2014 Treatability Study Data Evaluation Technical Memorandum

Barker-Hughesville Mining District Superfund Site
Cascade and Judith Basin Counties, Montana

EPA Contract No. EP-W-05-049
Work Assignment No: 325-RICO-085N

Prepared by CDM Smith

January 2017

CDM Smith

REMEDIAL ACTION CONTRACT
FOR REMEDIAL, ENFORCEMENT OVERSIGHT, AND NON-TIME CRITICAL REMOVAL ACTIVITIES AT SITES OF RELEASE OR THREATENED RELEASE OF HAZARDOUS SUBSTANCES
IN EPA REGION VIII

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List of Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
AC	alternating current
Al	aluminum
APC	aerobic polishing cell
As	arsenic
BCR	biochemical reactor
bgs	below ground surface
BOD	biological oxygen demand
Ca	calcium
Cd	cadmium
CDM Smith	CDM Federal Programs Corporation
Chitorem	Chitorem SC-20®
CLP	Contract Laboratory Program
Cu	copper
DEQ	Montana Department of Environmental Quality
DEQ-7	DEQ Water Quality Bureau Bulletin 7
DC	direct current
DO	dissolved oxygen
DQO	data quality objective
ESAT	Environmental Services Assistance Team
EPA	United States Environmental Protection Agency
Fe	Iron
FS	feasibility study
ft	feet
ft^3	cubic feet
g	gram
gal/day	gallons per day
GARD	Global Acid Rock Drainage Guide
gpm	gallons per minute
HDPE	high density polyethylene
ID	inner diameter
in^3	cubic inches
ITRC	Interstate Technology Regulatory Council
L	liter
LED	light-emitting diode
MIW	mining influenced water
Mg	magnesium
mg/L	milligrams per liter
MIW	mining influenced water
ml	milliliter
ml/min	milliliters per minute
mm	millimeter
mmol Me/day	millimoles metal per day
mmol SO_4/m^3-day	millimoles sulfate per cubic meter per day
Mn	manganese
mS/cm	milliSiemens per centimeter

mV	millivolts
NaOH	sodium hydroxide
Ni	nickel
NPL	National Priorities List
ORP	oxidation-reduction potential
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
Pb	lead
PRP	potentially responsible party
PVC	polyvinyl chloride
QAPP	quality assurance project plan
QA	quality assurance
QC	quality control
RAC	Remedial Action Contract
RI	remedial investigation
RPD	relative percent difference
SAP	sampling and analysis plan
SAPS	successive alkalinity producing system
site	Barker Hughesville Mining District Superfund Site
SPLP	synthetic precipitation leaching procedure
SRB	sulfite reducing bacteria
SOPs	standard operating procedures
su	standard units
TBD	to be determined
TDS	total dissolved solids
TCLP	toxicity characteristic leaching procedure
µg/L	micrograms per liter
µS/cm	microSiemens per centimeter
USFS	United States Forest Service
VFA	volatile fatty acid
Zn	zinc

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Executive Summary

In 2014, two treatability studies were conducted for the Barker-Hughesville Mining District Superfund Site (the Site). The studies were conducted as part of the remedial investigation/feasibility study (RI/FS) process to ultimately provide data to support screening and evaluation of process options and treatment technologies in the FS. The second season (year 2) of the Danny T Adit pilot-study was conducted in the field and the Tiger Mine bench-scale study was conducted at the CDM Smith Denver, Colorado Treatability Laboratory. The year 2 study follows up from the year 1 field pilot study conducted in 2013 to evaluate various passive and semi-passive methods for treatment of the Danny T Mine adit water. This acidic mining-influenced water (MIW) is representative of various MIW sources across the Site and provides treatability effectiveness data for this water type. The study for the Tiger Mine was focused on potential in-situ based treatments that could be deployed inside the underground mine workings area. A representative mine discharge water (Tiger mine adit TI-AD004, the "Firehose" adit) was collected in bulk and analyzed at the treatability laboratory in batch container tests with various reagents. The following sections summarize each of these studies, including their objectives, experimental and sampling procedures, results, conclusions, and recommendations.

ES.1 Danny T Adit Treatability Study

The Danny T Mine contains a large waste rock dump and discharging MIW from a collapsed adit portal. Seasonal flow rates range from 4 to 32 gallons per minute (gpm) based on RI data, and generally water quality becomes more concentrated (high concentrations of metals) as the dry season continues into fall. This MIW is acidic, has high sulfate, and high concentrations of aluminum (Al), arsenic (As), cadmium (Cd), copper (Cu), iron (Fe), lead (Pb), and zinc (Zn). Because of the strength of the MIW, any passive approaches to MIW treatment would require a pre-treatment step to condition the water ahead of the BCR. In addition, because of the high metals loading, adequate hydraulic retention time (HRT) in the BCR for treatment is a critical design factor. HRT is needed to estimate the required treatment system size when scaling up to treatment flow rates in the FS.

The primary goals of the Danny T treatability study were to test the effectiveness of MIW treatment using various pre-treatment methods, ex-situ biochemical reactor (BCR) treatment with solid substrates, and a post-treatment oxidation/wetland process. Treatment effectiveness was evaluated by calculating metal removal efficiency, comparing effluent to water quality standards, and evaluating the biological treatment effectiveness. The BCR treatment process utilizes a carbon source as food for sulfate-reducing bacteria (SRB) that reduce sulfate to sulfide, which then react with metals in the MIW to form metal sulfides. Biological treatment effectiveness is measured by several metrics in effluent treated water including sulfate decrease, volumetric sulfate reduction rate, alkalinity increase, sulfide rotten-egg odor, oxidation-reduction potential (ORP) and dissolved oxygen (DO) decrease, and pH increase. Along with metal removal efficiency, these parameters and observations provide evidence to show whether conditions are adequate for biological sulfate reduction to occur, the extent of sulfate reduction, and to what degree the treatment is effective over the study period. Changes in HRT were evaluated by modifying influent flow rate until the BCR showed signs of stress (i.e., treatment failure).

The year 2 study consisted of similar pre-treatment and BCR components as the year 1 study. Four treatment trains were tested, each with the same BCR substrate mixture, except for BCR1 that contained a small fraction of Chitorem (dried and crushed crab shell). All BCRs contained a mixture of wood chips, sawdust, compost, dairy manure, and limestone. With the exception of the limestone, these materials were all locally sourced. BCR1 had no pre-treatment, whereas BCR2, BCR3, and BCR4 had a successive alkalinity producing system (SAPS), Chitorem, and sodium hydroxide (NaOH) pre-treatment, respectively. Due to hydraulic clogging issues in the year 1 study, bench-scale hydraulic tests were conducted in May 2014 that determined a more favorable Chitorem, sand, and gravel mixture to maintain flow through the pre-treatment barrel.

Water was collected near the adit portal, gravity piped to an overflow tank, and gravity piped to the pilot system area. Influent MIW flow was controlled using a main timer valve set to open at 2-hour intervals to fill head tanks. Each head tank had its own individual timer valve, set to dose the MIW through each treatment train. An additional timer valve was located on the NaOH barrel effluent pipe and NaOH dosing was operated by a chemical metering pump powered with solar panels. The remaining treatment trains flowed by gravity through pre-treatment and BCR barrels. Water level in each barrel was maintained after each MIW batch at 3 inches above the substrate layer. After sampling ports, effluent from the 4 BCRs was piped together through a post-treatment system consisting of cascade aeration, aerobic wetland, and gravel filtration. The post-treatment was tested to evaluate sulfide removal, nutrients, and increase DO concentration that may be potentially harmful to the aquatic ecosystem in the receiving stream.

The initial average flow rate through the system was approximately 8.3 milliliters per minute (ml/min), yielding a HRT of 121 hours (h). The flow rate was calculated as an average over a 24-hour period dosing 1 liter (L) batch volumes every 2 hours. This flow rate was maintained for the first nine weeks of the pilot test. During week 10, the flow rate was increased to approximately 1.5 L per 2 h (80.6 h HRT). During week 12, flow rate was further increased to approximately 2 L per 2 h (60.5 h HRT). Following observations of decreased efficiency at this flow rate, flow rate was decreased to the original 8.3 ml/min in week 13 for the remaining 3 weeks. Operations and maintenance checks and collection of field parameters at all sampling ports were conducted weekly, which included MIW influent, pre-treatment effluents, BCR effluents, and post-treatment influent and effluent. Samples for analytical laboratory testing were collected bi-weekly, except for the last three weeks when laboratory samples were collected weekly. A total of 10 laboratory sample events were conducted.

Overall treatment performance was improved compared to the year 1 study due to the increased HRT for all treatment trains, increases in BCR and SAPS substrate volumes for the decreased flow rate, increases in limestone for all BCRs to provide greater buffering capacity, and improvements to the Chitorem pre-treatment hydraulics. BCRs for each treatment train had variable metal removal efficiencies as a result of different pre-treatments; however, high percent metal removals greater than 90 percent (%) were obtained, systems maintained net alkalinity, and maintained adequate sulfate reduction for lower treatment flow rates. Dissolved Cd, Cu, Fe, Pb, and Zn removal efficiencies were maintained above 98%, except for some efficiencies around 94 to 96% in the first two weeks. Total metal removal efficiencies were similarly high, although less consistent due to solid precipitates that discharge from the BCRs and require settling. Some exceedances of water quality standards occurred at times, although Al, As, Cd, and Fe often had higher laboratory detection limits than the water quality standards, making it difficult to perform comparative analysis. All BCRs responded in some degree to increases in flow rate with signs of biological stress including increases in ORP, decreases in the sulfate reduction rate and sulfide concentration, and/or increases in metals concentrations. Comparing some of the most difficult to remove metals, BCR2 and BCR3 dissolved and total Fe and Zn removal efficiencies were maintained at the highest percentage when flow rates were increased. BCR1 had the largest increase in ORP, while increases for BCRs 2 through 4 were all similarly less. All BCRs had an ORP decrease to more reducing conditions in September after decreasing flow rate, which indicates signs of recovery of the biological stress.

Year 2 results indicate the BCR1 substrate type with no pre-treatment may not be able to maintain the desired reducing conditions for consistent metal removal at the fastest retention time (60.5 hours). The middle retention time of 80 hours may be appropriate for this treatment type; however, based on evidence from the SAPS and Chitorem pre-treatments, use of a pre-treatment is an important component for the acidic MIW type. A pre-treatment that reduces Al and Fe and increases pH and alkalinity provides long-term protection of the BCR from Al and Fe fouling and from upset to the biological communities that are necessary to maintain reducing conditions and the desired treatment efficiency. Comparing the SAPS and Chitorem pre-treatments, overall treatment performance was better for the SAPS. Large increases in some total metals occurred in the Chitorem barrel in the last month, possibly a result of release of precipitates no longer stable at the more oxidized conditions. Increased ORP may have been a result of some exhaustion of the Chitorem material in the barrel to maintain the reducing condition. Long-term use of a Chitorem-based pre-treatment with this Chitorem grain size is also questionable due to hydraulic issues observed in year 1 and the potential exhaustion of substrate observed in year 2. NaOH dosing provided many challenges, although these are primarily due to the low-flow nature of the pilot study. At higher treatment flow rates, dosing pumps and tubing would be larger and less prone to clogging issues, and the degree of mixing efficiency would increase at a higher and more turbulent flow rate. NaOH would be highly effective and consistent to remove Al and Fe acidity; however, the SAPS appears as efficient as the NaOH treatment at Al removal, and provides adequate reduction in Fe oxidation state to protect the BCR from Fe oxy-hydroxide fouling, all with no electrical power, mechanical operations, or handling of hazardous (caustic) reagents.

As an overall conclusion based on the data provided from the study, a treatment train consisting of a SAPS pre-treatment followed by a BCR with a small fraction of Chitorem (similar to BCR1) may provide the best treatment scenario to maintain efficiency and limit costs. To increase longevity and maintain flow, a coarser Chitorem size would be recommended for the BCR amendment. The treatment effectiveness observations during flow rate changes for the three pre-treatment systems indicates that the SAPS system was the most consistent of the pre-treatments, and that a SAPS/BCR treatment type could be designed with a retention time of approximately 80 hours and still maintain the desired effectiveness. The longest retention time of 121 hours was more than necessary for the treatment types evaluated.

A gradual decrease in biological oxygen demand (BOD), orthophosphate, and ammonia was observed for all BCR effluents, and the combined influent to the post-treatment system. This observation is typical after startup as soluble components are flushed from the BCR system. The post-treatment system provided significant removal of sulfide, BOD, and orthophosphate that was present in the combined BCR influent. By the beginning of September as the pilot wetland had better acclimated, BOD reduction began to greatly improve to over an order of magnitude. Due to the slow establishment of the wetland to reduce BOD, removal of ammonia by the post-treatment was limited. For ammonia to be treated biologically to nitrate, followed by uptake by plants, BOD must first be substantially reduced in the wetland system. For a short-term study, this step-wise process was not able to be evaluated. However, as a fundamental part of nitrogen cycling in natural wetlands, this process would be expected to occur in a larger and permanent wetland post-treatment system.

ES.2 Tiger Mine Treatability Study

The Tiger Mine consists of several waste rock dumps located in a narrow and steep valley, vertical shafts, and seasonal discharging MIW from adits and seeps. MIW from the seasonally discharging Firehose adit seep was collected and shipped to the CDM Smith Denver, CO Treatability Laboratory for the bench-scale treatability study. This MIW is similar to the Danny T adit MIW as acidic and containing elevated concentrations of several metals of concern.

The primary goal of the Tiger Mine in-situ treatability study was to evaluate potential improvement of water quality discharging from the Firehose adit location through injection of substrates into water in the lower Tiger shaft. Because of the identified hydraulic connection to MIW within the underground workings at the lower Tiger shaft, in-situ treatment could potentially be conducted through the shaft and treatment effectiveness observed at the Firehose Adit or lower discharging connected adits. A bench-scale study was conducted to identify the most effective organic substrates and alkaline reagents, along with inspection of the shaft with a down-hole camera to determine viability. In-situ treatment within an underground mine (e.g., mine pool groundwater) would involve similar treatment mechanisms as an ex-situ BCR, except substrates such as liquids or slurried solids would be injected underground. Biological treatment effectiveness was measured similarly to the Danny T study, except only minimal analytical laboratory measurements were conducted with the small-scale batch test volume.

Three alkaline reagents were tested to raise pH above 5 before organic substrate amendment: NaOH solution, Chitorem fines, and limestone fines. Titration tests were conducted with each reagent to determine the required dosage rate. After titration and settling, samples were collected for laboratory analysis. Batch tests were conducted with 1-gallon cubitainers with spigots, 2.5 L of MIW, 1 L of inert pea gravel, and then addition of various organic substrates and alkaline reagents. One control container was tested with only gravel and MIW. Organic substrates included ethanol, methanol, molasses, and sieved Chitorem. An extract created from dairy manure and deionized water was utilized as an SRB inoculum source for non-Chitorem tests. Three tests with different substrate quantities were evaluated for each of the four organic substrates, and ethanol, methanol, and molasses were all evaluated with the same doses of NaOH and manure extract before the organic amendment. Three Chitorem tests did not include other alkaline reagents or organic substrates; however, four additional Chitorem tests had additions of molasses, NaOH, limestone fines, and manure extract. One additional molasses, limestone, and manure extract container was also tested for a total of 17 batch tests and 1 control test.

Sampling for in-house parameters at the CDM Smith laboratory was conducted weekly starting after the first week for a total of 7 weeks. At the conclusion of the study period, treated water was extracted and submitted for analytical laboratory analysis. After approximately 1 month, low pH in four of the containers prompted the need for additional NaOH and Chitorem doses. Elevated ORP and lack of sulfide generation in 11 of the 17 containers at that time also indicated the need for additional manure extract to provide inoculum. During the first month, significant amounts of gas was formed within some of the containers. Gas was vented once or more per week from the containers but no air was allowed into the containers during venting.

The methanol and ethanol tests (BCR2 through BCR4 and BCR5 through BCR7, respectively), had some reduction in metals such as Al, Cu, Fe, Pb, and Zn from initial NaOH dosing. Sulfate reducing conditions were not obtained in methanol tests and only the lowest-dose ethanol test obtained sulfate reducing conditions near the end of the study as a result of the additional inoculum dose. These results were not expected, since numerous applications using alcohols as substrates for SRB have been demonstrated. The study results indicate that all methanol doses and the higher ethanol doses were not appropriate for the microbial population contained within the inoculum and for the MIW tested. Doses may have been too high and caused some biological toxicity.

Molasses-based containers (BCRs 8 through 10, 16, and 17) appeared initially effective based on significantly reducing conditions and generation of a large amount of biogenic gas. However, ORP increased to oxidizing and pH decreased after three weeks and could no longer sustain sulfate reduction. Additional NaOH doses were added to BCRs 8 through 10 halfway through the study; however, after a slight pH increase and ORP decrease, conditions quickly reverted to more oxidizing and low pH. Additional molasses tests included BCR16 with limestone and BCR17 with Chitorem. Results in these containers were similar to BCRs 8 through 10 despite having additional alkaline material. Overall, molasses as an organic substrate did not appear to be an appropriate substrate for the microbial population contained within the inoculum and for the MIW tested.

In conclusion, the Chitorem-only containers (BCRs 11 through 13) were the most effective at maintaining sulfate reducing conditions and removal of metals from the MIW. Concentrations of key metals were lower than when methanol, ethanol, or molasses were used. Slightly greater sulfate reduction was observed for the higher dose (BCR13), although the lowest dose (BCR11) achieved the same metals reduction with less material. BCRs 14, 15, and 18 evaluated the lowest Chitorem dose with NaOH, limestone, and ethanol additions, respectively. Comparing each of these tests to BCR11 showed some improvements in sulfate reduction with additional alkaline materials; however, metal removal efficiencies were all similar. Overall, these results suggest that the lowest Chitorem dose along with NaOH can maintain sulfate reducing conditions and result in acceptable metals removal. Adjustment of pH with NaOH would be conducted first, followed by Chitorem addition using a guar-gum based slurry of the fine material or tremmie-pipe solids into an open void. Further studies utilizing lower ethanol doses are also recommended.

The Tiger bench-scale study provided an important set of data to be utilized for FS evaluations of possible in-situ treatments regarding reagent dosing and effectiveness. However, the bench-tests do not provide insight into the technical feasibility of such treatments. Downhole camera field investigations in the summer of 2014 indicated that the Tiger shaft was collapsed at approximately 80 ft and was not visibly connected to an open mine tunnel. Therefore, application of a treatability test at the Tiger shaft was not recommended. Future potential field applications could be conducted at the Tiger mine or other mine sites with further evaluations of underground workings locations, geology reviews, and planning and installation of injection/extraction wells for treatment application.

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Section 1

Introduction

CDM Federal Programs Corporation (CDM Smith) has been tasked by the United States Environmental Protection Agency (EPA) Region 8 to conduct bench-scale and pilot-scale treatability studies for mining influenced water (MIW) discharges at the Barker-Hughesville Mining District Superfund Site (the site). This document is a technical memorandum prepared by CDM Smith to present the results of the studies conducted in accordance with the sampling and analysis plan (SAP) addendum #2 specific for the year 2 of the Danny T adit pilot-scale treatability study (CDM Smith 2014a) and the SAP/quality assurance project plan (QAPP) specific for the Tiger Mine bench-scale treatability study (CDM Smith 2014b). The Tiger Mine bench-scale treatability study was conducted from July through August 2014. The year 2 Danny T pilot-scale treatability study was conducted from June through September 2014 along with hydraulic bench tests conducted in May 2014. These activities were conducted under CDM Smith's EPA Remedial Action Contract (RAC) for Region VIII (EPA Contract No. EP-W-05-049).

The treatability study activities are intended to evaluate potential passive or in-situ treatment alternatives for MIW sources at the site. Treatability study results will be utilized for remedial alternative development and evaluations in the feasibility study (FS). The initial phase of the Danny T treatability study (year 1) included bench-scale testing in the laboratory for determination of the most promising treatment and substrate alternatives. Following these tests and preliminary assessment of results, the pilot-scale treatability testing was planned, installed, and operated in 2013. Results from the year 1 study were published in the Final Danny T Adit Treatability Study Year 1 Technical Memorandum (CDM Smith 2014c, Appendix A). Based on the results, the second phase of the Danny T treatability study (year 2) was planned and operated in 2014. Since the Danny T adit is one of many similar acidic MIW discharges at the site, the passive treatment treatability studies conducted at the Danny T adit can be used as a surrogate for other similar MIW discharges for the purposes of FS evaluations.

The Tiger Mine was identified as a potential location for demonstration of a pilot-scale in-situ treatability study, based on the MIW, the location of the mine in a steep valley (lack of flatter space for passive treatment), and the presence of an open vertical raise that could be used to administer in-situ treatment substrates into the underground mine. A bench-scale treatability study was implemented to evaluate several in-situ substrate treatment approaches, and field investigations were conducted on the vertical shaft to evaluate the efficacy of substrate addition to the underground mine.

This technical memorandum summarizes the project background, treatment technology, and study objectives (Section 1); the treatability study methods and sampling (Section 2); quality assurance summary (Section 3); results, analysis, and discussion (Section 4); and summary and conclusions (Section 5) for both the bench-scale and pilot-scale treatability studies.

1.1 Site Description and Background

The site is located in central Montana, southeast of Great Falls (Exhibit 1-1). It consists of approximately 9,600 acres in Cascade and Judith Basin counties. There are no full-time residents at the site, but up to a dozen properties have structures that may be inhabitable during the winter months while other property owners use campers or trailers during the summer. There are 11 drainages on the site and 45 abandoned mine sites scattered across those drainages. The two major creeks within these drainages are Galena Creek and Lower Dry Fork Belt Creek. Most of the other tributaries on site feed into those two creeks. The exception is Otter Creek, which flows north out of the site. Several smaller mines, operated under the name of the Block "P" Mine, are located near the top of Galena Creek. Under an EPA order, this portion of the site (Block P Mine and Block P Tailings) is currently undergoing removal actions by Doe Run Resources, an identified potentially responsible party (PRP).

Exhibit 1-1. Site Location Map

Various sampling events were undertaken by the State of Montana, the United States Forest Service (USFS), and Cascade County since 1972. In 2004, EPA directed CDM Smith to summarize the data obtained to date and identify data gaps. That work was presented in the *Final Technical Memorandum, Site Investigation Summary Report for Barker Hughesville Mining District NPL Site* (CDM Smith 2005). The technical memorandum also established a three-tier ranking system for mine sites, which considered their potential threat based on several factors: mass wasting, waste material in contact with surface water, volume of waste material, acid mine drainage discharge to surface water, visual impacts to surface water, and severity of environmental impacts. Tier I sites had the most impacts while Tier III had the least.

Remedial investigation (RI) and FS sampling activities were initiated by CDM Smith in 2009 and completed in 2014. Further information on site description, background, sampling activities, and data can be found in the respective SAP/QAPPs for the studies presented in this report (CDM Smith 2014a and 2013) or in the RI report (CDM Smith 2014d).

1.1.1 Danny T Mine

The Danny T Mine is part of the Liberty Mine Complex and located within the Middle Galena Creek area of the site, approximately ½ mile north of Barker. The Liberty Mine Complex includes the Liberty, Danny T, and Marceline mines (in order of highest elevation). The Danny T mine has one large waste rock dump, abandoned structures, and a collapsed discharged adit. Most waste rock is acid generating, and the adit discharge is a highly acidic MIW. The pH is consistently low, ranging from 2.66 to 3.08 standards units (su), and concentrations exceed the acute aquatic life standards for aluminum (Al), arsenic (As), cadmium (Cd), copper (Cu), iron (Fe), lead (Pb), and zinc (Zn). Several human health standards are also exceeded in the adit MIW discharge. The adit discharge has scoured multiple paths down the access road, ultimately reporting to Galena Creek.

According to historic mine maps, the Danny T portal is the lowest level of underground mine workings connecting up to the Liberty mine and is likely draining these workings. The discharge from the Danny T had been estimated previously at 40 gallons per minute (gpm), and it was suspected that the flow would vary during spring runoff and into the fall. To measure the changing flow rate, a cutthroat flume and data logger were installed in June 2012 and operated until the end of September 2012. Manual measurements were made in early May 2012 at 32 gpm. By the time the flume was installed, flow had decreased to around 20 gpm, followed by a steady decline in flow through the summer to a low of around 4 to 5 gpm.

1.1.2 Tiger Mine

The Tiger Mine is located near the top of the Upper Galena Creek drainage. The eastern boundary is near the top of the saddle between Mixes Baldy and Clendennin Mountain. The area is bounded to the north by a steep talus slope, to the south by forest, and to the west by the Pioneer Mine. There are four large waste piles at the mine that extend up the valley in a terraced pattern. Two open shafts and up to five collapsed adits are present. The source of Galena creek is a seep in the upper waste rock piles at Tiger mine, and the creek subsequently flows around and directly adjacent to the lower two waste piles.

During 2012, as part of the RI, five discharging seeps or adits associated with the Tiger mine were sampled. A deep open shaft is located below the waste rock dumps and adjacent to the stream channel. After spring runoff when conditions dry out, water in the streambed soaks into the ground just above the shaft.

A short distance to the west, and down the hill, water from monitoring station TI-AD004 discharges from a small circular hole in the hillside and then cascades down the hillside that is coated with hardened terraces of Fe precipitates. The field team nicknamed this feature the “Firehose adit.” Sampling results from TI-AD004 in the RI (2012) indicate the water is severely impacted, with a low pH ranging between 2.78 and 3.53 su and very high concentrations of dissolved Al, Fe, and manganese (Mn) characteristic of MIW in the area. High concentrations of total and dissolved Cd, Cu, Pb, and Zn exceed acute aquatic life standards and occasionally the human health standard. Discharge from this adit was among the highest flow rates measured, ranging from a high of 79 gpm in late May 2012 to 13.3 gpm in late June 2012. No discharge was observed in the July and August sample events. Based on the RI data, given the large flow rate and poor water quality, this adit is one of the largest contributors to metals contamination in Upper Galena Creek when it is flowing.

Because of the transient nature of the adit discharge observed in 2012, water quality monitoring has continued through 2014. The Firehose adit was observed to be discharging during May and June 2013, and then discharge ceased once conditions dried. In May 2013, a dye tracer test showed a hydraulic connection between the discharge at TI-AD004 and the open shaft (lower tiger shaft). Review of historic underground workings maps confirmed this connection, and it appears that the Firehose adit is one of the primary discharge locations for MIW flowing downgradient through the underground workings at the Tiger Mine during the higher flow season.

The Pioneer mine workings map indicated it consisted of an adit and a crosscut to reach the vein and mine workings at the Tiger mine. In the vicinity of the Firehose adit, the tunnel would not have been far below ground. It is likely that while the Pioneer adit was open, water from the Tiger mine would have drained through the Pioneer adit portal. However, based on the mine workings maps and the field observations, it appears that as the portal at the Pioneer mine collapsed and was blocked, the mine water surfaced through a fracture in the bedrock and formed this new discharge point at TI-AD004.

1.2 Treatment Technology Description

This section presents an overview of the sulfate reduction process, in-situ treatment, and passive treatment (ex-situ).

1.2.1 Sulfate Reduction Background

The overall anaerobic sulfate reduction biochemical treatment approach has a wide variation of design possibilities, including ex-situ treatment of surface MIW from mine tunnels and/or surface mine reclamation features as well as in-situ treatment of groundwater in or adjacent to underground mine areas through open shafts, an array of injection/extraction wells, or using sub-surface permeable reactive barriers. Sulfate reduction is the key process in anaerobic biochemical treatment of MIW. In simplified terms, sulfate reduction relies on the addition of an electron donor (organic reagent) to stimulate bacterial activity. These sulfate reducing bacteria (SRB) consume the organic reagent while functioning to reduce sulfate to sulfide. The sulfide combines with dissolved metals in the MIW, resulting in precipitation of metal sulfides. In this process, formation of metal sulfide precipitates is the dominant MIW removal mechanism by which metals are treated over the long term. The sulfate reduction reaction can be simplified as follows:

$$SO_4^{-2} + 2\ CH_2O \rightarrow HS^- + 2\ HCO_3^- + H^+$$

Sulfate reduction produces both reduced sulfide (HS^-) and bicarbonate alkalinity (HCO_3^-), resulting in net increase in pH of the MIW during the reaction. The formation of metal sulfides proceeds generally as follows (where Me = divalent metal species):

$$S^{2-} + Me^{2+} \rightarrow MeS \text{ and } HS^- + Me^{2+} \rightarrow MeS + H^+$$

CH_2O in the sulfate reduction reaction is a generic representation of an organic substrate. The actual form of organic compound utilized by SRB to reduce sulfate can be complex and can vary for each substrate or combination of substrates. The availability of a readily usable carbon source by SRB is the limiting factor for the overall sulfide generation, and subsequent metal removal rate, as long as adequate sulfate is present. Solid substrates must proceed through an anaerobic fermentation process to produce a soluble form of carbon. Common cellulosic-based solid substrates may include wood chips, sawdust, hay, compost, and manures. Anaerobic fermentation of cellulosic materials converts sugars into volatile fatty acids (VFAs) such as a lactic or acetic acid that are used by the SRBs to reduce sulfate. Liquid substrates, such as ethanol, methanol, and molasses, must also undergo anaerobic fermentation; however, they are more readily available to SRB because they are already in the aqueous form and can produce faster reaction rates as compared to solid substrates alone, which require a consortium of bacteria to process carbon into a usable form by the SRB.

1.2.2 Ex-situ Passive/Semi-Passive Treatment Background

Ex-situ passive or semi-passive treatment involves the use of processes, such as biochemical reactor (BCR) cells that rely on the anaerobic biological sulfate reduction process for treatment, successive alkalinity producing systems (SAPS), aerobic wetlands, and abiotic chemical treatment methods such as limestone beds, sorption beds, or semi-passive lime or other alkaline material addition. Several references detail all of these processes, including but not limited to the Global Acid Rock Drainage Guide (GARD) Guide in (International Network for Acid Prevention 2009), Interstate Technology Regulatory Council (ITRC) BCRs for Mining-Influenced Water Treatment guidance document (ITRC

2013), and the Reference Guide to Treatment Technologies for MIW (EPA 2014). The type of treatment method or combination of treatments depends on the MIW characteristics, flow, treatment goals, and other site-specific conditions. The Danny T study focused on evaluation of primary BCR treatment, various pre-treatment, and post-treatment methods.

BCRs can be composed of solid organic substrates such as wood chips, sawdust, hay, compost, manure, marine animal wastes (crab shells, oyster shells, fish bones), other food wastes, limestone gravel, and inert gravel. A truly passive BCR operates by gravity with only solid substrate materials. BCRs can also operate exclusively with liquid-based organic substrates or as an augmentation to other solid organic substrate materials. However, these BCR systems would be classified as semi-passive since the delivery of liquid substrates likely would need to be implemented using an energy source. In remote areas, addition of liquid substrates can potentially be achieved with the use of solar power and/or water-wheel technologies, so the treatment systems are still semi-passive by design. Liquid substrate BCRs can be a beneficial application because the substrate is more readily available to SRB in shorter chain and soluble carbon forms, thus, increasing the size of the bacteria population, especially SRB. This benefit can produce higher sulfate reduction reaction rates, which may result in a reduction in space required for treatment versus a solid-based-only substrate system with a lower sulfate reduction rate. However, liquid substrates also have limitations such as the need for continuous replenishment, the likely requirement of an energy source for delivery, and the potential to create a less-diverse microbial community that is more susceptible to stressed conditions.

For most MIWs, especially acidic MIWs, pre-treatment processes are usually necessary prior to BCR treatment. Three primary pre-treatment methods include oxidation, neutralization, and sedimentation/filtration. Because BCRs are living biological treatment systems, their treatment efficiency (metal removal) can be affected by changes in influent MIW chemistry and flow. Activity of SRB may also be limited by low pH and high mineral acidity MIW. Another factor that affects the treatment process is the oxidation state of the water and the presence of Fe and Al at significant concentrations. MIWs with high Fe and Al in an oxygen atmosphere can result in formation of Fe and Al oxyhydroxide precipitates. Under oxidizing conditions (high dissolved oxygen [DO] and positive oxidation-reduction potential [ORP]), the rate of precipitation can be increased. These precipitates can lead to plugging in the BCR piping and substrate layers and possible premature failure of the BCR treatment system. Therefore, various pre-treatment methods may be required, depending on the MIW water quality, in order to provide suitable chemistry for the sulfate reduction to occur, maintain system longevity, and reduce maintenance.

As part of an overall passive treatment system, a BCR cell is commonly followed by aeration processes, which may include cascades, aeration/settling ponds, and aerobic wetlands. Aeration provides oxidation of the BCR effluent that decreases sulfides, increases DO, and reduces biological oxygen demand (BOD) and ammonia formed from the BCR organic substrates prior to discharge to the receiving water. A common post-treatment application includes an open settling pond followed by an aerobic constructed wetland. The pond provides settling capacity for residual suspended solids from the BCR effluent and aeration processes. The wetland component provides additional metals polishing treatment from vegetation as well as additional filtration of solids, oxygen entrainment, and degradation of BOD and other nutrients through microbial activity and plant uptake.

1.2.3 In-situ Treatment Background

In-situ treatment within an underground mine (e.g., mine pool groundwater) involves the use of an injectable organic substrate to increase anaerobic microbial populations and to drive biochemical reactions that reduce concentrations of metals, acidity, and sulfate in MIW. For in-situ treatment, sulfate reduction with metal sulfide precipitation is the primary biochemical treatment process, provided that the mine pool is sufficiently anaerobic with low concentrations of dissolved oxygen. Examples of substrates that could be utilized for food to stimulate the microbial population include soluble materials such as ethanol, methanol, beer, VFAs (such as lactic or citric acid), glycols, and milk, or materials that can be slurried or emulsified, including but not limited to whey, vegetable oils, molasses, and crushed marine organism shells or bones.

Injection and delivery of substrate is the key to this approach, as access to underground mine workings is often limited due to collapse or safety concerns. In cases where low pH MIW is present, injection of an alkaline material into the mine pool groundwater may be needed to raise pH to minimize microbial mortality and provide the optimum conditions for the SRB population to function and multiply. In-situ treatment may also require injection of an inoculum of SRB into the mine pool groundwater to initiate the desired anaerobic biochemical reactions. Although SRB are generally ubiquitous in the mine environment, addition of an inoculum may better ensure that the desired treatment is initiated.

In-situ treatment of MIW within an underground mine area has a number of potential benefits, including but not limited to:

- Treatment of the contamination source area inside the underground mine and potential passivation of ore materials (e.g., sulfide minerals) inside the mine, thus, reducing he formation of MIW.
- Reduction of capital costs associated with construction of infrastructure for ex-situ passive or active treatment technologies.
- Reduction of operations and maintenance costs associated with ex-situ active or passive treatment technologies. Reduction of issues associated with these technologies such as plugging and freezing of water conveyance structures.
- Reduction or elimination of metal-containing treatment precipitates or metal-containing substrates that need disposal associated with ex-situ active or passive treatment technologies (disposal occurs within the underground mine and fractures).
- Reduction in space required for treatment or electrical requirements (may be limited to portable generators or solar power systems).
- Ability to treat MIW in remote areas.
- Seeps associated with the underground mine (non-point discharges) may be treated or greatly improved.

Although there are many potential benefits to in-situ treatment of underground mine pool groundwater, there are also many uncertainties and challenges associated with the technology, including:

- Limitations to completely understanding the nature and extent of contamination of historic underground mines, extent of underground workings, and geology as they relate to generation and transport of MIW.
- Uncertainty with the volume of water in the underground mine pool area requiring treatment and, thus, uncertainty with the amount of reagents required to deliver underground.
- Limitations on the ability to effectively deliver and distribute substrates for treatment and to evaluate the effectiveness of those treatments.
- Uncertainty with achieving and maintaining treatment efficiency in the long term and understanding of the frequency, type, method, and amount of injection needed.
- Potential need for costly source control measures, such as opening and rehabilitation of underground mine tunnels for access to deliver substrates and/or install a bulkhead, and potential risk that these measures to control the mine pool may be ineffective (e.g., leaking bulkhead, discharge emerges elsewhere).
- Potential for discharge of treated water from adits or seep locations that contains low DO and high BOD and sulfide, which may require post-treatment before discharge to receiving waters.
- Potential for solubilization of Fe and Mn that may be present in the underground mine area under anaerobic conditions that may be imposed by the in-situ treatment process.

Overall, treatment of the source area of contamination is the primary benefit of in-situ treatment. In-situ treatment can also be coupled with other source control technologies that limit infiltration of water into the underground workings or modify the mine pool groundwater level. Implementation of these technologies in conjunction with in-situ treatment may greatly improve long-term effectiveness of the treatment technology. For example, grout injection, surface water re-routing, or groundwater control may limit infiltration of water into the mine pool area and reduce the amount of contaminated water requiring treatment. Installation of hydrostatic bulkheads on draining adits may increase the local mine pool groundwater level, thereby potentially flooding areas containing the source materials that are generating the MIW (e.g., ore or waste rock). By flooding, generation of MIW through oxidation processes can be limited. Flooding workings areas also provides the ability to effectively treat water present within the workings tunnels or fracture zones as opposed to the condition where tunnels may have only been seasonally flooded with spring inflows. Other MIW treatment techniques can be combined with in-situ treatment to produce an overall scenario for limiting and treating MIW.

Given the above information, identification of the proper substrates to treat a particular MIW in-situ effectively is the first phase of the pre-design process. The second phase is to investigate and plan the methods for in-situ delivery of substrates. Delivery of substrates could be implemented by injection through groundwater wells screened within a mine void or in fracture zone areas associated with the underground mine, through open vertical shafts, or through open and rehabilitated horizontal mine tunnels. Treatment in a particular groundwater zone could be implemented by multiple injection points or by installation of both injection and extraction groundwater wells to create re-circulation loops. Another alternative for substrate delivery could be to bulkhead a mine opening and provide injection of substrates through the bulkhead.

1.3 Study Objectives and Evaluation Criteria

Completion of bench-scale and pilot-scale treatability studies provides data for evaluating potential MIW treatment technologies at the site. The overall goal of the treatability studies was to determine if a particular method and/or amendment provides more desirable results with regard to reduction of metal concentrations, neutralization of acidic MIW, and practical considerations for full-scale field implementation. Treatability study data can ultimately be utilized for evaluation of MIW treatment technologies in the FS and utilized for design of full-scale treatment of MIW should these technologies be selected as part of the site remedy.

The primary goals of the Danny T treatability study were to test the effectiveness of MIW treatment using pre-treatment methods, ex-situ BCR treatment solid substrates, and a post-treatment oxidation/wetland process. The primary goal of the Tiger Mine in-situ treatability study was to evaluate potential improvement of water quality discharging from the Firehose adit location through injection of substrates into water in the lower Tiger shaft. Because of the identified hydraulic connection to MIW within the underground workings at the lower Tiger shaft, in-situ treatment could potentially be conducted through the shaft. In order to identify the most effective treatment substrates and dosage rates per volume of MIW, a bench-scale study was conducted first in the laboratory. Field investigations to evaluate the ability to utilize the shaft for substrate injection were also conducted.

The approaches and criteria used to evaluate treatment effectiveness during the treatability studies are presented in the following sections. Specific objectives for the bench-and pilot-scale treatability studies were presented as principal study questions in the appropriate SAP/QAPPs (CDM Smith 2014a and b). These study questions and information inputs are presented in the sections below to provide the framework for data assessment in Section 4 of this memorandum. Information inputs provide greater detail on the rationale for the treatability test design during the bench-and pilot-scale phases.

1.3.1 Analytic Approach and Evaluation Criteria

An effective treatment is one where toxic metals are removed from the water efficiently, and the water quality meets federal and state criteria and/or guidelines for ambient water quality. The primary measure of treatment effectiveness for either in-situ or ex-situ treatments tested in the study is the removal efficiency. Removal efficiency is the percent by which metals or other constituents are removed between the influent and effluent of the treatment system (or raw untreated water versus treated water) and is calculated as the difference between the influent and effluent concentrations divided by the influent concentration. Where applicable, the removal efficiency calculation was applied to all samples collected in the treatability study to evaluate effectiveness. In addition, metals concentrations measured at the end of the tests (treated water) were compared to Montana Department of Environmental Quality (DEQ) Water Quality Bureau Bulletin 7 (DEQ-7) acute and chronic ambient water quality standards and human health standards (DEQ 2012). Table 1.3-1 below provides a summary of the DEQ-7 standards.

In addition to metals removal, anaerobic biological treatment effectiveness is measured by several metrics that indicate the extent of the sulfate reduction process and the type of metal removal mechanism(s) that are occurring. The extent of sulfate reduction can be correlated with removal efficiency in order to verify that metal removal was predominantly occurring via a sulfate reduction mechanism, rather than by other removal processes such as adsorption to substrates or precipitation of metal oxy-hydroxides or carbonates. The metrics for identifying the extent of sulfate reduction include the following:

Table 1-1. DEQ-7 Standards

Parameter	Concentration (µg/L)		
	Aquatic Life		Human Health
	Acute	Chronic	
Aluminum (dissolved)	750	87	n/a
Antimony	n/a	n/a	5.6
Arsenic	340	150	10
Barium	n/a	n/a	1,000
Beryllium	n/a	n/a	4.0
Cadmium*	2.1	0.3	5.0
Chromium	1,803	86	100
Copper*	14	9.3	1,300
Iron	n/a	1,000	n/a
Lead*	82	3.2	15
Manganese	n/a	n/a	n/a
Mercury	1.7	0.9	0.1
Nickel*	469	52	100
Selenium	20	5.0	50
Silver*	4.1	n/a	100
Thallium	n/a	n/a	0.2
Zinc*	120	120	2,000

Standards are for the total recoverable fraction, unless otherwise noted; µg/L – micrograms per liter; n/a – no standard available; * Standard shown calculated at a hardness of 100 milligrams per liter (mg/L)

- Decrease in sulfate concentrations from the untreated raw water to the final treated water. The magnitude of the sulfate concentration decrease is site-specific to the influent water sulfate concentration being evaluated and extent of biological activity.

- Alkalinity concentration changes between the initial untreated MIW and the treated MIW at the end of the study period will be measured and quantified as an indicator of SRB activity. Bicarbonate alkalinity is produced as a byproduct of the sulfate reduction process by SRB (Section 1.2.1) and should increase from the initial untreated MIW concentrations. In addition, alkalinity can increase from calcium carbonate-based materials in the substrates. The contribution of alkalinity increases by either calcium carbonate dissolution or microbial activity can be difficult to distinguish, although typically contributions by calcium carbonate are constant or slowly decreasing over time, whereas sudden increases in alkalinity can be interpreted as a result of biological activity, in correlation with other metrics (i.e., good sulfate reduction and sulfide generation).

- Generation of sulfide from the sulfate reduction as measured in the treated water. The values will be used as an indicator of successful sulfate reduction resulting in metals removal by formation of metal sulfides. Sulfate can be metabolized by SRB and generate hydrogen sulfide gas. The presence of hydrogen sulfide odor (rotten egg odor) is empirical evidence of sulfate reduction.

- A target pH at 6.5 to 8.5 su is desired for effective treatment (meets aquatic water quality standards). Based on numerous treatment case studies by others and by CDM Smith, observations of ORP less than approximately -150 millivolts (mV) and decreasing and DO less than 2 mg/L in the treated effluent is indicative of the appropriate reducing environment necessary for sulfate reduction to occur. The optimum water temperature for incubation and system startup is generally desired to be within 5 to 15 degrees Celsius, but reduced sulfate reduction can still occur at temperatures less than 5 degrees Celsius.

Further details of the analytical testing approach and evaluation of data are provided in the following sections that present the principal study questions.

1.3.2 Tiger Study Principal Study Questions and Information Inputs

As presented in the Tiger Mine treatability study SAP/QAPP (CDM Smith 2014b), the principal study questions and information inputs for the bench-scale study included the following:

1. *What is the water quality of the Firehose Adit water used in the bench test?*

   MIW from the Firehose Adit at the Tiger Mine was collected in early June 2014 and shipped to the CDM Smith Treatability Laboratory in Denver, Colorado. A sample was collected from the MIW in the field and submitted to a laboratory for analysis of total and dissolved metals, alkalinity, and sulfate. In-house parameters at the CDM Smith laboratory were also measured, including pH, temperature, specific conductance, ORP, DO, HACH sulfide, and HACH ferrous Fe.

2. *What dosages of alkaline reagents are required to raise the pH to approximately 5.0 su for pre-treatment?*

   Alkaline materials were identified and titrations conducted using each material. The titrations were conducted by slowly adding the alkaline materials until the endpoint pH was reached (approximately 5.0 su). A sample of the treated MIW was collected and submitted to a laboratory for analysis of total and dissolved metals, alkalinity, and sulfate. In-house parameters at the CDM Smith laboratory were also measured, including pH, temperature, specific conductance, ORP, DO, and HACH ferrous Fe. The quantity of alkaline material needed per volume of MIW was calculated and scaled for application of the bench-scale tests.

3. *Which liquid or slurried solid organic substrate is the most effective treatment of the MIW?*

   A series of batch container tests were prepared using a set volume of MIW and varying types and quantities of liquid or slurried solid organic substrates, including alkaline materials to increase pH. Containers were sealed after initial light mixing. After 1 week of incubation, a small aliquot of sample was collected from each container for in-house measurement at the CDM Smith laboratory for pH, temperature, specific conductance, ORP, DO, HACH sulfide, alkalinity, and ferrous Fe. This process was repeated weekly for a total of six sample events, and then a sample was collected and submitted to a laboratory for analysis of dissolved metals, alkalinity, and sulfate. The same in-house parameters at the CDM Smith laboratory were also measured at the end of the study. Treatment effectiveness was evaluated based on a number of metrics as presented in Section 1.3.1.

4. *What is the dosage required for a liquid or slurried solid organic substrate to achieve effective treatment of MIW?*

   A variety of substrates were tested as well as different quantities of the same substrates. By evaluating the metrics provided in Section 1.3.1 for the different batch tests, substrate to MIW volume (or weight) ratio can be determined that maintains effective treatment but minimizes the substrate volume needed to optimize treatment costs.

5. *What is the physical condition of the lower Tiger shaft, including: are there any obstructions present, is water present at the bottom, and what is the shaft total depth and/or water depth?*

Deployment of a lighted video camera illuminated the shaft and provided recorded information about the shaft. Information included whether any obstruction exists in the shaft such as historical mine equipment, whether areas of the shaft were collapsed, or whether water was present at the bottom of the shaft and at what depth.

1.3.3 Danny T Year 2 Study Principal Study Questions and Information Inputs

As presented in the pilot-scale treatability study SAP addendum #2 (CDM Smith 2014a), the principal study questions and information inputs for the year 2 pilot-scale study included the following:

1. *What is the water quality of the Danny T adit water used in the pilot-scale test?*

   Influent MIW collected from the Danny T adit was characterized based upon analytical results of samples collected during the study. Influent MIW samples were collected from the treatability study system influent sampling port during each sample event. Variability in the influent MIW water quality through the course of the study was evaluated.

2. *What pre-treatment steps are necessary to condition the water for the BCR treatment?*

   Due to the very low pH and high metals concentrations in the Danny T adit water, pre-treatment was expected to be a necessary component of any passive treatment process. The pre-treatment is intended to condition the MIW for treatment in the BCR, decrease the likelihood of clogging the BCR, and thus, increase the longevity of the BCR. The study evaluated three types of pre-treatment for effectiveness and implementability. The pre-treatment steps investigated were:

   - Pre-treatment with an alkaline reagent (sodium hydroxide) to increase pH to approximately 4.5 to 5.5 su. This treatment was similar to the pre-treatment conducted during the year 1 study, except sodium hydroxide (NaOH) was utilized instead of magnesium hydroxide due to the operational issues encountered with magnesium hydroxide in the year 1 study. The existing solar-powered chemical dosing system was utilized for dosing the NaOH solution into the pre-treatment barrel.

   - Addition of water directly to a SAPS. This treatment reduces DO and ORP and adds alkalinity to the influent MIW without metering in a reagent. The substrate consisted of an organic layer of compost, manure, and pea gravel to reduce the oxidation state of the influent MIW, followed by a bed of limestone to raise pH. This test evaluated a passive pre-treatment approach that does not require electrical power for alkaline addition.

   - Addition of water directly to a Chitorem SC-20® (Chitorem), sand, and pea gravel barrel. On average analysis, the product contains 30% by weight calcium carbonate (from the crab shells), 40% protein (from leftover meat, ligaments, and other sources), and 20% chitin (organic compound in the crab shell). Similar to the SAPS pre-treatment, this treatment reduces the oxidation state and adds alkalinity without metering in a reagent. Chitorem is a proprietary product made of dried and crushed crab shells designed for passive treatment.

   A fourth BCR without a pre-treatment step was also tested. The year 1 Treatability Study memorandum (CDM Smith 2014c) recommended not testing a BCR without pre-treatment due to the inability of the woody substrate materials to maintain sulfate reduction and a net-alkaline condition without pre-treatment. Upon further consideration, the technical team decided to include the non-pretreated BCR treatment train but to augment the woody substrate to include Chitorem material to provide added alkalinity.

3. *What pre-treatment dosage of sodium hydroxide reagent is required to achieve the optimal pH range?*

   The optimal pH range targeted in the pre-treatment step for the study was 4.5 to 5.5 su. NaOH titration results from the bench-scale study were utilized as an initial estimate of the dosing ratio required. The result of the 2013 bench test titration indicated an estimated dose of 3.7 milliliters (ml) of 5% by mass NaOH solution per liter of Danny T adit water. During startup of the year 2 study, a field titration was conducted with the NaOH solution to confirm this assumption. The field titration indicated an estimated dose of 25 ml of 1% (by mass) NaOH solution per liter of Danny T adit water.

4. *What is the nature of the sludge and the sludge volume generated during alkaline addition pre-treatment?*

   During the bench-scale treatability study, a measurement of the settled volume of sludge generated from a NaOH titration to a pH of approximately 5 su was completed. During the year 2 study, sludge volumes were not measured due to the inability to access the inside of the pre-treatment tank without disassembling the MIW or NaOH solution feeds.

5. *What is the effectiveness of the alkaline addition pre-treatment?*

   The alkaline addition pre-treatment efficiency assessment was based upon analytical results of samples collected from the alkaline addition pre-treatment effluent and raw water influent. Pre-treatment efficiency was based upon removal of a selected subset of metals (e.g., Al and Fe) and the observed expected increase in effluent pH and alkalinity. Removal efficiency was measured by calculating the percent difference of metal concentrations in the pre-treatment effluent versus the influent.

6. *What is the effectiveness of the SAPS pre-treatment?*

   The SAPS pre-treatment efficiency assessment was based upon analytical results of samples collected from the SAPS pre-treatment effluent and raw water influent. Pre-treatment efficiency was based upon removal of a selected subset of metals, increases in pH and alkalinity, and decrease in ORP and DO. Removal efficiency was measured by calculating the percent difference of metal concentrations in the pre-treatment effluent versus the influent.

7. *What is the effectiveness of the Chitorem pre-treatment?*

   The Chitorem pre-treatment efficiency assessment was based upon analytical results of samples collected from the Chitorem pre-treatment effluent and raw water influent. Pre-treatment efficiency was based upon the same metrics as defined in Study Question 6. Removal efficiency was measured by calculating the percent difference of metal concentrations in the pre-treatment effluent versus the influent.

8. *What is the removal efficiency achieved for various elements in the BCR treatment barrels?*

   Removal efficiency is the primary metric to determine treatment effectiveness. Consistently high removal efficiency of site-specific target metals (i.e., focusing on Al, As, Cd, Cu, Fe, Pb, and Zn) is a specific quantifiable goal of the treatability study. The targeted metal removal efficiency for the BCR barrel effluent water is a value equal to or greater than 90% reduction in metals content after the initial adaptation phase. The actual target removal efficiency for some metals varies based on the chemical-specific endpoint values as provided in Study Question 10 below and variable influent concentrations throughout the study. Samples were collected from the effluent sampling ports for each BCR treatment barrel. Analytical results were used to calculate removal efficiency by comparison of the metals concentrations in BCR barrel effluent versus the influent MIW concentrations collected from the system feed tank or pre-treatment effluents. Removal efficiency for BCR barrels that first received a pre-treatment step were calculated by comparison to the pre-treatment barrel effluent concentrations, rather than the treatment system influent MIW.

9. *What is the extent of sulfate reduction in the BCRs?*

   Sulfate reduction and metal sulfide formation are the main biochemical reactions used for removal of metals by the BCR treatment process. Therefore, measurement endpoints are established to understand the extent of sulfate reduction as part of overall treatment effectiveness evaluation. The extent of sulfate reduction in the BCR treatment barrels was assessed using the metrics presented in Section 1.3.1, which include evaluations of bi-weekly analytical laboratory sulfate, sulfide, and alkalinity concentrations and evaluation of weekly field measurements.

10. *What are the chemical-specific endpoint values to evaluate test effectiveness?*

    As discussed in Section 1.3.1, treatability data were compared to DEQ-7 aquatic life criteria and human health drinking water standards. Table 1-1 provides the site-specific values to be used as comparison criteria for metals. Hardness-based standards are shown at a hardness of 100 mg/L; however, actual evaluations were conducted using a calculated standard based on the actual sample hardness.

11. *What is the effect of seasonal weather changes on treatment effectiveness?*

    The year 2 pilot-scale treatability study was started earlier in the summer (early June) and continued through the end of September. Weather effects to metrics identified in Study Questions 7 through 9, including precipitation, colder ambient air, and colder influent MIW, were evaluated by documenting site-specific weather conditions using data from a temporary weather station installed at the Danny T mine and local weather stations. Since the treatment system was operated during warmer weather for the most part, limited changes to influent MIW temperature occurred. The pre-treatment and BCR treatment systems were constructed to prevent any percolation of precipitation water into the process flow; however, precipitation may result in percolation into the underground mine and may have an effect on the influent MIW chemistry to the treatment system, as described in Study Question 12 below.

12. *How does treatment effectiveness vary in response to potential changes in the Danny T adit MIW chemistry?*

    Throughout the course of the study, MIW influent was sampled and the analytical results compared to the analytical results of treated effluent. This comparison allowed observation of changes to influent MIW chemistry if they occurred and assessment of changes in treatment effectiveness. Measurement of changes in influent MIW chemistry as a result of precipitation or other effects was limited to the bi-weekly laboratory sampling and weekly field parameter sampling. Changes in chemistry between these weekly periods cannot not be evaluated.

13. *What is the BCR retention time for contact between BCR substrate and MIW flow?*

    Based on the average flow rates utilized, substrate volume, and porosity, the retention time was calculated and reported. The initial average design flow rate and retention time is defined in Section 2.2.2. The treatability study began at this flow rate; however, modifications to this flow rate were made during the study as described in Section 2.2.4.2.

14. *What is the effectiveness of the post-treatment oxidation system to increase the DO and ORP and decrease concentrations of BOD, sulfide, nitrate, phosphorus, and ammonia?*

    As part of the anaerobic processes in the BCR that facilitate the formation of sulfides, constituents such as sulfide, ammonia, and BOD are generated in concentrations that are toxic to aquatic life. In addition, substrates can discharge nitrogen and phosphorus that can cause stress to the surface water system. Therefore, aeration and aerobic wetland treatment of the BCR effluent is required prior to discharge. A post-treatment system was implemented for all four combined BCR effluents that consisted of a series of cascade aeration steps, followed by flow through a small aerobic wetland treatment cell. Further details of the post-treatment are provided in Section 2.2.2.6. Post-treatment effectiveness was evaluated by comparing the analytical laboratory concentrations and field measurement data from the combined BCR influent to the post-treatment system to the final treated effluent.

15. *What is the optimum Chitorem, sand, and gravel mixture to maintain adequate permeability of the substrate mixture during treatment?*

    Maintaining adequate permeability in the Chitorem substrate barrel was problematic during the 2013 pilot testing. Field cone-drainage tests were conducted in the field in September 2013 to determine a revised amount of gravel to add to the existing substrate in the Chitorem pre-treatment barrel. However, only a limited number of tests were conducted at the time. Further drainage tests were conducted at the CDM Smith treatability laboratory in Denver, Colorado in April through May 2014 to better optimize the Chitorem, sand, and gravel content to maintain adequate permeability for water to be free-draining. These laboratory bench-scale tests were conducted with similar acidic MIW to the Danny T adit to attempt to simulate the process that created a slimy biomass layer observed in the year 1 pilot study. Further details of these tests are provided in Section 2.1. The outcome of the bench study provided a recommendation for an optimum mixture to be used in the year 2 pilot study.

Section 2

Study Methods and Sampling

2.1 Danny T Bench-Scale Hydraulic Tests

Over the course of the test in year 1, the permeability of the Chitorem barrel was substantially reduced, with substantial influent water overflowing from the top of the barrel. In September 2013, the Chitorem, sand, and gravel substrate was removed from the pre-treatment barrel, and a fraction of the removed substrate was mixed with more pea gravel to increase the permeability. Field cone drainage tests were conducted on site to determine the amount of gravel to add that would be required to maintain a free-flowing hydraulic condition. Based on these observations, a mix of 1 part original substrate to 1.5 parts pea gravel was chosen as the replacement substrate for the pre-treatment Chitorem barrel. After replacing the barrel with the revised substrate, adequate flow-through was observed through the barrel. Table 2.1-1 shows the substrate percentage variations between the original mixture, cone drainage test mixtures, and final selected mixture.

Table 2.1-1. Chitorem Pre-treatment Substrate Mixture Percentages for Year 1 Study

		Cone Test 1	Cone Test 2	Revised Mixture
Material	Original Mixture	1 Part New Pea Gravel: 1 Part Original Mixture	2 Parts New Pea Gravel: 1 Part Original Mixture	1.5 Parts New Pea Gravel: 1 Part Original Mixture
Chitorem	40.0%	20.0%	13.3%	16.0%
Sand	30.0%	15.0%	10.0%	12.0%
Pea Gravel	30.0%	65.0%	76.7%	72.0%
Sum	100.0%	100.0%	100.0%	100.0%

Further optimization of the volume ratio of Chitorem, sand, and gravel was determined through column drainage tests at the CDM Smith Denver treatability laboratory in April and May 2014. Based on the field cone tests, a range of tests was conducted varying the Chitorem content between 12 and 28%, sand between 9 and 21%, and pea gravel between 51 and 79%. A 10/20 well filter pack sand was utilized for the bench and pilot-scale testing rather than the common construction sand used previously. This sand is coarser and more uniform with particle sizes between 10 and 20 mesh sizes (2 to 0.84 millimeter [mm]). Density tests were conducted on the sand and Chitorem materials by measuring the weight of a known volume of material in various size beakers.

Five columns were set up, consisting of 3-inch stainless steel columns, bottom fittings, and stainless steel needle valves. Prior to addition of substrates, the time necessary to drain 1 liter from each column was tested in order to provide a control and determine if any of the valves drained at variable rates when opened to the maximum position. Five 1-liter volume mixtures were created within the percentage ranges shown in Table 2.1-2. After mixing, the materials were added to the columns. Approximately 1-inch of drainage pea gravel was added to the bottom of each column prior to the Chitorem, sand, and pea gravel mixture. The columns bottoms were equipped with a needle valve to control flow. MIW from another mine site with similar characteristics to the Danny T was added to each column along with the substrate mixtures. The surrogate MIW has similar pH and metals content to the Danny T. MIW and substrate were added at the same time, and the mixture was stirred to ensure complete wetting of the substrate. MIW was filled to approximately 2 inches above the substrate level and allowed to equilibrate for adequate time to allow voids to saturate. Additional MIW was added as necessary once the voids saturated, and then approximately 300 ml MIW volume was drained and recycled back into the top of the column. This recycle process was repeated four times for each column. After recycling, the tops of the columns were covered with parafilm to hold moisture and limit oxygen influx during incubation.

Table 2.1-2. Hydraulic Drain Bench Test Substrate Mixtures

Item	Material	#1	#2	#3	#4	#5
Percent	Chitorem	12.0%	16.0%	20.0%	24.0%	28.0%
	Sand	9.0%	12.0%	15.0%	18.0%	21.0%
	Pea Gravel	79.0%	72.0%	65.0%	58.0%	51.0%
	Sum	100.0%	100.0%	100.0%	100.0%	100.0%
Volume (ml)	Chitorem	120	160	200	240	280
	Sand	90	120	150	180	210
	Pea Gravel	790	720	650	580	510
	Sum	1000	1000	1000	1000	1000

After incubation for approximately 1 week, each valve was opened, and the time required to gravity drain 300 ml from the columns was measured. After draining, 150 ml of the collected water was recycled back to the top of the column along with 100 ml of fresh MIW. A second drainage test was conducted for 100 ml drained, and then 50 ml of the drained MIW was recycled back to the top of the columns. Columns were covered with parafilm until the next testing day.

Tests were continued every 3 to 4 days over a period of 3 weeks as shown in Table 2.1-3. Variable tests were conducted for 100 and 200 ml drainage volumes, and variable amounts of fresh MIW were added to top of the columns after each test as shown. Some amount of drained water was also recycled at times, and additional water was drained at times to maintain the approximate 2-inch free water surface above the substrate.

Table 2.1-3. Hydraulic Drain Bench Test Operations

Date	Test No.	Test Description	Volume Fresh MIW added (ml)	Recycle Volume (ml)	Extra Volume Drained (ml)
4/30/2014	NA	Column setup, saturation, recycling, etc.	700	300 ml X 4	0
5/6/2014	1	Time to drain 300 ml	100	150	0
5/6/2014	2	Time to drain 100 ml	100	50	0
5/9/2014	3	Time to drain 200 ml	200	50	0
5/13/2014	4	Time to drain 200 ml	300	0	0
5/16/2014	5	Time to drain 200 ml	300	0	25
5/16/2014	6	Time to drain 200 ml	0	0	0
5/20/2014	7	Time to drain 200 ml	300	0	25
5/20/2014	8	Time to drain 100 ml	50	0	0
5/23/2014	9	Time to drain 200 ml	300	0	25
5/23/2014	10	Time to drain 100 ml	0	0	0
5/27/2014	11	Time to drain 200 ml	300	0	0
5/27/2014	12	Time to drain 100 ml	0	0	0

Drainage test data are presented in Section 4.1. Based on the optimum free-drainage observed, a Chitorem, sand, and gravel mixture was selected for the year 2 pilot-study. The goals of the bench tests were to maintain free flowing hydraulic conditions and minimize the volume of Chitorem due to high material cost but not decrease the percentage below the threshold tested in the year 1 revised mixture (approximately 16% by volume).

2.2 Danny T Year 2 Pilot-Scale Treatability Study

The year 2 pilot-scale treatability study was conducted from June through September 2014. Updates to the treatment system were completed in early-June 2014 and system startup completed in mid-June. The treatment system operated through the end of September 2014. Details of the pilot-scale construction and operations, including collection and routing of MIW, pilot-scale treatment description and process flow design, system startup and shutdown, and sampling and maintenance activities for the year 1 study were presented in the year 1 technical memorandum (CDM Smith 2014c/Appendix A). This section only presents changes in construction, operations, and sampling activities for the year 2 study.

2.2.1 Collection and Routing of MIW

At the conclusion of the year 1 study, the MIW collection pipes and feed tank were disconnected and drained to prevent freezing. All pipes and tank were re-connected as originally installed and operated in 2013. No changes to the piping or collection system were made, except for minor improvements to the MIW collection dam structure to repair erosion damage from the winter. Accumulated sludge in the collection pond was shoveled out and disposed on the side of the pond, and debris was scraped out of the overflow pipes with brushes. Refer to Appendix A Year 1 technical memorandum for additional details on MIW collection and routing to the pilot system.

2.2.2 Pilot-Scale Treatment Description and Process Flow Design

This section provides updates to the process flow details of the pilot-scale treatment system. An updated process flow diagram is shown as Figure 2.2-1. The basic process flow consists of a MIW collection pond, feed tank with overflow, a MIW influent timer valve, 8 liter (L) head tanks, head tank outlet timer valves, 35-gallon or 55-gallon pre-treatment barrels, pre-treatment effluent timer valves where applicable, pre-treatment effluent lines and sample ports, 55-gallon BCR barrels, BCR effluent lines and sample ports, and the post-treatment system that mixes all four BCR effluents into one.

Based on the 2013 study conclusions that most of the BCRs were overloaded with acidity, the overall average flow rates were reduced for the year 2 study. Flow rate can be calculated based on the BCR substrate volume and assumed hydraulic retention time and porosity using Darcy's Law, as follows:

$$Q_d = V_s/t_{BCR}*\eta_s \qquad \textit{Equation 1}$$

Where,

Q_d = BCR design flow rate, gpm
V_s = BCR volume, gallons
t_{BCR} = BCR substrate hydraulic retention time, hours
η_s = BCR substrate effective porosity, %

For the year 1 study design, a targeted BCR hydraulic retention time of 24 hours, a substrate volume of 35 gallons, and a substrate porosity of 0.40 were used to calculate the target flow rate of 0.01 gpm or 37 milliliters per minute (ml/min). Because overloading was evident in the year 1 data, this flow rate was decreased in year 2 in order to increase the hydraulic retention time or contact time that the influent MIW has with the substrate media.

To aid in determining the required retention time, a common sizing approach is recommended based on the approach originally presented in Wildeman et al. (1993), the recently published ITRC guidance *Biochemical Reactors for Treating Mining-Influenced Water* (ITRC 2013), Gusek and Figueroa (2009), and several other references (not listed herein). Overall, the approach suggests calculating the BCR substrate volume needed for treatment based on the metal loading of the MIW influent. The stoichiometric molar metal load (expressed in units of millimoles metal/day) is balanced with the rate at which sulfate is reduced, according to the following reactions:

$SO_4^{-2} + 2\ CH_2O \rightarrow HS^- + 2\ HCO_3^- + H^+$ *Reaction 1*

$HS^- + Me^{2+} \rightarrow MeS + H^+$ *Reaction 2*

As shown in reaction 1, reduced sulfide is generated by the sulfate reduction process. Metal sulfides are then precipitated by reaction 2. Since reduced sulfide forms are a reactant in reaction 2, the rate at which metals sulfides form will be limited by the rate of sulfate reduction by the SRB. Therefore, the molar rate of sulfate reduction should be equal to or greater than the molar metal feed rate. The metals utilized in the calculation include all major divalent metals (except for Mn). Mn is not removed in a BCR as a stable sulfide precipitate. An important limitation to this sizing approach is that it assumes all metal removal in a BCR occurs through metal sulfide precipitation. Since divalent metals can be removed by precipitation as carbonates, oxy-hydroxide co-precipitation with Al and Fe, or through sorption to organic surfaces, this calculation approach provides a conservative estimate of BCR design size and may ensure better long term treatment effectiveness.

Calculations using the molar metal method were provided in the SAP addendum #2 (CDM Smith 2014a). Influent MIW metals concentrations from the year 1 study were converted to a molar quantity using the molecular weight and multiplied by the flow rate to obtain a molar loading rate in millimoles metal per day (mmol Me/day). The volume of substrate needed to balance the metal load can be calculated by dividing the metal load by the sulfate reduction rate in units of millimoles sulfate per cubic meter per day (mmol SO_4/m^3-day). Published literature sulfate reduction rates can be used for the calculation or from field data collected from treatability studies. Widely accepted literature sulfate reduction rates range from 300 mmol SO_4/m^3-day for a woody-based substrate mixture (Gusek 1998) to 800 mmol SO_4/m^3-day (Willow and Cohen 1998). Values in this range have been used for design of several pilot and full-scale passive treatment systems. Actual rates may be higher or lower depending on the substrate mixture and testing data for each site.

The greatest molar metal load from the year 1 study was utilized for the calculation (July 11, 2013 sample). Since the planned BCR substrate volume for the year 2 study is 40 gallons, the flow rate was then calculated based on the July 11, 2013 metal load and an assumed 300 mmol SO_4/m^3-day sulfate reduction rate. Based on the calculation, the recommended flow rate for the year 2 study was 7.3 ml/min (0.002 gpm). This flow rate is approximately one-fifth of the year 1 flow rate. Assuming that the influent MIW will be dosed into the treatment system in batches every 2 hours, a batch volume of 0.91 L is required to maintain this flow rate. For practicality, the batch volume was rounded to 1 L every 2 hours. Therefore, the actual field flow rate was approximately 8.3 ml/min. Although porosities can vary, assuming 40% porosity, the BCR retention time for this flow rate is approximately 121 hours.

For the SAPS pre-treatment, the targeted retention time will be approximately the same as the BCRs since the reactive substrate volume was also 40 gallons. For the Chitorem pre-treatment, which contained 20 gallons of substrate, the retention time is one-half of the BCR retention time (60.5 hours).

As the study progressed, batch volume modifications were made. These modifications and other activities and system changes are described in Section 2.2.4.2 Operations and Maintenance.

2.2.2.1 Scaffold and Platform Construction

No changes to the scaffold and platform construction were made for the year 2 study. For winterization at the end of the year 1 study, the roof was disassembled and removed to prevent possible collapse due to snow load. The roof was reassembled, and existing tie downs were adjusted for wind protection for the year 2 study.

2.2.2.2 Head Tanks

Due to the slower flow rate and smaller batch volume, the 5-gallon (approximately 19 L) bucket head tanks from the year 1 study were replaced with smaller 8 L tanks. The new head tanks were constructed from 6-inch diameter schedule 40 polyvinyl chloride (PVC) pipe. Each head tank

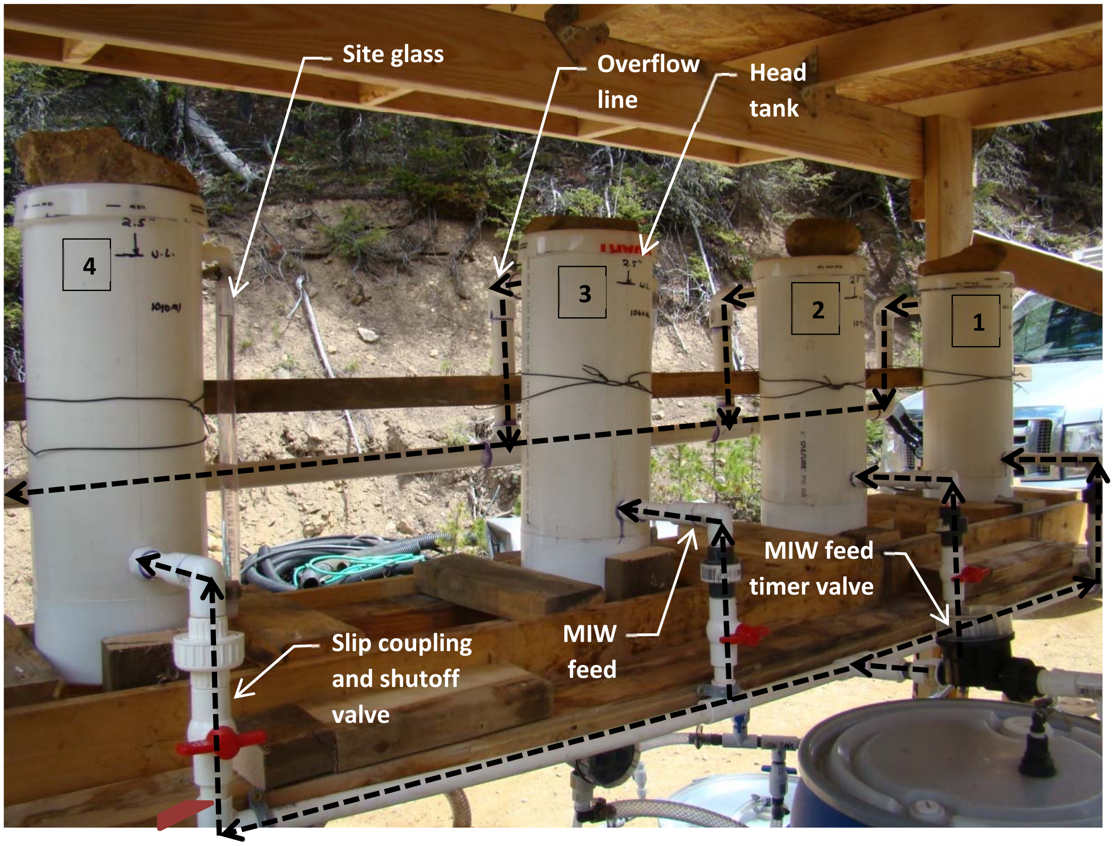

Exhibit 2-1. Head tanks and appurtenances

consisted of an 18-inch long section of pipe with a 6-inch PVC cap glued on the bottom end. A hole was drilled in the bottom cap, and a ½-inch PVC bulkhead fitting was inserted for effluent pipe connection. Appropriate sized holes were drilled and tapped in the tank walls to accept threaded PVC pipe adaptors for the influent piping and overflow piping and the nylon fittings for sight glasses.

Existing influent and effluent plumbing was reused, with minor fitting or piping modifications as needed to connect to the new head tanks. The high density polyethylene (HDPE) overflow tubing used in the year 1 study was replaced with 1-inch PVC pipe and fittings. All four head tank overflows were connected together and routed to a common section of HDPE tubing. The HDPE tubing was routed into the larger 4-inch diameter HDPE corrugated diversion line that routed overflow water away from the treatment system. A sight glass, made from 3/8-inch clear flexible tubing and two 90-degree plastic elbows (3/8-inch barb by 3/8-inch male thread) was attached to the side of each head tank, allowing a visual check of head tank water levels.

The top of the PVC riser pipe inside the head tank functions as the tank outlet. To provide the target 1 L batch volume, a male thread adaptor was glued to the end of a short section of ½-inch PVC pipe. The riser was then cut to approximately 13-inches long and threaded into the bulkhead fittings in the tank bottom. Using a graduated cylinder to measure each head tank batch volume, the riser lengths were adjusted so each head tank contained 1 L (plus or minus 10%) of water between the overflow elevation and the top of the riser pipe. This approach allowed for increases to the system flow by decreasing the riser pipe height if needed.

The MIW feed timer was set to open 5 minutes before the scheduled dose and remain open for 1 minute to fill all the head tanks simultaneously. The head tank outlet timer valves were programmed to open on the hour of the scheduled dose, 4 minutes after the feed inlet timer valve closed, to discharge the 1 L batch of MIW into each pre-treatment or BCR barrel. The head tank outlet timer valves were set to remain open for 1 minute. The cycle was repeated every 2 hours to provide an average flow rate of 8.3 ml/min. Exhibit 2-1 shows the installed head tanks and associated piping, valves, and fittings.

After completion of the reconstruction shown in Exhibit 2-1, the influent pipelines to each head tank were realigned at system startup (after the incubation period) to enter the head tanks at an elevation above the overflow elevation. This modification was made in order to prevent any backflow through influent lines.

2.2.2.3 Pre-treatment Barrels

Pre-treatment components and system implementation are described in the following sections. Pre-treatment was provided for three of the four treatment trains. As shown on Figure 2.2-1, alkaline addition pre-treatment was installed downstream of head tank 4 (flow line 4), Chitorem pre-treatment was installed downstream of head tank 3 (flow line 3), and SAPS pre-treatment was installed downstream of head tank 2 (flow line 2). Flow from head tank 1 (flow line 1) was fed directly into BCR1 without pre-treatment. The head tank locations and numbers are shown in Exhibit 2-1. The pre-treatment test design generally mirrored the year 1 study, except for the reduced flow rates and the following general changes:

- SAPS substrate was slightly modified, increased in volume, and placed in a larger 55-gallon barrel for flow line 2.

- Chitorem substrate was modified and increased slightly in volume for flow line 3.
- Magnesium hydroxide was replaced with sodium hydroxide (NaOH) for flow line 4.

Treatment train 1 with no pre-treatment provides a control to compare to each of the pre-treatment trains; however, the BCR substrate composition for BCR1 was slightly modified to include Chitorem compared to other BCRs. Since it was determined that pre-treatment was needed to neutralize acidity in the raw MIW from the year 1 study, addition of Chitorem to the BCR substrate was tested to determine if the material provided enough buffering to acidity without pre-treatment.

Alkaline Addition Pre-Treatment

Alkaline addition was conducted using a NaOH solution. The complete pre-treatment system required the use of a solar charger and battery-powered dosing pump, timer switch, a NaOH stock tank, and associated piping and tubing. The process operated in the same manner as in the year 1 study except for the replacement of the base, and since NaOH remains in solution, the mixer associated with the stock tank to suspend the magnesium hydroxide slurry was not necessary for year 2. Overall, the system operated sequentially with a batch of NaOH solution fed into the 55-gallon pre-treatment barrel, followed by a batch flow of influent MIW at timed intervals, a set reaction time inside the reactor (static flow condition), and an effluent timer valve that drained the treated water into a subsequent BCR barrel.

A 25% concentration by weight NaOH solution was purchased in liquid form. Titration testing conducted during startup determined that an alkaline addition rate of 25 ml of 1% NaOH solution was needed per 1 L of raw MIW to raise the pH to approximately 5.0 su. The feed concentration and total volume in the NaOH dose were determined so that the volume pumped would be within the operating limits of the metering pump and timer. Based on the titration, a 9 L batch of 1% NaOH solution was made at startup by adding 360 ml of the 25% solution to 8,640 ml of distilled water and placed in the 10-liter stock tank. The stock tank was a factory made carboy equipped with a screw lid and a bottom outlet to which a valve was attached. Partial batches were made each week as necessary to ensure the stock tank did not completely empty between field visits. The suction end of the peristaltic tubing was connected to the stock tank outlet valve and routed through the metering pump head. The Masterflex C/L® variable speed peristaltic pump was initially set at a flow rate of 25 ml/min for a duration of 1 minute. The pump would operate for 1 minute every 2 hours at 5 minutes before the hour. The metering pump fed the NaOH solution through 2.79 millimeter (inside diameter) PharMed® tubing to the 55-gallon pre-treatment barrel. Four minutes after the metering pump shut off, raw MIW discharged from the head tank would enter the pre-treatment tank to mix with the NaOH solution. Changes to the NaOH dosing operation were implemented later and are summarized in Section 2.2.4.2.

Chitorem Pre-Treatment

A Chitorem pre-treatment system was installed in the same 30-gallon barrel as year 1. Previous substrate was removed, and a new batch of substrate was mixed and added to the barrel. Modification to the substrate mixture for year 2 included a decreased percentage of both sand and Chitorem and an increased percentage of pea gravel, as shown in Table 2.2-1 below. The Chitorem media was mixed with standard construction sand and pea gravel at a ratio of approximately 12% sand, 72% pea gravel, and 16% Chitorem by volume. The construction sand and pea gravel were purchased from a local hardware store. In addition, approximately 3.75 gallons of inert gravel was placed in the bottom of the barrel as the drainage layer.

The large decrease in the Chitorem percent from 40 to only 16% compared to the year 1 study was based on both hydraulic bench-scale testing performed at the CDM Smith Denver Treatability Laboratory and successful Chitorem treatment results for a similar pilot treatment system and MIW type operated in 2013 at the Blue Ledge Mine Superfund Site in Northern California. Based on the other pilot study, this lower percentage was determined to be sufficient for the desired treatment effectiveness (Anton, Personal Communication). Hydraulic bench-scale testing results with the 16% Chitorem and higher pea gravel percentage suggested this mixture would provide adequate hydraulic conductivity to maintain flow-through operation. Hydraulic testing using the year 1 mixture proved to have limited hydraulic conductivity after several weeks of testing.

Standard dimensions for a plastic 30-gallon barrel used in the study are 18.6-inch inner diameter (ID) by 29.5 inches tall, with a total volume capacity of 32 gallons. Twenty gallons of the reactive substrate mixture were added to the barrel along with the 3.75 gallons of inert gravel on the bottom of the barrel with effluent collection piping embedded in the gravel. The overall substrate volume equated to approximately 20 inches of substrate in the barrel (measured as 9.5 inches from the top). The operational water level was set approximately 3 inches above the top of the substrate elevation. Previously used plumbing was reassembled, and no other changes to the Chitorem pre-treatment barrel were made for the year 2 operation.

SAPS Pre-Treatment

The SAPS pre-treatment system was the same as in year 1, except the SAPS substrate mixture was slightly modified and increased in size to fit in a 55-gallon barrel. A total of 40 gallons of reactive substrate was installed along with 7.5 gallons of inert pea gravel on the bottom of the barrel. The SAPS substrate consisted of 0.75- to 1.5-inch size limestone gravel, overlain by a manure, compost, and pea gravel layer. By volume percent, the manure/compost/pea gravel layer consists of approximately 33% of the volume (13.0 gallons), and the limestone consists of approximately 67.5% of the volume (27.0 gallons). The compost and manure mixture was split evenly based on volume (5.0 gallons for each material), and 3.0 gallons of inert pea gravel was added to the mixture to increase hydraulic conductivity of the mixture. Percentages and volumes for the SAPS pre-treatment are presented in Table 2.2-1 below.

Standard dimensions for a plastic 55-gallon barrel used in the study are 22.7-inch ID by 35.3 inches tall, with a total volume capacity of 57 gallons. The overall 47.5 gallons of substrate mixture equated to approximately 26.8 inches from the bottom of the barrel. The operational water level was set approximately 3 inches above the top of the substrate elevation. A bulkhead fitting was installed through the barrel lid, and an influent distribution piping gallery was installed. The piping gallery was suspended approximately 2-3 inches above the operational water level. A bulkhead fitting was also installed on the bottom of the barrel with effluent collection piping. Installation details for influent and effluent components were described for other barrels in the year 1 technical memorandum (Appendix A). Other previously used plumbing was reassembled, and no other changes to the SAPS pre-treatment were made for the year 2 operation.

2.2.2.4 BCR Barrels

The BCR substrate percentages and the SAPS and Chitorem pre-treatment substrate percentages are provided in Table 2.2-1. The same substrate materials were utilized as for year 1 with slight changes in the percent mixtures. The primary change for year 2 was to double the limestone percentage to 30% due to the acidic nature of the Danny T adit MIW. With the increase in limestone, percentages of

Table 2.2-1. BCR and Pre-Treatment Barrel Substrate Percentages and Volumes for Year 2 Study

Substrate	BCR1		BCRs 2 through 4		Chitorem Pre-Treatment		SAPS Pre-Treatment	
	Substrate Mix (v/v %)	Volume (gallon)	Substrate Mix (v/v %)	Volume (gallon)	Substrate Mix (v/v %)	Volume (gallon)	Substrate Mix (v/v %)	Volume (gallon)
Sawdust	12.5%	5.0	12.5%	5.0				
Wood chips	25.0%	10.0	25.0%	10.0				
Compost	12.5%	5.0	12.5%	5.0			12.5%	5.0
Fresh dairy manure	15.0%	6.0	20.0%	8.0			12.5%	5.0
¾ to 1 ½-inch limestone	30.0%	12.0	30.0%	12.0			67.5%	27.0
Chitorem	5.0%	2.0			16.0%	3.2		
Construction sand					12.0%	2.4		
Inert pea gravel					72.0%	14.4	7.5%	3.0
Subtotal	**100.0%**	**40.0**	**100.0%**	**40.0**	**100.0%**	**20.0**	**100.0%**	**40.0**
Drainage pea gravel	--	7.5	--	7.5	--	3.75	--	7.5
Total Substrate		**47.5**		**47.5**		**23.8**		**47.5**

v/v = volume fraction per volume total

sawdust, wood chips, and compost were decreased. The manure percentage was also increased from 12.6 to 20% for the year 2 study to provide more inoculum and readily soluble organics. For BCR1 that did not receive pre-treatment, Chitorem was added to the BCR barrel at a rate of 5% by volume. To displace the added volume, the manure quantity was decreased to 15%.

A photograph of the BCR barrels and effluent piping is shown in Exhibit 2-2. Existing discharge bulkheads, piping, valves, and other fittings were utilized from the year 1 study. The inlet to each BCR was modified for year 2 to flow through the barrel lid rather than through the side of the barrel. A bulkhead fitting was installed in the barrel lid and an influent piping distribution gallery was installed using the same design as the pre-treatment SAPS and Chitorem barrels.

The effluent piping array was modified after each sampling port to combine all four BCR effluents into one ½-inch PVC pipe to feed the post-treatment system. After combining, the PVC was converted to 1-inch HPDE pipe, and a sampling port was installed to collect a combined effluent sample. Approximately 15 feet of piping was installed to provide inline mixing prior to the sampling port.

Similar to the pre-treatment barrels, the top elevation of the vertical riser pipe determined the operational water surface. For each BCR, the height of substrate in the barrel was slightly different due to heterogeneity and compaction that can occur. The operational water surfaces for each BCR were set at 3 inches above the top of the substrate layer. Due to slightly different substrate heights, operational water surfaces for each barrel were set at slightly different elevations. Water surfaces were set at 28.3, 29.3, 30.3, and 31.3 inches for BCR1, BCR2, BCR3, and BCR4, respectively. Distribution galleries, connected to the barrel lids, extended down between 2 to 3 inches below the top of the barrel.

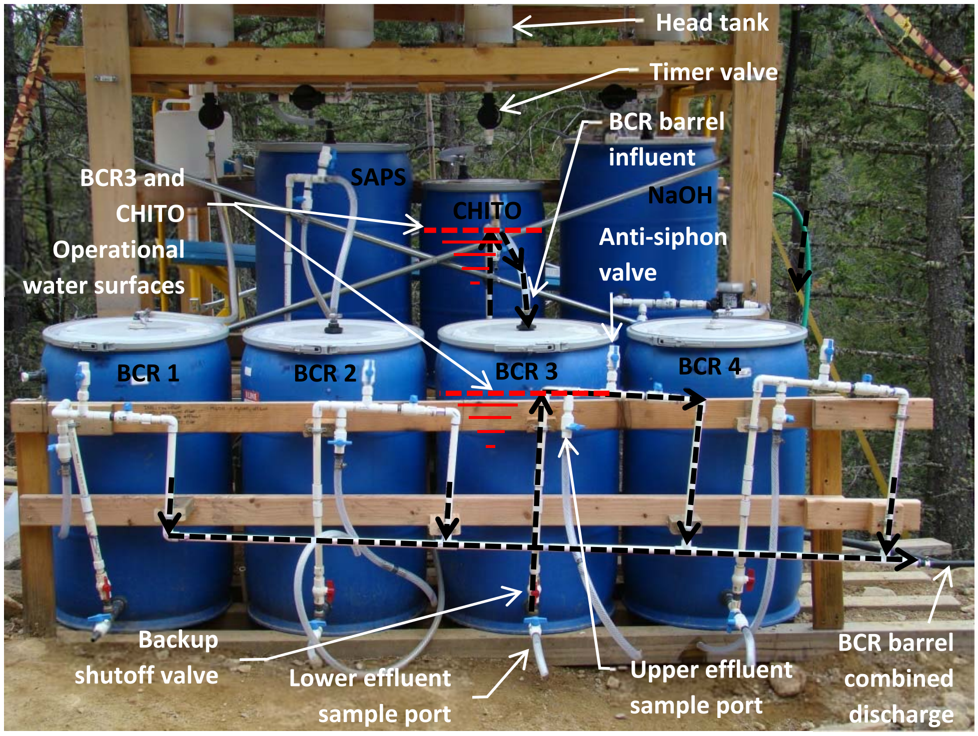

Exhibit 2-2. BCR barrels and effluent assemblies

2.2.2.5 Solar Power System

Similar to the year 1 study, 12-volt battery power was used to operate the peristaltic pump and pump timer. The solar charging panels, batteries, and controller were reinstalled in the same configuration used in year 1. The only change was to disconnect the 12-volt to 120-volt inverter since no mixer was required for the alkaline addition system in year 2. The inverter was disconnected from the system but left mounted in the control box.

2.2.2.6 Post-Treatment

A post-treatment system for all four combined BCR effluents was implemented to evaluate if aeration, an aerobic wetland, and gravel filtration could reduce concentrations of BOD, ammonia, sulfide, nitrate/nitrite, and phosphate. The four BCR effluents were combined in order to provide sufficient water flow to simulate aeration activity of a larger stream and simplify the study by not having to install infrastructure for each effluent line. Based on other studies, the low flow for each BCR would result in stagnant and non-aerating conditions. The four BCR effluents were combined into a 1-inch HDPE pipe and a sampling port installed to represent the combined influent to the post-treatment system. An annotated photograph of the post-treatment system is provided in Exhibit 2-3 below.

The combined effluent after the sampling port discharged into a 3-inch corrugated HDPE pipe and through the cascade aeration system. All 3-inch corrugated HDPE pipe was modified to increase aeration by drilling 2-inch diameter holes through the top of the pipe runs with a hole saw bit every 6 inches. The cascade system consists of two 18-inch by 25-inch (bottom dimension) plastic bins situated approximately 30 feet apart. The bins were situated on leveled ground with the influent 3-inch HDPE pipe strapped to the top of the influent side of the bin and the effluent installed through the opposite side wall. The effluent was set to provide an elevation within the bin of approximately 4 inches and installed by drilling a hole through the side of the bin and installing a 1-inch threaded male adapter with conversion fitting back to 1-inch solid HDPE pipe. The 1-inch HPDE pipe then discharged back into an open 3-inch corrugated HDPE pipe.

After the aeration bins and approximately 100 feet of 3-inch HDPE corrugated pipe, the aerobic wetland system was installed. The aerobic wetland consisted of a 22-inch by 42-inch plastic bin lined with 7 inches of pea gravel bedding and planted with transplanted wetland plants. The wetland plants were collected using 5-gallon buckets and shovels from a wetland area located on USFS land below the Town of Barker. The wetland plant borrow area was the same general location where test pits were excavated in 2014 to evaluate the potential for a passive treatment installation in this area. Whole clods of wetland plants were fitted into the bin to completely fill the surface area.

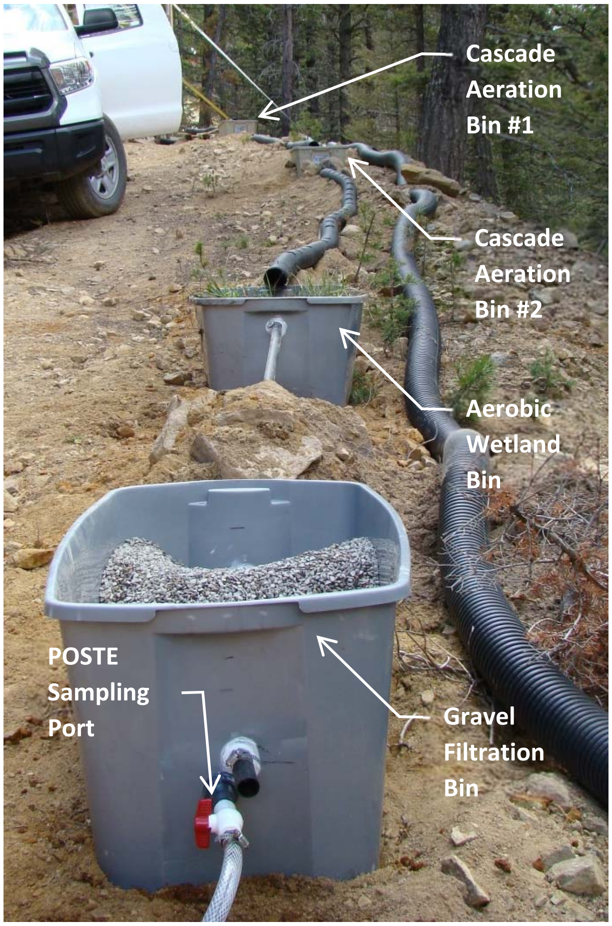

Exhibit 2-3. Post-treatment system

The influent and effluent for the aerobic wetland bin was installed using the same construction approach as the cascade bins. The effluent was installed in the aerobic wetland bin at approximately 2 inches from the top of the bin to saturate the plants but allowed emergent vegetation to acclimate and grow. One-inch HDPE effluent piping from the aerobic wetland bin was routed to the final gravel filtration bin. The gravel filtration bin consisted of the same size bin as the aerobic wetland and contained a berm of pea gravel placed across the inlet side of the bin. Larger rocks were placed in the bin to stabilize the sloped pea gravel. The effluent from the final bin was placed at approximately half the distance of the bin to provide a water depth of approximately 10 inches. Just below the effluent pipe elevation, a sampling port (POSTE location) was installed that consisted of a bulkhead fitting installed through the plastic bin side wall, connected to a manual shutoff valve and sample tubing. Samples were collected by opening the valve slowly to fill bottles.

2.2.3 System Startup and Shutdown

Consistently wet manure was utilized for the year 2 study, compared to some dry and some wet in year 1. Therefore, no further incubation of the manure was necessary. Pre-treatment and BCR substrate materials were mixed in batches using hand tools on a plastic tarp. Similar textured materials, such as a manure and compost, were mixed first, followed by mixing in sawdust, then wood chips, and lastly limestone. A rake and shovel were used to mix the materials. The tarp was also used to tumble the materials together with two people positioned on either side of the tarp. Each BCR mixture or pre-treatment mixture was completed in batches, and the materials were loaded into the barrels. A photograph of a BCR substrate batch is shown in Exhibit 2-4.

The sequence of loading the barrels consisted of the SAPS and Chitorem pre-treatments first, followed by the BCRs. When loading the material into the pre-treatment SAPS, Chitorem, and BCR barrel 1 (no pre-treatment), influent MIW was added as the material was placed in the barrels to aid in saturating the substrate. The substrate was mixed using a stick of PVC pipe during filling of MIW and substrate material. The substrate was added to BCR barrels 2 through 4 without saturating since these barrels were to receive pre-treated water only. MIW was added manually to near the top of the pre-treatment SAPS and Chitorem barrels until the material was saturated and had sufficient standing water to commence the recycle process.

The pre-treatment barrel effluent valves were opened to allow the MIW to drain through the barrels for the recycle process. Effluent water was recycled back through the pre-treatment barrels for approximately 1 pore volume by collecting the water in 5 gallon buckets and manually pouring back into the top of the barrel. Standing water was always maintained in the barrel during the recycle process. Utilizing an estimated 40% substrate porosity, 1 pore volume for the 20 gallon Chitorem substrate is 8 gallons, and 1 pore volume for the 40 gallon SAPS barrel is 16 gallons. At approximately half way through the recycle process for the pre-treatment barrels, some of the pre-treatment effluent water was diverted into the subsequent BCR barrels (BCR2 and BCR3). Once the recycle volume was completed, the pre-treatment effluents were allowed to drain to their designed operating level into the BCRs. More MIW was added to the pre-treatment barrels until the BCRs were saturated and filled to their operating level, plus additional volume to provide for recycle. The same recycling process was then completed for BCRs 2 and 3 for volume of approximately 16 gallons (1 substrate pore volume). Recycle for BCR1 was conducted using the same process except raw MIW was added directly to the BCR barrel.

Exhibit 2-4. BCR2 substrate mixture

As in year 1 for the alkaline addition pre-treatment, MIW was added to the pre-treatment barrel up to the operational water level at the effluent, followed by an additional volume adequate to fill BCR barrel 4. The additional volume was estimated based on the approximate porosity of the BCR substrate, plus additional water above the substrate surface. Based on the volume of water added to the barrel above the effluent level, the MIW was batch treated with the volume of NaOH solution scaled up from titration testing. The barrel was mixed with a piece of PVC pipe and tested with a pH meter to allow time for reaction and ensure the target pH range was reached. The final pH of the pre-treatment batch was confirmed to be 5.0 su, then the effluent valve was opened to drain the water into BCR 4 after a period of settling. Additional batches of pre-treated MIW were made as necessary to fill the BCR and provide sufficient volume for recycle. Sixteen gallons of treated water was then recycled through BCR4.

Various plumbing components were disassembled after the conclusion of the year 1 study. Decommissioning of year 1 substrates from the barrels and reconstruction of the year 2 system was conducted from June 3 through June 6, 2014. Recycling water through all year 2 barrels was completed by June 5 to begin the incubation period. On June 9, miscellaneous plumbing work was completed, all timer valves were programmed and tested, batch NaOH solution was made, and the NaOH dosing system was programmed and calibrated. Flow through the treatment system began at around 1300 on June 9, 2014, and field samples were collected shortly thereafter from the influent, pre-treatment, and BCR barrels. Laboratory samples were then collected on June 9 from the influent, pre-treatment, and BCR barrels. Sampling of the post-treatment system began the following week. Further details on sampling are provided in Section 2.2.4 below. The system operation continued until September 29, 2014 for a total of 16 weeks.

2.2.4 Sampling and Maintenance Activities

This section discusses the field sampling schedule, procedures, sampling locations, and system maintenance activities during operation.

2.2.4.1 Sampling Activities

Water samples were collected from the influent MIW sampling port (INF), Chitorem (CHIT) and SAPS (SAPS) pre-treatment barrel lower effluent sampling ports, the alkaline addition effluent port (NAOH), the four BCR barrel lower effluent sampling ports (BCR1, BCR2, BCR3, BCR4), the combined post-treatment influent (POSTI), and the post-treatment effluent (POSTE). Sampling for the influent, pre-treatments, and BCRs began on June 11 and continued bi-weekly throughout the testing period, except for the last 3 weeks of the study when laboratory sampling was conducted weekly in anticipation of winter conditions and system shutdown. Sampling of the post-treatment influent and effluent began on June 24 and continued bi-weekly in conjunction with other samples collected. Sample collection for field parameters was conducted on a weekly basis. A total of 10 laboratory sample events were conducted from June 11 through September 29. Since sampling of the post-treatment system commenced after 2 weeks of operation, this system was only sampled for laboratory parameters a total of nine times.

During each sample event, the system was inspected and maintenance conducted as necessary. Field parameters (pH, specific conductance, temperature, ORP, and DO) were collected using a multi-parameter Horiba U-5000 meter or YSI 556 meter. The Horiba meter was used for the first week of sampling work, and the YSI meter was used for the remainder of the study.

Laboratory analysis of pilot study water samples was conducted by Energy Laboratories in Helena, Montana and the EPA's Environmental Services Assistance Team (ESAT) laboratory in Denver, Colorado. Metals analysis for the last sample event was analyzed through EPA's Contract Laboratory

Program (CLP). Energy Laboratories provided analysis of acidity, sulfide, BOD, and orthophosphate. ESAT provided analysis of metals, alkalinity, ammonia, chloride, fluoride, nitrate/nitrite, and sulfate.

All 10 sample locations were analyzed for total and dissolved metals, acidity, alkalinity, chloride, fluoride, nitrate/nitrite, orthophosphate, and sulfate. Ammonia, BOD, and sulfide were also analyzed for the BCR effluents, post-treatment influent, and post-treatment effluent. Dissolved metals, alkalinity, chloride, fluoride, nitrate/nitrite, orthophosphate, sulfate, and ammonia were field filtered through a 0.45 micron in-line filter and dedicated tubing with a peristaltic pump. Some exceptions occurred to the sampling schedule and analyses as follows:

- June 11: POSTI and POSTE laboratory samples were not collected since the post-treatment system was not in full operation during the first sample event. The lack of post-treatment sampling was anticipated and in accordance with the SAP addendum #2.
- June 11: Sulfide bottles were not available for sampling; therefore, sulfide samples were not collected.
- June 24: Sulfide and BOD exceeded their holding times in storage; therefore, sulfide and BOD samples were not submitted for analysis.
- September 16: POSTI and POSTE samples were not collected and analyzed for dissolved metals, alkalinity, ammonia, chloride, fluoride, nitrate/nitrite, orthophosphate, and sulfate due to a lack of in-line filters available for these samples to be filtered for analysis. Total metals, acidity, BOD, and sulfide samples were still collected and analyzed for POSTI and POSTE locations, and all other sample locations/parameters were collected and filtered as planned for this sample event.
- September 29: Sample bottles for ESAT were mistakenly stored in CDM Smith's storage unit refrigerator and never submitted for analysis. After discovery of the error in January of 2015, metals bottles were submitted to a CLP laboratory for analysis since they were preserved and still within holding time. All of the wet chemistry analyses intended for ESAT exceeded holding times and were not submitted for analysis.

All samples were securely packaged and delivered to the laboratories for analysis, following the procedures outlined in the SAP addendum #2 (CDM Smith 2014a). The minimum sample volumes acceptable by the analytical laboratories for analysis were used to the extent possible because of the low treatment flow rates of the system.

2.2.4.2 Operations and Maintenance

Pilot system operation was routinely checked every week, field parameters measured every week, and laboratory samples were collected every other week. Routine operational checks included the following:

- The 12-volt timer clock was checked against a mobile telephone time or personal watch to make sure the system had been in continuous operation since the last sample event.
- The charge controller indicator lights were observed to check for low battery voltage.
- Timer valve operation was observed to make sure the timing sequence had not changed.

- Timer valves outlet tubing was disconnected to check for valve leakage.
- Timer valve indicator lights were observed to check for low timer battery voltage.
- The amount of NaOH solution in the stock tank was observed as a measure of whether the dosing system had functioned properly.
- The NaOH metering pump tubing was either advanced in the pump head or replaced with new tubing, and the pump output was reset.

Operational problems occurred during pilot operation that required non-routine procedures. These procedures included any action necessary to remedy the malfunctions. Non-routine procedures and general observations included the following:

June 11

- Metering pump peristaltic tubing had pulled out of the alkaline addition pre-treatment tank. As a result, alkaline addition pre-treatment tank pH was low at 3.21 su. The tank was bulk dosed with 400 ml of 1% NaOH solution. After the bulk dose, the pH was measured at 5.06 su.

June 17

- Replaced NaOH metering pump tubing and set metering pump output to 24.5 ml/min.
- Alkaline addition pH of 4.07 su was measured at the effluent sampling port approximately 45 minutes after NaOH dose. All future routine pH measurements were made at the pre-treatment tank drain.

June 24

- At 12:00, the post treatment feed piping was observed to have a low spot and effluent was leaking from the piping onto the ground. The tubing was straightened and supported to avoid leaking.
- The alkaline addition pre-treatment tank pH was 3.2 su, lower than the target of pH 5 su. At 13:45, the metering pump speed and output was increased to 30 ml/min from the previous rate of 24.5 ml/min.
- Not enough water was available at the post influent sample tap to collect the required sample volume. Equal volumes were collected from the four BCR effluent sample taps for a composite sample instead. This regimen became the standard procedure for all post-influent samples (POSTI).
- At 14:00, the head tank timer valve #3 was observed to have a small amount of flow when the timer valve was closed, indicating the timer ball valve was leaking. The timer valve was replaced with a new valve.
- Disassembled, cleaned, and lubricated the timer valve removed from head tank #3 on June 17.

July 2

- The alkaline addition pre-treatment tank pH was measured at 2.83 su. Metering pump output checked at 25 ml/min, down from the 30 ml/min set on June 24. Advanced tubing in metering pump without changing the pump setting and measured flow at 32 ml/min, indicating the peristaltic tubing had deteriorated.

- At 07:45, observed the head tank timers #2 and #4 leaking and timer #1 dripping. Replaced #4 timer with the rebuilt timer #3 removed the previous week. Replaced #2 timer with a new timer. At 08:00, programmed timers #2 and #4. Cleaned and lubricated timer #1 and re-installed it with no change to the programming.

July 8

- Measured alkaline addition pre-treatment tank pH at 3.21 su. Checked metering pump output at 28 ml/min, down slightly from the 32 ml/min set on July 2. Reset the metering pump output to 48 ml/min to increase pH in alkaline addition pre-treatment tank.

- At 11:45, installed new timer valve on #4 head tank, as it was leaking again. At 12:00, programed new timer. At 12:00, head tank #1 timer valve was replaced as it was stuck in the open position.

July 15

- Measured alkaline addition pre-treatment tank pH at 2.94 su. Suction tubing for the metering pump had become disconnected from the NaOH stock tank outlet fitting, which may explain low pH. Re-installed tubing to tank outlet valve and taped in place. Installed new peristaltic pump tubing and set metering pump output to 50 ml/min.

July 22

- Checked metering pump output at 42 ml/min, down from the 50 ml/min set on July 8.

July 29

- At 09:45, observed head tank timer valve #2 leaking, and head tank timer valve #4 not closing. Replaced both with new timers. Head tank timer valve #1 dripping slightly but not replaced.

- Measured alkaline addition pre-treatment tank pH at 2.80 su. Checked metering pump output at 45 ml/min down from 50 ml/min set on July 22. Advanced tubing and set pump output to 55.2 ml/min.

August 6

- Checked metering pump rate at 45 ml/min. Reversed peristaltic tubing and left pump output set to 44 ml/min since alkaline addition pre-treatment tank pH was measured at 5.23 su.

August 12

- Observed timer valves for head tanks #1, #2, and #4 leaking. Installed new timers for all three head tanks and reprogrammed them at 10:00.
- At 10:55, measured alkaline addition pre-treatment tank pH at 3.84 su.
- After measuring field parameters, MIW dose was increased to 1.5 L/dose (previously 1 L/dose) by shortening head tank riser pipes. Original riser lengths, new riser pipe lengths, and new dose volume are listed in Table 2.2-2 below:

Table 2.2-2. Riser Lengths and Measured Dose Volume on August 12

Head Tank Number	Original Riser (inch)	New Riser (inch)	Dose Volume (milliliter)
1	13 1/8	12 3/64	1490
2	13 1/8	12 3/64	1560
3	13 1/4	12 3/64	1640
4	13 1/8	12 1/2	1650

- Set metering pump timer to 2 minutes per cycle, advanced tubing, and set pump output to 37.5 ml/min, for a total NaOH dose of 75 ml, or 50 ml per 1 L MIW.

August 19

- At 08:45, observed head tank #4 to be fully ahead of schedule. No immediate cause was determined. At 10:00, head tank #4 was observed to be empty, indicating a possible need to reprogram the timer. Reset timers #1 and #4.
- At 09:20, NaOH metering pump output checked at 31 ml/min, down from 37.5 ml/min set on August 12. Advanced tubing in pump and adjusted output to 39 ml/min.

August 26

- High spring-like flows were observed at the adit, and feed tank was overflowing.
- Observed head tank timer #4 leaking, and replaced the timer.
- At 12:45, alkaline addition pre-treatment tank pH was measured at 2.82 su. Metering pump suction tubing came loose from NaOH stock tank, draining stock tank. Re-attached tubing and clamped in place.
- At 14:00, batteries in head tank timer valves #1, #2, #3, and #4 and feed timer were replaced, and the timers were re-programed.
- At 16:30, the MIW dose was increased to 2.0 L/dose (previously 1.5 L/dose) by shortening head tank riser pipes. Original riser lengths, existing riser lengths, new riser lengths, and new dose volume are listed in Table 2.2-3 below:

Table 2.2-3. Riser Lengths and Measured Dose Volume on August 26

Head Tank Number	Original Riser (inch)	Existing Riser (inch)	New Riser (inch)	Dose Volume (milliliter)
1	13 1/8	12 3/64	10 31/32	2080
2	13 1/8	12 3/64	10 31/32	2080
3	13 1/4	12 3/64	10 31/32	2220
4	13 1/8	12 1/2	11 27/64	2130

- After 16:30, the NaOH dose was set to 117 ml/dose by adjusting the metering pump output to 39 ml/min and increasing the dose time to 3 minutes per cycle. After 16:30, the alkaline addition tank was bulk dosed with 880 ml of 1% NaOH solution.

September 2

- At 09:15, the adit flow was observed to have returned to normal. The feed tank overflow was plugged, and MIW was running over the tank lip. Removed and cleaned the tank overflow piping.
- At 12:00, head tank timers #3 and #4 were leaking, so both timers were replaced.
- At 14:15, set dose back to 1 L/dose by installing longer head tank risers. Riser lengths and dose volumes for each head tank are shown in Table 2.2-4 below:

Table 2.2-4. Riser Lengths and Measured Dose Volume on September 2

Head Tank Number	Riser (inch)	Dose Volume (milliliter)
1	13 1/8	1070
2	13 1/8	1070
3	13 1/4	1160
4	13 25/32	980

- At 14:42, the metering pump output was set to 40 ml/min, and the metering pump timer was reset to 2 minutes per cycle.
- At 14:45, the head tank #2 timer was replaced.
- At 17:15, the NaOH dose was set to 56 ml/dose by adjusting metering pump output to 28 ml/min and leaving the timer set to 2 minutes per cycle.
- New batteries were installed in the alkaline addition effluent timer.

September 9

- At 12:10, start times on head tank timers were re-set.
- Checked metering pump output at 24 ml/min, down from 28 ml/min set on September 2. Advanced the tubing and reset pump output to 28 ml/min.

September 16

- At 10:30, the feed line sample tap was observed to have frozen and broken, and the MIW feed water was running out on the ground instead of into the head tanks. Repaired the damage by replacing the valve. Noted that the max/min thermometer recorded a minimum temperature of 40 degrees Fahrenheit, which possibly indicated the thermometer was not calibrated properly. Available weather data from the Stringer Creek weather station at an elevation of 6,550 feet (ft) indicate the temperatures began to go below freezing on the night of September 10 and continued to go below freezing until September 14. The coldest night was at 22 degrees Fahrenheit on September 12. Therefore, it is likely the influent pipeline froze at some point during this period and flow was disrupted to the treatment system after that point until maintenance was conducted on September 16.

- The alkaline addition tank pH was measured at 11.47 su due to lack of influent MIW while the NaOH metering pump continued to operate.

September 23

- At 15:00, checked metering pump output at 24 ml/min, advanced tubing, and reset pump output to 28 ml/min.

- Around 15:00, new batteries were installed in the head tank timers #1 and #4.

2.3 Tiger Mine Treatability Study and Investigation

The Tiger Mine bench-scale treatability study was conducted from early July through the end of August in CDM Smith's Denver, Colorado treatability laboratory. The bench-scale treatability study included titrations and comparative container tests utilizing various amendments and methods. MIW from the Firehose adit was collected from the site in early June 2014 and utilized in the bench-scale treatability study. Inspection of the lower shaft was completed in August 2014. Based on results of the inspection, application of the field in-situ demonstration study was not implemented.

2.3.1 MIW Collection

MIW was collected using 2.5-gallon cubitainers (total of 20 gallons collected) and shipped to the Denver laboratory for refrigerated storage until used in the study. Cubitainers were completely filled and air bubbles removed to the greatest extent possible to minimize oxidation. An MIW sample was collected for laboratory analysis using appropriate containers and preservatives and shipped to the Region 8 EPA ESAT laboratory in Denver, Colorado. Laboratory analyses included total and dissolved metals, sulfate, chloride, fluoride, alkalinity, and total dissolved solids (TDS). Field parameters, including pH, specific conductance, ORP, DO, and temperature, were also collected. This sample documented the initial water chemistry at the start of the testing.

2.3.2 Laboratory Bench-Scale Study

This section provides the study methods and sampling activity details for the Tiger Mine laboratory bench-scale study.

2.3.2.1 Alkaline Addition Titrations

Titration tests were conducted using a 25% by weight NaOH solution, Chitorem fines, and limestone fines. These materials represent substances that could potentially be injected (pumped) through a well, pipe, or tube. Chitorem is a food waste product from JRW Bioremediation derived from dried and crushed crab shells (entire body with meat removed). The material is crushed in a ball mill to a specified particle size. The Chitorem product used in this study is the same product utilized in the Danny T study. The Chitorem particle sizes are relatively fine, with the majority of the material (e.g., greater than 95%) passing a 10-mesh (2 millimeter) sieve. The material was further sieved in the laboratory to 100% less than 10 mesh for titrations. The limestone product to be used for the study was obtained from the Graymont mine in Townsend, Montana. The product is a screen reject material containing particles less than ¼-inch. The limestone material was further sieved to 100% less than a 10 mesh (2 millimeter) for titrations.

Alkaline amendments were added slowly by titration method into a continuously stirred open container to reach a pH of approximately 5.0 su. Titration tests were conducted using 1 L of MIW. The pH was recorded after each added dose of alkaline reagent. Sufficient time was allowed after each dose to allow the neutralization reaction to stabilize. After the endpoint pH was reached, the treated water was allowed to settle for 1 hour and then decanted into sample containers for analysis. Samples were collected for total and dissolved metals, total alkalinity, nitrate/nitrite, chloride, fluoride, and sulfate and submitted to an analytical laboratory (ESAT). For metals, only Al, As, Cd, Cu, Pb, Mn, and Zn were analyzed. Dissolved metals, alkalinity, and anions (nitrate/nitrite, chloride, fluoride, and sulfate) were filtered using a peristaltic pump, dedicated tubing, and an in-line 0.45 micron filter. A sample of the raw untreated water plus a duplicate were submitted to ESAT for the same parameters.

Based on the quantity of alkaline reagent added, calculations were performed to scale up the quantity for each batch test to receive alkaline addition to reach the endpoint pH of 5.0. The titrations provide an ideal dosage of alkaline reagent required due to simulated mixing; however, treatment within the underground mine or within a fractured bedrock groundwater system will not be well-mixed. Therefore, field application would require dosing of excess reagent to account for this inefficiency and uncertainty.

2.3.2.2 Batch Tests

Batch tests were conducted using 1-gallon cubitainers with spigots. A total of 2.5 L of MIW was added to each cubitainer. Approximately 1 L of inert pea gravel was also added to each cubitainer to provide a media for microbial growth to occur, which would simulate the presence of rock materials within an underground mine area. An array of organic and neutralization substrates were utilized for the batch study based on previous experience with other batch studies and literature research. The substrates utilized include the following:

- Ethanol (190 proof), store bought
- Methanol, 99.97%, VP M1 racing fuel with no fuel additives
- Molasses (food grade)
- Chitorem sieved to minus 2 mm
- Dairy manure extract inoculum

- Sodium hydroxide, 25% by weight
- Limestone fines sieved to minus 2 mm

Table 2.3-1 provides the array of substrate mixtures and doses, all of which include some combination of organic material, an alkaline material, and inoculum. A total of 18 tests were completed for the in-situ treatment bench-scale study, including a control test that had no substrates added except for the inert pea gravel.

Table 2.3-1 Tiger Bench-Scale Treatability Study Container Test Setup

Container Test Number	Organic Substrates				Alkaline Materials			Inoculum	
	Methanol	Ethanol	Molasses	Chitorem	25% NaOH	Limestone Fines	Chitorem	Manure Extract	Chitorem
1	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	25 ml				4.575 ml			25 ml	
3	50 ml				4.575 ml			25 ml	
4	100 ml				4.575 ml			25 ml	
5		25 ml			4.575 ml			25 ml	
6		50 ml			4.825 ml			25 ml	
7		100 ml			4.575 ml			25 ml	
8			25 ml		4.800 ml			25 ml	
9			50 ml		4.575 ml			25 ml	
10			100 ml		4.575 ml			25 ml	
11				15 g			†		†
12				22 g			†		†
13				34 g			†		†
14				7 g	4.575 ml		†		†
15				7 g		8.2 g	†		†
16			50 ml			14.7 g		25 ml	
17			50 ml	15 g			†	25 ml	†
18		25 ml		7 g	4.575 ml		†	25 ml	†

g = gram; †Chitorem as an alkaline material or inoculum is indicated because these properties are inherent to the material as part of the organic substrate dose; Chitorem was not dosed in addition to the organic substrate dose.

The first three organic substrates listed above (ethanol, methanol, and molasses) are liquid solutions, whereas the Chitorem was a slurried solid in a guar gel, as described below. The dairy manure extract was utilized as an inoculum of SRB to initiate the sulfate reduction process. More than one dose of each organic substrate was tested to evaluate the effectiveness of different doses and identify the minimum dose needed to provide effective treatment. In the case of Chitorem tests, the substrate material contains calcium carbonate in the shell material to provide neutralization and also provides its own SRB inoculum; therefore, some tests were conducted for this material as the sole treatment substrate, and some tests were conducted with another alkaline material and inoculum addition to augment the Chitorem. All tests contained an inoculum of either manure extract or Chitorem.

All alkaline materials, guar, and Chitorem~~, and propylene glycol~~ were in stock at the laboratory. Alcohols and molasses were purchased to complete the laboratory work. Wet dairy manure was obtained from a dairy farm near Denver, Colorado. The moist manure was collected in plastic bags and transported to the Denver laboratory for refrigerated storage until use. The inoculum slurry was created by first processing the manure (grinding/breaking) into smaller pieces as necessary and combining with deionized water at a ratio of 10 L water to 0.2 L manure. After mixing and allowing it to incubate at room temperature for at least 24 hours, the slurry was poured through a 2 mm sieve to remove larger suspended solids.

For addition to the batch test containers, the sieved Chitorem was suspended in a guar gum gel in order to simulate the potential application of this solid material in an injection-type application. Guar gels are derived from ground guar beans that are further processed with minerals (e.g., borax or calcium) to cause the ground powder to self-gel in water. Wyo-Ben® G-150 guar material was utilized to create the guar gel suspension. The selected Chitorem:water:guar ratio utilized was 20:79.43:0.57 by weight, based on recommendations from JRW (Chitorem manufacturer). For example, a batch of 0.57 g G-150 guar, 79.43 g deionized water, and 20 g Chitorem could be created, or scaled accordingly to the mass of Chitorem needed. The guar was mixed with the water for approximately 10 to 15 minutes until a gel formed on a stir plate. Chitorem fines were then added and sufficiently mixed for several more minutes.

After addition of gravel and the MIW, alkaline material doses were added (NaOH solution, limestone, or Chitorem), containers were closed, and each was tumbled for several seconds to mix the materials. After allowing time for settling of precipitates, the pH of each container was measured. Initial pH test results indicated containers 6 and 8 were less than 4.0 su; therefore, additional NaOH solution was added to these containers. Based on results for containers 15 and 16 that also had a low pH, additional limestone fines were added to these containers. The total added quantities are provided in Table 2.3-1.

After the initial pre-treatment pH was reached (generally between 4 and 5 su), organic substrate doses and manure inoculum (where applicable) were added to each container. Following introduction of all substrates, each cubitainer was collapsed to remove as much air space as possible, and the spigot was sealed. The cubitainers were then mixed gently and placed on the bench top so that the spigot was completely submerged. This allowed for opening of the spigots for sample collection without introducing significant air into the containers. During the first several weeks of the study, buildup of biogenic gases occurred in some containers. As necessary, these gases were released from the cubitainers by slowly opening the spigot while applying pressure to limit any inflow of air into the containers.

Addition of all substrates was completed on July 9. The containers were allowed to incubate for a total of 7 weeks until August 26. After 1 week of incubation, a small aliquot of sample was collected from the container for in-house analysis at the CDM Smith laboratory for pH, temperature, specific conductance, ORP, DO, HACH sulfide, alkalinity, and ferrous Fe. This process was repeated weekly until completion of the study, and then a sample was collected and submitted to the analytical laboratory (ESAT) for analysis of dissolved and total metals, alkalinity, and sulfate. The same in-house parameters as measured each week at the CDM Smith laboratory were also analyzed at the end of the study.

On August 6, low pH in containers 8, 9, 10, and 17 prompted the need for additional base to be added to raise pH. Containers 8, 9, and 10 each received an additional 25% NaOH dose of 7.1 ml, 9.4 ml, and

9.4 ml, respectively. Container 17 received an additional Chitorem dose of 7 g. In addition, a 25 ml manure extract inoculum was added to containers 2 through 10, 16, and 17. The inoculum dose was added at this time to ensure bacteria were present in the container. Final total quantities added to each container are provided in Table 2.3-2. Values in bold and italics indicate where additional materials were added on 8/6.

Table 2.3-2 Final Tiger Bench-Scale Treatability Study Container Test Setup

Container Test Number	Organic Substrates				Alkaline Materials			Inoculum	
	Methanol	Ethanol	Molasses	Chitorem	25% NaOH	Limestone Fines	Chitorem	Manure Extract	Chitorem
1	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	25 ml				4.6 ml			***50 ml***	
3	50 ml				4.6 ml			***50 ml***	
4	100 ml				4.6 ml			***50 ml***	
5		25 ml			4.6 ml			***50 ml***	
6		50 ml			4.6 ml			***50 ml***	
7		100 ml			4.6 ml			***50 ml***	
8			25 ml		***11.9 ml***			***50 ml***	
9			50 ml		***14.0 ml***			***50 ml***	
10			100 ml		***14.0 ml***			***50 ml***	
11				15 g			†		†
12				22 g			†		†
13				34 g			†		†
14				7 g	4.6 ml		†		†
15				7 g		8.2 g	†		†
16			50 ml			14.7 g		***50 ml***	
17			50 ml	***22 g***			†	***50 ml***	†
18		25 ml		7 g	4.6 ml		†	25 ml	†

†Chitorem as an alkaline material or inoculum is indicated because these properties are inherent to the material as part of the organic substrate dose; Chitorem was not dosed in addition to the organic substrate dose.

2.3.3 Tiger Mine Field Investigation

On August 5, 2014, a protective grating was installed at the Tiger Mine shaft. In addition to installing the protective grating, minor improvements were made to the site to bypass surface water around the mine workings and spoils piles. Water from a spring located in the north-facing hillside above the mine shaft was diverted into a shallow trench created along an old roadbed above the mine shaft. The water was directed to a small drainage sump excavated in the road bend immediately uphill from the mine shaft. Approximately 1,000 feet of 2-inch HDPE pipe was placed parallel to the access road below the mine site to carry the diverted water into the forested hillside away from the mine site. A second trench and drainage sump was constructed in the drainage bottom immediately adjacent to the mine shaft to divert runoff and additional spring flow around the shaft. A short length of HDPE pipe connected this second drainage sump to a tee in the longer HDPE pipe run.

An Insight Vision DXP-300 video camera, operated on 12-volt battery power, was used to inspect the mine shaft. The video camera lens was mounted at the end of a 150-foot long ½-inch diameter flexible cable, shown in Exhibit 2-5. The cable came coiled on a spool, with the electronics module mounted on the top. Exhibit 2-6 shows the camera cable and 12-volt battery being prepared on the Tiger Shaft grating.

Exhibit 2-5. Video camera lens

Exhibit 2-6. Camera cable and battery

The upper portion of the shaft directly below the grating was partially obstructed with collapsed timbers, so the camera cable was inserted into a 10-foot length of 1 ½-inch schedule 40 PVC pipe. The PVC pipe was then lowered through the grate opening and guided carefully into an opening in the obstructions. The upper end of the PVC pipe with the cable inside can be seen in Exhibit 2-7 extending about 1 foot above the grate. The PVC pipe was fixed in place and the camera cable lowered through the pipe. The lens was equipped with an adjustable light-emitting diode (LED) light, and initially the camera was lowered down the shaft with the camera lens pointed straight down. This alignment gave a good overall survey of the shaft construction. To obtain a better view of the sidewalls, additional recordings were made with an auxiliary light source, consisting of an LED headlamp, attached to the camera lens. Also, for the subsequent recordings, the end of the camera cable was inserted into a 1 ½-inch diameter PVC pipe elbow to hold the camera lens horizontally (see Exhibit 2-8).

Exhibit 2-7. Inserting PVC guide pipe and camera into shaft

Exhibit 2-8. Camera lens installed in PVC pipe fitting to obtain horizontal recordings

Exhibit 2-9. Onsite video screen and computer

The flexible cable was rigid enough to allow the operator to rotate the camera in any desired direction as it was lowered into the shaft. In this way, each sidewall could be carefully inspected. Live video was displayed on a small video screen during the operation (Exhibit 2-9), and the video signal was recorded to a portable flash drive.

Five separate videos were recorded. In the first video, the camera was lowered down the west half of the shaft to the 87-foot level with the camera pointed straight down. In each of the other four videos, the camera was lowered to the 87-foot level with the camera directed horizontally at each of the four shaft walls.

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Section 3

Quality Assurance Summary

This section describes the quality assurance (QA) and quality control (QC) aspects of the treatability study data. Deviations are presented and how or if they affected the achievement of the data quality objectives (DQOs). A summary of field QC activities is presented, and a summary of the data evaluation is presented.

3.1 Danny T Bench-Scale Hydraulic Tests

3.1.1 Deviations and Data Quality Objectives

The bench-scale hydraulic tests were conducted in accordance with the QC requirements detailed in the SAP/QAPP (CDM Smith 2014a). Laboratory procedures conducted at the Denver Laboratory were conducted in accordance with the QA protocols outlined in the Laboratory Quality Assurance Plan for the CDM Smith Denver Treatability Laboratory (CDM Smith 2007). Laboratory and sampling procedures did not deviate from the requirements of these plans during the bench-scale hydraulic tests, with the exception that 3-inch columns were utilized for testing instead of 4-inch columns. All DQOs developed for the investigation were met.

3.1.2 Field Quality Control Summary

CDM Smith field QC procedures and CDM Smith Denver Laboratory QC procedures were followed during the work completed. Laboratory glassware, columns, and other miscellaneous items were cleaned with Alconox® powdered detergent and rinsed with deionized laboratory grade water prior to and after use. All data collected were recorded in the laboratory log book.

3.1.3 Data Evaluation

Analytical samples were not collected during the hydraulic tests. Data collected included volumes of MIW either added, recycled, or drained from the columns and time recordings. These data are usable for their intended purpose.

3.2 Danny T Pilot-Scale Treatability Study

3.2.1 Deviations and Data Quality Objectives

The pilot-scale treatability study was conducted in accordance with the QC requirements detailed in the SAP addendum #1 and #2 (CDM Smith 2013 and 2014a). Field and sampling procedures did not deviate from the requirements of these plans during the pilot-scale treatability study except as detailed below:

- As detailed in Section 2.2.4.2, several issues occurred with the NaOH dosing system that resulted in the inability to consistently pre-treat the influent MIW prior to the BCR. These issues included temporary disconnection of the peristaltic pump tubing, unintended draining of the NaOH stock tank, and collapsing of the pump tubing that resulted in plugging. In addition, modifications of the NaOH solution dosing rate were implemented to achieve the desired pre-treatment pH. These deviations somewhat limited the ability to completely answer DQOs 2 through 5. Better pH control was achieved in August and September compared to the earlier months to better answer DQOs.

- Sludge generated from the pre-treatment NaOH process was not measured during the study due to the inability to access the inside of the pre-treatment tank without disassembling the MIW or NaOH solution feeds. This deviation does not significantly affect the ability to answer DQO 4 regarding the sludge volume generated because the volume of sludge generated by NaOH addition was measured during the bench-scale treatability study conducted in 2013. This bench test volume measured provides an estimate for sludge generation for the FS.
- Throughout the course of the year 2 study, several of the timer valves were observed to have partially clogged from the high mineral content of the influent MIW. As a result, ball valves in some cases were not closing completely in between weekly maintenance visits. This issue resulted in more influent MIW entering these BCRs than designed for an unknown period of time and for an unknown volume. As a result, BCRs may have been overloaded beyond the designed average flow rate specified in the SAP addendum #2. Details of these observations are provided in Section 2.2.4.2. Ball valves were cleaned and replaced as necessary to maintain operations as designed. Resulting flow variations may have had an effect on treatment efficiency as a result of more flow moving through the pre-treatments and BCRs than intended. Therefore, this deviation likely had some effect on answering DQOs related to treatment efficiency and hydraulic retention time through the BCRs and pre-treatments (DQOs 6 through 8 and 13).
- Construction of the post-treatment system was slightly different than the one proposed in the SAP addendum #2 (CDM Smith 2014a). After the second aeration cascade bin, water was routed to the aerobic wetland bin instead of through a third wading pool with baffles. Following the aerobic wetland bin, the final gravel filter was placed in a separate bin instead of the same bin as the aerobic wetland plants. These modifications were made based on readily available materials and simplicity in construction. These deviations do not affect the ability to utilize the data or answer DQO 14 related to the post-treatment system.
- Rather than collecting the post-treatment influent sample from the designated sample port after in-line mixing of the four BCR effluents, equal volumes were collected from the four BCR effluent sample taps and composited. This method was utilized due to the lack of adequate volume to fill bottles at the post-treatment influent sample port. During each batch flow every 2 hours, the flow rate of water moving through each treatment train varied, limiting the flow at any given point and providing a variable mixing ratio of the four BCR effluents. By compositing the actual BCR effluents at equal volume, this sampling method actually provided a more representative average influent to the post-treatment system during each 2-hour interval.
- A total of 10 laboratory sample events were conducted instead of 9 since laboratory sampling was conducted weekly for the last 3 weeks of the study. This deviation improved data quality and quantity.
- Nutrients (ammonia and nitrate/nitrite) were mistakenly filtered along with other wet chemistry parameters. Samples were filtered into the sulfuric acid preserved bottle. This deviation may have limited the ability to understand total concentrations of these parameters since filtration may have removed some organic carbon-bound nitrogen species.

- As detailed in Section 2.2.4.1, some deviations occurred with not sampling some of the parameters for various sample events. These include:
    - June 11: Sulfide bottles were not available for sampling; therefore, sulfide samples were not collected.
    - June 24: Due to a miscommunication, sulfide and BOD exceeded their holding times in storage; therefore, sulfide and BOD samples were not submitted for analysis.
    - September 16: POSTI and POSTE samples were not collected and analyzed for dissolved metals, alkalinity, ammonia, chloride, fluoride, nitrate/nitrite, orthophosphate, and sulfate due to a lack of in-line filters available for these samples to be filtered for analysis. Total metals, acidity, BOD, and sulfide samples were still collected and analyzed for POSTI and POSTE locations, and all other sample locations/parameters were collected and filtered as normally conducted on this sample event.
    - September 29: Sample bottles for ESAT were mistakenly stored in CDM Smith's storage unit refrigerator and not submitted for analysis. After discovery of the error in January of 2015, metals bottles were submitted to a CLP laboratory for analysis since they were preserved and still within holding time. All of the wet chemistry analyses intended for ESAT exceeded holding times and were not submitted for analysis.

The deviations listed above did not have an effect on the overall usability of the data generated. Where applicable, specific effects on DQOs developed for this investigation were described above. Otherwise, all DQOs were met for this treatability study and data are evaluated in Section 4.

3.2.2 Field Quality Control Summary

The field meter was calibrated during each sample event. All field notes, field measurements, and other sampling observations were recorded in field log books. All samples were collected in certified clean containers obtained from the laboratory or from a supplier. Titrations for the NaOH solution were completed using a mechanical pipet and disposable tip. Titrations were completed in certified clean containers or containers cleaned with Alconox® powdered detergent and grocery-purchased distilled water. NaOH solutions were created using a graduated cylinder for measurements and with grocery-purchased distilled water.

Field QC samples consisted of field duplicates and matrix spike/matrix spike duplicates. A total of 9 field duplicates were collected for a total of 98 normal field samples. This rate of field duplicate collection is just under the minimum 10% requirement for collection of field duplicates specified in the SAP. The field duplicates collected are still considered representative of the data set and adequate for use of the data for their intended purpose.

3.2.3 Data Evaluation

Data evaluation by checklist format was not conducted for the year 2 treatability study data set; however, data were still reviewed as part of the overall analysis. No data were rejected, and all data are considered usable for their intended purpose. Data evaluation by checklist was not conducted since the intended use of the data is for technology evaluation in the FS. Laboratory data packages are provided in Appendix A.

Field duplicate samples were compared to their respective normal samples in Table 3.2-1. The relative percent difference (RPD) between the two results were calculated. Table 3.2-1 shows low RPDs for most samples below 10% and for many metals at less than 1%. For the first sample event, total Al and dissolved Mn RPDs were greater than 10% for the BCR1 duplicate and normal samples. No other metals had RPDs greater than 10%. Orthophosphate RPDs were greater than 10% for the influent MIW normal and field duplicate samples collected on 8/6, 9/2, and 9/23. Overall, these low RPDs indicate good data precision and representativeness that standard prescribed methods were followed throughout the study.

3.3 Tiger Bench-Scale Treatability Study

3.3.1 Deviations and Data Quality Objectives

The bench-scale treatability study was conducted in accordance with the QC requirements detailed in the SAP/QAPP (CDM Smith 2014b). Field sampling at the Firehose adit was completed in accordance with the 2014 Barker SAP/QAPP (CDM Smith 2014e). In addition, laboratory procedures conducted at the Denver Laboratory were conducted in accordance with the QA protocols outlined in the Laboratory Quality Assurance Plan for the CDM Smith Denver Treatability Laboratory (CDM Smith 2007). Laboratory and sampling procedures did not deviate from the requirements of these plans during the bench-scale treatability study, with the following exceptions:

- Variations were made on test setup, including addition of 2.5 L of MIW to each container instead of 2 L.
- Guar slurries of Chitorem and limestone were not used for titrations. Based on the small volumes/weights of these materials needed, titration of a slurry would not have been feasible.
- Limestone fines were added directly to applicable test containers without creating a guar slurry for this material. Guar slurries were only created for Chitorem addition.
- ¼-inch minus limestone was not utilized in the testing containers. Only screened limestone fines to less than 2 mm size were utilized in the study.

The deviations listed above did not have an effect on the overall data quality or usability of the data generated. All DQOs developed for the investigation were met.

3.3.2 Field Quality Control Summary

CDM Smith field QC procedures and CDM Smith Denver Laboratory QC procedures were followed during completion of the work. The laboratory uses a Milli-DI® water filtration system to create high resistivity purified water. This laboratory grade water was utilized for making the NaOH solution for titrations, cleaning measurement probes (e.g., pH, specific conductance, ORP), cleaning and rinsing glassware, and preparing guar slurries. Laboratory glassware and other miscellaneous items were cleaned after each use with tap water and Alconox® powdered detergent and rinsed with the deionized water.

Titrations were conducted with a mechanical pipet and disposable pipet tips. All pipet tips were disposed after use. The 25% NaOH solution was made on a weight basis using a laboratory balance measureable up to one-thousandth of a gram. Liquid substrates were measured using volumetric flasks, and solid substrates were measured using the laboratory balance. All measurement probes were calibrated daily, and notes were recorded in a laboratory log book. All samples were collected in certified clean containers obtained from the laboratory or from a supplier.

Field QC samples (i.e., field or matrix spike duplicates) were not collected during the bench-scale treatability study due to the lack of additional volume for each step in the treatability study process. However, a control batch container was tested alongside of the other test containers that did not have any substrates added to it except for the pea gravel. Only limited test volumes were utilized and collected for analysis in accordance with the SAP/QAPP (CDM Smith 2014b). For the Firehose adit water sample, a field duplicate was collected and submitted to the laboratory for analysis.

3.3.3 Data Evaluation

Data were obtained from the laboratory and utilized for analysis. A data evaluation review was not conducted on the bench-scale and the pilot study data. Field duplicates were not collected during the bench scale testing because of limited sample volume, except for the original Firehose adit sample collected in the field. The laboratory performed matrix duplicate and matrix spike and spike duplicate analyses as required by the methods. Although a formal data evaluation was not performed, all data are considered usable for their intended purpose. No data were flagged as rejected. Laboratory data packages are provided in Appendix B.

3.4 Tiger Mine Field Investigation

3.4.1 Deviations and Data Quality Objectives

The field investigation of the lower shaft was conducted in accordance with the requirements detailed in the SAP/QAPP (CDM Smith 2014b). No laboratory samples were collected as part of the investigation. Field investigation procedures did not deviate from the requirements of the SAP/QAPP, except that a water level meter was not deployed down the shaft because of obstructions present. Water was observed through the video camera recording in a shallow pool, and a depth below the surface was estimated. All DQOs developed for the investigation were met to the extent that the shaft could be investigated down to obstructions.

3.4.2 Field Quality Control Summary

Field QC procedures related to maintaining notes and digital records (photographs and video recordings) were followed during the investigation of the lower Tiger shaft.

3.4.3 Data Evaluation

Since analytical data were not collected, data evaluation is not applicable. Semi-quantitative information obtained from the study includes depth measurements and visual observations using the down-hole camera. This information was used for planning and evaluation purposes only.

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Section 4

Results, Analysis, and Discussion

This section describes the results, analysis, and discussion of the treatability study data.

4.1 Danny T Bench-Scale Hydraulic Tests

Bench-scale treatability results are presented below. This bench-test work was conducted to determine the optimum mixture of Chitorem to sand and gravel that maintained adequate porosity and hydraulic conductivity for use in the year 2 field study. Section 2.1 described the test setup and operations. A total of 12 drain tests were conducted over an approximately 4-week period for five test columns, including 1 week of incubation of the substrate with MIW before drain tests. The ratios of Chitorem, sand, and gravel varied for the five columns, with column 1 having the least Chitorem (12%) and column 5 having the most Chitorem (28%). Sand contents varied from 9 (column 1) to 21% (column 5), and gravel contents varied from 79 (column 1) to 51% (column 5).

Table 4.1-1 presents all time measurement results for the hydraulic drain tests. Figures 4.1-1 and 4.1-2 present graphs of the time to drain 100 ml of water and 200 ml of water, respectively. Prior to loading substrates to the columns, the initial drain tests with tap water indicated that the valve for column 5 provided biased faster drain times compared to other columns. Column 1 also was slightly biased slower compared to columns 2 through 4. These differences can be attributed to variability in the valves utilized. Testing throughout the study also indicated that column 5 was repeatedly biased fast compared to column 4. Since column 5 had more Chitorem than the other columns, flow should be more restricted and slower in this column. However, column 5 had consistently faster drain times than column 4 and sometimes other columns. Therefore, results for this column are considered skewed and not reliable for comparison to other columns.

Table 4.1-1. Hydraulic Drain Bench Results

Date	Test No.	Test Description	Time to Drain in Seconds				
			#1	#2	#3	#4	#5
Column Contents		Chitorem	12.0%	16.0%	20.0%	24.0%	28.0%
		Sand	9.0%	12.0%	15.0%	18.0%	21.0%
		Pea Gravel	79.0%	72.0%	65.0%	58.0%	51.0%
4/24/2014	0	Time to drain 1 L tap water with no substrate	132	114	113	114	96
5/6/2014	1	Time to drain 300 ml	49	48	84	125	95
5/6/2014	2	Time to drain 100 ml	33	23	103	72	42
5/9/2014	3	Time to drain 200 ml	49	61	100	89	47
5/13/2014	4	Time to drain 200 ml	60	95	123	115	80
5/16/2014	5	Time to drain 200 ml	75	80	130	142	100
5/16/2014	6	Time to drain 200 ml	140	201	480	249	277
5/20/2014	7	Time to drain 200 ml	139	72	64	158	72
5/20/2014	8	Time to drain 100 ml	118	234	170	316	92
5/23/2014	9	Time to drain 200 ml	265	263	95	304	102
5/23/2014	10	Time to drain 100 ml	119	207	139	258	39
5/27/2014	11	Time to drain 200 ml	267	206	144	200	68
5/27/2014	12	Time to drain 100 ml	156	241	303	371	72

Trends for the remaining columns generally follow the initial hypothesis in that the more Chitorem present per sand and gravel, the lower the hydraulic conductivity and the slower the drain time. In general, column 4 had the slowest drain time compared to columns 1 through 3 for the 200 ml and 100 ml drain tests. Variations occurred from test to test, however, which may be due to issues such as mobilization of smaller particles stuck in the valve and restricting flow, formation of precipitates, or preferential pathways through the substrate.

At the end of the test, column 1 had approximately 2 inches of orange precipitate on the top of the Chitorem/sand/gravel substrate from the Fe in the MIW tested. Column 2 had approximately 1.5 inches orange precipitate, and columns 3 and 4 had approximately 1 inch of precipitate. Column 5 had only approximately 0.3 inches of orange precipitate. Each of these orange layers was followed by a blackish-gray color presumably from Fe and Zn sulfide formation. This observation trend indicates that more oxidized Fe precipitate formed on the surface layer with the least amount of Chitorem and most pea gravel in column 1. For column 5 with the most Chitorem, less orange-colored oxide precipitate formed due to the reduced oxidation state. The variability of Fe oxide sludge formation probably had some effect on the hydraulic drain time, especially for the 200 ml drain tests that were conducted first without disturbing the column. After the 200 ml drain test, additional MIW was added to the columns and the 100 ml drain test was conducted. Addition of MIW to the top of the column disturbed the top oxidized sludge layer. This change may explain why for the last test date column 1 was the slowest to drain the 200 ml compared to columns 2 through 4.

Overall, hydraulic testing results indicated that the use of a higher Chitorem percentage as in column 4 (20% by volume) may have resulted in flow restrictions similar to what was observed in the year 1 pilot study. Therefore, the decision was made to implement the year 2 study with the same ratio of Chitorem (16%) to sand (12%) and gravel (72%) that was implemented at the end of the year 1 study and that was tested in column 2 of the hydraulic testing. At the end of the year 1 study and in the hydraulic test, this ratio of materials seemed to provide adequate hydraulic conductivity and enough Chitorem to maintain the desired treatment effectiveness.

4.2 Danny T Year 2 Pilot-Scale Treatability Study

The second year of the Danny T treatability study again focused on different pre-treatment methods to condition the water ahead of a woody substrate BCR but with slightly different substrate mixtures and significantly lower flow rates. The effluents from the BCRs were combined and fed into a post-treatment system to test re-aeration of the water and degradation of BOD, sulfide, and nutrients. The mixtures were detailed in Table 2.2-1, but as a reminder to the reader, the four treatment trains tested included:

1. BCR1 – no pre-treatment but woody substrate mixture amended with a small volume of Chitorem
2. SAPS/BCR2 – pre-treatment with a SAPS barrel, followed by a woody substrate BCR
3. CHIT/BCR3 – pre-treatment with a Chitorem-based barrel, followed by a woody substrate BCR

4. NaOH/BCR4 – pre-treatment with NaOH solution, followed by a woody substrate BCR

Pilot-scale treatability results for the year 2 study are presented in the following sections. Table 4.2-1 presents all analytical laboratory results for the pilot-scale study. Field duplicate sample results were provided in Table 3.2-1. Table 4.2-2 presents all field measurement data. Table 4.2-3 presents the removal efficiency for all metals and select wet chemistry parameters. Finally, Table 4.2-4 presents a comparison of results to DEQ-7 aquatic water quality standards.

Removal efficiencies in Table 4.2-3 are shown for each step in the process by comparison of the treated effluent to the influent of a particular treatment process step. Removal efficiency was calculated by comparing the pre-treatment effluent to the raw water influent when pre-treatment occurred (flow lines 2 through 4). Then the BCR removal efficiency was calculated by comparison of the BCR effluent to the pre-treatment effluent as well as to the raw water influent (overall removal efficiency). For the post-treatment system, removal efficiency was calculated by comparing the post-treatment effluent to the combined influent.

The removal efficiency calculations in Table 4.2-3 considered analytical results (either influent or effluent) near or at laboratory reporting limits; however, removal efficiency for a metal or other analyte was not calculated if the influent water and treated water effluent results were both non-detect (U or UJ flagged data). Similarly, comparison to water quality standards in Table 4.2-4 was not conducted if the sample results were non-detect (U or UJ flagged). As shown in Table 4.2-3, removal efficiency calculations are qualified by a less than or greater than sign if applicable or a not applicable (NA) designation. Negative removal efficiencies indicate that concentrations increased compared to the influent due to leaching from substrates, suspension of suspended solids, or precipitate dissolution. If the raw water is non-detect and the treated water effluent is greater than the raw water reporting limit, then the removal efficiency is less than the percent shown. This would also result in a negative efficiency although results near the reporting limits may not be statistically significant to indicate that an increase in a particular metal occurred in the effluent. In contrast, if the treated water effluent is non-detect and the raw water is greater than the treated water effluent reporting limit, then the removal efficiency is greater than the percent shown.

Reporting limits provided by Energy, ESAT, or CLP laboratories varied throughout the study and for some metals were above water quality standards for ESAT data. Reporting limits also sometimes varied between dissolved and total results for the same sample. Overall, these variabilities result in limitations in calculating removal efficiencies, comparing to standards, and drawing conclusions about the results. For example, the Al reporting limit provided by ESAT for this data set varied between 50 and 500 µg/L. As reporting limits varied between 20 and 200 µg/L. Cd reporting limits varied between 2 and 20 µg/L. Cu reporting limits varied between 10 and 100 µg/L. Fe reporting limits varied between 250 and 1,250 µg/L. Pb reporting limits varied between 2 and 20 µg/L. Some of these reporting limits are above human health and/or chronic aquatic standards and in some cases above acute aquatic standards (i.e., Cd and Cu). Comparison to standards is provided in the sections that follow; however, caution should be applied to drawing conclusions from this comparison due to the high reporting limits.

Zn was the only metal that had consistently low enough reporting limits to compare to all standards, with one exception for dissolved results on 9/29. An anomalously low hardness of 2.8 mg/L was reported on 9/29, which resulted in significantly lower standards for all hardness-dependent metals.

Due to utilizing the CLP laboratory for the last event versus ESAT on all previous events, reporting limits for Al and other metals were also lower for the last event. Data on the last event, therefore, sometimes provides better resolution on comparison to standards and treatment efficiency evaluations.

Data from the system influent, pre-treatment effluents, and BCR barrel effluents are also presented in a series of figures to aid in data analysis and discussion. Figures 4.2-1 through 4.2-5 present time-based charts of pH, temperature, DO, ORP, and specific conductance results, respectively. Figures 4.2-6 through 4.2-14 present time-based charts of dissolved Al, As, Cd, Cu, Fe, Pb, Mn, nickel (Ni), and Zn, respectively. Figures 4.2-15 through 4.2-22 present time-based charts of sulfate, volumetric sulfate reduction rate, sulfide, total alkalinity, acidity, BOD, orthophosphate, and ammonia, respectively. Figures 4.2-23 through 4.2-26 present comparative figures of pH, alkalinity, and acidity to visualize whether the treatment processes were net acidic or net alkaline throughout the study. Note that concentrations in the first and second sample events are often higher due to startup conditions and these are not necessarily discussed in relation to the performance.

Figure 4.2-16 presents the volumetric sulfate reduction rate calculated over time for each BCR, the SAPS barrel, and the CHIT barrel. The volumetric sulfate reduction rate was calculated based on the average process flow rate (using the batch dosing rate), reactive substrate volumes presented in Table 2-4, and the influent and effluent sulfate concentrations measured for each barrel. Note that during some sample events, the head tank timer valves were observed to be leaking (as a result of valves not completely closing due to clogging), thus, delivering some additional flow of MIW to the treatment barrels. Although corrected upon the weekly site visits, the leaking valves would have caused some increase in overall flow rate through the treatment barrels. Since the average flow rate is multiplied by the difference in sulfate concentration to obtain the sulfate reduction rate, a larger flow would actually increase the calculated sulfate reduction rate. Therefore, actual volumetric sulfate reduction rates are likely greater than shown on Figure 4.2-16.

To determine whether or not the system could handle increased flow, on August 12 (after sampling), the flow rate was increased to a batch dose of 1.5 L every 2 hours, which equates to an average flow rate of 12.5 ml/min, up from the original 8.3 ml/min. On August 26 (after sampling), flow rate was increased to a batch dose of 2.0 L every 2 hours, which equates to an average flow rate of 16.7 ml/min. Then, for the next sampling event on September 2, based on cooler ambient temperatures and field measurements showing signs of stress, flow rates for all treatments were reduced back to 1.0 L every 2 hours, equivalent to the original 8.3 ml/min flow rate for the remainder of the study. The effects of these flow rate changes are discussed in the summary of individual reactor performances below. These flow rate variations were incorporated into the sulfate reduction rate calculations.

4.2.1 Danny T Adit MIW Influent

The following subsections summarize the MIW influent water quality.

Field Parameters

The chemistry of the influent MIW water remained relatively consistent even into the later summer in September. The pH ranged from 2.40 to 2.85 su throughout the pilot-scale study period. Specific conductance of the influent MIW ranged from 1,542 to 2,700 microSiemens per centimeter (μS/cm), with no obvious trend over the range observed. Temperature ranged from 6.25°C to 22.5°C, with fluctuations throughout the season. The minimum temperature of 6.25°C was observed on 9/9, corresponding with much cooler air temperatures; however, MIW influent water temperatures increased to around 15°C for the last 3 weeks. ORP ranged from 311.4 to 510 mV. DO ranged from 1.25 to 6.56 mg/L. The lowest DO values were recorded at various times that do not appear to correlate with ORP or other parameters. Temperature gradually decreased into the beginning of September (9/9), but then increased again over the last sample events.

Metals

Observations of dissolved metal trends (Table 4.2-1 and Figures 4.2-6 through 4.2-14) and comparison to water quality standards (Table 4.2-4) of the MIW influent are described below. A comparison of dissolved metals to total metals in the influent generally shows dissolved concentrations nearly the same as total concentrations, indicating the metals are largely in the dissolved phase. Fe was the most common metal with higher total than dissolved concentrations. Some dissolved metals concentrations were greater than total concentrations where the differences may be within the analytical accuracy and precision of the instruments used to analyze the samples or due to slight variabilities that can occur between dissolved and total metals sample bottles. The discussion and graphs focus on trends in the dissolved phases because the treatment system seeks to remove the dissolved metals from the raw water. Metals in the total phase can be removed through adequate filtration and/or settling.

- Dissolved Al concentrations ranged from 10,600 to 15,000 µg/L. A slight increasing concentration trend appeared to occur over the last month of the study. Total and dissolved concentrations were significantly in exceedance of the chronic and acute aquatic water quality standards throughout the study. Dissolved and total Al concentrations were very similar through the study, which indicates that most of the Al was in the dissolved form as expected at the low adit water pH.

- Dissolved As concentrations ranged from 129 µg/L to a high of 264 µg/L. Total and dissolved concentrations always exceeded the human health standard and exceeded the chronic aquatic standard during most of the study. Overall, dissolved or total As did not appear to change significantly throughout the study.

- Dissolved Cd concentrations ranged from 220 µg/L to a high of 285 µg/L. Total and dissolved concentrations significantly exceeded the human health standard and the chronic and acute aquatic water quality standards. Overall, dissolved or total Cd concentrations did not appear to change significantly throughout the study.

- Dissolved Cu concentrations ranged from 812 to 1,270 µg/L. Total and dissolved concentrations always exceeded the chronic and acute aquatic water quality standards.

- Dissolved Fe concentrations ranged from 111,000 to 184,000 µg/L. Total and dissolved concentrations always exceeded the chronic aquatic water quality standard.

- Dissolved Pb concentrations ranged from 134 to 246 µg/L. Total and dissolved concentrations always exceeded the human health and chronic aquatic standards.

- Dissolved Mn concentrations ranged from 75,500 to 123,000 µg/L. Mn does not have a Montana DEQ-7 standard for comparison; however, Mn is a major metal ion contributing to influent acidity loading along with Al and Fe.

- Dissolved Ni concentrations ranged from 17.9 to 53.9 µg/L. No exceedances of standards were observed. Based on these influent MIW results, Ni is not discussed further in the sections that follow for the pilot treatment system.

- Dissolved Zn concentrations ranged from 44,000 to 66,500 µg/L. Total and dissolved concentrations significantly exceeded the human health standard and the chronic and acute aquatic water quality standards.

Wet Chemistry Parameters

Sulfate (Figure 4.2-15) concentrations in the influent MIW ranged from 894 to 1,280 mg/L. Acidity (Figure 4.2-19) concentrations in the influent MIW ranged from 600 to 790 mg/L. Alkalinity (Figure 4.2-18) concentrations in the influent MIW were non-detect throughout the study as expected for this type of acidic MIW.

Summary

Unlike in the year 1 study that had decreasing metals concentrations, year 2 Danny T MIW metals concentrations stayed relatively constant throughout the study period. Metals concentrations exceeded water quality standards and pH remained below 3.0 su.

4.2.2 BCR1

BCR1 had no pre-treatment but contained 5 percent volume Chitorem added to it unlike other BCRs in the study. The following subsections summarize the BCR1 effluent water quality.

Field parameters

The field parameters of pH, specific conductance, ORP, temperature, and DO are broad indicators of the BCR performance. BCR1 raised the pH to between 5.95 and 7.23 su; however, the discharge pH was not always within the range of 6.5 to 9.0 su set forth by DEQ[1]. Discharge pH was above 6.5 su for the first month, followed by a decrease to around 6 su for several weeks, and then an increase in September.

Temperature ranged from 7.37 to 19.20°C, correlating with influent MIW temperatures as expected.

Specific conductance ranged from 1,400 to 7,160 µS/cm. Effluent specific conductance was greater than the influent initially due to the flushing of soluble components from the substrates, which is expected in BCRs during startup. After startup, specific conductance steadily declined towards the influent specific conductance and was then less than the influent for the last month of the study.

ORP ranged from -299.0 to 107.3 mV, varying between negative and positive values for the first few weeks (considered the startup period for the first month), decreasing below -150 mV on 6/24, and increasing greater than -100 mV on 9/2. Since ORP is one of the most sensitive parameters to changing influent conditions, the increase to more oxidizing conditions on 9/2 could be due to the second increase in flow rate from 1.5 L per 2 hours (80.6 h retention) to 2.0 L per 2 hours on 8/26 (60.5 h retention). The first increase in flow rate from 1.0 L per 2 hours (121 h retention) to 1.5 L per

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[1] Administrative Rules of Montana, Title 17, Chapter 30 – Water Quality, Sub-Chapter 6 – Surface Water Quality Standards, Section 17.30.628 Classification Standards.

2 hours (80.6 h retention) on 8/12 did not appear to have had an effect on maintaining adequate reducing conditions for sulfate reduction; however, the further flow increase on 8/26 did increase ORP above levels considered amenable to sulfate reduction. The increase in ORP on 9/2 and 9/9 may also be related to the decreasing influent water temperature below 10^{O}C.

DO ranged from less than 0.1 to 2.78 mg/L.

Metals

The following includes observations of metal trends, removal efficiency ranges, and comparison to water quality standards.

- Dissolved and total Al were removed by BCR1 with an efficiency of 96.5 and 90.9%, respectively, for the first sample event, followed by greater than 98% for the remainder of the study. However, when estimated below the reporting limit of 250 µg/L (J qualified data), dissolved concentrations were in exceedance of the chronic aquatic standard of 87 µg/L. Concentrations were non-detect (less than 250 µg/L) on 9/16 and 9/23 and below the aquatic standard for the last sample event on 9/29 (13 µg/L). Analysis by the CLP laboratory for the last event provided the lower detection compared to previous ESAT analyses. When both total and dissolved concentrations were detected, total metals concentrations were slightly greater than dissolved.

- Dissolved and total As were removed by BCR1 with an efficiency ranging from greater than 83.7 to 99.5%, except for the first two sample events that had lower efficiencies. Dissolved and total As concentrations exceeded the human health standard during the first two sample events. From 8/6 through 9/23 (5 events), both dissolved and total As were non-detect at less than 20 µg/L. In the last sample event (with lower reporting limits), As was less than 2 µg/L.

- Dissolved Cd was removed by BCR1 with an efficiency of greater than 99% consistently, with concentrations at non-detect or detected at the reporting limit (ranged from 1.0 to 2.1 µg/L). Total Cd removal efficiency was greater than 99% except for the first sample event. Note that the reporting limit was typically not low enough for direct comparison against the low chronic aquatic standard (0.76 µg/L at a 400 mg/L hardness). From 7/22 through 9/23 (six events), both dissolved and total Cd were non-detect at less than 2 µg/L. For the last sample event, dissolved Cd was non-detect at less than 1 µg/L, and total Cd was estimated at 0.047 µg/L.

- Dissolved Cu was removed by BCR1 with an efficiency of greater than 98% throughout the study. Total Cu was also removed with an efficiency of greater than 98% except for the first sample event. In the incubation sample (first sample event), total Cu was much greater than dissolved at 145 µg/L, which exceeded the acute and chronic aquatic water quality standards. Later measurements of total Cu were lower or non-detect (less than 10 µg/L), and no other sample events had concentrations that exceeded the acute (51.6 µg/L) or chronic (30.5 µg/L) aquatic water quality standards.

- Dissolved Fe was removed by BCR1 with an efficiency of greater than 98% throughout the study. Total Fe was removed with an efficiency of greater than 98%, except for sample events on 7/8 (11,000 µg/L) and 9/2 (6,450 µg/L). The increase in BCR1 total Fe on 7/8 may have been associated with a concurrent increase in influent total Fe on 7/8 by 30 mg/L compared to the previous sample event. The increase in BCR1 total Fe on 9/2 may have been related to the overloading of metals due to the increased flow rate the previous week. This observation concurs with the ORP readings that indicate an increase in oxidation state on 9/2, which may limit the stability of Fe sulfide precipitates and increase Fe discharge. In some samples, Fe was detected above the reporting limit and exceeded the aquatic standard. For the last sample event which had a lower reporting limit, both dissolved (1,930 µg/L) and total (2,450 µg/L) Fe exceeded the chronic aquatic standard.

- Dissolved Pb was removed by BCR1 with an efficiency of greater than 98% throughout the study. Total Pb was removed with an efficiency of greater than 98%, except for sample events on 6/11 (20.5 µg/L) and 8/19 (6 µg/L). All other dissolved and total results were either non-detect or near the reporting limit of 2 µg/L. For the last sample event, dissolved Pb was non-detect (less than 1 µg/L), and total Pb was estimated at 0.48 µg/L. Pb concentrations did not exceed water quality standards except for the first sample event.

- Dissolved and total Mn was removed by BCR1 for the first sample event at approximately 95%, followed by 98% during the next sample event. Removal efficiency decreased for the remainder of the study, with influent and effluent concentrations roughly equivalent. Some sample events had a negative removal efficiency, indicating that Mn was leaching from the substrate or re-dissolving from precipitates. Removal of Mn is not expected in a BCR since Mn does not form a stable sulfide precipitate. Mn is typically removed by carbonate precipitate formation, adsorption, or through biologically mediated Mn oxide formation (by aerobic bacteria). The Mn effluent data resemble removal by adsorption and then breakthrough. As sorption sites became saturated, removal efficiency decreased as anticipated. Similar results were observed for sorption breakthrough in the year 1 study for Mn and other metals.

- Dissolved Zn was removed by BCR1 with an efficiency of greater than 99% throughout the study. Total Zn was removed with an efficiency of greater than 99%, except for sample events on 6/11 (882 µg/L) and 7/8 (2,200 µg/L). Typically, total metals such as Zn can be elevated in BCR effluent close to startup as suspended sulfide precipitates or sorbed to organic matter. The increase in effluent total Zn from BCR1 on 7/8 may have been associated with the concurrent increase in influent total Fe that may have stressed the biological system. Interestingly, Zn removal was maintained at greater than 99% for the last half of the study despite increases in flow rate and ORP. In comparison to water quality standards, only total Zn exceeded acute and chronic water quality standards (387.8 µg/L) on 6/11, 7/8, and 7/22. The high total Zn concentration on 7/8 also exceeded the human health standard.

Wet Chemistry Parameters

Sulfate concentrations ranged from 924 mg/L in the first sample to a low of 378 mg/L on 7/22, followed by an increase and steady removal for the remainder of the study. Sulfate removal efficiency ranged from 19.7% in the first sample to a high of 65% on 7/22. Sulfide concentrations ranged from 6 mg/L on 9/23 to a high of 61 mg/L on 8/6, which generally correlates with increases or decreases in sulfate reduction. The flow-adjusted volumetric sulfate reduction rates (Figure 4.2-16) ranged from 186 mmol SO_4/m^3-day in the first sample to a high of 577 mmol SO_4/m^3-day on 7/22. These measured volumetric sulfate reduction rates are well within the range of published literature values for BCRs, which indicates that the BCR1 system was functioning effectively as designed at a rate of approximately 300 mmol SO_4/m^3-day (see section 2.2.2).

Nutrient-related parameters are shown in Figures 4.2-20 (BOD), 4.2-21 (orthophosphate), and 4.2-22 (ammonia). As a common trend for all BCR effluents, concentrations of each of these constituents started at their maximum concentrations or reached a maximum within the first month, followed by a decrease for the remainder of the study. For the last 2 to 4 weeks, concentrations of these constituents appeared to have reached a steady state rather than continuing to decrease. Over the life of a BCR, some release of these nutrients is expected due to the presence of woody substrate materials and manure in the substrate. Nitrate or nitrite were not detected in the BCR effluents during the study likely because nitrogen remains in the ammonia form at reduced oxidation states.

Figure 4.2-23 illustrates the acidity and alkalinity relationship for BCR1. Separate plots of alkalinity and acidity are also shown in Figures 4.2-18 and 4.2-19, respectively. This relationship is important because it shows whether or not the net acidic influent MIW was treated to the desired net alkaline condition. Acidity concentrations in BCR1 were non-detect (less than 4 mg/L) or detected at a concentration of 4 mg/L. The first sample had the greatest alkalinity (3,020 mg/L), followed by a gradual decrease for the remainder of the study. For the last 2 weeks of the study, alkalinity concentrations appeared to stabilize to around 90 mg/L, similar to other BCRs. These results indicate that the BCR1 system was generating significant alkalinity and remained in a net alkaline condition; however, whether alkalinity would have continued to decrease beyond the study period is unknown.

Summary

Overall, results were positive for the BCR1 with woody substrate augmented by 5% Chitorem and no pre-treatment. Compared to the year 1 study, addition of Chitorem directly to the BCR and a large increase in retention time appears to have provided an adequate treatment system to treat the high acidity loads from the Danny T adit, at least for the duration of the study. Some effect to ORP was observed due to the increases in flow rate in August although ORP recovered after decreasing the flow rate at the end of the study. Also on 9/2, sulfide detected in BCR1 decreased although the rate of sulfate reduction was not affected. Note that somewhere between the sampling events of 9/9 and 9/16, flow to all BCRs was temporarily disrupted due to freezing and a break in the influent MIW pipeline. Along with the flow rate reduction on 9/2, this lack of flow may have also helped with the decrease in ORP observed on 9/16 due to a much longer residence time for water in the BCR barrel. Regardless, BCR1 was able to maintain a net-alkaline condition by generating significant alkalinity, positive sulfate reduction, and sulfide generation throughout the study. Effects to ORP on 9/2 and 9/9 indicate that the increased retention time to 60.5 h was too fast for this MIW type and substrate mixture, especially with colder fall temperatures. Overall, the BCR1 data indicate that the optimum retention time for this BCR substrate may range between 80.6 and 121 h for the water quality tested.

Dissolved removal efficiencies for many of the key metals (Cd, Cu, Fe, Pb, and Zn) were maintained above 98% for the entire study period. The variability in the removal efficiencies for most metals were often due to the relatively high laboratory reporting limits. A decrease in total removal efficiency in Fe and Zn on 7/8 may correlate with a corresponding increase in influent Fe acidity that caused stress to the biological system. A decrease in total Fe removal efficiency on 9/2 also correlates with the increased flow rate at that time as well as increased oxidation state that could result in FeS instability and flushing.

For Al, As, Cd, and Fe, high reporting limits limited the ability to compare to water quality standards that were less than the reporting limits; however, these high reporting limit concentrations are significantly lower than the raw MIW influent concentrations. Cu, Pb, and Zn reporting limits were consistently low enough to compare to standards. When detected, some exceedances of water quality standards occurred for Al, As, Cd, and Fe. With the lower reporting limits on the last sample event, greater resolution of concentrations indicates that all standards for Al, As, and Cd were met for this event. Fe slightly exceeded the chronic aquatic standard for the last event. For Cu and Pb, only results from the first sample event exceeded water quality standards. For Zn, some exceedances occurred over the first month of the study only.

Generation of secondary effluent constituents harmful to aquatic ecosystems, including BOD, orthophosphate, and ammonia, were measured during each sample event. Overall, concentrations of each of these constituents started out at their maximum concentrations, followed by a decrease for the remainder of the study and reaching steady-state in the effluent. Removal of these constituents is demonstrated by the post-treatment system results presented in Section 4.2.6.

4.2.3 SAPS Pre-treatment and BCR2

The second treatment train included SAPS pre-treatment followed by woody substrate BCR2 (no additional Chitorem). The following subsections summarize the SAPS and BCR2 effluent water quality.

Field Parameters

The SAPS raised pH to a range between 5.06 and 6.63 su, and BCR2 further increased the pH to 5.92 to 6.78. The amount of pH increase from BCR2 compared to the SAPS varied throughout the study but was as high as a 0.8 to 1.1 su increase in some samples; however, effluent pH from BCR2 was often not within the DEQ standard range (6.5 to 9.0 su).

Specific conductance ranged from 1,350 to 2,760 µS/cm in the SAPS and from 1,300 to 6,680 µS/cm in BCR2. Effluent specific conductance was greater than the influent initially in both barrels due to the flushing of soluble components from the substrates, which is expected during startup. After startup, specific conductance was similar to or less than the influent.

SAPS ORP ranged from -55.0 mV on 6/11 to a high of 154.3 mV on 6/24, and BCR2 ORP ranged from 32.3 mV on 6/17 to a low of -288.1 mV on 7/15. SAPS ORP remained positive after the first sample; however, it was still significantly less than the influent MIW ORP. BCR2 ORP varied but remained negative and below approximately -150 mV after the first few weeks. ORP increases to around -150 mV on 8/19 and 9/2 may have been related to flow rate increases although the ORP increase to greater than -100 mV in BCR1 was not observed with the SAPS/BCR2 system.

The SAPS DO ranged from less than 0.1 mg/L initially to as high as 3.86 mg/L. DO in the SAPS was always less than the influent MIW. BCR2 DO ranged from less than 0.1 mg/L initially to 2.1 mg/L on 9/16. DO for BCR2 was significantly reduced throughout the study as compared to the influent MIW.

Metals

The following includes observations of metal trends, removal efficiency ranges, and comparison to water quality standards.

- Dissolved Al concentrations from the SAPS ranged from non-detect (250 µg/L) to 732 µg/L compared to 10,000 to 15,000 µg/L in the influent MIW. This reduction equates to a removal efficiency range of 94.7 to 99.1%. Removal of dissolved Al in the SAPS is desirable so that aluminum precipitates do not clog the BCR. Where measureable, BCR2 provided additional Al removal with a dissolved concentration range of 9.6 to 282 µg/L. Dissolved removal efficiency for BCR2 compared to the SAPS effluent ranged from greater than 17.8 to 98.7% while the overall removal efficiency was consistently greater than 97% (calculated by comparing the BCR2 effluent to the SAPS MIW influent). Dissolved Al from BCR2 exceeded the chronic aquatic standard of 87 µg/L on 6/11, 6/24, and 9/2. On 9/16 and 9/23, both dissolved and total Al were non-detect (less than 250 µg/L), followed by a detection of dissolved Al at less than the chronic aquatic standard on 9/29.

- Dissolved As concentrations from the SAPS ranged from 3.1 to 36.2 µg/L while removal efficiency ranged from 78.2 to 98.3%. For BCR2, dissolved As concentrations ranged from 15.6 µg/L for the first event to 1.2 µg/L for the last event. From 8/6 through 9/23 (five events), both dissolved and total As in BCR2 effluent were non-detect (less than 20 µg/L). The last sample event indicated significant removal of As to less than 2 µg/L. Due to the higher SAPS As removal, additional As removal by BCR2 cannot be determined. Except for the first event, the overall total and dissolved removal efficiencies ranged from 83.7 to 99% and 84.5 to 99.3%, respectively. When detected, results from the first three events exceeded the human health As standard of 10 µg/L.

- Dissolved Cd concentrations from the SAPS ranged from 5.25 µg/L in the first sample to non-detect (less than 2 µg/L) for most of the study while the removal efficiency ranged from 98 to greater than 99%. For BCR2, dissolved Cd concentrations were non-detect (less than 2 µg/L) for most of the study except on 6/24 (1.1 µg/L). Total Cd did not vary significantly compared to dissolved Cd for both the SAPS and BCR2. Due to low concentrations and reporting limits, differences between Cd removal in the SAPS and BCR2 cannot be determined, except for the last event, which shows that both total and dissolved Cd were slightly decreased by BCR2 (less than 1 µg/L) compared to the SAPS (2.2 µg/L). Overall dissolved Cd removal efficiency was greater than 99% for the entire study.

- Dissolved Cu concentrations from the SAPS ranged from 44 µg/L in the first sample to a low of non-detect (less than 10 µg/L) while the removal efficiency was greater than 98%, except for the first sample (96.4%). For BCR2, dissolved Cu concentrations ranged from 35.2 µg/L in the second sample to non-detect (less than 10 µg/L) while the overall dissolved Cu removal efficiency was consistently greater than 96%. In the first few sample events, total Cu was greater than dissolved for BCR2 representing suspended Cu precipitates and/or sorbed to organic matter discharging from the BCR. Total Cu exceeded the acute and chronic aquatic water quality standards for the first two sample events. No other exceedance of water quality standards occurred for the remainder of the study.

- Dissolved Fe concentrations from the SAPS ranged from 6,260 µg/L in the first sample to a high of 112,000 µg/L while the removal efficiency was 95.9% initially, followed by a decrease to a removal ranging from 16.5 to 41.8% for the last eight sample events. Total Fe discharging from the SAPS was slightly higher but not significantly different than dissolved. This indicates that the SAPS was performing as intended in decreasing the oxidation state of the raw MIW and converting ferric Fe to soluble ferrous Fe that would not precipitate out in the higher pH of the SAPS. For BCR2, dissolved Fe concentrations ranged from non-detect (less than 1,250 or 250 µg/L) to 1,730 µg/L while the removal efficiency compared to the SAPS effluent was greater than 99%, except for the first sample event. Where comparisons could be made, the chronic aquatic standard was exceeded in some BCR2 samples.

- Dissolved Pb concentrations from the SAPS were non-detect for the entire study (less than 2 µg/L) with a removal efficiency of greater than 98%. For the last sample event, dissolved and total Pb were detected in the SAPS at 0.21 and 1.8 µg/L, respectively. Due to low concentrations and reporting limits significant differences between Pb removal in BCR2 after the SAPS cannot be determined, except for the last event, which shows that both total and dissolved Pb were slightly decreased by BCR2 compared to the SAPS. Overall dissolved Pb removal efficiency compared to the MIW influent was greater than 98% throughout the study. Total removal efficiency was slightly lower for the first 6 weeks. Total Pb exceeded the human health and chronic aquatic standards on 6/11 only.

- Dissolved Mn concentrations in the SAPS ranged from 28,200 µg/L in the first sample to a high of 118,000 µg/L while the removal efficiency ranged from 73.4% initially, down to slightly negative from 7/22 through 9/2, and 11.1 to 21.4% for the last month. For BCR2, dissolved Mn concentrations ranged from 3,980 µg/L in the first sample to a high of 107,000 µg/L. BCR2 removed significant additional Mn for the first 7 weeks, but then removal efficiency declined to slightly negative or at less than 20%. Again, these trends are representative of removal via adsorption and then breakthrough.

- Dissolved Zn concentrations in the SAPS ranged from 2,260 µg/L in the first sample to a high of 38,100 µg/L while the removal efficiency ranged from 96.2% initially to 28.5% at the end of the study. Based on the data trend, Zn removal by the SAPS follows a breakthrough curve representing sorption to organic matter. For BCR2, dissolved Zn concentrations ranged from 39.9 to 268 µg/L while the removal efficiency compared to the SAPS effluent was greater than 99% except for the first sample event. For some sample events, total Zn was greater than dissolved for BCR2 representing suspended Zn precipitates and/or sorbed to organic matter discharging from the BCR. Total Zn also exceeded the chronic and acute aquatic water quality standards for some sample events. The human health Zn standard was also exceeded on 7/8. Overall dissolved Zn removal efficiency for the SAPS/BCR2 system was greater than 99% for the entire study.

Wet Chemistry Parameters

SAPS effluent sulfate concentrations ranged from 806 to 1,130 mg/L, generally following the trend in changing influent sulfate where concentrations were the highest at the beginning of the study and then decreased. SAPS sulfate removal efficiency ranged from 20 to a low of 1%, which was expected since a SAPS is not intended to provide sulfate reduction but to provide a reduction in oxidation state. Precipitation of gypsum ($CaSO_4$) may account for the slight sulfate decrease in the SAPS as it reacts with the calcium dissolved from the limestone. BCR2 effluent sulfate concentrations ranged from 349 to 960 mg/L, with removal efficiency compared to the SAPS of 9.4% for the first sample to as high as 62.8% on 7/22. Sulfide concentrations in BCR2 ranged from 10 mg/L on 9/23 to a high of 45 mg/L on 7/22, which generally correlates with changes in sulfate reduction. The flow-adjusted volumetric sulfate reduction rates for BCR2 ranged from 82 mmol SO_4/m^3-day in the first sample to a high of 485 mmol SO_4/m^3-day on 7/22. BCR2 sulfate reduction rate was calculated based on the SAPS effluent sulfate concentrations. Sulfate reduction also decreased to 88 mmol SO_4/m^3-day on 9/2, which likely was related to the increase in flow rate on 8/26 and stress to the microbial system. Overall, BCR2 volumetric sulfate reduction rates were near the designed rate of 300 mmol SO_4/m^3-day, except for the first sample event and after the flow rate increase at the end of August.

Nutrient-related parameters are shown in Figure 4.2-20 (BOD), 4.2-21 (orthophosphate), and 4.2-22 (ammonia). As a common trend for all BCR effluents, concentrations of each of these constituents started out at their maximum concentrations, followed by a decreasing trend and more stable discharge concentrations for the last 2 to 4 weeks.

Acidity concentrations in the SAPS ranged from non-detect (less than 4 mg/L) in the first sample to a high of 410 mg/L; however, compared to the raw influent MIW, acidity was reduced by 31.7 to 62.9%, not including the initial stagnant incubation time during startup. Alkalinity concentrations ranged from 481 mg/L in the first sample to 12.5 mg/L on 9/16. Over time, the SAPS pre-treatment went from net alkaline to net acidic; however, the SAPS was still generating alkalinity and maintaining a near-neutral pH. Once through BCR2, alkalinity increased significantly and acidity decreased. BCR2 acidity ranged from non-detect (less than 4 mg/L) to 30 mg/L on 9/2. The increase in acidity on 9/2 could be associated with stress to the microbial system from the increased flow rate. However, acidity again decreased to non-detect for the last three events once the flow rate was decreased. The first sample had the greatest alkalinity (1,630 mg/L), followed by a steady decrease for the remainder of the study. Similar to BCR, alkalinity concentrations may have stabilized around 60 mg/L for the last two weeks. Overall, these results indicate that the BCR2 system was generating significant alkalinity and remained in a net alkaline condition for the entire study.

Summary

The SAPS pre-treatment was intended to reduce some of the metals concentrations, reduce the oxidation state, and add alkalinity. The BCR treatment was intended to reduce sulfate and remove additional metals through metal sulfide precipitation. Compared to the year 1 study, the SAPS/BCR2 combination for year 2 improved in treatment efficiency due to the greater substrate retention time. The SAPS increased pH to greater than 5 su, generated alkalinity, decreased ORP and DO, and reduced concentrations of some metals prior to BCR treatment, primarily Al and Fe. Although effluent from the SAPS was still net acidic for most of the study, alkalinity was being generated, and acidity was much less than the influent MIW.

Removal of Cd, Cu, and Pb by the SAPS was significant; however, the removal was not expected to be sustained as surface sorption sites on the organic substrate become saturated. Removal of some amount of Al and Fe should continue due to increased pH resulting in Al and Fe oxy-hydroxide precipitation. By the end of the study, Al removal efficiency started to decrease. Some Fe removal was likely due to initial formation of Fe oxy-hydroxide precipitates, but as the ORP decreased, iron reduces from ferric to ferrous iron, which remains soluble at the higher pH. Iron removal efficiency reached a consistent range (26 to 37% Fe removal for the last three sample events). Arsenic was also removed by the SAPS, most likely through co-precipitation with the iron oxy-hydroxide precipitates that formed.

After the SAPS, BCR2 removed additional Al to concentrations near or below the aquatic standard and significant amounts of the remaining Fe and Zn. After the first month of startup, removal efficiency of dissolved Fe and Zn compared to the SAPS effluent was greater than 97% and in many samples greater than 99%. Removal of these metals was often to concentrations near or below human health and aquatic standards where applicable. The degree of additional removal of As, Cd, Cu, and Pb by

BCR2 after the SAPS could not be determined due to the significant removal by the SAPS and the variable laboratory reporting limits. Except for the first sample event, overall dissolved and total Al, Cd, Cu, Fe, Pb, and Zn removal efficiencies for the SAPS/BCR2 system compared to the influent MIW ranged from greater than 92 to 99% for the entire study.

Overall, the SAPS/BCR2 treatment provided significant sulfate reduction, sulfide formation, alkalinity generation, and metal removal. The treatment improvements for year 2 can be attributed to the lower treatment flow rates and larger SAPS substrate volume compared to the year 1 study. The year 2 study started at 8.3 ml/min, compared to 37 ml/min for year 1. After the two-fold increase in flow rate on 8/26, results from the 9/2 sample event indicate decreased sulfate reduction and increased acidity production by the BCR. On 9/2, field observations of a slightly increased ORP compared to on 8/26 prompted decreasing the flow rate back to 8.3 ml/min. This decrease in flow rate made an apparent improvement in treatment by decreasing acidity back to non-detect, increasing sulfate reduction, and decreasing ORP. BCR effluent pH also began to increase in response to the reduced flow rate.

4.2.4 Chitorem Pre-treatment and BCR3

The third treatment train included Chitorem pre-treatment followed by a woody substrate BCR3. The following subsections summarize the Chitorem and BCR3 effluent water quality.

Field Parameters

The Chitorem barrel (shown as "CHIT" in sample names and referred to in this report for simplification) raised pH to a range between 5.37 and 8.43 su while BCR3 effluent pH ranged from 6.30 to 6.87. Effluent pH from CHIT was highest at the beginning of the study and gradually decreased to between approximately 5.5 and 6.1 su for the last month. After the first 5 weeks, pH began to increase from BCR3 compared to the CHIT. During this period, BCR3 provided on average a 0.6 su pH increase. Effluent pH from BCR3 was within the DEQ standard range (6.5 to 9.0 su) for most of the samples.

Specific conductance ranged from 1,300 to 5,794 µS/cm in CHIT and from 1,300 to 6,706 µS/cm in BCR3. Effluent specific conductance was greater than the influent initially in both barrels due to the flushing of soluble components from the substrates, which is expected during startup. By the last month of the study, effluent specific conductance from the CHIT and BCR3 was similar to or less than the MIW influent. Effluent specific conductance from the Chitorem barrel was not as high at the beginning of the study as it was in year 1, which may be related to the lower quantity of Chitorem used in the barrel for year 2.

CHIT ORP was mostly above 0 for the first month, followed by a decrease to between -144.1 to -260 mV until 8/12. After the flow rate increases on 8/12 and 8/26, ORP in CHIT gradually increased to 60.8 mV. After the decrease in flow rate on 9/9, ORP in CHIT appeared to recover initially to -260.1 mV (and due to no influent MIW flow from the broken pipeline) but then increased again to above 0 by the end of the study. For BCR3, flow rate changes had much less of an effect on ORP results. ORP in BCR3 ranged from 13.2 to -332.1 mV. The highest values were during the first three weeks of the study, followed by a significantly negative ORP trend within the range needed for sulfate reduction to occur. After the second flow rate increase, ORP did increase to -188 mV on 9/2 but then decreased again in the next sample events.

The CHIT DO ranged from 0.27 mg/L to as high as 9.77 mg/L on 6/11. The high value on 6/11 was higher than the DO of the influent water and was measured only 2 days after the 0.27 mg/L measurement, which indicates a potential measurement error for this high value. In addition, the corresponding DO reading from BCR3 on 6/11 was less than 0.1 mg/L. BCR3 DO ranged from less than 0.1 mg/L initially to 2.22 mg/L on 9/16, with values less than the CHIT effluent for most of the study.

Metals

The following includes observations of metal trends, removal efficiency ranges, and comparison to water quality standards.

- Dissolved Al concentrations from the CHIT ranged from non-detect (50 µg/L) to 2,300 µg/L while removal efficiency was greater than 98% through 8/19, followed by a decrease in efficiency likely due to flow rate increases. Both dissolved and total Al began to increase on 9/2 and thereafter to a high total Al of 17,600 µg/L on 9/29. Total metals were generally similar to dissolved in the CHIT, except for the last month when total concentrations increased. For BCR3, dissolved Al concentrations ranged from 5.5 µg/L to 279 µg/L while the overall removal efficiency was greater than 98%, except for the first sample event. When Al was detected in the CHIT, BCR3 provided additional removal. Dissolved Al from BCR3 slightly exceeded the chronic aquatic standard of 87 µg/L in some samples.

- Dissolved As concentrations from the CHIT ranged from 2.8 to 48.5 µg/L while removal efficiency ranged from 81.6 to 98.4%. For BCR3, dissolved As concentrations had a decreasing trend from a high of 15.6 µg/L for the first event down to 1.2 µg/L for the last event. Compared to the year 1 study, these As results for the CHIT/BCR3 system were much lower overall. A significant difference between As removal in the CHIT and BCR3 cannot be determined. When detected, the As human health standard of 10 µg/L was exceeded in BCR2 only for the first five sample events.

- Dissolved Cd concentrations from the CHIT ranged from non-detect (less than 2 µg/L) to 0.27 µg/L for the last sample event while removal efficiency was greater than 99% for the entire study. Total Cd began to increase for the last month of the study and reached influent MIW concentrations by the last sample event. For BCR3, dissolved Cd concentrations were consistently non-detect (less than 2 µg/L and less than 1 µg/L for the last sample event). Total Cd in BCR3 was also non-detect except for the first sample event. Overall dissolved and total Cd removal efficiency by the CHIT/BCR3 system was greater than 99% for the entire study. Significant differences between Cd removal in the CHIT and BCR3 cannot be determined except when total Cd concentrations began to increase in the CHIT effluent for the last month of the study. High total Cd removal efficiency was observed in BCR3 during this period.

- Dissolved Cu concentrations from the CHIT ranged from 24.3 µg/L in the first sample to 2 µg/L for the last sample while removal efficiency was greater than 99% for the entire study. From 7/8 through 9/23 (seven events), dissolved Cu was non-detect (less than 10 µg/L). Similar to Cd, total Cu began to increase for the last month of the study in the CHIT effluent, and a higher removal efficiency by the BCR3 was observed. For the last month, BCR3 total Cu removal efficiency ranged from 94 to 99%. Total Cu in BCR3 exceeded the chronic aquatic water quality standard for the first two sample events and the acute standard for the first event. No other exceedance of water quality standards occurred for the remainder of the study.

- Dissolved Fe concentrations from the CHIT ranged from 407 µg/L in the first sample to a high of 74,900 µg/L in the last sample, while the removal efficiency ranged from 97 to 98% for the first six sample events (through 8/19), followed by variable efficiencies between approximately 50 and 98%. Total Fe followed a similar trend although at higher concentrations overall. The increase in total Fe on 9/2 likely was due to the increased flow rate the previous week. This observation concurs with the ORP readings that indicate an increased oxidation state on 9/2 above 0, which may lead to instability of Fe sulfide precipitates. For BCR3, dissolved Fe concentrations ranged from 2,070 µg/L to non-detect (less than 1,250 or 250 µg/L) while the removal efficiency compared to the CHIT effluent ranged from negative in the first sample to greater than 97%. The overall removal efficiency of the CHIT/BCR3 system was consistently greater than 98 and 97% for dissolved and total Fe, respectively. Where comparisons could be made, the chronic aquatic standard was exceeded in some BCR3 samples.

- Dissolved Pb concentrations in the CHIT were non-detect (less than 2 µg/L) except for the last sample event (estimated at 0.2 µg/L). Dissolved removal efficiency was greater than 98% for the entire study. Similar to Al, Cd, Cu, and Fe, total Pb began to increase for the last month of the study. For BCR3, dissolved Pb concentrations ranged from 2.19 µg/L in the first sample to 0.062 µg/L in the last sample. Several dissolved results in BCR3 were non-detect (less than 2 µg/L), which limits the ability to compare changes with the CHIT effluent that was also non-detect. Once CHIT total Pb concentrations increased above reporting limits for the last month of the study, BCR3 total Pb removal efficiency compared to the CHIT was greater than 94%. Total Pb in BCR3 effluent exceeded the human health and chronic aquatic standards on 6/11 only.

- Dissolved Mn concentrations in the CHIT ranged from 2,110 µg/L in the first sample to a high of 96,300 µg/L while the removal efficiency ranged from 98% initially to 12.2%. For BCR3, dissolved Mn concentrations ranged from 4,010 µg/L in the first sample to a high of 66,000 µg/L. Except for the first event, BCR3 removed additional total Mn from the CHIT effluent ranging from 86.4 to 28.4%. The overall total Mn removal efficiency of the CHIT/BCR3 system ranged from 95.6% in the first sample down to around 30 to 50% in the last month.

- Dissolved Zn concentrations in the CHIT ranged from 30.2 to 297 µg/L for the first nine sample events. On the last sample event, dissolved Zn significantly increased to 14,100 µg/L. Dissolved removal efficiency was greater than 99%, except for the last sample. On sample events from 7/22 through 8/19, total Zn was detected greater than dissolved but still less than 1,000 µg/L. Then on 9/2, total zinc significantly increased to 15,900 µg/L and remained high for the month. These results appear to follow similar trends as Fe and other metals with respect to oxidation state increases with flow rate; however, dissolved Zn was still less than 100 on 9/2, 9/16, and 9/23. Thus, the increased total Zn was related to increased discharge of suspended Zn precipitates or particulates with sorbed Zn. For the last event, precipitates may have been dissolving or the CHIT was removing only limited Zn. For BCR3, dissolved Zn concentrations ranged from 7.4 to 155 µg/L while the overall dissolved removal efficiency of the CHIT/BCR3 system was consistently greater than 99%. Total Zn removal efficiency was also greater than 99%, except for the first sample event (98.8%). Total Zn in BCR3 exceeded water quality standards in the first sample only.

Wet Chemistry Parameters

CHIT effluent sulfate concentrations ranged from 543 to 1,020 mg/L, generally following the trend in changing influent sulfate. CHIT sulfate removal efficiency ranged from 49.3 to 15.3%. Sulfate removal in the CHIT was greater than the SAPS as a pre-treatment since the Chitorem contains SRB and maintained a reducing condition conducive for sulfate reduction through at least August. BCR3 effluent sulfate concentrations ranged from 237 to 912 mg/L, with removal efficiency compared to the CHIT of 6.4% for the first sample to as high as 70.7% on 9/23. Sulfide concentrations in BCR3 ranged from 41 mg/L on 7/8 to a high of 120 mg/L on 7/22, which are the highest sulfide concentrations generated by any of the BCRs. The flow-adjusted volumetric sulfate reduction rates for BCR3 ranged from 51 mmol SO_4/m^3-day in the first sample to a high of 529 mmol SO_4/m^3-day on 7/8. Throughout most of the study CHIT sulfate reduction rates were actually greater than the BCR3 that followed it although some of the observed sulfate removal may be due to gypsum precipitation from the high calcium content of the Chitorem. Overall, BCR3 volumetric sulfate reduction rates were near the designed rate of 300 mmol SO_4/m^3-day, except for the first two sample events and after the flow rate increase at the end of August.

Nutrient-related parameters for BCR3 have the same general trends as the other BCR treatment systems. Concentrations of each of these constituents started out at their maximum concentrations, followed by a decreasing trend and more stable discharge concentrations for the last 2 to 4 weeks. BCR3 had the highest overall BOD and ammonia concentrations compared to other BCRs throughout the study. BCR3 orthophosphate concentrations were similar to other BCRs and slightly higher during the last month. For CHIT, lows in orthophosphate concentrations correlated with ORP values near or above 0. These results may indicate that the Chitorem material is releasing phosphate only under more reducing conditions.

Acidity concentrations in the CHIT ranged from non-detect (less than 4 mg/L) to a high of 320 mg/L, and alkalinity concentrations ranged from 2,270 mg/L on 7/8 down to 28.1 mg/L on 9/23. The CHIT pre-treatment remained net alkaline until the last 2 weeks of the study. In BCR3, alkalinity concentrations ranged from 1,300 to 2,600 mg/L. The BCR3 effluent was net alkaline throughout the course of the study as a result of the alkalinity generated by the Chitorem barrel. Even as the Chitorem barrel alkalinity continued to decrease, BCR3 was generating additional alkalinity greater than the Chitorem barrel effluent, some of which likely was created by the sulfate reduction processes. For BCR3 however, acidity remained non-detect throughout the study. BCR3 alkalinity reached a peak on 7/8 (2,490 mg/L) and 7/22 (2,450 mg/L), followed by a gradual decrease for the remainder of the study. These peak alkalinity concentrations corresponded with some of the most reduced ORP values, highest sulfide concentrations, and greatest sulfate reduction rate, which indicated elevated alkalinity was probably biologically driven by the sulfate reduction process.

Related to the alkalinity, CHIT hardness also reached a maximum concentration on 7/8 (2,920 mg/L), followed by a decrease to 637 mg/L on 9/23. Although calcium and magnesium concentrations were not analyzed, hardness provides a representation of the dissolution of calcium carbonate into calcium and magnesium ions. The coinciding decreases in alkalinity and hardness in CHIT may indicate a decrease in available calcium carbonate in the system to react with the influent acidity.

Summary

The CHIT pre-treatment was intended to provide a similar water quality improvement as the SAPS; however, because the substrate contains SRB, alkalinity, and a carbon source, some sulfate reduction occurred ahead of the BCR. The combined sulfate reduction and chemical precipitation processes from the calcium carbonate in the substrate resulted in significant removal of many metals prior to the BCR.

The CHIT consistently removed dissolved Cd, Cu, Pb to greater than 98 to 99% throughout the study. However, for the last month, total concentrations of these metals began to increase along with total and dissolved increases in Al, Fe, and Zn. Through 8/19, dissolved removal efficiencies for Al and Fe were greater than 97 to 99%, followed by a decrease in efficiency. Dissolved Zn removal efficiency was also greater than 99% except for the last sample. Increases in metals in the last month correspond with an increase in ORP above 0 and a decrease in pH below 6 su on 9/2 due to the second flow rate increase. A large increase in dissolved and total Fe occurred on 9/2 along with increases in total Al, Cd, Cu, Pb, and Zn but no equivalent increases in dissolved concentrations of these metals. Based on the high suspended metal concentration, the increases in these metals may have been due to co-precipitation with Fe oxy-hydroxides that passed through the CHIT barrel. With these observations in the last month, the higher Chitorem treatment efficiency observed at the beginning of the study is not likely to be maintained for the longer term or at higher flow rates. The decrease in hardness and alkalinity, along with decreased metal removal efficiency and increased ORP, indicates that the Chitorem in the pre-treatment barrel may have begun to be exhausted.

After the CHIT, BCR3 provided significant additional metal removal where comparisons could be made. Even when metals concentrations increased in the last month from the CHIT effluent, BCR3 total removal efficiencies remained greater than 94 to 99% for Al, Cd, Cu, Fe, Pb, and Zn. Except for the first sample event, overall CHIT/BCR3 dissolved and total removal efficiencies for these same metals were greater than 96 to 99%. Some of the Al, Cd, Cu, Fe, Pb, and Zn concentrations exceeded water quality standards where comparisons could be made.

Overall, the CHIT/BCR3 treatment provided significant sulfate reduction, sulfide formation, alkalinity generation, and metal removal. The treatment improvements for year 2 can be attributed to the lower treatment flow rates compared to the year 1 study and a decrease in Chitorem percentage in the substrate mixture, allowing for maintained hydraulic flow throughout the study. After the two-fold increase in flow rate on 8/26, CHIT results from the 9/2 sample event indicate increased ORP, decreased pH and sulfate reduction, increased acidity, and increased total metals. However, BCR3 still maintained net alkalinity, sulfate reduction, sulfide generation, and metal removal. A similar decrease in sulfate reduction as other BCRs occurred in BCR3 2 weeks later on 9/16 rather than on 9/2 in other BCRs.

4.2.5 Alkaline Addition Pre-treatment and BCR4

The alkaline addition pre-treatment (NaOH barrel) was followed by BCR4. The following subsections summarize the NaOH pre-treatment and BCR4 effluent water quality. As discussed in Section 2.2.4.2, problems occurred with the NaOH solution dosing. The peristaltic pump tubing was collapsing within the pump headstock, which required advancing or replacing tubing at times. In three cases, the tubing line became disconnected from the NaOH stock tank, resulting in no NaOH dosing for some period of time between the weekly site visits. NaOH dosing also had to be fine-tuned throughout the study to provide adequate NaOH to raise pH to the desired result, including when MIW flow rates were modified later in the study. All of these issues resulted in inconsistent dosing and pH adjustment, which limits the ability to evaluate trends and treatment effectiveness. Because of these overall issues, less effective or inconsistent pre-treatment is expected; therefore, more emphasis is placed on overall

BCR4 treatment performance (NaOH and BCR4) in the subsections below. Where applicable, specific NaOH field or laboratory results are discussed. All data are still presented in the tables and figures.

Field Parameters

The NaOH barrel raised pH to a range between 2.80 and 11.47 su while BCR4 increased pH to a range between 5.96 and 7.11. The one time high result of 11.47 su occurred on 9/16, consistent with when the MIW influent line froze and broke in the week prior to this event. As a result of lack of influent MIW at some point during that week, continued NaOH dosing resulted in a significant increase in pH. Issues with the pre-treatment resulted in field pH measurements less than 4.0 su in a number of cases. Despite the often low influent pH on some of the sample events, effluent pH from BCR4 remained similar to other BCRs, with some samples below the 6.5 su standard. After the first month (7/15 event), NaOH effluent pH fluctuated between greater than 4 and less than 4 su through 9/2. Although the pre-treatment had operational issues, the pre-treatment successfully increased pH to greater than 4 or 5 su on 7/22, 8/6, 8/19, 9/2, 9/16, and 9/23. All of these sample events corresponded to laboratory sample dates, which allows evaluation of treatment efficiency with laboratory data. Pre-treatment results less than 4 su that occurred on 7/29, 8/12, and 8/26 corresponded with non-laboratory sample dates.

Specific conductance ranged from 1,340 to 7,010 µS/cm in BCR4. Effluent specific conductance was greater than the influent initially due to the flushing of soluble components from the substrates, which is expected during startup. After startup, specific conductance was similar to the influent.

BCR4 ORP ranged from 18.9 mV on 6/17 to a low of -310 mV on 8/12. After the initially high ORP, values decreased to less than -250 mV by 7/8. ORP increased to -170.7 mV after the first flow rate increase on 8/12, decreased the next week, and increased again to -157 mV after the second flow rate increase on 8/26. Following the flow rate decrease on 9/9 (and lack of influent MIW flow during part of that week), ORP decreased again to below -200 mV. ORP remained less than -150 mV for the last 2 weeks.

BCR4 DO ranged from less than 0.1 mg/L initially to 2.33 mg/L on 9/16. The NaOH pre-treatment DO remained greater than the influent MIW for most of the study likely due to the splash mixing that occurred in the barrel. Despite this high DO, BCR4 maintained effective treatment as exemplified by ORP and other parameters described in the subsections below.

Metals

The following includes observations of metal trends, removal efficiency ranges, and comparison to water quality standards.

- Al removal did not occur in the NaOH pre-treatment until pH increases were above 5 su on 8/6, 8/19, 9/2, and 9/16. Dissolved Al concentrations in BCR4 ranged from 460 µg/L in the first event to 4.2 µg/L in the last event while the overall removal efficiency compared to the raw MIW influent was greater than 97%, except for the first event. Total Al was similar to or slightly greater than dissolved. Dissolved Al from BCR4 exceeded the chronic aquatic standard of 87 µg/L on 6/11, 6/24, 7/8, and 9/2. On 7/22, 8/6, 8/19, 9/16, and 9/23, dissolved Al was non-detect (less than 250 µg/L), followed by a detection of dissolved Al at less than the chronic aquatic standard on 9/29.

- Dissolved As removal efficiency in the NaOH barrel ranged from greater than 81 to 96%, likely due to higher Fe removal (see below). BCR4 dissolved As concentrations ranged from 29.5 µg/L for the first event to non-detect for the last event (less than 1 µg/L) while the overall dissolved removal efficiency ranged from 86.0 to 95.8%. When detected, the As human health standard was exceeded in BCR4 only for the first four sample events.

- The NaOH pre-treatment did not reduce Cd concentrations except for on 8/19, 9/2, and on 9/16 when pre-treatment pH was above 5 su. BCR4 dissolved Cd concentrations were non-detect (less than 2 or 1 µg/L), except for the first two sample events. Overall dissolved and total Cd removal efficiencies were greater than 99% except for the first three sample events. Total Cd removal was less for the first three sample events due to elevated total Cd compared to dissolved Cd. When detected, total Cd often exceeded the low chronic aquatic water quality standard.

- Similar to Cd, the NaOH pre-treatment only reduced Cu concentrations during periods of elevated pre-treatment pH above 5 su. BCR4 dissolved Cu concentrations ranged from 63.3 µg/L for the first event to non-detect for the last event (less than 2 µg/L). The overall dissolved removal efficiency ranged from 94.8% to greater than 99%. Dissolved and total copper exceeded the acute and chronic aquatic water quality standards for the first sample event. Total copper exceeded the chronic standard only for the next two sample events.

- Of all other metals, Fe was the most significantly reduced by the NaOH pre-treatment due to even slight pH increases above 3 su that result in increased ferric Fe precipitate formation. Dissolved Fe concentrations in the NaOH barrel ranged from 563 to 51,700 µg/L while the dissolved and total removal efficiencies ranged from greater than 99% to 59%. Removal efficiencies were the lowest at the beginning and end of the study, with dissolved efficiencies greater than total. For BCR4, dissolved Fe concentrations ranged from 496 to 1,440 µg/L while the overall dissolved and total removal efficiencies were 98% or greater for the entire study. BCR4 Fe concentrations exceeded the chronic aquatic standard for the first three sample events.

- Similar to Cd and Cu, the NaOH pre-treatment only reduced Pb concentrations during periods of elevated pre-treatment pH above 5 su. For BCR4, dissolved Pb concentrations ranged from 16.2 µg/L in the first sample to non-detect (less than 1 or 2 µg/L) while the overall dissolved and total removal efficiencies were greater than 98%, except for the first and third sample events. Pb in BCR4 effluent exceeded water quality standards on 6/11 only.

- Mn was not removed by the pre-treatment NaOH barrel except for when pH was increased above 11 su. This elevated pH is sufficient to precipitate Mn in oxy-hydroxide forms. BCR4 followed the same Mn removal trends as other BCRs, with higher removal initially followed by a decline in efficiency. BCR4 dissolved Mn concentrations ranged from 9,680 µg/L in the first sample to a high of 99,300 µg/L. Dissolved Mn was also significantly reduced on the last sample event to 366 µg/L while the total Mn on that same day was 67,000 µg/L. This difference could be explained as suspended precipitates from the NaOH treatment passing through the BCR4 while dissolved Mn remained low.

- Zn was removed by the NaOH pre-treatment only when the pH was greater than 5 su. For BCR4, dissolved Zn concentrations ranged from 1,920 µg/L for the first sample event to 50.4 µg/L while the overall dissolved Zn removal efficiency was greater than 98%, except for the first sample event. Overall total Zn removal efficiencies ranged from 88.7 to greater than 99%. Typically, total zinc concentrations were greater than dissolved. BCR4 total Zn exceeded the chronic and acute aquatic standards for the entire study. Total Zn also exceeded the human health standard during some sample events.

Wet Chemistry Parameters

The NaOH pre-treatment did not reduce sulfate nor was it expected to. BCR4 effluent sulfate concentrations ranged from 526 to 1,030 mg/L, with removal efficiency compared to the MIW influent of 10.4% for the first sample to as high as 51.3% on 7/22. Sulfide concentrations in BCR4 ranged from 5 mg/L on 7/8 to a high of 68 mg/L on 8/19. The flow-adjusted volumetric sulfate reduction rates for BCR4 ranged from 8 mmol SO_4/m^3-day in the first sample to a high of 595 mmol SO_4/m^3-day on 7/8. The NaOH/BCR4 system followed a similar trend to the previous BCRs.

Compared to the influent MIW, the NaOH pre-treatment provided some decrease to influent acidity, which can be attributed to the iron removal that occurred. Acidity concentrations in BCR4 were non-detect throughout the study while alkalinity concentrations ranged from 1,540 mg/L in the first sample to 51 mg/L. Alkalinity concentrations in BCR4 gradually decreased throughout the study but maintained a net alkaline treatment.

Summary

Overall, NaOH treatment effectiveness was inconsistent due to operational problems. After the first month, pre-treatment pH was above 4 or 5 su on five laboratory sample events from 7/22 to 9/16 but coincidentally decreased below 4 su on the non-laboratory sample events. As expected, the higher the pH, the more removal of higher solubility metals such as Cd, Cu, Pb, Zn, and even Mn when pH was greater than 11 su. Removal of Fe and As was more consistent throughout the study, despite pH fluctuations. Due to the high Fe concentration present in the influent MIW, even slight pH increases would have resulted in ferric Fe oxy-hydroxide precipitation and co-precipitation of the As.

Despite the pre-treatment fluctuations, BCR4 provided fairly consistent metal treatment efficiency and maintained sulfate reduction, alkalinity, and sulfide generation similar to other BCRs in the study. ORP was significantly negative (e.g., less than -250 mV) until flow rate changes were implemented. Similar to other BCRs, ORP increased after each flow rate increase compared to the previous week, followed by an overall ORP decrease after the flow rate decrease on 9/9. However, even with flow rate increases, ORP remained less than -150 mV. Also similar to BCR2 and BCR3, the volumetric sulfate reduction rate decreased after the flow rate increases, followed by a recovery when flows were decreased.

Except for the first sample event, overall dissolved Al, Cd, Cu, Fe, Pb, and Zn removal efficiencies for the NaOH/BCR4 system compared to the influent MIW were greater than 97% for the entire study. Overall total removal efficiencies for these same metals ranged from 88.7% to greater than 99% (again excluding the first sample event). When detected in BCR4, results for some of these metals exceeded water quality standards.

4.2.6 Post-Treatment Oxidation Tests

The following subsections summarize the results for the influent and effluent from the post-treatment oxidation system.

Field parameters

The combined post-treatment system influent (POSTI) pH ranged from 5.93 to 7.71 su while the post-treatment (POSTE) pH ranged from 6.07 to 8.08 su. From 7/2 through 8/26, the post-treatment system provided a 0.58 to 1.25 su pH increase from the average influent. On 9/2 and 9/9, POSTE pH was less than the DEQ standard of 6.5 su.

POSTI-specific conductance was similar to BCRs as values continued to decline throughout the study. The post-treatment system appeared to provide some specific conductance reduction during the middle part of the study although values between POSTI and POSTE were mostly very similar for the last month of the study.

POSTI ORP ranged from -315.9 to 27.8 mV while POSTE ORP ranged from -299.4 to 326 mV. During the startup period through mid-July, the post-treatment system did not provide much increase in oxidation state. On 7/22, the post-treatment system began to provide some increase in ORP. On 8/26 and beyond, a significant increase in ORP was observed. Similarly, an increase in DO was observed at the end of the study although rather erroneous POSTE DO measurements were collected. On 9/9, 9/16, and 9/30, POSTE DO was above 10 mg/L and above the saturation limit of DO. At the temperature range observed for these samples (6 to 15°C), saturated DO concentrations at an elevation of approximately 6,000 ft should probably not be greater than approximately 8 to 10 mg/L. Since increased salinity also results in decreases in DO concentration, the range may be even lower for the higher salinity waters evaluated in this study. Salinity for the POSTE samples mostly comes from the dissolved calcium, sodium, manganese, magnesium, and sulfate ions.

Metals

Due to low or often non-detect metals concentrations in BCR effluents, additional removal of metals by the post-treatment system is difficult to determine, especially for dissolved metals. In an established full-scale system, some additional metal removal by the post-treatment system is anticipated, especially the total metal fraction that may be present as discharged precipitates from the BCR. Settling and polishing of these precipitates can occur in the settling pond(s) after the BCR as well as in the post-treatment aerobic wetland.

Some total metals concentrations were detectable in the POSTI and POSTE samples although removal efficiencies were variable. Total Al removal efficiency was negative for the study until the last sample event at 60.7%. As, Cd, Cu, Fe, Pb, and Zn total removal efficiencies were 53.2 to 85.3% on 7/8 but varied from negative to positive on other events, or calculations could not be made due to all non-detected results. For example, total Fe removal efficiency was -53.3% on 7/22, 73.2% on 8/6, non-detect on 8/19, greater than 50.4% on 9/2, and -477% on 9/16. A lot of the variability has to do with reporting limit fluctuations but is also due to variable discharge chemistries, air and water temperature, and degree of wetland biological activity. Except for the first event (6/24) and on 9/16, total Zn removal efficiency ranged from 35.7 to 80.9%. All major total metals concentrations (Al, As, Cd, Cu, Fe, Pb, and Zn) increased from the post-treatment influent to the effluent on 6/24 and 9/16.

Mn is one metal of note that was generally not removed effectively by the BCRs and appears to have been removed to some degree by the post-treatment system. Typically, Mn removal does not occur abiotically without a significant pH increase above 10 su (as happened with the NaOH barrel) or biochemically with the use of limestone and specific oxidizing bacteria. The total Mn removal efficiencies observed for the study ranged from 8.9% for the first POSTE sample on 6/24 to a high of

71% on 7/8. The specific removal mechanism is unknown although most plausibly is related to the aerobic wetland component.

Wet Chemistry Parameters

No acidity was detected in the post-treatment samples. Alkalinity concentrations between the POSTI and POSTE were similar. Sulfate concentrations between POSTI and POSTE varied between reduction and no significant change. During mid-summer (7/22 and 8/6), additional reduction in sulfate occurred, whereas concentrations were similar at the beginning and end of the study. Some additional sulfate reduction probably occurred in the post-treatment system due to the low influent ORP values and flushing of suspended substrate, soluble VFAs, and microorganisms to support some sulfate reduction.

Significant reduction in sulfide occurred in the post-treatment system. POSTI sulfide ranged from 12 to 53 mg/L, whereas POSTE sulfide ranged from 8 mg/L in the first sample on 7/8 to a low detection of 0.06 mg/L on 9/29. POSTE sulfide concentrations were non-detect from 8/19 through 9/23, with variable reporting limits (0.04, 0.2, and 1 mg/L). Sulfide removal efficiency ranged from 70.4% on 7/8 to greater than 99%.

As with BCR effluents, BOD, orthophosphate, and ammonia concentrations declined in the POSTI samples as the study progressed. BOD decreased in the post-treatment system throughout the study period (7/8 to 9/29), even at initially high concentrations. BOD removal efficiency ranged from 14.8% on 7/8 to greater than 96.8% on 9/29. BOD concentrations were non-detect on 9/2, 9/16, and 9/29, with variable reporting limits (40, 6, and 2 mg/L), which indicate increased removal towards the end of the study after the aerobic wetland system had become established. The post-treatment system also had high removal of orthophosphate, with removal efficiencies ranging from 71.6 to 99.3%. Ammonia was removed only slightly by the post-treatment system likely due to the lack of sufficient oxidation throughout the small-scale pilot process. Except for the results on 6/24 (-0.2% removal efficiency), ammonia removal efficiency ranged from 4.1 to 34.2%.

