Golder Associates

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DATE	May 4, 2012	**PROJECT No.**	11-1118-0066 (4000-TM-DOC016 Rev A-1)
TO	Rick Schryer Fortune Minerals Limited 140 Fullarton Street, Suite 1902 London, Ontario N6A 5P2	**FROM**	Eric Blumstein, Bridgette Hendricks
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BENCH SCALE PASSIVE TREATMENT TESTING RESULTS TECHNICAL MEMORANDUM

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1	Technical Memorandum	Bench Scale Passive Treatment Testing Results

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Golder Associates

TECHNICAL MEMORANDUM

Date:	May 4, 2012	**Project No.:**	11-1118-0066 (4000-TM-DOC016 REV A-1)
To:	Dr. Rick Schryer, Director of Regulatory Affairs	**Company:**	Fortune Minerals
From:	Eric Blumenstein, Bridgette Hendricks		
cc:	Marc Rougier, Ken DeVos, Kevin Conroy	**Email:**	eblumenstein@golder.com
RE:	**BENCH SCALE PASSIVE TREATMENT TESTING RESULTS**		

1.0 BACKGROUND AND PURPOSE OF BENCH-SCALE TESTING

A bench-scale passive treatment system was constructed to demonstrate the feasibility of passive treatment as a post-closure water treatment strategy for the NICO gold-cobalt-bismuth-copper Project (NICO Project). Fortune Minerals Limited (Fortune) is developing the NICO Project and has retained Golder Associates Ltd. (Golder) to support several engineering efforts, including water treatment. Water treatment options have been developed previously on a preliminary basis for the projected 18-year active mining period and the post-closure period. One of the post-reclamation goals is the implementation of a long-term, economical water treatment strategy that includes passive treatment for metals removal. The bench-scale testing of passive treatment is the initial step in demonstrating this technology for implementation at the NICO Project.

The bench-scale passive treatment system was set up at the Golder Water Treatment Laboratory in Denver, Colorado using water generated during pilot plant operations and processing of ore from the NICO Project. The objective of the bench testing was to provide “proof-of-principle”; therefore, the system was operated at room temperature to demonstrate that metals can be removed passively and that the water matrix does not inhibit the metals removal processes. Operations in cold weather, optimization of retention time, optimization of substrate, evaluation of locally available substrate, and other scale-up parameters were not evaluated on this scale, but will be developed during pilot-scale testing planned for the active mining period.

This technical memorandum provides details on the bench test and an assessment of the test data. It includes sections on the bench test experimental setup, the influent water source, field and analytical results, and recommendations for on-site pilot testing.

2.0 BENCH SYSTEM DESCRIPTION

Passive wetland treatment has been selected as the base case for post-closure treatment of water that accumulates in SCP (Seepage Collection Ponds) No. 1, 2, 3, and 5, and the Surge Pond. Passive treatment may also be implemented to treat Flooded Open Pit overflow if it is necessary and appropriate. Evaluation of a wetlands type system on a bench-scale with limited quantities of water is not feasible due to space constraints and time constraints. There are several types of treatment systems that are classified as “passive” and they all typically rely on similar mechanisms for metals removal, which includes a combination of both anaerobic and aerobic biotreatment. Thus, an alternate method for the “proof-of-principal” test was used for bench-scale testing and included a passive biochemical reactor (BCR) as the anaerobic step and an aerobic polishing cell (APC) as the aerobic step. The anaerobic and aerobic biological treatment mechanisms are the same mechanisms that provide metals removal in wetlands systems. Removal mechanisms in a biological passive treatment system are dependent upon the constituent, but typically include: metal sulphide precipitation, metal hydroxide precipitation, biological reduction, abiotic adsorption, and filtration. This “proof-of-principle” testing is the first step in developing a passive treatment system.

The bench setup was constructed with substrate materials available locally to the Denver laboratory location. Pilot-scale testing will use materials collected closer to the mine site. Because of the limited volume of water available, the bench-scale system was constructed in 5-gallon pails with only one substrate mixture evaluated. The water used for the bench-scale passive testing was generated during the 2011 pilot plant ore processing operation and simulated the tailings and process water that will be generated during full-scale operations at the NICO Project. The total quantity of water available for the bench-scale passive testing was approximately 750 liters (200 gallons). Table 1 displays the typical mixture of BCR substrate that was used for the bench test.

Table 1: Substrate Mixture Used in Bench BCR Cell

Substrate	Percent of Mixture (by weight)	Mass	Bulk Density	Volume
	(%)	(kg)	(kg/L)	(L)
Wood Chips	74.7%	3.98	0.23	17.53
Limestone Chips	15%	0.80	1.70	0.47
Hay	10%	0.53	0.15	3.53
Inoculum (Steer Manure)	0.3%	0.02	0.27	0.06
Totals	100%	5.33	0.27*	21.59**

*Cannot be calculated from percent of mixture and bulk density due to compression that occurs when the mixed substrate is placed in BCR Cell.

**Substrate compressed to 19.4 liters when being placed and compacted in BCR Cell.

A small peristaltic pump was used to deliver BCR influent to the top of the BCR Cell. Flow through the BCR Cell was vertical from top to bottom. In the bottom of the BCR Cell there is a perforated PVC pipe covered with pea gravel. The pea gravel acts as a filter to ensure that small particulate organic materials do not enter the PVC pipe or effluent tubing. The BCR effluent flowed via gravity into the top of the APC, where there were several aquarium aerator diffusers to provide oxygen to polish the BCR effluent. Flow through the APC was also vertical from top to bottom. APC effluent was collected at the bottom of the APC and through tubing up along the side of the APC container, where it spilled over via gravity into the APC effluent collection tank. A photograph of the bench-scale setup is shown in Figure 1.

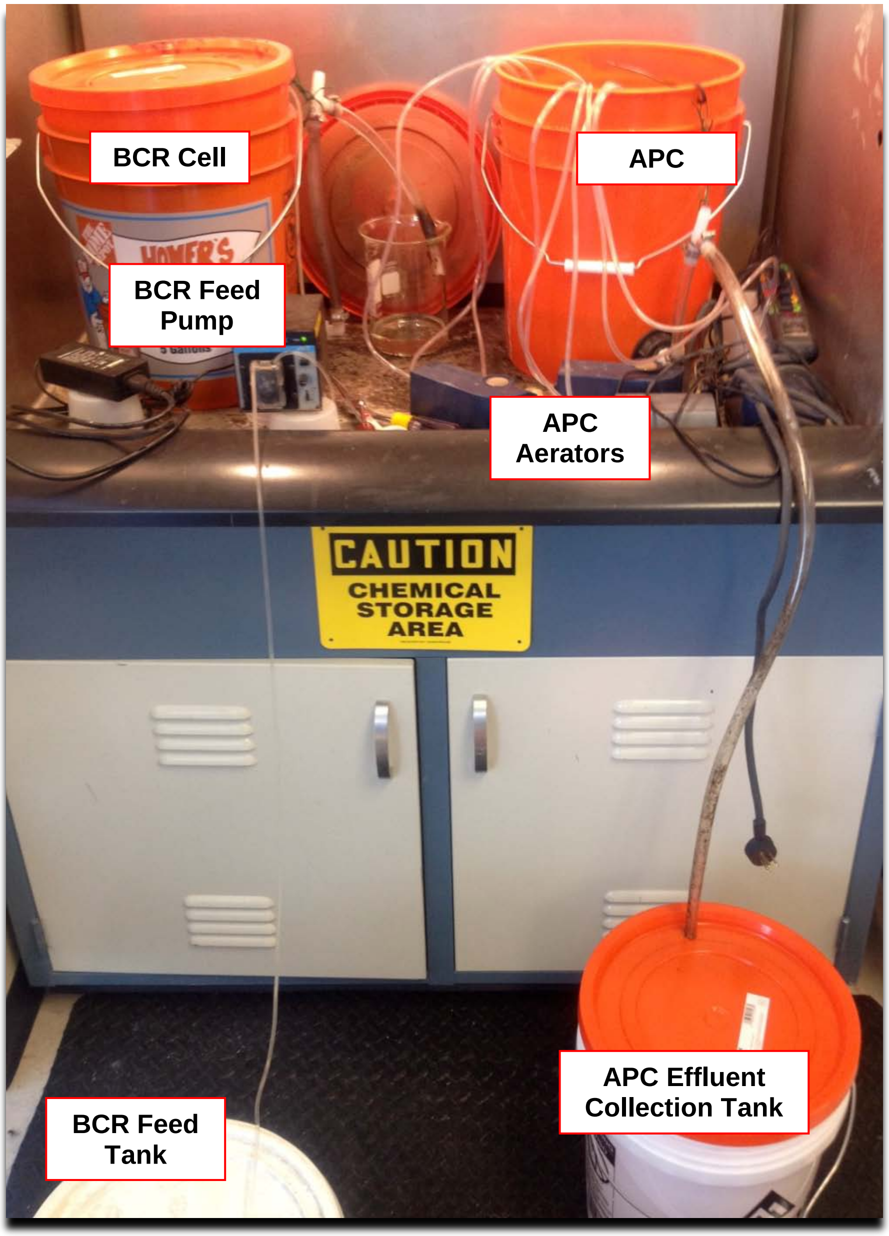


Figure 1: Bench Feed Tank, Piping, BCR Cell, APC, and APC Effluent Collection Tank

3.0 BENCH WATER SOURCE AND FLOW INITIATION

Approximately 40 buckets (5-gallon/19-liter) of water generated during pilot plant ore processing was combined to produce a composite water for the bench-scale passive system. After reviewing the analytical data from the composite water and determining that the metals concentrations were lower than the worst-case projections for post-closure water quality, the composite water was processed through a single membrane bench-scale reverse osmosis (RO) system to provide a three to four times concentration of the metals. Table 2 shows the projected post-closure influent quality, the combined water generated from pilot system ore processing operations, the brine (concentrate used for passive testing), and the permeate (treated water) from the bench-scale RO operation. After processing the composite water through the RO, there was approximately 90 gallons (340 liters) of RO brine to be used as influent to the passive bench system. The brine is reasonably representative of the projected post-closure water with a few more contaminants of concern than expected during post-closure.

The bench-scale passive system was set up and inoculated on September 23, 2011 with inoculum material obtained from local hardware, horse stables, and home and garden stores. Flow was started through the system on October 12 and maintained at approximately 3 mL/min to each cell. This flow rate resulted in an approximate three day hydraulic retention time (HRT) in the BCR and a three day HRT in the APC. A pilot- or full-scale passive treatment system constructed on-site would likely use a significantly longer HRT (10-20 days) to counteract the lower temperatures expected in the field.

4.0 DATA ANALYSIS

Once a week, Golder personnel monitored field parameters and collected and submitted samples to TestAmerica (4955 Yarrow Street, Arvada, Colorado 80002) for chemical analysis.

Figure 2 through Figure 23 graphically compare the data/results of the influent, BCR cell, and polishing cell with respect to the following parameters:

- Flow (Figure 2);
- pH (Figure 3);
- Temperature (Figure 4);
- Conductivity (Figure 5);
- Oxidation Reduction Potential (Figure 6);
- Dissolved Oxygen (Figure 7);
- Aluminum Concentration (Figure 8 – total, Figure 9 – dissolved);
- Cadmium Concentration (Figure 10 – total, Figure 11 – dissolved);
- Cobalt Concentration (Figure 12 – total, Figure 13 – dissolved);
- Lead Concentration (Figure 14 – total, Figure 15 – dissolved);
- Selenium Concentration (Figure 16 – total, Figure 17 – dissolved);

- Arsenic Concentration (Figure 18 – total, Figure 19 – dissolved);
- Iron Concentration (Figure 20 – total, Figure 21 – dissolved); and
- Uranium Concentration (Figure 22 – total, Figure 23 – dissolved).

Graphs were developed using the field data collected by Golder personnel during the weekly sampling events and the TestAmerica analytical results.

The data and graphs all show essentially three phases of operations, including a steady state phase to approximately week six, an upset period from approximately week six through week ten, and then redevelopment of steady state conditions. At approximately week six of operations, there were some plugging issues with the APC portion of the bench system. The tubing was cleaned out and the system was brought back on-line and the plugging issues continued until the tubing was replaced. The graphs show that after the upset period the effluent values were decreasing and approximately reached steady state values at the end of the test period. Testing was stopped when the available water was all processed.

The bench-scale system was not fully passive in the way in which a pilot- or full-scale system set up in the field would be operated. Due to the size of the system, space available in the laboratory, and quantity of water available, the system was set up with a small peristaltic pump to provide feed and to move water from the anaerobic BCR Cell to the aerobic APC. Aeration was provided via a mechanical system similar to small aquarium aeration systems. The design of the pilot- and full-scale systems will incorporate gravity flow, and aeration will be provided from the surface by the plant material and by the water flow and movement.

The small flows in the bench system require the use of small bore tubing, which can plug after several weeks of operation. Inspection of the tubing is difficult because of discoloration and the configuration of the reactor cell precluding preventative maintenance. Plugging and mechanical flow issues were detected in the system in mid-December (around week six of operation) and the system was shut down for several days so that it could be cleaned and rebuilt. Several weeks of steady state operating data in October and November had been obtained and deemed sufficient to fulfill the “proof-of-principal” goal of the project before the shut-down. The shut-down period and subsequent restart provided additional data on restart of the system. The final round of sampling demonstrated that the system could sustain an extended shut-down period and provide metals removal after restart. The mechanical flow issues are not of concern in larger pilot-scale and full-scale systems as they are designed to be fully passive.

Table 3 shows the data from the steady state period (data from weeks one through five of operation) before the mechanical issues caused system upset and the shut-down period. The overall average data presented on Table 4 reflects all of the data, including the data from the upset period and restart. These various operational periods (steady state, upset, and restart) are apparent in the graphical presentation of the data in the attached Figures 2-23. However, the conclusion from the bench-scale testing program is that the "proof-of-principle" was confirmed and the metals of concern in the water are treatable to low levels by passive mechanisms.

Other general observations regarding the data shown on Tables 2, 3, and 4 include:

- The parameters present above the Site Specific Water Quality Objectives (SSWQOs) in the brine used as bench passive system influent included aluminum, arsenic, cobalt, iron, selenium, and uranium. Some of these parameters are projected to be present in the post-closure water and some are parameter projected to be present only during active mining. Cadmium and lead are not present at projected concentrations in the brine tested although the removal of the other metals present provide demonstration that the technology removes metals to low levels in the water matrix generated by mining operations. Removal of most metals in a passive treatment system occurs by a similar mechanism so demonstration of metals removal is indicative of post-closure treatment success.
- While not part of the passive testing, the RO operations provides an indication of the permeate water quality as shown on Table 2 with most metals reported at non-detect.
- Most metals are present in the influent to the bench passive treatment system primarily in the dissolved form with the major exceptions being aluminum, iron, lead, and thallium.
- Most metals are present at consistent levels throughout the testing period. The primary exceptions are aluminum and iron in both the total and dissolved form which showed a decrease through the testing program.
- The bench passive treatment system provided an order of magnitude removal for most metals, the exceptions being aluminum and iron which were strongly influenced by the amount of the particulate form present and cadmium and lead that were near the detection limit in the influent as discussed below.
- The majority of the metals removal occurred in the BCR indicating good metals removal can be expected via an anaerobic biological mechanism.

4.1 Field Measurements

4.1.1 pH (Figure 3)

The influent pH to the bench cells averaged 8.0 standard units (s.u.). The pH in the BCR effluent averaged 6.6 s.u. and the pH in the APC effluent averaged 8.2 s.u. The average pH values are presented in Table 5.

Table 5: Average pH Values During Bench Testing (standard units)

Date Range	BCR INF	BCR EFF	APC EFF
19 October – 10 January	8.0	6.6	8.2

4.1.2 Temperature (Figure 4)

The influent temperature to the bench cells averaged 22.7°C. The temperature in the BCR effluent averaged 20.4°C and the temperature in the APC effluent averaged 20.5°C. The average temperature values are presented in Table 6.

Table 6: Average Temperature Values During Bench Testing (degrees Celsius)

Date Range	BCR INF	BCR EFF	APC EFF
19 October – 10 January	22.7	20.4	20.5

4.1.3 Conductivity (Figure 5)

The influent conductivity to the bench cells averaged 1.35 milliSiemens per centimeter (mS/cm). The conductivity in the BCR effluent averaged 1.47 mS/cm and the conductivity in the APC effluent averaged 1.36 mS/cm. The average conductivity values are summarized in Table 7.

Table 7: Average Conductivity Values During Bench Testing (mS/cm)

Date Range	BCR INF	BCR EFF	APC EFF
19 October – 10 January	1.35	1.47	1.36

The conductivity in the bench system effluent was essentially equal to the conductivity of the influent throughout testing. Conductivity was not expected to change through the system.

