentrations at all sites were similar to those measured during 2001. We found no indication of acute toxicity in water from the three biomonitoring sites.

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APPENDIX 1. USFS DEFINITIONS OF CHANNEL TYPES

The following definitions of channel types, used in this report, are from Paustian et al. 1999.

MM2 Channel Type

An MM2 channel is defined as "normally found in the middle to lower portion of moderate size drainage basins. MM2 streams are often confined by mountainslope, footslope, and hillslope landforms, but they can develop a narrow flood plain. Bedrock knickpoints with cascades or falls may be present.

MM2 channels are generally accessible to anadromous species, with several species of spawners using the moderate amounts of available spawning area (ASA). These channels have moderate amounts of rearing area which are used by coho, Dolly Varden char, and steelhead juveniles. Pools are relatively deep and are highly dependent on large woody debris. Overwintering habitat is primarily associated with these pools. When located next to accessible lakes, these channels provide good quality spawning for sockeye salmon and steelhead trout.

Large woody debris significantly influences channel morphology and fish habitat quality. Large wood volume is generally high. Large wood accumulations form pool and stream bank rearing habitat, as well as stabilize spawning substrate behind log steps. Maintenance of large woody debris sources is an important management concern.

Banks are composed primarily of unconsolidated cobble and gravel size materials, therefore, stream bank sensitivity is rated high. The volume and energy of flood discharge in MM2 channels are the major factors affecting bank erosion. Disturbance of streamside vegetation root mats may contribute to accelerated channel scour and lateral channel migration.

Flood plains associated with MM2 channel types are generally narrow, however, side channels and flood overflow channels are commonly found along MM2 reaches. Flood plain stability can be a concern in these uncontained channel segments.

FP3 Channel Type

FP3 streams are located in the valley bottoms and may also occur within flat lowlands or low elevation drainage divides. Frequently, FP3 streams lie adjacent to the toe of footslopes or hillslopes, adjacent to the main trunk, valley bottom channels. The flood plain of large, low gradient alluvial channels may be dissected by FP3 streams. Where FP3 streams occur parallel to the foot slopes or in the valley bottom locations, they are typically fed by high gradient streams. Less frequently, FP3 streams are situated on mountain slope benches.

The riparian plant associations for FP3 streams are dominated by the Sitka spruce series and the western hemlock series. Salmonberry and alder shrub communities are the principal non-forest riparian plant communities. Willow, shrub and sedge/sphagnum bog communities are the primary non-forest riparian communities in the FP3 phase. Sitka alder and willow shrub communities are the predominant riparian vegetation associated with the FP3 phase.

FP3 channels are frequently accessible to anadromous species. Coarse and fine gravels compose 49% of the substrate, therefore, available spawning area is high. These channels receive moderate to high spawning use by all anadromous species.

APPENDIX 2. AQUATIC INVERTEBRATE DATA

Greens Creek Site 48, 2001 and 2002.

Taxa			2001	2002
Ephemeroptera	Baetidae	*Baetis*	309	152
	Ephemerellidae	*Caudatella*	2	
		Drunella	47	49
	Heptageniidae	*Cinygmula*	99	20
		Epeorus	444	190
		Rhithrogena	193	187
	Leptophlebiidae	*Paraleptophlebia*		1
Plecoptera	Chloroperlidae	*Alloperla*	1	1
		Plumiperla	5	
		Suwallia	8	1
		Sweltsa	1	4
	Leuctridae	*Despaxia*		2
		Paraleuctra	4	3
		Perlomyia		12
	Nemouridae	*Podmosta*	7	5
		Zapada	23	4
	Perlodidae	*Skwala*		9
Trichoptera	Apataniidae	*Apatania*		1
	Hydropsychidae	*Arctopsyche*	2	
	Rhyacophilidae	*Rhyacophila*	5	8
Coleoptera	Staphylinidae		1	
Diptera	Ceratopogonidae	*Dasyhelea*		1
	Chironomidae		14	30
	Deuterophlebiidae	*Deuterophlebia*	2	
	Empididae	*Chelifera*	1	2
		Oreogeton	3	2
	Psychodidae	*Psychoda*	1	
	Simuliidae	*Parasimulium*	2	
		Prosimulium	2	
		Simulium	6	4
Collembola	Onychiuridae	*Onychiurus*		1
	Sminthuridae	*Dicyrtoma*	2	
Acarina				2
Oligochaeta				5
Ostracoda				8

Greens Creek Site 54, 2001 and 2002.

