TAILINGS AND PRODUCTION ROCK SITE
2005 ANNUAL REPORT

Kennecott Greens Creek Mining Company

June 2006

TABLE OF CONTENTS

TABLES

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 0211-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 0211-BA001 is presented:

Permit Section		Report Section
6.2.1	Closure plan summary	2.8
	Precipitation	2.4, 3.4
	Mill Site 79.43" Tailings 76.43"	
	Summary of internal monitoring and fresh water monitoring plans	2.5, 3.5
	FWMP annual report separate for water year 2005 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 continues higher in some tailings wells due to migration of redox boundary. Seasonal compositional fluctuations continue 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 in all other than most November and December samples.	
	Cover performance	3.8
	>85% saturation maintained, barrier layer not subject to freeze/thaw cycles. Net percolation up to 20%. No effect seen of HDPE cover placed above lysimeter.	
	Pond D flow and composition	3.4, 3.5
	Average flow pumped from pond is about 60 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 2005	2.5, 3.5
6.2.4	Location and volume of materials	2.2, 3.2, A1, A2
	East Tailings and West Buttress 394,159 total tons in 2005 (tailings 349,695 and other materials 44,464 tons)	
	Site 23 west end and north ramps 20,700 total tons in 2005	
	Compaction	2.3, 3.3
	Target compaction densities achieved in most nuclear density tests.	
	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)	
	Possible water releases	2.5
	Continue to monitor water compositions for effects related to 2002 remedial actions.	
	No new signs of possible release were identified in 2005.	
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 Management Permit 0211-BA001. A summary of all operational and monitoring activities performed in 2005 is provided. Refer to GPO Appendix 3 and permit 0211-BA001 for a detailed description of the tailings facility and associated monitoring requirements.

KGCMC operated its tailings facility continuously in 2005. Primary placement areas included the East Expansion and West Buttress (see Tailings Facility as-built in Appendix 1). KGCMC added 217,563 cubic yards of material to the Tailings Facility in 2005, bringing the total facility volume to approximately 2,229,550 cubic yards. These yardages convert to approximately 349,695 tons of tailings placed at the Tailings Facility during this report period with a total placement of all materials at the Tailings Facility totaling approximately 394,159 tons as calculated from KGCMC surveyed volumes and material densities.

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 2005. 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 23,000 tons to the facility. 22,000 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 2005. 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 4.04 million tons of material. Based on the survey data presented in Table 2.1 there is a remaining permitted capacity of approximately 5,462,841 tons in the 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**	**2005 Prod Rock from Site 23**	**2005 All Other Materials (Ditch Seds and Construction)**	**2005 Tailings Only**
Date	survey (yd^3)	survey (yd^3)	tons (calculated)	tons (calculated)	tons (truck count)	tons (truck count)	tons (calculated)
2/1/2005	0	2,011,987	0	3,645,117	0	0	0
3/4/2005	35,525	2,047,512	64,361	3,709,477	2924	2244	59,193
4/1/2005	21,357	2,068,869	38,692	3,748,170	2295	2261	34,136
5/2/2005	21,736	2,090,605	39,379	3,787,549	1734	2125	35,520
6/1/2005	19,212	2,109,817	34,806	3,822,355	493	1989	32,324
6/30/2005	17,281	2,127,098	31,308	3,853,663	560	1920	28,828
8/1/2005	20,465	2,147,563	37,076	3,890,740	1608	0	35,468
8/31/2005	19,987	2,167,550	36,210	3,926,950	1368	2898	31,944
9/30/2005	10,663	2,178,213	19,318	3,946,268	2072	3328	13,918
11/1/2005	17,828	2,196,041	32,299	3,978,567	4185	0	28,114
11/30/2005	15,260	2,211,301	27,647	4,006,214	2772	4928	19,947
12/30/2005	18,249	2,229,550	33,062	4,039,276	2760	0	30,302
Totals	**217,563**	**2,229,550**	**394,159**	**4,039,276**	**22,771**	**21,693**	**349,695**
Tons calculated at 134.2 pounds per cubic foot for tailings							

Table 2.2 Miscellaneous 2005 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 single of 4 minute measurement at a 12-inch depth is taken. Dry densities are calculated and compared to laboratory measured standard Proctors.

Compaction

Summary results for 2005 are shown in Table 2.3. Standard Proctor values were measured on three samples taken from the tailings-loadout facility at the 920 throughout the year and submitted to an outside materials testing lab, which performed the test within the ASTM guidelines for method #D698. The mean standard Proctor value was 132 pcf (pounds per cubic foot). KGCMC instituted a program at its on-site lab to determine 1-point proctors at the end of 2005. The mean dry density for four samples taken in December 2005 was 136 pcf, and the average percent moisture was 13.4%. Results to date confirm proctor and moisture data received from the outside materials testing lab.

Field measurement results show a high degree of achieving greater than 90% compaction (with respect to an average Standard Proctor value of 132.2), except for most of the samples taken in November and December, which ranged between 73 – 89%. Density results obtained using the Troxler procedure were compared with those from another procedure (Rubber Balloon Method ASTM D-2167) at 26 sites in 2005. The Troxler densities averaged 2 percent higher than the densities obtained via the comparative method.

Table 2.3 Summary Statistics for 2005 Tailings Compaction Testing Data

Compaction Variable	Mean	Max	Min	Std. Dev.	Number
Std. Proctor (ASTM #D698)	**132**	135	129	3.47	3
Opt. Moisture (%)	13.8%	14.2%	13.2%	0.5%	
Measured Dry Density	131	162	99	18.98	45*
Measured moisture (%)	13.2%	19.3%	6.9%	3.2%	
Rel. Compaction % **	99.4%	122.5%	72.8%	15.5%	

* n=45 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, which has been expanded to include the new Pond 7 constructed in 2005. The ADEC and ADNR inspected the site on two occasions in 2005, in June and November. No visible signs of physical instability were observed at the tailings facility during this report period.

During 2005 the USFS inspected the facility 17 times (Site inspections #197-#213) 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). Well MW-A3 was decommissioned in the summer of 2004, and MW-T-02-05 was decommissioned in 2005. However, a vibrating wire was installed in MW-T-02-05, and water levels can still be monitored at this location. 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 in 2003. Since this time, the water table elevation returned to historical levels, and varied within a two foot differential in 2004. These three instruments showed a 3 to 6 foot increase in head in 2005, likely due to problems with the pump at wet well 2. 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 again taken with a depth to water tape, and these head measurements again reflect historical values. The last two measurements taken in 2005 were slightly higher than historical levels. Piezometer 76 (Figure 2.10), completed in the northern portion of the West Buttress, showed approximately 10 feet of saturation in this area in late 2002 and 2003. In 2004, anomalous readings were indicative of a broken instrument. The piezometer was replaced in the spring of 2005. Readings have been variable in 2005 and 2006, showing intermittent saturation. The 10 feet of saturation usually seen in this piezometer 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 and maintain 10 to 15 feet of saturation through capillary action. Head levels are expected to continue rising as the slope length and tailings thickness of the West Buttress increase.

Section AA of the tailings facility as-built shows the inferred water table in the tailings pile. The maximum saturated thickness (approximately 30 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. KGCMC's continuing close monitoring of these conditions has shown no return of these increased heads.

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 over 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-00-03A (Figure 2.15) and MW-T-00-03B (Figure 2.16), are completed in the shallow sands 12 and 17 feet, respectively, below ground surface. The figures for these wells show that the water elevation in shallow completions in native materials can be readily influenced by abnormal weather conditions. 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. These wells show similar water level fluctuations with weather conditions as the two eastern wells. However, the water level in MW-T-01-03B shows a larger differential than MW-T-01-03A because silts and clays hold more water in tension, so a small increase in water content causes a large change in head. 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.

The 2003 Environmental Impact Statement (USFS 2003) process analyzed the incremental expansion of the tailings facility storage capacity, a continuation of which is planned between 2004 and 2007 to accommodate the projected tailings storage requirements for the mine. As part of the expansion work, Tank 6 and Pond 6 areas will be used for tailings storage. To accommodate these expansion plans and a change in the regulatory requirements for storm water retention, KGCMC constructed a new 30 acre-foot storm water pond (Pond 7) in 2005, and will reroute collection and distribution facilities to include the new Pond 7. For background and design information for Pond 7, see Klohn Crippen's 2005 report, and EDE's 2005 Pond 7 Hydrology Report.

Precipitation and temperature data are presented in Table 2.4. Precipitation was above normal for the year, with January (12.38) and November (11.73 in) recording the wettest totals. May was the driest month with only 1.56 inches of precipitation. June, July and August were the warmest months. 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. The use of the wet well flow meters was temporarily discontinued in 2005 as part of the tailings expansion activities. KGCMC anticipates that once the final routing of pipelines associated with these wet wells and the new Pond 7 construction is complete that flow monitoring will resume.

Table 2.4 Monthly Summaries of Tailings Area Climate Data

Month	Avg. Temp (°C)	Precipitation (inches)
January	-2.85	12.38
February	-0.48	5.24
March	2.99	3.87
April	6.74	2.73
May	11.15	1.56
June	12.91	3.68
July	13.44	6.64
August	14.23	6.45
September	10.62	9.62
October	6.00	7.53
November	2.43	11.73
December	1.86	5.00
2005	6.59	76.43

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 2005 is being prepared separately and will be submitted to the Forest Service and ADEC upon completion.

Internal Monitoring

As described in Waste Management Permit Number 0211-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 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 needs of KGCMC.

The analytical results of KGCMC's internal site monitoring plan are summarized in Figures 2.20 to 2.31. Sites were distinguished between foundation wet wells (Wet Well 2 and Wet Well 3), wells completed in tailings (PZ-T-00-01, PZ-T-00-02, PZ-T-00-03, 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 lysimeters are installed at various depths within the pile's vadose zone. These groups are separated on Figures 2.20 through 2.31 with the suffix a, b or c, respectively. 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 2002a) and the Tailings Expansion EIS (USFS 2003). The observations made under the 2005 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) from EPA.

Values of pH remained between 6 and 8.5 for all internal monitoring site samples in 2005 (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, b and c. 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. 2005 conductivity measurement were between 1629 (wet wells) and 4550 (suction lysimeters) µS/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 suggest changes in the relative contributions from runoff, addition of the Northwest Diversion Ditch flow, infiltration and groundwater as the West Buttress was constructed. The increase in conductivity seen in Wet Well 2 over the past several years likely reflects an increasing contribution from contact water in the drain system and an increase in the dissolved load from migration/remobilization of oxidation products in the pile. The suction lysimeters have conductivity values ranging from 3180 to 7350 µS/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 3200 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 for Wet Well 2 shows 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) is expected as the waters respond to the changing redox conditions. This will contribute arsenic and iron (Figures 2.30a, b and c) to the drainage water. Arsenic concentrations in the drainage will therefore decrease when redox conditions in the pile stabilize (e.g. with closure and capping of the pile).

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 in 2003 and 2004, along with the lower alkalinity, suggest that sulfate reduction may not yet have been occurring in this portion of the west buttress. However, the April 2005 data showed a significant decrease in the concentration of zinc (from an average of 1,000 µg/l to less than 10 µg/l). This sample also showed an increase in pH, an increase in sulfate and a decrease in manganese. Placement of argillite on the outer slopes of the West Buttress has also led to higher zinc concentrations in Wet Well 3 from surface runoff flushing of this material when it was initially placed. In 2003, the zinc concentration in this wet well returned to within historical limits, and remained similar in 2004 and 2005. The two 20 foot suction lysimeters showed zinc concentrations between 400 – 2,000 µg/l (SL-02-05, SL-02-07), and the two 40 foot lysimeters (SL-02-04, SL-02-06) had zinc concentrations less that 50 µg/l (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 µg/l in water from each site (Figures 2.27a, b and c and 2.28a, b and c). Exceptions (Wet Well 3 and suction lysimeters, and MW-T-02-06) occur in the unsaturated zone and in areas of active tailings placement. These observations are consistent with the previous observations that copper and lead mobility are greatest when the tailings are first placed, then decrease with time.

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 µg/l). Cadmium in Wet Well 3 had a maximum value of 27 µg/l in 2002 and showed seasonal fluctuation similar that of zinc, albeit at significantly lower concentrations. Well MW-T-02-06 showed a cadmium concentration of 4.5 µg/l in June 2003; however, both samples in 2004 and the sample in 2005 were all less than the detection limit of 0.5 µg/l.

Iron and manganese data are presented in Figures 2.30 a, b and c and 2.31 a, b and c, respectively. Concentrations of iron and manganese are high in the wet wells, groundwater and most of the suction lysimeters due to oxidation/reduction and buffering reactions. Lower concentrations of iron and other metals in PZ-T-00-01, PZ-T-00-02 and PZ-T-00-03 likely indicates sulfide precipitation resulting from sulfate reduction in these waters.

Acid Base Accounting Analyses

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 2.32 shows the monthly composite sample ABA results for 2001 through 2005. The average NNP results for the past five years have been -281, -197, -194, -200 and -134 tons $CaCO_3$/1000t, respectively.

The results of ABA analyses on 10 grid samples taken from the tailing facility in 2005 are presented in Figures 2.33 and 2.34. The grid included portions of the pile that had exposures of tailings, argillite slope armoring, road rock, and ditch sediment. Of the 10 samples, 5 were relatively pure tailings. Figure 2.33 shows the acid generation potential (AP) versus neutralization potential (NP) of all the 2005 grid samples. The pure tailings samples plot in the upper half of the figure. The average neutralization potential (NP) of the 5 tailings samples from 2005 was 326 tons $CaCO_3$/1000t, which indicates a significant carbonate content in the tailings. The acid potential (AP) was determined by iron assay (assuming all iron is in the form of pyrite) and yielded an average of 440 tons $CaCO_3$/1000t. The resulting average net neutralization potential (NNP) was -114 tons $CaCO_3$/1000t, which indicates that the tailings are potentially acid generating. These results remain consistent with previous studies of the mine's tailings. Samples of weathered tailings (after approximately 12 years of exposure) have been shown to still retain a considerable amount of neutralization potential, equivalent to approximately 20% calcium carbonate (KGCMC, 2002b). This suggests that the potential lag time to acid generation of exposed tailings is on the order of decades. This long lag time allows time for construction and adequate closure of the site (including covering the pile with a composite soil cover that minimizes oxygen ingress).

Figure 2.34 shows the relationship of rinse pH to Net Neutralization Potential for the same suite of 2005 samples shown in Figure 2.33. Rinse pH is a measure of the pH of a one-to-one mixture of "as received" fines and water. The rinse pH of all of the tailings samples are above 6.0, indicating that the exposed surfaces of the pile are well buffered.

Sulfate Reduction Monitoring Program (SRMP)

Organic carbon amendment of tailings is being evaluated as a means of promoting sulfate reduction, metal removal and more generally pore-water remediation. Five organic carbon amended cells and two controls were installed in the existing tailings pile on the West Buttress in October and November 2004 by representatives from University of Waterloo, Environmental Engineering, Whitlock and Associates, and KGCMC. The cells received the following treatments:

Table 2.5 SRMP Cell Treatments

	Tailings (volume %)	Peat (volume %)	Brewery Waste (volume %)	Sewage Sludge (volume %)	
Cell 1	100	0	0	0	Unexcavated
Cell 2	100	0	0	0	Excavated
Cell 3	95	5	0	0	Amended
Cell 4	95	2.5	2.5	0	Amended
Cell 5	95	2.5	0	2.5	Amended
Cell 6	95	2.5	1.25	1.25	Amended
Cell 7	90	5	2.5	2.5	Amended

Each cell is 3 meters square by 4 meters deep. Cells 2 through 7 are lined on the sides with HDPE liner and are open at the top and bottom. Core samples were also taken from a vertical profile through each cell.

The following paragraphs summarize the SRMP results to date. For more detailed information, see the report *Investigations into Tailings Pore Water Remediation at the Greens Creek Mine, Alaska, USA*, University of Waterloo, 2006.

Field trial experiments, designed to assess the potential for sulfate reduction and metal removal associated with varied organic carbon amendments began on the cells in 2004. Five amended cells and two controls were constructed in the existing mill tailings deposit. Suction lysimeters, tensiometers and moisture probe access tubes were installed in each cell at regular depth intervals. Aqueous and solid-phase samples were collected in November 2004 to determine initial conditions. This initial pore-water chemistry was characterized by near-neutral pH (average 8.17) and elevated concentrations of dissolved sulfate (211 - 2980 mg/L), thiosulfate (381 - 3510 mg/L) and trace metals (Al, Ag, Cd, Cu, Mn, Mo, Ni, Pb, Se, Sb, Tl, V, Zn). Microbial enumeration of core samples indicated the presence of bacteria that mediate sulfate and iron reduction in addition to sulfur oxidation.

Suction lysimeter samples collected in October 2005 suggest conditions favorable to sulfate reduction have developed in some carbon amended test cells. Populations of sulfate reducing bacteria have increased significantly suggesting oxygen deficient conditions. Increases in dissolved manganese, iron and ammonia in some amended cells also suggests reduction reactions are occurring. Concentrations of dissolved Ag, Cd, Cu, Sb, Se, Pb, and Tl generally decreased from November 2004 to 2005, while As, Ni, and Zn increased. Pore-water concentrations of sulfate and thiosulfate decreased in some cells: however, additional investigation is required to determine controlling mechanisms.

Additional aqueous and solid-phase samples will be collected and analyzed to evaluate geochemical, microbial, mineralogical and hydrogeological controls on pore water remediation. Data collected from tailings facility characterization and laboratory experiments will be discussed in subsequent reports.

2.6 General Site Management

Tailings Operation and Management

The General Plan of Operations (GPO) Appendix 3 includes the general operating and management goals to achieve site stability and satisfy regulatory requirements for the KGCMC Tailings Facility In Appendix 3, Section 2.1.4, KGCMC Operations place tailings within the impoundment using specific criteria 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 2005.

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. Initial development of the lined area occurred 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.

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 2006 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. The Stage II Tailings Expansion Environmental Impact Statement (EIS) is summarized in KGCMC Tailing and Production Rock Site 2004 Annual Report (KGCMC, 2005). In 2005, 87 percent of the tailings were placed in the East Tails area, and the remaining 13 percent were placed at the West Buttress area.

Some of the significant construction activities in 2004 included the development of a construction rock source in the future location of Pond 7 and expansion of the lined tailings deposition area in the southeast expansion area. Major tailings facility expansion project accomplishments in 2005 included the construction of a 32.5 ac-ft retention pond (Pond 7), the extension of the existing liner to the south for the southeast expansion-phase II, and the removal of the old truck wash and Tank 6.

2.7 Site as-built

As-built drawings for the tailings facility are presented in Appendix 1. The as-built shows the 2005 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
- projected locations of piezometers from Figures 2.1 – 2.18

Photographs taken during routine site inspections in 2005 are presented in Figures 2.35 to 2.37 (Appendix 4). Figure 2.35 shows the additional liner installation in the southeast expansion area. This photo was taken on July 11, 2005. Figure 2.36 shows Pond 7 in November of 2005. The SRMP test plots are shown in Figure 2.37. Figure 2.38 shows an aerial view of tailings area taken in May 2005.

2.8 Reclamation/Closure Plan

<u>Reclamation Plan</u>

In November 2001, as part of the ADEC Waste Disposal Permit requirements, KGCMC submitted a "Detail Reclamation Plan with Cost Estimates" as an attachment to the GPO Appendix 14. A Federal/State/Municipal 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 through 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. As noted above, the Regulatory Agencies accepted this bond revision amount and KGCMC deposited the necessary funds in the Forest Service administered Federal Reserve account.

The value of the reclamation bonding fund was recalculated in 2005 for a Rio Tinto closure review. Based on this new estimate, KGCMC proposes an adjustment in the fund level from the current $26,200,000 to $29,000,000. This proposal will be discussed at the Annual Presentation meeting in July.

Reclamation Projects

KGCMC continued using past interim reclamation measures, such as hydroseeding and various erosion controls 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, course-rock 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 2006.

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. Ongoing, additional geotechnical assessment programs were conducted in late 2004 into 2005. The site geotechnical analysis report will again be updated with data from these studies.

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 remains ongoing since its installation in 2000 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.

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 2006 - 2007.

Approximately 5,000 cubic yards of material was excavated from the backslope of Site 23 during the 2005 construction season. The material was used as fill in the 960 road base and the Mill backslope road. Additional material that was removed is stored at 4.9-mile on the B road for future site reclamation activities. A spring was uncovered during the removal activities. Its flow of approximately 5 – 50 gpm was diverted into two of the existing finger drain collection system pipes (Sites 313 and 315). Flow differences between the inlet and outlet of the drains indicates a discontinuity in the piping. When rock placement reaches the level of the spring, KGCMC will re-route the water in a dedicated pipe to the toe of the pile. Though not ideal, discontinuities in perforated piping will not alter the primary function of the drains, which is to prevent water table mounding at the base of the pile. In 2006, approximately 2,500 – 5,000 cubic yards are planned to be removed from this Site 23 backslope development area. KGCMC is cautious not to over-excavate the Site 23 backslope because of highwall safety issues due to the unconsolidated nature of the material. Any future 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.

In 2003, EDE performed mass loading calculations to test hypotheses about flow regimes at Site 23/D and to predict possible post-closure water compositions (EDE, 2004). The results compare favorably with the TDS analysis, the hydrologic analysis as well as past and present flow and water compositional data. The model was used to compare 12 potential post-closure scenarios, including removal of Site D, a range of cover percolation values and a range of annual precipitation rates. The results showed flows at Pond D ranged from 70 gpm to 176 gpm while sulfate values ranged from 24 to 233 mg/l. Cadmium appears to be the metal of greatest concern for this site with respect to meeting water quality standards at Pond D after closure. Cover percolation rates of 20% or less may be required to meet the dissolved freshwater chronic zinc standard, and rates as low as 2% may be required to meet the recently lowered cadmium standard. These predictions do not consider natural attenuation processes, such as microbial or abiotic oxidation/reduction and sorption that could occur in the system following closure of the facility. These predictions will likely require refinement as more information about the site and its final configuration becomes available.

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 Management Permit 0211-BA001. A summary of all operational and monitoring activities performed in 2005 is provided. Refer to GPO Appendix 11 and Permit 0211-BA001 for a detailed description of Site 23, Site D and associated monitoring requirements.

Operation of Site 23 (KGCMC's only active production rock disposal facility) continued in 2005. See the Site 23 as-built in Appendix 2 for facility layout. Approximately 20,700 tons of production rock were placed at Site 23 during this report period. KGCMC estimates the projected remaining permitted capacity at Site 23 at approximately 748,300 tons.

3.2 Placement Records

Site 23 survey data and truck count haulage information are presented in Table 3.1. Site 23 received approximately 20,706 tons of production rock in 2005 as calculated from KGCMC surveyed volumes. Also placed at Site 23 in 2005 was approximately 3350 tons of material from the Site 1350 removal. A tonnage factor of 1.693 tons/yd^3 was used to convert surveyed volume to tonnage. More Class 1 production rock was hauled to tailings in 2005 than was placed at Site 23, recovering some of these materials placed in previous years. 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. Additionally in 2005, 1185 cubic yards of oxidized, class 3 material was removed from Site 23 and placed underground. 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					ADDITIONAL PRODUCTION ROCK HAULED					
	Surveyed (cy)		Surveyed (tons)		Hauled To Tails From Site 23 (tons)		From UG Truck Counts (tons)			
Date	Monthly	Cumulative	Monthly	Cumulative	Monthly	Cumulative	Class 1	Class 2	Class 3	Total
2/1/2005	0	464,821	0	786,844	816	73,764	1,200	630	0	1,830
3/3/2005	0	464,821	0	786,844	2,873	74,580	660	840	120	1,620
3/31/2005	1,298	466,119	2,197	789,042	1,836	77,453	570	390	270	1,230
5/1/2005	1,207	467,326	2,043	791,085	1,734	79,289	1,980	420	1,440	3,840
6/1/2005	1,402	468,728	2,373	793,458	493	81,023	180	1,050	510	1,740
6/30/2005	1,064	469,792	1,801	795,259	560	81,516	150	0	1,650	1,800
7/31/2005	2,462	472,254	4,168	799,427	1,592	82,076	1,920	180	3,660	5,760
8/31/2005	2,612	474,866	4,422	803,848	1,368	83,668	5,400	0	390	5,790
9/30/2005	1,850	476,716	3,132	806,980	2,865	85,036	480	60	0	540
* 10/31/2005	-1,393	475,323	-2,358	804,622	4,304	87,901	1,140	1,920	0	3,060
* 11/30/2005	-875	474,448	-1,481	803,141	2,464	92,205	990	0	0	990
12/30/2005	2,605	477,053	4,410	807,551	1,365	94,669	2,910	2,070	1,710	6,690
TOTAL	12,232		20,706		22,270		17,580	7,560	9,750	34,890
						Class 1 Placed:	-4,690	*		
						Total less tails hauled:	12,620			
* Excavation of material to tailings exceeded rock being placed on Site 23										

3.3 Stability

Klohn Crippen conducted a stability assessment of Site 23 and Site D in 2003. The stratigraphy and geology were reassessed using the results from drilling programs by KGCMC and Klohn Crippen, historical drill hole data, seismic refraction data, geological mapping and piezometer data. This assessment enabled the previous stratigraphic interpretations to be revised as follows (from top to bottom): a layer of colluvium and blocky rubble about 80 feet thick; a layer of glacial till and sediment about 120 feet thick; a comparatively thin layer of weathered bedrock about 10 to 20 feet thick; and unweathered bedrock (Klohn Crippen, 2004). The blocky colluvium is interpreted to be historical (likely ancient) landslide debris.

Limit-equilibrium stability analyses and the liquefaction potential of the foundation materials were evaluated for Site 23 and Site D, using the reinterpreted geological model. Site 23 has calculated static Factors of Safety greater than 1.6 for the existing configuration, and 1.7 for the proposed final build-out geometry at 1,120 feet with 3H:1V exterior slopes. The static calculated Factor of Safety of the backslope above Site 23 ranges from 1.0 for shallow surficial slips to 1.3 for deeper surfaces.

The excavation of the soil from the slope behind Site 23 (temporary construction condition) reduces the calculated Factor of Safety for those sections of the backslope, but this temporary reduction is not expected to cause serious backslope instability. Placement of rock fill within the excavation and construction of the final build-out geometry for the production rock site increases the calculated Factor of Safety to slightly above those for the pre-excavation condition.

Approximately 20 feet of saturated fill material identified at the base of Drill Holes DH-00-03 (north-central) and DH-02-14 (east end) at Site D was found to be potentially liquefiable under DBE and MDE loading. Liquefaction of this fill material will impact the stability of Site D, but will not reduce the stability of Site 23 to unacceptable levels.

Site D is projected to fail under a significant earthquake. In its current configuration, Site D will fail under the 1/475-year magnitude design earthquake. This represents an approximate probability of failure of about 0.21% annually, or about 2% during the mine’s current projected period of about 10 years.

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 2005 the USFS inspected Site 23 approximately 17 times (Site inspections #197-#213) monitoring for Best Management Practices effectiveness and compliance to the General Plan of Operations (GPO). No issues of non-compliance or poor operations practices were noted in the inspections. In fact, the USFS inspections typically noted that Site 23 was being developed and operated to required operations and maintenance specifications of GPO Appendix 11. Also, the ADEC and ADNR inspected the site on two occasions in 2005, in June and November.

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. An inclinometer was installed at Site 23 at the end of 2005 to aid with stability monitoring.

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. Comparison of historic versus modeled flow from the finger drains and the curtain drain indicated they are performing as designed and as necessary (EDE, 2004). See 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 in Appendix 2. 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 alluvial sands (Figures 3.9 and 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 79.43 inches of precipitation fell in 2005. The driest month was May (1.27 in).The wettest months were November and September with 15.26 and 12.66 inches of precipitation, respectively. An unusually heavy rainfall event occurred from November 14th through the 25th, with 13.5 inches of rain. Within this time frame, there were two days with greater than three inches, and two days with greater than two inches of rain. This wet fall is reflected in the increase of between 1.5 feet and 14 feet in groundwater elevations above average levels (see Figures 3.6, 3.7, 3.9, and 3.11). The production rock and colluvium units respond rapidly to hydrologic events such as snowmelt and rainfall, indicating very local recharge and discharge (EDE, 2004).

Flow data for Pond D are shown with precipitation in Figure 3.13. A review of curtain drain and Pond D flow measurements suggest that the current Pond D flow meter readings are approximately 40% low (EDE, 2004). Piping and flow meter modifications may be required to obtain more accurate readings.

Table 3.2 Monthly Summaries of Mill Site Climate Data

Month	Avg Temp (°C)	Precipitation (inches)
January	-4.02	4.90
February	-1.76	4.73
March	1.41	4.82
April	5.18	2.93
May	10.38	1.27
June	11.68	3.54
July	12.36	6.56
August	13.40	6.08
September	9.11	12.66
October	4.06	9.89
November	0.41	15.26
December	0.56	6.79
2005	5.23	79.43

3.5 Water Quality

An in-depth re-evaluation of the geochemistry and hydrology of Site 23 and Site D was performed in 2003 by Environmental Design Engineering (EDE) and KGCMC in accordance with the ADEC Waste Management Permit Section 4.1.1. In general, metal concentrations in the production rock are above crustal averages and are higher than those of the underlying till, colluvium, and alluvium units. Site contact water, therefore, has a generally higher dissolved load than background surface water and groundwater. Bruin Creek and Greens Creek have specific conductivities that range seasonally from 50 to 225 µS/cm. The lack of significant differences between upgradient and downgradient sites on these two creeks demonstrates that effects from Site 23/D are negligible.

Groundwater upgradient and downgradient of Site 23/D also varies between sites and seasonally, with specific conductivity ranging from 200 to 800 µS/cm. Compositional differences between upgradient and downgradient wells demonstrate that the slide unit hosts a series of disconnected, perched water tables.

Monitoring data from surface water and groundwater sites indicate that the combination of finger drains, curtain drain, ditches and ponds is effectively collecting contact waters and that downgradient effects from Site 23/D are negligible.

Data collected from basal drains, the curtain drain and Pond D show a progressive, down-slope increase in the groundwater component of the flow. This is consistent with the hydrologic interpretation that water infiltrates through the slide material and daylights as springs near the toe of this unit. As Site 23 expands, the proportion of contact water in the flow increases, as demonstrated by the increase in the curtain drain dissolved load since 1995. While the volume of contact water has increased, the dissolved load of the contact water has not increased over time. This is a positive result because it demonstrates that acid generation is not imminent.

A dissolved load analysis based on calculated TDS was performed to determine the relative proportions of various source waters in downgradient waters. Based on this analysis, Pond D contains 12% contact water, and approximately 80% of the D Pond flow is contributed by the curtain drain.

Representative water quality analyses for the major water types are consistent with the conductivity and TDS results and help to further define the geochemical processes occurring at the site. Alkalinity and pH values from all site waters support the conclusion that carbonate minerals are effectively neutralizing acids formed by oxidation of pyrite in the production rock. Zinc, cadmium, manganese, nickel and arsenic are more mobile than other metals of interest in the drainage. Precipitation of iron oxy-hydroxides and manganese oxides controls the concentrations of iron, manganese, and arsenic. Zinc, cadmium and nickel are controlled by mixing and sorption mechanisms. Gypsum is controlling the concentration of calcium in the drainage and will slowly be removed from the system after the pile is covered.

Compliance Monitoring

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 2005 is being prepared separately and will be submitted to the Forest Service and ADEC upon completion.

Internal Monitoring

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. The provision was retained within Waste Management Permit 0211-BA001 with its issuance in November 2003.

As described in Section 2.8.3.1 of both permits, 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) from EPA.

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 impractical. 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 groundwater. These groups are separated on the Figures 3.14 through 3.24 with the suffix a or b, respectively. For example, a figure number such as 3.14a would show the pH data for the finger drains, and 3.14b would show the pH data for the groundwater sites. 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 3.27). 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 2005. The lower pH values (generally pH 6.0 to 7.0) 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 8.5). 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. 2005 conductivity measurements range up to 5,050 µS/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) generally have 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 serves 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 and groundwater wells are plotted in Figures 3.18a and 3.18b 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 2003, 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 (Figures 3.25 a and b) 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, and this average further decreased to approximately 14 mg/l in 2004 and 2005. Zinc concentrations in the range of 20 to 70 mg/l are consistent with laboratory 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. MW-D3 showed elevated zinc concentrations in both 2005 samples: zinc levels rose from an average of 10 µg/l in 1998-2004 to an average of 177 µg/l in 2005. Average sulfate also increased by approximately 30 mg/l in 2005 compared to average values from 2002-2004. The cause for these increases is not immediately apparent; however, if it was the arrival of a contact water front, a significant increase in conductivity, sulfate, calcium and magnesium should have preceded an increase in metals such as lead and zinc.

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 µg/l).

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. The December 2005 sample from MW-23-A2D showed elevated metal concentrations when compared to historical data. Monitoring will continue to determine trends.

Manganese concentrations (Figures 3.26a and b) are generally less than 50 µg/l for MW23-A2D, MW23-A4, and three of the finger drains (23FD-3, 23FD-5 and 23FD-8). The other three finger drains (23FD-2, 23FD-6 and 23FD-7) and MW-D3 and Pond D have elevated manganese concentrations, indicative of the different redox conditions. Precipitation/dissolution of iron oxyhydroxides and manganese oxides controls the concentrations of iron and manganese in these waters.

Acid Base Accounting Data

Acid base accounting (ABA) results from 43 underground rib composites collected in 2005 are presented in Table 3.3 and Figure 3.28. Class 1 rib samples had an average neutralization potential (NP) of 467 tons $CaCO_3$/1000t, which is equivalent to 47% carbonate. The Class 1 samples had an average acid potential (AP) of 95 tons$CaCO_3$/1000t, which produced an average net neutralization potential (NNP) of 372 tons $CaCO_3$/1000t. Class 1 production rock does not have the potential to generate acid rock drainage, however KGCMC recognizes the potential for metal mobility (primarily zinc) from argillite. 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 rib samples had a moderate average NP value (208 tons$CaCO_3$/1000t) and an average AP of 214 tons$CaCO_3$/1000t. The resulting average NNP for the Class 2 rib samples was -6. Class 3 rib samples had an average NP, AP and NNP of 163, 361 and -198 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 rib samples produced an average NNP of -493 tons$CaCO_3$/1000t. Class 4 material is retained underground.

Figure 3.28 compares actual class designation based on ABA analyses to the results of visual designation use underground to classify the production rock. Of the 43 composites, visual classification assigned only 1 sample (2%) to a lower, less conservative class. 22 (51%) of the composites were assigned to the appropriate class and 20 (47%) to a higher, more conservative class. These data represent a 98% 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	547	467	262	208	307	163	99
AP	63	95	227	214	268	361	592
NNP	484	372	35	-6	39	-198	-493

Notes:
Values are averages from 43 samples for rib samples in 2005, and 11 samples for Site 23 in 2004
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 3.28 shows the ABA data from surface sampling at Site 23 in 2004. The AP to NP distribution in the Site 23 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. Currently drainage from the Site 23/D area is collected and pumped to the Pit 5 water treatment facility.

3.6 General Site Management

The construction method used at Site 23 (bottom-up construction) limits the site's complexity. All placement activity in 2005 occurred between the 920 and 1000 levels of the pile. Designated placement zones are marked on the active lift of the site and production rock is placed according to class. Prior to 2004, Class 2 and Class 3 materials were placed five and ten feet, respectively, from the outer edges of the pile. Class 1 was 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.

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 proposed placement changes included reducing the five foot zone of Class 1 production rock on outer surfaces to two feet, and blending Class 2 and 3 materials for placement in the center of the pile. Agency (ADEC and Forest Service) approval was confirmed in an ADEC 13 May 2004 letter. KGCMC placement under this protocol was initiated during the summer of 2004, and continued through 2005. KGCMC filled a significant portion of the depression between the excavated backslope and the Class 3 zone in 2004 and ceased placing Class 1 rock against the backslope (except near finger drains). This will help KGCMC meet the demand for Class 1 rock on the outer slopes of Site 23 and the tailings pile.

Approximately 5,000 cubic yards of material was excavated from the backslope of Site 23 during the 2005 construction season. The material was used as fill in the 960 road base and the Mill backslope road. Additional material that was removed is stored at 4.9 on the B road for future site reclamation activities. In 2006, approximately 2,500 – 5,000 cubic yards are planned to be removed from this area.

3.7 Site as-built

As-built drawings for Site 23/D are presented in Appendix 2. Three drawings from the Site 23/D Hydrogeology and Geochemistry Analysis Report (EDE 2004) (Site 23/D conceptual model, Site 23/D colluviam potentiometric surface and Site 23/D cross section) are also included in Appendix 2. The drawings show 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

Figures 3.30 through 3.32 show photographs of Site 23. Figure 3.30 shows the designated storage area on Site 23 for Class 1 production rock. Native material removal activities in the backslope area are shown in Figure 2.31. Figure 3.32 shows the Mill backslope road, where some of the Site 23 backslope materials were used in reestablishing the road base. An aerial photograph of Site 23/D taken in May 2005 is shown in Figure 3.33.

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). As of June 1, 2006, the 2005 performance monitoring summary for the cover has not been received from the contractor. KGCMC does not anticipate significant changes relative to 2004 performance and will summarize the 2005 results at the July 11, 2006 annual meeting. Key performance aspects of the cover system through 2004 include:

- The monitoring indicates that the primary objective of maintaining at least 85% saturation in the compacted barrier layer of the cover has continually 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 304 inches of precipitation that fell since the lysimeter collection system was installed, approximately 60 inches of percolation into the lysimeter has been recorded. Thus the cover system appears to have allowed approximately 20 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. In early 2004, the malfunctioning tipping bucket was replaced with direct measurement and physical collection. A new tipping bucket was installed in July. On September 23, 2004, a circular, 6 feet diameter HDPE cover was placed directly over the lysimeter. The covered area was increased with the addition of a rectangular HDPE cover that extended approximately 18 feet up-slope on November 16th.

- The high net percolation rate recorded for the monitoring period suggests that the HDPE covers have not reduced the amount of moisture reaching the lysimeter. This suggests that the net percolation being recorded is from a source outside of the covered area (e.g. not direct vertical percolation through the cap), or that the net percolation being recorded presently was within the cover profile before the placement of the covers (some 18-month time period now makes this possibility unlikely). However, if this second scenario is accurate, the net percolation recorded during the monitoring period is moisture being flushed through the cover system.

- Nuetron probe measurements were completed in December 2004 for the first time since early 2003 (due to equipment failure and delayed repairs). Analysis of the results showed little change in the volumetric water content of the soil profiles during this period.

- 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.

- Data capture from the 20 monitoring instruments in 2005 was 65%.

- Vegetative cover continues dominated by the hydroseeded grass and clover plant species. However natural invasion, primarily by spruce seedlings, is evident, particularly on the western-most portion of the cover area.

- 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.

Reclamation Plan

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

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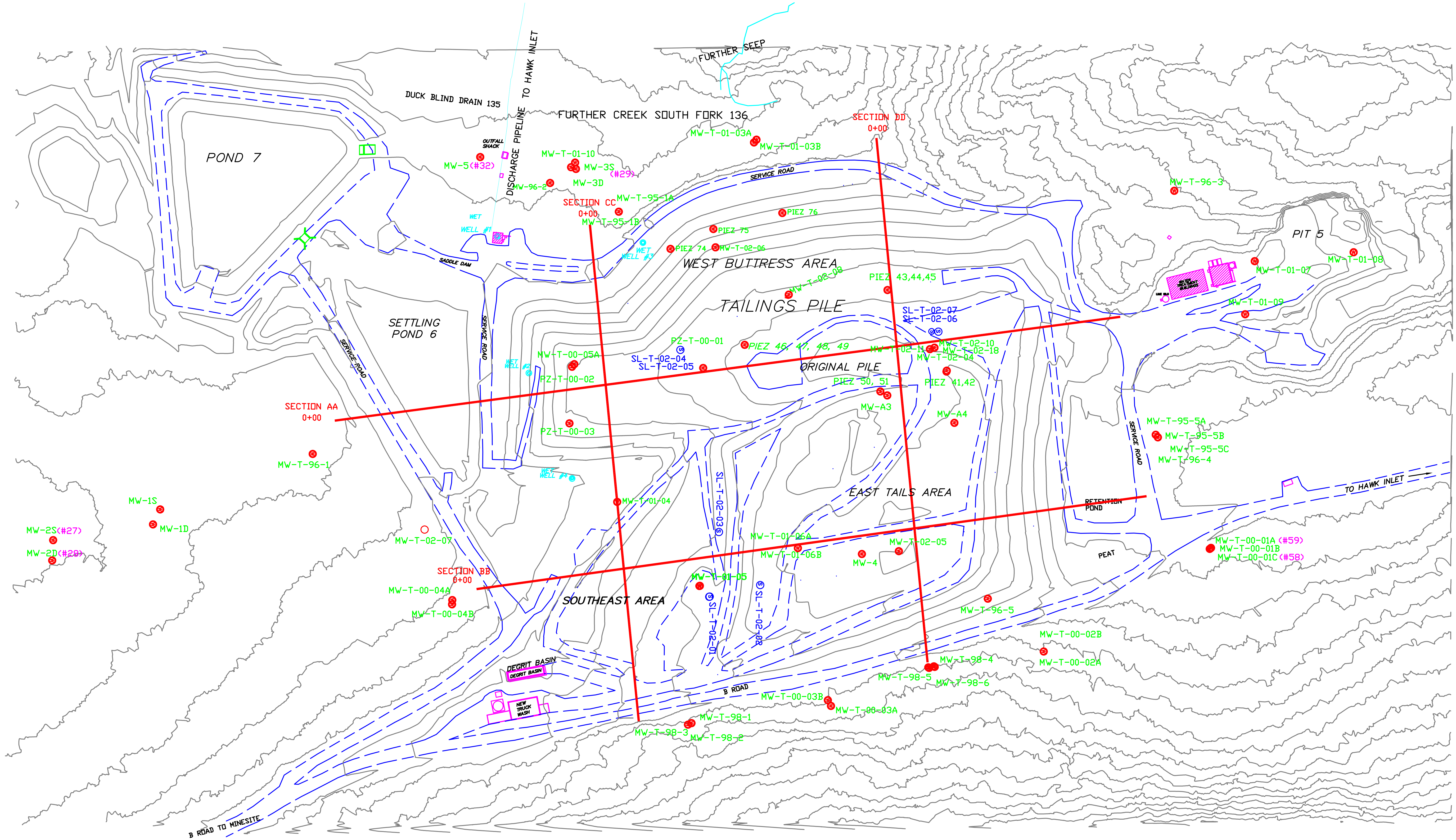
Vos, R.J., 1993, Weathering Characteristics of Waste Rock From Admiralty Island Deposit (23 Month Report, B.C. Research Inc., July, 1993.

APPENDIX 1

Tailings Facility 2005 As-built and Cross Sections



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LEGEND:

EXISTING GROUND	———
EXISTING ROADS	———
CROSS SECTIONS	———
MONITORING WELL	MW-T-01-05 (W)
SUCTION LYSIMETER	SL-T-02-02 (S)
PIEZOMETER	PZ-T-00-01 (P)
FWMP Site Number	(#58)

KENNECOTT MINERALS

KENNECOTT GREENS CREEK MINING CO.
P.O. BOX 32199 JUNEAU, ALASKA 99803
PHONE: (907)790-8441 FAX: (907)790-8448

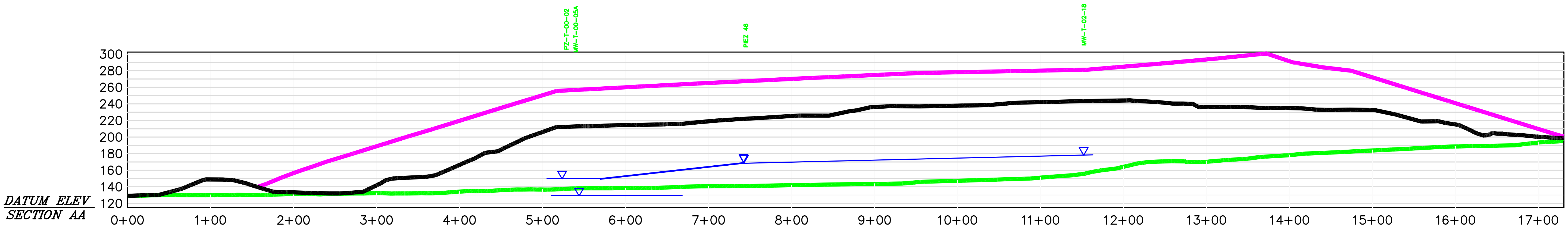
TITLE: 2005 TAILS YEAR END ASBUILT

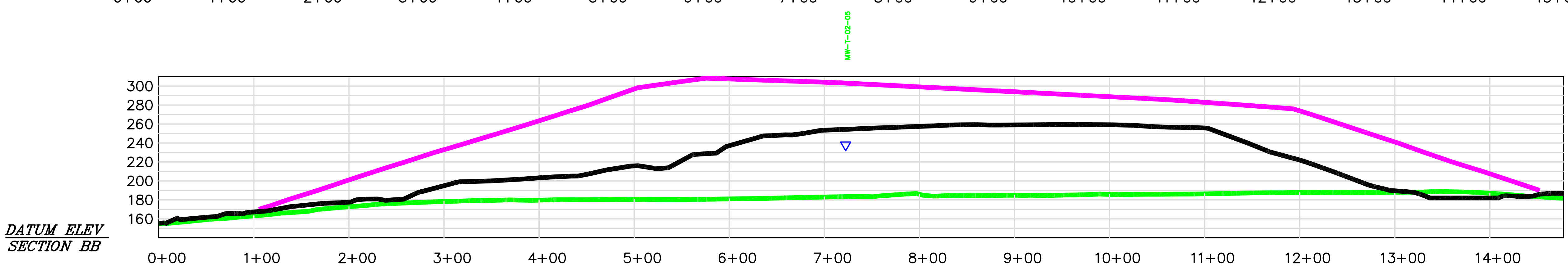
DATE: 1-4-06
DRAWING BY: Shelby Edwards
DESIGN BY: ----
REVIEWED BY: ----
PROJ OR REF. ----

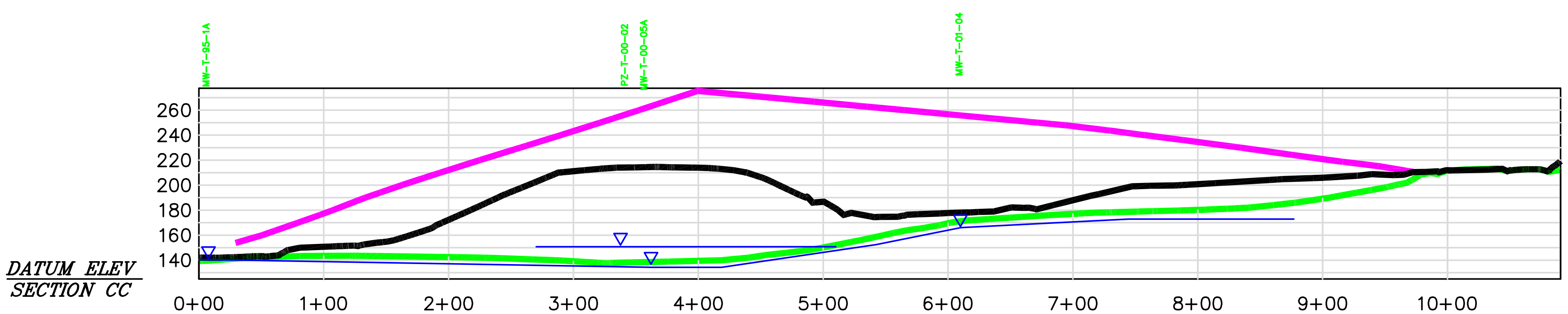
0 20 50 100

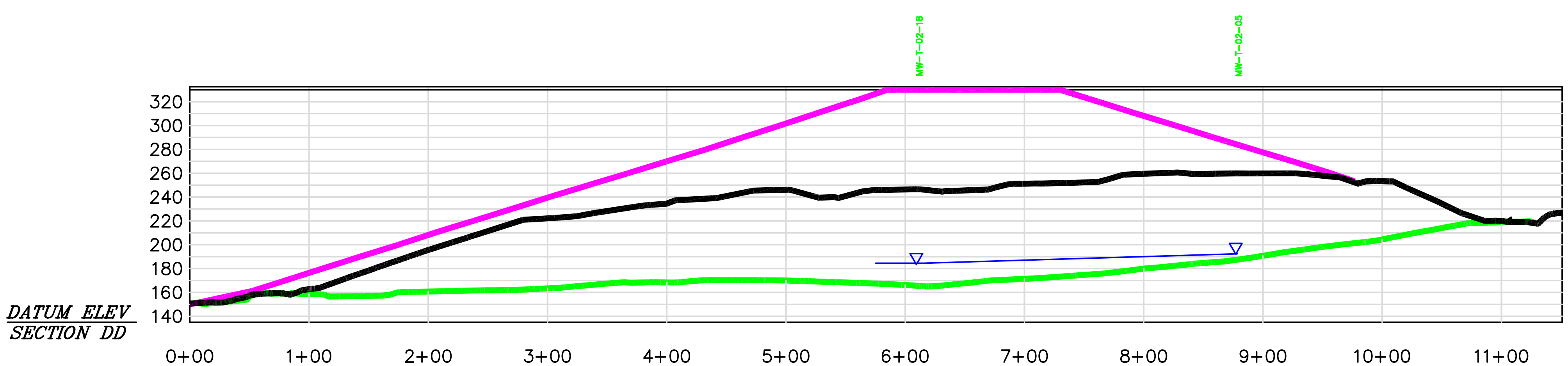
SHEET: 1 OF 1

REVISIONS	DWG NO.	DESCRIPTION	DATE	BY	PROJ.	CLIENT









LEGEND:
DESIGN PLAN
ORIGINAL GROUND
EXISTING GROUND
WATER TABLE

SYMBOLS:
FIRE HYDRANT
MONITORING POINT
BOLLARDS
POWER POLES
WATER VALVE
CATCH BASIN

KENNECOTT MINERALS

DATE: 1-4-06
DRAWING BY: Shelby Edwards
DESIGN BY: ----
REVIEWED BY: ----
PROJ OR REF ----

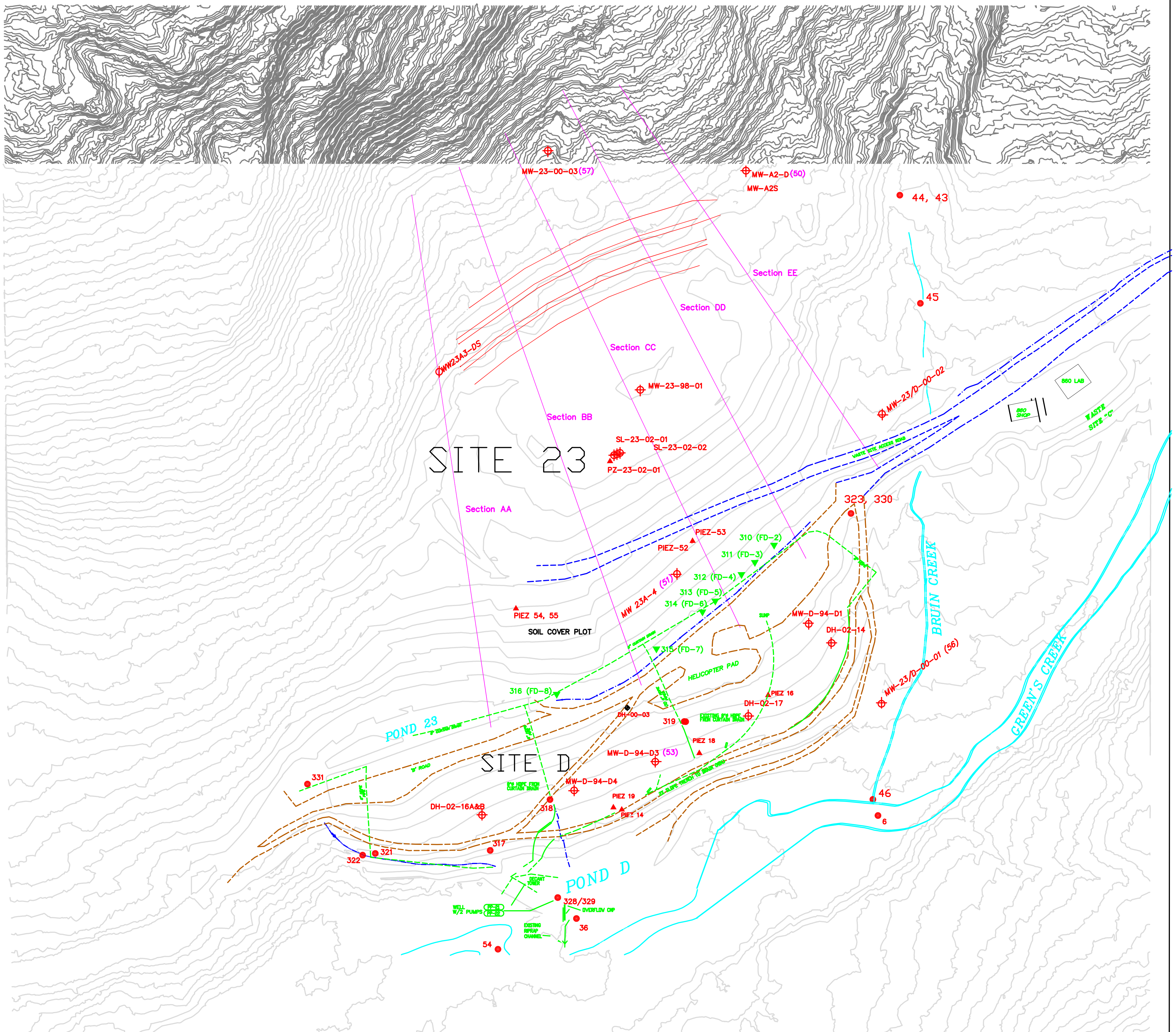
KENNECOTT GREENS CREEK MINING CO.
P.O. BOX 32199 JUNEAU, ALASKA 99803
PHONE: (907)790-8441 FAX: (907)790-8448

TITLE: 2005 TAILS YEAR END CROSS SECTIONS

SHEET: 1 OF 1

APPENDIX 2

Site 23/D 2005 As-built and Cross Section



LEGEND:

EXISTING GROUND

CROSS SECTIONS

PIEZOMETER

WELL

Surface Sampling Site

DRAIN SAMPLING POINT

FWMP Site Number (53)

KENNECOTT GREENS CREEK MINE
ADMIRALTY ISLAND, ALASKA

WASTE SITE 23
ROAD AND PILE DESIGN
W/ CROSS SECTIONS

DATE: 12-30-05
DRAWING BY: Shelby Edwards
DESIGN BY: -----
REVIEWED BY: -----
PROJ OR REF. # -----

PREPARED BY:
Greens Creek Mining Co.
JUNEAU, ALASKA

GCMC DWG

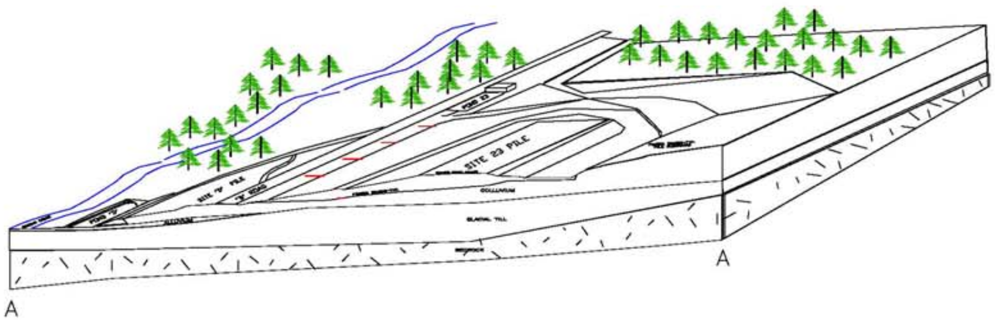
SCALE: 1"=60'