4.1.4 Oxidation Reduction Potential (Figure 6)

The influent oxidation reduction potential (ORP) to the bench cells averaged -23 milliVolt (mV). The ORP in the BCR effluent averaged -225 mV and the ORP in the APC effluent averaged -68 mV. The average ORP values are summarized in Table 8. The BCR operates at a lower ORP due to the anaerobic conditions maintained in the system while the aerated APC has a higher ORP.

Table 8: Average Oxidation-Reduction Potential During Bench Testing (mV)

Date Range	BCR INF	BCR EFF	APC EFF
19 October – 10 January	-23	-225	-68

4.1.5 Dissolved Oxygen (Figure 7)

The influent dissolved oxygen (DO) to the bench cells averaged 4.5 milligrams per liter (mg/L). The DO in the BCR effluent averaged 0.2 mg/L and the DO in the APC effluent averaged 3.9 mg/L. The average DO values are summarized in Table 9.

Table 9: Average Dissolved Oxygen During Bench Testing (mg/L)

Date Range	BCR INF	BCR EFF	APC EFF
19 October – 22 November	4.5	0.2	3.9

DO was only monitored during the first five weeks of testing to ensure that the BCR effluent was sufficiently oxygenated in the APC prior to being discharged. The DO values corresponded to the ORP values and were low in the BCR which operates anaerobically while the APC is aerated.

4.2 Analytical Results

4.2.1 Aluminum (Total – Figure 8, Dissolved – Figure 9)

The total influent aluminum concentration to the bench cells averaged 0.195 mg/L. The total aluminum concentration in the BCR effluent averaged 0.048 mg/L and the polishing cell effluent averaged 0.450 mg/L. The dissolved influent aluminum concentration averaged 0.016 mg/L. The dissolved aluminum concentration in the BCR effluent averaged 0.017 mg/L and the polishing cell effluent averaged 0.110 mg/L. The average aluminum concentrations are presented in Table 10.

Table 10: Average Total and Dissolved Aluminum During Bench Testing (mg/L)

	BCR INF		**BCR EFF**		**APC EFF**	
Date Range	**Total**	**Diss.**	**Total**	**Diss.**	**Total**	**Diss.**
19 October – 10 January	0.27	0.016	0.048	0.017	0.450	0.11

As can be seen in Table 10, aluminum is present in the raw water primarily as a particulate and is removed in the BCR through filtration. The overall increase in aluminum in the APC is attributed to the plugging issues in the system. If the problem were to persist in the pilot- and full-scale system, and aluminum was present primarily as a particulate then the system could be designed to promote settling of particulate metals prior to the passive treatment cells. Past experience indicates that dissolved aluminum would be removed in the pilot- or full-scale passive treatment system influent, so long as the dissolved aluminum concentration is less than 2 mg/L,

4.2.2 Cadmium (Total – Figure 10, Dissolved – Figure 11)

The total and dissolved values for cadmium are sufficiently similar to allow the use of only the total values for analysis. All data for cadmium, however, is near the analytical detection limit of 0.00004 mg/L. The influent cadmium concentration to the bench cells averaged 0.00005 mg/L. The average cadmium concentration in the BCR effluent was 0.00007 mg/L and the average cadmium concentration in the APC effluent was 0.00006 mg/L. The average cadmium concentrations are summarized in Table 11. The calculation of removal efficiency across the system is not meaningful with the data so near the analytical detection limit.

Table 11: Average Total Cadmium During Bench Testing (mg/L)

Date Range	**BCR INF**	**BCR EFF**	**APC EFF**
19 October – 10 January	0.00005	0.00007	0.00006

Cadmium is one of the parameters that is projected to be higher than the SSWQOs (0.00015 mg/L) but was present at lower levels in the test water. The projected concentration of cadmium in the post-closure water is approximately an order of magnitude higher than the water used for testing at 0.00287 mg/L.

Past experience indicates that cadmium would be removed in the pilot- or full-scale passive treatment system if present in the influent.

4.2.3 Cobalt (Total – Figure 12, Dissolved – Figure 13)

The total and dissolved values for cobalt are sufficiently similar to allow the use of only the total values for analysis. The influent cobalt concentration to the bench cells averaged 0.033 mg/L. The BCR effluent averaged 0.0053 mg/L and the APC effluent averaged 0.0025 mg/L. All BCR effluent and APC effluent cobalt values are below that of the SSWQOs (0.0100 mg/L) throughout the entirety of bench testing. The average cobalt concentrations are summarized in Table 12.

Table 12: Average Total Cobalt During Bench Testing (mg/L)

Date Range	BCR INF	BCR EFF	APC EFF
19 October – 10 January	0.033	0.0053	0.0025

4.2.4 Lead (Total – Figure 14, Dissolved – Figure 15)

The total and dissolved values for lead are sufficiently similar to allow the use of only the total values for analysis. The influent lead concentration to the bench cells averaged 0.0004 mg/L which is near the analytical detection limit of 0.00018 mg/L. The average lead concentration in the BCR effluent was 0.0003 mg/L and the average lead concentration in the APC effluent was 0.0003 mg/L. All BCR effluent and APC effluent lead values are below that of the SSWQOs (0.0076 mg/L) throughout the entirety of bench testing, however, the removal efficiency is low due to the low influent concentration near the analytical detection limit. Lead is projected to be present in the post-closure water at levels approximately an order of magnitude higher than the test water at 0.0143 mg/L. Past experience indicates that lead would be removed in the pilot- or full-scale passive treatment system if present in the influent,

The average lead concentrations are summarized in Table 13.

Table 13: Average Total Lead During Bench Testing (mg/L)

Date Range	BCR INF	BCR EFF	APC EFF
19 October – 10 January	0.0005	0.0003	0.0003

4.2.5 Selenium (Total – Figure 16, Dissolved – Figure 17)

The total and dissolved values for selenium are sufficiently similar to allow the use of only the total values for analysis. The influent selenium concentration to the bench cells averaged 0.021 mg/L. The BCR effluent averaged 0.003 mg/L and the selenium concentration in the APC effluent averaged 0.003 mg/L. All BCR effluent and APC effluent selenium values are below that of the SSWQOs (0.005 mg/L) throughout the entirety of bench testing, save the first analytical sample (October 19 sample that took place one week after flow was initiated, the microbial population was likely still acclimating and growing in numbers). The average selenium concentrations are summarized in Table 14.

Table 14: Average Total Selenium During Bench Testing (mg/L)

Date Range	BCR INF	BCR EFF	APC EFF
19 October – 10 January	0.021	0.003	0.003

4.2.6 Arsenic (Total – Figure 18, Dissolved – Figure 19)

The total and dissolved values for arsenic are sufficiently similar to allow the use of only the total values for analysis. The influent arsenic concentration to the bench cells averaged 0.123 mg/L. The arsenic concentration in the BCR effluent averaged 0.047 mg/L and the polishing cell effluent averaged 0.050 mg/L. The average arsenic concentrations are presented in Table 15.

Table 15: Average Total Arsenic During Bench Testing (mg/L)

Date Range	BCR INF	BCR EFF	APC EFF
19 October – 10 January	0.123	0.047	0.050

Review of the total and dissolved arsenic plots (Figure 18 and Figure 19) shows a gradual increase in the BCR effluent and APC effluent throughout the first five weeks of bench testing, after which the arsenic levels appeared to plateau. It is assumed that the arsenic removal at the beginning of bench testing was partially arsenic hydroxide precipitation at the influent surface of the BCR cell (prior to anaerobic conditions being fully developed) or adsorption to organic media. As the BCR cell grew more anaerobic and the organic binding sites were occupied by adsorbed compounds, the arsenic levels increased slightly.

The remainder of the arsenic should be removed as part of an iron-arsenic hydroxide co-precipitation in the APC. When looking at Table 3 and Table 4, it should be noted that there was no arsenic removal in the APC throughout bench testing. The explanation for this is that there was not sufficient dissolved iron compared to the concentration of arsenic present in the BCR effluent being delivered to the APC. Past studies have shown that arsenic leaving a BCR cell can be easily co-precipitated as an iron-arsenic hydroxide particulate in aerobic conditions so long as there is at least five times as much iron as arsenic present in the BCR effluent (Langmuir et al., 1999). Throughout the bench test, the average dissolved iron levels entering the APC were 0.124 mg/L while the average dissolved arsenic levels entering the APC were 0.042 mg/L, a ratio of 2.95 parts iron to arsenic, well short of the required 5 parts iron to arsenic. This will need to be considered in the design of a pilot- or full-scale system if the SSWQOs for arsenic (0.050 mg/L) is to be met.

4.2.7 Iron (Total – Figure 20, Dissolved – Figure 21)

The total and dissolved values for iron have been kept separate to help understand the difference in iron present in the total form versus the dissolved form. The results for iron are similar to those discussed above for aluminum with the results influenced by the presence of mostly particulate iron. The total influent iron concentration to the bench cells received averaged 1.18 mg/L. The total iron concentration in the BCR effluent averaged 0.235 mg/L and the polishing cell effluent averaged 0.250 mg/L. The dissolved influent iron concentration of the water the bench cells received averaged 0.024 mg/L. The dissolved iron concentration in the BCR effluent averaged 0.124 mg/L and the polishing cell effluent averaged 0.068 mg/L. All BCR effluent and APC effluent total and dissolved iron values are below that of the SSWQOs (1.5 mg/L) throughout the entirety of bench testing. The average iron concentrations are presented in Table 16.

Table 16: Average Total and Dissolved Iron During Bench Testing (mg/L)

	BCR INF		**BCR EFF**		**APC EFF**	
Date Range	Total	Diss.	Total	Diss.	Total	Diss.
19 October – 10 January	1.18	0.024	0.235	0.124	0.250	0.068

4.2.8 Uranium (Total – Figure 22, Dissolved – Figure 23)

The total and dissolved values for uranium are sufficiently similar to allow the use of only the total values for analysis. The influent uranium concentration to the bench cells averaged 0.047 mg/L. The BCR effluent averaged 0.005 mg/L and the uranium concentration in the APC effluent averaged 0.005 mg/L. All BCR effluent and APC effluent uranium values are below that of the SSWQOs (0.027 mg/L) throughout the entirety of bench testing. The average uranium concentrations are summarized in Table 17.

Table 17: Average Total Uranium During Bench Testing (mg/L)

Date Range	**BCR INF**	**BCR EFF**	**APC EFF**
19 October – 10 January	0.046	0.005	0.005

5.0 BENCH TEST PERFORMANCE SUMMARY

The objective of the bench testing was to provide “proof-of-principle” and was operated at room temperature to demonstrate that metals can be removed passively and that the water matrix does not inhibit the metals removal processes. Operations in cold weather, optimization of retention time, optimization of substrate, evaluation of locally available substrate, and other scale-up parameters were not evaluated on this scale but will be developed during pilot-scale testing planned for the active mining period. It can be concluded from the bench testing results, summarized above, that passive treatment will be able to remove metals in the water matrix expected at the Fortune NICO Project site.

The Fortune NICO Project bench testing can be characterized by four distinct phases:

- Incubation Period (23 September 2011 – 12 October 2011);
- Primary Start-up (flow initiation) & Steady-State Period (12 October 2011 – approximately 22 November 2011);
- Mechanical Issues Period (approximately 23 November 2011 – 28 December 2011); and
- Secondary Start-up and Steady-State Period (28 December 2011 – 10 January 2012).

The Steady-State operations period of bench testing provided data that is most representative of what would be expected during the operation of a pilot- or full-scale BCR cell. The bench BCR cell effectively removed aluminum, cobalt, selenium, arsenic, iron, and uranium throughout the entirety of bench testing. The APC showed effective removal of cadmium, cobalt, lead, iron, and uranium during Steady-State operations. Mechanical issues impacted the aeration of the APC and caused clogging in the small bench system tubing. The mechanical issues resulted from using an electrical peristaltic pump, electrical aeration, and small tubing, none of which would be expected to be present in a pilot- or full-scale passive treatment system on the Fortune NICO Project site during mining activity.

There were three occasions in which the aluminum levels exceeded the SSWQOs (0.41 mg/L), once a week after flow was initiated to the bench system (19 October) and twice during the mechanical operations issues period (2 December and 21 December). The first instance of aluminum exceedance is believed to be due to the flushing out of particulate matter from the BCR cell, which is normal shortly after start-up of a BCR. The other two elevated aluminum levels in the APC effluent are the result of plugging in the APC leading to the build-up of particulate aluminum in the APC. Additionally, the APC effluent was not sent to a settling cell where organic and inorganic particulates would be removed from the water prior to discharge. The aerobic portion of a pilot- or full-scale passive treatment system would most likely be a constructed wetland or aerobic lagoon. A constructed wetland would have vegetation to filter out the particulate matter and sufficient HRT to allow for particulates to be settled out of solution. An aerobic lagoon would be followed by a settling pond that would be sized to allow for sufficient particulate settling.

There was only one sampling event in which the selenium levels exceeded that of the SSWQOs (0.005 mg/L), and that was the first sampling event one week after flow was initiated (19 October) and the selenium concentration was measured at 0.006 mg/L. It is believed that anaerobic conditions were still being developed in the BCR cell during this time and the selenium reducing microbial population was still developing. None of the other samples collected throughout bench testing showed a selenium level above 0.003 mg/L. Selenium is expected to be removed effectively in a pilot- or full-scale passive treatment system.

Arsenic levels in the bench system effluent were slightly above the SSWQOs (0.050 mg/L) because there was not sufficient reduced (dissolved) iron present in the APC influent for the arsenic to co-precipitate with. Pilot - or full-scale operations will need to look into this issue and determine if the addition of a sacrificial iron material be included in the passive treatment system substrate to effectively meet the SSWQOs.

Based on these “proof-of-principal” results a pilot program will be conducted at the NICO site to evaluate construction of passive treatment systems with locally available materials and treat a larger quantity of water from site activities. The pilot systems will be operated over several seasons to confirm the treatment efficiency and design parameters during cold weather operations. Recommendations for the pilot test program include:

- Evaluation of constructed wetlands over several seasons to determine the treatment efficiency and design load rate parameters for operations with cold water. Several cells should be compared side-by-side to determine the optimal cell depth. The bench testing demonstrated good metals removal anaerobically.
- Evaluation of BCR type passive systems should also be conducted in parallel with the wetlands evaluation to provide a baseline of the design parameters for this type of passive system.
- Evaluation of aerobic polishing should be incorporated into the pilot test program. Regardless of the configuration of the anaerobic passive cells, aerobic polishing is required, at a minimum to increase the DO and ORP of the effluent water. Aerobic polishing may also be required for residual metals removal and potentially BOD removal if increased in the anaerobic cells.

6.0 REFERENCES

Langmuir et al., 1999. D. Langmuir, J. Mahoney, A. MacDonald, J. Rowson. “Predicting the Arsenic Source-Term from Buried Uranium Mill Tailings.” Proceedings of the Sixth International Conference on Tailings and Mine Waste ’99, Fort Collins, CO. January 24-27, 1999. Published by Balkema, Brookfield, VT.

