UNITED STATES AIR FORCE
JOINT BASE ELMENDORF-RICHARDSON
ALASKA

ENVIRONMENTAL RESTORATION PROGRAM

TREATABILITY STUDY REPORT
CG039 – POLELINE ROAD DISPOSAL AREA

FINAL

APRIL 2015

This page intentionally left blank.

FINAL

TREATABILITY STUDY REPORT
CG039 – POLELINE ROAD DISPOSAL AREA

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

Prepared for
Air Force Civil Engineer Center

Contract No. FA8903-09-D-8589 / Task Order 0016

APRIL 2015

This page intentionally left blank.

EXECUTIVE SUMMARY

The Air Force Civil Engineer Center (AFCEC) has conducted a treatability study at CG039 – Poleline Road Disposal Area pursuant to the process established in the Fort Richardson Federal Facility Agreement (1994) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The purpose of the treatability study was to assess the effectiveness of enhanced reductive dechlorination (ERD) and biogeochemical reductive dechlorination (BiRD), which AFCEC considers to be an innovative treatment technology, for treating contaminated groundwater at the site as part of a pilot scale study.

This work was conducted by CH2M HILL under subcontract to Weston Solutions, Inc. (WESTON) within the scope of the Joint Base Elmendorf-Richardson (JBER) Performance-Based Remediation (PBR) project authorized by AFCEC Contract Number FA8903-09-D-8589, Task Order 0016. Work was performed in accordance with the *Uniform Federal Policy-Quality Assurance Project Plan, CG039 – Poleline Road Disposal Area Treatability Study Work Plan, Joint Base Elmendorf-Richardson, Alaska* (Work Plan).

CG039 is located in the eastern portion of JBER, near the Eagle River Valley. Groundwater and soil contamination at the site resulted from historical activities associated with four chemical disposal areas that were used from 1950 to 1972. During this time, chemical agent identification sets (CAISs) and other military debris were burned and disposed of in trenches. Chlorinated solvents such as trichloroethene (TCE) were used to neutralize the chemical agents in the CAIS. As a result of these historical activities, volatile organic compounds (VOCs), primarily TCE, have contaminated the groundwater at CG039.

This study evaluated whether the injection of an emulsified vegetable oil (EVO) substrate, with and without ferrous sulfate, into a TCE-contaminated aquifer is able to enhance the natural degradation of TCE, speed up the cleanup process, and reduce overall life-cycle costs. Additionally, the treatability study tested how easily EVO can be injected into the ground and how far it traveled. Three target treatment zones were evaluated: AP-4550 located in the shallow aquifer was injected with an EVO substrate, and AP-3983R (shallow aquifer) and AP-4551 (deep perched aquifer) were injected with EVO and ferrous sulfate substrate.

ERD is a form of anaerobic biodegradation in which microbes are stimulated with a carbon substrate (such as EVO) to break down chlorinated aliphatic hydrocarbons (CAHs) such as TCE, tetrachloroethene (PCE), and their daughter products, the dichloroethene (DCE) isomers (cis-1,2-DCE, trans-1,2-DCE, and 1,1-DCE) and vinyl chloride. During ERD, TCE is degraded to the DCE isomers, which are then degraded to vinyl chloride and then to ethene. The generation of daughter products is a key line of evidence indicating that ERD is occurring.

BiRD is a two-step process where biological processes facilitate the production of reactive iron sulfide minerals which then react with TCE in groundwater to abiotically reduce the TCE to acetylene. To promote the reducing conditions necessary for the formation of iron sulfide minerals in the subsurface a carbon substrate (such as EVO) and a ferrous iron supplement (such as ferrous sulfate) are injected into the subsurface. A key line of evidence for identifying whether BiRD is occurring is the degradation of TCE without the generation of daughter products (cis-1,2-DCE and

vinyl chloride). The benefit of BiRD is that TCE can be reduced without producing toxic daughter products. An additional benefit is that if the chemistry is not correct to produce reactive iron sulfide minerals, then the carbon substrate has been provided to stimulate the microbial community to break down TCE biotically.

This treatability study report provides the results of four rounds of groundwater monitoring that followed the ERD and BiRD substrate injections at CG039. Details of the injection well installation, baseline soil and groundwater sampling results, and injections were provided in the *Treatability Study Implementation Report, CG039 – Poleline Road Disposal Area, Joint Base Elmendorf-Richardson, Alaska* (Implementation Report).

Post-Injection Quarterly Groundwater Monitoring

Four rounds of groundwater sampling were conducted at the three performance monitoring wells (AP-3983R, AP-4550, and AP-4551) during October 2013, January 2014, April 2014, and September 2014. During the September 2014 sampling event, three additional groundwater monitoring wells within the shallow aquifer were also sampled to assess geochemical conditions downgradient of the target treatment zones. Groundwater samples were analyzed for VOCs, total organic carbon (TOC), dissolved iron, dissolved manganese, dissolved gases, sulfide, nitrate+nitrite, alkalinity, chloride, sulfate, and volatile fatty acids.

Performance Monitoring Wells AP-3983R, AP-4550, and AP-4551

Geochemical parameters indicate that the injection of either EVO or EVO and ferrous sulfate has been effective in generating anaerobic conditions necessary for reductive dechlorination. Reducing conditions within the shallow aquifer remain stable. However, increases in oxidation reduction potential (ORP) and a decrease in the TOC concentrations in AP-4551 during the fourth quarter event may indicate that geochemical conditions within the deep perched aquifer are becoming less favorable to biodegradation of TCE.

The concentration of TCE in groundwater at each performance monitoring well (AP-3983R, AP-4550, and AP-4551) has been reduced by 99 percent when compared to the 2013 baseline concentration. High concentrations of TCE daughter products, primarily cis-1,2-DCE and vinyl chloride, have been generated at AP-3983R, AP-4550, and AP-4551. At AP-4550, concentrations of cis-1,2-DCE have since decreased by more than half, indicating that reductive dechlorination is proceeding beyond TCE. Concentrations of cis-1,2-DCE and vinyl chloride have yet to decrease at AP-3983R and AP-4551; however, ORP and TOC remain favorable for dechlorination to proceed. The generation of daughter products from the breakdown of TCE indicates that ERD is the primary method of reductive dechlorination at all three target treatment zones. The production of vinyl chloride and ethene at all three target treatment zones also indicates that a microbial consortium appears to be present that is capable of facilitating complete dechlorination.

Downgradient Monitoring Wells AP-3744, AP-3747, and AP-3989

Because of greater than expected downgradient distribution of the EVO and ferrous sulfate substrate, the concentration of TCE in groundwater at shallow downgradient monitoring well AP-3989, approximately 100 feet downgradient of the injection wells, was also reduced by 99 percent. Relatively high concentrations of the TCE daughter product, cis-1,2-DCE, as well as

low concentrations of vinyl chloride, have been generated at AP-3989, indicating that ERD is the primary method of reductive dechlorination.

Monitoring wells AP-3744 and AP-3747, which are located downgradient of the EVO distribution area, have shown little indication of reducing conditions being generated and no reduction in TCE concentrations.

Treatability Study Conclusions

Reducing conditions and substantial reductions in TCE concentrations have been produced in groundwater at all three target treatment zones. The following are the conclusions of the treatability study from implementation through the first year of monitoring:

- The use of sodium permanganate was not a viable treatment option because of the high and heterogeneous natural oxidant demand results from across the site.

- Groundwater samples collected from injection wells prior to substrate injections indicated that TCE concentrations within each target treatment zone were similar (approximately 2,000 micrograms per liter [µg/L]) to each other and to historical TCE concentrations.

- The design of the treatability study was sufficient to distribute substrate over the majority of the TCE "hotspot" as follows:

  - The shallow aquifer readily accepted the injection of EVO substrate at rates between 15 to 35 gallons per minute (gpm) with an observed distribution (in the downgradient direction) of between 90 and 130 feet. Because of lack of crossgradient monitoring locations, observations of lateral distribution of EVO substrate were limited to the 15 feet between the injection wells at each target treatment zone. Lateral distribution of EVO substrate was at least 15 feet.

  - The deep perched aquifer consists of partially interconnected silty sand and gravel lenses within a basal till/weathered bedrock and, based on the variability of the achievable injection rates into the deep perched aquifer (1 to 28 gpm), it is likely that preferential flow pathways significantly control the distribution of substrate. Because of the limited monitoring locations within the deep perched aquifer, observations of lateral distribution of EVO substrate were limited to the 15 feet between the injection wells at each target treatment zone. Lateral distribution of EVO substrate was at least 15 feet.

- Geochemical parameters indicate that both the EVO and the EVO and ferrous sulfate injections have generated the anaerobic conditions necessary for reductive dechlorination. There is some indication within the deep perched aquifer, such as increasing ORP and decreasing TOC concentrations, that geochemical conditions in the deep perched aquifer are becoming less favorable to biodegradation of TCE.

- Both the EVO (AP-4550) and the EVO and ferrous sulfate (AP-3983R and AP-4551) injections have resulted in the TCE concentration at each performance monitoring well being reduced by 99 percent. Additionally, TCE concentrations were reduced by 99 percent at a shallow

downgradient monitoring well (AP-3989) that is located approximately 100 feet downgradient of the nearest shallow injection wells.

- ERD appears to be the primary method of reductive dechlorination, even in areas where EVO and ferrous sulfate were injected. While BiRD may also be occurring, various lines of evidence indicate that it is occurring to a significantly lesser degree (if at all) than ERD include the following:
  - High concentrations of TCE daughter products have been produced at all three target treatment zones corresponding to the substantial decrease in TCE concentrations. (Geochemical reactions that occur during BiRD do not create daughter products.)
  - Concentrations of TCE daughter products have begun to decrease at AP-4550 (EVO injection), indicating that an appropriate microbial population and reducing conditions are present for complete reduction of CAHs.
- Concentrations of TCE daughter products have not yet begun to decrease at AP-3983R and AP-4551 (EVO and ferrous sulfate injection). The production of vinyl chloride and ethene at all three target treatment zones, along with the results at AP-4550 (reduction of DCE and vinyl chloride), indicate that the appropriate microbial consortium is present in the subsurface for conversion of DCE to vinyl chloride and subsequently to ethene. However, while the appropriate microbes are present, it is not yet known if the population is sufficient for complete reduction of DCE concentrations, but it is anticipated that concentrations of DCE and vinyl chloride will be reduced at both AP-3983R and AP-4550.
- EVO-only injections appear to be more successful in the short term at reducing concentrations of TCE and TCE daughter products than the EVO and ferrous sulfate mixture used during the treatability study.

Recommendations

Based on the results of this treatability study report, the following actions are recommended:

- Two years of annual groundwater monitoring (2015 and 2016) to assess potential rebound of TCE concentrations, degradation of TCE daughter products, and persistence of reducing groundwater conditions. The annual groundwater monitoring at CG039 will be modified to better monitor the progress of the treatability study. All requirements of the 2011 *Memorandum to the Site File for OUB/Poleline Road Disposal Area* (Memo to Site File) will continue to be monitored. Analytical and field parameters will be added as necessary so that the treatability study wells (AP-3744, AP-3747, AP-3983R, AP-3989, AP-4550, and AP-4551) continue to be monitored as outlined in Table 18-1 of the Work Plan. The annual sampling will be modified, as follows:
  - Five wells will be sampled annually as prescribed by the Memo to Site File: AP-3748, AP-4344, AP-4353, AP-5246, and AP-5683 (AP-4019 replacement well).

  - Two wells identified for annual sampling in the Memo to Site File will still be sampled as prescribed, with the addition of the treatability study parameters listed in Table 18-1 of the Work Plan: AP-3747 and AP-4550.

  - Two wells identified as Sentinel Wells to be sampled in the year preceding the Five-Year Review (2017) will also be sampled in 2015 and 2016 for the treatability study parameters listed in Table 18-1 of the Work Plan: AP-3744 and AP-3989.

  - Three wells that are not identified to be sampled in the Memo to Site File, either annually or every 5 years, will be sampled in 2015 and 2016 for the treatability study parameters listed in Table 18-1 of the Work Plan: AP-3983R, AP-4525, and AP-4551.

- The 2015 and 2016 annual groundwater monitoring work plans will formally outline this plan.

- The monitoring results from the seven wells to be sampled for the treatability study parameters will be reported in a distinct section of the annual groundwater monitoring report.

This page intentionally left blank.

TABLE OF CONTENTS

Tables

Figures

Appendixes

This page intentionally left blank.

LIST OF ABBREVIATIONS AND ACRONYMS

µg/L	microgram(s) per liter
AFCEC	Air Force Civil Engineer Center
AFCEE	Air Force Center for Engineering and the Environment
bgs	below ground surface
BiRD	biogeochemical reductive dechlorination
CAH	chlorinated aliphatic hydrocarbon
CAIS	chemical agent identification set
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DCE	dichloroethene
DPW	United States Army Directorate of Public Works
DQE	data quality evaluation
DQO	data quality objective
EB	equipment blank
EPA	United States Environmental Protection Agency
ERD	enhanced reductive dechlorination
ESF	Environmental Staging Facility
EVO	emulsified vegetable oil
FD	field duplicate
FeS	iron sulfide
f_{oc}	fraction of organic carbon
gpm	gallon(s) per minute
IDW	investigative-derived waste
ISCO	in situ chemical oxidation
JBER	Joint Base Elmendorf-Richardson
JBER-R	JBER-Richardson
MCL	maximum contaminant level
mg/L	milligram(s) per liter
MS	matrix spike
MSD	matrix spike duplicate
mV	millivolt(s)
NOD	natural oxidant demand
ORP	oxidation reduction potential
PBR	Performance-Based Remediation

PCA	tetrachloroethane
PCE	tetrachloroethene
PPE	personal protective equipment
psi	pound(s) per square inch
QC	quality control
ROD	Record of Decision
ROI	radius of influence
SARA	Superfund Amendments and Reauthorization Act of 1986
TB	trip blank
TCE	trichloroethene
TOC	total organic carbon
USAF	United States Air Force
VFA	volatile fatty acid
VOC	volatile organic compound
WESTON	Weston Solutions, Inc.

1.0 INTRODUCTION

The Air Force Civil Engineer Center (AFCEC) has conducted a treatability study at CG039 – Poleline Road Disposal Area pursuant to the process established in the Fort Richardson Federal Facility Agreement (1994) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The purpose of the treatability study was to assess the effectiveness of enhanced reductive dechlorination (ERD) and biogeochemical reductive dechlorination (BiRD), which AFCEC considers to be an innovative treatment technology, for treating contaminated groundwater at the site as part of a pilot scale study.

This treatability study report provides the results of four rounds of groundwater monitoring following the ERD and BiRD substrate injections at CG039, located at Joint Base Elmendorf-Richardson (JBER), Alaska (Figure 1-1). Details of the injection well installation, baseline soil and groundwater sampling results, and the emulsified vegetable oil (EVO) and EVO and ferrous sulfate injections are provided in the *Treatability Study Implementation Report CG039 – Poleline Road Disposal Area Joint Base Elmendorf-Richardson, Alaska* (referred to as the Implementation Report throughout the remainder of this report) (United States Air Force [USAF], 2014).

The treatability study evaluated whether the injection of an EVO substrate, with and without ferrous sulfate, into a trichloroethene (TCE)-contaminated aquifer is able to enhance the natural degradation of TCE, speed up the cleanup process, and reduce overall life-cycle costs. Additionally, the treatability study tested how easily EVO can be injected into the ground and how far it travels.

