INACTIVE PRODUCTION ROCK SITES AND QUARRIES
2015 ANNUAL REPORT

Hecla Greens Creek Mining Company

April 15, 2016

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(See Appendix 1 for figures)

1.0 Executive Summary

This annual report has been prepared by Hecla Greens Creek Mining Company (HGCMC) in accordance with the mine's General Plan of Operations Appendix 1, Integrated Monitoring Plan. Monitoring data summaries are presented for five inactive production rock sites (1350, 960, Mill Backslope, Site C and Site E) and five quarries (Pit 405, Pit 6, Pit 174, Pit 5 and Pit 7). Pit 5 was the most recent active quarry and is now part of the Northwest Tailings Expansion area. A discussion of the 2.5 mile roadcut on the B Road is also included in this report.

This report is separated such that all aspects of the inactive production rock sites are discussed first in Section 2 followed by discussion of the quarries 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.

The exposures in the rock quarries generally contain far less pyrite and carbonate than production rock. Each of the five quarries has zones of pyritic rock exposed in the pit walls; however, the volume of runoff from these zones is relatively small. Lower sulfide contents and smaller surface areas yield a lower flux of oxidation products from quarries compared to production rock sites. However, buildup of acidic oxidation products on overhanging exposures can produce low rinse pH values. Water monitoring indicates that metal loading from pit walls is also lower than loading from production rock sites.

Removal activities at the inactive production rock 1350 Site continued in 2015. Approximately 160 cubic yards of potentially acid generating material was excavated from the slope adjacent to the adit and placed in the underground mine for disposal. To stabilize the slope, approximately 180 cubic yards of clean fill material was placed and compacted onto the slope and the area was hydroseeded. In addition, the remaining material on the Site 23 temporary storage pad placed during the 2014 removal activities was hauled to the underground mine as backfill. The total volume of material removed from the 1350 Site since 2005 is approximately 50,860 cubic yards. The remaining production rock, estimated at 9,000 to 10,000 cubic yards in the immediate vicinity of the adit, will be removed at final mine closure.

The benefits of the 1350 Site removal activities are evident in the water quality monitoring data. Conductivity and sulfate measurements in 2015 were among the lowest ever recorded at the two monitoring sites. Following the 2014 removal activities there was a spike in the cadmium, copper, lead, manganese, nickel and zinc concentrations at water quality monitoring Site 13. Concentrations for all of these constituents were lower in 2015 and there appears to be a downward trend for each. Continued improvement in water quality is expected as the mineral surfaces on the recently exposed production rock become coated with oxidation products.

Other activities in 2015 include the removal of approximately 20,500 cubic yards of production rock from the inactive Site E. The total volume of material hauled from Site E to the tailings facility is approximately 121,900 cubic yards.

2.0 Inactive Production Rock Sites

2.1 Introduction

The term production rock (or waste rock) refers to material removed during mine development to access ore for mineral extraction. Production rock is typically highly mineralized, but does not possess concentrations of target minerals that make it economical for processing. It is therefore disposed of as a mine waste product. Several sites were utilized for disposal of production rock during the early operations of the Greens Creek Mine, including the 1350 Site, 960 Site, Mill Backslope, Site C and Site E. The site locations are shown on Figure 2.1. *(Note: The 960 Site, Mill Backslope and Site C are located within or adjacent to the 920 Area indicated on Figure 2.1).* These sites have been inactive since 1994 or earlier, with Site 23 being the only currently active production rock site.

The initial reclamation plan called for engineered covers to be constructed on each site to prevent acid generation and potential long-term water quality impacts. HGCMC currently plans to remove all of the production rock from each site for placement underground as backfill or disposal in the tailings facility. Removal activities were initiated in 2000 and have continued intermittently as mining operations allow. However, complete removal of some sites cannot occur until final cessation of mining operations due to the need to protect/maintain site infrastructure. A monitoring program is in place to evaluate potential impacts from each site on water quality and the acid generation potential of the material.

This section of the report provides a summary of all operational and monitoring activities performed at inactive production rock sites in 2015. Refer to GPO Appendix 11 for a description of the facilities and GPO Appendix 1 for associated monitoring requirements. Aspects of the inactive Site D are covered in the Tailings and Production Rock Site 2015 Annual Report (HGCMC 2016), which also covers the adjacent active production rock Site 23. Summary statistics for HGCMC's inactive production rock sites are presented in Table 2.1.

Table 2.1 Summary Statistics for Inactive Production Rock Sites
(ND=no data)

	Inactive Sites				
	1350	960	Mill Slope	Site C	Site E
Years Active (approx.)	1978-1985	1987-1988	1987-1988	1987-1988	1988-1994
Acreage	5	1	20	2	10
Approx. Total Original Volume (yds)	60,000	10,000	ND	50,000	270,000
Approx. Volume Removed (yds)	50,860	16,000	1,500	0	121,900
Approx. Volume Remaining (yds)	9,140	ND	ND	50,000	148,100

Water quality monitoring locations associated with Site E are shown on Figure 2.2. Historical acid-base accounting (ABA) data associated with the inactive production rock sites are illustrated on Figures 2.3 and 2.4. Composite flow and water quality data are summarized in Figures 2.5 to 2.19 for all inactive production rock sites except Site E, which are summarized separately in

Figures 2.20 to 2.34. A general summary of trends is discussed in this introductory section, followed by individual site discussions in the subsequent sections.

The results of ABA sampling and water monitoring through 2015 are consistent with previous investigations (KGCMC 1994, & 2004; Shepherd Miller 2000; ADEC 2003). These investigations concluded that some of the material is potentially acid generating but that the vast majority of the material continues to maintain a pH greater than 6.0, and that sensitive receiving areas continue to be adequately protected. This report serves as an annual follow-up to these previous investigations and generally does not repeat data and information presented in these reports, unless doing so provides continuity and clarity.

Figure 2.3 compares acid potential (AP) with neutralization potential (NP) for samples collected between 2002 and 2013 from the surface of the inactive sites. The sites were constructed prior to development of the classification protocol that HGCMC currently uses for segregation of production rock. Symbols in Figure 2.3 represent actual laboratory data points. Lines indicating the currently utilized production rock classes are shown on Figure 2.3 for reference only. Figure 2.3 shows the distribution of potentially acid generating (upper left half of figure) and potentially acid neutralizing (lower right half of figure) samples. Many samples from Site E have more neutralization potential than those from other sites, reflecting a greater proportion of argillite in the material. Samples from the Mill Backslope and the 1350 Site generally showed a higher acid generation potential than those from the other sites. Reclamation activities at the 960, 1350 and Site E have removed significant quantities of potentially acid generating material from these sites.

Figure 2.4 shows the 2002-2013 results of rinse pH relative to net neutralization potential (NNP) for the five inactive sites. Most samples produced a rinse pH greater than 6.0; however, each site has produced at least two samples with rinse pH values less than 5.0. This is consistent with the distribution of NNP values and the duration of waste rock exposure. ABA sampling occurs at the surface of the piles where oxidation rates are greatest. Drainage from the inactive sites remains near neutral because the bulk of the material in the piles contains sufficient carbonate to neutralize the acidity formed by pyrite oxidation near the pile surface. There are a few cases where samples produced a low rinse pH and high NNP. This is likely a result of accumulated acidic oxidation products in the fines fraction of the sample and remaining carbonate minerals in the coarse fraction.

There was no ABA sampling performed at inactive production rock sites in 2015. Per the approved Integrated Monitoring Plan (GPO Appendix 1), this sampling is performed on five-year intervals. The most recent sampling was performed in 2013 and the next sampling will occur in 2018.

Flow data presented in Figures 2.5 and 2.20 show that flows at most of the sample locations are generally low (less than 10 gpm) with the exception of Site E. Some of the flow data were collected as part of the APDES stormwater monitoring program. Collected during or following storm events, flow data from these locations (e.g. Site E, 356; 960 Site, 347 and 570) represent short-term maximum flow values in response to relatively large precipitation events. Lack of significant flow from inactive sites is a positive characteristic because it reflects minimization of potential off-site impacts.

Figures 2.6 and 2.21 show pH data from sampling locations associated with the inactive sites. Lower pH values can represent influences from pyrite oxidation and/or organic acids from muskeg and forest soils. The data show that the vast majority of the site drainage remains above pH 6.0. Drainage from the Mill Backslope consistently shows the lowest pH due to the quantity of pyritic rock. The drainage from this area is collected and routed to water treatment facilities prior to discharge at the permitted outfall. For a brief period in 1998 and 1999, acidic conditions began developing at the 960 (sites 347 and 570). Hecla's predecessor Kennecott Greens Creek Mining Company (KGCMC) applied lime and removed approximately 1,000 cubic yards of oxidized pyritic rock from the site in 2000. The pH of the drainage quickly rebounded and has remained near-neutral since 2000. Removal of additional Site 960 material occurred in 2003, 2004 and 2005.

Alkalinity data presented in Figures 2.7 and 2.22 are consistent with the pH results in Figures 2.6 and 2.21. Drainage from the inactive sites continues to maintain measurable alkalinity provided by dissolution of carbonate minerals. A substantial reduction in alkalinity has been observed at monitoring locations associated with the 1350 Site (Sites 13 and 307) due to the removal of carbonate-rich production rock that began in 2005. The most notable reductions occurred following the completion of 2014 removal activities, which targeted material located directly up-gradient of Site 13. For this site, the low alkalinity is a positive sign and indicates the drainage quality is returning to its natural condition with less influence from the remaining production rock.

Conductivity data are shown in Figures 2.8 and 2.23. Conductivity indicates the amount of dissolved constituents in the water. Samples showing higher conductivity values usually have elevated sulfate, calcium and magnesium (hardness) concentrations, reflecting influences from sulfide oxidation and carbonate mineral dissolution. Water that has contacted production rock is expected to have higher conductivity values than background waters. Drainage from the 960 (Sites 347 and 570) and 1350 (Sites 13 and 307) has shown a substantial decrease in conductivity following removal of the production rock. The decreasing trends apparent in Figures 2.8 and 2.23 are the result of decreasing reactive surface area available for oxidation and dissolution. The reactive surface area decreases as reactants are consumed and mineral surfaces become coated with oxidation products. The results for sulfate, magnesium and hardness, shown in Figures 2.9 and 2.24, 2.10 and 2.25, and 2.11 and 2.26, respectively, correlate with conductivity results and are consistent with the concept of generally decreasing or static reactive surface area.

The data for zinc, copper, lead, cadmium, nickel, arsenic, iron and manganese are presented in Figures 2.12 to 2.19 and Figures 2.27 to 2.34. Sample results that were less than the detection limit are plotted at one half the detection limit value. While this allows the results to be plotted on a graph, it causes non-detect results with high detection levels to appear more concentrated than they actually are. Detection limits have varied with time and are often evident on the graphs as horizontal groupings of symbols. The results for metals generally correlate with conductivity values. Zinc concentrations reflect the higher solubility of this element relative to the other metals at near-neutral pH conditions. Manganese concentrations are elevated at most of the inactive sites, indicating the generation of secondary products from localized redox and buffering reactions as well as this metal's higher solubility in the prevailing pH conditions. Metal loads from inactive sites have either remained relatively constant or decreased with time. The decrease in metal loading is attributed to the reduction of reactive surface area discussed above.

Site 960 showed elevated copper, zinc and cadmium concentrations in 2004. This was likely due to the removal of production rock from the area, which exposed additional production rock materials in the base of the road, and rerouted additional water sources into the sampling area, confounding comparative water sampling with pre-removal data. Post removal Site 960 data since 2005 have shown a decrease in most metal concentrations, with close to an order of magnitude decrease in cadmium, nickel, manganese and zinc. A similar spike in metals concentrations was also observed at the 1350 Site following the 2014 removal activities, which occurred adjacent to and up-gradient of the monitoring site. With the majority of the production rock removal from the 1350 Site now complete, except in the immediate vicinity of the adit, future monitoring is expected to show a substantial decrease in metals and sulfate concentrations.

2.2 1350 Site

The 1350 Site is located at 1,350 feet above mean sea level (AMSL), up-slope from the main portal and concentrator facility (Figure 2.1). The site contained an estimated 60,000 cubic yards of material derived from advancement of the 1350 adit, which began in 1978 and continued intermittently through 1985. Flow from the site is low, generally less than 10 gpm, and the drainage remains near-neutral. Historically, characteristics of the drainage (Figures 2.9 to 2.19) included a sulfate load, generally low metal concentrations, and localized iron staining. The results of ABA sampling through 2013 demonstrate that although some of the rock was potentially acid generating, the majority of the material remained near-neutral.

After evaluating reclamation alternatives for the 1350 Site, it was determined that removal of the production rock for disposal in the underground mine as backfill was the best option for this site. Removal activities commenced in 2005 and continued on an intermittent seasonal basis. Initially, material was hauled to the 920 remuck area for temporary storage prior to placement underground as backfill. However, the small size and limited availability of the remuck area hindered the pace of removal activities. In 2008, a temporary storage pad was constructed on Site 23. This enabled a larger quantity of 1350 material to be hauled over a short campaign during the summer, which was then available to be hauled underground on a year-round basis as mine operations allowed. There was no removal in 2006, 2009 or 2012 due to limited availability of space in the mine for disposal. A new temporary storage pad was constructed on Site 23 in 2013 to replace the previous pad.

From 2005 through 2015, a total of approximately 50,860 cubic yards of material was removed from the 1350 Site. It is estimated that 9,000 to 10,000 cubic yards of waste rock remain, all of which is in the immediate vicinity of the 1350 adit. This material will not be removed until final closure of the mine due to the need to maintain access for the mine ventilation system. The area around the adit has been graded so that surface runoff from the production rock is directed into the mine water collection system.

Activities in 2015 included removing approximately 160 cubic yards of acid generating production rock located on the slope adjacent to the 1350 adit. To maintain stability of the slope, the excavated area was backfilled with approximately 180 cubic yards of clean fill material. A photograph of the area after completing backfill is presented as Figure 2.35. Figure 2.36 shows a photo of the same area in October 2015 with vegetation established. Additional work in 2015 included hauling the remaining material from the temporary storage pad on Site 23 to the underground.

The benefits of the production rock removal activities are evident in the monitoring data for Site 307. The majority of the waste rock removed in 2010 and 2011 was located immediately above this monitoring site. This site, which had not been monitored since 2009, was sampled in 2015 and the results show a significant reduction in nearly all metals, as well as alkalinity, sulfate and conductivity, compared to pre-removal data (Figures 2.6 through 2.19).

Following completion of the 2014 removal activities, there was a substantial spike in metals concentrations at Site 13, including cadmium, copper, lead, manganese, nickel and zinc. This was expected since the removal activities were up-gradient of the monitoring site and resulted in exposing relatively unoxidized production rock at the edge of the removal area near the 1350 adit. It was also expected that there would be a relatively short flushing period of residual oxidation products from the underlying soils beneath the recently removed waste rock. A similar spike in metals was observed in 2003 and 2004 at the 960 Site following production rock removal, and by 2005 concentrations decreased significantly to well below pre-removal levels. The 2015 monitoring results from Site 13 showed that the concentrations of all metals were lower than the peaks observed in 2014 and appear to be trending downward. The 2015 measurements of conductivity and sulfate were among the lowest ever observed at Site 13. Cadmium and zinc concentrations remain elevated compared to previous levels, likely caused by oxidation of the recently exposed waste rock near the adit. The concentrations are expected to decrease as the mineral surfaces become coated with oxidation products and vegetation becomes fully established.

2.3 960 Site

The 960 Site is located just above the 920 Portal on the road to the 1350 level. Approximately 10,000 cubic yards of production rock were placed at the site in 1987 and 1988 during development of the 920 Portal and access road to the 1350 level. Placement was terminated when signs of slope instability developed below the site. The 960 Site is relatively small in extent (1 acre) and drainage flows are low (typically below 5 gpm). Monitoring in Greens Creek below the 960 Site historically showed some influence from this site or other up-gradient sites on water quality.

Approximately 1,000 cy of rock were removed from the site and placed at Site 23 or underground as backfill in 2000. Approximately 10,000 cy of material were removed from the 960 Site and placed in underground workings in 2003. An additional 5,000 cy of oxidized material and associated underlying soil were removed in 2004. In May and June of 2005, additional road sub-base production rock material was found and removed. Butressing material was brought in as fill to ensure road stability. The site was then recontoured and allowed to naturally reseed with native species.

The 960 Site showed some elevated copper, zinc and cadmium concentrations in 2003 and 2004 (Figures 2.12, 2.13 and 2.15). This was likely due to the removal activities, which exposed some additional production rock materials in the base of the road and altered drainage patterns. Comparison of pre- and post-removal monitoring data (Table 2.2) demonstrates that water quality of drainage from the 960 Site has improved considerably.

A small volume of pyritic material remains within the road prism, as evidenced by localized iron staining. An ABA sample of this material collected in 2013 showed a NNP of -30.3 (tCaCO3/kt) and a paste pH of 3.6. HGCMC plans to remove this material during final reclamation of the 1350 access road following cessation of mining operations. The 960 Site will continue to be monitored for water quality changes and potential impacts on Greens Creek.

Table 2.2 Effects of Removal of 960 Site Production Rock (ND = Non-detect)

Site 347		**Before Removal**	**After Removal**	**After Removal**	**After Removal**	**After Removal**	**After Removal**
Parameter	**Unit**	**9/12/95**	**9/28/06**	**8/17/09**	**5/30/12**	**5/27/14**	**8/23/15**
pH	s.u	6.1	7.6	7.5	7.7	6.6	7.1
Sulfate	mg/l (tot)	1300	161	230	119	138	146
Calcium	mg/l (diss)	412	64	102	56	53.8	68.2
Magnesium	mg/l (diss)	164	21	28	17	16.9	20.9
Iron	mg/l (diss)	5.5	0.2	ND	0.09	0.04	0.1
Manganese	mg/l (diss)	7.1	0.4	0.272	0.06	0.082	0.081
Zinc	mg/l (diss)	11	0.1	0.054	0.032	0.048	0.024
Lead	mg/l (diss)	0.004	ND	0.00008	ND	ND	ND
Nickel	mg/l (diss)	0.3	0.005	0.007	0.0016	0.0025	0.001

2.4 Mill Backslope

A bench was cut into the valley floor at the 920 elevation providing level ground to facilitate construction of the Mill/concentrator facility in 1987. Glacial till excavated from the site was hauled to Site D and Site E. During construction of the Mill and related facilities, tension cracks developed above the excavated slope. Approximately 100 dewatering drains were drilled into the slope to lower the water table and reduce pore pressures. Two benches of production rock were placed on the lower half of the bank to buttress the slope and protect the drain manifold system. Pyritic rock was also used in the construction of an access road above the cut slope. Numerous piezometers were installed throughout the Mill Backslope at varying depths to monitor the pore water pressure.

Drainage from the Mill Backslope is a combination of groundwater intercepted by the dewatering drains, seepage from the surface expression of shallow groundwater, and surface runoff from precipitation. Average flows from combined Mill Backslope sources are low (less than 10 gpm). Sample site MBS 341 was established in 2003 and represents a composite of the groundwater and surface runoff. As shown in Figures 2.6 through 2.19, this site typically has the lowest pH and highest metals concentrations of all inactive production rocks sites. Water quality at site MBS 341 is monitored infrequently since all flow is captured and routed to water treatment facilities. This site was sampled in May 2015 and the results were generally consistent with past monitoring data, though some metals concentrations were lower.

Collection and treatment of slope drainage remain the preferred near-term options for this site because removal of all of the production rock would destroy the dewatering system that maintains slope stability. Long term closure options for the slope include removing the pyritic material and either replacing it with non-pyritic fill or decreasing the slope angle to ensure long-term slope stability for closure.

2.5 Site C

Site C is located near the end of the B Road just below the 920 Mill/concentrator facilities. The site received producton rock in 1987 and 1988 and currently contains approximately 50,000 cubic yards of material. Results of ABA analyses (Figures 2.3 and 2.4) indicate that some of the material is potentially acid generating, however the pH of the site's drainage remains near-neutral. The 860 safety building and assay lab have been constructed on this site, therefore removal of the material will not occur until final cessation of mining activities.

During construction of the assay lab, glacial till from Site 23 was placed over much of the exposed production rock. The Site 23 material is not potentially acid generating and reduces exposure of the covered production rock to precipitation and oxygen. A network of drains and catchments diverts surface water away from the underlying production rock. Two stormwater retention ponds were constructed below Site C, the upper and lower Pond C, to contain sediments from Site C as well as from the B Road below the 920 area. The collected stormwater is pumped to water treatment facilities and discharged at the permitted outfall.

Drainage from Site C has been monitored routinely since 2002 at the toe of the slope that makes up the upper side of Pond C (Site 308). Flow at this site is low (generally less than 1 gpm), remains near-neutral, and contains elevated manganese concentrations, as well as moderate sulfate, zinc, cadmium and iron concentrations. The monitoring data for Site 308 indicate a downward trend in sulfate, cadmium, lead and zinc concentrations, which may be attributable to diversion of non-contact water away from Site C. This site was dry in May 2015 and not able to be sampled. This site will continue to be monitored on an annual basis.

2.6 Site E

Site E is located 4.6 miles up the B Road halfway between the Hawk Inlet port facility and the 920 Mill facility (Figure 2.1). Approximately 95,000 cubic yards of glacial till and 270,000 cubic yards of production rock were placed at the site from 1988 to 1994. The glacial sediments were excavated from the 920 site during construction of the Mill facility. Once the sediments were naturally dewatered in the placement cells constructed at this site, production rock materials were placed on top of those sediments at Site E. Flows from the site are minimal because it sits on a topographic high and only receives water from direct precipitation (e.g., no run-on or groundwater input). Water quality monitoring at Site 356, between Site E and the B Road (Figure 2.2), was initiated in 1995. The co-located Site 545 has been routinely monitored since 1998 as part of the Greens Creek Mine stormwater monitoring program.

In late 2002 and in 2003, three monitoring wells were installed and 13 surface water sampling sites were established at Site E to better understand the potential pile influence on the area. The surface water sampling program has since been reduced to only 6 sites. Figure 2.2 shows the locations of these sites. Water quality data for the wells and surface water sites are shown on Figures 2.21 to 2.34. The wells were not sampled in 2015, nor was one of the surface water sites (Site 708) due to lack of flow when visited in August. One of the wells (MW-E-02-03) is completed in till to a depth of approximately 99 feet, and the two other wells are completed in gravels at 76 and 86 feet (MW-E-02-09 and MW-E-02-12). The surface water sites depicted in the figures represent water quality at the toe of the pile (sites 708, 709, and 710, along with the older site 356), and two downgradient drainages (703 and 704) that report to Greens Creek. Two sites in Greens Creek, one upgradient of Site E (711) and one downgradient (712), were added to the HGCMC Fresh Water Monitoring Program in 2014. Monitoring data for those sites are presented in the HGCMC "Fresh Water Monitoring Program Annual Report, Water Year 2015" and are not included in this report. Sulfate and metals concentrations are relatively high near the toe of the pile, but decrease as the distance from Site E increases. Monitoring at Site E will continue until final reclamation is completed.

Greens Creek compared the relative costs of recountouring and covering the pile versus consolidating it with one of the other surface facilities, and found that relocating the material to the surface tailings facility for co-disposal is the most economical and environmentally protective solution. Removal of production rock material from Site E for disposal at the tailings facility commenced in 2006. Between 2006 and 2011, a total of approximately 101,400 cubic yards of material were removed from Site E. In 2015, approximately 20,500 cubic yards of material were hauled to the tailings facility, bringing the total volume removed to approximately 121,900 cubic yards. HGCMC plans to remove the remaining production rock from Site E for disposal in the tailings expansion area.

2.7 2.5 Mile B Road Cut

Pyritic rock was exposed in the road cut at 2.5 mile during construction of the B Road in 1988. Weathering has decreased the reactive surface area of pyrite grains in the outcrop, and precipitation of hydroxide coatings has further decreased the reactivity of the rock. HGCMC will use monitoring of Zinc Creek to determine if additional efforts are required at the road cut. HGCMC has determined that Site 8 (inactive FWMP site) is an appropriate monitoring point in Zinc Creek below the road cut to evaluate its effects on water quality. Site 8 is located immediately above the confluence of Tributary Creek with Zinc Creek. Very limited sampling has occurred at this site since 1995, but semi-annual monitoring began in 2015 and will continue. The results from the 2015 sampling are included in Table 2.3 below for comparison with other up-gradient Zinc Creek monitoring data. The results show a slight increase in conductivity, manganese and sulfate between Site 8 and Site 368.

Two areas along the B road corridor were filled with material from the 2.5 mile B Road cut: 1.8 mile pullout and Zinc Creek Bridge Abutment.

1.8 Mile Pullout

Pyritic rock from the road cut at 2.5 mile B Road was used as fill for the 1.8 mile B Road pullout. HGCMC redirected road ditch water around the pad to reduce infiltration through the pyritic rock. HGCMC plans to continue monitoring this site, with removal of the pyritic material following removal of other higher priority sites.

Zinc Creek Bridge Abutment

Pyritic rock from the road cut at 2.5 mile B Road was also used as fill in the abutment of the Zinc Creek Bridge during road construction. Iron staining and poor quality runoff has been observed at the site. HGCMC maintains an APDES stormwater monitoring point at the site and has sampled the water composition of Zinc Creek above (Site 371) and below (Site 368) the bridge. Monitoring data (Table 2.3) demonstrate that the contribution of runoff has a detectable influence on the quality of Zinc Creek. The data indicate that concentrations are below water quality standard levels for constituents having practical quantification levels (PQL) low enough to compare to the standard. HGCMC applied lime to the fill in 2013. Additional treatments will be applied as needed prior to mine closure, when the pyritic rock will be removed with recovery and reclamation of the road. Sampling results from 2006 through 2015 show the pH values are not decreasing and the metals concentrations are not increasing with time.

Table 2.3 Zinc Creek Water Compositions

	Site	Date	pH	Cond	Alk	Mg	SO4	As	Cd	Cu	Fe	Mn	Ni	Pb	Zn
			s.u.	uS/cm	mg/l	mg/l	mg/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Zinc Creek Above Bridge	371	Mar-06	7.2	127.4	46	3.2	6.0	0.6	<0.2	0.6	0.0	2.7	2.3	0.1	2.4
	371	May-07	7.2	58.2	20	1.4	2.0	0.4	<0.2	0.8	51.7	2.4	2.1	0.2	9.0
	371	Dec-07	7.8	120.8	50	2.8	5.0	0.4	<0.3	0.7	<50	2.6	1.5	<0.1	4.1
	371	Aug-09	6.7	77.4	33	2.4	4.2	0.6	0.1	2.6	<27	2.4	2.9	0.1	6.6
	371	Jan-10	7.5	97.3	<2	2.4	5.2	0.4	<0.1	1.5	64.8	1.8	2.4	0.1	5.5
	371	Apr-11	7.5	107.0	35	2.4	4.3	<0.5	<0.1	1.0	50	1.8	1.7	<0.1	7.0
	371	Sept-11	6.8	79.0	37	2.4	4.2	0.5	<0.1	1.3	210	2.5	2.0	<0.1	6.0
	371	Jul-12	7.7	65.0	24	1.7	2.5	<0.2	<0.1	4.0	160	2.6	2.2	0.1	11
	371	Mar-13	7.7	125.0	45	2.9	5.0	0.4	<0.1	2.6	50	1.9	1.5	<0.1	5.0
	371	Mar-14	7.6	110.0	47	2.8	7.0	0.2	<0.1	<0.5	30	1.5	1.1	<0.1	5.0
	371	Nov-14	7.2	79.0	32.9	2.0	3.5	0.3	<0.1	0.8	150	3.4	1.9	<0.1	6.0
	371	Apr-15	6.7	79.0	32.9	2.0	3.6	0.3	<0.1	0.8	70	1.4	1.8	<0.1	3.0
	371	Oct-15	7.9	88.8	43.5	2.5	4.7	0.3	<0.1	0.9	70	2.2	2.1	<0.1	5.0
Zinc Creek Below Bridge	368	Mar-06	7.1	121.3	42	3.7	11.9	0.3	<0.2	3.4	0.3	40	5.5	<0.1	12.0
	368	May-07	7.2	58.4	21	1.4	2.2	0.4	<0.2	0.9	59.7	3.0	2.1	0.1	8.6
	368	Dec-07	7.6	123.9	49	2.8	6.9	0.2	<0.3	1.0	120	12	2.7	<0.1	6.7
	368	Aug-09	6.8	80.4	34	2.3	4.8	0.5	0.1	2.0	<27	4.9	2.9	0.2	7.7
	368	Jan-10	7.6	101.0	<2	2.6	6.6	0.4	0.1	5.7	239	7.3	3.3	0.1	10.8
	368	Apr-11	6.6	114.0	32	2.8	8.5	0.6	<0.1	1.8	410	10.6	3.7	<0.1	12.0
	368	Sept-11	7.8	81.0	36	2.4	6.1	<0.5	<0.1	1.6	230	5.6	2.8	<0.1	8.0
	368	Jul-12	7.5	64.0	22	1.7	3.4	<0.2	<0.1	2.9	290	6.0	3.0	<0.1	12.0
	368	Mar-13	7.6	130.0	43	3.1	8.2	0.3	<0.1	2.7	240	8.4	2.6	<0.1	8.0
	368	Mar-14	7.5	117.0	46	3.2	11.3	<0.2	<0.1	1.0	270	12.3	2.3	<0.1	7.0
	368	Nov-14	7.0	80.1	32.1	2.1	4.8	0.3	<0.1	1.0	240	6.9	2.3	<0.1	6.0
	368	Apr-15	7.3	80.0	31.3	2.1	4.7	0.3	<0.1	1.0	170	4.0	2.2	<0.1	3.0
	368	Oct-15	7.8	90.8	43.0	2.6	6.3	<0.2	<0.1	1.3	180	6.6	2.5	<0.1	7.0
Zinc Cr Above Tributary Creek	8	Apr-15	7.2	84.0	32.1	2.2	7.3	0.3	<0.1	1.0	170	4.8	2.1	<0.1	<2.0
	8	Oct-15	7.6	99.6	43.5	2.8	9.3	0.2	<0.1	1.1	180	14.1	2.3	<0.1	5.0

3.0 Quarries

3.1 Introduction

Five quarry sites were developed in 1987 and 1988 to provide rock for constructing roads and other infrastructure at the Greens Creek facilities. All quarries are currently inactive and are being used to stockpile reclamation materials (rock, organic soils and glacial till). A summary of all operational and monitoring activities performed at these five quarry sites (borrow pits) in 2015 is provided. Refer to GPO Appendix 1 for a description of the monitoring requirements.

