TAILINGS AND PRODUCTION ROCK SITE
2003 ANNUAL REPORT

Kennecott Greens Creek Mining Company

December 2004

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FIGURES

(Data Graphs see Appendix 3; Photographs see Appendix 4)

APPENDICES

1.0 Executive Summary

This annual report has been prepared by Kennecott Greens Creek Mining Company in accordance with Alaska Waste Disposal Permit 0111-BA001 and the mine's General Plan of Operations Appendices 3 and 11. The following itemized list summarizes key information and indicates where in this report the information outlined in Section 6.2 of Permit 0111-BA001 is presented:

Permit Section		Report Section
6.2.1	Closure plan summary	2.8
	Cost estimate revision to Reclamation Plan (due to Tailings Expansion project)	
	Precipitation	2.4, 3.4
	Mill Site 59.48" Tailings 51.24" Over 10" in September 2003	
	Summary of internal monitoring and fresh water monitoring plans	2.5, 3.5
	FWMP annual report separate in 2003 as per the ADEC request for full data presentation.	
	Internal monitoring water compositions at both sites dominated by Ca, Mg, SO_4, neutral pH, high alkalinity, high zinc, low to moderate concentrations of other metals. Data are consistent with sulfide oxidation and carbonate mineral buffering. Sulfate reduction in saturated zone of tailings pile yields low concentrations of all metals. Concentration of As higher in some tailings wells due to migration of redox boundary. Seasonal compositional fluctuations are evident in most wells/drains.	
	Stability	2.3, 3.3
	No signs of instability at either the Tailings Facility or Site 23. Foundation heads consistently low at both sites except for short-lived spikes in one piezometer (north end of West Buttress). Target compaction densities achieved.	
	Updated stability analyses completed	
	Cover performance	3.8
	>85% saturation maintained, barrier layer not subject to freeze/thaw cycles. Net percolation up to 19%. Installed cutoff trench above cover plot and sealed neutron access tube contact with bentonite.	
	Pond D flow and composition	3.4, 3.5
	Average flow is about 50 gpm, similar composition to dilute Site 23 finger drains (e.g 23FD-3 and 23FD-6).	
	Summary of inspections	2.3, 3.3
	Inspections confirm compliance with WDP and GPO guidelines at both sites.	
6.2.2	Summary of inspections	2.3, 3.3
	Summarized above	
	Monitoring results	
	Summarized above	2.3, 3.3
6.2.3	Changes to GPO in 2003	
	Tailings GPO was revised to reflect EIS requirements	2.5, 3.5
6.2.4	Location and volume of materials	2.2, 3.2, A1, A2
	East Tailings and West Buttress 283,000 total tons in 2003 (tailings 261,000 & rock material 22,000 tons)	
	Site 23 west end and north ramps 30,000 total tons 2003	

	Compaction	2.3, 3.3
	Target compaction densities achieved in all nuclear density tests. Change to method specification for production rock	
	Acid Base Accounting	2.5, 3.5
	Potentially acid generating Class 3 production rock	
	Neutralization potential values continue to demonstrate long lag time (buffering capacity)	
	Class 1 is significantly acid neutralizing (about 35% carbonate)	
	None of the 32 production rock samples had rinse pH values less than 6.0	
	Possible water releases	2.5
	Tailings perimeter waters: removed pyritic southern access road, removed W. Buttress tailings residue, captured NW Diversion ditch, improved ditch to N. Retention Pond, capped artesian well for non-winter months. Continue to monitor water compositions for effects related to 2002 remedial actions.	
	No new signs of possible release were identified in 2003.	
6.2.5	Information regarding validity, variations and trends	various
	Full FWMP data assessment in separate report	
	Internal Monitoring Plan variations are seasonal, no deleterious trends identified	

The report is separated such that all aspects of the tailings facility are discussed first in Section 2 followed by discussion of Site 23/D in Section 3. Information that is pertinent to both sections is generally not repeated but is discussed in the most relevant section and identified by reference in the other section.

2.0 Tailings area

2.1 Introduction

Kennecott Greens Creek Mining Company (KGCMC) has prepared this section of the Annual Report in accordance with the mine's General Plan of Operations (Appendix 3) and Alaska Waste Disposal Permit 0111-BA001 (note: 0111-BA001 was replaced by 0211-BA001 on Nov 7, 2003. The 2004 annual report will be prepared in accordance with the revised permit). A summary of all operational and monitoring activities performed in 2003 is provided. Refer to GPO Appendix 3 and permit 0111-BA001 for a detailed description of the tailings facility and associated monitoring requirements.

KGCMC operated its tailings facility continuously in 2003. Primary placement areas included the East Expansion and West Buttress (see Tailings Facility as-built in Appendix 1). KGCMC added 156,415 cubic yards of material to the Tailings Facility in 2003, bringing the total facility volume to approximately 1,821,470 cubic yards. Approximately 261,300 tons of tailings were placed at the tailings facility during this report period with a total placement of all materials at the tailings facility totaling approximately 283,377 tons as calculated from KGCMC surveyed volumes.

2.2 Placement records

Table 2.1 contains the monthly placement records for tailings, production rock and other materials (e.g. ditch sediments) at the tailings facility for 2003. Surveyed volumes (cubic yards) were converted to tons using a tonnage factor of 1.8117 tons per cubic yard (134.2 pcf for tailings). Production rock used for road access and erosion control contributed approximately 12,600 tons to the facility. 9500 tons of materials such as sediments from ditch maintenance, other construction rock (crushed quarried rock) and a minor amount of treated sewage sludge were also placed at the facility in 2003. The calculated tonnage of tailings was derived by subtracting the tons of production rock and other material from the surveyed total. The pile currently contains approximately 3.30 million tons of material. Based on the survey data presented in Table 2.1 there is a remaining capacity of approximately 202,000 tons in the existing facility. Estimates of other miscellaneous materials disposed in the facility are shown in Table 2.2

Table 2.1 Tailings Placement Data

	All Materials Monthly Total	**All Materials Cumulative total**	**All Materials Monthly Total**	**All Materials Cumulative Total**	**Prod Rock from Site 23**	**All Other Materials (Ditch Seds and Construction)**	**Tailings**
Date	survey (yd^3)	survey (yd^3)	tons (calculated)	tons (calculated)	tons (truck count)	tons (truck count)	tons (calculated)
2/3/2003	12,126	1,677,181	21,969	3,038,549	688	270	21,011
2/27/2003	5,525	1,682,706	10,010	3,048,558	2048	848	7,114
03/31/03	8,488	1,691,194	15,378	3,063,936	1488	1632	12,258
5/1/2003	16,130	1,707,324	29,223	3,093,159	1390	80	27,753
6/2/2003	10,917	1,718,241	19,778	3,112,937	1071	527	18,180
7/2/2003	12,502	1,730,743	22,650	3,135,587	204	68	22,378
7/29/2003	13,721	1,744,464	24,858	3,160,445	136	102	24,620
9/2/2003	19,814	1,764,278	35,897	3,196,342	731	561	34,605
10/1/2003	17,861	1,782,139	32,359	3,228,701	731	1547	30,081
10/30/2003	14,296	1,796,435	25,900	3,254,601	221	3502	22,177
12/2/2003	10,619	1,807,054	19,238	3,273,840	2064	0	17,174
12/30/2003	14,416	1,821,470	26,117	3,299,957	1836	340	23,941
Totals	**156,415**	**1,821,470**	**283,377**	**3,299,957**	**12,608**	**9,477**	**261,292**
Tons calculated at 134.2 pounds per cubic foot for tailings							

Table 2.2 Miscellaneous Materials Disposal Estimates

Surface Tailings	yds^3
Pressed Sewage Solids	50
Pressed Water Treatment Plant Sludge	500
Incinerator Ash	16
Underground	yds^3
Tires	550 ea
Sump Sediments	3640
Shop Refuse	730
Mill Refuse	310
Electrical Refuse	120

2.3 Stability

Tailings placement compaction was regularly tested throughout the year to monitor the performance goal of achieving 90 percent or greater compaction relative to a standard Proctor density. KGCMC staff utilizes a Troxler Model 3430 nuclear moisture-density gauge to measure wet density and percent moisture content of placed tailings. Typically one or more sites per active placement cell are selected on a monthly basis and a series of 1 minute replicate measurements at a 12-inch depth are taken. Dry densities are calculated and compared to laboratory measured standard Proctors.

Compaction

Summary results for 2003 are shown in Table 2.3. Standard Proctor values were measured on five samples taken from the tailings-loadout facility at the 920 throughout the year and submitted to an outside materials testing lab, which preformed the test within the ASTM guidelines for method #D698. The mean standard Proctor value was 139 PCF (pounds per cubic foot), which compares closely to previous data.

Field measurement results show a high degree of achieving greater than 87% compaction with respect to an average Standard Proctor value of 137.2. Density results obtained using the Troxler procedure were compared with those from another procedure (Rubber Balloon Method ASTM D-2167) at 16 sites in 2003. The Troxler densities averaged 9 percent higher than the densities obtained via the comparative method, however the average density indicated by the rubber balloon method also exceeded the 90% target (92%).

Table 2.3 Summary Statistics for 2003 Tailings Compaction Testing Data

Compaction Variable	Mean	Max	Min	Std. Dev.	n
Std. Proctor (ASTM #D698)	**139**	142	135	3.06	5
Opt. Moisture (%)	13.0%	14.0%	12.0%	0.8%	
Measured Dry Density	147	169	123	12.83	32*
Measured moisture (%)	13.2%	21.7%	7.5%	3.9%	
Rel. Compaction % **	105.5%	125.4%	87.9%	8.9%	
* n=31 represents the number of individual sites at which multiple replicates are taken.					
** Percent compaction calculated with respect to corresponding monthly proctor.					

Inspections

Several independent inspections are carried out at the tailings area throughout the year. Operators working at the site carry out daily visual work place inspections. The Surface Civil Engineer and/ or Surface Operations Manager carry out weekly visual inspections. The environmental department carries out a monthly checklist inspection of Pond 6. No visible signs of physical instability were observed at the tailings facility during this report period.

During 2003 the USFS inspected the facility 31 times (Site inspections #135-#165) to monitor for Best Management Practices effectiveness and compliance to the General Plan of Operations. No issues of non-compliance or poor operations practices of the surface tailings facility were noted during the inspections. The USFS typically noted that the facility is being developed and operated to required operations and maintenance specifications of GPO Appendix 3.

Well and piezometer water level data

Pneumatic piezometer and well water level data for the tailings site are presented in Figures 2.1 to 2.18. Well and piezometer locations and water level cross sections are shown on the tailing facility as-built (Appendix 1). Piezometers 43, 48, and 73 and monitoring well MW-T-B2 were decommissioned in 2001 and early 2002, and replacement or redundant completions are currently in place. Water levels at several measurement points showed similar fluctuations in 2002 and 2003. Instruments in the south (PZ-T-00-01, PZ-T-00-02, PZ-T-00-03; Figures 2.11, 2.12 and 2.13) showed a 3 to 7 foot decrease in head in response to below average precipitation during the spring and summer months. Monitoring well MW-T-00-05A showed unusual depth to water reading in 2002 and 2003 (Figure 2.14). Historical data indicate that this well's depth to water is consistent and is not influenced by seasonal or other affects. KGCMC determined that the abnormal readings were a result of the method of depth to water measurements. A sonic indicator was used at this location until it was discovered that the small amount of water in the well's casing causes problems with the reading. Beginning in June 2003, the depth to water measurements were taken with a depth to water tape, and these head measurements again reflect historical values. Piezometer 76 (Figure 2.10), completed in the northern portion of the West Buttress, continues to indicate approximately 10 feet of saturation in this area. Though this is a relatively recent development (over the past two years), it is consistent with the behavior of tailings elsewhere in the pile. Even when placed on an unsaturated blanket drain, the fine-grained tailings can develop 10 to 15 feet of saturation. Head levels are expected to rise as the slope length and tailings thickness of the West Buttress increase.

Section CC of the tailings facility as-built shows the inferred water table in the tailings pile. The maximum saturated thickness (approximately 45 feet) occurs near the center of the main portion of the pile. However, that water table level does not extend close to the down-slope toes of the pile. The foundation of the West Buttress and southern portion of the pile is well drained, as indicated by typically consistent unsaturated conditions in the blanket drains (MW-T-00-05A, Figure 2.14) and at the base of the West Buttress (piezometers 74 and 75 in Figures 2.8 and 2.9). Low head elevations near the pile toe maximize the pile's geotechnical stability. The head increases observed in 2003 appear to be localized and of short duration and should not have an adverse effect on pile stability; however, KGCMC will continue to monitor and evaluate these conditions closely.

The data from standpipe piezometers completed above the blanket drain (PZ-T-00-01, PZ-T-00-02, PZ-T-00-03 in Figures 2.11, 2.12, 2.13) indicate that the water perches above the unsaturated underdrains to a thickness of approximately 12 feet. This is consistent with the low permeability of the tailings and the un-capped condition of the pile. Covering the pile will help minimize the saturated zone in the pile. This was demonstrated by the 10+ foot decrease in the water table that occurred from 1995 to 1997 when the pile was covered (see Figures 2.1 to 2.7). Water levels have rebounded to, and in some cases above, 1994 elevations in most areas. Areas where water levels exceed their 1994 values are areas where the pile is considerably thicker than it was in 1994.

Water levels for four wells completed east and west of the pile are shown for comparison in Figures 2.15 to 2.18. The eastern wells, MW-T-00-3A (Figure 2.15) and MW-T-00-3B (Figure 2.16), are completed in the shallow sands 12 and 17 feet, respectively, below ground surface. The shallower well shows a water table at the surface and the deeper well indicates a water elevation about three feet below ground surface throughout 2003. The water table remained close to an elevation of 228 feet in 2003. Wells MW-T-01-03A and MW-T-01-03B are installed west of the pile. Their water levels are shown in Figures 2. 17 and 2.18, respectively. MW-T-01-03A is completed in bedrock to a depth of 20 feet and MW-T-01-03B is completed in clayey silt to a depth of 12 feet. The bedrock well indicates a water elevation drop of approximately 1 foot from 2002 to 2003, with an average of 123.5 feet in 2003. The clayey silt well shows a water elevation of 130 feet. Figure 2.18 suggests that it may have taken approximately six months for the water level to equilibrate after it was baled dry following a slug injection test in February 2001. If this is the case it reflects the very low permeability of the clayey silt. The ground surface elevation is 134 feet in the proximity of these two wells.

2.4 Hydrology

A detailed review of the hydrology of the tailings facility was performed by Environmental Design Engineering (EDE) in 2001 (EDE 2002a). The report describes the hydrogeology of the site and presents calculations of anticipated post-closure hydrologic conditions. Water management at the facility consists of a complex network of drains under the pile, bentonite slurry walls around the perimeter of the site, and ditches to divert up-slope water and collect surface runoff. See the tailings facility as-built for locations of the site's water management components. The site is underlain by a low permeability silt/clay till and other glacial/marine deposits or an engineered HDPE liner. These features minimize the potential for the downward migration of contact waters. An upward hydrologic gradient under the site further improves contact water collection.

Precipitation and temperature data are presented in Table 2.4. The wettest months were September (10.91 in) and October (5.74 in). April was the driest month with only 0.72 inches. The area received relatively little precipitation from February through July and experienced an extremely high precipitation period in September. Flow data from Wet Wells 2 and 3 are presented with the precipitation data in Figure 2.19. The wet well flows respond relatively quickly to precipitation events, demonstrating a significant contribution of surface water.

Table 2.4 Monthly Summary of Tailings Area Climate Data

Month	AvgTemp (°C)	Precipitation (inches)
January	0.70	5.07
February	0.10	2.21
March	-0.30	3.62
April	5.50	0.72
May	8.40	3.10
June	11.40	3.68
July	14.30	2.45
August	13.30	4.11
September	9.70	10.91
October	7.20	5.74
November	0.10	4.88
December	0.20	4.75
2003	5.90	51.24

2.5 Water Quality

Compliance Monitoring

Water sites around the surface tailings storage facility have been monitored continuously since 1988. This sampling pre-dates the placement of tailings at this facility. The FWMP Annual Report for water year 2003 is being prepared separately and will be submitted to the Forest Service and ADEC upon completion. The full FWMP report provides the additional, full data and analyses requested by ADEC in comments to Tailings and Production Rock Annual Report 2002.

Internal Monitoring

As described in Waste Management Permit Number 0111-BA001 Section 2.8.3.1, the internal plan addressed monitoring at both the surface tailings facility and the surface production rock storage areas covered by the permit. The Internal Monitoring Plan describes monitoring within the pile areas, in contrast to the compliance monitoring (under the Fresh Water Monitoring Plan) at peripheral facility boundary sites. As such, data generated by the Internal Monitoring Plan effort are "… not for compliance purposes…" as noted in the above referenced permit Section 2.8.3.1., but provide a continuing perspective on in-pile geochemical processes.

While the Internal Monitoring Plan sets minimal monitoring standards, KGCMC generally conducts additional monitoring over and above those requirements. As the opportunity arises, or the need is seen, such additional sampling may include sampling of different media, more frequent samples from the monitoring plan-specified locations, or perhaps analyses of samples for additional constituents. Instances also arise where sampling of different locations/sites is conducted. While not required to present these additional data, KGCMC has chosen to generally include much of such extra data in this report as it is felt to help better understand conditions at the permitted areas. Collection of these extra data may or may not continue, based upon changing conditions and/or need of KGCMC.

The analytical results of KGCMC's internal site monitoring plan are summarized in Figures 2.20 to 2.29. Sites were distinguished between foundation wet wells (Wet Well 2 and Wet Well 3), wells completed in tailings (PZ-T-01, PZ-T-02, PZ-T-03, MW-T-02-5 and MW-T-02-6) and suction lysimeters (SL-T-02-4, SL-T-02-5, SL-T-02-6, and SL-T-02-7). These groups are separated on Figures 2.20 through 2.29 with the suffix a, b or c. For example, a figure number such as 2.20a would show the data for the wet wells group, 2.20b would show the data for the tailings completion wells, and 2.20c would show the data for the suction lysimeters.

An in-depth evaluation of the hydrology and geochemistry of the tailings facility was performed by Environmental Design Engineering (EDE) and KGCMC in late 2001 (EDE 2002a, EDE 2002b, KGCMC 2002) and the Tailings Expansion EIS (USFS 2003). The observations made under the 2003 internal monitoring plan are consistent with the findings of the EDE, KGCMC and USFS reports.

All internal monitoring waters are captured and treated prior to discharge to the ocean floor under KGCMC's National Pollutant Discharge Elimination System Permit (AK 004320-6).

Values of pH were between 6 and 8.5 for all internal monitoring site samples in 2003 (Figure 2.20a, b and c). PZ-T-00-01, PZ-T-00-2 and PZ-T-00-3, which screen the lower ten feet of tailings pile, have the highest pH of the internal monitoring sites. This is likely a result of microbial sulfate reduction and equilibration with carbonate in the saturated zone of the pile. The wet wells produce water with slightly lower pH (generally between 6.5 and 7), reflecting minor influences from groundwater (organic acids) and oxidized surface waters (acidity from thiosalt, sulfide and iron oxidation). The suction lysimeters all have pH values between 7 and 8.

Alkalinity data are presented in Figure 2.21a and b. Alkalinity generally ranges between 200 and 600 mg/l $CaCO_3$ within the tailings pile, consistent with buffering from carbonate minerals and the products of microbial sulfate reduction. The fact that these internal waters are near-neutral to alkaline and have substantial alkalinity indicates that the buffering capacity of the tailings is sufficient to prevent acidification of site drainage in the near-term (at least tens of years).

The conductivity results from internal monitoring site waters are presented in Figure 2.22a, b, and c. 2003 conductivity measurement are between 1898 (wet wells) and 7350 (suction lysimeters) uS/cm. The higher conductivity of the site contact waters reflects a larger dissolved load caused by weathering of the tailings. Pyrite oxidation and carbonate dissolution contribute dissolved ions such as sulfate, bicarbonate, calcium and magnesium to the contact waters, increasing their conductivity. Wet Well 3 has a different capture area than Wet Well 2 and shows a different pattern with respect to conductivity. The changes in conductivity observed in Wet Well 3 probably reflect changes in the relative contributions from runoff, addition of the Northwest Diversion Ditch flow, infiltration and groundwater as the West Buttress was constructed. The suction lysimeters have conductivity values ranging from 3320 to 7350 uS/cm. Suction lysimeter samples are drawn from the smallest pore spaces of the unsaturated zone. Water held in these pores is often isolated from flow paths and thus has higher dissolved constituent concentrations than water from the saturated zone and foundation drains.

Hardness and sulfate concentrations are consistent with the conductivity results. Calcium and magnesium are the primary contributors to hardness (Figure 2.23a and b) and reflect dissolution of carbonate minerals, such as calcite and dolomite. Carbonate dissolution neutralizes acidity formed by sulfide oxidation, which is also the source of sulfate shown in Figure 2.24a, b, and c. Sulfate concentrations range between 500 and 3000 mg/l in the tailings pile waters. The increase in sulfate and other constituents seen in PZ-T-00-03 likely reflects the replacement of interstitial process water with infiltrating surface water, which carries a higher dissolved load.

Arsenic data are presented in Figures 2.25a, b and c. The data, especially for Wet Well 2 (and other sites to a lesser extent) show a distinct increasing trend. As arsenic-bearing minerals such as tetrahedrite/tennantite (and to a lesser extent pyrite) weather, the arsenic that is released is typically co-precipitated with iron oxy-hydroxides. As the pile grows, reducing conditions overtake areas that were once oxidizing. This was particularly true as the water table rose following removal of the temporary PVC cover that was placed on the pile in 1995 (removal began in 1997). Dissolution of oxyhydroxides (and possibly sulfates) should occur as the waters respond to the changing redox conditions. This will contribute arsenic (and iron) to the drainage water. Arsenic concentrations in the drainage will decrease when redox conditions in the pile stabilize.

Figure 2.26a, b and c shows the concentration of zinc from the monitoring sites. Zinc levels from the saturated zone of the pile continue to remain low (Figure 2.26b), a result of sulfate reduction, which promotes zinc sulfide precipitation. The zinc concentration in MW-T-02-06 suggests that sulfate reduction may not be occurring in this portion of the west buttress. Placement of argillite on the outer slopes of the West Buttress has also led to higher zinc concentrations in Wet Well 3 from flushing of this newly placed material. In 2003, the zinc concentration in this wet well returned to within historical limits. The two 20 foot suction lysimeters showed zinc concentrations between 400 – 1600 ppb (SL-02-05, SL-02-07), and the two 40 foot lysimeters (SL-02-04, SL-02-06) had zinc concentrations less that 50 ppb (Figure 2.26c).

The concentrations of copper and lead are considerably lower than that of zinc. Both of these metals' concentrations were generally less than 5 ppb in water from each site (Figures 2.27a, b and c and 2.28a, b and c). Exceptions (Wet Well 3 and suction lysimeters) occur in the unsaturated zone and in areas of active tailings placement. These observations are consistent with the observation that copper and lead mobility are greatest when the tailings are first placed, then decrease with time. The concentrations of copper and lead in the lysimeter samples were all less than 25 ppb and 12 ppb, respectively.

Cadmium data are shown in Figure 2.29a, b and c. With the exception of Wet Well 3, cadmium concentrations are very low (less than 0.5 ppb). Cadmium in Wet Well 3 had a maximum value of 27 ppb and showed seasonal fluctuation similar that of zinc, albeit at significantly lower concentrations. The new well MW-T-02-06 showed a cadmium concentration of 4.5 ppb in June, which was the only cadmium value to date for this well. As discussed above for zinc, this cadmium value also suggests that sulfate reduction is not occurring in this portion of the West Buttress.

Acid Base Accounting Analyses

There were no tailings facility grid samples taken for ABA analyses in 2003. Grid sampling is planned in 2004. ABA analyses of monthly composite samples were taken of tailings at the Mill filter press. These samples are representative of Mill feed and not necessarily tailings area placement. Figure 2.30 shows the monthly composite sample ABA results for 2001, 2002 and 2003. The average NNP results for the past three years have been -281, -197 and -194 tons $CaCO_3$/1000t, respectively.

2.6 General Site Management

Tailings Operation and Management

In January 2001, Kennecott Greens Creek Mining Company (KGCMC) received approval for an updated General Plan of Operations – Appendix 3 Tailings Impoundment (GPO Appendix 3), dated August 2000, in conjunction with issuance of the Alaska Department of Environmental Conservation Waste Disposal Permit #0111-BA001. GPO Appendix 3 includes the general operating and management goals to achieve site stability and satisfy regulatory requirements.

As per GPO Appendix 3, Section 2.1.4, KGCMC Operations place tailings within the impoundment using specific criteria that were established by Klohn Crippen Engineering in 1999 for the placement of tailings in cellular configurations with compaction standards. KGCMC continued to place tailings in this manner through 2003.

In 2002, KGCMC's main placement area for tailings continued to be the East Side Tailings – Northeast area and the newly developed Southeast Liner area, which lies within the current lease permit boundary. The lined area was developed in May 2002 and added approximately 2 years of tailing storage capacity to the existing impoundment site. This area was developed differently from prior site development, in that an HDPE liner system was installed over the shallow fractured bedrock areas (caused by rock quarry blasting) of the wide corner quarry site. The intent is to minimize the potential for downward migration of contact waters in the area that does not have the natural aquatard (silt/clay till) layer underneath the tailing placement footprint area. A liner design plan was submitted in December 2001 with approvals granted for installation from the USFS and ADEC in early 2002. Liner installation and construction activities began in late April 2002 and completion was in late June 2002. A Southeast Expansion Construction Summary report (Klohn Crippen, November 2002) was submitted to the agencies following the construction of the Southeast Liner area.

KGCMC focused on placing in this new area after the construction and liner installation to even out the pile height with the existing north end of the pile and to give operations a broader extent of cell availability. Approximately 83% of the 2003 tailings production went into the overall East-side area. The remainder of the tailings were placed in the West Buttress area. KGCMC continues to place in this area with consideration of the purpose of the buttress installation, which is to structurally support the portion of the existing tailings pile that was constructed prior to 1994.

No changes to the methodology of tailings placement occurred in 2003, as KGCMC continues the use of off-highway lidded trailered trucks to transport the tailings to the surface placement area. The material is end dumped, spread and compacted using a bulldozer, followed by a smooth-drum vibratory compactor. Regular compaction checks using a Troxler density and moisture gauge confirm the resultant performance in the placement area, as per the GPO Appendix 3. See Section 2.3 for a discussion of compaction results.

KGCMC does not expect any changes to the placement methodology in 2004 and will continue placement according to the established criteria in GPO Appendix 3. Continued development of placement areas for the remaining mine life are a part of the Stage 2 Expansion Project, approved in January 2004.

<u>Stage 2 Tailings: Environmental Impact Statement (EIS) Update</u>

In January 2001, KGCMC applied for an expansion of tailings surface storage capacity that can satisfy the current production requirements and reasonable anticipated reserve increases. That application initiated a National Environmental Policy Act (NEPA) process with the U.S. Forest Service as lead agency due to their land management responsibility for the proposed Stage 2 Expansion area. For the KGCMC application, the USFS established an inter-agency regulatory team (IDT) with two memoranda of understanding, which act as guides for the involvement of additional Federal, State and Local regulatory agencies. A third-party EIS contractor, Michael Baker Inc. (MB), was selected to coordinate and conduct the EIS analysis of the project proposal.

In March 2001, MB began baseline study reviews, and KGCMC started additional site investigation projects, such as surface drilling, geotechnical and hydrology studies, sensitive plant surveys, update wetland studies and detail topographic mapping. In the following month of April 2001, MB organized public project review meetings in Juneau and Angoon to establish the project issue lists, as baseline studies continued throughout the summer. In late July 2001, in the process of investigating the surface drainages around the tailings site, KGCMC discovered water issues that initiated a report submittal to ADEC and the USFS in July 2001 per GPO and Solid Waste Permit requirements.

Final water quality at closure was identified for the Stage II Tailings Expansion EIS as a significant scoping issue surrounding the proposed tailings storage area expansion. An extensive review of historic and current water monitoring information from within and surrounding the existing tailings area was accomplished by Environmental Design Engineering (EDE). Their efforts resulted in the submittal of an updated hydrologic analysis report (EDE 2002a) and a geochemistry report (EDE 2002b) as baseline studies of the expansion proposal. These documents updated previous analyses, drawing on data collected in the interim to discuss the predicted water quantities and qualities as well as the conditions which influence those topics. This report process started in June 2001 and was finalized in February 2002.

In March 2002, MB initiated a significant effort to confirm the water quality results by creating a second water quality modeling exercise (see Appendix B of the DEIS published on 25 April 2003) utilizing different methodologies than used in the EDE reports. Also, final reviews of the baseline studies were completed, and comprehensive reviews of the potential alternatives, as a part of the USFS led NEPA process, resulted in a Preliminary Draft EIS (PDEIS) being issued for Regulatory Agency review in late July 2002. With publication in the Federal Register, an Alaska Department of Environmental Conservation Solid Waste Permit public notice was provided for public comment to allow these related Stage II Tailings project's permitting to proceed concurrently. In conjunction with the U.S. Army Corps of Engineers 404 wetlands permit, and the draft Alaska Costal Zone Determination this will provide the Public with a comprehensive review of the project's overall permitting.

Greens Creek received a Notice of Request in 2002 for an Adjudicatory Hearing filed by Earthjustice on behalf of the Southeast Alaska Conservation Council (SEACC) and Northern Alaska Environmental Center contesting the ADEC's grant of a solid waste permit for the continued storage of tailings and production rock. After numerous negotiations, ADEC dismissed the request.

The USFS, ADEC and the CBJ accepted an increase in Greens Creek reclamation bond in October 2003 from the 2001 amount of $24.4 million to $26.2 million. This bond amount was incorporated into the Alaska Department of Environmental Conservation Waste Management Permit and the USFS GPO and the Final EIS (FEIS) for the tailings expansion project.

ADEC approved the Tailings Area Expansion Waste Management Permit in November 2003. Several of Greens Creek permitting actions associated with the tailings expansion project's FEIS were determined to be consistent with the Alaska Coastal Zone Management Program. The USFS published its Record of Decision (ROD) for the Tailings Expansion Project in November 2003. The ROD was appealed by SEACC, Friends of Admiralty Island, and the Friends of the Northern Alaska Environmental Center on December 29, 2003. The USFS issued a decision on the appeal in January 2004 that allowed Greens Creek to proceed with the tailings expansion project.

2.7 Site as-built

An as-built for the tailings facility is presented in Appendix 1. The as-built shows the 2003 year-end topography, water management features, monitoring device locations and other significant features of the site. The as-built also includes cross sections that show the following information:

- existing topographic surface
- prepared ground upon which the pile was constructed
- water levels

Photographs taken during routine site inspections in 2003 are presented in Figures 2.31 to 2.33 (Appendix 4). Figure 2.31 shows Curlex blankets or erosion mats that had been placed on a slope of the tailings pile to test their ability to control erosion from storm water runoff. The blankets are made of a biodegradable wood fiber. This photo was taken on April 17, 2003.

Figure 2.32 shows the west side of tailings, in a typical placement area. Tailings are spread in thin lifts with a bulldozer (left) and compacted with a vibratory roller (right). The tailings are spread and compacted in thin, inclined lifts in a cell that has an overall thickness of approximately five feet. This promotes drainage and dissipation of pore pressures that rise as the material is compacted. 17% of the overall placed tails for 2003 were put into West Buttress. Tailings are placed in cells and the 3H:1V outer slope is covered with Class 1 production rock or native materials to minimize erosion.

Figure 2.33 shows the north side of tailings. The photo was taken in August, a few months after the area had been hydroseeded.

2.8 Reclamation/Closure Plan

Reclamation Plan

In November 2001, as part of the Waste Disposal Permit requirements, KGCMC submitted a "Detail Reclamation Plan with Cost Estimates" as an attachment to the GPO Appendix 14. An inter-agency team approved this attachment to Appendix 14, as the basis of current site reclamation bonding levels. Bonding levels were set for $24,400,000 in conjunction with the approved site reclamation plan. The Detail Reclamation Plan includes all estimated costs (labor, materials, equipment, consumables, administration, monitoring and long term maintenance) for task specific work associated with the final closure of the property under a default scenario. KGCMC detailed a scope of work to accommodate the physical reclamation projects and the reclamation monitoring and maintenance of all site facilities by segmenting the overall project work at the mine into 7 elements:

- Roads
- Production Rock Sites
- Tailings Area
- Site General
- Water Systems
- Maintenance and Monitoring
- Administration

Each of the above elements of the Detail Reclamation Plan include narrative and cost estimates to define the closure of the property by discipline (type of work) and area. The elements of the plan encompass the entire mine site, and also include reclamation performance monitoring and facility maintenance after final closure according to the Waste Disposal Permit standards.

The Stage 2 Tailings Expansion EIS process triggered a National Environmental Policy Act (NEPA) review and an Environmental Impact Statement (EIS) to analyze the potential environmental effects of the project. As part of the tailings expansion, a reclamation review was requested to update the current General Plan of Operations (GPO) Appendix 14 – Reclamation Plan (the Plan) and the costs associated with the tailings expansion area and to revise the Plan's cost estimates to year 2003 values. The request was made in a joint letter dated October 16, 2003 from the Alaska Department of Natural Resources (ADNR), USFS, and ADEC. KGCMC submitted a cost estimate revision as Attachment A.1 to the Plan on October 22, 2003. The estimated reclamation cost detailed in this document, including the anticipated first, 5-year

Tailings area expansion development phase, was approximately $26,200,000, a difference of approximately $1,800,000 from the 2001 estimate.

Reclamation Projects

KGCMC continued using past interim reclamation measures, such as hydroseeding and erosion control at the tailings facility, to improve and maintain established site controls. A growth media (six inches to one foot) of native soils was placed on selected slopes of the tailings pile to promote the hydroseed growth. KGCMC also continued the use of other sediment control measures such as silt fencing, hay bales, polymer addition, slope armoring and slope contouring throughout the site. KGCMC is committed to the continued use of site controls as the operation has consistently demonstrated the benefits of these interim reclamation programs to reduce impacts during the operational period. Housekeeping projects were also initiated at Pit 5 and Pit 7 quarries and will continue into 2004.

For year 2002, concurrent reclamation project assessments included investigation for closure methodology, cost estimating, technical analysis and performance monitoring. Subsurface investigations at Site 23/D and the Tailings Facility are significant parts of the assessment process. In late October 2002 a geotechnical drilling program was completed. See Section 3.3 of this document for a discussion of the hydrology and stability results from this study.

The waste disposal permit allows time to gather cover performance information for further analysis, prior to installing the covers en mass. Continued evaluation of the cover performance is ongoing to justify and improve closure capping technology. Extensive reviews in 2002 of the cap performance have also taken place during the KGCMC Stage 2 Tailings Expansion project work with the USFS (O'Kane 2001). KGCMC recognizes that the soil covers represent a significant part of the site reclamation plan. Therefore, KGCMC has continued to commit resources to develop and monitor the performance of the cover at Site 23.

Concurrent reclamation projects completed in 2002 included items related to the 2002 Tailings Action Plan approved by the Agency. Removal of drilling access ramps on the west side of the tailings area, and the removal of the Pond 6 seepage return structure highlighted the work, along with the addition of diversion ditches and tailings material cleanup at the northwestern rim of the tailings pile.

Site 23 has limited area available for continued cap installation, because the available space on the lower western slope continues to be affected by ramp development above the area. As the access ramp is raised past this area, KGCMC will have approximately an acre of available final outside slope for cap installation. This project area may become available in 2004. Therefore, no significant Site 23 backslope excavation is planned in the year 2004 unless a need to develop additional production rock placement area or to accumulate additional native soils for reclamation becomes necessary. Excavation estimates between 30,000-40,000cy of backslope material could be taken in the northeastern portion of the site, as these projects commence. KGCMC can not over-excavate the Site 23 backslope because of highwall safety issues. The planned removals are dependent on several factors, such as production rock availability for Site 23 excavation fill, weather and potential reclamation sites being ready for soil capping. At this time, the concurrent reclamation plan has a flexible schedule and is addressed in the Detail Reclamation Plan - Cost Estimates document in Section 5.

3.0 Site 23/D

3.1 Introduction

Kennecott Greens Creek Mining Company (KGCMC) has prepared this report in accordance with the mine's General Plan of Operations (Appendix 11) and Alaska Department of Environmental Conservation Waste Disposal Permit 0111-BA001. A summary of all operational and monitoring activities performed in 2003 is provided. Refer to GPO Appendix 11 and permit 0111-BA001 for a detailed description of Site 23, Site D and associated monitoring requirements.

KGCMC operated Site 23 (its only active production rock disposal facility) continuously in 2003. See the Site 23 as-built in Appendix 2 for facility layout. Approximately 30,000 tons of production rock were placed at Site 23 during this report period. The projected remaining capacity at Site 23 is approximately 820,000 tons.

3.2 Placement records

Site 23 survey data and truck count haulage information are presented in Table 3.1. Site 23 received approximately 30,000 tons of production rock in 2003 as calculated from KGCMC surveyed volumes. A tonnage factor of 1.693 tons/yd^3 was used to convert surveyed volume to tonnage. Class 1 production rock comprised 4% of the total placement at the site. Class 2 and Class 3 production rock comprised 51 and 45 percent, respectively. The small (less than 3 percent) difference between truck count totals and calculated totals based on survey data reflects variations in tonnage factors, small differences in load capacities and double handling of materials. The surveyed volume reported in cubic yards has the least uncertainty relative to other quantities reported in Table 3.1. The acid base accounting data presented in Section 3.5 indicate that KGCMC continues to conservatively classify its production rock. Some of the phyllite that is visually classified as Class 3 is actually chemically Class 2 (i.e. laboratory testing demonstrates a NNP between 100 and –100 tons $CaCO_3$/1000t).

Table 3.1 Production Rock Placement Data

	Production Rock Placed At Site 23				Production Rock Hauled (truck count, tons)					
Date	Monthly	Cumulative	Monthly	Cumulative	Class 1	Class 2	Class 3		Class 1	Total
	survey (yd^3)	survey (yd^3)	calc. (tons)	calc. (tons)	To Site 23	To Site 23	To Site 23	Total	To Tailings	(less tails haul)
2/3/2003	1,852	419,870	3,135	710752	3,000	2,100	480	5,580	688	4,892
2/28/2003	2,126	421,996	3,599	714351	3510	2904	810	7,224	2,048	5,176
3/31/2003	0	421,996	0	714351	1020	270	390	1,680	1,488	192
4/30/2003	3,506	425,502	5,935	720286	2310	2070	450	4,830	1,390	3,440
6/1/2003	0	425,502	0	720286	210	630	0	840	1,071	-231
7/1/2003	2,064	427,566	3,494	723779	900	150	540	1,590	204	1,386
7/31/2003	1,627	429,193	2,754	726534	777	150	1590	2,517	136	2,381
9/2/2003	0	429,193	0	726534	0	0	1740	1,740	731	1,009
9/30/2003	2,467	431,660	4,176	730710	510	90	960	1,560	731	829
10/30/2003	0	431,660	0	730710	0	0	180	180	221	-41
12/11/2003	2,783	434,443	4,711	735421	1110	2520	1022	4,652	2,064	2,588
12/31/2003	0	434,443	0	735421	180	1140	2610	3,930	1,836	2,094
Totals	16,425	5,133,024	27,804	8,689,135	13,527	12,024	10,772	36,323	12,608	23,715
					919	Class 1 placement (total minus fraction hauled to tailings)				
		Placement percentage by class:			4%	51%	45%			

3.3 Stability

Inspections

Several independent inspections are carried out at Site 23 throughout the year. Operators working at the site carry out daily visual work place inspections. The Surface Civil Engineer and or Surface Operations Manager carry out weekly visual inspections. The environmental department carries out a monthly checklist inspection. No visible signs of physical instability were observed at Site 23 during this report period.

During 2003 the USFS inspected Site 23 approximately 31 times (Site inspections #135-#165) monitoring for Best Management Practices effectiveness and compliance to the General Plan of Operations. No issues of non-compliance or poor operations practices were noted in the inspections. In fact, the USFS inspections typically noted that Site 23 is being developed and operated to required operations and maintenance specifications of GPO Appendix 11.

Slope monitoring

Slope monitoring at Site 23/D consisted of GPS monitoring of 14 survey hubs distributed across the sites. See the Site 23 as-built for hub locations. The resolution was sufficient to identify large potential movement and no such movements were identified.

Well and piezometer water level data

Well and piezometer water level data are provided in Figures 3.1 to 3.12. The lack of significant pressure in piezometers installed close to the base of Site 23 (piezometers 52-55, Figures 3.1 to 3.4) demonstrates that the pile remains free draining. This is consistent with the construction of a network of finger drains under the pile and a blanket drain at the pile toe. See the Site 23 as-built (Appendix 2) for piezometer and finger drain locations. The lack of pore pressure at the toe indicates that pile stability has been maximized. Water levels from several monitoring locations are shown on Section CC of the as-built. The inferred water table is 30 to 60 feet below the base of the production rock pile material up-slope of the Site 23 active placement area and 5 to 20 feet below the base of material placed in Site D and the toe of Site 23, respectively (see also Figures 3.5 to 3.12). Observations from wells completed in the colluvium below the sites indicate that perched water tables and braided flow paths exist beneath the site (e.g compare Figure 3.6 and 3.7). This unit also shows large (up to 10 feet) fluctuations in head levels, which are consistent with perched, confined conditions and channel-like flow. There is a distinct seasonal pattern to the water level fluctuations beneath Site 23/D, particularly in the colluvial unit (Figure 3.9) and the alluvial sands (Figure 3.11).

The silty/clay till that underlies the colluvial unit impedes downward flow and has an upward hydrologic gradient caused by confining the more permeable bedrock below it. MW-23-98-01 (Figure 3.8) is completed in the till unit and indicates a water table near the top of the till, which is approximately 100 feet below the existing topographic surface. Alluvial sands occur between the colluvial unit and the silt/clay till near the toe of Site 23 and under Site D. Data from MW-23-A4 and MW-D-94-D3 (Figures 3.9 and 3.11) indicate that the sands are saturated. A curtain drain installed in between Site D and Site 23 in 1994 collects water that flows at the base of the colluvial unit and the top of the alluvial sands (see as-built and Section CC for locations). This drain helps reduce pore pressures in the foundation of Site D, as well as capturing infiltration waters from Site 23.

3.4 Hydrology

Surface and groundwater are managed using a network of drains, ditches and sediment ponds at both Site D and Site 23. See the Site 23 as-built for locations of these features. Water that is collected in the finger drains beneath Site 23 is routed to Pond 23 along with Site 23 runoff via a lined ditch. Pond 23 also periodically receives stormwater via pipeline from the 920 area. A curtain drain below the toe of Site 23 captures groundwater from the colluvial unit beneath the site and reports to the Pond D wet well via pipelines. Pond D also captures surface water and drainage from seeps near the toe of Site D. Pond D water is returned to the Pond 23 pump station where it is either sent to the mill or down to the Pit 5 water treatment facility.

Monthly temperature and precipitation data are provided in Table 3.2. A total of 59.48 inches of precipitation fell in 2003. The wettest months were September and November with 11.64 and 8.09 inches of precipitation, respectively. The driest month was April (1.16 in). Flow data for Pond D are shown with precipitation in Figure 3.13.

Table 3.2 Monthly Summary of Mill Site Climate Data

Month	Avg Temp (°C)	Precipitation (inches)
January	-0.80	5.76
February	-1.30	1.63
March	-2.00	3.66
April	4.00	1.16
May	7.00	4.09
June	10.20	4.28
July	13.50	2.67
August	12.10	4.63
September	8.50	11.64
October	5.60	5.54
November	-1.90	8.09
December	-1.30	6.33
2003	4.50	59.48

3.5 Water quality

<u>Compliance Monitoring</u>

Water sites around the Site 23/D production rock storage area have been monitored for various periods. Sites have been added and deleted over time as rock storage area development required. Monitoring under the revised FWMP schedule and sites began with October 2002 sampling, the first month of water year 2003. The full FWMP Annual Report for water year 2003 is being prepared separately and will be submitted to the Forest Service and ADEC upon completion.

<u>Internal Monitoring</u>

In May 2001 Kennecott Greens Creek Mining Company (KGCMC) submitted an Internal Monitoring Plan to the Alaska Department of Environmental Conservation – Solid Waste Management Program. This submittal satisfied Section 2.8.3.1 of the KGCMC Waste Disposal Permit Number 0111-BA001.

As described in permit Section 2.8.3.1, the internal plan addressed monitoring at both the surface tailings facility and the surface production rock storage areas covered by the permit. The Internal Monitoring Plan describes monitoring within the pile areas, in contrast to the compliance monitoring (under the Fresh Water Monitoring Plan) at peripheral facility boundary sites. As such, data generated by the Internal Monitoring Plan effort are "… not for compliance purposes…" as noted in the above referenced permit Section 2.8.3.1.

Waters represented by the internal monitoring sites are captured, routed to the mill or tailings facility and treated prior to discharge to the ocean floor under KGCMC's National Pollutant Discharge Elimination System Permit (AK 004320-6).

Operationally for KGCMC, the production rock Site 23 and the adjacent production rock Site D are treated as a single entity, primarily due to their conterminous positions making isolation from one another unpractical. Consequently, they are operated and referred to as Site 23/D in this report.

The results of KGCMC's Site 23/D internal site monitoring plan are summarized in Figures 3.14 to 3.25. Sites were distinguished between finger drains and ground water. These groups are separated on the Figures 3.14 through 3.24 with the suffix a or b. For example, a figure number such as 3.14a would show the data for the finger drains, and 3.14b would show the data for the ground water. Sample collection from the Site 23 finger drains is dependent upon their flow. Flow from several of these finger drains is very irregular, responding directly to precipitation-induced infiltration and groundwater fluctuations (Figure 3.25). Monthly sampling of the flowing drains has identified the typical range of concentrations of constituents in the drain waters. KGCMC reduced the frequency of sampling to quarterly for all internal monitoring sites starting in 2003.

Figure 3.14a shows the pH of waters collected from Site 23 Finger Drains 2 through 8, and Figure 3.14b shows the pH of monitoring wells MW-23-A2D, MW-23-A4, MW-D3 and Pond D (see as-built in Appendix 2 for locations). Values of pH were between 6 and 8.5 for all internal monitoring site samples in 2003. The lower pH values (generally pH 6 to 7) were recorded in MW-23-A4 and MW-D3, both of which are completed in alluvial sands beneath Site 23 and Site D, respectively. MW-23-A2D, which screens colluvium up-gradient of Site 23 typically has the highest pH (generally pH 7.0 to 8.0). The Site 23 finger drains fluctuate at values between those of the monitoring wells. Figure 3.14a and b suggest that waters from different foundation units have different pH values and that Site 23 and Site D contact waters and the materials with which they are in contact exhibit sufficient buffering capacity to prevent acidification of site drainage in the near term. Seasonal fluctuations are apparent in the finger drains with highest pH values occurring in winter months and lower pH in mid to late summer.

As with pH, high alkalinity values (Figure 3.15a and b) indicate that the waters are well buffered. Fluctuations in alkalinity correlate with those of other parameters, such as hardness (Figure 3.16a and b) and conductivity (Figure 3.17a and b), and appear to be seasonal. Carbonate minerals in the production rock contribute to the high alkalinity of the drainage from the finger drains. Alkalinity is lowest in samples with the highest groundwater component (e.g. the monitoring wells, D Pond, 23FD-5 and 23FD-7). Calcium and magnesium are the primary contributors to hardness (Figure 3.16a) and reflect dissolution of carbonate minerals, such as calcite and dolomite. Carbonate dissolution neutralizes acidity formed by sulfide oxidation, which is also the source of sulfate shown in Figure 3.18a.

Conductivity results from internal monitoring site waters are presented in Figure 3.17a and b. 2003 conductivity measurements range up to 5020 uS/cm. MW-23-A2D and MW-D3 have the lowest conductivity. MW-D3 is completed in alluvial sands below the fill placed at Site D. The finger drains with the highest flow (e.g. 23FD-5, which directly drains an excavated spring) have the lower conductivities than the drains with lower flow. This reflects a larger contribution from groundwater to the high-flow drains relative to a higher proportion of site contact water in the other finger drains. The significant decrease in conductivity in 23FD-7 that occurred in 2000 is probably the result of incorporation of groundwater collected in the upper portion of the drain above the active placement area. The presence of contact water in the alluvial sand below Site 23 (as seen in MW-23-A4) is not surprising given the permeable nature of the colluvium that lies immediately beneath the site. A clay till layer underlies the colluvium and alluvial sands beneath the site. The clay till acts as a barrier to downward flow, however as discussed earlier, it occurs well below the base of both piles.

The fact that MW-D3 does not show signs of a contribution from contact water suggests that an upward hydrologic gradient may exist beneath Site D. Finger Drain 23FD-2 has the highest conductivity but consistently low flow, suggesting no significant influence from groundwater. This drain may also be influenced by runoff that infiltrates along the access ramp to the site. The higher conductivity of the site contact waters reflects a larger dissolved load caused by weathering of the production rock. As with tailings, pyrite oxidation and carbonate dissolution contribute dissolved ions such as sulfate, bicarbonate, calcium and magnesium to the contact waters, increasing their conductivity. Sulfate concentrations for the finger drains are plotted in Figure 3.18a and match closely the relative value patterns of conductivity.

Arsenic data are presented in Figure 3.19a and b and are generally quite low. All finger drains and MW-23-A4 experienced increases in their arsenic concentrations in September, with subsequent decreases to historical levels in October. The flows in the finger drains positively correlate with these changes. Fluctuations in arsenic values in 23FD-2 are likely due to changes in redox conditions. Low arsenic and iron concentrations indicate that these metals are precipitating as oxyhydroxides on rock surfaces inside the pile.

Figure 3.20a and b shows the concentration of zinc in the internal monitoring locations at Site 23/D. Zinc levels appear to be controlled by seasonal conditions. The changes in zinc concentrations mimic those for conductivity and sulfate. 23FD-2 had a zinc concentration of approximately 70 mg/l in June 2002. In 2003, the zinc concentration averaged 20 mg/l. Zinc concentrations in the range of 20 to 70 mg/l are consistent with kinetic weathering tests performed on samples of argillite and serpentinite (Vos 1993). The zinc concentrations recorded for Pond D are generally below 0.7 mg/l and reflect contributions from several source waters. Pond D receives water from Site D surface runoff, seeps on the slope and at the toe of the site and the effluent from the curtain drain that KGCMC installed between Site D and Site 23.

Cadmium concentrations (Figure 3.21a and b) correlate well with those of zinc for the internal monitoring sites although at much lower values (0 to 35 ppb).

The concentrations of copper and lead (Figures 3.22a and b and 3.23a and b) are considerably lower than that of zinc in the Site 23/D internal monitoring sites. Both of these metals show the same general trends as zinc with the exception of one anomalous lead result in a sample from 23FD-2 in 1999. The nickel concentrations presented in Figure 3.24a and b support the observation that the drainage from 23FD-2 is different than that of other drainages. It is possible that the material that supplies water to this drain has a greater proportion of serpentinite, which was shown to produce higher zinc and nickel concentrations than other rock types such as argillite and phyllite (Vos 1993). What appeared to be a linear increase in nickel concentrations in 23FD-2 prior to 2002 now appears to be decreasing or at least cyclical.

Acid Base Accounting Data

Acid base accounting (ABA) results from 46 underground composites are presented in Table 3.3 and Figure 3.26. Class 1 samples had an average neutralization potential (NP) of 353 tons $CaCO_3$/1000t, which is equivalent to 35% carbonate. The Class 1 samples had an average acid potential (AP) of 71 tons$CaCO_3$/1000t, which produced an average net neutralization potential (NNP) of 282 tons $CaCO_3$/1000t. Class 1 production rock does not have the potential to generate acid rock drainage, however the potential for metal mobility (primarily zinc) from argillite does exist. KGCMC recognizes this characteristic of Class 1 production rock and handles the material accordingly by placing it in controlled facilities, such as Site 23 and the tailings area.

Class 2 production rock samples had a moderate average NP value (255 tons$CaCO_3$/1000t) and an average AP of 222 tons$CaCO_3$/1000t. The resulting average NNP for the Class 2 samples was 33. Class 3 samples had an average NP, AP and NNP of 214, 253 and -39 tons$CaCO_3$/1000t, respectively. Negative values for NNP indicate that the materials are potentially acid generating, thus requiring appropriate ARD control measures. Carbonate in the Class 2 and Class 3 production rock prevents ARD formation in the short term, allowing time for placement of a composite soil cover to be constructed during reclamation. The soil cover is designed to inhibit ARD formation by minimizing oxygen and water infiltration into the underlying production rock. Class 4 samples produced an average NNP of -180 tons$CaCO_3$/1000t, which is within the range for Class 3 material (-100 to -300 tons$CaCO_3$/1000t). Class 4 material is retained underground.

Figure 3.26 compares actual class designation based on ABA analyses to the results of visual designation use underground to classify the production rock. Of the 46 composites, visual classification assigned only 2 samples (4%) to a lower, less conservative class. 35 (76%) of the composites were assigned to the appropriate class and 9 (20%) to a higher, more conservative class. These data represent a 96% success rate for the visual classification program.

Table 3.3 Acid Base Accounting Data Summary for Underground Rib Samples and Site 23

	Class 1		**Class 2**		**Class 3**		**Class 4**
	Site 23	Rib Sample	Site 23	Rib Sample	Site 23	Rib Sample	Rib Sample
NP	337	353	265	255	180	214	145
AP	83	71	204	222	268	253	324
NNP	254	282	61	33	-88	-39	-180

Notes:
Values are averages from 46 samples for Rib samples, and 8 samples for Site 23
ABA units are tons $CaCO_3$/1000t
NP determined by standard Sobek method
AP determined from iron assay (converted to pyrite equivalent)

Table 3.3 and Figure 3.27 shows the ABA data from surface sampling at Site 23 and the Site D interim soil cover. The AP to NP distribution in the Site 23/D samples is similar to the underground rib samples. Many of the samples at Site 23 were taken near the boundaries of the classification areas, and may be more representative of a mixture of classes. Therefore some of the data points do not fall neatly into the classification areas on the graph.