Summary

As with BCR effluents, BOD, orthophosphate, and ammonia concentrations declined in the POSTI samples as the study progressed. The post-treatment system provided significant removal of sulfide, BOD, and orthophosphate in the combined BCR influent. Acidity, alkalinity, and sulfate concentrations did not vary between POSTI and POSTE samples. Some minor additional sulfate reduction occurred in the post-treatment system during mid-summer. Due to low concentrations of metals in the BCR effluents, differences between the POSTI and POSTE samples cannot be identified. BOD, orthophosphate, and sulfide removal efficiencies ranged from 14.8 to greater than 96.8%, 71.6 to 99.3%, and 70.4 to greater than 99%, respectively. Ammonia removal in the post-treatment system was limited due to the high concentrations of BOD and insufficient oxidation.

4.3 Tiger Bench-Scale Treatability Study

The bench-scale treatability results are presented below. This bench-test work was conducted to determine an optimum combination of organic substrate, alkaline material, and inoculum that most efficiently achieves and maintains sulfate reduction for metals removal. Section 2.3.2 described the test setup and operations.

Table 4.3-1 presents all of the analytical laboratory metals and wet chemistry data for the bench-scale study. Table 4.3-2 presents all of the in-house CDM Smith laboratory data for the batch tests. Table 4.3-3 provides all of the removal efficiency calculations for the titration tests and batch tests. Removal efficiencies for titration tests were calculated by comparing samples collected after the titration to the raw MIW sample. Removal efficiencies for the batch tests were calculated by comparing samples collected at the end of the batch tests to the batch control test results. Table 4.3-4 provides a comparison to water quality standards for the batch test results. All of the same limitations to completing removal efficiency calculations or water quality standard comparisons discussed in Section 4.2 for the Danny T study apply to the Tiger bench-scale study.

Reporting limits provided by ESAT for metals were similar to the Danny T study data and varied between dissolved and total results. The variabilities limit the ability to compare to water quality standards. For example, the Al reporting limit provided by ESAT for this data set was 500 µg/L. As reporting limits varied between 20 and 100 µg/L. Cd reporting limits varied between 2 and 15 µg/L. Cu reporting limits varied between 10 and 50 µg/L. The Fe reporting limit was set at 2,500 µg/L. All of these reporting limits are above human health and/or chronic aquatic standards and in some cases above acute aquatic standards (i.e., Cd and Cu). Comparison to standards is provided in the sections that follow; however, caution should be applied to drawing conclusions from this comparison due to the high reporting limits. Pb and Zn were the only metals that had consistently low enough reporting limits to compare to all standards.

4.3.1 Raw MIW

To answer principal study question 1, this section describes the water quality parameters for the untreated (raw) MIW used in the Tiger bench-scale treatability study. Dissolved and total metals concentrations in the raw MIW were found to be very similar. Similar to the Danny T study, eight metals of concern are discussed in the following sections: Al, As, Cd, Cu, Fe, Pb, Mn, and Zn. Dissolved Fe, Mn, and Zn were found to have the highest concentrations of any metals in the raw MIW: 269,000, 25,400, and 12,100 µg/L, respectively. Dissolved Al, Cu, and Pb were measured to be 2,340, 1,450, and 952 µg/L, respectively. Dissolved As and Cd were measured at much lower concentrations of 29.5 and 43.8, respectively. Alkalinity, chloride, fluoride, nitrate, and nitrite were not detected in the raw MIW, but sulfate was found to be 1,120 mg/L, which provides enough sulfate for microbes to begin the sulfate reduction processes. Water hardness was measured to be 286 mg/L.

In comparison of the raw MIW to DEQ-7 standards (DEQ 2012), both dissolved and total metals exceeded human health standards for As, Cd, Pb, and Zn. Dissolved Cu (but not total Cu) exceeded the human health standards as well. Dissolved and total Al, Cd, Cu, Fe, Pb, and Zn exceeded chronic aquatic life standards, while Al, Cd, Cu, Pb, and Zn exceeded acute aquatic life standards.

4.3.2 Alkaline Addition Titrations

This section discusses the changes in water quality from titrating the raw MIW using three separate alkaline substances: NaOH, limestone, and Chitorem. These discussions will answer the principal study question 2 for the Tiger Mine study. As described earlier in Section 2.3.2.1, an endpoint pH of 5.0 was targeted for the following titrations.

4.3.2.1 NaOH

For the NaOH titration, a total of 1.83 ml of a 25% NaOH solution was needed to achieve a pH of 5.0 in 1 L of the raw MIW (Figure 4.3-1). Dissolved and total metals removal efficiency for the titrations are provided in Table 4.3-3. Dissolved and total removal efficiency values were very similar for the NaOH titration. Dissolved Al had a removal efficiency of 93.6% while dissolved Fe and Pb were removed at 98.8%. Dissolved As was removed at 32.2%, and dissolved Cu was removed at 72.6%. Mn and Zn were removed to a much lesser extent at 11% and 5%, respectively. Cd concentrations were unchanged compared to the raw MIW.

Chloride was estimated to be 6.7 mg/L, which was increased relative to the raw MIW, while sulfate was slightly decreased to 1,020 mg/L. Other parameters, such as alkalinity, fluoride, nitrate, and nitrite, were not detected. Hardness was equal to the raw MIW at 286 mg/L.

Results from Table 4.3-4 show that after the NaOH titration, dissolved and total As and Cu and dissolved Pb no longer exceeded human health standards. Total Pb, however, still exceeded human health standards. Dissolved Fe and Pb no longer exceeded chronic aquatic life standards while dissolved and total Al and Pb no longer exceeded acute aquatic life standards.

4.3.2.2 Limestone

For the limestone titration, 2.61 g of limestone was needed to reach a pH of 5.0 in 1 L of the raw MIW (Figure 4.3-2). A thin layer of limestone flakes was observed on the bottom of the beaker, indicating that the pH may have continued to increase with time with no additional limestone. Table 4.3-3 shows that the dissolved and total removal efficiency values were very similar for the limestone titration. Dissolved Al and Cu were removed at over 95% while dissolved Fe and Pb were removed at over 99%. Dissolved As was removed at greater than 32.2%. Cd, Mn, and Zn had removal efficiency values of 0.0, 4.3, and 19.9%, respectively, which was a similar result to the NaOH titration.

Chloride was estimated to be 6.7 mg/L, which was increased relative to the raw MIW, while sulfate was slightly decreased to 1,040 mg/L. Other parameters, such as alkalinity, fluoride, nitrate, and nitrite, were not detected. Due to the mineral makeup of limestone, hardness of the MIW was increased relative to the raw MIW to 991 mg/L.

Results from Table 4.3-4 show that after the limestone titration, dissolved and total As and Cu and dissolved Pb no longer exceeded human health standards Also, dissolved Al, Fe, and Pb no longer exceeded chronic aquatic life standards while dissolved and total Al and Pb no longer exceeded acute aquatic life standards.

4.3.2.3 Chitorem

For the titration using Chitorem, 6.15 g of Chitorem was needed to reach a pH of 5.0 in the raw MIW (Figure 4.3-3). However, a layer of Chitorem flakes was observed on the bottom of the beaker, indicating that the pH may have continued to increase with time with no additional Chitorem. Table 4.3-3 shows that the dissolved and total removal efficiency values were very similar for the Chitorem titration and that the removal efficiency values followed similar trends to the two previous titrations. Dissolved Al was removed at 87.1% while dissolved Fe and Pb were removed at over 99.4%. Dissolved Cu was removed at 62.6%. The removal efficiency for Mn and Zn were higher in this titration than in the previous two, with values of 16.9 and 35.5%, respectively. Dissolved As and Cd had slightly negative removal efficiency values (indicating increases in concentration or no major statistical change) of -22.0 and -10.5%, respectively, which was a similar result to the NaOH and limestone titrations.

Chloride was estimated to be 169 mg/L, which was increased relative to the raw MIW while sulfate was slightly decreased to 944 mg/L. Other parameters, such as alkalinity, fluoride, nitrate, and nitrite, were not detected. Due to the mineral composition of the Chitorem substrate, hardness was increased relative to the raw MIW to 1,000 mg/L.

Results from Table 4.3-4 show that after the Chitorem titration, dissolved Cu and Pb no longer exceeded human health standards. Also, dissolved Fe and Pb no longer exceeded chronic aquatic life standards while dissolved and total Al and Pb no longer exceeded acute aquatic life standards. These changes in water quality standards are similar to the previous two titrations as well.

4.3.3 Batch Tests

This section provides a summary of the bench-scale batch tests. Section 2.3.2.2 provides details on the initial setup of the 18 batch containers, and Table 4.3-2 provides details on the CDM Smith laboratory parameters sampled weekly during the study. Figures 4.3-4 through 4.3-13 provide time-based charts of the CDM Smith laboratory parameters, including pH, ORP, DO, sulfide, and alkalinity. Due to the number of batch tests, each parameter is split between two separate charts to illustrate the data more effectively.

4.3.3.1 Control

The control batch system was comprised of 2.5 L raw MIW and 1 L of an inert pea gravel. Table 4.3-2 showed that the control pH stayed in the acidic range of 2.28 to 3.0 su while the ORP stayed highly oxidizing between 579 and 624 mV. Sulfide was measured to range between 7 and 14 µg/L. Specific conductance ranged from 1,951 to 2,130 µS/cm. DO remained consistently at 12 mg/L for each sampling event, indicating that no geochemical processes were noticeably consuming oxygen in the raw MIW. Alkalinity was not detected in the raw MIW, and ferrous Fe ranged between 1.05 to 2.36 mg/L. No clear trends in these parameters were observed over the course of the bench-study, other than the range of data indicated that the control container provided a fairly stable comparison control test to all of the other container tests.

Comparing the control batch to the raw MIW shows that the control significantly increased total and dissolved Al, Cd, and to a lesser extent, Zn. Dissolved and total Fe and Pb were decreased by a large amount compared to the raw water collected in the field. Dissolved Cu was unchanged, but total Cu was increased in the control relative to the raw MIW.

Water quality standards provided in Table 4.3-4 show that on the bench-scale sampling date (8/26/2014), the control exceeded human health standards for dissolved and total Cd, Cu, Pb, and Zn. The chronic aquatic life standard was also exceeded for dissolved and total Al, Cd, Cu, Fe, Pb, and Zn. The acute aquatic life standard was exceeded for dissolved and total Al, Cd, Cu, and Zn. In comparison to the raw MIW sample, the control removed dissolved and total As to below all standards, as well as dissolved and total Pb to below acute aquatic life standards, but also raised total Cu to above human health standards.

4.3.3.2 BCR2 – 25 ml Methanol and NaOH

The second batch system was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 25 ml methanol, 4.575 ml NaOH, and 25 ml manure extract. The pH of BCR2 ranged from 4.5 to 6.07 su, which was higher than the control. The ORP ranged from 185 to 341 mV (oxidizing conditions) and was less than the control. Sulfide ranged from 9 to 24 µg/L, which was higher than the control, and indicated that some sulfate reduction was occurring. Alkalinity was measured between 6.8 and 17 mg/L, which was higher than the control. DO ranged from 1 to 5 mg/L, with a decreasing trend, which was lower than the control. Ferrous Fe was lower than the control and ranged from 0.04 to 0.82 mg/L. Sulfate was not removed by BCR2, which supports other observations of no sulfate reduction.

Relative to the control, BCR2 was very successful at removing Al, Cu, Fe, and Pb from the MIW; removal efficiency values for BCR2 were greater than 88% for dissolved and total Al, Cu, Fe, and Pb. Dissolved and total Cd and Zn were removed at approximately 58 and 54%, respectively.

Table 4.3-4 shows that BCR2 was able to achieve human health water quality standards for dissolved and total Cu and Pb. Chronic aquatic life standards were met for dissolved Al as well as dissolved and total Pb. Standards for acute aquatic life were met for dissolved Al as well as dissolved Cu.

4.3.3.3 BCR3 – 50 ml Methanol and NaOH

The third batch system was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 50 ml methanol, 4.575 ml NaOH, and 25 ml manure extract. The pH of BCR3 ranged from 4.47 to 5.77 su, which was higher than the control but similar to BCR2. The ORP ranged from 208 to 346 mV. Sulfide ranged from 12 to 24 µg/L, which was higher than the control and equal to BCR2, indicating that some minor sulfate reduction was occurring. Alkalinity was measured between 6.8 and 17 mg/L, which was higher than the control. DO ranged from 1 to 5 mg/L, with a decreasing trend, which was much lower than the control. Ferrous Fe was lower than the control and ranged from non-detect (less than 0.02 mg/L) to 0.42 mg/L. Sulfate was not removed by BCR2.

Relative to the control, BCR3 was successful at removing dissolved and total Al, Cu, Fe, and Pb; the removal efficiency for these four metals was above 92% for each. This result is very similar to BCR2. Dissolved and total Cd and Zn were removed at approximately 52 and 48%, respectively, which is a very similar result to BCR2.

Improvements in water quality relative to the control (Table 4.3-4) show that BCR3 was able to reach human health standards for dissolved and total Cu and Pb. Chronic aquatic life standards were met with dissolved Al and dissolved and total Pb. Acute aquatic life standards were met by dissolved Al.

4.3.3.4 BCR4 – 100 ml Methanol and NaOH

The fourth batch system was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 100 ml methanol, 4.575 ml NaOH, and 25 ml manure extract. The pH of BCR4 ranged from 4.49 to 5.73 su, which was higher than the control but similar to BCR2 and BCR3. The ORP ranged from 271 to 358 mV. Sulfide ranged from 6 to 42 µg/L, which was higher than the control, BCR2, and BCR3, and indicates that some sulfate reduction may have occurred. Alkalinity was measured between 6.8 and 17 mg/L, which was higher than the control and equal to BCR2 and BCR3. DO ranged from 1 to 7 mg/L, with no obvious trend, which is lower than the control but higher than BCR2 and BCR3. Ferrous Fe was lower than the control and ranged from non-detect (less than 0.02 mg/L) to 0.3 mg/L. Sulfate was not removed by BCR2.

BCR4 was successful at removing dissolved and total Al, Cu, Fe, and Pb; the removal efficiency for these four metals was above 87%. This removal efficiency result is very similar to BCR2 and BCR3. Dissolved and total Cd and Zn were removed at approximately 51 and 44%, respectively, which was also very similar to BCR2 and BCR3.

Relative to the control, BCR4 was able to reach human health standards for dissolved and total Cu and Pb, which was the same result as BCR2 and BCR3. Chronic aquatic life standards were met by dissolved Fe and dissolved and total Pb. Acute aquatic life standards were met by dissolved Al.

Overall, the three methanol treatments were very similar in the geochemical conditions, and each was able to remove the majority of Al, Cu, Fe, and Pb from the MIW although the removal process for these metals was likely precipitate formation after NaOH addition and sorption to organic matter contained in the manure extract. Limited to no sulfate reduction occurred, and the solutions remained oxidized, indicating that methanol was not a compatible organic substrate for the bacteria contained within the manure tea. Dissolved and total Cd and Zn were metals that these three BCRs were consistently unable to reduce below human health water quality standards, and Mn appeared to be only moderately removed from these treatments.

4.3.3.5 BCR5 – 25 ml Ethanol and NaOH

The fifth batch system was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 25 ml ethanol, 4.575 ml NaOH, and 25 ml manure extract. The pH of BCR5 ranged from 4.46 to 6.93 su, which was had the highest values of any of the other methanol or ethanol test containers. The ORP ranged from -100.7 to 378 mV. Sulfide ranged from 7 to 7,030 µg/L, which is significantly higher than the control, indicating that sulfate reduction was occurring. Alkalinity was measured between 6.8 and 170 mg/L, which was higher than the control. After the addition of more manure tea inoculum on 8/6, ORP began to decrease below 0, and sulfide and alkalinity increased due to sulfate reduction. However, pH actually decreased from 6.93 to 5.66 after the additional inoculum. DO ranged from 1 to 6 mg/L, with a decreasing trend, which was lower than the control. Ferrous Fe ranged from 0.01 to 5.2 mg/L. The higher ferrous Fe concentrations in the last 3 weeks indicates iron-reducing conditions were present. In the last sample, ferrous Fe was 4.38 mg/L while total laboratory Fe was 18.2 mg/L. In BCR5, sulfate was removed by 91% at the end of the study, most likely indicating significant reduction of sulfate.

Relative to the control, BCR5 was very successful at removing Al, Cd, Cu, Pb, and Zn from the MIW; dissolved and total removal efficiency values were greater than 83% for these metals. Dissolved and total Fe was removed at approximately 60%.

Relative to the control, BCR5 was able to reach human health standards on all remaining dissolved and total metals (not already met by the control): Cd, Cu, Pb, and Zn. Chronic aquatic life standards were met by dissolved and total Cd, Cu, Pb, and Zn. Acute aquatic life standards were met by dissolved and total Al, Cd, Cu, and Zn. Only chronic aquatic life standards for Al and Fe were exceeded with this treatment.

4.3.3.6 BCR6 – 50 ml Ethanol and NaOH

The sixth batch system was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 50 ml ethanol, 4.825 ml NaOH, and 25 ml manure extract. The pH of BCR6 ranged from 4.34 to 5.61 su, which was higher than the control and in the same range as BCR5. The ORP ranged from 75 to 406 mV.

Sulfide ranged from 7 to 93 µg/L, which was higher than the control but significantly less than BCR5. Alkalinity was measured between 6.8 and 27.2 mg/L, which was higher than the control but less than BCR5. DO ranged from 2 to 5 mg/L, with a decreasing trend, which was much lower than the control. Ferrous Fe was lower than BCR5 and ranged from 0.02 to 3.22 mg/L. Sulfate in BCR6 was reduced by 15.3%, which was a much lower removal value than BCR5, and suggests less sulfate reduction activity. Addition of manure tea on 8/6 did not have an effect on improving results towards sulfate reduction (i.e., ORP, sulfide, and alkalinity).

Relative to the control, BCR6 was very successful at removing Al, Cu, Pb, and Zn from the MIW; removal efficiency values were greater than 88% for each of these metals. Dissolved and total Cd had removal efficiency values of 71.6 and 83%, respectively, which was lower than BCR5. Dissolved and total Fe concentrations were increased in BCR6 relative to the control by 11.1 and 12.6%, which was a different result than from BCR5, which had moderate removal of Fe.

With the exception of total Pb, BCR6 was able to reach human health standards on dissolved and total Cd, Cu, and Zn and dissolved Pb. Chronic aquatic life standards were met by dissolved and total Cd as well as dissolved Al, Cd, Pb, and Zn. Acute aquatic life standards were met by dissolved and total Al, Cd, and Cu as well as dissolved Zn. These results suggest that, although similar, BCR6 did not remove metals from the MIW to the extent of BCR5 due to the lack of sulfate reduction.

4.3.3.7 BCR7 – 100 ml Ethanol and NaOH

The seventh batch system was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 100 ml ethanol, 4.575 ml NaOH, and 25 ml manure extract. The pH of BCR7 ranged from 4.4 to 5.21 su, which was higher than the control and in the same range as BCR5 and BCR6. The ORP ranged from 189.4 to 395 mV, which was within the same range as BCR6. Sulfide ranged from 8 to 32 µg/L, which was higher than the control but less than BCR5 and BCR6. Alkalinity was measured between 6.8 and 20.4 mg/L, which was higher than the control but less than BCR5. DO ranged from 2 to 6 mg/L, with no obvious trend, and was much lower than the control. Ferrous Fe was lower than BCR5 and ranged from less than 0.02 to 0.1 mg/L. Sulfate in BCR7 was reduced by 3.5%, which was a much lower removal value than BCR5 and BCR6, and suggests much less sulfate reduction activity. Addition of manure tea on 8/6 did not have an effect on improving results towards sulfate reduction (i.e., ORP, sulfide, and alkalinity).

Relative to the control, BCR7 was very successful at removing Al, Cu, Fe, and Pb from the MIW; removal efficiency values were greater than 89% for each of these metals. Dissolved and total Cd had removal efficiency values of 49.7 and 48.9%, respectively, which was lower than BCR5 and BCR6. Dissolved and total Zn removal efficiency values were 43.4 and 44.0%, respectively, which was significantly less than the BCR5 and BCR6 treatments.

BCR7 was able to reduce dissolved and total Cu and Pb to below human health standards, which was a similar result to BCR5 and BCR6. Chronic aquatic life standards were met only by dissolved and total Pb, which is a different result from BCR5 and BCR6. Acute aquatic life standards were met only by Al, which again was a different result than from BCR5 and BCR6.

Overall, the three ethanol test results suggest that BCR5 performed the best at reducing sulfate and removing metals from the MIW while BCR6 performed similar in metals removal. BCR7 did not perform as well as either BCR5 or BCR6 at removing metals from the MIW and achieving water quality standards but was still able to remove a significant portion of Al, Cu, Fe, and Pb.

4.3.3.8 BCR8 – 25 ml Molasses and NaOH

The eighth batch system was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 25 ml molasses, 4.80 ml NaOH, and 25 ml manure extract. The pH of BCR8 ranged from 3.91 to 4.75 su, which was higher than the control. The ORP ranged from -375.0 to 102.5 mV, which ranges from highly reducing during the first couple weeks to oxidizing conditions. Sulfide ranged from 72 to 194 µg/L, which was higher than the control and indicated that some sulfate reduction was occurring. Alkalinity was measured between less than 5 to 102.0 mg/L, which was higher than the control. DO ranged from 1 to 2 mg/L, which was much lower than the control. Ferrous Fe ranged from 1.44 to 4.28 mg/L, which indicates that iron-reducing conditions were present in the container. Sulfate in BCR8 was not reduced relative to the control at the end of the test, which suggests a low rate of sulfate reduction activity.

During the first 3 weeks, significant gas production was occurring in BCR8 and required venting of the cubitainer every few days. After the gas production ceased, pH decreased below 4 su, and ORP increased above 0. Based on the gas generation and first week in-house results (7/17) of high alkalinity, low ORP, and elevated sulfide, some sulfate reduction was likely occurring and contributing to the sulfide and alkalinity generation and likely CO_2 gas. The significant gas generation may have also been related to methanogenic conditions within the container, which generates methane gas. The sharp increase in ORP and decrease in pH and alkalinity may have been due to an overproduction of organic acids from the molasses within the enclosed container as well as release of Fe from the molasses (see below). After addition of NaOH and inoculum on 8/6, ORP decreased from above 0 to -51 mV although this decrease in oxidation state was not sustained for later samples. Sulfide slightly decreased and alkalinity remained non-detect after the additional amendments.

Relative to the control, BCR8 removed dissolved and total Al at 80.7 and 75.3%, respectively. Dissolved and total Cd was similar to Al and was removed at 71.6 and 83.0%, respectively. Dissolved and total Cu was the highest removed metal in BCR8 at 96.5 and 93.4%, respectively. Dissolved and total Fe significantly increased in BCR8 relative to the control, indicating the presence of Fe in the molasses. Dissolved and total Pb were moderately removed at 66.6 and 46.2%, respectively. Dissolved and total Zn was removed at 18.3 and 11.9%, respectively, suggesting that this metal was not meaningfully affected by the BCR8 treatment.

Relative to the control, BCR8 was able to further reduce dissolved and total Cd and Cu to below human health standards although Pb and Zn remained above this standard. Total As increased from non-detect in the control to above human health standards in BCR8. Chronic aquatic life standards were met by dissolved and total Cd and by dissolved Cu. Acute aquatic life standards were met only by dissolved and total Cd and dissolved Cu.

4.3.3.9 BCR9 – 50 ml Molasses and NaOH

The ninth batch system was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 50 ml molasses, 4.575 ml NaOH, and 25 ml manure extract. The pH of BCR9 ranged from 3.82 to 4.50 su, which was higher than the control and in the same range as BCR8. The ORP ranged from -425.0 to 104.8 mV, which was within the same range as BCR8. Sulfide ranged from 127 to 268 µg/L, and alkalinity was measured between less than 5 and 187 mg/L. Sulfide production, higher alkalinity in the first 2 weeks, and low ORP indicates that some sulfate reduction was occurring initially. DO ranged from 1 to 3 mg/L, which was much lower than the control but in the same range as BCR8. Ferrous Fe ranged from 1.96 to 4.04 mg/L. Sulfate in BCR9 was reduced by 4.1% relative to the control in the laboratory sample, which was similar to BCR8 and suggests a low rate of sulfate reduction activity at the end of the study. After addition of NaOH and inoculum on 8/6, no observable improvement in ORP, sulfide, or alkalinity generation was observed in BCR8.

Removal efficiencies for Al, Cd, and Cu were lower in BCR9 than in BCR8. Relative to the control, BCR9 removed dissolved and total Al at 59.9 and 55.9%, respectively. Dissolved and total Cd were removed at 46.5 and 47.2%, respectively. Dissolved and total Cu were removed at 66.3 and 91.1%, respectively. Dissolved and total Fe significantly increased in BCR9 relative to the control, and to a lesser extent, dissolved and total Pb increased in concentration. Dissolved and total Zn were removed at 12.2 and 9.6%, respectively, suggesting that this metal was not significantly affected by the BCR9 treatment.

Relative to the control, BCR9 was only able to further reduce dissolved and total Cu to below human health standards while Cd, Pb, and Zn remained above this standard. Chronic and acute aquatic life standards were not met by any metal.

4.3.3.10 BCR10 – 100 ml Molasses and NaOH

The tenth batch system was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 100 ml molasses, 4.575 ml NaOH, and 25 ml manure extract. The pH of BCR10 ranged from 3.89 to 4.53 su, which was higher than the control and in the same range as BCR8 and BCR9. The ORP ranged from -436.0 to 98.7 mV. Sulfide ranged from 276 to 520 μg/L, and alkalinity ranged from less than 20 to 204 mg/L. Similarly, BCR8, BCR9, and BCR10 all had reducing conditions and higher alkalinity at the start of the study and elevated sulfide, indicating that some sulfate reduction was occurring. Interestingly, BCR10 had the highest sulfide compared to BCRs 8 and 9, ethanol, and methanol treatments. DO ranged from 1 to 4 mg/L, which is lower than the control but in the same range as BCR8 and BCR9. Ferrous Fe ranged from 0.44 to 3.06 mg/L. Sulfate in BCR10 was reduced by 4.7% relative to the control, which was similar to BCR8 and BCR9 and suggests a low rate of sulfate reduction activity.

After addition of NaOH and inoculum on 8/6 to BCR10, ORP decreased from above 0 to -87 mV although this decrease in oxidation state was not sustained for later samples. Sulfide slightly decreased and alkalinity remained non-detect after the additional amendments.

Relative to the control, BCR10 removed dissolved and total Al at 49.3 and 41.6%, respectively, which was lower than in BCR8 and BCR9. Dissolved and total Cd was removed at 16.3 and 19.8%, respectively, which was lower than in BCR8 and BCR9. Dissolved and total Cu was removed at 77.7 and 71.1%, respectively, which was lower than in BCR8 but in the same range as BCR9. Dissolved and total Fe significantly increased in BCR10 relative to the control and to a lesser extent dissolved and total Pb. The increases in these metals concentrations was also observed in BCR9 and similarly in BCR8. Dissolved and total Zn was removed at 18.3 and 15.6%, respectively, suggesting that this metal was not meaningfully affected by the BCR10 treatment, which was the same result as from BCR8 and BCR9.

Relative to the control, BCR10 was only able to further reduce dissolved and total Cu to below human health standards while As, Cd, Pb, and Zn remained above this standard. Chronic and acute aquatic life standards were not met by any metal.

Overall, none of the three molasses treatments were able to meaningfully reduce metals concentrations to meet many of the water quality standards, especially when compared to the BCRs that utilized ethanol. This finding is in contrast to the fact that these molasses BCRs showed evidence of reducing conditions at the beginning of the study with significant sulfide production when compared to the methanol and ethanol BCRs.

4.3.3.11 BCR11 – 15 g Chitorem

BCR11 was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 15 g Chitorem. The pH of BCR11 ranged from 3.28 to 7.60 su, which was significantly higher than the control. The ORP ranged from -330.0 to 367.0 mV, which exhibited a decreasing trend over time, and ranges from highly reducing to oxidizing conditions. Sulfide ranged from 16 to 6,350 µg/L, which indicates that sulfate reduction was occurring. Alkalinity was measured between less than 5 mg/L initially to a high of 595.0 mg/L. DO ranged from 1 to 5 mg/L, which was much lower than the control. Sulfate in BCR11 was reduced relative to the control by 76.5%, which further suggests sulfate reducing processes.

Ferrous Fe ranged from 2.44 to 0.02 mg/L at the end of the study, exhibiting a decreasing trend over time. When compared to the low final laboratory Fe concentrations, this steady decrease in ferrous Fe may represent continued Fe removal over time. Relative to the control, BCR11 significantly removed dissolved and total Al, Cd, Cu, Fe, Pb, and Zn from the MIW; all were over 85.9%.

Relative to the control, BCR11 was able to further reduce dissolved Cd, Cu, Pb, and Zn to below human health standards. Total Cu, Pb, and Zn were also removed to below the human health standard. Dissolved and total As, which were not detected in the control (less than 100 µg/L), were detected above human health standards in BCR11. Chronic aquatic life standards were met by dissolved Al, Cd, Cu, Fe, Pb, and Zn. Acute aquatic life standards were met by dissolved Al, Cd, Cu, and Zn, and total Al and Cd.

4.3.3.12 BCR12 – 22 g Chitorem

BCR12 was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 22 g Chitorem versus only 15 g Chitorem in BCR11. The pH of BCR12 ranged from 4.33 to 7.65 su, which was significantly higher than the control and was within the same range as BCR11. The ORP ranged from -344.0 to 185.0 mV, with a decreasing trend over time similar to BCR11. Sulfide ranged from 29 to 6,440 µg/L, which was higher than the control and similar to BCR11, and indicates that significant sulfate reduction was occurring. Alkalinity was measured between 102.0 and 714.0 mg/L, which was in the same range as BCR11. DO ranged from 1 to 3 mg/L, which was much lower than the control. Sulfate in BCR12 was reduced relative to the control by 83.9%, which further suggests sulfate reducing processes.

Ferrous Fe ranged from 2.59 to less than 0.02 mg/L at the end of the study, similar to BCR11. Relative to the control, BCR12 significantly removed dissolved and total Al, Cd, Cu, Fe, Pb, and Zn from the MIW; all were over 87.3%.

Relative to the control, BCR12 was able to further reduce dissolved and total Cd, Cu, and Zn to below human health standards. Dissolved Pb was also removed to below the human health standard. Dissolved and total As were detected above human health standards in BCR12. This result was also found in BCR11. Chronic aquatic life standards were met by dissolved Cd, Cu, Pb, and Zn. Acute aquatic life standards were met by dissolved Al, Cd, Cu, and Zn, and total Al, Cd, and Cu.

4.3.3.13 BCR13 – 34 g Chitorem

BCR13 was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 34 g Chitorem versus the lower quantities in BCRs 11 and 12. The pH of BCR13 ranged from 5.58 to 7.47 su, which was significantly higher than the control and was within the same range as BCR11 and BCR12. The ORP ranged from -365 to 64.8 mV, with a decreasing trend over time similar to BCR11 and BCR12. Sulfide ranged from 140 to 13,580 µg/L, which was significantly higher than the control but within the same range overall as BCR11 and BCR12. These sulfide results indicate that significant sulfate reduction was occurring in BCR13. Alkalinity was measured between 289 and 850 mg/L, which was in the same range as BCR11 and BCR12. DO ranged from 1 to 2 mg/L, which was much lower than the control. Sulfate in BCR13 was reduced relative to the control by 89.8%, which was a similar result to BCR11 and BCR12 and further suggests sulfate reducing processes.

Ferrous Fe ranged from 3.38 to less than 0.02 mg/L at the end of the study, similar to BCR11 and BCR12. Relative to the control, BCR13 significantly removed dissolved and total Al, Cd, Cu, Fe, Pb, and Zn from the MIW; all were over 82.8%, and most were greater than 90% removal.

Relative to the control, BCR13 was able to further reduce dissolved and total Cu and Zn to below human health standards. Dissolved Cd and Pb were also removed to below the human health standard. Dissolved and total As were detected above human health standards in BCR13. Chronic aquatic life standards were met by dissolved Cd, Cu, Fe, Pb, and Zn. Acute aquatic life standards were met by dissolved Al, Cd, Cu, and Zn, and total Al and Cd.

Overall, the addition of Chitorem to the raw MIW was able to achieve and maintain sulfate reducing conditions and reduce more of the metals of concern to below water quality standards than the methanol, ethanol, and molasses treatments.

4.3.3.14 BCR14 – 7 g Chitorem and NaOH

BCR14 was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 7 g Chitorem and 4.575 ml NaOH. The pH of BCR14 ranged from 4.64 to 8.02 su, which was significantly higher than the control. The ORP ranged from -397.0 to 40.8 mV, with a decreasing trend over time. BCR14 reached an ORP of less than -300 mV faster than BCRs 11 through 13 and had lower values at the end of the study. Sulfide ranged from 51 to 66,560 µg/L, which indicates that sulfate reduction was occurring. BCR14 had the highest detected sulfide of any other treatment container. Alkalinity was measured between 119 and 1,275 mg/L. Both alkalinity and sulfide steadily increased to their maximum concentrations on 8/11, followed by decreases in the last two sample events. The correlating trend indicates that some of the alkalinity produced was from sulfate reduction. DO ranged from 1 to 2 mg/L, which was lower than the control. Sulfate in BCR14 was reduced relative to the control by 99.5%, which further suggests sulfate reducing processes.

Ferrous Fe was lower than the control and ranged from 1.25 mg/L initially down to 0.02 mg/L at the end of the study. Relative to the control, BCR14 significantly removed dissolved and total Al, Cd, Cu, Fe, Pb, Mn, and Zn from the MIW; all were over 87.7%, and most were over 98%. Compared to previous Chitorem BCRs and specifically BCR11 that contained the same amount of Chitorem, BCR14 did not show a discernable improvement in dissolved metal removal. Total metals removal slightly increased for BCR14.

Relative to the control, BCR14 was able to further reduce dissolved and total Cd, Cu, Pb, and Zn to below human health standards. Dissolved and total As were detected above human health standards in BCR14. Chronic aquatic life standards were met by dissolved and total Al, Cd, Cu, Fe, Pb, and Zn. Acute aquatic life standards were met by dissolved and total Al, Cd, Cu, and Zn.

4.3.3.15 BCR15 – 7 g Chitorem and Limestone

BCR15 was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 7 g Chitorem and 8.2 g limestone fines. The pH of BCR15 ranged from 4.89 to 7.85 su. BCR15 and 14 were similar in magnitude and the highest overall of any other BCRs. The ORP ranged from -387 to 52.3 mV, with a decreasing trend over time. Similar to BCR14, BCR15 reached an ORP of less than -300 mV faster than BCRs 11 through 13 and had lower values at the end of the study. Sulfide ranged from 76 to 41,280 µg/L, and alkalinity ranged between 170 and 1,700 mg/L. The trends and magnitude of sulfide and alkalinity concentrations were similar to BCR14. DO ranged from 1 to 2 mg/L, which was lower than the control. Sulfate in BCR15 was reduced relative to the control by 88.2%, which further suggests sulfate reducing processes.

Ferrous Fe was lower than the control and ranged from 2.05 mg/L initially down to 0.01 mg/L in the second to last week. Relative to the control, BCR15 significantly removed dissolved and total Al, Cd, Cu, Fe, Pb, and Zn from the MIW; all were over 94.3%.

Relative to the control, BCR15 was able to further reduce dissolved and total Cd, Cu, Pb, and Zn to below human health standards. Dissolved and total As were detected above human health standards in BCR15. Chronic aquatic life standards were met by dissolved and total Al, Cd, Cu, Fe, Pb, and Zn. Acute aquatic life standards were met by dissolved and total Al, Cd, Cu, and Zn.

4.3.3.16 BCR16 – 50 ml Molasses and Limestone

BCR16 was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 50 ml molasses, 14.7 g limestone, and 25 ml manure extract. Like BCRs 2 through 10, BCR16 had 25 ml inoculum added to the container on 8/6. The pH of BCR16 ranged from 4.45 to 5.16 su, which was higher than the control but much less overall compared to BCRs 11 through 15. The ORP ranged from -453 to 27.6 mV, with an increasing trend with time, similar to the other BCRs that utilized molasses. Sulfide ranged from 149 to 316 µg/L, and alkalinity ranged from less than 5 to 136 mg/L. DO ranged from 1 to 4 mg/L, which was lower than the control. Sulfate in BCR16 was reduced relative to the control by only 3.6%, which suggests that sulfate reducing processes may have stalled at an early point in time.

Ferrous Fe was in the same range as the control and ranged from 1.42 to 4.16 mg/L. Relative to the control, BCR16 removed dissolved and total Al at approximately 82%. Dissolved and total Cd removal efficiencies were 84.6 and 83.2%, respectively. Dissolved and total Cu had the greatest metal removal efficiencies in BCR16 at 95.0 and 88.1%, respectively. Dissolved and total Fe significantly increased in BCR16 relative to the control, and to a lesser extent, dissolved and total Pb increased in concentration. Dissolved and total Zn were removed at approximately 28%. These removal efficiency results and trends are very similar to the other BCRs that utilized molasses as an organic substrate.

Relative to the control, BCR16 was only able to further reduce dissolved and total Cu to below human health standards. Total As was detected above human health standards in BCR16. Chronic aquatic life standards were not met by any metal, and acute aquatic life standards were met only by dissolved Cd.

4.3.3.17 BCR17 –50 ml Molasses and Chitorem

BCR17 was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 50 ml molasses and 15 gm Chitorem and 25 ml manure extract. BCR17 also had the additional 25 ml inoculum dose and had 7 g Chitorem added on 8/6. BCR17 was meant as a comparison to BCR16 with a different alkaline material. The pH of BCR17 ranged from 3.36 to 4.0 su, which was only slightly higher than the control and less than all other BCRs. The ORP ranged from -292.0 to 76.9 mV. After the initial sample event, ORP remained in oxidizing conditions throughout the study and did not improve with the additional Chitorem and inoculum doses. Sulfide ranged from 289 to 683 µg/L, which was in the same range as other molasses BCRs. Alkalinity was measured between less than 5 and 13.6 mg/L, which was higher than the control. DO ranged from 1 to 3 mg/L, which was lower than the control. Sulfate in BCR17 was reduced relative to the control by only 8.2%, which was a similar result to BCR16 and suggests that sulfate reducing processes may have stalled at an early point in time.

Ferrous Fe was in the same range as the control and ranged from 1.32 to 4.7 mg/L. Relative to the control, BCR17 removed dissolved and total Al at 52.0 and 47.4%, respectively. Total and dissolved As were increased relative to the control, potentially from addition of the Chitorem substrate. Dissolved and total Cu had the greatest metal removal efficiencies in BCR17 at 96.0 and 92.6%, respectively. Dissolved and total Fe significantly increased in BCR17 relative to the control. Dissolved and total Zn were removed at approximately 16%. These removal efficiency results and trends are very similar to the other BCRs that utilized molasses as an organic substrate.

Relative to the control, BCR17 was not able to further reduce any dissolved or total metal to below human health standards. Dissolved and total As were elevated relative to the control above human health standards. Acute and chronic aquatic life standards were not met for most metals.

4.3.3.18 BCR18 –7 g Chitorem and 25 ml Ethanol

BCR18 was comprised of 2.5 L raw MIW with 1 L inert pea gravel, with an addition of 7 gm Chitorem, 25 ml ethanol, 4.575 ml NaOH, and 25 ml manure extract. No additional substrate was added to this BCR later in the study. The pH of BCR18 ranged from 4.52 to 5.65 su, which was higher than the control but did not follow a similar trend to other Chitorem BCRs 11 through 15. The ORP ranged from -88.8 to 118.9 mV, with a decreasing trend for the first couple weeks to the lowest value, followed by an increasing trend towards 0. Sulfide ranged from 57 to 2,400 µg/L, which was initially following the same trend as Chitorem BCRs 11 through 15 but then began to decrease in concentration. Alkalinity was measured between 119 and 224.4 mg/L, which was higher than the control but not as high as Chitorem BCRs 11 through 15. Some alkalinity and sulfide generation indicates that some sulfate reduction occurred. DO ranged from 1 to 3 mg/L, which was lower than the control. Sulfate in BCR18 was reduced relative to the control by 14.3%, which supports the conclusion that sulfate reducing processes might have been greater initially, followed by a decrease in activity.

Ferrous Fe was lower than the control and ranged from 0.67 to 3.36 mg/L. Relative to the control, BCR18 significantly removed dissolved and total Al, Cu, Pb, and Zn from the MIW; all were over 94.0%. Dissolved and total Cd were removed to below detection limits. Dissolved and total Fe significantly increased in BCR18 relative to the control, which indicates that under the near oxidizing conditions at the end of the study, Fe was being released from the Chitorem.

Relative to the control, BCR18 was able to further reduce dissolved and total Cd, Cu, Pb, and Zn to below human health standards. Chronic aquatic life standards were met by dissolved and total Cd, Cu, and Pb, and by dissolved Al and Zn. Acute aquatic life standards were met by dissolved and total Al, Cd, and Cu, and by dissolved Zn.

4.4 Tiger Mine Field Investigation

To answer the Tiger Study principal study question 5 regarding the physical condition of the Tiger shaft, a field investigation of the shaft was completed using the Insight Vision DXP-300 video camera with an LED light attached. Five videos were recorded down to the 87-foot level of the shaft, four with the camera facing each wall and one with the camera facing straight down.

Between the surface and about 20 feet below ground surface (bgs), there were numerous collapsed timbers and other debris, partially obstructing the shaft. The video inspection revealed that the Tiger shaft was reasonably intact below the partial collapse. The shaft, estimated to be approximately 8-foot by 8-foot, is timbered with large wood timbers estimated to be at least 12-inch by 12-inch, with vertical wood cribbing outside the timbers on the sidewalls. There are horizontal timber sets approximately every 5-feet vertically, vertical posts in each corner, and horizontal timbers around the perimeter. At each 5-foot vertical interval, a cross timber separates the shaft in half horizontally.

The west half of the shaft was open from below the partial obstruction at the 20-foot level to a depth of 87 feet bgs. At the 87-foot level, a relatively flat and level layer of dirt was encountered. This may have been the shaft bottom or a wood landing covered with dirt. As the camera was lowered down the west side with the lens pointed to the east, there were two wood landings observed on the east side of the center dividing timbers. The first landing was noted at a depth of about 20 feet bgs, and the second landing was noted at a depth of about 50 feet bgs. The landing at the 20-foot level was supporting debris from the partial collapse near the surface. The east side of the shaft ended at the same 87-foot bgs level as the west side.

A small stream or pool of water was observed at the 87-foot level against the east wall, but due to the landings above and the cross timbers, the camera operator was not successful swinging the camera from the west side over to the east side to inspect the water source more closely. This stream or pool is shown in a video snapshot below in Exhibit 4-1. In review of the video recording, evidence of bubbling or flowing of water was observed. It is possible this water represents the mine pool elevation at the time of the investigation.

No openings of any kind were observed in any of the four sidewalls, suggesting this shaft may have been constructed to service mine workings at lower depths. Mapping of the mine workings suggest the shaft should be much deeper if it connects to the main tunnels. It seems likely that the 87-foot level reached with the camera was not the shaft bottom but another landing or a partial collapse. The inspection determined that the shaft was still open to the 87-foot level, but due to the partial collapse near the surface, significant stabilization effort would be required to access any part of the lower shaft for placement of treatment chemicals or treatment processes. The small stream of water observed at the 87-foot level against the east wall is in an area difficult to access due to the placement of landings above and the partial collapse near the surface. With these observations, near-term plans to add reactive materials into the Tiger mine workings were suspended due to the high costs to safely and effectively deliver substances into the shaft.

Exhibit 4-1. Bottom view of Tiger Shaft showing small stream or pool adjacent to collapse

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Section 5

Summary and Conclusions

This section provides treatability study summaries and conclusions of the bench-scale and pilot-scale treatability studies for the site completed in 2014.

5.1 Danny T Adit Treatability Study Summary and Conclusions

5.1.1 Summary

Using the lessons learned from the year 1 study, all of the year 2 treatment systems improved in metal treatment efficiency, sulfate reduction, sulfide generation, and maintaining a net alkaline condition. The improved results are primarily due to the increased retention time for all of the treatment systems. The year 2 study started at 8.3 ml/min (121 h retention time), compared to 37 ml/min for year 1 (24 h retention time), and BCR substrate volumes were increased for year 2, along with an increase in limestone content. The SAPS substrate volume was also doubled in size.

For BCR1, addition of the 5% Chitorem and the increased limestone content provided a significant improvement compared to the year 1 BCR1 without pre-treatment. In addition, overall treatment efficiency and sulfate reduction results for BCR1 were nearly as good as other BCRs at the lower flow rates tested. Some effect to ORP was observed due to increases in flow rate although ORP recovered after decreasing the flow rate at the end of the study. BCR1 was able to maintain a net-alkaline condition by generating significant alkalinity, positive sulfate reduction, and sulfide generation throughout the study. Dissolved removal efficiencies for many of the key metals (Cd, Cu, Fe, Pb, and Zn) were maintained above 98% for the entire study period. Total removal efficiencies were similarly high after the first sample event, with some exceptions probably due to flow rate increases, and on 7/8 when a 30 mg/L Fe increase occurred in the influent MIW compared to the previous sample event.

For BCR1 and all other BCRs, the high laboratory reporting limits for Al, As, Cd, and Fe limited the ability to compare the effluent concentrations to water quality standards that were less than the reporting limits. Cu, Pb, and Zn reporting limits were typically low enough to compare to standards due to the higher hardness values. Given this, observations for BCR1 indicate some exceedance of water quality standards for Al, As, Cd, Fe, and Zn occurred when results were detectable. With the lower reporting limits on the last sample event, greater resolution of concentrations indicates that all standards for Al, As, and Cd were met for this event.

Overall, the SAPS/BCR2 treatment provided significant sulfate reduction, sulfide formation, alkalinity generation, and metal removal. The SAPS pre-treatment increased pH to greater than 5 su, generated alkalinity, decreased ORP and DO, and reduced concentrations of several metals prior to BCR treatment. Removal of Cd, Cu, Pb, and Zn by the SAPS was significant; however, this removal is not expected to be sustained as surface sorption sites on the organic substrate become saturated. Data for Zn provides an example of sorption breakthrough at the end of the study. Removal of some amount of Al and Fe should be sustained from increased pH, resulting in Al and Fe oxy-hydroxide precipitation. While some Fe was likely removed in the top of the SAPS as Fe oxy-hydroxides, the decreased ORP in the SAPS was sufficient to reduce ferric Fe to ferrous Fe, keeping it in the dissolved phase, and lessening the likelihood of clogging. Arsenic was also removed by the SAPS consistently due to co-precipitation with the iron oxy-hydroxide precipitates that formed.

Due to significant removal of some metals, such as Cd, Cu, and Pb by the SAPS, further removal by BCR2 is difficult to evaluate. For Al, Fe, and Zn, BCR2 provided additional removal to concentrations at or below reporting limits and/or aquatic standards. Once Fe and Zn started to increase in the SAPS effluent, BCR2 maintained a 97 to greater than 99% total and dissolved removal efficiency for these metals. The SAPS/BCR2 system provided overall dissolved and total Al, Cd, Cu, Fe, Pb, and Zn removal efficiencies from greater than 92 to 99%, except for the first sample event. For Cu and Pb that had reporting limits consistently low enough to compare to water quality standards, BCR2 effluent only exceeded standards in the first two sample events. Some Al, As, Cd, Fe, and Zn results also exceeded some of the standards during the study.

Overall, the CHIT/BCR3 treatment provided similar treatment effectiveness as the SAPS/BCR2 treatment. Based on bench-scale hydraulic test results and year 1 results, the Chitorem mixture was adjusted to maintain hydraulic flow through the treatment substrate while still providing some treatment capacity. Similar to the SAPS, the CHIT increased pH to greater than 5 su, generated alkalinity, decreased ORP and DO, and reduced concentrations of several metals prior to BCR treatment. Removal of Cd, Cu, Pb, and Zn by the CHIT was significant; however, total concentrations of these metals began to increase in the last month along with total and dissolved increases in Al, Fe, and Zn, and increases in ORP. Formation of metal sulfides in the CHIT would have no longer been a stable removal mechanism with the increased oxidation state.

BCR3 provided additional metal removal after the CHIT where comparisons could be made. BCR3 total removal efficiencies compared to the SAPS remained greater than 94 to 99% for Al, Cd, Cu, Fe, Pb, and Zn in the last month of the study when concentrations increased in the CHIT effluent. Except for the first sample event, overall dissolved and total removal efficiencies for the CHIT/BCR3 system compared to the influent MIW for these same metals were greater than 96 to 99% for the entire study. Like other BCRs, comparison to water quality standards is inconsistent due to high reporting limits. Some of the BCR3 Al, As, Cd, Cu, Fe, Pb, and Zn concentrations in the first 8 weeks exceeded some of the water quality standards. Minor additional exceedances occurred later for Al and Fe.

Along with metals and ORP increases, hardness and alkalinity decreased in the last month for CHIT pre-treatment. All of these changes indicate likely effects from flow rate changes that occurred but also that the Chitorem in the pre-treatment barrel may have begun to be exhausted. As long as the Chitorem material is present to contribute alkalinity, some degree of metal removal should be sustained similar to the SAPS. However, unlike the SAPS with a significant quantity of limestone, the CHIT pre-treatment only tested a finite amount of Chitorem that contains only approximately 30% calcium carbonate by weight. Possible exhaustion of Chitorem was reviewed utilizing the Tiger bench-scale study data. The average MIW acidity in the year 2 Danny T study was 667 mg/L while the estimated acidity for the Tiger study was 533 mg/L. Since these two MIWs are similar, a comparison can be made between the two studies. As reported in Section 4.3.2.2, approximately 6.15 g Chitorem was required to increase 1 L MIW to a pH of 5.0 su, with some Chitorem leftover in the bottom of the beaker. For batch Tiger BCR tests, the 15 g Chitorem dose provided adequate treatment for the 2.5 L, which is equivalent to 6 g Chitorem per 1 L MIW (see Section 4.3.3.11 BCR11). The Danny T year 2 study utilized 3.2 gallons Chitorem, which is equivalent to approximately 6,900 g Chitorem using a 0.57 kg/L density. Based on the 6 g estimate per liter MIW, the amount of MIW that could theoretically be treated with this mass of Chitorem is approximately 1,200 L. Using average flow rates and variations in flow rates for the number of pilot-study days, a total of approximately 1,500 L Danny T adit water was treated in the study. Comparison of the two MIW volumes indicates the Chitorem could have been exhausted by the end of the year 2 study.

The NaOH pre-treatment effectiveness was variable due to operational problems with maintaining adequate and consistent pH dosing and pre-treatment pH. Although inconsistent pre-treatment pH levels did occur, when above 5 su, total Al removal efficiency ranged from 61 to 96.5%. When pH was above 4 su, total Fe removal efficiency ranged from 90.6 to 95.7%. Overall, Fe removal by the NaOH pre-treatment was the most consistent compared to other metals. Removal efficiencies for other metals were quite variable but in general increased with increasing pH.

Although pre-treatment variability occurred, BCR4 maintained a high level of metal removal efficiency similar to the other BCRs in the study. Except for the first sample event, overall dissolved Al, Cd, Cu, Fe, Pb, and Zn removal efficiencies for the NaOH/BCR4 system compared to the influent MIW were greater than 97% for the entire study. Overall total removal efficiencies for these same metals ranged from 88.7 to greater than 99% (again excluding the first sample event). Compared to other BCRs, BCR4 had a higher frequency of water quality exceedances throughout the study, especially for metals such as Cd and Zn that exceeded standards for most sample events (when detected for Cd).

Each of the treatment systems reacted slightly different to increases in flow rate although, regardless of the pre-treatment type, the BCRs still maintained significantly high total and dissolved metal removal efficiencies. ORP increases were observed for all BCRs after the flow rate increased to 12.5 ml/min (80.6 h retention time) and 16.7 ml/min (60.5 h retention time) although some signs of recovery were observed after the first increase. For the second flow rate increase, further increases in ORP occurred in all BCRs, decreases in sulfate reduction rate occurred in BCRs 2 through 4, and increases in Fe occurred in BCRs 1 and 2. Volumetric sulfate reduction rates were near or above the designed rate of 300 mmol SO_4/m^3-day but then decreased in BCRs 2 through 4 after the second flow rate increase. BCR1 maintained a sulfate reduction rate of 443 mmol SO_4/m^3-day on 9/2 while BCR3 was at 329 mmol SO_4/m^3-day and BCRs 2 and 4 were below 150 mmol SO_4/m^3-day. Both passive pre-treatments (SAPS and CHIT) also had decreased metal removal, increased ORP, and generation of acidity at the fastest retention time observed on 9/2. However, after the decrease in flow rate and stagnated conditions from the pipeline break, sulfate reduction rates again increased in BCRs 2 through 4.

The combined post-treatment system provided promising test results even for such a small-scale system that has a limited aeration effect at the low and batch-based flow rate. As with BCR effluents, BOD, orthophosphate, and ammonia concentrations declined in the POSTI samples as the study progressed. The post-treatment system provided significant removal of sulfide, BOD, and orthophosphate in the combined BCR influent. Because the BCRs had already removed most of the metals, and because of higher reporting limits, additional metal removal by the post-treatment system could not be determined. BOD, orthophosphate, and sulfide removal efficiencies ranged from 14.8 to greater than 96.8%, 71.6 to 99.3%, and 70.4 to greater than 99%, respectively.

Ammonia removal in the post-treatment system was limited. While some ammonia would volatize to the atmosphere, ammonia removal would predominantly occur via a biologically mediated nitrification process to nitrate/nitrite, followed by uptake of nitrate/nitrite by plants. However, nitrification requires significantly more oxygen than what is required for BOD degradation; therefore, nitrification is impeded until BOD concentrations decrease to approximately the same level as ammonia (Kadlec and Knight 1996). Concentrations of POSTE BOD and ammonia were not similar until the last month of the study when BOD removal increased to greater than 90%.

5.1.1 Conclusions

The overall data collected in this study indicate that the 60.5 h retention time may be too fast for maintaining adequate treatment of the Danny T adit discharge and for the types and sizes of treatment systems evaluated in this study. In contrast, the original 121 h retention time may be longer than necessary for adequate treatment. The optimum treatment retention time may then fall somewhere between 121 and 60.5 hours. This conclusion validates the use of the 300 mmol SO_4/m^3-day sulfate reduction rate and metals acidity loading as key in sizing the BCR for the water to be treated. In FS and future design evaluations, the optimum design retention time should consider available land surface area for the passive treatment system within this retention time range to optimize the system and costs. The lower the retention time of the BCR and pre-treatment components, the less land surface area required. However, too small of a system can result in loss of long-term and consistent treatment efficiency.

Although BCR1 results indicate that addition of a small fraction of Chitorem to the BCR provides treatment enhancement and nearly equivalent efficiency as other BCRs with pre-treatment, pre-treatment by one of the other methods tested would be highly recommended to maintain adequate long-term treatment. Because of the potential exhaustion of Chitorem in the CHIT pre-treatment, eventual exhaustion of the Chitorem in a BCR-only type treatment could also lead to the same effects. Most importantly, the pre-treatment component, such as a SAPS, provides a method to reduce acidity load and oxidation state prior to the BCR, which reduces stress to the overall biological community. An initial reduction of oxidation state improves the efficiency of the sulfate reduction process. Use of pre-treatment also limits potential for clogging of piping or other infrastructure due to suspended solids and precipitates to one treatment unit rather than the BCR.

As an overall conclusion based on the data provided from the study, a SAPS pre-treatment followed by a BCR with a small fraction of Chitorem (similar to BCR1) may provide the best treatment scenario to maintain efficiency and limit costs. BCR1 exhibited more resilience to changing flow rates than the other three BCRs. This approach reduces costs and also allows for the majority of the materials in the BCR and SAPS to be sourced by local Montana suppliers. In a low-flow passive system, NaOH dosing proved to be challenging, just as magnesium hydroxide dosing was in the year 1 study. In a full-scale system, NaOH dosing would also bring challenges, such as adequate and safe storage of NaOH solution, and issues with winter operations due to the freezing point elevation of NaOH solution. The NaOH system would also require a power source that would need regular maintenance and inspection. Putting all these issues aside, the NaOH still would have the greatest potential to maintain high Al and Fe removal prior to the BCR and increase the longevity of the BCR. Assuming the NaOH system maintained a pH above 4.5 to 5.5 su, study results indicate higher metals removal compared to other pre-treatments tested.

Due to the higher cost of the Chitorem, relying solely on the Chitorem as a pre-treatment system may be more costly and achieve similar results as a SAPS system. However, based on the study design, a SAPS would need to be twice as large volumetrically compared to a Chitorem-based pre-treatment to achieve the same level of overall treatment. Additionally, because of the clogging observed in year 1, it is difficult to recommend a Chitorem-based reactor or pre-treatment with this one hydraulically successful test.

For post-treatment, the basic technologies tested appear to provide a high level of sulfide, BOD, and orthophosphate removal, especially after adequate establishment and acclimation of the aerobic wetland, BOD removal efficiencies increased above 90% at the end of the study. In a full-scale system, the lack of oxidation issue is addressed by the fact that the system would operate with a continuous and much larger flow rate. The larger flow rate results in turbulence and mixing. More aeration can be attained with simple systems such as cascades. The lack of oxidation can also be addressed by increased pond size and retention time, oxidation processes such as passively operated floating solar aerators, and a larger and more established series of aerobic wetland ponds. Inoculation with specific autotrophic nitrifying bacteria may also be considered to help initiate the nitrification process in the post-treatment ponds and wetlands such as from a local wastewater treatment plant. Another issue related to ammonia removal by nitrification is that the nitrification process converts alkalinity to carbonic acid, potentially resulting in a decreased water pH (Kadlec and Knight 1996). To address this potential issue, use of a passive limestone bed at the final discharge from the aerobic wetland or within the wetland may be considered.

5.2 Tiger Mine Treatability Study Summary and Conclusions

MIW from the Firehose Adit at the Tiger Mine was collected in early June 2014 and shipped to the CDM Smith Treatability Laboratory in Denver, Colorado. Analysis of the raw MIW was then performed to answer the Tiger Study principal study question 1, which showed very high levels of Fe, Mn, and Zn and lower levels of Al, As, Cd, Cu, Pb, and Ni. Comparison of the MIW to DEQ-7 standards showed human health standard exceedances of As, Cd, Cu, Pb, and Zn and chronic aquatic exceedances of Al, Cd, Cu, Pb, and Zn. Further analysis of this water at the Denver Laboratory showed that this MIW had a pH of around 2.5 su, a highly oxidizing ORP, no alkalinity, and enough sulfate for microbially mediated sulfate reduction processes for metals removal.

Alkaline materials NaOH, limestone, and Chitorem were used for titration tests on the raw MIW. The titrations were conducted to determine how much of each alkaline material was needed to increase the raw MIW to a pH of 5.0 su for later use in the bench-scale treatment study; the quantity of alkaline material needed per volume of MIW was calculated and scaled for application of the bench-scale tests. Results from these titrations showed that to raise the raw MIW to approximately 5.0 su required 1.83 ml of 25% NaOH, or 2.61 g limestone, or 6.15 g of the Chitorem material. With this information, the bench-scale treatability study initial batch parameters were designed.

The bench-scale study was implemented at the Denver Laboratory to test which combinations of organic substrates, alkaline materials, and microbial inoculum is most effective at treatment of the MIW. The organic substrates utilized were methanol, ethanol, molasses, and Chitorem, and the inoculum materials were a manure extract and Chitorem. After assembling a series of batch containers with varying quantities of these materials, the batch containers were sampled over a period of 7 weeks. The control batch container was assembled using only raw MIW and inert pea gravel, but water quality analysis at the end of the study showed that the control batch had reductions in concentrations of Fe and Pb but increased concentrations of Al, Cd, and Zn.

Methanol (BCRs 2 through 4) as an organic substrate along with NaOH addition was able to achieve large reductions in Al, Cu, Fe, and Pb, with smaller reductions in Zn. These reductions were likely due to precipitate formation from the initial NaOH addition. Concentrations of Cd and Zn remained well above water quality standards regardless of the initial methanol concentration. All methanol BCRs produced only a trace of sulfide, had low alkalinity and positive ORP, and did not reduce sulfate in the final analytical laboratory sample. These results support the conclusion that sulfate reduction did not occur and methanol was not an appropriate organic substrate for the microbial population contained within the inoculum utilized and for the MIW tested.

When ethanol was used as the organic substrate (BCRs 5 through 7), further reductions in Cd and Zn were observed compared to methanol. However, Fe was removed with ethanol to a lesser degree than methanol. As with the methanol, further increases in initial ethanol concentrations did not appear to increase the metals removal efficiencies. Of the three ethanol tests, only BCR5 with the lowest ethanol dose achieved sulfate reducing conditions during the study. Addition of more inoculum on 8/6 appeared to provide a boost to the system to decrease ORP to a more reducing condition, generate more sulfide and alkalinity, and increase pH above 6 su as a result. CDM Smith laboratory ORP, sulfide, and alkalinity results and laboratory metal removal efficiencies and sulfate results suggest that the addition of more ethanol to the MIW did not increase the amount of sulfate reduction or metals removal, and the increased dose may have caused toxicity to the microbial system.

Using molasses as an organic substrate (BCRs 8 through 10, 16, and 17) appeared to be the least effective at treating the MIW. On the final sampling date, high concentrations of Al, Cd, Cu, Fe, Pb, Ni, and Zn remained in the MIW compared to the control. Although all molasses BCRs initially began the study with more reducing ORP values and significant gas generation, ORP quickly increased to oxidizing while the pH remained most likely too acidic for sulfate reduction and metals removal to occur. All molasses BCRs also released a significant amount of iron into solution from the molasses substrate, which resulted in a decrease in acidity and may have inhibited further sulfate reduction. Breakdown of molasses also may have increased concentrations of organic acids to reduce acidity. Overall, molasses BCRs were not able to sustain sulfate reduction throughout the study. Even with additional alkaline materials in BCR16 (limestone) and BCR17 (Chitorem), some component was present with the molasses that inhibited further sulfate reduction after the first couple weeks.

With the exception of a combined Chitorem/molasses substrate (BCR17), the use of Chitorem as an organic substrate appears to be the most effective at maintaining sulfate reducing conditions and removal of metals from the MIW. BCRs 11 through 13 utilized Chitorem only at different doses for the organic substrate, alkaline material, and inoculum. BCRs 14 and 15 evaluated the augmentation of a lower Chitorem dose with NaOH and limestone alkaline materials. BCR18 evaluated the augmentation of a lower Chitorem dose with ethanol.

Overall, when Chitorem was employed, levels of Al, Cd, Cu, Fe, Pb, Ni, and Zn were lower than when methanol, ethanol, or molasses were used. This finding is confirmed by consistently reducing ORP, neutral pH, higher sulfide concentration and alkalinity, and lower DO levels in the Chitorem batches than when the other three substrates were employed. Between the three Chitorem-only BCRs, the greater the Chitorem content, the slightly greater the sulfate reduction measured at the end of the study although a greater Chitorem content did not show a discernable improvement in metals removal. During the study, CDM Smith laboratory sulfide and alkalinity concentrations were slightly greater with the successively greater Chitorem contents. ORP was also the lowest with the greater Chitorem content.

When comparing Chitorem-only BCRs 11 through 13, both BCRs 14 and 15 with additional alkaline material reached an ORP of less than -300 mV faster and had lower values at the end of the study.

BCRs 14 (7 g Chitorem and NaOH) and 15 (7 g Chitorem and Limestone) had higher sulfide and alkalinity concentrations than BCRs 11 through 13 on 8/11, followed by a decrease to less than BCRs 11 through 13 for the last two sample events. For metals, BCRs 14 and 15 did not have a discernable improvement in removal efficiency. Similarly, BCR14 and BCR15 also had no difference in removal efficiencies with the different alkaline reagents utilized. However, sulfate removal was slightly greater with the use of NaOH in BCR14.

In the last container with Chitorem, the use of ethanol with Chitorem did not improve metals removal compared to other Chitorem treatments. Based on increasing ORP towards 0 and lower overall sulfide and alkalinity generation compared to other Chitorem BCRs, the addition of ethanol appeared to have provided some inhibitory effect to sulfate reduction. Overall, these results suggest that in order to maintain sulfate reducing conditions that will result in acceptable metals removal from MIW, at least 7 g of Chitorem is needed for the 2.5 L of MIW in conjunction with a separate alkaline material, or a dose of 15 g Chitorem alone may be sufficient. These findings answer the Tiger principal study questions 3 and 4.

Overall, the Chitorem bench-tests provided the best metals removal and indication of sustained sulfate reducing conditions. Adequate treatment effectiveness with the right ethanol dose also appears promising and has been shown effective in passive treatment systems by others. Assuming injection of substrates into underground workings is feasible in a field application, a combination of NaOH pH adjustment, followed by Chitorem-guar injection, is recommended given the study data results. Limestone fines also would appear to provide pH adjustment; however, NaOH as an alkaline amendment would be easier to implement and more mobile and reactive to increase pH compared to limestone. The lowest Chitorem doses tested were adequate for treatment in the batch tests; however, in a field application, higher doses probably would be recommended to provide longer-term treatment and stabilization of the mine pool oxidation state to a more reducing environment.

In conclusion, the Tiger bench-scale study provides an important set of data to be utilized for FS evaluations of possible in-situ treatments regarding reagent dosing and effectiveness. However, the bench-tests do not provide insight into the technical feasibility of such treatments. Based on downhole camera field investigations, application of a treatability test at the Tiger shaft is not recommended at this time. Future potential field applications could be conducted at the Tiger mine or other mine sites with further evaluations of underground workings locations, geology reviews, and planning and installation of injection/extraction wells for treatment application.

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Section 6

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Appendix A

Laboratory Data Packages

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Appendix A.1

Danny T Year 2 Pilot Study Laboratory Data Packages

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ANALYTICAL SUMMARY REPORT

June 24, 2014

CDM Federal Programs
555 17th St Ste 1100
Denver, CO 80202

Work Order: H14060257 Quote ID: H823 - Baker-Hughsville Superfund Site
Project Name: Baker-Hughsville

Energy Laboratories Inc Helena MT received the following 9 samples for CDM Federal Programs on 6/12/2014 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H14060257-001	14BH-DT-Pilot-INF-061114	06/11/14 12:50	06/12/14	Aqueous	Acidity, Total as CaCO3 Phosphorus, Orthophosphate as P
H14060257-002	14BH-DT-Pilot-INFD-061114	06/11/14 13:00	06/12/14	Aqueous	Same As Above
H14060257-003	14BH-DT-Pilot-SAPS-061114	06/11/14 13:50	06/12/14	Aqueous	Same As Above
H14060257-004	14BH-DT-Pilot-CHIT-061114	06/11/14 14:05	06/12/14	Aqueous	Same As Above
H14060257-005	14BH-DT-Pilot-NAOH-061114	06/11/14 14:15	06/12/14	Aqueous	Same As Above
H14060257-006	14BH-DT-Pilot-BCR1-061114	06/11/14 14:35	06/12/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Phosphorus, Orthophosphate as P
H14060257-007	14BH-DT-Pilot-BCR2-061114	06/11/14 14:55	06/12/14	Aqueous	Same As Above
H14060257-008	14BH-DT-Pilot-BCR3-061114	06/11/14 15:20	06/12/14	Aqueous	Same As Above
H14060257-009	14BH-DT-Pilot-BCR4-061114	06/11/14 15:40	06/12/14	Aqueous	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	06/24/14
Project:	Baker-Hughsville	**Collection Date:**	06/11/14 12:50
Lab ID:	H14060257-001	**DateReceived:**	06/12/14
Client Sample ID:	14BH-DT-Pilot-INF-061114	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	620	mg/L	D	4.0		A2310 B	06/13/14 10:10 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.391	mg/L		0.005		E365.1	06/13/14 12:00 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	06/24/14
Project:	Baker-Hughsville	**Collection Date:**	06/11/14 13:00
Lab ID:	H14060257-002	**DateReceived:**	06/12/14
Client Sample ID:	14BH-DT-Pilot-INFD-061114	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	630	mg/L	D	4.0		A2310 B	06/13/14 10:14 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.262	mg/L		0.005		E365.1	06/13/14 12:02 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.

MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	06/24/14
Project:	Baker-Hughsville	**Collection Date:**	06/11/14 13:50
Lab ID:	H14060257-003	**DateReceived:**	06/12/14
Client Sample ID:	14BH-DT-Pilot-SAPS-061114	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	06/13/14 10:21 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	3.10	mg/L	D	0.01		E365.1	06/13/14 12:03 / cmm

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	06/24/14
Project:	Baker-Hughsville	**Collection Date:**	06/11/14 14:05
Lab ID:	H14060257-004	**DateReceived:**	06/12/14
Client Sample ID:	14BH-DT-Pilot-CHIT-061114	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	06/13/14 10:30 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.090	mg/L		0.005		E365.1	06/13/14 12:04 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Baker-Hughsville
Lab ID: H14060257-005
Client Sample ID: 14BH-DT-Pilot-NAOH-061114

Report Date: 06/24/14
Collection Date: 06/11/14 14:15
DateReceived: 06/12/14
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	270	mg/L	D	4.0		A2310 B	06/13/14 10:32 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.038	mg/L		0.005		E365.1	06/13/14 12:07 / cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	06/24/14
Project:	Baker-Hughsville	**Collection Date:**	06/11/14 14:35
Lab ID:	H14060257-006	**DateReceived:**	06/12/14
Client Sample ID:	14BH-DT-Pilot-BCR1-061114	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	06/13/14 11:08 / SRW
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	>1755	mg/L		2000		A5210 B	06/12/14 16:39 / SRW
Minimum DO for BOD is less than 1.0 mg/L.							
NUTRIENTS							
Phosphorus, Orthophosphate as P	10.6	mg/L	D	0.02		E365.1	06/13/14 12:08 / cmm

Report Definitions:		
	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	06/24/14
Project:	Baker-Hughsville	**Collection Date:**	06/11/14 14:55
Lab ID:	H14060257-007	**DateReceived:**	06/12/14
Client Sample ID:	14BH-DT-Pilot-BCR2-061114	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	06/13/14 11:13 / SRW
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	>1758	mg/L		2000		A5210 B	06/12/14 16:41 / SRW
Minimum DO for BOD is less than 1.0 mg/L.							
NUTRIENTS							
Phosphorus, Orthophosphate as P	73.8	mg/L	D	0.2		E365.1	06/13/14 12:09 / cmm

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	06/24/14
Project:	Baker-Hughsville	**Collection Date:**	06/11/14 15:20
Lab ID:	H14060257-008	**DateReceived:**	06/12/14
Client Sample ID:	14BH-DT-Pilot-BCR3-061114	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	06/13/14 11:20 / SRW
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	>1758	mg/L		2000		A5210 B	06/12/14 16:43 / SRW
Minimum DO for BOD is less than 1.0 mg/L.							
NUTRIENTS							
Phosphorus, Orthophosphate as P	55.9	mg/L	D	0.2		E365.1	06/13/14 12:10 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Baker-Hughsville
Lab ID: H14060257-009
Client Sample ID: 14BH-DT-Pilot-BCR4-061114

Report Date: 06/24/14
Collection Date: 06/11/14 15:40
DateReceived: 06/12/14
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	06/13/14 11:25 / SRW
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	>1749	mg/L		2000		A5210 B	06/12/14 16:46 / SRW
Minimum DO for BOD is less than 1.0 mg/L.							
NUTRIENTS							
Phosphorus, Orthophosphate as P	43.0	mg/L	D	0.2		E365.1	06/13/14 12:11 / cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Baker-Hughsville

Report Date: 06/24/14
Work Order: H14060257

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2310 B										Batch: H140613A
Lab ID: H14060257-001ADUP		Sample Duplicate				Run: PH_140613A				06/13/14 10:12
Acidity, Total as CaCO3		640	mg/L	4.0				3.2	20	
Lab ID: LCS1406130000		Laboratory Control Sample				Run: PH_140613A				06/13/14 10:07
Acidity, Total as CaCO3		970	mg/L	4.0	98	90	110			
Lab ID: MBLK1406130000		Method Blank				Run: PH_140613A				06/13/14 10:06
Acidity, Total as CaCO3		4	mg/L							

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Baker-Hughsville

Report Date: 06/24/14
Work Order: H14060257

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A5210 B									Batch: 140612_1_BOD5-W	
Lab ID: Dil-H201_140612		Dilution Water Blank				Run: MISC WC_140612B			06/12/14 14:23	
Oxygen Demand, Biochemical (BOD)		ND	mg/L	2.0		0	0.2			
Lab ID: GGA1_140612		Laboratory Control Sample				Run: MISC WC_140612B			06/12/14 14:29	
Oxygen Demand, Biochemical (BOD)		180	mg/L	67	91	85	115			
Lab ID: H14060249-001ADUP		Sample Duplicate				Run: MISC WC_140612B			06/12/14 14:48	
Oxygen Demand, Biochemical (BOD)		ND	mg/L	130		90	110			

No BOD dilution depleted greater than 2.0 mg/L DO.

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs **Report Date:** 06/24/14

Project: Baker-Hughsville **Work Order:** H14060257

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E365.1							Analytical Run: FIA202-HE_140613B			
Lab ID: ICV		Initial Calibration Verification Standard								06/13/14 11:55
Phosphorus, Orthophosphate as P		0.250	mg/L	0.0050	100	90	110			
Lab ID: ICB		Initial Calibration Blank, Instrument Blank								06/13/14 11:56
Phosphorus, Orthophosphate as P		-0.00273	mg/L	0.0050		0	0			
Lab ID: CCV		Continuing Calibration Verification Standard								06/13/14 11:58
Phosphorus, Orthophosphate as P		0.0982	mg/L	0.0050	98	90	110			
Method: E365.1										Batch: R97993
Lab ID: LFB		Laboratory Fortified Blank				Run: FIA202-HE_140613B				06/13/14 11:57
Phosphorus, Orthophosphate as P		0.181	mg/L	0.0050	91	90	110			
Lab ID: H14060257-004BMS		Sample Matrix Spike				Run: FIA202-HE_140613B				06/13/14 12:05
Phosphorus, Orthophosphate as P		0.129	mg/L	0.0050	20	90	110			S
- The MS/MSD were re-analyzed at a higher dilution and showed improved recoveries. It is suspected that the failing Matrix Spike is due to matrix interference.										
Lab ID: H14060257-004BMSD		Sample Matrix Spike Duplicate				Run: FIA202-HE_140613B				06/13/14 12:06
Phosphorus, Orthophosphate as P		0.127	mg/L	0.0050	19	90	110	1.6	20	S
- The MS/MSD were re-analyzed at a higher dilution and showed improved recoveries. It is suspected that the failing Matrix Spike is due to matrix interference.										
Lab ID: H14060264-002CMS		Sample Matrix Spike				Run: FIA202-HE_140613B				06/13/14 12:15
Phosphorus, Orthophosphate as P		0.237	mg/L	0.0050	90	90	110			
Lab ID: H14060264-002CMSD		Sample Matrix Spike Duplicate				Run: FIA202-HE_140613B				06/13/14 12:16
Phosphorus, Orthophosphate as P		0.245	mg/L	0.0050	94	90	110	3.3	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

Workorder Receipt Checklist

CDM Federal Programs

H14060257

Login completed by:	Amanda B. Blackburn	Date Received:	6/12/2014
Reviewed by:	BL2000\wjohnson	Received by:	TLL
Reviewed Date:	6/13/2014	Carrier name:	Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☑	No ☐	Not Applicable ☐
Container/Temp Blank temperature:	1.3°C No Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☑	No ☐	Not Applicable ☐

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

Orthophosphate samples received filtered as indicated on sample container. Abb 6/12/14

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 1 of 1

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM Smith

Project Name, PWS, Permit, Etc. BARKER - HUGHESVILLE

Sample Origin State: MT

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address (Required):

☒ No Hard Copy Email: FrandsenAK@cdmsmith.com

Contact Name: ANGELA FRANDSEN

Phone/Fax: (406) 441-1400

Cell: (406) 439-3776

Sampler: (Please Print) TOM ASKIN

Invoice Contact & Phone: SAME

Purchase Order:

Quote/Bottle Order:

Invoice Address (Required):

☒ No Hard Copy Email: Same as Report

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: ______
☐ Other: ______
☒ EDD/EDT (Electronic Data) Format: Excel
☐ LEVEL IV
☐ NELAC

ANALYSIS REQUESTED

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: USE 1000 mL BOTTLES FOR COMBINED BOD & ACIDITY

Shipped by: Hand

Cooler ID(s): Y

Receipt Temp 1.3 °C TB

On Ice: Y [✓ N]

Custody Seal
On Bottle Y [✓ N]
On Cooler Y [✓ N]

Intact Y N

Signature Match Y N

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	Number of Containers Sample Type: A W S V B O DW Air Water Soils/Solids Vegetation Bioassay Other DW - Drinking Water MATRIX	ACIDITY	BOD	ORTHOPHOSPHATE							SEE ATTACHED	Standard Turnaround (TAT)	RUSH	LABORATORY USE ONLY
1	14BH-DT-Pilot-INF-061114	6/11/14	12:50	2 W	X		X										#14060257
2	14BH-DT-Pilot-INFD-061114	6/11/14	13:00	2 W	X		X										
3	14BH-DT-Pilot-SAPS-061114	6/11/14	13:50	2 W	X		X										
4	14BH-DT-Pilot-CHIT-061114	6/11/14	14:05	2 W	X		X										
5	14BH-DT-Pilot-NAOH-061114	6/11/14	14:15	2 W	X		X										
6	14BH-DT-Pilot-BCR1-061114	6/11/14	14:35	2 W	X	X	X										
7	14BH-DT-Pilot-BCR2-061114	6/11/14	14:55	2 W	X	X	X										
8	14BH-DT-Pilot-BCR3-061114	6/11/14	15:20	2 W	X	X	X										
9	14BH-DT-Pilot-BCR4-061114	6/11/14	15:40	2 W	X	X	X										
10																	

Custody Record MUST be Signed

Relinquished by (print): TOM ASKIN	Date/Time: 6/12/14 15:26	Signature: Tom Askin	Received by (print):	Date/Time:	Signature:
Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Sample Disposal:	Return to Client: ______	Lab Disposal: ______	Received by Laboratory: Tracy Lorash	Date/Time: 6/12/14 15:26	Signature: Tracy Lorash

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested.

Statement of Work

Laboratory Analysis of Treatability Study Samples
Energy Laboratories, Inc.
Subcontract No. 3383-325-006-AL, Modification 02

CDM Federal Programs Corporation (CDM Smith) has been contracted by the U.S. Environmental Protection Agency (EPA) under Contract No. EP-W-05-049, Region 8, to conduct laboratory analysis of samples collected from the Danny T adit pilot-scale treatability study at the Barker-Hughesville Superfund Site (the site). This modified statement of work (SOW) is to extend the period of performance and increase the number of sample analyses requested. Sections not requiring revision from the original SOW have not been included in this amendment, although the services are still requested. The Subcontractor requirements under this amendment are summarized in the following sections.

1.1 Scope

Scope of additional requested analyses is presented in Exhibit 1. The requested analytes are orthophosphate, acidity, sulfide, and BOD. For the 2014 pilot-scale study, up to 99 samples will be analyzed for orthophosphate acidity and up to 58 samples will be analyzed for sulfide and BOD.

Exhibit 1. List of analyses and samples required

[illegible]	[illegible]	[illegible]	[illegible]
Orthophosphate	SM4500-S D or EPA 365.1	99	0.5 mg/L
Acidity	A2310B or EPA 305.1	99	4 mg/L
Sulfide	A4500-S D or EPA 376.1	58	1 mg/L
BOD	A5210 B or EPA 405.1	58	40 mg/L

1.2 Schedule

The anticipated schedule is as follows:

- CDM Smith anticipates initiation of the 2014 pilot-scale treatability study in early June 2014. Samples from the pilot-scale study influent and effluent will be collected bi-weekly, starting at the week of June 9, 2014 and continuing through early October 2014. A total of 9 sampling events are planned.
- A 10 business day turn-around-time from sample receipt will be required for all results.

1.3 Deliverable Requirements

Deliverable requirements are unchanged from the original SOW.

1.4 Methods of Analyses and Number of Samples

The required analyses and number of samples for the 2014 study are provided in Exhibit 1.

U.S. Environmental Protection Agency
Region 8
Technical and Management Services

Laboratory Services Program

Certificate of Analysis

Ref: 8TMS-L

MEMORANDUM

Date: 07/11/14

Subject: Analytical Results--- **Barker-Hughesville_Treatability_JUN 2014_A046 / A-046**

From: Don Goodrich; EPA Region 8 Analytical Chemistry WAM

To: Roger Hoogerheide
Superfund
8 MO

Received Sample Set(s), [Work Order : Date Received]:
[C140612 : 06/13/2014]

Attached are the analytical results for the samples received from the Barker-Hughesville_Treatability_JUN 2014_A046 sampling event, according to TDF A-046. All analyses were performed within their method specified holding times unless otherwise noted in the following narrative.

These samples were prepared, analyzed, and verified by the Environmental Services Assistance Team Laboratory (ESAT) according to the requirements of the Technical Direction Form (TDF).

Note: The laboratory herewith transmits this deliverable to the program/project partner for determination of "final data usability" which may include data validation and data quality asessment per and in accordance with EPA QA/G-8, *Guidance on Environmental Data Verification and Data Validation*, November 2002, EPA/240/R-02/004. Laboratory data qualifiers are applied based on the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004, referred to as "NFGI".

Laboratory policy is to dispose of any remaining sample 60 days after data analysis packages are delivered to EPA. If you would like the laboratory to retain the samples for a period longer than 60 days,

Case Narrative

C140612

Quality Assessment: Unless indicated by exception, the QA/QC associated with this sample set produced data within the TDF-specified criteria.

Holding Times: All samples were analyzed within their method-specified technical holding time(s).

1. Initial and Continuing calibration blanks (ICBs and CCBs).
   Exceptions: None.
2. Preparation (PB) / Method blanks (MB)
   Exceptions: None.
3. Interference Checks (ICSA / ICSAB) for ICP-MS and ICP-OE analyses only.
   Exceptions: None.
4. Initial and Continuing calibration verification analyses (ICVs, SCVs and CCVs).
   Exceptions: In ICP-MS sequence 1407038, lead recovered high in the SCV. As a result, all sample results for lead were qualified "J" as estimated.
5. Laboratory Control Sample (LCS) or second source analysis or SRM.
   Exceptions: None.
6. Laboratory Fortified blank (LFB) / Blank spike (BS), same source as used for the matrix spikes. PBS performed with analyses/methods requiring preparation or digestion prior to analysis.
   Exceptions: None.
7. Contract Reporting Detection Limit Standard, labeled as CRA, CRDL or CRL.
   Exceptions: None.
8. Laboratory Duplicate (DUP). "Source" identifies field sample duplicated in the laboratory. If either the "source" or the duplicate result is <5X the reporting limit, the %D limit of 20% does not apply.
   Exceptions: None.
9. Laboratory Matrix Spike (MS) and spike duplicate (MSD). "Source" defines original field sample fortified prior to analysis. Percent recovery (%R) limits do not apply when sample concentration(s) exceed the corresponding analyte spike level by a factor of 4 or greater.
   Exceptions: None.
10. Serial Dilution sample analysis (SRD). "Source" is parent field sample diluted 1:5 in the laboratory. Performed for ICP-OE and ICP-MS metals analyses. Percent difference (%D) limits do not apply when analyte concentration(s) are below 50x the source sample's MDL (or 10x it's PQL).
    Exceptions: None.
11. Internal standards, criteria specified for ICP-MS analyses only, monitored at the instrument.
    Exceptions: None.
12. Any calibration using more than two-points produced a correlation coefficient equal to or greater than 0.995.
    Exceptions: None.

Acronyms and Definitions:

ESAT	Environmental Services Assistance Team
J	Data Estimated qualifier (also applied to all data less than PQL, greater than or equal to MDL)
MDL	Method Detection Limit
PQL	Practical Quantitation Limit, also known as reporting limit.
RPD	Relative Percent Difference (difference divided by the mean)
%D	Percent difference, serial dilution criteria unit, difference divided by the original result.
%R	Percent recovery, analyzed (less sample contribution) divided by true value
<	Analyte NOT DETECTED at or above the Method Detection Limit (MDL)
mg/L	Parts per million (millligrams per liter). Solids equivalent = mg/Kg.
ug/L	Parts per billion (micrograms per liter). Solids equivalent = ug/Kg.
NR	No Recovery (matrix spike) - Often seen for calcium/magnesium when their concentration exceeds the spike level by > 4x.
NFGI	*USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004
RE	Sample Re-analysis. Usually seen on raw data and sequences for required sample dilutions due to over-range analytes.
U	Analyte not detected at or above MDL qualifier
D	Diluted value qualifier.

Method(s) Summary:

As defined in the Technical Direction Form (TDF), some or all of the methods listed below were used for the determination of the reported target analytes.

From EPA's *Methods for the Determination of Metals in Environmental Samples*, Supplement I, May 1994, dissolved, total, and/or total recoverable metals were determined by:

- Method 200.7 / 6010B using a PE Optima ICP -OE (ICP).
- Method 200.8 / 6020 using a Perkin -Elmer Elan 6000 ICP-MS.
- Method 200.2 for total recoverable metals (only) digestion.
- Method 245.1 using a Perkin -Elmer FIMS CVAA (aqueous mercury only).

From *Standard Methods for the Examination of Water and Wastewater*, 18th Edition, 1992, Method 2340B was used for the calculated hardness determination. Hardness is reported as mg (milligram) equivalent $CaCO_3$ per liter (L) determined as follows:

Calculated hardness = 2.497 * (Calcium, mg/L) + 4.118 * (Magnesium, mg/L).

From *EPA's Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846*,

- Method 3015A was used for microwave assisted total metals digestion.
- Method 7473 was used for mercury in solids.

From EPA's *Determination of Inorganic Anions by Ion Chromatography*, Revision 2.1, 1993, Method 300.0 was used to determine the anions.

From EPA's *Methods for Chemical Analysis of Water and Wastes*, March 1983:

- Method 310.1 was followed for the alkalinity determination.
- Method 160.1 was followed for gravimetric total dissolved solids (TDS) determination.
- Method 160.2 was used for gravimetric total suspended solids (TSS) determination.
- Method 415.3 was used for total organic carbon (TOC) determination using either an Apollo 9000 or Phoenix 8000 Non-Dispersive IR (NDIR) system. Also known as dissolved organic carbon (DOC) when performed on the dissolved sample fraction.

The quality control procedures listed in the TDF request were utilized by ESAT to verify accuracy of the results and to evaluate any matrix interferences.

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-061114 **Date / Time Sampled:** 06/11/14 14:35 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140612-02 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**436**	J	ug/L	200	10	07/08/2014	SV	1407023
200.7	**Iron**	**1410**	J	ug/L	1000	10	07/08/2014	SV	1407023
200.7	**Manganese**	**4380**		ug/L	20.0	10	07/08/2014	SV	1407023
200.7	**Zinc**	**142**	J	ug/L	100	10	07/08/2014	SV	1407023
200.8	**Arsenic**	**94.5**		ug/L	5.00	10	07/10/2014	SV	1407027
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	07/10/2014	SV	1407027
200.8	**Copper**	**18.6**		ug/L	5.00	10	07/10/2014	SV	1407027
200.8	Lead	< 2.00	U	ug/L	1.00	10	07/10/2014	SV	1407027
200.8	Nickel	< 10.0	U	ug/L	5.00	10	07/10/2014	SV	1407027
2340B	**Hardness**	**3270**		mg/L	15	10	07/08/2014	SV	1407023

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-061114 **Date / Time Sampled:** 06/11/14 14:55 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140612-06 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**282**	J	ug/L	200	10	07/08/2014	SV	1407023
200.7	**Iron**	**1030**	J	ug/L	1000	10	07/08/2014	SV	1407023
200.7	**Manganese**	**3980**		ug/L	20.0	10	07/08/2014	SV	1407023
200.7	**Zinc**	**165**	J	ug/L	100	10	07/08/2014	SV	1407023
200.8	**Arsenic**	**15.6**	J	ug/L	5.00	10	07/10/2014	SV	1407027
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	07/10/2014	SV	1407027
200.8	**Copper**	**20.2**		ug/L	5.00	10	07/10/2014	SV	1407027
200.8	**Lead**	**2.61**		ug/L	1.00	10	07/10/2014	SV	1407027
200.8	**Nickel**	**29.3**		ug/L	5.00	10	07/10/2014	SV	1407027
2340B	**Hardness**	**1600**		mg/L	15	10	07/08/2014	SV	1407023

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-061114 **Date / Time Sampled:** 06/11/14 15:20 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140612-10 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**279**	J	ug/L	200	10	07/08/2014	SV	1407023
200.7	**Iron**	**1320**	J	ug/L	1000	10	07/08/2014	SV	1407023
200.7	**Manganese**	**4010**		ug/L	20.0	10	07/08/2014	SV	1407023
200.7	**Zinc**	**155**	J	ug/L	100	10	07/08/2014	SV	1407023
200.8	**Arsenic**	**174**		ug/L	5.00	10	07/10/2014	SV	1407027
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	07/10/2014	SV	1407027
200.8	**Copper**	**22.7**		ug/L	5.00	10	07/10/2014	SV	1407027
200.8	**Lead**	**2.19**		ug/L	1.00	10	07/10/2014	SV	1407027
200.8	**Nickel**	**27.0**		ug/L	5.00	10	07/10/2014	SV	1407027
2340B	**Hardness**	**1870**		mg/L	15	10	07/08/2014	SV	1407023

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-061114 **Date / Time Sampled:** 06/11/14 15:40 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140612-14 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**460**	J	ug/L	200	10	07/08/2014	SV	1407023
200.7	**Iron**	**1310**	J	ug/L	1000	10	07/08/2014	SV	1407023
200.7	**Manganese**	**9680**		ug/L	20.0	10	07/08/2014	SV	1407023
200.7	**Zinc**	**1920**		ug/L	100	10	07/08/2014	SV	1407023
200.8	**Arsenic**	**29.5**		ug/L	5.00	10	07/10/2014	SV	1407027
200.8	**Cadmium**	**12.5**		ug/L	1.00	10	07/10/2014	SV	1407027
200.8	**Copper**	**63.3**		ug/L	5.00	10	07/10/2014	SV	1407027
200.8	**Lead**	**16.2**		ug/L	1.00	10	07/10/2014	SV	1407027
200.8	**Nickel**	**25.0**		ug/L	5.00	10	07/10/2014	SV	1407027
2340B	**Hardness**	**1040**		mg/L	15	10	07/08/2014	SV	1407023

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-061114 **Date / Time Sampled:** 06/11/14 14:05 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140612-18 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**94.5**		ug/L	20.0	1	07/08/2014	SV	1407023
200.7	**Iron**	**407**		ug/L	100	1	07/08/2014	SV	1407023
200.7	**Manganese**	**2110**		ug/L	2.00	1	07/08/2014	SV	1407023
200.7	**Zinc**	**205**		ug/L	10.0	1	07/08/2014	SV	1407023
200.8	**Arsenic**	**48.5**		ug/L	5.00	10	07/10/2014	SV	1407027
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	07/10/2014	SV	1407027
200.8	**Copper**	**24.3**		ug/L	5.00	10	07/10/2014	SV	1407027
200.8	Lead	< 2.00	U	ug/L	1.00	10	07/10/2014	SV	1407027
200.8	Nickel	< 10.0	U	ug/L	5.00	10	07/10/2014	SV	1407027
2340B	**Hardness**	**1140**		mg/L	2	1	07/08/2014	SV	1407023

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INF-061114 **Date / Time Sampled:** 06/11/14 12:50 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140612-21 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**12400**		ug/L	200	10	07/08/2014	SV	1407023
200.7	**Iron**	**154000**		ug/L	1000	10	07/08/2014	SV	1407023
200.7	**Manganese**	**106000**		ug/L	20.0	10	07/08/2014	SV	1407023
200.7	**Zinc**	**59500**		ug/L	100	10	07/08/2014	SV	1407023
200.8	**Arsenic**	**264**		ug/L	5.00	10	07/10/2014	SV	1407027
200.8	**Cadmium**	**258**		ug/L	1.00	10	07/10/2014	SV	1407027
200.8	**Copper**	**1210**		ug/L	5.00	10	07/10/2014	SV	1407027
200.8	**Lead**	**245**		ug/L	1.00	10	07/10/2014	SV	1407027
200.8	**Nickel**	**27.6**		ug/L	5.00	10	07/10/2014	SV	1407027
2340B	**Hardness**	**337**		mg/L	15	10	07/08/2014	SV	1407023

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFD-061114 **Date / Time Sampled:** 06/11/14 13:00 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140612-24 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**13200**		ug/L	200	10	07/08/2014	SV	1407023
200.7	**Iron**	**160000**		ug/L	1000	10	07/08/2014	SV	1407023
200.7	**Manganese**	**106000**		ug/L	20.0	10	07/08/2014	SV	1407023
200.7	**Zinc**	**59800**		ug/L	100	10	07/08/2014	SV	1407023
200.8	**Arsenic**	**256**		ug/L	5.00	10	07/10/2014	SV	1407027
200.8	**Cadmium**	**256**		ug/L	1.00	10	07/10/2014	SV	1407027
200.8	**Copper**	**1160**		ug/L	5.00	10	07/10/2014	SV	1407027
200.8	**Lead**	**242**		ug/L	1.00	10	07/10/2014	SV	1407027
200.8	**Nickel**	**26.4**		ug/L	5.00	10	07/10/2014	SV	1407027
2340B	**Hardness**	**359**		mg/L	15	10	07/08/2014	SV	1407023

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NAOH-061114 **Date / Time Sampled:** 06/11/14 14:15 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140612-27 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**5530**		ug/L	200	10	07/08/2014	SV	1407023
200.7	**Iron**	**31700**		ug/L	1000	10	07/08/2014	SV	1407023
200.7	**Manganese**	**99100**		ug/L	20.0	10	07/08/2014	SV	1407023
200.7	**Zinc**	**56200**		ug/L	100	10	07/08/2014	SV	1407023
200.8	**Arsenic**	**14.7**	J	ug/L	5.00	10	07/10/2014	SV	1407027
200.8	**Cadmium**	**256**		ug/L	1.00	10	07/10/2014	SV	1407027
200.8	**Copper**	**787**		ug/L	5.00	10	07/10/2014	SV	1407027
200.8	**Lead**	**72.7**		ug/L	1.00	10	07/10/2014	SV	1407027
200.8	**Nickel**	**27.1**		ug/L	5.00	10	07/10/2014	SV	1407027
2340B	**Hardness**	**367**		mg/L	15	10	07/08/2014	SV	1407023

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-061114 **Date / Time Sampled:** 06/11/14 13:50 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140612-30 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 500	U	ug/L	200	10	07/08/2014	SV	1407023
200.7	**Iron**	**6260**		ug/L	1000	10	07/08/2014	SV	1407023
200.7	**Manganese**	**28200**		ug/L	20.0	10	07/08/2014	SV	1407023
200.7	**Zinc**	**2260**		ug/L	100	10	07/08/2014	SV	1407023
200.8	**Arsenic**	**17.4**	J	ug/L	5.00	10	07/10/2014	SV	1407027
200.8	**Cadmium**	**5.25**		ug/L	1.00	10	07/10/2014	SV	1407027
200.8	**Copper**	**44.0**		ug/L	5.00	10	07/10/2014	SV	1407027
200.8	Lead	< 2.00	U	ug/L	1.00	10	07/10/2014	SV	1407027
200.8	Nickel	< 10.0	U	ug/L	5.00	10	07/10/2014	SV	1407027
2340B	**Hardness**	**987**		mg/L	15	10	07/08/2014	SV	1407023

"J" Qualifier indicates an estimated value

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-061114 **Date / Time Sampled:** 06/11/14 14:35 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140612-01 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**1190**		ug/L	200	10	07/08/2014	SV	1406114
200.7	**Iron**	**2610**		ug/L	1000	10	07/08/2014	SV	1406114
200.7	**Manganese**	**5040**		ug/L	20.0	10	07/08/2014	SV	1406114
200.7	**Zinc**	**882**		ug/L	100	10	07/08/2014	SV	1406114
200.8	**Arsenic**	**109**		ug/L	5.00	10	07/10/2014	SV	1406114
200.8	**Cadmium**	**17.1**		ug/L	1.00	10	07/10/2014	SV	1406114
200.8	**Copper**	**145**		ug/L	5.00	10	07/10/2014	SV	1406114
200.8	**Lead**	**20.5**	J	ug/L	1.00	10	07/10/2014	SV	1406114
200.8	Nickel	< 10.0	U	ug/L	5.00	10	07/10/2014	SV	1406114

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-061114 **Date / Time Sampled:** 06/11/14 14:55 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140612-05 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**1340**		ug/L	200	10	07/08/2014	SV	1406114
200.7	**Iron**	**3400**		ug/L	1000	10	07/08/2014	SV	1406114
200.7	**Manganese**	**5300**		ug/L	20.0	10	07/08/2014	SV	1406114
200.7	**Zinc**	**1370**		ug/L	100	10	07/08/2014	SV	1406114
200.8	Arsenic	< 200	U	ug/L	50.0	100	07/10/2014	SV	1406114
200.8	Cadmium	< 20.0	U	ug/L	10.0	100	07/10/2014	SV	1406114
200.8	**Copper**	**271**		ug/L	50.0	100	07/10/2014	SV	1406114
200.8	**Lead**	**55.7**	J	ug/L	10.0	100	07/10/2014	SV	1406114
200.8	Nickel	< 100	U	ug/L	50.0	100	07/10/2014	SV	1406114

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-061114 **Date / Time Sampled:** 06/11/14 15:20 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140612-09 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**1500**		ug/L	200	10	07/08/2014	SV	1406114
200.7	**Iron**	**3530**		ug/L	1000	10	07/08/2014	SV	1406114
200.7	**Manganese**	**4700**		ug/L	20.0	10	07/08/2014	SV	1406114
200.7	**Zinc**	**693**		ug/L	100	10	07/08/2014	SV	1406114
200.8	**Arsenic**	**180**		ug/L	5.00	10	07/10/2014	SV	1406114
200.8	**Cadmium**	**4.87**		ug/L	1.00	10	07/10/2014	SV	1406114
200.8	**Copper**	**144**		ug/L	5.00	10	07/10/2014	SV	1406114
200.8	**Lead**	**33.6**	J	ug/L	1.00	10	07/10/2014	SV	1406114
200.8	**Nickel**	**29.5**		ug/L	5.00	10	07/10/2014	SV	1406114

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-061114 **Date / Time Sampled:** 06/11/14 15:40 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140612-13 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**1100**		ug/L	200	10	07/08/2014	SV	1406114
200.7	**Iron**	**3230**		ug/L	1000	10	07/08/2014	SV	1406114
200.7	**Manganese**	**10800**		ug/L	20.0	10	07/08/2014	SV	1406114
200.7	**Zinc**	**3340**		ug/L	100	10	07/08/2014	SV	1406114
200.8	**Arsenic**	**35.4**		ug/L	5.00	10	07/10/2014	SV	1406114
200.8	**Cadmium**	**38.0**		ug/L	1.00	10	07/10/2014	SV	1406114
200.8	**Copper**	**194**		ug/L	5.00	10	07/10/2014	SV	1406114
200.8	**Lead**	**43.8**	J	ug/L	1.00	10	07/10/2014	SV	1406114
200.8	**Nickel**	**29.3**		ug/L	5.00	10	07/10/2014	SV	1406114

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-061114 **Date / Time Sampled:** 06/11/14 14:05 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140612-17 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**211**		ug/L	20.0	1	07/08/2014	SV	1406114
200.7	**Iron**	**2250**		ug/L	100	1	07/08/2014	SV	1406114
200.7	**Manganese**	**2570**		ug/L	2.00	1	07/08/2014	SV	1406114
200.7	**Zinc**	**401**		ug/L	10.0	1	07/08/2014	SV	1406114
200.8	**Arsenic**	**52.0**		ug/L	5.00	10	07/10/2014	SV	1406114
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	07/10/2014	SV	1406114
200.8	**Copper**	**22.7**		ug/L	5.00	10	07/10/2014	SV	1406114
200.8	**Lead**	**1.27**	J	ug/L	1.00	10	07/10/2014	SV	1406114
200.8	Nickel	< 10.0	U	ug/L	5.00	10	07/10/2014	SV	1406114

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INF-061114 **Date / Time Sampled:** 06/11/14 12:50 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140612-20 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**13100**		ug/L	200	10	07/08/2014	SV	1406114
200.7	**Iron**	**160000**		ug/L	1000	10	07/08/2014	SV	1406114
200.7	**Manganese**	**107000**		ug/L	20.0	10	07/08/2014	SV	1406114
200.7	**Zinc**	**59300**		ug/L	100	10	07/08/2014	SV	1406114
200.8	**Arsenic**	**269**		ug/L	5.00	10	07/10/2014	SV	1406114
200.8	**Cadmium**	**256**		ug/L	1.00	10	07/10/2014	SV	1406114
200.8	**Copper**	**1120**		ug/L	5.00	10	07/10/2014	SV	1406114
200.8	**Lead**	**239**	J	ug/L	1.00	10	07/10/2014	SV	1406114
200.8	**Nickel**	**25.8**		ug/L	5.00	10	07/10/2014	SV	1406114

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFD-061114 **Date / Time Sampled:** 06/11/14 13:00 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140612-23 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**13100**		ug/L	200	10	07/08/2014	SV	1406114
200.7	**Iron**	**159000**		ug/L	1000	10	07/08/2014	SV	1406114
200.7	**Manganese**	**106000**		ug/L	20.0	10	07/08/2014	SV	1406114
200.7	**Zinc**	**59200**		ug/L	100	10	07/08/2014	SV	1406114
200.8	**Arsenic**	**251**		ug/L	5.00	10	07/10/2014	SV	1406114
200.8	**Cadmium**	**253**		ug/L	1.00	10	07/10/2014	SV	1406114
200.8	**Copper**	**1070**		ug/L	5.00	10	07/10/2014	SV	1406114
200.8	**Lead**	**260**	J	ug/L	1.00	10	07/10/2014	SV	1406114
200.8	**Nickel**	**26.1**		ug/L	5.00	10	07/10/2014	SV	1406114

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NAOH-061114 **Date / Time Sampled:** 06/11/14 14:15 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140612-26 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**5740**		ug/L	200	10	07/08/2014	SV	1406114
200.7	**Iron**	**53800**		ug/L	1000	10	07/08/2014	SV	1406114
200.7	**Manganese**	**99000**		ug/L	20.0	10	07/08/2014	SV	1406114
200.7	**Zinc**	**55600**		ug/L	100	10	07/08/2014	SV	1406114
200.8	**Arsenic**	**57.6**		ug/L	5.00	10	07/10/2014	SV	1406114
200.8	**Cadmium**	**249**		ug/L	1.00	10	07/10/2014	SV	1406114
200.8	**Copper**	**712**		ug/L	5.00	10	07/10/2014	SV	1406114
200.8	**Lead**	**80.9**	J	ug/L	1.00	10	07/10/2014	SV	1406114
200.8	**Nickel**	**24.1**		ug/L	5.00	10	07/10/2014	SV	1406114

Project Name: **Barker-Hughesville_Treatability_JUN 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-061114 **Date / Time Sampled:** 06/11/14 13:50 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140612-29 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 500	U	ug/L	200	10	07/08/2014	SV	1406114
200.7	**Iron**	**6390**		ug/L	1000	10	07/08/2014	SV	1406114
200.7	**Manganese**	**28900**		ug/L	20.0	10	07/08/2014	SV	1406114
200.7	**Zinc**	**2480**		ug/L	100	10	07/08/2014	SV	1406114
200.8	**Arsenic**	**16.8**	J	ug/L	5.00	10	07/10/2014	SV	1406114
200.8	**Cadmium**	**6.66**		ug/L	1.00	10	07/10/2014	SV	1406114
200.8	**Copper**	**77.7**		ug/L	5.00	10	07/10/2014	SV	1406114
200.8	**Lead**	**1.75**	J	ug/L	1.00	10	07/10/2014	SV	1406114
200.8	Nickel	< 10.0	U	ug/L	5.00	10	07/10/2014	SV	1406114

"J" Qualifier indicates an estimated value

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-061114 **Date / Time Sampled:** 06/11/14 14:35 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140612-03 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**182**	D	mg/L	30.0	1000	06/19/2014	SW	1406093

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-061114 **Date / Time Sampled:** 06/11/14 14:35 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140612-04 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**437**		mg/L	5.0	10	06/24/2014	NP	1406085
EPA 300.0	**Fluoride**	**104**		mg/L	1.0	10	06/24/2014	NP	1406085
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	06/24/2014	NP	1406085
EPA 300.0	**Sulfate as SO4**	**924**		mg/L	0.5	10	06/24/2014	NP	1406085
EPA 310.1	**Total Alkalinity**	**3020**		mg CaCO3 / L	250	50	06/17/2014	KJB	1406076

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-061114 **Date / Time Sampled:** 06/11/14 14:55 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140612-07 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**80.9**	D	mg/L	30.0	1000	06/19/2014	SW	1406093

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-061114 **Date / Time Sampled:** 06/11/14 14:55 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140612-08 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**425**		mg/L	5.0	10	06/24/2014	NP	1406085
EPA 300.0	**Fluoride**	**54.5**		mg/L	1.0	10	06/24/2014	NP	1406085
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	06/24/2014	NP	1406085
EPA 300.0	**Sulfate as SO4**	**960**		mg/L	0.5	10	06/24/2014	NP	1406085
EPA 310.1	**Total Alkalinity**	**1630**		mg CaCO3 / L	250	50	06/17/2014	KJB	1406076

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-061114 **Date / Time Sampled:** 06/11/14 15:20 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140612-11 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**127**	D	mg/L	30.0	1000	06/19/2014	SW	1406093

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-061114 **Date / Time Sampled:** 06/11/14 15:20 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140612-12 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**652**		mg/L	5.0	10	06/24/2014	NP	1406085
EPA 300.0	**Fluoride**	**71.7**		mg/L	1.0	10	06/24/2014	NP	1406085
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	06/24/2014	NP	1406085
EPA 300.0	**Sulfate as SO4**	**912**		mg/L	0.5	10	06/24/2014	NP	1406085
EPA 310.1	**Total Alkalinity**	**1670**		mg CaCO3 / L	250	50	06/17/2014	KJB	1406076

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-061114 **Date / Time Sampled:** 06/11/14 15:40 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140612-15 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**52.6**	D	mg/L	30.0	1000	06/19/2014	SW	1406093

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-061114 **Date / Time Sampled:** 06/11/14 15:40 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140612-16 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**382**		mg/L	5.0	10	06/24/2014	NP	1406085
EPA 300.0	**Fluoride**	**32.5**		mg/L	1.0	10	06/24/2014	NP	1406085
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	06/24/2014	NP	1406085
EPA 300.0	**Sulfate as SO4**	**1030**		mg/L	0.5	10	06/24/2014	NP	1406085
EPA 310.1	**Total Alkalinity**	**1540**		mg CaCO3 / L	250	50	06/17/2014	KJB	1406076

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-CHIT-061114 **Date / Time Sampled:** 06/11/14 14:05 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140612-19 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**163**		mg/L	5.0	10	06/24/2014	NP	1406085
EPA 300.0	**Fluoride**	**9.0**		mg/L	1.0	10	06/24/2014	NP	1406085
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	06/24/2014	NP	1406085
EPA 300.0	**Sulfate as SO4**	**974**		mg/L	0.5	10	06/24/2014	NP	1406085
EPA 310.1	**Total Alkalinity**	**894**		mg CaCO3 / L	250	50	06/17/2014	KJB	1406076

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-INF-061114 **Date / Time Sampled:** 06/11/14 12:50 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140612-22 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**7.7**	J	mg/L	5.0	10	06/24/2014	NP	1406085
EPA 300.0	**Fluoride**	**2.7**		mg/L	1.0	10	06/24/2014	NP	1406085
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	06/24/2014	NP	1406085
EPA 300.0	**Sulfate as SO4**	**1150**		mg/L	0.5	10	06/24/2014	NP	1406085
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	06/17/2014	KJB	1406076

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-INFD-061114 **Date / Time Sampled:** 06/11/14 13:00 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140612-25 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**7.6**	J	mg/L	5.0	10	06/24/2014	NP	1406085
EPA 300.0	**Fluoride**	**2.9**		mg/L	1.0	10	06/24/2014	NP	1406085
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	06/24/2014	NP	1406085
EPA 300.0	**Sulfate as SO4**	**1160**		mg/L	0.5	10	06/24/2014	NP	1406085
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	06/17/2014	KJB	1406076

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-NAOH-061114 **Date / Time Sampled:** 06/11/14 14:15 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140612-28 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**7.7**	J	mg/L	5.0	10	06/24/2014	NP	1406085
EPA 300.0	**Fluoride**	**2.2**		mg/L	1.0	10	06/24/2014	NP	1406085
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	06/24/2014	NP	1406085
EPA 300.0	**Sulfate as SO4**	**1040**		mg/L	0.5	10	06/24/2014	NP	1406085
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	06/17/2014	KJB	1406076

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-SAPS-061114 **Date / Time Sampled:** 06/11/14 13:50 **Workorder:** C140612
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140612-31 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**60.8**		mg/L	5.0	10	06/24/2014	NP	1406085
EPA 300.0	**Fluoride**	**5.0**		mg/L	1.0	10	06/24/2014	NP	1406085
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	06/24/2014	NP	1406085
EPA 300.0	**Sulfate as SO4**	**1060**		mg/L	0.5	10	06/24/2014	NP	1406085
EPA 310.1	**Total Alkalinity**	**481**	J	mg CaCO3 / L	250	50	06/17/2014	KJB	1406076

"J" Qualifier indicates an estimated value

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ICPMS-PE DRC-II									
Batch 1407027 - No Lab Prep Reqd			***Water***						**ICPMS-PE DRC-II**
Method Blank (1407027-BLK1)		Dilution Factor: 1				Prepared: 07/08/14 Analyzed: 07/10/14			
Nickel	< 0.500	1.00	ug/L						
Copper	< 0.500	1.00	"						
Arsenic	< 0.500	2.00	"						
Cadmium	< 0.100	0.200	"						
Lead	< 0.100	0.200	"						
Method Blank Spike (1407027-BS1)		Dilution Factor: 1				Prepared: 07/08/14 Analyzed: 07/10/14			
Nickel	91.7	1.00	ug/L	100		92	85-115		
Copper	90.0	1.00	"	100		90	85-115		
Arsenic	87.4	2.00	"	100		87	85-115		
Cadmium	97.2	0.200	"	100		97	85-115		
Lead	108	0.200	"	100		108	85-115		
Duplicate (1407027-DUP1)		Dilution Factor: 1	**Source: C140612-18**			Prepared: 07/08/14 Analyzed: 07/10/14			
Nickel	< 5.00	10.0	ug/L		< 5.00				20
Copper	24.7	10.0	"		24.3			1	20
Arsenic	45.7	20.0	"		48.5			6	20
Cadmium	< 1.00	2.00	"		< 1.00				20
Lead	< 1.00	2.00	"		< 1.00				20
Matrix Spike (1407027-MS1)		Dilution Factor: 1	**Source: C140612-18**			Prepared: 07/08/14 Analyzed: 07/10/14			
Nickel	95.4	10.0	ug/L	100	< 5.00	95	70-130		
Copper	115	10.0	"	100	24.3	91	70-130		
Arsenic	137	20.0	"	100	48.5	89	70-130		
Cadmium	97.2	2.00	"	100	< 1.00	97	70-130		
Lead	109	2.00	"	100	< 1.00	109	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1407037 - 1407027			***Water***						**ICPMS-PE DRC-II**
Serial Dilution (1407037-SRD1)		Dilution Factor: 5	**Source: C140612-18**			Prepared: 07/08/14	Analyzed: 07/10/14		
Nickel	< 25.0	50.0	ug/L		< 5.00				10
Copper	< 25.0	50.0	"		24.3				10
Arsenic	40.8	100	"		48.5			17	10
Cadmium	< 5.00	10.0	"		< 1.00				10
Lead	< 5.00	10.0	"		< 1.00				10
ICPOE - PE Optima									
Batch 1407023 - No Lab Prep Reqd			***Water***						**ICPOE - PE Optima**
Method Blank (1407023-BLK1)		Dilution Factor: 1				Prepared: 07/07/14	Analyzed: 07/08/14		
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						
Method Blank Spike (1407023-BS1)		Dilution Factor: 1				Prepared: 07/07/14	Analyzed: 07/08/14		
Aluminum	10170	50.0	ug/L	10100		101	85-115		
Iron	10470	250	"	10100		104	85-115		
Manganese	99.87	5.00	"	100		100	85-115		
Zinc	99.78	20.0	"	100		100	85-115		
Duplicate (1407023-DUP1)		Dilution Factor: 1	**Source: C140612-18**			Prepared: 07/07/14	Analyzed: 07/08/14		
Aluminum	88.42	50.0	ug/L		94.52			7	20
Iron	369.7	250	"		407.0			10	20
Manganese	2081	5.00	"		2107			1	20
Zinc	201.5	20.0	"		205.2			2	20
Matrix Spike (1407023-MS1)		Dilution Factor: 1	**Source: C140612-18**			Prepared: 07/07/14	Analyzed: 07/08/14		
Aluminum	9567	50.0	ug/L	10100	94.52	94	70-130		
Iron	9886	250	"	10100	407.0	94	70-130		
Manganese	2161	5.00	"	100	2107	54	70-130		
Zinc	289.6	20.0	"	100	205.2	84	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1407028 - 1407023			*Water*						ICPOE - PE Optima
Serial Dilution (1407028-SRD1)		Dilution Factor: 5	**Source: C140612-18**			Prepared: 07/07/14	Analyzed: 07/08/14		
Aluminum	217.0	250	ug/L		94.52			79	10
Iron	584.9	1250	"		407.0			36	10
Manganese	2249	25.0	"		2107			7	10
Zinc	223.9	100	"		205.2			9	10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ICPMS-PE DRC-II									
Batch 1406114 - 200.2 - TR Metals			*Water*						**ICPMS-PE DRC-II**
Method Blank (1406114-BLK2)		Dilution Factor: 5				Prepared: 06/25/14 Analyzed: 07/10/14			
Nickel	< 2.50	5.00	ug/L						
Copper	< 2.50	5.00	"						
Arsenic	< 2.50	10.0	"						
Cadmium	< 0.500	1.00	"						
Lead	< 0.500	1.00	"						
Duplicate (1406114-DUP2)		Dilution Factor: 1	**Source: C140612-17**			Prepared: 06/25/14 Analyzed: 07/10/14			
Nickel	< 5.00	10.0	ug/L		< 5.00				20
Copper	25.22	10.0	"		22.69			11	20
Arsenic	48.78	20.0	"		51.96			6	20
Cadmium	1.119	2.00	"		< 1.00				20
Lead	1.350	2.00	"		1.271			6	20
Matrix Spike (1406114-MS2)		Dilution Factor: 5	**Source: C140612-20**			Prepared: 06/25/14 Analyzed: 07/10/14			
Nickel	439.1	5.00	ug/L	500	25.83	83	70-130		
Copper	1246	5.00	"	300	1115	44	70-130		
Arsenic	883.0	10.0	"	800	268.6	77	70-130		
Cadmium	393.9	1.00	"	200	256.0	69	70-130		
Lead	1168	1.00	"	1000	239.1	93	70-130		
Reference (1406114-SRM2)		Dilution Factor: 2				Prepared: 06/25/14 Analyzed: 07/10/14			
Nickel	1031	20.0	ug/L	1000		103	85-115		
Copper	1005	20.0	"	1000		101	85-115		
Arsenic	2077	40.0	"	2000		104	85-115		
Cadmium	990.4	4.00	"	1000		99	85-115		
Lead	1948	4.00	"	2000		97	85-115		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Batch 1407038 - 1406114 *Water* **ICPMS-PE DRC-II**

Serial Dilution (1407038-SRD1) Dilution Factor: 5 **Source: C140612-17** Prepared: 06/25/14 Analyzed: 07/10/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	< 25.0	50.0	ug/L		< 5.00				10
Copper	29.89	50.0	"		22.69			27	10
Arsenic	42.42	100	"		51.96			20	10
Cadmium	< 5.00	10.0	"		< 1.00				10
Lead	< 5.00	10.0	"		1.271				10

ICPOE - PE Optima

Batch 1406114 - 200.2 - TR Metals *Water* **ICPOE - PE Optima**

Method Blank (1406114-BLK1) Dilution Factor: 1 Prepared: 06/25/14 Analyzed: 07/08/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						

Duplicate (1406114-DUP1) Dilution Factor: 1 **Source: C140612-17** Prepared: 06/25/14 Analyzed: 07/08/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	213.6	50.0	ug/L		210.7			1	20
Iron	2336	250	"		2253			4	20
Manganese	2557	5.00	"		2568			0.5	20
Zinc	395.8	20.0	"		401.1			1	20

Matrix Spike (1406114-MS1) Dilution Factor: 1 **Source: C140612-20** Prepared: 06/25/14 Analyzed: 07/08/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	15040	500	ug/L	2000	13140	95	70-130		
Iron	163800	2500	"	3000	160100	124	70-130		
Manganese	105700	50.0	"	200	107200	NR	70-130		
Zinc	58770	200	"	200	59260	NR	70-130		

Reference (1406114-SRM1) Dilution Factor: 1 Prepared: 06/25/14 Analyzed: 07/08/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	950.2	50.0	ug/L	1000		95	85-115		
Iron	1019	250	"	1000		102	85-115		
Manganese	1016	5.00	"	1000		102	85-115		
Zinc	985.7	20.0	"	1000		99	85-115		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1407029 - 1406114			***Water***						**ICPOE - PE Optima**
Serial Dilution (1407029-SRD1)		Dilution Factor: 5	**Source: C140612-17**			Prepared: 06/25/14 Analyzed: 07/08/14			
Aluminum	333.0	250	ug/L		210.7			45	10
Iron	2432	1250	"		2253			8	10
Manganese	2582	25.0	"		2568			0.5	10
Zinc	405.6	100	"		401.1			1	10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ESAT Dionex IC									
Batch 1406085 - No Prep Req			*Water*						**ESAT Dionex IC**
Method Blank (1406085-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 06/24/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						
Method Blank Spike (1406085-BS1)		Dilution Factor: 1				Prepared & Analyzed: 06/24/14			
Fluoride	5.1	0.2	mg/L	5.00		102	90-110		
Chloride	24.2	2.0	"	25.0		97	90-110		
Sulfate as SO4	23.1	0.1	"	25.0		92	90-110		
Nitrate/Nitrite as N	20.7	5.0	"	20.0		103	90-110		
Duplicate (1406085-DUP1)		Dilution Factor: 1	**Source: C140612-04**			Prepared & Analyzed: 06/24/14			
Fluoride	103	2.0	mg/L		104			0.1	20
Chloride	437	20.0	"		437			0.03	20
Sulfate as SO4	925	1.0	"		924			0.1	20
Nitrate/Nitrite as N	< 10.0	50.0	"		< 10.0				20
Matrix Spike (1406085-MS1)		Dilution Factor: 1	**Source: C140612-04**			Prepared & Analyzed: 06/24/14			
Fluoride	100	2.0	mg/L	50.0	104	NR	80-120		
Chloride	646	20.0	"	250	437	84	80-120		
Sulfate as SO4	1100	1.0	"	250	924	72	80-120		
Nitrate/Nitrite as N	201	50.0	"	200	< 10.0	100	80-120		
Batch 1406112 - 1406085			*Water*						**ESAT Dionex IC**
Instrument Blank (1406112-IBL1)		Dilution Factor: 1				Prepared & Analyzed: 06/24/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Lachat 8500									
Batch 1406093 - No Prep Req			*Water*						**Lachat 8500**
Method Blank (1406093-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 06/19/14			
Ammonia as N	< 0.0200	0.0500	mg/L						
Method Blank Spike (1406093-BS1)		Dilution Factor: 1				Prepared & Analyzed: 06/19/14			
Ammonia as N	0.994	0.0500	mg/L	1.00		99	90-110		
Duplicate (1406093-DUP1)		Dilution Factor: 1	**Source: C140612-03**			Prepared & Analyzed: 06/19/14			
Ammonia as N	183	50.0	mg/L		182			0.2	20
Matrix Spike (1406093-MS1)		Dilution Factor: 1	**Source: C140612-03**			Prepared & Analyzed: 06/19/14			
Ammonia as N	1160		mg/L	1000	182	98	90-110		
Reference (1406093-SRM1)		Dilution Factor: 1				Prepared & Analyzed: 06/19/14			
Ammonia as N	0.491	0.0500	mg/L	0.480		102	90-110		
Phoenix Carbon Anal									
Batch 1406076 - No Prep Req			*Water*						**Phoenix Carbon Anal**
Method Blank (1406076-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 06/17/14			
Total Alkalinity	< 5.00	10.0	mg CaCO3 / L						
Method Blank (1406076-BLK2)		Dilution Factor: 1				Prepared & Analyzed: 06/17/14			
Total Alkalinity	< 5.00	10.0	mg CaCO3 / L						
Duplicate (1406076-DUP1)		Dilution Factor: 5	**Source: C140612-04**			Prepared & Analyzed: 06/17/14			
Total Alkalinity	3030	500	mg CaCO3 / L		3020			0.2	20
Duplicate (1406076-DUP2)		Dilution Factor: 1	**Source: C140613-01**			Prepared & Analyzed: 06/17/14			
Total Alkalinity	73.5	10.0	mg CaCO3 / L		73.3			0.2	20

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1406076 - No Prep Req			***Water***						**Phoenix Carbon Anal**
Duplicate (1406076-DUP3)		Dilution Factor: 1	**Source: C140613-17**			Prepared & Analyzed: 06/17/14			
Total Alkalinity	104	10.0	mg CaCO3 / L		109			4	20
Reference (1406076-SRM1)		Dilution Factor: 1				Prepared & Analyzed: 06/17/14			
Total Alkalinity	23.3	10.0	mg CaCO3 / L	23.8		98	90-110		
Reference (1406076-SRM2)		Dilution Factor: 1				Prepared & Analyzed: 06/17/14			
Total Alkalinity	23.5	10.0	mg CaCO3 / L	23.8		99	90-110		

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Project Name: **Barker-Hughesville_Treatability_JUN 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 310.1

Analysis Name: WC - Alkalinity

Instrument: **Phoenix Carbon Anal**

Work Order: Nu C140612

Analytical Sequence: **Total**

Concentration Units: mg CaCO3 / L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Total Alkalinity		**1**	**2**	**3**	**4**	NA	1406076-BLK2	10.00
		1.38	1.42	1.68	2.22	NA	1.42	
		5	**6**	**7**	**8**			
		1.52						
		1	**2**	**3**	**4**	1406076-BLK1	NA	10.00
		1.38	1.42	1.68	2.22	1.16	NA	
		5	**6**	**7**	**8**			
		1.52						

Project Name: **Barker-Hughesville_Treatability_JUN 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 350.1

Analysis Name: WC - Ammonia

Instrument: **Lachat 8500**

Work Order: Nu C140612

Analytical Sequence: **Total**

Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
		1	**2**	**3**	**4**	1406093-BLK1	NA	
Ammonia as N		0.00	0.00			0.00	NA	0.05
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_JUN 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method:	EPA 300.0	Analysis Name:	WC - Anions by Ion Chromatography
Instrument:	**ESAT Dionex IC**	Work Order: Nu	C140612
Analytical Sequence:	1406112 **Dissolved**	Concentration Units:	mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Fluoride	0.00	**1**	**2**	**3**	**4**	1406085-BLK1	NA	0.20
		0.00	0.00			0.00	NA	
		5	**6**	**7**	**8**			
Chloride	0.00	**1**	**2**	**3**	**4**	1406085-BLK1	NA	2.00
		0.00	0.00			0.00	NA	
		5	**6**	**7**	**8**			
Sulfate as SO4	0.00	**1**	**2**	**3**	**4**	1406085-BLK1	NA	0.10
		0.00	0.00			0.00	NA	
		5	**6**	**7**	**8**			
Nitrate/Nitrite as N	0.00	**1**	**2**	**3**	**4**	1406085-BLK1	NA	5.00
		0.00	0.00			0.00	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_JUN 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7

Analysis Name: ICPOE Diss. Metals

Instrument: **ICPOE - PE Optima**

Work Order: Nu C140612

Analytical Sequence: 1407028 **Dissolved**

Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Aluminum	0.72	**1**	**2**	**3**	**4**	1407023-BLK1	NA	50.00
		0.88	1.74			-0.21	NA	
		5	**6**	**7**	**8**			
Iron	48.58	**1**	**2**	**3**	**4**	1407023-BLK1	NA	250.00
		73.20	109.13			57.67	NA	
		5	**6**	**7**	**8**			
Manganese	0.13	**1**	**2**	**3**	**4**	1407023-BLK1	NA	5.00
		0.07	0.28			-0.04	NA	
		5	**6**	**7**	**8**			
Zinc	-1.06	**1**	**2**	**3**	**4**	1407023-BLK1	NA	20.00
		-3.17	-0.91			-2.85	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_JUN 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Instrument: **ICPOE - PE Optima** Work Order: Nu C140612

Analytical Sequence: 1407029 **Total Recoverable** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Aluminum	0.72	**1**	**2**	**3**	**4**	1406114-BLK1	NA	50.00
		0.88	1.74	0.08	0.02	-2.03	NA	
		5	**6**	**7**	**8**			
Iron	48.58	**1**	**2**	**3**	**4**	1406114-BLK1	NA	250.00
		73.20	109.13	71.91	81.79	52.91	NA	
		5	**6**	**7**	**8**			
Manganese	0.13	**1**	**2**	**3**	**4**	1406114-BLK1	NA	5.00
		0.07	0.28	0.05	0.13	-0.04	NA	
		5	**6**	**7**	**8**			
Zinc	-1.06	**1**	**2**	**3**	**4**	1406114-BLK1	NA	20.00
		-3.17	-0.91	-0.58	-1.42	2.98	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_JUN 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8

Analysis Name: ICPMS Diss. Metals

Instrument: **ICPMS-PE DRC-II**

Work Order: Nu C140612

Analytical Sequence: 1407037 **Dissolved**

Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Nickel	0.01	**1**	**2**	**3**	**4**	1407027-BLK1	NA	1.00
		0.00	-0.02			0.00	NA	
		5	**6**	**7**	**8**			
Copper	-0.03	**1**	**2**	**3**	**4**	1407027-BLK1	NA	1.00
		0.02	-0.01			-0.04	NA	
		5	**6**	**7**	**8**			
Arsenic	-0.28	**1**	**2**	**3**	**4**	1407027-BLK1	NA	2.00
		0.04	0.12			-0.03	NA	
		5	**6**	**7**	**8**			
Cadmium	-0.01	**1**	**2**	**3**	**4**	1407027-BLK1	NA	0.20
		-0.01	0.00			0.00	NA	
		5	**6**	**7**	**8**			
Lead	0.00	**1**	**2**	**3**	**4**	1407027-BLK1	NA	0.20
		0.00	0.00			0.02	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_JUN 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8

Analysis Name: ICPMS Tot. Rec. Metals

Instrument: **ICPMS-PE DRC-II**

Work Order: Nu C140612

Analytical Sequence: 1407038 **Total Recoverable**

Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Nickel	0.01	**1**	**2**	**3**	**4**	NA	1406114-BLK2	1.00
		0.01	0.01			NA	0.01	
		5	**6**	**7**	**8**			
Copper	-0.03	**1**	**2**	**3**	**4**	NA	1406114-BLK2	1.00
		-0.01	0.00			NA	-0.02	
		5	**6**	**7**	**8**			
Arsenic	-0.37	**1**	**2**	**3**	**4**	NA	1406114-BLK2	2.00
		0.06	-0.17			NA	-0.05	
		5	**6**	**7**	**8**			
Cadmium	-0.01	**1**	**2**	**3**	**4**	NA	1406114-BLK2	0.20
		0.00	0.00			NA	0.01	
		5	**6**	**7**	**8**			
Lead	0.01	**1**	**2**	**3**	**4**	NA	1406114-BLK2	0.20
		0.01	0.01			NA	0.00	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_JUN 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Phoenix Carbon Anal Method: EPA 310.1 Analysis Name: WC - Alkalinity

Sequence: 1406081 Work Order: C140612 Units: mg CaCO3 / L

Total Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
Total Alkalinity					**1**			**2**			**3**	
				100	101	101.0	100	101	101.0	100	101	101.0
					4			**5**			**6**	
				100	100	100.0	100	101	101.0			
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Lachat 8500 Method: EPA 350.1 Analysis Name: WC - Ammonia

Sequence: 1406094 Work Order: C140612 Units: mg/L

Total Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Ammonia as N					1			2			3	
				1.00	1.03	103.0	1.00	1.07	107.0			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability_JUN 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ESAT Dionex IC Method: EPA 300.0 Analysis Name: WC - Anions by Ion Chromatography 2013

Sequence: 1406112 Work Order: C140612 Units: mg/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Chloride	40.0	39.3	98.3	40.0	39.6	99.0	40.0	39.7	99.3			
					4			5			6	
					7			8			9	
					1			2			3	
Fluoride	4.00	3.9	97.5	4.00	3.9	97.5	4.00	3.9	97.5			
					4			5			6	
					7			8			9	
					1			2			3	
Nitrate/Nitrite as N	20.0	19.8	99.0	20.0	19.9	99.5	20.0	20.0	100.0			
					4			5			6	
					7			8			9	
					1			2			3	
Sulfate as SO4	100	97.9	97.9	100	98.7	98.7	100	99.2	99.2			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Diss. Metals

Sequence: 1407028 Work Order: C140612 Units: ug/L

Dissolved Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
Aluminum	12500	12660	101.3		**1**			**2**			**3**	
				12500	12410	99.3	12500	12460	99.7			
					4			**5**			**6**	
					7			**8**			**9**	
Iron	12500	12840	102.7		**1**			**2**			**3**	
				12500	12760	102.1	12500	12640	101.1			
					4			**5**			**6**	
					7			**8**			**9**	
Manganese	1000	1018	101.8		**1**			**2**			**3**	
				1000	1020	102.0	1000	1017	101.7			
					4			**5**			**6**	
					7			**8**			**9**	
Zinc	2500	2528	101.1		**1**			**2**			**3**	
				2500	2580	103.2	2500	2572	102.9			
					4			**5**			**6**	
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Sequence: 1407029 Work Order: C140612 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Aluminum	12500	12660	101.3	12500	12410	99.3	12500	12460	99.7	12500	12650	101.2
					4			5			6	
				12500	12270	98.2						
					7			8			9	
					1			2			3	
Iron	12500	12840	102.7	12500	12760	102.1	12500	12640	101.1	12500	12830	102.6
					4			5			6	
				12500	12510	100.1						
					7			8			9	
					1			2			3	
Manganese	1000	1018	101.8	1000	1020	102.0	1000	1017	101.7	1000	1021	102.1
					4			5			6	
				1000	1019	101.9						
					7			8			9	
					1			2			3	
Zinc	2500	2528	101.1	2500	2580	103.2	2500	2572	102.9	2500	2586	103.4
					4			5			6	
				2500	2597	103.9						
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability_JUN 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Diss. Metals

Sequence: 1407037 Work Order: C140612 Units: ug/L

Dissolved Analyte	Initial (ICV1, ICV2) True	Found	%R	Continuing Calibration Verification Standards (CCVs) True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Arsenic	50.0	51.0	102.0	50.0	52.9	105.8	50.0	51.3	102.6			
					4			5			6	
					7			8			9	
					1			2			3	
Cadmium	50.0	49.6	99.2	50.0	50.2	100.4	50.0	49.5	99.0			
					4			5			6	
					7			8			9	
					1			2			3	
Copper	50.0	49.5	99.0	50.0	52.8	105.6	50.0	49.5	99.0			
					4			5			6	
					7			8			9	
					1			2			3	
Lead	50.0	51.6	103.2	50.0	51.8	103.6	50.0	51.2	102.4			
					4			5			6	
					7			8			9	
					1			2			3	
Nickel	50.0	51.1	102.2	50.0	52.8	105.6	50.0	50.6	101.2			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability_JUN 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1407038 Work Order: C140612 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Arsenic	50.0	50.54	101.1		1			2			3	
				50.0	50.04	100.1	50.0	50.38	100.8			
					4			5			6	
					7			8			9	
Cadmium	50.0	49.87	99.7		1			2			3	
				50.0	50.49	101.0	50.0	48.42	96.8			
					4			5			6	
					7			8			9	
Copper	50.0	46.31	92.6		1			2			3	
				50.0	46.03	92.1	50.0	47.33	94.7			
					4			5			6	
					7			8			9	
Lead	50.0	52.17	104.3		1			2			3	
				50.0	53.78	107.6	50.0	47.91	95.8			
					4			5			6	
					7			8			9	
Nickel	50.0	47.83	95.7		1			2			3	
				50.0	48.17	96.3	50.0	48.12	96.2			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

ICP Interference Check Sample

ICPMS-PE DRC-II

Sequence: 1407037 Analysis: ICPMS Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.2	ug/L			2.00
	IFB1	20.9	ug/L	20	104	2.00
Cadmium	IFA1	0.0	ug/L			0.200
	IFB1	20.0	ug/L	20	100	0.200
Copper	IFA1	0.3	ug/L			1.00
	IFB1	20.3	ug/L	20	101	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	-0.4	ug/L			1.00
	IFB1	19.9	ug/L	20	100	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1407038 Analysis: ICPMS Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.0	ug/L			2.00
	IFB1	20.6	ug/L	20	103	2.00
Cadmium	IFA1	0.0	ug/L			0.200
	IFB1	20.0	ug/L	20	100	0.200
Copper	IFA1	0.3	ug/L			1.00
	IFB1	18.3	ug/L	20	92	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	-0.3	ug/L			1.00
	IFB1	18.3	ug/L	20	92	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8

ICP Interference Check Sample

ICPOE - PE Optima

Sequence: 1407028 Analysis: ICPOE Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	58,372.9	ug/L	60,000	97	50.0
	IFB1	59,804.1	ug/L	60,000	100	50.0
Iron	IFA1	232,466.3	ug/L	250,000	93	250
	IFB1	237,311.4	ug/L	250,000	95	250
Manganese	IFA1	-0.2	ug/L			5.00
	IFB1	193.6	ug/L	200	97	5.00
Zinc	IFA1	5.5	ug/L			20.0
	IFB1	289.5	ug/L	300	96	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1407029 Analysis: ICPOE Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	58,372.9	ug/L	60,000	97	50.0
	IFB1	59,804.1	ug/L	60,000	100	50.0
Iron	IFA1	232,466.3	ug/L	250,000	93	250
	IFB1	237,311.4	ug/L	250,000	95	250
Manganese	IFA1	-0.2	ug/L			5.00
	IFB1	193.6	ug/L	200	97	5.00
Zinc	IFA1	5.5	ug/L			20.0
	IFB1	289.5	ug/L	300	96	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPMS-PE DRC-II

Metals (Dissolved) by EPA 200/7000 Series Methods

Sequence: 1407037

Analyte	True	Found	%R	Units
Arsenic	2.00	1.67	84	ug/L
Cadmium	0.200	0.194	97	ug/L
Copper	1.00	0.988	99	ug/L
Lead	0.200	0.203	101	ug/L
Nickel	1.00	1.08	108	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPOE - PE Optima

Metals (Dissolved) by EPA 200/7000 Series Methods

Sequence: 1407028

Analyte	True	Found	%R	Units
Aluminum	100	99.56	100	ug/L
Iron	100	152.9	153	ug/L
Manganese	10.0	10.27	103	ug/L
Zinc	50.0	50.80	102	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

Lachat 8500

Classical Chemistry by EPA/ASTM/APHA Methods

Sequence: 1406094

Analyte	True	Found	%R	Units
Ammonia as N	0.0500	0.0453	91	mg/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

ICPMS-PE DRC-II

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1407038

Analyte	True	Found	%R	Units
Arsenic	2.00	2.015	101	ug/L
Cadmium	0.200	0.1963	98	ug/L
Copper	1.00	0.9383	94	ug/L
Lead	0.200	0.2021	101	ug/L
Nickel	1.00	1.014	101	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

ICPOE - PE Optima

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1407029

Analyte	True	Found	%R	Units
Aluminum	100	99.56	100	ug/L
Iron	100	152.9	153	ug/L
Manganese	10.0	10.27	103	ug/L
Zinc	50.0	50.80	102	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 310.1 **Total** **Sequence ID#:** 1406081

Instrument ID #: Phoenix Carbon Anal Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1406076-SRM1	Reference	06/17/14	08:24
1406076-BLK1	Blank	06/17/14	08:24
C140612-04	14BH-DT-PILOT-BCR1-061114	06/17/14	08:24
1406076-DUP1	Duplicate	06/17/14	08:24
C140612-08	14BH-DT-PILOT-BCR2-061114	06/17/14	08:24
C140612-12	14BH-DT-PILOT-BCR3-061114	06/17/14	08:24
C140612-16	14BH-DT-PILOT-BCR4-061114	06/17/14	08:24
C140612-19	14BH-DT-PILOT-CHIT-061114	06/17/14	08:24
C140612-22	14BH-DT-PILOT-INF-061114	06/17/14	08:24
C140612-25	14BH-DT-PILOT-INFD-061114	06/17/14	08:24
C140612-28	14BH-DT-PILOT-NAOH-06111	06/17/14	08:24
C140612-31	14BH-DT-PILOT-SAPS-061114	06/17/14	08:24
1406076-SRM2	Reference	06/17/14	08:24
1406076-BLK2	Blank	06/17/14	08:24
1406076-DUP3	Duplicate	06/17/14	08:24
1406076-DUP2	Duplicate	06/17/14	08:24
1406081-CCV1	Calibration Check	06/17/14	13:15
1406081-CCB1	Calibration Blank	06/17/14	13:15
1406081-CCV2	Calibration Check	06/17/14	13:15
1406081-CCB2	Calibration Blank	06/17/14	13:15
1406081-CCV3	Calibration Check	06/17/14	13:15
1406081-CCB3	Calibration Blank	06/17/14	13:15
1406081-CCV4	Calibration Check	06/17/14	13:15
1406081-CCB4	Calibration Blank	06/17/14	13:15
1406081-CCV5	Calibration Check	06/17/14	13:15
1406081-CCB5	Calibration Blank	06/17/14	13:15

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 350.1 **Total** **Sequence ID#:** 1406094

Instrument ID #: Lachat 8500 Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1406093-SRM1	Reference	06/19/14	09:17
1406093-BLK1	Blank	06/19/14	09:18
1406093-BS1	Blank Spike	06/19/14	09:19
1406094-CRL1	Instrument RL Check	06/19/14	09:20
C140612-03	14BH-DT-PILOT-BCR1-06111	06/19/14	09:22
1406093-DUP1	Duplicate	06/19/14	09:23
1406093-MS1	Matrix Spike	06/19/14	09:24
C140612-07	14BH-DT-PILOT-BCR2-06111	06/19/14	09:25
1406094-CCV1	Calibration Check	06/19/14	09:26
1406094-CCB1	Calibration Blank	06/19/14	09:28
C140612-11	14BH-DT-PILOT-BCR3-06111	06/19/14	09:29
C140612-15	14BH-DT-PILOT-BCR4-06111	06/19/14	09:30
1406094-CCV2	Calibration Check	06/19/14	09:41
1406094-CCB2	Calibration Blank	06/19/14	09:42

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 300.0 **Dissolved** **Sequence ID#:** 1406112

Instrument ID #: ESAT Dionex IC Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1406112-ICV1	Initial Cal Check	06/24/14	10:57
1406112-ICB1	Initial Cal Blank	06/24/14	11:15
1406112-SCV1	Secondary Cal Check	06/24/14	11:34
1406112-IBL1	Instrument Blank	06/24/14	11:52
1406085-BS1	Blank Spike	06/24/14	12:11
1406085-BLK1	Blank	06/24/14	12:30
C140612-04	14BH-DT-PILOT-BCR1-06111	06/24/14	12:48
1406085-DUP1	Duplicate	06/24/14	13:07
1406085-MS1	Matrix Spike	06/24/14	13:25
C140612-08	14BH-DT-PILOT-BCR2-06111	06/24/14	13:44
C140612-12	14BH-DT-PILOT-BCR3-06111	06/24/14	14:02
C140612-16	14BH-DT-PILOT-BCR4-06111	06/24/14	14:21
1406112-CCV1	Calibration Check	06/24/14	14:40
1406112-CCB1	Calibration Blank	06/24/14	14:58
C140612-22	14BH-DT-PILOT-INF-061114	06/24/14	15:17
C140612-19	14BH-DT-PILOT-CHIT-061114	06/24/14	15:35
C140612-25	14BH-DT-PILOT-INFD-06111	06/24/14	15:54
C140612-28	14BH-DT-PILOT-NAOH-0611	06/24/14	16:12
C140612-31	14BH-DT-PILOT-SAPS-06111	06/24/14	16:31
1406112-CCV2	Calibration Check	06/24/14	16:50
1406112-CCB2	Calibration Blank	06/24/14	17:08

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Dissolved** **Sequence ID#:** 1407028

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1407028-ICV1	Initial Cal Check	07/08/14	08:19
1407028-SCV1	Secondary Cal Check	07/08/14	08:23
1407028-ICB1	Initial Cal Blank	07/08/14	08:26
1407028-CRL1	Instrument RL Check	07/08/14	08:29
1407028-IFA1	Interference Check A	07/08/14	08:31
1407028-IFB1	Interference Check B	07/08/14	08:35
1407023-BLK1	Blank	07/08/14	08:39
1407023-BS1	Blank Spike	07/08/14	08:42
C140612-18	14BH-DT-PILOT-CHIT-061114	07/08/14	08:45
1407023-DUP1	Duplicate	07/08/14	08:50
1407028-SRD1	Serial Dilution	07/08/14	08:54
1407023-MS1	Matrix Spike	07/08/14	08:57
C140612-02	14BH-DT-PILOT-BCR1-06111	07/08/14	09:01
C140612-06	14BH-DT-PILOT-BCR2-06111	07/08/14	09:04
C140612-10	14BH-DT-PILOT-BCR3-06111	07/08/14	09:08
1407028-CCV1	Calibration Check	07/08/14	09:14
1407028-CCB1	Calibration Blank	07/08/14	09:17
C140612-14	14BH-DT-PILOT-BCR4-06111	07/08/14	09:20
C140612-21	14BH-DT-PILOT-INF-061114	07/08/14	09:23
C140612-24	14BH-DT-PILOT-INFD-06111	07/08/14	09:26
C140612-30	14BH-DT-PILOT-SAPS-06111	07/08/14	09:33
C140612-27	14BH-DT-PILOT-NAOH-0611	07/08/14	09:39
1407028-CCV2	Calibration Check	07/08/14	09:42
1407028-CCB2	Calibration Blank	07/08/14	09:45

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Total Recoverable** **Sequence ID#:** 1407029

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1407029-ICV1	Initial Cal Check	07/08/14	08:19
1407029-SCV1	Secondary Cal Check	07/08/14	08:23
1407029-ICB1	Initial Cal Blank	07/08/14	08:26
1407029-CRL1	Instrument RL Check	07/08/14	08:29
1407029-IFA1	Interference Check A	07/08/14	08:31
1407029-IFB1	Interference Check B	07/08/14	08:35
1407029-CCV1	Calibration Check	07/08/14	09:14
1407029-CCB1	Calibration Blank	07/08/14	09:17
1407029-CCV2	Calibration Check	07/08/14	09:42
1407029-CCB2	Calibration Blank	07/08/14	09:45
1406114-BLK1	Blank	07/08/14	09:53
1406114-SRM1	Reference	07/08/14	09:56
C140612-17	14BH-DT-PILOT-CHIT-061114	07/08/14	09:59
1406114-DUP1	Duplicate	07/08/14	10:03
1407029-SRD1	Serial Dilution	07/08/14	10:08
C140612-20	14BH-DT-PILOT-INF-061114	07/08/14	10:10
1406114-MS1	Matrix Spike	07/08/14	10:13
C140612-01	14BH-DT-PILOT-BCR1-06111	07/08/14	10:17
C140612-05	14BH-DT-PILOT-BCR2-06111	07/08/14	10:20
1407029-CCV3	Calibration Check	07/08/14	10:26
1407029-CCB3	Calibration Blank	07/08/14	10:29
C140612-09	14BH-DT-PILOT-BCR3-06111	07/08/14	10:32
C140612-13	14BH-DT-PILOT-BCR4-06111	07/08/14	10:35
C140612-23	14BH-DT-PILOT-INFD-06111	07/08/14	10:38
C140612-26	14BH-DT-PILOT-NAOH-0611	07/08/14	10:41
C140612-29	14BH-DT-PILOT-SAPS-06111	07/08/14	10:44
1407029-CCV4	Calibration Check	07/08/14	10:50
1407029-CCB4	Calibration Blank	07/08/14	10:53

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Dissolved** **Sequence ID#:** 1407037

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1407037-ICV1	Initial Cal Check	07/10/14	10:07
1407037-SCV1	Secondary Cal Check	07/10/14	10:10
1407037-ICB1	Initial Cal Blank	07/10/14	10:14
1407037-CRL1	Instrument RL Check	07/10/14	10:17
1407037-IFA1	Interference Check A	07/10/14	10:20
1407037-IFB1	Interference Check B	07/10/14	10:23
1407027-BLK1	Blank	07/10/14	10:27
C140612-18	14BH-DT-PILOT-CHIT-061114	07/10/14	10:30
1407027-DUP1	Duplicate	07/10/14	10:33
1407037-SRD1	Serial Dilution	07/10/14	10:36
1407027-BS1	Blank Spike	07/10/14	10:39
1407027-MS1	Matrix Spike	07/10/14	10:42
C140612-02	14BH-DT-PILOT-BCR1-06111	07/10/14	10:45
C140612-06	14BH-DT-PILOT-BCR2-06111	07/10/14	10:48
C140612-10	14BH-DT-PILOT-BCR3-06111	07/10/14	10:51
1407037-CCV1	Calibration Check	07/10/14	10:57
1407037-CCB1	Calibration Blank	07/10/14	11:01
C140612-14	14BH-DT-PILOT-BCR4-06111	07/10/14	11:04
C140612-21	14BH-DT-PILOT-INF-061114	07/10/14	11:07
C140612-24	14BH-DT-PILOT-INFD-06111	07/10/14	11:10
C140612-27	14BH-DT-PILOT-NAOH-0611	07/10/14	11:13
C140612-30	14BH-DT-PILOT-SAPS-06111	07/10/14	11:16
1407037-CCV2	Calibration Check	07/10/14	11:22
1407037-CCB2	Calibration Blank	07/10/14	11:25

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Total Recoverable** **Sequence ID#:** 1407038

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1407038-ICV1	Initial Cal Check	07/10/14	12:57
1407038-SCV1	Secondary Cal Check	07/10/14	13:00
1407038-ICB1	Initial Cal Blank	07/10/14	13:04
1407038-CRL1	Instrument RL Check	07/10/14	13:07
1407038-IFA1	Interference Check A	07/10/14	13:10
1407038-IFB1	Interference Check B	07/10/14	13:13
1406114-BLK2	Blank	07/10/14	13:17
C140612-17	14BH-DT-PILOT-CHIT-061114	07/10/14	13:20
1406114-DUP2	Duplicate	07/10/14	13:23
1407038-SRD1	Serial Dilution	07/10/14	13:26
1406114-SRM2	Reference	07/10/14	13:29
C140612-20	14BH-DT-PILOT-INF-061114	07/10/14	13:32
1406114-MS2	Matrix Spike	07/10/14	13:35
C140612-01	14BH-DT-PILOT-BCR1-06111	07/10/14	13:38
C140612-05	14BH-DT-PILOT-BCR2-06111	07/10/14	13:41
1407038-CCV1	Calibration Check	07/10/14	13:47
1407038-CCB1	Calibration Blank	07/10/14	13:50
C140612-09	14BH-DT-PILOT-BCR3-06111	07/10/14	13:54
C140612-13	14BH-DT-PILOT-BCR4-06111	07/10/14	13:57
C140612-23	14BH-DT-PILOT-INFD-06111	07/10/14	14:00
C140612-26	14BH-DT-PILOT-NAOH-0611	07/10/14	14:03
C140612-29	14BH-DT-PILOT-SAPS-06111	07/10/14	14:06
1407038-CCV2	Calibration Check	07/10/14	14:12
1407038-CCB2	Calibration Blank	07/10/14	14:15

CHAIN OF CUSTODY RECORD

CDM Smith | **Danny T Pilot Test** | **Analysis**

NOTES: Limited sample volumes due to treatability testing

SAMPLE NUMBER	DATE	TIME	MATRIX	Preservative	Type & No. of Containers	Total Metals (TAL), 200.7 or 200.8	Dissolved Metals (TAL), 200.7 or 200.8	Alkalinity, Anions (sulfate, chloride, fluoride)	Nitrate+Nitrite, Ammonia	Other Instructions and Notes
14BH-DT-PILOT-INF-061114	6/11/14	12:50	aqueous	HNO3 (metals), H2SO4 (nutrients), cool	3, 125 mL poly	X	X	X		TAL metals = Al, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, Tl, Zn.
14BH-DT-PILOT-INFD-061114	6/11/14	13:00	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-SAPS-061114	6/11/14	13:50	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-CHIT-061114	6/11/14	14:05	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-NAOH-061114	6/11/14	14:15	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-BCR1-061114	6/11/14	14:35	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR2-061114	6/11/14	14:55	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR3-061114	6/11/14	15:20	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR4-061114	6/11/14	15:40	aqueous		4, 125 mL poly	X	X	X	X	

Relinquished by: (*Signature*)	**Date/Time** 6/12/14 15:00	**Received for Laboratory by: (*Signature*)** Kelsey 6/13/14 9:55
Received by: (*Signature*)	**Date/Time**	**Airbill No.(s)**

ESAT

C14 0612

ESAT Technical Direction Form

Contract No. EPW13028
EPA Region 8

Site ID: 085N
TDF ID: A-046

Date Issued: 5/29/2014
Date Updated:

Date
Closed By:

Name: Barker-Hughesville Treatability Study

Details: The Contractor shall analyze several water samples associated with the treatability study at the Barker-Hughesville Superfund site as indicated in the Analytical Information Section. The samples will be sent to the ESAT R8 Lab during the 2014 field season starting in mid-June though early October 2014. There will be 9 sampling events associated with this project averaging approximately 10 samples per an event. The samples will be collected by Nick Anton/Erin Louden of CDM Smith.

Samples designated as influent samples (-INF) are expected to have high metal concentrations and should be analyzed by 200.7. Additionally, metals with sufficiently high concentrations may be reported from the 200.7 analyses.

ESAT should return the coolers to the following address:

CDM Smith/Lauren Helland
50 West 14th Street, Suite 200
Helena, MT 59601
406-441-1435
FedEx # 1323-6393-5

TO02/Subtask 02b: Inorganic Chemistry

Site RPM: Roger Hoogerheide

Analytical Information:

MATRIX

☑ Water ☐ Soils ☐ Vegetation ☐ Biota

WET CHEM

☐ TSS ☐ TDS ☐ DOC ☑ Alk ☑ Chloride ☑ Sulfate ☑ Fluoride ☑ Nitrate ☑ Nitrite
Other: Analyze for Ammonia and report NO2 and NO3 as NO2-NO3 combined.

METALS

☑ Dissolved ☑ Total Recoverable ☐ Total ☐ Hardness (Calc)

200.7: ☐ Ag ☑ Al ☐ As ☐ Ba ☐ Be ☐ B ☐ Ca ☐ Cd ☐ Co ☐ Cr ☐ Cu ☑ Fe ☐ K ☐ Mg
☒ Mn ☐ Mo ☐ Na ☐ Ni ☐ Pb ☐ Sb ☐ Se ☐ Sr ☐ Ti ☐ Tl ☐ V ☑ Zn ☐ SiO2

200.8: ☐ Ag ☐ Al ☑ As ☐ Ba ☐ Be ☑ Cd ☐ Co ☐ Cr ☑ Cu ☑ Mn ☐ Mo ☑ Ni ☑ Pb ☐ Sb
☐ Se ☐ Th ☐ Tl ☐ U ☐ V ☐ Zn

7470/7471/747 ☐ Hg

07/4/14

FIBERS

☐ PLM ☐ TEM

Deliverables

ID	*Description*	*Due Date*	*Submission Date*
1	Provide final deliverable package to Task Monitor no later than 30 days after delivery of samples.		

5/29/14

ANALYTICAL SUMMARY REPORT

July 24, 2014

CDM Federal Programs
555 17th St Ste 1100
Denver, CO 80202

Work Order: H14070203 Quote ID: H823 - Baker-Hughsville Superfund Site

Project Name: Barker Hughsville - Danny T

Energy Laboratories Inc Helena MT received the following 11 samples for CDM Federal Programs on 7/10/2014 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H14070203-001	14BH-DT-PILOT-INFL-062414	06/24/14 13:25	07/10/14	Aqueous	Acidity, Total as CaCO3 Phosphorus, Orthophosphate as P
H14070203-002	14BH-DT-PILOT-SAPS-062414	06/24/14 13:50	07/10/14	Aqueous	Same As Above
H14070203-003	14BH-DT-PILOT-CHIT-062414	06/24/14 14:05	07/10/14	Aqueous	Same As Above
H14070203-004	14BH-DT-PILOT-NAOH-062414	06/24/14 14:20	07/10/14	Aqueous	Same As Above
H14070203-005	14BH-DT-PILOT-BCR1-062414	06/24/14 14:35	07/10/14	Aqueous	Same As Above
H14070203-006	14BH-DT-PILOT-BCR1D-062414	06/24/14 14:40	07/10/14	Aqueous	Same As Above
H14070203-007	14BH-DT-PILOT-BCR2-062414	06/24/14 15:05	07/10/14	Aqueous	Same As Above
H14070203-008	14BH-DT-PILOT-BCR3-062414	06/24/14 15:20	07/10/14	Aqueous	Same As Above
H14070203-009	14BH-DT-PILOT-BCR4-062414	06/24/14 15:35	07/10/14	Aqueous	Same As Above
H14070203-010	14BH-DT-PILOT-POSTE-062414	06/24/14 15:50	07/10/14	Aqueous	Same As Above
H14070203-011	14BH-DT-PILOT-POST1-062414	06/24/14 16:10	07/10/14	Aqueous	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14070203-001
Client Sample ID: 14BH-DT-PILOT-INFL-062414

Report Date: 07/24/14
Collection Date: 06/24/14 13:25
Date Received: 07/10/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	640	mg/L	DH	4.0		1	A2310 B	07/11/14 13:18/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	ND	mg/L	DH	0.1		100	E365.1	07/11/14 11:17/cmm

Report Definitions:		
	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14070203-002
Client Sample ID: 14BH-DT-PILOT-SAPS-062414

Report Date: 07/24/14
Collection Date: 06/24/14 13:50
Date Received: 07/10/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	15	mg/L	DH	4.0		1	A2310 B	07/11/14 13:31/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	0.2	mg/L	DH	0.1		100	E365.1	07/11/14 11:20/cmm

Report Definitions:		
	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	07/24/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	06/24/14 14:05
Lab ID:	H14070203-003	**Date Received:**	07/10/14
Client Sample ID:	14BH-DT-PILOT-CHIT-062414	**Matrix:**	AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	DH	4.0		1	A2310 B	07/11/14 13:35/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	0.3	mg/L	DH	0.1		100	E365.1	07/11/14 11:21/cmm

Report Definitions:		
	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14070203-004
Client Sample ID: 14BH-DT-PILOT-NAOH-062414

Report Date: 07/24/14
Collection Date: 06/24/14 14:20
Date Received: 07/10/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	430	mg/L	DH	4.0		1	A2310 B	07/11/14 13:40/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	ND	mg/L	DH	0.1		100	E365.1	07/11/14 11:22/cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	07/24/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	06/24/14 14:35
Lab ID:	H14070203-005	**Date Received:**	07/10/14
Client Sample ID:	14BH-DT-PILOT-BCR1-062414	**Matrix:**	AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	DH	4.0		1	A2310 B	07/11/14 13:44/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	2.9	mg/L	DH	0.1		100	E365.1	07/11/14 11:23/cmm

Report Definitions:		
	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14070203-006
Client Sample ID: 14BH-DT-PILOT-BCR1D-062414

Report Date: 07/24/14
Collection Date: 06/24/14 14:40
Date Received: 07/10/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	DH	4.0		1	A2310 B	07/11/14 13:49/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	2.5	mg/L	DH	0.1		100	E365.1	07/11/14 11:24/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	07/24/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	06/24/14 15:05
Lab ID:	H14070203-007	**Date Received:**	07/10/14
Client Sample ID:	14BH-DT-PILOT-BCR2-062414	**Matrix:**	AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	DH	4.0		1	A2310 B	07/11/14 13:52/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	41.0	mg/L	DH	0.1		100	E365.1	07/11/14 11:25/cmm

Report Definitions:		
	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14070203-008
Client Sample ID: 14BH-DT-PILOT-BCR3-062414

Report Date: 07/24/14
Collection Date: 06/24/14 15:20
Date Received: 07/10/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	DH	4.0		1	A2310 B	07/11/14 13:57/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	39.7	mg/L	DH	0.1		100	E365.1	07/11/14 11:28/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	07/24/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	06/24/14 15:35
Lab ID:	H14070203-009	**Date Received:**	07/10/14
Client Sample ID:	14BH-DT-PILOT-BCR4-062414	**Matrix:**	AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	DH	4.0		1	A2310 B	07/11/14 13:59/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	28.2	mg/L	DH	0.1		100	E365.1	07/11/14 11:29/cmm

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14070203-010
Client Sample ID: 14BH-DT-PILOT-POSTE-062414

Report Date: 07/24/14
Collection Date: 06/24/14 15:50
Date Received: 07/10/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	DH	4.0		1	A2310 B	07/11/14 14:03/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	4.5	mg/L	DH	0.1		100	E365.1	07/11/14 11:30/cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	07/24/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	06/24/14 16:10
Lab ID:	H14070203-011	**Date Received:**	07/10/14
Client Sample ID:	14BH-DT-PILOT-POST1-062414	**Matrix:**	AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	DH	4.0		1	A2310 B	07/11/14 14:08/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	26.2	mg/L	DH	0.1		100	E365.1	07/11/14 11:31/cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs

Project: Barker Hughsville - Danny T

Report Date: 07/24/14

Work Order: H14070203

Analyte		Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method:	**A2310 B**									Batch: H140711A
Lab ID:	**H14070203-001ADUP**	Sample Duplicate				Run: PH_140711A				07/11/14 13:25
Acidity, Total as CaCO3		650	mg/L	4.0				1.9	20	
Lab ID:	**H14070203-011ADUP**	Sample Duplicate				Run: PH_140711A				07/11/14 14:12
Acidity, Total as CaCO3		ND	mg/L	4.0					20	
Lab ID:	**LCS1407110000**	Laboratory Control Sample				Run: PH_140711A				07/11/14 14:17
Acidity, Total as CaCO3		950	mg/L	4.0	97	90	110			
Lab ID:	**MBLK1407110000**	Method Blank				Run: PH_140711A				07/11/14 14:22
Acidity, Total as CaCO3		2	mg/L							

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T

Report Date: 07/24/14
Work Order: H14070203

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **E365.1**									Analytical Run: FIA202-HE_140711C
Lab ID: **ICV**	Initial Calibration Verification Standard								07/11/14 11:12
Phosphorus, Orthophosphate as P	0.257	mg/L	0.0050	103	90	110			
Lab ID: **ICB**	Initial Calibration Blank, Instrument Blank								07/11/14 11:13
Phosphorus, Orthophosphate as P	0.000150	mg/L	0.0050		0	0			
Lab ID: **CCV**	Continuing Calibration Verification Standard								07/11/14 11:15
Phosphorus, Orthophosphate as P	0.101	mg/L	0.0050	101	90	110			
Lab ID: **CCV**	Continuing Calibration Verification Standard								07/11/14 11:27
Phosphorus, Orthophosphate as P	0.105	mg/L	0.0050	105	90	110			
Lab ID: **CCV**	Continuing Calibration Verification Standard								07/11/14 11:38
Phosphorus, Orthophosphate as P	0.103	mg/L	0.0050	103	90	110			
Method: **E365.1**									Batch: R98773
Lab ID: **LFB**	Laboratory Fortified Blank				Run: FIA202-HE_140711C				07/11/14 11:14
Phosphorus, Orthophosphate as P	0.196	mg/L	0.0050	98	90	110			
Lab ID: **H14070203-001BMS**	Sample Matrix Spike				Run: FIA202-HE_140711C				07/11/14 11:18
Phosphorus, Orthophosphate as P	12.7	mg/L	0.10	64	90	110			S
Lab ID: **H14070203-001BMSD**	Sample Matrix Spike Duplicate				Run: FIA202-HE_140711C				07/11/14 11:19
Phosphorus, Orthophosphate as P	12.2	mg/L	0.10	61	90	110	3.8	20	S
Lab ID: **H14070206-001BMS**	Sample Matrix Spike				Run: FIA202-HE_140711C				07/11/14 11:33
Phosphorus, Orthophosphate as P	0.203	mg/L	0.0050	96	90	110			
Lab ID: **H14070206-001BMSD**	Sample Matrix Spike Duplicate				Run: FIA202-HE_140711C				07/11/14 11:34
Phosphorus, Orthophosphate as P	0.209	mg/L	0.0050	100	90	110	3.1	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

Workorder Receipt Checklist

CDM Federal Programs

H14070203

Login completed by: Tracy L. Lorash

Date Received: 7/10/2014

Reviewed by: BL2000\kwiegand

Received by: blm

Reviewed Date: 7/11/2014

Carrier name: Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☐	No ☑	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	6.9°C On Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☑	No ☐	Not Applicable ☐

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

All samples except for14BH-DT-PILOT-POSTI-062414 were received past the method holding time for both alkalinity and orthophosphate.
14BH-DT-PILOT-POSTI-062414 sample collected at 16:10 was not received with sufficient time to complete analysis within method recommended hold time.
Per Angela, we are to analyze samples past the holding time. TI 7/10/14

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 1 of 2

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM Smith

Project Name, PWS, Permit, Etc.: Barker Hughesville - Danny T

Sample Origin State: MT

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address (Required):

☒ No Hard Copy Email: FrandsenAK@cdmsmith.com

Contact Name: Angela Frandsen Phone/Fax: (406) 441-1400 Cell:

Sampler: (Please Print) Lauren Helland

Invoice Contact & Phone: SAME

Purchase Order:

Quote/Bottle Order:

Invoice Address (Required):

☒ No Hard Copy Email: Same as above

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: ___________
☐ Other: ___________
☒ EDD/EDT (Electronic Data) Format: Excel
☐ LEVEL IV
☐ NELAC

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids
Vegetation Bioassay Other
DW - Drinking Water

ANALYSIS REQUESTED

SEE ATTACHED

Standard Turnaround (TAT)

RUSH

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: BOD not included in this set of samples.

Shipped by: Hand

Cooler ID(s): X

Receipt Temp NO 6.9 °C

On Ice: [✓ Y] N

Custody Seal
On Bottle Y [✓ N]
On Cooler Y [✓ N]
Intact Y N
Signature Match Y N

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	Acidity	Orthophosphate
1 14BH-DT-PILOT-INFL-062414	06/24/14	13:25	2,W	X	X
2 14BH-DT-PILOT-SAPS-062414	06/24/14	13:50	2,W	X	X
3 14BH-DT-PILOT-CHIT-062414	06/24/14	14:05	2,W	X	X
4 14BH-DT-PILOT-NAOH-062414	06/24/14	14:20	2,W	X	X
5 14BH-DT-PILOT-BCR1-062414	06/24/14	14:35	2,W	X	X
6 14BH-DT-PILOT-BCR1D-062414	06/24/14	14:40	2,W	X	X
7 14BH-DT-PILOT-BCR2-062414	06/24/14	15:05	2,W	X	X
8 14BH-DT-PILOT-BCR3-062414	06/24/14	15:20	2,W	X	X
9 14BH-DT-PILOT-BCR4-062414	06/24/14	15:35	2,W	X	X
10 14BH-DT-PILOT-POSTE-062414	06/24/14	15:50	2,W	X	X

LABORATORY USE ONLY H14070203

Custody Record MUST be Signed

Relinquished by (print): Lauren Helland Date/Time: 07/10/14 1553 Signature: Lauren Helland

Relinquished by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Received by Laboratory: Brice Madison Date/Time: 7/10/14 15:53 Signature:

Sample Disposal: Return to Client: ________ Lab Disposal: ________

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 2 of 2

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM Smith

Project Name, PWS, Permit, Etc.: Barker Hughesville - DannyT

Sample Origin State: MT

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address (Required):

☒ No Hard Copy Email: FrandsenAK@cdmsmith.com

Contact Name: Angela Frandsen

Phone/Fax: (406) 441-1400

Cell:

Sampler: (Please Print) Lauren Helland

Invoice Contact & Phone: Same

Purchase Order:

Quote/Bottle Order:

Invoice Address (Required):

☒ No Hard Copy Email: Same as above

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: ______
☐ Other: ______
☒ EDD/EDT (Electronic Data) Format: Excel
☐ LEVEL IV
☐ NELAC

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids Vegetation Bioassay Other
DW - Drinking Water

ANALYSIS REQUESTED

SEE ATTACHED

Standard Turnaround (TAT)

RUSH

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: BOD not included in this set of samples.

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	Acidity	Orthophosphate
1 14BH-DT-PILOT-POST1-062414	06/24/14	16:10	2, W	X	X
2					
3					
4					
5					
6					
7					
8					
9					
10					

LABORATORY USE ONLY

Shipped by: Hand

Cooler ID(s): Y

Receipt Temp 6.9 °C

On Ice: [✓ Y] N

Custody Seal
On Bottle Y [✓ N]
On Cooler Y [✓ N]
Intact Y [✓ N]
Signature Match Y N

H14070203

Custody Record MUST be Signed

Relinquished by (print): Lauren Helland Date/Time: 07/10/14 1553 Signature: Lauren Helland

Relinquished by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Received by Laboratory: Brice Madison Date/Time: 7/10/14 1553 Signature:

Sample Disposal: Return to Client: ______ Lab Disposal: ______

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.

Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

U.S. Environmental Protection Agency
Region 8
Technical and Management Services

Laboratory Services Program

Certificate of Analysis

Ref: 8TMS-L

MEMORANDUM

Date: 09/15/14

Subject: Analytical Results--- **Barker-Hughesville_Treatability 2_JUL 2014_A046 / A-046**

From: Don Goodrich; EPA Region 8 Analytical Chemistry WAM

To: Roger Hoogerheide
Superfund
8 MO

Received Sample Set(s), [Work Order : Date Received]:
[C140711 : 07/11/2014]

Attached are the analytical results for the samples received from the Barker-Hughesville_Treatability 2_JUL 2014_A046 sampling event, according to TDF A-046. All analyses were performed within their method specified holding times unless otherwise noted in the following narrative.

These samples were prepared, analyzed, and verified by the Environmental Services Assistance Team Laboratory (ESAT) according to the requirements of the Technical Direction Form (TDF).

Note: The laboratory herewith transmits this deliverable to the program/project partner for determination of "final data usability" which may include data validation and data quality asessment per and in accordance with EPA QA/G-8, *Guidance on Environmental Data Verification and Data Validation*, November 2002, EPA/240/R-02/004. Laboratory data qualifiers are applied based on the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004, referred to as "NFGI".

Laboratory policy is to dispose of any remaining sample 60 days after data analysis packages are delivered to EPA. If you would like the laboratory to retain the samples for a period longer than 60 days, please contact Don Goodrich within the 60 day period at (303) 312-6687.

Case Narrative

C140711

Quality Assessment: Unless indicated by exception, the QA/QC associated with this sample set produced data within the TDF-specified criteria.

Holding Times: Alkalinity results are qualified "J" as estimated as they were analyzed past holding times. All other samples were analyzed within their method-specified technical holding time(s).

1. Initial and Continuing calibration blanks (ICBs and CCBs).
   Exceptions: None.
2. Preparation (PB) / Method blanks (MB)
   Exceptions: None.
3. Interference Checks (ICSA / ICSAB) for ICP-MS and ICP-OE analyses only.
   Exceptions: None.
4. Initial and Continuing calibration verification analyses (ICVs, SCVs and CCVs).
   Exceptions: None.
5. Laboratory Control Sample (LCS) or second source analysis or SRM.
   Exceptions: None.
6. Laboratory Fortified blank (LFB) / Blank spike (BS), same source as used for the matrix spikes. PBS performed with analyses/methods requiring preparation or digestion prior to analysis.
   Exceptions: None.
7. Contract Reporting Detection Limit Standard, labeled as CRA, CRDL or CRL.
   Exceptions: None.
8. Laboratory Duplicate (DUP). "Source" identifies field sample duplicated in the laboratory. If either the "source" or the duplicate result is <5X the reporting limit, the %D limit of 20% does not apply.
   Exceptions: None.
9. Laboratory Matrix Spike (MS) and spike duplicate (MSD). "Source" defines original field sample fortified prior to analysis. Percent recovery (%R) limits do not apply when sample concentration(s) exceed the corresponding analyte spike level by a factor of 4 or greater.
   Exceptions: In ICP-MS batch 1409017, nickel, copper, and arsenic recovered low in the MS4. No qualifiers were assigned since all other QC requirements for these analytes were met.
10. Serial Dilution sample analysis (SRD). "Source" is parent field sample diluted 1:5 in the laboratory. Performed for ICP-OE and ICP-MS metals analyses. Percent difference (%D) limits do not apply when analyte concentration(s) are below 50x the source sample's MDL (or 10x it's PQL).
    Exceptions: None.
11. Internal standards, criteria specified for ICP-MS analyses only, monitored at the instrument.
    Exceptions: None.
12. Any calibration using more than two-points produced a correlation coefficient equal to or greater than 0.995.
    Exceptions: None.

Acronyms and Definitions:

ESAT	Environmental Services Assistance Team
J	Data Estimated qualifier (also applied to all data less than PQL, greater than or equal to MDL)
MDL	Method Detection Limit
PQL	Practical Quantitation Limit, also known as reporting limit.
RPD	Relative Percent Difference (difference divided by the mean)
%D	Percent difference, serial dilution criteria unit, difference divided by the original result.
%R	Percent recovery, analyzed (less sample contribution) divided by true value
<	Analyte NOT DETECTED at or above the Method Detection Limit (MDL)
mg/L	Parts per million (millligrams per liter). Solids equivalent = mg/Kg.
ug/L	Parts per billion (micrograms per liter). Solids equivalent = ug/Kg.
NR	No Recovery (matrix spike) - Often seen for calcium/magnesium when their concentration exceeds the spike level by > 4x.
NFGI	*USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004
RE	Sample Re-analysis. Usually seen on raw data and sequences for required sample dilutions due to over-range analytes.
U	Analyte not detected at or above MDL qualifier
D	Diluted value qualifier.

Method(s) Summary:

As defined in the Technical Direction Form (TDF), some or all of the methods listed below were used for the determination of the reported target analytes.

From EPA's *Methods for the Determination of Metals in Environmental Samples* , Supplement I, May 1994, dissolved, total, and/or total recoverable metals were determined by:

- Method 200.7 / 6010B using a PE Optima ICP -OE (ICP).
- Method 200.8 / 6020 using a Perkin -Elmer Elan 6000 ICP-MS.
- Method 200.2 for total recoverable metals (only) digestion.
- Method 245.1 using a Perkin -Elmer FIMS CVAA (aqueous mercury only).

From *Standard Methods for the Examination of Water and Wastewater* , 18th Edition, 1992, Method 2340B was used for the calculated hardness determination. Hardness is reported as mg (milligram) equivalent $CaCO_3$ per liter (L) determined as follows:

Calculated hardness = 2.497 * (Calcium, mg/L) + 4.118 * (Magnesium, mg/L).

From *EPA's Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW -846*,

- Method 3015A was used for microwave assisted total metals digestion.
- Method 7473 was used for mercury in solids .

From EPA's *Determination of Inorganic Anions by Ion Chromatography* , Revision 2.1, 1993, Method 300.0 was used to determine the anions.

From EPA's *Methods for Chemical Analysis of Water and Wastes* , March 1983:

- Method 310.1 was followed for the alkalinity determination.
- Method 160.1 was followed for gravimetric total dissolved solids (TDS) determination.
- Method 160.2 was used for gravimetric total suspended solids (TSS) determination.
- Method 415.3 was used for total organic carbon (TOC) determination using either an Apollo 9000 or Phoenix 8000 Non-Dispersive IR (NDIR) system. Also known as dissolved organic carbon (DOC) when performed on the dissolved sample fraction.

The quality control procedures listed in the TDF request were utilized by ESAT to verify accuracy of the results and to evaluate any matrix interferences.

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-062414 **Date / Time Sampled:** 06/24/14 14:35 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140711-01 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	09/12/2014	SV	1409051
200.7	Iron	< 1250	U	ug/L	500	5	09/12/2014	SV	1409051
200.7	**Manganese**	**1870**		ug/L	10.0	5	09/12/2014	SV	1409051
200.7	**Zinc**	**82.2**	J	ug/L	50.0	5	09/12/2014	SV	1409051
200.8	**Arsenic**	**20.3**		ug/L	5.00	10	09/12/2014	SV	1409052
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Copper**	**5.30**	J	ug/L	5.00	10	09/12/2014	SV	1409052
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Nickel**	**27.1**		ug/L	5.00	10	09/12/2014	SV	1409052
2340B	**Hardness**	**2320**		mg/L	8	5	09/12/2014	SV	1409051

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1D-062414 **Date / Time Sampled:** 06/24/14 14:40 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140711-05 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 50.0	U	ug/L	20.0	1	09/12/2014	SV	1409051
200.7	**Iron**	**180**	J	ug/L	100	1	09/12/2014	SV	1409051
200.7	**Manganese**	**2850**		ug/L	2.00	1	09/12/2014	SV	1409051
200.7	**Zinc**	**86.0**		ug/L	10.0	1	09/12/2014	SV	1409051
200.8	**Arsenic**	**18.3**	J	ug/L	5.00	10	09/12/2014	SV	1409052
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Copper**	**6.94**	J	ug/L	5.00	10	09/12/2014	SV	1409052
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Nickel**	**29.7**		ug/L	5.00	10	09/12/2014	SV	1409052
2340B	**Hardness**	**2250**		mg/L	2	1	09/12/2014	SV	1409051

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-062414 **Date / Time Sampled:** 06/24/14 15:05 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140711-09 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**129**		ug/L	20.0	1	09/12/2014	SV	1409051
200.7	**Iron**	**1470**		ug/L	100	1	09/12/2014	SV	1409051
200.7	**Manganese**	**4010**		ug/L	2.00	1	09/12/2014	SV	1409051
200.7	**Zinc**	**268**		ug/L	10.0	1	09/12/2014	SV	1409051
200.8	**Arsenic**	**12.4**	J	ug/L	5.00	10	09/12/2014	SV	1409052
200.8	**Cadmium**	**1.10**	J	ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Copper**	**35.2**		ug/L	5.00	10	09/12/2014	SV	1409052
200.8	**Lead**	**2.95**		ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Nickel**	**12.0**		ug/L	5.00	10	09/12/2014	SV	1409052
2340B	**Hardness**	**1300**		mg/L	2	1	09/12/2014	SV	1409051

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-062414 **Date / Time Sampled:** 06/24/14 15:20 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140711-13 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**127**		ug/L	20.0	1	09/12/2014	SV	1409051
200.7	**Iron**	**2060**		ug/L	100	1	09/12/2014	SV	1409051
200.7	**Manganese**	**4380**		ug/L	2.00	1	09/12/2014	SV	1409051
200.7	**Zinc**	**63.6**		ug/L	10.0	1	09/12/2014	SV	1409051
200.8	**Arsenic**	**46.4**		ug/L	5.00	10	09/12/2014	SV	1409052
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Copper**	**12.9**		ug/L	5.00	10	09/12/2014	SV	1409052
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Nickel**	**51.8**		ug/L	5.00	10	09/12/2014	SV	1409052
2340B	**Hardness**	**1570**		mg/L	2	1	09/12/2014	SV	1409051

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-062414 **Date / Time Sampled:** 06/24/14 15:35 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140711-17 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**108**	J	ug/L	100	5	09/12/2014	SV	1409051
200.7	**Iron**	**1440**		ug/L	500	5	09/12/2014	SV	1409051
200.7	**Manganese**	**10700**		ug/L	10.0	5	09/12/2014	SV	1409051
200.7	**Zinc**	**734**		ug/L	50.0	5	09/12/2014	SV	1409051
200.8	**Arsenic**	**9.03**	J	ug/L	5.00	10	09/12/2014	SV	1409052
200.8	**Cadmium**	**4.51**		ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Copper**	**15.9**		ug/L	5.00	10	09/12/2014	SV	1409052
200.8	**Lead**	**2.12**		ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Nickel**	**31.1**		ug/L	5.00	10	09/12/2014	SV	1409052
2340B	**Hardness**	**868**		mg/L	8	5	09/12/2014	SV	1409051

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-062414 **Date / Time Sampled:** 06/24/14 14:05 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140711-21 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 50.0	U	ug/L	20.0	1	09/12/2014	SV	1409051
200.7	**Iron**	**2300**		ug/L	100	1	09/12/2014	SV	1409051
200.7	**Manganese**	**13200**		ug/L	2.00	1	09/12/2014	SV	1409051
200.7	**Zinc**	**35.2**		ug/L	10.0	1	09/12/2014	SV	1409051
200.8	**Arsenic**	**23.6**		ug/L	5.00	10	09/12/2014	SV	1409052
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Copper**	**10.8**		ug/L	5.00	10	09/12/2014	SV	1409052
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Nickel**	**29.1**		ug/L	5.00	10	09/12/2014	SV	1409052
2340B	**Hardness**	**2130**		mg/L	2	1	09/12/2014	SV	1409051

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFL-062414 **Date / Time Sampled:** 06/24/14 13:25 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140711-24 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**13700**		ug/L	100	5	09/12/2014	SV	1409051
200.7	**Iron**	**155000**		ug/L	500	5	09/12/2014	SV	1409051
200.7	**Manganese**	**113000**		ug/L	10.0	5	09/12/2014	SV	1409051
200.7	**Zinc**	**64400**		ug/L	50.0	5	09/12/2014	SV	1409051
200.8	**Arsenic**	**136**		ug/L	5.00	10	09/12/2014	SV	1409052
200.8	**Cadmium**	**284**		ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Copper**	**1060**		ug/L	5.00	10	09/12/2014	SV	1409052
200.8	**Lead**	**213**		ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Nickel**	**53.9**		ug/L	5.00	10	09/12/2014	SV	1409052
2340B	**Hardness**	**366**		mg/L	8	5	09/12/2014	SV	1409051

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NAOH-062414 **Date / Time Sampled:** 06/24/14 14:20 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140711-27 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**11100**		ug/L	100	5	09/12/2014	SV	1409051
200.7	**Iron**	**17200**		ug/L	500	5	09/12/2014	SV	1409051
200.7	**Manganese**	**104000**		ug/L	10.0	5	09/12/2014	SV	1409051
200.7	**Zinc**	**59900**		ug/L	50.0	5	09/12/2014	SV	1409051
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/12/2014	SV	1409052
200.8	**Cadmium**	**264**		ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Copper**	**799**		ug/L	5.00	10	09/12/2014	SV	1409052
200.8	**Lead**	**135**		ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Nickel**	**51.3**		ug/L	5.00	10	09/12/2014	SV	1409052
2340B	**Hardness**	**365**		mg/L	8	5	09/12/2014	SV	1409051

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-062414 **Date / Time Sampled:** 06/24/14 15:50 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140711-30 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**89.3**		ug/L	20.0	1	09/12/2014	SV	1409051
200.7	**Iron**	**1020**		ug/L	100	1	09/12/2014	SV	1409051
200.7	**Manganese**	**2910**		ug/L	2.00	1	09/12/2014	SV	1409051
200.7	**Zinc**	**73.8**		ug/L	10.0	1	09/12/2014	SV	1409051
200.8	**Arsenic**	**49.9**		ug/L	5.00	10	09/12/2014	SV	1409052
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Copper**	**8.48**	J	ug/L	5.00	10	09/12/2014	SV	1409052
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Nickel**	**53.0**		ug/L	5.00	10	09/12/2014	SV	1409052
2340B	**Hardness**	**1520**		mg/L	2	1	09/12/2014	SV	1409051

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-062414 **Date / Time Sampled:** 06/24/14 16:10 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140711-34 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**49.9**	J	ug/L	20.0	1	09/12/2014	SV	1409051
200.7	**Iron**	**863**		ug/L	100	1	09/12/2014	SV	1409051
200.7	**Manganese**	**5490**		ug/L	2.00	1	09/12/2014	SV	1409051
200.7	**Zinc**	**281**		ug/L	10.0	1	09/12/2014	SV	1409051
200.8	**Arsenic**	**14.3**	J	ug/L	5.00	10	09/12/2014	SV	1409052
200.8	**Cadmium**	**1.57**	J	ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Copper**	**13.3**		ug/L	5.00	10	09/12/2014	SV	1409052
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Nickel**	**25.6**		ug/L	5.00	10	09/12/2014	SV	1409052
2340B	**Hardness**	**1440**		mg/L	2	1	09/12/2014	SV	1409051

Project Name: **Barker-Hughesville_Treatability 2_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-062414 **Date / Time Sampled:** 06/24/14 13:50 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140711-38 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	09/12/2014	SV	1409051
200.7	**Iron**	**26800**		ug/L	500	5	09/12/2014	SV	1409051
200.7	**Manganese**	**75900**		ug/L	10.0	5	09/12/2014	SV	1409051
200.7	**Zinc**	**6280**		ug/L	50.0	5	09/12/2014	SV	1409051
200.8	**Arsenic**	**19.7**	J	ug/L	5.00	10	09/12/2014	SV	1409052
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/12/2014	SV	1409052
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/12/2014	SV	1409052
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/12/2014	SV	1409052
200.8	**Nickel**	**27.1**		ug/L	5.00	10	09/12/2014	SV	1409052
2340B	**Hardness**	**903**		mg/L	8	5	09/12/2014	SV	1409051

"J" Qualifier indicates an estimated value

Project Name: **Barker-Hughesville_Treatability 2_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-062414 **Date / Time Sampled:** 06/24/14 14:35 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140711-02 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**151**	J	ug/L	100	5	09/15/2014	SV	1409017
200.7	Iron	< 1250	U	ug/L	500	5	09/15/2014	SV	1409017
200.7	**Manganese**	**2100**		ug/L	10.0	5	09/15/2014	SV	1409017
200.7	**Zinc**	**250**		ug/L	50.0	5	09/15/2014	SV	1409017
200.8	**Arsenic**	**20.5**		ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Cadmium**	**1.37**	J	ug/L	1.00	10	09/15/2014	SV	1409017
200.8	**Copper**	**17.1**		ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Lead**	**1.23**	J	ug/L	1.00	10	09/15/2014	SV	1409017
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/15/2014	SV	1409017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1D-062414 **Date / Time Sampled:** 06/24/14 14:40 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140711-06 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**47.4**	J	ug/L	20.0	1	09/15/2014	SV	1409017
200.7	**Iron**	**531**		ug/L	100	1	09/15/2014	SV	1409017
200.7	**Manganese**	**2870**		ug/L	2.00	1	09/15/2014	SV	1409017
200.7	**Zinc**	**236**		ug/L	10.0	1	09/15/2014	SV	1409017
200.8	**Arsenic**	**21.1**		ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Cadmium**	**1.76**	J	ug/L	1.00	10	09/15/2014	SV	1409017
200.8	**Copper**	**22.0**		ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Lead**	**1.61**	J	ug/L	1.00	10	09/15/2014	SV	1409017
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/15/2014	SV	1409017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-062414 **Date / Time Sampled:** 06/24/14 15:05 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140711-10 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**304**		ug/L	20.0	1	09/15/2014	SV	1409017
200.7	**Iron**	**2530**		ug/L	100	1	09/15/2014	SV	1409017
200.7	**Manganese**	**4320**		ug/L	2.00	1	09/15/2014	SV	1409017
200.7	**Zinc**	**670**		ug/L	10.0	1	09/15/2014	SV	1409017
200.8	**Arsenic**	**17.1**	J	ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Cadmium**	**3.01**		ug/L	1.00	10	09/15/2014	SV	1409017
200.8	**Copper**	**80.0**		ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Lead**	**10.7**		ug/L	1.00	10	09/15/2014	SV	1409017
200.8	**Nickel**	**5.54**	J	ug/L	5.00	10	09/15/2014	SV	1409017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-062414 **Date / Time Sampled:** 06/24/14 15:20 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140711-14 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**133**		ug/L	20.0	1	09/15/2014	SV	1409017
200.7	**Iron**	**1990**		ug/L	100	1	09/15/2014	SV	1409017
200.7	**Manganese**	**4490**		ug/L	2.00	1	09/15/2014	SV	1409017
200.7	**Zinc**	**121**		ug/L	10.0	1	09/15/2014	SV	1409017
200.8	**Arsenic**	**31.0**		ug/L	5.00	10	09/15/2014	SV	1409017
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/15/2014	SV	1409017
200.8	**Copper**	**39.5**		ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Lead**	**4.07**		ug/L	1.00	10	09/15/2014	SV	1409017
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/15/2014	SV	1409017

Project Name: **Barker-Hughesville_Treatability 2_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-062414 **Date / Time Sampled:** 06/24/14 15:35 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140711-18 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**169**	J	ug/L	100	5	09/15/2014	SV	1409017
200.7	**Iron**	**1490**		ug/L	500	5	09/15/2014	SV	1409017
200.7	**Manganese**	**11100**		ug/L	10.0	5	09/15/2014	SV	1409017
200.7	**Zinc**	**1700**		ug/L	50.0	5	09/15/2014	SV	1409017
200.8	**Arsenic**	**17.0**	J	ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Cadmium**	**13.2**		ug/L	1.00	10	09/15/2014	SV	1409017
200.8	**Copper**	**40.2**		ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Lead**	**3.87**		ug/L	1.00	10	09/15/2014	SV	1409017
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/15/2014	SV	1409017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-062414 **Date / Time Sampled:** 06/24/14 14:05 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140711-22 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 50.0	U	ug/L	20.0	1	09/15/2014	SV	1409017
200.7	**Iron**	**2700**		ug/L	100	1	09/15/2014	SV	1409017
200.7	**Manganese**	**13600**		ug/L	2.00	1	09/15/2014	SV	1409017
200.7	**Zinc**	**63.0**		ug/L	10.0	1	09/15/2014	SV	1409017
200.8	**Arsenic**	**18.5**	J	ug/L	5.00	10	09/15/2014	SV	1409017
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/15/2014	SV	1409017
200.8	**Copper**	**14.9**		ug/L	5.00	10	09/15/2014	SV	1409017
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/15/2014	SV	1409017
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/15/2014	SV	1409017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFL-062414 **Date / Time Sampled:** 06/24/14 13:25 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140711-25 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**14000**		ug/L	100	5	09/15/2014	SV	1409017
200.7	**Iron**	**156000**		ug/L	500	5	09/15/2014	SV	1409017
200.7	**Manganese**	**114000**		ug/L	10.0	5	09/15/2014	SV	1409017
200.7	**Zinc**	**63800**		ug/L	50.0	5	09/15/2014	SV	1409017
200.8	**Arsenic**	**134**		ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Cadmium**	**283**		ug/L	1.00	10	09/15/2014	SV	1409017
200.8	**Copper**	**1130**		ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Lead**	**189**		ug/L	1.00	10	09/15/2014	SV	1409017
200.8	**Nickel**	**22.7**		ug/L	5.00	10	09/15/2014	SV	1409017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NAOH-062414 **Date / Time Sampled:** 06/24/14 14:20 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140711-28 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**11200**		ug/L	100	5	09/15/2014	SV	1409017
200.7	**Iron**	**25000**		ug/L	500	5	09/15/2014	SV	1409017
200.7	**Manganese**	**103000**		ug/L	10.0	5	09/15/2014	SV	1409017
200.7	**Zinc**	**58700**		ug/L	50.0	5	09/15/2014	SV	1409017
200.8	**Arsenic**	**16.2**	J	ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Cadmium**	**259**		ug/L	1.00	10	09/15/2014	SV	1409017
200.8	**Copper**	**878**		ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Lead**	**119**		ug/L	1.00	10	09/15/2014	SV	1409017
200.8	**Nickel**	**21.6**		ug/L	5.00	10	09/15/2014	SV	1409017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-062414 **Date / Time Sampled:** 06/24/14 15:50 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140711-31 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**246**		ug/L	20.0	1	09/15/2014	SV	1409017
200.7	**Iron**	**2720**		ug/L	100	1	09/15/2014	SV	1409017
200.7	**Manganese**	**5030**		ug/L	2.00	1	09/15/2014	SV	1409017
200.7	**Zinc**	**815**		ug/L	10.0	1	09/15/2014	SV	1409017
200.8	**Arsenic**	**65.3**		ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Cadmium**	**5.75**		ug/L	1.00	10	09/15/2014	SV	1409017
200.8	**Copper**	**48.3**		ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Lead**	**15.8**		ug/L	1.00	10	09/15/2014	SV	1409017
200.8	**Nickel**	**28.2**		ug/L	5.00	10	09/15/2014	SV	1409017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-062414 **Date / Time Sampled:** 06/24/14 16:10 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140711-35 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**102**		ug/L	20.0	1	09/15/2014	SV	1409017
200.7	**Iron**	**1340**		ug/L	100	1	09/15/2014	SV	1409017
200.7	**Manganese**	**5520**		ug/L	2.00	1	09/15/2014	SV	1409017
200.7	**Zinc**	**626**		ug/L	10.0	1	09/15/2014	SV	1409017
200.8	**Arsenic**	**18.2**	J	ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Cadmium**	**4.33**		ug/L	1.00	10	09/15/2014	SV	1409017
200.8	**Copper**	**38.5**		ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Lead**	**3.25**		ug/L	1.00	10	09/15/2014	SV	1409017
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/15/2014	SV	1409017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID:	14BH-DT-PILOT-SAPS-062414	**Date / Time Sampled:**	06/24/14 13:50	**Workorder:**	C140711
EPA Tag No.:	No Tag Prefix-B	**Matrix:**	Water	**Lab Number:**	C140711-39 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	09/15/2014	SV	1409017
200.7	**Iron**	**26100**		ug/L	500	5	09/15/2014	SV	1409017
200.7	**Manganese**	**74600**		ug/L	10.0	5	09/15/2014	SV	1409017
200.7	**Zinc**	**5950**		ug/L	50.0	5	09/15/2014	SV	1409017
200.8	**Arsenic**	**19.9**	J	ug/L	5.00	10	09/15/2014	SV	1409017
200.8	**Cadmium**	**2.18**		ug/L	1.00	10	09/15/2014	SV	1409017
200.8	**Copper**	**8.61**	J	ug/L	5.00	10	09/15/2014	SV	1409017
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/15/2014	SV	1409017
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/15/2014	SV	1409017

"J" Qualifier indicates an estimated value

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-062414 **Date / Time Sampled:** 06/24/14 14:35 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140711-03 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**83.2**	J	mg/L	50.0	100	07/22/2014	NP	1407094
EPA 300.0	**Fluoride**	**67.1**		mg/L	10.0	100	07/22/2014	NP	1407094
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/22/2014	NP	1407094
EPA 300.0	**Sulfate as SO4**	**840**		mg/L	5.0	100	07/22/2014	NP	1407094
EPA 310.1	**Total Alkalinity**	**1570**	J	mg CaCO3 / L	250	50	07/14/2014	KJB	1407052

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-062414 **Date / Time Sampled:** 06/24/14 14:35 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140711-04 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**94.2**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1D-062414 **Date / Time Sampled:** 06/24/14 14:40 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140711-07 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**79.8**	J	mg/L	50.0	100	07/22/2014	NP	1407094
EPA 300.0	**Fluoride**	**59.1**		mg/L	10.0	100	07/22/2014	NP	1407094
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/22/2014	NP	1407094
EPA 300.0	**Sulfate as SO4**	**831**		mg/L	5.0	100	07/22/2014	NP	1407094
EPA 310.1	**Total Alkalinity**	**1540**	J	mg CaCO3 / L	250	50	07/14/2014	KJB	1407052

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1D-062414 **Date / Time Sampled:** 06/24/14 14:40 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140711-08 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**85.6**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-062414 **Date / Time Sampled:** 06/24/14 15:05 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140711-11 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**137**	J	mg/L	50.0	100	07/22/2014	NP	1407094
EPA 300.0	Fluoride	< 20.0	U	mg/L	10.0	100	07/22/2014	NP	1407094
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/22/2014	NP	1407094
EPA 300.0	**Sulfate as SO4**	**824**		mg/L	5.0	100	07/22/2014	NP	1407094
EPA 310.1	**Total Alkalinity**	**927**	J	mg CaCO3 / L	250	50	07/14/2014	KJB	1407052

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-062414 **Date / Time Sampled:** 06/24/14 15:05 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140711-12 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**38.8**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-062414 **Date / Time Sampled:** 06/24/14 15:20 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140711-15 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**186**	J	mg/L	50.0	100	07/22/2014	NP	1407094
EPA 300.0	Fluoride	< 20.0	U	mg/L	10.0	100	07/22/2014	NP	1407094
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/22/2014	NP	1407094
EPA 300.0	**Sulfate as SO4**	**838**		mg/L	5.0	100	07/22/2014	NP	1407094
EPA 310.1	**Total Alkalinity**	**1140**	J	mg CaCO3 / L	250	50	07/14/2014	KJB	1407052

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-062414 **Date / Time Sampled:** 06/24/14 15:20 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140711-16 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**80.8**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-062414 **Date / Time Sampled:** 06/24/14 15:35 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140711-19 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**80.8**	J	mg/L	50.0	100	07/22/2014	NP	1407094
EPA 300.0	Fluoride	< 20.0	U	mg/L	10.0	100	07/22/2014	NP	1407094
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/22/2014	NP	1407094
EPA 300.0	**Sulfate as SO4**	**862**		mg/L	5.0	100	07/22/2014	NP	1407094
EPA 310.1	**Total Alkalinity**	**569**	J	mg CaCO3 / L	250	50	07/14/2014	KJB	1407052

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-062414 **Date / Time Sampled:** 06/24/14 15:35 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140711-20 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**12.1**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-CHIT-062414 **Date / Time Sampled:** 06/24/14 14:05 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140711-23 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**83.7**	J	mg/L	50.0	100	07/22/2014	NP	1407094
EPA 300.0	**Fluoride**	**44.2**		mg/L	10.0	100	07/22/2014	NP	1407094
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/22/2014	NP	1407094
EPA 300.0	**Sulfate as SO4**	**932**		mg/L	5.0	100	07/22/2014	NP	1407094
EPA 310.1	**Total Alkalinity**	**1330**	J	mg CaCO3 / L	250	50	07/14/2014	KJB	1407052

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-INFL-062414 **Date / Time Sampled:** 06/24/14 13:25 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140711-26 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**7.1**	J	mg/L	5.0	10	07/22/2014	NP	1407094
EPA 300.0	**Fluoride**	**2.8**		mg/L	1.0	10	07/22/2014	NP	1407094
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/22/2014	NP	1407094
EPA 300.0	**Sulfate as SO4**	**1280**		mg/L	0.5	10	07/22/2014	NP	1407094
EPA 310.1	Total Alkalinity	< 500	J	mg CaCO3 / L	250	50	07/14/2014	KJB	1407052

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-NAOH-062414 **Date / Time Sampled:** 06/24/14 14:20 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140711-29 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**6.9**	J	mg/L	5.0	10	07/22/2014	NP	1407094
EPA 300.0	**Fluoride**	**2.5**		mg/L	1.0	10	07/22/2014	NP	1407094
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/22/2014	NP	1407094
EPA 300.0	**Sulfate as SO4**	**1050**		mg/L	0.5	10	07/22/2014	NP	1407094
EPA 310.1	Total Alkalinity	< 500	J	mg CaCO3 / L	250	50	07/14/2014	KJB	1407052

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTE-062414 **Date / Time Sampled:** 06/24/14 15:50 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140711-32 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**312**		mg/L	50.0	100	07/22/2014	NP	1407094
EPA 300.0	**Fluoride**	**57.6**		mg/L	10.0	100	07/22/2014	NP	1407094
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/22/2014	NP	1407094
EPA 300.0	**Sulfate as SO4**	**888**		mg/L	5.0	100	07/22/2014	NP	1407094
EPA 310.1	**Total Alkalinity**	**1480**	J	mg CaCO3 / L	250	50	07/14/2014	KJB	1407052

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTE-062414 **Date / Time Sampled:** 06/24/14 15:50 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140711-33 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**51.3**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTI-062414 **Date / Time Sampled:** 06/24/14 16:10 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140711-36 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**90.4**	J	mg/L	50.0	100	07/22/2014	NP	1407094
EPA 300.0	Fluoride	< 20.0	U	mg/L	10.0	100	07/22/2014	NP	1407094
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/22/2014	NP	1407094
EPA 300.0	**Sulfate as SO4**	**831**		mg/L	5.0	100	07/22/2014	NP	1407094
EPA 310.1	**Total Alkalinity**	**949**	J	mg CaCO3 / L	250	50	07/14/2014	KJB	1407052

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTI-062414 **Date / Time Sampled:** 06/24/14 16:10 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140711-37 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**51.2**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-SAPS-062414 **Date / Time Sampled:** 06/24/14 13:50 **Workorder:** C140711
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140711-40 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**11.6**	J	mg/L	5.0	10	07/22/2014	NP	1407094
EPA 300.0	**Fluoride**	**1.0**	J	mg/L	1.0	10	07/22/2014	NP	1407094
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/22/2014	NP	1407094
EPA 300.0	**Sulfate as SO4**	**1130**		mg/L	0.5	10	07/22/2014	NP	1407094
EPA 310.1	Total Alkalinity	< 500	J	mg CaCO3 / L	250	50	07/14/2014	KJB	1407052

"J" Qualifier indicates an estimated value

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ICPMS-PE DRC-II									
Batch 1409052 - No Lab Prep Reqd			***Water***						**ICPMS-PE DRC-II**
Method Blank (1409052-BLK1)		Dilution Factor: 1				Prepared: 09/11/14 Analyzed: 09/12/14			
Nickel	< 0.500	1.00	ug/L						
Copper	< 0.500	1.00	"						
Arsenic	< 0.500	2.00	"						
Cadmium	< 0.100	0.200	"						
Lead	< 0.100	0.200	"						
Method Blank Spike (1409052-BS1)		Dilution Factor: 1				Prepared: 09/11/14 Analyzed: 09/12/14			
Nickel	93.2	1.00	ug/L	100		93	85-115		
Copper	94.8	1.00	"	100		95	85-115		
Arsenic	86.8	2.00	"	100		87	85-115		
Cadmium	97.3	0.200	"	100		97	85-115		
Lead	96.0	0.200	"	100		96	85-115		
Duplicate (1409052-DUP1)		Dilution Factor: 1	**Source: C140711-09**			Prepared: 09/11/14 Analyzed: 09/12/14			
Nickel	119	10.0	ug/L		12.0			163	20
Copper	35.2	10.0	"		35.2			0.003	20
Arsenic	12.1	20.0	"		12.4			3	20
Cadmium	1.05	2.00	"		1.10			5	20
Lead	2.95	2.00	"		2.95			0.05	20
Matrix Spike (1409052-MS1)		Dilution Factor: 1	**Source: C140711-09**			Prepared: 09/11/14 Analyzed: 09/12/14			
Nickel	81.8	10.0	ug/L	100	12.0	70	70-130		
Copper	103	10.0	"	100	35.2	67	70-130		
Arsenic	91.6	20.0	"	100	12.4	79	70-130		
Cadmium	95.3	2.00	"	100	1.10	94	70-130		
Lead	96.7	2.00	"	100	2.95	94	70-130		
Matrix Spike (1409052-MS2)		Dilution Factor: 1	**Source: C140711-13**			Prepared: 09/11/14 Analyzed: 09/12/14			
Nickel	84.8	10.0	ug/L	100	51.8	33	70-130		
Copper	93.3	10.0	"	100	12.9	80	70-130		
Arsenic	125	20.0	"	100	46.4	79	70-130		
Cadmium	92.1	2.00	"	100	< 1.00	92	70-130		
Lead	94.5	2.00	"	100	< 1.00	95	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409056 - 1409052			*Water*						**ICPMS-PE DRC-II**
Serial Dilution (1409056-SRD1)		Dilution Factor: 5	**Source: C140711-09**			Prepared: 09/11/14	Analyzed: 09/12/14		
Nickel	138	50.0	ug/L		12.0			168	10
Copper	34.4	50.0	"		35.2			2	10
Arsenic	< 25.0	100	"		12.4				10
Cadmium	< 5.00	10.0	"		1.10				10
Lead	< 5.00	10.0	"		2.95				10

ICPOE - PE Optima

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409051 - No Lab Prep Reqd			*Water*						**ICPOE - PE Optima**
Method Blank (1409051-BLK1)		Dilution Factor: 1				Prepared: 09/11/14	Analyzed: 09/12/14		
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						
Method Blank Spike (1409051-BS1)		Dilution Factor: 1				Prepared: 09/11/14	Analyzed: 09/12/14		
Aluminum	10360	50.0	ug/L	10100		103	85-115		
Iron	10190	250	"	10100		101	85-115		
Manganese	99.96	5.00	"	100		100	85-115		
Zinc	98.86	20.0	"	100		99	85-115		
Duplicate (1409051-DUP1)		Dilution Factor: 1	**Source: C140711-09**			Prepared: 09/11/14	Analyzed: 09/12/14		
Aluminum	126.7	50.0	ug/L		129.3			2	20
Iron	1509	250	"		1467			3	20
Manganese	3917	5.00	"		4010			2	20
Zinc	261.6	20.0	"		268.0			2	20
Matrix Spike (1409051-MS1)		Dilution Factor: 1	**Source: C140711-09**			Prepared: 09/11/14	Analyzed: 09/12/14		
Aluminum	10640	50.0	ug/L	10100	129.3	104	70-130		
Iron	11640	250	"	10100	1467	101	70-130		
Manganese	3961	5.00	"	100	4010	NR	70-130		
Zinc	353.7	20.0	"	100	268.0	86	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409051 - No Lab Prep Reqd			*Water*						ICPOE - PE Optima
Matrix Spike (1409051-MS2)		Dilution Factor: 1	**Source: C140711-13**			Prepared: 09/11/14	Analyzed: 09/12/14		
Aluminum	10620	50.0	ug/L	10100	126.9	104	70-130		
Iron	12050	250	"	10100	2058	99	70-130		
Manganese	4396	5.00	"	100	4384	12	70-130		
Zinc	160.2	20.0	"	100	63.60	97	70-130		
Batch 1409054 - 1409051			*Water*						ICPOE - PE Optima
Serial Dilution (1409054-SRD1)		Dilution Factor: 5	**Source: C140711-09**			Prepared: 09/11/14	Analyzed: 09/12/14		
Aluminum	132.5	250	ug/L		129.3			2	10
Iron	1596	1250	"		1467			8	10
Manganese	3962	25.0	"		4010			1	10
Zinc	282.2	100	"		268.0			5	10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ICPMS-PE DRC-II									
Batch 1409017 - 200.2 - TR Metals			***Water***						**ICPMS-PE DRC-II**
Method Blank (1409017-BLK2)		Dilution Factor: 5				Prepared: 09/04/14 Analyzed: 09/15/14			
Nickel	< 2.50	5.00	ug/L						
Copper	< 2.50	5.00	"						
Arsenic	< 2.50	10.0	"						
Cadmium	< 0.500	1.00	"						
Lead	< 0.500	1.00	"						
Duplicate (1409017-DUP2)		Dilution Factor: 1	**Source: C140711-02**			Prepared: 09/04/14 Analyzed: 09/15/14			
Nickel	< 5.00	10.0	ug/L		< 5.00				20
Copper	18.15	10.0	"		17.12			6	20
Arsenic	19.74	20.0	"		20.54			4	20
Cadmium	1.016	2.00	"		1.369			30	20
Lead	< 1.00	2.00	"		1.233				20
Matrix Spike (1409017-MS2)		Dilution Factor: 1	**Source: C140711-06**			Prepared: 09/04/14 Analyzed: 09/15/14			
Nickel	184.8	10.0	ug/L	250	< 5.00	74	70-130		
Copper	143.5	10.0	"	150	22.01	81	70-130		
Arsenic	365.6	20.0	"	400	21.06	86	70-130		
Cadmium	101.4	2.00	"	100	1.764	100	70-130		
Lead	461.0	2.00	"	500	1.606	92	70-130		
Matrix Spike (1409017-MS4)		Dilution Factor: 1	**Source: C140711-10**			Prepared: 09/04/14 Analyzed: 09/15/14			
Nickel	171.7	10.0	ug/L	250	5.541	66	70-130		
Copper	183.1	10.0	"	150	80.00	69	70-130		
Arsenic	291.8	20.0	"	400	17.06	69	70-130		
Cadmium	82.67	2.00	"	100	3.010	80	70-130		
Lead	389.5	2.00	"	500	10.74	76	70-130		
Reference (1409017-SRM2)		Dilution Factor: 2				Prepared: 09/04/14 Analyzed: 09/15/14			
Nickel	486.9	20.0	ug/L	500		97	85-115		
Copper	513.7	20.0	"	500		103	85-115		
Arsenic	999.4	40.0	"	1000		100	85-115		
Cadmium	531.8	4.00	"	500		106	85-115		
Lead	1028	4.00	"	1000		103	85-115		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409061 - 1409017			*Water*						ICPMS-PE DRC-II
Serial Dilution (1409061-SRD1)		Dilution Factor: 5	**Source: C140711-02**			Prepared: 09/04/14	Analyzed: 09/15/14		
Nickel	< 25.0	50.0	ug/L		< 5.00				10
Copper	< 25.0	50.0	"		17.12				10
Arsenic	< 25.0	100	"		20.54				10
Cadmium	< 5.00	10.0	"		1.369				10
Lead	< 5.00	10.0	"		1.233				10