Summary statistics for HGCMC's quarry sites are presented in Table 3.1. Flow and water quality data are summarized in Figures 3.1 to 3.15. The sites are discussed individually in subsequent sections. Refer to Figure 2.1 for site locations.

Table 3.1 Summary Statistics for Quarry Sites

	Quarries				
	Pit 405	Pit 6	Pit 174	Pit 5	Pit 7
Years Active (approx)	1987-1988	1987-1988	1987-1988	1987-2003	1987-1997
Acreage	3	3	2	Part of NW Tailings Expansion	4
Total Volume (cy)	17,000	22,800	10,000		153,800
Prod Rock/Other Vol (cy)	13,000	0	0		0
Reclamation Material (cy)	4,000	22,800	10,000		153,800

Acid Base Accounting data collected from 2002 to 2013 are summarized in Figures 3.16 and 3.17. Pit 405 and Pit 174 have significant exposures of potentially acid generating rock and produced several samples with acidic rinse pH. Pit 6 and Pit 7 produced samples showing a broad distribution of NNP and rinse pH, and Pit 5 generally produced acid neutralizing samples with alkaline rinse pH. Buildup of oxidation products (salts) on overhanging quarry walls was noted at each of the five quarry sites and may have contributed to the lower rinse pH readings for several samples.

Flow data for the quarry sites are presented in Figure 3.1. Much of the flow data prior to 2003 were collected during or shortly following storm events and represents maximum flow values. Recent flow estimates vary from 60 gpm to less than 1 gpm with most less than 10 gpm. The bowl-shaped geometry and low permeability of the quarry walls and floors tend to focus flow toward the entrance of the pits.

The amount of reactive surface area available for sulfide oxidation is considerably less for quarries than for production rock piles. Oxidation is limited to the non-coated outer face of the near-vertical quarry wall and near surface fractures. Lower sulfide contents and smaller surface area yield a lower flux of oxidation products from quarries compared to production rock sites.

Figure 3.2 shows pH data from the quarry site sampling locations. Since 1995 all but two samples have had a pH between 6.0 and 8.0. A pH of 5.8 was recorded from Pit 174; however, more recent samples from this site were above 7. Alkalinity data presented in Figure 3.3 are consistent with the pH results, with all sites maintaining measurable alkalinity provided by dissolution of carbonate minerals. The lower alkalinity value from Pit 6 represents influences from organic acids derived from forest soils (note associated low conductivities of Pit 6 samples). Sample sites with the highest alkalinity are groundwater monitoring wells in Pit 5, which is now part of the tailings facility.

Conductivity data are shown in Figure 3.4. Conductivity indicates the amount of dissolved constituents in the water. Samples having higher conductivity values usually have higher sulfate, calcium and magnesium (hardness) concentrations, reflecting influences from sulfide oxidation and carbonate mineral dissolution. Conductivity data are consistent with waters derived from freshly exposed low to moderately mineralized quarry rock. The results for sulfate, magnesium and hardness, shown in Figures 3.5, 3.6 and 3.7, respectively, correlate with conductivity results.

The data for zinc, copper, lead, cadmium, nickel, arsenic, iron and manganese are presented in Figures 3.8 to 3.15. Sample results that were less than the detection limit are plotted at one half the detection limit value. While this allows the results to be plotted on graphs, it causes non-detect results with high detection levels to appear more concentrated than they actually are. Detection limits have varied with time and are often evident on the graphs as horizontal groupings of symbols. The results for metals generally correlate with conductivity values. Zinc and manganese concentrations reflect the higher solubility of these elements relative to the others at the near-neutral pH conditions. Dissolved metal loads from quarry sites have been consistently low and generally either remained fairly constant or decreased with time. The decrease in dissolved metal loading is attributed to a reduction of reactive surfaces as reactants are consumed and coatings form on mineral surfaces. Elevated total metal concentrations occur periodically in response to increased suspended solids during storm events. The stormwater monitoring data are presented to provide a general indication of the effects of sediment loading, typically from road surfaces, and do not reflect dissolved loading from the quarry walls.

Closure options for pyritic pit walls are relatively limited. Since there are no proven long term surface treatments available, it is best to let naturally occurring coatings that have formed over the past 20 years continue to form. As the coatings form and the amount of available pyrite decreases, so too will the relatively small dissolved load generated by these surfaces.

3.2 Pit 405

Pit 405 is located at 7.6 mile on the B Road. The rock from this quarry was used for construction of the B Road and other mine infrastructure. Mine records indicate that approximately 13,000 cubic yards of production rock were backfilled into the quarry in 1988. The quarry received reclamation materials (colluvium and glacial till) in 1994, 1995 and 1998 for use in future reclamation projects. HGCMC drilled a hole through the fill material in June of 2005 to characterize the materials. The profile at the center of the pit from the surface down consists of approximately two feet of glacial till and organics (fill), 15 feet of sericitic phyllite (waste rock) and 22 feet of grey silty till (fill). The foundation of the pit is fractured, pyritic, chloritic rock.

Monitoring of drainage downgradient of the quarry (Figures 3.1 to 3.15) demonstrates that influences from the site are negligible. The site will be reclaimed when the reclamation materials stored in the quarry have been utilized at other sites. The production rock in the quarry will either be removed or covered in-situ. Removal of the rock could prove detrimental as this would increase exposure of the now covered pyritic quarry wall.

3.3 Pit 6

Pit 6 is located at 4.6 mile on the B Road across from Site E. The quarry produced rock for construction of the B Road in 1987. Reclamation materials were hauled to the site from Site 23 and the 920 facility during various construction seasons. Monitoring of surface drainage from the pit access ramp indicates no significant influence from the pit walls or stored material. Reclamation materials will be used to reclaim other mine facilities. Approximately 3,800 cubic yards of reclamation materials from the backslope of Site 23 were hauled and stored at Pit 6 in September 2007. Reclamation material (6,500 cy) from the top of Site E was hauled to Pit 6 in 2009. Water quality at the stormwater sampling site at Pit 6 showed increases in total lead and zinc in 2009, potentially attributable to hauling the reclamation materials from Site E to Pit 6. Since 2010, lead and zinc levels have returned to within historical levels at this site. The elevated lead levels shown on Figure 3.10 in 2013 and 2014 are the result of analytical error in which the incorrect MDL was used for the analyses. The actual results were non-detect, but are plotted on the figure at one-half the MDL. Lead levels in 2015 were non-detect at a MDL of 0.1 µg/L.

3.4 Pit 174

Pit 174 is located at 3.3 mile on the B road and was used for road construction in 1987. The pit has been partially backfilled with reclamation materials that will be used to reclaim other site facilities. Drainage from the site has an average pH of 6.7 (Figure 3.2). Sulfate and metal concentrations in the pit drainage are moderate, however flows are generally low (typically less than 10 gpm during rain events). Iron staining periodically occurs in the drainage below the site which collects runoff from this quarry and surrounding areas. Once the stored reclamation materials (rock, organic soils and glacial till) are utilized, the site will be reclaimed. Reclamation goals include minimizing runoff from the exposed pit wall and covering as much of the exposed pyritic rock as possible by placing a wedge of glacial till at the base of the wall.

A runaway truck ramp was installed at Pit 174 following a haul truck incident at the site in 2006. The water tank was also moved from the quarry to the other side of the haul road to facilitate the emergency access route to the truck ramp.

3.5 Pit 5

Pit 5 was located in the northern portion of the Tailings Facility at 0.8 mile on the B Road, and until 2008 housed the water treatment plant. The Pit 5 water treatment plant was decommissioned in June of 2008. Rock from the pit was originally used for construction of roads and other surface facility infrastructure. Approximately 13,500 cubic yards of rock were quarried from Pit 5 in 2002. Between 2006 and 2008 approximately 268,110 cubic yards of shot rock were taken from Pit 5 in conjunction with the tailings expansion. The expansion of the Tailings Facility in the Pit 5 area was completed in 2008. The Pit 5 area is now completely backfilled with tailings (northwest area) which is underlain with an HDPE liner tied into the natural till underlying the tailings pile to the south.

Lead and zinc levels in MW-T-01-07 and MW-T-01-09 have fluctuated widely since 2006. Fluctuations in metal concentrations appear to be independent of major ion concentrations and may reflect changes in carbonate speciation and sorption/desorption mechanisms resulting from covering the quarry floor with a liner.

3.6 Pit 7

Pit 7 is located at 1.8 mile on the A Road between Hawk Inlet and Young Bay. The pit was initially developed in 1987 to support construction of the roads and other mine facilities. Pit 7 has been partially backfilled with overburden material derived during expansion of the tailings pile and development of the sand pit at 1.4 mile on the A Road. In 2008 crews stockpiled, crushed and hauled sorted material from the 1.4 mile sand pit to Pit 7. Despite iron staining on the south pit wall, iron staining observed in the drainage from the pit is mostly due to dissolution of iron-rich oxide coatings in the fill rather than from the pit walls themselves.

Monitoring results of drainage from the pit are shown in Figures 3.2 to 3.15. Relatively low sulfate concentrations (typically less than 200 mg/l) and low dissolved metal values support the conclusion that limited sulfide oxidation is occurring at Pit 7. Dissolution of iron and manganese oxides in the fill stored in the pit has produced elevated concentrations of these metals in the drainage. Oxidation of the drainage and re-precipitation of the metals is expected in the constructed wetlands downgradient of the pit. Increases in total lead and zinc concentrations were observed in stormwater samples from Pit 7 (Site 521) in 2010. The increase in total metals was accompanied by a decrease in conductivity, which suggests that entrainment of sediments from the access road during the storm event could be the source of the elevated metals. Since 2011, the zinc, lead, and conductivity results have returned to historical levels. The approved stormwater monitoring site has not yielded enough flow for sampling during routine storm event sampling since 2012.

In 2011, crews stockpiled topsoil material in Pit 7 from the East Ridge Expansion development area at the Tailings Facility. An additional 46,800 cubic yards of reclamation material was hauled to Pit 7 in 2015. This material was comprised of overburden from expansion of the sand pit at 1.4 mile on the A-Road and also a relocated stockpile of material from the 2005 construction of Pond 7 at the current tailings water treatment plant. Pit 7 currently contains approximately 153,800 cy of reclamation materials to be used for capping at closure. Following removal of stockpiled capping materials for reclamation of other sites, the Pit 7 site will be contoured and hydroseeded.

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APPENDIX 1

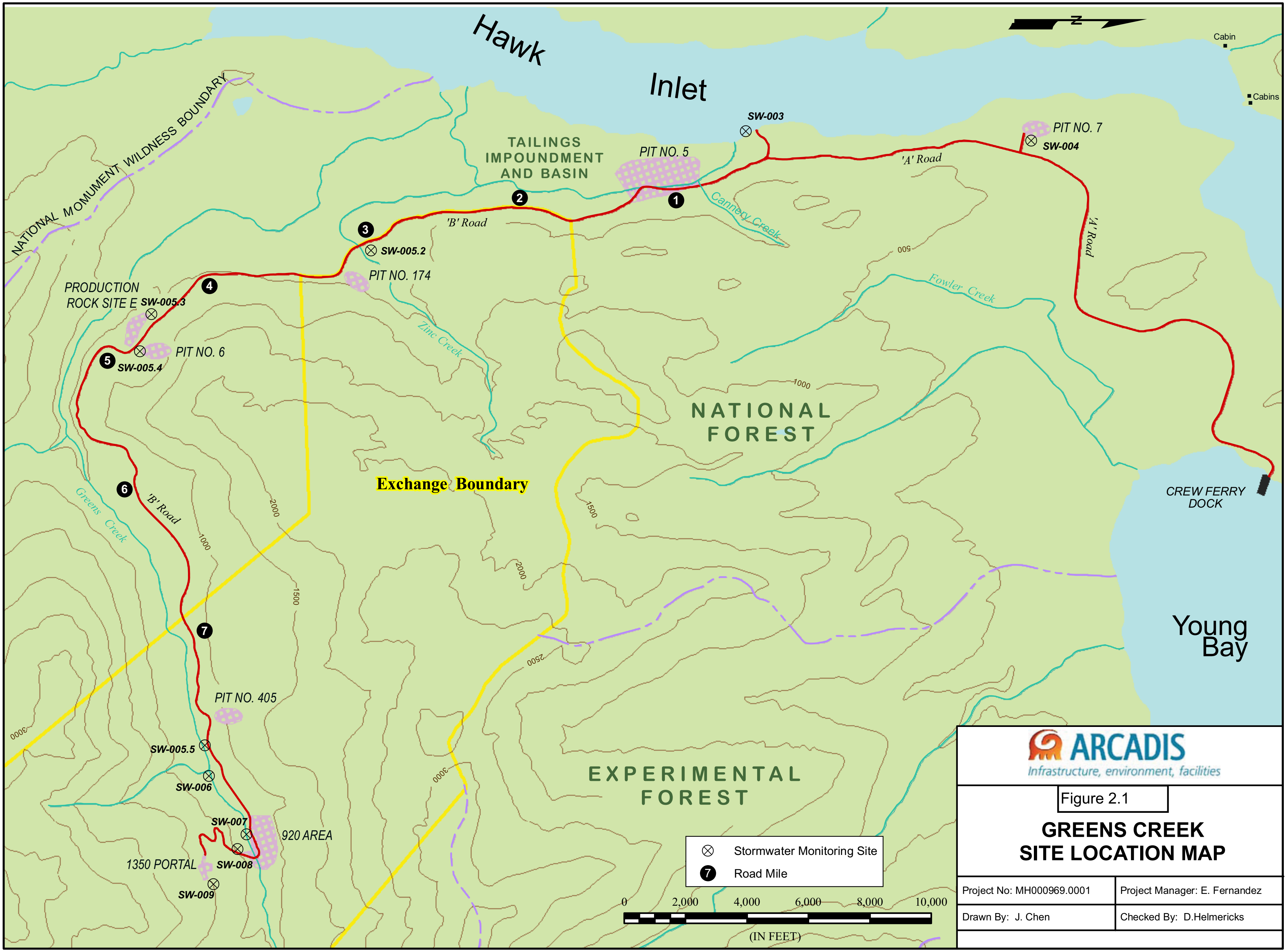


Figure 2.1

GREENS CREEK SITE LOCATION MAP

Project No: MH000969.0001	Project Manager: E. Fernandez
Drawn By: J. Chen	Checked By: D.Helmericks

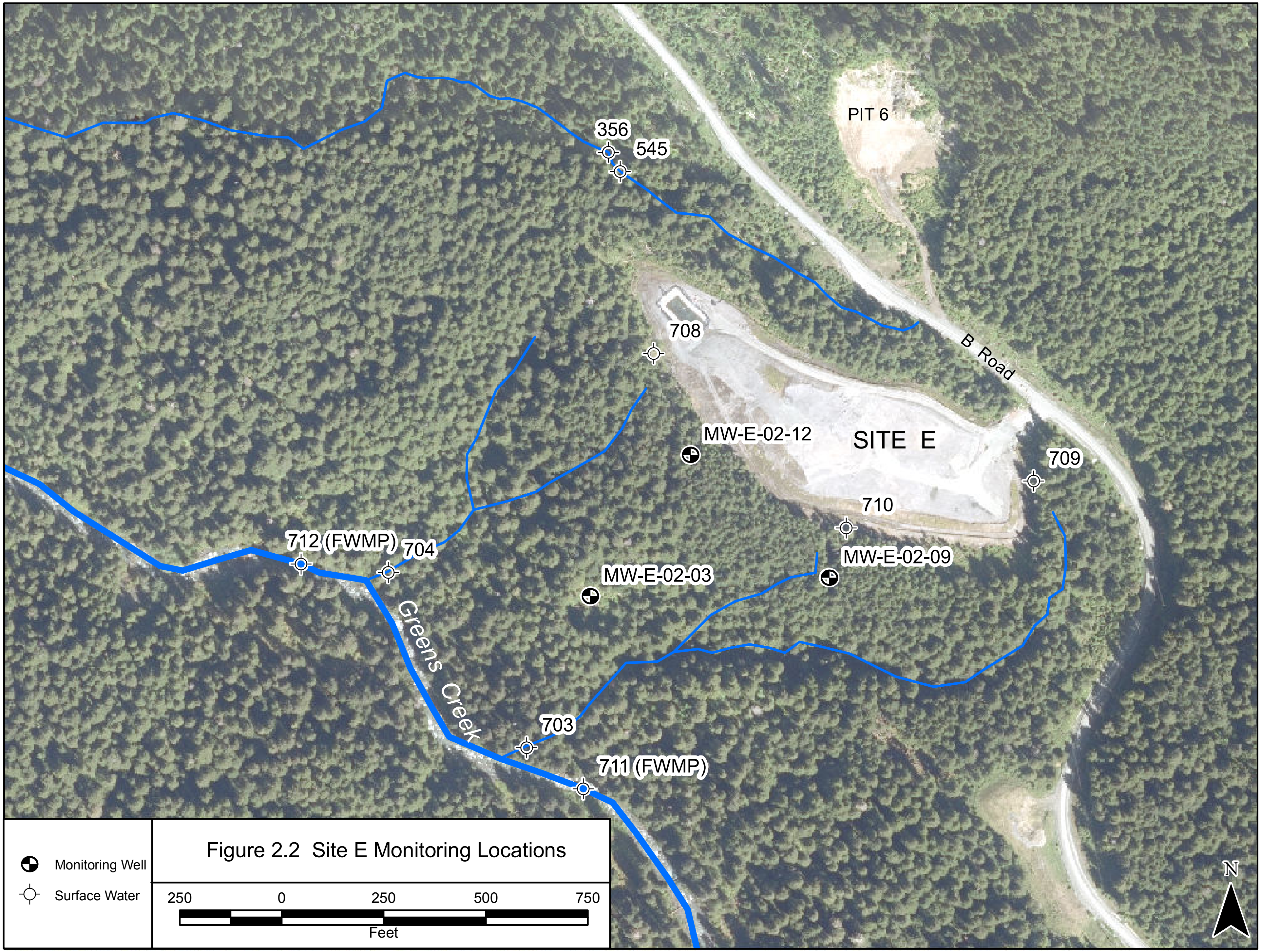


Figure 2.2 Site E Monitoring Locations

FIGURE 2.3 2002-2013 INACTIVE SITE ABA DATA

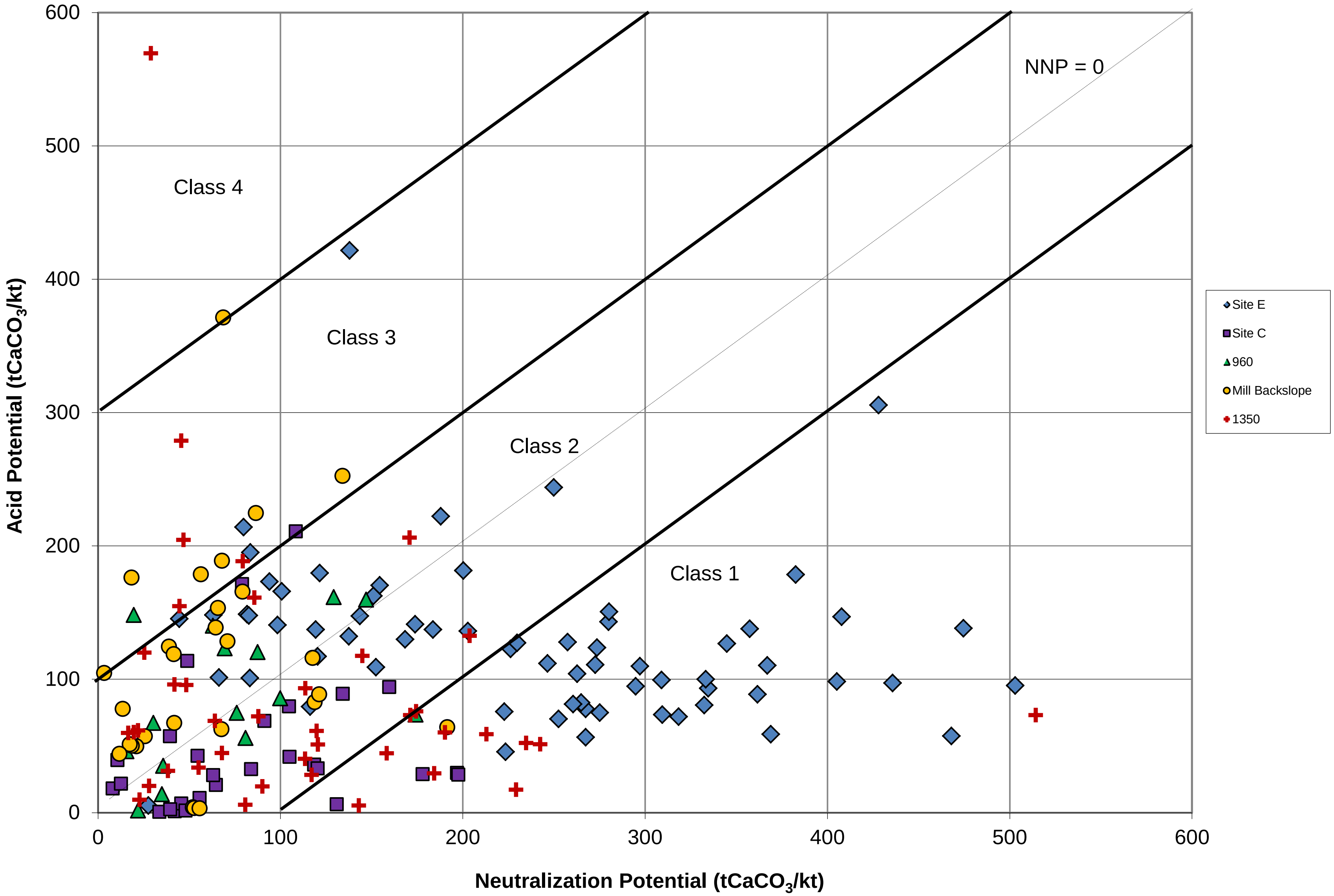


FIGURE 2.4 2002-2013 INACTIVE SITE ABA DATA (NNP vs pH)