During the grid sampling of Site 23 and Site D, 32 rinse pH measurements were taken. None of the samples had a rinse pH value less than 6.0. Currently drainage from this area is collected and pumped to the Pit 5 water treatment facility. The distribution of pH and NNP (Figure 3.28) illustrates that alkaline conditions persist at both sites. The difference between paste pH and rinse pH is due to different preparation methods. The paste pH is typically higher than rinse pH because the sample is pulverized, which tends to expose fresh mineral surfaces. The rinse pH method uses more water, which can dissolve oxidation products and lower the test solution pH.

3.6 General site management

The construction method used at Site 23 (bottom-up construction) limits the site's complexity. All placement activity in 2003 occurred between the 960 and 990 levels of the pile. Designated placement zones are marked on the active lift of the site and production rock is placed according to class. Class 2 and Class 3 materials are placed five and ten feet, respectively, from the outer edges of the pile. Class 1 can be place anywhere in the pile but is most often used to provide the thickness required to maintain the five-foot zone between the outer surface and the Class 1-2 placement zone interface. See Section 3.7 for photographic presentations of designated placement zones.

In 2002 KGCMC continued to raise the west portion of the pile where the access ramp reaches the active placement surface. This will facilitate construction of a switchback in the access ramp, which would allow a reasonable grade access route to the crest of the pile design capacity.

No significant changes to the slope above Site 23 were made in 2003, and routine inspections revealed no problems associated with management of the site.

In the 2002 annual report, KGCMC proposed modifying the placement procedures at Site 23 to minimize physical discontinuities between placement zones and to maximize the beneficial use of Class 1 material (KCGMC 2003). The modifications were not implemented in 2003, pending comments and regulatory approval.

3.7 Site as-built

An as-built for Site 23/D is presented in Appendix 2. The as-built shows the year-end topography, water management features, monitoring device locations, and other significant features of the site. The as-built also includes cross sections that show the following information:

- existing topographic surface
- prepared ground upon which the pile was constructed
- original unprepared ground
- fill design level

The cross sections will be updated and discussed in greater detail in the 2004 annual report based on the findings of the EDE Site 23/D Hydrogeology and Geochemistry Analysis report, to be completed in 2004.

Figures 3.29 through 3.31 show photographs of the Site 23 designated placement zones (Class 1, Class 2, and Class 3). Figure 3.32 is a photograph of sediments that have been removed from the desilting basins for disposal at Site 23.

3.8 Reclamation

KGCMC has monitored the performance of a one-acre composite soil cover plot on Site 23 since September 2000 (see Site 23 as-built in Appendix 2 for plot location). Key performance aspects of the cover system include:

- The monitoring indicates that the primary objective of maintaining at least 85% saturation in the compacted barrier layer of the cover has been met. In fact, saturation appears to have stabilized at about 95 percent. This is significant because maintaining water saturation in the barrier layer minimizes oxygen transport into the underlying production rock, the key barrier layer performance criteria.

- Of the 230 inches of precipitation that fell since the lysimeter collection system was installed, approximately 40 inches of percolation into the lysimeter has been recorded. The cover system appears to have allowed approximately 18 percent of the incident precipitation into the lysimeter. Late in 2002 a lined cutoff trench was installed above the cover plot and bentonite was applied around the access tube to the lysimeter. Data collected in 2003 suggest that these maintenance activities had little effect on amount of water draining from the lysimeter. Installation of a temporary plastic cover over the capture area of the lysimeter is planned for 2004.

- The temperature in the barrier layer throughout this monitoring period has again remained above 32°F, which implies that the barrier layer is not subjected to freeze/thaw cycles.

- Malfunction of the neutron moisture probe and the lysimeter tipping bucket decreased the data capture from the 20 monitoring instruments to about 60%.

- Despite experiencing a measurable earthquake and intense rain, the cover showed no signs of erosion or slope instability, and thus no repair costs were incurred. The reclamation plan however does allow for cover maintenance, which to date has not been required. This is a positive result with respect to the structural integrity of the cover, which currently does not have a buttressed toe. Full-scale cover placement will include toe support.

<u>Reclamation Plan</u>

The KGCMC Reclamation Plan, as well as its implementation is discussed above in Section 2.8 Tailings of this report. Please refer to that discussion for aspects relevant to Site 23/D area reclamation.

4.0 References

Environmental Design Engineering (EDE), 2002a, Kennecott Greens Creek Mining Company Stage II Tailings Expansion Hydrologic Analysis, February 5, 2002.

Environmental Design Engineering (EDE), 2002b, Kennecott Greens Creek Mining Company Stage II Tailings Expansion Geochemistry Report, February 5, 2002.

Kennecott Greens Creek Mining Company (KGCMC), 2002 Update of Information and Action Plan on Seeps West of the Current Tailings Disposal Facility, January 2002.

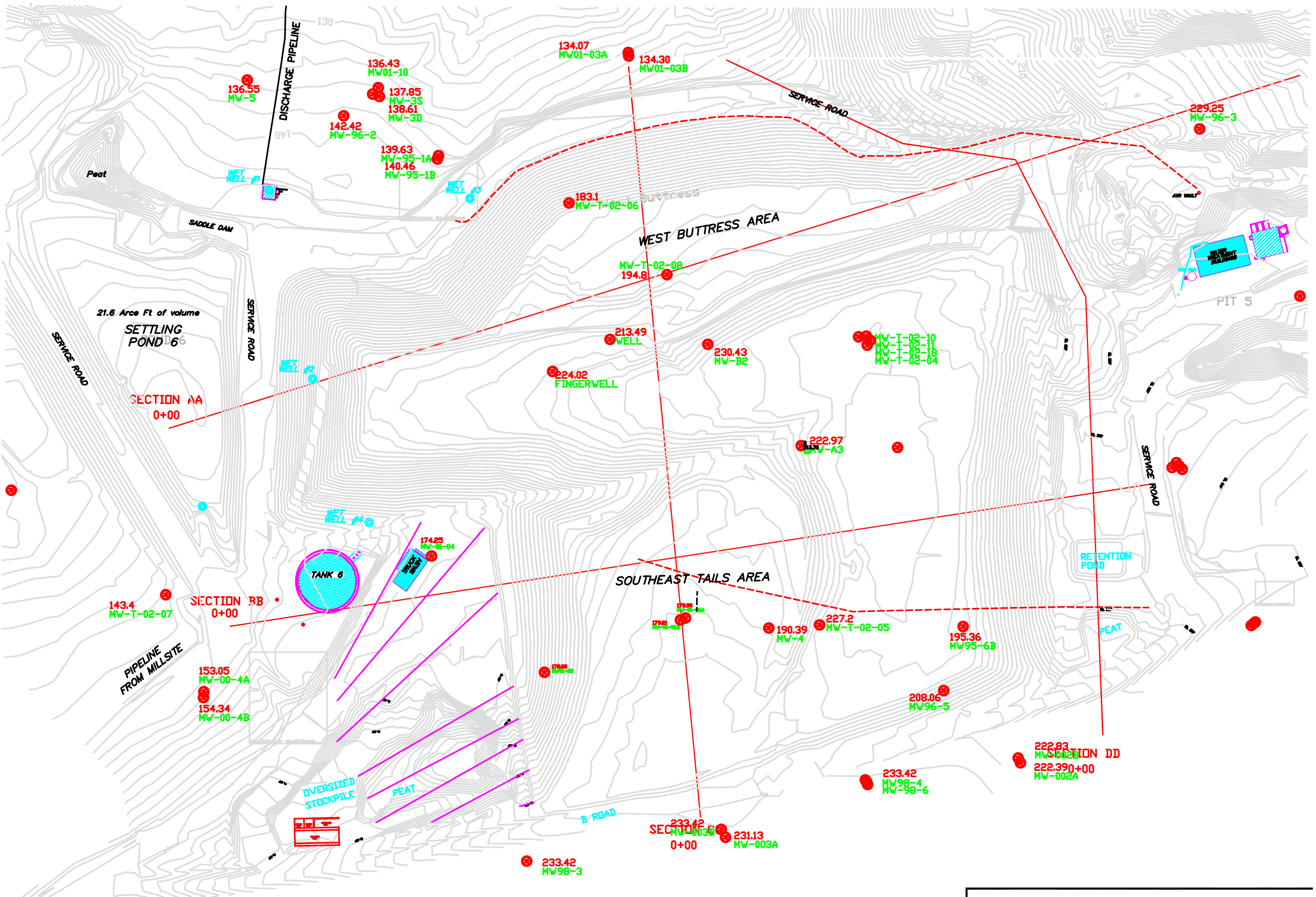
Klohn Crippen, 2002, Existing Tailings Facility Southeast Expansion Construction Summary, November, 2002.

O’Kane Consultants Inc. (O’Kane), 2001, Cover System Performance at the Kennecott Greens Creek Mine, Report # 678-01, December, 2001.

Vos, R.J., 1993, Weathering Characteristics of Waste Rock From Admiralty Island Deposit (23 Month Report, B.C. Research Inc., July, 1993.

APPENDIX 1

Tailings Facility 2003 As-built and Cross Sections



LEGEND:

EXISTING GROUND

EXISTING ROADS

CROSS SECTIONS

KENNECOTT GREENS CREEK MINE

ADMIRALTY ISLAND, ALASKA

PLATE 1-1

2003 TAILINGS FACILITY

AS BUILT

DATE: 12-31-03

DRAWING BY: Shelby Edwards

DESIGN BY: ----

REVIEWED BY: ----

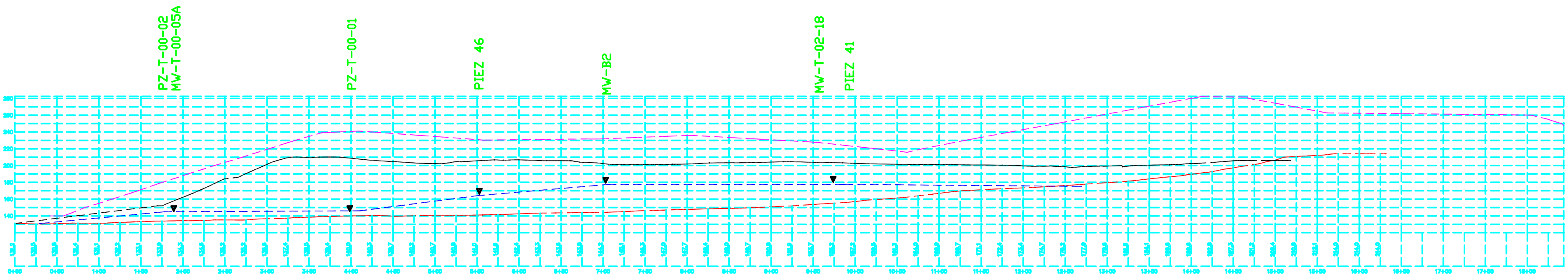
PROJ OR REF. ----

PREPARED BY:
GREENS CREEK MINING CO.
JUNEAU, ALASKA
PHONE: (907)790-8441 FAX: (907)789-8448

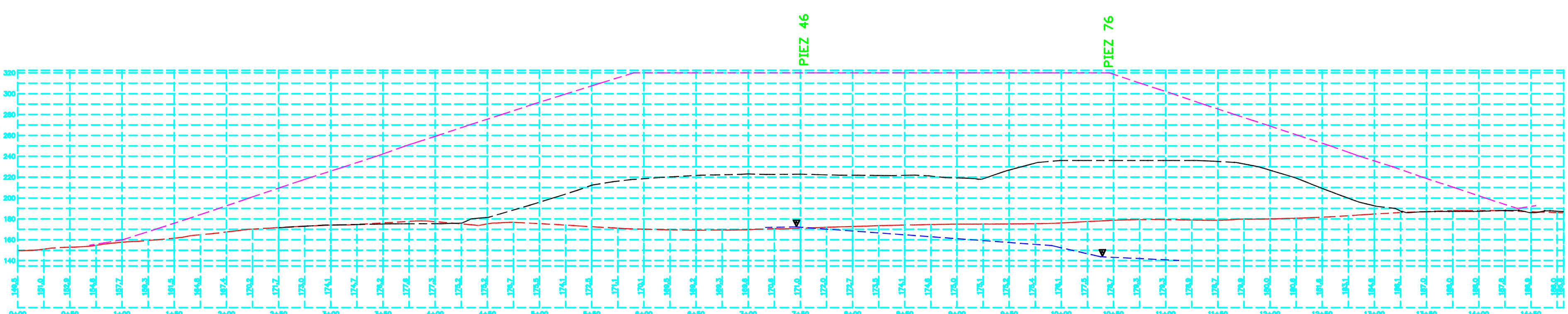
GCMC DWG #

SCALE: not to scale

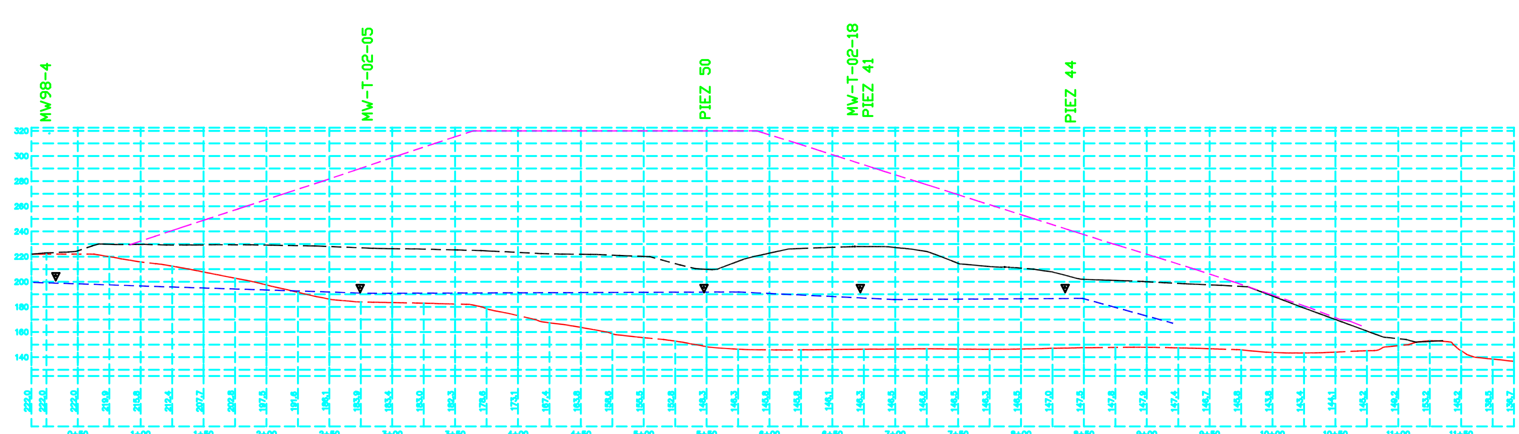
SHEET: 1 OF 1



DATUM ELEV
AA



DATUM ELEV
BB



DATUM ELEV
CC

LEGEND:

DESIGN PLAN

WATER TABLE

EXISTING GROUND

EXISTING ROADS

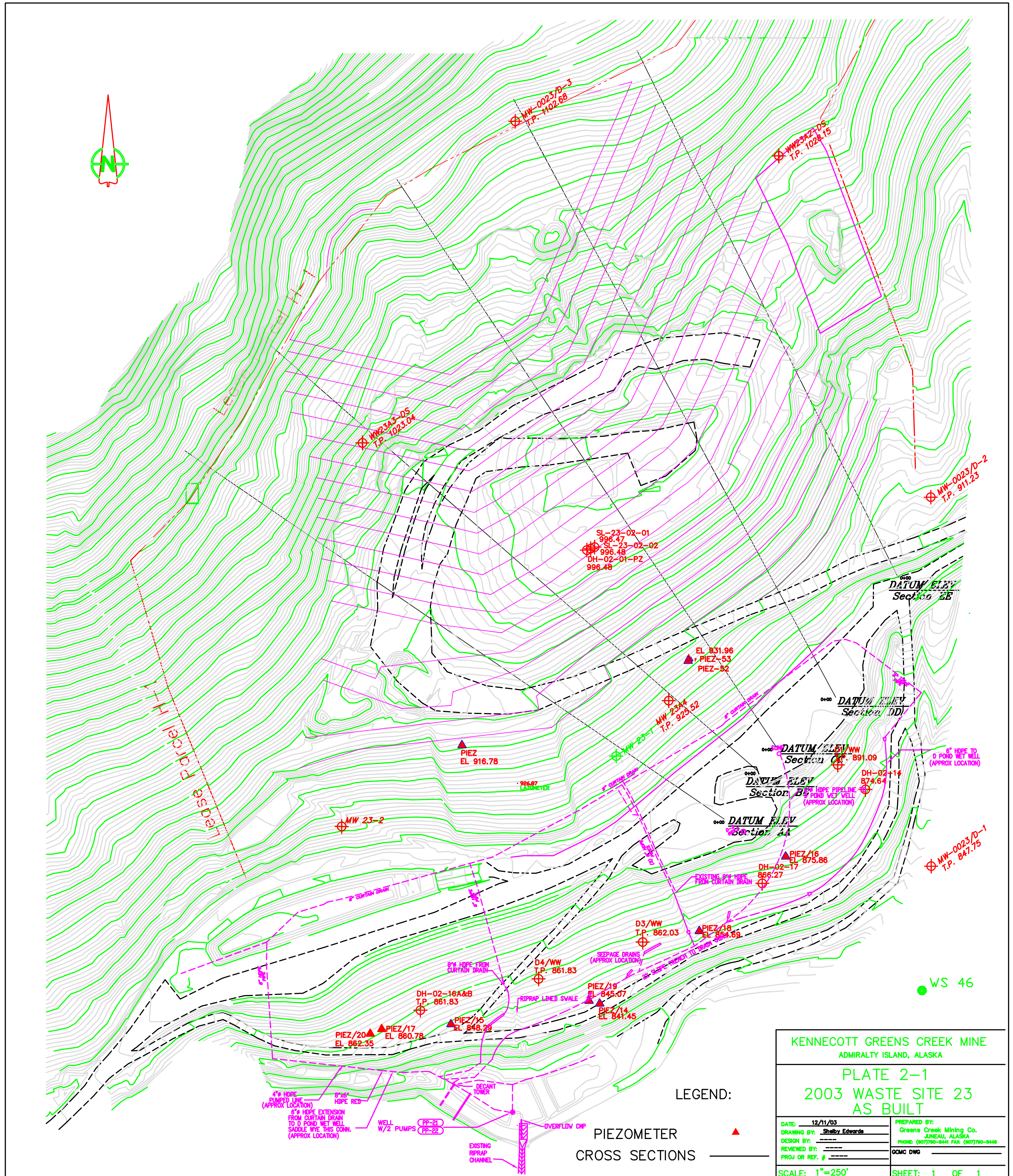
KENNECOTT GREENS CREEK MINE
ADMIRALTY ISLAND, ALASKA

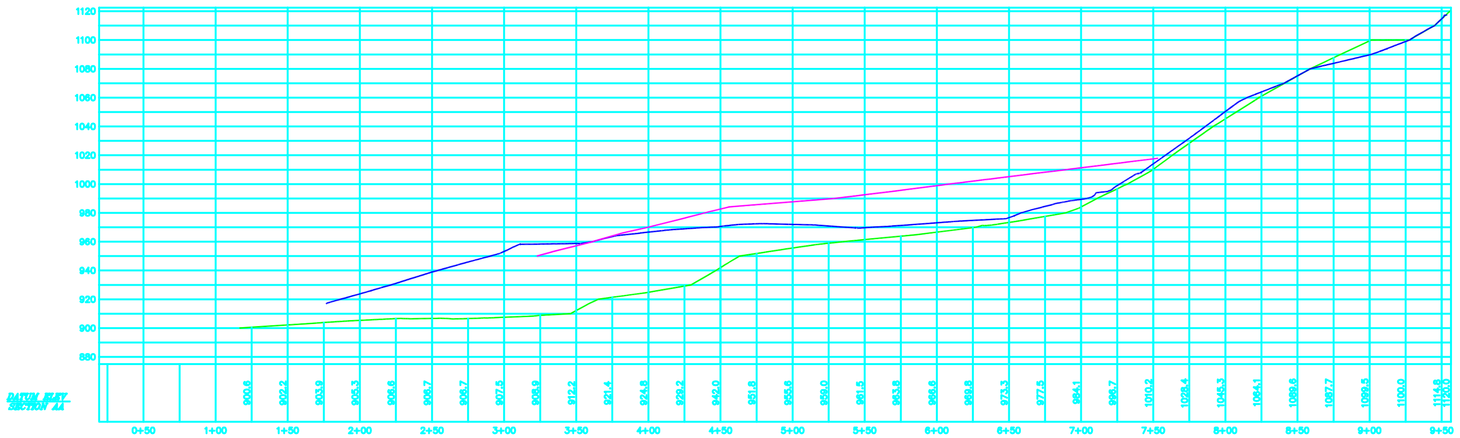
PLATE 1–2
2003 TAILINGS FACILITY
AS BUILT CROSS SECTIONS

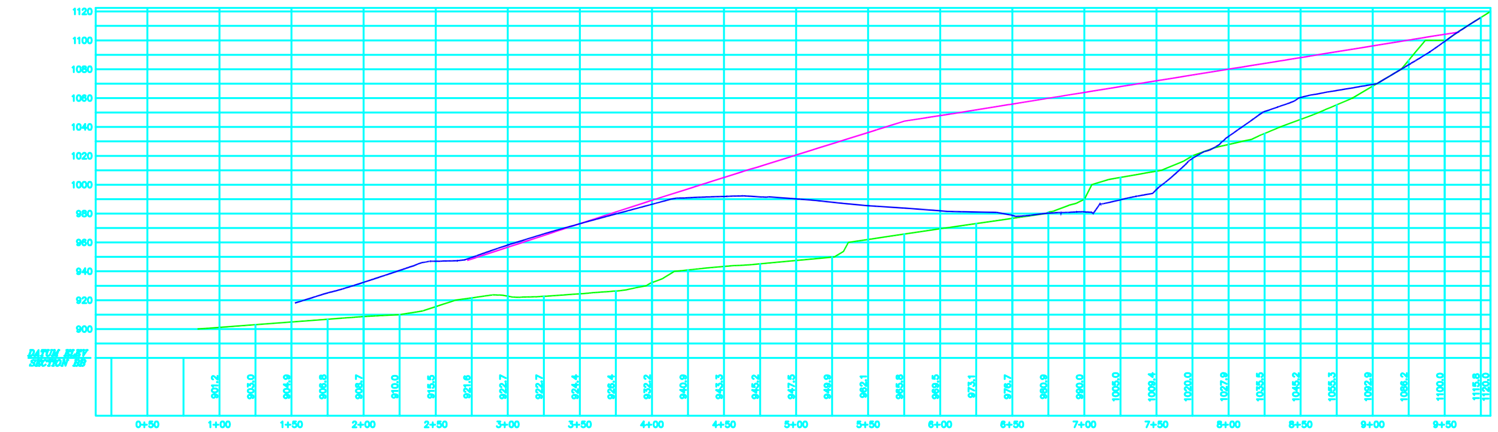
DATE: 12-31-03	PREPARED BY: GREENS CREEK MINING CO. JUNEAU, ALASKA PHONE: (907)790-8441 FAX: (907)789-8448
DRAWING BY: Shelby Edwards	
DESIGN BY: ----	
REVIEWED BY: ----	GCMC DWG #:
PROJ OR REF. ----	
SCALE: not to scale	SHEET: 1 OF 1

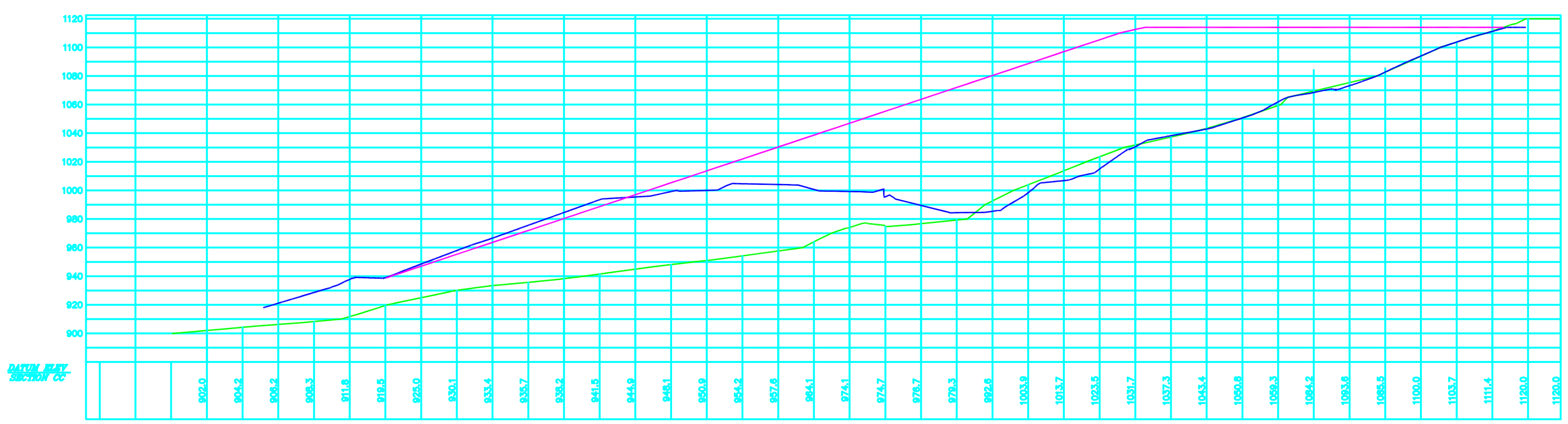
APPENDIX 2

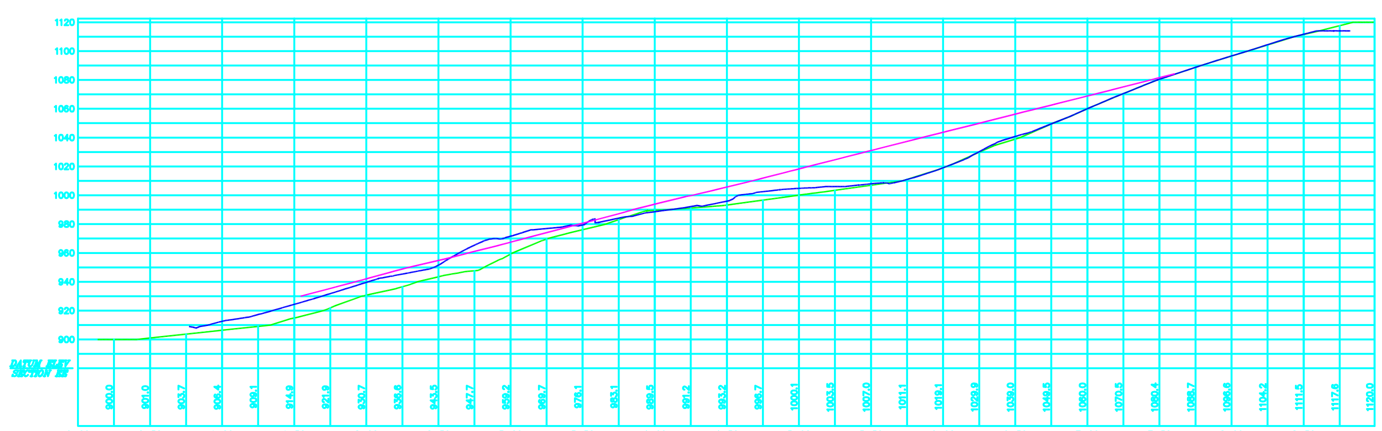
Site 23/D 2003 As-built and Cross Section


KENNECOTT GREENS CREEK MINE
ADMIRALTY ISLAND, ALASKA
PLATE 2-1
2003 WASTE SITE 23
AS BUILT
DATE: 12/11/03
DRAWING BY: Shelby Edwards
DESIGN BY: -----
REVIEWED BY: -----
PROJ OR REF. # -----
PREPARED BY:
Greens Creek Mining Co.
JUNEAU, ALASKA
PHONE: (907)790-8441 FAX: (907)790-8448
GCMC DWG
SCALE: 1"=250'
SHEET: 1 OF 1
LEGEND:
PIEZOMETER
CROSS SECTIONS
WS 46
Lease Parcel H
MW-0023/D-3
T.P. 1102.68
MW23A2-DS
T.P. 1028.15
MW23A3-DS
T.P. 1023.04
MW-0023/D-2
T.P. 911.23
MW-0023/D-1
T.P. 847.75
MW 23-2
PIEZ
EL 916.78
EL 931.96
PIEZ-53
PIEZ-52
DATUM ELEV
Section EE
Section DD
Section CC
Section BB
Section AA
PIEZ/16
EL 875.86
DH-02-17
PIEZ/18
D3/WW
T.P. 862.03
D4/WW
T.P. 861.83
DH-02-16A&B
T.P. 861.83
PIEZ/19
PIEZ/14
PIEZ/15
PIEZ/17
EL 860.78
PIEZ/20
EL 862.35
RIPRAP LINED SWALE
OVERFLOW CMP
EXISTING RIPRAP CHANNEL
DECANT TOWER
WELL W/2 PUMPS
PP-21
PP-22









NOTE: The Site 23 Cross Sections will be updated and discussed in greater detail in the 2004 report. The updates and discussion will be based on the findings of the EDE Site23/D Hydrogeology and Geochemistry Analysis, to be completed in 2004.

LEGEND:		
EXISTING GROUND	KENNECOTT MINERALS	KENNECOTT GREENS CREEK MINING CO. P.O. BOX 32199 JUNEAU, ALASKA 99803 PHONE: (907)790-8441 FAX: (907)790-8448
3T01 FILL DESIGN	DATE: 4-9-03	TITLE: PLATE 2-2 Site 23 Cross Sections 2003
ORIGINAL UNDISTURBED GROUND	DRAWING BY: Shelby Edwards	
	DESIGN BY: ----	
	REVIEWED BY: ----	SHEET: 1 OF 1
	PROJ OR REF. ----	