ICPOE - PE Optima

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409017 - 200.2 - TR Metals			*Water*						ICPOE - PE Optima
Method Blank (1409017-BLK1)		Dilution Factor: 1				Prepared: 09/04/14	Analyzed: 09/15/14		
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						
Duplicate (1409017-DUP1)		Dilution Factor: 5	**Source: C140711-02**			Prepared: 09/04/14	Analyzed: 09/15/14		
Aluminum	346.6	250	ug/L		150.9			79	20
Iron	< 500	1250	"		< 500				20
Manganese	2064	25.0	"		2097			2	20
Zinc	229.1	100	"		249.9			9	20
Matrix Spike (1409017-MS1)		Dilution Factor: 1	**Source: C140711-06**			Prepared: 09/04/14	Analyzed: 09/15/14		
Aluminum	1088	50.0	ug/L	1000	47.36	104	70-130		
Iron	2120	250	"	1500	531.3	106	70-130		
Manganese	3016	5.00	"	100	2871	145	70-130		
Zinc	336.4	20.0	"	100	236.1	100	70-130		
Matrix Spike (1409017-MS3)		Dilution Factor: 1	**Source: C140711-10**			Prepared: 09/04/14	Analyzed: 09/15/14		
Aluminum	1139	50.0	ug/L	1000	304.4	83	70-130		
Iron	3743	250	"	1500	2527	81	70-130		
Manganese	4328	5.00	"	100	4320	9	70-130		
Zinc	746.2	20.0	"	100	669.6	77	70-130		

Project Name: **Barker-Hughesville_Treatability 2_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409017 - 200.2 - TR Metals			***Water***						**ICPOE - PE Optima**
Reference (1409017-SRM1)		Dilution Factor: 1				Prepared: 09/04/14 Analyzed: 09/15/14			
Aluminum	507.0	50.0	ug/L	500		101	85-115		
Iron	493.5	250	"	500		99	85-115		
Manganese	541.6	5.00	"	500		108	85-115		
Zinc	528.5	20.0	"	500		106	85-115		
Batch 1409060 - 1409017			***Water***						**ICPOE - PE Optima**
Serial Dilution (1409060-SRD1)		Dilution Factor: 2	**Source: C140711-02**			Prepared: 09/04/14 Analyzed: 09/15/14			
Aluminum	< 500	1250	ug/L		150.9				10
Iron	< 2500	6250	"		< 500.00				10
Manganese	2108	125	"		2097			0.5	10
Zinc	< 250	500	"		249.9				10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ESAT Dionex IC									
Batch 1407094 - No Prep Req			***Water***						**ESAT Dionex IC**
Method Blank (1407094-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 07/22/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						
Method Blank Spike (1407094-BS1)		Dilution Factor: 1				Prepared & Analyzed: 07/22/14			
Fluoride	5.4	0.2	mg/L	5.00		107	90-110		
Chloride	25.4	2.0	"	25.0		102	90-110		
Sulfate as SO4	24.5	0.1	"	25.0		98	90-110		
Nitrate/Nitrite as N	21.4	5.0	"	20.0		107	90-110		
Duplicate (1407094-DUP1)		Dilution Factor: 1	**Source: C140711-03**			Prepared & Analyzed: 07/22/14			
Fluoride	60.5	20.0	mg/L		67.1			10	20
Chloride	82.9	200	"		83.2			0.4	20
Sulfate as SO4	846	10.0	"		840			0.8	20
Nitrate/Nitrite as N	< 100	500	"		< 100				20
Matrix Spike (1407094-MS1)		Dilution Factor: 1	**Source: C140711-03**			Prepared & Analyzed: 07/22/14			
Fluoride	578	20.0	mg/L	500	67.1	102	80-120		
Chloride	2560	200	"	2500	83.2	99	80-120		
Sulfate as SO4	3370	10.0	"	2500	840	101	80-120		
Nitrate/Nitrite as N	2130	500	"	2000	< 100	107	80-120		
Matrix Spike (1407094-MS2)		Dilution Factor: 1	**Source: C140711-40**			Prepared & Analyzed: 07/22/14			
Fluoride	51.4	2.0	mg/L	50.0	1.0	101	80-120		
Chloride	251	20.0	"	250	11.6	96	80-120		
Sulfate as SO4	1350	1.0	"	250	1130	88	80-120		
Nitrate/Nitrite as N	206	50.0	"	200	< 10.0	103	80-120		

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1407122 - 1407094			***Water***						**ESAT Dionex IC**
Instrument Blank (1407122-IBL1)		Dilution Factor: 1				Prepared & Analyzed: 07/22/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						

Lachat 8500

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1407080 - No Prep Req			***Water***						**Lachat 8500**
Method Blank (1407080-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 07/18/14			
Ammonia as N	< 0.0300	0.0500	mg/L						
Method Blank Spike (1407080-BS1)		Dilution Factor: 1				Prepared & Analyzed: 07/18/14			
Ammonia as N	0.980	0.0500	mg/L	1.00		98	90-110		
Duplicate (1407080-DUP1)		Dilution Factor: 1	**Source: C140708-04**			Prepared & Analyzed: 07/18/14			
Ammonia as N	58.1	5.00	mg/L		58.2			0.3	20
Duplicate (1407080-DUP2)		Dilution Factor: 1	**Source: C140711-20**			Prepared & Analyzed: 07/18/14			
Ammonia as N	12.0	5.00	mg/L		12.1			0.8	20
Matrix Spike (1407080-MS1)		Dilution Factor: 1	**Source: C140708-04**			Prepared & Analyzed: 07/18/14			
Ammonia as N	154	5.00	mg/L	100	58.2	96	90-110		
Matrix Spike (1407080-MS2)		Dilution Factor: 1	**Source: C140711-20**			Prepared & Analyzed: 07/18/14			
Ammonia as N	107	5.00	mg/L	100	12.1	95	90-110		
Reference (1407080-SRM1)		Dilution Factor: 5				Prepared & Analyzed: 07/18/14			
Ammonia as N	4.91	0.250	mg/L	4.80		102	90-110		

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Mettler AT									
Batch 1407052 - No Prep Req			***Water***						**Mettler AT**
Method Blank (1407052-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 07/14/14			
Total Alkalinity	< 5.00	10.0	mg CaCO3 / L						
Duplicate (1407052-DUP1)		Dilution Factor: 5	**Source: C140711-03**			Prepared & Analyzed: 07/14/14			
Total Alkalinity	1560	500	mg CaCO3 / L		1570			0.7	20
Duplicate (1407052-DUP2)		Dilution Factor: 5	**Source: C140711-26**			Prepared & Analyzed: 07/14/14			
Total Alkalinity	< 250	500	mg CaCO3 / L		< 250				20
Reference (1407052-SRM1)		Dilution Factor: 1				Prepared & Analyzed: 07/14/14			
Total Alkalinity	72.2	10.0	mg CaCO3 / L	73.4		98	85-115		

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Project Name: **Barker-Hughesville_Treatability 2_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 310.1

Analysis Name: WC - Alkalinity

Instrument: **Mettler AT**

Work Order: Nu C140711

Analytical Sequence: **Total**

Concentration Units: mg CaCO3 / L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Total Alkalinity		**1**	**2**	**3**	**4**	1407052-BLK1	NA	10.00
		0.96	1.23			1.10	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 350.1

Analysis Name: WC - Ammonia

Instrument: **Lachat 8500**

Work Order: Nu C140711

Analytical Sequence: **Total**

Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
		1	2	3	4	1407080-BLK1	NA	
Ammonia as N		0.00	0.00	0.00		0.02	NA	0.05
		5	6	7	8			

Project Name: **Barker-Hughesville_Treatability 2_JUL 2014_A046** **Certificate of Analysis**

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TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 300.0

Analysis Name: WC - Anions by Ion Chromatography

Instrument: **ESAT Dionex IC**

Work Order: Nu C140711

Analytical Sequence: 1407122 **Dissolved**

Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	1407094-BLK1	NA	
Fluoride	0.00	0.00	0.00			0.00	NA	0.20
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1407094-BLK1	NA	
Chloride	0.00	0.00	0.00			0.00	NA	2.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1407094-BLK1	NA	
Sulfate as SO4	0.00	0.00	0.00			0.00	NA	0.10
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1407094-BLK1	NA	
Nitrate/Nitrite as N	0.00	0.00	0.00			0.00	NA	5.00
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7

Analysis Name: ICPOE Diss. Metals

Instrument: **ICPOE - PE Optima**

Work Order: Nu C140711

Analytical Sequence: 1409054 **Dissolved**

Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Aluminum	-0.68	**1**	**2**	**3**	**4**	1409051-BLK1	NA	50.00
		-0.80	-0.20			-3.50	NA	
		5	**6**	**7**	**8**			
Iron	24.36	**1**	**2**	**3**	**4**	1409051-BLK1	NA	250.00
		31.08	50.36			47.74	NA	
		5	**6**	**7**	**8**			
Manganese	0.12	**1**	**2**	**3**	**4**	1409051-BLK1	NA	5.00
		0.04	0.21			-0.22	NA	
		5	**6**	**7**	**8**			
Zinc	0.21	**1**	**2**	**3**	**4**	1409051-BLK1	NA	20.00
		-0.02	-0.07			-1.29	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8 Analysis Name: ICPMS Diss. Metals

Instrument: **ICPMS-PE DRC-II** Work Order: Nu C140711

Analytical Sequence: 1409056 **Dissolved** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**								**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**			
Nickel	0.01	0.00	0.39							1409052-BLK1 0.05	NA NA	1.00
Copper	0.02	0.02	-0.04							1409052-BLK1 -0.05	NA NA	1.00
Arsenic	-0.02	-0.03	0.08							1409052-BLK1 0.01	NA NA	2.00
Cadmium	0.01	0.01	0.01							1409052-BLK1 0.00	NA NA	0.20
Lead	0.01	0.00	0.00							1409052-BLK1 -0.03	NA NA	0.20

Project Name: **Barker-Hughesville_Treatability 2_JUL 2014_A046** **Certificate of Analysis**

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TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Instrument: **ICPOE - PE Optima** Work Order: Nu C140711

Analytical Sequence: 1409060 **Total Recoverable** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Aluminum	-1.24	**1**	**2**	**3**	**4**	1409017-BLK1	NA	50.00
		0.08	-0.04			0.57	NA	
		5	**6**	**7**	**8**			
Iron	-5.12	**1**	**2**	**3**	**4**	1409017-BLK1	NA	250.00
		0.31	9.10			43.90	NA	
		5	**6**	**7**	**8**			
Manganese	0.13	**1**	**2**	**3**	**4**	1409017-BLK1	NA	5.00
		0.10	0.20			-0.18	NA	
		5	**6**	**7**	**8**			
Zinc	-2.62	**1**	**2**	**3**	**4**	1409017-BLK1	NA	20.00
		-1.41	0.26			-1.95	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Instrument: **ICPMS-PE DRC-II** Work Order: Nu C140711

Analytical Sequence: 1409061 **Total Recoverable** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Nickel	0.01	**1**	**2**	**3**	**4**	NA	1409017-BLK2	1.00
		0.02	0.00			NA	-0.01	
		5	**6**	**7**	**8**			
Copper	0.00	**1**	**2**	**3**	**4**	NA	1409017-BLK2	1.00
		0.04	0.03			NA	0.01	
		5	**6**	**7**	**8**			
Arsenic	-0.01	**1**	**2**	**3**	**4**	NA	1409017-BLK2	2.00
		-0.01	0.16			NA	-0.15	
		5	**6**	**7**	**8**			
Cadmium	0.00	**1**	**2**	**3**	**4**	NA	1409017-BLK2	0.20
		0.01	0.01			NA	0.00	
		5	**6**	**7**	**8**			
Lead	0.01	**1**	**2**	**3**	**4**	NA	1409017-BLK2	0.20
		-0.01	0.01			NA	0.01	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Mettler AT Method: EPA 310.1 Analysis Name: WC - Alkalinity

Sequence: 1407054 Work Order: C140711 Units: mg CaCO3 / L

Total Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Total Alkalinity					1			2			3	
				100	101	101.0	100	100	100.0			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Lachat 8500 Method: EPA 350.1 Analysis Name: WC - Ammonia

Sequence: 1407091 Work Order: C140711 Units: mg/L

Total Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Ammonia as N					1			2			3	
				1.00	0.979	97.9	1.00	0.980	98.0	1.00	0.982	98.2
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability 2_JUL 2014_A046** **Certificate of Analysis**

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TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ESAT Dionex IC Method: EPA 300.0 Analysis Name: WC - Anions by Ion Chromatography 2013

Sequence: 1407122 Work Order: C140711 Units: mg/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Chloride	40.0	42.5	106.3		1			2			3	
				40.0	42.7	106.8	40.0	42.3	105.8			
					4			5			6	
					7			8			9	
Fluoride	4.00	4.3	107.5		1			2			3	
				4.00	4.2	105.0	4.00	4.2	105.0			
					4			5			6	
					7			8			9	
Nitrate/Nitrite as N	20.0	21.1	105.5		1			2			3	
				20.0	21.2	106.0	20.0	21.0	105.0			
					4			5			6	
					7			8			9	
Sulfate as SO4	100	107	107.0		1			2			3	
				100	106	106.0	100	106	106.0			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Diss. Metals

Sequence: 1409054 Work Order: C140711 Units: ug/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Aluminum	12500	12910	103.3	1			2			3		
				12500	12570	100.6	12500	12560	100.5			
				4			5			6		
				7			8			9		
Iron	12500	12870	103.0	1			2			3		
				12500	12590	100.7	12500	12530	100.2			
				4			5			6		
				7			8			9		
Manganese	1000	1026	102.6	1			2			3		
				1000	1037	103.7	1000	1030	103.0			
				4			5			6		
				7			8			9		
Zinc	2500	2596	103.8	1			2			3		
				2500	2600	104.0	2500	2570	102.8			
				4			5			6		
				7			8			9		

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Diss. Metals

Sequence: 1409056 Work Order: C140711 Units: ug/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Arsenic	50.0	51.0	102.0		1			2			3	
				50.0	48.8	97.6	50.0	48.7	97.4			
					4			5			6	
					7			8			9	
Cadmium	50.0	49.2	98.4		1			2			3	
				50.0	49.8	99.6	50.0	49.7	99.4			
					4			5			6	
					7			8			9	
Copper	50.0	51.7	103.4		1			2			3	
				50.0	51.1	102.2	50.0	48.5	97.0			
					4			5			6	
					7			8			9	
Lead	50.0	49.4	98.8		1			2			3	
				50.0	49.8	99.6	50.0	50.1	100.2			
					4			5			6	
					7			8			9	
Nickel	50.0	48.7	97.4		1			2			3	
				50.0	48.7	97.4	50.0	46.8	93.6			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

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Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Sequence: 1409060 Work Order: C140711 Units: ug/L

Total Recoverable Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
Aluminum	12500	12660	101.3	**1**			**2**			**3**		
				12500	12540	100.3	12500	12650	101.2			
				4			**5**			**6**		
				7			**8**			**9**		
Iron	12500	12620	101.0	**1**			**2**			**3**		
				12500	12600	100.8	12500	12740	101.9			
				4			**5**			**6**		
				7			**8**			**9**		
Manganese	1000	1028	102.8	**1**			**2**			**3**		
				1000	1033	103.3	1000	1032	103.2			
				4			**5**			**6**		
				7			**8**			**9**		
Zinc	2500	2558	102.3	**1**			**2**			**3**		
				2500	2552	102.1	2500	2559	102.4			
				4			**5**			**6**		
				7			**8**			**9**		

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability 2_JUL 2014_A046** **Certificate of Analysis**

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Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1409061 Work Order: C140711 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Arsenic	50.0	50.54	101.1	50.0	49.42	98.8	50.0	47.93	95.9			
					4			5			6	
					7			8			9	
					1			2			3	
Cadmium	50.0	50.97	101.9	50.0	49.49	99.0	50.0	49.74	99.5			
					4			5			6	
					7			8			9	
					1			2			3	
Copper	50.0	51.24	102.5	50.0	50.32	100.6	50.0	47.54	95.1			
					4			5			6	
					7			8			9	
					1			2			3	
Lead	50.0	50.85	101.7	50.0	50.59	101.2	50.0	48.62	97.2			
					4			5			6	
					7			8			9	
					1			2			3	
Nickel	50.0	48.29	96.6	50.0	46.34	92.7	50.0	46.25	92.5			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8
ICP Interference Check Sample
ICPMS-PE DRC-II

Sequence: 1409056 Analysis: ICPMS Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.0	ug/L			2.00
	IFB1	19.5	ug/L	20	98	2.00
Cadmium	IFA1	0.1	ug/L			0.200
	IFB1	20.3	ug/L	20	102	0.200
Copper	IFA1	0.6	ug/L			1.00
	IFB1	17.6	ug/L	20	88	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	-0.2	ug/L			1.00
	IFB1	17.3	ug/L	20	87	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1409061 Analysis: ICPMS Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.0	ug/L			2.00
	IFB1	19.1	ug/L	20	95	2.00
Cadmium	IFA1	0.1	ug/L			0.200
	IFB1	19.8	ug/L	20	99	0.200
Copper	IFA1	0.7	ug/L			1.00
	IFB1	18.7	ug/L	20	94	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	-0.1	ug/L			1.00
	IFB1	17.5	ug/L	20	88	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8

ICP Interference Check Sample

ICPOE - PE Optima

Sequence: 1409054 Analysis: ICPOE Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	60,863.9	ug/L	60,000	101	50.0
	IFB1	59,253.1	ug/L	60,000	99	50.0
Iron	IFA1	235,293.0	ug/L	250,000	94	250
	IFB1	227,940.5	ug/L	250,000	91	250
Manganese	IFA1	-0.3	ug/L			5.00
	IFB1	196.8	ug/L	200	98	5.00
Zinc	IFA1	7.4	ug/L			20.0
	IFB1	295.0	ug/L	300	98	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1409060 Analysis: ICPOE Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	60,231.5	ug/L	60,000	100	50.0
	IFB1	60,976.9	ug/L	60,000	102	50.0
Iron	IFA1	234,077.4	ug/L	250,000	94	250
	IFB1	235,125.1	ug/L	250,000	94	250
Manganese	IFA1	-0.4	ug/L			5.00
	IFB1	197.0	ug/L	200	98	5.00
Zinc	IFA1	5.7	ug/L			20.0
	IFB1	285.0	ug/L	300	95	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPMS-PE DRC-II

Metals (Dissolved) by EPA 200/7000 Series Methods
Sequence: 1409056

Analyte	True	Found	%R	Units
Arsenic	2.00	1.97	99	ug/L
Cadmium	0.200	0.216	108	ug/L
Copper	1.00	1.01	101	ug/L
Lead	0.200	0.197	99	ug/L
Nickel	1.00	0.960	96	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPOE - PE Optima

Metals (Dissolved) by EPA 200/7000 Series Methods
Sequence: 1409054

Analyte	True	Found	%R	Units
Aluminum	100	96.30	96	ug/L
Iron	100	108.2	108	ug/L
Manganese	10.0	10.12	101	ug/L
Zinc	50.0	53.34	107	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

Lachat 8500

Classical Chemistry by EPA/ASTM/APHA Methods

Sequence: 1407091

Analyte	True	Found	%R	Units
Ammonia as N	0.0250	0.0197	79	mg/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPMS-PE DRC-II

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1409061

Analyte	True	Found	%R	Units
Arsenic	2.00	1.961	98	ug/L
Cadmium	0.200	0.1964	98	ug/L
Copper	1.00	1.066	107	ug/L
Lead	0.200	0.2166	108	ug/L
Nickel	1.00	1.004	100	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPOE - PE Optima

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1409060

Analyte	True	Found	%R	Units
Aluminum	100	94.95	95	ug/L
Iron	100	70.86	71	ug/L
Manganese	10.0	10.16	102	ug/L
Zinc	50.0	50.88	102	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 310.1 **Total** **Sequence ID#:** 1407054

Instrument ID #: Mettler AT Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1407052-SRM1	Reference	07/14/14	10:16
1407052-BLK1	Blank	07/14/14	10:16
C140711-03	14BH-DT-PILOT-BCR1-06241	07/14/14	10:16
1407052-DUP1	Duplicate	07/14/14	10:16
C140711-07	14BH-DT-PILOT-BCR1D-0624	07/14/14	10:16
C140711-11	14BH-DT-PILOT-BCR2-06241	07/14/14	10:16
C140711-15	14BH-DT-PILOT-BCR3-06241	07/14/14	10:16
C140711-19	14BH-DT-PILOT-BCR4-06241	07/14/14	10:16
C140711-23	14BH-DT-PILOT-CHIT-062414	07/14/14	10:16
1407054-CCV1	Calibration Check	07/14/14	10:16
1407054-CCB1	Calibration Blank	07/14/14	10:16
C140711-26	14BH-DT-PILOT-INFL-062414	07/14/14	10:16
1407052-DUP2	Duplicate	07/14/14	10:16
C140711-29	14BH-DT-PILOT-NAOH-0624	07/14/14	10:16
C140711-32	14BH-DT-PILOT-POSTE-0624	07/14/14	10:16
C140711-36	14BH-DT-PILOT-POSTI-06241	07/14/14	10:16
C140711-40	14BH-DT-PILOT-SAPS-06241	07/14/14	10:16
1407054-CCV2	Calibration Check	07/14/14	10:16
1407054-CCB2	Calibration Blank	07/14/14	10:16

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 350.1 **Total** **Sequence ID#:** 1407091

Instrument ID #: Lachat 8500 Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1407080-BLK1	Blank	07/18/14	13:02
1407080-BS1	Blank Spike	07/18/14	13:02
1407091-CRL1	Instrument RL Check	07/18/14	13:02
1407080-DUP1	Duplicate	07/18/14	13:02
1407080-MS1	Matrix Spike	07/18/14	13:02
1407091-CCV1	Calibration Check	07/18/14	13:02
1407091-CCB1	Calibration Blank	07/18/14	13:02
C140711-04	14BH-DT-PILOT-BCR1-06241	07/18/14	13:02
C140711-08	14BH-DT-PILOT-BCR1D-0624	07/18/14	13:02
C140711-12	14BH-DT-PILOT-BCR2-06241	07/18/14	13:02
C140711-16	14BH-DT-PILOT-BCR3-06241	07/18/14	13:02
C140711-20	14BH-DT-PILOT-BCR4-06241	07/18/14	13:02
1407080-DUP2	Duplicate	07/18/14	13:02
1407091-CCV2	Calibration Check	07/18/14	13:02
1407091-CCB2	Calibration Blank	07/18/14	13:02
1407080-MS2	Matrix Spike	07/18/14	13:02
C140711-33	14BH-DT-PILOT-POSTE-0624	07/18/14	13:02
C140711-37	14BH-DT-PILOT-POSTI-06241	07/18/14	13:02
1407080-SRM1	Reference	07/18/14	13:02
1407091-CCV3	Calibration Check	07/18/14	13:02
1407091-CCB3	Calibration Blank	07/18/14	13:02

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 300.0 **Dissolved** **Sequence ID#:** 1407122

Instrument ID #: ESAT Dionex IC Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1407122-ICV1	Initial Cal Check	07/22/14	03:47
1407122-ICB1	Initial Cal Blank	07/22/14	04:06
1407122-IBL1	Instrument Blank	07/22/14	04:43
1407094-BS1	Blank Spike	07/22/14	05:01
1407094-BLK1	Blank	07/22/14	05:20
C140711-03	14BH-DT-PILOT-BCR1-06241	07/22/14	05:38
1407094-DUP1	Duplicate	07/22/14	05:57
1407094-MS1	Matrix Spike	07/22/14	06:16
C140711-07	14BH-DT-PILOT-BCR1D-0624	07/22/14	06:34
C140711-11	14BH-DT-PILOT-BCR2-06241	07/22/14	06:53
C140711-15	14BH-DT-PILOT-BCR3-06241	07/22/14	07:11
1407122-CCV1	Calibration Check	07/22/14	07:30
1407122-CCB1	Calibration Blank	07/22/14	07:49
C140711-19	14BH-DT-PILOT-BCR4-06241	07/22/14	08:07
C140711-23	14BH-DT-PILOT-CHIT-062414	07/22/14	08:26
C140711-26	14BH-DT-PILOT-INFL-062414	07/22/14	08:44
C140711-29	14BH-DT-PILOT-NAOH-0624	07/22/14	09:03
C140711-32	14BH-DT-PILOT-POSTE-0624	07/22/14	09:21
C140711-36	14BH-DT-PILOT-POSTI-06241	07/22/14	09:40
C140711-40	14BH-DT-PILOT-SAPS-06241	07/22/14	09:59
1407094-MS2	Matrix Spike	07/22/14	10:17
1407122-SCV1	Secondary Cal Check	07/22/14	10:54
1407122-CCV2	Calibration Check	07/22/14	11:17
1407122-CCB2	Calibration Blank	07/22/14	11:36

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Dissolved** **Sequence ID#:** 1409054

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409054-ICV1	Initial Cal Check	09/12/14	08:37
1409054-SCV1	Secondary Cal Check	09/12/14	08:40
1409054-ICB1	Initial Cal Blank	09/12/14	08:43
1409054-CRL1	Instrument RL Check	09/12/14	08:47
1409054-IFA1	Interference Check A	09/12/14	08:49
1409054-IFB1	Interference Check B	09/12/14	08:53
1409051-BLK1	Blank	09/12/14	08:57
1409051-BS1	Blank Spike	09/12/14	09:00
C140711-09	14BH-DT-PILOT-BCR2-06241	09/12/14	09:03
1409051-DUP1	Duplicate	09/12/14	09:08
1409054-SRD1	Serial Dilution	09/12/14	09:12
1409051-MS1	Matrix Spike	09/12/14	09:15
C140711-13	14BH-DT-PILOT-BCR3-06241	09/12/14	09:19
1409051-MS2	Matrix Spike	09/12/14	09:24
C140711-01	14BH-DT-PILOT-BCR1-06241	09/12/14	09:28
1409054-CCV1	Calibration Check	09/12/14	09:34
1409054-CCB1	Calibration Blank	09/12/14	09:37
C140711-05	14BH-DT-PILOT-BCR1D-0624	09/12/14	09:40
C140711-17	14BH-DT-PILOT-BCR4-06241	09/12/14	09:44
C140711-21	14BH-DT-PILOT-CHIT-062414	09/12/14	09:47
C140711-24	14BH-DT-PILOT-INFL-062414	09/12/14	09:51
C140711-27	14BH-DT-PILOT-NAOH-0624	09/12/14	09:54
C140711-30	14BH-DT-PILOT-POSTE-0624	09/12/14	09:58
C140711-34	14BH-DT-PILOT-POSTI-06241	09/12/14	10:02
C140711-38	14BH-DT-PILOT-SAPS-06241	09/12/14	10:06
1409054-CCV2	Calibration Check	09/12/14	10:12
1409054-CCB2	Calibration Blank	09/12/14	10:15

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Dissolved** **Sequence ID#:** 1409056

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409056-ICV1	Initial Cal Check	09/12/14	09:41
1409056-SCV1	Secondary Cal Check	09/12/14	09:44
1409056-ICB1	Initial Cal Blank	09/12/14	09:48
1409056-CRL1	Instrument RL Check	09/12/14	09:51
1409056-IFA1	Interference Check A	09/12/14	09:54
1409056-IFB1	Interference Check B	09/12/14	09:58
1409052-BLK1	Blank	09/12/14	10:01
1409052-BS1	Blank Spike	09/12/14	10:04
C140711-09	14BH-DT-PILOT-BCR2-06241	09/12/14	10:07
1409052-DUP1	Duplicate	09/12/14	10:10
1409056-SRD1	Serial Dilution	09/12/14	10:13
1409052-MS1	Matrix Spike	09/12/14	10:16
C140711-13	14BH-DT-PILOT-BCR3-06241	09/12/14	10:19
1409052-MS2	Matrix Spike	09/12/14	10:22
C140711-01	14BH-DT-PILOT-BCR1-06241	09/12/14	10:25
1409056-CCV1	Calibration Check	09/12/14	10:31
1409056-CCB1	Calibration Blank	09/12/14	10:35
C140711-05	14BH-DT-PILOT-BCR1D-0624	09/12/14	10:38
C140711-17	14BH-DT-PILOT-BCR4-06241	09/12/14	10:41
C140711-21	14BH-DT-PILOT-CHIT-06241	09/12/14	10:44
C140711-24	14BH-DT-PILOT-INFL-062414	09/12/14	10:47
C140711-27	14BH-DT-PILOT-NAOH-0624	09/12/14	10:50
C140711-30	14BH-DT-PILOT-POSTE-0624	09/12/14	10:53
C140711-34	14BH-DT-PILOT-POSTI-06241	09/12/14	10:56
C140711-38	14BH-DT-PILOT-SAPS-06241	09/12/14	10:59
1409056-CCV2	Calibration Check	09/12/14	11:22
1409056-CCB2	Calibration Blank	09/12/14	11:26

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Total Recoverable** **Sequence ID#:** 1409060

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409060-ICV1	Initial Cal Check	09/15/14	08:28
1409060-SCV1	Secondary Cal Check	09/15/14	08:31
1409060-ICB1	Initial Cal Blank	09/15/14	08:34
1409060-CRL1	Instrument RL Check	09/15/14	08:37
1409060-IFA1	Interference Check A	09/15/14	08:40
1409060-IFB1	Interference Check B	09/15/14	08:44
1409017-BLK1	Blank	09/15/14	08:48
1409017-SRM1	Reference	09/15/14	08:51
C140711-02	14BH-DT-PILOT-BCR1-06241	09/15/14	08:54
1409017-DUP1	Duplicate	09/15/14	08:57
1409060-SRD1	Serial Dilution	09/15/14	09:00
C140711-06	14BH-DT-PILOT-BCR1D-0624	09/15/14	09:03
1409017-MS1	Matrix Spike	09/15/14	09:08
C140711-10	14BH-DT-PILOT-BCR2-06241	09/15/14	09:12
1409017-MS3	Matrix Spike	09/15/14	09:16
1409060-CCV1	Calibration Check	09/15/14	09:23
1409060-CCB1	Calibration Blank	09/15/14	09:26
C140711-14	14BH-DT-PILOT-BCR3-06241	09/15/14	09:30
C140711-18	14BH-DT-PILOT-BCR4-06241	09/15/14	09:34
C140711-22	14BH-DT-PILOT-CHIT-062414	09/15/14	09:37
C140711-25	14BH-DT-PILOT-INFL-062414	09/15/14	09:41
C140711-28	14BH-DT-PILOT-NAOH-0624	09/15/14	09:44
C140711-31	14BH-DT-PILOT-POSTE-0624	09/15/14	09:47
C140711-35	14BH-DT-PILOT-POSTI-06241	09/15/14	09:51
C140711-39	14BH-DT-PILOT-SAPS-06241	09/15/14	09:55
1409060-CCV2	Calibration Check	09/15/14	10:02
1409060-CCB2	Calibration Blank	09/15/14	10:05

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Total Recoverable** **Sequence ID#:** 1409061

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409061-ICV1	Initial Cal Check	09/15/14	11:22
1409061-SCV1	Secondary Cal Check	09/15/14	11:26
1409061-ICB1	Initial Cal Blank	09/15/14	11:29
1409061-CRL1	Instrument RL Check	09/15/14	11:32
1409061-IFA1	Interference Check A	09/15/14	11:36
1409061-IFB1	Interference Check B	09/15/14	11:39
1409017-BLK2	Blank	09/15/14	11:42
1409017-SRM2	Reference	09/15/14	11:45
C140711-02	14BH-DT-PILOT-BCR1-06241	09/15/14	11:48
1409017-DUP2	Duplicate	09/15/14	11:51
1409061-SRD1	Serial Dilution	09/15/14	11:54
C140711-06	14BH-DT-PILOT-BCR1D-0624	09/15/14	11:57
1409017-MS2	Matrix Spike	09/15/14	12:00
C140711-10	14BH-DT-PILOT-BCR2-06241	09/15/14	12:03
1409017-MS4	Matrix Spike	09/15/14	12:06
1409061-CCV1	Calibration Check	09/15/14	12:13
1409061-CCB1	Calibration Blank	09/15/14	12:16
C140711-14	14BH-DT-PILOT-BCR3-06241	09/15/14	12:19
C140711-18	14BH-DT-PILOT-BCR4-06241	09/15/14	12:22
C140711-22	14BH-DT-PILOT-CHIT-062414	09/15/14	12:25
C140711-25	14BH-DT-PILOT-INFL-062414	09/15/14	12:28
C140711-28	14BH-DT-PILOT-NAOH-0624	09/15/14	12:31
C140711-31	14BH-DT-PILOT-POSTE-0624	09/15/14	12:34
C140711-35	14BH-DT-PILOT-POSTI-06241	09/15/14	12:37
C140711-39	14BH-DT-PILOT-SAPS-06241	09/15/14	12:41
1409061-CCV2	Calibration Check	09/15/14	12:47
1409061-CCB2	Calibration Blank	09/15/14	12:50

CHAIN OF CUSTODY RECORD

CDM Smith — **Danny T Pilot Test**

NOTES: Limited sample volumes due to treatability testing
Contact: Angela Franden, CDM Smith (406)441-1400

SAMPLE NUMBER	DATE	TIME	MATRIX	Preservative	Type & No. of Containers	Total Metals (TAL), 200.7 or 200.8	Dissolved Metals (TAL), 200.7 or 200.8	Alkalinity, Anions (sulfate, chloride, fluoride)	Nitrate+Nitrite, Ammonia	Other Instructions and Notes
14BH-DT-PILOT-INFL-062414	6/24/14	13:25	aqueous	HNO3 (metals), H2SO4 (nutrients), cool	3, 125 mL poly	X	X	X		TAL metals = Al, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, Tl, Zn.
14BH-DT-PILOT-SAPS-062414	6/24/14	13:50	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-CHIT-062414	6/24/14	14:05	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-NAOH-062414	6/24/14	14:20	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-BCR1-062414	6/24/14	14:35	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR1D-062414	6/24/14	14:40	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR2-062414	6/24/14	15:05	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR3-062414	6/24/14	15:20	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR4-062414	6/24/14	15:35	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-POSTE-062414	6/24/14	15:50	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-POSTI-062414	6/24/14	16:10	aqueous		4, 125 mL poly	X	X	X	X	

Relinquished by: (*Signature*) Laura Helland	**Date/Time** 07/10/14 1600	**Received for Laboratory by: (*Signature*)**			
Received by: (*Signature*) Kelsey Bartling	**Date/Time** 7/11/14 10:05	**Airbill No.(s)**	**Carrier Name:** FedEx	**Lab:** USEPA Lab Region 8	

ESAT

C140711

ESAT Technical Direction Form

Contract No. EPW13028
EPA Region 8

Site ID:	085N	***Date Issued:***	5/29/2014	***Date***	
TDF ID:	A-046	***Date Updated:***		***Closed By:***	

Name: Barker-Hughesville Treatability Study

Details: The Contractor shall analyze several water samples associated with the treatability study at the Barker-Hughesville Superfund site as indicated in the Analytical Information Section. The samples will be sent to the ESAT R8 Lab during the 2014 field season starting in mid-June though early October 2014. There will be 9 sampling events associated with this project averaging approximately 10 samples per an event. The samples will be collected by Nick Anton/Erin Louden of CDM Smith.

Samples designated as influent samples (-INF) are expected to have high metal concentrations and should be analyzed by 200.7. Additionally, metals with sufficiently high concentrations may be reported from the 200.7 analyses.

ESAT should return the coolers to the following address:

CDM Smith/Lauren Helland
50 West 14th Street, Suite 200
Helena, MT 59601
406-441-1435
FedEx # 1323-6393-5

TO02/Subtask 02b: Inorganic Chemistry

Site RPM: Roger Hoogerheide

Analytical Information:

MATRIX

☑ Water ☐ Soils ☐ Vegetation ☐ Biota

WET CHEM

☐ TSS ☐ TDS ☐ DOC ☑ Alk ☑ Chloride ☑ Sulfate ☑ Fluoride ☑ Nitrate ☑ Nitrite
Other: Analyze for Ammonia and report NO2 and NO3 as NO2-NO3 combined.

METALS

☑ Dissolved ☑ Total Recoverable ☐ Total ☐ Hardness (Calc)

200.7: ☐ Ag ☑ Al ☐ As ☐ Ba ☐ Be ☐ B ☐ Ca ☐ Cd ☐ Co ☐ Cr ☐ Cu ☑ Fe ☐ K ☐ Mg
☒ Mn ☐ Mo ☐ Na ☐ Ni ☐ Pb ☐ Sb ☐ Se ☐ Sr ☐ Ti ☐ Tl ☐ V ☑ Zn ☐ SiO2

200.8: ☐ Ag ☐ Al ☑ As ☐ Ba ☐ Be ☑ Cd ☐ Co ☐ Cr ☑ Cu ☑ Mn ☐ Mo ☑ Ni ☑ Pb ☐ Sb
☐ Se ☐ Th ☐ Tl ☐ U ☐ V ☐ Zn

lw
09/12/14

7470/7471/747 ☐ Hg

FIBERS

☐ PLM ☐ TEM

Deliverables

ID	*Description*	*Due Date*	*Submission Date*
1	Provide final deliverable package to Task Monitor no later than 30 days after delivery of samples.		

5/29/14

ANALYTICAL SUMMARY REPORT

July 23, 2014

CDM Federal Programs
555 17th St Ste 1100
Denver, CO 80202

Work Order: H14070167 Quote ID: H823 - Baker-Hughsville Superfund Site

Project Name: Barker Hughsville - Danny T

Energy Laboratories Inc Helena MT received the following 11 samples for CDM Federal Programs on 7/9/2014 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H14070167-001	148H-DT-PILOT-INFL-070814	07/08/14 8:45	07/09/14	Aqueous	Acidity, Total as CaCO3 Phosphorus, Orthophosphate as P
H14070167-002	148H-DT-PILOT-INFLD-070814	07/08/14 9:05	07/09/14	Aqueous	Same As Above
H14070167-003	148H-DT-PILOT-SAPS-070814	07/08/14 9:15	07/09/14	Aqueous	Same As Above
H14070167-004	148H-DT-PILOT-CHIT-070814	07/08/14 9:25	07/09/14	Aqueous	Same As Above
H14070167-005	148H-DT-PILOT-NAOH-070814	07/08/14 9:40	07/09/14	Aqueous	Same As Above
H14070167-006	148H-DT-PILOT-BCR1-070814	07/08/14 9:55	07/09/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Phosphorus, Orthophosphate as P Sulfide, Iodine Titrimetric
H14070167-007	148H-DT-PILOT-BCR2-070814	07/08/14 10:10	07/09/14	Aqueous	Same As Above
H14070167-008	148H-DT-PILOT-BCR3-070814	07/08/14 10:30	07/09/14	Aqueous	Same As Above
H14070167-009	148H-DT-PILOT-BCR4-070814	07/08/14 10:50	07/09/14	Aqueous	Same As Above
H14070167-010	148H-DT-PILOT-POSTI-070814	07/08/14 11:05	07/09/14	Aqueous	Same As Above
H14070167-011	148H-DT-PILOT-POSTE-070814	07/08/14 11:25	07/09/14	Aqueous	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

CLIENT:	CDM Federal Programs
Project:	Barker Hughsville - Danny T
Work Order:	H14070167

Report Date: 07/23/14

CASE NARRATIVE

Tests associated with analyst identified as ELI-B were subcontracted to Energy Laboratories, 1120 S. 27th St., Billings, MT, EPA Number MT00005.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14070167-001
Client Sample ID: 148H-DT-PILOT-INFL-070814

Report Date: 07/23/14
Collection Date: 07/08/14 08:45
Date Received: 07/09/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	700	mg/L	D	4.0		1	A2310 B	07/14/14 11:50/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	ND	mg/L	DH	0.05		50	E365.1	07/10/14 09:47/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14070167-002
Client Sample ID: 148H-DT-PILOT-INFLD-070814

Report Date: 07/23/14
Collection Date: 07/08/14 09:05
Date Received: 07/09/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	720	mg/L	D	4.0		1	A2310 B	07/14/14 11:54/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	0.20	mg/L	DH	0.01		10	E365.1	07/10/14 09:50/cmm

Report Definitions:		
	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14070167-003
Client Sample ID: 148H-DT-PILOT-SAPS-070814

Report Date: 07/23/14
Collection Date: 07/08/14 09:15
Date Received: 07/09/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	260	mg/L	D	4.0		1	A2310 B	07/14/14 11:57/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	0.166	mg/L	H	0.005		2	E365.1	07/10/14 09:51/cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	07/23/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	07/08/14 09:25
Lab ID:	H14070167-004	**Date Received:**	07/09/14
Client Sample ID:	148H-DT-PILOT-CHIT-070814	**Matrix:**	AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	07/14/14 12:00/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	3.97	mg/L	DH	0.05		50	E365.1	07/10/14 09:52/cmm

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	07/23/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	07/08/14 09:40
Lab ID:	H14070167-005	**Date Received:**	07/09/14
Client Sample ID:	148H-DT-PILOT-NAOH-070814	**Matrix:**	AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	340	mg/L	D	4.0		1	A2310 B	07/14/14 12:03/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	0.036	mg/L	H	0.005		2	E365.1	07/10/14 09:53/cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14070167-006
Client Sample ID: 148H-DT-PILOT-BCR1-070814

Report Date: 07/23/14
Collection Date: 07/08/14 09:55
Date Received: 07/09/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	07/14/14 12:08/SRW
Sulfide	12	mg/L		1		1	A4500-S F	07/14/14 12:20/eli-b2
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	580	mg/L		400		1	A5210 B	07/09/14 17:14/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	37.7	mg/L	DH	0.1		100	E365.1	07/10/14 10:06/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14070167-007
Client Sample ID: 148H-DT-PILOT-BCR2-070814

Report Date: 07/23/14
Collection Date: 07/08/14 10:10
Date Received: 07/09/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	07/14/14 12:13/SRW
Sulfide	30	mg/L		1		1	A4500-S F	07/14/14 12:20/eli-b2
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	<363	mg/L		400		1	A5210 B	07/09/14 17:17/SRW
No BOD dilution depleted greater than 2.0 mg/L DO.								
NUTRIENTS								
Phosphorus, Orthophosphate as P	24.0	mg/L	D	0.05		50	E365.1	07/10/14 10:07/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	07/23/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	07/08/14 10:30
Lab ID:	H14070167-008	**Date Received:**	07/09/14
Client Sample ID:	148H-DT-PILOT-BCR3-070814	**Matrix:**	AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	07/14/14 12:29/SRW
Sulfide	41	mg/L		1		1	A4500-S F	07/14/14 12:20/eli-b2
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	1400	mg/L		400		1	A5210 B	07/09/14 17:18/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	19.1	mg/L	D	0.05		50	E365.1	07/10/14 10:08/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14070167-009
Client Sample ID: 148H-DT-PILOT-BCR4-070814

Report Date: 07/23/14
Collection Date: 07/08/14 10:50
Date Received: 07/09/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	07/14/14 12:35/SRW
Sulfide	5	mg/L		1		1	A4500-S F	07/14/14 12:20/eli-b2
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	<363	mg/L		400		1	A5210 B	07/09/14 17:21/SRW
No BOD dilution depleted greater than 2.0 mg/L DO.								
NUTRIENTS								
Phosphorus, Orthophosphate as P	13.6	mg/L	DH	0.05		50	E365.1	07/10/14 13:42/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14070167-010
Client Sample ID: 148H-DT-PILOT-POSTI-070814

Report Date: 07/23/14
Collection Date: 07/08/14 11:05
Date Received: 07/09/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	07/14/14 12:41/SRW
Sulfide	27	mg/L		1		1	A4500-S F	07/14/14 12:20/eli-b
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	540	mg/L		400		1	A5210 B	07/09/14 17:24/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	20.6	mg/L	D	0.05		50	E365.1	07/10/14 10:09/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14070167-011
Client Sample ID: 148H-DT-PILOT-POSTE-070814

Report Date: 07/23/14
Collection Date: 07/08/14 11:25
Date Received: 07/09/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	07/14/14 12:44/SRW
Sulfide	8	mg/L		1		1	A4500-S F	07/14/14 12:20/eli-b2
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	460	mg/L		400		1	A5210 B	07/09/14 17:26/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	5.36	mg/L	D	0.05		50	E365.1	07/10/14 10:03/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Report Date: 07/23/14
Project: Barker Hughsville - Danny T
Work Order: H14070167

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2310 B										Batch: H140714A
Lab ID: H14070167-001ADUP		Sample Duplicate				Run: PH_140714A				07/14/14 11:51
Acidity, Total as CaCO3		720	mg/L	4.0				2.1	20	
Lab ID: H14070167-011ADUP		Sample Duplicate				Run: PH_140714A				07/14/14 12:49
Acidity, Total as CaCO3		ND	mg/L	4.0					20	
Lab ID: LCS1407140000		Laboratory Control Sample				Run: PH_140714A				07/14/14 11:48
Acidity, Total as CaCO3		940	mg/L	4.0	96	90	110			
Lab ID: MBLK1407140000		Method Blank				Run: PH_140714A				07/14/14 11:45
Acidity, Total as CaCO3		3	mg/L							

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs

Project: Barker Hughsville - Danny T

Report Date: 07/23/14

Work Order: H14070167

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **A4500-S F**									Batch: B_R227086	
Lab ID: **MB-R227086**		Method Blank				Run: SUB-B227086			07/14/14 12:20	
Sulfide		ND	mg/L	0.5						
Lab ID: **LCS-R227086**		Laboratory Control Sample				Run: SUB-B227086			07/14/14 12:20	
Sulfide		24.4	mg/L	1.0	95	70	130			
Lab ID: **H14070167-006C**		Sample Matrix Spike				Run: SUB-B227086			07/14/14 12:20	
Sulfide		37.4	mg/L	1.0	99	80	120			
Lab ID: **H14070167-006C**		Sample Matrix Spike Duplicate				Run: SUB-B227086			07/14/14 12:20	
Sulfide		37.1	mg/L	1.0	98	80	120	0.6	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs

Project: Barker Hughsville - Danny T

Report Date: 07/23/14

Work Order: H14070167

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A5210 B									Batch: 140709_1_BOD5-W	
Lab ID: Dil-H201_140709		Dilution Water Blank				Run: MISC WC_140709A			07/09/14 14:51	
Oxygen Demand, Biochemical (BOD)		0.35	mg/L	2.0		0	0.2			
Dilution water blank exceeds 0.2 mg/L.										
Lab ID: GGA1_140709		Laboratory Control Sample				Run: MISC WC_140709A			07/09/14 14:55	
Oxygen Demand, Biochemical (BOD)		180	mg/L	60	93	85	115			
Lab ID: H14070167-010ADUP		Sample Duplicate				Run: MISC WC_140709A			07/09/14 17:23	
Oxygen Demand, Biochemical (BOD)		ND	mg/L	1500		90	110			
No BOD dilution depleted greater than 2.0 mg/L DO.										

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Report Date: 07/23/14
Project: Barker Hughsville - Danny T
Work Order: H14070167

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E365.1										Analytical Run: FIA202-HE_140710A
Lab ID: ICV		Initial Calibration Verification Standard								07/10/14 09:41
Phosphorus, Orthophosphate as P		0.246	mg/L	0.0050	98	90	110			
Lab ID: ICB		Initial Calibration Blank, Instrument Blank								07/10/14 09:42
Phosphorus, Orthophosphate as P		-0.00108	mg/L	0.0050		0	0			
Lab ID: CCV		Continuing Calibration Verification Standard								07/10/14 09:45
Phosphorus, Orthophosphate as P		0.0979	mg/L	0.0050	98	90	110			
Lab ID: CCV		Continuing Calibration Verification Standard								07/10/14 10:02
Phosphorus, Orthophosphate as P		0.110	mg/L	0.0050	110	90	110			
Method: E365.1										Batch: R98735
Lab ID: LFB		Laboratory Fortified Blank				Run: FIA202-HE_140710A				07/10/14 09:43
Phosphorus, Orthophosphate as P		0.187	mg/L	0.0050	93	90	110			
Lab ID: H14070167-001BMS		Sample Matrix Spike				Run: FIA202-HE_140710A				07/10/14 09:48
Phosphorus, Orthophosphate as P		3.97	mg/L	0.050	40	90	110			S
Lab ID: H14070167-001BMSD		Sample Matrix Spike Duplicate				Run: FIA202-HE_140710A				07/10/14 09:49
Phosphorus, Orthophosphate as P		4.07	mg/L	0.050	41	90	110	2.4	20	S
Lab ID: H14070167-002BMS		Sample Matrix Spike				Run: FIA202-HE_140710A				07/10/14 09:54
Phosphorus, Orthophosphate as P		1.81	mg/L	0.010	80	90	110			S
Lab ID: H14070167-002BMSD		Sample Matrix Spike Duplicate				Run: FIA202-HE_140710A				07/10/14 09:55
Phosphorus, Orthophosphate as P		1.91	mg/L	0.010	85	90	110	5.3	20	S
Lab ID: H14070167-011BMS		Sample Matrix Spike				Run: FIA202-HE_140710A				07/10/14 10:04
Phosphorus, Orthophosphate as P		15.4	mg/L	0.050	101	90	110			
Lab ID: H14070167-011BMSD		Sample Matrix Spike Duplicate				Run: FIA202-HE_140710A				07/10/14 10:05
Phosphorus, Orthophosphate as P		15.8	mg/L	0.050	105	90	110	2.6	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs **Report Date:** 07/23/14
Project: Barker Hughsville - Danny T **Work Order:** H14070167

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E365.1										Analytical Run: FIA202-HE_140710B
Lab ID: ICV		Initial Calibration Verification Standard								07/10/14 13:33
Phosphorus, Orthophosphate as P		0.248	mg/L	0.0050	99	90	110			
Lab ID: ICB		Initial Calibration Blank, Instrument Blank								07/10/14 13:34
Phosphorus, Orthophosphate as P		-0.000730	mg/L	0.0050		0	0			
Lab ID: CCV		Continuing Calibration Verification Standard								07/10/14 13:36
Phosphorus, Orthophosphate as P		0.0982	mg/L	0.0050	98	90	110			
Method: E365.1										Batch: R98742
Lab ID: LFB		Laboratory Fortified Blank				Run: FIA202-HE_140710B				07/10/14 13:35
Phosphorus, Orthophosphate as P		0.189	mg/L	0.0050	95	90	110			
Lab ID: H14070186-001AMS		Sample Matrix Spike				Run: FIA202-HE_140710B				07/10/14 13:39
Phosphorus, Orthophosphate as P		0.262	mg/L	0.0050	99	90	110			
Lab ID: H14070186-001AMSD		Sample Matrix Spike Duplicate				Run: FIA202-HE_140710B				07/10/14 13:40
Phosphorus, Orthophosphate as P		0.263	mg/L	0.0050	99	90	110	0.4	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Workorder Receipt Checklist

CDM Federal Programs H14070167

Login completed by: Tracy L. Lorash
Date Received: 7/9/2014
Reviewed by: BL2000\kwiegand
Received by: TLL
Reviewed Date: 7/11/2014
Carrier name: Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	2.9℃ On Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☑	No ☐	Not Applicable ☐

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

None

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 1 of 2

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM Smith

Project Name, PWS, Permit, Etc.: Barker Hughesville - Danny T

Sample Origin State: MT

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address (Required):

Contact Name: ANGELA FRANDSEN

Phone/Fax: (406)441-1400

Cell: (406)439-3776

Sampler: (Please Print) Lauren Helland

☒ No Hard Copy Email: FrandsenAK@cdmsmith.com

Invoice Contact & Phone: SAME

Purchase Order:

Quote/Bottle Order:

Invoice Address (Required):

☒ No Hard Copy Email: same as report

Special Report/Formats:

☐ DW

☐ POTW/WWTP

☐ State: ____

☐ Other: ____

☒ EDD/EDT (Electronic Data) Format: Excel

☐ LEVEL IV

☐ NELAC

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids
Vegetation Bioassay Other
DW - Drinking Water

ANALYSIS REQUESTED

➡ Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: USE 1000mL bottles for combined BOD + Acidity

Shipped by: Hand

Cooler ID(s): Y

Receipt Temp 2.9 °C

On Ice: [✓ Y] N

Custody Seal On Bottle Y [✓ N]

Custody Seal On Cooler Y [✓ N]

Intact Y N

Signature Match Y N

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	BOD, SM5210 B or EPA 410.1	Sulfide, SM4500-SF or EPA 376.1	Acidity, SM2310 B or EPA 305.1	O-Phosphate, EPA 365.1						SEE ATTACHED	Standard Turnaround (TAT)	RUSH		LABORATORY USE ONLY
1 14BH-DT-PILOT-INFL-070814	07/08/14	08:45	2, W			X	X										H14070167
2 14BH-DT-PILOT-INFLD-070814	07/08/14	09:05	2, W			X	X										
3 14BH-DT-PILOT-SAPS-070814	07/08/14	09:15	2, W			X	X										
4 14BH-DT-PILOT-CHIT-070814	07/08/14	09:25	2, W			X	X										
5 14BH-DT-PILOT-NAOH-070814	07/08/14	09:40	2, W			X	X										
6 14BH-DT-PILOT-BCR1-070814	07/08/14	09:55	3, W	X	X	X	X										
7 14BH-DT-PILOT-BCR2-070814	07/08/14	10:10	3, W	X	X	X	X										
8 14BH-DT-PILOT-BCR3-070814	07/08/14	10:30	3, W	X	X	X	X										
9 14BH-DT-PILOT-BCR4-070814	07/08/14	10:50	3, W	X	X	X	X										
10 14BH-DT-PILOT-POST1-070814	07/08/14	11:05	3, W	X	X	X	X										

Custody Record MUST be Signed

Relinquished by (print): Lauren Helland Date/Time: 07/09/14 1611 Signature: Lauren Helland

Relinquished by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Received by Laboratory: Tracy Lorash Date/Time: 7/9/14 16:11 Signature: Tracy Lorash

Sample Disposal: Return to Client: ____ Lab Disposal: ____

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 2 of 2

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM Smith

Project Name, PWS, Permit, Etc. Barker Hughesville - DannyT

Sample Origin State: MT

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address (Required):

Contact Name: ANGELA FRANDSEN Phone/Fax: (406)441-1400 Cell: (406)439-3776

Sampler: (Please Print) Lauren Helland

☒ No Hard Copy Email: FrandsenAL@cdmsmith.com

Invoice Contact & Phone: SAME

Purchase Order:

Quote/Bottle Order:

Invoice Address (Required):

☒ No Hard Copy Email: Same as report

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: ___
☐ Other: ___
☒ EDD/EDT (Electronic Data) Format: Excel
☐ LEVEL IV
☐ NELAC

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids
Vegetation Bioassay Other
DW - Drinking Water

ANALYSIS REQUESTED

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: Use 1000mL bottles for combined BOD+acidity

Shipped by: Hand

Cooler ID(s): Y

Receipt Temp 2.9 °C

On Ice: [✓ Y] N

Custody Seal
On Bottle Y [✓ N]
On Cooler Y [✓ N]

Intact Y N

Signature Match Y N

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	BOD, SM5210B or EPA 410.1	Sulfide, SM4500-SF or EPA 376.1	Acidity, SM2310B or EPA 305.1	O-Phosphate, EPA 365.1						SEE ATTACHED	Standard Turnaround (TAT)	R U S H	LABORATORY USE ONLY
1 14BH-DT-PILOT-POSTE-070814	07/08/14	11:25	3, W	X	X	X	X									#14070167
2																
3																
4																
5																
6																
7																
8																
9																
10																

Custody Record MUST be Signed

Relinquished by (print): Lauren Helland Date/Time: 07/09/14 1611 Signature: Lauren Helland

Received by (print): Date/Time: Signature:

Relinquished by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Sample Disposal: Return to Client: ___ Lab Disposal: ___

Received by Laboratory: Tracy Lvad Date/Time: 7/9/14 16:11 Signature:

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.

U.S. Environmental Protection Agency
Region 8
Technical and Management Services

Laboratory Services Program

Certificate of Analysis

Ref: 8TMS-L

MEMORANDUM

Date: 09/12/14

Subject: Analytical Results--- **Barker-Hughesville_Treatability_JUL 2014_A046 / A-046**

From: Don Goodrich; EPA Region 8 Analytical Chemistry WAM

To: Roger Hoogerheide
Superfund
8 MO

Received Sample Set(s), [Work Order : Date Received]:
[C140708 : 07/10/2014]

Attached are the analytical results for the samples received from the Barker-Hughesville_Treatability_JUL 2014_A046 sampling event, according to TDF A-046. All analyses were performed within their method specified holding times unless otherwise noted in the following narrative.

These samples were prepared, analyzed, and verified by the Environmental Services Assistance Team Laboratory (ESAT) according to the requirements of the Technical Direction Form (TDF).

Note: The laboratory herewith transmits this deliverable to the program/project partner for determination of "final data usability" which may include data validation and data quality asessment per and in accordance with EPA QA/G-8, *Guidance on Environmental Data Verification and Data Validation*, November 2002, EPA/240/R-02/004. Laboratory data qualifiers are applied based on the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004, referred to as "NFGI".

Laboratory policy is to dispose of any remaining sample 60 days after data analysis packages are delivered to EPA. If you would like the laboratory to retain the samples for a period longer than 60 days,

Case Narrative

C140708

Quality Assessment: Unless indicated by exception, the QA/QC associated with this sample set produced data within the TDF-specified criteria.

Holding Times: All samples were analyzed within their method-specified technical holding time(s).

1. Initial and Continuing calibration blanks (ICBs and CCBs).
   Exceptions: None.
2. Preparation (PB) / Method blanks (MB)
   Exceptions: None.
3. Interference Checks (ICSA / ICSAB) for ICP-MS and ICP-OE analyses only.
   Exceptions: None.
4. Initial and Continuing calibration verification analyses (ICVs, SCVs and CCVs).
   Exceptions: In ICP-MS sequence 1407038, lead recovered high in the SCV. As a result, all sample results for lead were qualified "J" as estimated. In ICP-MS sequence 1409053, arsenic recovered low in the SCV. All arsenic results were qualified "J" as estimated.
5. Laboratory Control Sample (LCS) or second source analysis or SRM.
   Exceptions: In ICP-MS batch 1409005, copper recovered l% below acceptable limits in the SRM. Since all other QC requirements for copper were met, no qualifiers were assigned.
6. Laboratory Fortified blank (LFB) / Blank spike (BS), same source as used for the matrix spikes.
   PBS performed with analyses/methods requiring preparation or digestion prior to analysis.
   Exceptions: None.
7. Contract Reporting Detection Limit Standard, labeled as CRA, CRDL or CRL.
   Exceptions: None.
8. Laboratory Duplicate (DUP). "Source" identifies field sample duplicated in the laboratory. If either the "source" or the duplicate result is <5X the reporting limit, the %D limit of 20% does not apply.
   Exceptions: None.
9. Laboratory Matrix Spike (MS) and spike duplicate (MSD). "Source" defines original field sample fortified prior to analysis. Percent recovery (%R) limits do not apply when sample concentration(s) exceed the corresponding analyte spike level by a factor of 4 or greater.
   Exceptions: None.
10. Serial Dilution sample analysis (SRD). "Source" is parent field sample diluted 1:5 in the laboratory. Performed for ICP-OE and ICP-MS metals analyses. Percent difference (%D) limits do not apply when analyte concentration(s) are below 50x the source sample's MDL (or 10x it's PQL).
    Exceptions: In ICP-OE sequence 1409037, manganese recovered high in the SRD. As a result, the source sample was qualfied "J" as estimated for manganese.
11. Internal standards, criteria specified for ICP-MS analyses only, monitored at the instrument.
    Exceptions: None.
12. Any calibration using more than two-points produced a correlation coefficient equal to or greater than 0.995.
    Exceptions: None.

Acronyms and Definitions:

ESAT	Environmental Services Assistance Team
J	Data Estimated qualifier (also applied to all data less than PQL, greater than or equal to MDL)
MDL	Method Detection Limit
PQL	Practical Quantitation Limit, also known as reporting limit.
RPD	Relative Percent Difference (difference divided by the mean)
%D	Percent difference, serial dilution criteria unit, difference divided by the original result.
%R	Percent recovery, analyzed (less sample contribution) divided by true value
<	Analyte NOT DETECTED at or above the Method Detection Limit (MDL)
mg/L	Parts per million (millligrams per liter). Solids equivalent = mg/Kg.
ug/L	Parts per billion (micrograms per liter). Solids equivalent = ug/Kg.
NR	No Recovery (matrix spike) - Often seen for calcium/magnesium when their concentration exceeds the spike level by > 4x.
NFGI	*USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004
RE	Sample Re-analysis. Usually seen on raw data and sequences for required sample dilutions due to over-range analytes.
U	Analyte not detected at or above MDL qualifier
D	Diluted value qualifier.

Method(s) Summary:

As defined in the Technical Direction Form (TDF), some or all of the methods listed below were used for the determination of the reported target analytes.

From EPA's *Methods for the Determination of Metals in Environmental Samples* , Supplement I, May 1994, dissolved, total, and/or total recoverable metals were determined by:

- Method 200.7 / 6010B using a PE Optima ICP -OE (ICP).
- Method 200.8 / 6020 using a Perkin -Elmer Elan 6000 ICP-MS.
- Method 200.2 for total recoverable metals (only) digestion.
- Method 245.1 using a Perkin -Elmer FIMS CVAA (aqueous mercury only).

From *Standard Methods for the Examination of Water and Wastewater* , 18th Edition, 1992, Method 2340B was used for the calculated hardness determination. Hardness is reported as mg (milligram) equivalent $CaCO_3$ per liter (L) determined as follows:

Calculated hardness = 2.497 * (Calcium, mg/L) + 4.118 * (Magnesium, mg/L).

From *EPA's Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW -846*,

- Method 3015A was used for microwave assisted total metals digestion.
- Method 7473 was used for mercury in solids .

From EPA's *Determination of Inorganic Anions by Ion Chromatography* , Revision 2.1, 1993, Method 300.0 was used to determine the anions.

From EPA's *Methods for Chemical Analysis of Water and Wastes* , March 1983:

- Method 310.1 was followed for the alkalinity determination.
- Method 160.1 was followed for gravimetric total dissolved solids (TDS) determination.
- Method 160.2 was used for gravimetric total suspended solids (TSS) determination.
- Method 415.3 was used for total organic carbon (TOC) determination using either an Apollo 9000 or Phoenix 8000 Non-Dispersive IR (NDIR) system. Also known as dissolved organic carbon (DOC) when performed on the dissolved sample fraction.

The quality control procedures listed in the TDF request were utilized by ESAT to verify accuracy of the results and to evaluate any matrix interferences.

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-070814 **Date / Time Sampled:** 07/08/14 09:55 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-01 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 50.0	U	ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**2190**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**45000**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**59.2**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	**Arsenic**	**5.98**	J	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**1760**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-070814 **Date / Time Sampled:** 07/08/14 10:10 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-05 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**81.2**		ug/L	20.0	1	09/08/2014	SV	1409031
200.7	Iron	< 250	U	ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**17200**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**46.8**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**1220**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-070814
Date / Time Sampled: 07/08/14 10:30
Workorder: C140708
EPA Tag No.: No Tag Prefix-A
Matrix: Water
Lab Number: C140708-09 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**37.9**	J	ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**2070**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**9710**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**95.7**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	**Arsenic**	**26.0**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**17.0**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**1.04**	J	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**2520**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-070814
Date / Time Sampled: 07/08/14 10:50
Workorder: C140708
EPA Tag No.: No Tag Prefix-A
Matrix: Water
Lab Number: C140708-13 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**133**	J	ug/L	100	5	09/08/2014	SV	1409031
200.7	**Iron**	**1030**	J	ug/L	500	5	09/08/2014	SV	1409031
200.7	**Manganese**	**61800**		ug/L	10.0	5	09/08/2014	SV	1409031
200.7	**Zinc**	**271**		ug/L	50.0	5	09/08/2014	SV	1409031
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**754**		mg/L	8	5	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-070814 **Date / Time Sampled:** 07/08/14 09:25 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-17 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 50.0	U	ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**5000**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**30300**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**30.2**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	**Arsenic**	**7.06**	J	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**2920**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFL-070814 **Date / Time Sampled:** 07/08/14 08:45 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-21 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**15000**		ug/L	200	10	09/08/2014	SV	1409031
200.7	**Iron**	**184000**		ug/L	1000	10	09/08/2014	SV	1409031
200.7	**Manganese**	**123000**		ug/L	20.0	10	09/08/2014	SV	1409031
200.7	**Zinc**	**66500**		ug/L	100	10	09/08/2014	SV	1409031
200.8	**Arsenic**	**166**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**285**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**1270**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**147**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**28.5**		ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**375**		mg/L	15	10	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFLD-070814 **Date / Time Sampled:** 07/08/14 09:05 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-25 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**14900**		ug/L	200	10	09/08/2014	SV	1409031
200.7	**Iron**	**184000**		ug/L	1000	10	09/08/2014	SV	1409031
200.7	**Manganese**	**122000**		ug/L	20.0	10	09/08/2014	SV	1409031
200.7	**Zinc**	**66100**		ug/L	100	10	09/08/2014	SV	1409031
200.8	**Arsenic**	**178**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**294**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**1250**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**149**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**25.3**		ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**369**		mg/L	15	10	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NOAH-070814 **Date / Time Sampled:** 07/08/14 09:40 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-29 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**13600**		ug/L	100	5	09/08/2014	SV	1409031
200.7	**Iron**	**23300**		ug/L	500	5	09/08/2014	SV	1409031
200.7	**Manganese**	**112000**		ug/L	10.0	5	09/08/2014	SV	1409031
200.7	**Zinc**	**64100**		ug/L	50.0	5	09/08/2014	SV	1409031
200.8	**Arsenic**	**5.61**	J	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**294**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**1260**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**123**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**27.0**		ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**371**		mg/L	8	5	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-070814 **Date / Time Sampled:** 07/08/14 11:25 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-33 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**70.2**		ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**974**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**11500**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**1120**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	**Arsenic**	**16.9**	J	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**1.75**	J	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**5.78**	J	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**1480**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-070814 **Date / Time Sampled:** 07/08/14 11:05 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-37 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**33.9**	J	ug/L	20.0	1	09/08/2014	SV	1409031
200.7	Iron	< 250	U	ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**37400**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**29.4**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	**Arsenic**	**9.21**	J	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**1540**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-070814 **Date / Time Sampled:** 07/08/14 09:15 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-41 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**142**	J	ug/L	100	5	09/08/2014	SV	1409031
200.7	**Iron**	**107000**		ug/L	500	5	09/08/2014	SV	1409031
200.7	**Manganese**	**111000**		ug/L	10.0	5	09/08/2014	SV	1409031
200.7	**Zinc**	**16100**		ug/L	50.0	5	09/08/2014	SV	1409031
200.8	**Arsenic**	**36.2**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**19.0**		ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**802**		mg/L	8	5	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-CHIT-0708 **Date / Time Sampled:** 07/08/14 19:15 **Workorder:** C140708
EPA Tag No.: 14 No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-45 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**301**		ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**547**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**21100**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**7810**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	**Arsenic**	**36.0**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**48.4**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**542**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**5.80**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**14.8**		ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**1000**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-LSTN-070 **Date / Time Sampled:** 07/08/14 18:55 **Workorder:** C140708
EPA Tag No.: 814No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-48 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**40.1**	J	ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**651**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**24300**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**9690**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**43.8**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**62.9**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**4.71**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**7.78**	J	ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**991**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-NAOH-070 **Date / Time Sampled:** 07/08/14 17:30 **Workorder:** C140708
EPA Tag No.: 814No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-51 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**150**		ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**420**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**22600**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**11500**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**46.4**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**397**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**11.7**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**19.5**		ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**286**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-RAW-0708 **Date / Time Sampled:** 07/08/14 16:30 **Workorder:** C140708
EPA Tag No.: 14 No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-54 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**2340**		ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**269000**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**25400**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**12100**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	**Arsenic**	**29.5**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**43.8**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**1450**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**952**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**11.4**		ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**286**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-RAWD-07 **Date / Time Sampled:** 07/08/14 16:50 **Workorder:** C140708
EPA Tag No.: 0814 No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-57 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**2210**		ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**254000**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**24400**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**11700**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	**Arsenic**	**30.5**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**45.2**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**1410**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**954**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**10.5**		ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**273**		mg/L	2	1	09/08/2014	SV	1409031

"J" Qualifier indicates an estimated value

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-070814 **Date / Time Sampled:** 07/08/14 09:55 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-02 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**265**		ug/L	100	5	09/11/2014	SV	1409005
200.7	**Iron**	**11000**		ug/L	500	5	09/11/2014	SV	1409005
200.7	**Manganese**	**56800**		ug/L	10.0	5	09/11/2014	SV	1409005
200.7	**Zinc**	**2200**		ug/L	50.0	5	09/11/2014	SV	1409005
200.8	**Arsenic**	**13.7**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**2.10**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**15.7**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**1.59**	J	ug/L	1.00	10	09/11/2014	SV	1409005
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-070814 **Date / Time Sampled:** 07/08/14 10:10 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-06 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**161**		ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**1000**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**19500**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**2100**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	**Arsenic**	**19.3**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**1.21**	J	ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**25.6**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**7.48**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-070814 **Date / Time Sampled:** 07/08/14 10:30 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-10 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**26.2**	J	ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**2510**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**9760**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**116**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	**Arsenic**	**29.3**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**36.2**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**6.88**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-070814 **Date / Time Sampled:** 07/08/14 10:50 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-14 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**654**		ug/L	100	5	09/11/2014	SV	1409005
200.7	**Iron**	**2070**		ug/L	500	5	09/11/2014	SV	1409005
200.7	**Manganese**	**64700**		ug/L	10.0	5	09/11/2014	SV	1409005
200.7	**Zinc**	**7400**		ug/L	50.0	5	09/11/2014	SV	1409005
200.8	**Arsenic**	**17.4**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**13.8**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**49.6**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**8.54**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-070814 **Date / Time Sampled:** 07/08/14 09:25 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-18 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 50.0	U	ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**6170**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**33200**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**298**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	**Arsenic**	**7.06**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**1.69**	J	ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**8.24**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/11/2014	SV	1409005
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFL-070814 **Date / Time Sampled:** 07/08/14 08:45 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-22 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**15100**		ug/L	200	10	09/11/2014	SV	1409005
200.7	**Iron**	**185000**		ug/L	1000	10	09/11/2014	SV	1409005
200.7	**Manganese**	**123000**		ug/L	20.0	10	09/11/2014	SV	1409005
200.7	**Zinc**	**65300**		ug/L	100	10	09/11/2014	SV	1409005
200.8	**Arsenic**	**198**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**291**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**1060**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**221**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Nickel**	**20.9**		ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFLD-070814 **Date / Time Sampled:** 07/08/14 09:05 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-26 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**15100**		ug/L	200	10	09/11/2014	SV	1409005
200.7	**Iron**	**186000**		ug/L	1000	10	09/11/2014	SV	1409005
200.7	**Manganese**	**123000**		ug/L	20.0	10	09/11/2014	SV	1409005
200.7	**Zinc**	**66500**		ug/L	100	10	09/11/2014	SV	1409005
200.8	**Arsenic**	**207**	J	ug/L	50.0	100	09/11/2014	SV	1409005
200.8	**Cadmium**	**288**		ug/L	10.0	100	09/11/2014	SV	1409005
200.8	**Copper**	**1160**		ug/L	50.0	100	09/11/2014	SV	1409005
200.8	**Lead**	**206**		ug/L	10.0	100	09/11/2014	SV	1409005
200.8	Nickel	< 100	U	ug/L	50.0	100	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NOAH-070814 **Date / Time Sampled:** 07/08/14 09:40 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-30 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**13500**		ug/L	100	5	09/11/2014	SV	1409005
200.7	**Iron**	**34800**		ug/L	500	5	09/11/2014	SV	1409005
200.7	**Manganese**	**110000**		ug/L	10.0	5	09/11/2014	SV	1409005
200.7	**Zinc**	**62000**		ug/L	50.0	5	09/11/2014	SV	1409005
200.8	**Arsenic**	**19.7**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**283**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**1040**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**175**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Nickel**	**21.3**		ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-070814 **Date / Time Sampled:** 07/08/14 11:25 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-34 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**138**		ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**1370**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**11900**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**1440**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	**Arsenic**	**36.5**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**2.95**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**18.1**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**5.61**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-070814 **Date / Time Sampled:** 07/08/14 11:05 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-38 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**108**		ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**4550**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**41000**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**3080**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	Arsenic	< 200	J,	ug/L	50.0	100	09/11/2014	SV	1409005
200.8	Cadmium	< 20.0	U	ug/L	10.0	100	09/11/2014	SV	1409005
200.8	Copper	< 100	U	ug/L	50.0	100	09/11/2014	SV	1409005
200.8	Lead	< 20.0	U	ug/L	10.0	100	09/11/2014	SV	1409005
200.8	Nickel	< 100	U	ug/L	50.0	100	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-070814 **Date / Time Sampled:** 07/08/14 09:15 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-42 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**159**	J	ug/L	100	5	09/11/2014	SV	1409005
200.7	**Iron**	**103000**		ug/L	500	5	09/11/2014	SV	1409005
200.7	**Manganese**	**112000**		ug/L	10.0	5	09/11/2014	SV	1409005
200.7	**Zinc**	**18300**		ug/L	50.0	5	09/11/2014	SV	1409005
200.8	**Arsenic**	**38.8**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**5.40**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**10.5**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Nickel**	**11.3**		ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-CHIT-0708 **Date / Time Sampled:** 07/08/14 19:15 **Workorder:** C140708
EPA Tag No.: 14 No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-46 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**530**		ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**41500**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**21200**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**7600**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	**Arsenic**	**43.1**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**47.0**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**497**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**102**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Nickel**	**9.78**	J	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-LSTN-070 **Date / Time Sampled:** 07/08/14 18:55 **Workorder:** C140708
EPA Tag No.: 814No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-49 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**222**		ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**16800**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**24400**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**9480**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	Arsenic	< 20.0	J,	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**38.6**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**114**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**70.1**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-NAOH-070 **Date / Time Sampled:** 07/08/14 17:30 **Workorder:** C140708
EPA Tag No.: 814No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-52 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**212**		ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**6710**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**22700**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**11200**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	Arsenic	< 20.0	J,	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**42.1**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**331**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**42.5**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Nickel**	**14.2**		ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-RAW-0708 **Date / Time Sampled:** 07/08/14 16:30 **Workorder:** C140708

EPA Tag No.: 14 No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-55 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**2310**		ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**261000**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**24800**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**11500**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	**Arsenic**	**30.1**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**39.0**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**1100**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**1240**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Nickel**	**8.30**	J	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-RAWD-07 **Date / Time Sampled:** 07/08/14 16:50 **Workorder:** C140708

EPA Tag No.: 0814No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-58 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**2260**		ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**255000**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**24500**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**11300**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	**Arsenic**	**28.9**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**40.4**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**1110**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**1260**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Nickel**	**7.71**	J	ug/L	5.00	10	09/11/2014	SV	1409005

"J" Qualifier indicates an estimated value

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-070814 **Date / Time Sampled:** 07/08/14 09:55 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-03 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**65.7**	J	mg/L	50.0	100	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**55.2**		mg/L	10.0	100	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**701**		mg/L	5.0	100	07/11/2014	NP	1407040
EPA 310.1	**Total Alkalinity**	**1020**		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-070814 **Date / Time Sampled:** 07/08/14 09:55 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140708-04 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**58.2**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-070814 **Date / Time Sampled:** 07/08/14 10:10 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-07 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**85.7**	J	mg/L	50.0	100	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**30.3**		mg/L	10.0	100	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**562**		mg/L	5.0	100	07/11/2014	NP	1407040
EPA 310.1	**Total Alkalinity**	**685**		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-070814 **Date / Time Sampled:** 07/08/14 10:10 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140708-08 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**14.6**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-070814 **Date / Time Sampled:** 07/08/14 10:30 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-11 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**110**	J	mg/L	50.0	100	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**134**		mg/L	10.0	100	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**376**		mg/L	5.0	100	07/11/2014	NP	1407040
EPA 310.1	**Total Alkalinity**	**2490**		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-070814 **Date / Time Sampled:** 07/08/14 10:30 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140708-12 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**199**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-070814 **Date / Time Sampled:** 07/08/14 10:50 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-15 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**68.5**	J	mg/L	50.0	100	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**18.0**	J	mg/L	10.0	100	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**724**		mg/L	5.0	100	07/11/2014	NP	1407040
EPA 310.1	**Total Alkalinity**	**404**	J	mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-070814 **Date / Time Sampled:** 07/08/14 10:50 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140708-16 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**4.55**	D	mg/L	0.300	10	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-CHIT-070814 **Date / Time Sampled:** 07/08/14 09:25 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-19 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	Chloride	< 200	U	mg/L	50.0	100	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**139**		mg/L	10.0	100	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1020**		mg/L	5.0	100	07/11/2014	NP	1407040
EPA 310.1	**Total Alkalinity**	**2270**		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-INFL-070814 **Date / Time Sampled:** 07/08/14 08:45 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-23 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**6.9**	J	mg/L	5.0	10	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**2.8**		mg/L	1.0	10	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1280**		mg/L	0.5	10	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-INFLD-070814 **Date / Time Sampled:** 07/08/14 09:05 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-27 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**7.0**	J	mg/L	5.0	10	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**3.1**		mg/L	1.0	10	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1310**		mg/L	0.5	10	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-NOAH-070814 **Date / Time Sampled:** 07/08/14 09:40 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-31 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**6.9**	J	mg/L	5.0	10	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**2.6**		mg/L	1.0	10	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1160**		mg/L	0.5	10	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTE-070814 **Date / Time Sampled:** 07/08/14 11:25 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-35 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**85.3**	J	mg/L	50.0	100	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**38.8**		mg/L	10.0	100	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**656**		mg/L	5.0	100	07/11/2014	NP	1407040
EPA 310.1	**Total Alkalinity**	**1100**		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTE-070814 **Date / Time Sampled:** 07/08/14 11:25 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140708-36 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**46.6**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTI-070814 **Date / Time Sampled:** 07/08/14 11:05 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-39 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**77.1**	J	mg/L	50.0	100	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**63.9**		mg/L	10.0	100	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**603**		mg/L	5.0	100	07/11/2014	NP	1407040
EPA 310.1	**Total Alkalinity**	**1190**		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTI-070814 **Date / Time Sampled:** 07/08/14 11:05 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140708-40 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**70.8**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-SAPS-070814 **Date / Time Sampled:** 07/08/14 09:15 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-43 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**7.4**	J	mg/L	5.0	10	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**3.6**		mg/L	1.0	10	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1030**		mg/L	0.5	10	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-TN-CHIT-0708 **Date / Time Sampled:** 07/08/14 19:15 **Workorder:** C140708
EPA Tag No.: 14 No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-47 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**169**	J	mg/L	50.0	100	07/11/2014	NP	1407040
EPA 300.0	Fluoride	< 20.0	U	mg/L	10.0	100	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**944**		mg/L	5.0	100	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-TN-LSTN-070 **Date / Time Sampled:** 07/08/14 18:55 **Workorder:** C140708
EPA Tag No.: 814No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-50 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**6.7**	J	mg/L	5.0	10	07/11/2014	NP	1407040
EPA 300.0	Fluoride	< 2.0	U	mg/L	1.0	10	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1040**		mg/L	0.5	10	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-TN-NAOH-070 **Date / Time Sampled:** 07/08/14 17:30 **Workorder:** C140708
EPA Tag No.: 814No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-53 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**6.7**	J	mg/L	5.0	10	07/11/2014	NP	1407040
EPA 300.0	Fluoride	< 2.0	U	mg/L	1.0	10	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1020**		mg/L	0.5	10	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-TN-RAW-0708 **Date / Time Sampled:** 07/08/14 16:30 **Workorder:** C140708
EPA Tag No.: 14 No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-56 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	Chloride	< 20.0	U	mg/L	5.0	10	07/11/2014	NP	1407040
EPA 300.0	Fluoride	< 2.0	U	mg/L	1.0	10	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1120**		mg/L	0.5	10	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-TN-RAWD-07 **Date / Time Sampled:** 07/08/14 16:50 **Workorder:** C140708
EPA Tag No.: 0814No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-59 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	Chloride	< 20.0	U	mg/L	5.0	10	07/11/2014	NP	1407040
EPA 300.0	Fluoride	< 2.0	U	mg/L	1.0	10	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1120**		mg/L	0.5	10	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

"J" Qualifier indicates an estimated value

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

ICPMS-PE DRC-II

Batch 1409032 - No Lab Prep Reqd *Water* **ICPMS-PE DRC-II**

Method Blank (1409032-BLK1) Dilution Factor: 1 Prepared: 09/08/14 Analyzed: 09/09/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	< 0.500	1.00	ug/L						
Copper	< 0.500	1.00	"						
Arsenic	< 0.500	2.00	"						
Cadmium	< 0.100	0.200	"						
Lead	< 0.100	0.200	"						

Method Blank Spike (1409032-BS1) Dilution Factor: 1 Prepared: 09/08/14 Analyzed: 09/09/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	93.9	1.00	ug/L	100		94	85-115		
Copper	92.0	1.00	"	100		92	85-115		
Arsenic	87.1	2.00	"	100		87	85-115		
Cadmium	97.6	0.200	"	100		98	85-115		
Lead	96.0	0.200	"	100		96	85-115		

Duplicate (1409032-DUP1) Dilution Factor: 1 **Source: C140708-01** Prepared: 09/08/14 Analyzed: 09/09/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	< 5.00	10.0	ug/L		< 5.00				20
Copper	< 5.00	10.0	"		< 5.00				20
Arsenic	5.26	20.0	"		5.98			13	20
Cadmium	< 1.00	2.00	"		< 1.00				20
Lead	< 1.00	2.00	"		< 1.00				20

Matrix Spike (1409032-MS1) Dilution Factor: 1 **Source: C140708-01** Prepared: 09/08/14 Analyzed: 09/09/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	125	10.0	ug/L	100	< 5.00	125	70-130		
Copper	85.2	10.0	"	100	< 5.00	85	70-130		
Arsenic	92.9	20.0	"	100	5.98	87	70-130		
Cadmium	96.8	2.00	"	100	< 1.00	97	70-130		
Lead	81.9	2.00	"	100	< 1.00	82	70-130		

Matrix Spike (1409032-MS2) Dilution Factor: 1 **Source: C140708-05** Prepared: 09/08/14 Analyzed: 09/09/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	103	10.0	ug/L	100	< 5.00	103	70-130		
Copper	83.5	10.0	"	100	< 5.00	83	70-130		
Arsenic	87.6	20.0	"	100	< 5.00	88	70-130		
Cadmium	94.0	2.00	"	100	< 1.00	94	70-130		
Lead	80.7	2.00	"	100	< 1.00	81	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409039 - 1409032			***Water***						**ICPMS-PE DRC-II**
Serial Dilution (1409039-SRD1)		Dilution Factor: 5	**Source: C140708-01**			Prepared: 09/08/14 Analyzed: 09/09/14			
Nickel	< 25.0	50.0	ug/L		< 5.00				10
Copper	< 25.0	50.0	"		< 5.00				10
Arsenic	< 25.0	100	"		5.98				10
Cadmium	< 5.00	10.0	"		< 1.00				10
Lead	< 5.00	10.0	"		< 1.00				10

ICPOE - PE Optima

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409031 - No Lab Prep Reqd			***Water***						**ICPOE - PE Optima**
Method Blank (1409031-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 09/08/14			
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						
Method Blank Spike (1409031-BS1)		Dilution Factor: 1				Prepared & Analyzed: 09/08/14			
Aluminum	10430	50.0	ug/L	10100		103	85-115		
Iron	10500	250	"	10100		104	85-115		
Manganese	99.69	5.00	"	100		100	85-115		
Zinc	100.1	20.0	"	100		100	85-115		
Duplicate (1409031-DUP1)		Dilution Factor: 1	**Source: C140708-01**			Prepared & Analyzed: 09/08/14			
Aluminum	< 20.0	50.0	ug/L		< 20.0				20
Iron	2231	250	"		2188			2	20
Manganese	45050	5.00	"		44950			0.2	20
Zinc	61.18	20.0	"		59.24			3	20
Matrix Spike (1409031-MS1)		Dilution Factor: 1	**Source: C140708-01**			Prepared & Analyzed: 09/08/14			
Aluminum	10670	50.0	ug/L	10100	< 20.0	106	70-130		
Iron	12470	250	"	10100	2188	102	70-130		
Manganese	44260	5.00	"	100	44950	NR	70-130		
Zinc	161.3	20.0	"	100	59.24	102	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409031 - No Lab Prep Reqd			*Water*						ICPOE - PE Optima
Matrix Spike (1409031-MS2)		Dilution Factor: 1	**Source: C140708-05**			Prepared & Analyzed: 09/08/14			
Aluminum	10540	50.0	ug/L	10100	81.22	104	70-130		
Iron	10400	250	"	10100	< 100	103	70-130		
Manganese	16580	5.00	"	100	17200	NR	70-130		
Zinc	138.7	20.0	"	100	46.82	92	70-130		
Batch 1409037 - 1409031			*Water*						ICPOE - PE Optima
Serial Dilution (1409037-SRD1)		Dilution Factor: 5	**Source: C140708-01**			Prepared & Analyzed: 09/08/14			
Aluminum	264.1	250	ug/L		< 20.00				10
Iron	1811	1250	"		2188			19	10
Manganese	50820	25.0	"		44950			12	10
Zinc	81.80	100	"		59.24			32	10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ICPMS-PE DRC-II									
Batch 1409005 - 200.2 - TR Metals			***Water***						**ICPMS-PE DRC-II**
Method Blank (1409005-BLK2)		Dilution Factor: 5				Prepared: 09/02/14 Analyzed: 09/11/14			
Nickel	2.832	5.00	ug/L						
Copper	< 2.50	5.00	"						
Arsenic	< 2.50	10.0	"						
Cadmium	< 0.500	1.00	"						
Lead	< 0.500	1.00	"						
Duplicate (1409005-DUP2)		Dilution Factor: 1	**Source: C140708-02**			Prepared: 09/02/14 Analyzed: 09/11/14			
Nickel	< 5.00	10.0	ug/L		< 5.00				20
Copper	16.03	10.0	"		15.65			2	20
Arsenic	13.27	20.0	"		13.65			3	20
Cadmium	2.148	2.00	"		2.102			2	20
Lead	1.584	2.00	"		1.585			0.1	20
Matrix Spike (1409005-MS2)		Dilution Factor: 1	**Source: C140708-02**			Prepared: 09/02/14 Analyzed: 09/11/14			
Nickel	392.9	10.0	ug/L	500	< 5.00	79	70-130		
Copper	248.7	10.0	"	300	15.65	78	70-130		
Arsenic	744.0	20.0	"	800	13.65	91	70-130		
Cadmium	192.8	2.00	"	200	2.102	95	70-130		
Lead	1038	2.00	"	1000	1.585	104	70-130		
Matrix Spike (1409005-MS4)		Dilution Factor: 1	**Source: C140708-06**			Prepared: 09/02/14 Analyzed: 09/11/14			
Nickel	376.2	10.0	ug/L	500	< 5.00	75	70-130		
Copper	254.0	10.0	"	300	25.57	76	70-130		
Arsenic	743.4	20.0	"	800	19.31	91	70-130		
Cadmium	191.9	2.00	"	200	1.206	95	70-130		
Lead	1024	2.00	"	1000	7.484	102	70-130		
Reference (1409005-SRM2)		Dilution Factor: 2				Prepared: 09/02/14 Analyzed: 09/11/14			
Nickel	911.9	20.0	ug/L	1000		91	85-115		
Copper	844.4	20.0	"	1000		84	85-115		
Arsenic	1910	40.0	"	2000		96	85-115		
Cadmium	990.8	4.00	"	1000		99	85-115		
Lead	2056	4.00	"	2000		103	85-115		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409053 - 1409005			*Water*						ICPMS-PE DRC-II
Serial Dilution (1409053-SRD1)		Dilution Factor: 5	**Source: C140708-02**			Prepared: 09/02/14	Analyzed: 09/11/14		
Nickel	< 25.0	50.0	ug/L		< 5.00				10
Copper	< 25.0	50.0	"		15.65				10
Arsenic	< 25.0	100	"		13.65				10
Cadmium	< 5.00	10.0	"		2.102				10
Lead	< 5.00	10.0	"		1.585				10

ICPOE - PE Optima

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409005 - 200.2 - TR Metals			*Water*						**ICPOE - PE Optima**
Method Blank (1409005-BLK1)		Dilution Factor: 1				Prepared: 09/02/14	Analyzed: 09/11/14		
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						
Duplicate (1409005-DUP1)		Dilution Factor: 5	**Source: C140708-02**			Prepared: 09/02/14	Analyzed: 09/11/14		
Aluminum	249.9	250	ug/L		265.4			6	20
Iron	11080	1250	"		11030			0.5	20
Manganese	56130	25.0	"		56820			1	20
Zinc	2159	100	"		2195			2	20
Matrix Spike (1409005-MS1)		Dilution Factor: 1	**Source: C140708-02**			Prepared: 09/02/14	Analyzed: 09/11/14		
Aluminum	2116	50.0	ug/L	2000	265.4	93	70-130		
Iron	3960	250	"	3000	11030	NR	70-130		
Manganese	19950	5.00	"	200	56820	NR	70-130		
Zinc	2323	20.0	"	200	2195	64	70-130		
Matrix Spike (1409005-MS3)		Dilution Factor: 1	**Source: C140708-06**			Prepared: 09/02/14	Analyzed: 09/11/14		
Aluminum	2004	50.0	ug/L	2000	161.4	92	70-130		
Iron	5369	250	"	3000	1003	146	70-130		
Manganese	9980	5.00	"	200	19530	NR	70-130		
Zinc	294.6	20.0	"	200	2100	NR	70-130		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409005 - 200.2 - TR Metals			***Water***						**ICPOE - PE Optima**
Reference (1409005-SRM1)		Dilution Factor: 1				Prepared: 09/02/14 Analyzed: 09/11/14			
Aluminum	965.3	50.0	ug/L	1000		97	85-115		
Iron	918.2	250	"	1000		92	85-115		
Manganese	1005	5.00	"	1000		100	85-115		
Zinc	975.4	20.0	"	1000		98	85-115		
Batch 1409050 - 1409005			***Water***						**ICPOE - PE Optima**
Serial Dilution (1409050-SRD1)		Dilution Factor: 2	**Source: C140708-02**			Prepared: 09/02/14 Analyzed: 09/11/14			
Aluminum	< 500	1250	ug/L		265.4				10
Iron	10590	6250	"		11030			4	10
Manganese	57760	125	"		56820			2	10
Zinc	2224	500	"		2195			1	10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ESAT Dionex IC									
Batch 1407040 - No Prep Req			***Water***						**ESAT Dionex IC**
Method Blank (1407040-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 07/11/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						
Method Blank Spike (1407040-BS1)		Dilution Factor: 1				Prepared & Analyzed: 07/11/14			
Fluoride	4.9	0.2	mg/L	5.00		99	90-110		
Chloride	23.6	2.0	"	25.0		94	90-110		
Sulfate as SO4	22.6	0.1	"	25.0		90	90-110		
Nitrate/Nitrite as N	20.1	5.0	"	20.0		100	90-110		
Duplicate (1407040-DUP1)		Dilution Factor: 1	**Source: C140708-03**			Prepared & Analyzed: 07/11/14			
Fluoride	55.8	20.0	mg/L		55.2			1	20
Chloride	66.4	200	"		65.7			1	20
Sulfate as SO4	714	10.0	"		701			2	20
Nitrate/Nitrite as N	< 100	500	"		< 100				20
Matrix Spike (1407040-MS1)		Dilution Factor: 1	**Source: C140708-03**			Prepared & Analyzed: 07/11/14			
Fluoride	566	20.0	mg/L	500	55.2	102	80-120		
Chloride	2420	200	"	2500	65.7	94	80-120		
Sulfate as SO4	3170	10.0	"	2500	701	99	80-120		
Nitrate/Nitrite as N	2040	500	"	2000	< 100	102	80-120		
Matrix Spike (1407040-MS2)		Dilution Factor: 1	**Source: C140708-43**			Prepared & Analyzed: 07/11/14			
Fluoride	53.1	2.0	mg/L	50.0	3.6	99	80-120		
Chloride	237	20.0	"	250	7.4	92	80-120		
Sulfate as SO4	1270	1.0	"	250	1030	95	80-120		
Nitrate/Nitrite as N	200	50.0	"	200	< 10.0	100	80-120		

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1407055 - 1407040			***Water***						**ESAT Dionex IC**
Instrument Blank (1407055-IBL1)		Dilution Factor: 1				Prepared & Analyzed: 07/11/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						

Lachat 8500

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1407080 - No Prep Req			***Water***						**Lachat 8500**
Method Blank (1407080-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 07/18/14			
Ammonia as N	< 0.0300	0.0500	mg/L						
Method Blank Spike (1407080-BS1)		Dilution Factor: 1				Prepared & Analyzed: 07/18/14			
Ammonia as N	0.980	0.0500	mg/L	1.00		98	90-110		
Duplicate (1407080-DUP1)		Dilution Factor: 1	**Source: C140708-04**			Prepared & Analyzed: 07/18/14			
Ammonia as N	58.1	5.00	mg/L		58.2			0.3	20
Duplicate (1407080-DUP2)		Dilution Factor: 1	**Source: C140711-20**			Prepared & Analyzed: 07/18/14			
Ammonia as N	12.0	5.00	mg/L		12.1			0.8	20
Matrix Spike (1407080-MS1)		Dilution Factor: 1	**Source: C140708-04**			Prepared & Analyzed: 07/18/14			
Ammonia as N	154	5.00	mg/L	100	58.2	96	90-110		
Matrix Spike (1407080-MS2)		Dilution Factor: 1	**Source: C140711-20**			Prepared & Analyzed: 07/18/14			
Ammonia as N	107	5.00	mg/L	100	12.1	95	90-110		
Reference (1407080-SRM1)		Dilution Factor: 5				Prepared & Analyzed: 07/18/14			
Ammonia as N	4.91	0.250	mg/L	4.80		102	90-110		

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Mettler AT

Batch 1407059 - No Prep Req *Water* **Mettler AT**

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Method Blank (1407059-BLK1)		Dilution Factor: 1				Prepared: 07/14/14 Analyzed: 07/15/14			
Total Alkalinity	< 5.00	10.0	mg CaCO3 / L						
Duplicate (1407059-DUP1)		Dilution Factor: 5	**Source: C140708-03**			Prepared: 07/14/14 Analyzed: 07/15/14			
Total Alkalinity	1010	500	mg CaCO3 / L		1020			0.5	20
Duplicate (1407059-DUP2)		Dilution Factor: 5	**Source: C140708-43**			Prepared: 07/14/14 Analyzed: 07/15/14			
Total Alkalinity	< 250	500	mg CaCO3 / L		< 250				20
Reference (1407059-SRM1)		Dilution Factor: 1				Prepared: 07/14/14 Analyzed: 07/15/14			
Total Alkalinity	12.0	10.0	mg CaCO3 / L	10.4		115	61.3-143.9		

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 300.0

Analysis Name: WC - Anions by Ion Chromatography

Instrument: **ESAT Dionex IC**

Work Order: Nu C140708

Analytical Sequence: 1407055 **Dissolved**

Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**								**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**			
Fluoride	0.00	0.00	0.00	0.00						1407040-BLK1 0.00	NA NA	0.20
Chloride	0.00	0.00	0.00	0.00						1407040-BLK1 0.00	NA NA	2.00
Sulfate as SO4	0.00	0.00	0.00	0.00						1407040-BLK1 0.00	NA NA	0.10
Nitrate/Nitrite as N	0.00	0.00	0.00	0.00						1407040-BLK1 0.00	NA NA	5.00

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 310.1

Analysis Name: WC - Alkalinity

Instrument: **Mettler AT**

Work Order: Nu C140708

Analytical Sequence: **Total**

Concentration Units: mg CaCO3 / L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	1407059-BLK1	NA	
Total Alkalinity		1.12	1.32			1.04	NA	10.00
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 350.1

Analysis Name: WC - Ammonia

Instrument: **Lachat 8500**

Work Order: Nu C140708

Analytical Sequence: **Total**

Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Ammonia as N		1	2	3	4	1407080-BLK1	NA	0.05
		0.00	0.00	0.00		0.02	NA	
		5	6	7	8			

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7

Analysis Name: ICPOE Diss. Metals

Instrument: **ICPOE - PE Optima**

Work Order: Nu C140708

Analytical Sequence: 1409037 **Dissolved**

Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Aluminum	1.95	**1**	**2**	**3**	**4**	1409031-BLK1	NA	50.00
		1.62	1.03	2.79		2.95	NA	
		5	**6**	**7**	**8**			
Iron	-23.76	**1**	**2**	**3**	**4**	1409031-BLK1	NA	250.00
		21.79	-12.15	19.33		26.11	NA	
		5	**6**	**7**	**8**			
Manganese	0.04	**1**	**2**	**3**	**4**	1409031-BLK1	NA	5.00
		0.22	0.63	0.75		-0.01	NA	
		5	**6**	**7**	**8**			
Zinc	0.83	**1**	**2**	**3**	**4**	1409031-BLK1	NA	20.00
		1.03	2.01	2.13		0.01	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8 Analysis Name: ICPMS Diss. Metals

Instrument: **ICPMS-PE DRC-II** Work Order: Nu C140708

Analytical Sequence: 1409039 **Dissolved** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Nickel	0.00	1	2	3	4	1409032-BLK1	NA	1.00
		0.01	0.02	0.02		-0.01	NA	
		5	6	7	8			
Copper	0.00	1	2	3	4	1409032-BLK1	NA	1.00
		0.00	0.00	0.00		-0.04	NA	
		5	6	7	8			
Arsenic	0.09	1	2	3	4	1409032-BLK1	NA	2.00
		0.02	0.07	0.09		0.11	NA	
		5	6	7	8			
Cadmium	0.01	1	2	3	4	1409032-BLK1	NA	0.20
		0.02	0.02	0.01		0.00	NA	
		5	6	7	8			
Lead	0.03	1	2	3	4	1409032-BLK1	NA	0.20
		0.00	-0.02	-0.04		-0.02	NA	
		5	6	7	8			

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Instrument: **ICPOE - PE Optima** Work Order: Nu C140708

Analytical Sequence: 1409050 **Total Recoverable** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Aluminum	0.89	**1**	**2**	**3**	**4**	1409005-BLK1	NA	50.00
		0.92	2.04	3.46		1.22	NA	
		5	**6**	**7**	**8**			
Iron	15.55	**1**	**2**	**3**	**4**	1409005-BLK1	NA	250.00
		7.23	2.61	15.25		24.26	NA	
		5	**6**	**7**	**8**			
Manganese	0.08	**1**	**2**	**3**	**4**	1409005-BLK1	NA	5.00
		0.13	0.38	0.38		-0.28	NA	
		5	**6**	**7**	**8**			
Zinc	0.64	**1**	**2**	**3**	**4**	1409005-BLK1	NA	20.00
		1.02	0.50	0.91		1.64	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8

Analysis Name: ICPMS Tot. Rec. Metals

Instrument: **ICPMS-PE DRC-II**

Work Order: Nu C140708

Analytical Sequence: 1409053 **Total Recoverable**

Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Nickel	0.01	**1**	**2**	**3**	**4**	NA	1409005-BLK2	1.00
		0.00	0.00	0.00		NA	0.57	
		5	**6**	**7**	**8**			
Copper	0.01	**1**	**2**	**3**	**4**	NA	1409005-BLK2	1.00
		0.00	-0.02	-0.02		NA	-0.03	
		5	**6**	**7**	**8**			
Arsenic	0.02	**1**	**2**	**3**	**4**	NA	1409005-BLK2	2.00
		0.03	-0.04	-0.04		NA	-0.21	
		5	**6**	**7**	**8**			
Cadmium	0.00	**1**	**2**	**3**	**4**	NA	1409005-BLK2	0.20
		-0.01	-0.01	0.00		NA	-0.02	
		5	**6**	**7**	**8**			
Lead	-0.01	**1**	**2**	**3**	**4**	NA	1409005-BLK2	0.20
		-0.02	-0.01	-0.02		NA	-0.03	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ESAT Dionex IC Method: EPA 300.0 Analysis Name: WC - Anions by Ion Chromatography 2013

Sequence: 1407055 Work Order: C140708 Units: mg/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)											
	True	Found	%R		True	Found	%R		True	Found	%R		True	Found	%R
Chloride	40.0	40.4	101.0	1	40.0	41.4	103.5	2	40.0	41.4	103.5	3	40.0	41.6	104.0
				4				5				6			
				7				8				9			
Fluoride	4.00	4.0	100.0	1	4.00	4.1	102.5	2	4.00	4.2	105.0	3	4.00	4.2	105.0
				4				5				6			
				7				8				9			
Nitrate/Nitrite as N	20.0	20.1	100.5	1	20.0	20.6	103.0	2	20.0	20.6	103.0	3	20.0	20.7	103.5
				4				5				6			
				7				8				9			
Sulfate as SO4	100	101	101.0	1	100	104	104.0	2	100	104	104.0	3	100	106	106.0
				4				5				6			
				7				8				9			

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Mettler AT Method: EPA 310.1 Analysis Name: WC - Alkalinity

Sequence: 1407064 Work Order: C140708 Units: mg CaCO3 / L

Total Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
					1			**2**			**3**	
Total Alkalinity				100	100	100.0	100	99.9	99.9			
					4			**5**			**6**	
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Lachat 8500 Method: EPA 350.1 Analysis Name: WC - Ammonia

Sequence: 1407091 Work Order: C140708 Units: mg/L

Total Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
				1			2			3		
Ammonia as N				1.00	0.979	97.9	1.00	0.980	98.0	1.00	0.982	98.2
				4			5			6		
				7			8			9		

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Diss. Metals

Sequence: 1409037 Work Order: C140708 Units: ug/L

Dissolved Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
Aluminum	12500	12400	99.2		**1**			**2**			**3**	
				12500	12700	101.6	12500	12670	101.4	12500	12550	100.4
					4			**5**			**6**	
					7			**8**			**9**	
Iron	12500	12630	101.0		**1**			**2**			**3**	
				12500	12660	101.3	12500	12730	101.8	12500	12650	101.2
					4			**5**			**6**	
					7			**8**			**9**	
Manganese	1000	1028	102.8		**1**			**2**			**3**	
				1000	1009	100.9	1000	1027	102.7	1000	1033	103.3
					4			**5**			**6**	
					7			**8**			**9**	
Zinc	2500	2546	101.8		**1**			**2**			**3**	
				2500	2544	101.8	2500	2579	103.2	2500	2592	103.7
					4			**5**			**6**	
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Diss. Metals

Sequence: 1409039 Work Order: C140708 Units: ug/L

Dissolved Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
Arsenic	50.0	50.9	101.8		**1**			**2**			**3**	
				50.0	49.5	99.0	50.0	50.8	101.6	50.0	49.1	98.2
					4			**5**			**6**	
					7			**8**			**9**	
Cadmium	50.0	49.4	98.8		**1**			**2**			**3**	
				50.0	49.5	99.0	50.0	53.6	107.2	50.0	54.4	108.8
					4			**5**			**6**	
					7			**8**			**9**	
Copper	50.0	54.2	108.4		**1**			**2**			**3**	
				50.0	51.3	102.6	50.0	49.6	99.2	50.0	49.3	98.6
					4			**5**			**6**	
					7			**8**			**9**	
Lead	50.0	50.2	100.4		**1**			**2**			**3**	
				50.0	46.7	93.4	50.0	48.7	97.4	50.0	46.1	92.2
					4			**5**			**6**	
					7			**8**			**9**	
Nickel	50.0	53.6	107.2		**1**			**2**			**3**	
				50.0	51.5	103.0	50.0	50.4	100.8	50.0	52.5	105.0
					4			**5**			**6**	
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Sequence: 1409050 Work Order: C140708 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Aluminum	12500	12950	103.6	12500	12790	102.3	12500	12730	101.8	12500	12790	102.3
					4			5			6	
					7			8			9	
					1			2			3	
Iron	12500	12900	103.2	12500	12490	99.9	12500	12470	99.8	12500	12430	99.4
					4			5			6	
					7			8			9	
					1			2			3	
Manganese	1000	1022	102.2	1000	1027	102.7	1000	1028	102.8	1000	1033	103.3
					4			5			6	
					7			8			9	
					1			2			3	
Zinc	2500	2566	102.6	2500	2594	103.8	2500	2569	102.8	2500	2589	103.6
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1409053 Work Order: C140708 Units: ug/L

Total Recoverable Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
					1			**2**			**3**	
Arsenic	50.0	49.46	98.9	50.0	47.28	94.6	50.0	47.79	95.6	50.0	47.73	95.5
					4			**5**			**6**	
					7			**8**			**9**	
					1			**2**			**3**	
Cadmium	50.0	50.55	101.1	50.0	49.98	100.0	50.0	49.81	99.6	50.0	50.15	100.3
					4			**5**			**6**	
					7			**8**			**9**	
					1			**2**			**3**	
Copper	50.0	48.25	96.5	50.0	46.86	93.7	50.0	48.17	96.3	50.0	45.32	90.6
					4			**5**			**6**	
					7			**8**			**9**	
					1			**2**			**3**	
Lead	50.0	49.15	98.3	50.0	52.27	104.5	50.0	51.98	104.0	50.0	51.52	103.0
					4			**5**			**6**	
					7			**8**			**9**	
					1			**2**			**3**	
Nickel	50.0	49.76	99.5	50.0	48.69	97.4	50.0	49.50	99.0	50.0	47.25	94.5
					4			**5**			**6**	
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

ICP Interference Check Sample

ICPMS-PE DRC-II

Sequence: 1409039 Analysis: ICPMS Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.0	ug/L			2.00
	IFB1	18.8	ug/L	20	94	2.00
Cadmium	IFA1	0.1	ug/L			0.200
	IFB1	20.0	ug/L	20	100	0.200
Copper	IFA1	0.7	ug/L			1.00
	IFB1	20.6	ug/L	20	103	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	-0.1	ug/L			1.00
	IFB1	20.3	ug/L	20	102	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1409053 Analysis: ICPMS Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.0	ug/L			2.00
	IFB1	20.1	ug/L	20	101	2.00
Cadmium	IFA1	0.0	ug/L			0.200
	IFB1	20.7	ug/L	20	104	0.200
Copper	IFA1	0.5	ug/L			1.00
	IFB1	17.4	ug/L	20	87	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	-0.2	ug/L			1.00
	IFB1	18.3	ug/L	20	92	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8
ICP Interference Check Sample
ICPOE - PE Optima

Sequence: 1409037 Analysis: ICPOE Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	59,888.8	ug/L	60,000	100	50.0
	IFB1	60,565.4	ug/L	60,000	101	50.0
Iron	IFA1	234,765.4	ug/L	250,000	94	250
	IFB1	235,009.8	ug/L	250,000	94	250
Manganese	IFA1	-0.1	ug/L			5.00
	IFB1	196.0	ug/L	200	98	5.00
Zinc	IFA1	8.6	ug/L			20.0
	IFB1	291.9	ug/L	300	97	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1409050 Analysis: ICPOE Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	61,035.1	ug/L	60,000	102	50.0
	IFB1	61,569.3	ug/L	60,000	103	50.0
Iron	IFA1	234,323.5	ug/L	250,000	94	250
	IFB1	234,561.1	ug/L	250,000	94	250
Manganese	IFA1	-0.5	ug/L			5.00
	IFB1	195.4	ug/L	200	98	5.00
Zinc	IFA1	4.8	ug/L			20.0
	IFB1	287.6	ug/L	300	96	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPMS-PE DRC-II

Metals (Dissolved) by EPA 200/7000 Series Methods

Sequence: 1409039

Analyte	True	Found	%R	Units
Arsenic	2.00	2.11	105	ug/L
Cadmium	0.200	0.180	90	ug/L
Copper	1.00	0.978	98	ug/L
Lead	0.200	0.224	112	ug/L
Nickel	1.00	0.952	95	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPOE - PE Optima

Metals (Dissolved) by EPA 200/7000 Series Methods

Sequence: 1409037

Analyte	True	Found	%R	Units
Aluminum	100	99.63	100	ug/L
Iron	100	91.41	91	ug/L
Manganese	10.0	10.06	101	ug/L
Zinc	50.0	53.60	107	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

Lachat 8500

Classical Chemistry by EPA/ASTM/APHA Methods

Sequence: 1407091

Analyte	True	Found	%R	Units
Ammonia as N	0.0250	0.0197	79	mg/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

ICPMS-PE DRC-II

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1409053

Analyte	True	Found	%R	Units
Arsenic	2.00	1.956	98	ug/L
Cadmium	0.200	0.1660	83	ug/L
Copper	1.00	1.085	109	ug/L
Lead	0.200	0.1620	81	ug/L
Nickel	1.00	1.014	101	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

ICPOE - PE Optima

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1409050

Analyte	True	Found	%R	Units
Aluminum	100	98.99	99	ug/L
Iron	100	129.6	130	ug/L
Manganese	10.0	10.10	101	ug/L
Zinc	50.0	51.67	103	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 300.0 **Dissolved** **Sequence ID#:** 1407055

Instrument ID #: ESAT Dionex IC Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1407055-ICV1	Initial Cal Check	07/11/14	14:23
1407055-ICB1	Initial Cal Blank	07/11/14	14:42
1407055-SCV1	Secondary Cal Check	07/11/14	15:00
1407055-IBL1	Instrument Blank	07/11/14	15:19
1407040-BS1	Blank Spike	07/11/14	15:38
1407040-BLK1	Blank	07/11/14	15:56
C140708-03	14BH-DT-PILOT-BCR1-07081	07/11/14	16:15
1407040-DUP1	Duplicate	07/11/14	16:33
1407040-MS1	Matrix Spike	07/11/14	16:52
C140708-07	14BH-DT-PILOT-BCR2-07081	07/11/14	17:10
C140708-11	14BH-DT-PILOT-BCR3-07081	07/11/14	17:29
C140708-15	14BH-DT-PILOT-BCR4-07081	07/11/14	17:48
1407055-CCV1	Calibration Check	07/11/14	18:06
1407055-CCB1	Calibration Blank	07/11/14	18:25
C140708-19	14BH-DT-PILOT-CHIT-07081	07/11/14	18:43
C140708-23	14BH-DT-PILOT-INFL-07081	07/11/14	19:02
C140708-27	14BH-DT-PILOT-INFLD-0708	07/11/14	19:20
C140708-31	14BH-DT-PILOT-NOAH-0708	07/11/14	19:39
C140708-35	14BH-DT-PILOT-POSTE-0708	07/11/14	19:58
C140708-39	14BH-DT-PILOT-POSTI-07081	07/11/14	20:16
C140708-43	14BH-DT-PILOT-SAPS-07081	07/11/14	20:35
1407040-MS2	Matrix Spike	07/11/14	20:53
C140708-47	14BH-TI-BENCH-TN-CHIT-07	07/11/14	21:12
C140708-50	14BH-TI-BENCH-TN-LSTN-0	07/11/14	21:30
1407055-CCV2	Calibration Check	07/11/14	21:49
1407055-CCB2	Calibration Blank	07/11/14	22:08
C140708-53	14BH-TI-BENCH-TN-NAOH-	07/11/14	22:26
C140708-56	14BH-TI-BENCH-TN-RAW-07	07/11/14	22:45
C140708-59	14BH-TI-BENCH-TN-RAWD-	07/11/14	23:03
1407055-CCV3	Calibration Check	07/11/14	23:22
1407055-CCB3	Calibration Blank	07/11/14	23:40

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 310.1 **Total** **Sequence ID#:** 1407064

Instrument ID #: Mettler AT Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1407059-SRM1	Reference	07/15/14	12:08
1407059-BLK1	Blank	07/15/14	12:08
C140708-03	14BH-DT-PILOT-BCR1-07081	07/15/14	12:08
1407059-DUP1	Duplicate	07/15/14	12:08
C140708-07	14BH-DT-PILOT-BCR2-07081	07/15/14	12:08
C140708-11	14BH-DT-PILOT-BCR3-07081	07/15/14	12:08
C140708-15	14BH-DT-PILOT-BCR4-07081	07/15/14	12:08
C140708-19	14BH-DT-PILOT-CHIT-070814	07/15/14	12:08
C140708-23	14BH-DT-PILOT-INFL-070814	07/15/14	12:08
C140708-27	14BH-DT-PILOT-INFLD-0708	07/15/14	12:08
1407064-CCV1	Calibration Check	07/15/14	12:08
1407064-CCB1	Calibration Blank	07/15/14	12:08
C140708-31	14BH-DT-PILOT-NOAH-0708	07/15/14	12:08
C140708-35	14BH-DT-PILOT-POSTE-0708	07/15/14	12:08
C140708-39	14BH-DT-PILOT-POSTI-07081	07/15/14	12:08
C140708-43	14BH-DT-PILOT-SAPS-07081	07/15/14	12:08
1407059-DUP2	Duplicate	07/15/14	12:08
C140708-47	14BH-TI-BENCH-TN-CHIT-07	07/15/14	12:08
C140708-50	14BH-TI-BENCH-TN-LSTN-0	07/15/14	12:08
C140708-53	14BH-TI-BENCH-TN-NAOH-	07/15/14	12:08
C140708-56	14BH-TI-BENCH-TN-RAW-07	07/15/14	12:08
C140708-59	14BH-TI-BENCH-TN-RAWD-	07/15/14	12:08
1407064-CCV2	Calibration Check	07/15/14	12:08
1407064-CCB2	Calibration Blank	07/15/14	12:08

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 350.1 **Total** **Sequence ID#:** 1407091

Instrument ID #: Lachat 8500 Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1407080-BLK1	Blank	07/18/14	13:02
1407080-BS1	Blank Spike	07/18/14	13:02
1407091-CRL1	Instrument RL Check	07/18/14	13:02
C140708-04	14BH-DT-PILOT-BCR1-07081	07/18/14	13:02
1407080-DUP1	Duplicate	07/18/14	13:02
1407080-MS1	Matrix Spike	07/18/14	13:02
C140708-08	14BH-DT-PILOT-BCR2-07081	07/18/14	13:02
1407091-CCV1	Calibration Check	07/18/14	13:02
1407091-CCB1	Calibration Blank	07/18/14	13:02
C140708-12	14BH-DT-PILOT-BCR3-07081	07/18/14	13:02
C140708-36	14BH-DT-PILOT-POSTE-0708	07/18/14	13:02
C140708-40	14BH-DT-PILOT-POSTI-07081	07/18/14	13:02
1407080-DUP2	Duplicate	07/18/14	13:02
1407091-CCV2	Calibration Check	07/18/14	13:02
1407091-CCB2	Calibration Blank	07/18/14	13:02
1407080-MS2	Matrix Spike	07/18/14	13:02
1407080-SRM1	Reference	07/18/14	13:02
C140708-16	14BH-DT-PILOT-BCR4-07081	07/18/14	13:02
1407091-CCV3	Calibration Check	07/18/14	13:02
1407091-CCB3	Calibration Blank	07/18/14	13:02

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Dissolved** **Sequence ID#:** 1409037

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409037-ICV1	Initial Cal Check	09/08/14	11:08
1409037-SCV1	Secondary Cal Check	09/08/14	11:11
1409037-ICB1	Initial Cal Blank	09/08/14	11:14
1409037-CRL1	Instrument RL Check	09/08/14	11:17
1409037-IFA1	Interference Check A	09/08/14	11:20
1409037-IFB1	Interference Check B	09/08/14	11:24
1409031-BLK1	Blank	09/08/14	11:28
1409031-BS1	Blank Spike	09/08/14	11:31
C140708-01	14BH-DT-PILOT-BCR1-07081	09/08/14	11:34
1409031-DUP1	Duplicate	09/08/14	11:39
1409037-SRD1	Serial Dilution	09/08/14	11:43
1409031-MS1	Matrix Spike	09/08/14	11:46
C140708-05	14BH-DT-PILOT-BCR2-07081	09/08/14	11:50
1409031-MS2	Matrix Spike	09/08/14	11:55
C140708-09	14BH-DT-PILOT-BCR3-07081	09/08/14	11:59
1409037-CCV1	Calibration Check	09/08/14	12:06
1409037-CCB1	Calibration Blank	09/08/14	12:09
C140708-17	14BH-DT-PILOT-CHIT-070814	09/08/14	12:17
C140708-21	14BH-DT-PILOT-INFL-070814	09/08/14	12:21
C140708-25	14BH-DT-PILOT-INFLD-0708	09/08/14	12:24
C140708-33	14BH-DT-PILOT-POSTE-0708	09/08/14	12:31
C140708-37	14BH-DT-PILOT-POSTI-07081	09/08/14	12:35
C140708-45	14BH-TI-BENCH-TN-CHIT-07	09/08/14	12:43
1409037-CCV2	Calibration Check	09/08/14	12:51
1409037-CCB2	Calibration Blank	09/08/14	12:54
C140708-48	14BH-TI-BENCH-TN-LSTN-0	09/08/14	12:57
C140708-51	14BH-TI-BENCH-TN-NAOH-	09/08/14	13:01
C140708-54	14BH-TI-BENCH-TN-RAW-07	09/08/14	13:05
C140708-57	14BH-TI-BENCH-TN-RAWD-	09/08/14	13:08
C140708-13	14BH-DT-PILOT-BCR4-07081	09/08/14	13:16
C140708-29	14BH-DT-PILOT-NOAH-0708	09/08/14	13:19
C140708-41	14BH-DT-PILOT-SAPS-07081	09/08/14	13:22
1409037-CCV3	Calibration Check	09/08/14	13:25
1409037-CCB3	Calibration Blank	09/08/14	13:28

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Dissolved** **Sequence ID#:** 1409039

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409039-ICV1	Initial Cal Check	09/09/14	08:55
1409039-SCV1	Secondary Cal Check	09/09/14	08:59
1409039-ICB1	Initial Cal Blank	09/09/14	09:02
1409039-CRL1	Instrument RL Check	09/09/14	09:05
1409039-IFA1	Interference Check A	09/09/14	09:09
1409039-IFB1	Interference Check B	09/09/14	09:12
1409032-BLK1	Blank	09/09/14	09:15
1409032-BS1	Blank Spike	09/09/14	09:18
C140708-01	14BH-DT-PILOT-BCR1-07081	09/09/14	09:21
1409032-DUP1	Duplicate	09/09/14	09:24
1409039-SRD1	Serial Dilution	09/09/14	09:27
1409032-MS1	Matrix Spike	09/09/14	09:30
C140708-05	14BH-DT-PILOT-BCR2-07081	09/09/14	09:33
1409032-MS2	Matrix Spike	09/09/14	09:36
C140708-09	14BH-DT-PILOT-BCR3-07081	09/09/14	09:39
1409039-CCV1	Calibration Check	09/09/14	09:46
1409039-CCB1	Calibration Blank	09/09/14	09:49
C140708-13	14BH-DT-PILOT-BCR4-07081	09/09/14	09:52
C140708-17	14BH-DT-PILOT-CHIT-070814	09/09/14	09:55
C140708-21	14BH-DT-PILOT-INFL-070814	09/09/14	09:58
C140708-25	14BH-DT-PILOT-INFLD-0708	09/09/14	10:01
C140708-29	14BH-DT-PILOT-NOAH-0708	09/09/14	10:04
C140708-33	14BH-DT-PILOT-POSTE-0708	09/09/14	10:07
C140708-37	14BH-DT-PILOT-POSTI-07081	09/09/14	10:10
C140708-41	14BH-DT-PILOT-SAPS-07081	09/09/14	10:14
C140708-45	14BH-TI-BENCH-TN-CHIT-07	09/09/14	10:17
1409039-CCV2	Calibration Check	09/09/14	10:42
1409039-CCB2	Calibration Blank	09/09/14	10:45
C140708-48	14BH-TI-BENCH-TN-LSTN-0	09/09/14	10:49
C140708-51	14BH-TI-BENCH-TN-NAOH-	09/09/14	10:52
C140708-54	14BH-TI-BENCH-TN-RAW-07	09/09/14	10:55
C140708-57	14BH-TI-BENCH-TN-RAWD-	09/09/14	10:58
1409039-CCV3	Calibration Check	09/09/14	11:15
1409039-CCB3	Calibration Blank	09/09/14	11:18

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Total Recoverable** **Sequence ID#:** 1409050

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409050-ICV1	Initial Cal Check	09/11/14	10:04
1409050-SCV1	Secondary Cal Check	09/11/14	10:07
1409050-ICB1	Initial Cal Blank	09/11/14	10:10
1409050-CRL1	Instrument RL Check	09/11/14	10:13
1409050-IFA1	Interference Check A	09/11/14	10:16
1409050-IFB1	Interference Check B	09/11/14	10:20
1409005-BLK1	Blank	09/11/14	10:24
1409005-SRM1	Reference	09/11/14	10:27
C140708-02	14BH-DT-PILOT-BCR1-07081	09/11/14	10:30
1409005-DUP1	Duplicate	09/11/14	10:33
1409050-SRD1	Serial Dilution	09/11/14	10:36
C140708-06	14BH-DT-PILOT-BCR2-07081	09/11/14	10:40
1409005-MS1	Matrix Spike	09/11/14	10:44
C140708-10	14BH-DT-PILOT-BCR3-07081	09/11/14	10:48
1409005-MS3	Matrix Spike	09/11/14	10:52
1409050-CCV1	Calibration Check	09/11/14	10:59
1409050-CCB1	Calibration Blank	09/11/14	11:02
C140708-14	14BH-DT-PILOT-BCR4-07081	09/11/14	11:05
C140708-18	14BH-DT-PILOT-CHIT-070814	09/11/14	11:09
C140708-22	14BH-DT-PILOT-INFL-070814	09/11/14	11:12
C140708-26	14BH-DT-PILOT-INFLD-0708	09/11/14	11:16
C140708-30	14BH-DT-PILOT-NOAH-0708	09/11/14	11:19
C140708-34	14BH-DT-PILOT-POSTE-0708	09/11/14	11:22
C140708-38	14BH-DT-PILOT-POSTI-07081	09/11/14	11:26
C140708-42	14BH-DT-PILOT-SAPS-07081	09/11/14	11:30
C140708-46	14BH-TI-BENCH-TN-CHIT-07	09/11/14	11:33
1409050-CCV2	Calibration Check	09/11/14	11:40
1409050-CCB2	Calibration Blank	09/11/14	11:43
C140708-49	14BH-TI-BENCH-TN-LSTN-0	09/11/14	11:46
C140708-52	14BH-TI-BENCH-TN-NAOH-	09/11/14	11:50
C140708-55	14BH-TI-BENCH-TN-RAW-07	09/11/14	11:54
C140708-58	14BH-TI-BENCH-TN-RAWD-	09/11/14	11:58
1409050-CCV3	Calibration Check	09/11/14	12:05
1409050-CCB3	Calibration Blank	09/11/14	12:08

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Total Recoverable** **Sequence ID#:** 1409053

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409053-ICV1	Initial Cal Check	09/11/14	12:39
1409053-SCV1	Secondary Cal Check	09/11/14	12:42
1409053-ICB1	Initial Cal Blank	09/11/14	12:46
1409053-CRL1	Instrument RL Check	09/11/14	12:49
1409053-IFA1	Interference Check A	09/11/14	12:52
1409053-IFB1	Interference Check B	09/11/14	12:56
1409005-BLK2	Blank	09/11/14	12:59
C140708-02	14BH-DT-PILOT-BCR1-07081	09/11/14	13:02
1409005-DUP2	Duplicate	09/11/14	13:05
1409053-SRD1	Serial Dilution	09/11/14	13:08
C140708-06	14BH-DT-PILOT-BCR2-07081	09/11/14	13:11
1409005-SRM2	Reference	09/11/14	13:14
1409005-MS2	Matrix Spike	09/11/14	13:17
C140708-10	14BH-DT-PILOT-BCR3-07081	09/11/14	13:20
1409005-MS4	Matrix Spike	09/11/14	13:23
1409053-CCV1	Calibration Check	09/11/14	13:29
1409053-CCB1	Calibration Blank	09/11/14	13:33
C140708-14	14BH-DT-PILOT-BCR4-07081	09/11/14	13:36
C140708-18	14BH-DT-PILOT-CHIT-07081	09/11/14	13:39
C140708-22	14BH-DT-PILOT-INFL-070814	09/11/14	13:47
C140708-30	14BH-DT-PILOT-NOAH-0708	09/11/14	13:53
C140708-34	14BH-DT-PILOT-POSTE-0708	09/11/14	13:56
C140708-42	14BH-DT-PILOT-SAPS-07081	09/11/14	14:02
C140708-46	14BH-TI-BENCH-TN-CHIT-0	09/11/14	14:05
1409053-CCV2	Calibration Check	09/11/14	14:27
1409053-CCB2	Calibration Blank	09/11/14	14:30
C140708-49	14BH-TI-BENCH-TN-LSTN-0	09/11/14	14:34
C140708-52	14BH-TI-BENCH-TN-NAOH-	09/11/14	14:37
C140708-55	14BH-TI-BENCH-TN-RAW-0	09/11/14	14:40
C140708-58	14BH-TI-BENCH-TN-RAWD-	09/11/14	14:43
C140708-26	14BH-DT-PILOT-INFLD-0708	09/11/14	14:49
C140708-38	14BH-DT-PILOT-POSTI-07081	09/11/14	14:52
1409053-CCV3	Calibration Check	09/11/14	15:18
1409053-CCB3	Calibration Blank	09/11/14	15:22

Chain of Custody Record

From: CDM Smith
555 17th Street, Suite 1100
Denver, CO 80202

Barker-Hughesville Mining District Superfund Site
CDM Smith
50 West 14th Street, Suite 200
Helena, Montana 59601

Page: 1 of 1

Send To: EPA Region 8 Laboratory
Attn: ESAT R8/Scott Walker
16194 W 45th Dr.
Golden, CO 80403

via: Hand Delivery

Ship Date: 7/10/2014

Sample Placed in Cooler/Bag	Sample ID	Sample Date	Sample Time	Sample Type (S=soil) (W=water)	# of Bottles	Turn Around Time	Total Metals	Dissolved Metals	Alkalinity, Sulfate	Comments	Sample Disposition	Sample Received by Lab
	14BH-TI-BENCH-TN-RAW-070814	7/8/2014	1630	W	9	Standard (21 days)	X	X	X	Triplicate sample for MS/MSD		
	14BH-TI-BENCH-TN-RAWD-070814	7/8/2014	1650	W	3		X	X	X			
	14BH-TI-BENCH-TN-NAOH-070814	7/8/2014	1730	W	3		X	X	X			
	14BH-TI-BENCH-TN-CHIT-070814	7/8/2014	MF ~~1855~~ 1915	W	3		X	X	X			
	14BH-TI-BENCH-TN-LSTN-070814	7/8/2014	MF ~~1915~~ 1855	W	3		X	X	X			

Total No. of Samples: 5

Remarks: Send reports to Nick Anton (antonnr@cdmsmith.com 720 264-1147) and Michael Fischer (fischermj@cdmsmith.com 303-383-2328).
Dissolved metals and anions were field filtered (0.45 micron)

Relinquished by (Signature and Company)	Date/Time	Received by (Signature and Company)	Date/Time	Sample Condition Upon Receipt
Michael J. Fischer CDM Smith	7/10/14 1443		7-10-13 15:18	

CHAIN OF CUSTODY RECORD

CDM Smith Danny T Pilot Test

NOTES: Limited sample volumes due to treatability testing
Contact: Angela Franden, CDM Smith (406)441-1400

SAMPLE NUMBER	DATE	TIME	MATRIX	Preservative	Type & No. of Containers	Total Metals (TAL), 200.7 or 200.8	Dissolved Metals (TAL), 200.7 or 200.8	Alkalinity, Anions (sulfate, chloride, fluoride)	Nitrate+Nitrite, Ammonia	Other Instructions and Notes
14BH-DT-PILOT-INFL-070814	7/8/14	8:45	aqueous	HNO3 (metals), H2SO4 (nutrients), cool	3, 125 mL poly	X	X	X		TAL metals = Al, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, Tl, Zn.
14BH-DT-PILOT-INFLD-070814	7/8/14	9:05	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-SAPS-070814	7/8/14	9:15	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-CHIT-070814	7/8/14	9:25	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-NAOH-070814	7/8/14	9:40	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-BCR1-070814	7/8/14	9:55	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR2-070814	7/8/14	10:10	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR3-070814	7/8/14	10:30	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR4-070814	7/8/14	10:50	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-POSTI-070814	7/8/14	11:05	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-POSTE-070814	7/8/14	11:25	aqueous		4, 125 mL poly	X	X	X	X	

Relinquished by: (*Signature*) Lauren Helland	**Date/Time** 07/09/14 0615	**Received for Laboratory by: (*Signature*)**		
Received by: (*Signature*)	**Date/Time** 7/10/2014 @ 12:30	**Airbill No.(s)**	**Carrier Name:** FedEx	**Lab:** USEPA Lab Region 8

ESAT

C140708

ESAT Technical Direction Form

Contract No. EPW13028
EPA Region 8

Site ID: 085N
TDF ID: A-046

Date Issued: 5/29/2014
Date Updated:

Date Closed By:

Name: Barker-Hughesville Treatability Study July

Details: The Contractor shall analyze several water samples associated with the treatability study at the Barker-Hughesville Superfund site as indicated in the Analytical Information Section. The samples will be sent to the ESAT R8 Lab during the 2014 field season starting in mid-June though early October 2014. There will be 9 sampling events associated with this project averaging approximately 10 samples per an event. The samples will be collected by Nick Anton/Erin Louden of CDM Smith.

Samples designated as influent samples (-INF) are expected to have high metal concentrations and should be analyzed by 200.7. Additionally, metals with sufficiently high concentrations may be reported from the 200.7 analyses.

ESAT should return the coolers to the following address:
CDM Smith/Lauren Helland
50 West 14th Street, Suite 200
Helena, MT 59601
406-441-1435
FedEx # 1323-6393-5

TO02/Subtask 02b: Inorganic Chemistry

Site RPM: Roger Hoogerheide

Analytical Information:

MATRIX

☑ Water ☐ Soils ☐ Vegetation ☐ Biota

WET CHEM

☐ TSS ☐ TDS ☐ DOC ☑ Alk ☑ Chloride ☑ Sulfate ☑ Fluoride ☑ Nitrate ☑ Nitrite
Other: Analyze for Ammonia and report NO2 and NO3 as NO2-NO3 combined.

METALS

☑ Dissolved ☑ Total Recoverable ☐ Total ☐ Hardness (Calc)
200.7: ☐ Ag ☑ Al ☐ As ☐ Ba ☐ Be ☐ B ☐ Ca ☐ Cd ☐ Co ☐ Cr ☐ Cu ☑ Fe ☐ K ☐ Mg
☒ Mn ☐ Mo ☐ Na ☐ Ni ☐ Pb ☐ Sb ☐ Se ☐ Sr ☐ Ti ☐ Tl ☐ V ☑ Zn ☐ SiO2
200.8: ☐ Ag ☐ Al ☑ As ☐ Ba ☐ Be ☑ Cd ☐ Co ☐ Cr ☑ Cu ☑ Mn ☐ Mo ☑ Ni ☑ Pb ☐ Sb
☐ Se ☐ Th ☐ Tl ☐ U ☐ V ☐ Zn
7470/7471/747 ☐ Hg

Sv
09/08/14

FIBERS

☐ PLM ☐ TEM

Deliverables

ID	*Description*	*Due Date*	*Submission Date*
1	Provide final deliverable package to Task Monitor no later than 30 days after delivery of samples.		

5/29/14

ENERGY LABORATORIES
www.energylab.com
Analytical Excellence Since 1952
Helena, MT 877-472-0711 • Billings, MT 800-735-4489 • Casper, WY 888-235-0515
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ANALYTICAL SUMMARY REPORT

August 05, 2014

CDM Federal Programs
555 17th St Ste 1100
Denver, CO 80202

Work Order: H14070430 Quote ID: H823 - Baker-Hughsville Superfund Site
Project Name: 79171.3383.325.TTZ.DANNY

Energy Laboratories Inc Helena MT received the following 11 samples for CDM Federal Programs on 7/24/2014 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H14070430-001	14BH-DT-PILOT-INF-072214	07/22/14 8:30	07/24/14	Aqueous	Acidity, Total as CaCO3 Phosphorus, Orthophosphate as P
H14070430-002	14BH-DT-PILOT-SAPS-072214	07/22/14 8:45	07/24/14	Aqueous	Same As Above
H14070430-003	14BH-DT-PILOT-CHIT-072214	07/22/14 9:00	07/24/14	Aqueous	Same As Above
H14070430-004	14BH-DT-PILOT-NAOH-072214	07/22/14 9:10	07/24/14	Aqueous	Same As Above
H14070430-005	14BH-DT-PILOT-BCR1-072214	07/22/14 9:25	07/24/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Phosphorus, Orthophosphate as P Sulfide, Iodine Titrimetric
H14070430-006	14BH-DT-PILOT-BCR2-072214	07/22/14 9:45	07/24/14	Aqueous	Same As Above
H14070430-007	14BH-DT-PILOT-BCR2D-072214	07/22/14 10:00	07/24/14	Aqueous	Same As Above
H14070430-008	14BH-DT-PILOT-BCR3-072214	07/22/14 10:10	07/24/14	Aqueous	Same As Above
H14070430-009	14BH-DT-PILOT-BCR4-072214	07/22/14 10:20	07/24/14	Aqueous	Same As Above
H14070430-010	14BH-DT-PILOT-POSTI-072214	07/22/14 10:30	07/24/14	Aqueous	Same As Above
H14070430-011	14BH-DT-PILOT-POSTE-072214	07/22/14 10:45	07/24/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Phosphorus, Orthophosphate as P Sulfide, Methylene Blue Colorimetric

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

CLIENT: CDM Federal Programs
Project: 79171.3383.325.TTZ.DANNY
Work Order: H14070430

Report Date: 08/04/14

CASE NARRATIVE

Tests associated with analyst identified as ELI-B were subcontracted to Energy Laboratories, 1120 S. 27th St., Billings, MT, EPA Number MT00005.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/04/14
Project:	79171.3383.325.TTZ.DANNY	**Collection Date:**	07/22/14 08:30
Lab ID:	H14070430-001	**DateReceived:**	07/24/14
Client Sample ID:	14BH-DT-PILOT-INF-072214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	790	mg/L	D	4.0		A2310 B	07/25/14 10:44 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.322	mg/L	H	0.005		E365.1	07/24/14 16:09 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/04/14
Project:	79171.3383.325.TTZ.DANNY	**Collection Date:**	07/22/14 08:45
Lab ID:	H14070430-002	**DateReceived:**	07/24/14
Client Sample ID:	14BH-DT-PILOT-SAPS-072214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	300	mg/L	D	4.0		A2310 B	07/25/14 10:54 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.30	mg/L	DH	0.01		E365.1	07/24/14 16:12 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: 79171.3383.325.TTZ.DANNY
Lab ID: H14070430-003
Client Sample ID: 14BH-DT-PILOT-CHIT-072214

Report Date: 08/04/14
Collection Date: 07/22/14 09:00
DateReceived: 07/24/14
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	07/25/14 10:59 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	5.93	mg/L	DH	0.02		E365.1	07/24/14 16:13 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/04/14
Project:	79171.3383.325.TTZ.DANNY	**Collection Date:**	07/22/14 09:10
Lab ID:	H14070430-004	**DateReceived:**	07/24/14
Client Sample ID:	14BH-DT-PILOT-NAOH-072214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	390	mg/L	D	4.0		A2310 B	07/25/14 11:06 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.013	mg/L	H	0.005		E365.1	07/24/14 16:15 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/04/14
Project:	79171.3383.325.TTZ.DANNY	**Collection Date:**	07/22/14 09:25
Lab ID:	H14070430-005	**DateReceived:**	07/24/14
Client Sample ID:	14BH-DT-PILOT-BCR1-072214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	07/25/14 11:15 / SRW
Sulfide	46	mg/L		1		A4500-S F	07/28/14 11:45 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	710	mg/L	H	200		A5210 B	07/24/14 15:35 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	58.2	mg/L	DH	0.2		E365.1	07/24/14 16:16 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/04/14
Project:	79171.3383.325.TTZ.DANNY	**Collection Date:**	07/22/14 09:45
Lab ID:	H14070430-006	**DateReceived:**	07/24/14
Client Sample ID:	14BH-DT-PILOT-BCR2-072214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	07/25/14 11:22 / SRW
Sulfide	45	mg/L		1		A4500-S F	07/28/14 11:45 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	280	mg/L	H	200		A5210 B	07/24/14 15:38 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	14.4	mg/L	DH	0.1		E365.1	07/24/14 16:17 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/04/14
Project:	79171.3383.325.TTZ.DANNY	**Collection Date:**	07/22/14 10:00
Lab ID:	H14070430-007	**DateReceived:**	07/24/14
Client Sample ID:	14BH-DT-PILOT-BCR2D-072214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	07/25/14 11:29 / SRW
Sulfide	50	mg/L		1		A4500-S F	07/28/14 11:45 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	280	mg/L	H	200		A5210 B	07/24/14 15:41 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	14.0	mg/L	DH	0.1		E365.1	07/24/14 16:19 / cmm

Report Definitions:		
	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/04/14
Project:	79171.3383.325.TTZ.DANNY	**Collection Date:**	07/22/14 10:10
Lab ID:	H14070430-008	**DateReceived:**	07/24/14
Client Sample ID:	14BH-DT-PILOT-BCR3-072214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	07/25/14 11:34 / SRW
Sulfide	120	mg/L		1		A4500-S F	07/28/14 11:45 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	1300	mg/L	H	300		A5210 B	07/24/14 15:42 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	11.6	mg/L	DH	0.1		E365.1	07/24/14 16:20 / cmm

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/04/14
Project:	79171.3383.325.TTZ.DANNY	**Collection Date:**	07/22/14 10:20
Lab ID:	H14070430-009	**DateReceived:**	07/24/14
Client Sample ID:	14BH-DT-PILOT-BCR4-072214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	07/25/14 11:41 / SRW
Sulfide	48	mg/L		1		A4500-S F	07/28/14 11:45 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	200	mg/L	H	200		A5210 B	07/24/14 15:47 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	7.1	mg/L	DH	0.1		E365.1	07/24/14 16:23 / cmm

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: 79171.3383.325.TTZ.DANNY
Lab ID: H14070430-010
Client Sample ID: 14BH-DT-PILOT-POSTI-072214

Report Date: 08/04/14
Collection Date: 07/22/14 10:30
DateReceived: 07/24/14
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	07/25/14 11:48 / SRW
Sulfide	53	mg/L		1		A4500-S F	07/28/14 11:45 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	550	mg/L	H	200		A5210 B	07/24/14 15:49 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	25.5	mg/L	DH	0.2		E365.1	07/24/14 16:43 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/04/14
Project:	79171.3383.325.TTZ.DANNY	**Collection Date:**	07/22/14 10:45
Lab ID:	H14070430-011	**DateReceived:**	07/24/14
Client Sample ID:	14BH-DT-PILOT-POSTE-072214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	07/25/14 11:52 / SRW
Sulfide	3.4	mg/L	D	0.2		A4500-S D	07/28/14 13:15 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	280	mg/L	H	200		A5210 B	07/24/14 15:52 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	4.2	mg/L	DH	0.1		E365.1	07/24/14 16:48 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Report Date: 08/04/14
Project: 79171.3383.325.TTZ.DANNY
Work Order: H14070430

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2310 B									Batch: H140725A
Lab ID: H14070430-001BDUP	Sample Duplicate				Run: MISC WC_140725C				07/25/14 10:49
Acidity, Total as CaCO3	820	mg/L	4.0				3.1	20	
Lab ID: H14070430-011BDUP	Sample Duplicate				Run: MISC WC_140725C				07/25/14 11:57
Acidity, Total as CaCO3	ND	mg/L	4.0					20	
Lab ID: LCS1407250000	Laboratory Control Sample				Run: MISC WC_140725C				07/25/14 10:38
Acidity, Total as CaCO3	950	mg/L	4.0	97	90	110			
Lab ID: MBLK1407250000	Method Blank				Run: MISC WC_140725C				07/25/14 10:34
Acidity, Total as CaCO3	4	mg/L	3						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: 79171.3383.325.TTZ.DANNY

Report Date: 08/04/14
Work Order: H14070430

Analyte		Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method:	**A4500-S D**									Batch: B_R227876
Lab ID:	**MB-R227876**	Method Blank				Run: SUB-B227876				07/28/14 13:15
Sulfide		ND	mg/L	0.002						
Lab ID:	**LCS-R227876**	Laboratory Control Sample				Run: SUB-B227876				07/28/14 13:15
Sulfide		0.222	mg/L	0.040	117	70	130			
Lab ID:	**B14072200-002FMS**	Sample Matrix Spike				Run: SUB-B227876				07/28/14 13:15
Sulfide		0.266	mg/L	0.040	107	70	130			
Lab ID:	**B14072200-002FMSD**	Sample Matrix Spike Duplicate				Run: SUB-B227876				07/28/14 13:15
Sulfide		0.271	mg/L	0.040	110	70	130	1.6	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: 79171.3383.325.TTZ.DANNY

Report Date: 08/04/14
Work Order: H14070430

Analyte		Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method:	**A4500-S F**									Batch: B_R227877
Lab ID:	**MB-R227877**	Method Blank				Run: SUB-B227877				07/28/14 11:45
Sulfide		ND	mg/L	0.5						
Lab ID:	**LCS-R227877**	Laboratory Control Sample				Run: SUB-B227877				07/28/14 11:45
Sulfide		21.5	mg/L	1.0	100	70	130			
Lab ID:	**H14070412-003F**	Sample Matrix Spike				Run: SUB-B227877				07/28/14 11:45
Sulfide		21.9	mg/L	1.0	100	80	120			
Lab ID:	**H14070412-003F**	Sample Matrix Spike Duplicate				Run: SUB-B227877				07/28/14 11:45
Sulfide		21.8	mg/L	1.0	99	80	120	0.7	20	
Lab ID:	**H14070412-001F**	Sample Matrix Spike				Run: SUB-B227877				07/28/14 11:45
Sulfide		22.0	mg/L	1.0	100	80	120			
Lab ID:	**H14070412-001F**	Sample Matrix Spike Duplicate				Run: SUB-B227877				07/28/14 11:45
Sulfide		21.9	mg/L	1.0	99	80	120	0.4	20	
Method:	**A4500-S F**									Batch: B_R227879
Lab ID:	**MB-R227879**	Method Blank				Run: SUB-B227879				07/28/14 11:45
Sulfide		ND	mg/L	0.5						
Lab ID:	**LCS-R227879**	Laboratory Control Sample				Run: SUB-B227879				07/28/14 11:45
Sulfide		21.0	mg/L	1.0	98	70	130			
Lab ID:	**H14070430-008C**	Sample Matrix Spike				Run: SUB-B227879				07/28/14 11:45
Sulfide		216	mg/L	1.0	89	80	120			
Lab ID:	**H14070430-008C**	Sample Matrix Spike Duplicate				Run: SUB-B227879				07/28/14 11:45
Sulfide		216	mg/L	1.0	90	80	120	0.2	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: 79171.3383.325.TTZ.DANNY

Report Date: 08/04/14
Work Order: H14070430

Analyte		Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **A5210 B**								Batch: 140724_1_BOD5-W		
Lab ID: **Dil-H201_140724**	Dilution Water Blank					Run: MISC WC_140724C			07/24/14 15:28	
Oxygen Demand, Biochemical (BOD)		0.15	mg/L	2.0		0	0.2			
Lab ID: **GGA1_140724**	Laboratory Control Sample					Run: MISC WC_140724C			07/24/14 15:31	
Oxygen Demand, Biochemical (BOD)		210	mg/L	56	106	85	115			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: 79171.3383.325.TTZ.DANNY

Report Date: 08/04/14
Work Order: H14070430

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **E365.1**					Analytical Run: FIA202-HE_140724D				
Lab ID: **ICV**	Initial Calibration Verification Standard								07/24/14 15:59
Phosphorus, Orthophosphate as P	0.238	mg/L	0.0050	95	90	110			
Lab ID: **ICB**	Initial Calibration Blank, Instrument Blank								07/24/14 16:00
Phosphorus, Orthophosphate as P	-0.00184	mg/L	0.0050		0	0			
Lab ID: **CCV**	Continuing Calibration Verification Standard								07/24/14 16:03
Phosphorus, Orthophosphate as P	0.0896	mg/L	0.0050	90	90	110			
Lab ID: **CCV**	Continuing Calibration Verification Standard								07/24/14 16:42
Phosphorus, Orthophosphate as P	0.0959	mg/L	0.0050	96	90	110			
Method: **E365.1**									Batch: R99139
Lab ID: **LFB**	Laboratory Fortified Blank				Run: FIA202-HE_140724D				07/24/14 16:02
Phosphorus, Orthophosphate as P	0.183	mg/L	0.0050	92	90	110			
Lab ID: **H14070430-001AMS**	Sample Matrix Spike				Run: FIA202-HE_140724D				07/24/14 16:10
Phosphorus, Orthophosphate as P	0.783	mg/L	0.0050	115	90	110			S
Lab ID: **H14070430-001AMSD**	Sample Matrix Spike Duplicate				Run: FIA202-HE_140724D				07/24/14 16:11
Phosphorus, Orthophosphate as P	0.796	mg/L	0.0050	119	90	110	1.7	20	S
Lab ID: **H14070430-010AMS**	Sample Matrix Spike				Run: FIA202-HE_140724D				07/24/14 16:44
Phosphorus, Orthophosphate as P	66.4	mg/L	0.20	102	90	110			
Lab ID: **H14070430-010AMSD**	Sample Matrix Spike Duplicate				Run: FIA202-HE_140724D				07/24/14 16:45
Phosphorus, Orthophosphate as P	89.6	mg/L	0.20	160	90	110	30	20	SR

Qualifiers:

RL - Analyte reporting limit.
ND - Not detected at the reporting limit.
R - RPD exceeds advisory limit.
S - Spike recovery outside of advisory limits.

Workorder Receipt Checklist

CDM Federal Programs H14070430

Login completed by: Tracy L. Lorash
Reviewed by: BL2000\wjohnson
Reviewed Date: 8/4/2014

Date Received: 7/24/2014
Received by: TLL
Carrier name: Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☐	No ☑	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	7.9°C No Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☑	No ☐	Not Applicable ☐

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

14BH-DT-PILOT-INF-072214 and SAPS-072214 samples were received past the method holding time for Orthophosphate. All other Orthophosphate and BOD samples were not received with sufficient time to complete analysis within method recommended hold time. Per Tom, we are to analyze. Tl 7/24/14

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 1 of 2

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM SMITH

Report Mail Address (Required):

☒ No Hard Copy Email: frandsenak@cdmsmith.com

Invoice Address (Required):

☒ No Hard Copy Email: SAME

Project Name, PWS, Permit, Etc. 79171.3383.325. ~~79171.3383-312-R12.MONIT~~ TTZ.DANNY

Sample Origin State: MT

EPA/State Compliance: Yes ☐ No ☐

Contact Name: ANGELA FRANDSEN

Phone/Fax: 441-1400

Cell: 439-3776

Sampler: (Please Print) TOM ASKIN

Invoice Contact & Phone: SAME

Purchase Order:

Quote/Bottle Order:

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: ____
☐ Other: ____
☒ EDD/EDT (Electronic Data) Format: xls
☐ LEVEL IV
☐ NELAC

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids
Vegetation Bioassay Other
DW - Drinking Water

ANALYSIS REQUESTED

SEE ATTACHED

Standard Turnaround (TAT)

RUSH

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: B.O.D & ACIDITY COMBINED IN 1000 mL BOTTLES

Shipped by: Hand

Cooler ID(s): Y

Receipt Temp 7.9 °C

On Ice: Y [✓ N]

Custody Seal
On Bottle Y [✓ N]
On Cooler Y [✓ N]

Intact Y N

Signature Match Y N

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	ORTHO-PHOSPHATE	ACIDITY	B.O.D.	SULFIDE	LABORATORY USE ONLY
1 14BH-DT-PILOT-INF-072214	7/22/14	8:30	2 W	X	X			H14070430
2 14BH-DT-PILOT-SAPS-072214		8:45	2 W	X	X			
3 14BH-DT-PILOT-CHIT-072214		9:00	2 W	X	X			
4 14BH-DT-PILOT-NAOH-072214		9:10	2 W	X	X			
5 14BH-DT-PILOT-BCR1-072214		9:25	3 W	X	X	X	X	
6 14BH-DT-PILOT-BCR2-072214		9:45	3 W	X	X	X	X	
7 14BH-DT-PILOT-BCR2D-072214		10:00	3 W	X	X	X	X	
8 14BH-DT-PILOT-BCR3-072214		10:10	3 W	X	X	X	X	
9 14BH-DT-PILOT-BCR4-072214		10:20	3 W	X	X	X	X	
10 14BH-DT-PILOT-POST1-072214	↓	10:30	3 W	X	X	X	X	

Custody Record MUST be Signed

Relinquished by (print): TOM ASKIN Date/Time: 7/24/14 / 8:54 Signature:
Relinquished by (print): Date/Time: Signature:
Received by (print): Date/Time: Signature:
Received by (print): Date/Time: Signature:
Received by Laboratory: Tracy [illegible] Date/Time: 7/24/14 8:54 Signature:

Sample Disposal: Return to Client: ____ Lab Disposal: ____

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 2 of 2

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM SMITH	Project Name, PWS, Permit, Etc. 79171.3383.325.TTZ.DANNY	Sample Origin State: MT	EPA/State Compliance: Yes ☐ No ☐
Report Mail Address (Required): ☒ No Hard Copy Email: frandsenak@cdmsmith.com	Contact Name: ANGELA FRANDSEN Phone/Fax: 441-1400	Cell: 439-3776	Sampler: (Please Print) TOM ASKIN
	Invoice Contact & Phone: SAME	Purchase Order:	Quote/Bottle Order:

Invoice Address (Required):

☒ No Hard Copy Email: SAME

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: ____
☐ Other: ____
☒ EDD/EDT (Electronic Data)
Format: xls
☐ LEVEL IV
☐ NELAC

ANALYSIS REQUESTED

➡ Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments:
B.O.D. & ACIDITY COMBINED IN 1000 mL BOTTLES

Shipped by: Hand
Cooler ID(s): Y
Receipt Temp 7.9 °C
On Ice: Y [✓ N]
Custody Seal On Bottle Y [✓ N]
On Cooler Y [✓ N]
Intact Y N
Signature Match Y N

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX (Number of Containers; Sample Type: A W S V B O DW — Air Water Soils/Solids Vegetation Bioassay Other DW - Drinking Water)	ORTHO-PHOSPHATE	ACIDITY	B.O.D.	SULFIDE						SEE ATTACHED	Standard Turnaround (TAT)	RUSH		LABORATORY USE ONLY
1 14BH-DT-PILOT-POSTE-072214	7/22/14	10:45	3 W	X	X	X	X										H14070430
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

Custody Record MUST be Signed

Relinquished by (print): TOM ASKIN	Date/Time: 7/24/14/8:54	Signature: Tom Askin	Received by (print):	Date/Time:	Signature:
Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Sample Disposal: Return to Client: ____	Lab Disposal: ____		Received by Laboratory: Tracy Lorash	Date/Time: 7/24/14 8:54	Signature:

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested.
This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.
Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

U.S. Environmental Protection Agency
Region 8
Technical and Management Services

Laboratory Services Program Certificate of Analysis

Ref: 8TMS-L

MEMORANDUM

Date: 09/18/14

Subject: Analytical Results--- **Barker-Hughesville_Treatability 3_JUL 2014_A046 / A-046**

From: Don Goodrich; EPA Region 8 Analytical Chemistry WAM

To: Roger Hoogerheide
Superfund
8 MO

Received Sample Set(s), [Work Order : Date Received]:
[C140717 : 07/24/2014]

Attached are the analytical results for the samples received from the Barker-Hughesville_Treatability 3_JUL 2014_A046 sampling event, according to TDF A-046. All analyses were performed within their method specified holding times unless otherwise noted in the following narrative.

These samples were prepared, analyzed, and verified by the Environmental Services Assistance Team Laboratory (ESAT) according to the requirements of the Technical Direction Form (TDF).

Note: The laboratory herewith transmits this deliverable to the program/project partner for determination of "final data usability" which may include data validation and data quality asessment per and in accordance with EPA QA/G-8, *Guidance on Environmental Data Verification and Data Validation*, November 2002, EPA/240/R-02/004. Laboratory data qualifiers are applied based on the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004, referred to as "NFGI".

Laboratory policy is to dispose of any remaining sample 60 days after data analysis packages are delivered to EPA. If you would like the laboratory to retain the samples for a period longer than 60 days, please contact Don Goodrich within the 60 day period at (303) 312-6687.

Case Narrative

C140717

Quality Assessment: Unless indicated by exception, the QA/QC associated with this sample set produced data within the TDF-specified criteria.

Holding Times: All samples were analyzed within their method-specified technical holding time(s).

1. Initial and Continuing calibration blanks (ICBs and CCBs).
   Exceptions: None.
2. Preparation (PB) / Method blanks (MB)
   Exceptions: None.
3. Interference Checks (ICSA / ICSAB) for ICP-MS and ICP-OE analyses only.
   Exceptions: None.
4. Initial and Continuing calibration verification analyses (ICVs, SCVs and CCVs).
   Exceptions: In ICP-MS sequence 1409083, copper and nickel recovered low in the ending CCV. All bracketed samples were qualified "J" as estimated for copper and nickel.
5. Laboratory Control Sample (LCS) or second source analysis or SRM.
   Exceptions: None.
6. Laboratory Fortified blank (LFB) / Blank spike (BS), same source as used for the matrix spikes. PBS performed with analyses/methods requiring preparation or digestion prior to analysis.
   Exceptions: None.
7. Contract Reporting Detection Limit Standard, labeled as CRA, CRDL or CRL.
   Exceptions: None.
8. Laboratory Duplicate (DUP). "Source" identifies field sample duplicated in the laboratory. If either the "source" or the duplicate result is <5X the reporting limit, the %D limit of 20% does not apply.
   Exceptions: None.
9. Laboratory Matrix Spike (MS) and spike duplicate (MSD). "Source" defines original field sample fortified prior to analysis. Percent recovery (%R) limits do not apply when sample concentration(s) exceed the corresponding analyte spike level by a factor of 4 or greater.
   Exceptions: In ICP-MS batches 1409073 and 1409057, copper and nickel recovered low in the all matrix spikes. No qualifiers were assigned.
10. Serial Dilution sample analysis (SRD). "Source" is parent field sample diluted 1:5 in the laboratory. Performed for ICP-OE and ICP-MS metals analyses. Percent difference (%D) limits do not apply when analyte concentration(s) are below 50x the source sample's MDL (or 10x it's PQL).
    Exceptions: None.
11. Internal standards, criteria specified for ICP-MS analyses only, monitored at the instrument.
    Exceptions: None.
12. Any calibration using more than two-points produced a correlation coefficient equal to or greater than 0.995.
    Exceptions: None.

Acronyms and Definitions:

ESAT	Environmental Services Assistance Team
J	Data Estimated qualifier (also applied to all data less than PQL, greater than or equal to MDL)
MDL	Method Detection Limit
PQL	Practical Quantitation Limit, also known as reporting limit.
RPD	Relative Percent Difference (difference divided by the mean)
%D	Percent difference, serial dilution criteria unit, difference divided by the original result.
%R	Percent recovery, analyzed (less sample contribution) divided by true value
<	Analyte NOT DETECTED at or above the Method Detection Limit (MDL)
mg/L	Parts per million (millligrams per liter). Solids equivalent = mg/Kg.
ug/L	Parts per billion (micrograms per liter). Solids equivalent = ug/Kg.
NR	No Recovery (matrix spike) - Often seen for calcium/magnesium when their concentration exceeds the spike level by > 4x.
NFGI	*USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004
RE	Sample Re-analysis. Usually seen on raw data and sequences for required sample dilutions due to over-range analytes.
U	Analyte not detected at or above MDL qualifier
D	Diluted value qualifier.

Method(s) Summary:

As defined in the Technical Direction Form (TDF), some or all of the methods listed below were used for the determination of the reported target analytes.

From EPA's *Methods for the Determination of Metals in Environmental Samples* , Supplement I, May 1994, dissolved, total, and/or total recoverable metals were determined by:

- Method 200.7 / 6010B using a PE Optima ICP -OE (ICP).
- Method 200.8 / 6020 using a Perkin -Elmer Elan 6000 ICP-MS.
- Method 200.2 for total recoverable metals (only) digestion.
- Method 245.1 using a Perkin -Elmer FIMS CVAA (aqueous mercury only).

From *Standard Methods for the Examination of Water and Wastewater* , 18th Edition, 1992, Method 2340B was used for the calculated hardness determination. Hardness is reported as mg (milligram) equivalent $CaCO_3$ per liter (L) determined as follows:

Calculated hardness = 2.497 * (Calcium, mg/L) + 4.118 * (Magnesium, mg/L).

From *EPA's Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW -846*,

- Method 3015A was used for microwave assisted total metals digestion.
- Method 7473 was used for mercury in solids .

From EPA's *Determination of Inorganic Anions by Ion Chromatography* , Revision 2.1, 1993, Method 300.0 was used to determine the anions.

From EPA's *Methods for Chemical Analysis of Water and Wastes* , March 1983:

- Method 310.1 was followed for the alkalinity determination.
- Method 160.1 was followed for gravimetric total dissolved solids (TDS) determination.
- Method 160.2 was used for gravimetric total suspended solids (TSS) determination.
- Method 415.3 was used for total organic carbon (TOC) determination using either an Apollo 9000 or Phoenix 8000 Non-Dispersive IR (NDIR) system. Also known as dissolved organic carbon (DOC) when performed on the dissolved sample fraction.

The quality control procedures listed in the TDF request were utilized by ESAT to verify accuracy of the results and to evaluate any matrix interferences.

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-072214 **Date / Time Sampled:** 07/22/14 09:25 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140717-02 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**172**	J	ug/L	100	5	09/17/2014	SV	1409072
200.7	Iron	< 1250	U	ug/L	500	5	09/17/2014	SV	1409072
200.7	**Manganese**	**57300**		ug/L	10.0	5	09/17/2014	SV	1409072
200.7	Zinc	< 100	U	ug/L	50.0	5	09/17/2014	SV	1409072
200.8	**Arsenic**	**5.24**	J	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
2340B	**Hardness**	**1340**		mg/L	8	5	09/17/2014	SV	1409072

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-072214 **Date / Time Sampled:** 07/22/14 09:45 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140717-05 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	09/17/2014	SV	1409072
200.7	Iron	< 1250	U	ug/L	500	5	09/17/2014	SV	1409072
200.7	**Manganese**	**46300**		ug/L	10.0	5	09/17/2014	SV	1409072
200.7	Zinc	< 100	U	ug/L	50.0	5	09/17/2014	SV	1409072
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	**Copper**	**5.43**	J	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
2340B	**Hardness**	**895**		mg/L	8	5	09/17/2014	SV	1409072

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2D-072214 **Date / Time Sampled:** 07/22/14 10:00 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140717-09 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	09/17/2014	SV	1409072
200.7	Iron	< 1250	U	ug/L	500	5	09/17/2014	SV	1409072
200.7	**Manganese**	**50600**		ug/L	10.0	5	09/17/2014	SV	1409072
200.7	**Zinc**	**50.7**	J	ug/L	50.0	5	09/17/2014	SV	1409072
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	**Copper**	**6.81**	J	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
2340B	**Hardness**	**882**		mg/L	8	5	09/17/2014	SV	1409072

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-072214 **Date / Time Sampled:** 07/22/14 10:10 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140717-13 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 50.0	U	ug/L	20.0	1	09/17/2014	SV	1409072
200.7	Iron	< 250	U	ug/L	100	1	09/17/2014	SV	1409072
200.7	**Manganese**	**11900**		ug/L	2.00	1	09/17/2014	SV	1409072
200.7	**Zinc**	**40.8**		ug/L	10.0	1	09/17/2014	SV	1409072
200.8	**Arsenic**	**16.2**	J	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	**Copper**	**5.69**	J	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
2340B	**Hardness**	**2410**		mg/L	2	1	09/17/2014	SV	1409072

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-072214 **Date / Time Sampled:** 07/22/14 10:20 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140717-17 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	09/17/2014	SV	1409072
200.7	Iron	< 1250	U	ug/L	500	5	09/17/2014	SV	1409072
200.7	**Manganese**	**62800**		ug/L	10.0	5	09/17/2014	SV	1409072
200.7	**Zinc**	**324**		ug/L	50.0	5	09/17/2014	SV	1409072
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	**Copper**	**6.00**	J	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
2340B	**Hardness**	**552**		mg/L	8	5	09/17/2014	SV	1409072

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-072214 **Date / Time Sampled:** 07/22/14 09:00 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140717-21 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**277**		ug/L	100	5	09/17/2014	SV	1409072
200.7	**Iron**	**4310**		ug/L	500	5	09/17/2014	SV	1409072
200.7	**Manganese**	**96300**		ug/L	10.0	5	09/17/2014	SV	1409072
200.7	**Zinc**	**297**		ug/L	50.0	5	09/17/2014	SV	1409072
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
2340B	**Hardness**	**2010**		mg/L	8	5	09/17/2014	SV	1409072

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INF-072214 **Date / Time Sampled:** 07/22/14 08:30 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140717-24 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**14600**		ug/L	100	5	09/17/2014	SV	1409072
200.7	**Iron**	**181000**		ug/L	500	5	09/17/2014	SV	1409072
200.7	**Manganese**	**116000**		ug/L	10.0	5	09/17/2014	SV	1409072
200.7	**Zinc**	**62700**		ug/L	50.0	5	09/17/2014	SV	1409072
200.8	**Arsenic**	**186**		ug/L	5.00	10	09/17/2014	SV	1409073
200.8	**Cadmium**	**276**		ug/L	1.00	10	09/17/2014	SV	1409073
200.8	**Copper**	**919**		ug/L	5.00	10	09/17/2014	SV	1409073
200.8	**Lead**	**199**		ug/L	1.00	10	09/17/2014	SV	1409073
200.8	**Nickel**	**17.9**		ug/L	5.00	10	09/17/2014	SV	1409073
2340B	**Hardness**	**372**		mg/L	8	5	09/17/2014	SV	1409072

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NAOH-072214 **Date / Time Sampled:** 07/22/14 09:10 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140717-27 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**12900**		ug/L	100	5	09/17/2014	SV	1409072
200.7	**Iron**	**563**	J	ug/L	500	5	09/17/2014	SV	1409072
200.7	**Manganese**	**112000**		ug/L	10.0	5	09/17/2014	SV	1409072
200.7	**Zinc**	**63000**		ug/L	50.0	5	09/17/2014	SV	1409072
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	**Cadmium**	**285**		ug/L	1.00	10	09/17/2014	SV	1409073
200.8	**Copper**	**911**		ug/L	5.00	10	09/17/2014	SV	1409073
200.8	**Lead**	**86.7**		ug/L	1.00	10	09/17/2014	SV	1409073
200.8	**Nickel**	**19.4**		ug/L	5.00	10	09/17/2014	SV	1409073
2340B	**Hardness**	**358**		mg/L	8	5	09/17/2014	SV	1409072

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-072214 **Date / Time Sampled:** 07/22/14 10:45 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140717-30 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 50.0	U	ug/L	20.0	1	09/17/2014	SV	1409072
200.7	Iron	< 250	U	ug/L	100	1	09/17/2014	SV	1409072
200.7	**Manganese**	**13100**		ug/L	2.00	1	09/17/2014	SV	1409072
200.7	**Zinc**	**16.3**	J	ug/L	10.0	1	09/17/2014	SV	1409072
200.8	**Arsenic**	**16.5**	J	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
2340B	**Hardness**	**933**		mg/L	2	1	09/17/2014	SV	1409072

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-072214 **Date / Time Sampled:** 07/22/14 10:30 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140717-34 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**29.1**	J	ug/L	20.0	1	09/17/2014	SV	1409072
200.7	Iron	< 250	U	ug/L	100	1	09/17/2014	SV	1409072
200.7	**Manganese**	**42100**		ug/L	2.00	1	09/17/2014	SV	1409072
200.7	**Zinc**	**31.3**		ug/L	10.0	1	09/17/2014	SV	1409072
200.8	**Arsenic**	**5.88**	J	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	**Copper**	**5.52**	J	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	**Lead**	**1.48**	J	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
2340B	**Hardness**	**1300**		mg/L	2	1	09/17/2014	SV	1409072

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-072214 **Date / Time Sampled:** 07/22/14 08:45 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140717-38 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**321**		ug/L	100	5	09/17/2014	SV	1409072
200.7	**Iron**	**112000**		ug/L	500	5	09/17/2014	SV	1409072
200.7	**Manganese**	**118000**		ug/L	10.0	5	09/17/2014	SV	1409072
200.7	**Zinc**	**5520**		ug/L	50.0	5	09/17/2014	SV	1409072
200.8	**Arsenic**	**9.62**	J	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/17/2014	SV	1409073
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409073
200.8	**Nickel**	**7.19**	J	ug/L	5.00	10	09/17/2014	SV	1409073
2340B	**Hardness**	**677**		mg/L	8	5	09/17/2014	SV	1409072

"J" Qualifier indicates an estimated value

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-072214 **Date / Time Sampled:** 07/22/14 09:25 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140717-01 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**185**	J	ug/L	100	5	09/17/2014	SV	1409057
200.7	**Iron**	**687**	J	ug/L	500	5	09/17/2014	SV	1409057
200.7	**Manganese**	**64200**		ug/L	10.0	5	09/17/2014	SV	1409057
200.7	**Zinc**	**497**		ug/L	50.0	5	09/17/2014	SV	1409057
200.8	**Arsenic**	**6.77**	J	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409057
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	**Lead**	**2.23**		ug/L	1.00	10	09/17/2014	SV	1409057
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/17/2014	SV	1409057

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-072214 **Date / Time Sampled:** 07/22/14 09:45 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140717-04 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**148**	J	ug/L	100	5	09/17/2014	SV	1409057
200.7	**Iron**	**615**	J	ug/L	500	5	09/17/2014	SV	1409057
200.7	**Manganese**	**48500**		ug/L	10.0	5	09/17/2014	SV	1409057
200.7	**Zinc**	**326**		ug/L	50.0	5	09/17/2014	SV	1409057
200.8	**Arsenic**	**7.73**	J	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409057
200.8	**Copper**	**11.7**		ug/L	5.00	10	09/17/2014	SV	1409057
200.8	**Lead**	**5.73**		ug/L	1.00	10	09/17/2014	SV	1409057
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/17/2014	SV	1409057

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2D-072214 **Date / Time Sampled:** 07/22/14 10:00 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140717-08 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**116**	J	ug/L	100	5	09/17/2014	SV	1409057
200.7	**Iron**	**517**	J	ug/L	500	5	09/17/2014	SV	1409057
200.7	**Manganese**	**51100**		ug/L	10.0	5	09/17/2014	SV	1409057
200.7	**Zinc**	**287**		ug/L	50.0	5	09/17/2014	SV	1409057
200.8	**Arsenic**	**7.42**	J	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409057
200.8	**Copper**	**8.03**	J	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	**Lead**	**4.27**		ug/L	1.00	10	09/17/2014	SV	1409057
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/17/2014	SV	1409057

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-072214 **Date / Time Sampled:** 07/22/14 10:10 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140717-12 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 50.0	U	ug/L	20.0	1	09/17/2014	SV	1409057
200.7	**Iron**	**152**	J	ug/L	100	1	09/17/2014	SV	1409057
200.7	**Manganese**	**13000**		ug/L	2.00	1	09/17/2014	SV	1409057
200.7	**Zinc**	**162**		ug/L	10.0	1	09/17/2014	SV	1409057
200.8	**Arsenic**	**19.7**	J	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409057
200.8	**Copper**	**9.34**	J	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	**Lead**	**1.97**	J	ug/L	1.00	10	09/17/2014	SV	1409057
200.8	**Nickel**	**29.3**	J	ug/L	5.00	10	09/17/2014	SV	1409057

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-072214 **Date / Time Sampled:** 07/22/14 10:20 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140717-16 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**148**	J	ug/L	100	5	09/17/2014	SV	1409057
200.7	**Iron**	**578**	J	ug/L	500	5	09/17/2014	SV	1409057
200.7	**Manganese**	**67700**		ug/L	10.0	5	09/17/2014	SV	1409057
200.7	**Zinc**	**3180**		ug/L	50.0	5	09/17/2014	SV	1409057
200.8	**Arsenic**	**14.4**	J	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	**Cadmium**	**2.25**		ug/L	1.00	10	09/17/2014	SV	1409057
200.8	**Copper**	**8.53**	J	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	**Lead**	**3.67**		ug/L	1.00	10	09/17/2014	SV	1409057
200.8	Nickel	< 10.0	J,	ug/L	5.00	10	09/17/2014	SV	1409057

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-072214 **Date / Time Sampled:** 07/22/14 09:00 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140717-20 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**298**		ug/L	100	5	09/17/2014	SV	1409057
200.7	**Iron**	**2950**		ug/L	500	5	09/17/2014	SV	1409057
200.7	**Manganese**	**95700**		ug/L	10.0	5	09/17/2014	SV	1409057
200.7	**Zinc**	**887**		ug/L	50.0	5	09/17/2014	SV	1409057
200.8	**Arsenic**	**6.36**	J	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	**Cadmium**	**1.86**	J	ug/L	1.00	10	09/17/2014	SV	1409057
200.8	**Copper**	**6.58**	J	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409057
200.8	**Nickel**	**11.8**	J	ug/L	5.00	10	09/17/2014	SV	1409057

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INF-072214 **Date / Time Sampled:** 07/22/14 08:30 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140717-23 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**14500**		ug/L	100	5	09/17/2014	SV	1409057
200.7	**Iron**	**180000**		ug/L	500	5	09/17/2014	SV	1409057
200.7	**Manganese**	**117000**		ug/L	10.0	5	09/17/2014	SV	1409057
200.7	**Zinc**	**62600**		ug/L	50.0	5	09/17/2014	SV	1409057
200.8	**Arsenic**	**189**		ug/L	5.00	10	09/17/2014	SV	1409057
200.8	**Cadmium**	**272**		ug/L	1.00	10	09/17/2014	SV	1409057
200.8	**Copper**	**852**	J	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	**Lead**	**207**		ug/L	1.00	10	09/17/2014	SV	1409057
200.8	**Nickel**	**48.2**	J	ug/L	5.00	10	09/17/2014	SV	1409057

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NAOH-072214 **Date / Time Sampled:** 07/22/14 09:10 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140717-26 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**13300**		ug/L	100	5	09/17/2014	SV	1409057
200.7	**Iron**	**16900**		ug/L	500	5	09/17/2014	SV	1409057
200.7	**Manganese**	**115000**		ug/L	10.0	5	09/17/2014	SV	1409057
200.7	**Zinc**	**64900**		ug/L	50.0	5	09/17/2014	SV	1409057
200.8	**Arsenic**	**17.2**	J	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	**Cadmium**	**272**		ug/L	1.00	10	09/17/2014	SV	1409057
200.8	**Copper**	**820**	J	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	**Lead**	**105**		ug/L	1.00	10	09/17/2014	SV	1409057
200.8	**Nickel**	**22.5**	J	ug/L	5.00	10	09/17/2014	SV	1409057

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-072214 **Date / Time Sampled:** 07/22/14 10:45 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140717-29 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**590**		ug/L	20.0	1	09/17/2014	SV	1409057
200.7	**Iron**	**756**		ug/L	100	1	09/17/2014	SV	1409057
200.7	**Manganese**	**14300**		ug/L	2.00	1	09/17/2014	SV	1409057
200.7	**Zinc**	**347**		ug/L	10.0	1	09/17/2014	SV	1409057
200.8	**Arsenic**	**22.4**		ug/L	5.00	10	09/17/2014	SV	1409057
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409057
200.8	Copper	< 10.0	J,	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	**Lead**	**7.81**		ug/L	1.00	10	09/17/2014	SV	1409057
200.8	Nickel	< 10.0	J,	ug/L	5.00	10	09/17/2014	SV	1409057

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-072214 **Date / Time Sampled:** 07/22/14 10:30 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140717-33 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**66.7**		ug/L	20.0	1	09/17/2014	SV	1409057
200.7	**Iron**	**493**		ug/L	100	1	09/17/2014	SV	1409057
200.7	**Manganese**	**46100**		ug/L	2.00	1	09/17/2014	SV	1409057
200.7	**Zinc**	**857**		ug/L	10.0	1	09/17/2014	SV	1409057
200.8	**Arsenic**	**9.52**	J	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	**Cadmium**	**1.16**	J	ug/L	1.00	10	09/17/2014	SV	1409057
200.8	**Copper**	**6.12**	J	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	**Lead**	**2.62**		ug/L	1.00	10	09/17/2014	SV	1409057
200.8	Nickel	< 10.0	J,	ug/L	5.00	10	09/17/2014	SV	1409057

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-072214 **Date / Time Sampled:** 07/22/14 08:45 **Workorder:** C140717

EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140717-37 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**587**		ug/L	100	5	09/17/2014	SV	1409057
200.7	**Iron**	**118000**		ug/L	500	5	09/17/2014	SV	1409057
200.7	**Manganese**	**118000**		ug/L	10.0	5	09/17/2014	SV	1409057
200.7	**Zinc**	**7180**		ug/L	50.0	5	09/17/2014	SV	1409057
200.8	**Arsenic**	**10.7**	J	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/17/2014	SV	1409057
200.8	Copper	< 10.0	J,	ug/L	5.00	10	09/17/2014	SV	1409057
200.8	**Lead**	**1.32**	J	ug/L	1.00	10	09/17/2014	SV	1409057
200.8	**Nickel**	**9.74**	J	ug/L	5.00	10	09/17/2014	SV	1409057

"J" Qualifier indicates an estimated value

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-072214 **Date / Time Sampled:** 07/22/14 09:25 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140717-03 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**10.2**	J	mg/L	5.0	10	08/05/2014	NP	1408009
EPA 300.0	**Fluoride**	**56.3**		mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrite as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	**Sulfate as SO4**	**378**		mg/L	0.5	10	08/05/2014	NP	1408009
EPA 310.1	**Total Alkalinity**	**1040**		mg CaCO3 / L	50.0	10	07/25/2014	KJB	1407136

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-072214 **Date / Time Sampled:** 07/22/14 09:45 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140717-06 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**10.9**	J	mg/L	5.0	10	08/05/2014	NP	1408009
EPA 300.0	**Fluoride**	**15.8**		mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrite as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	**Sulfate as SO4**	**349**		mg/L	0.5	10	08/05/2014	NP	1408009
EPA 310.1	**Total Alkalinity**	**650**		mg CaCO3 / L	50.0	10	07/25/2014	KJB	1407136

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-072214 **Date / Time Sampled:** 07/22/14 09:45 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140717-07 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**11.4**	D	mg/L	3.00	100	08/05/2014	KJB	1408011

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2D-072214 **Date / Time Sampled:** 07/22/14 10:00 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140717-10 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**11.7**	J	mg/L	5.0	10	08/05/2014	NP	1408009
EPA 300.0	**Fluoride**	**15.0**		mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrite as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	**Sulfate as SO4**	**370**		mg/L	0.5	10	08/05/2014	NP	1408009
EPA 310.1	**Total Alkalinity**	**637**		mg CaCO3 / L	50.0	10	07/25/2014	KJB	1407136

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2D-072214 **Date / Time Sampled:** 07/22/14 10:00 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140717-11 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**10.2**	D	mg/L	3.00	100	08/05/2014	KJB	1408011

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-072214 **Date / Time Sampled:** 07/22/14 10:10 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140717-14 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**15.5**	J	mg/L	5.0	10	08/05/2014	NP	1408009
EPA 300.0	**Fluoride**	**90.1**		mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrite as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	**Sulfate as SO4**	**299**		mg/L	0.5	10	08/05/2014	NP	1408009
EPA 310.1	**Total Alkalinity**	**2450**		mg CaCO3 / L	50.0	10	07/25/2014	KJB	1407136

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-072214 **Date / Time Sampled:** 07/22/14 10:10 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140717-15 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**172**	D	mg/L	3.00	100	08/05/2014	KJB	1408011

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-072214 **Date / Time Sampled:** 07/22/14 10:20 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140717-18 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**9.8**	J	mg/L	5.0	10	08/05/2014	NP	1408009
EPA 300.0	**Fluoride**	**10.8**		mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrite as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	**Sulfate as SO4**	**526**		mg/L	0.5	10	08/05/2014	NP	1408009
EPA 310.1	**Total Alkalinity**	**507**		mg CaCO3 / L	50.0	10	07/25/2014	KJB	1407136

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-072214 **Date / Time Sampled:** 07/22/14 10:20 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140717-19 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**7.65**	D	mg/L	0.300	10	08/05/2014	KJB	1408011

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-CHIT-072214 **Date / Time Sampled:** 07/22/14 09:00 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140717-22 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**7.2**	J	mg/L	5.0	10	08/05/2014	NP	1408009
EPA 300.0	**Fluoride**	**59.7**		mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrite as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	**Sulfate as SO4**	**778**		mg/L	0.5	10	08/05/2014	NP	1408009
EPA 310.1	**Total Alkalinity**	**1500**		mg CaCO3 / L	50.0	10	07/25/2014	KJB	1407136

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-INF-072214 **Date / Time Sampled:** 07/22/14 08:30 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140717-25 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**7.0**	J	mg/L	5.0	10	08/05/2014	NP	1408009
EPA 300.0	**Fluoride**	**2.5**		mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrite as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	**Sulfate as SO4**	**1080**		mg/L	0.5	10	08/05/2014	NP	1408009
EPA 310.1	Total Alkalinity	< 100		mg CaCO3 / L	50.0	10	07/25/2014	KJB	1407136

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-NAOH-072214 **Date / Time Sampled:** 07/22/14 09:10 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140717-28 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**7.1**	J	mg/L	5.0	10	08/05/2014	NP	1408009
EPA 300.0	**Fluoride**	**2.7**		mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrite as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	**Sulfate as SO4**	**1250**		mg/L	0.5	10	08/05/2014	NP	1408009
EPA 310.1	Total Alkalinity	< 100		mg CaCO3 / L	50.0	10	07/25/2014	KJB	1407136

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTE-072214 **Date / Time Sampled:** 07/22/14 10:45 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140717-31 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**15.0**	J	mg/L	5.0	10	08/05/2014	NP	1408009
EPA 300.0	**Fluoride**	**11.7**		mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrite as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	**Sulfate as SO4**	**264**		mg/L	0.5	10	08/05/2014	NP	1408009
EPA 310.1	**Total Alkalinity**	**893**		mg CaCO3 / L	50.0	10	07/25/2014	KJB	1407136

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTE-072214 **Date / Time Sampled:** 07/22/14 10:45 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140717-32 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**41.7**	D	mg/L	3.00	100	08/05/2014	KJB	1408011

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTI-072214 **Date / Time Sampled:** 07/22/14 10:30 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140717-35 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**10.5**	J	mg/L	5.0	10	08/05/2014	NP	1408009
EPA 300.0	**Fluoride**	**42.3**		mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrite as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	**Sulfate as SO4**	**424**		mg/L	0.5	10	08/05/2014	NP	1408009
EPA 310.1	**Total Alkalinity**	**1040**		mg CaCO3 / L	50.0	10	07/25/2014	KJB	1407136

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTI-072214 **Date / Time Sampled:** 07/22/14 10:30 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140717-36 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**58.6**	D	mg/L	3.00	100	08/05/2014	KJB	1408011

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-SAPS-072214 **Date / Time Sampled:** 07/22/14 08:45 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140717-39 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**7.1**	J	mg/L	5.0	10	08/05/2014	NP	1408009
EPA 300.0	**Fluoride**	**2.2**		mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/05/2014	NP	1408009
EPA 300.0	Nitrite as N	< 5.0	U	mg/L	1.0	10	08/05/2014	NP	1408009
EPA 300.0	**Sulfate as SO4**	**939**		mg/L	0.5	10	08/05/2014	NP	1408009
EPA 310.1	**Total Alkalinity**	**138**		mg CaCO3 / L	50.0	10	07/25/2014	KJB	1407136

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-072214 **Date / Time Sampled:** 07/22/14 09:25 **Workorder:** C140717
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140717-40 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**73.5**	D	mg/L	3.00	100	08/05/2014	KJB	1408011

"J" Qualifier indicates an estimated value

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ICPMS-PE DRC-II									
Batch 1409073 - No Lab Prep Reqd			***Water***						**ICPMS-PE DRC-II**
Method Blank (1409073-BLK1)		Dilution Factor: 1				Prepared: 09/16/14 Analyzed: 09/17/14			
Nickel	< 0.500	1.00	ug/L						
Copper	< 0.500	1.00	"						
Arsenic	< 0.500	2.00	"						
Cadmium	< 0.100	0.200	"						
Lead	< 0.100	0.200	"						
Method Blank Spike (1409073-BS1)		Dilution Factor: 1				Prepared: 09/16/14 Analyzed: 09/17/14			
Nickel	97.0	1.00	ug/L	100		97	85-115		
Copper	98.5	1.00	"	100		99	85-115		
Arsenic	85.3	2.00	"	100		85	85-115		
Cadmium	95.6	0.200	"	100		96	85-115		
Lead	96.2	0.200	"	100		96	85-115		
Duplicate (1409073-DUP1)		Dilution Factor: 1	**Source: C140717-05**			Prepared: 09/16/14 Analyzed: 09/17/14			
Nickel	< 5.00	10.0	ug/L		< 5.00				20
Copper	6.13	10.0	"		5.43			12	20
Arsenic	< 5.00	20.0	"		< 5.00				20
Cadmium	< 1.00	2.00	"		< 1.00				20
Lead	< 1.00	2.00	"		< 1.00				20
Matrix Spike (1409073-MS1)		Dilution Factor: 1	**Source: C140717-05**			Prepared: 09/16/14 Analyzed: 09/17/14			
Nickel	65.3	10.0	ug/L	100	< 5.00	65	70-130		
Copper	70.1	10.0	"	100	5.43	65	70-130		
Arsenic	94.1	20.0	"	100	< 5.00	94	70-130		
Cadmium	93.3	2.00	"	100	< 1.00	93	70-130		
Lead	103	2.00	"	100	< 1.00	103	70-130		
Matrix Spike (1409073-MS2)		Dilution Factor: 1	**Source: C140717-09**			Prepared: 09/16/14 Analyzed: 09/17/14			
Nickel	61.0	10.0	ug/L	100	< 5.00	61	70-130		
Copper	63.7	10.0	"	100	6.81	57	70-130		
Arsenic	94.4	20.0	"	100	< 5.00	94	70-130		
Cadmium	93.4	2.00	"	100	< 1.00	93	70-130		
Lead	107	2.00	"	100	< 1.00	107	70-130		

Project Name: **Barker-Hughesville_Treatability 3_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Batch 1409082 - 1409073 *Water* **ICPMS-PE DRC-II**

Serial Dilution (1409082-SRD1) Dilution Factor: 5 **Source: C140717-05** Prepared: 09/16/14 Analyzed: 09/17/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	< 25.0	50.0	ug/L		< 5.00				10
Copper	< 25.0	50.0	"		5.43				10
Arsenic	< 25.0	100	"		< 5.00				10
Cadmium	< 5.00	10.0	"		< 1.00				10
Lead	< 5.00	10.0	"		< 1.00				10

ICPOE - PE Optima

Batch 1409072 - No Lab Prep Reqd *Water* **ICPOE - PE Optima**

Method Blank (1409072-BLK1) Dilution Factor: 1 Prepared: 09/16/14 Analyzed: 09/17/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						

Method Blank Spike (1409072-BS1) Dilution Factor: 1 Prepared: 09/16/14 Analyzed: 09/17/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	10540	50.0	ug/L	10100		104	85-115		
Iron	10580	250	"	10100		105	85-115		
Manganese	113.7	5.00	"	100		114	85-115		
Zinc	101.4	20.0	"	100		101	85-115		

Duplicate (1409072-DUP1) Dilution Factor: 5 **Source: C140717-05** Prepared: 09/16/14 Analyzed: 09/17/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	< 100	250	ug/L		< 100				20
Iron	< 500	1250	"		< 500				20
Manganese	46120	25.0	"		46310			0.4	20
Zinc	< 50.0	100	"		< 50.0				20

Matrix Spike (1409072-MS1) Dilution Factor: 5 **Source: C140717-05** Prepared: 09/16/14 Analyzed: 09/17/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	10830	250	ug/L	10100	< 100	107	70-130		
Iron	10620	1250	"	10100	< 500	105	70-130		
Manganese	45590	25.0	"	100	46310	NR	70-130		
Zinc	130.2	100	"	100	< 50.0	130	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409072 - No Lab Prep Reqd			***Water***						**ICPOE - PE Optima**
Matrix Spike (1409072-MS2)		Dilution Factor: 5	**Source: C140717-09**			Prepared: 09/16/14 Analyzed: 09/17/14			
Aluminum	10290	250	ug/L	10100	< 100	102	70-130		
Iron	10300	1250	"	10100	< 500	102	70-130		
Manganese	50940	25.0	"	100	50630	302	70-130		
Zinc	150.9	100	"	100	50.70	100	70-130		
Batch 1409077 - 1409072			***Water***						**ICPOE - PE Optima**
Serial Dilution (1409077-SRD1)		Dilution Factor: 2	**Source: C140717-05**			Prepared: 09/16/14 Analyzed: 09/17/14			
Aluminum	< 500	1250	ug/L		< 100.00				10
Iron	< 2500	6250	"		< 500.00				10
Manganese	48230	125	"		46310			4	10
Zinc	< 250	500	"		< 50.00				10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ICPMS-PE DRC-II									
Batch 1409057 - 200.2 - TR Metals			***Water***						**ICPMS-PE DRC-II**
Method Blank (1409057-BLK2)		Dilution Factor: 5				Prepared: 09/15/14 Analyzed: 09/17/14			
Nickel	< 2.50	5.00	ug/L						
Copper	< 2.50	5.00	"						
Arsenic	< 2.50	10.0	"						
Cadmium	< 0.500	1.00	"						
Lead	< 0.500	1.00	"						
Duplicate (1409057-DUP2)		Dilution Factor: 1	**Source: C140717-01**			Prepared: 09/15/14 Analyzed: 09/17/14			
Nickel	< 5.00	10.0	ug/L		< 5.00				20
Copper	< 5.00	10.0	"		< 5.00				20
Arsenic	8.224	20.0	"		6.766			19	20
Cadmium	< 1.00	2.00	"		< 1.00				20
Lead	1.841	2.00	"		2.233			19	20
Matrix Spike (1409057-MS2)		Dilution Factor: 1	**Source: C140717-04**			Prepared: 09/15/14 Analyzed: 09/17/14			
Nickel	332.8	10.0	ug/L	500	< 5.00	67	70-130		
Copper	192.7	10.0	"	300	11.68	60	70-130		
Arsenic	747.9	20.0	"	800	7.734	93	70-130		
Cadmium	188.3	2.00	"	200	< 1.00	94	70-130		
Lead	1144	2.00	"	1000	5.728	114	70-130		
Matrix Spike (1409057-MS4)		Dilution Factor: 1	**Source: C140717-08**			Prepared: 09/15/14 Analyzed: 09/17/14			
Nickel	333.3	10.0	ug/L	500	< 5.00	67	70-130		
Copper	187.2	10.0	"	300	8.033	60	70-130		
Arsenic	752.7	20.0	"	800	7.422	93	70-130		
Cadmium	195.9	2.00	"	200	< 1.00	98	70-130		
Lead	1174	2.00	"	1000	4.268	117	70-130		
Reference (1409057-SRM2)		Dilution Factor: 2				Prepared: 09/15/14 Analyzed: 09/17/14			
Nickel	878.1	20.0	ug/L	1000		88	85-115		
Copper	896.1	20.0	"	1000		90	85-115		
Arsenic	1977	40.0	"	2000		99	85-115		
Cadmium	987.3	4.00	"	1000		99	85-115		
Lead	2071	4.00	"	2000		104	85-115		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Batch 1409083 - 1409057 *Water* **ICPMS-PE DRC-II**

Serial Dilution (1409083-SRD1) Dilution Factor: 5 **Source: C140717-01** Prepared: 09/15/14 Analyzed: 09/17/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	< 25.0	50.0	ug/L		< 5.00				10
Copper	< 25.0	50.0	"		< 5.00				10
Arsenic	< 25.0	100	"		6.766				10
Cadmium	< 5.00	10.0	"		< 1.00				10
Lead	< 5.00	10.0	"		2.233				10

ICPOE - PE Optima

Batch 1409057 - 200.2 - TR Metals *Water* **ICPOE - PE Optima**

Method Blank (1409057-BLK1) Dilution Factor: 1 Prepared: 09/15/14 Analyzed: 09/17/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						

Duplicate (1409057-DUP1) Dilution Factor: 5 **Source: C140717-01** Prepared: 09/15/14 Analyzed: 09/17/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	205.7	250	ug/L		185.3			10	20
Iron	552.2	1250	"		686.6			22	20
Manganese	63530	25.0	"		64210			1	20
Zinc	468.4	100	"		496.8			6	20

Matrix Spike (1409057-MS1) Dilution Factor: 5 **Source: C140717-04** Prepared: 09/15/14 Analyzed: 09/17/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	2102	250	ug/L	2000	148.2	98	70-130		
Iron	3787	1250	"	3000	614.8	106	70-130		
Manganese	48150	25.0	"	200	48490	NR	70-130		
Zinc	532.8	100	"	200	326.4	103	70-130		

Matrix Spike (1409057-MS3) Dilution Factor: 5 **Source: C140717-08** Prepared: 09/15/14 Analyzed: 09/17/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	2074	250	ug/L	2000	116.2	98	70-130		
Iron	3375	1250	"	3000	516.6	95	70-130		
Manganese	52540	25.0	"	200	51060	739	70-130		
Zinc	507.5	100	"	200	287.1	110	70-130		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409057 - 200.2 - TR Metals			***Water***						**ICPOE - PE Optima**
Reference (1409057-SRM1)		Dilution Factor: 1				Prepared: 09/15/14 Analyzed: 09/17/14			
Aluminum	995.5	50.0	ug/L	1000		100	85-115		
Iron	1002	250	"	1000		100	85-115		
Manganese	1038	5.00	"	1000		104	85-115		
Zinc	1010	20.0	"	1000		101	85-115		
Batch 1409078 - 1409057			***Water***						**ICPOE - PE Optima**
Serial Dilution (1409078-SRD1)		Dilution Factor: 2	**Source: C140717-01**			Prepared: 09/15/14 Analyzed: 09/17/14			
Aluminum	< 500	1250	ug/L		185.3				10
Iron	< 2500	6250	"		686.6				10
Manganese	66680	125	"		64210			4	10
Zinc	456.8	500	"		496.8			8	10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ESAT Dionex IC									
Batch 1408009 - No Prep Req			***Water***						**ESAT Dionex IC**
Method Blank (1408009-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 08/05/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Nitrite as N	< 0.1	0.5	"						
Nitrate as N	< 0.1	0.5	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						
Method Blank Spike (1408009-BS1)		Dilution Factor: 1				Prepared & Analyzed: 08/05/14			
Fluoride	5.0	0.2	mg/L	5.00		101	90-110		
Chloride	24.3	2.0	"	25.0		97	90-110		
Nitrite as N	10.3	0.5	"	10.0		103	90-110		
Nitrate as N	10.2	0.5	"	10.0		102	90-110		
Sulfate as SO4	23.2	0.1	"	25.0		93	90-110		
Nitrate/Nitrite as N	20.5	5.0	"	20.0		103	90-110		
Duplicate (1408009-DUP1)		Dilution Factor: 1	**Source: C140717-03**			Prepared & Analyzed: 08/05/14			
Fluoride	56.7	2.0	mg/L		56.3			0.6	20
Chloride	10.2	20.0	"		10.2			0.1	20
Nitrite as N	< 1.0	5.0	"		< 1.0				20
Nitrate as N	< 1.0	5.0	"		< 1.0				20
Sulfate as SO4	377	1.0	"		378			0.4	20
Nitrate/Nitrite as N	< 10.0	50.0	"		< 10.0				20
Matrix Spike (1408009-MS1)		Dilution Factor: 1	**Source: C140717-03**			Prepared & Analyzed: 08/05/14			
Fluoride	46.2	2.0	mg/L	50.0	56.3	NR	80-120		
Chloride	254	20.0	"	250	10.2	98	80-120		
Nitrite as N	104	5.0	"	100	< 1.0	104	80-120		
Nitrate as N	103	5.0	"	100	< 1.0	103	80-120		
Sulfate as SO4	634	1.0	"	250	378	102	80-120		
Nitrate/Nitrite as N	207	50.0	"	200	< 10.0	103	80-120		

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Batch 1408009 - No Prep Req *Water* **ESAT Dionex IC**

Matrix Spike (1408009-MS2) Dilution Factor: 1 **Source: C140717-39** Prepared & Analyzed: 08/05/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Fluoride	49.8	2.0	mg/L	50.0	2.2	95	80-120		
Chloride	235	20.0	"	250	7.1	91	80-120		
Nitrite as N	99.4	5.0	"	100	< 1.0	99	80-120		
Nitrate as N	97.8	5.0	"	100	< 1.0	98	80-120		
Sulfate as SO4	1180	1.0	"	250	939	98	80-120		
Nitrate/Nitrite as N	197	50.0	"	200	< 10.0	99	80-120		

Batch 1408042 - 1408009 *Water* **ESAT Dionex IC**

Instrument Blank (1408042-IBL1) Dilution Factor: 1 Prepared & Analyzed: 08/05/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Nitrite as N	< 0.1	0.5	"						
Nitrate as N	< 0.1	0.5	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						

Lachat 8500

Batch 1408011 - No Prep Req *Water* **Lachat 8500**

Method Blank (1408011-BLK1) Dilution Factor: 1 Prepared: 08/04/14 Analyzed: 08/05/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Ammonia as N	< 0.0300	0.0500	mg/L						

Method Blank Spike (1408011-BS1) Dilution Factor: 1 Prepared: 08/04/14 Analyzed: 08/05/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Ammonia as N	1.01	0.0500	mg/L	1.00		101	90-110		

Duplicate (1408011-DUP1) Dilution Factor: 1 **Source: C140717-07** Prepared: 08/04/14 Analyzed: 08/05/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Ammonia as N	11.5	5.00	mg/L		11.4			0.5	20

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1408011 - No Prep Req			*Water*						**Lachat 8500**
Matrix Spike (1408011-MS1)		Dilution Factor: 1	**Source: C140717-07**			Prepared: 08/04/14 Analyzed: 08/05/14			
Ammonia as N	112	5.00	mg/L	100	11.4	101	90-110		
Reference (1408011-SRM1)		Dilution Factor: 5				Prepared: 08/04/14 Analyzed: 08/05/14			
Ammonia as N	4.89	0.250	mg/L	4.80		102	90-110		
Mettler AT									
Batch 1407136 - No Prep Req			*Water*						**Mettler AT**
Method Blank (1407136-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 07/25/14			
Total Alkalinity	< 5.00	10.0	mg CaCO3 / L						
Duplicate (1407136-DUP1)		Dilution Factor: 1	**Source: C140717-03**			Prepared & Analyzed: 07/25/14			
Total Alkalinity	1040	100	mg CaCO3 / L		1040			0.05	20
Duplicate (1407136-DUP2)		Dilution Factor: 1	**Source: C140717-39**			Prepared & Analyzed: 07/25/14			
Total Alkalinity	137	100	mg CaCO3 / L		138			0.9	20
Reference (1407136-SRM1)		Dilution Factor: 1				Prepared & Analyzed: 07/25/14			
Total Alkalinity	12.1	10.0	mg CaCO3 / L	10.4		117	61.3-143.9		

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Project Name: **Barker-Hughesville_Treatability 3_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 310.1

Analysis Name: WC - Alkalinity

Instrument: **Mettler AT**

Work Order: Nu C140717

Analytical Sequence: **Total**

Concentration Units: mg CaCO3 / L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Total Alkalinity		**1**	**2**	**3**	**4**	1407136-BLK1	NA	10.00
		1.44	1.26			1.10	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 3_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 350.1

Analysis Name: WC - Ammonia

Instrument: **Lachat 8500**

Work Order: Nu C140717

Analytical Sequence: **Total**

Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	1408011-BLK1	NA	
Ammonia as N		0.00	-0.01	0.00		0.00	NA	0.05
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 3_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 300.0 Analysis Name: WC - Anions by Ion Chromatography

Instrument: **ESAT Dionex IC** Work Order: Nu C140717

Analytical Sequence: 1408042 **Dissolved** Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Fluoride	0.00	1	2	3	4	1408009-BLK1	NA	0.20
		0.00	0.00			0.00	NA	
		5	6	7	8			
Chloride	0.00	1	2	3	4	1408009-BLK1	NA	2.00
		0.00	0.00			0.00	NA	
		5	6	7	8			
Nitrite as N	0.00	1	2	3	4	1408009-BLK1	NA	0.50
		0.00	0.00			0.00	NA	
		5	6	7	8			
Nitrate as N	0.00	1	2	3	4	1408009-BLK1	NA	0.50
		0.00	0.00			0.00	NA	
		5	6	7	8			
Sulfate as SO4	0.00	1	2	3	4	1408009-BLK1	NA	0.10
		0.00	0.00			0.00	NA	
		5	6	7	8			
Nitrate/Nitrite as N	0.00	1	2	3	4	1408009-BLK1	NA	5.00
		0.00	0.00			0.00	NA	
		5	6	7	8			

Project Name: **Barker-Hughesville_Treatability 3_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7 Analysis Name: ICPOE Diss. Metals

Instrument: **ICPOE - PE Optima** Work Order: Nu C140717

Analytical Sequence: 1409077 **Dissolved** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Aluminum	0.07	**1**	**2**	**3**	**4**	1409072-BLK1	NA	50.00
		-0.39	1.97	0.92		-0.72	NA	
		5	**6**	**7**	**8**			
Iron	45.09	**1**	**2**	**3**	**4**	1409072-BLK1	NA	250.00
		83.83	43.55	61.16		80.98	NA	
		5	**6**	**7**	**8**			
Manganese	0.10	**1**	**2**	**3**	**4**	1409072-BLK1	NA	5.00
		0.40	0.88	0.61		-0.20	NA	
		5	**6**	**7**	**8**			
Zinc	-2.01	**1**	**2**	**3**	**4**	1409072-BLK1	NA	20.00
		-0.03	0.56	-0.96		-2.69	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 3_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7

Analysis Name: ICPOE Tot. Rec. Metals

Instrument: **ICPOE - PE Optima**

Work Order: Nu C140717

Analytical Sequence: 1409078 **Total Recoverable**

Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Aluminum	0.07	**1**	**2**	**3**	**4**	1409057-BLK1	NA	50.00
		-0.39	1.97	0.92	1.48	-3.85	NA	
		5	**6**	**7**	**8**			
		1.81						
Iron	45.09	**1**	**2**	**3**	**4**	1409057-BLK1	NA	250.00
		83.83	43.55	61.16	26.13	26.88	NA	
		5	**6**	**7**	**8**			
		64.45						
Manganese	0.10	**1**	**2**	**3**	**4**	1409057-BLK1	NA	5.00
		0.40	0.88	0.61	0.30	-0.03	NA	
		5	**6**	**7**	**8**			
		0.56						
Zinc	-2.01	**1**	**2**	**3**	**4**	1409057-BLK1	NA	20.00
		-0.03	0.56	-0.96	-0.39	-0.21	NA	
		5	**6**	**7**	**8**			
		-1.40						

Project Name: **Barker-Hughesville_Treatability 3_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8 Analysis Name: ICPMS Diss. Metals

Instrument: **ICPMS-PE DRC-II** Work Order: Nu C140717

Analytical Sequence: 1409082 **Dissolved** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	1409073-BLK1	NA	
Nickel	0.03	0.02	0.02			-0.01	NA	1.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1409073-BLK1	NA	
Copper	-0.02	-0.01	-0.02			-0.09	NA	1.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1409073-BLK1	NA	
Arsenic	-0.01	-0.10	0.00			0.03	NA	2.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1409073-BLK1	NA	
Cadmium	0.01	0.01	0.01			0.00	NA	0.20
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1409073-BLK1	NA	
Lead	0.02	0.05	0.02			0.00	NA	0.20
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 3_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Instrument: **ICPMS-PE DRC-II** Work Order: Nu C140717

Analytical Sequence: 1409083 **Total Recoverable** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Nickel	0.03	**1**	**2**	**3**	**4**	NA	1409057-BLK2	1.00
		0.02	0.02	0.03	0.02	NA	-0.02	
		5	**6**	**7**	**8**			
Copper	-0.02	**1**	**2**	**3**	**4**	NA	1409057-BLK2	1.00
		-0.01	-0.02	-0.04	-0.04	NA	-0.10	
		5	**6**	**7**	**8**			
Arsenic	-0.01	**1**	**2**	**3**	**4**	NA	1409057-BLK2	2.00
		-0.10	0.00	-0.03	-0.06	NA	0.16	
		5	**6**	**7**	**8**			
Cadmium	0.01	**1**	**2**	**3**	**4**	NA	1409057-BLK2	0.20
		0.01	0.01	0.02	0.01	NA	0.00	
		5	**6**	**7**	**8**			
Lead	0.02	**1**	**2**	**3**	**4**	NA	1409057-BLK2	0.20
		0.05	0.02	0.02	0.02	NA	0.04	
		5	**6**	**7**	**8**			

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Mettler AT Method: EPA 310.1 Analysis Name: WC - Alkalinity

Sequence: 1407142 Work Order: C140717 Units: mg CaCO3 / L

Total Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
					1			**2**			**3**	
Total Alkalinity				100	99.6	99.6	100	100	100.0			
					4			**5**			**6**	
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Lachat 8500 Method: EPA 350.1 Analysis Name: WC - Ammonia

Sequence: 1408030 Work Order: C140717 Units: mg/L

Total Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Ammonia as N					1			2			3	
				1.00	1.02	102.0	1.00	1.02	102.0	1.00	1.02	102.0
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ESAT Dionex IC Method: EPA 300.0 Analysis Name: WC - Anions by Ion Chromatography 2013

Sequence: 1408042 Work Order: C140717 Units: mg/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Chloride	40.0	41.2	103.0	40.0	41.5	103.8	40.0	38.4	96.0			
					4			5			6	
					7			8			9	
					1			2			3	
Fluoride	4.00	4.1	102.5	4.00	4.1	102.5	4.00	3.7	92.5			
					4			5			6	
					7			8			9	
					1			2			3	
Nitrate as N	10.0	10.2	102.0	10.0	10.3	103.0	10.0	9.5	95.0			
					4			5			6	
					7			8			9	
					1			2			3	
Nitrate/Nitrite as N	20.0	20.5	102.5	20.0	20.6	103.0	20.0	19.0	95.0			
					4			5			6	
					7			8			9	
					1			2			3	
Nitrite as N	10.0	10.3	103.0	10.0	10.3	103.0	10.0	9.6	96.0			
					4			5			6	
					7			8			9	
					1			2			3	
Sulfate as SO4	100	103	103.0	100	104	104.0	100	93.1	93.1			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability 3_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Diss. Metals

Sequence: 1409077 Work Order: C140717 Units: ug/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Aluminum	12500	12520	100.2	12500	12820	102.6	12500	12860	102.9	12500	13100	104.8
					4			5			6	
					7			8			9	
					1			2			3	
Iron	12500	12720	101.8	12500	13020	104.2	12500	12970	103.8	12500	12920	103.4
					4			5			6	
					7			8			9	
					1			2			3	
Manganese	1000	1028	102.8	1000	1024	102.4	1000	1038	103.8	1000	1035	103.5
					4			5			6	
					7			8			9	
					1			2			3	
Zinc	2500	2565	102.6	2500	2606	104.2	2500	2609	104.4	2500	2616	104.6
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Sequence: 1409078 Work Order: C140717 Units: ug/L

Total Recoverable Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
					1			**2**			**3**	
Aluminum	12500	12520	100.2	12500	12820	102.6	12500	12860	102.9	12500	13100	104.8
					4			**5**			**6**	
				12500	12780	102.2	12500	12800	102.4			
					7			**8**			**9**	
					1			**2**			**3**	
Iron	12500	12720	101.8	12500	13020	104.2	12500	12970	103.8	12500	12920	103.4
					4			**5**			**6**	
				12500	12870	103.0	12500	12880	103.0			
					7			**8**			**9**	
					1			**2**			**3**	
Manganese	1000	1028	102.8	1000	1024	102.4	1000	1038	103.8	1000	1035	103.5
					4			**5**			**6**	
				1000	1054	105.4	1000	1050	105.0			
					7			**8**			**9**	
					1			**2**			**3**	
Zinc	2500	2565	102.6	2500	2606	104.2	2500	2609	104.4	2500	2616	104.6
					4			**5**			**6**	
				2500	2678	107.1	2500	2651	106.0			
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Diss. Metals

Sequence: 1409082 Work Order: C140717 Units: ug/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Arsenic	50.0	49.5	99.0	50.0	48.5	97.0	50.0	48.6	97.2			
					4			5			6	
					7			8			9	
					1			2			3	
Cadmium	50.0	47.8	95.6	50.0	49.0	98.0	50.0	48.8	97.6			
					4			5			6	
					7			8			9	
					1			2			3	
Copper	50.0	48.4	96.8	50.0	46.9	93.8	50.0	44.8	89.6			
					4			5			6	
					7			8			9	
					1			2			3	
Lead	50.0	48.7	97.4	50.0	51.4	102.8	50.0	52.4	104.8			
					4			5			6	
					7			8			9	
					1			2			3	
Nickel	50.0	48.3	96.6	50.0	46.7	93.4	50.0	45.1	90.2			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1409083 Work Order: C140717 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Arsenic	50.0	49.46	98.9		1			2			3	
				50.0	48.45	96.9	50.0	48.58	97.2	50.0	48.19	96.4
					4			5			6	
				50.0	46.99	94.0						
					7			8			9	
Cadmium	50.0	47.84	95.7		1			2			3	
				50.0	48.95	97.9	50.0	48.75	97.5	50.0	48.02	96.0
					4			5			6	
				50.0	48.29	96.6						
					7			8			9	
Copper	50.0	48.45	96.9		1			2			3	
				50.0	46.88	93.8	50.0	44.77	89.5	50.0	46.27	92.5
					4			5			6	
				50.0	42.58	85.2						
					7			8			9	
Lead	50.0	48.68	97.4		1			2			3	
				50.0	51.37	102.7	50.0	52.40	104.8	50.0	53.29	106.6
					4			5			6	
				50.0	54.62	109.2						
					7			8			9	
Nickel	50.0	48.32	96.6		1			2			3	
				50.0	46.69	93.4	50.0	45.14	90.3	50.0	45.80	91.6
					4			5			6	
				50.0	42.66	85.3						
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8
ICP Interference Check Sample
ICPMS-PE DRC-II

Sequence: 1409082 Analysis: ICPMS Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.0	ug/L			2.00
	IFB1	19.8	ug/L	20	99	2.00
Cadmium	IFA1	0.1	ug/L			0.200
	IFB1	19.5	ug/L	20	97	0.200
Copper	IFA1	0.6	ug/L			1.00
	IFB1	17.6	ug/L	20	88	1.00
Lead	IFA1	0.1	ug/L			0.200
	IFB1	0.1	ug/L			0.200
Nickel	IFA1	-0.1	ug/L			1.00
	IFB1	17.2	ug/L	20	86	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1409083 Analysis: ICPMS Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.0	ug/L			2.00
	IFB1	19.8	ug/L	20	99	2.00
Cadmium	IFA1	0.1	ug/L			0.200
	IFB1	19.5	ug/L	20	97	0.200
Copper	IFA1	0.6	ug/L			1.00
	IFB1	17.6	ug/L	20	88	1.00
Lead	IFA1	0.1	ug/L			0.200
	IFB1	0.1	ug/L			0.200
Nickel	IFA1	-0.1	ug/L			1.00
	IFB1	17.2	ug/L	20	86	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8

ICP Interference Check Sample

ICPOE - PE Optima

Sequence: 1409077 Analysis: ICPOE Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	60,300.9	ug/L	60,000	101	50.0
	IFB1	60,573.2	ug/L	60,000	101	50.0
Iron	IFA1	235,735.5	ug/L	250,000	94	250
	IFB1	238,388.9	ug/L	250,000	95	250
Manganese	IFA1	-0.4	ug/L			5.00
	IFB1	199.2	ug/L	200	100	5.00
Zinc	IFA1	1.3	ug/L			20.0
	IFB1	294.7	ug/L	300	98	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1409078 Analysis: ICPOE Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	60,300.9	ug/L	60,000	101	50.0
	IFB1	60,573.2	ug/L	60,000	101	50.0
Iron	IFA1	235,735.5	ug/L	250,000	94	250
	IFB1	238,388.9	ug/L	250,000	95	250
Manganese	IFA1	-0.4	ug/L			5.00
	IFB1	199.2	ug/L	200	100	5.00
Zinc	IFA1	1.3	ug/L			20.0
	IFB1	294.7	ug/L	300	98	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPMS-PE DRC-II

Metals (Dissolved) by EPA 200/7000 Series Methods

Sequence: 1409082

Analyte	True	Found	%R	Units
Arsenic	2.00	1.96	98	ug/L
Cadmium	0.200	0.199	100	ug/L
Copper	1.00	1.02	102	ug/L
Lead	0.200	0.221	111	ug/L
Nickel	1.00	0.977	98	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPOE - PE Optima

Metals (Dissolved) by EPA 200/7000 Series Methods

Sequence: 1409077

Analyte	True	Found	%R	Units
Aluminum	100	99.22	99	ug/L
Iron	100	143.0	143	ug/L
Manganese	10.0	10.19	102	ug/L
Zinc	50.0	51.56	103	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

Lachat 8500

Classical Chemistry by EPA/ASTM/APHA Methods

Sequence: 1408030

Analyte	True	Found	%R	Units
Ammonia as N	0.0250	0.0237	95	mg/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

ICPMS-PE DRC-II

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1409083

Analyte	True	Found	%R	Units
Arsenic	2.00	1.959	98	ug/L
Cadmium	0.200	0.1995	100	ug/L
Copper	1.00	1.017	102	ug/L
Lead	0.200	0.2214	111	ug/L
Nickel	1.00	0.9769	98	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

ICPOE - PE Optima

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1409078

Analyte	True	Found	%R	Units
Aluminum	100	99.22	99	ug/L
Iron	100	143.0	143	ug/L
Manganese	10.0	10.19	102	ug/L
Zinc	50.0	51.56	103	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 310.1 **Total** **Sequence ID#:** 1407142

Instrument ID #: Mettler AT Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1407136-SRM1	Reference	07/25/14	13:25
1407136-BLK1	Blank	07/25/14	13:25
C140717-03	14BH-DT-PILOT-BCR1-07221	07/25/14	13:25
1407136-DUP1	Duplicate	07/25/14	13:25
C140717-06	14BH-DT-PILOT-BCR2-07221	07/25/14	13:25
C140717-10	14BH-DT-PILOT-BCR2D-0722	07/25/14	13:25
C140717-14	14BH-DT-PILOT-BCR3-07221	07/25/14	13:25
C140717-18	14BH-DT-PILOT-BCR4-07221	07/25/14	13:25
C140717-22	14BH-DT-PILOT-CHIT-07221	07/25/14	13:25
C140717-25	14BH-DT-PILOT-INF-072214	07/25/14	13:25
1407142-CCV1	Calibration Check	07/25/14	13:25
1407142-CCB1	Calibration Blank	07/25/14	13:25
C140717-28	14BH-DT-PILOT-NAOH-0722	07/25/14	13:25
C140717-31	14BH-DT-PILOT-POSTE-0722	07/25/14	13:25
C140717-35	14BH-DT-PILOT-POSTI-07221	07/25/14	13:25
C140717-39	14BH-DT-PILOT-SAPS-07221	07/25/14	13:25
1407136-DUP2	Duplicate	07/25/14	13:25
1407142-CCV2	Calibration Check	07/25/14	13:25
1407142-CCB2	Calibration Blank	07/25/14	13:25

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 350.1 **Total** **Sequence ID#:** 1408030

Instrument ID #: Lachat 8500 Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1408011-SRM1	Reference	08/05/14	15:27
1408011-BLK1	Blank	08/05/14	15:27
1408011-BS1	Blank Spike	08/05/14	15:27
1408030-CRL1	Instrument RL Check	08/05/14	15:27
C140717-07	14BH-DT-PILOT-BCR2-07221	08/05/14	15:27
1408011-DUP1	Duplicate	08/05/14	15:27
1408011-MS1	Matrix Spike	08/05/14	15:27
C140717-11	14BH-DT-PILOT-BCR2D-072	08/05/14	15:27
1408030-CCV1	Calibration Check	08/05/14	15:27
1408030-CCB1	Calibration Blank	08/05/14	15:27
C140717-15	14BH-DT-PILOT-BCR3-07221	08/05/14	15:27
C140717-32	14BH-DT-PILOT-POSTE-0722	08/05/14	15:27
C140717-36	14BH-DT-PILOT-POSTI-07221	08/05/14	15:27
C140717-40	14BH-DT-PILOT-BCR1-07221	08/05/14	15:27
1408030-CCV2	Calibration Check	08/05/14	15:27
1408030-CCB2	Calibration Blank	08/05/14	15:27
C140717-19	14BH-DT-PILOT-BCR4-07221	08/05/14	15:27
1408030-CCV3	Calibration Check	08/05/14	15:27
1408030-CCB3	Calibration Blank	08/05/14	15:27

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 300.0 **Dissolved** **Sequence ID#:** 1408042

Instrument ID #: ESAT Dionex IC Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1408042-ICV1	Initial Cal Check	08/05/14	10:36
1408042-ICB1	Initial Cal Blank	08/05/14	10:55
1408009-BS1	Blank Spike	08/05/14	11:32
1408009-BLK1	Blank	08/05/14	11:51
C140717-03	14BH-DT-PILOT-BCR1-07221	08/05/14	12:09
1408009-DUP1	Duplicate	08/05/14	12:28
1408009-MS1	Matrix Spike	08/05/14	12:46
C140717-06	14BH-DT-PILOT-BCR2-07221	08/05/14	13:05
C140717-10	14BH-DT-PILOT-BCR2D-0722	08/05/14	13:24
C140717-14	14BH-DT-PILOT-BCR3-07221	08/05/14	13:42
1408042-CCV1	Calibration Check	08/05/14	14:01
1408042-CCB1	Calibration Blank	08/05/14	14:56
1408042-SCV1	Secondary Cal Check	08/05/14	15:15
1408042-IBL1	Instrument Blank	08/05/14	15:34
C140717-18	14BH-DT-PILOT-BCR4-07221	08/05/14	15:52
C140717-22	14BH-DT-PILOT-CHIT-07221	08/05/14	16:11
C140717-25	14BH-DT-PILOT-INF-072214	08/05/14	16:29
C140717-28	14BH-DT-PILOT-NAOH-0722	08/05/14	16:48
C140717-31	14BH-DT-PILOT-POSTE-0722	08/05/14	17:06
C140717-35	14BH-DT-PILOT-POSTI-07221	08/05/14	17:25
C140717-39	14BH-DT-PILOT-SAPS-07221	08/05/14	17:44
1408009-MS2	Matrix Spike	08/05/14	18:02
1408042-CCV2	Calibration Check	08/05/14	18:21
1408042-CCB2	Calibration Blank	08/05/14	19:17

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Dissolved** **Sequence ID#:** 1409077

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409077-ICV1	Initial Cal Check	09/17/14	08:04
1409077-SCV1	Secondary Cal Check	09/17/14	08:08
1409077-ICB1	Initial Cal Blank	09/17/14	08:11
1409077-CRL1	Instrument RL Check	09/17/14	08:14
1409077-IFA1	Interference Check A	09/17/14	08:16
1409077-IFB1	Interference Check B	09/17/14	08:20
1409072-BLK1	Blank	09/17/14	08:24
1409072-BS1	Blank Spike	09/17/14	08:27
C140717-02	14BH-DT-PILOT-BCR1-07221	09/17/14	08:55
1409077-CCV1	Calibration Check	09/17/14	09:01
1409077-CCB1	Calibration Blank	09/17/14	09:04
C140717-13	14BH-DT-PILOT-BCR3-07221	09/17/14	09:07
C140717-17	14BH-DT-PILOT-BCR4-07221	09/17/14	09:11
C140717-24	14BH-DT-PILOT-INF-072214	09/17/14	09:18
C140717-27	14BH-DT-PILOT-NAOH-0722	09/17/14	09:22
C140717-30	14BH-DT-PILOT-POSTE-0722	09/17/14	09:25
C140717-34	14BH-DT-PILOT-POSTI-07221	09/17/14	09:29
C140717-38	14BH-DT-PILOT-SAPS-07221	09/17/14	09:33
C140717-05	14BH-DT-PILOT-BCR2-07221	09/17/14	09:39
1409077-CCV2	Calibration Check	09/17/14	09:42
1409077-CCB2	Calibration Blank	09/17/14	09:45
1409072-DUP1	Duplicate	09/17/14	09:48
1409077-SRD1	Serial Dilution	09/17/14	09:51
1409072-MS1	Matrix Spike	09/17/14	09:55
C140717-09	14BH-DT-PILOT-BCR2D-0722	09/17/14	09:58
1409072-MS2	Matrix Spike	09/17/14	10:01
C140717-21	14BH-DT-PILOT-CHIT-07221	09/17/14	10:04
1409077-CCV3	Calibration Check	09/17/14	10:07
1409077-CCB3	Calibration Blank	09/17/14	10:10

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Total Recoverable** **Sequence ID#:** 1409078

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409078-ICV1	Initial Cal Check	09/17/14	08:04
1409078-SCV1	Secondary Cal Check	09/17/14	08:08
1409078-ICB1	Initial Cal Blank	09/17/14	08:11
1409078-CRL1	Instrument RL Check	09/17/14	08:14
1409078-IFA1	Interference Check A	09/17/14	08:16
1409078-IFB1	Interference Check B	09/17/14	08:20
1409078-CCV1	Calibration Check	09/17/14	09:01
1409078-CCB1	Calibration Blank	09/17/14	09:04
1409078-CCV2	Calibration Check	09/17/14	09:42
1409078-CCB2	Calibration Blank	09/17/14	09:45
1409078-CCV3	Calibration Check	09/17/14	10:07
1409078-CCB3	Calibration Blank	09/17/14	10:10
1409057-BLK1	Blank	09/17/14	10:17
1409057-SRM1	Reference	09/17/14	10:20
C140717-01	14BH-DT-PILOT-BCR1-07221	09/17/14	10:23
1409057-DUP1	Duplicate	09/17/14	10:26
1409078-SRD1	Serial Dilution	09/17/14	10:29
C140717-04	14BH-DT-PILOT-BCR2-07221	09/17/14	10:32
1409057-MS1	Matrix Spike	09/17/14	10:36
C140717-08	14BH-DT-PILOT-BCR2D-0722	09/17/14	10:39
1409057-MS3	Matrix Spike	09/17/14	10:42
1409078-CCV4	Calibration Check	09/17/14	10:48
1409078-CCB4	Calibration Blank	09/17/14	10:51
C140717-12	14BH-DT-PILOT-BCR3-07221	09/17/14	10:54
C140717-16	14BH-DT-PILOT-BCR4-07221	09/17/14	10:58
C140717-20	14BH-DT-PILOT-CHIT-07221	09/17/14	11:01
C140717-23	14BH-DT-PILOT-INF-072214	09/17/14	11:04
C140717-26	14BH-DT-PILOT-NAOH-0722	09/17/14	11:07
C140717-29	14BH-DT-PILOT-POSTE-0722	09/17/14	11:11
C140717-33	14BH-DT-PILOT-POSTI-07221	09/17/14	11:15
C140717-37	14BH-DT-PILOT-SAPS-07221	09/17/14	11:19
1409078-CCV5	Calibration Check	09/17/14	11:25
1409078-CCB5	Calibration Blank	09/17/14	11:28

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Dissolved** **Sequence ID#:** 1409082

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409082-ICV1	Initial Cal Check	09/17/14	09:18
1409082-SCV1	Secondary Cal Check	09/17/14	09:21
1409082-ICB1	Initial Cal Blank	09/17/14	09:25
1409082-CRL1	Instrument RL Check	09/17/14	09:28
1409082-IFA1	Interference Check A	09/17/14	09:31
1409082-IFB1	Interference Check B	09/17/14	09:34
1409073-BLK1	Blank	09/17/14	09:38
1409073-BS1	Blank Spike	09/17/14	09:41
C140717-05	14BH-DT-PILOT-BCR2-07221	09/17/14	09:44
1409073-DUP1	Duplicate	09/17/14	09:47
1409082-SRD1	Serial Dilution	09/17/14	09:50
1409073-MS1	Matrix Spike	09/17/14	09:53
C140717-09	14BH-DT-PILOT-BCR2D-0722	09/17/14	09:56
1409073-MS2	Matrix Spike	09/17/14	09:59
C140717-02	14BH-DT-PILOT-BCR1-07221	09/17/14	10:02
1409082-CCV1	Calibration Check	09/17/14	10:29
1409082-CCB1	Calibration Blank	09/17/14	10:32
C140717-13	14BH-DT-PILOT-BCR3-07221	09/17/14	10:35
C140717-17	14BH-DT-PILOT-BCR4-07221	09/17/14	10:39
C140717-21	14BH-DT-PILOT-CHIT-072214	09/17/14	10:42
C140717-24	14BH-DT-PILOT-INF-072214	09/17/14	10:45
C140717-27	14BH-DT-PILOT-NAOH-0722	09/17/14	10:48
C140717-30	14BH-DT-PILOT-POSTE-0722	09/17/14	10:51
C140717-34	14BH-DT-PILOT-POSTI-07221	09/17/14	10:54
C140717-38	14BH-DT-PILOT-SAPS-072214	09/17/14	10:57
1409082-CCV2	Calibration Check	09/17/14	12:26
1409082-CCB2	Calibration Blank	09/17/14	12:29

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Total Recoverable** **Sequence ID#:** 1409083

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409083-ICV1	Initial Cal Check	09/17/14	09:18
1409083-SCV1	Secondary Cal Check	09/17/14	09:21
1409083-ICB1	Initial Cal Blank	09/17/14	09:25
1409083-CRL1	Instrument RL Check	09/17/14	09:28
1409083-IFA1	Interference Check A	09/17/14	09:31
1409083-IFB1	Interference Check B	09/17/14	09:34
1409083-CCV1	Calibration Check	09/17/14	10:29
1409083-CCB1	Calibration Blank	09/17/14	10:32
1409083-CCV2	Calibration Check	09/17/14	12:26
1409083-CCB2	Calibration Blank	09/17/14	12:29
1409057-BLK2	Blank	09/17/14	12:35
1409057-SRM2	Reference	09/17/14	12:38
C140717-01	14BH-DT-PILOT-BCR1-07221	09/17/14	12:41
1409057-DUP2	Duplicate	09/17/14	12:44
1409083-SRD1	Serial Dilution	09/17/14	12:47
C140717-04	14BH-DT-PILOT-BCR2-07221	09/17/14	12:51
1409057-MS2	Matrix Spike	09/17/14	12:54
C140717-08	14BH-DT-PILOT-BCR2D-0722	09/17/14	12:57
1409057-MS4	Matrix Spike	09/17/14	13:00
1409083-CCV3	Calibration Check	09/17/14	13:53
1409083-CCB3	Calibration Blank	09/17/14	13:56
C140717-12	14BH-DT-PILOT-BCR3-07221	09/17/14	14:00
C140717-16	14BH-DT-PILOT-BCR4-07221	09/17/14	14:03
C140717-20	14BH-DT-PILOT-CHIT-072214	09/17/14	14:06
C140717-23	14BH-DT-PILOT-INF-072214	09/17/14	14:09
C140717-26	14BH-DT-PILOT-NAOH-0722	09/17/14	14:12
C140717-29	14BH-DT-PILOT-POSTE-0722	09/17/14	14:15
C140717-33	14BH-DT-PILOT-POSTI-07221	09/17/14	14:18
C140717-37	14BH-DT-PILOT-SAPS-07221	09/17/14	14:21
1409083-CCV4	Calibration Check	09/17/14	15:18
1409083-CCB4	Calibration Blank	09/17/14	15:21

CHAIN OF CUSTODY RECORD

CDM Smith | **Danny T Pilot Test**

NOTES: Limited sample volumes due to treatability testing

SAMPLE NUMBER	DATE	TIME	MATRIX	Preservative	Type & No. of Containers	Total Metals (TAL), 200.7 or 200.8	Dissolved Metals (TAL), 200.7 or 200.8	Alkalinity, Anions (sulfate, chloride, fluoride)	Nitrate+Nitrite, Ammonia		Other Instructions and Notes
14BH-DT-PILOT-INF-072214	7/22/14	8:30	aqueous	HNO3 (metals), H2SO4 (nutrients), cool	3, 125 mL poly	X	X	X			TAL metals = Al, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, Tl, Zn.
14BH-DT-PILOT-SAPS-072214	7/22/14	8:45	aqueous		3, 125 mL poly	X	X	X			
14BH-DT-PILOT-CHIT-072214	7/22/14	9:00	aqueous		3, 125 mL poly	X	X	X			
14BH-DT-PILOT-NAOH-072214	7/22/14	9:10	aqueous		3, 125 mL poly	X	X	X			
14BH-DT-PILOT-BCR1-072214	7/22/14	9:25	aqueous		3, 125 mL poly	X	X	X	X	KB 7/25/14	
14BH-DT-PILOT-BCR2-072214	7/22/14	9:45	aqueous		4, 125 mL poly	X	X	X	X		
14BH-DT-PILOT-BCR2D-072214	7/22/14	10:00	aqueous		4, 125 mL poly	X	X	X	X		
14BH-DT-PILOT-BCR3-072214	7/22/14	10:10	aqueous		4, 125 mL poly	X	X	X	X		
14BH-DT-PILOT-BCR4-072214	7/22/14	10:20	aqueous		4, 125 mL poly	X	X	X	X		
14BH-DT-PILOT-POSTI-072214	7/22/14	10:30	aqueous		4, 125 mL poly	X	X	X	X		
14BH-DT-PILOT-POSTE-072214	7/22/14	10:45	aqueous		4, 125 mL poly	X	X	X	X		

Relinquished by: (*Signature*)	Date/Time 7/22/2014 16:00	Received for Laboratory by: (*Signature*)
Received by: (*Signature*)	Date/Time 7/24/14 @ 11:00	Airbill No.(s)

ESAT

C140717

ESAT Technical Direction Form

Contract No. EPW13028
EPA Region 8

Site ID:	085N	***Date Issued:***	5/29/2014	***Date***	
TDF ID:	A-046	***Date Updated:***		***Closed By:***	

Name: Barker-Hughesville Treatability Study

Details: The Contractor shall analyze several water samples associated with the treatability study at the Barker-Hughesville Superfund site as indicated in the Analytical Information Section. The samples will be sent to the ESAT R8 Lab during the 2014 field season starting in mid-June though early October 2014. There will be 9 sampling events associated with this project averaging approximately 10 samples per an event. The samples will be collected by Nick Anton/Erin Louden of CDM Smith.