Taxa			2001	2002
Ephemeroptera	Baetidae	*Baetis*	248	225
	Ephemerellidae	*Ephemerella*	2	6
		Drunella	118	280
	Heptageniidae	*Cinygmula*	319	75
		Epeorus	935	626
		Rhithrogena		140
	Leptophlebiidae	*Paraleptophlebia*	1	
	Ameletidae	*Ameletus*	4	
Plecoptera	Chloroperlidae	*Alloperla*	3	
		Neaviperla		14
		Plumiperla	2	
		Sweltsa	6	
	Leuctridae	*Paraleuctra*		4
		Perlomyia	13	3
	Nemouridae	*Podmosta*		7
		Zapada	52	22
	Perlodidae	*Diura*	1	
		Isoperla	3	
		Skwala		3
		Rickera		1
Trichoptera	Hydropsychidae	*Arctopsyche*		1
	Limnephilidae	*Psychoglypha*	1	
	Rhyacophilidae	*Rhyacophila*	6	5
Coleoptera	Staphylinidae		1	1
Diptera	Chironomidae		33	27
	Deuterophlebiidae	*Deuterophlebia*		1
	Dolichopodidae		2	
	Empididae	*Chelifera*	2	
		Oreogeton	10	4
	Simuliidae	*Prosimulium*		1
		Simulium	3	3
	Tipulidae	*Antocha*	1	
		Dicranota	2	1
		Hesperoconopa		1
		Tipula		1
Collembola	Onychiuridae	*Onychiurus*		1
	Sminthuridae	*Dicyrtoma*		1
Acarina			9	3
Oligochaeta			3	7
Gastropoda	Valvatidae		1	1
Ostracoda			1	1

Tributary Creek Site 9, 2001 and 2002.

Taxa			2001	2002
Ephemeroptera	Baetidae	*Baetis*	41	123
		Procloeon	5	
	Ephemerellidae	*Caudatella*	3	
		Drunella		3
		Ephemerella		14
		Epeorus		8
	Heptageniidae	*Cinygma*	1	
		Cinygmula	89	177
	Leptophlebiidae	*Paraleptophlebia*	66	96
	Ameletidae	*Ameletus*		15
Plecoptera	Chloroperlidae	*Paraperla*		11
		Suwallia	34	
		Sweltsa		42
	Leuctridae	*Despaxia*	3	
		Paraleuctra	7	
		Perlomyia		3
	Nemouridae	*Podmosta*		1
		Zapada	23	12
	Perlodidae	*Isoperla*	1	
Trichoptera	Apataniidae	*Apatania*		1
	Rhycophilidae	*Rhycophila*		1
Coleoptera	Elmidae	*Narpus*	2	6
Diptera	Ceratopogonidae	*Dasyhelea*	3	
	Chironomidae		35	36
	Empididae	*Chelifera*		1
		Oreogeton	4	2
	Psychodidae	*Psychoda*		
	Simuliidae	*Simulium*	40	22
	Tipulidae	*Tipula*	4	5
Collembola	Sminthuridae	*Dicyrtoma*		2
Acarina			15	20
Oligochaeta			40	45
Gastropoda			1	
Ostracoda			92	102

APPENDIX 3. JUVENILE FISH TISSUE DATA

Information on fish collected for analysis of metals in tissues, 2000, 2001 and 2002.