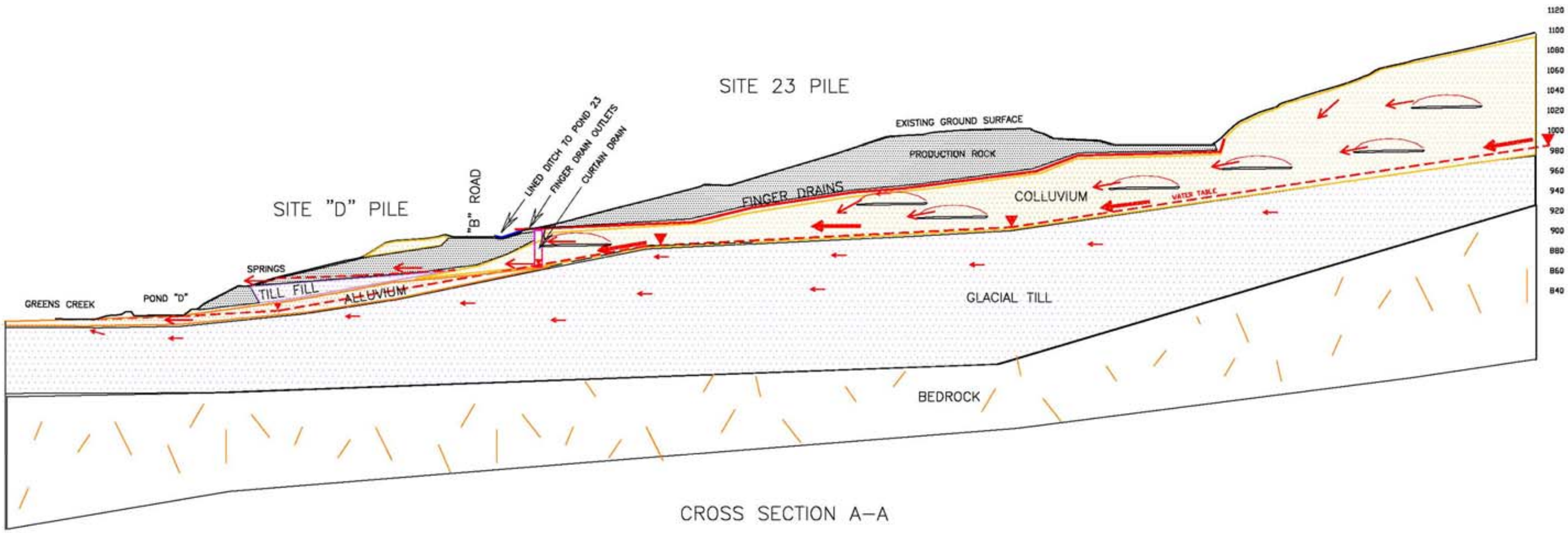
SHEET: 1 OF 1

KENNECOTT MINERALS	KENNECOTT GREENS CREEK MINING CO.
DATE: 4-30-03 DRAWING BY: TZ DESIGN BY: PC REVIEWED BY: ---- PROJ OR REF. EDE-Site 23/D Hydrology	TITLE: SITE 23/D CONCEPTUAL GROUNDWATER FLOW

LEGEND:

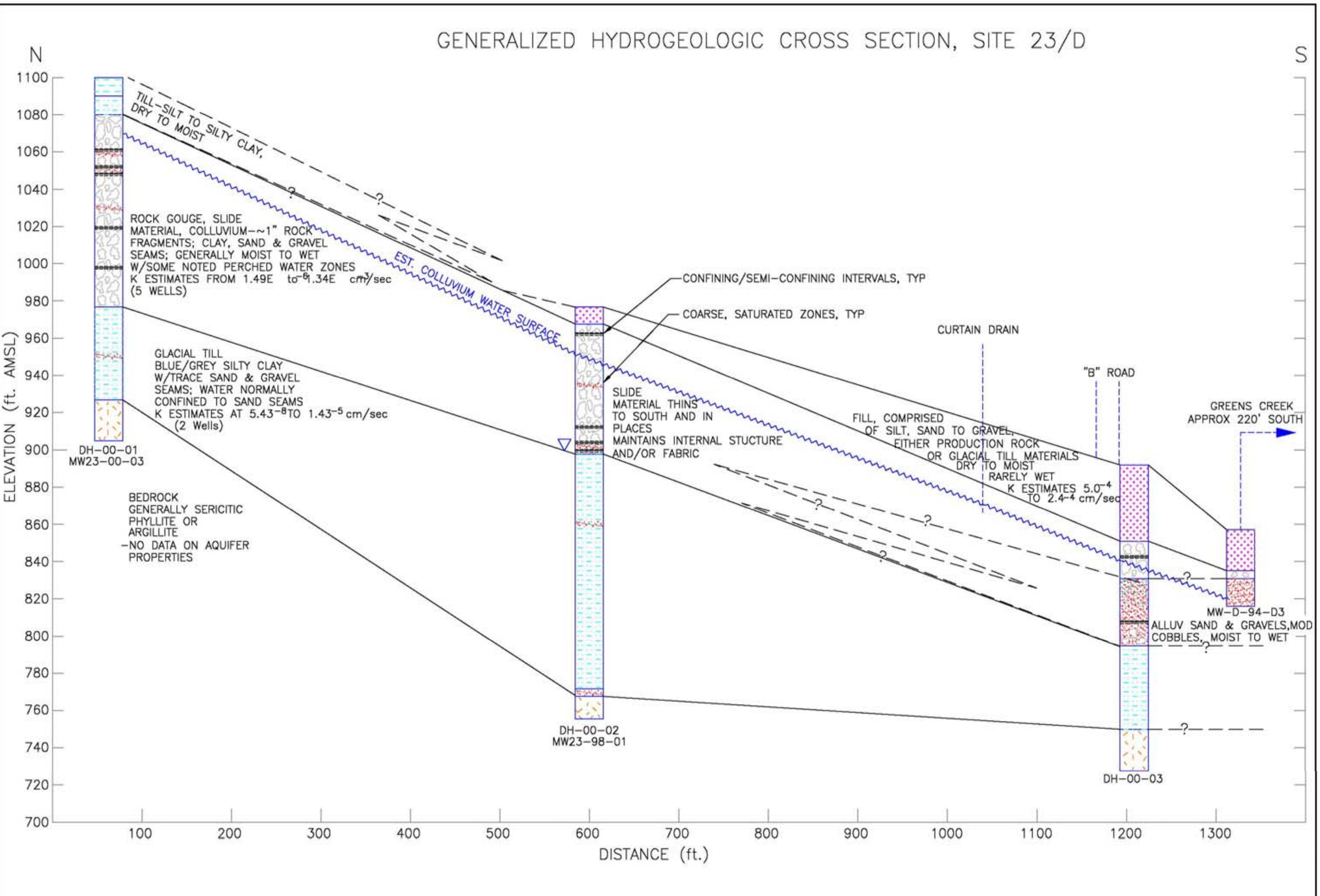
- CLAY LENSES WITH PERCHED WATER
- WATER TABLE
- WATER FLOW VECTORS – FLOW RATE PROPORTIONAL
- EXISTING GROUND
- PRODUCTION ROCK FILL
- FINGER DRAINS TYPICAL
- COLLUVIUM
- ALLUVIUM
- GLACIAL TILL LAYER
- BEDROCK





CROSS SECTION A–A

South North


GENERALIZED HYDROGEOLOGIC CROSS SECTION, SITE 23/D
N
S
TILL-SILT TO SILTY CLAY, DRY TO MOIST
ROCK GOUGE, SLIDE MATERIAL, COLLUVIUM-~1" ROCK FRAGMENTS; CLAY, SAND & GRAVEL SEAMS; GENERALLY MOIST TO WET W/SOME NOTED PERCHED WATER ZONES K ESTIMATES FROM 1.49E to 1.34E cm/sec (5 WELLS)
EST. COLLUVIUM WATER SURFACE
CONFINING/SEMI-CONFINING INTERVALS, TYP
COARSE, SATURATED ZONES, TYP
CURTAIN DRAIN
"B" ROAD
GREENS CREEK APPROX 220' SOUTH
GLACIAL TILL BLUE/GREY SILTY CLAY W/TRACE SAND & GRAVEL SEAMS; WATER NORMALLY CONFINED TO SAND SEAMS K ESTIMATES AT 5.43-8 TO 1.43-5 cm/sec (2 Wells)
SLIDE MATERIAL THINS TO SOUTH AND IN PLACES MAINTAINS INTERNAL STUCTURE AND/OR FABRIC
FILL, COMPRISED OF SILT, SAND TO GRAVEL, EITHER PRODUCTION ROCK OR GLACIAL TILL MATERIALS DRY TO MOIST RARELY WET K ESTIMATES 5.0-4 TO 2.4-4 cm/sec
DH-00-01
MW23-00-03
BEDROCK GENERALLY SERICITIC PHYLLITE OR ARGILLITE -NO DATA ON AQUIFER PROPERTIES
DH-00-02
MW23-98-01
MW-D-94-D3
ALLUV SAND & GRAVELS,MOD COBBLES, MOIST TO WET
DH-00-03
ELEVATION (ft. AMSL)
DISTANCE (ft.)
1100 1080 1060 1040 1020 1000 980 960 940 920 900 880 860 840 820 800 780 760 740 720 700
100 200 300 400 500 600 700 800 900 1000 1100 1200 1300

LEGEND:

- PIEZOMETER/WELL
- LEASE BOUNDARY
- 10' CONTOUR LINE
- STREAM CHANNEL
- ROAD
- CURTAIN DRAIN
- CURTAIN DRAIN OUTFALL
- 7.95-4 SEEPS/SPRINGS
- COLLUVIUM POTENTIOMETRIC ISOPLETHS C.I. = 10'

KENNECOTT GREENS CREEK MINE
ADMIRALTY ISLAND, ALASKA

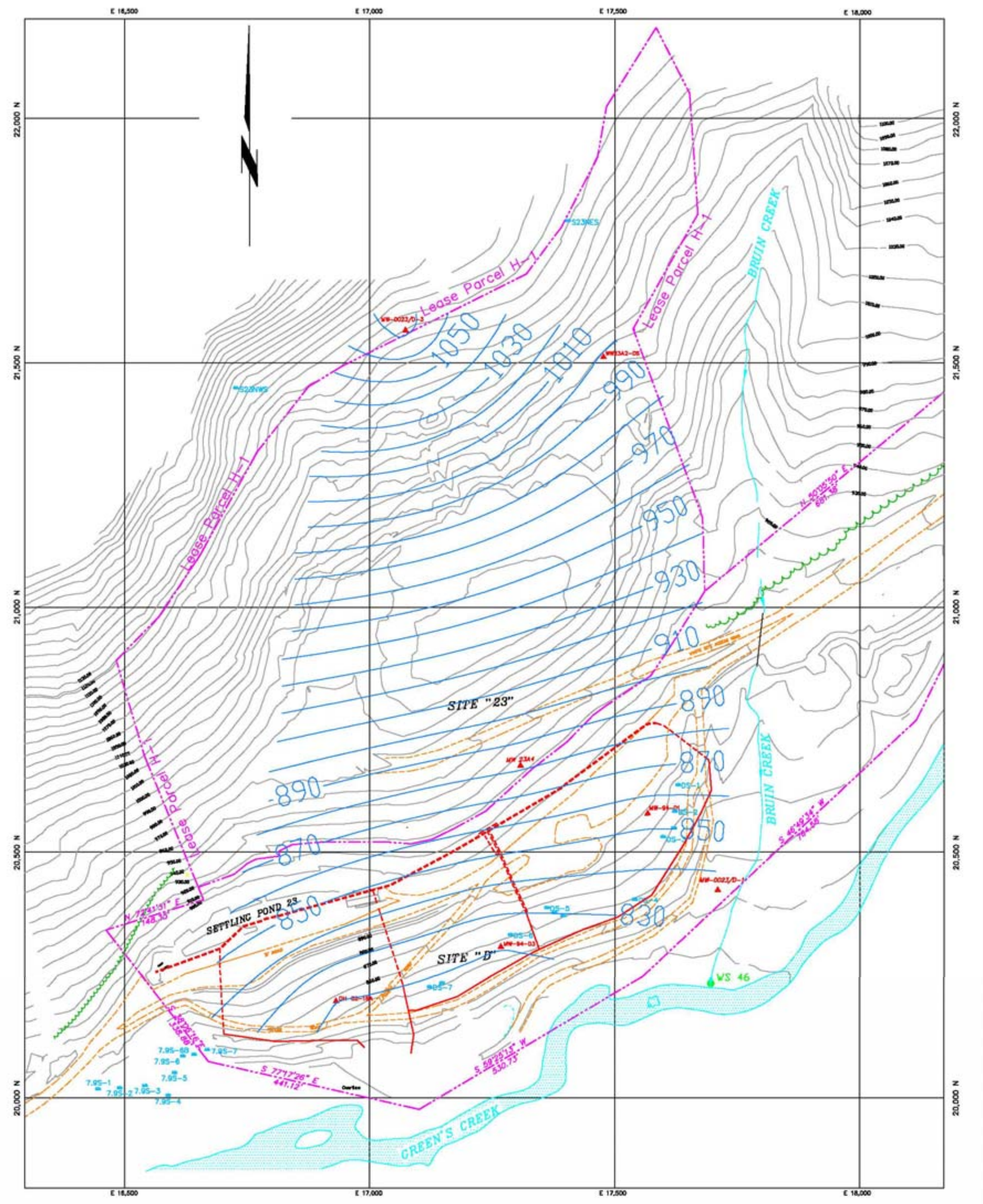
SITE 23/D
COLLUVIUM POTENTIOMETRIC
SURFACE 2003