TABLES

Table 2: Summary of Expected Influent Water Quality for Post-Closure Passive System and Brine Used for Bench-Scale Passive Testing

Constituent	Units	Effluent Treatment Goals based on Site Specific Water Quality Objectives for End-of-Pipe Feb 2011	Maximum Site Water Quality Predicted Post-Closure Influent	Average of Available Water from Geochemical Testing (5 Buckets)	Blended Water from Pilot Plant Ore Testing		Brine Used as Influent for Passive Bench-Scale Test		Permeate - Bench-Scale Test
					Total Metals	Dissolved Metals	Total Metals	Dissolved Metals	Total Metals
pH	s.u.	6.5 to 9.0	5.9	8.5	7.5				
Aluminum	mg/L	0.410		0.063	0.180	<0.018	0.420	0.029	<0.018
Antimony	mg/L	0.03	0.003	0.0128	0.0087	0.0088	0.019	0.018	0.00095
Arsenic	mg/L	0.05	**0.37**	0.034	0.046	0.042	0.1	0.095	0.00042
Barium	mg/L	-	0.04	0.012	0.014	0.013	0.017	0.018	<0.00029
Beryllium	mg/L	-	0.00287	<0.00002	<0.00008	<0.00008	0.000091	<0.00008	<0.00008
Boron	mg/L	-	0.14	0.089	0.066	0.066	0.098	0.096	0.031
Cadmium	mg/L	0.00015	**0.00287**	0.00005	0.000045	0.000071	<0.00004	0.0001	<0.00004
Calcium	mg/L	-	46.9	22.5	15	15	32	30	0.042
Chloride	mg/L	353	152	35	35				
Chromium	mg/L	-	0.0143	<0.0005	0.00061	<0.0005	0.0012	<0.0005	<0.0005
Cobalt	mg/L	0.01	0.01	0.0018	0.012	0.0088	0.030	0.0220	<0.000054
Copper	mg/L	0.022	0.012	0.0013	0.018	0.016	0.0068	0.0079	<0.00056
Iron	mg/L	1.5	9.0	0.0082	0.75	0.024	1.9	0.051	<0.022
Lead	mg/L	0.0076	**0.0143**	0.00030	0.0014	<0.001	0.00088	<0.00018	<0.00018
Magnesium	mg/L	-	19.9	6.8	7.4	7.2	16	15	0.012
Manganese	mg/L	-	0.870	0.017	0.050	0.044	0.077	0.061	<0.00031
Mercury	mg/L	-	0.000574	<0.0001	<0.000027		<0.000027		<0.000027
Molybdenum	mg/L	-	0.014	0.049	0.078	0.08	0.160	0.170	<0.00014
Nickel	mg/L	-	0.006	0.0014	0.0043	0.0042	0.0037	0.0033	<0.0003
Phosphorous	mg/L	-	0.424	0.024	<0.014	<0.014	0.019	<0.014	<0.014
Potassium	mg/L	-	5.8	78.2	81	78	170	160	1.0
Selenium	mg/L	0.005	0.0013	0.017	0.0089	0.0096	0.020	0.021	<0.0007
Silver	mg/L	-	0.01400	0.000008	<0.000015	<0.000015	<0.000015	<0.000015	<0.000015
Sodium	mg/L	-	15.3	28.2	29	28	59	55	0.7
Strontium	mg/L	-	0.150	0.07	0.039	0.039	0.077	0.073	<0.0003
Sulfate	mg/L	500	27	101	110				
Thallium	mg/L	-	0.1400	0.00005	0.0003	0.000043	0.00017	0.000038	<0.00002
Tin	mg/L	-	0.140	0.0003	<.0.0058	<.0.0058	<.0.0058	<.0.0058	<.0.0058
Uranium	mg/L	0.027	0.1400	0.011	0.017	0.016	0.043	0.044	0.000047
Vanadium	mg/L	-	0.0029	0.0002	<0.00014	0.00014	0.00085	0.00016	<0.00014
Zinc	mg/L	0.11	0.067	0.0055	0.042	0.038	0.043	0.044	0.0023

🟨 equals exceedance of treatment goals

Table 3: Data from Steady State Bench System Operations During Weeks 1 Through 5 [1]

Parameter		Units	Effluent Limit[2]	BCR Influent (RO Brine)			BCR Effluent				APC Effluent				Overall Bench % Removal
				Average	Maximum	Minimum	Average		Maximum	Minimum	Average		Maximum	Minimum	
				Conc.	Conc.	Conc.	Conc.	% Removal	Conc.	Conc.	Conc.	% Removal	Conc.	Conc.	
FIELD	pH	s.u.	6.5 to 9.0	8.1	N/A	N/A	6.8	N/A	7.3	6.4	8.1	N/A	8.3	7.9	N/A
	Temperature	deg. C	N/A	22.8	N/A	N/A	20.0	N/A	22.6	18.4	19.3	N/A	22.5	18.2	N/A
	Conductivity	mS/cm	N/A	1.88	N/A	N/A	1.12	N/A	1.28	0.99	1.41	N/A	1.77	1.14	N/A
	ORP	mV	N/A	-52	N/A	N/A	-221	N/A	-146	-324	-69	N/A	-50	-82	N/A
	DO	mg/L	N/A	4.5	N/A	N/A	0.1	N/A	0.3	0.0	3.9	N/A	5.3	2.7	N/A
	Flow	mL/min	N/A	3.1	3.5	2.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
METALS	Aluminum-Total	mg/L	0.41	0.27	0.10	0.42	0.06	78.9%	0.14	0.03	0.36	-531.6%	1.20	0.11	-33.3%
	Aluminum-Dissolved	mg/L	0.41	0.02	0.03	0.01	0.02	10.5%	0.05	0.01	0.07	-300.0%	0.10	0.05	-257.9%
	Cadmium-Total	mg/L	0.00015	0.00005	0.00010	0.00004	0.00009	-62.3%	0.00014	0.00005	0.00006	27.9%	0.00013	0.00002	-17.0%
	Cadmium-Dissolved	mg/L	0.00015	0.00008	0.00010	0.00006	0.00004	48.7%	0.00010	0.00001	0.00004	-5.0%	0.00009	0.00002	46.2%
	Cobalt-Total	mg/L	0.0100	0.033	0.03	0.039	0.0063	80.9%	0.0095	0.0037	0.0026	58.7%	0.0059	0.0015	92.1%
	Cobalt-Dissolved	mg/L	0.0100	0.0280	0.0340	0.0220	0.0033	88.2%	0.0068	0.0016	0.0032	3.0%	0.0048	0.0015	88.6%
	Lead-Total	mg/L	0.0076	0.0005	0.0002	0.0009	0.0004	28.8%	0.0007	0.0002	0.0002	51.4%	0.0003	0.0001	65.4%
	Lead-Dissolved	mg/L	0.0076	0.0001	N/A	N/A	0.0002	-100.0%	0.0004	0.0001	0.0001	22.2%	0.0002	0.0001	-55.6%
	Selenium-Total	mg/L	0.005	0.021	0.019	0.023	0.003	84.8%	0.006	0.002	0.003	0.0%	0.006	0.002	84.8%
	Selenium-Dissolved	mg/L	0.005	0.022	0.022	0.021	0.002	88.8%	0.004	0.002	0.003	-8.3%	0.004	0.002	87.9%
	Arsenic-Total	mg/L	0.05	0.123	0.1	0.14	0.044	64.2%	0.057	0.034	0.040	9.1%	0.057	0.026	67.5%
	Arsenic-Dissolved	mg/L	0.05	0.113	0.130	0.095	0.040	64.6%	0.052	0.032	0.041	-2.5%	0.061	0.023	63.7%
	Iron-Total	mg/L	1.5	1.18	0.44	1.90	0.325	72.5%	1.100	0.084	0.236	27.4%	0.800	0.067	80.0%
	Iron-Dissolved	mg/L	1.5	0.031	0.051	0.011	0.185	-496.8%	0.720	0.033	0.091	50.8%	0.190	0.040	-193.5%
	Uranium-Total	mg/L	0.027	0.046	0.043	0.049	0.004	91.1%	0.008	0.002	0.003	34.1%	0.004	0.002	94.1%
	Uranium-Dissolved	mg/L	0.027	0.047	0.050	0.044	0.001	97.2%	0.002	0.001	0.003	-92.3%	0.004	0.002	94.7%

[1] Based on three analytical samples for the BCR Influent and five samples for the BCR Effluent and the APC Effluent

[2] Effluent Treatment Goals based on Site Specific Water Quality Objectives for End-of-Pipe Feb 2011

🟨 equals exceedance of treatment goals

Table 4: Data from Overall Bench System Operations, Week 1 Through 12 [1]

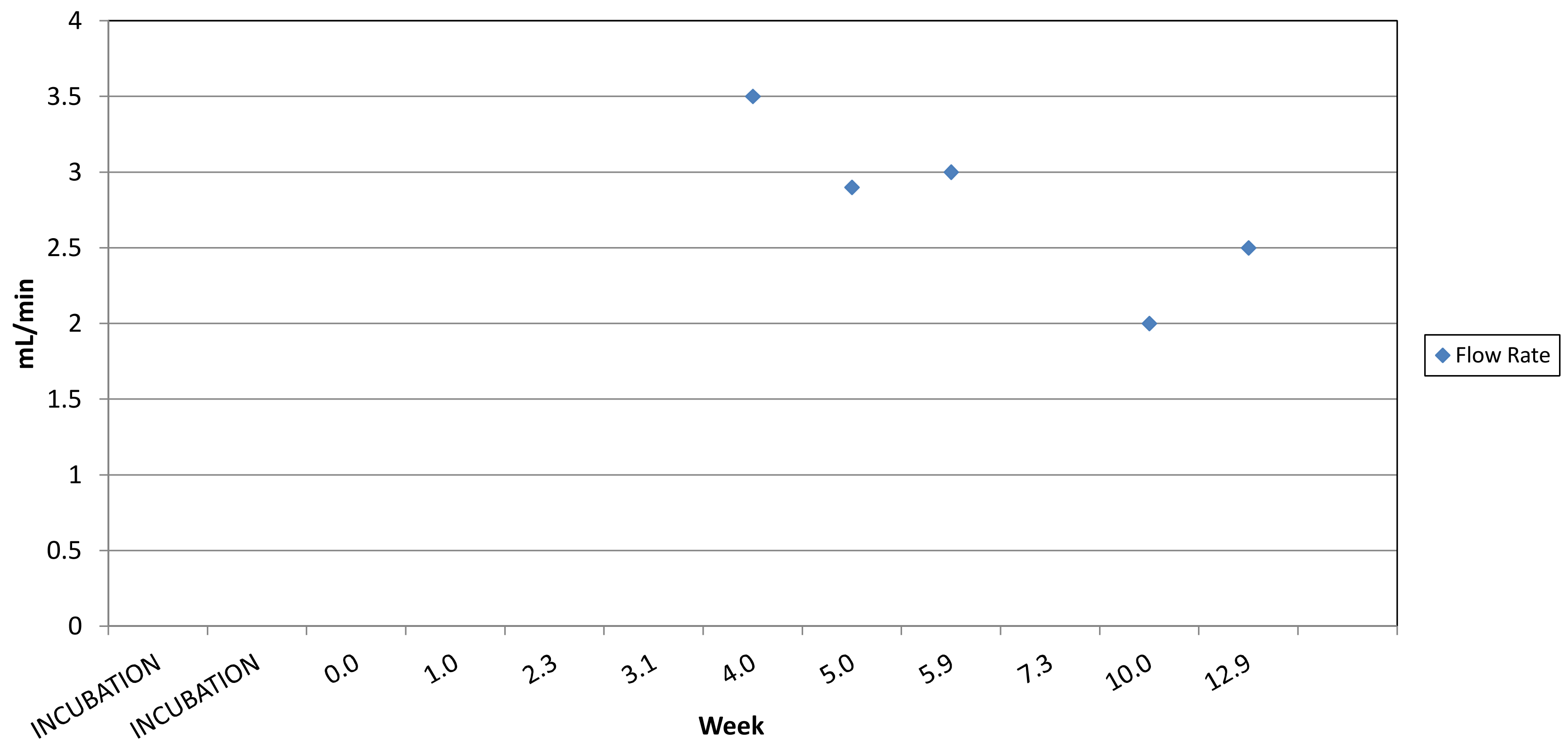
Parameter		Units	Effluent Limit[2]	BCR Influent (RO Brine)			BCR Effluent				APC Effluent				Overall Bench % Removal
				Average	Maximum	Minimum	Average		Maximum	Minimum	Average		Maximum	Minimum	
				Conc.	Conc.	Conc.	Conc.	% Removal	Conc.	Conc.	Conc.	% Removal	Conc.	Conc.	
FIELD	**pH**	s.u.	6.5 to 9.0	8.0	8.1	7.9	6.6	N/A	7.3	5.7	8.2	N/A	8.4	7.9	N/A
	Temperature	deg. C	N/A	22.7	25.0	20.4	20.4	N/A	25.0	18.1	20.5	N/A	25.0	18.2	N/A
	Conductivity	mS/cm	N/A	1.35	1.88	1.07	1.47	N/A	2.40	0.99	1.36	N/A	1.77	1.14	N/A
	ORP	mV	N/A	-23	28	-52	-225	N/A	-146	-324	-68	N/A	-50	-82	N/A
	DO	mg/L	N/A	4.5	N/A	N/A	0.2	N/A	0.4	0.0	3.9	N/A	5.3	2.7	N/A
	Flow	mL/min	N/A	2.8	3.5	2.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
METALS	**Aluminum-Total**	mg/L	0.41	0.27	0.10	0.42	0.048	82.2%	0.140	0.023	0.450	-837.5%	1.200	0.110	-66.7%
	Aluminum-Dissolved	mg/L	0.41	0.016	0.029	0.009	0.017	-6.3%	0.050	0.009	0.110	-547.1%	0.300	0.050	-587.5%
	Cadmium-Total	mg/L	0.00015	0.00005	0.00010	0.00004	0.00007	-35.8%	0.00014	0.00002	0.00006	16.7%	0.00013	0.00002	-13.2%
	Cadmium-Dissolved	mg/L	0.00015	0.00005	0.00002	0.00010	0.00004	20.8%	0.00010	0.00001	0.00006	-50.0%	0.00015	0.00002	-18.9%
	Cobalt-Total	mg/L	0.0100	0.033	0.03	0.039	0.0053	83.9%	0.0095	0.0008	0.0025	52.8%	0.0059	0.0003	92.4%
	Cobalt-Dissolved	mg/L	0.0100	0.0287	0.024	0.022	0.0029	89.9%	0.0068	0.0016	0.0032	-10.3%	0.0059	0.0015	88.9%
	Lead-Total	mg/L	0.0076	0.0005	0.0002	0.0009	0.0003	34.6%	0.0007	0.0002	0.0003	0.0%	0.0009	0.0001	34.6%
	Lead-Dissolved	mg/L	0.0076	0.0001	0.0001	0.0001	0.0002	-77.8%	0.0004	0.0001	0.0002	6.3%	0.0003	0.0001	-66.7%
	Selenium-Total	mg/L	0.005	0.021	0.019	0.023	0.003	86.7%	0.006	0.002	0.003	-7.1%	0.006	0.002	85.7%
	Selenium-Dissolved	mg/L	0.005	0.020	0.022	0.017	0.002	89.5%	0.004	0.001	0.003	-19.0%	0.004	0.002	87.5%
	Arsenic-Total	mg/L	0.05	0.123	0.1	0.14	0.047	61.8%	0.057	0.034	0.05	-6.4%	0.068	0.026	59.3%
	Arsenic-Dissolved	mg/L	0.05	0.112	0.130	0.095	0.042	62.5%	0.052	0.032	0.05	-19.0%	0.068	0.023	55.4%
	Iron-Total	mg/L	1.5	1.18	0.44	1.90	0.235	80.1%	1.100	0.052	0.25	-6.4%	0.800	0.030	78.8%
	Iron-Dissolved	mg/L	1.5	0.024	0.051	0.011	0.124	-416.7%	0.720	0.011	0.068	45.2%	0.190	0.011	-183.3%
	Uranium-Total	mg/L	0.027	0.046	0.043	0.049	0.005	89.8%	0.009	0.002	0.005	4.3%	0.010	0.002	90.2%
	Uranium-Dissolved	mg/L	0.027	0.047	0.050	0.044	0.002	96.0%	0.003	0.001	0.005	-136.8%	0.010	0.002	90.4%

[1] Based on three analytical samples for the BCR Influent and eight samples for the BCR Effluent and the APC Effluent

[2] Effluent Treatment Goals based on Site Specific Water Quality Objectives for End-of-Pipe Feb 2011