Sample Number	Date collected	Creek	Site	Fish	Weight (gm)	Length (FL) mm
062100GCCOJ01	21-Jun-00	Greens	54	Coho	4.4	72
062100GCCOJ02	21-Jun-00	Greens	54	Coho	6.1	82
062100GCCOJ03	21-Jun-00	Greens	54	Coho	4.9	73
062100GCCOJ04	21-Jun-00	Greens	54	Coho	3.4	68
062100GCCOJ05	21-Jun-00	Greens	54	Coho	5.9	73
062100GCCOJ06	21-Jun-00	Greens	54	Coho	6	75
072301GC54DVJ01	23-Jun-01	Greens	54	Dolly Varden	21.5	121
072301GC54DVJ02	23-Jun-01	Greens	54	Dolly Varden	19.32	119
072301GC54DVJ03	23-Jun-01	Greens	54	Dolly Varden	15.73	107
072301GC54DVJ04	23-Jun-01	Greens	54	Dolly Varden	13.64	109
072301GC54DVJ05	23-Jun-01	Greens	54	Dolly Varden	13.52	105
072301GC54DVJ06	23-Jun-01	Greens	54	Dolly Varden	27.54	138
072402GC54DVJ01	24-Jul-02	Greens	54	Dolly Varden	17.96	118
072402GC54DVJ02	24-Jul-02	Greens	54	Dolly Varden	22.26	128
072402GC54DVJ03	24-Jul-02	Greens	54	Dolly Varden	17.7	115
072402GC54DVJ04	24-Jul-02	Greens	54	Dolly Varden	18.94	115
072402GC54DVJ05	24-Jul-02	Greens	54	Dolly Varden	21.09	124
072402GC54DVJ06	24-Jul-02	Greens	54	Dolly Varden	20.88	123
062100TRCOJ01	21-Jun-00	Tributary	9	Coho	9.7	102
062100TRCOJ02	21-Jun-00	Tributary	9	Coho	5.3	75
062100TRDVJ03	21-Jun-00	Tributary	9	Dolly Varden	12.8	112
062100TRDVJ04	21-Jun-00	Tributary	9	Dolly Varden	13.8	105
062100TRDVJ05	21-Jun-00	Tributary	9	Dolly Varden	13.4	105
062100TRDVJ06	21-Jun-00	Tributary	9	Dolly Varden	11.3	100
072301TR09DVJ01	23-Jul-01	Tributary	9	Dolly Varden	9.05	97
072301TR09DVJ02	23-Jul-01	Tributary	9	Dolly Varden	9.66	97
072301TR09DVJ03	23-Jul-01	Tributary	9	Dolly Varden	9.5	97
072301TR09DVJ04	23-Jul-01	Tributary	9	Dolly Varden	10.37	98
072301TR09DVJ05	23-Jul-01	Tributary	9	Dolly Varden	6.42	86
072301TR09DVJ06	23-Jul-01	Tributary	9	Dolly Varden	7.83	93
072402TR09DVJ01	24-Jul-02	Tributary	9	Dolly Varden	10.8	103
072402TR09DVJ02	24-Jul-02	Tributary	9	Dolly Varden	10.43	97
072402TR09DVJ03	24-Jul-02	Tributary	9	Dolly Varden	11.16	100
072402TR09DVJ04	24-Jul-02	Tributary	9	Dolly Varden	7.93	90
072402TR09DVJ05	24-Jul-02	Tributary	9	Dolly Varden	9.19	90
072402TR09DVJ06	24-Jul-02	Tributary	9	Dolly Varden	9.33	100
072301GC48DVJ01	23-Jul-01	Greens	48	Dolly Varden	26.02	131
072301GC48DVJ02	23-Jul-01	Greens	48	Dolly Varden	28.81	137
072301GC48DVJ03	23-Jul-01	Greens	48	Dolly Varden	18.84	119
072301GC48DVJ04	23-Jul-01	Greens	48	Dolly Varden	21.13	121
072301GC48DVJ05	23-Jul-01	Greens	48	Dolly Varden	13.71	111
072301GC48DVJ06	23-Jul-01	Greens	48	Dolly Varden	21.08	121

Sample Number	Date collected	Creek	Site	Fish	Weight (gm)	Length (FL) mm
072402GC48DVJ01	24-Jul-02	Greens	48	Dolly Varden	23.23	133
072402GC48DVJ02	24-Jul-02	Greens	48	Dolly Varden	15.04	120
072402GC48DVJ03	24-Jul-02	Greens	48	Dolly Varden	17.52	122
072402GC48DVJ04	24-Jul-02	Greens	48	Dolly Varden	20.75	127
072402GC48DVJ05	24-Jul-02	Greens	48	Dolly Varden	24.77	134
072402GC48DVJ06	24-Jul-02	Greens	48	Dolly Varden	21.66	128
072301GC06DVJ01	23-Jul-01	Greens	6	Dolly Varden	28.4	139
072301GC06DVJ02	23-Jul-01	Greens	6	Dolly Varden	30.49	140
072301GC06DVJ03	23-Jul-01	Greens	6	Dolly Varden	43.9	167
072301GC06DVJ04	23-Jul-01	Greens	6	Dolly Varden	34.8	155
072301GC06DVJ05	23-Jul-01	Greens	6	Dolly Varden	15.69	109
072301GC06DVJ06	23-Jul-01	Greens	6	Dolly Varden	49.1	168

Concentration of select elements in juvenile fish, 2000, 2001 and 2002.