The CG039 treatability study effort was administered by AFCEC. This Treatability Study Report has been prepared by CH2M HILL in support of Weston Solutions, Inc.'s (WESTON's) prime contract FA8903-09-D-8589 with AFCEC (formerly the Air Force Center for Engineering and the Environment [AFCEE]), Task Order 0016.

Quarterly groundwater monitoring was conducted from October 2013 through September 2014, in accordance with the Final *Uniform Federal Policy-Quality Assurance Project Plan, CG039 – Poleline Road Disposal Area Treatability Study Work Plan, Joint Base Elmendorf-Richardson, Alaska* (Work Plan) (USAF, 2013a).

1.1 Project Objectives

The objectives of the treatability study are as follows:

- Assess the effectiveness of in situ treatment for reducing TCE concentrations in groundwater at the site through (1) ERD using EVO, (2) BiRD using EVO with ferrous sulfate solution addition, and/or (3) in situ chemical oxidation (ISCO) using sodium permanganate. The effectiveness of the treatability study substrate injections will be evaluated by calculating reductions in the concentration of TCE in each performance well as compared to the pre-injection baseline TCE concentrations.

- Evaluate the ability to distribute substrate into the subsurface using permanent injection wells.

- Evaluate amendment/oxidant dosing requirements and lateral spacing of injection points (radius of influence) needed for full-scale application at CG039.

- Assess the ability of the substrate to stimulate and sustain anaerobic biodegradation (biotic) processes and promote conditions for abiotic reduction of TCE.

- Assess the potential need for substrate replenishment or other contingency measures.

The approach for the treatability study is described in the Work Plan (USAF, 2013a). The Work Plan describes the injection protocols, data quality objectives (DQOs), sampling methodologies, and analytical program for assessing conditions at CG039 to facilitate decisions about substrate selection and measure the success of the technologies applied in the treatability study.

1.2 Site Description

CG039 is located approximately 3 miles northeast of the main cantonment area of JBER-Richardson (JBER-R), and lies approximately 10 miles northeast of Anchorage, Alaska, 1 mile south of Eagle River and 0.6 mile north of the Anchorage Regional Landfill (Figure 1-1). Poleline Road is a gravel road that trends northeast-southwest along a power line route, and provides access to CG039. CG039 is a low-lying, flat area bordered by an 80-foot hill to the west, by wetlands to the south and southwest, and by low, wooded hills on the remaining borders.

Groundwater and soil contamination at the site resulted from the historical activities associated with four chemical disposal areas that were used from 1950 to 1972. During this time, chemical agent identification sets (CAISs) and other military debris were burned and disposed of in trenches. Chlorinated solvents such as TCE were used to neutralize the chemical agents in the CAIS. As a result of these historical activities, volatile organic compounds (VOCs), primarily TCE, have contaminated the groundwater at CG039.

VOCs in groundwater (TCE, tetrachloroethene [PCE], 1,1,2,2-tetrachloroethane [PCA], benzene, carbon tetrachloride, and 1,2-dichloroethene [DCE]) and soil (TCE and PCE) pose a potential risk to human health and the environment and were identified as contaminants of concern in the Record of Decision for Operable Units A and B (ROD) (United States Army, 1997). Remedial actions have removed an estimated 95 to 99 percent of the soil contamination from the source area, thereby reducing the source of groundwater contamination at the site (United States Army Directorate of Public Works [DPW], 2008).

The geology underlying the site is relatively heterogeneous. The following hydrostratigraphic units have been identified:

- Shallow Aquifer: Silty sands and gravels present from the surface to 40 feet below ground surface (bgs), the interval in which most of the mass of TCE is present.

- Intermediate Aquitard: Relatively impermeable dense till aquitard that serves as a leaky barrier between the shallow aquifer and the deep perched aquifer.

- Deep Perched Aquifer: Locally perched layer of groundwater extending from approximately 95 to 126 feet bgs located within the base of the relatively impermeable till aquitard. There is enough water to sample in some places; however, the unit is more characteristic of an aquitard.

- Regional Aquifer: Primary aquifer across the Anchorage Bowl where groundwater migrates from the base of the Chugach Mountains toward Knik Arm; underlies the shallow and deep perched aquifers at depths of approximately 140 to 190 feet bgs; no evidence of TCE contamination.

Refer to the Implementation Report (USAF, 2014) for a more complete discussion of the site history and hydrogeology.

1.3 Summary of Treatability Study Implementation Report

The Implementation Report provides an overview of the treatability study implementation activities and initial results for the site, including injection well installation details, baseline soil and groundwater sampling results, and substrate injection data. The following provides a brief summary of the information provided in the Implementation Report.

1.3.1 Well Installation and Development

Three areas of high TCE concentrations in groundwater (labeled target treatment zones) were identified at CG039. Two of the target treatment zones are located in the shallow aquifer near performance monitoring wells AP-3983R and AP-4550 (the wells used to evaluate the effectiveness of the injections). Performance monitoring well AP-3983R was installed as a replacement for well AP-3983, which had previously been destroyed. The third target treatment zone is located in the deep perched aquifer near performance monitoring well AP-4551. At each target treatment zone, two injection wells were installed upgradient of the designated performance monitoring well, for a total of six injection wells. Additionally, at each of the shallow target treatment zones, a monitoring well to measure the distribution of EVO substrate (known as a radius of influence [ROI] well) was installed. Soil boring logs and well completion diagrams are presented in Appendix A.

1.3.2 Soil Sampling and Analysis

Soil samples were collected from soils within the target treatment zones during well installation. Samples were tested for grain size distribution, natural oxidant demand (NOD), and fraction of organic carbon (f_{oc}). Grain size distribution testing indicated that the soil is composed primarily of silty sand with gravel to poorly graded gravel with silt and sand. The NOD results indicated that ISCO would be inefficient and expensive to implement; therefore, ISCO was not selected as a treatment option for this treatability study.

1.3.3 Baseline Groundwater Sampling and Analysis

Prior to performing the injections, baseline groundwater samples were collected and analyzed from each performance monitoring well and injection well within the three target treatment zones. The baseline groundwater sample results indicated a slight variability in TCE concentrations

within a given target treatment zone; however, TCE concentrations were generally similar to each other and to historical TCE concentrations.

1.3.4 Substrate Injection

An EVO or EVO and ferrous sulfate solution (a mixture of EVO with or without ferrous sulfate and clean water) was injected into injection wells within a target treatment zone, as summarized in Table 1-1.

Table 1-1: EVO Injection Summary

Field Location	Total Injection Volume (gallons)	Volume of EVO (gallons)	Mass of EVO (pounds)	Mass of Ferrous Sulfate (pounds)	Injection Rate (gpm)	Injection Pressure (psi)
IW01-3983	5,388	305	2455	650	30-35	0
IW02-3983	5,400	305	2455	650	30-35	0
IW01-4550	6,750	350	2817	0	19-25	4-8
IW02-4550	6,750	375	3018	0	13-20	8-10
IW01-4551	1,350	75	604	160	<1-2	12
IW02-4551	1,380	80	644	160	28-40	0-2

Note:
psi = pound(s) per square inch

The silty sands and gravels within the shallow aquifer at CG039 easily accepted the injection of EVO substrate. The lithology of the deep perched aquifer at CG039 consists of partially interconnected silty sand and gravel lenses within a basal till, overlying weathered bedrock. Soil variability within the deep perched aquifer was the cause for considerable variance in the injection rate between the injection wells within the AP-4551 target treatment zone.

Before, during, and after the substrate injections, the wells within each target treatment zone were monitored to assess how far the EVO substrate traveled. Groundwater within the wells was monitored both visually (EVO is milky white) and with a water-level indicator and water quality meter. In the shallow aquifer, visual observations of EVO substrate at monitoring wells confirmed that EVO substrate had travelled at least 90 and 130 feet (in the downgradient direction) during injection at the AP-4550 and AP-3983 target treatment zones, respectively; lateral distribution of EVO substrate was at least 15 feet. In the deep aquifer, visual observations of EVO substrate in monitoring wells (EVO substrate was observed laterally hours before it was observed downgradient) suggest that preferential flow pathways partially control the distribution of substrate within the deep perched aquifer. This is consistent with the interpretation that the deep perched aquifer is composed of partially interconnected sand and gravel lenses within a larger till/weathered bedrock body. The observed distribution of EVO substrate in the shallow and deep aquifers are presented on Figures 1-2 and 1-3, respectively.

1.4 Organization of Report

This report presents the results of four quarterly rounds of groundwater monitoring following the ERD substrate injections for the treatability study at CG039, and is organized into the following sections:

- **Section 1.0: Introduction** – presents project objectives, site description, summary of the Implementation Report, and the organization of this report.
- **Section 2.0: Description of Technology** – provides a description of how both ERD and BiRD function to reduce concentrations of TCE.
- **Section 3.0: Field Activities** – summarizes the activities performed during the quarterly groundwater monitoring events.
- **Section 4.0: Groundwater Quarterly Monitoring Results** – presents results of the quarterly groundwater monitoring following substrate injections.
- **Section 5.0: Conclusions** – presents conclusions following quarterly groundwater monitoring.
- **Section 6.0: Recommendations** – presents a proposed approach for continued monitoring of the treatability study.
- **Section 7.0: References** – lists reference material used in preparation of this report.

Figures and appendixes follow Section 7.0.

This page intentionally left blank.

2.0 DESCRIPTION OF TECHNOLOGY

2.1 Contaminant Chemistry

Chlorinated aliphatic hydrocarbons (CAHs) are typically composed of one or two carbon atoms and between one and six chlorine atoms. Common CAHs include PCE, TCE, 1,2-DCE, and vinyl chloride. This treatability study was designed to evaluate the effectiveness of ERD (a form of biotic reductive dechlorination) and BiRD (a form of abiotic reductive dechlorination) to reduce concentrations of CAHs, particularly TCE, in groundwater at CG039.

2.1.1 Biotic Reductive Dechlorination

Biotic reductive dechlorination is a microbial-mediated reaction where microorganisms gain energy for growth as one or more of the chlorine atoms on a CAH molecule are replaced by hydrogen atoms in an anaerobic environment. In general, biotic reductive dechlorination occurs by sequential removal of chlorine atoms. For example, the chlorinated ethenes are transformed sequentially from PCE to TCE to the 1,2-DCE isomers (cis-1,2-DCE or trans-1,2-DCE) to vinyl chloride to ethene (United States Environmental Protection Agency [EPA], 2000). These microbial mediated degradation reactions proceed via oxidation-reduction (redox) reactions, where electrons are sequentially transferred from one compound, the electron donor, to an electron acceptor (Pathway 1 on Figure 2-1).

Microorganisms couple the oxidation of organic compounds or hydrogen to the reduction of an electron acceptor to generate energy in a process called microbial respiration. In the reductive dechlorination process, CAH molecules serve as electron acceptors. The reduction of oxygen is the most energetically favorable and efficient metabolic pathway. However, oxygen can be rapidly depleted in systems with elevated organic carbon contents and low recharge rates, rendering the environment anaerobic. Anaerobic respiration uses oxidized compounds (e.g., CAH molecules) in groundwater as electron acceptors, in order of their respective thermodynamic favorability (EPA, 2000).

The carbon atoms in PCE and TCE are in a more highly oxidized state than the less oxidized compounds cis-1,2-DCE and vinyl chloride (Christ et al., 2005). As such, the highly chlorinated compounds PCE and TCE are more readily and rapidly biodegraded through reductive dechlorination reactions than the less chlorinated compounds cis-1,2-DCE and vinyl chloride (Wiedemeier, et al., 1999). Biotic reductive dechlorination of CAHs occurs most favorably under conditions where the environment is highly anaerobic, is elevated in dissolved hydrogen concentrations, is strongly reducing, and where an appropriate microbial population is present.

2.1.2 Abiotic Reductive Dechlorination

Abiotic reductive dechlorination is a chemical reaction where a CAH compound is reduced by a reactive mineral (typically iron sulfide [FeS]). The abiotic reduction of a CAH compound by reaction with a FeS mineral is referred to as a biogeochemical transformation because the reactive mineral may be formed by the operation of both biological and chemical processes. In many cases, these minerals are formed at least in part by, or indirectly from, anaerobic biological processes (AFCEE, 2002). For example, PCE and TCE may be reduced in an abiotic reaction with FeS that is formed in the subsurface under iron- and sulfate-reducing conditions. Alternatively, cis-DCE

may be oxidized by a reaction with magnetite (Fe_3O_4), which could be a product of anaerobic biological ferric iron reduction. An advantage of these transformation reactions is that, in general, intermediate dechlorination products are not produced (AFCEE, 2002).

The formation of a reactive mineral may begin with the biological reduction of sulfate coupled with the oxidation of organic material by sulfate-reducing bacteria to produce hydrogen sulfide. Ferric iron in the subsurface soil may be reduced to ferrous iron by either biological or chemical processes. Biologically produced ferrous iron will precipitate in mineral form in the presence of hydrogen sulfide to produce an iron sulfide mineral such as FeS. Alternatively, hydrogen sulfide may chemically reduce ferric iron present in iron oxide or iron hydroxide minerals to form FeS. These FeS minerals, which exist in a reduced state, may react rapidly with oxidized compounds such as PCE and TCE to form acetylene (AFCEE, 2002).

2.2 Enhanced Reductive Dechlorination Treatment Technology

ERD is a treatment method that aims to increase the propensity for biotic reductive dechlorination. ERD treatments manipulate the geochemical environment through injection of short- and long-term carbon sources. The consumption of the short-term carbon source (typically lactate) rapidly transitions the contaminated aquifer into a highly anaerobic and strongly reducing environment, consequently affecting the microbial community. The prolonged consumption of the long-term carbon source (typically EVO) effectively sustains the geochemical conditions and supplies the chemical requirements for reductive dechlorination. The carbon source serves as a supplemental energy source for microbial processes in the subsurface, and provides a pool of electron donors to stimulate dechlorinating bacteria that can use chlorinated compounds as electron acceptors.

ERD injection treatments are engineered to create treatment zones. EVO substrates are sparingly soluble and will adsorb to sediments. Consequently, the substrate typically has the greatest effect on contaminants in the immediate vicinity of the injection location, depending on substrate distribution. An EVO substrate manufactured by Terra Systems was selected for injection at the three target treatment zones. The EVO substrate was a custom blend of 60 percent SRS-SD (0.6-micrometer [µm] droplet size) and 40 percent SRS-FR (5-µm droplet size). Each SRS solution contains 60 percent soybean oil and 4 percent potassium or sodium lactate, with the remainder being water, surfactants, and organic and inorganic nutrients. The custom blend of small and large EVO droplet size allows for the transport of the small EVO droplets through the aquifer to treat a larger area, and the larger EVO droplets allow for greater retention within the injection area.

2.3 Biogeochemical Reductive Dechlorination Treatment Technology

BiRD is dependent on the generation of reactive iron sulfide minerals in the subsurface soil. Stimulating the production of reduced iron sulfide requires the following:

- A source of sulfate that can be reduced to form hydrogen sulfide
- A source of reducible iron for the hydrogen sulfide to react with to precipitate FeS

- A source of organic substrate to stimulate anaerobic iron and sulfate reduction processes and sustain reducing conditions in the subsurface to prevent oxidation of the reduced iron sulfide minerals

Iron and sulfate are present naturally in the subsurface, but typically not at concentrations sufficient for effective stimulation of biogeochemical transformation. Therefore, supplemental forms of sulfate and iron that can be injected into the subsurface are needed. Because it is desirable to sustain anaerobic conditions in the subsurface long enough for the reduced iron sulfides to form (weeks to months) and to prevent oxidation of the reduced iron sulfides (months to years), a long-lasting substrate such as EVO is needed. To evaluate the effectiveness of BiRD as part of this treatability study, soluble ferrous iron sulfate was injected along with EVO into target treatment zones AP-3983R and AP-4551. More details regarding the injection of ferrous sulfate and EVO are included in the Implementation Report (USAF, 2014).