🟨 equals exceedance of treatment goals

FIGURES



Golder Associates
Denver, Colorado

TITLE

Bench BCR Field Data - Flow

CLIENT/PROJECT

NICO FORTUNE MINERALS BENCH TESTING

DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
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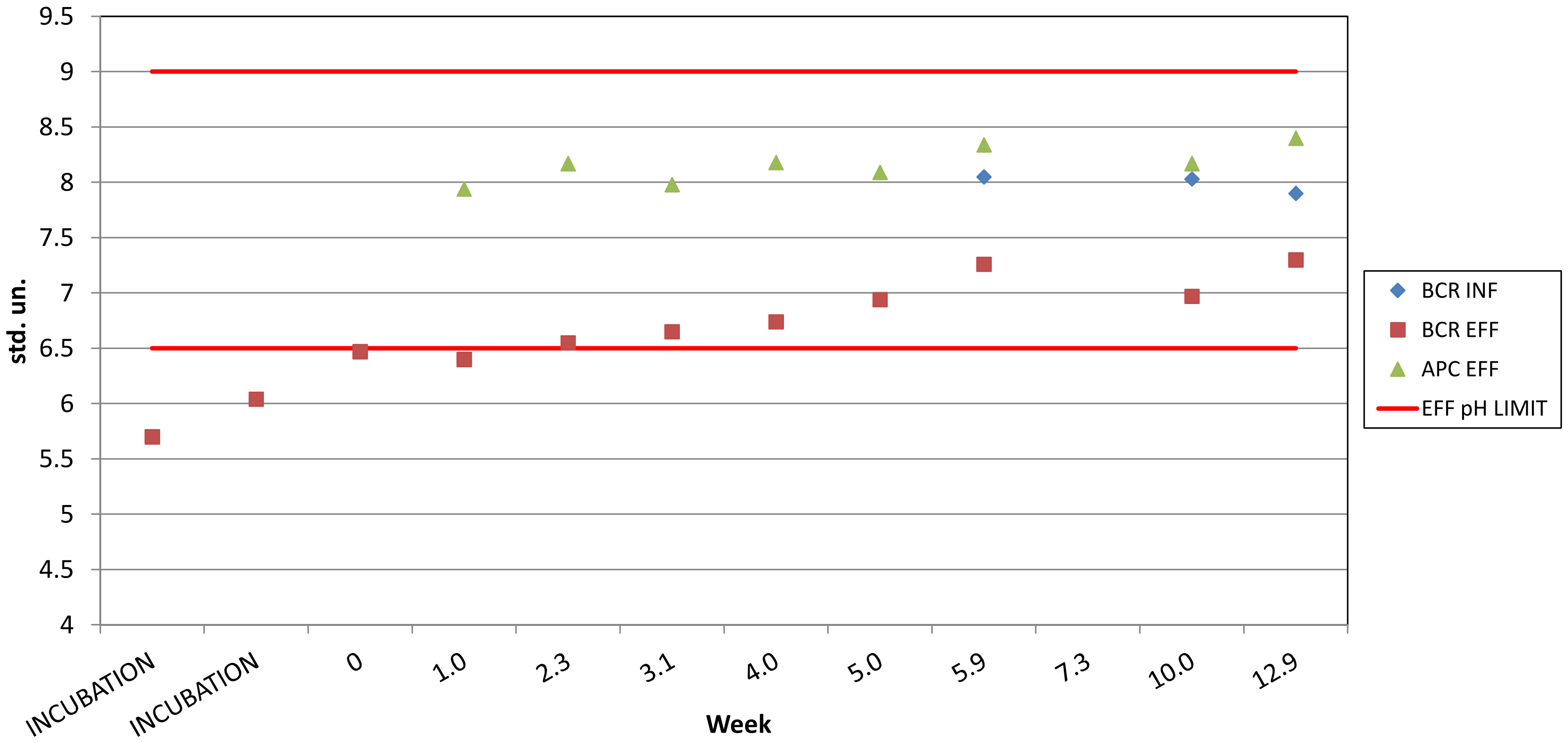

Golder Associates
Denver, Colorado

CLIENT/PROJECT

NICO FORTUNE MINERALS BENCH TESTING

TITLE

Bench BCR Field Data - pH

DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
CHECKED	EPB	SCALE	N/A	DWG. NO.	N/A
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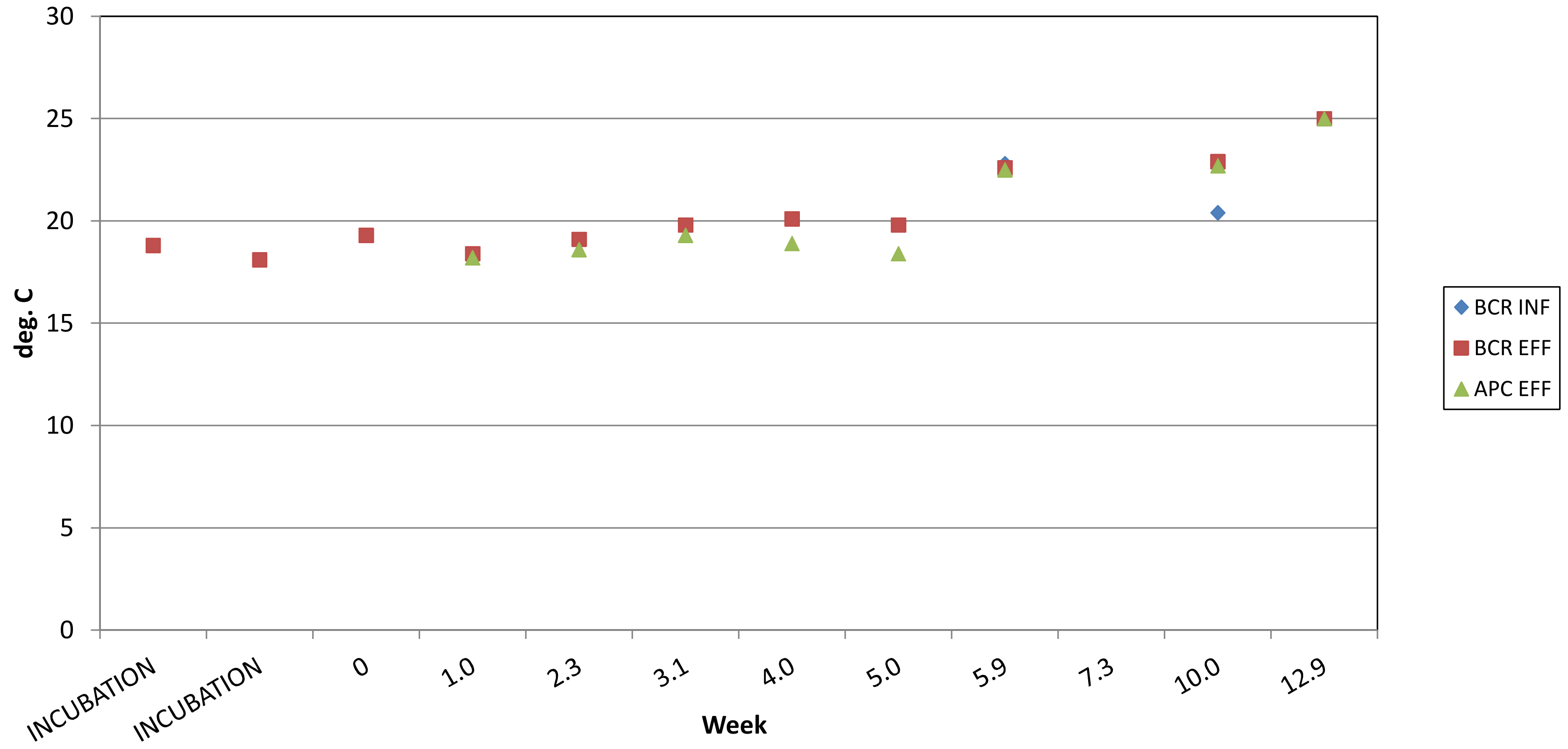

Golder Associates Denver, Colorado

TITLE	**Bench BCR Field Data - Temperature**				
CLIENT/PROJECT	**NICO FORTUNE MINERALS BENCH TESTING**				
DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
CHECKED	EPB	SCALE	N/A	DWG. NO.	N/A
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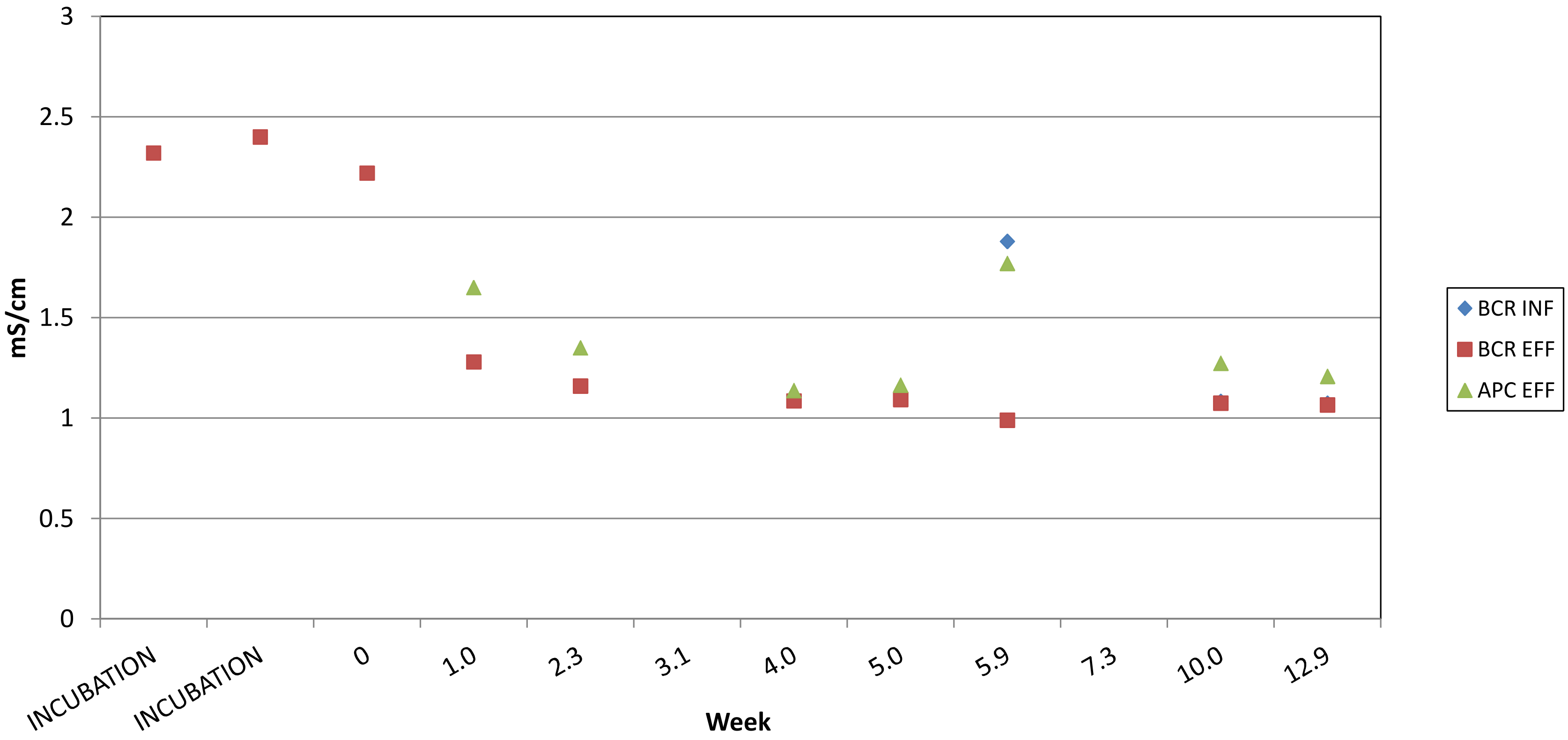

Golder Associates
Denver, Colorado

TITLE

Bench BCR Field Data - Conductivity

CLIENT/PROJECT

NICO FORTUNE MINERALS BENCH TESTING

DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
CHECKED	EPB	SCALE	N/A	DWG. NO.	N/A
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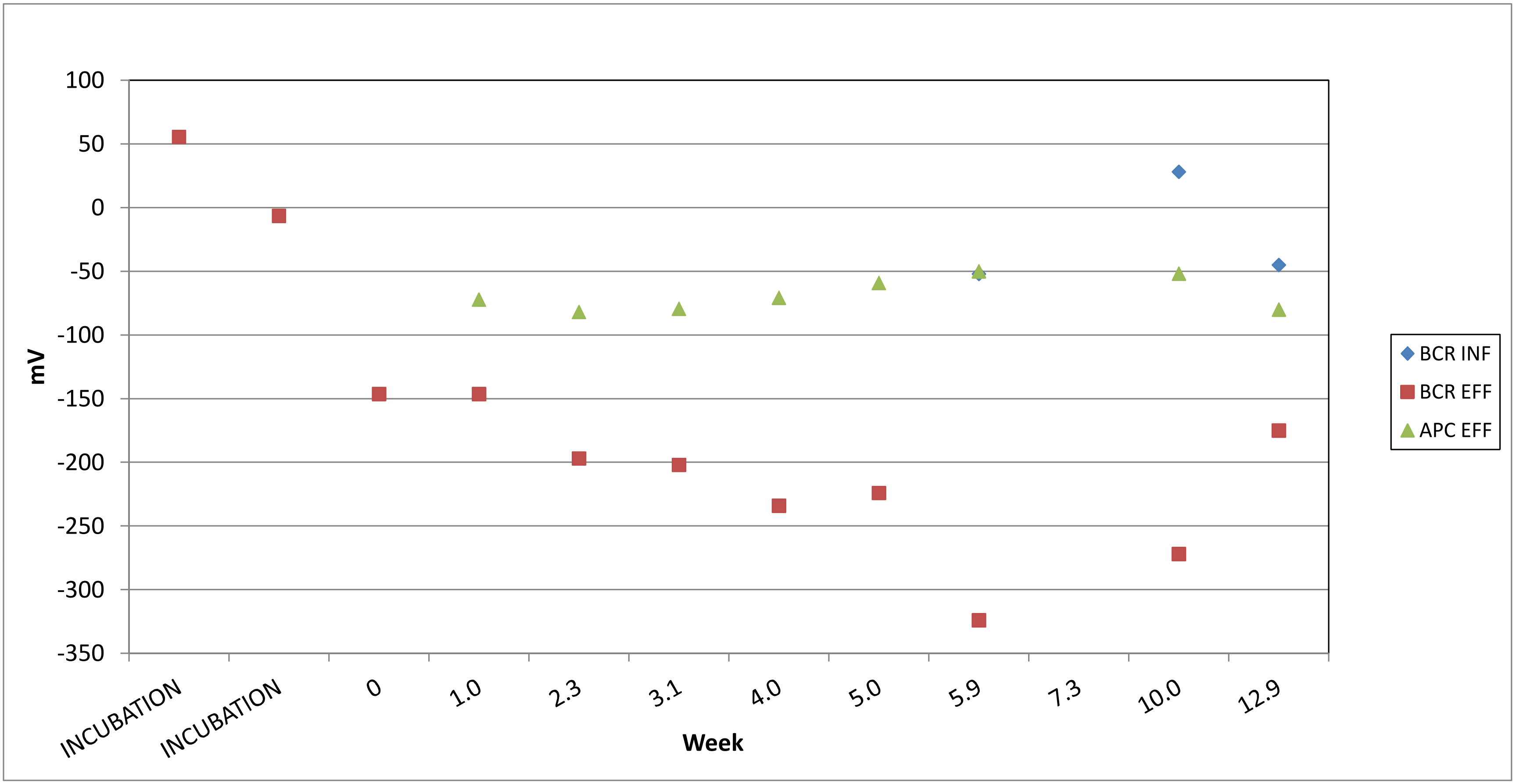

Golder Associates
Denver, Colorado

CLIENT/PROJECT		TITLE			
NICO FORTUNE MINERALS BENCH TESTING		**Bench BCR Field Data - ORP**			
DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
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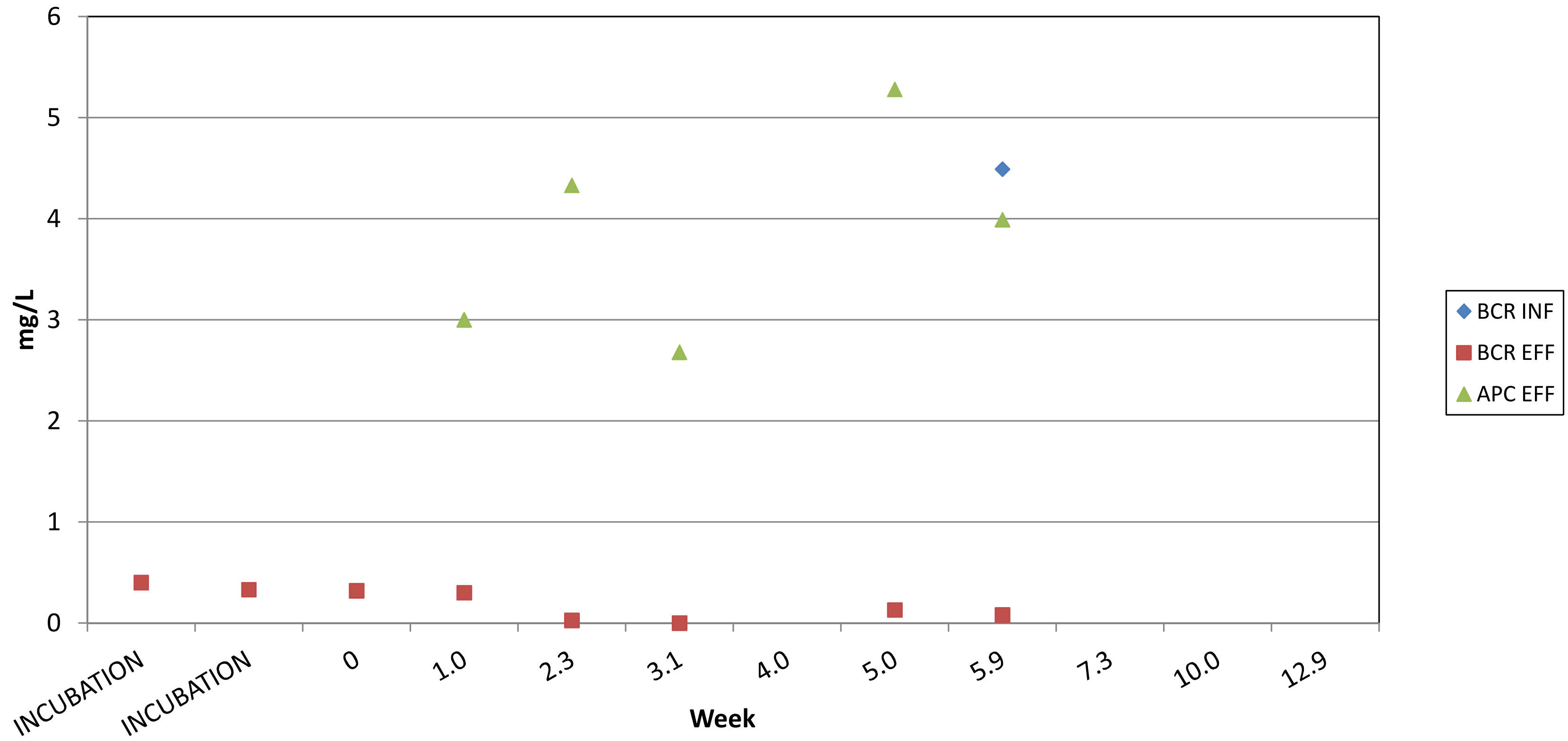