Samples designated as influent samples (-INF) are expected to have high metal concentrations and should be analyzed by 200.7. Additionally, metals with sufficiently high concentrations may be reported from the 200.7 analyses.

ESAT should return the coolers to the following address:
CDM Smith/Lauren Helland
50 West 14th Street, Suite 200
Helena, MT 59601
406-441-1435
FedEx # 1323-6393-5

TO02/Subtask 02b: Inorganic Chemistry

Site RPM: Roger Hoogerheide

Analytical Information:

MATRIX

☑ Water ☐ Soils ☐ Vegetation ☐ Biota

WET CHEM

☐ TSS ☐ TDS ☐ DOC ☑ Alk ☑ Chloride ☑ Sulfate ☑ Fluoride ☑ Nitrate ☑ Nitrite
Other: Analyze for Ammonia and report NO2 and NO3 as NO2-NO3 combined.

METALS

☑ Dissolved ☑ Total Recoverable ☐ Total ☐ Hardness (Calc)
200.7: ☐ Ag ☑ Al ☐ As ☐ Ba ☐ Be ☐ B ☐ Ca ☐ Cd ☐ Co ☐ Cr ☐ Cu ☑ Fe ☐ K ☐ Mg
☒ Mn ☐ Mo ☐ Na ☐ Ni ☐ Pb ☐ Sb ☐ Se ☐ Sr ☐ Ti ☐ Tl ☐ V ☑ Zn ☐ SiO2
200.8: ☐ Ag ☐ Al ☑ As ☐ Ba ☐ Be ☑ Cd ☐ Co ☐ Cr ☑ Cu ☑ ~~Mn~~ ☐ Mo ☑ Ni ☑ Pb ☐ Sb
☐ Se ☐ Th ☐ Tl ☐ U ☐ V ☐ Zn
7470/7471/747 ☐ Hg

09/17/14

FIBERS

☐ PLM ☐ TEM

Deliverables

ID	*Description*	*Due Date*	*Submission Date*
1	Provide final deliverable package to Task Monitor no later than 30 days after delivery of samples.		

5/29/14

ANALYTICAL SUMMARY REPORT

August 25, 2014

CDM Federal Programs
555 17th St Ste 1100
Denver, CO 80202

Work Order: H14080124 Quote ID: H823 - Baker-Hughsville Superfund Site
Project Name: Barker Hughsville - Danny T

Energy Laboratories Inc Helena MT received the following 11 samples for CDM Federal Programs on 8/7/2014 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H14080124-001	14BH-DT-PILOT-INFL-080614	08/06/14 8:55	08/07/14	Aqueous	Acidity, Total as CaCO3 Phosphorus, Orthophosphate as P
H14080124-002	14BH-DT-PILOT-INFLD-080614	08/06/14 9:00	08/07/14	Aqueous	Same As Above
H14080124-003	14BH-DT-PILOT-SAPS-080614	08/06/14 9:10	08/07/14	Aqueous	Same As Above
H14080124-004	14BH-DT-PILOT-CHIT-080614	08/06/14 9:20	08/07/14	Aqueous	Same As Above
H14080124-005	14BH-DT-PILOT-NAOH-080614	08/06/14 9:35	08/07/14	Aqueous	Same As Above
H14080124-006	14BH-DT-PILOT-BCR1-080614	08/06/14 9:45	08/07/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Phosphorus, Orthophosphate as P Sulfide, Iodine Titrimetric
H14080124-007	14BH-DT-PILOT-BCR2-080614	08/06/14 10:10	08/07/14	Aqueous	Same As Above
H14080124-008	14BH-DT-PILOT-BCR3-080614	08/06/14 10:35	08/07/14	Aqueous	Same As Above
H14080124-009	14BH-DT-PILOT-BCR4-080614	08/06/14 10:50	08/07/14	Aqueous	Same As Above
H14080124-010	14BH-DT-PILOT-POSTI-080614	08/06/14 11:10	08/07/14	Aqueous	Same As Above
H14080124-011	14BH-DT-PILOT-POSTE-080614	08/06/14 11:25	08/07/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Phosphorus, Orthophosphate as P Sulfide, Methylene Blue Colorimetric

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

CLIENT: CDM Federal Programs
Project: Barker Hughsville - Danny T
Work Order: H14080124

Report Date: 08/25/14

CASE NARRATIVE

Tests associated with analyst identified as ELI-B were subcontracted to Energy Laboratories, 1120 S. 27th St., Billings, MT, EPA Number MT00005.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/25/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/06/14 08:55
Lab ID:	H14080124-001	**DateReceived:**	08/07/14
Client Sample ID:	14BH-DT-PILOT-INFL-080614	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	690	mg/L	D	4.0		A2310 B	08/11/14 11:09 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.362	mg/L		0.005		E365.1	08/08/14 08:39 / cmm

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/25/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/06/14 09:00
Lab ID:	H14080124-002	**DateReceived:**	08/07/14
Client Sample ID:	14BH-DT-PILOT-INFLD-080614	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	730	mg/L	D	4.0		A2310 B	08/11/14 11:17 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.10	mg/L	D	0.05		E365.1	08/07/14 16:17 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/25/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/06/14 09:10
Lab ID:	H14080124-003	**DateReceived:**	08/07/14
Client Sample ID:	14BH-DT-PILOT-SAPS-080614	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	400	mg/L	D	4.0		A2310 B	08/11/14 11:22 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.10	mg/L	D	0.02		E365.1	08/08/14 08:44 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/25/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/06/14 09:20
Lab ID:	H14080124-004	**DateReceived:**	08/07/14
Client Sample ID:	14BH-DT-PILOT-CHIT-080614	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	08/11/14 11:27 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	26.9	mg/L	D	0.1		E365.1	08/07/14 16:19 / cmm

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/25/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/06/14 09:35
Lab ID:	H14080124-005	**DateReceived:**	08/07/14
Client Sample ID:	14BH-DT-PILOT-NAOH-080614	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	320	mg/L	D	4.0		A2310 B	08/11/14 11:34 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	ND	mg/L	D	0.01		E365.1	08/08/14 09:02 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/25/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/06/14 09:45
Lab ID:	H14080124-006	**DateReceived:**	08/07/14
Client Sample ID:	14BH-DT-PILOT-BCR1-080614	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	08/11/14 11:41 / SRW
Sulfide	61	mg/L		1		A4500-S F	08/11/14 13:45 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	250	mg/L		100		A5210 B	08/07/14 17:40 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	24.5	mg/L	D	0.1		E365.1	08/07/14 16:21 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/25/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/06/14 10:10
Lab ID:	H14080124-007	**DateReceived:**	08/07/14
Client Sample ID:	14BH-DT-PILOT-BCR2-080614	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	08/11/14 11:48 / SRW
Sulfide	31	mg/L		1		A4500-S F	08/11/14 13:45 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	<121	mg/L		100		A5210 B	08/07/14 17:45 / SRW
No BOD dilution depleted greater than 2.0 mg/L DO.							
NUTRIENTS							
Phosphorus, Orthophosphate as P	6.9	mg/L	D	0.1		E365.1	08/07/14 16:22 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/25/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/06/14 10:35
Lab ID:	H14080124-008	**DateReceived:**	08/07/14
Client Sample ID:	14BH-DT-PILOT-BCR3-080614	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	08/11/14 11:55 / SRW
Sulfide	82	mg/L		1		A4500-S F	08/11/14 13:45 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	710	mg/L		200		A5210 B	08/07/14 17:46 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	10.7	mg/L	D	0.1		E365.1	08/07/14 16:23 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/25/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/06/14 10:50
Lab ID:	H14080124-009	**DateReceived:**	08/07/14
Client Sample ID:	14BH-DT-PILOT-BCR4-080614	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	08/11/14 12:01 / SRW
Sulfide	35	mg/L		1		A4500-S F	08/11/14 13:45 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	<121	mg/L		100		A5210 B	08/07/14 17:51 / SRW
No BOD dilution depleted greater than 2.0 mg/L DO.							
NUTRIENTS							
Phosphorus, Orthophosphate as P	2.5	mg/L	D	0.1		E365.1	08/07/14 16:25 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/25/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/06/14 11:10
Lab ID:	H14080124-010	**DateReceived:**	08/07/14
Client Sample ID:	14BH-DT-PILOT-POSTI-080614	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	08/11/14 12:05 / SRW
Sulfide	33	mg/L		1		A4500-S F	08/11/14 13:45 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	310	mg/L		100		A5210 B	08/07/14 17:58 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	13.5	mg/L	D	0.1		E365.1	08/07/14 16:26 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	08/25/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/06/14 11:25
Lab ID:	H14080124-011	**DateReceived:**	08/07/14
Client Sample ID:	14BH-DT-PILOT-POSTE-080614	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	08/11/14 12:11 / SRW
Sulfide	5.7	mg/L	D	0.2		A4500-S D	08/11/14 14:00 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	73	mg/L		70		A5210 B	08/07/14 18:04 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	2.3	mg/L	D	0.1		E365.1	08/07/14 16:33 / cmm

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T

Report Date: 08/25/14
Work Order: H14080124

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2310 B										Batch: H140811A
Lab ID: H14080124-001BDUP		Sample Duplicate				Run: PH_140811A				08/11/14 11:13
Acidity, Total as CaCO3		720	mg/L	4.0				4.3	20	
Lab ID: H14080124-011ADUP		Sample Duplicate				Run: PH_140811A				08/11/14 12:17
Acidity, Total as CaCO3		ND	mg/L	4.0					20	
Lab ID: LCS1408110000		Laboratory Control Sample				Run: PH_140811A				08/11/14 11:06
Acidity, Total as CaCO3		940	mg/L	4.0	96	90	110			
Lab ID: MBLK1408110000		Method Blank				Run: PH_140811A				08/11/14 11:03
Acidity, Total as CaCO3		2	mg/L							

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Report Date: 08/25/14
Work Order: H14080124

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **A4500-S D**									Batch: B_R228747	
Lab ID: **MB-R228747**		Method Blank				Run: SUB-B228747			08/11/14 14:00	
Sulfide		ND	mg/L	0.002						
Lab ID: **LCS-R228747**		Laboratory Control Sample				Run: SUB-B228747			08/11/14 14:00	
Sulfide		0.278	mg/L	0.040	115	70	130			
Lab ID: **B14080622-002EMS**		Sample Matrix Spike				Run: SUB-B228747			08/11/14 14:00	
Sulfide		0.403	mg/L	0.040	86	70	130			
Lab ID: **B14080622-002EMSD**		Sample Matrix Spike Duplicate				Run: SUB-B228747			08/11/14 14:00	
Sulfide		0.404	mg/L	0.040	87	70	130	0.4	20	
Lab ID: **B14080843-001FMS**		Sample Matrix Spike				Run: SUB-B228747			08/11/14 14:00	
Sulfide		0.305	mg/L	0.040	117	70	130			
Lab ID: **B14080843-001FMSD**		Sample Matrix Spike Duplicate				Run: SUB-B228747			08/11/14 14:00	
Sulfide		0.276	mg/L	0.040	105	70	130	9.8	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T

Report Date: 08/25/14
Work Order: H14080124

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **A4500-S F**										Batch: B_R228749
Lab ID: **MB-R228749**		Method Blank				Run: SUB-B228749				08/11/14 13:45
Sulfide		ND	mg/L	0.5						
Lab ID: **LCS-R228749**		Laboratory Control Sample				Run: SUB-B228749				08/11/14 13:45
Sulfide		23.2	mg/L	1.0	101	70	130			
Lab ID: **H14080093-001F**		Sample Matrix Spike				Run: SUB-B228749				08/11/14 13:45
Sulfide		23.7	mg/L	1.0	98	80	120			
Lab ID: **H14080093-001F**		Sample Matrix Spike Duplicate				Run: SUB-B228749				08/11/14 13:45
Sulfide		23.6	mg/L	1.0	98	80	120	0.3	20	
Lab ID: **H14080093-002F**		Sample Matrix Spike				Run: SUB-B228749				08/11/14 13:45
Sulfide		23.3	mg/L	1.0	101	80	120			
Lab ID: **H14080093-002F**		Sample Matrix Spike Duplicate				Run: SUB-B228749				08/11/14 13:45
Sulfide		23.1	mg/L	1.0	100	80	120	0.7	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T

Report Date: 08/25/14
Work Order: H14080124

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A5210 B									Batch: 140807_2_BOD5-W	
Lab ID: Dil-H201_140807		Dilution Water Blank				Run: MISC WC_140807B			08/07/14 17:19	
Oxygen Demand, Biochemical (BOD)		ND	mg/L	2.0		0	0.2			
Lab ID: GGA1_140807		Laboratory Control Sample				Run: MISC WC_140807B			08/07/14 17:24	
Oxygen Demand, Biochemical (BOD)		180	mg/L	60	89	85	115			
Lab ID: H14080121-001ADUP		Sample Duplicate				Run: MISC WC_140807B			08/07/14 17:34	
Oxygen Demand, Biochemical (BOD)		810	mg/L	360		90	110	6.8	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs

Project: Barker Hughsville - Danny T

Report Date: 08/25/14

Work Order: H14080124

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E365.1							Analytical Run: FIA202-HE_140807B			
Lab ID: ICV		Initial Calibration Verification Standard								08/07/14 16:09
Phosphorus, Orthophosphate as P		0.242	mg/L	0.0050	97	90	110			
Lab ID: ICB		Initial Calibration Blank, Instrument Blank								08/07/14 16:10
Phosphorus, Orthophosphate as P		-0.00109	mg/L	0.0050		0	0			
Lab ID: CCV		Continuing Calibration Verification Standard								08/07/14 16:12
Phosphorus, Orthophosphate as P		0.0994	mg/L	0.0050	99	90	110			
Lab ID: CCV		Continuing Calibration Verification Standard								08/07/14 16:32
Phosphorus, Orthophosphate as P		0.103	mg/L	0.0050	103	90	110			
Method: E365.1										Batch: R99540
Lab ID: LFB		Laboratory Fortified Blank				Run: FIA202-HE_140807B				08/07/14 16:11
Phosphorus, Orthophosphate as P		0.186	mg/L	0.0050	93	90	110			
Lab ID: H14080124-001AMS		Sample Matrix Spike				Run: FIA202-HE_140807B				08/07/14 16:15
Phosphorus, Orthophosphate as P		9.36	mg/L	0.10	47	90	110			S
Lab ID: H14080124-001AMSD		Sample Matrix Spike Duplicate				Run: FIA202-HE_140807B				08/07/14 16:16
Phosphorus, Orthophosphate as P		9.80	mg/L	0.10	49	90	110	4.6	20	S
Lab ID: H14080124-011BMS		Sample Matrix Spike				Run: FIA202-HE_140807B				08/07/14 16:34
Phosphorus, Orthophosphate as P		21.5	mg/L	0.10	96	90	110			
Lab ID: H14080124-011BMSD		Sample Matrix Spike Duplicate				Run: FIA202-HE_140807B				08/07/14 16:35
Phosphorus, Orthophosphate as P		21.7	mg/L	0.10	97	90	110	1.1	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Report Date: 08/25/14
Work Order: H14080124

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E365.1							Analytical Run: FIA202-HE_140808A			
Lab ID: ICV		Initial Calibration Verification Standard								08/08/14 08:34
Phosphorus, Orthophosphate as P		0.246	mg/L	0.0050	98	90	110			
Lab ID: ICB		Initial Calibration Blank, Instrument Blank								08/08/14 08:35
Phosphorus, Orthophosphate as P		-0.000320	mg/L	0.0050		0	0			
Lab ID: CCV		Continuing Calibration Verification Standard								08/08/14 08:37
Phosphorus, Orthophosphate as P		0.101	mg/L	0.0050	101	90	110			
Lab ID: CCV		Continuing Calibration Verification Standard								08/08/14 08:57
Phosphorus, Orthophosphate as P		0.105	mg/L	0.0050	105	90	110			
Method: E365.1										Batch: R99566
Lab ID: LFB		Laboratory Fortified Blank				Run: FIA202-HE_140808A				08/08/14 08:36
Phosphorus, Orthophosphate as P		0.192	mg/L	0.0050	96	90	110			
Lab ID: H14080124-002AMS		Sample Matrix Spike				Run: FIA202-HE_140808A				08/08/14 08:42
Phosphorus, Orthophosphate as P		4.07	mg/L	0.050	41	90	110			S
Lab ID: H14080124-002AMSD		Sample Matrix Spike Duplicate				Run: FIA202-HE_140808A				08/08/14 08:43
Phosphorus, Orthophosphate as P		5.12	mg/L	0.050	51	90	110	23	20	SR
Lab ID: H14080124-011BMS		Sample Matrix Spike				Run: FIA202-HE_140808A				08/08/14 08:59
Phosphorus, Orthophosphate as P		22.7	mg/L	0.10	101	90	110			
Lab ID: H14080124-011BMSD		Sample Matrix Spike Duplicate				Run: FIA202-HE_140808A				08/08/14 09:00
Phosphorus, Orthophosphate as P		23.1	mg/L	0.10	103	90	110	1.4	20	

Qualifiers:

RL - Analyte reporting limit.
ND - Not detected at the reporting limit.
R - RPD exceeds advisory limit.
S - Spike recovery outside of advisory limits.

Workorder Receipt Checklist

CDM Federal Programs

H14080124

Login completed by: Wanda Johnson

Reviewed by: BL2000\sdull

Reviewed Date: 8/11/2014

Date Received: 8/7/2014

Received by: wjj

Carrier name: Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	8.2°C On Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☑	No ☐	Not Applicable ☐

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

None

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 1 of 2

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM Smith

Project Name, PWS, Permit, Etc.: BarkerHughesville - Danny T

Sample Origin State: MT

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address (Required):

Contact Name: Angela Frandsen

Phone/Fax: (406) 441-1400

Cell:

Sampler: (Please Print) Lauren Helland

☒ No Hard Copy Email: FrandsenAK@cdmsmith.com

Invoice Contact & Phone: Same

Purchase Order:

Quote/Bottle Order:

Invoice Address (Required):

☒ No Hard Copy Email: FrandsenAK@cdmsmith.com

Special Report/Formats:

☐ DW

☐ POTW/WWTP

☐ State: ______

☐ Other: ______

☒ EDD/EDT (Electronic Data)

Format: Excel

☐ LEVEL IV

☐ NELAC

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids
Vegetation Bioassay Other
DW - Drinking Water

ANALYSIS REQUESTED

SEE ATTACHED

Standard Turnaround (TAT)

RUSH

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: Please use 1000mL bottles for Combined BOD and acidity.

Shipped by: hand del

Cooler ID(s): Y

Receipt Temp 8.2 °C

On Ice: [✓ Y] N

Custody Seal
On Bottle Y N
On Cooler Y N
Intact Y N
Signature Match Y N

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	BOD	Sulfide	Acidity	Ortho-Phosphate
1	14BH-DT-PILOT-INFL-080614	08/06/14	08:55	2, W			X	X
2	14BH-DT-PILOT-INFLQ-080614	08/06/14	9:00	2, W			X	X
3	14BH-DT-PILOT-SAPS-080614	08/06/14	9:10	2, W			X	X
4	14BH-DT-PILOT-CHIT-080614	08/06/14	9:20	2, W			X	X
5	14BH-DT-PILOT-NAOH-080614	08/06/14	9:35	2, W			X	X
6	14BH-DT-PILOT-BCR1-080614	08/06/14	9:45	3, W	X	X	X	X
7	14BH-DT-PILOT-BCR2-080614	08/06/14	LH ~~9:5~~ 10:10	3, W	X	X	X	X
8	14BH-DT-PILOT-BCR3-080614	08/06/14	10:35	3, W	X	X	X	X
9	14BH-DT-PILOT-BCR4-080614	08/06/14	10:50	3, W	X	X	X	X
10	14BH-DT-PILOT-POSTI-080614	08/06/14	11:10	3, W	X	X	X	X

LABORATORY USE ONLY

#1408124

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Lauren Helland	08/07/14 1418	Lauren Helland			

Received by Laboratory: Wanda [illegible]

Date/Time: 8-7-14 1418

Signature:

Sample Disposal: Return to Client: ______ Lab Disposal: ______

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 2 of 2

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM Smith

Project Name, PWS, Permit, Etc.: Barker Hughesville - DannyT

Sample Origin State: MT

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address (Required):

Contact Name: Angela Frandsen Phone/Fax: (406) 441-1400

Cell:

Sampler: (Please Print) Lauren Helland

☒ No Hard Copy Email: FrandsenAK@cdmsmith.com

Invoice Contact & Phone: Same.

Purchase Order:

Quote/Bottle Order:

Invoice Address (Required):

☒ No Hard Copy Email: Same.

Special Report/Formats:

☐ DW ☒ EDD/EDT(Electronic Data)
☐ POTW/WWTP Format: Excel.
☐ State: ____ ☐ LEVEL IV
☐ Other: ____ ☐ NELAC

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids
Vegetation Bioassay Other
DW - Drinking Water

ANALYSIS REQUESTED

SEE ATTACHED

Standard Turnaround (TAT)

RUSH

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: Please 4x 1000mL bottles for combined BOD + acidity.

Shipped by: Handdel

Cooler ID(s): Y

Receipt Temp 8.2 °C

On Ice: [✓ Y] N

Custody Seal
On Bottle Y [✓ N]
On Cooler Y [✓ N]
Intact Y [✓ N]
Signature Match Y [✓ N]

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	BOD	Sulfide	Acidity	Ortho-phosphate						SEE ATTACHED	Standard Turnaround (TAT)	RUSH		LABORATORY USE ONLY
1 14BH-DT-PILOT-POSTE-080614	08/06/14	11:25	3, W	X	X	X	X										H14080124
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Lauren Helland	08/07/14 1418	Lauren Helland			

Received by Laboratory: Wanda Dm Date/Time: 8-7-14 1418 Signature:

Sample Disposal: Return to Client: ____ Lab Disposal: ____

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested.
This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.
Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

U.S. Environmental Protection Agency
Region 8
Technical and Management Services

Laboratory Services Program

Certificate of Analysis

Ref: 8TMS-L

MEMORANDUM

Date: 09/24/14

Subject: Analytical Results--- **Barker-Hughesville_Treatability_AUG 2014_A046 / A-046**

From: Don Goodrich; EPA Region 8 Analytical Chemistry WAM

To: Roger Hoogerheide
Superfund
8 MO

Received Sample Set(s), [Work Order : Date Received]:
[C140804 : 08/08/2014]

Attached are the analytical results for the samples received from the Barker-Hughesville_Treatability_AUG 2014_A046 sampling event, according to TDF A-046. All analyses were performed within their method specified holding times unless otherwise noted in the following narrative.

These samples were prepared, analyzed, and verified by the Environmental Services Assistance Team Laboratory (ESAT) according to the requirements of the Technical Direction Form (TDF).

Note: The laboratory herewith transmits this deliverable to the program/project partner for determination of "final data usability" which may include data validation and data quality asessment per and in accordance with EPA QA/G-8, *Guidance on Environmental Data Verification and Data Validation*, November 2002, EPA/240/R-02/004. Laboratory data qualifiers are applied based on the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004, referred to as "NFGI".

Laboratory policy is to dispose of any remaining sample 60 days after data analysis packages are delivered to EPA. If you would like the laboratory to retain the samples for a period longer than 60 days,

Case Narrative

C140804

Quality Assessment: Unless indicated by exception, the QA/QC associated with this sample set produced data within the TDF-specified criteria.

Holding Times: All samples were analyzed within their method-specified technical holding time(s).

1. Initial and Continuing calibration blanks (ICBs and CCBs).
   Exceptions: None.
2. Preparation (PB) / Method blanks (MB)
   Exceptions: None.
3. Interference Checks (ICSA / ICSAB) for ICP-MS and ICP-OE analyses only.
   Exceptions: None.
4. Initial and Continuing calibration verification analyses (ICVs, SCVs and CCVs).
   Exceptions: None.
5. Laboratory Control Sample (LCS) or second source analysis or SRM.
   Exceptions: None.
6. Laboratory Fortified blank (LFB) / Blank spike (BS), same source as used for the matrix spikes.
   PBS performed with analyses/methods requiring preparation or digestion prior to analysis.
   Exceptions: None.
7. Contract Reporting Detection Limit Standard, labeled as CRA, CRDL or CRL.
   Exceptions: None.
8. Laboratory Duplicate (DUP). "Source" identifies field sample duplicated in the laboratory. If either the "source" or the duplicate result is <5X the reporting limit, the %D limit of 20% does not apply.
   Exceptions: None.
9. Laboratory Matrix Spike (MS) and spike duplicate (MSD). "Source" defines original field sample fortified prior to analysis. Percent recovery (%R) limits do not apply when sample concentration(s) exceed the corresponding analyte spike level by a factor of 4 or greater.
   Exceptions: In ICP-MS batch 1409088, copper recovered low in the MS1 and MS2. Nickel also recovered low in the MS1. No qualifiers were assigned since all other QC requirements for nickel and copper were met.
10. Serial Dilution sample analysis (SRD). "Source" is parent field sample diluted 1:5 in the laboratory. Performed for ICP-OE and ICP-MS metals analyses. Percent difference (%D) limits do not apply when analyte concentration(s) are below 50x the source sample's MDL (or 10x it's PQL).
    Exceptions: None.
11. Internal standards, criteria specified for ICP-MS analyses only, monitored at the instrument.
    Exceptions: None.
12. Any calibration using more than two-points produced a correlation coefficient equal to or greater than 0.995.
    Exceptions: None.

Acronyms and Definitions:

ESAT	Environmental Services Assistance Team
J	Data Estimated qualifier (also applied to all data less than PQL, greater than or equal to MDL)
MDL	Method Detection Limit
PQL	Practical Quantitation Limit, also known as reporting limit.
RPD	Relative Percent Difference (difference divided by the mean)
%D	Percent difference, serial dilution criteria unit, difference divided by the original result.
%R	Percent recovery, analyzed (less sample contribution) divided by true value
<	Analyte NOT DETECTED at or above the Method Detection Limit (MDL)
mg/L	Parts per million (millligrams per liter). Solids equivalent = mg/Kg.
ug/L	Parts per billion (micrograms per liter). Solids equivalent = ug/Kg.
NR	No Recovery (matrix spike) - Often seen for calcium/magnesium when their concentration exceeds the spike level by > 4x.
NFGI	*USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004
RE	Sample Re-analysis. Usually seen on raw data and sequences for required sample dilutions due to over-range analytes.
U	Analyte not detected at or above MDL qualifier
D	Diluted value qualifier.

Method(s) Summary:

As defined in the Technical Direction Form (TDF), some or all of the methods listed below were used for the determination of the reported target analytes.

From EPA's *Methods for the Determination of Metals in Environmental Samples*, Supplement I, May 1994, dissolved, total, and/or total recoverable metals were determined by:

- Method 200.7 / 6010B using a PE Optima ICP -OE (ICP).
- Method 200.8 / 6020 using a Perkin -Elmer Elan 6000 ICP-MS.
- Method 200.2 for total recoverable metals (only) digestion.
- Method 245.1 using a Perkin -Elmer FIMS CVAA (aqueous mercury only).

From *Standard Methods for the Examination of Water and Wastewater*, 18th Edition, 1992, Method 2340B was used for the calculated hardness determination. Hardness is reported as mg (milligram) equivalent $CaCO_3$ per liter (L) determined as follows:

Calculated hardness = 2.497 * (Calcium, mg/L) + 4.118 * (Magnesium, mg/L).

From *EPA's Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW -846*,

- Method 3015A was used for microwave assisted total metals digestion.
- Method 7473 was used for mercury in solids.

From EPA's *Determination of Inorganic Anions by Ion Chromatography*, Revision 2.1, 1993, Method 300.0 was used to determine the anions.

From EPA's *Methods for Chemical Analysis of Water and Wastes*, March 1983:

- Method 310.1 was followed for the alkalinity determination.
- Method 160.1 was followed for gravimetric total dissolved solids (TDS) determination.
- Method 160.2 was used for gravimetric total suspended solids (TSS) determination.
- Method 415.3 was used for total organic carbon (TOC) determination using either an Apollo 9000 or Phoenix 8000 Non-Dispersive IR (NDIR) system. Also known as dissolved organic carbon (DOC) when performed on the dissolved sample fraction.

The quality control procedures listed in the TDF request were utilized by ESAT to verify accuracy of the results and to evaluate any matrix interferences.

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-080614 **Date / Time Sampled:** 08/06/14 09:45 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140804-02 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	09/22/2014	SV	1409087
200.7	Iron	< 1250	U	ug/L	500	5	09/22/2014	SV	1409087
200.7	**Manganese**	**83000**		ug/L	10.0	5	09/22/2014	SV	1409087
200.7	Zinc	< 100	U	ug/L	50.0	5	09/22/2014	SV	1409087
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/22/2014	SV	1409088
200.8	**Copper**	**6.94**	J	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/22/2014	SV	1409088
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
2340B	**Hardness**	**963**		mg/L	8	5	09/22/2014	SV	1409087

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-080614 **Date / Time Sampled:** 08/06/14 10:10 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140804-06 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	09/22/2014	SV	1409087
200.7	Iron	< 1250	U	ug/L	500	5	09/22/2014	SV	1409087
200.7	**Manganese**	**88000**		ug/L	10.0	5	09/22/2014	SV	1409087
200.7	Zinc	< 100	U	ug/L	50.0	5	09/22/2014	SV	1409087
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/22/2014	SV	1409088
200.8	**Copper**	**5.09**	J	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/22/2014	SV	1409088
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
2340B	**Hardness**	**774**		mg/L	8	5	09/22/2014	SV	1409087

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-080614 **Date / Time Sampled:** 08/06/14 10:35 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140804-10 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 50.0	U	ug/L	20.0	1	09/22/2014	SV	1409087
200.7	Iron	< 250	U	ug/L	100	1	09/22/2014	SV	1409087
200.7	**Manganese**	**39300**		ug/L	2.00	1	09/22/2014	SV	1409087
200.7	**Zinc**	**44.6**		ug/L	10.0	1	09/22/2014	SV	1409087
200.8	**Arsenic**	**10.4**	J	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/22/2014	SV	1409088
200.8	**Copper**	**9.81**	J	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/22/2014	SV	1409088
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
2340B	**Hardness**	**2060**		mg/L	2	1	09/22/2014	SV	1409087

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-080614 **Date / Time Sampled:** 08/06/14 10:50 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140804-14 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	09/22/2014	SV	1409087
200.7	Iron	< 1250	U	ug/L	500	5	09/22/2014	SV	1409087
200.7	**Manganese**	**99300**		ug/L	10.0	5	09/22/2014	SV	1409087
200.7	**Zinc**	**205**		ug/L	50.0	5	09/22/2014	SV	1409087
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/22/2014	SV	1409088
200.8	**Copper**	**7.04**	J	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/22/2014	SV	1409088
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
2340B	**Hardness**	**599**		mg/L	8	5	09/22/2014	SV	1409087

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-080614 **Date / Time Sampled:** 08/06/14 09:20 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140804-18 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**173**	J	ug/L	100	5	09/22/2014	SV	1409087
200.7	**Iron**	**2320**		ug/L	500	5	09/22/2014	SV	1409087
200.7	**Manganese**	**79400**		ug/L	10.0	5	09/22/2014	SV	1409087
200.7	Zinc	< 100	U	ug/L	50.0	5	09/22/2014	SV	1409087
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/22/2014	SV	1409088
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/22/2014	SV	1409088
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
2340B	**Hardness**	**1620**		mg/L	8	5	09/22/2014	SV	1409087

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFL-080614 **Date / Time Sampled:** 08/06/14 08:55 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140804-21 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**12600**		ug/L	100	5	09/22/2014	SV	1409087
200.7	**Iron**	**159000**		ug/L	500	5	09/22/2014	SV	1409087
200.7	**Manganese**	**109000**		ug/L	10.0	5	09/22/2014	SV	1409087
200.7	**Zinc**	**57000**		ug/L	50.0	5	09/22/2014	SV	1409087
200.8	**Arsenic**	**143**		ug/L	5.00	10	09/22/2014	SV	1409088
200.8	**Cadmium**	**232**		ug/L	1.00	10	09/22/2014	SV	1409088
200.8	**Copper**	**849**		ug/L	5.00	10	09/22/2014	SV	1409088
200.8	**Lead**	**134**		ug/L	1.00	10	09/22/2014	SV	1409088
200.8	**Nickel**	**19.0**		ug/L	5.00	10	09/22/2014	SV	1409088
2340B	**Hardness**	**346**		mg/L	8	5	09/22/2014	SV	1409087

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFLD-080614 **Date / Time Sampled:** 08/06/14 09:00 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140804-24 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**12300**		ug/L	100	5	09/22/2014	SV	1409087
200.7	**Iron**	**156000**		ug/L	500	5	09/22/2014	SV	1409087
200.7	**Manganese**	**108000**		ug/L	10.0	5	09/22/2014	SV	1409087
200.7	**Zinc**	**57100**		ug/L	50.0	5	09/22/2014	SV	1409087
200.8	**Arsenic**	**140**		ug/L	5.00	10	09/22/2014	SV	1409088
200.8	**Cadmium**	**237**		ug/L	1.00	10	09/22/2014	SV	1409088
200.8	**Copper**	**852**		ug/L	5.00	10	09/22/2014	SV	1409088
200.8	**Lead**	**137**		ug/L	1.00	10	09/22/2014	SV	1409088
200.8	**Nickel**	**18.3**		ug/L	5.00	10	09/22/2014	SV	1409088
2340B	**Hardness**	**335**		mg/L	8	5	09/22/2014	SV	1409087

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NAOH-080614 **Date / Time Sampled:** 08/06/14 09:35 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140804-27 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**4380**		ug/L	100	5	09/22/2014	SV	1409087
200.7	Iron	< 1250	U	ug/L	500	5	09/22/2014	SV	1409087
200.7	**Manganese**	**105000**		ug/L	10.0	5	09/22/2014	SV	1409087
200.7	**Zinc**	**56400**		ug/L	50.0	5	09/22/2014	SV	1409087
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	**Cadmium**	**251**		ug/L	1.00	10	09/22/2014	SV	1409088
200.8	**Copper**	**660**		ug/L	5.00	10	09/22/2014	SV	1409088
200.8	**Lead**	**5.60**		ug/L	1.00	10	09/22/2014	SV	1409088
200.8	**Nickel**	**19.7**		ug/L	5.00	10	09/22/2014	SV	1409088
2340B	**Hardness**	**343**		mg/L	8	5	09/22/2014	SV	1409087

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-080614 **Date / Time Sampled:** 08/06/14 11:25 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140804-30 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 50.0	U	ug/L	20.0	1	09/22/2014	SV	1409087
200.7	Iron	< 250	U	ug/L	100	1	09/22/2014	SV	1409087
200.7	**Manganese**	**34400**		ug/L	2.00	1	09/22/2014	SV	1409087
200.7	**Zinc**	**15.1**	J	ug/L	10.0	1	09/22/2014	SV	1409087
200.8	**Arsenic**	**14.1**	J	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/22/2014	SV	1409088
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/22/2014	SV	1409088
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
2340B	**Hardness**	**1010**		mg/L	2	1	09/22/2014	SV	1409087

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-080614 **Date / Time Sampled:** 08/06/14 11:10 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140804-34 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	09/22/2014	SV	1409087
200.7	Iron	< 1250	U	ug/L	500	5	09/22/2014	SV	1409087
200.7	**Manganese**	**83800**		ug/L	10.0	5	09/22/2014	SV	1409087
200.7	Zinc	< 100	U	ug/L	50.0	5	09/22/2014	SV	1409087
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/22/2014	SV	1409088
200.8	**Copper**	**5.72**	J	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/22/2014	SV	1409088
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
2340B	**Hardness**	**997**		mg/L	8	5	09/22/2014	SV	1409087

Project Name: **Barker-Hughesville_Treatability_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-080614 **Date / Time Sampled:** 08/06/14 09:10 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140804-38 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**554**		ug/L	100	5	09/22/2014	SV	1409087
200.7	**Iron**	**107000**		ug/L	500	5	09/22/2014	SV	1409087
200.7	**Manganese**	**118000**		ug/L	10.0	5	09/22/2014	SV	1409087
200.7	**Zinc**	**18200**		ug/L	50.0	5	09/22/2014	SV	1409087
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/22/2014	SV	1409088
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/22/2014	SV	1409088
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/22/2014	SV	1409088
200.8	**Nickel**	**15.0**		ug/L	5.00	10	09/22/2014	SV	1409088
2340B	**Hardness**	**640**		mg/L	8	5	09/22/2014	SV	1409087

"J" Qualifier indicates an estimated value

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-080614 **Date / Time Sampled:** 08/06/14 09:45 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140804-01 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**140**	J	ug/L	100	5	09/24/2014	SV	1409084
200.7	Iron	< 1250	U	ug/L	500	5	09/24/2014	SV	1409084
200.7	**Manganese**	**87400**		ug/L	10.0	5	09/24/2014	SV	1409084
200.7	**Zinc**	**175**		ug/L	50.0	5	09/24/2014	SV	1409084
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/24/2014	SV	1409084
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/24/2014	SV	1409084
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/24/2014	SV	1409084
200.8	**Lead**	**1.34**	J	ug/L	1.00	10	09/24/2014	SV	1409084
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/24/2014	SV	1409084

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-080614 **Date / Time Sampled:** 08/06/14 10:10 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140804-05 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	09/24/2014	SV	1409084
200.7	**Iron**	**657**	J	ug/L	500	5	09/24/2014	SV	1409084
200.7	**Manganese**	**94800**		ug/L	10.0	5	09/24/2014	SV	1409084
200.7	**Zinc**	**62.4**	J	ug/L	50.0	5	09/24/2014	SV	1409084
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/24/2014	SV	1409084
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/24/2014	SV	1409084
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/24/2014	SV	1409084
200.8	**Lead**	**1.09**	J	ug/L	1.00	10	09/24/2014	SV	1409084
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/24/2014	SV	1409084

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-080614 **Date / Time Sampled:** 08/06/14 10:35 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140804-09 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 50.0	U	ug/L	20.0	1	09/24/2014	SV	1409084
200.7	Iron	< 250	U	ug/L	100	1	09/24/2014	SV	1409084
200.7	**Manganese**	**41000**		ug/L	2.00	1	09/24/2014	SV	1409084
200.7	**Zinc**	**108**		ug/L	10.0	1	09/24/2014	SV	1409084
200.8	**Arsenic**	**12.2**	J	ug/L	5.00	10	09/24/2014	SV	1409084
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/24/2014	SV	1409084
200.8	**Copper**	**7.47**	J	ug/L	5.00	10	09/24/2014	SV	1409084
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/24/2014	SV	1409084
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/24/2014	SV	1409084

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-080614 **Date / Time Sampled:** 08/06/14 10:50 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140804-13 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**105**	J	ug/L	100	5	09/24/2014	SV	1409084
200.7	Iron	< 1250	U	ug/L	500	5	09/24/2014	SV	1409084
200.7	**Manganese**	**105000**		ug/L	10.0	5	09/24/2014	SV	1409084
200.7	**Zinc**	**1290**		ug/L	50.0	5	09/24/2014	SV	1409084
200.8	**Arsenic**	**7.65**	J	ug/L	5.00	10	09/24/2014	SV	1409084
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/24/2014	SV	1409084
200.8	**Copper**	**6.80**	J	ug/L	5.00	10	09/24/2014	SV	1409084
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/24/2014	SV	1409084
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/24/2014	SV	1409084

Project Name: **Barker-Hughesville_Treatability_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-080614 **Date / Time Sampled:** 08/06/14 09:20 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140804-17 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**219**	J	ug/L	100	5	09/24/2014	SV	1409084
200.7	**Iron**	**5830**		ug/L	500	5	09/24/2014	SV	1409084
200.7	**Manganese**	**81200**		ug/L	10.0	5	09/24/2014	SV	1409084
200.7	**Zinc**	**404**		ug/L	50.0	5	09/24/2014	SV	1409084
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/24/2014	SV	1409084
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/24/2014	SV	1409084
200.8	**Copper**	**7.05**	J	ug/L	5.00	10	09/24/2014	SV	1409084
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/24/2014	SV	1409084
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/24/2014	SV	1409084

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFL-080614 **Date / Time Sampled:** 08/06/14 08:55 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140804-20 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**12800**		ug/L	100	5	09/24/2014	SV	1409084
200.7	**Iron**	**162000**		ug/L	500	5	09/24/2014	SV	1409084
200.7	**Manganese**	**110000**		ug/L	10.0	5	09/24/2014	SV	1409084
200.7	**Zinc**	**57800**		ug/L	50.0	5	09/24/2014	SV	1409084
200.8	**Arsenic**	**147**	J	ug/L	50.0	100	09/24/2014	SV	1409084
200.8	**Cadmium**	**245**		ug/L	10.0	100	09/24/2014	SV	1409084
200.8	**Copper**	**1140**		ug/L	50.0	100	09/24/2014	SV	1409084
200.8	**Lead**	**129**		ug/L	10.0	100	09/24/2014	SV	1409084
200.8	Nickel	< 100	U	ug/L	50.0	100	09/24/2014	SV	1409084

Project Name: **Barker-Hughesville_Treatability_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFLD-080614 **Date / Time Sampled:** 08/06/14 09:00 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140804-23 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**12800**		ug/L	100	5	09/24/2014	SV	1409084
200.7	**Iron**	**165000**		ug/L	500	5	09/24/2014	SV	1409084
200.7	**Manganese**	**111000**		ug/L	10.0	5	09/24/2014	SV	1409084
200.7	**Zinc**	**57900**		ug/L	50.0	5	09/24/2014	SV	1409084
200.8	**Arsenic**	**158**	J	ug/L	50.0	100	09/24/2014	SV	1409084
200.8	**Cadmium**	**238**		ug/L	10.0	100	09/24/2014	SV	1409084
200.8	**Copper**	**1070**		ug/L	50.0	100	09/24/2014	SV	1409084
200.8	**Lead**	**126**		ug/L	10.0	100	09/24/2014	SV	1409084
200.8	Nickel	< 100	U	ug/L	50.0	100	09/24/2014	SV	1409084

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NAOH-080614 **Date / Time Sampled:** 08/06/14 09:35 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140804-26 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**4990**		ug/L	100	5	09/24/2014	SV	1409084
200.7	**Iron**	**9280**		ug/L	500	5	09/24/2014	SV	1409084
200.7	**Manganese**	**108000**		ug/L	10.0	5	09/24/2014	SV	1409084
200.7	**Zinc**	**57600**		ug/L	50.0	5	09/24/2014	SV	1409084
200.8	Arsenic	< 200	U	ug/L	50.0	100	09/24/2014	SV	1409084
200.8	**Cadmium**	**255**		ug/L	10.0	100	09/24/2014	SV	1409084
200.8	**Copper**	**785**		ug/L	50.0	100	09/24/2014	SV	1409084
200.8	Lead	< 20.0	U	ug/L	10.0	100	09/24/2014	SV	1409084
200.8	Nickel	< 100	U	ug/L	50.0	100	09/24/2014	SV	1409084

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-080614 **Date / Time Sampled:** 08/06/14 11:25 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140804-29 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**329**		ug/L	20.0	1	09/24/2014	SV	1409084
200.7	**Iron**	**335**		ug/L	100	1	09/24/2014	SV	1409084
200.7	**Manganese**	**36200**		ug/L	2.00	1	09/24/2014	SV	1409084
200.7	**Zinc**	**169**		ug/L	10.0	1	09/24/2014	SV	1409084
200.8	Arsenic	< 200	U	ug/L	50.0	100	09/24/2014	SV	1409084
200.8	Cadmium	< 20.0	U	ug/L	10.0	100	09/24/2014	SV	1409084
200.8	Copper	< 100	U	ug/L	50.0	100	09/24/2014	SV	1409084
200.8	Lead	< 20.0	U	ug/L	10.0	100	09/24/2014	SV	1409084
200.8	Nickel	< 100	U	ug/L	50.0	100	09/24/2014	SV	1409084

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-080614 **Date / Time Sampled:** 08/06/14 11:10 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140804-33 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**138**	J	ug/L	100	5	09/24/2014	SV	1409084
200.7	Iron	< 1250	U	ug/L	500	5	09/24/2014	SV	1409084
200.7	**Manganese**	**85400**		ug/L	10.0	5	09/24/2014	SV	1409084
200.7	**Zinc**	**263**		ug/L	50.0	5	09/24/2014	SV	1409084
200.8	Arsenic	< 200	U	ug/L	50.0	100	09/24/2014	SV	1409084
200.8	Cadmium	< 20.0	U	ug/L	10.0	100	09/24/2014	SV	1409084
200.8	Copper	< 100	U	ug/L	50.0	100	09/24/2014	SV	1409084
200.8	Lead	< 20.0	U	ug/L	10.0	100	09/24/2014	SV	1409084
200.8	Nickel	< 100	U	ug/L	50.0	100	09/24/2014	SV	1409084

Project Name: **Barker-Hughesville_Treatability_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-080614 **Date / Time Sampled:** 08/06/14 09:10 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140804-37 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**1650**		ug/L	100	5	09/24/2014	SV	1409084
200.7	**Iron**	**109000**		ug/L	500	5	09/24/2014	SV	1409084
200.7	**Manganese**	**119000**		ug/L	10.0	5	09/24/2014	SV	1409084
200.7	**Zinc**	**18300**		ug/L	50.0	5	09/24/2014	SV	1409084
200.8	Arsenic	< 200	U	ug/L	50.0	100	09/24/2014	SV	1409084
200.8	Cadmium	< 20.0	U	ug/L	10.0	100	09/24/2014	SV	1409084
200.8	Copper	< 100	U	ug/L	50.0	100	09/24/2014	SV	1409084
200.8	Lead	< 20.0	U	ug/L	10.0	100	09/24/2014	SV	1409084
200.8	Nickel	< 100	U	ug/L	50.0	100	09/24/2014	SV	1409084

"J" Qualifier indicates an estimated value

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-080614 **Date / Time Sampled:** 08/06/14 09:45 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140804-03 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.8**	J	mg/L	5.0	10	08/25/2014	NP	1408082
EPA 300.0	**Fluoride**	**20.5**		mg/L	1.0	10	08/25/2014	NP	1408082
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/25/2014	NP	1408082
EPA 300.0	**Sulfate as SO4**	**527**		mg/L	0.5	10	08/25/2014	NP	1408082
EPA 310.1	**Total Alkalinity**	**649**		mg CaCO3 / L	50.0	10	08/12/2014	KJB	1408056

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-080614 **Date / Time Sampled:** 08/06/14 09:45 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140804-04 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**39.8**	D	mg/L	3.00	100	08/27/2014	KJB	1408127

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-080614 **Date / Time Sampled:** 08/06/14 10:10 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140804-07 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**6.0**	J	mg/L	5.0	10	08/25/2014	NP	1408082
EPA 300.0	**Fluoride**	**4.9**		mg/L	1.0	10	08/25/2014	NP	1408082
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/25/2014	NP	1408082
EPA 300.0	**Sulfate as SO4**	**615**		mg/L	0.5	10	08/25/2014	NP	1408082
EPA 310.1	**Total Alkalinity**	**399**		mg CaCO3 / L	50.0	10	08/12/2014	KJB	1408056

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-080614 **Date / Time Sampled:** 08/06/14 10:10 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140804-08 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**7.74**	D	mg/L	3.00	100	08/27/2014	KJB	1408127

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-080614 **Date / Time Sampled:** 08/06/14 10:35 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140804-11 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.9**	J	mg/L	5.0	10	08/25/2014	NP	1408082
EPA 300.0	**Fluoride**	**63.1**		mg/L	1.0	10	08/25/2014	NP	1408082
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/25/2014	NP	1408082
EPA 300.0	**Sulfate as SO4**	**311**		mg/L	0.5	10	08/25/2014	NP	1408082
EPA 310.1	**Total Alkalinity**	**1950**		mg CaCO3 / L	50.0	10	08/12/2014	KJB	1408056

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-080614 **Date / Time Sampled:** 08/06/14 10:35 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140804-12 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**117**	D	mg/L	3.00	100	08/27/2014	KJB	1408127

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-080614 **Date / Time Sampled:** 08/06/14 10:50 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140804-15 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	08/25/2014	NP	1408082
EPA 300.0	**Fluoride**	**2.2**		mg/L	1.0	10	08/25/2014	NP	1408082
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/25/2014	NP	1408082
EPA 300.0	**Sulfate as SO4**	**628**		mg/L	0.5	10	08/25/2014	NP	1408082
EPA 310.1	**Total Alkalinity**	**461**		mg CaCO3 / L	50.0	10	08/12/2014	KJB	1408056

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-080614 **Date / Time Sampled:** 08/06/14 10:50 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140804-16 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**6.00**	D	mg/L	3.00	100	08/27/2014	KJB	1408127

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-CHIT-080614 **Date / Time Sampled:** 08/06/14 09:20 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140804-19 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**6.3**	J	mg/L	5.0	10	08/26/2014	NP	1408082
EPA 300.0	**Fluoride**	**64.7**		mg/L	1.0	10	08/26/2014	NP	1408082
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/26/2014	NP	1408082
EPA 300.0	**Sulfate as SO4**	**653**		mg/L	0.5	10	08/26/2014	NP	1408082
EPA 310.1	**Total Alkalinity**	**1230**		mg CaCO3 / L	50.0	10	08/12/2014	KJB	1408056

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-INFL-080614 **Date / Time Sampled:** 08/06/14 08:55 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140804-22 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.6**	J	mg/L	5.0	10	08/26/2014	NP	1408082
EPA 300.0	**Fluoride**	**2.5**		mg/L	1.0	10	08/26/2014	NP	1408082
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/26/2014	NP	1408082
EPA 300.0	**Sulfate as SO4**	**1170**		mg/L	0.5	10	08/26/2014	NP	1408082
EPA 310.1	Total Alkalinity	< 100		mg CaCO3 / L	50.0	10	08/12/2014	KJB	1408056

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-INFLD-080614 **Date / Time Sampled:** 08/06/14 09:00 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140804-25 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	08/26/2014	NP	1408082
EPA 300.0	**Fluoride**	**2.5**		mg/L	1.0	10	08/26/2014	NP	1408082
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/26/2014	NP	1408082
EPA 300.0	**Sulfate as SO4**	**1190**		mg/L	0.5	10	08/26/2014	NP	1408082
EPA 310.1	Total Alkalinity	< 100		mg CaCO3 / L	50.0	10	08/12/2014	KJB	1408056

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-NAOH-080614 **Date / Time Sampled:** 08/06/14 09:35 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140804-28 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.3**	J	mg/L	5.0	10	08/26/2014	NP	1408082
EPA 300.0	**Fluoride**	**2.2**		mg/L	1.0	10	08/26/2014	NP	1408082
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/26/2014	NP	1408082
EPA 300.0	**Sulfate as SO4**	**1120**		mg/L	0.5	10	08/26/2014	NP	1408082
EPA 310.1	Total Alkalinity	< 100		mg CaCO3 / L	50.0	10	08/12/2014	KJB	1408056

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTE-080614 **Date / Time Sampled:** 08/06/14 11:25 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140804-31 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**9.0**	J	mg/L	5.0	10	08/26/2014	NP	1408082
EPA 300.0	**Fluoride**	**2.0**		mg/L	1.0	10	08/26/2014	NP	1408082
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/26/2014	NP	1408082
EPA 300.0	**Sulfate as SO4**	**422**		mg/L	0.5	10	08/26/2014	NP	1408082
EPA 310.1	**Total Alkalinity**	**849**		mg CaCO3 / L	50.0	10	08/12/2014	KJB	1408056

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTE-080614 **Date / Time Sampled:** 08/06/14 11:25 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140804-32 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**29.7**	D	mg/L	3.00	100	08/27/2014	KJB	1408127

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTI-080614 **Date / Time Sampled:** 08/06/14 11:10 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140804-35 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.6**	J	mg/L	5.0	10	08/26/2014	NP	1408082
EPA 300.0	**Fluoride**	**19.6**		mg/L	1.0	10	08/26/2014	NP	1408082
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/26/2014	NP	1408082
EPA 300.0	**Sulfate as SO4**	**546**		mg/L	0.5	10	08/26/2014	NP	1408082
EPA 310.1	**Total Alkalinity**	**742**		mg CaCO3 / L	50.0	10	08/12/2014	KJB	1408056

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTI-080614 **Date / Time Sampled:** 08/06/14 11:10 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140804-36 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**35.8**	D	mg/L	3.00	100	08/27/2014	KJB	1408127

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-SAPS-080614 **Date / Time Sampled:** 08/06/14 09:10 **Workorder:** C140804
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140804-39 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.7**	J	mg/L	5.0	10	08/26/2014	NP	1408082
EPA 300.0	**Fluoride**	**2.0**		mg/L	1.0	10	08/26/2014	NP	1408082
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/26/2014	NP	1408082
EPA 300.0	**Sulfate as SO4**	**1040**		mg/L	0.5	10	08/26/2014	NP	1408082
EPA 310.1	**Total Alkalinity**	**82.5**		mg CaCO3 / L	25.0	5	08/12/2014	KJB	1408056

"J" Qualifier indicates an estimated value

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit

ICPMS-PE DRC-II

Batch 1409088 - No Lab Prep Reqd *Water* **ICPMS-PE DRC-II**

Method Blank (1409088-BLK1) Dilution Factor: 1 Prepared: 09/19/14 Analyzed: 09/22/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	< 0.500	1.00	ug/L						
Copper	< 0.500	1.00	"						
Arsenic	< 0.500	2.00	"						
Cadmium	< 0.100	0.200	"						
Lead	< 0.100	0.200	"						

Method Blank Spike (1409088-BS1) Dilution Factor: 1 Prepared: 09/19/14 Analyzed: 09/22/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	98.1	1.00	ug/L	100		98	85-115		
Copper	100	1.00	"	100		100	85-115		
Arsenic	93.3	2.00	"	100		93	85-115		
Cadmium	96.5	0.200	"	100		97	85-115		
Lead	98.3	0.200	"	100		98	85-115		

Duplicate (1409088-DUP1) Dilution Factor: 1 **Source: C140804-02** Prepared: 09/19/14 Analyzed: 09/22/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	< 5.00	10.0	ug/L		< 5.00				20
Copper	7.12	10.0	"		6.94			3	20
Arsenic	< 5.00	20.0	"		< 5.00				20
Cadmium	< 1.00	2.00	"		< 1.00				20
Lead	< 1.00	2.00	"		< 1.00				20

Matrix Spike (1409088-MS1) Dilution Factor: 1 **Source: C140804-02** Prepared: 09/19/14 Analyzed: 09/22/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	69.3	10.0	ug/L	100	< 5.00	69	70-130		
Copper	75.1	10.0	"	100	6.94	68	70-130		
Arsenic	91.5	20.0	"	100	< 5.00	91	70-130		
Cadmium	91.7	2.00	"	100	< 1.00	92	70-130		
Lead	90.6	2.00	"	100	< 1.00	91	70-130		

Matrix Spike (1409088-MS2) Dilution Factor: 1 **Source: C140804-06** Prepared: 09/19/14 Analyzed: 09/22/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	70.4	10.0	ug/L	100	< 5.00	70	70-130		
Copper	69.5	10.0	"	100	5.09	64	70-130		
Arsenic	91.1	20.0	"	100	< 5.00	91	70-130		
Cadmium	95.5	2.00	"	100	< 1.00	95	70-130		
Lead	92.8	2.00	"	100	< 1.00	93	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409097 - 1409088			***Water***						**ICPMS-PE DRC-II**
Serial Dilution (1409097-SRD1)		Dilution Factor: 5	**Source: C140804-02**			Prepared: 09/19/14 Analyzed: 09/22/14			
Nickel	< 25.0	50.0	ug/L		< 5.00				10
Copper	< 25.0	50.0	"		6.94				10
Arsenic	< 25.0	100	"		< 5.00				10
Cadmium	< 5.00	10.0	"		< 1.00				10
Lead	< 5.00	10.0	"		< 1.00				10

ICPOE - PE Optima

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409087 - No Lab Prep Reqd			***Water***						**ICPOE - PE Optima**
Method Blank (1409087-BLK1)		Dilution Factor: 1				Prepared: 09/19/14 Analyzed: 09/22/14			
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						
Method Blank Spike (1409087-BS1)		Dilution Factor: 1				Prepared: 09/19/14 Analyzed: 09/22/14			
Aluminum	10360	50.0	ug/L	10100		103	85-115		
Iron	10420	250	"	10100		103	85-115		
Manganese	100.3	5.00	"	100		100	85-115		
Zinc	101.2	20.0	"	100		101	85-115		
Duplicate (1409087-DUP1)		Dilution Factor: 5	**Source: C140804-02**			Prepared: 09/19/14 Analyzed: 09/22/14			
Aluminum	< 100	250	ug/L		< 100				20
Iron	< 500	1250	"		< 500				20
Manganese	82250	25.0	"		83020			0.9	20
Zinc	< 50.0	100	"		< 50.0				20
Matrix Spike (1409087-MS1)		Dilution Factor: 5	**Source: C140804-02**			Prepared: 09/19/14 Analyzed: 09/22/14			
Aluminum	10050	250	ug/L	10100	< 100	99	70-130		
Iron	10170	1250	"	10100	< 500	101	70-130		
Manganese	81590	25.0	"	100	83020	NR	70-130		
Zinc	125.2	100	"	100	< 50.0	125	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409087 - No Lab Prep Reqd			*Water*						ICPOE - PE Optima
Matrix Spike (1409087-MS2)		Dilution Factor: 5	**Source: C140804-06**			Prepared: 09/19/14 Analyzed: 09/22/14			
Aluminum	10180	250	ug/L	10100	< 100	101	70-130		
Iron	10430	1250	"	10100	< 500	103	70-130		
Manganese	89830	25.0	"	100	88040	NR	70-130		
Zinc	101.0	100	"	100	< 50.0	101	70-130		
Batch 1409095 - 1409087			*Water*						ICPOE - PE Optima
Serial Dilution (1409095-SRD1)		Dilution Factor: 2	**Source: C140804-02**			Prepared: 09/19/14 Analyzed: 09/22/14			
Aluminum	< 500	1250	ug/L		< 100.00				10
Iron	< 2500	6250	"		< 500.00				10
Manganese	86790	125	"		83020			4	10
Zinc	< 250	500	"		< 50.00				10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ICPMS-PE DRC-II									
Batch 1409084 - 200.2 - TR Metals			***Water***						**ICPMS-PE DRC-II**
Method Blank (1409084-BLK2)		Dilution Factor: 5				Prepared: 09/18/14 Analyzed: 09/24/14			
Nickel	< 2.50	5.00	ug/L						
Copper	< 2.50	5.00	"						
Arsenic	< 2.50	10.0	"						
Cadmium	< 0.500	1.00	"						
Lead	< 0.500	1.00	"						
Duplicate (1409084-DUP2)		Dilution Factor: 1	**Source: C140804-01**			Prepared: 09/18/14 Analyzed: 09/24/14			
Nickel	< 5.00	10.0	ug/L		< 5.00				20
Copper	< 5.00	10.0	"		< 5.00				20
Arsenic	< 5.00	20.0	"		< 5.00				20
Cadmium	< 1.00	2.00	"		< 1.00				20
Lead	1.611	2.00	"		1.342			18	20
Matrix Spike (1409084-MS2)		Dilution Factor: 1	**Source: C140804-05**			Prepared: 09/18/14 Analyzed: 09/24/14			
Nickel	425.5	10.0	ug/L	500	< 5.00	85	70-130		
Copper	248.2	10.0	"	300	< 5.00	83	70-130		
Arsenic	726.9	20.0	"	800	< 5.00	91	70-130		
Cadmium	196.0	2.00	"	200	< 1.00	98	70-130		
Lead	933.1	2.00	"	1000	1.095	93	70-130		
Matrix Spike (1409084-MS4)		Dilution Factor: 1	**Source: C140804-09**			Prepared: 09/18/14 Analyzed: 09/24/14			
Nickel	418.6	10.0	ug/L	500	< 5.00	84	70-130		
Copper	255.7	10.0	"	300	7.475	83	70-130		
Arsenic	749.3	20.0	"	800	12.15	92	70-130		
Cadmium	192.7	2.00	"	200	< 1.00	96	70-130		
Lead	936.9	2.00	"	1000	< 1.00	94	70-130		
Reference (1409084-SRM2)		Dilution Factor: 2				Prepared: 09/18/14 Analyzed: 09/24/14			
Nickel	993.3	20.0	ug/L	1000		99	85-115		
Copper	1002	20.0	"	1000		100	85-115		
Arsenic	2047	40.0	"	2000		102	85-115		
Cadmium	1020	4.00	"	1000		102	85-115		
Lead	1995	4.00	"	2000		100	85-115		

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409104 - 1409084			*Water*						ICPMS-PE DRC-II
Serial Dilution (1409104-SRD1)		Dilution Factor: 5	**Source: C140804-01**			Prepared: 09/18/14	Analyzed: 09/24/14		
Nickel	< 25.0	50.0	ug/L		< 5.00				10
Copper	< 25.0	50.0	"		< 5.00				10
Arsenic	< 25.0	100	"		< 5.00				10
Cadmium	< 5.00	10.0	"		< 1.00				10
Lead	< 5.00	10.0	"		1.342				10

ICPOE - PE Optima

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409084 - 200.2 - TR Metals			*Water*						ICPOE - PE Optima
Method Blank (1409084-BLK1)		Dilution Factor: 1				Prepared: 09/18/14	Analyzed: 09/24/14		
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						
Duplicate (1409084-DUP1)		Dilution Factor: 5	**Source: C140804-01**			Prepared: 09/18/14	Analyzed: 09/24/14		
Aluminum	144.6	250	ug/L		140.2			3	20
Iron	< 500	1250	"		< 500				20
Manganese	86460	25.0	"		87360			1	20
Zinc	147.9	100	"		174.5			17	20
Matrix Spike (1409084-MS1)		Dilution Factor: 5	**Source: C140804-05**			Prepared: 09/18/14	Analyzed: 09/24/14		
Aluminum	2036	250	ug/L	2000	< 100	102	70-130		
Iron	3748	1250	"	3000	657.1	103	70-130		
Manganese	95590	25.0	"	200	94800	398	70-130		
Zinc	274.6	100	"	200	62.43	106	70-130		
Matrix Spike (1409084-MS3)		Dilution Factor: 1	**Source: C140804-09**			Prepared: 09/18/14	Analyzed: 09/24/14		
Aluminum	2029	50.0	ug/L	2000	< 20.0	101	70-130		
Iron	3137	250	"	3000	< 100	105	70-130		
Manganese	40490	5.00	"	200	40970	NR	70-130		
Zinc	292.8	20.0	"	200	107.7	93	70-130		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409084 - 200.2 - TR Metals			*Water*						**ICPOE - PE Optima**
Reference (1409084-SRM1)		Dilution Factor: 1				Prepared: 09/18/14 Analyzed: 09/24/14			
Aluminum	980.7	50.0	ug/L	1000		98	85-115		
Iron	1037	250	"	1000		104	85-115		
Manganese	1045	5.00	"	1000		104	85-115		
Zinc	1016	20.0	"	1000		102	85-115		
Batch 1409103 - 1409084			*Water*						**ICPOE - PE Optima**
Serial Dilution (1409103-SRD1)		Dilution Factor: 2	**Source: C140804-01**			Prepared: 09/18/14 Analyzed: 09/24/14			
Aluminum	< 500	1250	ug/L		140.2				10
Iron	< 2500	6250	"		< 500.00				10
Manganese	91590	125	"		87360			5	10
Zinc	< 250	500	"		174.5				10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ESAT Dionex IC									
Batch 1408082 - No Prep Req			***Water***						**ESAT Dionex IC**
Method Blank (1408082-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 08/25/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						
Method Blank Spike (1408082-BS1)		Dilution Factor: 1				Prepared & Analyzed: 08/25/14			
Fluoride	4.8	0.2	mg/L	5.00		97	90-110		
Chloride	24.6	2.0	"	25.0		98	90-110		
Sulfate as SO4	24.9	0.1	"	25.0		100	90-110		
Nitrate/Nitrite as N	19.2	5.0	"	20.0		96	90-110		
Duplicate (1408082-DUP1)		Dilution Factor: 1	**Source: C140804-03**			Prepared & Analyzed: 08/25/14			
Fluoride	20.9	2.0	mg/L		20.5			2	20
Chloride	5.7	20.0	"		5.8			0.7	20
Sulfate as SO4	529	1.0	"		527			0.6	20
Nitrate/Nitrite as N	< 10.0	50.0	"		< 10.0				20
Matrix Spike (1408082-MS1)		Dilution Factor: 1	**Source: C140804-03**			Prepared & Analyzed: 08/25/14			
Fluoride	59.4	2.0	mg/L	50.0	20.5	78	80-120		
Chloride	250	20.0	"	250	5.8	98	80-120		
Sulfate as SO4	751	1.0	"	250	527	90	80-120		
Nitrate/Nitrite as N	195	50.0	"	200	< 10.0	97	80-120		
Matrix Spike (1408082-MS2)		Dilution Factor: 1	**Source: C140804-39**			Prepared & Analyzed: 08/26/14			
Fluoride	52.2	2.0	mg/L	50.0	2.0	100	80-120		
Chloride	255	20.0	"	250	5.7	100	80-120		
Sulfate as SO4	1280	1.0	"	250	1040	94	80-120		
Nitrate/Nitrite as N	195	50.0	"	200	< 10.0	98	80-120		

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409003 - 1408082			*Water*						ESAT Dionex IC
Instrument Blank (1409003-IBL1)		Dilution Factor: 1				Prepared & Analyzed: 08/25/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						

Lachat 8500

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1408127 - No Prep Req			*Water*						Lachat 8500
Method Blank (1408127-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 08/27/14			
Ammonia as N	< 0.0300	0.0500	mg/L						
Method Blank Spike (1408127-BS1)		Dilution Factor: 1				Prepared & Analyzed: 08/27/14			
Ammonia as N	1.01	0.0500	mg/L	1.00		101	90-110		
Duplicate (1408127-DUP1)		Dilution Factor: 1	**Source: C140804-04**			Prepared & Analyzed: 08/27/14			
Ammonia as N	40.1	5.00	mg/L		39.8			0.7	20
Duplicate (1408127-DUP2)		Dilution Factor: 1	**Source: C140809-20**			Prepared & Analyzed: 08/27/14			
Ammonia as N	5.58	0.500	mg/L		5.52			1	20
Matrix Spike (1408127-MS1)		Dilution Factor: 1	**Source: C140804-04**			Prepared & Analyzed: 08/27/14			
Ammonia as N	136	5.00	mg/L	100	39.8	96	90-110		
Matrix Spike (1408127-MS2)		Dilution Factor: 1	**Source: C140809-20**			Prepared & Analyzed: 08/27/14			
Ammonia as N	15.5	0.500	mg/L	10.0	5.52	100	90-110		
Reference (1408127-SRM1)		Dilution Factor: 5				Prepared & Analyzed: 08/27/14			
Ammonia as N	4.86	0.250	mg/L	4.80		101	90-110		

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Mettler AT

Batch 1408056 - No Prep Req *Water* **Mettler AT**

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Method Blank (1408056-BLK1)		Dilution Factor: 1				Prepared: 08/11/14 Analyzed: 08/12/14			
Total Alkalinity	< 5.00	10.0	mg CaCO3 / L						
Duplicate (1408056-DUP1)		Dilution Factor: 1	**Source: C140804-03**			Prepared: 08/11/14 Analyzed: 08/12/14			
Total Alkalinity	649	100	mg CaCO3 / L		649			0.1	20
Duplicate (1408056-DUP2)		Dilution Factor: 5	**Source: C140804-39**			Prepared: 08/11/14 Analyzed: 08/12/14			
Total Alkalinity	83.0	50.0	mg CaCO3 / L		82.5			0.7	20
Reference (1408056-SRM1)		Dilution Factor: 1				Prepared: 08/11/14 Analyzed: 08/12/14			
Total Alkalinity	11.8	10.0	mg CaCO3 / L	10.4		113	61.3-143.9		

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Project Name: **Barker-Hughesville_Treatability_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 310.1

Analysis Name: WC - Alkalinity

Instrument: **Mettler AT**

Work Order: Nu C140804

Analytical Sequence: **Total**

Concentration Units: mg CaCO3 / L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Total Alkalinity		**1**	**2**	**3**	**4**	1408056-BLK1	NA	10.00
		1.19	1.31			1.19	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 350.1 Analysis Name: WC - Ammonia

Instrument: **Lachat 8500** Work Order: Nu C140804

Analytical Sequence: **Total** Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Ammonia as N		**1**	**2**	**3**	**4**	1408127-BLK1	NA	0.05
		0.00	0.00	0.00		0.00	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 300.0 Analysis Name: WC - Anions by Ion Chromatography

Instrument: **ESAT Dionex IC** Work Order: Nu C140804

Analytical Sequence: 1409003 **Dissolved** Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Fluoride	0.00	**1**	**2**	**3**	**4**	1408082-BLK1	NA	0.20
		0.00	0.00	0.00		0.00	NA	
		5	**6**	**7**	**8**			
Chloride	0.00	**1**	**2**	**3**	**4**	1408082-BLK1	NA	2.00
		0.00	0.00	0.00		0.00	NA	
		5	**6**	**7**	**8**			
Sulfate as SO4	0.00	**1**	**2**	**3**	**4**	1408082-BLK1	NA	0.10
		0.00	0.00	0.00		0.00	NA	
		5	**6**	**7**	**8**			
Nitrate/Nitrite as N	0.00	**1**	**2**	**3**	**4**	1408082-BLK1	NA	5.00
		0.00	0.00	0.00		0.00	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7

Analysis Name: ICPOE Diss. Metals

Instrument: **ICPOE - PE Optima**

Work Order: Nu C140804

Analytical Sequence: 1409095 **Dissolved**

Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Aluminum	-5.80	**1**	**2**	**3**	**4**	1409087-BLK1	NA	50.00
		-3.95	-4.83			-6.21	NA	
		5	**6**	**7**	**8**			
Iron	28.50	**1**	**2**	**3**	**4**	1409087-BLK1	NA	250.00
		54.46	39.67			79.70	NA	
		5	**6**	**7**	**8**			
Manganese	0.17	**1**	**2**	**3**	**4**	1409087-BLK1	NA	5.00
		0.64	1.25			-0.22	NA	
		5	**6**	**7**	**8**			
Zinc	0.30	**1**	**2**	**3**	**4**	1409087-BLK1	NA	20.00
		-0.53	0.72			-0.31	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8 Analysis Name: ICPMS Diss. Metals

Instrument: **ICPMS-PE DRC-II** Work Order: Nu C140804

Analytical Sequence: 1409097 **Dissolved** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Nickel	0.02	**1**	**2**	**3**	**4**	1409088-BLK1	NA	1.00
		0.01	0.01			-0.04	NA	
		5	**6**	**7**	**8**			
Copper	-0.05	**1**	**2**	**3**	**4**	1409088-BLK1	NA	1.00
		-0.05	-0.09			0.07	NA	
		5	**6**	**7**	**8**			
Arsenic	-0.10	**1**	**2**	**3**	**4**	1409088-BLK1	NA	2.00
		-0.04	-0.05			-0.16	NA	
		5	**6**	**7**	**8**			
Cadmium	0.01	**1**	**2**	**3**	**4**	1409088-BLK1	NA	0.20
		0.01	0.01			0.01	NA	
		5	**6**	**7**	**8**			
Lead	0.02	**1**	**2**	**3**	**4**	1409088-BLK1	NA	0.20
		0.01	0.03			-0.02	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Instrument: **ICPOE - PE Optima** Work Order: Nu C140804

Analytical Sequence: 1409103 **Total Recoverable** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
		1	**2**	**3**	**4**	1409084-BLK1	NA	
Aluminum	1.53	1.08	2.20			3.02	NA	50.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1409084-BLK1	NA	
Iron	38.83	44.44	44.72			86.56	NA	250.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1409084-BLK1	NA	
Manganese	0.11	0.45	0.49			-0.66	NA	5.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1409084-BLK1	NA	
Zinc	0.02	1.13	0.68			1.47	NA	20.00
		5	**6**	**7**	**8**			

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Instrument: **ICPMS-PE DRC-II** Work Order: Nu C140804

Analytical Sequence: 1409104 **Total Recoverable** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Nickel	0.01	**1**	**2**	**3**	**4**	NA	1409084-BLK2	1.00
		0.02	0.02	0.03		NA	0.07	
		5	**6**	**7**	**8**			
Copper	0.00	**1**	**2**	**3**	**4**	NA	1409084-BLK2	1.00
		0.00	-0.02	-0.02		NA	-0.05	
		5	**6**	**7**	**8**			
Arsenic	-0.11	**1**	**2**	**3**	**4**	NA	1409084-BLK2	2.00
		-0.03	-0.05	0.12		NA	-0.03	
		5	**6**	**7**	**8**			
Cadmium	0.02	**1**	**2**	**3**	**4**	NA	1409084-BLK2	0.20
		0.01	-0.01	0.00		NA	0.00	
		5	**6**	**7**	**8**			
Lead	0.01	**1**	**2**	**3**	**4**	NA	1409084-BLK2	0.20
		0.02	0.01	0.00		NA	0.01	
		5	**6**	**7**	**8**			

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Mettler AT Method: EPA 310.1 Analysis Name: WC - Alkalinity

Sequence: 1408062 Work Order: C140804 Units: mg CaCO3 / L

Total Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Total Alkalinity				1			2			3		
				100	97.4	97.4	100	96.8	96.8			
				4			5			6		
				7			8			9		

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Lachat 8500 Method: EPA 350.1 Analysis Name: WC - Ammonia

Sequence: 1408133 Work Order: C140804 Units: mg/L

Total Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Ammonia as N				1.00	1.00	100.0	1.00	1.00	100.0	1.00	1.01	101.0
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ESAT Dionex IC Method: EPA 300.0 Analysis Name: WC - Anions by Ion Chromatography 2013

Sequence: 1409003 Work Order: C140804 Units: mg/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Chloride	40.0	39.6	99.0		1			2			3	
				40.0	41.3	103.3	40.0	39.7	99.3	40.0	40.4	101.0
					4			5			6	
					7			8			9	
Fluoride	4.00	3.9	97.5		1			2			3	
				4.00	4.1	102.5	4.00	3.9	97.5	4.00	4.0	100.0
					4			5			6	
					7			8			9	
Nitrate/Nitrite as N	20.0	20.3	101.5		1			2			3	
				20.0	20.9	104.5	20.0	19.9	99.5	20.0	20.6	103.0
					4			5			6	
					7			8			9	
Sulfate as SO4	100	100	100.0		1			2			3	
				100	104	104.0	100	99.3	99.3	100	101	101.0
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Diss. Metals

Sequence: 1409095 Work Order: C140804 Units: ug/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Aluminum	12500	12660	101.3	12500	12640	101.1	12500	12740	101.9			
					4			5			6	
					7			8			9	
					1			2			3	
Iron	12500	12790	102.3	12500	12760	102.1	12500	12730	101.8			
					4			5			6	
					7			8			9	
					1			2			3	
Manganese	1000	1021	102.1	1000	1044	104.4	1000	1047	104.7			
					4			5			6	
					7			8			9	
					1			2			3	
Zinc	2500	2540	101.6	2500	2623	104.9	2500	2650	106.0			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Diss. Metals

Sequence: 1409097 Work Order: C140804 Units: ug/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Arsenic	50.0	51.6	103.2	50.0	48.4	96.8	50.0	48.0	96.0			
					4			5			6	
					7			8			9	
					1			2			3	
Cadmium	50.0	48.5	97.0	50.0	49.6	99.2	50.0	49.9	99.8			
					4			5			6	
					7			8			9	
					1			2			3	
Copper	50.0	52.8	105.6	50.0	45.0	90.0	50.0	45.8	91.6			
					4			5			6	
					7			8			9	
					1			2			3	
Lead	50.0	49.8	99.6	50.0	49.6	99.2	50.0	50.1	100.2			
					4			5			6	
					7			8			9	
					1			2			3	
Nickel	50.0	51.2	102.4	50.0	45.8	91.6	50.0	46.7	93.4			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Sequence: 1409103 Work Order: C140804 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Aluminum	12500	12860	102.9	12500	12770	102.2	12500	12690	101.5			
					4			5			6	
					7			8			9	
					1			2			3	
Iron	12500	13070	104.6	12500	12920	103.4	12500	12690	101.5			
					4			5			6	
					7			8			9	
					1			2			3	
Manganese	1000	1038	103.8	1000	1049	104.9	1000	1039	103.9			
					4			5			6	
					7			8			9	
					1			2			3	
Zinc	2500	2603	104.1	2500	2647	105.9	2500	2612	104.5			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1409104 Work Order: C140804 Units: ug/L

Total Recoverable Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**											
	True	**Found**	**%R**		**True**	**Found**	**%R**		**True**	**Found**	**%R**		**True**	**Found**	**%R**
Arsenic	50.0	50.19	100.4	**1**	50.0	49.55	99.1	**2**	50.0	46.40	92.8	**3**	50.0	47.13	94.3
				4				**5**				**6**			
				7				**8**				**9**			
Cadmium	50.0	49.36	98.7	**1**	50.0	48.56	97.1	**2**	50.0	49.44	98.9	**3**	50.0	50.01	100.0
				4				**5**				**6**			
				7				**8**				**9**			
Copper	50.0	50.20	100.4	**1**	50.0	47.88	95.8	**2**	50.0	46.64	93.3	**3**	50.0	47.90	95.8
				4				**5**				**6**			
				7				**8**				**9**			
Lead	50.0	49.41	98.8	**1**	50.0	48.83	97.7	**2**	50.0	48.13	96.3	**3**	50.0	48.35	96.7
				4				**5**				**6**			
				7				**8**				**9**			
Nickel	50.0	49.50	99.0	**1**	50.0	49.32	98.6	**2**	50.0	47.92	95.8	**3**	50.0	47.93	95.9
				4				**5**				**6**			
				7				**8**				**9**			

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

ICP Interference Check Sample

ICPMS-PE DRC-II

Sequence: 1409097 Analysis: ICPMS Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.0	ug/L			2.00
	IFB1	19.9	ug/L	20	100	2.00
Cadmium	IFA1	0.2	ug/L			0.200
	IFB1	19.9	ug/L	20	99	0.200
Copper	IFA1	0.5	ug/L			1.00
	IFB1	18.6	ug/L	20	93	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	-0.2	ug/L			1.00
	IFB1	18.4	ug/L	20	92	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1409104 Analysis: ICPMS Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.1	ug/L			2.00
	IFB1	19.2	ug/L	20	96	2.00
Cadmium	IFA1	0.1	ug/L			0.200
	IFB1	20.4	ug/L	20	102	0.200
Copper	IFA1	0.5	ug/L			1.00
	IFB1	19.7	ug/L	20	99	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	-0.2	ug/L			1.00
	IFB1	19.6	ug/L	20	98	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8

ICP Interference Check Sample

ICPOE - PE Optima

Sequence: 1409095 Analysis: ICPOE Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	59,509.4	ug/L	60,000	99	50.0
	IFB1	60,207.7	ug/L	60,000	100	50.0
Iron	IFA1	230,698.2	ug/L	250,000	92	250
	IFB1	234,772.6	ug/L	250,000	94	250
Manganese	IFA1	-0.4	ug/L			5.00
	IFB1	194.2	ug/L	200	97	5.00
Zinc	IFA1	7.0	ug/L			20.0
	IFB1	287.4	ug/L	300	96	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1409103 Analysis: ICPOE Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	59,968.5	ug/L	60,000	100	50.0
	IFB1	61,677.7	ug/L	60,000	103	50.0
Iron	IFA1	236,988.4	ug/L	250,000	95	250
	IFB1	240,251.7	ug/L	250,000	96	250
Manganese	IFA1	-0.7	ug/L			5.00
	IFB1	199.3	ug/L	200	100	5.00
Zinc	IFA1	4.8	ug/L			20.0
	IFB1	300.3	ug/L	300	100	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

ICPMS-PE DRC-II

Metals (Dissolved) by EPA 200/7000 Series Methods

Sequence: 1409097

Analyte	True	Found	%R	Units
Arsenic	2.00	2.08	104	ug/L
Cadmium	0.200	0.189	95	ug/L
Copper	1.00	0.970	97	ug/L
Lead	0.200	0.222	111	ug/L
Nickel	1.00	0.989	99	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

ICPOE - PE Optima

Metals (Dissolved) by EPA 200/7000 Series Methods

Sequence: 1409095

Analyte	True	Found	%R	Units
Aluminum	100	93.36	93	ug/L
Iron	100	147.8	148	ug/L
Manganese	10.0	10.17	102	ug/L
Zinc	50.0	50.48	101	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

Lachat 8500

Classical Chemistry by EPA/ASTM/APHA Methods

Sequence: 1408133

Analyte	True	Found	%R	Units
Ammonia as N	0.0250	0.0230	92	mg/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPMS-PE DRC-II

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1409104

Analyte	True	Found	%R	Units
Arsenic	2.00	2.100	105	ug/L
Cadmium	0.200	0.2029	101	ug/L
Copper	1.00	0.9799	98	ug/L
Lead	0.200	0.1949	97	ug/L
Nickel	1.00	0.9846	98	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPOE - PE Optima

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1409103

Analyte	True	Found	%R	Units
Aluminum	100	100.3	100	ug/L
Iron	100	147.1	147	ug/L
Manganese	10.0	9.833	98	ug/L
Zinc	50.0	52.62	105	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 310.1 **Total** **Sequence ID#:** 1408062

Instrument ID #: Mettler AT Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1408056-SRM1	Reference	08/12/14	08:30
1408056-BLK1	Blank	08/12/14	08:30
C140804-03	14BH-DT-PILOT-BCR1-08061	08/12/14	08:30
1408056-DUP1	Duplicate	08/12/14	08:30
C140804-07	14BH-DT-PILOT-BCR2-08061	08/12/14	08:30
C140804-11	14BH-DT-PILOT-BCR3-08061	08/12/14	08:30
C140804-15	14BH-DT-PILOT-BCR4-08061	08/12/14	08:30
C140804-19	14BH-DT-PILOT-CHIT-080614	08/12/14	08:30
C140804-22	14BH-DT-PILOT-INFL-080614	08/12/14	08:30
C140804-25	14BH-DT-PILOT-INFLD-0806	08/12/14	08:30
1408062-CCV1	Calibration Check	08/12/14	08:30
1408062-CCB1	Calibration Blank	08/12/14	08:30
C140804-28	14BH-DT-PILOT-NAOH-0806	08/12/14	08:30
C140804-31	14BH-DT-PILOT-POSTE-0806	08/12/14	08:30
C140804-35	14BH-DT-PILOT-POSTI-08061	08/12/14	08:30
C140804-39	14BH-DT-PILOT-SAPS-08061	08/12/14	08:30
1408056-DUP2	Duplicate	08/12/14	08:30
1408062-CCV2	Calibration Check	08/12/14	08:30
1408062-CCB2	Calibration Blank	08/12/14	08:30

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 350.1 **Total** **Sequence ID#:** 1408133

Instrument ID #: Lachat 8500 Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1408127-SRM1	Reference	08/27/14	15:23
1408127-BLK1	Blank	08/27/14	15:23
1408127-BS1	Blank Spike	08/27/14	15:23
1408133-CRL1	Instrument RL Check	08/27/14	15:23
C140804-04	14BH-DT-PILOT-BCR1-08061	08/27/14	15:23
1408127-DUP1	Duplicate	08/27/14	15:23
1408127-MS1	Matrix Spike	08/27/14	15:23
C140804-08	14BH-DT-PILOT-BCR2-08061	08/27/14	15:23
1408133-CCV1	Calibration Check	08/27/14	15:23
1408133-CCB1	Calibration Blank	08/27/14	15:23
C140804-12	14BH-DT-PILOT-BCR3-08061	08/27/14	15:23
C140804-16	14BH-DT-PILOT-BCR4-08061	08/27/14	15:23
C140804-32	14BH-DT-PILOT-POSTE-0806	08/27/14	15:23
C140804-36	14BH-DT-PILOT-POSTI-08061	08/27/14	15:23
1408133-CCV2	Calibration Check	08/27/14	15:23
1408133-CCB2	Calibration Blank	08/27/14	15:23
1408127-DUP2	Duplicate	08/27/14	15:23
1408127-MS2	Matrix Spike	08/27/14	15:23
1408133-CCV3	Calibration Check	08/27/14	15:23
1408133-CCB3	Calibration Blank	08/27/14	15:23

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 300.0 **Dissolved** **Sequence ID#:** 1409003

Instrument ID #: ESAT Dionex IC Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409003-ICV1	Initial Cal Check	08/25/14	11:05
1409003-ICB1	Initial Cal Blank	08/25/14	11:24
1409003-SCV1	Secondary Cal Check	08/25/14	11:43
1409003-IBL1	Instrument Blank	08/25/14	12:02
1408082-BS1	Blank Spike	08/25/14	12:20
1408082-BLK1	Blank	08/25/14	12:39
C140804-03	14BH-DT-PILOT-BCR1-08061	08/25/14	12:58
1408082-DUP1	Duplicate	08/25/14	13:17
1408082-MS1	Matrix Spike	08/25/14	13:36
C140804-07	14BH-DT-PILOT-BCR2-08061	08/25/14	13:54
C140804-11	14BH-DT-PILOT-BCR3-08061	08/25/14	14:13
C140804-15	14BH-DT-PILOT-BCR4-08061	08/25/14	14:32
1409003-CCV1	Calibration Check	08/25/14	14:51
1409003-CCB1	Calibration Blank	08/25/14	15:10
1409003-CCV2	Calibration Check	08/26/14	17:39
1409003-CCB2	Calibration Blank	08/26/14	17:58
C140804-19	14BH-DT-PILOT-CHIT-080614	08/26/14	18:17
C140804-22	14BH-DT-PILOT-INFL-080614	08/26/14	18:36
C140804-25	14BH-DT-PILOT-INFLD-0806	08/26/14	18:55
C140804-28	14BH-DT-PILOT-NAOH-0806	08/26/14	19:13
C140804-39	14BH-DT-PILOT-SAPS-08061	08/26/14	19:32
C140804-31	14BH-DT-PILOT-POSTE-0806	08/26/14	19:51
C140804-35	14BH-DT-PILOT-POSTI-08061	08/26/14	20:10
1408082-MS2	Matrix Spike	08/26/14	20:29
1409003-CCV3	Calibration Check	08/26/14	20:47
1409003-CCB3	Calibration Blank	08/26/14	21:25

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Dissolved** **Sequence ID#:** 1409095

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409095-ICV1	Initial Cal Check	09/22/14	08:56
1409095-SCV1	Secondary Cal Check	09/22/14	08:59
1409095-ICB1	Initial Cal Blank	09/22/14	09:02
1409095-CRL1	Instrument RL Check	09/22/14	09:05
1409095-IFA1	Interference Check A	09/22/14	09:08
1409095-IFB1	Interference Check B	09/22/14	09:12
1409087-BLK1	Blank	09/22/14	09:16
1409087-BS1	Blank Spike	09/22/14	09:19
C140804-02	14BH-DT-PILOT-BCR1-08061	09/22/14	09:22
1409087-DUP1	Duplicate	09/22/14	09:25
1409095-SRD1	Serial Dilution	09/22/14	09:28
1409087-MS1	Matrix Spike	09/22/14	09:31
C140804-06	14BH-DT-PILOT-BCR2-08061	09/22/14	09:34
1409087-MS2	Matrix Spike	09/22/14	09:37
C140804-10	14BH-DT-PILOT-BCR3-08061	09/22/14	09:41
1409095-CCV1	Calibration Check	09/22/14	09:48
1409095-CCB1	Calibration Blank	09/22/14	09:51
C140804-14	14BH-DT-PILOT-BCR4-08061	09/22/14	09:54
C140804-18	14BH-DT-PILOT-CHIT-08061	09/22/14	09:57
C140804-21	14BH-DT-PILOT-INFL-08061	09/22/14	10:00
C140804-24	14BH-DT-PILOT-INFLD-0806	09/22/14	10:03
C140804-27	14BH-DT-PILOT-NAOH-0806	09/22/14	10:06
C140804-30	14BH-DT-PILOT-POSTE-0806	09/22/14	10:09
C140804-38	14BH-DT-PILOT-SAPS-08061	09/22/14	10:18
C140804-34	14BH-DT-PILOT-POSTI-08061	09/22/14	10:24
1409095-CCV2	Calibration Check	09/22/14	10:27
1409095-CCB2	Calibration Blank	09/22/14	10:30

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Dissolved** **Sequence ID#:** 1409097

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409097-ICV1	Initial Cal Check	09/22/14	10:43
1409097-SCV1	Secondary Cal Check	09/22/14	10:46
1409097-ICB1	Initial Cal Blank	09/22/14	10:49
1409097-CRL1	Instrument RL Check	09/22/14	10:53
1409097-IFA1	Interference Check A	09/22/14	10:56
1409097-IFB1	Interference Check B	09/22/14	10:59
1409088-BS1	Blank Spike	09/22/14	11:06
C140804-02	14BH-DT-PILOT-BCR1-08061	09/22/14	11:09
1409088-DUP1	Duplicate	09/22/14	11:12
1409097-SRD1	Serial Dilution	09/22/14	11:15
1409088-MS1	Matrix Spike	09/22/14	11:18
C140804-06	14BH-DT-PILOT-BCR2-08061	09/22/14	11:21
1409088-MS2	Matrix Spike	09/22/14	11:24
C140804-10	14BH-DT-PILOT-BCR3-08061	09/22/14	11:27
1409088-BLK1	Blank	09/22/14	11:30
1409097-CCV1	Calibration Check	09/22/14	11:33
1409097-CCB1	Calibration Blank	09/22/14	11:36
C140804-14	14BH-DT-PILOT-BCR4-08061	09/22/14	11:40
C140804-18	14BH-DT-PILOT-CHIT-080614	09/22/14	11:43
C140804-21	14BH-DT-PILOT-INFL-080614	09/22/14	11:46
C140804-24	14BH-DT-PILOT-INFLD-0806	09/22/14	11:49
C140804-27	14BH-DT-PILOT-NAOH-0806	09/22/14	11:52
C140804-30	14BH-DT-PILOT-POSTE-0806	09/22/14	11:55
C140804-34	14BH-DT-PILOT-POSTI-08061	09/22/14	11:58
C140804-38	14BH-DT-PILOT-SAPS-08061	09/22/14	12:01
1409097-CCV2	Calibration Check	09/22/14	12:23
1409097-CCB2	Calibration Blank	09/22/14	12:27

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Total Recoverable** **Sequence ID#:** 1409103

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409103-ICV1	Initial Cal Check	09/24/14	08:10
1409103-SCV1	Secondary Cal Check	09/24/14	08:13
1409103-ICB1	Initial Cal Blank	09/24/14	08:16
1409103-CRL1	Instrument RL Check	09/24/14	08:19
1409103-IFA1	Interference Check A	09/24/14	08:22
1409103-IFB1	Interference Check B	09/24/14	08:26
1409084-BLK1	Blank	09/24/14	08:30
1409084-SRM1	Reference	09/24/14	08:33
C140804-01	14BH-DT-PILOT-BCR1-08061	09/24/14	08:36
1409084-DUP1	Duplicate	09/24/14	08:39
1409103-SRD1	Serial Dilution	09/24/14	08:42
C140804-05	14BH-DT-PILOT-BCR2-08061	09/24/14	08:45
1409084-MS1	Matrix Spike	09/24/14	08:48
C140804-09	14BH-DT-PILOT-BCR3-08061	09/24/14	08:51
1409084-MS3	Matrix Spike	09/24/14	08:56
1409103-CCV1	Calibration Check	09/24/14	09:03
1409103-CCB1	Calibration Blank	09/24/14	09:06
C140804-13	14BH-DT-PILOT-BCR4-08061	09/24/14	09:09
C140804-17	14BH-DT-PILOT-CHIT-080614	09/24/14	09:12
C140804-20	14BH-DT-PILOT-INFL-080614	09/24/14	09:15
C140804-23	14BH-DT-PILOT-INFLD-0806	09/24/14	09:18
C140804-26	14BH-DT-PILOT-NAOH-0806	09/24/14	09:21
C140804-29	14BH-DT-PILOT-POSTE-0806	09/24/14	09:24
C140804-33	14BH-DT-PILOT-POSTI-08061	09/24/14	09:28
C140804-37	14BH-DT-PILOT-SAPS-08061	09/24/14	09:32
1409103-CCV2	Calibration Check	09/24/14	09:38
1409103-CCB2	Calibration Blank	09/24/14	09:41

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Total Recoverable** **Sequence ID#:** 1409104

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409104-ICV1	Initial Cal Check	09/24/14	09:15
1409104-SCV1	Secondary Cal Check	09/24/14	09:18
1409104-ICB1	Initial Cal Blank	09/24/14	09:21
1409104-CRL1	Instrument RL Check	09/24/14	09:25
1409104-IFA1	Interference Check A	09/24/14	09:28
1409104-IFB1	Interference Check B	09/24/14	09:31
1409084-BLK2	Blank	09/24/14	09:34
1409084-SRM2	Reference	09/24/14	09:37
C140804-01	14BH-DT-PILOT-BCR1-08061	09/24/14	09:40
1409084-DUP2	Duplicate	09/24/14	09:44
1409104-SRD1	Serial Dilution	09/24/14	09:47
C140804-05	14BH-DT-PILOT-BCR2-08061	09/24/14	09:50
1409084-MS2	Matrix Spike	09/24/14	09:53
C140804-09	14BH-DT-PILOT-BCR3-08061	09/24/14	09:56
1409084-MS4	Matrix Spike	09/24/14	09:59
1409104-CCV1	Calibration Check	09/24/14	10:05
1409104-CCB1	Calibration Blank	09/24/14	10:08
C140804-13	14BH-DT-PILOT-BCR4-08061	09/24/14	10:11
C140804-17	14BH-DT-PILOT-CHIT-08061	09/24/14	10:15
1409104-CCV2	Calibration Check	09/24/14	10:46
1409104-CCB2	Calibration Blank	09/24/14	10:49
C140804-20	14BH-DT-PILOT-INFL-080614	09/24/14	10:52
C140804-23	14BH-DT-PILOT-INFLD-0806	09/24/14	10:55
C140804-26	14BH-DT-PILOT-NAOH-0806	09/24/14	10:58
C140804-29	14BH-DT-PILOT-POSTE-0806	09/24/14	11:01
C140804-33	14BH-DT-PILOT-POSTI-08061	09/24/14	11:05
C140804-37	14BH-DT-PILOT-SAPS-08061	09/24/14	11:08
1409104-CCV3	Calibration Check	09/24/14	11:14
1409104-CCB3	Calibration Blank	09/24/14	11:17

CHAIN OF CUSTODY RECORD

CDM Smith — **Danny T Pilot Test**

NOTES: Limited sample volumes due to treatability testing
Contact: Angela Franden, CDM Smith (406)441-1400

SAMPLE NUMBER	DATE	TIME	MATRIX	Preservative	Type & No. of Containers	Total Metals (TAL), 200.7 or 200.8	Dissolved Metals (TAL), 200.7 or 200.8	Alkalinity, Anions (sulfate, chloride, fluoride)	Nitrate+Nitrite, Ammonia	Other Instructions and Notes
14BH-DT-PILOT-INFL-080614	8/6/14	8:55	aqueous	HNO3 (metals), H2SO4 (nutrients), cool	3, 125 mL poly	X	X	X		TAL metals = Al, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, Tl, Zn.
14BH-DT-PILOT-INFLD-080614	8/6/14	9:00	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-SAPS-080614	8/6/14	9:10	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-CHIT-080614	8/6/14	9:20	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-NAOH-080614	8/6/14	9:35	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-BCR1-080614	8/6/14	9:45	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR2-080614	8/6/14	10:10	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR3-080614	8/6/14	10:35	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR4-080614	8/6/14	10:50	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-POSTI-080614	8/6/14	11:10	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-POSTE-080614	8/6/14	11:25	aqueous		4, 125 mL poly	X	X	X	X	

Relinquished by: (*Signature*) Lauren Helland	**Date/Time** 08/07/14 14:00	**Received for Laboratory by: (*Signature*)**		
Received by: (*Signature*) Kelsey Bartley	**Date/Time** 8/8/14 12:15	**Airbill No.(s)**	**Carrier Name:** FedEx	**Lab:** USEPA Lab Region 8

ESAT

C140804

ESAT Technical Direction Form

Contract No. EPW13028
EPA Region 8

Site ID:	085N	***Date Issued:***	5/29/2014	***Date***	
TDF ID:	A-046	***Date Updated:***		***Closed By:***	

Name: Barker-Hughesville Treatability Study

Details: The Contractor shall analyze several water samples associated with the treatability study at the Barker-Hughesville Superfund site as indicated in the Analytical Information Section. The samples will be sent to the ESAT R8 Lab during the 2014 field season starting in mid-June though early October 2014. There will be 9 sampling events associated with this project averaging approximately 10 samples per an event. The samples will be collected by Nick Anton/Erin Louden of CDM Smith.

Samples designated as influent samples (-INF) are expected to have high metal concentrations and should be analyzed by 200.7. Additionally, metals with sufficiently high concentrations may be reported from the 200.7 analyses.

ESAT should return the coolers to the following address:
CDM Smith/Lauren Helland
50 West 14th Street, Suite 200
Helena, MT 59601
406-441-1435
FedEx # 1323-6393-5

TO02/Subtask 02b: Inorganic Chemistry

Site RPM: Roger Hoogerheide

Analytical Information:

MATRIX

☑ Water ☐ Soils ☐ Vegetation ☐ Biota

WET CHEM

☐ TSS ☐ TDS ☐ DOC ☑ Alk ☑ Chloride ☑ Sulfate ☑ Fluoride ☑ Nitrate ☑ Nitrite
Other: Analyze for Ammonia and report NO2 and NO3 as NO2-NO3 combined.

METALS

☑ Dissolved ☑ Total Recoverable ☐ Total ☐ Hardness (Calc)
200.7: ☐ Ag ☑ Al ☐ As ☐ Ba ☐ Be ☐ B ☐ Ca ☐ Cd ☐ Co ☐ Cr ☐ Cu ☑ Fe ☐ K ☐ Mg
☒ Mn ☐ Mo ☐ Na ☐ Ni ☐ Pb ☐ Sb ☐ Se ☐ Sr ☐ Ti ☐ Tl ☐ V ☑ Zn ☐ SiO2
200.8: ☐ Ag ☐ Al ☑ As ☐ Ba ☐ Be ☑ Cd ☐ Co ☐ Cr ☑ Cu ☑ Mn ☐ Mo ☑ Ni ☑ Pb ☐ Sb
☐ Se ☐ Th ☐ Tl ☐ U ☐ V ☐ Zn
7470/7471/747 ☐ Hg

N
09/22/14

FIBERS

☐ PLM ☐ TEM

Deliverables

ID	*Description*	*Due Date*	*Submission Date*
1	Provide final deliverable package to Task Monitor no later than 30 days after delivery of samples.		

5/29/14

ANALYTICAL SUMMARY REPORT

September 02, 2014

CDM Federal Programs
555 17th St Ste 1100
Denver, CO 80202

Work Order: H14080372 Quote ID: H823 - Baker-Hughsville Superfund Site

Project Name: Barker Hughsville - Danny T

Energy Laboratories Inc Helena MT received the following 11 samples for CDM Federal Programs on 8/20/2014 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H14080372-001	14BH-DT-PILOT-INFL-081914	08/19/14 9:40	08/20/14	Aqueous	Acidity, Total as CaCO3 Phosphorus, Orthophosphate as P
H14080372-002	14BH-DT-PILOT-SAPS-081914	08/19/14 9:50	08/20/14	Aqueous	Same As Above
H14080372-003	14BH-DT-PILOT-CHIT-081914	08/19/14 10:05	08/20/14	Aqueous	Same As Above
H14080372-004	14BH-DT-PILOT-NAOH-081914	08/19/14 10:15	08/20/14	Aqueous	Same As Above
H14080372-005	14BH-DT-PILOT-BCR1-081914	08/19/14 10:30	08/20/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Phosphorus, Orthophosphate as P Sulfide, Iodine Titrimetric
H14080372-006	14BH-DT-PILOT-BCR2-081914	08/19/14 10:45	08/20/14	Aqueous	Same As Above
H14080372-007	14BH-DT-PILOT-BCR3-081914	08/19/14 11:00	08/20/14	Aqueous	Same As Above
H14080372-008	14BH-DT-PILOT-BCR3D-081914	08/19/14 11:10	08/20/14	Aqueous	Same As Above
H14080372-009	14BH-DT-PILOT-BCR4-081914	08/19/14 11:25	08/20/14	Aqueous	Same As Above
H14080372-010	14BH-DT-PILOT-POSTI-081914	08/19/14 11:40	08/20/14	Aqueous	Same As Above
H14080372-011	14BH-DT-PILOT-POSTE-081914	08/19/14 12:00	08/20/14	Aqueous	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

CLIENT: CDM Federal Programs
Project: Barker Hughsville - Danny T
Work Order: H14080372

Report Date: 09/02/14

CASE NARRATIVE

Tests associated with analyst identified as ELI-B were subcontracted to Energy Laboratories, 1120 S. 27th St., Billings, MT, EPA Number MT00005.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/02/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/19/14 09:40
Lab ID:	H14080372-001	**DateReceived:**	08/20/14
Client Sample ID:	14BH-DT-PILOT-INFL-081914	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	600	mg/L	D	4.0		A2310 B	08/26/14 11:20 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.297	mg/L		0.005		E365.1	08/20/14 15:27 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/02/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/19/14 09:50
Lab ID:	H14080372-002	**DateReceived:**	08/20/14
Client Sample ID:	14BH-DT-PILOT-SAPS-081914	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	410	mg/L	D	4.0		A2310 B	08/26/14 11:33 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.079	mg/L		0.005		E365.1	08/20/14 15:28 / cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14080372-003
Client Sample ID: 14BH-DT-PILOT-CHIT-081914

Report Date: 09/02/14
Collection Date: 08/19/14 10:05
DateReceived: 08/20/14
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	08/26/14 11:36 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	20.6	mg/L	D	0.1		E365.1	08/20/14 14:12 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/02/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/19/14 10:15
Lab ID:	H14080372-004	**DateReceived:**	08/20/14
Client Sample ID:	14BH-DT-PILOT-NAOH-081914	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	260	mg/L	D	4.0		A2310 B	08/26/14 11:40 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	ND	mg/L		0.005		E365.1	08/20/14 15:29 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/02/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/19/14 10:30
Lab ID:	H14080372-005	**DateReceived:**	08/20/14
Client Sample ID:	14BH-DT-PILOT-BCR1-081914	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	08/26/14 11:43 / SRW
Sulfide	25	mg/L	D	1		A4500-S F	08/22/14 13:30 / eli-b
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	110	mg/L		80		A5210 B	08/20/14 16:15 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	16.4	mg/L	D	0.1		E365.1	08/20/14 14:14 / cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/02/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/19/14 10:45
Lab ID:	H14080372-006	**DateReceived:**	08/20/14
Client Sample ID:	14BH-DT-PILOT-BCR2-081914	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	08/26/14 11:46 / SRW
Sulfide	12	mg/L	D	1		A4500-S F	08/22/14 13:30 / eli-b
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	<83	mg/L		80		A5210 B	08/20/14 16:23 / SRW
No BOD dilution depleted greater than 2.0 mg/L DO.							
NUTRIENTS							
Phosphorus, Orthophosphate as P	2.84	mg/L	D	0.02		E365.1	08/20/14 15:30 / cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14080372-007
Client Sample ID: 14BH-DT-PILOT-BCR3-081914

Report Date: 09/02/14
Collection Date: 08/19/14 11:00
DateReceived: 08/20/14
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	08/26/14 11:50 / SRW
Sulfide	80	mg/L	D	1		A4500-S F	08/22/14 13:30 / eli-b
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	390	mg/L		100		A5210 B	08/20/14 16:28 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	19.1	mg/L	D	0.1		E365.1	08/20/14 14:16 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14080372-008
Client Sample ID: 14BH-DT-PILOT-BCR3D-081914

Report Date: 09/02/14
Collection Date: 08/19/14 11:10
DateReceived: 08/20/14
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	08/26/14 11:54 / SRW
Sulfide	79	mg/L	D	1		A4500-S F	08/22/14 13:30 / eli-b
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	370	mg/L		100		A5210 B	08/20/14 16:35 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	19.6	mg/L	D	0.1		E365.1	08/20/14 14:17 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14080372-009
Client Sample ID: 14BH-DT-PILOT-BCR4-081914

Report Date: 09/02/14
Collection Date: 08/19/14 11:25
DateReceived: 08/20/14
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	08/26/14 11:59 / SRW
Sulfide	68	mg/L	D	1		A4500-S F	08/22/14 13:30 / eli-b
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	84	mg/L		80		A5210 B	08/20/14 16:44 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	2.2	mg/L	D	0.1		E365.1	08/20/14 14:18 / cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/02/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/19/14 11:40
Lab ID:	H14080372-010	**DateReceived:**	08/20/14
Client Sample ID:	14BH-DT-PILOT-POSTI-081914	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	08/26/14 12:03 / SRW
Sulfide	48	mg/L	D	1		A4500-S F	08/22/14 13:30 / eli-b
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	120	mg/L		80		A5210 B	08/20/14 16:52 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	9.8	mg/L	D	0.1		E365.1	08/20/14 14:19 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/02/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	08/19/14 12:00
Lab ID:	H14080372-011	**DateReceived:**	08/20/14
Client Sample ID:	14BH-DT-PILOT-POSTE-081914	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	08/26/14 12:08 / SRW
Sulfide	ND	mg/L	D	1		A4500-S F	08/22/14 13:30 / eli-b
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	87	mg/L		30		A5210 B	08/20/14 16:55 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	1.7	mg/L	D	0.1		E365.1	08/20/14 14:22 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs

Project: Barker Hughsville - Danny T

Report Date: 09/02/14

Work Order: H14080372

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **A2310 B**									Batch: H140826A
Lab ID: **H14080372-001ADUP**	Sample Duplicate				Run: PH_140826A				08/26/14 11:24
Acidity, Total as CaCO3	600	mg/L	4.0				0.4	20	
Lab ID: **H14080372-011ADUP**	Sample Duplicate				Run: PH_140826A				08/26/14 12:12
Acidity, Total as CaCO3	ND	mg/L	4.0					20	
Lab ID: **LCS1408260000**	Laboratory Control Sample				Run: PH_140826A				08/26/14 11:16
Acidity, Total as CaCO3	940	mg/L	4.0	96	90	110			
Lab ID: **MBLK1408260000**	Method Blank				Run: PH_140826A				08/26/14 11:13
Acidity, Total as CaCO3	3	mg/L							

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs

Project: Barker Hughsville - Danny T

Report Date: 09/02/14

Work Order: H14080372

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **A4500-S F**									Batch: B_R229412
Lab ID: **MB-R229412**	Method Blank				Run: SUB-B229412				08/22/14 13:30
Sulfide	ND	mg/L	0.5						
Lab ID: **LCS-R229412**	Laboratory Control Sample				Run: SUB-B229412				08/22/14 13:30
Sulfide	21.7	mg/L	1.0	100	70	130			
Lab ID: **H14080372-005C**	Sample Matrix Spike				Run: SUB-B229412				08/22/14 13:30
Sulfide	46.6	mg/L	1.0	99	80	120			
Lab ID: **H14080372-005C**	Sample Matrix Spike Duplicate				Run: SUB-B229412				08/22/14 13:30
Sulfide	46.5	mg/L	1.0	99	80	120	0.2	20	
Lab ID: **H14080355-001F**	Sample Matrix Spike				Run: SUB-B229412				08/22/14 13:30
Sulfide	21.8	mg/L	1.0	98	80	120			
Lab ID: **H14080355-001F**	Sample Matrix Spike Duplicate				Run: SUB-B229412				08/22/14 13:30
Sulfide	21.8	mg/L	1.0	98	80	120	0.0	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T

Report Date: 09/02/14
Work Order: H14080372

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A5210 B									Batch: 140820_1_BOD5-W
Lab ID: Dil-H201_140820	Dilution Water Blank				Run: BOD-SKALAR_140820A				08/20/14 15:29
Oxygen Demand, Biochemical (BOD)	ND	mg/L	2.0		0	0.2			
Lab ID: GGA1_140820	Laboratory Control Sample				Run: BOD-SKALAR_140820A				08/20/14 15:39
Oxygen Demand, Biochemical (BOD)	130	mg/L	70	64	85	115			S
Glucose-glutamic acid check falls outside acceptable limits.									
Lab ID: H14080364-001ADUP	Sample Duplicate				Run: BOD-SKALAR_140820A				08/20/14 16:06
Oxygen Demand, Biochemical (BOD)	690	mg/L	210		90	110	2.5	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Report Date: 09/02/14
Project: Barker Hughsville - Danny T
Work Order: H14080372

Analyte	**Result**	**Units**	**RL**	**%REC**	**Low Limit**	**High Limit**	**RPD**	**RPDLimit**	**Qual**
Method: **E365.1**									Analytical Run: FIA202-HE_140820B
Lab ID: **ICV**	Initial Calibration Verification Standard								08/20/14 13:58
Phosphorus, Orthophosphate as P	0.247	mg/L	0.0050	99	90	110			
Lab ID: **ICB**	Initial Calibration Blank, Instrument Blank								08/20/14 13:59
Phosphorus, Orthophosphate as P	-0.000460	mg/L	0.0050		0	0			
Lab ID: **CCV**	Continuing Calibration Verification Standard								08/20/14 14:06
Phosphorus, Orthophosphate as P	0.105	mg/L	0.0050	105	90	110			
Lab ID: **CCV**	Continuing Calibration Verification Standard								08/20/14 14:21
Phosphorus, Orthophosphate as P	0.110	mg/L	0.0050	110	90	110			
Lab ID: **CCV**	Continuing Calibration Verification Standard								08/20/14 14:28
Phosphorus, Orthophosphate as P	0.107	mg/L	0.0050	107	90	110			
Method: **E365.1**									Batch: R99904
Lab ID: **LFB**	Laboratory Fortified Blank				Run: FIA202-HE_140820B				08/20/14 14:05
Phosphorus, Orthophosphate as P	0.189	mg/L	0.0050	95	90	110			
Lab ID: **H14080372-001BMS**	Sample Matrix Spike				Run: FIA202-HE_140820B				08/20/14 14:09
Phosphorus, Orthophosphate as P	17.0	mg/L	0.11	85	90	110			S
Lab ID: **H14080372-001BMSD**	Sample Matrix Spike Duplicate				Run: FIA202-HE_140820B				08/20/14 14:10
Phosphorus, Orthophosphate as P	17.3	mg/L	0.11	87	90	110	1.7	20	S
Lab ID: **H14080372-011BMS**	Sample Matrix Spike				Run: FIA202-HE_140820B				08/20/14 14:23
Phosphorus, Orthophosphate as P	23.6	mg/L	0.11	110	90	110			
Lab ID: **H14080372-011BMSD**	Sample Matrix Spike Duplicate				Run: FIA202-HE_140820B				08/20/14 14:24
Phosphorus, Orthophosphate as P	22.9	mg/L	0.11	106	90	110	3.1	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T

Report Date: 09/02/14
Work Order: H14080372

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E365.1									Analytical Run: FIA202-HE_140820C
Lab ID: ICV	Initial Calibration Verification Standard								08/20/14 15:19
Phosphorus, Orthophosphate as P	0.239	mg/L	0.0050	96	90	110			
Lab ID: ICB	Initial Calibration Blank, Instrument Blank								08/20/14 15:20
Phosphorus, Orthophosphate as P	-0.00150	mg/L	0.0050		0	0			
Lab ID: CCV	Continuing Calibration Verification Standard								08/20/14 15:22
Phosphorus, Orthophosphate as P	0.102	mg/L	0.0050	102	90	110			
Method: E365.1									Batch: R99911
Lab ID: LFB	Laboratory Fortified Blank				Run: FIA202-HE_140820C				08/20/14 15:21
Phosphorus, Orthophosphate as P	0.183	mg/L	0.0050	91	90	110			
Lab ID: H14080372-011BMS	Sample Matrix Spike				Run: FIA202-HE_140820C				08/20/14 15:25
Phosphorus, Orthophosphate as P	22.3	mg/L	0.11	103	90	110			
Lab ID: H14080372-011BMSD	Sample Matrix Spike Duplicate				Run: FIA202-HE_140820C				08/20/14 15:26
Phosphorus, Orthophosphate as P	21.7	mg/L	0.11	101	90	110	2.5	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Workorder Receipt Checklist

CDM Federal Programs

H14080372

Login completed by:	Wanda Johnson	Date Received:	8/20/2014
Reviewed by:	BL2000\rwilliams	Received by:	wjj
Reviewed Date:	8/21/2014	Carrier name:	Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☑	No ☐	Not Applicable ☐
Container/Temp Blank temperature:	1.7°C On Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☑	No ☐	Not Applicable ☐

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

None

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 1 of 2

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM Smith

Project Name, PWS, Permit, Etc.: Barker Hughesville - Danny T

Sample Origin State: MT

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address (Required):

Contact Name: Angela Frandsen

Phone/Fax: (406) 441-1435

Cell:

Sampler: (Please Print) Lauren Helland.

☒ No Hard Copy Email: FrandsenAK@cdmsmith.com

Invoice Contact & Phone: Same.

Purchase Order:

Quote/Bottle Order:

Invoice Address (Required):

☒ No Hard Copy Email: Same.

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: ____
☐ Other: ____
☒ EDD/EDT (Electronic Data) Format: Excel
☐ LEVEL IV
☐ NELAC

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: Please use 1000mL bottles for combined BOD and acidity.

Shipped by: hand del

Cooler ID(s): Y

Receipt Temp 1.7 °C TB

On Ice: [✓ Y] N

Custody Seal On Bottle Y [✓ N]

On Cooler Y [✓ N]

Intact Y [✓ N]

Signature Match Y [✓ N]

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX (Number of Containers; Sample Type: A W S V B O DW – Air Water Soils/Solids Vegetation Bioassay Other DW - Drinking Water)	BOD	Sulfide	Acidity	Ortho-phosphate						SEE ATTACHED	Standard Turnaround (TAT)	RUSH		LABORATORY USE ONLY
1 14BH-DT-PILOT-INFL-081914	08/19/14	9:40	2, W			X	X										H14080372
2 14BH-DT-PILOT-SAPS-081914	08/19/14	9:50	2, W			X	X										
3 14BH-DT-PILOT-CHIT-081[illegible]4	08/19/14	10:05	2, W			X	X										
4 14BH-DT-PILOT-NAOH-081914	08/19/14	10:15	2, W			X	X										
5 14BH-DT-PILOT-BCR1-081914	08/19/14	10:30	3W	X	X	X	X										
6 14BH-DT-PILOT-BCR2-081914	08/1[illegible]	10:45	3, W	X	X	X	X										
7 14BH-DT-PILOT-BCR3-081914	08/19/14	11:00	3, W	X	X	X	X										
8 14BH-DT-PILOT-BCR3D-081914	08/19/14	11:10	3, W	X	X	X	X										
9 14BH-DT-PILOT-[illegible]-081914	08/19/14	11:25	3, W	X	X	X	X										
10 14BH-DT-PILOT-[illegible]-081914	08/19/14	11:40	3, W	X	X	X	X										

Custody Record MUST be Signed

Relinquished by (print): Lauren Helland Date/Time: 08/20/14 12:43 Signature: Lauren Helland

Relinquished by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Received by Laboratory: W. Condon Date/Time: 8-20-14 12:43 Signature:

Sample Disposal: Return to Client: ____ Lab Disposal: ____

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 2 of 2

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM Smith

Project Name, PWS, Permit, Etc.: Barker Hughesville - Danny T

Sample Origin State: MT

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address (Required):

Contact Name: Angela Frandsen Phone/Fax: (406) 441-1435 Cell:

Sampler: (Please Print) Lauren Helland

☒ No Hard Copy Email: FrandsenAK@cdmsmith.com

Invoice Contact & Phone: same

Purchase Order:

Quote/Bottle Order:

Invoice Address (Required):

☒ No Hard Copy Email: Same

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: ____
☐ Other: ____
☒ EDD/EDT (Electronic Data) Format: Excel
☐ LEVEL IV
☐ NELAC

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: Please use 1000mL bottles for combined BOD + acidity.

Shipped by: Fed Ex

Cooler ID(s): Y

Receipt Temp 1.7 °C TB

On Ice: [✓ Y] N

Custody Seal
On Bottle Y [✓ N]
On Cooler Y [✓ N]
Intact Y [✓ N]
Signature Match Y [✓ N]

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	Number of Containers Sample Type: A W S V B O DW Air Water Soils/Solids Vegetation Bioassay Other DW - Drinking Water / MATRIX	ANALYSIS REQUESTED: BOD	Sulfide	Acidity	Ortho-phosphate						SEE ATTACHED	Standard Turnaround (TAT)	RUSH		LABORATORY USE ONLY
1 14B4-DT-PILOT-POSTE-081914	08/19/14	12:00	3, W	X	X	X	X										H14080372
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

Custody Record MUST be Signed

Relinquished by (print): Lauren Helland	Date/Time: 08/20/14 12:43	Signature: Lauren Helland	Received by (print):	Date/Time:	Signature:
Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Sample Disposal: Return to Client: ____		Lab Disposal: ____	Received by Laboratory: Wanda Jon	Date/Time: 8-20-14 12 15	Signature:

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested.
This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.
Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

U.S. Environmental Protection Agency
Region 8
Technical and Management Services

Laboratory Services Program

Certificate of Analysis

Ref: 8TMS-L

MEMORANDUM

Date: 10/02/14

Subject: Analytical Results--- **Barker-Hughesville_Treatability 2_AUG 2014_A046 / A-046**

From: Don Goodrich; EPA Region 8 Analytical Chemistry WAM

To: Roger Hoogerheide
Superfund
8 MO

Received Sample Set(s), [Work Order : Date Received]:
[C140809 : 08/21/2014]

Attached are the analytical results for the samples received from the Barker-Hughesville_Treatability 2_AUG 2014_A046 sampling event, according to TDF A-046. All analyses were performed within their method specified holding times unless otherwise noted in the following narrative.

These samples were prepared, analyzed, and verified by the Environmental Services Assistance Team Laboratory (ESAT) according to the requirements of the Technical Direction Form (TDF).

Note: The laboratory herewith transmits this deliverable to the program/project partner for determination of "final data usability" which may include data validation and data quality asessment per and in accordance with EPA QA/G-8, *Guidance on Environmental Data Verification and Data Validation*, November 2002, EPA/240/R-02/004. Laboratory data qualifiers are applied based on the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004, referred to as "NFGI".

Laboratory policy is to dispose of any remaining sample 60 days after data analysis packages are delivered to EPA. If you would like the laboratory to retain the samples for a period longer than 60 days, please contact Don Goodrich within the 60 day period at (303) 312-6687.

Case Narrative

C140809

Quality Assessment: Unless indicated by exception, the QA/QC associated with this sample set produced data within the TDF-specified criteria.

Holding Times: All samples were analyzed within their method-specified technical holding time(s).

1. Initial and Continuing calibration blanks (ICBs and CCBs).
   Exceptions: None.
2. Preparation (PB) / Method blanks (MB)
   Exceptions: None.
3. Interference Checks (ICSA / ICSAB) for ICP-MS and ICP-OE analyses only.
   Exceptions: None.
4. Initial and Continuing calibration verification analyses (ICVs, SCVs and CCVs).
   Exceptions: None.
5. Laboratory Control Sample (LCS) or second source analysis or SRM.
   Exceptions: None.
6. Laboratory Fortified blank (LFB) / Blank spike (BS), same source as used for the matrix spikes. PBS performed with analyses/methods requiring preparation or digestion prior to analysis.
   Exceptions: None.
7. Contract Reporting Detection Limit Standard, labeled as CRA, CRDL or CRL.
   Exceptions: None.
8. Laboratory Duplicate (DUP). "Source" identifies field sample duplicated in the laboratory. If either the "source" or the duplicate result is <5X the reporting limit, the %D limit of 20% does not apply.
   Exceptions: None.
9. Laboratory Matrix Spike (MS) and spike duplicate (MSD). "Source" defines original field sample fortified prior to analysis. Percent recovery (%R) limits do not apply when sample concentration(s) exceed the corresponding analyte spike level by a factor of 4 or greater.
   Exceptions: In ICP-MS batch 1410002, nickel recovered low in the MS1, and copper recovered low in the MS1 and MS2. No qualifiers were assigned since all other QC requirements for these analytes were met.
10. Serial Dilution sample analysis (SRD). "Source" is parent field sample diluted 1:5 in the laboratory. Performed for ICP-OE and ICP-MS metals analyses. Percent difference (%D) limits do not apply when analyte concentration(s) are below 50x the source sample's MDL (or 10x it's PQL).
    Exceptions: None.
11. Internal standards, criteria specified for ICP-MS analyses only, monitored at the instrument.
    Exceptions: None.
12. Any calibration using more than two-points produced a correlation coefficient equal to or greater than 0.995.
    Exceptions: None.

Acronyms and Definitions:

ESAT	Environmental Services Assistance Team
J	Data Estimated qualifier (also applied to all data less than PQL, greater than or equal to MDL)
MDL	Method Detection Limit
PQL	Practical Quantitation Limit, also known as reporting limit.
RPD	Relative Percent Difference (difference divided by the mean)
%D	Percent difference, serial dilution criteria unit, difference divided by the original result.
%R	Percent recovery, analyzed (less sample contribution) divided by true value
<	Analyte NOT DETECTED at or above the Method Detection Limit (MDL)
mg/L	Parts per million (millligrams per liter). Solids equivalent = mg/Kg.
ug/L	Parts per billion (micrograms per liter). Solids equivalent = ug/Kg.
NR	No Recovery (matrix spike) - Often seen for calcium/magnesium when their concentration exceeds the spike level by > 4x.
NFGI	*USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004
RE	Sample Re-analysis. Usually seen on raw data and sequences for required sample dilutions due to over-range analytes.
U	Analyte not detected at or above MDL qualifier
D	Diluted value qualifier.

Method(s) Summary:

As defined in the Technical Direction Form (TDF), some or all of the methods listed below were used for the determination of the reported target analytes.

From EPA's *Methods for the Determination of Metals in Environmental Samples*, Supplement I, May 1994, dissolved, total, and/or total recoverable metals were determined by:

- Method 200.7 / 6010B using a PE Optima ICP-OE (ICP).
- Method 200.8 / 6020 using a Perkin-Elmer Elan 6000 ICP-MS.
- Method 200.2 for total recoverable metals (only) digestion.
- Method 245.1 using a Perkin-Elmer FIMS CVAA (aqueous mercury only).

From *Standard Methods for the Examination of Water and Wastewater*, 18th Edition, 1992, Method 2340B was used for the calculated hardness determination. Hardness is reported as mg (milligram) equivalent $CaCO_3$ per liter (L) determined as follows:

Calculated hardness = 2.497 * (Calcium, mg/L) + 4.118 * (Magnesium, mg/L).

From *EPA's Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846*,

- Method 3015A was used for microwave assisted total metals digestion.
- Method 7473 was used for mercury in solids.

From EPA's *Determination of Inorganic Anions by Ion Chromatography*, Revision 2.1, 1993, Method 300.0 was used to determine the anions.

From EPA's *Methods for Chemical Analysis of Water and Wastes*, March 1983:

- Method 310.1 was followed for the alkalinity determination.
- Method 160.1 was followed for gravimetric total dissolved solids (TDS) determination.
- Method 160.2 was used for gravimetric total suspended solids (TSS) determination.
- Method 415.3 was used for total organic carbon (TOC) determination using either an Apollo 9000 or Phoenix 8000 Non-Dispersive IR (NDIR) system. Also known as dissolved organic carbon (DOC) when performed on the dissolved sample fraction.

The quality control procedures listed in the TDF request were utilized by ESAT to verify accuracy of the results and to evaluate any matrix interferences.

Project Name: **Barker-Hughesville_Treatability 2_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-081914 **Date / Time Sampled:** 08/19/14 10:30 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140809-02 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**137**	J	ug/L	100	5	10/01/2014	SV	1410001
200.7	Iron	< 1250	U	ug/L	500	5	10/01/2014	SV	1410001
200.7	**Manganese**	**90900**		ug/L	10.0	5	10/01/2014	SV	1410001
200.7	Zinc	< 100	U	ug/L	50.0	5	10/01/2014	SV	1410001
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	**Copper**	**14.3**		ug/L	5.00	10	10/01/2014	SV	1410002
200.8	**Lead**	**1.01**	J	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/01/2014	SV	1410002
2340B	**Hardness**	**925**		mg/L	8	5	10/01/2014	SV	1410001

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-081914 **Date / Time Sampled:** 08/19/14 10:45 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140809-06 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	10/01/2014	SV	1410001
200.7	**Iron**	**533**	J	ug/L	500	5	10/01/2014	SV	1410001
200.7	**Manganese**	**102000**		ug/L	10.0	5	10/01/2014	SV	1410001
200.7	Zinc	< 100	U	ug/L	50.0	5	10/01/2014	SV	1410001
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	**Copper**	**5.36**	J	ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/01/2014	SV	1410002
2340B	**Hardness**	**746**		mg/L	8	5	10/01/2014	SV	1410001

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-081914 **Date / Time Sampled:** 08/19/14 11:00 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140809-10 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**175**	J	ug/L	100	5	10/01/2014	SV	1410001
200.7	Iron	< 1250	U	ug/L	500	5	10/01/2014	SV	1410001
200.7	**Manganese**	**39800**		ug/L	10.0	5	10/01/2014	SV	1410001
200.7	Zinc	< 100	U	ug/L	50.0	5	10/01/2014	SV	1410001
200.8	**Arsenic**	**6.81**	J	ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	**Copper**	**13.9**		ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/01/2014	SV	1410002
2340B	**Hardness**	**1300**		mg/L	8	5	10/01/2014	SV	1410001

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3D-081914 **Date / Time Sampled:** 08/19/14 11:10 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140809-14 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**178**	J	ug/L	100	5	10/01/2014	SV	1410001
200.7	Iron	< 1250	U	ug/L	500	5	10/01/2014	SV	1410001
200.7	**Manganese**	**40900**		ug/L	10.0	5	10/01/2014	SV	1410001
200.7	Zinc	< 100	U	ug/L	50.0	5	10/01/2014	SV	1410001
200.8	**Arsenic**	**7.44**	J	ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	**Copper**	**11.5**		ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/01/2014	SV	1410002
2340B	**Hardness**	**1200**		mg/L	8	5	10/01/2014	SV	1410001

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-081914 **Date / Time Sampled:** 08/19/14 11:25 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140809-18 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	10/01/2014	SV	1410001
200.7	Iron	< 1250	U	ug/L	500	5	10/01/2014	SV	1410001
200.7	**Manganese**	**72100**		ug/L	10.0	5	10/01/2014	SV	1410001
200.7	**Zinc**	**137**		ug/L	50.0	5	10/01/2014	SV	1410001
200.8	**Arsenic**	**5.38**	J	ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	**Copper**	**12.8**		ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/01/2014	SV	1410002
2340B	**Hardness**	**418**		mg/L	8	5	10/01/2014	SV	1410001

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-081914 **Date / Time Sampled:** 08/19/14 10:05 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140809-22 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**144**	J	ug/L	100	5	10/01/2014	SV	1410001
200.7	**Iron**	**1620**		ug/L	500	5	10/01/2014	SV	1410001
200.7	**Manganese**	**69000**		ug/L	10.0	5	10/01/2014	SV	1410001
200.7	Zinc	< 100	U	ug/L	50.0	5	10/01/2014	SV	1410001
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/01/2014	SV	1410002
2340B	**Hardness**	**958**		mg/L	8	5	10/01/2014	SV	1410001

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFL-081914 **Date / Time Sampled:** 08/19/14 09:40 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140809-25 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**10600**		ug/L	100	5	10/01/2014	SV	1410001
200.7	**Iron**	**133000**		ug/L	500	5	10/01/2014	SV	1410001
200.7	**Manganese**	**101000**		ug/L	10.0	5	10/01/2014	SV	1410001
200.7	**Zinc**	**52400**		ug/L	50.0	5	10/01/2014	SV	1410001
200.8	**Arsenic**	**129**		ug/L	5.00	10	10/01/2014	SV	1410002
200.8	**Cadmium**	**222**		ug/L	1.00	10	10/01/2014	SV	1410002
200.8	**Copper**	**812**		ug/L	5.00	10	10/01/2014	SV	1410002
200.8	**Lead**	**136**		ug/L	1.00	10	10/01/2014	SV	1410002
200.8	**Nickel**	**19.4**		ug/L	5.00	10	10/01/2014	SV	1410002
2340B	**Hardness**	**313**		mg/L	8	5	10/01/2014	SV	1410001

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NAOH-081914 **Date / Time Sampled:** 08/19/14 10:15 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140809-28 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**912**		ug/L	100	5	10/01/2014	SV	1410001
200.7	**Iron**	**1740**		ug/L	500	5	10/01/2014	SV	1410001
200.7	**Manganese**	**91200**		ug/L	10.0	5	10/01/2014	SV	1410001
200.7	**Zinc**	**28200**		ug/L	50.0	5	10/01/2014	SV	1410001
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/01/2014	SV	1410002
200.8	**Cadmium**	**147**		ug/L	1.00	10	10/01/2014	SV	1410002
200.8	**Copper**	**87.7**		ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	**Nickel**	**13.7**		ug/L	5.00	10	10/01/2014	SV	1410002
2340B	**Hardness**	**308**		mg/L	8	5	10/01/2014	SV	1410001

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-081914 **Date / Time Sampled:** 08/19/14 12:00 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140809-31 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**119**	J	ug/L	100	5	10/01/2014	SV	1410001
200.7	Iron	< 1250	U	ug/L	500	5	10/01/2014	SV	1410001
200.7	**Manganese**	**51100**		ug/L	10.0	5	10/01/2014	SV	1410001
200.7	Zinc	< 100	U	ug/L	50.0	5	10/01/2014	SV	1410001
200.8	**Arsenic**	**12.0**	J	ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/01/2014	SV	1410002
2340B	**Hardness**	**891**		mg/L	8	5	10/01/2014	SV	1410001

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-081914 **Date / Time Sampled:** 08/19/14 11:40 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140809-35 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**118**	J	ug/L	100	5	10/01/2014	SV	1410001
200.7	Iron	< 1250	U	ug/L	500	5	10/01/2014	SV	1410001
200.7	**Manganese**	**76500**		ug/L	10.0	5	10/01/2014	SV	1410001
200.7	Zinc	< 100	U	ug/L	50.0	5	10/01/2014	SV	1410001
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	**Copper**	**7.85**	J	ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/01/2014	SV	1410002
2340B	**Hardness**	**813**		mg/L	8	5	10/01/2014	SV	1410001

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-081914 **Date / Time Sampled:** 08/19/14 09:50 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140809-39 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**394**		ug/L	100	5	10/01/2014	SV	1410001
200.7	**Iron**	**111000**		ug/L	500	5	10/01/2014	SV	1410001
200.7	**Manganese**	**108000**		ug/L	10.0	5	10/01/2014	SV	1410001
200.7	**Zinc**	**27200**		ug/L	50.0	5	10/01/2014	SV	1410001
200.8	**Arsenic**	**5.75**	J	ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	**Copper**	**5.34**	J	ug/L	5.00	10	10/01/2014	SV	1410002
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/01/2014	SV	1410002
200.8	**Nickel**	**19.9**		ug/L	5.00	10	10/01/2014	SV	1410002
2340B	**Hardness**	**622**		mg/L	8	5	10/01/2014	SV	1410001

"J" Qualifier indicates an estimated value

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-081914 **Date / Time Sampled:** 08/19/14 10:30 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140809-01 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**199**	J	ug/L	100	5	10/01/2014	SV	1409140
200.7	Iron	< 1250	U	ug/L	500	5	10/01/2014	SV	1409140
200.7	**Manganese**	**95800**		ug/L	10.0	5	10/01/2014	SV	1409140
200.7	**Zinc**	**119**		ug/L	50.0	5	10/01/2014	SV	1409140
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	**Lead**	**6.00**		ug/L	1.00	10	10/02/2014	SV	1409140
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/02/2014	SV	1409140

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-081914 **Date / Time Sampled:** 08/19/14 10:45 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140809-05 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**100**	J	ug/L	100	5	10/01/2014	SV	1409140
200.7	**Iron**	**710**	J	ug/L	500	5	10/01/2014	SV	1409140
200.7	**Manganese**	**106000**		ug/L	10.0	5	10/01/2014	SV	1409140
200.7	**Zinc**	**102**		ug/L	50.0	5	10/01/2014	SV	1409140
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	**Lead**	**1.00**	J	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/02/2014	SV	1409140

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-081914 **Date / Time Sampled:** 08/19/14 11:00 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140809-09 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**181**	J	ug/L	100	5	10/01/2014	SV	1409140
200.7	Iron	< 1250	U	ug/L	500	5	10/01/2014	SV	1409140
200.7	**Manganese**	**40600**		ug/L	10.0	5	10/01/2014	SV	1409140
200.7	**Zinc**	**56.0**	J	ug/L	50.0	5	10/01/2014	SV	1409140
200.8	**Arsenic**	**8.30**	J	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	**Nickel**	**6.41**	J	ug/L	5.00	10	10/02/2014	SV	1409140

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3D-081914 **Date / Time Sampled:** 08/19/14 11:10 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140809-13 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**188**	J	ug/L	100	5	10/01/2014	SV	1409140
200.7	Iron	< 1250	U	ug/L	500	5	10/01/2014	SV	1409140
200.7	**Manganese**	**41200**		ug/L	10.0	5	10/01/2014	SV	1409140
200.7	**Zinc**	**64.8**	J	ug/L	50.0	5	10/01/2014	SV	1409140
200.8	**Arsenic**	**8.46**	J	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/02/2014	SV	1409140

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-081914 **Date / Time Sampled:** 08/19/14 11:25 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140809-17 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	10/01/2014	SV	1409140
200.7	Iron	< 1250	U	ug/L	500	5	10/01/2014	SV	1409140
200.7	**Manganese**	**71900**		ug/L	10.0	5	10/01/2014	SV	1409140
200.7	**Zinc**	**1040**		ug/L	50.0	5	10/01/2014	SV	1409140
200.8	**Arsenic**	**9.17**	J	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	**Cadmium**	**1.11**	J	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	**Copper**	**9.19**	J	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/02/2014	SV	1409140

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-081914 **Date / Time Sampled:** 08/19/14 10:05 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140809-21 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**155**	J	ug/L	100	5	10/01/2014	SV	1409140
200.7	**Iron**	**5120**		ug/L	500	5	10/01/2014	SV	1409140
200.7	**Manganese**	**70500**		ug/L	10.0	5	10/01/2014	SV	1409140
200.7	**Zinc**	**586**		ug/L	50.0	5	10/01/2014	SV	1409140
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/02/2014	SV	1409140

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFL-081914 **Date / Time Sampled:** 08/19/14 09:40 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140809-24 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**10900**		ug/L	100	5	10/01/2014	SV	1409140
200.7	**Iron**	**137000**		ug/L	500	5	10/01/2014	SV	1409140
200.7	**Manganese**	**98200**		ug/L	10.0	5	10/01/2014	SV	1409140
200.7	**Zinc**	**50400**		ug/L	50.0	5	10/01/2014	SV	1409140
200.8	**Arsenic**	**123**		ug/L	5.00	10	10/02/2014	SV	1409140
200.8	**Cadmium**	**232**		ug/L	1.00	10	10/02/2014	SV	1409140
200.8	**Copper**	**871**		ug/L	5.00	10	10/02/2014	SV	1409140
200.8	**Lead**	**104**		ug/L	1.00	10	10/02/2014	SV	1409140
200.8	**Nickel**	**21.3**		ug/L	5.00	10	10/02/2014	SV	1409140

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NAOH-081914 **Date / Time Sampled:** 08/19/14 10:15 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140809-27 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**1300**		ug/L	100	5	10/01/2014	SV	1409140
200.7	**Iron**	**9670**		ug/L	500	5	10/01/2014	SV	1409140
200.7	**Manganese**	**91000**		ug/L	10.0	5	10/01/2014	SV	1409140
200.7	**Zinc**	**27900**		ug/L	50.0	5	10/01/2014	SV	1409140
200.8	**Arsenic**	**8.38**	J	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	**Cadmium**	**145**		ug/L	1.00	10	10/02/2014	SV	1409140
200.8	**Copper**	**125**		ug/L	5.00	10	10/02/2014	SV	1409140
200.8	**Lead**	**5.79**		ug/L	1.00	10	10/02/2014	SV	1409140
200.8	**Nickel**	**13.9**		ug/L	5.00	10	10/02/2014	SV	1409140

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-081914 **Date / Time Sampled:** 08/19/14 12:00 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140809-30 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**174**	J	ug/L	100	5	10/01/2014	SV	1409140
200.7	Iron	< 1250	U	ug/L	500	5	10/01/2014	SV	1409140
200.7	**Manganese**	**51900**		ug/L	10.0	5	10/01/2014	SV	1409140
200.7	**Zinc**	**156**		ug/L	50.0	5	10/01/2014	SV	1409140
200.8	**Arsenic**	**11.5**	J	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/02/2014	SV	1409140

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-081914 **Date / Time Sampled:** 08/19/14 11:40 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140809-34 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**134**	J	ug/L	100	5	10/01/2014	SV	1409140
200.7	Iron	< 1250	U	ug/L	500	5	10/01/2014	SV	1409140
200.7	**Manganese**	**77400**		ug/L	10.0	5	10/01/2014	SV	1409140
200.7	**Zinc**	**326**		ug/L	50.0	5	10/01/2014	SV	1409140
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/02/2014	SV	1409140

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-081914 **Date / Time Sampled:** 08/19/14 09:50 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140809-38 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**494**		ug/L	100	5	10/01/2014	SV	1409140
200.7	**Iron**	**108000**		ug/L	500	5	10/01/2014	SV	1409140
200.7	**Manganese**	**107000**		ug/L	10.0	5	10/01/2014	SV	1409140
200.7	**Zinc**	**25800**		ug/L	50.0	5	10/01/2014	SV	1409140
200.8	**Arsenic**	**5.41**	J	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/02/2014	SV	1409140
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/02/2014	SV	1409140
200.8	**Nickel**	**21.4**		ug/L	5.00	10	10/02/2014	SV	1409140

"J" Qualifier indicates an estimated value

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-081914 **Date / Time Sampled:** 08/19/14 10:30 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140809-03 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	08/28/2014	NP	1408111
EPA 300.0	**Fluoride**	**8.7**		mg/L	1.0	10	08/28/2014	NP	1408111
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/28/2014	NP	1408111
EPA 300.0	**Sulfate as SO4**	**682**		mg/L	0.5	10	08/28/2014	NP	1408111
EPA 310.1	**Total Alkalinity**	**457**		mg CaCO3 / L	25.0	5	08/25/2014	KJB	1408112

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-081914 **Date / Time Sampled:** 08/19/14 10:30 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140809-04 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**20.6**	D	mg/L	3.00	100	08/27/2014	KJB	1408127

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-081914 **Date / Time Sampled:** 08/19/14 10:45 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140809-07 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.5**	J	mg/L	5.0	10	08/28/2014	NP	1408111
EPA 300.0	**Fluoride**	**1.6**	J	mg/L	1.0	10	08/28/2014	NP	1408111
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/28/2014	NP	1408111
EPA 300.0	**Sulfate as SO4**	**688**		mg/L	0.5	10	08/28/2014	NP	1408111
EPA 310.1	**Total Alkalinity**	**314**		mg CaCO3 / L	25.0	5	08/25/2014	KJB	1408112

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-081914 **Date / Time Sampled:** 08/19/14 10:45 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140809-08 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**5.98**	D	mg/L	0.300	10	08/27/2014	KJB	1408127

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-081914 **Date / Time Sampled:** 08/19/14 11:00 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140809-11 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.5**	J	mg/L	5.0	10	08/28/2014	NP	1408111
EPA 300.0	**Fluoride**	**29.1**		mg/L	1.0	10	08/28/2014	NP	1408111
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/28/2014	NP	1408111
EPA 300.0	**Sulfate as SO4**	**270**		mg/L	0.5	10	08/28/2014	NP	1408111
EPA 310.1	**Total Alkalinity**	**1330**		mg CaCO3 / L	25.0	5	08/25/2014	KJB	1408112

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-081914 **Date / Time Sampled:** 08/19/14 11:00 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140809-12 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**79.8**	D	mg/L	3.00	100	08/27/2014	KJB	1408127

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3D-081914 **Date / Time Sampled:** 08/19/14 11:10 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140809-15 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	08/28/2014	NP	1408111
EPA 300.0	**Fluoride**	**27.4**		mg/L	1.0	10	08/28/2014	NP	1408111
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/28/2014	NP	1408111
EPA 300.0	**Sulfate as SO4**	**289**		mg/L	0.5	10	08/28/2014	NP	1408111
EPA 310.1	**Total Alkalinity**	**1300**		mg CaCO3 / L	25.0	5	08/25/2014	KJB	1408112

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3D-081914 **Date / Time Sampled:** 08/19/14 11:10 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140809-16 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**77.8**	D	mg/L	3.00	100	08/27/2014	KJB	1408127

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-081914 **Date / Time Sampled:** 08/19/14 11:25 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140809-19 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	08/28/2014	NP	1408111
EPA 300.0	**Fluoride**	**2.1**		mg/L	1.0	10	08/28/2014	NP	1408111
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/28/2014	NP	1408111
EPA 300.0	**Sulfate as SO4**	**630**		mg/L	0.5	10	08/28/2014	NP	1408111
EPA 310.1	**Total Alkalinity**	**451**		mg CaCO3 / L	25.0	5	08/25/2014	KJB	1408112

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-081914 **Date / Time Sampled:** 08/19/14 11:25 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140809-20 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**5.52**	D	mg/L	0.300	10	08/27/2014	KJB	1408127

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-CHIT-081914 **Date / Time Sampled:** 08/19/14 10:05 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140809-23 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.5**	J	mg/L	5.0	10	08/28/2014	NP	1408111
EPA 300.0	**Fluoride**	**13.9**		mg/L	1.0	10	08/28/2014	NP	1408111
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/28/2014	NP	1408111
EPA 300.0	**Sulfate as SO4**	**623**		mg/L	0.5	10	08/28/2014	NP	1408111
EPA 310.1	**Total Alkalinity**	**621**		mg CaCO3 / L	25.0	5	08/25/2014	KJB	1408112

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-INFL-081914 **Date / Time Sampled:** 08/19/14 09:40 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140809-26 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	08/29/2014	NP	1408111
EPA 300.0	**Fluoride**	**2.2**		mg/L	1.0	10	08/29/2014	NP	1408111
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/29/2014	NP	1408111
EPA 300.0	**Sulfate as SO4**	**1010**		mg/L	0.5	10	08/29/2014	NP	1408111
EPA 310.1	Total Alkalinity	< 50.0		mg CaCO3 / L	25.0	5	08/25/2014	KJB	1408112

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-NAOH-081914 **Date / Time Sampled:** 08/19/14 10:15 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140809-29 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	08/29/2014	NP	1408111
EPA 300.0	**Fluoride**	**1.1**	J	mg/L	1.0	10	08/29/2014	NP	1408111
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/29/2014	NP	1408111
EPA 300.0	**Sulfate as SO4**	**1010**		mg/L	0.5	10	08/29/2014	NP	1408111
EPA 310.1	Total Alkalinity	< 10.0		mg CaCO3 / L	5.00	1	08/25/2014	KJB	1408112

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTE-081914 **Date / Time Sampled:** 08/19/14 12:00 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140809-32 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**6.6**	J	mg/L	5.0	10	08/29/2014	NP	1408111
EPA 300.0	**Fluoride**	**3.5**		mg/L	1.0	10	08/29/2014	NP	1408111
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/29/2014	NP	1408111
EPA 300.0	**Sulfate as SO4**	**539**		mg/L	0.5	10	08/29/2014	NP	1408111
EPA 310.1	**Total Alkalinity**	**726**		mg CaCO3 / L	25.0	5	08/25/2014	KJB	1408112

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTE-081914 **Date / Time Sampled:** 08/19/14 12:00 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140809-33 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**25.5**	D	mg/L	3.00	100	08/27/2014	KJB	1408127

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTI-081914 **Date / Time Sampled:** 08/19/14 11:40 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140809-36 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.3**	J	mg/L	5.0	10	08/29/2014	NP	1408111
EPA 300.0	**Fluoride**	**9.4**		mg/L	1.0	10	08/29/2014	NP	1408111
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/29/2014	NP	1408111
EPA 300.0	**Sulfate as SO4**	**559**		mg/L	0.5	10	08/29/2014	NP	1408111
EPA 310.1	**Total Alkalinity**	**611**		mg CaCO3 / L	25.0	5	08/25/2014	KJB	1408112

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTI-081914 **Date / Time Sampled:** 08/19/14 11:40 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140809-37 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**26.6**	D	mg/L	3.00	100	08/27/2014	KJB	1408127

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-SAPS-081914 **Date / Time Sampled:** 08/19/14 09:50 **Workorder:** C140809
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140809-40 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	08/29/2014	NP	1408111
EPA 300.0	**Fluoride**	**1.6**	J	mg/L	1.0	10	08/29/2014	NP	1408111
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	08/29/2014	NP	1408111
EPA 300.0	**Sulfate as SO4**	**1000**		mg/L	0.5	10	08/29/2014	NP	1408111
EPA 310.1	**Total Alkalinity**	**97.8**		mg CaCO3 / L	25.0	5	08/25/2014	KJB	1408112

"J" Qualifier indicates an estimated value

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ICPMS-PE DRC-II									
Batch 1410002 - No Lab Prep Reqd			***Water***						**ICPMS-PE DRC-II**
Method Blank (1410002-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 10/01/14			
Nickel	< 0.500	1.00	ug/L						
Copper	< 0.500	1.00	"						
Arsenic	< 0.500	2.00	"						
Cadmium	< 0.100	0.200	"						
Lead	< 0.100	0.200	"						
Method Blank Spike (1410002-BS1)		Dilution Factor: 1				Prepared & Analyzed: 10/01/14			
Nickel	92.6	1.00	ug/L	100		93	85-115		
Copper	92.9	1.00	"	100		93	85-115		
Arsenic	90.9	2.00	"	100		91	85-115		
Cadmium	98.8	0.200	"	100		99	85-115		
Lead	96.1	0.200	"	100		96	85-115		
Duplicate (1410002-DUP1)		Dilution Factor: 1	**Source: C140809-02**			Prepared & Analyzed: 10/01/14			
Nickel	< 5.00	10.0	ug/L		< 5.00				20
Copper	7.61	10.0	"		14.3			61	20
Arsenic	< 5.00	20.0	"		< 5.00				20
Cadmium	< 1.00	2.00	"		< 1.00				20
Lead	< 1.00	2.00	"		1.01				20
Matrix Spike (1410002-MS1)		Dilution Factor: 1	**Source: C140809-02**			Prepared & Analyzed: 10/01/14			
Nickel	66.5	10.0	ug/L	100	< 5.00	66	70-130		
Copper	75.7	10.0	"	100	14.3	61	70-130		
Arsenic	98.8	20.0	"	100	< 5.00	99	70-130		
Cadmium	96.8	2.00	"	100	< 1.00	97	70-130		
Lead	98.9	2.00	"	100	1.01	98	70-130		
Matrix Spike (1410002-MS2)		Dilution Factor: 1	**Source: C140809-06**			Prepared & Analyzed: 10/01/14			
Nickel	75.0	10.0	ug/L	100	< 5.00	75	70-130		
Copper	44.0	10.0	"	100	5.36	39	70-130		
Arsenic	97.4	20.0	"	100	< 5.00	97	70-130		
Cadmium	96.1	2.00	"	100	< 1.00	96	70-130		
Lead	99.2	2.00	"	100	< 1.00	99	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1410014 - 1410002			*Water*						ICPMS-PE DRC-II
Serial Dilution (1410014-SRD1)		Dilution Factor: 5	**Source: C140809-02**			Prepared & Analyzed: 10/01/14			
Nickel	< 25.0	50.0	ug/L		< 5.00				10
Copper	< 25.0	50.0	"		14.3				10
Arsenic	< 25.0	100	"		< 5.00				10
Cadmium	< 5.00	10.0	"		< 1.00				10
Lead	< 5.00	10.0	"		1.01				10

ICPOE - PE Optima

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1410001 - No Lab Prep Reqd			*Water*						ICPOE - PE Optima
Method Blank (1410001-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 10/01/14			
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						
Method Blank Spike (1410001-BS1)		Dilution Factor: 1				Prepared & Analyzed: 10/01/14			
Aluminum	9920	50.0	ug/L	10100		98	85-115		
Iron	9896	250	"	10100		98	85-115		
Manganese	97.58	5.00	"	100		98	85-115		
Zinc	99.44	20.0	"	100		99	85-115		
Duplicate (1410001-DUP1)		Dilution Factor: 5	**Source: C140809-02**			Prepared & Analyzed: 10/01/14			
Aluminum	133.0	250	ug/L		137.0			3	20
Iron	< 500	1250	"		< 500				20
Manganese	91620	25.0	"		90920			0.8	20
Zinc	< 50.0	100	"		< 50.0				20
Matrix Spike (1410001-MS1)		Dilution Factor: 5	**Source: C140809-02**			Prepared & Analyzed: 10/01/14			
Aluminum	10010	250	ug/L	10100	137.0	98	70-130		
Iron	9863	1250	"	10100	< 500	98	70-130		
Manganese	90870	25.0	"	100	90920	NR	70-130		
Zinc	115.3	100	"	100	< 50.0	115	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1410001 - No Lab Prep Reqd			***Water***						**ICPOE - PE Optima**
Matrix Spike (1410001-MS2)		Dilution Factor: 5	**Source: C140809-06**			Prepared & Analyzed: 10/01/14			
Aluminum	9885	250	ug/L	10100	< 100	98	70-130		
Iron	10710	1250	"	10100	533.0	101	70-130		
Manganese	102100	25.0	"	100	102500	NR	70-130		
Zinc	113.1	100	"	100	< 50.0	113	70-130		
Batch 1410008 - 1410001			***Water***						**ICPOE - PE Optima**
Serial Dilution (1410008-SRD1)		Dilution Factor: 2	**Source: C140809-02**			Prepared & Analyzed: 10/01/14			
Aluminum	< 500	1250	ug/L		137.0				10
Iron	< 2500	6250	"		< 500.00				10
Manganese	96760	125	"		90920			6	10
Zinc	< 250	500	"		< 50.00				10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ICPMS-PE DRC-II									
Batch 1409140 - 200.2 - TR Metals			*Water*						**ICPMS-PE DRC-II**
Method Blank (1409140-BLK2)		Dilution Factor: 5				Prepared: 09/29/14 Analyzed: 10/02/14			
Nickel	< 2.50	5.00	ug/L						
Copper	< 2.50	5.00	"						
Arsenic	< 2.50	10.0	"						
Cadmium	< 0.500	1.00	"						
Lead	< 0.500	1.00	"						
Duplicate (1409140-DUP2)		Dilution Factor: 1	**Source: C140809-01**			Prepared: 09/29/14 Analyzed: 10/02/14			
Nickel	< 5.00	10.0	ug/L		< 5.00				20
Copper	< 5.00	10.0	"		< 5.00				20
Arsenic	< 5.00	20.0	"		< 5.00				20
Cadmium	< 1.00	2.00	"		< 1.00				20
Lead	6.138	2.00	"		5.995			2	20
Matrix Spike (1409140-MS2)		Dilution Factor: 1	**Source: C140809-05**			Prepared: 09/29/14 Analyzed: 10/02/14			
Nickel	453.1	10.0	ug/L	500	< 5.00	91	70-130		
Copper	270.0	10.0	"	300	< 5.00	90	70-130		
Arsenic	723.6	20.0	"	800	< 5.00	90	70-130		
Cadmium	197.3	2.00	"	200	< 1.00	99	70-130		
Lead	859.1	2.00	"	1000	1.004	86	70-130		
Matrix Spike (1409140-MS4)		Dilution Factor: 1	**Source: C140809-09**			Prepared: 09/29/14 Analyzed: 10/02/14			
Nickel	474.6	10.0	ug/L	500	6.411	94	70-130		
Copper	275.1	10.0	"	300	< 5.00	92	70-130		
Arsenic	751.1	20.0	"	800	8.296	93	70-130		
Cadmium	191.3	2.00	"	200	< 1.00	96	70-130		
Lead	889.4	2.00	"	1000	< 1.00	89	70-130		
Reference (1409140-SRM2)		Dilution Factor: 2				Prepared: 09/29/14 Analyzed: 10/02/14			
Nickel	1019	20.0	ug/L	1000		102	85-115		
Copper	1019	20.0	"	1000		102	85-115		
Arsenic	1962	40.0	"	2000		98	85-115		
Cadmium	1007	4.00	"	1000		101	85-115		
Lead	1955	4.00	"	2000		98	85-115		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1410015 - 1409140			*Water*						ICPMS-PE DRC-II
Serial Dilution (1410015-SRD1)		Dilution Factor: 5	**Source: C140809-01**			Prepared: 09/29/14	Analyzed: 10/02/14		
Nickel	< 25.0	50.0	ug/L		< 5.00				10
Copper	< 25.0	50.0	"		< 5.00				10
Arsenic	< 25.0	100	"		< 5.00				10
Cadmium	< 5.00	10.0	"		< 1.00				10
Lead	5.718	10.0	"		5.995			5	10
ICPOE - PE Optima									
Batch 1409140 - 200.2 - TR Metals			*Water*						ICPOE - PE Optima
Method Blank (1409140-BLK1)		Dilution Factor: 1				Prepared: 09/29/14	Analyzed: 10/01/14		
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						
Duplicate (1409140-DUP1)		Dilution Factor: 5	**Source: C140809-01**			Prepared: 09/29/14	Analyzed: 10/01/14		
Aluminum	207.9	250	ug/L		199.5			4	20
Iron	< 500	1250	"		< 500				20
Manganese	97190	25.0	"		95850			1	20
Zinc	99.56	100	"		119.0			18	20
Matrix Spike (1409140-MS1)		Dilution Factor: 5	**Source: C140809-05**			Prepared: 09/29/14	Analyzed: 10/01/14		
Aluminum	1943	250	ug/L	2000	100.2	92	70-130		
Iron	3472	1250	"	3000	709.9	92	70-130		
Manganese	107500	25.0	"	200	106000	756	70-130		
Zinc	279.7	100	"	200	101.7	89	70-130		
Matrix Spike (1409140-MS3)		Dilution Factor: 5	**Source: C140809-09**			Prepared: 09/29/14	Analyzed: 10/01/14		
Aluminum	2021	250	ug/L	2000	181.2	92	70-130		
Iron	2956	1250	"	3000	< 500	99	70-130		
Manganese	39490	25.0	"	200	40590	NR	70-130		
Zinc	250.3	100	"	200	56.03	97	70-130		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409140 - 200.2 - TR Metals			***Water***						**ICPOE - PE Optima**
Reference (1409140-SRM1)		Dilution Factor: 1				Prepared: 09/29/14 Analyzed: 10/01/14			
Aluminum	952.0	50.0	ug/L	1000		95	85-115		
Iron	934.7	250	"	1000		93	85-115		
Manganese	1008	5.00	"	1000		101	85-115		
Zinc	1003	20.0	"	1000		100	85-115		
Batch 1410009 - 1409140			***Water***						**ICPOE - PE Optima**
Serial Dilution (1410009-SRD1)		Dilution Factor: 2	**Source: C140809-01**			Prepared: 09/29/14 Analyzed: 10/01/14			
Aluminum	< 500	1250	ug/L		199.5				10
Iron	< 2500	6250	"		< 500.00				10
Manganese	100800	125	"		95850			5	10
Zinc	< 250	500	"		119.0				10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ESAT Dionex IC									
Batch 1408111 - No Prep Req			***Water***						**ESAT Dionex IC**
Method Blank (1408111-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 08/28/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						
Method Blank Spike (1408111-BS1)		Dilution Factor: 1				Prepared & Analyzed: 08/28/14			
Fluoride	4.9	0.2	mg/L	5.00		98	90-110		
Chloride	24.8	2.0	"	25.0		99	90-110		
Sulfate as SO4	25.7	0.1	"	25.0		103	90-110		
Nitrate/Nitrite as N	19.5	5.0	"	20.0		98	90-110		
Duplicate (1408111-DUP1)		Dilution Factor: 1	**Source: C140809-03**			Prepared & Analyzed: 08/28/14			
Fluoride	8.5	2.0	mg/L		8.7			2	20
Chloride	5.4	20.0	"		5.4			1	20
Sulfate as SO4	644	1.0	"		682			6	20
Nitrate/Nitrite as N	< 10.0	50.0	"		< 10.0				20
Matrix Spike (1408111-MS1)		Dilution Factor: 1	**Source: C140809-03**			Prepared & Analyzed: 08/28/14			
Fluoride	55.8	2.0	mg/L	50.0	8.7	94	80-120		
Chloride	253	20.0	"	250	5.4	99	80-120		
Sulfate as SO4	925	1.0	"	250	682	97	80-120		
Nitrate/Nitrite as N	194	50.0	"	200	< 10.0	97	80-120		
Matrix Spike (1408111-MS2)		Dilution Factor: 1	**Source: C140809-40**			Prepared & Analyzed: 08/29/14			
Fluoride	51.8	2.0	mg/L	50.0	1.6	100	80-120		
Chloride	257	20.0	"	250	5.4	101	80-120		
Sulfate as SO4	1240	1.0	"	250	1000	94	80-120		
Nitrate/Nitrite as N	197	50.0	"	200	< 10.0	99	80-120		

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409002 - 1408111			***Water***						**ESAT Dionex IC**
Instrument Blank (1409002-IBL1)		Dilution Factor: 1				Prepared & Analyzed: 08/28/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						

Lachat 8500

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1408127 - No Prep Req			***Water***						**Lachat 8500**
Method Blank (1408127-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 08/27/14			
Ammonia as N	< 0.0300	0.0500	mg/L						
Method Blank Spike (1408127-BS1)		Dilution Factor: 1				Prepared & Analyzed: 08/27/14			
Ammonia as N	1.01	0.0500	mg/L	1.00		101	90-110		
Duplicate (1408127-DUP1)		Dilution Factor: 1	**Source: C140804-04**			Prepared & Analyzed: 08/27/14			
Ammonia as N	40.1	5.00	mg/L		39.8			0.7	20
Duplicate (1408127-DUP2)		Dilution Factor: 1	**Source: C140809-20**			Prepared & Analyzed: 08/27/14			
Ammonia as N	5.58	0.500	mg/L		5.52			1	20
Matrix Spike (1408127-MS1)		Dilution Factor: 1	**Source: C140804-04**			Prepared & Analyzed: 08/27/14			
Ammonia as N	136	5.00	mg/L	100	39.8	96	90-110		
Matrix Spike (1408127-MS2)		Dilution Factor: 1	**Source: C140809-20**			Prepared & Analyzed: 08/27/14			
Ammonia as N	15.5	0.500	mg/L	10.0	5.52	100	90-110		
Reference (1408127-SRM1)		Dilution Factor: 5				Prepared & Analyzed: 08/27/14			
Ammonia as N	4.86	0.250	mg/L	4.80		101	90-110		

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Mettler AT

Batch 1408112 - No Prep Req *Water* **Mettler AT**

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Method Blank (1408112-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 08/25/14			
Total Alkalinity	< 5.00	10.0	mg CaCO3 / L						
Duplicate (1408112-DUP1)		Dilution Factor: 5	**Source: C140809-03**			Prepared & Analyzed: 08/25/14			
Total Alkalinity	454	50.0	mg CaCO3 / L		457			0.6	20
Duplicate (1408112-DUP2)		Dilution Factor: 5	**Source: C140809-40**			Prepared & Analyzed: 08/25/14			
Total Alkalinity	97.1	50.0	mg CaCO3 / L		97.8			0.7	20
Reference (1408112-SRM1)		Dilution Factor: 1				Prepared & Analyzed: 08/25/14			
Total Alkalinity	11.9	10.0	mg CaCO3 / L	10.4		114	61.3-143.9		

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Project Name: **Barker-Hughesville_Treatability 2_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 310.1

Analysis Name: WC - Alkalinity

Instrument: **Mettler AT**

Work Order: Nu C140809

Analytical Sequence: **Total**

Concentration Units: mg CaCO3 / L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Total Alkalinity		**1**	**2**	**3**	**4**	1408112-BLK1	NA	10.00
		1.56	1.52			1.00	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 350.1 Analysis Name: WC - Ammonia

Instrument: **Lachat 8500** Work Order: Nu C140809

Analytical Sequence: **Total** Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Ammonia as N		**1**	**2**	**3**	**4**	1408127-BLK1	NA	0.05
		0.00	0.00	0.00		0.00	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 300.0 Analysis Name: WC - Anions by Ion Chromatography

Instrument: **ESAT Dionex IC** Work Order: Nu C140809

Analytical Sequence: 1409002 **Dissolved** Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Fluoride	0.00	**1**	**2**	**3**	**4**	1408111-BLK1	NA	0.20
		0.00	0.00			0.00	NA	
		5	**6**	**7**	**8**			
Chloride	0.00	**1**	**2**	**3**	**4**	1408111-BLK1	NA	2.00
		0.00	0.00			0.00	NA	
		5	**6**	**7**	**8**			
Sulfate as SO4	0.00	**1**	**2**	**3**	**4**	1408111-BLK1	NA	0.10
		0.00	0.00			0.00	NA	
		5	**6**	**7**	**8**			
Nitrate/Nitrite as N	0.00	**1**	**2**	**3**	**4**	1408111-BLK1	NA	5.00
		0.00	0.00			0.00	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7

Analysis Name: ICPOE Diss. Metals

Instrument: **ICPOE - PE Optima**

Work Order: Nu C140809

Analytical Sequence: 1410008 **Dissolved**

Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Aluminum	2.12	**1**	**2**	**3**	**4**	1410001-BLK1	NA	50.00
		2.18	1.79			2.40	NA	
		5	**6**	**7**	**8**			
Iron	6.64	**1**	**2**	**3**	**4**	1410001-BLK1	NA	250.00
		11.44	28.95			19.29	NA	
		5	**6**	**7**	**8**			
Manganese	0.09	**1**	**2**	**3**	**4**	1410001-BLK1	NA	5.00
		0.27	0.66			-0.03	NA	
		5	**6**	**7**	**8**			
Zinc	1.18	**1**	**2**	**3**	**4**	1410001-BLK1	NA	20.00
		0.57	2.99			-0.19	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Instrument: **ICPOE - PE Optima** Work Order: Nu C140809

Analytical Sequence: 1410009 **Total Recoverable** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	1409140-BLK1	NA	
Aluminum	2.12	2.18	1.79	2.70	3.69	2.55	NA	50.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1409140-BLK1	NA	
Iron	6.64	11.44	28.95	26.30	-14.38	-13.83	NA	250.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1409140-BLK1	NA	
Manganese	0.09	0.27	0.66	0.59	0.59	0.17	NA	5.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1409140-BLK1	NA	
Zinc	1.18	0.57	2.99	0.35	1.59	2.22	NA	20.00
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8

Analysis Name: ICPMS Diss. Metals

Instrument: **ICPMS-PE DRC-II**

Work Order: Nu C140809

Analytical Sequence: 1410014 **Dissolved**

Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Nickel	0.03	**1**	**2**	**3**	**4**	1410002-BLK1	NA	1.00
		0.01	0.00			-0.02	NA	
		5	**6**	**7**	**8**			
Copper	0.03	**1**	**2**	**3**	**4**	1410002-BLK1	NA	1.00
		0.00	-0.03			-0.08	NA	
		5	**6**	**7**	**8**			
Arsenic	0.15	**1**	**2**	**3**	**4**	1410002-BLK1	NA	2.00
		0.13	0.07			0.22	NA	
		5	**6**	**7**	**8**			
Cadmium	0.01	**1**	**2**	**3**	**4**	1410002-BLK1	NA	0.20
		0.02	0.00			-0.01	NA	
		5	**6**	**7**	**8**			
Lead	0.01	**1**	**2**	**3**	**4**	1410002-BLK1	NA	0.20
		0.01	0.01			-0.01	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Instrument: **ICPMS-PE DRC-II** Work Order: Nu C140809

Analytical Sequence: 1410015 **Total Recoverable** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
		1	**2**	**3**	**4**	NA	1409140-BLK2	
Nickel	0.00	0.01	-0.02			NA	-0.03	1.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	NA	1409140-BLK2	
Copper	-0.04	-0.04	-0.07			NA	-0.15	1.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	NA	1409140-BLK2	
Arsenic	0.12	0.07	0.09			NA	-0.14	2.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	NA	1409140-BLK2	
Cadmium	0.01	0.00	0.00			NA	0.00	0.20
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	NA	1409140-BLK2	
Lead	0.04	0.03	0.01			NA	-0.01	0.20
		5	**6**	**7**	**8**			

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Mettler AT Method: EPA 310.1 Analysis Name: WC - Alkalinity

Sequence: 1408117 Work Order: C140809 Units: mg CaCO3 / L

Total Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
					1			**2**			**3**	
Total Alkalinity				100	98.2	98.2	100	98.3	98.3			
					4			**5**			**6**	
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability 2_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Lachat 8500 Method: EPA 350.1 Analysis Name: WC - Ammonia

Sequence: 1408133 Work Order: C140809 Units: mg/L

Total Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Ammonia as N					1			2			3	
				1.00	1.00	100.0	1.00	1.00	100.0	1.00	1.01	101.0
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ESAT Dionex IC Method: EPA 300.0 Analysis Name: WC - Anions by Ion Chromatography 2013

Sequence: 1409002 Work Order: C140809 Units: mg/L

Dissolved Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
					1			**2**			**3**	
Chloride	40.0	38.4	96.0	40.0	40.9	102.3	40.0	40.9	102.3			
					4			**5**			**6**	
					7			**8**			**9**	
					1			**2**			**3**	
Fluoride	4.00	3.7	92.5	4.00	4.1	102.5	4.00	4.0	100.0			
					4			**5**			**6**	
					7			**8**			**9**	
					1			**2**			**3**	
Nitrate/Nitrite as N	20.0	19.7	98.5	20.0	21.0	105.0	20.0	20.9	104.5			
					4			**5**			**6**	
					7			**8**			**9**	
					1			**2**			**3**	
Sulfate as SO4	100	94.8	94.8	100	105	105.0	100	102	102.0			
					4			**5**			**6**	
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability 2_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Diss. Metals

Sequence: 1410008 Work Order: C140809 Units: ug/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Aluminum	12500	12140	97.1	1			2			3		
				12500	12260	98.1	12500	12570	100.6			
				4			5			6		
				7			8			9		
Iron	12500	12280	98.2	1			2			3		
				12500	12280	98.2	12500	12590	100.7			
				4			5			6		
				7			8			9		
Manganese	1000	1007	100.7	1			2			3		
				1000	1008	100.8	1000	1016	101.6			
				4			5			6		
				7			8			9		
Zinc	2500	2541	101.6	1			2			3		
				2500	2532	101.3	2500	2567	102.7			
				4			5			6		
				7			8			9		

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability 2_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Sequence: 1410009 Work Order: C140809 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Aluminum	12500	12140	97.1		1			2			3	
				12500	12260	98.1	12500	12570	100.6	12500	12450	99.6
					4			5			6	
				12500	12490	99.9						
					7			8			9	
Iron	12500	12280	98.2		1			2			3	
				12500	12280	98.2	12500	12590	100.7	12500	12520	100.2
					4			5			6	
				12500	12490	99.9						
					7			8			9	
Manganese	1000	1007	100.7		1			2			3	
				1000	1008	100.8	1000	1016	101.6	1000	1012	101.2
					4			5			6	
				1000	1019	101.9						
					7			8			9	
Zinc	2500	2541	101.6		1			2			3	
				2500	2532	101.3	2500	2567	102.7	2500	2547	101.9
					4			5			6	
				2500	2573	102.9						
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability 2_AUG 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Diss. Metals

Sequence: 1410014 Work Order: C140809 Units: ug/L

Dissolved Analyte	Initial (ICV1, ICV2) True	Initial (ICV1, ICV2) Found	Initial (ICV1, ICV2) %R	CCVs True	Found	%R	True	Found	%R	True	Found	%R
Arsenic	50.0	50.7	101.4		1			2			3	
				50.0	49.7	99.4	50.0	49.5	99.0			
					4			5			6	
					7			8			9	
Cadmium	50.0	49.7	99.4		1			2			3	
				50.0	49.3	98.6	50.0	51.4	102.8			
					4			5			6	
					7			8			9	
Copper	50.0	48.6	97.2		1			2			3	
				50.0	44.9	89.8	50.0	45.0	90.0			
					4			5			6	
					7			8			9	
Lead	50.0	48.6	97.2		1			2			3	
				50.0	49.7	99.4	50.0	50.2	100.4			
					4			5			6	
					7			8			9	
Nickel	50.0	47.7	95.4		1			2			3	
				50.0	45.1	90.2	50.0	46.8	93.6			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1410015 Work Order: C140809 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)											
	True	Found	%R		True	Found	%R		True	Found	%R		True	Found	%R
Arsenic	50.0	49.05	98.1	1	50.0	49.07	98.1	2	50.0	46.22	92.4	3			
				4				5				6			
				7				8				9			
Cadmium	50.0	48.63	97.3	1	50.0	49.81	99.6	2	50.0	50.00	100.0	3			
				4				5				6			
				7				8				9			
Copper	50.0	48.88	97.8	1	50.0	50.07	100.1	2	50.0	46.34	92.7	3			
				4				5				6			
				7				8				9			
Lead	50.0	49.70	99.4	1	50.0	48.58	97.2	2	50.0	44.85	89.7	3			
				4				5				6			
				7				8				9			
Nickel	50.0	48.68	97.4	1	50.0	49.88	99.8	2	50.0	48.42	96.8	3			
				4				5				6			
				7				8				9			

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

ICP Interference Check Sample

ICPMS-PE DRC-II

Sequence: 1410014 Analysis: ICPMS Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.1	ug/L			2.00
	IFB1	20.3	ug/L	20	102	2.00
Cadmium	IFA1	0.1	ug/L			0.200
	IFB1	20.4	ug/L	20	102	0.200
Copper	IFA1	0.4	ug/L			1.00
	IFB1	17.7	ug/L	20	88	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	-0.3	ug/L			1.00
	IFB1	17.1	ug/L	20	86	1.00

*Criteria = 80-120%R of True Value or +/- PQL

See raw data for complete analyte list and results.

Sequence: 1410015 Analysis: ICPMS Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.0	ug/L			2.00
	IFB1	18.6	ug/L	20	93	2.00
Cadmium	IFA1	0.2	ug/L			0.200
	IFB1	19.8	ug/L	20	99	0.200
Copper	IFA1	0.5	ug/L			1.00
	IFB1	18.8	ug/L	20	94	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	-0.2	ug/L			1.00
	IFB1	18.5	ug/L	20	92	1.00

*Criteria = 80-120%R of True Value or +/- PQL

See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8

ICP Interference Check Sample

ICPOE - PE Optima

Sequence: 1410008 Analysis: ICPOE Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	59,822.0	ug/L	60,000	100	50.0
	IFB1	58,594.8	ug/L	60,000	98	50.0
Iron	IFA1	233,950.4	ug/L	250,000	94	250
	IFB1	230,762.6	ug/L	250,000	92	250
Manganese	IFA1	-0.3	ug/L			5.00
	IFB1	193.1	ug/L	200	97	5.00
Zinc	IFA1	2.8	ug/L			20.0
	IFB1	286.7	ug/L	300	96	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1410009 Analysis: ICPOE Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	59,822.0	ug/L	60,000	100	50.0
	IFB1	58,594.8	ug/L	60,000	98	50.0
Iron	IFA1	233,950.4	ug/L	250,000	94	250
	IFB1	230,762.6	ug/L	250,000	92	250
Manganese	IFA1	-0.3	ug/L			5.00
	IFB1	193.1	ug/L	200	97	5.00
Zinc	IFA1	2.8	ug/L			20.0
	IFB1	286.7	ug/L	300	96	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPMS-PE DRC-II

Metals (Dissolved) by EPA 200/7000 Series Methods
Sequence: 1410014

Analyte	True	Found	%R	Units
Arsenic	2.00	2.07	103	ug/L
Cadmium	0.200	0.214	107	ug/L
Copper	1.00	0.942	94	ug/L
Lead	0.200	0.157	79	ug/L
Nickel	1.00	0.983	98	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPOE - PE Optima

Metals (Dissolved) by EPA 200/7000 Series Methods
Sequence: 1410008

Analyte	True	Found	%R	Units
Aluminum	100	95.73	96	ug/L
Iron	100	103.0	103	ug/L
Manganese	10.0	9.989	100	ug/L
Zinc	50.0	52.38	105	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

Lachat 8500

Classical Chemistry by EPA/ASTM/APHA Methods

Sequence: 1408133

Analyte	True	Found	%R	Units
Ammonia as N	0.0250	0.0230	92	mg/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

ICPMS-PE DRC-II

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1410015

Analyte	True	Found	%R	Units
Arsenic	2.00	2.270	113	ug/L
Cadmium	0.200	0.1910	96	ug/L
Copper	1.00	0.9230	92	ug/L
Lead	0.200	0.2310	116	ug/L
Nickel	1.00	0.9571	96	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

ICPOE - PE Optima

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1410009

Analyte	True	Found	%R	Units
Aluminum	100	95.73	96	ug/L
Iron	100	103.0	103	ug/L
Manganese	10.0	9.989	100	ug/L
Zinc	50.0	52.38	105	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 310.1 **Total** **Sequence ID#:** 1408117

Instrument ID #: Mettler AT Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1408112-SRM1	Reference	08/25/14	15:16
1408112-BLK1	Blank	08/25/14	15:16
C140809-03	14BH-DT-PILOT-BCR1-08191	08/25/14	15:16
1408112-DUP1	Duplicate	08/25/14	15:16
C140809-07	14BH-DT-PILOT-BCR2-08191	08/25/14	15:16
C140809-11	14BH-DT-PILOT-BCR3-08191	08/25/14	15:16
C140809-15	14BH-DT-PILOT-BCR3D-0819	08/25/14	15:16
C140809-19	14BH-DT-PILOT-BCR4-08191	08/25/14	15:16
C140809-23	14BH-DT-PILOT-CHIT-08191	08/25/14	15:16
C140809-26	14BH-DT-PILOT-INFL-081914	08/25/14	15:16
1408117-CCV1	Calibration Check	08/25/14	15:16
1408117-CCB1	Calibration Blank	08/25/14	15:16
C140809-29	14BH-DT-PILOT-NAOH-0819	08/25/14	15:16
C140809-32	14BH-DT-PILOT-POSTE-0819	08/25/14	15:16
C140809-36	14BH-DT-PILOT-POSTI-08191	08/25/14	15:16
C140809-40	14BH-DT-PILOT-SAPS-08191	08/25/14	15:16
1408112-DUP2	Duplicate	08/25/14	15:16
1408117-CCV2	Calibration Check	08/25/14	15:16
1408117-CCB2	Calibration Blank	08/25/14	15:16

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 350.1 **Total** **Sequence ID#:** 1408133

Instrument ID #: Lachat 8500 Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1408127-SRM1	Reference	08/27/14	15:23
1408127-BLK1	Blank	08/27/14	15:23
1408127-BS1	Blank Spike	08/27/14	15:23
1408133-CRL1	Instrument RL Check	08/27/14	15:23
1408127-DUP1	Duplicate	08/27/14	15:23
1408127-MS1	Matrix Spike	08/27/14	15:23
1408133-CCV1	Calibration Check	08/27/14	15:23
1408133-CCB1	Calibration Blank	08/27/14	15:23
C140809-04	14BH-DT-PILOT-BCR1-08191	08/27/14	15:23
1408133-CCV2	Calibration Check	08/27/14	15:23
1408133-CCB2	Calibration Blank	08/27/14	15:23
C140809-12	14BH-DT-PILOT-BCR3-08191	08/27/14	15:23
C140809-16	14BH-DT-PILOT-BCR3D-081	08/27/14	15:23
C140809-33	14BH-DT-PILOT-POSTE-0819	08/27/14	15:23
C140809-37	14BH-DT-PILOT-POSTI-0819	08/27/14	15:23
C140809-08	14BH-DT-PILOT-BCR2-08191	08/27/14	15:23
C140809-20	14BH-DT-PILOT-BCR4-08191	08/27/14	15:23
1408127-DUP2	Duplicate	08/27/14	15:23
1408127-MS2	Matrix Spike	08/27/14	15:23
1408133-CCV3	Calibration Check	08/27/14	15:23
1408133-CCB3	Calibration Blank	08/27/14	15:23

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 300.0 **Dissolved** **Sequence ID#:** 1409002

Instrument ID #: ESAT Dionex IC Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409002-ICV1	Initial Cal Check	08/28/14	19:07
1409002-ICB1	Initial Cal Blank	08/28/14	19:26
1409002-SCV1	Secondary Cal Check	08/28/14	19:45
1409002-IBL1	Instrument Blank	08/28/14	20:04
1408111-BS1	Blank Spike	08/28/14	20:23
1408111-BLK1	Blank	08/28/14	20:41
C140809-03	14BH-DT-PILOT-BCR1-08191	08/28/14	21:00
1408111-DUP1	Duplicate	08/28/14	21:19
1408111-MS1	Matrix Spike	08/28/14	21:38
C140809-07	14BH-DT-PILOT-BCR2-08191	08/28/14	21:57
C140809-11	14BH-DT-PILOT-BCR3-08191	08/28/14	22:16
C140809-15	14BH-DT-PILOT-BCR3D-0819	08/28/14	22:34
1409002-CCV1	Calibration Check	08/28/14	22:53
1409002-CCB1	Calibration Blank	08/28/14	23:12
C140809-19	14BH-DT-PILOT-BCR4-08191	08/28/14	23:31
C140809-23	14BH-DT-PILOT-CHIT-081914	08/28/14	23:50
C140809-26	14BH-DT-PILOT-INFL-081914	08/29/14	00:09
C140809-29	14BH-DT-PILOT-NAOH-0819	08/29/14	00:27
C140809-32	14BH-DT-PILOT-POSTE-0819	08/29/14	00:46
C140809-36	14BH-DT-PILOT-POSTI-08191	08/29/14	01:05
C140809-40	14BH-DT-PILOT-SAPS-08191	08/29/14	01:24
1408111-MS2	Matrix Spike	08/29/14	01:43
1409002-CCV2	Calibration Check	08/29/14	02:02
1409002-CCB2	Calibration Blank	08/29/14	02:39

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Dissolved** **Sequence ID#:** 1410008

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1410008-ICV1	Initial Cal Check	10/01/14	10:27
1410008-SCV1	Secondary Cal Check	10/01/14	10:30
1410008-ICB1	Initial Cal Blank	10/01/14	10:33
1410008-CRL1	Instrument RL Check	10/01/14	10:36
1410008-IFA1	Interference Check A	10/01/14	10:39
1410008-IFB1	Interference Check B	10/01/14	10:43
1410001-BLK1	Blank	10/01/14	10:47
1410001-BS1	Blank Spike	10/01/14	10:50
C140809-02	14BH-DT-PILOT-BCR1-08191	10/01/14	10:53
1410001-DUP1	Duplicate	10/01/14	10:56
1410008-SRD1	Serial Dilution	10/01/14	10:59
1410001-MS1	Matrix Spike	10/01/14	11:03
C140809-06	14BH-DT-PILOT-BCR2-08191	10/01/14	11:06
1410001-MS2	Matrix Spike	10/01/14	11:09
C140809-10	14BH-DT-PILOT-BCR3-08191	10/01/14	11:12
1410008-CCV1	Calibration Check	10/01/14	11:18
1410008-CCB1	Calibration Blank	10/01/14	11:21
C140809-14	14BH-DT-PILOT-BCR3D-081	10/01/14	11:24
C140809-18	14BH-DT-PILOT-BCR4-08191	10/01/14	11:27
C140809-22	14BH-DT-PILOT-CHIT-081914	10/01/14	11:31
C140809-25	14BH-DT-PILOT-INFL-081914	10/01/14	11:34
C140809-28	14BH-DT-PILOT-NAOH-0819	10/01/14	11:37
C140809-31	14BH-DT-PILOT-POSTE-0819	10/01/14	11:40
C140809-35	14BH-DT-PILOT-POSTI-08191	10/01/14	11:43
C140809-39	14BH-DT-PILOT-SAPS-08191	10/01/14	11:46
1410008-CCV2	Calibration Check	10/01/14	11:52
1410008-CCB2	Calibration Blank	10/01/14	11:55

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Total Recoverable** **Sequence ID#:** 1410009

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1410009-ICV1	Initial Cal Check	10/01/14	10:27
1410009-SCV1	Secondary Cal Check	10/01/14	10:30
1410009-ICB1	Initial Cal Blank	10/01/14	10:33
1410009-CRL1	Instrument RL Check	10/01/14	10:36
1410009-IFA1	Interference Check A	10/01/14	10:39
1410009-IFB1	Interference Check B	10/01/14	10:43
1410009-CCV1	Calibration Check	10/01/14	11:18
1410009-CCB1	Calibration Blank	10/01/14	11:21
1410009-CCV2	Calibration Check	10/01/14	11:52
1410009-CCB2	Calibration Blank	10/01/14	11:55
1409140-BLK1	Blank	10/01/14	12:01
1409140-SRM1	Reference	10/01/14	12:05
C140809-01	14BH-DT-PILOT-BCR1-08191	10/01/14	12:08
1409140-DUP1	Duplicate	10/01/14	12:11
1410009-SRD1	Serial Dilution	10/01/14	12:14
C140809-05	14BH-DT-PILOT-BCR2-08191	10/01/14	12:17
1409140-MS1	Matrix Spike	10/01/14	12:20
C140809-09	14BH-DT-PILOT-BCR3-08191	10/01/14	12:23
1409140-MS3	Matrix Spike	10/01/14	12:26
1410009-CCV3	Calibration Check	10/01/14	12:33
1410009-CCB3	Calibration Blank	10/01/14	12:36
C140809-13	14BH-DT-PILOT-BCR3D-0819	10/01/14	12:39
C140809-17	14BH-DT-PILOT-BCR4-08191	10/01/14	12:42
C140809-21	14BH-DT-PILOT-CHIT-081914	10/01/14	12:45
C140809-24	14BH-DT-PILOT-INFL-081914	10/01/14	12:48
C140809-27	14BH-DT-PILOT-NAOH-0819	10/01/14	12:51
C140809-30	14BH-DT-PILOT-POSTE-0819	10/01/14	12:54
C140809-34	14BH-DT-PILOT-POSTI-08191	10/01/14	12:58
C140809-38	14BH-DT-PILOT-SAPS-08191	10/01/14	13:00
1410009-CCV4	Calibration Check	10/01/14	13:07
1410009-CCB4	Calibration Blank	10/01/14	13:10

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Dissolved** **Sequence ID#:** 1410014

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1410014-ICV1	Initial Cal Check	10/01/14	11:47
1410014-SCV1	Secondary Cal Check	10/01/14	11:50
1410014-ICB1	Initial Cal Blank	10/01/14	11:53
1410014-CRL1	Instrument RL Check	10/01/14	11:57
1410014-IFA1	Interference Check A	10/01/14	12:00
1410014-IFB1	Interference Check B	10/01/14	12:03
1410002-BLK1	Blank	10/01/14	12:06
1410002-BS1	Blank Spike	10/01/14	12:09
C140809-02	14BH-DT-PILOT-BCR1-08191	10/01/14	12:13
1410002-DUP1	Duplicate	10/01/14	12:16
1410014-SRD1	Serial Dilution	10/01/14	12:19
1410002-MS1	Matrix Spike	10/01/14	12:22
C140809-06	14BH-DT-PILOT-BCR2-08191	10/01/14	12:25
1410002-MS2	Matrix Spike	10/01/14	12:28
C140809-10	14BH-DT-PILOT-BCR3-08191	10/01/14	12:31
1410014-CCV1	Calibration Check	10/01/14	13:00
1410014-CCB1	Calibration Blank	10/01/14	13:03
C140809-14	14BH-DT-PILOT-BCR3D-0819	10/01/14	13:06
C140809-18	14BH-DT-PILOT-BCR4-08191	10/01/14	13:09
C140809-22	14BH-DT-PILOT-CHIT-081914	10/01/14	13:12
C140809-25	14BH-DT-PILOT-INFL-081914	10/01/14	13:15
C140809-28	14BH-DT-PILOT-NAOH-0819	10/01/14	13:19
C140809-31	14BH-DT-PILOT-POSTE-0819	10/01/14	13:22
C140809-35	14BH-DT-PILOT-POSTI-08191	10/01/14	13:25
C140809-39	14BH-DT-PILOT-SAPS-08191	10/01/14	13:28
1410014-CCV2	Calibration Check	10/01/14	14:57
1410014-CCB2	Calibration Blank	10/01/14	15:00

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Total Recoverable** **Sequence ID#:** 1410015

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1410015-ICV1	Initial Cal Check	10/02/14	10:11
1410015-SCV1	Secondary Cal Check	10/02/14	10:15
1410015-ICB1	Initial Cal Blank	10/02/14	10:18
1410015-CRL1	Instrument RL Check	10/02/14	10:21
1410015-IFA1	Interference Check A	10/02/14	10:24
1410015-IFB1	Interference Check B	10/02/14	10:28
1409140-BLK2	Blank	10/02/14	10:31
1409140-SRM2	Reference	10/02/14	10:34
C140809-01	14BH-DT-PILOT-BCR1-08191	10/02/14	10:37
1409140-DUP2	Duplicate	10/02/14	10:40
1410015-SRD1	Serial Dilution	10/02/14	10:43
C140809-05	14BH-DT-PILOT-BCR2-08191	10/02/14	10:46
1409140-MS2	Matrix Spike	10/02/14	10:49
C140809-09	14BH-DT-PILOT-BCR3-08191	10/02/14	10:52
1409140-MS4	Matrix Spike	10/02/14	10:55
1410015-CCV1	Calibration Check	10/02/14	11:02
1410015-CCB1	Calibration Blank	10/02/14	11:05
C140809-13	14BH-DT-PILOT-BCR3D-0819	10/02/14	11:08
C140809-17	14BH-DT-PILOT-BCR4-08191	10/02/14	11:11
C140809-21	14BH-DT-PILOT-CHIT-081914	10/02/14	11:14
C140809-24	14BH-DT-PILOT-INFL-081914	10/02/14	11:17
C140809-27	14BH-DT-PILOT-NAOH-0819	10/02/14	11:20
C140809-30	14BH-DT-PILOT-POSTE-0819	10/02/14	11:23
C140809-34	14BH-DT-PILOT-POSTI-08191	10/02/14	11:26
C140809-38	14BH-DT-PILOT-SAPS-08191	10/02/14	11:29
1410015-CCV2	Calibration Check	10/02/14	11:36
1410015-CCB2	Calibration Blank	10/02/14	11:39

CHAIN OF CUSTODY RECORD

CDM Smith | **Danny T Pilot Test** | **Analysis**

NOTES: Limited sample volumes due to treatability testing
Contact: Angela Franden, CDM Smith (406)441-1400

SAMPLE NUMBER	DATE	TIME	MATRIX	Preservative	Type & No. of Containers	Total Metals (TAL), 200.7 or 200.8	Dissolved Metals (TAL), 200.7 or 200.8	Alkalinity, Anions (sulfate, chloride, fluoride)	Nitrate+Nitrite, Ammonia	Other Instructions and Notes
14BH-DT-PILOT-INFL-081914	8/19/14	9:40	aqueous	HNO3 (metals), H2SO4 (nutrients), cool	3, 125 mL poly	X	X	X		TAL metals = Al, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, Tl, Zn.
14BH-DT-PILOT-SAPS-081914	8/19/14	9:50	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-CHIT-081914	8/19/14	10:05	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-NAOH-081914	8/19/14	10:15	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-BCR1-081914	8/19/14	10:30	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR2-081914	8/19/14	10:45	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR3-081914	8/19/14	11:00	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR3D-081914	8/19/14	11:10	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR4-081914	8/19/14	11:25	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-POSTI-081914	8/19/14	11:40	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-POSTE-081914	8/19/14	12:00	aqueous		4, 125 mL poly	X	X	X	X	

Relinquished by: (*Signature*) Lauren Holland	**Date/Time** 08/20/14 12:45	**Received for Laboratory by: (*Signature*)** Kelsey Bartley 8/21/14 10:00		
Received by: (*Signature*)	**Date/Time**	**Airbill No.(s)**	**Carrier Name:** FedEx	**Lab:** USEPA Lab Region 8

ESAT

C140809

ESAT Technical Direction Form

Contract No. EPW13028
EPA Region 8

Site ID: 085N
TDF ID: A-046

Date Issued: 5/29/2014
Date Updated:

Date Closed By:

Name: Barker-Hughesville Treatability Study Aug

Details: The Contractor shall analyze several water samples associated with the treatability study at the Barker-Hughesville Superfund site as indicated in the Analytical Information Section. The samples will be sent to the ESAT R8 Lab during the 2014 field season starting in mid-June though early October 2014. There will be 9 sampling events associated with this project averaging approximately 10 samples per an event. The samples will be collected by Nick Anton/Erin Louden of CDM Smith.