DATE: 03/04/04
DRAWING BY: RWH
DESIGN BY: RWH
REVIEWED BY: RWH
PROJ OR REF. -----

EDE Consultants

EDE DWG site 23 base map.dwg

SCALE: 1" = 200'
SHEET: 1 OF 1



APPENDIX 3

Data Figures

Figure 2.1 Water Level Data for Piezometer 41

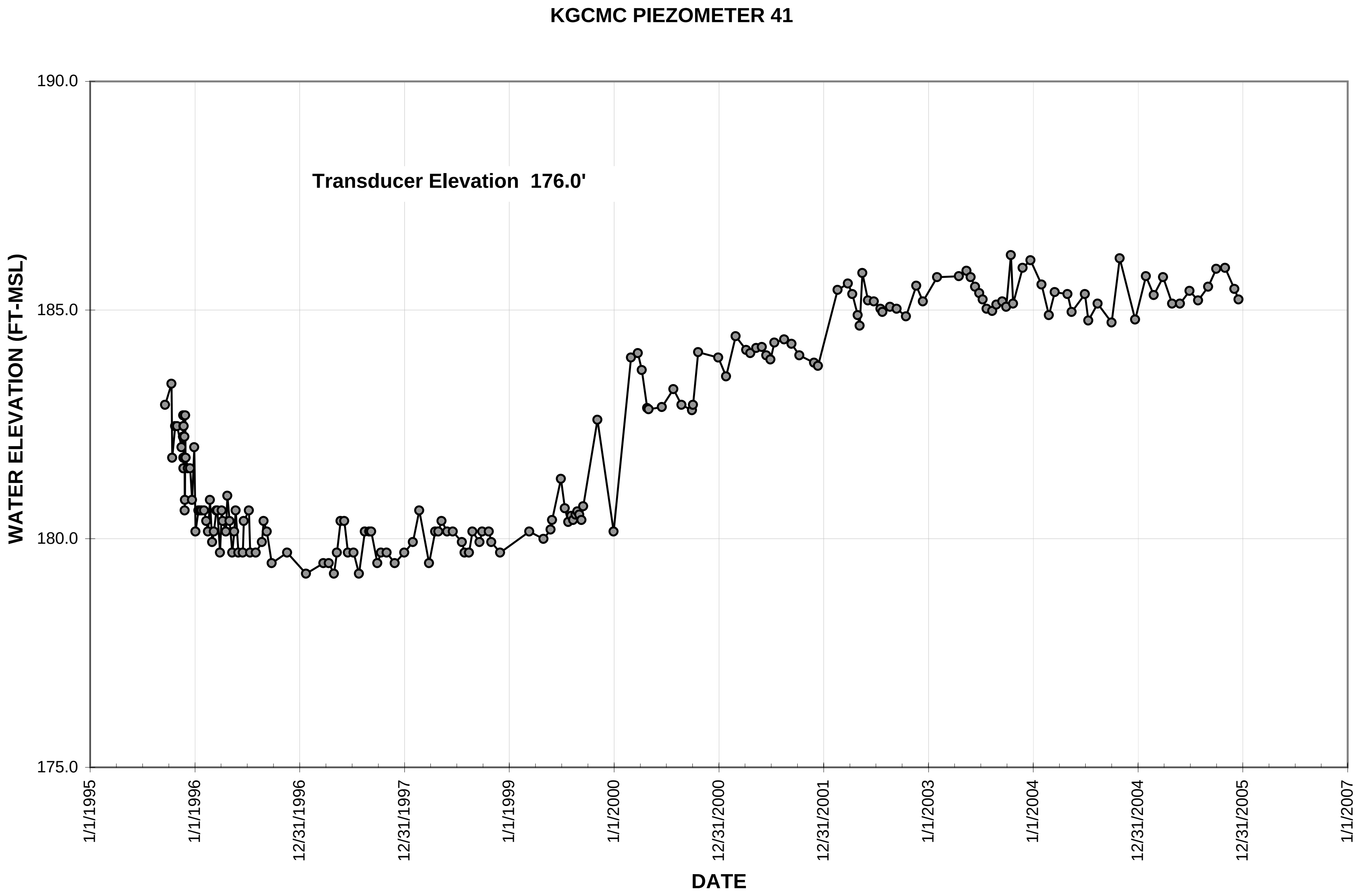


Figure 2.2 Water Level Data for Piezometer 42

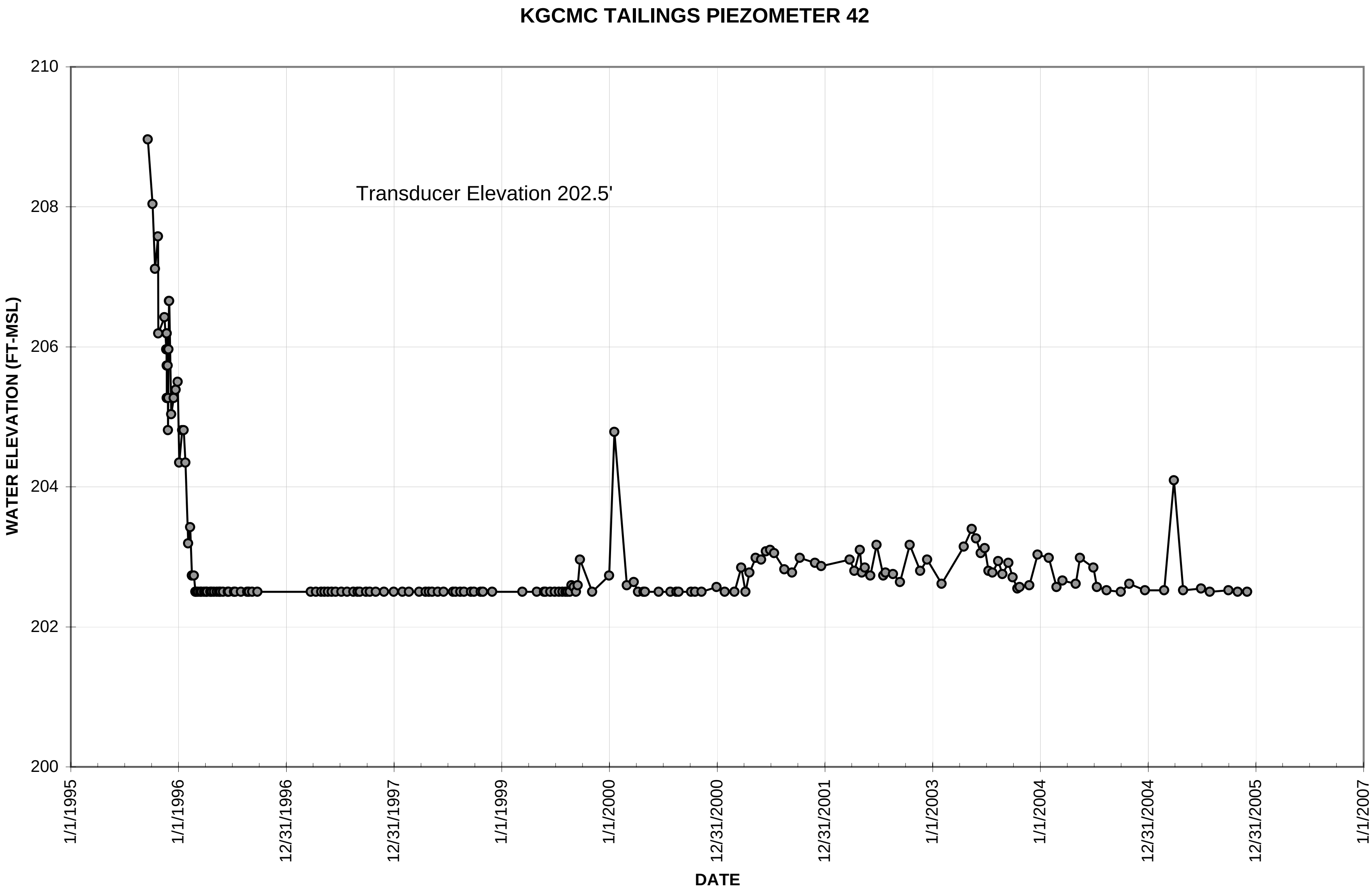


Figure 2.3 Water Level Data for Piezometer 44

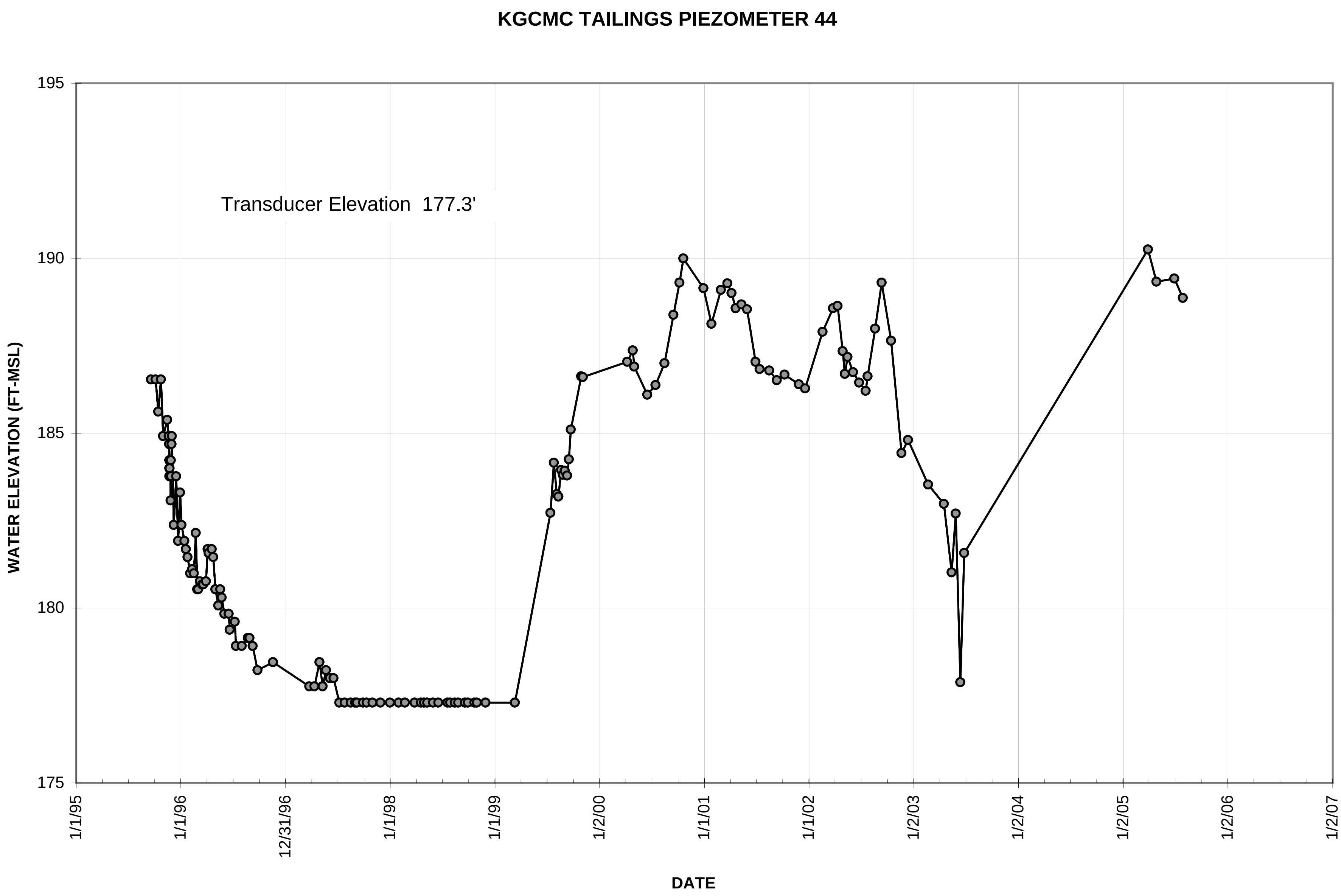


Figure 2.4 Water Level Data for Piezometer 46

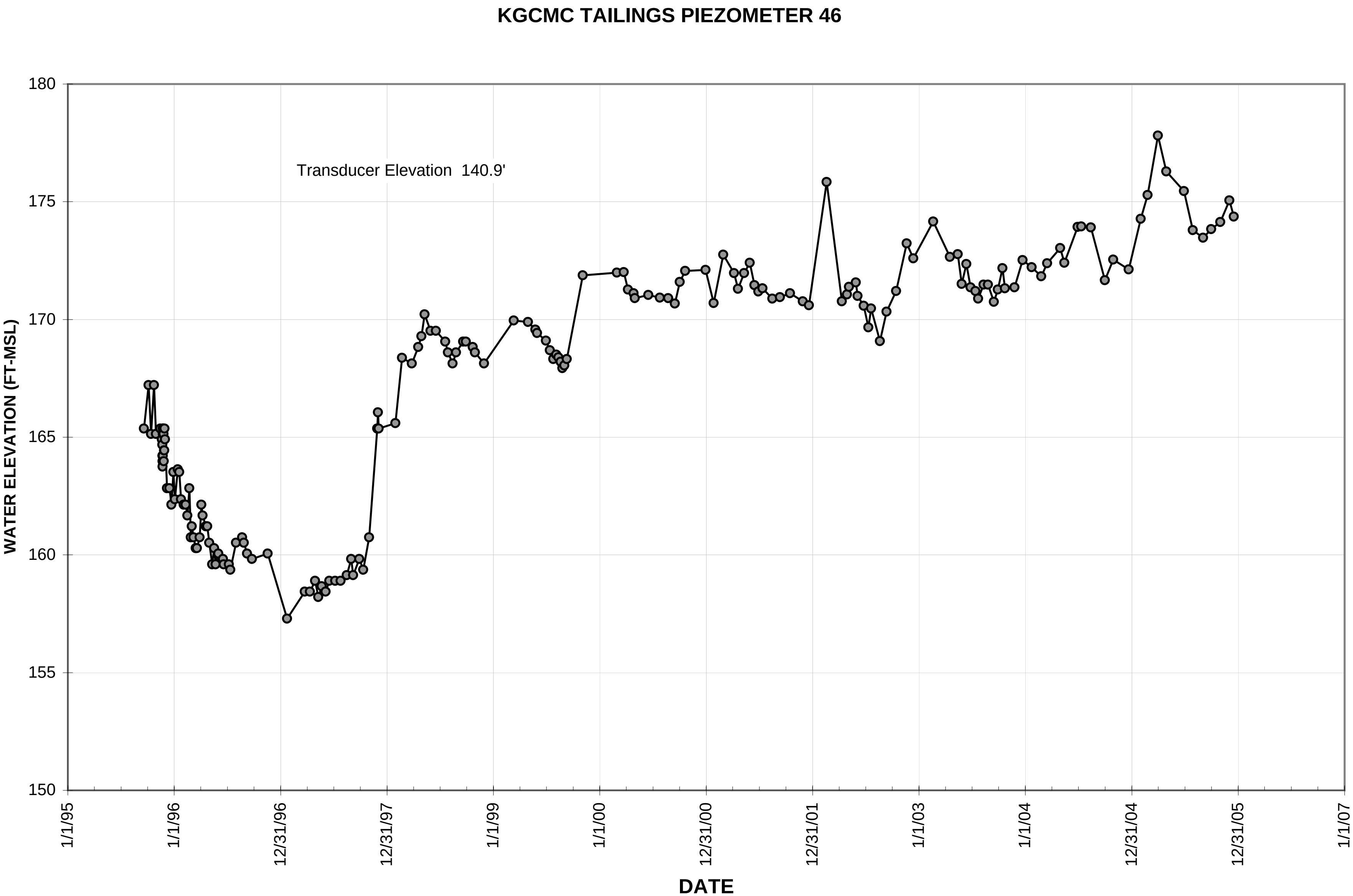


Figure 2.5 Water Level Data for Piezometer 47

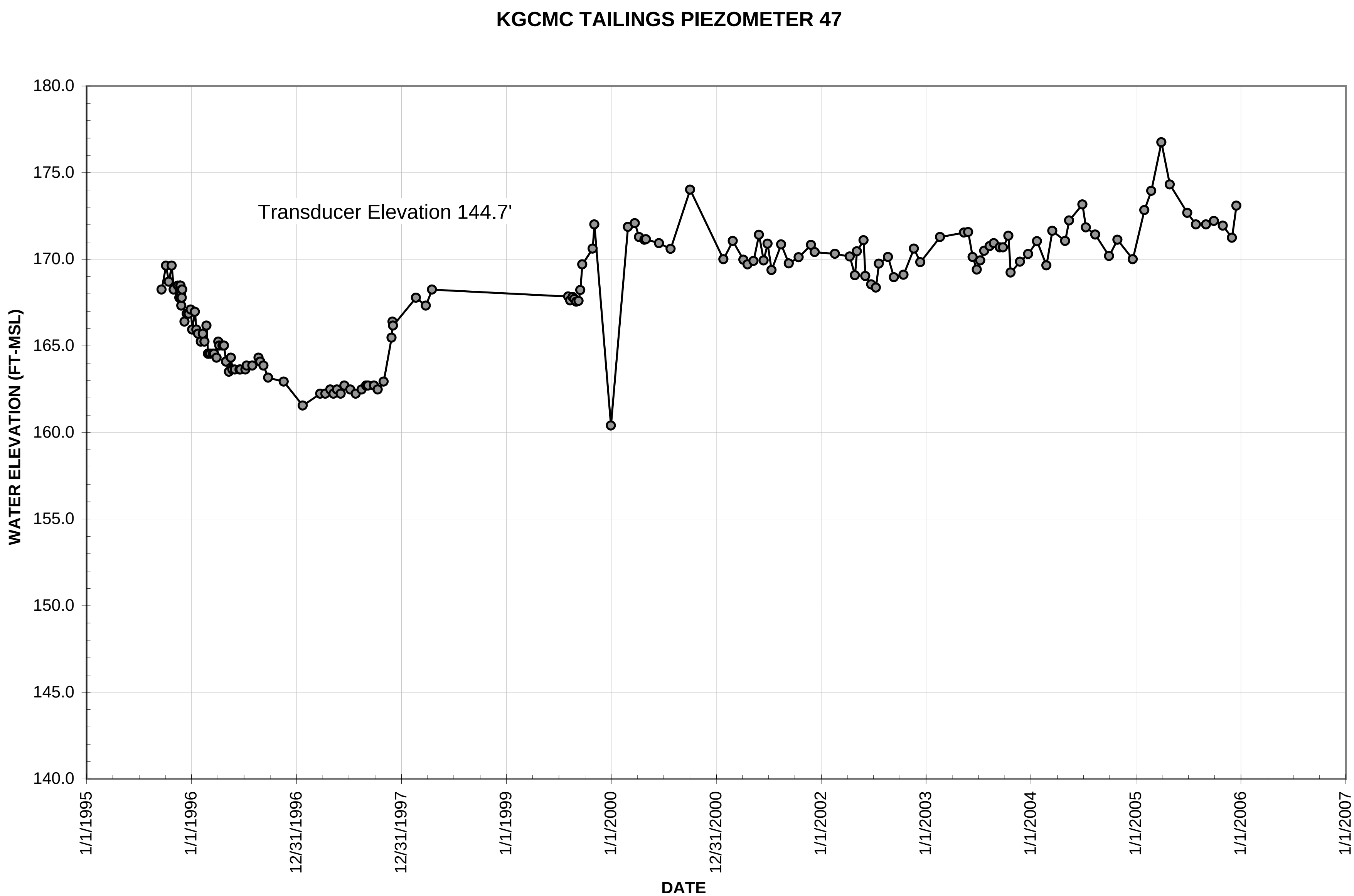


Figure 2.6 Water Level Data for Piezometer 50

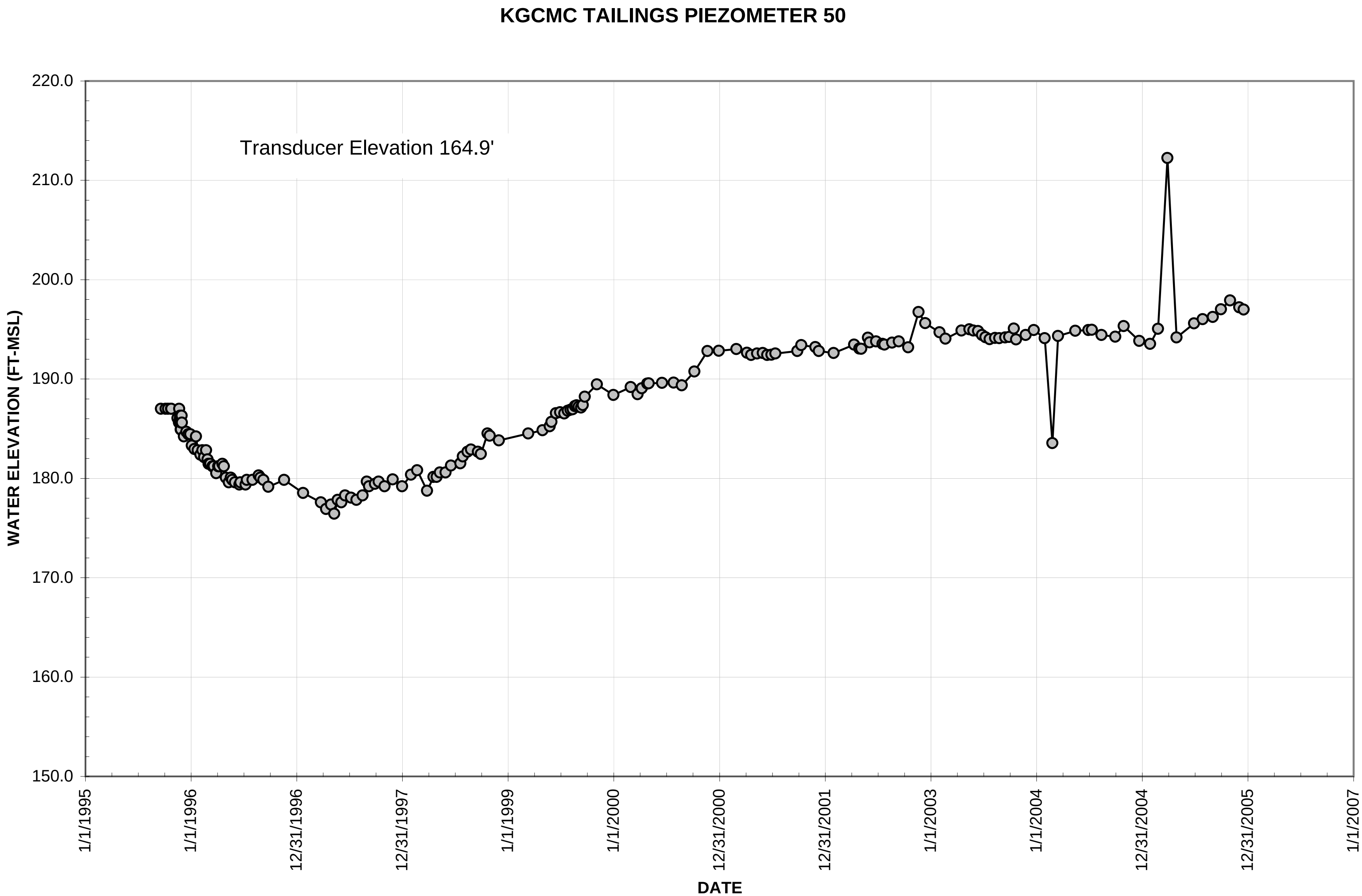


Figure 2.7 Water Level Data for Piezometer 51

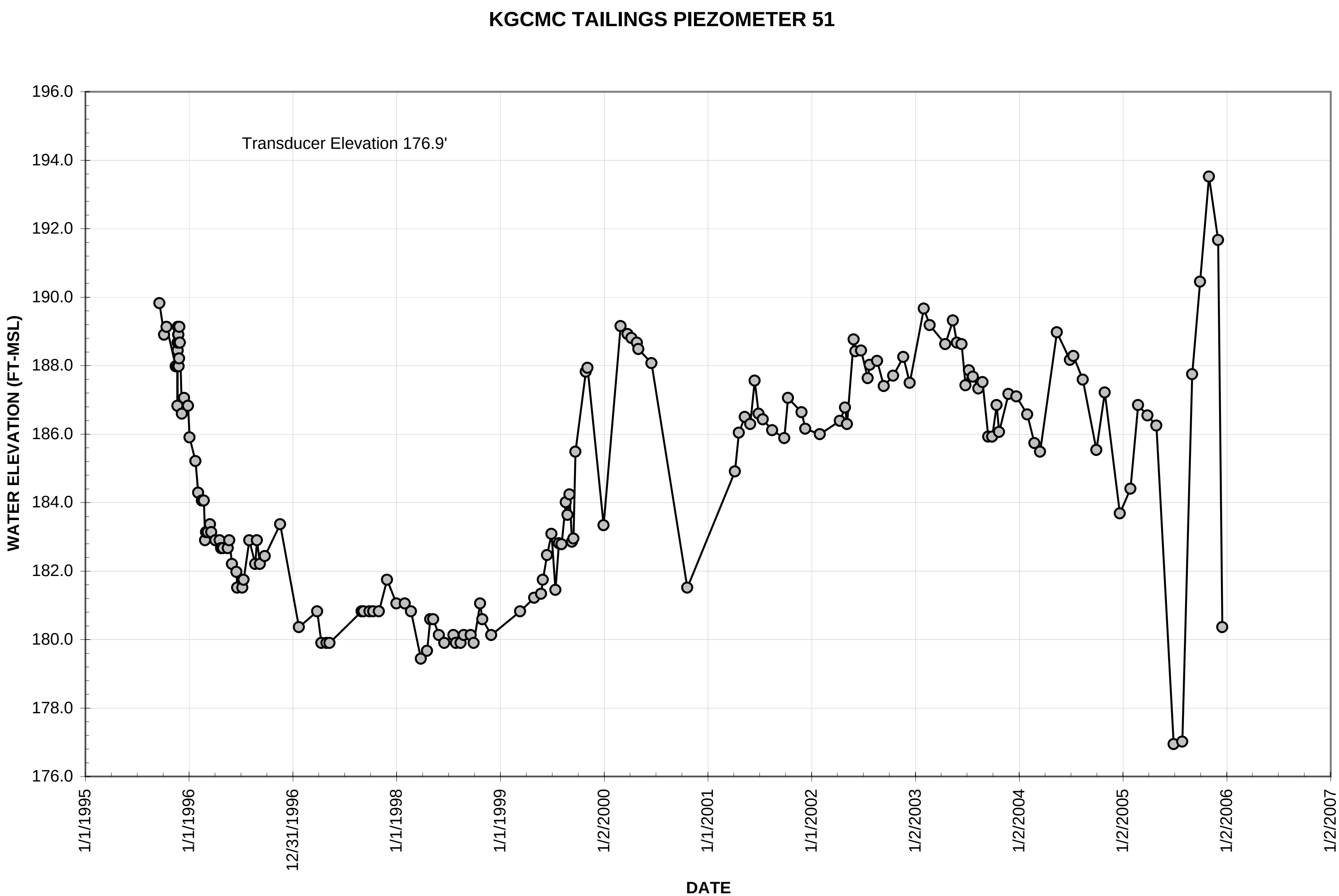


Figure 2.8 Water Level Data for Piezometer 74

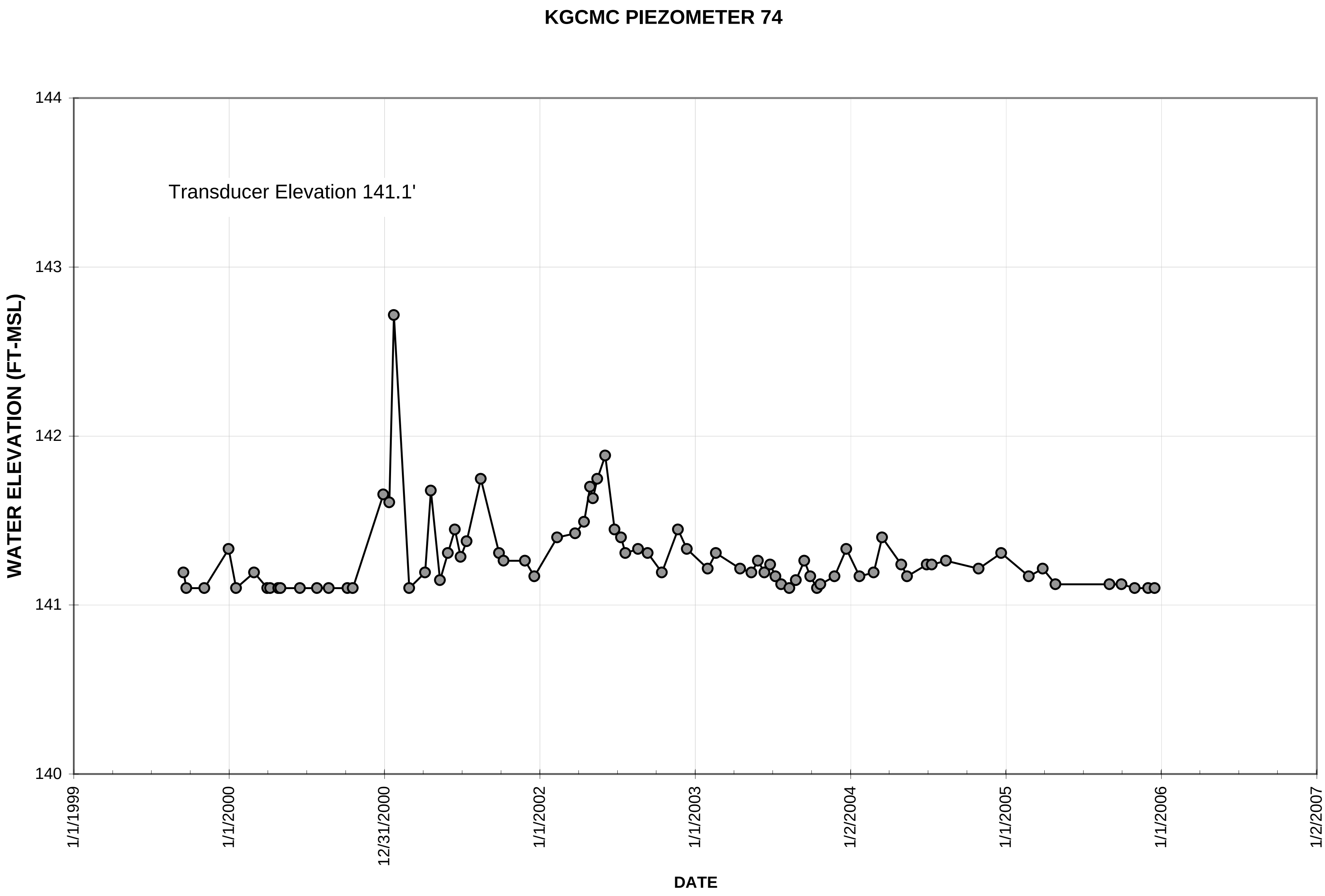


Figure 2.9 Water Level Data for Piezometer 75

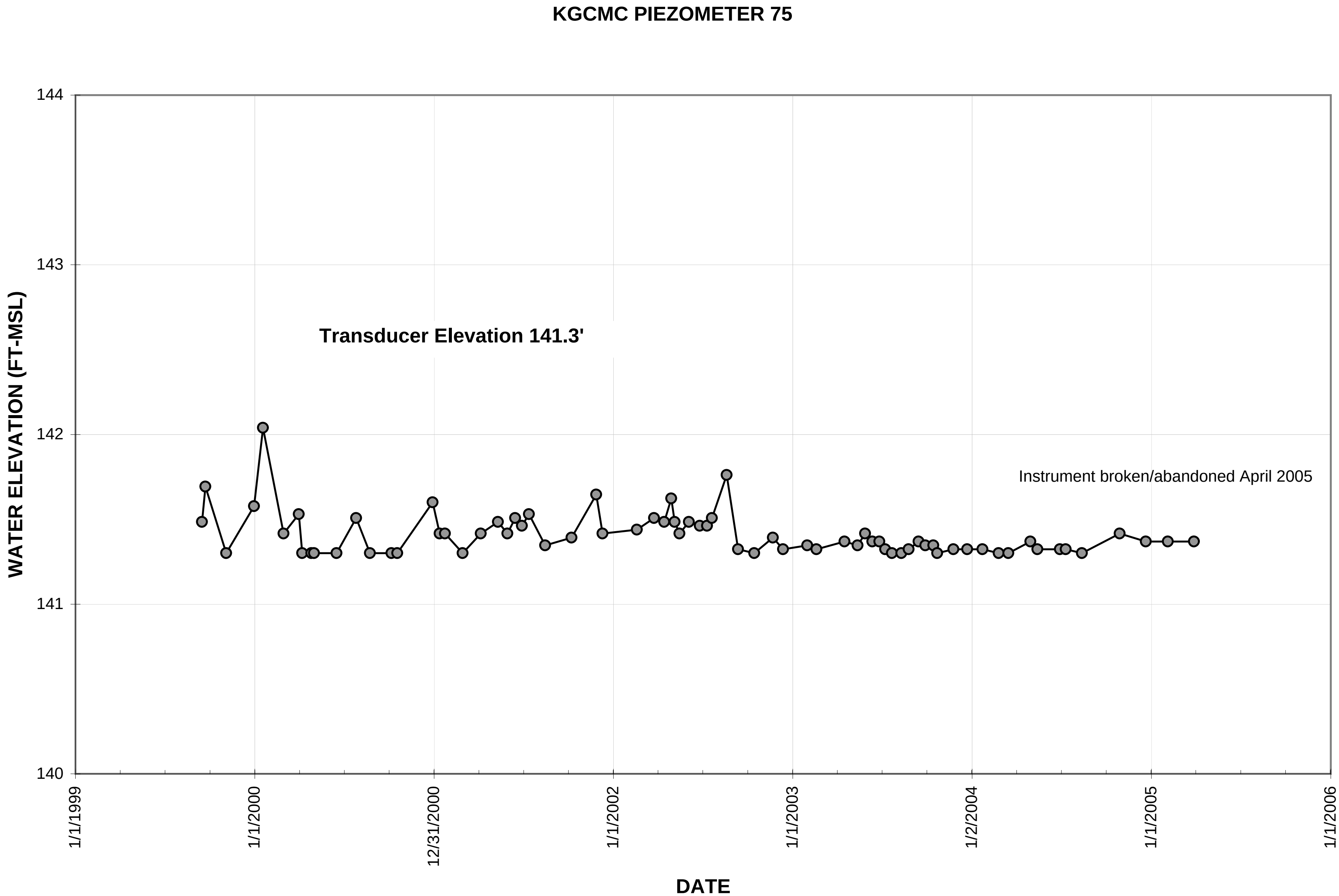


Figure 2.10 Water Level Data for Piezometer 76

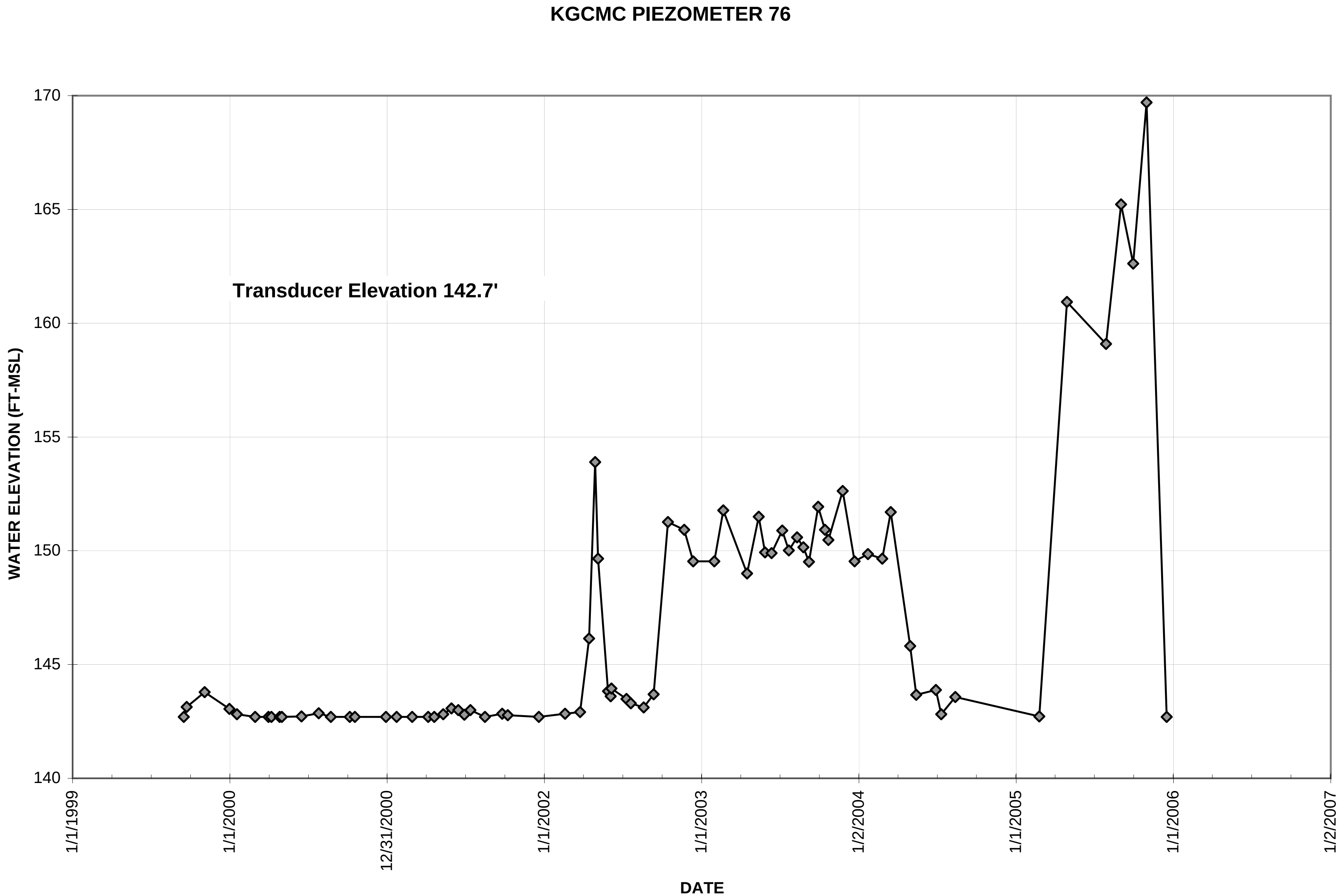


Figure 2.11 Water Level Data for Standpipe Piezometer PZ-T-00-01

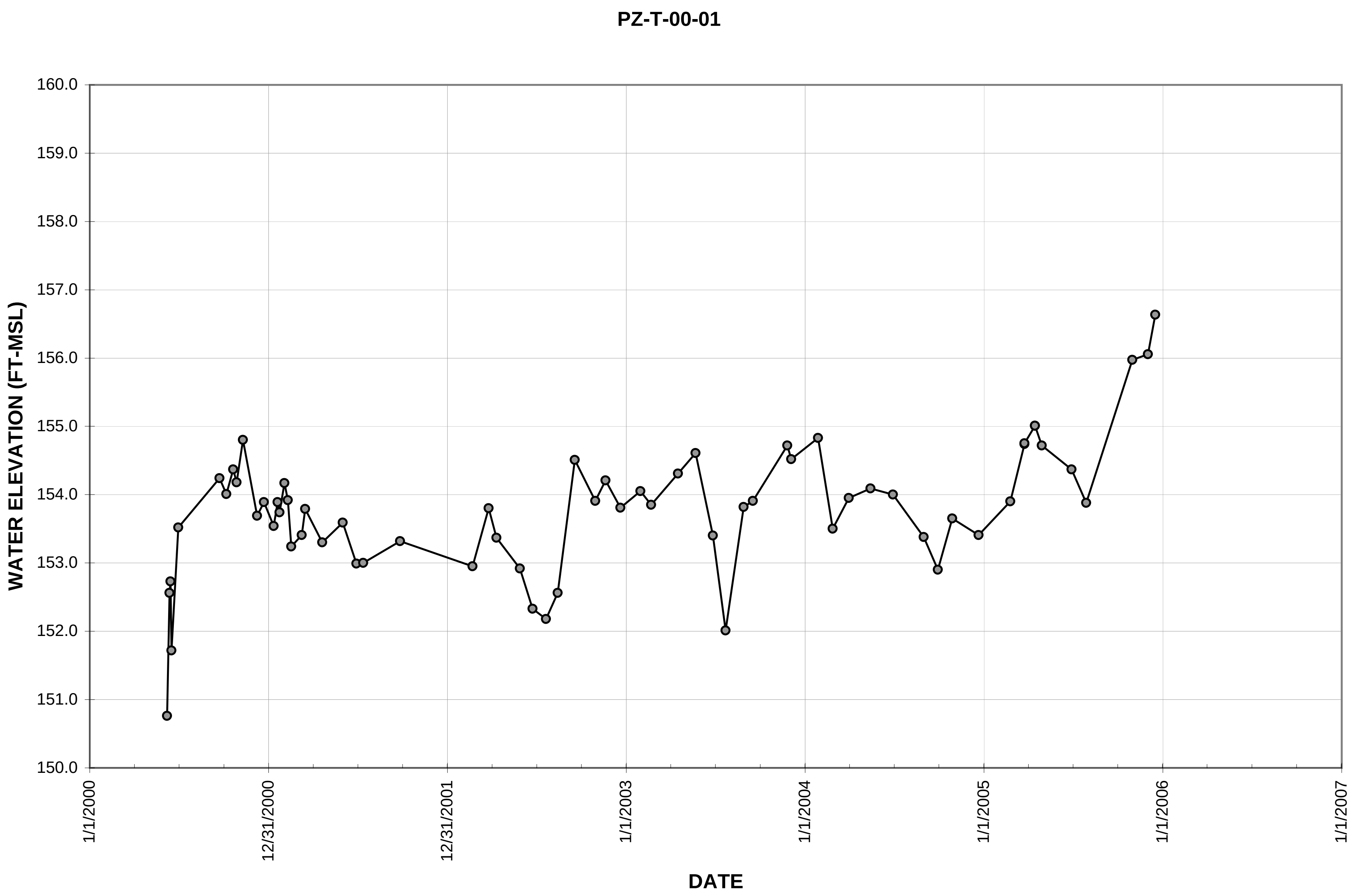


Figure 2.12 Water Level Data for Standpipe Piezometer PZ-T-00-02

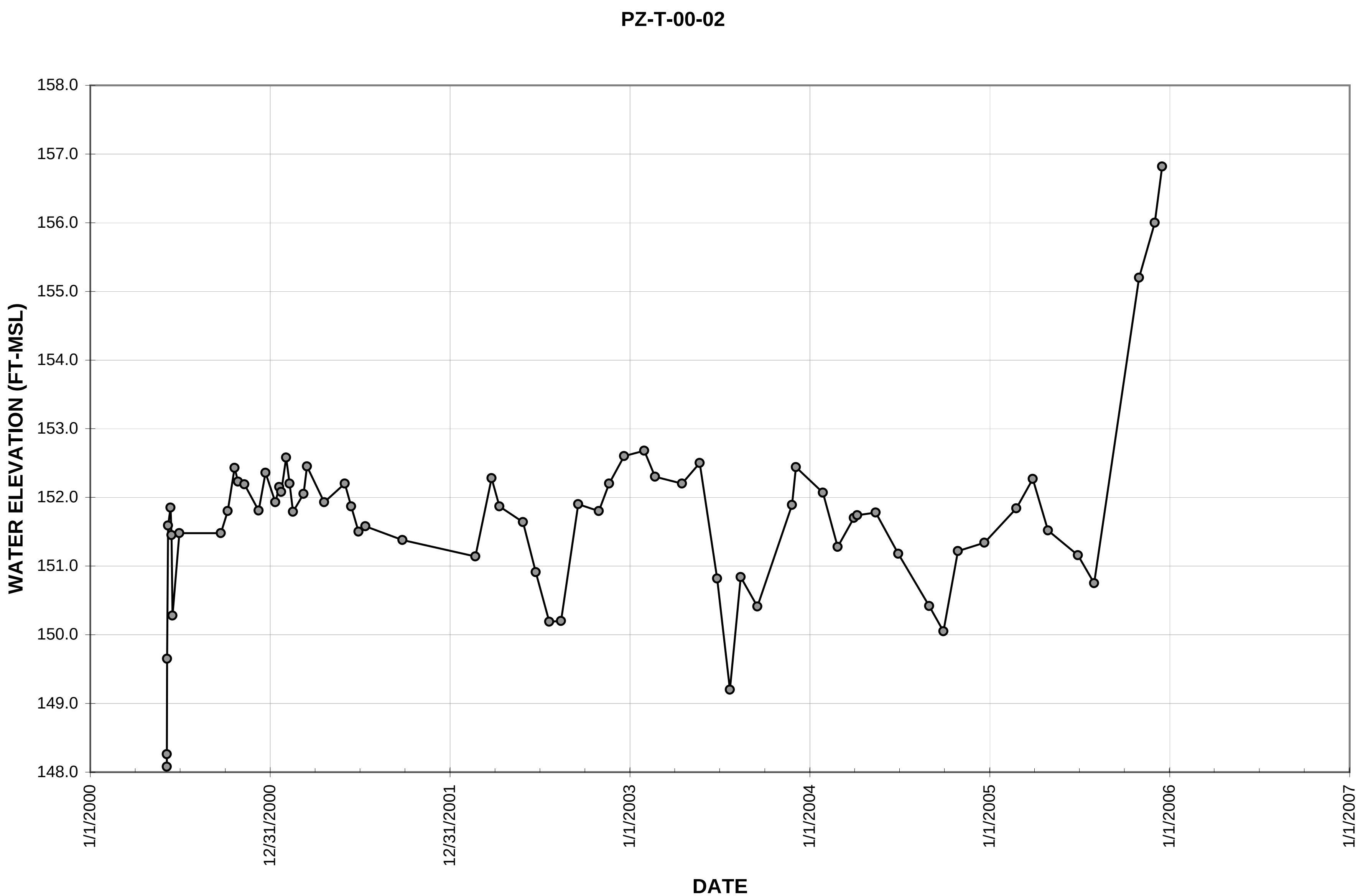


Figure 2.13 Water Level Data for Standpipe Piezometer PZ-T-00-03

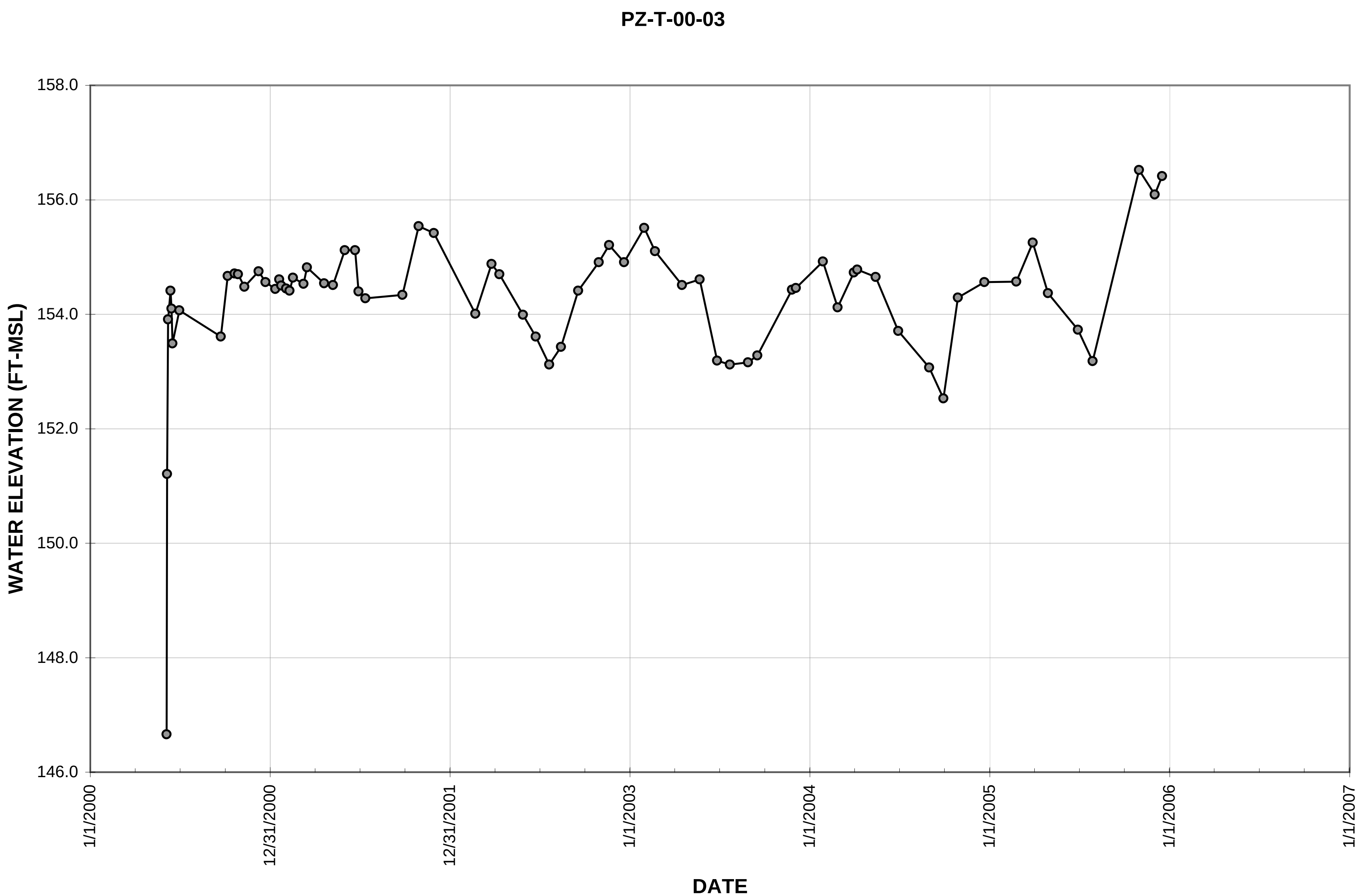


Figure 2.14 Water Level Data for Well MW-T-00-05A

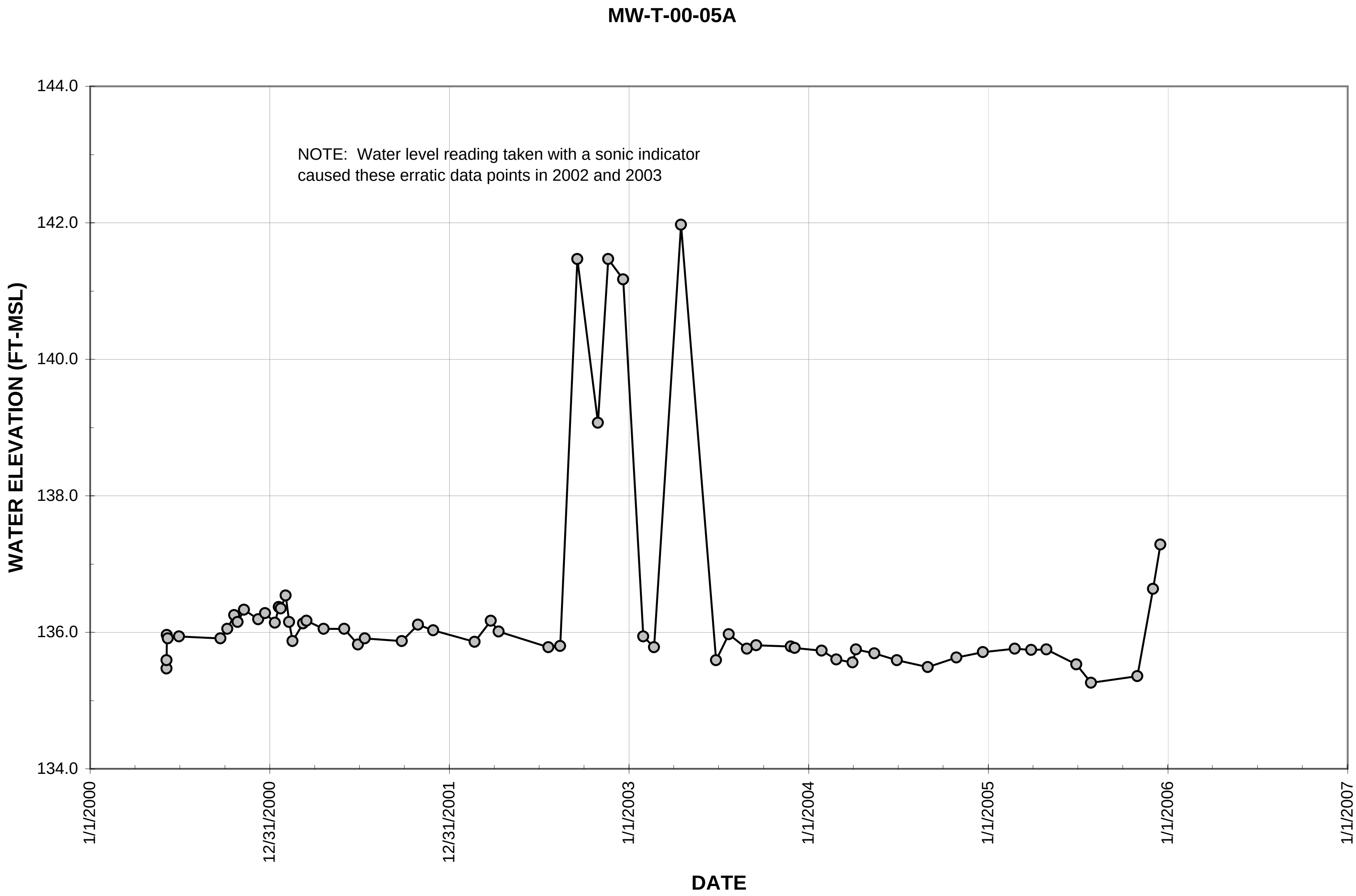


Figure 2.15 Water Level Data for Well MW-T-00-3A

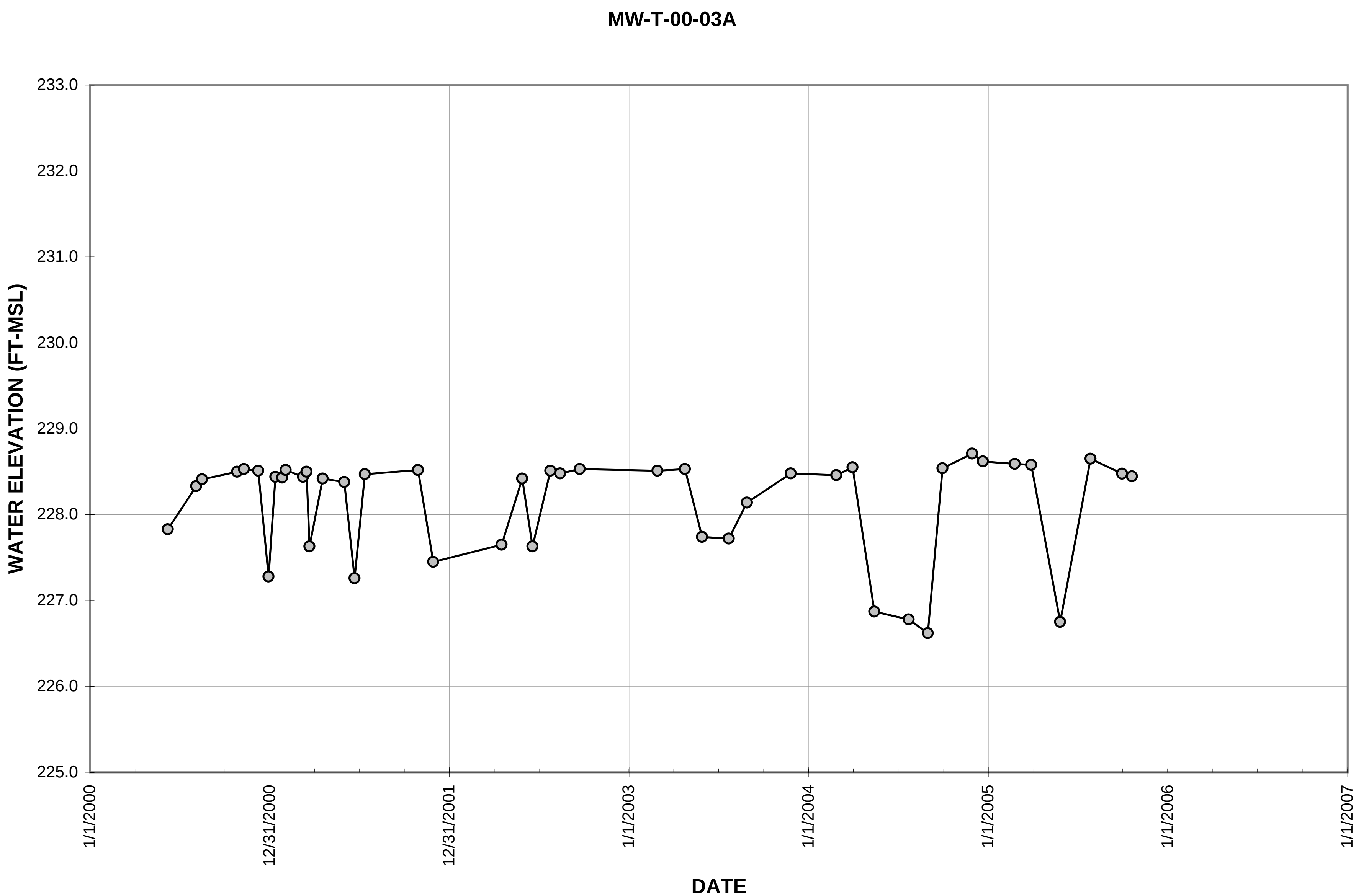


Figure 2.16 Water Level Data for Well MW-T-00-3B

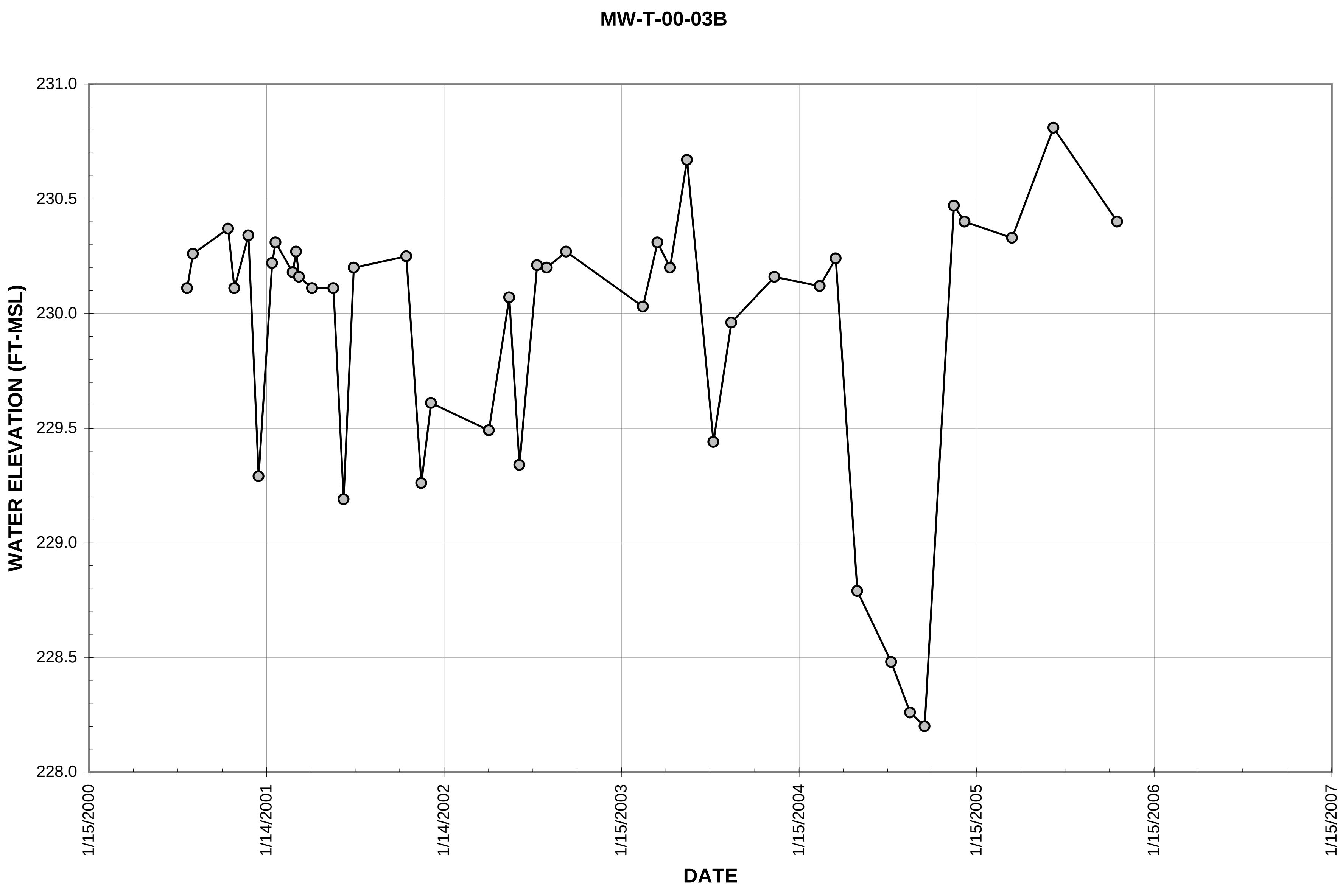


Figure 2.17 Water Level Data for Well MW-T-01-03A

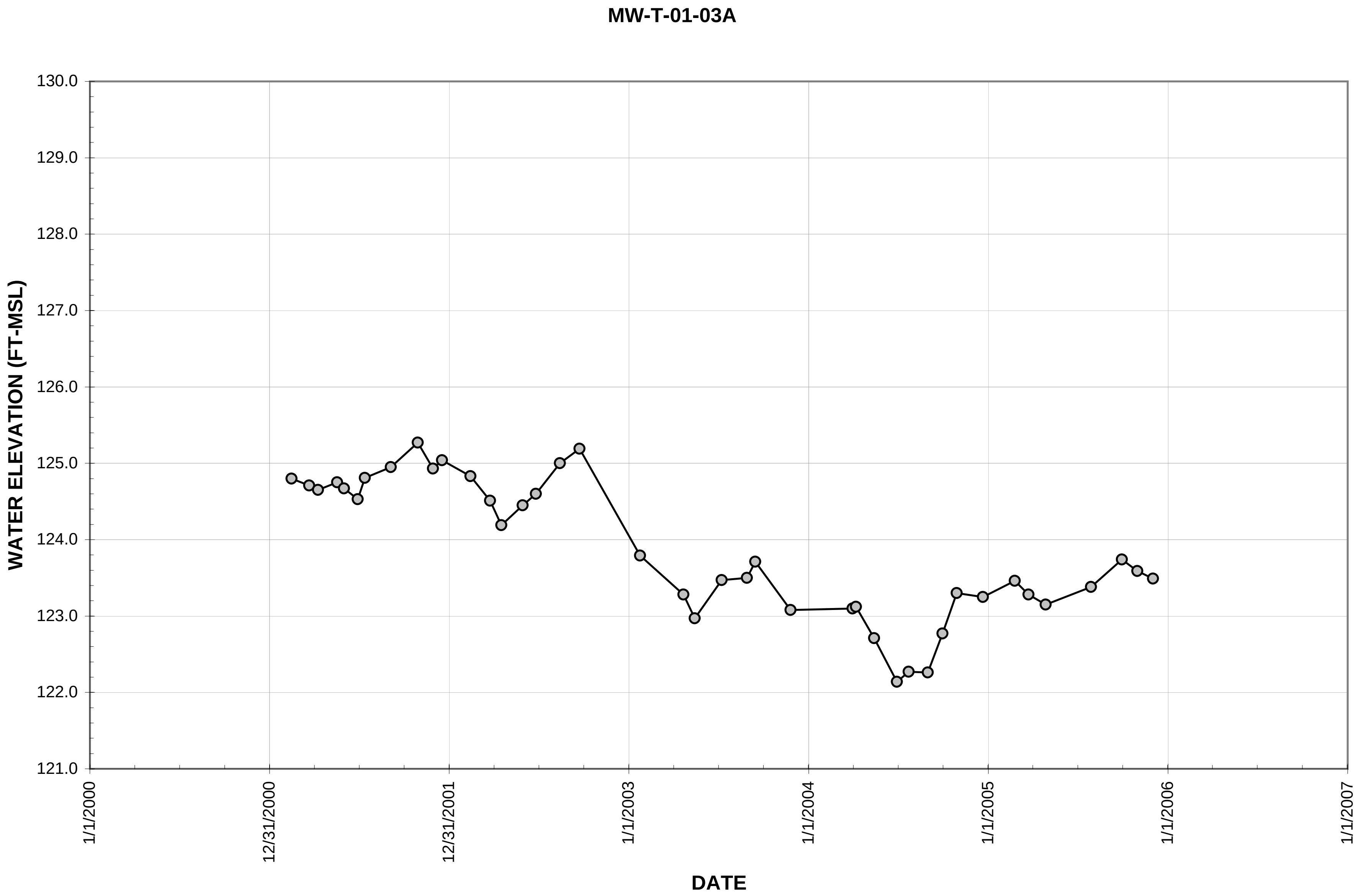


Figure 2.18 Water Level Data for Well MW-T-01-03B

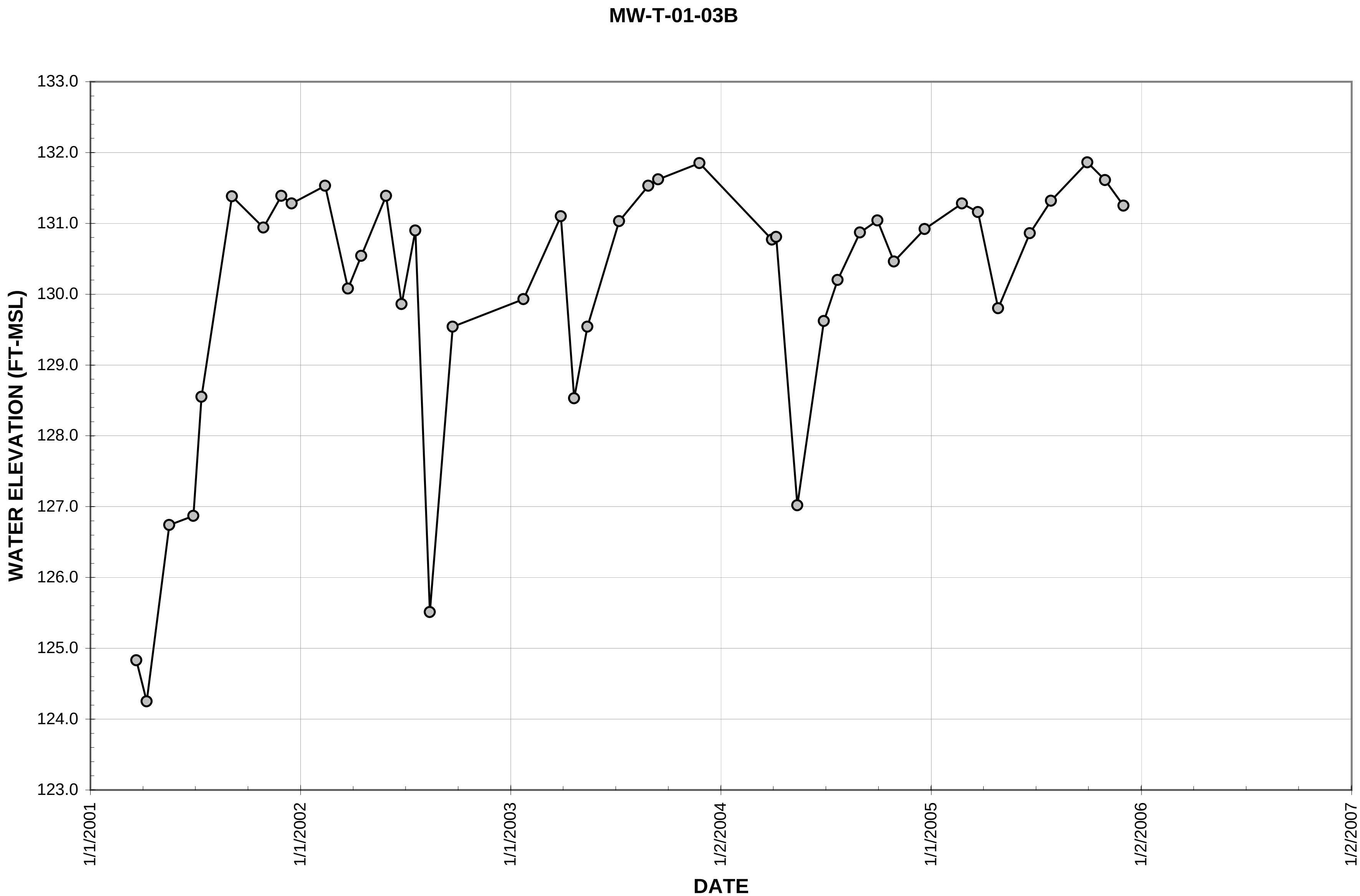


Figure 2.19 Tailings Area Wet Well Flow Data

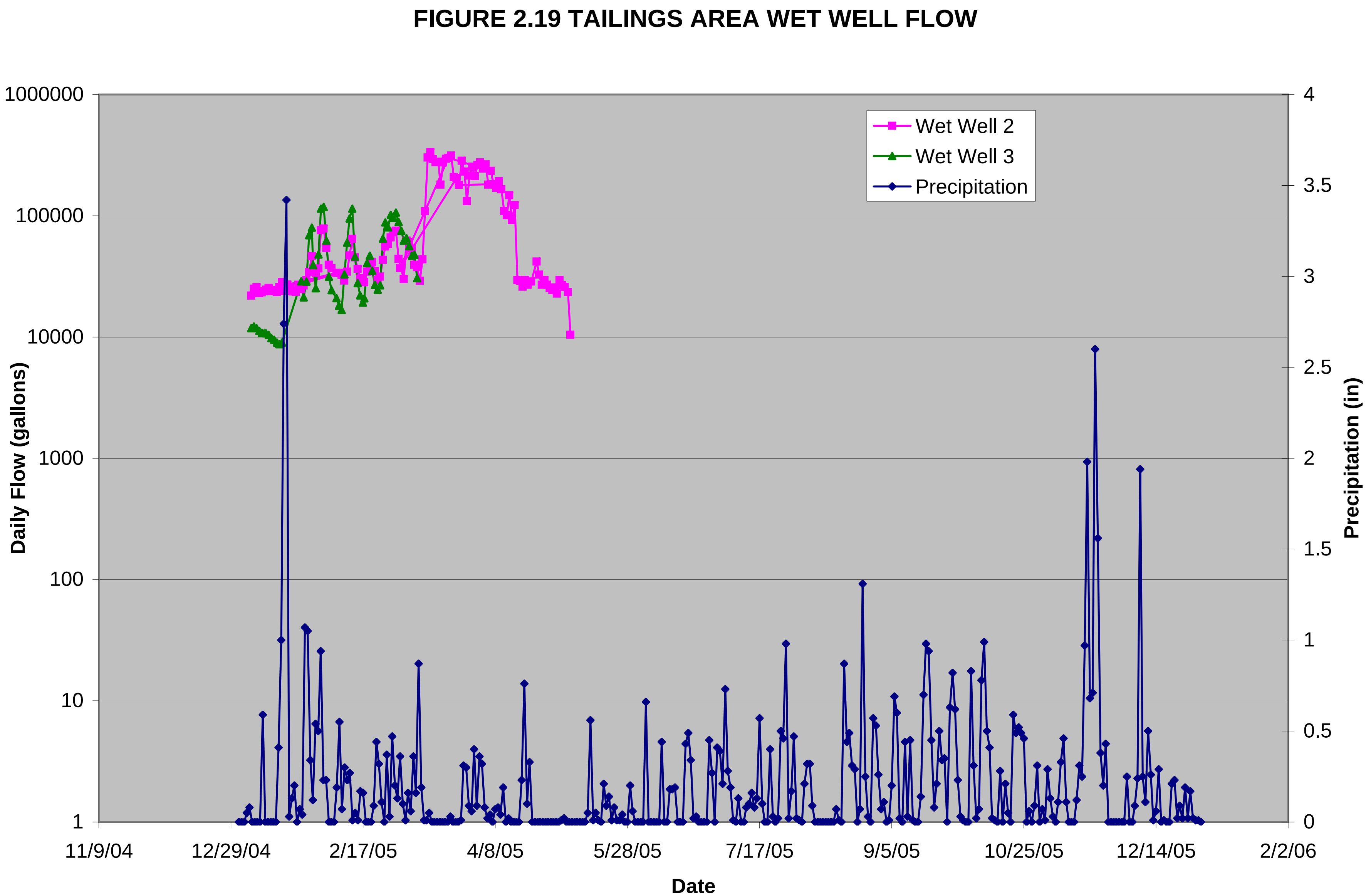


FIGURE 2.20a GREENS CREEK TAILINGS AREA INTERNAL MONITORING SITES:
WET WELLS - pH DATA

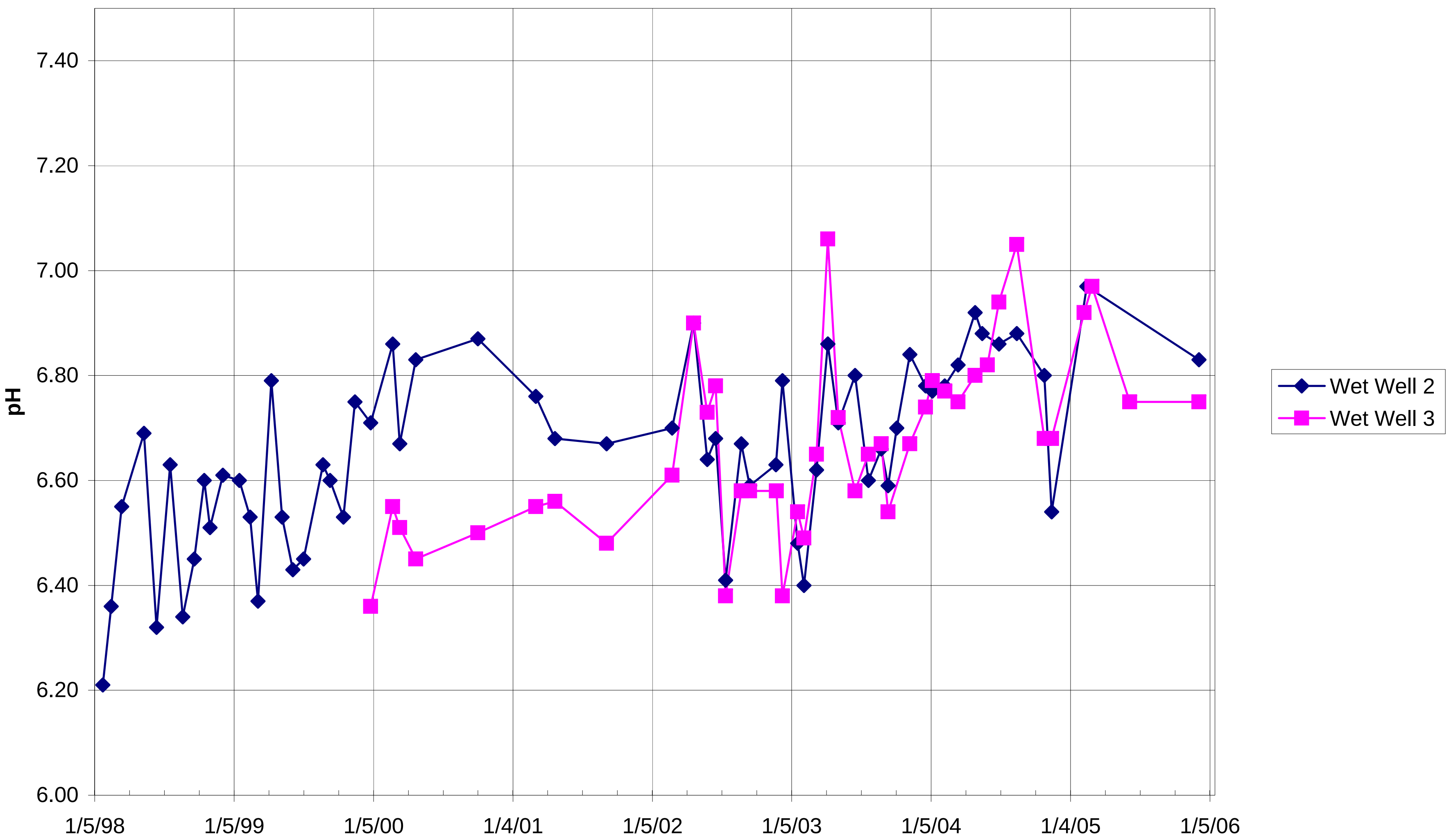


FIGURE 2.20b GREENS CREEK TAILINGS INTERNAL MONITORING SITES: TAILINGS COMPLETIONS - pH DATA

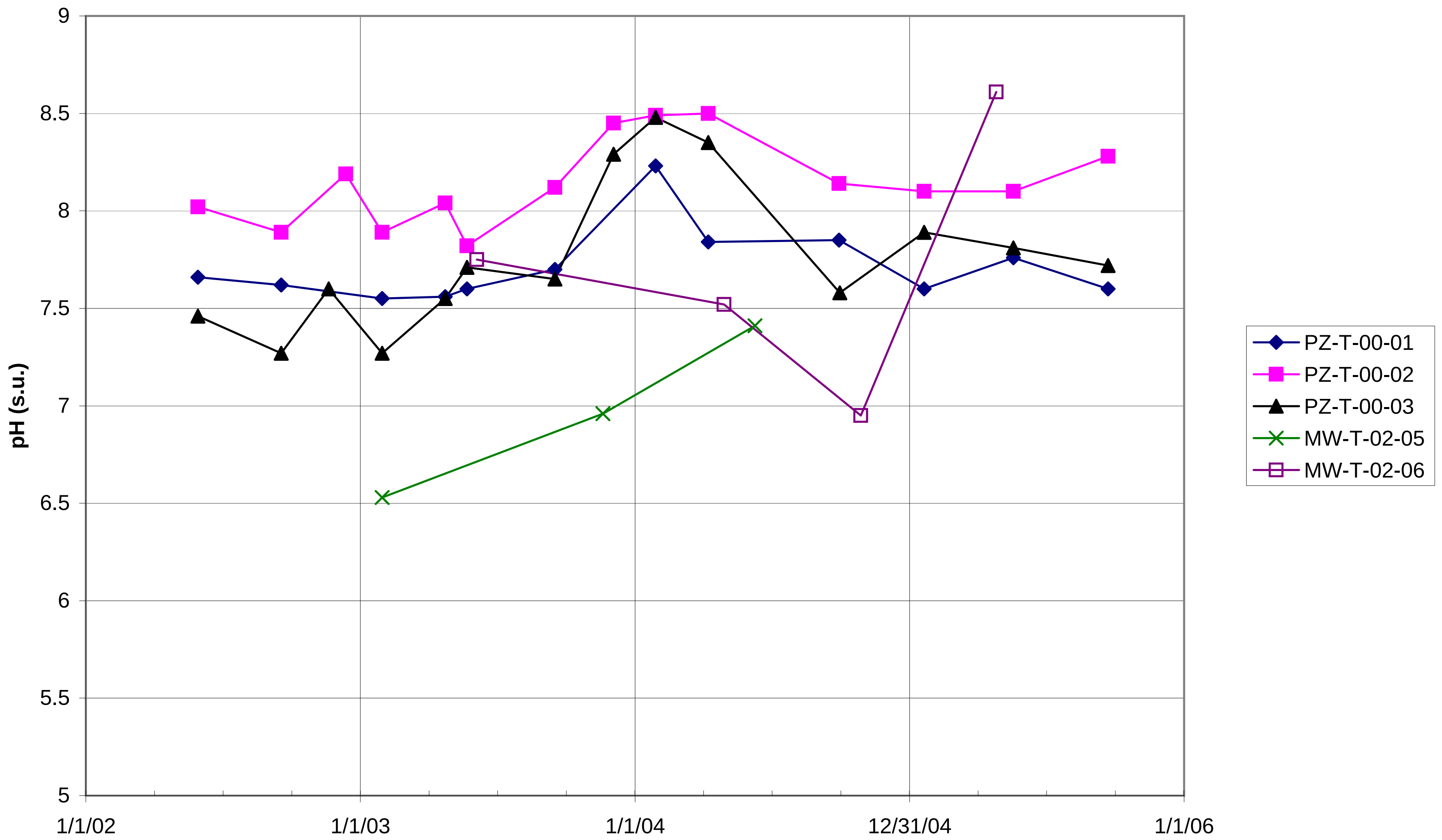


FIGURE 2.20c GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
SUCTION LYSIMETERS - pH

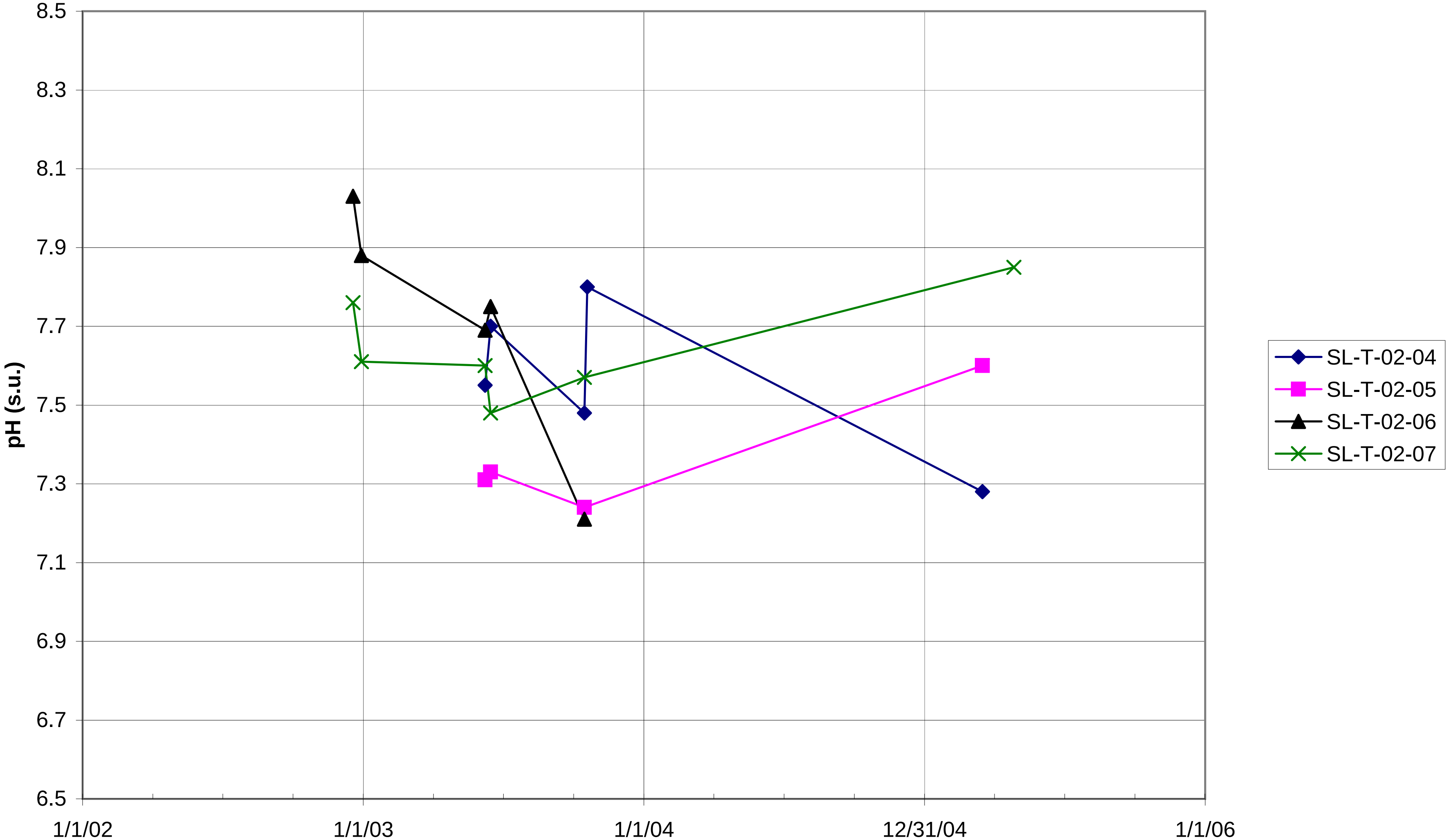


FIGURE 2.21a GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
WET WELLS - ALKALINITY
(Non-detectable analyses plotted as zero)

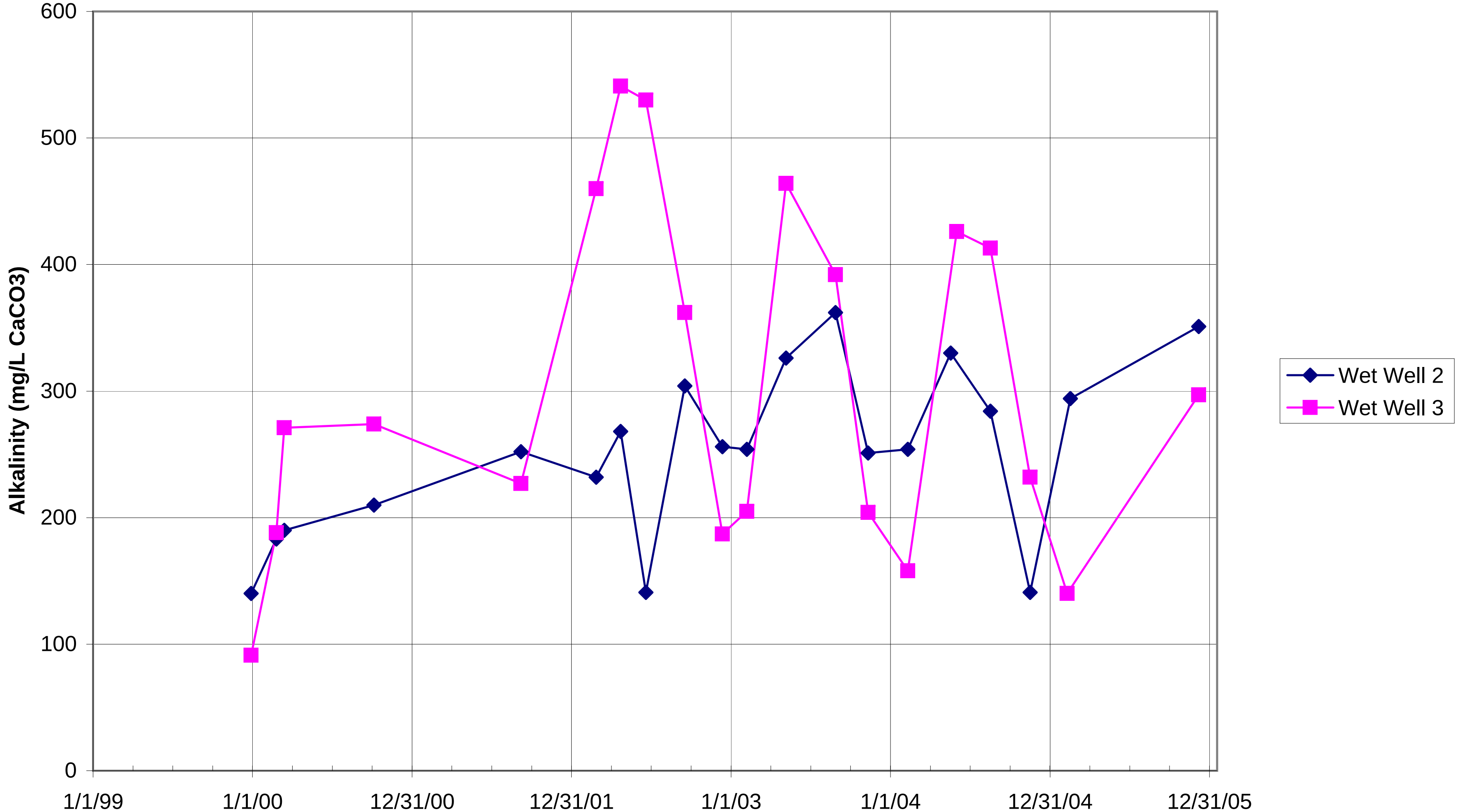


FIGURE 2.21b GREENS CREEK TAILINGS INTERNAL MONITORING SITES: TAILINGS COMPLETIONS - ALKALINITY DATA (Non-detectable analyses plotted as zero)

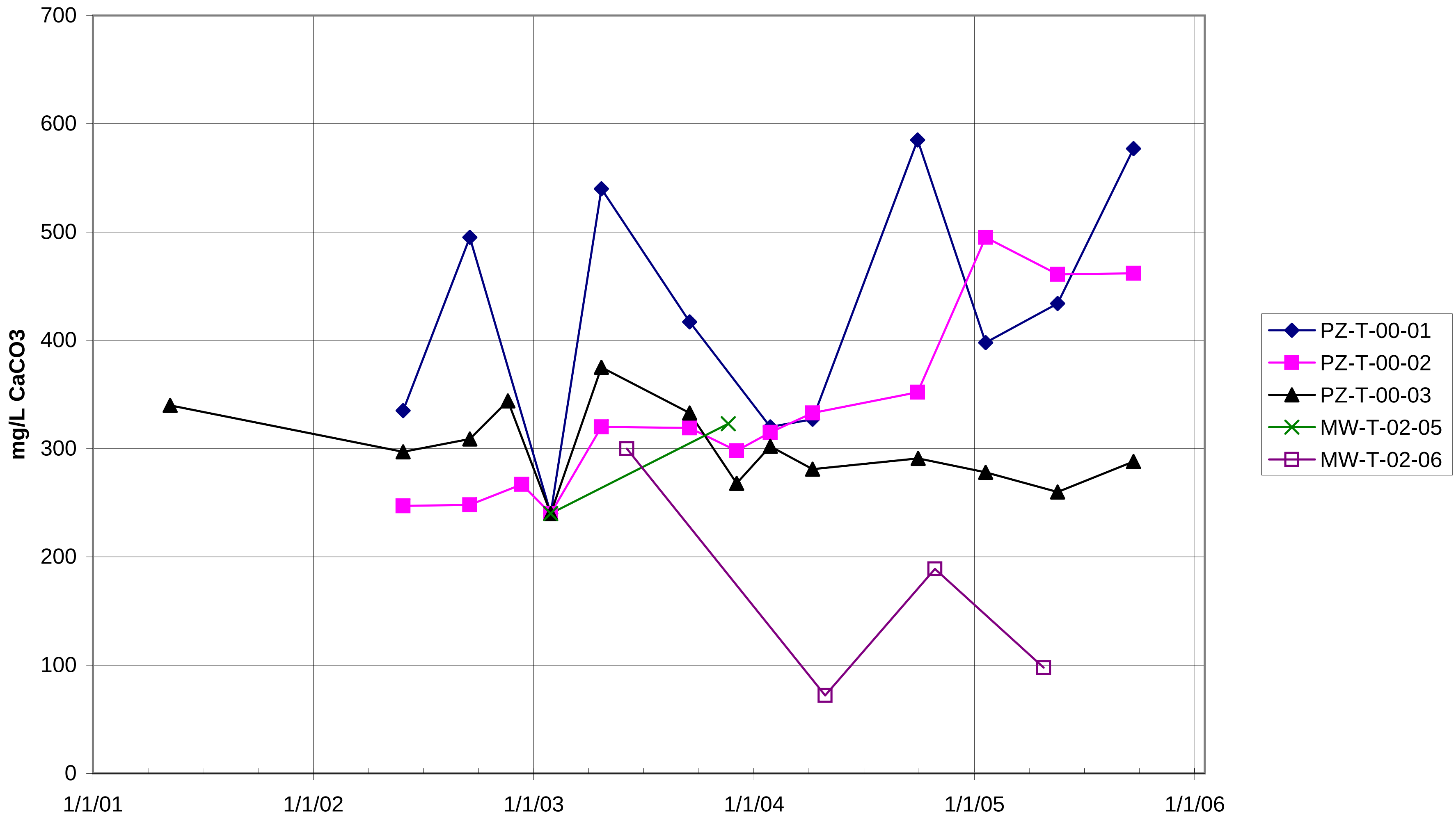


FIGURE 2.21c GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
SUCTION LYSIMETERS - FIELD ALKALINITY

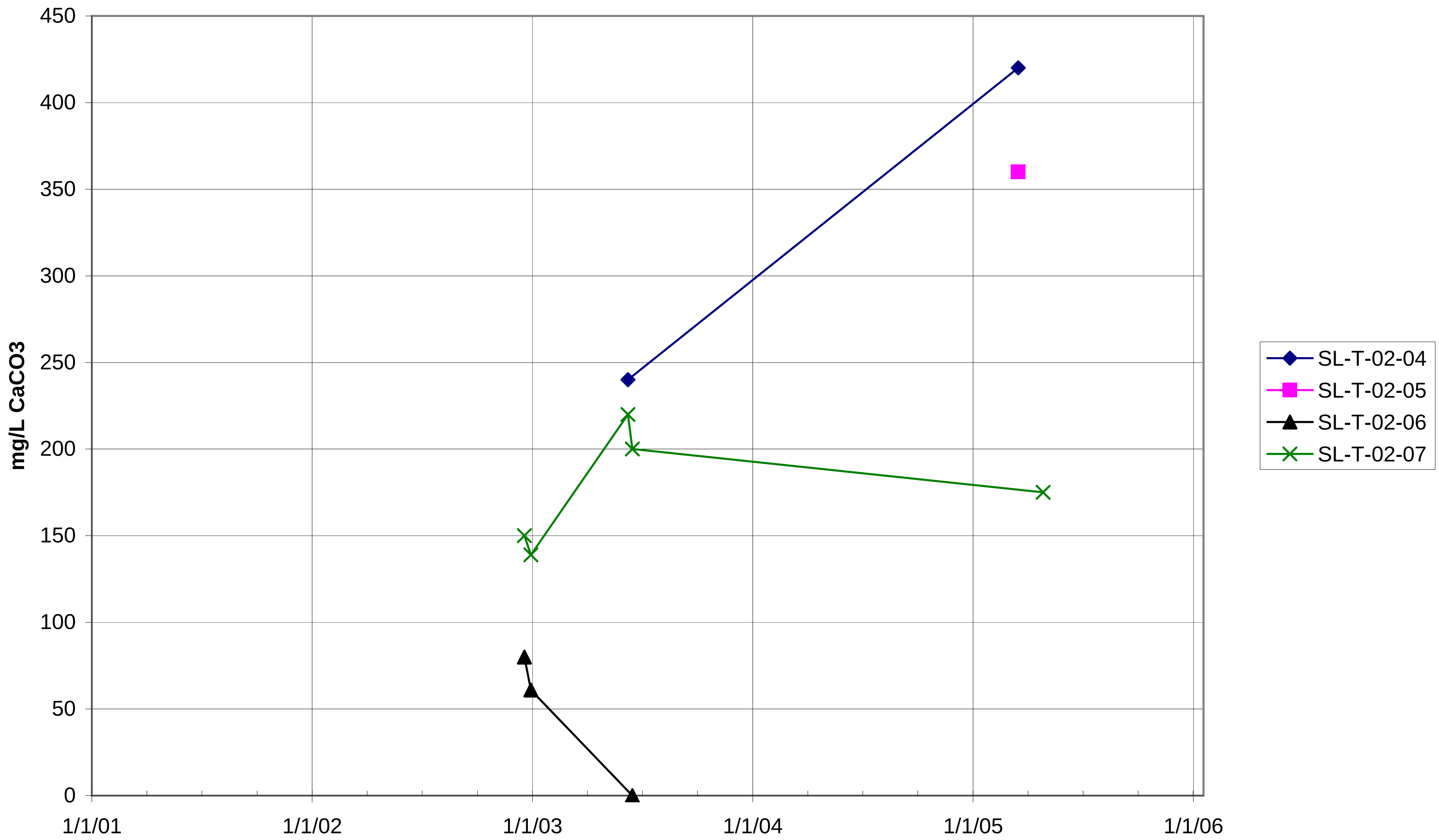


FIGURE 2.22a GREENS CREEK TAILINGS INTERNAL MONITORING SITES: WET WELLS - CONDUCTIVITY DATA

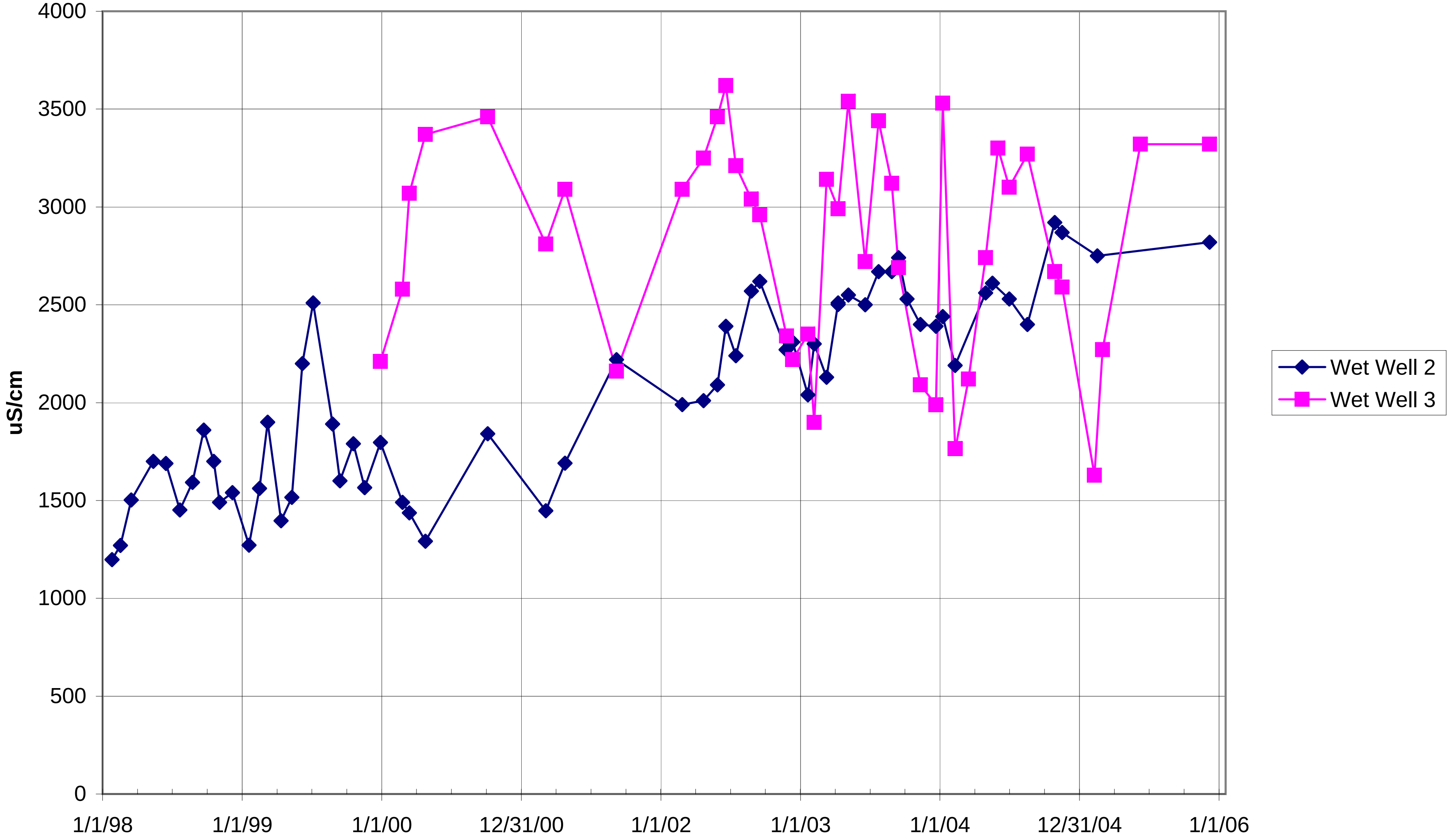


FIGURE 2.22b GREENS CREEK TAILINGS INTERNAL MONITORING SITES: TAILINGS COMPLETIONS - CONDUCTIVITY DATA

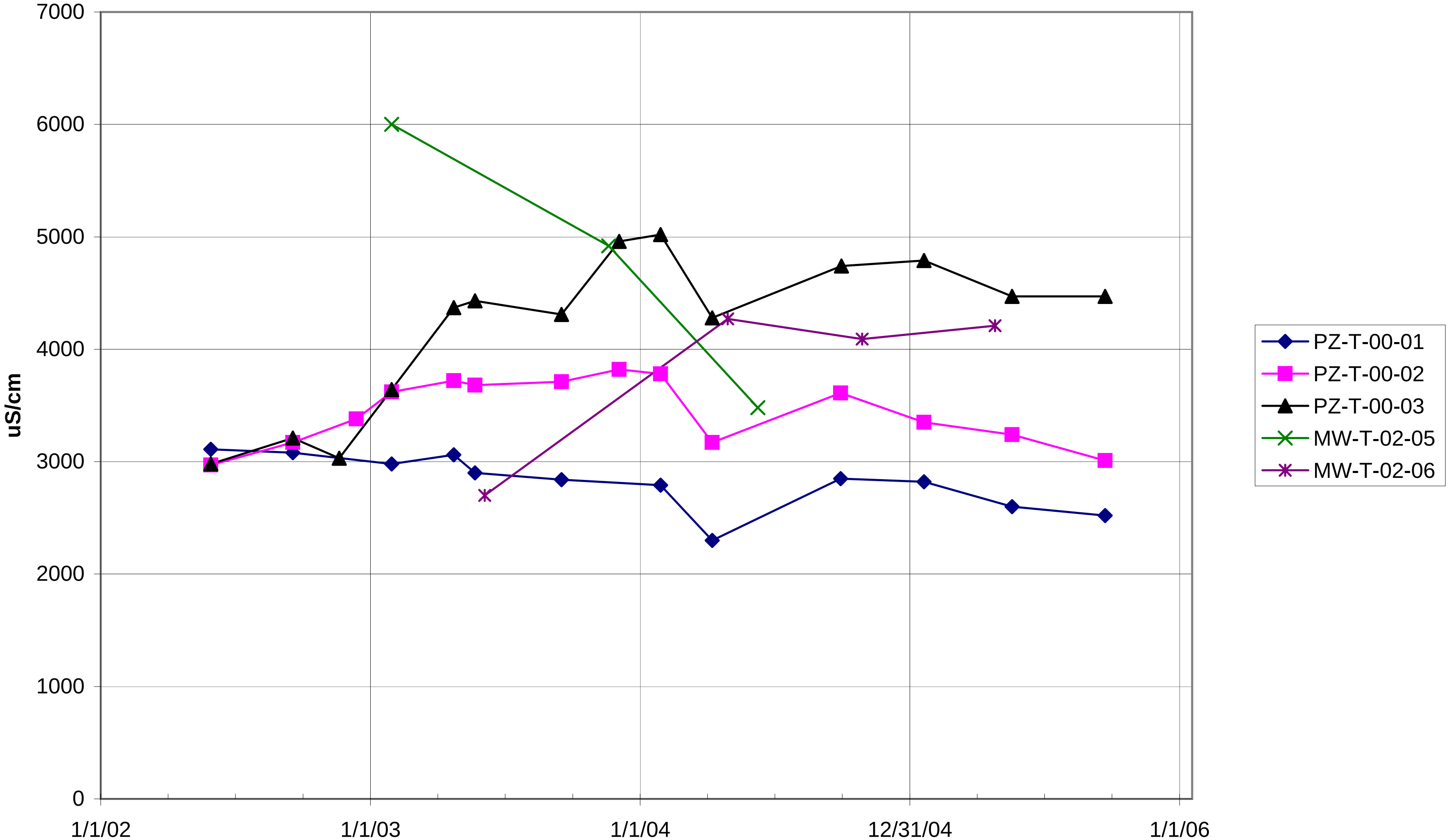


FIGURE 2.22c GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
SUCTION LYSIMETERS - CONDUCTIVITY