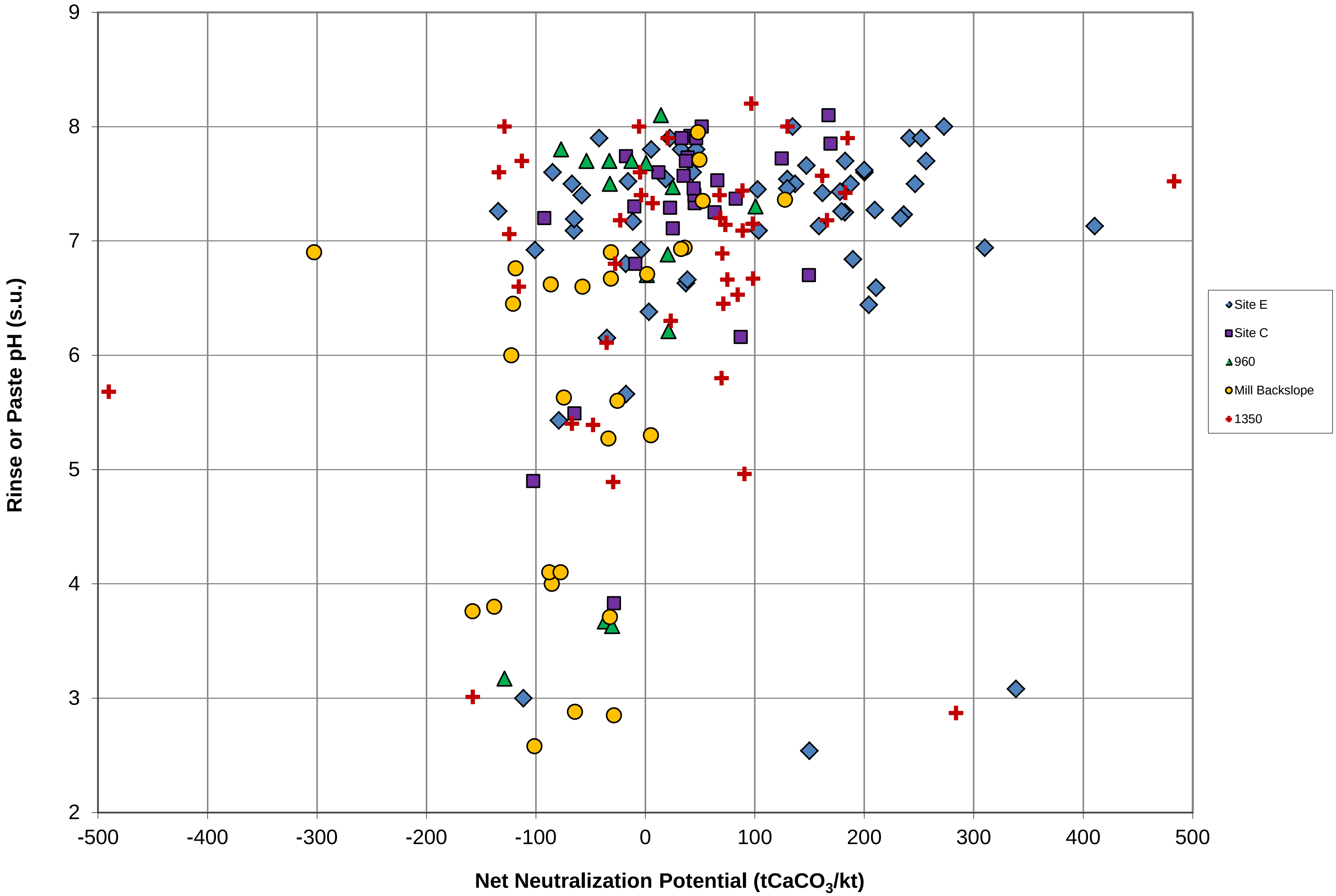


Figure 2.5 INACTIVE PRODUCTION ROCK SITE FLOW DATA

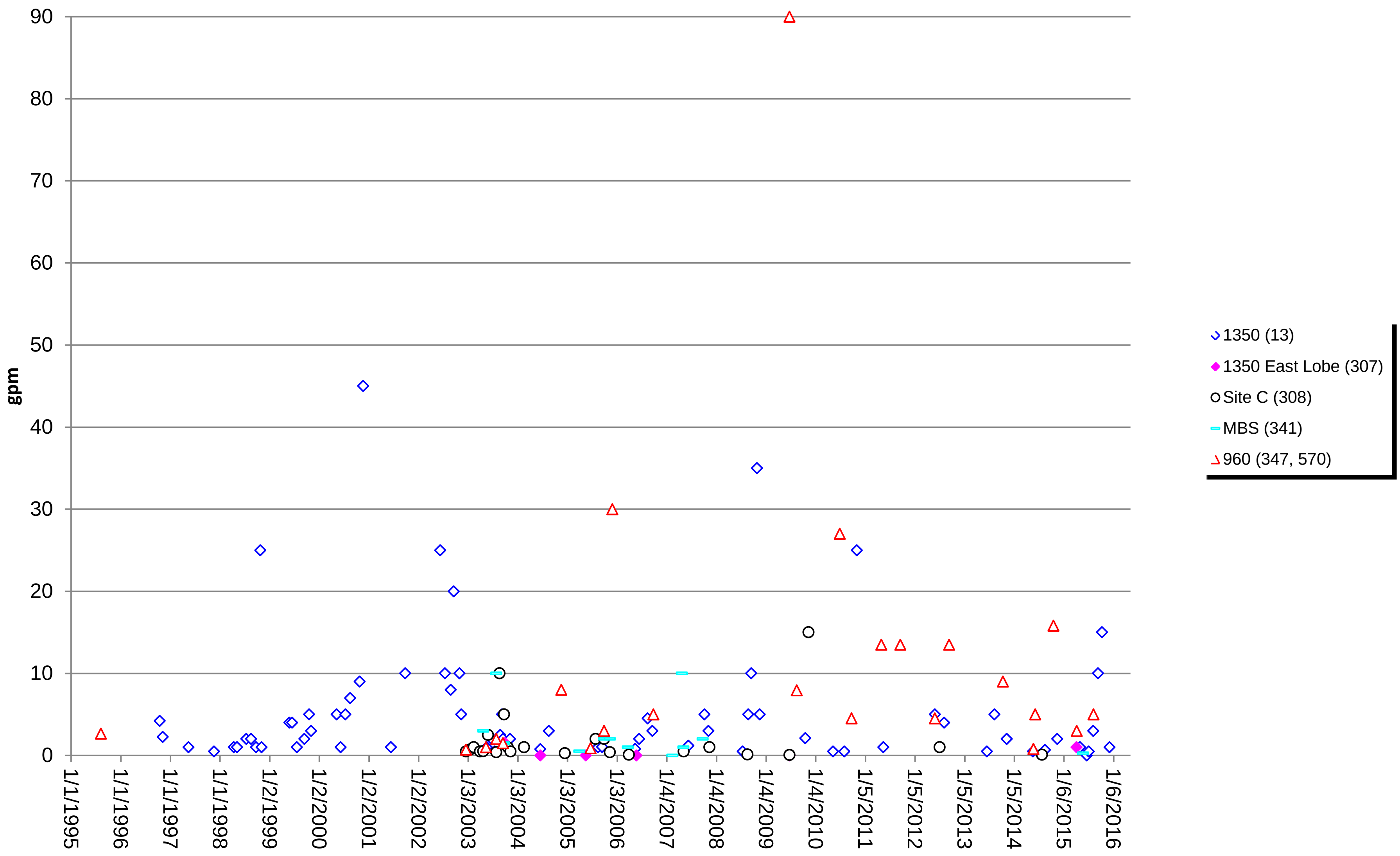
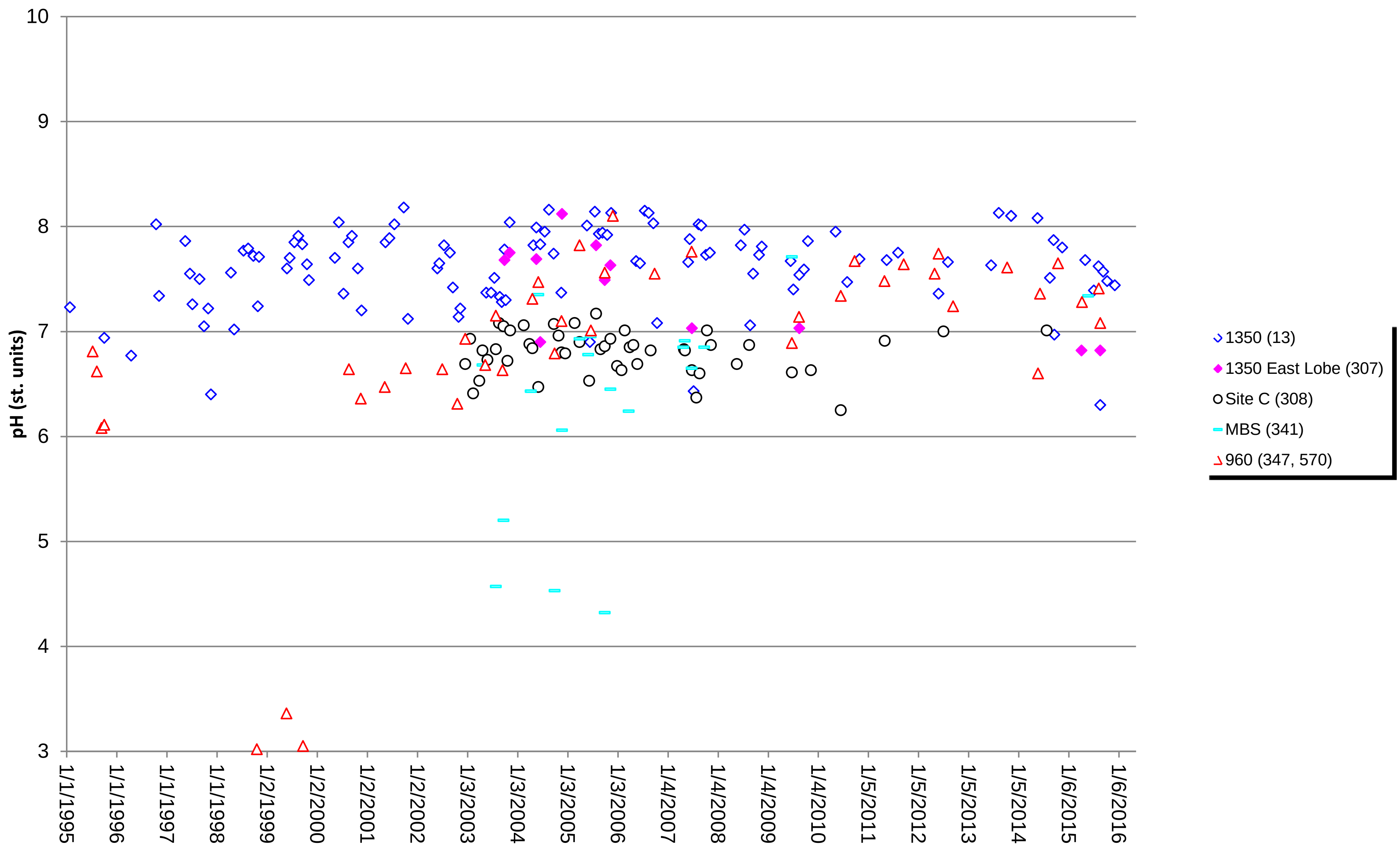


Figure 2.6 INACTIVE PRODUCTION ROCK SITE pH DATA



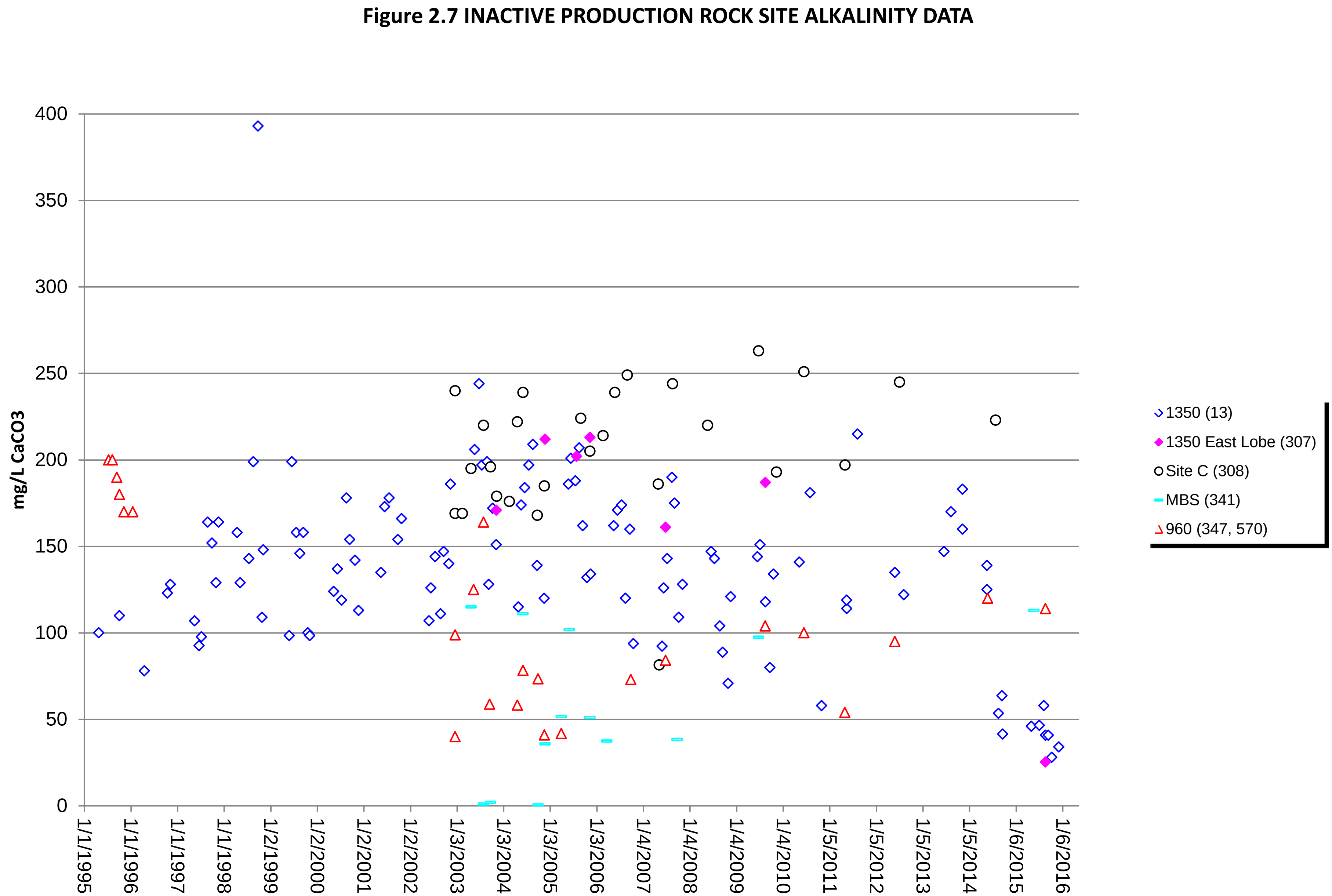


Figure 2.7 INACTIVE PRODUCTION ROCK SITE ALKALINITY DATA
mg/L CaCO3
400
350
300
250
200
150
100
50
0
1/1/1995
1/1/1996
1/1/1997
1/1/1998
1/2/1999
1/2/2000
1/2/2001
1/2/2002
1/3/2003
1/3/2004
1/3/2005
1/3/2006
1/4/2007
1/4/2008
1/4/2009
1/4/2010
1/5/2011
1/5/2012
1/5/2013
1/5/2014
1/6/2015
1/6/2016
1350 (13)
1350 East Lobe (307)
Site C (308)
MBS (341)
960 (347, 570)

Figure 2.8 INACTIVE PRODUCTION ROCK SITE CONDUCTIVITY DATA

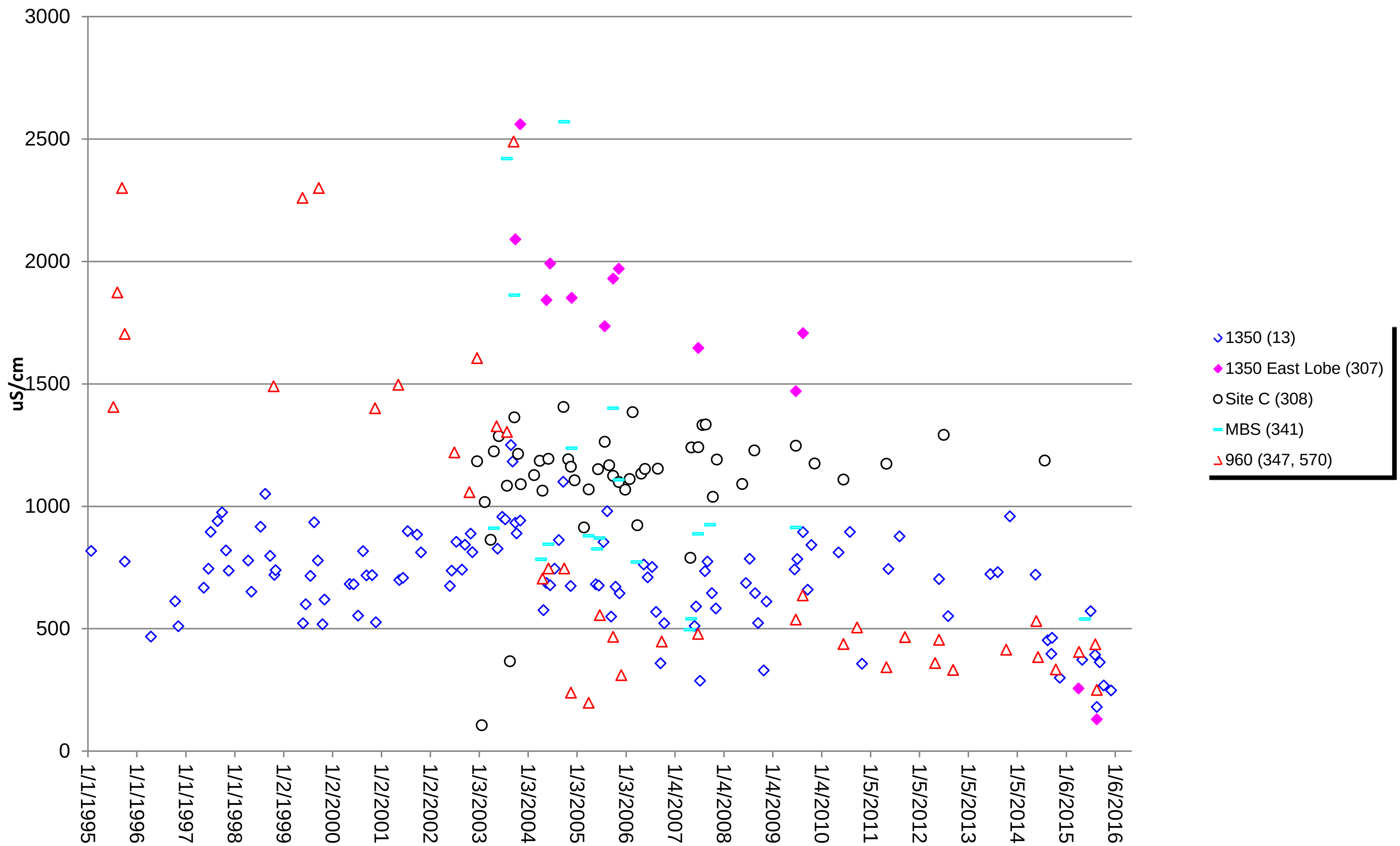


Figure 2.9 INACTIVE PRODUCTION ROCK SITE SULFATE DATA

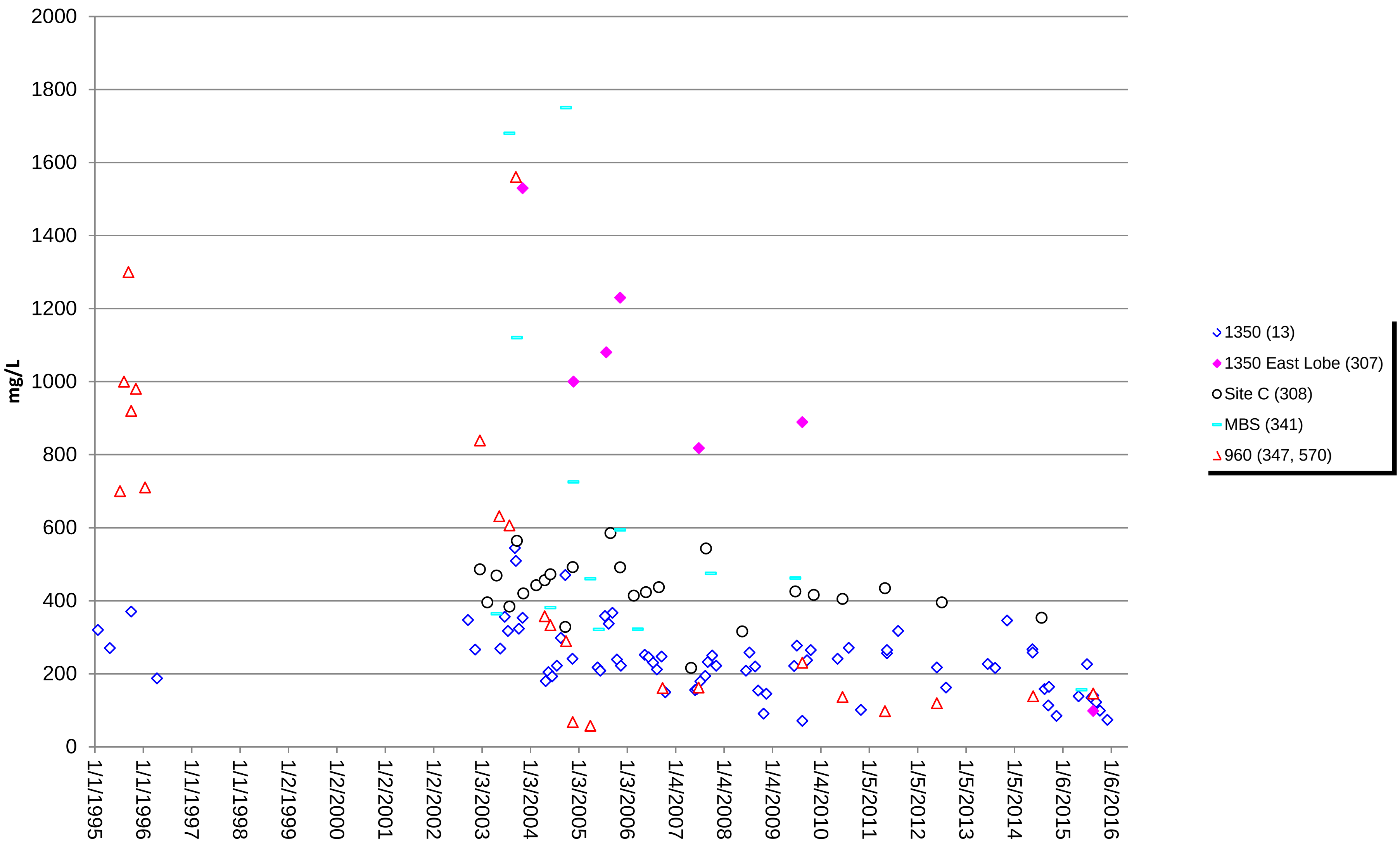


Figure 2.10 INACTIVE PRODUCTION ROCK SITE MAGNESIUM DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

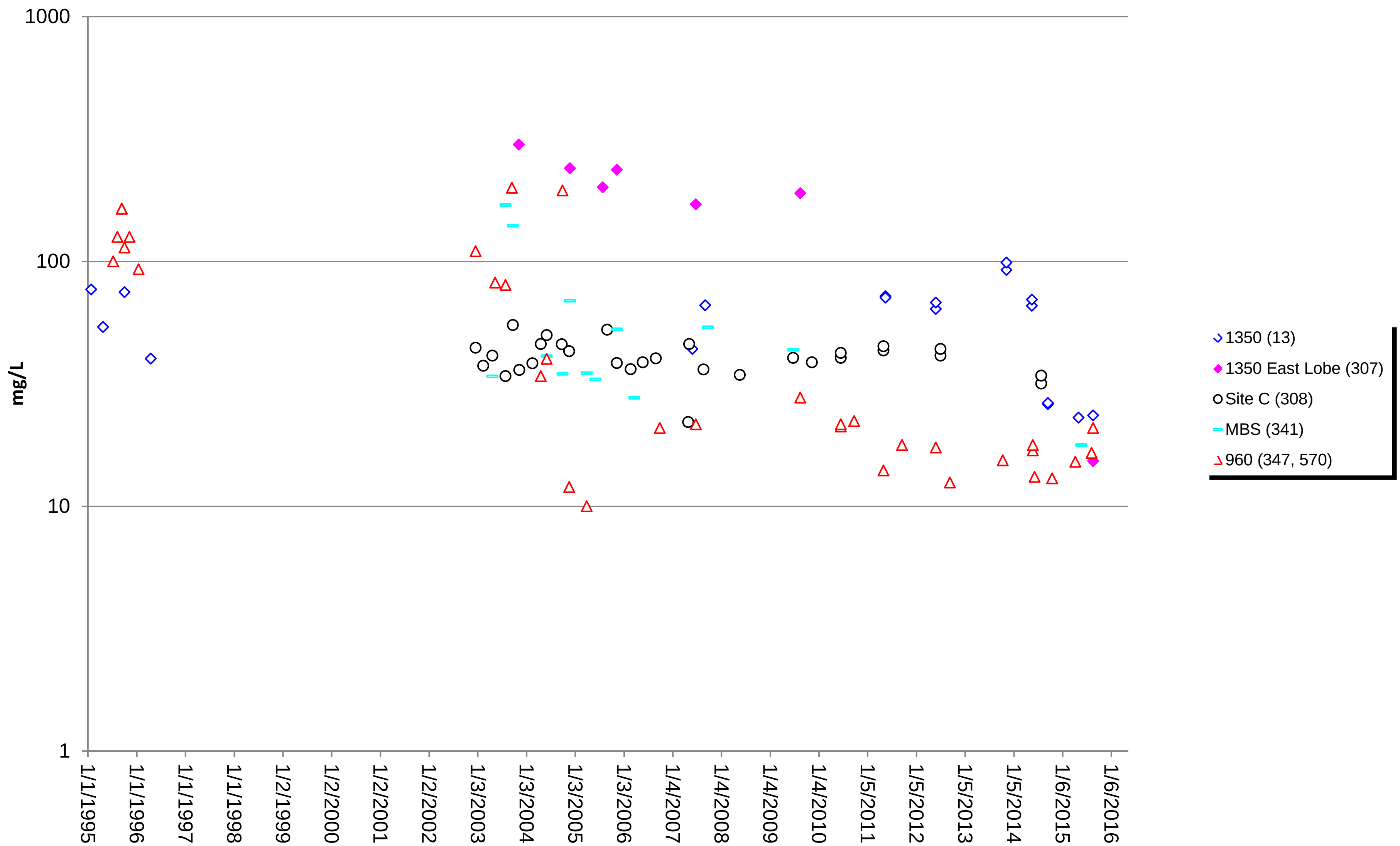


Figure 2.11 INACTIVE PRODUCTION ROCK SITE HARDNESS DATA

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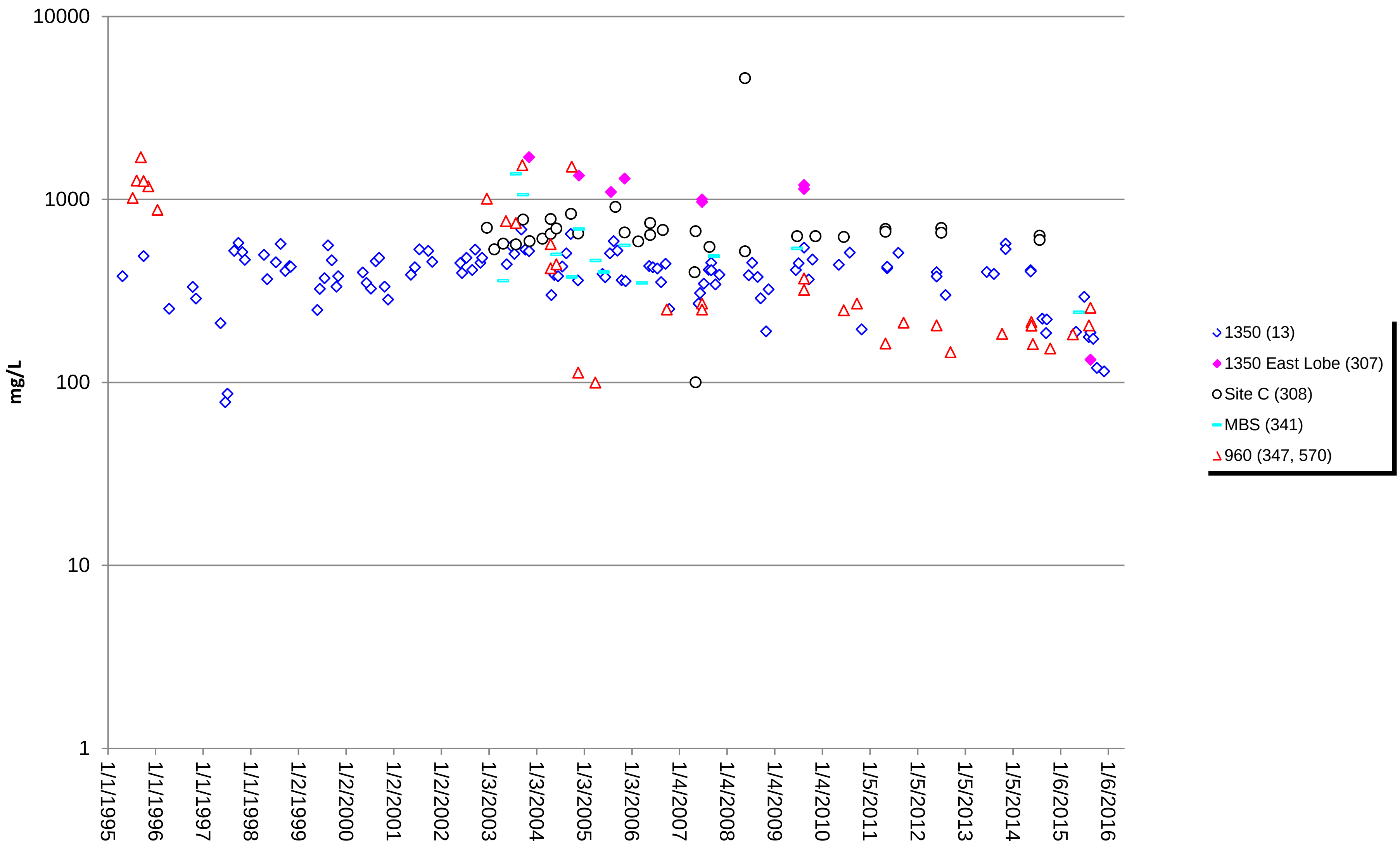

Figure 2.12 INACTIVE PRODUCTION ROCK SITE ZINC DATA

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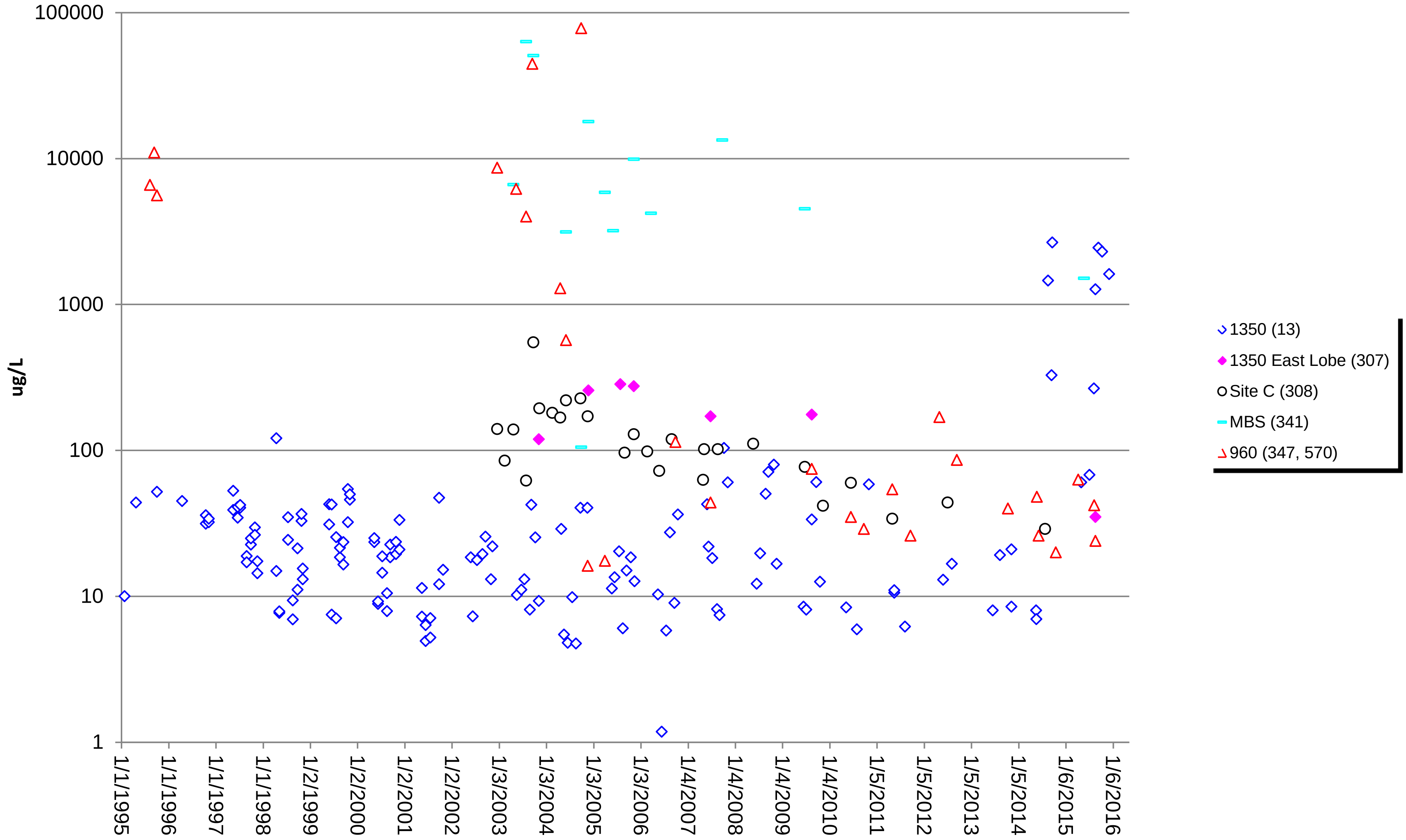

Figure 2.13 INACTIVE PRODUCTION ROCK SITE COPPER DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