APPENDIX 3

Data Figures

FIGURE 2.1 WATER LEVEL DATA FOR PIZOMETER 41

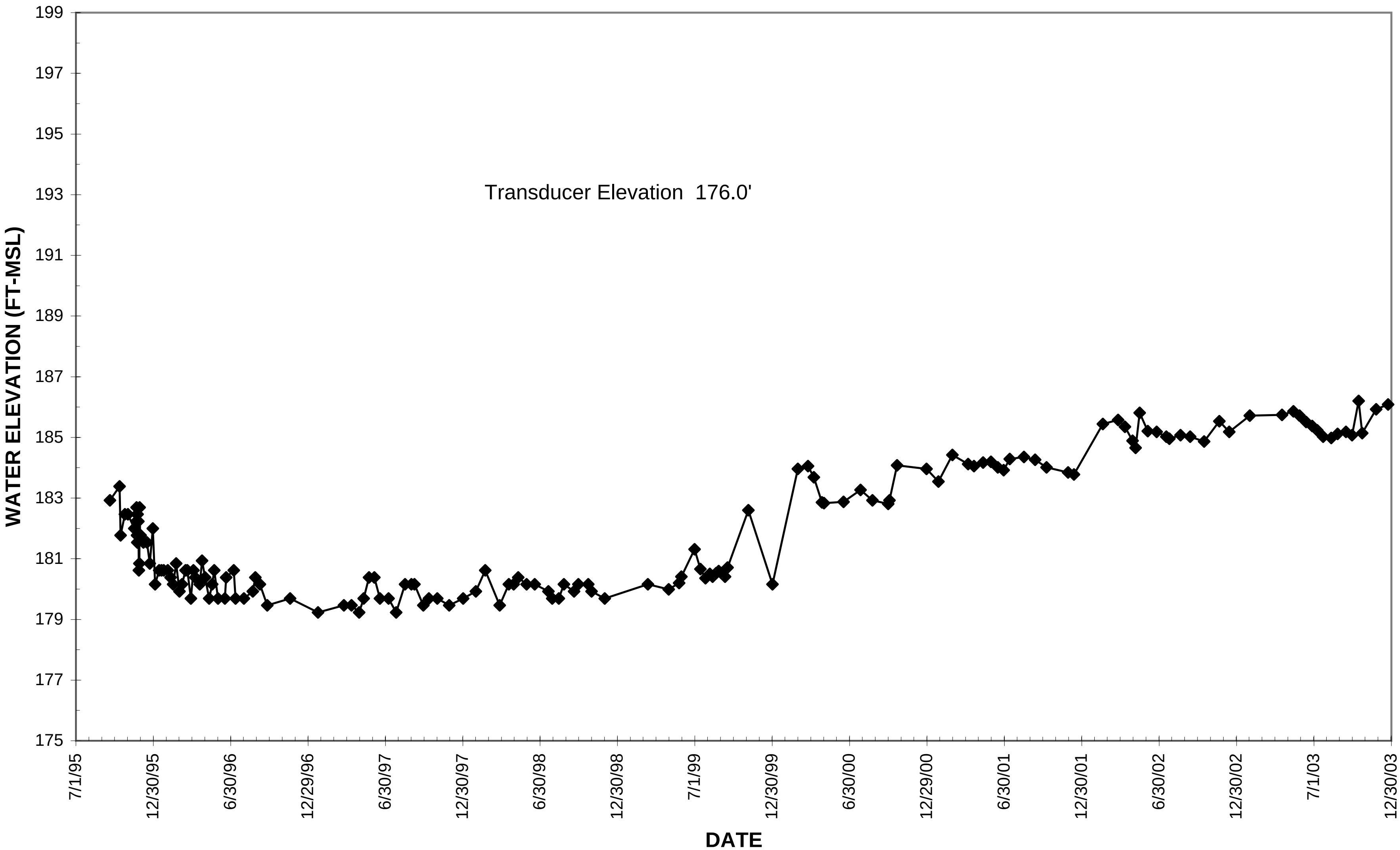


FIGURE 2.2   WATER LEVEL DATA FOR PIZOMETER 42

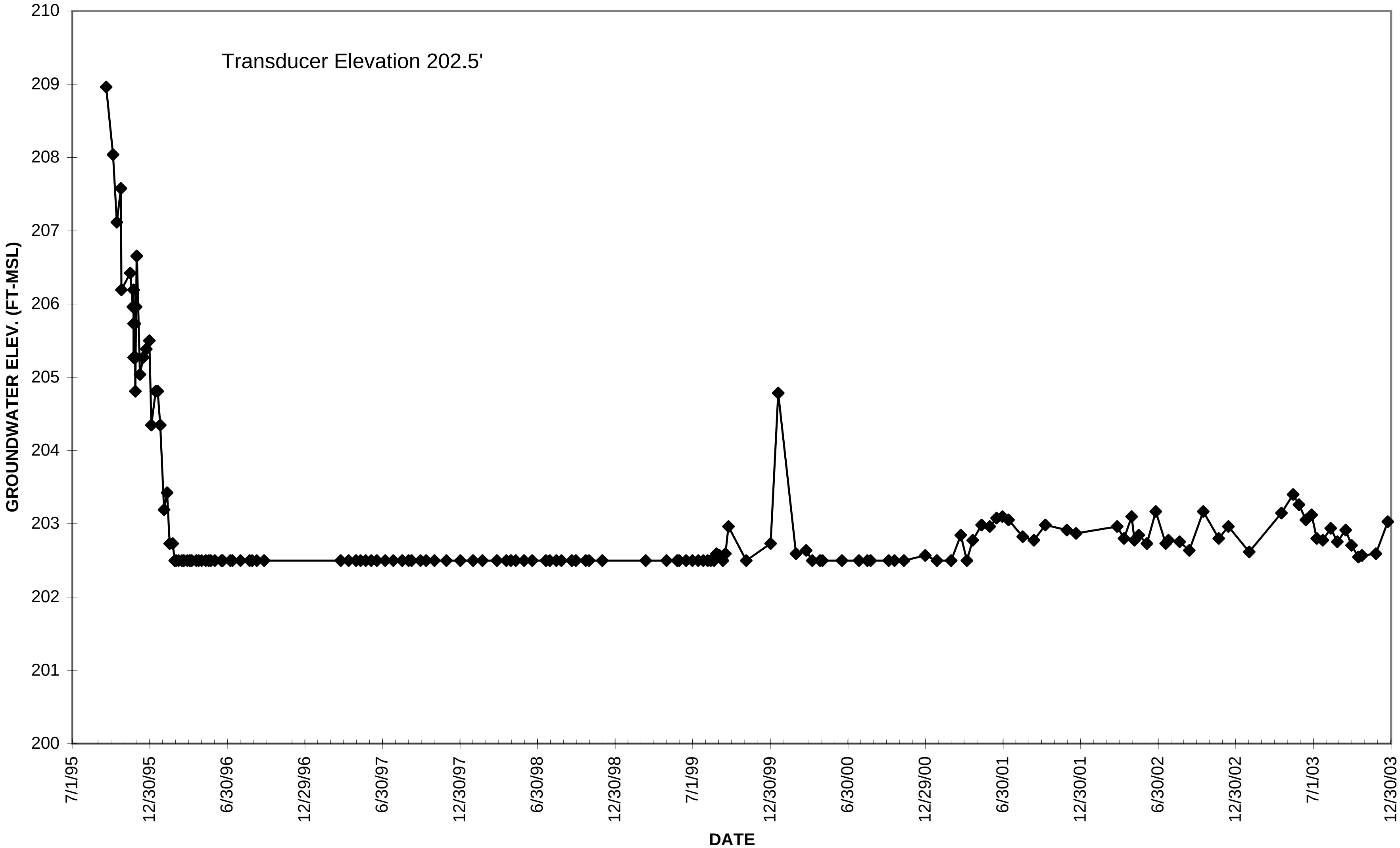


FIGURE 2.3 WATER LEVEL DATA FOR PIZOMETER 44

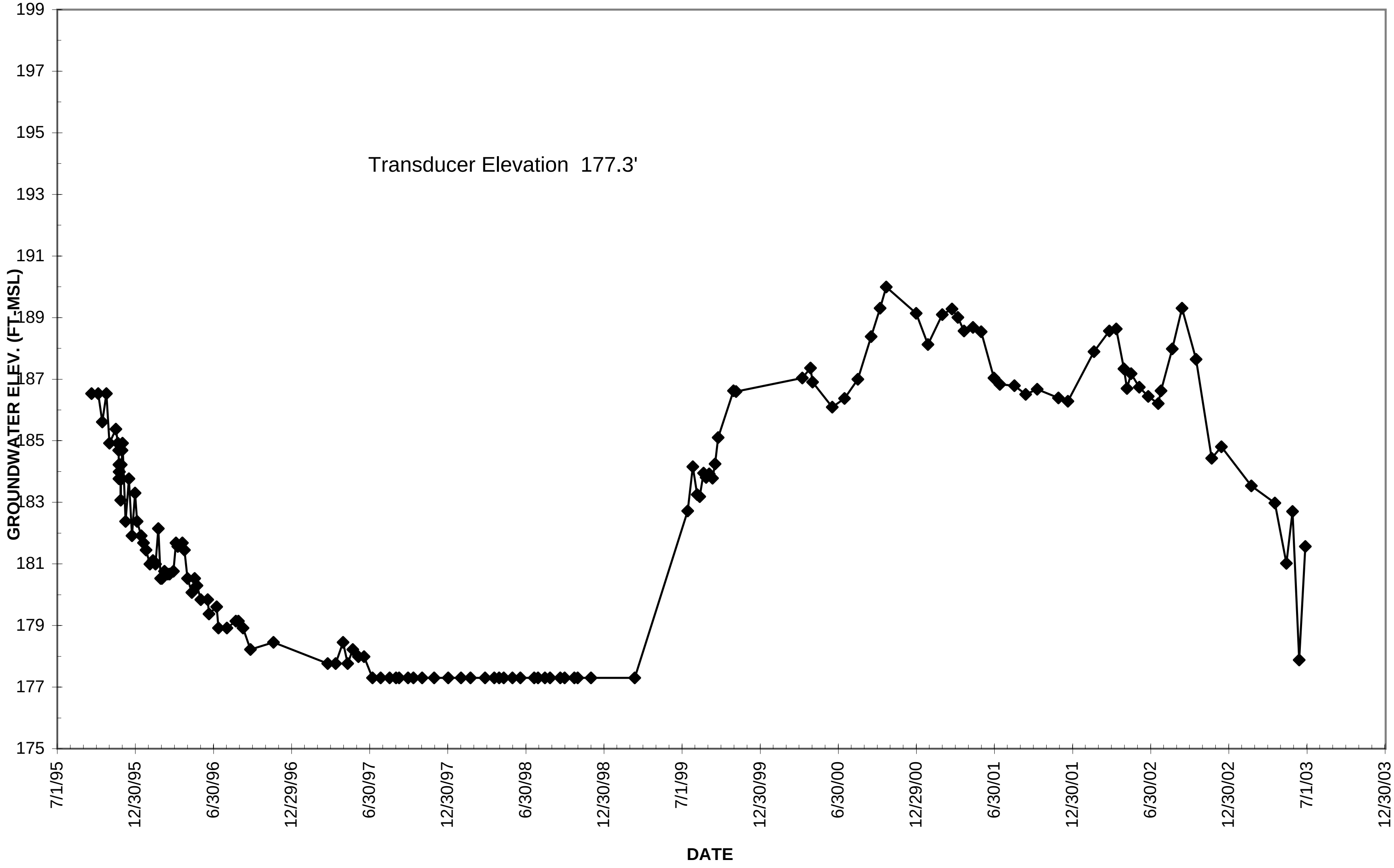


FIGURE 2.4 WATER LEVEL DATA FOR PIZOMETER 46

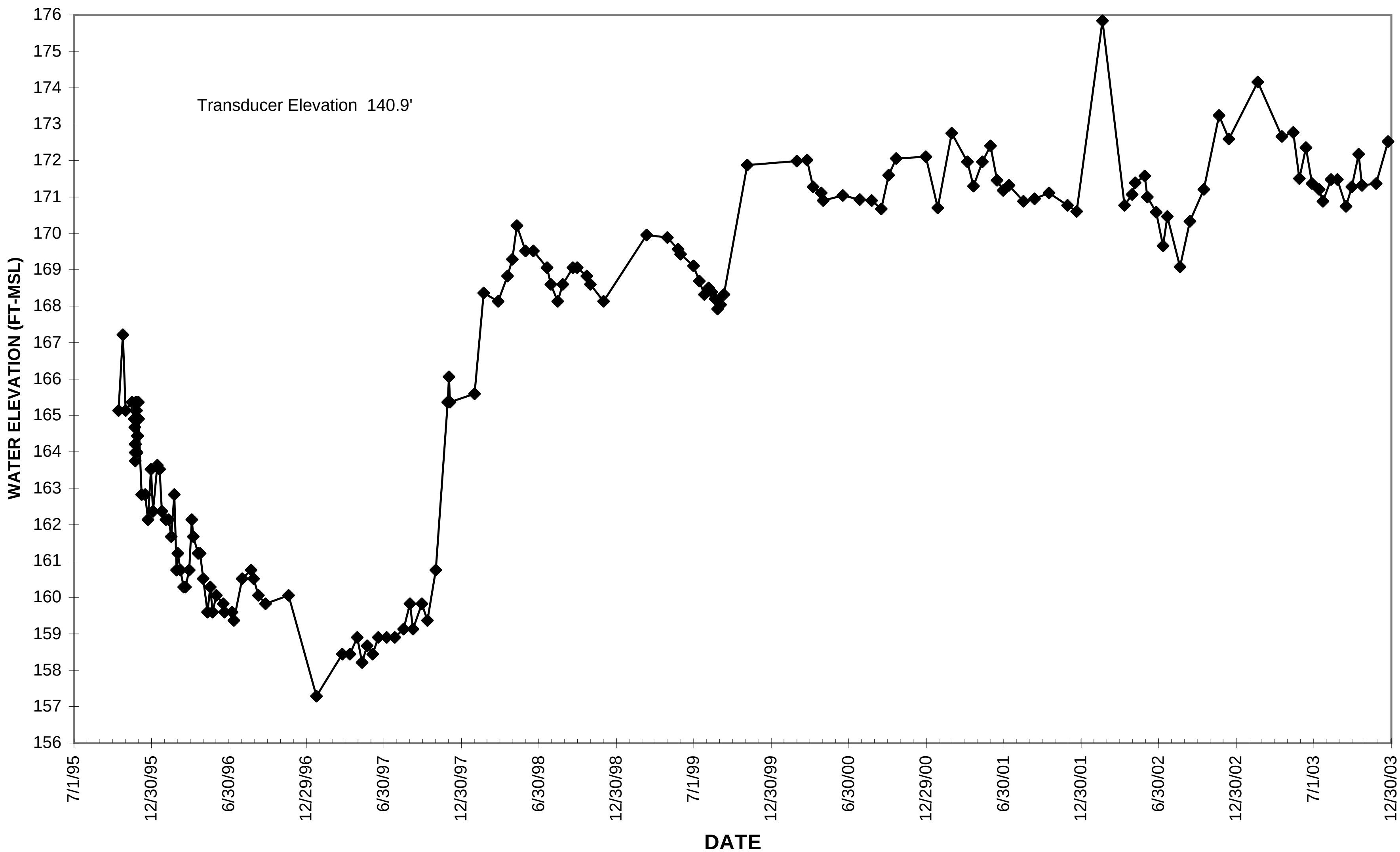


FIGURE 2.5 WATER LEVEL DATA FOR PIZOMETER 47

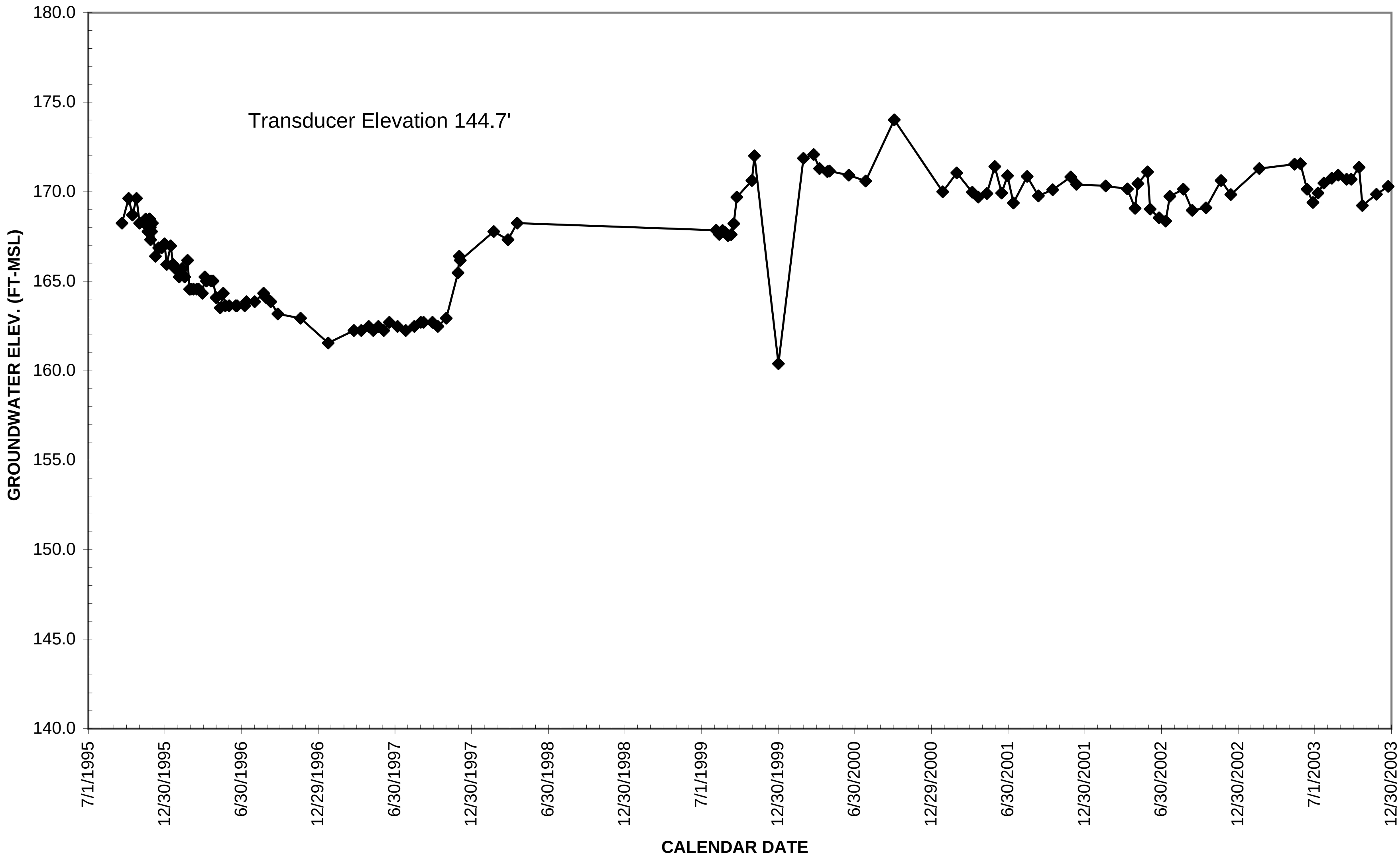


FIGURE 2.6   WATER LEVEL DATA FOR PIZOMETER 50

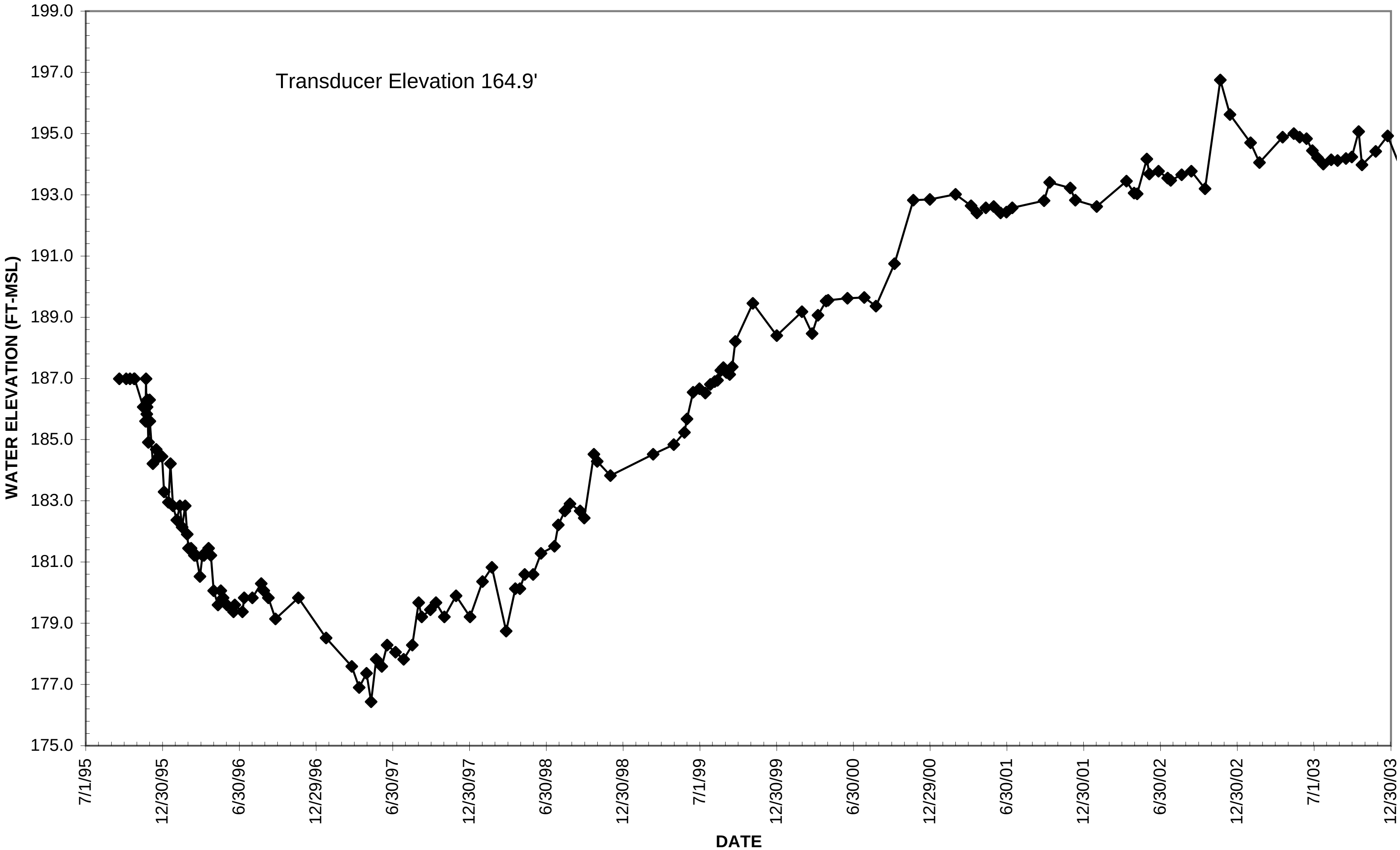


FIGURE 2.7 WATER LEVEL DATA FOR PIZOMETER 51

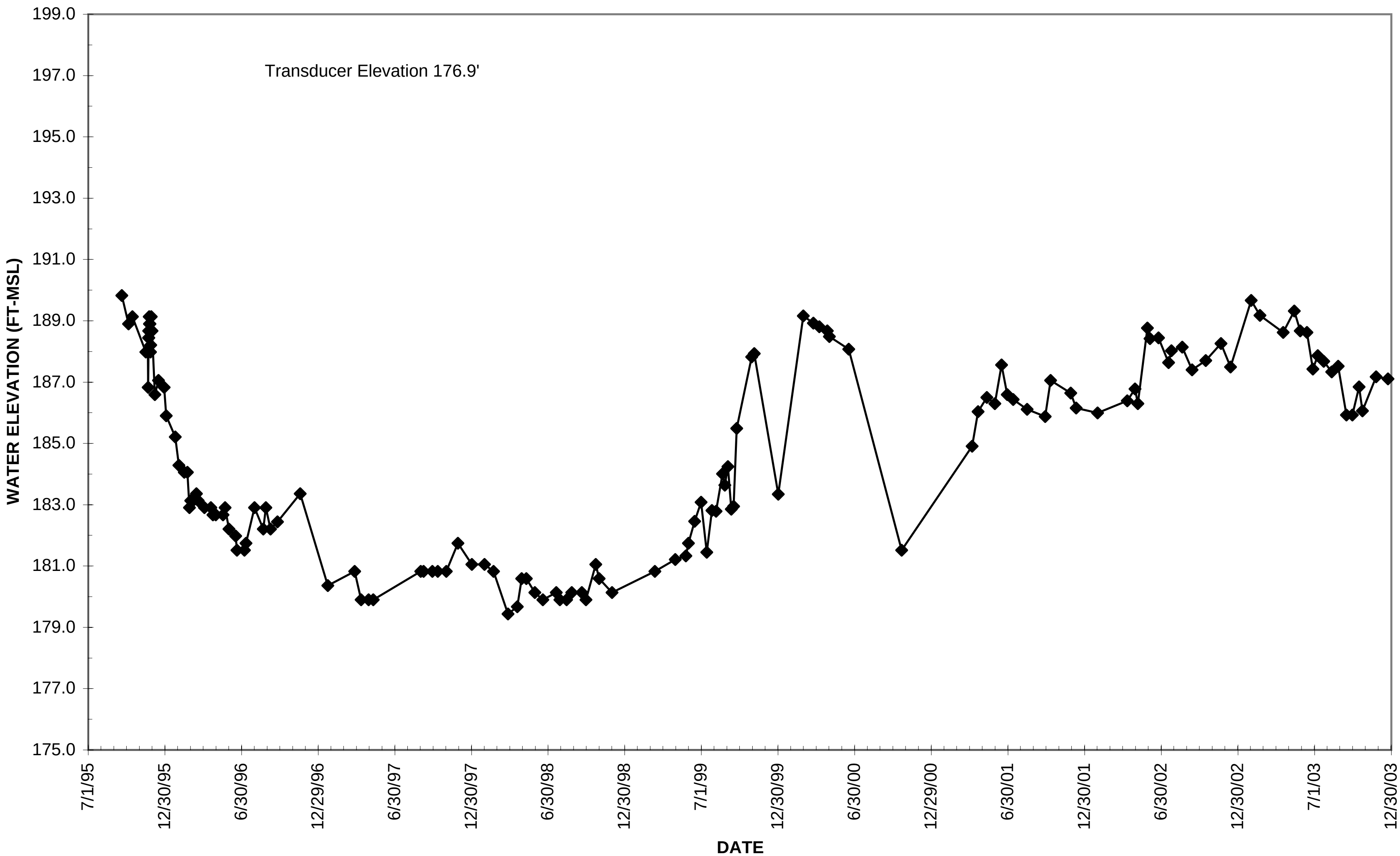


FIGURE 2.8   WATER LEVEL DATA FOR PIZOMETER 74

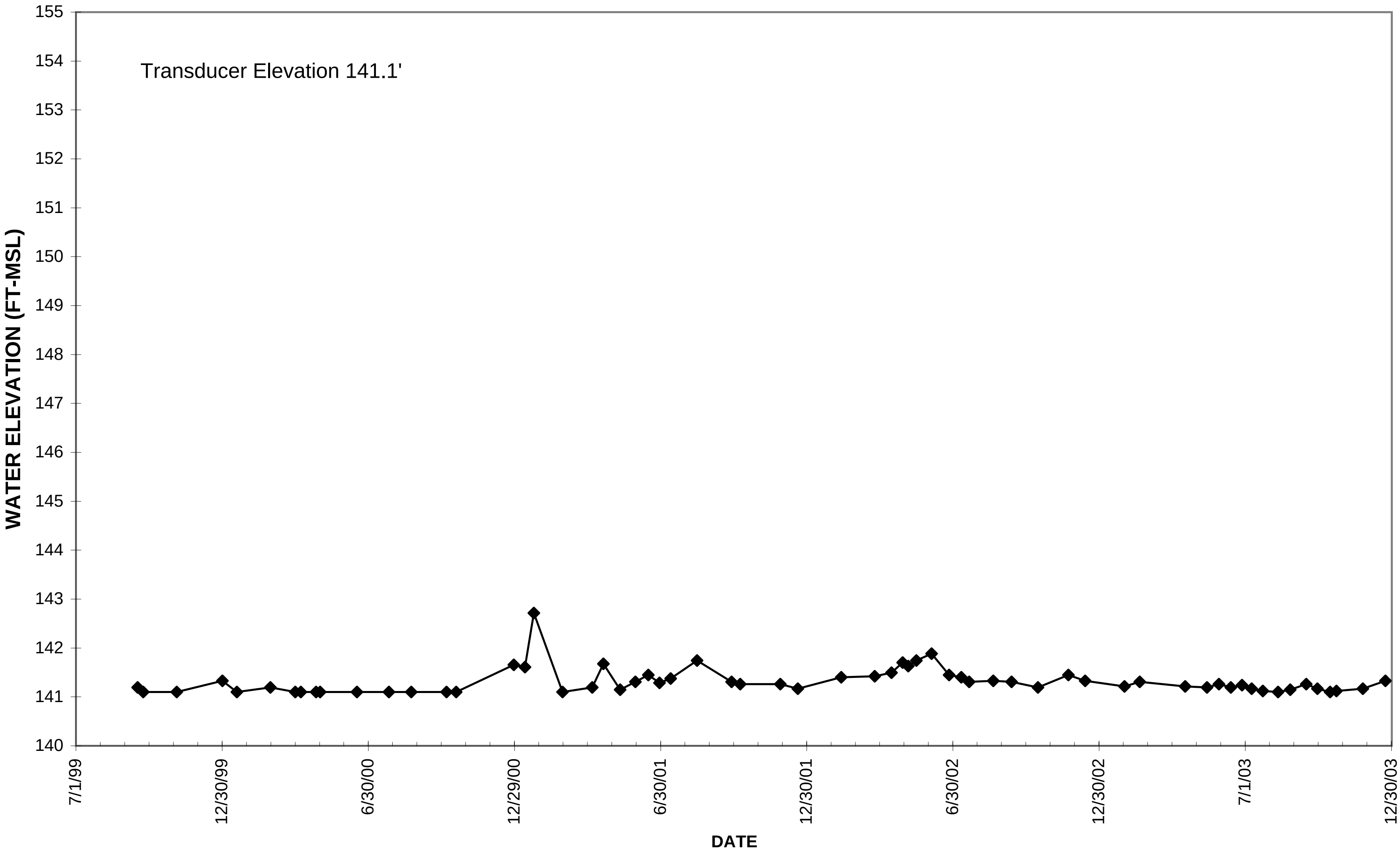


FIGURE 2.9   WATER LEVEL DATA FOR PIZOMETER 75

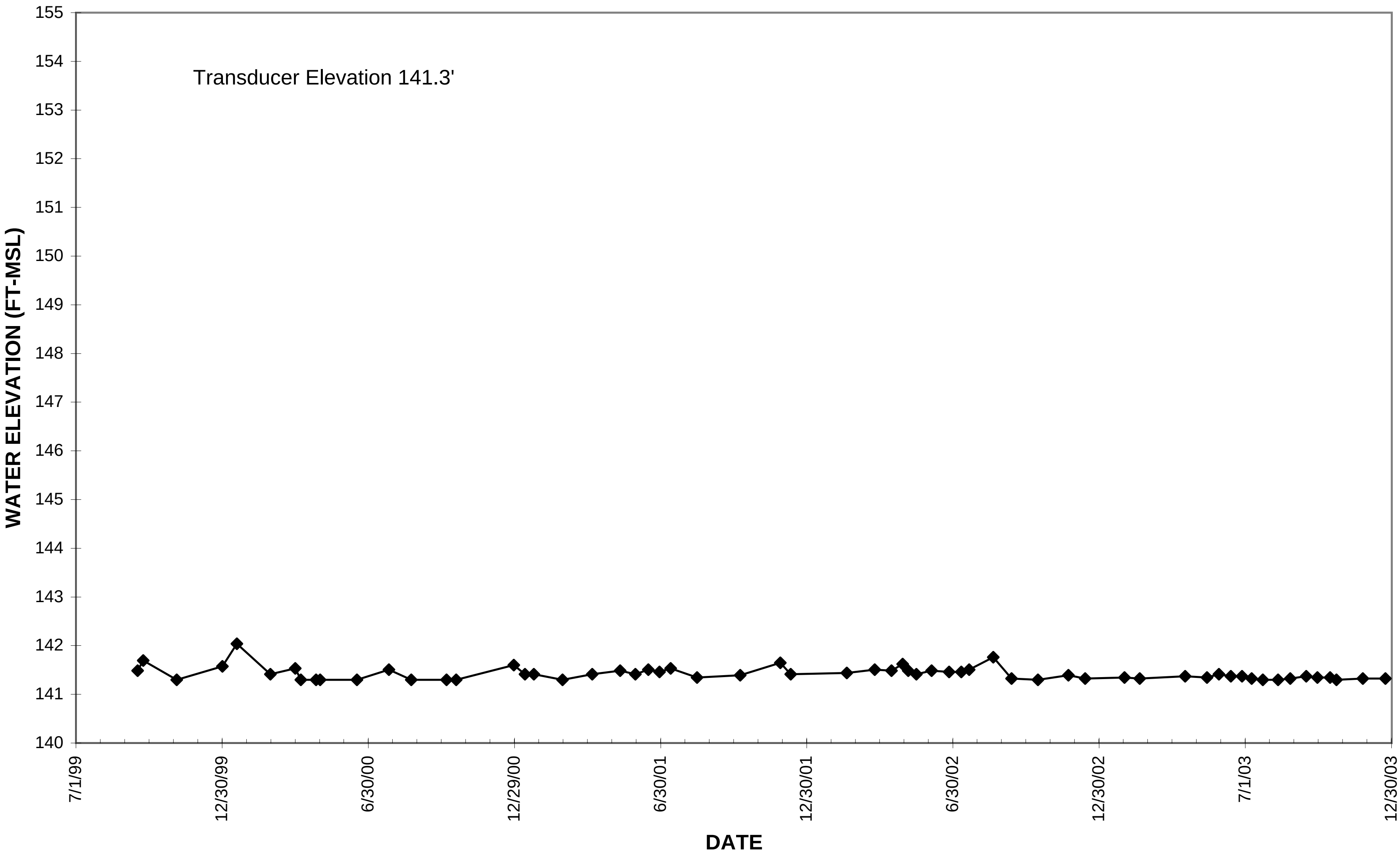


FIGURE 2.10 WATER LEVEL DATA FOR PIZOMETER 76

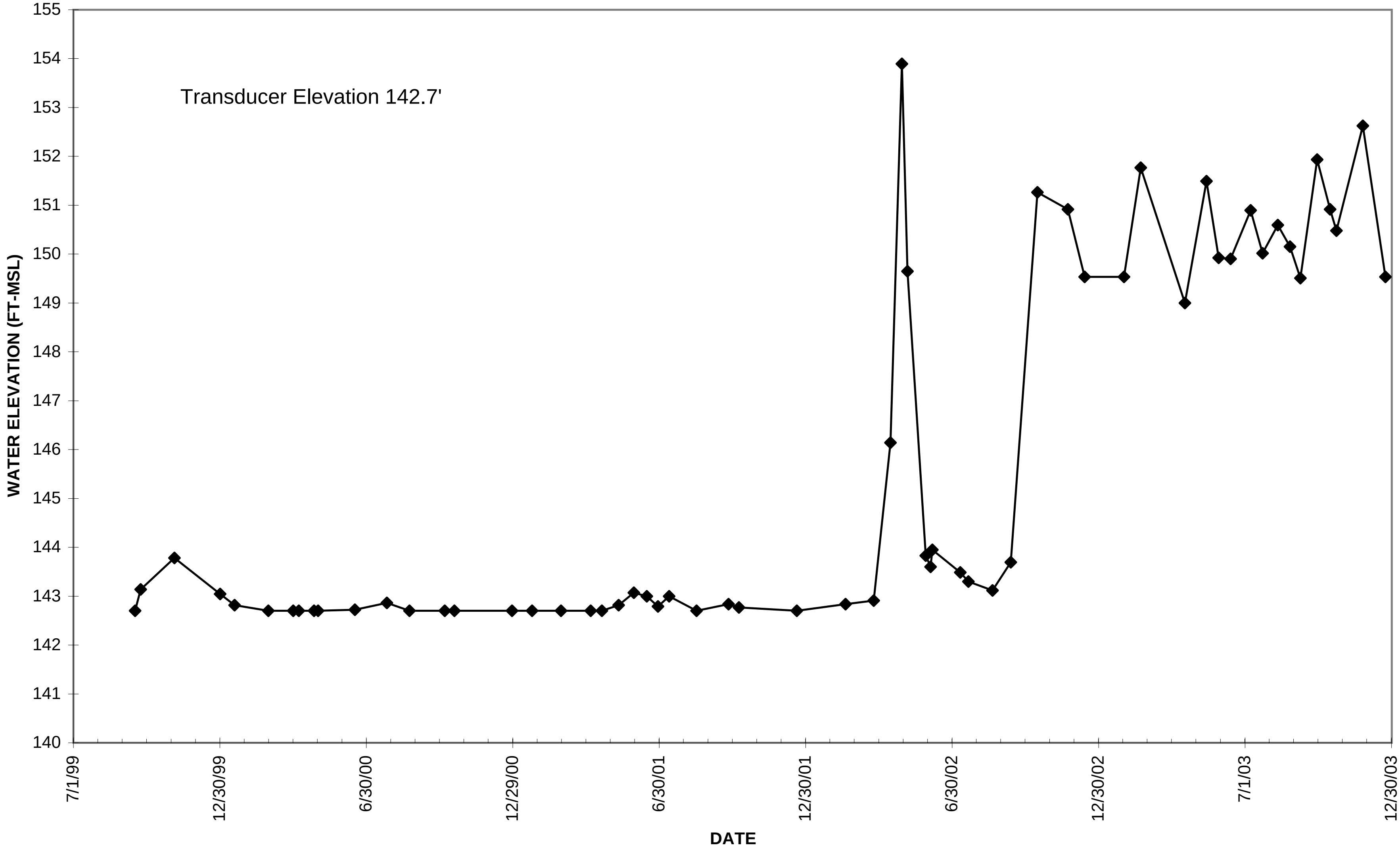


FIGURE 2.11 WATER LEVEL DATA FOR STANDPIPE PIEZOMETER PZ-T-00-01

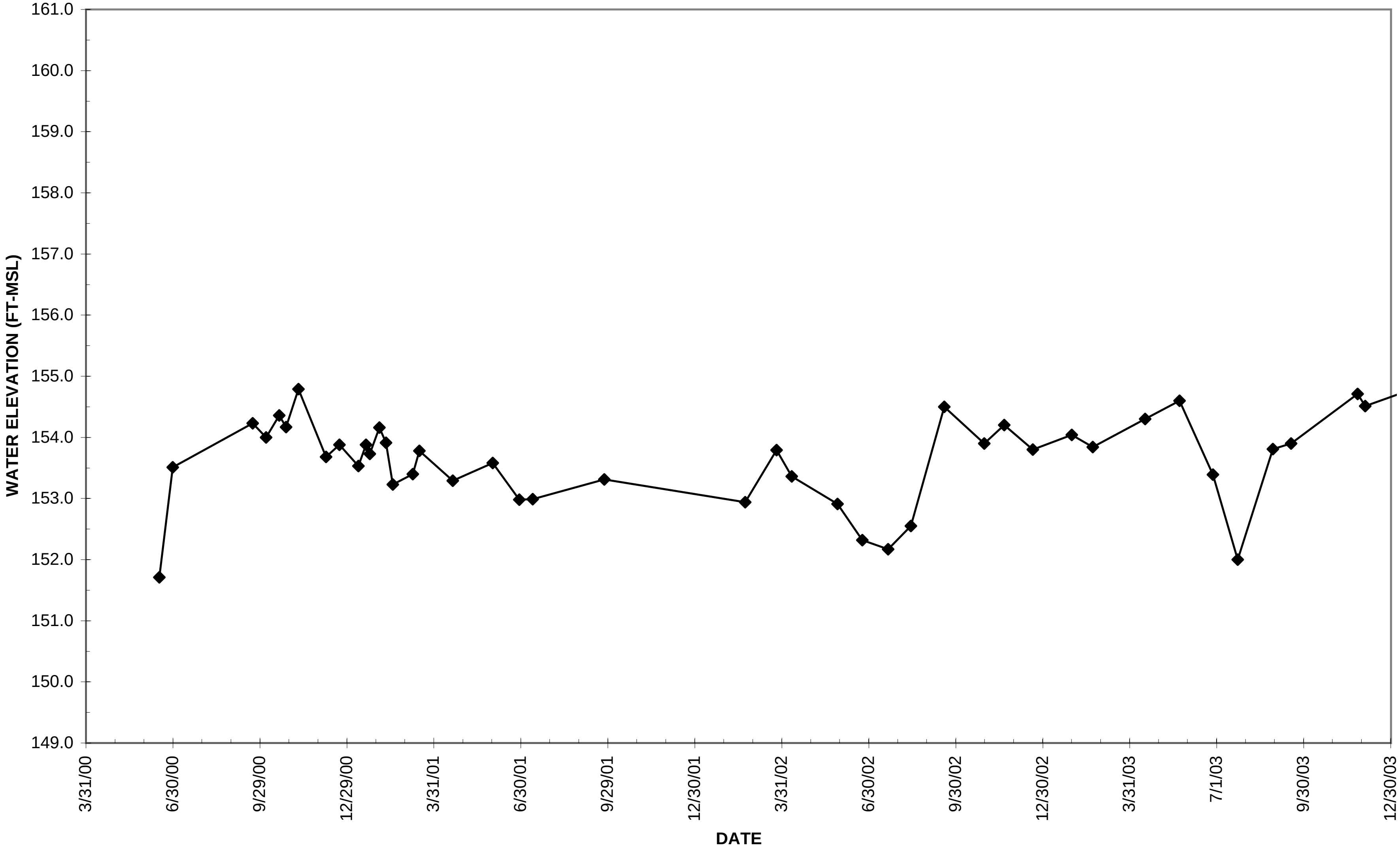


FIGURE 2.12 WATER LEVEL DATA FOR STANDPIPE PIEZOMETER PZ-T-00-02

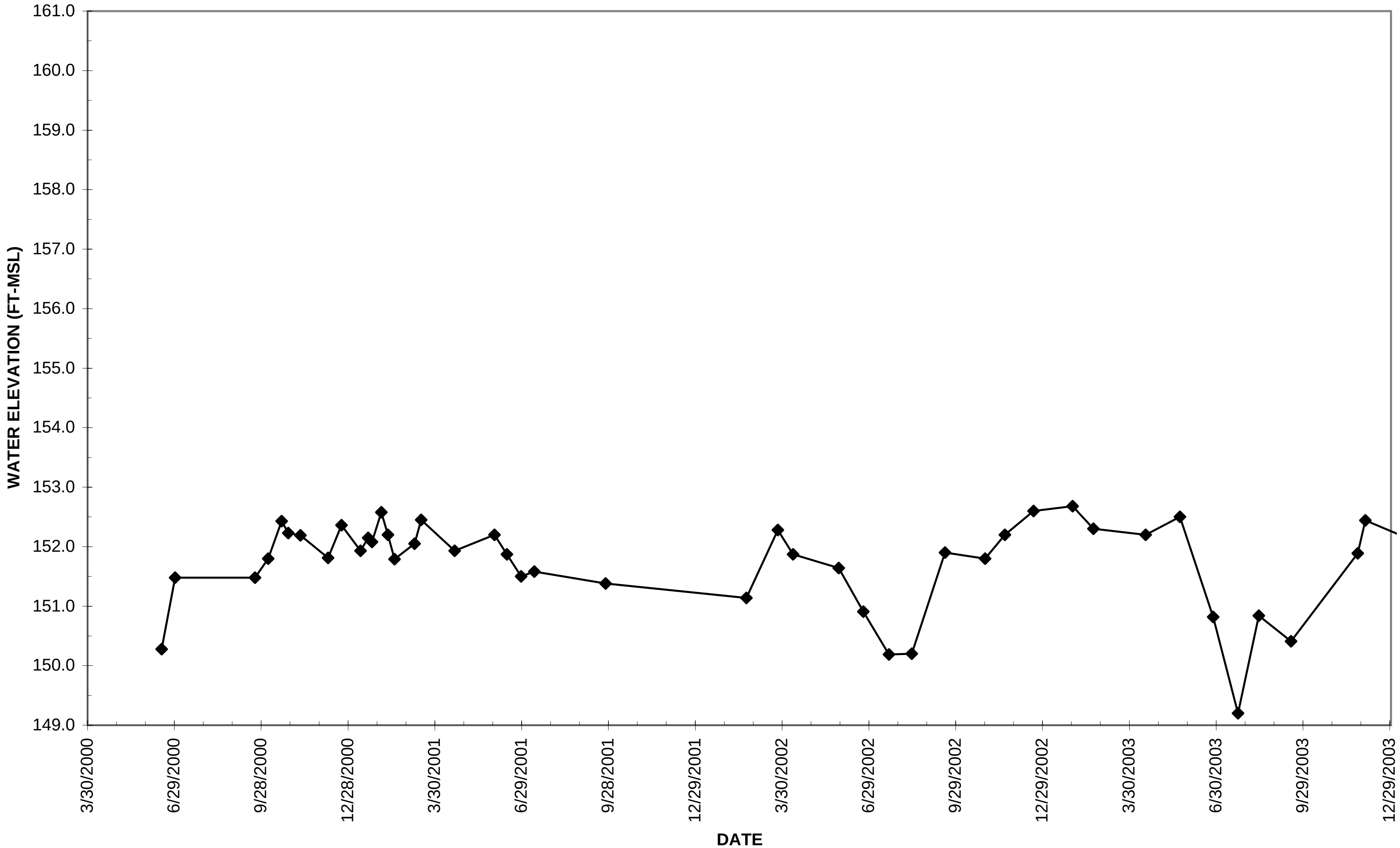


FIGURE 2.13 WATER LEVEL DATA FOR STANDPIPE PIEZOMETER PZ-T-00-03

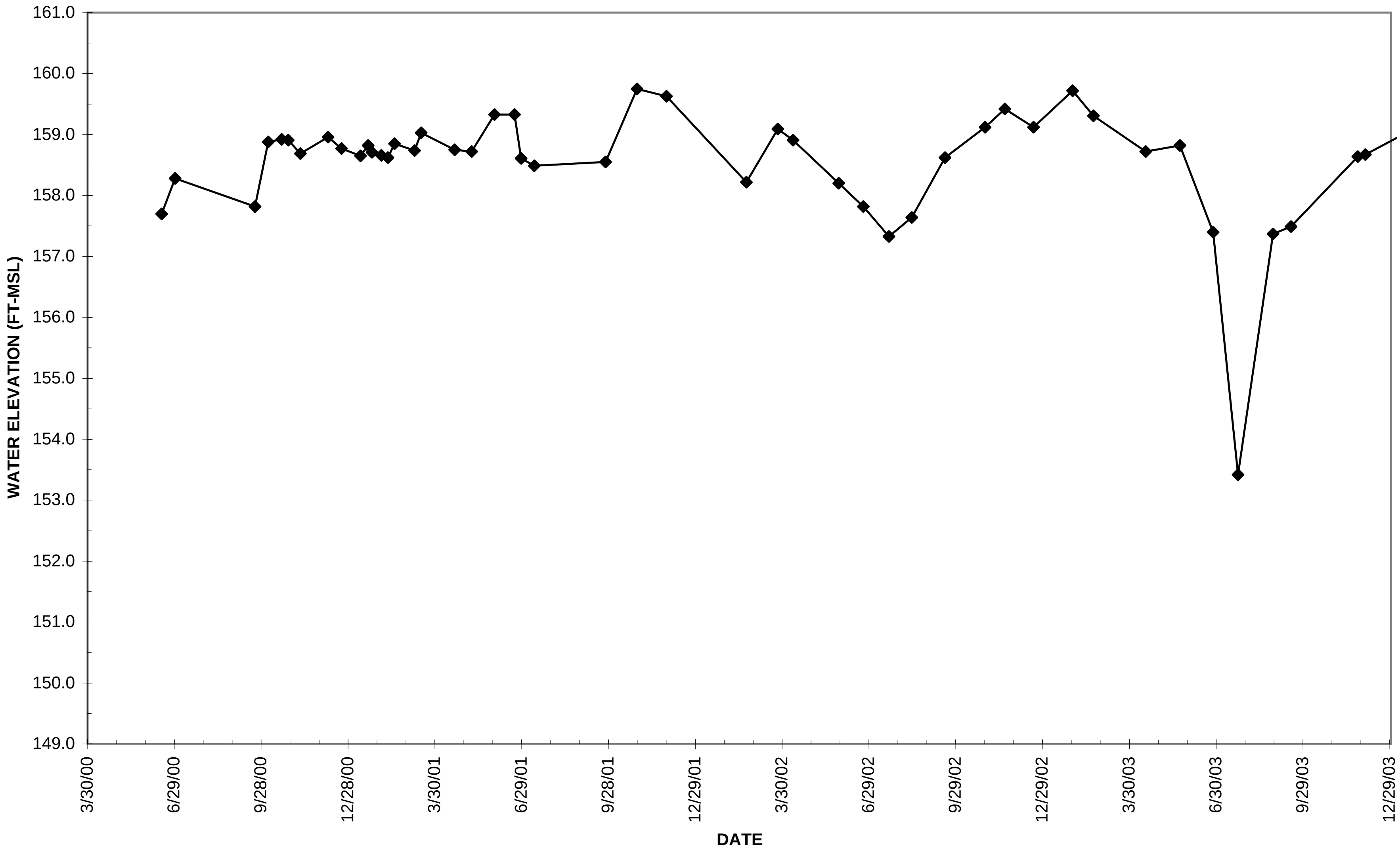


FIGURE 2.14 WATER LEVEL DATA FOR WELL MW-T-00-05A

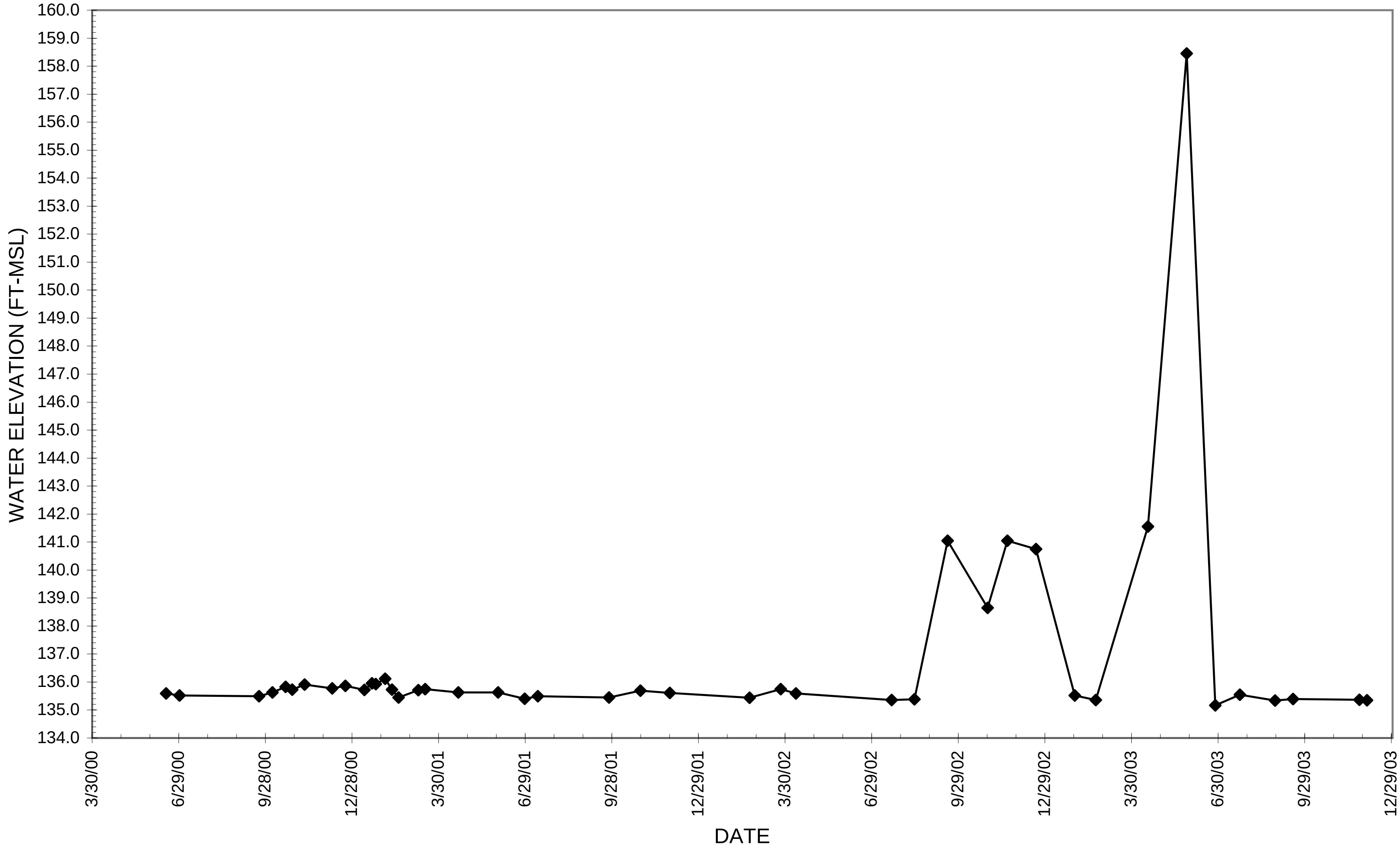


FIGURE 2.15 WATER LEVEL DATA FOR WELL MW-T-00-03A

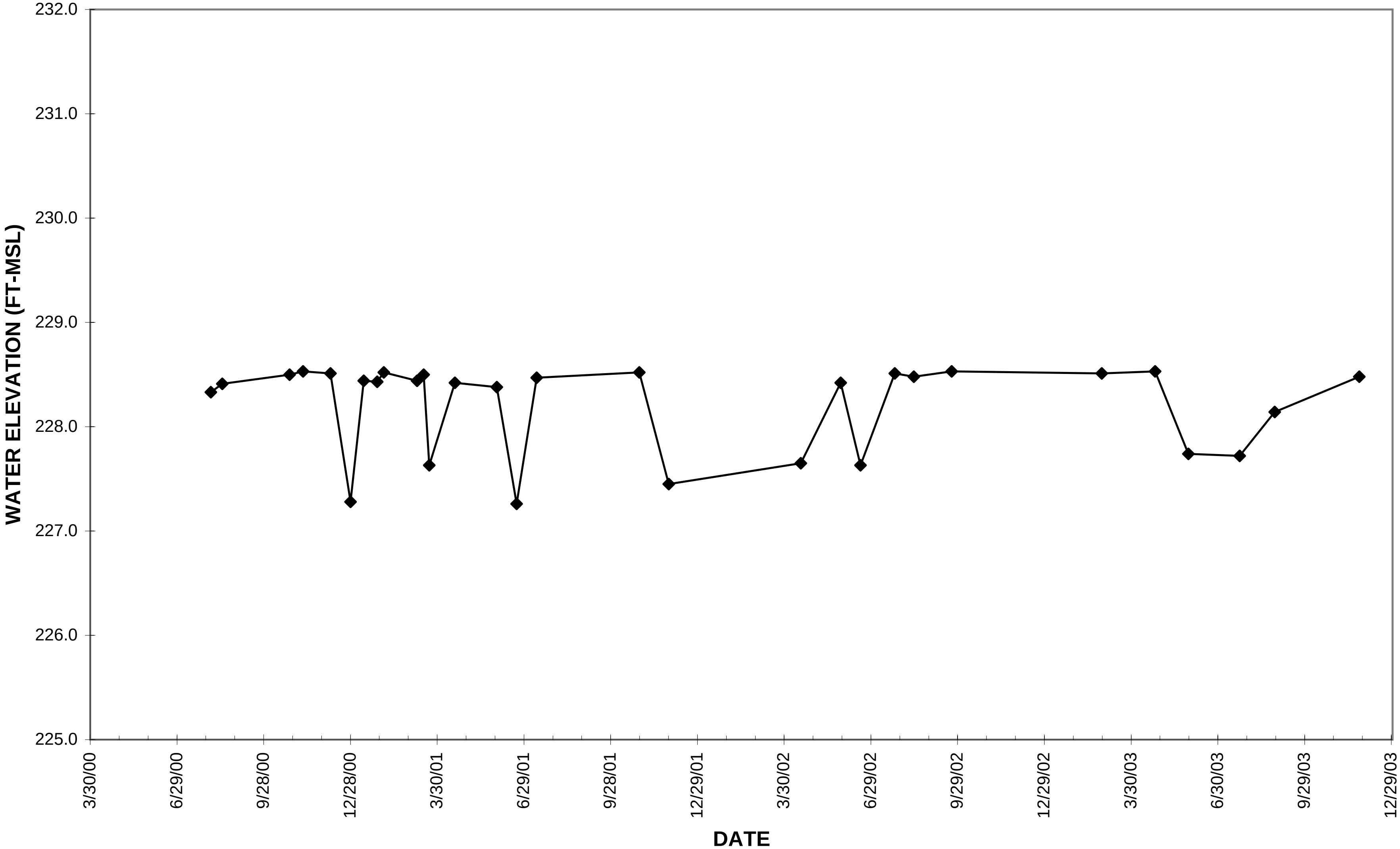


FIGURE 2.16 WATER LEVEL DATA FOR WELL MW-T-00-03B

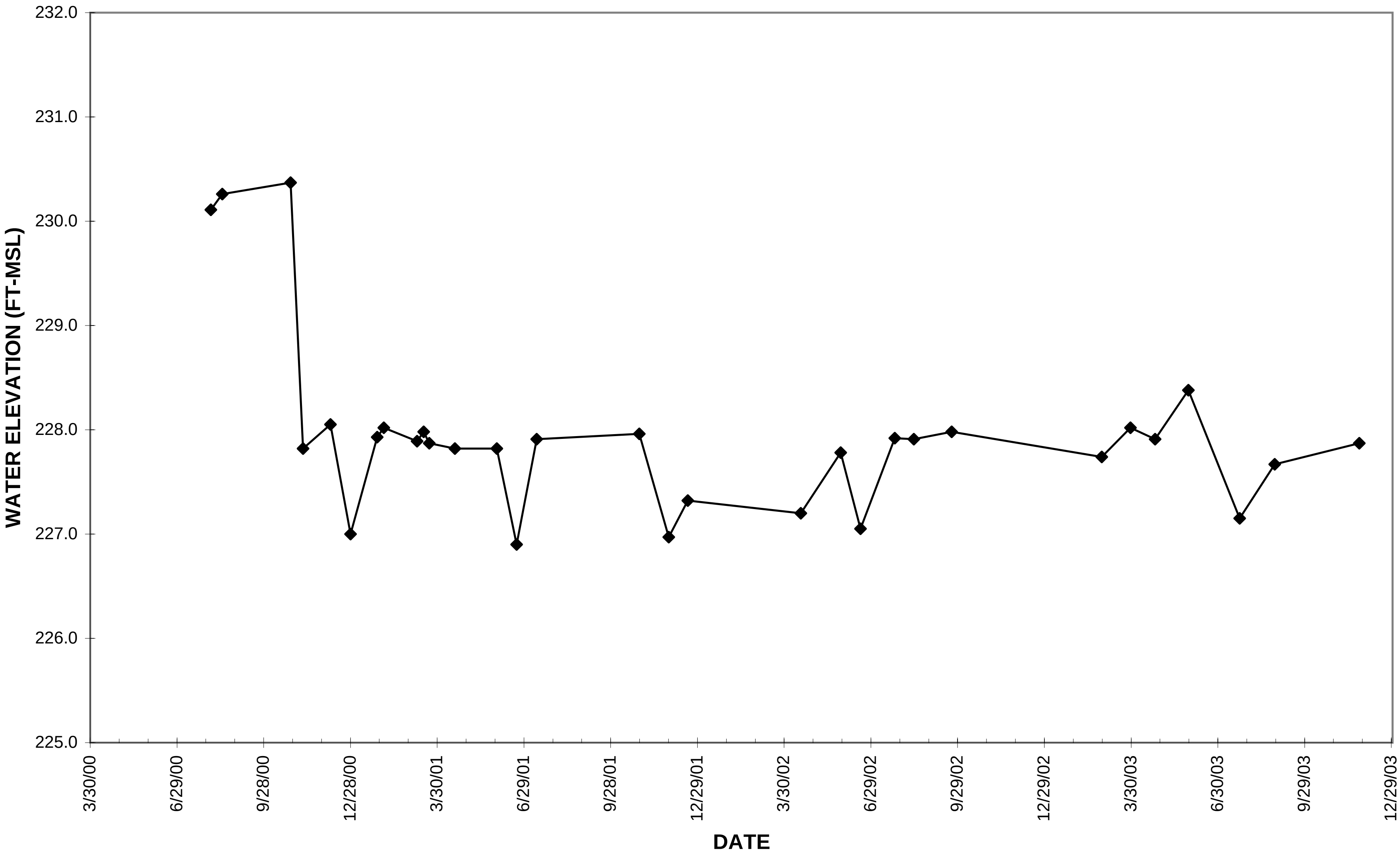


FIGURE 2.17 WATER LEVEL DATA FOR WELL MW-T-01-03A

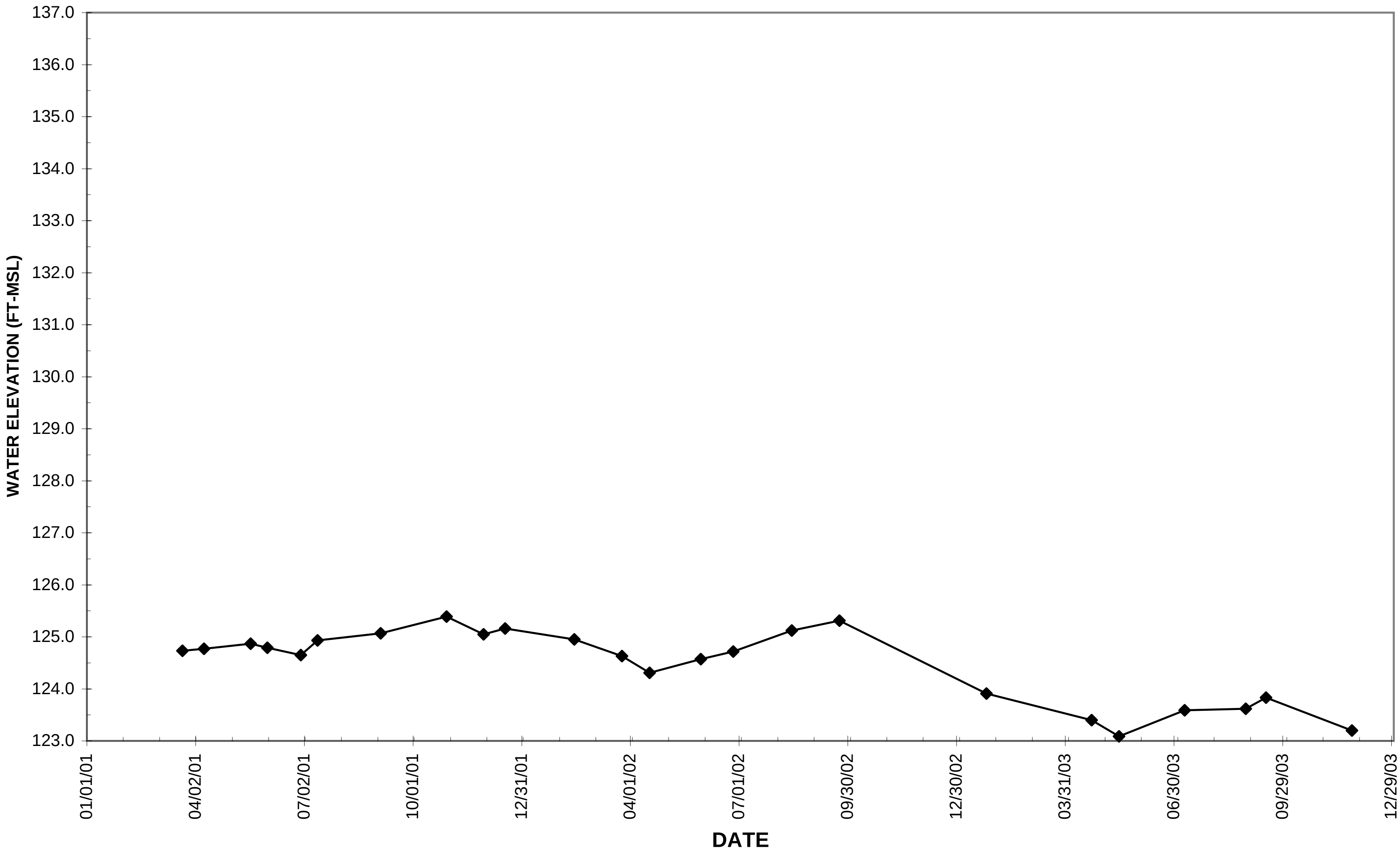


FIGURE 2.18 WATER LEVEL DATA FOR WELL MW-T-01-03B

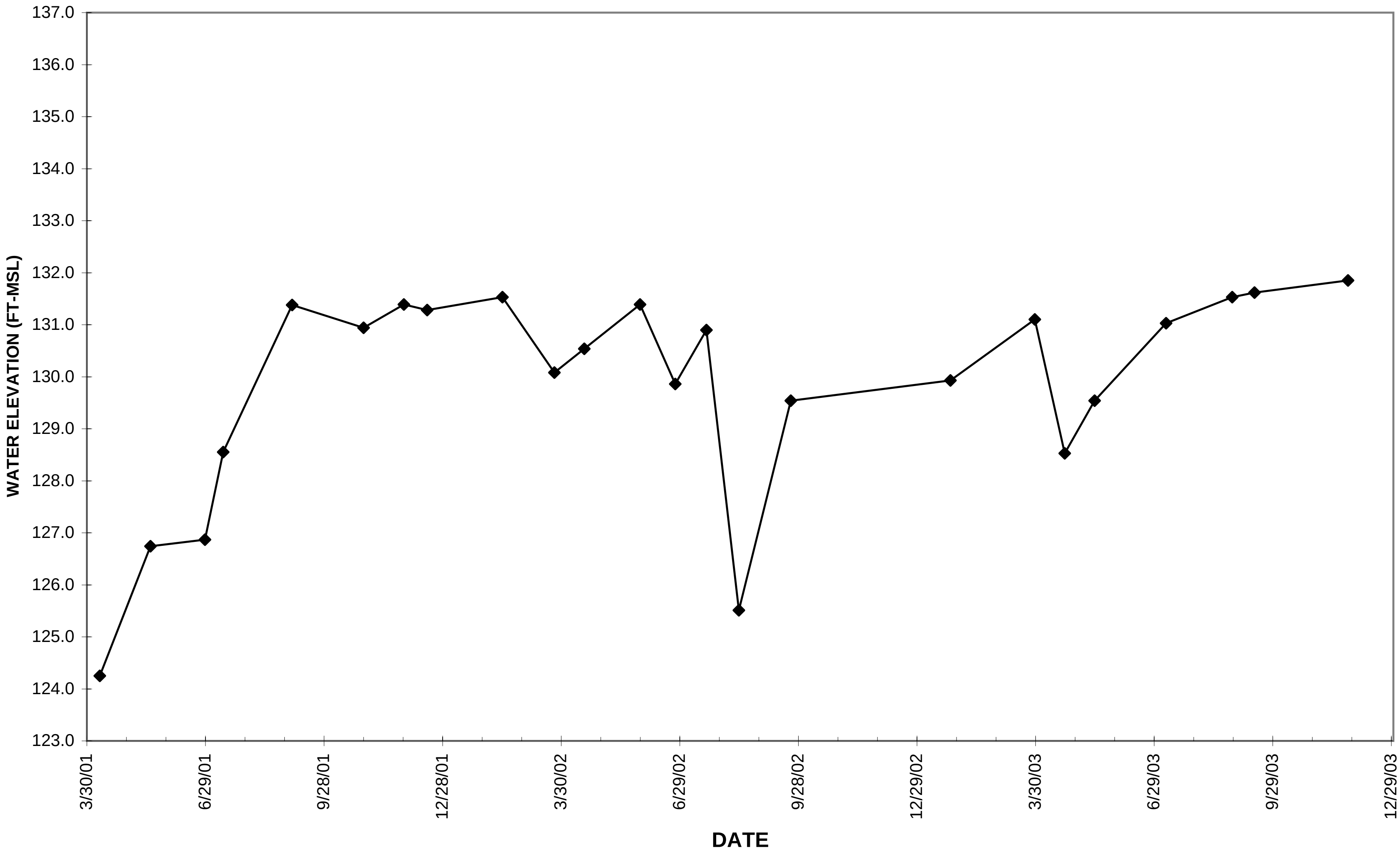


FIGURE 2.19 TAILINGS AREA WET WELL FLOW DATA

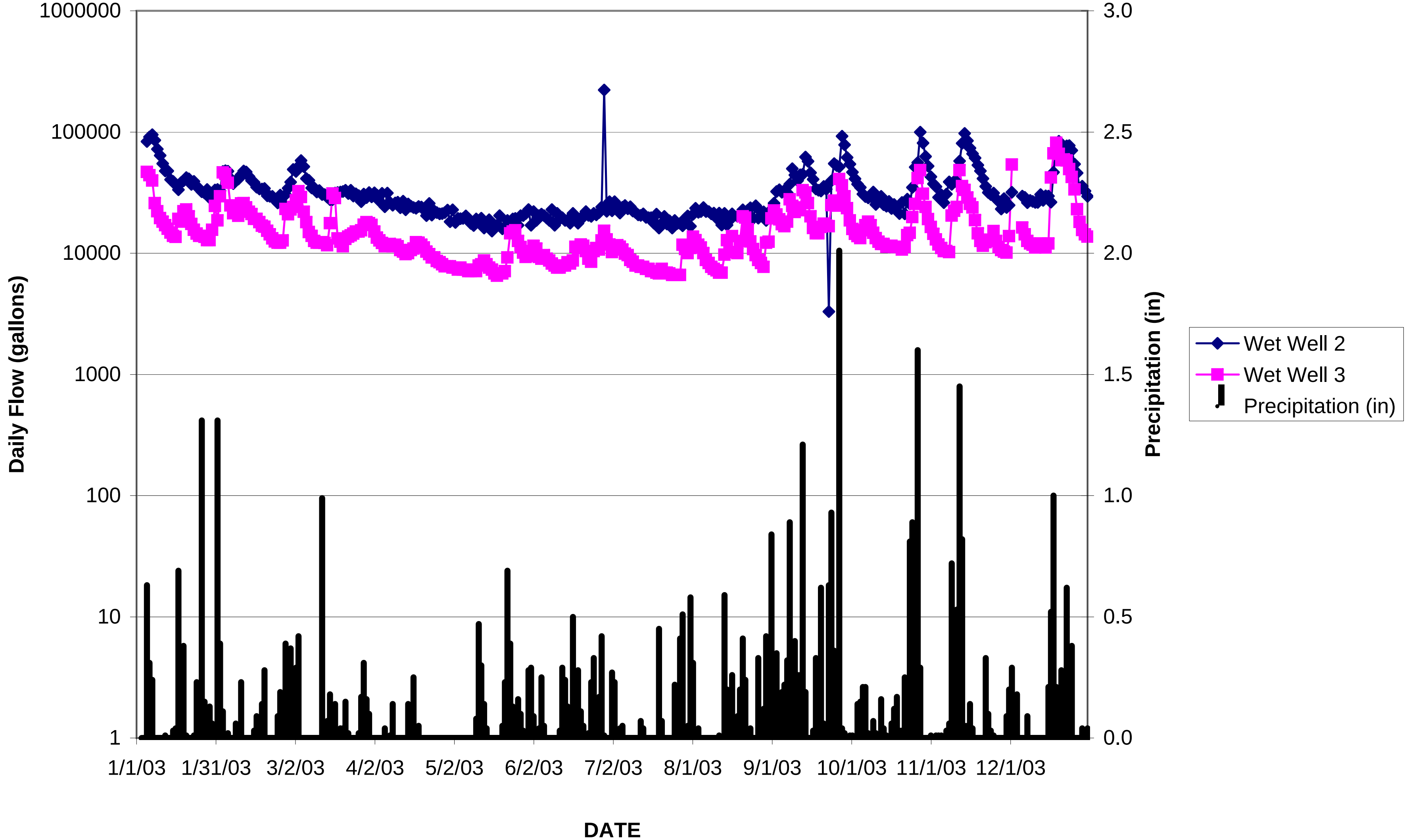


FIGURE 2.20a GREENS CREEK TAILINGS AREA INTERNAL MONITORING SITES: WET WELLS - pH DATA

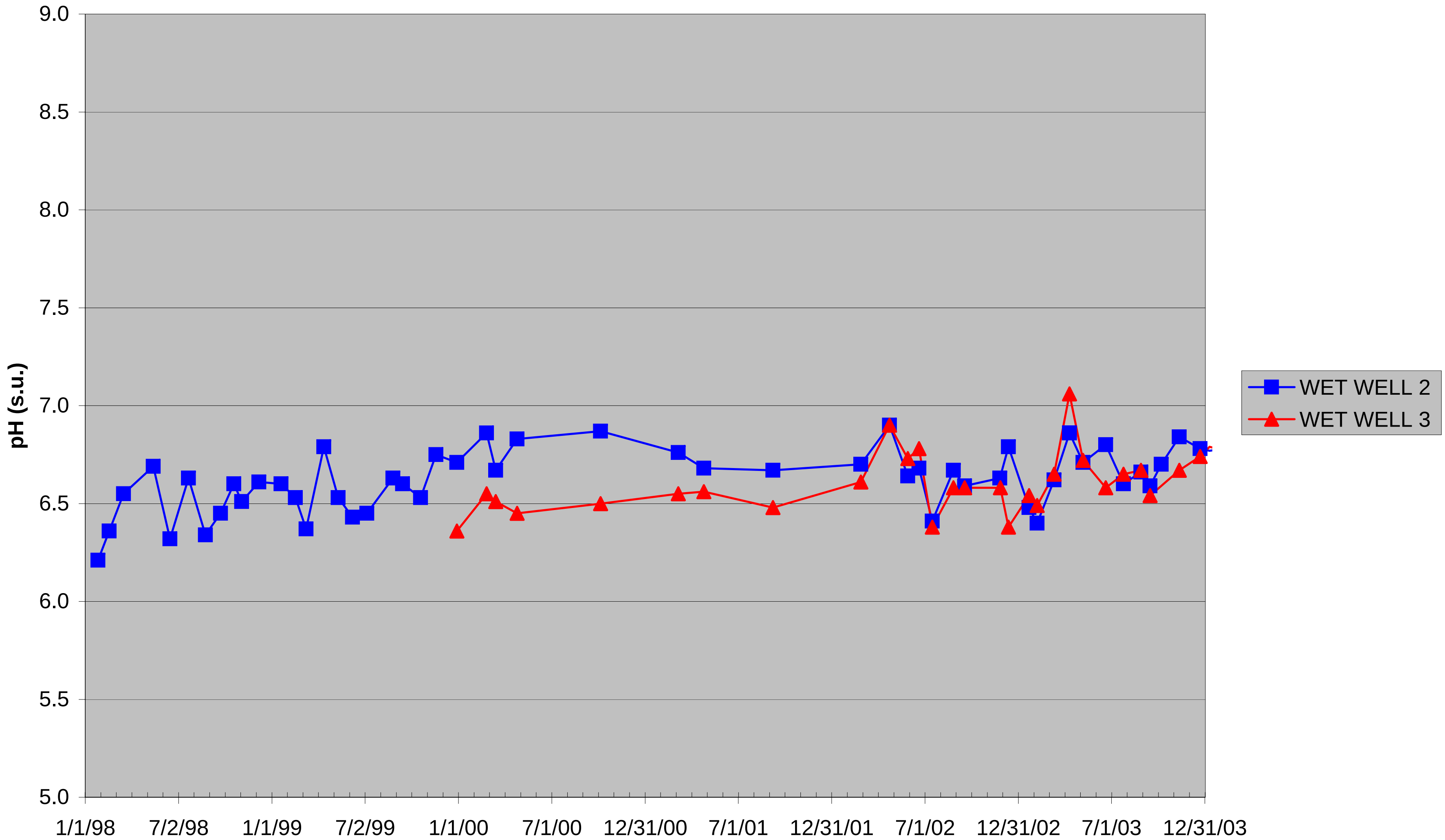


FIGURE 2.20b GREENS CREEK TAILINGS INTERNAL MONITORING SITES: TAILINGS COMPLETIONS - pH DATA

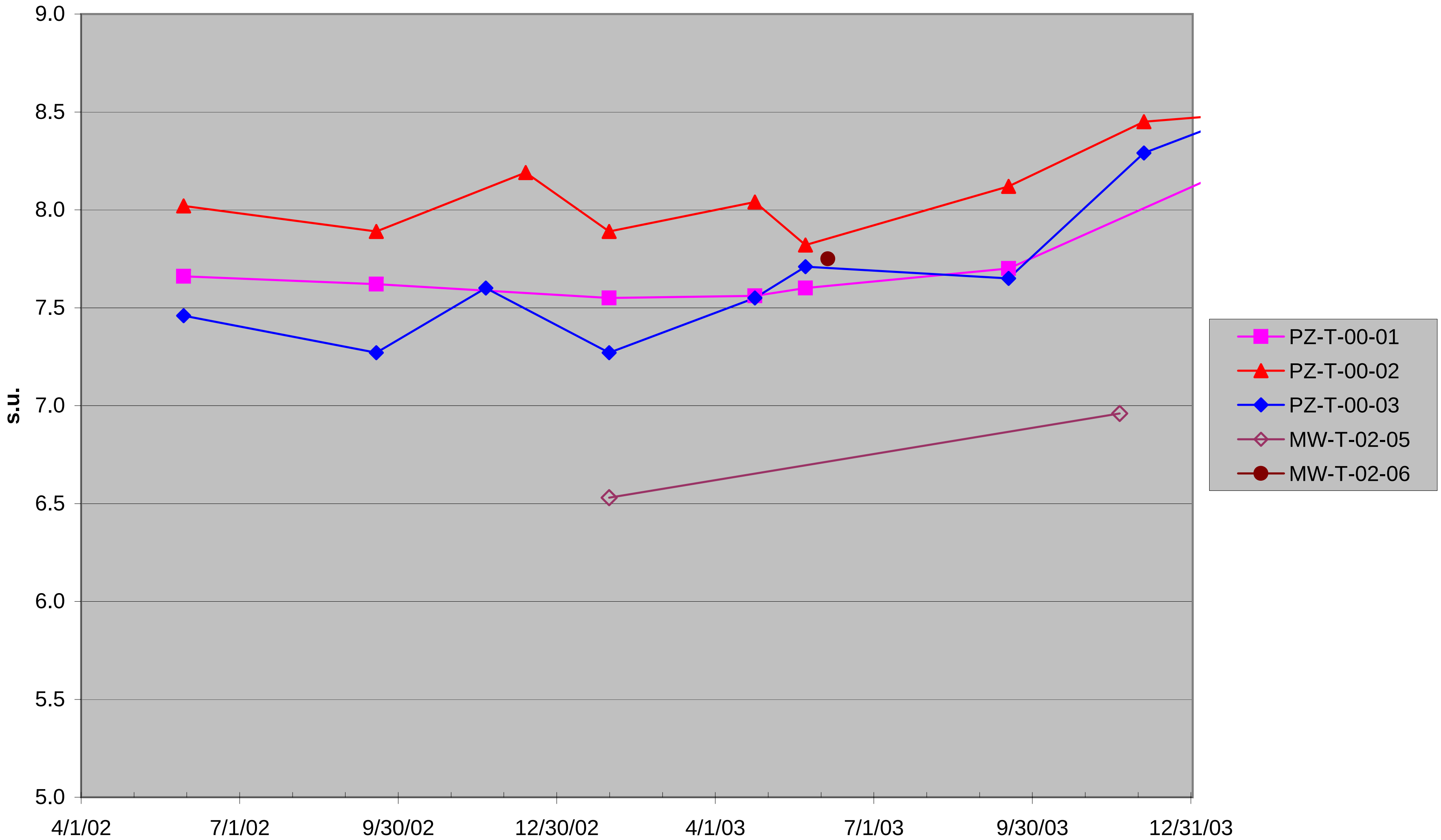


FIGURE 2.20c GREENS CREEK TAILINGS INTERNAL MONITORING SITES: SUCTION LYSIMETERS - pH

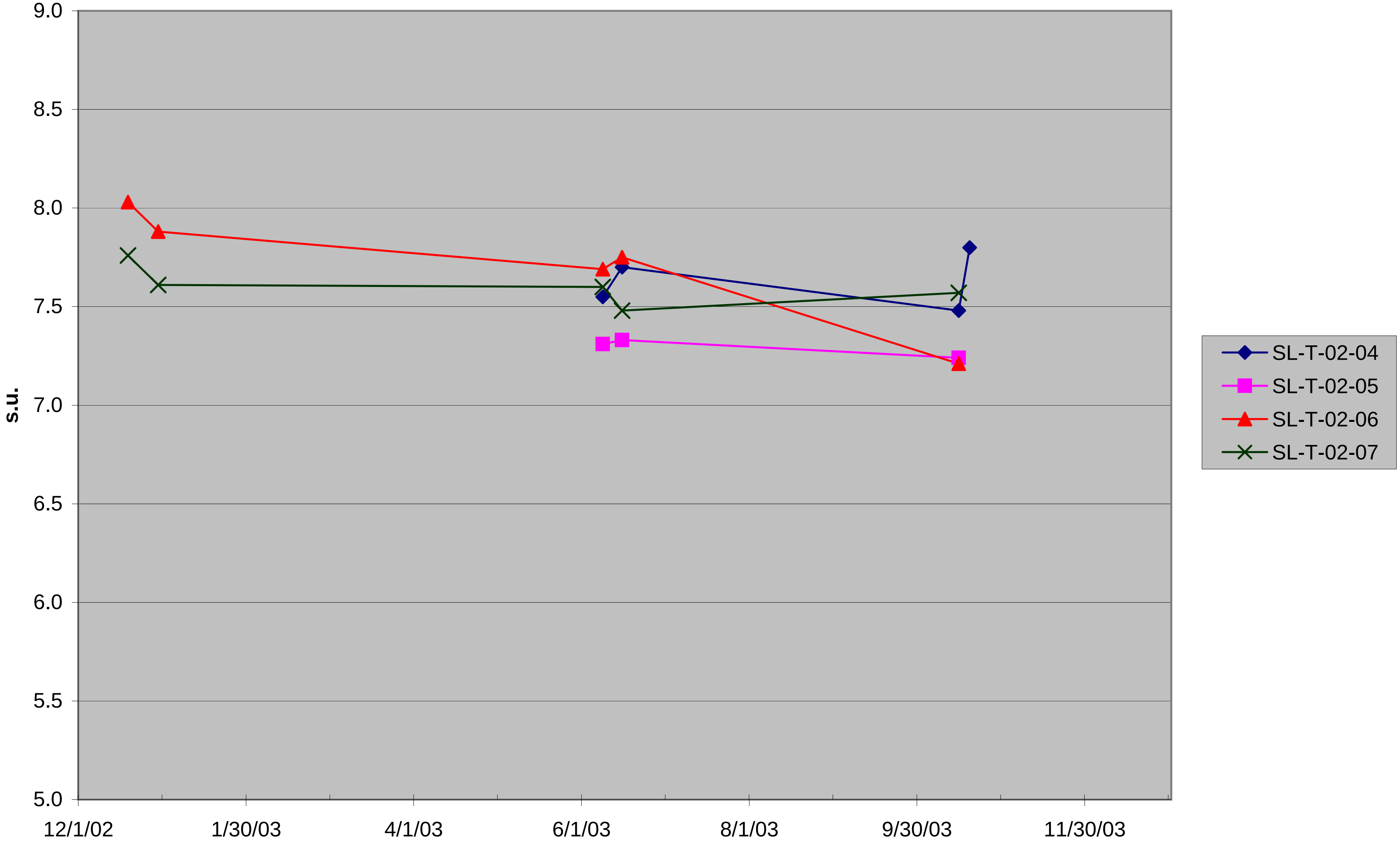


FIGURE 2.21a GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
WET WELLS - ALKALINITY
(Non-detectable analyses plotted as zero)