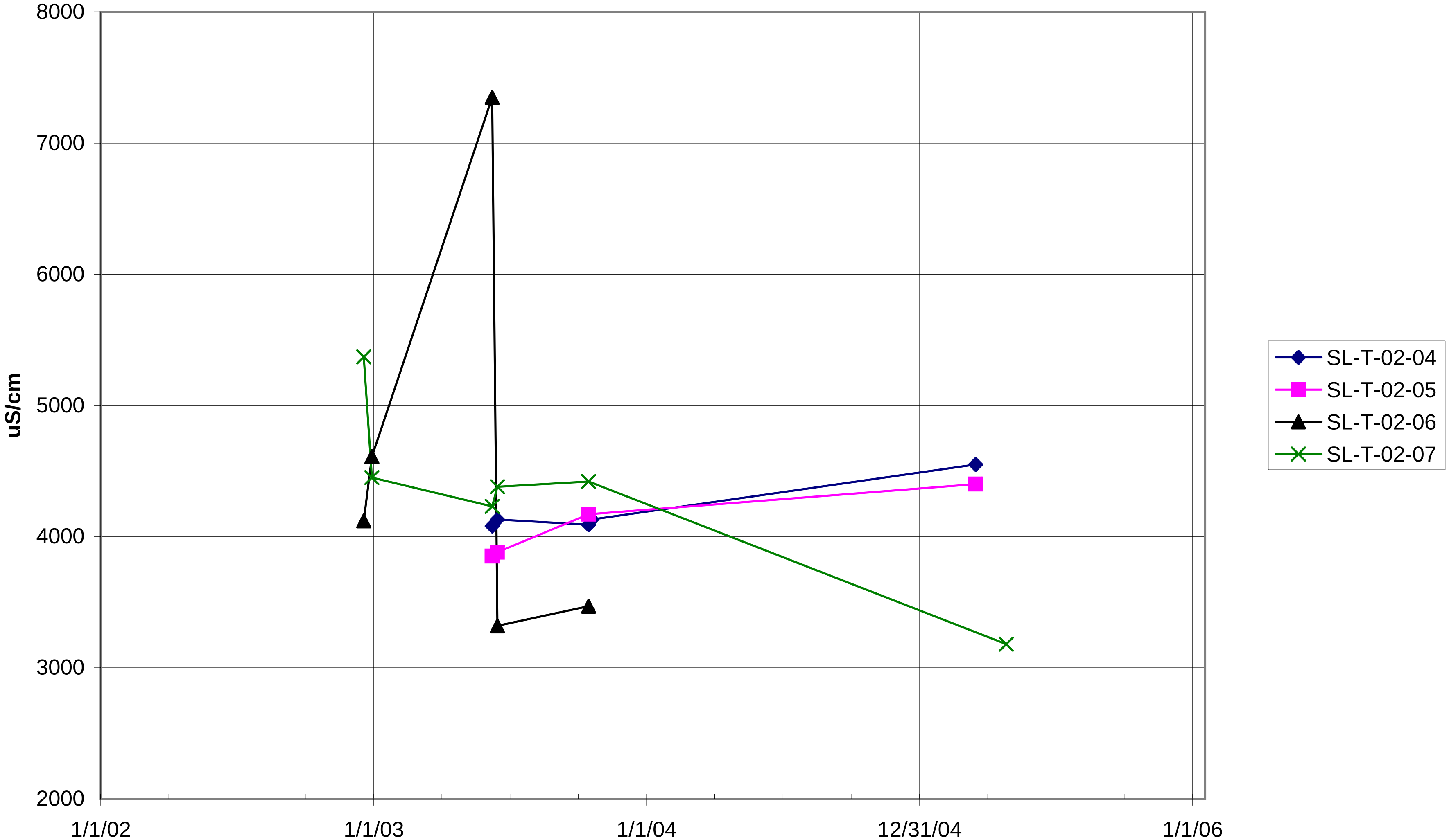


FIGURE 2.23a GREENS CREEK TAILINGS INTERNAL MONITORING SITES: WET WELLS - HARDNESS DATA (Non-detectable analyses plotted as zero)

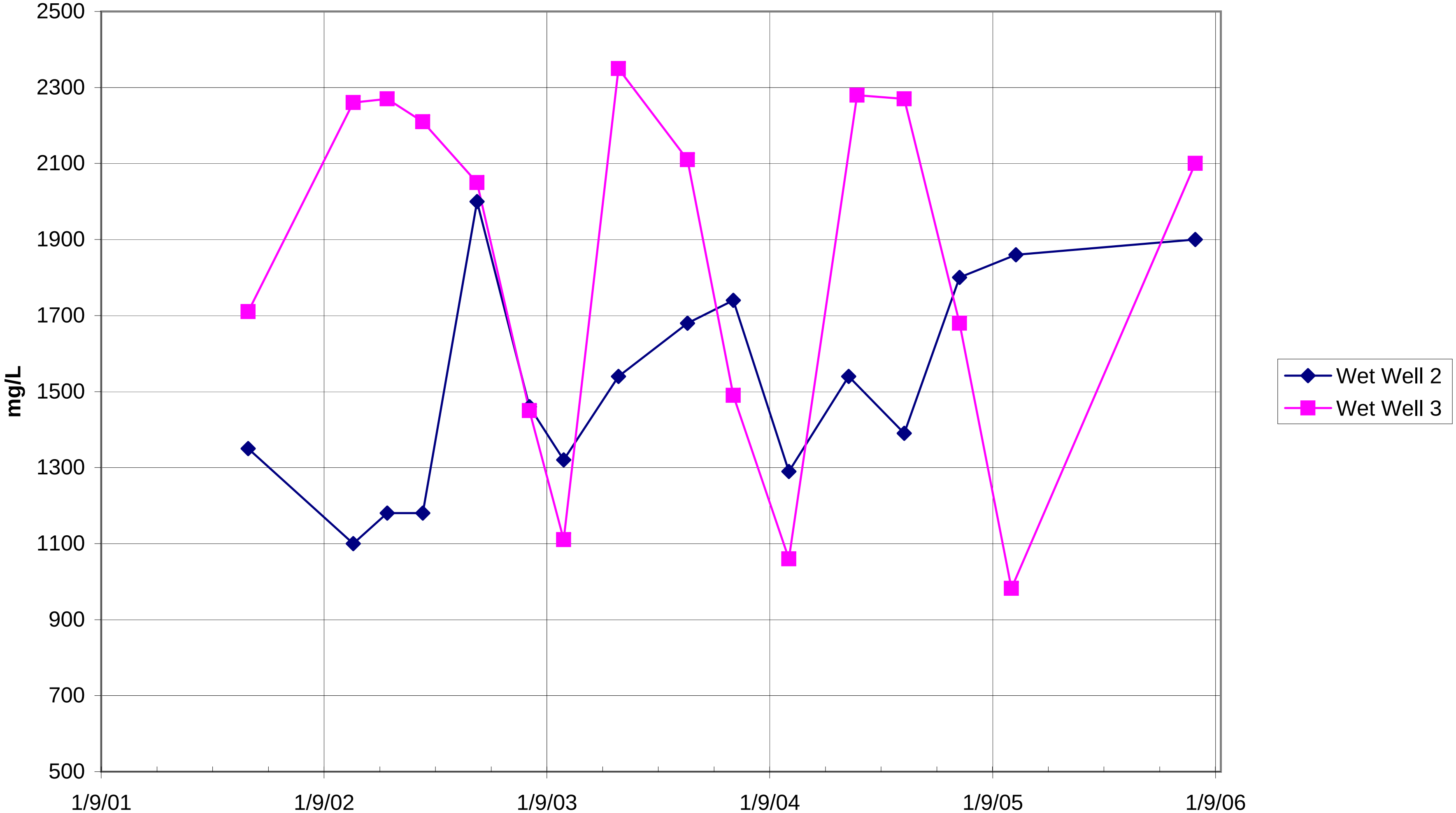


FIGURE 2.23b GREENS CREEK TAILINGS INTERNAL MONITORING SITES: TAILINGS COMPLETIONS - HARDNESS DATA (Non-detectable analyses plotted as zero)

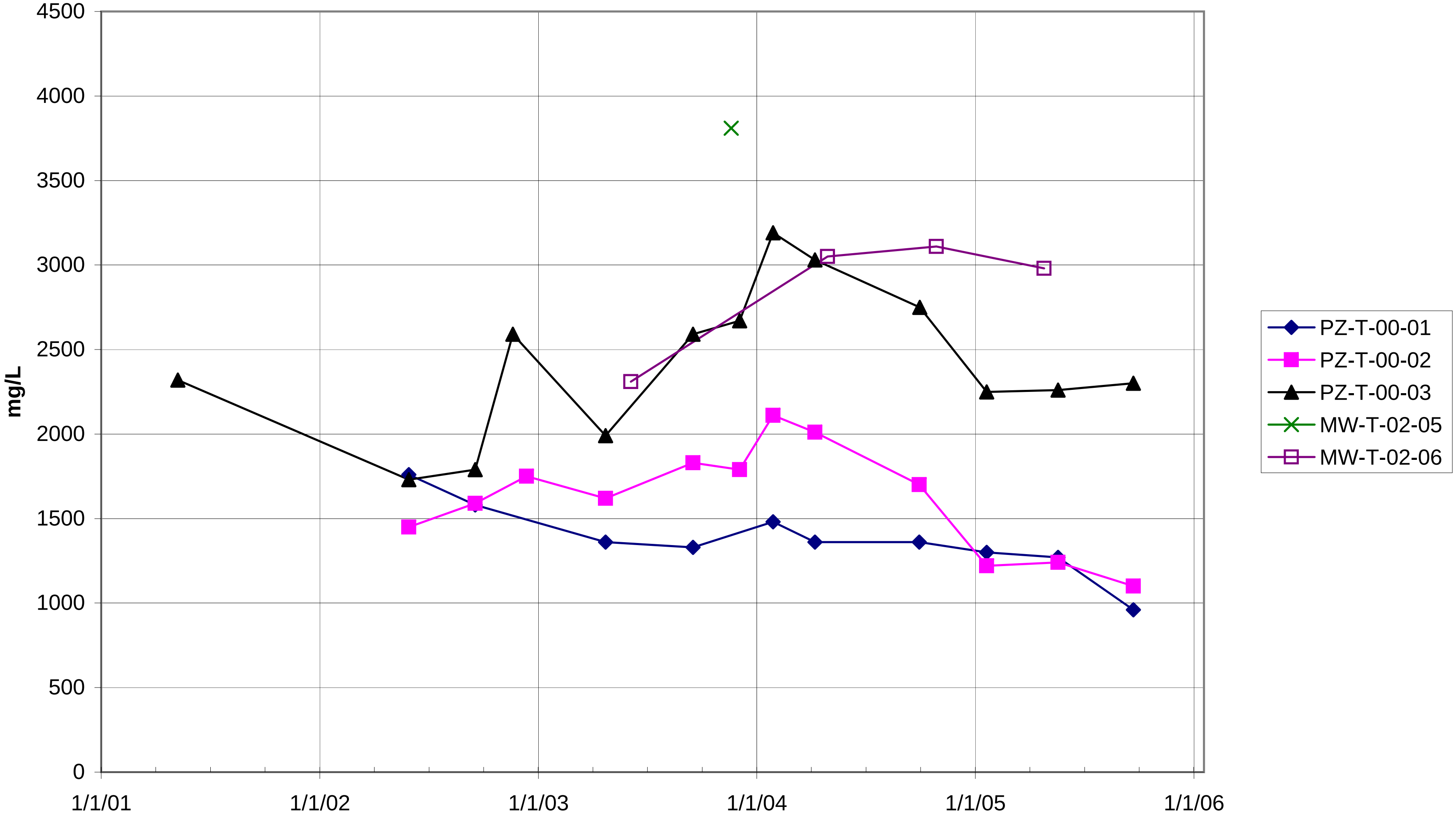


FIGURE 2.24a GREENS CREEK TAILINGS INTERNAL MONITORING SITES: WET WELLS - SULFATE DATA (Non-detectable analyses plotted as zero)

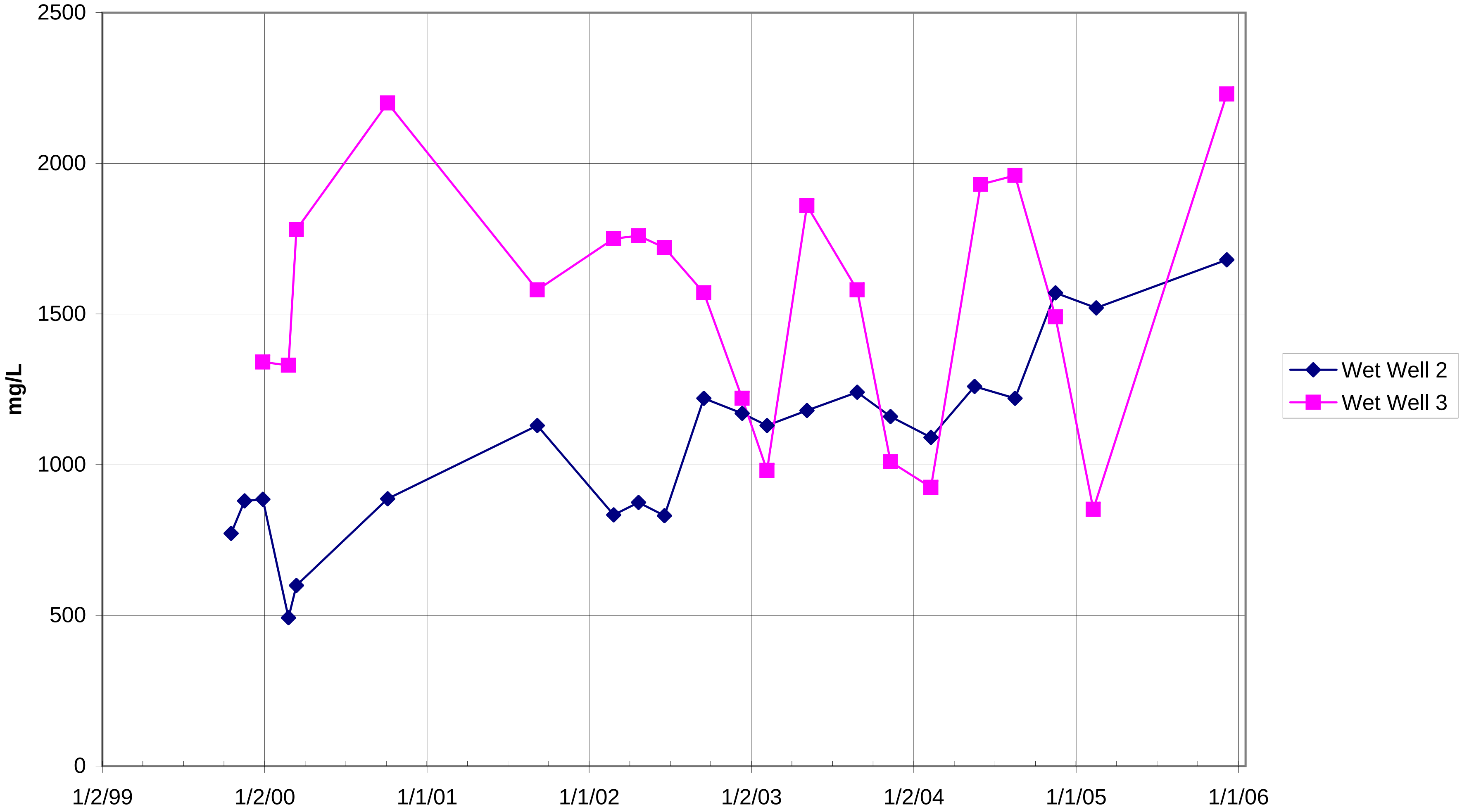


FIGURE 2.24b GREENS CREEK TAILINGS INTERNAL MONITORING SITES: TAILINGS COMPLETIONS - SULFATE DATA (Non-detectable analyses plotted as zero)

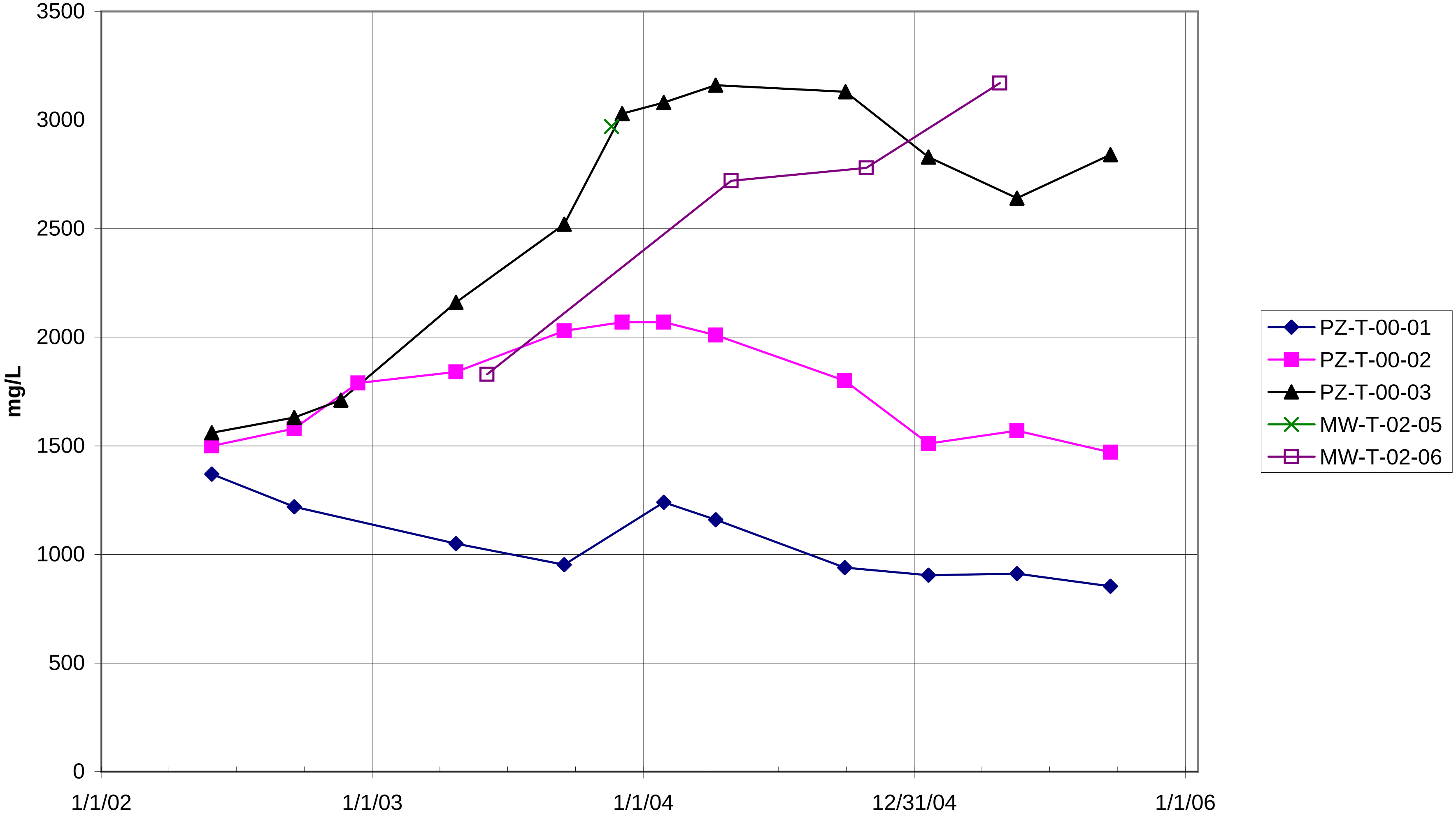


FIGURE 2.24c GREENS CREEK TAILINGS INTERNAL MONITORING SITES: SUCTION LYSIMETERS- SULFATE DATA
(Non-detectable analyses plotted as zero)

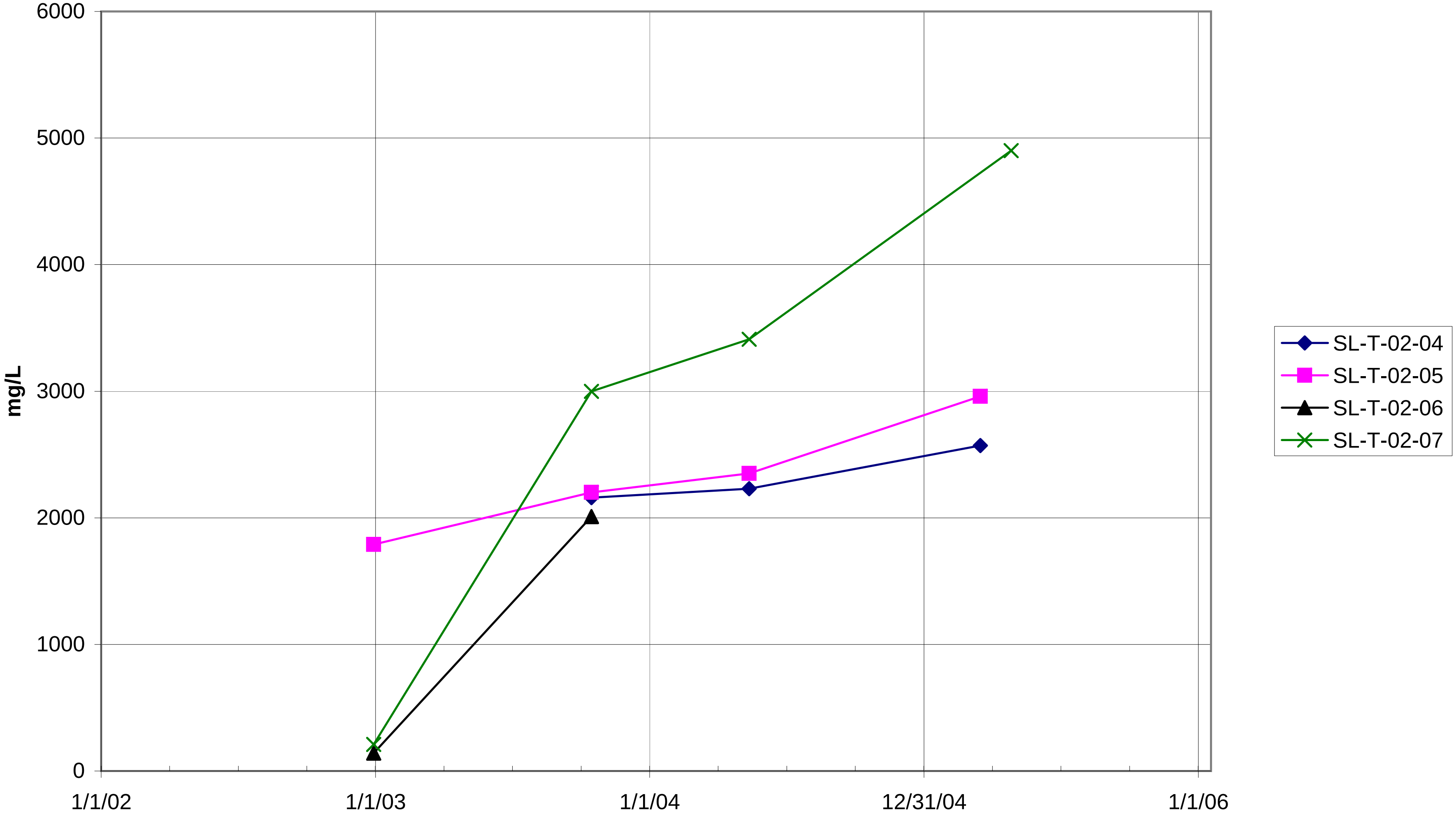


FIGURE 2.25a GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
WET WELLS- ARSENIC DATA
(Non-detectable analyses plotted as zero)

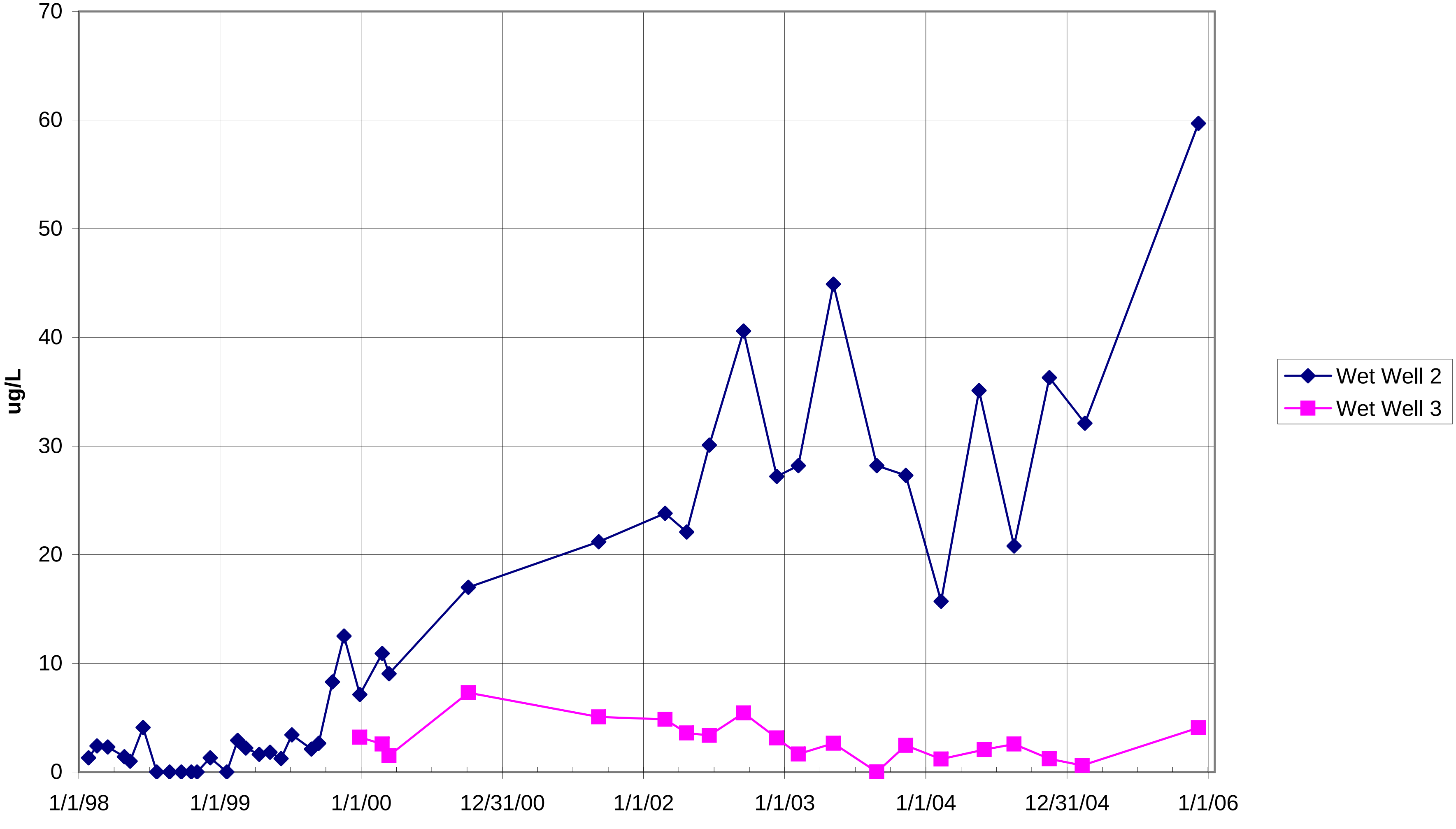


FIGURE 2.25b GREENS CREEK TAILINGS INTERNAL MONITORING SITES: TAILINGS COMPLETIONS - ARSENIC DATA (Non-detectable analyses plotted as zero)

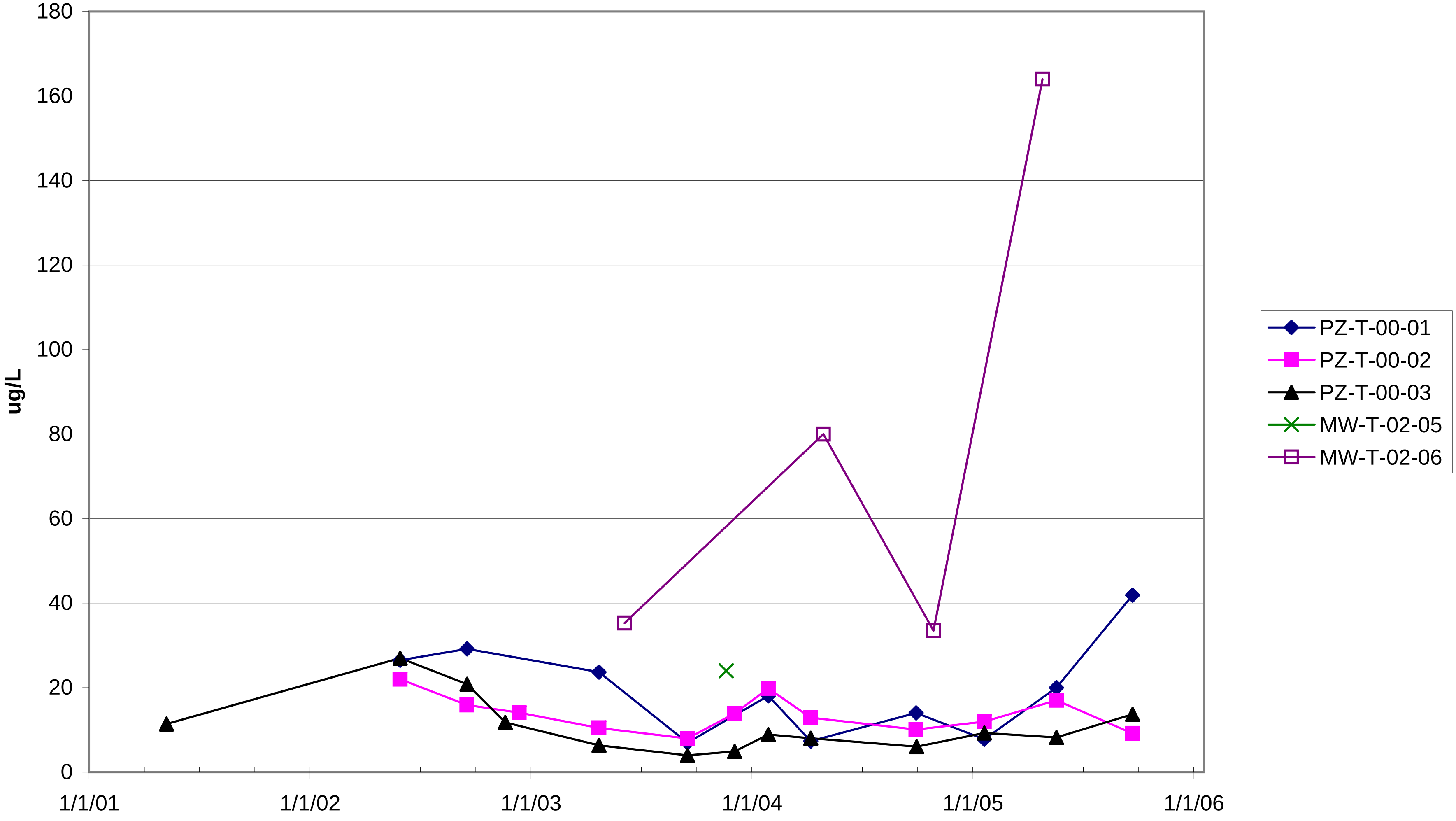


FIGURE 2.25c GREENS CREEK TAILINGS INTERNAL MONITORING SITES: SUCTION LYSIMETERS - ARSENIC DATA (Non-detectable analyses plotted as zero)

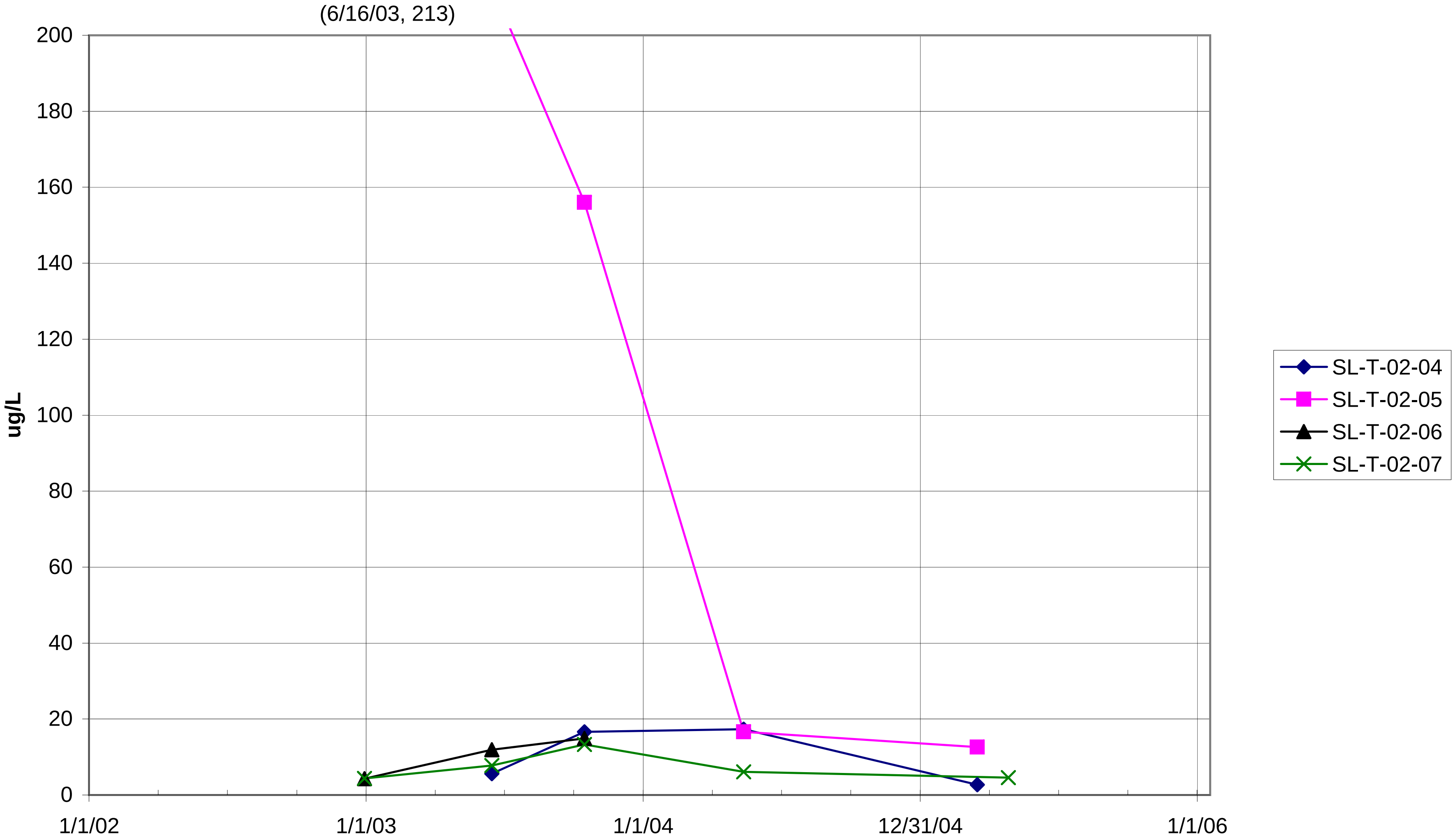


FIGURE 2.26a GREENS CREEK TAILINGS INTERNAL MONITORING SITES: WET WELLS - ZINC DATA (Non-detectable analyses plotted as zero)

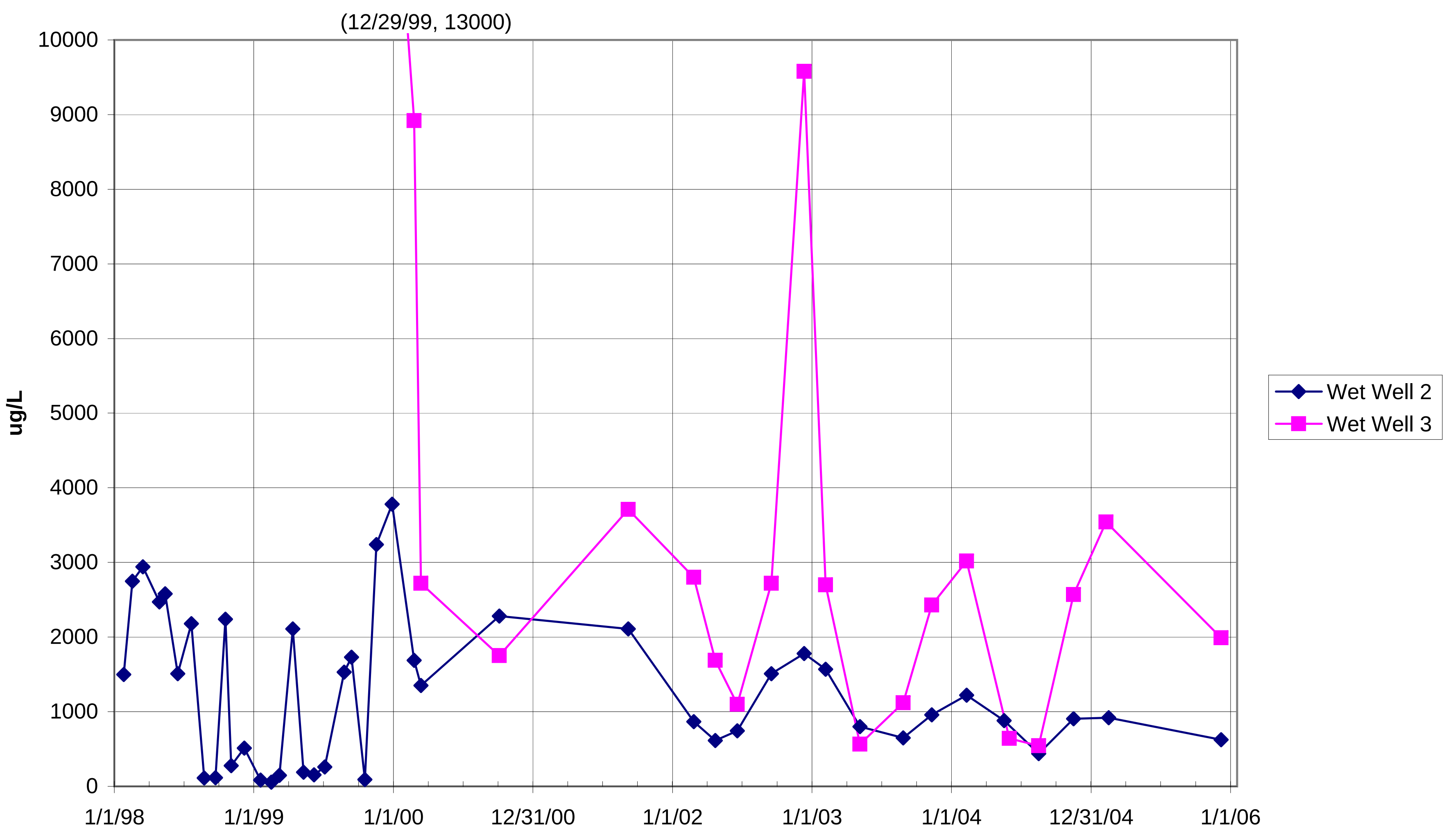


FIGURE 2.26b GREENS CREEK TAILINGS INTERNAL MONITORING SITES: TAILINGS COMPLETIONS - ZINC DATA
(Non-detectable analyses plotted as zero)

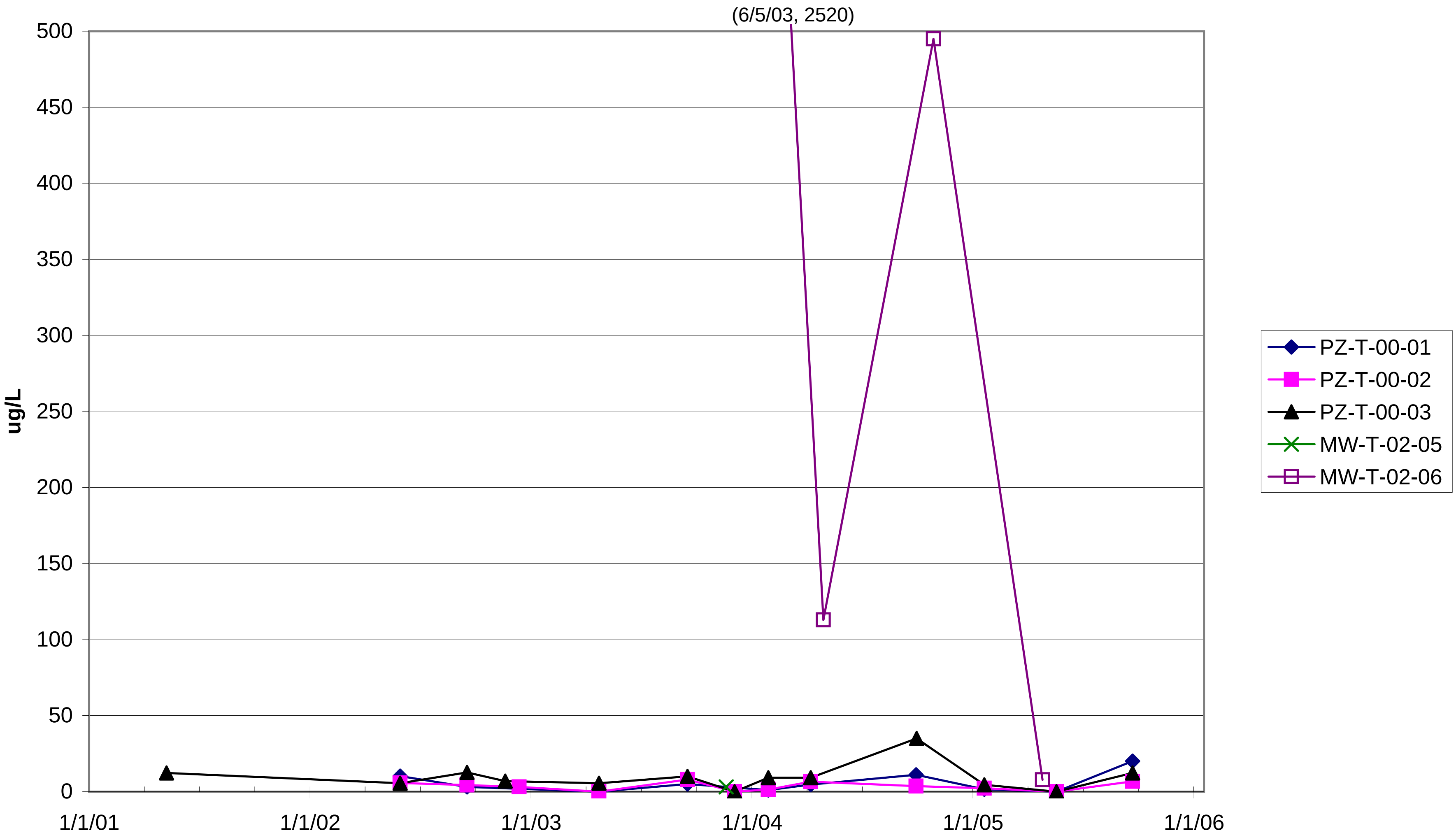


FIGURE 2.26c GREENS CREEK TAILINGS INTERNAL MONITORING SITES: SUCTION LYSIMETERS - ZINC DATA
(Primary and secondary y axis: Non-detectable analyses plotted as zero)

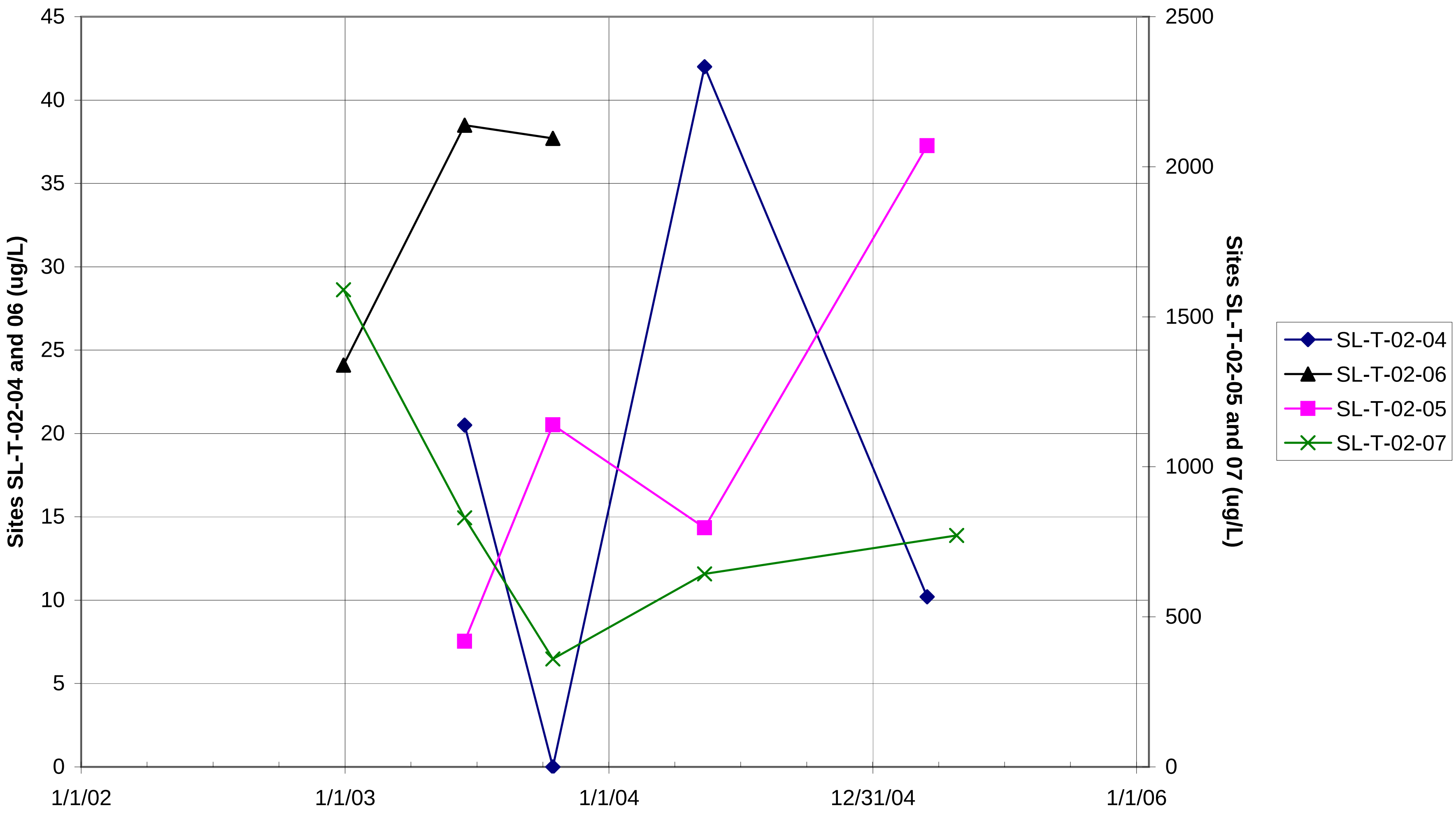


FIGURE 2.27a GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
WET WELLS - COPPER DATA
(Non-detectable analyses plotted as zero)

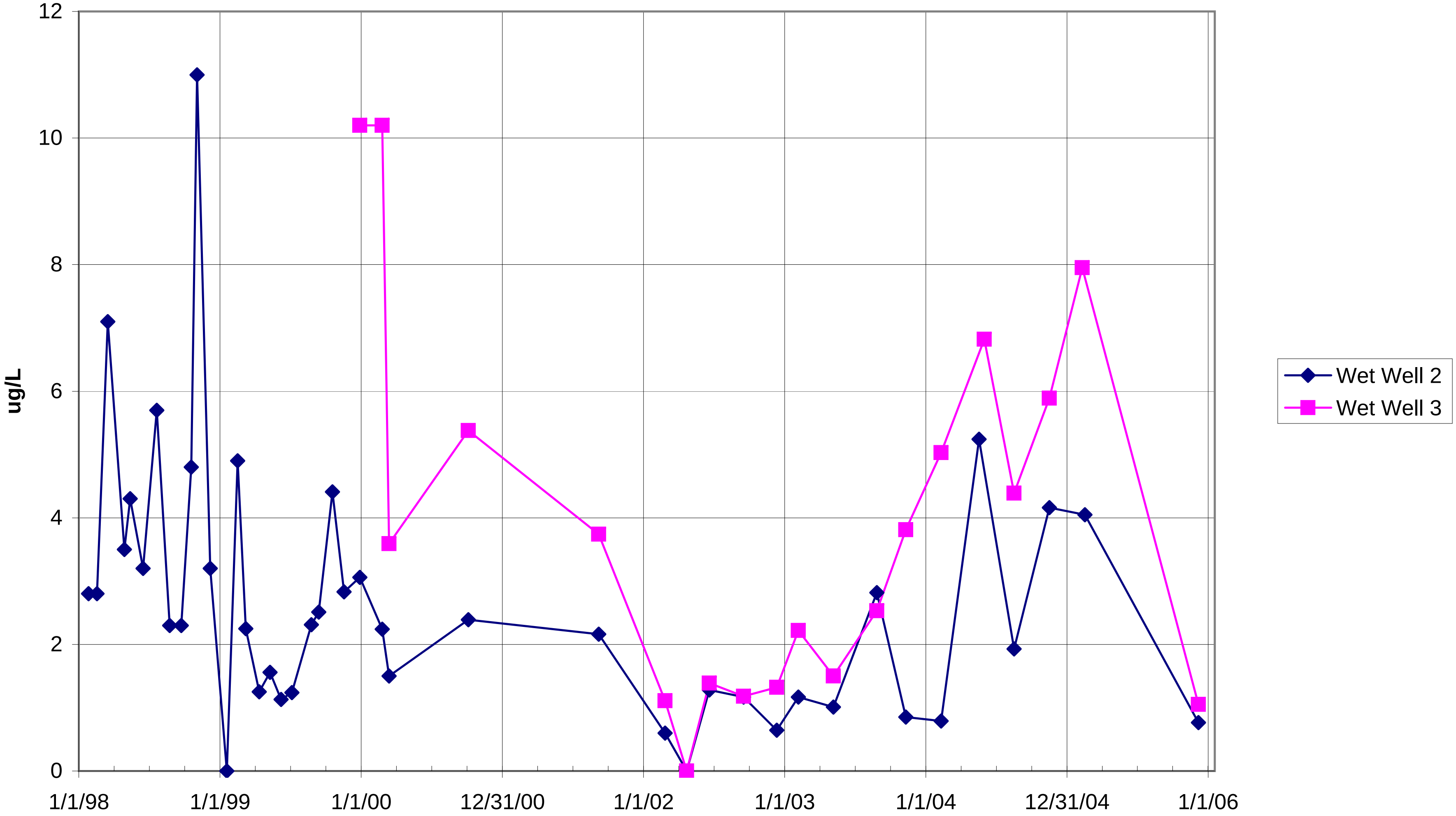


FIGURE 2.27b GREENS CREEK TAILINGS INTERNAL MONITORING SITES: TAILINGS COMPLETIONS - COPPER DATA (Non-detectable analyses plotted as zero)