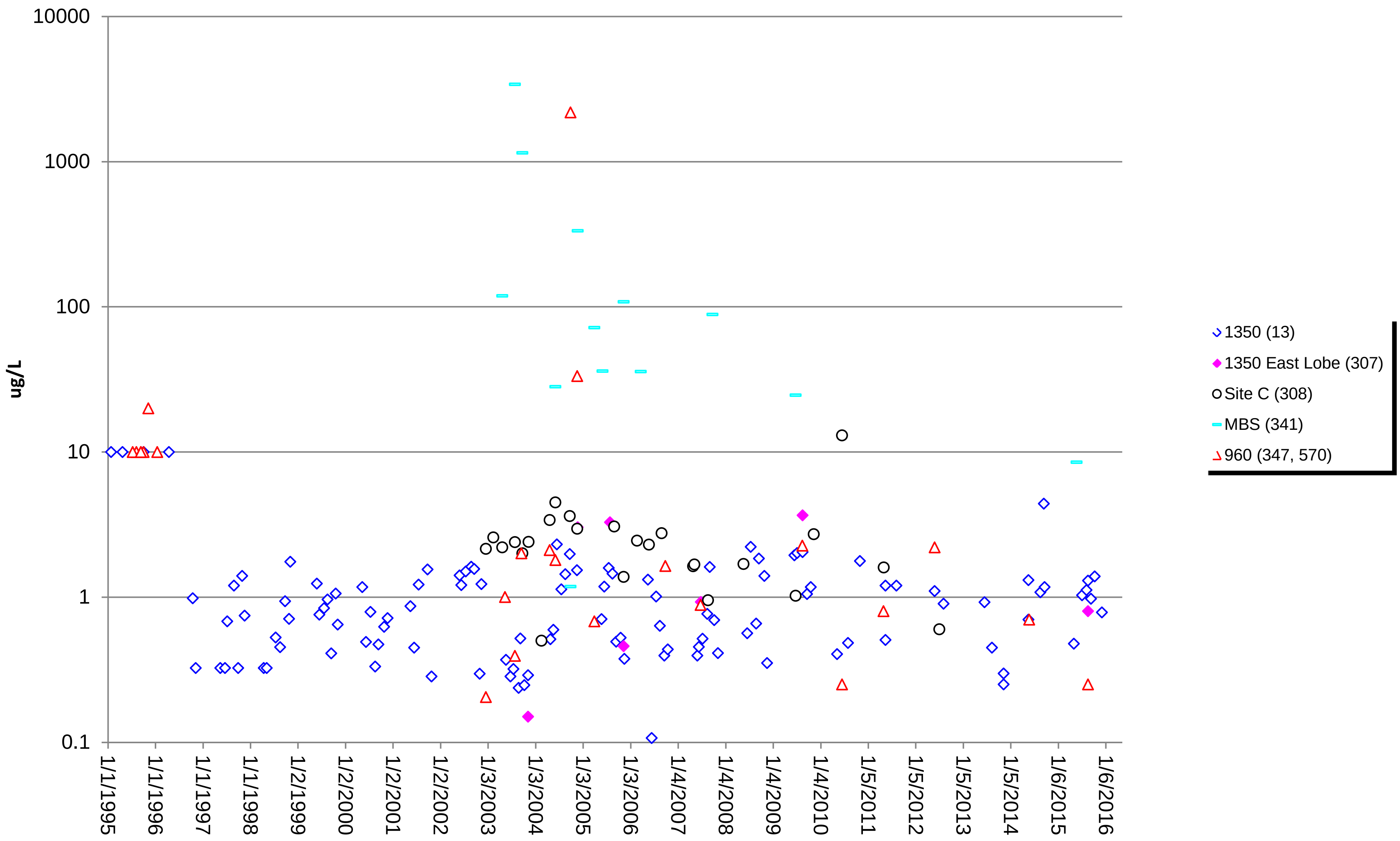

Figure 2.14 INACTIVE PRODUCTION ROCK SITE LEAD DATA

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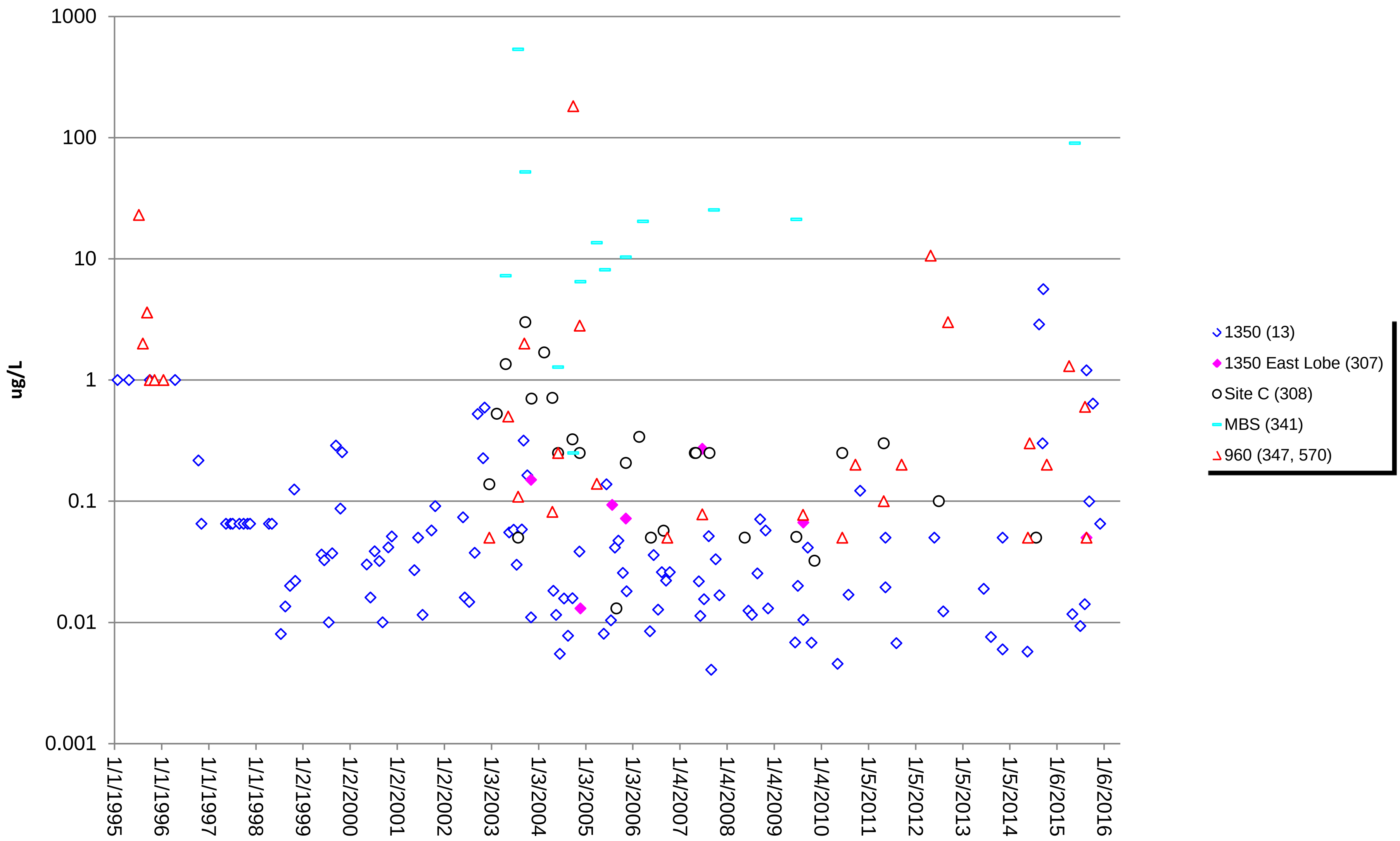

Figure 2.15 INACTIVE PRODUCTION ROCK SITE CADMIUM DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

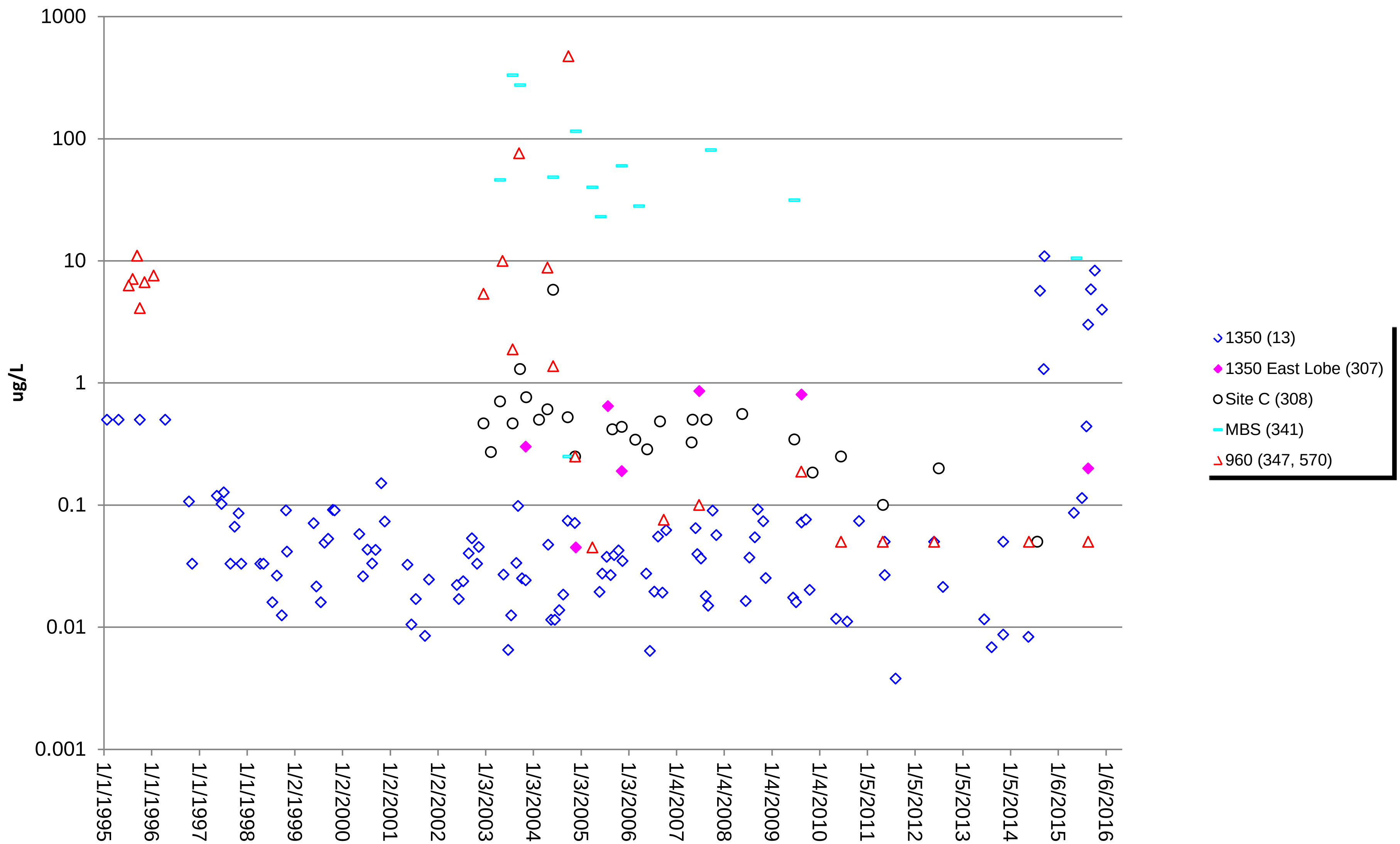

Figure 2.16 INACTIVE PRODUCTION ROCK SITE NICKEL DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

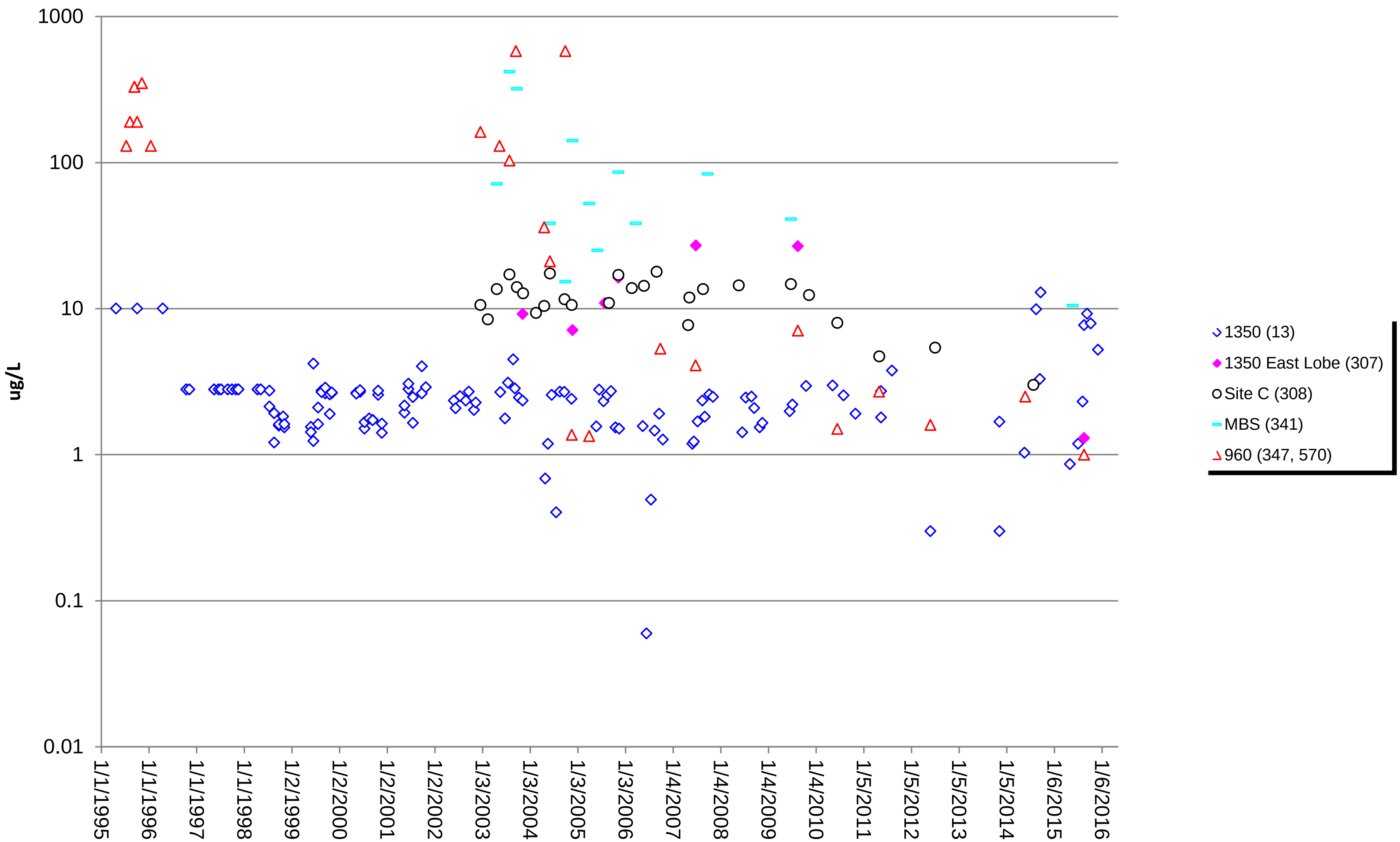

Figure 2.17 INACTIVE PRODUCTION ROCK SITE ARSENIC DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

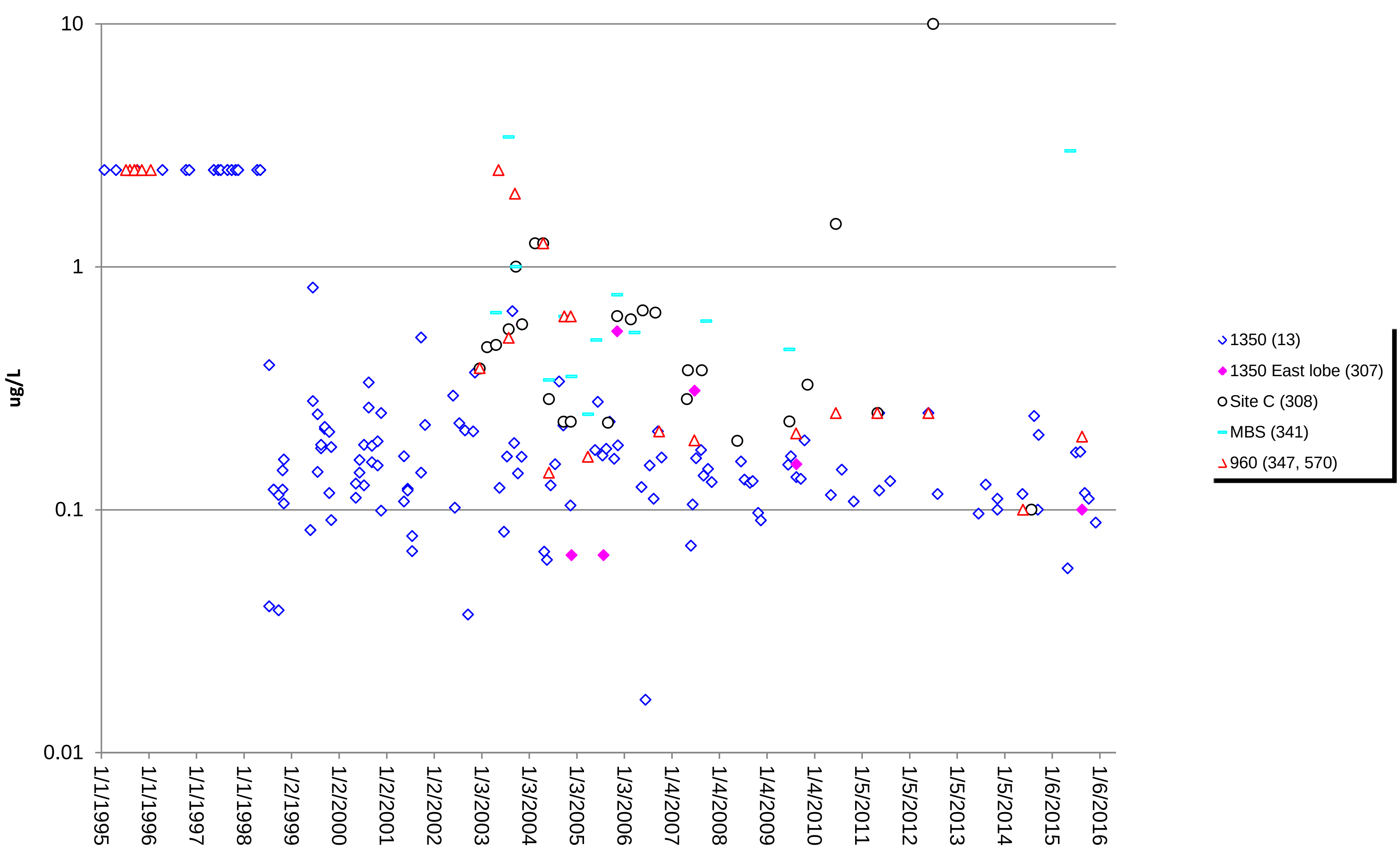

Figure 2.18 INACTIVE PRODUCTION ROCK SITE IRON DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

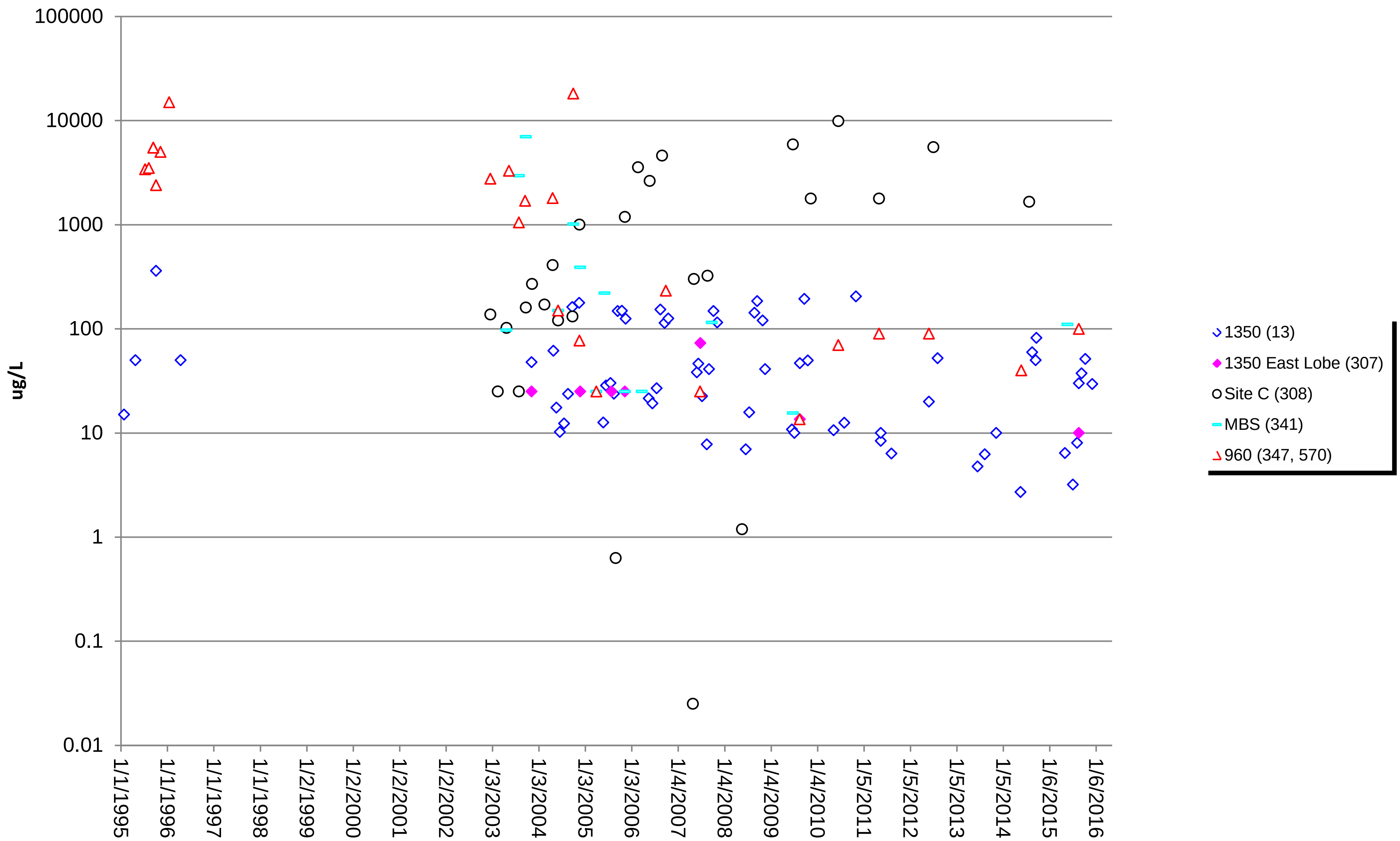

Figure 2.19 INACTIVE PRODUCTION ROCK SITE MANGANESE DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