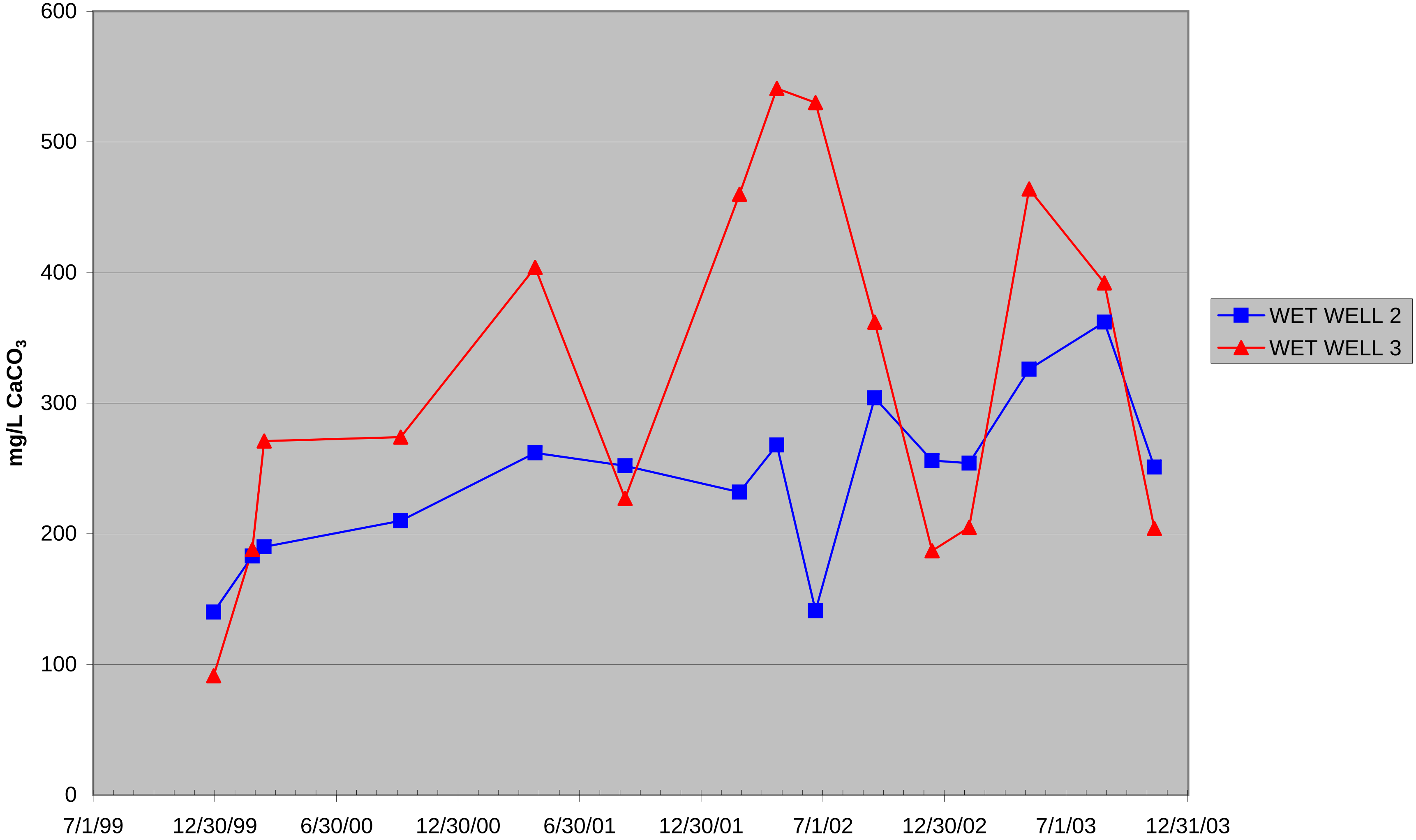


FIGURE 2.21b GREENS CREEK TAILINGS INTERNAL MONITORING SITES: TAILINGS COMPLETIONS - ALKALINITY DATA
(Non-detectable analyses plotted as zero)

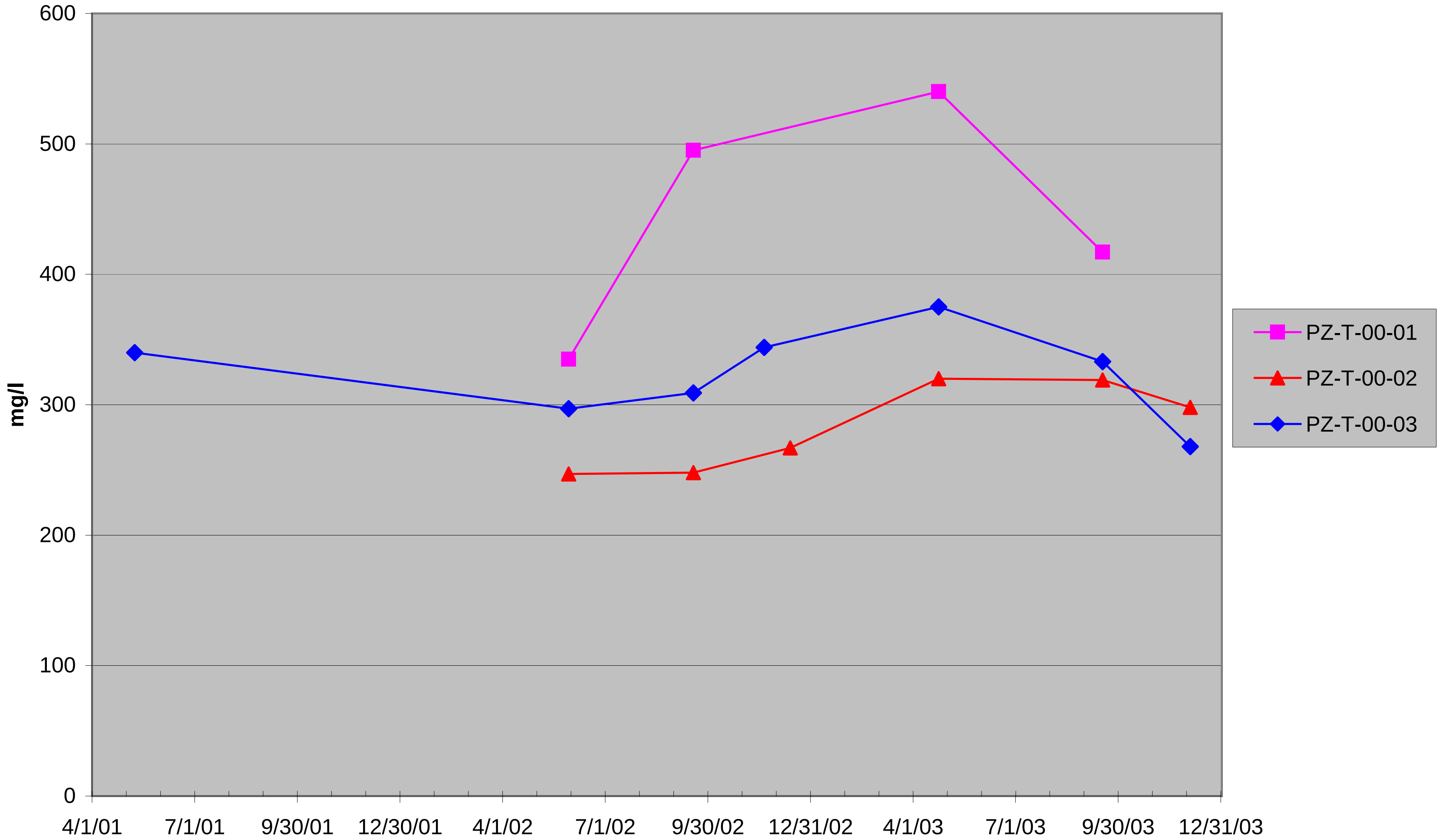


FIGURE 2.22a GREENS CREEK TAILINGS INTERNAL MONITORING SITES: WET WELLS - CONDUCTIVITY DATA

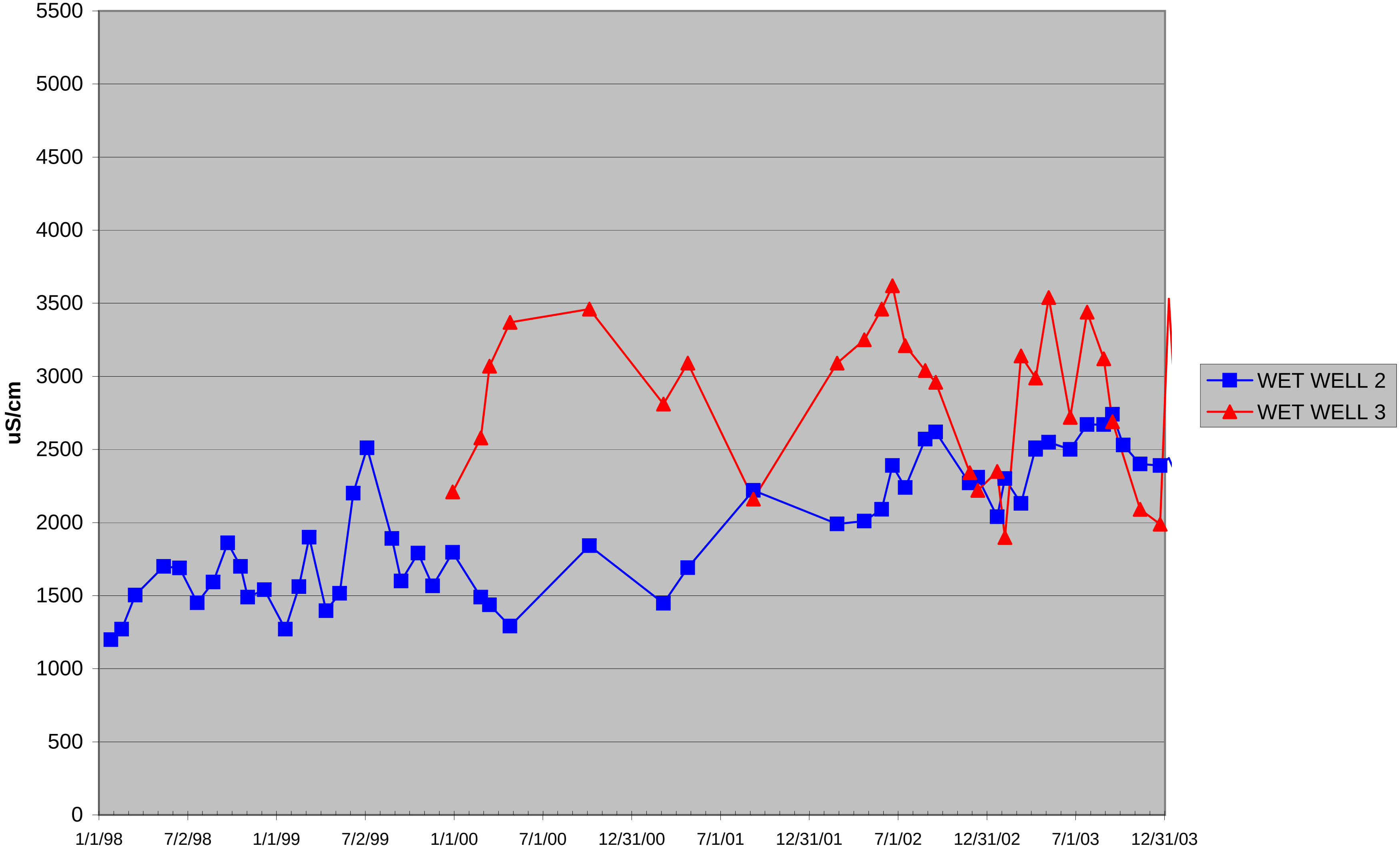


FIGURE 2.22b   GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
TAILINGS COMPLETIONS - CONDUCTIVITY DATA

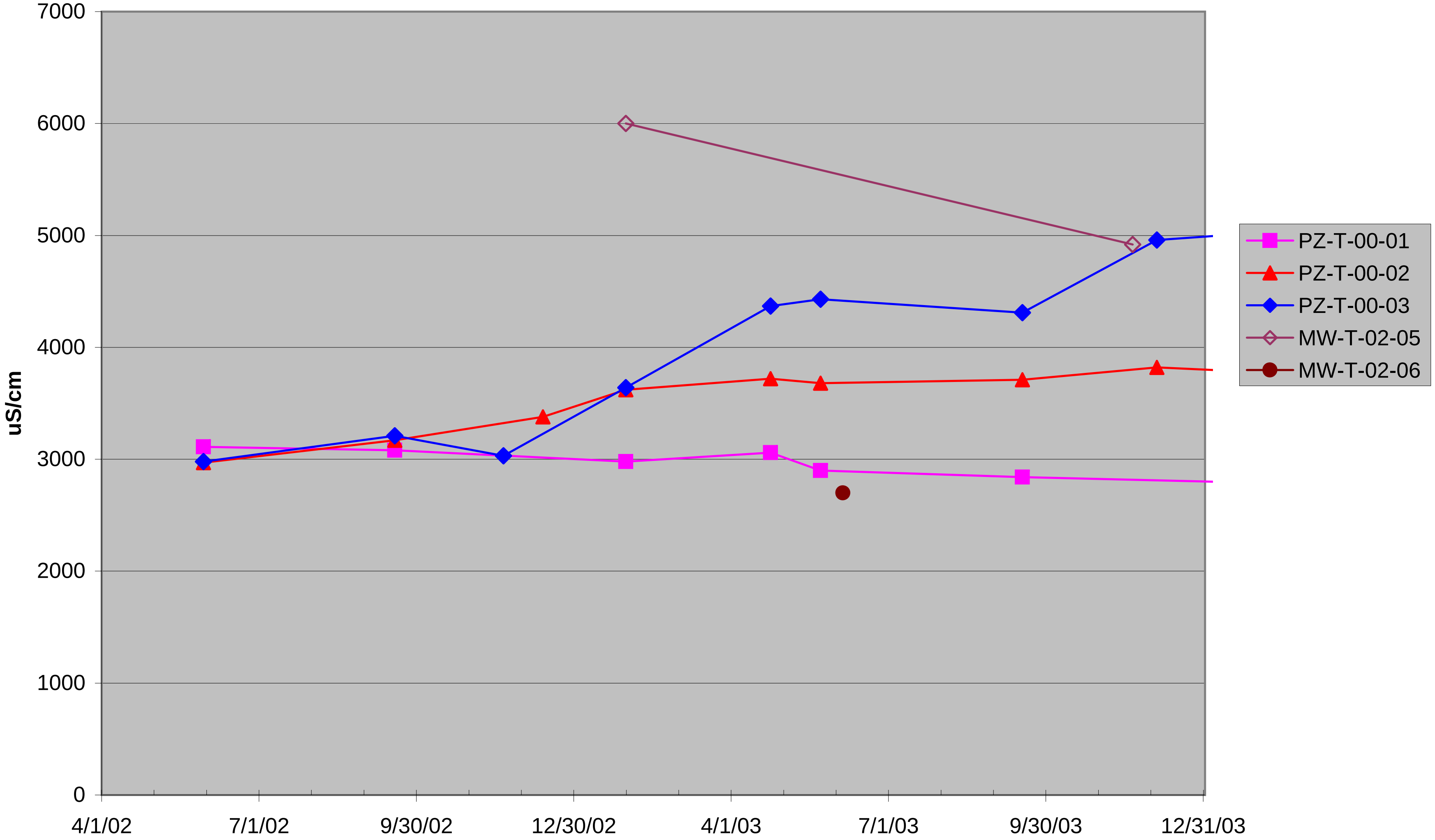


FIGURE 2.22c GREENS CREEK TAILINGS INTERNAL MONITORING SITES: SUCTION LYSIMETERS - CONDUCTIVITY DATA

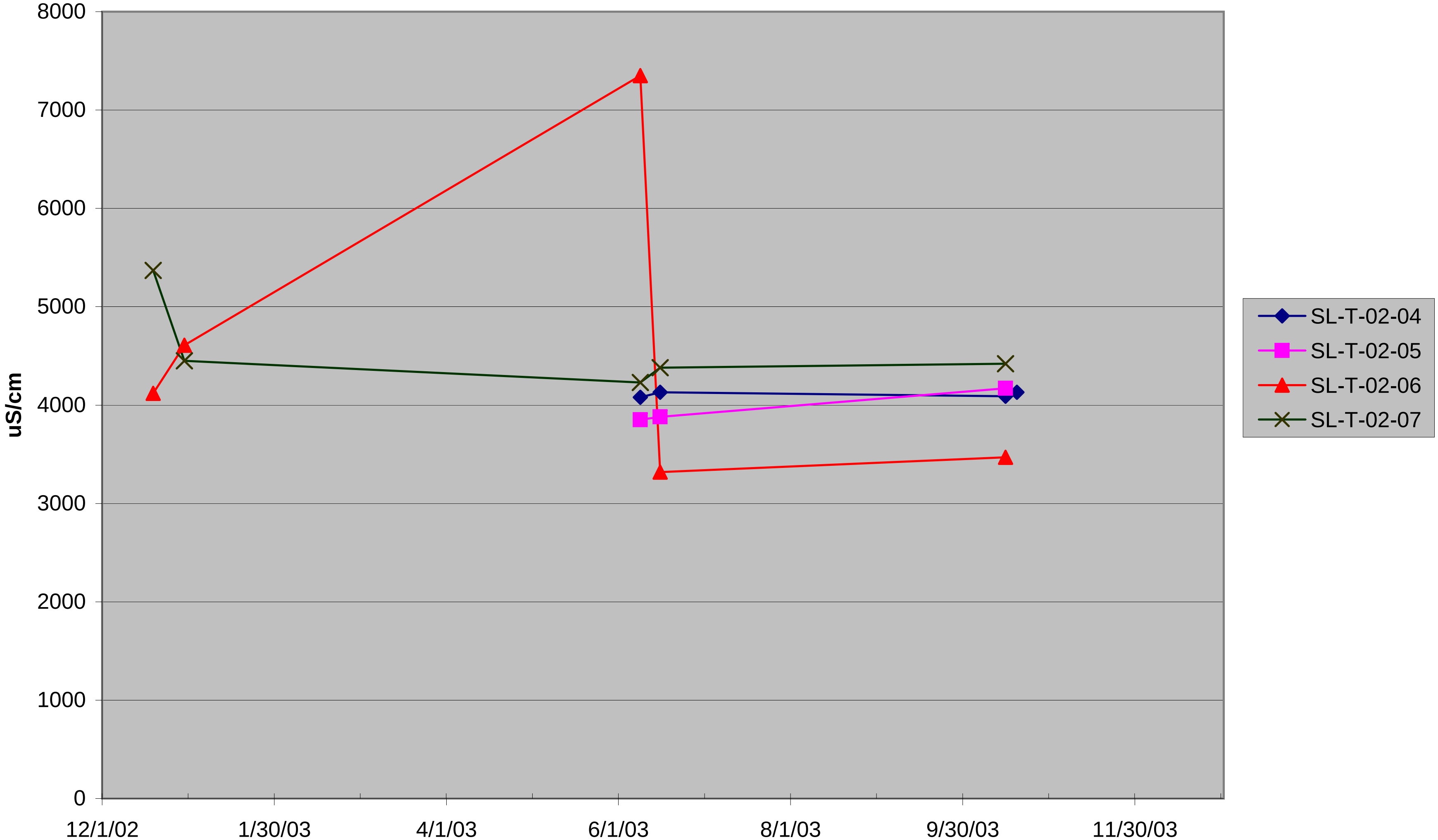


FIGURE 2.23a GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
WET WELLS - HARDNESS DATA
(Non-detectable analyses plotted as zero)

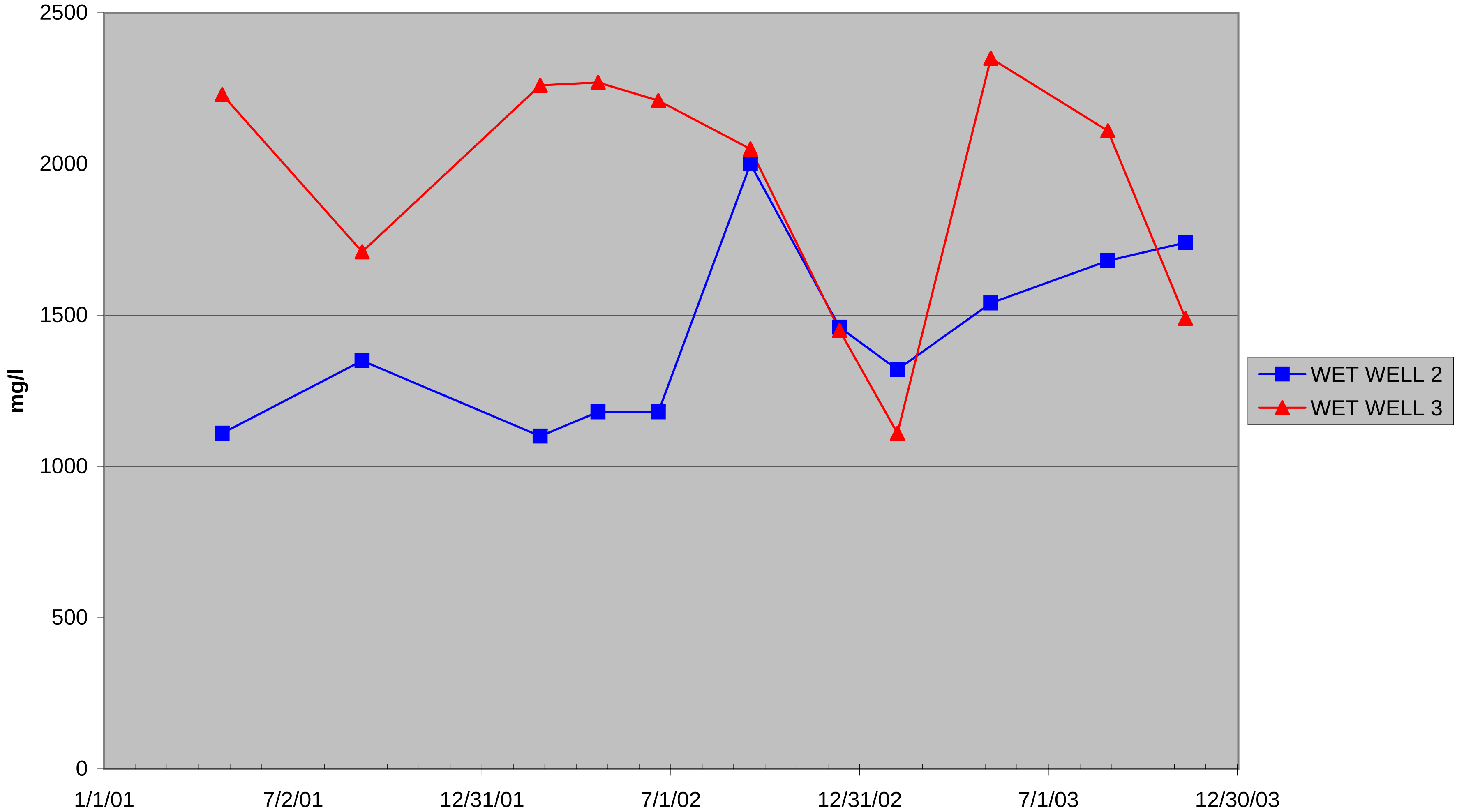


FIGURE 2.23b GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
TAILINGS COMPLETIONS - HARDNESS DATA
(Non-detectable analyses plotted as zero)

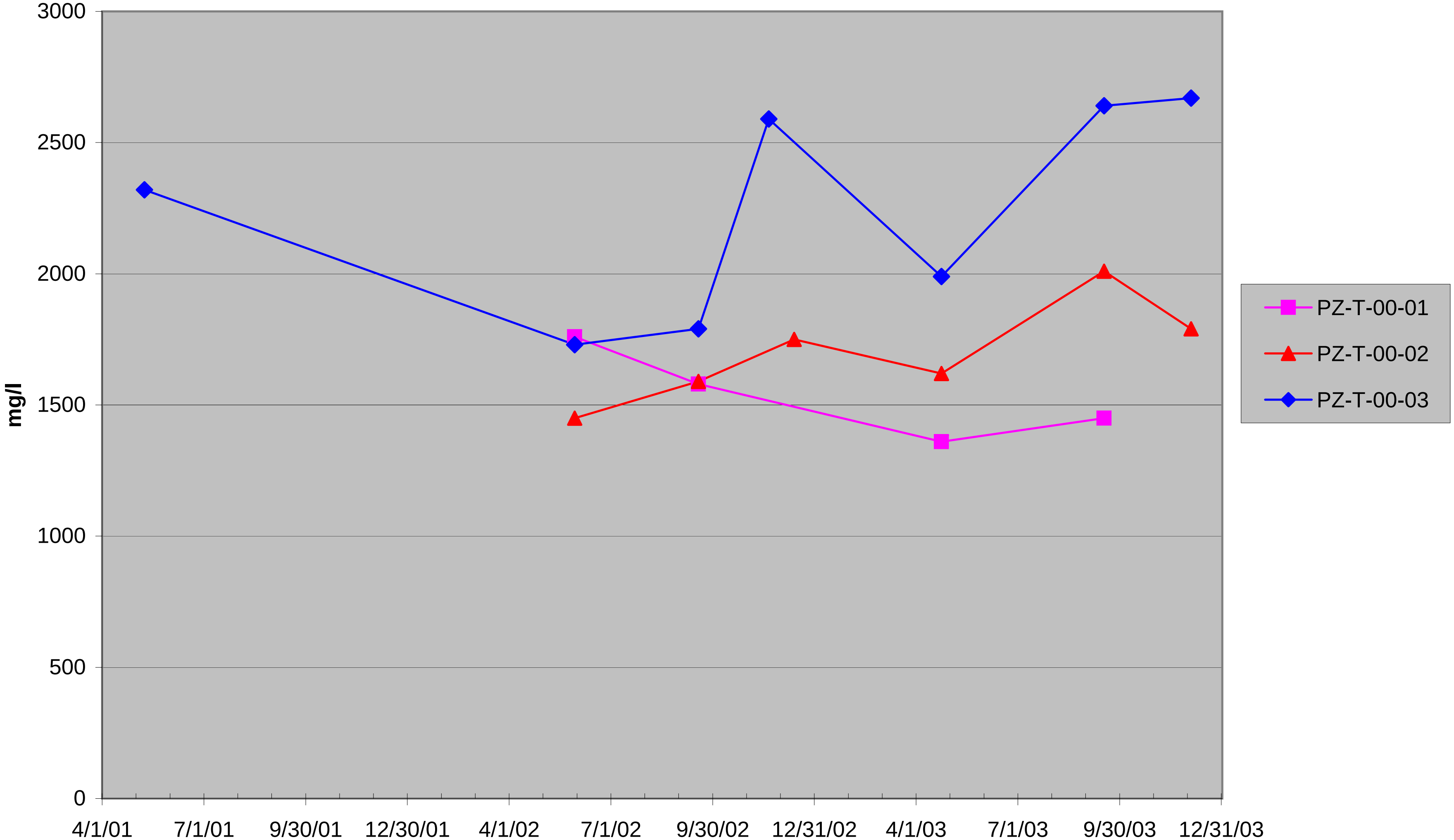


FIGURE 2.24a GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
WET WELLS - SULFATE DATA
(Non-detectable analyses plotted as zero)

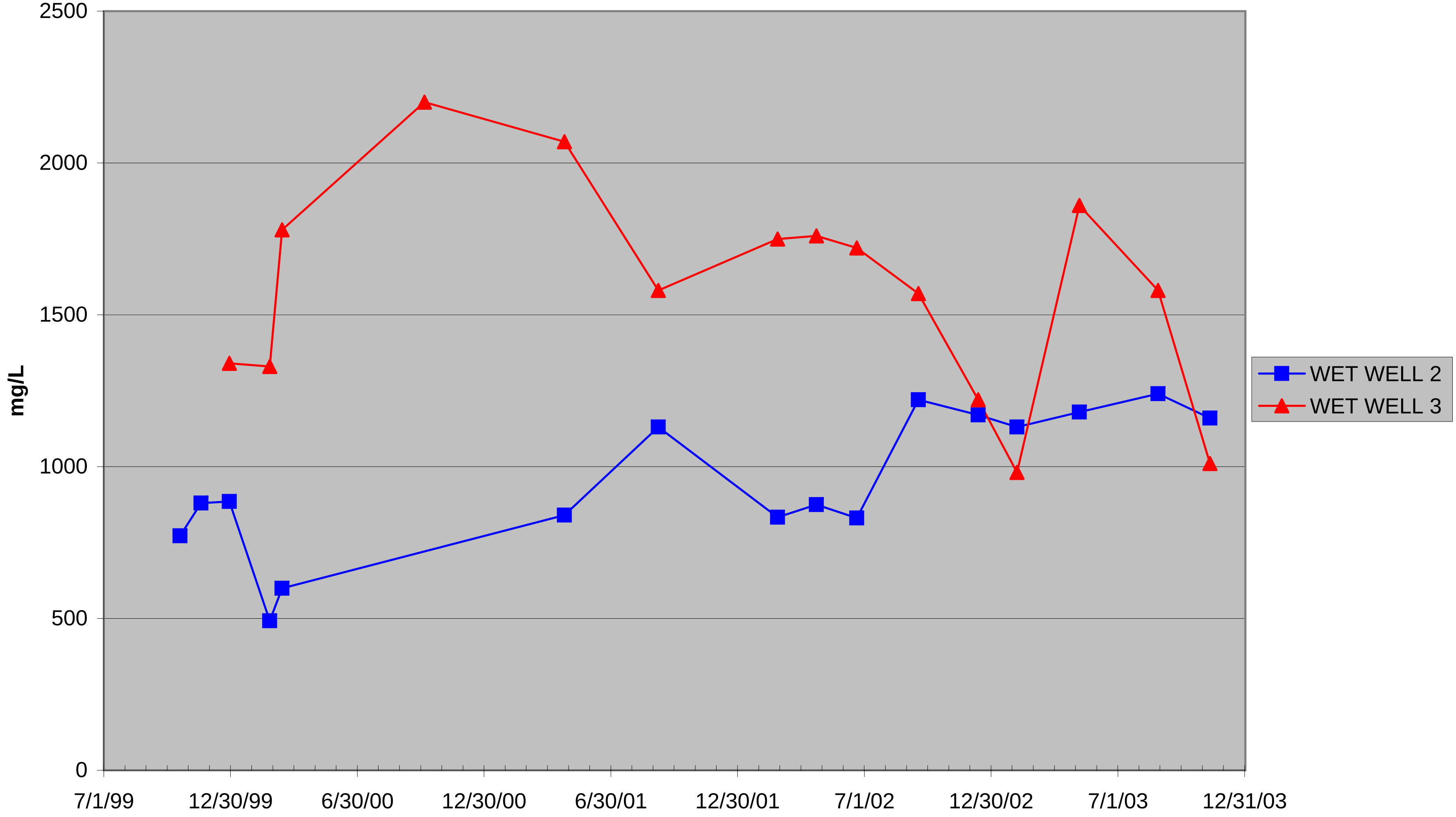


FIGURE 2.24b GREENS CREEK TAILINGS INTERNAL MONITORING SITES: TAILINGS COMPLETIONS - SULFATE DATA

(Non-detectable analyses plotted as zero)

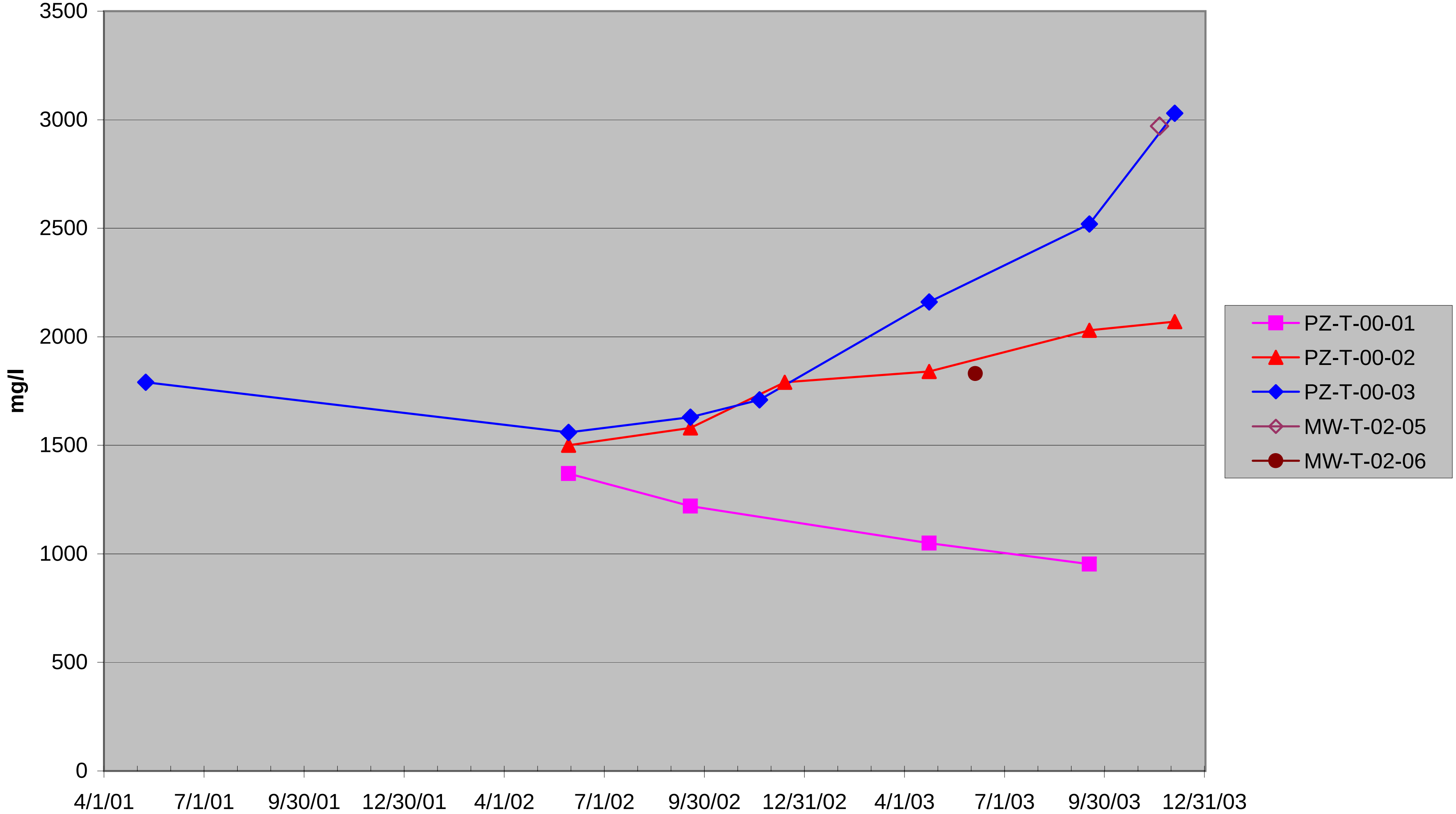


FIGURE 2.24c GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
SUCTION LYSIMETERS - SULFATE DATA
(Non-detectable analyses plotted as zero)

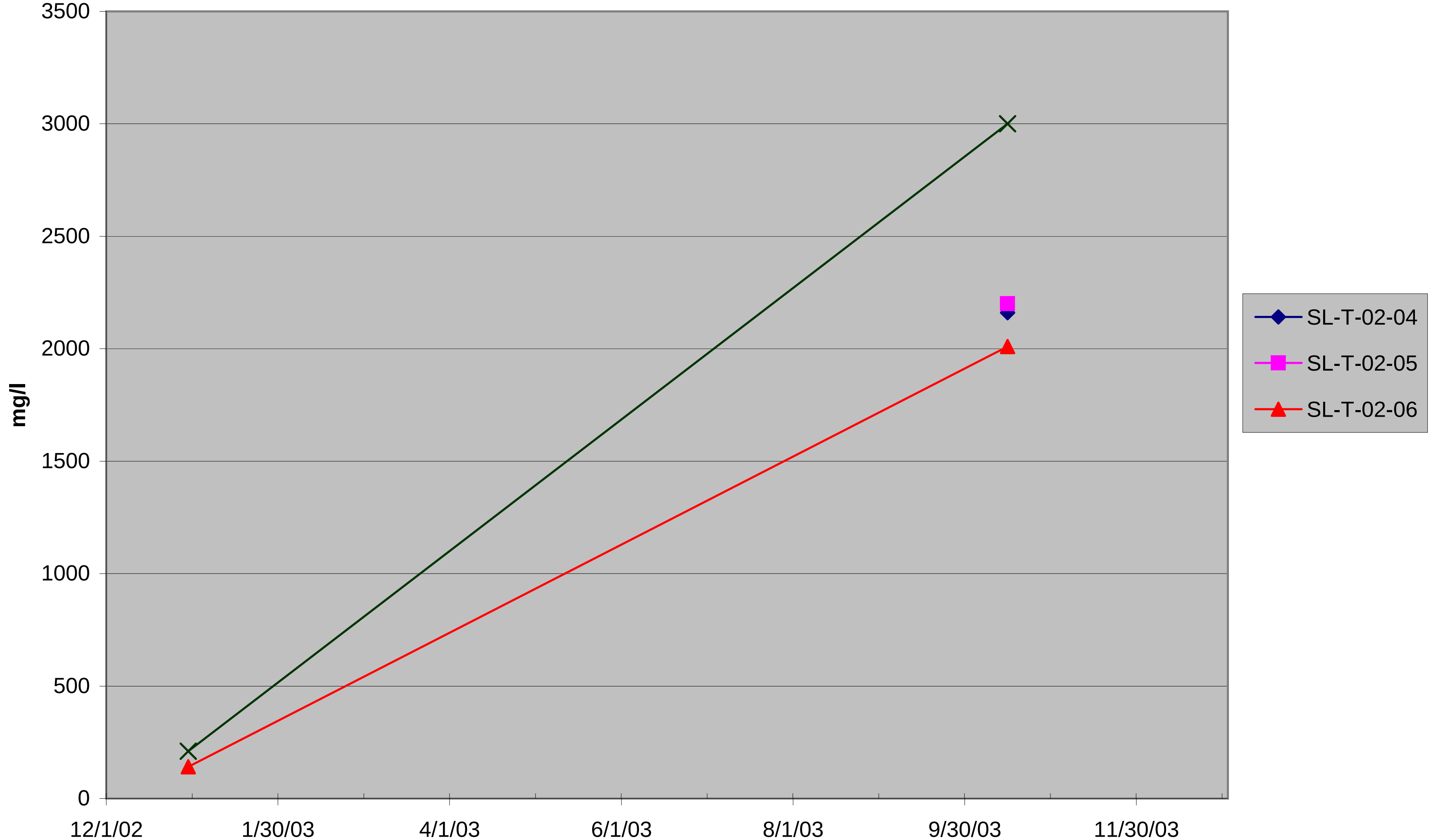


FIGURE 2.25a GREENS CREEK TAILINGS INTERNAL MONITORING SITES: WET WELLS- ARSENIC DATA

(Non-detectable analyses plotted as zero)

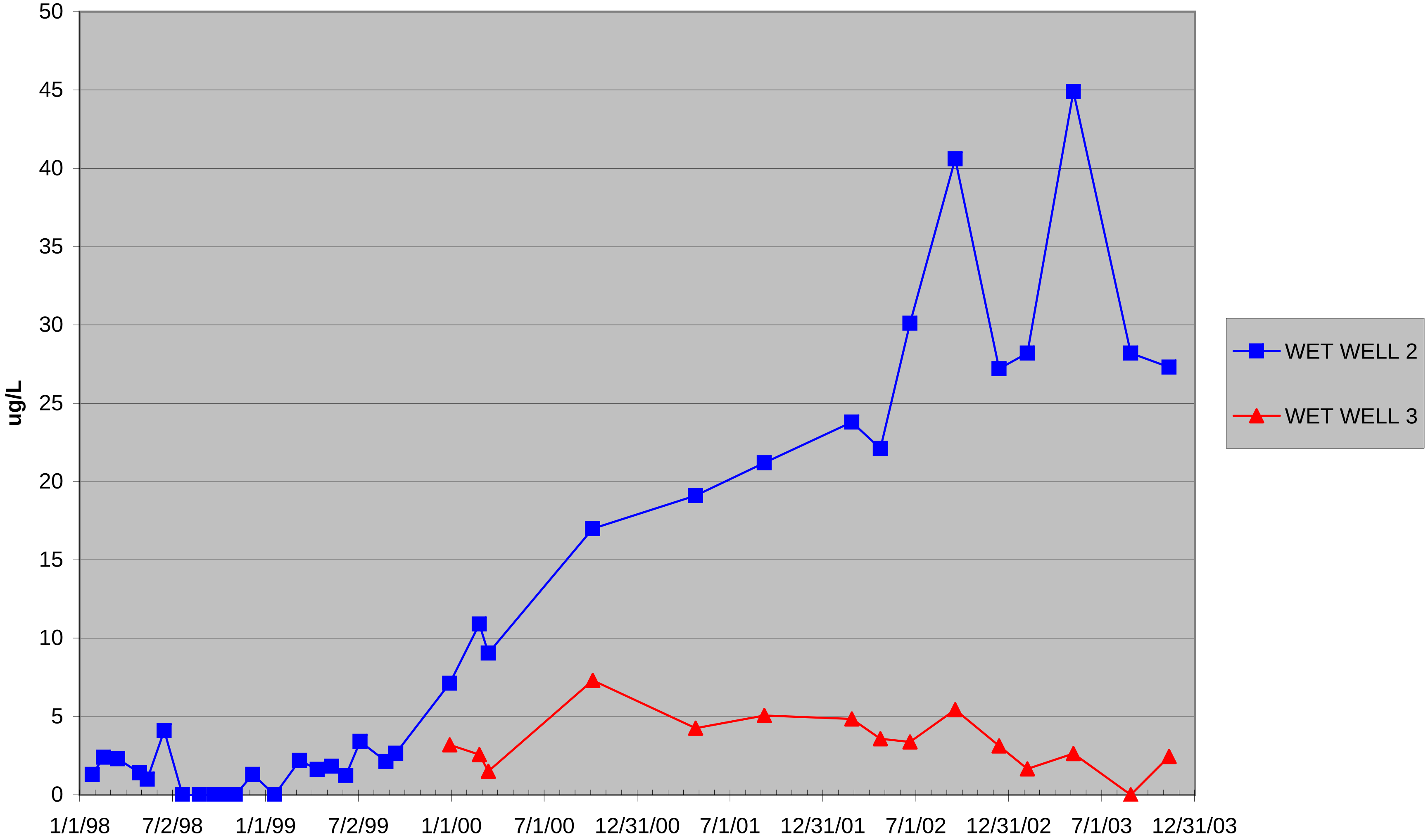


FIGURE 2.25b GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
TAILINGS COMPLETIONS - ARSENIC DATA
(Non-detectable analyses plotted as zero)

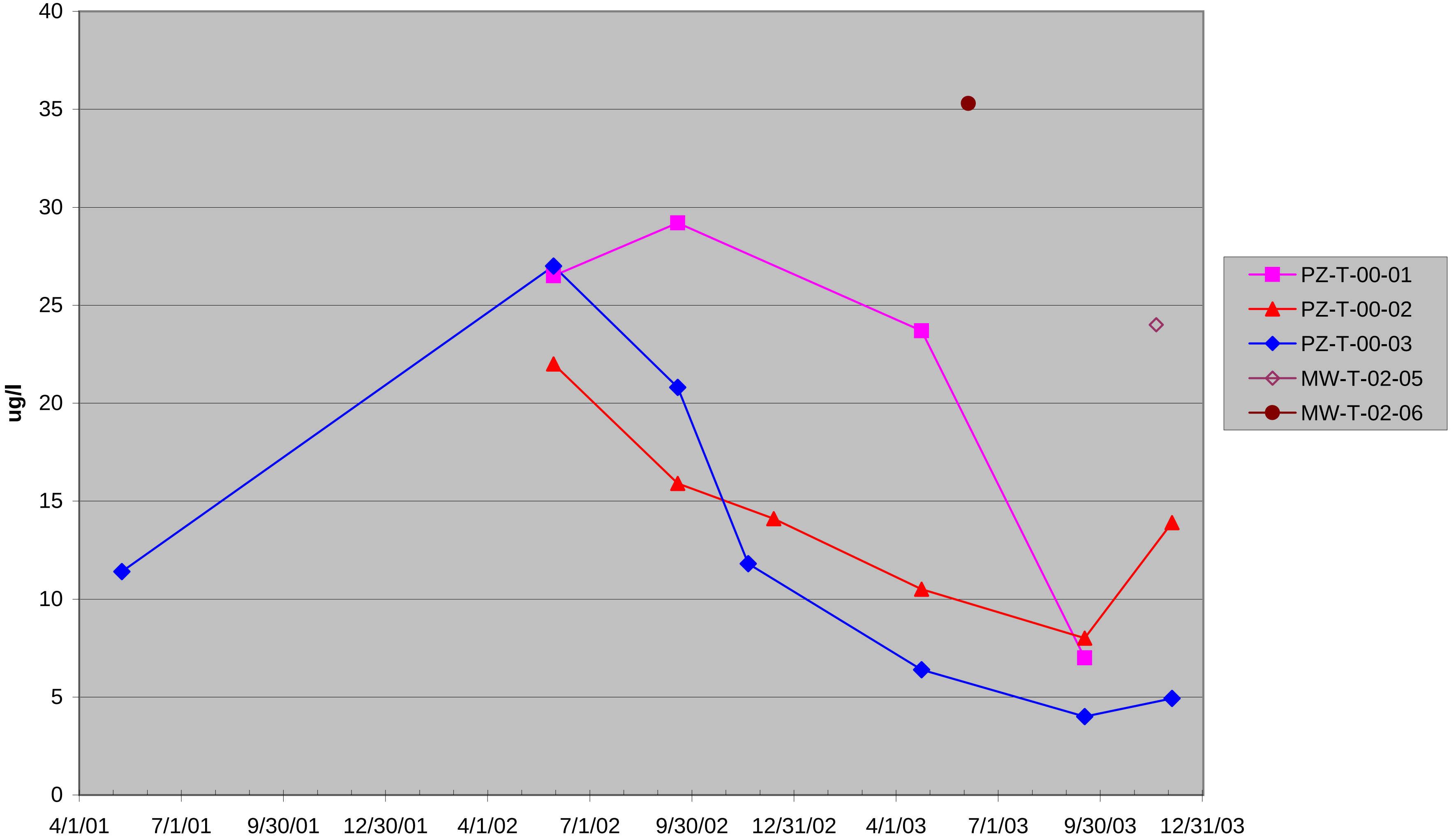


FIGURE 2.25c GREENS CREEK TAILINGS INTERNAL MONITORING SITES: SUCTION LYSIMETERS - ARSENIC DATA

(Non-detectable analyses plotted as zero)