2.4 Evaluating Anaerobic Degradation Processes

Adding an organic substrate (such as EVO) to the subsurface enhances anaerobic conditions that may directly or indirectly initiate one or more of the degradation reactions described above. The primary line of evidence for evaluation of contaminant degradation is the observation of changes in contaminant concentrations (or mass) over time and space. Biogeochemical data can then be used as a secondary/confirmatory line of evidence.

Biotic and abiotic degradation mechanisms can be differentiated by analyzing the patterns of reductions in CAHs over time. Biotic reductive dechlorination of CAHs is a sequential process where PCE and TCE are sequentially dechlorinated to the DCE isomers (cis-DCE, trans-1,2-DCE, and 1,1-DCE), then to vinyl chloride, and finally to ethene. This sequential dechlorination pattern is evident as sequential peaks in the concentration of each dechlorination product over time. Therefore, the formation of intermediate dechlorination products is indicative of sequential biotic reductive dechlorination.

Intermediate dechlorination products are typically not produced by abiotic dechlorination of PCE and TCE with FeS. Therefore, abiotic dechlorination over time would be expected to produce a concentration profile where the concentration of each of the CAH compounds would be expected to decrease over time.

This page intentionally left blank.

3.0 FIELD ACTIVITIES

Field activities documented in this report include quarterly groundwater sampling conducted in support of the treatability study objectives. Field notes and groundwater sampling forms from the quarterly sampling are provided in Appendix A.

3.1 Quarterly Groundwater Sampling and Analysis

Four rounds of groundwater sampling were conducted at the three performance monitoring wells (AP-3983R, AP-4550, and AP-4551) during October 2013, January 2014, April 2014, and September 2014. During the September 2014 sampling event, three additional groundwater monitoring wells within the shallow aquifer were also sampled to assess geochemical conditions downgradient of the target treatment zones. Groundwater samples were analyzed for VOCs, total organic carbon (TOC), dissolved iron, dissolved manganese, dissolved gases, sulfide, nitrate+nitrite, alkalinity, chloride, sulfate, and volatile fatty acids (VFAs). Field quality control (QC) samples were collected during the quarterly groundwater sampling. The rationale and objective of the field QC samples are presented in Worksheet #20 of the Work Plan (USAF, 2013a). Field QC samples for CG039 included three field duplicates (FDs), four matrix spike/matrix spike duplicates (MS/MSDs), four equipment blanks (EBs), and four trip blanks (TBs).

Groundwater sampling was supervised by "qualified persons" as defined in 18 AAC 75.990 (100) and whose resumes are provided in Appendix F of the Basewide UFP-QAPP (USAF, 2013b) and in Appendix A of this document.

Table 3-1 presents a summary of the groundwater samples and analyses. Groundwater sampling logs are presented in Appendix A.

3.2 Management of Investigative-Derived Waste

Wastes generated during the quarterly groundwater sampling portion of the treatability study include general refuse (expended personal protective equipment [PPE], paper towels, plastic bags, and plastic water containers) and investigative-derived waste (IDW) (purge water from well sampling and wastewater from decontamination activities).

Consistent with the Basewide UFP-QAPP (USAF, 2013b), wastes were taken to the Environmental Staging Facility (ESF), which is located at Building 955 on Warehouse Street near the intersection with Otter Lake Road. Access to the facility is coordinated through the current operations contractor. Specific wastes were handled as follows:

- General refuse and expended PPE were disposed of daily in JBER refuse waste containers at the ESF.

- Decontamination and purge water was collected in 15-gallon containers, transported to the ESF, transferred into open-top 55-gallon drums, and labeled. Decontamination water was then batch treated with other IDW water. After treatment, the water was sampled for constituents in the JBER water discharge permit, and was discharged to the sanitary sewer after verifying that constituents were below permit requirements. Treated IDW from CG039 discharged to the

sanitary sewer is considered to be exempt from the CERCLA Off-Site Rule as a de minimis release.

3.3 Deviations from the Work Plan

The treatability study field activities were conducted in accordance with the Work Plan (USAF, 2013a). The following deviations from the Work Plan (USAF, 2013a) occurred:

- The primary sample and FD collected from AP-4550 during the October 2013 sampling event were not analyzed for alkalinity, VFAs, sulfide, or TOC because of inadvertent omission.

- Three additional monitoring wells (AP-3744, AP-3747, and AP-3989) installed within the shallow aquifer and located downgradient of the target treatment zones were sampled for the treatability study suite of analytes to assess the distal effects of ERD.

- An attempt was made to sample one additional monitoring well (AP-4525) installed within the deep perched aquifer and located downgradient of the target treatment zones, to assess the effects of ERD. However, no sample could be collected due to insufficient water in the well.

Table 3-1: Groundwater Samples and Analyses

Location	Sample ID	Matrix	Sample Type	Depth (ft)	Collection Date	E310.1	E300.0M	E300.0	E353.2	E376.2	RSK-175	SW6010B/C	SW9060	SW8260C
AP-3744	14Q3CG039-AP3744-GW-0	GW	N	26.5-36.5	09-Sep-14	X	X	X	X	X	X	X	X	X
AP-3747	13Q3CG039-AP3747-GW-0	GW	N	20-30	05-Sep-14	X	X	X	X	X	X	X	X	X
AP-3983R	13Q4CG039-AP3983R-GW-0	GW	N	30-40	16-Oct-13	X	X	X	X	X	X	X	X	X
	14Q1CG039-AP3983R-GW-0	GW	N	30-40	16-Jan-14	X	X	X	X	X	X	X	X	X
	14Q2CG039-AP3983R-GW-0	GW	N	30-40	15-Apr-14	X	X	X	X	X	X	X	X	X
	14Q3CG039-AP3983R-GW-0	GW	N	30-40	09-Sep-14	X	X	X	X	X	X	X	X	X
AP-3989	14Q3CG039-AP3989-GW-0	GW	N	24-34	09-Sep-14	X	X	X	X	X	X	X	X	X
AP-4550	13Q4CG039-AP4550-GW-0	GW	N	32-42	15-Oct-13			X	X		X	X		X
	13Q4CG039-AP4550-GW-1	GW	FD	32-42	15-Oct-13			X	X		X	X		X
	14Q1CG039-AP4550-GW-0	GW	N	32-42	16-Jan-14	X	X	X	X	X	X	X	X	X
	14Q1CG039-AP4550-GW-1	GW	FD	32-42	16-Jan-14	X	X	X	X	X	X	X	X	X
	14Q2CG039-AP4550-GW-0	GW	N	32-42	15-Apr-14	X	X	X	X	X	X	X	X	X
	14Q3CG039-AP4550-GW-0	GW	N	32-42	09-Sep-14	X	X	X	X	X	X	X	X	X
	14Q3CG039-AP4550-GW-1	GW	FD	32-42	09-Sep-14	X	X	X	X	X	X	X	X	X
AP-4551	13Q4CG039-AP4551-GW-0	GW	N	85.2-95.2	16-Oct-13	X	X	X	X	X	X	X	X	X
	14Q1CG039-AP4551-GW-0	GW	N	85.2-95.2	16-Jan-14	X	X	X	X	X	X	X	X	X
	14Q2CG039-AP4551-GW-0	GW	N	85.2-95.2	15-Apr-14	X	X	X	X	X	X	X	X	X
	14Q3CG039-AP4551-GW-0	GW	N	85.2-95.2	10-Sep-14	X	X	X	X	X	X	X	X	X

Notes:
N = primary sample
FD = field duplicate
ft = feet
GW = groundwater
E310.1 = Alkalinity
E300.0M = Volatile fatty acids
E300.0 = Chloride and sulfate
E353.2 = Nitrate+nitrite
E376.2 = Sulfide
RSK-175 = Dissolved gases
SW6010C = Dissolved iron and manganese
SW9060 = Total organic carbon
SW8260C = Volatile organic compounds

This page intentionally left blank

4.0 GROUNDWATER QUARTERLY MONITORING RESULTS

The results of the quarterly groundwater sampling are presented for each performance monitoring well in the following sections. Complete analytical results are presented in Appendix B. The data quality evaluation (DQE) report is included as Appendix C, and the laboratory analytical reports are included in Appendix D.

4.1 AP-3983R Groundwater Results (EVO and Ferrous Sulfate in Shallow Aquifer)

Four groundwater samples were collected from AP-3983R from October 2013 to September 2014. Analyte concentration trends are summarized in the following subsections. CAH results for AP-3983R and an updated representation of the shallow TCE plume are presented on Figure 4-1. Graphs presenting CAH and geochemical parameter concentration trends are presented in Figures 4-2 and 4-3, respectively. An updated conceptual site model/cross section is presented on Figure 4-5. Complete analytical results for AP-3983R are presented in Appendix B.

4.1.1 Chlorinated Aliphatic Hydrocarbons

Concentrations of TCE in groundwater at AP-3983R have decreased substantially since the injection of EVO and ferrous sulfate in September 2013. In turn, concentrations of TCE daughter products, particularly cis-1,2-DCE and vinyl chloride, have increased substantially compared to pre-injection concentrations. A summary of the concentration trends observed for the CAHs at AP-3983R is provided in Table 4-1.

Table 4-1: AP-3983R Chlorinated Aliphatic Hydrocarbon Results

Analyte (µg/L)	MCL	August 2013 (baseline)	Oct 2013	Jan 2014	April 2014	Sept 2014	Comments
PCE	5	**30.5**	**20.9**	**27.8**	3.44 J	0.79	Decrease indicates that PCE is being dechlorinated.
TCE	5	**1,880**	**1,820**	**1,190**	**118**	**12.4**	Decrease indicates that TCE is being dechlorinated.
cis-1,2-DCE	70	**180**	**207**	**1,470**	**2,260**	**4,070**	Increase indicates that TCE is being dechlorinated.
trans-1,2-DCE	100	62	71.4	**113**	99.9	98.8	Increase indicates that TCE is being dechlorinated. Subsequent decrease indicates that trans-1,2-DCE is being dechlorinated.
1,1-DCE	7	3.88	3.62	6.71	6.74	**8.12**	Stable and low concentrations indicate that 1,1-DCE is not a primary dechlorination pathway.
Vinyl chloride	2	0.25 U	0.32 J	**14.1**	**16.5**	**43.7**	Increase indicates that DCE is being dechlorinated.
Ethene	NA	0.0682	0.252 J	0.253 J	0.501	2.36	Increase indicates that complete dechlorination is occurring.

Notes:
µg/L = microgram(s) per liter
J = The analyte was positively identified: the associated value is the approximate concentration of the analyte in the sample.
MCL = maximum contaminant level
NA = Not available
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
Bold values indicate the result exceeded the MCL

4.1.2 Geochemical Parameters

The geochemical parameters measured in groundwater at AP-3983R indicate that the groundwater environment has been and remains sufficiently anaerobic for reductive dechlorination to occur. A summary of the trends observed for the geochemical parameters at AP-3983R is provided in Table 4-2.

Table 4-2: AP-3983R Geochemical Parameter Results

Analyte	August 2013 (baseline)	Oct 2013	Jan 2014	April 2014	Sept 2014	Comments
ORP (mV)	52	60.1	-79	-111.9	-94.2	Decreasing value indicates that conditions are becoming more reducing and favorable for dechlorination.
TOC (mg/L)	3.47	3.96	61.6	93.2	138	Greater than 20 mg/L is considered a sufficient carbon and energy source to drive dechlorination.
VFAs* – primarily acetic acid (µg/L)	60 U	15,700	148,000	152,000	179,000	VFAs are a degradation product of EVO, and concentrations of VFAs greater than 10,000 to 20,000 µg/L are a good indicator of sufficient EVO distribution at a given location.
Methane (µg/L)	9.84	15.8	11.8	29.9	720	Levels greater than 1,000 µg/L are an indicator of highly reducing conditions, and are desirable for dechlorination to occur.
Manganese (mg/L)	0.416	5.11	4.24	4.31	2.73	An increase in manganese concentrations can indicate that groundwater is sufficiently reducing for anaerobic dechlorination to occur.
Dissolved Iron (mg/L)	3.03	64.7	27.5	60.9	50.9	See discussion below.
Sulfate (mg/L)	25.3	369	84.5	3.01	0.557	Depleted concentrations of sulfate relative to background indicate that the groundwater is sufficiently reducing for anaerobic dechlorination to occur. Abundant sulfate and iron can promote FeS formation and abiotic reduction of TCE.
Sulfide (mg/L)	0.0647	0.705	0.264	5.16	2.05	Increase in sulfide corresponds to a decrease in sulfate. Subsequent decrease in sulfide is likely due to reaction with ferrous iron to form FeS minerals.
Nitrate (mg/L)	0.0611	0.191	0.0847	0.155	0.173	A nitrate level of <1.0 mg/L is desirable for dechlorination.
pH	5.78	6.36	6.73	6.79	7.05	pH values are within the acceptable range (6 to 8) for reductive dechlorination.

*VFAs include acetic acid, butyric acid, formic acid, lactic acid, propionic acid, and pyruvic acid.
Dissolved Iron: Although dissolved iron reported from laboratory analysis did not speciate between ferric and ferrous iron, ferrous iron was measured using a field test kit (Appendix A). The ferrous iron results from the field test kit exceeded the range of the test kit (3.3 mg/L), which, along with the addition of ferrous iron during the injections and reducing conditions, indicate that most of the dissolved iron concentration is likely to be in the ferrous form of iron. The lack of evidence of ferric iron being present indicates that groundwater is sufficiently reducing for anaerobic dechlorination to occur. Elevated ferrous iron can promote FeS formation and abiotic reduction of TCE.

Notes:
mg/L = milligram(s) per liter
mV = millivolt(s)
ORP = oxidation reduction potential
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

4.2 AP-4550 Groundwater Results (EVO in Shallow Aquifer)

Four primary and three FD groundwater samples were collected from AP-4550 from October 2013 to September 2014. Analyte concentration trends are summarized in the following subsections. CAH results for AP-4550 and an updated representation of the shallow TCE plume are presented on Figure 4-1. Graphs presenting CAH and geochemical parameter concentration trends are presented in Figures 4-2 and 4-3, respectively. An updated conceptual site model/cross section is presented on Figure 4-5. Complete analytical results for AP-4550 are presented in Appendix B.

4.2.1 Chlorinated Aliphatic Hydrocarbons

Concentrations of TCE in groundwater at AP-4550 have decreased substantially since the injection of EVO in September 2013. In turn, concentrations of TCE daughter products, particularly cis-1,2-DCE and vinyl chloride, have increased substantially compared to pre-injection concentrations. A summary of the concentration trends observed for the CAHs at AP-4550 is provided in Table 4-3.