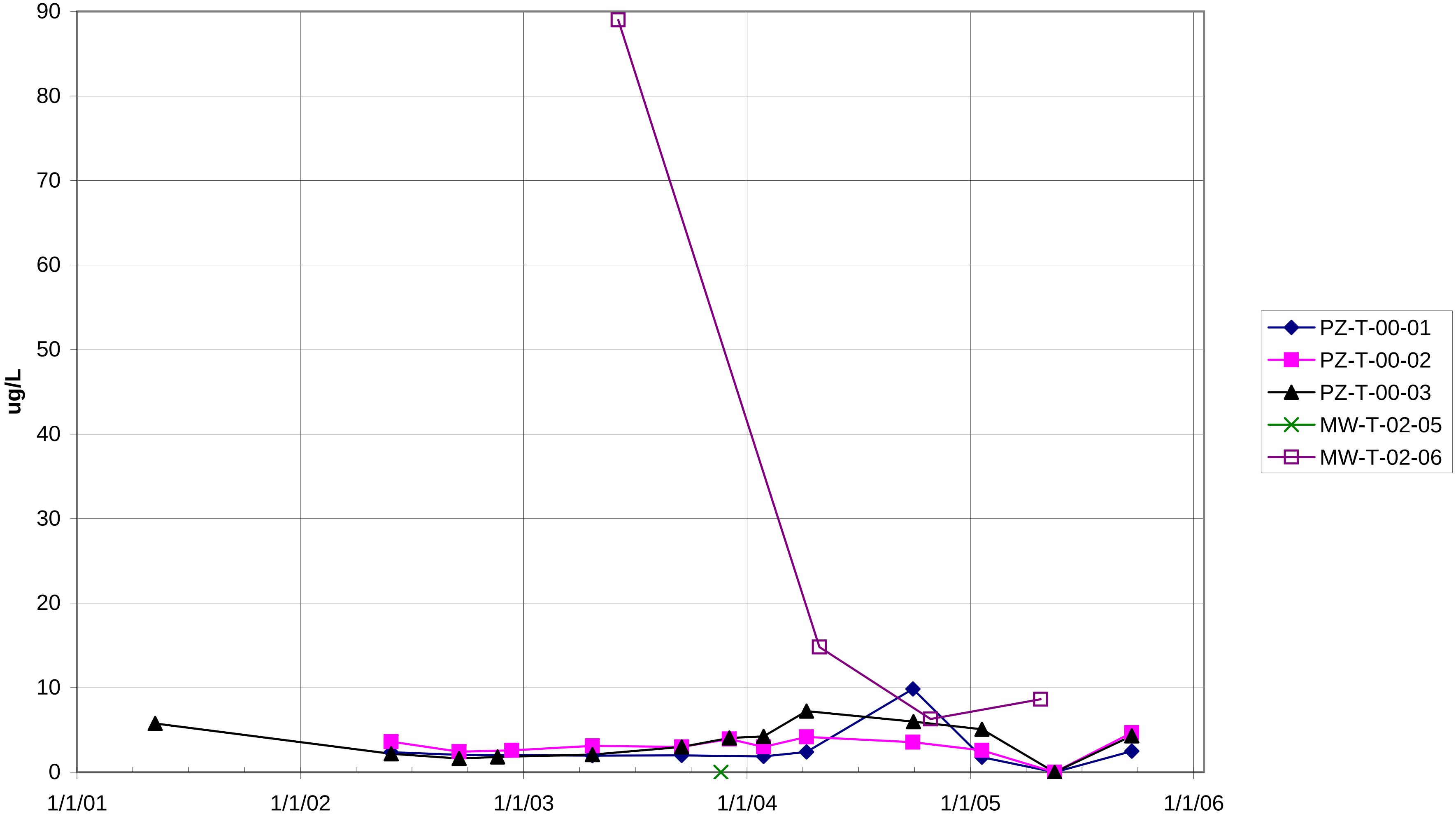


FIGURE 2.27c GREENS CREEK TAILINGS INTERNAL MONITORING SITES: SUCTION LYSIMETERS - COPPER DATA (Non-detectable analyses plotted as zero)

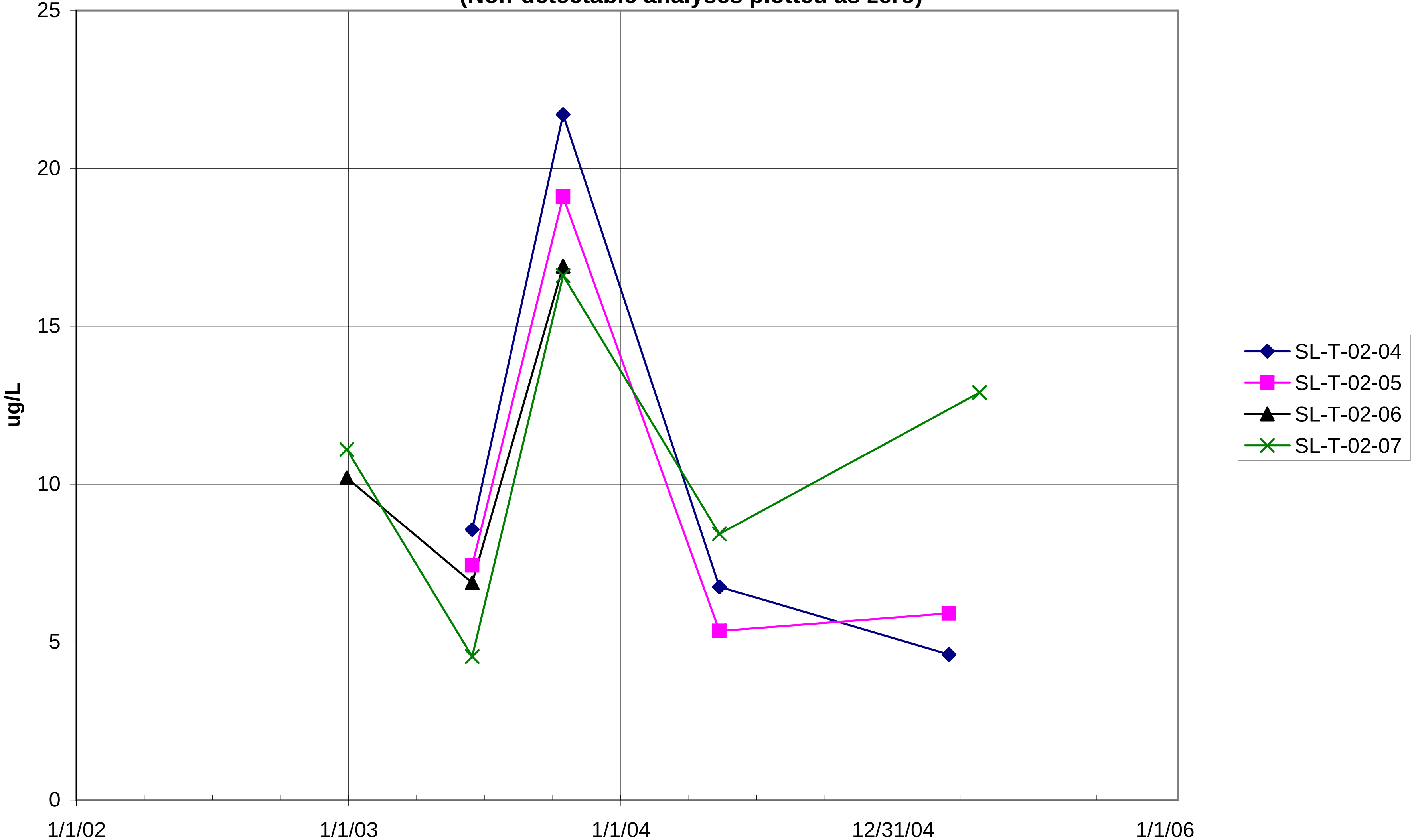


FIGURE 2.28a GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
WET WELLS - LEAD DATA
(Non-detectable analyses plotted as zero)

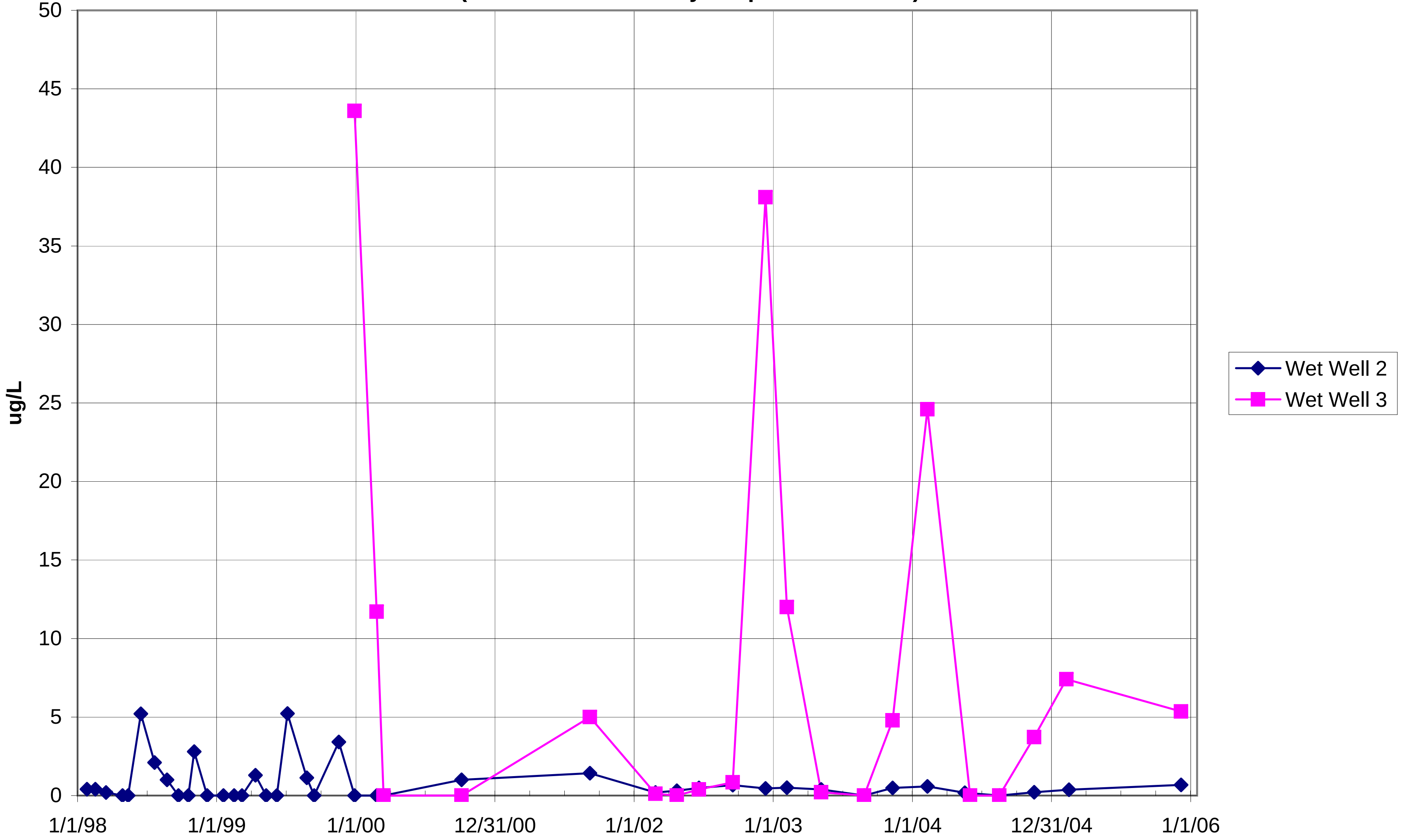


FIGURE 2.28b GREENS CREEK TAILINGS INTERNAL MONITORING SITES: TAILINGS COMPLETIONS - LEAD DATA (Non-detectable analyses plotted as zero)

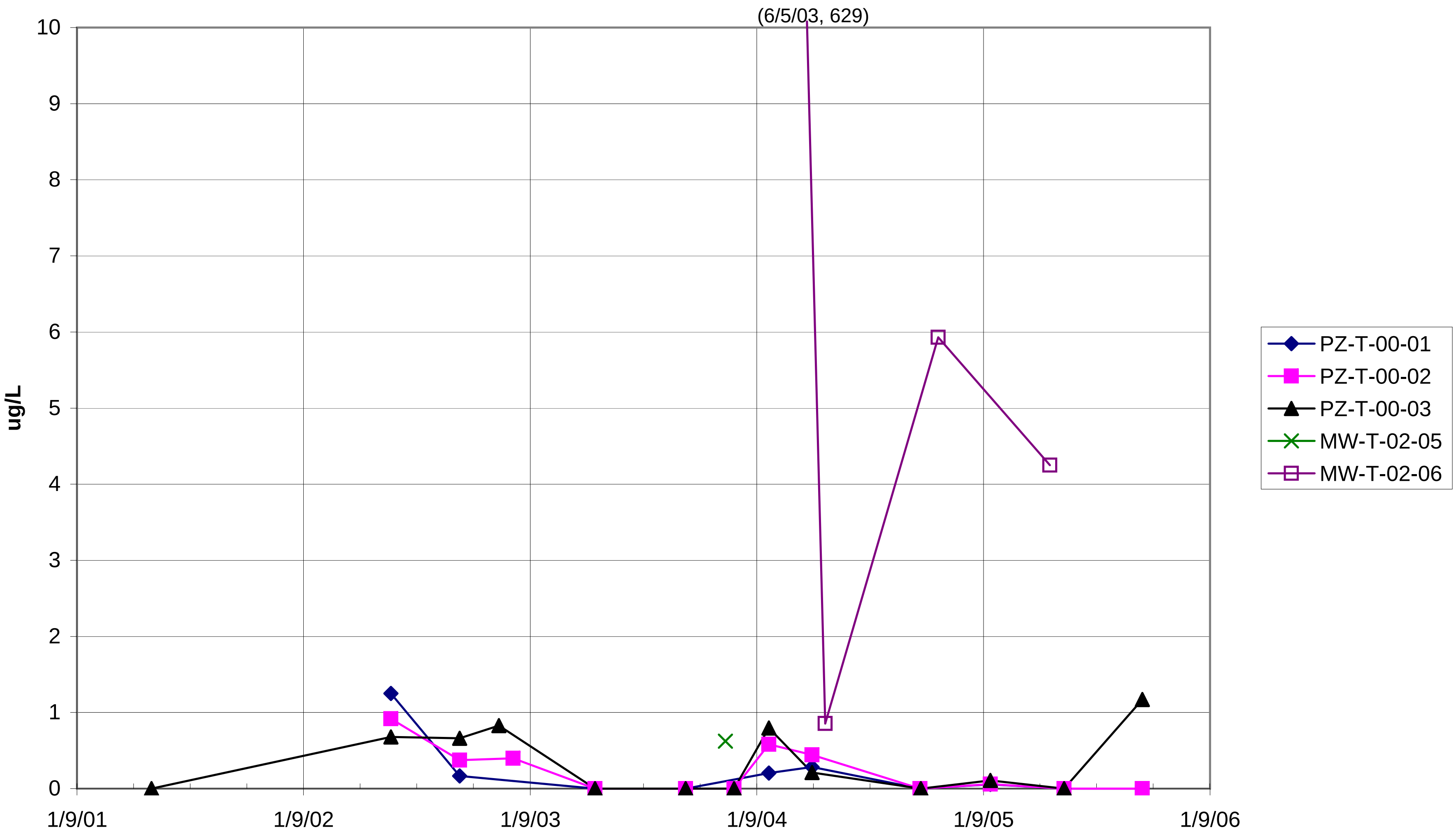


FIGURE 2.28c GREENS CREEK TAILINGS INTERNAL MONITORING SITES: SUCTION LYSIMETERS - LEAD DATA (Non-detectable analyses plotted as zero)

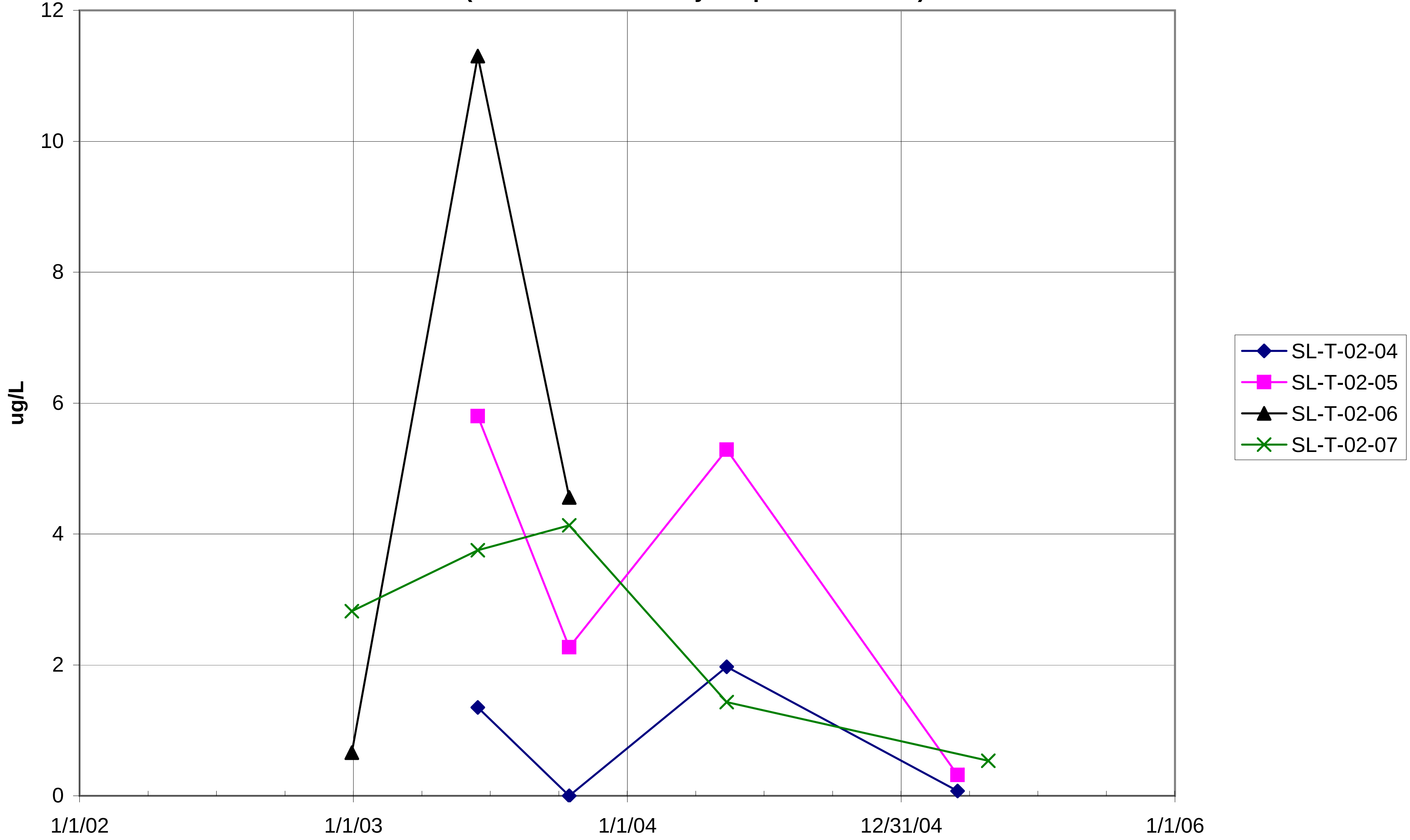


FIGURE 2.29a GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
WET WELLS - CADMIUM DATA
(Non-detectable analyses plotted as zero)

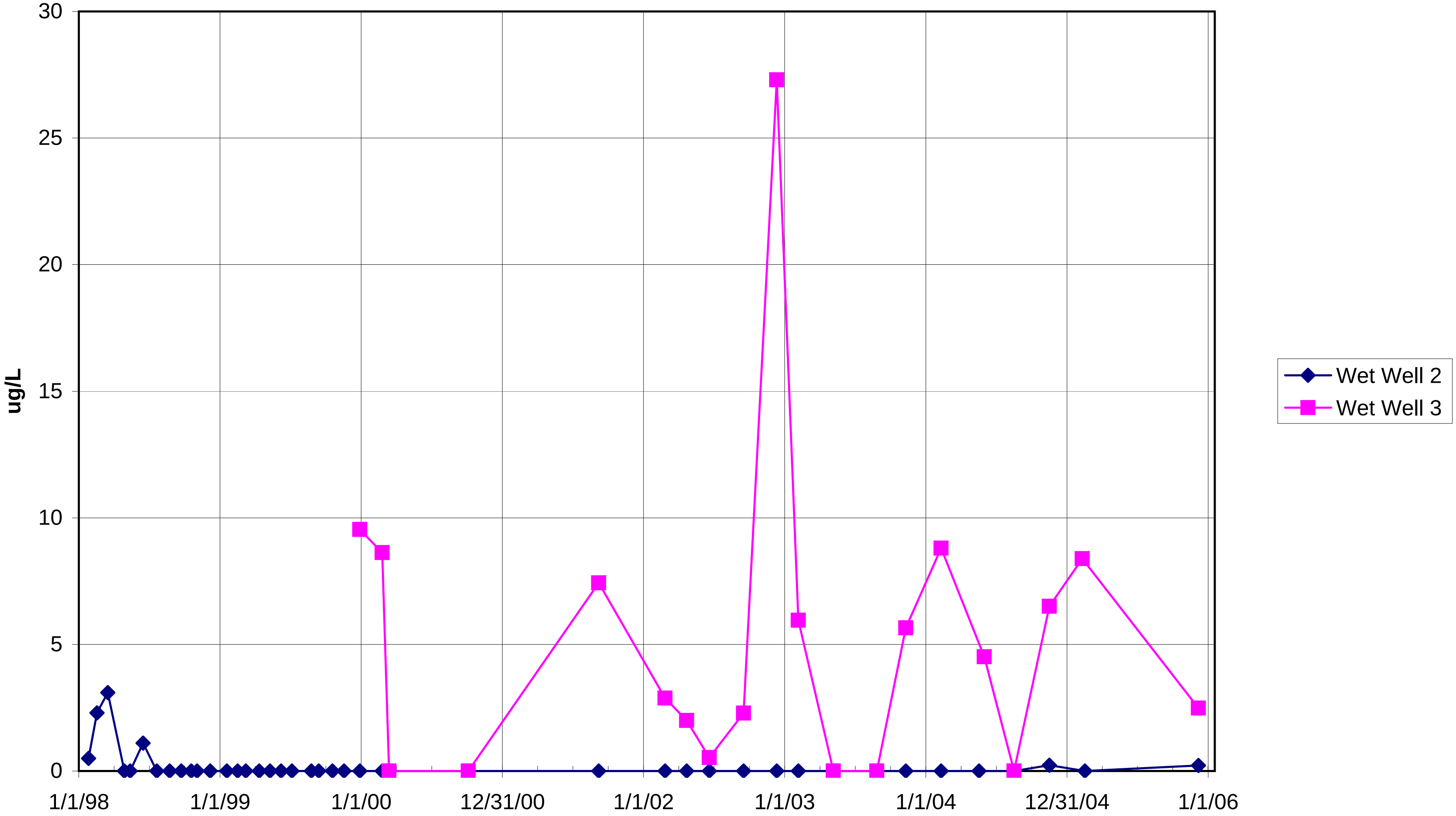


FIGURE 2.29b GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
TAILINGS COMPLETIONS - CADMIUM DATA
(Non-detectable analyses plotted as zero)

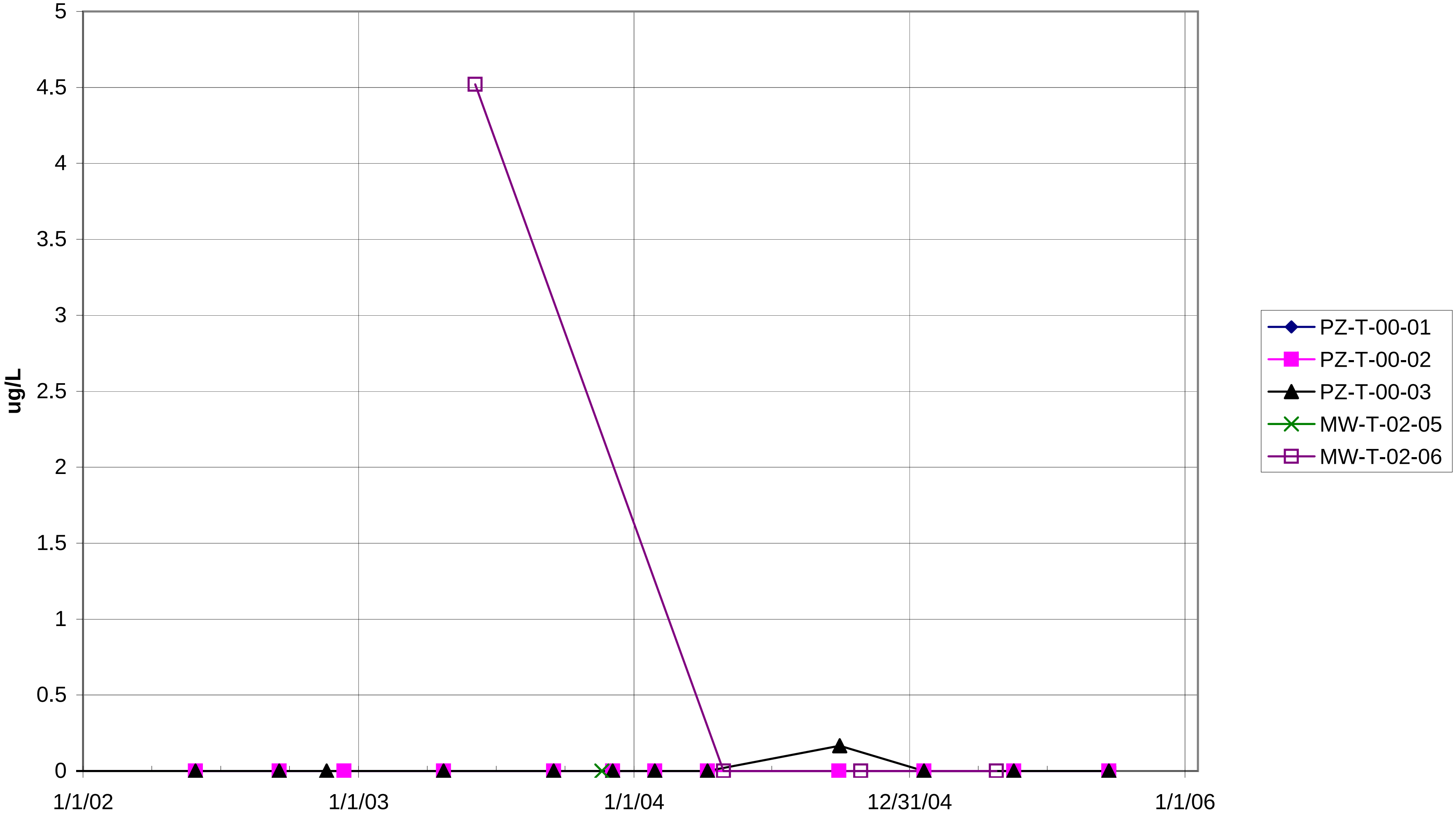


FIGURE 2.29c GREENS CREEK TAILINGS INTERNAL MONITORING SITES: SUCTION LYSIMETERS - CADMIUM DATA (Non-detectable analyses plotted as zero)

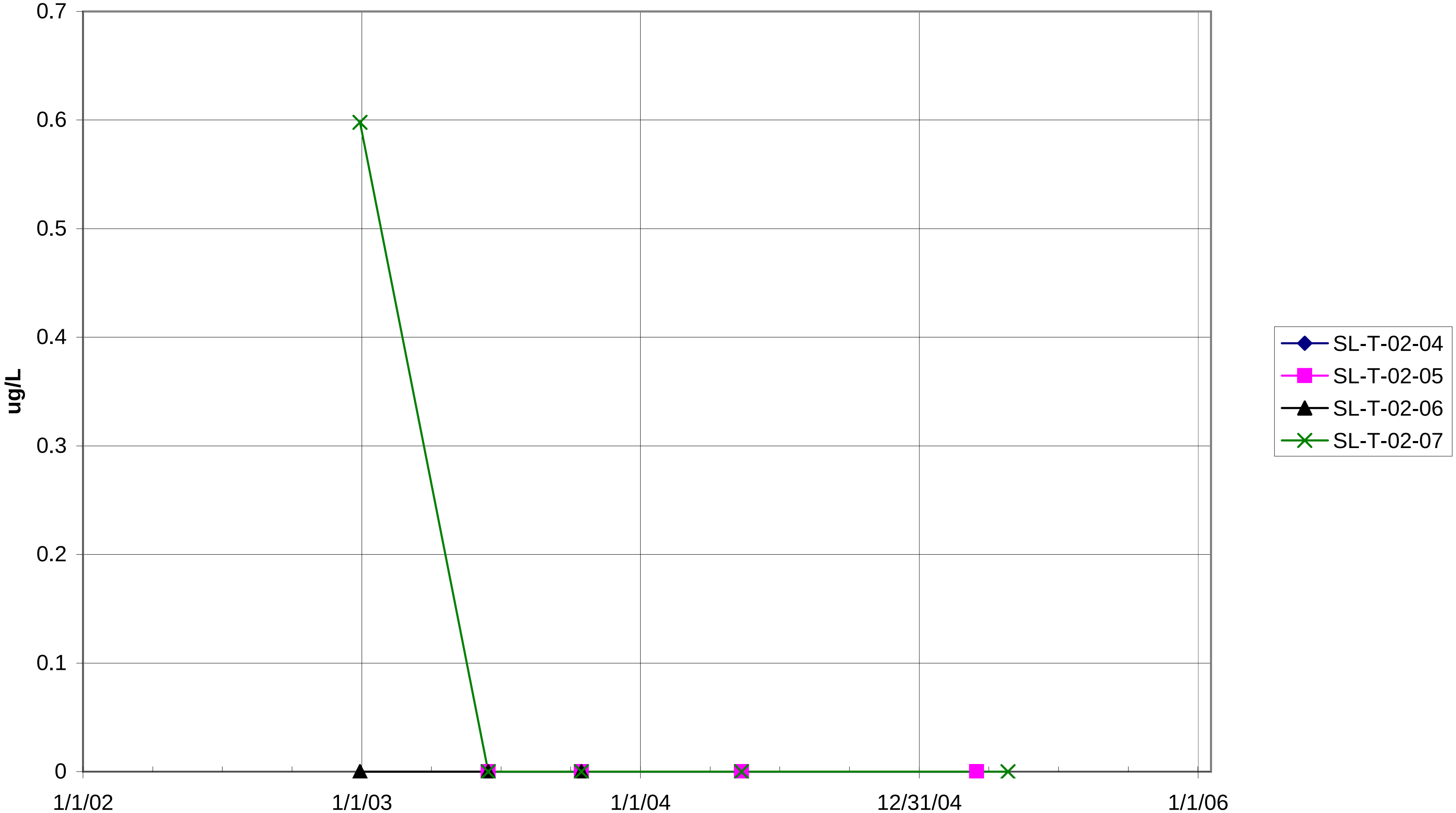


FIGURE 2.30a GREENS CREEK TAILINGS INTERNAL MONITORING SITES: WET WELLS - IRON DATA
(Non-detectable analyses plotted as zero)

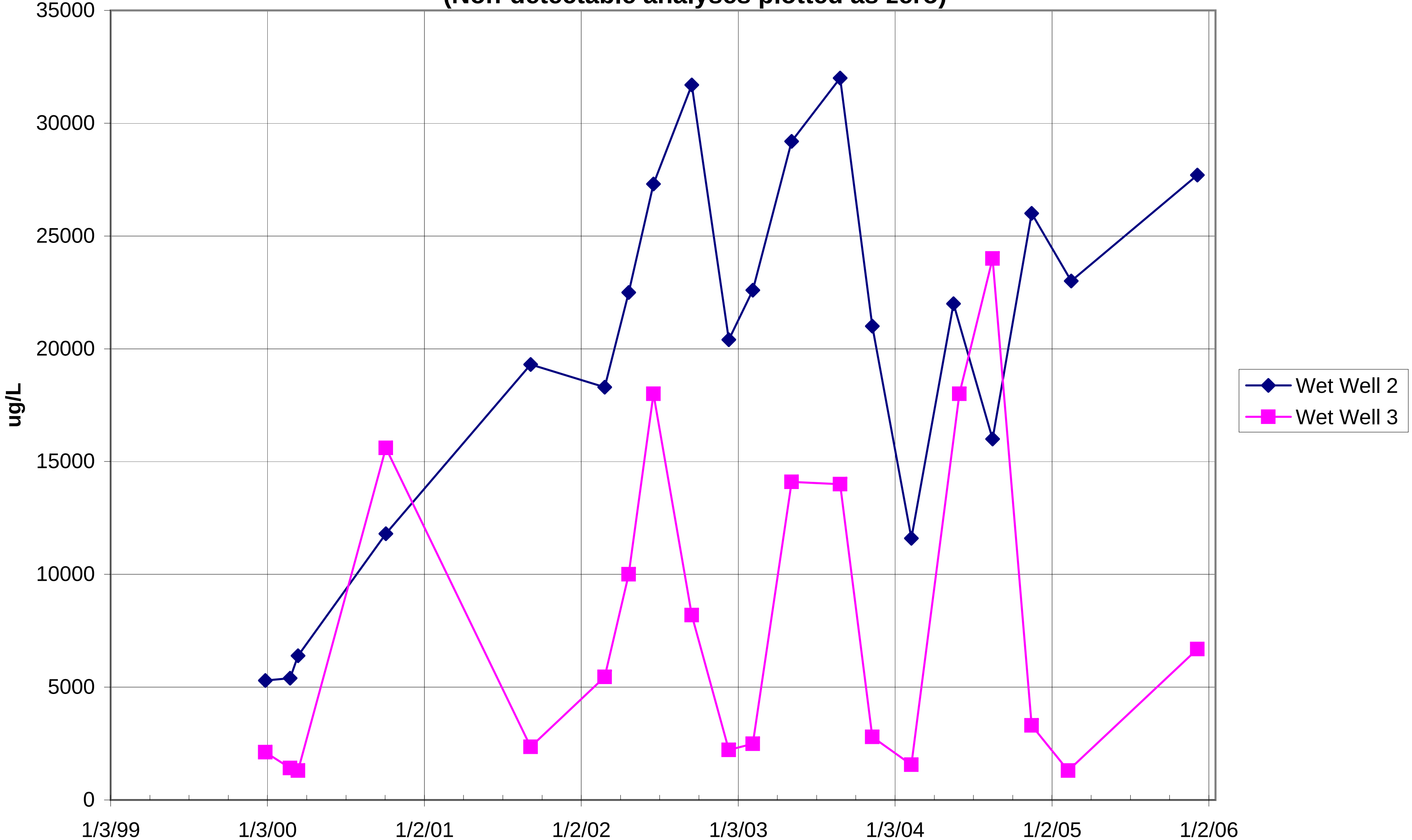


FIGURE 2.30b GREENS CREEK TAILINGS INTERNAL MONITORING SITES:
TAILINGS COMPLETIONS - IRON DATA
(Non-detectable analyses plotted as zero)

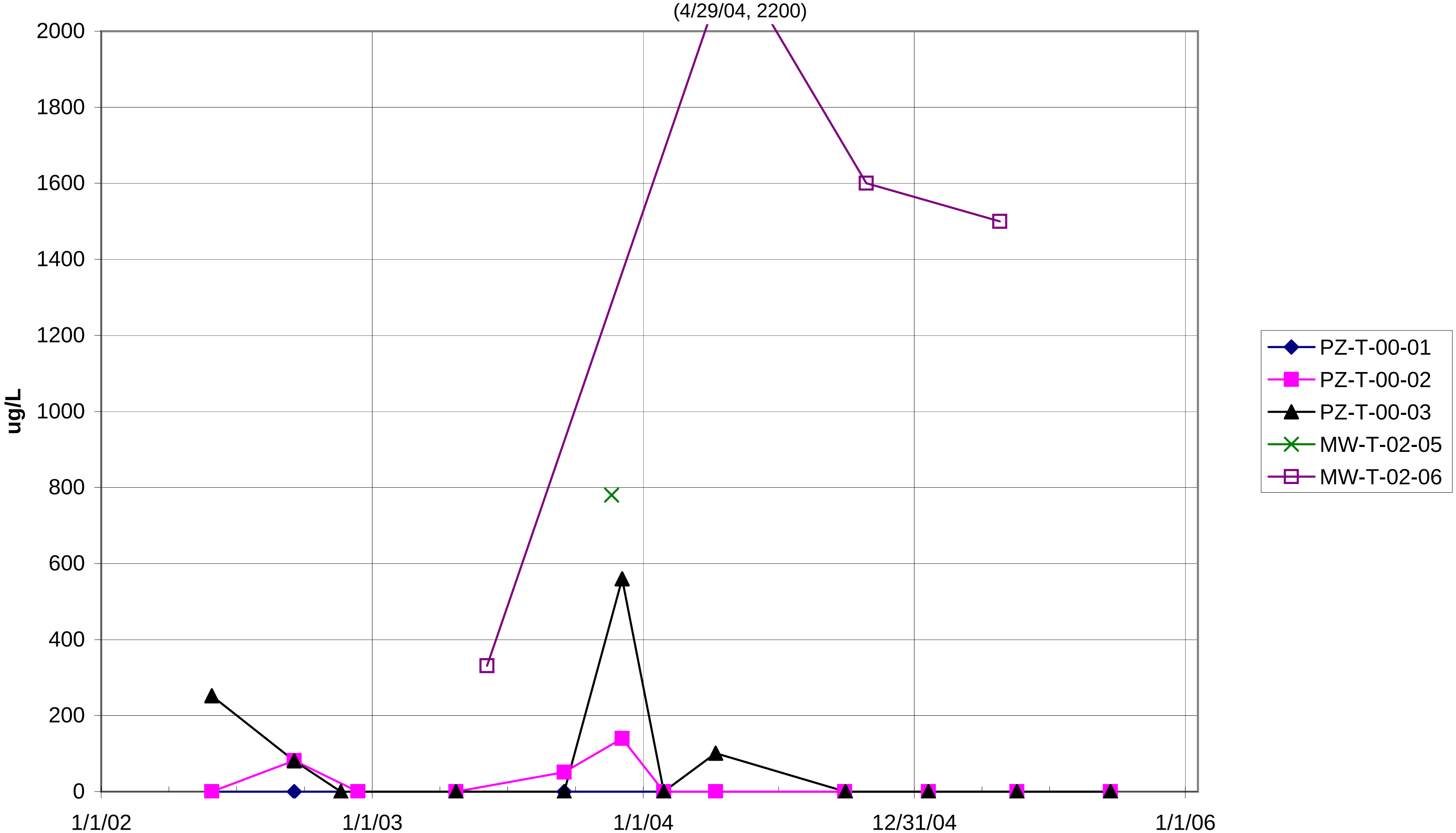


FIGURE 2.30c GREENS CREEK TAILINGS INTERNAL MONITORING SITES: SUCTION LYSIMETERS - IRON DATA (Non-detectable analyses plotted as zero)

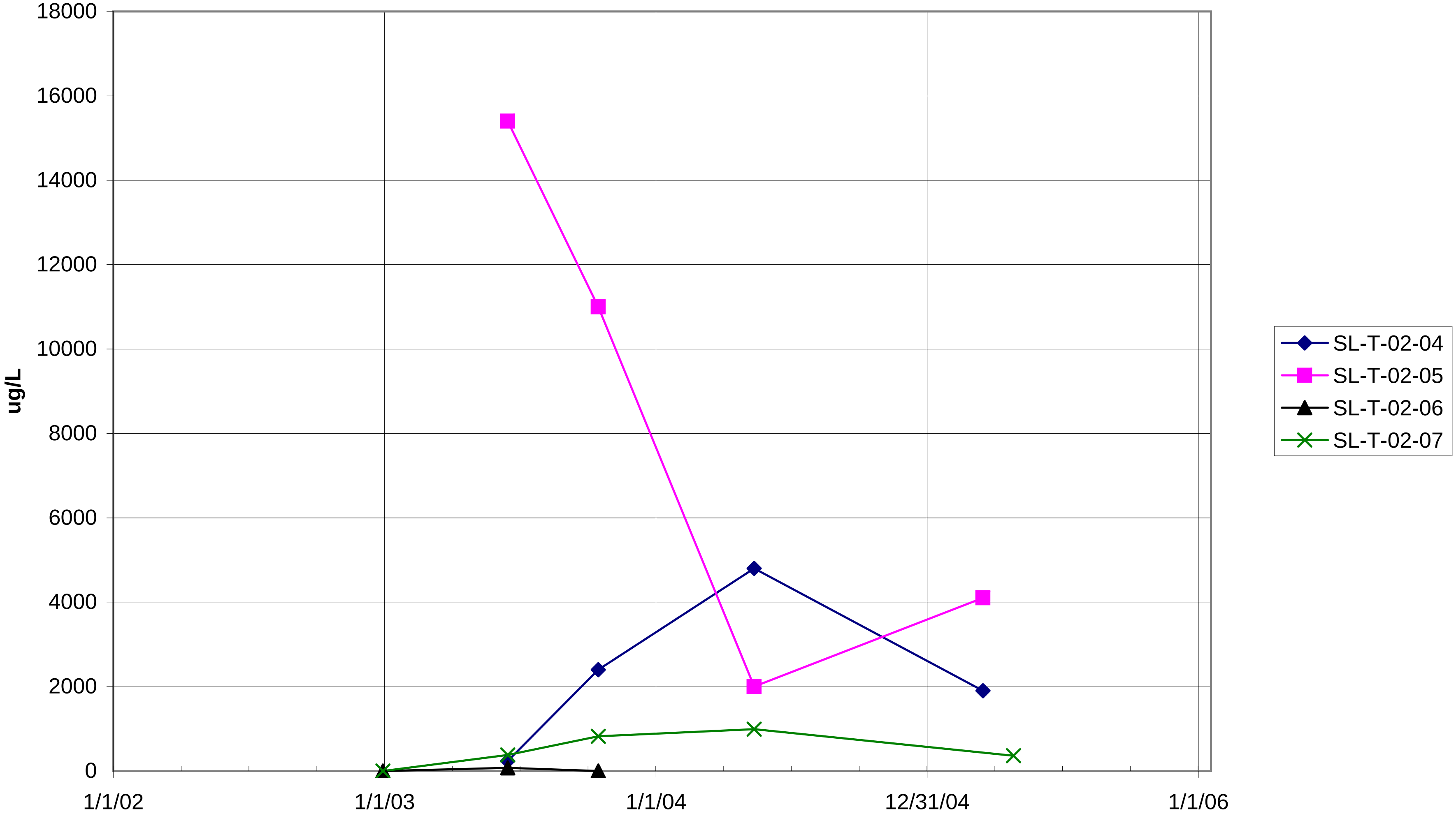


FIGURE 2.31a GREENS CREEK TAILINGS INTERNAL MONITORING SITES: WET WELLS - MANGANESE DATA (Non-detectable analyses plotted as zero)

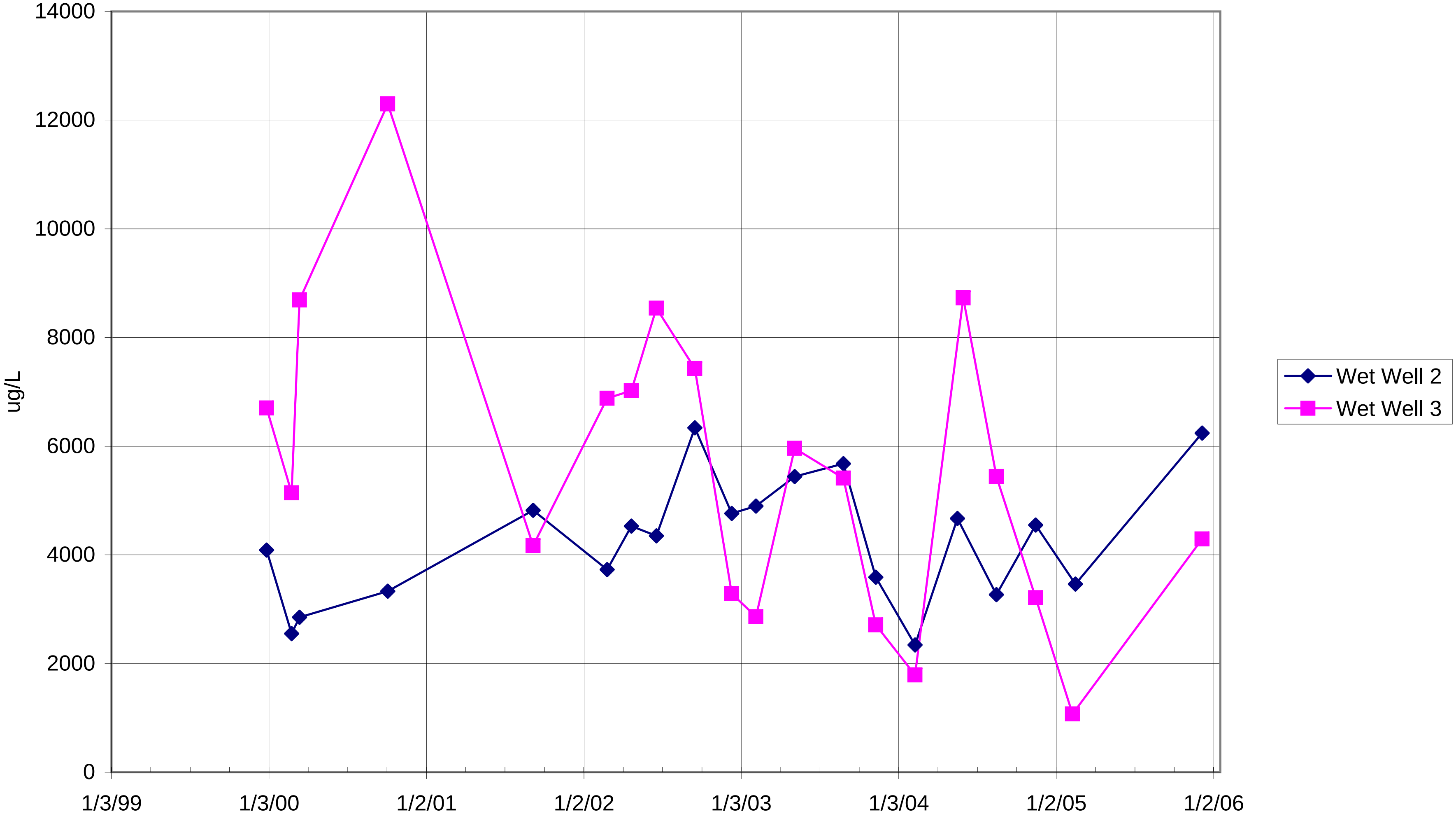


FIGURE 2.31b GREENS CREEK TAILINGS INTERNAL MONITORING SITES: TAILINGS COMPLETIONS - MANGANESE DATA (Non-detectable analyses plotted as zero)

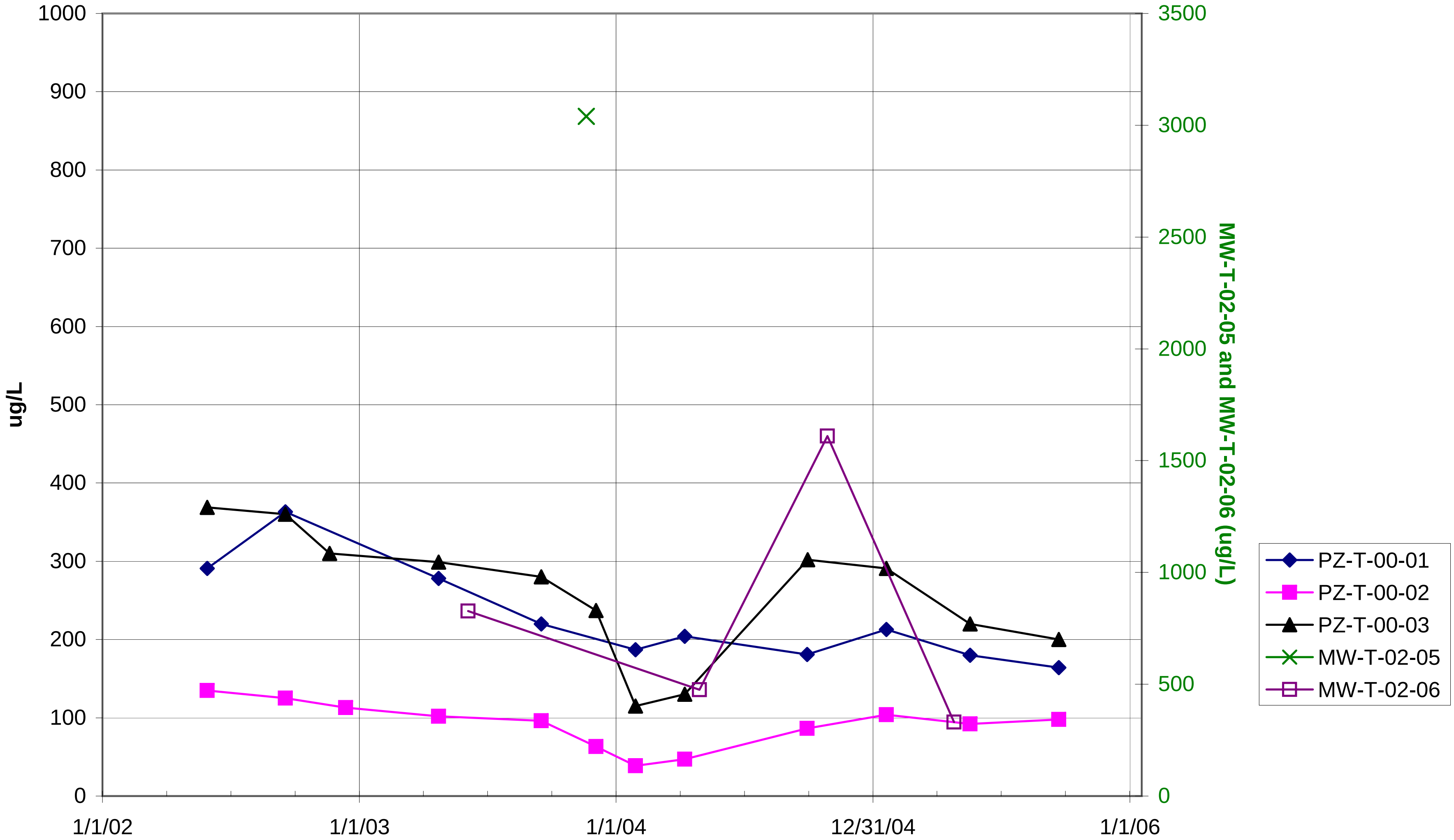


FIGURE 2.31c GREENS CREEK TAILINGS INTERNAL MONITORING SITES: SUCTION LYSIMETERS - MANGANESE DATA (Non-detectable analyses plotted as zero)