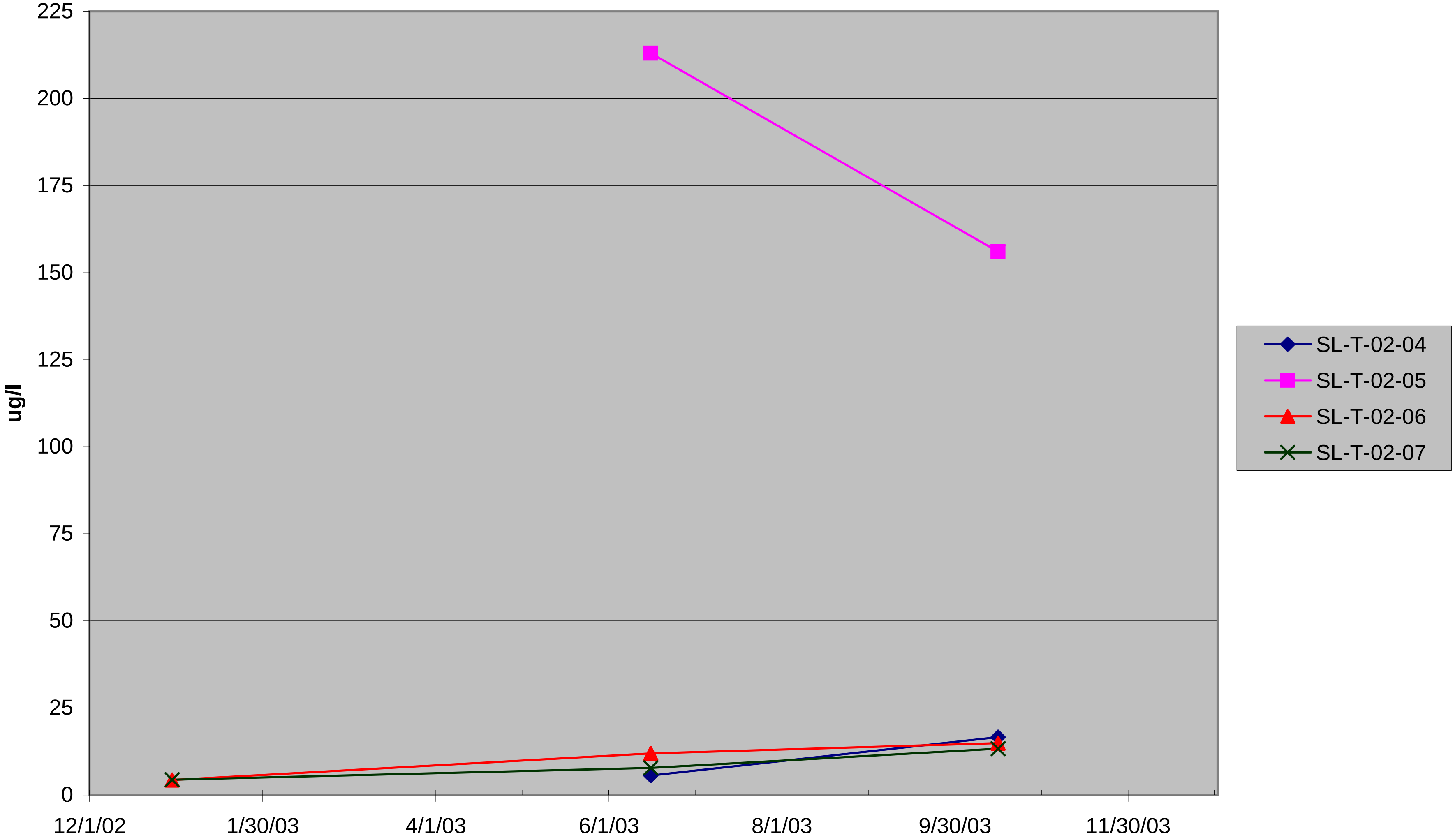


FIGURE 2.26a GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
WET WELLS - ZINC DATA
(Non-detectable analyses plotted as zero)

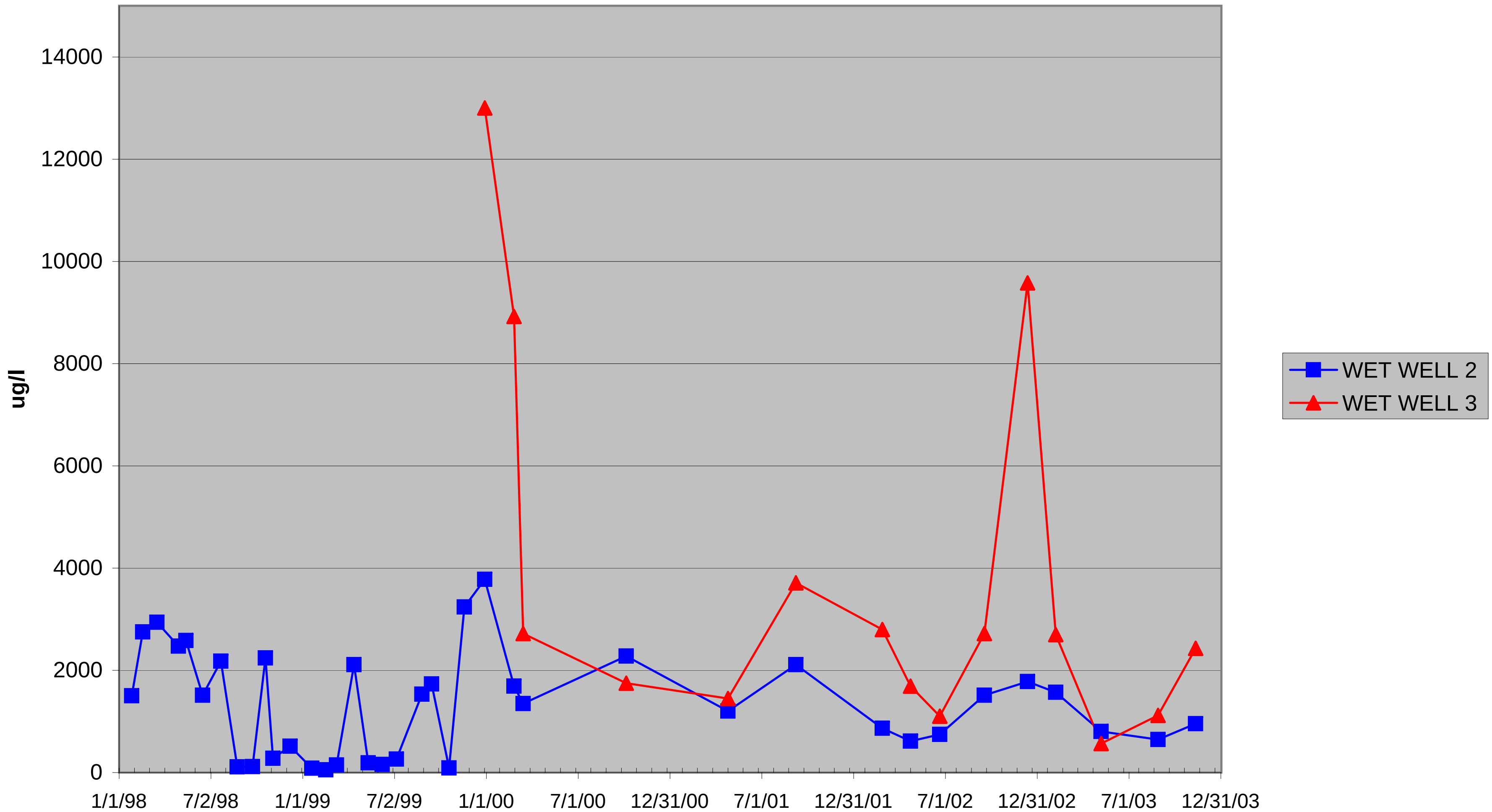


FIGURE 2.26b GREENS CREEK TAILINGS INTERNAL MONITORING SITES: TAILINGS COMPLETIONS - ZINC DATA

(Non-detectable analyses plotted as zero)

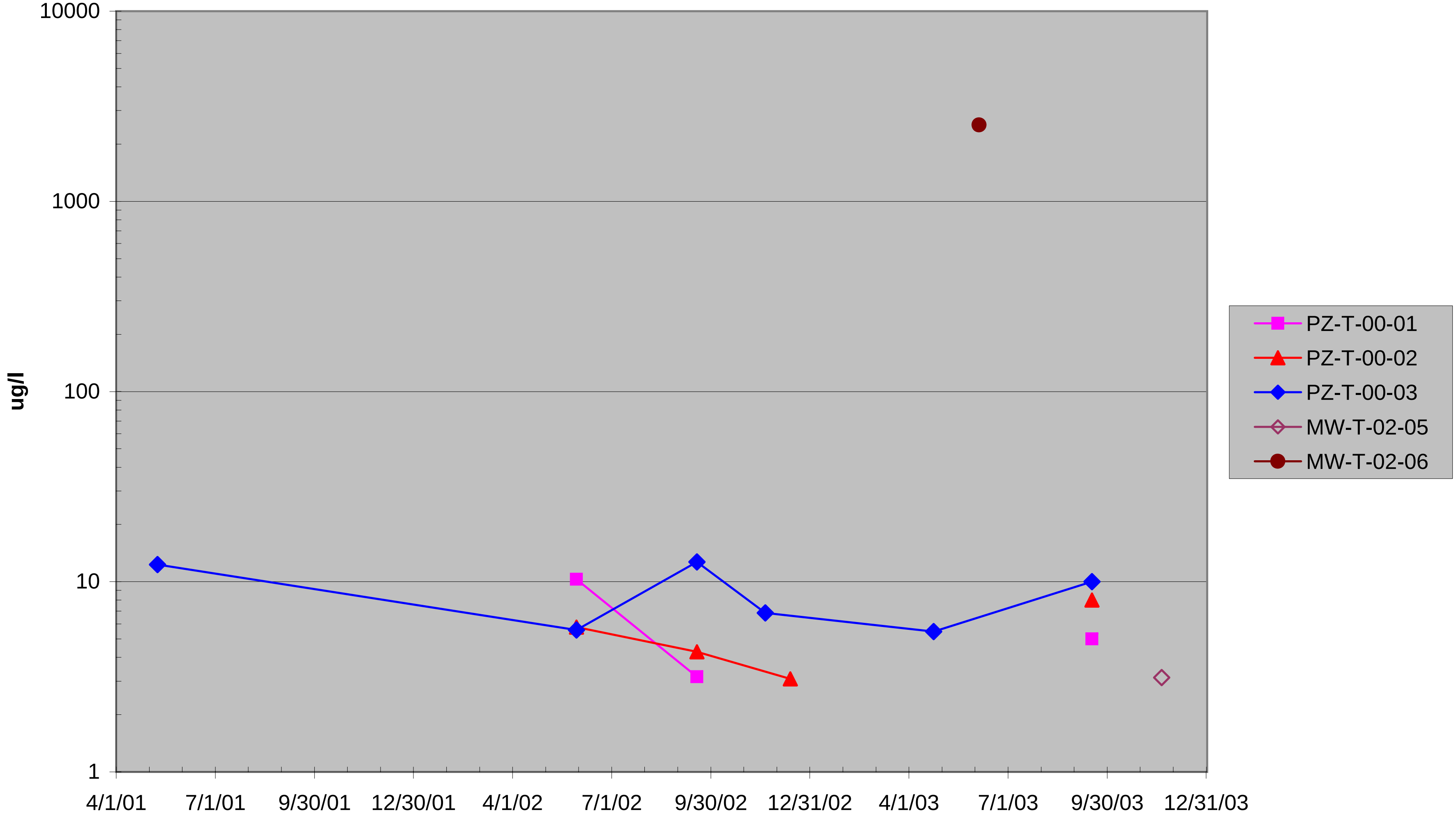


FIGURE 2.26c GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
SUCTION LYSIMETERS - ZINC DATA
(Non-detectable analyses plotted as zero)

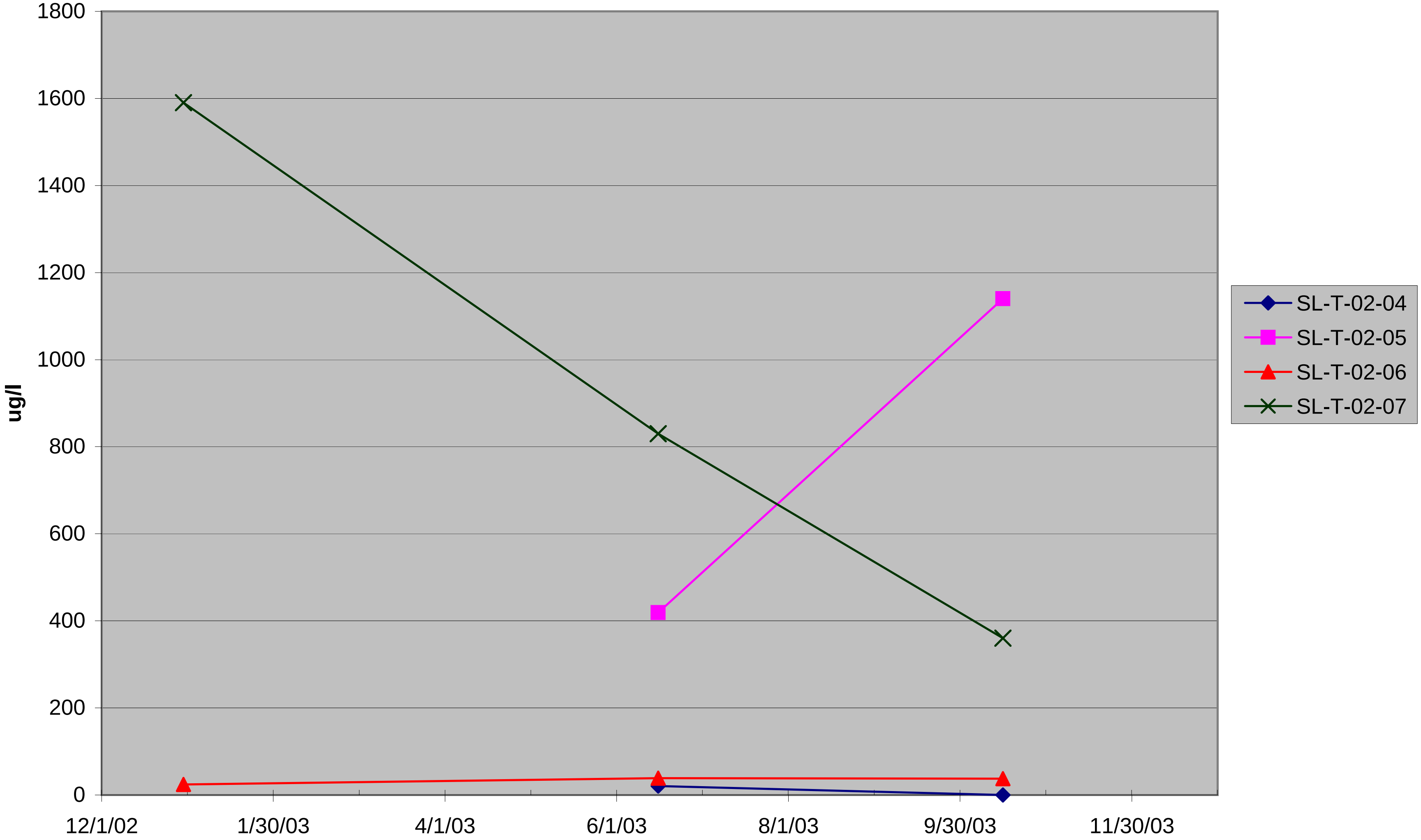


FIGURE 2.27a GREENS CREEK TAILINGS INTERNAL MONITORING SITES: WET WELLS - COPPER DATA
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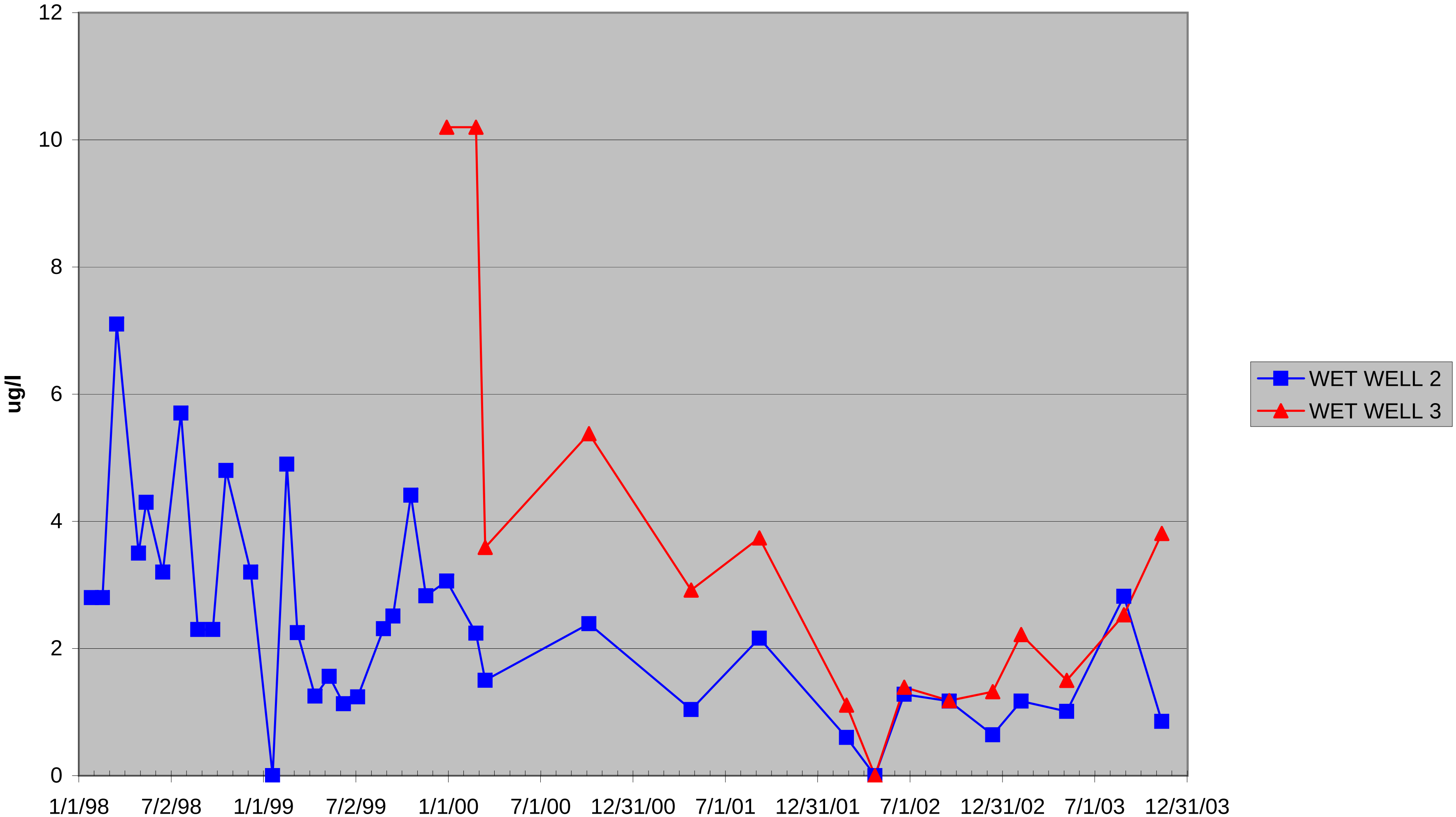


FIGURE 2.27b GREENS CREEK TAILINGS INTERNAL MONITORING SITES: TAILINGS COMPLETIONS - COPPER DATA

(Non-detectable analyses plotted as zero)

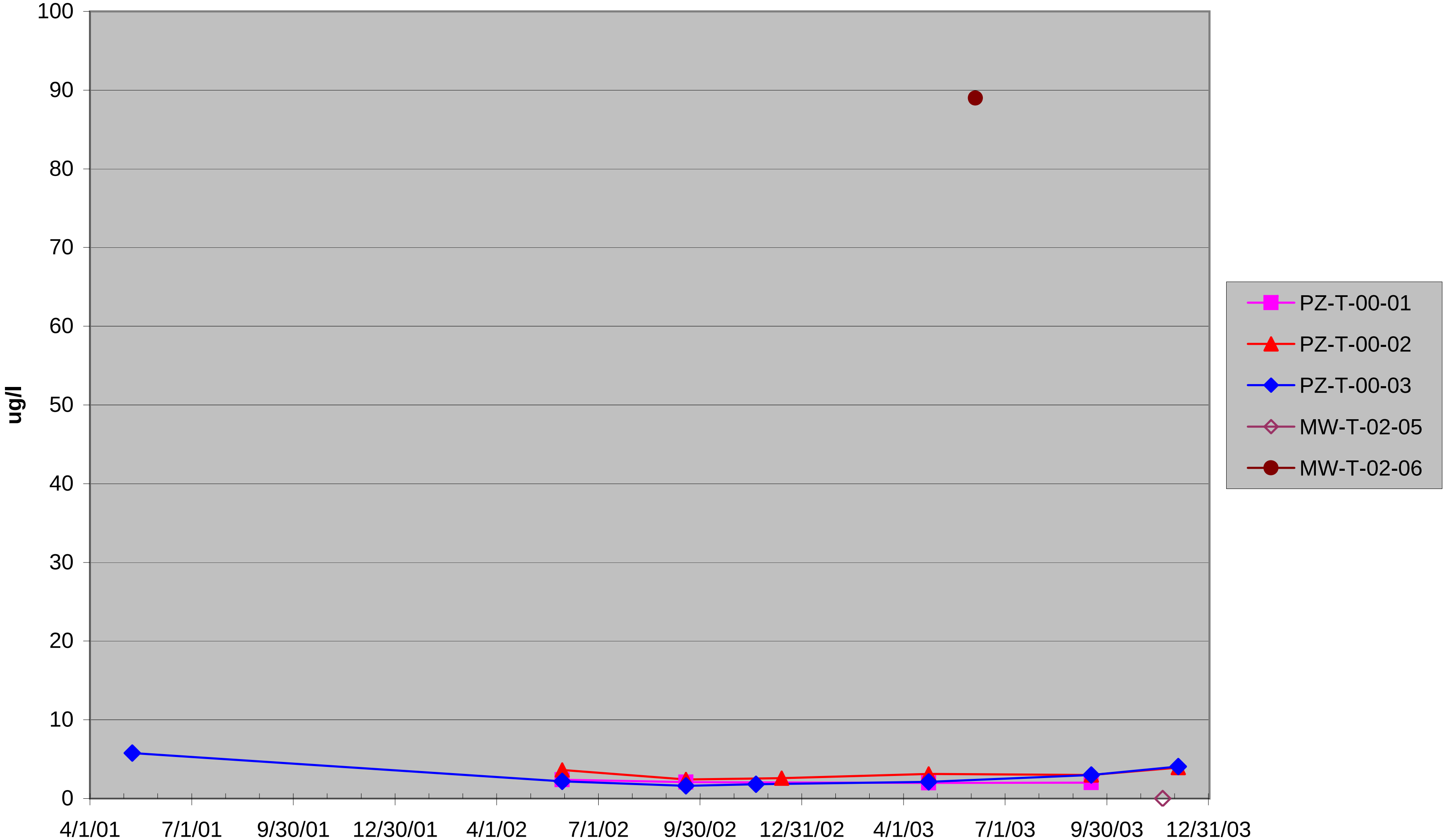


FIGURE 2.27c GREENS CREEK TAILINGS INTERNAL MONITORING SITES: SUCTION LYSIMETERS - COPPER DATA
(Non-detectable analyses plotted as zero)

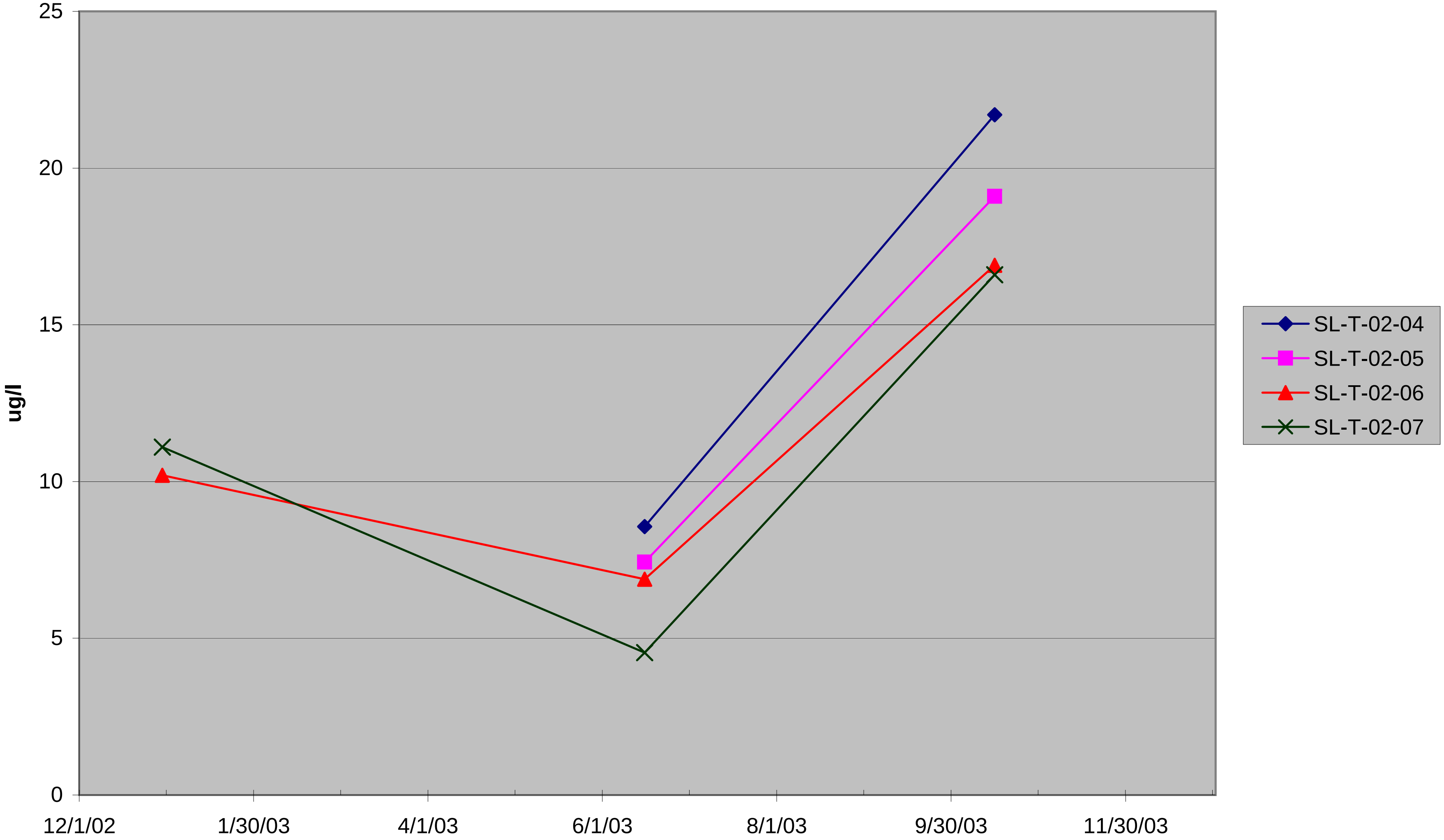


FIGURE 2.28a GREENS CREEK TAILINGS INTERNAL MONITORING SITES: WET WELLS - LEAD DATA

(Non-detectable analyses plotted as zero)

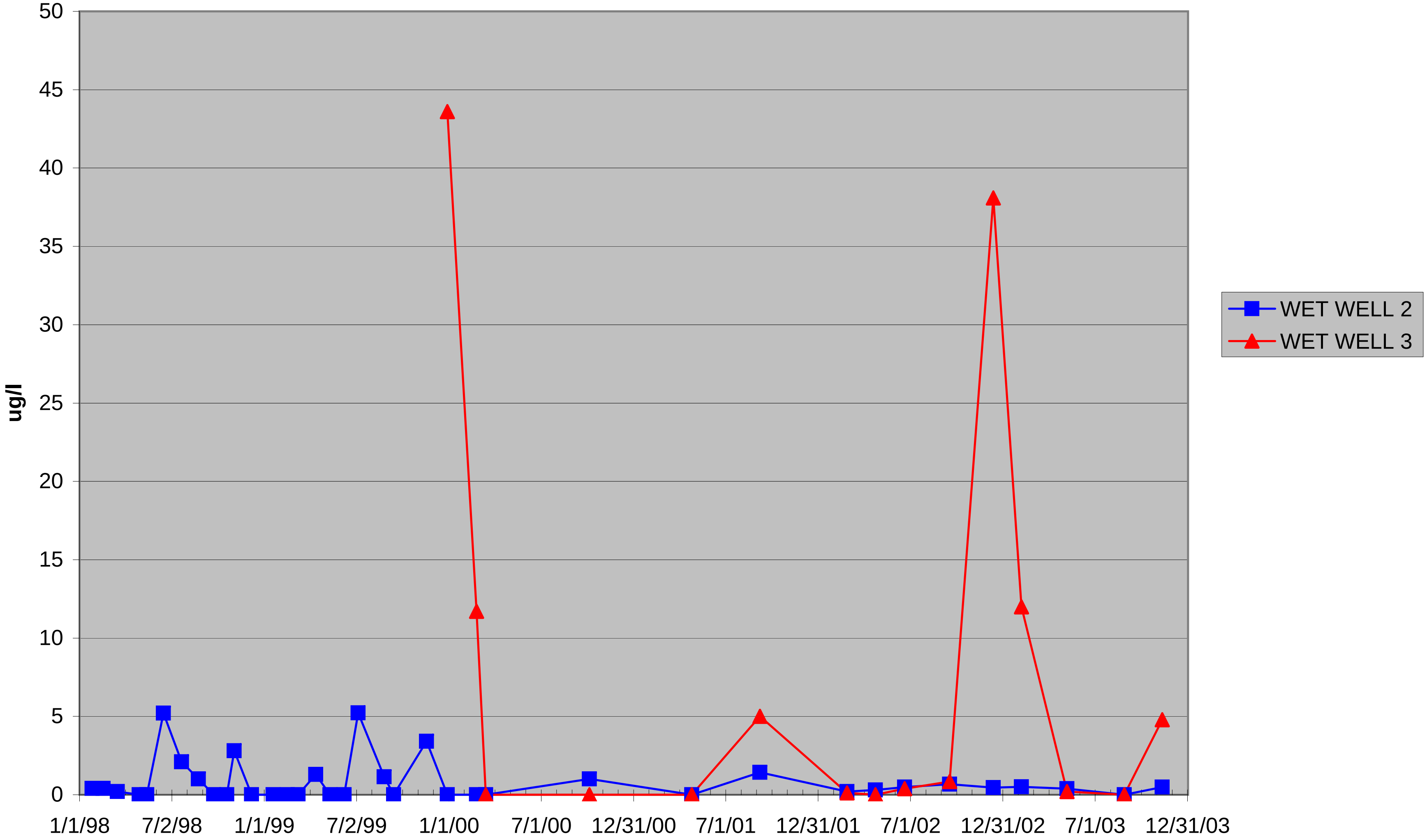


FIGURE 2.28b GREENS CREEK TAILINGS INTERNAL MONITORING SITES: TAILINGS COMPLETIONS - LEAD DATA

(Non-detectable analyses plotted as zero)

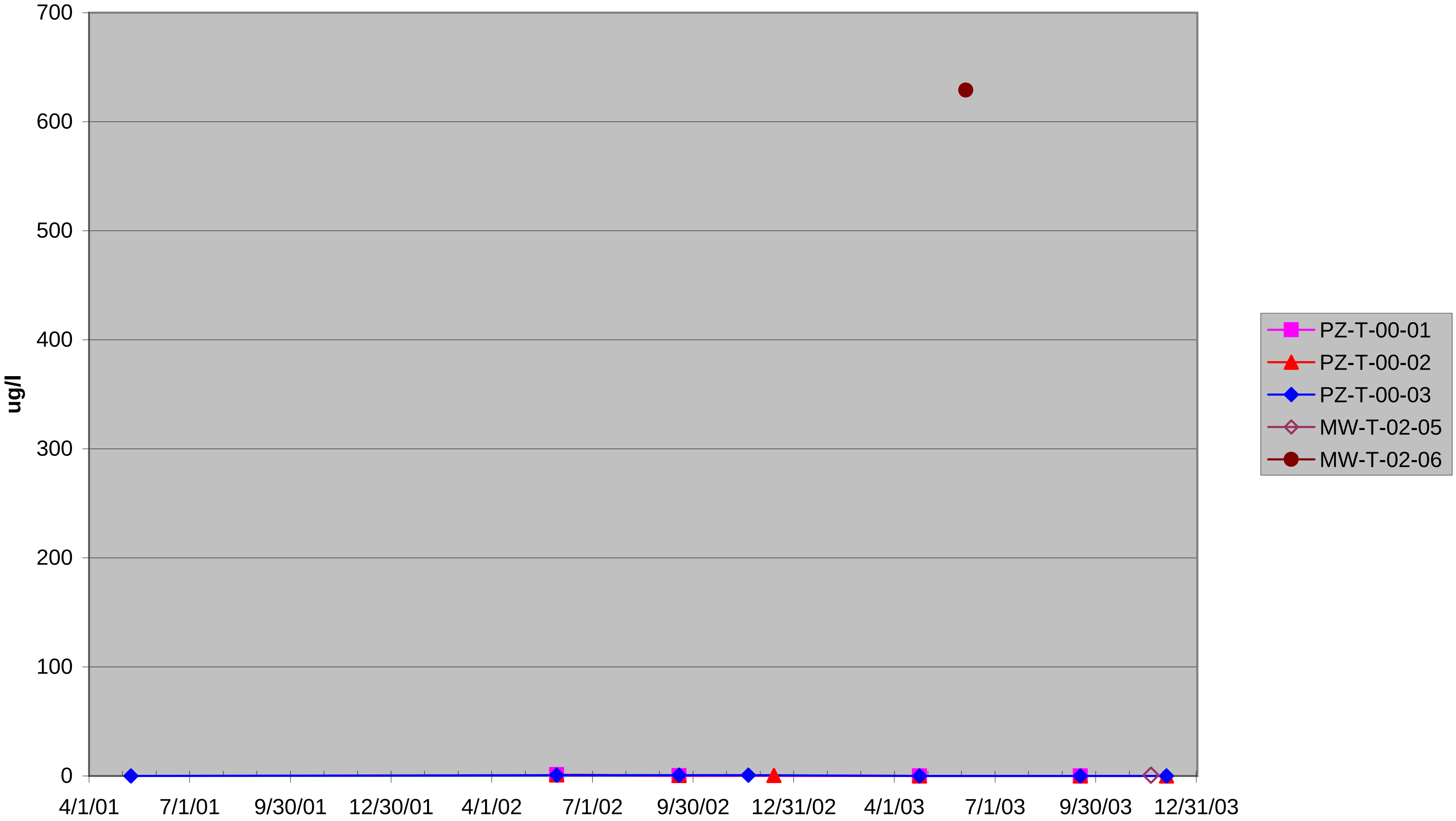


FIGURE 2.28c GREENS CREEK TAILINGS INTERNAL MONITORING SITES: SUCTION LYSIMETERS - LEAD DATA

(Non-detectable analyses plotted as zero)

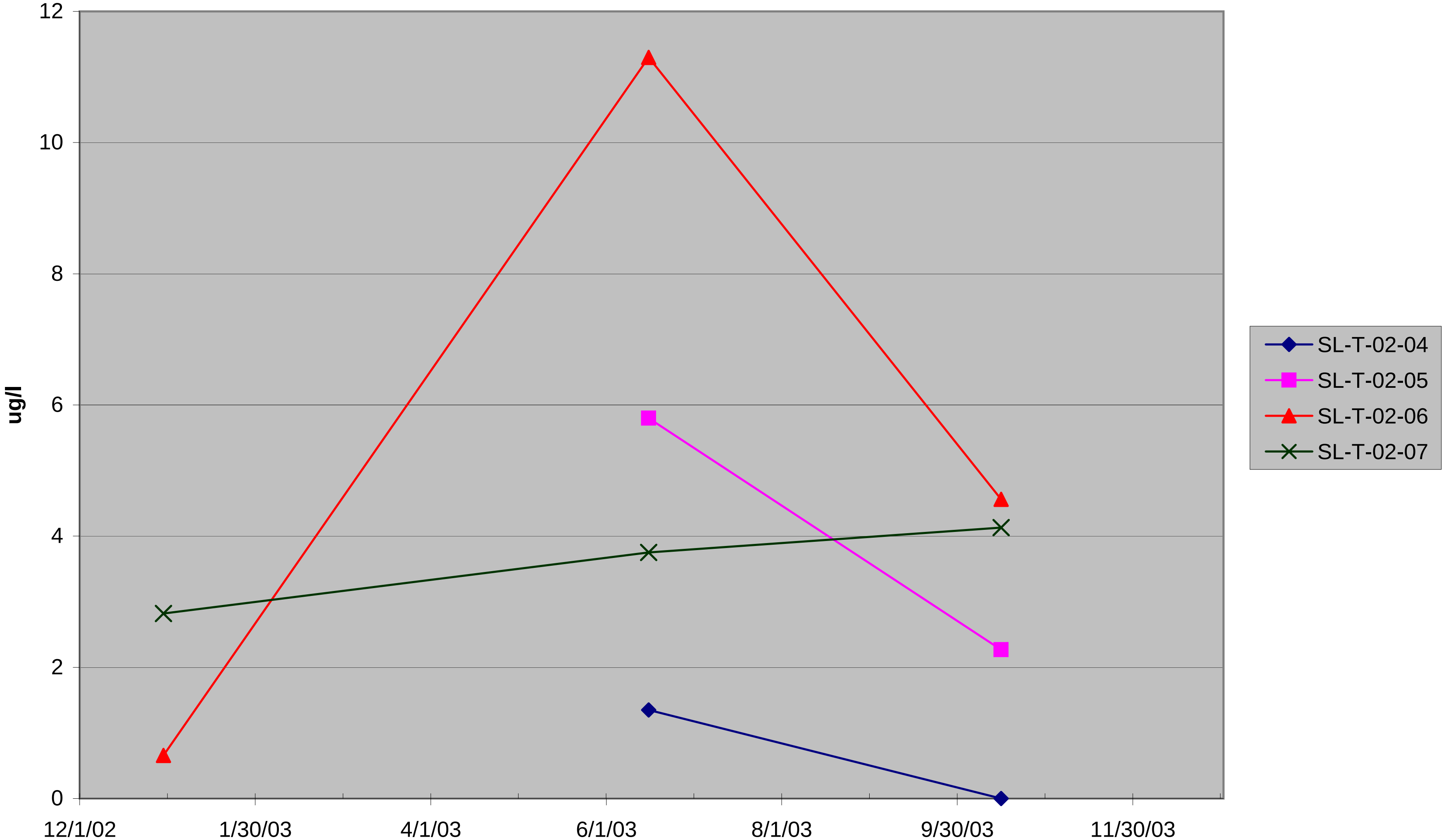


FIGURE 2.29a GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
WET WELLS - CADMIUM DATA
(Non-detectable analyses plotted as zero)

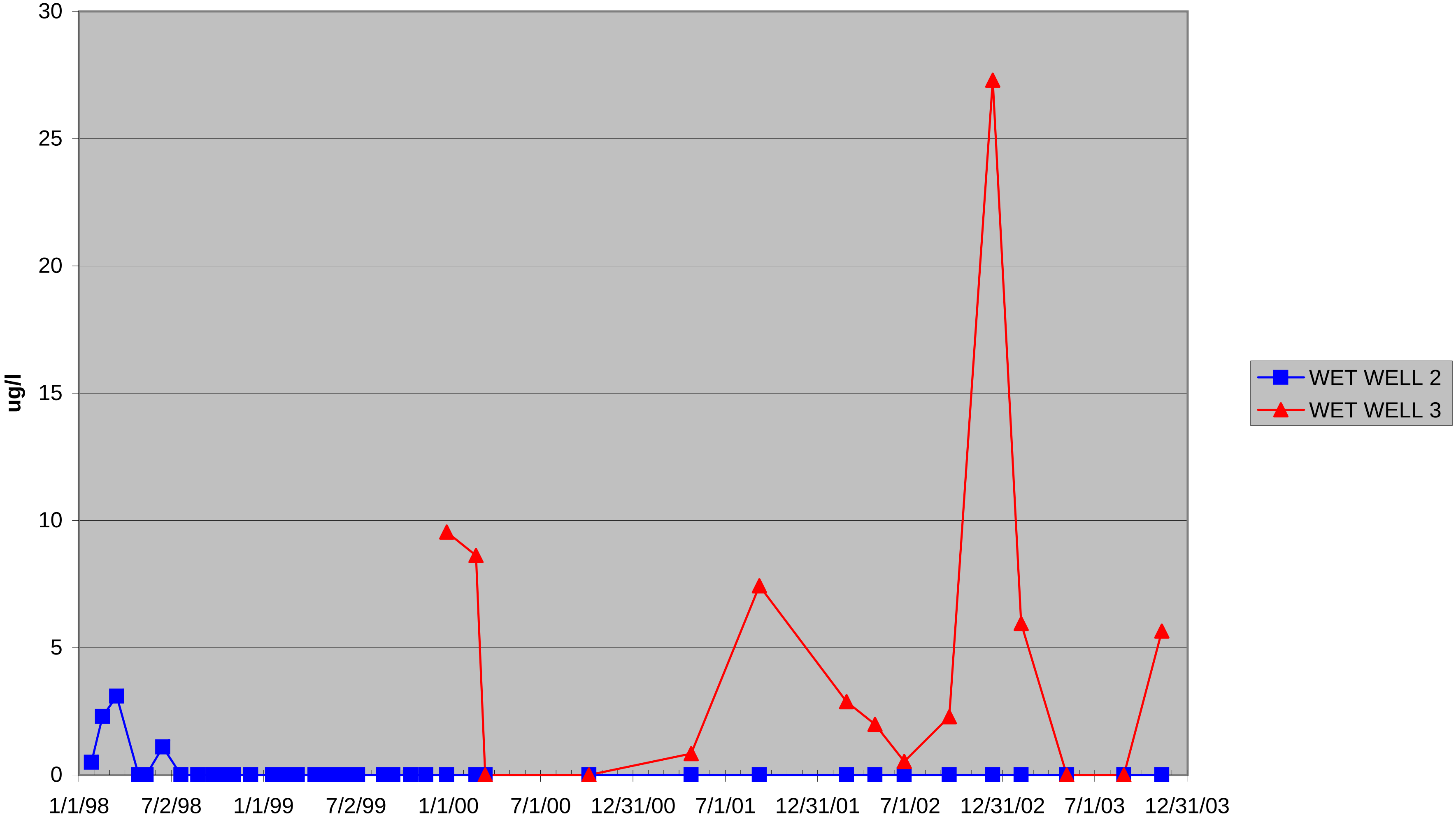


FIGURE 2.29b GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
TAILINGS COMPLETIONS - CADMIUM DATA
(Non-detectable analyses plotted as zero)

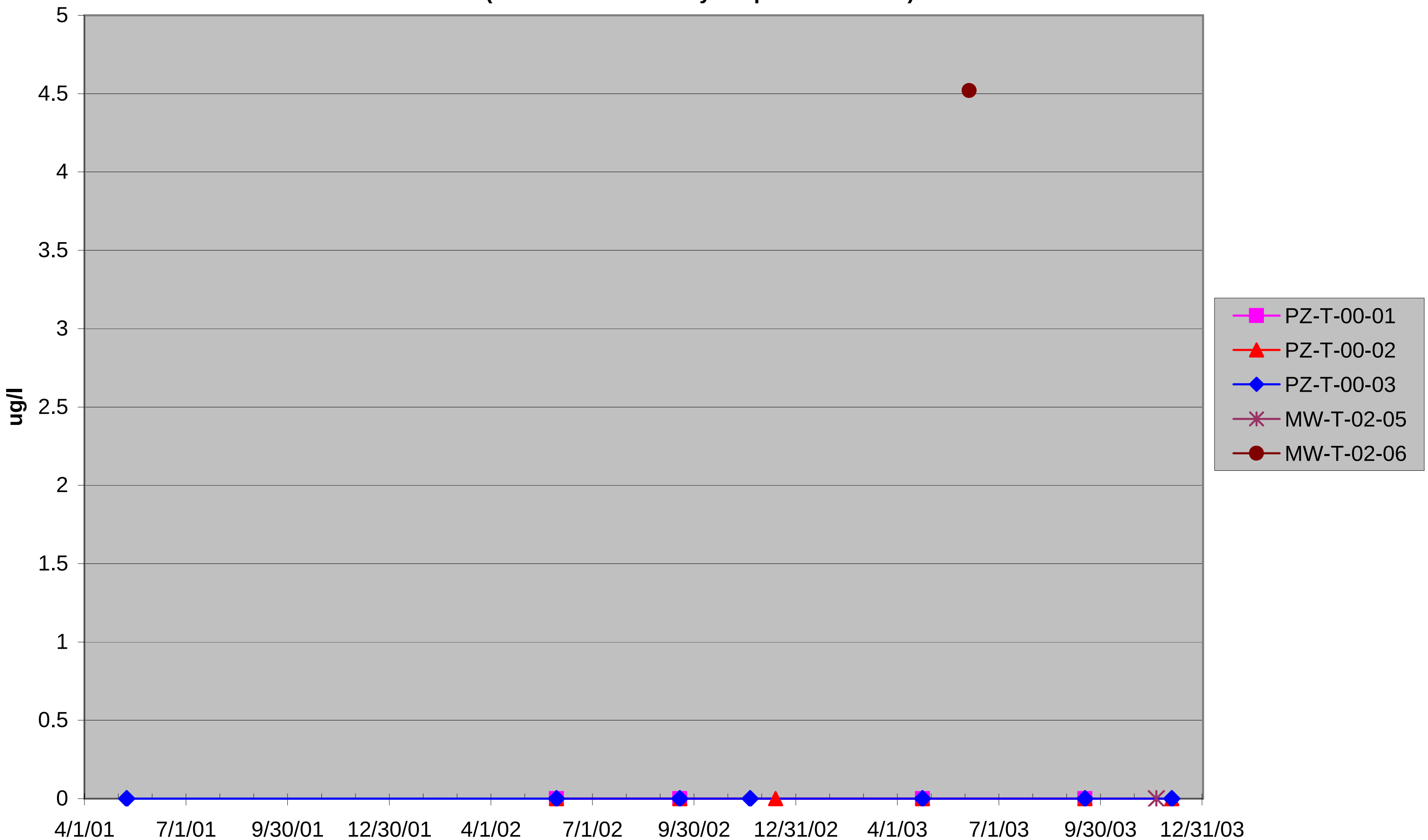


FIGURE 2.29c GREENS CREEK TAILINGS INTERNAL MONITORING SITES: SUCTION LYSIMETERS - CADMIUM DATA

(Non-detectable analyses plotted as zero)