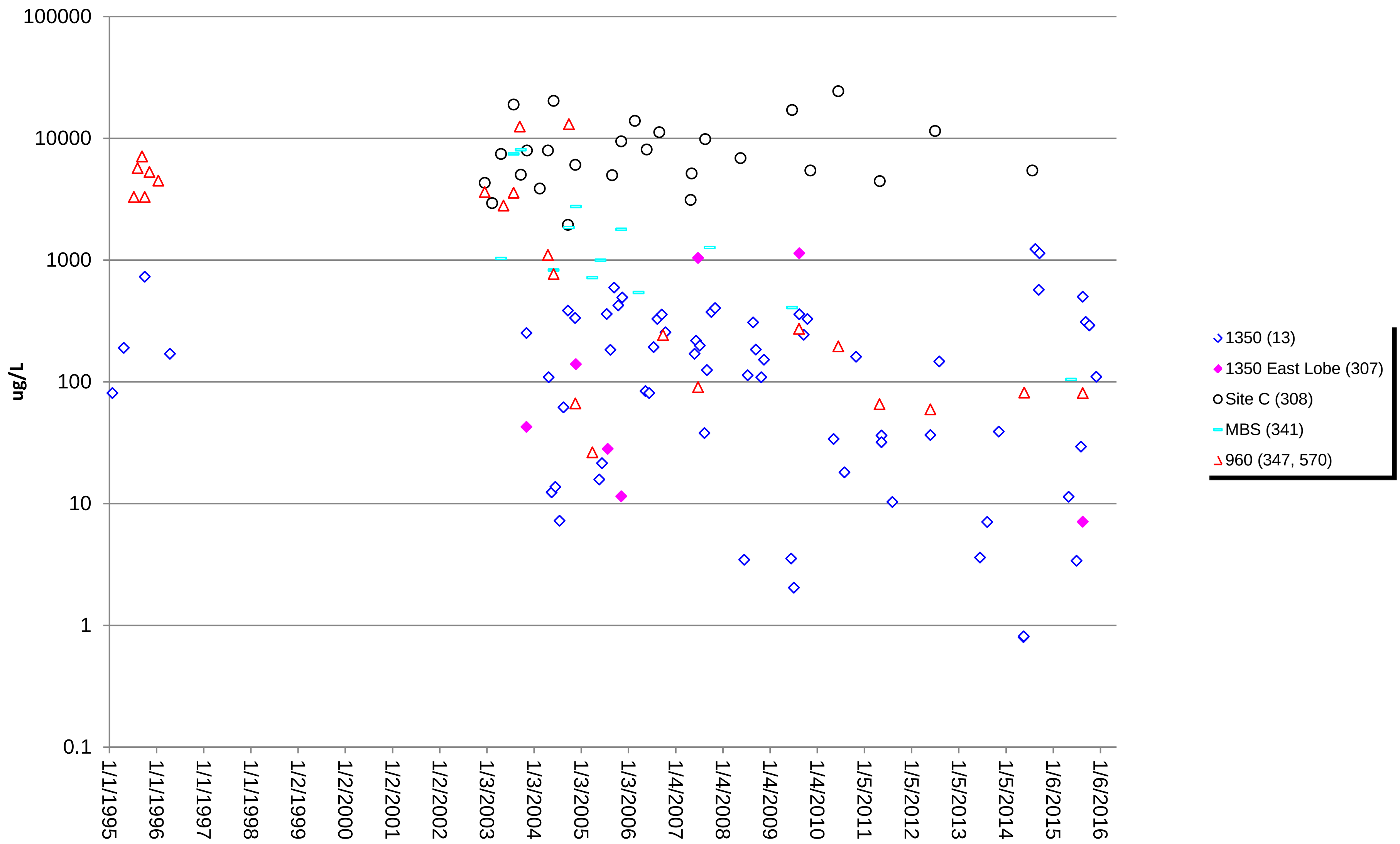

Figure 2.20 INACTIVE PRODUCTION ROCK SITE E FLOW DATA

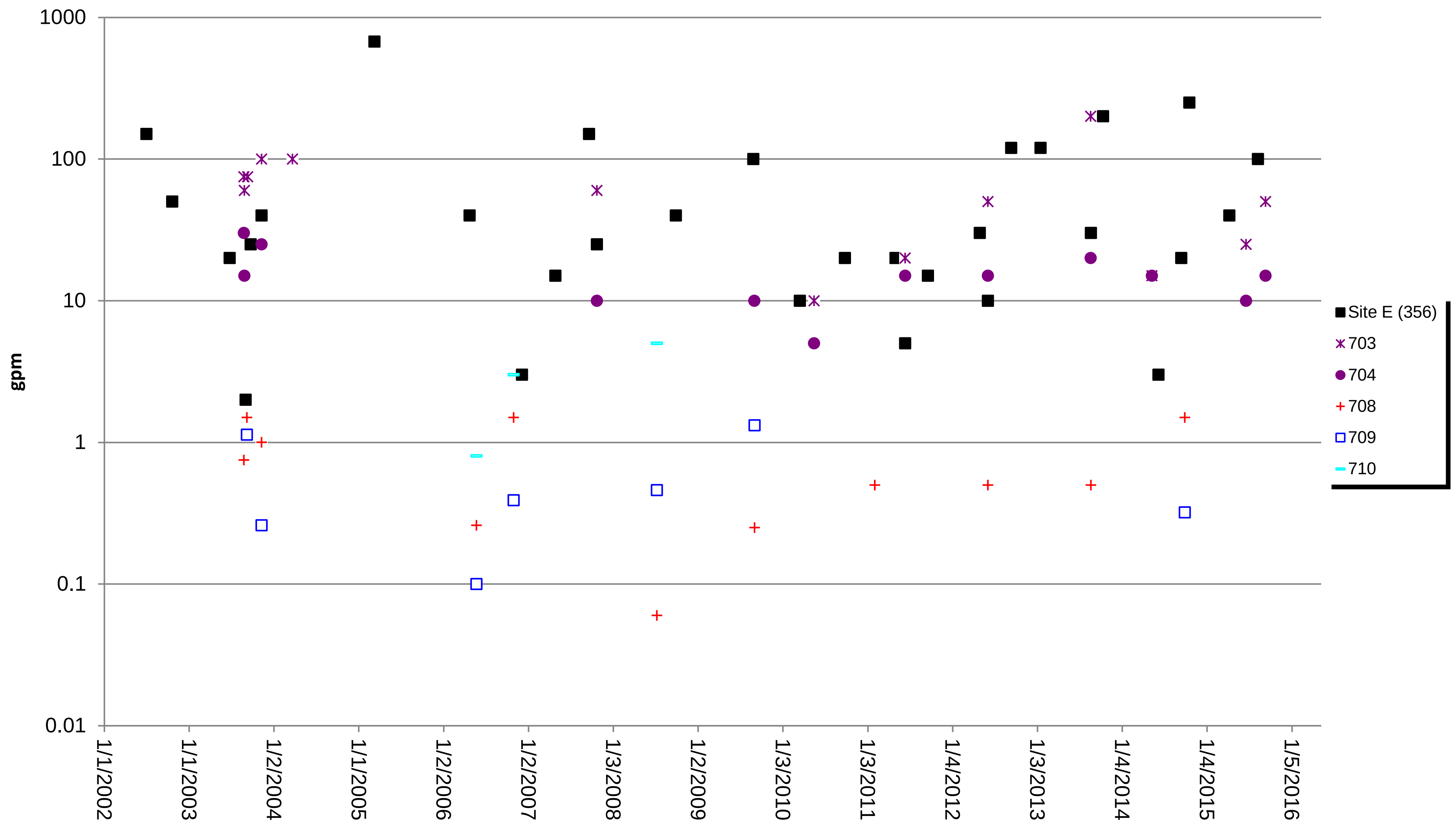

Figure 2.21 INACTIVE PRODUCTION ROCK SITE E pH DATA

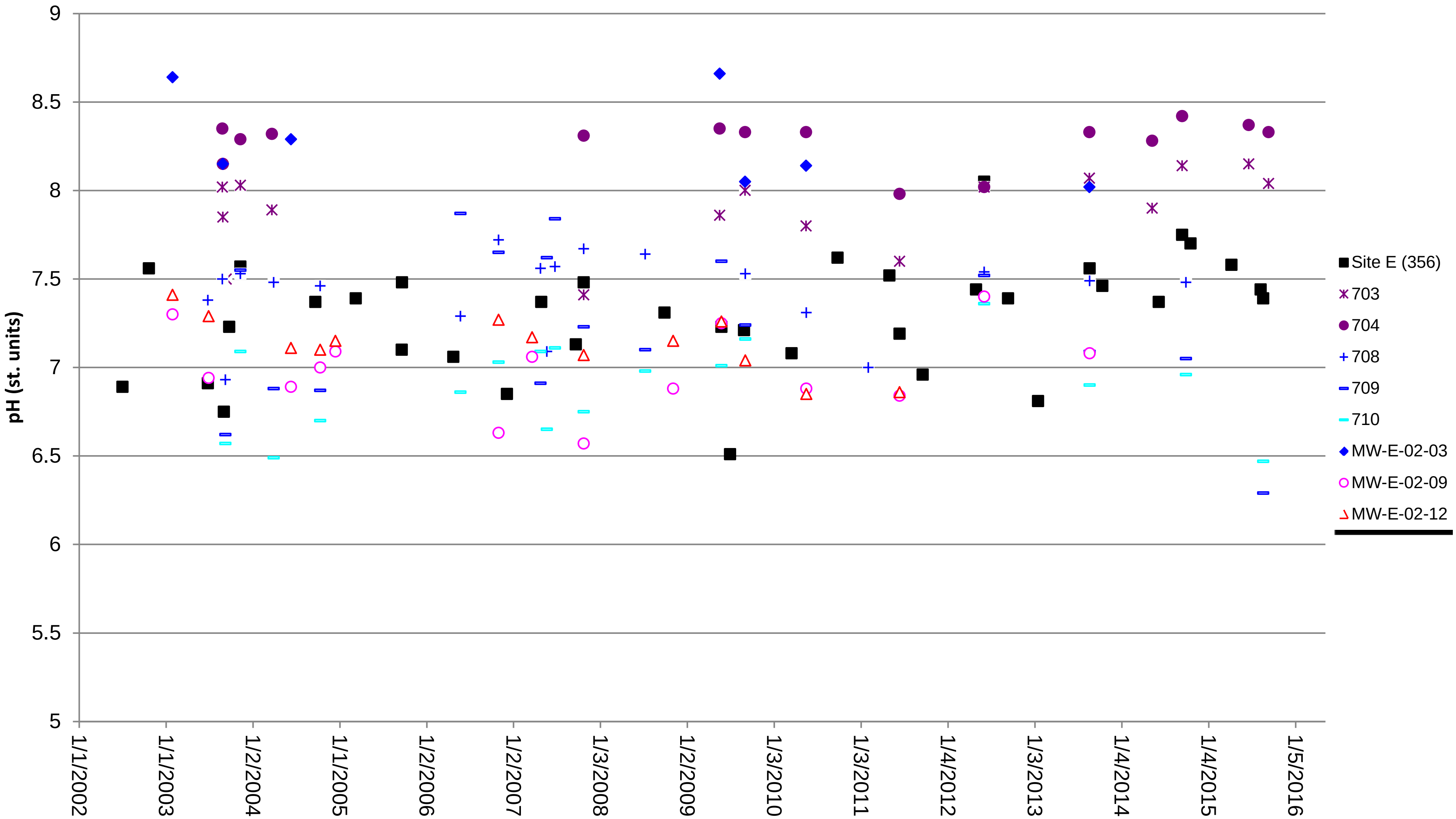

Figure 2.22 INACTIVE PRODUCTION ROCK SITE E ALKALINITY DATA

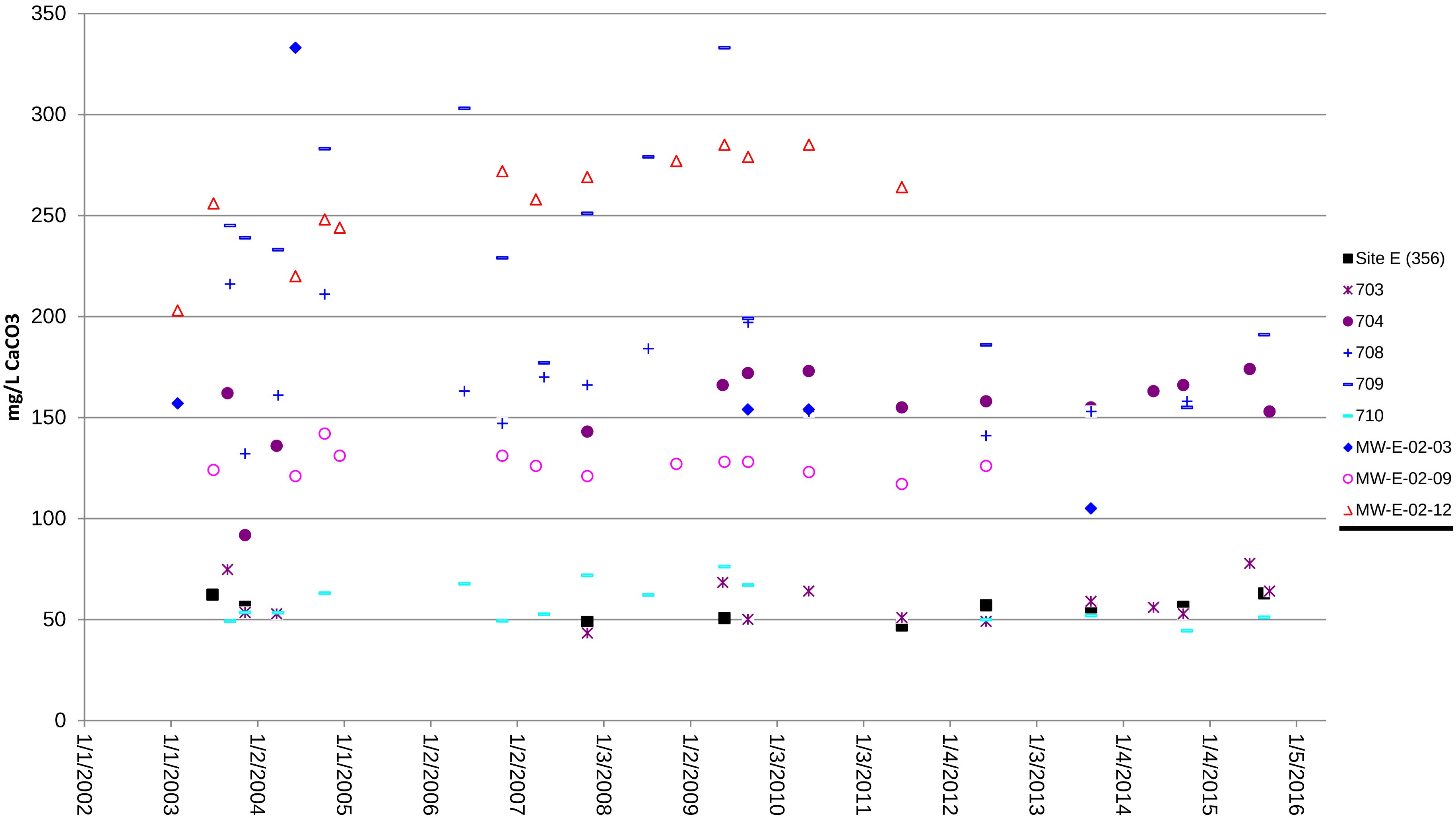

Figure 2.23 INACTIVE PRODUCTION ROCK SITE E CONDUCTIVITY DATA

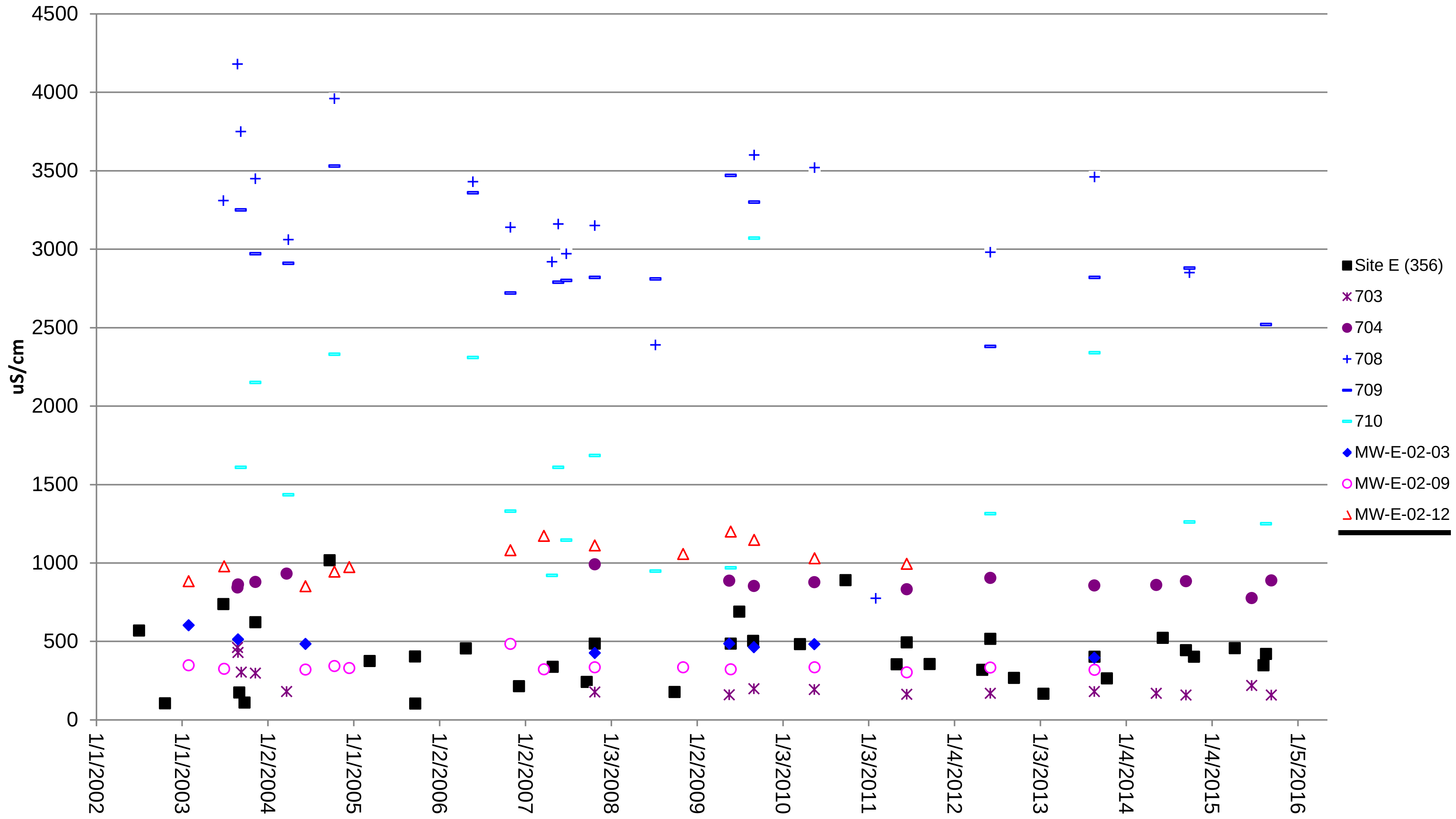

Figure 2.24 INACTIVE PRODUCTION ROCK SITE E SULFATE DATA

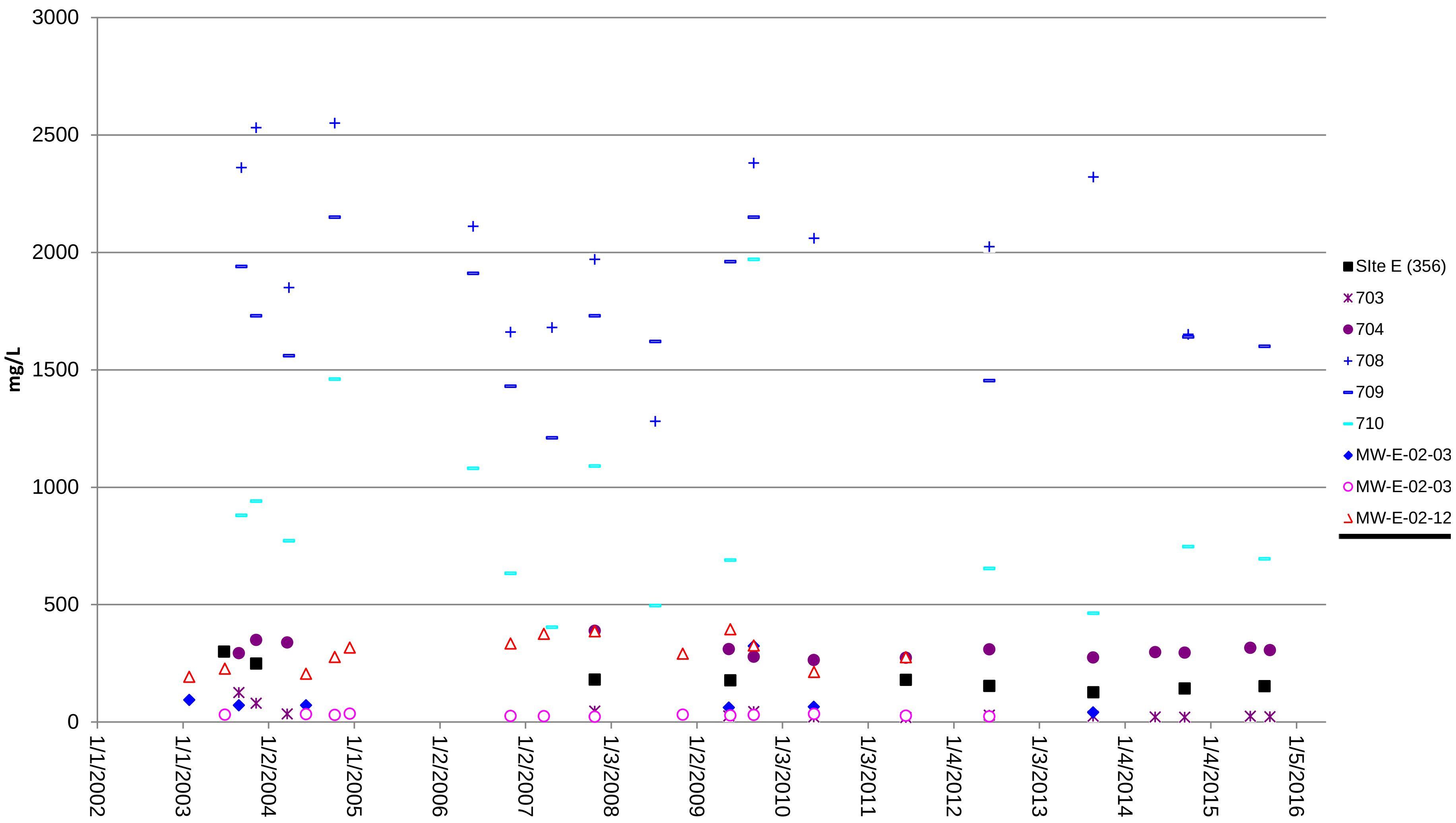

Figure 2.25 INACTIVE PRODUCTION ROCK SITE E MAGNESIUM DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

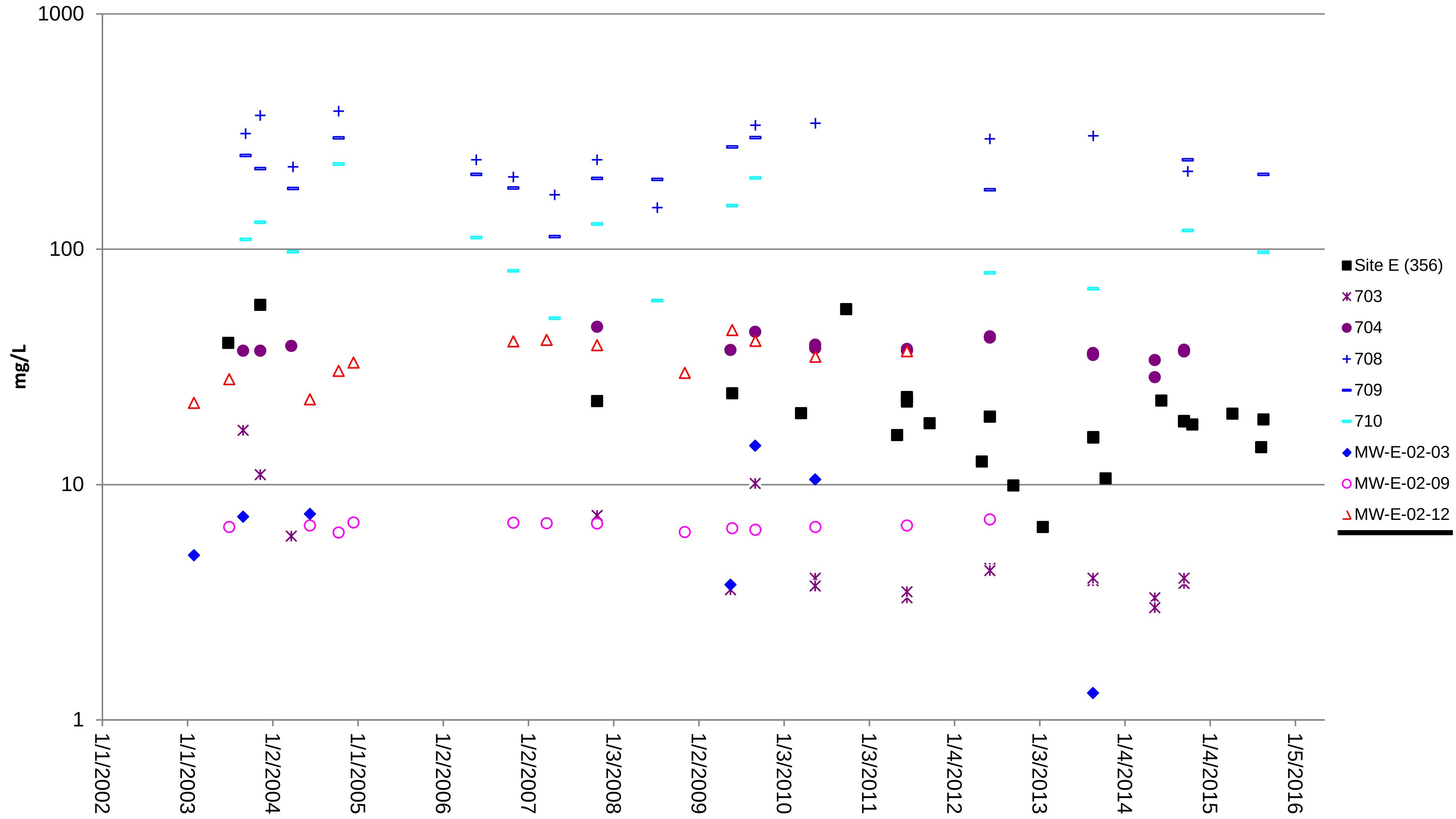

Figure 2.26 INACTIVE PRODUCTION ROCK SITE E HARDNESS DATA

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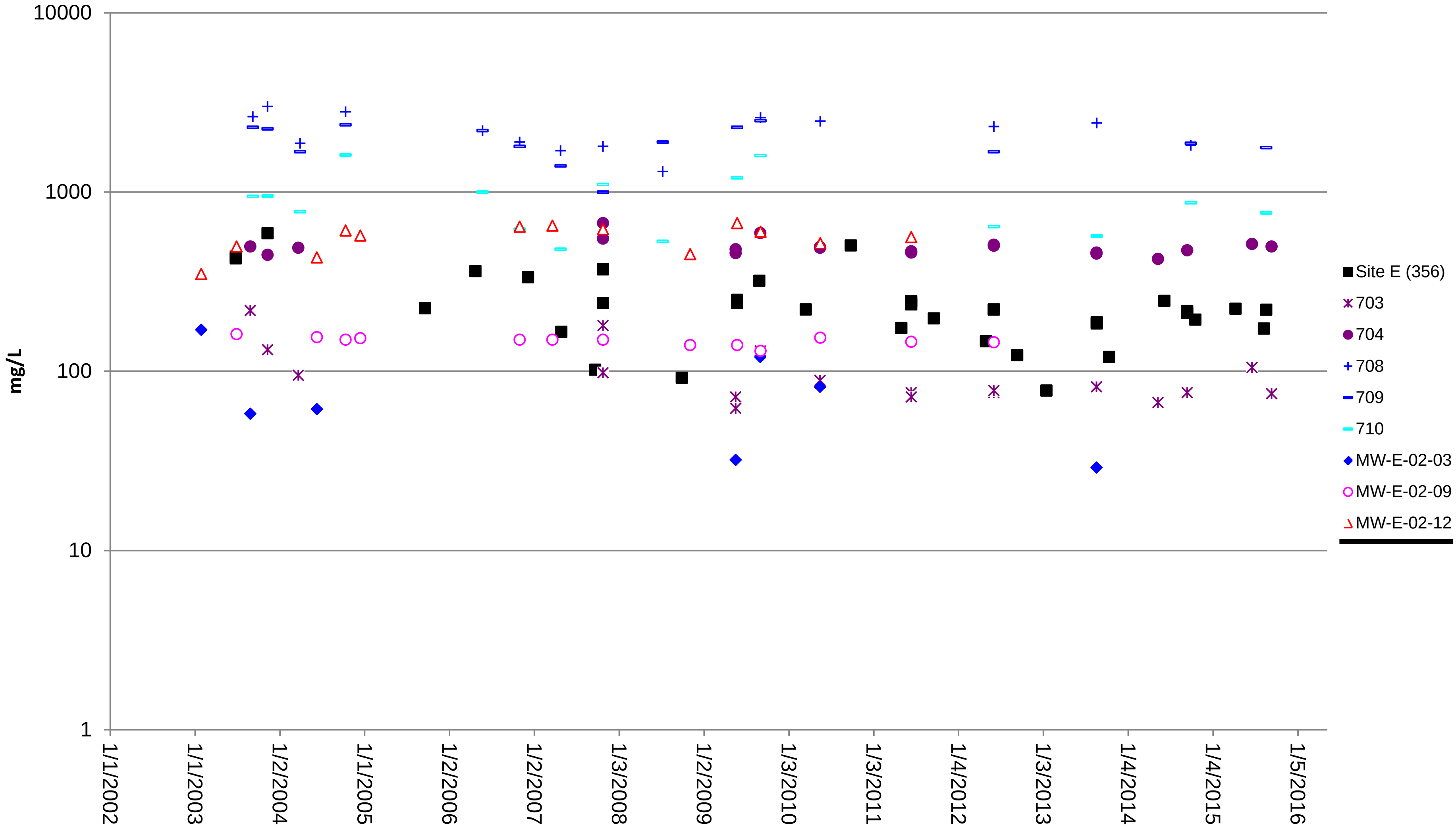

Figure 2.27 INACTIVE PRODUCTION ROCK SITE E ZINC DATA

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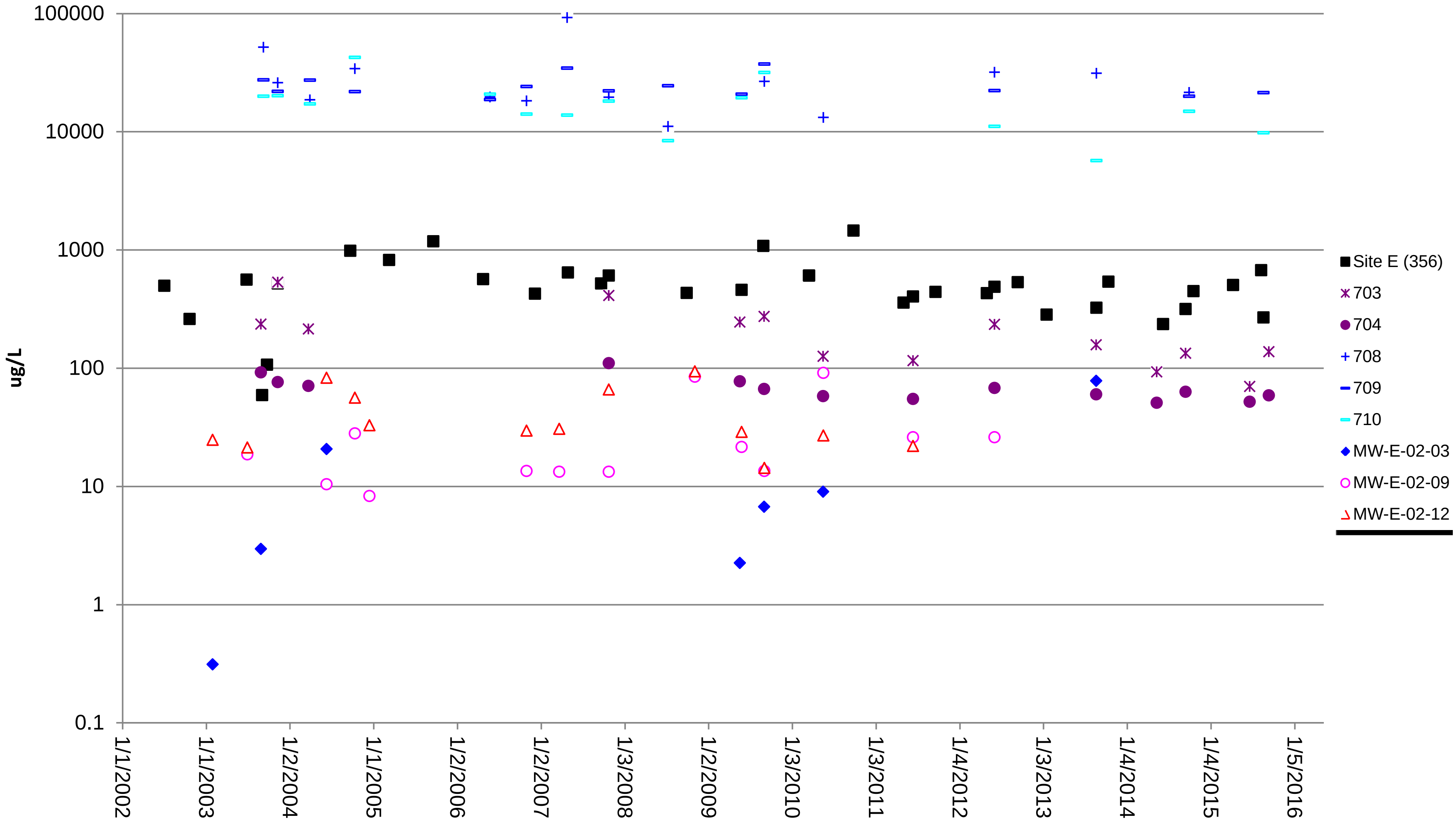


Figure 2.28 INACTIVE PRODUCTION ROCK SITE E COPPER DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