Table 4-3: AP-4550 Chlorinated Aliphatic Hydrocarbon Results

Analyte (µg/L)	MCL	August 2013 (baseline)	Oct 2013	Jan 2014	April 2014	Sept 2014	Comments
PCE	5	**29.3**	**8.76**	1.68	1.5	0.52	Decrease indicates that PCE is being dechlorinated.
TCE	5	**1,500**	**822**	**34.9**	**6.89**	**10.6**	Decrease indicates that TCE is being dechlorinated.
cis-1,2-DCE	70	**160**	**115**	**2,040**	**1,130**	**924**	Increase indicates that TCE is being dechlorinated. Subsequent decrease indicates that cis-1,2-DCE is also being dechlorinated.
trans-1,2-DCE	100	58.4	38.6	62.2	37.5	31.8	Increase indicates that TCE is being dechlorinated. Subsequent decrease indicates that trans-1,2-DCE is also being dechlorinated.
1,1-DCE	7	4.05	1.94 J	**7.94**	3.94	3.14	Increase indicates that TCE is being dechlorinated. Subsequent decrease indicates that 1,1-DCE is also being dechlorinated. Not a primary dechlorination pathway.
Vinyl chloride	2	0.28 U	1.25 U	**40.3**	**11.1**	**5.25**	Increase indicates that DCE is being dechlorinated. Subsequent decrease indicates that vinyl chloride is also being dechlorinated.
Ethene	NA	0.0407	0.537	1.29	0.261 J	0.303 J	Initial increase and ongoing concentrations indicate that complete dechlorination is occurring.

Notes:
J = The analyte was positively identified: the associated value is the approximate concentration of the analyte in the sample.
MCL = maximum contaminant level
NA = Not available
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
Bold values indicate the result exceeded the MCL

4.2.2 Geochemical Parameters

The geochemical parameters measured in groundwater at AP-4550 indicate that the groundwater environment has been and remains sufficiently anaerobic for reductive dechlorination to occur. A summary of the trends observed for the geochemical parameters at AP-4550 is provided in Table 4-4.

Table 4-4: AP-4550 Geochemical Parameter Results

Analyte	August 2013 (baseline)	Oct 2013	Jan 2014	April 2014	Sept 2014	Comments
ORP (mV)	40.5	40.7	-50.5	-71.8	-96.2	Decreasing value indicates that conditions are becoming more reducing and favorable for dechlorination.
TOC (mg/L)	3.53	NA	134	41.3	51.9	Greater than 20 mg/L is considered a sufficient carbon and energy source to drive dechlorination.
VFAs* – primarily acetic acid (µg/L)	60 U	NA	129,000	52,900	98,100	VFAs are a degradation product of EVO, and concentrations of VFAs greater than 10,000 to 20,000 µg/L are a good indicator of sufficient EVO distribution at a given location.
Methane (µg/L)	53.3	44.2	220	1,060	5,860	Levels greater than 1,000 µg/L are an indicator of highly reducing conditions and are desirable for dechlorination to occur.
Manganese (mg/L)	0.775	1.19	1.75	1.07	0.983	An increase in manganese concentrations can indicate that groundwater is sufficiently reducing for anaerobic dechlorination to occur.
Dissolved Iron (mg/L)	8.36	14.7	35.9	27.3	25.6	See discussion below.
Sulfate (mg/L)	30.3	115	0.222	0.353	0.1 U	Depleted concentrations of sulfate relative to background indicate that the groundwater is sufficiently reducing for anaerobic dechlorination to occur.
Sulfide (mg/L)	0.0456	NA	0.141	0.148	0.0839	Low concentrations could indicate that FeS minerals have been formed.
Nitrate (mg/L)	0.0661	0.15	0.114	0.154	0.156	A nitrate level of <1.0 mg/L is desirable for dechlorination.
pH	6.11	6.54	6.27	6.69	6.76	pH values are within the acceptable range (6 to 8) for reductive dechlorination.

*VFAs include acetic acid, butyric acid, formic acid, lactic acid, propionic acid, and pyruvic acid.
Dissolved Iron: Although dissolved iron reported from laboratory analysis did not speciate between ferric and ferrous iron, ferrous iron was measured using a field test kit (Appendix A). The ferrous iron results from the field test kit exceeded the range of the test kit (3.3 mg/L), which, along with reducing conditions in the groundwater environment, indicate that most of the dissolved iron concentration is likely to be in the ferrous form of iron. An increase in ferrous iron concentrations can indicate that groundwater is sufficiently reducing for anaerobic dechlorination to occur.

Notes:
NA = not analyzed
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

4.3 AP-4551 Groundwater Results (EVO and Ferrous Sulfate in Deep Perched Aquifer)

Four primary groundwater samples were collected from AP-4551 from October 2013 to September 2014. Analyte concentration trends are summarized in the following subsections. CAH results for AP-4551 and an updated representation of the deep TCE plume are presented on Figure 4-4. Graphs presenting CAH and geochemical parameter concentration trends are presented in Figures 4-2 and 4-3, respectively. An updated conceptual site model/cross section is presented on Figure 4-5. Complete analytical results for AP-4551 are presented in Appendix B.

4.3.1 Chlorinated Aliphatic Hydrocarbons

Concentrations of TCE in groundwater at AP-4551 have decreased substantially since the injection of EVO and ferrous sulfate in September 2013. In turn, concentrations of TCE daughter products, particularly cis-1,2-DCE and vinyl chloride, have increased substantially compared to pre-injection concentrations. A summary of the concentration trends observed for the CAHs at AP-4551 is provided in Table 4-5.

Table 4-5: AP-4551 Chlorinated Aliphatic Hydrocarbon Results

Analyte (µg/L)	MCL	August 2013 (baseline)	Oct 2013	Jan 2014	April 2014	Sept 2014	Comments
PCE	5	5	0.64	2.42	3 U	0.3 U	Decrease indicates that PCE is being dechlorinated.
TCE	5	**2,300**	**698**	**1,190**	**14.7**	**8.43**	Decrease indicates that TCE is being dechlorinated.
cis-1,2-DCE	70	**113**	**82.7**	**730**	**2,370**	**2,520**	Increase indicates that TCE is being dechlorinated.
trans-1,2-DCE	100	9.59	8.92	14.2	24.1	28.2	Increase indicates that TCE is being dechlorinated. Not a primary pathway.
1,1-DCE	7	**10.4**	2.11	4.76	**15.2**	**16.7**	Increase indicates that TCE is being dechlorinated. Not a primary pathway.
Vinyl chloride	2	0.25 U	0.25 U	**2.43**	**7.87**	**5.55**	Increase indicates that DCE is being dechlorinated. Subsequent decrease indicates that vinyl chloride is also being dechlorinated.
Ethene	NA	0.123	0.293 J	0.0858 J	0.115 J	0.219 J	Detectable ethene concentrations indicate that complete dechlorination is occurring.

Notes:
J = The analyte was positively identified: the associated value is the approximate concentration of the analyte in the sample.
MCL = maximum contaminant level
NA = Not available
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
Bold values indicate the result exceeded the MCL

4.3.2 Geochemical Parameters

The geochemical parameters measured in groundwater at AP-4551 indicate that the groundwater environment was sufficiently anaerobic for reductive dechlorination to occur; however, there are some indications that those conditions may not be persistent. A summary of the trends observed for the geochemical parameters at AP-4551 is provided in Table 4-6.

Table 4-6: AP-4551 Geochemical Parameter Results

Analyte	August 2013 (baseline)	Oct 2013	Jan 2014	April 2014	Sept 2014	Comments
ORP (mV)	45.1	48.6	-102.3	-68.8	-41.3	Decreased values indicate that conditions were reduced and favorable for dechlorination, but are becoming less reduced.
TOC (mg/L)	4.25	4.13	38	28.1	24.1	Greater than 20 mg/L is considered a sufficient carbon and energy source to drive dechlorination.
VFAs* – acetic acid (µg/L)	60 U	60 U	16,100	27,300	400 U	VFAs are a degradation product of EVO, and concentrations of VFAs greater than 10,000 to 20,000 µg/L are a good indicator of sufficient EVO distribution at a given location.
VFAs* – lactic acid (µg/L)	60 U	60 U	60 U	100 U	31,800	
Methane (µg/L)	0.463	0.364 B	0.849	119	849	Levels greater than 1,000 µg/L are an indicator of highly reducing conditions and are desirable for dechlorination to occur.
Manganese (mg/L)	0.00552	19.3	19.2	12.5	10.5	An increase in manganese concentrations can indicate that groundwater is sufficiently reducing for anaerobic dechlorination to occur.
Dissolved Iron (mg/L)	0.0312	0.13	21.9	7.27	5.46	See discussion below.
Sulfate (mg/L)	9.53	117	12	0.289	1.11	Depleted concentrations of sulfate relative to background indicate that the groundwater is sufficiently reducing for anaerobic dechlorination to occur. Abundant sulfate and iron can promote FeS formation and abiotic reduction of TCE.
Sulfide (mg/L)	0.0142	0.112	0.0197 J	0.258	0.032	Low concentrations could indicate that FeS minerals have been formed.
Nitrate (mg/L)	0.0357	0.0302 B	0.0976	0.0656	0.0416	A nitrate level of <1.0 mg/L is desirable for dechlorination.
pH	6.58	7.11	6.79	6.97	7.07	pH values are within the acceptable range (6 to 8) for reductive dechlorination.

*VFAs include acetic acid, butyric acid, formic acid, lactic acid, propionic acid, and pyruvic acid.
Dissolved Iron: Although dissolved iron reported from laboratory analysis did not speciate between ferric and ferrous iron, ferrous iron was measured using a field test kit (Appendix A). The ferrous iron results from the field test kit either exceeded the range of the test kit (3.3 mg/L) or were close to the maximum concentration, which, along with the addition of ferrous iron during the injections and the reducing conditions of the groundwater environment, indicate that most of the dissolved iron concentration is likely to be in the ferrous form of iron. The lack of evidence of ferric iron being present indicates that groundwater is sufficiently reducing for anaerobic dechlorination to occur. Elevated ferrous iron can promote FeS formation and abiotic reduction of TCE.
Notes:
B = The analyte was detected in the associated method and/or calibration blank.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

4.4 Downgradient Groundwater Results

Based on the positive results of the first three rounds of groundwater monitoring at the planned performance monitoring wells, groundwater samples were also collected from three groundwater monitoring wells in the shallow aquifer to assess the influence of the EVO injections downgradient of the anticipated target treatment zones. One groundwater sample was collected from shallow aquifer monitoring wells AP-3744, AP-3747, and AP-3989 during September 2014. Analyte concentration trends as compared to the most recent data (2012) are summarized in the following subsections. CAH results for AP-3744, AP-3747, and AP-3989, as well as an updated representation of the shallow TCE plume, are presented on Figure 4-1. An updated conceptual site model/cross section is presented on Figure 4-5. Complete analytical results are presented in Appendix B.

4.4.1 AP-3744

4.4.1.1 Chlorinated Aliphatic Hydrocarbons

AP-3744 is approximately 220 feet downgradient of the closest target treatment zone, AP-3983. TCE concentrations in groundwater have remained relatively stable since September 2012. All other CAH concentrations have remained stable, with the exception of cis-1,2-DCE, which has slightly increased. These results indicate that as of September 2014, reductive dechlorination resulting from upgradient injections is not occurring at AP-3744. A comparison of the September 2012 and 2014 CAH concentrations at AP-3744 is provided in Table 4-7.

Table 4-7: AP-3744 Chlorinated Aliphatic Hydrocarbon Results

Analyte (µg/L)	MCL	September 2012	September 2014	Comments
PCE	5	0.4 U	0.33 J	Concentrations are below the MCL of 5 µg/L.
TCE	5	**42**	**47.2**	Concentration is stable.
cis-1,2-DCE	70	1.5	13.7	Slight increase could indicate that some dechlorination of TCE is occurring.
trans-1,2-DCE	100	0.38 J	0.82	Concentration is stable.
1,1-DCE	7	0.2 U	0.3 U	1,1-DCE is not present.
Vinyl chloride	2	0.8 U	0.3 U	Vinyl chloride is not present.
Ethene	NA	0.64 U	0.118 U	Ethene is not present.

Notes:
J = The analyte was positively identified: the associated value is the approximate concentration of the analyte in the sample.
MCL = maximum contaminant level
NA = Not available
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
Bold values indicate the result exceeded the MCL

4.4.1.2 Geochemical Parameters

The geochemical parameters measured at AP-3744 indicate that the groundwater environment is not sufficiently anaerobic to promote reductive dechlorination. The following results were observed for the geochemical parameters at AP-3744. A summary of the results observed for the geochemical parameters at AP-3744 is provided in Table 4-8.

Table 4-8: AP-3744 Geochemical Parameter Results

Analyte	September 2014	Comments
ORP (mV)	6.4	Positive value indicates that conditions are not reduced enough for dechlorination to occur.
TOC (mg/L)	1.01 B	Insufficient carbon and energy source to drive dechlorination (>20 mg/L is considered sufficient).
VFAs* (µg/L)	40 U – 80 U	Indicates that EVO distribution did not reach AP-3744. VFAs are a degradation product of EVO, and concentrations of VFAs greater than 10,000 to 20,000 µg/L are a good indicator of sufficient EVO distribution at a given location.
Methane (µg/L)	1.04 B	Levels greater than 1,000 µg/L are an indicator of highly reducing conditions, and are desirable for dechlorination to occur.
Dissolved Iron (mg/L)	0.02 U	Ferrous iron was measured at 0.0 mg/L using a field test kit, indicating that conditions are not sufficiently reduced.
Sulfate (mg/L)	13.1	The presence of sulfate indicates that the groundwater is insufficiently reduced for anaerobic dechlorination to occur.
Sulfide (mg/L)	0.0193 U	Lack of sulfide is consistent with the presence of sulfate.
Nitrate (mg/L)	0.394	A nitrate level of <1.0 mg/L is desirable for dechlorination.
pH	7.08	pH value is within the acceptable range (6 to 8) for reductive dechlorination.

* VFAs include acetic acid, butyric acid, formic acid, lactic acid, propionic acid, and pyruvic acid.
Notes:
B = The analyte was detected in the associated method and/or calibration blank.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

4.4.2 AP-3747

4.4.2.1 Chlorinated Aliphatic Hydrocarbons

AP-3747 is approximately 375 feet downgradient of the closest target treatment zone, AP-3983. TCE concentrations in groundwater have increased since September 2012. All other CAH concentrations have remained stable, with the exception of cis-1,2-DCE, which has slightly increased. When compared with only the 2012 result, it appears as if the TCE concentration is rapidly increasing at AP-3747. However, the TCE concentrations from 2010 and 2011 were 680 and 600 micrograms per liter (µg/L), respectively. It is likely that the results from 2012 represented an anomalously low result, and it does not seem likely that the TCE plume is expanding. These results indicate that as of September 2014, reductive dechlorination resulting from upgradient injections is not occurring at AP-3747. A comparison of the September 2012 and 2014 CAH concentrations at AP-3747 is provided in Table 4-9.

Table 4-9: AP-3747 Chlorinated Aliphatic Hydrocarbon Results

Analyte (µg/L)	MCL	September 2012	September 2014	Comments
PCE	5	0.87 J	1.96	Concentrations are below the MCL of 5 µg/L.
TCE	5	**88**	**209**	Concentration has increased from 2012 value, but the 2012 value is suspiciously low compared to 2010 and 2011 sample results.
cis-1,2-DCE	70	5.1	13.4	Likely related to increase in TCE concentration.
trans-1,2-DCE	100	1.7	3.17	Concentration is stable.
1,1-DCE	7	0.33 J	0.79	Concentration is stable.
Vinyl chloride	2	0.8 U	0.3 U	Vinyl chloride is not present.
Ethene	NA	0.64 U	0.119 U	Ethene is not present.