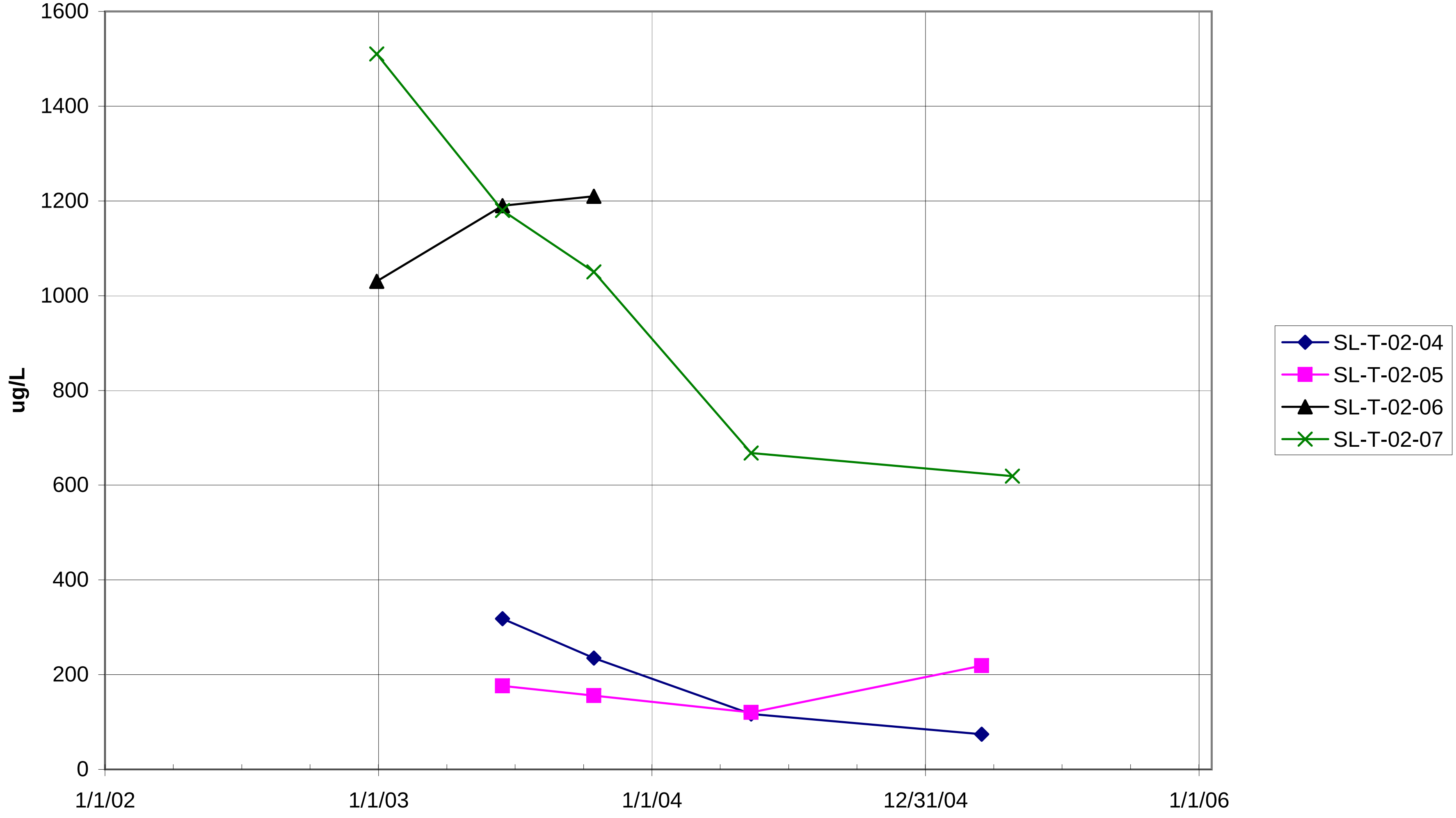


FIGURE 2.32 TAILINGS MONTHLY COMPOSITE ABA RESULTS

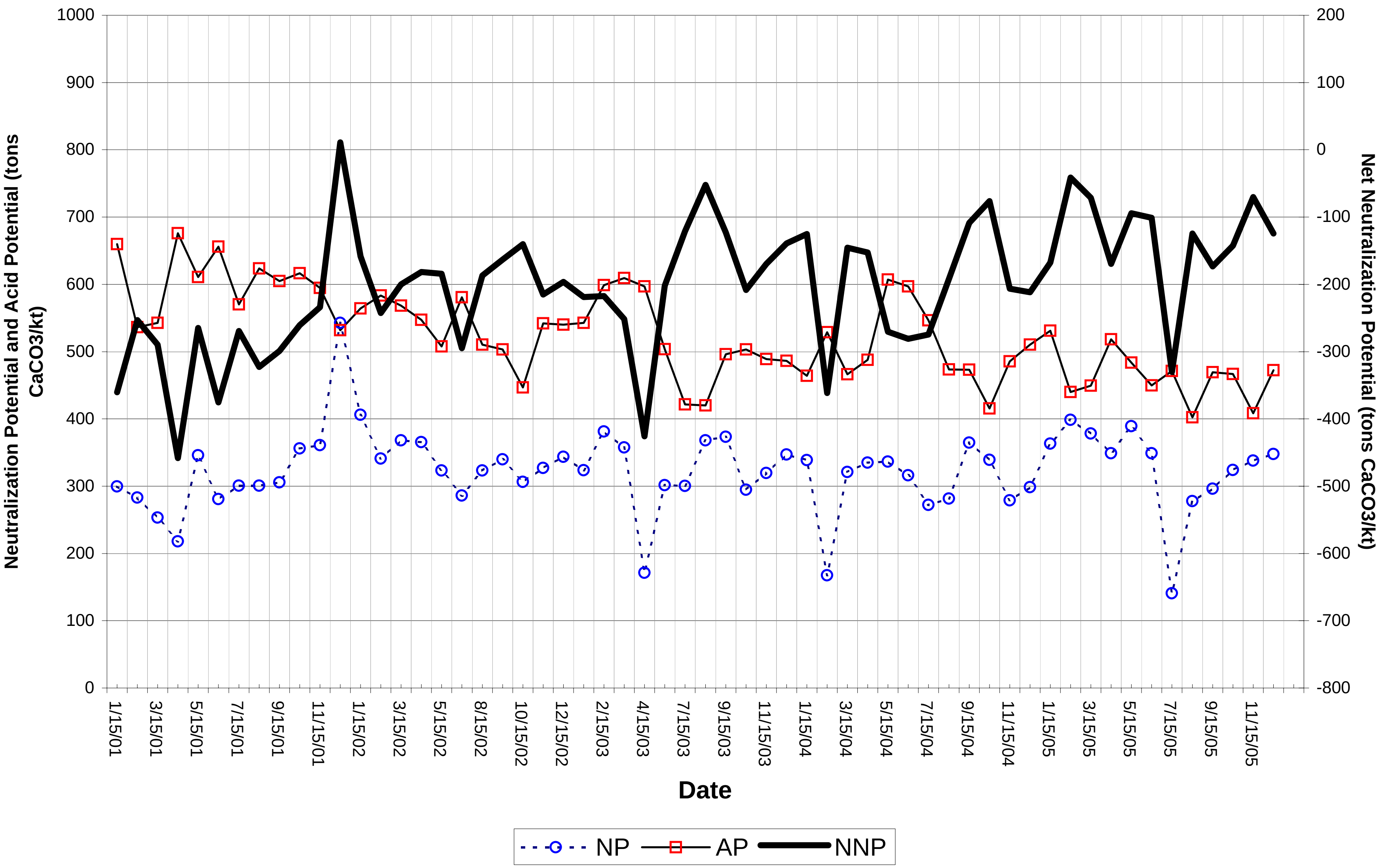


FIGURE 2.33 TAILINGS FACILITY 2005 ACID BASE ACCOUNTNG DATA

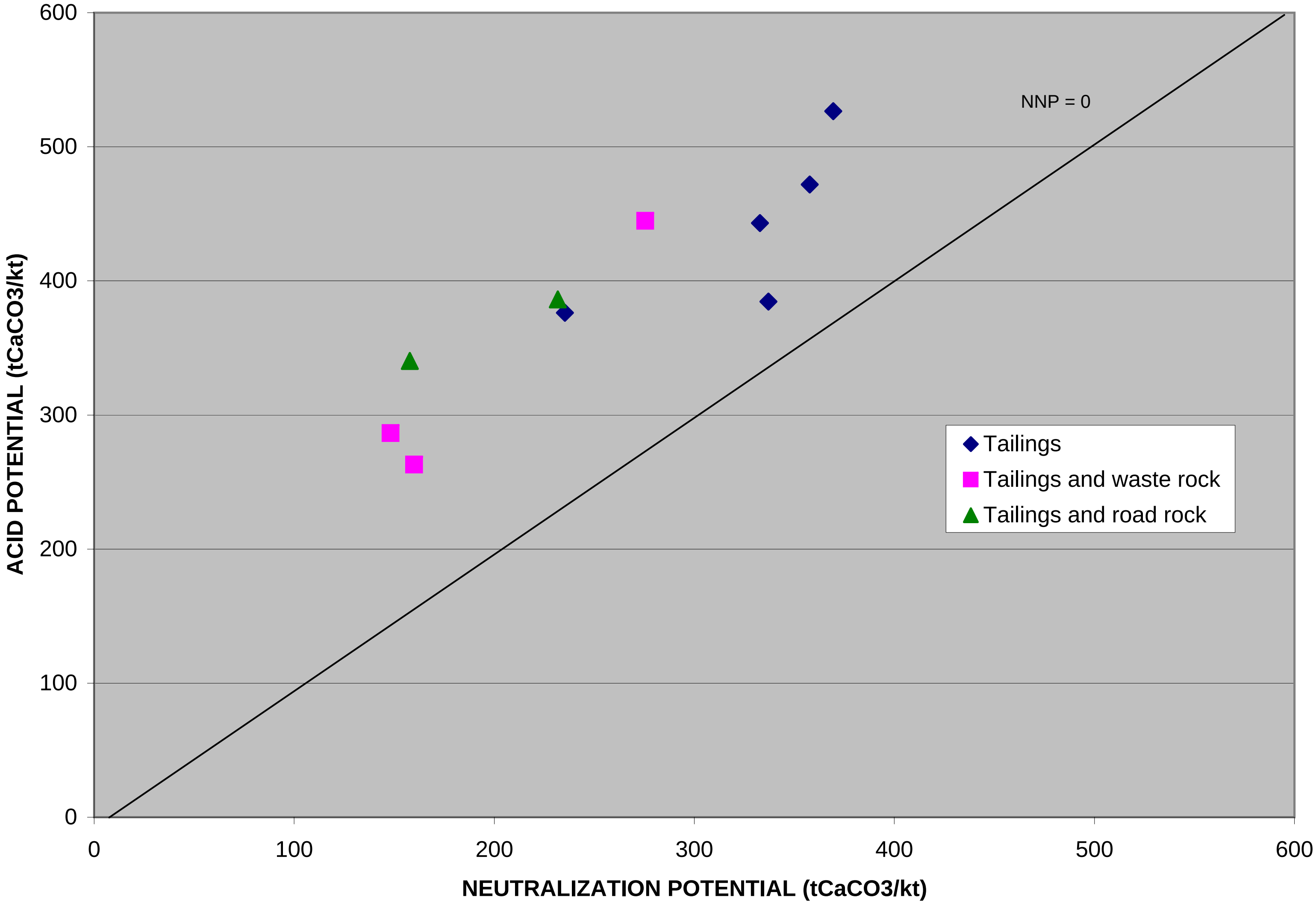


FIGURE 2.34 TAILINGS FACILITY PH VERSUS NET NEUTRALIZATION POTENTIAL

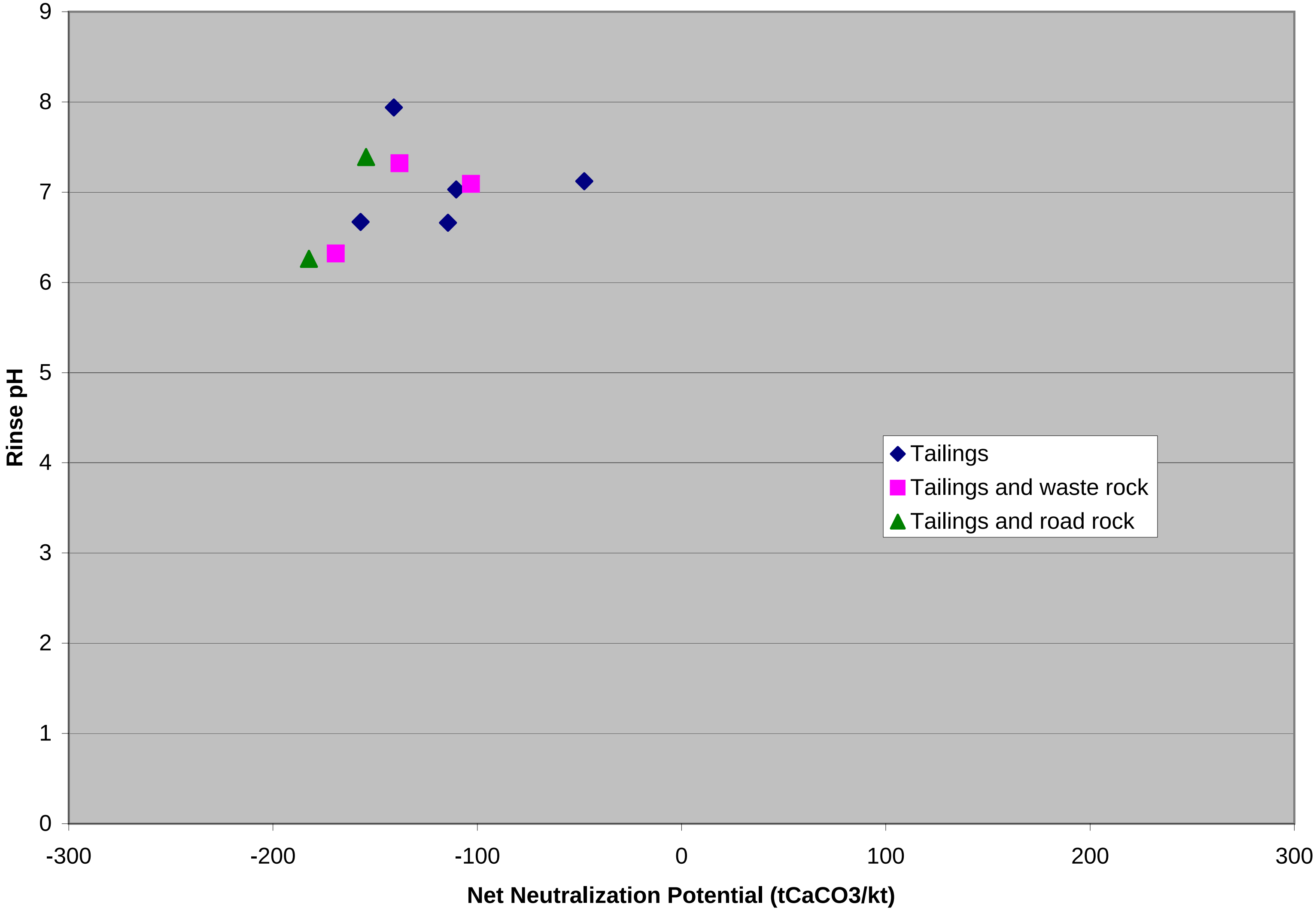


Figure 3.1 Pressure Data for Piezometer 52

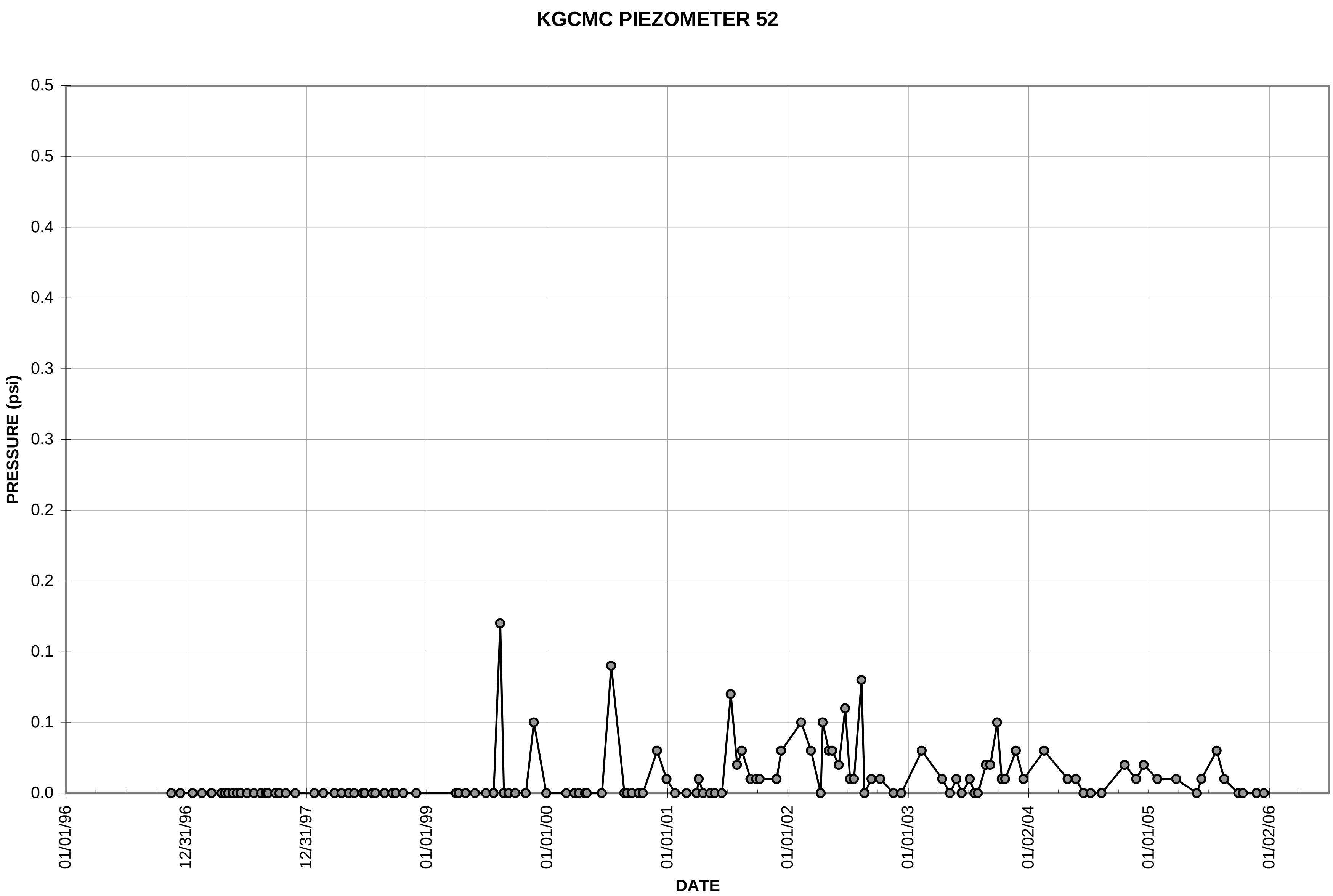


Figure 3.2 Pressure Data for Piezometer 53

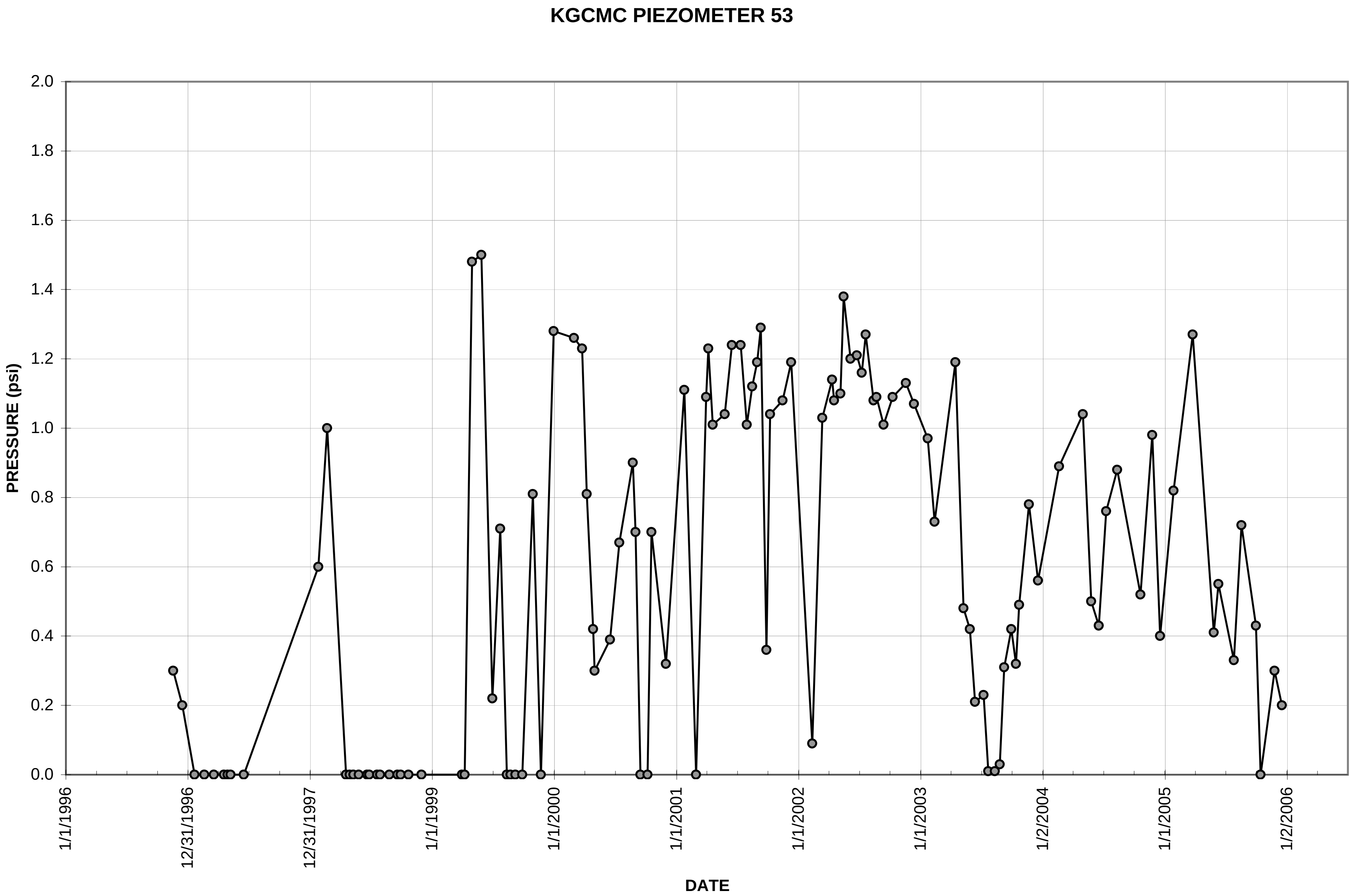


Figure 3.3 Pressure Data for Piezometer 54

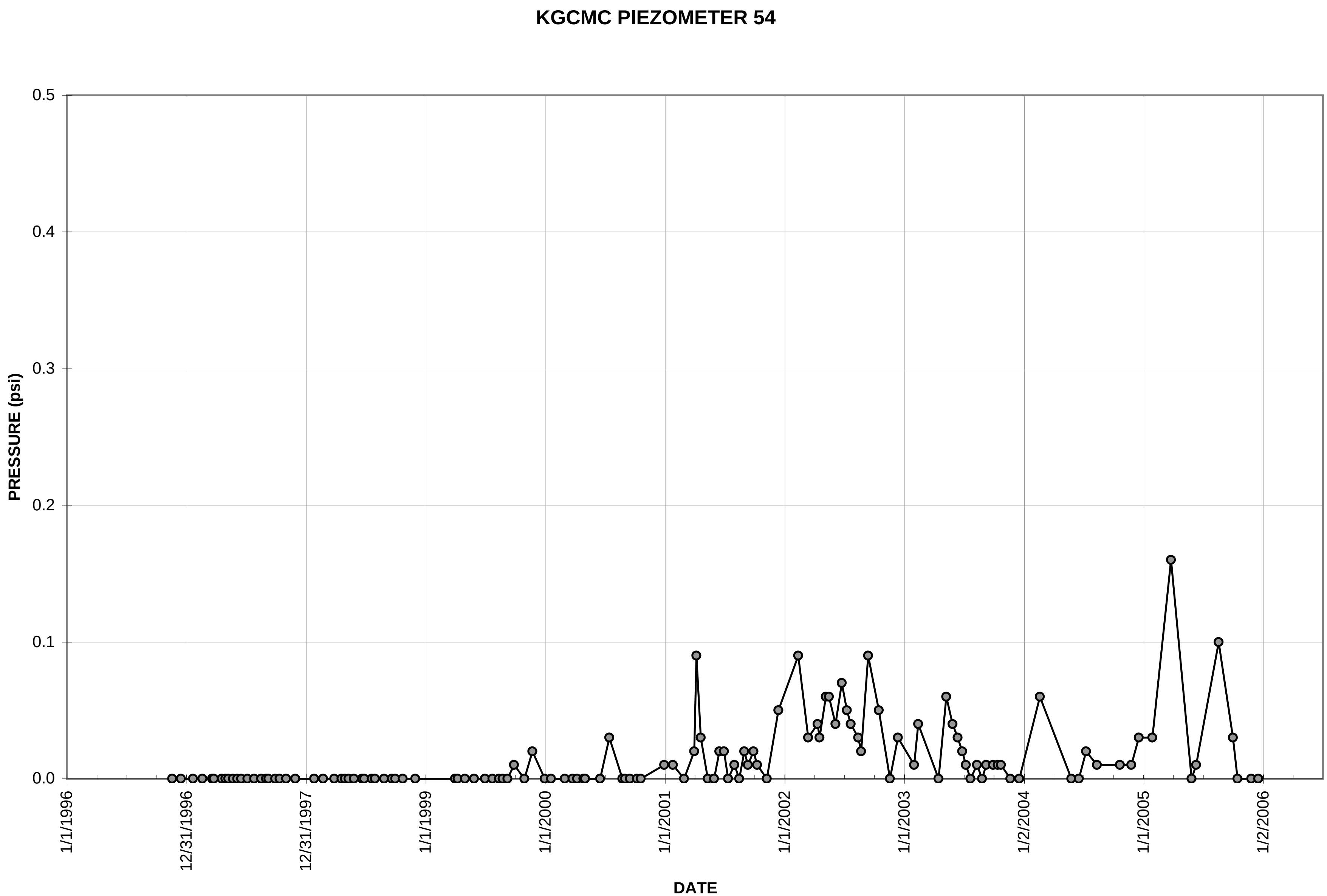


Figure 3.4 Pressure Data for Piezometer 55

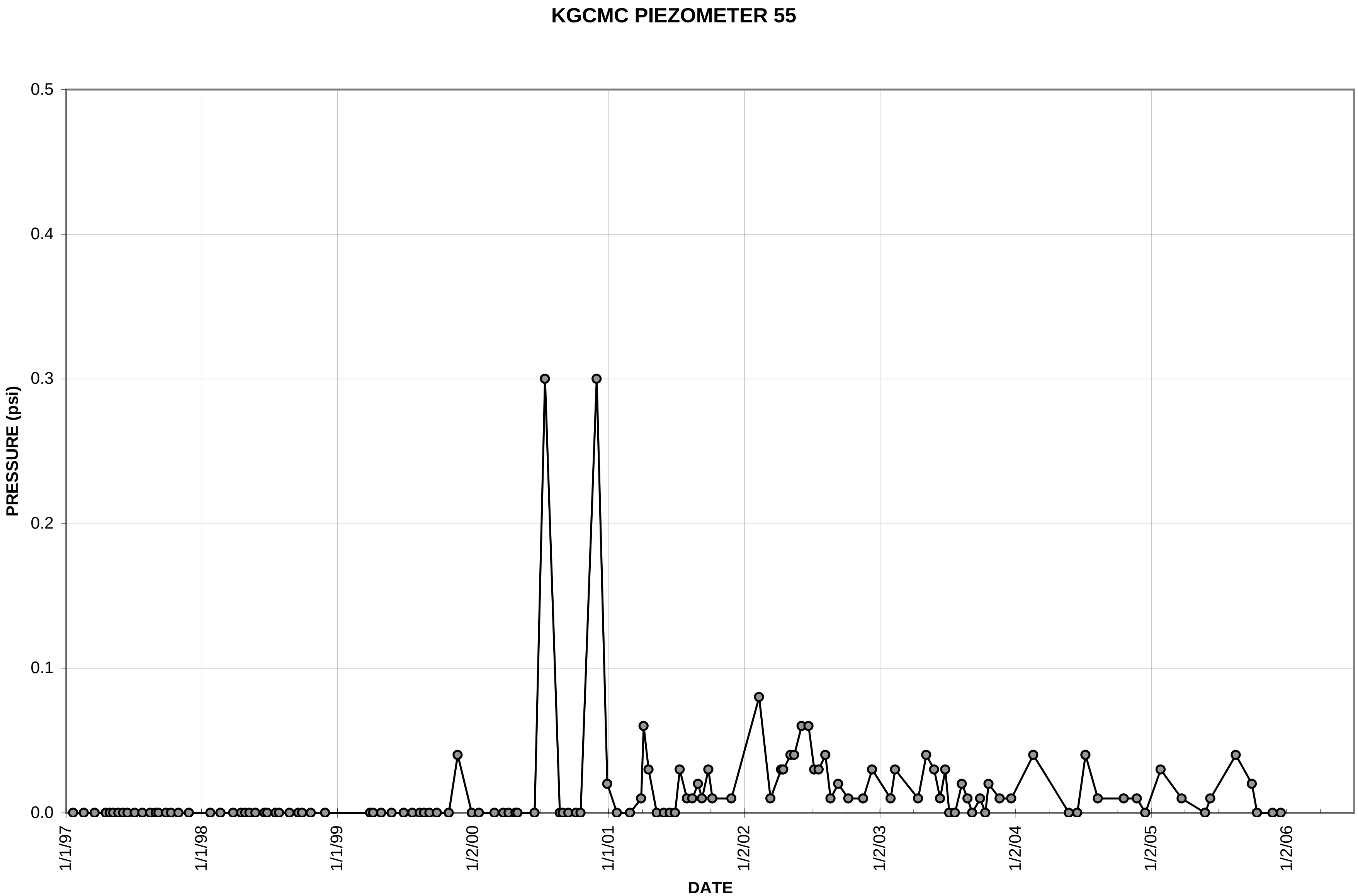


Figure 3.5 Water Level Data for Well MW-23/D-00-03

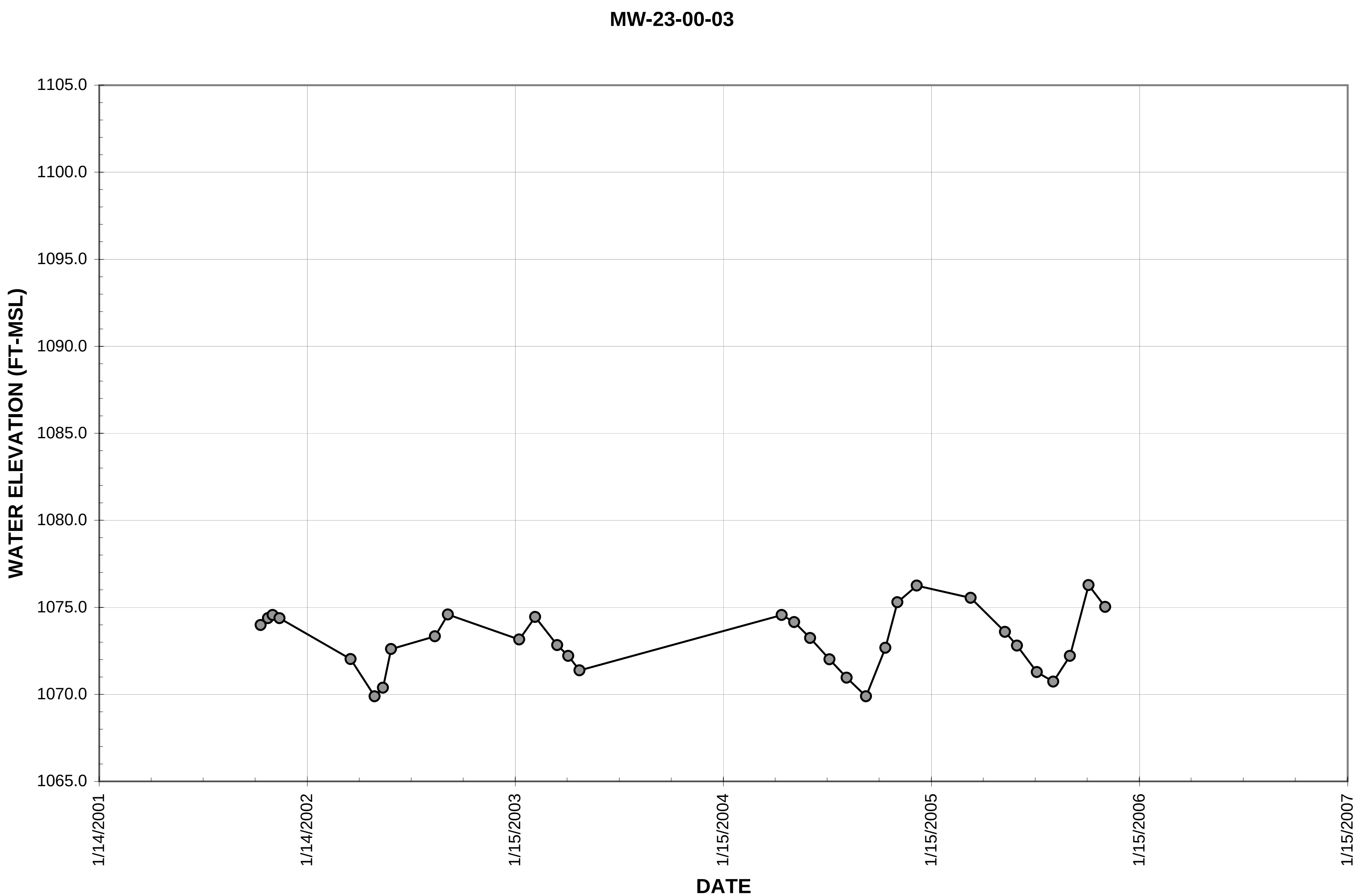


Figure 3.6 Water Level Data for Well MW-23-A2D

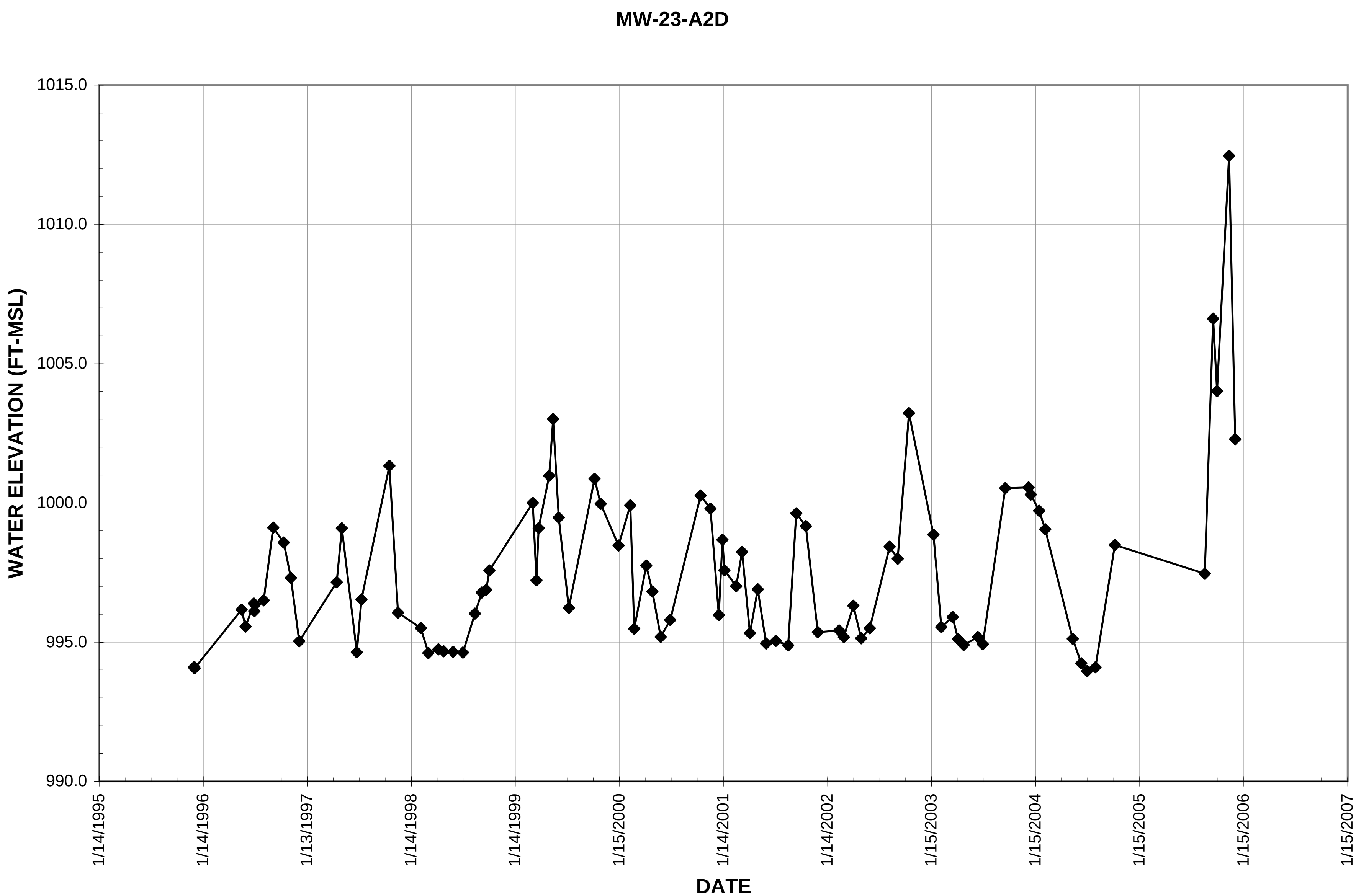


Figure 3.7 Water Level Data for Well MW-23-A2S

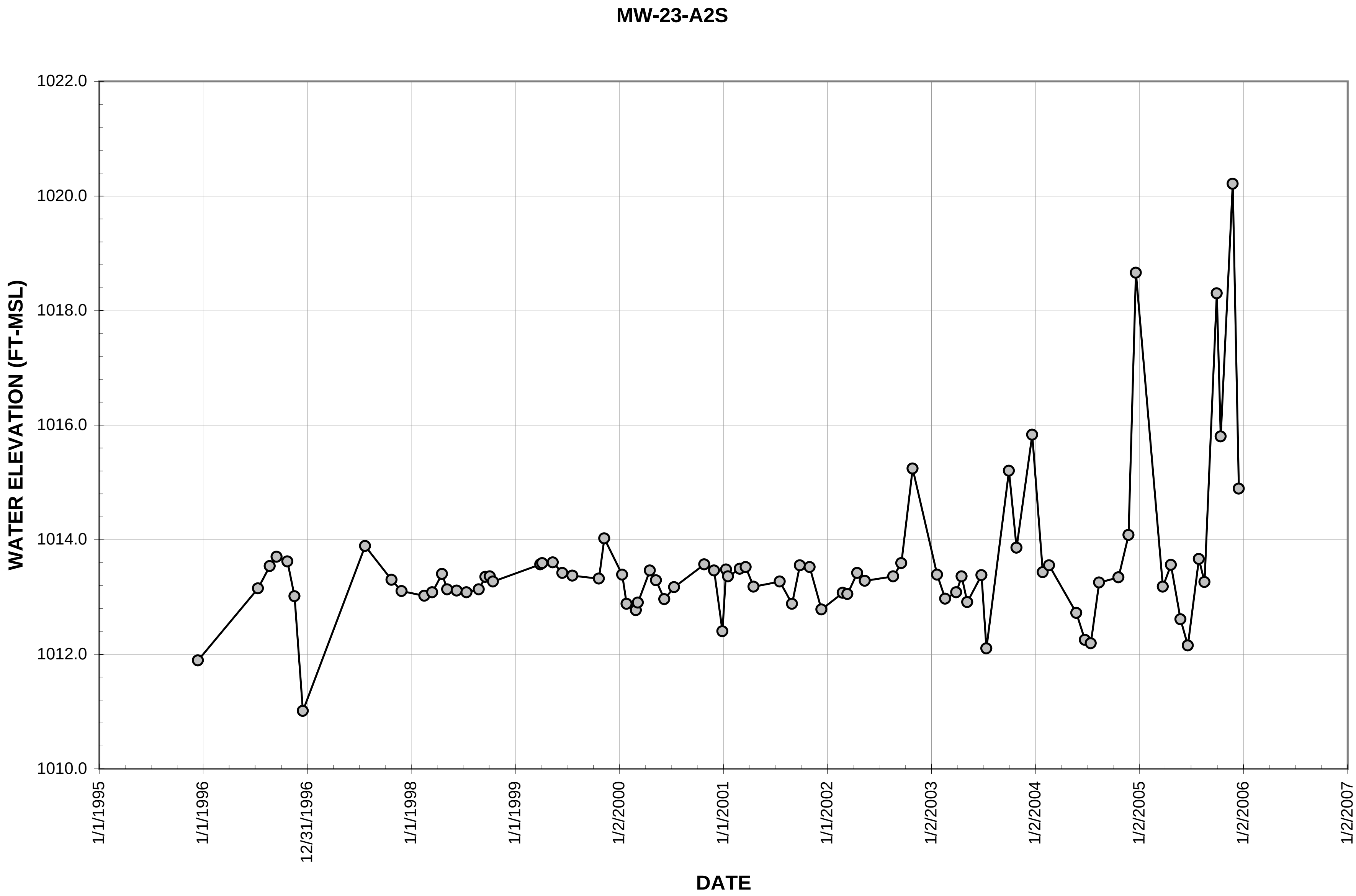


Figure 3.8 Water Level Data for Well MW-23-A4

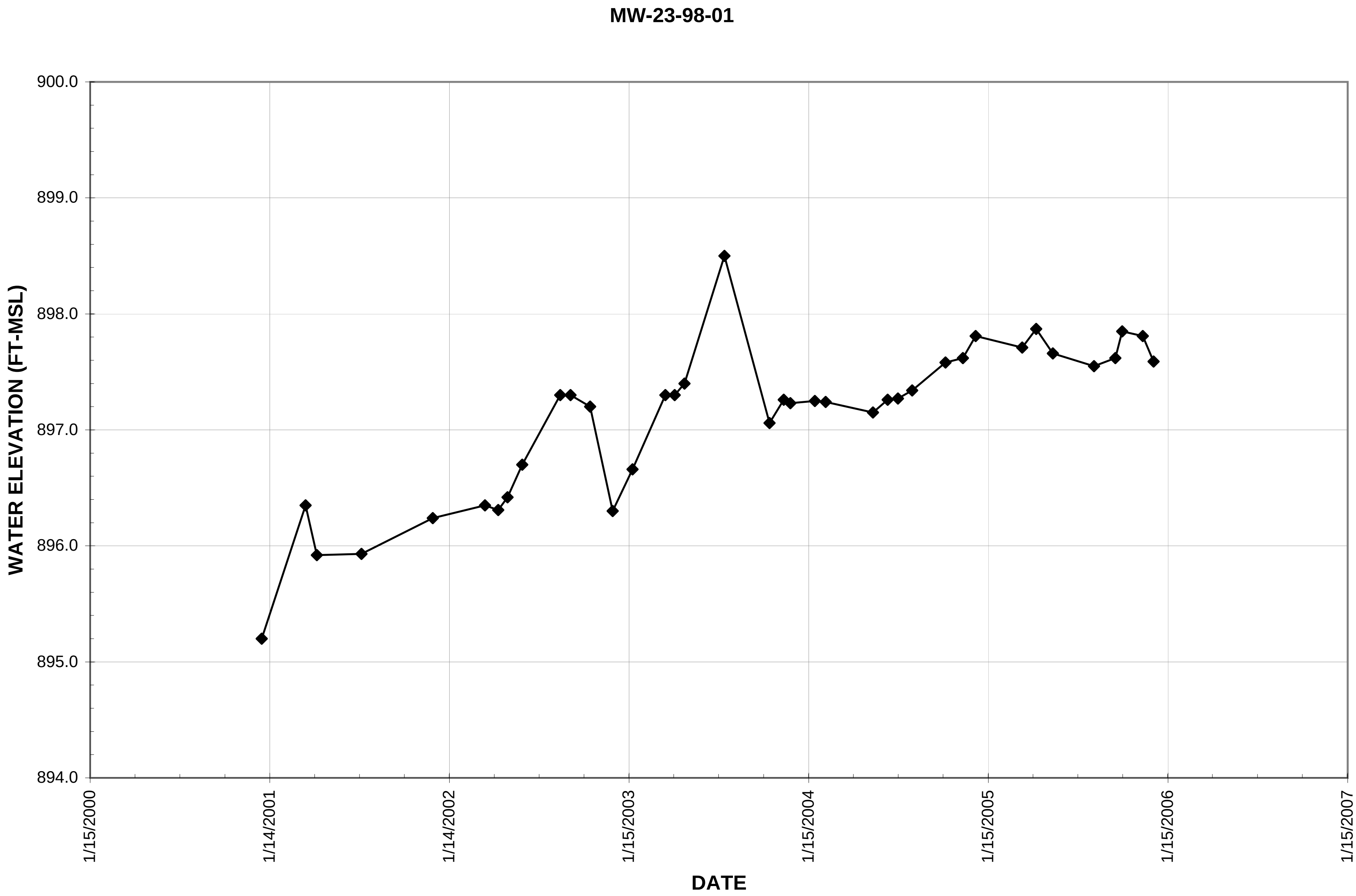


Figure 3.9 Water Level Data for Well MW-23-A4

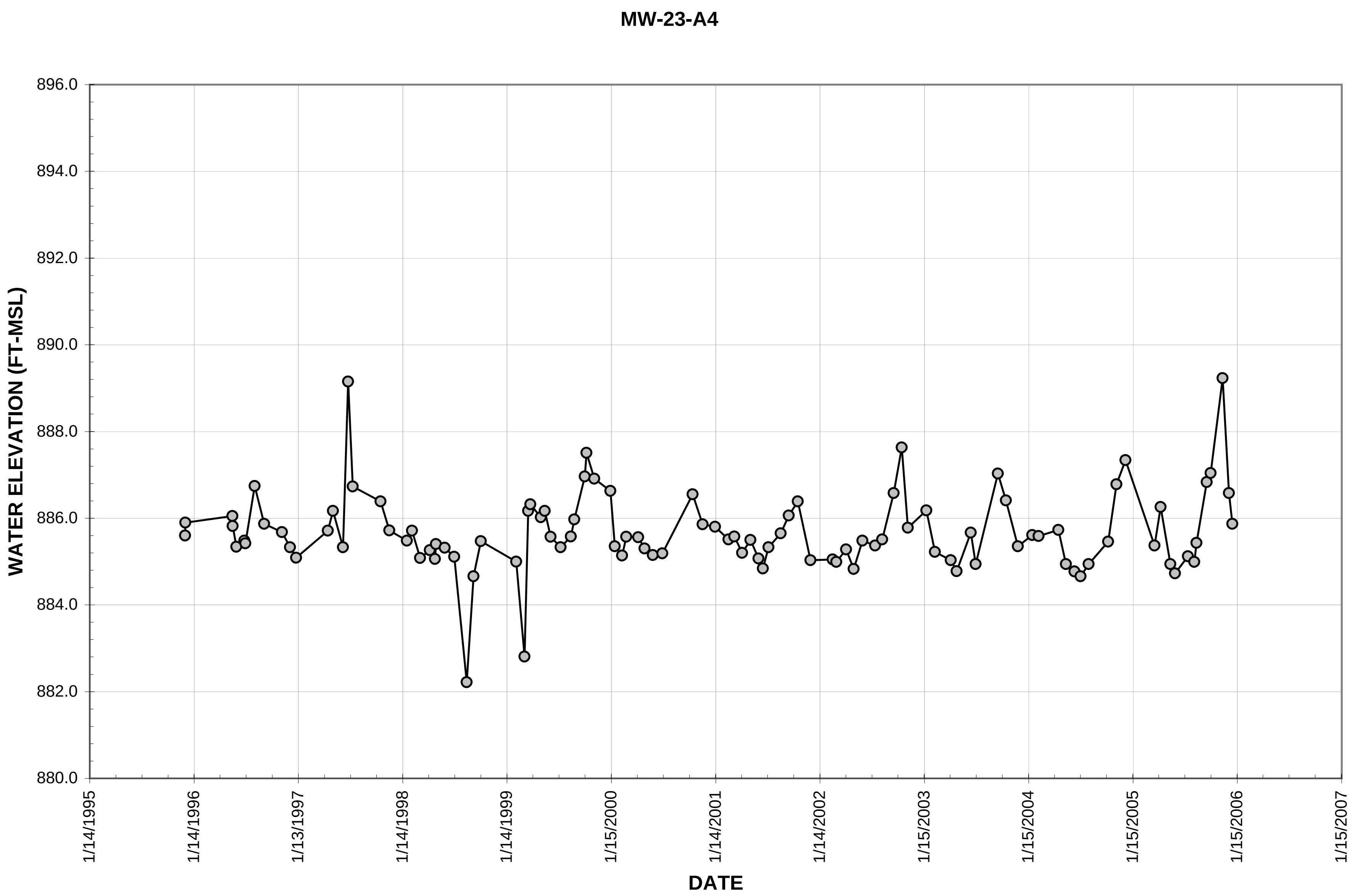


Figure 3.10 Water Level Data for Well MW-23/D-00-01

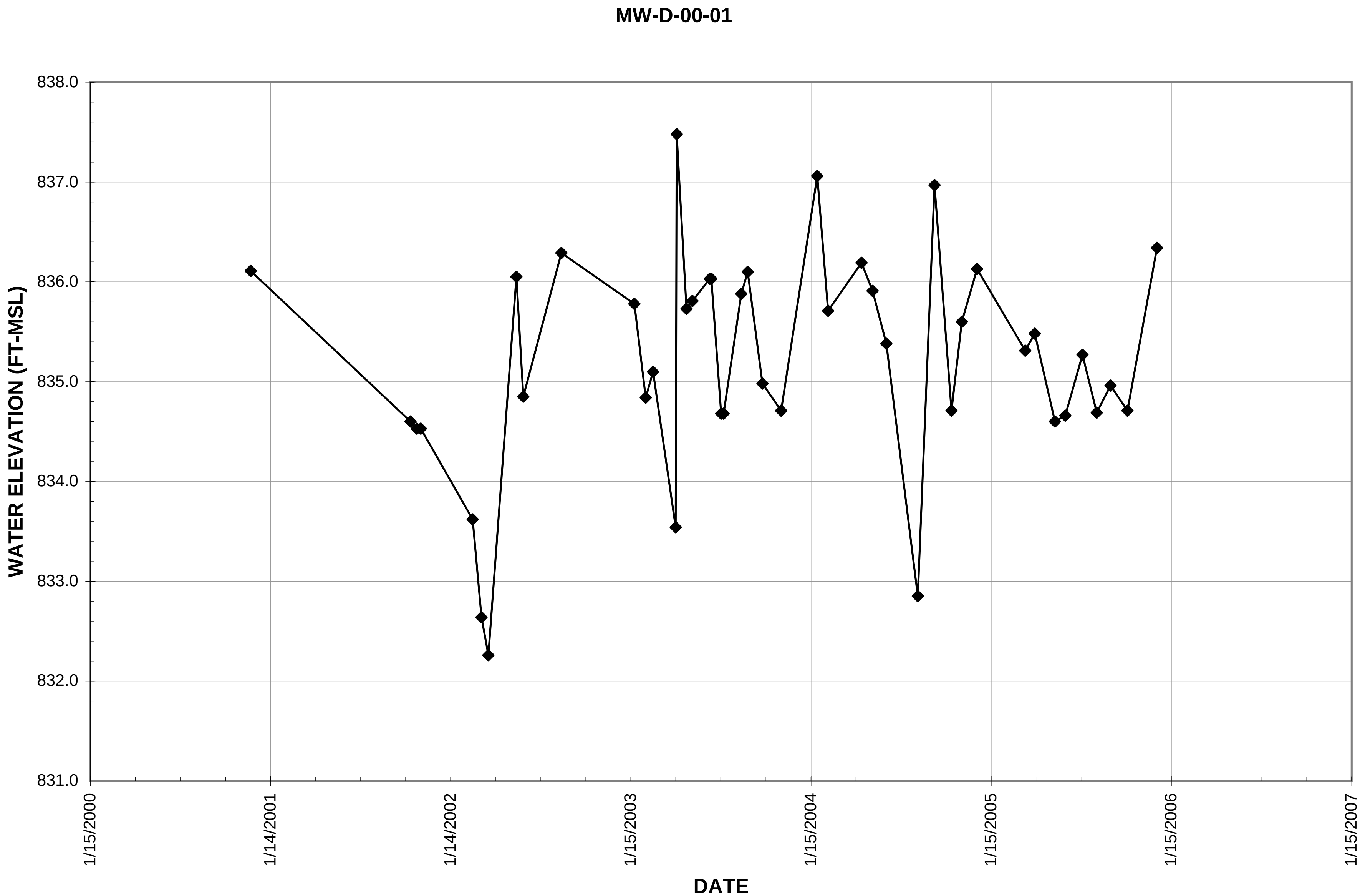


Figure 3.11 Water Level Data for Well MW-D-94-D3

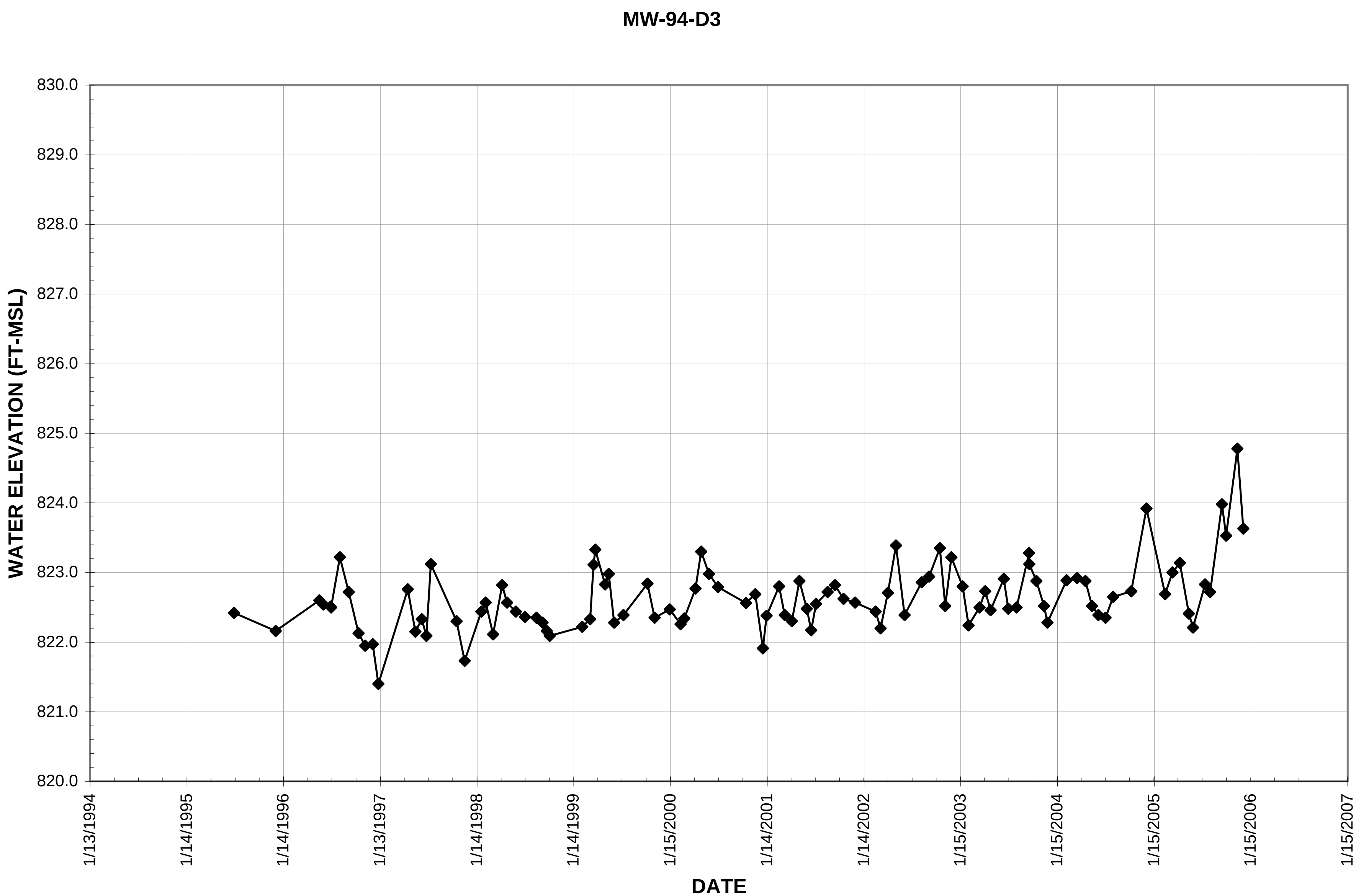


Figure 3.12 Water Level Data for Well MW-D-94-D4

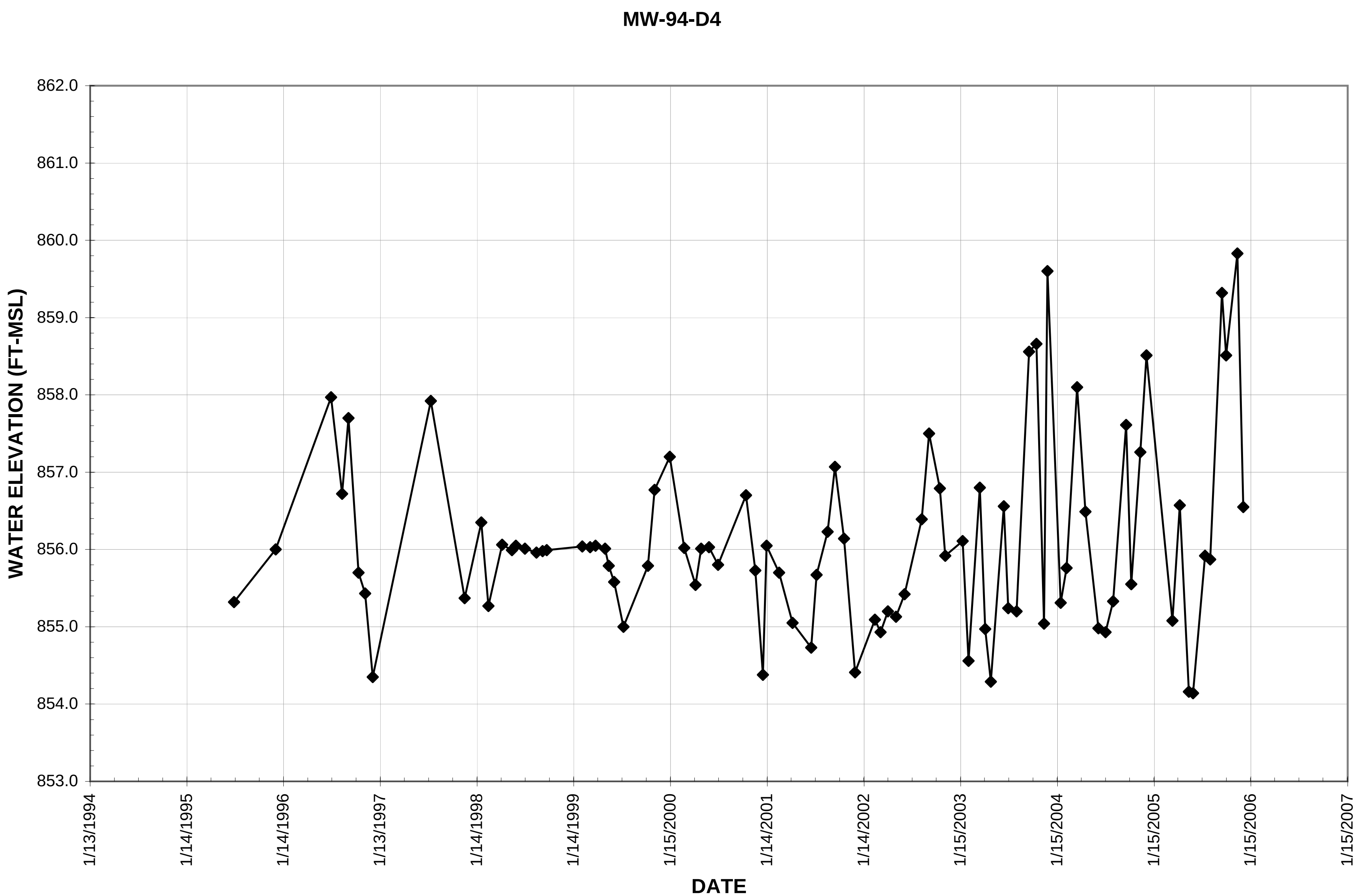


Figure 3.13 Pond D Flow Data

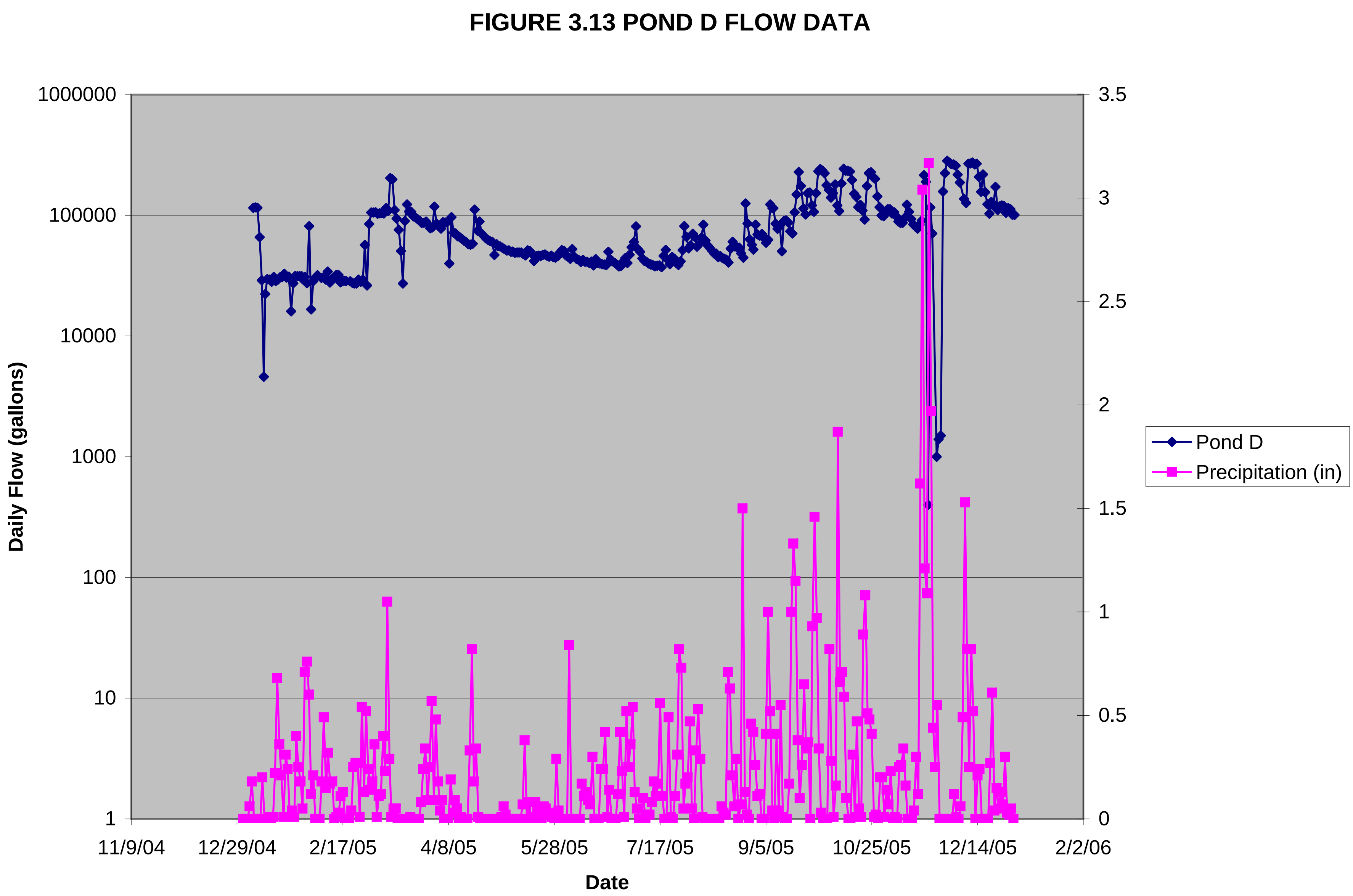


FIGURE 3.14a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - pH DATA

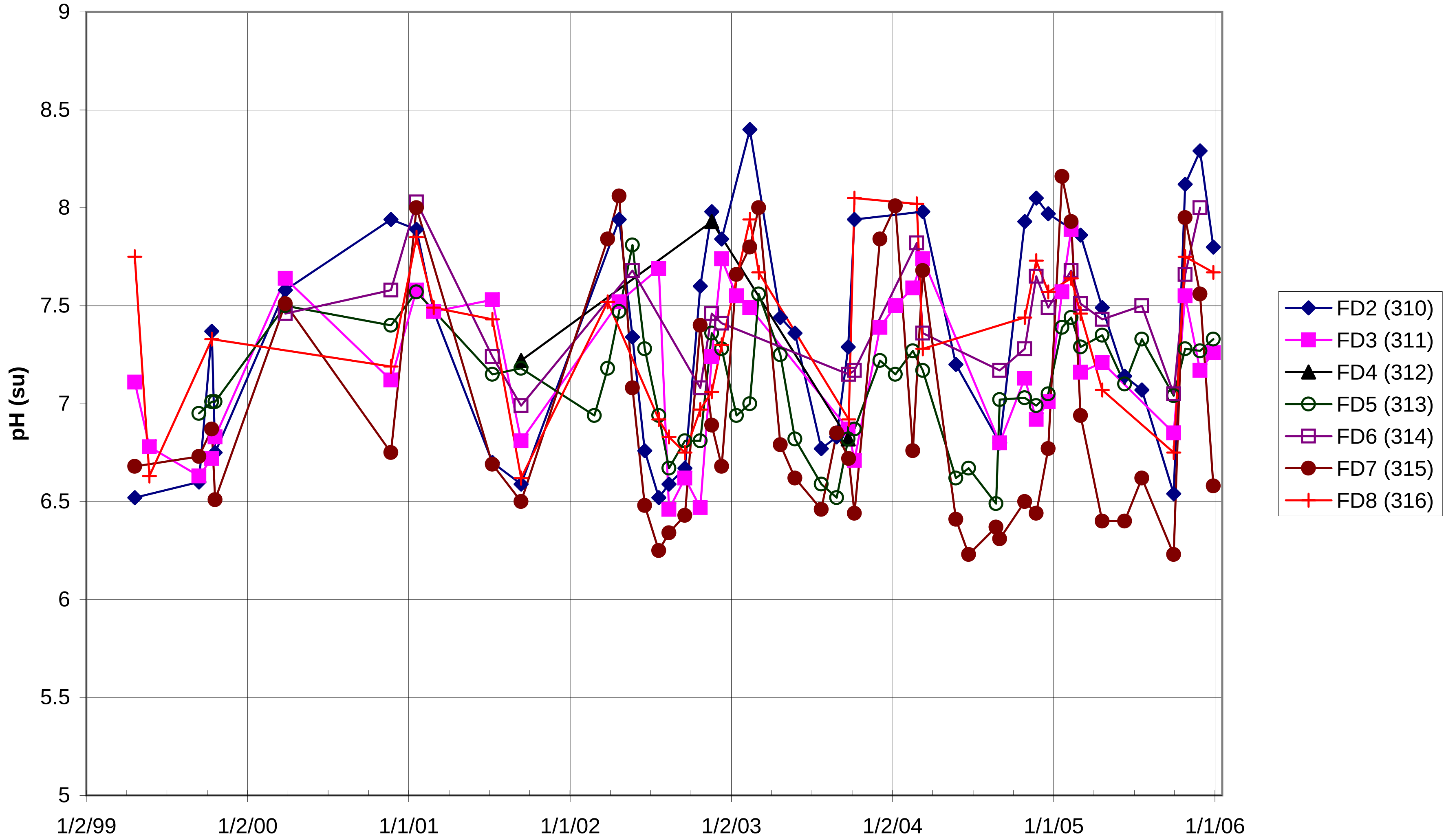


FIGURE 3.14b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - pH DATA

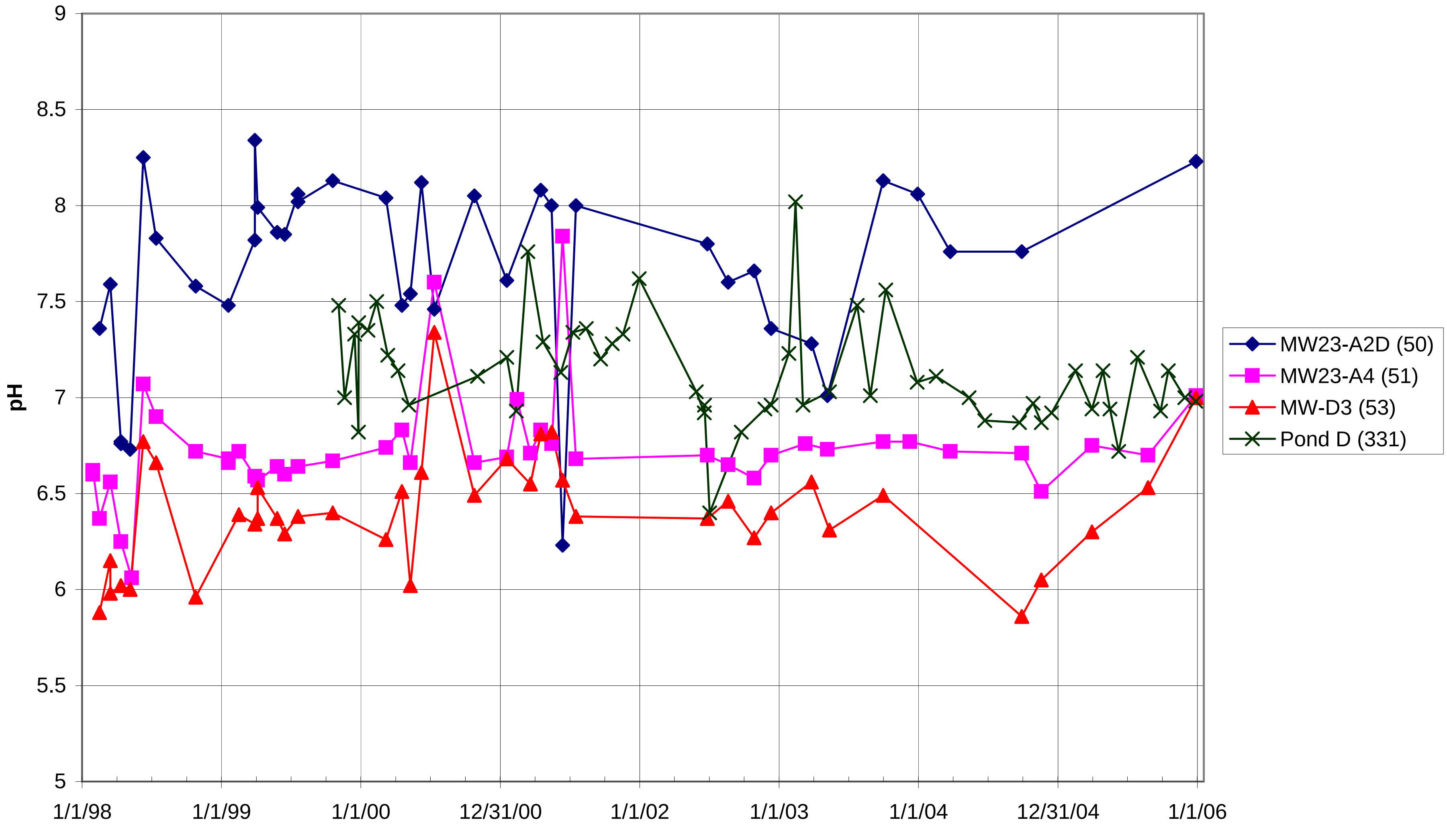


FIGURE 3.15a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES:
FINGER DRAINS - ALKALINITY DATA
(Non-detectable analyses plotted as zero)

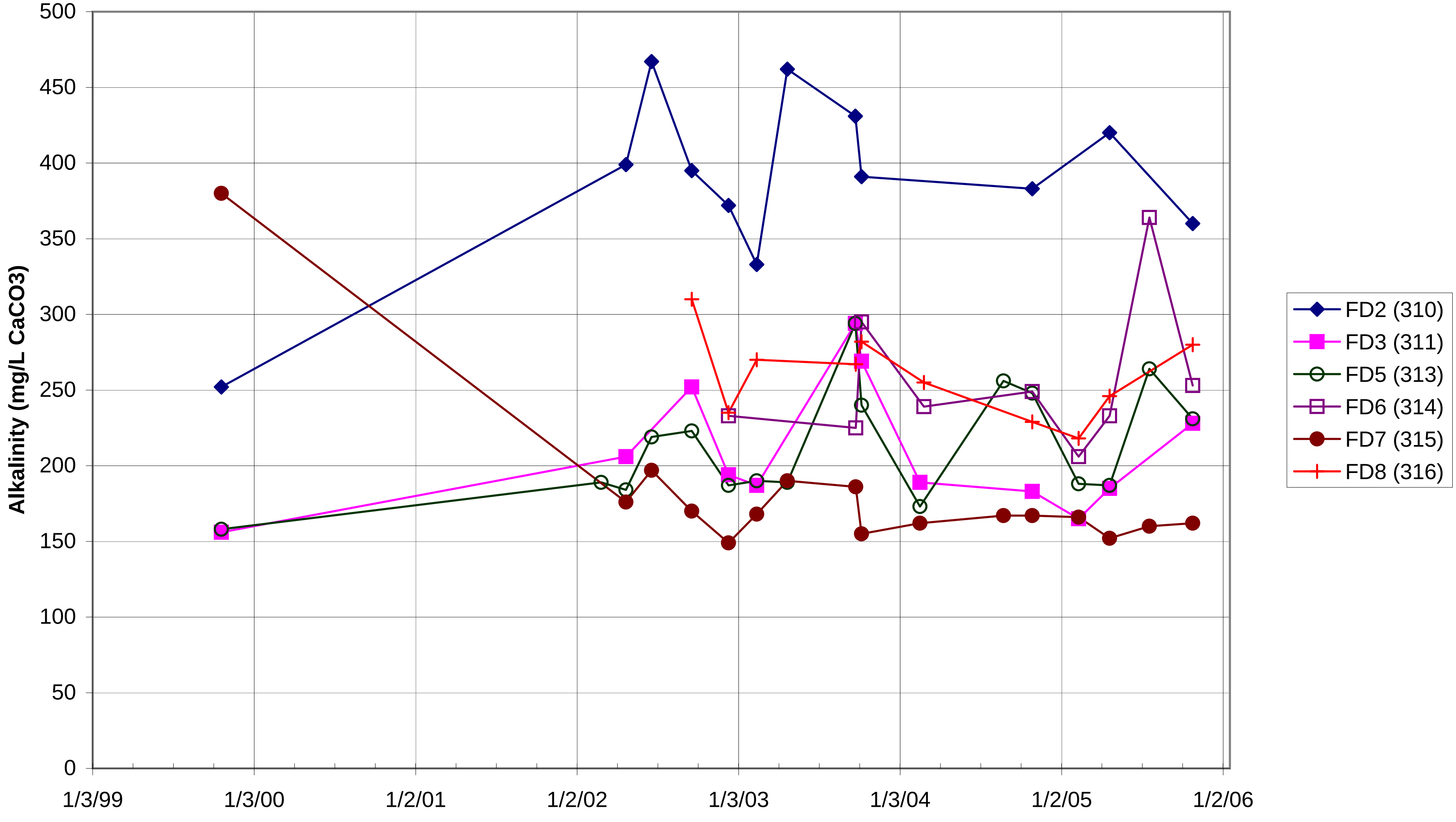