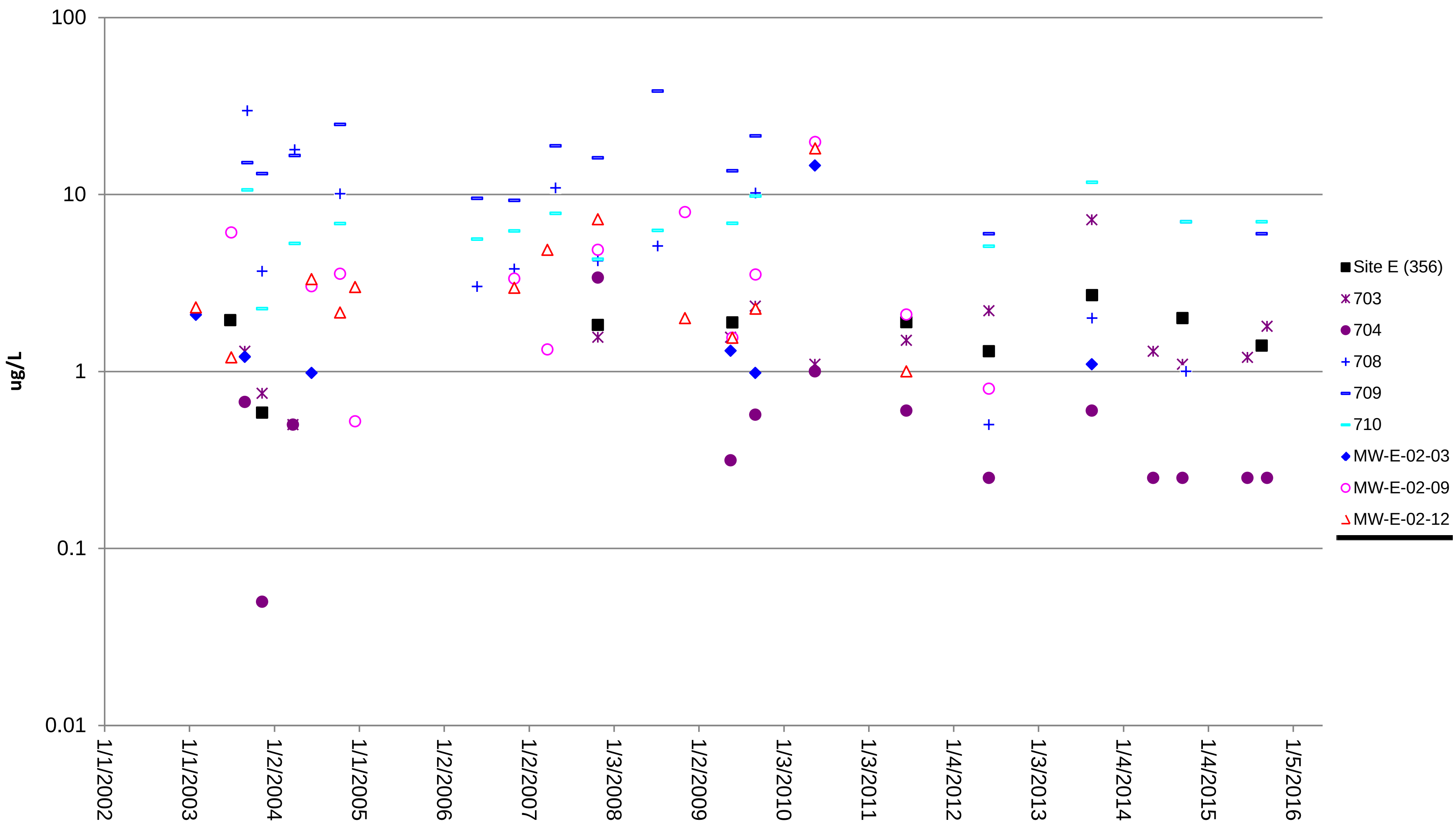


Figure 2.29 INACTIVE PRODUCTION ROCK SITE E LEAD DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

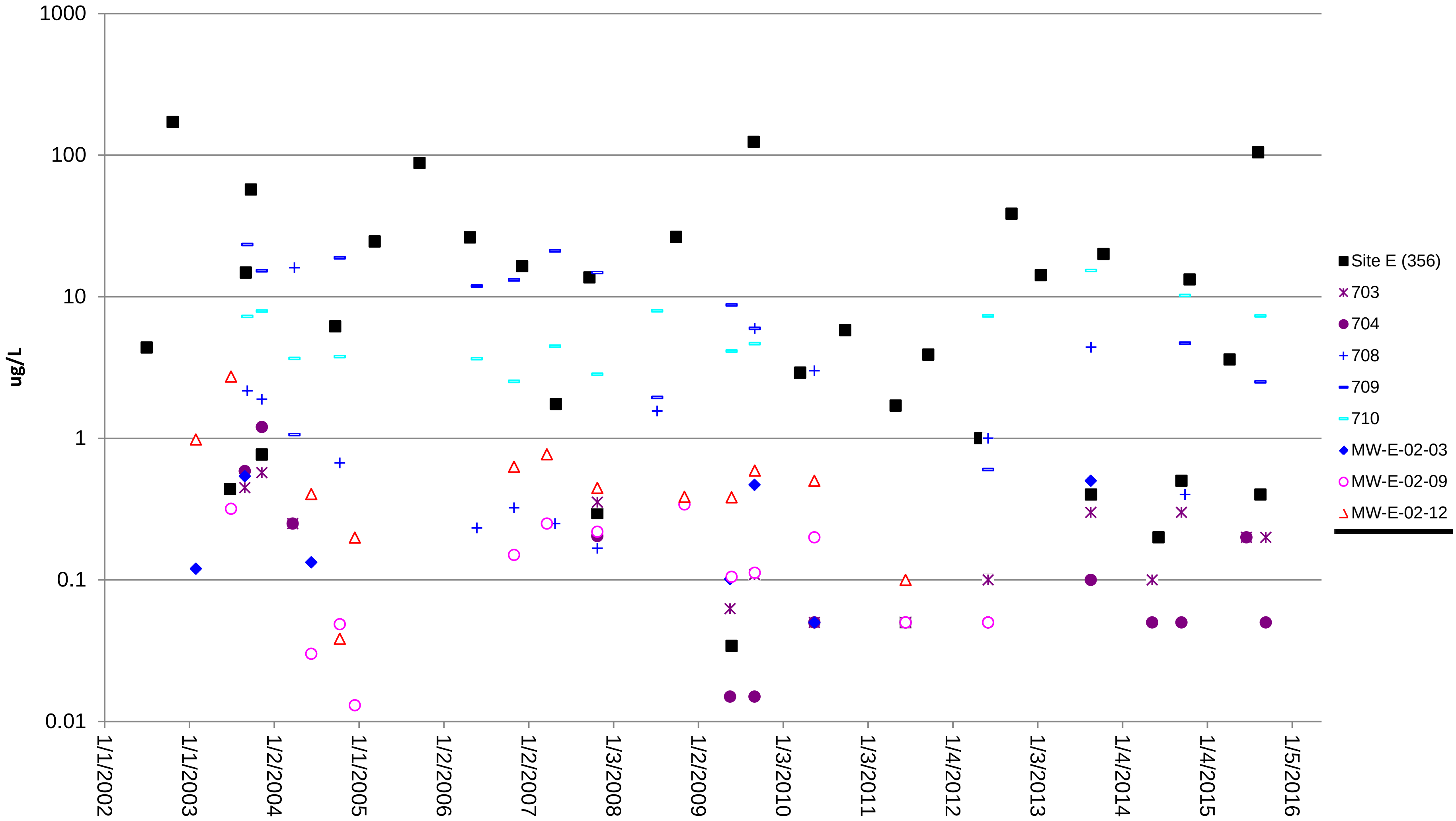
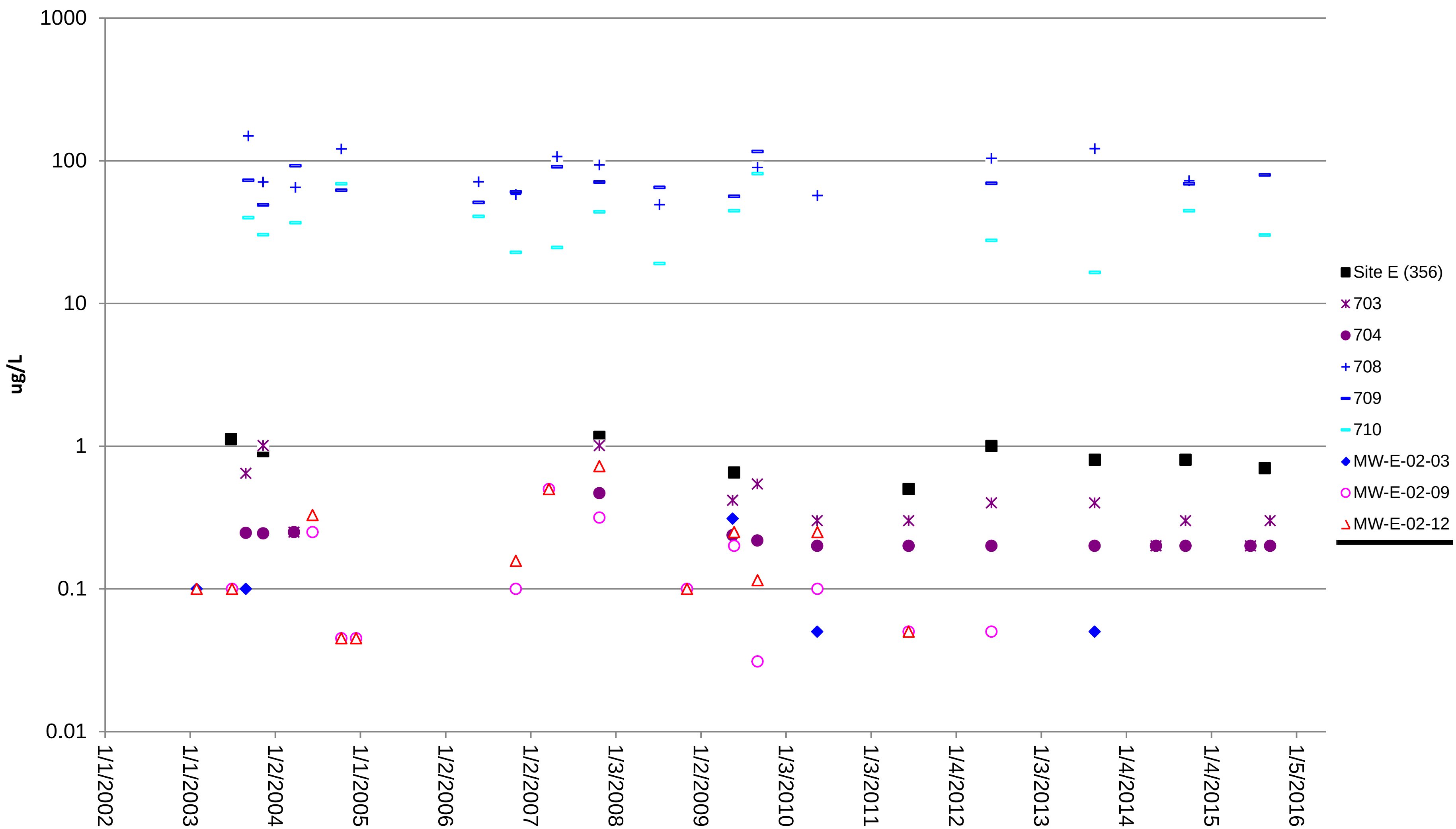


Figure 2.30 INACTIVE PRODUCTION ROCK SITE E CADMIUM DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results



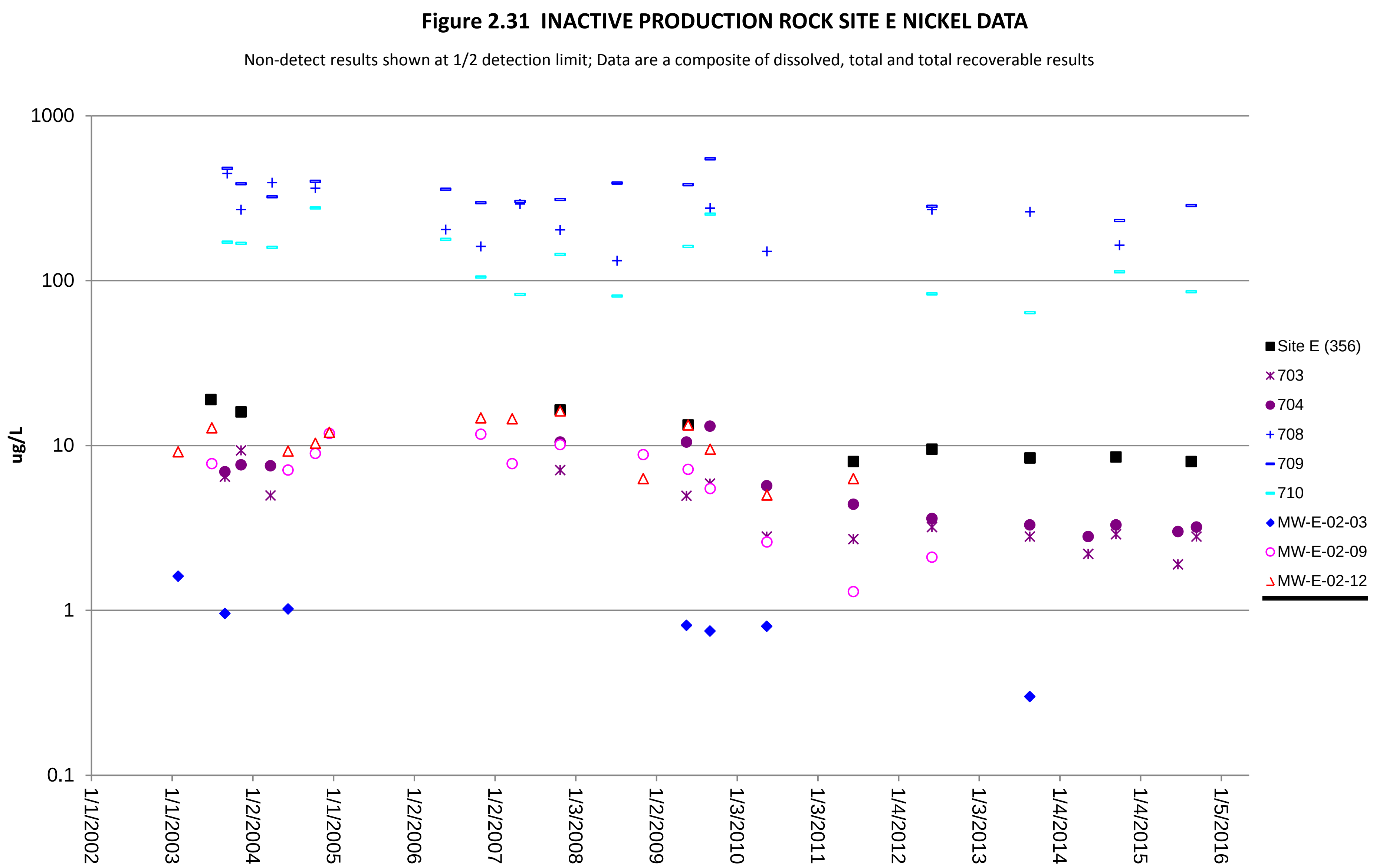


Figure 2.31 INACTIVE PRODUCTION ROCK SITE E NICKEL DATA
Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results
ug/L
1000
100
10
1
0.1
1/1/2002
1/1/2003
1/2/2004
1/1/2005
1/2/2006
1/2/2007
1/3/2008
1/2/2009
1/3/2010
1/3/2011
1/4/2012
1/3/2013
1/4/2014
1/4/2015
1/5/2016
Site E (356)
703
704
708
709
710
MW-E-02-03
MW-E-02-09
MW-E-02-12

Figure 2.32 INACTIVE PRODUCTION ROCK SITE E ARSENIC DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

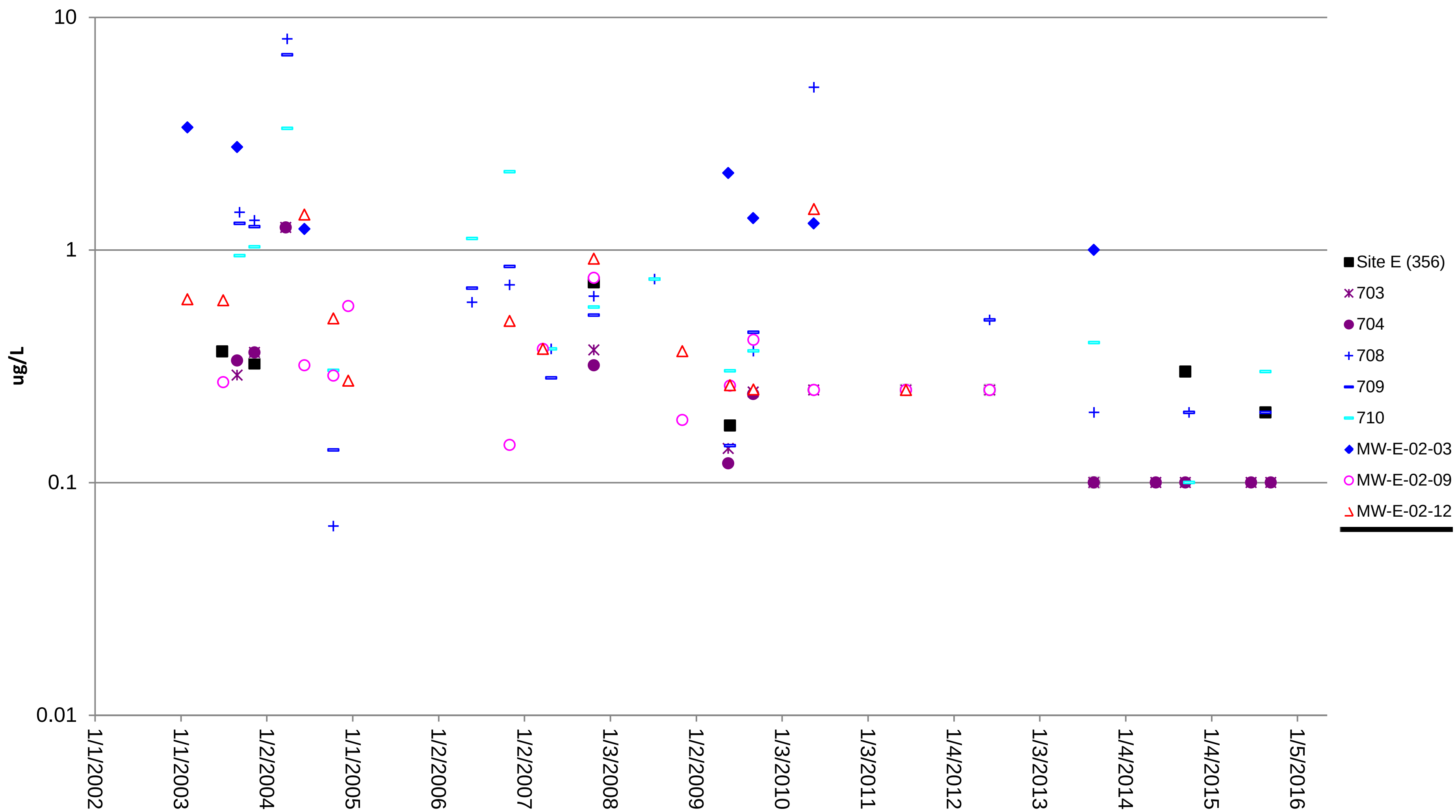


Figure 2.33 INACTIVE PRODUCTION ROCK SITE E IRON DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

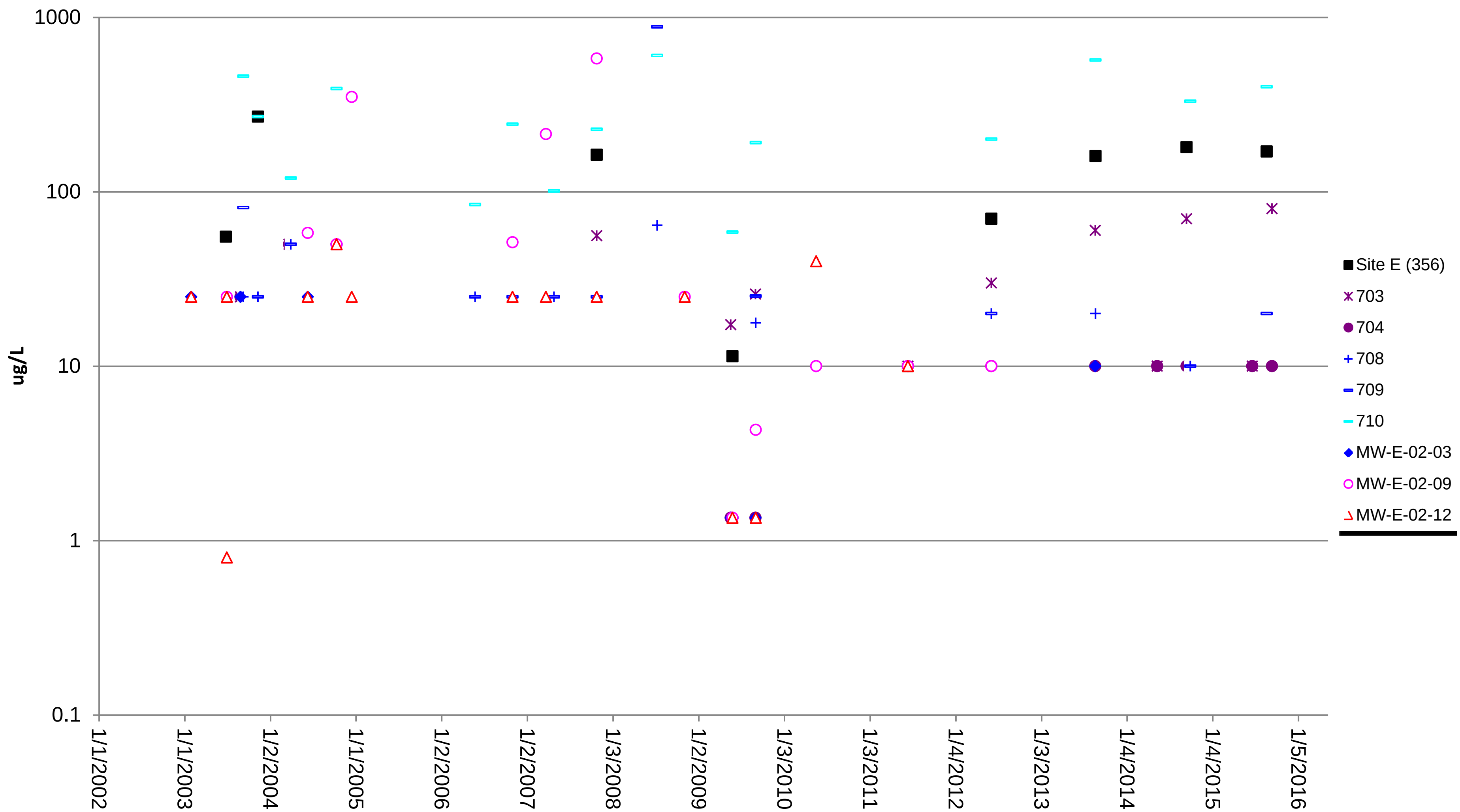


Figure 2.34 INACTIVE PRODUCTION ROCK SITE E MANGANESE DATA

Non-detect results are shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable

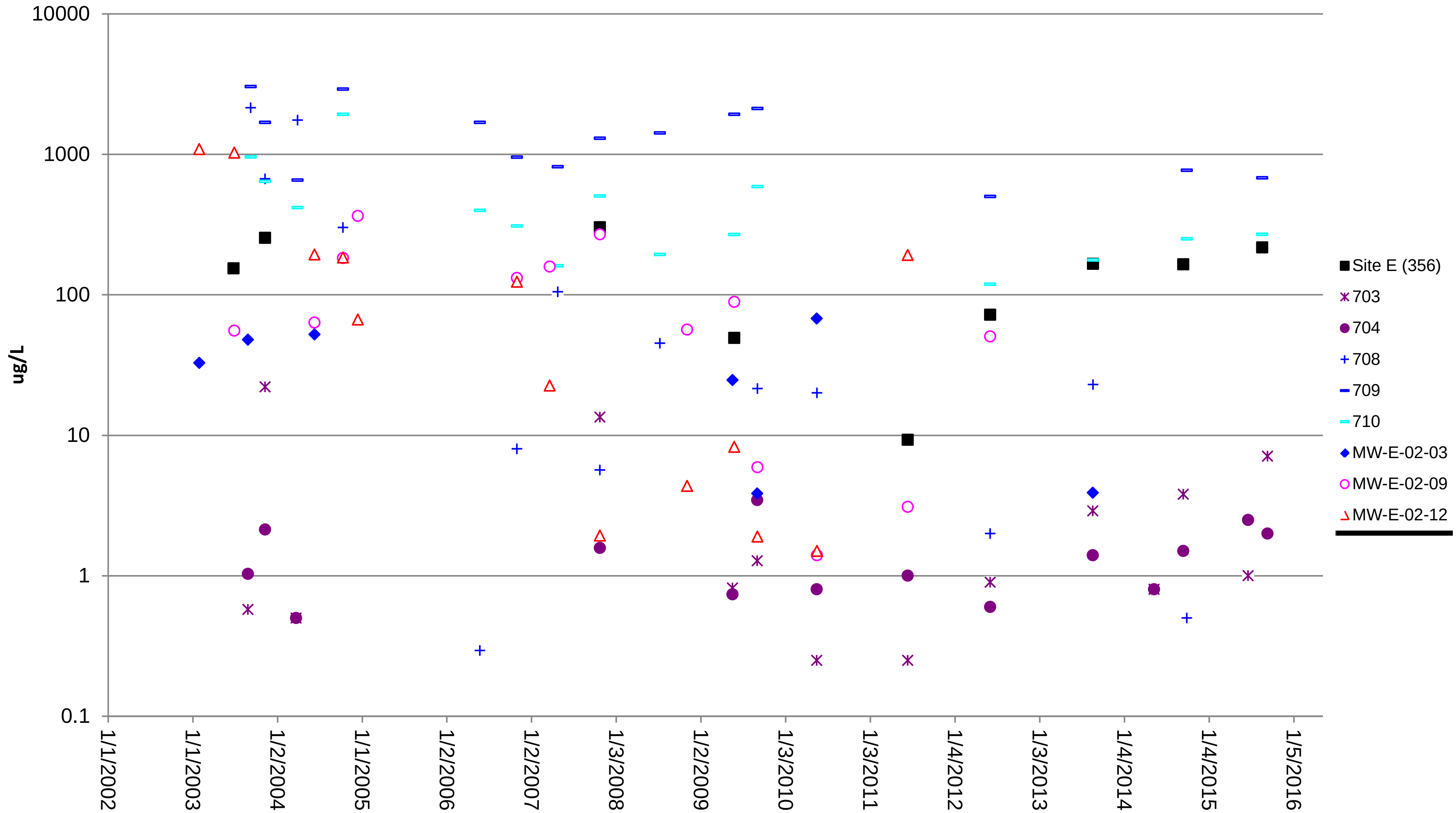


Figure 2.35: 1350 Site - 2015 Production Rock Removal Area (April)

Figure 2.36: 1350 Site - 2015 Production Rock Removal Area (October)