Notes:
J = The analyte was positively identified: the associated value is the approximate concentration of the analyte in the sample.
MCL = maximum contaminant level
NA = Not available
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
Bold values indicate the result exceeded the MCL

4.4.2.2 Geochemical Parameters

The geochemical parameters measured at AP-3747 indicate that the groundwater environment is not sufficiently anaerobic to promote reductive dechlorination. The following results were observed for the geochemical parameters at AP-3747. A summary of the results observed for the geochemical parameters at AP-3747 is provided in Table 4-10.

Table 4-10: AP-3747 Geochemical Parameter Results

Analyte	September 2014	Comments
ORP (mV)	250.3	High value indicates that conditions are very oxidizing.
TOC (mg/L)	0.859 B	Insufficient carbon and energy source to drive dechlorination (>20 mg/L is considered sufficient).
VFAs* (µg/L)	40 U – 80 U	Indicates that EVO distribution did not reach AP-3747. VFAs are a degradation product of EVO, and concentrations of VFAs greater than 10,000 to 20,000 µg/L are a good indicator of sufficient EVO distribution at a given location.
Methane (µg/L)	0.0961 B	Levels greater than 1,000 µg/L are an indicator of highly reducing conditions, and are desirable for dechlorination to occur.
Dissolved Iron (mg/L)	0.02 U	The lack of ferrous iron is an indication that conditions are not sufficiently reduced for dechlorination to occur.
Sulfate (mg/L)	11.4	The presence of sulfate indicates that the groundwater is insufficiently reduced for anaerobic dechlorination to occur.
Sulfide (mg/L)	0.0193 U	Lack of sulfide is consistent with the presence of sulfate.
Nitrate (mg/L)	0.334	A nitrate level of <1.0 mg/L is desirable for dechlorination.
pH	7.60	pH value is within the acceptable range (6 to 8) for reductive dechlorination.

* VFAs include acetic acid, butyric acid, formic acid, lactic acid, propionic acid, and pyruvic acid.
Notes:
B = The analyte was detected in the associated method and/or calibration blank.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

4.4.3 AP-3989

4.4.3.1 Chlorinated Aliphatic Hydrocarbons

AP-3989 is approximately 100 feet downgradient of the closest target treatment zone, AP-3983. Current groundwater results indicate that reductive dechlorination is occurring at AP-3989. A comparison of the September 2012 and 2014 CAH concentrations at AP-3989 is provided in Table 4-11.

Table 4-11: AP-3989 Chlorinated Aliphatic Hydrocarbon Results

Analyte (µg/L)	MCL	September 2012	September 2014	Comments
PCE	5	4.1	0.3 U	Decrease indicates that PCE is being dechlorinated.
TCE	5	**610**	2.47	Decrease indicates that TCE is being dechlorinated.
cis-1,2-DCE	70	83	**1,250**	Increase indicates that TCE is being dechlorinated.
trans-1,2-DCE	100	26	39.9	Increase indicates that TCE is being dechlorinated.
1,1-DCE	7	1.7 J	3.2	Not a primary dechlorination pathway.
Vinyl chloride	2	1.6 U	**8.71**	Increase indicates that DCE is also being dechlorinated.
Ethene	NA	0.64 U	0.368 J	Detection indicates that complete dechlorination is occurring.

Notes:
J = The analyte was positively identified: the associated value is the approximate concentration of the analyte in the sample.
MCL = maximum contaminant level
NA = Not available
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
Bold values indicate the result exceeded the MCL

4.4.3.2 Geochemical Parameters

The geochemical parameters measured in groundwater at AP-3989 indicate that the groundwater environment is sufficiently anaerobic for reductive dechlorination to occur. A summary of the results observed for the geochemical parameters at AP-3989 is provided in Table 4-12.

Table 4-12: AP-3989 Geochemical Parameter Results

Analyte	September 2014	Comments
ORP (mV)	-119	Value less than -100 indicates that conditions are sufficiently reduced for dechlorination to occur.
TOC (mg/L)	63.3	Sufficient carbon and energy source to drive dechlorination (>20 mg/L is considered sufficient).
VFAs* – primarily acetic acid (µg/L)	116,000	VFAs are a degradation product of EVO, and concentrations of VFAs greater than 10,000 to 20,000 µg/L are a good indicator of sufficient EVO distribution at a given location.
Methane (µg/L)	1,700	Levels greater than 1,000 µg/L are an indicator of highly reducing conditions and are desirable for dechlorination to occur.
Dissolved Iron (mg/L)	32.5	See discussion below.
Sulfate (mg/L)	0.1 U	The lack of sulfate indicates that the groundwater is sufficiently reduced for dechlorination to occur.
Sulfide (mg/L)	0.0304	Low concentrations could indicate that FeS minerals have been formed.
Nitrate (mg/L)	0.228	A nitrate level of <1.0 mg/L is desirable for dechlorination.
pH	7.43	pH value is within the acceptable range (6 to 8) for reductive dechlorination.

* VFAs include acetic acid, butyric acid, formic acid, lactic acid, propionic acid, and pyruvic acid.
Dissolved Iron: Although dissolved iron reported from laboratory analysis did not speciate between ferric and ferrous iron, ferrous iron was measured using a field test kit (Appendix A). The ferrous iron results from the field test kit exceeded the range of the test kit (3.3 mg/L), which, along with the addition of ferrous iron during the injections and reducing conditions, indicate that most of the dissolved iron concentration is likely to be in the ferrous form of iron. The lack of evidence of ferric iron being present indicates that groundwater is sufficiently reducing for anaerobic dechlorination to occur. Elevated ferrous iron can promote FeS formation and abiotic reduction of TCE.
Notes:
B = The analyte was detected in the associated method and/or calibration blank.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

4.5 Data Quality Evaluation

Sample receipt forms, laboratory data review checklists, and a comprehensive DQE report are included in Appendix C. The goal of the DQE is to demonstrate that a sufficient number of representative samples were collected, and the resulting analytical data can be used to support the decision making process. Because of the concurrent monitoring schedule, the DQE report includes samples from the quarterly monitoring at CG039, as well as samples from the 2014 groundwater monitoring event DA089 and CG039, and the DA089 treatability study. The following summary highlights the DQE findings:

- No data were rejected and completeness was 100 percent for all method/matrix/analyte combinations.
- Approximately 5 percent of the E300.0 (Chloride/Sulfate) data and 5 percent of the E376.2 (Sulfide) data were qualified because of low-level detections in the EBs. The degree to which blank contamination was observed is within reasonable method expectations considering the small size of the dataset.

- Approximately 9 percent of the E353.2 (Nitrate+Nitrite) data were qualified because of low-level detections in the EBs. The degree to which blank contamination was observed suggests a contamination issue during sample collection.
- Approximately 16 percent of the RSK-175 (Dissolved gases) data were qualified because of low-level detections in the laboratory blanks, TBs, and EBs. The degree to which blank contamination was observed suggests a contamination issue at the laboratory and/or during sample collection.
- Approximately 11 percent of the SW6010B (Iron and Manganese) data were qualified because of low-level detections in the EBs. The degree to which blank contamination was observed suggests a contamination issue during sample collection.
- Less than 1 percent of the SW8260C (VOCs) data were qualified because of low-level detections in the EBs. The degree to which blank contamination was observed is within reasonable method expectations.
- Approximately 18 percent of the SW9060 (TOC) data were qualified because of low-level detections in the EBs. The degree to which blank contamination was observed suggests a contamination issue during sample collection.
- Two sample containers were received frozen; three results were qualified as estimated.
- FD relative percent difference exceedances were observed for Methods E300.0 (Chloride/Sulfate), E376.2 (Sulfide), and SW8260C (VOCs); 11 results were qualified as estimated.
- MS/MSD recovery exceedances were observed for Methods SW9060 (TOC) and SW8260C (VOCs); three results were qualified as estimated.

Although data were qualified as estimated because of QC exceedances as noted, overall precision and accuracy of the data as measured by field and laboratory QC indicators suggest that data are usable for project objectives.

5.0 CONCLUSIONS

The following is a discussion of the conclusions drawn for each target treatment zone and for the treatability study as a whole.

5.1 AP-4550 (EVO Injection in Shallow Aquifer)

Conclusions for AP-4550 are as follows:

- Geochemical parameters indicate that the injection of EVO has proven effective in generating anaerobic conditions necessary for reductive dechlorination in the shallow aquifer.
- Concentrations of TCE in groundwater at monitoring well AP-4550 have been reduced by over 99 percent when compared to the 2013 baseline concentrations.
- High concentrations of TCE daughter products, primarily cis-1,2-DCE and vinyl chloride, were generated at AP-4550 and have since decreased by more than half indicating that the microbial consortium present appears to be capable of facilitating complete dechlorination.

5.2 AP-3983R (EVO and Ferrous Sulfate Injection in Shallow Aquifer)

Conclusions for AP-3983R are as follows:

- Geochemical parameters indicate that the injection of EVO and ferrous sulfate has proven effective in generating anaerobic conditions necessary for reductive dechlorination in the shallow aquifer.
- Concentrations of TCE in groundwater at monitoring well AP-3983R have been reduced by over 99 percent when compared to the 2013 baseline concentrations.
- High concentrations of TCE daughter products, primarily cis-1,2-DCE and vinyl chloride, have been generated at AP-3983R and have yet to decrease, however, ORP and TOC remain favorable for dechlorination to proceed.

5.3 AP-4551 (EVO and Ferrous Sulfate Injection in Deep Perched Aquifer)

Conclusions for AP-4551 are as follows:

- Geochemical parameters indicate that the injection of EVO and ferrous sulfate has proven effective in generating anaerobic conditions necessary for reductive dechlorination in the deep perched aquifer. However, recent increases in ORP and a decrease in the TOC concentrations may indicate that geochemical conditions are becoming less favorable to biodegradation of TCE.
- Concentrations of TCE in groundwater at monitoring well AP-4551 have been reduced by over 99 percent when compared to the 2013 baseline concentrations.

- High concentrations of TCE daughter products, primarily cis-1,2-DCE and vinyl chloride, were generated at AP-4551. Concentrations of cis-1,2-DCE have yet to decrease, but concentrations of vinyl chloride appear to have started to decrease.

5.4 Downgradient Monitoring Wells AP-3744, AP-3747, and AP-3989

Conclusions for AP-3744, AP-3747, and AP-3989 are as follows:

- Because of greater-than-expected downgradient distribution of the substrate, concentrations of TCE in groundwater at shallow monitoring well AP-3989 approximately 100 feet downgradient of the AP-3983 injections were also reduced by over 99 percent. Correspondingly, relatively high concentrations of the TCE daughter product, cis-1,2-DCE, as well as low concentrations of vinyl chloride, have been generated.

- Monitoring wells AP-3744 and AP-3747, which are located further downgradient of the EVO distribution area, have shown little indication of reducing conditions being generated and no reduction in TCE concentrations.

5.5 Overall Treatability Study Conclusions

All three target treatment zones have shown generation of reducing conditions and substantial reductions in TCE concentrations in groundwater. The following are the conclusions of the treatability study, from implementation through the first year of monitoring:

- The use of sodium permanganate was not a viable treatment option because of the heterogeneous natural oxidant demand results from across the site.

- Groundwater samples collected from injection wells prior to substrate injections indicated that TCE concentrations within each target treatment zone were similar to each other and to historical TCE concentrations (approximately 2,000 µg/L).

- The design of the treatability study was sufficient to distribute substrate over the majority of the TCE "hotspot" as follows:

  - The shallow aquifer readily accepted the injection of EVO substrate at rates between 15 to 35 gallons per minute (gpm) with an observed distribution (in the downgradient direction) of between 90 and 130 feet. Because of lack of crossgradient monitoring locations, observations of lateral distribution of EVO substrate were limited to the 15 feet between the injection wells at each target treatment zone. Lateral distribution of EVO substrate was at least 15 feet.

  - The deep perched aquifer consists of partially interconnected silty sand and gravel lenses within a basal till/weathered bedrock; and based on the variability of the achievable injection rates into the deep perched aquifer (1 to 28 gpm), it is likely that preferential flow pathways significantly control the distribution substrate. Because of the lack of monitoring locations within the deep perched aquifer, observations of lateral distribution of EVO substrate were limited to the 15 feet between the injection wells at each target treatment zone. Lateral distribution of EVO substrate was at least 15 feet.

- Geochemical parameters indicate that both the EVO and the EVO and ferrous sulfate injections have generated the anaerobic conditions necessary for reductive dechlorination. There is some indication within the deep perched aquifer, such as increasing ORP and decreasing TOC concentrations, that geochemical conditions in the deep perched aquifer are becoming less favorable to biodegradation of TCE.

- Both the EVO (AP-4550) and the EVO and ferrous sulfate (AP-3983R and AP-4551) injections have resulted in the TCE concentration at each performance monitoring well being reduced by over 99 percent (current TCE concentrations are slightly above the MCL of 5 µg/L—see Tables 4-1, 4-3, and 4-5). Additionally, TCE concentrations were also reduced by over 99 percent at a shallow downgradient monitoring well (AP-3989) that is located approximately 100 feet downgradient of the nearest shallow injection wells.

- ERD appears to be the primary method of dechlorination, even in areas where EVO and ferrous sulfate were injected. While BiRD may also be occurring, various lines of evidence that indicate that it is occurring to a significantly lesser degree (if at all) than ERD include the following:

  - Geochemical reactions that occur during BiRD do not produce daughter products.

  - High concentrations of TCE daughter products have been produced at all three target treatment zones corresponding to the substantial decrease in TCE concentrations. (Geochemical reactions that occur during BiRD do not create daughter products.)

  - Concentrations of TCE daughter products have begun to decrease at AP-4550 (EVO only injection), indicating that an appropriate microbial population and reducing conditions are present for complete reduction of CAHs.

- Concentrations of TCE daughter products have not yet begun to decrease at AP-3983R and AP-4551 (EVO and ferrous sulfate injection). It is likely that the addition of ferrous sulfate to the subsurface environment has slowed the development of reducing conditions. However, the results at AP-4550 indicate that the appropriate microbial population is present in the subsurface for complete reduction of CAHs, and reduction of TCE daughter products is anticipated at both AP-3983R and AP-4550. The production of vinyl chloride and ethene at all three target treatment zones also indicates that a microbial consortium is present that is capable of facilitating complete dechlorination.

- EVO-only injections appear to be more successful in the short term at reducing concentrations of TCE and TCE daughter products than the EVO + ferrous sulfate mixture used during the treatability study.

This page intentionally left blank.

6.0 RECOMMENDATIONS

Based on the results of this treatability study report, the following actions are recommended:

- Two years of annual groundwater monitoring (2015 and 2016) to assess potential rebound of TCE concentrations, degradation of TCE daughter products, and persistence of reducing groundwater conditions. The annual groundwater monitoring at CG039 will be modified to better monitor the progress of the treatability study. All requirements of the 2011 *Memorandum to the Site File for OUB/Poleline Road Disposal Area* (Memo to Site File) will continue to be monitored. Analytical and field parameters will be added as necessary so that the treatability study wells (AP-3744, AP-3747, AP-3983R, AP-3989, AP-4550, and AP-4551) continue to be monitored as outlined in Table 18-1 of the Work Plan. The annual sampling will be modified as follows:

  - Five wells will be sampled annually as prescribed by the Memo to Site File: AP-3748, AP-4344, AP-4353, AP-5246, and AP-5683 (AP-4019R).