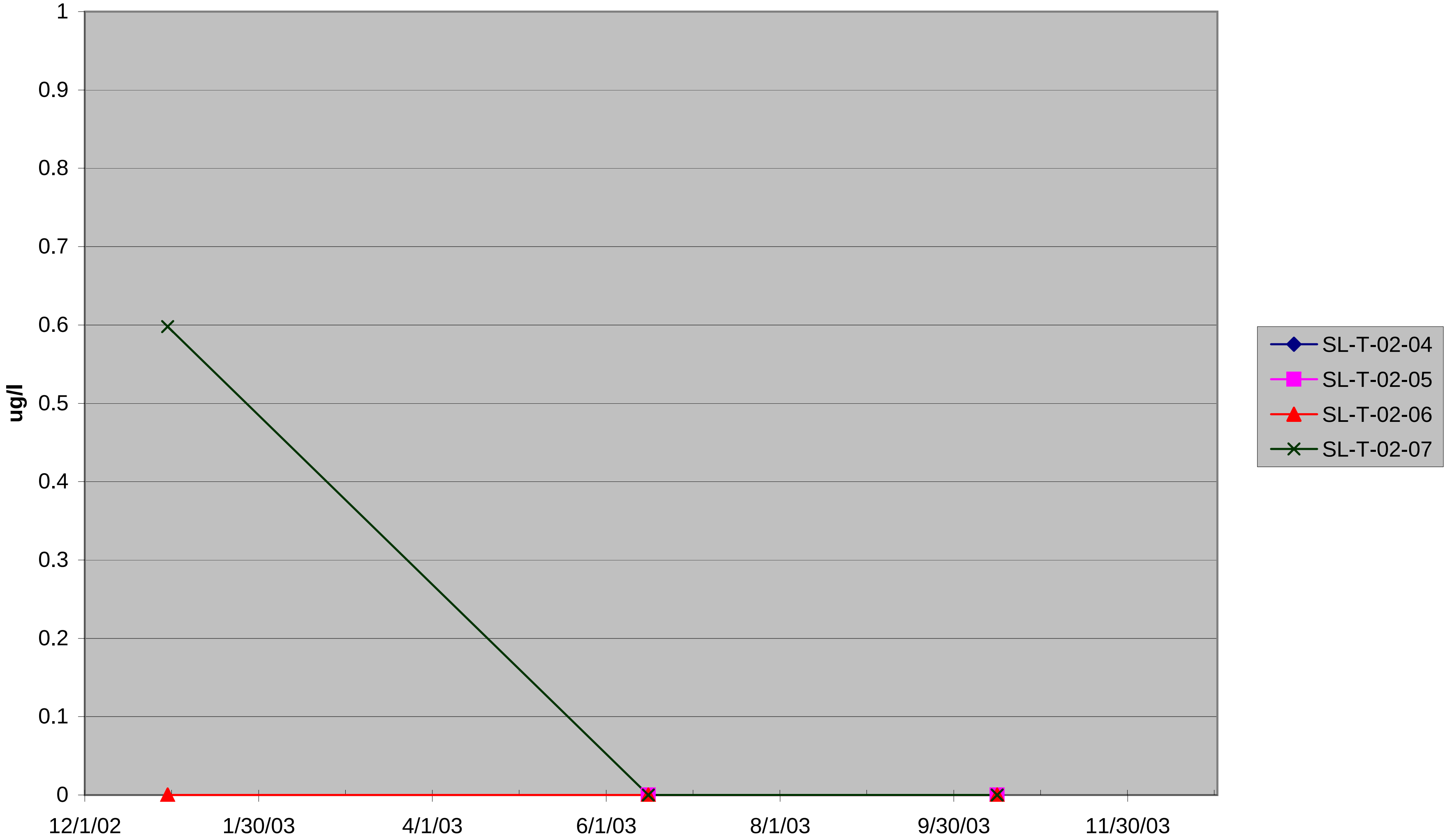


FIGURE 2.30 TAILINGS MONTHLY COMPOSITE ABA RESULTS

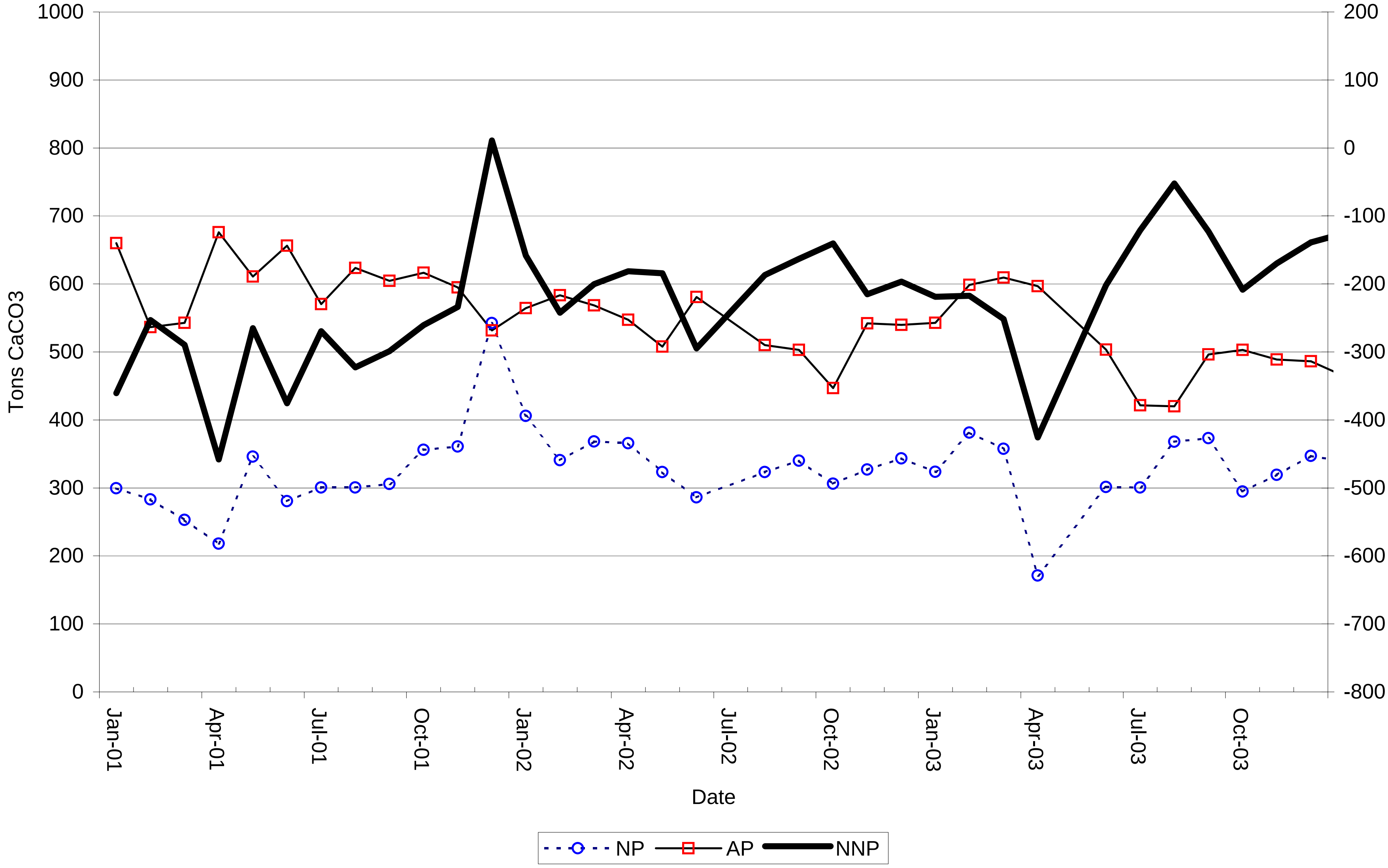


FIGURE 3.1 PRESSURE DATA FOR PIEZOMETER 52

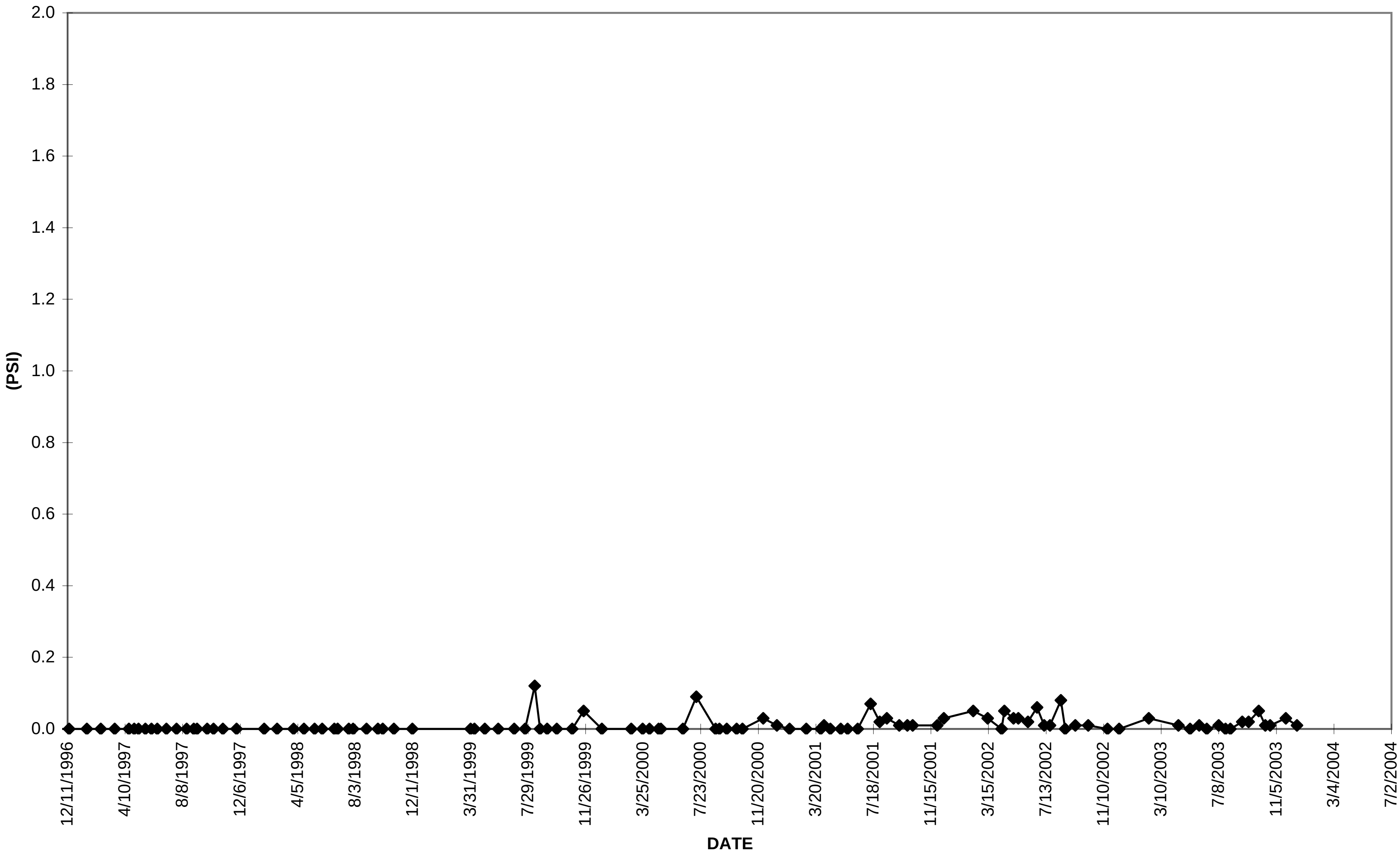


FIGURE 3.2 PRESSURE DATA FOR PIEZOMETER 53

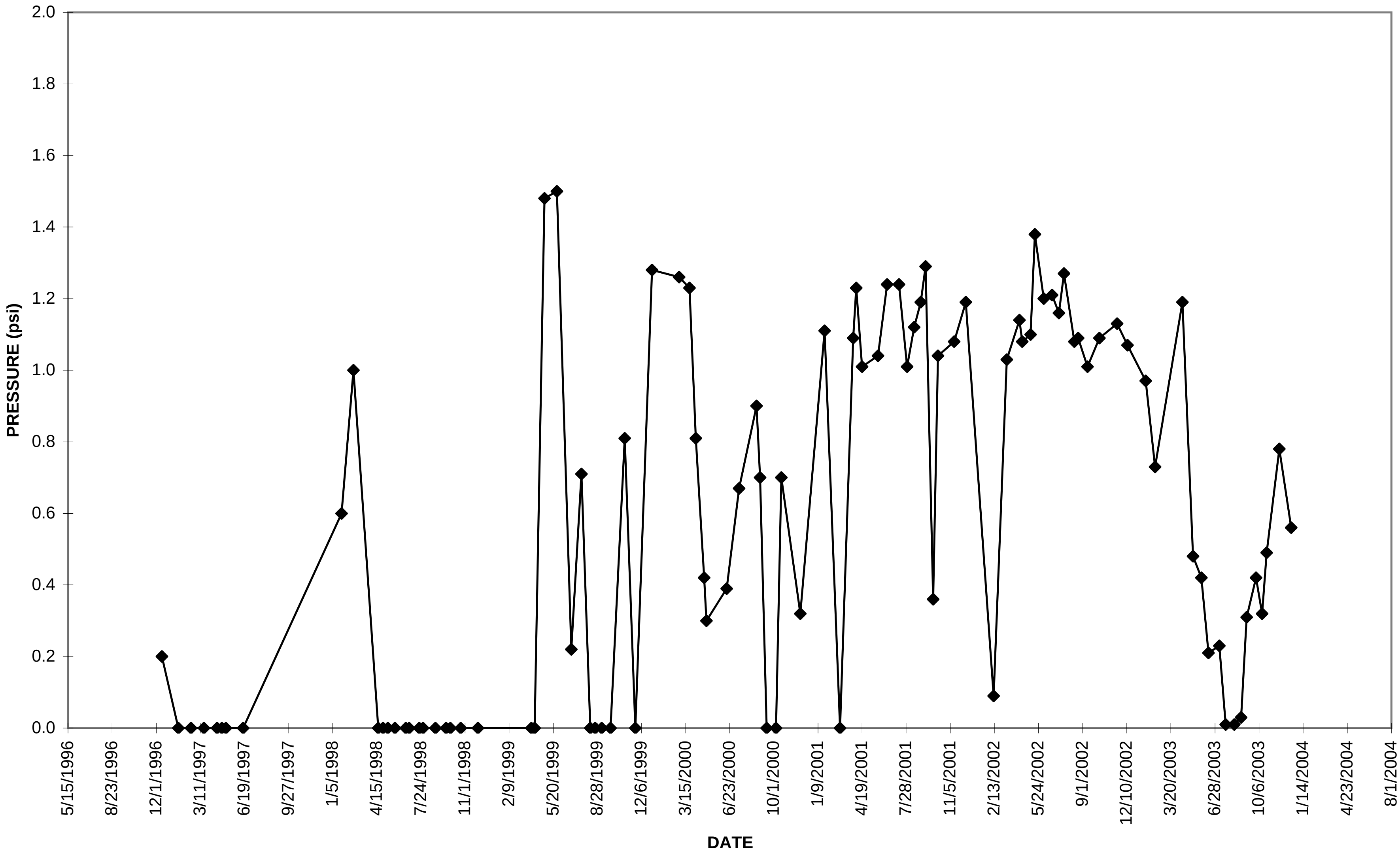


FIGURE 3.3 PRESSURE DATA FOR PIEZOMETER 54

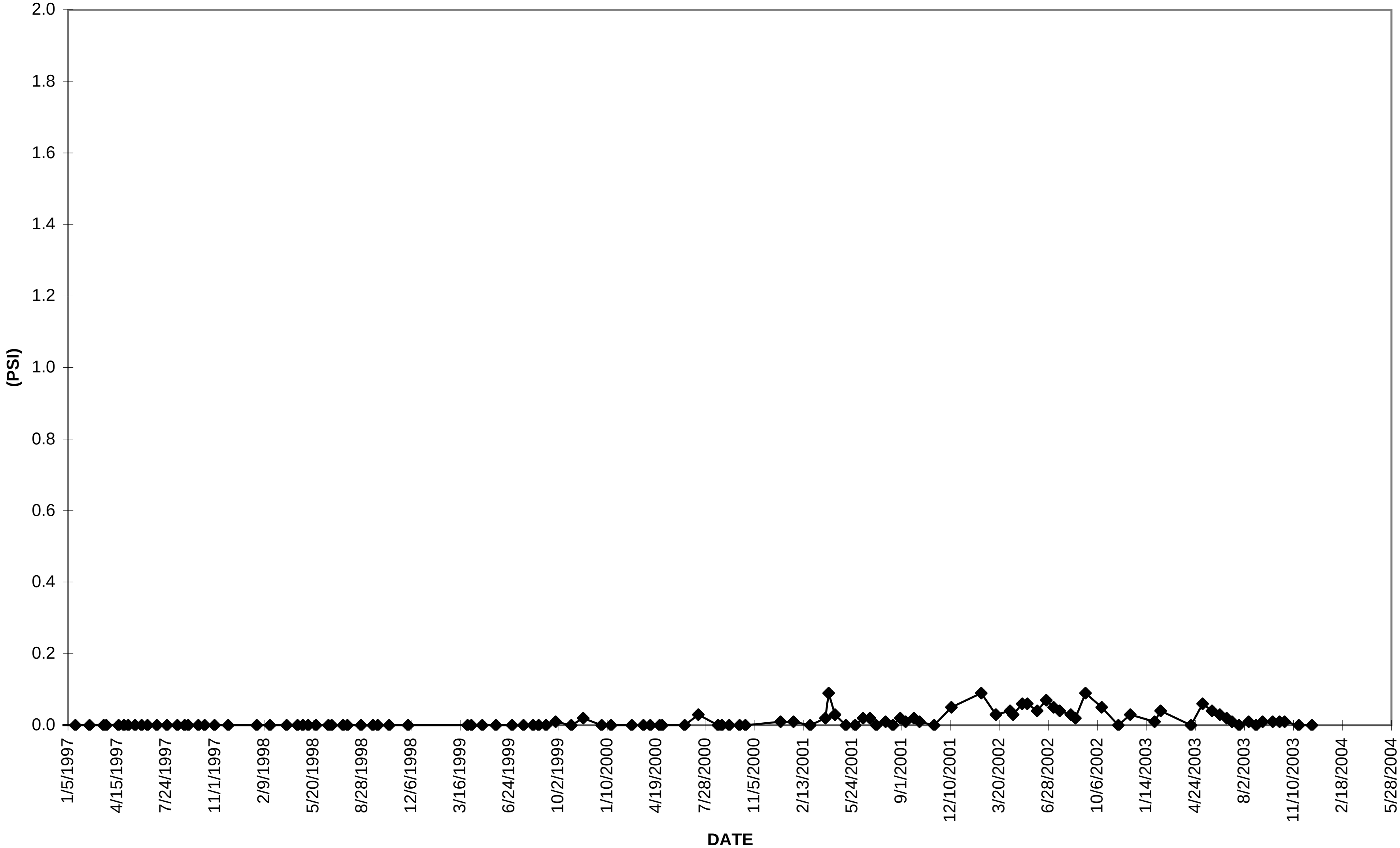


FIGURE 3.4 PRESSURE DATA FOR PIEZOMETER 55

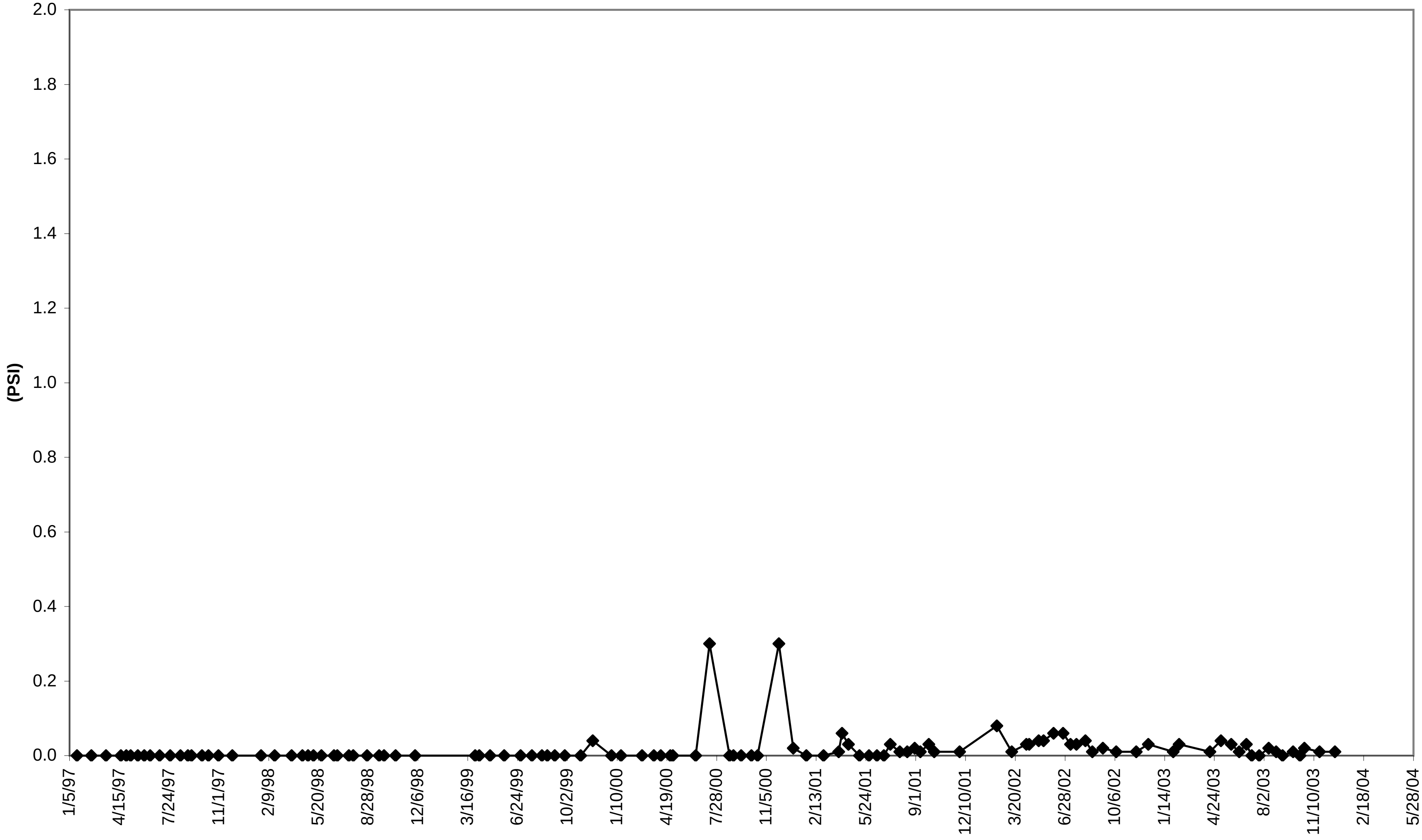


FIGURE 3.5 WATER LEVEL DATA FOR WELL MW-23/D-00-03

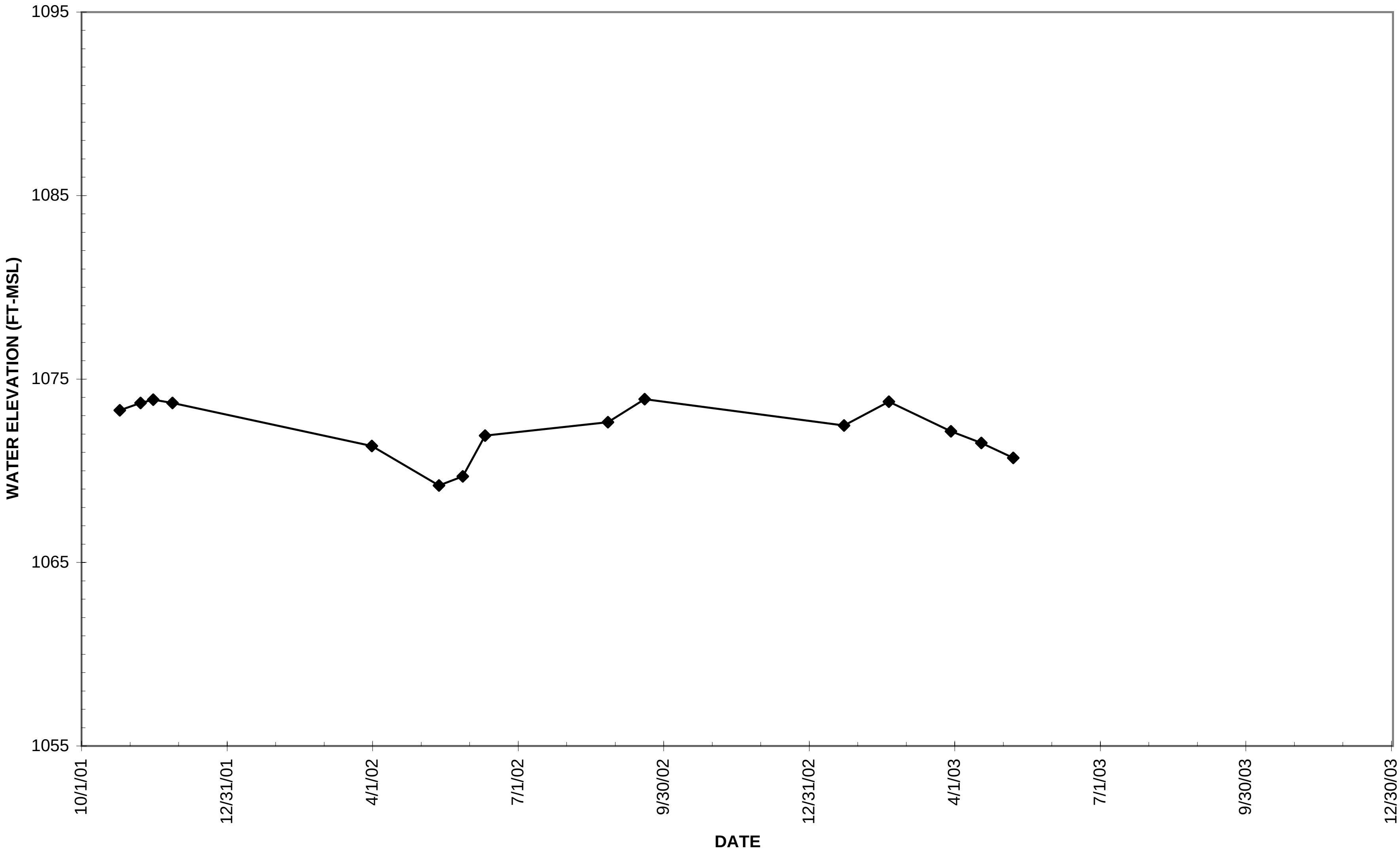


FIGURE 3.6 WATER LEVEL DATA FOR WELL MW-23-A2D

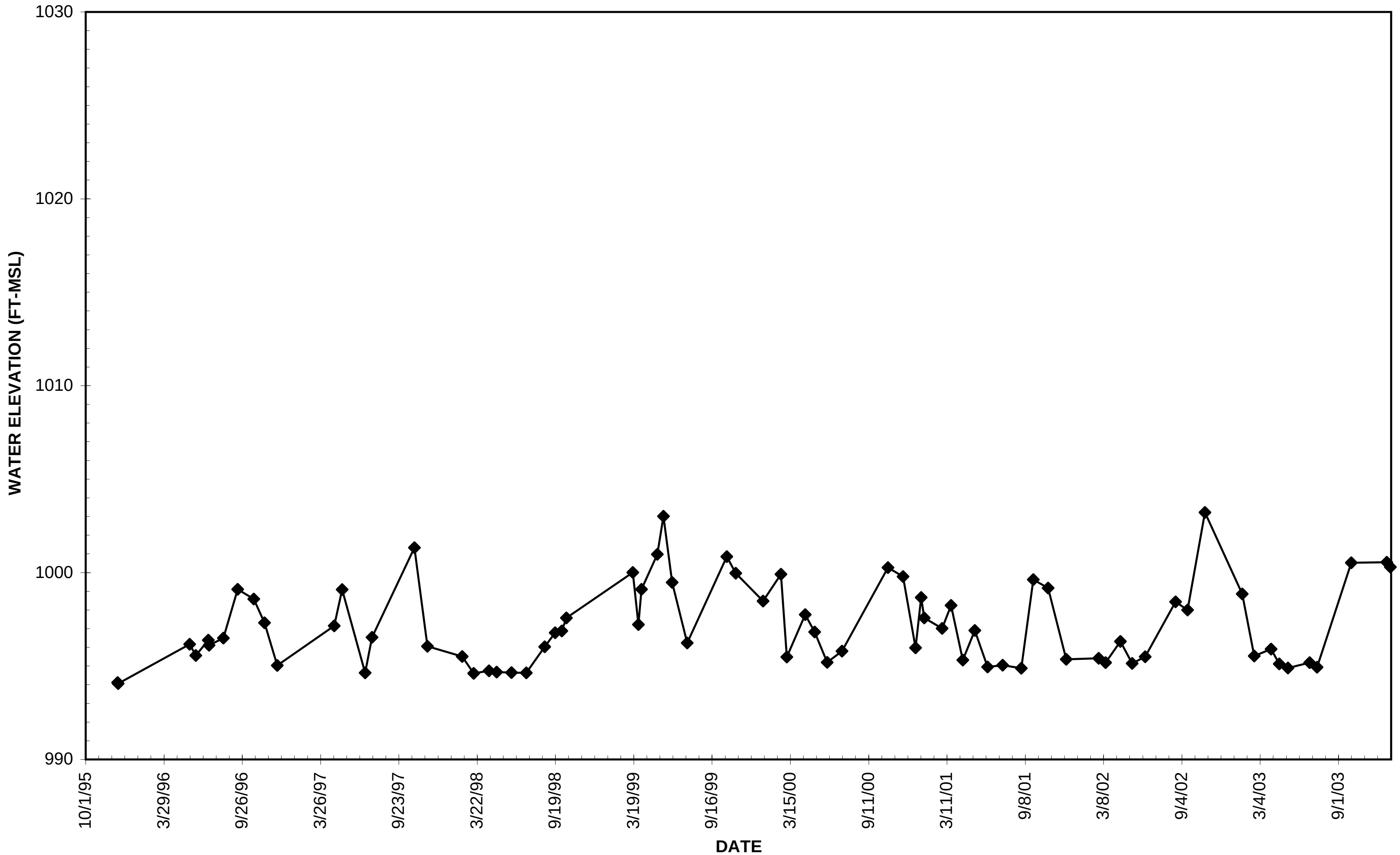


FIGURE 3.7 WATER LEVEL DATA FOR WELL MW-23-A2S

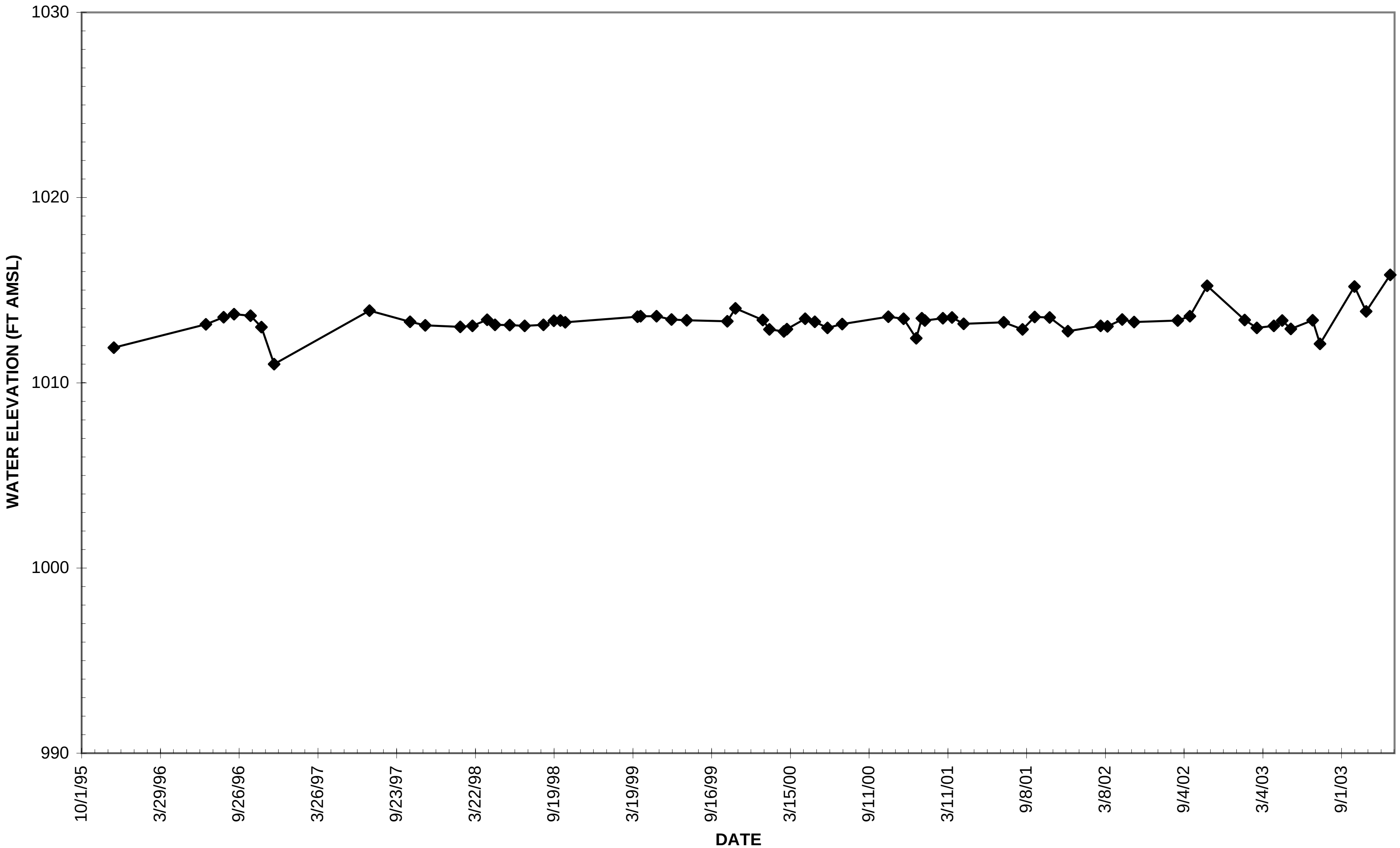


FIGURE 3.8 DEPTH TO WATER DATA FOR WELL MW-23-98-01

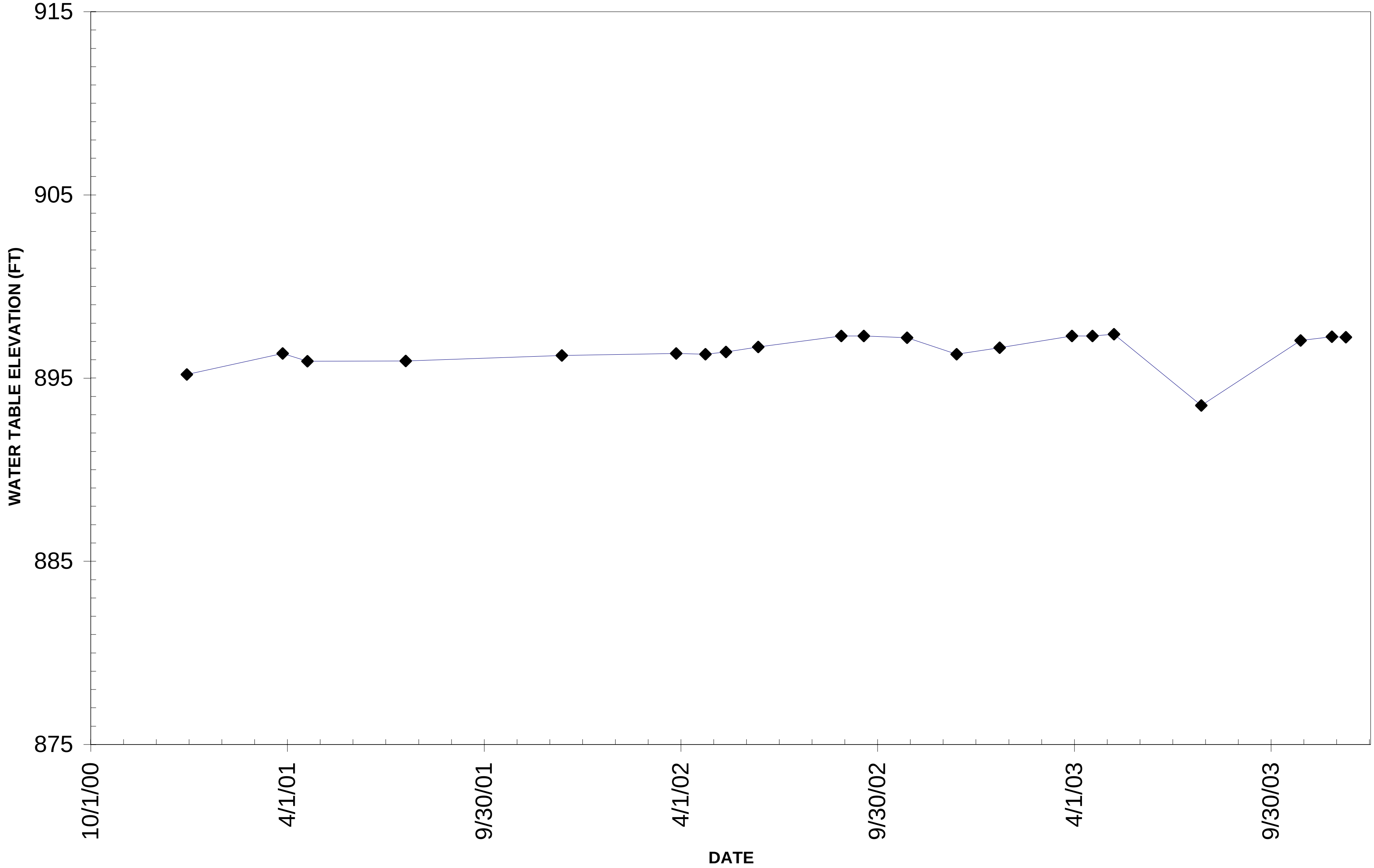


FIGURE 3.9 WATER LEVEL DATA FOR WELL MW-23-A4

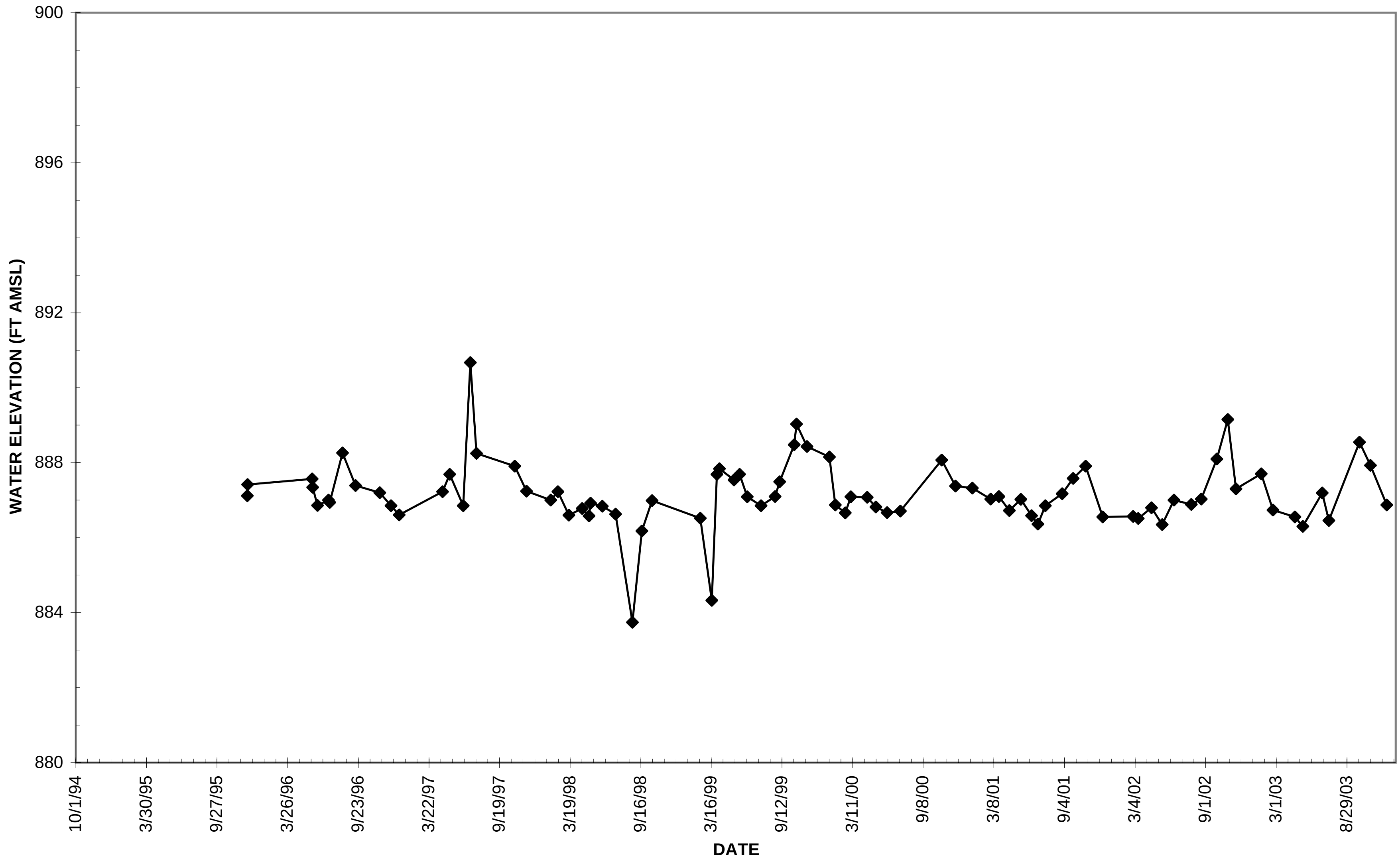


FIGURE 3.10 WATER LEVEL DATA FOR WELL MW-23/D-00-01

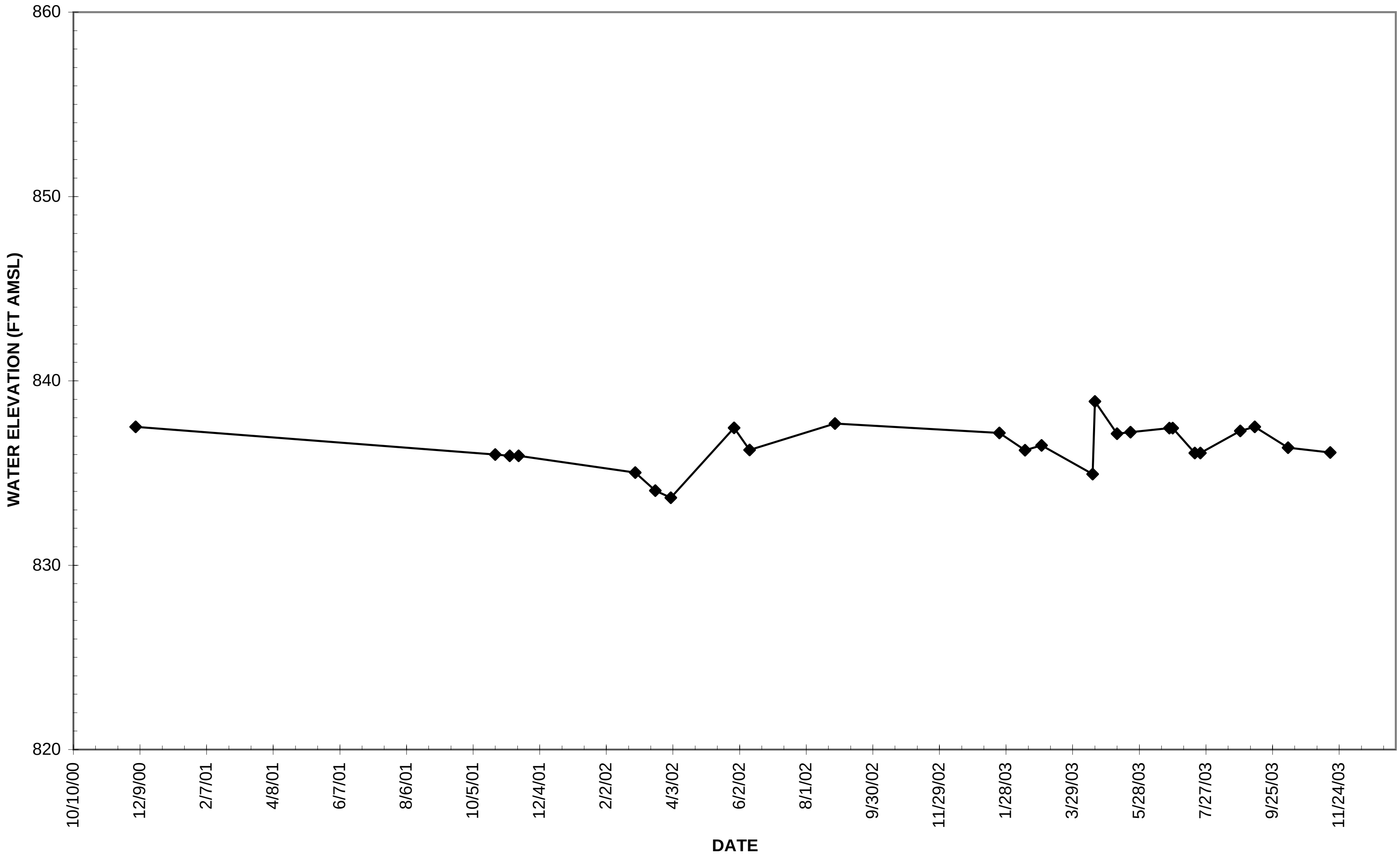


FIGURE 3.11 WATER LEVEL DATA FOR WELL MW-D-94-D3

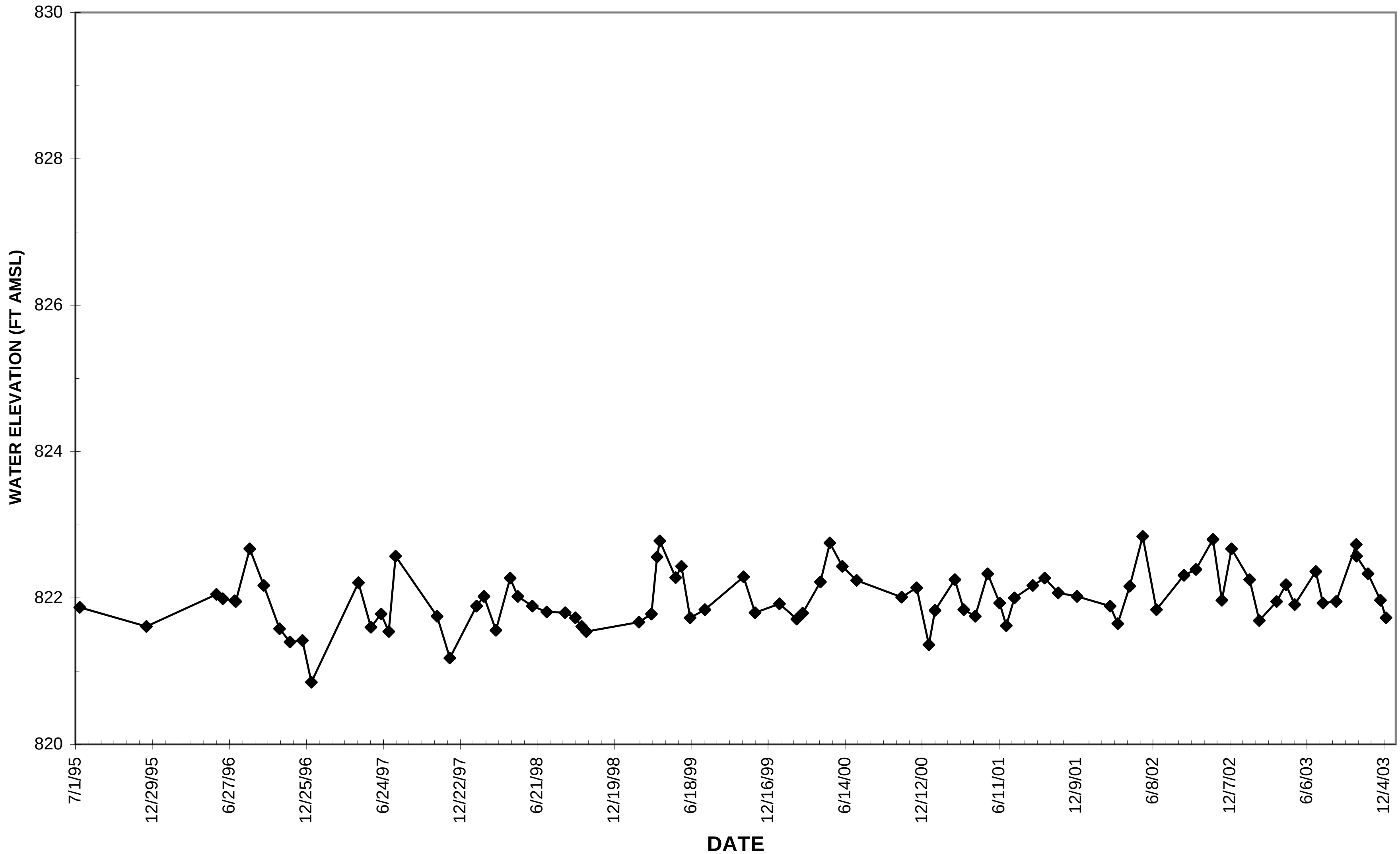


FIGURE 3.12 WATER LEVEL DATA FOR WELL MW-D-94-D4

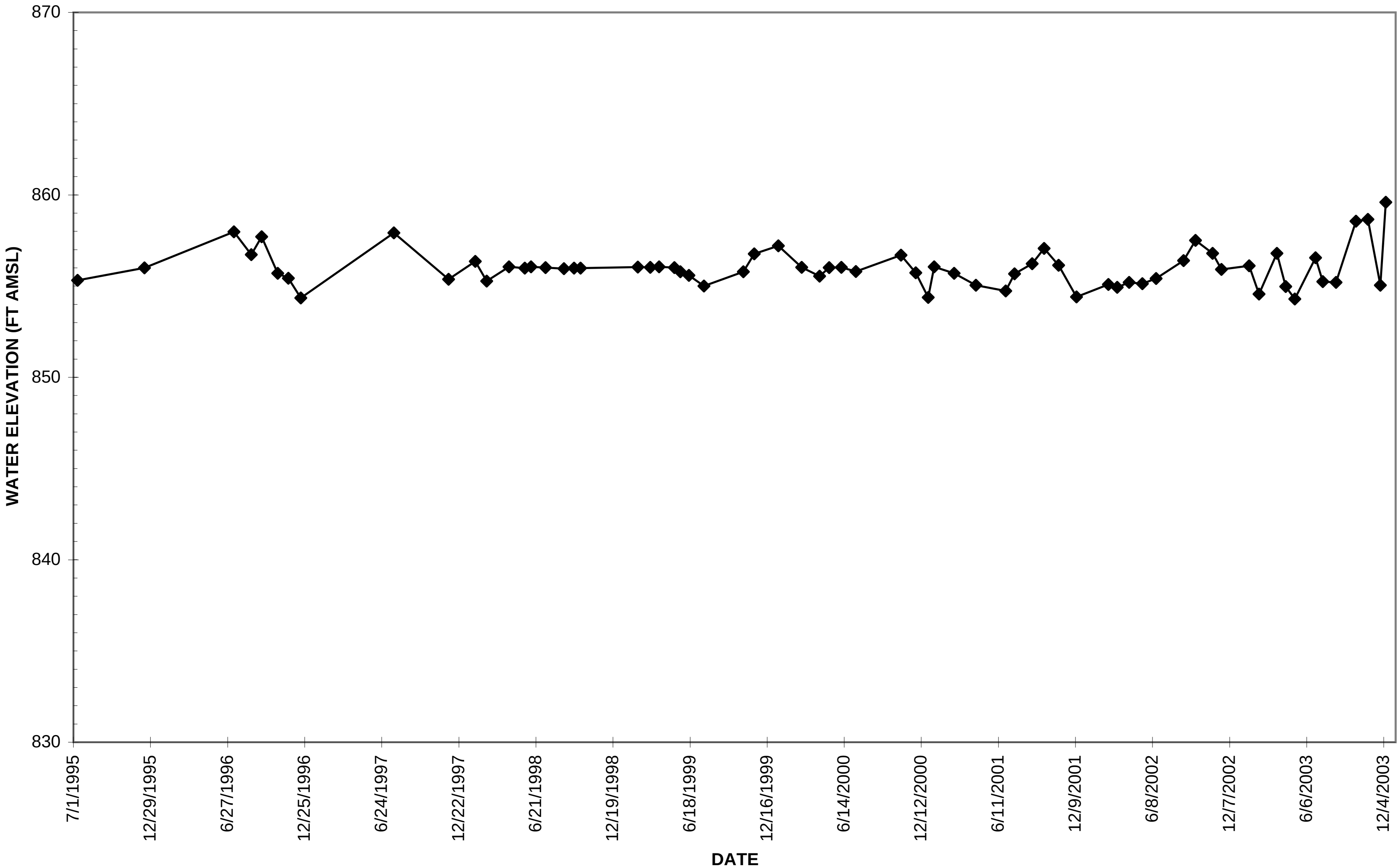


FIGURE 3.13 POND D FLOW DATA

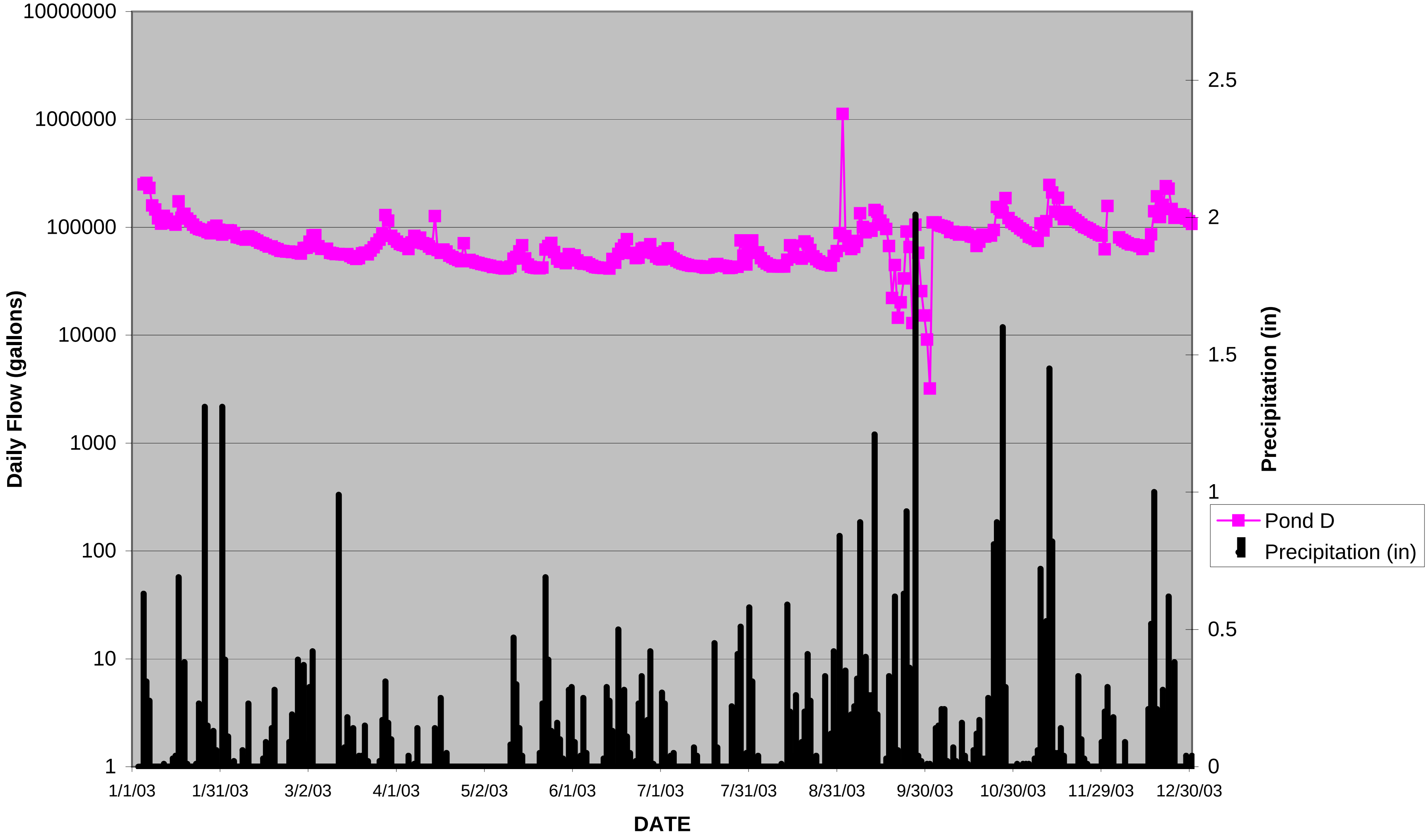


FIGURE 3.14a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - pH DATA

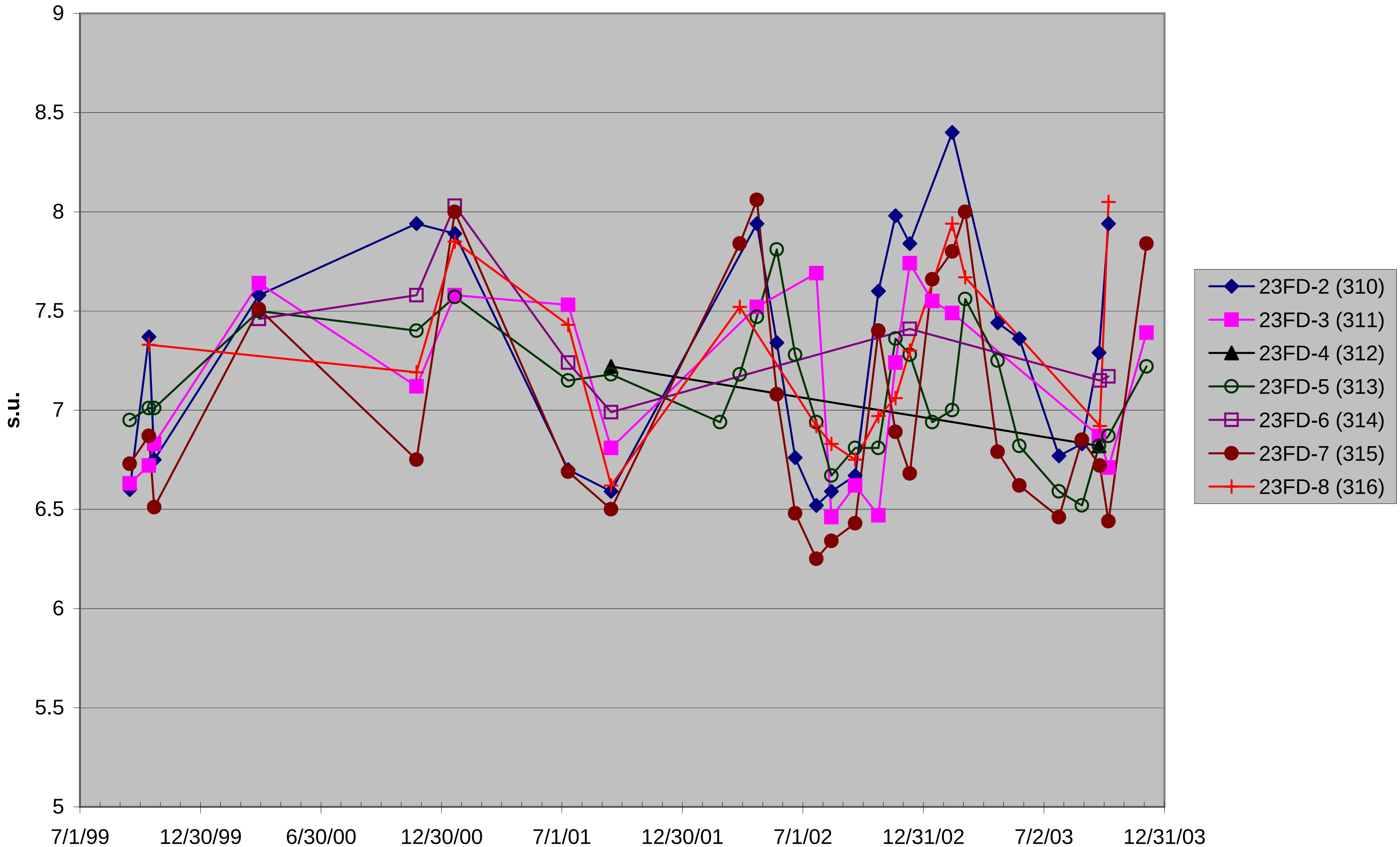


FIGURE 3.14b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - pH DATA

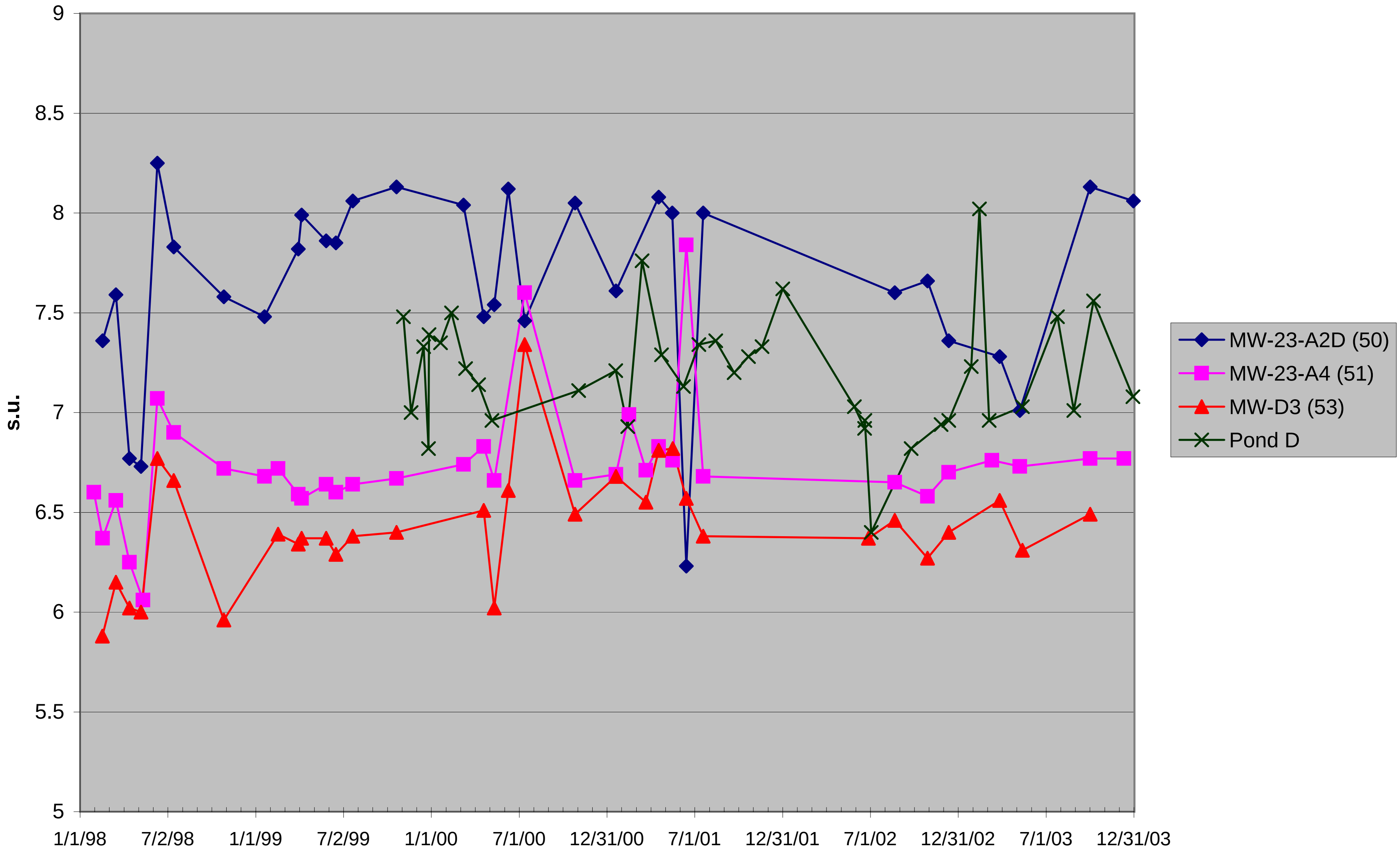


FIGURE 3.15a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - ALKALINITY DATA