Sample Number	**Ag (mg/kg)**	**Cd (mg/kg)**	**Cu (mg/kg)**	**Pb (mg/kg)**	**Se (mg/kg)**	**Zn (mg/kg)**	**% Solids**
	0.02 (MRL)	**0.02 (MRL)**	**0.1 (MRL)**	**0.02 (MRL)**	**1 (MRL)**	**0.5 (MRL)**	
062100GCCOJ01	0.04	0.95	15.3	1.4	4.9	251	20.5
062100GCCOJ02	0.09	0.66	11.7	1.21	4.7	224	20.2
062100GCCOJ03	0.22	1.07	24.2	1.4	3.4	206	20.4
062100GCCOJ04	0.1	0.97	24	1.12	3.5	181	21.4
062100GCCOJ05	0.05	0.96	44	1.53	4.9	304	20.7
062100GCCOJ06	0.08	1.47	36.1	5.02	4.7	340	20.2
072301GC54DVJ01	0.03	0.46	4.3	0.33	5.7	126	22.6
072301GC54DVJ02	0.02	0.21	3.2	0.22	3.6	82	26.1
072301GC54DVJ03	0.03	0.73	6.3	0.59	4.7	144	23.5
072301GC54DVJ04	0.02	0.82	5.4	0.86	4.9	172	21.1
072301GC54DVJ05	0.02	0.79	6.5	0.45	5.8	203	22.8
072301GC54DVJ06	0.02	0.74	5.8	0.4	5.4	171	22.1
072402GC54DVJ01	0.03	0.5	4.4	0.94	3.4	363	21.2
072402GC54DVJ02	0.03	0.52	4.5	0.35	4.7	150	23.2
072402GC54DVJ03	0.05	0.95	6	0.66	4.4	161	21.9
072402GC54DVJ04	0.03	1.03	5.2	0.66	4.2	216	21.3
072402GC54DVJ05	0.05	1.32	5.2	0.74	3.9	194	21.4
072402GC54DVJ06	0.02	0.7	3.9	0.78	4.4	195	20.9
062100TRCOJ01	0.04	0.42	16.2	1.03	3.2	213	22.9
062100TRCOJ02	0.07	0.5	16.5	2.01	3.7	220	22.5
062100TRDVJ03	0.12	0.75	11.2	1.63	3.8	194	23.1
062100TRDVJ04	0.07	0.56	10.6	1.53	3.6	87.9	22.2
062100TRDVJ05	0.06	0.58	12.8	1.59	3.5	204	22.1
062100TRDVJ06	0.05	0.45	32.8	1.57	5.	213	23.
072301TR09DVJ01	0.09	0.35	4.3	0.56	6.8	127	22.1
072301TR09DVJ02	0.1	0.77	5.2	0.67	8	118	21.3
072301TR09DVJ03	0.15	0.92	5.4	4.88	5.3	144	22.2
072301TR09DVJ04	0.15	0.86	6.7	2.19		99.1	22.6
072301TR09DVJ05	0.08	0.76	4.9	0.33	6.2	106	22.2
072301TR09DVJ06	0.06	0.37	12	0.38	6.8	122	20.6
072402TR09DVJ01	0.02	0.22	3.7	0.12	1.4	144	20.9
072402TR09DVJ02	0.07	1.2	5.5	1.66	3.3	172	22.8
072402TR09DVJ03	0.13	1.06	6.1	3.4	5	138	23.2
072402TR09DVJ04	0.23	1.29	7.1	4.08	5.2	168	23.1
072402TR09DVJ05	0.08	1.15	5.2	1.39	6.2	150	23
072402TR09DVJ06	0.04	0.84	3.2	0.33	5.4	152	17.8
072301GC48DVJ01	0.02	1.76	8.3	0.2	6.1	180	21.6
072301GC48DVJ02	0.03	0.89	7.2	0.17	4.6	146	23.7
072301GC48DVJ03	0.02	2.27	5.7	0.2	6.2	189	20.7
072301GC48DVJ04	0.02	1.56	6.9	0.17	5.2	182	22.8
072301GC48DVJ05	0.03	0.89	4.7	0.23	5.4	138	21.8
072301GC48DVJ06	0.02	1.26	7.4	0.1	5.6	157	20.3

Sample Number	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)	% Solids
	0.02 (MRL)	**0.02 (MRL)**	**0.1 (MRL)**	**0.02 (MRL)**	**1 (MRL)**	**0.5 (MRL)**	
072402GC48DVJ01	0.03	1.64	6.8	0.72	4.8	239	24.3
072402GC48DVJ02	0.07	0.85	7	0.28	4.1	210	19.2
072402GC48DVJ03	0.03	0.74	4.3	0.17	4.9	162	22.1
072402GC48DVJ04	0.04	1.4	6.1	0.16	4.7	185	21.2
072402GC48DVJ05	0.05	1.3	7.9	0.46	4.3	208	21.5
072402GC48DVJ06	0.04	1.56	6.8	0.22	5.7	343	20.9
072301GC06DVJ01	0.04	1.94	16.7	1.24	5	173	20.8
072301GC06DVJ02	0.03	0.84	4.6	1	4.5	167	22.8
072301GC06DVJ03	0.03	0.82	5.3	1.94	4.3	171	21.7
072301GC06DVJ04	0.03	1.52	5.4	1.78	4.5	215	21.6
072301GC06DVJ05	0.02	0.89	11.1	0.33	5.3	126	22.2
072301GC06DVJ06	0.04	0.73	8	1.96	4.6	169	21.9