Golder Associates
Denver, Colorado

TITLE

Bench BCR Field Data - Dissolved Oxygen

CLIENT/PROJECT

NICO FORTUNE MINERALS BENCH TESTING

DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
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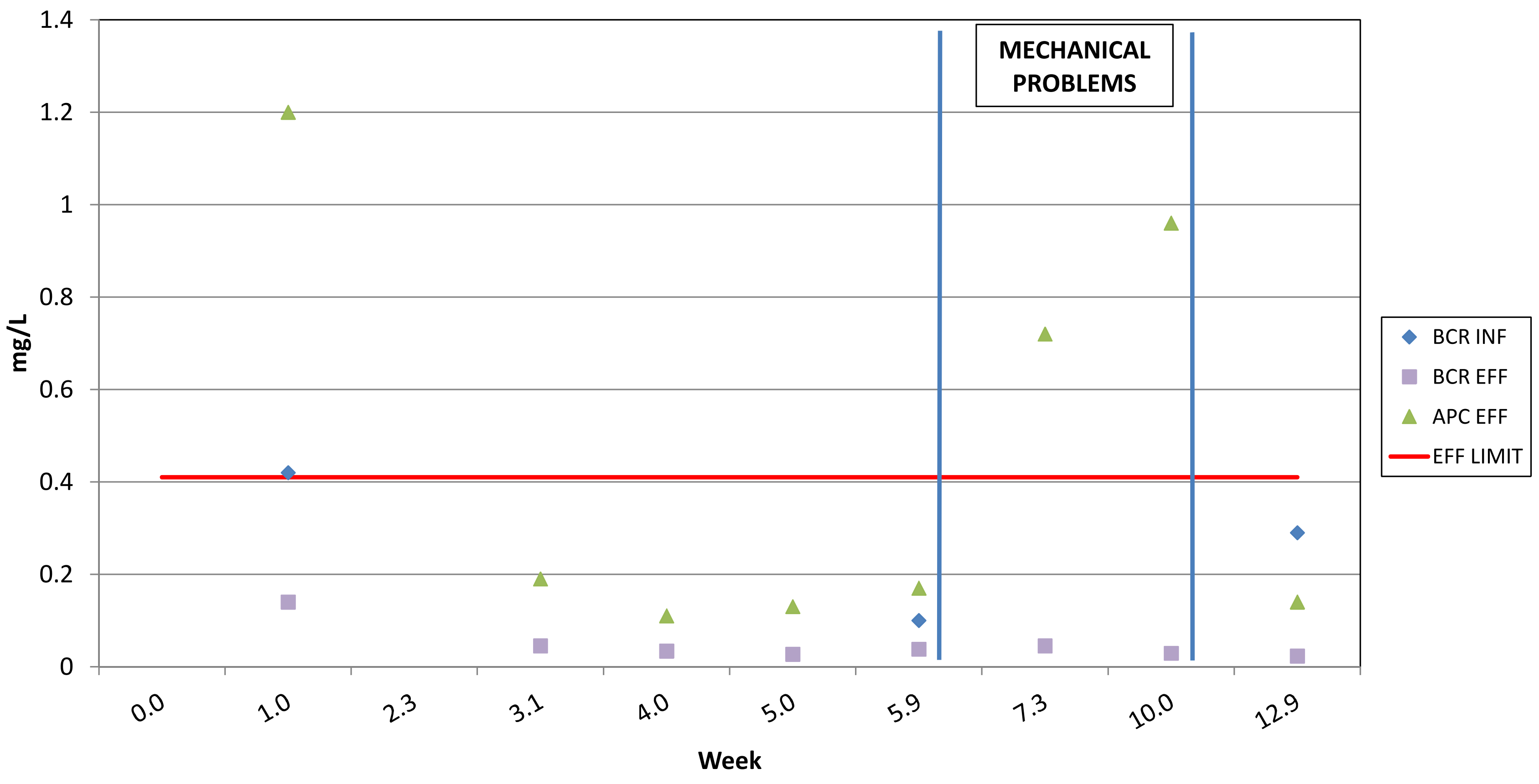

Golder Associates Denver, Colorado

TITLE

Bench BCR Field Data - Total Aluminum

CLIENT/PROJECT

NICO FORTUNE MINERALS BENCH TESTING

DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
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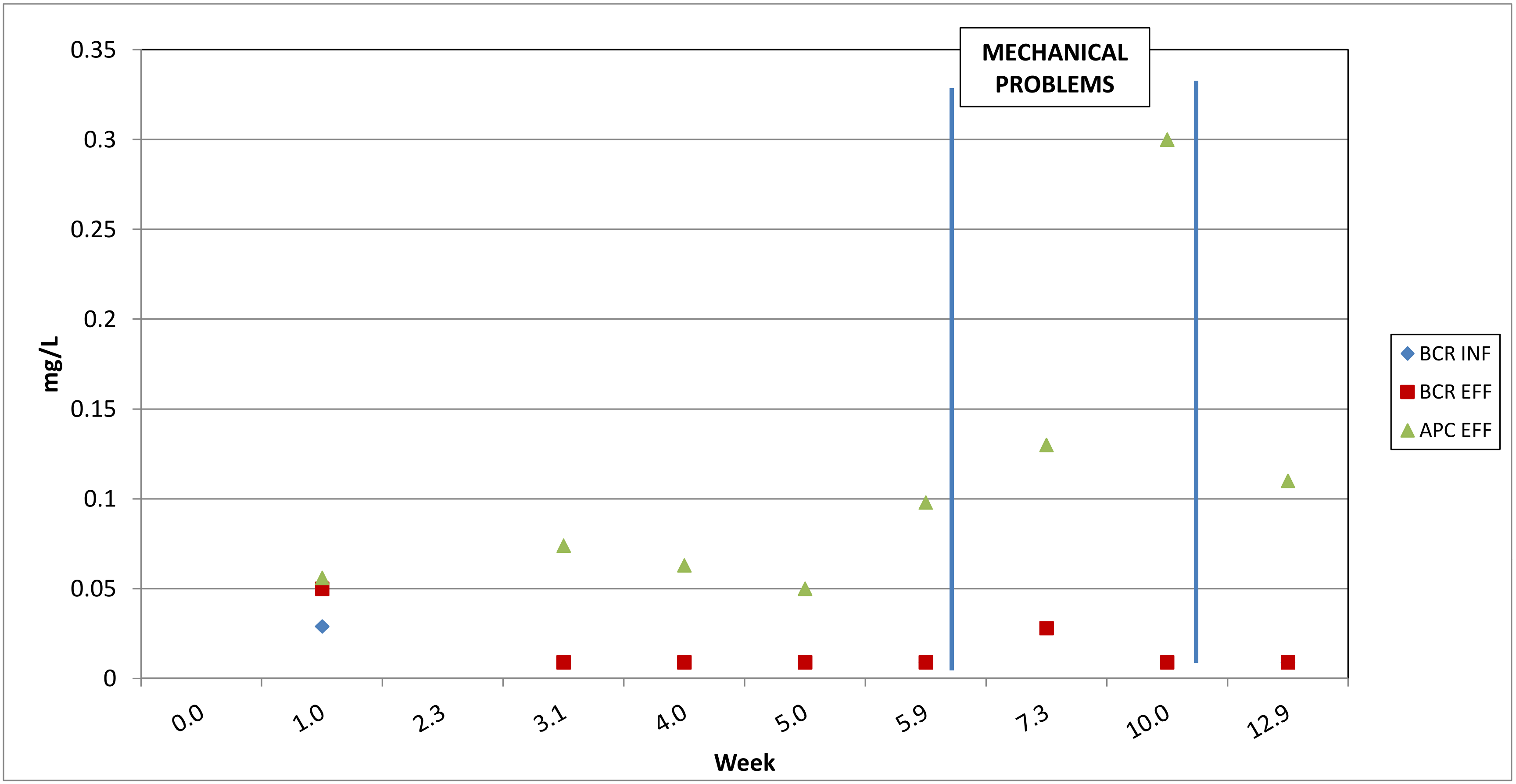

Golder Associates

Denver, Colorado

CLIENT/PROJECT	NICO FORTUNE MINERALS BENCH TESTING
TITLE	**Bench BCR Field Data - Dissolved Aluminum**

DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
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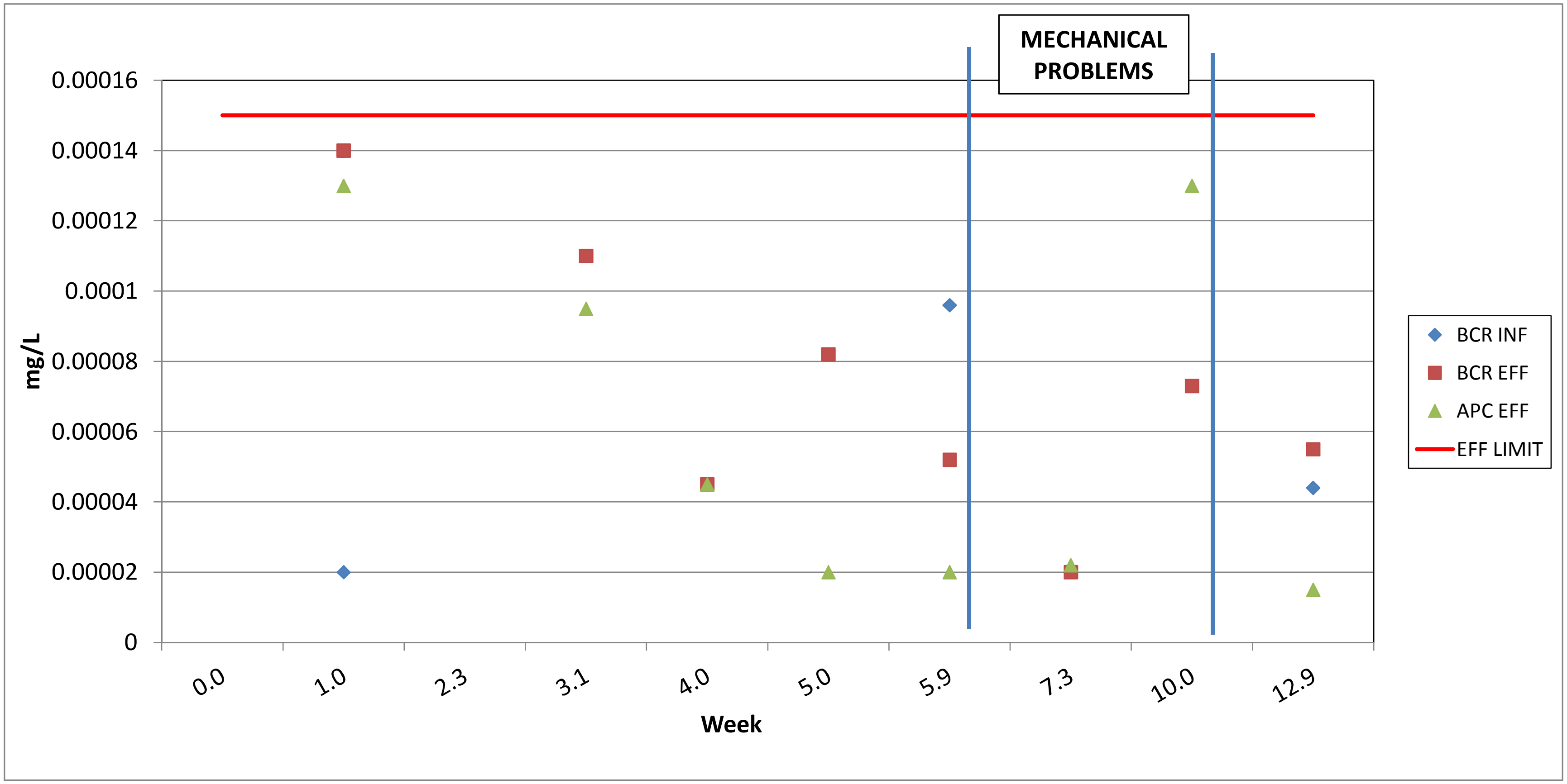
REVIEWED	BCH	FILE NO.		FIGURE NO.	9



Golder Associates Denver, Colorado	TITLE **Bench BCR Field Data - Total Cadmium**
CLIENT/PROJECT **NICO FORTUNE MINERALS BENCH TESTING**	DRAWN JAS CHECKED EPB REVIEWED BCH

DATE 4-May-12	JOB NO. 11-1118-0066	
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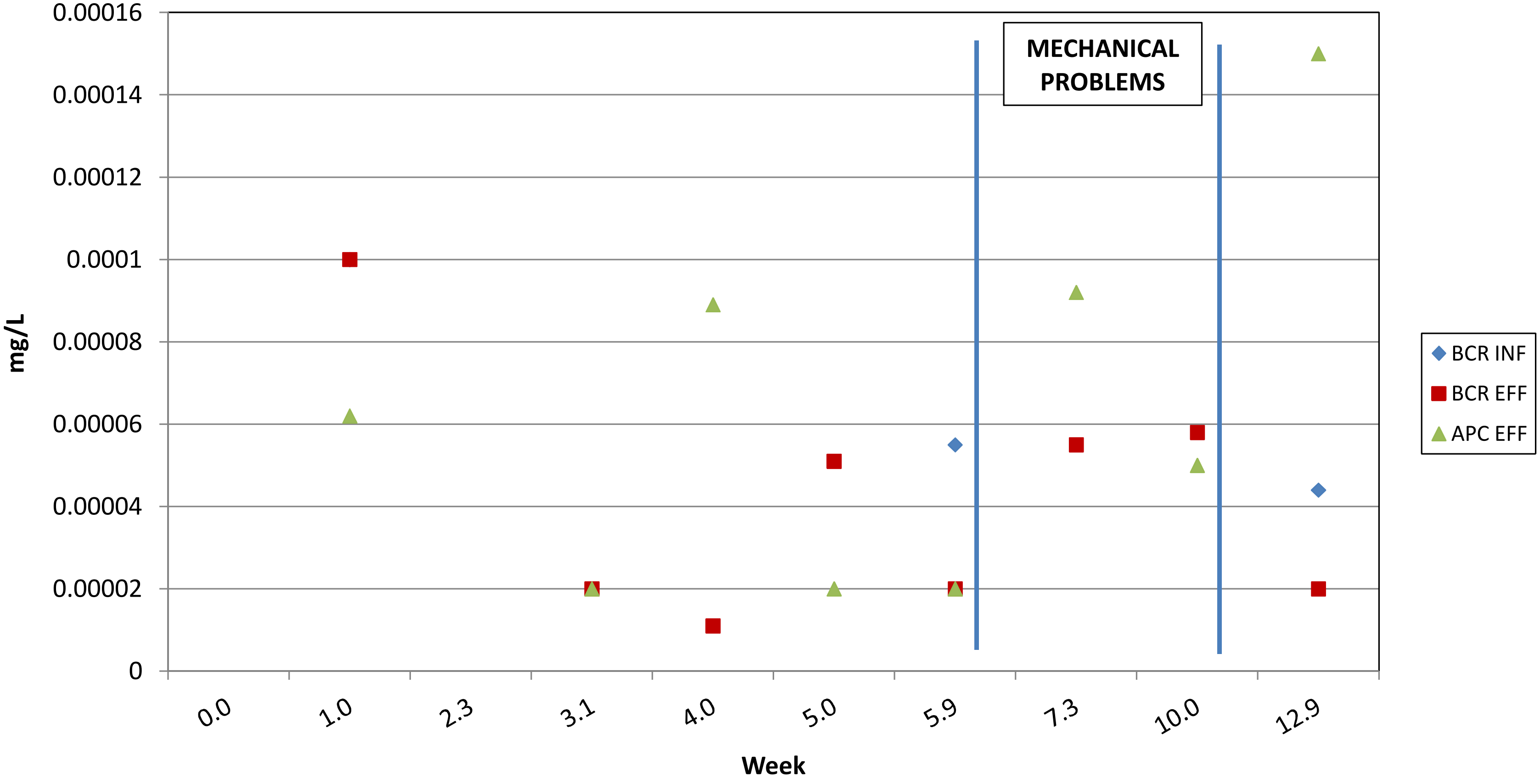
FILE NO.	FIGURE NO. 10	



Golder Associates	Denver, Colorado	TITLE	Bench BCR Field Data - Dissolved Cadmium		
CLIENT/PROJECT		DRAWN	JAS	DATE	4-May-12
NICO FORTUNE MINERALS BENCH TESTING		CHECKED	EPB	SCALE	N/A
		REVIEWED	BCH	FILE NO.	