FIGURE 3.15b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - ALKALINITY DATA (Non-detectable analyses plotted as zero)

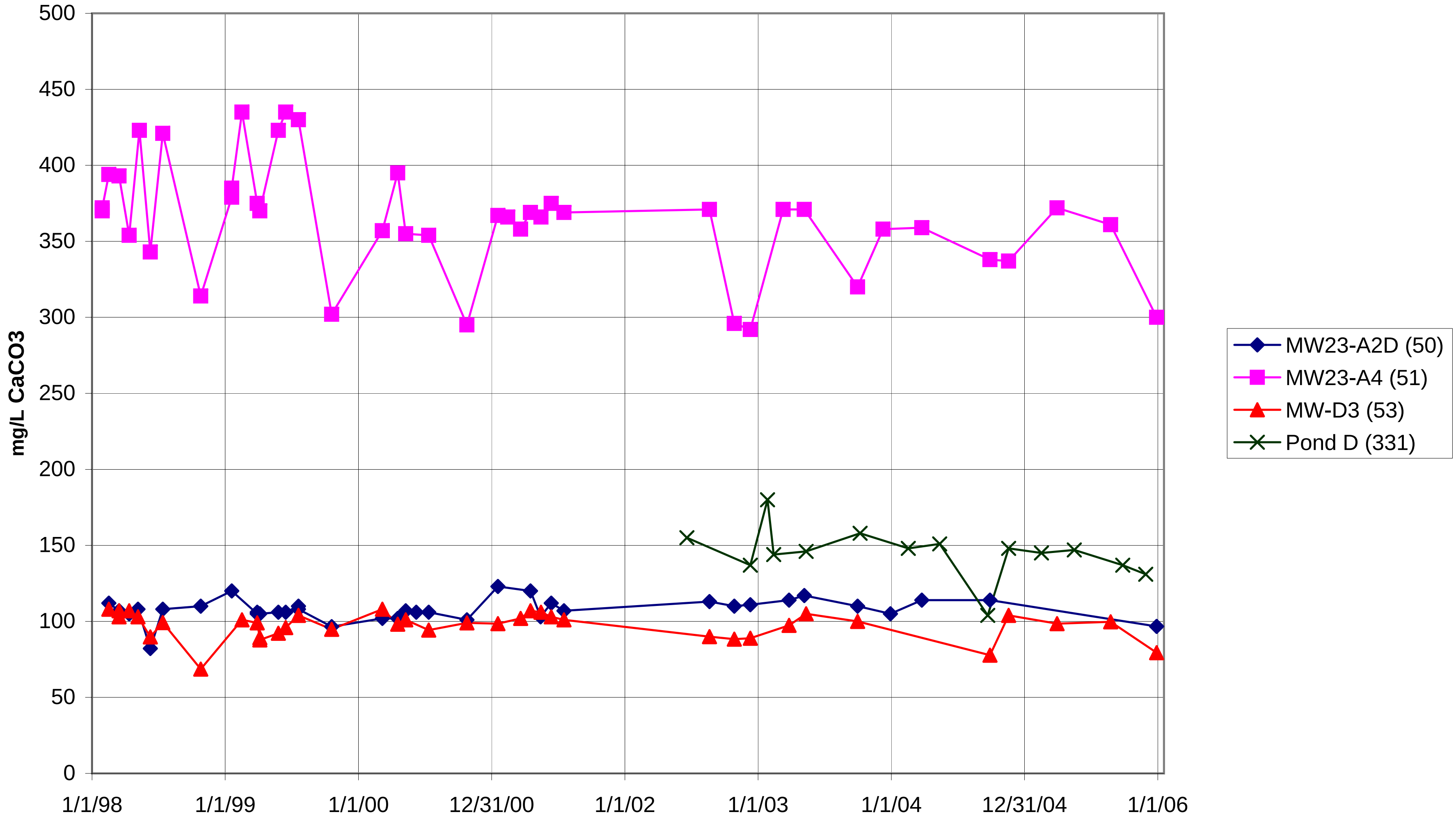


FIGURE 3.16a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES:
FINGER DRAINS - HARDNESS DATA
(Non-detectable analyses plotted as zero)

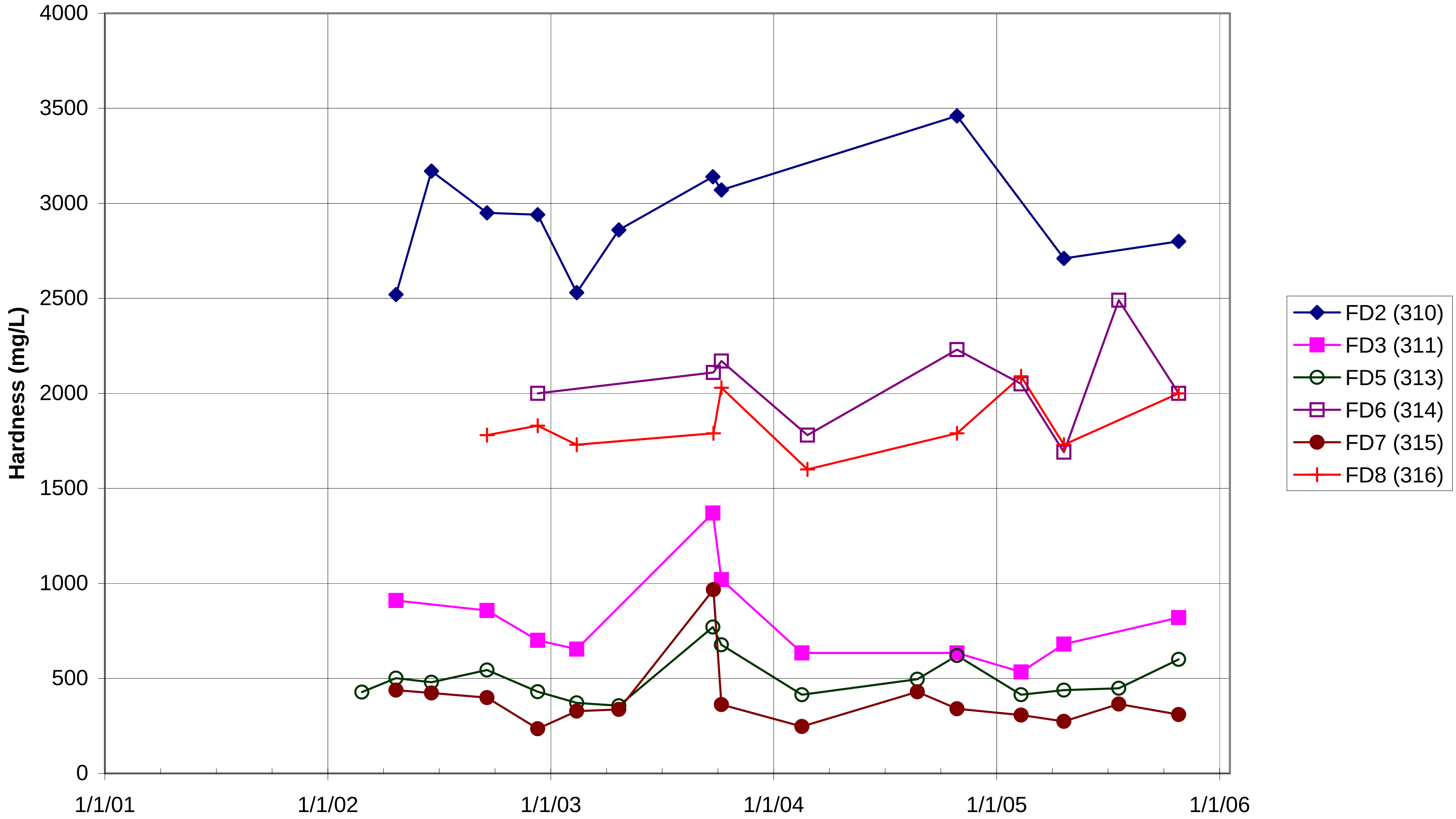


FIGURE 3.16b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - HARDNESS DATA
(Non-detectable analyses plotted as zero)

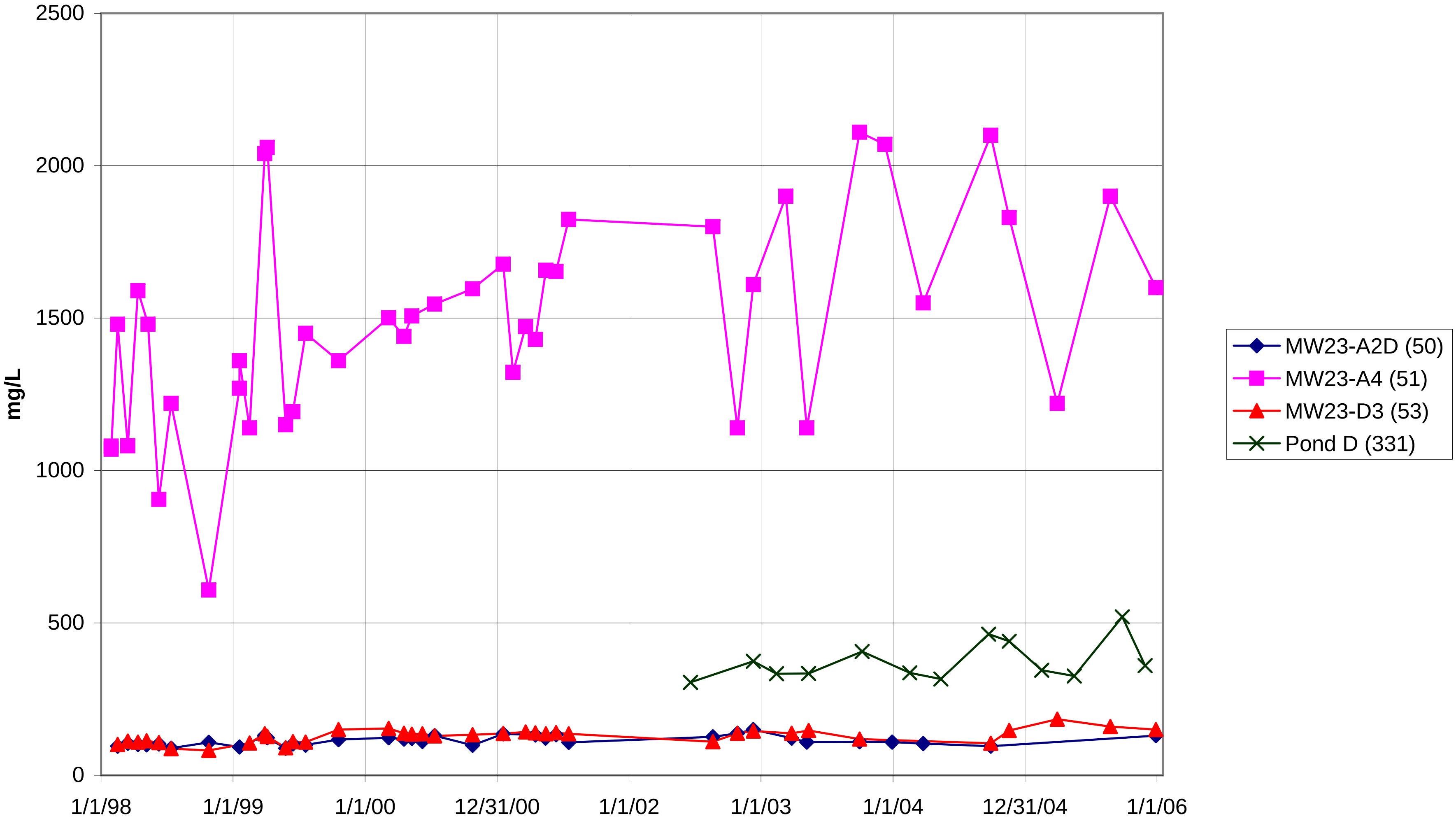


FIGURE 3.17a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - CONDUCTIVITY DATA

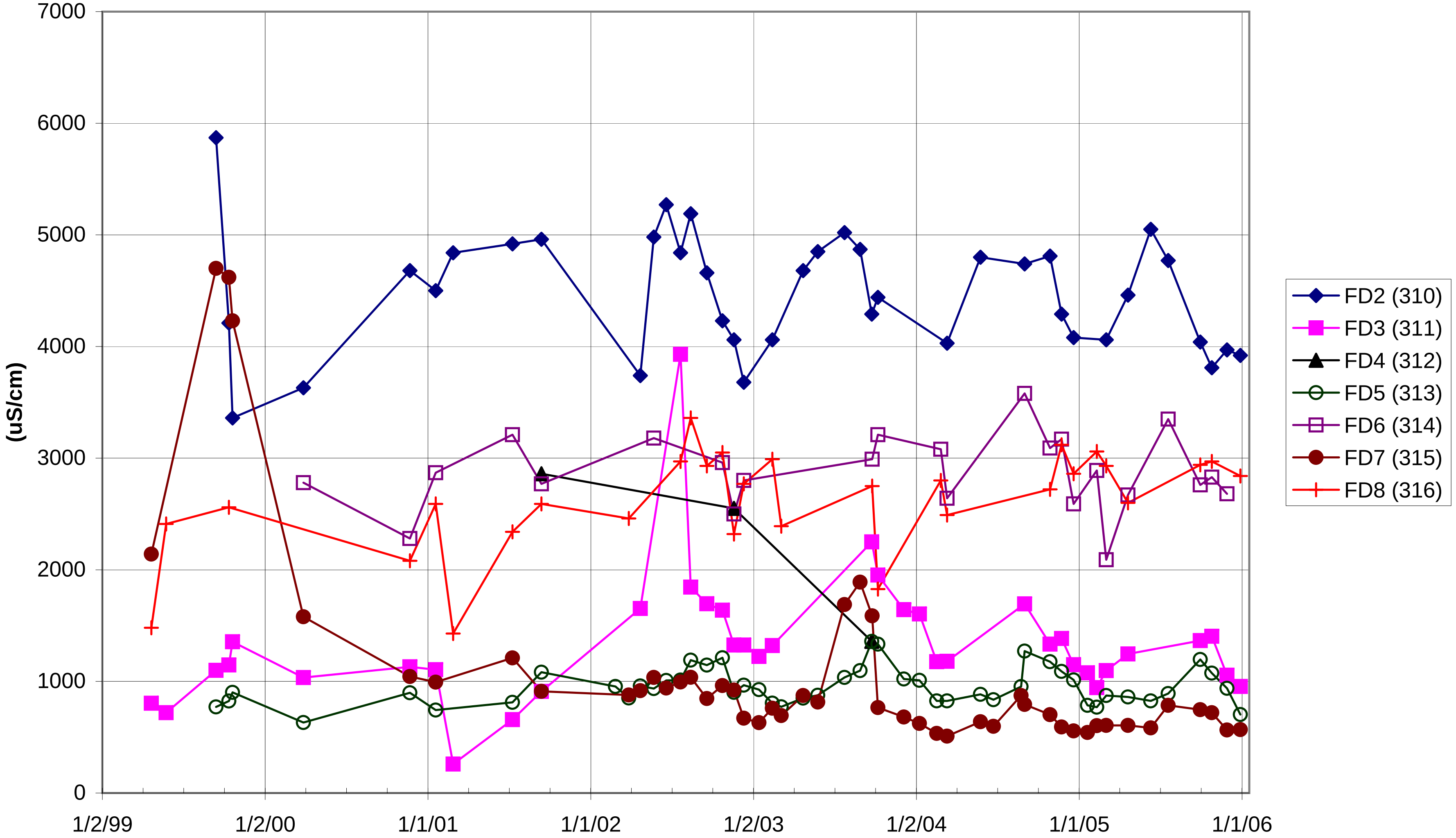


FIGURE 3.17b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - CONDUCTIVITY DATA

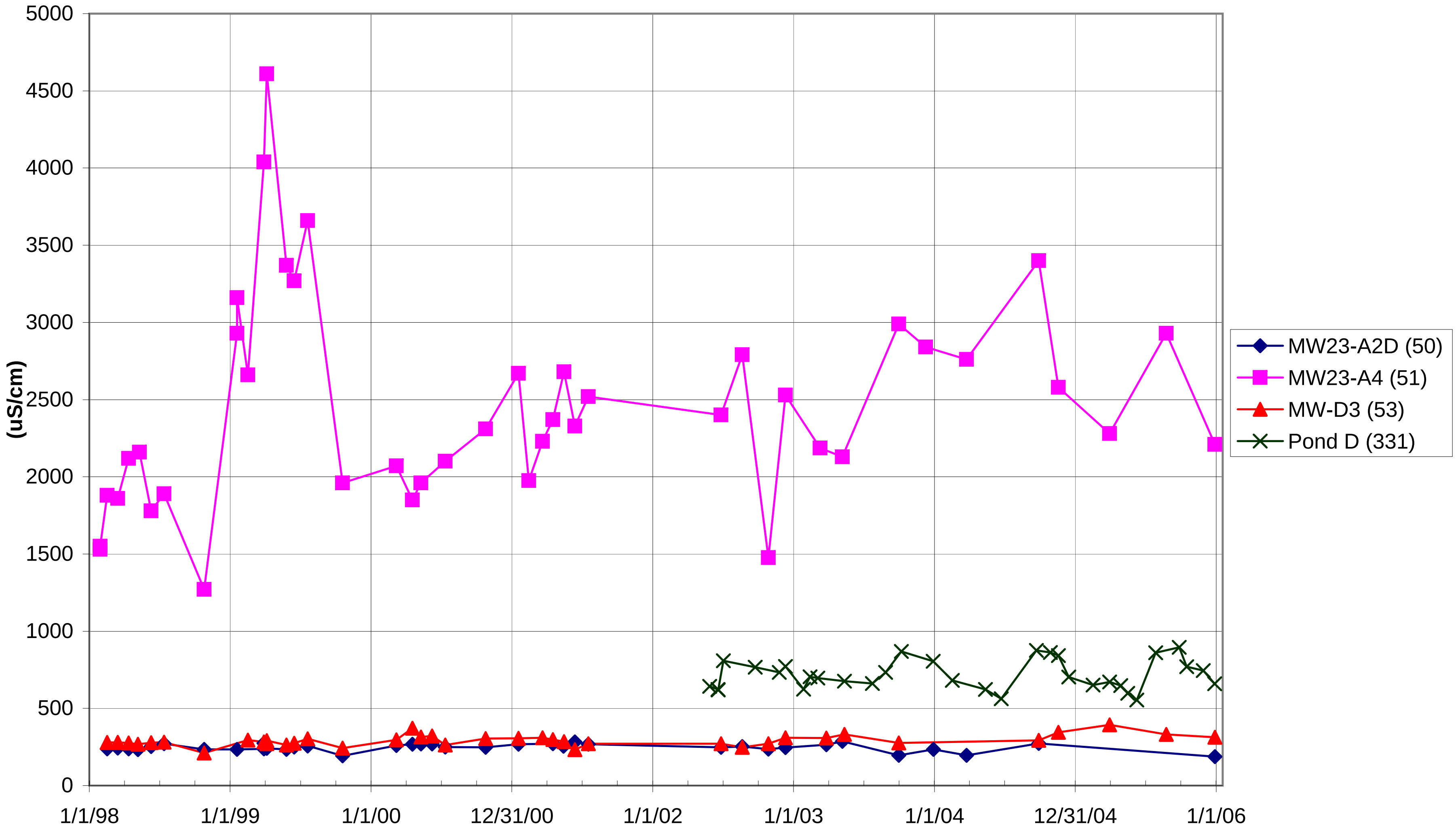


FIGURE 3.18a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - SULFATE DATA
(Non-detectable analyses plotted as zero)

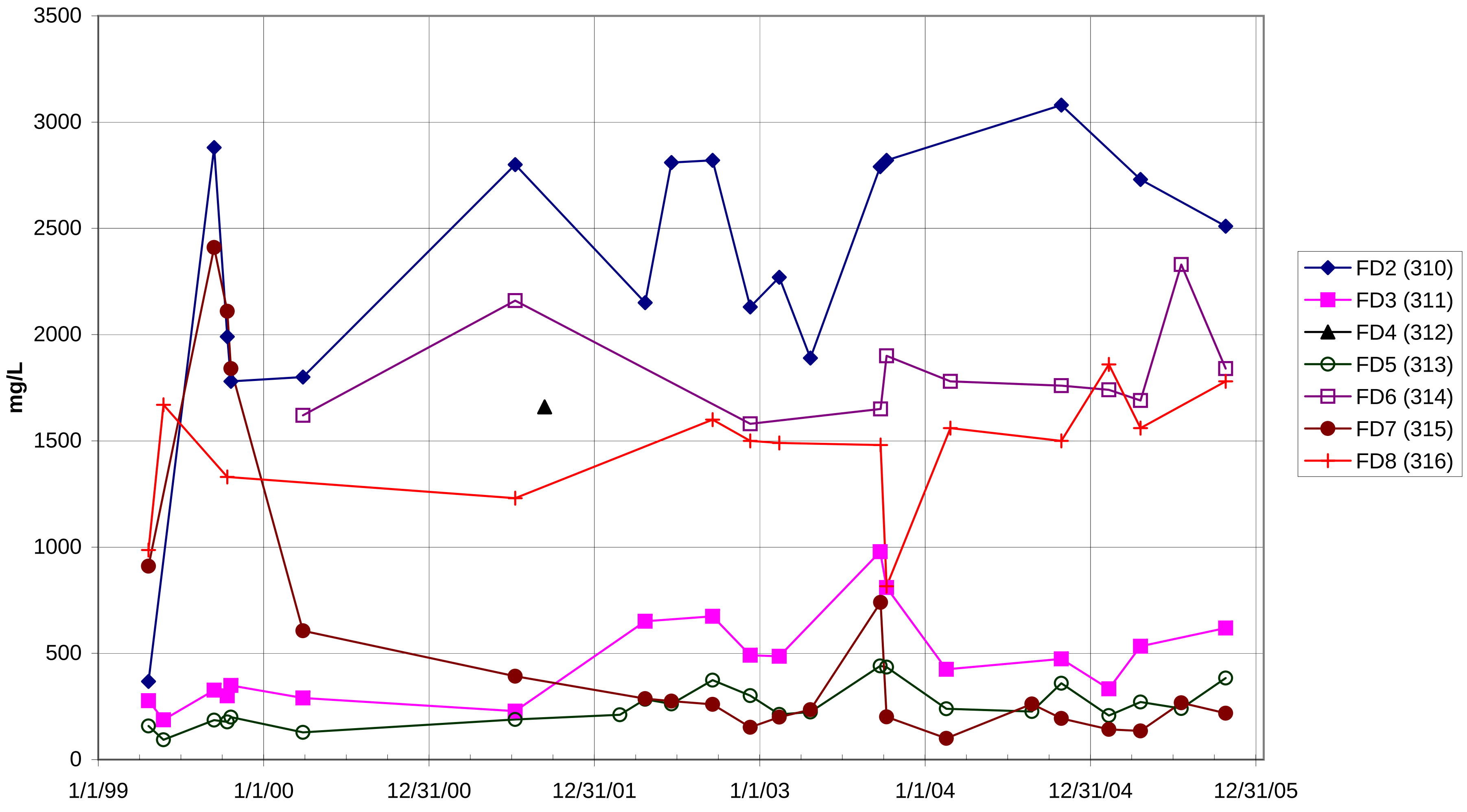


FIGURE 3.18b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - SULFATE
(Non-detectable analyses plotted as zero)

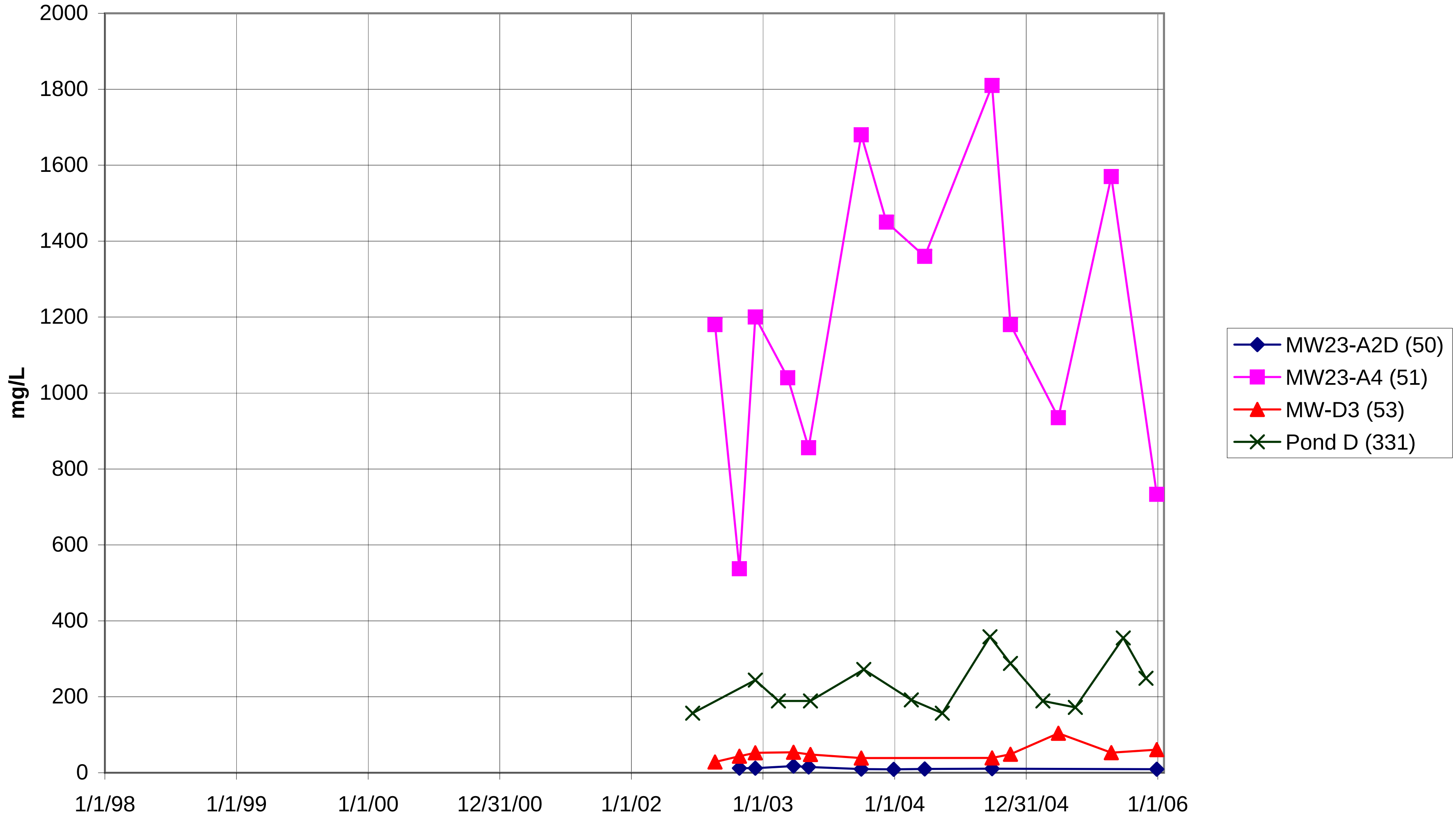


FIGURE 3.19a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - ARSENIC DATA
(Non-detectable analyses plotted as zero)

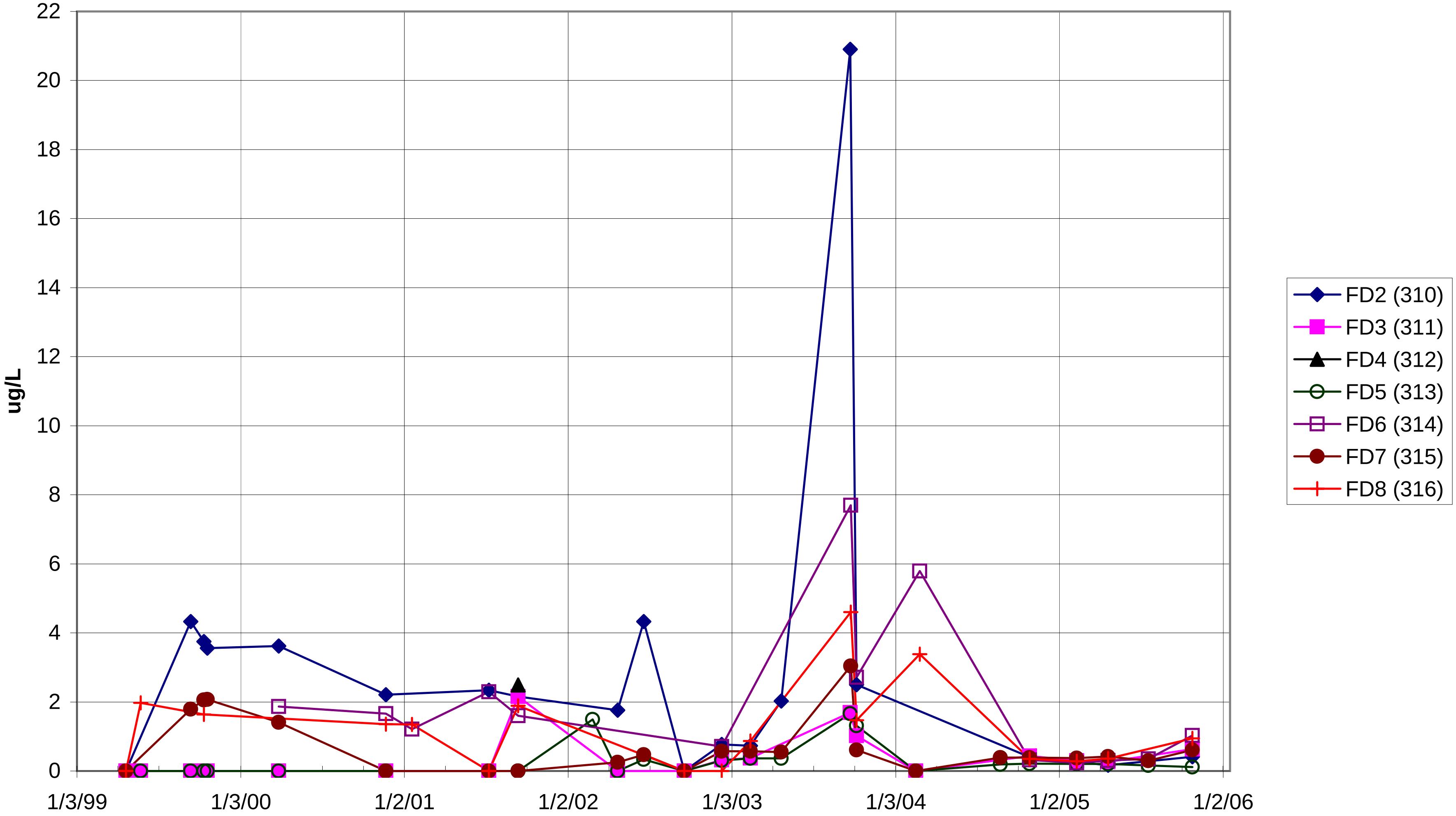


FIGURE 3.19b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - ARSENIC DATA (Non-detectable analyses plotted as zero)

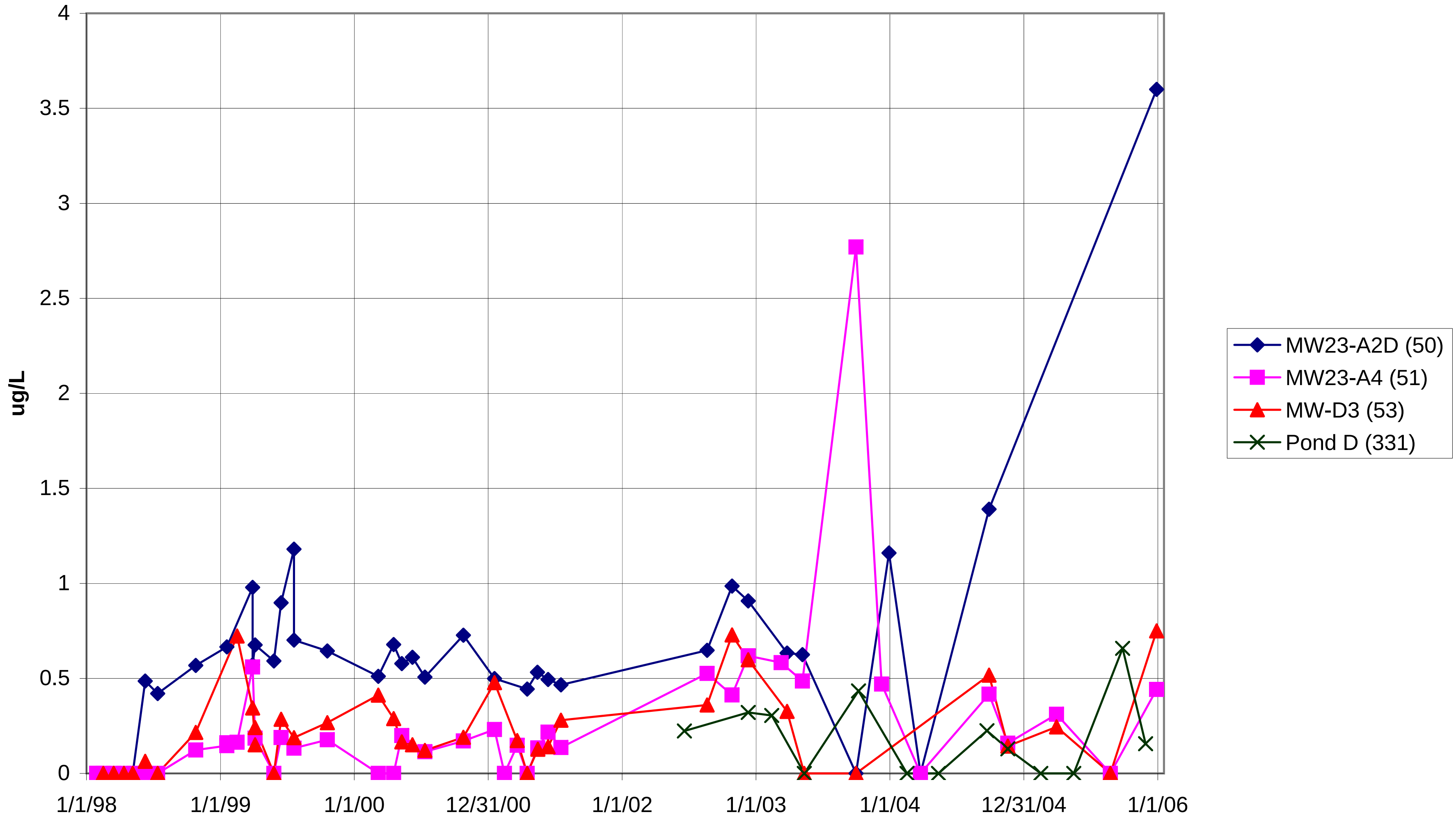


FIGURE 3.20a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - ZINC DATA (Non-detectable analyses plotted as zero)

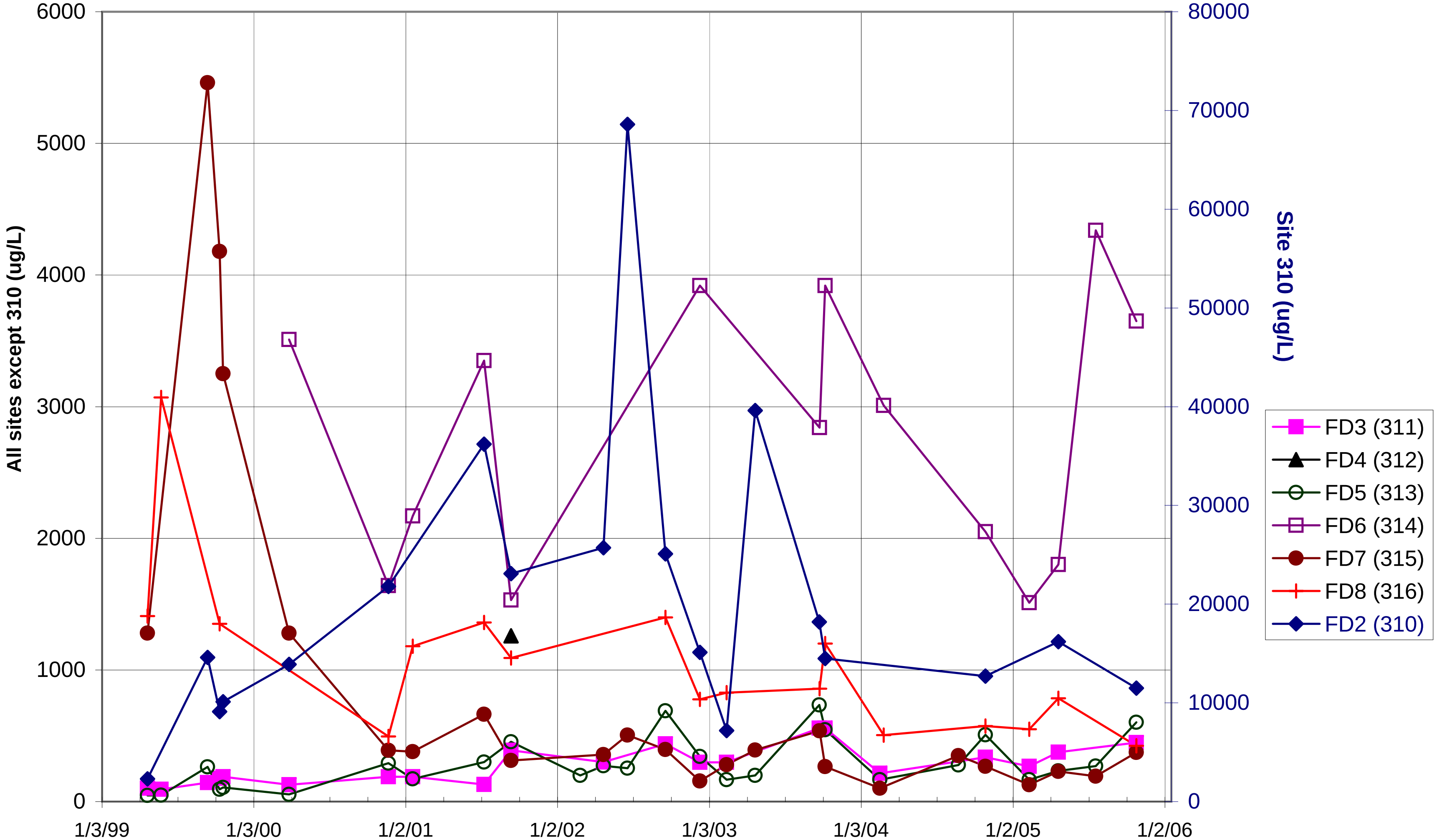


FIGURE 3.20b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES:
GROUND WATER - ZINC DATA
(Non-detectable analyses plotted as zero)

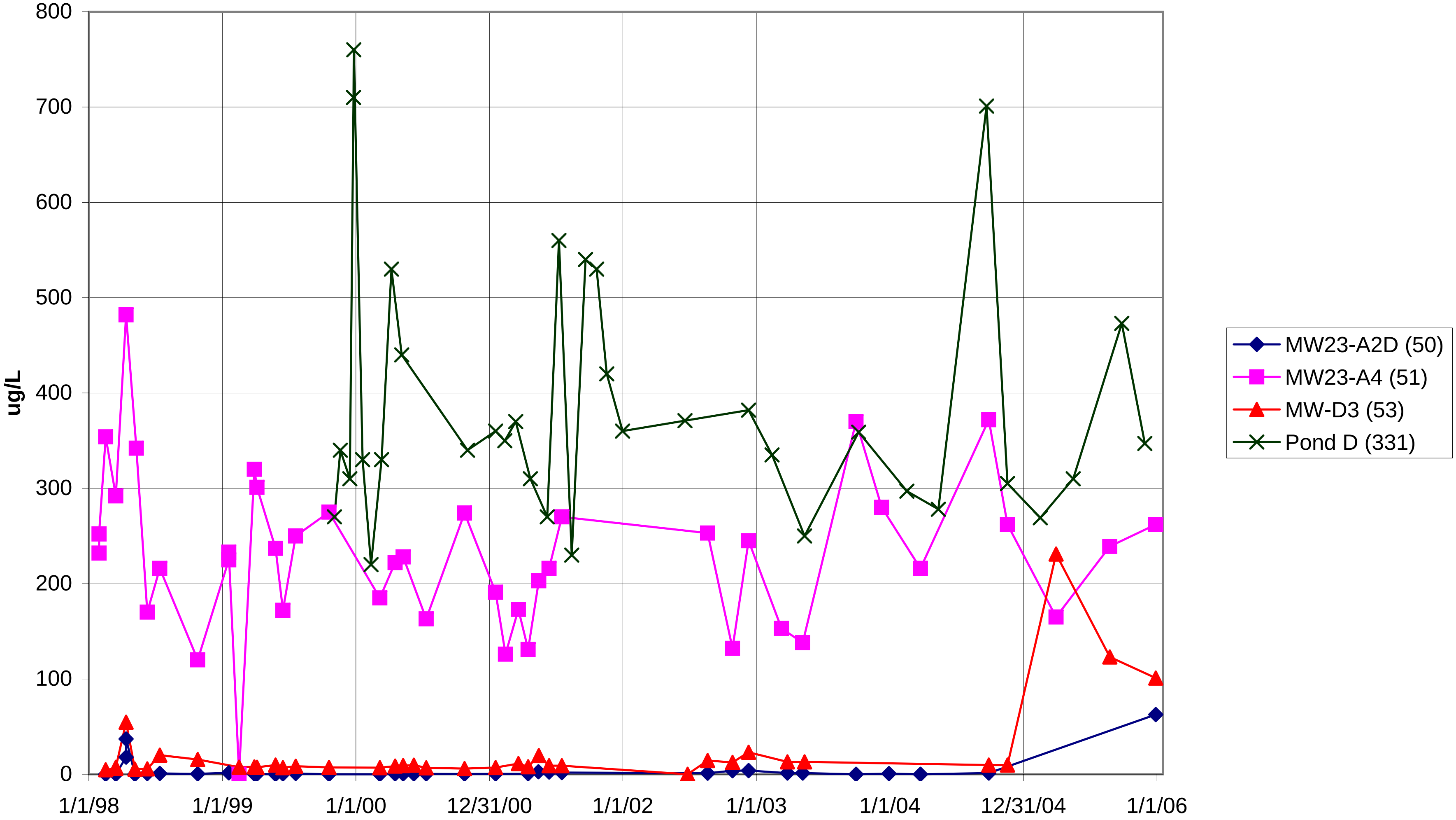


FIGURE 3.21a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES:
FINGER DRAINS - CADMIUM DATA
(Non-detectable analyses plotted as zero)