  - Two wells identified for annual sampling in the Memo to Site File will still be sampled, although for the treatability study parameters listed in Table 18-1 of the Work Plan: AP-3747 and AP-4550.

  - Two wells identified as Sentinel Wells to be sampled in the year preceding the Five-Year Review (2017) will also be sampled in 2015 and 2016 for the treatability study parameters listed in Table 18-1 of the Work Plan: AP-3744 and AP-3989.

  - Three wells that are not identified to be sampled in the Memo to Site File, either annually or every 5 years, will be sampled in 2015 and 2016 for the treatability study parameters listed in Table 18-1 of the Work Plan: AP-3983R, AP-4525, and AP-4551.

- The 2015 and 2016 groundwater monitoring work plans will formally outline this plan.

- The monitoring results from the seven wells (AP-3744, AP-3747, AP-3983R, AP-3989, AP-4525, AP-4550, and AP-4551) to be sampled for the treatability study parameters will be reported in a distinct section of the annual groundwater monitoring report.

This page intentionally left blank.

7.0 REFERENCES

Air Force Center for Engineering and the Environment (AFCEE). 2002. *Aqueous and Mineral Intrinsic Bioremediation Assessment (AMIBA) Protocol*. Prepared by Earth Science Services and Rowan University.

Butler, E.C. and K. F. Hayes. 2001. *Factors Influencing rates and Products in the Transformation of Trichloroethylene by Iron Sulfide and Iron Metal.* Environmental Science & Technology, Vol. 35 (19): 3884-3891.

Christ, J.A., C.A. Ramsburg, L.M. Abriola, K.D. Pennell, and F.E Loffler. 2005. *Coupling Aggressive Mass Removal with Microbial Reductive Dechlorination for Remediation of DNAPL Source Zones: A Review and Assessment.* Environmental Health Perspectives. Vol. 113, No. 4. Pp. 465-477.

United States Air Force (USAF). 2013a. *Uniform Federal Policy-Quality Assurance Project Plan, CG039 – Poleline Road Disposal Area Treatability Study Work Plan, Joint Base Elmendorf-Richardson, Alaska.* Final. September.

United States Air Force (USAF). 2013b. *Basewide Uniform Federal Policy-Quality Assurance Project Plan.* Joint Base Elmendorf-Richardson. Final. March.

United States Air Force (USAF). 2014. *Treatability Study Implementation Report, CG039 – Poleline Road Disposal Area, Joint Base Elmendorf-Richardson, Alaska.* Final. June.

United States Army Directorate of Public Works (DPW). 2008. *Five-Year Review Report, Second Five-Year Review for Fort Richardson, Alaska.* February.

United States Army. 1997. *Final Record of Decision for Operable Units A and B, Fort Richardson Anchorage, Alaska*. August.

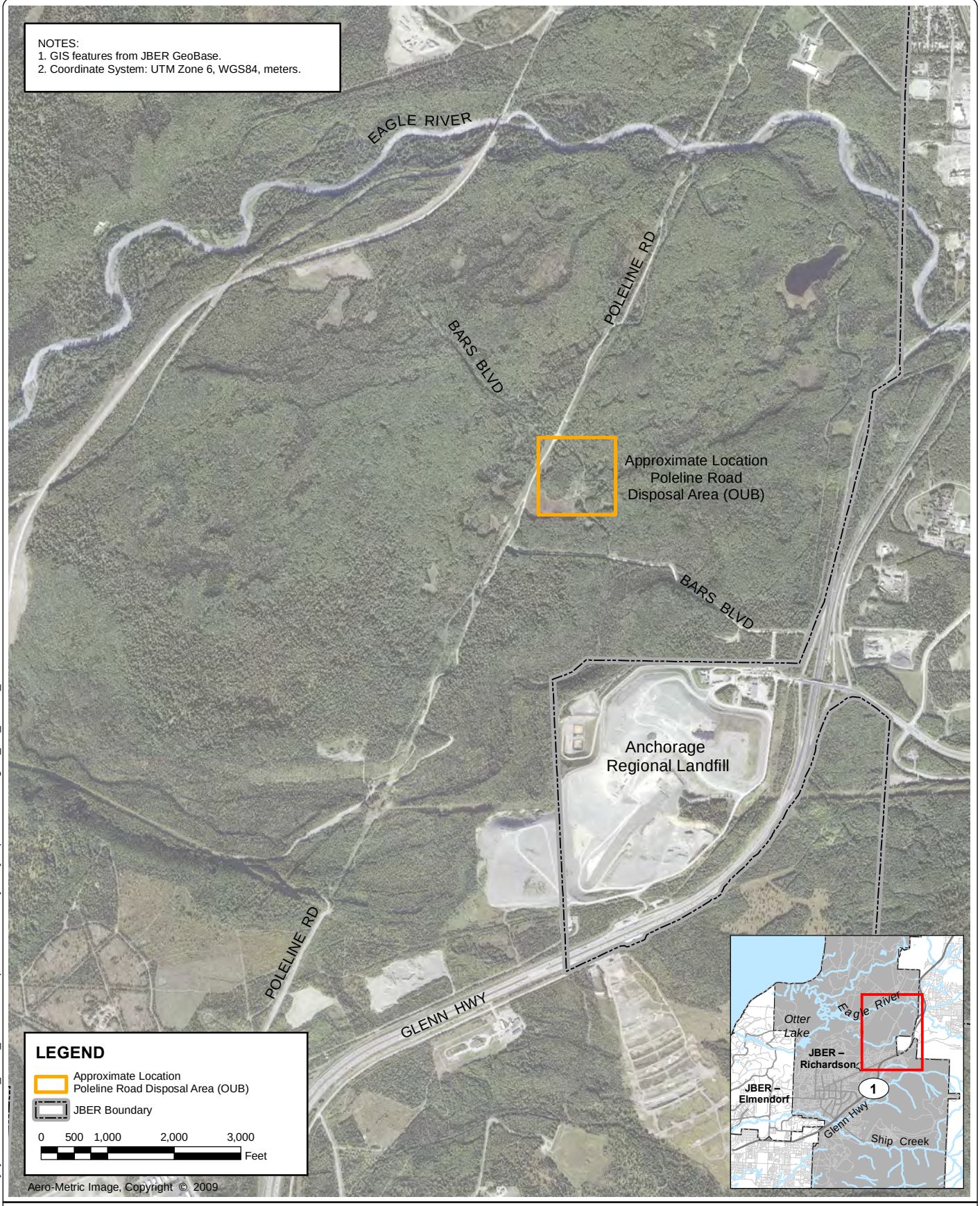
United States Environmental Protection Agency (EPA). 2000. *_Engineered Approaches to In Situ Bioremediation of Chlorinated Solvents: Fundamentals and Field Applications.* Office of Solid Waste and Emergency Response. EPA 542-R-00-008. July.

Wiedemeier, T.H., H.S. Rifai, C.J. Newell, and J.T. Wilson, 1999. *Natural Attenuation of Fuels and Chlorinated Solvents in the Subsurface.* New York: John Wiley and Sons.

This page intentionally left blank.

Figures

This page intentionally left blank.



Date: 18 Nov 2014 Drawn by: jcarr R:\AFCEE_JBER_20001102\MapFiles\TreatabilityStudyReport\CG039\Figure_1-1_CG039_SiteLocation.mxd

N
W E
S

SITE LOCATION

Figure
1-1

Treatability Study Report
CG039 - Poleline Road Disposal Area
Joint Base Elmendorf-Richardson, Alaska

NOTES:
1. Coordinate System: UTM Zone 6, WGS84, meters.
2. **Bold blue** = regulatory exceedance when compared against RAO or MCL, EPA 40 CFR 141/143, ADEC 18AAC75, and ADEC 18AAC80.
3. Approximate groundwater flow directions were based on 2013 Long-Term Monitoring groundwater elevation data.
4. Groundwater plume contoured using historical (October 2009 through September 2012) TCE groundwater data at each monitoring well. August 2013 baseline TCE concentrations (pre-injection) are displayed.
5. EVO = emulsified vegetable oil
   MCL = maximum contaminant level
   ROI = Radius of Influence
   TCE = trichloroethene
   µg/L = micrograms per liter

BARS BOULEVARD

AP-4352

AP-3747

AP-3983R
TCE (µg/L) 1,880

AP-3744

AP-3982

IW-02-3983
TCE (µg/L) 1,160

AP-3989

AP-3746

Area A-4

IW-01-3983
TCE (µg/L) 987

AP-4550
TCE (µg/L) 1,500

AP-4347

AP-3984

IW-01-4550
TCE (µg/L) 1,330

Area A-3

Area A-2

Area A-1

AP-3985

IW-02-4550
TCE (µg/L) 3,200

AP-3745

AP-3981

AP-4354

AP-4518

AP-4353

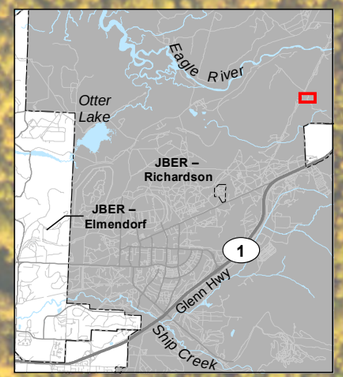
AP-4519

LEGEND

- Monitoring Well Location (Shallow)
- Injection Well Location
- ROI Well
- Disposal Area
- Building (Facility ID)
- General Groundwater Flow Direction (Approximate)

TCE Contour Interval

- 5 to 100 µg/L
- 100 to 500 µg/L
- 500 to 1000 µg/L
- 1000 to 2000 µg/L
- Greater than 2000 µg/L
- Approximate Area of EVO Distribution - Shallow - AP-4550
- Approximate Area of EVO Distribution - Shallow - AP-3983



N W E S

0 50 100 200 300 Feet

BASELINE TCE CONCENTRATIONS AND EVO DISTRIBUTION - SHALLOW AQUIFER

Figure **1-2**

Treatability Study Report
CG039 – Poleline Road Disposal Area
Joint Base Elmendorf-Richardson, Alaska

Date: 16 Dec 2014 Drawn by: lclark R:\AFCEE_JBER_20001102\MapFiles\TreatabilityStudyReport\CG039\Figure_1-2_CG039_BaselineShallow_TCE_EVODistribution.mxd

NOTES:
1. Coordinate System: UTM Zone 6, WGS84, meters.
2. **Bold blue** = regulatory exceedance when compared against RAO or MCL, EPA 40 CFR 141/143, ADEC 18AAC75, and ADEC 18AAC80.
3. Groundwater plume contoured using historical (October 2009 through September 2012) TCE groundwater data at each monitoring well. August 2013 baseline TCE concentrations (pre-injection) are displayed.
4. EVO = emulsified vegetable oil
   J = estimated quantity
   MCL = maximum contaminant level
   TCE = trichloroethene
   µg/L = micrograms per liter

AP-4344

AP-3748

AP-5683 (AP-4019R)

AP-4019

AP-4525

AP-4011

Area A-4

AP-4551
TCE (µg/L) 2,300

IW-01-4551
TCE (µg/L) 2,690 J

Area A-2

Area A-1

IW-02-4551
TCE (µg/L) 2,640

Area A-3

AP-4017

AP-4353

AP-4349

POLE LINE ROAD

LEGEND

- Monitoring Well Location (Deep)
- Injection Well Location
- Disposal Area
- Building (Facility ID)
- General Groundwater Flow Direction (Approximate)

TCE Contour Interval

- 5 to 100 µg/L
- 100 to 500 µg/L
- 500 to 1000 µg/L
- 1000 to 2000 µg/L
- Greater than 2000 µg/L
- Approximate Area of EVO Distribution - Deep

N W E S

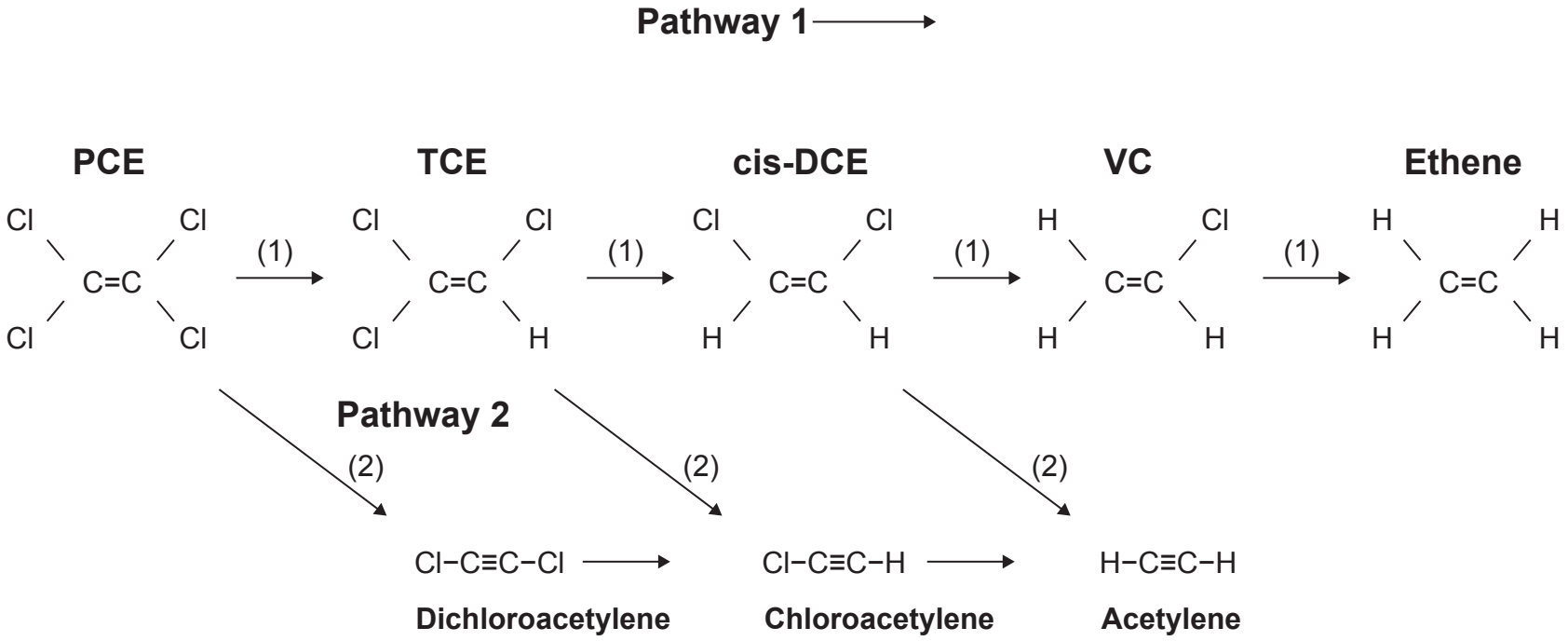
0 50 100 200 300 Feet

BASELINE TCE CONCENTRATIONS AND EVO DISTRIBUTION - DEEP PERCHED AQUIFER

Figure **1-3**

Treatability Study Report
CG039 – Poleline Road Disposal Area
Joint Base Elmendorf-Richardson, Alaska

Date: 16 Dec 2014 Drawn by: lclark R:\AFCEE_JBER_20001102\MapFiles\TreatabilityStudyReport\CG039Figure_1-3_CG039_BaselineDeep_TCE_EVODistribution.mxd