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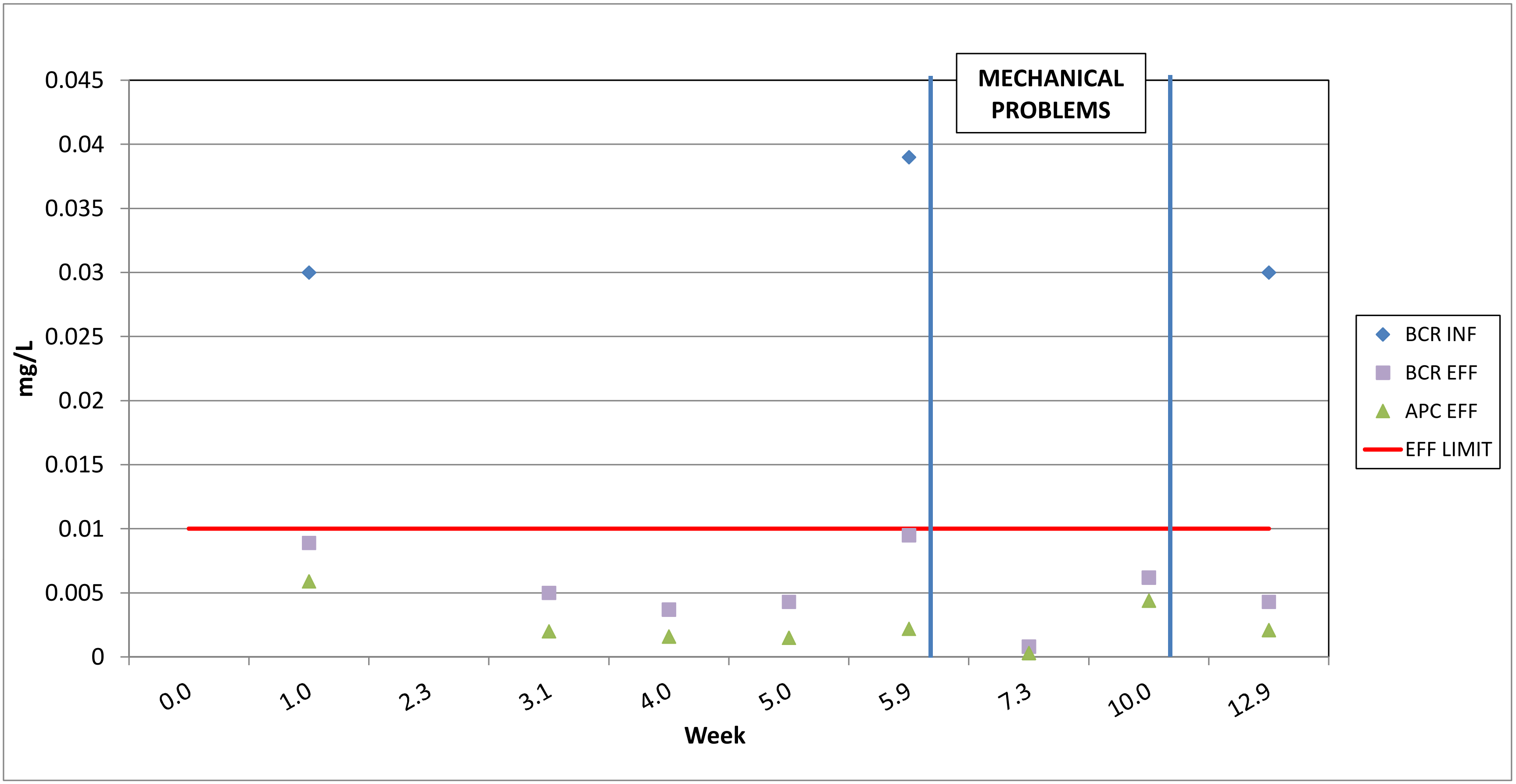
FIGURE NO.	11



Golder Associates Denver, Colorado

TITLE

Bench BCR Field Data - Total Cobalt

CLIENT/PROJECT

NICO FORTUNE MINERALS BENCH TESTING

DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
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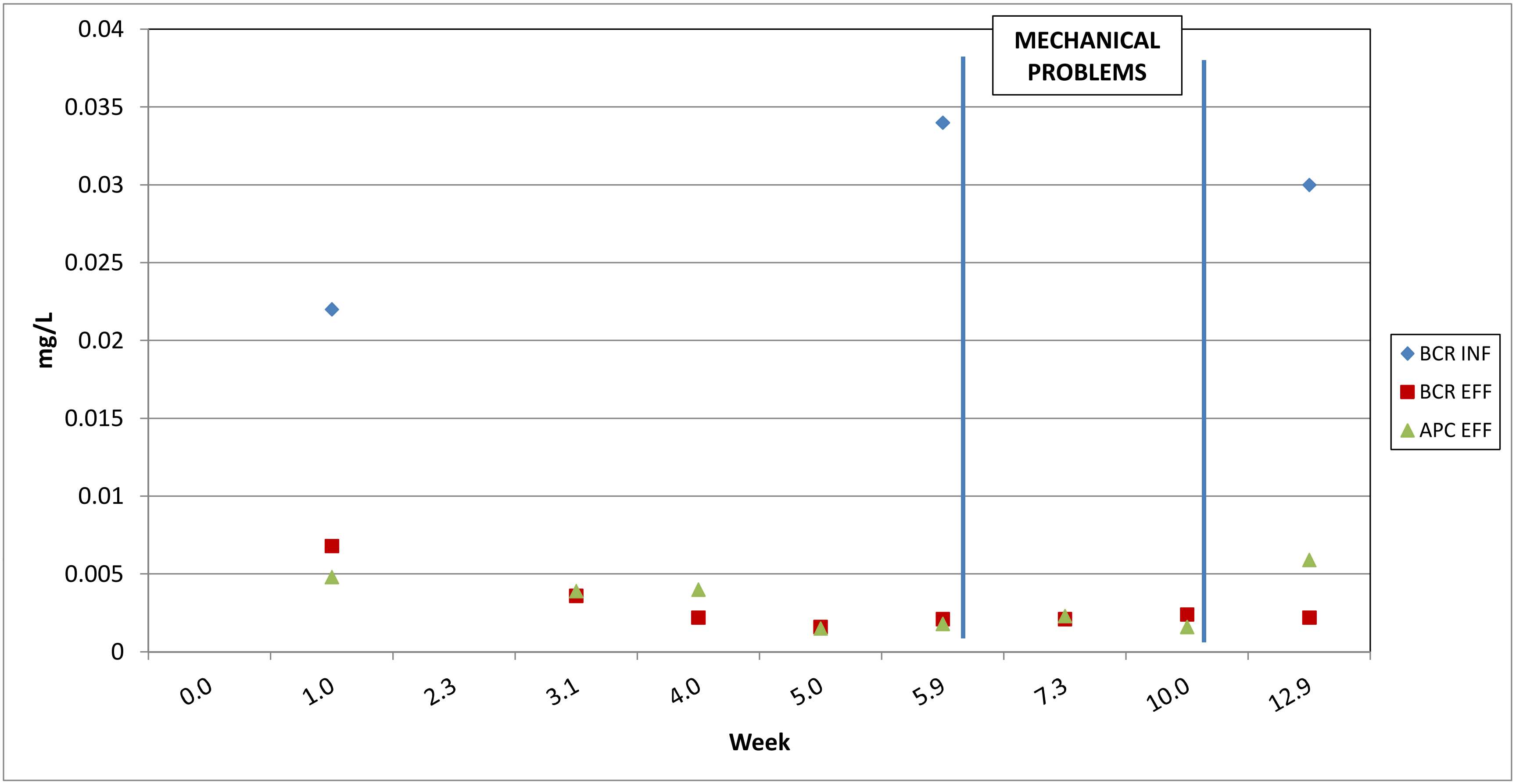
REVIEWED	BCH	FILE NO.		FIGURE NO.	12



Golder Associates

Denver, Colorado

TITLE

Bench BCR Field Data - Dissolved Cobalt

CLIENT/PROJECT

NICO FORTUNE MINERALS BENCH TESTING

DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
CHECKED	EPB	SCALE	N/A	DWG. NO.	N/A
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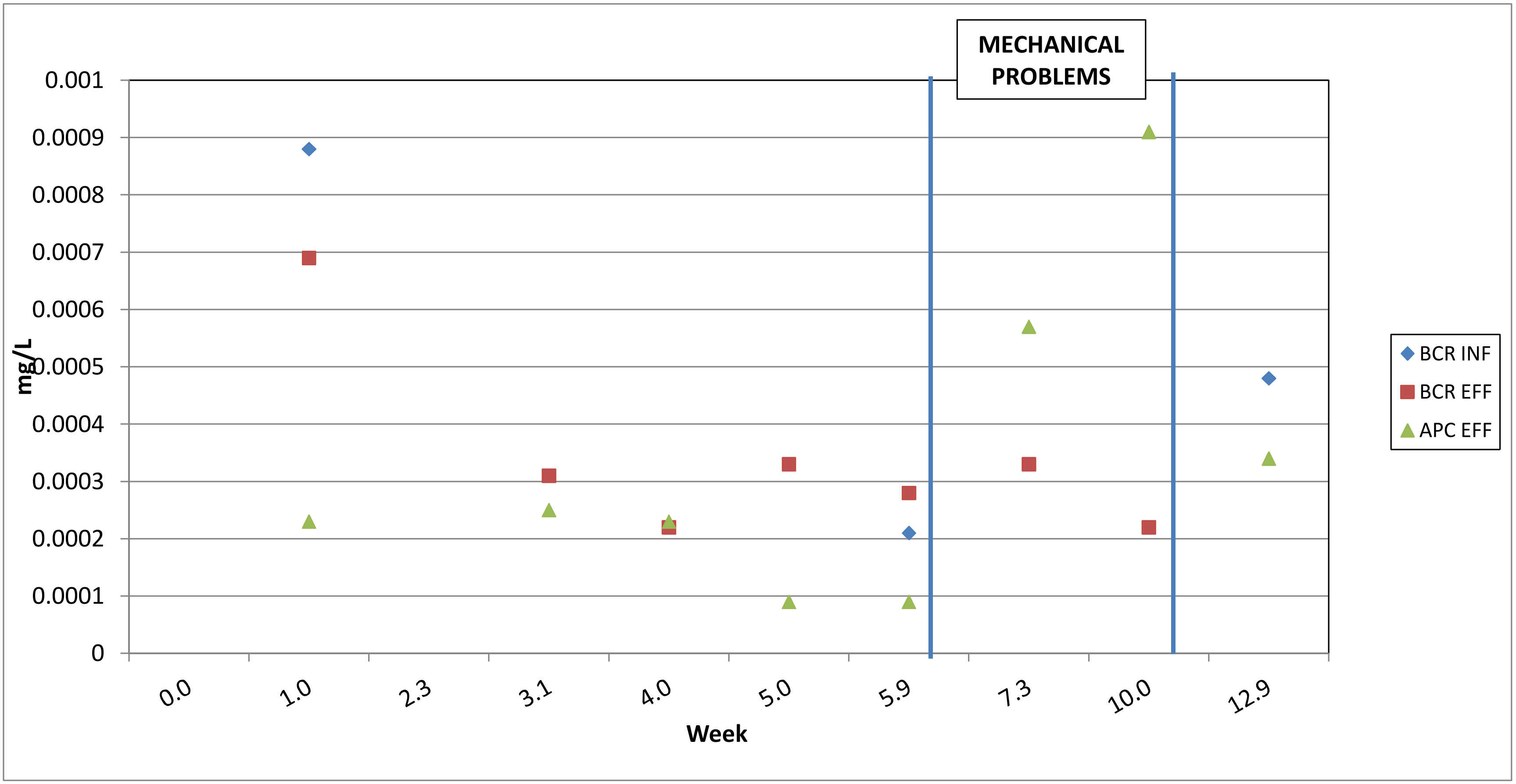

Denver, Colorado

CLIENT/PROJECT	NICO FORTUNE MINERALS BENCH TESTING
TITLE	**Bench BCR Field Data - Total Lead**

DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
CHECKED	EPB	SCALE	N/A	DWG. NO.	N/A
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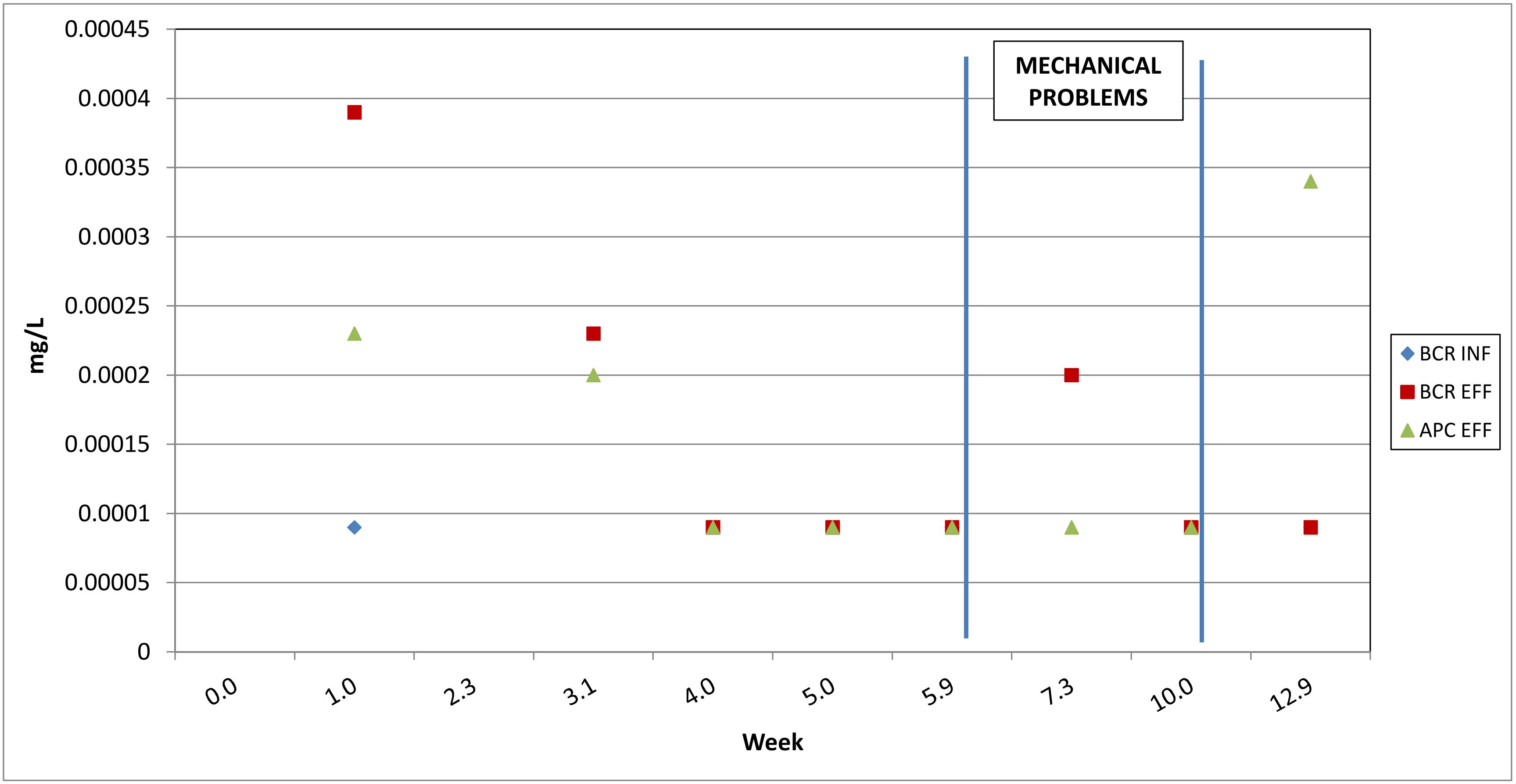