Figure 3.1 QUARRY SITE FLOW DATA

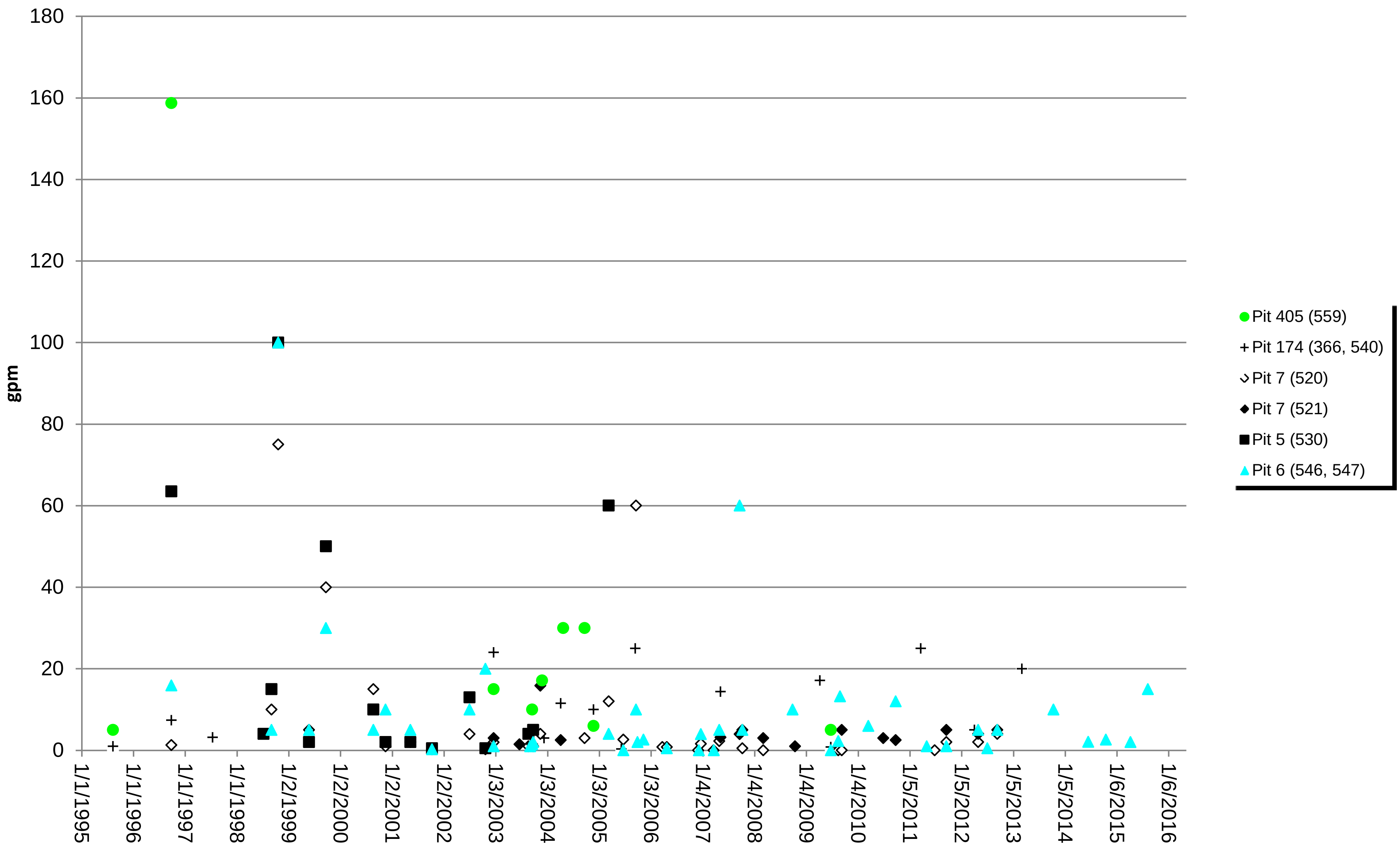


Figure 3.2 QUARRY SITE pH DATA

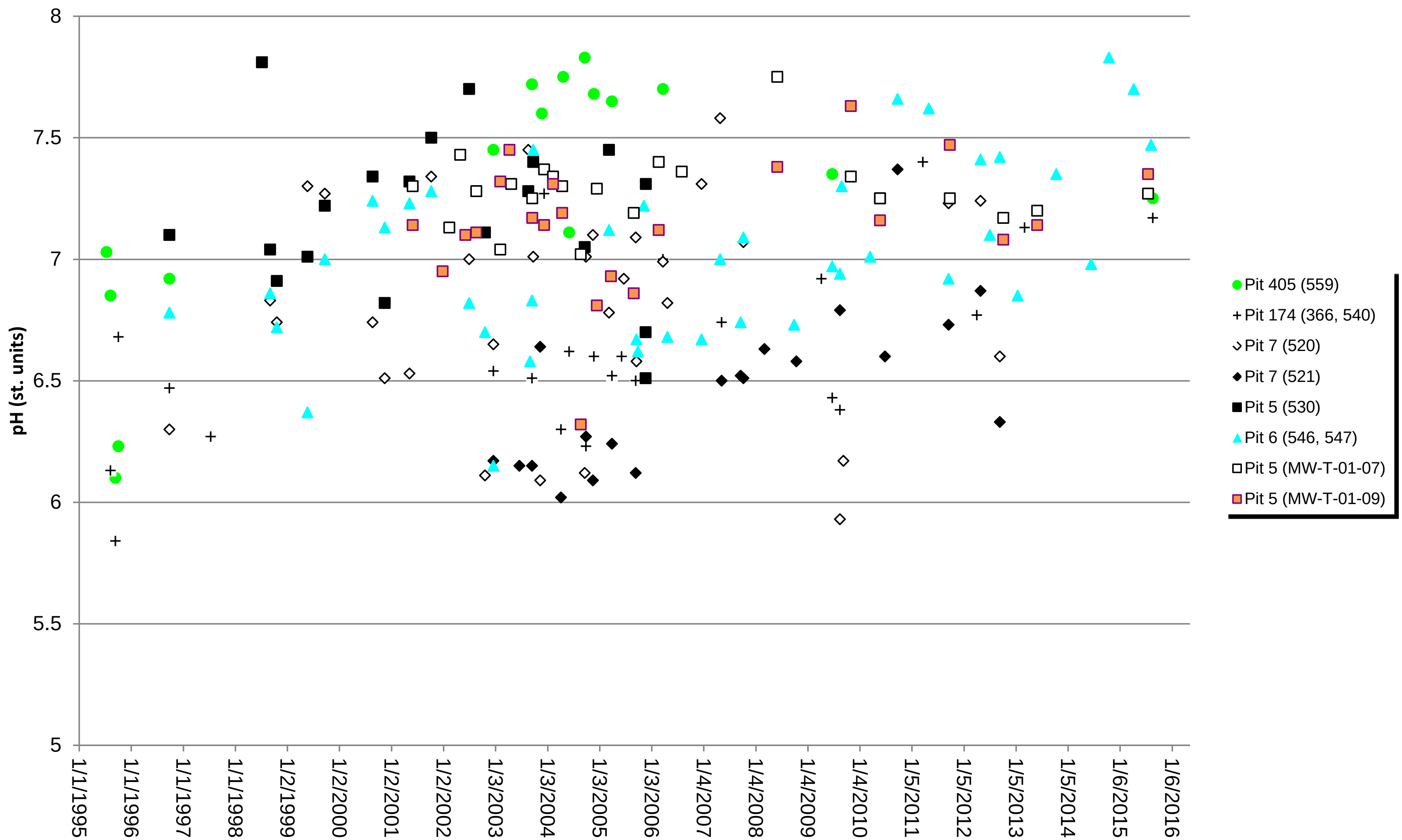


Figure 3.3 QUARRY SITE ALKALINITY DATA

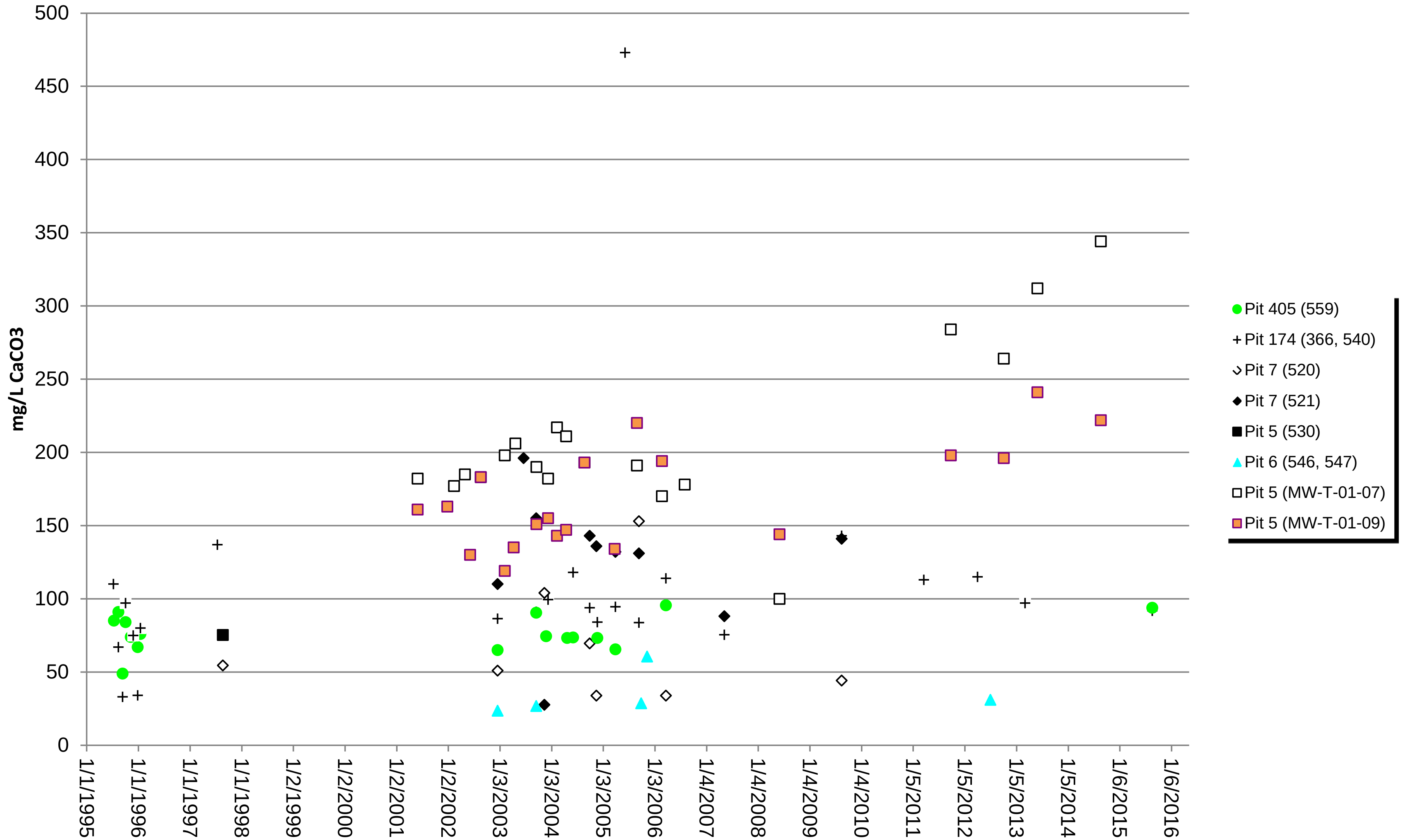


Figure 3.4 QUARRY SITE CONDUCTIVITY DATA

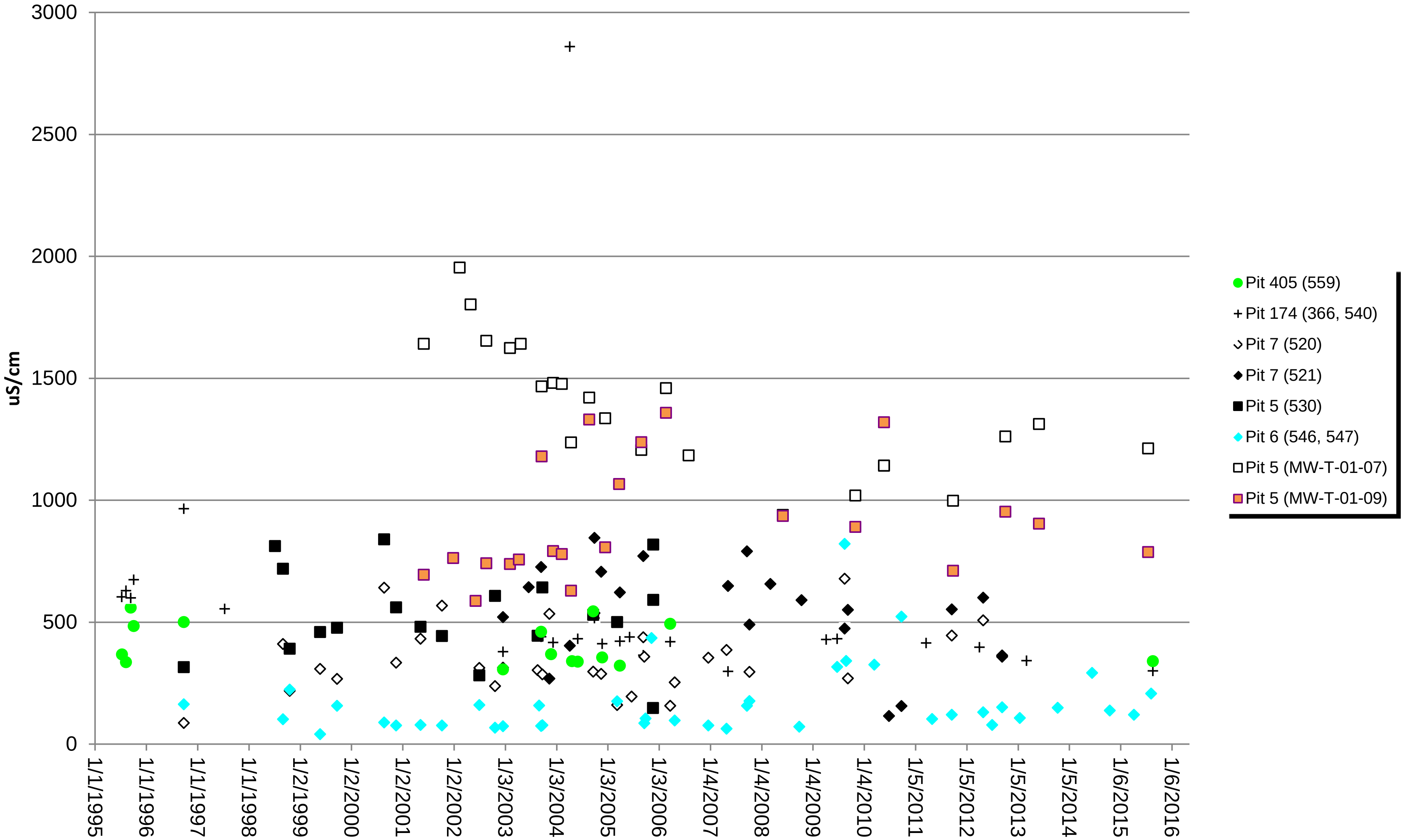


Figure 3.5 QUARRY SITE SULFATE DATA

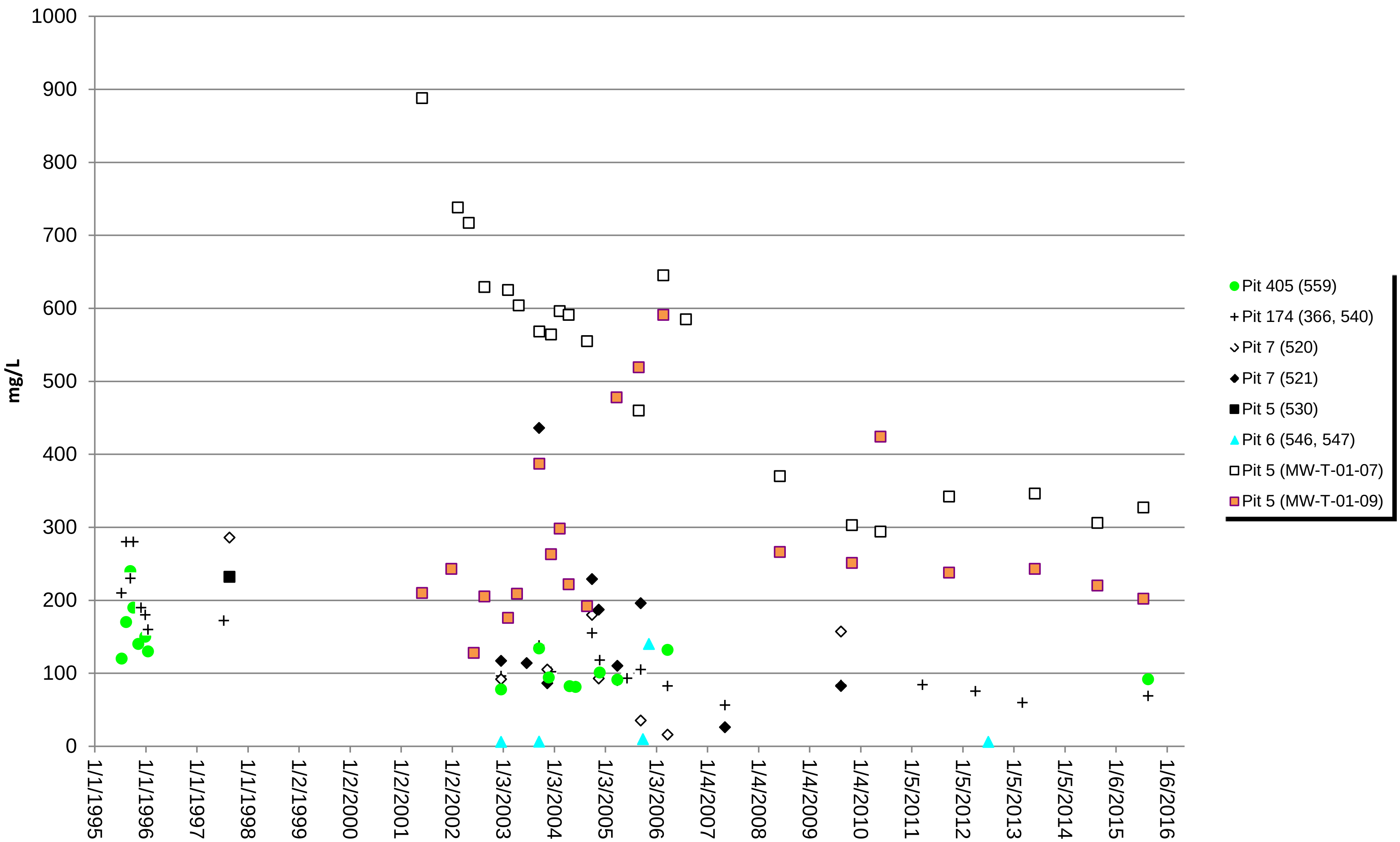


Figure 3.6 QUARRY SITE MAGNESIUIM DATA

Non-detect results are shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

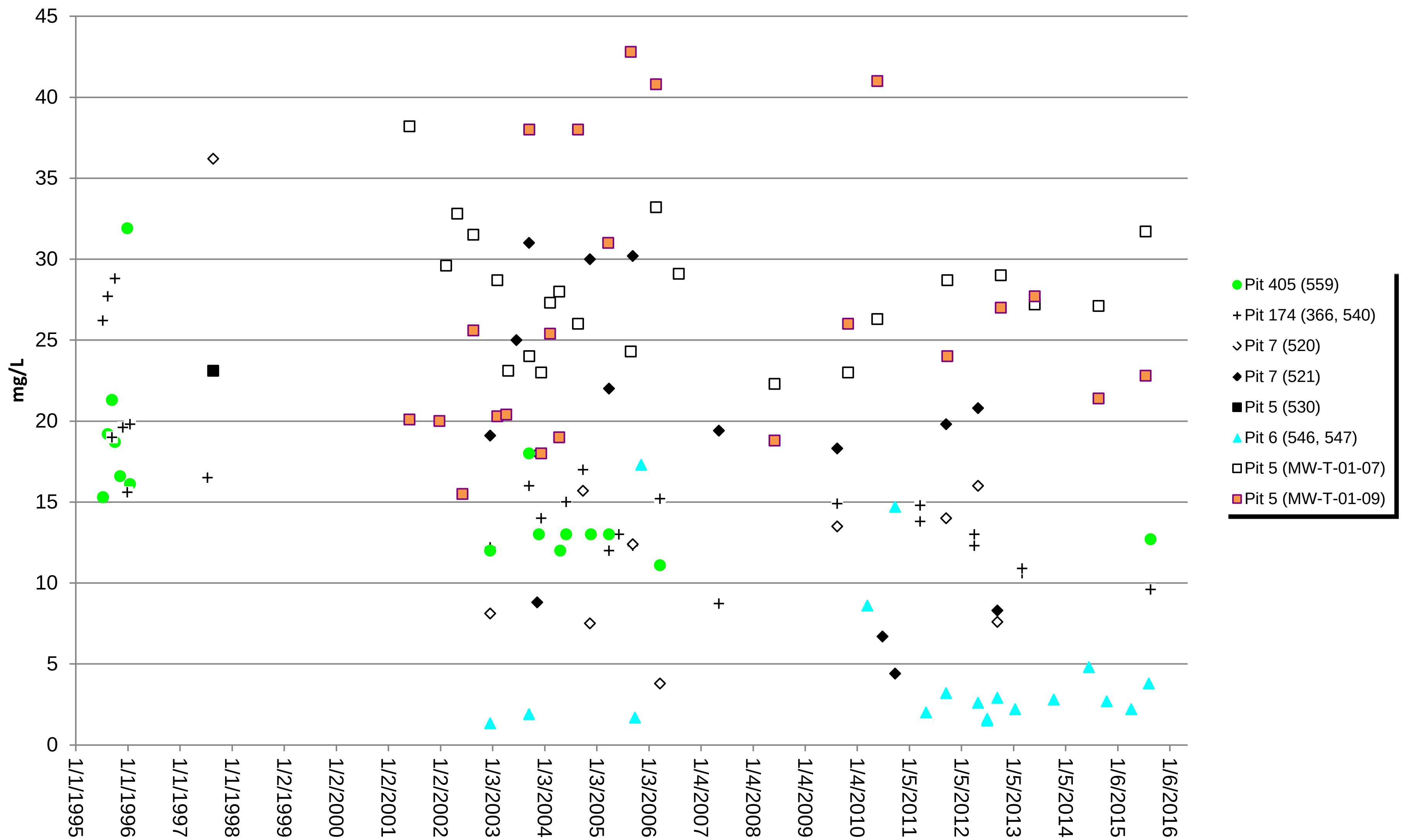


Figure 3.7 QUARRY SITE HARDNESS DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

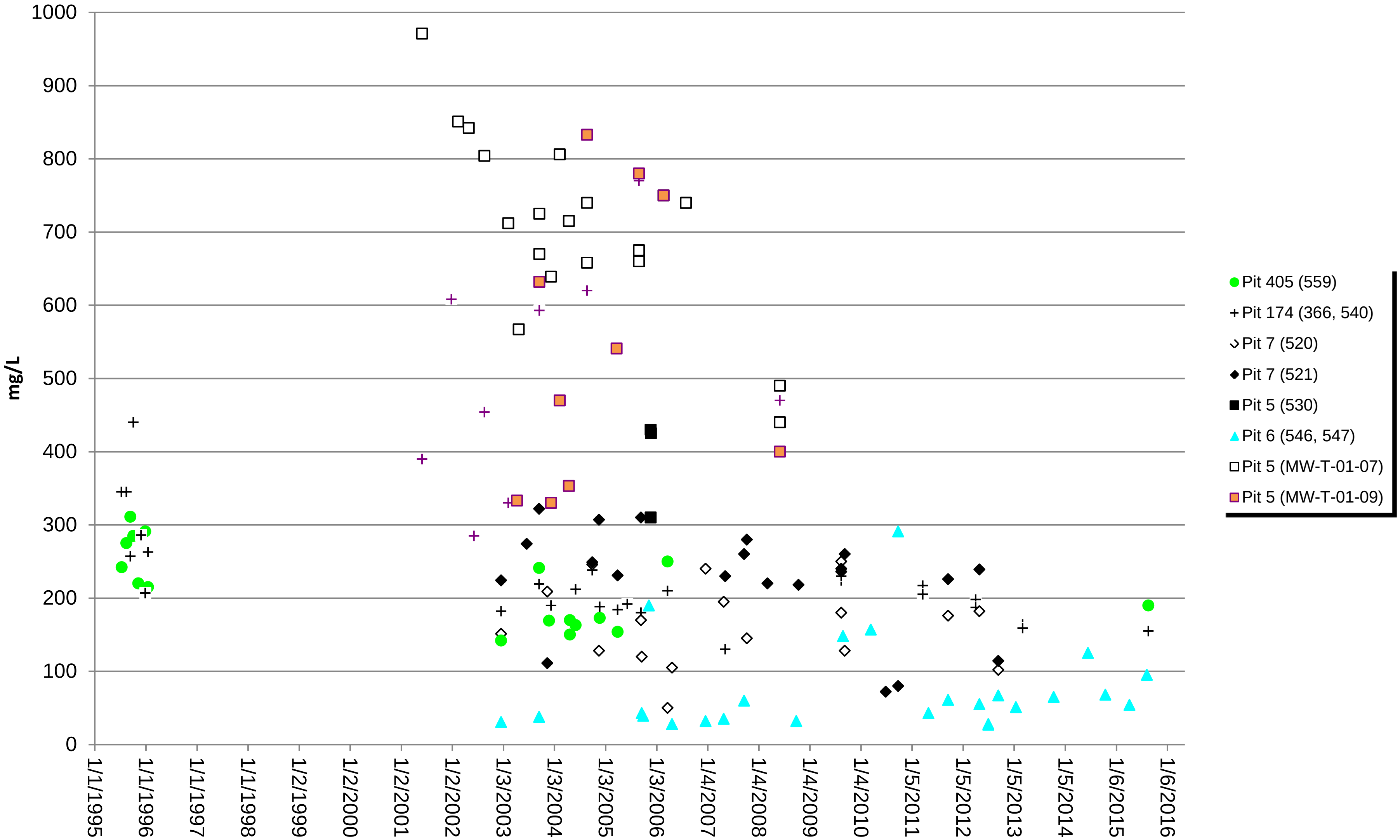


Figure 3.8 QUARRY SITE ZINC DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

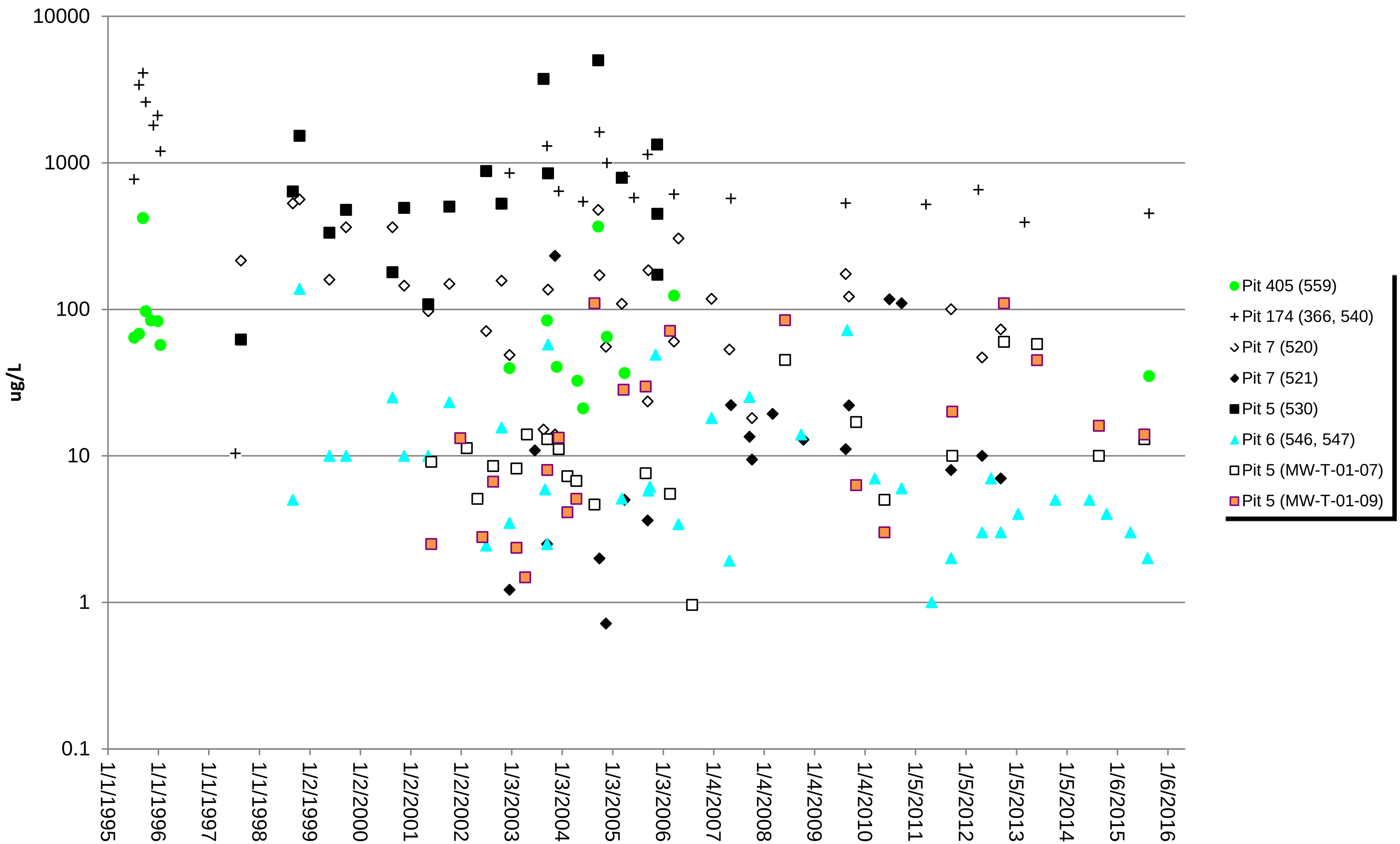


Figure 3.9 QUARRY SITE COPPER DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