Samples designated as influent samples (-INF) are expected to have high metal concentrations and should be analyzed by 200.7. Additionally, metals with sufficiently high concentrations may be reported from the 200.7 analyses.

ESAT should return the coolers to the following address:
CDM Smith/Lauren Helland
50 West 14th Street, Suite 200
Helena, MT 59601
406-441-1435
FedEx # 1323-6393-5

TO02/Subtask 02b: Inorganic Chemistry

Site RPM: Roger Hoogerheide

Analytical Information:

MATRIX

☑ Water ☐ Soils ☐ Vegetation ☐ Biota

WET CHEM

☐ TSS ☐ TDS ☐ DOC ☑ Alk ☑ Chloride ☑ Sulfate ☑ Fluoride ☑ Nitrate ☑ Nitrite
Other: Analyze for Ammonia and report NO2 and NO3 as NO2-NO3 combined.

METALS

☑ Dissolved ☑ Total Recoverable ☐ Total ☐ Hardness (Calc)

200.7: ☐ Ag ☑ Al ☐ As ☐ Ba ☐ Be ☐ B ☐ Ca ☐ Cd ☐ Co ☐ Cr ☐ Cu ☑ Fe ☐ K ☐ Mg
☒ Mn ☐ Mo ☐ Na ☐ Ni ☐ Pb ☐ Sb ☐ Se ☐ Sr ☐ Ti ☐ Tl ☐ V ☑ Zn ☐ SiO2

200.8: ☐ Ag ☐ Al ☑ As ☐ Ba ☐ Be ☑ Cd ☐ Co ☐ Cr ☑ Cu ☑ Mn ☐ Mo ☑ Ni ☑ Pb ☐ Sb
☐ Se ☐ Th ☐ Tl ☐ U ☐ V ☐ Zn

7470/7471/747 ☐ Hg

Sv
10/01/14

FIBERS

☐ PLM ☐ TEM

Deliverables

ID	*Description*	*Due Date*	*Submission Date*
1	Provide final deliverable package to Task Monitor no later than 30 days after delivery of samples.		

5/29/14

ANALYTICAL SUMMARY REPORT

September 18, 2014

CDM Federal Programs
555 17th St Ste 1100
Denver, CO 80202

Work Order: H14090029 Quote ID: H823 - Baker-Hughsville Superfund Site

Project Name: Barker Hughsville - Danny T

Energy Laboratories Inc Helena MT received the following 11 samples for CDM Federal Programs on 9/3/2014 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H14090029-001	14BH-DT-PILOT-INFL-090214	09/02/14 10:10	09/03/14	Aqueous	Acidity, Total as CaCO3 Phosphorus, Orthophosphate as P
H14090029-002	14BH-DT-PILOT-INFLD-090214	09/02/14 10:15	09/03/14	Aqueous	Same As Above
H14090029-003	14BH-DT-PILOT-SAPS-090214	09/02/14 10:25	09/03/14	Aqueous	Same As Above
H14090029-004	14BH-DT-PILOT-CHTT-090214	09/02/14 10:35	09/03/14	Aqueous	Same As Above
H14090029-005	14BH-DT-PILOT-NAOH-090214	09/02/14 10:45	09/03/14	Aqueous	Same As Above
H14090029-006	14BH-DT-PILOT-BCR1-090214	09/02/14 10:55	09/03/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Phosphorus, Orthophosphate as P Sulfide, Methylene Blue Colorimetric
H14090029-007	14BH-DT-BCR2-090214	09/02/14 11:10	09/03/14	Aqueous	Same As Above
H14090029-008	14BH-DT-BCR3-090214	09/02/14 11:25	09/03/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Phosphorus, Orthophosphate as P Sulfide, Iodine Titrimetric
H14090029-009	14BH-DT-BCR4-090214	09/02/14 11:35	09/03/14	Aqueous	Same As Above
H14090029-010	14BH-DT-POST1-090214	09/02/14 11:50	09/03/14	Aqueous	Same As Above
H14090029-011	14BH-DT-PILOT-POSTE-090214	09/02/14 12:05	09/03/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Phosphorus, Orthophosphate as P Sulfide, Methylene Blue Colorimetric

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

CLIENT: CDM Federal Programs
Project: Barker Hughsville - Danny T
Work Order: H14090029

Report Date: 09/18/14

CASE NARRATIVE

Tests associated with analyst identified as ELI-B were subcontracted to Energy Laboratories, 1120 S. 27th St., Billings, MT, EPA Number MT00005.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/18/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/02/14 10:10
Lab ID:	H14090029-001	**DateReceived:**	09/03/14
Client Sample ID:	14BH-DT-PILOT-INFL-090214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	600	mg/L	D	4.0		A2310 B	09/12/14 10:00 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.399	mg/L		0.005		E365.1	09/03/14 15:55 / cmm

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/18/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/02/14 10:15
Lab ID:	H14090029-002	**DateReceived:**	09/03/14
Client Sample ID:	14BH-DT-PILOT-INFLD-090214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	570	mg/L	D	4.0		A2310 B	09/12/14 10:11 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.05	mg/L	D	0.01		E365.1	09/04/14 08:40 / cmm

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/18/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/02/14 10:25
Lab ID:	H14090029-003	**DateReceived:**	09/03/14
Client Sample ID:	14BH-DT-PILOT-SAPS-090214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	280	mg/L	D	4.0		A2310 B	09/12/14 10:14 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.049	mg/L		0.005		E365.1	09/04/14 08:41 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/18/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/02/14 10:35
Lab ID:	H14090029-004	**DateReceived:**	09/03/14
Client Sample ID:	14BH-DT-PILOT-CHTT-090214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	58	mg/L	D	4.0		A2310 B	09/12/14 10:19 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.066	mg/L		0.005		E365.1	09/04/14 08:45 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/18/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/02/14 10:45
Lab ID:	H14090029-005	**DateReceived:**	09/03/14
Client Sample ID:	14BH-DT-PILOT-NAOH-090214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	120	mg/L	D	4.0		A2310 B	09/12/14 10:22 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	ND	mg/L		0.005		E365.1	09/04/14 08:46 / cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/18/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/02/14 10:55
Lab ID:	H14090029-006	**DateReceived:**	09/03/14
Client Sample ID:	14BH-DT-PILOT-BCR1-090214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	09/12/14 10:27 / SRW
Sulfide	7.4	mg/L	D	0.2		A4500-S D	09/05/14 15:20 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	<40	mg/L		40		A5210 B	09/03/14 17:04 / SRW
No BOD dilution depleted greater than 2.0 mg/L DO.							
NUTRIENTS							
Phosphorus, Orthophosphate as P	6.36	mg/L	D	0.02		E365.1	09/04/14 08:47 / cmm

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/18/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/02/14 11:10
Lab ID:	H14090029-007	**DateReceived:**	09/03/14
Client Sample ID:	14BH-DT-BCR2-090214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	30	mg/L	D	4.0		A2310 B	09/12/14 10:31 / SRW
Sulfide	16.4	mg/L	D	0.4		A4500-S D	09/05/14 15:20 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	<40	mg/L		40		A5210 B	09/03/14 17:11 / SRW
No BOD dilution depleted greater than 2.0 mg/L DO.							
NUTRIENTS							
Phosphorus, Orthophosphate as P	2.28	mg/L	D	0.01		E365.1	09/04/14 08:48 / cmm

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14090029-008
Client Sample ID: 14BH-DT-BCR3-090214

Report Date: 09/18/14
Collection Date: 09/02/14 11:25
DateReceived: 09/03/14
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	09/12/14 10:36 / SRW
Sulfide	46	mg/L		1		A4500-S F	09/05/14 13:30 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	120	mg/L		40		A5210 B	09/03/14 17:17 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	16.2	mg/L	D	0.1		E365.1	09/04/14 08:49 / cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/18/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/02/14 11:35
Lab ID:	H14090029-009	**DateReceived:**	09/03/14
Client Sample ID:	14BH-DT-BCR4-090214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	09/12/14 10:40 / SRW
Sulfide	18	mg/L		1		A4500-S F	09/05/14 13:30 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	<40	mg/L		40		A5210 B	09/03/14 17:26 / SRW
No BOD dilution depleted greater than 2.0 mg/L DO.							
NUTRIENTS							
Phosphorus, Orthophosphate as P	1.23	mg/L		0.005		E365.1	09/04/14 08:50 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/18/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/02/14 11:50
Lab ID:	H14090029-010	**DateReceived:**	09/03/14
Client Sample ID:	14BH-DT-POST1-090214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	09/12/14 10:44 / SRW
Sulfide	12	mg/L		1		A4500-S F	09/05/14 13:30 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	44	mg/L		40		A5210 B	09/03/14 17:33 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	6.44	mg/L	D	0.02		E365.1	09/04/14 08:51 / cmm

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/18/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/02/14 12:05
Lab ID:	H14090029-011	**DateReceived:**	09/03/14
Client Sample ID:	14BH-DT-PILOT-POSTE-090214	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	09/12/14 10:49 / SRW
Sulfide	ND	mg/L	D	0.2		A4500-S D	09/05/14 15:20 / eli-b22
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	<40	mg/L		40		A5210 B	09/03/14 17:41 / SRW
No BOD dilution depleted greater than 2.0 mg/L DO.							
NUTRIENTS							
Phosphorus, Orthophosphate as P	1.83	mg/L		0.005		E365.1	09/04/14 08:52 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T

Report Date: 09/18/14
Work Order: H14090029

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **A2310 B**									Batch: H140912A
Lab ID: **H14090029-001BDUP**	Sample Duplicate				Run: PH_140912A				09/12/14 10:05
Acidity, Total as CaCO3	610	mg/L	4.0				0.8	20	
Lab ID: **H14090029-011ADUP**	Sample Duplicate				Run: PH_140912A				09/12/14 10:54
Acidity, Total as CaCO3	ND	mg/L	4.0					20	
Lab ID: **LCS1409120000**	Laboratory Control Sample				Run: PH_140912A				09/12/14 09:57
Acidity, Total as CaCO3	940	mg/L	4.0	96	90	110			
Lab ID: **MBLK1409120000**	Method Blank				Run: PH_140912A				09/12/14 09:53
Acidity, Total as CaCO3	2	mg/L							

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T

Report Date: 09/18/14
Work Order: H14090029

Analyte		Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method:	**A4500-S D**								Batch: B_R230108	
Lab ID:	**MB-R230108**	Method Blank				Run: SUB-B230108			09/05/14 15:20	
Sulfide		ND	mg/L	0.002						
Lab ID:	**LCS-R230108**	Laboratory Control Sample				Run: SUB-B230108			09/05/14 15:20	
Sulfide		0.256	mg/L	0.040	115	70	130			
Lab ID:	**B14090340-002AMS**	Sample Matrix Spike				Run: SUB-B230108			09/05/14 15:20	
Sulfide		0.259	mg/L	0.040	102	70	130			
Lab ID:	**B14090340-002AMSD**	Sample Matrix Spike Duplicate				Run: SUB-B230108			09/05/14 15:20	
Sulfide		0.254	mg/L	0.040	100	70	130	1.7	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs **Report Date:** 09/18/14
Project: Barker Hughsville - Danny T **Work Order:** H14090029

Analyte		Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method:	**A4500-S F**								Batch: B_R230109	
Lab ID:	**MB-R230109**	Method Blank				Run: SUB-B230109			09/05/14 13:30	
Sulfide		ND	mg/L	0.5						
Lab ID:	**LCS-R230109**	Laboratory Control Sample				Run: SUB-B230109			09/05/14 13:30	
Sulfide		24.0	mg/L	1.0	100	70	130			
Lab ID:	**B14090380-003EMS**	Sample Matrix Spike				Run: SUB-B230109			09/05/14 13:30	
Sulfide		24.0	mg/L	1.0	100	80	120			
Lab ID:	**B14090380-003EMSD**	Sample Matrix Spike Duplicate				Run: SUB-B230109			09/05/14 13:30	
Sulfide		24.2	mg/L	1.0	101	80	120	0.7	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T

Report Date: 09/18/14
Work Order: H14090029

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A5210 B									Batch: 140903_1_BOD5-W
Lab ID: Dil-H201_140903	Dilution Water Blank				Run: BOD-SKALAR_140903A				09/03/14 15:47
Oxygen Demand, Biochemical (BOD)	ND	mg/L	2.0		0	0.2			
Lab ID: GGA1_140903	Laboratory Control Sample				Run: BOD-SKALAR_140903A				09/03/14 15:58
Oxygen Demand, Biochemical (BOD)	130	mg/L	66	68	85	115			S

Glucose-glutamic acid check falls outside acceptable limits.

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Report Date: 09/18/14
Work Order: H14090029

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E365.1									Analytical Run: FIA202-HE_140903A
Lab ID: ICV	Initial Calibration Verification Standard								09/03/14 15:36
Phosphorus, Orthophosphate as P	0.238	mg/L	0.0050	95	90	110			
Lab ID: ICB	Initial Calibration Blank, Instrument Blank								09/03/14 15:37
Phosphorus, Orthophosphate as P	0.000570	mg/L	0.0050		0	0			
Lab ID: CCV	Continuing Calibration Verification Standard								09/03/14 15:39
Phosphorus, Orthophosphate as P	0.0951	mg/L	0.0050	95	90	110			
Lab ID: CCV	Continuing Calibration Verification Standard								09/03/14 16:01
Phosphorus, Orthophosphate as P	0.0929	mg/L	0.0050	93	90	110			
Lab ID: CCV	Continuing Calibration Verification Standard								09/03/14 16:18
Phosphorus, Orthophosphate as P	0.0979	mg/L	0.0050	98	90	110			
Method: E365.1									Batch: R100259
Lab ID: LFB	Laboratory Fortified Blank				Run: FIA202-HE_140903A				09/03/14 15:41
Phosphorus, Orthophosphate as P	0.185	mg/L	0.0050	93	90	110			
Lab ID: MB-26001	Method Blank				Run: FIA202-HE_140903A				09/03/14 15:51
Phosphorus, Orthophosphate as P	0.001	mg/L	0.0010						
Lab ID: H14090026-001HMS	Sample Matrix Spike				Run: FIA202-HE_140903A				09/03/14 15:53
Phosphorus, Orthophosphate as P	3.19	mg/L	0.010	109	90	110			
Lab ID: H14090026-001HMSD	Sample Matrix Spike Duplicate				Run: FIA202-HE_140903A				09/03/14 15:54
Phosphorus, Orthophosphate as P	3.33	mg/L	0.010	116	90	110	4.3	20	S

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Report Date: 09/18/14
Work Order: H14090029

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E365.1									Analytical Run: FIA202-HE_140904A
Lab ID: ICV	Initial Calibration Verification Standard								09/04/14 08:34
Phosphorus, Orthophosphate as P	0.238	mg/L	0.0050	95	90	110			
Lab ID: ICB	Initial Calibration Blank, Instrument Blank								09/04/14 08:35
Phosphorus, Orthophosphate as P	0.000230	mg/L	0.0050		0	0			
Lab ID: CCV	Continuing Calibration Verification Standard								09/04/14 08:37
Phosphorus, Orthophosphate as P	0.0971	mg/L	0.0050	97	90	110			
Method: E365.1									Batch: R100270
Lab ID: LFB	Laboratory Fortified Blank				Run: FIA202-HE_140904A				09/04/14 08:36
Phosphorus, Orthophosphate as P	0.186	mg/L	0.0050	93	90	110			
Lab ID: H14090029-003AMS	Sample Matrix Spike				Run: FIA202-HE_140904A				09/04/14 08:43
Phosphorus, Orthophosphate as P	0.345	mg/L	0.0050	73	90	110			S
Lab ID: H14090029-003AMSD	Sample Matrix Spike Duplicate				Run: FIA202-HE_140904A				09/04/14 08:44
Phosphorus, Orthophosphate as P	0.385	mg/L	0.0050	83	90	110	11	20	S

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

Workorder Receipt Checklist

CDM Federal Programs H14090029

Login completed by: Wanda Johnson
Reviewed by: BL2000\rwilliams
Reviewed Date: 9/9/2014

Date Received: 9/3/2014
Received by: tsp
Carrier name: Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☑	No ☐	Not Applicable ☐
Container/Temp Blank temperature:	2.3℃ On Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☑	No ☐	Not Applicable ☐

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

None

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 1 of 2

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM Smith

Report Mail Address (Required):

☒ No Hard Copy Email: FrandsenAK@cdmsmith.com

Invoice Address (Required):

☒ No Hard Copy Email: FrandsenAK@cdmsmith.com

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: ______
☐ Other: ______
☒ EDD/EDT (Electronic Data)
Format: Excel
☐ LEVEL IV
☐ NELAC

Project Name, PWS, Permit, Etc.: Barker Hughesville - Danny T

Sample Origin State: MT

EPA/State Compliance: Yes ☐ No ☐

Contact Name: Angela Frandsen

Phone/Fax: (406) 441-1400

Cell:

Sampler: (Please Print) L. Helland

Invoice Contact & Phone: Same.

Purchase Order:

Quote/Bottle Order:

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids Vegetation Bioassay Other
DW - Drinking Water

ANALYSIS REQUESTED

SEE ATTACHED

Standard Turnaround (TAT)

RUSH

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: Please use 1000mL bottles for BOD and acidity combined.

Shipped by: Hand

Cooler ID(s): Y

Receipt Temp 23 °C TD

On Ice: [✓ Y] N

Custody Seal
On Bottle Y [✓ N]
On Cooler Y [✓ N]
Intact Y N
Signature Match Y N

LABORATORY USE ONLY

H14090029

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	BOD	Sulfide	Acidity	Orthophosphate
1	14BH-DT-PILOT-INFL-090214	09/02/14	10:10	2,W			X	X
2	14BH-DT-PILOT-INFLD-090214	09/02/14	10:15	2,W			X	X
3	14BH-DT-PILOT-SAPS-090214	09/02/14	10:25	2,W			X	X
4	14BH-DT-PILOT-CHTT-090214	09/02/14	10:35	2,W			X	X
5	14BH-DT-PILOT-NAOH-090214	09/02/14	10:45	2,W			X	X
6	14BH-DT-PILOT-BCR1-090214	09/02/14	10:55	3,W	X	X	X	X
7	14BH-DT-PILOT-BCR2-090214	09/02/14	11:10	3,W	X	X	X	X
8	14BH-DT-PILOT-BCR3-090214	09/02/14	11:25	3,W	X	X	X	X
9	14BH-DT-PILOT-BCR4-090214	09/02/14	11:35	3,W	X	X	X	X
10	14BH-DT-PILOT-POSTT-090214	09/02/14	11:50	3,W	X	X	X	X

Custody Record MUST be Signed

Relinquished by (print): Lauren Helland Date/Time: 09/03/14 1248 Signature: Lauren Helland
Relinquished by (print): Date/Time: Signature:
Received by (print): Date/Time: Signature:
Received by (print): Date/Time: Signature:
Received by Laboratory: Tyler Rich Date/Time: 9/3/14 12:48 Signature:

Sample Disposal: Return to Client: ______ Lab Disposal: ______

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 2 of 2

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM Smith

Report Mail Address (Required):

☒ No Hard Copy Email: FrandsenAK@cdmsmith.com

Invoice Address (Required):

☒ No Hard Copy Email: Same

Project Name, PWS, Permit, Etc.: Barker Hughesville - Danny T

Sample Origin State: MT

EPA/State Compliance: Yes ☐ No ☐

Contact Name: Angela Frandsen

Phone/Fax: (406) 441-1400

Cell:

Sampler: (Please Print) Lauren Helland

Invoice Contact & Phone: Same

Purchase Order:

Quote/Bottle Order:

Special Report/Formats:
☐ DW
☐ POTW/WWTP
☐ State: ______
☐ Other: ______
☒ EDD/EDT (Electronic Data) Format: Excel
☐ LEVEL IV
☐ NELAC

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids Vegetation Bioassay Other
DW - Drinking Water

ANALYSIS REQUESTED

SEE ATTACHED

Standard Turnaround (TAT)

RUSH

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: Please use 1000mL bottles for BOD and acidity combined.

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	BOD	Sulfide	Acidity	Ortho-phosphate						
1 14BH-DT-PILOT-POSTE-090214	09/02/14	12:05	3,W	X	X	X	X						
2													
3													
4													
5													
6													
7													
8													
9													
10													

LABORATORY USE ONLY
Shipped by: Hand Del
Cooler ID(s): 4
Receipt Temp 2.3 °C TB
On Ice: [✓ Y] N
Custody Seal On Bottle Y [✓ N]
Custody Seal On Cooler Y [✓ N]
Intact Y N
Signature Match Y N
#14090029

Custody Record MUST be Signed

Relinquished by (print): Lauren Helland	Date/Time: 09/03/14 12:48	Signature: Lauren Helland	Received by (print):	Date/Time:	Signature:
Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Sample Disposal: Return to Client: ______	Lab Disposal: ______		Received by Laboratory: Tyler Peck	Date/Time: 9/3/14 12:48	Signature:

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.

Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

U.S. Environmental Protection Agency
Region 8
Technical and Management Services

Laboratory Services Program

Certificate of Analysis

Ref: 8TMS-L

MEMORANDUM

Date: 10/14/14

Subject: Analytical Results--- **Barker-Hughesville_Treatability_SEP 2014_A046 / A-046**

From: Don Goodrich; EPA Region 8 Analytical Chemistry WAM

To: Roger Hoogerheide
Superfund
8 MO

Received Sample Set(s), [Work Order : Date Received]:
[C140903 : 09/04/2014]

Attached are the analytical results for the samples received from the Barker-Hughesville_Treatability_SEP 2014_A046 sampling event, according to TDF A-046. All analyses were performed within their method specified holding times unless otherwise noted in the following narrative.

These samples were prepared, analyzed, and verified by the Environmental Services Assistance Team Laboratory (ESAT) according to the requirements of the Technical Direction Form (TDF).

Note: The laboratory herewith transmits this deliverable to the program/project partner for determination of "final data usability" which may include data validation and data quality asessment per and in accordance with EPA QA/G-8, *Guidance on Environmental Data Verification and Data Validation*, November 2002, EPA/240/R-02/004. Laboratory data qualifiers are applied based on the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004, referred to as "NFGI".

Laboratory policy is to dispose of any remaining sample 60 days after data analysis packages are delivered to EPA. If you would like the laboratory to retain the samples for a period longer than 60 days,

Case Narrative

C140903

Quality Assessment: Unless indicated by exception, the QA/QC associated with this sample set produced data within the TDF-specified criteria.

Holding Times: All samples were analyzed within their method-specified technical holding time(s).

1. Initial and Continuing calibration blanks (ICBs and CCBs).
   Exceptions: None.
2. Preparation (PB) / Method blanks (MB)
   Exceptions: None.
3. Interference Checks (ICSA / ICSAB) for ICP-MS and ICP-OE analyses only.
   Exceptions: None.
4. Initial and Continuing calibration verification analyses (ICVs, SCVs and CCVs).
   Exceptions: In ICP-MS sequence 1410057 and 1410058, arsenic recovered high in the SCV. Matrix spike recoveries for arsenic were within acceptable limits. In ICP-MS sequence 1410058, arsenic recovered high in CCV3. As a result, bracketed arsenic detections were qualified "J" as estimated.
5. Laboratory Control Sample (LCS) or second source analysis or SRM.
   Exceptions: None.
6. Laboratory Fortified blank (LFB) / Blank spike (BS), same source as used for the matrix spikes. PBS performed with analyses/methods requiring preparation or digestion prior to analysis.
   Exceptions: None.
7. Contract Reporting Detection Limit Standard, labeled as CRA, CRDL or CRL.
   Exceptions: None.
8. Laboratory Duplicate (DUP). "Source" identifies field sample duplicated in the laboratory. If either the "source" or the duplicate result is <5X the reporting limit, the %D limit of 20% does not apply.
   Exceptions: None.
9. Laboratory Matrix Spike (MS) and spike duplicate (MSD). "Source" defines original field sample fortified prior to analysis. Percent recovery (%R) limits do not apply when sample concentration(s) exceed the corresponding analyte spike level by a factor of 4 or greater.
   Exceptions: None.
10. Serial Dilution sample analysis (SRD). "Source" is parent field sample diluted 1:5 in the laboratory. Performed for ICP-OE and ICP-MS metals analyses. Percent difference (%D) limits do not apply when analyte concentration(s) are below 50x the source sample's MDL (or 10x it's PQL).
    Exceptions: None.
11. Internal standards, criteria specified for ICP-MS analyses only, monitored at the instrument.
    Exceptions: None.
12. Any calibration using more than two-points produced a correlation coefficient equal to or greater than 0.995.
    Exceptions: None.

Acronyms and Definitions:

ESAT	Environmental Services Assistance Team
J	Data Estimated qualifier (also applied to all data less than PQL, greater than or equal to MDL)
MDL	Method Detection Limit
PQL	Practical Quantitation Limit, also known as reporting limit.
RPD	Relative Percent Difference (difference divided by the mean)
%D	Percent difference, serial dilution criteria unit, difference divided by the original result.
%R	Percent recovery, analyzed (less sample contribution) divided by true value
<	Analyte NOT DETECTED at or above the Method Detection Limit (MDL)
mg/L	Parts per million (millligrams per liter). Solids equivalent = mg/Kg.
ug/L	Parts per billion (micrograms per liter). Solids equivalent = ug/Kg.
NR	No Recovery (matrix spike) - Often seen for calcium/magnesium when their concentration exceeds the spike level by > 4x.
NFGI	*USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004
RE	Sample Re-analysis. Usually seen on raw data and sequences for required sample dilutions due to over-range analytes.
U	Analyte not detected at or above MDL qualifier
D	Diluted value qualifier.

Method(s) Summary:

As defined in the Technical Direction Form (TDF), some or all of the methods listed below were used for the determination of the reported target analytes.

From EPA's *Methods for the Determination of Metals in Environmental Samples*, Supplement I, May 1994, dissolved, total, and/or total recoverable metals were determined by:

- Method 200.7 / 6010B using a PE Optima ICP-OE (ICP).
- Method 200.8 / 6020 using a Perkin-Elmer Elan 6000 ICP-MS.
- Method 200.2 for total recoverable metals (only) digestion.
- Method 245.1 using a Perkin-Elmer FIMS CVAA (aqueous mercury only).

From *Standard Methods for the Examination of Water and Wastewater*, 18th Edition, 1992, Method 2340B was used for the calculated hardness determination. Hardness is reported as mg (milligram) equivalent $CaCO_3$ per liter (L) determined as follows:

Calculated hardness = 2.497 * (Calcium, mg/L) + 4.118 * (Magnesium, mg/L).

From *EPA's Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846*,

- Method 3015A was used for microwave assisted total metals digestion.
- Method 7473 was used for mercury in solids.

From EPA's *Determination of Inorganic Anions by Ion Chromatography*, Revision 2.1, 1993, Method 300.0 was used to determine the anions.

From EPA's *Methods for Chemical Analysis of Water and Wastes*, March 1983:

- Method 310.1 was followed for the alkalinity determination.
- Method 160.1 was followed for gravimetric total dissolved solids (TDS) determination.
- Method 160.2 was used for gravimetric total suspended solids (TSS) determination.
- Method 415.3 was used for total organic carbon (TOC) determination using either an Apollo 9000 or Phoenix 8000 Non-Dispersive IR (NDIR) system. Also known as dissolved organic carbon (DOC) when performed on the dissolved sample fraction.

The quality control procedures listed in the TDF request were utilized by ESAT to verify accuracy of the results and to evaluate any matrix interferences.

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-090214 **Date / Time Sampled:** 09/02/14 10:55 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140903-02 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**129**	J	ug/L	100	5	10/14/2014	SV	1410050
200.7	Iron	< 1250	U	ug/L	500	5	10/14/2014	SV	1410050
200.7	**Manganese**	**85900**		ug/L	10.0	5	10/14/2014	SV	1410050
200.7	Zinc	< 100	U	ug/L	50.0	5	10/14/2014	SV	1410050
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	**Nickel**	**15.6**		ug/L	5.00	10	10/14/2014	SV	1410051
2340B	**Hardness**	**736**		mg/L	8	5	10/14/2014	SV	1410050

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-090214 **Date / Time Sampled:** 09/02/14 11:10 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140903-06 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**126**	J	ug/L	100	5	10/14/2014	SV	1410050
200.7	**Iron**	**1730**		ug/L	500	5	10/14/2014	SV	1410050
200.7	**Manganese**	**107000**		ug/L	10.0	5	10/14/2014	SV	1410050
200.7	Zinc	< 100	U	ug/L	50.0	5	10/14/2014	SV	1410050
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	**Nickel**	**5.59**	J	ug/L	5.00	10	10/14/2014	SV	1410051
2340B	**Hardness**	**734**		mg/L	8	5	10/14/2014	SV	1410050

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-090214 **Date / Time Sampled:** 09/02/14 11:25 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140903-10 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**148**	J	ug/L	100	5	10/14/2014	SV	1410050
200.7	Iron	< 1250	U	ug/L	500	5	10/14/2014	SV	1410050
200.7	**Manganese**	**46800**		ug/L	10.0	5	10/14/2014	SV	1410050
200.7	Zinc	< 100	U	ug/L	50.0	5	10/14/2014	SV	1410050
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	**Copper**	**5.48**	J	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
2340B	**Hardness**	**896**		mg/L	8	5	10/14/2014	SV	1410050

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-090214 **Date / Time Sampled:** 09/02/14 11:35 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140903-14 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**304**		ug/L	100	5	10/14/2014	SV	1410050
200.7	Iron	< 1250	U	ug/L	500	5	10/14/2014	SV	1410050
200.7	**Manganese**	**71100**		ug/L	10.0	5	10/14/2014	SV	1410050
200.7	**Zinc**	**88.9**	J	ug/L	50.0	5	10/14/2014	SV	1410050
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
2340B	**Hardness**	**355**		mg/L	8	5	10/14/2014	SV	1410050

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-090214 **Date / Time Sampled:** 09/02/14 10:35 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140903-18 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**428**		ug/L	100	5	10/14/2014	SV	1410050
200.7	**Iron**	**31500**		ug/L	500	5	10/14/2014	SV	1410050
200.7	**Manganese**	**66300**		ug/L	10.0	5	10/14/2014	SV	1410050
200.7	**Zinc**	**53.0**	J	ug/L	50.0	5	10/14/2014	SV	1410050
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	**Nickel**	**11.3**		ug/L	5.00	10	10/14/2014	SV	1410051
2340B	**Hardness**	**585**		mg/L	8	5	10/14/2014	SV	1410050

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFL-090214 **Date / Time Sampled:** 09/02/14 10:10 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140903-21 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**12300**		ug/L	100	5	10/14/2014	SV	1410050
200.7	**Iron**	**111000**		ug/L	500	5	10/14/2014	SV	1410050
200.7	**Manganese**	**75500**		ug/L	10.0	5	10/14/2014	SV	1410050
200.7	**Zinc**	**44000**		ug/L	50.0	5	10/14/2014	SV	1410050
200.8	**Arsenic**	**227**		ug/L	5.00	10	10/14/2014	SV	1410051
200.8	**Cadmium**	**220**		ug/L	1.00	10	10/14/2014	SV	1410051
200.8	**Copper**	**933**		ug/L	5.00	10	10/14/2014	SV	1410051
200.8	**Lead**	**246**		ug/L	1.00	10	10/14/2014	SV	1410051
200.8	**Nickel**	**31.4**		ug/L	5.00	10	10/14/2014	SV	1410051
2340B	**Hardness**	**256**		mg/L	8	5	10/14/2014	SV	1410050

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFLD-090214 **Date / Time Sampled:** 09/02/14 10:15 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140903-24 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**12300**		ug/L	100	5	10/14/2014	SV	1410050
200.7	**Iron**	**111000**		ug/L	500	5	10/14/2014	SV	1410050
200.7	**Manganese**	**76400**		ug/L	10.0	5	10/14/2014	SV	1410050
200.7	**Zinc**	**45400**		ug/L	50.0	5	10/14/2014	SV	1410050
200.8	**Arsenic**	**228**		ug/L	5.00	10	10/14/2014	SV	1410051
200.8	**Cadmium**	**216**		ug/L	1.00	10	10/14/2014	SV	1410051
200.8	**Copper**	**936**		ug/L	5.00	10	10/14/2014	SV	1410051
200.8	**Lead**	**246**		ug/L	1.00	10	10/14/2014	SV	1410051
200.8	**Nickel**	**26.9**		ug/L	5.00	10	10/14/2014	SV	1410051
2340B	**Hardness**	**255**		mg/L	8	5	10/14/2014	SV	1410050

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NAOH-090214 **Date / Time Sampled:** 09/02/14 10:45 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140903-27 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	10/14/2014	SV	1410050
200.7	Iron	< 1250	U	ug/L	500	5	10/14/2014	SV	1410050
200.7	**Manganese**	**58100**		ug/L	10.0	5	10/14/2014	SV	1410050
200.7	**Zinc**	**11000**		ug/L	50.0	5	10/14/2014	SV	1410050
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	**Cadmium**	**77.2**		ug/L	1.00	10	10/14/2014	SV	1410051
200.8	**Copper**	**6.85**	J	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	**Nickel**	**13.7**		ug/L	5.00	10	10/14/2014	SV	1410051
2340B	**Hardness**	**226**		mg/L	8	5	10/14/2014	SV	1410050

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-090214 **Date / Time Sampled:** 09/02/14 12:05 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140903-30 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	10/14/2014	SV	1410050
200.7	Iron	< 1250	U	ug/L	500	5	10/14/2014	SV	1410050
200.7	**Manganese**	**67400**		ug/L	10.0	5	10/14/2014	SV	1410050
200.7	Zinc	< 100	U	ug/L	50.0	5	10/14/2014	SV	1410050
200.8	**Arsenic**	**5.20**	J	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	**Copper**	**5.29**	J	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	**Nickel**	**7.13**	J	ug/L	5.00	10	10/14/2014	SV	1410051
2340B	**Hardness**	**693**		mg/L	8	5	10/14/2014	SV	1410050

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-090214 **Date / Time Sampled:** 09/02/14 11:50 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140903-34 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	10/14/2014	SV	1410050
200.7	**Iron**	**1720**		ug/L	500	5	10/14/2014	SV	1410050
200.7	**Manganese**	**80700**		ug/L	10.0	5	10/14/2014	SV	1410050
200.7	Zinc	< 100	U	ug/L	50.0	5	10/14/2014	SV	1410050
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
2340B	**Hardness**	**676**		mg/L	8	5	10/14/2014	SV	1410050

Project Name: **Barker-Hughesville_Treatability_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-090214 **Date / Time Sampled:** 09/02/14 10:25 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140903-38 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**464**		ug/L	100	5	10/14/2014	SV	1410050
200.7	**Iron**	**81900**		ug/L	500	5	10/14/2014	SV	1410050
200.7	**Manganese**	**84800**		ug/L	10.0	5	10/14/2014	SV	1410050
200.7	**Zinc**	**25600**		ug/L	50.0	5	10/14/2014	SV	1410050
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410051
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410051
200.8	**Nickel**	**26.7**		ug/L	5.00	10	10/14/2014	SV	1410051
2340B	**Hardness**	**531**		mg/L	8	5	10/14/2014	SV	1410050

"J" Qualifier indicates an estimated value

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-090214 **Date / Time Sampled:** 09/02/14 10:55 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140903-01 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**140**	J	ug/L	100	5	10/14/2014	SV	1410018
200.7	**Iron**	**6450**		ug/L	500	5	10/14/2014	SV	1410018
200.7	**Manganese**	**89400**		ug/L	10.0	5	10/14/2014	SV	1410018
200.7	**Zinc**	**76.2**	J	ug/L	50.0	5	10/14/2014	SV	1410018
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410018
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410018
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410018

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-090214 **Date / Time Sampled:** 09/02/14 11:10 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140903-05 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**113**	J	ug/L	100	5	10/14/2014	SV	1410018
200.7	**Iron**	**1770**		ug/L	500	5	10/14/2014	SV	1410018
200.7	**Manganese**	**112000**		ug/L	10.0	5	10/14/2014	SV	1410018
200.7	**Zinc**	**125**		ug/L	50.0	5	10/14/2014	SV	1410018
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410018
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410018
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410018

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-090214 **Date / Time Sampled:** 09/02/14 11:25 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140903-09 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**175**	J	ug/L	100	5	10/14/2014	SV	1410018
200.7	Iron	< 1250	U	ug/L	500	5	10/14/2014	SV	1410018
200.7	**Manganese**	**47400**		ug/L	10.0	5	10/14/2014	SV	1410018
200.7	Zinc	< 100	U	ug/L	50.0	5	10/14/2014	SV	1410018
200.8	**Arsenic**	**8.60**	J	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410018
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410018
200.8	**Nickel**	**5.85**	J	ug/L	5.00	10	10/14/2014	SV	1410018

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-090214 **Date / Time Sampled:** 09/02/14 11:35 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140903-13 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	10/14/2014	SV	1410018
200.7	Iron	< 1250	U	ug/L	500	5	10/14/2014	SV	1410018
200.7	**Manganese**	**74100**		ug/L	10.0	5	10/14/2014	SV	1410018
200.7	**Zinc**	**772**		ug/L	50.0	5	10/14/2014	SV	1410018
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	**Cadmium**	**1.39**	J	ug/L	1.00	10	10/14/2014	SV	1410018
200.8	**Copper**	**5.44**	J	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410018
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410018

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-090214 **Date / Time Sampled:** 09/02/14 10:35 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140903-17 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**5400**		ug/L	100	5	10/14/2014	SV	1410018
200.7	**Iron**	**49900**		ug/L	500	5	10/14/2014	SV	1410018
200.7	**Manganese**	**69500**		ug/L	10.0	5	10/14/2014	SV	1410018
200.7	**Zinc**	**15900**		ug/L	50.0	5	10/14/2014	SV	1410018
200.8	**Arsenic**	**15.8**	J	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	**Cadmium**	**53.5**		ug/L	1.00	10	10/14/2014	SV	1410018
200.8	**Copper**	**172**		ug/L	5.00	10	10/14/2014	SV	1410018
200.8	**Lead**	**48.0**		ug/L	1.00	10	10/14/2014	SV	1410018
200.8	**Nickel**	**13.6**		ug/L	5.00	10	10/14/2014	SV	1410018

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFL-090214 **Date / Time Sampled:** 09/02/14 10:10 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140903-20 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**12300**		ug/L	100	5	10/14/2014	SV	1410018
200.7	**Iron**	**111000**		ug/L	500	5	10/14/2014	SV	1410018
200.7	**Manganese**	**77200**		ug/L	10.0	5	10/14/2014	SV	1410018
200.7	**Zinc**	**45100**		ug/L	50.0	5	10/14/2014	SV	1410018
200.8	**Arsenic**	**233**	J	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	**Cadmium**	**211**		ug/L	1.00	10	10/14/2014	SV	1410018
200.8	**Copper**	**917**		ug/L	5.00	10	10/14/2014	SV	1410018
200.8	**Lead**	**250**		ug/L	1.00	10	10/14/2014	SV	1410018
200.8	**Nickel**	**24.7**		ug/L	5.00	10	10/14/2014	SV	1410018

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFLD-090214 **Date / Time Sampled:** 09/02/14 10:15 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140903-23 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**12100**		ug/L	100	5	10/14/2014	SV	1410018
200.7	**Iron**	**111000**		ug/L	500	5	10/14/2014	SV	1410018
200.7	**Manganese**	**77700**		ug/L	10.0	5	10/14/2014	SV	1410018
200.7	**Zinc**	**45600**		ug/L	50.0	5	10/14/2014	SV	1410018
200.8	**Arsenic**	**244**	J	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	**Cadmium**	**222**		ug/L	1.00	10	10/14/2014	SV	1410018
200.8	**Copper**	**946**		ug/L	5.00	10	10/14/2014	SV	1410018
200.8	**Lead**	**253**		ug/L	1.00	10	10/14/2014	SV	1410018
200.8	**Nickel**	**26.7**		ug/L	5.00	10	10/14/2014	SV	1410018

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NAOH-090214 **Date / Time Sampled:** 09/02/14 10:45 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140903-26 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**824**		ug/L	100	5	10/14/2014	SV	1410018
200.7	**Iron**	**7940**		ug/L	500	5	10/14/2014	SV	1410018
200.7	**Manganese**	**59300**		ug/L	10.0	5	10/14/2014	SV	1410018
200.7	**Zinc**	**12200**		ug/L	50.0	5	10/14/2014	SV	1410018
200.8	**Arsenic**	**18.1**	J	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	**Cadmium**	**83.1**		ug/L	1.00	10	10/14/2014	SV	1410018
200.8	**Copper**	**73.1**		ug/L	5.00	10	10/14/2014	SV	1410018
200.8	**Lead**	**15.9**		ug/L	1.00	10	10/14/2014	SV	1410018
200.8	**Nickel**	**14.2**		ug/L	5.00	10	10/14/2014	SV	1410018

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-090214 **Date / Time Sampled:** 09/02/14 12:05 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140903-29 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**145**	J	ug/L	100	5	10/14/2014	SV	1410018
200.7	Iron	< 1250	U	ug/L	500	5	10/14/2014	SV	1410018
200.7	**Manganese**	**69600**		ug/L	10.0	5	10/14/2014	SV	1410018
200.7	**Zinc**	**92.1**	J	ug/L	50.0	5	10/14/2014	SV	1410018
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410018
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410018
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410018

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-090214 **Date / Time Sampled:** 09/02/14 11:50 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140903-33 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**130**	J	ug/L	100	5	10/14/2014	SV	1410018
200.7	**Iron**	**2520**		ug/L	500	5	10/14/2014	SV	1410018
200.7	**Manganese**	**79900**		ug/L	10.0	5	10/14/2014	SV	1410018
200.7	**Zinc**	**268**		ug/L	50.0	5	10/14/2014	SV	1410018
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410018
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410018
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/14/2014	SV	1410018

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-090214 **Date / Time Sampled:** 09/02/14 10:25 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140903-37 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**575**		ug/L	100	5	10/14/2014	SV	1410018
200.7	**Iron**	**80200**		ug/L	500	5	10/14/2014	SV	1410018
200.7	**Manganese**	**85500**		ug/L	10.0	5	10/14/2014	SV	1410018
200.7	**Zinc**	**26400**		ug/L	50.0	5	10/14/2014	SV	1410018
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410018
200.8	**Copper**	**5.52**	J	ug/L	5.00	10	10/14/2014	SV	1410018
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/14/2014	SV	1410018
200.8	**Nickel**	**26.8**		ug/L	5.00	10	10/14/2014	SV	1410018

"J" Qualifier indicates an estimated value

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-090214 **Date / Time Sampled:** 09/02/14 10:55 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140903-03 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	09/16/2014	NP	1409035
EPA 300.0	**Fluoride**	**1.7**	J	mg/L	1.0	10	09/16/2014	NP	1409035
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	09/16/2014	NP	1409035
EPA 300.0	**Sulfate as SO4**	**626**		mg/L	0.5	10	09/16/2014	NP	1409035
EPA 310.1	**Total Alkalinity**	**284**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409021

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-090214 **Date / Time Sampled:** 09/02/14 10:55 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140903-04 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**6.41**	D	mg/L	0.300	10	09/26/2014	KJB	1409128

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-090214 **Date / Time Sampled:** 09/02/14 11:10 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140903-07 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	09/16/2014	NP	1409035
EPA 300.0	**Fluoride**	**1.5**	J	mg/L	1.0	10	09/16/2014	NP	1409035
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	09/16/2014	NP	1409035
EPA 300.0	**Sulfate as SO4**	**753**		mg/L	0.5	10	09/16/2014	NP	1409035
EPA 310.1	**Total Alkalinity**	**229**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409021

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-090214 **Date / Time Sampled:** 09/02/14 11:10 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140903-08 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**2.59**	D	mg/L	0.300	10	09/26/2014	KJB	1409128

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-090214 **Date / Time Sampled:** 09/02/14 11:25 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140903-11 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.3**	J	mg/L	5.0	10	09/16/2014	NP	1409035
EPA 300.0	**Fluoride**	**3.8**		mg/L	1.0	10	09/16/2014	NP	1409035
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	09/16/2014	NP	1409035
EPA 300.0	**Sulfate as SO4**	**464**		mg/L	0.5	10	09/16/2014	NP	1409035
EPA 310.1	**Total Alkalinity**	**588**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409021

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-090214 **Date / Time Sampled:** 09/02/14 11:25 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140903-12 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**21.9**	D	mg/L	0.300	10	09/26/2014	KJB	1409128

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-090214 **Date / Time Sampled:** 09/02/14 11:35 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140903-15 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	09/16/2014	NP	1409035
EPA 300.0	**Fluoride**	**1.6**	J	mg/L	1.0	10	09/16/2014	NP	1409035
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	09/16/2014	NP	1409035
EPA 300.0	**Sulfate as SO4**	**732**		mg/L	0.5	10	09/16/2014	NP	1409035
EPA 310.1	**Total Alkalinity**	**176**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409021

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-090214 **Date / Time Sampled:** 09/02/14 11:35 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140903-16 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**1.33**	D	mg/L	0.300	10	09/26/2014	KJB	1409128

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-CHIT-090214 **Date / Time Sampled:** 09/02/14 10:35 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140903-19 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	09/16/2014	NP	1409035
EPA 300.0	**Fluoride**	**2.5**		mg/L	1.0	10	09/16/2014	NP	1409035
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	09/16/2014	NP	1409035
EPA 300.0	**Sulfate as SO4**	**663**		mg/L	0.5	10	09/16/2014	NP	1409035
EPA 310.1	**Total Alkalinity**	**155**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409021

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-INFL-090214 **Date / Time Sampled:** 09/02/14 10:10 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140903-22 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	09/16/2014	NP	1409035
EPA 300.0	**Fluoride**	**2.2**		mg/L	1.0	10	09/16/2014	NP	1409035
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	09/16/2014	NP	1409035
EPA 300.0	**Sulfate as SO4**	**894**		mg/L	0.5	10	09/16/2014	NP	1409035
EPA 310.1	Total Alkalinity	< 100		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409021

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-INFLD-090214 **Date / Time Sampled:** 09/02/14 10:15 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140903-25 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	09/16/2014	NP	1409035
EPA 300.0	**Fluoride**	**2.5**		mg/L	1.0	10	09/16/2014	NP	1409035
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	09/16/2014	NP	1409035
EPA 300.0	**Sulfate as SO4**	**904**		mg/L	0.5	10	09/16/2014	NP	1409035
EPA 310.1	Total Alkalinity	< 100		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409021

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-NAOH-090214 **Date / Time Sampled:** 09/02/14 10:45 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140903-28 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	09/16/2014	NP	1409035
EPA 300.0	**Fluoride**	**1.3**	J	mg/L	1.0	10	09/16/2014	NP	1409035
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	09/16/2014	NP	1409035
EPA 300.0	**Sulfate as SO4**	**819**		mg/L	0.5	10	09/16/2014	NP	1409035
EPA 310.1	Total Alkalinity	< 100		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409021

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTE-090214 **Date / Time Sampled:** 09/02/14 12:05 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140903-31 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.8**	J	mg/L	5.0	10	09/16/2014	NP	1409035
EPA 300.0	**Fluoride**	**1.5**	J	mg/L	1.0	10	09/16/2014	NP	1409035
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	09/16/2014	NP	1409035
EPA 300.0	**Sulfate as SO4**	**697**		mg/L	0.5	10	09/16/2014	NP	1409035
EPA 310.1	**Total Alkalinity**	**295**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409021

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTE-090214 **Date / Time Sampled:** 09/02/14 12:05 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140903-32 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**7.10**	D	mg/L	0.300	10	09/26/2014	KJB	1409128

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTI-090214 **Date / Time Sampled:** 09/02/14 11:50 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140903-35 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.3**	J	mg/L	5.0	10	09/16/2014	NP	1409035
EPA 300.0	**Fluoride**	**2.2**		mg/L	1.0	10	09/16/2014	NP	1409035
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	09/16/2014	NP	1409035
EPA 300.0	**Sulfate as SO4**	**662**		mg/L	0.5	10	09/16/2014	NP	1409035
EPA 310.1	**Total Alkalinity**	**307**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409021

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTI-090214 **Date / Time Sampled:** 09/02/14 11:50 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140903-36 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**8.09**	D	mg/L	0.300	10	09/26/2014	KJB	1409128

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-SAPS-090214 **Date / Time Sampled:** 09/02/14 10:25 **Workorder:** C140903
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140903-39 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	09/16/2014	NP	1409035
EPA 300.0	**Fluoride**	**1.8**	J	mg/L	1.0	10	09/16/2014	NP	1409035
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	09/16/2014	NP	1409035
EPA 300.0	**Sulfate as SO4**	**806**		mg/L	0.5	10	09/16/2014	NP	1409035
EPA 310.1	**Total Alkalinity**	**85.8**	J	mg CaCO3 / L	50.0	10	09/09/2014	SW	1409021

"J" Qualifier indicates an estimated value

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ICPMS-PE DRC-II									
Batch 1410051 - No Lab Prep Reqd			***Water***						**ICPMS-PE DRC-II**
Method Blank (1410051-BLK1)		Dilution Factor: 1				Prepared: 10/13/14 Analyzed: 10/14/14			
Nickel	< 0.500	1.00	ug/L						
Copper	< 0.500	1.00	"						
Arsenic	< 0.500	2.00	"						
Cadmium	< 0.100	0.200	"						
Lead	< 0.100	0.200	"						
Method Blank Spike (1410051-BS1)		Dilution Factor: 1				Prepared: 10/13/14 Analyzed: 10/14/14			
Nickel	101	1.00	ug/L	100		101	85-115		
Copper	101	1.00	"	100		101	85-115		
Arsenic	100	2.00	"	100		100	85-115		
Cadmium	99.7	0.200	"	100		100	85-115		
Lead	105	0.200	"	100		105	85-115		
Duplicate (1410051-DUP1)		Dilution Factor: 1	**Source: C140903-02**			Prepared: 10/13/14 Analyzed: 10/14/14			
Nickel	20.3	10.0	ug/L		15.6			26	20
Copper	< 5.00	10.0	"		< 5.00				20
Arsenic	< 5.00	20.0	"		< 5.00				20
Cadmium	< 1.00	2.00	"		< 1.00				20
Lead	131	2.00	"		< 1.00				20
Matrix Spike (1410051-MS1)		Dilution Factor: 1	**Source: C140903-02**			Prepared: 10/13/14 Analyzed: 10/14/14			
Nickel	105	10.0	ug/L	100	15.6	89	70-130		
Copper	96.2	10.0	"	100	< 5.00	96	70-130		
Arsenic	106	20.0	"	100	< 5.00	106	70-130		
Cadmium	98.9	2.00	"	100	< 1.00	99	70-130		
Lead	105	2.00	"	100	< 1.00	105	70-130		
Matrix Spike (1410051-MS2)		Dilution Factor: 1	**Source: C140903-06**			Prepared: 10/13/14 Analyzed: 10/14/14			
Nickel	101	10.0	ug/L	100	5.59	95	70-130		
Copper	87.2	10.0	"	100	< 5.00	87	70-130		
Arsenic	104	20.0	"	100	< 5.00	104	70-130		
Cadmium	102	2.00	"	100	< 1.00	102	70-130		
Lead	107	2.00	"	100	< 1.00	107	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Batch 1410057 - 1410051 *Water* **ICPMS-PE DRC-II**

Serial Dilution (1410057-SRD1) Dilution Factor: 5 **Source: C140903-02** Prepared: 10/13/14 Analyzed: 10/14/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	51.0	50.0	ug/L		15.6			106	10
Copper	< 25.0	50.0	"		< 5.00				10
Arsenic	< 25.0	100	"		< 5.00				10
Cadmium	< 5.00	10.0	"		< 1.00				10
Lead	< 5.00	10.0	"		< 1.00				10

ICPOE - PE Optima

Batch 1410050 - No Lab Prep Reqd *Water* **ICPOE - PE Optima**

Method Blank (1410050-BLK1) Dilution Factor: 1 Prepared: 10/13/14 Analyzed: 10/14/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						

Method Blank Spike (1410050-BS1) Dilution Factor: 1 Prepared: 10/13/14 Analyzed: 10/14/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	10440	50.0	ug/L	10100		103	85-115		
Iron	10440	250	"	10100		103	85-115		
Manganese	101.0	5.00	"	100		101	85-115		
Zinc	101.5	20.0	"	100		102	85-115		

Duplicate (1410050-DUP1) Dilution Factor: 5 **Source: C140903-02** Prepared: 10/13/14 Analyzed: 10/14/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	110.1	250	ug/L		128.7			16	20
Iron	< 500	1250	"		< 500				20
Manganese	84470	25.0	"		85950			2	20
Zinc	< 50.0	100	"		< 50.0				20

Matrix Spike (1410050-MS1) Dilution Factor: 5 **Source: C140903-02** Prepared: 10/13/14 Analyzed: 10/14/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	10400	250	ug/L	10100	128.7	102	70-130		
Iron	10450	1250	"	10100	< 500	103	70-130		
Manganese	83730	25.0	"	100	85950	NR	70-130		
Zinc	100.3	100	"	100	< 50.0	100	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1410050 - No Lab Prep Reqd			*Water*						ICPOE - PE Optima
Matrix Spike (1410050-MS2)		Dilution Factor: 5	**Source: C140903-06**			Prepared: 10/13/14	Analyzed: 10/14/14		
Aluminum	10140	250	ug/L	10100	125.7	99	70-130		
Iron	11630	1250	"	10100	1728	98	70-130		
Manganese	107000	25.0	"	100	107100	NR	70-130		
Zinc	121.0	100	"	100	< 50.0	121	70-130		
Batch 1410053 - 1410050			*Water*						ICPOE - PE Optima
Serial Dilution (1410053-SRD1)		Dilution Factor: 2	**Source: C140903-02**			Prepared: 10/13/14	Analyzed: 10/14/14		
Aluminum	< 500	1250	ug/L		128.7				10
Iron	< 2500	6250	"		< 500.00				10
Manganese	88650	125	"		85950			3	10
Zinc	< 250	500	"		< 50.00				10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

ICPMS-PE DRC-II

Batch 1410018 - 200.2 - TR Metals *Water* **ICPMS-PE DRC-II**

Method Blank (1410018-BLK2) Dilution Factor: 5 Prepared: 10/02/14 Analyzed: 10/14/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	< 2.50	5.00	ug/L						
Copper	< 2.50	5.00	"						
Arsenic	< 2.50	10.0	"						
Cadmium	< 0.500	1.00	"						
Lead	< 0.500	1.00	"						

Duplicate (1410018-DUP2) Dilution Factor: 1 **Source: C140903-01** Prepared: 10/02/14 Analyzed: 10/14/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	< 5.00	10.0	ug/L		< 5.00				20
Copper	< 5.00	10.0	"		< 5.00				20
Arsenic	< 5.00	20.0	"		< 5.00				20
Cadmium	< 1.00	2.00	"		< 1.00				20
Lead	< 1.00	2.00	"		< 1.00				20

Matrix Spike (1410018-MS2) Dilution Factor: 1 **Source: C140903-05** Prepared: 10/02/14 Analyzed: 10/14/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	478.6	10.0	ug/L	500	< 5.00	96	70-130		
Copper	292.0	10.0	"	300	< 5.00	97	70-130		
Arsenic	854.9	20.0	"	800	< 5.00	107	70-130		
Cadmium	202.3	2.00	"	200	< 1.00	101	70-130		
Lead	1101	2.00	"	1000	< 1.00	110	70-130		

Matrix Spike (1410018-MS4) Dilution Factor: 1 **Source: C140903-09** Prepared: 10/02/14 Analyzed: 10/14/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	481.2	10.0	ug/L	500	5.850	95	70-130		
Copper	283.1	10.0	"	300	< 5.00	94	70-130		
Arsenic	859.5	20.0	"	800	8.595	106	70-130		
Cadmium	207.5	2.00	"	200	< 1.00	104	70-130		
Lead	1083	2.00	"	1000	< 1.00	108	70-130		

Reference (1410018-SRM2) Dilution Factor: 2 Prepared: 10/02/14 Analyzed: 10/14/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	987.1	20.0	ug/L	1000		99	85-115		
Copper	990.9	20.0	"	1000		99	85-115		
Arsenic	2147	40.0	"	2000		107	85-115		
Cadmium	992.3	4.00	"	1000		99	85-115		
Lead	2175	4.00	"	2000		109	85-115		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1410058 - 1410018			*Water*						ICPMS-PE DRC-II
Serial Dilution (1410058-SRD1)		Dilution Factor: 5	**Source: C140903-01**			Prepared: 10/02/14	Analyzed: 10/14/14		
Nickel	< 25.0	50.0	ug/L		< 5.00				10
Copper	< 25.0	50.0	"		< 5.00				10
Arsenic	< 25.0	100	"		< 5.00				10
Cadmium	< 5.00	10.0	"		< 1.00				10
Lead	< 5.00	10.0	"		< 1.00				10

ICPOE - PE Optima

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1410018 - 200.2 - TR Metals			*Water*						ICPOE - PE Optima
Method Blank (1410018-BLK1)		Dilution Factor: 1				Prepared: 10/02/14	Analyzed: 10/14/14		
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						
Duplicate (1410018-DUP1)		Dilution Factor: 5	**Source: C140903-01**			Prepared: 10/02/14	Analyzed: 10/14/14		
Aluminum	127.1	250	ug/L		140.2			10	20
Iron	6439	1250	"		6455			0.2	20
Manganese	88790	25.0	"		89420			0.7	20
Zinc	71.39	100	"		76.22			7	20
Matrix Spike (1410018-MS1)		Dilution Factor: 5	**Source: C140903-05**			Prepared: 10/02/14	Analyzed: 10/14/14		
Aluminum	2049	250	ug/L	2000	113.2	97	70-130		
Iron	4815	1250	"	3000	1766	102	70-130		
Manganese	111600	25.0	"	200	112200	NR	70-130		
Zinc	323.2	100	"	200	124.7	99	70-130		
Matrix Spike (1410018-MS3)		Dilution Factor: 5	**Source: C140903-09**			Prepared: 10/02/14	Analyzed: 10/14/14		
Aluminum	2055	250	ug/L	2000	174.6	94	70-130		
Iron	3091	1250	"	3000	< 500	103	70-130		
Manganese	47280	25.0	"	200	47430	NR	70-130		
Zinc	214.9	100	"	200	< 50.0	107	70-130		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1410018 - 200.2 - TR Metals			***Water***						**ICPOE - PE Optima**
Reference (1410018-SRM1)		Dilution Factor: 1				Prepared: 10/02/14 Analyzed: 10/14/14			
Aluminum	972.5	50.0	ug/L	1000		97	85-115		
Iron	971.2	250	"	1000		97	85-115		
Manganese	1031	5.00	"	1000		103	85-115		
Zinc	1020	20.0	"	1000		102	85-115		
Batch 1410054 - 1410018			***Water***						**ICPOE - PE Optima**
Serial Dilution (1410054-SRD1)		Dilution Factor: 2	**Source: C140903-01**			Prepared: 10/02/14 Analyzed: 10/14/14			
Aluminum	< 500	1250	ug/L		140.2				10
Iron	6313	6250	"		6455			2	10
Manganese	92420	125	"		89420			3	10
Zinc	< 250	500	"		76.22				10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ESAT Dionex IC									
Batch 1409035 - No Prep Req			***Water***						**ESAT Dionex IC**
Method Blank (1409035-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 09/16/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	0.6	2.0	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						
Method Blank Spike (1409035-BS1)		Dilution Factor: 1				Prepared & Analyzed: 09/16/14			
Fluoride	4.5	0.2	mg/L	5.00		91	90-110		
Chloride	23.9	2.0	"	25.0		95	90-110		
Sulfate as SO4	24.0	0.1	"	25.0		96	90-110		
Nitrate/Nitrite as N	18.8	5.0	"	20.0		94	90-110		
Duplicate (1409035-DUP1)		Dilution Factor: 1	**Source: C140903-03**			Prepared & Analyzed: 09/16/14			
Fluoride	1.7	2.0	mg/L		1.7			3	20
Chloride	5.3	20.0	"		5.4			2	20
Sulfate as SO4	629	1.0	"		626			0.6	20
Nitrate/Nitrite as N	< 10.0	50.0	"		< 10.0				20
Matrix Spike (1409035-MS1)		Dilution Factor: 1	**Source: C140903-03**			Prepared & Analyzed: 09/16/14			
Fluoride	53.2	2.0	mg/L	50.0	1.7	103	80-120		
Chloride	256	20.0	"	250	5.4	100	80-120		
Sulfate as SO4	890	1.0	"	250	626	106	80-120		
Nitrate/Nitrite as N	198	50.0	"	200	< 10.0	99	80-120		
Matrix Spike (1409035-MS2)		Dilution Factor: 1	**Source: C140903-39**			Prepared & Analyzed: 09/16/14			
Fluoride	52.2	2.0	mg/L	50.0	1.8	101	80-120		
Chloride	265	20.0	"	250	5.4	104	80-120		
Sulfate as SO4	1070	1.0	"	250	806	106	80-120		
Nitrate/Nitrite as N	202	50.0	"	200	< 10.0	101	80-120		

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409108 - 1409035			***Water***						**ESAT Dionex IC**
Instrument Blank (1409108-IBL1)		Dilution Factor: 1				Prepared & Analyzed: 09/16/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						
Lachat 8500									
Batch 1409128 - No Prep Req			***Water***						**Lachat 8500**
Method Blank (1409128-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 09/26/14			
Ammonia as N	< 0.0300	0.0500	mg/L						
Method Blank Spike (1409128-BS1)		Dilution Factor: 1				Prepared & Analyzed: 09/26/14			
Ammonia as N	0.997	0.0500	mg/L	1.00		100	90-110		
Duplicate (1409128-DUP1)		Dilution Factor: 1	**Source: C140903-04**			Prepared & Analyzed: 09/26/14			
Ammonia as N	6.38	0.500	mg/L		6.41			0.6	20
Matrix Spike (1409128-MS1)		Dilution Factor: 1	**Source: C140903-04**			Prepared & Analyzed: 09/26/14			
Ammonia as N	16.2	0.500	mg/L	10.0	6.41	97	90-110		
Reference (1409128-SRM1)		Dilution Factor: 5				Prepared & Analyzed: 09/26/14			
Ammonia as N	5.14	0.250	mg/L	4.80		107	90-110		
Mettler AT									
Batch 1409021 - No Prep Req			***Water***						**Mettler AT**
Method Blank (1409021-BLK1)		Dilution Factor: 1				Prepared: 09/04/14 Analyzed: 09/09/14			
Total Alkalinity	< 5.00	10.0	mg CaCO3 / L						

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409021 - No Prep Req			*Water*						**Mettler AT**
Duplicate (1409021-DUP1)		Dilution Factor: 1	**Source: C140903-03**			Prepared: 09/04/14		Analyzed: 09/09/14	
Total Alkalinity	282	100	mg CaCO3 / L		284			0.7	20
Duplicate (1409021-DUP2)		Dilution Factor: 1	**Source: C140903-39**			Prepared: 09/04/14		Analyzed: 09/09/14	
Total Alkalinity	87.3	100	mg CaCO3 / L		85.8			2	20
Reference (1409021-SRM1)		Dilution Factor: 1				Prepared: 09/04/14		Analyzed: 09/09/14	
Total Alkalinity	12.1	10.0	mg CaCO3 / L	10.4		116	61.3-143.9		

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Project Name: **Barker-Hughesville_Treatability_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 310.1

Analysis Name: WC - Alkalinity

Instrument: **Mettler AT**

Work Order: Nu C140903

Analytical Sequence: **Total**

Concentration Units: mg CaCO3 / L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	1409021-BLK1	NA	
Total Alkalinity		1.02	1.08	1.04	1.04	1.25	NA	10.00
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 300.0

Analysis Name: WC - Anions by Ion Chromatography

Instrument: **ESAT Dionex IC**

Work Order: Nu C140903

Analytical Sequence: 1409108 **Dissolved**

Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Fluoride	0.00	**1**	**2**	**3**	**4**	1409035-BLK1	NA	0.20
		0.00	0.00			0.06	NA	
		5	**6**	**7**	**8**			
Chloride	0.00	**1**	**2**	**3**	**4**	1409035-BLK1	NA	2.00
		0.00	0.00			0.59	NA	
		5	**6**	**7**	**8**			
Sulfate as SO4	0.00	**1**	**2**	**3**	**4**	1409035-BLK1	NA	0.10
		0.00	0.00			0.00	NA	
		5	**6**	**7**	**8**			
Nitrate/Nitrite as N	0.00	**1**	**2**	**3**	**4**	1409035-BLK1	NA	5.00
		0.00	0.00			0.16	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 350.1

Analysis Name: WC - Ammonia

Instrument: **Lachat 8500**

Work Order: Nu C140903

Analytical Sequence: **Total**

Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	1409128-BLK1	NA	
Ammonia as N		0.00	0.00			0.00	NA	0.05
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7 Analysis Name: ICPOE Diss. Metals

Instrument: **ICPOE - PE Optima** Work Order: Nu C140903

Analytical Sequence: 1410053 **Dissolved** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	1410050-BLK1	NA	
Aluminum	1.05	-0.17	0.82			2.90	NA	50.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1410050-BLK1	NA	
Iron	21.96	20.42	9.49			42.65	NA	250.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1410050-BLK1	NA	
Manganese	0.07	0.24	0.20			0.01	NA	5.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1410050-BLK1	NA	
Zinc	-0.19	-0.59	-0.16			0.79	NA	20.00
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Instrument: **ICPOE - PE Optima** Work Order: Nu C140903

Analytical Sequence: 1410054 **Total Recoverable** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Aluminum	1.05	**1**	**2**	**3**	**4**	1410018-BLK1	NA	50.00
		-0.17	0.82	3.79	3.77	-0.08	NA	
		5	**6**	**7**	**8**			
Iron	21.96	**1**	**2**	**3**	**4**	1410018-BLK1	NA	250.00
		20.42	9.49	21.18	15.35	20.12	NA	
		5	**6**	**7**	**8**			
Manganese	0.07	**1**	**2**	**3**	**4**	1410018-BLK1	NA	5.00
		0.24	0.20	0.25	0.42	0.01	NA	
		5	**6**	**7**	**8**			
Zinc	-0.19	**1**	**2**	**3**	**4**	1410018-BLK1	NA	20.00
		-0.59	-0.16	0.72	0.22	1.91	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8

Analysis Name: ICPMS Diss. Metals

Instrument: **ICPMS-PE DRC-II**

Work Order: Nu C140903

Analytical Sequence: 1410057 **Dissolved**

Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**								**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	1410051-BLK1	NA	
Nickel	0.01	0.01	0.01							-0.07	NA	1.00
Copper	-0.01	0.00	0.01							-0.06	NA	1.00
Arsenic	0.12	0.22	-0.11							0.11	NA	2.00
Cadmium	0.01	0.01	0.00							-0.01	NA	0.20
Lead	0.01	0.01	0.01							-0.01	NA	0.20

Project Name: **Barker-Hughesville_Treatability_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Instrument: **ICPMS-PE DRC-II** Work Order: Nu C140903

Analytical Sequence: 1410058 **Total Recoverable** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Nickel	0.01	**1**	**2**	**3**	**4**	NA	1410018-BLK2	1.00
		0.01	0.01	0.00	0.02	NA	-0.05	
		5	**6**	**7**	**8**			
Copper	-0.01	**1**	**2**	**3**	**4**	NA	1410018-BLK2	1.00
		0.00	0.01	0.00	0.02	NA	-0.02	
		5	**6**	**7**	**8**			
Arsenic	0.12	**1**	**2**	**3**	**4**	NA	1410018-BLK2	2.00
		0.22	-0.11	0.04	0.29	NA	-0.19	
		5	**6**	**7**	**8**			
Cadmium	0.01	**1**	**2**	**3**	**4**	NA	1410018-BLK2	0.20
		0.01	0.00	0.02	0.01	NA	-0.01	
		5	**6**	**7**	**8**			
Lead	0.01	**1**	**2**	**3**	**4**	NA	1410018-BLK2	0.20
		0.01	0.01	0.01	0.01	NA	0.00	
		5	**6**	**7**	**8**			

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Mettler AT Method: EPA 310.1 Analysis Name: WC - Alkalinity

Sequence: 1409045 Work Order: C140903 Units: mg CaCO3 / L

Total Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
Total Alkalinity					**1**			**2**			**3**	
				100	99.6	99.6	100	99.7	99.7	100	99.5	99.5
					4			**5**			**6**	
				100	99.6	99.6						
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ESAT Dionex IC Method: EPA 300.0 Analysis Name: WC - Anions by Ion Chromatography 2013

Sequence: 1409108 Work Order: C140903 Units: mg/L

Dissolved Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
Chloride	40.0	38.9	97.3		**1**			**2**			**3**	
				40.0	40.2	100.5	40.0	40.7	101.8			
					4			**5**			**6**	
					7			**8**			**9**	
Fluoride	4.00	3.7	92.5		**1**			**2**			**3**	
				4.00	3.9	97.5	4.00	4.0	100.0			
					4			**5**			**6**	
					7			**8**			**9**	
Nitrate/Nitrite as N	20.0	19.9	99.5		**1**			**2**			**3**	
				20.0	20.6	103.0	20.0	20.7	103.5			
					4			**5**			**6**	
					7			**8**			**9**	
Sulfate as SO4	100	98.0	98.0		**1**			**2**			**3**	
				100	102	102.0	100	102	102.0			
					4			**5**			**6**	
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Lachat 8500 Method: EPA 350.1 Analysis Name: WC - Ammonia

Sequence: 1409130 Work Order: C140903 Units: mg/L

Total Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
Ammonia as N				**1**			**2**			**3**		
				1.00	0.998	99.8	1.00	0.998	99.8			
				4			**5**			**6**		
				7			**8**			**9**		

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Diss. Metals

Sequence: 1410053 Work Order: C140903 Units: ug/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Aluminum	12500	12680	101.4		1			2			3	
				12500	12720	101.8	12500	12740	101.9			
					4			5			6	
					7			8			9	
Iron	12500	12710	101.7		1			2			3	
				12500	12710	101.7	12500	12870	103.0			
					4			5			6	
					7			8			9	
Manganese	1000	1035	103.5		1			2			3	
				1000	1036	103.6	1000	1056	105.6			
					4			5			6	
					7			8			9	
Zinc	2500	2581	103.2		1			2			3	
				2500	2581	103.2	2500	2672	106.9			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Sequence: 1410054 Work Order: C140903 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Aluminum	12500	12680	101.4		1			2			3	
				12500	12720	101.8	12500	12740	101.9	12500	12930	103.4
					4			5			6	
				12500	12870	103.0						
					7			8			9	
Iron	12500	12710	101.7		1			2			3	
				12500	12710	101.7	12500	12870	103.0	12500	12900	103.2
					4			5			6	
				12500	13060	104.5						
					7			8			9	
Manganese	1000	1035	103.5		1			2			3	
				1000	1036	103.6	1000	1056	105.6	1000	1067	106.7
					4			5			6	
				1000	1071	107.1						
					7			8			9	
Zinc	2500	2581	103.2		1			2			3	
				2500	2581	103.2	2500	2672	106.9	2500	2698	107.9
					4			5			6	
				2500	2698	107.9						
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Diss. Metals

Sequence: 1410057 Work Order: C140903 Units: ug/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Arsenic	50.0	52.2	104.4	50.0	53.1	106.2	50.0	53.1	106.2			
					4			5			6	
					7			8			9	
					1			2			3	
Cadmium	50.0	49.4	98.8	50.0	52.7	105.4	50.0	51.6	103.2			
					4			5			6	
					7			8			9	
					1			2			3	
Copper	50.0	48.6	97.2	50.0	52.0	104.0	50.0	52.7	105.4			
					4			5			6	
					7			8			9	
					1			2			3	
Lead	50.0	48.0	96.0	50.0	53.3	106.6	50.0	52.9	105.8			
					4			5			6	
					7			8			9	
					1			2			3	
Nickel	50.0	48.9	97.8	50.0	50.9	101.8	50.0	51.6	103.2			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1410058 Work Order: C140903 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)											
	True	Found	%R		True	Found	%R		True	Found	%R		True	Found	%R
Arsenic	50.0	52.25	104.5	1	50.0	53.13	106.3	2	50.0	53.14	106.3	3	50.0	55.84	111.7
				4	50.0	53.72	107.4	5				6			
				7				8				9			
Cadmium	50.0	49.40	98.8	1	50.0	52.67	105.3	2	50.0	51.59	103.2	3	50.0	52.72	105.4
				4	50.0	52.93	105.9	5				6			
				7				8				9			
Copper	50.0	48.63	97.3	1	50.0	51.98	104.0	2	50.0	52.71	105.4	3	50.0	51.25	102.5
				4	50.0	51.77	103.5	5				6			
				7				8				9			
Lead	50.0	48.01	96.0	1	50.0	53.26	106.5	2	50.0	52.85	105.7	3	50.0	53.38	106.8
				4	50.0	53.98	108.0	5				6			
				7				8				9			
Nickel	50.0	48.92	97.8	1	50.0	50.92	101.8	2	50.0	51.64	103.3	3	50.0	51.88	103.8
				4	50.0	51.21	102.4	5				6			
				7				8				9			

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

ICP Interference Check Sample

ICPMS-PE DRC-II

Sequence: 1410057 Analysis: ICPMS Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.1	ug/L			2.00
	IFB1	20.6	ug/L	20	103	2.00
Cadmium	IFA1	0.0	ug/L			0.200
	IFB1	20.3	ug/L	20	102	0.200
Copper	IFA1	0.8	ug/L			1.00
	IFB1	21.0	ug/L	20	105	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	0.3	ug/L			1.00
	IFB1	20.9	ug/L	20	105	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1410058 Analysis: ICPMS Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.1	ug/L			2.00
	IFB1	20.6	ug/L	20	103	2.00
Cadmium	IFA1	0.0	ug/L			0.200
	IFB1	20.3	ug/L	20	102	0.200
Copper	IFA1	0.8	ug/L			1.00
	IFB1	21.0	ug/L	20	105	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	0.3	ug/L			1.00
	IFB1	20.9	ug/L	20	105	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8
ICP Interference Check Sample
ICPOE - PE Optima

Sequence: 1410053 Analysis: ICPOE Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	61,002.7	ug/L	60,000	102	50.0
	IFB1	61,372.0	ug/L	60,000	102	50.0
Iron	IFA1	240,138.1	ug/L	250,000	96	250
	IFB1	241,455.5	ug/L	250,000	97	250
Manganese	IFA1	-0.2	ug/L			5.00
	IFB1	201.6	ug/L	200	101	5.00
Zinc	IFA1	4.8	ug/L			20.0
	IFB1	310.5	ug/L	300	104	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1410054 Analysis: ICPOE Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	61,002.7	ug/L	60,000	102	50.0
	IFB1	61,372.0	ug/L	60,000	102	50.0
Iron	IFA1	240,138.1	ug/L	250,000	96	250
	IFB1	241,455.5	ug/L	250,000	97	250
Manganese	IFA1	-0.2	ug/L			5.00
	IFB1	201.6	ug/L	200	101	5.00
Zinc	IFA1	4.8	ug/L			20.0
	IFB1	310.5	ug/L	300	104	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPMS-PE DRC-II

Metals (Dissolved) by EPA 200/7000 Series Methods

Sequence: 1410057

Analyte	True	Found	%R	Units
Arsenic	2.00	2.21	111	ug/L
Cadmium	0.200	0.176	88	ug/L
Copper	1.00	0.973	97	ug/L
Lead	0.200	0.194	97	ug/L
Nickel	1.00	0.911	91	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPOE - PE Optima

Metals (Dissolved) by EPA 200/7000 Series Methods

Sequence: 1410053

Analyte	True	Found	%R	Units
Aluminum	100	98.49	98	ug/L
Iron	100	111.2	111	ug/L
Manganese	10.0	10.19	102	ug/L
Zinc	50.0	50.44	101	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

Lachat 8500

Classical Chemistry by EPA/ASTM/APHA Methods

Sequence: 1409130

Analyte	True	Found	%R	Units
Ammonia as N	0.0250	0.0245	98	mg/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPMS-PE DRC-II

Metals (Total Recov) by EPA 200/7000 Series Methods
Sequence: 1410058

Analyte	True	Found	%R	Units
Arsenic	2.00	2.213	111	ug/L
Cadmium	0.200	0.1759	88	ug/L
Copper	1.00	0.9730	97	ug/L
Lead	0.200	0.1941	97	ug/L
Nickel	1.00	0.9112	91	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPOE - PE Optima

Metals (Total Recov) by EPA 200/7000 Series Methods
Sequence: 1410054

Analyte	True	Found	%R	Units
Aluminum	100	98.49	98	ug/L
Iron	100	111.2	111	ug/L
Manganese	10.0	10.19	102	ug/L
Zinc	50.0	50.44	101	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 310.1 **Total** **Sequence ID#:** 1409045

Instrument ID #: Mettler AT Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409045-CCV1	Calibration Check	09/09/14	10:35
1409045-CCB1	Calibration Blank	09/09/14	10:38
1409045-CCV2	Calibration Check	09/09/14	10:55
1409045-CCB2	Calibration Blank	09/09/14	10:58
1409021-SRM1	Reference	09/09/14	12:14
1409021-BLK1	Blank	09/09/14	12:16
C140903-03	14BH-DT-PILOT-BCR1-09021	09/09/14	12:17
1409021-DUP1	Duplicate	09/09/14	12:19
C140903-07	14BH-DT-PILOT-BCR2-09021	09/09/14	12:20
C140903-11	14BH-DT-PILOT-BCR3-09021	09/09/14	12:22
C140903-15	14BH-DT-PILOT-BCR4-09021	09/09/14	12:24
C140903-19	14BH-DT-PILOT-CHIT-090214	09/09/14	12:26
1409045-CCV3	Calibration Check	09/09/14	12:28
1409045-CCB3	Calibration Blank	09/09/14	12:31
C140903-22	14BH-DT-PILOT-INFL-090214	09/09/14	12:32
C140903-25	14BH-DT-PILOT-INFLD-0902	09/09/14	12:33
C140903-28	14BH-DT-PILOT-NAOH-0902	09/09/14	12:34
C140903-31	14BH-DT-PILOT-POSTE-0902	09/09/14	12:35
C140903-35	14BH-DT-PILOT-POSTI-09021	09/09/14	12:37
C140903-39	14BH-DT-PILOT-SAPS-09021	09/09/14	12:39
1409021-DUP2	Duplicate	09/09/14	12:40
1409045-CCV4	Calibration Check	09/09/14	12:47
1409045-CCB4	Calibration Blank	09/09/14	12:50

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 300.0 **Dissolved** **Sequence ID#:** 1409108

Instrument ID #: ESAT Dionex IC Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409108-ICV1	Initial Cal Check	09/16/14	10:57
1409108-ICB1	Initial Cal Blank	09/16/14	11:16
1409108-SCV1	Secondary Cal Check	09/16/14	11:35
1409108-IBL1	Instrument Blank	09/16/14	11:54
1409035-BS1	Blank Spike	09/16/14	12:13
1409035-BLK1	Blank	09/16/14	12:32
C140903-03	14BH-DT-PILOT-BCR1-09021	09/16/14	12:50
1409035-DUP1	Duplicate	09/16/14	13:09
1409035-MS1	Matrix Spike	09/16/14	13:28
C140903-07	14BH-DT-PILOT-BCR2-09021	09/16/14	13:47
C140903-11	14BH-DT-PILOT-BCR3-09021	09/16/14	14:06
C140903-15	14BH-DT-PILOT-BCR4-09021	09/16/14	14:25
1409108-CCV1	Calibration Check	09/16/14	14:43
1409108-CCB1	Calibration Blank	09/16/14	15:02
C140903-19	14BH-DT-PILOT-CHIT-09021	09/16/14	15:21
C140903-22	14BH-DT-PILOT-INFL-090214	09/16/14	15:40
C140903-25	14BH-DT-PILOT-INFLD-0902	09/16/14	15:59
C140903-28	14BH-DT-PILOT-NAOH-0902	09/16/14	16:17
C140903-31	14BH-DT-PILOT-POSTE-0902	09/16/14	16:36
C140903-35	14BH-DT-PILOT-POSTI-09021	09/16/14	16:55
C140903-39	14BH-DT-PILOT-SAPS-09021	09/16/14	17:14
1409035-MS2	Matrix Spike	09/16/14	17:33
1409108-CCV2	Calibration Check	09/16/14	17:52
1409108-CCB2	Calibration Blank	09/16/14	18:10

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 350.1 **Total** **Sequence ID#:** 1409130

Instrument ID #: Lachat 8500 Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409128-SRM1	Reference	09/26/14	13:14
1409128-BLK1	Blank	09/26/14	13:14
1409128-BS1	Blank Spike	09/26/14	13:14
1409130-CRL1	Instrument RL Check	09/26/14	13:14
C140903-04	14BH-DT-PILOT-BCR1-09021	09/26/14	13:14
1409128-DUP1	Duplicate	09/26/14	13:14
1409128-MS1	Matrix Spike	09/26/14	13:14
C140903-08	14BH-DT-PILOT-BCR2-09021	09/26/14	13:14
C140903-12	14BH-DT-PILOT-BCR3-09021	09/26/14	13:14
1409130-CCV1	Calibration Check	09/26/14	13:14
1409130-CCB1	Calibration Blank	09/26/14	13:14
C140903-16	14BH-DT-PILOT-BCR4-09021	09/26/14	13:14
C140903-32	14BH-DT-PILOT-POSTE-0902	09/26/14	13:14
C140903-36	14BH-DT-PILOT-POSTI-09021	09/26/14	13:14
1409130-CCV2	Calibration Check	09/26/14	13:14
1409130-CCB2	Calibration Blank	09/26/14	13:14

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Dissolved** **Sequence ID#:** 1410053

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1410053-ICV1	Initial Cal Check	10/14/14	08:15
1410053-SCV1	Secondary Cal Check	10/14/14	08:18
1410053-ICB1	Initial Cal Blank	10/14/14	08:21
1410053-CRL1	Instrument RL Check	10/14/14	08:24
1410053-IFA1	Interference Check A	10/14/14	08:27
1410053-IFB1	Interference Check B	10/14/14	08:31
1410050-BLK1	Blank	10/14/14	08:35
1410050-BS1	Blank Spike	10/14/14	08:38
C140903-02	14BH-DT-PILOT-BCR1-09021	10/14/14	08:41
1410050-DUP1	Duplicate	10/14/14	08:44
1410053-SRD1	Serial Dilution	10/14/14	08:47
1410050-MS1	Matrix Spike	10/14/14	08:50
C140903-06	14BH-DT-PILOT-BCR2-09021	10/14/14	08:53
1410050-MS2	Matrix Spike	10/14/14	08:56
C140903-10	14BH-DT-PILOT-BCR3-09021	10/14/14	09:00
1410053-CCV1	Calibration Check	10/14/14	09:06
1410053-CCB1	Calibration Blank	10/14/14	09:09
C140903-14	14BH-DT-PILOT-BCR4-09021	10/14/14	09:12
C140903-18	14BH-DT-PILOT-CHIT-090214	10/14/14	09:15
C140903-21	14BH-DT-PILOT-INFL-090214	10/14/14	09:18
C140903-24	14BH-DT-PILOT-INFLD-0902	10/14/14	09:21
C140903-27	14BH-DT-PILOT-NAOH-0902	10/14/14	09:24
C140903-30	14BH-DT-PILOT-POSTE-0902	10/14/14	09:27
C140903-34	14BH-DT-PILOT-POSTI-09021	10/14/14	09:31
C140903-38	14BH-DT-PILOT-SAPS-09021	10/14/14	09:33
1410053-CCV2	Calibration Check	10/14/14	09:40
1410053-CCB2	Calibration Blank	10/14/14	09:43

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Total Recoverable** **Sequence ID#:** 1410054

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1410054-ICV1	Initial Cal Check	10/14/14	08:15
1410054-SCV1	Secondary Cal Check	10/14/14	08:18
1410054-ICB1	Initial Cal Blank	10/14/14	08:21
1410054-CRL1	Instrument RL Check	10/14/14	08:24
1410054-IFA1	Interference Check A	10/14/14	08:27
1410054-IFB1	Interference Check B	10/14/14	08:31
1410054-CCV1	Calibration Check	10/14/14	09:06
1410054-CCB1	Calibration Blank	10/14/14	09:09
1410054-CCV2	Calibration Check	10/14/14	09:40
1410054-CCB2	Calibration Blank	10/14/14	09:43
1410018-BLK1	Blank	10/14/14	09:51
1410018-SRM1	Reference	10/14/14	09:54
C140903-01	14BH-DT-PILOT-BCR1-09021	10/14/14	09:57
1410018-DUP1	Duplicate	10/14/14	10:00
1410054-SRD1	Serial Dilution	10/14/14	10:03
C140903-05	14BH-DT-PILOT-BCR2-09021	10/14/14	10:06
1410018-MS1	Matrix Spike	10/14/14	10:09
C140903-09	14BH-DT-PILOT-BCR3-09021	10/14/14	10:12
1410018-MS3	Matrix Spike	10/14/14	10:16
1410054-CCV3	Calibration Check	10/14/14	10:22
1410054-CCB3	Calibration Blank	10/14/14	10:25
C140903-13	14BH-DT-PILOT-BCR4-09021	10/14/14	10:28
C140903-17	14BH-DT-PILOT-CHIT-090214	10/14/14	10:31
C140903-20	14BH-DT-PILOT-INFL-090214	10/14/14	10:34
C140903-23	14BH-DT-PILOT-INFLD-0902	10/14/14	10:37
C140903-26	14BH-DT-PILOT-NAOH-0902	10/14/14	10:40
C140903-29	14BH-DT-PILOT-POSTE-0902	10/14/14	10:44
C140903-33	14BH-DT-PILOT-POSTI-09021	10/14/14	10:47
C140903-37	14BH-DT-PILOT-SAPS-09021	10/14/14	10:50
1410054-CCV4	Calibration Check	10/14/14	10:56
1410054-CCB4	Calibration Blank	10/14/14	10:59

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Dissolved** **Sequence ID#:** 1410057

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1410057-ICV1	Initial Cal Check	10/14/14	11:08
1410057-SCV1	Secondary Cal Check	10/14/14	11:11
1410057-ICB1	Initial Cal Blank	10/14/14	11:14
1410057-CRL1	Instrument RL Check	10/14/14	11:17
1410057-IFA1	Interference Check A	10/14/14	11:21
1410057-IFB1	Interference Check B	10/14/14	11:24
1410051-BLK1	Blank	10/14/14	11:27
1410051-BS1	Blank Spike	10/14/14	11:30
C140903-02	14BH-DT-PILOT-BCR1-09021	10/14/14	11:33
1410051-DUP1	Duplicate	10/14/14	11:36
1410057-SRD1	Serial Dilution	10/14/14	11:39
1410051-MS1	Matrix Spike	10/14/14	11:42
C140903-06	14BH-DT-PILOT-BCR2-09021	10/14/14	11:46
1410051-MS2	Matrix Spike	10/14/14	11:49
C140903-10	14BH-DT-PILOT-BCR3-09021	10/14/14	11:52
1410057-CCV1	Calibration Check	10/14/14	11:58
1410057-CCB1	Calibration Blank	10/14/14	12:01
C140903-14	14BH-DT-PILOT-BCR4-09021	10/14/14	12:04
C140903-18	14BH-DT-PILOT-CHIT-090214	10/14/14	12:07
C140903-21	14BH-DT-PILOT-INFL-090214	10/14/14	12:10
C140903-24	14BH-DT-PILOT-INFLD-0902	10/14/14	12:13
C140903-27	14BH-DT-PILOT-NAOH-0902	10/14/14	12:17
C140903-30	14BH-DT-PILOT-POSTE-0902	10/14/14	12:20
C140903-34	14BH-DT-PILOT-POSTI-09021	10/14/14	12:23
C140903-38	14BH-DT-PILOT-SAPS-09021	10/14/14	12:26
1410057-CCV2	Calibration Check	10/14/14	12:32
1410057-CCB2	Calibration Blank	10/14/14	12:35

Project Name: **Barker-Hughesville_Treatability_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Total Recoverable** **Sequence ID#:** 1410058

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1410058-ICV1	Initial Cal Check	10/14/14	11:08
1410058-SCV1	Secondary Cal Check	10/14/14	11:11
1410058-ICB1	Initial Cal Blank	10/14/14	11:14
1410058-CRL1	Instrument RL Check	10/14/14	11:17
1410058-IFA1	Interference Check A	10/14/14	11:21
1410058-IFB1	Interference Check B	10/14/14	11:24
1410058-CCV1	Calibration Check	10/14/14	11:58
1410058-CCB1	Calibration Blank	10/14/14	12:01
1410058-CCV2	Calibration Check	10/14/14	12:32
1410058-CCB2	Calibration Blank	10/14/14	12:35
1410018-BLK2	Blank	10/14/14	12:40
1410018-SRM2	Reference	10/14/14	12:43
C140903-01	14BH-DT-PILOT-BCR1-09021	10/14/14	12:46
1410018-DUP2	Duplicate	10/14/14	12:49
1410058-SRD1	Serial Dilution	10/14/14	12:52
C140903-05	14BH-DT-PILOT-BCR2-09021	10/14/14	12:55
1410018-MS2	Matrix Spike	10/14/14	12:58
C140903-09	14BH-DT-PILOT-BCR3-09021	10/14/14	13:01
1410018-MS4	Matrix Spike	10/14/14	13:04
1410058-CCV3	Calibration Check	10/14/14	13:18
1410058-CCB3	Calibration Blank	10/14/14	13:21
C140903-13	14BH-DT-PILOT-BCR4-09021	10/14/14	13:24
C140903-17	14BH-DT-PILOT-CHIT-090214	10/14/14	13:27
C140903-20	14BH-DT-PILOT-INFL-090214	10/14/14	13:30
C140903-23	14BH-DT-PILOT-INFLD-0902	10/14/14	13:33
C140903-26	14BH-DT-PILOT-NAOH-0902	10/14/14	13:36
C140903-29	14BH-DT-PILOT-POSTE-0902	10/14/14	13:40
C140903-33	14BH-DT-PILOT-POSTI-09021	10/14/14	13:43
C140903-37	14BH-DT-PILOT-SAPS-09021	10/14/14	13:46
1410058-CCV4	Calibration Check	10/14/14	13:52
1410058-CCB4	Calibration Blank	10/14/14	13:55

CHAIN OF CUSTODY RECORD

CDM Smith Danny T Pilot Test

NOTES: Limited sample volumes due to treatability testing
Contact: Angela Franden, CDM Smith (406)441-1400

SAMPLE NUMBER	DATE	TIME	MATRIX	Preservative	Type & No. of Containers	Total Metals (TAL), 200.7 or 200.8	Dissolved Metals (TAL), 200.7 or 200.8	Alkalinity, Anions (sulfate, chloride, fluoride)	Nitrate+Nitrite, Ammonia	Other Instructions and Notes
14BH-DT-PILOT-INFL-090214	9/2/14	10:10	aqueous	HNO3 (metals), H2SO4 (nutrients), cool	3, 125 mL poly	X	X	X		TAL metals = Al, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, Tl, Zn.
14BH-DT-PILOT-INFLD-090214	9/2/14	10:15	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-SAPS-090214	9/2/14	10:25	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-CHIT-090214	9/2/14	10:35	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-NAOH-090214	9/2/14	10:45	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-BCR1-090214	9/2/14	10:55	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR2-090214	9/2/14	11:10	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR3-090214	9/2/14	11:25	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR4-090214	9/2/14	11:35	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-POSTI-090214	9/2/14	11:50	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-POSTE-090214	9/2/14	12:05	aqueous		4, 125 mL poly	X	X	X	X	

Relinquished by: (*Signature*) Lauren Holland
Date/Time 09/03/14 12:45
Received for Laboratory by: (*Signature*)

Received by: (*Signature*) Kelsey Bartling
Date/Time 9/4/14 10:30
Airbill No.(s)
Carrier Name: FedEx
Lab: USEPA Lab Region 8

ESAT

10/06/14

C1409013

ESAT Technical Direction Form

Contract No. EPW13028
EPA Region 8

Site ID:	085N	***Date Issued:***	5/29/2014	***Date***	
TDF ID:	A-046	***Date Updated:***		***Closed By:***	

Name: Barker-Hughesville Treatability Study Sept.

Details: The Contractor shall analyze several water samples associated with the treatability study at the Barker-Hughesville Superfund site as indicated in the Analytical Information Section. The samples will be sent to the ESAT R8 Lab during the 2014 field season starting in mid-June though early October 2014. There will be 9 sampling events associated with this project averaging approximately 10 samples per an event. The samples will be collected by Nick Anton/Erin Louden of CDM Smith.

Samples designated as influent samples (-INF) are expected to have high metal concentrations and should be analyzed by 200.7. Additionally, metals with sufficiently high concentrations may be reported from the 200.7 analyses.

ESAT should return the coolers to the following address:
CDM Smith/Lauren Helland
50 West 14th Street, Suite 200
Helena, MT 59601
406-441-1435
FedEx # 1323-6393-5

TO02/Subtask 02b: Inorganic Chemistry

Site RPM: Roger Hoogerheide

Analytical Information:

MATRIX

☑ Water ☐ Soils ☐ Vegetation ☐ Biota

WET CHEM

☐ TSS ☐ TDS ☐ DOC ☑ Alk ☑ Chloride ☑ Sulfate ☑ Fluoride ☑ Nitrate ☑ Nitrite
Other: Analyze for Ammonia and report NO2 and NO3 as NO2-NO3 combined.

METALS

☑ Dissolved ☑ Total Recoverable ☐ Total ☐ Hardness (Calc)
200.7: ☐ Ag ☑ Al ☐ As ☐ Ba ☐ Be ☐ B ☐ Ca ☐ Cd ☐ Co ☐ Cr ☐ Cu ☑ Fe ☐ K ☐ Mg
☒ Mn ☐ Mo ☐ Na ☐ Ni ☐ Pb ☐ Sb ☐ Se ☐ Sr ☐ Ti ☐ Tl ☐ V ☑ Zn ☐ SiO2
200.8: ☐ Ag ☐ Al ☑ As ☐ Ba ☐ Be ☑ Cd ☐ Co ☐ Cr ☑ Cu [✓ ☑ Mn] ☐ Mo ☑ Ni ☑ Pb ☐ Sb
☐ Se ☐ Th ☐ Tl ☐ U ☐ V ☐ Zn
7470/7471/747 ☐ Hg

10/14/14

FIBERS

☐ PLM ☐ TEM

Deliverables

ID	*Description*	*Due Date*	*Submission Date*
1	Provide final deliverable package to Task Monitor no later than 30 days after delivery of samples.		

5/29/14

ANALYTICAL SUMMARY REPORT

September 22, 2014

CDM Federal Programs
555 17th St Ste 1100
Denver, CO 80202

Work Order: H14090301 Quote ID: H823 - Baker-Hughsville Superfund Site

Project Name: Barker Hughsville - Danny T

Energy Laboratories Inc Helena MT received the following 11 samples for CDM Federal Programs on 9/17/2014 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H14090301-001	14BH-DT-PILOT-INFL-091614	09/16/14 11:05	09/17/14	Aqueous	Acidity, Total as CaCO3 Phosphorus, Orthophosphate as P
H14090301-002	14BH-DT-PILOT-SAPS-091614	09/16/14 11:30	09/17/14	Aqueous	Same As Above
H14090301-003	14BH-DT-PILOT-CHIT-091614	09/16/14 11:45	09/17/14	Aqueous	Same As Above
H14090301-004	14BH-DT-PILOT-NAOH-091614	09/16/14 12:00	09/17/14	Aqueous	Same As Above
H14090301-005	14BH-DT-PILOT-BCR1-091614	09/16/14 12:15	09/17/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Phosphorus, Orthophosphate as P Sulfide, Iodine Titrimetric
H14090301-006	14BH-DT-PILOT-BCR2-091614	09/16/14 12:30	09/17/14	Aqueous	Same As Above
H14090301-007	14BH-DT-PILOT-BCR3-091614	09/16/14 12:45	09/17/14	Aqueous	Same As Above
H14090301-008	14BH-DT-PILOT-BCR4-091614	09/16/14 13:00	09/17/14	Aqueous	Same As Above
H14090301-009	14BH-DT-PILOT-BCR4D-091614	09/16/14 13:05	09/17/14	Aqueous	Same As Above
H14090301-010	14BH-DT-PILOT-POSTI-091614	09/16/14 13:20	09/17/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Sulfide, Iodine Titrimetric
H14090301-011	14BH-DT-PILOT-POSTE-091614	09/16/14 13:30	09/17/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Sulfide, Methylene Blue Colorimetric

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

CLIENT: CDM Federal Programs
Project: Barker Hughsville - Danny T
Work Order: H14090301

Report Date: 09/22/14

CASE NARRATIVE

Tests associated with analyst identified as ELI-B were subcontracted to Energy Laboratories, 1120 S. 27th St., Billings, MT, EPA Number MT00005.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14090301-001
Client Sample ID: 14BH-DT-PILOT-INFL-091614

Report Date: 09/22/14
Collection Date: 09/16/14 11:05
Date Received: 09/17/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	670	mg/L	D	4.0		1	A2310 B	09/18/14 10:57/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	0.338	mg/L		0.005		2	E365.1	09/18/14 09:29/cmm

Report Definitions:	
RL - Analyte reporting limit.	MCL - Maximum contaminant level.
QCL - Quality control limit.	ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.	

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14090301-002
Client Sample ID: 14BH-DT-PILOT-SAPS-091614

Report Date: 09/22/14
Collection Date: 09/16/14 11:30
Date Received: 09/17/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	280	mg/L	D	4.0		1	A2310 B	09/18/14 11:03/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	0.115	mg/L		0.005		1	E365.1	09/18/14 09:19/cmm

Report Definitions:		
	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/22/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/16/14 11:45
Lab ID:	H14090301-003	**Date Received:**	09/17/14
Client Sample ID:	14BH-DT-PILOT-CHIT-091614	**Matrix:**	AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	09/18/14 11:07/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	7.64	mg/L	D	0.02		25	E365.1	09/18/14 09:20/cmm

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/22/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/16/14 12:00
Lab ID:	H14090301-004	**Date Received:**	09/17/14
Client Sample ID:	14BH-DT-PILOT-NAOH-091614	**Matrix:**	AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	09/18/14 11:11/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	0.014	mg/L		0.005		1	E365.1	09/18/14 09:21/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14090301-005
Client Sample ID: 14BH-DT-PILOT-BCR1-091614

Report Date: 09/22/14
Collection Date: 09/16/14 12:15
Date Received: 09/17/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	09/18/14 11:14/SRW
Sulfide	19	mg/L		1		1	A4500-S F	09/19/14 13:00/eli-b2
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	64	mg/L		30		1	A5210 B	09/17/14 15:51/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	8.96	mg/L	D	0.02		25	E365.1	09/18/14 09:24/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14090301-006
Client Sample ID: 14BH-DT-PILOT-BCR2-091614

Report Date: 09/22/14
Collection Date: 09/16/14 12:30
Date Received: 09/17/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	09/18/14 11:19/SRW
Sulfide	29	mg/L		1		1	A4500-S F	09/19/14 13:00/eli-b2
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	54	mg/L		30		1	A5210 B	09/17/14 15:59/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	2.71	mg/L	D	0.01		10	E365.1	09/18/14 09:25/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14090301-007
Client Sample ID: 14BH-DT-PILOT-BCR3-091614

Report Date: 09/22/14
Collection Date: 09/16/14 12:45
Date Received: 09/17/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	09/18/14 11:23/SRW
Sulfide	53	mg/L		1		1	A4500-S F	09/19/14 13:00/eli-b2
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	130	mg/L		30		1	A5210 B	09/17/14 16:04/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	14.7	mg/L	D	0.05		50	E365.1	09/18/14 09:26/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/22/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/16/14 13:00
Lab ID:	H14090301-008	**Date Received:**	09/17/14
Client Sample ID:	14BH-DT-PILOT-BCR4-091614	**Matrix:**	AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	09/18/14 11:26/SRW
Sulfide	35	mg/L		1		1	A4500-S F	09/19/14 13:00/eli-b2
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	67	mg/L		30		1	A5210 B	09/17/14 16:13/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	1.28	mg/L		0.005		5	E365.1	09/18/14 09:27/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14090301-009
Client Sample ID: 14BH-DT-PILOT-BCR4D-091614

Report Date: 09/22/14
Collection Date: 09/16/14 13:05
Date Received: 09/17/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	09/18/14 11:29/SRW
Sulfide	34	mg/L		1		1	A4500-S F	09/19/14 13:00/eli-b2
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	62	mg/L		30		1	A5210 B	09/17/14 16:21/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	1.22	mg/L		0.005		5	E365.1	09/18/14 09:28/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14090301-010
Client Sample ID: 14BH-DT-PILOT-POSTI-091614

Report Date: 09/22/14
Collection Date: 09/16/14 13:20
Date Received: 09/17/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	09/18/14 11:34/SRW
Sulfide	30	mg/L		1		1	A4500-S F	09/19/14 13:00/eli-b2
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	67	mg/L		30		1	A5210 B	09/17/14 16:33/SRW

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	09/22/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/16/14 13:30
Lab ID:	H14090301-011	**Date Received:**	09/17/14
Client Sample ID:	14BH-DT-PILOT-POSTE-091614	**Matrix:**	AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	09/18/14 11:38/SRW
Sulfide	ND	mg/L	D	0.2		10	A4500-S D	09/19/14 13:15/eli-b2
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	<6	mg/L		6		1	A5210 B	09/17/14 16:44/SRW
No BOD dilution depleted greater than 2.0 mg/L DO.								

Report Definitions:	RL - Analyte reporting limit. QCL - Quality control limit. D - RL increased due to sample matrix.	MCL - Maximum contaminant level. ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T

Report Date: 09/22/14
Work Order: H14090301

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2310 B								Batch: H140918A	
Lab ID: H14090301-001ADUP	Sample Duplicate				Run: PH_140918A			09/18/14 10:59	
Acidity, Total as CaCO3	700	mg/L	4.0				4.0	20	
Lab ID: H14090301-011ADUP	Sample Duplicate				Run: PH_140918A			09/18/14 11:43	
Acidity, Total as CaCO3	ND	mg/L	4.0					20	
Lab ID: LCS1409180000	Laboratory Control Sample				Run: PH_140918A			09/18/14 10:55	
Acidity, Total as CaCO3	950	mg/L	4.0	97	90	110			
Lab ID: MBLK1409180000	Method Blank				Run: PH_140918A			09/18/14 10:53	
Acidity, Total as CaCO3	3	mg/L							

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs

Project: Barker Hughsville - Danny T

Report Date: 09/22/14

Work Order: H14090301

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **A4500-S D**									Batch: B_R230858
Lab ID: **MB-R230858**	Method Blank				Run: SUB-B230858				09/19/14 13:15
Sulfide	ND	mg/L	0.002						
Lab ID: **LCS-R230858**	Laboratory Control Sample				Run: SUB-B230858				09/19/14 13:15
Sulfide	0.231	mg/L	0.040	112	70	130			
Lab ID: **B14091665-002AMS**	Sample Matrix Spike				Run: SUB-B230858				09/19/14 13:15
Sulfide	0.261	mg/L	0.040	107	70	130			
Lab ID: **B14091665-002AMSD**	Sample Matrix Spike Duplicate				Run: SUB-B230858				09/19/14 13:15
Sulfide	0.273	mg/L	0.040	113	70	130	4.7	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T

Report Date: 09/22/14
Work Order: H14090301

Analyte		Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method:	**A4500-S F**									Batch: B_R230859
Lab ID:	**MB-R230859**	Method Blank				Run: SUB-B230859				09/19/14 13:00
Sulfide		ND	mg/L	0.5						
Lab ID:	**LCS-R230859**	Laboratory Control Sample				Run: SUB-B230859				09/19/14 13:00
Sulfide		19.7	mg/L	1.0	100	70	130			
Lab ID:	**H14090301-005C**	Sample Matrix Spike				Run: SUB-B230859				09/19/14 13:00
Sulfide		36.9	mg/L	1.0	90	80	120			
Lab ID:	**H14090301-005C**	Sample Matrix Spike Duplicate				Run: SUB-B230859				09/19/14 13:00
Sulfide		37.2	mg/L	1.0	91	80	120	0.9	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T

Report Date: 09/22/14
Work Order: H14090301

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A5210 B						Batch: 140917_1_BOD5-W			
Lab ID: Dil-H201_140917	Dilution Water Blank				Run: BOD-SKALAR_140917A			09/17/14 14:45	
Oxygen Demand, Biochemical (BOD)	ND	mg/L	2.0		0	0.2			
Lab ID: GGA1_140917	Laboratory Control Sample				Run: BOD-SKALAR_140917A			09/17/14 14:56	
Oxygen Demand, Biochemical (BOD)	220	mg/L	52	109	85	115			
Lab ID: H14090301-009ADUP	Sample Duplicate				Run: BOD-SKALAR_140917A			09/17/14 16:28	
Oxygen Demand, Biochemical (BOD)	60	mg/L	31		90	110	3.0	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T

Report Date: 09/22/14
Work Order: H14090301

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E365.1						Analytical Run: FIA202-HE_140918A			
Lab ID: ICV	Initial Calibration Verification Standard								09/18/14 09:11
Phosphorus, Orthophosphate as P	0.238	mg/L	0.0050	95	90	110			
Lab ID: ICB	Initial Calibration Blank, Instrument Blank								09/18/14 09:12
Phosphorus, Orthophosphate as P	-0.000260	mg/L	0.0050		0	0			
Lab ID: CCV	Continuing Calibration Verification Standard								09/18/14 09:15
Phosphorus, Orthophosphate as P	0.105	mg/L	0.0050	105	90	110			
Method: E365.1								Batch: R100660	
Lab ID: LFB	Laboratory Fortified Blank				Run: FIA202-HE_140918A				09/18/14 09:13
Phosphorus, Orthophosphate as P	0.199	mg/L	0.0050	100	90	110			
Lab ID: H14090301-004BMS	Sample Matrix Spike				Run: FIA202-HE_140918A				09/18/14 09:22
Phosphorus, Orthophosphate as P	0.149	mg/L	0.0050	68	90	110			S
Lab ID: H14090301-004BMSD	Sample Matrix Spike Duplicate				Run: FIA202-HE_140918A				09/18/14 09:23
Phosphorus, Orthophosphate as P	0.149	mg/L	0.0050	68	90	110	0.2	20	S

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

Workorder Receipt Checklist

CDM Federal Programs

H14090301

Login completed by: Amanda B. Blackburn

Reviewed by: BL2000\sdull

Reviewed Date: 9/18/2014

Date Received: 9/17/2014

Received by: kjw

Carrier name: Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☑	No ☐	Not Applicable ☐
Container/Temp Blank temperature:	5.1℃ No Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☑	No ☐	Not Applicable ☐

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

None

LABORATORIES

Chain of Custody and Analytical Request Record

Page 1 of 2

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM SMITH

Report Mail Address (Required):

☒ No Hard Copy Email: frandsenak@cdmsmith.com

Invoice Address (Required):

☒ No Hard Copy Email: SAME

Project Name, PWS, Permit, Etc.: BARKER HUGHESVILLE - DANNY T

Sample Origin State: MT

EPA/State Compliance: Yes ☐ No ☐

Contact Name: ANGELA FRANDSEN

Phone/Fax: (406) 441-1435

Cell:

Sampler: (Please Print) TOM ASKIN

Invoice Contact & Phone: SAME

Purchase Order:

Quote/Bottle Order:

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: ____
☐ Other: ____
☒ EDD/EDT (Electronic Data) Format: EXCEL
☐ LEVEL IV
☐ NELAC

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids
Vegetation Bioassay Other
DW - Drinking Water

ANALYSIS REQUESTED

SEE ATTACHED

Standard Turnaround (TAT)

RUSH

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: 1000 mL BOTTLES FOR COMBINED BOD + ACIDITY

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	BOD	SULFIDE	ACIDITY	ORTHO-PHOSPHATE
1	14BH-DT-PILOT-INFL-091614	9/16/14	11:05	2, W			X	X
2	14BH-DT-PILOT-SAPS-091614	9/16/14	11:30	2, W			X	X
3	14BH-DT-PILOT-CHIT-091614	9/16/14	11:45	2, W			X	X
4	14BH-DT-PILOT-NAOH-091614	9/16/14	12:00	2, W			X	X
5	14BH-DT-PILOT-BCR1-091614	9/16/14	12:15	3, W	X	X	X	X
6	14BH-DT-PILOT-BCR2-091614	9/16/14	12:30	3, W	X	X	X	X
7	14BH-DT-PILOT-BCR3-091614	9/16/14	12:45	3, W	X	X	X	X
8	14BH-DT-PILOT-BCR4-091614	9/16/14	13:00	3, W	X	X	X	X
9	14BH-DT-PILOT-BCR4D-091614	9/16/14	13:05	3, W	X	X	X	X
10	14BH-DT-PILOT-POSTI-091614	9/16/14	13:20	2, W	X	X	X	

LABORATORY USE ONLY

Shipped by: Hand

Cooler ID(s): Y

Receipt Temp 5.1 °C TB

On Ice: Y [✓ N]

Custody Seal
On Bottle Y [✓ N]
On Cooler Y [✓ N]
Intact Y [✓ N]
Signature Match Y [✓ N]

H14090301

Custody Record MUST be Signed

Relinquished by (print): TOM ASKIN Date/Time: 9/17/14 @ 13:14 Signature:
Relinquished by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:
Received by (print): Date/Time: Signature:

Sample Disposal: Return to Client: ____ Lab Disposal: ____

Received by Laboratory: Kathy Wiegand Date/Time: 9-17-14 13:14 Signature: Kathy Wiegand

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.
Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 2 of 2

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM SMITH

Project Name, PWS, Permit, Etc.: BARKER HUGHESVILLE - DANNY T

Sample Origin State: MT

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address (Required):

Contact Name: ANGELA FRANDSEN

Phone/Fax: (406) 441-1435

Cell:

Sampler: (Please Print) TOM ASKIN

☑ No Hard Copy Email: frandsenak@cdmsmith.com

Invoice Contact & Phone: SAME

Purchase Order:

Quote/Bottle Order:

Invoice Address (Required):

☑ No Hard Copy Email: SAME

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: ______
☐ Other: ______
☒ EDD/EDT (Electronic Data)
Format: EXCEL
☐ LEVEL IV
☐ NELAC

ANALYSIS REQUESTED

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids
Vegetation Bioassay Other
DW - Drinking Water

➡ Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Standard Turnaround (TAT)

R U S H

Comments: 1000 mL BOTTLES FOR COMBINED BOD + ACIDITY

Shipped by: Hand

Cooler ID(s): Y

Receipt Temp TB 5.1 °C

On Ice: Y [✓ N]

Custody Seal
On Bottle Y [✓ N]
On Cooler Y [✓ N]
Intact Y [✓ N]
Signature Match Y N

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	BOD	SULFIDE	ACIDITY							SEE ATTACHED	Standard Turnaround (TAT)	RUSH	LABORATORY USE ONLY
1	14BH-DT-PILOT-POSTE-091614	9/16/14	13:30	2, W	X	X	X										H14090301
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

Custody Record MUST be Signed

Relinquished by (print): TOM ASKIN Date/Time: 9/17/14 @ 13:14 Signature: Tom Askin
Relinquished by (print): Date/Time: Signature:
Received by (print): Date/Time: Signature:
Received by (print): Date/Time: Signature:
Received by Laboratory: Kathy Wiegand Date/Time: 9-17-14 13:14 Signature: Kathy Jo Wiegand

Sample Disposal: Return to Client: ______ Lab Disposal: ______

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.
Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

U.S. Environmental Protection Agency
Region 8
Technical and Management Services

Laboratory Services Program

Certificate of Analysis

Ref: 8TMS-L

MEMORANDUM

Date: 12/01/14

Subject: Analytical Results--- **Barker-Hughesville_Treatability 2_SEP 2014_A046 / A-046**

From: Don Goodrich; EPA Region 8 Analytical Chemistry WAM

To: Roger Hoogerheide
Superfund
8 MO

Received Sample Set(s), [Work Order : Date Received]:
[C140918 : 09/29/2014]

Attached are the analytical results for the samples received from the Barker-Hughesville_Treatability 2_SEP 2014_A046 sampling event, according to TDF A-046. All analyses were performed within their method specified holding times unless otherwise noted in the following narrative.

These samples were prepared, analyzed, and verified by the Environmental Services Assistance Team Laboratory (ESAT) according to the requirements of the Technical Direction Form (TDF).

Note: The laboratory herewith transmits this deliverable to the program/project partner for determination of "final data usability" which may include data validation and data quality asessment per and in accordance with EPA QA/G-8, *Guidance on Environmental Data Verification and Data Validation*, November 2002, EPA/240/R-02/004. Laboratory data qualifiers are applied based on the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004, referred to as "NFGI".

Laboratory policy is to dispose of any remaining sample 60 days after data analysis packages are delivered to EPA. If you would like the laboratory to retain the samples for a period longer than 60 days, please contact Don Goodrich within the 60 day period at (303) 312-6687.

Case Narrative

C140918

Quality Assessment: Unless indicated by exception, the QA/QC associated with this sample set produced data within the TDF-specified criteria.

Holding Times: All samples were analyzed within their method-specified technical holding time(s).

1. Initial and Continuing calibration blanks (ICBs and CCBs).
   Exceptions: None.
2. Preparation (PB) / Method blanks (MB)
   Exceptions: None.
3. Interference Checks (ICSA / ICSAB) for ICP-MS and ICP-OE analyses only.
   Exceptions: None.
4. Initial and Continuing calibration verification analyses (ICVs, SCVs and CCVs).
   Exceptions: In ICP-OE sequence 1411092, iron recovered 1% below acceptable limits in the ICV. No qualifiers were assigned since all other QC requirements for iron were met.
5. Laboratory Control Sample (LCS) or second source analysis or SRM.
   Exceptions: None.
6. Laboratory Fortified blank (LFB) / Blank spike (BS), same source as used for the matrix spikes. PBS performed with analyses/methods requiring preparation or digestion prior to analysis.
   Exceptions: None.
7. Contract Reporting Detection Limit Standard, labeled as CRA, CRDL or CRL.
   Exceptions: None.
8. Laboratory Duplicate (DUP). "Source" identifies field sample duplicated in the laboratory. If either the "source" or the duplicate result is <5X the reporting limit, the %D limit of 20% does not apply.
   Exceptions: None.
9. Laboratory Matrix Spike (MS) and spike duplicate (MSD). "Source" defines original field sample fortified prior to analysis. Percent recovery (%R) limits do not apply when sample concentration(s) exceed the corresponding analyte spike level by a factor of 4 or greater.
   Exceptions: None.
10. Serial Dilution sample analysis (SRD). "Source" is parent field sample diluted 1:5 in the laboratory. Performed for ICP-OE and ICP-MS metals analyses. Percent difference (%D) limits do not apply when analyte concentration(s) are below 50x the source sample's MDL (or 10x it's PQL).
    Exceptions: None.
11. Internal standards, criteria specified for ICP-MS analyses only, monitored at the instrument.
    Exceptions: Scandium was high for samples C140918-40, -43, -68, -71. Affected analytes (copper and nickel), were "J" flagged as estimated. Suspect matrix interference (high manganese).
12. Any calibration using more than two-points produced a correlation coefficient equal to or greater than 0.995.
    Exceptions: None.

Acronyms and Definitions:

ESAT	Environmental Services Assistance Team
J	Data Estimated qualifier (also applied to all data less than PQL, greater than or equal to MDL)
MDL	Method Detection Limit
PQL	Practical Quantitation Limit, also known as reporting limit.
RPD	Relative Percent Difference (difference divided by the mean)
%D	Percent difference, serial dilution criteria unit, difference divided by the original result.
%R	Percent recovery, analyzed (less sample contribution) divided by true value
<	Analyte NOT DETECTED at or above the Method Detection Limit (MDL)
mg/L	Parts per million (millligrams per liter). Solids equivalent = mg/Kg.
ug/L	Parts per billion (micrograms per liter). Solids equivalent = ug/Kg.
NR	No Recovery (matrix spike) - Often seen for calcium/magnesium when their concentration exceeds the spike level by > 4x.
NFGI	*USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004
RE	Sample Re-analysis. Usually seen on raw data and sequences for required sample dilutions due to over-range analytes.
U	Analyte not detected at or above MDL qualifier
D	Diluted value qualifier.

Method(s) Summary:

As defined in the Technical Direction Form (TDF), some or all of the methods listed below were used for the determination of the reported target analytes.

From EPA's *Methods for the Determination of Metals in Environmental Samples*, Supplement I, May 1994, dissolved, total, and/or total recoverable metals were determined by:

- Method 200.7 / 6010B using a PE Optima ICP-OE (ICP).
- Method 200.8 / 6020 using a Perkin-Elmer Elan 6000 ICP-MS.
- Method 200.2 for total recoverable metals (only) digestion.
- Method 245.1 using a Perkin-Elmer FIMS CVAA (aqueous mercury only).

From *Standard Methods for the Examination of Water and Wastewater*, 18th Edition, 1992, Method 2340B was used for the calculated hardness determination. Hardness is reported as mg (milligram) equivalent $CaCO_3$ per liter (L) determined as follows:

Calculated hardness = 2.497 * (Calcium, mg/L) + 4.118 * (Magnesium, mg/L).

From *EPA's Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846*,

- Method 3015A was used for microwave assisted total metals digestion.
- Method 7473 was used for mercury in solids.

From EPA's *Determination of Inorganic Anions by Ion Chromatography*, Revision 2.1, 1993, Method 300.0 was used to determine the anions.

From EPA's *Methods for Chemical Analysis of Water and Wastes*, March 1983:

- Method 310.1 was followed for the alkalinity determination.
- Method 160.1 was followed for gravimetric total dissolved solids (TDS) determination.
- Method 160.2 was used for gravimetric total suspended solids (TSS) determination.
- Method 415.3 was used for total organic carbon (TOC) determination using either an Apollo 9000 or Phoenix 8000 Non-Dispersive IR (NDIR) system. Also known as dissolved organic carbon (DOC) when performed on the dissolved sample fraction.

The quality control procedures listed in the TDF request were utilized by ESAT to verify accuracy of the results and to evaluate any matrix interferences.

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-091614 **Date / Time Sampled:** 09/16/14 12:15 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-02 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/21/2014	SV	1411085
200.7	Iron	< 1250	U	ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**80700**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	Zinc	< 100	U	ug/L	50.0	5	11/21/2014	SV	1411085
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Copper	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**777**		mg/L	8	5	11/21/2014	SV	1411085

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-092314 **Date / Time Sampled:** 09/23/14 12:45 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-06 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/21/2014	SV	1411085
200.7	Iron	< 1250	U	ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**84500**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	Zinc	< 100	U	ug/L	50.0	5	11/21/2014	SV	1411085
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Copper	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**832**		mg/L	8	5	11/21/2014	SV	1411085

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-091614 **Date / Time Sampled:** 09/16/14 12:30 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-10 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/21/2014	SV	1411085
200.7	Iron	< 1250	U	ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**96000**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	Zinc	< 100	U	ug/L	50.0	5	11/21/2014	SV	1411085
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Copper**	**5.93**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**653**		mg/L	8	5	11/21/2014	SV	1411085

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-092314 **Date / Time Sampled:** 09/23/14 13:10 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-14 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/21/2014	SV	1411085
200.7	Iron	< 1250	U	ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**90200**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	Zinc	< 100	U	ug/L	50.0	5	11/21/2014	SV	1411085
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Copper**	**6.19**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**662**		mg/L	8	5	11/21/2014	SV	1411085

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-091614 **Date / Time Sampled:** 09/16/14 12:45 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-18 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/21/2014	SV	1411085
200.7	Iron	< 1250	U	ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**48100**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	Zinc	< 100	U	ug/L	50.0	5	11/21/2014	SV	1411085
200.8	**Arsenic**	**5.37**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Copper**	**7.39**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**798**		mg/L	8	5	11/21/2014	SV	1411085

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-092314 **Date / Time Sampled:** 09/23/14 13:25 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-22 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/21/2014	SV	1411085
200.7	Iron	< 1250	U	ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**54100**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	Zinc	< 100	U	ug/L	50.0	5	11/21/2014	SV	1411085
200.8	**Arsenic**	**6.56**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Copper**	**7.69**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**767**		mg/L	8	5	11/21/2014	SV	1411085

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-091614 **Date / Time Sampled:** 09/16/14 13:00 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-26 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/21/2014	SV	1411085
200.7	Iron	< 1250	U	ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**55600**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	**Zinc**	**50.4**	J	ug/L	50.0	5	11/21/2014	SV	1411085
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Copper**	**6.29**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**284**		mg/L	8	5	11/21/2014	SV	1411085

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-092314 **Date / Time Sampled:** 09/23/14 13:45 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-30 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/21/2014	SV	1411085
200.7	Iron	< 1250	U	ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**55500**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	**Zinc**	**159**		ug/L	50.0	5	11/21/2014	SV	1411085
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Copper**	**7.68**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**289**		mg/L	8	5	11/21/2014	SV	1411085

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4D-091614 **Date / Time Sampled:** 09/16/14 13:05 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-34 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/21/2014	SV	1411085
200.7	Iron	< 1250	U	ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**56600**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	**Zinc**	**63.6**	J	ug/L	50.0	5	11/21/2014	SV	1411085
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Copper**	**5.97**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**284**		mg/L	8	5	11/21/2014	SV	1411085

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-091614 **Date / Time Sampled:** 09/16/14 11:45 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-38 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/21/2014	SV	1411085
200.7	**Iron**	**3120**		ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**63400**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	Zinc	< 100	U	ug/L	50.0	5	11/21/2014	SV	1411085
200.8	**Arsenic**	**7.97**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Copper	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**871**		mg/L	8	5	11/21/2014	SV	1411085

Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-092314 **Date / Time Sampled:** 09/23/14 12:20 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-41 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**626**		ug/L	100	5	11/21/2014	SV	1411085
200.7	**Iron**	**59100**		ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**90800**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	Zinc	< 100	U	ug/L	50.0	5	11/21/2014	SV	1411085
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Copper	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Nickel**	**6.64**	J	ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**637**		mg/L	8	5	11/21/2014	SV	1411085

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFL-091614 **Date / Time Sampled:** 09/16/14 11:05 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-44 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**12900**		ug/L	100	5	11/21/2014	SV	1411085
200.7	**Iron**	**140000**		ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**96200**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	**Zinc**	**52400**		ug/L	50.0	5	11/21/2014	SV	1411085
200.8	**Arsenic**	**227**		ug/L	5.00	10	11/21/2014	SV	1411086
200.8	**Cadmium**	**226**		ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Copper**	**825**		ug/L	5.00	10	11/21/2014	SV	1411086
200.8	**Lead**	**169**		ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Nickel**	**25.6**		ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**306**		mg/L	8	5	11/21/2014	SV	1411085

Metrics (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFL-092314 **Date / Time Sampled:** 09/23/14 11:15 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-47 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**13300**		ug/L	100	5	11/21/2014	SV	1411085
200.7	**Iron**	**140000**		ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**104000**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	**Zinc**	**55500**		ug/L	50.0	5	11/21/2014	SV	1411085
200.8	**Arsenic**	**150**		ug/L	5.00	10	11/21/2014	SV	1411086
200.8	**Cadmium**	**238**		ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Copper**	**892**		ug/L	5.00	10	11/21/2014	SV	1411086
200.8	**Lead**	**158**		ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Nickel**	**24.4**		ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**325**		mg/L	8	5	11/21/2014	SV	1411085

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFLD-092314 **Date / Time Sampled:** 09/23/14 11:40 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-50 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**12900**		ug/L	100	5	11/21/2014	SV	1411085
200.7	**Iron**	**142000**		ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**103000**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	**Zinc**	**54900**		ug/L	50.0	5	11/21/2014	SV	1411085
200.8	**Arsenic**	**148**		ug/L	5.00	10	11/21/2014	SV	1411086
200.8	**Cadmium**	**235**		ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Copper**	**870**		ug/L	5.00	10	11/21/2014	SV	1411086
200.8	**Lead**	**156**		ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Nickel**	**23.8**		ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**317**		mg/L	8	5	11/21/2014	SV	1411085

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NAOH-091614 **Date / Time Sampled:** 09/16/14 12:00 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-53 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**236**	J	ug/L	100	5	11/21/2014	SV	1411085
200.7	Iron	< 1250	U	ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**24.8**	J	ug/L	10.0	5	11/21/2014	SV	1411085
200.7	**Zinc**	**57.6**	J	ug/L	50.0	5	11/21/2014	SV	1411085
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Copper**	**5.29**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**138**		mg/L	8	5	11/21/2014	SV	1411085

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NAOH-092314 **Date / Time Sampled:** 09/23/14 12:35 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-56 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**8540**		ug/L	100	5	11/21/2014	SV	1411085
200.7	**Iron**	**981**	J	ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**89500**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	**Zinc**	**47700**		ug/L	50.0	5	11/21/2014	SV	1411085
200.8	**Arsenic**	**5.20**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	**Cadmium**	**210**		ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Copper**	**647**		ug/L	5.00	10	11/21/2014	SV	1411086
200.8	**Lead**	**33.5**		ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Nickel**	**21.1**		ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**317**		mg/L	8	5	11/21/2014	SV	1411085

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-092314 **Date / Time Sampled:** 09/23/14 14:20 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-60 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/21/2014	SV	1411085
200.7	Iron	< 1250	U	ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**47700**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	Zinc	< 100	U	ug/L	50.0	5	11/21/2014	SV	1411085
200.8	**Arsenic**	**8.25**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Copper	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**629**		mg/L	8	5	11/21/2014	SV	1411085

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-092314 **Date / Time Sampled:** 09/23/14 14:00 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-65 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/21/2014	SV	1411085
200.7	Iron	< 1250	U	ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**69500**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	Zinc	< 100	U	ug/L	50.0	5	11/21/2014	SV	1411085
200.8	**Arsenic**	**5.53**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Copper**	**6.84**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**629**		mg/L	8	5	11/21/2014	SV	1411085

Metrals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-091614 **Date / Time Sampled:** 09/16/14 11:30 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-69 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**304**		ug/L	100	5	11/21/2014	SV	1411085
200.7	**Iron**	**88600**		ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**84300**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	**Zinc**	**27100**		ug/L	50.0	5	11/21/2014	SV	1411085
200.8	**Arsenic**	**5.35**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Copper**	**5.08**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Nickel**	**18.2**		ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**601**		mg/L	8	5	11/21/2014	SV	1411085

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-092314 **Date / Time Sampled:** 09/23/14 12:00 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-72 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**411**		ug/L	100	5	11/21/2014	SV	1411085
200.7	**Iron**	**101000**		ug/L	500	5	11/21/2014	SV	1411085
200.7	**Manganese**	**92500**		ug/L	10.0	5	11/21/2014	SV	1411085
200.7	**Zinc**	**33900**		ug/L	50.0	5	11/21/2014	SV	1411085
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Copper**	**5.41**	J	ug/L	5.00	10	11/21/2014	SV	1411086
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/21/2014	SV	1411086
200.8	**Nickel**	**21.0**		ug/L	5.00	10	11/21/2014	SV	1411086
2340B	**Hardness**	**638**		mg/L	8	5	11/21/2014	SV	1411085

"J" Qualifier indicates an estimated value

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-091614 **Date / Time Sampled:** 09/16/14 12:15 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-01 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/24/2014	SW	1411075
200.7	Iron	< 1250	U	ug/L	500	5	11/24/2014	SW	1411075
200.7	**Manganese**	**85600**		ug/L	10.0	5	11/24/2014	SW	1411075
200.7	**Zinc**	**96.3**	J	ug/L	50.0	5	11/24/2014	SW	1411075
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	Copper	< 10.0	U	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	**Lead**	**1.11**	J	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/24/2014	SW	1411075

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-092314 **Date / Time Sampled:** 09/23/14 12:45 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-05 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/24/2014	SW	1411075
200.7	Iron	< 1250	U	ug/L	500	5	11/24/2014	SW	1411075
200.7	**Manganese**	**88900**		ug/L	10.0	5	11/24/2014	SW	1411075
200.7	**Zinc**	**50.8**	J	ug/L	50.0	5	11/24/2014	SW	1411075
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	Copper	< 10.0	U	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/24/2014	SW	1411075

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-091614 **Date / Time Sampled:** 09/16/14 12:30 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-09 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/24/2014	SW	1411075
200.7	Iron	< 1250	U	ug/L	500	5	11/24/2014	SW	1411075
200.7	**Manganese**	**98900**		ug/L	10.0	5	11/24/2014	SW	1411075
200.7	**Zinc**	**514**		ug/L	50.0	5	11/24/2014	SW	1411075
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	Copper	< 10.0	U	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	**Lead**	**1.19**	J	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/24/2014	SW	1411075

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-092314 **Date / Time Sampled:** 09/23/14 13:10 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-13 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/24/2014	SW	1411075
200.7	Iron	< 1250	U	ug/L	500	5	11/24/2014	SW	1411075
200.7	**Manganese**	**93200**		ug/L	10.0	5	11/24/2014	SW	1411075
200.7	**Zinc**	**160**		ug/L	50.0	5	11/24/2014	SW	1411075
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	Copper	< 10.0	U	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/24/2014	SW	1411075

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-091614 **Date / Time Sampled:** 09/16/14 12:45 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-17 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/24/2014	SW	1411075
200.7	Iron	< 1250	U	ug/L	500	5	11/24/2014	SW	1411075
200.7	**Manganese**	**48500**		ug/L	10.0	5	11/24/2014	SW	1411075
200.7	Zinc	< 100	U	ug/L	50.0	5	11/24/2014	SW	1411075
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	Copper	< 10.0	U	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/24/2014	SW	1411075

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-092314 **Date / Time Sampled:** 09/23/14 13:25 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-21 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**116**	J	ug/L	100	5	11/24/2014	SW	1411075
200.7	Iron	< 1250	U	ug/L	500	5	11/24/2014	SW	1411075
200.7	**Manganese**	**56000**		ug/L	10.0	5	11/24/2014	SW	1411075
200.7	Zinc	< 100	U	ug/L	50.0	5	11/24/2014	SW	1411075
200.8	**Arsenic**	**7.09**	J	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	Copper	< 10.0	U	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/24/2014	SW	1411075

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-091614 **Date / Time Sampled:** 09/16/14 13:00 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-25 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/24/2014	SW	1411075
200.7	Iron	< 1250	U	ug/L	500	5	11/24/2014	SW	1411075
200.7	**Manganese**	**58200**		ug/L	10.0	5	11/24/2014	SW	1411075
200.7	**Zinc**	**468**		ug/L	50.0	5	11/24/2014	SW	1411075
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	**Copper**	**7.35**	J	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/24/2014	SW	1411075

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-092314 **Date / Time Sampled:** 09/23/14 13:45 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-29 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/24/2014	SW	1411075
200.7	Iron	< 1250	U	ug/L	500	5	11/24/2014	SW	1411075
200.7	**Manganese**	**57000**		ug/L	10.0	5	11/24/2014	SW	1411075
200.7	**Zinc**	**938**		ug/L	50.0	5	11/24/2014	SW	1411075
200.8	**Arsenic**	**5.98**	J	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	**Cadmium**	**2.27**		ug/L	1.00	10	11/24/2014	SW	1411075
200.8	**Copper**	**10.6**		ug/L	5.00	10	11/24/2014	SW	1411075
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/24/2014	SW	1411075

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4D-091614 **Date / Time Sampled:** 09/16/14 13:05 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-33 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/24/2014	SW	1411075
200.7	Iron	< 1250	U	ug/L	500	5	11/24/2014	SW	1411075
200.7	**Manganese**	**59000**		ug/L	10.0	5	11/24/2014	SW	1411075
200.7	**Zinc**	**466**		ug/L	50.0	5	11/24/2014	SW	1411075
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	**Copper**	**7.03**	J	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/24/2014	SW	1411075
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/24/2014	SW	1411075

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-091614 **Date / Time Sampled:** 09/16/14 11:45 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-37 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**6740**		ug/L	100	5	11/24/2014	SW	1411075
200.7	**Iron**	**51400**		ug/L	500	5	11/24/2014	SW	1411075
200.7	**Manganese**	**72900**		ug/L	10.0	5	11/24/2014	SW	1411075
200.7	**Zinc**	**22600**		ug/L	50.0	5	11/24/2014	SW	1411075
200.8	**Arsenic**	**21.9**		ug/L	5.00	10	11/24/2014	SW	1411075
200.8	**Cadmium**	**77.1**		ug/L	1.00	10	11/24/2014	SW	1411075
200.8	**Copper**	**299**		ug/L	5.00	10	11/24/2014	SW	1411075
200.8	**Lead**	**55.3**		ug/L	1.00	10	11/24/2014	SW	1411075
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/24/2014	SW	1411075

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-092314 **Date / Time Sampled:** 09/23/14 12:20 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-40 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**12400**		ug/L	100	5	11/24/2014	SW	1411075
200.7	**Iron**	**87700**		ug/L	500	5	11/24/2014	SW	1411075
200.7	**Manganese**	**95800**		ug/L	10.0	5	11/24/2014	SW	1411075
200.7	**Zinc**	**31300**		ug/L	50.0	5	11/24/2014	SW	1411075
200.8	**Arsenic**	**12.5**	J	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	**Cadmium**	**54.5**		ug/L	1.00	10	11/24/2014	SW	1411075
200.8	**Copper**	**179**	J	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	**Lead**	**39.1**		ug/L	1.00	10	11/24/2014	SW	1411075
200.8	**Nickel**	**11.2**	J	ug/L	5.00	10	11/24/2014	SW	1411075

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFL-091614 **Date / Time Sampled:** 09/16/14 11:05 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-43 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**13600**		ug/L	100	5	11/24/2014	SW	1411075
200.7	**Iron**	**146000**		ug/L	500	5	11/24/2014	SW	1411075
200.7	**Manganese**	**99300**		ug/L	10.0	5	11/24/2014	SW	1411075
200.7	**Zinc**	**54600**		ug/L	50.0	5	11/24/2014	SW	1411075
200.8	**Arsenic**	**225**		ug/L	5.00	10	11/24/2014	SW	1411075
200.8	**Cadmium**	**240**		ug/L	1.00	10	11/24/2014	SW	1411075
200.8	**Copper**	**901**	J	ug/L	5.00	10	11/24/2014	SW	1411075
200.8	**Lead**	**166**		ug/L	1.00	10	11/24/2014	SW	1411075
200.8	**Nickel**	**23.2**	J	ug/L	5.00	10	11/24/2014	SW	1411075

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFL-092314 **Date / Time Sampled:** 09/23/14 11:15 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-46 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**13500**		ug/L	100	5	11/25/2014	SW	1411076
200.7	**Iron**	**148000**		ug/L	500	5	11/25/2014	SW	1411076
200.7	**Manganese**	**107000**		ug/L	10.0	5	11/25/2014	SW	1411076
200.7	**Zinc**	**58400**		ug/L	50.0	5	11/25/2014	SW	1411076
200.8	**Arsenic**	**169**		ug/L	5.00	10	11/25/2014	SW	1411076
200.8	**Cadmium**	**246**		ug/L	1.00	10	11/25/2014	SW	1411076
200.8	**Copper**	**1010**		ug/L	5.00	10	11/25/2014	SW	1411076
200.8	**Lead**	**175**		ug/L	1.00	10	11/25/2014	SW	1411076
200.8	**Nickel**	**27.0**		ug/L	5.00	10	11/25/2014	SW	1411076

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFLD-092314 **Date / Time Sampled:** 09/23/14 11:40 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-49 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**13400**		ug/L	100	5	11/25/2014	SW	1411076
200.7	**Iron**	**140000**		ug/L	500	5	11/25/2014	SW	1411076
200.7	**Manganese**	**104000**		ug/L	10.0	5	11/25/2014	SW	1411076
200.7	**Zinc**	**55400**		ug/L	50.0	5	11/25/2014	SW	1411076
200.8	**Arsenic**	**158**		ug/L	5.00	10	11/25/2014	SW	1411076
200.8	**Cadmium**	**247**		ug/L	1.00	10	11/25/2014	SW	1411076
200.8	**Copper**	**944**		ug/L	5.00	10	11/25/2014	SW	1411076
200.8	**Lead**	**167**		ug/L	1.00	10	11/25/2014	SW	1411076
200.8	**Nickel**	**25.2**		ug/L	5.00	10	11/25/2014	SW	1411076

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NAOH-091614 **Date / Time Sampled:** 09/16/14 12:00 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-52 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**479**		ug/L	100	5	11/25/2014	SW	1411076
200.7	**Iron**	**6230**		ug/L	500	5	11/25/2014	SW	1411076
200.7	**Manganese**	**2520**		ug/L	10.0	5	11/25/2014	SW	1411076
200.7	**Zinc**	**1130**		ug/L	50.0	5	11/25/2014	SW	1411076
200.8	**Arsenic**	**10.8**	J	ug/L	5.00	10	11/25/2014	SW	1411076
200.8	**Cadmium**	**4.25**		ug/L	1.00	10	11/25/2014	SW	1411076
200.8	**Copper**	**26.5**		ug/L	5.00	10	11/25/2014	SW	1411076
200.8	**Lead**	**4.32**		ug/L	1.00	10	11/25/2014	SW	1411076
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/25/2014	SW	1411076

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NAOH-092314 **Date / Time Sampled:** 09/23/14 12:35 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-55 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**9030**		ug/L	100	5	11/25/2014	SW	1411076
200.7	**Iron**	**25500**		ug/L	500	5	11/25/2014	SW	1411076
200.7	**Manganese**	**91500**		ug/L	10.0	5	11/25/2014	SW	1411076
200.7	**Zinc**	**47300**		ug/L	50.0	5	11/25/2014	SW	1411076
200.8	**Arsenic**	**32.8**		ug/L	5.00	10	11/25/2014	SW	1411076
200.8	**Cadmium**	**216**		ug/L	1.00	10	11/25/2014	SW	1411076
200.8	**Copper**	**696**		ug/L	5.00	10	11/25/2014	SW	1411076
200.8	**Lead**	**72.4**		ug/L	1.00	10	11/25/2014	SW	1411076
200.8	**Nickel**	**22.5**		ug/L	5.00	10	11/25/2014	SW	1411076

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-091614 **Date / Time Sampled:** 09/16/14 13:30 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-58 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**3960**		ug/L	100	5	11/25/2014	SW	1411076
200.7	**Iron**	**7210**		ug/L	500	5	11/25/2014	SW	1411076
200.7	**Manganese**	**61300**		ug/L	10.0	5	11/25/2014	SW	1411076
200.7	**Zinc**	**1680**		ug/L	50.0	5	11/25/2014	SW	1411076
200.8	**Arsenic**	**41.5**		ug/L	5.00	10	11/25/2014	SW	1411076
200.8	**Cadmium**	**3.43**		ug/L	1.00	10	11/25/2014	SW	1411076
200.8	**Copper**	**34.2**		ug/L	5.00	10	11/25/2014	SW	1411076
200.8	**Lead**	**118**		ug/L	1.00	10	11/25/2014	SW	1411076
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/25/2014	SW	1411076

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-092314 **Date / Time Sampled:** 09/23/14 14:20 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-59 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/25/2014	SW	1411076
200.7	Iron	< 1250	U	ug/L	500	5	11/25/2014	SW	1411076
200.7	**Manganese**	**47200**		ug/L	10.0	5	11/25/2014	SW	1411076
200.7	**Zinc**	**101**		ug/L	50.0	5	11/25/2014	SW	1411076
200.8	**Arsenic**	**8.71**	J	ug/L	5.00	10	11/25/2014	SW	1411076
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/25/2014	SW	1411076
200.8	Copper	< 10.0	U	ug/L	5.00	10	11/25/2014	SW	1411076
200.8	**Lead**	**1.50**	J	ug/L	1.00	10	11/25/2014	SW	1411076
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/25/2014	SW	1411076

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-091614 **Date / Time Sampled:** 09/16/14 13:20 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-63 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/25/2014	SW	1411076
200.7	Iron	< 1250	U	ug/L	500	5	11/25/2014	SW	1411076
200.7	**Manganese**	**77000**		ug/L	10.0	5	11/25/2014	SW	1411076
200.7	**Zinc**	**191**		ug/L	50.0	5	11/25/2014	SW	1411076
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/25/2014	SW	1411076
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/25/2014	SW	1411076
200.8	**Copper**	**5.07**	J	ug/L	5.00	10	11/25/2014	SW	1411076
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/25/2014	SW	1411076
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/25/2014	SW	1411076

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-092314 **Date / Time Sampled:** 09/23/14 14:00 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-64 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 250	U	ug/L	100	5	11/25/2014	SW	1411076
200.7	Iron	< 1250	U	ug/L	500	5	11/25/2014	SW	1411076
200.7	**Manganese**	**73800**		ug/L	10.0	5	11/25/2014	SW	1411076
200.7	**Zinc**	**346**		ug/L	50.0	5	11/25/2014	SW	1411076
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/25/2014	SW	1411076
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/25/2014	SW	1411076
200.8	Copper	< 10.0	U	ug/L	5.00	10	11/25/2014	SW	1411076
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/25/2014	SW	1411076
200.8	Nickel	< 10.0	U	ug/L	5.00	10	11/25/2014	SW	1411076

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-091614 **Date / Time Sampled:** 09/16/14 11:30 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-68 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**894**		ug/L	100	5	11/25/2014	SW	1411076
200.7	**Iron**	**88100**		ug/L	500	5	11/25/2014	SW	1411076
200.7	**Manganese**	**84400**		ug/L	10.0	5	11/25/2014	SW	1411076
200.7	**Zinc**	**26800**		ug/L	50.0	5	11/25/2014	SW	1411076
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/25/2014	SW	1411076
200.8	**Cadmium**	**1.20**	J	ug/L	1.00	10	11/25/2014	SW	1411076
200.8	**Copper**	**11.8**	J	ug/L	5.00	10	11/25/2014	SW	1411076
200.8	**Lead**	**1.30**	J	ug/L	1.00	10	11/25/2014	SW	1411076
200.8	**Nickel**	**26.2**	J	ug/L	5.00	10	11/25/2014	SW	1411076

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-092314 **Date / Time Sampled:** 09/23/14 12:00 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-71 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**498**		ug/L	100	5	11/25/2014	SW	1411076
200.7	**Iron**	**103000**		ug/L	500	5	11/25/2014	SW	1411076
200.7	**Manganese**	**93600**		ug/L	10.0	5	11/25/2014	SW	1411076
200.7	**Zinc**	**33600**		ug/L	50.0	5	11/25/2014	SW	1411076
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	11/25/2014	SW	1411076
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	11/25/2014	SW	1411076
200.8	**Copper**	**6.26**	J	ug/L	5.00	10	11/25/2014	SW	1411076
200.8	Lead	< 2.00	U	ug/L	1.00	10	11/25/2014	SW	1411076
200.8	**Nickel**	**18.3**	J	ug/L	5.00	10	11/25/2014	SW	1411076

"J" Qualifier indicates an estimated value

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-091614 **Date / Time Sampled:** 09/16/14 12:15 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-03 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.5**	J	mg/L	5.0	10	10/03/2014	NP	1410026
EPA 300.0	**Fluoride**	**1.5**	J	mg/L	1.0	10	10/03/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/03/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**552**		mg/L	0.5	10	10/03/2014	NP	1410026
EPA 310.1	**Total Alkalinity**	**82.3**		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-091614 **Date / Time Sampled:** 09/16/14 12:15 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-04 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**9.54**	J D	mg/L	0.300	10	10/17/2014	KJB	1410088

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-092314 **Date / Time Sampled:** 09/23/14 12:45 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-07 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.8**	J	mg/L	5.0	10	10/03/2014	NP	1410026
EPA 300.0	**Fluoride**	**1.1**	J	mg/L	1.0	10	10/03/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/03/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**587**		mg/L	0.5	10	10/03/2014	NP	1410026
EPA 310.1	**Total Alkalinity**	**91.5**		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-092314 **Date / Time Sampled:** 09/23/14 12:45 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-08 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**10.8**	D	mg/L	0.300	10	10/17/2014	KJB	1410088

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-091614 **Date / Time Sampled:** 09/16/14 12:30 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-11 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.3**	J	mg/L	5.0	10	10/03/2014	NP	1410026
EPA 300.0	**Fluoride**	**1.5**	J	mg/L	1.0	10	10/03/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/03/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**566**		mg/L	0.5	10	10/03/2014	NP	1410026
EPA 310.1	**Total Alkalinity**	**61.1**		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-091614 **Date / Time Sampled:** 09/16/14 12:30 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-12 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**2.39**	J D	mg/L	0.300	10	10/17/2014	KJB	1410088

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-092314 **Date / Time Sampled:** 09/23/14 13:10 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-15 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**6.0**	J	mg/L	5.0	10	10/03/2014	NP	1410026
EPA 300.0	**Fluoride**	**1.5**	J	mg/L	1.0	10	10/03/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/03/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**560**		mg/L	0.5	10	10/03/2014	NP	1410026
EPA 310.1	**Total Alkalinity**	**61.7**		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-092314 **Date / Time Sampled:** 09/23/14 13:10 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-16 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**2.45**	D	mg/L	0.300	10	10/17/2014	KJB	1410088

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-091614 **Date / Time Sampled:** 09/16/14 12:45 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-19 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.5**	J	mg/L	5.0	10	10/03/2014	NP	1410026
EPA 300.0	**Fluoride**	**3.0**		mg/L	1.0	10	10/03/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/03/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**352**		mg/L	0.5	10	10/03/2014	NP	1410026
EPA 310.1	**Total Alkalinity**	**116**		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-091614 **Date / Time Sampled:** 09/16/14 12:45 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-20 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**14.4**	J D	mg/L	0.300	10	10/17/2014	KJB	1410088

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-092314 **Date / Time Sampled:** 09/23/14 13:25 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-23 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	10/03/2014	NP	1410026
EPA 300.0	Fluoride	< 2.0	U	mg/L	1.0	10	10/03/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/03/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**237**		mg/L	0.5	10	10/03/2014	NP	1410026
EPA 310.1	**Total Alkalinity**	**141**		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-092314 **Date / Time Sampled:** 09/23/14 13:25 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-24 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**16.0**	D	mg/L	0.300	10	10/17/2014	KJB	1410088

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-091614 **Date / Time Sampled:** 09/16/14 13:00 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-27 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	10/03/2014	NP	1410026
EPA 300.0	**Fluoride**	**1.8**	J	mg/L	1.0	10	10/03/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/03/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**642**		mg/L	0.5	10	10/03/2014	NP	1410026
EPA 310.1	**Total Alkalinity**	**51.0**		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-091614 **Date / Time Sampled:** 09/16/14 13:00 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-28 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**1.27**	J D	mg/L	0.300	10	10/17/2014	KJB	1410088

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-092314 **Date / Time Sampled:** 09/23/14 13:45 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-31 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	10/03/2014	NP	1410026
EPA 300.0	**Fluoride**	**1.7**	J	mg/L	1.0	10	10/03/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/03/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**636**		mg/L	0.5	10	10/03/2014	NP	1410026
EPA 310.1	**Total Alkalinity**	**58.5**		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-092314 **Date / Time Sampled:** 09/23/14 13:45 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-32 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**1.56**	D	mg/L	0.300	10	10/17/2014	KJB	1410088

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4D-091614 **Date / Time Sampled:** 09/16/14 13:05 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-35 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.3**	J	mg/L	5.0	10	10/03/2014	NP	1410026
EPA 300.0	**Fluoride**	**1.6**	J	mg/L	1.0	10	10/03/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/03/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**629**		mg/L	0.5	10	10/03/2014	NP	1410026
EPA 310.1	**Total Alkalinity**	**51.2**		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4D-091614 **Date / Time Sampled:** 09/16/14 13:05 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-36 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**1.25**	J D	mg/L	0.300	10	10/17/2014	KJB	1410088

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-CHIT-091614 **Date / Time Sampled:** 09/16/14 11:45 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-39 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.7**	J	mg/L	5.0	10	10/03/2014	NP	1410026
EPA 300.0	**Fluoride**	**1.2**	J	mg/L	1.0	10	10/03/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/03/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**543**		mg/L	0.5	10	10/03/2014	NP	1410026
EPA 310.1	**Total Alkalinity**	**107**		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-CHIT-092314 **Date / Time Sampled:** 09/23/14 12:20 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-42 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	10/03/2014	NP	1410026
EPA 300.0	**Fluoride**	**3.1**		mg/L	1.0	10	10/03/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/03/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**808**		mg/L	0.5	10	10/03/2014	NP	1410026
EPA 310.1	**Total Alkalinity**	**28.1**		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-INFL-091614 **Date / Time Sampled:** 09/16/14 11:05 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-45 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.5**	J	mg/L	5.0	10	10/03/2014	NP	1410026
EPA 300.0	**Fluoride**	**2.5**		mg/L	1.0	10	10/03/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/03/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**1070**		mg/L	0.5	10	10/03/2014	NP	1410026
EPA 310.1	Total Alkalinity	< 10.0		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-INFL-092314 **Date / Time Sampled:** 09/23/14 11:15 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-48 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	10/03/2014	NP	1410026
EPA 300.0	**Fluoride**	**2.3**		mg/L	1.0	10	10/03/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/03/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**1110**		mg/L	0.5	10	10/03/2014	NP	1410026
EPA 310.1	Total Alkalinity	< 10.0		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-INFLD-092314 **Date / Time Sampled:** 09/23/14 11:40 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-51 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.5**	J	mg/L	5.0	10	10/04/2014	NP	1410026
EPA 300.0	**Fluoride**	**2.5**		mg/L	1.0	10	10/04/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/04/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**1110**		mg/L	0.5	10	10/04/2014	NP	1410026
EPA 310.1	Total Alkalinity	< 10.0		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-NAOH-091614 **Date / Time Sampled:** 09/16/14 12:00 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-54 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	10/04/2014	NP	1410026
EPA 300.0	**Fluoride**	**2.0**		mg/L	1.0	10	10/04/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/04/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**883**		mg/L	0.5	10	10/04/2014	NP	1410026
EPA 310.1	**Total Alkalinity**	**34.7**		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-NAOH-092314 **Date / Time Sampled:** 09/23/14 12:35 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-57 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	10/04/2014	NP	1410026
EPA 300.0	**Fluoride**	**2.0**		mg/L	1.0	10	10/04/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/04/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**976**		mg/L	0.5	10	10/04/2014	NP	1410026
EPA 310.1	Total Alkalinity	< 10.0		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTE-092314 **Date / Time Sampled:** 09/23/14 14:20 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-61 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**6.3**	J	mg/L	5.0	10	10/04/2014	NP	1410026
EPA 300.0	**Fluoride**	**1.6**	J	mg/L	1.0	10	10/04/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/04/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**543**		mg/L	0.5	10	10/04/2014	NP	1410026
EPA 310.1	**Total Alkalinity**	**75.5**		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTE-092314 **Date / Time Sampled:** 09/23/14 14:20 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-62 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**6.33**	D	mg/L	0.300	10	10/17/2014	KJB	1410088

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTI-092314 **Date / Time Sampled:** 09/23/14 14:00 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-66 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.4**	J	mg/L	5.0	10	10/04/2014	NP	1410026
EPA 300.0	Fluoride	< 2.0	U	mg/L	1.0	10	10/04/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/04/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**488**		mg/L	0.5	10	10/04/2014	NP	1410026
EPA 310.1	**Total Alkalinity**	**89.4**		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTI-092314 **Date / Time Sampled:** 09/23/14 14:00 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-67 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**7.90**	D	mg/L	0.300	10	10/17/2014	KJB	1410088

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-SAPS-091614 **Date / Time Sampled:** 09/16/14 11:30 **Workorder:** C140918
EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-70 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**6.2**	J	mg/L	5.0	10	10/04/2014	NP	1410026
EPA 300.0	**Fluoride**	**1.5**	J	mg/L	1.0	10	10/04/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/04/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**856**		mg/L	0.5	10	10/04/2014	NP	1410026
EPA 310.1	**Total Alkalinity**	**12.5**		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-SAPS-092314 **Date / Time Sampled:** 09/23/14 12:00 **Workorder:** C140918

EPA Tag No.: **Matrix:** Water **Lab Number:** C140918-73 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**5.5**	J	mg/L	5.0	10	10/04/2014	NP	1410026
EPA 300.0	**Fluoride**	**1.5**	J	mg/L	1.0	10	10/04/2014	NP	1410026
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	10/04/2014	NP	1410026
EPA 300.0	**Sulfate as SO4**	**948**		mg/L	0.5	10	10/04/2014	NP	1410026
EPA 310.1	**Total Alkalinity**	**17.3**		mg CaCO3 / L	5.00	1	09/30/2014	KJB	1409148

"J" Qualifier indicates an estimated value

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ICPMS-PE DRC-II									
Batch 1411086 - No Lab Prep Reqd			***Water***						**ICPMS-PE DRC-II**
Method Blank (1411086-BLK1)		Dilution Factor: 1				Prepared: 11/20/14 Analyzed: 11/21/14			
Nickel	< 0.500	1.00	ug/L						
Copper	< 0.500	1.00	"						
Arsenic	< 0.500	2.00	"						
Cadmium	< 0.100	0.200	"						
Lead	< 0.100	0.200	"						
Method Blank Spike (1411086-BS1)		Dilution Factor: 1				Prepared: 11/20/14 Analyzed: 11/21/14			
Nickel	97.4	1.00	ug/L	100		97	85-115		
Copper	97.5	1.00	"	100		97	85-115		
Arsenic	102	2.00	"	100		102	85-115		
Cadmium	95.4	0.200	"	100		95	85-115		
Lead	99.7	0.200	"	100		100	85-115		
Duplicate (1411086-DUP1)		Dilution Factor: 1	**Source: C140918-02**			Prepared: 11/20/14 Analyzed: 11/21/14			
Nickel	< 5.00	10.0	ug/L		< 5.00				20
Copper	< 5.00	10.0	"		< 5.00				20
Arsenic	< 5.00	20.0	"		< 5.00				20
Cadmium	< 1.00	2.00	"		< 1.00				20
Lead	< 1.00	2.00	"		< 1.00				20
Matrix Spike (1411086-MS1)		Dilution Factor: 1	**Source: C140918-02**			Prepared: 11/20/14 Analyzed: 11/21/14			
Nickel	78.9	10.0	ug/L	100	< 5.00	79	70-130		
Copper	82.1	10.0	"	100	< 5.00	82	70-130		
Arsenic	86.7	20.0	"	100	< 5.00	87	70-130		
Cadmium	90.5	2.00	"	100	< 1.00	91	70-130		
Lead	85.2	2.00	"	100	< 1.00	85	70-130		
Matrix Spike (1411086-MS2)		Dilution Factor: 1	**Source: C140918-06**			Prepared: 11/20/14 Analyzed: 11/21/14			
Nickel	76.2	10.0	ug/L	100	< 5.00	76	70-130		
Copper	81.5	10.0	"	100	< 5.00	82	70-130		
Arsenic	83.7	20.0	"	100	< 5.00	84	70-130		
Cadmium	91.7	2.00	"	100	< 1.00	92	70-130		
Lead	86.1	2.00	"	100	< 1.00	86	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1411094 - 1411086			*Water*						**ICPMS-PE DRC-II**
Serial Dilution (1411094-SRD1)		Dilution Factor: 5	**Source: C140918-02**			Prepared: 11/20/14	Analyzed: 11/21/14		
Nickel	< 25.0	50.0	ug/L		< 5.00				10
Copper	< 25.0	50.0	"		< 5.00				10
Arsenic	< 25.0	100	"		< 5.00				10
Cadmium	< 5.00	10.0	"		< 1.00				10
Lead	< 5.00	10.0	"		< 1.00				10

ICPOE - PE Optima

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1411085 - No Lab Prep Reqd			*Water*						**ICPOE - PE Optima**
Method Blank (1411085-BLK1)		Dilution Factor: 1				Prepared: 11/20/14	Analyzed: 11/21/14		
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						
Method Blank Spike (1411085-BS1)		Dilution Factor: 1				Prepared: 11/20/14	Analyzed: 11/21/14		
Aluminum	10310	50.0	ug/L	10100		102	85-115		
Iron	10440	250	"	10100		103	85-115		
Manganese	102.5	5.00	"	100		102	85-115		
Zinc	100.9	20.0	"	100		101	85-115		
Duplicate (1411085-DUP1)		Dilution Factor: 5	**Source: C140918-02**			Prepared: 11/20/14	Analyzed: 11/21/14		
Aluminum	< 100	250	ug/L		< 100				20
Iron	< 500	1250	"		< 500				20
Manganese	83850	25.0	"		80740			4	20
Zinc	< 50.0	100	"		< 50.0				20
Matrix Spike (1411085-MS1)		Dilution Factor: 5	**Source: C140918-02**			Prepared: 11/20/14	Analyzed: 11/21/14		
Aluminum	10180	250	ug/L	10100	< 100	101	70-130		
Iron	10160	1250	"	10100	< 500	101	70-130		
Manganese	81420	25.0	"	100	80740	676	70-130		
Zinc	113.6	100	"	100	< 50.0	114	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1411085 - No Lab Prep Reqd			*Water*						ICPOE - PE Optima
Matrix Spike (1411085-MS2)		Dilution Factor: 5	**Source: C140918-06**			Prepared: 11/20/14 Analyzed: 11/21/14			
Aluminum	10180	250	ug/L	10100	< 100	101	70-130		
Iron	10440	1250	"	10100	< 500	103	70-130		
Manganese	83870	25.0	"	100	84540	NR	70-130		
Zinc	107.0	100	"	100	< 50.0	107	70-130		
Batch 1411092 - 1411085			*Water*						ICPOE - PE Optima
Serial Dilution (1411092-SRD1)		Dilution Factor: 2	**Source: C140918-02**			Prepared: 11/20/14 Analyzed: 11/21/14			
Aluminum	< 500	1250	ug/L		< 100.00				10
Iron	< 2500	6250	"		< 500.00				10
Manganese	83420	125	"		80740			3	10
Zinc	< 250	500	"		< 50.00				10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

ICPMS-PE DRC-II

Batch 1411075 - 200.2 - TR Metals *Water* **ICPMS-PE DRC-II**

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Method Blank (1411075-BLK2)		Dilution Factor: 5				Prepared: 11/18/14 Analyzed: 11/24/14			
Nickel	< 2.50	5.00	ug/L						
Copper	< 2.50	5.00	"						
Arsenic	< 2.50	10.0	"						
Cadmium	< 0.500	1.00	"						
Lead	< 0.500	1.00	"						
Duplicate (1411075-DUP2)		Dilution Factor: 1	**Source: C140918-01**			Prepared: 11/18/14 Analyzed: 11/24/14			
Nickel	< 5.00	10.0	ug/L		< 5.00				20
Copper	< 5.00	10.0	"		< 5.00				20
Arsenic	< 5.00	20.0	"		< 5.00				20
Cadmium	< 1.00	2.00	"		< 1.00				20
Lead	< 1.00	2.00	"		1.113				20
Matrix Spike (1411075-MS2)		Dilution Factor: 1	**Source: C140918-05**			Prepared: 11/18/14 Analyzed: 11/24/14			
Nickel	431.8	10.0	ug/L	500	< 5.00	86	70-130		
Copper	263.9	10.0	"	300	< 5.00	88	70-130		
Arsenic	734.1	20.0	"	800	< 5.00	92	70-130		
Cadmium	188.6	2.00	"	200	< 1.00	94	70-130		
Lead	855.7	2.00	"	1000	< 1.00	86	70-130		
Matrix Spike (1411075-MS4)		Dilution Factor: 1	**Source: C140918-09**			Prepared: 11/18/14 Analyzed: 11/24/14			
Nickel	430.2	10.0	ug/L	500	< 5.00	86	70-130		
Copper	262.3	10.0	"	300	< 5.00	87	70-130		
Arsenic	710.4	20.0	"	800	< 5.00	89	70-130		
Cadmium	190.4	2.00	"	200	< 1.00	95	70-130		
Lead	839.5	2.00	"	1000	1.191	84	70-130		
Reference (1411075-SRM2)		Dilution Factor: 2				Prepared: 11/18/14 Analyzed: 11/24/14			
Nickel	922.8	20.0	ug/L	1000		92	85-115		
Copper	942.1	20.0	"	1000		94	85-115		
Arsenic	1900	40.0	"	2000		95	85-115		
Cadmium	935.2	4.00	"	1000		94	85-115		
Lead	1959	4.00	"	2000		98	85-115		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1411076 - 200.2 - TR Metals			*Water*						**ICPMS-PE DRC-II**
Method Blank (1411076-BLK2)		Dilution Factor: 5				Prepared: 11/18/14 Analyzed: 11/25/14			
Nickel	< 2.50	5.00	ug/L						
Copper	< 2.50	5.00	"						
Arsenic	< 2.50	10.0	"						
Cadmium	< 0.500	1.00	"						
Lead	< 0.500	1.00	"						
Duplicate (1411076-DUP2)		Dilution Factor: 1	**Source: C140918-46**			Prepared: 11/18/14 Analyzed: 11/25/14			
Nickel	25.30	10.0	ug/L		27.02			7	20
Copper	974.0	10.0	"		1008			3	20
Arsenic	164.0	20.0	"		169.4			3	20
Cadmium	249.5	2.00	"		246.1			1	20
Lead	168.8	2.00	"		175.4			4	20
Matrix Spike (1411076-MS2)		Dilution Factor: 1	**Source: C140918-49**			Prepared: 11/18/14 Analyzed: 11/25/14			
Nickel	461.9	10.0	ug/L	500	25.18	87	70-130		
Copper	1189	10.0	"	300	943.6	82	70-130		
Arsenic	842.0	20.0	"	800	158.4	85	70-130		
Cadmium	434.3	2.00	"	200	246.6	94	70-130		
Lead	1070	2.00	"	1000	166.9	90	70-130		
Reference (1411076-SRM2)		Dilution Factor: 2				Prepared: 11/18/14 Analyzed: 11/25/14			
Nickel	947.5	20.0	ug/L	1000		95	85-115		
Copper	961.5	20.0	"	1000		96	85-115		
Arsenic	1945	40.0	"	2000		97	85-115		
Cadmium	941.9	4.00	"	1000		94	85-115		
Lead	1867	4.00	"	2000		93	85-115		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1411102 - 1411075			*Water*						**ICPMS-PE DRC-II**
Serial Dilution (1411102-SRD1)		Dilution Factor: 5	**Source: C140918-01**			Prepared: 11/18/14 Analyzed: 11/24/14			
Nickel	< 25.0	50.0	ug/L		< 5.00				10
Copper	< 25.0	50.0	"		< 5.00				10
Arsenic	< 25.0	100	"		< 5.00				10
Cadmium	< 5.00	10.0	"		< 1.00				10
Lead	< 5.00	10.0	"		1.113				10
Batch 1411103 - 1411076			*Water*						**ICPMS-PE DRC-II**
Serial Dilution (1411103-SRD1)		Dilution Factor: 5	**Source: C140918-46**			Prepared: 11/18/14 Analyzed: 11/25/14			
Nickel	27.08	50.0	ug/L		27.02			0.2	10
Copper	1051	50.0	"		1008			4	10
Arsenic	171.4	100	"		169.4			1	10
Cadmium	252.9	10.0	"		246.1			3	10
Lead	166.0	10.0	"		175.4			6	10

ICPOE - PE Optima

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1411075 - 200.2 - TR Metals			*Water*						**ICPOE - PE Optima**
Method Blank (1411075-BLK1)		Dilution Factor: 1				Prepared: 11/18/14 Analyzed: 11/24/14			
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						
Duplicate (1411075-DUP1)		Dilution Factor: 5	**Source: C140918-01**			Prepared: 11/18/14 Analyzed: 11/24/14			
Aluminum	< 100	250	ug/L		< 100				20
Iron	< 500	1250	"		< 500				20
Manganese	86730	25.0	"		85590			1	20
Zinc	115.6	100	"		96.31			18	20

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1411075 - 200.2 - TR Metals			***Water***						**ICPOE - PE Optima**
Matrix Spike (1411075-MS1)		Dilution Factor: 5	**Source: C140918-05**			Prepared: 11/18/14 Analyzed: 11/24/14			
Aluminum	2010	250	ug/L	2000	< 100	100	70-130		
Iron	3407	1250	"	3000	< 500	114	70-130		
Manganese	88390	25.0	"	200	88880	NR	70-130		
Zinc	265.8	100	"	200	50.79	107	70-130		
Matrix Spike (1411075-MS3)		Dilution Factor: 5	**Source: C140918-09**			Prepared: 11/18/14 Analyzed: 11/24/14			
Aluminum	1990	250	ug/L	2000	< 100	100	70-130		
Iron	3538	1250	"	3000	< 500	118	70-130		
Manganese	100100	25.0	"	200	98930	582	70-130		
Zinc	704.6	100	"	200	514.4	95	70-130		
Reference (1411075-SRM1)		Dilution Factor: 1				Prepared: 11/18/14 Analyzed: 11/24/14			
Aluminum	917.5	50.0	ug/L	1000		92	85-115		
Iron	914.2	250	"	1000		91	85-115		
Manganese	1028	5.00	"	1000		103	85-115		
Zinc	988.1	20.0	"	1000		99	85-115		
Batch 1411076 - 200.2 - TR Metals			***Water***						**ICPOE - PE Optima**
Method Blank (1411076-BLK1)		Dilution Factor: 1				Prepared: 11/18/14 Analyzed: 11/25/14			
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						
Duplicate (1411076-DUP1)		Dilution Factor: 5	**Source: C140918-46**			Prepared: 11/18/14 Analyzed: 11/25/14			
Aluminum	13340	250	ug/L		13460			0.9	20
Iron	144500	1250	"		147700			2	20
Manganese	104700	25.0	"		107400			3	20
Zinc	55760	100	"		58410			5	20

Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1411076 - 200.2 - TR Metals			***Water***						**ICPOE - PE Optima**
Matrix Spike (1411076-MS1)		Dilution Factor: 5	**Source: C140918-49**			Prepared: 11/18/14	Analyzed: 11/25/14		
Aluminum	15080	250	ug/L	2000	13390	84	70-130		
Iron	143700	1250	"	3000	140300	114	70-130		
Manganese	104400	25.0	"	200	104300	52	70-130		
Zinc	56190	100	"	200	55440	377	70-130		
Reference (1411076-SRM1)		Dilution Factor: 1				Prepared: 11/18/14	Analyzed: 11/25/14		
Aluminum	924.7	50.0	ug/L	1000		92	85-115		
Iron	907.6	250	"	1000		91	85-115		
Manganese	1027	5.00	"	1000		103	85-115		
Zinc	959.7	20.0	"	1000		96	85-115		
Batch 1411099 - 1411075			***Water***						**ICPOE - PE Optima**
Serial Dilution (1411099-SRD1)		Dilution Factor: 2	**Source: C140918-01**			Prepared: 11/18/14	Analyzed: 11/24/14		
Aluminum	< 500	1250	ug/L		< 100.00				10
Iron	< 2500	6250	"		< 500.00				10
Manganese	90050	125	"		85590			5	10
Zinc	< 250	500	"		96.31				10
Batch 1411100 - 1411076			***Water***						**ICPOE - PE Optima**
Serial Dilution (1411100-SRD1)		Dilution Factor: 2	**Source: C140918-46**			Prepared: 11/18/14	Analyzed: 11/25/14		
Aluminum	13610	1250	ug/L		13460			1	10
Iron	146100	6250	"		147700			1	10
Manganese	113800	125	"		107400			6	10
Zinc	57340	500	"		58410			2	10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ESAT Dionex IC									
Batch 1410026 - No Prep Req			***Water***						**ESAT Dionex IC**
Method Blank (1410026-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 10/03/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						
Method Blank Spike (1410026-BS1)		Dilution Factor: 1				Prepared & Analyzed: 10/03/14			
Fluoride	5.1	0.2	mg/L	5.00		101	90-110		
Chloride	25.6	2.0	"	25.0		102	90-110		
Sulfate as SO4	26.0	0.1	"	25.0		104	90-110		
Nitrate/Nitrite as N	20.5	5.0	"	20.0		102	90-110		
Duplicate (1410026-DUP1)		Dilution Factor: 1	**Source: C140918-03**			Prepared & Analyzed: 10/03/14			
Fluoride	1.5	2.0	mg/L		1.5			3	20
Chloride	5.6	20.0	"		5.5			1	20
Sulfate as SO4	553	1.0	"		552			0.2	20
Nitrate/Nitrite as N	< 10.0	50.0	"		< 10.0				20
Matrix Spike (1410026-MS1)		Dilution Factor: 1	**Source: C140918-03**			Prepared & Analyzed: 10/03/14			
Fluoride	53.5	2.0	mg/L	50.0	1.5	104	80-120		
Chloride	253	20.0	"	250	5.5	99	80-120		
Sulfate as SO4	824	1.0	"	250	552	109	80-120		
Nitrate/Nitrite as N	196	50.0	"	200	< 10.0	98	80-120		
Matrix Spike (1410026-MS2)		Dilution Factor: 1	**Source: C140918-42**			Prepared & Analyzed: 10/03/14			
Fluoride	51.7	2.0	mg/L	50.0	3.1	97	80-120		
Chloride	254	20.0	"	250	5.4	100	80-120		
Sulfate as SO4	1070	1.0	"	250	808	107	80-120		
Nitrate/Nitrite as N	196	50.0	"	200	< 10.0	98	80-120		

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1410034 - 1410026			*Water*						**ESAT Dionex IC**
Instrument Blank (1410034-IBL1)		Dilution Factor: 1				Prepared & Analyzed: 10/03/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						
Lachat 8500									
Batch 1410088 - No Prep Req			*Water*						**Lachat 8500**
Method Blank (1410088-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 10/17/14			
Ammonia as N	< 0.0300	0.0500	mg/L						
Method Blank Spike (1410088-BS1)		Dilution Factor: 1				Prepared & Analyzed: 10/17/14			
Ammonia as N	1.04	0.0500	mg/L	1.00		104	90-110		
Duplicate (1410088-DUP1)		Dilution Factor: 1	**Source: C140918-08**			Prepared & Analyzed: 10/17/14			
Ammonia as N	10.6	0.500	mg/L		10.8			1	20
Duplicate (1410088-DUP2)		Dilution Factor: 1	**Source: C140918-67**			Prepared & Analyzed: 10/17/14			
Ammonia as N	7.32	0.500	mg/L		7.90			8	20
Matrix Spike (1410088-MS1)		Dilution Factor: 1	**Source: C140918-08**			Prepared & Analyzed: 10/17/14			
Ammonia as N	19.3	0.500	mg/L	10.0	10.8	86	80-120		
Matrix Spike (1410088-MS2)		Dilution Factor: 1	**Source: C140918-67**			Prepared & Analyzed: 10/17/14			
Ammonia as N	16.2	0.500	mg/L	10.0	7.90	83	80-120		
Reference (1410088-SRM1)		Dilution Factor: 5				Prepared & Analyzed: 10/17/14			
Ammonia as N	5.30	0.250	mg/L	4.80		110	90-110		

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Mettler AT									
Batch 1409148 - No Prep Req			*Water*						**Mettler AT**
Method Blank (1409148-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 09/30/14			
Total Alkalinity	< 5.00	10.0	mg CaCO3 / L						
Duplicate (1409148-DUP1)		Dilution Factor: 1	**Source: C140918-03**			Prepared & Analyzed: 09/30/14			
Total Alkalinity	82.2	10.0	mg CaCO3 / L		82.3			0.09	20
Duplicate (1409148-DUP2)		Dilution Factor: 1	**Source: C140918-42**			Prepared & Analyzed: 09/30/14			
Total Alkalinity	27.8	10.0	mg CaCO3 / L		28.1			1	20
Reference (1409148-SRM1)		Dilution Factor: 1				Prepared & Analyzed: 09/30/14			
Total Alkalinity	12.1	10.0	mg CaCO3 / L	10.4		117	61.3-143.9		

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

TechLaw Inc., ESAT Region 8
INORGANIC ANALYSES DATA SHEET
Intial and Continuing Calibration Blanks

Analytical Method: EPA 300.0 Analysis Name: WC - Anions by Ion Chromatography

Instrument: **ESAT Dionex IC** Work Order: Nu C140918

Analytical Sequence: 1410034 **Dissolved** Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Fluoride	0.00	**1**	**2**	**3**	**4**	1410026-BLK1	NA	0.20
		0.00	0.00	0.00		0.00	NA	
		5	**6**	**7**	**8**			
Chloride	0.00	**1**	**2**	**3**	**4**	1410026-BLK1	NA	2.00
		0.00	0.00	0.00		0.00	NA	
		5	**6**	**7**	**8**			
Sulfate as SO4	0.00	**1**	**2**	**3**	**4**	1410026-BLK1	NA	0.10
		0.00	0.00	0.00		0.00	NA	
		5	**6**	**7**	**8**			
Nitrate/Nitrite as N	0.00	**1**	**2**	**3**	**4**	1410026-BLK1	NA	5.00
		0.00	0.00	0.00		0.00	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

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TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 310.1

Analysis Name: WC - Alkalinity

Instrument: **Mettler AT**

Work Order: Nu C140918

Analytical Sequence: **Total**

Concentration Units: mg CaCO3 / L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
		1	**2**	**3**	**4**	1409148-BLK1	NA	
Total Alkalinity		1.43	1.58			1.14	NA	10.00
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

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TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 350.1 Analysis Name: WC - Ammonia

Instrument: **Lachat 8500** Work Order: Nu C140918

Analytical Sequence: **Total** Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	1410088-BLK1	NA	
Ammonia as N		0.00	-0.01			0.00	NA	0.05
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

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INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7 Analysis Name: ICPOE Diss. Metals

Instrument: **ICPOE - PE Optima** Work Order: Nu C140918

Analytical Sequence: 1411092 **Dissolved** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Aluminum	0.33	**1**	**2**	**3**	**4**	1411085-BLK1	NA	50.00
		0.16	0.11	-0.17		5.38	NA	
		5	**6**	**7**	**8**			
Iron	-12.30	**1**	**2**	**3**	**4**	1411085-BLK1	NA	250.00
		-8.11	-8.60	-8.54		50.72	NA	
		5	**6**	**7**	**8**			
Manganese	0.10	**1**	**2**	**3**	**4**	1411085-BLK1	NA	5.00
		0.34	0.52	0.46		-0.11	NA	
		5	**6**	**7**	**8**			
Zinc	0.56	**1**	**2**	**3**	**4**	1411085-BLK1	NA	20.00
		0.67	0.90	-0.84		0.11	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

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TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8 Analysis Name: ICPMS Diss. Metals

Instrument: **ICPMS-PE DRC-II** Work Order: Nu C140918

Analytical Sequence: 1411094 **Dissolved** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Nickel	0.01	**1**	**2**	**3**	**4**	1411086-BLK1	NA	1.00
		0.02	0.01	0.01		0.03	NA	
		5	**6**	**7**	**8**			
Copper	0.01	**1**	**2**	**3**	**4**	1411086-BLK1	NA	1.00
		0.02	0.02	0.02		-0.01	NA	
		5	**6**	**7**	**8**			
Arsenic	0.21	**1**	**2**	**3**	**4**	1411086-BLK1	NA	2.00
		0.10	0.30	0.24		0.22	NA	
		5	**6**	**7**	**8**			
Cadmium	0.02	**1**	**2**	**3**	**4**	1411086-BLK1	NA	0.20
		0.01	0.00	0.01		-0.01	NA	
		5	**6**	**7**	**8**			
Lead	0.02	**1**	**2**	**3**	**4**	1411086-BLK1	NA	0.20
		0.01	0.00	0.01		0.00	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

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TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method:	200.7	Analysis Name:	ICPOE Tot. Rec. Metals
Instrument:	**ICPOE - PE Optima**	Work Order: Nu	C140918
Analytical Sequence:	1411099 **Total Recoverable**	Concentration Units:	ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks								Method Blank (Batch ID)				PQL
		1	2	3	4	5	6	7	8					
Aluminum	-0.99	1.05	0.56							1411076-BLK1	-0.21	NA	NA	50.00
	-0.99	1.05	0.56							1411075-BLK1	-1.31	NA	NA	50.00
Iron	-8.48	-12.40	-3.42							1411076-BLK1	34.43	NA	NA	250.00
	-8.48	-12.40	-3.42							1411075-BLK1	7.87	NA	NA	250.00
Manganese	0.13	0.37	0.38							1411076-BLK1	0.14	NA	NA	5.00
	0.13	0.37	0.38							1411075-BLK1	-0.19	NA	NA	5.00
Zinc	-0.48	2.96	2.41							1411076-BLK1	3.34	NA	NA	20.00
	-0.48	2.96	2.41							1411075-BLK1	3.28	NA	NA	20.00

Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

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TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method:	200.7	Analysis Name:	ICPOE Tot. Rec. Metals
Instrument:	**ICPOE - PE Optima**	Work Order: Nu	C140918
Analytical Sequence:	1411100 **Total Recoverable**	Concentration Units:	ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Aluminum	-0.35	**1**	**2**	**3**	**4**	1411076-BLK1	NA	50.00
		2.92	1.22			-0.21	NA	
		5	**6**	**7**	**8**			
	-0.35	**1**	**2**	**3**	**4**	1411075-BLK1	NA	50.00
		2.92	1.22			-1.31	NA	
		5	**6**	**7**	**8**			
Iron	0.25	**1**	**2**	**3**	**4**	1411075-BLK1	NA	250.00
		-3.93	23.15			7.87	NA	
		5	**6**	**7**	**8**			
	0.25	**1**	**2**	**3**	**4**	1411076-BLK1	NA	250.00
		-3.93	23.15			34.43	NA	
		5	**6**	**7**	**8**			
Manganese	0.14	**1**	**2**	**3**	**4**	1411075-BLK1	NA	5.00
		0.27	0.59			-0.19	NA	
		5	**6**	**7**	**8**			
	0.14	**1**	**2**	**3**	**4**	1411076-BLK1	NA	5.00
		0.27	0.59			0.14	NA	
		5	**6**	**7**	**8**			
Zinc	-1.68	**1**	**2**	**3**	**4**	1411076-BLK1	NA	20.00
		0.21	2.84			3.34	NA	
		5	**6**	**7**	**8**			
	-1.68	**1**	**2**	**3**	**4**	1411075-BLK1	NA	20.00
		0.21	2.84			3.28	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

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TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Instrument: **ICPMS-PE DRC-II** Work Order: Nu C140918

Analytical Sequence: 1411102 **Total Recoverable** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Nickel	0.00	**1**	**2**	**3**	**4**	NA	1411076-BLK2	1.00
		0.00	0.00			NA	0.00	
		5	**6**	**7**	**8**			
	0.00	**1**	**2**	**3**	**4**	NA	1411075-BLK2	1.00
		0.00	0.00			NA	0.02	
		5	**6**	**7**	**8**			
Copper	0.00	**1**	**2**	**3**	**4**	NA	1411076-BLK2	1.00
		0.01	0.02			NA	0.08	
		5	**6**	**7**	**8**			
	0.00	**1**	**2**	**3**	**4**	NA	1411075-BLK2	1.00
		0.01	0.02			NA	0.25	
		5	**6**	**7**	**8**			
Arsenic	0.18	**1**	**2**	**3**	**4**	NA	1411075-BLK2	2.00
		0.21	0.13			NA	0.13	
		5	**6**	**7**	**8**			
	0.18	**1**	**2**	**3**	**4**	NA	1411076-BLK2	2.00
		0.21	0.13			NA	0.03	
		5	**6**	**7**	**8**			
Cadmium	0.00	**1**	**2**	**3**	**4**	NA	1411076-BLK2	0.20
		0.01	0.02			NA	0.00	
		5	**6**	**7**	**8**			
	0.00	**1**	**2**	**3**	**4**	NA	1411075-BLK2	0.20
		0.01	0.02			NA	0.01	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8

Analysis Name: ICPMS Tot. Rec. Metals

Instrument: **ICPMS-PE DRC-II**

Work Order: Nu C140918

Analytical Sequence: 1411102 **Total Recoverable**

Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

<table>
<tr><th>Analyte</th><th>Initial Calibration Blank (1 & 2)</th><th colspan="4">Continuing Calibration Blanks</th><th colspan="2">Method Blank (Batch ID)</th><th>PQL</th></tr>
<tr><td rowspan="4">Lead</td><td rowspan="2">0.00</td><td>1</td><td>2</td><td>3</td><td>4</td><td>NA</td><td>1411075-BLK2</td><td rowspan="4">0.20</td></tr>
<tr><td>-0.02</td><td>-0.03</td><td></td><td></td><td rowspan="3">NA</td><td rowspan="3">0.01</td></tr>
<tr><td rowspan="2"></td><td>5</td><td>6</td><td>7</td><td>8</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="4"></td><td rowspan="2">0.00</td><td>1</td><td>2</td><td>3</td><td>4</td><td>NA</td><td>1411076-BLK2</td><td rowspan="4">0.20</td></tr>
<tr><td>-0.02</td><td>-0.03</td><td></td><td></td><td rowspan="3">NA</td><td rowspan="3">-0.01</td></tr>
<tr><td rowspan="2"></td><td>5</td><td>6</td><td>7</td><td>8</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
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Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Instrument: **ICPMS-PE DRC-II** Work Order: Nu C140918

Analytical Sequence: 1411103 **Total Recoverable** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Nickel	0.00	**1**	**2**	**3**	**4**	NA	1411075-BLK2	1.00
		0.00	0.00			NA	0.02	
		5	**6**	**7**	**8**			
	0.00	**1**	**2**	**3**	**4**	NA	1411076-BLK2	1.00
		0.00	0.00			NA	0.00	
		5	**6**	**7**	**8**			
Copper	0.00	**1**	**2**	**3**	**4**	NA	1411076-BLK2	1.00
		0.00	0.00			NA	0.08	
		5	**6**	**7**	**8**			
	0.00	**1**	**2**	**3**	**4**	NA	1411075-BLK2	1.00
		0.00	0.00			NA	0.25	
		5	**6**	**7**	**8**			
Arsenic	0.10	**1**	**2**	**3**	**4**	NA	1411076-BLK2	2.00
		0.12	0.30			NA	0.03	
		5	**6**	**7**	**8**			
	0.10	**1**	**2**	**3**	**4**	NA	1411075-BLK2	2.00
		0.12	0.30			NA	0.13	
		5	**6**	**7**	**8**			
Cadmium	0.01	**1**	**2**	**3**	**4**	NA	1411075-BLK2	0.20
		0.01	0.00			NA	0.01	
		5	**6**	**7**	**8**			
	0.01	**1**	**2**	**3**	**4**	NA	1411076-BLK2	0.20
		0.01	0.00			NA	0.00	
		5	**6**	**7**	**8**			

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8
Analysis Name: ICPMS Tot. Rec. Metals
Instrument: **ICPMS-PE DRC-II**
Work Order: Nu C140918
Analytical Sequence: 1411103 **Total Recoverable**
Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	NA	1411076-BLK2	
Lead	0.01	-0.02	-0.02			NA	-0.01	0.20
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	NA	1411075-BLK2	
	0.01	-0.02	-0.02			NA	0.01	0.20
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ESAT Dionex IC Method: EPA 300.0 Analysis Name: WC - Anions by Ion Chromatography 2013

Sequence: 1410034 Work Order: C140918 Units: mg/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Chloride					1			2			3	
	40.0	39.4	98.5	40.0	39.7	99.3	40.0	39.6	99.0	40.0	39.6	99.0
					4			5			6	
					7			8			9	
Fluoride					1			2			3	
	4.00	3.8	95.0	4.00	3.9	97.5	4.00	3.9	97.5	4.00	3.9	97.5
					4			5			6	
					7			8			9	
Nitrate/Nitrite as N					1			2			3	
	20.0	20.6	103.0	20.0	20.7	103.5	20.0	20.6	103.0	20.0	20.6	103.0
					4			5			6	
					7			8			9	
Sulfate as SO4					1			2			3	
	100	98.8	98.8	100	100	100.0	100	100	100.0	100	99.5	99.5
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Mettler AT Method: EPA 310.1 Analysis Name: WC - Alkalinity

Sequence: 1410059 Work Order: C140918 Units: mg CaCO3 / L

Total Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
Total Alkalinity				**1**			**2**			**3**		
				100	99.9	99.9	100	99.6	99.6	100	100	100.0
				4			**5**			**6**		
				7			**8**			**9**		

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Lachat 8500 Method: EPA 350.1 Analysis Name: WC - Ammonia

Sequence: 1410095 Work Order: C140918 Units: mg/L

Total Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Ammonia as N					1			2			3	
				1.00	0.969	96.9	1.00	0.971	97.1			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Diss. Metals

Sequence: 1411092 Work Order: C140918 Units: ug/L

Dissolved Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
Aluminum	12500	12740	101.9		**1**			**2**			**3**	
				12500	13000	104.0	12500	12940	103.5	12500	12720	101.8
					4			**5**			**6**	
					7			**8**			**9**	
Iron	12500	12710	101.7		**1**			**2**			**3**	
				12500	13270	106.2	12500	13060	104.5	12500	12830	102.6
					4			**5**			**6**	
					7			**8**			**9**	
Manganese	1000	1035	103.5		**1**			**2**			**3**	
				1000	1040	104.0	1000	1038	103.8	1000	1034	103.4
					4			**5**			**6**	
					7			**8**			**9**	
Zinc	2500	2583	103.3		**1**			**2**			**3**	
				2500	2589	103.6	2500	2585	103.4	2500	2562	102.5
					4			**5**			**6**	
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Diss. Metals

Sequence: 1411094 Work Order: C140918 Units: ug/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Arsenic	50.0	50.6	101.2	50.0	49.2	98.4	50.0	45.4	90.8	50.0	45.5	91.0
					4			5			6	
					7			8			9	
					1			2			3	
Cadmium	50.0	47.9	95.8	50.0	48.3	96.6	50.0	48.8	97.6	50.0	48.0	96.0
					4			5			6	
					7			8			9	
					1			2			3	
Copper	50.0	50.2	100.4	50.0	49.5	99.0	50.0	45.9	91.8	50.0	45.3	90.6
					4			5			6	
					7			8			9	
					1			2			3	
Lead	50.0	49.0	98.0	50.0	48.2	96.4	50.0	46.3	92.6	50.0	46.5	93.0
					4			5			6	
					7			8			9	
					1			2			3	
Nickel	50.0	49.8	99.6	50.0	49.0	98.0	50.0	47.1	94.2	50.0	46.3	92.6
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Sequence: 1411099 Work Order: C140918 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Aluminum	12500	12910	103.3	12500	12910	103.3	12500	12860	102.9			
					4			5			6	
					7			8			9	
					1			2			3	
Iron	12500	12680	101.4	12500	12640	101.1	12500	12500	100.0			
					4			5			6	
					7			8			9	
					1			2			3	
Manganese	1000	1035	103.5	1000	1042	104.2	1000	1041	104.1			
					4			5			6	
					7			8			9	
					1			2			3	
Zinc	2500	2613	104.5	2500	2621	104.8	2500	2628	105.1			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Sequence: 1411100 Work Order: C140918 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Aluminum	12500	12660	101.3		1			2			3	
				12500	12830	102.6	12500	12650	101.2			
					4			5			6	
					7			8			9	
Iron	12500	12770	102.2		1			2			3	
				12500	12670	101.4	12500	12490	99.9			
					4			5			6	
					7			8			9	
Manganese	1000	1021	102.1		1			2			3	
				1000	1016	101.6	1000	1033	103.3			
					4			5			6	
					7			8			9	
Zinc	2500	2529	101.2		1			2			3	
				2500	2540	101.6	2500	2581	103.2			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1411102 Work Order: C140918 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Arsenic	50.0	51.23	102.5		1			2			3	
				50.0	47.49	95.0	50.0	48.38	96.8			
					4			5			6	
					7			8			9	
Cadmium	50.0	48.40	96.8		1			2			3	
				50.0	49.32	98.6	50.0	49.36	98.7			
					4			5			6	
					7			8			9	
Copper	50.0	49.69	99.4		1			2			3	
				50.0	49.40	98.8	50.0	49.93	99.9			
					4			5			6	
					7			8			9	
Lead	50.0	50.68	101.4		1			2			3	
				50.0	46.79	93.6	50.0	47.32	94.6			
					4			5			6	
					7			8			9	
Nickel	50.0	48.59	97.2		1			2			3	
				50.0	48.12	96.2	50.0	50.13	100.3			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1411103 Work Order: C140918 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Arsenic	50.0	48.98	98.0		1			2			3	
				50.0	47.80	95.6	50.0	47.44	94.9			
					4			5			6	
					7			8			9	
Cadmium	50.0	48.80	97.6		1			2			3	
				50.0	48.36	96.7	50.0	48.04	96.1			
					4			5			6	
					7			8			9	
Copper	50.0	50.39	100.8		1			2			3	
				50.0	48.51	97.0	50.0	46.53	93.1			
					4			5			6	
					7			8			9	
Lead	50.0	48.47	96.9		1			2			3	
				50.0	47.17	94.3	50.0	48.03	96.1			
					4			5			6	
					7			8			9	
Nickel	50.0	50.50	101.0		1			2			3	
				50.0	49.25	98.5	50.0	47.69	95.4			
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

ICP Interference Check Sample

ICPMS-PE DRC-II

Sequence: 1411094 Analysis: ICPMS Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.1	ug/L			2.00
	IFB1	20.1	ug/L	20	100	2.00
Cadmium	IFA1	0.1	ug/L			0.200
	IFB1	19.8	ug/L	20	99	0.200
Copper	IFA1	0.7	ug/L			1.00
	IFB1	20.5	ug/L	20	103	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	0.0	ug/L			1.00
	IFB1	20.0	ug/L	20	100	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1411102 Analysis: ICPMS Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.0	ug/L			2.00
	IFB1	19.9	ug/L	20	99	2.00
Cadmium	IFA1	0.1	ug/L			0.200
	IFB1	20.1	ug/L	20	101	0.200
Copper	IFA1	0.8	ug/L			1.00
	IFB1	20.9	ug/L	20	104	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	-0.1	ug/L			1.00
	IFB1	19.3	ug/L	20	96	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8

ICP Interference Check Sample

ICPMS-PE DRC-II

Analyte	Check Sample	Result*	Units	True	%R	PQL
Sequence: 1411103	Analysis: ICPMS Tot. Rec. Metals					
Arsenic	IFA1	0.0	ug/L			2.00
	IFB1	19.9	ug/L	20	99	2.00
Cadmium	IFA1	0.1	ug/L			0.200
	IFB1	20.2	ug/L	20	101	0.200
Copper	IFA1	0.8	ug/L			1.00
	IFB1	20.4	ug/L	20	102	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	-0.1	ug/L			1.00
	IFB1	20.0	ug/L	20	100	1.00

*Criteria = 80-120%R of True Value or +/- PQL

See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8

ICP Interference Check Sample

ICPOE - PE Optima

Sequence: 1411092 Analysis: ICPOE Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	58,946.7	ug/L	60,000	98	50.0
	IFB1	60,393.6	ug/L	60,000	101	50.0
Iron	IFA1	235,374.5	ug/L	250,000	94	250
	IFB1	236,309.1	ug/L	250,000	95	250
Manganese	IFA1	0.0	ug/L			5.00
	IFB1	195.6	ug/L	200	98	5.00
Zinc	IFA1	5.3	ug/L			20.0
	IFB1	278.5	ug/L	300	93	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1411099 Analysis: ICPOE Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	59,605.2	ug/L	60,000	99	50.0
	IFB1	59,692.2	ug/L	60,000	99	50.0
Iron	IFA1	222,383.5	ug/L	250,000	89	250
	IFB1	226,580.4	ug/L	250,000	91	250
Manganese	IFA1	-0.5	ug/L			5.00
	IFB1	194.3	ug/L	200	97	5.00
Zinc	IFA1	0.3	ug/L			20.0
	IFB1	281.2	ug/L	300	94	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1411100 Analysis: ICPOE Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	58,490.7	ug/L	60,000	97	50.0
	IFB1	60,313.7	ug/L	60,000	101	50.0
Iron	IFA1	223,856.3	ug/L	250,000	90	250
	IFB1	232,796.3	ug/L	250,000	93	250
Manganese	IFA1	0.0	ug/L			5.00
	IFB1	193.5	ug/L	200	97	5.00
Zinc	IFA1	3.7	ug/L			20.0
	IFB1	280.9	ug/L	300	94	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPMS-PE DRC-II

Metals (Dissolved) by EPA 200/7000 Series Methods

Sequence: 1411094

Analyte	True	Found	%R	Units
Arsenic	2.00	2.26	113	ug/L
Cadmium	0.200	0.200	100	ug/L
Copper	1.00	1.22	122	ug/L
Lead	0.200	0.213	106	ug/L
Nickel	1.00	0.992	99	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPOE - PE Optima

Metals (Dissolved) by EPA 200/7000 Series Methods

Sequence: 1411092

Analyte	True	Found	%R	Units
Aluminum	100	101.4	101	ug/L
Iron	100	96.29	96	ug/L
Manganese	10.0	10.70	107	ug/L
Zinc	50.0	53.35	107	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

Lachat 8500

Classical Chemistry by EPA/ASTM/APHA Methods

Sequence: 1410095

Analyte	True	Found	%R	Units
Ammonia as N	0.0250	0.0224	90	mg/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPMS-PE DRC-II

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1411102

Analyte	True	Found	%R	Units
Arsenic	2.00	1.932	97	ug/L
Cadmium	0.200	0.2113	106	ug/L
Copper	1.00	0.9363	94	ug/L
Lead	0.200	0.1796	90	ug/L
Nickel	1.00	0.9006	90	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPMS-PE DRC-II

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1411103

Analyte	True	Found	%R	Units
Arsenic	2.00	2.067	103	ug/L
Cadmium	0.200	0.1959	98	ug/L
Copper	1.00	1.056	106	ug/L
Lead	0.200	0.2012	101	ug/L
Nickel	1.00	0.9537	95	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

ICPOE - PE Optima

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1411099

Analyte	True	Found	%R	Units
Aluminum	100	96.47	96	ug/L
Iron	100	74.14	74	ug/L
Manganese	10.0	10.44	104	ug/L
Zinc	50.0	53.81	108	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

ICPOE - PE Optima

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1411100

Analyte	True	Found	%R	Units
Aluminum	100	98.64	99	ug/L
Iron	100	85.00	85	ug/L
Manganese	10.0	10.61	106	ug/L
Zinc	50.0	52.90	106	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 300.0 **Dissolved** **Sequence ID#:** 1410034

Instrument ID #: ESAT Dionex IC Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1410034-ICV1	Initial Cal Check	10/03/14	15:57
1410034-ICB1	Initial Cal Blank	10/03/14	16:15
1410034-SCV1	Secondary Cal Check	10/03/14	16:34
1410034-IBL1	Instrument Blank	10/03/14	16:53
1410026-BS1	Blank Spike	10/03/14	17:12
1410026-BLK1	Blank	10/03/14	17:31
C140918-03	14BH-DT-PILOT-BCR1-09161	10/03/14	17:50
1410026-DUP1	Duplicate	10/03/14	18:08
1410026-MS1	Matrix Spike	10/03/14	18:27
C140918-07	14BH-DT-PILOT-BCR1-09231	10/03/14	18:46
C140918-11	14BH-DT-PILOT-BCR2-09161	10/03/14	19:05
C140918-15	14BH-DT-PILOT-BCR2-09231	10/03/14	19:24
1410034-CCV1	Calibration Check	10/03/14	19:43
1410034-CCB1	Calibration Blank	10/03/14	20:01
C140918-19	14BH-DT-PILOT-BCR3-09161	10/03/14	20:58
C140918-23	14BH-DT-PILOT-BCR3-09231	10/03/14	21:17
C140918-27	14BH-DT-PILOT-BCR4-09161	10/03/14	21:35
C140918-31	14BH-DT-PILOT-BCR4-09231	10/03/14	21:54
C140918-35	14BH-DT-PILOT-BCR4D-091	10/03/14	22:13
C140918-39	14BH-DT-PILOT-CHIT-09161	10/03/14	22:32
C140918-42	14BH-DT-PILOT-CHIT-09231	10/03/14	22:51
1410026-MS2	Matrix Spike	10/03/14	23:10
C140918-45	14BH-DT-PILOT-INFL-091614	10/03/14	23:28
C140918-48	14BH-DT-PILOT-INFL-092314	10/03/14	23:47
1410034-CCV2	Calibration Check	10/04/14	00:06
1410034-CCB2	Calibration Blank	10/04/14	00:25
C140918-51	14BH-DT-PILOT-INFLD-0923	10/04/14	01:21
C140918-54	14BH-DT-PILOT-NAOH-0916	10/04/14	01:40
C140918-57	14BH-DT-PILOT-NAOH-0923	10/04/14	01:59
C140918-61	14BH-DT-PILOT-POSTE-0923	10/04/14	02:18
C140918-66	14BH-DT-PILOT-POSTI-09231	10/04/14	02:37
C140918-70	14BH-DT-PILOT-SAPS-09161	10/04/14	02:56
C140918-73	14BH-DT-PILOT-SAPS-09231	10/04/14	03:14
1410034-CCV3	Calibration Check	10/04/14	03:33
1410034-CCB3	Calibration Blank	10/04/14	04:30

Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 310.1 **Total** **Sequence ID#:** 1410059

Instrument ID #: Mettler AT Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409148-SRM1	Reference	09/30/14	07:24
1409148-BLK1	Blank	09/30/14	07:24
C140918-03	14BH-DT-PILOT-BCR1-09161	09/30/14	07:24
1409148-DUP1	Duplicate	09/30/14	07:24
C140918-07	14BH-DT-PILOT-BCR1-09231	09/30/14	07:24
C140918-11	14BH-DT-PILOT-BCR2-09161	09/30/14	07:24
C140918-15	14BH-DT-PILOT-BCR2-09231	09/30/14	07:24
C140918-19	14BH-DT-PILOT-BCR3-09161	09/30/14	07:24
C140918-23	14BH-DT-PILOT-BCR3-09231	09/30/14	07:24
C140918-27	14BH-DT-PILOT-BCR4-09161	09/30/14	07:24
1410059-CCV1	Calibration Check	09/30/14	07:24
1410059-CCB1	Calibration Blank	09/30/14	07:24
C140918-31	14BH-DT-PILOT-BCR4-09231	09/30/14	07:24
C140918-35	14BH-DT-PILOT-BCR4D-091	09/30/14	07:24
C140918-39	14BH-DT-PILOT-CHIT-091614	09/30/14	07:24
C140918-42	14BH-DT-PILOT-CHIT-092314	09/30/14	07:24
1409148-DUP2	Duplicate	09/30/14	07:24
C140918-45	14BH-DT-PILOT-INFL-091614	09/30/14	07:24
C140918-48	14BH-DT-PILOT-INFL-092314	09/30/14	07:24
C140918-51	14BH-DT-PILOT-INFLD-0923	09/30/14	07:24
C140918-54	14BH-DT-PILOT-NAOH-0916	09/30/14	07:24
C140918-57	14BH-DT-PILOT-NAOH-0923	09/30/14	07:24
1410059-CCV2	Calibration Check	09/30/14	07:24
C140918-61	14BH-DT-PILOT-POSTE-0923	09/30/14	07:24
C140918-66	14BH-DT-PILOT-POSTI-09231	09/30/14	07:24
C140918-70	14BH-DT-PILOT-SAPS-09161	09/30/14	07:24
C140918-73	14BH-DT-PILOT-SAPS-09231	09/30/14	07:24
1410059-CCV3	Calibration Check	09/30/14	07:24
1410059-CCB3	Calibration Blank	09/30/14	07:24

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 350.1 **Total** **Sequence ID#:** 1410095

Instrument ID #: Lachat 8500 Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1410088-SRM1	Reference	10/17/14	12:23
1410088-BLK1	Blank	10/17/14	12:23
1410088-BS1	Blank Spike	10/17/14	12:23
1410095-CRL1	Instrument RL Check	10/17/14	12:23
C140918-04	14BH-DT-PILOT-BCR1-09161	10/17/14	12:23
C140918-08	14BH-DT-PILOT-BCR1-09231	10/17/14	12:23
1410088-DUP1	Duplicate	10/17/14	12:23
1410088-MS1	Matrix Spike	10/17/14	12:23
C140918-12	14BH-DT-PILOT-BCR2-09161	10/17/14	12:23
1410095-CCV1	Calibration Check	10/17/14	12:23
1410095-CCB1	Calibration Blank	10/17/14	12:23
C140918-16	14BH-DT-PILOT-BCR2-09231	10/17/14	12:23
C140918-20	14BH-DT-PILOT-BCR3-09161	10/17/14	12:23
C140918-24	14BH-DT-PILOT-BCR3-09231	10/17/14	12:23
C140918-28	14BH-DT-PILOT-BCR4-09161	10/17/14	12:23
C140918-32	14BH-DT-PILOT-BCR4-09231	10/17/14	12:23
C140918-36	14BH-DT-PILOT-BCR4D-0916	10/17/14	12:23
C140918-62	14BH-DT-PILOT-POSTE-0923	10/17/14	12:23
C140918-67	14BH-DT-PILOT-POSTI-09231	10/17/14	12:23
1410088-DUP2	Duplicate	10/17/14	12:23
1410088-MS2	Matrix Spike	10/17/14	12:23
1410095-CCV2	Calibration Check	10/17/14	12:23
1410095-CCB2	Calibration Blank	10/17/14	12:23

Project Name: **Barker-Hughesville_Treatability 2_SEP 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Dissolved** **Sequence ID#:** 1411092

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1411092-ICV1	Initial Cal Check	11/21/14	10:16
1411092-SCV1	Secondary Cal Check	11/21/14	10:19
1411092-ICB1	Initial Cal Blank	11/21/14	10:22
1411092-CRL1	Instrument RL Check	11/21/14	10:25
1411092-IFA1	Interference Check A	11/21/14	10:28
1411092-IFB1	Interference Check B	11/21/14	10:31
1411085-BLK1	Blank	11/21/14	10:35
1411085-BS1	Blank Spike	11/21/14	10:39
C140918-02	14BH-DT-PILOT-BCR1-09161	11/21/14	10:42
1411085-DUP1	Duplicate	11/21/14	10:45
1411092-SRD1	Serial Dilution	11/21/14	10:48
1411085-MS1	Matrix Spike	11/21/14	10:51
C140918-06	14BH-DT-PILOT-BCR1-09231	11/21/14	10:54
1411085-MS2	Matrix Spike	11/21/14	10:57
C140918-10	14BH-DT-PILOT-BCR2-09161	11/21/14	11:00
1411092-CCV1	Calibration Check	11/21/14	11:06
1411092-CCB1	Calibration Blank	11/21/14	11:09
C140918-14	14BH-DT-PILOT-BCR2-09231	11/21/14	11:12
C140918-18	14BH-DT-PILOT-BCR3-09161	11/21/14	11:15
C140918-22	14BH-DT-PILOT-BCR3-09231	11/21/14	11:18
C140918-26	14BH-DT-PILOT-BCR4-09161	11/21/14	11:21
C140918-30	14BH-DT-PILOT-BCR4-09231	11/21/14	11:25
C140918-34	14BH-DT-PILOT-BCR4D-0916	11/21/14	11:28
C140918-38	14BH-DT-PILOT-CHIT-091614	11/21/14	11:31
C140918-41	14BH-DT-PILOT-CHIT-092314	11/21/14	11:34
C140918-44	14BH-DT-PILOT-INFL-091614	11/21/14	11:37
1411092-CCV2	Calibration Check	11/21/14	11:43
1411092-CCB2	Calibration Blank	11/21/14	11:46
C140918-47	14BH-DT-PILOT-INFL-092314	11/21/14	11:49
C140918-50	14BH-DT-PILOT-INFLD-0923	11/21/14	11:52
C140918-53	14BH-DT-PILOT-NAOH-0916	11/21/14	11:55
C140918-56	14BH-DT-PILOT-NAOH-0923	11/21/14	11:58
C140918-60	14BH-DT-PILOT-POSTE-0923	11/21/14	12:02
C140918-65	14BH-DT-PILOT-POSTI-09231	11/21/14	12:05
C140918-69	14BH-DT-PILOT-SAPS-09161	11/21/14	12:08
C140918-72	14BH-DT-PILOT-SAPS-09231	11/21/14	12:11
1411092-CCV3	Calibration Check	11/21/14	12:17
1411092-CCB3	Calibration Blank	11/21/14	12:20

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Dissolved** **Sequence ID#:** 1411094

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1411094-ICV1	Initial Cal Check	11/21/14	10:45
1411094-SCV1	Secondary Cal Check	11/21/14	10:48
1411094-ICB1	Initial Cal Blank	11/21/14	10:52
1411094-CRL1	Instrument RL Check	11/21/14	10:55
1411094-IFA1	Interference Check A	11/21/14	10:58
1411094-IFB1	Interference Check B	11/21/14	11:02
1411086-BLK1	Blank	11/21/14	11:05
1411086-BS1	Blank Spike	11/21/14	11:08
C140918-02	14BH-DT-PILOT-BCR1-09161	11/21/14	11:11
1411086-DUP1	Duplicate	11/21/14	11:14
1411094-SRD1	Serial Dilution	11/21/14	11:17
1411086-MS1	Matrix Spike	11/21/14	11:20
C140918-06	14BH-DT-PILOT-BCR1-09231	11/21/14	11:23
1411086-MS2	Matrix Spike	11/21/14	11:26
C140918-10	14BH-DT-PILOT-BCR2-09161	11/21/14	11:30
1411094-CCV1	Calibration Check	11/21/14	11:43
1411094-CCB1	Calibration Blank	11/21/14	11:46
C140918-14	14BH-DT-PILOT-BCR2-09231	11/21/14	11:49
C140918-18	14BH-DT-PILOT-BCR3-09161	11/21/14	11:52
C140918-22	14BH-DT-PILOT-BCR3-09231	11/21/14	11:55
C140918-26	14BH-DT-PILOT-BCR4-09161	11/21/14	11:58
C140918-30	14BH-DT-PILOT-BCR4-09231	11/21/14	12:02
C140918-34	14BH-DT-PILOT-BCR4D-091	11/21/14	12:05
C140918-38	14BH-DT-PILOT-CHIT-09161	11/21/14	12:08
C140918-41	14BH-DT-PILOT-CHIT-09231	11/21/14	12:11
C140918-44	14BH-DT-PILOT-INFL-091614	11/21/14	12:14
1411094-CCV2	Calibration Check	11/21/14	12:20
1411094-CCB2	Calibration Blank	11/21/14	12:23
C140918-47	14BH-DT-PILOT-INFL-092314	11/21/14	12:27
C140918-50	14BH-DT-PILOT-INFLD-0923	11/21/14	12:30
C140918-53	14BH-DT-PILOT-NAOH-0916	11/21/14	12:33
C140918-56	14BH-DT-PILOT-NAOH-0923	11/21/14	12:36
C140918-60	14BH-DT-PILOT-POSTE-0923	11/21/14	12:39
C140918-65	14BH-DT-PILOT-POSTI-09231	11/21/14	12:42
C140918-69	14BH-DT-PILOT-SAPS-09161	11/21/14	12:45
C140918-72	14BH-DT-PILOT-SAPS-09231	11/21/14	12:48
1411094-CCV3	Calibration Check	11/21/14	12:54
1411094-CCB3	Calibration Blank	11/21/14	12:58

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Total Recoverable** **Sequence ID#:** 1411099

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1411099-ICV1	Initial Cal Check	11/24/14	10:23
1411099-SCV1	Secondary Cal Check	11/24/14	10:26
1411099-ICB1	Initial Cal Blank	11/24/14	10:30
1411099-CRL1	Instrument RL Check	11/24/14	10:33
1411099-IFA1	Interference Check A	11/24/14	10:35
1411099-IFB1	Interference Check B	11/24/14	10:39
1411075-BLK1	Blank	11/24/14	10:43
1411075-SRM1	Reference	11/24/14	10:46
C140918-01	14BH-DT-PILOT-BCR1-09161	11/24/14	10:49
1411075-DUP1	Duplicate	11/24/14	10:52
1411099-SRD1	Serial Dilution	11/24/14	10:55
1411075-MS1	Matrix Spike	11/24/14	10:59
C140918-05	14BH-DT-PILOT-BCR1-09231	11/24/14	11:02
1411075-MS3	Matrix Spike	11/24/14	11:05
C140918-09	14BH-DT-PILOT-BCR2-09161	11/24/14	11:08
1411099-CCV1	Calibration Check	11/24/14	11:14
1411099-CCB1	Calibration Blank	11/24/14	11:17
C140918-13	14BH-DT-PILOT-BCR2-09231	11/24/14	11:20
C140918-17	14BH-DT-PILOT-BCR3-09161	11/24/14	11:23
C140918-21	14BH-DT-PILOT-BCR3-09231	11/24/14	11:26
C140918-25	14BH-DT-PILOT-BCR4-09161	11/24/14	11:29
C140918-29	14BH-DT-PILOT-BCR4-09231	11/24/14	11:32
C140918-33	14BH-DT-PILOT-BCR4D-0916	11/24/14	11:36
C140918-37	14BH-DT-PILOT-CHIT-09161	11/24/14	11:39
C140918-40	14BH-DT-PILOT-CHIT-09231	11/24/14	11:42
C140918-43	14BH-DT-PILOT-INFL-091614	11/24/14	11:45
1411099-CCV2	Calibration Check	11/24/14	11:51
1411099-CCB2	Calibration Blank	11/24/14	11:54

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Total Recoverable** **Sequence ID#:** 1411100

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1411100-ICV1	Initial Cal Check	11/25/14	09:11
1411100-SCV1	Secondary Cal Check	11/25/14	09:15
1411100-ICB1	Initial Cal Blank	11/25/14	09:18
1411100-CRL1	Instrument RL Check	11/25/14	09:21
1411100-IFA1	Interference Check A	11/25/14	09:23
1411100-IFB1	Interference Check B	11/25/14	09:27
1411076-BLK1	Blank	11/25/14	09:31
1411076-SRM1	Reference	11/25/14	09:35
C140918-46	14BH-DT-PILOT-INFL-092314	11/25/14	09:37
1411076-DUP1	Duplicate	11/25/14	09:40
1411100-SRD1	Serial Dilution	11/25/14	09:44
C140918-49	14BH-DT-PILOT-INFLD-0923	11/25/14	09:47
1411076-MS1	Matrix Spike	11/25/14	09:50
C140918-52	14BH-DT-PILOT-NAOH-0916	11/25/14	09:53
C140918-55	14BH-DT-PILOT-NAOH-0923	11/25/14	09:56
1411100-CCV1	Calibration Check	11/25/14	10:02
1411100-CCB1	Calibration Blank	11/25/14	10:05
C140918-58	14BH-DT-PILOT-POSTE-0916	11/25/14	10:08
C140918-59	14BH-DT-PILOT-POSTE-0923	11/25/14	10:11
C140918-63	14BH-DT-PILOT-POSTI-09161	11/25/14	10:14
C140918-64	14BH-DT-PILOT-POSTI-09231	11/25/14	10:17
C140918-68	14BH-DT-PILOT-SAPS-091614	11/25/14	10:20
C140918-71	14BH-DT-PILOT-SAPS-092314	11/25/14	10:24
1411100-CCV2	Calibration Check	11/25/14	10:33
1411100-CCB2	Calibration Blank	11/25/14	10:36

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Total Recoverable** **Sequence ID#:** 1411102

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1411102-ICV1	Initial Cal Check	11/24/14	11:29
1411102-SCV1	Secondary Cal Check	11/24/14	11:32
1411102-ICB1	Initial Cal Blank	11/24/14	11:35
1411102-CRL1	Instrument RL Check	11/24/14	11:39
1411102-IFA1	Interference Check A	11/24/14	11:42
1411102-IFB1	Interference Check B	11/24/14	11:45
1411075-BLK2	Blank	11/24/14	11:48
1411075-SRM2	Reference	11/24/14	11:52
C140918-01	14BH-DT-PILOT-BCR1-09161	11/24/14	11:55
1411075-DUP2	Duplicate	11/24/14	11:58
1411102-SRD1	Serial Dilution	11/24/14	12:01
1411075-MS2	Matrix Spike	11/24/14	12:04
C140918-05	14BH-DT-PILOT-BCR1-09231	11/24/14	12:07
1411075-MS4	Matrix Spike	11/24/14	12:10
C140918-09	14BH-DT-PILOT-BCR2-09161	11/24/14	12:13
1411102-CCV1	Calibration Check	11/24/14	12:19
1411102-CCB1	Calibration Blank	11/24/14	12:23
C140918-13	14BH-DT-PILOT-BCR2-09231	11/24/14	12:26
C140918-17	14BH-DT-PILOT-BCR3-09161	11/24/14	12:29
C140918-21	14BH-DT-PILOT-BCR3-09231	11/24/14	12:32
C140918-25	14BH-DT-PILOT-BCR4-09161	11/24/14	12:35
C140918-29	14BH-DT-PILOT-BCR4-09231	11/24/14	12:38
C140918-33	14BH-DT-PILOT-BCR4D-091	11/24/14	12:41
C140918-37	14BH-DT-PILOT-CHIT-09161	11/24/14	12:44
C140918-40	14BH-DT-PILOT-CHIT-09231	11/24/14	12:48
C140918-43	14BH-DT-PILOT-INFL-09161	11/24/14	12:51
1411102-CCV2	Calibration Check	11/24/14	13:05
1411102-CCB2	Calibration Blank	11/24/14	13:08

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Total Recoverable** **Sequence ID#:** 1411103

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1411103-ICV1	Initial Cal Check	11/25/14	10:39
1411103-SCV1	Secondary Cal Check	11/25/14	10:42
1411103-ICB1	Initial Cal Blank	11/25/14	10:45
1411103-CRL1	Instrument RL Check	11/25/14	10:49
1411103-IFA1	Interference Check A	11/25/14	10:52
1411103-IFB1	Interference Check B	11/25/14	10:55
1411076-BLK2	Blank	11/25/14	10:59
1411076-SRM2	Reference	11/25/14	11:02
C140918-46	14BH-DT-PILOT-INFL-092314	11/25/14	11:05
1411076-DUP2	Duplicate	11/25/14	11:08
1411103-SRD1	Serial Dilution	11/25/14	11:11
C140918-49	14BH-DT-PILOT-INFLD-0923	11/25/14	11:14
1411076-MS2	Matrix Spike	11/25/14	11:17
C140918-52	14BH-DT-PILOT-NAOH-0916	11/25/14	11:20
C140918-55	14BH-DT-PILOT-NAOH-0923	11/25/14	11:23
1411103-CCV1	Calibration Check	11/25/14	11:30
1411103-CCB1	Calibration Blank	11/25/14	11:33
C140918-58	14BH-DT-PILOT-POSTE-0916	11/25/14	11:36
C140918-59	14BH-DT-PILOT-POSTE-0923	11/25/14	11:39
C140918-63	14BH-DT-PILOT-POSTI-09161	11/25/14	11:42
C140918-64	14BH-DT-PILOT-POSTI-09231	11/25/14	12:06
C140918-68	14BH-DT-PILOT-SAPS-091614	11/25/14	12:28
C140918-71	14BH-DT-PILOT-SAPS-092314	11/25/14	12:31
1411103-CCV2	Calibration Check	11/25/14	12:46
1411103-CCB2	Calibration Blank	11/25/14	12:50

C146918

ESAT Technical Direction Form

Contract No. EPW13028
EPA Region 8

Site ID: 085N
TDF ID: A-046

Date Issued: 5/29/2014
Date Updated:

Date Closed By:

Name: Barker-Hughesville Treatability Study Sept

Details: The Contractor shall analyze several water samples associated with the treatability study at the Barker-Hughesville Superfund site as indicated in the Analytical Information Section. The samples will be sent to the ESAT R8 Lab during the 2014 field season starting in mid-June though early October 2014. There will be 9 sampling events associated with this project averaging approximately 10 samples per an event. The samples will be collected by Nick Anton/Erin Louden of CDM Smith.