Golder Associates

Denver, Colorado

CLIENT/PROJECT		TITLE			
NICO FORTUNE MINERALS BENCH TESTING		**Bench BCR Field Data - Dissolved Lead**			
DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
CHECKED	EPB	SCALE	N/A	DWG. NO.	N/A
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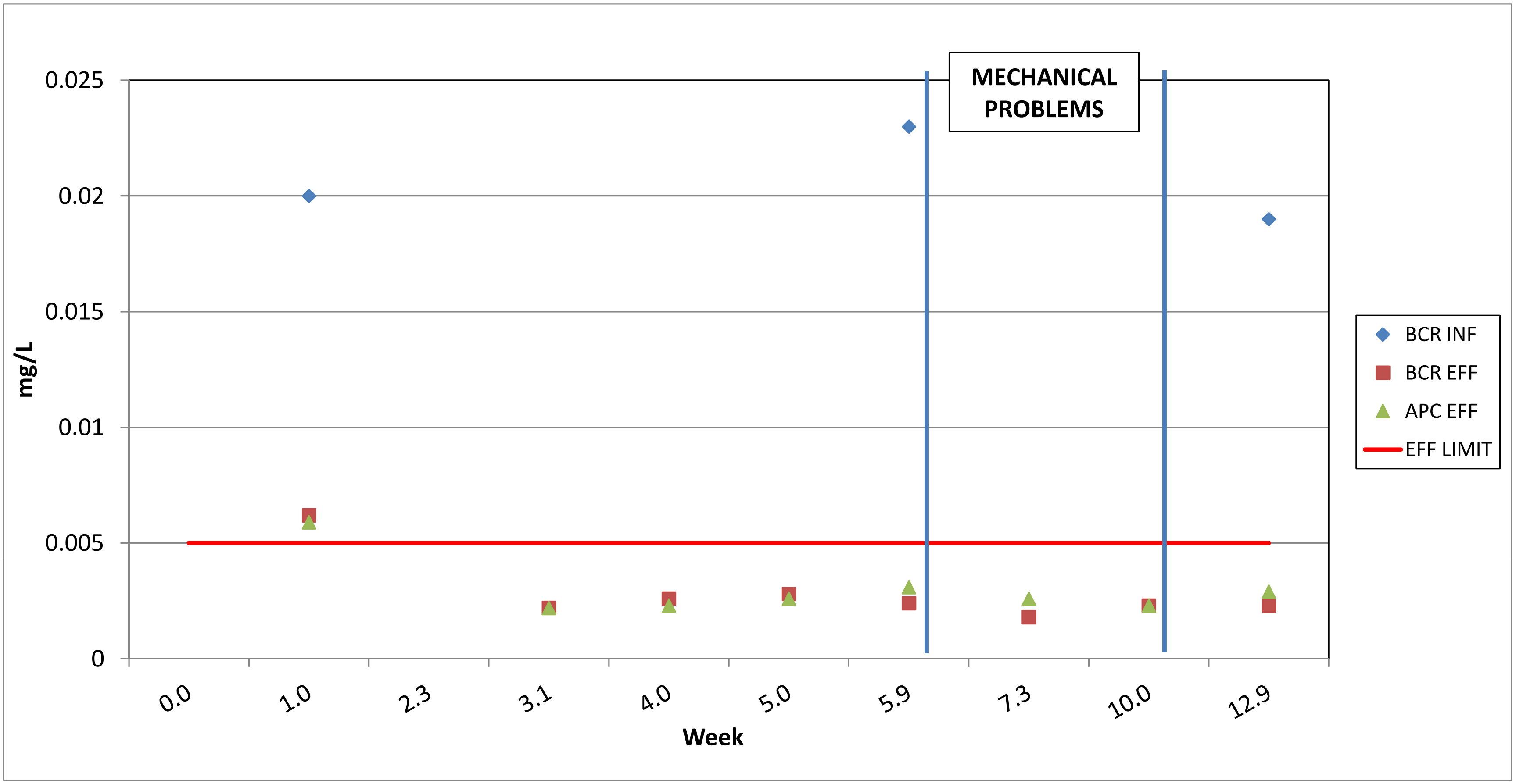


Golder Associates
Denver, Colorado

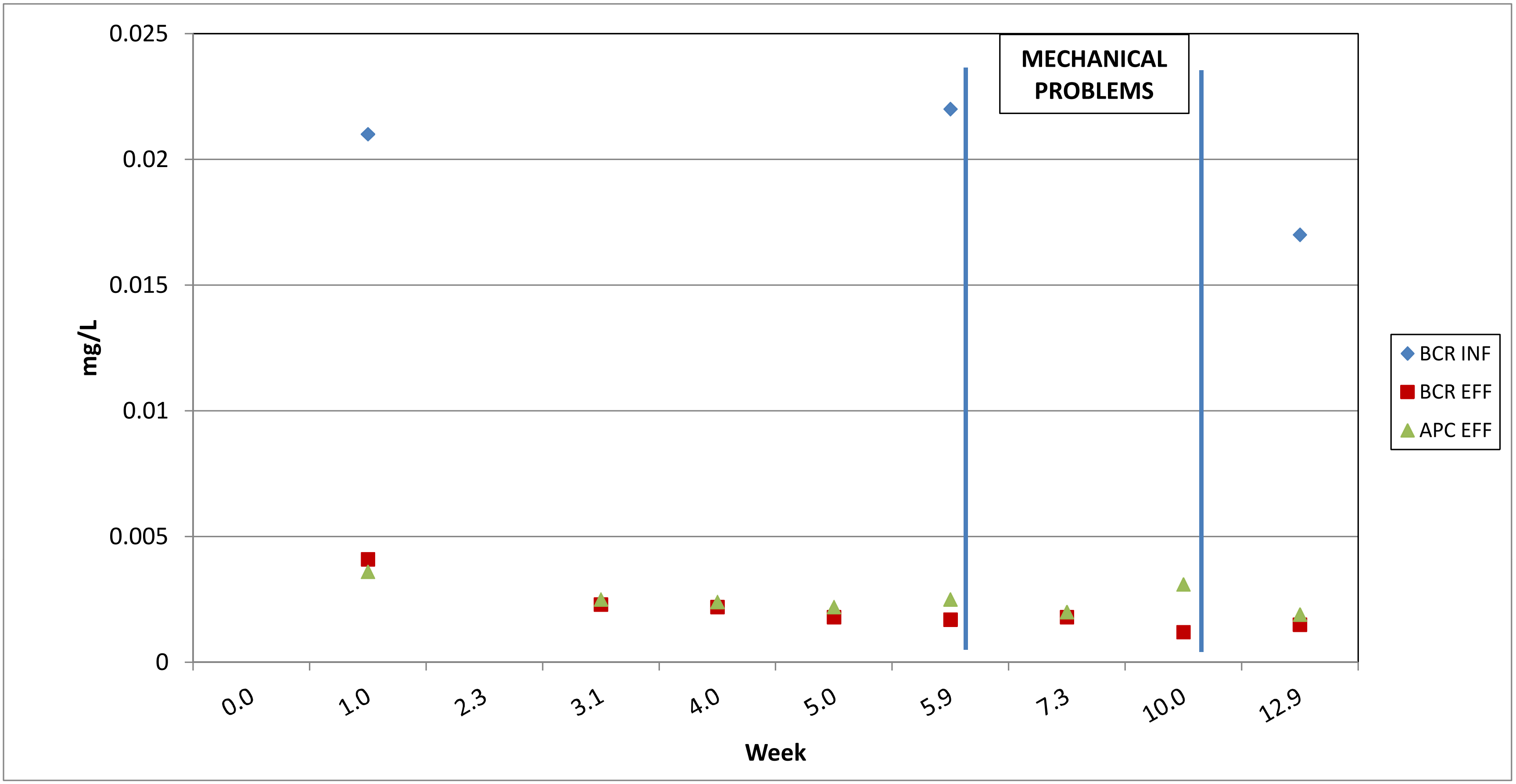
TITLE

Bench BCR Field Data - Total Selenium

CLIENT/PROJECT

NICO FORTUNE MINERALS BENCH TESTING

DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
CHECKED	EPB	SCALE	N/A	DWG. NO.	N/A
REVIEWED	BCH	FILE NO.		FIGURE NO.	16

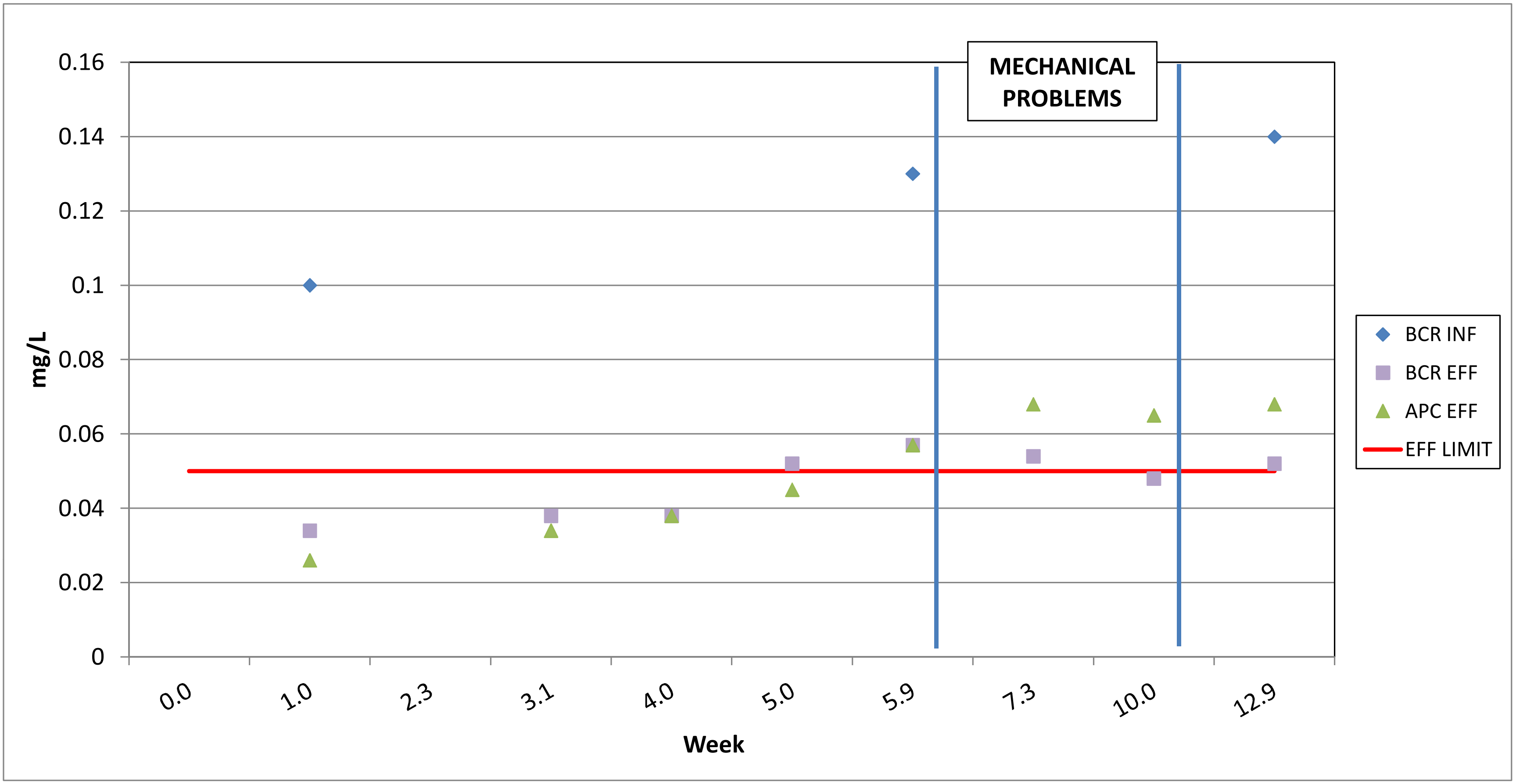


Golder Associates

Denver, Colorado

CLIENT/PROJECT	NICO FORTUNE MINERALS BENCH TESTING
TITLE	Bench BCR Field Data - Dissolved Selenium

DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
CHECKED	EPB	SCALE	N/A	DWG. NO.	N/A
REVIEWED	BCH	FILE NO.		FIGURE NO.	17



Golder Associates

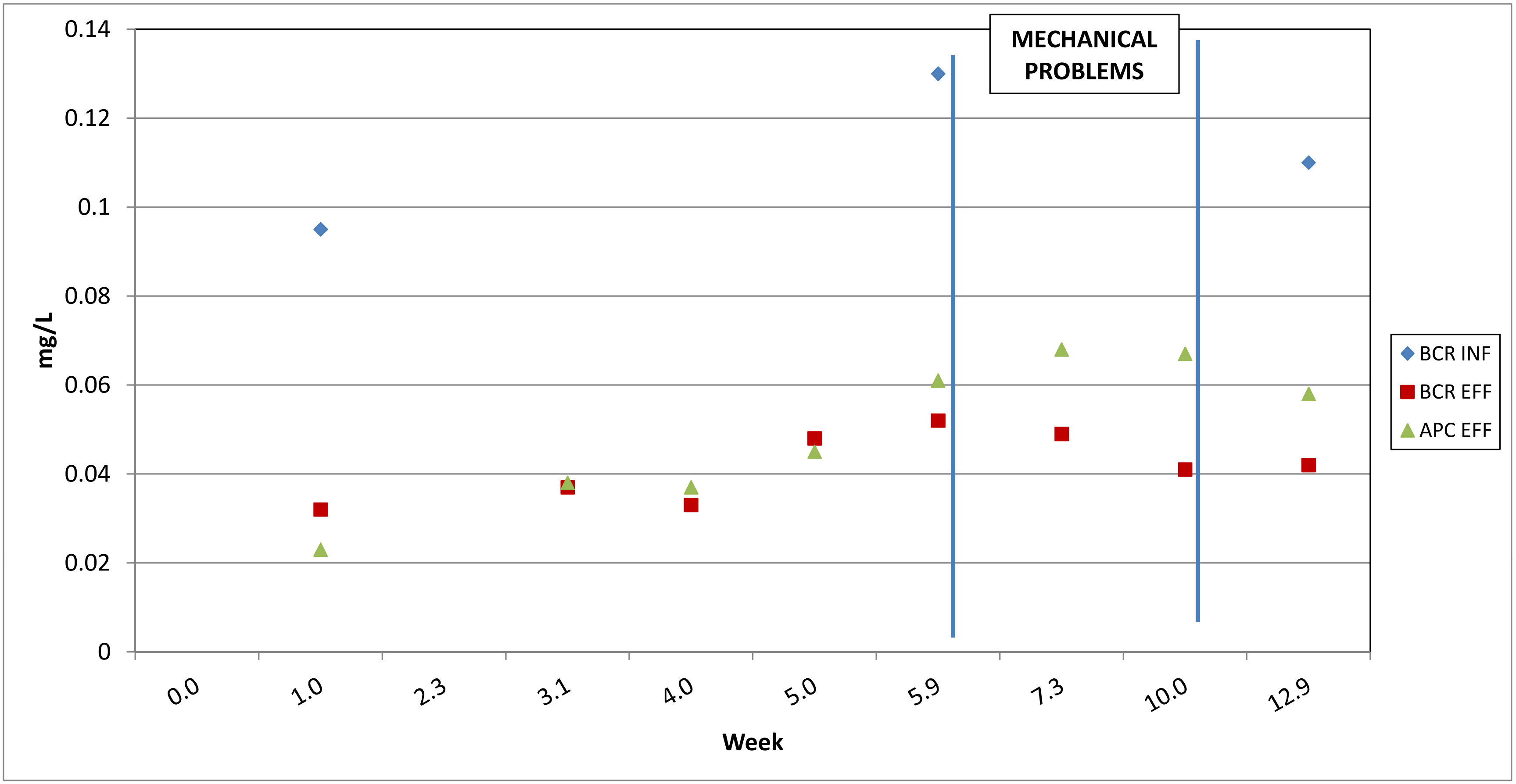
Denver, Colorado

TITLE	**Bench BCR Field Data - Total Arsenic**

DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
CHECKED	EPB	SCALE	N/A	DWG. NO.	N/A
REVIEWED	BCH	FILE NO.		FIGURE NO.	18