(Non-detectable analyses plotted as zero)

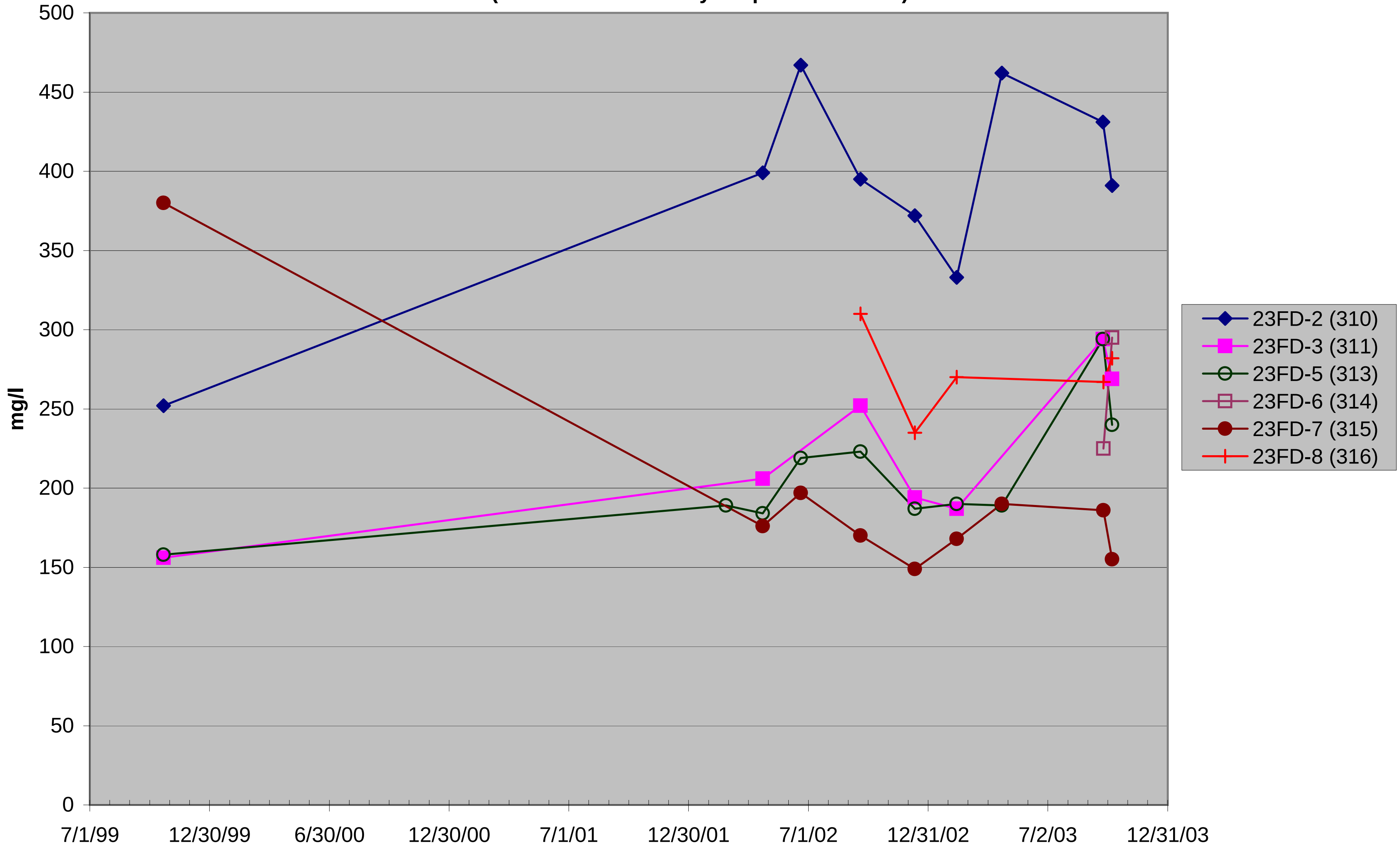


FIGURE 3.15b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - ALKALINITY DATA
(Non-detectable analyses plotted as zero)

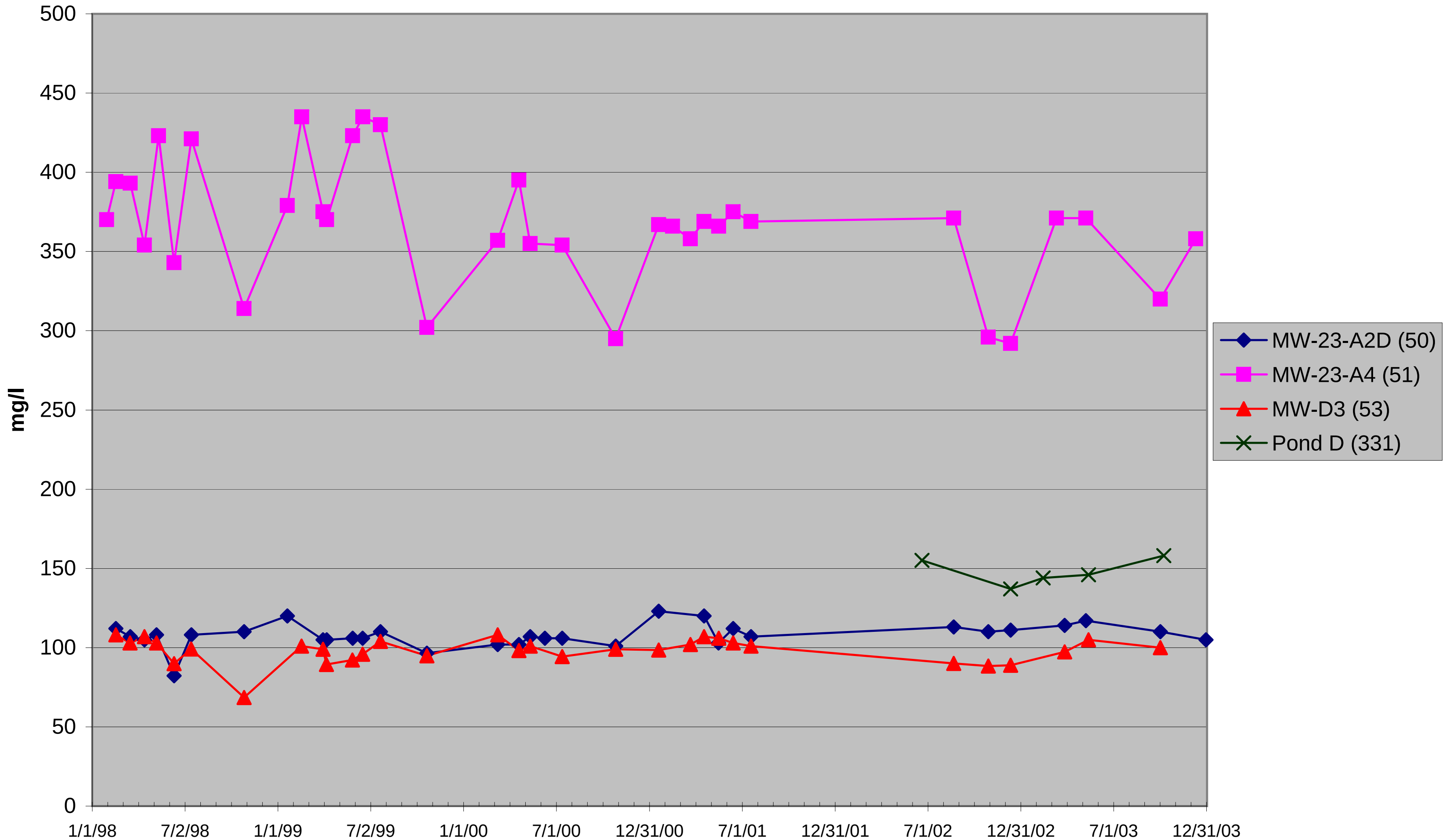


FIGURE 3.16a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - HARDNESS DATA

(Non-detectable analyses plotted as zero)

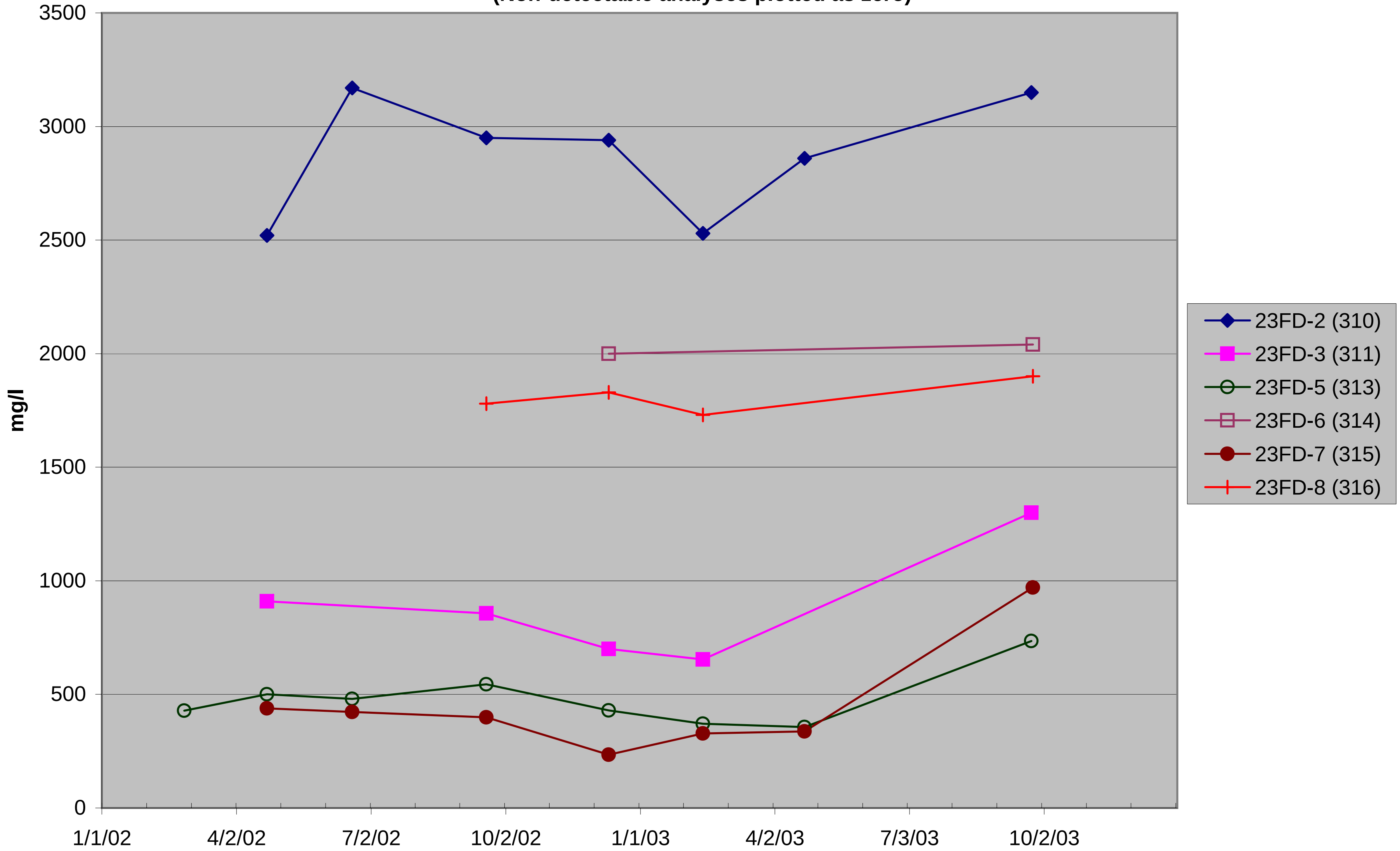


FIGURE 3.16b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES:
GROUND WATER - HARDNESS DATA
(Non-detectable analyses plotted as zero)

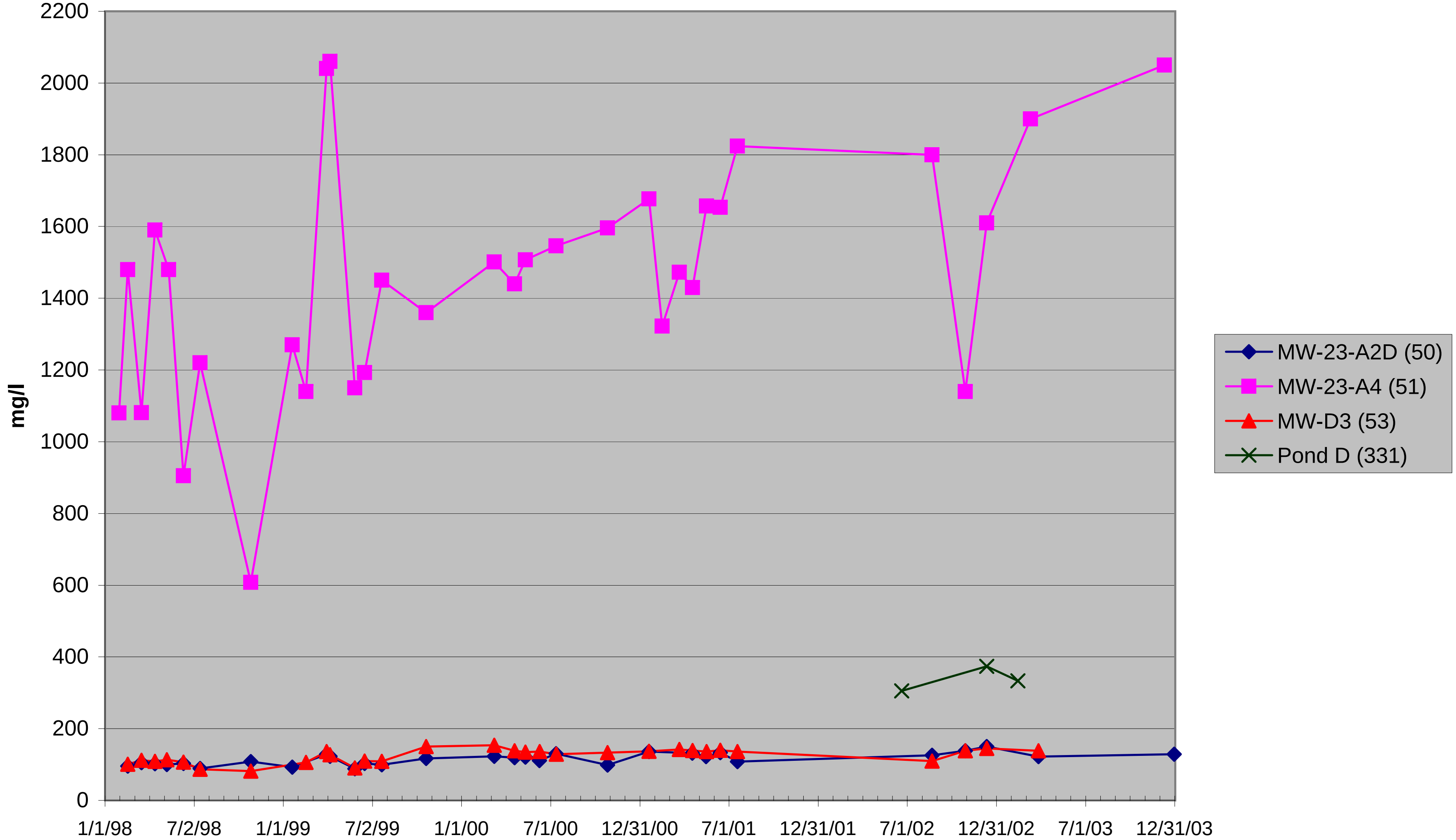


FIGURE 3.17a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - CONDUCTIVITY DATA

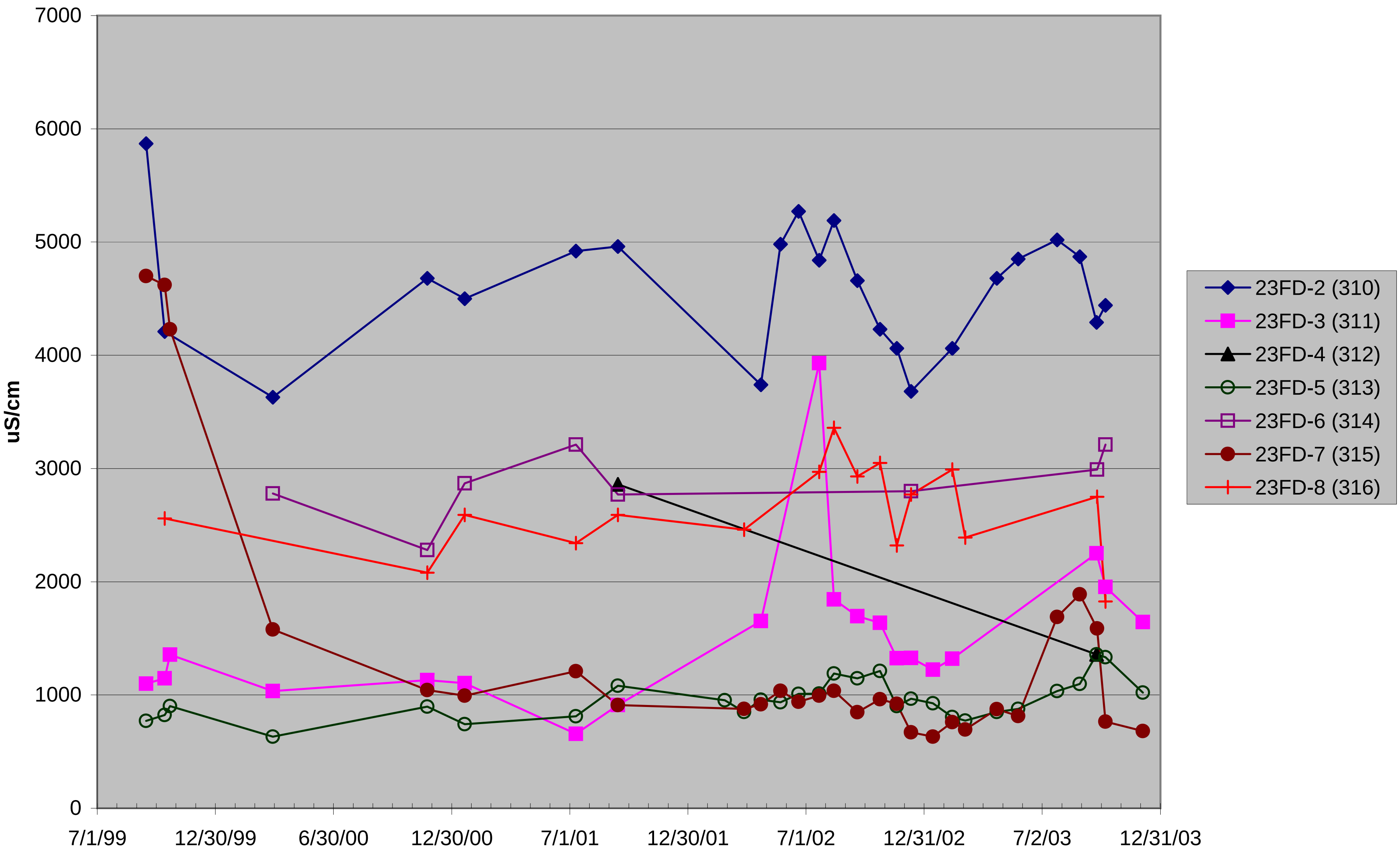


FIGURE 3.17b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - CONDUCTIVITY DATA

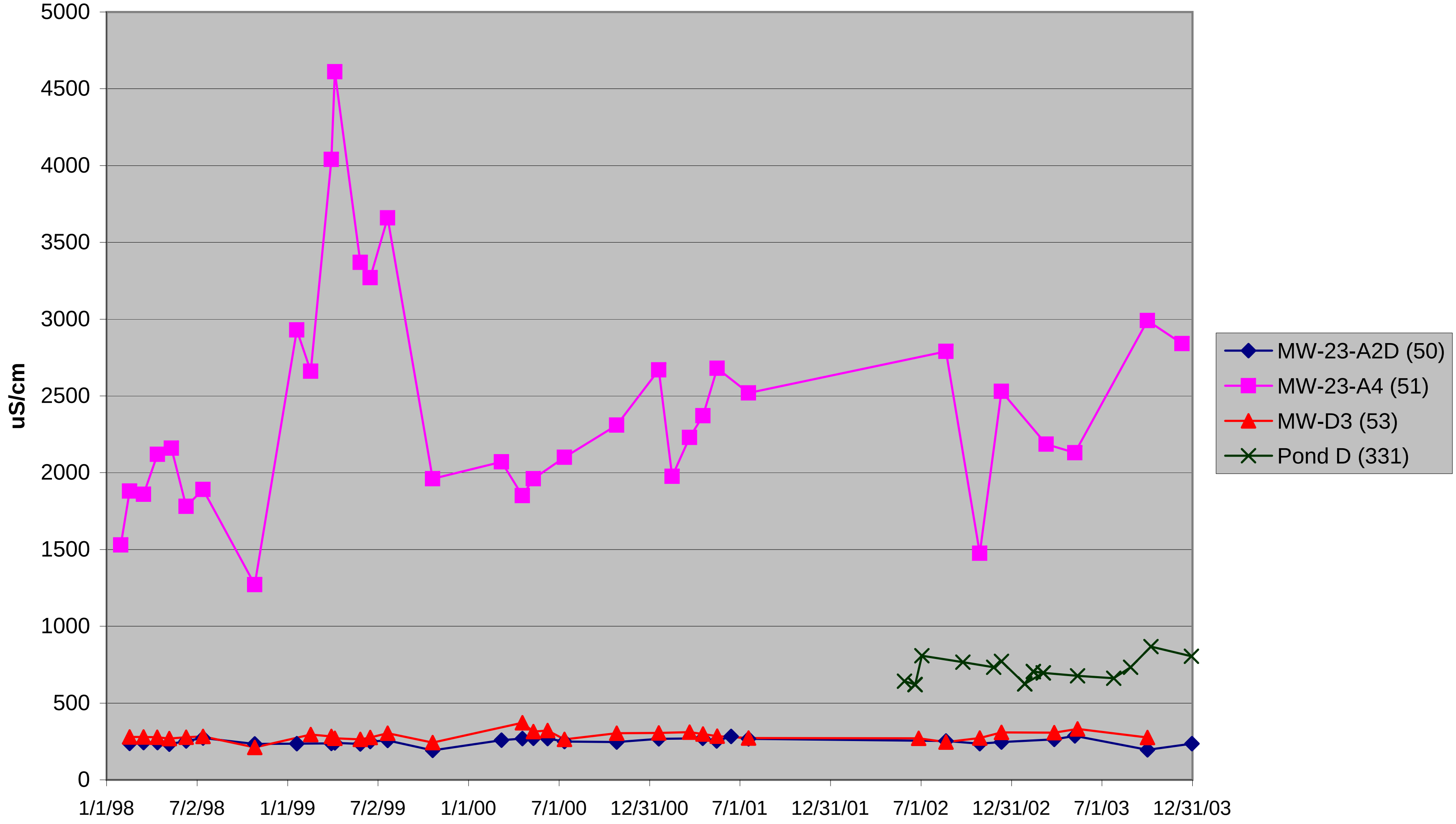


FIGURE 3.18a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - SULFATE DATA

(Non-detectable analyses plotted as zero)

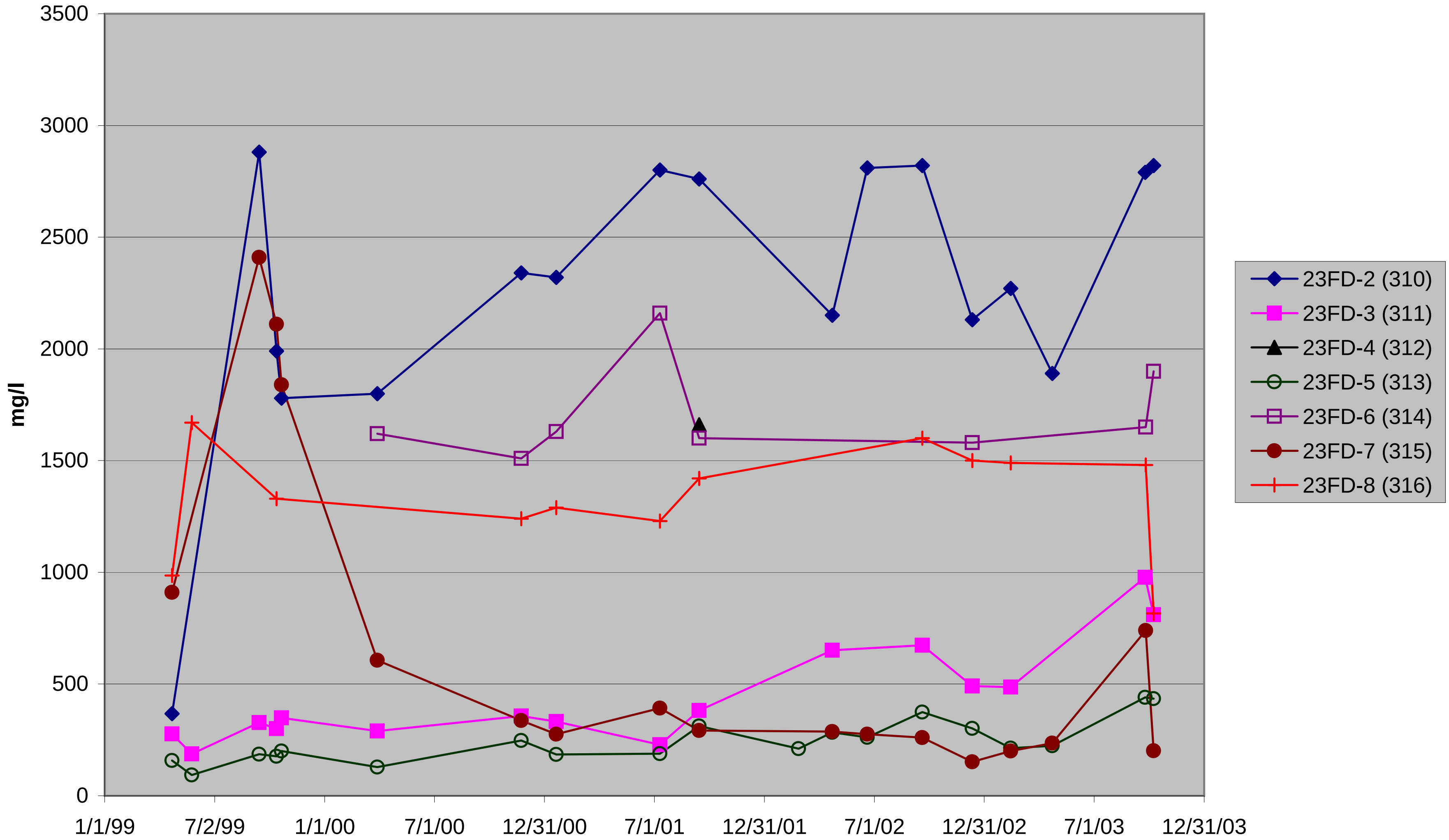


FIGURE 3.18b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - SULFATE

(Non-detectable analyses plotted as zero)

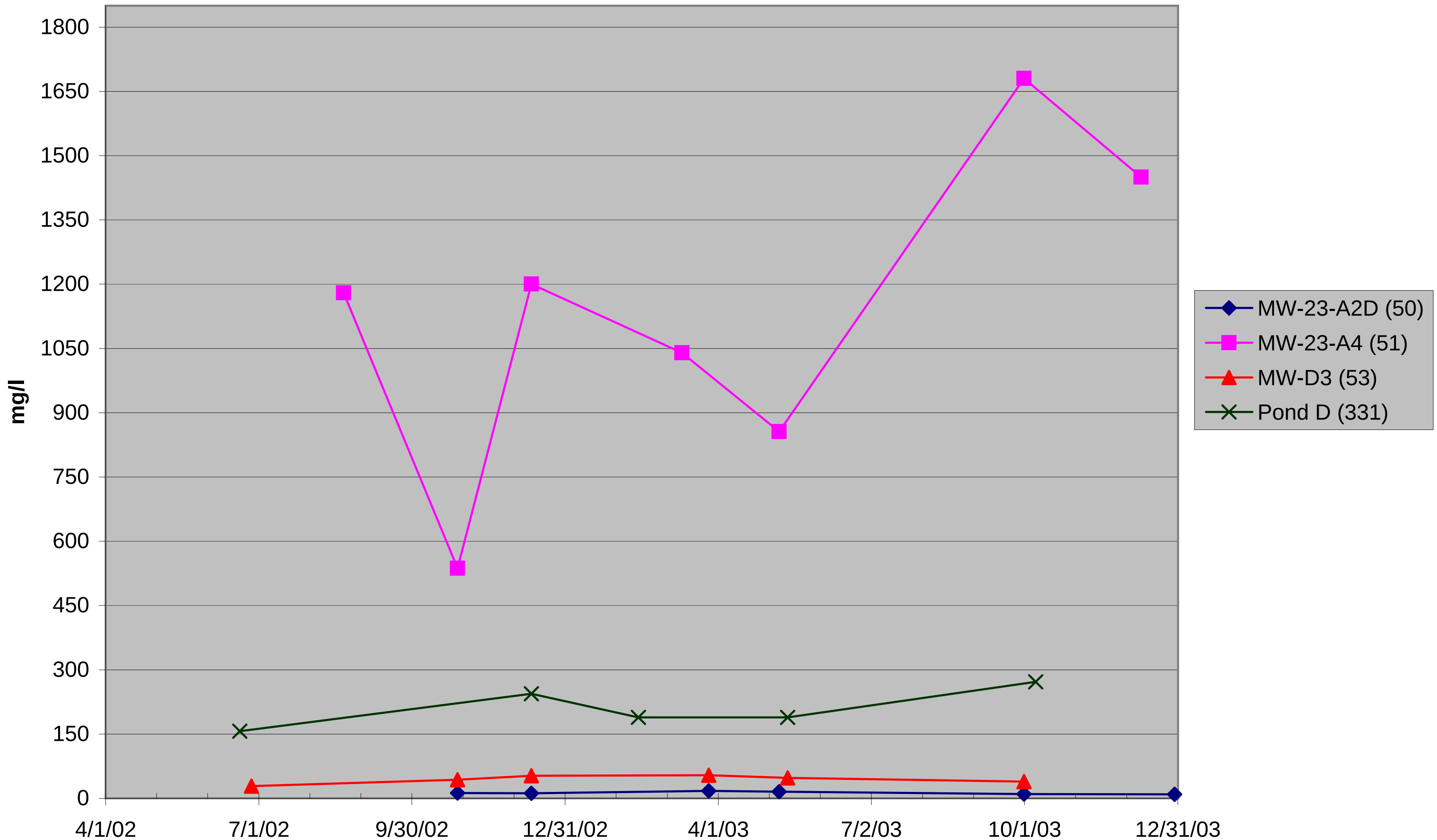


FIGURE 3.19a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - ARSENIC DATA

(Non-detectable analyses plotted as zero)

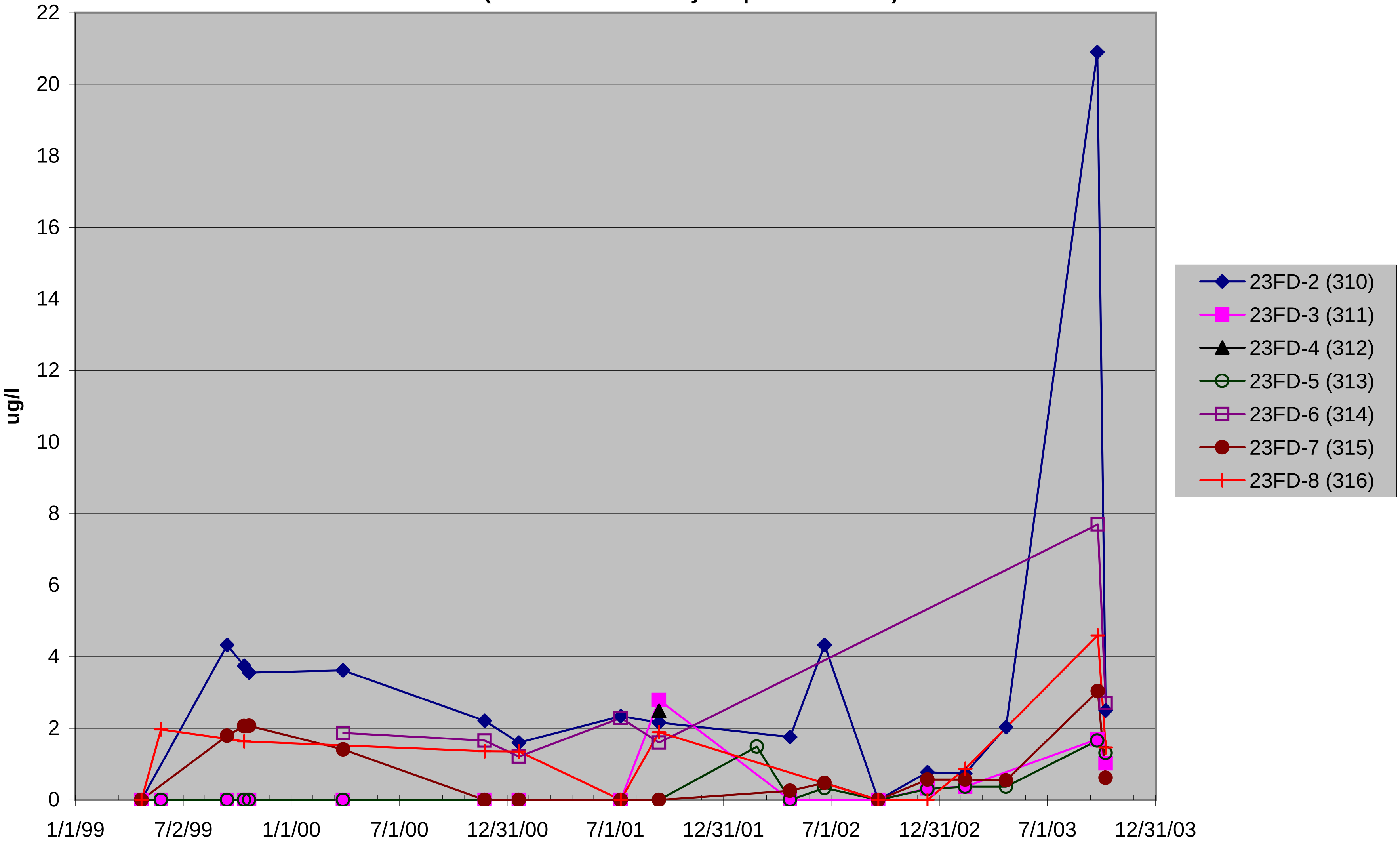


FIGURE 3.19b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - ARSENIC DATA

(Non-detectable analyses plotted as zero)

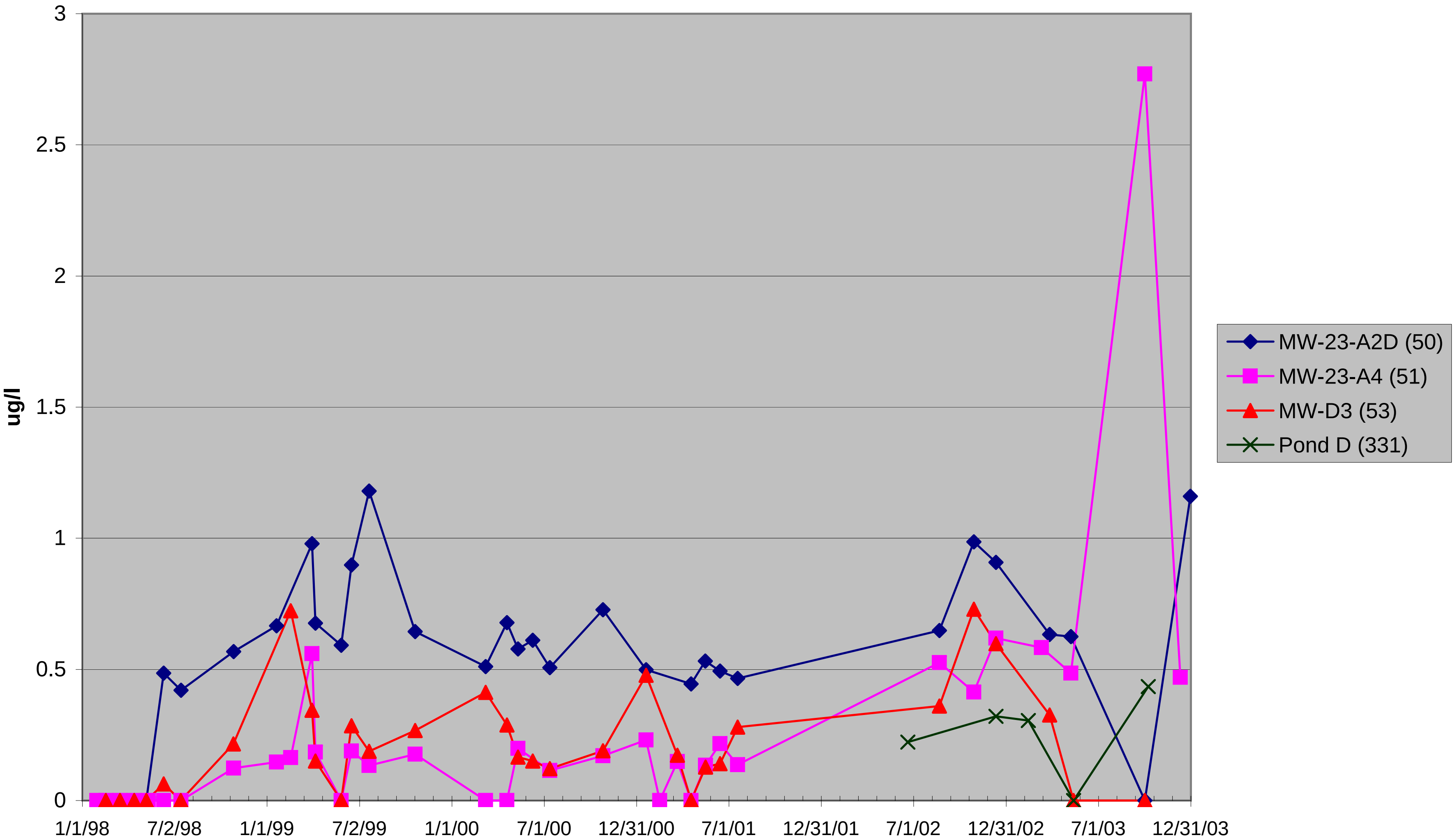


FIGURE 3.20a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - ZINC DATA
(Non-detectable analyses plotted as zero)

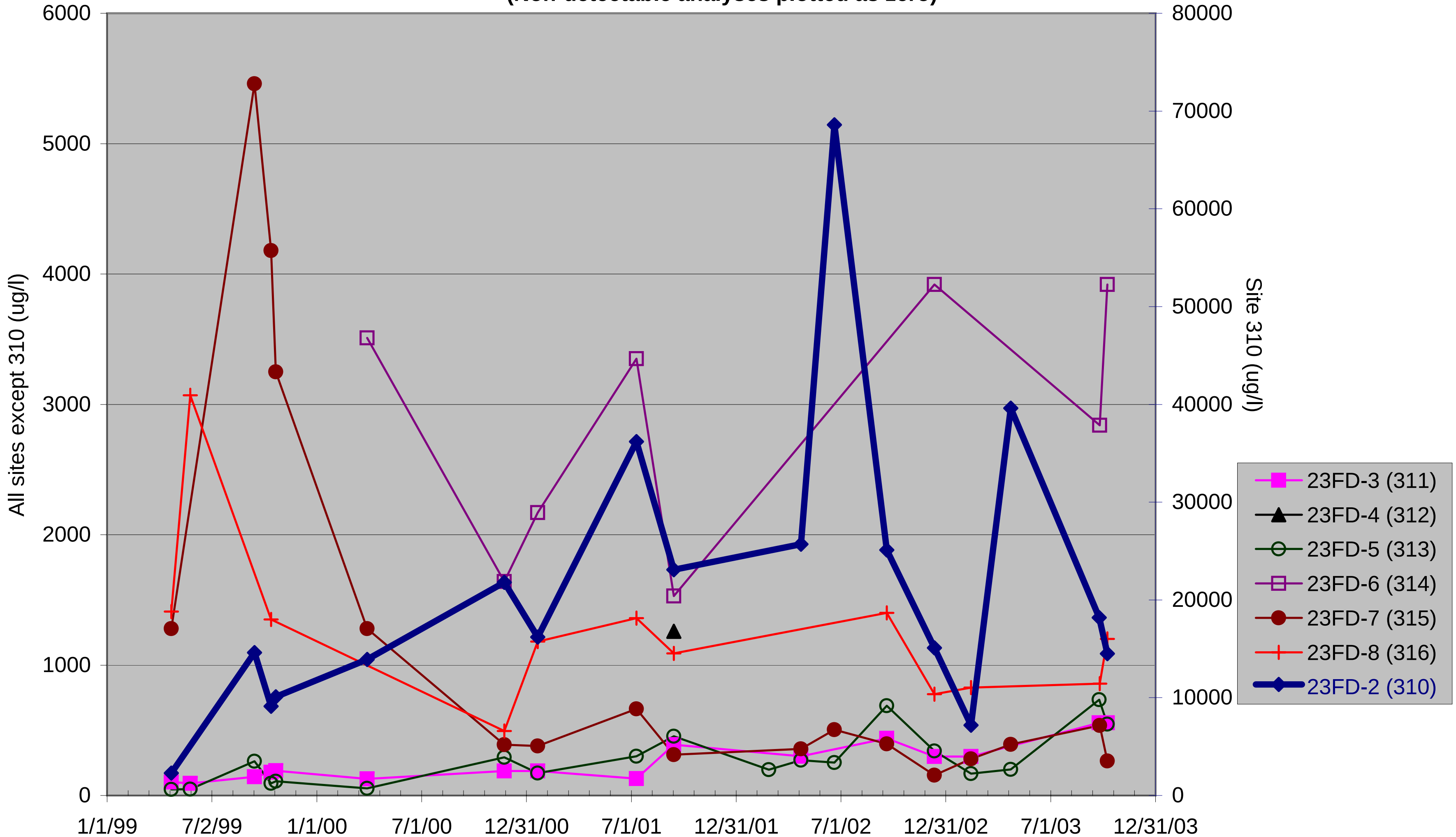


FIGURE 3.20b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES:
GROUND WATER - ZINC DATA
(Non-detectable analyses plotted as zero)

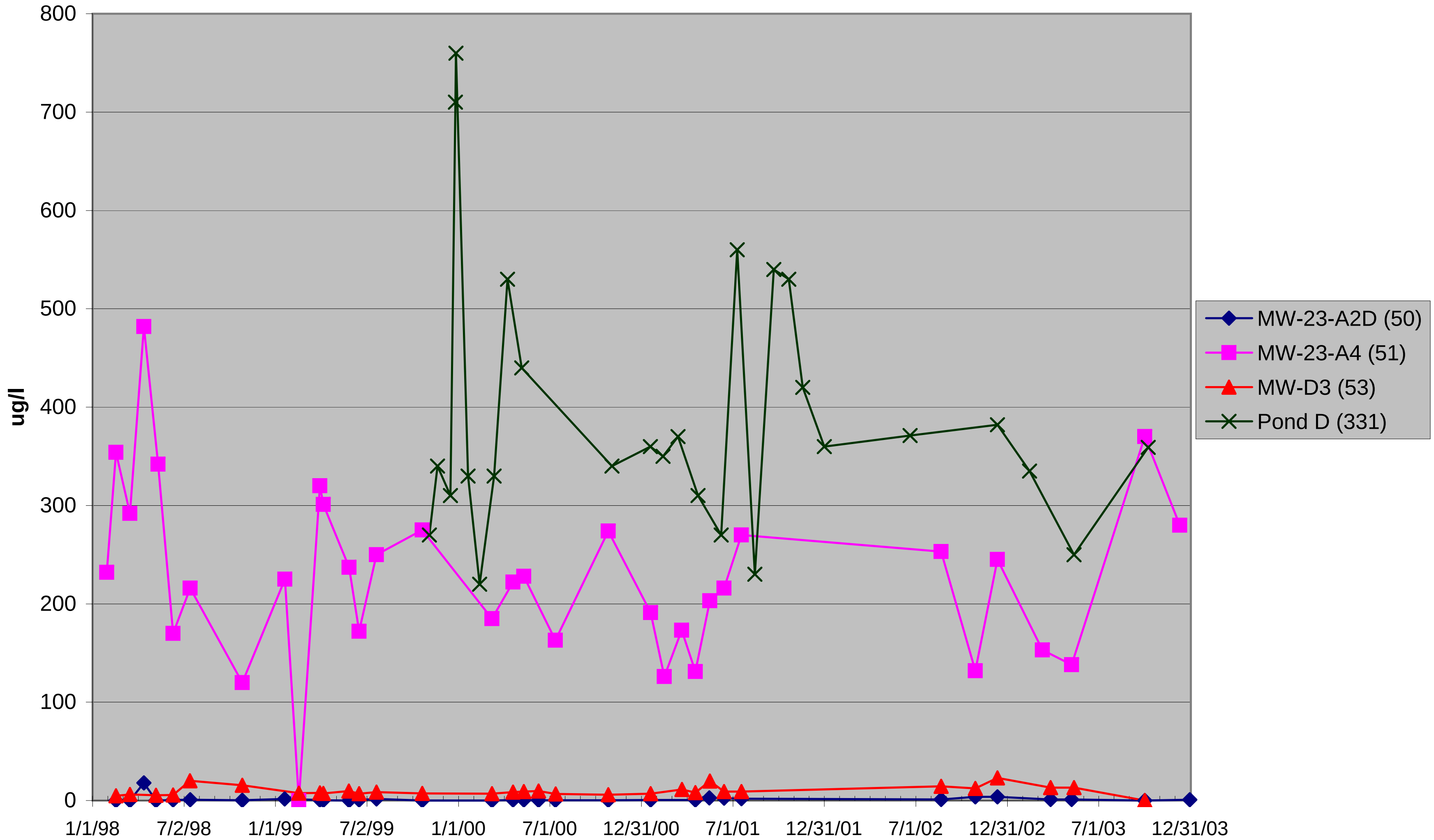


FIGURE 3.21a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - CADMIUM DATA

(Non-detectable analyses plotted as zero)

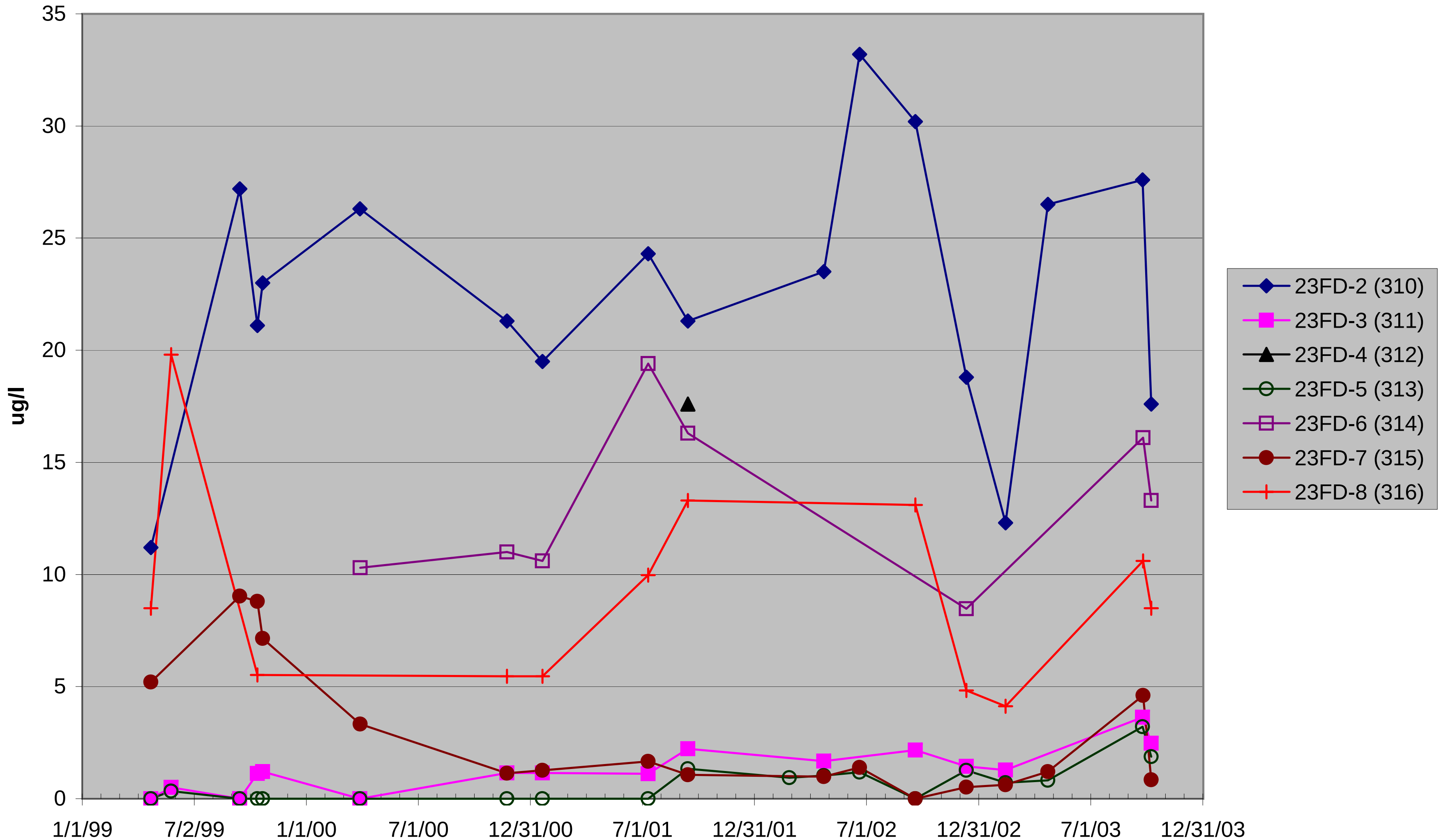


FIGURE 3.21b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - CADMIUM DATA

(Non-detectable analyses plotted as zero)