Samples designated as influent samples (-INF) are expected to have high metal concentrations and should be analyzed by 200.7. Additionally, metals with sufficiently high concentrations may be reported from the 200.7 analyses.

ESAT should return the coolers to the following address:
CDM Smith/Lauren Helland
50 West 14th Street, Suite 200
Helena, MT 59601
406-441-1435
FedEx # 1323-6393-5

TO02/Subtask 02b: Inorganic Chemistry

Site RPM: Roger Hoogerheide

Analytical Information:

MATRIX

☑ Water ☐ Soils ☐ Vegetation ☐ Biota

WET CHEM

☐ TSS ☐ TDS ☐ DOC ☑ Alk ☑ Chloride ☑ Sulfate ☑ Fluoride ☑ Nitrate ☑ Nitrite
Other: Analyze for Ammonia and report NO2 and NO3 as NO2-NO3 combined.

METALS

☑ Dissolved ☑ Total Recoverable ☐ Total ☐ Hardness (Calc)
200.7: ☐ Ag ☑ Al ☐ As ☐ Ba ☐ Be ☐ B ☐ Ca ☐ Cd ☐ Co ☐ Cr ☐ Cu ☑ Fe ☐ K ☐ Mg
☒ Mn ☐ Mo ☐ Na ☐ Ni ☐ Pb ☐ Sb ☐ Se ☐ Sr ☐ Ti ☐ Tl ☐ V ☑ Zn ☐ SiO2
200.8: ☐ Ag ☐ Al ☑ As ☐ Ba ☐ Be ☑ Cd ☐ Co ☐ Cr ☑ Cu ☑ Mn ☐ Mo ☑ Ni ☑ Pb ☐ Sb
☐ Se ☐ Th ☐ Tl ☐ U ☐ V ☐ Zn
7470/7471/747 ☐ Hg

Sv
11/21/14

FIBERS

☐ PLM ☐ TEM

Deliverables

ID	*Description*	*Due Date*	*Submission Date*
1	Provide final deliverable package to Task Monitor no later than 30 days after delivery of samples.		

5/29/14

CHAIN OF CUSTODY RECORD

CDM Smith	**Danny T Pilot Test**	**Analysis**	PAGE 1 OF 2

NOTES: Limited sample volumes due to treatability testing
Contact: Angela Frandsen, CDM Smith (406)441-1400

SAMPLE NUMBER	DATE	TIME	MATRIX	Preservative	Type & No. of Containers	Total Metals (TAL), 200.7 or 200.8	Dissolved Metals (TAL), 200.7 or 200.8	Alkalinity, Anions (sulfate, chloride, fluoride)	Nitrate+Nitrite, Ammonia	Other Instructions and Notes
14BH-DT-PILOT-INFL-091614	9/16/14	11:05✓	aqueous	HNO3 (metals), H2SO4 (nutrients), cool	3, 125 mL poly	X	X	X		TAL metals = Al, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, Tl, Zn.
14BH-DT-PILOT-SAPS-091614	9/16/14	11:30✓	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-CHIT-091614	9/16/14	11:45✓	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-NAOH-091614	9/16/14	12:00✓	aqueous		3, 125 mL poly	X	X	X		
✓14BH-DT-PILOT-BCR1-091614	9/16/14	12:15✓	aqueous		3, 125 mL poly	X	X	X	X	
✓14BH-DT-PILOT-BCR2-091614	9/16/14	12:30✓	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR3-091614	9/16/14	12:45✓	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR4-091614	9/16/14	13:00✓	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR4D-091614	9/16/14	13:05✓	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-POSTI-091614	9/16/14	13:20✓	aqueous		1, 125 mL poly	X				
14BH-DT-PILOT-POSTE-091614	9/16/14	13:30✓	aqueous		1, 125 mL poly	X				

Relinquished by: (*Signature*)	**Date/Time** 9/25/14	**Received for Laboratory by: (*Signature*)**		
Received by: (*Signature*)	**Date/Time** @ 12:15	**Airbill No.(s)**	**Carrier Name:** FedEx	**Lab:** USEPA Lab Region 8

CHAIN OF CUSTODY RECORD

CDM Smith | **Danny T Pilot Test** | **Analysis** | PAGE 2 OF 2

NOTES: Limited sample volumes due to treatability testing
Contact: Angela Frandsen, CDM Smith (406)441-1400

SAMPLE NUMBER	DATE	TIME	MATRIX	Preservative	Type & No. of Containers	Total Metals (TAL), 200.7 or 200.8	Dissolved Metals (TAL), 200.7 or 200.8	Alkalinity, Anions (sulfate, chloride, fluoride)	Nitrate+Nitrite, Ammonia																Other Instructions and Notes
14BH-DT-PILOT-INFL-092314	9/23/14	11:15✓	aqueous	HNO3 (metals), H2SO4 (nutrients), cool	3, 125 mL poly	X	X	X																	TAL metals = Al, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, Tl, Zn.
14BH-DT-PILOT-INFLD-092314	9/23/14	11:40✓	aqueous		3, 125 mL poly	X	X	X																	
14BH-DT-PILOT-SAPS-092314	9/23/14	12:00✓	aqueous		3, 125 mL poly	X	X	X																	
14BH-DT-PILOT-CHIT-092314	9/23/14	12:20✓	aqueous		3, 125 mL poly	X	X	X																	
14BH-DT-PILOT-NAOH-092314	9/23/14	12:35✓	aqueous		3, 125 mL poly	X	X	X																	
OK 14BH-DT-PILOT-BCR1-092314	9/23/14	12:45✓	aqueous		4, 125 mL poly	X	X	X	X																
✓ 14BH-DT-PILOT-BCR2-092314	9/23/14	13:10✓	aqueous		4, 125 mL poly	X	X	X	X																
14BH-DT-PILOT-BCR3-092314	9/23/14	13:25✓	aqueous		4, 125 mL poly	X	X	X	X																
14BH-DT-PILOT-BCR4-092314	9/23/14	13:45✓	aqueous		4, 125 mL poly	X	X	X	X																
14BH-DT-PILOT-POSTI-092314	9/23/14	14:00	aqueous		1, 125 mL poly	X	X	X	X																
14BH-DT-PILOT-POSTE-092314	9/23/14	14:20✓	aqueous		1, 125 mL poly	X	X	X	X																

Relinquished by: (*Signature*)	**Date/Time** 9/25/14 @ 12:15	**Received for Laboratory by: (*Signature*)**		
Received by: (*Signature*)	**Date/Time**	**Airbill No.(s)**	**Carrier Name:** FedEx	**Lab:** USEPA Lab Region 8

ESAT

TechLaw
Quality & Integrity

Sample Receipt Form - TLF-51.00

Project: Barker Treatability **TDF #:** A-046

Date Received: 9/29/14 **Time Received:** 9:55 **By:** Janelle Lohman

1	Airbill/shipping documents present?	Drop Off	[✓ Yes]	No
2	Custody seals on **shipping** containers present and intact?	None	[✓ Yes]	No
3	Custody seals on **sample** containers present and intact?	[✓ None]	Yes	No
4	Chain of Custody (COC) present?		[✓ Yes]	No
5	COC and sample container information agree?		[✓ Yes]	No
6	Aqueous samples preserved correctly, if required?	N/A	Yes	No
7	Samples received within holding times for requested analyses?		Yes	No
8	Sufficient sample volume for requested analyses?		[✓ Yes]	No
9	Sample containers intact and not leaking?		[✓ Yes]	No
10	Sample containers appropriate for requested analyses?		Yes	No
11	Samples shipped on ice?	melted	[✓ Yes]	No
12	Cooler temperature(s) ≤ 6.0 °C?	N/A	Yes	[✓ No]

Cooler #:	1	2	3	4	5
Temperature (°C):	18.1				

Comments and Additional Information:

Client notified of anomalies, if necessary?	N/A	Yes	No
Anomalies noted in case narrative and data qualified, if necessary ?	N/A	Yes	No

ANALYTICAL SUMMARY REPORT

October 09, 2014

CDM Federal Programs
555 17th St Ste 1100
Denver, CO 80202

Work Order: H14090462 Quote ID: H823 - Baker-Hughsville Superfund Site

Project Name: Barker Hughsville - Danny T

Energy Laboratories Inc Helena MT received the following 11 samples for CDM Federal Programs on 9/25/2014 for analysis.

Lab ID	**Client Sample ID**	**Collect Date**	**Receive Date**	**Matrix**	**Test**
H14090462-001	14BH-DT-PILOT-INFL-092314	09/23/14 11:15	09/25/14	Aqueous	Acidity, Total as CaCO3 Phosphorus, Orthophosphate as P
H14090462-002	14BH-DT-PILOT-INFLD-092314	09/23/14 11:40	09/25/14	Aqueous	Same As Above
H14090462-003	14BH-DT-PILOT-SAPS-092314	09/23/14 12:00	09/25/14	Aqueous	Same As Above
H14090462-004	14BH-DT-PILOT-CHIT-092314	09/23/14 12:20	09/25/14	Aqueous	Same As Above
H14090462-005	14BH-DT-PILOT-NAOH-092314	09/23/14 12:35	09/25/14	Aqueous	Same As Above
H14090462-006	14BH-DT-PILOT-BCR1-092314	09/23/14 12:45	09/25/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Phosphorus, Orthophosphate as P Sulfide, Iodine Titrimetric
H14090462-007	14BH-DT-PILOT-BCR2-092314	09/23/14 13:10	09/25/14	Aqueous	Same As Above
H14090462-008	14BH-DT-PILOT-BCR3-092314	09/23/14 13:25	09/25/14	Aqueous	Same As Above
H14090462-009	14BH-DT-PILOT-BCR4-092314	09/23/14 13:40	09/25/14	Aqueous	Same As Above
H14090462-010	14BH-DT-PILOT-POSTI-092314	09/23/14 14:00	09/25/14	Aqueous	Same As Above
H14090462-011	14BH-DT-PILOT-POSTE-092314	09/23/14 14:20	09/25/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Phosphorus, Orthophosphate as P Sulfide, Methylene Blue Colorimetric

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

CLIENT: CDM Federal Programs
Project: Barker Hughsville - Danny T
Work Order: H14090462

Report Date: 10/09/14

CASE NARRATIVE

Tests associated with analyst identified as ELI-B were subcontracted to Energy Laboratories, 1120 S. 27th St., Billings, MT, EPA Number MT00005.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14090462-001
Client Sample ID: 14BH-DT-PILOT-INFL-092314

Report Date: 10/09/14
Collection Date: 09/23/14 11:15
DateReceived: 09/25/14
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	660	mg/L	D	4.0		A2310 B	10/01/14 09:43 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.158	mg/L	H	0.005		E365.1	09/25/14 14:25 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	10/09/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/23/14 11:40
Lab ID:	H14090462-002	**DateReceived:**	09/25/14
Client Sample ID:	14BH-DT-PILOT-INFLD-092314	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	670	mg/L	D	4.0		A2310 B	10/01/14 09:49 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.377	mg/L	H	0.005		E365.1	09/25/14 14:28 / cmm

Report Definitions:

RL - Analyte reporting limit.

QCL - Quality control limit.

D - RL increased due to sample matrix.

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14090462-003
Client Sample ID: 14BH-DT-PILOT-SAPS-092314

Report Date: 10/09/14
Collection Date: 09/23/14 12:00
DateReceived: 09/25/14
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	320	mg/L	D	4.0		A2310 B	10/01/14 09:53 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.068	mg/L	H	0.005		E365.1	09/25/14 14:29 / cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	10/09/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/23/14 12:20
Lab ID:	H14090462-004	**DateReceived:**	09/25/14
Client Sample ID:	14BH-DT-PILOT-CHIT-092314	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	200	mg/L	D	4.0		A2310 B	10/01/14 09:58 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	0.033	mg/L	H	0.005		E365.1	09/25/14 14:30 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	10/09/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/23/14 12:35
Lab ID:	H14090462-005	**DateReceived:**	09/25/14
Client Sample ID:	14BH-DT-PILOT-NAOH-092314	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	340	mg/L	D	4.0		A2310 B	10/01/14 10:02 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	ND	mg/L	H	0.005		E365.1	09/25/14 14:31 / cmm

Report Definitions:		
	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	10/09/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/23/14 12:45
Lab ID:	H14090462-006	**DateReceived:**	09/25/14
Client Sample ID:	14BH-DT-PILOT-BCR1-092314	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	10/01/14 10:06 / SRW
Sulfide	6	mg/L	D	1		A4500-S F	09/30/14 12:30 / eli-b
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	73	mg/L	H	40		A5210 B	09/25/14 14:33 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	3.54	mg/L	DH	0.02		E365.1	09/25/14 14:32 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	10/09/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/23/14 13:10
Lab ID:	H14090462-007	**DateReceived:**	09/25/14
Client Sample ID:	14BH-DT-PILOT-BCR2-092314	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	10/01/14 10:11 / SRW
Sulfide	10	mg/L	D	1		A4500-S F	09/30/14 12:30 / eli-b
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	60	mg/L	H	20		A5210 B	09/25/14 14:42 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	1.78	mg/L	DH	0.01		E365.1	09/25/14 14:33 / cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	10/09/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/23/14 13:25
Lab ID:	H14090462-008	**DateReceived:**	09/25/14
Client Sample ID:	14BH-DT-PILOT-BCR3-092314	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	10/01/14 10:15 / SRW
Sulfide	67	mg/L	D	1		A4500-S F	09/30/14 12:30 / eli-b
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	140	mg/L	H	40		A5210 B	09/25/14 14:48 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	11.7	mg/L	DH	0.02		E365.1	09/25/14 14:34 / cmm

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	10/09/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/23/14 13:40
Lab ID:	H14090462-009	**DateReceived:**	09/25/14
Client Sample ID:	14BH-DT-PILOT-BCR4-092314	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	10/01/14 10:19 / SRW
Sulfide	39	mg/L	D	1		A4500-S F	09/30/14 12:30 / eli-b
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	87	mg/L	H	40		A5210 B	09/25/14 14:55 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	1.63	mg/L	H	0.005		E365.1	09/25/14 14:35 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Lab ID: H14090462-010
Client Sample ID: 14BH-DT-PILOT-POSTI-092314

Report Date: 10/09/14
Collection Date: 09/23/14 14:00
DateReceived: 09/25/14
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	10/01/14 10:24 / SRW
Sulfide	32	mg/L	D	1		A4500-S F	09/30/14 12:30 / eli-b
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	77	mg/L	H	40		A5210 B	09/25/14 15:03 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	5.25	mg/L	DH	0.02		E365.1	09/25/14 14:36 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	10/09/14
Project:	Barker Hughsville - Danny T	**Collection Date:**	09/23/14 14:20
Lab ID:	H14090462-011	**DateReceived:**	09/25/14
Client Sample ID:	14BH-DT-PILOT-POSTE-092314	**Matrix:**	Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
INORGANICS							
Acidity, Total as CaCO3	ND	mg/L	D	4.0		A2310 B	10/01/14 10:28 / SRW
Sulfide	ND	mg/L		0.04		A4500-S D	09/30/14 12:30 / eli-b
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	5	mg/L	H	4		A5210 B	09/25/14 15:14 / SRW
NUTRIENTS							
Phosphorus, Orthophosphate as P	1.23	mg/L	DH	0.02		E365.1	09/25/14 14:52 / cmm

Report Definitions:

RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T
Report Date: 10/09/14
Work Order: H14090462

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2310 B										Batch: H141001A
Lab ID: H14090462-001ADUP	Sample Duplicate					Run: PH_141001A				10/01/14 09:46
Acidity, Total as CaCO3		670	mg/L	4.0				1.9	20	
Lab ID: H14090462-011ADUP	Sample Duplicate					Run: PH_141001A				10/01/14 10:33
Acidity, Total as CaCO3		ND	mg/L	4.0					20	
Lab ID: LCS1410010000	Laboratory Control Sample					Run: PH_141001A				10/01/14 09:41
Acidity, Total as CaCO3		950	mg/L	4.0	97	90	110			
Lab ID: MBLK1410010000	Method Blank					Run: PH_141001A				10/01/14 09:40
Acidity, Total as CaCO3		3	mg/L							

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T

Report Date: 10/09/14
Work Order: H14090462

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A4500-S D										Batch: B_R231388
Lab ID: MB-R231388		Method Blank				Run: SUB-B231388				09/30/14 12:30
Sulfide		ND	mg/L	0.002						
Lab ID: LCS-R231388		Laboratory Control Sample				Run: SUB-B231388				09/30/14 12:30
Sulfide		0.253	mg/L	0.040	113	70	130			
Lab ID: B14092445-001GMS		Sample Matrix Spike				Run: SUB-B231388				09/30/14 12:30
Sulfide		0.226	mg/L	0.040	101	70	130			
Lab ID: B14092445-001GMSD		Sample Matrix Spike Duplicate				Run: SUB-B231388				09/30/14 12:30
Sulfide		0.231	mg/L	0.040	103	70	130	2.3	20	
Lab ID: B14092666-001FMS		Sample Matrix Spike				Run: SUB-B231388				09/30/14 12:30
Sulfide		0.473	mg/L	0.040	43	70	130			S
Lab ID: B14092666-001FMSD		Sample Matrix Spike Duplicate				Run: SUB-B231388				09/30/14 12:30
Sulfide		0.451	mg/L	0.040	33	70	130	4.8	20	S

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs

Project: Barker Hughsville - Danny T

Report Date: 10/09/14

Work Order: H14090462

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **A4500-S F**										Batch: B_R231389
Lab ID: **MB-R231389**		Method Blank				Run: SUB-B231389				09/30/14 12:30
Sulfide		ND	mg/L	0.5						
Lab ID: **LCS-R231389**		Laboratory Control Sample				Run: SUB-B231389				09/30/14 12:30
Sulfide		21.5	mg/L	1.0	100	70	130			
Lab ID: **B14092496-001EMS**		Sample Matrix Spike				Run: SUB-B231389				09/30/14 12:30
Sulfide		22.1	mg/L	1.0	97	80	120			
Lab ID: **B14092496-001EMSD**		Sample Matrix Spike Duplicate				Run: SUB-B231389				09/30/14 12:30
Sulfide		21.9	mg/L	1.0	96	80	120	0.7	20	
Lab ID: **B14092548-002AMS**		Sample Matrix Spike				Run: SUB-B231389				09/30/14 12:30
Sulfide		105	mg/L	1.0	107	80	120			
Lab ID: **B14092548-002AMSD**		Sample Matrix Spike Duplicate				Run: SUB-B231389				09/30/14 12:30
Sulfide		105	mg/L	1.0	108	80	120	0.2	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T

Report Date: 10/09/14
Work Order: H14090462

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A5210 B										Batch: 140925_1_BOD5-W
Lab ID: Dil-H201_140925		Dilution Water Blank				Run: BOD-SKALAR_140925A			09/25/14 14:01	
Oxygen Demand, Biochemical (BOD)		0.18	mg/L	2.0		0	0.2			
Lab ID: GGA1_140925		Laboratory Control Sample				Run: BOD-SKALAR_140925A			09/25/14 14:11	
Oxygen Demand, Biochemical (BOD)		140	mg/L	65	72	85	115			S
Glucose-glutamic acid check falls outside acceptable limits.										
Lab ID: H14090439-001ADUP		Sample Duplicate				Run: BOD-SKALAR_140925A			09/25/14 14:29	
Oxygen Demand, Biochemical (BOD)		52	mg/L	39		90	110	0.6	10	
Lab ID: H14090470-001ADUP		Sample Duplicate				Run: BOD-SKALAR_140925A			09/25/14 15:48	
Oxygen Demand, Biochemical (BOD)		610	mg/L	200		90	110	2.1	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Barker Hughsville - Danny T

Report Date: 10/09/14
Work Order: H14090462

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E365.1										Analytical Run: FIA202-HE_140925B
Lab ID: ICV		Initial Calibration Verification Standard								09/25/14 14:20
Phosphorus, Orthophosphate as P		0.237	mg/L	0.0050	95	90	110			
Lab ID: ICB		Initial Calibration Blank, Instrument Blank								09/25/14 14:21
Phosphorus, Orthophosphate as P		-0.00144	mg/L	0.0050		0	0			
Lab ID: CCV		Continuing Calibration Verification Standard								09/25/14 14:23
Phosphorus, Orthophosphate as P		0.0925	mg/L	0.0050	93	90	110			
Lab ID: CCV		Continuing Calibration Verification Standard								09/25/14 14:51
Phosphorus, Orthophosphate as P		0.0995	mg/L	0.0050	100	90	110			
Method: E365.1										Batch: R100884
Lab ID: LFB		Laboratory Fortified Blank				Run: FIA202-HE_140925B				09/25/14 14:22
Phosphorus, Orthophosphate as P		0.183	mg/L	0.0050	91	90	110			
Lab ID: H14090462-001BMS		Sample Matrix Spike				Run: FIA202-HE_140925B				09/25/14 14:26
Phosphorus, Orthophosphate as P		0.337	mg/L	0.0050	90	90	110			
Lab ID: H14090462-001BMSD		Sample Matrix Spike Duplicate				Run: FIA202-HE_140925B				09/25/14 14:27
Phosphorus, Orthophosphate as P		0.361	mg/L	0.0050	102	90	110	6.8	20	
Lab ID: H14090462-011CMS		Sample Matrix Spike				Run: FIA202-HE_140925B				09/25/14 14:53
Phosphorus, Orthophosphate as P		6.02	mg/L	0.025	96	90	110			
Lab ID: H14090462-011CMSD		Sample Matrix Spike Duplicate				Run: FIA202-HE_140925B				09/25/14 14:54
Phosphorus, Orthophosphate as P		6.14	mg/L	0.025	98	90	110	2.1	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Workorder Receipt Checklist

CDM Federal Programs

H14090462

Login completed by:	Tracy L. Lorash	Date Received:	9/25/2014
Reviewed by:	BL2000\rwilliams	Received by:	TLL
Reviewed Date:	9/30/2014	Carrier name:	Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☐	No ☑	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	8.3°C No Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☑	No ☐	Not Applicable ☐

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

14BH-DT-PILOT-INFL-092314 ortho-phosphate sample was received past the method holding time.
All other samples for BOD and ortho-phosphate were potentially not received with sufficient time to complete analysis within method recommended hold time. TI 9/25/14

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 1 of 2

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM SMITH	Project Name, PWS, Permit, Etc. BARKER - DANNY T	Sample Origin State: MT	EPA/State Compliance: Yes ☐ No ☐
Report Mail Address (Required): ☒ No Hard Copy Email: frandsenak@cdmsmith.com	Contact Name: ANGELA FRANDSEN Phone/Fax: (406) 441 1400	Cell:	Sampler: (Please Print) SLIM MILLER
	Invoice Contact & Phone: SAME	Purchase Order:	Quote/Bottle Order:

Invoice Address (Required):

☒ No Hard Copy Email: SAME

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: ____
☐ Other: ____
☒ EDD/EDT (Electronic Data) Format: EXCEL
☐ LEVEL IV
☐ NELAC

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids Vegetation Bioassay Other
DW - Drinking Water

ANALYSIS REQUESTED

➡ Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: 1000 ml BOTTLES FOR BOD AND ACIDITY

Shipped by: Hand

Cooler ID(s): Y

Receipt Temp 8.3 °C

On Ice: Y [✓ N]

Custody Seal
On Bottle Y [✓ N]
On Cooler Y [✓ N]

Intact Y N

Signature Match Y N

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	BOD	ACIDITY	SULFIDE	ORTHO-PHOSPHATE	SEE ATTACHED	Standard Turnaround (TAT)	RUSH	LABORATORY USE ONLY
1	14BH-DT-PILOT-INFL-092314	9/23/14	11:15	2 W		X		X				H14090462
2	14BH-DT-PILOT-INFLD-092314	9/23/14	11:40	2 W		X		X				
3	14BH-DT-PILOT-SAPS-092314	9/23/14	12:00	2 W		X		X				
4	14BH-DT-PILOT-CHIT-092314	9/23/14	12:20	2 W		X		X				
5	14BH-DT-PILOT-NAOH-092314	9/23/14	12:35	2 W		X		X				
6	14BH-DT-PILOT-BCR1-092314	9/23/14	12:45	3 W	X	X	X	X				
7	14BH-DT-PILOT-BCR2-092314	9/23/14	13:10	3 W	X	X	X	X				
8	14BH-DT-PILOT-BCR3-092314	9/23/14	13:25	3 W	X	X	X	X				
9	14BH-DT-PILOT-BCR4-092314	9/23/14	13:40	3 W	X	X	X	X				
10	14BH-DT-PILOT-POSTI-092314	9/23/14	14:00	3 W	X	X	X	X				

Custody Record MUST be Signed

Relinquished by (print): TOM ASKIN	Date/Time: 9/25/14 @ 11:33	Signature:	Received by (print):	Date/Time:	Signature:
Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Sample Disposal: Return to Client: ____	Lab Disposal: ____		Received by Laboratory: Tracy Arnol	Date/Time: 9/25/14 11:33	Signature: Tracy Arnol

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 2 of 2

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM SMITH

Project Name, PWS, Permit, Etc.: BARKER-DANNY T

Sample Origin State: MT

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address (Required):

☒ No Hard Copy Email: frandsenak@cdmsmith.com

Contact Name: ANGELA FRANDSEN

Phone/Fax: (406) 441-1400

Cell:

Sampler: (Please Print) SLIM MILLER

Invoice Contact & Phone: SAME

Purchase Order:

Quote/Bottle Order:

Invoice Address (Required):

☒ No Hard Copy Email: SAME

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: ___________
☐ Other: ___________
☒ EDD/EDT (Electronic Data)
Format: EXCEL
☐ LEVEL IV
☐ NELAC

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: 1000 ml BOTTLE FOR BOD AND ACIDITY

ANALYSIS REQUESTED

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	**MATRIX** (Number of Containers; Sample Type: A W S V B O DW; Air Water Soils/Solids Vegetation Bioassay Other; DW - Drinking Water)	BOD	ACIDITY	SULFIDE	ORTHO-PHOSPHATE						SEE ATTACHED	Standard Turnaround (TAT)	RUSH	LABORATORY USE ONLY
1 14BH-DT-PILOT-POSTE-092314	9/23/14	@ 14:20	3W	X	X	X	X									H14090462
2																
3																
4																
5																
6																
7																
8																
9																
10																

Shipped by: Hand

Cooler ID(s): Y

Receipt Temp 8.3 °C

On Ice: Y [✓ N]

Custody Seal
On Bottle Y [✓ N]
On Cooler Y [✓ N]

Intact Y N

Signature Match Y N

Custody Record MUST be Signed

Relinquished by (print): Date/Time: 9/25/14 @ 11:33 Signature: TOM ASKIN

Relinquished by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Received by (print): Date/Time: Signature:

Received by Laboratory: Tracy Conrad Date/Time: 9/25/14 11:33 Signature: Tracy Conrad

Sample Disposal: Return to Client: __________ Lab Disposal: __________

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.

ANALYTICAL SUMMARY REPORT

October 13, 2014

CDM Federal Programs
555 17th St Ste 1100
Denver, CO 80202

Work Order: H14100008 Quote ID: H823

Project Name: Baker-Hughsville Superfund Site

Energy Laboratories Inc Helena MT received the following 10 samples for CDM Federal Programs on 10/1/2014 for analysis.

Lab ID	**Client Sample ID**	**Collect Date**	**Receive Date**	**Matrix**	**Test**
H14100008-001	14BH-DT-PILOT-INFL-092914	09/29/14 14:25	10/01/14	Aqueous	Acidity, Total as CaCO3 Phosphorus, Orthophosphate as P
H14100008-002	14BH-DT-PILOT-SAPS-092914	09/29/14 14:40	10/01/14	Aqueous	Same As Above
H14100008-003	14BH-DT-PILOT-CHIT-092914	09/29/14 14:55	10/01/14	Aqueous	Same As Above
H14100008-004	14BH-DT-PILOT-NAOH-092914	09/29/14 15:10	10/01/14	Aqueous	Same As Above
H14100008-005	14BH-DT-PILOT-BCR1-092914	09/29/14 15:20	10/01/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Phosphorus, Orthophosphate as P Sulfide, Iodine Titrimetric
H14100008-006	14BH-DT-PILOT-BCR2-092914	09/29/14 15:50	10/01/14	Aqueous	Same As Above
H14100008-007	14BH-DT-PILOT-BCR3-092914	09/29/14 16:10	10/01/14	Aqueous	Same As Above
H14100008-008	14BH-DT-PILOT-BCR4-092914	09/29/14 16:20	10/01/14	Aqueous	Same As Above
H14100008-009	14BH-DT-PILOT-POSTI-092914	09/29/14 16:40	10/01/14	Aqueous	Same As Above
H14100008-010	14BH-DT-PILOT-POSTE-092914	09/29/14 17:00	10/01/14	Aqueous	Acidity, Total as CaCO3 Biochemical Oxygen Demand, 5 Day Phosphorus, Orthophosphate as P Sulfide, Methylene Blue Colorimetric

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

CLIENT: CDM Federal Programs
Project: Baker-Hughsville Superfund Site
Work Order: H14100008

Report Date: 10/13/14

CASE NARRATIVE

Tests associated with analyst identified as ELI-B were subcontracted to Energy Laboratories, 1120 S. 27th St., Billings, MT, EPA Number MT00005.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Baker-Hughsville Superfund Site
Lab ID: H14100008-001
Client Sample ID: 14BH-DT-PILOT-INFL-092914

Report Date: 10/13/14
Collection Date: 09/29/14 14:25
Date Received: 10/01/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	700	mg/L	D	4.0		1	A2310 B	10/10/14 10:38/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	0.106	mg/L	H	0.005		2	E365.1	10/02/14 11:26/cmm

Report Definitions:		
	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	10/13/14
Project:	Baker-Hughsville Superfund Site	**Collection Date:**	09/29/14 14:40
Lab ID:	H14100008-002	**Date Received:**	10/01/14
Client Sample ID:	14BH-DT-PILOT-SAPS-092914	**Matrix:**	AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	380	mg/L	D	4.0		1	A2310 B	10/10/14 10:45/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	0.070	mg/L	H	0.005		1	E365.1	10/02/14 11:29/cmm

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	10/13/14
Project:	Baker-Hughsville Superfund Site	**Collection Date:**	09/29/14 14:55
Lab ID:	H14100008-003	**Date Received:**	10/01/14
Client Sample ID:	14BH-DT-PILOT-CHIT-092914	**Matrix:**	AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as $CaCO_3$	320	mg/L	D	4.0		1	A2310 B	10/10/14 10:50/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	0.053	mg/L	H	0.005		1	E365.1	10/02/14 11:30/cmm

Report Definitions:	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Baker-Hughsville Superfund Site
Lab ID: H14100008-004
Client Sample ID: 14BH-DT-PILOT-NAOH-092914

Report Date: 10/13/14
Collection Date: 09/29/14 15:10
Date Received: 10/01/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	480	mg/L	D	4.0		1	A2310 B	10/10/14 10:55/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	0.036	mg/L	H	0.005		1	E365.1	10/02/14 11:31/cmm

Report Definitions:		
	RL - Analyte reporting limit.	MCL - Maximum contaminant level.
	QCL - Quality control limit.	ND - Not detected at the reporting limit.
	D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Baker-Hughsville Superfund Site
Lab ID: H14100008-005
Client Sample ID: 14BH-DT-PILOT-BCR1-092914

Report Date: 10/13/14
Collection Date: 09/29/14 15:20
Date Received: 10/01/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	10/10/14 11:00/SRW
Sulfide	18	mg/L		1		1	A4500-S F	10/03/14 12:50/eli-b
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	64	mg/L	H	20		1	A5210 B	10/01/14 16:16/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	3.43	mg/L	DH	0.02		25	E365.1	10/02/14 11:32/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Baker-Hughsville Superfund Site
Lab ID: H14100008-006
Client Sample ID: 14BH-DT-PILOT-BCR2-092914

Report Date: 10/13/14
Collection Date: 09/29/14 15:50
Date Received: 10/01/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	10/10/14 11:05/SRW
Sulfide	20	mg/L		1		1	A4500-S F	10/03/14 12:50/eli-b
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	42	mg/L	H	20		1	A5210 B	10/01/14 16:24/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	1.51	mg/L	DH	0.01		10	E365.1	10/02/14 11:33/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	10/13/14
Project:	Baker-Hughsville Superfund Site	**Collection Date:**	09/29/14 16:10
Lab ID:	H14100008-007	**Date Received:**	10/01/14
Client Sample ID:	14BH-DT-PILOT-BCR3-092914	**Matrix:**	AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	10/10/14 11:09/SRW
Sulfide	59	mg/L		1		1	A4500-S F	10/03/14 12:50/eli-b
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	110	mg/L	H	40		1	A5210 B	10/01/14 16:30/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	10.3	mg/L	DH	0.02		25	E365.1	10/02/14 11:34/cmm

Report Definitions:

RL - Analyte reporting limit.	MCL - Maximum contaminant level.
QCL - Quality control limit.	ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Baker-Hughsville Superfund Site
Lab ID: H14100008-008
Client Sample ID: 14BH-DT-PILOT-BCR4-092914

Report Date: 10/13/14
Collection Date: 09/29/14 16:20
Date Received: 10/01/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	10/10/14 11:14/SRW
Sulfide	34	mg/L		1		1	A4500-S F	10/03/14 12:50/eli-b
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	70	mg/L	H	40		1	A5210 B	10/01/14 16:40/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	5.79	mg/L	DH	0.02		25	E365.1	10/02/14 11:35/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	CDM Federal Programs	**Report Date:**	10/13/14
Project:	Baker-Hughsville Superfund Site	**Collection Date:**	09/29/14 16:40
Lab ID:	H14100008-009	**Date Received:**	10/01/14
Client Sample ID:	14BH-DT-PILOT-POSTI-092914	**Matrix:**	AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	10/10/14 11:19/SRW
Sulfide	33	mg/L		1		1	A4500-S F	10/03/14 12:50/eli-b
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	62	mg/L	H	20		1	A5210 B	10/01/14 16:48/SRW
NUTRIENTS								
Phosphorus, Orthophosphate as P	4.67	mg/L	DH	0.02		25	E365.1	10/02/14 11:36/cmm

Report Definitions:

RL - Analyte reporting limit.	MCL - Maximum contaminant level.
QCL - Quality control limit.	ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.	H - Analysis performed past recommended holding time.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Baker-Hughsville Superfund Site
Lab ID: H14100008-010
Client Sample ID: 14BH-DT-PILOT-POSTE-092914

Report Date: 10/13/14
Collection Date: 09/29/14 17:00
Date Received: 10/01/14
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	DF	Method	Analysis Date / By
INORGANICS								
Acidity, Total as CaCO3	ND	mg/L	D	4.0		1	A2310 B	10/10/14 11:26/SRW
Sulfide	0.06	mg/L		0.04		1	A4500-S D	10/03/14 13:15/eli-b2
AGGREGATE ORGANICS								
Oxygen Demand, Biochemical (BOD)	<2	mg/L	H	2		1	A5210 B	10/01/14 17:05/SRW
No BOD dilution depleted greater than 2.0 mg/L DO.								
NUTRIENTS								
Phosphorus, Orthophosphate as P	0.033	mg/L	H	0.005		2	E365.1	10/02/14 11:37/cmm

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
H - Analysis performed past recommended holding time.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Baker-Hughsville Superfund Site

Report Date: 10/13/14
Work Order: H14100008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2310 B									Batch: H141010A
Lab ID: H14100008-001ADUP	Sample Duplicate				Run: PH_141010A				10/10/14 10:41
Acidity, Total as CaCO3	700	mg/L	4.0				1.1	20	
Lab ID: LCS1410100000	Laboratory Control Sample				Run: PH_141010A				10/10/14 10:36
Acidity, Total as CaCO3	940	mg/L	4.0	96	90	110			
Lab ID: MBLK1410100000	Method Blank				Run: PH_141010A				10/10/14 10:33
Acidity, Total as CaCO3	3	mg/L							

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Baker-Hughsville Superfund Site

Report Date: 10/13/14
Work Order: H14100008

Analyte		Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method:	**A4500-S D**									Batch: B_R231630
Lab ID:	**MB-R231630**	Method Blank				Run: SUB-B231630				10/03/14 13:15
Sulfide		ND	mg/L	0.002						
Lab ID:	**LCS-R231630**	Laboratory Control Sample				Run: SUB-B231630				10/03/14 13:15
Sulfide		0.218	mg/L	0.040	107	70	130			
Lab ID:	**B14100215-002FMS**	Sample Matrix Spike				Run: SUB-B231630				10/03/14 13:15
Sulfide		0.289	mg/L	0.040	116	70	130			
Lab ID:	**B14100215-002FMSD**	Sample Matrix Spike Duplicate				Run: SUB-B231630				10/03/14 13:15
Sulfide		0.301	mg/L	0.040	122	70	130	3.9	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Baker-Hughsville Superfund Site

Report Date: 10/13/14
Work Order: H14100008

Analyte			Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method:	**A4500-S F**									Batch: B_R231644	
Lab ID:	**MB-R231644**	Method Blank					Run: SUB-B231644			10/03/14 12:50	
Sulfide			ND	mg/L	0.5						
Lab ID:	**LCS-R231644**	Laboratory Control Sample					Run: SUB-B231644			10/03/14 12:50	
Sulfide			22.6	mg/L	1.0	98	70	130			
Lab ID:	**B14100159-001CMS**	Sample Matrix Spike					Run: SUB-B231644			10/03/14 12:50	
Sulfide			33.8	mg/L	1.0	94	80	120			
Lab ID:	**B14100159-001CMSD**	Sample Matrix Spike Duplicate					Run: SUB-B231644			10/03/14 12:50	
Sulfide			33.8	mg/L	1.0	94	80	120	0.0	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs

Project: Baker-Hughsville Superfund Site

Report Date: 10/13/14

Work Order: H14100008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A5210 B								Batch: 141001_1_BOD5-W	
Lab ID: Dil-H201_141001	Dilution Water Blank				Run: BOD-SKALAR_141001A				10/01/14 15:00
Oxygen Demand, Biochemical (BOD)	ND	mg/L	2.0		0	0.2			
Lab ID: GGA1_141001	Laboratory Control Sample				Run: BOD-SKALAR_141001A				10/01/14 15:11
Oxygen Demand, Biochemical (BOD)	150	mg/L	61	76	85	115			S
Glucose-glutamic acid check falls outside acceptable limits.									
Lab ID: H14100008-009ADUP	Sample Duplicate				Run: BOD-SKALAR_141001A				10/01/14 16:56
Oxygen Demand, Biochemical (BOD)	58	mg/L	18		90	110	6.0	10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: CDM Federal Programs
Project: Baker-Hughsville Superfund Site
Report Date: 10/13/14
Work Order: H14100008

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E365.1					Analytical Run: FIA202-HE_141002C				
Lab ID: ICV	Initial Calibration Verification Standard								10/02/14 11:21
Phosphorus, Orthophosphate as P	0.240	mg/L	0.0050	96	90	110			
Lab ID: ICB	Initial Calibration Blank, Instrument Blank								10/02/14 11:22
Phosphorus, Orthophosphate as P	-0.000170	mg/L	0.0050		0	0			
Lab ID: CCV	Continuing Calibration Verification Standard								10/02/14 11:24
Phosphorus, Orthophosphate as P	0.0941	mg/L	0.0050	94	90	110			
Lab ID: ICV	Initial Calibration Verification Standard								10/02/14 11:21
Phosphorus, Orthophosphate as P	0.240	mg/L	0.0050	96	90	110			
Lab ID: ICB	Initial Calibration Blank, Instrument Blank								10/02/14 11:22
Phosphorus, Orthophosphate as P	-0.000170	mg/L	0.0050		0	0			
Lab ID: CCV	Continuing Calibration Verification Standard								10/02/14 11:24
Phosphorus, Orthophosphate as P	0.0941	mg/L	0.0050	94	90	110			
Method: E365.1									Batch: R101045
Lab ID: LFB	Laboratory Fortified Blank				Run: FIA202-HE_141002C				10/02/14 11:23
Phosphorus, Orthophosphate as P	0.195	mg/L	0.0050	97	90	110			
Lab ID: H14100008-001BMS	Sample Matrix Spike				Run: FIA202-HE_141002C				10/02/14 11:27
Phosphorus, Orthophosphate as P	0.713	mg/L	0.0050	152	90	110			S
Lab ID: H14100008-001BMSD	Sample Matrix Spike Duplicate				Run: FIA202-HE_141002C				10/02/14 11:28
Phosphorus, Orthophosphate as P	0.740	mg/L	0.0050	159	90	110	3.8	20	S
Lab ID: LFB	Laboratory Fortified Blank				Run: FIA202-HE_141002C				10/02/14 11:23
Phosphorus, Orthophosphate as P	0.195	mg/L	0.0050	97	90	110			
Lab ID: MB-26397	Method Blank				Run: FIA202-HE_141002C				10/02/14 11:45
Phosphorus, Orthophosphate as P	ND	mg/L	0.0010						
Lab ID: H14100009-001BMS	Sample Matrix Spike				Run: FIA202-HE_141002C				10/02/14 11:48
Phosphorus, Orthophosphate as P	0.429	mg/L	0.0050	115	90	110			S
Lab ID: H14100009-001BMSD	Sample Matrix Spike Duplicate				Run: FIA202-HE_141002C				10/02/14 11:49
Phosphorus, Orthophosphate as P	0.435	mg/L	0.0050	118	90	110	1.5	20	S

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

Workorder Receipt Checklist

CDM Federal Programs H14100008

Login completed by: Tracy L. Lorash
Reviewed by: BL2000\rwilliams
Reviewed Date: 10/3/2014

Date Received: 10/1/2014
Received by: wjj
Carrier name: Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☐	No ☑	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☑	No ☐	Not Applicable ☐
Container/Temp Blank temperature:	6.2°C Melted Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☑	No ☐	Not Applicable ☐

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

Sample ID on COC is 14BH-DT-PILOT-BCR2-092914 -ID on orthophos bottle is missing the number 2. Logged in with ID from COC.
Collection time on COC for CHIT sample is 14:55 - bottles have 14:45. Logged in with time from COC. TI 10/1/14

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page 1 of 1

PLEASE PRINT (Provide as much information as possible.)

Company Name: CDM SMITH

Project Name, PWS, Permit, Etc.: BARKER-DANNY T

Sample Origin State: MT

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address (Required):

☒ No Hard Copy Email: frandsenak@cdmsmith.com

Contact Name: ANGELA FRANDSEN

Phone/Fax: (406) 441-1400

Cell:

Sampler: (Please Print) SLIM MILLER

Invoice Contact & Phone: SAME

Purchase Order:

Quote/Bottle Order:

Invoice Address (Required):

☒ No Hard Copy Email: SAME

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: ____
☐ Other: ____
☒ EDD/EDT (Electronic Data) Format: EXCEL
☐ LEVEL IV
☐ NELAC

Number of Containers
Sample Type: A W S V B O DW
Air Water Soils/Solids Vegetation Bioassay Other
DW - Drinking Water

ANALYSIS REQUESTED

Standard Turnaround (TAT)

RUSH

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments: 1000 mL BOTTLE FOR BOD + ACIDITY

Shipped by: hand del

Cooler ID(s): Y

Receipt Temp 6.2 °C melted

On Ice: Y [✓ N]

Custody Seal
On Bottle Y [✓ N]
On Cooler Y [✓ N]
Intact Y [✓ N]
Signature Match Y [✓ N]

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	ACIDITY	ORTHO-PHOSPHATE	BOD	SULFIDE	SEE ATTACHED	LABORATORY USE ONLY
1 14BH-DT-PILOT-INFL-092914	9/29/14	14:25	2W	X	X				~~H46TL~~
2 14BH-DT-PILOT~~SAPS~~-092914	9/29/14	14:40	2W	X	X				H14100608
3 14BH-DT-PILOT-CHIT-092914	↓	14:55	2W	X	X				
4 14BH-DT-PILOT-NAOH-092914		15:10	2W	X	X				
5 14BH-DT-PILOT-BCR1-092914		15:30	3W	X	X	X	X		
6 14BH-DT-PILOT-BCR2-092914		15:50	3W	X	X	X	X		
7 14BH-DT-PILOT-BCR3-092914		16:10	3W	X	X	X	X		
8 14BH-DT-PILOT-BCR4-092914		16:20	3W	X	X	X	X		
9 14BH-DT-PILOT-POSTI-092914		16:40	3W	X	X	X	X		
10 14BH-DT-PILOT-POSTE-092914		17:00	3W	X	X	X	X		

Custody Record MUST be Signed

Relinquished by (print): TOM ASKIN	Date/Time: ~~9/29/14~~	Signature: Tom Askin	Received by (print):	Date/Time:	Signature:
Relinquished by (print):	Date/Time: 10/1/14 @ 12:55	Signature:	Received by (print):	Date/Time:	Signature:
Sample Disposal: Return to Client: ____	Lab Disposal: ____		Received by Laboratory: WandaJon	Date/Time: 10-1-14 12:55	Signature:

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.

Appendix A.2

Tiger Bench-Scale Treatability Study Laboratory Data Packages

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U.S. Environmental Protection Agency
Region 8
Technical and Management Services

Laboratory Services Program

Certificate of Analysis

Ref: 8TMS-L

MEMORANDUM

Date: 09/12/14

Subject: Analytical Results--- **Barker-Hughesville_Treatability_JUL 2014_A046 / A-046**

From: Don Goodrich; EPA Region 8 Analytical Chemistry WAM

To: Roger Hoogerheide
Superfund
8 MO

Received Sample Set(s), [Work Order : Date Received]:
[C140708 : 07/10/2014]

Attached are the analytical results for the samples received from the Barker-Hughesville_Treatability_JUL 2014_A046 sampling event, according to TDF A-046. All analyses were performed within their method specified holding times unless otherwise noted in the following narrative.

These samples were prepared, analyzed, and verified by the Environmental Services Assistance Team Laboratory (ESAT) according to the requirements of the Technical Direction Form (TDF).

Note: The laboratory herewith transmits this deliverable to the program/project partner for determination of "final data usability" which may include data validation and data quality asessment per and in accordance with EPA QA/G-8, *Guidance on Environmental Data Verification and Data Validation*, November 2002, EPA/240/R-02/004. Laboratory data qualifiers are applied based on the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004, referred to as "NFGI".

Laboratory policy is to dispose of any remaining sample 60 days after data analysis packages are delivered to EPA. If you would like the laboratory to retain the samples for a period longer than 60 days,

Case Narrative

C140708

Quality Assessment: Unless indicated by exception, the QA/QC associated with this sample set produced data within the TDF-specified criteria.

Holding Times: All samples were analyzed within their method-specified technical holding time(s).

1. Initial and Continuing calibration blanks (ICBs and CCBs).
   Exceptions: None.
2. Preparation (PB) / Method blanks (MB)
   Exceptions: None.
3. Interference Checks (ICSA / ICSAB) for ICP-MS and ICP-OE analyses only.
   Exceptions: None.
4. Initial and Continuing calibration verification analyses (ICVs, SCVs and CCVs).
   Exceptions: In ICP-MS sequence 1407038, lead recovered high in the SCV. As a result, all sample results for lead were qualified "J" as estimated. In ICP-MS sequence 1409053, arsenic recovered low in the SCV. All arsenic results were qualified "J" as estimated.
5. Laboratory Control Sample (LCS) or second source analysis or SRM.
   Exceptions: In ICP-MS batch 1409005, copper recovered l% below acceptable limits in the SRM. Since all other QC requirements for copper were met, no qualifiers were assigned.
6. Laboratory Fortified blank (LFB) / Blank spike (BS), same source as used for the matrix spikes.
   PBS performed with analyses/methods requiring preparation or digestion prior to analysis.
   Exceptions: None.
7. Contract Reporting Detection Limit Standard, labeled as CRA, CRDL or CRL.
   Exceptions: None.
8. Laboratory Duplicate (DUP). "Source" identifies field sample duplicated in the laboratory. If either the "source" or the duplicate result is <5X the reporting limit, the %D limit of 20% does not apply.
   Exceptions: None.
9. Laboratory Matrix Spike (MS) and spike duplicate (MSD). "Source" defines original field sample fortified prior to analysis. Percent recovery (%R) limits do not apply when sample concentration(s) exceed the corresponding analyte spike level by a factor of 4 or greater.
   Exceptions: None.
10. Serial Dilution sample analysis (SRD). "Source" is parent field sample diluted 1:5 in the laboratory. Performed for ICP-OE and ICP-MS metals analyses. Percent difference (%D) limits do not apply when analyte concentration(s) are below 50x the source sample's MDL (or 10x it's PQL).
    Exceptions: In ICP-OE sequence 1409037, manganese recovered high in the SRD. As a result, the source sample was qualfied "J" as estimated for manganese.
11. Internal standards, criteria specified for ICP-MS analyses only, monitored at the instrument.
    Exceptions: None.
12. Any calibration using more than two-points produced a correlation coefficient equal to or greater than 0.995.
    Exceptions: None.

Acronyms and Definitions:

ESAT	Environmental Services Assistance Team
J	Data Estimated qualifier (also applied to all data less than PQL, greater than or equal to MDL)
MDL	Method Detection Limit
PQL	Practical Quantitation Limit, also known as reporting limit.
RPD	Relative Percent Difference (difference divided by the mean)
%D	Percent difference, serial dilution criteria unit, difference divided by the original result.
%R	Percent recovery, analyzed (less sample contribution) divided by true value
<	Analyte NOT DETECTED at or above the Method Detection Limit (MDL)
mg/L	Parts per million (millligrams per liter). Solids equivalent = mg/Kg.
ug/L	Parts per billion (micrograms per liter). Solids equivalent = ug/Kg.
NR	No Recovery (matrix spike) - Often seen for calcium/magnesium when their concentration exceeds the spike level by > 4x.
NFGI	*USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004
RE	Sample Re-analysis. Usually seen on raw data and sequences for required sample dilutions due to over-range analytes.
U	Analyte not detected at or above MDL qualifier
D	Diluted value qualifier.

Method(s) Summary:

As defined in the Technical Direction Form (TDF), some or all of the methods listed below were used for the determination of the reported target analytes.

From EPA's *Methods for the Determination of Metals in Environmental Samples*, Supplement I, May 1994, dissolved, total, and/or total recoverable metals were determined by:

- Method 200.7 / 6010B using a PE Optima ICP -OE (ICP).
- Method 200.8 / 6020 using a Perkin -Elmer Elan 6000 ICP-MS.
- Method 200.2 for total recoverable metals (only) digestion.
- Method 245.1 using a Perkin -Elmer FIMS CVAA (aqueous mercury only).

From *Standard Methods for the Examination of Water and Wastewater*, 18th Edition, 1992, Method 2340B was used for the calculated hardness determination. Hardness is reported as mg (milligram) equivalent $CaCO_3$ per liter (L) determined as follows:

Calculated hardness = 2.497 * (Calcium, mg/L) + 4.118 * (Magnesium, mg/L).

From *EPA's Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW -846*,

- Method 3015A was used for microwave assisted total metals digestion.
- Method 7473 was used for mercury in solids.

From EPA's *Determination of Inorganic Anions by Ion Chromatography*, Revision 2.1, 1993, Method 300.0 was used to determine the anions.

From EPA's *Methods for Chemical Analysis of Water and Wastes*, March 1983:

- Method 310.1 was followed for the alkalinity determination.
- Method 160.1 was followed for gravimetric total dissolved solids (TDS) determination.
- Method 160.2 was used for gravimetric total suspended solids (TSS) determination.
- Method 415.3 was used for total organic carbon (TOC) determination using either an Apollo 9000 or Phoenix 8000 Non-Dispersive IR (NDIR) system. Also known as dissolved organic carbon (DOC) when performed on the dissolved sample fraction.

The quality control procedures listed in the TDF request were utilized by ESAT to verify accuracy of the results and to evaluate any matrix interferences.

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-070814 **Date / Time Sampled:** 07/08/14 09:55 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-01 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 50.0	U	ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**2190**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**45000**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**59.2**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	**Arsenic**	**5.98**	J	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**1760**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-070814 **Date / Time Sampled:** 07/08/14 10:10 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-05 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**81.2**		ug/L	20.0	1	09/08/2014	SV	1409031
200.7	Iron	< 250	U	ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**17200**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**46.8**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**1220**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-070814 **Date / Time Sampled:** 07/08/14 10:30 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-09 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**37.9**	J	ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**2070**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**9710**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**95.7**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	**Arsenic**	**26.0**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**17.0**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**1.04**	J	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**2520**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-070814 **Date / Time Sampled:** 07/08/14 10:50 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-13 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**133**	J	ug/L	100	5	09/08/2014	SV	1409031
200.7	**Iron**	**1030**	J	ug/L	500	5	09/08/2014	SV	1409031
200.7	**Manganese**	**61800**		ug/L	10.0	5	09/08/2014	SV	1409031
200.7	**Zinc**	**271**		ug/L	50.0	5	09/08/2014	SV	1409031
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**754**		mg/L	8	5	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-070814 **Date / Time Sampled:** 07/08/14 09:25 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-17 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 50.0	U	ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**5000**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**30300**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**30.2**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	**Arsenic**	**7.06**	J	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**2920**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFL-070814 **Date / Time Sampled:** 07/08/14 08:45 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-21 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**15000**		ug/L	200	10	09/08/2014	SV	1409031
200.7	**Iron**	**184000**		ug/L	1000	10	09/08/2014	SV	1409031
200.7	**Manganese**	**123000**		ug/L	20.0	10	09/08/2014	SV	1409031
200.7	**Zinc**	**66500**		ug/L	100	10	09/08/2014	SV	1409031
200.8	**Arsenic**	**166**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**285**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**1270**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**147**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**28.5**		ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**375**		mg/L	15	10	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFLD-070814 **Date / Time Sampled:** 07/08/14 09:05 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-25 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**14900**		ug/L	200	10	09/08/2014	SV	1409031
200.7	**Iron**	**184000**		ug/L	1000	10	09/08/2014	SV	1409031
200.7	**Manganese**	**122000**		ug/L	20.0	10	09/08/2014	SV	1409031
200.7	**Zinc**	**66100**		ug/L	100	10	09/08/2014	SV	1409031
200.8	**Arsenic**	**178**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**294**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**1250**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**149**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**25.3**		ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**369**		mg/L	15	10	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NOAH-070814 **Date / Time Sampled:** 07/08/14 09:40 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-29 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**13600**		ug/L	100	5	09/08/2014	SV	1409031
200.7	**Iron**	**23300**		ug/L	500	5	09/08/2014	SV	1409031
200.7	**Manganese**	**112000**		ug/L	10.0	5	09/08/2014	SV	1409031
200.7	**Zinc**	**64100**		ug/L	50.0	5	09/08/2014	SV	1409031
200.8	**Arsenic**	**5.61**	J	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**294**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**1260**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**123**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**27.0**		ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**371**		mg/L	8	5	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-070814 **Date / Time Sampled:** 07/08/14 11:25 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-33 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**70.2**		ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**974**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**11500**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**1120**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	**Arsenic**	**16.9**	J	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**1.75**	J	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**5.78**	J	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**1480**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-070814 **Date / Time Sampled:** 07/08/14 11:05 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-37 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**33.9**	J	ug/L	20.0	1	09/08/2014	SV	1409031
200.7	Iron	< 250	U	ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**37400**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**29.4**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	**Arsenic**	**9.21**	J	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**1540**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-070814 **Date / Time Sampled:** 07/08/14 09:15 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-41 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**142**	J	ug/L	100	5	09/08/2014	SV	1409031
200.7	**Iron**	**107000**		ug/L	500	5	09/08/2014	SV	1409031
200.7	**Manganese**	**111000**		ug/L	10.0	5	09/08/2014	SV	1409031
200.7	**Zinc**	**16100**		ug/L	50.0	5	09/08/2014	SV	1409031
200.8	**Arsenic**	**36.2**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	Copper	< 10.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**19.0**		ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**802**		mg/L	8	5	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-CHIT-0708 **Date / Time Sampled:** 07/08/14 19:15 **Workorder:** C140708
EPA Tag No.: 14 No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-45 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**301**		ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**547**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**21100**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**7810**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	**Arsenic**	**36.0**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**48.4**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**542**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**5.80**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**14.8**		ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**1000**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-LSTN-070 **Date / Time Sampled:** 07/08/14 18:55 **Workorder:** C140708
EPA Tag No.: 814No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-48 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**40.1**	J	ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**651**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**24300**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**9690**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**43.8**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**62.9**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**4.71**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**7.78**	J	ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**991**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-NAOH-070 **Date / Time Sampled:** 07/08/14 17:30 **Workorder:** C140708
EPA Tag No.: 814No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-51 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**150**		ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**420**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**22600**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**11500**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**46.4**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**397**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**11.7**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**19.5**		ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**286**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-RAW-0708 **Date / Time Sampled:** 07/08/14 16:30 **Workorder:** C140708
EPA Tag No.: 14 No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-54 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**2340**		ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**269000**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**25400**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**12100**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	**Arsenic**	**29.5**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**43.8**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**1450**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**952**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**11.4**		ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**286**		mg/L	2	1	09/08/2014	SV	1409031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-RAWD-07 **Date / Time Sampled:** 07/08/14 16:50 **Workorder:** C140708
EPA Tag No.: 0814 No Tag Prefix-A **Matrix:** Water **Lab Number:** C140708-57 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**2210**		ug/L	20.0	1	09/08/2014	SV	1409031
200.7	**Iron**	**254000**		ug/L	100	1	09/08/2014	SV	1409031
200.7	**Manganese**	**24400**		ug/L	2.00	1	09/08/2014	SV	1409031
200.7	**Zinc**	**11700**		ug/L	10.0	1	09/08/2014	SV	1409031
200.8	**Arsenic**	**30.5**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Cadmium**	**45.2**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Copper**	**1410**		ug/L	5.00	10	09/09/2014	SV	1409032
200.8	**Lead**	**954**		ug/L	1.00	10	09/09/2014	SV	1409032
200.8	**Nickel**	**10.5**		ug/L	5.00	10	09/09/2014	SV	1409032
2340B	**Hardness**	**273**		mg/L	2	1	09/08/2014	SV	1409031

"J" Qualifier indicates an estimated value

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR1-070814 **Date / Time Sampled:** 07/08/14 09:55 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-02 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**265**		ug/L	100	5	09/11/2014	SV	1409005
200.7	**Iron**	**11000**		ug/L	500	5	09/11/2014	SV	1409005
200.7	**Manganese**	**56800**		ug/L	10.0	5	09/11/2014	SV	1409005
200.7	**Zinc**	**2200**		ug/L	50.0	5	09/11/2014	SV	1409005
200.8	**Arsenic**	**13.7**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**2.10**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**15.7**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**1.59**	J	ug/L	1.00	10	09/11/2014	SV	1409005
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR2-070814 **Date / Time Sampled:** 07/08/14 10:10 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-06 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**161**		ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**1000**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**19500**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**2100**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	**Arsenic**	**19.3**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**1.21**	J	ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**25.6**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**7.48**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR3-070814 **Date / Time Sampled:** 07/08/14 10:30 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-10 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**26.2**	J	ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**2510**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**9760**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**116**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	**Arsenic**	**29.3**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**36.2**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**6.88**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-BCR4-070814 **Date / Time Sampled:** 07/08/14 10:50 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-14 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**654**		ug/L	100	5	09/11/2014	SV	1409005
200.7	**Iron**	**2070**		ug/L	500	5	09/11/2014	SV	1409005
200.7	**Manganese**	**64700**		ug/L	10.0	5	09/11/2014	SV	1409005
200.7	**Zinc**	**7400**		ug/L	50.0	5	09/11/2014	SV	1409005
200.8	**Arsenic**	**17.4**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**13.8**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**49.6**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**8.54**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-CHIT-070814 **Date / Time Sampled:** 07/08/14 09:25 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-18 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 50.0	U	ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**6170**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**33200**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**298**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	**Arsenic**	**7.06**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**1.69**	J	ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**8.24**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	Lead	< 2.00	U	ug/L	1.00	10	09/11/2014	SV	1409005
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFL-070814 **Date / Time Sampled:** 07/08/14 08:45 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-22 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**15100**		ug/L	200	10	09/11/2014	SV	1409005
200.7	**Iron**	**185000**		ug/L	1000	10	09/11/2014	SV	1409005
200.7	**Manganese**	**123000**		ug/L	20.0	10	09/11/2014	SV	1409005
200.7	**Zinc**	**65300**		ug/L	100	10	09/11/2014	SV	1409005
200.8	**Arsenic**	**198**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**291**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**1060**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**221**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Nickel**	**20.9**		ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-INFLD-070814 **Date / Time Sampled:** 07/08/14 09:05 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-26 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**15100**		ug/L	200	10	09/11/2014	SV	1409005
200.7	**Iron**	**186000**		ug/L	1000	10	09/11/2014	SV	1409005
200.7	**Manganese**	**123000**		ug/L	20.0	10	09/11/2014	SV	1409005
200.7	**Zinc**	**66500**		ug/L	100	10	09/11/2014	SV	1409005
200.8	**Arsenic**	**207**	J	ug/L	50.0	100	09/11/2014	SV	1409005
200.8	**Cadmium**	**288**		ug/L	10.0	100	09/11/2014	SV	1409005
200.8	**Copper**	**1160**		ug/L	50.0	100	09/11/2014	SV	1409005
200.8	**Lead**	**206**		ug/L	10.0	100	09/11/2014	SV	1409005
200.8	Nickel	< 100	U	ug/L	50.0	100	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-NOAH-070814 **Date / Time Sampled:** 07/08/14 09:40 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-30 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**13500**		ug/L	100	5	09/11/2014	SV	1409005
200.7	**Iron**	**34800**		ug/L	500	5	09/11/2014	SV	1409005
200.7	**Manganese**	**110000**		ug/L	10.0	5	09/11/2014	SV	1409005
200.7	**Zinc**	**62000**		ug/L	50.0	5	09/11/2014	SV	1409005
200.8	**Arsenic**	**19.7**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**283**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**1040**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**175**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Nickel**	**21.3**		ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTE-070814 **Date / Time Sampled:** 07/08/14 11:25 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-34 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**138**		ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**1370**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**11900**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**1440**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	**Arsenic**	**36.5**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**2.95**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**18.1**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**5.61**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-POSTI-070814 **Date / Time Sampled:** 07/08/14 11:05 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-38 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**108**		ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**4550**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**41000**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**3080**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	Arsenic	< 200	J,	ug/L	50.0	100	09/11/2014	SV	1409005
200.8	Cadmium	< 20.0	U	ug/L	10.0	100	09/11/2014	SV	1409005
200.8	Copper	< 100	U	ug/L	50.0	100	09/11/2014	SV	1409005
200.8	Lead	< 20.0	U	ug/L	10.0	100	09/11/2014	SV	1409005
200.8	Nickel	< 100	U	ug/L	50.0	100	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-DT-PILOT-SAPS-070814 **Date / Time Sampled:** 07/08/14 09:15 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-42 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**159**	J	ug/L	100	5	09/11/2014	SV	1409005
200.7	**Iron**	**103000**		ug/L	500	5	09/11/2014	SV	1409005
200.7	**Manganese**	**112000**		ug/L	10.0	5	09/11/2014	SV	1409005
200.7	**Zinc**	**18300**		ug/L	50.0	5	09/11/2014	SV	1409005
200.8	**Arsenic**	**38.8**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**5.40**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**10.5**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Nickel**	**11.3**		ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-CHIT-0708 **Date / Time Sampled:** 07/08/14 19:15 **Workorder:** C140708
EPA Tag No.: 14 No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-46 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**530**		ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**41500**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**21200**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**7600**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	**Arsenic**	**43.1**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**47.0**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**497**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**102**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Nickel**	**9.78**	J	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-LSTN-070 **Date / Time Sampled:** 07/08/14 18:55 **Workorder:** C140708
EPA Tag No.: 814No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-49 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**222**		ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**16800**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**24400**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**9480**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	Arsenic	< 20.0	J,	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**38.6**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**114**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**70.1**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	Nickel	< 10.0	U	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-NAOH-070 **Date / Time Sampled:** 07/08/14 17:30 **Workorder:** C140708
EPA Tag No.: 814No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-52 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**212**		ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**6710**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**22700**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**11200**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	Arsenic	< 20.0	J,	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**42.1**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**331**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**42.5**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Nickel**	**14.2**		ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-RAW-0708 **Date / Time Sampled:** 07/08/14 16:30 **Workorder:** C140708
EPA Tag No.: 14 No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-55 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**2310**		ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**261000**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**24800**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**11500**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	**Arsenic**	**30.1**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**39.0**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**1100**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**1240**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Nickel**	**8.30**	J	ug/L	5.00	10	09/11/2014	SV	1409005

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-TN-RAWD-07 **Date / Time Sampled:** 07/08/14 16:50 **Workorder:** C140708
EPA Tag No.: 0814No Tag Prefix-B **Matrix:** Water **Lab Number:** C140708-58 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**2260**		ug/L	20.0	1	09/11/2014	SV	1409005
200.7	**Iron**	**255000**		ug/L	100	1	09/11/2014	SV	1409005
200.7	**Manganese**	**24500**		ug/L	2.00	1	09/11/2014	SV	1409005
200.7	**Zinc**	**11300**		ug/L	10.0	1	09/11/2014	SV	1409005
200.8	**Arsenic**	**28.9**	J	ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Cadmium**	**40.4**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Copper**	**1110**		ug/L	5.00	10	09/11/2014	SV	1409005
200.8	**Lead**	**1260**		ug/L	1.00	10	09/11/2014	SV	1409005
200.8	**Nickel**	**7.71**	J	ug/L	5.00	10	09/11/2014	SV	1409005

"J" Qualifier indicates an estimated value

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-070814 **Date / Time Sampled:** 07/08/14 09:55 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-03 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**65.7**	J	mg/L	50.0	100	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**55.2**		mg/L	10.0	100	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**701**		mg/L	5.0	100	07/11/2014	NP	1407040
EPA 310.1	**Total Alkalinity**	**1020**		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR1-070814 **Date / Time Sampled:** 07/08/14 09:55 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140708-04 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**58.2**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-070814 **Date / Time Sampled:** 07/08/14 10:10 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-07 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**85.7**	J	mg/L	50.0	100	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**30.3**		mg/L	10.0	100	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**562**		mg/L	5.0	100	07/11/2014	NP	1407040
EPA 310.1	**Total Alkalinity**	**685**		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR2-070814 **Date / Time Sampled:** 07/08/14 10:10 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140708-08 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**14.6**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-070814 **Date / Time Sampled:** 07/08/14 10:30 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-11 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**110**	J	mg/L	50.0	100	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**134**		mg/L	10.0	100	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**376**		mg/L	5.0	100	07/11/2014	NP	1407040
EPA 310.1	**Total Alkalinity**	**2490**		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR3-070814 **Date / Time Sampled:** 07/08/14 10:30 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140708-12 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**199**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-070814 **Date / Time Sampled:** 07/08/14 10:50 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-15 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**68.5**	J	mg/L	50.0	100	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**18.0**	J	mg/L	10.0	100	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**724**		mg/L	5.0	100	07/11/2014	NP	1407040
EPA 310.1	**Total Alkalinity**	**404**	J	mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-BCR4-070814 **Date / Time Sampled:** 07/08/14 10:50 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140708-16 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**4.55**	D	mg/L	0.300	10	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-CHIT-070814 **Date / Time Sampled:** 07/08/14 09:25 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-19 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	Chloride	< 200	U	mg/L	50.0	100	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**139**		mg/L	10.0	100	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1020**		mg/L	5.0	100	07/11/2014	NP	1407040
EPA 310.1	**Total Alkalinity**	**2270**		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-INFL-070814 **Date / Time Sampled:** 07/08/14 08:45 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-23 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**6.9**	J	mg/L	5.0	10	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**2.8**		mg/L	1.0	10	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1280**		mg/L	0.5	10	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-INFLD-070814 **Date / Time Sampled:** 07/08/14 09:05 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-27 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**7.0**	J	mg/L	5.0	10	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**3.1**		mg/L	1.0	10	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1310**		mg/L	0.5	10	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-NOAH-070814 **Date / Time Sampled:** 07/08/14 09:40 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-31 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**6.9**	J	mg/L	5.0	10	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**2.6**		mg/L	1.0	10	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1160**		mg/L	0.5	10	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTE-070814 **Date / Time Sampled:** 07/08/14 11:25 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-35 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**85.3**	J	mg/L	50.0	100	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**38.8**		mg/L	10.0	100	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**656**		mg/L	5.0	100	07/11/2014	NP	1407040
EPA 310.1	**Total Alkalinity**	**1100**		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTE-070814 **Date / Time Sampled:** 07/08/14 11:25 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140708-36 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**46.6**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTI-070814 **Date / Time Sampled:** 07/08/14 11:05 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-39 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**77.1**	J	mg/L	50.0	100	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**63.9**		mg/L	10.0	100	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**603**		mg/L	5.0	100	07/11/2014	NP	1407040
EPA 310.1	**Total Alkalinity**	**1190**		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-POSTI-070814 **Date / Time Sampled:** 07/08/14 11:05 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-D **Matrix:** Water **Lab Number:** C140708-40 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 350.1	**Ammonia as N**	**70.8**	D	mg/L	3.00	100	07/18/2014	KJB	1407080

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-DT-PILOT-SAPS-070814 **Date / Time Sampled:** 07/08/14 09:15 **Workorder:** C140708
EPA Tag No.: No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-43 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**7.4**	J	mg/L	5.0	10	07/11/2014	NP	1407040
EPA 300.0	**Fluoride**	**3.6**		mg/L	1.0	10	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1030**		mg/L	0.5	10	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-TN-CHIT-0708
EPA Tag No.: 14 No Tag Prefix-C
Date / Time Sampled: 07/08/14 19:15
Matrix: Water
Workorder: C140708
Lab Number: C140708-47 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**169**	J	mg/L	50.0	100	07/11/2014	NP	1407040
EPA 300.0	Fluoride	< 20.0	U	mg/L	10.0	100	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 500	U	mg/L	100	100	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**944**		mg/L	5.0	100	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-TN-LSTN-070
EPA Tag No.: 814No Tag Prefix-C
Date / Time Sampled: 07/08/14 18:55
Matrix: Water
Workorder: C140708
Lab Number: C140708-50 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**6.7**	J	mg/L	5.0	10	07/11/2014	NP	1407040
EPA 300.0	Fluoride	< 2.0	U	mg/L	1.0	10	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1040**		mg/L	0.5	10	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-TN-NAOH-070 **Date / Time Sampled:** 07/08/14 17:30 **Workorder:** C140708
EPA Tag No.: 814No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-53 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Chloride**	**6.7**	J	mg/L	5.0	10	07/11/2014	NP	1407040
EPA 300.0	Fluoride	< 2.0	U	mg/L	1.0	10	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1020**		mg/L	0.5	10	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-TN-RAW-0708 **Date / Time Sampled:** 07/08/14 16:30 **Workorder:** C140708
EPA Tag No.: 14 No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-56 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	Chloride	< 20.0	U	mg/L	5.0	10	07/11/2014	NP	1407040
EPA 300.0	Fluoride	< 2.0	U	mg/L	1.0	10	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1120**		mg/L	0.5	10	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-TN-RAWD-07 **Date / Time Sampled:** 07/08/14 16:50 **Workorder:** C140708
EPA Tag No.: 0814 No Tag Prefix-C **Matrix:** Water **Lab Number:** C140708-59 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	Chloride	< 20.0	U	mg/L	5.0	10	07/11/2014	NP	1407040
EPA 300.0	Fluoride	< 2.0	U	mg/L	1.0	10	07/11/2014	NP	1407040
EPA 300.0	Nitrate/Nitrite as N	< 50.0	U	mg/L	10.0	10	07/11/2014	NP	1407040
EPA 300.0	**Sulfate as SO4**	**1120**		mg/L	0.5	10	07/11/2014	NP	1407040
EPA 310.1	Total Alkalinity	< 500		mg CaCO3 / L	250	50	07/15/2014	KJB	1407059

"J" Qualifier indicates an estimated value

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ICPMS-PE DRC-II									
Batch 1409032 - No Lab Prep Reqd			***Water***						**ICPMS-PE DRC-II**
Method Blank (1409032-BLK1)		Dilution Factor: 1				Prepared: 09/08/14 Analyzed: 09/09/14			
Nickel	< 0.500	1.00	ug/L						
Copper	< 0.500	1.00	"						
Arsenic	< 0.500	2.00	"						
Cadmium	< 0.100	0.200	"						
Lead	< 0.100	0.200	"						
Method Blank Spike (1409032-BS1)		Dilution Factor: 1				Prepared: 09/08/14 Analyzed: 09/09/14			
Nickel	93.9	1.00	ug/L	100		94	85-115		
Copper	92.0	1.00	"	100		92	85-115		
Arsenic	87.1	2.00	"	100		87	85-115		
Cadmium	97.6	0.200	"	100		98	85-115		
Lead	96.0	0.200	"	100		96	85-115		
Duplicate (1409032-DUP1)		Dilution Factor: 1	**Source: C140708-01**			Prepared: 09/08/14 Analyzed: 09/09/14			
Nickel	< 5.00	10.0	ug/L		< 5.00				20
Copper	< 5.00	10.0	"		< 5.00				20
Arsenic	5.26	20.0	"		5.98			13	20
Cadmium	< 1.00	2.00	"		< 1.00				20
Lead	< 1.00	2.00	"		< 1.00				20
Matrix Spike (1409032-MS1)		Dilution Factor: 1	**Source: C140708-01**			Prepared: 09/08/14 Analyzed: 09/09/14			
Nickel	125	10.0	ug/L	100	< 5.00	125	70-130		
Copper	85.2	10.0	"	100	< 5.00	85	70-130		
Arsenic	92.9	20.0	"	100	5.98	87	70-130		
Cadmium	96.8	2.00	"	100	< 1.00	97	70-130		
Lead	81.9	2.00	"	100	< 1.00	82	70-130		
Matrix Spike (1409032-MS2)		Dilution Factor: 1	**Source: C140708-05**			Prepared: 09/08/14 Analyzed: 09/09/14			
Nickel	103	10.0	ug/L	100	< 5.00	103	70-130		
Copper	83.5	10.0	"	100	< 5.00	83	70-130		
Arsenic	87.6	20.0	"	100	< 5.00	88	70-130		
Cadmium	94.0	2.00	"	100	< 1.00	94	70-130		
Lead	80.7	2.00	"	100	< 1.00	81	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409039 - 1409032			*Water*						ICPMS-PE DRC-II
Serial Dilution (1409039-SRD1)		Dilution Factor: 5		**Source: C140708-01**		Prepared: 09/08/14 Analyzed: 09/09/14			
Nickel	< 25.0	50.0	ug/L		< 5.00				10
Copper	< 25.0	50.0	"		< 5.00				10
Arsenic	< 25.0	100	"		5.98				10
Cadmium	< 5.00	10.0	"		< 1.00				10
Lead	< 5.00	10.0	"		< 1.00				10

ICPOE - PE Optima

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409031 - No Lab Prep Reqd			*Water*						ICPOE - PE Optima
Method Blank (1409031-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 09/08/14			
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						
Method Blank Spike (1409031-BS1)		Dilution Factor: 1				Prepared & Analyzed: 09/08/14			
Aluminum	10430	50.0	ug/L	10100		103	85-115		
Iron	10500	250	"	10100		104	85-115		
Manganese	99.69	5.00	"	100		100	85-115		
Zinc	100.1	20.0	"	100		100	85-115		
Duplicate (1409031-DUP1)		Dilution Factor: 1		**Source: C140708-01**		Prepared & Analyzed: 09/08/14			
Aluminum	< 20.0	50.0	ug/L		< 20.0				20
Iron	2231	250	"		2188			2	20
Manganese	45050	5.00	"		44950			0.2	20
Zinc	61.18	20.0	"		59.24			3	20
Matrix Spike (1409031-MS1)		Dilution Factor: 1		**Source: C140708-01**		Prepared & Analyzed: 09/08/14			
Aluminum	10670	50.0	ug/L	10100	< 20.0	106	70-130		
Iron	12470	250	"	10100	2188	102	70-130		
Manganese	44260	5.00	"	100	44950	NR	70-130		
Zinc	161.3	20.0	"	100	59.24	102	70-130		

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409031 - No Lab Prep Reqd			*Water*						ICPOE - PE Optima
Matrix Spike (1409031-MS2)		Dilution Factor: 1	**Source: C140708-05**			Prepared & Analyzed: 09/08/14			
Aluminum	10540	50.0	ug/L	10100	81.22	104	70-130		
Iron	10400	250	"	10100	< 100	103	70-130		
Manganese	16580	5.00	"	100	17200	NR	70-130		
Zinc	138.7	20.0	"	100	46.82	92	70-130		
Batch 1409037 - 1409031			*Water*						ICPOE - PE Optima
Serial Dilution (1409037-SRD1)		Dilution Factor: 5	**Source: C140708-01**			Prepared & Analyzed: 09/08/14			
Aluminum	264.1	250	ug/L		< 20.00				10
Iron	1811	1250	"		2188			19	10
Manganese	50820	25.0	"		44950			12	10
Zinc	81.80	100	"		59.24			32	10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ICPMS-PE DRC-II									
Batch 1409005 - 200.2 - TR Metals			***Water***						**ICPMS-PE DRC-II**
Method Blank (1409005-BLK2)		Dilution Factor: 5				Prepared: 09/02/14 Analyzed: 09/11/14			
Nickel	2.832	5.00	ug/L						
Copper	< 2.50	5.00	"						
Arsenic	< 2.50	10.0	"						
Cadmium	< 0.500	1.00	"						
Lead	< 0.500	1.00	"						
Duplicate (1409005-DUP2)		Dilution Factor: 1	**Source: C140708-02**			Prepared: 09/02/14 Analyzed: 09/11/14			
Nickel	< 5.00	10.0	ug/L		< 5.00				20
Copper	16.03	10.0	"		15.65			2	20
Arsenic	13.27	20.0	"		13.65			3	20
Cadmium	2.148	2.00	"		2.102			2	20
Lead	1.584	2.00	"		1.585			0.1	20
Matrix Spike (1409005-MS2)		Dilution Factor: 1	**Source: C140708-02**			Prepared: 09/02/14 Analyzed: 09/11/14			
Nickel	392.9	10.0	ug/L	500	< 5.00	79	70-130		
Copper	248.7	10.0	"	300	15.65	78	70-130		
Arsenic	744.0	20.0	"	800	13.65	91	70-130		
Cadmium	192.8	2.00	"	200	2.102	95	70-130		
Lead	1038	2.00	"	1000	1.585	104	70-130		
Matrix Spike (1409005-MS4)		Dilution Factor: 1	**Source: C140708-06**			Prepared: 09/02/14 Analyzed: 09/11/14			
Nickel	376.2	10.0	ug/L	500	< 5.00	75	70-130		
Copper	254.0	10.0	"	300	25.57	76	70-130		
Arsenic	743.4	20.0	"	800	19.31	91	70-130		
Cadmium	191.9	2.00	"	200	1.206	95	70-130		
Lead	1024	2.00	"	1000	7.484	102	70-130		
Reference (1409005-SRM2)		Dilution Factor: 2				Prepared: 09/02/14 Analyzed: 09/11/14			
Nickel	911.9	20.0	ug/L	1000		91	85-115		
Copper	844.4	20.0	"	1000		84	85-115		
Arsenic	1910	40.0	"	2000		96	85-115		
Cadmium	990.8	4.00	"	1000		99	85-115		
Lead	2056	4.00	"	2000		103	85-115		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Batch 1409053 - 1409005 *Water* **ICPMS-PE DRC-II**

Serial Dilution (1409053-SRD1) Dilution Factor: 5 **Source: C140708-02** Prepared: 09/02/14 Analyzed: 09/11/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	< 25.0	50.0	ug/L		< 5.00				10
Copper	< 25.0	50.0	"		15.65				10
Arsenic	< 25.0	100	"		13.65				10
Cadmium	< 5.00	10.0	"		2.102				10
Lead	< 5.00	10.0	"		1.585				10

ICPOE - PE Optima

Batch 1409005 - 200.2 - TR Metals *Water* **ICPOE - PE Optima**

Method Blank (1409005-BLK1) Dilution Factor: 1 Prepared: 09/02/14 Analyzed: 09/11/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						

Duplicate (1409005-DUP1) Dilution Factor: 5 **Source: C140708-02** Prepared: 09/02/14 Analyzed: 09/11/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	249.9	250	ug/L		265.4			6	20
Iron	11080	1250	"		11030			0.5	20
Manganese	56130	25.0	"		56820			1	20
Zinc	2159	100	"		2195			2	20

Matrix Spike (1409005-MS1) Dilution Factor: 1 **Source: C140708-02** Prepared: 09/02/14 Analyzed: 09/11/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	2116	50.0	ug/L	2000	265.4	93	70-130		
Iron	3960	250	"	3000	11030	NR	70-130		
Manganese	19950	5.00	"	200	56820	NR	70-130		
Zinc	2323	20.0	"	200	2195	64	70-130		

Matrix Spike (1409005-MS3) Dilution Factor: 1 **Source: C140708-06** Prepared: 09/02/14 Analyzed: 09/11/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	2004	50.0	ug/L	2000	161.4	92	70-130		
Iron	5369	250	"	3000	1003	146	70-130		
Manganese	9980	5.00	"	200	19530	NR	70-130		
Zinc	294.6	20.0	"	200	2100	NR	70-130		

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409005 - 200.2 - TR Metals			***Water***						**ICPOE - PE Optima**
Reference (1409005-SRM1)		Dilution Factor: 1				Prepared: 09/02/14 Analyzed: 09/11/14			
Aluminum	965.3	50.0	ug/L	1000		97	85-115		
Iron	918.2	250	"	1000		92	85-115		
Manganese	1005	5.00	"	1000		100	85-115		
Zinc	975.4	20.0	"	1000		98	85-115		
Batch 1409050 - 1409005			***Water***						**ICPOE - PE Optima**
Serial Dilution (1409050-SRD1)		Dilution Factor: 2	**Source: C140708-02**			Prepared: 09/02/14 Analyzed: 09/11/14			
Aluminum	< 500	1250	ug/L		265.4				10
Iron	10590	6250	"		11030			4	10
Manganese	57760	125	"		56820			2	10
Zinc	2224	500	"		2195			1	10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ESAT Dionex IC									
Batch 1407040 - No Prep Req			***Water***						**ESAT Dionex IC**
Method Blank (1407040-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 07/11/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						
Method Blank Spike (1407040-BS1)		Dilution Factor: 1				Prepared & Analyzed: 07/11/14			
Fluoride	4.9	0.2	mg/L	5.00		99	90-110		
Chloride	23.6	2.0	"	25.0		94	90-110		
Sulfate as SO4	22.6	0.1	"	25.0		90	90-110		
Nitrate/Nitrite as N	20.1	5.0	"	20.0		100	90-110		
Duplicate (1407040-DUP1)		Dilution Factor: 1	**Source: C140708-03**			Prepared & Analyzed: 07/11/14			
Fluoride	55.8	20.0	mg/L		55.2			1	20
Chloride	66.4	200	"		65.7			1	20
Sulfate as SO4	714	10.0	"		701			2	20
Nitrate/Nitrite as N	< 100	500	"		< 100				20
Matrix Spike (1407040-MS1)		Dilution Factor: 1	**Source: C140708-03**			Prepared & Analyzed: 07/11/14			
Fluoride	566	20.0	mg/L	500	55.2	102	80-120		
Chloride	2420	200	"	2500	65.7	94	80-120		
Sulfate as SO4	3170	10.0	"	2500	701	99	80-120		
Nitrate/Nitrite as N	2040	500	"	2000	< 100	102	80-120		
Matrix Spike (1407040-MS2)		Dilution Factor: 1	**Source: C140708-43**			Prepared & Analyzed: 07/11/14			
Fluoride	53.1	2.0	mg/L	50.0	3.6	99	80-120		
Chloride	237	20.0	"	250	7.4	92	80-120		
Sulfate as SO4	1270	1.0	"	250	1030	95	80-120		
Nitrate/Nitrite as N	200	50.0	"	200	< 10.0	100	80-120		

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1407055 - 1407040			***Water***						**ESAT Dionex IC**
Instrument Blank (1407055-IBL1)		Dilution Factor: 1				Prepared & Analyzed: 07/11/14			
Fluoride	< 0.1	0.2	mg/L						
Chloride	< 0.5	2.0	"						
Sulfate as SO4	< 0.05	0.1	"						
Nitrate/Nitrite as N	< 1.0	5.0	"						

Lachat 8500

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1407080 - No Prep Req			***Water***						**Lachat 8500**
Method Blank (1407080-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 07/18/14			
Ammonia as N	< 0.0300	0.0500	mg/L						
Method Blank Spike (1407080-BS1)		Dilution Factor: 1				Prepared & Analyzed: 07/18/14			
Ammonia as N	0.980	0.0500	mg/L	1.00		98	90-110		
Duplicate (1407080-DUP1)		Dilution Factor: 1	**Source: C140708-04**			Prepared & Analyzed: 07/18/14			
Ammonia as N	58.1	5.00	mg/L		58.2			0.3	20
Duplicate (1407080-DUP2)		Dilution Factor: 1	**Source: C140711-20**			Prepared & Analyzed: 07/18/14			
Ammonia as N	12.0	5.00	mg/L		12.1			0.8	20
Matrix Spike (1407080-MS1)		Dilution Factor: 1	**Source: C140708-04**			Prepared & Analyzed: 07/18/14			
Ammonia as N	154	5.00	mg/L	100	58.2	96	90-110		
Matrix Spike (1407080-MS2)		Dilution Factor: 1	**Source: C140711-20**			Prepared & Analyzed: 07/18/14			
Ammonia as N	107	5.00	mg/L	100	12.1	95	90-110		
Reference (1407080-SRM1)		Dilution Factor: 5				Prepared & Analyzed: 07/18/14			
Ammonia as N	4.91	0.250	mg/L	4.80		102	90-110		

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Mettler AT

Batch 1407059 - No Prep Req *Water* **Mettler AT**

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Method Blank (1407059-BLK1)		Dilution Factor: 1				Prepared: 07/14/14 Analyzed: 07/15/14			
Total Alkalinity	< 5.00	10.0	mg CaCO3 / L						
Duplicate (1407059-DUP1)		Dilution Factor: 5	**Source: C140708-03**			Prepared: 07/14/14 Analyzed: 07/15/14			
Total Alkalinity	1010	500	mg CaCO3 / L		1020			0.5	20
Duplicate (1407059-DUP2)		Dilution Factor: 5	**Source: C140708-43**			Prepared: 07/14/14 Analyzed: 07/15/14			
Total Alkalinity	< 250	500	mg CaCO3 / L		< 250				20
Reference (1407059-SRM1)		Dilution Factor: 1				Prepared: 07/14/14 Analyzed: 07/15/14			
Total Alkalinity	12.0	10.0	mg CaCO3 / L	10.4		115	61.3-143.9		

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 300.0

Analysis Name: WC - Anions by Ion Chromatography

Instrument: **ESAT Dionex IC**

Work Order: Nu C140708

Analytical Sequence: 1407055 **Dissolved**

Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	1407040-BLK1	NA	
Fluoride	0.00	0.00	0.00	0.00		0.00	NA	0.20
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1407040-BLK1	NA	
Chloride	0.00	0.00	0.00	0.00		0.00	NA	2.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1407040-BLK1	NA	
Sulfate as SO4	0.00	0.00	0.00	0.00		0.00	NA	0.10
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	1407040-BLK1	NA	
Nitrate/Nitrite as N	0.00	0.00	0.00	0.00		0.00	NA	5.00
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

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INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 310.1

Analysis Name: WC - Alkalinity

Instrument: **Mettler AT**

Work Order: Nu C140708

Analytical Sequence: **Total**

Concentration Units: mg CaCO3 / L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	1407059-BLK1	NA	
Total Alkalinity		1.12	1.32			1.04	NA	10.00
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

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TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 350.1

Analysis Name: WC - Ammonia

Instrument: **Lachat 8500**

Work Order: Nu C140708

Analytical Sequence: **Total**

Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Ammonia as N		**1**	**2**	**3**	**4**	1407080-BLK1	NA	0.05
		0.00	0.00	0.00		0.02	NA	
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

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TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7

Analysis Name: ICPOE Diss. Metals

Instrument: **ICPOE - PE Optima**

Work Order: Nu C140708

Analytical Sequence: 1409037 **Dissolved**

Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Aluminum	1.95	1	2	3	4	1409031-BLK1	NA	50.00
		1.62	1.03	2.79		2.95	NA	
		5	6	7	8			
Iron	-23.76	1	2	3	4	1409031-BLK1	NA	250.00
		21.79	-12.15	19.33		26.11	NA	
		5	6	7	8			
Manganese	0.04	1	2	3	4	1409031-BLK1	NA	5.00
		0.22	0.63	0.75		-0.01	NA	
		5	6	7	8			
Zinc	0.83	1	2	3	4	1409031-BLK1	NA	20.00
		1.03	2.01	2.13		0.01	NA	
		5	6	7	8			

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8 Analysis Name: ICPMS Diss. Metals

Instrument: **ICPMS-PE DRC-II** Work Order: Nu C140708

Analytical Sequence: 1409039 **Dissolved** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Nickel	0.00	**1**	**2**	**3**	**4**	1409032-BLK1	NA	1.00
		0.01	0.02	0.02		-0.01	NA	
		5	**6**	**7**	**8**			
Copper	0.00	**1**	**2**	**3**	**4**	1409032-BLK1	NA	1.00
		0.00	0.00	0.00		-0.04	NA	
		5	**6**	**7**	**8**			
Arsenic	0.09	**1**	**2**	**3**	**4**	1409032-BLK1	NA	2.00
		0.02	0.07	0.09		0.11	NA	
		5	**6**	**7**	**8**			
Cadmium	0.01	**1**	**2**	**3**	**4**	1409032-BLK1	NA	0.20
		0.02	0.02	0.01		0.00	NA	
		5	**6**	**7**	**8**			
Lead	0.03	**1**	**2**	**3**	**4**	1409032-BLK1	NA	0.20
		0.00	-0.02	-0.04		-0.02	NA	
		5	**6**	**7**	**8**			

Project Name: Barker-Hughesville_Treatability_JUL 2014_A046 **Certificate of Analysis**

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TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Instrument: **ICPOE - PE Optima** Work Order: Nu C140708

Analytical Sequence: 1409050 **Total Recoverable** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks								Method Blank (Batch ID)		PQL
		1	2	3	4	5	6	7	8			
Aluminum	0.89	0.92	2.04	3.46						1409005-BLK1 1.22	NA NA	50.00
Iron	15.55	7.23	2.61	15.25						1409005-BLK1 24.26	NA NA	250.00
Manganese	0.08	0.13	0.38	0.38						1409005-BLK1 -0.28	NA NA	5.00
Zinc	0.64	1.02	0.50	0.91						1409005-BLK1 1.64	NA NA	20.00

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

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TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Instrument: **ICPMS-PE DRC-II** Work Order: Nu C140708

Analytical Sequence: 1409053 **Total Recoverable** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
		1	**2**	**3**	**4**	NA	1409005-BLK2	
Nickel	0.01	0.00	0.00	0.00		NA	0.57	1.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	NA	1409005-BLK2	
Copper	0.01	0.00	-0.02	-0.02		NA	-0.03	1.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	NA	1409005-BLK2	
Arsenic	0.02	0.03	-0.04	-0.04		NA	-0.21	2.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	NA	1409005-BLK2	
Cadmium	0.00	-0.01	-0.01	0.00		NA	-0.02	0.20
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	NA	1409005-BLK2	
Lead	-0.01	-0.02	-0.01	-0.02		NA	-0.03	0.20
		5	**6**	**7**	**8**			

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

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TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ESAT Dionex IC Method: EPA 300.0 Analysis Name: WC - Anions by Ion Chromatography 2013

Sequence: 1407055 Work Order: C140708 Units: mg/L

Dissolved Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
Chloride	40.0	40.4	101.0		**1**			**2**			**3**	
				40.0	41.4	103.5	40.0	41.4	103.5	40.0	41.6	104.0
					4			**5**			**6**	
					7			**8**			**9**	
Fluoride	4.00	4.0	100.0		**1**			**2**			**3**	
				4.00	4.1	102.5	4.00	4.2	105.0	4.00	4.2	105.0
					4			**5**			**6**	
					7			**8**			**9**	
Nitrate/Nitrite as N	20.0	20.1	100.5		**1**			**2**			**3**	
				20.0	20.6	103.0	20.0	20.6	103.0	20.0	20.7	103.5
					4			**5**			**6**	
					7			**8**			**9**	
Sulfate as SO4	100	101	101.0		**1**			**2**			**3**	
				100	104	104.0	100	104	104.0	100	106	106.0
					4			**5**			**6**	
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Mettler AT Method: EPA 310.1 Analysis Name: WC - Alkalinity

Sequence: 1407064 Work Order: C140708 Units: mg CaCO3 / L

Total Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
Total Alkalinity					**1**			**2**			**3**	
				100	100	100.0	100	99.9	99.9			
					4			**5**			**6**	
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Lachat 8500 Method: EPA 350.1 Analysis Name: WC - Ammonia

Sequence: 1407091 Work Order: C140708 Units: mg/L

Total Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Ammonia as N					1			2			3	
				1.00	0.979	97.9	1.00	0.980	98.0	1.00	0.982	98.2
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Diss. Metals

Sequence: 1409037 Work Order: C140708 Units: ug/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Aluminum	12500	12400	99.2	12500	12700	101.6	12500	12670	101.4	12500	12550	100.4
					4			5			6	
					7			8			9	
					1			2			3	
Iron	12500	12630	101.0	12500	12660	101.3	12500	12730	101.8	12500	12650	101.2
					4			5			6	
					7			8			9	
					1			2			3	
Manganese	1000	1028	102.8	1000	1009	100.9	1000	1027	102.7	1000	1033	103.3
					4			5			6	
					7			8			9	
					1			2			3	
Zinc	2500	2546	101.8	2500	2544	101.8	2500	2579	103.2	2500	2592	103.7
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Diss. Metals

Sequence: 1409039 Work Order: C140708 Units: ug/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Arsenic	50.0	50.9	101.8		1			2			3	
				50.0	49.5	99.0	50.0	50.8	101.6	50.0	49.1	98.2
					4			5			6	
					7			8			9	
Cadmium	50.0	49.4	98.8		1			2			3	
				50.0	49.5	99.0	50.0	53.6	107.2	50.0	54.4	108.8
					4			5			6	
					7			8			9	
Copper	50.0	54.2	108.4		1			2			3	
				50.0	51.3	102.6	50.0	49.6	99.2	50.0	49.3	98.6
					4			5			6	
					7			8			9	
Lead	50.0	50.2	100.4		1			2			3	
				50.0	46.7	93.4	50.0	48.7	97.4	50.0	46.1	92.2
					4			5			6	
					7			8			9	
Nickel	50.0	53.6	107.2		1			2			3	
				50.0	51.5	103.0	50.0	50.4	100.8	50.0	52.5	105.0
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Sequence: 1409050 Work Order: C140708 Units: ug/L

Total Recoverable Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
Aluminum	12500	12950	103.6		**1**			**2**			**3**	
				12500	12790	102.3	12500	12730	101.8	12500	12790	102.3
					4			**5**			**6**	
					7			**8**			**9**	
Iron	12500	12900	103.2		**1**			**2**			**3**	
				12500	12490	99.9	12500	12470	99.8	12500	12430	99.4
					4			**5**			**6**	
					7			**8**			**9**	
Manganese	1000	1022	102.2		**1**			**2**			**3**	
				1000	1027	102.7	1000	1028	102.8	1000	1033	103.3
					4			**5**			**6**	
					7			**8**			**9**	
Zinc	2500	2566	102.6		**1**			**2**			**3**	
				2500	2594	103.8	2500	2569	102.8	2500	2589	103.6
					4			**5**			**6**	
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1409053 Work Order: C140708 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
					1			2			3	
Arsenic	50.0	49.46	98.9	50.0	47.28	94.6	50.0	47.79	95.6	50.0	47.73	95.5
					4			5			6	
					7			8			9	
					1			2			3	
Cadmium	50.0	50.55	101.1	50.0	49.98	100.0	50.0	49.81	99.6	50.0	50.15	100.3
					4			5			6	
					7			8			9	
					1			2			3	
Copper	50.0	48.25	96.5	50.0	46.86	93.7	50.0	48.17	96.3	50.0	45.32	90.6
					4			5			6	
					7			8			9	
					1			2			3	
Lead	50.0	49.15	98.3	50.0	52.27	104.5	50.0	51.98	104.0	50.0	51.52	103.0
					4			5			6	
					7			8			9	
					1			2			3	
Nickel	50.0	49.76	99.5	50.0	48.69	97.4	50.0	49.50	99.0	50.0	47.25	94.5
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8
ICP Interference Check Sample
ICPMS-PE DRC-II

Sequence: 1409039 Analysis: ICPMS Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.0	ug/L			2.00
	IFB1	18.8	ug/L	20	94	2.00
Cadmium	IFA1	0.1	ug/L			0.200
	IFB1	20.0	ug/L	20	100	0.200
Copper	IFA1	0.7	ug/L			1.00
	IFB1	20.6	ug/L	20	103	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	-0.1	ug/L			1.00
	IFB1	20.3	ug/L	20	102	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1409053 Analysis: ICPMS Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.0	ug/L			2.00
	IFB1	20.1	ug/L	20	101	2.00
Cadmium	IFA1	0.0	ug/L			0.200
	IFB1	20.7	ug/L	20	104	0.200
Copper	IFA1	0.5	ug/L			1.00
	IFB1	17.4	ug/L	20	87	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	-0.2	ug/L			1.00
	IFB1	18.3	ug/L	20	92	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8

ICP Interference Check Sample

ICPOE - PE Optima

Sequence: 1409037 Analysis: ICPOE Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	59,888.8	ug/L	60,000	100	50.0
	IFB1	60,565.4	ug/L	60,000	101	50.0
Iron	IFA1	234,765.4	ug/L	250,000	94	250
	IFB1	235,009.8	ug/L	250,000	94	250
Manganese	IFA1	-0.1	ug/L			5.00
	IFB1	196.0	ug/L	200	98	5.00
Zinc	IFA1	8.6	ug/L			20.0
	IFB1	291.9	ug/L	300	97	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1409050 Analysis: ICPOE Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	61,035.1	ug/L	60,000	102	50.0
	IFB1	61,569.3	ug/L	60,000	103	50.0
Iron	IFA1	234,323.5	ug/L	250,000	94	250
	IFB1	234,561.1	ug/L	250,000	94	250
Manganese	IFA1	-0.5	ug/L			5.00
	IFB1	195.4	ug/L	200	98	5.00
Zinc	IFA1	4.8	ug/L			20.0
	IFB1	287.6	ug/L	300	96	20.0

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPMS-PE DRC-II

Metals (Dissolved) by EPA 200/7000 Series Methods
Sequence: 1409039

Analyte	True	Found	%R	Units
Arsenic	2.00	2.11	105	ug/L
Cadmium	0.200	0.180	90	ug/L
Copper	1.00	0.978	98	ug/L
Lead	0.200	0.224	112	ug/L
Nickel	1.00	0.952	95	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPOE - PE Optima

Metals (Dissolved) by EPA 200/7000 Series Methods
Sequence: 1409037

Analyte	True	Found	%R	Units
Aluminum	100	99.63	100	ug/L
Iron	100	91.41	91	ug/L
Manganese	10.0	10.06	101	ug/L
Zinc	50.0	53.60	107	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8

Detection Limit (PQL) Standard

Lachat 8500

Classical Chemistry by EPA/ASTM/APHA Methods

Sequence: 1407091

Analyte	True	Found	%R	Units
Ammonia as N	0.0250	0.0197	79	mg/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPMS-PE DRC-II

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1409053

Analyte	True	Found	%R	Units
Arsenic	2.00	1.956	98	ug/L
Cadmium	0.200	0.1660	83	ug/L
Copper	1.00	1.085	109	ug/L
Lead	0.200	0.1620	81	ug/L
Nickel	1.00	1.014	101	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPOE - PE Optima

Metals (Total Recov) by EPA 200/7000 Series Methods

Sequence: 1409050

Analyte	True	Found	%R	Units
Aluminum	100	98.99	99	ug/L
Iron	100	129.6	130	ug/L
Manganese	10.0	10.10	101	ug/L
Zinc	50.0	51.67	103	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 300.0 **Dissolved** **Sequence ID#:** 1407055

Instrument ID #: ESAT Dionex IC Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1407055-ICV1	Initial Cal Check	07/11/14	14:23
1407055-ICB1	Initial Cal Blank	07/11/14	14:42
1407055-SCV1	Secondary Cal Check	07/11/14	15:00
1407055-IBL1	Instrument Blank	07/11/14	15:19
1407040-BS1	Blank Spike	07/11/14	15:38
1407040-BLK1	Blank	07/11/14	15:56
C140708-03	14BH-DT-PILOT-BCR1-07081	07/11/14	16:15
1407040-DUP1	Duplicate	07/11/14	16:33
1407040-MS1	Matrix Spike	07/11/14	16:52
C140708-07	14BH-DT-PILOT-BCR2-07081	07/11/14	17:10
C140708-11	14BH-DT-PILOT-BCR3-07081	07/11/14	17:29
C140708-15	14BH-DT-PILOT-BCR4-07081	07/11/14	17:48
1407055-CCV1	Calibration Check	07/11/14	18:06
1407055-CCB1	Calibration Blank	07/11/14	18:25
C140708-19	14BH-DT-PILOT-CHIT-070814	07/11/14	18:43
C140708-23	14BH-DT-PILOT-INFL-070814	07/11/14	19:02
C140708-27	14BH-DT-PILOT-INFLD-0708	07/11/14	19:20
C140708-31	14BH-DT-PILOT-NOAH-0708	07/11/14	19:39
C140708-35	14BH-DT-PILOT-POSTE-0708	07/11/14	19:58
C140708-39	14BH-DT-PILOT-POSTI-07081	07/11/14	20:16
C140708-43	14BH-DT-PILOT-SAPS-07081	07/11/14	20:35
1407040-MS2	Matrix Spike	07/11/14	20:53
C140708-47	14BH-TI-BENCH-TN-CHIT-07	07/11/14	21:12
C140708-50	14BH-TI-BENCH-TN-LSTN-0	07/11/14	21:30
1407055-CCV2	Calibration Check	07/11/14	21:49
1407055-CCB2	Calibration Blank	07/11/14	22:08
C140708-53	14BH-TI-BENCH-TN-NAOH-	07/11/14	22:26
C140708-56	14BH-TI-BENCH-TN-RAW-07	07/11/14	22:45
C140708-59	14BH-TI-BENCH-TN-RAWD-	07/11/14	23:03
1407055-CCV3	Calibration Check	07/11/14	23:22
1407055-CCB3	Calibration Blank	07/11/14	23:40

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 310.1 **Total** **Sequence ID#:** 1407064

Instrument ID #: Mettler AT Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1407059-SRM1	Reference	07/15/14	12:08
1407059-BLK1	Blank	07/15/14	12:08
C140708-03	14BH-DT-PILOT-BCR1-07081	07/15/14	12:08
1407059-DUP1	Duplicate	07/15/14	12:08
C140708-07	14BH-DT-PILOT-BCR2-07081	07/15/14	12:08
C140708-11	14BH-DT-PILOT-BCR3-07081	07/15/14	12:08
C140708-15	14BH-DT-PILOT-BCR4-07081	07/15/14	12:08
C140708-19	14BH-DT-PILOT-CHIT-070814	07/15/14	12:08
C140708-23	14BH-DT-PILOT-INFL-070814	07/15/14	12:08
C140708-27	14BH-DT-PILOT-INFLD-0708	07/15/14	12:08
1407064-CCV1	Calibration Check	07/15/14	12:08
1407064-CCB1	Calibration Blank	07/15/14	12:08
C140708-31	14BH-DT-PILOT-NOAH-0708	07/15/14	12:08
C140708-35	14BH-DT-PILOT-POSTE-0708	07/15/14	12:08
C140708-39	14BH-DT-PILOT-POSTI-07081	07/15/14	12:08
C140708-43	14BH-DT-PILOT-SAPS-07081	07/15/14	12:08
1407059-DUP2	Duplicate	07/15/14	12:08
C140708-47	14BH-TI-BENCH-TN-CHIT-07	07/15/14	12:08
C140708-50	14BH-TI-BENCH-TN-LSTN-0	07/15/14	12:08
C140708-53	14BH-TI-BENCH-TN-NAOH-	07/15/14	12:08
C140708-56	14BH-TI-BENCH-TN-RAW-07	07/15/14	12:08
C140708-59	14BH-TI-BENCH-TN-RAWD-	07/15/14	12:08
1407064-CCV2	Calibration Check	07/15/14	12:08
1407064-CCB2	Calibration Blank	07/15/14	12:08

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 350.1 **Total** **Sequence ID#:** 1407091

Instrument ID #: Lachat 8500 Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1407080-BLK1	Blank	07/18/14	13:02
1407080-BS1	Blank Spike	07/18/14	13:02
1407091-CRL1	Instrument RL Check	07/18/14	13:02
C140708-04	14BH-DT-PILOT-BCR1-07081	07/18/14	13:02
1407080-DUP1	Duplicate	07/18/14	13:02
1407080-MS1	Matrix Spike	07/18/14	13:02
C140708-08	14BH-DT-PILOT-BCR2-07081	07/18/14	13:02
1407091-CCV1	Calibration Check	07/18/14	13:02
1407091-CCB1	Calibration Blank	07/18/14	13:02
C140708-12	14BH-DT-PILOT-BCR3-07081	07/18/14	13:02
C140708-36	14BH-DT-PILOT-POSTE-0708	07/18/14	13:02
C140708-40	14BH-DT-PILOT-POSTI-07081	07/18/14	13:02
1407080-DUP2	Duplicate	07/18/14	13:02
1407091-CCV2	Calibration Check	07/18/14	13:02
1407091-CCB2	Calibration Blank	07/18/14	13:02
1407080-MS2	Matrix Spike	07/18/14	13:02
1407080-SRM1	Reference	07/18/14	13:02
C140708-16	14BH-DT-PILOT-BCR4-07081	07/18/14	13:02
1407091-CCV3	Calibration Check	07/18/14	13:02
1407091-CCB3	Calibration Blank	07/18/14	13:02

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Dissolved** **Sequence ID#:** 1409037

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409037-ICV1	Initial Cal Check	09/08/14	11:08
1409037-SCV1	Secondary Cal Check	09/08/14	11:11
1409037-ICB1	Initial Cal Blank	09/08/14	11:14
1409037-CRL1	Instrument RL Check	09/08/14	11:17
1409037-IFA1	Interference Check A	09/08/14	11:20
1409037-IFB1	Interference Check B	09/08/14	11:24
1409031-BLK1	Blank	09/08/14	11:28
1409031-BS1	Blank Spike	09/08/14	11:31
C140708-01	14BH-DT-PILOT-BCR1-07081	09/08/14	11:34
1409031-DUP1	Duplicate	09/08/14	11:39
1409037-SRD1	Serial Dilution	09/08/14	11:43
1409031-MS1	Matrix Spike	09/08/14	11:46
C140708-05	14BH-DT-PILOT-BCR2-07081	09/08/14	11:50
1409031-MS2	Matrix Spike	09/08/14	11:55
C140708-09	14BH-DT-PILOT-BCR3-07081	09/08/14	11:59
1409037-CCV1	Calibration Check	09/08/14	12:06
1409037-CCB1	Calibration Blank	09/08/14	12:09
C140708-17	14BH-DT-PILOT-CHIT-070814	09/08/14	12:17
C140708-21	14BH-DT-PILOT-INFL-070814	09/08/14	12:21
C140708-25	14BH-DT-PILOT-INFLD-0708	09/08/14	12:24
C140708-33	14BH-DT-PILOT-POSTE-0708	09/08/14	12:31
C140708-37	14BH-DT-PILOT-POSTI-07081	09/08/14	12:35
C140708-45	14BH-TI-BENCH-TN-CHIT-07	09/08/14	12:43
1409037-CCV2	Calibration Check	09/08/14	12:51
1409037-CCB2	Calibration Blank	09/08/14	12:54
C140708-48	14BH-TI-BENCH-TN-LSTN-0	09/08/14	12:57
C140708-51	14BH-TI-BENCH-TN-NAOH-	09/08/14	13:01
C140708-54	14BH-TI-BENCH-TN-RAW-07	09/08/14	13:05
C140708-57	14BH-TI-BENCH-TN-RAWD-	09/08/14	13:08
C140708-13	14BH-DT-PILOT-BCR4-07081	09/08/14	13:16
C140708-29	14BH-DT-PILOT-NOAH-0708	09/08/14	13:19
C140708-41	14BH-DT-PILOT-SAPS-07081	09/08/14	13:22
1409037-CCV3	Calibration Check	09/08/14	13:25
1409037-CCB3	Calibration Blank	09/08/14	13:28

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Dissolved** **Sequence ID#:** 1409039

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409039-ICV1	Initial Cal Check	09/09/14	08:55
1409039-SCV1	Secondary Cal Check	09/09/14	08:59
1409039-ICB1	Initial Cal Blank	09/09/14	09:02
1409039-CRL1	Instrument RL Check	09/09/14	09:05
1409039-IFA1	Interference Check A	09/09/14	09:09
1409039-IFB1	Interference Check B	09/09/14	09:12
1409032-BLK1	Blank	09/09/14	09:15
1409032-BS1	Blank Spike	09/09/14	09:18
C140708-01	14BH-DT-PILOT-BCR1-07081	09/09/14	09:21
1409032-DUP1	Duplicate	09/09/14	09:24
1409039-SRD1	Serial Dilution	09/09/14	09:27
1409032-MS1	Matrix Spike	09/09/14	09:30
C140708-05	14BH-DT-PILOT-BCR2-07081	09/09/14	09:33
1409032-MS2	Matrix Spike	09/09/14	09:36
C140708-09	14BH-DT-PILOT-BCR3-07081	09/09/14	09:39
1409039-CCV1	Calibration Check	09/09/14	09:46
1409039-CCB1	Calibration Blank	09/09/14	09:49
C140708-13	14BH-DT-PILOT-BCR4-07081	09/09/14	09:52
C140708-17	14BH-DT-PILOT-CHIT-070814	09/09/14	09:55
C140708-21	14BH-DT-PILOT-INFL-070814	09/09/14	09:58
C140708-25	14BH-DT-PILOT-INFLD-0708	09/09/14	10:01
C140708-29	14BH-DT-PILOT-NOAH-0708	09/09/14	10:04
C140708-33	14BH-DT-PILOT-POSTE-0708	09/09/14	10:07
C140708-37	14BH-DT-PILOT-POSTI-07081	09/09/14	10:10
C140708-41	14BH-DT-PILOT-SAPS-07081	09/09/14	10:14
C140708-45	14BH-TI-BENCH-TN-CHIT-07	09/09/14	10:17
1409039-CCV2	Calibration Check	09/09/14	10:42
1409039-CCB2	Calibration Blank	09/09/14	10:45
C140708-48	14BH-TI-BENCH-TN-LSTN-0	09/09/14	10:49
C140708-51	14BH-TI-BENCH-TN-NAOH-	09/09/14	10:52
C140708-54	14BH-TI-BENCH-TN-RAW-07	09/09/14	10:55
C140708-57	14BH-TI-BENCH-TN-RAWD-	09/09/14	10:58
1409039-CCV3	Calibration Check	09/09/14	11:15
1409039-CCB3	Calibration Blank	09/09/14	11:18

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INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Total Recoverable** **Sequence ID#:** 1409050

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409050-ICV1	Initial Cal Check	09/11/14	10:04
1409050-SCV1	Secondary Cal Check	09/11/14	10:07
1409050-ICB1	Initial Cal Blank	09/11/14	10:10
1409050-CRL1	Instrument RL Check	09/11/14	10:13
1409050-IFA1	Interference Check A	09/11/14	10:16
1409050-IFB1	Interference Check B	09/11/14	10:20
1409005-BLK1	Blank	09/11/14	10:24
1409005-SRM1	Reference	09/11/14	10:27
C140708-02	14BH-DT-PILOT-BCR1-07081	09/11/14	10:30
1409005-DUP1	Duplicate	09/11/14	10:33
1409050-SRD1	Serial Dilution	09/11/14	10:36
C140708-06	14BH-DT-PILOT-BCR2-07081	09/11/14	10:40
1409005-MS1	Matrix Spike	09/11/14	10:44
C140708-10	14BH-DT-PILOT-BCR3-07081	09/11/14	10:48
1409005-MS3	Matrix Spike	09/11/14	10:52
1409050-CCV1	Calibration Check	09/11/14	10:59
1409050-CCB1	Calibration Blank	09/11/14	11:02
C140708-14	14BH-DT-PILOT-BCR4-07081	09/11/14	11:05
C140708-18	14BH-DT-PILOT-CHIT-070814	09/11/14	11:09
C140708-22	14BH-DT-PILOT-INFL-070814	09/11/14	11:12
C140708-26	14BH-DT-PILOT-INFLD-0708	09/11/14	11:16
C140708-30	14BH-DT-PILOT-NOAH-0708	09/11/14	11:19
C140708-34	14BH-DT-PILOT-POSTE-0708	09/11/14	11:22
C140708-38	14BH-DT-PILOT-POSTI-07081	09/11/14	11:26
C140708-42	14BH-DT-PILOT-SAPS-07081	09/11/14	11:30
C140708-46	14BH-TI-BENCH-TN-CHIT-07	09/11/14	11:33
1409050-CCV2	Calibration Check	09/11/14	11:40
1409050-CCB2	Calibration Blank	09/11/14	11:43
C140708-49	14BH-TI-BENCH-TN-LSTN-0	09/11/14	11:46
C140708-52	14BH-TI-BENCH-TN-NAOH-	09/11/14	11:50
C140708-55	14BH-TI-BENCH-TN-RAW-07	09/11/14	11:54
C140708-58	14BH-TI-BENCH-TN-RAWD-	09/11/14	11:58
1409050-CCV3	Calibration Check	09/11/14	12:05
1409050-CCB3	Calibration Blank	09/11/14	12:08

Project Name: **Barker-Hughesville_Treatability_JUL 2014_A046** **Certificate of Analysis**

TDF #: **A-046**

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Total Recoverable** **Sequence ID#:** 1409053

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-046

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409053-ICV1	Initial Cal Check	09/11/14	12:39
1409053-SCV1	Secondary Cal Check	09/11/14	12:42
1409053-ICB1	Initial Cal Blank	09/11/14	12:46
1409053-CRL1	Instrument RL Check	09/11/14	12:49
1409053-IFA1	Interference Check A	09/11/14	12:52
1409053-IFB1	Interference Check B	09/11/14	12:56
1409005-BLK2	Blank	09/11/14	12:59
C140708-02	14BH-DT-PILOT-BCR1-07081	09/11/14	13:02
1409005-DUP2	Duplicate	09/11/14	13:05
1409053-SRD1	Serial Dilution	09/11/14	13:08
C140708-06	14BH-DT-PILOT-BCR2-07081	09/11/14	13:11
1409005-SRM2	Reference	09/11/14	13:14
1409005-MS2	Matrix Spike	09/11/14	13:17
C140708-10	14BH-DT-PILOT-BCR3-07081	09/11/14	13:20
1409005-MS4	Matrix Spike	09/11/14	13:23
1409053-CCV1	Calibration Check	09/11/14	13:29
1409053-CCB1	Calibration Blank	09/11/14	13:33
C140708-14	14BH-DT-PILOT-BCR4-07081	09/11/14	13:36
C140708-18	14BH-DT-PILOT-CHIT-070814	09/11/14	13:39
C140708-22	14BH-DT-PILOT-INFL-070814	09/11/14	13:47
C140708-30	14BH-DT-PILOT-NOAH-0708	09/11/14	13:53
C140708-34	14BH-DT-PILOT-POSTE-0708	09/11/14	13:56
C140708-42	14BH-DT-PILOT-SAPS-07081	09/11/14	14:02
C140708-46	14BH-TI-BENCH-TN-CHIT-07	09/11/14	14:05
1409053-CCV2	Calibration Check	09/11/14	14:27
1409053-CCB2	Calibration Blank	09/11/14	14:30
C140708-49	14BH-TI-BENCH-TN-LSTN-0	09/11/14	14:34
C140708-52	14BH-TI-BENCH-TN-NAOH-	09/11/14	14:37
C140708-55	14BH-TI-BENCH-TN-RAW-07	09/11/14	14:40
C140708-58	14BH-TI-BENCH-TN-RAWD-	09/11/14	14:43
C140708-26	14BH-DT-PILOT-INFLD-0708	09/11/14	14:49
C140708-38	14BH-DT-PILOT-POSTI-07081	09/11/14	14:52
1409053-CCV3	Calibration Check	09/11/14	15:18
1409053-CCB3	Calibration Blank	09/11/14	15:22

Chain of Custody Record

From: CDM Smith
555 17th Street, Suite 1100
Denver, CO 80202

Barker-Hughesville Mining District Superfund Site
CDM Smith
50 West 14th Street, Suite 200
Helena, Montana 59601

Page: 1 of 1

Send To: EPA Region 8 Laboratory
Attn: ESAT R8/Scott Walker
16194 W 45th Dr.
Golden, CO 80403

via: Hand Delivery

Ship Date: 7/10/2014

Sample Placed in Cooler/Bag	Sample ID	Sample Date	Sample Time	Sample Type (S=soil) (W=water)	# of Bottles	Turn Around Time	Total Metals	Dissolved Metals	Alkalinity, Sulfate	Comments	Sample Disposition	Sample Received by Lab
✓	14BH-TI-BENCH-TN-RAW-070814	7/8/2014	1630	W	9	Standard (21 days)	X	X	X	Triplicate sample for MS/MSD		
✓	14BH-TI-BENCH-TN-RAWD-070814	7/8/2014	1650	W	3		X	X	X			
✓	14BH-TI-BENCH-TN-NAOH-070814	7/8/2014	1730	W	3		X	X	X			
✓	14BH-TI-BENCH-TN-CHIT-070814	7/8/2014	MF ~~1855~~ 1915	W	3		X	X	X			
✓	14BH-TI-BENCH-TN-LSTN-070814	7/8/2014	MF ~~1915~~ 1855	W	3		X	X	X			

Total No. of Samples: 5

Remarks: Send reports to Nick Anton (antonnr@cdmsmith.com 720 264-1147) and Michael Fischer (fischermj@cdmsmith.com 303-383-2328).
Dissolved metals and anions were field filtered (0.45 micron)

Relinquished by (Signature and Company)	Date/Time	Received by (Signature and Company)	Date/Time	Sample Condition Upon Receipt
Michael J. Fischer CDM Smith	7/10/14 1443		7-10-13 15:18	

CHAIN OF CUSTODY RECORD

CDM Smith | Danny T Pilot Test | **Analysis**

NOTES: Limited sample volumes due to treatability testing
Contact: Angela Franden, CDM Smith (406)441-1400

SAMPLE NUMBER	DATE	TIME	MATRIX	Preservative	Type & No. of Containers	Total Metals (TAL), 200.7 or 200.8	Dissolved Metals (TAL), 200.7 or 200.8	Alkalinity, Anions (sulfate, chloride, fluoride)	Nitrate+Nitrite, Ammonia	Other Instructions and Notes
14BH-DT-PILOT-INFL-070814	7/8/14	8:45	aqueous	HNO3 (metals), H2SO4 (nutrients), cool	3, 125 mL poly	X	X	X		TAL metals = Al, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, Tl, Zn.
14BH-DT-PILOT-INFLD-070814	7/8/14	9:05	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-SAPS-070814	7/8/14	9:15	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-CHIT-070814	7/8/14	9:25	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-NAOH-070814	7/8/14	9:40	aqueous		3, 125 mL poly	X	X	X		
14BH-DT-PILOT-BCR1-070814	7/8/14	9:55	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR2-070814	7/8/14	10:10	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR3-070814	7/8/14	10:30	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-BCR4-070814	7/8/14	10:50	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-POSTI-070814	7/8/14	11:05	aqueous		4, 125 mL poly	X	X	X	X	
14BH-DT-PILOT-POSTE-070814	7/8/14	11:25	aqueous		4, 125 mL poly	X	X	X	X	

Relinquished by: (*Signature*) Laura Holland	**Date/Time** 07/09/14 0615	**Received for Laboratory by: (*Signature*)**		
Received by: (*Signature*)	**Date/Time** 7/10/2014 @ 12:30	**Airbill No.(s)**	**Carrier Name:** FedEx	**Lab:** USEPA Lab Region 8

ESAT

C140708

ESAT Technical Direction Form

Contract No. EPW13028
EPA Region 8

Site ID: 085N
TDF ID: A-046

Date Issued: 5/29/2014
Date Updated:

Date Closed By:

Name: Barker-Hughesville Treatability Study July

Details: The Contractor shall analyze several water samples associated with the treatability study at the Barker-Hughesville Superfund site as indicated in the Analytical Information Section. The samples will be sent to the ESAT R8 Lab during the 2014 field season starting in mid-June though early October 2014. There will be 9 sampling events associated with this project averaging approximately 10 samples per an event. The samples will be collected by Nick Anton/Erin Louden of CDM Smith.

Samples designated as influent samples (-INF) are expected to have high metal concentrations and should be analyzed by 200.7. Additionally, metals with sufficiently high concentrations may be reported from the 200.7 analyses.

ESAT should return the coolers to the following address:
CDM Smith/Lauren Helland
50 West 14th Street, Suite 200
Helena, MT 59601
406-441-1435
FedEx # 1323-6393-5

TO02/Subtask 02b: Inorganic Chemistry

Site RPM: Roger Hoogerheide

Analytical Information:

MATRIX

☑ Water ☐ Soils ☐ Vegetation ☐ Biota

WET CHEM

☐ TSS ☐ TDS ☐ DOC ☑ Alk ☑ Chloride ☑ Sulfate ☑ Fluoride ☑ Nitrate ☑ Nitrite
Other: Analyze for Ammonia and report NO2 and NO3 as NO2-NO3 combined.

METALS

☑ Dissolved ☑ Total Recoverable ☐ Total ☐ Hardness (Calc)
200.7: ☐ Ag ☑ Al ☐ As ☐ Ba ☐ Be ☐ B ☐ Ca ☐ Cd ☐ Co ☐ Cr ☐ Cu ☑ Fe ☐ K ☐ Mg
☒ Mn ☐ Mo ☐ Na ☐ Ni ☐ Pb ☐ Sb ☐ Se ☐ Sr ☐ Ti ☐ Tl ☐ V ☑ Zn ☐ SiO2
200.8: ☐ Ag ☐ Al ☑ As ☐ Ba ☐ Be ☑ Cd ☐ Co ☐ Cr ☑ Cu [✓ ☑ Mn] ☐ Mo ☑ Ni ☑ Pb ☐ Sb
☐ Se ☐ Th ☐ Tl ☐ U ☐ V ☐ Zn
7470/7471/747 ☐ Hg

Sv
09/08/14

FIBERS

☐ PLM ☐ TEM

Deliverables

ID	*Description*	*Due Date*	*Submission Date*
1	Provide final deliverable package to Task Monitor no later than 30 days after delivery of samples.		

Don 5/29/14

U.S. Environmental Protection Agency
Region 8
Technical and Management Services

Laboratory Services Program

Certificate of Analysis

Ref: 8TMS-L

MEMORANDUM

Date: 10/14/14

Subject: Analytical Results--- **Barker-Hugh_Tiger Mine Treatability_SEP 2014_A058 / A-058**

From: Don Goodrich; EPA Region 8 Analytical Chemistry WAM

To: Roger Hoogerheide
Superfund
8 MO

Received Sample Set(s), [Work Order : Date Received]:
[C140901 : 08/29/2014]

Attached are the analytical results for the samples received from the Barker-Hugh_Tiger Mine Treatability_SEP 2014_A058 sampling event, according to TDF A-058. All analyses were performed within their method specified holding times unless otherwise noted in the following narrative.

These samples were prepared, analyzed, and verified by the Environmental Services Assistance Team Laboratory (ESAT) according to the requirements of the Technical Direction Form (TDF).

Note: The laboratory herewith transmits this deliverable to the program/project partner for determination of "final data usability" which may include data validation and data quality asessment per and in accordance with EPA QA/G-8, *Guidance on Environmental Data Verification and Data Validation*, November 2002, EPA/240/R-02/004. Laboratory data qualifiers are applied based on the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004, referred to as "NFGI".

Laboratory policy is to dispose of any remaining sample 60 days after data analysis packages are delivered to EPA. If you would like the laboratory to retain the samples for a period longer than 60 days, please contact Don Goodrich within the 60 day period at (303) 312-6687.

Case Narrative

C140901

Quality Assessment: Unless indicated by exception, the QA/QC associated with this sample set produced data within the TDF-specified criteria.

Holding Times: All samples were analyzed within their method-specified technical holding time(s).

1. Initial and Continuing calibration blanks (ICBs and CCBs).
   Exceptions: None.
2. Preparation (PB) / Method blanks (MB)
   Exceptions: None.
3. Interference Checks (ICSA / ICSAB) for ICP-MS and ICP-OE analyses only.
   Exceptions: None.
4. Initial and Continuing calibration verification analyses (ICVs, SCVs and CCVs).
   Exceptions: In ICP-MS sequence 1410052, lead recovered 1% above acceptable limits in the ending CCV. As a result, bracketed samples were qualified "J" as estimated for lead.
5. Laboratory Control Sample (LCS) or second source analysis or SRM.
   Exceptions: In ICP-MS batch 1410017, lead recovered high in the SRM. No qualifiers were assigned since matrix spike recoveries were within acceptable range for lead.
6. Laboratory Fortified blank (LFB) / Blank spike (BS), same source as used for the matrix spikes. PBS performed with analyses/methods requiring preparation or digestion prior to analysis.
   Exceptions: None.
7. Contract Reporting Detection Limit Standard, labeled as CRA, CRDL or CRL.
   Exceptions: None.
8. Laboratory Duplicate (DUP). "Source" identifies field sample duplicated in the laboratory. If either the "source" or the duplicate result is <5X the reporting limit, the %D limit of 20% does not apply.
   Exceptions: None.
9. Laboratory Matrix Spike (MS) and spike duplicate (MSD). "Source" defines original field sample fortified prior to analysis. Percent recovery (%R) limits do not apply when sample concentration(s) exceed the corresponding analyte spike level by a factor of 4 or greater.
   Exceptions: None.
10. Serial Dilution sample analysis (SRD). "Source" is parent field sample diluted 1:5 in the laboratory. Performed for ICP-OE and ICP-MS metals analyses. Percent difference (%D) limits do not apply when analyte concentration(s) are below 50x the source sample's MDL (or 10x it's PQL).
    Exceptions: In ICP-MS sequence 1410046, cadmium was detected just above the PQL in the ICSA. As a result, the reporting limit for cadmium was raised from 0.20 ug/L. to 0.30 ug/L. No qualifiers were assigned.
11. Internal standards, criteria specified for ICP-MS analyses only, monitored at the instrument.
    Exceptions: None.
12. Any calibration using more than two-points produced a correlation coefficient equal to or greater than 0.995.
    Exceptions: None.

Acronyms and Definitions:

ESAT	Environmental Services Assistance Team
J	Data Estimated qualifier (also applied to all data less than PQL, greater than or equal to MDL)
MDL	Method Detection Limit
PQL	Practical Quantitation Limit, also known as reporting limit.
RPD	Relative Percent Difference (difference divided by the mean)
%D	Percent difference, serial dilution criteria unit, difference divided by the original result.
%R	Percent recovery, analyzed (less sample contribution) divided by true value
<	Analyte NOT DETECTED at or above the Method Detection Limit (MDL)
mg/L	Parts per million (millligrams per liter). Solids equivalent = mg/Kg.
ug/L	Parts per billion (micrograms per liter). Solids equivalent = ug/Kg.
NR	No Recovery (matrix spike) - Often seen for calcium/magnesium when their concentration exceeds the spike level by > 4x.
NFGI	*USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* October 2004
RE	Sample Re-analysis. Usually seen on raw data and sequences for required sample dilutions due to over-range analytes.
U	Analyte not detected at or above MDL qualifier
D	Diluted value qualifier.

Method(s) Summary:

As defined in the Technical Direction Form (TDF), some or all of the methods listed below were used for the determination of the reported target analytes.

From EPA's *Methods for the Determination of Metals in Environmental Samples* , Supplement I, May 1994, dissolved, total, and/or total recoverable metals were determined by:

- Method 200.7 / 6010B using a PE Optima ICP -OE (ICP).
- Method 200.8 / 6020 using a Perkin -Elmer Elan 6000 ICP-MS.
- Method 200.2 for total recoverable metals (only) digestion.
- Method 245.1 using a Perkin -Elmer FIMS CVAA (aqueous mercury only).

From *Standard Methods for the Examination of Water and Wastewater* , 18th Edition, 1992, Method 2340B was used for the calculated hardness determination. Hardness is reported as mg (milligram) equivalent $CaCO_3$ per liter (L) determined as follows:

Calculated hardness = 2.497 * (Calcium, mg/L) + 4.118 * (Magnesium, mg/L).

From *EPA's Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW -846*,

- Method 3015A was used for microwave assisted total metals digestion.
- Method 7473 was used for mercury in solids .

From EPA's *Determination of Inorganic Anions by Ion Chromatography* , Revision 2.1, 1993, Method 300.0 was used to determine the anions.

From EPA's *Methods for Chemical Analysis of Water and Wastes* , March 1983:

- Method 310.1 was followed for the alkalinity determination.
- Method 160.1 was followed for gravimetric total dissolved solids (TDS) determination.
- Method 160.2 was used for gravimetric total suspended solids (TSS) determination.
- Method 415.3 was used for total organic carbon (TOC) determination using either an Apollo 9000 or Phoenix 8000 Non-Dispersive IR (NDIR) system. Also known as dissolved organic carbon (DOC) when performed on the dissolved sample fraction.

The quality control procedures listed in the TDF request were utilized by ESAT to verify accuracy of the results and to evaluate any matrix interferences.

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR10-0826 **Date / Time Sampled:** 08/26/14 11:30 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-03 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**14900**		ug/L	200	10	10/08/2014	SV	1410031
200.7	**Iron**	**303000**		ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**41100**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	**Zinc**	**10700**		ug/L	100	10	10/08/2014	SV	1410031
200.8	**Arsenic**	**38.4**	J	ug/L	25.0	50	10/08/2014	SV	1410036
200.8	**Cadmium**	**44.3**		ug/L	5.00	50	10/08/2014	SV	1410036
200.8	**Copper**	**314**		ug/L	25.0	50	10/08/2014	SV	1410036
200.8	**Lead**	**255**		ug/L	5.00	50	10/08/2014	SV	1410036
200.8	**Nickel**	**108**		ug/L	25.0	50	10/08/2014	SV	1410036
2340B	**Hardness**	**651**		mg/L	15	10	10/08/2014	SV	1410031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR11-0826 **Date / Time Sampled:** 08/26/14 11:45 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-06 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 500	U	ug/L	200	10	10/08/2014	SV	1410031
200.7	Iron	< 2500	U	ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**16100**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	**Zinc**	**371**		ug/L	100	10	10/08/2014	SV	1410031
200.8	**Arsenic**	**40.0**		ug/L	5.00	10	10/08/2014	SV	1410036
200.8	Cadmium	< 3.00	U	ug/L	1.00	10	10/08/2014	SV	1410036
200.8	**Copper**	**7.37**	J	ug/L	5.00	10	10/08/2014	SV	1410036
200.8	**Lead**	**2.18**		ug/L	1.00	10	10/08/2014	SV	1410036
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/08/2014	SV	1410036
2340B	**Hardness**	**1140**		mg/L	15	10	10/08/2014	SV	1410031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR12-0826 **Date / Time Sampled:** 08/26/14 12:00 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-09 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**219**	J	ug/L	200	10	10/08/2014	SV	1410031
200.7	**Iron**	**1050**	J	ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**13000**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	**Zinc**	**167**	J	ug/L	100	10	10/08/2014	SV	1410031
200.8	**Arsenic**	**59.9**		ug/L	5.00	10	10/08/2014	SV	1410036
200.8	Cadmium	< 3.00	U	ug/L	1.00	10	10/08/2014	SV	1410036
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/08/2014	SV	1410036
200.8	**Lead**	**3.35**		ug/L	1.00	10	10/08/2014	SV	1410036
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/08/2014	SV	1410036
2340B	**Hardness**	**1420**		mg/L	15	10	10/08/2014	SV	1410031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR13-0826 **Date / Time Sampled:** 08/26/14 12:15 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-12 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**299**	J	ug/L	200	10	10/08/2014	SV	1410031
200.7	Iron	< 2500	U	ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**12800**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	Zinc	< 200	U	ug/L	100	10	10/08/2014	SV	1410031
200.8	**Arsenic**	**104**		ug/L	5.00	10	10/08/2014	SV	1410036
200.8	Cadmium	< 3.00	U	ug/L	1.00	10	10/08/2014	SV	1410036
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/08/2014	SV	1410036
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/08/2014	SV	1410036
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/08/2014	SV	1410036
2340B	**Hardness**	**2070**		mg/L	15	10	10/08/2014	SV	1410031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR14-0826 **Date / Time Sampled:** 08/26/14 12:30 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-15 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 500	U	ug/L	200	10	10/08/2014	SV	1410031
200.7	Iron	< 2500	U	ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**3480**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	Zinc	< 200	U	ug/L	100	10	10/08/2014	SV	1410031
200.8	**Arsenic**	**20.9**		ug/L	5.00	10	10/08/2014	SV	1410036
200.8	Cadmium	< 3.00	U	ug/L	1.00	10	10/08/2014	SV	1410036
200.8	**Copper**	**8.37**	J	ug/L	5.00	10	10/08/2014	SV	1410036
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/08/2014	SV	1410036
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/08/2014	SV	1410036
2340B	**Hardness**	**543**		mg/L	15	10	10/08/2014	SV	1410031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR15-0826 **Date / Time Sampled:** 08/26/14 12:45 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-18 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 500	U	ug/L	200	10	10/08/2014	SV	1410031
200.7	Iron	< 2500	U	ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**12100**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	Zinc	< 200	U	ug/L	100	10	10/08/2014	SV	1410031
200.8	**Arsenic**	**20.9**		ug/L	5.00	10	10/08/2014	SV	1410036
200.8	Cadmium	< 3.00	U	ug/L	1.00	10	10/08/2014	SV	1410036
200.8	**Copper**	**6.45**	J	ug/L	5.00	10	10/08/2014	SV	1410036
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/08/2014	SV	1410036
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/08/2014	SV	1410036
2340B	**Hardness**	**1170**		mg/L	15	10	10/08/2014	SV	1410031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR16-0826 **Date / Time Sampled:** 08/26/14 13:00 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-21 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**5340**		ug/L	200	10	10/08/2014	SV	1410031
200.7	**Iron**	**268000**		ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**42900**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	**Zinc**	**9500**		ug/L	100	10	10/08/2014	SV	1410031
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/08/2014	SV	1410036
200.8	**Cadmium**	**8.17**	J	ug/L	5.00	50	10/08/2014	SV	1410036
200.8	**Copper**	**71.0**		ug/L	25.0	50	10/08/2014	SV	1410036
200.8	**Lead**	**185**		ug/L	5.00	50	10/08/2014	SV	1410036
200.8	**Nickel**	**53.8**		ug/L	25.0	50	10/08/2014	SV	1410036
2340B	**Hardness**	**4850**		mg/L	15	10	10/08/2014	SV	1410031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR17-0826 **Date / Time Sampled:** 08/26/14 13:15 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-24 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**14100**		ug/L	200	10	10/08/2014	SV	1410031
200.7	**Iron**	**326000**		ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**43800**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	**Zinc**	**11100**		ug/L	100	10	10/08/2014	SV	1410031
200.8	**Arsenic**	**126**		ug/L	25.0	50	10/08/2014	SV	1410036
200.8	**Cadmium**	**83.8**		ug/L	5.00	50	10/08/2014	SV	1410036
200.8	**Copper**	**55.7**		ug/L	25.0	50	10/08/2014	SV	1410036
200.8	**Lead**	**116**		ug/L	5.00	50	10/08/2014	SV	1410036
200.8	**Nickel**	**110**		ug/L	25.0	50	10/08/2014	SV	1410036
2340B	**Hardness**	**3480**		mg/L	15	10	10/08/2014	SV	1410031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR18-0826 **Date / Time Sampled:** 08/26/14 09:15 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-27 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 500	U	ug/L	200	10	10/08/2014	SV	1410031
200.7	**Iron**	**155000**		ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**30400**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	Zinc	< 200	U	ug/L	100	10	10/08/2014	SV	1410031
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/08/2014	SV	1410036
200.8	Cadmium	< 15.0	U	ug/L	5.00	50	10/08/2014	SV	1410036
200.8	Copper	< 50.0	U	ug/L	25.0	50	10/08/2014	SV	1410036
200.8	Lead	< 10.0	U	ug/L	5.00	50	10/08/2014	SV	1410036
200.8	Nickel	< 50.0	U	ug/L	25.0	50	10/08/2014	SV	1410036
2340B	**Hardness**	**875**		mg/L	15	10	10/08/2014	SV	1410031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR2-0826 **Date / Time Sampled:** 08/26/14 09:30 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-30 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 500	U	ug/L	200	10	10/08/2014	SV	1410031
200.7	**Iron**	**3870**		ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**23000**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	**Zinc**	**5980**		ug/L	100	10	10/08/2014	SV	1410031
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/08/2014	SV	1410036
200.8	**Cadmium**	**21.8**		ug/L	5.00	50	10/08/2014	SV	1410036
200.8	**Copper**	**26.6**	J	ug/L	25.0	50	10/08/2014	SV	1410036
200.8	Lead	< 10.0	U	ug/L	5.00	50	10/08/2014	SV	1410036
200.8	Nickel	< 50.0	U	ug/L	25.0	50	10/08/2014	SV	1410036
2340B	**Hardness**	**335**		mg/L	15	10	10/08/2014	SV	1410031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR3-0826 **Date / Time Sampled:** 08/26/14 09:45 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-33 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 500	U	ug/L	200	10	10/08/2014	SV	1410031
200.7	**Iron**	**2550**		ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**22700**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	**Zinc**	**6810**		ug/L	100	10	10/08/2014	SV	1410031
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/08/2014	SV	1410036
200.8	**Cadmium**	**25.4**		ug/L	5.00	50	10/08/2014	SV	1410036
200.8	**Copper**	**70.5**		ug/L	25.0	50	10/08/2014	SV	1410036
200.8	Lead	< 10.0	U	ug/L	5.00	50	10/08/2014	SV	1410036
200.8	Nickel	< 50.0	U	ug/L	25.0	50	10/08/2014	SV	1410036
2340B	**Hardness**	**343**		mg/L	15	10	10/08/2014	SV	1410031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR4-0826 **Date / Time Sampled:** 08/26/14 10:00 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-36 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**306**	J	ug/L	200	10	10/08/2014	SV	1410031
200.7	Iron	< 2500	U	ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**20000**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	**Zinc**	**7420**		ug/L	100	10	10/08/2014	SV	1410031
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/08/2014	SV	1410036
200.8	**Cadmium**	**26.4**		ug/L	5.00	50	10/08/2014	SV	1410036
200.8	**Copper**	**174**		ug/L	25.0	50	10/08/2014	SV	1410036
200.8	Lead	< 10.0	U	ug/L	5.00	50	10/08/2014	SV	1410036
200.8	Nickel	< 50.0	U	ug/L	25.0	50	10/08/2014	SV	1410036
2340B	**Hardness**	**319**		mg/L	15	10	10/08/2014	SV	1410031

Project Name: **Barker-Hugh_Tiger Mine Treatability_SEP 2014_A058** **Certificate of Analysis**

TDF #: **A-058**

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR5-0826 **Date / Time Sampled:** 08/26/14 10:15 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-39 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**450**	J	ug/L	200	10	10/08/2014	SV	1410031
200.7	**Iron**	**18600**		ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**30600**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	Zinc	< 200	U	ug/L	100	10	10/08/2014	SV	1410031
200.8	Arsenic	< 20.0	U	ug/L	5.00	10	10/08/2014	SV	1410036
200.8	Cadmium	< 3.00	U	ug/L	1.00	10	10/08/2014	SV	1410036
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/08/2014	SV	1410036
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/08/2014	SV	1410036
200.8	Nickel	< 10.0	U	ug/L	5.00	10	10/08/2014	SV	1410036
2340B	**Hardness**	**317**		mg/L	15	10	10/08/2014	SV	1410031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR6-0826 **Date / Time Sampled:** 08/26/14 10:30 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-42 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 500	U	ug/L	200	10	10/08/2014	SV	1410031
200.7	**Iron**	**52900**		ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**30000**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	**Zinc**	**239**		ug/L	100	10	10/08/2014	SV	1410031
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/08/2014	SV	1410036
200.8	Cadmium	< 15.0	U	ug/L	5.00	50	10/08/2014	SV	1410036
200.8	Copper	< 50.0	U	ug/L	25.0	50	10/08/2014	SV	1410036
200.8	Lead	< 10.0	U	ug/L	5.00	50	10/08/2014	SV	1410036
200.8	Nickel	< 50.0	U	ug/L	25.0	50	10/08/2014	SV	1410036
2340B	**Hardness**	**338**		mg/L	15	10	10/08/2014	SV	1410031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR7-0826 **Date / Time Sampled:** 08/26/14 10:45 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-45 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**240**	J	ug/L	200	10	10/08/2014	SV	1410031
200.7	**Iron**	**1930**	J	ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**22800**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	**Zinc**	**7410**		ug/L	100	10	10/08/2014	SV	1410031
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/08/2014	SV	1410036
200.8	**Cadmium**	**26.6**		ug/L	5.00	50	10/08/2014	SV	1410036
200.8	**Copper**	**112**		ug/L	25.0	50	10/08/2014	SV	1410036
200.8	Lead	< 10.0	U	ug/L	5.00	50	10/08/2014	SV	1410036
200.8	Nickel	< 50.0	U	ug/L	25.0	50	10/08/2014	SV	1410036
2340B	**Hardness**	**312**		mg/L	15	10	10/08/2014	SV	1410031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR8-0826 **Date / Time Sampled:** 08/26/14 11:00 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-48 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**5680**		ug/L	200	10	10/08/2014	SV	1410031
200.7	**Iron**	**273000**		ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**39800**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	**Zinc**	**10700**		ug/L	100	10	10/08/2014	SV	1410031
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/08/2014	SV	1410036
200.8	Cadmium	< 15.0	U	ug/L	5.00	50	10/08/2014	SV	1410036
200.8	Copper	< 50.0	U	ug/L	25.0	50	10/08/2014	SV	1410036
200.8	**Lead**	**55.7**		ug/L	5.00	50	10/08/2014	SV	1410036
200.8	**Nickel**	**85.7**		ug/L	25.0	50	10/08/2014	SV	1410036
2340B	**Hardness**	**434**		mg/L	15	10	10/08/2014	SV	1410031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR9-0826 **Date / Time Sampled:** 08/26/14 11:15 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-51 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**11800**		ug/L	200	10	10/08/2014	SV	1410031
200.7	**Iron**	**278000**		ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**39500**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	**Zinc**	**11500**		ug/L	100	10	10/08/2014	SV	1410031
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/08/2014	SV	1410036
200.8	**Cadmium**	**28.3**		ug/L	5.00	50	10/08/2014	SV	1410036
200.8	**Copper**	**475**		ug/L	25.0	50	10/08/2014	SV	1410036
200.8	**Lead**	**248**		ug/L	5.00	50	10/08/2014	SV	1410036
200.8	**Nickel**	**104**		ug/L	25.0	50	10/08/2014	SV	1410036
2340B	**Hardness**	**493**		mg/L	15	10	10/08/2014	SV	1410031

Metals (Dissolved) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-CONTROL-08 **Date / Time Sampled:** 08/26/14 09:00 **Workorder:** C140901
EPA Tag No.: 26 No Tag Prefix-C **Matrix:** Ground Water **Lab Number:** C140901-54 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**29400**		ug/L	200	10	10/08/2014	SV	1410031
200.7	**Iron**	**47600**		ug/L	1000	10	10/08/2014	SV	1410031
200.7	**Manganese**	**30100**		ug/L	20.0	10	10/08/2014	SV	1410031
200.7	**Zinc**	**13100**		ug/L	100	10	10/08/2014	SV	1410031
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/08/2014	SV	1410036
200.8	**Cadmium**	**52.9**		ug/L	5.00	50	10/08/2014	SV	1410036
200.8	**Copper**	**1410**		ug/L	25.0	50	10/08/2014	SV	1410036
200.8	**Lead**	**167**		ug/L	5.00	50	10/08/2014	SV	1410036
200.8	**Nickel**	**59.3**		ug/L	25.0	50	10/08/2014	SV	1410036
2340B	**Hardness**	**499**		mg/L	15	10	10/08/2014	SV	1410031

"J" Qualifier indicates an estimated value

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR10-0826 **Date / Time Sampled:** 08/26/14 11:30 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-02 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**16400**		ug/L	200	10	10/08/2014	SV	1410017
200.7	**Iron**	**322000**		ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**43100**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	**Zinc**	**11400**		ug/L	100	10	10/08/2014	SV	1410017
200.8	**Arsenic**	**38.5**	J	ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Cadmium**	**47.1**		ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Copper**	**508**		ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Lead**	**371**		ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Nickel**	**141**		ug/L	25.0	50	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR11-0826 **Date / Time Sampled:** 08/26/14 11:45 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-05 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**397**	J	ug/L	200	10	10/08/2014	SV	1410017
200.7	**Iron**	**3210**		ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**16800**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	**Zinc**	**1510**		ug/L	100	10	10/08/2014	SV	1410017
200.8	**Arsenic**	**54.0**		ug/L	5.00	10	10/13/2014	SV	1410017
200.8	**Cadmium**	**5.95**		ug/L	1.00	10	10/13/2014	SV	1410017
200.8	**Copper**	**85.8**		ug/L	5.00	10	10/13/2014	SV	1410017
200.8	**Lead**	**27.5**		ug/L	1.00	10	10/13/2014	SV	1410017
200.8	**Nickel**	**15.6**		ug/L	5.00	10	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR12-0826 **Date / Time Sampled:** 08/26/14 12:00 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-08 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**473**	J	ug/L	200	10	10/08/2014	SV	1410017
200.7	**Iron**	**4570**		ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**13800**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	**Zinc**	**573**		ug/L	100	10	10/08/2014	SV	1410017
200.8	**Arsenic**	**76.9**		ug/L	5.00	10	10/13/2014	SV	1410017
200.8	**Cadmium**	**3.87**		ug/L	1.00	10	10/13/2014	SV	1410017
200.8	**Copper**	**51.0**		ug/L	5.00	10	10/13/2014	SV	1410017
200.8	**Lead**	**24.7**		ug/L	1.00	10	10/13/2014	SV	1410017
200.8	**Nickel**	**22.1**		ug/L	5.00	10	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR13-0826 **Date / Time Sampled:** 08/26/14 12:15 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-11 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**720**		ug/L	200	10	10/08/2014	SV	1410017
200.7	**Iron**	**5230**		ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**13600**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	**Zinc**	**809**		ug/L	100	10	10/08/2014	SV	1410017
200.8	**Arsenic**	**123**		ug/L	5.00	10	10/13/2014	SV	1410017
200.8	**Cadmium**	**7.15**		ug/L	1.00	10	10/13/2014	SV	1410017
200.8	**Copper**	**79.5**		ug/L	5.00	10	10/13/2014	SV	1410017
200.8	**Lead**	**33.6**		ug/L	1.00	10	10/13/2014	SV	1410017
200.8	**Nickel**	**32.6**		ug/L	5.00	10	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR14-0826 **Date / Time Sampled:** 08/26/14 12:30 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-14 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 500	U	ug/L	200	10	10/08/2014	SV	1410017
200.7	Iron	< 2500	U	ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**3820**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	Zinc	< 200	U	ug/L	100	10	10/08/2014	SV	1410017
200.8	**Arsenic**	**21.7**		ug/L	5.00	10	10/13/2014	SV	1410017
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/13/2014	SV	1410017
200.8	**Copper**	**5.93**	J	ug/L	5.00	10	10/13/2014	SV	1410017
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/13/2014	SV	1410017
200.8	**Nickel**	**7.78**	J	ug/L	5.00	10	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR15-0826 **Date / Time Sampled:** 08/26/14 12:45 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-17 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 500	U	ug/L	200	10	10/08/2014	SV	1410017
200.7	Iron	< 2500	U	ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**12500**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	Zinc	< 200	U	ug/L	100	10	10/08/2014	SV	1410017
200.8	**Arsenic**	**26.5**		ug/L	5.00	10	10/13/2014	SV	1410017
200.8	Cadmium	< 2.00	U	ug/L	1.00	10	10/13/2014	SV	1410017
200.8	Copper	< 10.0	U	ug/L	5.00	10	10/13/2014	SV	1410017
200.8	Lead	< 2.00	U	ug/L	1.00	10	10/13/2014	SV	1410017
200.8	**Nickel**	**12.7**		ug/L	5.00	10	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR16-0826 **Date / Time Sampled:** 08/26/14 13:00 **Workorder:** C140901

EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-20 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**5180**		ug/L	200	10	10/08/2014	SV	1410017
200.7	**Iron**	**264000**		ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**44000**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	**Zinc**	**9730**		ug/L	100	10	10/08/2014	SV	1410017
200.8	**Arsenic**	**30.4**	J	ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Cadmium**	**9.89**	J	ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Copper**	**209**		ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Lead**	**227**		ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Nickel**	**173**		ug/L	25.0	50	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR17-0826 **Date / Time Sampled:** 08/26/14 13:15 **Workorder:** C140901

EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-23 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**14800**		ug/L	200	10	10/08/2014	SV	1410017
200.7	**Iron**	**330000**		ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**45000**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	**Zinc**	**11300**		ug/L	100	10	10/08/2014	SV	1410017
200.8	**Arsenic**	**162**		ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Cadmium**	**98.1**		ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Copper**	**130**		ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Lead**	**181**		ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Nickel**	**207**		ug/L	25.0	50	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR18-0826 **Date / Time Sampled:** 08/26/14 09:15 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-26 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**238**	J	ug/L	200	10	10/08/2014	SV	1410017
200.7	**Iron**	**180000**		ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**33800**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	**Zinc**	**504**		ug/L	100	10	10/08/2014	SV	1410017
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/13/2014	SV	1410017
200.8	Cadmium	< 10.0	U	ug/L	5.00	50	10/13/2014	SV	1410017
200.8	Copper	< 50.0	U	ug/L	25.0	50	10/13/2014	SV	1410017
200.8	Lead	< 10.0	U	ug/L	5.00	50	10/13/2014	SV	1410017
200.8	Nickel	< 50.0	U	ug/L	25.0	50	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR2-0826 **Date / Time Sampled:** 08/26/14 09:30 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-29 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**226**	J	ug/L	200	10	10/08/2014	SV	1410017
200.7	**Iron**	**5360**		ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**22800**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	**Zinc**	**6160**		ug/L	100	10	10/08/2014	SV	1410017
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Cadmium**	**24.4**		ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Copper**	**45.2**	J	ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Lead**	**7.10**	J	ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Nickel**	**36.3**	J	ug/L	25.0	50	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR3-0826 **Date / Time Sampled:** 08/26/14 09:45 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-32 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	Aluminum	< 500	U	ug/L	200	10	10/08/2014	SV	1410017
200.7	**Iron**	**3620**		ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**23100**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	**Zinc**	**7150**		ug/L	100	10	10/08/2014	SV	1410017
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Cadmium**	**27.8**		ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Copper**	**102**		ug/L	25.0	50	10/13/2014	SV	1410017
200.8	Lead	< 10.0	U	ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Nickel**	**35.6**	J	ug/L	25.0	50	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR4-0826 **Date / Time Sampled:** 08/26/14 10:00 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-35 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**357**	J	ug/L	200	10	10/08/2014	SV	1410017
200.7	**Iron**	**1560**	J	ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**19900**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	**Zinc**	**7440**		ug/L	100	10	10/08/2014	SV	1410017
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Cadmium**	**28.3**		ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Copper**	**215**		ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Lead**	**8.07**	J	ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Nickel**	**31.1**	J	ug/L	25.0	50	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR5-0826 **Date / Time Sampled:** 08/26/14 10:15 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-38 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**443**	J	ug/L	200	10	10/08/2014	SV	1410017
200.7	**Iron**	**18200**		ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**30400**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	Zinc	< 200	U	ug/L	100	10	10/08/2014	SV	1410017
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/13/2014	SV	1410017
200.8	Cadmium	< 10.0	U	ug/L	5.00	50	10/13/2014	SV	1410017
200.8	Copper	< 50.0	U	ug/L	25.0	50	10/13/2014	SV	1410017
200.8	Lead	< 10.0	J,	ug/L	5.00	50	10/13/2014	SV	1410017
200.8	Nickel	< 50.0	U	ug/L	25.0	50	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR6-0826 **Date / Time Sampled:** 08/26/14 10:30 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-41 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**620**		ug/L	200	10	10/08/2014	SV	1410017
200.7	**Iron**	**51800**		ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**29500**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	**Zinc**	**811**		ug/L	100	10	10/08/2014	SV	1410017
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/13/2014	SV	1410017
200.8	Cadmium	< 10.0	U	ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Copper**	**27.7**	J	ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Lead**	**22.7**	J	ug/L	5.00	50	10/13/2014	SV	1410017
200.8	Nickel	< 50.0	U	ug/L	25.0	50	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR7-0826 **Date / Time Sampled:** 08/26/14 10:45 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-44 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**395**	J	ug/L	200	10	10/08/2014	SV	1410017
200.7	**Iron**	**3800**		ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**22800**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	**Zinc**	**7560**		ug/L	100	10	10/08/2014	SV	1410017
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Cadmium**	**30.0**		ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Copper**	**180**		ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Lead**	**12.4**	J	ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Nickel**	**39.2**	J	ug/L	25.0	50	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR8-0826 **Date / Time Sampled:** 08/26/14 11:00 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-47 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**6930**		ug/L	200	10	10/08/2014	SV	1410017
200.7	**Iron**	**301000**		ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**44100**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	**Zinc**	**11900**		ug/L	100	10	10/08/2014	SV	1410017
200.8	**Arsenic**	**29.2**	J	ug/L	25.0	50	10/13/2014	SV	1410017
200.8	Cadmium	< 10.0	U	ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Copper**	**117**		ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Lead**	**105**	J	ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Nickel**	**119**		ug/L	25.0	50	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-BCR9-0826 **Date / Time Sampled:** 08/26/14 11:15 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-50 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**12400**		ug/L	200	10	10/08/2014	SV	1410017
200.7	**Iron**	**295000**		ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**41500**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	**Zinc**	**12200**		ug/L	100	10	10/08/2014	SV	1410017
200.8	**Arsenic**	**33.2**	J	ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Cadmium**	**31.0**		ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Copper**	**157**		ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Lead**	**287**	J	ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Nickel**	**130**		ug/L	25.0	50	10/13/2014	SV	1410017

Metals (Total Recov) by EPA 200/7000 Series Methods

Station ID: 14BH-TI-BENCH-CONTROL-08 **Date / Time Sampled:** 08/26/14 09:00 **Workorder:** C140901
EPA Tag No.: 26 No Tag Prefix-B **Matrix:** Ground Water **Lab Number:** C140901-53 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
200.7	**Aluminum**	**28100**		ug/L	200	10	10/08/2014	SV	1410017
200.7	**Iron**	**46000**		ug/L	1000	10	10/08/2014	SV	1410017
200.7	**Manganese**	**31100**		ug/L	20.0	10	10/08/2014	SV	1410017
200.7	**Zinc**	**13500**		ug/L	100	10	10/08/2014	SV	1410017
200.8	Arsenic	< 100	U	ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Cadmium**	**58.7**		ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Copper**	**1760**		ug/L	25.0	50	10/13/2014	SV	1410017
200.8	**Lead**	**195**	J	ug/L	5.00	50	10/13/2014	SV	1410017
200.8	**Nickel**	**86.0**		ug/L	25.0	50	10/13/2014	SV	1410017

"J" Qualifier indicates an estimated value

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR10-0826 **Date / Time Sampled:** 08/26/14 11:30 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-01 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**972**		mg/L	5.0	100	09/04/2014	NP	1409010
EPA 310.1	Total Alkalinity	< 100		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR11-0826 **Date / Time Sampled:** 08/26/14 11:45 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-04 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**240**		mg/L	0.5	10	09/04/2014	NP	1409010
EPA 310.1	**Total Alkalinity**	**1530**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR12-0826 **Date / Time Sampled:** 08/26/14 12:00 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-07 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**164**		mg/L	0.5	10	09/04/2014	NP	1409010
EPA 310.1	**Total Alkalinity**	**2190**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR13-0826 **Date / Time Sampled:** 08/26/14 12:15 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-10 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**104**		mg/L	0.5	10	09/04/2014	NP	1409010
EPA 310.1	**Total Alkalinity**	**2760**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR14-0826 **Date / Time Sampled:** 08/26/14 12:30 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-13 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**5.0**		mg/L	0.05	1	09/08/2014	NP	1409010
EPA 310.1	**Total Alkalinity**	**1470**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR15-0826 **Date / Time Sampled:** 08/26/14 12:45 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-16 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**120**		mg/L	0.05	1	09/08/2014	NP	1409010
EPA 310.1	**Total Alkalinity**	**1320**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR16-0826 **Date / Time Sampled:** 08/26/14 13:00 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-19 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**983**		mg/L	0.5	10	09/08/2014	NP	1409010
EPA 310.1	**Total Alkalinity**	**2220**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR17-0826 **Date / Time Sampled:** 08/26/14 13:15 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-22 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**936**		mg/L	5.0	100	09/04/2014	NP	1409010
EPA 310.1	Total Alkalinity	< 100		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR18-0826 **Date / Time Sampled:** 08/26/14 09:15 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-25 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**874**		mg/L	0.5	10	09/04/2014	NP	1409010
EPA 310.1	**Total Alkalinity**	**721**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR2-0826 **Date / Time Sampled:** 08/26/14 09:30 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-28 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**1040**		mg/L	0.5	10	09/04/2014	NP	1409010
EPA 310.1	Total Alkalinity	< 100		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR3-0826 **Date / Time Sampled:** 08/26/14 09:45 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-31 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**1000**		mg/L	0.5	10	09/04/2014	NP	1409010
EPA 310.1	Total Alkalinity	< 100		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR4-0826 **Date / Time Sampled:** 08/26/14 10:00 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-34 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**1000**		mg/L	0.5	10	09/04/2014	NP	1409010
EPA 310.1	Total Alkalinity	< 100		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR5-0826 **Date / Time Sampled:** 08/26/14 10:15 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-37 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**92.0**		mg/L	0.5	10	09/04/2014	NP	1409010
EPA 310.1	**Total Alkalinity**	**498**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR6-0826 **Date / Time Sampled:** 08/26/14 10:30 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-40 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**864**		mg/L	0.5	10	09/08/2014	NP	1409010
EPA 310.1	**Total Alkalinity**	**139**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR7-0826 **Date / Time Sampled:** 08/26/14 10:45 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-43 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**984**		mg/L	0.5	10	09/08/2014	NP	1409010
EPA 310.1	Total Alkalinity	< 100		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR8-0826 **Date / Time Sampled:** 08/26/14 11:00 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-46 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**1020**		mg/L	0.5	10	09/08/2014	NP	1409010
EPA 310.1	**Total Alkalinity**	**509**		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-BCR9-0826 **Date / Time Sampled:** 08/26/14 11:15 **Workorder:** C140901
EPA Tag No.: No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-49 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**978**		mg/L	5.0	100	09/08/2014	NP	1409010
EPA 310.1	Total Alkalinity	< 100		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

Classical Chemistry by EPA/ASTM/APHA Methods

Station ID: 14BH-TI-BENCH-CONTROL-08 **Date / Time Sampled:** 08/26/14 09:00 **Workorder:** C140901
EPA Tag No.: 26 No Tag Prefix-A **Matrix:** Ground Water **Lab Number:** C140901-52 A

Method	Parameter	Results	Qualifier	Units	MDL	Dilution Factor	Analyzed	By	Batch
EPA 300.0	**Sulfate as SO4**	**1020**		mg/L	0.5	10	09/08/2014	NP	1409010
EPA 310.1	Total Alkalinity	< 100		mg CaCO3 / L	50.0	10	09/09/2014	SW	1409008

"J" Qualifier indicates an estimated value

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ICPMS-PE DRC-II									
Batch 1410036 - No Lab Prep Reqd			***Water***						**ICPMS-PE DRC-II**
Method Blank (1410036-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 10/08/14			
Nickel	< 0.500	1.00	ug/L						
Copper	< 0.500	1.00	"						
Arsenic	< 0.500	2.00	"						
Cadmium	< 0.100	0.200	"						
Lead	< 0.100	0.200	"						
Method Blank Spike (1410036-BS1)		Dilution Factor: 1				Prepared & Analyzed: 10/08/14			
Nickel	95.9	1.00	ug/L	100		96	85-115		
Copper	93.8	1.00	"	100		94	85-115		
Arsenic	87.4	2.00	"	100		87	85-115		
Cadmium	95.9	0.200	"	100		96	85-115		
Lead	93.2	0.200	"	100		93	85-115		
Duplicate (1410036-DUP1)		Dilution Factor: 5	**Source: C140901-03**			Prepared & Analyzed: 10/08/14			
Nickel	114	50.0	ug/L		108			5	20
Copper	324	50.0	"		314			3	20
Arsenic	35.1	100	"		38.4			9	20
Cadmium	41.2	10.0	"		44.3			7	20
Lead	258	10.0	"		255			1	20
Matrix Spike (1410036-MS1)		Dilution Factor: 5	**Source: C140901-03**			Prepared & Analyzed: 10/08/14			
Nickel	206	50.0	ug/L	100	108	98	70-130		
Copper	422	50.0	"	100	314	107	70-130		
Arsenic	119	100	"	100	38.4	81	70-130		
Cadmium	155	10.0	"	100	44.3	111	70-130		
Lead	366	10.0	"	100	255	111	70-130		
Matrix Spike (1410036-MS2)		Dilution Factor: 1	**Source: C140901-06**			Prepared & Analyzed: 10/08/14			
Nickel	84.5	10.0	ug/L	100	< 5.00	84	70-130		
Copper	94.3	10.0	"	100	7.37	87	70-130		
Arsenic	127	20.0	"	100	40.0	87	70-130		
Cadmium	97.0	2.00	"	100	< 1.00	97	70-130		
Lead	95.5	2.00	"	100	2.18	93	70-130		

Batch 1410046 - 1410036 *Water* **ICPMS-PE DRC-II**

Serial Dilution (1410046-SRD1) Dilution Factor: 2 **Source: C140901-03** Prepared & Analyzed: 10/08/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Nickel	< 125	250	ug/L		108				10
Copper	318	250	"		314			1	10
Arsenic	< 125	500	"		38.4				10
Cadmium	49.3	50.0	"		44.3			11	10
Lead	250	50.0	"		255			2	10

ICPOE - PE Optima

Batch 1410031 - No Lab Prep Reqd *Water* **ICPOE - PE Optima**

Method Blank (1410031-BLK1) Dilution Factor: 1 Prepared: 10/07/14 Analyzed: 10/08/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						

Method Blank Spike (1410031-BS1) Dilution Factor: 1 Prepared: 10/07/14 Analyzed: 10/08/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	10510	50.0	ug/L	10100		104	85-115		
Iron	10640	250	"	10100		105	85-115		
Manganese	98.11	5.00	"	100		98	85-115		
Zinc	97.54	20.0	"	100		98	85-115		

Duplicate (1410031-DUP1) Dilution Factor: 1 **Source: C140901-03** Prepared: 10/07/14 Analyzed: 10/08/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	14390	500	ug/L		14920			4	20
Iron	293100	2500	"		302700			3	20
Manganese	39770	50.0	"		41120			3	20
Zinc	10440	200	"		10730			3	20

Matrix Spike (1410031-MS1) Dilution Factor: 1 **Source: C140901-03** Prepared: 10/07/14 Analyzed: 10/08/14

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Aluminum	24390	500	ug/L	10100	14920	94	70-130		
Iron	301400	2500	"	10100	302700	NR	70-130		
Manganese	39910	50.0	"	100	41120	NR	70-130		
Zinc	10510	200	"	100	10730	NR	70-130		

Metals (Dissolved) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1410031 - No Lab Prep Reqd			*Water*						**ICPOE - PE Optima**
Matrix Spike (1410031-MS2)		Dilution Factor: 1	**Source: C140901-06**			Prepared: 10/07/14 Analyzed: 10/08/14			
Aluminum	10680	500	ug/L	10100	< 200	106	70-130		
Iron	11220	2500	"	10100	< 1000	111	70-130		
Manganese	15920	50.0	"	100	16050	NR	70-130		
Zinc	472.3	200	"	100	371.1	101	70-130		
Batch 1410039 - 1410031			*Water*						**ICPOE - PE Optima**
Serial Dilution (1410039-SRD1)		Dilution Factor: 5	**Source: C140901-03**			Prepared: 10/07/14 Analyzed: 10/08/14			
Aluminum	14380	2500	ug/L		14920			4	10
Iron	298900	12500	"		302700			1	10
Manganese	41990	250	"		41120			2	10
Zinc	10880	1000	"		10730			1	10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ICPMS-PE DRC-II									
Batch 1410017 - 200.2 - TR Metals			***Water***						**ICPMS-PE DRC-II**
Method Blank (1410017-BLK2)		Dilution Factor: 5				Prepared: 10/02/14 Analyzed: 10/13/14			
Nickel	< 2.50	5.00	ug/L						
Copper	< 2.50	5.00	"						
Arsenic	< 2.50	10.0	"						
Cadmium	< 0.500	1.00	"						
Lead	< 0.500	1.00	"						
Duplicate (1410017-DUP2)		Dilution Factor: 5	**Source: C140901-02**			Prepared: 10/02/14 Analyzed: 10/13/14			
Nickel	139.5	50.0	ug/L		140.9			0.9	20
Copper	518.5	50.0	"		507.9			2	20
Arsenic	30.30	100	"		38.48			24	20
Cadmium	47.64	10.0	"		47.14			1	20
Lead	379.0	10.0	"		371.0			2	20
Matrix Spike (1410017-MS2)		Dilution Factor: 1	**Source: C140901-05**			Prepared: 10/02/14 Analyzed: 10/13/14			
Nickel	526.1	10.0	ug/L	500	15.58	102	70-130		
Copper	396.5	10.0	"	300	85.77	104	70-130		
Arsenic	971.3	20.0	"	800	54.04	115	70-130		
Cadmium	231.4	2.00	"	200	5.947	113	70-130		
Lead	1188	2.00	"	1000	27.52	116	70-130		
Matrix Spike (1410017-MS4)		Dilution Factor: 1	**Source: C140901-08**			Prepared: 10/02/14 Analyzed: 10/13/14			
Nickel	516.3	10.0	ug/L	500	22.06	99	70-130		
Copper	344.3	10.0	"	300	50.97	98	70-130		
Arsenic	1038	20.0	"	800	76.89	120	70-130		
Cadmium	220.3	2.00	"	200	3.873	108	70-130		
Lead	1148	2.00	"	1000	24.73	112	70-130		
Reference (1410017-SRM2)		Dilution Factor: 2				Prepared: 10/02/14 Analyzed: 10/13/14			
Nickel	1033	20.0	ug/L	1000		103	85-115		
Copper	1057	20.0	"	1000		106	85-115		
Arsenic	2183	40.0	"	2000		109	85-115		
Cadmium	1116	4.00	"	1000		112	85-115		
Lead	2407	4.00	"	2000		120	85-115		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1410052 - 1410017			*Water*						ICPMS-PE DRC-II
Serial Dilution (1410052-SRD1)		Dilution Factor: 2	**Source: C140901-02**			Prepared: 10/02/14	Analyzed: 10/13/14		
Nickel	< 125	250	ug/L		140.9				10
Copper	509.9	250	"		507.9			0.4	10
Arsenic	< 125	500	"		38.48				10
Cadmium	39.46	50.0	"		47.14			18	10
Lead	373.1	50.0	"		371.0			0.6	10

ICPOE - PE Optima

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1410017 - 200.2 - TR Metals			*Water*						ICPOE - PE Optima
Method Blank (1410017-BLK1)		Dilution Factor: 1				Prepared: 10/02/14	Analyzed: 10/08/14		
Aluminum	< 20.0	50.0	ug/L						
Iron	< 100	250	"						
Manganese	< 2.00	5.00	"						
Zinc	< 10.0	20.0	"						
Duplicate (1410017-DUP1)		Dilution Factor: 1	**Source: C140901-02**			Prepared: 10/02/14	Analyzed: 10/08/14		
Aluminum	14830	500	ug/L		16430			10	20
Iron	289900	2500	"		322300			11	20
Manganese	40260	50.0	"		43060			7	20
Zinc	10560	200	"		11360			7	20
Matrix Spike (1410017-MS1)		Dilution Factor: 1	**Source: C140901-05**			Prepared: 10/02/14	Analyzed: 10/08/14		
Aluminum	2269	500	ug/L	2000	397.3	94	70-130		
Iron	6090	2500	"	3000	3214	96	70-130		
Manganese	17090	50.0	"	200	16760	164	70-130		
Zinc	1697	200	"	200	1511	93	70-130		
Matrix Spike (1410017-MS3)		Dilution Factor: 1	**Source: C140901-08**			Prepared: 10/02/14	Analyzed: 10/08/14		
Aluminum	2362	500	ug/L	2000	473.0	94	70-130		
Iron	7196	2500	"	3000	4575	87	70-130		
Manganese	14540	50.0	"	200	13800	366	70-130		
Zinc	818.2	200	"	200	573.0	123	70-130		

Metals (Total Recov) by EPA 200/7000 Series Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1410017 - 200.2 - TR Metals			***Water***						**ICPOE - PE Optima**
Reference (1410017-SRM1)		Dilution Factor: 1				Prepared: 10/02/14 Analyzed: 10/08/14			
Aluminum	972.7	50.0	ug/L	1000		97	85-115		
Iron	961.9	250	"	1000		96	85-115		
Manganese	1027	5.00	"	1000		103	85-115		
Zinc	1012	20.0	"	1000		101	85-115		
Batch 1410040 - 1410017			***Water***						**ICPOE - PE Optima**
Serial Dilution (1410040-SRD1)		Dilution Factor: 5	**Source: C140901-02**			Prepared: 10/02/14 Analyzed: 10/08/14			
Aluminum	15050	2500	ug/L		16430			9	10
Iron	304500	12500	"		322300			6	10
Manganese	42840	250	"		43060			0.5	10
Zinc	11060	1000	"		11360			3	10

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
ESAT Dionex IC									
Batch 1409010 - No Prep Req			*Water*						**ESAT Dionex IC**
Method Blank (1409010-BLK1)		Dilution Factor: 1				Prepared & Analyzed: 09/04/14			
Sulfate as SO4	< 0.05	0.1	mg/L						
Method Blank Spike (1409010-BS1)		Dilution Factor: 1				Prepared & Analyzed: 09/04/14			
Sulfate as SO4	25.6	0.1	mg/L	25.0		102	90-110		
Duplicate (1409010-DUP1)		Dilution Factor: 1	**Source: C140901-01**			Prepared & Analyzed: 09/04/14			
Sulfate as SO4	981	10.0	mg/L		972			0.9	20
Matrix Spike (1409010-MS1)		Dilution Factor: 1	**Source: C140901-01**			Prepared & Analyzed: 09/04/14			
Sulfate as SO4	3480	10.0	mg/L	2500	972	100	80-120		
Matrix Spike (1409010-MS2)		Dilution Factor: 1	**Source: C140901-31**			Prepared & Analyzed: 09/04/14			
Sulfate as SO4	1260	1.0	mg/L	250	1000	104	80-120		
Batch 1409107 - 1409010			*Water*						**ESAT Dionex IC**
Instrument Blank (1409107-IBL1)		Dilution Factor: 1				Prepared & Analyzed: 09/04/14			
Sulfate as SO4	< 0.05	0.1	mg/L						
Mettler AT									
Batch 1409008 - No Prep Req			*Water*						**Mettler AT**
Method Blank (1409008-BLK1)		Dilution Factor: 1				Prepared: 09/02/14 Analyzed: 09/09/14			
Total Alkalinity	< 5.00	10.0	mg CaCO3 / L						
Duplicate (1409008-DUP1)		Dilution Factor: 1	**Source: C140901-01**			Prepared: 09/02/14 Analyzed: 09/09/14			
Total Alkalinity	< 50.0	100	mg CaCO3 / L		< 50.0				20

Classical Chemistry by EPA/ASTM/APHA Methods - Quality Control

TechLaw, Inc. - ESAT Region 8

Analyte	Result	Det. Limit	Units	Spike Level	Source Result	%R	%R Limits	%D or RPD	%D or RPD Limit
Batch 1409008 - No Prep Req			*Water*						Mettler AT
Duplicate (1409008-DUP2)		Dilution Factor: 1		**Source: C140901-31**		Prepared: 09/02/14	Analyzed: 09/09/14		
Total Alkalinity	< 50.0	100	mg CaCO3 / L		< 50.0				20
Reference (1409008-SRM1)		Dilution Factor: 1				Prepared: 09/02/14	Analyzed: 09/09/14		
Total Alkalinity	11.9	10.0	mg CaCO3 / L	10.4		115	61.3-143.9		

NOTE: %R = % Recovery, %R limits do not apply when sample levels exceed 4x the spike level.
RPD = Relative Percent Difference, %D = % Difference, DL = Detection Limit for QC sample .

Project Name: **Barker-Hugh_Tiger Mine Treatability_SEP 2014_A058** **Certificate of Analysis**

TDF #: **A-058**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 310.1

Analysis Name: WC - Alkalinity

Instrument: **Mettler AT**

Work Order: Nu C140901

Analytical Sequence: **Total**

Concentration Units: mg CaCO3 / L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	1409008-BLK1	NA	
Total Alkalinity		1.02	1.08	1.04	1.04	0.96	NA	10.00
		5	**6**	**7**	**8**			

Project Name: **Barker-Hugh_Tiger Mine Treatability_SEP 2014_A058** **Certificate of Analysis**

TDF #: **A-058**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: EPA 300.0

Analysis Name: WC - Anions by Ion Chromatography

Instrument: **ESAT Dionex IC**

Work Order: Nu C140901

Analytical Sequence: 1409107 **Dissolved**

Concentration Units: mg/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
		1	**2**	**3**	**4**	1409010-BLK1	NA	
Sulfate as SO4	0.00	0.00	0.00	0.00	0.00	0.00	NA	0.10
		5	**6**	**7**	**8**			

Project Name: **Barker-Hugh_Tiger Mine Treatability_SEP 2014_A058** **Certificate of Analysis**

TDF #: **A-058**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.7

Analysis Name: ICPOE Diss. Metals

Instrument: **ICPOE - PE Optima**

Work Order: Nu C140901

Analytical Sequence: 1410039 **Dissolved**

Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Aluminum	1.73	**1**	**2**	**3**	**4**	1410031-BLK1	NA	50.00
		0.68	2.27	4.09		-0.17	NA	
		5	**6**	**7**	**8**			
Iron	-4.23	**1**	**2**	**3**	**4**	1410031-BLK1	NA	250.00
		65.85	47.50	17.24		46.62	NA	
		5	**6**	**7**	**8**			
Manganese	0.14	**1**	**2**	**3**	**4**	1410031-BLK1	NA	5.00
		0.12	0.11	0.16		-0.12	NA	
		5	**6**	**7**	**8**			
Zinc	-0.49	**1**	**2**	**3**	**4**	1410031-BLK1	NA	20.00
		-0.39	-0.06	-0.31		-2.57	NA	
		5	**6**	**7**	**8**			

TechLaw Inc., ESAT Region 8
INORGANIC ANALYSES DATA SHEET
Intial and Continuing Calibration Blanks

Analytical Method: 200.7
Analysis Name: ICPOE Tot. Rec. Metals

Instrument: **ICPOE - PE Optima**
Work Order: Nu C140901

Analytical Sequence: 1410040 **Total Recoverable**
Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	**Initial Calibration Blank (1 & 2)**	**Continuing Calibration Blanks**				**Method Blank (Batch ID)**		**PQL**
Aluminum	1.73	**1**	**2**	**3**	**4**	1410017-BLK1	NA	50.00
		0.68	2.27	4.09	0.91	0.00	NA	
		5	**6**	**7**	**8**			
		0.84	2.56					
Iron	-4.23	**1**	**2**	**3**	**4**	1410017-BLK1	NA	250.00
		65.85	47.50	17.24	59.77	8.09	NA	
		5	**6**	**7**	**8**			
		38.46	31.29					
Manganese	0.14	**1**	**2**	**3**	**4**	1410017-BLK1	NA	5.00
		0.12	0.11	0.16	0.06	0.11	NA	
		5	**6**	**7**	**8**			
		0.06	0.18					
Zinc	-0.49	**1**	**2**	**3**	**4**	1410017-BLK1	NA	20.00
		-0.39	-0.06	-0.31	-0.90	0.42	NA	
		5	**6**	**7**	**8**			
		0.35	-0.04					

Project Name: **Barker-Hugh_Tiger Mine Treatability_SEP 2014_A058** **Certificate of Analysis**

TDF #: **A-058**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8

Analysis Name: ICPMS Diss. Metals

Instrument: **ICPMS-PE DRC-II**

Work Order: Nu C140901

Analytical Sequence: 1410046 **Dissolved**

Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
Nickel	0.03	**1**	**2**	**3**	**4**	1410036-BLK1	NA	1.00
		0.02	0.00	0.03	0.01	-0.15	NA	
		5	**6**	**7**	**8**			
		0.02						
Copper	0.00	**1**	**2**	**3**	**4**	1410036-BLK1	NA	1.00
		-0.01	-0.01	0.01	-0.01	-0.06	NA	
		5	**6**	**7**	**8**			
		-0.03						
Arsenic	0.12	**1**	**2**	**3**	**4**	1410036-BLK1	NA	2.00
		0.05	0.16	0.11	0.09	0.14	NA	
		5	**6**	**7**	**8**			
		0.01						
Cadmium	0.02	**1**	**2**	**3**	**4**	1410036-BLK1	NA	0.20
		0.00	0.02	0.02	0.01	0.02	NA	
		5	**6**	**7**	**8**			
		0.01						
Lead	0.06	**1**	**2**	**3**	**4**	1410036-BLK1	NA	0.20
		0.03	0.06	0.08	0.07	0.06	NA	
		5	**6**	**7**	**8**			
		0.08						

Project Name: **Barker-Hugh_Tiger Mine Treatability_SEP 2014_A058** **Certificate of Analysis**

TDF #: **A-058**

TechLaw Inc., ESAT Region 8

INORGANIC ANALYSES DATA SHEET

Intial and Continuing Calibration Blanks

Analytical Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Instrument: **ICPMS-PE DRC-II** Work Order: Nu C140901

Analytical Sequence: 1410052 **Total Recoverable** Concentration Units: ug/L

Blank criteria = +/- 5x analyte MDL (+/- PQL)

Analyte	Initial Calibration Blank (1 & 2)	Continuing Calibration Blanks				Method Blank (Batch ID)		PQL
		1	**2**	**3**	**4**	NA	1410017-BLK2	
Nickel	0.03	0.01	0.01	0.00		NA	-0.07	1.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	NA	1410017-BLK2	
Copper	0.00	-0.01	0.00	-0.03		NA	-0.05	1.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	NA	1410017-BLK2	
Arsenic	0.14	0.23	0.22	0.12		NA	-0.05	2.00
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	NA	1410017-BLK2	
Cadmium	-0.01	-0.01	0.00	0.01		NA	-0.01	0.20
		5	**6**	**7**	**8**			
		1	**2**	**3**	**4**	NA	1410017-BLK2	
Lead	0.01	0.01	0.01	0.01		NA	0.00	0.20
		5	**6**	**7**	**8**			

Project Name: **Barker-Hugh_Tiger Mine Treatability_SEP 2014_A058** **Certificate of Analysis**

TDF #: **A-058**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

Mettler AT Method: EPA 310.1 Analysis Name: WC - Alkalinity

Sequence: 1409045 Work Order: C140901 Units: mg CaCO3 / L

Total Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
					1			**2**			**3**	
Total Alkalinity				100	99.6	99.6	100	99.7	99.7	100	99.5	99.5
					4			**5**			**6**	
				100	99.6	99.6						
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ESAT Dionex IC Method: EPA 300.0 Analysis Name: WC - Anions by Ion Chromatography 2013

Sequence: 1409107 Work Order: C140901 Units: mg/L

Dissolved Analyte	**Initial (ICV1, ICV2)**			**Continuing Calibration Verification Standards (CCVs)**								
	True	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**	**True**	**Found**	**%R**
					1			**2**			**3**	
Sulfate as SO4	100	104	104.0	100	106	106.0	100	102	102.0	100	106	106.0
					4			**5**			**6**	
				100	108	108.0						
					7			**8**			**9**	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hugh_Tiger Mine Treatability_SEP 2014_A058** **Certificate of Analysis**

TDF #: **A-058**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Diss. Metals

Sequence: 1410039 Work Order: C140901 Units: ug/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Aluminum	12500	11940	95.5		1			2			3	
				12500	13230	105.8	12500	12830	102.6	12500	13110	104.9
					4			5			6	
					7			8			9	
Iron	12500	12310	98.5		1			2			3	
				12500	13230	105.8	12500	13110	104.9	12500	13170	105.4
					4			5			6	
					7			8			9	
Manganese	1000	1037	103.7		1			2			3	
				1000	1054	105.4	1000	1055	105.5	1000	1061	106.1
					4			5			6	
					7			8			9	
Zinc	2500	2615	104.6		1			2			3	
				2500	2676	107.0	2500	2663	106.5	2500	2674	107.0
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hugh_Tiger Mine Treatability_SEP 2014_A058** **Certificate of Analysis**

TDF #: **A-058**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPOE - PE Optima Method: 200.7 Analysis Name: ICPOE Tot. Rec. Metals

Sequence: 1410040 Work Order: C140901 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Aluminum	12500	11940	95.5	1			2			3		
				12500	13230	105.8	12500	12830	102.6	12500	13110	104.9
				4			5			6		
				12500	13100	104.8	12500	13140	105.1	12500	13410	107.3
				7			8			9		
Iron	12500	12310	98.5	1			2			3		
				12500	13230	105.8	12500	13110	104.9	12500	13170	105.4
				4			5			6		
				12500	13180	105.4	12500	13130	105.0	12500	13420	107.4
				7			8			9		
Manganese	1000	1037	103.7	1			2			3		
				1000	1054	105.4	1000	1055	105.5	1000	1061	106.1
				4			5			6		
				1000	1062	106.2	1000	1062	106.2	1000	1063	106.3
				7			8			9		
Zinc	2500	2615	104.6	1			2			3		
				2500	2676	107.0	2500	2663	106.5	2500	2674	107.0
				4			5			6		
				2500	2708	108.3	2500	2715	108.6	2500	2684	107.4
				7			8			9		

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

Project Name: **Barker-Hugh_Tiger Mine Treatability_SEP 2014_A058** **Certificate of Analysis**

TDF #: **A-058**

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Diss. Metals

Sequence: 1410046 Work Order: C140901 Units: ug/L

Dissolved Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Arsenic	50.0	50.1	100.2		1			2			3	
				50.0	50.0	100.0	50.0	49.9	99.8	50.0	49.0	98.0
					4			5			6	
				50.0	47.2	94.4	50.0	46.8	93.6			
					7			8			9	
Cadmium	50.0	50.8	101.6		1			2			3	
				50.0	51.7	103.4	50.0	53.2	106.4	50.0	52.2	104.4
					4			5			6	
				50.0	53.5	107.0	50.0	53.7	107.4			
					7			8			9	
Copper	50.0	48.8	97.6		1			2			3	
				50.0	47.8	95.6	50.0	50.6	101.2	50.0	49.7	99.4
					4			5			6	
				50.0	45.5	91.0	50.0	47.7	95.4			
					7			8			9	
Lead	50.0	49.7	99.4		1			2			3	
				50.0	49.5	99.0	50.0	49.9	99.8	50.0	52.2	104.4
					4			5			6	
				50.0	51.6	103.2	50.0	52.1	104.2			
					7			8			9	
Nickel	50.0	49.8	99.6		1			2			3	
				50.0	48.7	97.4	50.0	50.9	101.8	50.0	51.4	102.8
					4			5			6	
				50.0	47.2	94.4	50.0	49.5	99.0			
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8

Initial and Continuing Calibration Verification Results

ICPMS-PE DRC-II Method: 200.8 Analysis Name: ICPMS Tot. Rec. Metals

Sequence: 1410052 Work Order: C140901 Units: ug/L

Total Recoverable Analyte	Initial (ICV1, ICV2)			Continuing Calibration Verification Standards (CCVs)								
	True	Found	%R	True	Found	%R	True	Found	%R	True	Found	%R
Arsenic	50.0	52.61	105.2		1			2			3	
				50.0	52.79	105.6	50.0	51.37	102.7	50.0	53.11	106.2
					4			5			6	
					7			8			9	
Cadmium	50.0	50.94	101.9		1			2			3	
				50.0	51.36	102.7	50.0	51.97	103.9	50.0	52.87	105.7
					4			5			6	
					7			8			9	
Copper	50.0	49.43	98.9		1			2			3	
				50.0	48.00	96.0	50.0	49.54	99.1	50.0	50.46	100.9
					4			5			6	
					7			8			9	
Lead	50.0	48.43	96.9		1			2			3	
				50.0	51.84	103.7	50.0	54.43	108.9	50.0	55.69	111.4
					4			5			6	
					7			8			9	
Nickel	50.0	49.21	98.4		1			2			3	
				50.0	48.54	97.1	50.0	49.29	98.6	50.0	49.74	99.5
					4			5			6	
					7			8			9	

Metals - ICV & CCV %R Criteria = 90 - 110%, Classical Chemistry %R Criteria - ICV = 90 - 110%R, CCV = 80 - 120%R.

TechLaw, Inc. - ESAT Region 8
ICP Interference Check Sample
ICPMS-PE DRC-II

Sequence: 1410046 Analysis: ICPMS Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.0	ug/L			2.00
	IFB1	18.4	ug/L	20	92	2.00
Cadmium	IFA1	0.2	ug/L			0.200
	IFB1	20.2	ug/L	20	101	0.200
Copper	IFA1	0.5	ug/L			1.00
	IFB1	18.5	ug/L	20	92	1.00
Lead	IFA1	0.1	ug/L			0.200
	IFB1	0.1	ug/L			0.200
Nickel	IFA1	-0.3	ug/L			1.00
	IFB1	18.7	ug/L	20	93	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

Sequence: 1410052 Analysis: ICPMS Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Arsenic	IFA1	0.2	ug/L			2.00
	IFB1	20.3	ug/L	20	102	2.00
Cadmium	IFA1	0.0	ug/L			0.200
	IFB1	21.4	ug/L	20	107	0.200
Copper	IFA1	0.7	ug/L			1.00
	IFB1	20.8	ug/L	20	104	1.00
Lead	IFA1	0.0	ug/L			0.200
	IFB1	0.0	ug/L			0.200
Nickel	IFA1	0.3	ug/L			1.00
	IFB1	20.3	ug/L	20	101	1.00

*Criteria = 80-120%R of True Value or +/- PQL
See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8

ICP Interference Check Sample

ICPOE - PE Optima

Sequence: 1410039 Analysis: ICPOE Diss. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	59,949.1	ug/L	60,000	100	50.0
	IFB1	63,224.5	ug/L	60,000	105	50.0
Iron	IFA1	233,436.0	ug/L	250,000	93	250
	IFB1	247,526.4	ug/L	250,000	99	250
Manganese	IFA1	-0.3	ug/L			5.00
	IFB1	198.7	ug/L	200	99	5.00
Zinc	IFA1	6.7	ug/L			20.0
	IFB1	290.2	ug/L	300	97	20.0

*Criteria = 80-120%R of True Value or +/- PQL

See raw data for complete analyte list and results.

Sequence: 1410040 Analysis: ICPOE Tot. Rec. Metals

Analyte	Check Sample	Result*	Units	True	%R	PQL
Aluminum	IFA1	59,949.1	ug/L	60,000	100	50.0
	IFB1	63,224.5	ug/L	60,000	105	50.0
Iron	IFA1	233,436.0	ug/L	250,000	93	250
	IFB1	247,526.4	ug/L	250,000	99	250
Manganese	IFA1	-0.3	ug/L			5.00
	IFB1	198.7	ug/L	200	99	5.00
Zinc	IFA1	6.7	ug/L			20.0
	IFB1	290.2	ug/L	300	97	20.0

*Criteria = 80-120%R of True Value or +/- PQL

See raw data for complete analyte list and results.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPMS-PE DRC-II

Metals (Dissolved) by EPA 200/7000 Series Methods

Sequence: 1410046

Analyte	True	Found	%R	Units
Arsenic	2.00	2.23	111	ug/L
Cadmium	0.200	0.199	100	ug/L
Copper	1.00	1.02	102	ug/L
Lead	0.200	0.255	127	ug/L
Nickel	1.00	0.831	83	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPOE - PE Optima

Metals (Dissolved) by EPA 200/7000 Series Methods

Sequence: 1410039

Analyte	True	Found	%R	Units
Aluminum	100	99.00	99	ug/L
Iron	100	136.1	136	ug/L
Manganese	10.0	10.29	103	ug/L
Zinc	50.0	52.07	104	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPMS-PE DRC-II

Metals (Total Recov) by EPA 200/7000 Series Methods
Sequence: 1410052

Analyte	True	Found	%R	Units
Arsenic	2.00	2.094	105	ug/L
Cadmium	0.200	0.2102	105	ug/L
Copper	1.00	0.9794	98	ug/L
Lead	0.200	0.2122	106	ug/L
Nickel	1.00	0.9186	92	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw, Inc. - ESAT Region 8
Detection Limit (PQL) Standard
ICPOE - PE Optima

Metals (Total Recov) by EPA 200/7000 Series Methods
Sequence: 1410040

Analyte	True	Found	%R	Units
Aluminum	100	99.00	99	ug/L
Iron	100	136.1	136	ug/L
Manganese	10.0	10.29	103	ug/L
Zinc	50.0	52.07	104	ug/L

Recovery Control Limits: 70-130% except Pb, Tl, Sb, & Hg at 50-150%. No limits for Al, Ca, Fe, K, Mg & Na.