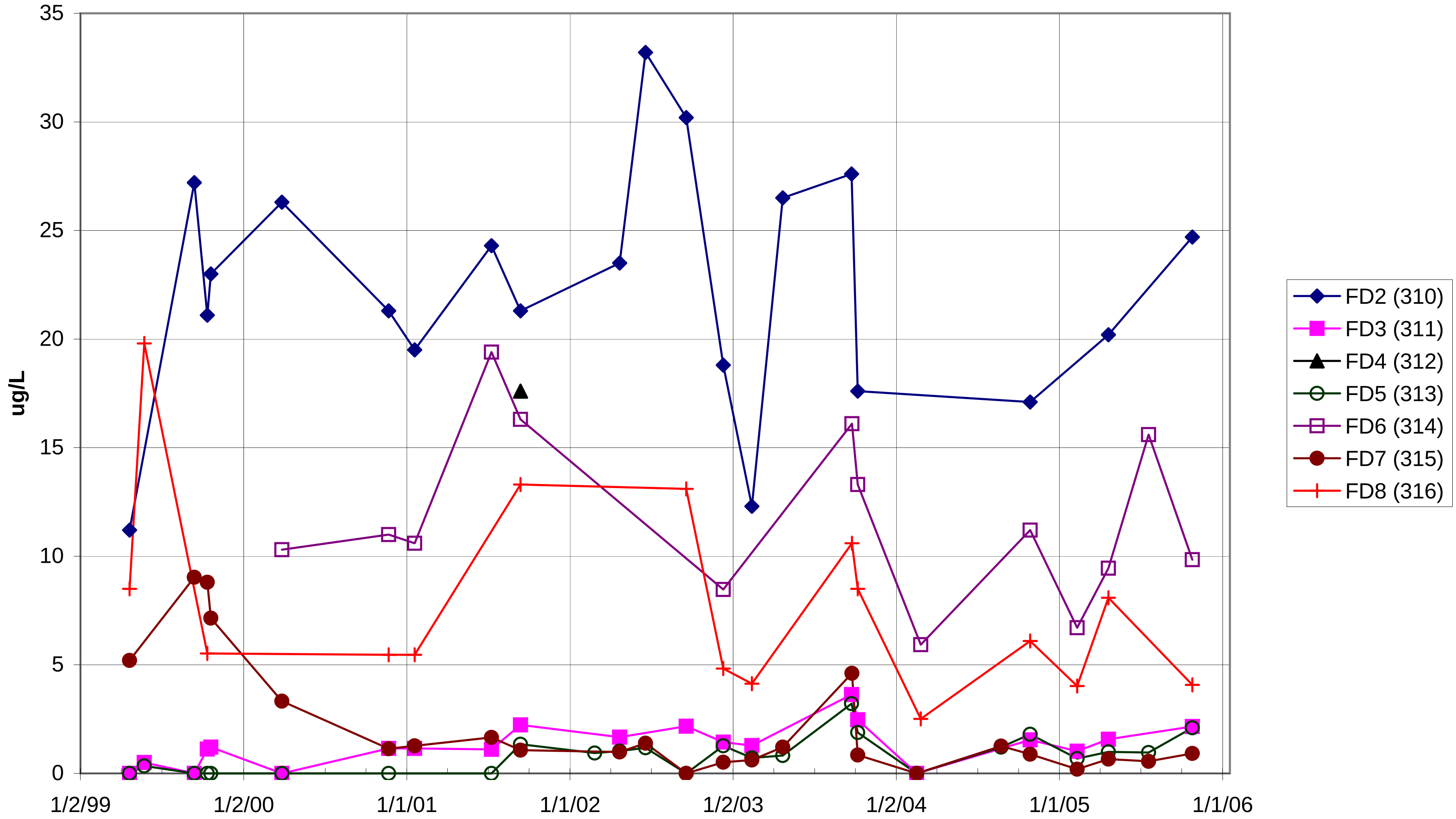


FIGURE 3.21b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - CADMIUM DATA (Non-detectable analyses plotted as zero)

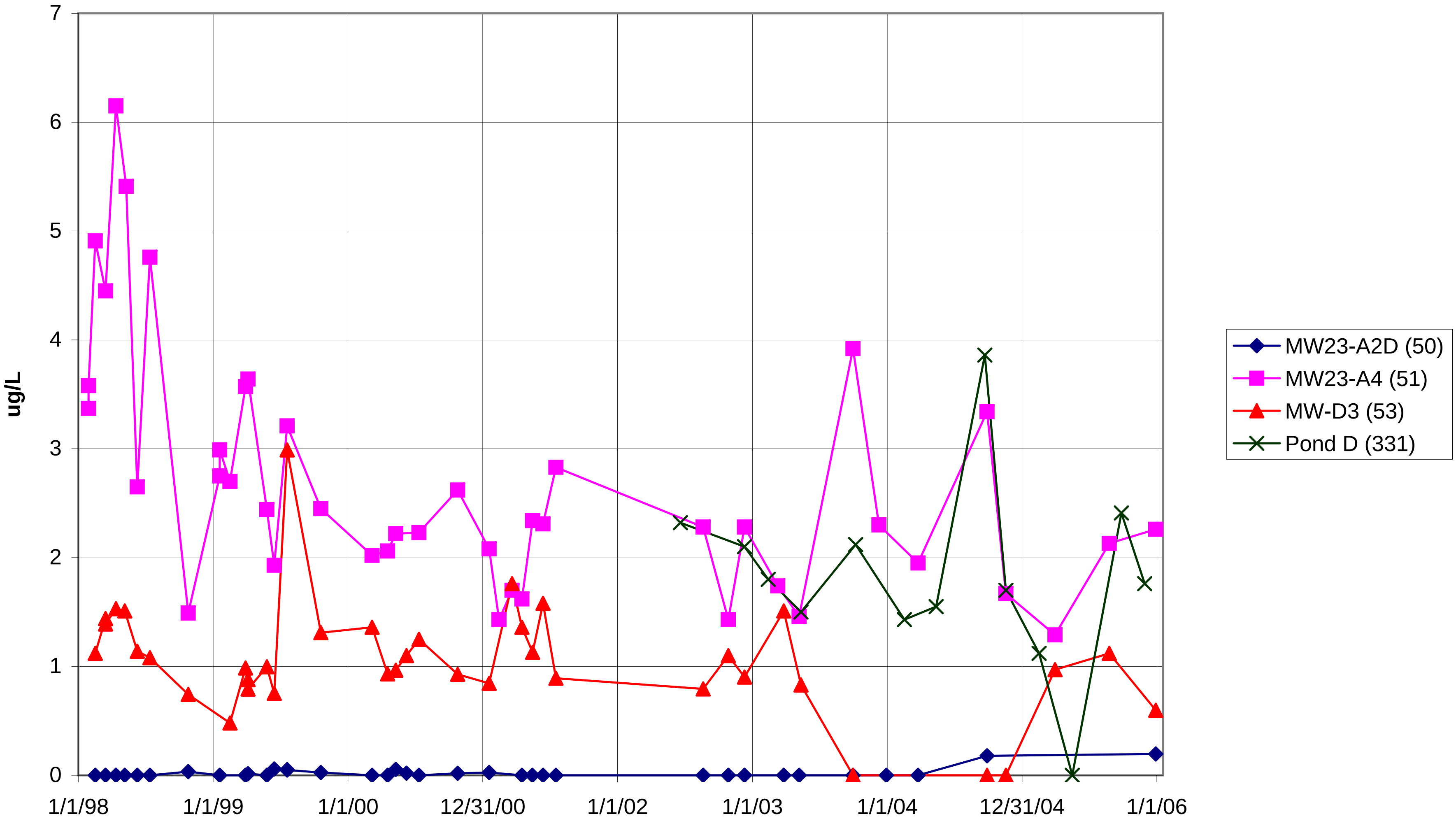


FIGURE 3.22a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - COPPER DATA (Non-detectable analyses plotted as zero)

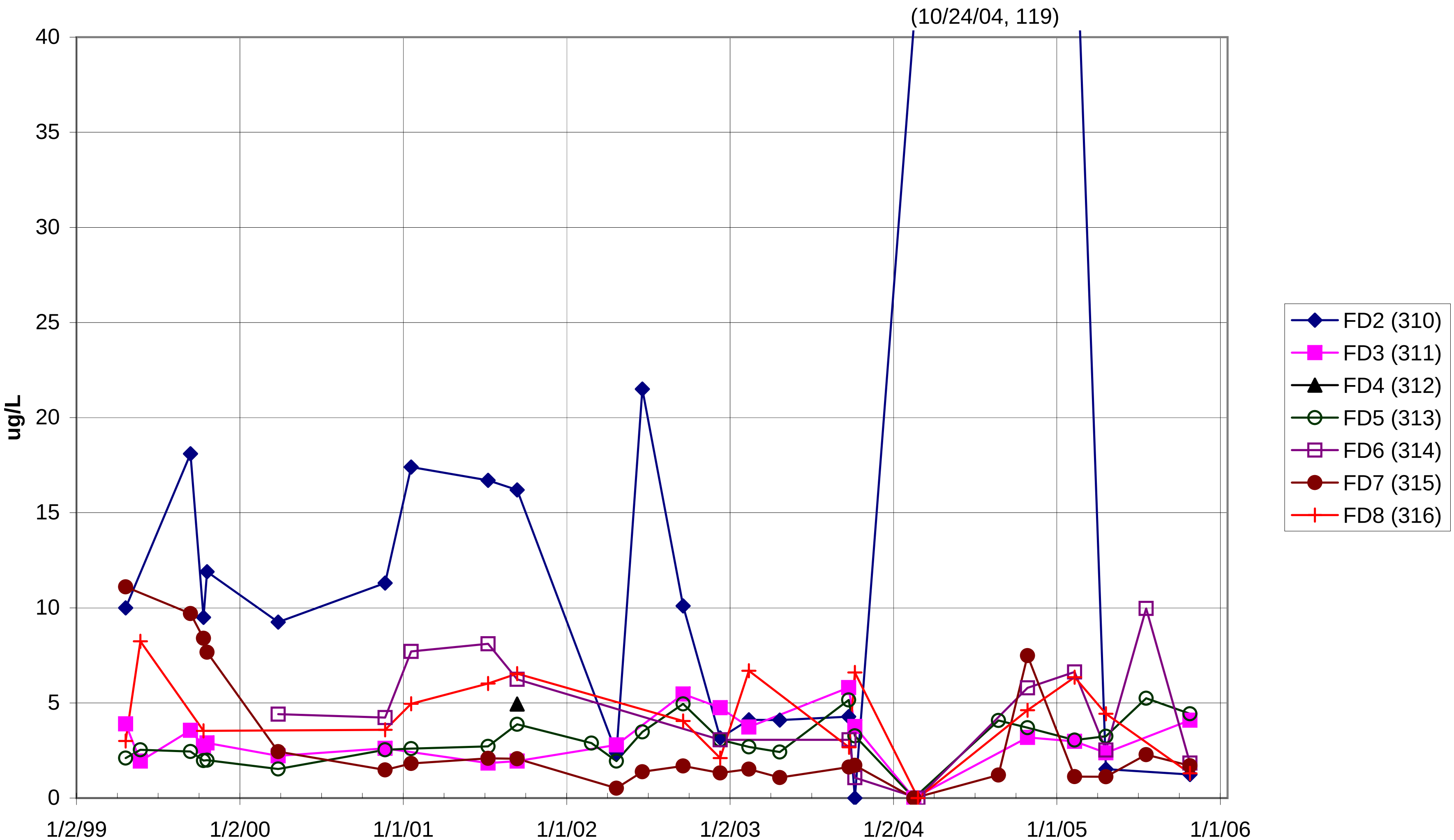


FIGURE 3.22b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - COPPER DATA (Non-detectable analyses plotted as zero)

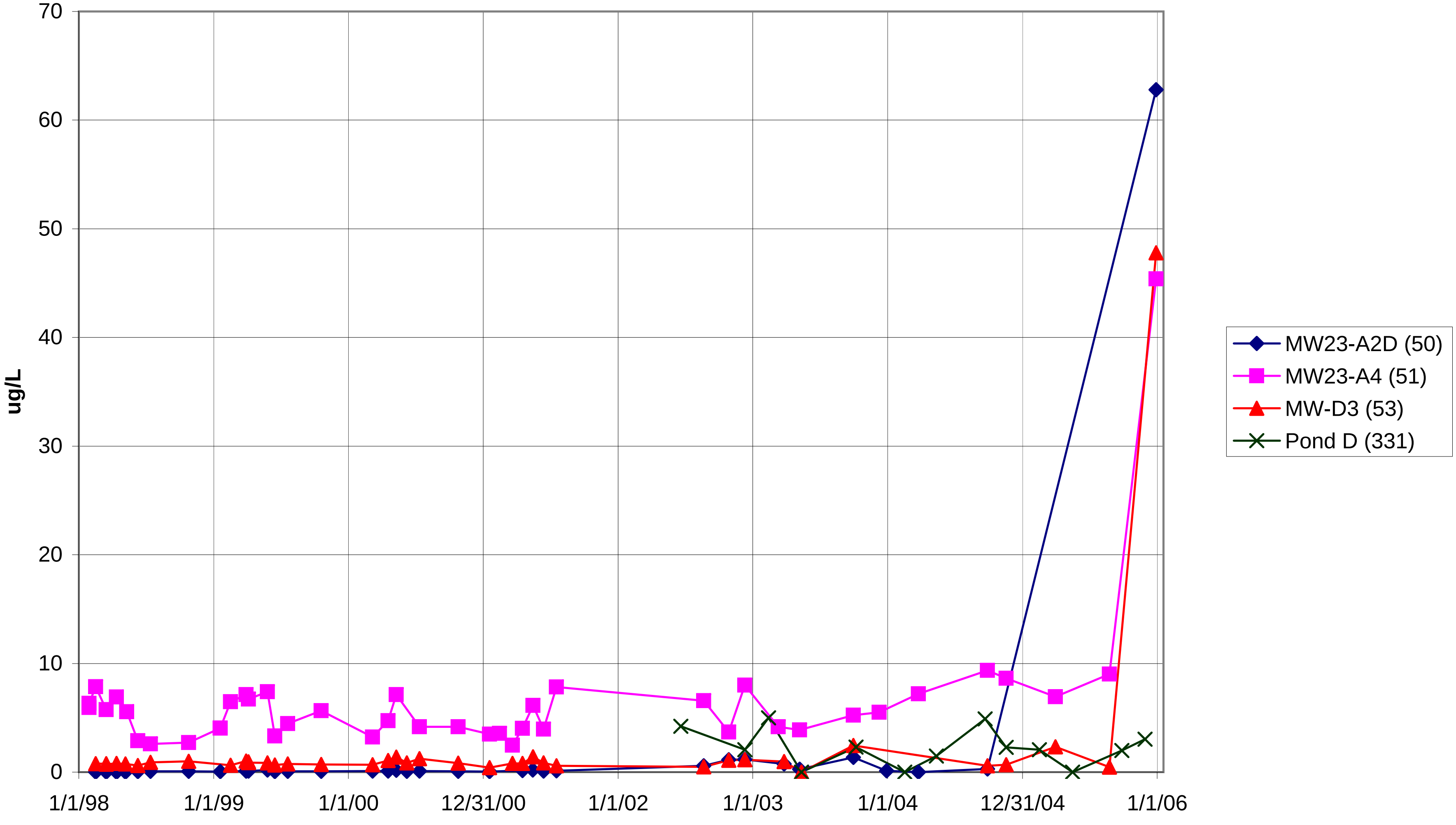


FIGURE 3.23a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES:
FINGER DRAINS - LEAD DATA
(Non-detectable analyses plotted as zero)

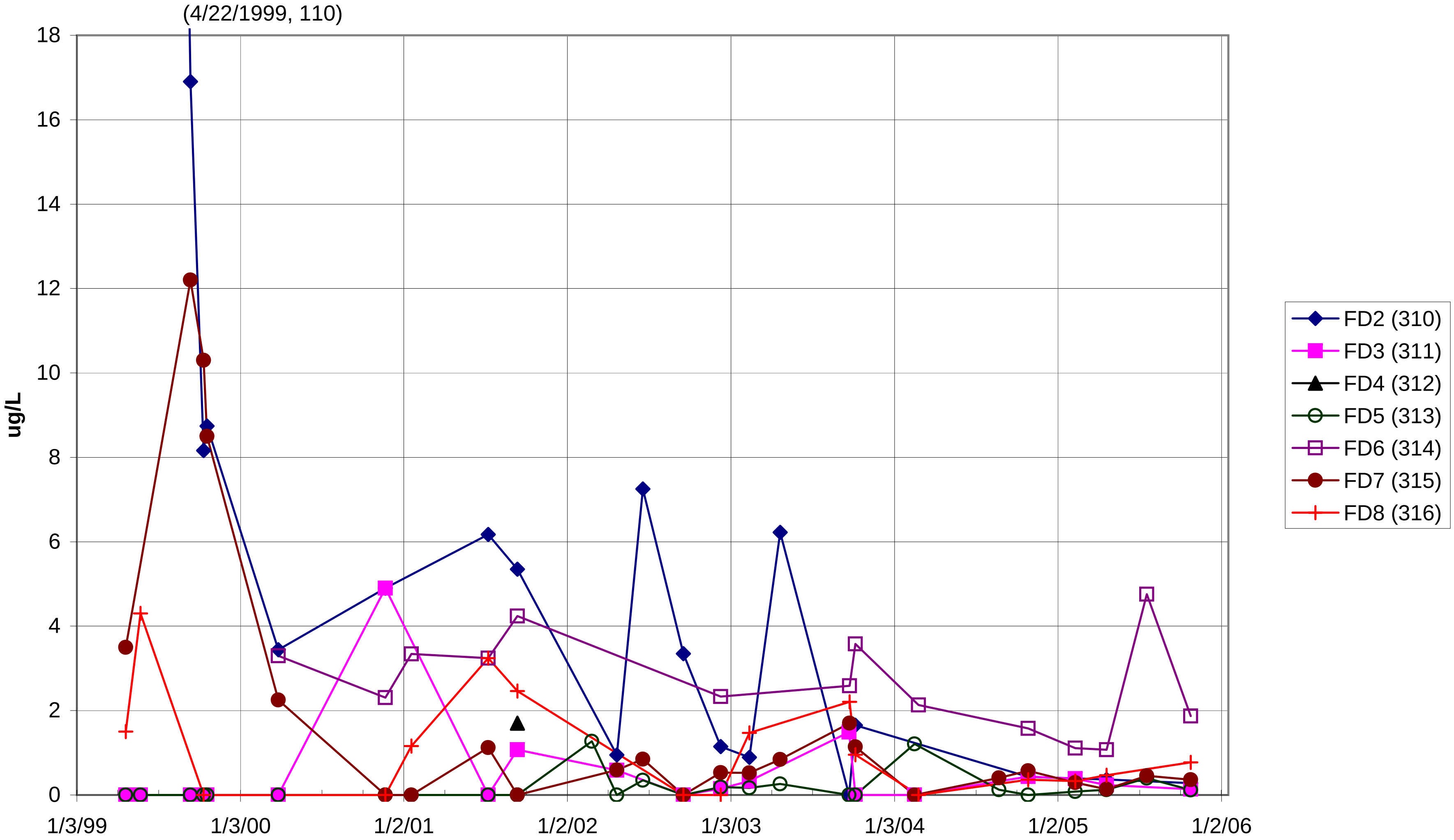


FIGURE 3.23b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - LEAD DATA (Non-detectable analyses plotted as zero)

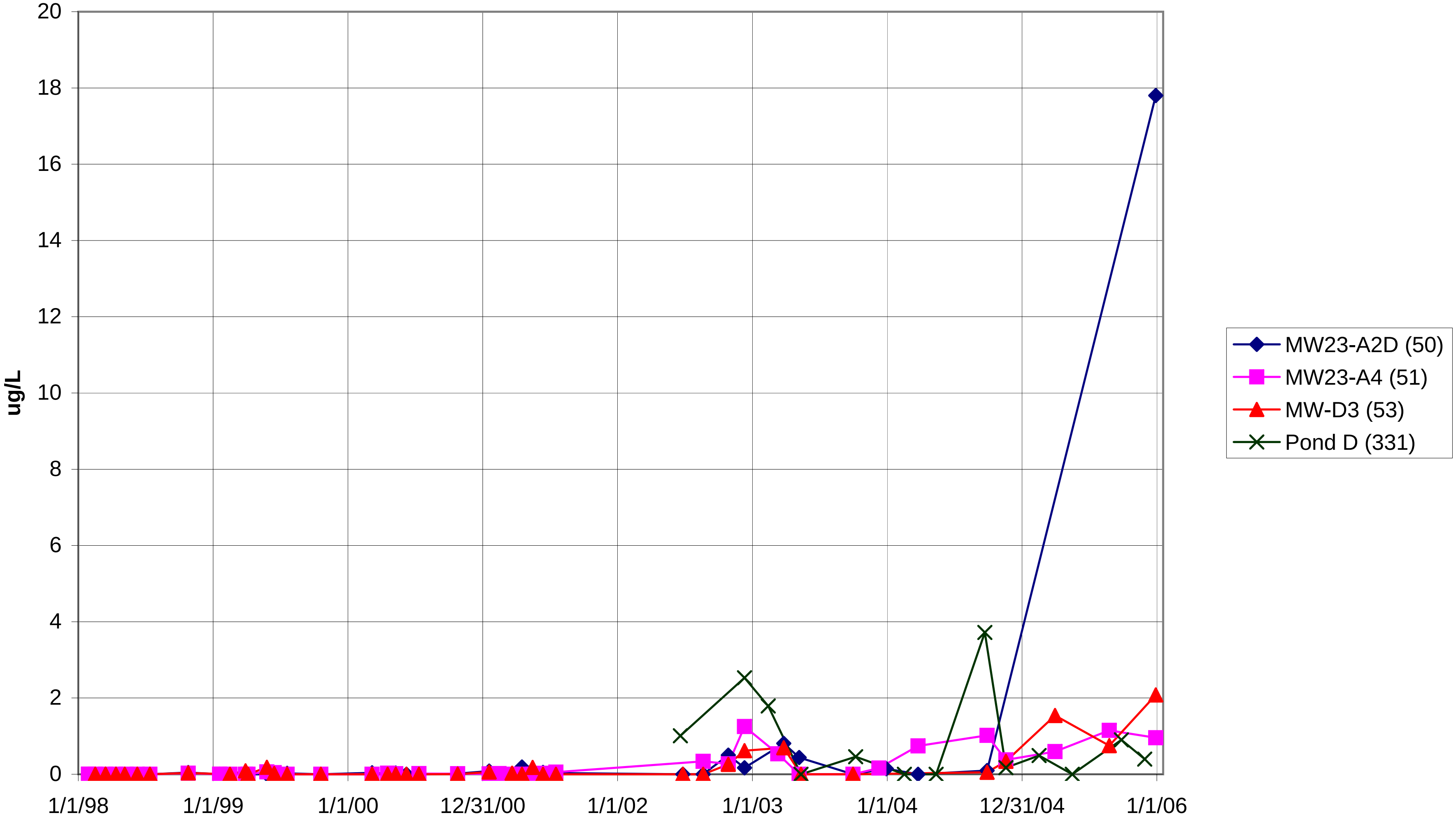


FIGURE 3.24a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES:
FINGER DRAINS - NICKEL DATA
(Non-detectable analyses plotted as zero)

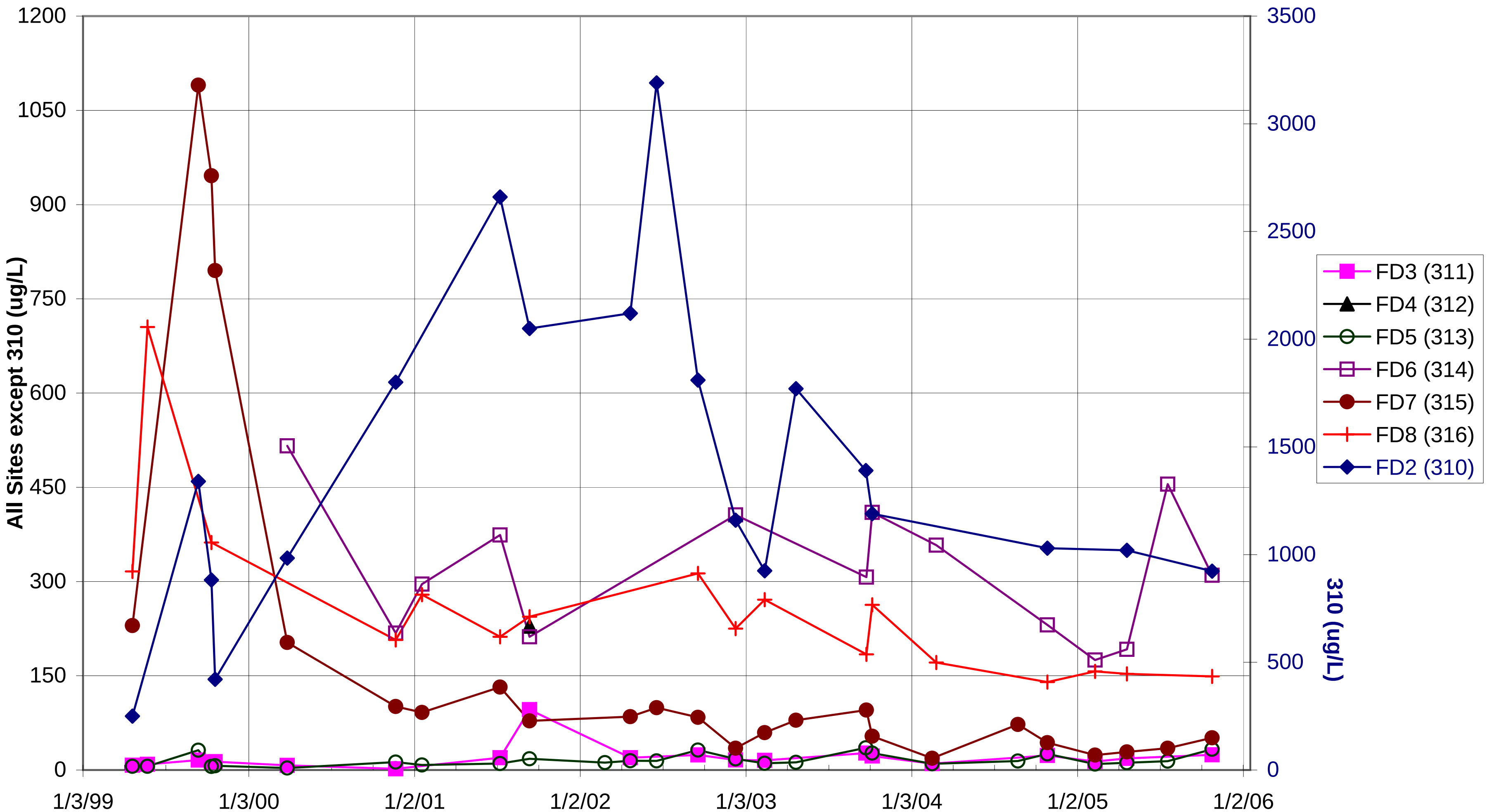


FIGURE 3.24b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - NICKEL DATA
(Non-detectable analyses plotted as zero)

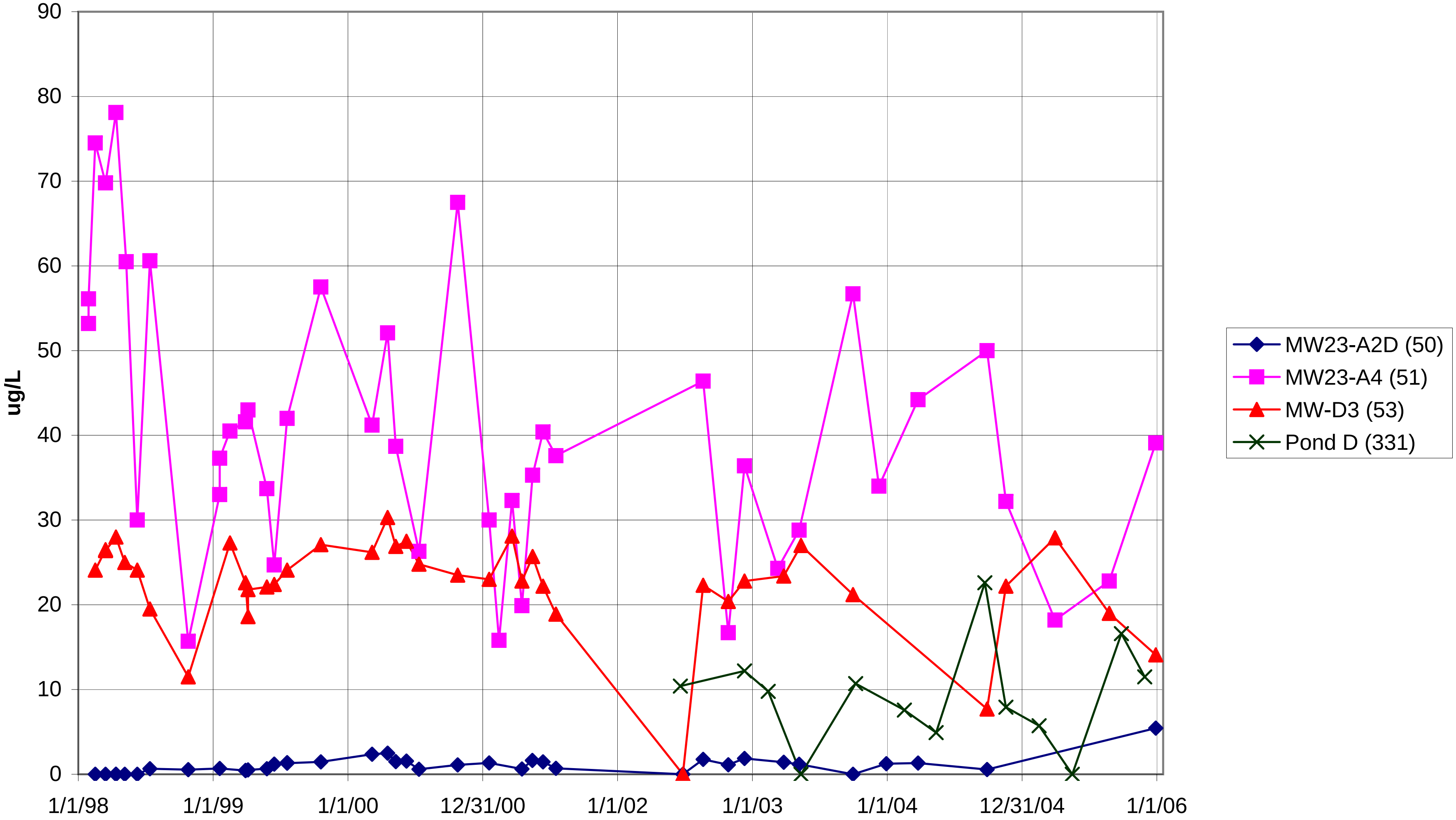


FIGURE 3.25a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES:
FINGER DRAINS - IRON DATA
(Non-detectable analyses plotted as zero)

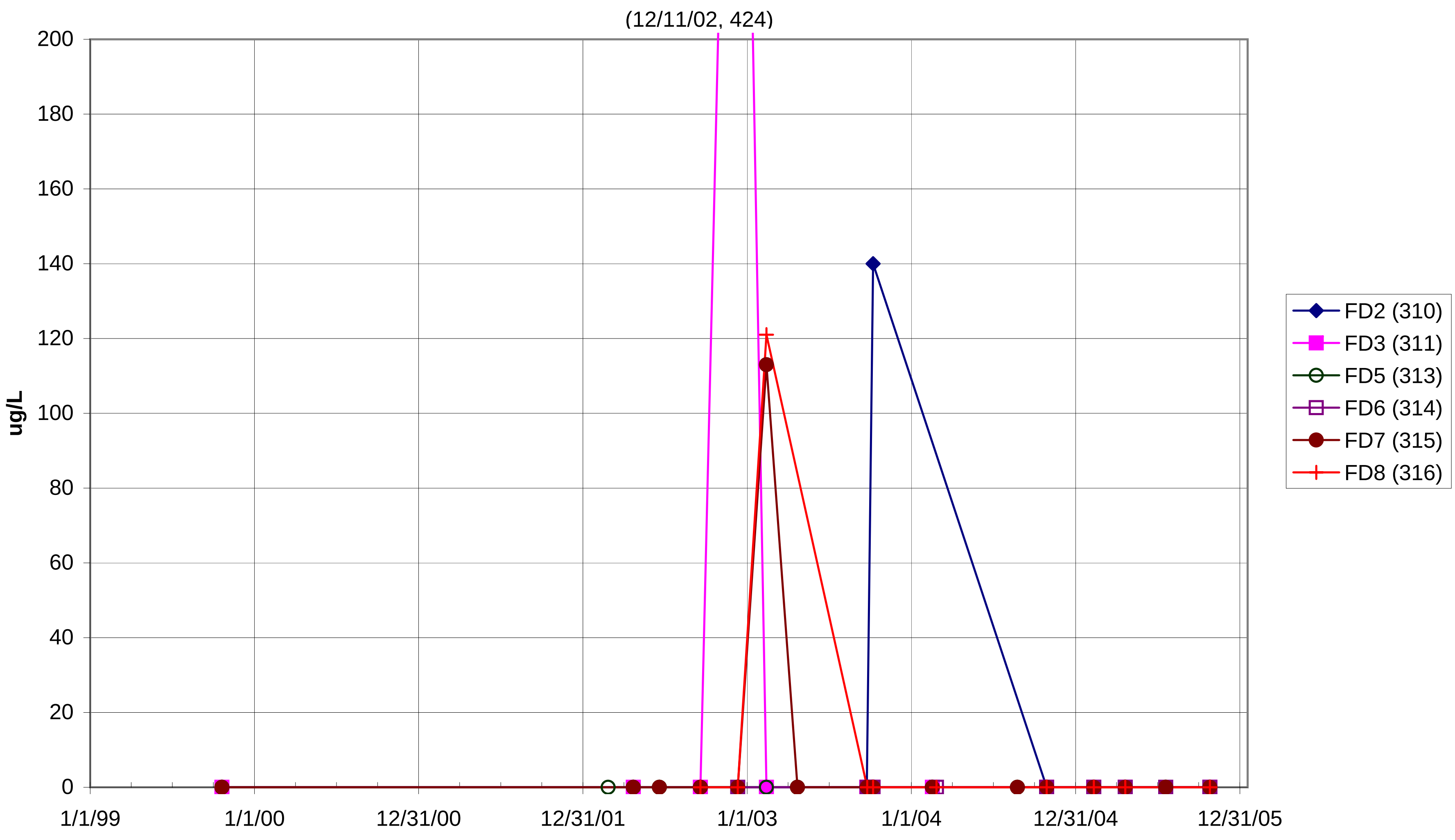


FIGURE 3.25b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - IRON DATA (Non-detectable analyses plotted as zero)

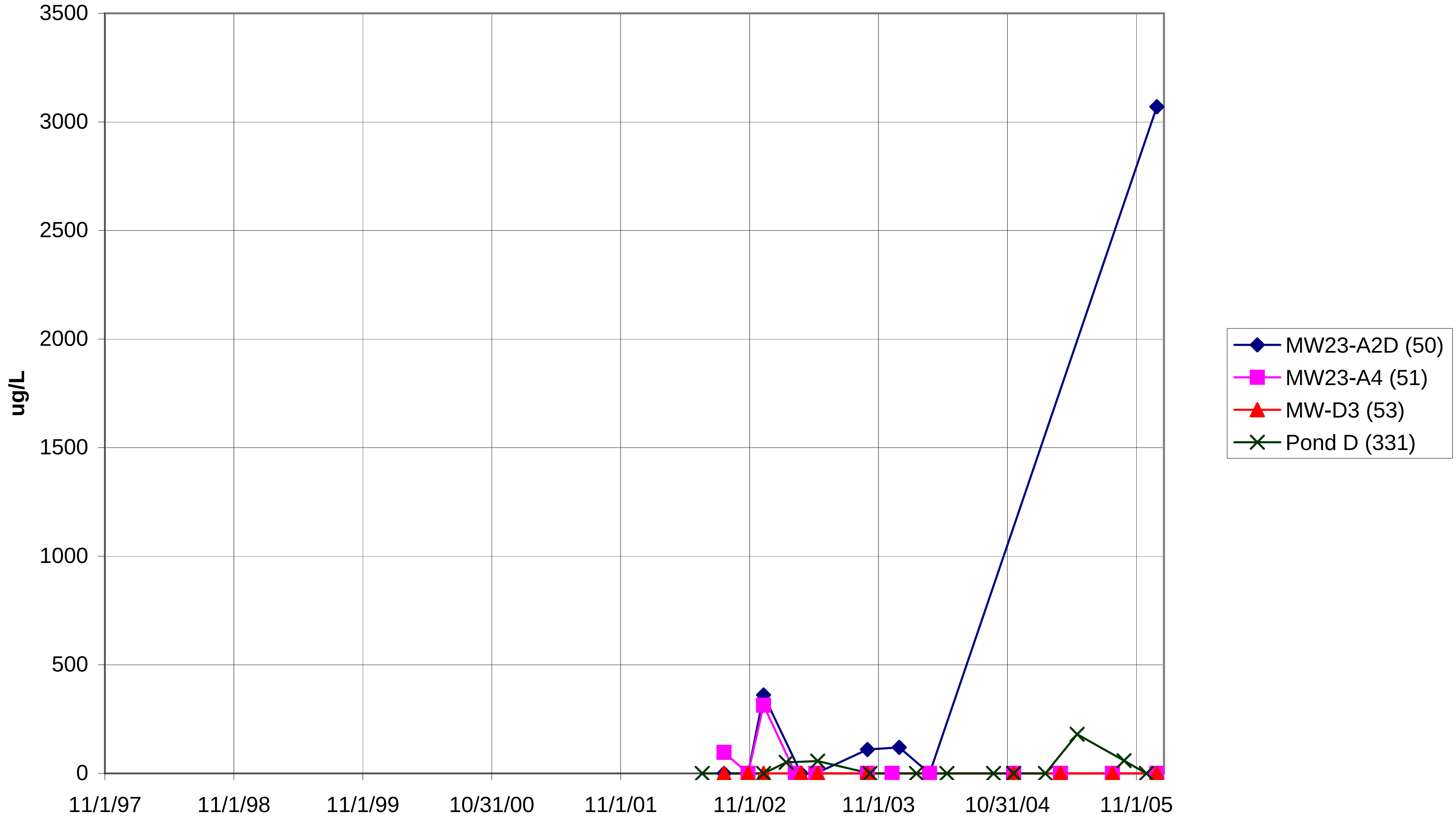


FIGURE 3.26a GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - MANGANESE DATA
(Non-detectable analyses plotted as zero)

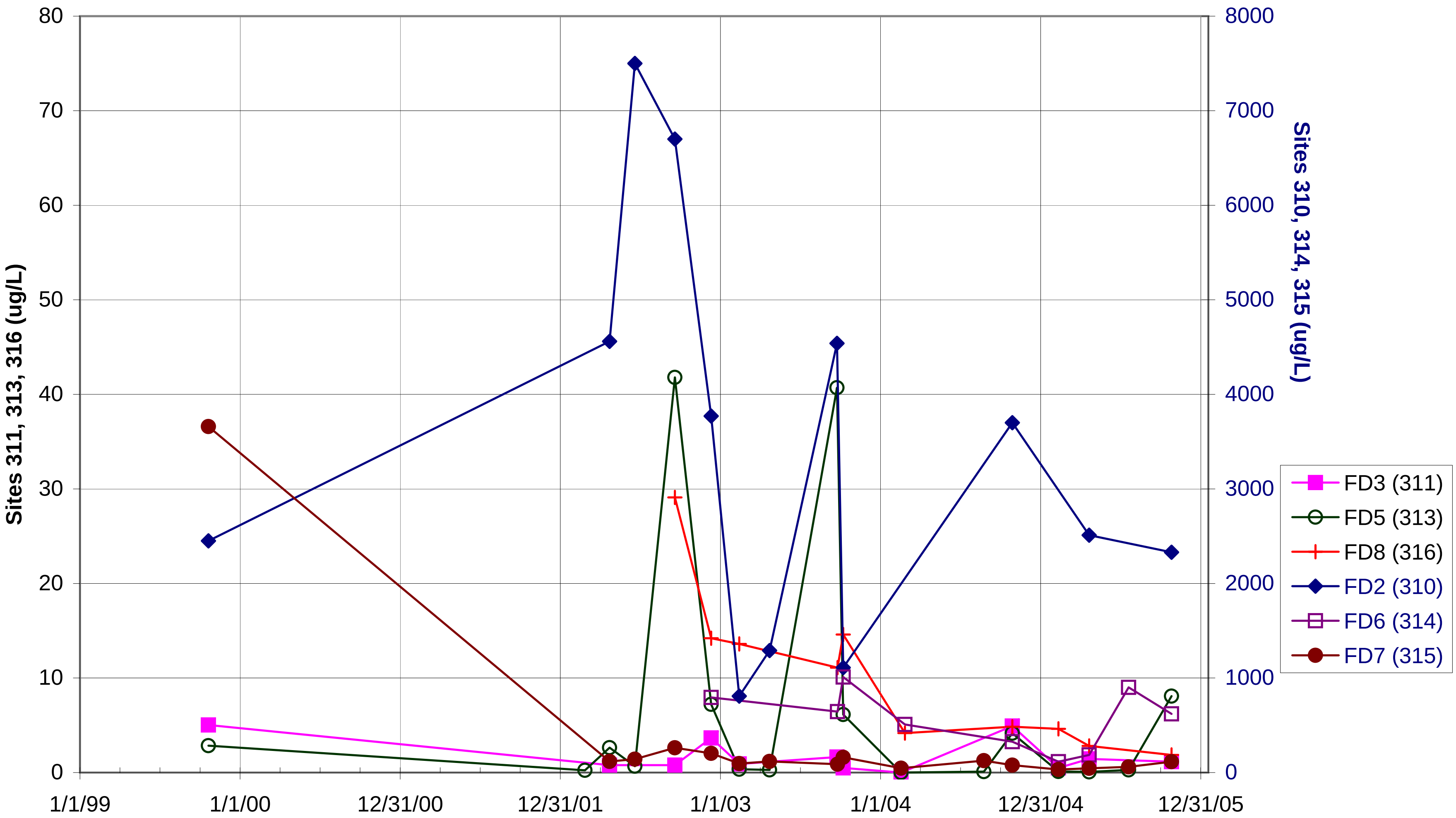


FIGURE 3.26b GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: GROUND WATER - MANGANESE DATA (Non-detectable analyses plotted as zero)

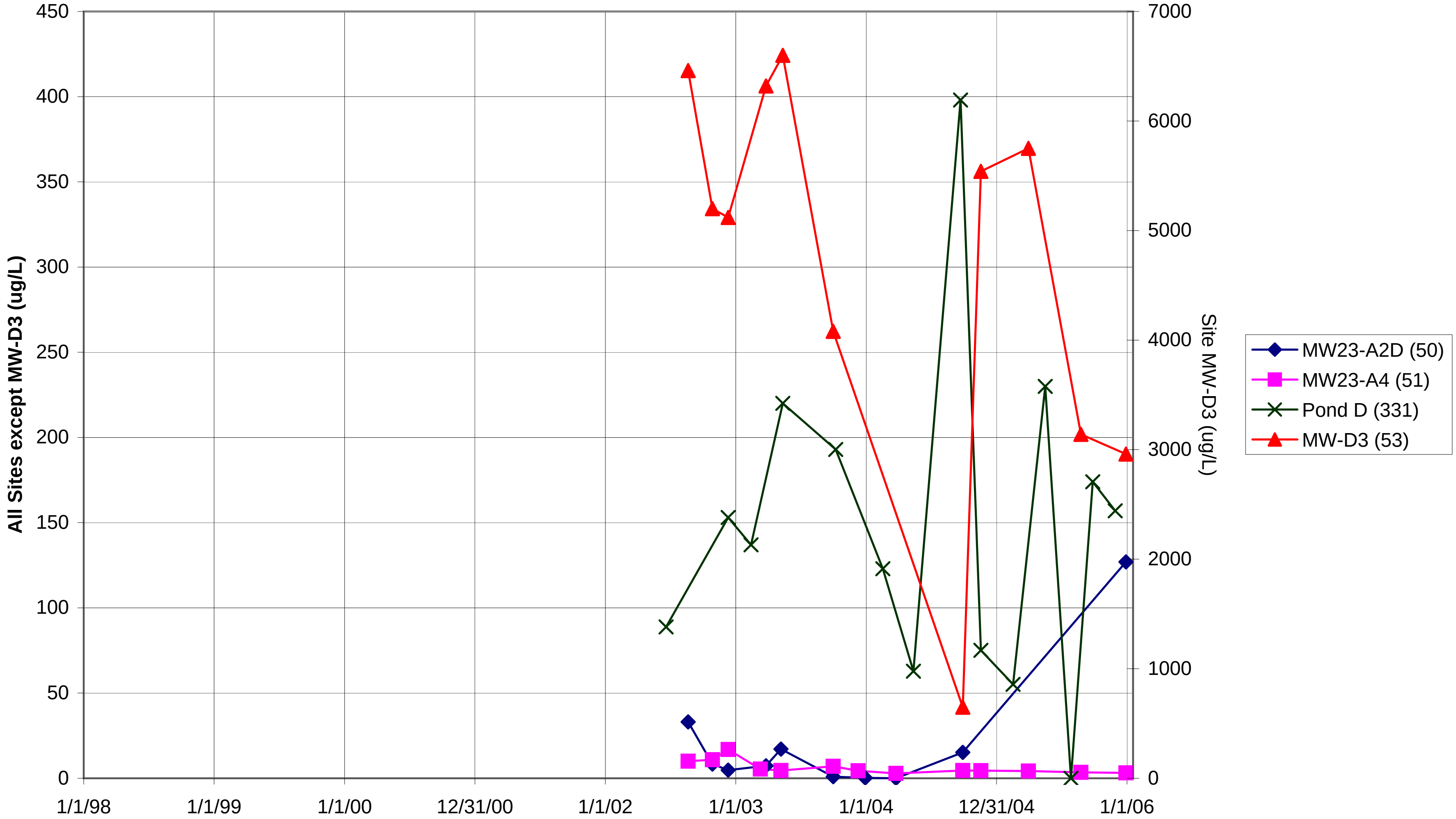


FIGURE 3.27 GREENS CREEK SITE 23/D INTERNAL MONITORING SITES: FINGER DRAINS - FLOW

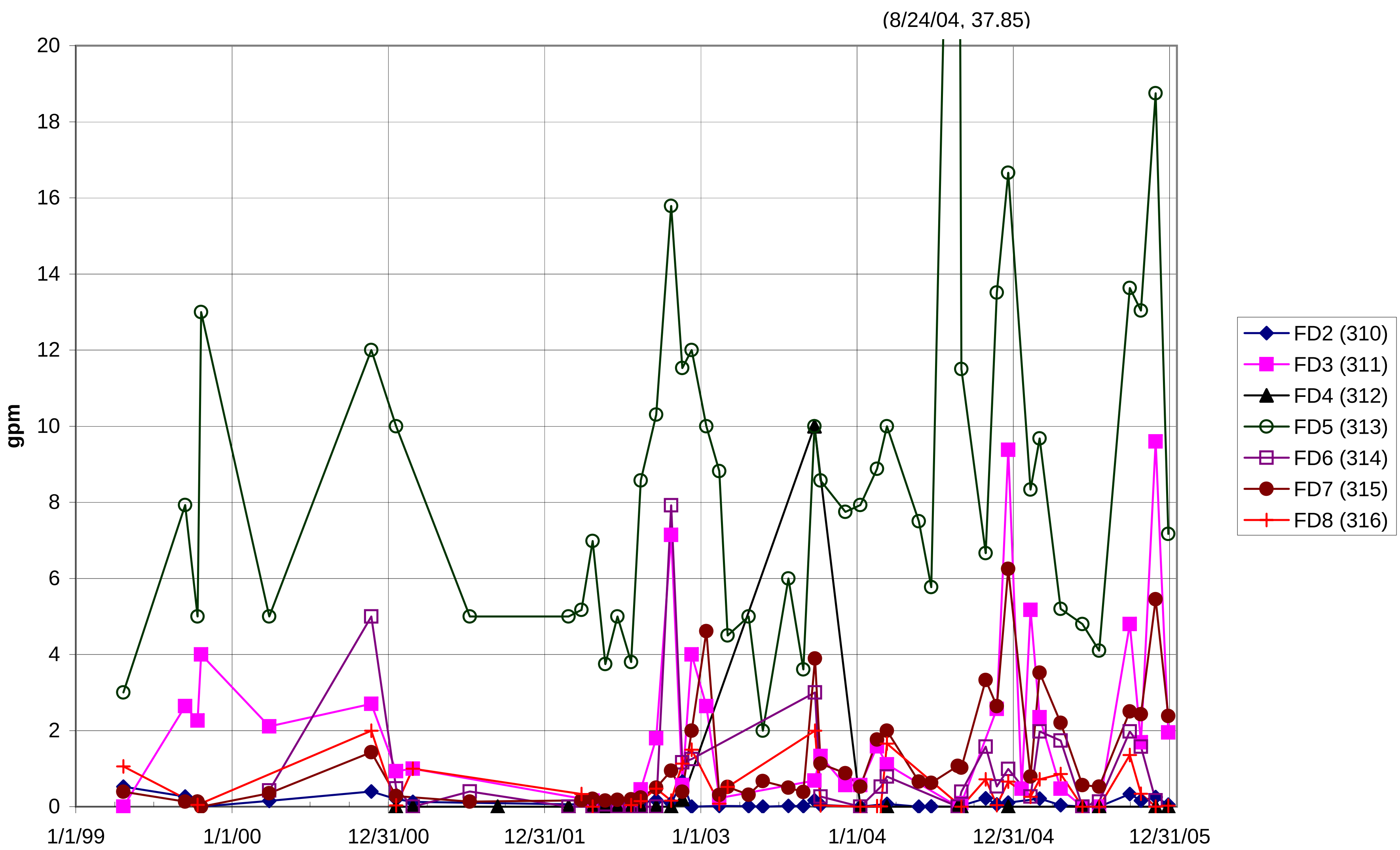


FIGURE 3.28 2005 ABA DATA FROM UNDERGROUND RIB SAMPLES

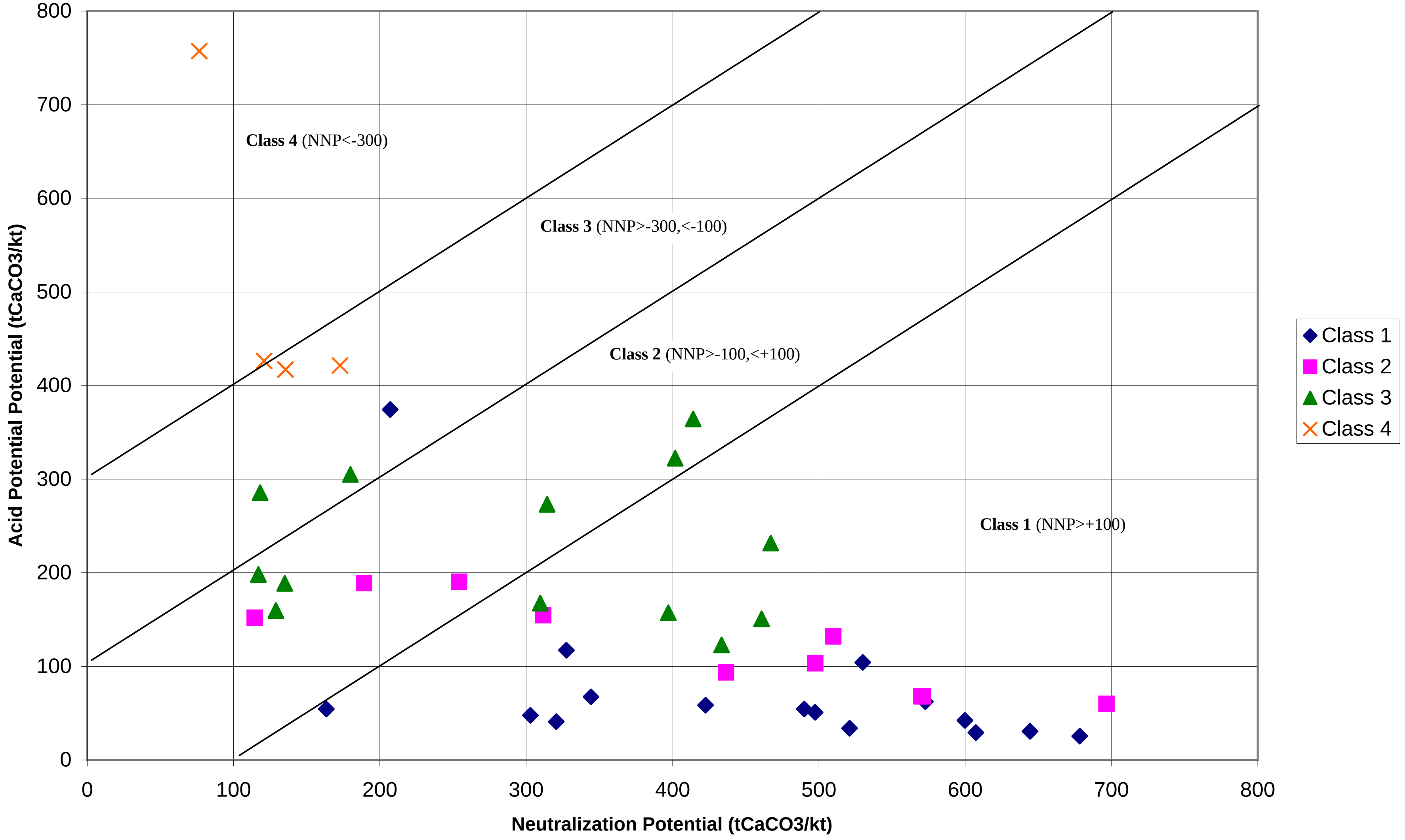
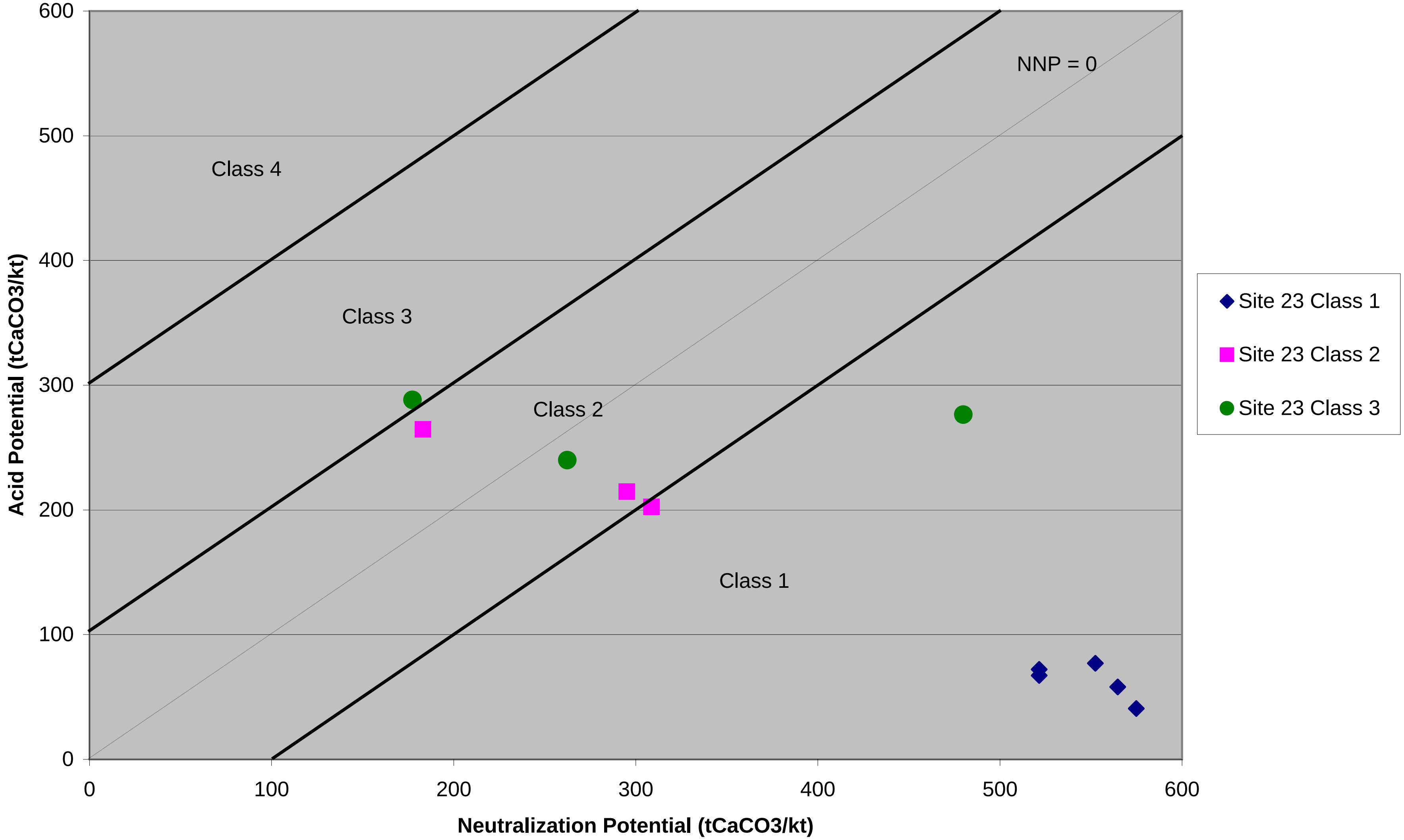


FIGURE 3.29   ACID-BASE ACCOUNTING DATA FOR SURFACE SITE 23



APPENDIX 4

Site Photographs

FIGURE 2.35 Southeast Expansion Liner Phase II: July 11, 2005

FIGURE 2.36 Pond 7: November 16, 2005

FIGURE 2.37   SRMP Plots

FIGURE 2.38 May 2005 Aerial Photograph of Tailings Area

FIGURE 3.30 Class 1 Site 23: June 9, 2005

FIGURE 3.31 Site 23 Backslope: July 11, 2005

FIGURE 3.32 Mill Backslope Road: October 27, 2005

FIGURE 3.33 Aerial Photograph Site 23/D May 2005