Pathways for (1) Biotic Reduction of Chlorinated Ethenes and (2) Abiotic Reduction by Iron Sulfide

Modified from Butler and Hayes, 2001

BIOTIC AND ABIOTIC REDUCTIVE DECHLORINATION PATHWAYS

Figure **2-1**

Treatability Study Report
CG039 - Poleline Road Disposal Area
Joint Base Elmendorf-Richardson, Alaska

ES062612224557SAC CG039_Figure_2-1_V2.ai tdaus 12.15.2014

NOTES:
1. Coordinate System: UTM Zone 6, WGS84, meters.
2. **Bold** = regulatory exceedance when compared against RAO or MCL, EPA 40 CFR 141/143, ADEC 18AAC75, and ADEC 18AAC80. Cleanup Levels TCE = 5 µg/L (MCL); PCE = 5 µg/L (MCL); cis-1,2-DCE = 70 µg/L (MCL); 1,1-DCE = 7 µg/L (MCL); trans-1,2-DCE = 100 µg/L (MCL) Vinyl chloride = 2 µg/L (MCL)
3. Approximate groundwater flow directions were based on 2014 Long-Term Monitoring groundwater elevation data.
4. Groundwater plume contoured using September 2014 TCE groundwater data where available. In the absence of September 2014 data, the most recent TCE groundwater result was used.
5. DCE = dichloroethene
   J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
   MCL = maximum contaminant level
   PCE = tetrachloroethene
   ROI = Radius of Influence
   TCE = trichloroethene
   U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
   µg/L = micrograms per liter

AP-3983R (µg/L)

Date	PCE	TCE	cis-1,2-DCE	1,1-DCE	trans-1,2-DCE	Vinyl Chloride	Ethene
10/15/2009		**2320**					
8/15/2013	**30.5**	**1880**	**180**	3.88	62	0.25 U	0.0682
10/16/2013	**20.9**	**1820**	**207**	3.62	71.4	0.32 J	0.252 J
1/15/2014	**27.8**	**1190**	**1470**	6.71	**113**	**14.1**	0.253 J
4/15/2014	3.44 J	**118**	**2260**	6.74	99.9	**16.5**	0.501
9/9/2014	0.79	**12.4**	**4070**	**8.12**	98.8	**43.7**	2.36

AP-4550 (µg/L)

Date	PCE	TCE	cis-1,2-DCE	1,1-DCE	trans-1,2-DCE	Vinyl Chloride	Ethene
10/15/2009		**2260**					
8/16/2013	**29.3**	**1500**	**160**	4.05	58.4	0.28 U	0.0407
10/15/2013	**8.76**	**822**	**115**	1.94 J	38.6	1.25 U	0.537
1/16/2014	1.68	**34.9**	**2040**	**7.94**	62.2	**40.3**	1.29
4/15/2014	1.5	**6.89**	**1130**	3.94	37.5	**11.1**	0.261 J
9/9/2014	0.52	**10.6**	**924**	3.14	31.8	**5.25**	0.303 J

AP-3989 (µg/L)

Date	PCE	TCE	cis-1,2-DCE	1,1-DCE	trans-1,2-DCE	Vinyl Chloride	Ethene
9/26/2012	4.1	**610**	**83**	1.7 J	26	1.6 U	0.64 U
9/9/2014	0.3 U	2.47	**1250**	3.2	39.9	**8.71**	0.368 J

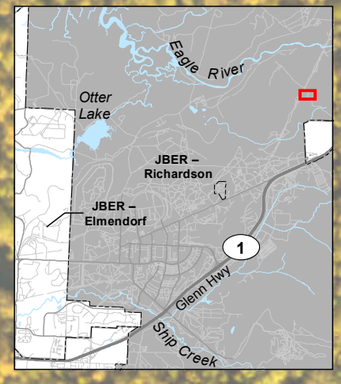
AP-3747 (µg/L)

Date	PCE	TCE	cis-1,2-DCE	1,1-DCE	trans-1,2-DCE	Vinyl Chloride	Ethene
9/25/2012	0.87 J	**88**	5.1	0.33 J	1.7	0.8 U	0.64 U
9/9/2014	1.96	**209**	13.4	0.79	3.17	0.3 U	0.119 U

AP-3744 (µg/L)

Date	PCE	TCE	cis-1,2-DCE	1,1-DCE	trans-1,2-DCE	Vinyl Chloride	Ethene
9/25/2012	0.4 U	**42**	1.5	0.2 U	0.38 J	0.8 U	0.64 U
9/9/2014	0.33 J	**47.2**	13.7	0.3 U	0.82	0.3 U	0.118 U

AP-4352
AP-3982
AP-4347
IW-02-3983
IW-01-3983
AP-3746
AP-3984
IW-01-4550
AP-3985
AP-3981
AP-4354
AP-4353
AP-4519
AP-4518
AP-3745
IW-02-4550
Area A-1
Area A-2
Area A-3
Area A-4
BARS BOULEVARD



LEGEND
- Monitoring Well Location (Shallow)
- Injection Well Location
- ROI Well
- Disposal Area
- Building (Facility ID)
- General Groundwater Flow Direction (Approximate)

TCE Contour Interval
- 5 to 100 µg/L
- 100 to 500 µg/L

N W E S

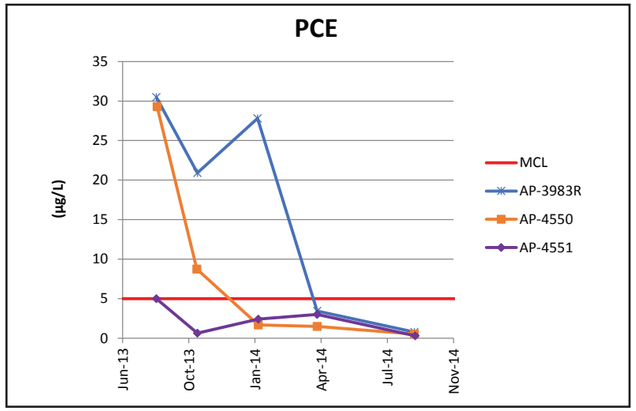
0 50 100 200 300 Feet

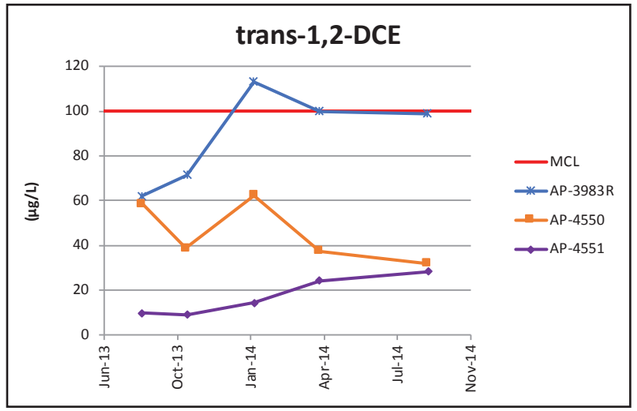
TREATABILITY STUDY RESULTS - SHALLOW AQUIFER

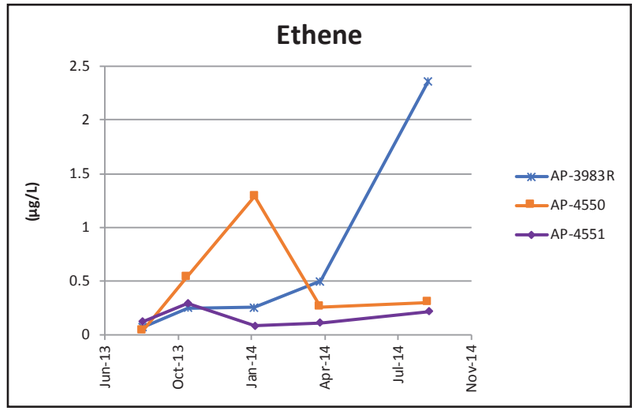
Treatability Study Report
CG039 – Poleline Road Disposal Area
Joint Base Elmendorf-Richardson, Alaska

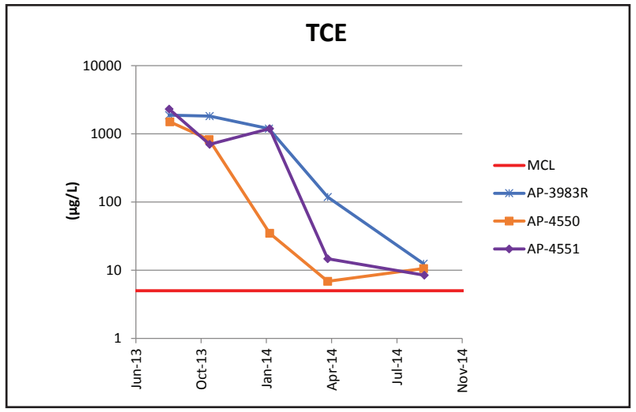
Figure **4-1**

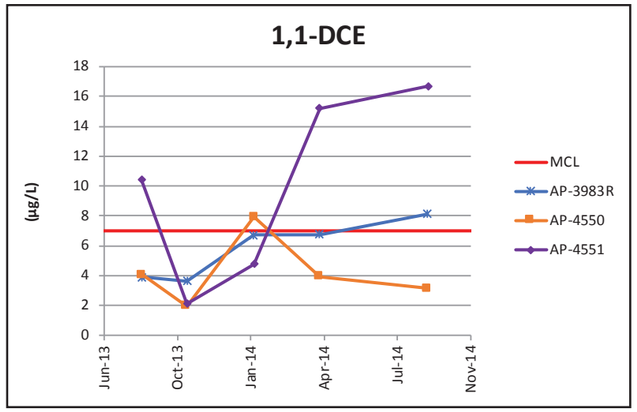
Date: 16 Dec 2014 Drawn by: lclark R:\AFCEE_JBER_20001102\MapFiles\TreatabilityStudyReport\CG039\Figure_4-1_CG039_ShallowAquifer

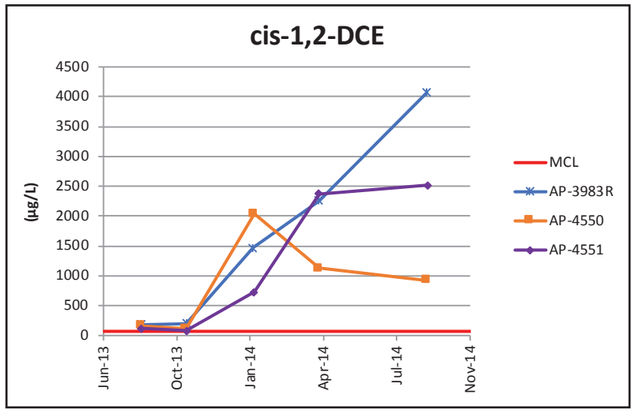


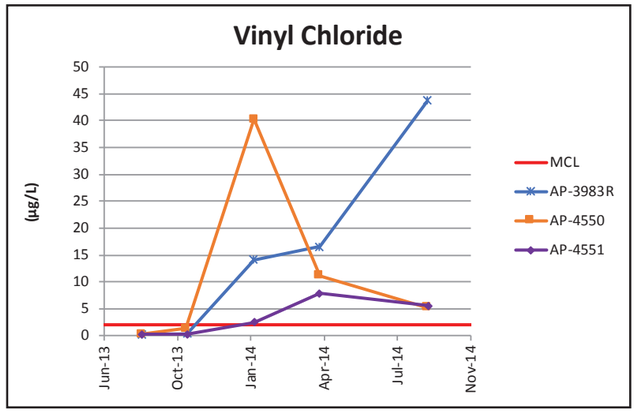










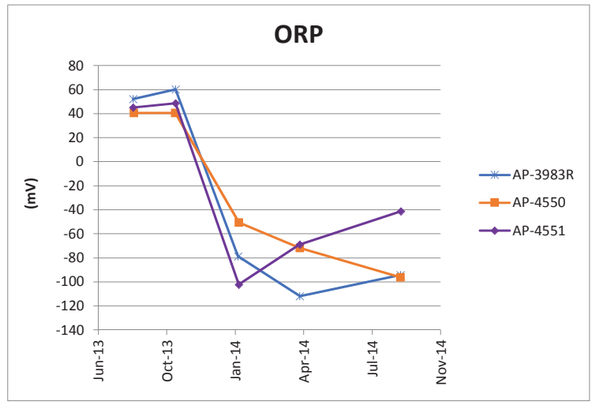


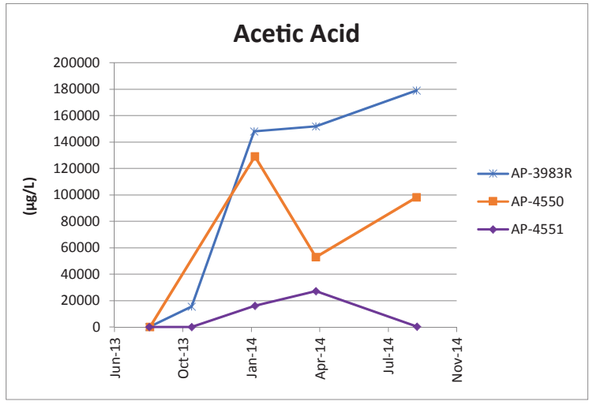
ES062612224557SAC CG039_Figure_4-2.ai tdaus 03.30.2015

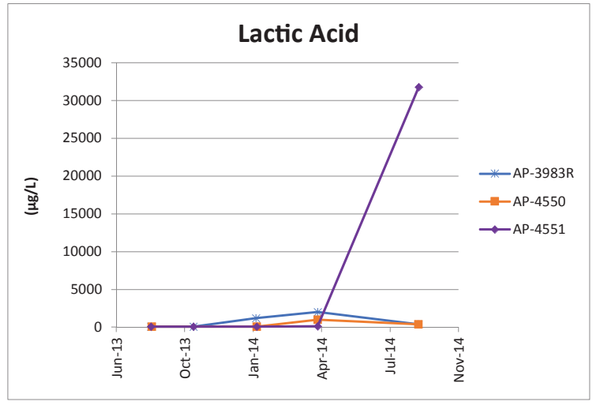
CHLORINATED ALIPHATIC HYDROCARBON CONCENTRATION TRENDS

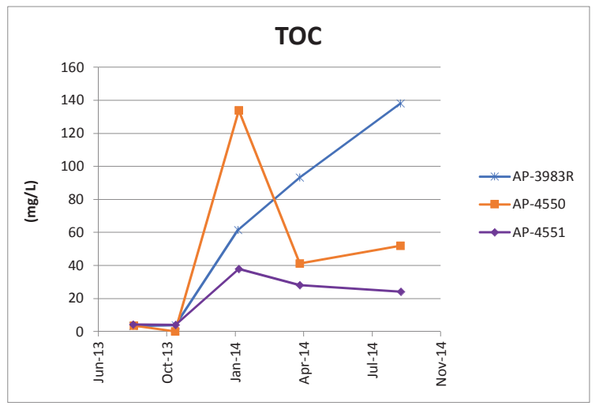
Treatability Study Report
CG039 - Poleline Road Disposal Area
Joint Base Elmendorf-Richardson, Alaska