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 310.1 **Total** **Sequence ID#:** 1409045

Instrument ID #: Mettler AT Water **LSR #:** A-058

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409008-SRM1	Reference	09/09/14	10:06
1409008-BLK1	Blank	09/09/14	10:07
C140901-01	14BH-TI-BENCH-BCR10-082	09/09/14	10:09
1409008-DUP1	Duplicate	09/09/14	10:10
C140901-04	14BH-TI-BENCH-BCR11-082	09/09/14	10:10
C140901-07	14BH-TI-BENCH-BCR12-082	09/09/14	10:14
C140901-10	14BH-TI-BENCH-BCR13-082	09/09/14	10:19
C140901-13	14BH-TI-BENCH-BCR14-082	09/09/14	10:24
C140901-16	14BH-TI-BENCH-BCR15-082	09/09/14	10:28
C140901-19	14BH-TI-BENCH-BCR16-082	09/09/14	10:31
1409045-CCV1	Calibration Check	09/09/14	10:35
1409045-CCB1	Calibration Blank	09/09/14	10:38
C140901-22	14BH-TI-BENCH-BCR17-082	09/09/14	10:39
C140901-25	14BH-TI-BENCH-BCR18-082	09/09/14	10:40
C140901-28	14BH-TI-BENCH-BCR2-0826	09/09/14	10:43
C140901-31	14BH-TI-BENCH-BCR3-0826	09/09/14	10:44
1409008-DUP2	Duplicate	09/09/14	10:45
C140901-34	14BH-TI-BENCH-BCR4-0826	09/09/14	10:47
C140901-37	14BH-TI-BENCH-BCR5-0826	09/09/14	10:48
C140901-40	14BH-TI-BENCH-BCR6-0826	09/09/14	10:50
C140901-43	14BH-TI-BENCH-BCR7-0826	09/09/14	10:52
C140901-46	14BH-TI-BENCH-BCR8-0826	09/09/14	10:53
1409045-CCV2	Calibration Check	09/09/14	10:55
1409045-CCB2	Calibration Blank	09/09/14	10:58
C140901-49	14BH-TI-BENCH-BCR9-0826	09/09/14	12:12
C140901-52	14BH-TI-BENCH-CONTROL-	09/09/14	12:13
1409045-CCV3	Calibration Check	09/09/14	12:28
1409045-CCB3	Calibration Blank	09/09/14	12:31
1409045-CCV4	Calibration Check	09/09/14	12:47
1409045-CCB4	Calibration Blank	09/09/14	12:50

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: EPA 300.0 **Dissolved** **Sequence ID#:** 1409107

Instrument ID #: ESAT Dionex IC Water **LSR #:** A-058

Analysis ID	Sample Name	Analysis Date	Analysis Time
1409107-ICV1	Initial Cal Check	09/04/14	13:42
1409107-ICB1	Initial Cal Blank	09/04/14	14:01
1409107-SCV1	Secondary Cal Check	09/04/14	14:20
1409107-IBL1	Instrument Blank	09/04/14	14:39
1409010-BS1	Blank Spike	09/04/14	14:57
1409010-BLK1	Blank	09/04/14	15:16
C140901-01	14BH-TI-BENCH-BCR10-082	09/04/14	15:35
1409010-DUP1	Duplicate	09/04/14	15:54
1409010-MS1	Matrix Spike	09/04/14	16:13
C140901-04	14BH-TI-BENCH-BCR11-082	09/04/14	16:32
C140901-07	14BH-TI-BENCH-BCR12-082	09/04/14	16:50
C140901-10	14BH-TI-BENCH-BCR13-082	09/04/14	17:09
1409107-CCV1	Calibration Check	09/04/14	17:28
1409107-CCB1	Calibration Blank	09/04/14	17:47
C140901-22	14BH-TI-BENCH-BCR17-082	09/04/14	19:02
C140901-25	14BH-TI-BENCH-BCR18-082	09/04/14	19:21
C140901-28	14BH-TI-BENCH-BCR2-0826	09/04/14	19:40
C140901-31	14BH-TI-BENCH-BCR3-0826	09/04/14	19:59
1409010-MS2	Matrix Spike	09/04/14	20:17
C140901-34	14BH-TI-BENCH-BCR4-0826	09/04/14	20:36
C140901-37	14BH-TI-BENCH-BCR5-0826	09/04/14	20:55
1409107-CCV2	Calibration Check	09/04/14	21:14
1409107-CCB2	Calibration Blank	09/04/14	23:44
1409107-CCV3	Calibration Check	09/08/14	11:33
1409107-CCB3	Calibration Blank	09/08/14	11:52
C140901-40	14BH-TI-BENCH-BCR6-0826	09/08/14	12:11
C140901-43	14BH-TI-BENCH-BCR7-0826	09/08/14	12:29
C140901-46	14BH-TI-BENCH-BCR8-0826	09/08/14	12:48
C140901-49	14BH-TI-BENCH-BCR9-0826	09/08/14	13:07
C140901-52	14BH-TI-BENCH-CONTROL-	09/08/14	13:26
C140901-13	14BH-TI-BENCH-BCR14-082	09/08/14	13:45
C140901-16	14BH-TI-BENCH-BCR15-082	09/08/14	14:04
C140901-19	14BH-TI-BENCH-BCR16-082	09/08/14	14:22
1409107-CCV4	Calibration Check	09/08/14	14:41
1409107-CCB4	Calibration Blank	09/08/14	15:19

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Dissolved** **Sequence ID#:** 1410039

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-058

Analysis ID	Sample Name	Analysis Date	Analysis Time
1410039-ICV1	Initial Cal Check	10/08/14	08:17
1410039-SCV1	Secondary Cal Check	10/08/14	08:20
1410039-ICB1	Initial Cal Blank	10/08/14	08:23
1410039-CRL1	Instrument RL Check	10/08/14	08:26
1410039-IFA1	Interference Check A	10/08/14	08:29
1410039-IFB1	Interference Check B	10/08/14	08:33
1410031-BLK1	Blank	10/08/14	08:37
1410031-BS1	Blank Spike	10/08/14	08:40
C140901-03	14BH-TI-BENCH-BCR10-082(	10/08/14	08:43
1410031-DUP1	Duplicate	10/08/14	08:46
1410039-SRD1	Serial Dilution	10/08/14	08:49
1410031-MS1	Matrix Spike	10/08/14	08:52
C140901-06	14BH-TI-BENCH-BCR11-082(	10/08/14	08:56
1410031-MS2	Matrix Spike	10/08/14	08:59
C140901-09	14BH-TI-BENCH-BCR12-082(	10/08/14	09:02
1410039-CCV1	Calibration Check	10/08/14	09:08
1410039-CCB1	Calibration Blank	10/08/14	09:11
C140901-12	14BH-TI-BENCH-BCR13-082(	10/08/14	09:14
C140901-15	14BH-TI-BENCH-BCR14-082(	10/08/14	09:17
C140901-18	14BH-TI-BENCH-BCR15-082(	10/08/14	09:20
C140901-21	14BH-TI-BENCH-BCR16-082(	10/08/14	09:23
C140901-24	14BH-TI-BENCH-BCR17-082(	10/08/14	09:27
C140901-27	14BH-TI-BENCH-BCR18-082(	10/08/14	09:30
C140901-30	14BH-TI-BENCH-BCR2-0826	10/08/14	09:33
C140901-33	14BH-TI-BENCH-BCR3-0826	10/08/14	09:36
C140901-36	14BH-TI-BENCH-BCR4-0826	10/08/14	09:39
1410039-CCV2	Calibration Check	10/08/14	09:45
1410039-CCB2	Calibration Blank	10/08/14	09:48
C140901-39	14BH-TI-BENCH-BCR5-0826	10/08/14	09:51
C140901-42	14BH-TI-BENCH-BCR6-0826	10/08/14	09:54
C140901-45	14BH-TI-BENCH-BCR7-0826	10/08/14	09:57
C140901-48	14BH-TI-BENCH-BCR8-0826	10/08/14	10:00
C140901-51	14BH-TI-BENCH-BCR9-0826	10/08/14	10:03
C140901-54	14BH-TI-BENCH-CONTROL-	10/08/14	10:07
1410039-CCV3	Calibration Check	10/08/14	10:13
1410039-CCB3	Calibration Blank	10/08/14	10:16

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Total Recoverable** **Sequence ID#:** 1410040

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-058

Analysis ID	Sample Name	Analysis Date	Analysis Time
1410040-ICV1	Initial Cal Check	10/08/14	08:17
1410040-SCV1	Secondary Cal Check	10/08/14	08:20
1410040-ICB1	Initial Cal Blank	10/08/14	08:23
1410040-CRL1	Instrument RL Check	10/08/14	08:26
1410040-IFA1	Interference Check A	10/08/14	08:29
1410040-IFB1	Interference Check B	10/08/14	08:33
1410040-CCV1	Calibration Check	10/08/14	09:08
1410040-CCB1	Calibration Blank	10/08/14	09:11
1410040-CCV2	Calibration Check	10/08/14	09:45
1410040-CCB2	Calibration Blank	10/08/14	09:48
1410040-CCV3	Calibration Check	10/08/14	10:13
1410040-CCB3	Calibration Blank	10/08/14	10:16
1410017-BLK1	Blank	10/08/14	10:28
1410017-SRM1	Reference	10/08/14	10:32
C140901-02	14BH-TI-BENCH-BCR10-082	10/08/14	10:35
1410017-DUP1	Duplicate	10/08/14	10:38
1410040-SRD1	Serial Dilution	10/08/14	10:41
C140901-05	14BH-TI-BENCH-BCR11-082	10/08/14	10:44
1410017-MS1	Matrix Spike	10/08/14	10:47
C140901-08	14BH-TI-BENCH-BCR12-082	10/08/14	10:50
1410017-MS3	Matrix Spike	10/08/14	10:53
1410040-CCV4	Calibration Check	10/08/14	11:00
1410040-CCB4	Calibration Blank	10/08/14	11:03
C140901-11	14BH-TI-BENCH-BCR13-082	10/08/14	11:06
C140901-14	14BH-TI-BENCH-BCR14-082	10/08/14	11:09
C140901-17	14BH-TI-BENCH-BCR15-082	10/08/14	11:12
C140901-20	14BH-TI-BENCH-BCR16-082	10/08/14	11:15
C140901-23	14BH-TI-BENCH-BCR17-082	10/08/14	11:18
C140901-26	14BH-TI-BENCH-BCR18-082	10/08/14	11:21
C140901-29	14BH-TI-BENCH-BCR2-0826	10/08/14	11:24
C140901-32	14BH-TI-BENCH-BCR3-0826	10/08/14	11:27
C140901-35	14BH-TI-BENCH-BCR4-0826	10/08/14	11:31
1410040-CCV5	Calibration Check	10/08/14	11:37
1410040-CCB5	Calibration Blank	10/08/14	11:40
C140901-38	14BH-TI-BENCH-BCR5-0826	10/08/14	11:43
C140901-41	14BH-TI-BENCH-BCR6-0826	10/08/14	11:46
C140901-44	14BH-TI-BENCH-BCR7-0826	10/08/14	11:49
C140901-47	14BH-TI-BENCH-BCR8-0826	10/08/14	11:52

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.7 **Total Recoverable** **Sequence ID#:** 1410040

Instrument ID #: ICPOE - PE Optima Water **LSR #:** A-058

Analysis ID	Sample Name	Analysis Date	Analysis Time
C140901-50	14BH-TI-BENCH-BCR9-0826	10/08/14	11:55
C140901-53	14BH-TI-BENCH-CONTROL-	10/08/14	11:58
1410040-CCV6	Calibration Check	10/08/14	12:04
1410040-CCB6	Calibration Blank	10/08/14	12:08

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Dissolved** **Sequence ID#:** 1410046

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-058

Analysis ID	Sample Name	Analysis Date	Analysis Time
1410046-ICV1	Initial Cal Check	10/08/14	10:33
1410046-SCV1	Secondary Cal Check	10/08/14	10:36
1410046-ICB1	Initial Cal Blank	10/08/14	10:40
1410046-CRL1	Instrument RL Check	10/08/14	10:43
1410046-IFA1	Interference Check A	10/08/14	10:46
1410046-IFB1	Interference Check B	10/08/14	10:50
1410036-BLK1	Blank	10/08/14	10:53
1410036-BS1	Blank Spike	10/08/14	10:56
C140901-06	14BH-TI-BENCH-BCR11-082	10/08/14	11:11
1410036-MS2	Matrix Spike	10/08/14	11:14
C140901-09	14BH-TI-BENCH-BCR12-082	10/08/14	11:17
1410046-CCV1	Calibration Check	10/08/14	11:23
1410046-CCB1	Calibration Blank	10/08/14	11:27
C140901-12	14BH-TI-BENCH-BCR13-082	10/08/14	11:30
C140901-15	14BH-TI-BENCH-BCR14-082	10/08/14	11:33
C140901-18	14BH-TI-BENCH-BCR15-082	10/08/14	11:36
1410046-CCV2	Calibration Check	10/08/14	12:07
1410046-CCB2	Calibration Blank	10/08/14	12:11
C140901-39	14BH-TI-BENCH-BCR5-0826	10/08/14	12:14
C140901-03	14BH-TI-BENCH-BCR10-082	10/08/14	12:58
1410036-DUP1	Duplicate	10/08/14	13:02
1410046-SRD1	Serial Dilution	10/08/14	13:05
1410046-CCV3	Calibration Check	10/08/14	13:17
1410046-CCB3	Calibration Blank	10/08/14	13:20
1410036-MS1	Matrix Spike	10/08/14	13:23
C140901-21	14BH-TI-BENCH-BCR16-082	10/08/14	13:26
C140901-24	14BH-TI-BENCH-BCR17-082	10/08/14	13:30
C140901-27	14BH-TI-BENCH-BCR18-082	10/08/14	13:33
C140901-30	14BH-TI-BENCH-BCR2-0826	10/08/14	13:36
C140901-33	14BH-TI-BENCH-BCR3-0826	10/08/14	13:39
C140901-36	14BH-TI-BENCH-BCR4-0826	10/08/14	13:42
C140901-42	14BH-TI-BENCH-BCR6-0826	10/08/14	13:45
C140901-45	14BH-TI-BENCH-BCR7-0826	10/08/14	13:48
C140901-48	14BH-TI-BENCH-BCR8-0826	10/08/14	13:51
1410046-CCV4	Calibration Check	10/08/14	13:54
1410046-CCB4	Calibration Blank	10/08/14	13:57
C140901-51	14BH-TI-BENCH-BCR9-0826	10/08/14	14:01
C140901-54	14BH-TI-BENCH-CONTROL-	10/08/14	14:04

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Dissolved** **Sequence ID#:** 1410046

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-058

Analysis ID	Sample Name	Analysis Date	Analysis Time
1410046-CCV5	Calibration Check	10/08/14	14:07
1410046-CCB5	Calibration Blank	10/08/14	14:10

TechLaw Inc., ESAT Region 8

INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: 200.8 **Total Recoverable** **Sequence ID#:** 1410052

Instrument ID #: ICPMS-PE DRC-II Water **LSR #:** A-058

Analysis ID	Sample Name	Analysis Date	Analysis Time
1410052-ICV1	Initial Cal Check	10/13/14	13:58
1410052-SCV1	Secondary Cal Check	10/13/14	14:02
1410052-ICB1	Initial Cal Blank	10/13/14	14:05
1410052-CRL1	Instrument RL Check	10/13/14	14:08
1410052-IFA1	Interference Check A	10/13/14	14:12
1410052-IFB1	Interference Check B	10/13/14	14:15
1410017-BLK2	Blank	10/13/14	14:18
1410017-SRM2	Reference	10/13/14	14:21
C140901-02	14BH-TI-BENCH-BCR10-082	10/13/14	14:24
1410017-DUP2	Duplicate	10/13/14	14:27
1410052-SRD1	Serial Dilution	10/13/14	14:30
C140901-05	14BH-TI-BENCH-BCR11-082	10/13/14	14:33
1410017-MS2	Matrix Spike	10/13/14	14:36
C140901-08	14BH-TI-BENCH-BCR12-082	10/13/14	14:39
1410017-MS4	Matrix Spike	10/13/14	14:42
1410052-CCV1	Calibration Check	10/13/14	14:49
1410052-CCB1	Calibration Blank	10/13/14	14:52
C140901-11	14BH-TI-BENCH-BCR13-082	10/13/14	14:55
C140901-14	14BH-TI-BENCH-BCR14-082	10/13/14	14:58
C140901-17	14BH-TI-BENCH-BCR15-082	10/13/14	15:01
C140901-20	14BH-TI-BENCH-BCR16-082	10/13/14	15:04
C140901-23	14BH-TI-BENCH-BCR17-082	10/13/14	15:07
C140901-26	14BH-TI-BENCH-BCR18-082	10/13/14	15:10
C140901-29	14BH-TI-BENCH-BCR2-0826	10/13/14	15:13
C140901-32	14BH-TI-BENCH-BCR3-0826	10/13/14	15:17
C140901-35	14BH-TI-BENCH-BCR4-0826	10/13/14	15:20
1410052-CCV2	Calibration Check	10/13/14	15:26
1410052-CCB2	Calibration Blank	10/13/14	15:29
C140901-38	14BH-TI-BENCH-BCR5-0826	10/13/14	15:32
C140901-41	14BH-TI-BENCH-BCR6-0826	10/13/14	15:35
C140901-44	14BH-TI-BENCH-BCR7-0826	10/13/14	15:38
C140901-47	14BH-TI-BENCH-BCR8-0826	10/13/14	15:41
C140901-50	14BH-TI-BENCH-BCR9-0826	10/13/14	15:45
C140901-53	14BH-TI-BENCH-CONTROL-	10/13/14	15:48
1410052-CCV3	Calibration Check	10/13/14	16:00
1410052-CCB3	Calibration Blank	10/13/14	16:04

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USEPA

DateShipped: 8/28/2014

A-058 TDF

CHAIN OF CUSTODY RECORD

Site #: MT6122307485

Contact Name: Nick Anton

Contact Phone: 720-264-1147

No: 8-082714-181518-0001

Cooler #:

Lab: ESAT

Lab #	Sample #	Location	Analyses	Matrix	Collected	Numb Cont	Container	Preservative	Lab QC
	14BH-TI-BENCH-BCR10-0826	BENCH-BCR10	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	
11:30	14BH-TI-BENCH-BCR10-0826	BENCH-BCR10	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR10-0826	BENCH-BCR10	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR11-0826	BENCH-BCR11	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	
11:45	14BH-TI-BENCH-BCR11-0826	BENCH-BCR11	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR11-0826	BENCH-BCR11	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR12-0826	BENCH-BCR12	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	
1200	14BH-TI-BENCH-BCR12-0826	BENCH-BCR12	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR12-0826	BENCH-BCR12	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR13-0826	BENCH-BCR13	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	

Special Instructions:	**SAMPLES TRANSFERRED FROM** **CHAIN OF CUSTODY #**

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
	Nick Anton	8/28/2014 1500	Kelsey Bartley ESAT	8/29/14	8:00
	CDM SMITH				

USEPA

DateShipped: 8/28/2014

A-058 TDF

CHAIN OF CUSTODY RECORD

Site #: MT6122307485

Contact Name: Nick Anton

Contact Phone: 720-264-1147

No: 8-082714-181518-0001

Cooler #:

Lab: ESAT

Lab #	Sample #	Location	Analyses	Matrix	Collected	Numb Cont	Container	Preservative	Lab QC
12:15	14BH-TI-BENCH-BCR13-0826	BENCH-BCR13	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR13-0826	BENCH-BCR13	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR14-0826	BENCH-BCR14	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	
12:30	14BH-TI-BENCH-BCR14-0826	BENCH-BCR14	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR14-0826	BENCH-BCR14	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR15-0826	BENCH-BCR15	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	
12:45	14BH-TI-BENCH-BCR15-0826	BENCH-BCR15	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR15-0826	BENCH-BCR15	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR16-0826	BENCH-BCR16	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	
13:00	14BH-TI-BENCH-BCR16-0826	BENCH-BCR16	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	

Special Instructions:	**SAMPLES TRANSFERRED FROM** **CHAIN OF CUSTODY #**

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
			Kelsey Bartley ESAT	8/29/14 8:00	

USEPA

DateShipped: 8/28/2014

A-058 TDF

CHAIN OF CUSTODY RECORD

Site #: MT6122307485

Contact Name: Nick Anton

Contact Phone: 720-264-1147

No: 8-082714-181518-0001

Cooler #:

Lab: ESAT

Lab #	Sample #	Location	Analyses	Matrix	Collected	Numb Cont	Container	Preservative	Lab QC
	14BH-TI-BENCH-BCR16-0826	BENCH-BCR16	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
13:15	14BH-TI-BENCH-BCR17-0826	BENCH-BCR17	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	
	14BH-TI-BENCH-BCR17-0826	BENCH-BCR17	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR17-0826	BENCH-BCR17	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR2-0826	BENCH-BCR2	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	
9 30	14BH-TI-BENCH-BCR2-0826	BENCH-BCR2	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR2-0826	BENCH-BCR2	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR3-0826	BENCH-BCR3	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	
	14BH-TI-BENCH-BCR3-0826	BENCH-BCR3	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
9:45	14BH-TI-BENCH-BCR3-0826	BENCH-BCR3	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	

Special Instructions:	SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
			Kelsey Bartley ESAT	8/29/14 8:00	

USEPA

DateShipped: 8/28/2014

A-058 TDF

CHAIN OF CUSTODY RECORD

Site #: MT6122307485

Contact Name: Nick Anton

Contact Phone: 720-264-1147

No: 8-082714-181518-0001

Cooler #:

Lab: ESAT

Lab #	Sample #	Location	Analyses	Matrix	Collected	Numb Cont	Container	Preservative	Lab QC
	14BH-TI-BENCH-BCR4-0826	BENCH-BCR4	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	
10:00	14BH-TI-BENCH-BCR4-0826	BENCH-BCR4	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR4-0826	BENCH-BCR4	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR5-0826	BENCH-BCR5	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	
10:15	14BH-TI-BENCH-BCR5-0826	BENCH-BCR5	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR5-0826	BENCH-BCR5	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR6-0826	BENCH-BCR6	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	
10:30	14BH-TI-BENCH-BCR6-0826	BENCH-BCR6	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR6-0826	BENCH-BCR6	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
10:45	14BH-TI-BENCH-BCR7-0826	BENCH-BCR7	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	

Special Instructions:	**SAMPLES TRANSFERRED FROM** **CHAIN OF CUSTODY #**

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
			Kelsey Bartley ESAT	8/29/14 8:00	

USEPA
DateShipped: 8/28/2014

A-058 TDF

CHAIN OF CUSTODY RECORD
Site #: MT6122307485
Contact Name: Nick Anton
Contact Phone: 720-264-1147

No: 8-082714-181518-0001
Cooler #:
Lab: ESAT

Lab #	Sample #	Location	Analyses	Matrix	Collected	Numb Cont	Container	Preservative	Lab QC
	14BH-TI-BENCH-BCR7-0826	BENCH-BCR7	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR7-0826	BENCH-BCR7	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR8-0826	BENCH-BCR8	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	
	14BH-TI-BENCH-BCR8-0826	BENCH-BCR8	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
11:00	14BH-TI-BENCH-BCR8-0826	BENCH-BCR8	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR9-0826	BENCH-BCR9	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	
11:15	14BH-TI-BENCH-BCR9-0826	BENCH-BCR9	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-BCR9-0826	BENCH-BCR9	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
	14BH-TI-BENCH-CONTROL-0826	BENCH-CONTROL	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	
900	14BH-TI-BENCH-CONTROL-0826	BENCH-CONTROL	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	

Special Instructions:	**SAMPLES TRANSFERRED FROM**
	CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
			Kelsey Bartling ESAT	8/29/14 8:00	

Page 6 of 6

USEPA

DateShipped: 8/28/2014

A-058 TDF

CHAIN OF CUSTODY RECORD

Site #: MT6122307485

Contact Name: Nick Anton

Contact Phone: 720-264-1147

No: 8-082714-181518-0001

Cooler #:

Lab: ESAT

Lab #	Sample #	Location	Analyses	Matrix	Collected	Numb Cont	Container	Preservative	Lab QC
	14BH-TI-BENCH-CONTROL-0826	BENCH-CONTROL	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
BCR18	14BH-TI-BENCH-~~BCR1~~-0826	BENCH-BCR1	Alkalinity/Sulfate-Filtered	Ground Water	8/26/2014	1	poly	4 C	9:15
BCR18	14BH-TI-BENCH-~~BCR1~~-0826	BENCH-BCR1	TAL Metals - Diss - Filtered	Ground Water	8/26/2014	1	poly	HNO3 pH<2	
BCR18	14BH-TI-BENCH-~~BCR1~~-0826	BENCH-BCR1	TAL Metals - Total	Ground Water	8/26/2014	1	poly	HNO3 pH<2	

N.A.
8/28/14

Special Instructions:	**SAMPLES TRANSFERRED FROM**
	CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
			Kelsey Barthey ESAT	8/29/14	8:00

C140901

ESAT Technical Direction Form

Contract No. EPW13028
EPA Region 8

Site ID:	085N	***Date Issued:***	7/8/2014	***Date***	
TDF ID:	A-058	***Date Updated:***		***Closed By:***	

Name: Tiger Mine-BH Treatability Study

Details: The Contractor shall analyze a total of approximately 23 water samples encompassing two collection events as part of a treatability study of the Tiger Mine located at the Barker-Hughesville Superfund site. The first set of samples (5) will arrive at the ESAT R8 Lab during the week ending July 11, 2014. The second set of samples (18) will arrive in mid-August 2014. Nick Anton of CDM Smith will hand deliver the samples to the lab.

The samples will be analyzed for total and dissolved metals, alkalinity, and sulfate as indicate in the Analytical Information Section.

TO02/Subtask 02b: Inorganic Chemistry

The site RPM is Roger Hoogerheide.

Analytical Information:

MATRIX

☑ Water ☐ Soils ☐ Vegetation ☐ Biota

WET CHEM

☐ TSS ☐ TDS ☐ DOC ☑ Alk ☐ Chloride ☑ Sulfate ☐ Fluoride ☐ Nitrate ☐ Nitrite

Other

METALS

☑ Dissolved ☑ Total Recoverable ☐ Total ☐ Hardness (Calc)

200.7: ☐ Ag ☑ Al ☐ As ☐ Ba ☐ Be ☐ B ☐ Ca ☐ Cd ☐ Co ☐ Cr ☐ Cu ☑ Fe ☐ K ☐ Mg
☒ Mn ☐ Mo ☐ Na ☐ Ni ☐ Pb ☐ Sb ☐ Se ☐ Sr ☐ Ti ☐ Tl ☐ V ☑ Zn ☐ SiO2

200.8: ☐ Ag ☐ Al ☑ As ☐ Ba ☐ Be ☑ Cd ☐ Co ☐ Cr ☑ Cu ☑ Mn ☐ Mo ☑ Ni ☑ Pb ☐ Sb
☐ Se ☐ Th ☐ Tl ☐ U ☐ V ☐ Zn

7470/7471/747 ☐ Hg

lv 10/08/14

FIBERS

☐ PLM ☐ TEM

Deliverables

ID	*Description*	*Due Date*	*Submission Date*
1	Provide final deliverable package to Task Monitor no later than 30 days after delivery of samples.		
2	Provide preliminary data to Task Monitor and Nick Anton no later than 7 days after delivery of samples. Final delivery package is due to Task Monitor no later than 30 days after delivery of samples.		

7/8/14

Tables

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Table 3.2-1

Danny T Treatability Study Year 2 Relative Percent Differences between Normal and Field Duplicates

Barker-Hughesville Mining District Superfund Site

Location	BCR1										BCR2										BCR3									
Sample ID	14BH-DT-PILOT-BCR1-062414				14BH-DT-PILOT-BCR1D-062414				BCR1 RPD		14BH-DT-PILOT-BCR2-072214				14BH-DT-PILOT-BCR2D-072214				BCR2 RPD		14BH-DT-PILOT-BCR3-081914				14BH-DT-PILOT-BCR3D-081914				BCR3 RPD	
Sample Date	6/24/2014				6/24/2014				6/24/2014		7/22/2014				7/22/2014				7/22/2014		8/19/2014				8/19/2014				8/19/2014	
Fraction	D		T		D		T		D	T	D		T		D		T		D	T	D		T		D		T		D	T
Analyte	Result	Q	Result	Q	Result	Q	Result	Q	RPD	RPD	Result	Q	Result	Q	Result	Q	Result	Q	RPD	RPD	Result	Q	Result	Q	Result	Q	Result	Q	RPD	RPD
Aluminum	250	U	151	J	50	U	47.4	J	NA	26.1%	250	U	148	J	250	U	116	J	NA	6.1%	175	J	181	J	178	J	188	J	0.4%	0.9%
Arsenic	20.3		20.5		18.3	J	21.1		2.6%	0.7%	20	U	7.73	J	20	U	7.42	J	NA	1.0%	6.81	J	8.3	J	7.44	J	8.46	J	2.2%	0.5%
Cadmium	2	U	1.37	J	2	U	1.76	J	NA	6.2%	2	U	2	U	2	U	2	U	NA	NA	2	U	2	U	2	U	2	U	NA	NA
Copper	5.3	J	17.1		6.94	J	22		6.7%	6.3%	5.43	J	11.7		6.81	J	8.03	J	5.6%	9.3%	13.9		10	U	11.5		10	U	4.7%	NA
Iron	1250	U	1250	U	180	J	531		NA	NA	1250	U	615	J	1250	U	517	J	NA	4.3%	1250	U	1250	U	1250	U	1250	U	NA	NA
Lead	2	U	1.23	J	2	U	1.61	J	NA	6.7%	2	U	5.73		2	U	4.27		NA	7.3%	2	U	2	U	2	U	2	U	NA	NA
Manganese	1870		2100		2850		2870		10.4%	7.7%	46300		48500		50600		51100		2.2%	1.3%	39800		40600		40900		41200		0.7%	0.4%
Nickel	27.1		10	U	29.7		10	U	2.3%	NA	10	U	10	U	10	U	10	U	NA	NA	10	U	6.41	J	10	U	10	U	NA	NA
Zinc	82.2	J	250		86		236		1.1%	1.4%	100	U	326		50.7	J	287		NA	3.2%	100	U	56	J	100	U	64.8	J	NA	3.6%
Acidity			4	U			4	U	NA	NA			4	U			4	U	NA	NA			4	U			4	U	NA	NA
Alkalinity	1570				1540				0.5%	NA	650				637				0.5%	NA	1330				1300				0.6%	NA
Ammonia	94.2				85.6				2.4%	NA	11.4				10.2				2.8%	NA	79.8				77.8				0.6%	NA
BOD									NA	NA			280				280		NA	0.0%			390				370		NA	1.3%
Chloride	83.2	J			79.8	J			1.0%	NA	10.9	J			11.7	J			1.8%	NA	5.5	J			5.4	J			0.5%	NA
Fluoride	67.1				59.1				3.2%	NA	15.8				15				1.3%	NA	29.1				27.4				1.5%	NA
Hardness			2320				2250		NA	0.8%			895				882		NA	0.4%			1300				1200		NA	2.0%
Nitrate									NA	NA	5	U			5	U			NA	NA									NA	NA
Nitrate/Nitrite	500	U			500	U			NA	NA	50	U			50	U			NA	NA	50	U			50	U			NA	NA
Nitrite									NA	NA	5	U			5	U			NA	NA									NA	NA
Orthophosphate	2.9				2.5				3.7%	NA	14.4				14				0.7%	NA	19.1				19.6				0.6%	NA
Sulfate	840				831				0.3%	NA	349				370				1.5%	NA	270				289				1.7%	NA
Sulfide									NA	NA			45				50		NA	2.6%			80				79		NA	0.3%

Notes:

INF = Adit influent to treatment system; BCRX = Biochemical reactor barrel effluent; SAPS = Successive alkalinity producing system pre-treatment to BCR2;

CHIT = Chitorem pre-treatment to BCR3; NAOH = Sodium hydroxide pre-treatment to BCR4

Q = Qualifier; U = Result below method reporting limit shown; J = estimated result; D = dissolved fraction; T = total fraction

µg/L = micrograms per liter; mg/L = milligrams per liter

Flags:

Text-	RPD exceeds 10%

Table 3.2-1
Danny T Treatability Study Year 2 Relative Percent Differences between Normal and Field Duplicates
Barker-Hughesville Mining District Superfund Site

Location	BCR4										INF																			
Sample ID	14BH-DT-PILOT-BCR4-091614				14BH-DT-PILOT-BCR4D-091614				BCR4 RPD		14BH-DT-PILOT-INF-061114				14BH-DT-PILOT-INFD-061114				INF RPD		14BH-DT-PILOT-INF-070814				14BH-DT-PILOT-INFD-070814				INF RPD	
Sample Date	9/16/2014				9/16/2014				9/16/2014		6/11/2014				6/11/2014				6/11/2014		7/8/2014				7/8/2014				7/8/2014	
Fraction	D		T		D		T		D	T	D		T		D		T		D	T	D		T		D		T		D	T
Analyte	Result	Q	Result	Q	Result	Q	Result	Q	RPD	RPD	Result	Q	Result	Q	Result	Q	Result	Q	RPD	RPD	Result	Q	Result	Q	Result	Q	Result	Q	RPD	RPD
Aluminum	250	U	250	U	250	U	250	U	NA	NA	12400		13100		13200		13100		1.6%	0.0%	15000		15100		14900		15100		0.2%	0.0%
Arsenic	20	U	20	U	20	U	20	U	NA	NA	264		269		256		251		0.8%	1.7%	166		198	J	178		207	J	1.7%	1.1%
Cadmium	2	U	2	U	2	U	2	U	NA	NA	258		256		256		253		0.2%	0.3%	285		291		294		288		0.8%	0.3%
Copper	6.29	J	7.35	J	5.97	J	7.03	J	1.3%	1.1%	1210		1120		1160		1070		1.1%	1.1%	1270		1060		1250		1160		0.4%	2.3%
Iron	1250	U	1250	U	1250	U	1250	U	NA	NA	154000		160000		160000		159000		1.0%	0.2%	184000		185000		184000		186000		0.0%	0.1%
Lead	2	U	2	U	2	U	2	U	NA	NA	245		239	J	242		260	J	0.3%	2.1%	147		221		149		206		0.3%	1.8%
Manganese	55600		58200		56600		59000		0.4%	0.3%	106000		107000		106000		106000		0.0%	0.2%	123000		123000		122000		123000		0.2%	0.0%
Nickel	10	U	10	U	10	U	10	U	NA	NA	27.6		25.8		26.4		26.1		1.1%	0.3%	28.5		20.9		25.3		100	U	3.0%	NA
Zinc	50.4	J	468		63.6	J	466		5.8%	0.1%	59500		59300		59800		59200		0.1%	0.0%	66500		65300		66100		66500		0.2%	0.5%
Acidity			4	U			4	U	NA	NA			620				630		NA	0.4%			700				720		NA	0.7%
Alkalinity	51				51.2				0.1%	NA	500	U			500	U			NA	NA	500	U			500	U			NA	NA
Ammonia	1.27				1.25				0.4%	NA									NA	NA									NA	NA
BOD			67				62		NA	1.9%									NA	NA									NA	NA
Chloride	5.4	J			5.3	J			0.5%	NA	7.7	J			7.6	J			0.3%	NA	6.9	J			7	J			0.4%	NA
Fluoride	1.8	J			1.6	J			2.9%	NA	2.7				2.9				1.8%	NA	2.8				3.1				2.5%	NA
Hardness			284				284		NA	0.0%			337				359		NA	1.6%			375				369		NA	0.4%
Nitrate									NA	NA									NA	NA									NA	NA
Nitrate/Nitrite	50	U			50	U			NA	NA	50	U			50	U			NA	NA	50	U			50	U			NA	NA
Nitrite									NA	NA									NA	NA									NA	NA
Orthophosphate	1.28				1.22				1.2%	NA	0.391				0.262				9.9%	NA	0.05	U			0.2				NA	NA
Sulfate	642				629				0.5%	NA	1150				1160				0.2%	NA	1280				1310				0.6%	NA
Sulfide			35				34		NA	0.7%									NA	NA									NA	NA

Notes:

INF = Adit influent to treatment system; BCRX = Biochemical reactor barrel effluent; SAPS = Successive alkalinity producing system pre-treatment to BCR2;

CHIT = Chitorem pre-treatment to BCR3; NAOH = Sodium hydroxide pre-treatment to BCR4

Q = Qualifier; U = Result below method reporting limit shown; J = estimated result; D = dissolved fraction; T = total fraction

µg/L = micrograms per liter; mg/L = milligrams per liter

Flags:

Text- RPD exceeds 10%

Table 3.2-1
Danny T Treatability Study Year 2 Relative Percent Differences between Normal and Field Duplicates
Barker-Hughesville Mining District Superfund Site

Location	INF																													
Sample ID	14BH-DT-PILOT-INF-080614				14BH-DT-PILOT-INFD-080614				INF RPD		14BH-DT-PILOT-INF-090214				14BH-DT-PILOT-INFD-090214				INF RPD		14BH-DT-PILOT-INF-092314				14BH-DT-PILOT-INFD-092314				INF RPD	
Sample Date	8/6/2014				8/6/2014				8/6/2014		9/2/2014				9/2/2014				9/2/2014		9/23/2014				9/23/2014				9/23/2014	
Fraction	D		T		D		T		D	T	D		T		D		T		D	T	D		T		D		T		D	T
Analyte	Result	Q	Result	Q	Result	Q	Result	Q	RPD	RPD	Result	Q	Result	Q	Result	Q	Result	Q	RPD	RPD	Result	Q	Result	Q	Result	Q	Result	Q	RPD	RPD
Aluminum	12600		12800		12300		12800		0.6%	0.0%	12300		12300		12300		12100		0.0%	0.4%	13300		13500		12900		13400		0.8%	0.2%
Arsenic	143		147	J	140		158	J	0.5%	1.8%	227		233	J	228		244	J	0.1%	1.2%	150		169		148		158		0.3%	1.7%
Cadmium	232		245		237		238		0.5%	0.7%	220		211		216		222		0.5%	1.3%	238		246		235		247		0.3%	0.1%
Copper	849		1140		852		1070		0.1%	1.6%	933		917		936		946		0.1%	0.8%	892		1010		870		944		0.6%	1.7%
Iron	159000		162000		156000		165000		0.5%	0.5%	111000		111000		111000		111000		0.0%	0.0%	140000		148000		142000		140000		0.4%	1.4%
Lead	134		129		137		126		0.6%	0.6%	246		250		246		253		0.0%	0.3%	158		175		156		167		0.3%	1.2%
Manganese	109000		110000		108000		111000		0.2%	0.2%	75500		77200		76400		77700		0.3%	0.2%	104000		107000		103000		104000		0.2%	0.7%
Nickel	19		100	U	18.3		100	U	0.9%	NA	31.4		24.7		26.9		26.7		3.9%	1.9%	24.4		27		23.8		25.2		0.6%	1.7%
Zinc	57000		57800		57100		57900		0.0%	0.0%	44000		45100		45400		45600		0.8%	0.3%	55500		58400		54900		55400		0.3%	1.3%
Acidity			690				730		NA	1.4%			600				570		NA	1.3%			660				670		NA	0.4%
Alkalinity	100	U			100	U			NA	NA	100	U			100	U			NA	NA	10	U			10	U			NA	NA
Ammonia									NA	NA									NA	NA									NA	NA
BOD									NA	NA									NA	NA									NA	NA
Chloride	5.6	J			5.4	J			0.9%	NA	5.4	J			5.4	J			0.0%	NA	5.4	J			5.5	J			0.5%	NA
Fluoride	2.5				2.5				0.0%	NA	2.2				2.5				3.2%	NA	2.3				2.5				2.1%	NA
Hardness			346				335		NA	0.8%			256				255		NA	0.1%			325				317		NA	0.6%
Nitrate									NA	NA									NA	NA									NA	NA
Nitrate/Nitrite	50	U			50	U			NA	NA	50	U			50	U			NA	NA	50	U			50	U			NA	NA
Nitrite									NA	NA									NA	NA									NA	NA
Orthophosphate	0.362				0.1				28.4%	NA	0.399				0.05				38.9%	NA	0.158				0.377				20.5%	NA
Sulfate	1170				1190				0.4%	NA	894				904				0.3%	NA	1110				1110				0.0%	NA
Sulfide									NA	NA									NA	NA									NA	NA

Notes:

INF = Adit influent to treatment system; BCRX = Biochemical reactor barrel effluent; SAPS = Successive alkalinity producing system pre-treatment to BCR2;

CHIT = Chitorem pre-treatment to BCR3; NAOH = Sodium hydroxide pre-treatment to BCR4

Q = Qualifier; U = Result below method reporting limit shown; J = estimated result; D = dissolved fraction; T = total fraction

µg/L = micrograms per liter; mg/L = milligrams per liter

Flags:

Text- RPD exceeds 10%

Table 4.2-1
Danny T Treatability Study Year 2: Analytical Laboratory Data
Barker-Hughesville Mining District Superfund Site

Location		INF																			
Sample ID		14BH-DT-PILOT-INF-061114				14BH-DT-PILOT-INF-062414				14BH-DT-PILOT-INF-070814				14BH-DT-PILOT-INF-072214				14BH-DT-PILOT-INF-080614			
Sample Date		6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014			
Fraction		D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Metals																					
Aluminum	µg/L	12400		13100		13700		14000		15000		15100		14600		14500		12600		12800	
Antimony	µg/L																				
Arsenic	µg/L	264		269		136		134		166		198	J	186		189		143		147	J
Barium	µg/L																				
Beryllium	µg/L																				
Cadmium	µg/L	258		256		284		283		285		291		276		272		232		245	
Calcium	µg/L																				
Chromium	µg/L																				
Cobalt	µg/L																				
Copper	µg/L	1210		1120		1060		1130		1270		1060		919		852	J	849		1140	
Iron	µg/L	154000		160000		155000		156000		184000		185000		181000		180000		159000		162000	
Lead	µg/L	245		239	J	213		189		147		221		199		207		134		129	
Magnesium	µg/L																				
Manganese	µg/L	106000		107000		113000		114000		123000		123000		116000		117000		109000		110000	
Nickel	µg/L	27.6		25.8		53.9		22.7		28.5		20.9		17.9		48.2	J	19		100	U
Potassium	µg/L																				
Selenium	µg/L																				
Silver	µg/L																				
Sodium	µg/L																				
Thallium	µg/L																				
Vanadium	µg/L																				
Zinc	µg/L	59500		59300		64400		63800		66500		65300		62700		62600		57000		57800	
Wet Chemistry																					
Acidity	mg/L			620				640				700				790				690	
Alkalinity	mg/L	500	U			500	U			500	U			100	U			100	U		
Ammonia	mg/L																				
BOD	mg/L																				
Chloride	mg/L	7.7	J			7.1	J			6.9	J			7	J			5.6	J		
Fluoride	mg/L	2.7				2.8				2.8				2.5				2.5			
Hardness	mg/L			337				366				375				372				346	
Nitrate/Nitrite	mg/L	50	U			50	U			50	U			50	U			50	U		
Nitrate	mg/L													5	U						
Nitrite	mg/L													5	U						
Orthophosphate	mg/L	0.391				0.1	U			0.05	U			0.322				0.362			
Sulfate	mg/L	1150				1280				1280				1080				1170			
Sulfide	mg/L																				

Location		INF																			
Sample ID		14BH-DT-PILOT-INF-081914				14BH-DT-PILOT-INF-090214				14BH-DT-PILOT-INF-091614				14BH-DT-PILOT-INF-092314				14BH-DT-PILOT-INF-092914			
Sample Date		8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
Fraction		D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Metals																					
Aluminum	µg/L	10600		10900		12300		12300		12900		13600		13300		13500		13700		14100	
Antimony	µg/L																	2	J	2	J
Arsenic	µg/L	129		123		227		233	J	227		225		150		169		178		189	
Barium	µg/L																	3.8	J	3.9	J
Beryllium	µg/L																	7.4		7.8	
Cadmium	µg/L	222		232		220		211		226		240		238		246		271		275	
Calcium	µg/L																	96300	J	110000	
Chromium	µg/L																	5.7		7.8	
Cobalt	µg/L																	34.3		33.2	
Copper	µg/L	812		871		933		917		825		901	J	892		1010		1170		1230	
Iron	µg/L	133000		137000		111000		111000		140000		146000		140000		148000		152000		164000	
Lead	µg/L	136		104		246		250		169		166		158		175		169		172	
Magnesium	µg/L																	22800		23100	
Manganese	µg/L	101000		98200		75500		77200		96200		99300		104000		107000		114000		94900	
Nickel	µg/L	19.4		21.3		31.4		24.7		25.6		23.2	J	24.4		27		35.9		38.4	
Potassium	µg/L																	724		754	
Selenium	µg/L																	5	J	5	J
Silver	µg/L																	1	J	1	J
Sodium	µg/L																	4840		4900	
Thallium	µg/L																	1.9		1.9	
Vanadium	µg/L																	2.8	J	1.8	J
Zinc	µg/L	52400		50400		44000		45100		52400		54600		55500		58400		53300		54500	
Wet Chemistry																					
Acidity	mg/L			600				600				670				660				700	
Alkalinity	mg/L	50	U			100	U			10	U			10	U						
Ammonia	mg/L																				
BOD	mg/L																				
Chloride	mg/L	5.4	J			5.4	J			5.5	J			5.4	J						
Fluoride	mg/L	2.2				2.2				2.5				2.3							
Hardness	mg/L			313				256				306				325					
Nitrate/Nitrite	mg/L	50	U			50	U			50	U			50	U						
Nitrate	mg/L																				
Nitrite	mg/L																				
Orthophosphate	mg/L	0.297				0.399				0.338				0.158				0.106			
Sulfate	mg/L	1010				894				1070				1110							
Sulfide	mg/L																				

Notes:

INF = Adit influent to treatment system; BCRX = Biochemical reactor barrel effluent; SAPS = Successive alkalinity producing system pre-treatment to BCR2;

CHIT = Chitorem pre-treatment to BCR3; NAOH = Sodium hydroxide pre-treatment to BCR4; POSTI = Combined four BCR effluents into post-treatment system; POSTE = Effluent from post-treatment system

Q = Qualifier; U = Result below method reporting limit shown; J = estimated result; D = dissolved fraction; T = total fraction

µg/L = micrograms per liter; mg/L = milligrams per liter

BOD= Biological oxygen demand

Table 4.2-1
Danny T Treatability Study Year 2: Analytical Laboratory Data
Barker-Hughesville Mining District Superfund Site

Location		BCR1																																							
Sample ID		14BH-DT-PILOT-BCR1-061114				14BH-DT-PILOT-BCR1-062414				14BH-DT-PILOT-BCR1-070814				14BH-DT-PILOT-BCR1-072214				14BH-DT-PILOT-BCR1-080614				14BH-DT-PILOT-BCR1-081914				14BH-DT-PILOT-BCR1-090214				14BH-DT-PILOT-BCR1-091614				14BH-DT-PILOT-BCR1-092314				14BH-DT-PILOT-BCR1-092914			
Sample Date		6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014				8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
Fraction		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Metals																																									
Aluminum	µg/L	436	J	1190		250	U	151	J	50	U	265		172	J	185	J	250	U	140	J	137	J	199	J	129	J	140	J	250	U	250	U	250	U	250	U	13	J	23.9	
Antimony	µg/L																																					2	J	2	J
Arsenic	µg/L	94.5		109		20.3		20.5		5.98	J	13.7	J	5.24	J	6.77	J	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	0.97	J	1.4	
Barium	µg/L																																					188		181	
Beryllium	µg/L																																					1	U	1	U
Cadmium	µg/L	2	U	17.1		2	U	1.37	J	2	U	2.1		2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	1	U	0.047	J
Calcium	µg/L																																					315000		300000	
Chromium	µg/L																																					3.6		6.4	
Cobalt	µg/L																																					1.4		0.66	J
Copper	µg/L	18.6		145		5.3	J	17.1		10	U	15.7		10	U	10	U	6.94	J	10	U	14.3		10	U	10	U	10	U	10	U	10	U	10	U	10	U	2	U	2	J
Iron	µg/L	1410	J	2610		1250	U	1250	U	2190		11000		1250	U	687	J	1250	U	1250	U	1250	U	1250	U	1250	U	6450		1250	U	1250	U	1250	U	1250	U	1930		2450	
Lead	µg/L	2	U	20.5	J	2	U	1.23	J	2	U	1.59	J	2	U	2.23		2	U	1.34	J	1.01	J	6		2	U	2	U	2	U	1.11	J	2	U	2	U	1	U	0.48	J
Magnesium	µg/L																																					27800		26000	
Manganese	µg/L	4380		5040		1870		2100		45000		56800		57300		64200		83000		87400		90900		95800		85900		89400		80700		85600		84500		88900		85200		86600	
Nickel	µg/L	10	U	10	U	27.1		10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	15.6		10	U	10	U	10	U	10	U	10	U	11.4		13.2	
Potassium	µg/L																																					1020		975	
Selenium	µg/L																																					5	J	9.4	
Silver	µg/L																																					1	U	1	U
Sodium	µg/L																																					6080		5690	
Thallium	µg/L																																					1	U	1	U
Vanadium	µg/L																																					0.14	J	5	U
Zinc	µg/L	142	J	882		82.2	J	250		59.2		2200		100	U	497		100	U	175		100	U	119		100	U	76.2	J	100	U	96.3	J	100	U	50.8	J	3.8		76.2	
Wet Chemistry																																									
Acidity	mg/L			4	U			4	U			4	U			4	U			4	U			4	U			4	U			4	U			4	U			4	U
Alkalinity	mg/L	3020				1570				1020				1040				649				457				284				82.3				91.5							
Ammonia	mg/L	182				94.2				58.2				73.5				39.8				20.6				6.41				9.54				10.8							
BOD	mg/L			1755								580				710				250				110				40	U			64				73				64	
Chloride	mg/L	437				83.2	J			65.7	J			10.2	J			5.8	J			5.4	J			5.4	J			5.5	J			5.8	J						
Fluoride	mg/L	104				67.1				55.2				56.3				20.5				8.7				1.7	J			1.5	J			1.1	J						
Hardness	mg/L			3270				2320				1760				1340				963				925				736				777				832					
Nitrate/Nitrite	mg/L	50	U			500	U			500	U			50	U			50	U			50	U			50	U			50	U			50	U						
Nitrate	mg/L													5	U																										
Nitrite	mg/L													5	U																										
Orthophosphate	mg/L	10.6				2.9				37.7				58.2				24.5				16.4				6.36				8.96				3.54				3.43			
Sulfate	mg/L	924				840				701				378				527				682				626				552				587							
Sulfide	mg/L											12				46				61				25				7.4				19				6				18	

Notes:

INF = Adit influent to treatment system; BCRX = Biochemical reactor barrel effluent; SAPS = Successive alkalinity producing system pre-treatment to BCR2;

CHIT = Chitorem pre-treatment to BCR3; NAOH = Sodium hydroxide pre-treatment to BCR4; POSTI = Combined four BCR effluents into post-treatment system; POSTE = Effluent from post-treatment system

Q = Qualifier; U = Result below method reporting limit shown; J = estimated result; D = dissolved fraction; T = total fraction

µg/L = micrograms per liter; mg/L = milligrams per liter

BOD= Biological oxygen demand

Table 4.2-1
Danny T Treatability Study Year 2: Analytical Laboratory Data
Barker-Hughesville Mining District Superfund Site

	Location	SAPS																																							
	Sample ID	14BH-DT-PILOT-SAPS-061114				14BH-DT-PILOT-SAPS-062414				14BH-DT-PILOT-SAPS-070814				14BH-DT-PILOT-SAPS-072214				14BH-DT-PILOT-SAPS-080614				14BH-DT-PILOT-SAPS-081914				14BH-DT-PILOT-SAPS-090214				14BH-DT-PILOT-SAPS-091614				14BH-DT-PILOT-SAPS-092314				14BH-DT-PILOT-SAPS-092914			
	Sample Date	6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014				8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
	Fraction	D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Metals																																									
Aluminum	µg/L	500	U	500	U	250	U	250	U	142	J	159	J	321		587		554		1650		394		494		464		575		304		894		411		498		732		856	
Antimony	µg/L																																					2	J	2	J
Arsenic	µg/L	17.4	J	16.8	J	19.7	J	19.9	J	36.2		38.8	J	9.62	J	10.7	J	20	U	200	U	5.75	J	5.41	J	20	U	20	U	5.35	J	20	U	20	U	20	U	3.1		3.1	
Barium	µg/L																																					45.6		46.5	
Beryllium	µg/L																																					0.77	J	0.92	J
Cadmium	µg/L	5.25		6.66		2	U	2.18		2	U	2	U	2	U	2	U	2	U	20	U	2	U	2	U	2	U	2	U	2	U	1.2	J	2	U	2	U	2.2		1.9	
Calcium	µg/L																																					225000		250000	
Chromium	µg/L																																					4.9		10.4	
Cobalt	µg/L																																					36.9		24	
Copper	µg/L	44		77.7		10	U	8.61	J	10	U	5.4	J	10	U	10	UJ	10	U	100	U	5.34	J	10	U	10	U	5.52	J	5.08	J	11.8	J	5.41	J	6.26	J	2	J	13.1	
Iron	µg/L	6260		6390		26800		26100		107000		103000		112000		118000		107000		109000		111000		108000		81900		80200		88600		88100		101000		103000		111000		114000	
Lead	µg/L	2	U	1.75	J	2	U	2	U	2	U	10.5		2	U	1.32	J	2	U	20	U	2	U	2	U	2	U	2	U	2	U	1.3	J	2	U	2	U	0.21	J	1.8	
Magnesium	µg/L																																					26300		25300	
Manganese	µg/L	28200		28900		75900		74600		111000		112000		118000		118000		118000		119000		108000		107000		84800		85500		84300		84400		92500		93600		89600		91500	
Nickel	µg/L	10	U	10	U	27.1		10	U	19		11.3		7.19	J	9.74	J	15		100	U	19.9		21.4		26.7		26.8		18.2		26.2	J	21		18.3	J	71.3		65.5	
Potassium	µg/L																																					1550		1540	
Selenium	µg/L																																					5	J	5	J
Silver	µg/L																																					2.3		1	J
Sodium	µg/L																																					5290		5100	
Thallium	µg/L																																					0.21	J	0.24	J
Vanadium	µg/L																																					5	U	5	U
Zinc	µg/L	2260		2480		6280		5950		16100		18300		5520		7180		18200		18300		27200		25800		25600		26400		27100		26800		33900		33600		38100		39300	
Wet Chemistry																																									
Acidity	mg/L			4	U			15				260				300				400				410				280				280				320				380	
Alkalinity	mg/L	481	J			500	U			500	U			138				82.5				97.8				85.8	J			12.5				17.3							
Ammonia	mg/L																																								
BOD	mg/L																																								
Chloride	mg/L	60.8				11.6	J			7.4	J			7.1	J			5.7	J			5.4	J			5.4	J			6.2	J			5.5	J						
Fluoride	mg/L	5				1	J			3.6				2.2				2				1.6	J			1.8	J			1.5	J			1.5	J						
Hardness	mg/L			987				903				802				677				640				622				531				601				638					
Nitrate/Nitrite	mg/L	50	U			50	U			50	U			50	U			50	U			50	U			50	U			50	U			50	U						
Nitrate	mg/L													5	U																										
Nitrite	mg/L													5	U																										
Orthophosphate	mg/L	3.1				0.2				0.166				0.3				0.1				0.079				0.049				0.115				0.068				0.07			
Sulfate	mg/L	1060				1130				1030				939				1040				1000				806				856				948							
Sulfide	mg/L																																								

Notes:

INF = Adit influent to treatment system; BCRX = Biochemical reactor barrel effluent; SAPS = Successive alkalinity producing system pre-treatment to BCR2;

CHIT = Chitorem pre-treatment to BCR3; NAOH = Sodium hydroxide pre-treatment to BCR4; POSTI = Combined four BCR effluents into post-treatment system; POSTE = Effluent from post-treatment system

Q = Qualifier; U = Result below method reporting limit shown; J = estimated result; D = dissolved fraction; T = total fraction

µg/L = micrograms per liter; mg/L = milligrams per liter

BOD= Biological oxygen demand

Table 4.2-1
Danny T Treatability Study Year 2: Analytical Laboratory Data
Barker-Hughesville Mining District Superfund Site

Location		BCR2																																							
Sample ID		14BH-DT-PILOT-BCR2-061114				14BH-DT-PILOT-BCR2-062414				14BH-DT-PILOT-BCR2-070814				14BH-DT-PILOT-BCR2-072214				14BH-DT-PILOT-BCR2-080614				14BH-DT-PILOT-BCR2-081914				14BH-DT-PILOT-BCR2-090214				14BH-DT-PILOT-BCR2-091614				14BH-DT-PILOT-BCR2-092314				14BH-DT-PILOT-BCR2-092914			
Sample Date		6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014				8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
Fraction		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Metals																																									
Aluminum	µg/L	282	J	1340		129		304		81.2		161		250	U	148	J	250	U	250	U	250	U	100	J	126	J	113	J	250	U	250	U	250	U	250	U	9.6	J	24.9	
Antimony	µg/L																																					2	J	2	J
Arsenic	µg/L	15.6	J	200	U	12.4	J	17.1	J	20	U	19.3	J	20	U	7.73	J	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	1.2		1.9	
Barium	µg/L																																					219		211	
Beryllium	µg/L																																					1	U	1	U
Cadmium	µg/L	2	U	20	U	1.1	J	3.01		2	U	1.21	J	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	1	U	0.046	J
Calcium	µg/L																																					240000		241000	
Chromium	µg/L																																					1.9	J	11.5	
Cobalt	µg/L																																					0.86	J	0.7	J
Copper	µg/L	20.2		271		35.2		80		10	U	25.6		5.43	J	11.7		5.09	J	10	U	5.36	J	10	U	10	U	10	U	5.93	J	10	U	6.19	J	10	U	2	U	2	J
Iron	µg/L	1030	J	3400		1470		2530		250	U	1000		1250	U	615	J	1250	U	657	J	533	J	710	J	1730		1770		1250	U	1250	U	1250	U	1250	U	876		1210	
Lead	µg/L	2.61		55.7	J	2.95		10.7		2	U	7.48		2	U	5.73		2	U	1.09	J	2	U	1	J	2	U	2	U	2	U	1.19	J	2	U	2	U	0.045	J	1.1	
Magnesium	µg/L																																					24200		23800	
Manganese	µg/L	3980		5300		4010		4320		17200		19500		46300		48500		88000		94800		102000		106000		107000		112000		96000		98900		90200		93200		79000		83600	
Nickel	µg/L	29.3		100	U	12		5.54	J	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	5.59	J	10	U	10	U	10	U	10	U	10	U	4.6		13.2	
Potassium	µg/L																																					2450		2480	
Selenium	µg/L																																					5	J	8.4	
Silver	µg/L																																					1	U	1	U
Sodium	µg/L																																					5050		5000	
Thallium	µg/L																																					1	U	1	U
Vanadium	µg/L																																					0.19	J	5	U
Zinc	µg/L	165	J	1370		268		670		46.8		2100		100	U	326		100	U	62.4	J	100	U	102		100	U	125		100	U	514		100	U	160		39.9		288	
Wet Chemistry																																									
Acidity	mg/L			4	U			4	U			4	U			4	U			4	U			4	U			30				4	U			4	U			4	U
Alkalinity	mg/L	1630				927				685				650				399				314				229				61.1				61.7							
Ammonia	mg/L	80.9				38.8				14.6				11.4				7.74				5.98				2.59				2.39				2.45							
BOD	mg/L			1758								363	U			280				121	U			83	U			40	U			54				60				42	
Chloride	mg/L	425				137	J			85.7	J			10.9	J			6	J			5.5	J			5.4	J			5.3	J			6	J						
Fluoride	mg/L	54.5				20	U			30.3				15.8				4.9				1.6	J			1.5	J			1.5	J			1.5	J						
Hardness	mg/L			1600				1300				1220				895				774				746				734				653				662					
Nitrate/Nitrite	mg/L	50	U			500	U			500	U			50	U			50	U			50	U			50	U			50	U			50	U						
Nitrate	mg/L													5	U																										
Nitrite	mg/L													5	U																										
Orthophosphate	mg/L	73.8				41				24				14.4				6.9				2.84				2.28				2.71				1.78				1.51			
Sulfate	mg/L	960				824				562				349				615				688				753				566				560							
Sulfide	mg/L											30				45				31				12				16.4				29				10				20	

Notes:

INF = Adit influent to treatment system; BCRX = Biochemical reactor barrel effluent; SAPS = Successive alkalinity producing system pre-treatment to BCR2;

CHIT = Chitorem pre-treatment to BCR3; NAOH = Sodium hydroxide pre-treatment to BCR4; POSTI = Combined four BCR effluents into post-treatment system; POSTE = Effluent from post-treatment system

Q = Qualifier; U = Result below method reporting limit shown; J = estimated result; D = dissolved fraction; T = total fraction

µg/L = micrograms per liter; mg/L = milligrams per liter

BOD= Biological oxygen demand

Table 4.2-1
Danny T Treatability Study Year 2: Analytical Laboratory Data
Barker-Hughesville Mining District Superfund Site

Location		CHIT																																							
Sample ID		14BH-DT-PILOT-CHIT-061114				14BH-DT-PILOT-CHIT-062414				14BH-DT-PILOT-CHIT-070814				14BH-DT-PILOT-CHIT-072214				14BH-DT-PILOT-CHIT-080614				14BH-DT-PILOT-CHIT-081914				14BH-DT-PILOT-CHIT-090214				14BH-DT-PILOT-CHIT-091614				14BH-DT-PILOT-CHIT-092314				14BH-DT-PILOT-CHIT-092914			
Sample Date		6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014				8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
Fraction		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Metals																																									
Aluminum	µg/L	94.5		211		50	U	50	U	50	U	50	U	277		298		173	J	219	J	144	J	155	J	428		5400		250	U	6740		626		12400		2300		17600	
Antimony	µg/L																																					2	J	2	J
Arsenic	µg/L	48.5		52		23.6		18.5	J	7.06	J	7.06	J	20	U	6.36	J	20	U	20	U	20	U	20	U	20	U	15.8	J	7.97	J	21.9		20	U	12.5	J	2.8		12	
Barium	µg/L																																					20.8		46.5	
Beryllium	µg/L																																					1.8		8.1	
Cadmium	µg/L	2	U	2	U	2	U	2	U	2	U	1.69	J	2	U	1.86	J	2	U	2	U	2	U	2	U	2	U	53.5		2	U	77.1		2	U	54.5		0.27	J	256	
Calcium	µg/L																																					221000		220000	
Chromium	µg/L																																					1.9	J	10.5	
Cobalt	µg/L																																					26.1		12.7	
Copper	µg/L	24.3		22.7		10.8		14.9		10	U	8.24	J	10	U	6.58	J	10	U	7.05	J	10	U	10	U	10	U	172		10	U	299		10	U	179	J	2	J	363	
Iron	µg/L	407		2250		2300		2700		5000		6170		4310		2950		2320		5830		1620		5120		31500		49900		3120		51400		59100		87700		74900		98500	
Lead	µg/L	2	U	1.27	J	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	48		2	U	55.3		2	U	39.1		0.2	J	174	
Magnesium	µg/L																																					30100		29300	
Manganese	µg/L	2110		2570		13200		13600		30300		33200		96300		95700		79400		81200		69000		70500		66300		69500		63400		72900		90800		95800		87700		92800	
Nickel	µg/L	10	U	10	U	29.1		10	U	10	U	10	U	10	U	11.8	J	10	U	10	U	10	U	10	U	11.3		13.6		10	U	10	U	6.64	J	11.2	J	24.5		48	
Potassium	µg/L																																					1100		1210	
Selenium	µg/L																																					5	J	6.6	
Silver	µg/L																																					1.5		1	J
Sodium	µg/L																																					6520		6390	
Thallium	µg/L																																					1	U	1.9	
Vanadium	µg/L																																					0.27	J	4.2	J
Zinc	µg/L	205		401		35.2		63		30.2		298		297		887		100	U	404		100	U	586		53	J	15900		100	U	22600		100	U	31300		14100		61700	
Wet Chemistry																																									
Acidity	mg/L			4	U			4	U			4	U			4	U			4	U			4	U			58				4	U			200				320	
Alkalinity	mg/L	894				1330				2270				1500				1230				621				155				107				28.1							
Ammonia	mg/L																																								
BOD	mg/L																																								
Chloride	mg/L	163				83.7	J			200	U			7.2	J			6.3	J			5.5	J			5.4	J			5.7	J			5.4	J						
Fluoride	mg/L	9				44.2				139				59.7				64.7				13.9				2.5				1.2	J			3.1							
Hardness	mg/L			1140				2130				2920				2010				1620				958				585				871				637					
Nitrate/Nitrite	mg/L	50	U			500	U			500	U			50	U			50	U			50	U			50	U			50	U			50	U						
Nitrate	mg/L													5	U																										
Nitrite	mg/L													5	U																										
Orthophosphate	mg/L	0.09				0.3				3.97				5.93				26.9				20.6				0.066				7.64				0.033				0.053			
Sulfate	mg/L	974				932				1020				778				653				623				663				543				808							
Sulfide	mg/L																																								

Notes:

INF = Adit influent to treatment system; BCRX = Biochemical reactor barrel effluent; SAPS = Successive alkalinity producing system pre-treatment to BCR2;

CHIT = Chitorem pre-treatment to BCR3; NAOH = Sodium hydroxide pre-treatment to BCR4; POSTI = Combined four BCR effluents into post-treatment system; POSTE = Effluent from post-treatment system

Q = Qualifier; U = Result below method reporting limit shown; J = estimated result; D = dissolved fraction; T = total fraction

µg/L = micrograms per liter; mg/L = milligrams per liter

BOD= Biological oxygen demand

Table 4.2-1

Danny T Treatability Study Year 2: Analytical Laboratory Data

Barker-Hughesville Mining District Superfund Site

Location		BCR3																																							
Sample ID		14BH-DT-PILOT-BCR3-061114				14BH-DT-PILOT-BCR3-062414				14BH-DT-PILOT-BCR3-070814				14BH-DT-PILOT-BCR3-072214				14BH-DT-PILOT-BCR3-080614				14BH-DT-PILOT-BCR3-081914				14BH-DT-PILOT-BCR3-090214				14BH-DT-PILOT-BCR3-091614				14BH-DT-PILOT-BCR3-092314				14BH-DT-PILOT-BCR3-092914			
Sample Date		6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014				8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
Fraction		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Metals																																									
Aluminum	µg/L	279	J	1500		127		133		37.9	J	26.2	J	50	U	50	U	50	U	50	U	175	J	181	J	148	J	175	J	250	U	250	U	250	U	116	J	5.5	J	11.8	J
Antimony	µg/L																																					2	J	2	J
Arsenic	µg/L	174		180		46.4		31		26		29.3	J	16.2	J	19.7	J	10.4	J	12.2	J	6.81	J	8.3	J	20	U	8.6	J	5.37	J	20	U	6.56	J	7.09	J	4.3		4.3	
Barium	µg/L																																					105		107	
Beryllium	µg/L																																					1	U	1	U
Cadmium	µg/L	2	U	4.87		2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	1	U	1	U
Calcium	µg/L																																					282000		281000	
Chromium	µg/L																																					0.98	J	1.7	J
Cobalt	µg/L																																					2.7		0.88	J
Copper	µg/L	22.7		144		12.9		39.5		17		36.2		5.69	J	9.34	J	9.81	J	7.47	J	13.9		10	U	5.48	J	10	U	7.39	J	10	U	7.69	J	10	U	0.57	J	1.2	J
Iron	µg/L	1320	J	3530		2060		1990		2070		2510		250	U	152	J	250	U	250	U	1250	U	1250	U	1250	U	1250	U	1250	U	1250	U	1250	U	1250	U	1810		1940	
Lead	µg/L	2.19		33.6	J	2	U	4.07		1.04	J	6.88		2	U	1.97	J	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	0.062	J	0.36	J
Magnesium	µg/L																																					27400		27500	
Manganese	µg/L	4010		4700		4380		4490		9710		9760		11900		13000		39300		41000		39800		40600		46800		47400		48100		48500		54100		56000		66000		66400	
Nickel	µg/L	27		29.5		51.8		10	U	10	U	10	U	10	U	29.3	J	10	U	10	U	10	U	6.41	J	10	U	5.85	J	10	U	10	U	10	U	10	U	3.6		3.4	
Potassium	µg/L																																					1740		1750	
Selenium	µg/L																																					19		37.7	
Silver	µg/L																																					1	U	1	U
Sodium	µg/L																																					6770		6780	
Thallium	µg/L																																					1	U	1	U
Vanadium	µg/L																																					0.63	J	0.97	J
Zinc	µg/L	155	J	693		63.6		121		95.7		116		40.8		162		44.6		108		100	U	56	J	100	U	100	U	100	U	100	U	100	U	100	U	7.4		11.8	
Wet Chemistry																																									
Acidity	mg/L			4	U			4	U			4	U			4	U			4	U			4	U			4	U			4	U			4	U			4	U
Alkalinity	mg/L	1670				1140				2490				2450				1950				1330				588				116				141							
Ammonia	mg/L	127				80.8				199				172				117				79.8				21.9				14.4				16							
BOD	mg/L			1758								1400				1300				710				390				120				130				140				110	
Chloride	mg/L	652				186	J			110	J			15.5	J			5.9	J			5.5	J			5.3	J			5.5	J			5.4	J						
Fluoride	mg/L	71.7				20	U			134				90.1				63.1				29.1				3.8				3				2	U						
Hardness	mg/L			1870				1570				2520				2410				2060				1300				896				798				767					
Nitrate/Nitrite	mg/L	50	U			500	U			500	U			50	U			50	U			50	U			50	U			50	U			50	U						
Nitrate	mg/L													5	U																										
Nitrite	mg/L													5	U																										
Orthophosphate	mg/L	55.9				39.7				19.1				11.6				10.7				19.1				16.2				14.7				11.7				10.3			
Sulfate	mg/L	912				838				376				299				311				270				464				352				237							
Sulfide	mg/L											41				120				82				80				46				53				67				59	

Notes:

INF = Adit influent to treatment system; BCRX = Biochemical reactor barrel effluent; SAPS = Successive alkalinity producing system pre-treatment to BCR2;

CHIT = Chitorem pre-treatment to BCR3; NAOH = Sodium hydroxide pre-treatment to BCR4; POSTI = Combined four BCR effluents into post-treatment system; POSTE = Effluent from post-treatment system

Q = Qualifier; U = Result below method reporting limit shown; J = estimated result; D = dissolved fraction; T = total fraction

µg/L = micrograms per liter; mg/L = milligrams per liter

BOD= Biological oxygen demand

Table 4.2-1
Danny T Treatability Study Year 2: Analytical Laboratory Data
Barker-Hughesville Mining District Superfund Site

	Location	NAOH																																							
	Sample ID	14BH-DT-PILOT-NAOH-061114				14BH-DT-PILOT-NAOH-062414				14BH-DT-PILOT-NOAH-070814				14BH-DT-PILOT-NAOH-072214				14BH-DT-PILOT-NAOH-080614				14BH-DT-PILOT-NAOH-081914				14BH-DT-PILOT-NAOH-090214				14BH-DT-PILOT-NAOH-091614				14BH-DT-PILOT-NAOH-092314				14BH-DT-PILOT-NAOH-092914			
	Sample Date	6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014				8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
	Fraction	D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Metals																																									
Aluminum	µg/L	5530		5740		11100		11200		13600		13500		12900		13300		4380		4990		912		1300		250	U	824		236	J	479		8540		9030		7120		7810	
Antimony	µg/L																																					2	J	2	J
Arsenic	µg/L	14.7	J	57.6		20	U	16.2	J	5.61	J	19.7	J	20	U	17.2	J	20	U	200	U	20	U	8.38	J	20	U	18.1	J	20	U	10.8	J	5.2	J	32.8		32.8		62.4	
Barium	µg/L																																					4	J	3.8	J
Beryllium	µg/L																																					4.5		4.5	
Cadmium	µg/L	256		249		264		259		294		283		285		272		251		255		147		145		77.2		83.1		2	U	4.25		210		216		236		234	
Calcium	µg/L																																					97100		99400	
Chromium	µg/L																																					1.8	J	2.1	
Cobalt	µg/L																																					42.2		40.9	
Copper	µg/L	787		712		799		878		1260		1040		911		820	J	660		785		87.7		125		6.85	J	73.1		5.29	J	26.5		647		696		696		724	
Iron	µg/L	31700		53800		17200		25000		23300		34800		563	J	16900		1250	U	9280		1740		9670		1250	U	7940		1250	U	6230		981	J	25500		51700		66500	
Lead	µg/L	72.7		80.9	J	135		119		123		175		86.7		105		5.6		20	U	2	U	5.79		2	U	15.9		2	U	4.32		33.5		72.4		72.4		88.7	
Magnesium	µg/L																																					24300		24000	
Manganese	µg/L	99100		99000		104000		103000		112000		110000		112000		115000		105000		108000		91200		91000		58100		59300		24.8	J	2520		89500		91500		108000		109000	
Nickel	µg/L	27.1		24.1		51.3		21.6		27		21.3		19.4		22.5	J	19.7		100	U	13.7		13.9		13.7		14.2		10	U	10	U	21.1		22.5		29.9		35.7	
Potassium	µg/L																																					734		748	
Selenium	µg/L																																					1.4	J	5	U
Silver	µg/L																																					1	J	1	J
Sodium	µg/L																																					141000		141000	
Thallium	µg/L																																					2		1.9	
Vanadium	µg/L																																					0.45	J	0.95	J
Zinc	µg/L	56200		55600		59900		58700		64100		62000		63000		64900		56400		57600		28200		27900		11000		12200		57.6	J	1130		47700		47300		43700		43700	
Wet Chemistry																																									
Acidity	mg/L			270				430				340				390				320				260				120				4	U			340				480	
Alkalinity	mg/L	500	U			500	U			500	U			100	U			100	U			10	U			100	U			34.7				10	U						
Ammonia	mg/L																																								
BOD	mg/L																																								
Chloride	mg/L	7.7	J			6.9	J			6.9	J			7.1	J			5.3	J			5.4	J			5.4	J			5.4	J			5.4	J						
Fluoride	mg/L	2.2				2.5				2.6				2.7				2.2				1.1	J			1.3	J			2				2							
Hardness	mg/L			367				365				371				358				343				308				226				138				317					
Nitrate/Nitrite	mg/L	50	U			50	U			50	U			50	U			50	U			50	U			50	U			50	U			50	U						
Nitrate	mg/L													5	U																										
Nitrite	mg/L													5	U																										
Orthophosphate	mg/L	0.038				0.1	U			0.036				0.013				0.01	U			0.005	U			0.005	U			0.014				0.005				0.036			
Sulfate	mg/L	1040				1050				1160				1250				1120				1010				819				883				976							
Sulfide	mg/L																																								

Notes:

INF = Adit influent to treatment system; BCRX = Biochemical reactor barrel effluent; SAPS = Successive alkalinity producing system pre-treatment to BCR2;

CHIT = Chitorem pre-treatment to BCR3; NAOH = Sodium hydroxide pre-treatment to BCR4; POSTI = Combined four BCR effluents into post-treatment system; POSTE = Effluent from post-treatment system

Q = Qualifier; U = Result below method reporting limit shown; J = estimated result; D = dissolved fraction; T = total fraction

µg/L = micrograms per liter; mg/L = milligrams per liter

BOD= Biological oxygen demand

Table 4.2-1
Danny T Treatability Study Year 2: Analytical Laboratory Data
Barker-Hughesville Mining District Superfund Site

Location		BCR4																																							
Sample ID		14BH-DT-PILOT-BCR4-061114				14BH-DT-PILOT-BCR4-062414				14BH-DT-PILOT-BCR4-070814				14BH-DT-PILOT-BCR4-072214				14BH-DT-PILOT-BCR4-080614				14BH-DT-PILOT-BCR4-081914				14BH-DT-PILOT-BCR4-090214				14BH-DT-PILOT-BCR4-091614				14BH-DT-PILOT-BCR4-092314				14BH-DT-PILOT-BCR4-092914			
Sample Date		6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014				8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
Fraction		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Metals																																									
Aluminum	µg/L	460	J	1100		108	J	169	J	133	J	654		250	U	148	J	250	U	105	J	250	U	250	U	304		250	U	250	U	250	U	250	U	250	U	4.2	J	21.2	
Antimony	µg/L																																					2	U	2	J
Arsenic	µg/L	29.5		35.4		9.03	J	17	J	20	U	17.4	J	20	U	14.4	J	20	U	7.65	J	5.38	J	9.17	J	20	U	20	U	20	U	20	U	20	U	5.98	J	1	U	9.2	
Barium	µg/L																																					0.19	J	108	
Beryllium	µg/L																																					1	U	1	U
Cadmium	µg/L	12.5		38		4.51		13.2		2	U	13.8		2	U	2.25		2	U	2	U	2	U	1.11	J	2	U	1.39	J	2	U	2	U	2	U	2.27		1	U	2.4	
Calcium	µg/L																																					956		107000	J
Chromium	µg/L																																					2	U	12.2	
Cobalt	µg/L																																					0.21	J	1.3	
Copper	µg/L	63.3		194		15.9		40.2		10	U	49.6		6	J	8.53	J	7.04	J	6.8	J	12.8		9.19	J	10	U	5.44	J	6.29	J	7.35	J	7.68	J	10.6		2	U	6	
Iron	µg/L	1310	J	3230		1440		1490		1030	J	2070		1250	U	578	J	1250	U	1250	U	1250	U	1250	U	1250	U	1250	U	1250	U	1250	U	1250	U	1250	U	496		442	
Lead	µg/L	16.2		43.8	J	2.12		3.87		2	U	8.54		2	U	3.67		2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	1	U	0.48	J
Magnesium	µg/L																																					106	J	18400	
Manganese	µg/L	9680		10800		10700		11100		61800		64700		62800		67700		99300		105000		72100		71900		71100		74100		55600		58200		55500		57000		366		67000	
Nickel	µg/L	25		29.3		31.1		10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	0.26	J	24.8	
Potassium	µg/L																																					500	U	1740	
Selenium	µg/L																																					5	U	1.9	J
Silver	µg/L																																					1	J	1	J
Sodium	µg/L																																					36.4	J	226000	
Thallium	µg/L																																					1	U	1	U
Vanadium	µg/L																																					5	U	5	U
Zinc	µg/L	1920		3340		734		1700		271		7400		324		3180		205		1290		137		1040		88.9	J	772		50.4	J	468		159		938		158		970	
Wet Chemistry																																									
Acidity	mg/L			4	U			4	U			4	U			4	U			4	U			4	U			4	U			4	U			4	U			4	U
Alkalinity	mg/L	1540				569				404	J			507				461				451				176				51				58.5							
Ammonia	mg/L	52.6				12.1				4.55				7.65				6				5.52				1.33				1.27				1.56							
BOD	mg/L			1749								363	U			200				121	U			84				40	U			67				87				70	
Chloride	mg/L	382				80.8	J			68.5	J			9.8	J			5.4	J			5.4	J			5.4	J			5.4	J			5.4	J						
Fluoride	mg/L	32.5				20	U			18	J			10.8				2.2				2.1				1.6	J			1.8	J			1.7	J						
Hardness	mg/L			1040				868				754				552				599				418				355				284				289					
Nitrate/Nitrite	mg/L	50	U			500	U			500	U			50	U			50	U			50	U			50	U			50	U			50	U						
Nitrate	mg/L													5	U																										
Nitrite	mg/L													5	U																										
Orthophosphate	mg/L	43				28.2				13.6				7.1				2.5				2.2				1.23				1.28				1.63				5.79			
Sulfate	mg/L	1030				862				724				526				628				630				732				642				636							
Sulfide	mg/L											5				48				35				68				18				35				39				34	

Notes:

INF = Adit influent to treatment system; BCRX = Biochemical reactor barrel effluent; SAPS = Successive alkalinity producing system pre-treatment to BCR2;

CHIT = Chitorem pre-treatment to BCR3; NAOH = Sodium hydroxide pre-treatment to BCR4; POSTI = Combined four BCR effluents into post-treatment system; POSTE = Effluent from post-treatment system

Q = Qualifier; U = Result below method reporting limit shown; J = estimated result; D = dissolved fraction; T = total fraction

µg/L = micrograms per liter; mg/L = milligrams per liter

BOD= Biological oxygen demand

Table 4.2-1

Danny T Treatability Study Year 2: Analytical Laboratory Data

Barker-Hughesville Mining District Superfund Site

Location		POSTI															
Sample ID		14BH-DT-PILOT-POSTI-062414				14BH-DT-PILOT-POSTI-070814				14BH-DT-PILOT-POSTI-072214				14BH-DT-PILOT-POSTI-080614			
Sample Date		6/24/2014				7/8/2014				7/22/2014				8/6/2014			
Fraction		D		T		D		T		D		T		D		T	
Analyte	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Metals																	
Aluminum	µg/L	49.9	J	102		33.9	J	108		29.1	J	66.7		250	U	138	J
Antimony	µg/L																
Arsenic	µg/L	14.3	J	18.2	J	9.21	J	200	UJ	5.88	J	9.52	J	20	U	200	U
Barium	µg/L																
Beryllium	µg/L																
Cadmium	µg/L	1.57	J	4.33		2	U	20	U	2	U	1.16	J	2	U	20	U
Calcium	µg/L																
Chromium	µg/L																
Cobalt	µg/L																
Copper	µg/L	13.3		38.5		10	U	100	U	5.52	J	6.12	J	5.72	J	100	U
Iron	µg/L	863		1340		250	U	4550		250	U	493		1250	U	1250	U
Lead	µg/L	2	U	3.25		2	U	20	U	1.48	J	2.62		2	U	20	U
Magnesium	µg/L																
Manganese	µg/L	5490		5520		37400		41000		42100		46100		83800		85400	
Nickel	µg/L	25.6		10	U	10	U	100	U	10	U	10	UJ	10	U	100	U
Potassium	µg/L																
Selenium	µg/L																
Silver	µg/L																
Sodium	µg/L																
Thallium	µg/L																
Vanadium	µg/L																
Zinc	µg/L	281		626		29.4		3080		31.3		857		100	U	263	
Wet Chemistry																	
Acidity	mg/L			4	U			4	U			4	U			4	U
Alkalinity	mg/L	949				1190				1040				742			
Ammonia	mg/L	51.2				70.8				58.6				35.8			
BOD	mg/L							540				550				310	
Chloride	mg/L	90.4	J			77.1	J			10.5	J			5.6	J		
Fluoride	mg/L	20	U			63.9				42.3				19.6			
Hardness	mg/L			1440				1540				1300				997	
Nitrate/Nitrite	mg/L	500	U			500	U			50	U			50	U		
Nitrate	mg/L									5	U						
Nitrite	mg/L									5	U						
Orthophosphate	mg/L	26.2				20.6				25.5				13.5			
Sulfate	mg/L	831				603				424				546			
Sulfide	mg/L							27				53				33	

Location		POSTI																	
Sample ID		14BH-DT-PILOT-POSTI-081914				14BH-DT-PILOT-POSTI-090214				14BH-DT-PILOT-POSTI-091614		14BH-DT-PILOT-POSTI-092314				14BH-DT-PILOT-POSTI-092914			
Sample Date		8/19/2014				9/2/2014				9/16/2014		9/23/2014				9/29/2014			
Fraction		D		T		D		T		T		D		T		D		T	
Analyte	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Metals																			
Aluminum	µg/L	118	J	134	J	250	U	130	J	250	U	250	U	250	U	9	J	16.8	J
Antimony	µg/L															2	J	2	J
Arsenic	µg/L	20	U	20	U	20	U	20	U	20	U	5.53	J	20	U	1.7		2.9	
Barium	µg/L															159		161	
Beryllium	µg/L															1	U	1	U
Cadmium	µg/L	2	U	2	U	2	U	2	U	2	U	2	U	2	U	1	U	0.61	J
Calcium	µg/L															239000		238000	
Chromium	µg/L															0.79	J	1.1	J
Cobalt	µg/L															4.3		0.82	J
Copper	µg/L	7.85	J	10	U	10	U	10	U	5.07	J	6.84	J	10	U	2	U	1.7	J
Iron	µg/L	1250	U	1250	U	1720		2520		1250	U	1250	U	1250	U	1770		2140	
Lead	µg/L	2	U	2	U	2	U	2	U	2	U	2	U	2	U	0.045	J	0.37	J
Magnesium	µg/L															24300		24900	
Manganese	µg/L	76500		77400		80700		79900		77000		69500		73800		84700		84000	
Nickel	µg/L	10	U	10	U	10	U	10	U	10	U	10	U	10	U	3.2		2.8	
Potassium	µg/L															1750		1780	
Selenium	µg/L															10.1		15.4	
Silver	µg/L															1	U	1	U
Sodium	µg/L															64200		63400	
Thallium	µg/L															1	U	1	U
Vanadium	µg/L															0.56	J	0.73	J
Zinc	µg/L	100	U	326		100	U	268		191		100	U	346		16.3		360	
Wet Chemistry																			
Acidity	mg/L			4	U			4	U	4	U			4	U			4	U
Alkalinity	mg/L	611				307						89.4							
Ammonia	mg/L	26.6				8.09						7.9							
BOD	mg/L			120				44		67				77				62	
Chloride	mg/L	5.3	J			5.3	J					5.4	J						
Fluoride	mg/L	9.4				2.2						2	U						
Hardness	mg/L			813				676						629					
Nitrate/Nitrite	mg/L	50	U			50	U					50	U						
Nitrate	mg/L																		
Nitrite	mg/L																		
Orthophosphate	mg/L	9.8				6.44						5.25				4.67			
Sulfate	mg/L	559				662						488							
Sulfide	mg/L			48				12		30				32				33	

Notes:

INF = Adit influent to treatment system; BCRX = Biochemical reactor barrel effluent; SAPS = Successive alkalinity producing system pre-treatment to BCR2;

CHIT = Chitorem pre-treatment to BCR3; NAOH = Sodium hydroxide pre-treatment to BCR4; POSTI = Combined four BCR effluents into post-treatment system; POSTE = Effluent from post-treatment system

Q = Qualifier; U = Result below method reporting limit shown; J = estimated result; D = dissolved fraction; T = total fraction

µg/L = micrograms per liter; mg/L = milligrams per liter

BOD= Biological oxygen demand

Table 4.2-1
Danny T Treatability Study Year 2: Analytical Laboratory Data
Barker-Hughesville Mining District Superfund Site

Location		POSTE																																	
Sample ID		14BH-DT-PILOT-POSTE-062414				14BH-DT-PILOT-POSTE-070814				14BH-DT-PILOT-POSTE-072214				14BH-DT-PILOT-POSTE-080614				14BH-DT-PILOT-POSTE-081914				14BH-DT-PILOT-POSTE-090214				14BH-DT-PILOT-POSTE-091614		14BH-DT-PILOT-POSTE-092314				14BH-DT-PILOT-POSTE-092914			
Sample Date		6/24/2014				7/8/2014				7/22/2014				8/6/2014				8/19/2014				9/2/2014				9/16/2014		9/23/2014				9/29/2014			
Fraction		D		T		D		T		D		T		D		T		D		T		D		T		T		D		T		D		T	
Analyte	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Metals																																			
Aluminum	µg/L	89.3		246		70.2		138		50	U	590		50	U	329		119	J	174	J	250	U	145	J	3960		250	U	250	U	2.9	J	6.6	J
Antimony	µg/L																															2	J	2	J
Arsenic	µg/L	49.9		65.3		16.9	J	36.5	J	16.5	J	22.4		14.1	J	200	U	12	J	11.5	J	5.2	J	20	U	41.5		8.25	J	8.71	J	5.4		5.6	
Barium	µg/L																															87.8		92	
Beryllium	µg/L																															1	U	1	U
Cadmium	µg/L	2	U	5.75		1.75	J	2.95		2	U	2	U	2	U	20	U	2	U	2	U	2	U	2	U	3.43		2	U	2	U	1	U	0.073	J
Calcium	µg/L																															247000		238000	
Chromium	µg/L																															0.31	J	0.51	J
Cobalt	µg/L																															3.2		0.75	J
Copper	µg/L	8.48	J	48.3		5.78	J	18.1		10	U	10	UJ	10	U	100	U	10	U	10	U	5.29	J	10	U	34.2		10	U	10	U	0.64	J	0.82	J
Iron	µg/L	1020		2720		974		1370		250	U	756		250	U	335		1250	U	1250	U	1250	U	1250	U	7210		1250	U	1250	U	1580		1780	
Lead	µg/L	2	U	15.8		2	U	5.61		2	U	7.81		2	U	20	U	2	U	2	U	2	U	2	U	118		2	U	1.5	J	0.096	J	0.53	J
Magnesium	µg/L																															25000		24500	
Manganese	µg/L	2910		5030		11500		11900		13100		14300		34400		36200		51100		51900		67400		69600		61300		47700		47200		58000		56800	
Nickel	µg/L	53		28.2		10	U	10	U	10	U	10	UJ	10	U	100	U	10	U	10	U	7.13	J	10	U	10	U	10	U	10	U	3.6		8.1	
Potassium	µg/L																															3570		3500	
Selenium	µg/L																															1.3	J	1.2	J
Silver	µg/L																															1	U	1	U
Sodium	µg/L																															54000		53000	
Thallium	µg/L																															1	U	1	U
Vanadium	µg/L																															0.42	J	0.54	J
Zinc	µg/L	73.8		815		1120		1440		16.3	J	347		15.1	J	169		100	U	156		100	U	92.1	J	1680		100	U	101		6.2		68.7	
Wet Chemistry																																			
Acidity	mg/L			4	U			4	U			4	U			4	U			4	U			4	U	4	U			4	U			4	U
Alkalinity	mg/L	1480				1100				893				849				726				295						75.5							
Ammonia	mg/L	51.3				46.6				41.7				29.7				25.5				7.1						6.33							
BOD	mg/L							460				280				73				87				40	U	6	U			5				2	U
Chloride	mg/L	312				85.3	J			15	J			9	J			6.6	J			5.8	J					6.3	J						
Fluoride	mg/L	57.6				38.8				11.7				2				3.5				1.5	J					1.6	J						
Hardness	mg/L			1520				1480				933				1010				891				693						629					
Nitrate/Nitrite	mg/L	500	U			500	U			50	U			50	U			50	U			50	U					50	U						
Nitrate	mg/L									5	U																								
Nitrite	mg/L									5	U																								
Orthophosphate	mg/L	4.5				5.36				4.2				2.3				1.7				1.83						1.23				0.033			
Sulfate	mg/L	888				656				264				422				539				697						543							
Sulfide	mg/L							8				3.4				5.7				1	U			0.2	U	0.2	U			0.04	U			0.06	

Notes:

INF = Adit influent to treatment system; BCRX = Biochemical reactor barrel effluent; SAPS = Successive alkalinity producing system pre-treatment to BCR2;

CHIT = Chitorem pre-treatment to BCR3; NAOH = Sodium hydroxide pre-treatment to BCR4; POSTI = Combined four BCR effluents into post-treatment system; POSTE = Effluent from post-treatment system

Q = Qualifier; U = Result below method reporting limit shown; J = estimated result; D = dissolved fraction; T = total fraction

µg/L = micrograms per liter; mg/L = milligrams per liter

BOD= Biological oxygen demand

Table 4.2-2
Danny T Treatability Study Year 2: Pilot Test Field Parameters
Barker-Hughesville Mining District Superfund Site

Parameter	Units	Location	Date																	
			6/9/2014	6/11/2014	6/17/2014	6/24/2014	7/2/2014	7/8/2014	7/15/2014	7/22/2014	7/29/2014	8/6/2014	8/12/2014	8/19/2014	8/26/2014	9/2/2014	9/9/2014	9/16/2014	9/23/2014	9/30/2014
pH	su	INF	2.76	2.83	2.85	2.67	2.4	2.45	2.53	2.58	2.46	2.69	2.56	2.59	2.68	2.59	2.56	2.64	2.43	2.57
		BCR1	7.23	7.16	6.98	6.8	6.79	6.38	5.95	6.01	6	6.05	6.05	6.08	6.19	5.99	6.1	7.07	6.5	6.2
		SAPS	6.54	6.63	6.47	5.85	5.43	5.73	5.82	5.45	5.4	5.51	5.58	5.06	5.31	5.35	5.64	5.53	5.94	5.47
		BCR2	6.78	6.68	6.68	6.46	6.62	6.29	6.18	6.26	6.02	6.07	6.02	5.94	6.07	5.92	6.11	6.72	6.53	6.2
		CHIT	8.31	8.43	7.8	7.36	6.83	6.9	6.51	6.36	6.15	6.13	6.09	5.94	6.05	5.51	5.82	6.08	5.98	5.37
		BCR3	6.87	6.66	6.62	6.45	6.68	6.7	6.56	6.64	6.67	6.57	6.60	6.57	6.55	6.3	6.39	6.82	6.67	6.48
		NAOH	7.08	3.21	4.07	3.22	2.83	3.21	2.94	4.38	2.8	5.23	3.84	5.91	2.82	5.15	5.27	11.47	4.32	3.03
		BCR4	7.11	7.01	6.81	6.57	6.54	6.35	6.29	6.45	6.24	6.43	6.51	6.24	6.41	6.23	6.52	7.04	5.96	6.66
		POSTI	7.11	7.11	7.54	7.71	6.63	6.43	6.45	6.45	6.48	6.43	6.45	6.31	6.32	6.19	6.33	6.83	5.93	6.55
		POSTE			7.64	6.79	7.21	7.36	7.36	7.7	7.36	7.44	7.27	7.17	7.33	6.07	6.4	8.08	6.89	7.46
Conductivity	mS/cm	INF	1.84	1.79	2.7	1.994	2.146	2.162	2.04	2.024	1.96	1.615	1.89	1.542	1.63	1.91	2.35	1.813	1.82	1.84
		BCR1	6.74	7.16	6.09	3.827	4.261	3.284	3.115	2.611	2.2	1.78	2.01	1.634	1.68	1.74	2	1.548	1.63	1.4
		SAPS	2.55	2.76	2.285	1.967	2.022	1.926	1.721	1.719	1.74	1.492	1.74	1.46	1.53	1.62	1.93	1.491	1.55	1.35
		BCR2	5.78	6.68	6.071	3.468	2.774	2.276	1.969	1.768	1.68	1.438	1.74	1.308	1.52	1.77	1.87	1.384	1.3	1.43
		CHIT	3.59	3.17	2.802	3.941	5	5.794	4.316	3.72	3.1	2.649	2.57	1.707	1.67	1.58	1.91	1.702	1.55	1.3
		BCR3	6.35	6.66	6.706	3.481	4.463	5.435	5.113	4.673	3.53	3.366	3.65	2.412	2.02	2.11	2.09	1.584	1.42	1.3
		NAOH	1.44	3.21	1.862	1.897	2.104	2.076	2.068	1.911	1.96	1.623	1.85	1.603	1.56	1.81	2.27	2.358	1.62	1.49
		BCR4	5.99	7.01	5.45	2.631	2.381	2.141	1.84	1.774	1.85	1.562	1.79	1.638	1.65	1.81	2.05	1.577	1.51	1.34
		POSTI	6.32	7.11	6.091	4.836	3.526	3.367	2.564	2.552	2.43	1.915	2.31	1.779	1.7	1.8	2	1.52	1.46	1.31
		POSTE			5.792	3.167	3.218	3.102	2.566	1.938	2.14	1.792	2.05	2.153	1.62	1.81	1.99	1.405	1.49	1.29
ORP	mV	INF	471	463	486.1	479.5	311.4	NA	489.5	488.4	501	485.1	491	493.8	510	504	476	477.8	501	485
		BCR1	-91	-13	107.3	-173.2	-245.3	-214.6	-181.4	-144	-265	-191.1	-242	-166.3	-180	-61.6	-88	-261.7	-299	-235
		SAPS	-34	-55	130.1	154.3	100.4	71.1	46.1	61.1	42	63.8	48.2	130.2	102	110	58.3	54.3	26.5	83.5
		BCR2	-64	-50	32.3	-62.5	-204.9	-257.4	-288.1	-181.3	-255	-254.4	-164	-144.3	-200	-145	-235	-266.7	-231	-176
		CHIT	-113	149	97	93.6	71.2	20.5	-231.2	-144.1	-220	-157.5	-260	-127.9	-102	60.8	-80	-260.1	-10.7	155
		BCR3	-100	-55	13.2	-59.4	-250.6	-327.4	-332.1	-218.7	-330	-311.3	-296	-227.9	-215	-188	-218	-282.6	-228	-193
		NAOH	69	478	214.1	220.1	273	174.6	452.4	97.6	498	16.7	312	-9.4	503	338	198	36.9	364	474
		BCR4	-67	-71	18.9	-60	-216.2	-256.1	-273.2	-187.8	-255	-279.7	-310	-170.7	-209	-157	-223	-280.9	-217	-198
		POSTI	-39	-54	27.8	-27.4	-248.9	-315.9	-294.7	-188.2	-263	-248.1	-290	-199.1	-195	-123	-177	-262.3	-210	-165
		POSTE			33.6	-32	-251.5	-279.4	-299.4	-21.3	-215	-216.5	-258	-234	128	326	108	-36.4	195	163
Dissolved Oxygen	mg/L	INF	6.56	3.26	2.28	1.25	5.95	3.96	3.2	5.5	2.75		3.53	4.04	2.71	4.3	6.45	4.46	3.23	3.98
		BCR1	0.34	0	0.81	0.07	0.72	0.25	1.13	1.06	0.66	2.07	0.62	2.78	0.71	2.14	1.14	1.97	0.73	1.22
		SAPS	0.37	0	0.88	0.62	1.06	1.69	2.71	3.86	1.9		1.95	2.22	1.38	1.95	3.27	1.54	2.21	2.92
		BCR2	0	0	0.5	0.55	0.35	0.17	0.54	0.59	0.49	1.01	1.49	1.15	0.54	1.55	0.88	2.1	0.55	0.99
		CHIT	0.27	9.77	0.98	1.02	1.3	1.45	1	1.59	1.2	3.57	1.15	4.39	0.96	2.92	1.56	1.08	1.44	3.2
		BCR3	0	0	0.9	0.86	0.22	0.28	0.64	0.66	0.4	1.13	0.43	0.92	0.38	1.21	1.39	2.22	1.07	1.12
		NAOH	6.08	2.32	3.74	5.67	6.61	6.16	5.77	6.48	3.6	6.49	5.68	6.18	7.2	6.79	8.32	6.44	8.11	7.9
		BCR4	0	0	0.84	1.02	0.64	0.39	0.64	0.78	0.46	1.13	0.44	1.46	0.55	1.5	1.35	2.33	1.55	1.31
		POSTI	1.53	0	2.69	0	0.86	0.47	1.06	0.9	0.68	0.81	0.44	1.21	0.68	1.28	2.13	2.83	1.8	3.21
		POSTE	NA	NA	0.53	4.11	0.44	0.3	0.34	2.46	0.96	1.49	1.00	0.97	3.24	7.57	15.4	11.54	7.84	13.4
Temperature	°C	INF	22.5	8.19	19.21	22.18	8.14	10.98	16.27	11.75	21.9	12.65	17.1	13.46	17.6	9.94	6.25	16.63	15.4	14.5
		BCR1	15.7	9.74	10.26	15.17	11.1	14.45	16.59	14.02	19.2	14.59	18.3	15.1	12.5	9.44	7.37	12.82	16.4	8.94
		SAPS	16.84	8.38	10.86	13.87	10.59	12.69	15.92	14.37	19.1	14.7	19.3	15.2	10.4	9.56	6.17	10.89	15.1	8.25
		BCR2	16.19	9.54	9.14	13.23	10.71	13.75	15.95	13.94	18.2	15.15	19.7	14.88	10.4	9.57	6.69	11.44	14.2	8.7
		CHIT	16.03	8.96	10.95	14.37	11.44	13.72	16.15	14.75	19.5	14.82	19.2	15.24	10.3	9.42	6.46	10.29	16.2	8.43
		BCR3	15.12	9.67	10.03	13.26	10.9	15.19	15.8	14.15	19.1	15.01	19.6	15.25	10.9	9.86	7.36	8.8	13.5	8.21
		NAOH	16.37	8.98	11.81	16.66	10.67	13.43	16.22	14.32	18.7	14.65	18.6	15.41	8.8	9.8	6.34	12.29	14.4	8.3
		BCR4	15.21	9.36	9.96	13.2	10.93	15	15.65	14.59	19.9	15.02	20.7	15.82	10.3	10.6	6.93	9.4	13.8	8.06
		POSTI	15.85	13.4	11.02	19.61	10.75	16.84	16.11	14.49	21.2	15.55	20.8	17.44	11.5	11.2	6.22	14.42	14.6	9.11
		POSTE			14.09	13.58	8.57	16.2	15.66	13.21	17.3	15.32	17.4	16.9	15.2	10.1		13.8	17.2	11.1

Notes:

su = standard units
mS/cm = milliseimens per centimeter
mV= millivolts
mg/L = milligrams per liter
°C = degrees Celcius
INF = Adit influent to treatment system
BCRX = Biochemical reactor barrel effluent
SAPS = Successive alkalinity producing system pre-treatment to BCR 2
CHIT = Chitorem pre-treatment to BCR 3
NAOH = Sodium hydroxide pre-treatment to BCR 4
POSTI = Combined 4 BCR effluents into post-treatment system
POSTE = Effluent from post-treatment system

Table 4.2-3

Danny T Treatability Study Year 2: Pilot Test Percent Removal

Barker-Hughesville Mining District Superfund Site

Location	BCR1 (compared to Influent location)									
Sample ID	14BH-DT-PILOT-BCR1-061114		14BH-DT-PILOT-BCR1-062414		14BH-DT-PILOT-BCR1-070814		14BH-DT-PILOT-BCR1-072214		14BH-DT-PILOT-BCR1-080614	
Sample Date	6/11/2014		6/24/2014		7/8/2014		7/22/2014		8/6/2014	
Fraction	D	T	D	T	D	T	D	T	D	T
Analyte	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal
Metals										
Aluminum	96.5%	90.9%	> 98.2%	98.9%	> 99.7%	98.2%	98.8%	98.7%	> 98.0%	98.9%
Arsenic	64.2%	59.5%	85.1%	84.7%	96.4%	93.1%	97.2%	96.4%	> 86.0%	> 86.4%
Cadmium	> 99.2%	93.3%	> 99.3%	99.5%	> 99.3%	99.3%	> 99.3%	> 99.3%	> 99.1%	> 99.2%
Copper	98.5%	87.1%	99.5%	98.5%	> 99.2%	98.5%	> 98.9%	> 98.8%	99.2%	> 99.1%
Iron	99.1%	98.4%	> 99.2%	> 99.2%	98.8%	94.1%	> 99.3%	99.6%	> 99.2%	> 99.2%
Lead	> 99.2%	91.4%	> 99.1%	99.3%	> 98.6%	99.3%	> 99.0%	98.9%	> 98.5%	99.0%
Manganese	95.9%	95.3%	98.3%	98.2%	63.4%	53.8%	50.6%	45.1%	23.9%	20.5%
Nickel	> 63.8%	> 61.2%	49.7%	> 55.9%	> 64.9%	> 52.2%	> 44.1%	> 79.3%	> 47.4%	NA --
Zinc	99.8%	98.5%	99.9%	99.6%	99.9%	96.6%	> 99.8%	99.2%	> 99.8%	99.7%
Wet Chemistry										
Acidity		> 99.4%		> 99.4%		> 99.4%		> 99.5%		> 99.4%
Alkalinity	< -504.0%		< -214.0%		< -104.0%		< -940.0%		< -549.0%	
Ammonia	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --
BOD	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --
Orthophosphate	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --
Sulfate	19.7%		34.4%		45.2%		65.0%		55.0%	
Sulfide	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --

Location	BCR1 (compared to Influent location)									
Sample ID	14BH-DT-PILOT-BCR1-081914		14BH-DT-PILOT-BCR1-090214		14BH-DT-PILOT-BCR1-091614		14BH-DT-PILOT-BCR1-092314		14BH-DT-PILOT-BCR1-092914	
Sample Date	8/19/2014		9/2/2014		9/16/2014		9/23/2014		9/29/2014	
Fraction	D	T	D	T	D	T	D	T	D	T
Analyte	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal
Metals										
Aluminum	98.7%	98.2%	99.0%	98.9%	> 98.1%	> 98.2%	> 98.1%	> 98.1%	99.9%	99.8%
Arsenic	> 84.5%	> 83.7%	> 91.2%	> 91.4%	> 91.2%	> 91.1%	> 86.7%	> 88.2%	99.5%	99.3%
Cadmium	> 99.1%	> 99.1%	> 99.1%	> 99.1%	> 99.1%	> 99.2%	> 99.2%	> 99.2%	> 99.6%	100.0%
Copper	98.2%	> 98.9%	> 98.9%	> 98.9%	> 98.8%	> 98.9%	> 98.9%	> 99.0%	> 99.8%	99.8%
Iron	> 99.1%	> 99.1%	> 98.9%	94.2%	> 99.1%	> 99.1%	> 99.1%	> 99.2%	98.7%	98.5%
Lead	99.3%	94.2%	> 99.2%	> 99.2%	> 98.8%	99.3%	> 98.7%	> 98.9%	> 99.4%	99.7%
Manganese	10.0%	2.4%	-13.8%	-15.8%	16.1%	13.8%	18.8%	16.9%	25.3%	8.7%
Nickel	> 48.5%	> 53.1%	50.3%	> 59.5%	> 60.9%	> 56.9%	> 59.0%	> 63.0%	68.2%	65.6%
Zinc	> 99.8%	99.8%	> 99.8%	99.8%	> 99.8%	99.8%	> 99.8%	99.9%	100.0%	99.9%
Wet Chemistry										
Acidity		> 99.3%		> 99.3%		> 99.4%		> 99.4%		> 99.4%
Alkalinity	< -814.0%		< -184.0%		< -723.0%		< -815.0%			
Ammonia	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --
BOD	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --
Orthophosphate	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --
Sulfate	32.5%		30.0%		48.4%		47.1%			
Sulfide	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --

Notes:

NA = Percent removal calculation is not applicable due to the following logic cases:

1) The treated water effluent is non-detect, and the raw water was detected at a concentration less than the treated water effluent reporting limit.

2) The raw water is non-detect, and the treated effluent water was detected at a concentration less than the raw water reporting limit.

3) Both the raw water and the treated water effluent are non-detect.

4) Percent removal for certain wet chemistry parameters are not meaningful comparisons; therefore, calculations were not completed.

INF = Adit influent to treatment system

BCRX = Biochemical reactor barrel effluent

SAPS = Successive alkalinity producing system pre-treatment to BCR 2

CHIT = Chitorem pre-treatment to BCR 3

NAOH = Sodium hydroxide pre-treatment to BCR 4

POSTE = Effluent from post-treatment system

D = Dissolved Metals

T = Total Metals

BOD= Biological oxygen demand

Table 4.2-3
Danny T Treatability Study Year 2: Pilot Test Percent Removal
Barker-Hughesville Mining District Superfund Site

Location	SAPS (compared to Influent location)																			
Sample ID	14BH-DT-PILOT-SAPS-061114				14BH-DT-PILOT-SAPS-062414				14BH-DT-PILOT-SAPS-070814				14BH-DT-PILOT-SAPS-072214				14BH-DT-PILOT-SAPS-080614			
Sample Date	6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014			
Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal	
Metals																				
Aluminum	>	96.0%	>	96.2%	>	98.2%	>	98.2%		99.1%		98.9%		97.8%		96.0%		95.6%		87.1%
Arsenic		93.4%		93.8%		85.5%		85.1%		78.2%		80.4%		94.8%		94.3%	>	86.0%		-36.1%
Cadmium		98.0%		97.4%	>	99.3%		99.2%	>	99.3%	>	99.3%	>	99.3%	>	99.3%	>	99.1%	>	91.8%
Copper		96.4%		93.1%	>	99.1%		99.2%	>	99.2%		99.5%	>	98.9%		98.8%	>	98.8%	>	91.2%
Iron		95.9%		96.0%		82.7%		83.3%		41.8%		44.3%		38.1%		34.4%		32.7%		32.7%
Lead	>	99.2%		99.3%	>	99.1%	>	98.9%	>	98.6%		95.2%	>	99.0%		99.4%	>	98.5%	>	84.5%
Manganese		73.4%		73.0%		32.8%		34.6%		9.8%		8.9%		-1.7%		-0.9%		-8.3%		-8.2%
Nickel	>	63.8%	>	61.2%		49.7%	>	55.9%		33.3%		45.9%		59.8%		79.8%		21.1%	NA	--
Zinc		96.2%		95.8%		90.2%		90.7%		75.8%		72.0%		91.2%		88.5%		68.1%		68.3%
Wet Chemistry																				
Acidity			>	99.4%				97.7%				62.9%				62.0%				42.0%
Alkalinity		3.8%			NA	--			NA	--			<	-38.0%				17.5%		
Ammonia	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
BOD	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
Orthophosphate	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
Sulfate		7.8%				11.7%				19.5%				13.1%				11.1%		
Sulfide	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--

Location	SAPS (compared to Influent location)																			
Sample ID	14BH-DT-PILOT-SAPS-081914				14BH-DT-PILOT-SAPS-090214				14BH-DT-PILOT-SAPS-091614				14BH-DT-PILOT-SAPS-092314				14BH-DT-PILOT-SAPS-092914			
Sample Date	8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal	
Metals																				
Aluminum		96.3%		95.5%		96.2%		95.3%		97.6%		93.4%		96.9%		96.3%		94.7%		93.9%
Arsenic		95.5%		95.6%	>	91.2%	>	91.4%		97.6%	>	91.1%	>	86.7%	>	88.2%		98.3%		98.4%
Cadmium	>	99.1%	>	99.1%	>	99.1%	>	99.1%	>	99.1%		99.5%	>	99.2%	>	99.2%		99.2%		99.3%
Copper		99.3%	>	98.9%	>	98.9%		99.4%		99.4%		98.7%		99.4%		99.4%		99.8%		98.9%
Iron		16.5%		21.2%		26.2%		27.7%		36.7%		39.7%		27.9%		30.4%		27.0%		30.5%
Lead	>	98.5%	>	98.1%	>	99.2%	>	99.2%	>	98.8%		99.2%	>	98.7%	>	98.9%		99.9%		99.0%
Manganese		-6.9%		-9.0%		-12.3%		-10.8%		12.4%		15.0%		11.1%		12.5%		21.4%		3.6%
Nickel		-2.6%		-0.5%		15.0%		-8.5%		28.9%		-12.9%		13.9%		32.2%		-98.6%		-70.6%
Zinc		48.1%		48.8%		41.8%		41.5%		48.3%		50.9%		38.9%		42.5%		28.5%		27.9%
Wet Chemistry																				
Acidity				31.7%				53.3%				58.2%				51.5%				45.7%
Alkalinity	<	-95.6%				14.2%			<	-25.0%			<	-73.0%						
Ammonia	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
BOD	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
Orthophosphate	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
Sulfate		1.0%				9.8%				20.0%				14.6%						
Sulfide	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--

Notes:

NA = Percent removal calculation is not applicable due to the following logic cases:

1) The treated water effluent is non-detect, and the raw water was detected at a concentration less than the treated water effluent reporting limit.

2) The raw water is non-detect, and the treated effluent water was detected at a concentration less than the raw water reporting limit.

3) Both the raw water and the treated water effluent are non-detect.

4) Percent removal for certain wet chemistry parameters are not meaningful comparisons; therefore, calculations were not completed.

INF = Adit influent to treatment system

BCRX = Biochemical reactor barrel effluent

SAPS = Successive alkalinity producing system pre-treatment to BCR 2

CHIT = Chitorem pre-treatment to BCR 3

NAOH = Sodium hydroxide pre-treatment to BCR 4

POSTE = Effluent from post-treatment system

D = Dissolved Metals

T = Total Metals

BOD= Biological oxygen demand

Table 4.2-3

Danny T Treatability Study Year 2: Pilot Test Percent Removal

Barker-Hughesville Mining District Superfund Site

Location	BCR2 (compared to SAPS Pre-treatment location)																																							
Sample ID	14BH-DT-PILOT-BCR2-061114				14BH-DT-PILOT-BCR2-062414				14BH-DT-PILOT-BCR2-070814				14BH-DT-PILOT-BCR2-072214				14BH-DT-PILOT-BCR2-080614				14BH-DT-PILOT-BCR2-081914				14BH-DT-PILOT-BCR2-090214				14BH-DT-PILOT-BCR2-091614				14BH-DT-PILOT-BCR2-092314				14BH-DT-PILOT-BCR2-092914			
Sample Date	6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014				8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
Fraction	D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal	
Metals																																								
Aluminum		43.6%	<	-168.0%		48.4%	<	-21.6%		42.8%		-1.3%	>	22.1%		74.8%	>	54.9%	>	84.8%	>	36.5%		79.8%		72.8%		80.3%	>	17.8%	>	72.0%	>	39.2%	>	49.8%		98.7%		97.1%
Arsenic		10.3%		-1090.5%		37.1%		14.1%	>	44.8%		50.3%		-107.9%		27.8%	NA	--	NA	--		-247.8%		-269.7%	NA	--	NA	--		-273.8%	NA	--	NA	--	NA	--		61.3%		38.7%
Cadmium	>	61.9%		-200.3%		45.0%		-38.1%	NA	--		39.5%	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--		-66.7%	NA	--	NA	--	>	54.5%		97.6%
Copper		54.1%		-248.8%	<	-252.0%		-829.2%	NA	--		-374.1%		45.7%		-17.0%		49.1%	NA	--		-0.4%	NA	--	NA	--		-81.2%		-16.7%	>	15.3%		-14.4%		-59.7%		0.0%		84.7%
Iron		83.5%		46.8%		94.5%		90.3%	>	99.8%		99.0%	>	98.9%		99.5%	>	98.8%		99.4%		99.5%		99.3%		97.9%		97.8%	>	98.6%	>	98.6%	>	98.8%	>	98.8%		99.2%		98.9%
Lead	<	-30.5%		-3082.9%	<	-47.5%	<	-435.0%	NA	--		28.8%	NA	--		-334.1%	NA	--		94.6%	NA	--		50.0%	NA	--	NA	--	NA	--		8.5%	NA	--	NA	--		78.6%		38.9%
Manganese		85.9%		81.7%		94.7%		94.2%		84.5%		82.6%		60.8%		58.9%		25.4%		20.3%		5.6%		0.9%		-26.2%		-31.0%		-13.9%		-17.2%		2.5%		0.4%		11.8%		8.6%
Nickel	<	-193.0%	NA	--		55.7%		44.6%	>	47.4%	>	11.5%		-39.1%		-2.7%	>	33.3%	NA	--	>	49.7%	>	53.3%		79.1%	>	62.7%	>	45.1%	>	61.8%	>	52.4%	>	45.4%		93.5%		79.8%
Zinc		92.7%		44.8%		95.7%		88.7%		99.7%		88.5%	>	98.2%		95.5%	>	99.5%		99.7%	>	99.6%		99.6%	>	99.6%		99.5%	>	99.6%		98.1%	>	99.7%		99.5%		99.9%		99.3%
Wet Chemistry																																								
Acidity			NA	--			>	73.3%			>	98.5%			>	98.7%			>	99.0%			>	99.0%				89.3%			>	98.6%			>	98.8%			>	98.9%
Alkalinity		-238.9%			<	-85.4%			<	-37.0%				-371.0%				-383.6%				-221.1%				-166.9%				-388.8%				-256.6%						
Ammonia	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
BOD	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
Orthophosphate	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
Sulfate		9.4%				27.1%				45.4%				62.8%				40.9%				31.2%				6.6%				33.9%				40.9%						
Sulfide	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--

Notes:

NA = Percent removal calculation is not applicable due to the following logic cases:

1) The treated water effluent is non-detect, and the raw water was detected at a concentration less than the treated water effluent reporting limit.

2) The raw water is non-detect, and the treated effluent water was detected at a concentration less than the raw water reporting limit.

3) Both the raw water and the treated water effluent are non-detect.

4) Percent removal for certain wet chemistry parameters are not meaningful comparisons; therefore, calculations were not completed.

INF = Adit influent to treatment system
BCRX = Biochemical reactor barrel effluent
SAPS = Successive alkalinity producing system pre-treatment to BCR 2
CHIT = Chitorem pre-treatment to BCR 3
NAOH = Sodium hydroxide pre-treatment to BCR 4
POSTE = Effluent from post-treatment system

D = Dissolved Metals
T = Total Metals

BOD= Biological oxygen demand

Table 4.2-3

Danny T Treatability Study Year 2: Pilot Test Percent Removal

Barker-Hughesville Mining District Superfund Site

Location	CHIT (compared to Influent location)																			
Sample ID	14BH-DT-PILOT-CHIT-061114				14BH-DT-PILOT-CHIT-062414				14BH-DT-PILOT-CHIT-070814				14BH-DT-PILOT-CHIT-072214				14BH-DT-PILOT-CHIT-080614			
Sample Date	6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014			
Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal	
Metals																				
Aluminum		99.2%		98.4%	>	99.6%	>	99.6%	>	99.7%	>	99.7%		98.1%		97.9%		98.6%		98.3%
Arsenic		81.6%		80.7%		82.6%		86.2%		95.7%		96.4%	>	89.2%		96.6%	>	86.0%	>	86.4%
Cadmium	>	99.2%	>	99.2%	>	99.3%	>	99.3%	>	99.3%		99.4%	>	99.3%		99.3%	>	99.1%	>	99.2%
Copper		98.0%		98.0%		99.0%		98.7%	>	99.2%		99.2%	>	98.9%		99.2%	>	98.8%		99.4%
Iron		99.7%		98.6%		98.5%		98.3%		97.3%		96.7%		97.6%		98.4%		98.5%		96.4%
Lead	>	99.2%		99.5%	>	99.1%	>	98.9%	>	98.6%	>	99.1%	>	99.0%	>	99.0%	>	98.5%	>	98.4%
Manganese		98.0%		97.6%		88.3%		88.1%		75.4%		73.0%		17.0%		18.2%		27.2%		26.2%
Nickel	>	63.8%	>	61.2%		46.0%	>	55.9%	>	64.9%	>	52.2%	>	44.1%		75.5%	>	47.4%	NA	--
Zinc		99.7%		99.3%		99.9%		99.9%		100.0%		99.5%		99.5%		98.6%	>	99.8%		99.3%
Wet Chemistry																				
Acidity			>	99.4%			>	99.4%			>	99.4%			>	99.5%			>	99.4%
Alkalinity	<	-78.8%			<	-166.0%			<	-354.0%			<	-1400.0%			<	-1130.0%		
Ammonia	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
BOD	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
Orthophosphate	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
Sulfate		15.3%				27.2%				20.3%				28.0%				44.2%		
Sulfide	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--

Location	CHIT (compared to Influent location)																			
Sample ID	14BH-DT-PILOT-CHIT-081914				14BH-DT-PILOT-CHIT-090214				14BH-DT-PILOT-CHIT-091614				14BH-DT-PILOT-CHIT-092314				14BH-DT-PILOT-CHIT-092914			
Sample Date	8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal	
Metals																				
Aluminum		98.6%		98.6%		96.5%		56.1%	>	98.1%		50.4%		95.3%		8.1%		83.2%		-24.8%
Arsenic	>	84.5%	>	83.7%	>	91.2%		93.2%		96.5%		90.3%	>	86.7%		92.6%		98.4%		93.7%
Cadmium	>	99.1%	>	99.1%	>	99.1%		74.6%	>	99.1%		67.9%	>	99.2%		77.8%		99.9%		6.9%
Copper	>	98.8%	>	98.9%	>	98.9%		81.2%	>	98.8%		66.8%	>	98.9%		82.3%		99.8%		70.5%
Iron		98.8%		96.3%		71.6%		55.0%		97.8%		64.8%		57.8%		40.7%		50.7%		39.9%
Lead	>	98.5%	>	98.1%	>	99.2%		80.8%	>	98.8%		66.7%	>	98.7%		77.7%		99.9%		-1.2%
Manganese		31.7%		28.2%		12.2%		10.0%		34.1%		26.6%		12.7%		10.5%		23.1%		2.2%
Nickel	>	48.5%	>	53.1%		64.0%		44.9%	>	60.9%	>	56.9%		72.8%		58.5%		31.8%		-25.0%
Zinc	>	99.8%		98.8%		99.9%		64.7%	>	99.8%		58.6%	>	99.8%		46.4%		73.5%		-13.2%
Wet Chemistry																				
Acidity			>	99.3%				90.3%			>	99.4%				69.7%				54.3%
Alkalinity	<	-1142.0%			<	-55.0%			<	-970.0%			<	-181.0%						
Ammonia	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
BOD	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
Orthophosphate	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
Sulfate		38.3%				25.8%				49.3%				27.2%						
Sulfide	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--

Notes:

NA = Percent removal calculation is not applicable due to the following logic cases:

1) The treated water effluent is non-detect, and the raw water was detected at a concentration less than the treated water effluent reporting limit.

2) The raw water is non-detect, and the treated effluent water was detected at a concentration less than the raw water reporting limit.

3) Both the raw water and the treated water effluent are non-detect.

4) Percent removal for certain wet chemistry parameters are not meaningful comparisons; therefore, calculations were not completed.

INF = Adit influent to treatment system
BCRX = Biochemical reactor barrel effluent
SAPS = Successive alkalinity producing system pre-treatment to BCR 2
CHIT = Chitorem pre-treatment to BCR 3
NAOH = Sodium hydroxide pre-treatment to BCR 4
POSTE = Effluent from post-treatment system

D = Dissolved Metals
T = Total Metals

BOD= Biological oxygen demand

Table 4.2-3

Danny T Treatability Study Year 2: Pilot Test Percent Removal

Barker-Hughesville Mining District Superfund Site

Location	BCR3 (compared to Chitorem Pre-treatment)																			
Sample ID	14BH-DT-PILOT-BCR3-061114		14BH-DT-PILOT-BCR3-062414		14BH-DT-PILOT-BCR3-070814		14BH-DT-PILOT-BCR3-072214		14BH-DT-PILOT-BCR3-080614		14BH-DT-PILOT-BCR3-081914		14BH-DT-PILOT-BCR3-090214		14BH-DT-PILOT-BCR3-091614		14BH-DT-PILOT-BCR3-092314		14BH-DT-PILOT-BCR3-092914	
Sample Date	6/11/2014		6/24/2014		7/8/2014		7/22/2014		8/6/2014		8/19/2014		9/2/2014		9/16/2014		9/23/2014		9/29/2014	
Fraction	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T
Analyte	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal
Metals																				
Aluminum	-195.2%	-610.9%	< -154.0%	< -166.0%	24.2%	47.6%	> 81.9%	> 83.2%	> 71.1%	> 77.2%	-21.5%	-16.8%	65.4%	96.8%	NA --	> 96.3%	> 60.1%	99.1%	99.8%	99.9%
Arsenic	-258.8%	-246.2%	-96.6%	-67.6%	-268.3%	-315.0%	19.0%	-209.7%	48.0%	39.0%	66.0%	58.5%	NA --	45.6%	32.6%	> 8.7%	67.2%	43.3%	-53.6%	64.2%
Cadmium	NA --	< -143.5%	NA --	NA --	NA --	-18.3%	NA --	-7.5%	NA --	NA --	NA --	NA --	NA --	> 96.3%	NA --	> 97.4%	NA --	> 96.3%	-270.4%	> 99.6%
Copper	6.6%	-534.4%	-19.4%	-165.1%	< -70.0%	-339.3%	43.1%	-41.9%	1.9%	-6.0%	< -39.0%	NA --	45.2%	> 94.2%	26.1%	> 96.7%	23.1%	> 94.4%	71.5%	99.7%
Iron	-224.3%	-56.9%	10.4%	26.3%	58.6%	59.3%	> 94.2%	94.8%	> 89.2%	> 95.7%	> 22.8%	> 75.6%	> 96.0%	> 97.5%	> 59.9%	> 97.6%	> 97.9%	> 98.6%	97.6%	98.0%
Lead	< -9.5%	-2545.7%	NA --	< -103.5%	48.0%	< -244.0%	NA --	1.5%	NA --	NA --	NA --	NA --	NA --	> 95.8%	NA --	> 96.4%	NA --	> 94.9%	69.0%	99.8%
Manganese	-90.0%	-82.9%	66.8%	67.0%	68.0%	70.6%	87.6%	86.4%	50.5%	49.5%	42.3%	42.4%	29.4%	31.8%	24.1%	33.5%	40.4%	41.5%	24.7%	28.4%
Nickel	< -170.0%	< -195.0%	-78.0%	NA --	NA --	NA --	NA --	-148.3%	NA --	NA --	NA --	35.9%	> 11.5%	57.0%	NA --	NA --	-50.6%	> 10.7%	85.3%	92.9%
Zinc	24.4%	-72.8%	-80.7%	-92.1%	-216.9%	61.1%	86.3%	81.7%	55.4%	73.3%	NA --	90.4%	-88.7%	> 99.4%	NA --	> 99.6%	NA --	> 99.7%	99.9%	100.0%
Wet Chemistry																				
Acidity		NA --		NA --		NA --		NA --		NA --		NA --		> 93.1%		NA --		> 98.0%		> 98.8%
Alkalinity	-86.8%		14.3%		-9.7%		-63.3%		-58.5%		-114.2%		-279.4%		-8.4%		-401.8%			
Ammonia	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --
BOD	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --
Orthophosphate	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --
Sulfate	6.4%		10.1%		63.1%		61.6%		52.4%		56.7%		30.0%		35.2%		70.7%			
Sulfide	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --

Notes:

NA = Percent removal calculation is not applicable due to the following logic cases:

1) The treated water effluent is non-detect, and the raw water was detected at a concentration less than the treated water effluent reporting limit.

2) The raw water is non-detect, and the treated effluent water was detected at a concentration less than the raw water reporting limit.

3) Both the raw water and the treated water effluent are non-detect.

4) Percent removal for certain wet chemistry parameters are not meaningful comparisons; therefore, calculations were not completed.

INF = Adit influent to treatment system

BCRX = Biochemical reactor barrel effluent

SAPS = Successive alkalinity producing system pre-treatment to BCR 2

CHIT = Chitorem pre-treatment to BCR 3

NAOH = Sodium hydroxide pre-treatment to BCR 4

POSTE = Effluent from post-treatment system

D = Dissolved Metals

T = Total Metals

BOD= Biological oxygen demand

Table 4.2-3
Danny T Treatability Study Year 2: Pilot Test Percent Removal
Barker-Hughesville Mining District Superfund Site

Location	NAOH (compared to Influent location)																			
Sample ID	14BH-DT-PILOT-NAOH-061114		14BH-DT-PILOT-NAOH-062414		14BH-DT-PILOT-NOAH-070814		14BH-DT-PILOT-NAOH-072214		14BH-DT-PILOT-NAOH-080614		14BH-DT-PILOT-NAOH-081914		14BH-DT-PILOT-NAOH-090214		14BH-DT-PILOT-NAOH-091614		14BH-DT-PILOT-NAOH-092314		14BH-DT-PILOT-NAOH-092914	
Sample Date	6/11/2014		6/24/2014		7/8/2014		7/22/2014		8/6/2014		8/19/2014		9/2/2014		9/16/2014		9/23/2014		9/29/2014	
Fraction	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T
Analyte	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal
Metals																				
Aluminum	55.4%	56.2%	19.0%	20.0%	9.3%	10.6%	11.6%	8.3%	65.2%	61.0%	91.4%	88.1%	> 98.0%	93.3%	98.2%	96.5%	35.8%	33.1%	48.0%	44.6%
Arsenic	94.4%	78.6%	> 85.3%	87.9%	96.6%	90.1%	> 89.2%	90.9%	> 86.0%	-36.1%	> 84.5%	93.2%	> 91.2%	92.2%	> 91.2%	95.2%	96.5%	80.6%	81.6%	67.0%
Cadmium	0.8%	2.7%	7.0%	8.5%	-3.2%	2.7%	-3.3%	0.0%	-8.2%	-4.1%	33.8%	37.5%	64.9%	60.6%	> 99.1%	98.2%	11.8%	12.2%	12.9%	14.9%
Copper	35.0%	36.4%	24.6%	22.3%	0.8%	1.9%	0.9%	3.8%	22.3%	31.1%	89.2%	85.6%	99.3%	92.0%	99.4%	97.1%	27.5%	31.1%	40.5%	41.1%
Iron	79.4%	66.4%	88.9%	84.0%	87.3%	81.2%	99.7%	90.6%	> 99.2%	94.3%	98.7%	92.9%	> 98.9%	92.8%	> 99.1%	95.7%	99.3%	82.8%	66.0%	59.5%
Lead	70.3%	66.2%	36.6%	37.0%	16.3%	20.8%	56.4%	49.3%	95.8%	> 84.5%	> 98.5%	94.4%	> 99.2%	93.6%	> 98.8%	97.4%	78.8%	58.6%	57.2%	48.4%
Manganese	6.5%	7.5%	8.0%	9.6%	8.9%	10.6%	3.4%	1.7%	3.7%	1.8%	9.7%	7.3%	23.0%	23.2%	100.0%	97.5%	13.9%	14.5%	5.3%	-14.9%
Nickel	1.8%	6.6%	4.8%	4.8%	5.3%	-1.9%	-8.4%	53.3%	-3.7%	NA --	29.4%	34.7%	56.4%	42.5%	> 60.9%	> 56.9%	13.5%	16.7%	16.7%	7.0%
Zinc	5.5%	6.2%	7.0%	8.0%	3.6%	5.1%	-0.5%	-3.7%	1.1%	0.3%	46.2%	44.6%	75.0%	72.9%	99.9%	97.9%	14.1%	19.0%	18.0%	19.8%
Wet Chemistry																				
Acidity		56.5%		32.8%		51.4%		50.6%		53.6%		56.7%		80.0%		> 99.4%		48.5%		31.4%
Alkalinity	NA --		NA --		NA --		NA --		NA --		NA --		NA --		< -247.0%		NA --			
Ammonia	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --
BOD	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --
Orthophosphate	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --
Sulfate	9.6%		18.0%		9.4%		-15.7%		4.3%		0.0%		8.4%		17.5%		12.1%			
Sulfide	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --

Notes:

NA = Percent removal calculation is not applicable due to the following logic cases:

1) The treated water effluent is non-detect, and the raw water was detected at a concentration less than the treated water effluent reporting limit.

2) The raw water is non-detect, and the treated effluent water was detected at a concentration less than the raw water reporting limit.

3) Both the raw water and the treated water effluent are non-detect.

4) Percent removal for certain wet chemistry parameters are not meaningful comparisons; therefore, calculations were not completed.

INF = Adit influent to treatment system

BCRX = Biochemical reactor barrel effluent

SAPS = Successive alkalinity producing system pre-treatment to BCR 2

CHIT = Chitorem pre-treatment to BCR 3

NAOH = Sodium hydroxide pre-treatment to BCR 4

POSTE = Effluent from post-treatment system

D = Dissolved Metals

T = Total Metals

BOD= Biological oxygen demand

Table 4.2-3

Danny T Treatability Study Year 2: Pilot Test Percent Removal

Barker-Hughesville Mining District Superfund Site

Location	BCR4 (compared to NaOH Pre-treatment)																			
Sample ID	14BH-DT-PILOT-BCR4-061114				14BH-DT-PILOT-BCR4-062414				14BH-DT-PILOT-BCR4-070814				14BH-DT-PILOT-BCR4-072214				14BH-DT-PILOT-BCR4-080614			
Sample Date	6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014			
Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal	
Metals																				
Aluminum		91.7%		80.8%		99.0%		98.5%		99.0%		95.2%	>	98.1%		98.9%	>	94.3%		97.9%
Arsenic		-100.7%		38.5%		54.9%		-4.9%		-256.5%		11.7%	NA	--		16.3%	NA	--		96.2%
Cadmium		95.1%		84.7%		98.3%		94.9%	>	99.3%		95.1%	>	99.3%		99.2%	>	99.2%	>	99.2%
Copper		92.0%		72.8%		98.0%		95.4%	>	99.2%		95.2%		99.3%		99.0%		98.9%		99.1%
Iron		95.9%		94.0%		91.6%		94.0%		95.6%		94.1%		-122.0%		96.6%	NA	--	>	86.5%
Lead		77.7%		45.9%		98.4%		96.7%	>	98.4%		95.1%	>	97.7%		96.5%	>	64.3%	NA	--
Manganese		90.2%		89.1%		89.7%		89.2%		44.8%		41.2%		43.9%		41.1%		5.4%		2.8%
Nickel		7.7%		-21.6%		39.4%	>	53.7%	>	63.0%	>	53.1%	>	48.5%		55.6%	>	49.2%	NA	--
Zinc		96.6%		94.0%		98.8%		97.1%		99.6%		88.1%		99.5%		95.1%		99.6%		97.8%
Wet Chemistry																				
Acidity			>	98.5%			>	99.1%			>	98.8%			>	99.0%			>	98.8%
Alkalinity	<	-208.0%			<	-13.8%				19.2%			<	-407.0%			<	-361.0%		
Ammonia	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
BOD	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
Orthophosphate	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
Sulfate		1.0%				17.9%				37.6%				57.9%				43.9%		
Sulfide	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--

Location	BCR4 (compared to NaOH Pre-treatment)																			
Sample ID	14BH-DT-PILOT-BCR4-081914				14BH-DT-PILOT-BCR4-090214				14BH-DT-PILOT-BCR4-091614				14BH-DT-PILOT-BCR4-092314				14BH-DT-PILOT-BCR4-092914			
Sample Date	8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal	
Metals																				
Aluminum	>	72.6%	>	80.8%	<	-21.6%	>	69.7%		-5.9%	>	47.8%	>	97.1%	>	97.2%		99.9%		99.7%
Arsenic		73.1%		-9.4%	NA	--		-10.5%	NA	--		-85.2%		-284.6%		81.8%	>	97.0%		85.3%
Cadmium	>	98.6%		99.2%	>	97.4%		98.3%	NA	--	>	52.9%	>	99.0%		98.9%	>	99.6%		99.0%
Copper		85.4%		92.6%		-46.0%		92.6%		-18.9%		72.3%		98.8%		98.5%	>	99.7%		99.2%
Iron	>	28.2%	>	87.1%	NA	--	>	84.3%	NA	--	>	79.9%		-27.4%	>	95.1%		99.0%		99.3%
Lead	NA	--	>	65.5%	NA	--	>	87.4%	NA	--	>	53.7%	>	94.0%	>	97.2%	>	98.6%		99.5%
Manganese		20.9%		21.0%		-22.4%		-25.0%		-224093.5%		-2209.5%		38.0%		37.7%		99.7%		38.5%
Nickel	>	27.0%	>	28.1%	>	27.0%	>	29.6%	NA	--	NA	--	>	52.6%	>	55.6%		99.1%		30.5%
Zinc		99.5%		96.3%		99.2%		93.7%		12.5%		58.6%		99.7%		98.0%		99.6%		97.8%
Wet Chemistry																				
Acidity			>	98.5%			>	96.7%			NA	--			>	98.8%			>	99.2%
Alkalinity	<	-4410.0%			<	-76.0%				-47.0%			<	-485.0%						
Ammonia	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
BOD	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
Orthophosphate	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
Sulfate		37.6%				10.6%				27.3%				34.8%						
Sulfide	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--

Notes:

NA = Percent removal calculation is not applicable due to the following logic cases:

1) The treated water effluent is non-detect, and the raw water was detected at a concentration less than the treated water effluent reporting limit.

2) The raw water is non-detect, and the treated effluent water was detected at a concentration less than the raw water reporting limit.

3) Both the raw water and the treated water effluent are non-detect.

4) Percent removal for certain wet chemistry parameters are not meaningful comparisons; therefore, calculations were not completed.

INF = Adit influent to treatment system

BCRX = Biochemical reactor barrel effluent

SAPS = Successive alkalinity producing system pre-treatment to BCR 2

CHIT = Chitorem pre-treatment to BCR 3

NAOH = Sodium hydroxide pre-treatment to BCR 4

POSTE = Effluent from post-treatment system

D = Dissolved Metals

T = Total Metals

BOD= Biological oxygen demand

Table 4.2-3

Danny T Treatability Study Year 2: Pilot Test Percent Removal

Barker-Hughesville Mining District Superfund Site

Location	POSTE (compared to Post-influent location)																																	
Sample ID	14BH-DT-PILOT-POSTE-062414				14BH-DT-PILOT-POSTE-070814				14BH-DT-PILOT-POSTE-072214				14BH-DT-PILOT-POSTE-080614				14BH-DT-PILOT-POSTE-081914				14BH-DT-PILOT-POSTE-090214				14BH-DT-PILOT-POSTE-091614		14BH-DT-PILOT-POSTE-092314				14BH-DT-PILOT-POSTE-092914			
Sample Date	6/24/2014				7/8/2014				7/22/2014				8/6/2014				8/19/2014				9/2/2014				9/16/2014		9/23/2014				9/29/2014			
Fraction	D		T		D		T		D		T		D		T		D		T		D		T		T		D		T		D		T	
Analyte	% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal	
Metals																																		
Aluminum		-79.0%		-141.2%		-107.1%		-27.8%		-71.8%		-784.6%	NA	--		-138.4%		-0.8%		-29.9%	NA	--		-11.5%	<	-1484.0%	NA	--	NA	--		67.8%		60.7%
Arsenic		-249.0%		-258.8%		-83.5%		81.8%		-180.6%		-135.3%		29.5%	NA	--		40.0%		42.5%		74.0%	NA	--	<	-107.5%		-49.2%		56.5%		-217.6%		-93.1%
Cadmium		-27.4%		-32.8%		12.5%		85.3%	NA	--		-72.4%	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	<	-71.5%	NA	--	NA	--	NA	--		88.0%
Copper		36.2%		-25.5%		42.2%		81.9%		-81.2%		-63.4%		-74.8%	NA	--		-27.4%	NA	--		47.1%	NA	--		-574.6%		-46.2%	NA	--		68.0%		51.8%
Iron		-18.2%		-103.0%	<	-289.6%		69.9%	NA	--		-53.3%	NA	--		73.2%	NA	--	NA	--	>	27.3%	>	50.4%	<	-476.8%	NA	--	NA	--		10.7%		16.8%
Lead	NA	--		-386.2%	NA	--		72.0%		-35.1%		-198.1%	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	<	-5800.0%	NA	--		25.0%		-113.3%		-43.2%
Manganese		47.0%		8.9%		69.3%		71.0%		68.9%		69.0%		58.9%		57.6%		33.2%		32.9%		16.5%		12.9%		20.4%		31.4%		36.0%		31.5%		32.4%
Nickel		-107.0%	<	-182.0%	NA	--	NA	--	NA	--		0.0%	NA	--	NA	--	NA	--	NA	--		28.7%	NA	--	NA	--	NA	--	NA	--		-12.5%		-189.3%
Zinc		73.7%		-30.2%		-3709.5%		53.2%		47.9%		59.5%		84.9%		35.7%	NA	--		52.1%	NA	--		65.6%		-779.6%	NA	--		70.8%		62.0%		80.9%
Wet Chemistry																																		
Acidity			NA	--			NA	--			NA	--			NA	--			NA	--			NA	--	NA	--			NA	--			NA	--
Alkalinity		-56.0%				7.6%				14.1%				-14.4%				-18.8%				3.9%						15.5%						
Ammonia		-0.2%				34.2%				28.8%				17.0%				4.1%				12.2%						19.9%						
BOD								14.8%				49.1%				76.5%				27.5%			>	9.1%	>	91.0%				93.5%			>	96.8%
Orthophosphate		82.8%				74.0%				83.5%				83.0%				82.7%				71.6%						76.6%				99.3%		
Sulfate		-6.9%				-8.8%				37.7%				22.7%				3.6%				-5.3%						-11.3%						
Sulfide								70.4%				93.6%				82.7%			>	97.9%			>	98.3%	>	99.3%			>	99.9%				99.8%

Notes:

NA = Percent removal calculation is not applicable due to the following logic cases:

1) The treated water effluent is non-detect, and the raw water was detected at a concentration less than the treated water effluent reporting limit.

2) The raw water is non-detect, and the treated effluent water was detected at a concentration less than the raw water reporting limit.

3) Both the raw water and the treated water effluent are non-detect.

4) Percent removal for certain wet chemistry parameters are not meaningful comparisons; therefore, calculations were not completed.

INF = Adit influent to treatment system

BCRX = Biochemical reactor barrel effluent

SAPS = Successive alkalinity producing system pre-treatment to BCR 2

CHIT = Chitorem pre-treatment to BCR 3

NAOH = Sodium hydroxide pre-treatment to BCR 4

POSTE = Effluent from post-treatment system

D = Dissolved Metals

T = Total Metals

BOD= Biological oxygen demand

Table 4.2-3
Danny T Treatability Study Year 2: Pilot Test Percent Removal
Barker-Hughesville Mining District Superfund Site

Location	BCR2/SAPS (compared to Influent location)																			
Sample ID	14BH-DT-PILOT-BCR2-061114				14BH-DT-PILOT-BCR2-062414				14BH-DT-PILOT-BCR2-070814				14BH-DT-PILOT-BCR2-072214				14BH-DT-PILOT-BCR2-080614			
Sample Date	6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014			
Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal	
Metals																				
Aluminum		97.7%		89.8%		99.1%		97.8%		99.5%		98.9%	>	98.3%		99.0%	>	98.0%	>	98.0%
Arsenic		94.1%	>	25.7%		90.9%		87.2%	>	88.0%		90.3%	>	89.2%		95.9%	>	86.0%	>	86.4%
Cadmium	>	99.2%	>	92.2%		99.6%		98.9%	>	99.3%		99.6%	>	99.3%	>	99.3%	>	99.1%	>	99.2%
Copper		98.3%		75.8%		96.7%		92.9%	>	99.2%		97.6%		99.4%		98.6%		99.4%	>	99.1%
Iron		99.3%		97.9%		99.1%		98.4%	>	99.9%		99.5%	>	99.3%		99.7%	>	99.2%		99.6%
Lead		98.9%		76.7%		98.6%		94.3%	>	98.6%		96.6%	>	99.0%		97.2%	>	98.5%		99.2%
Manganese		96.2%		95.0%		96.5%		96.2%		86.0%		84.1%		60.1%		58.5%		19.3%		13.8%
Nickel		-6.2%		-287.6%		77.7%		75.6%	>	64.9%	>	52.2%	>	44.1%	>	79.3%	>	47.4%	NA	--
Zinc		99.7%		97.7%		99.6%		98.9%		99.9%		96.8%	>	99.8%		99.5%	>	99.8%		99.9%
Wet Chemistry																				
Acidity			>	99.4%			>	99.4%			>	99.4%			>	99.5%			>	99.4%
Alkalinity	<	-226.0%			<	-85.4%			<	-37.0%			<	-550.0%			<	-299.0%		
Ammonia			NA	--			NA	--			NA	--			NA	--			NA	--
BOD			NA	--			NA	--			NA	--			NA	--			NA	--
Orthophosphate		-18774.7%	NA	--	<	-40900.0%	NA	--	<	-47900.0%	NA	--		-4372.0%	NA	--		-1806.1%	NA	--
Sulfate		16.5%				35.6%				56.1%				67.7%				47.4%		
Sulfide			NA	--			NA	--			NA	--			NA	--			NA	--

Location	BCR2/SAPS (compared to Influent location)																			
Sample ID	14BH-DT-PILOT-BCR2-081914				14BH-DT-PILOT-BCR2-090214				14BH-DT-PILOT-BCR2-091614				14BH-DT-PILOT-BCR2-092314				14BH-DT-PILOT-BCR2-092914			
Sample Date	8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal	
Metals																				
Aluminum	>	97.6%		99.1%		99.0%		99.1%	>	98.1%	>	98.2%	>	98.1%	>	98.1%		99.9%		99.8%
Arsenic	>	84.5%	>	83.7%	>	91.2%	>	91.4%	>	91.2%	>	91.1%	>	86.7%	>	88.2%		99.3%		99.0%
Cadmium	>	99.1%	>	99.1%	>	99.1%	>	99.1%	>	99.1%	>	99.2%	>	99.2%	>	99.2%	>	99.6%		100.0%
Copper		99.3%	>	98.9%	>	98.9%	>	98.9%		99.3%	>	98.9%		99.3%	>	99.0%	>	99.8%		99.8%
Iron		99.6%		99.5%		98.4%		98.4%	>	99.1%	>	99.1%	>	99.1%	>	99.2%		99.4%		99.3%
Lead	>	98.5%		99.0%	>	99.2%	>	99.2%	>	98.8%		99.3%	>	98.7%	>	98.9%		100.0%		99.4%
Manganese		-1.0%		-7.9%		-41.7%		-45.1%		0.2%		0.4%		13.3%		12.9%		30.7%		11.9%
Nickel	>	48.5%	>	53.1%		82.2%	>	59.5%	>	60.9%	>	56.9%	>	59.0%	>	63.0%		87.2%		65.6%
Zinc	>	99.8%		99.8%	>	99.8%		99.7%	>	99.8%		99.1%	>	99.8%		99.7%		99.9%		99.5%
Wet Chemistry																				
Acidity			>	99.3%				95.0%			>	99.4%			>	99.4%			>	99.4%
Alkalinity	<	-528.0%			<	-129.0%			<	-511.0%			<	-517.0%						
Ammonia			NA	--			NA	--			NA	--			NA	--			NA	--
BOD			NA	--			NA	--			NA	--			NA	--			NA	--
Orthophosphate		-856.2%	NA	--		-471.4%	NA	--		-701.8%	NA	--		-1026.6%	NA	--		-1324.5%	NA	--
Sulfate		31.9%				15.8%				47.1%				49.5%						
Sulfide			NA	--			NA	--			NA	--			NA	--			NA	--

Notes:

NA = Percent removal calculation is not applicable due to the following logic cases:

1) The treated water effluent is non-detect, and the raw water was detected at a concentration less than the treated water effluent reporting limit.

2) The raw water is non-detect, and the treated effluent water was detected at a concentration less than the raw water reporting limit.

3) Both the raw water and the treated water effluent are non-detect.

4) Percent removal for certain wet chemistry parameters are not meaningful comparisons; therefore, calculations were not completed.

INF = Adit influent to treatment system
BCRX = Biochemical reactor barrel effluent
SAPS = Successive alkalinity producing system pre-treatment to BCR 2
CHIT = Chitorem pre-treatment to BCR 3
NAOH = Sodium hydroxide pre-treatment to BCR 4
POSTE = Effluent from post-treatment system
POSTE = Effluent from post-treatment system

D = Dissolved Metals
T = Total Metals

BOD= Biological oxygen demand

Table 4.2-3
Danny T Treatability Study Year 2: Pilot Test Percent Removal
Barker-Hughesville Mining District Superfund Site

Location	BCR3/Chitorem (compared to Influent location)																			
Sample ID	14BH-DT-PILOT-BCR3-061114		14BH-DT-PILOT-BCR3-062414		14BH-DT-PILOT-BCR3-070814		14BH-DT-PILOT-BCR3-072214		14BH-DT-PILOT-BCR3-080614		14BH-DT-PILOT-BCR3-081914		14BH-DT-PILOT-BCR3-090214		14BH-DT-PILOT-BCR3-091614		14BH-DT-PILOT-BCR3-092314		14BH-DT-PILOT-BCR3-092914	
Sample Date	6/11/2014		6/24/2014		7/8/2014		7/22/2014		8/6/2014		8/19/2014		9/2/2014		9/16/2014		9/23/2014		9/29/2014	
Fraction	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T
Analyte	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal	% Removal
Metals																				
Aluminum	97.8%	88.5%	99.1%	99.1%	99.7%	99.8%	> 99.7%	> 99.7%	> 99.6%	> 99.6%	98.3%	98.3%	98.8%	98.6%	> 98.1%	> 98.2%	> 98.1%	99.1%	100.0%	99.9%
Arsenic	34.1%	33.1%	65.9%	76.9%	84.3%	85.2%	91.3%	89.6%	92.7%	91.7%	94.7%	93.3%	> 91.2%	96.3%	97.6%	> 91.1%	95.6%	95.8%	97.6%	97.7%
Cadmium	> 99.2%	98.1%	> 99.3%	> 99.3%	> 99.3%	> 99.3%	> 99.3%	> 99.3%	> 99.1%	> 99.2%	> 99.1%	> 99.1%	> 99.1%	> 99.1%	> 99.1%	> 99.2%	> 99.2%	> 99.2%	> 99.6%	> 99.6%
Copper	98.1%	87.1%	98.8%	96.5%	98.7%	96.6%	99.4%	98.9%	98.8%	99.3%	98.3%	> 98.9%	99.4%	> 98.9%	99.1%	> 98.9%	99.1%	> 99.0%	100.0%	99.9%
Iron	99.1%	97.8%	98.7%	98.7%	98.9%	98.6%	> 99.9%	99.9%	> 99.8%	> 99.8%	> 99.1%	> 99.1%	> 98.9%	> 98.9%	> 99.1%	> 99.1%	> 99.1%	> 99.2%	98.8%	98.8%
Lead	99.1%	85.9%	> 99.1%	97.8%	99.3%	96.9%	> 99.0%	99.0%	> 98.5%	> 98.4%	> 98.5%	> 98.1%	> 99.2%	> 99.2%	> 98.8%	> 98.8%	> 98.7%	> 98.9%	100.0%	99.8%
Manganese	96.2%	95.6%	96.1%	96.1%	92.1%	92.1%	89.7%	88.9%	63.9%	62.7%	60.6%	58.7%	38.0%	38.6%	50.0%	51.2%	48.0%	47.7%	42.1%	30.0%
Nickel	2.2%	-14.3%	3.9%	> 55.9%	> 64.9%	> 52.2%	> 44.1%	39.2%	> 47.4%	NA --	> 48.5%	69.9%	> 68.2%	76.3%	> 60.9%	> 56.9%	> 59.0%	> 63.0%	90.0%	91.1%
Zinc	99.7%	98.8%	99.9%	99.8%	99.9%	99.8%	99.9%	99.7%	99.9%	99.8%	> 99.8%	99.9%	> 99.8%	> 99.8%	> 99.8%	> 99.8%	> 99.8%	> 99.8%	100.0%	100.0%
Wet Chemistry																				
Acidity		> 99.4%		> 99.4%		> 99.4%		> 99.5%		> 99.4%		> 99.3%		> 99.3%		> 99.4%		> 99.4%		> 99.4%
Alkalinity	< -234.0%		< -128.0%		< -398.0%		< -2350.0%		< -1850.0%		< -2560.0%		< -488.0%		< -1060.0%		< -1310.0%			
Ammonia																				
BOD																				
Orthophosphate	-14196.7%		< -39600.0%		< -38100.0%		-3502.5%		-2855.8%		-6331.0%		-3960.2%		-4249.1%		-7305.1%		-9617.0%	
Sulfate	20.7%		34.5%		70.6%		72.3%		73.4%		73.3%		48.1%		67.1%		78.6%			
Sulfide																				

Notes:

NA = Percent removal calculation is not applicable due to the following logic cases:

1) The treated water effluent is non-detect, and the raw water was detected at a concentration less than the treated water effluent reporting limit.

2) The raw water is non-detect, and the treated effluent water was detected at a concentration less than the raw water reporting limit.

3) Both the raw water and the treated water effluent are non-detect.

4) Percent removal for certain wet chemistry parameters are not meaningful comparisons; therefore, calculations were not completed.

INF = Adit influent to treatment system
BCRX = Biochemical reactor barrel effluent
SAPS = Successive alkalinity producing system pre-treatment to BCR 2
CHIT = Chitorem pre-treatment to BCR 3
NAOH = Sodium hydroxide pre-treatment to BCR 4
POSTE = Effluent from post-treatment system
POSTE = Effluent from post-treatment system

D = Dissolved Metals
T = Total Metals

BOD= Biological oxygen demand

Table 4.2-3

Danny T Treatability Study Year 2: Pilot Test Percent Removal

Barker-Hughesville Mining District Superfund Site

Location	BCR4/NAOH (compared to Influent location)																			
Sample ID	14BH-DT-PILOT-BCR4-061114				14BH-DT-PILOT-BCR4-062414				14BH-DT-PILOT-BCR4-070814				14BH-DT-PILOT-BCR4-072214				14BH-DT-PILOT-BCR4-080614			
Sample Date	6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014			
Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal	
Metals																				
Aluminum		96.3%		91.6%		99.2%		98.8%		99.1%		95.7%	>	98.3%		99.0%	>	98.0%		99.2%
Arsenic		88.8%		86.8%		93.4%		87.3%	>	88.0%		91.2%	>	89.2%		92.4%	>	86.0%		94.8%
Cadmium		95.2%		85.2%		98.4%		95.3%	>	99.3%		95.3%	>	99.3%		99.2%	>	99.1%	>	99.2%
Copper		94.8%		82.7%		98.5%		96.4%	>	99.2%		95.3%		99.3%		99.0%		99.2%		99.4%
Iron		99.1%		98.0%		99.1%		99.0%		99.4%		98.9%	>	99.3%		99.7%	>	99.2%	>	99.2%
Lead		93.4%		81.7%		99.0%		98.0%	>	98.6%		96.1%	>	99.0%		98.2%	>	98.5%	>	98.4%
Manganese		90.9%		89.9%		90.5%		90.3%		49.8%		47.4%		45.9%		42.1%		8.9%		4.5%
Nickel		9.4%		-13.6%		42.3%	>	55.9%	>	64.9%	>	52.2%	>	44.1%		79.3%	>	47.4%	NA	--
Zinc		96.8%		94.4%		98.9%		97.3%		99.6%		88.7%		99.5%		94.9%		99.6%		97.8%
Wet Chemistry																				
Acidity			>	99.4%			>	99.4%			>	99.4%			>	99.5%			>	99.4%
Alkalinity	<	-208.0%			<	-13.8%				19.2%			<	-407.0%			<	-361.0%		
Ammonia																				
BOD																				
Orthophosphate		-10897.4%			<	-28100.0%			<	-27100.0%				-2105.0%				-590.6%		
Sulfate		10.4%				32.7%				43.4%				51.3%				46.3%		
Sulfide																				

Location	BCR4/NAOH (compared to Influent location)																			
Sample ID	14BH-DT-PILOT-BCR4-081914				14BH-DT-PILOT-BCR4-090214				14BH-DT-PILOT-BCR4-091614				14BH-DT-PILOT-BCR4-092314				14BH-DT-PILOT-BCR4-092914			
Sample Date	8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal		% Removal	
Metals																				
Aluminum	>	97.6%	>	97.7%		97.5%	>	98.0%	>	98.1%	>	98.2%	>	98.1%	>	98.1%		100.0%		99.8%
Arsenic		95.8%		92.5%	>	91.2%	>	91.4%	>	91.2%	>	91.1%	>	86.7%		96.5%	>	99.4%		95.1%
Cadmium	>	99.1%		99.5%	>	99.1%		99.3%	>	99.1%	>	99.2%	>	99.2%		99.1%	>	99.6%		99.1%
Copper		98.4%		98.9%	>	98.9%		99.4%		99.2%		99.2%		99.1%		99.0%	>	99.8%		99.5%
Iron	>	99.1%	>	99.1%	>	98.9%	>	98.9%	>	99.1%	>	99.1%	>	99.1%	>	99.2%		99.7%		99.7%
Lead	>	98.5%	>	98.1%	>	99.2%	>	99.2%	>	98.8%	>	98.8%	>	98.7%	>	98.9%	>	99.4%		99.7%
Manganese		28.6%		26.8%		5.8%		4.0%		42.2%		41.4%		46.6%		46.7%		99.7%		29.4%
Nickel	>	48.5%	>	53.1%	>	68.2%	>	59.5%	>	60.9%	>	56.9%	>	59.0%	>	63.0%		99.3%		35.4%
Zinc		99.7%		97.9%		99.8%		98.3%		99.9%		99.1%		99.7%		98.4%		99.7%		98.2%
Wet Chemistry																				
Acidity			>	99.3%			>	99.3%			>	99.4%			>	99.4%			>	99.4%
Alkalinity	<	-802.0%			<	-76.0%			<	-410.0%			<	-485.0%						
Ammonia																				
BOD																				
Orthophosphate		-640.7%				-208.3%				-278.7%				-931.6%				-5362.3%		
Sulfate		37.6%				18.1%				40.0%				42.7%						
Sulfide																				

Notes:

NA = Percent removal calculation is not applicable due to the following logic cases:

1) The treated water effluent is non-detect, and the raw water was detected at a concentration less than the treated water effluent reporting limit.

2) The raw water is non-detect, and the treated effluent water was detected at a concentration less than the raw water reporting limit.

3) Both the raw water and the treated water effluent are non-detect.

4) Percent removal for certain wet chemistry parameters are not meaningful comparisons; therefore, calculations were not completed.

INF = Adit influent to treatment system

BCRX = Biochemical reactor barrel effluent

SAPS = Successive alkalinity producing system pre-treatment to BCR 2

CHIT = Chitorem pre-treatment to BCR 3

NAOH = Sodium hydroxide pre-treatment to BCR 4

POSTE = Effluent from post-treatment system

POSTE = Effluent from post-treatment system

D = Dissolved Metals

T = Total Metals

BOD= Biological oxygen demand

Table 4.2-4
Danny T Treatability Study Year 2: Pilot Test Comparison to Water Quality Standards
Barker-Hughesville Mining District Superfund Site

		Location	INF																			
		Sample ID	14BH-DT-PILOT-INF-061114				14BH-DT-PILOT-INF-062414				14BH-DT-PILOT-INF-070814				14BH-DT-PILOT-INF-072214				14BH-DT-PILOT-INF-080614			
		Sample Date	6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014			
		Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	**12400**		**13100**		**13700**		**14000**		**15000**		**15100**		**14600**		**14500**		**12600**		**12800**	
Antimony	µg/L	5.6																				
Arsenic	µg/L	10.0	**264**		**269**		136		134		**166**		**198**	J	**186**		**189**		143		147	J
Barium	µg/L	1000.0																				
Beryllium	µg/L	4.0																				
Cadmium	µg/L	0.3	**258**		**256**		**284**		**283**		**285**		**291**		**276**		**272**		**232**		**245**	
Chromium	µg/L	86.2																				
Copper	µg/L	9.3	**1210**		**1120**		**1060**		**1130**		**1270**		**1060**		**919**		**852**	J	**849**		**1140**	
Iron	µg/L	1000.0	**154000**		**160000**		**155000**		**156000**		**184000**		**185000**		**181000**		**180000**		**159000**		**162000**	
Lead	µg/L	3.2	**245**		**239**	J	**213**		**189**		**147**		**221**		**199**		**207**		**134**		**129**	
Nickel	µg/L	52.2	27.6		25.8		53.9		22.7		28.5		20.9		17.9		48.2	J	19		100	U
Selenium	µg/L	50.0																				
Silver	µg/L	100.0																				
Thallium	µg/L	0.2																				
Zinc	µg/L	119.8	**59500**		**59300**		**64400**		**63800**		**66500**		**65300**		**62700**		**62600**		**57000**		**57800**	
Hardness	mg/L	100	337		337		366		366		375		375		372		372		346		346	
Hardness for calculation[2]	mg/L	100	337		337		366		366		375		375		372		372		346		346	

		Location	INF																			
		Sample ID	14BH-DT-PILOT-INF-081914				14BH-DT-PILOT-INF-090214				14BH-DT-PILOT-INF-091614				14BH-DT-PILOT-INF-092314				14BH-DT-PILOT-INF-092914			
		Sample Date	8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
		Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	**10600**		**10900**		**12300**		**12300**		**12900**		**13600**		**13300**		**13500**		**13700**		**14100**	
Antimony	µg/L	5.6																	2	J	2	J
Arsenic	µg/L	10.0	129		123		**227**		**233**	J	**227**		**225**		150		**169**		**178**		**189**	
Barium	µg/L	1000.0																	3.8	J	3.9	J
Beryllium	µg/L	4.0																	7.4		7.8	
Cadmium	µg/L	0.3	**222**		**232**		**220**		**211**		**226**		**240**		**238**		**246**		**271**		**275**	
Chromium	µg/L	86.2																	5.7		7.8	
Copper	µg/L	9.3	**812**		**871**		**933**		**917**		**825**		**901**	J	**892**		**1010**		**1170**		**1230**	
Iron	µg/L	1000.0	**133000**		**137000**		**111000**		**111000**		**140000**		**146000**		**140000**		**148000**		**152000**		**164000**	
Lead	µg/L	3.2	**136**		**104**		**246**		**250**		**169**		**166**		**158**		**175**		**169**		**172**	
Nickel	µg/L	52.2	19.4		21.3		31.4		24.7		25.6		23.2	J	24.4		27		35.9		38.4	
Selenium	µg/L	50.0																	5	J	5	J
Silver	µg/L	100.0																	1	J	1	J
Thallium	µg/L	0.2																	1.9		1.9	
Zinc	µg/L	119.8	**52400**		**50400**		**44000**		**45100**		**52400**		**54600**		**55500**		**58400**		**53300**		**54500**	
Hardness	mg/L	100	313		313		256		256		306		306		325		325		334.23		369.71	
Hardness for calculation[2]	mg/L	100	313		313		256		256		306		306		325		325		334.23		369.71	

Notes:

Aquatic life hardness-based equations for 6 metals are shown below. Equations are from DEQ-7 Montana Numeric Water Quality Standards (October 2012).

[1] Standards shown for cadmium, chromium, copper, lead, nickel, and zinc are based on 100 mg/L hardness for comparison purposes only. Actual screening in the table is based on the calculated hardness for each particular sample result.

[2] A hardness concentration of 400 mg/L was used for all measurements greater than 400 mg/L as per MT DEQ Montana Numeric Water Quality Standards (October 2012).

[3] A hardness value of 400 mg/L was assumed for the standards' calculations for POSTI and POSTE on 9/16/2014. A hardness measurement was not collected on that date, however measurements before and after this date were significantly greater than 400 mg/L.

Cadmium	Acute	$e^{(1.0166*\ln(hardness)-3.924)}$
	Chronic	$e^{(0.7409*\ln(hardness)-4.719)}$
Chromium	Acute	$e^{(0.819*\ln(hardness)+3.7256)}$
	Chronic	$e^{(0.819*\ln(hardness)+0.6848)}$
Copper	Acute	$e^{(0.9422*\ln(hardness)-1.7)}$
	Chronic	$e^{(0.8545*\ln(hardness)-1.702)}$
Lead	Acute	$e^{(1.273*\ln(hardness)-1.46)}$
	Chronic	$e^{(1.273*\ln(hardness)-4.705)}$
Nickel	Acute	$e^{(0.846*\ln(hardness)+2.255)}$
	Chronic	$e^{(0.846*\ln(hardness)+0.0584)}$
Zinc	Acute/chronic	$e^{(0.8473*\ln(hardness)+0.884)}$

D = Dissolved Metals
T = Total Metals
Q = Qualifier
µg/L= micrograms per liter
mg/L = milligrams per liter

INF = Adit influent to treatment system
BCRX = Biochemical reactor barrel effluent
SAPS = Successive alkalinity producing system pre-treatment to BCR 2
CHIT = Chitorem pre-treatment to BCR 3
NAOH = Sodium hydroxide pre-treatment to BCR 4
POSTI = Combined four BCR effluents into post-treatment system
POSTE = Effluent from post-treatment system

Flags:

Text -	Exceeds Human Health standard.
Text -	Exceeds Chronic Aquatic Life standard.
Text -	Exceeds Acute Aquatic Life standard.

Table 4.2-4
Danny T Treatability Study Year 2: Pilot Test Comparison to Water Quality Standards
Barker-Hughesville Mining District Superfund Site

		Location	**BCR1**																				
		Sample ID	**14BH-DT-PILOT-BCR1-061114**				**14BH-DT-PILOT-BCR1-062414**				**14BH-DT-PILOT-BCR1-070814**				**14BH-DT-PILOT-BCR1-072214**				**14BH-DT-PILOT-BCR1-080614**			
		Sample Date	**6/11/2014**				**6/24/2014**				**7/8/2014**				**7/22/2014**				**8/6/2014**			
		Fraction	**D**		**T**		**D**		**T**		**D**		**T**		**D**		**T**		**D**		**T**	
Analyte	**Units**	**Standard[1]**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**
Aluminum	µg/L	87.0	**436**	J	**1190**		250	U	**151**	J	50	U	**265**		**172**	J	**185**	J	250	U	**140**	J
Antimony	µg/L	5.6																				
Arsenic	µg/L	10.0	94.5		109		20.3		20.5		5.98	J	13.7	J	5.24	J	6.77	J	20	U	20	U
Barium	µg/L	1000.0																				
Beryllium	µg/L	4.0																				
Cadmium	µg/L	0.3	2	U	**17.1**		2	U	**1.37**	J	2	U	**2.1**		2	U	2	U	2	U	2	U
Chromium	µg/L	86.2																				
Copper	µg/L	9.3	18.6		**145**		5.3	J	17.1		10	U	15.7		10	U	10	U	6.94	J	10	U
Iron	µg/L	1000.0	**1410**	J	**2610**		1250	U	1250	U	**2190**		**11000**		1250	U	687	J	1250	U	1250	U
Lead	µg/L	3.2	2	U	**20.5**	J	2	U	1.23	J	2	U	1.59	J	2	U	2.23		2	U	1.34	J
Nickel	µg/L	52.2	10	U	10	U	27.1		10	U	10	U	10	U	10	U	10	U	10	U	10	U
Selenium	µg/L	50.0																				
Silver	µg/L	100.0																				
Thallium	µg/L	0.2																				
Zinc	µg/L	119.8	142	J	**882**		82.2	J	250		59.2		**2200**		100	U	**497**		100	U	175	
Hardness	mg/L	100	3270		3270		2320		2320		1760		1760		1340		1340		963		963	
Hardness for calculation[2]	mg/L	100	400		400		400		400		400		400		400		400		400		400	

		Location	**BCR1**																				
		Sample ID	**14BH-DT-PILOT-BCR1-081914**				**14BH-DT-PILOT-BCR1-090214**				**14BH-DT-PILOT-BCR1-091614**				**14BH-DT-PILOT-BCR1-092314**				**14BH-DT-PILOT-BCR1-092914**			
		Sample Date	**8/19/2014**				**9/2/2014**				**9/16/2014**				**9/23/2014**				**9/29/2014**			
		Fraction	**D**		**T**		**D**		**T**		**D**		**T**		**D**		**T**		**D**		**T**	
Analyte	**Units**	**Standard[1]**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**
Aluminum	µg/L	87.0	**137**	J	**199**	J	**129**	J	**140**	J	250	U	250	U	250	U	250	U	13	J	23.9	
Antimony	µg/L	5.6																	2	J	2	J
Arsenic	µg/L	10.0	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	0.97	J	1.4	
Barium	µg/L	1000.0																	188		181	
Beryllium	µg/L	4.0																	1	U	1	U
Cadmium	µg/L	0.3	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	1	U	0.047	J
Chromium	µg/L	86.2																	3.6		6.4	
Copper	µg/L	9.3	14.3		10	U	10	U	10	U	10	U	10	U	10	U	10	U	2	U	2	J
Iron	µg/L	1000.0	1250	U	1250	U	1250	U	**6450**		1250	U	1250	U	1250	U	1250	U	**1930**		**2450**	
Lead	µg/L	3.2	1.01	J	6		2	U	2	U	2	U	1.11	J	2	U	2	U	1	U	0.48	J
Nickel	µg/L	52.2	10	U	10	U	15.6		10	U	10	U	10	U	10	U	10	U	11.4		13.2	
Selenium	µg/L	50.0																	5	J	**9.4**	
Silver	µg/L	100.0																	1	U	1	U
Thallium	µg/L	0.2																	1	U	1	U
Zinc	µg/L	119.8	100	U	119		100	U	76.2	J	100	U	96.3	J	100	U	50.8	J	3.8		76.2	
Hardness	mg/L	100	925		925		736		736		777		777		832		832		400		400	
Hardness for calculation[2]	mg/L	100	400		400		400		400		400		400		400		400		400		400	

Notes:

Aquatic life hardness-based equations for 6 metals are shown below. Equations are from DEQ-7 Montana Numeric Water Quality Standards (October 2012).

[1] Standards shown for cadmium, chromium, copper, lead, nickel, and zinc are based on 100 mg/L hardness for comparison purposes only. Actual screening in the table is based on the calculated hardness for each particular sample result.

[2] A hardness concentration of 400 mg/L was used for all measurements greater than 400 mg/L as per MT DEQ Montana Numeric Water Quality Standards (October 2012).

[3] A hardness value of 400 mg/L was assumed for the standards' calculations for POSTI and POSTE on 9/16/2014. A hardness measurement was not collected on that date, however measurements before and after this date were significantly greater than 400 mg/L.

Cadmium	Acute	$e^{(1.0166*\ln(hardness)-3.924)}$
	Chronic	$e^{(0.7409*\ln(hardness)-4.719)}$
Chromium	Acute	$e^{(0.819*\ln(hardness)+3.7256)}$
	Chronic	$e^{(0.819*\ln(hardness)+0.6848)}$
Copper	Acute	$e^{(0.9422*\ln(hardness)-1.7)}$
	Chronic	$e^{(0.8545*\ln(hardness)-1.702)}$
Lead	Acute	$e^{(1.273*\ln(hardness)-1.46)}$
	Chronic	$e^{(1.273*\ln(hardness)-4.705)}$
Nickel	Acute	$e^{(0.846*\ln(hardness)+2.255)}$
	Chronic	$e^{(0.846*\ln(hardness)+0.0584)}$
Zinc	Acute/chronic	$e^{(0.8473*\ln(hardness)+0.884)}$

D = Dissolved Metals
T = Total Metals
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POSTI = Combined four BCR effluents into post-treatment system
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Flags:

Text -	Exceeds Human Health standard.
Text -	Exceeds Chronic Aquatic Life standard.
Text -	Exceeds Acute Aquatic Life standard.

Table 4.2-4

Danny T Treatability Study Year 2: Pilot Test Comparison to Water Quality Standards

Barker-Hughesville Mining District Superfund Site

		Location	SAPS																																							
		Sample ID	14BH-DT-PILOT-SAPS-061114				14BH-DT-PILOT-SAPS-062414				14BH-DT-PILOT-SAPS-070814				14BH-DT-PILOT-SAPS-072214				14BH-DT-PILOT-SAPS-080614				14BH-DT-PILOT-SAPS-081914				14BH-DT-PILOT-SAPS-090214				14BH-DT-PILOT-SAPS-091614				14BH-DT-PILOT-SAPS-092314				14BH-DT-PILOT-SAPS-092914			
		Sample Date	6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014				8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
		Fraction	D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	500	U	500	U	250	U	250	U	**142**	J	**159**	J	**321**		**587**		**554**		**1650**		**394**		**494**		**464**		**575**		**304**		**894**		**411**		**498**		**732**		**856**	
Antimony	µg/L	5.6																																					2	J	2	J
Arsenic	µg/L	10.0	17.4	J	16.8	J	19.7	J	19.9	J	36.2		38.8	J	9.62	J	10.7	J	20	U	200	U	5.75	J	5.41	J	20	U	20	U	5.35	J	20	U	20	U	20	U	3.1		3.1	
Barium	µg/L	1000.0																																					45.6		46.5	
Beryllium	µg/L	4.0																																					0.77	J	0.92	J
Cadmium	µg/L	0.3	**5.25**		**6.66**		2	U	**2.18**		2	U	2	U	2	U	2	U	2	U	20	U	2	U	2	U	2	U	2	U	2	U	**1.2**	J	2	U	2	U	**2.2**		**1.9**	
Chromium	µg/L	86.2																																					4.9		10.4	
Copper	µg/L	9.3	**44**		**77.7**		10	U	8.61	J	10	U	5.4	J	10	U	10	UJ	10	U	100	U	5.34	J	10	U	10	U	5.52	J	5.08	J	11.8	J	5.41	J	6.26	J	2	J	13.1	
Iron	µg/L	1000.0	**6260**		**6390**		**26800**		**26100**		**107000**		**103000**		**112000**		**118000**		**107000**		**109000**		**111000**		**108000**		**81900**		**80200**		**88600**		**88100**		**101000**		**103000**		**111000**		**114000**	
Lead	µg/L	3.2	2	U	1.75	J	2	U	2	U	2	U	10.5		2	U	1.32	J	2	U	20	U	2	U	2	U	2	U	2	U	2	U	1.3	J	2	U	2	U	0.21	J	1.8	
Nickel	µg/L	52.2	10	U	10	U	27.1		10	U	19		11.3		7.19	J	9.74	J	15		100	U	19.9		21.4		26.7		26.8		18.2		26.2	J	21		18.3	J	71.3		65.5	
Selenium	µg/L	50.0																																					5	J	5	J
Silver	µg/L	100.0																																					2.3		1	J
Thallium	µg/L	0.2																																					0.21	J	0.24	J
Zinc	µg/L	119.8	**2260**		**2480**		**6280**		**5950**		**16100**		**18300**		**5520**		**7180**		**18200**		**18300**		**27200**		**25800**		**25600**		**26400**		**27100**		**26800**		**33900**		**33600**		**38100**		**39300**	
Hardness	mg/L	100	987		987		903		903		802		802		677		677		640		640		622		622		531		531		601		601		638		638		400		400	
Hardness for calculation[2]	mg/L	100	400		400		400		400		400		400		400		400		400		400		400		400		400		400		400		400		400		400		400		400	

Notes:

Aquatic life hardness-based equations for 6 metals are shown below. Equations are from DEQ-7 Montana Numeric Water Quality Standards (October 2012).

[1] Standards shown for cadmium, chromium, copper, lead, nickel, and zinc are based on 100 mg/L hardness for comparison purposes only. Actual screening in the table is based on the calculated hardness for each particular sample result.

[2] A hardness concentration of 400 mg/L was used for all measurements greater than 400 mg/L as per MT DEQ Montana Numeric Water Quality Standards (October 2012).

[3] A hardness value of 400 mg/L was assumed for the standards' calculations for POSTI and POSTE on 9/16/2014. A hardness measurement was not collected on that date, however measurements before and after this date were significantly greater than 400 mg/L.

Cadmium	Acute	$e^{(1.0166*\ln(hardness)-3.924)}$
	Chronic	$e^{(0.7409*\ln(hardness)-4.719)}$
Chromium	Acute	$e^{(0.819*\ln(hardness)+3.7256)}$
	Chronic	$e^{(0.819*\ln(hardness)+0.6848)}$
Copper	Acute	$e^{(0.9422*\ln(hardness)-1.7)}$
	Chronic	$e^{(0.8545*\ln(hardness)-1.702)}$
Lead	Acute	$e^{(1.273*\ln(hardness)-1.46)}$
	Chronic	$e^{(1.273*\ln(hardness)-4.705)}$
Nickel	Acute	$e^{(0.846*\ln(hardness)+2.255)}$
	Chronic	$e^{(0.846*\ln(hardness)+0.0584)}$
Zinc	Acute/chronic	$e^{(0.8473*\ln(hardness)+0.884)}$

D = Dissolved Metals
T = Total Metals
Q = Qualifier
µg/L= micrograms per liter
mg/L = milligrams per liter

INF = Adit influent to treatment system
BCRX = Biochemical reactor barrel effluent
SAPS = Successive alkalinity producing system pre-treatment to BCR 2
CHIT = Chitorem pre-treatment to BCR 3
NAOH = Sodium hydroxide pre-treatment to BCR 4
POSTI = Combined four BCR effluents into post-treatment system
POSTE = Effluent from post-treatment system

Flags:

Text -	Exceeds Human Health standard.
Text -	Exceeds Chronic Aquatic Life standard.
▨ Text -	Exceeds Acute Aquatic Life standard.

Table 4.2-4
Danny T Treatability Study Year 2: Pilot Test Comparison to Water Quality Standards
Barker-Hughesville Mining District Superfund Site

		Location	BCR2																			
		Sample ID	14BH-DT-PILOT-BCR2-061114				14BH-DT-PILOT-BCR2-062414				14BH-DT-PILOT-BCR2-070814				14BH-DT-PILOT-BCR2-072214				14BH-DT-PILOT-BCR2-080614			
		Sample Date	6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014			
		Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	**282**	J	**1340**		**129**		**304**		81.2		**161**		250	U	**148**	J	250	U	250	U
Antimony	µg/L	5.6																				
Arsenic	µg/L	10.0	15.6	J	200	U	12.4	J	17.1	J	20	U	19.3	J	20	U	7.73	J	20	U	20	U
Barium	µg/L	1000.0																				
Beryllium	µg/L	4.0																				
Cadmium	µg/L	0.3	2	U	20	U	**1.1**	J	**3.01**		2	U	**1.21**	J	2	U	2	U	2	U	2	U
Chromium	µg/L	86.2																				
Copper	µg/L	9.3	20.2		**271**		**35.2**		**80**		10	U	25.6		5.43	J	11.7		5.09	J	10	U
Iron	µg/L	1000.0	**1030**	J	**3400**		**1470**		**2530**		250	U	1000		1250	U	615	J	1250	U	657	J
Lead	µg/L	3.2	2.61		**55.7**	J	2.95		10.7		2	U	7.48		2	U	5.73		2	U	1.09	J
Nickel	µg/L	52.2	29.3		100	U	12		5.54	J	10	U	10	U	10	U	10	U	10	U	10	U
Selenium	µg/L	50.0																				
Silver	µg/L	100.0																				
Thallium	µg/L	0.2																				
Zinc	µg/L	119.8	165	J	**1370**		268		**670**		46.8		**2100**		100	U	326		100	U	62.4	J
Hardness	mg/L	100	1600		1600		1300		1300		1220		1220		895		895		774		774	
Hardness for calculation[2]	mg/L	100	400		400		400		400		400		400		400		400		400		400	

		Location	BCR2																			
		Sample ID	14BH-DT-PILOT-BCR2-081914				14BH-DT-PILOT-BCR2-090214				14BH-DT-PILOT-BCR2-091614				14BH-DT-PILOT-BCR2-092314				14BH-DT-PILOT-BCR2-092914			
		Sample Date	8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
		Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	250	U	**100**	J	**126**	J	**113**	J	250	U	250	U	250	U	250	U	9.6	J	24.9	
Antimony	µg/L	5.6																	2	J	2	J
Arsenic	µg/L	10.0	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	1.2		1.9	
Barium	µg/L	1000.0																	219		211	
Beryllium	µg/L	4.0																	1	U	1	U
Cadmium	µg/L	0.3	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	1	U	0.046	J
Chromium	µg/L	86.2																	1.9	J	11.5	
Copper	µg/L	9.3	5.36	J	10	U	10	U	10	U	5.93	J	10	U	6.19	J	10	U	2	U	2	J
Iron	µg/L	1000.0	533	J	710	J	**1730**		**1770**		1250	U	1250	U	1250	U	1250	U	876		**1210**	
Lead	µg/L	3.2	2	U	1	J	2	U	2	U	2	U	1.19	J	2	U	2	U	0.045	J	1.1	
Nickel	µg/L	52.2	10	U	10	U	5.59	J	10	U	10	U	10	U	10	U	10	U	4.6		13.2	
Selenium	µg/L	50.0																	5	J	**8.4**	
Silver	µg/L	100.0																	1	U	1	U
Thallium	µg/L	0.2																	1	U	1	U
Zinc	µg/L	119.8	100	U	102		100	U	125		100	U	**514**		100	U	160		39.9		288	
Hardness	mg/L	100	746		746		734		734		653		653		662		662		400		400	
Hardness for calculation[2]	mg/L	100	400		400		400		400		400		400		400		400		400		400	

Notes:

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	Chronic	$e^{(0.8545*\ln(hardness)-1.702)}$
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POSTE = Effluent from post-treatment system

Flags:

Text -	Exceeds Human Health standard.
Text -	Exceeds Chronic Aquatic Life standard.
▨ Text -	Exceeds Acute Aquatic Life standard.

Table 4.2-4

Danny T Treatability Study Year 2: Pilot Test Comparison to Water Quality Standards

Barker-Hughesville Mining District Superfund Site

		Location	CHIT																			
		Sample ID	14BH-DT-PILOT-CHIT-061114				14BH-DT-PILOT-CHIT-062414				14BH-DT-PILOT-CHIT-070814				14BH-DT-PILOT-CHIT-072214				14BH-DT-PILOT-CHIT-080614			
		Sample Date	6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014			
		Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	**94.5**		**211**		50	U	50	U	50	U	50	U	**277**		**298**		**173**	J	**219**	J
Antimony	µg/L	5.6																				
Arsenic	µg/L	10.0	48.5		52		23.6		18.5	J	7.06	J	7.06	J	20	U	6.36	J	20	U	20	U
Barium	µg/L	1000.0																				
Beryllium	µg/L	4.0																				
Cadmium	µg/L	0.3	2	U	2	U	2	U	2	U	2	U	**1.69**	J	2	U	**1.86**	J	2	U	2	U
Chromium	µg/L	86.2																				
Copper	µg/L	9.3	24.3		22.7		10.8		14.9		10	U	8.24	J	10	U	6.58	J	10	U	7.05	J
Iron	µg/L	1000.0	407		**2250**		**2300**		**2700**		**5000**		**6170**		**4310**		**2950**		**2320**		**5830**	
Lead	µg/L	3.2	2	U	1.27	J	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U
Nickel	µg/L	52.2	10	U	10	U	29.1		10	U	10	U	10	U	10	U	11.8	J	10	U	10	U
Selenium	µg/L	50.0																				
Silver	µg/L	100.0																				
Thallium	µg/L	0.2																				
Zinc	µg/L	119.8	205		**401**		35.2		63		30.2		298		297		**887**		100	U	**404**	
Hardness	mg/L	100	1140		1140		2130		2130		2920		2920		2010		2010		1620		1620	
Hardness for calculation[2]	mg/L	100	400		400		400		400		400		400		400		400		400		400	

		Location	CHIT																			
		Sample ID	14BH-DT-PILOT-CHIT-081914				14BH-DT-PILOT-CHIT-090214				14BH-DT-PILOT-CHIT-091614				14BH-DT-PILOT-CHIT-092314				14BH-DT-PILOT-CHIT-092914			
		Sample Date	8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
		Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	**144**	J	**155**	J	**428**		**5400**		250	U	**6740**		**626**		**12400**		**2300**		**17600**	
Antimony	µg/L	5.6																	2	J	2	J
Arsenic	µg/L	10.0	20	U	20	U	20	U	15.8	J	7.97	J	21.9		20	U	12.5	J	2.8		12	
Barium	µg/L	1000.0																	20.8		46.5	
Beryllium	µg/L	4.0																	1.8		8.1	
Cadmium	µg/L	0.3	2	U	2	U	2	U	**53.5**		2	U	**77.1**		2	U	**54.5**		0.27	J	**256**	
Chromium	µg/L	86.2																	1.9	J	10.5	
Copper	µg/L	9.3	10	U	10	U	10	U	**172**		10	U	**299**		10	U	**179**	J	2	J	**363**	
Iron	µg/L	1000.0	**1620**		**5120**		**31500**		**49900**		**3120**		**51400**		**59100**		**87700**		**74900**		**98500**	
Lead	µg/L	3.2	2	U	2	U	2	U	**48**		2	U	**55.3**		2	U	**39.1**		0.2	J	**174**	
Nickel	µg/L	52.2	10	U	10	U	11.3		13.6		10	U	10	U	6.64	J	11.2	J	24.5		48	
Selenium	µg/L	50.0																	5	J	**6.6**	
Silver	µg/L	100.0																	1.5		1	J
Thallium	µg/L	0.2																	1	U	1.9	
Zinc	µg/L	119.8	100	U	**586**		53	J	**15900**		100	U	**22600**		100	U	**31300**		**14100**		**61700**	
Hardness	mg/L	100	958		958		585		585		871		871		637		637		400		400	
Hardness for calculation[2]	mg/L	100	400		400		400		400		400		400		400		400		400		400	

Notes:

Aquatic life hardness-based equations for 6 metals are shown below. Equations are from DEQ-7 Montana Numeric Water Quality Standards (October 2012).

[1]Standards shown for cadmium, chromium, copper, lead, nickel, and zinc are based on 100 mg/L hardness for comparison purposes only. Actual screening in the table is based on the calculated hardness for each particular sample result.

[2] A hardness concentration of 400 mg/L was used for all measurements greater than 400 mg/L as per MT DEQ Montana Numeric Water Quality Standards (October 2012).

[3]A hardness value of 400 mg/L was assumed for the standards' calculations for POSTI and POSTE on 9/16/2014. A hardness measurement was not collected on that date, however measurements before and after this date were significantly greater than 400 mg/L.

Cadmium	Acute	$e^{(1.0166*\ln(hardness)-3.924)}$
	Chronic	$e^{(0.7409*\ln(hardness)-4.719)}$
Chromium	Acute	$e^{(0.819*\ln(hardness)+3.7256)}$
	Chronic	$e^{(0.819*\ln(hardness)+0.6848)}$
Copper	Acute	$e^{(0.9422*\ln(hardness)-1.7)}$
	Chronic	$e^{(0.8545*\ln(hardness)-1.702)}$
Lead	Acute	$e^{(1.273*\ln(hardness)-1.46)}$
	Chronic	$e^{(1.273*\ln(hardness)-4.705)}$
Nickel	Acute	$e^{(0.846*\ln(hardness)+2.255)}$
	Chronic	$e^{(0.846*\ln(hardness)+0.0584)}$
Zinc	Acute/chronic	$e^{(0.8473*\ln(hardness)+0.884)}$

D = Dissolved Metals
T = Total Metals
Q = Qualifier
µg/L= micrograms per liter
mg/L = milligrams per liter

INF = Adit influent to treatment system
BCRX = Biochemical reactor barrel effluent
SAPS = Successive alkalinity producing system pre-treatment to BCR 2
CHIT = Chitorem pre-treatment to BCR 3
NAOH = Sodium hydroxide pre-treatment to BCR 4
POSTI = Combined four BCR effluents into post-treatment system
POSTE = Effluent from post-treatment system

Flags:

Text -	Exceeds Human Health standard.
Text -	Exceeds Chronic Aquatic Life standard.
Text -	Exceeds Acute Aquatic Life standard.

Table 4.2-4
Danny T Treatability Study Year 2: Pilot Test Comparison to Water Quality Standards
Barker-Hughesville Mining District Superfund Site

		Location	BCR3																			
		Sample ID	14BH-DT-PILOT-BCR3-061114				14BH-DT-PILOT-BCR3-062414				14BH-DT-PILOT-BCR3-070814				14BH-DT-PILOT-BCR3-072214				14BH-DT-PILOT-BCR3-080614			
		Sample Date	6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014			
		Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	**279**	J	**1500**		**127**		**133**		37.9	J	26.2	J	50	U	50	U	50	U	50	U
Antimony	µg/L	5.6																				
Arsenic	µg/L	10.0	**174**		**180**		46.4		31		26		29.3	J	16.2	J	19.7	J	10.4	J	12.2	J
Barium	µg/L	1000.0																				
Beryllium	µg/L	4.0																				
Cadmium	µg/L	0.3	2	U	**4.87**		2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U
Chromium	µg/L	86.2																				
Copper	µg/L	9.3	22.7		**144**		12.9		**39.5**		17		**36.2**		5.69	J	9.34	J	9.81	J	7.47	J
Iron	µg/L	1000.0	**1320**	J	**3530**		**2060**		**1990**		**2070**		**2510**		250	U	152	J	250	U	250	U
Lead	µg/L	3.2	2.19		**33.6**	J	2	U	4.07		1.04	J	6.88		2	U	1.97	J	2	U	2	U
Nickel	µg/L	52.2	27		29.5		51.8		10	U	10	U	10	U	10	U	29.3	J	10	U	10	U
Selenium	µg/L	50.0																				
Silver	µg/L	100.0																				
Thallium	µg/L	0.2																				
Zinc	µg/L	119.8	155	J	**693**		63.6		121		95.7		116		40.8		162		44.6		108	
Hardness	mg/L	100	1870		1870		1570		1570		2520		2520		2410		2410		2060		2060	
Hardness for calculation[2]	mg/L	100	400		400		400		400		400		400		400		400		400		400	

		Location	BCR3																			
		Sample ID	14BH-DT-PILOT-BCR3-081914				14BH-DT-PILOT-BCR3-090214				14BH-DT-PILOT-BCR3-091614				14BH-DT-PILOT-BCR3-092314				14BH-DT-PILOT-BCR3-092914			
		Sample Date	8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
		Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	**175**	J	**181**	J	**148**	J	**175**	J	250	U	250	U	250	U	**116**	J	5.5	J	11.8	J
Antimony	µg/L	5.6																	2	J	2	J
Arsenic	µg/L	10.0	6.81	J	8.3	J	20	U	8.6	J	5.37	J	20	U	6.56	J	7.09	J	4.3		4.3	
Barium	µg/L	1000.0																	105		107	
Beryllium	µg/L	4.0																	1	U	1	U
Cadmium	µg/L	0.3	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	1	U	1	U
Chromium	µg/L	86.2																	0.98	J	1.7	J
Copper	µg/L	9.3	13.9		10	U	5.48	J	10	U	7.39	J	10	U	7.69	J	10	U	0.57	J	1.2	J
Iron	µg/L	1000.0	1250	U	1250	U	1250	U	1250	U	1250	U	1250	U	1250	U	1250	U	**1810**		**1940**	
Lead	µg/L	3.2	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	0.062	J	0.36	J
Nickel	µg/L	52.2	10	U	6.41	J	10	U	5.85	J	10	U	10	U	10	U	10	U	3.6		3.4	
Selenium	µg/L	50.0																	**19**		**37.7**	
Silver	µg/L	100.0																	1	U	1	U
Thallium	µg/L	0.2																	1	U	1	U
Zinc	µg/L	119.8	100	U	56	J	100	U	100	U	100	U	100	U	100	U	100	U	7.4		11.8	
Hardness	mg/L	100	1300		1300		896		896		798		798		767		767		400		400	
Hardness for calculation[2]	mg/L	100	400		400		400		400		400		400		400		400		400		400	

Notes:

Aquatic life hardness-based equations for 6 metals are shown below. Equations are from DEQ-7 Montana Numeric Water Quality Standards (October 2012).

[1] Standards shown for cadmium, chromium, copper, lead, nickel, and zinc are based on 100 mg/L hardness for comparison purposes only. Actual screening in the table is based on the calculated hardness for each particular sample result.

[2] A hardness concentration of 400 mg/L was used for all measurements greater than 400 mg/L as per MT DEQ Montana Numeric Water Quality Standards (October 2012).

[3] A hardness value of 400 mg/L was assumed for the standards' calculations for POSTI and POSTE on 9/16/2014. A hardness measurement was not collected on that date, however measurements before and after this date were significantly greater than 400 mg/L.

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	Chronic	$e^{(0.7409*\ln(hardness)-4.719)}$
Chromium	Acute	$e^{(0.819*\ln(hardness)+3.7256)}$
	Chronic	$e^{(0.819*\ln(hardness)+0.6848)}$
Copper	Acute	$e^{(0.9422*\ln(hardness)-1.7)}$
	Chronic	$e^{(0.8545*\ln(hardness)-1.702)}$
Lead	Acute	$e^{(1.273*\ln(hardness)-1.46)}$
	Chronic	$e^{(1.273*\ln(hardness)-4.705)}$
Nickel	Acute	$e^{(0.846*\ln(hardness)+2.255)}$
	Chronic	$e^{(0.846*\ln(hardness)+0.0584)}$
Zinc	Acute/chronic	$e^{(0.8473*\ln(hardness)+0.884)}$

D = Dissolved Metals
T = Total Metals
Q = Qualifier
µg/L= micrograms per liter
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INF = Adit influent to treatment system
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Flags:

Text -	Exceeds Human Health standard.
Text -	Exceeds Chronic Aquatic Life standard.
▨ Text -	Exceeds Acute Aquatic Life standard.

Table 4.2-4
Danny T Treatability Study Year 2: Pilot Test Comparison to Water Quality Standards
Barker-Hughesville Mining District Superfund Site

		Location	NAOH																																							
		Sample ID	14BH-DT-PILOT-NAOH-061114				14BH-DT-PILOT-NAOH-062414				14BH-DT-PILOT-NOAH-070814				14BH-DT-PILOT-NAOH-072214				14BH-DT-PILOT-NAOH-080614				14BH-DT-PILOT-NAOH-081914				14BH-DT-PILOT-NAOH-090214				14BH-DT-PILOT-NAOH-091614				14BH-DT-PILOT-NAOH-092314				14BH-DT-PILOT-NAOH-092914			
		Sample Date	6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014				8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
		Fraction	D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	**5530**		**5740**		**11100**		**11200**		**13600**		**13500**		**12900**		**13300**		**4380**		**4990**		**912**		**1300**		250	U	**824**		**236**	J	**479**		**8540**		**9030**		**7120**		**7810**	
Antimony	µg/L	5.6																																					2	J	2	J
Arsenic	µg/L	10.0	14.7	J	57.6		20	U	16.2	J	5.61	J	19.7	J	20	U	17.2	J	20	U	200	U	20	U	8.38	J	20	U	18.1	J	20	U	10.8	J	5.2	J	32.8		32.8		62.4	
Barium	µg/L	1000.0																																					4	J	3.8	J
Beryllium	µg/L	4.0																																					4.5		4.5	
Cadmium	µg/L	0.3	**256**		**249**		**264**		**259**		**294**		**283**		**285**		**272**		**251**		**255**		**147**		**145**		**77.2**		**83.1**		2	U	**4.25**		**210**		**216**		**236**		**234**	
Chromium	µg/L	86.2																																					1.8	J	2.1	
Copper	µg/L	9.3	**787**		**712**		**799**		**878**		**1260**		**1040**		**911**		**820**	J	**660**		**785**		**87.7**		**125**		6.85	J	**73.1**		5.29	J	**26.5**		**647**		**696**		**696**		**724**	
Iron	µg/L	1000.0	**31700**		**53800**		**17200**		**25000**		**23300**		**34800**		563	J	**16900**		1250	U	**9280**		**1740**		**9670**		1250	U	**7940**		1250	U	**6230**		981	J	**25500**		**51700**		**66500**	
Lead	µg/L	3.2	**72.7**		**80.9**	J	**135**		**119**		**123**		**175**		**86.7**		**105**		5.6		20	U	2	U	5.79		2	U	**15.9**		2	U	4.32		**33.5**		**72.4**		**72.4**		**88.7**	
Nickel	µg/L	52.2	27.1		24.1		51.3		21.6		27		21.3		19.4		22.5	J	19.7		100	U	13.7		13.9		13.7		14.2		10	U	10	U	21.1		22.5		29.9		35.7	
Selenium	µg/L	50.0																																					1.4	J	5	U
Silver	µg/L	100.0																																					1	J	1	J
Thallium	µg/L	0.2																																					2		1.9	
Zinc	µg/L	119.8	**56200**		**55600**		**59900**		**58700**		**64100**		**62000**		**63000**		**64900**		**56400**		**57600**		**28200**		**27900**		**11000**		**12200**		57.6	J	**1130**		**47700**		**47300**		**43700**		**43700**	
Hardness	mg/L	100	367		367		365		365		371		371		358		358		343		343		308		308		226		226		138		138		317		317		342.38		346.9	
Hardness for calculation[2]	mg/L	100	367		367		365		365		371		371		358		358		343		343		308		308		226		226		138		138		317		317		342.38		346.9	

Notes:

Aquatic life hardness-based equations for 6 metals are shown below. Equations are from DEQ-7 Montana Numeric Water Quality Standards (October 2012).

[1] Standards shown for cadmium, chromium, copper, lead, nickel, and zinc are based on 100 mg/L hardness for comparison purposes only. Actual screening in the table is based on the calculated hardness for each particular sample result.

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	Chronic	$e^{(0.8545*\ln(hardness)-1.702)}$
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	Chronic	$e^{(1.273*\ln(hardness)-4.705)}$
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	Chronic	$e^{(0.846*\ln(hardness)+0.0584)}$
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Flags:

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▨ Text -	Exceeds Acute Aquatic Life standard.

Table 4.2-4

Danny T Treatability Study Year 2: Pilot Test Comparison to Water Quality Standards

Barker-Hughesville Mining District Superfund Site

		Location	BCR4																																							
		Sample ID	14BH-DT-PILOT-BCR4-061114				14BH-DT-PILOT-BCR4-062414				14BH-DT-PILOT-BCR4-070814				14BH-DT-PILOT-BCR4-072214				14BH-DT-PILOT-BCR4-080614				14BH-DT-PILOT-BCR4-081914				14BH-DT-PILOT-BCR4-090214				14BH-DT-PILOT-BCR4-091614				14BH-DT-PILOT-BCR4-092314				14BH-DT-PILOT-BCR4-092914			
		Sample Date	6/11/2014				6/24/2014				7/8/2014				7/22/2014				8/6/2014				8/19/2014				9/2/2014				9/16/2014				9/23/2014				9/29/2014			
		Fraction	D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	Units	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	**460**	J	**1100**		**108**	J	**169**	J	**133**	J	**654**		250	U	**148**	J	250	U	**105**	J	250	U	250	U	**304**		250	U	250	U	250	U	250	U	250	U	4.2	J	21.2	
Antimony	µg/L	5.6																																					2	U	2	J
Arsenic	µg/L	10.0	29.5		35.4		9.03	J	17	J	20	U	17.4	J	20	U	14.4	J	20	U	7.65	J	5.38	J	9.17	J	20	U	20	U	20	U	20	U	20	U	5.98	J	1	U	9.2	
Barium	µg/L	1000.0																																					0.19	J	108	
Beryllium	µg/L	4.0																																					1	U	1	U
Cadmium	µg/L	0.3	**12.5**		**38**		**4.51**		**13.2**		2	U	**13.8**		2	U	**2.25**		2	U	2	U	2	U	**1.11**	J	2	U	**1.39**	J	2	U	2	U	2	U	**2.27**		1	U	**2.4**	
Chromium	µg/L	86.2																																					2	U	12.2	
Copper	µg/L	9.3	**63.3**		**194**		15.9		**40.2**		10	U	**49.6**		6	J	8.53	J	7.04	J	6.8	J	12.8		9.19	J	10	U	5.44	J	6.29	J	7.35	J	7.68	J	10.6		2	U	6	
Iron	µg/L	1000.0	**1310**	J	**3230**		**1440**		**1490**		**1030**	J	**2070**		1250	U	578	J	1250	U	1250	U	1250	U	1250	U	1250	U	1250	U	1250	U	1250	U	1250	U	1250	U	496		442	
Lead	µg/L	3.2	16.2		**43.8**	J	2.12		3.87		2	U	8.54		2	U	3.67		2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	1	U	0.48	J
Nickel	µg/L	52.2	25		29.3		31.1		10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	0.26	J	24.8	
Selenium	µg/L	50.0																																					5	U	1.9	J
Silver	µg/L	100.0																																					**1**	J	1	J
Thallium	µg/L	0.2																																					1	U	1	U
Zinc	µg/L	119.8	**1920**		**3340**		**734**		**1700**		271		**7400**		324		**3180**		205		**1290**		137		**1040**		88.9	J	**772**		50.4	J	**468**		159		**938**		**158**		**970**	
Hardness	mg/L	100	1040		1040		868		868		754		754		552		552		599		599		418		418		355		355		284		284		289		289		2.8246		342.94	
Hardness for calculation[2]	mg/L	100	400		400		400		400		400		400		400		400		400		400		400		400		355		355		284		284		289		289		2.8246		342.94	

Notes:

Aquatic life hardness-based equations for 6 metals are shown below. Equations are from DEQ-7 Montana Numeric Water Quality Standards (October 2012).

[1] Standards shown for cadmium, chromium, copper, lead, nickel, and zinc are based on 100 mg/L hardness for comparison purposes only. Actual screening in the table is based on the calculated hardness for each particular sample result.

[2] A hardness concentration of 400 mg/L was used for all measurements greater than 400 mg/L as per MT DEQ Montana Numeric Water Quality Standards (October 2012).

[3] A hardness value of 400 mg/L was assumed for the standards' calculations for POSTI and POSTE on 9/16/2014. A hardness measurement was not collected on that date, however measurements before and after this date were significantly greater than 400 mg/L.

Cadmium	Acute	$e^{(1.0166*\ln(hardness)-3.924)}$
	Chronic	$e^{(0.7409*\ln(hardness)-4.719)}$
Chromium	Acute	$e^{(0.819*\ln(hardness)+3.7256)}$
	Chronic	$e^{(0.819*\ln(hardness)+0.6848)}$
Copper	Acute	$e^{(0.9422*\ln(hardness)-1.7)}$
	Chronic	$e^{(0.8545*\ln(hardness)-1.702)}$
Lead	Acute	$e^{(1.273*\ln(hardness)-1.46)}$
	Chronic	$e^{(1.273*\ln(hardness)-4.705)}$
Nickel	Acute	$e^{(0.846*\ln(hardness)+2.255)}$
	Chronic	$e^{(0.846*\ln(hardness)+0.0584)}$
Zinc	Acute/chronic	$e^{(0.8473*\ln(hardness)+0.884)}$

D = Dissolved Metals
T = Total Metals
Q = Qualifier
µg/L= micrograms per liter
mg/L = milligrams per liter

INF = Adit influent to treatment system
BCRX = Biochemical reactor barrel effluent
SAPS = Successive alkalinity producing system pre-treatment to BCR 2
CHIT = Chitorem pre-treatment to BCR 3
NAOH = Sodium hydroxide pre-treatment to BCR 4
POSTI = Combined four BCR effluents into post-treatment system
POSTE = Effluent from post-treatment system

Flags:

Text -	Exceeds Human Health standard.
Text -	Exceeds Chronic Aquatic Life standard.
▨ Text -	Exceeds Acute Aquatic Life standard.

		Location	**POSTE**																																		
		Sample ID	**14BH-DT-PILOT-POSTE-062414**				**14BH-DT-PILOT-POSTE-070814**				**14BH-DT-PILOT-POSTE-072214**				**14BH-DT-PILOT-POSTE-080614**				**14BH-DT-PILOT-POSTE-081914**				**14BH-DT-PILOT-POSTE-090214**				**14BH-DT-PILOT-POSTE-091614**		**14BH-DT-PILOT-POSTE-092314**				**14BH-DT-PILOT-POSTE-092914**			
		Sample Date	**6/24/2014**				**7/8/2014**				**7/22/2014**				**8/6/2014**				**8/19/2014**				**9/2/2014**				**9/16/2014**		**9/23/2014**				**9/29/2014**			
		Fraction	**D**		**T**		**D**		**T**		**D**		**T**		**D**		**T**		**D**		**T**		**D**		**T**		**T**		**D**		**T**		**D**		**T**	
Analyte	**Units**	**Standard[1]**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result[3]**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**
Aluminum	µg/L	87.0	**89.3**		**246**		70.2		**138**		50	U	**590**		50	U	**329**		**119**	J	**174**	J	250	U	**145**	J	**3960**		250	U	250	U	2.9	J	6.6	J
Antimony	µg/L	5.6																															2	J	2	J
Arsenic	µg/L	10.0	49.9		65.3		16.9	J	36.5	J	16.5	J	22.4		14.1	J	200	U	12	J	11.5	J	5.2	J	20	U	41.5		8.25	J	8.71	J	5.4		5.6	
Barium	µg/L	1000.0																															87.8		92	
Beryllium	µg/L	4.0																															1	U	1	U
Cadmium	µg/L	0.3	2	U	**5.75**		**1.75**	J	**2.95**		2	U	2	U	2	U	20	U	2	U	2	U	2	U	2	U	**3.43**		2	U	2	U	1	U	0.073	J
Chromium	µg/L	86.2																															0.31	J	0.51	J
Copper	µg/L	9.3	8.48	J	**48.3**		5.78	J	18.1		10	U	10	UJ	10	U	100	U	10	U	10	U	5.29	J	10	U	**34.2**		10	U	10	U	0.64	J	0.82	J
Iron	µg/L	1000.0	**1020**		**2720**		974		**1370**		250	U	756		250	U	335		1250	U	1250	U	1250	U	1250	U	**7210**		1250	U	1250	U	**1580**		**1780**	
Lead	µg/L	3.2	2	U	15.8		2	U	5.61		2	U	7.81		2	U	20	U	2	U	2	U	2	U	2	U	**118**		2	U	1.5	J	0.096	J	0.53	J
Nickel	µg/L	52.2	53		28.2		10	U	10	U	10	U	10	UJ	10	U	100	U	10	U	10	U	7.13	J	10	U	10	U	10	U	10	U	3.6		8.1	
Selenium	µg/L	50.0																															1.3	J	1.2	J
Silver	µg/L	100.0																															1	U	1	U
Thallium	µg/L	0.2																															1	U	1	U
Zinc	µg/L	119.8	73.8		**815**		**1120**		**1440**		16.3	J	347		15.1	J	169		100	U	156		100	U	92.1	J	**1680**		100	U	101		6.2		68.7	
Hardness	mg/L	100	1520		1520		1480		1480		933		933		1010		1010		891		891		693		693		400		629		629		400		400	
Hardness for calculation[2]	mg/L	100	400		400		400		400		400		400		400		400		400		400		400		400		400		400		400		400		400	

Notes:

Aquatic life hardness-based equations for 6 metals are shown below. Equations are from DEQ-7 Montana Numeric Water Quality Standards (October 2012).

[1] Standards shown for cadmium, chromium, copper, lead, nickel, and zinc are based on 100 mg/L hardness for comparison purposes only. Actual screening in the table is based on the calculated hardness for each particular sample result.

[2] A hardness concentration of 400 mg/L was used for all measurements greater than 400 mg/L as per MT DEQ Montana Numeric Water Quality Standards (October 2012).

[3] A hardness value of 400 mg/L was assumed for the standards' calculations for POSTI and POSTE on 9/16/2014. A hardness measurement was not collected on that date, however measurements before and after this date were significantly greater than 400 mg/L.

Cadmium	Acute	$e^{(1.0166*\ln(hardness)-3.924)}$
	Chronic	$e^{(0.7409*\ln(hardness)-4.719)}$
Chromium	Acute	$e^{(0.819*\ln(hardness)+3.7256)}$
	Chronic	$e^{(0.819*\ln(hardness)+0.6848)}$
Copper	Acute	$e^{(0.9422*\ln(hardness)-1.7)}$
	Chronic	$e^{(0.8545*\ln(hardness)-1.702)}$
Lead	Acute	$e^{(1.273*\ln(hardness)-1.46)}$
	Chronic	$e^{(1.273*\ln(hardness)-4.705)}$
Nickel	Acute	$e^{(0.846*\ln(hardness)+2.255)}$
	Chronic	$e^{(0.846*\ln(hardness)+0.0584)}$
Zinc	Acute/chronic	$e^{(0.8473*\ln(hardness)+0.884)}$

D = Dissolved Metals
T = Total Metals
Q = Qualifier
µg/L= micrograms per liter
mg/L = milligrams per liter

INF = Adit influent to treatment system
BCRX = Biochemical reactor barrel effluent
SAPS = Successive alkalinity producing system pre-treatment to BCR 2
CHIT = Chitorem pre-treatment to BCR 3
NAOH = Sodium hydroxide pre-treatment to BCR 4
POSTI = Combined four BCR effluents into post-treatment system
POSTE = Effluent from post-treatment system

Flags:

Text -	Exceeds Human Health standard.
Text -	Exceeds Chronic Aquatic Life standard.
▨ Text -	Exceeds Acute Aquatic Life standard.

Table 4.2-4
Danny T Treatability Study Year 2: Pilot Test Comparison to Water Quality Standards
Barker-Hughesville Mining District Superfund Site

		Location	POSTI																																	
		Sample ID	14BH-DT-PILOT-POSTI-062414				14BH-DT-PILOT-POSTI-070814				14BH-DT-PILOT-POSTI-072214				14BH-DT-PILOT-POSTI-080614				14BH-DT-PILOT-POSTI-081914				14BH-DT-PILOT-POSTI-090214				14BH-DT-PILOT-POSTI-091614		14BH-DT-PILOT-POSTI-092314				14BH-DT-PILOT-POSTI-092914			
		Sample Date	6/24/2014				7/8/2014				7/22/2014				8/6/2014				8/19/2014				9/2/2014				9/16/2014		9/23/2014				9/29/2014			
		Fraction	D		T		D		T		D		T		D		T		D		T		D		T		T		D		T		D		T	
Analyte	Units	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result[2]	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	49.9	J	**102**		33.9	J	**108**		29.1	J	66.7		250	U	**138**	J	**118**	J	**134**	J	250	U	**130**	J	250	U	250	U	250	U	9	J	16.8	J
Antimony	µg/L	5.6																															2	J	2	J
Arsenic	µg/L	10.0	14.3	J	18.2	J	9.21	J	200	UJ	5.88	J	9.52	J	20	U	200	U	20	U	20	U	20	U	20	U	20	U	5.53	J	20	U	1.7		2.9	
Barium	µg/L	1000.0																															159		161	
Beryllium	µg/L	4.0																															1	U	1	U
Cadmium	µg/L	0.3	**1.57**	J	**4.33**		2	U	20	U	2	U	**1.16**	J	2	U	20	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	1	U	0.61	J
Chromium	µg/L	86.2																															0.79	J	1.1	J
Copper	µg/L	9.3	13.3		**38.5**		10	U	100	U	5.52	J	6.12	J	5.72	J	100	U	7.85	J	10	U	10	U	10	U	5.07	J	6.84	J	10	U	2	U	1.7	J
Iron	µg/L	1000.0	863		**1340**		250	U	**4550**		250	U	493		1250	U	1250	U	1250	U	1250	U	**1720**		**2520**		1250	U	1250	U	1250	U	**1770**		**2140**	
Lead	µg/L	3.2	2	U	3.25		2	U	20	U	1.48	J	2.62		2	U	20	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	0.045	J	0.37	J
Nickel	µg/L	52.2	25.6		10	U	10	U	100	U	10	U	10	UJ	10	U	100	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	3.2		2.8	
Selenium	µg/L	50.0																															**10.1**		**15.4**	
Silver	µg/L	100.0																															1	U	1	U
Thallium	µg/L	0.2																															1	U	1	U
Zinc	µg/L	119.8	281		**626**		29.4		**3080**		31.3		**857**		100	U	263		100	U	326		100	U	268		191		100	U	346		16.3		360	
Hardness	mg/L	100	1440		1440		1540		1540		1300		1300		997		997		813		813		676		676		400		629		629		400		400	
Hardness for calculation[2]	mg/L	100	400		400		400		400		400		400		400		400		400		400		400		400		400		400		400		400		400	

Notes:

Aquatic life hardness-based equations for 6 metals are shown below. Equations are from DEQ-7 Montana Numeric Water Quality Standards (October 2012).