CLIENT/PROJECT

NICO FORTUNE MINERALS BENCH TESTING

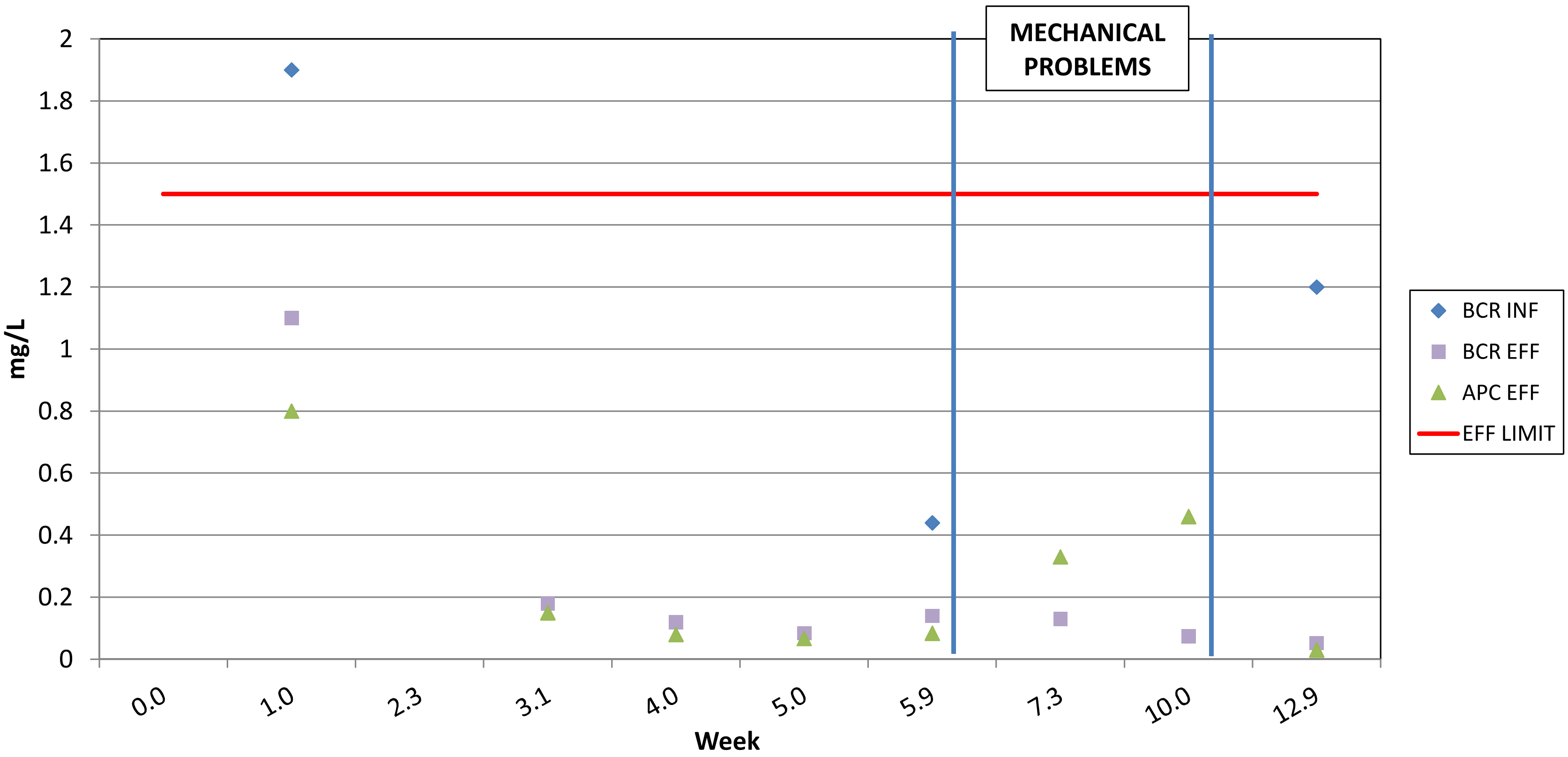


Golder Associates Denver, Colorado

TITLE	**Bench BCR Field Data - Dissolved Arsenic**				
DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
CHECKED	EPB	SCALE	N/A	DWG. NO.	N/A
REVIEWED	BCH	FILE NO.		FIGURE NO.	19

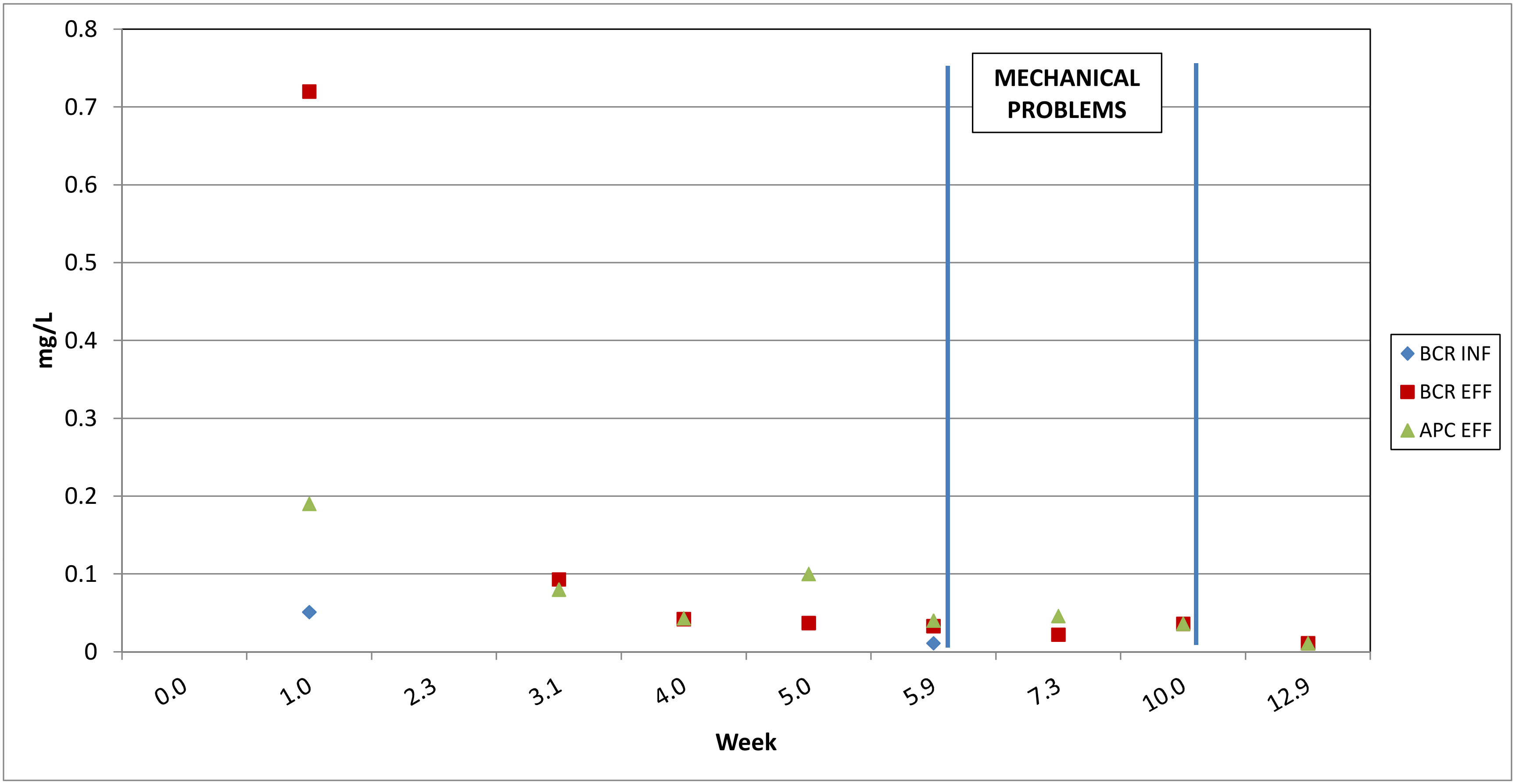
CLIENT/PROJECT

NICO FORTUNE MINERALS BENCH TESTING



Golder Associates
Denver, Colorado

CLIENT/PROJECT	NICO FORTUNE MINERALS BENCH TESTING	TITLE	Bench BCR Field Data - Total Iron		
DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
CHECKED	EPB	SCALE	N/A	DWG. NO.	N/A
REVIEWED	BCH	FILE NO.		FIGURE NO.	20



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Denver, Colorado

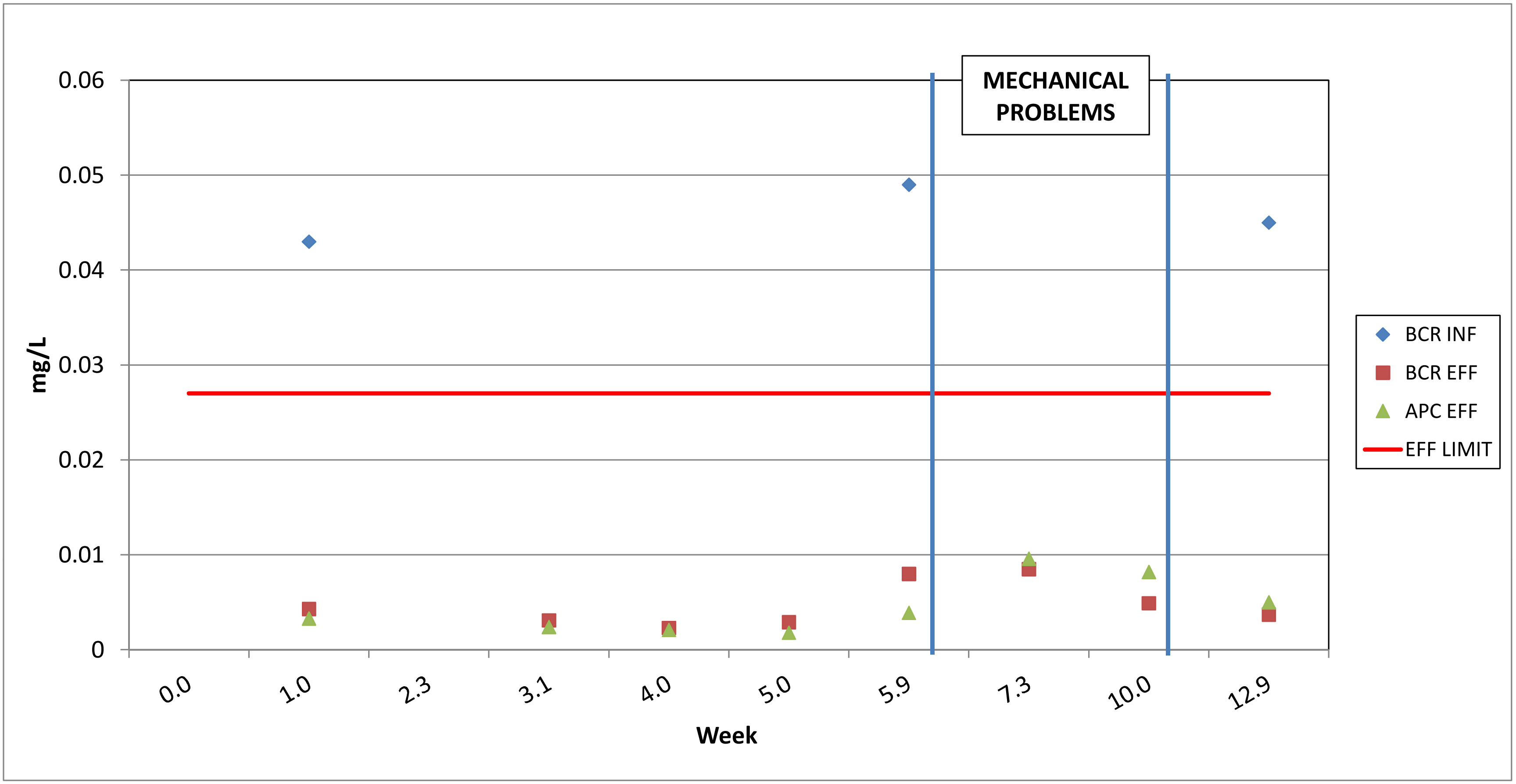
TITLE

Bench BCR Field Data - Dissolved Iron

CLIENT/PROJECT

NICO FORTUNE MINERALS BENCH TESTING

DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
CHECKED	EPB	SCALE	N/A	DWG. NO.	N/A
REVIEWED	BCH	FILE NO.		FIGURE NO.	21

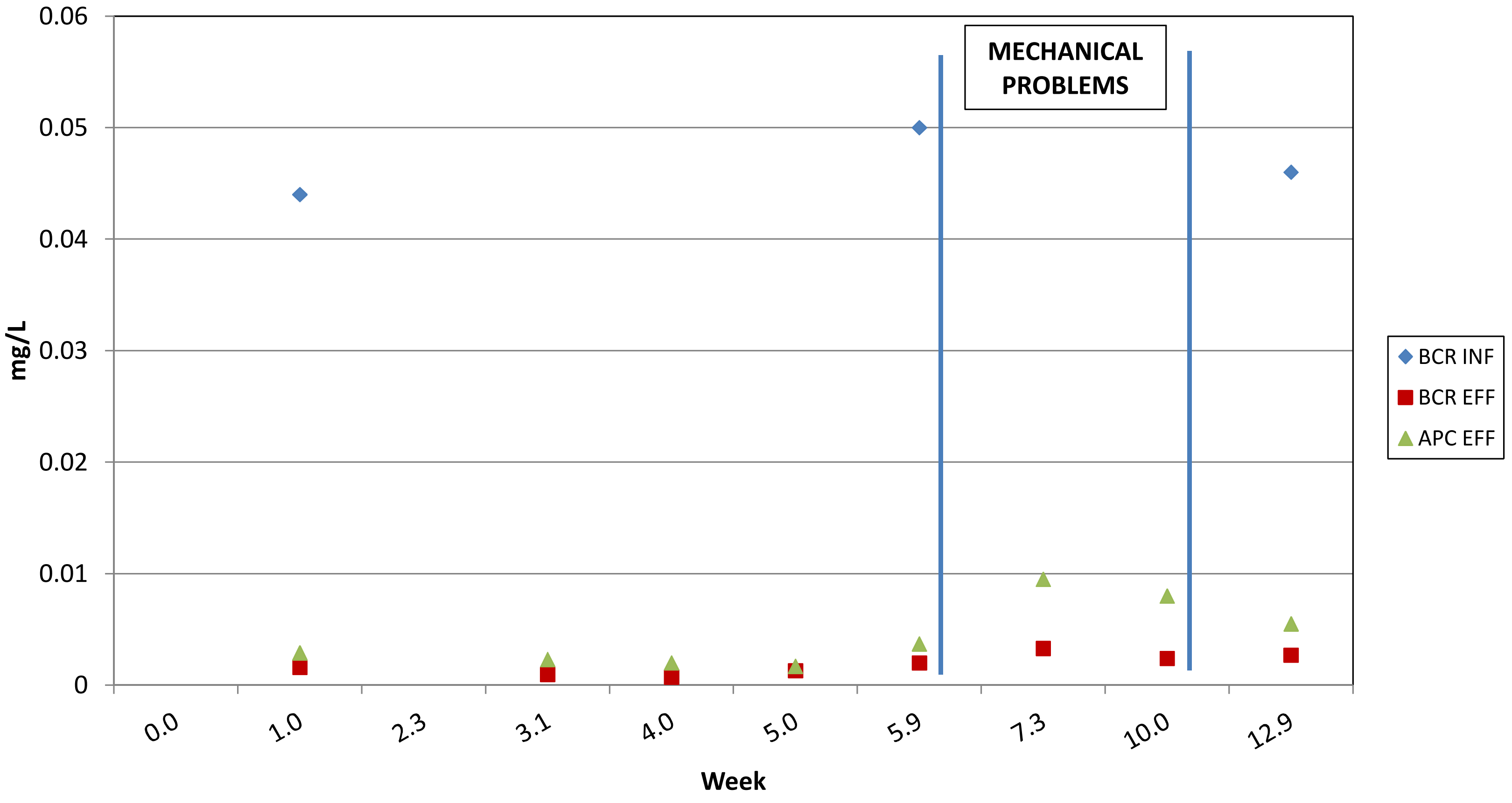


Golder Associates
Denver, Colorado

TITLE	**Bench BCR Field Data - Total Uranium**				
DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
CHECKED	EPB	SCALE	N/A	DWG. NO.	N/A
REVIEWED	BCH	FILE NO.		FIGURE NO.	22

CLIENT/PROJECT

NICO FORTUNE MINERALS BENCH TESTING



Golder Associates Denver, Colorado

TITLE	**Bench BCR Field Data - Dissolved Uranium**				
DRAWN	JAS	DATE	4-May-12	JOB NO.	11-1118-0066
CHECKED	EPB	SCALE	N/A	DWG. NO.	N/A
REVIEWED	BCH	FILE NO.		FIGURE NO.	23

CLIENT/PROJECT

NICO FORTUNE MINERALS BENCH TESTING