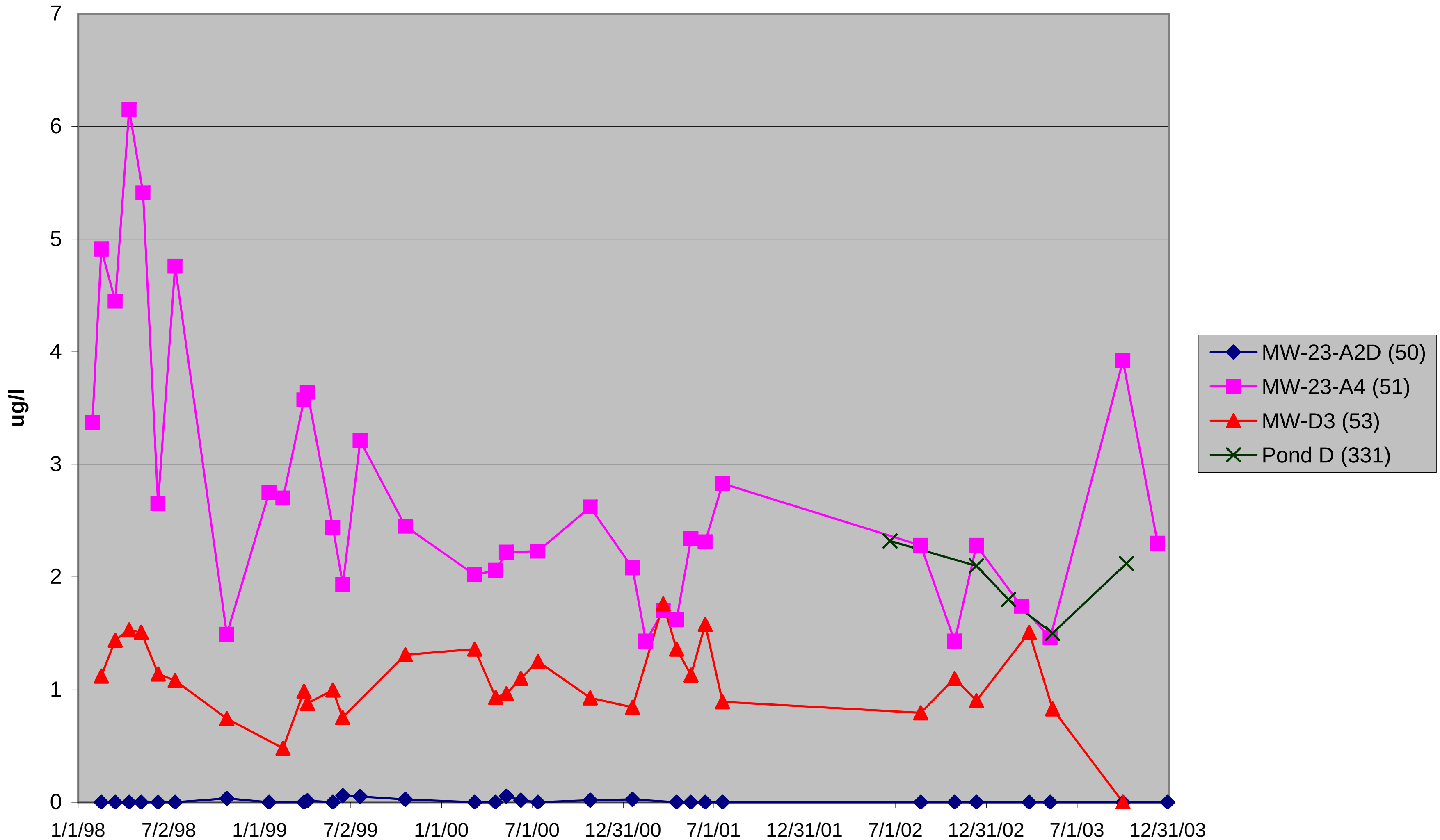


FIGURE 3.22a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - COPPER DATA

(Non-detectable analyses plotted as zero)

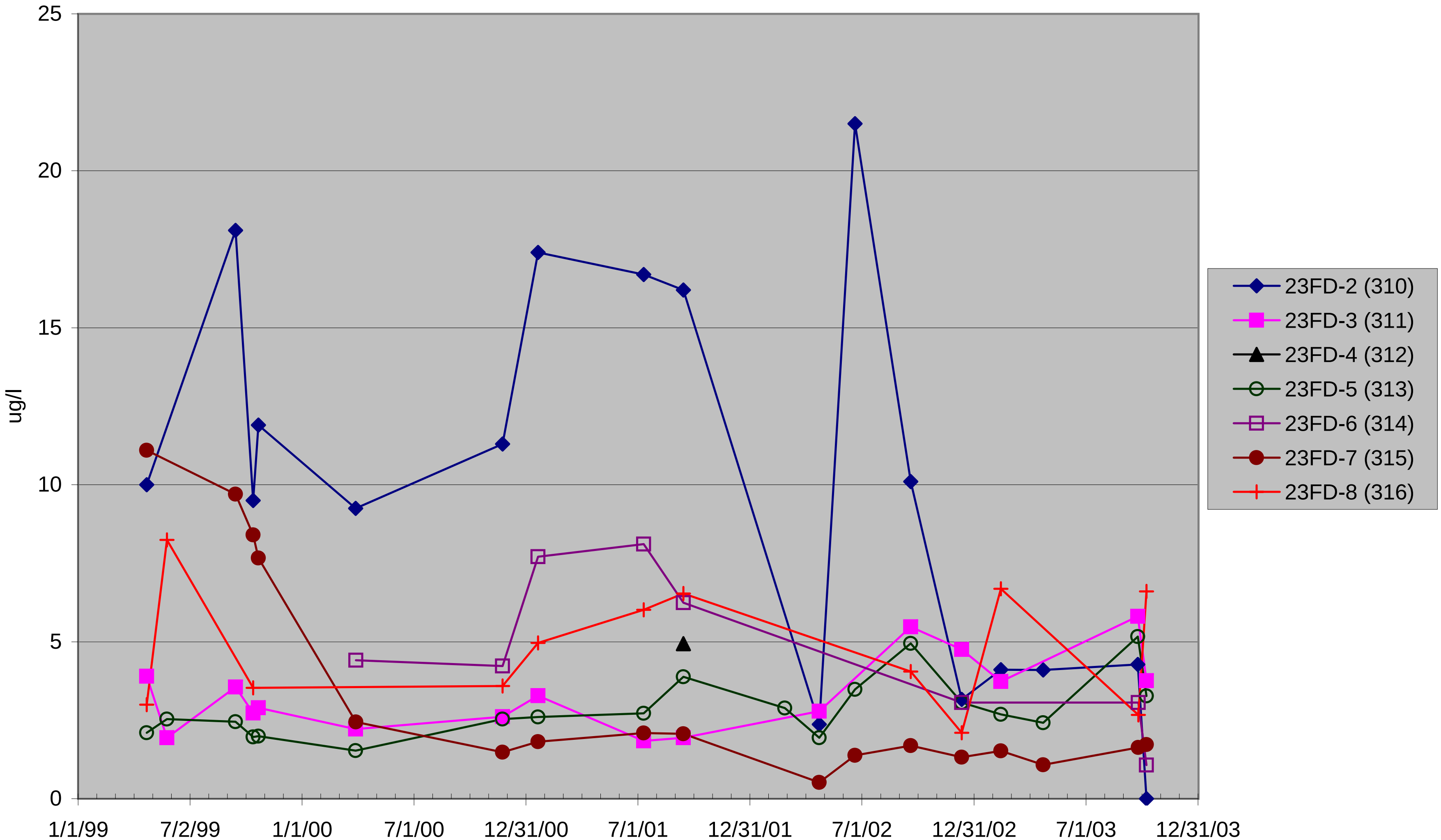


FIGURE 3.22b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES:
GROUND WATER - COPPER DATA
(Non-detectable analyses plotted as zero)

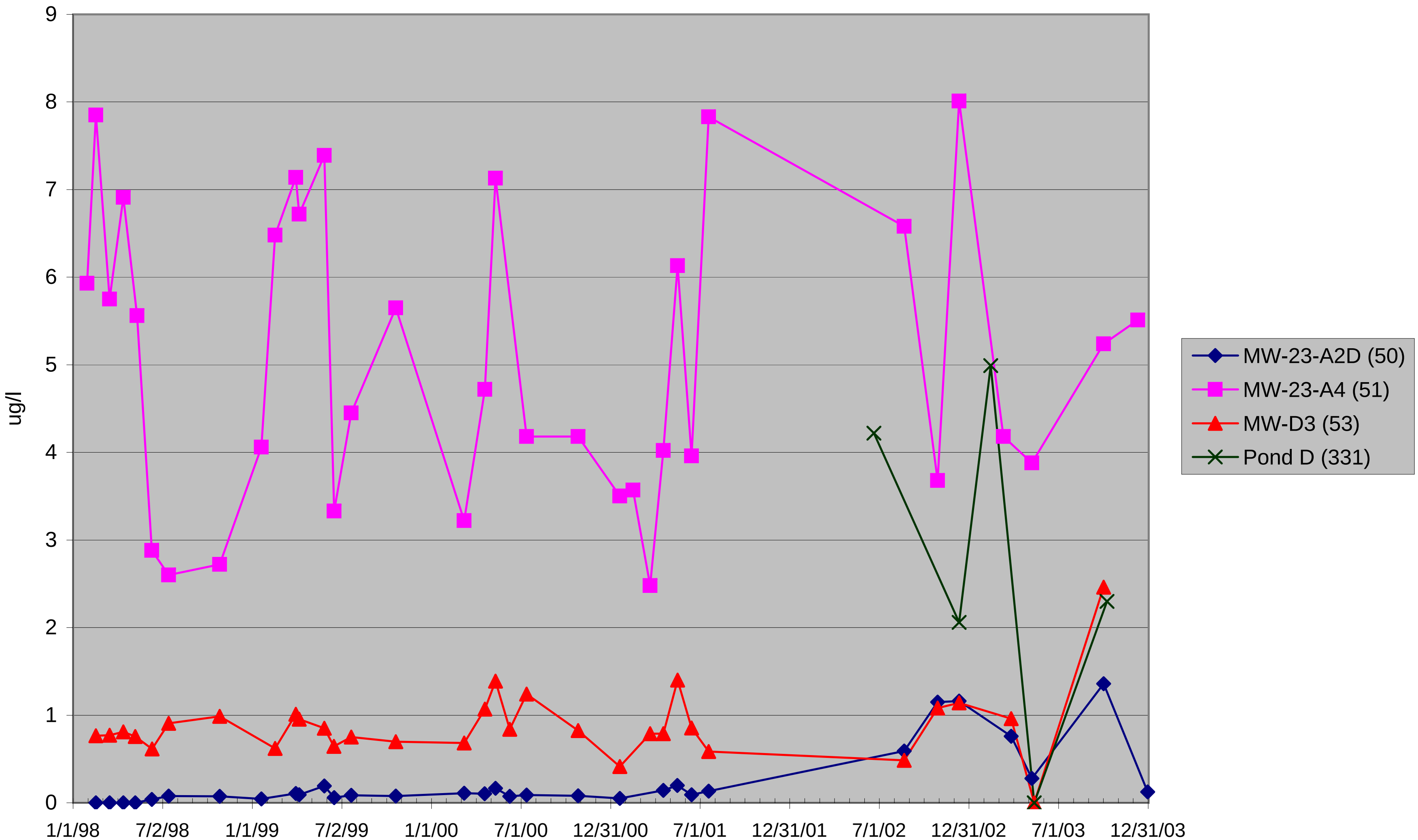


FIGURE 3.23a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - LEAD DATA
(Non-detectable analyses plotted as zero)

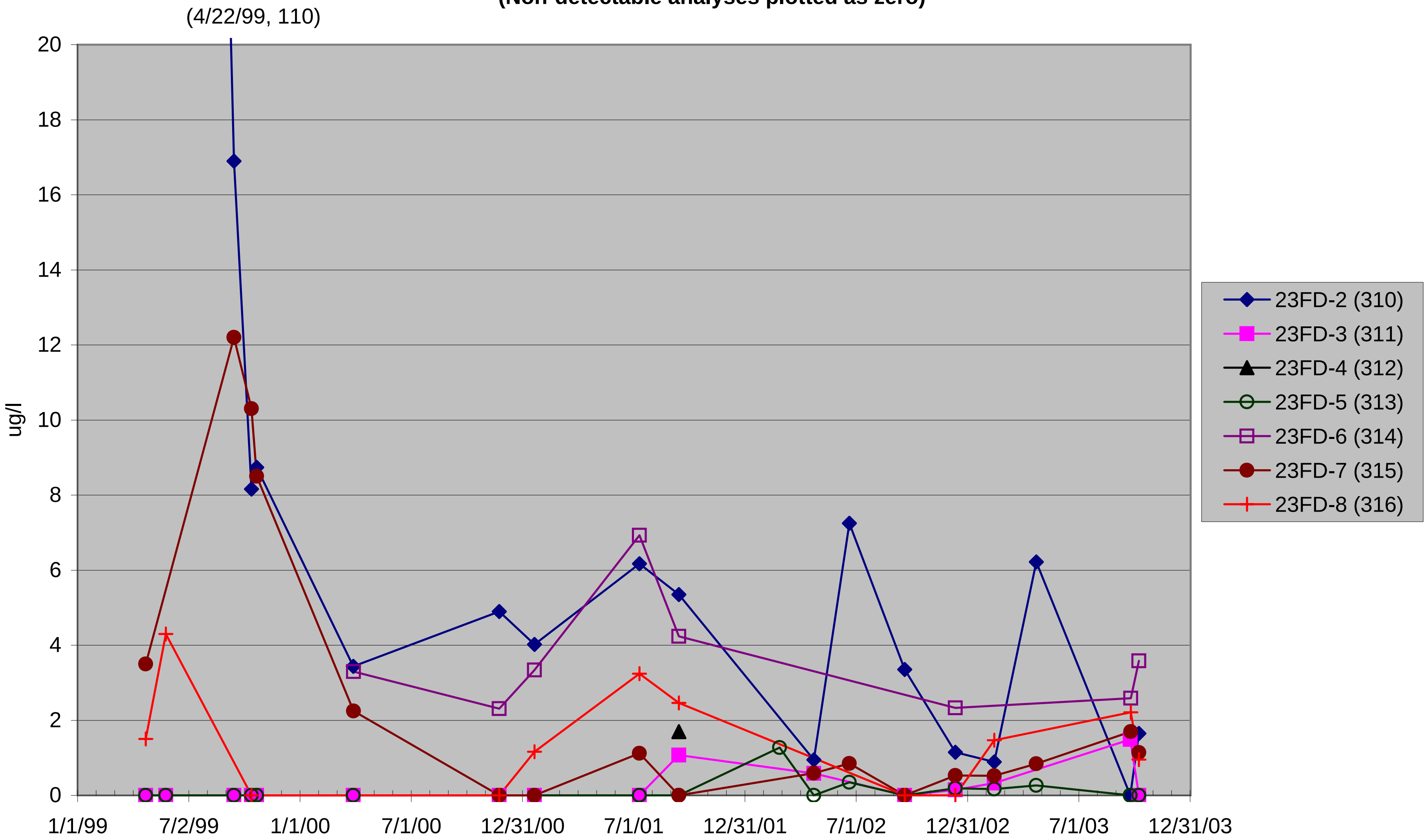


FIGURE 3.23b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - LEAD DATA
(Non-detectable analyses plotted as zero)

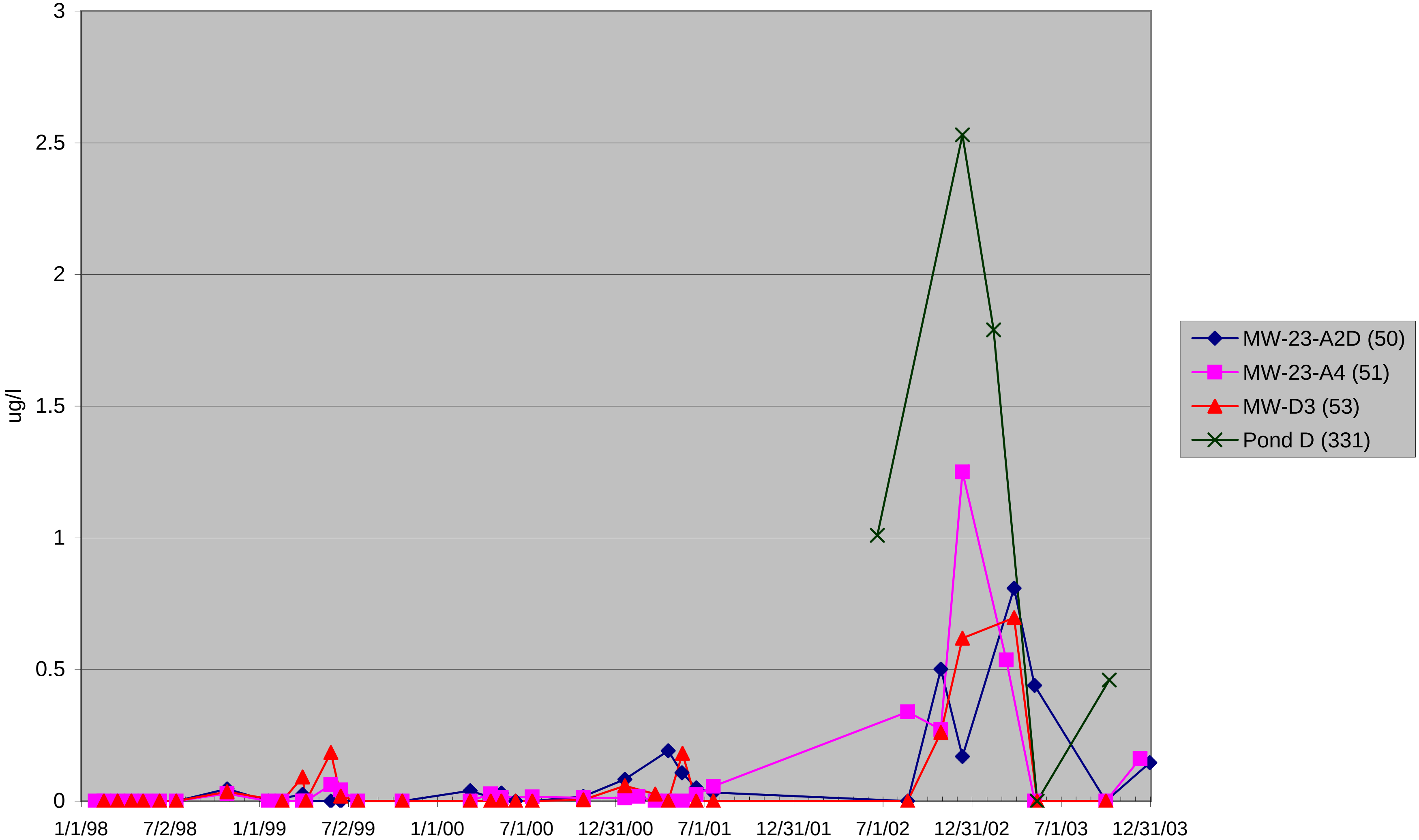


FIGURE 3.24a **GREENS CREEK SITE 23/D INTERNAL MONITORING SITES:**
FINGER DRAINS - NICKEL DATA
(Non-detectable analyses plotted as zero)

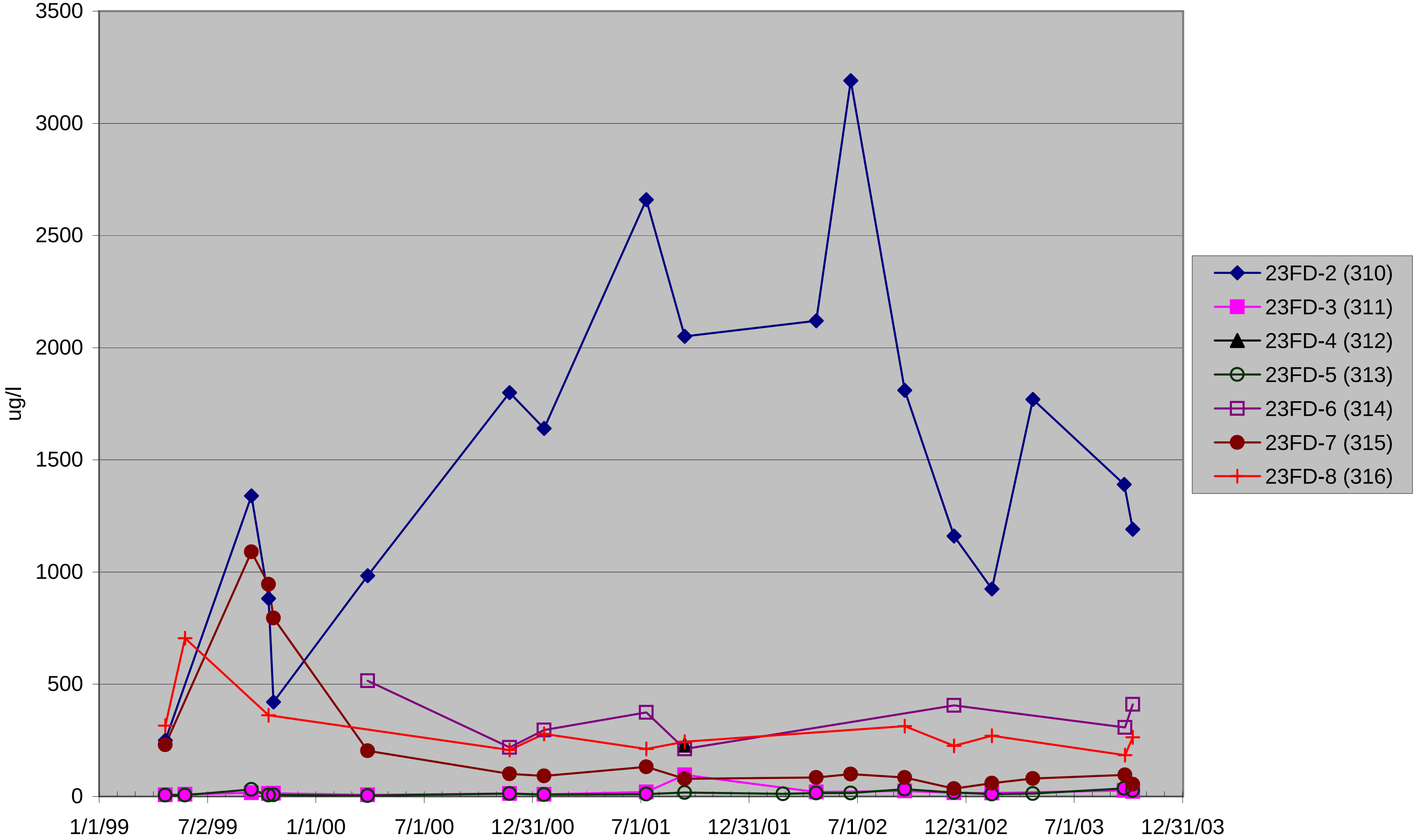


FIGURE 3.24b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES:
GROUND WATER - NICKEL DATA
(Non-detectable analyses plotted as zero)

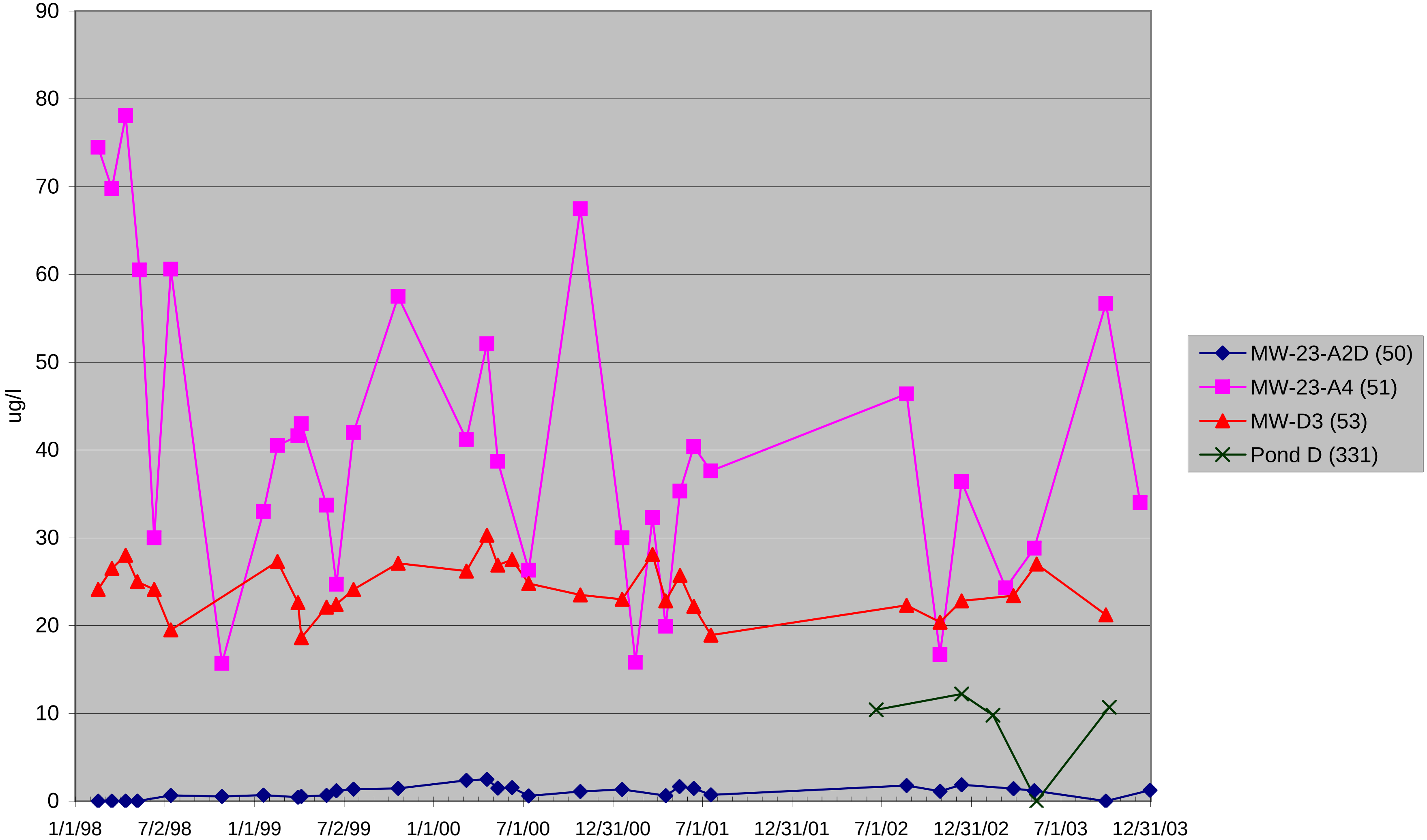


FIGURE 3.25 GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - FLOW

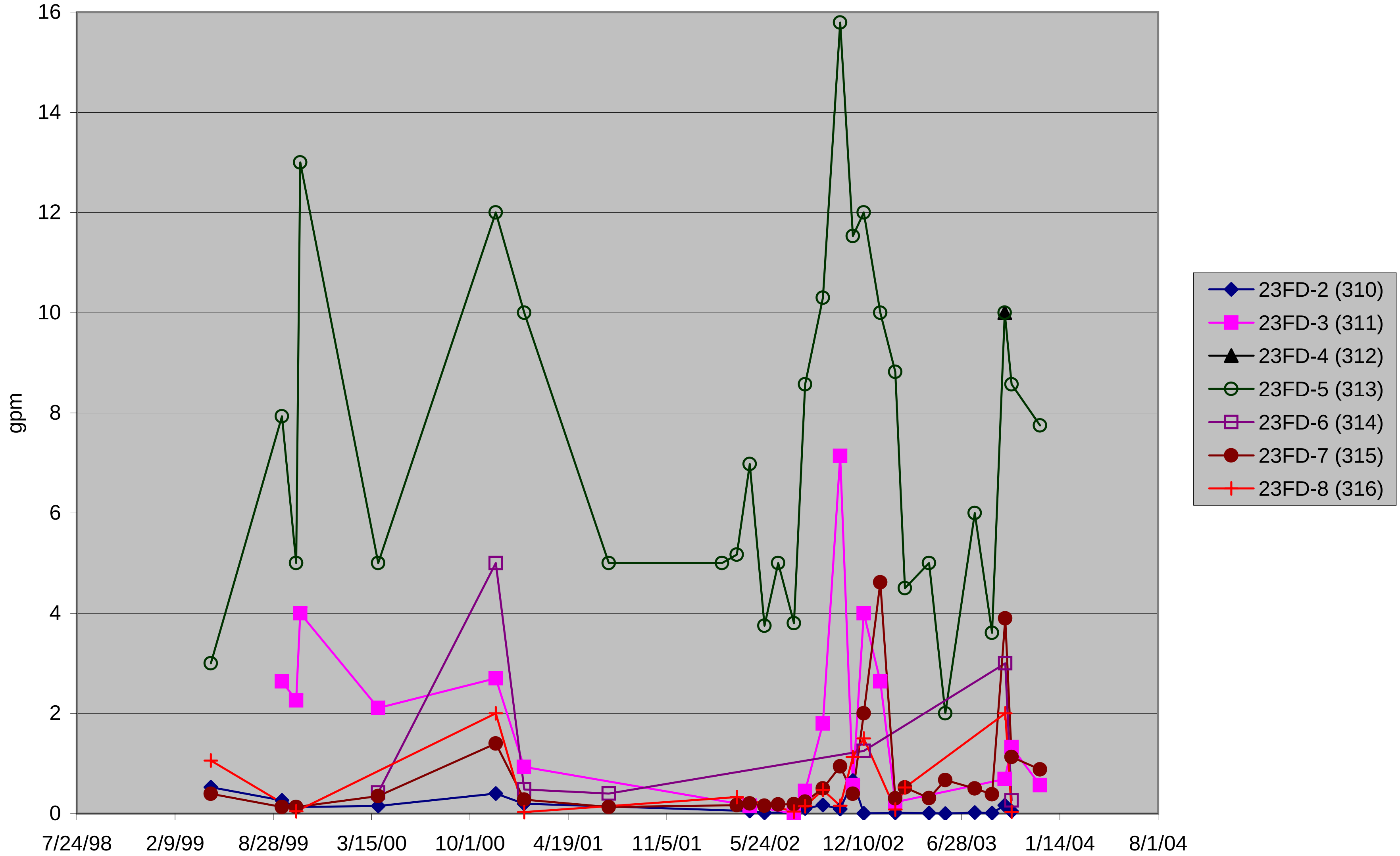


FIGURE 3.26 2003 UNDERGROUND RIB SAMPLES

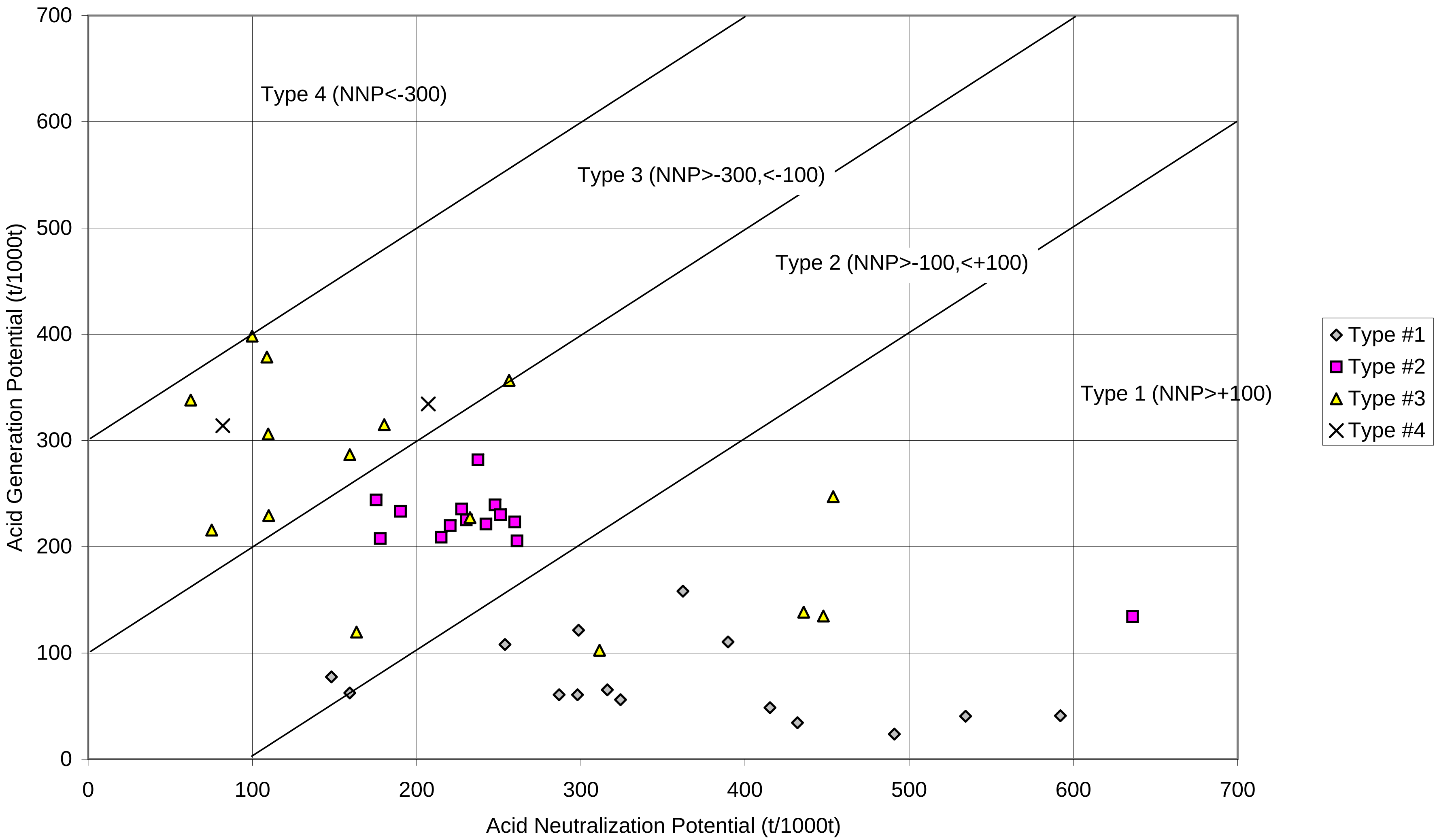


FIGURE 3.27 2003 ACID-BASE ACCOUNTING ANALYSES

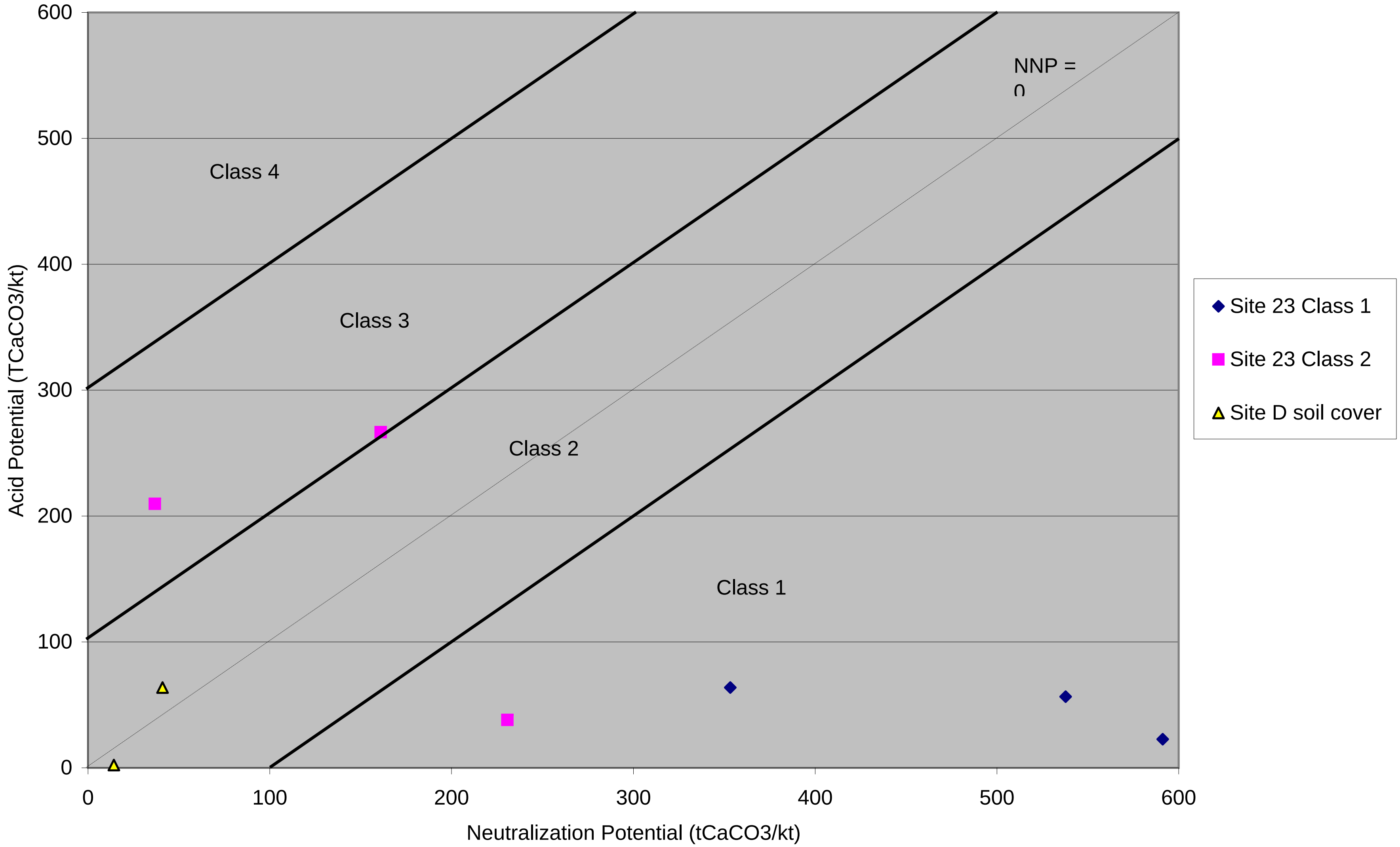
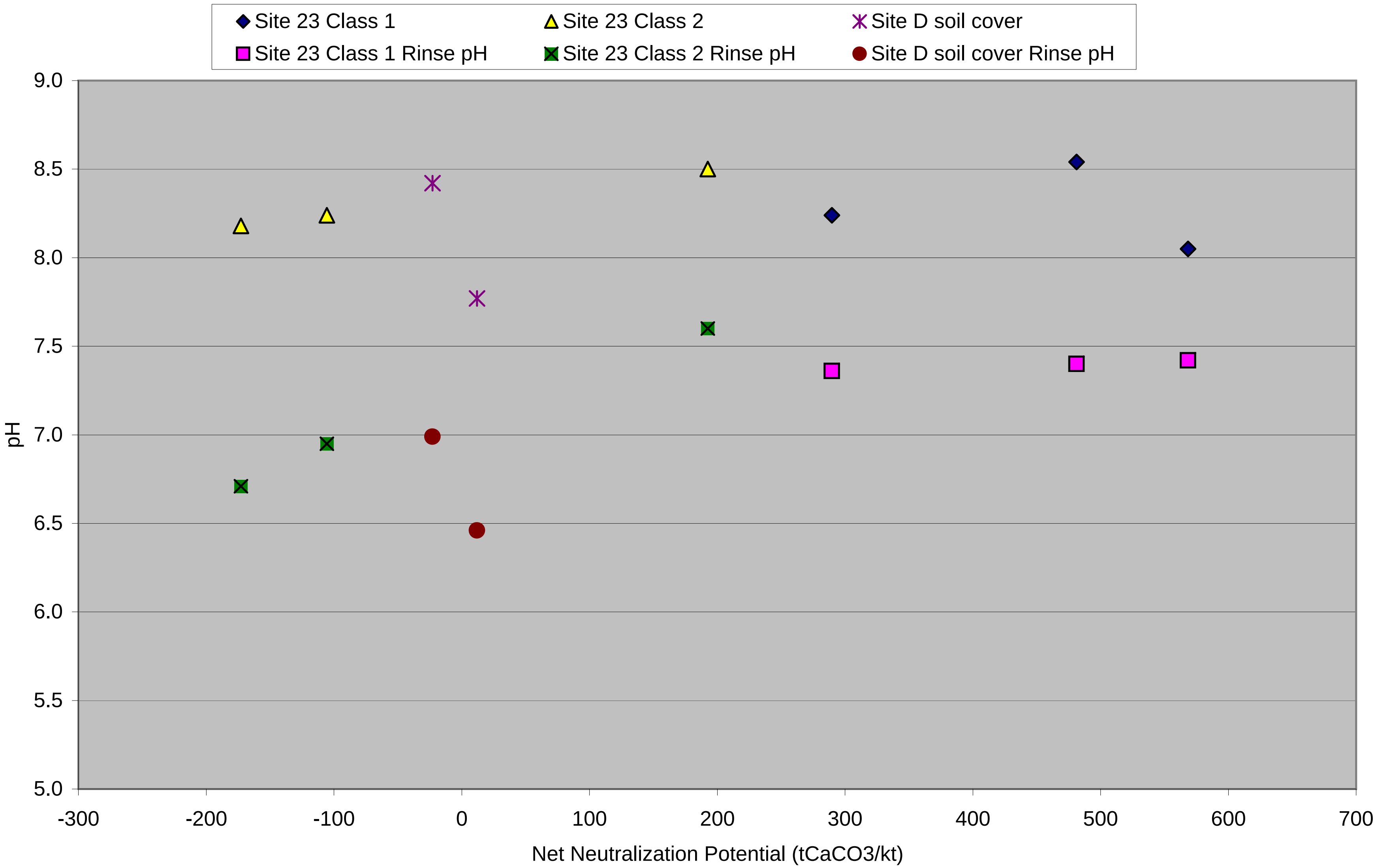


FIGURE 3.28 2003 pH versus NNP



APPENDIX 4

Site Photographs

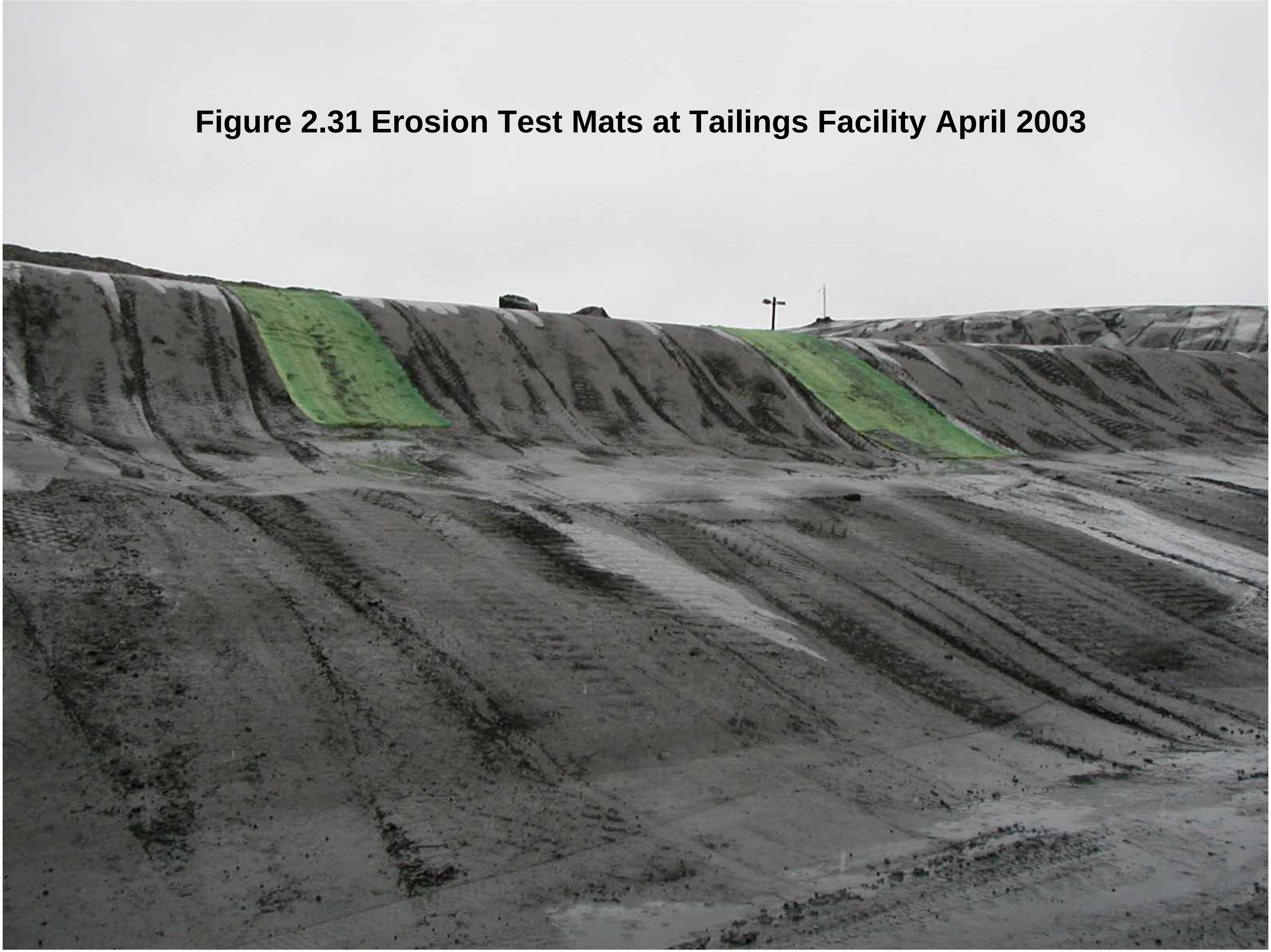


Figure 2.31 Erosion Test Mats at Tailings Facility April 2003

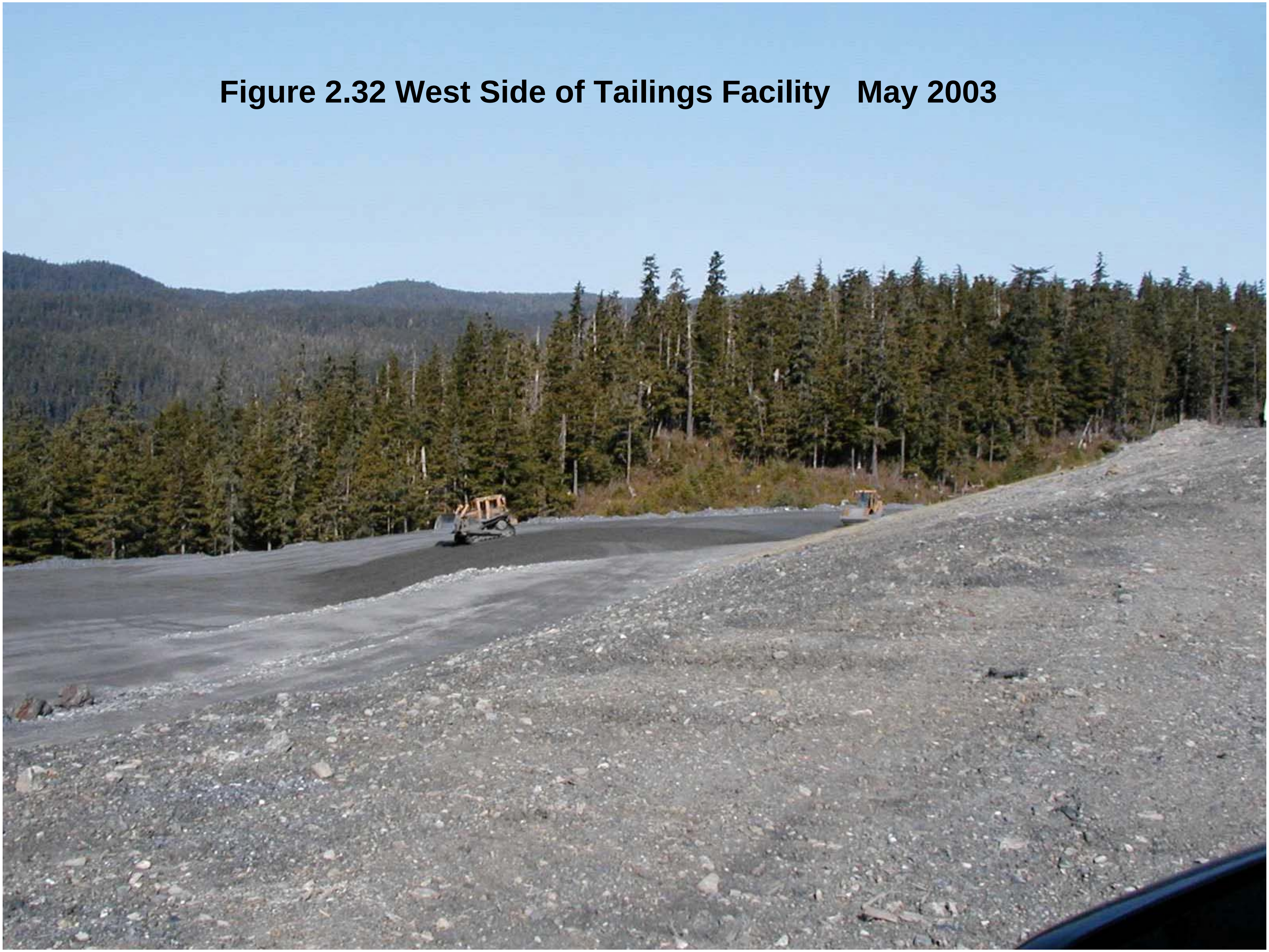


Figure 2.32 West Side of Tailings Facility   May 2003

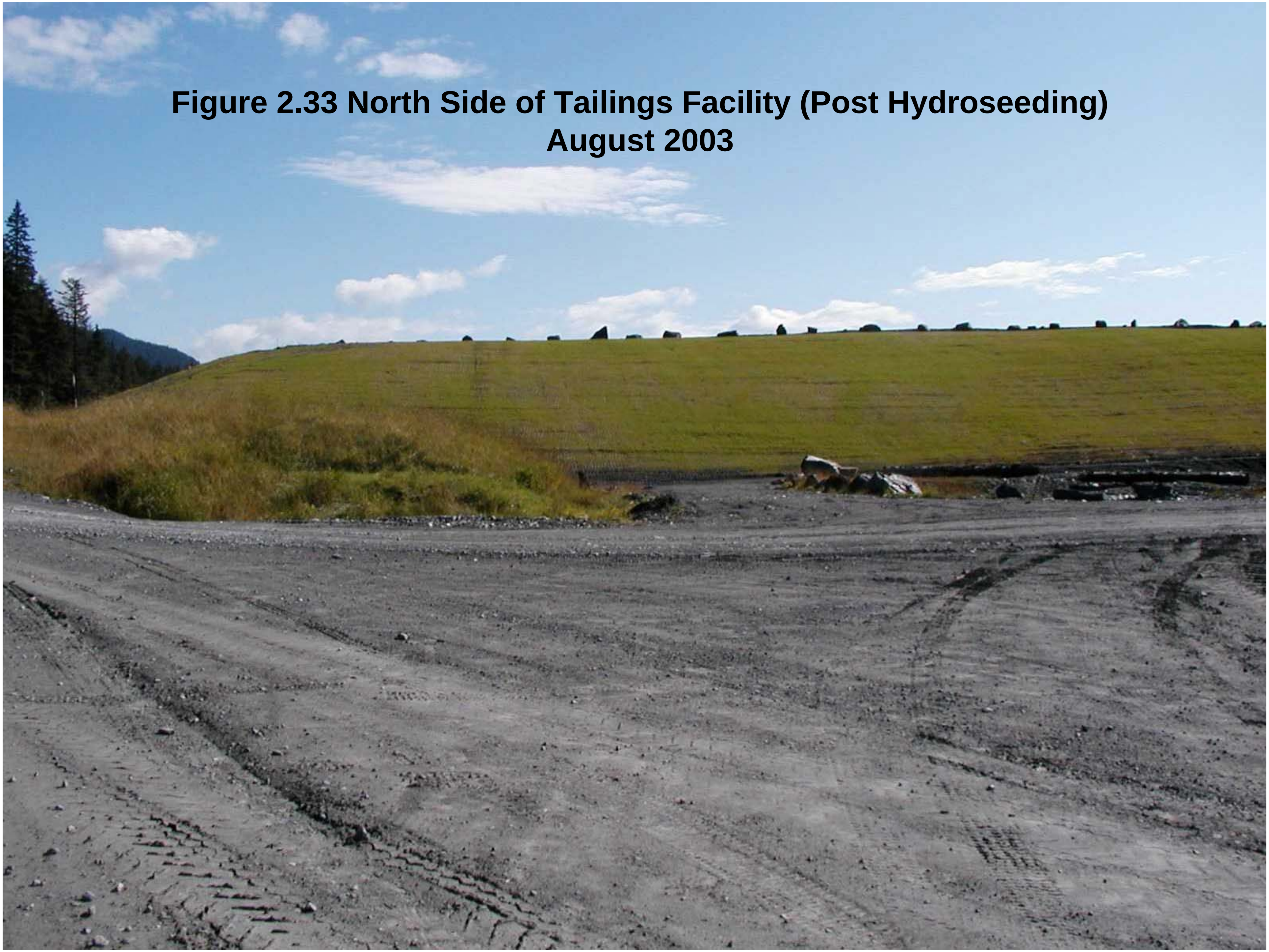


Figure 2.33 North Side of Tailings Facility (Post Hydroseeding)
August 2003

Figure 3.29 Site 23 Placement Zone for Class 1

Figure 3.30 Site 23 Placement Zone for Class 2

Figure 3.31 Site 23 Placement Zone for Class 3

Figure 3.32 Site 23 Disposal of Desilting Basin Sediments