[1] Standards shown for cadmium, chromium, copper, lead, nickel, and zinc are based on 100 mg/L hardness for comparison purposes only. Actual screening in the table is based on the calculated hardness for each particular sample result.

[2] A hardness concentration of 400 mg/L was used for all measurements greater than 400 mg/L as per MT DEQ Montana Numeric Water Quality Standards (October 2012).

[3] A hardness value of 400 mg/L was assumed for the standards' calculations for POSTI and POSTE on 9/16/2014. A hardness measurement was not collected on that date, however measurements before and after this date were significantly greater than 400 mg/L.

Cadmium	Acute	$e^{(1.0166*\ln(hardness)-3.924)}$
	Chronic	$e^{(0.7409*\ln(hardness)-4.719)}$
Chromium	Acute	$e^{(0.819*\ln(hardness)+3.7256)}$
	Chronic	$e^{(0.819*\ln(hardness)+0.6848)}$
Copper	Acute	$e^{(0.9422*\ln(hardness)-1.7)}$
	Chronic	$e^{(0.8545*\ln(hardness)-1.702)}$
Lead	Acute	$e^{(1.273*\ln(hardness)-1.46)}$
	Chronic	$e^{(1.273*\ln(hardness)-4.705)}$
Nickel	Acute	$e^{(0.846*\ln(hardness)+2.255)}$
	Chronic	$e^{(0.846*\ln(hardness)+0.0584)}$
Zinc	Acute/chronic	$e^{(0.8473*\ln(hardness)+0.884)}$

D = Dissolved Metals
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µg/L= micrograms per liter
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INF = Adit influent to treatment system
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SAPS = Successive alkalinity producing system pre-treatment to BCR 2
CHIT = Chitorem pre-treatment to BCR 3
NAOH = Sodium hydroxide pre-treatment to BCR 4
POSTI = Combined four BCR effluents into post-treatment system
POSTE = Effluent from post-treatment system

Flags:

Text -	Exceeds Human Health standard.
Text -	Exceeds Chronic Aquatic Life standard.
▨ Text -	Exceeds Acute Aquatic Life standard.

Table 4.3-1
Tiger Bench-Scale Treatability Study: Analytical Laboratory Data
Barker-Hughesville Mining District Superfund Site

Sample ID		14BH-TI-BENCH-TN-RAW-070814				14BH-TI-BENCH-TN-RAWD-070814				14BH-TI-BENCH-TN-CHIT-070814				14BH-TI-BENCH-TN-LSTN-070814				14BH-TI-BENCH-TN-NAOH-070814				14BH-TI-BENCH-CONTROL-0826				14BH-TI-BENCH-BCR2-0826				14BH-TI-BENCH-BCR3-0826			
Sample Date		7/8/2014				7/8/2014				7/8/2014				7/8/2014				7/8/2014				8/26/2014				8/26/2014				8/26/2014			
Fraction		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	Unit	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	2340.00		2310.00		2210.00		2260.00		301.00		530.00		40.10	J	222.00		150.00		212.00		29400.00		28100.00		500.00	U	226.00	J	500.00	U	500.00	U
Arsenic	µg/L	29.50		30.10	J	30.50		28.90	J	36.00		43.10	J	20.00	U	20.00	UJ	20.00	U	20.00	UJ	100.00	U	100.00	U	100.00	U	100.00	U	100.00	U	100.00	U
Cadmium	µg/L	43.80		39.00		45.20		40.40		48.40		47.00		43.80		38.60		46.40		42.10		52.90		58.70		21.80		24.40		25.40		27.80	
Copper	µg/L	1450.00		1100.00		1410.00		1110.00		542.00		497.00		62.90		114.00		397.00		331.00		1410.00		1760.00		26.60	J	45.20	J	70.50		102.00	
Iron	µg/L	269000.00		261000.00		254000.00		255000.00		547.00		41500.00		651.00		16800.00		420.00		6710.00		47600.00		46000.00		3870.00		5360.00		2550.00		3620.00	
Lead	µg/L	952.00		1240.00		954.00		1260.00		5.80		102.00		4.71		70.10		11.70		42.50		167.00		195.00	J	10.00	U	7.10	J	10.00	U	10.00	U
Manganese	µg/L	25400.00		24800.00		24400.00		24500.00		21100.00		21200.00		24300.00		24400.00		22600.00		22700.00		30100.00		31100.00		23000.00		22800.00		22700.00		23100.00	
Nickel	µg/L	11.40		8.30	J	10.50		7.71	J	14.80		9.78	J	7.78	J	10.00	U	19.50		14.20		59.30		86.00		50.00	U	36.30	J	50.00	U	35.60	J
Zinc	µg/L	12100.00		11500.00		11700.00		11300.00		7810.00		7600.00		9690.00		9480.00		11500.00		11200.00		13100.00		13500.00		5980.00		6160.00		6810.00		7150.00	
Alkalinity	mg/L	500.00	U			500.00	U			500.00	U			500.00	U			500.00	U			100.00	U			100.00	U			100.00	U		
Chloride	mg/L	20.00	U			20.00	U			169.00	J			6.70	J			6.70	J														
Fluoride	mg/L	2.00	U			2.00	U			20.00	U			2.00	U			2.00	U														
Hardness	mg/L			286.00				273.00				1000.00				991.00				286.00				499.00				335.00				343.00	
Nitrate/Nitrite	mg/L	50.00	U			50.00	U			500.00	U			50.00	U			50.00	U														
Sulfate	mg/L	1120.00				1120.00				944.00				1040.00				1020.00				1020.00				1040.00				1000.00			

Sample ID		14BH-TI-BENCH-BCR4-0826				14BH-TI-BENCH-BCR5-0826				14BH-TI-BENCH-BCR6-0826				14BH-TI-BENCH-BCR7-0826				14BH-TI-BENCH-BCR8-0826				14BH-TI-BENCH-BCR9-0826				14BH-TI-BENCH-BCR10-0826			
Sample Date		8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014			
Fraction		D		T		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	Unit	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	306.00	J	357.00	J	450.00	J	443.00	J	500.00	U	620.00		240.00	J	395.00	J	5680.00		6930.00		11800.00		12400.00		14900.00		16400.00	
Arsenic	µg/L	100.00	U	100.00	U	20.00	U	100.00	U	100.00	U	100.00	U	100.00	U	100.00	U	100.00	U	29.20	J	100.00	U	33.20	J	38.40	J	38.50	J
Cadmium	µg/L	26.40		28.30		3.00	U	10.00	U	15.00	U	10.00	U	26.60		30.00		15.00	U	10.00	U	28.30		31.00		44.30		47.10	
Copper	µg/L	174.00		215.00		10.00	U	50.00	U	50.00	U	27.70	J	112.00		180.00		50.00	U	117.00		475.00		157.00		314.00		508.00	
Iron	µg/L	2500.00	U	1560.00	J	18600.00		18200.00		52900.00		51800.00		1930.00	J	3800.00		273000.00		301000.00		278000.00		295000.00		303000.00		322000.00	
Lead	µg/L	10.00	U	8.07	J	2.00	U	10.00	UJ	10.00	U	22.70	J	10.00	U	12.40	J	55.70		105.00	J	248.00		287.00	J	255.00		371.00	
Manganese	µg/L	20000.00		19900.00		30600.00		30400.00		30000.00		29500.00		22800.00		22800.00		39800.00		44100.00		39500.00		41500.00		41100.00		43100.00	
Nickel	µg/L	50.00	U	31.10	J	10.00	U	50.00	U	50.00	U	50.00	U	50.00	U	39.20	J	85.70		119.00		104.00		130.00		108.00		141.00	
Zinc	µg/L	7420.00		7440.00		200.00	U	200.00	U	239.00		811.00		7410.00		7560.00		10700.00		11900.00		11500.00		12200.00		10700.00		11400.00	
Alkalinity	mg/L	100.00	U			498.00				139.00				100.00	U			509.00				100.00	U			100.00	U		
Chloride	mg/L																												
Fluoride	mg/L																												
Hardness	mg/L			319.00				317.00				338.00				312.00				434.00				493.00				651.00	
Nitrate/Nitrite	mg/L																												
Sulfate	mg/L	1000.00				92.00				864.00				984.00				1020.00				978.00				972.00			

Notes:
Q = Qualifier; U = Result below method reporting limit shown; J = estimated result; D = dissolved fraction; T = total fraction
µg/L = micrograms per liter; mg/L = milligrams per liter

Table 4.3-1
Tiger Bench-Scale Treatability Study: Analytical Laboratory Data
Barker-Hughesville Mining District Superfund Site

Sample ID		14BH-TI-BENCH-BCR11-0826				14BH-TI-BENCH-BCR12-0826				14BH-TI-BENCH-BCR13-0826				14BH-TI-BENCH-BCR14-0826				14BH-TI-BENCH-BCR15-0826				14BH-TI-BENCH-BCR16-0826				14BH-TI-BENCH-BCR17-0826				14BH-TI-BENCH-BCR18-0826			
Sample Date		8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014			
Fraction		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	Unit	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	500.00	U	397.00	J	219.00	J	473.00	J	299.00	J	720.00		500.00	U	500.00	U	500.00	U	500.00	U	5340.00		5180.00		14100.00		14800.00		500.00	U	238.00	J
Arsenic	µg/L	40.00		54.00		59.90		76.90		104.00		123.00		20.90		21.70		20.90		26.50		100.00	U	30.40	J	126.00		162.00		100.00	U	100.00	U
Cadmium	µg/L	3.00	U	5.95		3.00	U	3.87		3.00	U	7.15		3.00	U	2.00	U	3.00	U	2.00	U	8.17	J	9.89	J	83.80		98.10		15.00	U	10.00	U
Copper	µg/L	7.37	J	85.80		10.00	U	51.00		10.00	U	79.50		8.37	J	5.93	J	6.45	J	10.00	U	71.00		209.00		55.70		130.00		50.00	U	50.00	U
Iron	µg/L	2500.00	U	3210.00		1050.00	J	4570.00		2500.00	U	5230.00		2500.00	U	2500.00	U	2500.00	U	2500.00	U	268000.00		264000.00		326000.00		330000.00		155000.00		180000.00	
Lead	µg/L	2.18		27.50		3.35		24.70		2.00	U	33.60		2.00	U	2.00	U	2.00	U	2.00	U	185.00		227.00		116.00		181.00		10.00	U	10.00	U
Manganese	µg/L	16100.00		16800.00		13000.00		13800.00		12800.00		13600.00		3480.00		3820.00		12100.00		12500.00		42900.00		44000.00		43800.00		45000.00		30400.00		33800.00	
Nickel	µg/L	10.00	U	15.60		10.00	U	22.10		10.00	U	32.60		10.00	U	7.78	J	10.00	U	12.70		53.80		173.00		110.00		207.00		50.00	U	50.00	U
Zinc	µg/L	371.00		1510.00		167.00	J	573.00		200.00	U	809.00		200.00	U	200.00	U	200.00	U	200.00	U	9500.00		9730.00		11100.00		11300.00		200.00	U	504.00	
Alkalinity	mg/L	1530.00				2190.00				2760.00				1470.00				1320.00				2220.00				100.00	U			721.00			
Chloride	mg/L																																
Fluoride	mg/L																																
Hardness	mg/L			1140.00				1420.00				2070.00				543.00				1170.00				4850.00				3480.00				875.00	
Nitrate/Nitrite	mg/L																																
Sulfate	mg/L	240.00				164.00				104.00				5.00				120.00				983.00				936.00				874.00			

Notes:
Q = Qualifier; U = Result below method reporting limit shown; J = estimated result; D = dissolved fraction; T = total fraction
µg/L = micrograms per liter; mg/L = milligrams per liter

Table 4.3-2
Tiger Bench-ScaleTreatability Study: CDM Smith Laboratory Data
Barker-Hughesville Mining District Superfund Site

Test Number	Contents	Date	pH	Temp	Specific Conductivity	ORP	DO	Sulfide	Alkalinity	Ferrous Iron
			su	°C	mS/cm	mV	mg/L	µg/L	mg/L	mg/L
1	Control Sample	7/9/2014	2.28	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	2.55	24.0	NM	624	12	7	NM	2.36
		7/25/2014	2.69	23.3	NM	599	12	7	<5	1.81
		7/31/2014	2.40	23.0	2050	595	12	14	NM	1.52
		8/11/2014	3.00	22.7	2030	600	12	7	<5	1.30
		8/18/2014	2.52	22.3	2130	590	12	8	<5	1.27
		8/25/2014	2.51	21.9	1951	579	12	14	<5	1.05
2	25 mL methanol, 4.575 mL 25% NaOH, 25 mL manure extract	7/9/2014	4.50	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	5.04	24.0	NM	341	4	11	17.0	0.04
		7/25/2014	5.13	24.0	NM	312	3	19	6.8	0.07
		7/31/2014	4.90	21.9	1858	307	3	9	6.8	0.07
		8/11/2014	6.07	22.5	>1999	185	5	24	6.8	0.54
		8/18/2014	5.07	22.3	>1999	210	1	17	6.8	0.48
		8/25/2014	5.29	21.9	1730	213	1	19	13.6	0.82
3	50 mL methanol, 4.575 mL 25% NaOH, 25 mL manure extract	7/9/2014	4.47	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	4.91	24.0	NM	346	5	23	17.0	<0.02
		7/25/2014	4.96	24.0	NM	285	4	24	6.8	0.24
		7/31/2014	4.93	22.5	1829	278	3	15	6.8	<0.02
		8/11/2014	5.77	22.7	1968	226	1	18	6.8	0.23
		8/18/2014	5.29	22.4	>1999	208	2	12	6.8	0.20
		8/25/2014	5.30	21.9	1660	218	2	12	6.8	0.42
4	100 mL methanol, 4.575 mL 25% NaOH, 25 mL manure extract	7/9/2014	4.49	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	4.71	24.0	NM	358	6	16	17.0	<0.02
		7/25/2014	4.83	24.2	NM	271	7	42	6.8	0.30
		7/31/2014	4.77	22.4	1842	271	4	6	6.8	<0.02
		8/11/2014	5.73	22.9	1876	277	1	26	6.8	0.03
		8/18/2014	5.00	22.8	1928	275	5	20	6.8	0.02
		8/25/2014	5.03	21.9	1550	297	5	11	6.8	<0.02
5	25 mL ethanol, 4.575 mL 25% NaOH, 25 mL manure extract	7/9/2014	4.46	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	4.66	23.6	NM	378	5	10	13.6	0.01
		7/25/2014	5.29	24.3	NM	228	6	7	6.8	0.72
		7/31/2014	5.35	23.2	1969	205	6	27	6.8	1.27
		8/11/2014	6.93	22.4	>1999	85	1	38	20.4	3.14
		8/18/2014	5.66	22.5	>1999	-100	1	6120	68.0	5.20
		8/25/2014	5.37	21.9	1450	-101	1	7030	170.0	4.38
6	50 mL ethanol, 4.825 mL 25% NaOH, 25 mL manure extract	7/9/2014	4.34	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	4.35	23.6	NM	406	5	33	13.6	0.02
		7/25/2014	4.42	24.2	NM	291	5	10	6.8	0.02
		7/31/2014	4.51	21.6	1902	242	5	7	6.8	0.21
		8/11/2014	4.91	23.1	1976	162	3	24	6.8	2.69
		8/18/2014	4.65	23.0	>1999	114	2	12	6.8	3.22
		8/25/2014	5.61	21.7	1650	75	2	93	27.2	1.85
7	100 mL ethanol, 4.575 mL 25% NaOH, 25 mL manure extract	7/9/2014	4.69	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	5.06	23.6	NM	395	5	32	20.4	<0.02
		7/25/2014	4.40	24.2	NM	303	5	8	6.8	<0.02
		7/31/2014	4.49	21.8	1743	284	4	8	6.8	<0.02
		8/11/2014	4.66	23.3	1860	250	2	18	6.8	0.08
		8/18/2014	4.60	23.1	1884	201	6	10	6.8	0.10
		8/25/2014	5.21	21.7	1530	189	5	13	6.8	<0.02
8	25 mL molasses, 4.800 mL 25% NaOH, 25 mL manure extract	7/9/2014	4.42	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	4.25	22.9	NM	-375	2	91	102.0	1.44
		7/25/2014	4.12	24.2	NM	-245	1	162	<20	3.16
		7/31/2014	3.91	22.4	2300	103	2	194	<5	2.59
		8/11/2014	4.64	23.2	3990	-51	1	129	NM	4.00
		8/18/2014	4.59	23.1	4020	78	1	84	NM	3.66
		8/25/2014	4.75	21.8	3650	90	NM	72	NM	4.28
9	50 mL molasses, 4.575 mL 25% NaOH, 25 mL manure extract	7/9/2014	4.50	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	4.22	22.9	NM	-425	3	214	187.0	3.38
		7/25/2014	3.94	24.4	NM	-124	2	268	<20	1.96
		7/31/2014	3.82	22.4	2540	105	2	247	<5	2.79
		8/11/2014	4.15	22.8	4580	60	2	171	NM	3.42
		8/18/2014	4.13	23.1	4640	67	1	127	NM	2.56
		8/25/2014	4.22	21.5	4310	50	NM	141	NM	4.04
10	100 mL molasses, 4.575 mL 25% NaOH, 25 mL manure extract	7/9/2014	4.53	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	4.19	22.9	NM	-436	4	476	204.0	2.26
		7/25/2014	3.97	24.3	NM	-64	3	489	<20	0.44
		7/31/2014	3.89	23.2	2990	99	3	520	<20	2.90
		8/11/2014	4.25	22.7	4860	-87	2	375	NM	2.22
		8/18/2014	4.30	23.1	5010	-13	1	370	NM	1.56
		8/25/2014	4.23	21.6	4560	35	NM	276	NM	3.06

Notes:
NM = not measured
Some alkalinty measurements not collected due to low pH. Alkalinity is not detectable by the HACH method below pH 4.5 su.
Only pH was measured on 7/9 at startup per the sampling plan.
Other not measured results are due to malfunctioned equipment (e.g., conductivity).

Table 4.3-2

Tiger Bench-ScaleTreatability Study: CDM Smith Laboratory Data

Barker-Hughesville Mining District Superfund Site

Test Number	Contents	Date	pH	Temp	Specific Conductivity	ORP	DO	Sulfide	Alkalinity	Ferrous Iron
			su	°C	mS/cm	mV	mg/L	µg/L	mg/L	mg/L
11	15 g Chitorem	7/9/2014	NM	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	3.28	22.9	NM	367	4	51	<5	1.27
		7/25/2014	5.15	23.9	NM	152	2	16	102.0	1.68
		7/31/2014	5.90	22.8	2800	0	5	782	153.0	2.44
		8/11/2014	6.71	23.5	3230	-160	2	4160	595.0	0.94
		8/18/2014	7.17	23.9	3500	-298	1	6350	510.0	0.09
		8/25/2014	7.60	21.7	3150	-330	NM	4960	571.2	0.02
12	22 g Chitorem	7/9/2014	NM	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	4.33	22.9	NM	185	3	29	102.0	2.59
		7/25/2014	5.80	23.8	NM	-16	2	1558	255.0	1.40
		7/31/2014	6.24	22.7	2920	-60	3	3945	306.0	2.19
		8/11/2014	6.79	23.4	4520	-206	1	6440	510.0	0.23
		8/18/2014	7.28	23.9	4730	-327	1	6150	595.0	0.09
		8/25/2014	7.65	21.7	4330	-344	NM	5740	714.0	<0.02
13	34 g Chitorem	7/9/2014	NM	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	5.58	22.8	NM	65	2	140	289.0	2.25
		7/25/2014	6.13	24.0	NM	-117	1	2184	357.0	1.56
		7/31/2014	6.27	23.7	5040	-112	1	3960	646.0	3.38
		8/11/2014	6.75	23.4	6210	-263	1	13580	680.0	<0.02
		8/18/2014	7.00	23.9	6820	-339	1	3050	850.0	0.03
		8/25/2014	7.47	21.5	6340	-365	NM	3440	816.0	<0.02
14	7 g Chitorem, 4.575 mL 25% NaOH	7/9/2014	4.64	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	6.38	22.8	NM	41	2	51	119.0	1.25
		7/25/2014	6.94	23.9	NM	-182	1	4116	187.0	0.97
		7/31/2014	7.52	23.6	2550	-359	1	830	272.0	0.03
		8/11/2014	7.94	23.5	2670	-385	1	66560	1275.0	0.03
		8/18/2014	7.95	24.0	2740	-396	1	67	459.0	0.07
		8/25/2014	8.02	21.6	2540	-397	NM	110	510.0	0.02
15	7 g Chitorem, 8.2 g limestone fines	7/9/2014	4.89	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	6.19	22.8	NM	52	2	146	170.0	1.53
		7/25/2014	6.94	23.9	NM	-109	2	1926	221.0	2.05
		7/31/2014	7.50	23.5	2540	-303	1	4400	340.0	0.09
		8/11/2014	7.71	23.6	2550	-382	1	41280	1700.0	0.12
		8/18/2014	7.80	24.0	2560	-383	1	76	442.0	0.01
		8/25/2014	7.85	21.5	2390	-387	NM	428	408.0	0.04
16	50 mL molasses, 14.7 g limestone fines, 25 mL manure extract	7/9/2014	5.06	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	4.66	22.7	NM	-453	4	262	102.0	2.17
		7/25/2014	4.46	24.0	NM	-307	4	316	136.0	1.42
		7/31/2014	4.45	23.5	4280	-97	2	269	<20	2.90
		8/11/2014	4.86	23.4	5790	-67	1	295	<5	3.00
		8/18/2014	4.94	24.0	6240	7	1	164	NM	2.96
		8/25/2014	5.16	22.1	5970	28	NM	149	NM	4.16
17	50 mL molasses, 15 g Chitorem, 25 mL manure extract	7/9/2014	NM	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	3.62	22.7	NM	-292	3	630	<5	2.94
		7/25/2014	3.45	24.2	NM	61	3	683	13.6	2.91
		7/31/2014	3.36	23.0	3500	77	1	648	<5	3.33
		8/11/2014	3.66	23.2	5230	50	1	289	NM	1.32
		8/18/2014	3.65	24.0	5550	49	1	359	NM	1.68
		8/25/2014	4.00	22.2	5180	24	NM	331	NM	4.70
18	25 mL ethanol, 7 g Chitorem, 4.575 mL 25% NaOH, 25 mL manure extract	7/9/2014	4.52	NM	NM	NM	NM	NM	NM	NM
		7/17/2014	4.79	22.7	NM	119	3	57	119.0	0.67
		7/25/2014	5.23	23.6	NM	-35	1	1112	170.0	2.25
		7/31/2014	5.36	23.2	2300	-89	1	2400	170.0	2.14
		8/11/2014	5.53	23.1	2730	-2	1	620	176.8	3.36
		8/18/2014	5.51	24.1	2940	-36	1	623	204.0	3.06
		8/25/2014	5.65	22.3	2820	-15	NM	202	224.4	2.24

Notes:

NM = not measured

Some alkalinty measurements not collected due to low pH. Alkalinity is not detectable by the HACH method below pH 4.5 su.

Only pH was measured on 7/9 at startup per the sampling plan.

Other not measured results are due to malfunctioned equipment (e.g., conductivity).

Table 4.3-3
Tiger Bench-Scale Treatability Study: Percent Removal
Barker-Hughesville Mining District Superfund Site

Sample ID		14BH-TI-BENCH-TN-CHIT-070814		14BH-TI-BENCH-TN-LSTN-070814		14BH-TI-BENCH-TN-NAOH-070814		14BH-TI-BENCH-BCR2-0826		14BH-TI-BENCH-BCR3-0826		14BH-TI-BENCH-BCR4-0826		14BH-TI-BENCH-BCR5-0826	
Sample Date		7/8/2014		7/8/2014		7/8/2014		8/26/2014		8/26/2014		8/26/2014		8/26/2014	
Fraction		D	T	D	T	D	T	D	T	D	T	D	T	D	T
Analyte	Unit	% removal	% removal	% removal	% removal	% removal	% removal	% removal	% removal	% removal	% removal	% removal	% removal	% removal	% removal
Aluminum	µg/L	87.1%	77.1%	98.3%	90.4%	93.6%	90.8%	> 98.3%	99.2%	> 98.3%	> 98.2%	99.0%	98.7%	98.5%	98.4%
Arsenic	µg/L	-22.0%	-43.2%	> 32.2%	33.6%	> 32.2%	33.6%	NA --	NA --	NA --	NA --	NA --	NA --	NA --	NA --
Cadmium	µg/L	-10.5%	-20.5%	0.0%	1.0%	-5.9%	-7.9%	58.8%	58.4%	52.0%	52.6%	50.1%	51.8%	> 94.3%	> 83.0%
Copper	µg/L	62.6%	54.8%	95.7%	89.6%	72.6%	69.9%	98.1%	97.4%	95.0%	94.2%	87.7%	87.8%	> 99.3%	> 97.2%
Iron	µg/L	99.8%	84.1%	99.8%	93.6%	99.8%	97.4%	91.9%	88.3%	94.6%	92.1%	> 94.7%	96.6%	60.9%	60.4%
Lead	µg/L	99.4%	91.8%	99.5%	94.3%	98.8%	96.6%	> 94.0%	96.4%	> 94.0%	> 94.9%	> 94.0%	95.9%	> 98.8%	94.9%
Manganese	µg/L	16.9%	14.5%	4.3%	1.6%	11.0%	8.5%	23.6%	26.7%	24.6%	25.7%	33.6%	36.0%	-1.7%	2.3%
Nickel	µg/L	-29.8%	-17.8%	31.8%	-20.5%	-71.1%	-71.1%	> 15.7%	57.8%	> 15.7%	58.6%	> 15.7%	63.8%	> 83.1%	> 41.9%
Zinc	µg/L	35.5%	33.9%	19.9%	17.6%	5.0%	2.6%	54.4%	54.4%	48.0%	47.0%	43.4%	44.9%	> 98.5%	> 98.5%
Alkalinity	mg/L	NA --		NA --		NA --		NA --		NA --		NA --		< -398.0%	
Chloride	mg/L	< -745.0%		66.5%		66.5%									
Fluoride	mg/L	NA --		NA --		NA --									
Hardness	mg/L		-249.7%		-246.5%		0.0%		32.9%		31.3%		36.1%		36.5%
Nitrate/Nitrite	mg/L	NA --		NA --		NA --									
Sulfate	mg/L	15.7%		7.1%		8.9%		-2.0%		2.0%		2.0%		91.0%	

Notes:

NA = Percent removal calculation is not applicable due to the following logic cases:

1) The treated water is non-detect, and the raw water was detected at a concentration less than the treated water reporting limit.

2) The raw water is non-detect, and the treated water was detected at a concentration less than the raw water reporting limit.

3) Both the raw water and the treated water are non-detect.

4) Percent removal for certain wet chemistry parameters are not meaningful comparisons; therefore, calculations were not completed.

CHIT = Chitorem treatment
LSTN= Limestone treatment
NAOH = Sodium hydroxide treatment
BCRX = Biochemical reactor barrel effluent
D = Dissolved Metals
T = Total Metals

Table 4.3-3

Tiger Bench-Scale Treatability Study: Percent Removal

Barker-Hughesville Mining District Superfund Site

Sample ID		14BH-TI-BENCH-BCR6-0826				14BH-TI-BENCH-BCR7-0826				14BH-TI-BENCH-BCR8-0826				14BH-TI-BENCH-BCR9-0826				14BH-TI-BENCH-BCR10-0826				14BH-TI-BENCH-BCR11-0826				14BH-TI-BENCH-BCR12-0826			
Sample Date		8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014			
Fraction		D		T		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	Unit	% removal		% removal		% removal		% removal		% removal		% removal		% removal		% removal		% removal		% removal		% removal		% removal		% removal		% removal	
Aluminum	µg/L	>	98.3%		97.8%		99.2%		98.6%		80.7%		75.3%		59.9%		55.9%		49.3%		41.6%	>	98.3%		98.6%		99.3%		98.3%
Arsenic	µg/L	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--	NA	--
Cadmium	µg/L	>	71.6%	>	83.0%		49.7%		48.9%	>	71.6%	>	83.0%		46.5%		47.2%		16.3%		19.8%	>	94.3%		89.9%	>	94.3%		93.4%
Copper	µg/L	>	96.5%		98.4%		92.1%		89.8%	>	96.5%		93.4%		66.3%		91.1%		77.7%		71.1%		99.5%		95.1%	>	99.3%		97.1%
Iron	µg/L		-11.1%		-12.6%		95.9%		91.7%		-473.5%		-554.3%		-484.0%		-541.3%		-536.6%		-600.0%	>	94.7%		93.0%		97.8%		90.1%
Lead	µg/L	>	94.0%		88.4%	>	94.0%		93.6%		66.6%		46.2%		-48.5%		-47.2%		-52.7%		-90.3%		98.7%		85.9%		98.0%		87.3%
Manganese	µg/L		0.3%		5.1%		24.3%		26.7%		-32.2%		-41.8%		-31.2%		-33.4%		-36.5%		-38.6%		46.5%		46.0%		56.8%		55.6%
Nickel	µg/L	>	15.7%	>	41.9%	>	15.7%		54.4%		-44.5%		-38.4%		-75.4%		-51.2%		-82.1%		-64.0%	>	83.1%		81.9%	>	83.1%		74.3%
Zinc	µg/L		98.2%		94.0%		43.4%		44.0%		18.3%		11.9%		12.2%		9.6%		18.3%		15.6%		97.2%		88.8%		98.7%		95.8%
Alkalinity	mg/L	<	-39.0%			NA	--			<	-409.0%			NA	--			NA	--			<	-1430.0%			<	-2090.0%		
Chloride	mg/L																												
Fluoride	mg/L																												
Hardness	mg/L				32.3%				37.5%				13.0%				1.2%				-30.5%				-128.5%				-184.6%
Nitrate/Nitrite	mg/L																												
Sulfate	mg/L		15.3%				3.5%				0.0%				4.1%				4.7%				76.5%				83.9%		

Notes:

NA = Percent removal calculation is not applicable due to the following logic cases:

1) The treated water is non-detect, and the raw water was detected at a concentration less than the treated water reporting limit.

2) The raw water is non-detect, and the treated water was detected at a concentration less than the raw water reporting limit.

3) Both the raw water and the treated water are non-detect.

4) Percent removal for certain wet chemistry parameters are not meaningful comparisons; therefore, calculations were not completed.

CHIT = Chitorem treatment
LSTN= Limestone treatment
NAOH = Sodium hydroxide treatment
BCRX = Biochemical reactor barrel effluent
D = Dissolved Metals
T = Total Metals

Table 4.3-3
Tiger Bench-Scale Treatability Study Percent Removal
Barker-Hughesville Mining District Superfund Site

Sample ID		14BH-TI-BENCH-BCR13-0826				14BH-TI-BENCH-BCR14-0826				14BH-TI-BENCH-BCR15-0826				14BH-TI-BENCH-BCR16-0826				14BH-TI-BENCH-BCR17-0826				14BH-TI-BENCH-BCR18-0826			
Sample Date		8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014			
Fraction		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	Unit	% removal		% removal		% removal		% removal		% removal		% removal		% removal		% removal		% removal		% removal		% removal		% removal	
Aluminum	µg/L		99.0%		97.4%	>	98.3%	>	98.2%	>	98.3%	>	98.2%		81.8%		81.6%		52.0%		47.3%	>	98.3%		99.2%
Arsenic	µg/L	<	-4.0%	<	-23.0%	NA	--	NA	--	NA	--		73.5%	NA	--	NA	--	<	-26.0%	<	-62.0%	NA	--	NA	--
Cadmium	µg/L	>	94.3%		87.8%	>	94.3%	>	96.6%	>	94.3%	>	96.6%		84.6%		83.2%		-58.4%		-67.1%	>	71.6%	>	83.0%
Copper	µg/L	>	99.3%		95.5%		99.4%		99.7%		99.5%	>	99.4%		95.0%		88.1%		96.0%		92.6%	>	96.5%	>	97.2%
Iron	µg/L	>	94.7%		88.6%	>	94.7%	>	94.6%	>	94.7%	>	94.6%		-463.0%		-473.9%		-584.9%		-617.4%		-225.6%		-291.3%
Lead	µg/L	>	98.8%		82.8%	>	98.8%	>	99.0%	>	98.8%	>	99.0%		-10.8%		-16.4%		30.5%		7.2%	>	94.0%	>	94.9%
Manganese	µg/L		57.5%		56.3%		88.4%		87.7%		59.8%		59.8%		-42.5%		-41.5%		-45.5%		-44.7%		-1.0%		-8.7%
Nickel	µg/L	>	83.1%		62.1%	>	83.1%		91.0%	>	83.1%		85.2%		9.3%		-101.2%		-85.5%		-140.7%	>	15.7%	>	41.9%
Zinc	µg/L	>	98.5%		94.0%	>	98.5%	>	98.5%	>	98.5%	>	98.5%		27.5%		27.9%		15.3%		16.3%	>	98.5%		96.3%
Alkalinity	mg/L	<	-2660.0%			<	-1370.0%			<	-1220.0%			<	-2120.0%			NA	--			<	-621.0%		
Chloride	mg/L																								
Fluoride	mg/L																								
Hardness	mg/L				-314.8%				-8.8%				-134.5%				-871.9%				-597.4%				-75.4%
Nitrate/Nitrite	mg/L																								
Sulfate	mg/L		89.8%				99.5%				88.2%				3.6%				8.2%				14.3%		

Notes:

NA = Percent removal calculation is not applicable due to the following logic cases:

1) The treated water is non-detect, and the raw water was detected at a concentration less than the treated water reporting limit.

2) The raw water is non-detect, and the treated water was detected at a concentration less than the raw water reporting limit.

3) Both the raw water and the treated water are non-detect.

4) Percent removal for certain wet chemistry parameters are not meaningful comparisons; therefore, calculations were not completed.

CHIT = Chitorem treatment
LSTN= Limestone treatment
NAOH = Sodium hydroxide treatment
BCRX = Biochemical reactor barrel effluent
D = Dissolved Metals
T = Total Metals

Table 4.3-4
Tiger Bench-Scale Treatability Study: Comparisons to Water Quality Standards
Barker-Hughesville Mining District Superfund Site

		Sample ID	14BH-TI-BENCH-TN-RAW-070814				14BH-TI-BENCH-TN-RAWD-070814				14BH-TI-BENCH-TN-CHIT-070814				14BH-TI-BENCH-TN-LSTN-070814				14BH-TI-BENCH-TN-NAOH-070814			
		Sample Date	7/8/2014				7/8/2014				7/8/2014				7/8/2014				7/8/2014			
		Fraction	D		T		D		T		D		T		D		T		D		T	
Analyte	Unit	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	**2340**		**2310**		**2210**		**2260**		**301**		**530**		40.1	J	**222**		**150**		**212**	
Arsenic	µg/L	10.0	29.5		30.1	J	30.5		28.9	J	36		43.1	J	20	U	20	UJ	20	U	20	UJ
Cadmium	µg/L	0.3	**43.8**		**39**		**45.2**		**40.4**		**48.4**		**47**		**43.8**		**38.6**		**46.4**		**42.1**	
Copper	µg/L	9.3	**1450**		**1100**		**1410**		**1110**		**542**		**497**		**62.9**		**114**		**397**		**331**	
Iron	µg/L	1000.0	**269000**		**261000**		**254000**		**255000**		547		**41500**		651		**16800**		420		**6710**	
Lead	µg/L	3.2	**952**		**1240**		**954**		**1260**		5.8		**102**		4.71		**70.1**		11.7		**42.5**	
Nickel	µg/L	52.2	11.4		8.3	J	10.5		7.71	J	14.8		9.78	J	7.78	J	10	U	19.5		14.2	
Zinc	µg/L	119.8	**12100**		**11500**		**11700**		**11300**		**7810**		**7600**		**9690**		**9480**		**11500**		**11200**	
Hardness	mg/L	100	286		286		273		273		1000		1000		991		991		286		286	
Hardness for calculation[2]	mg/L	100	286		286		273		273		400		400		400		400		286		286	

Notes:

Aquatic life hardness-based equations for 6 metals are shown below. Equations are from DEQ-7 Montana Numeric Water Quality Standards (October 2012).

[1] Standards shown for cadmium, copper, lead, nickel, and zinc are based on 100 mg/L hardness for comparison purposes only. Actual screening in the table is based on the calculated hardness for each particular sample result.

[2] A hardness concentration of 400 mg/L was used for all measurements greater than 400 mg/L as per MT DEQ Montana Numeric Water Quality Standards (October 2012).

Cadmium	Acute	$e^{(1.0166*\ln(hardness)-3.924)}$
	Chronic	$e^{(0.7409*\ln(hardness)-4.719)}$
Copper	Acute	$e^{(0.9422*\ln(hardness)-1.7)}$
	Chronic	$e^{(0.8545*\ln(hardness)-1.702)}$
Lead	Acute	$e^{(1.273*\ln(hardness)-1.46)}$
	Chronic	$e^{(1.273*\ln(hardness)-4.705)}$
Nickel	Acute	$e^{(0.846*\ln(hardness)+2.255)}$
	Chronic	$e^{(0.846*\ln(hardness)+0.0584)}$
Zinc	Acute/chronic	$e^{(0.8473*\ln(hardness)+0.884)}$

D = Dissolved Metals
T = Total Metals
Q = Qualifier
µg/L= micrograms per liter
mg/L = milligrams per liter
CHIT = Chitorem treatment
LSTN= Limestone treatment
NAOH = Sodium hydroxide treatment
BCRX = Biochemical reactor barrel effluent

Flags:

Text -	Exceeds Human Health standard.
Text -	Exceeds Chronic Aquatic Life standard.
▨ Text -	Exceeds Acute Aquatic Life standard.

Table 4.3-4
Tiger Bench-Scale Treatability Study: Comparisons to Water Quality Standards
Barker-Hughesville Mining District Superfund Site

Sample ID			14BH-TI-BENCH-CONTROL-0826				14BH-TI-BENCH-BCR2-0826				14BH-TI-BENCH-BCR3-0826				14BH-TI-BENCH-BCR4-0826				14BH-TI-BENCH-BCR5-0826				14BH-TI-BENCH-BCR6-0826				14BH-TI-BENCH-BCR7-0826				14BH-TI-BENCH-BCR8-0826				14BH-TI-BENCH-BCR9-0826			
Sample Date			8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014				8/26/2014			
Fraction			D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T		D		T	
Analyte	Unit	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	**29400**		**28100**		500	U	**226**	J	500	U	500	U	**306**	J	**357**	J	**450**	J	**443**	J	500	U	**620**		**240**	J	**395**	J	**5680**		**6930**		**11800**		**12400**	
Arsenic	µg/L	10.0	100	U	100	U	100	U	100	U	100	U	100	U	100	U	100	U	20	U	100	U	100	U	100	U	100	U	100	U	100	U	29.2	J	100	U	33.2	J
Cadmium	µg/L	0.3	**52.9**		**58.7**		**21.8**		**24.4**		**25.4**		**27.8**		**26.4**		**28.3**		3	U	10	U	15	U	10	U	**26.6**		**30**		15	U	10	U	**28.3**		**31**	
Copper	µg/L	9.3	**1410**		**1760**		**26.6**	J	**45.2**	J	**70.5**		**102**		**174**		**215**		10	U	50	U	50	U	**27.7**	J	**112**		**180**		50	U	**117**		**475**		**157**	
Iron	µg/L	1000.0	**47600**		**46000**		**3870**		**5360**		**2550**		**3620**		2500	U	**1560**	J	**18600**		**18200**		**52900**		**51800**		**1930**	J	**3800**		**273000**		**301000**		**278000**		**295000**	
Lead	µg/L	3.2	**167**		**195**	J	10	U	7.1	J	10	U	10	U	10	U	8.07	J	2	U	10	UJ	10	U	**22.7**	J	10	U	12.4	J	**55.7**		**105**	J	**248**		**287**	J
Nickel	µg/L	52.2	59.3		86		50	U	36.3	J	50	U	35.6	J	50	U	31.1	J	10	U	50	U	50	U	50	U	50	U	39.2	J	85.7		119		104		130	
Zinc	µg/L	119.8	**13100**		**13500**		**5980**		**6160**		**6810**		**7150**		**7420**		**7440**		200	U	200	U	239		**811**		**7410**		**7560**		**10700**		**11900**		**11500**		**12200**	
Hardness	mg/L	100	499		499		335		335		343		343		319		319		317		317		338		338		312		312		434		434		493		493	
Hardness for calculation[2]	mg/L	100	400		400		335		335		343		343		319		319		317		317		338		338		312		312		400		400		400		400	

Notes:

Aquatic life hardness-based equations for 6 metals are shown below. Equations are from DEQ-7 Montana Numeric Water Quality Standards (October 2012).

[1]Standards shown for cadmium, copper, lead, nickel, and zinc are based on 100 mg/L hardness for comparison purposes only. Actual screening in the table is based on the calculated hardness for each particular sample result.

[2] A hardness concentration of 400 mg/L was used for all measurements greater than 400 mg/L as per MT DEQ Montana Numeric Water Quality Standards (October 2012).

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	Chronic	$e^{(0.8545\ast\ln(hardness)-1.702)}$
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	Chronic	$e^{(1.273\ast\ln(hardness)-4.705)}$
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	Chronic	$e^{(0.846\ast\ln(hardness)+0.0584)}$
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T = Total Metals
Q = Qualifier
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LSTN= Limestone treatment
NAOH = Sodium hydroxide treatment
BCRX = Biochemical reactor barrel effluent

Flags:

Text -	Exceeds Human Health standard.
Text -	Exceeds Chronic Aquatic Life standard.
▨ Text -	Exceeds Acute Aquatic Life standard.

Table 4.3-4
Tiger Bench-Scale Treatability Study: Comparisons to Water Quality Standards
Barker-Hughesville Mining District Superfund Site

		Sample ID	14BH-TI-BENCH-BCR10-0826				14BH-TI-BENCH-BCR11-0826				14BH-TI-BENCH-BCR12-0826			
		Sample Date	8/26/2014				8/26/2014				8/26/2014			
		Fraction	D		T		D		T		D		T	
Analyte	Unit	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	**14900**		**16400**		500	U	**397**	J	**219**	J	**473**	J
Arsenic	µg/L	10.0	38.4	J	38.5	J	40		54		59.9		76.9	
Cadmium	µg/L	0.3	**44.3**		**47.1**		3	U	**5.95**		3	U	**3.87**	
Copper	µg/L	9.3	**314**		**508**		7.37	J	**85.8**		10	U	**51**	
Iron	µg/L	1000.0	**303000**		**322000**		2500	U	**3210**		**1050**	J	**4570**	
Lead	µg/L	3.2	**255**		**371**		2.18		**27.5**		3.35		**24.7**	
Nickel	µg/L	52.2	108		141		10	U	15.6		10	U	22.1	
Zinc	µg/L	119.8	**10700**		**11400**		371		**1510**		167	J	**573**	
Hardness	mg/L	100	651		651		1140		1140		1420		1420	
Hardness for calculation[2]	mg/L	100	400		400		400		400		400		400	

		Sample ID	14BH-TI-BENCH-BCR13-0826				14BH-TI-BENCH-BCR14-0826				14BH-TI-BENCH-BCR15-0826			
		Sample Date	8/26/2014				8/26/2014				8/26/2014			
		Fraction	D		T		D		T		D		T	
Analyte	Unit	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	**299**	J	**720**		500	U	500	U	500	U	500	U
Arsenic	µg/L	10.0	104		123		20.9		21.7		20.9		26.5	
Cadmium	µg/L	0.3	3	U	**7.15**		3	U	2	U	3	U	2	U
Copper	µg/L	9.3	10	U	**79.5**		8.37	J	5.93	J	6.45	J	10	U
Iron	µg/L	1000.0	2500	U	**5230**		2500	U	2500	U	2500	U	2500	U
Lead	µg/L	3.2	2	U	**33.6**		2	U	2	U	2	U	2	U
Nickel	µg/L	52.2	10	U	32.6		10	U	7.78	J	10	U	12.7	
Zinc	µg/L	119.8	200	U	**809**		200	U	200	U	200	U	200	U
Hardness	mg/L	100	2070		2070		543		543		1170		1170	
Hardness for calculation[2]	mg/L	100	400		400		400		400		400		400	

		Sample ID	14BH-TI-BENCH-BCR16-0826				14BH-TI-BENCH-BCR17-0826				14BH-TI-BENCH-BCR18-0826			
		Sample Date	8/26/2014				8/26/2014				8/26/2014			
		Fraction	D		T		D		T		D		T	
Analyte	Unit	Standard[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	µg/L	87.0	**5340**		**5180**		**14100**		**14800**		500	U	**238**	J
Arsenic	µg/L	10.0	100	U	30.4	J	126		**162**		100	U	100	U
Cadmium	µg/L	0.3	**8.17**	J	**9.89**	J	**83.8**		**98.1**		15	U	10	U
Copper	µg/L	9.3	**71**		**209**		**55.7**		**130**		50	U	50	U
Iron	µg/L	1000.0	**268000**		**264000**		**326000**		**330000**		**155000**		**180000**	
Lead	µg/L	3.2	**185**		**227**		**116**		**181**		10	U	10	U
Nickel	µg/L	52.2	53.8		**173**		110		**207**		50	U	50	U
Zinc	µg/L	119.8	**9500**		**9730**		**11100**		**11300**		200	U	**504**	
Hardness	mg/L	100	4850		4850		3480		3480		875		875	
Hardness for calculation[2]	mg/L	100	400		400		400		400		400		400	

Notes:

Aquatic life hardness-based equations for 6 metals are shown below. Equations are from DEQ-7 Montana Numeric Water Quality Standards (October 2012).

[1] Standards shown for cadmium, copper, lead, nickel, and zinc are based on 100 mg/L hardness for comparison purposes only. Actual screening in the table is based on the calculated hardness for each particular sample result.

[2] A hardness concentration of 400 mg/L was used for all measurements greater than 400 mg/L as per MT DEQ Montana Numeric Water Quality Standards (October 2012).

Cadmium	Acute	$e^{(1.0166*\ln(hardness)-3.924)}$
	Chronic	$e^{(0.7409*\ln(hardness)-4.719)}$
Copper	Acute	$e^{(0.9422*\ln(hardness)-1.7)}$
	Chronic	$e^{(0.8545*\ln(hardness)-1.702)}$
Lead	Acute	$e^{(1.273*\ln(hardness)-1.46)}$
	Chronic	$e^{(1.273*\ln(hardness)-4.705)}$
Nickel	Acute	$e^{(0.846*\ln(hardness)+2.255)}$
	Chronic	$e^{(0.846*\ln(hardness)+0.0584)}$
Zinc	Acute/chronic	$e^{(0.8473*\ln(hardness)+0.884)}$

D = Dissolved Metals
T = Total Metals
Q = Qualifier
µg/L= micrograms per liter
mg/L = milligrams per liter
CHIT = Chitorem treatment
LSTN= Limestone treatment
NAOH = Sodium hydroxide treatment
BCRX = Biochemical reactor barrel effluent

Flags:

Text -	Exceeds Human Health standard.
Text -	Exceeds Chronic Aquatic Life standard.
▨ Text -	Exceeds Acute Aquatic Life standard.

Figures

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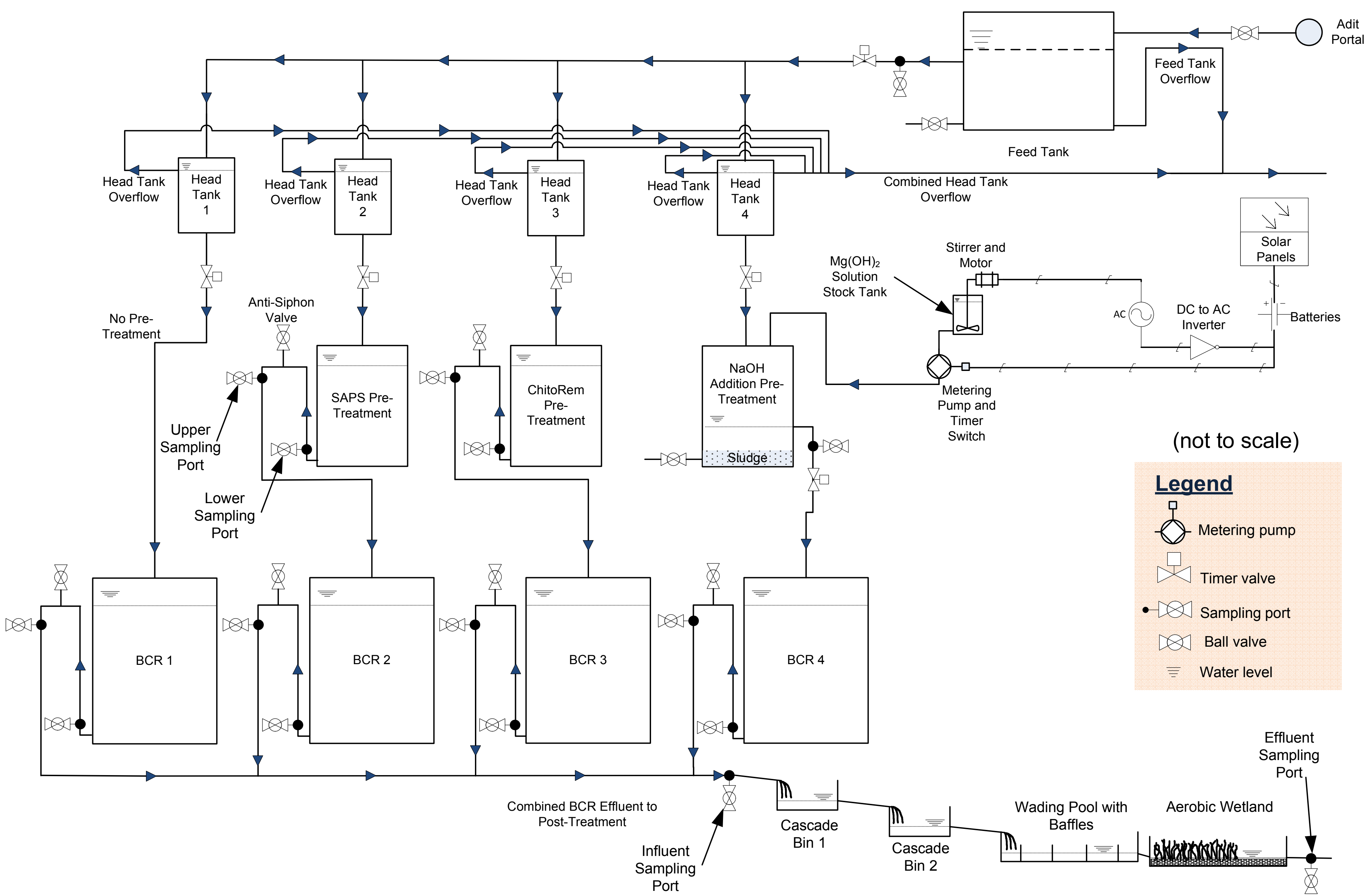

CDM Smith

CDM Smith Inc.
50 West 14th Street
Suite 200
Helena, MT 59601

Barker-Hughesville Mining District Superfund Site

Figure 2.2-1
Pilot-Scale Treatability Study
Year 2
Process Flow Diagram

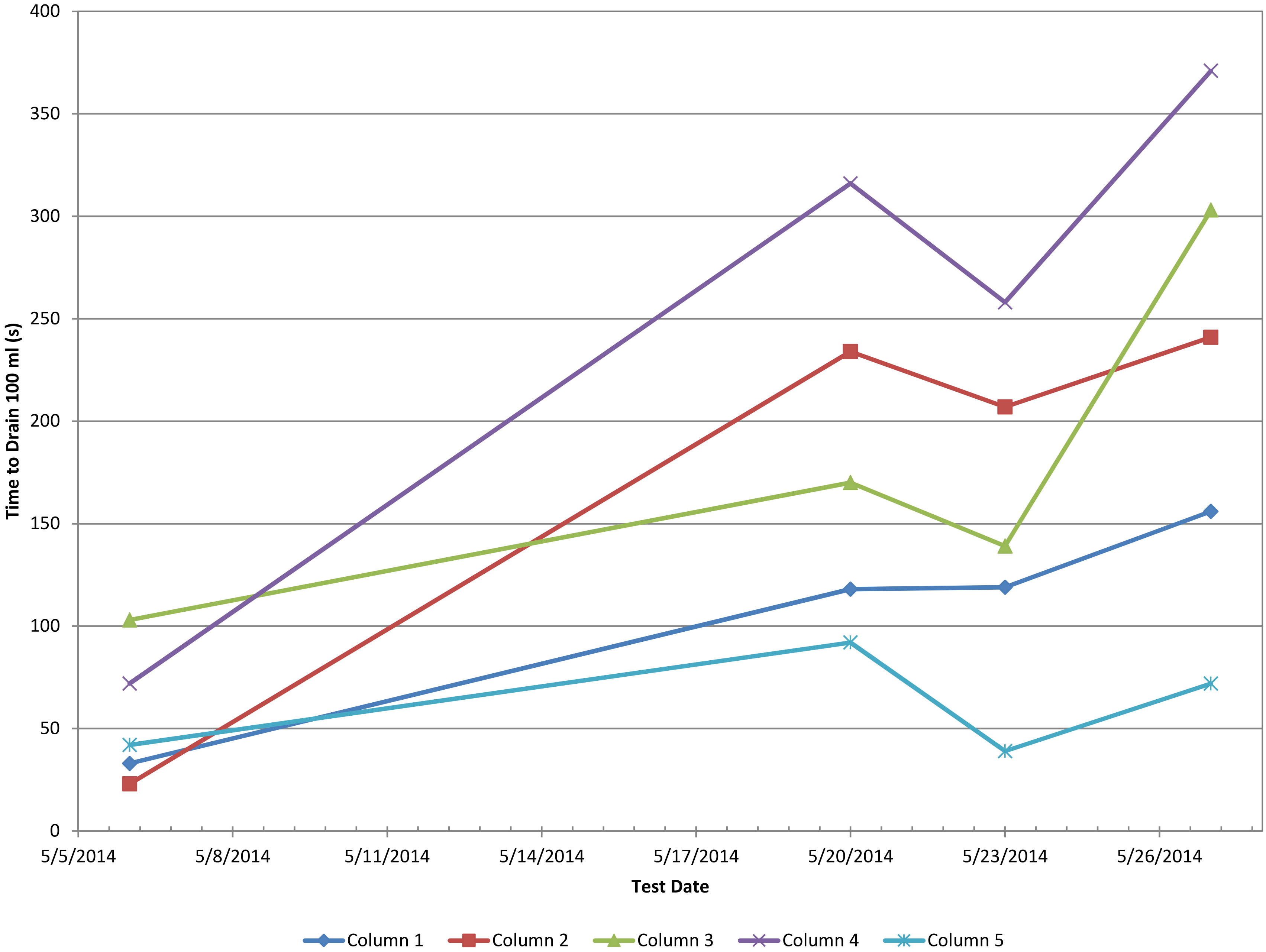

Figure 4.1-1
100 ml Drain Test Results
Danny T Hydraulic Bench-Scale Tests

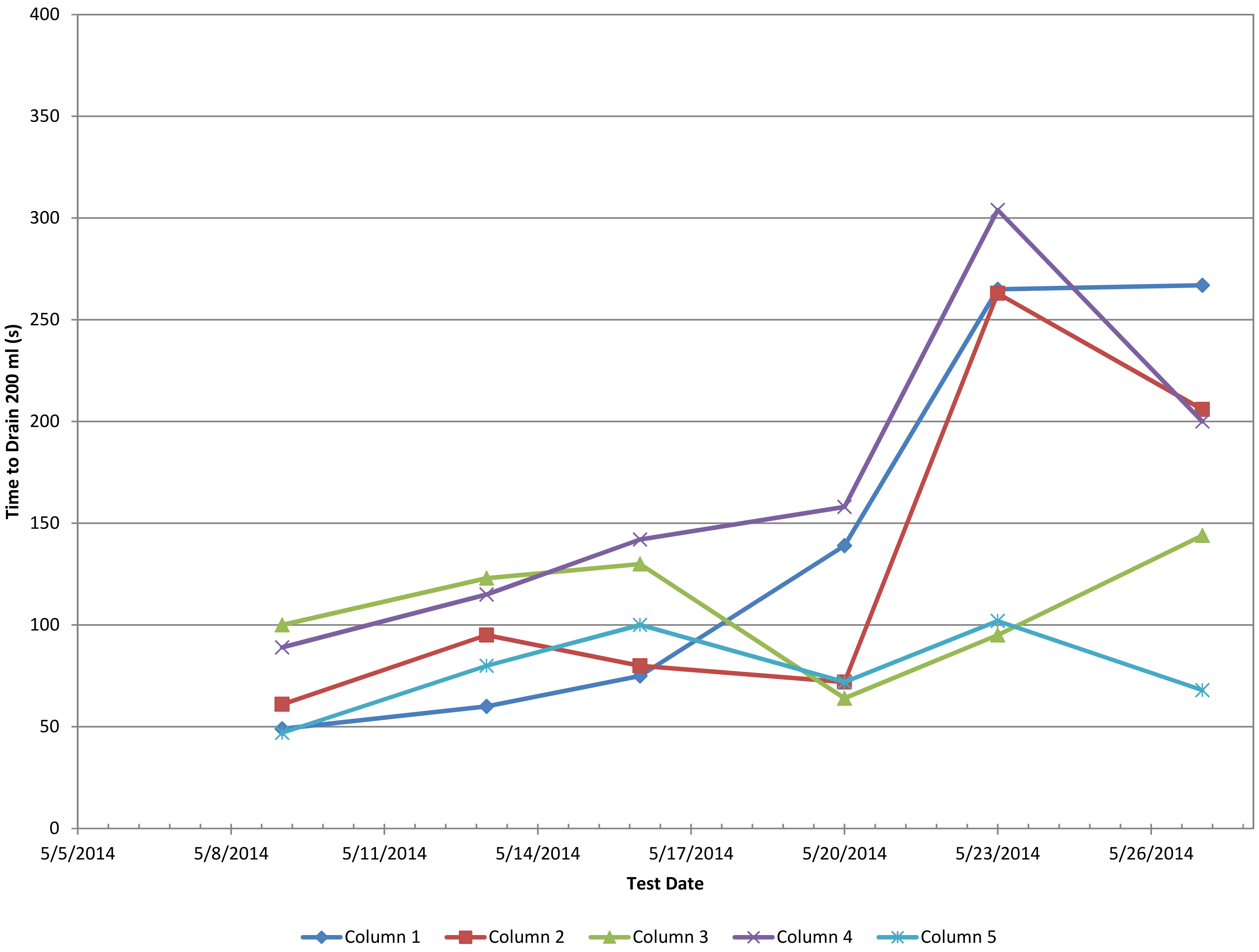

Figure 4.1-2
200 ml Drain Test Results
Danny T Hydraulic Bench-Scale Tests

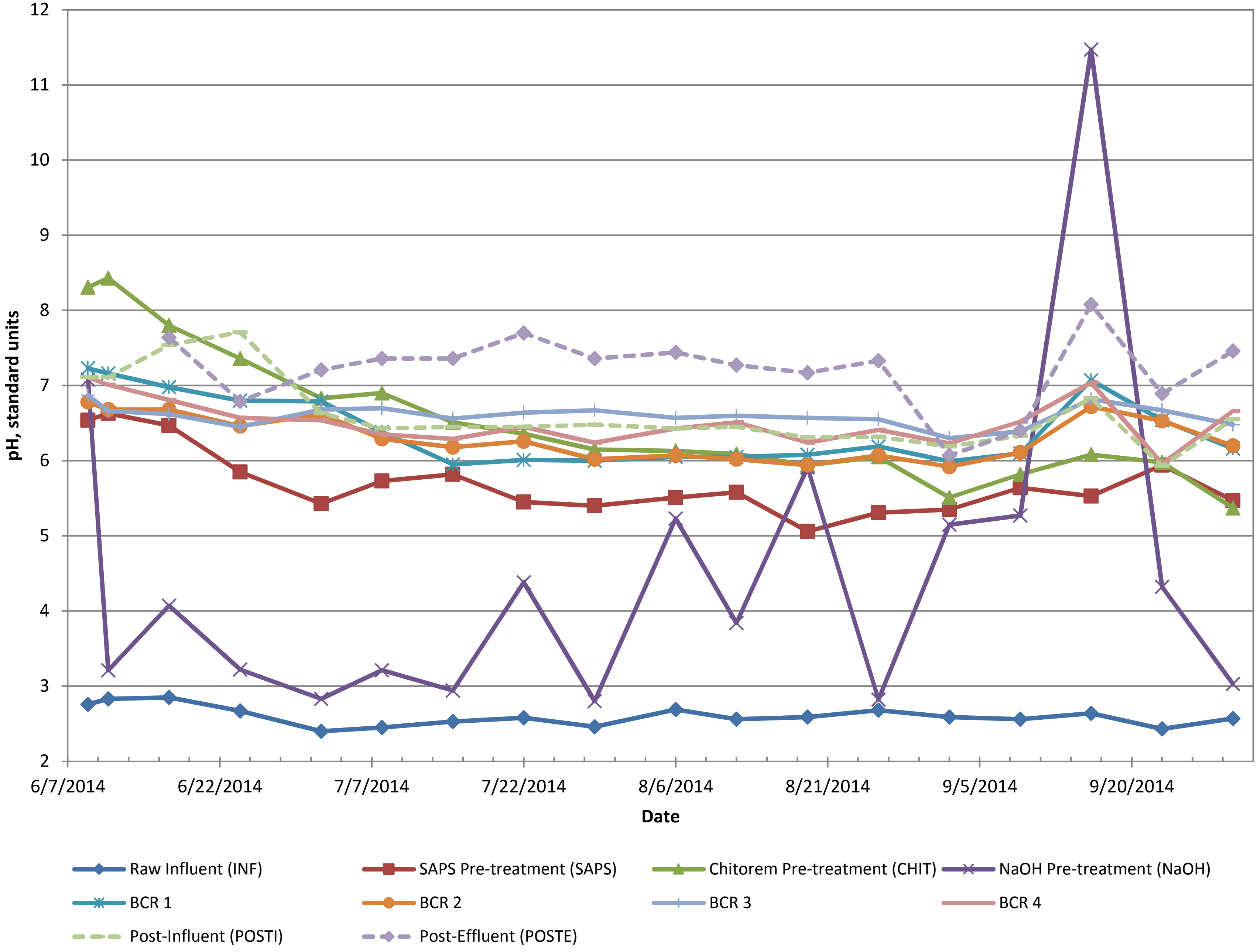

Figure 4.2-1
pH Measurements
Danny T Adit Treatability Study Year 2

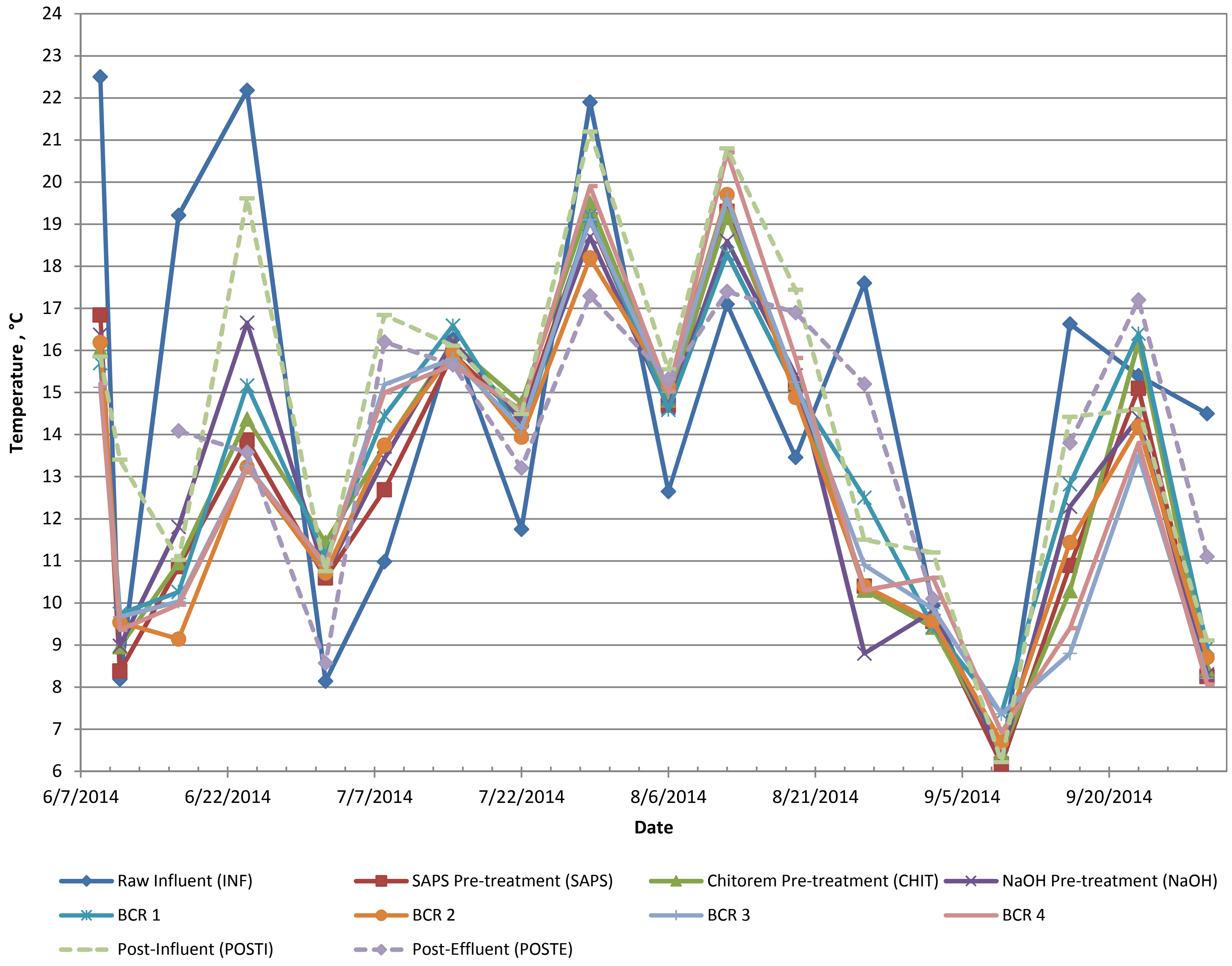

Figure 4.2-2
Temperature Measurments
Danny T Adit Treatability Study Year 2

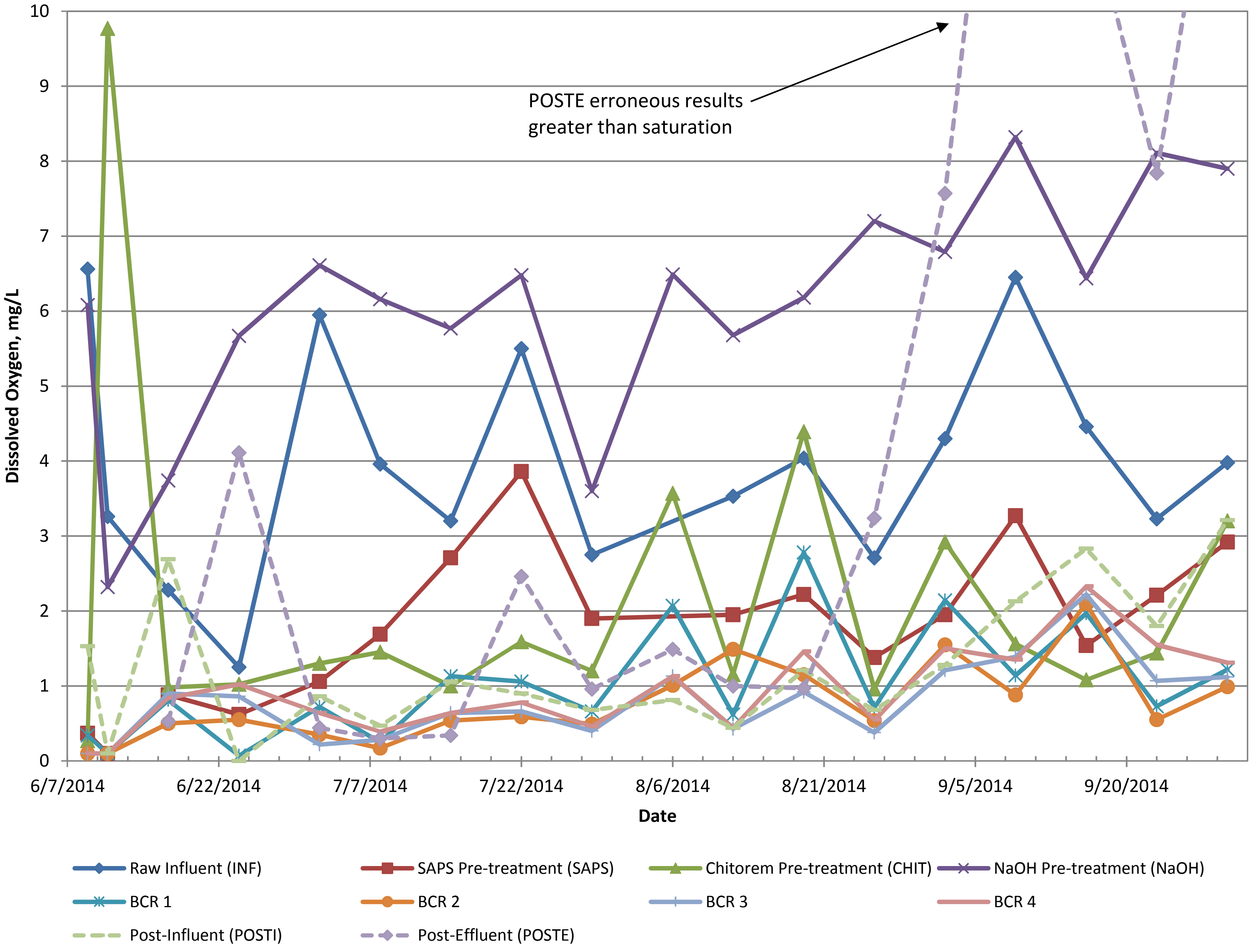

Figure 4.2-3
Dissolved Oxygen Measurements
Danny T Adit Treatability Study Year 2

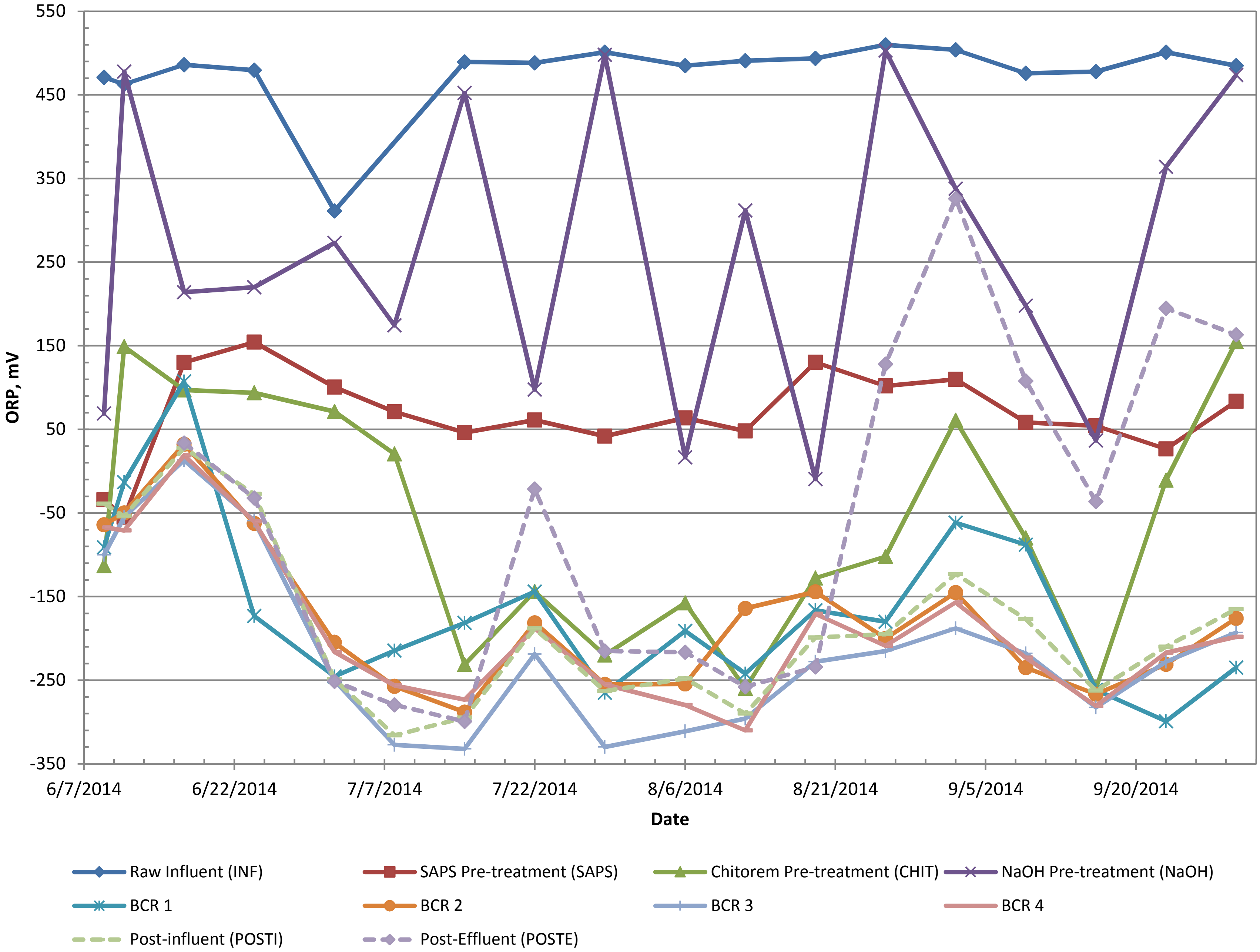

Figure 4.2-4
Oxidation-Reduction Potential Measurements
Danny T Adit Treatability Study Year 2

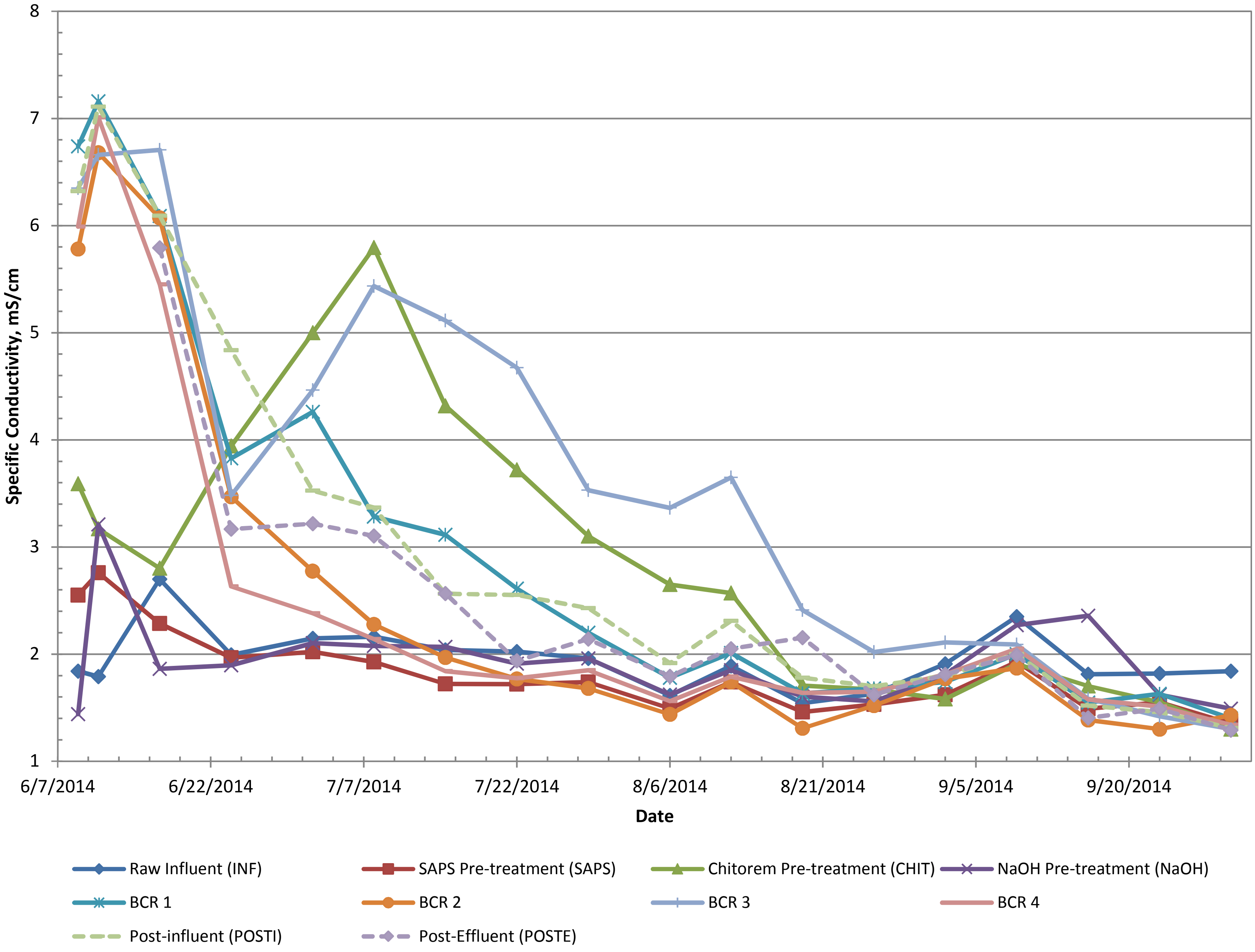

Figure 4.2-5
Specific Conductivity Measurements
Danny T Adit Treatability Study Year 2

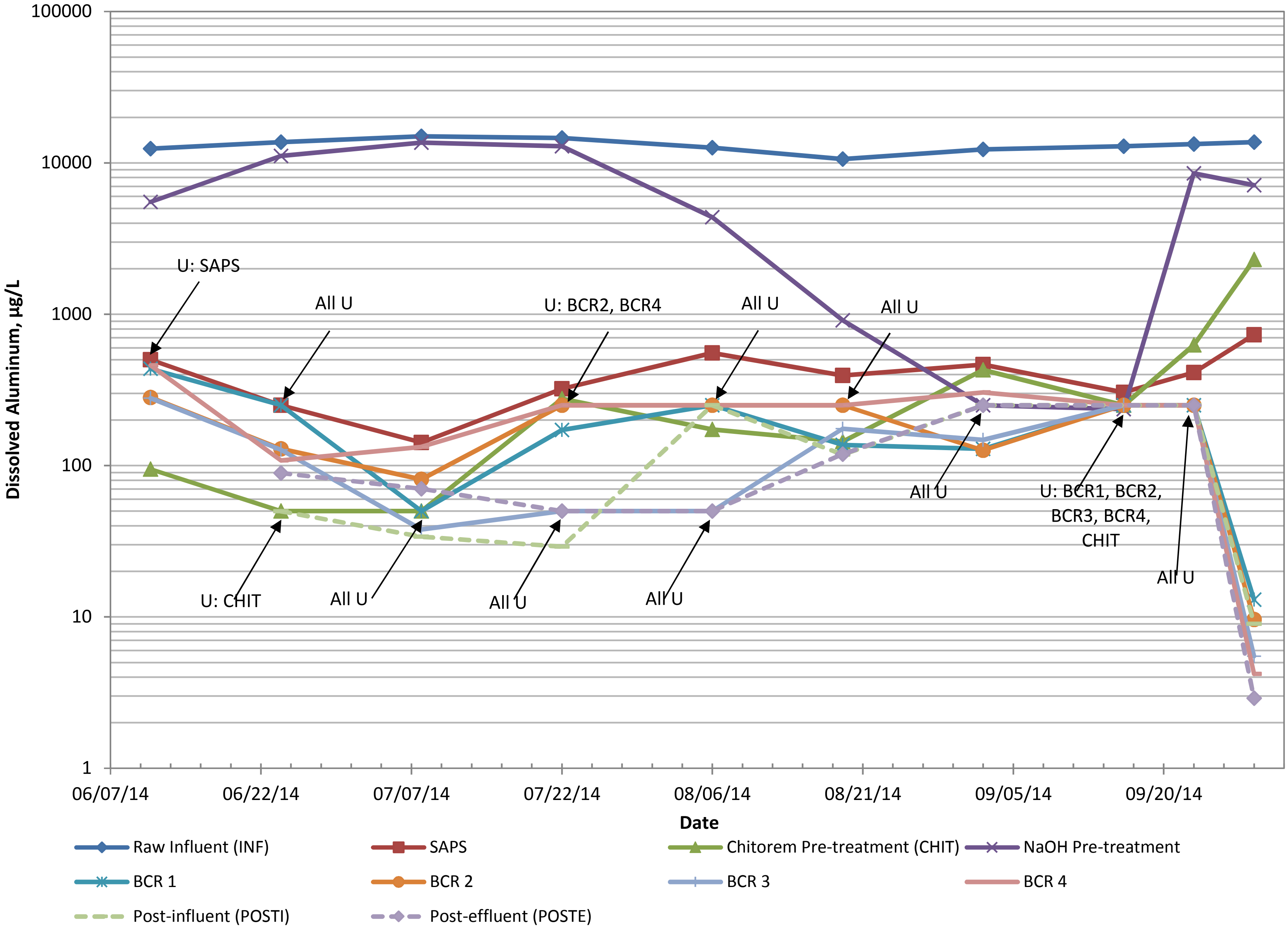

Figure 4.2-6
Dissolved Aluminum Concentrations
Danny T Adit Treatability Study Year 2

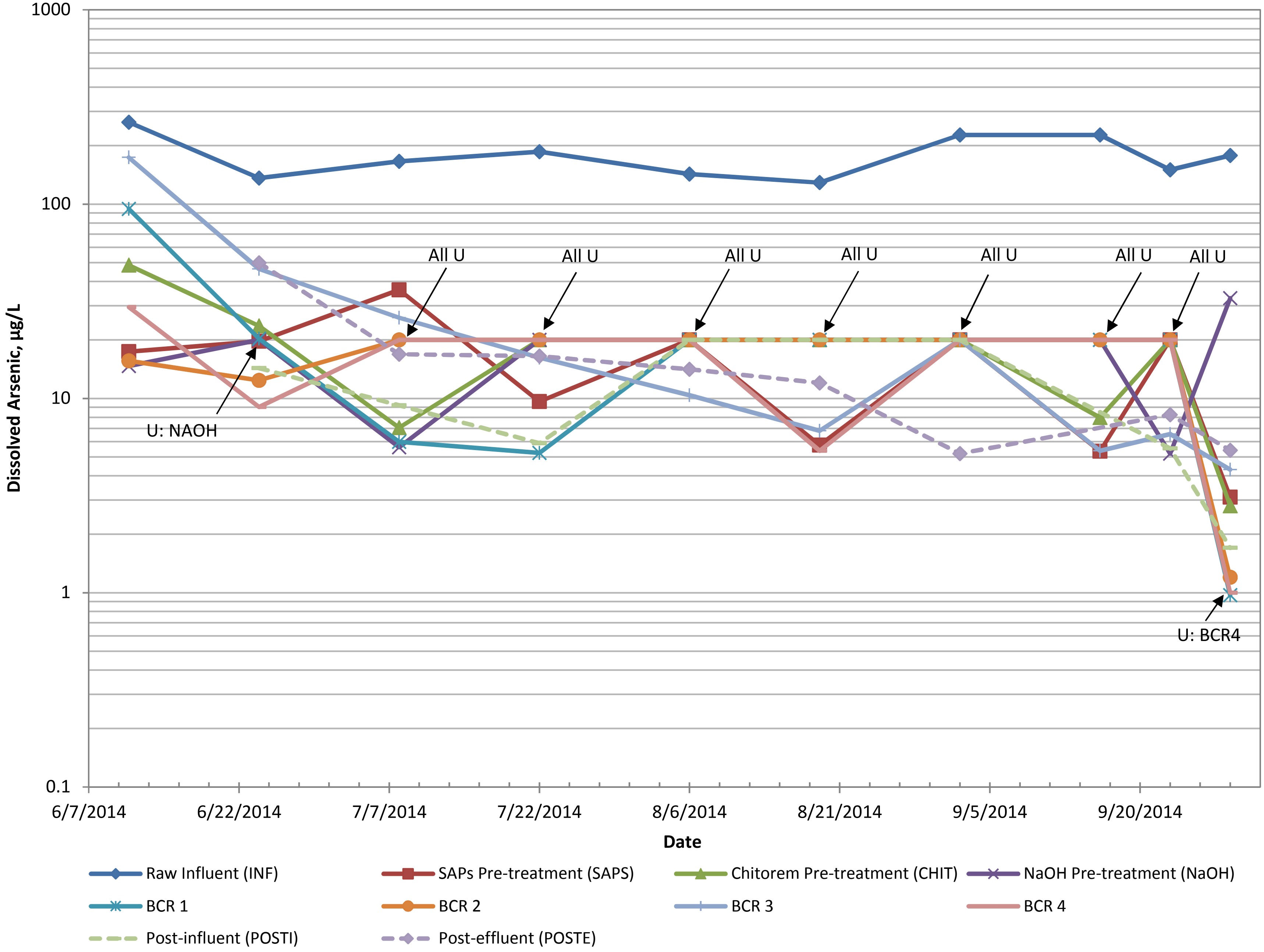

Figure 4.2-7
Dissolved Arsenic Concentrations
Danny T Adit Treatability Study Year 2

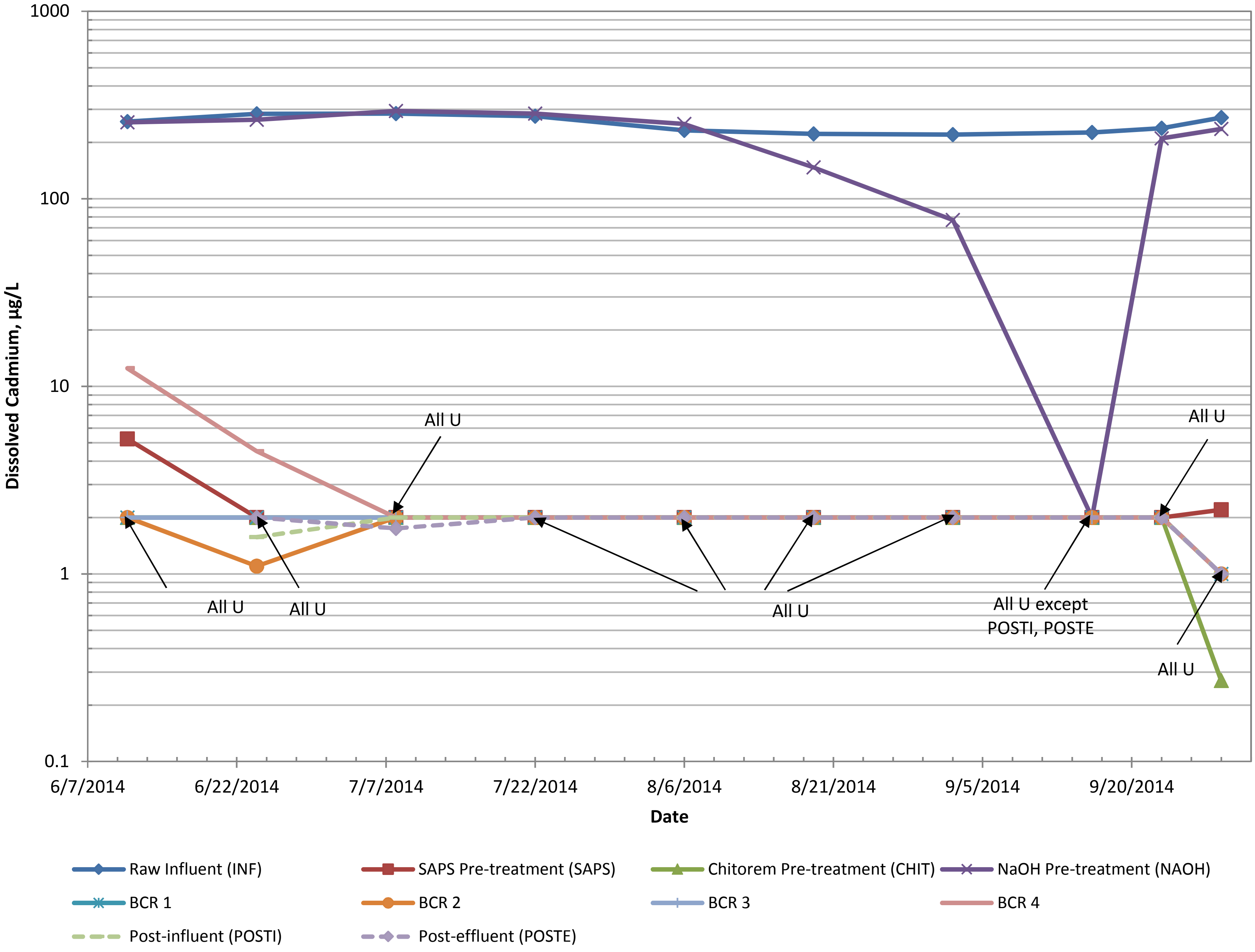

Figure 4.2-8
Dissolved Cadmium Concentrations
Danny T Adit Treatability Study Year 2

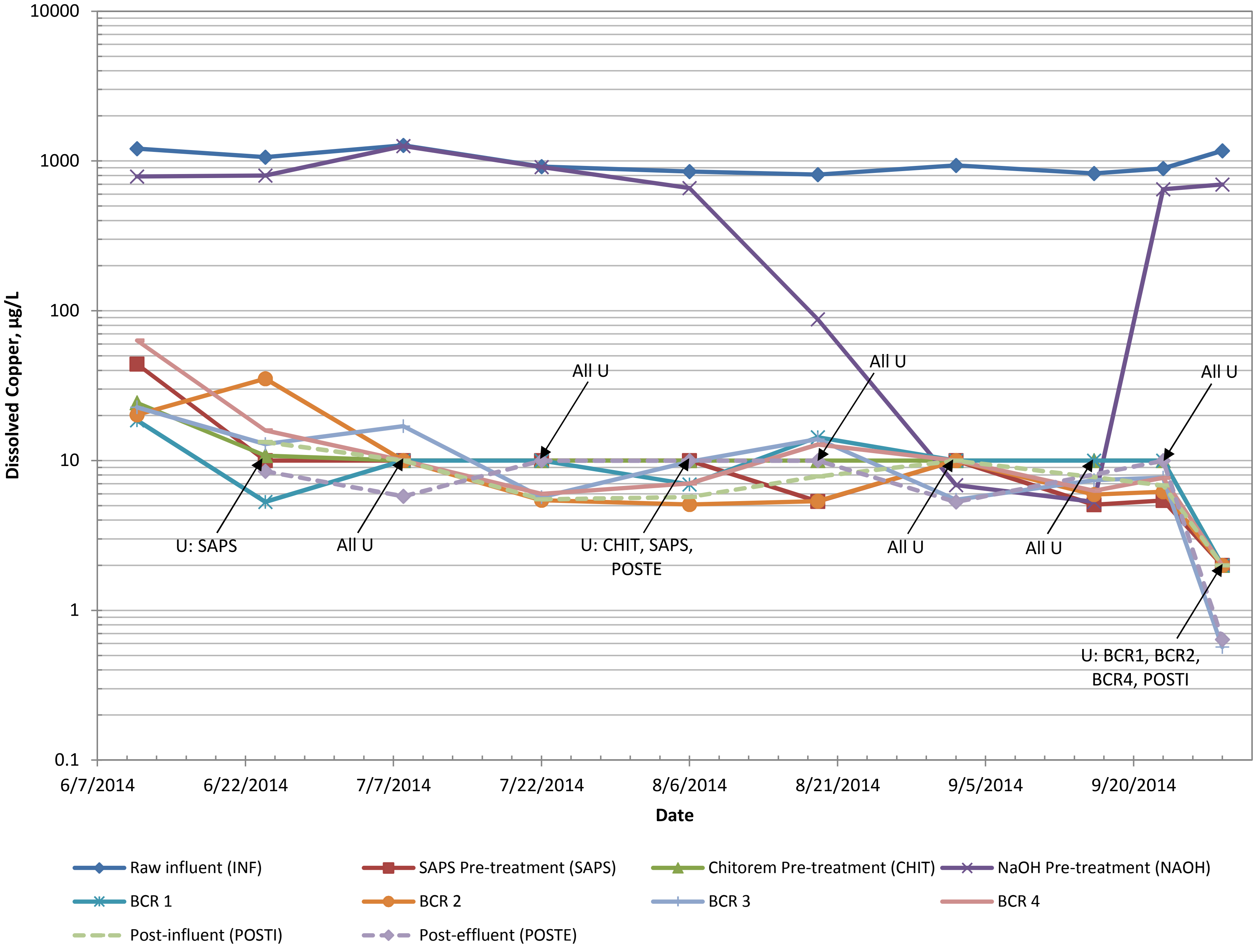

Figure 4.2-9
Dissolved Copper Concentrations
Danny T Adit Treatability Study Year 2

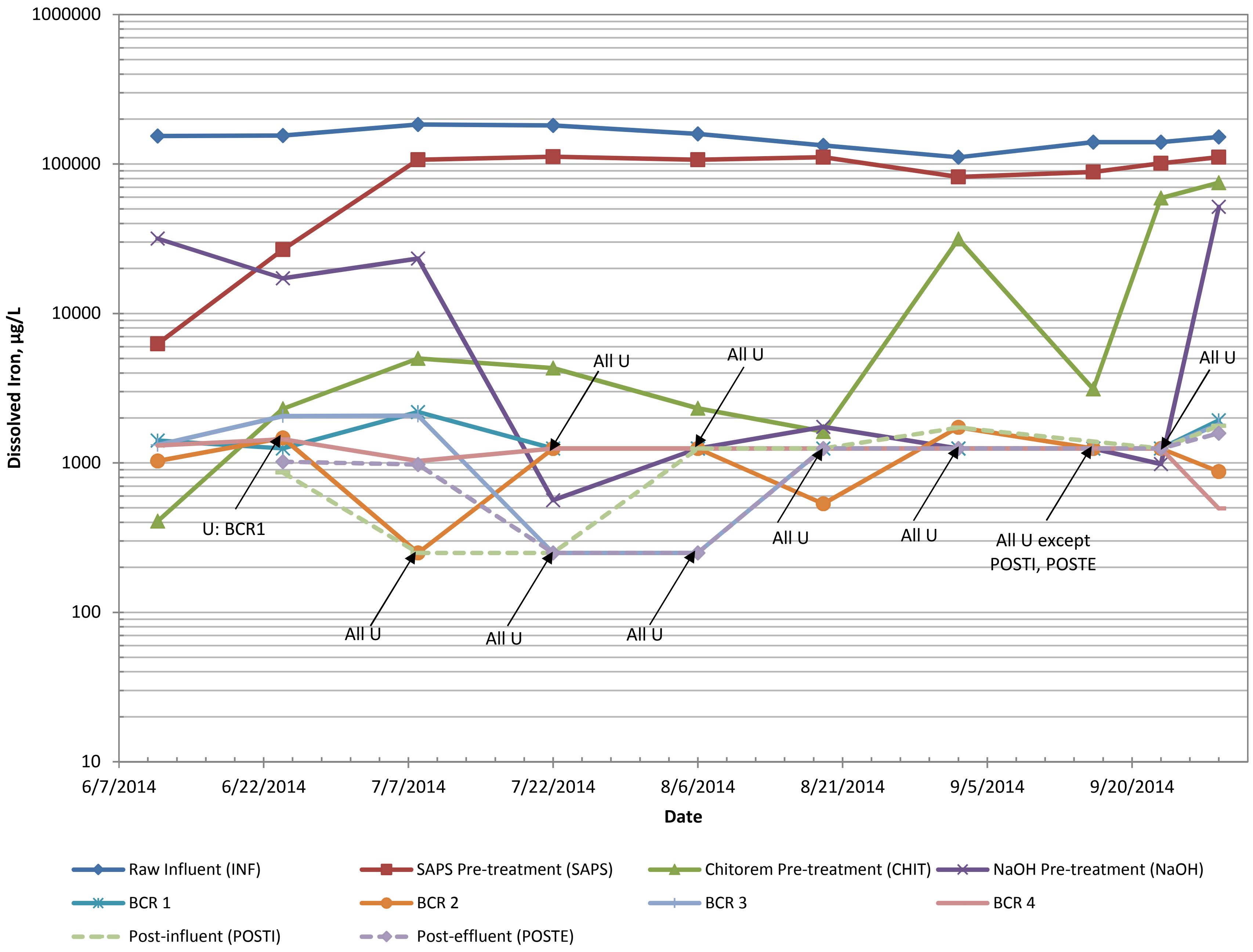

Figure 4.2-10
Dissolved Iron Concentrations
Danny T Adit Treatability Study Year 2

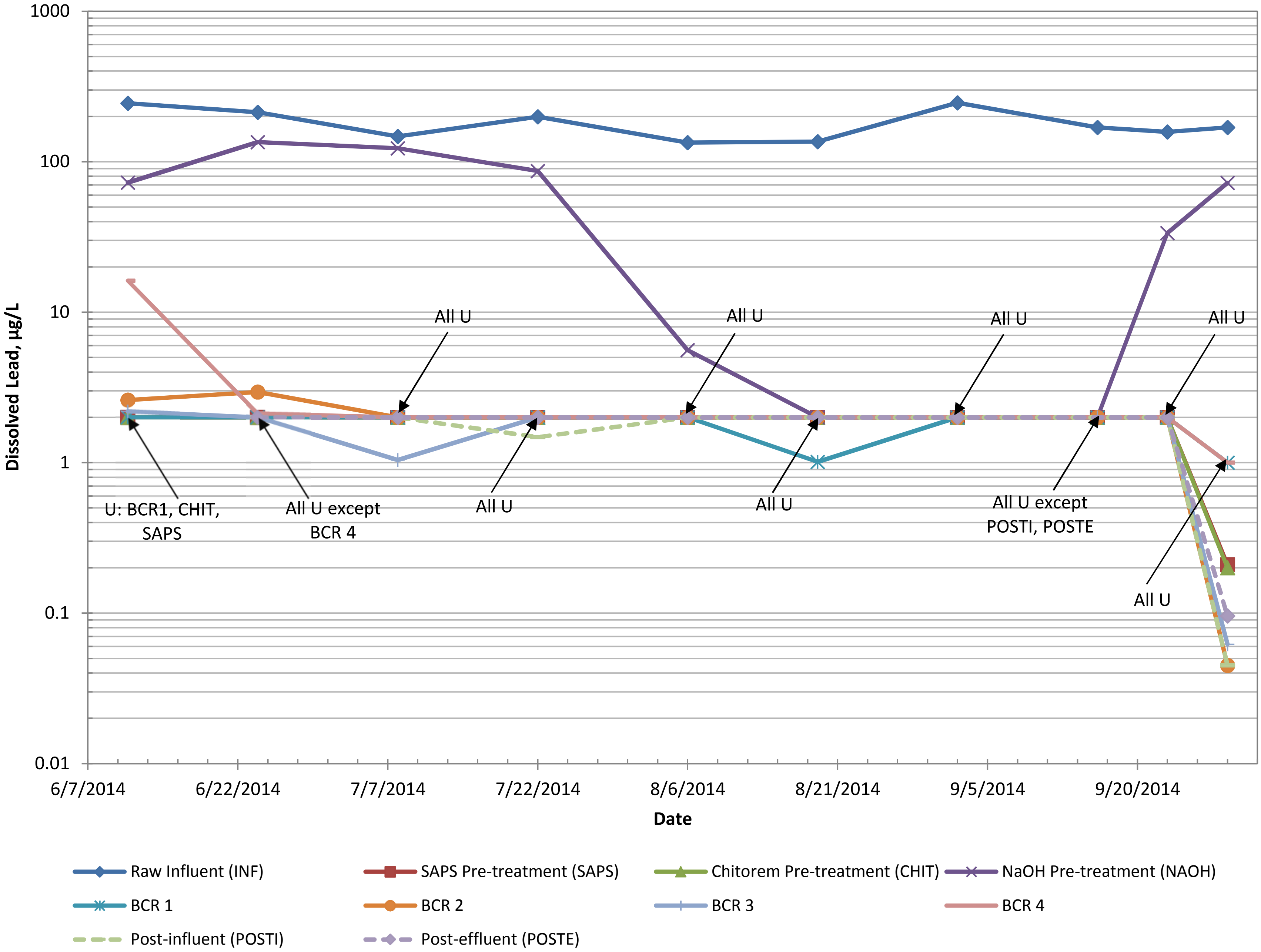

Figure 4.2-11
Dissolved Lead Concentrations
Danny T Adit Treatability Study Year 2

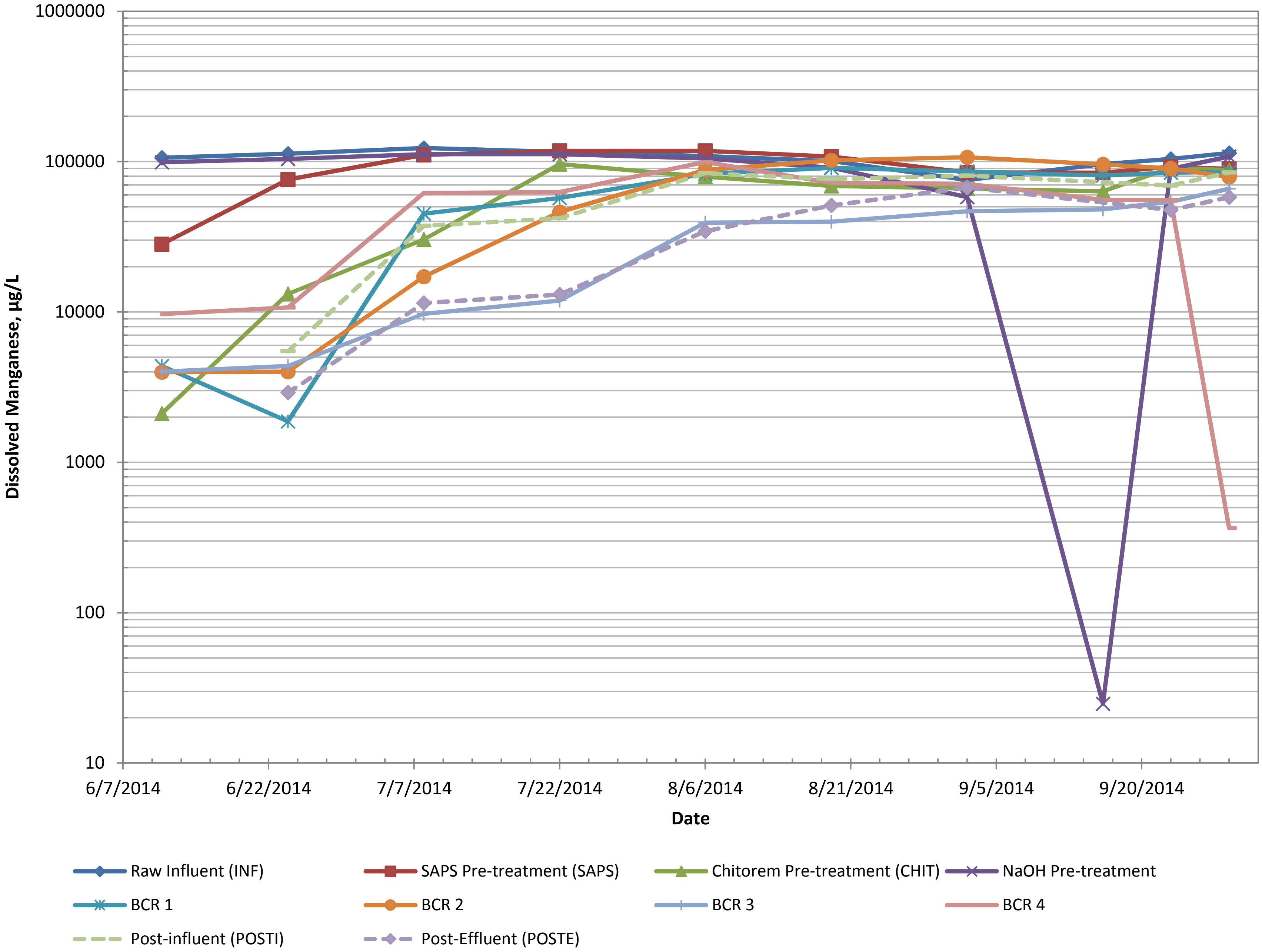

Figure 4.2-12
Dissolved Manganese Concentrations
Danny T Adit Treatability Study Year 2

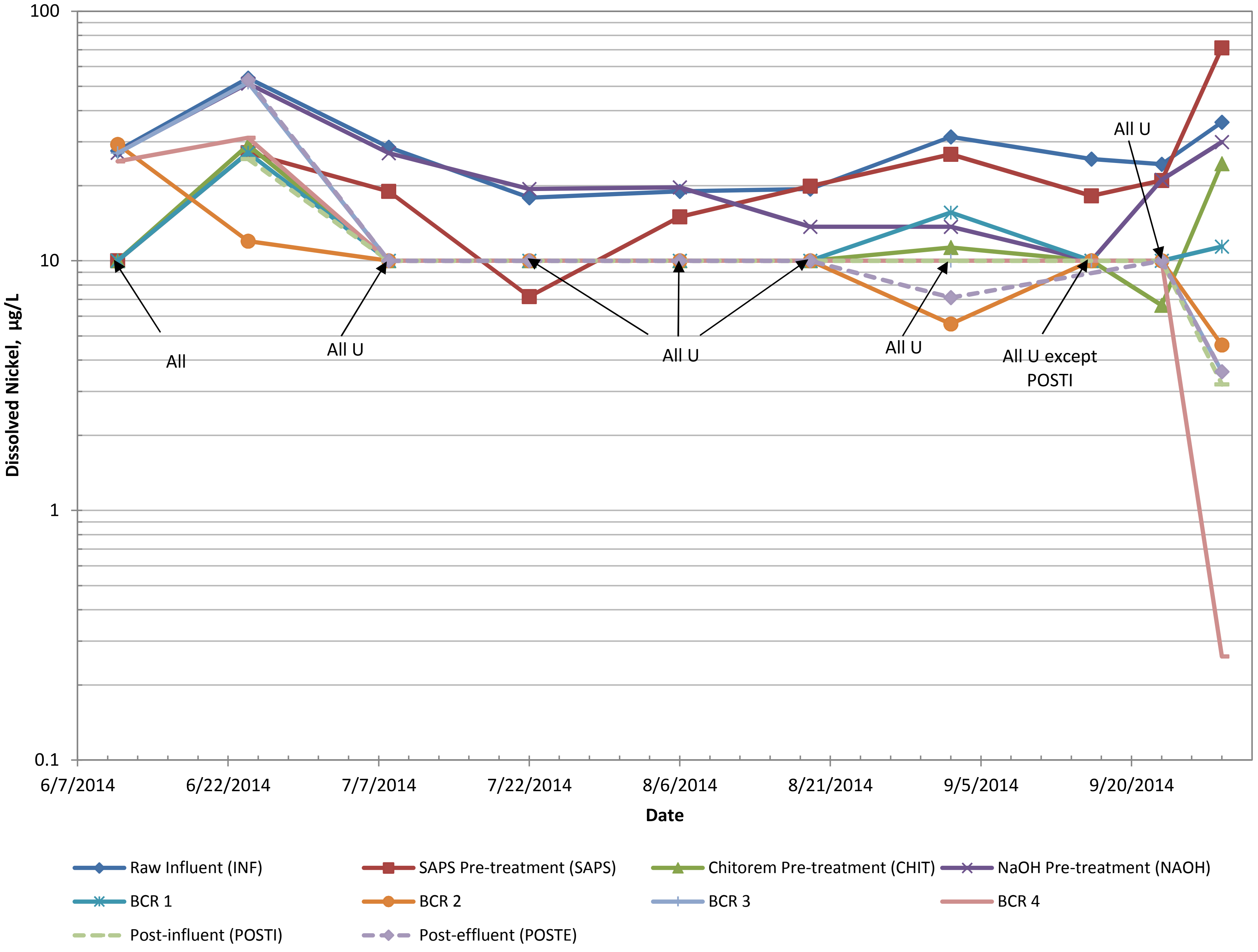

Figure 4.2-13
Dissolved Nickel Concentrations
Danny T Adit Treatability Study Year 2

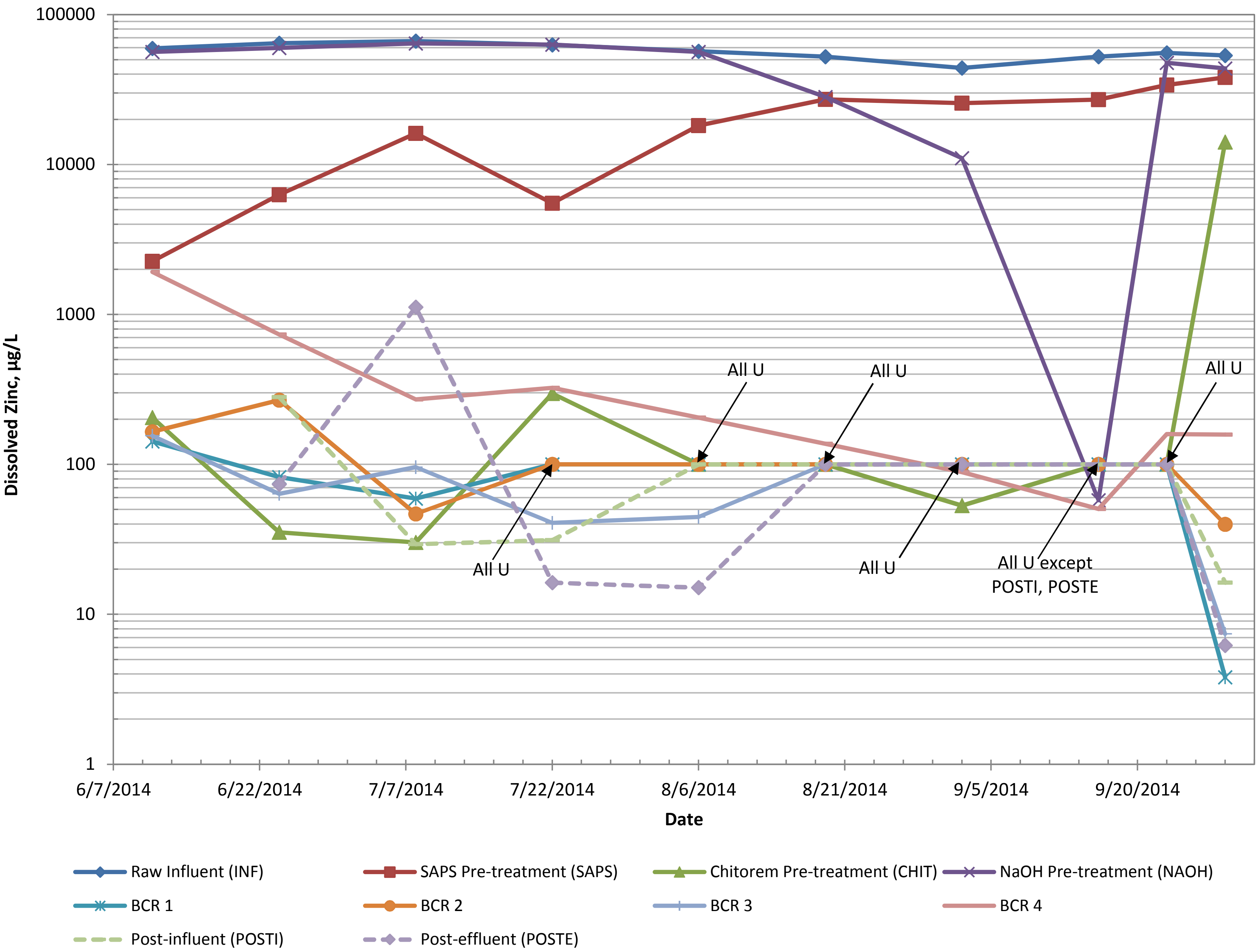

Figure 4.2-14
Dissolved Zinc Concentrations
Danny T Adit Treatability Study Year 2

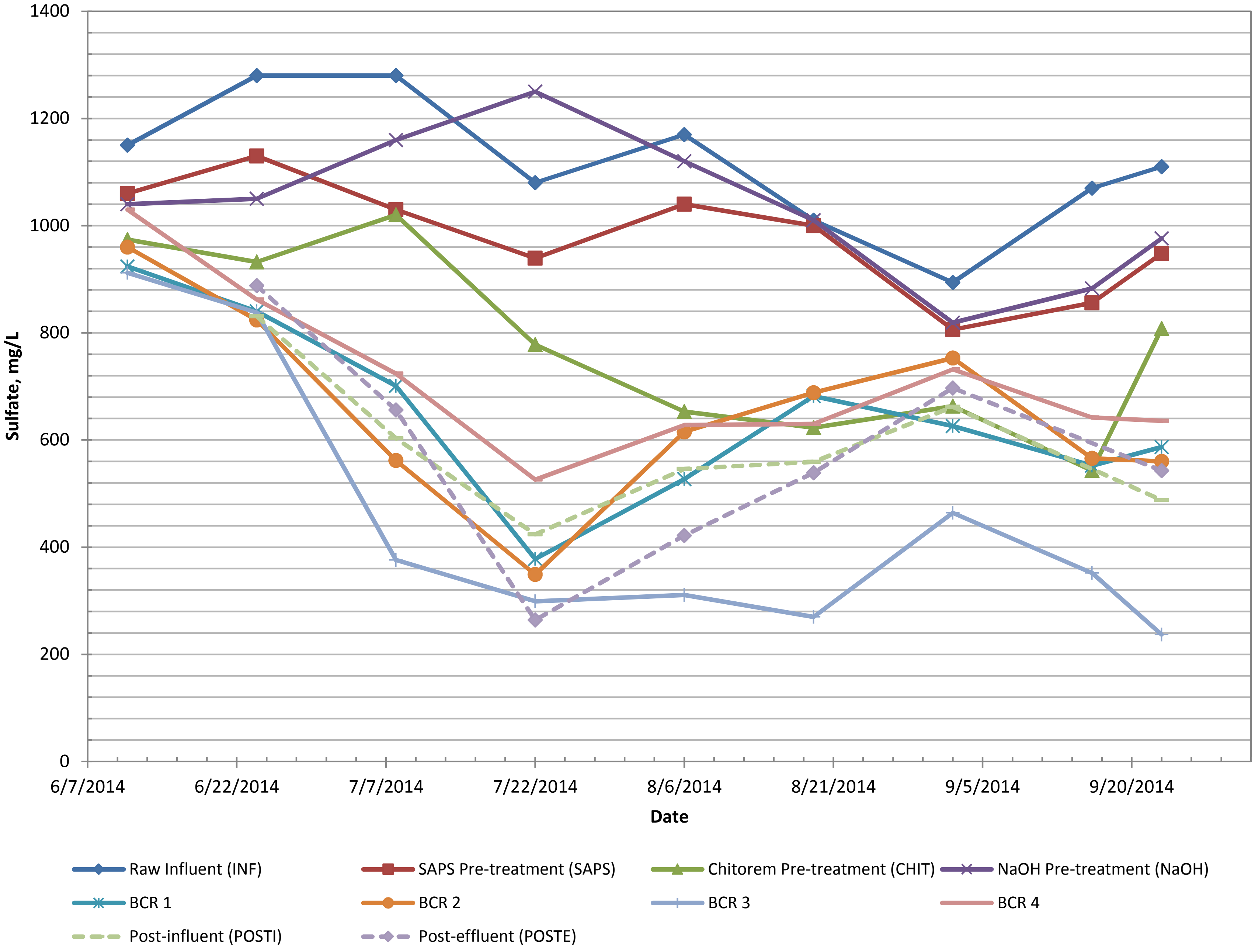

Figure 4.2-15
Sulfate Concentrations
Danny T Adit Treatability Study Year 2

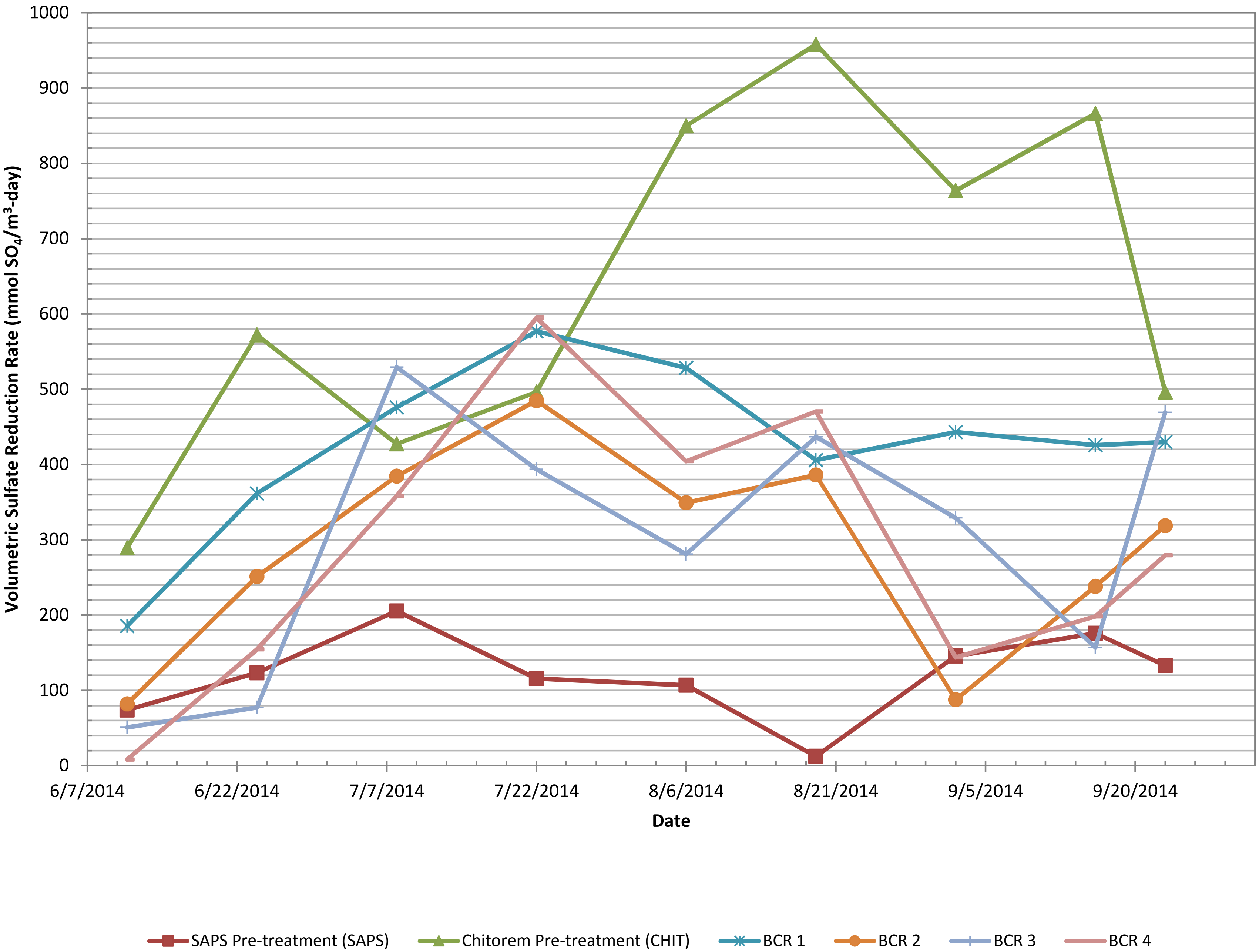

Figure 4.2-16
Sulfate Reduction Rate
Danny T Adit Treatability Study Year 2

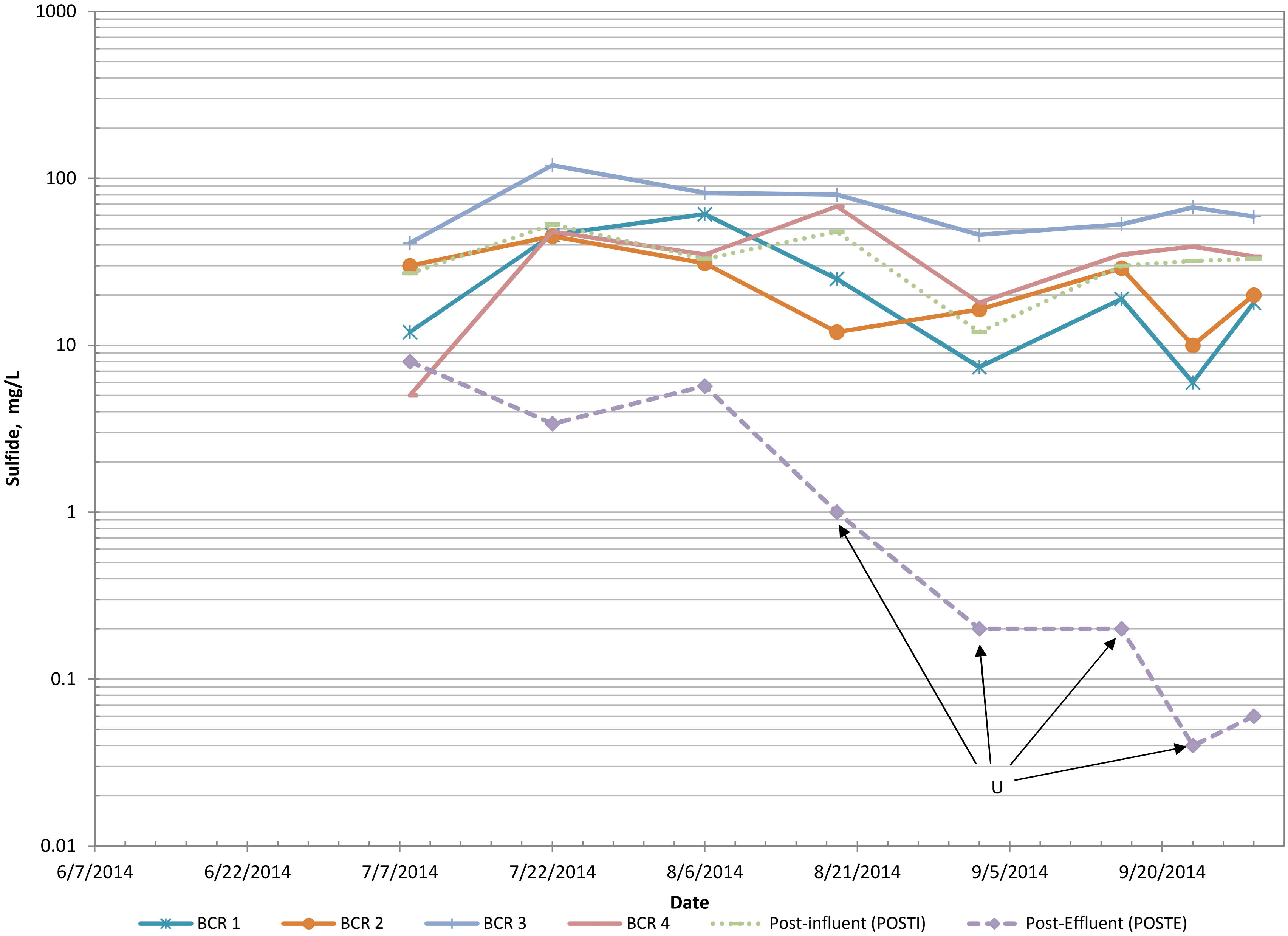

Figure 4.2-17
Sulfide Concentrations
Danny T Adit Treatability Study Year 2

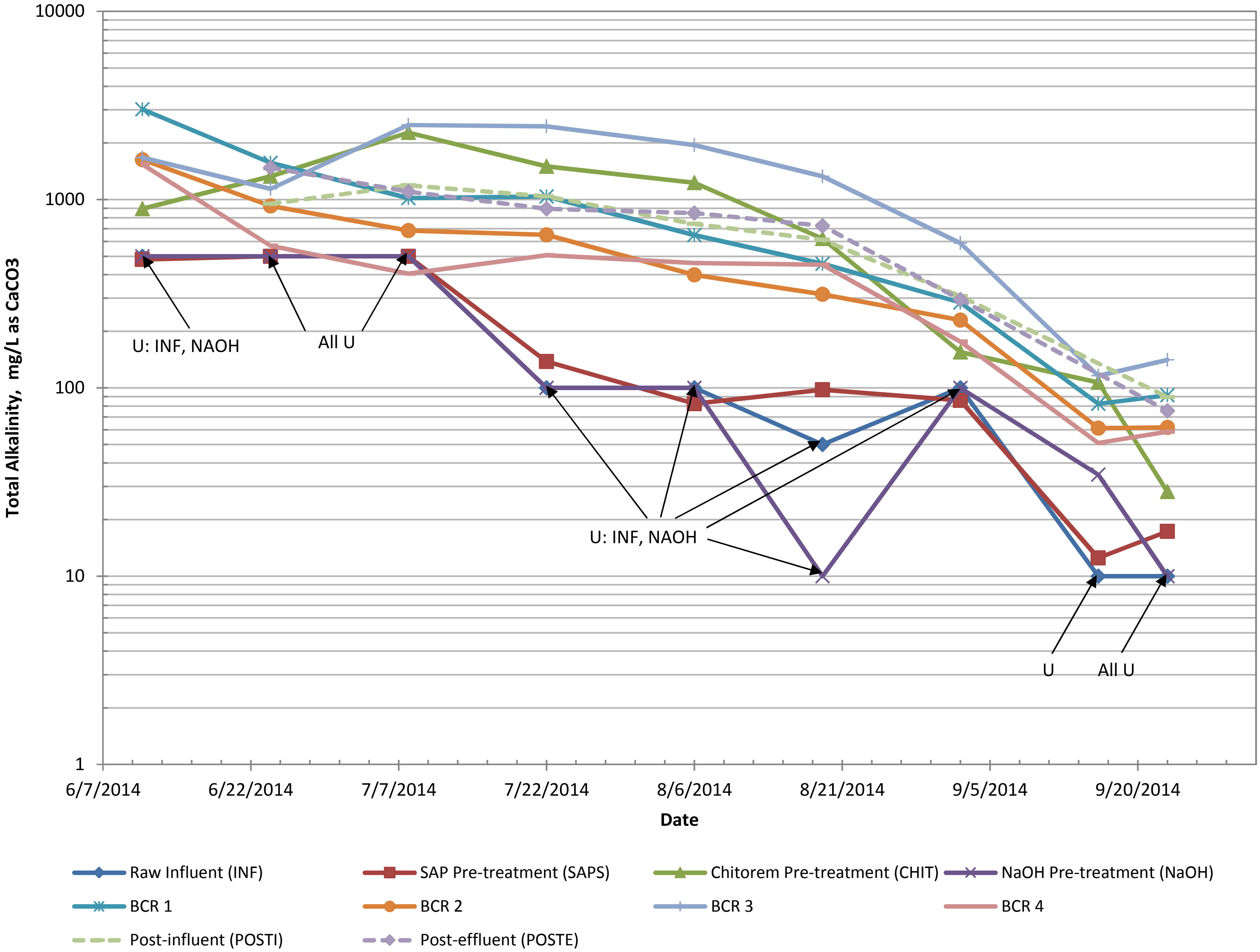

Figure 4.2-18
Total Alkalinity Measurements
Danny T Adit Treatability Study Year 2

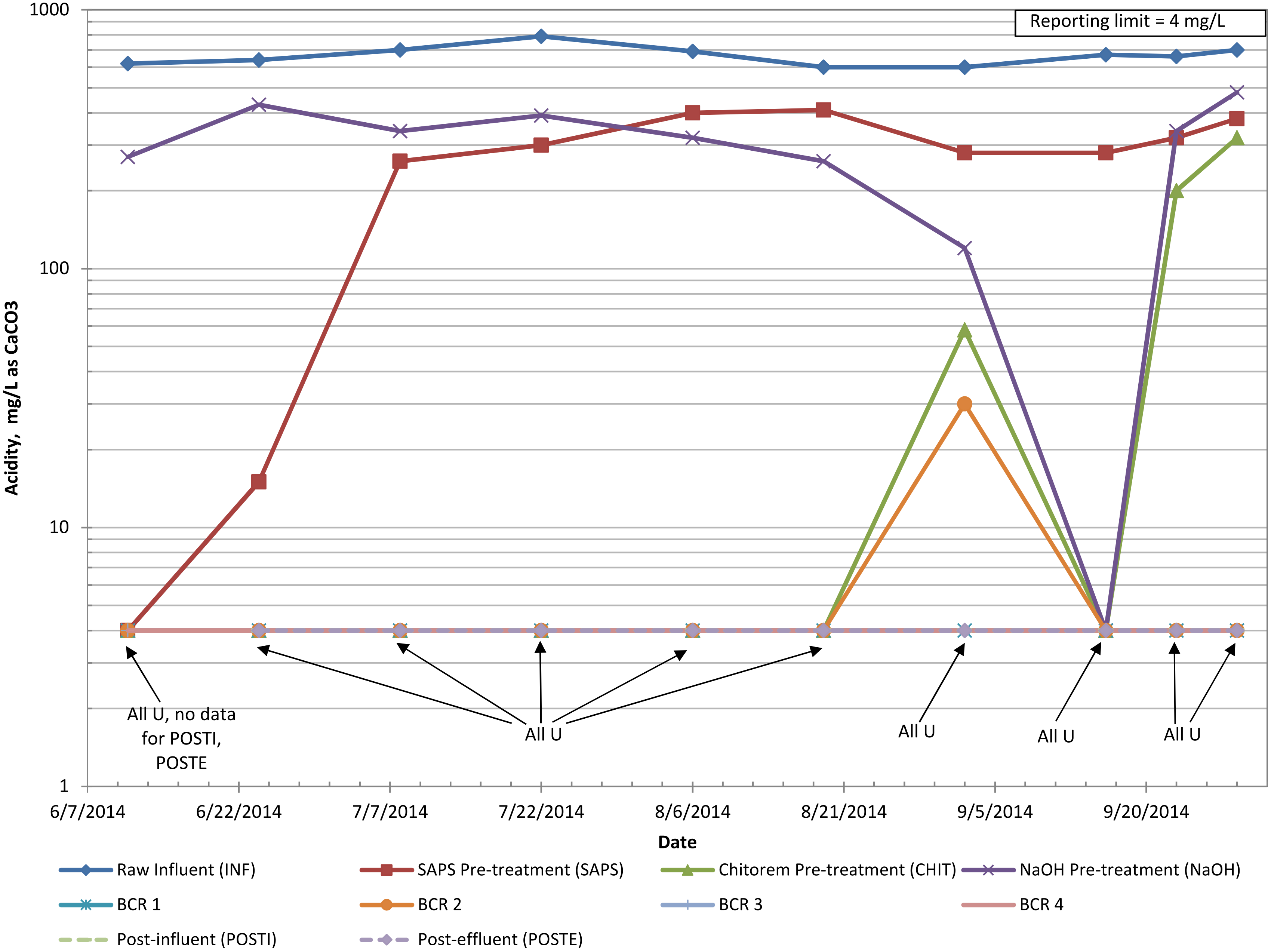

Figure 4.2-19
Acidity Measurements
Danny T Adit Treatability Study Year 2

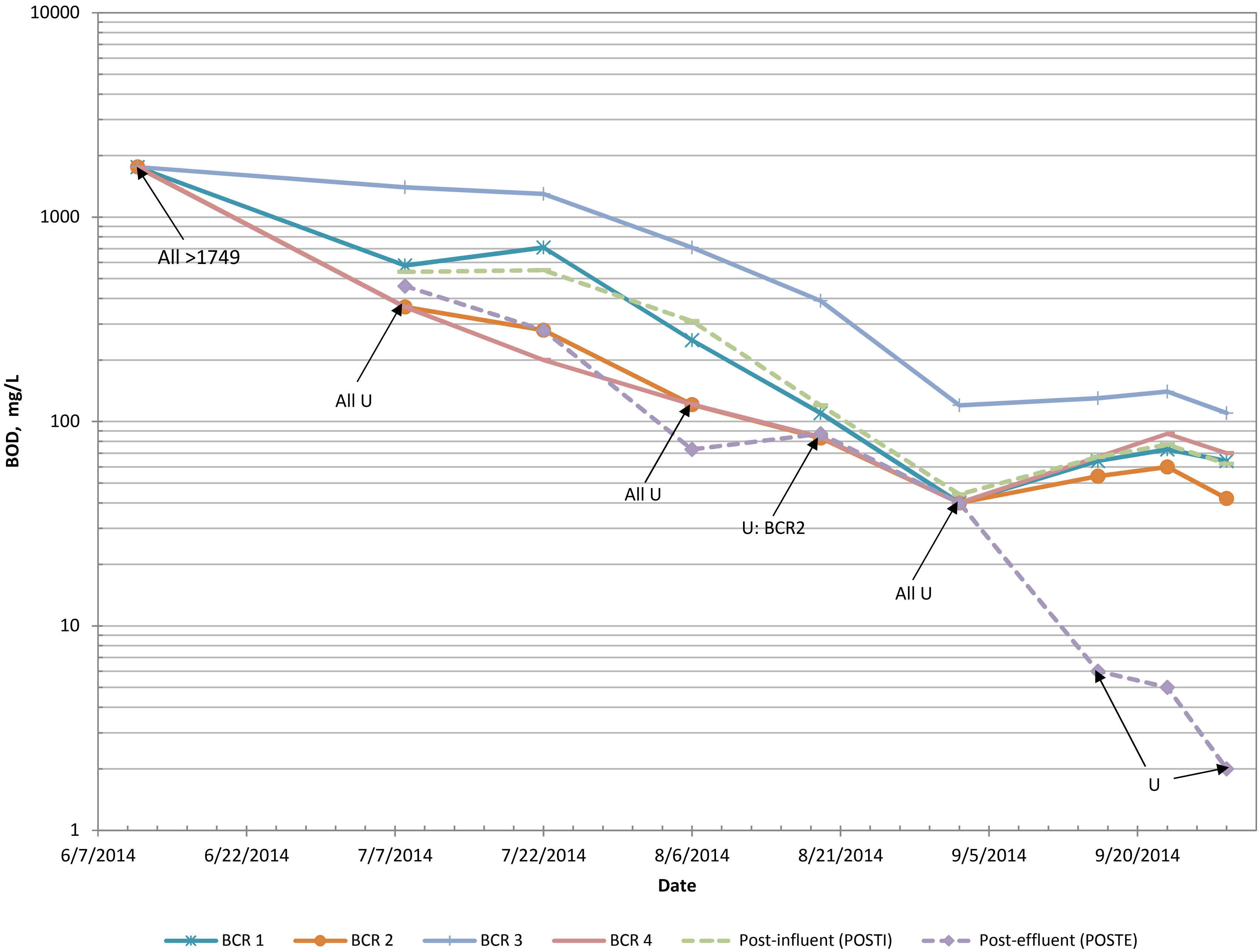

Figure 4.2-20
BOD Measurements
Danny T Adit Treatability Study Year 2

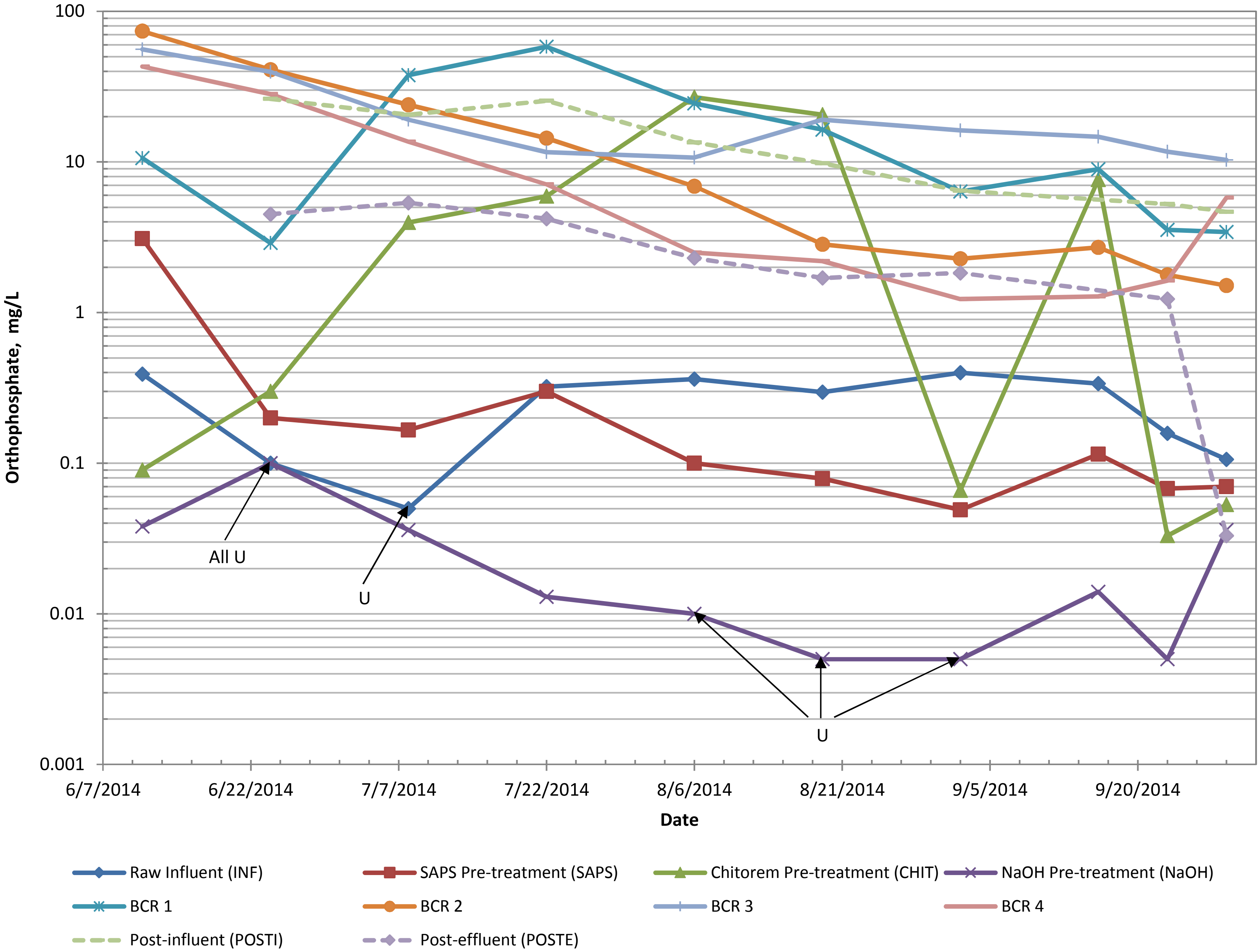

Figure 4.2-21
Phosphate Concentrations
Danny T Adit Treatability Study Year 2

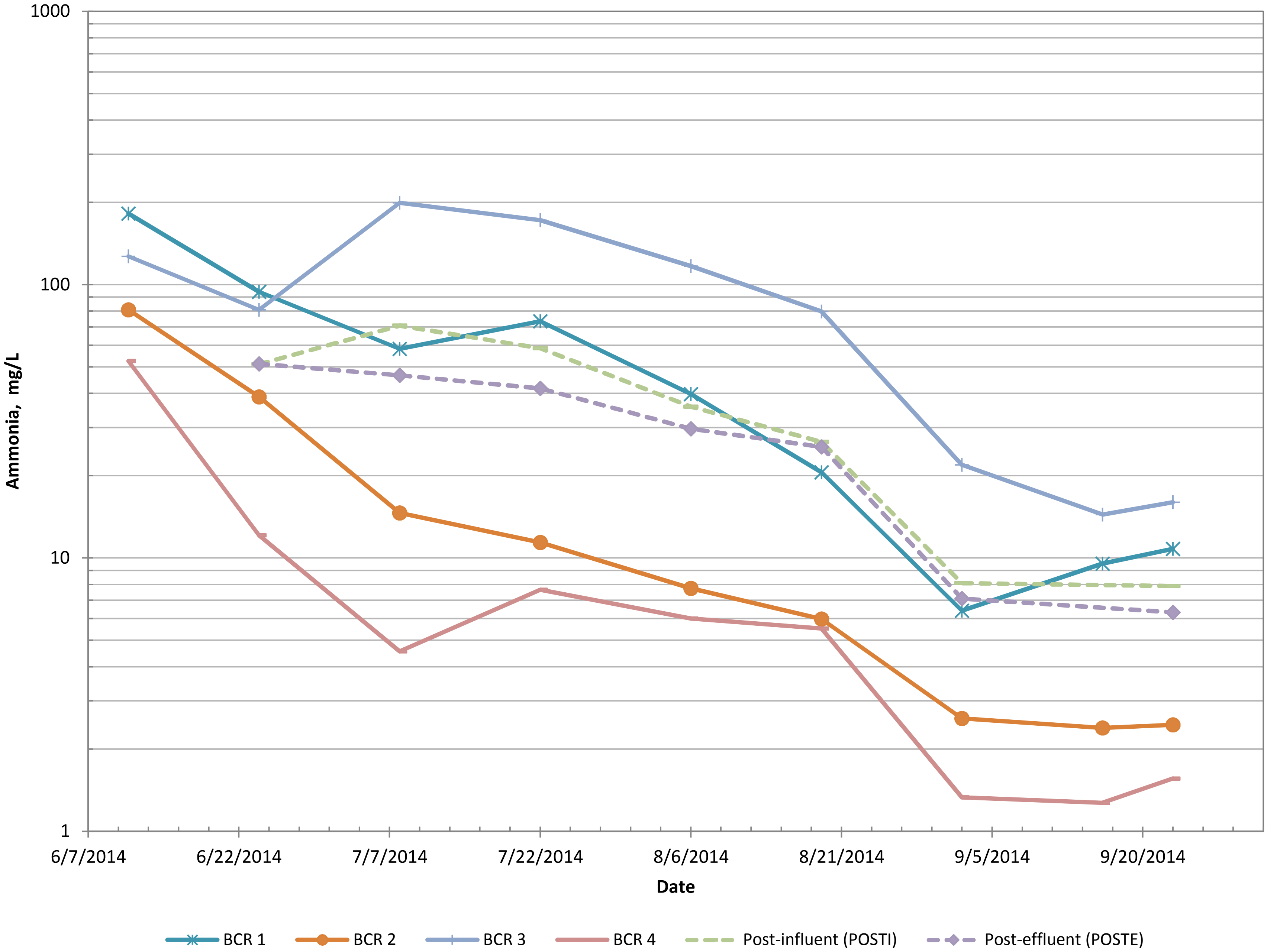

Figure 4.2-22
Ammonia Concentrations
Danny T Adit Treatability Study Year 2

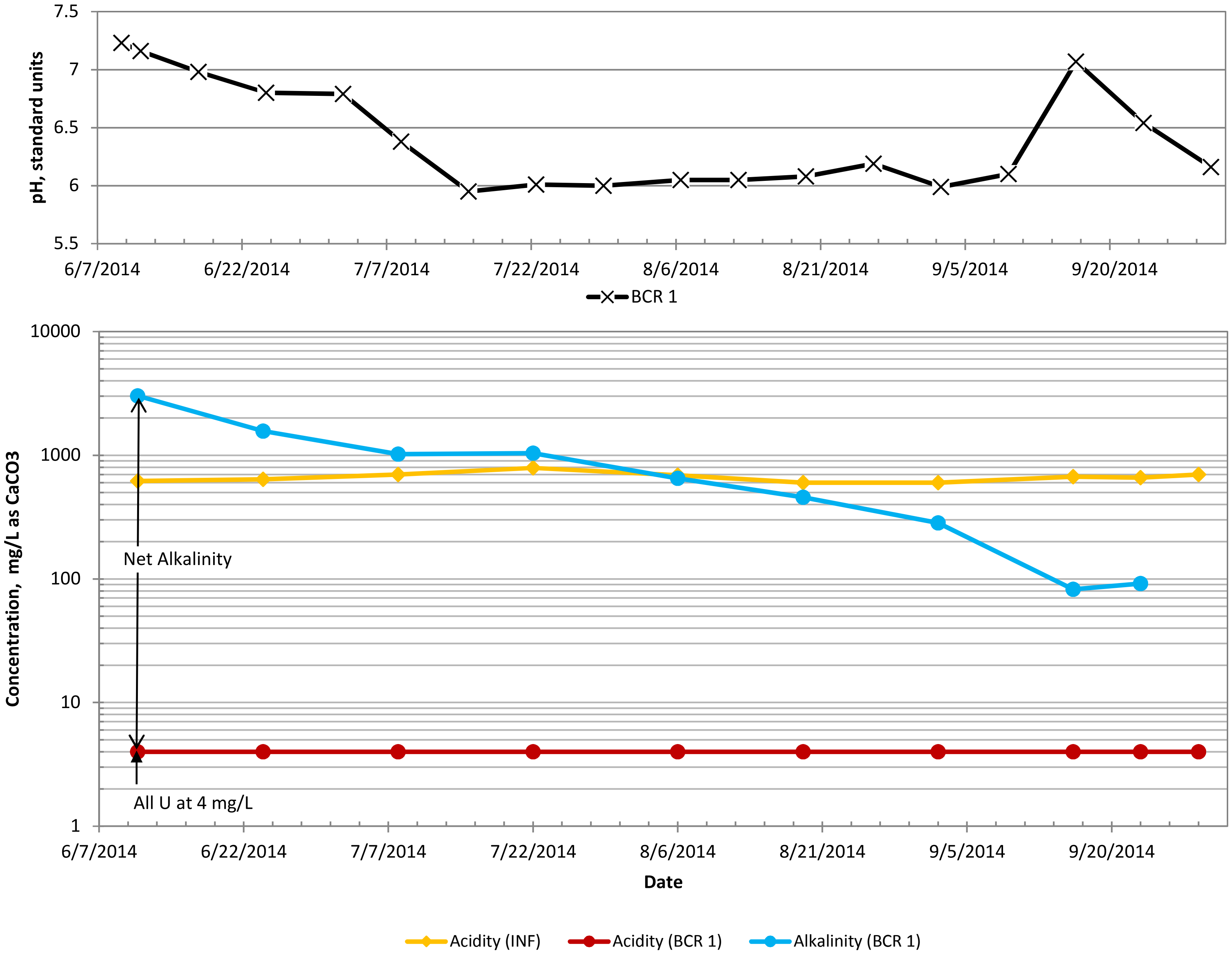

Figure 4.2-23
Trends in pH, Alkalinity, and Acidity in BCR 1
Danny T Adit Treatability Study Year 2

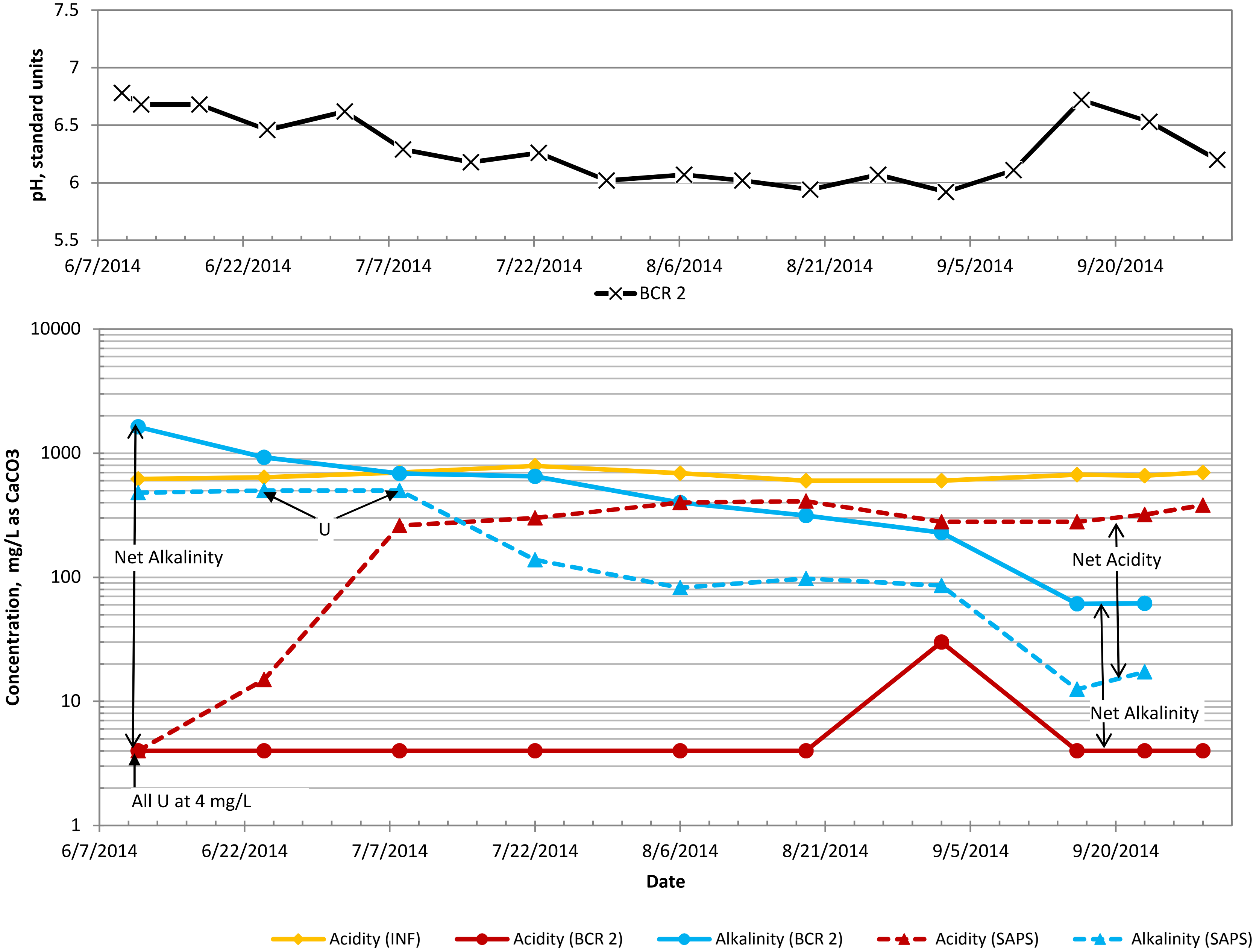

Figure 4.2-24
Trends in pH, Alkalinity, and Acidity in BCR 2
Danny T Adit Treatability Study Year 2

CDM Smith

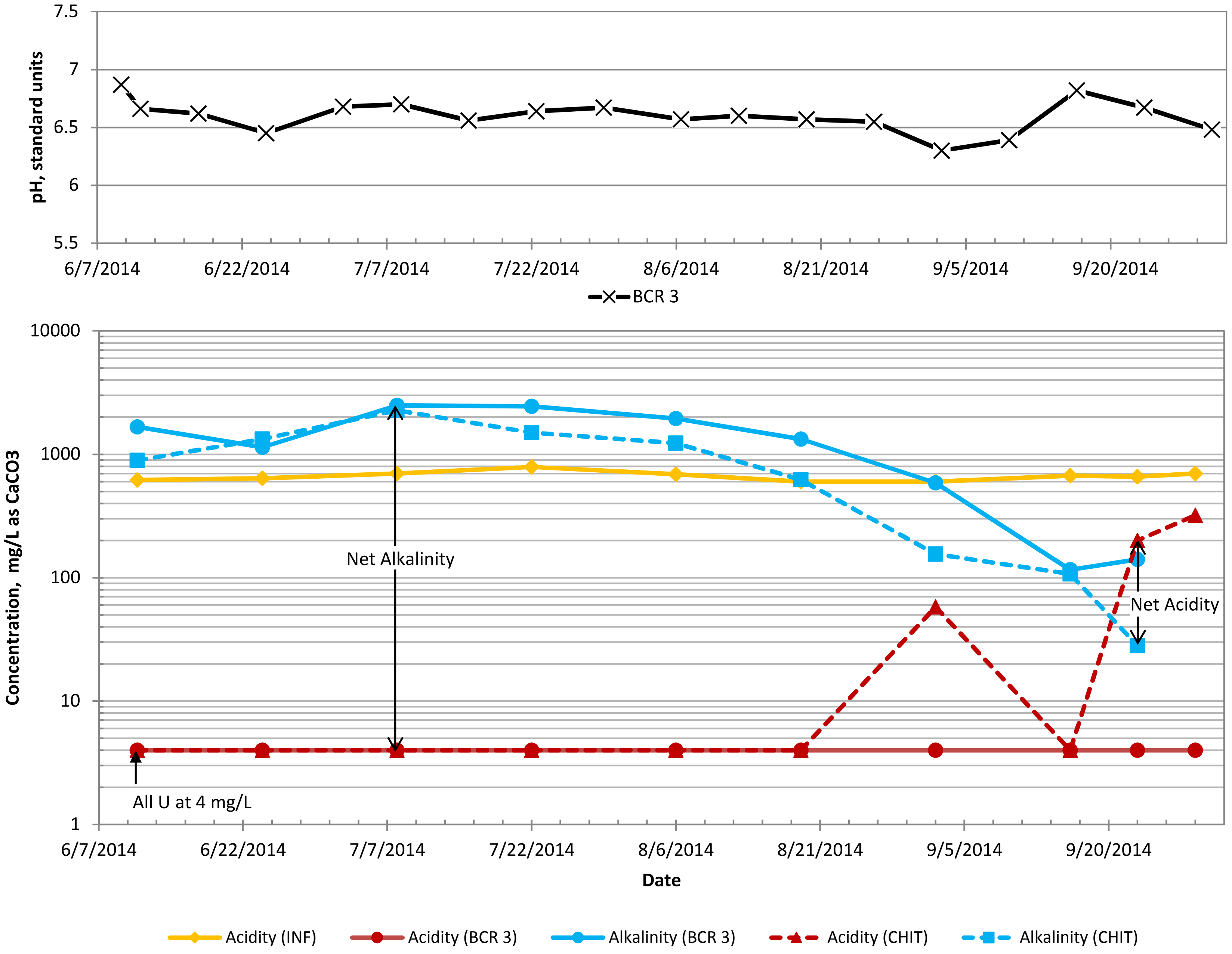

Figure 4.2-25
Trends in pH, Alkalinity, and Acidity in BCR 3
Danny T Adit Treatability Study Year 2

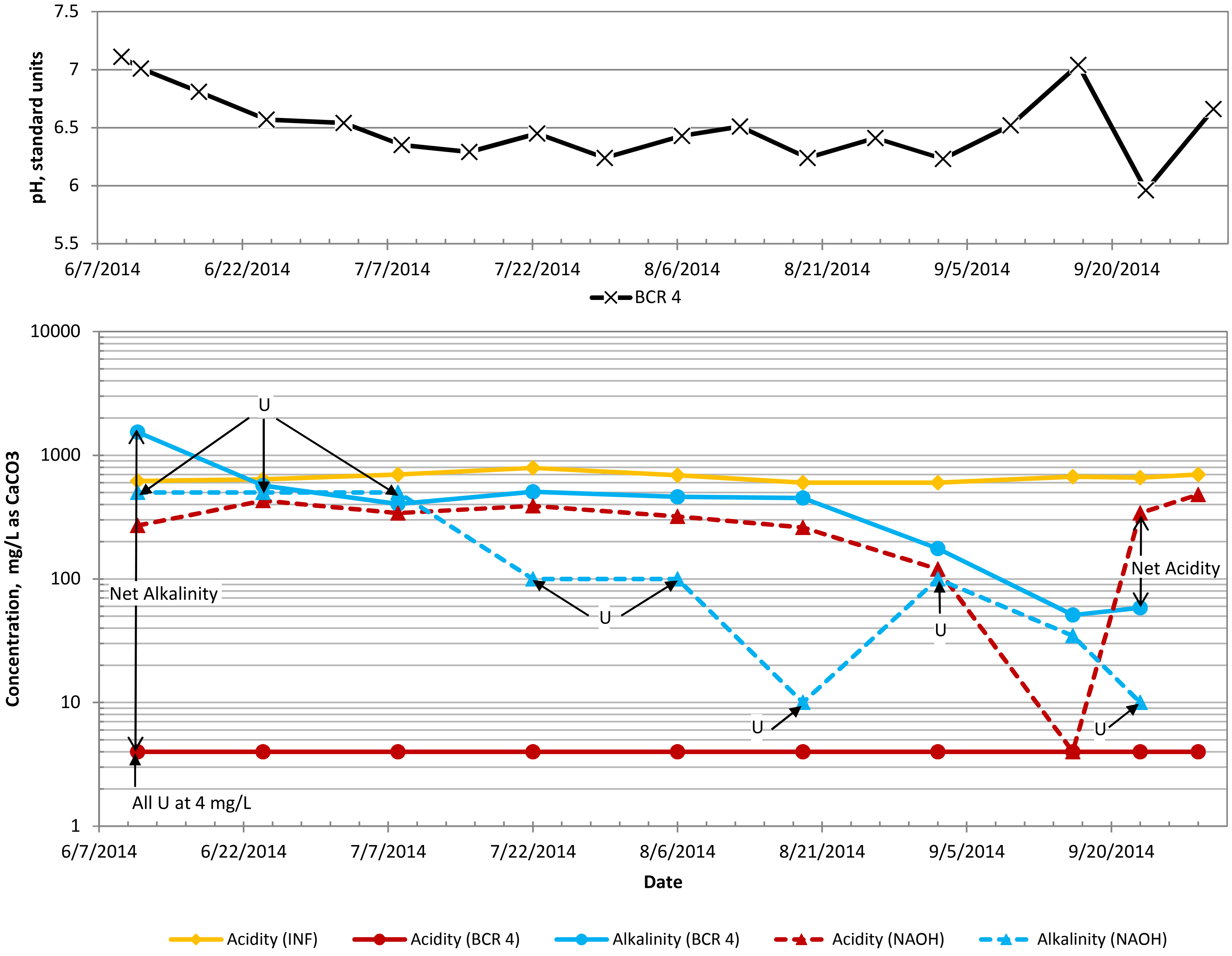

Figure 4.2-26
Trends in pH, Alkalinity, and Acidity in BCR 4
Danny T Adit Treatability Study Year 2

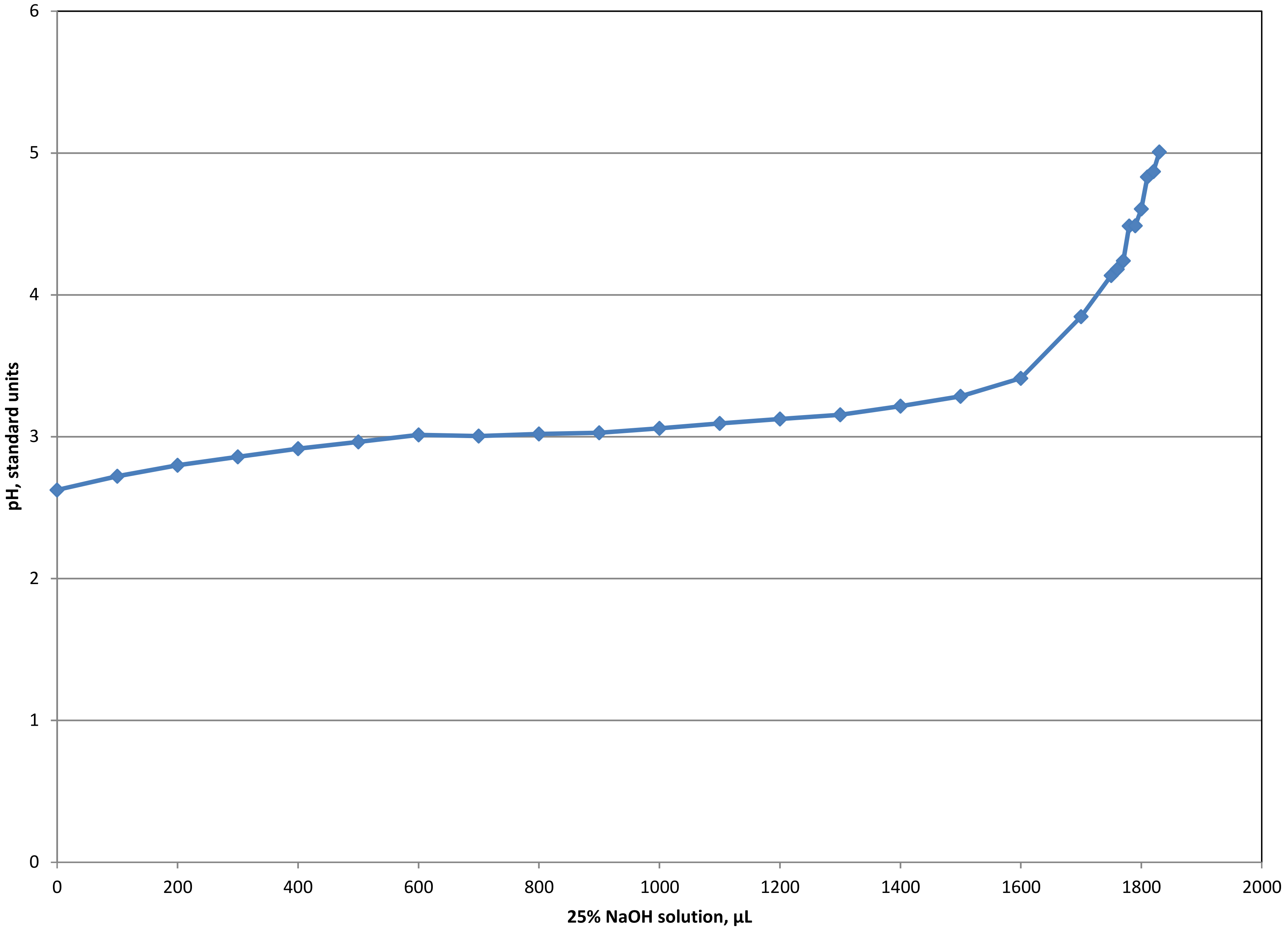

Figure 4.3-1
25% NaOH Titration
Tiger Bench-Scale Treatability Study

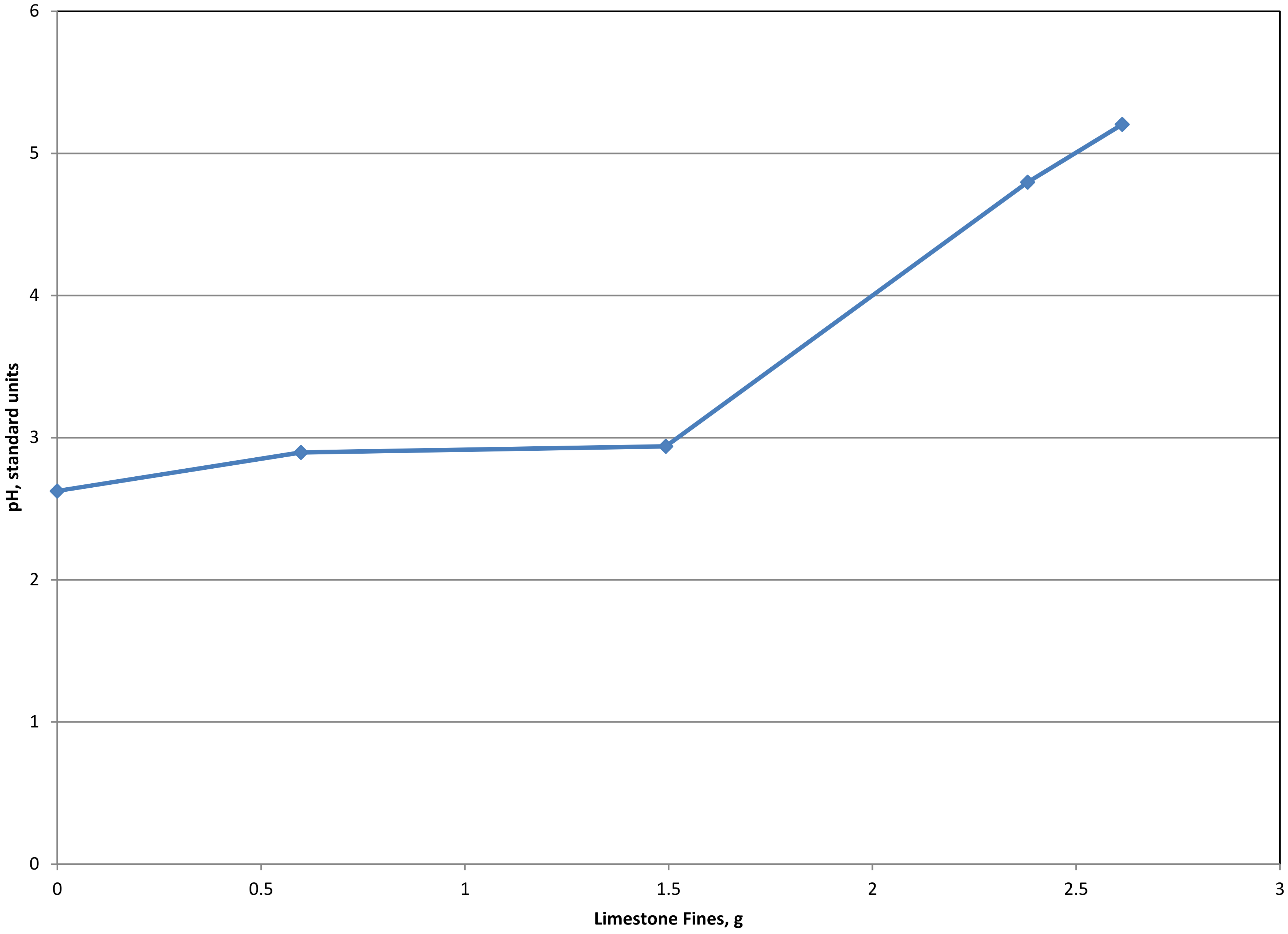

Figure 4.3-2
Limestone Fines Titration
Tiger Bench-Scale Treatability Study

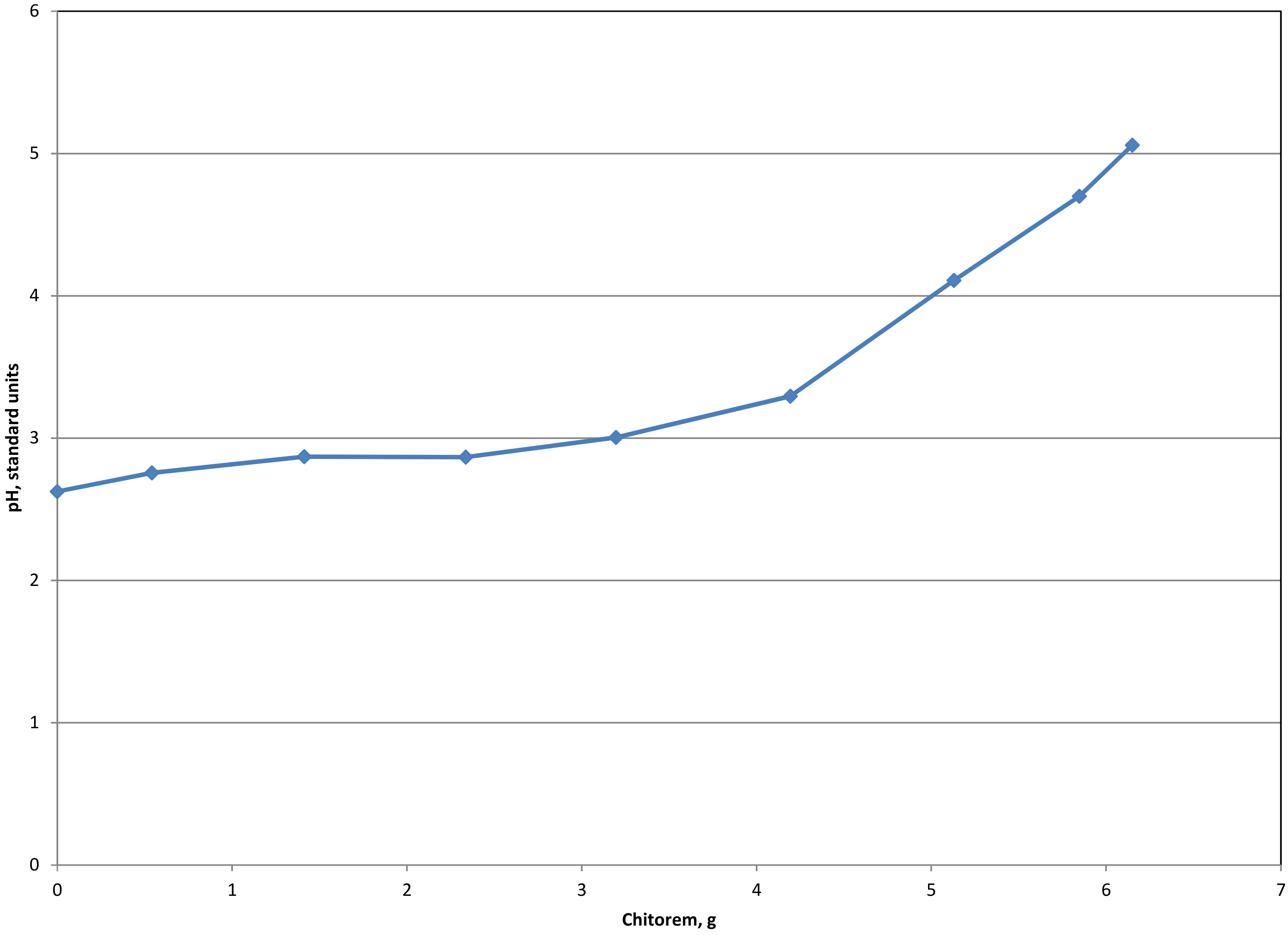

Figure 4.3-3
Chitorem Titration
Tiger Bench-Scale Treatability Study

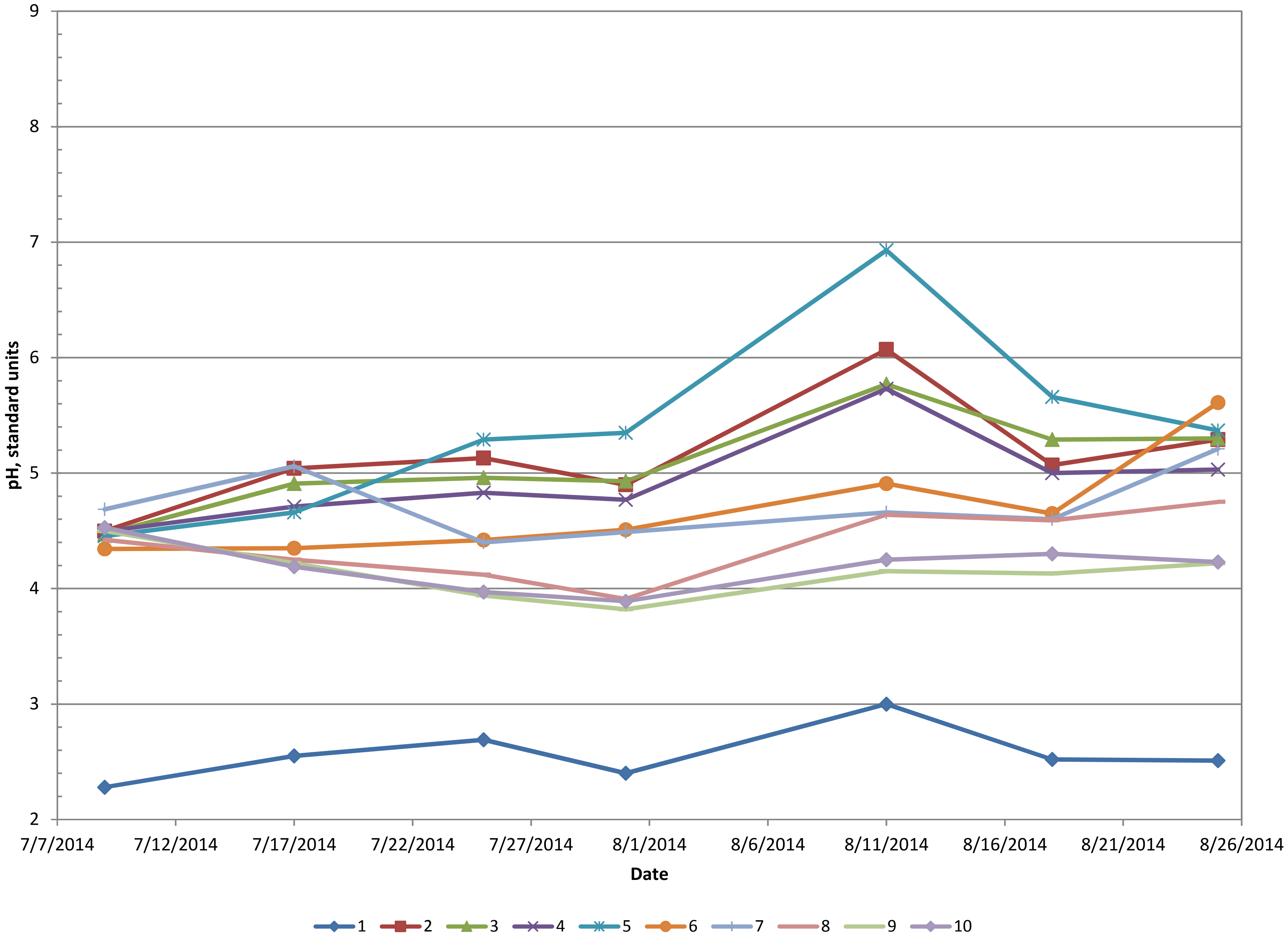

Figure 4.3-4
pH Measurements, 1-10
Tiger Bench-Scale Treatability Study

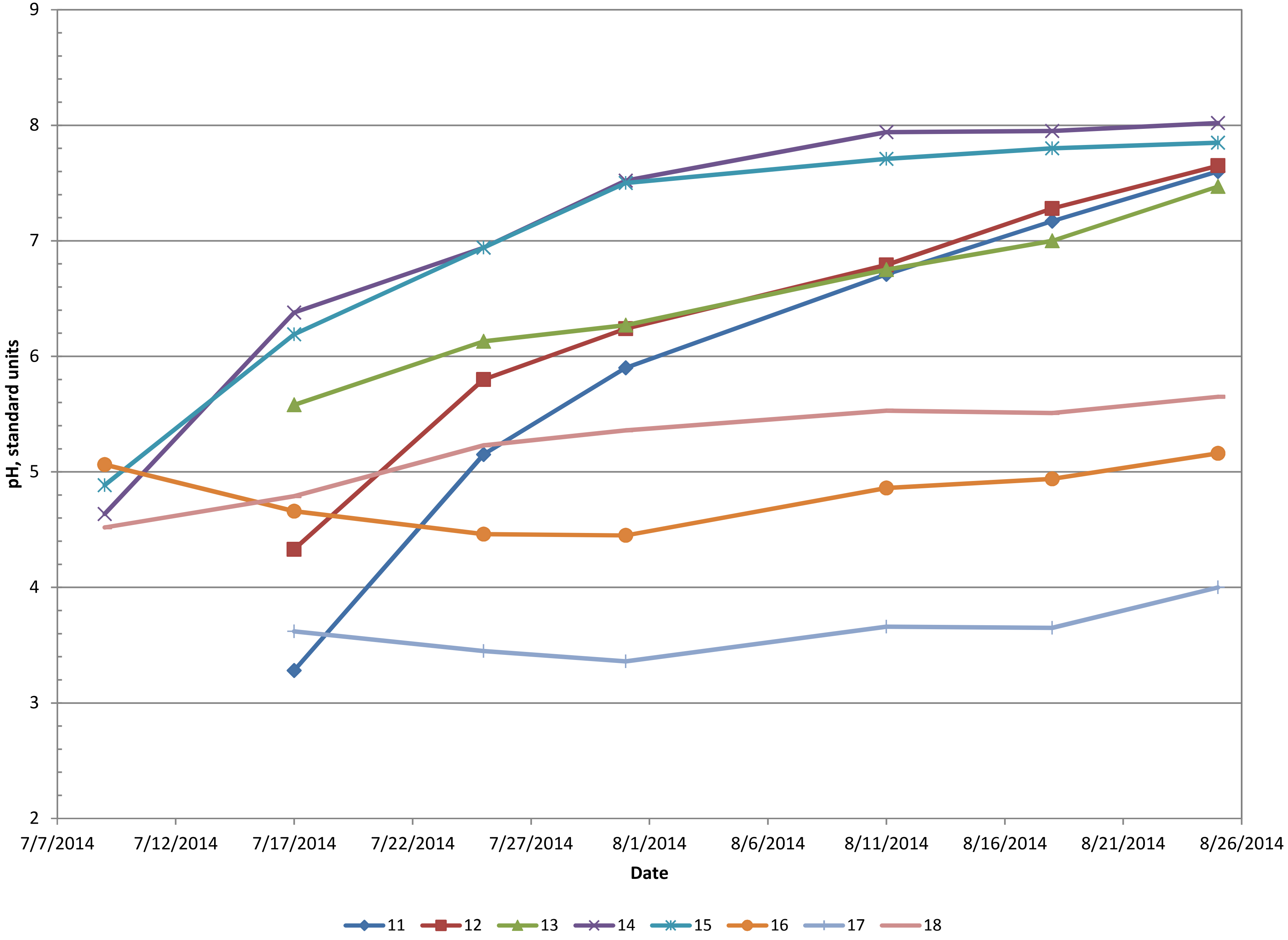

Figure 4.3-5
pH Measurements, 11-18
Tiger Bench-Scale Treatability Study

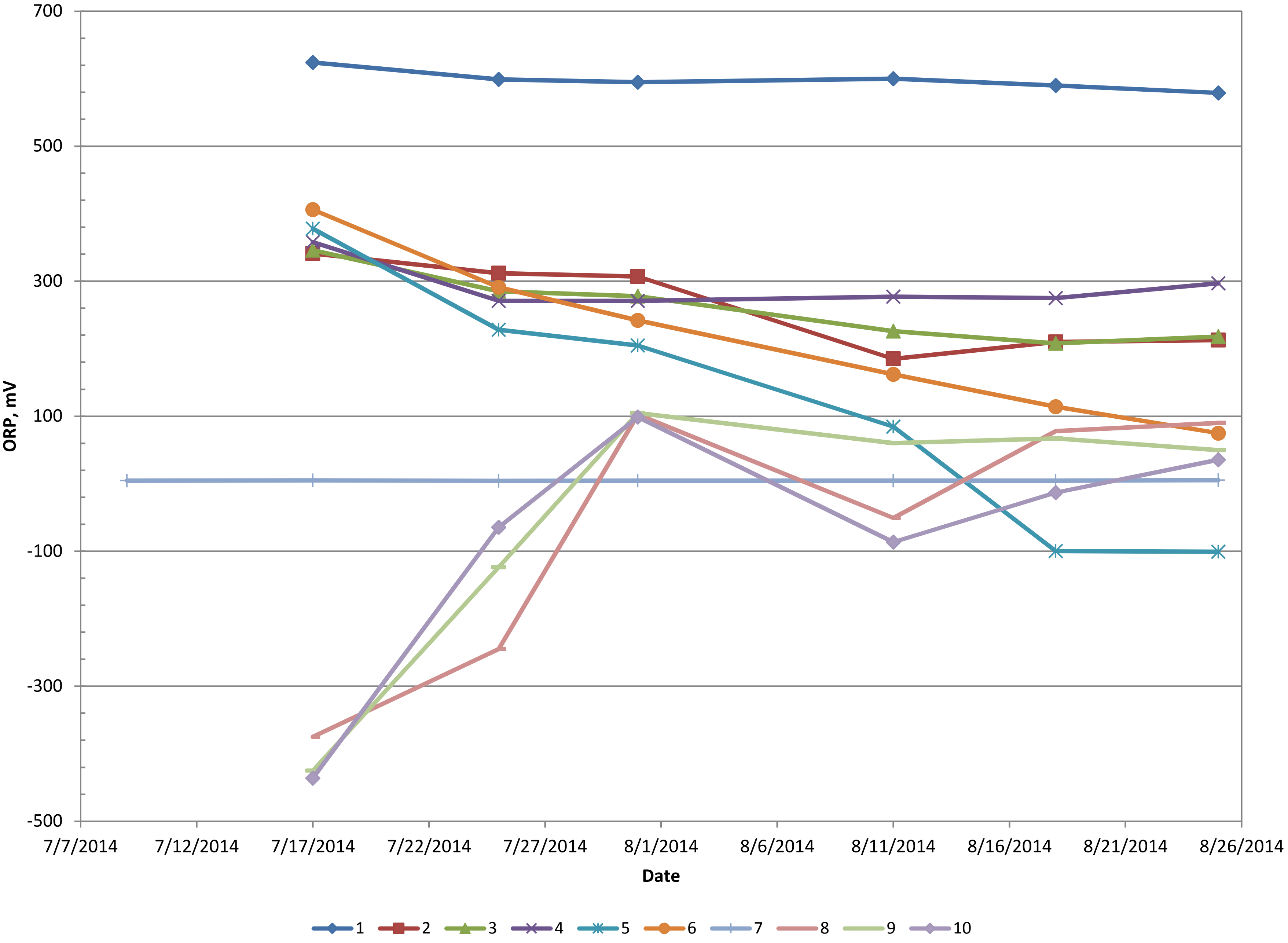

Figure 4.3-6
Oxidation-Reduction Potential Measurements, 1-10
Tiger Bench-Scale Treatability Study

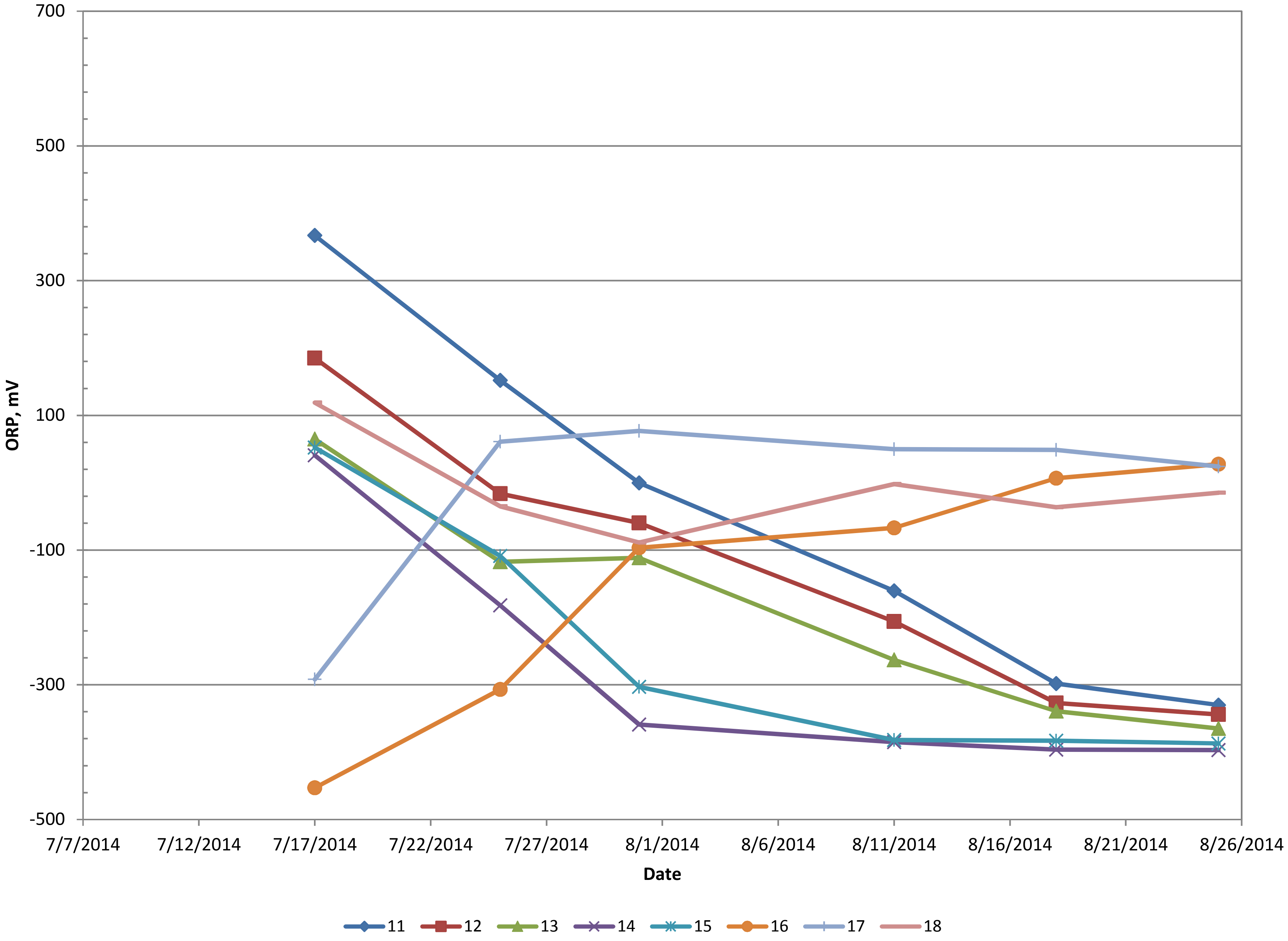

Figure 4.3-7
Oxidation-Reduction Potential Measurements, 11-18
Tiger Bench-Scale Treatability Study

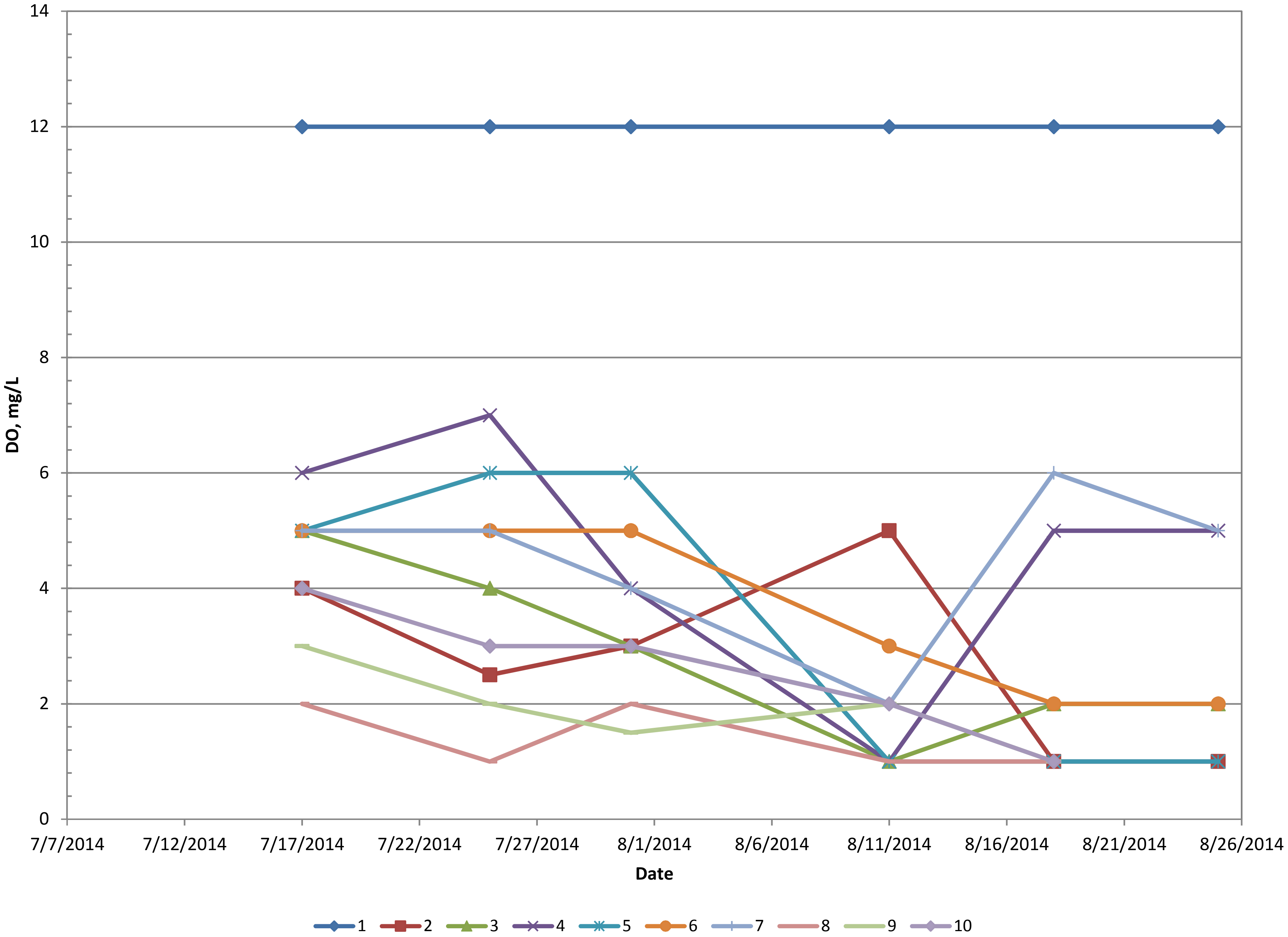

Figure 4.3-8
Dissolved Oxygen Measurements, 1-10
Tiger Bench-Scale Treatability Study

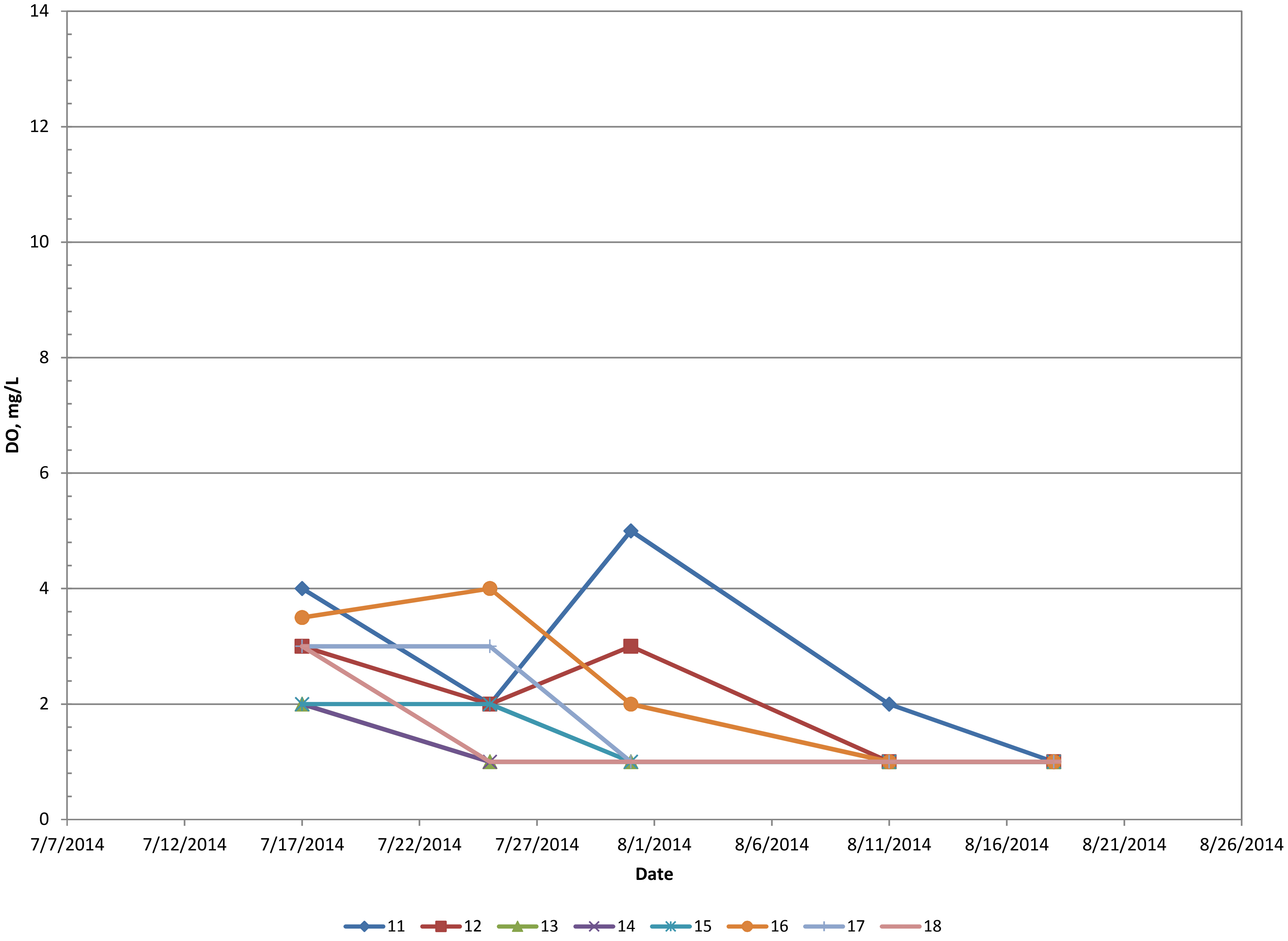

Figure 4.3-9
Dissolved Oxygen Measurements, 11-18
Tiger Bench-Scale Treatability Study

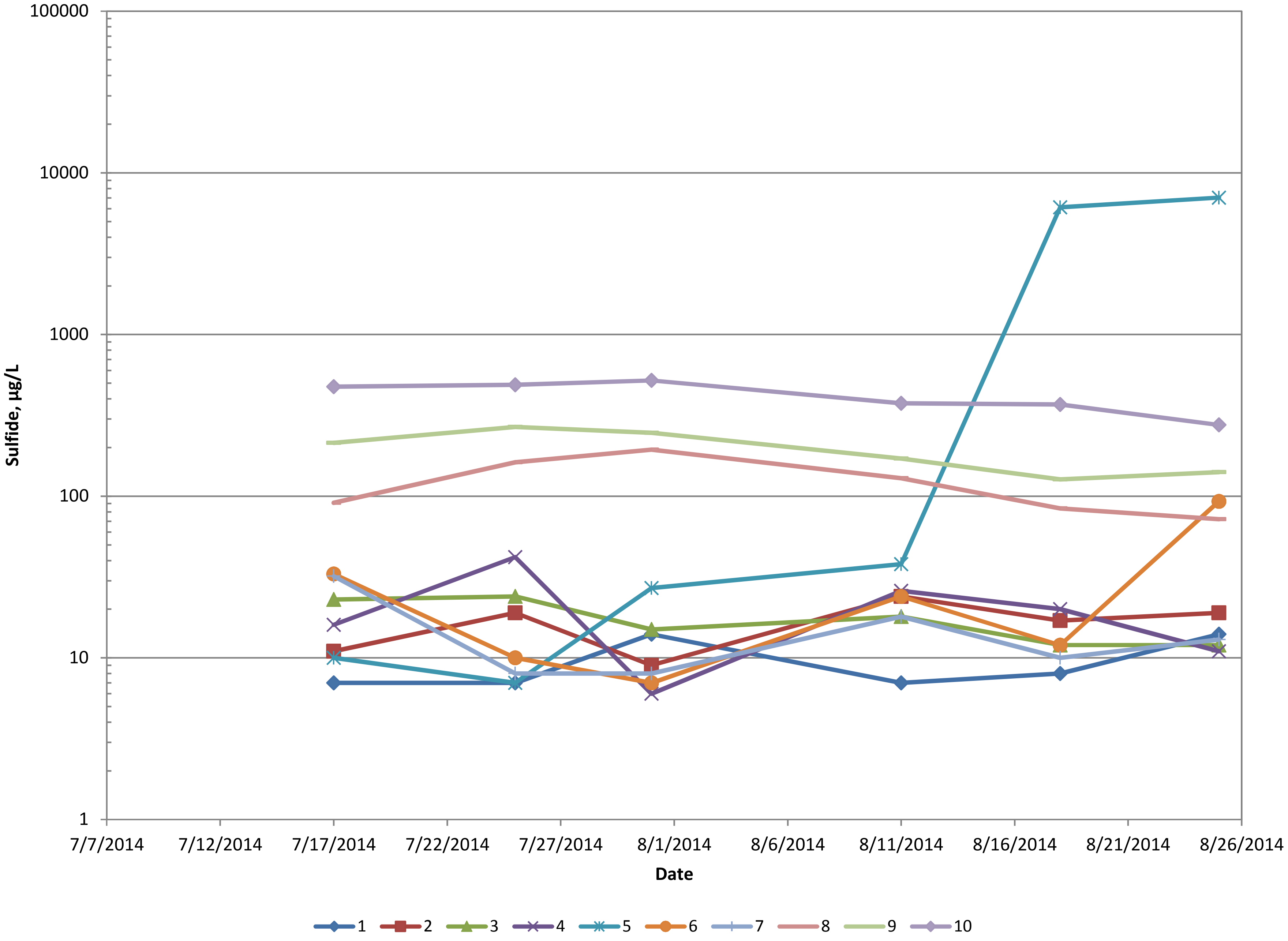

Figure 4.3-10
Sulfide Measurements, 1-10
Tiger Bench-Scale Treatability Study

Figure 4.3-11
Sulfide Measurements, 11-18
Tiger Bench-Scale Treatability Study

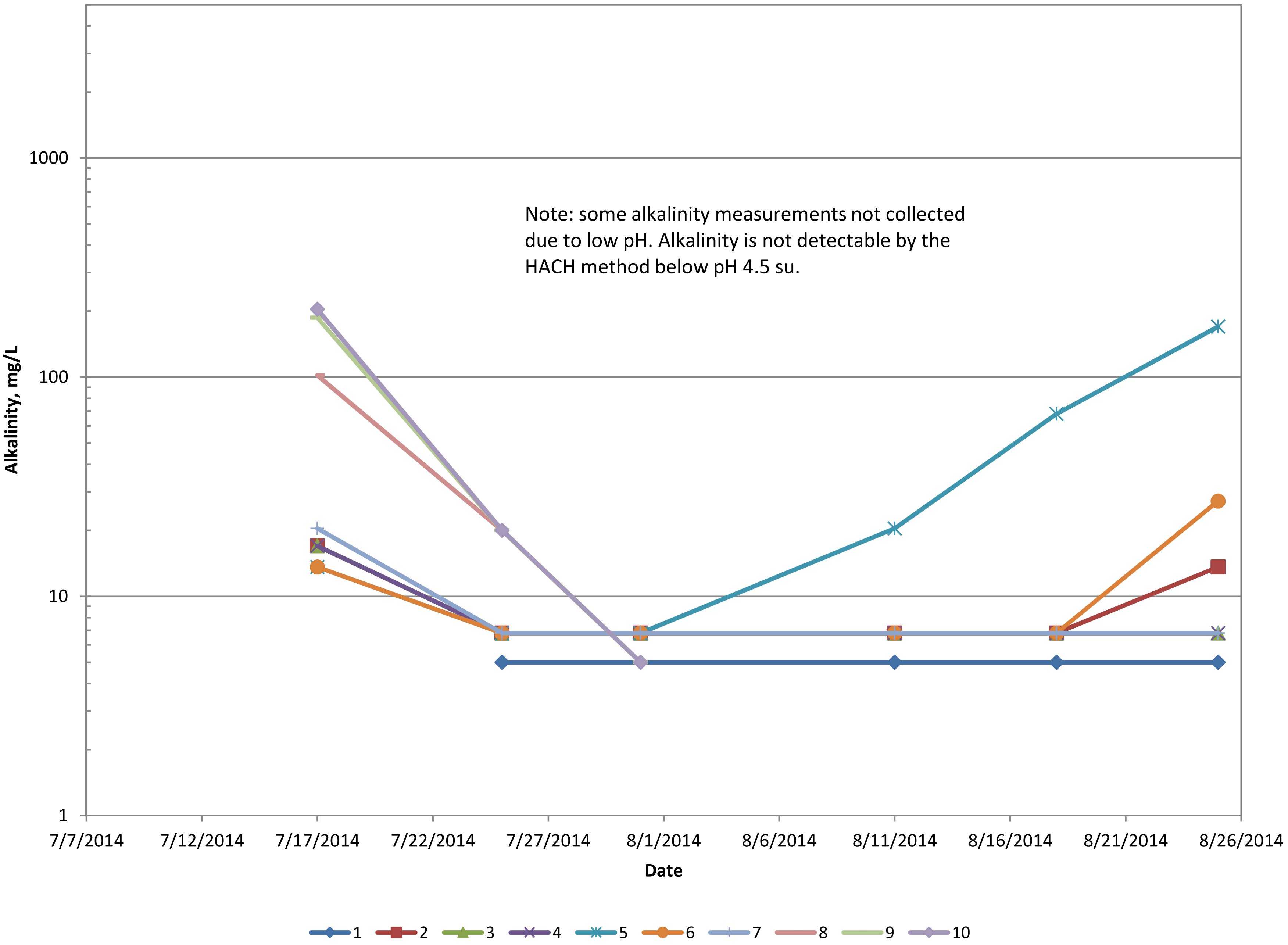

Figure 4.3-12
Alkalinity Measurements, 1-10
Tiger Bench-Scale Treatability Study

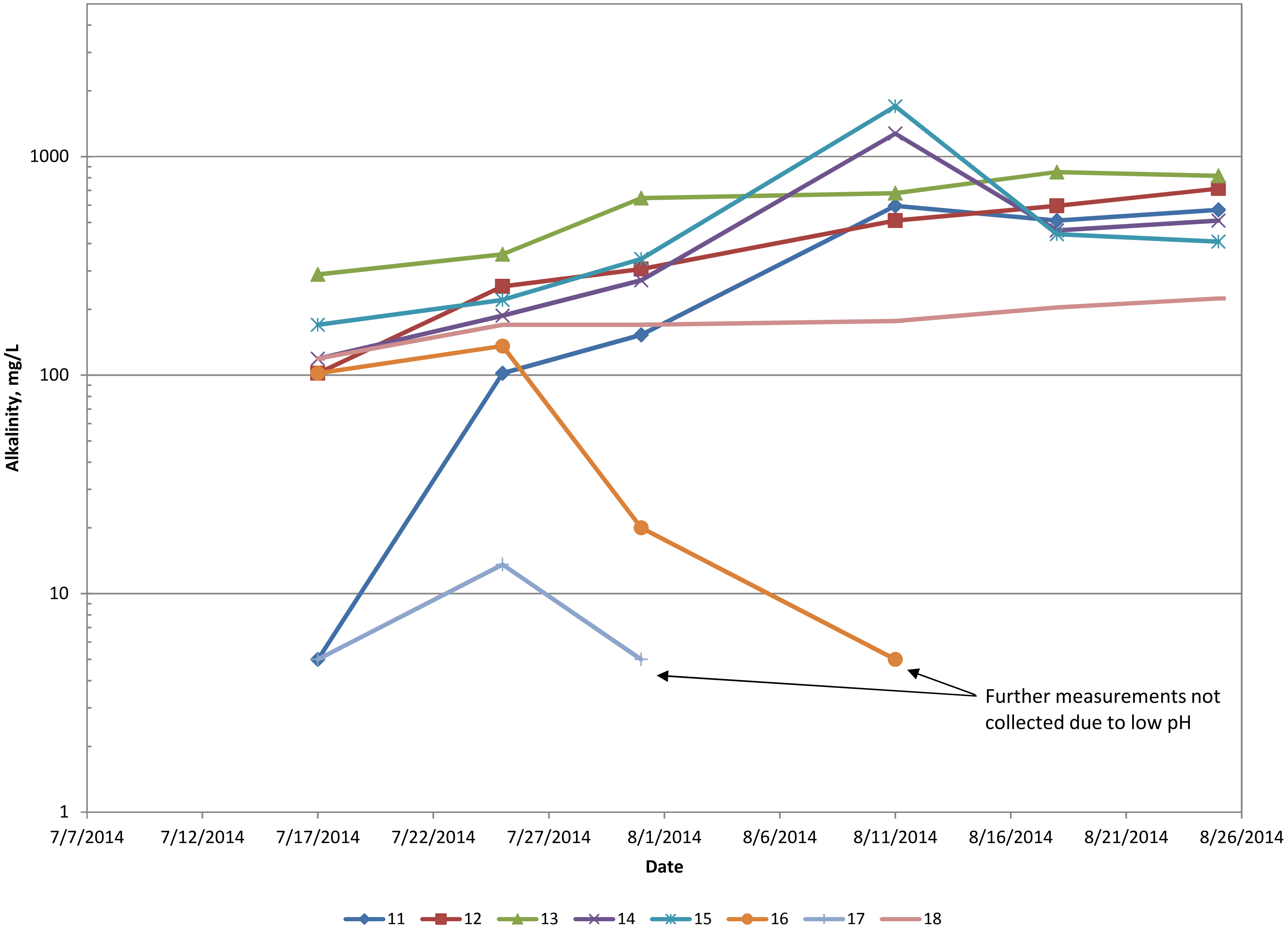

Figure 4.3-13
Alkalinity Measurements, 11-18
Tiger Bench-Scale Treatability Study