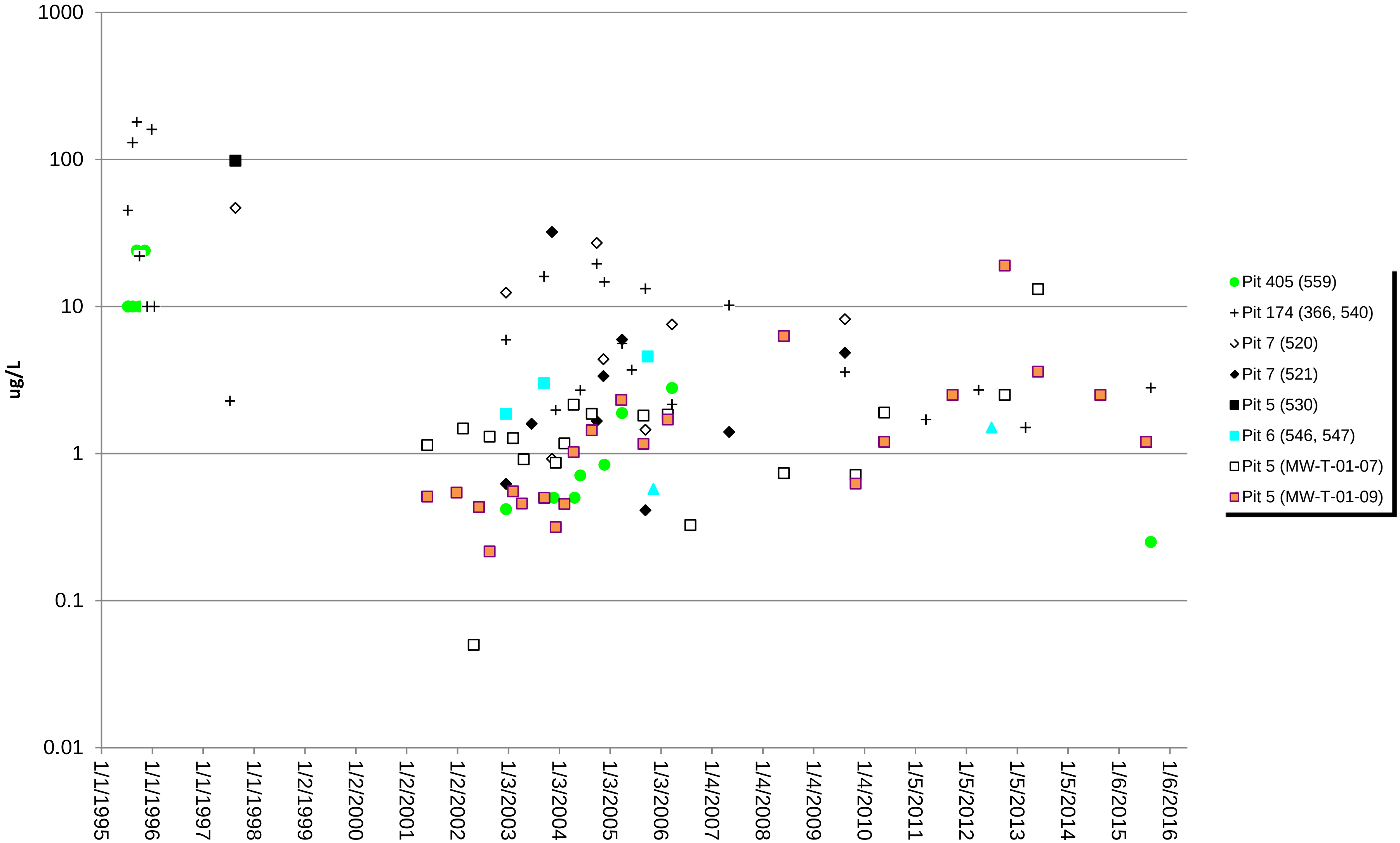


Figure 3.10 QUARRY SITE LEAD DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

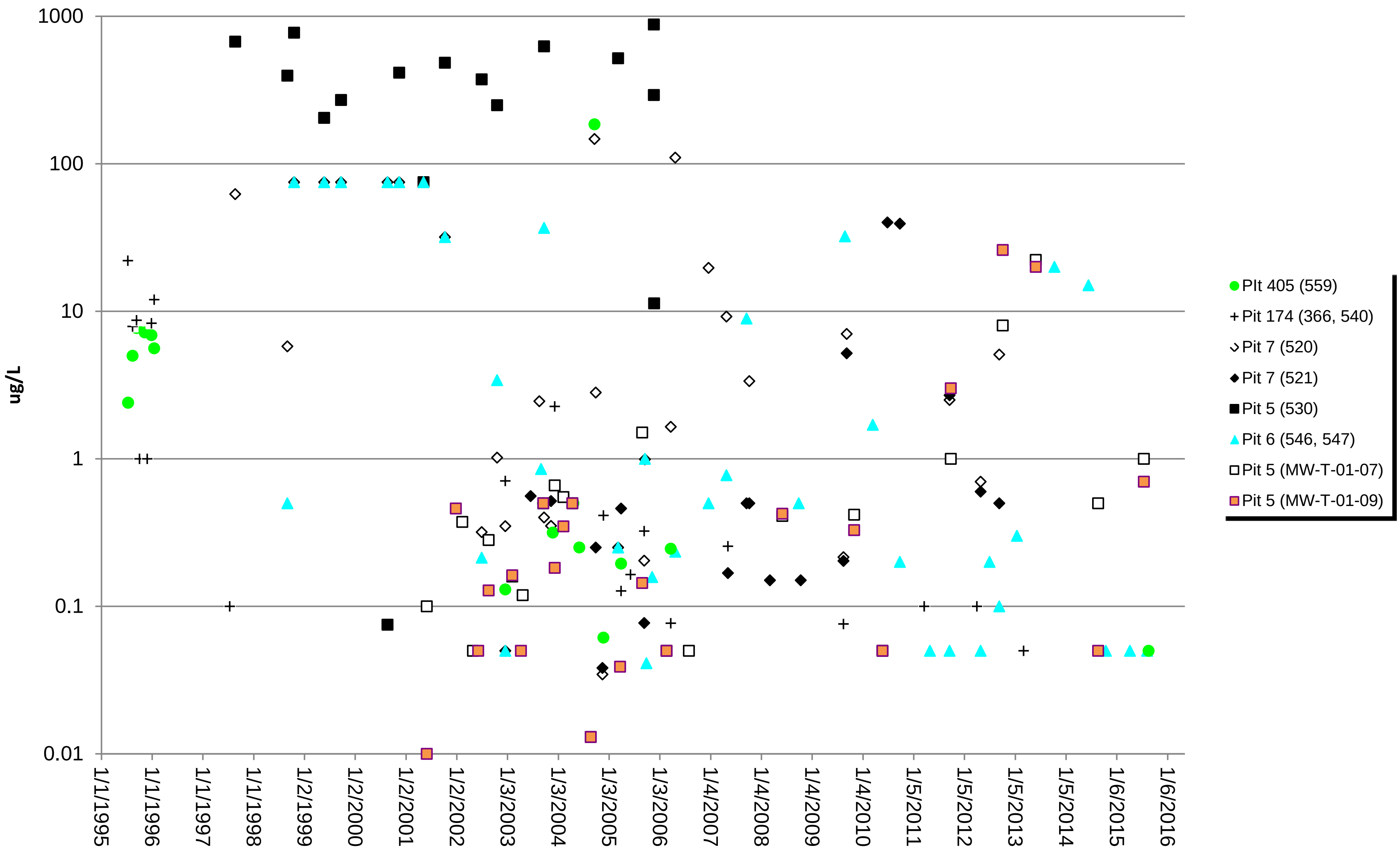


Figure 3.11 QUARRY SITE CADMIUM DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

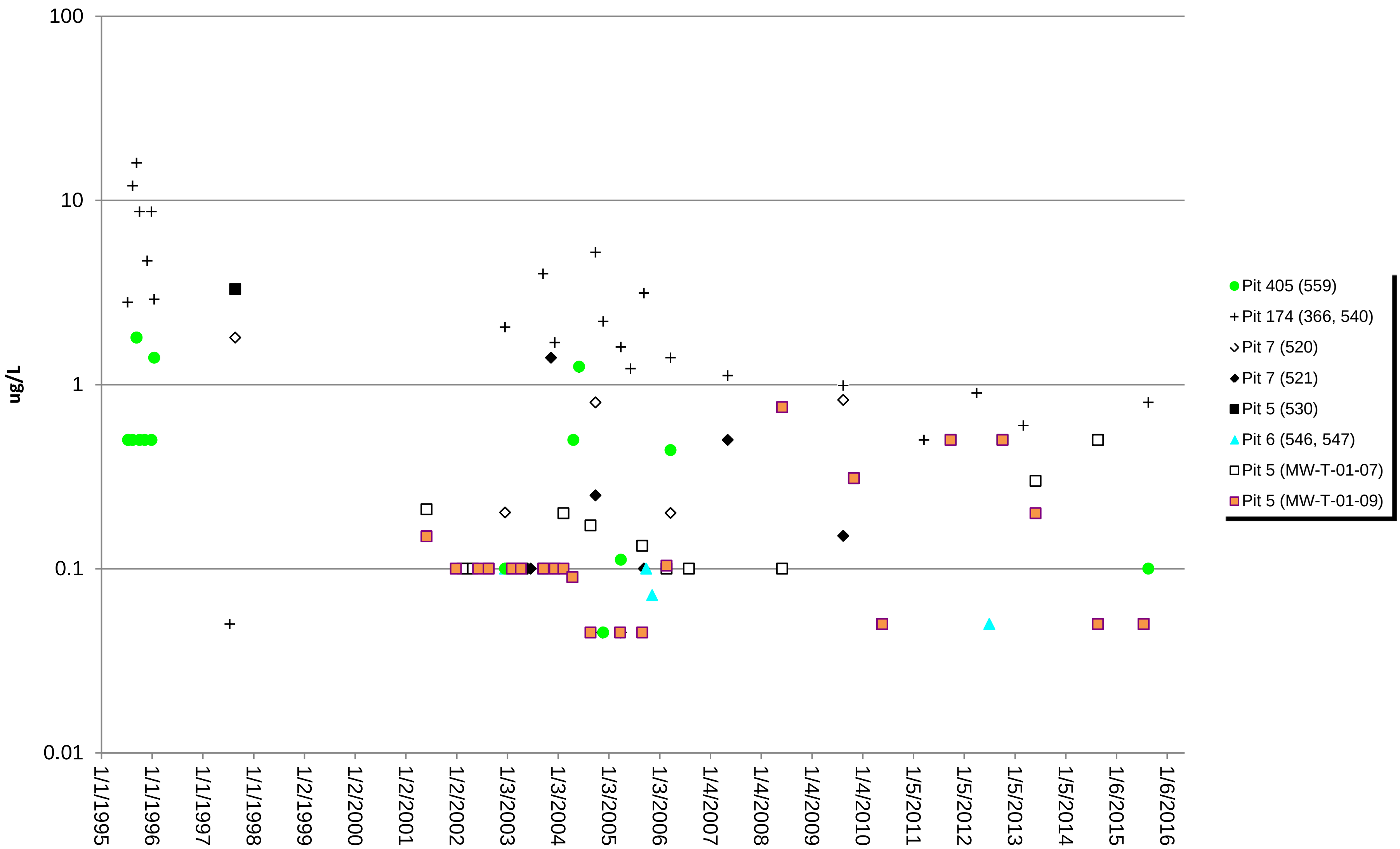


Figure 3.12 QUARRY SITE NICKEL DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

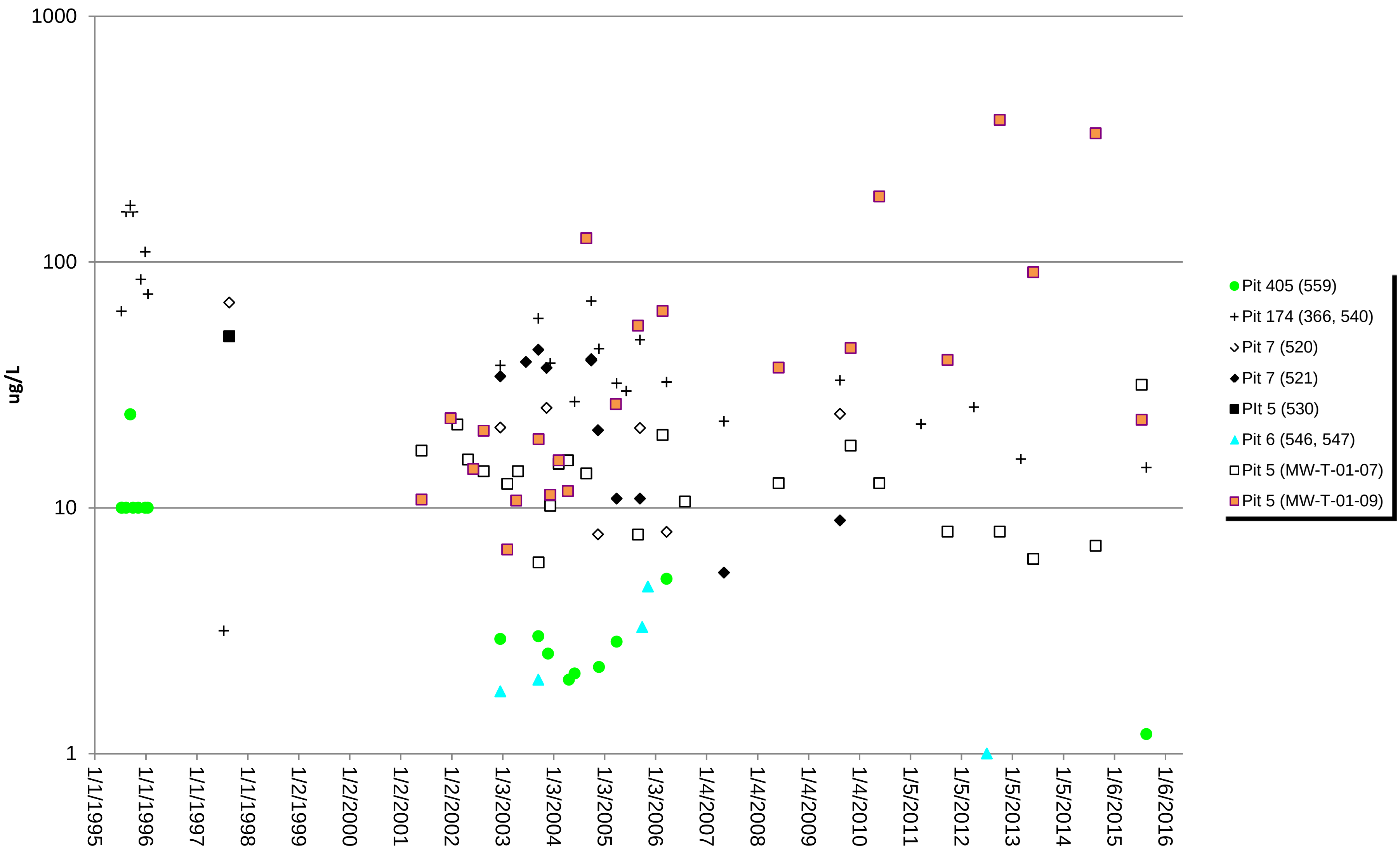


Figure 3.13 QUARRY SITE ARSENIC DATA

Non-detectable results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

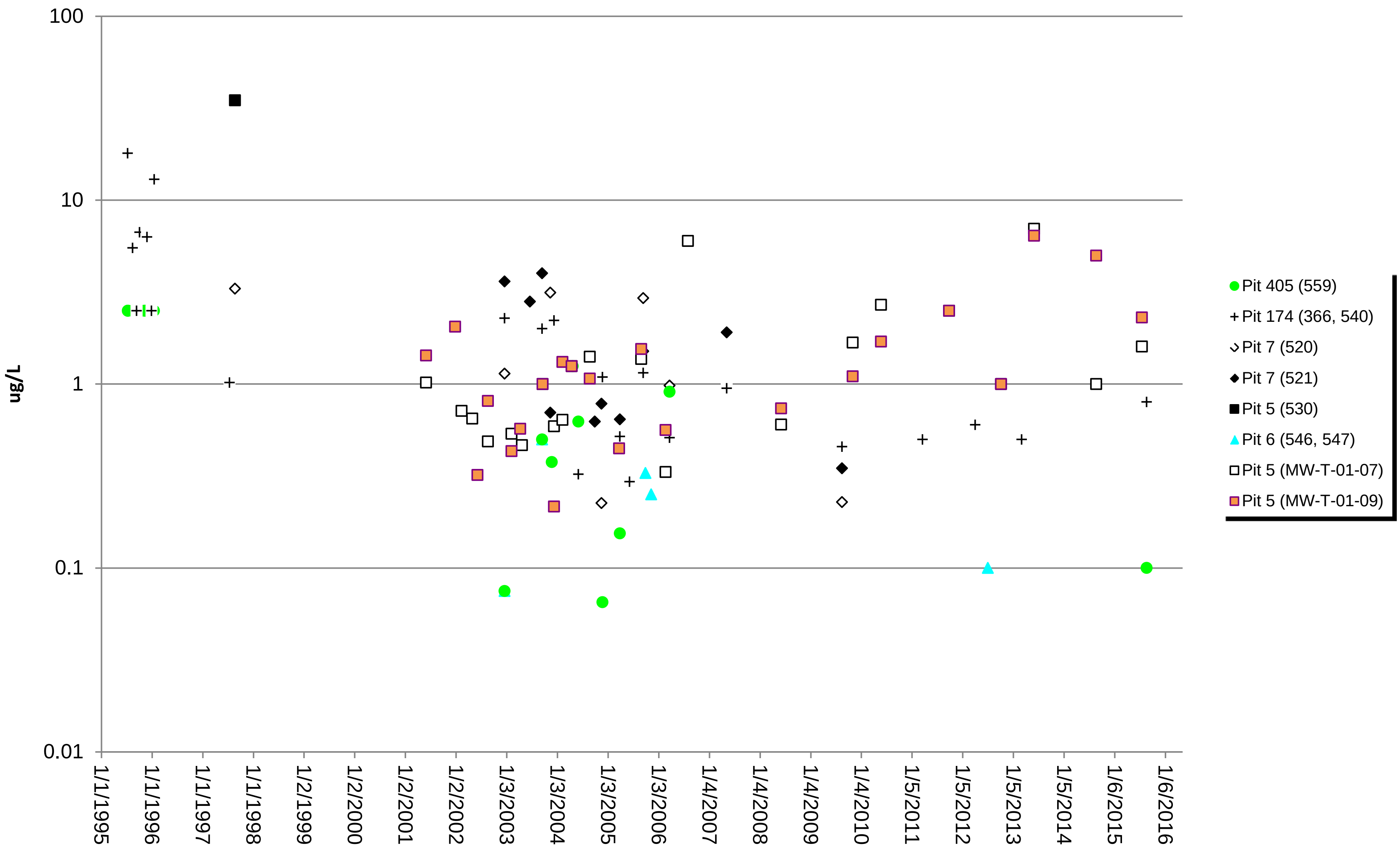


Figure 3.14 QUARRY SITE IRON DATA

Non-detect results shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

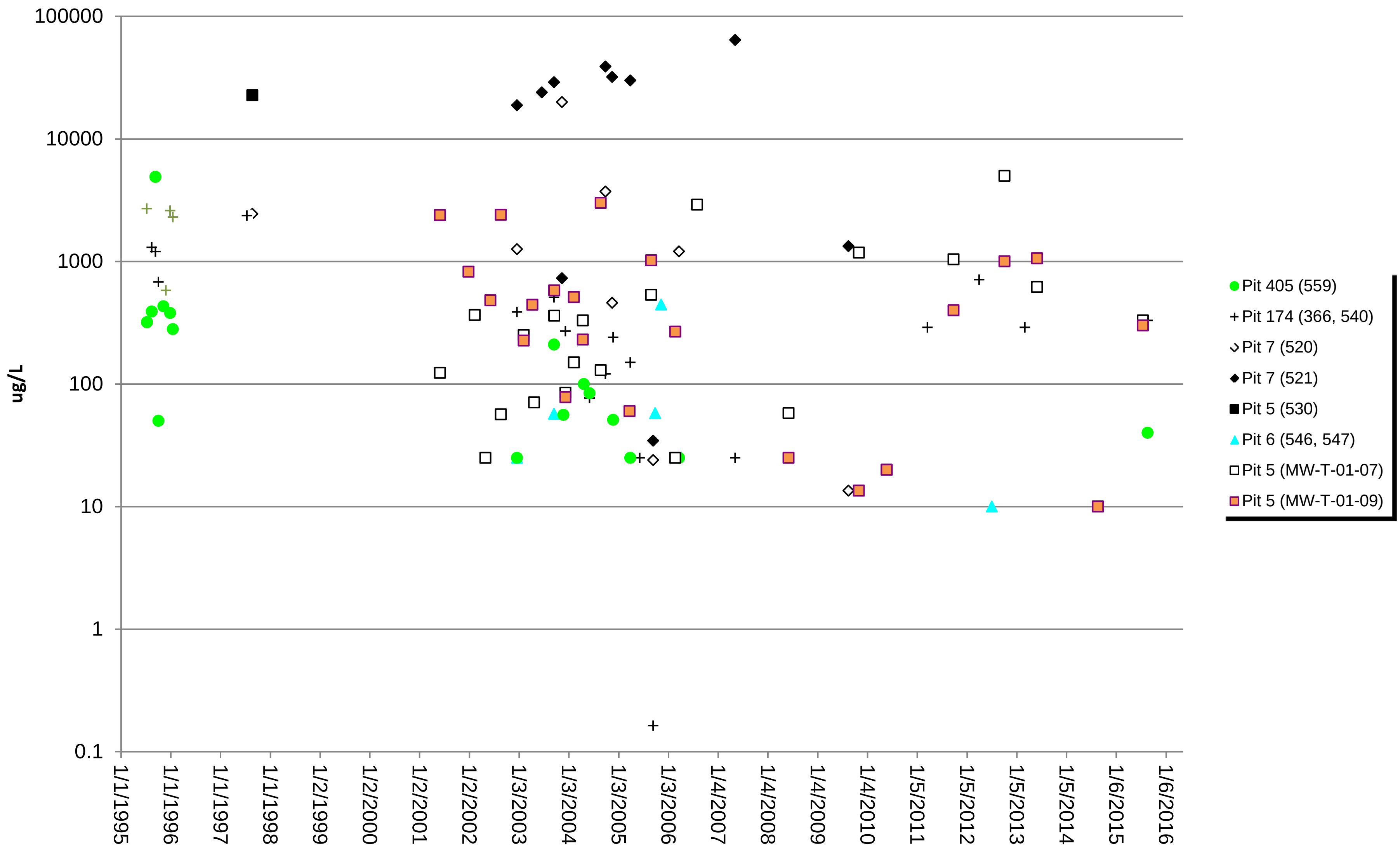


Figure 3.15 QUARRY SITE MANGANESE DATA

Non-detect results are shown at 1/2 detection limit; Data are a composite of dissolved, total and total recoverable results

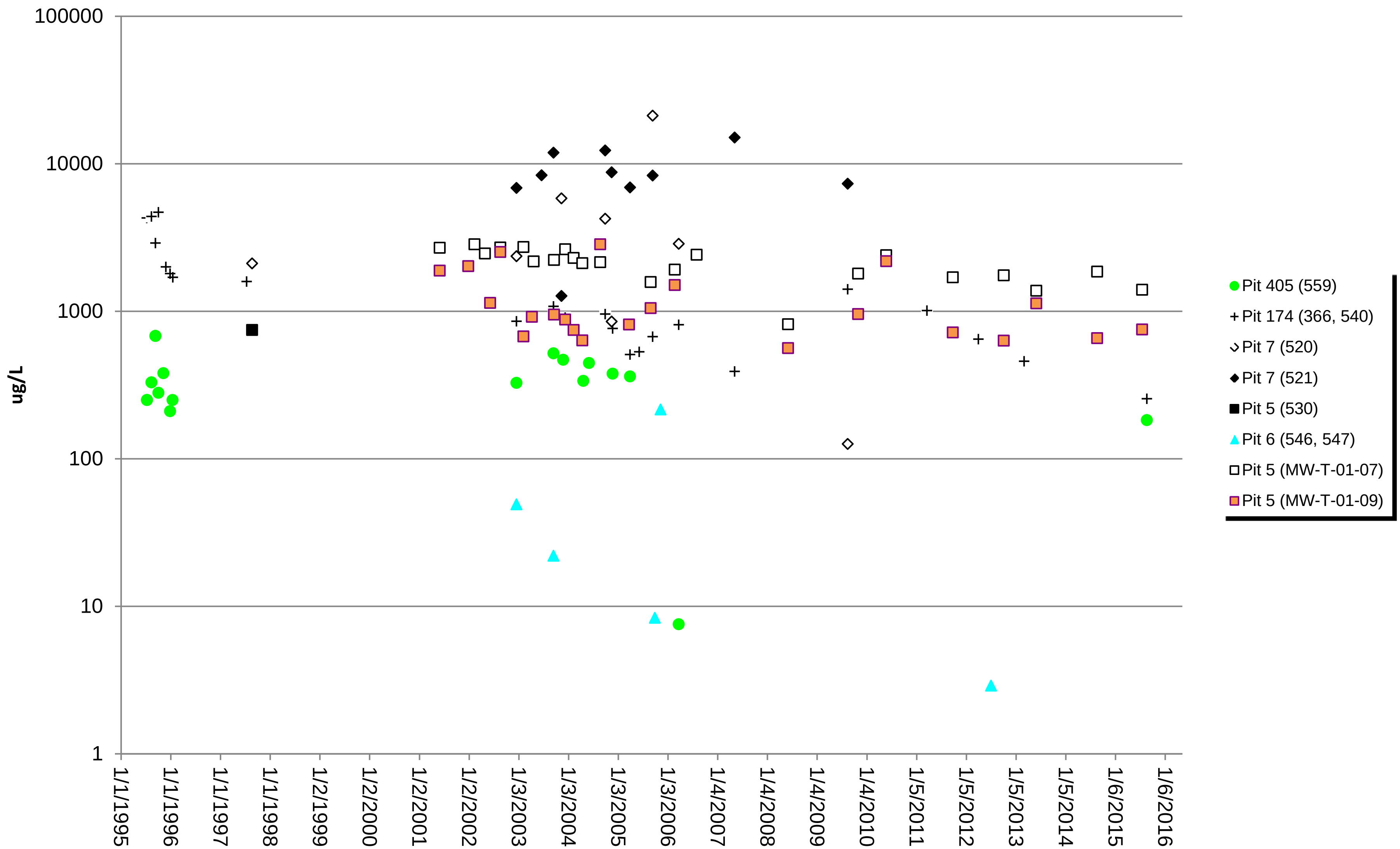


FIGURE 3.16 2002-2013 QUARRY SITE ABA DATA

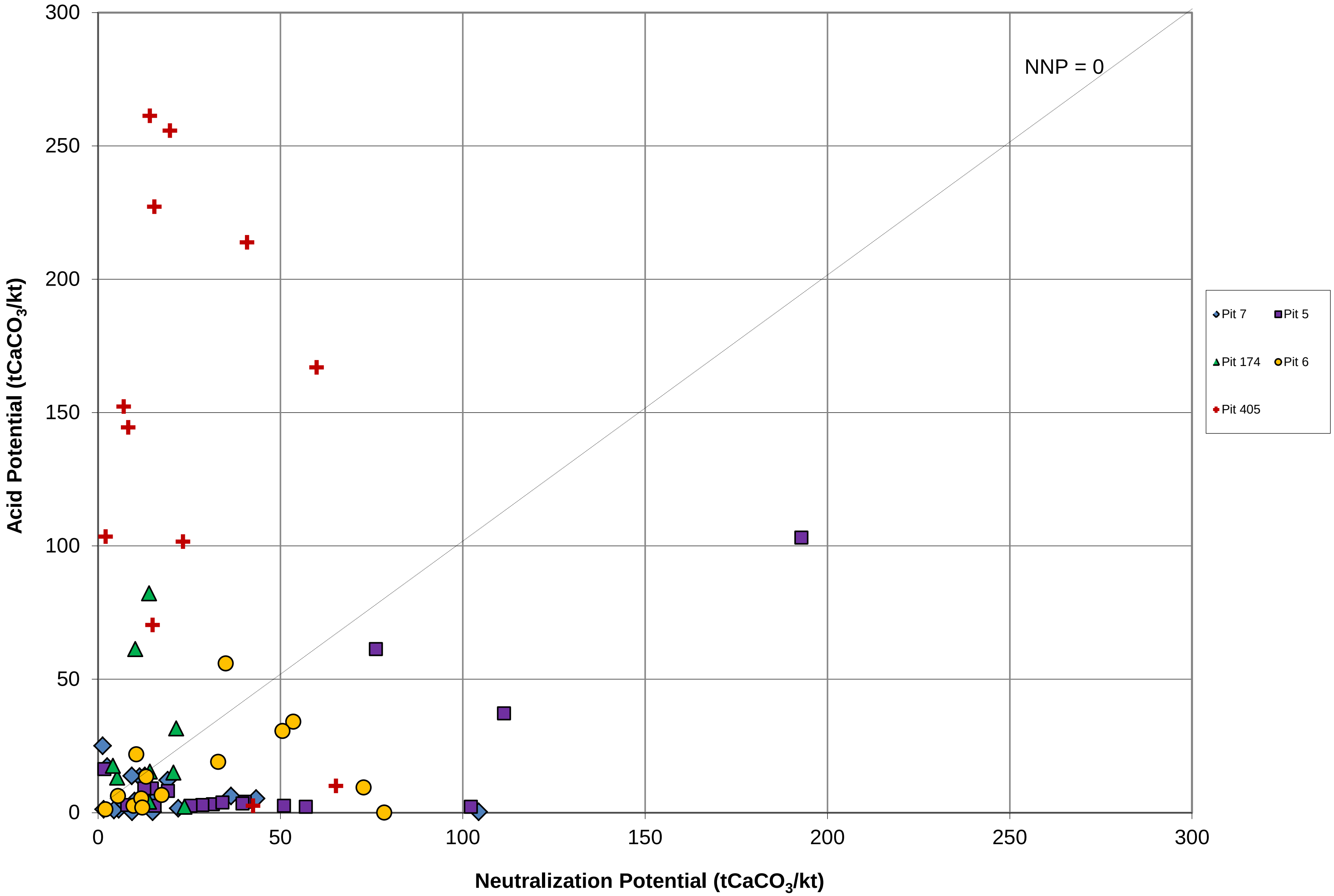


FIGURE 3.17 2002-2013 QUARRY SITE ABA DATA (NNP vs pH)