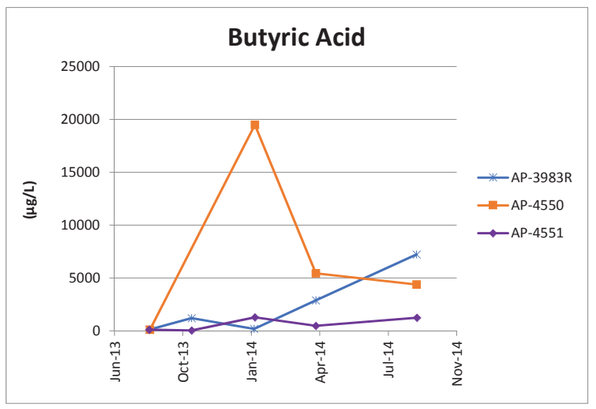
Figure
4-2

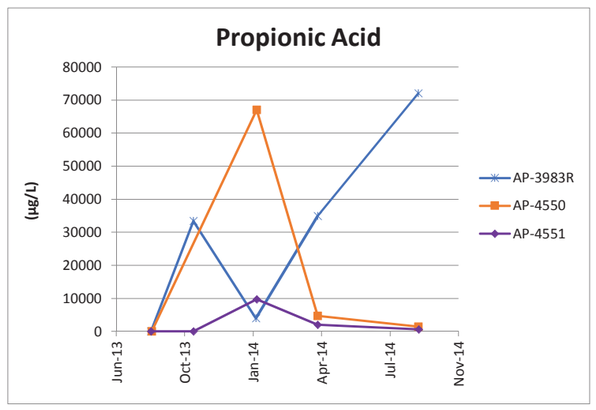


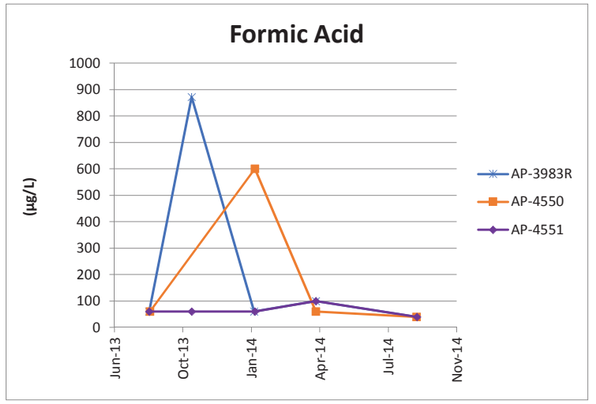


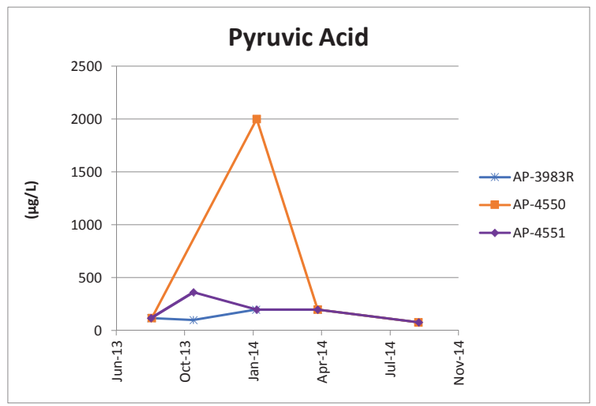










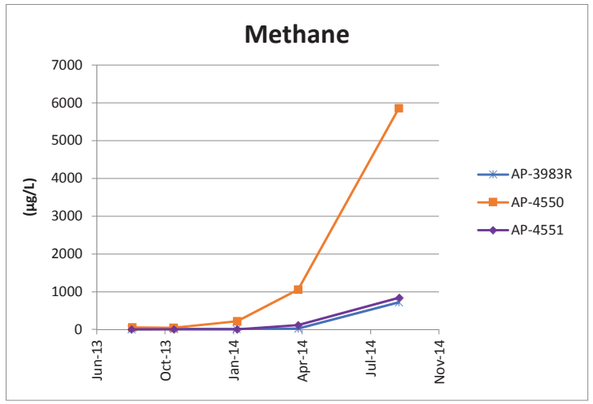


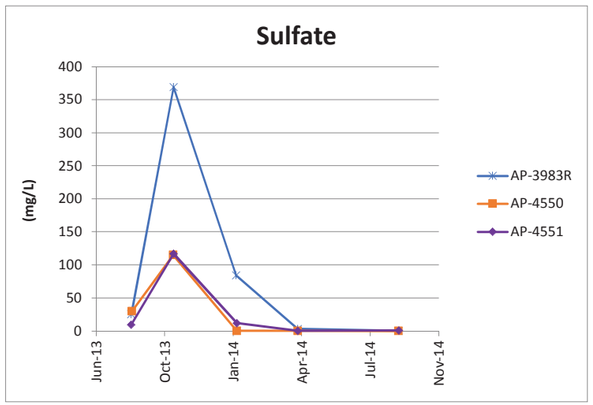
ES062612224557SAC CG039_Figure_4-3.ai idaus 12.15.2014

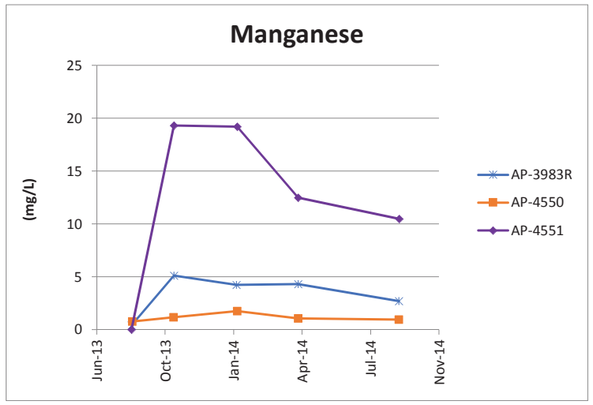
GEOCHEMICAL PARAMETER CONCENTRATION TRENDS

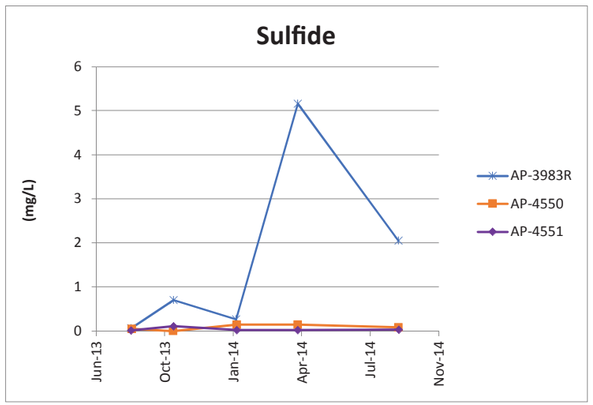
Treatability Study Report
CG039 - Poleline Road Disposal Area
Joint Base Elmendorf-Richardson, Alaska

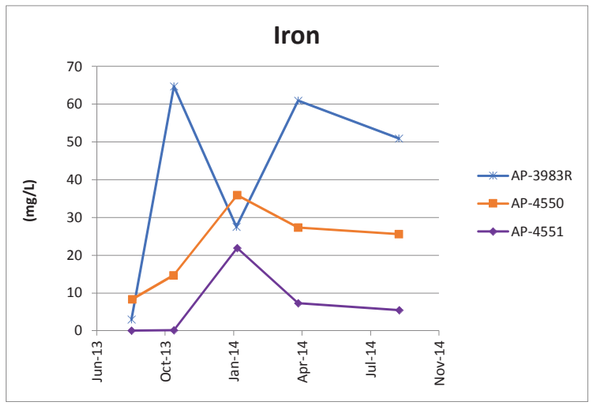
Figure
4-3

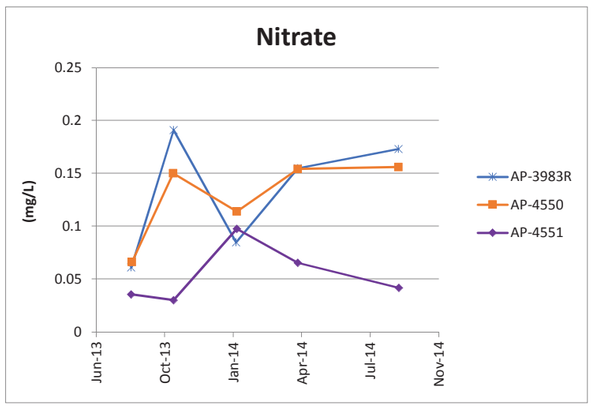












ES062612224557SAC CG039_Figure_4-3.ai tdaus 12.15.2014

GEOCHEMICAL PARAMETER CONCENTRATION TRENDS

Treatability Study Report
CG039 - Poleline Road Disposal Area
Joint Base Elmendorf-Richardson, Alaska

Figure
4-3 Cont.

NOTES:
1. Coordinate System: UTM Zone 6, WGS84, meters.
2. **Bold** = regulatory exceedance when compared against RAO or MCL, EPA 40 CFR 141/143, ADEC 18AAC75, and ADEC 18AAC80. Cleanup Levels TCE = 5 µg/L (MCL); PCE = 5 µg/L (MCL); cis-1,2-DCE = 70 µg/L (MCL); 1,1-DCE = 7 µg/L (MCL); trans-1,2-DCE = 100 µg/L (MCL) Vinyl chloride = 2 µg/L (MCL)
3. Groundwater plume contoured using September 2014 TCE groundwater data where available. In the absence of September 2014 data, the most recent TCE groundwater result was used.
4. DCE = dichloroethene
   J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
   MCL = maximum contaminant level
   PCE = tetrachloroethene
   TCE = trichloroethene
   U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
   µg/L = micrograms per liter

AP-4551 (µg/L)

Date	PCE	TCE	cis-1,2-DCE	1,1-DCE	trans-1,2-DCE	Vinyl Chloride	Ethene
10/15/2009		**1810**					
8/15/2013	5	**2300**	**113**	**10.4**	9.59	0.25 U	0.123
10/16/2013	0.64	**698**	**82.7**	2.11	8.92	0.25 U	0.293 J
1/16/2014	2.42	**1190**	**730**	4.76	14.2	**2.43**	0.0858 J
4/15/2014	3 U	**14.7**	**2370**	**15.2**	24.1	**7.87**	0.115 J
9/10/2014	0.3 U	**8.43**	**2520**	**16.7**	28.2	**5.55**	0.219 J

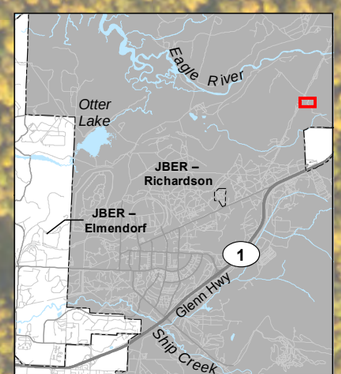
AP-4344
AP-3748
AP-5683 (AP-4019R)
AP-4019
AP-4525
AP-4011
Area A-4
Area A-2
Area A-1
IW-01-4551
IW-02-4551
Area A-3
AP-4017
AP-4353
AP-4349
POLE LINE ROAD

LEGEND

- Monitoring Well Location (Deep)
- Injection Well Location
- Disposal Area
- Building (Facility ID)
- General Groundwater Flow Direction (Approximate)

TCE Contour Interval

- 5 to 500 µg/L
- > 500 µg/L



N W E S

0 50 100 200 300 Feet

TREATABILITY STUDY RESULTS - DEEP PERCHED AQUIFER

Treatability Study Report
CG039 – Poleline Road Disposal Area
Joint Base Elmendorf-Richardson, Alaska

Figure
4-4

Date: 16 Dec 2014 Drawn by: lclark R:\AFCEE_JBER_20001102\MapFiles\TreatabilityStudyReport\CG039\Figure_4-4_CG039_DeepAquiferResults.mxd

A

A'

AP-4354
AP-4353
AP-3985
INJECTION WELLS
AP-4550
AP-4551
HILL
INJECTION WELLS
AP-3983R
AP-3989
AP-4525
AP-4019
AP-3747

Wetland
Peat
No Contamination

Shallow Aquifer

Intermediate Aquitard
(Dense matrix of silts, sands, and gravels with perched zones of saturation)

Deep Perched Aquifer

Bedrock

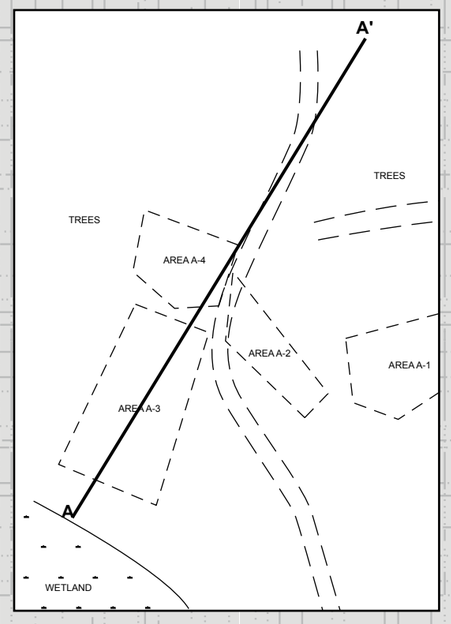
Bedrock

Elevation (Feet)

370
340
310
280
250
220
190
160
130
100

0 50 100 150 200 250 300 350 400 450 500 550 600 650 700

Longitudinal Scale (Feet)



Interpreted Groundwater Flow Direction
Low Permeability Lens
Potentiometric Surface

Note: This site model is conceptual, and based on site data, interpreted data, and professional judgement. Therefore, the contaminated zones and geologic features depicted in this figure should be used only for conceptual purposes.

µg/L = micrograms per liter

TCE Contour Interval (September 2014)

- 5 to 100 µg/L
- 100 to 500 µg/L
- 500 to 1,000 µg/L
- > 1,000 µg/L

ES062612224557SAC CG039_Figure_4-5_V2.ai tdaus 03.30.2015

CONCEPTUAL SITE MODEL

Treatability Study Report
CG039 - Poleline Road Disposal Area
Joint Base Elmendorf-Richardson, Alaska

Figure
4-5

Appendix A
Field Documentation

This page intentionally left blank.

Appendix A-1
Soil Boring Logs and Well Completion Diagrams

This page intentionally left blank.

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-AP-3983R	SHEET 1 OF 2

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668400.78 EASTING (NAD83 SPZN4 feet):1708835.23 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 304.82 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/15/13 09:30 END : 7/15/13 15:10 LOGGER : Seay/Horn

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	0.0				**SILT (OL)**, gray, low plasticity; fine, dry, very soft, very loose.		
5							
10							
	13.0				**SILTY GRAVEL (GM)**, gray, low plasticity; fine, dry, very soft, angular, loose.		Began with fines, ended with angular gravel
15							
	18.0				**SILTY GRAVEL (GM)**, grayish brown, low plasticity; cobbles, dry, very soft, angular, loose.		
20							
	23.0				**SILTY GRAVEL (GM)**, gray, low plasticity; cobbles, dry, very soft, angular, loose.		
25							groundwater encountered at 25 feet bgs
	28.0				**GRAVEL (GP)**, gray, cobbles, wet, angular, loose.		In water
30							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-AP-3983R	SHEET 2 OF 2

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668400.78 EASTING (NAD83 SPZN4 feet):1708835.23 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 304.82 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/15/13 09:30 END : 7/15/13 15:10 LOGGER : Seay/Horn

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
					GRAVEL (GP), gray, cobbles, wet, angular, loose.(Soil Description Repeated)		
	33.0				**GRAVEL (GP)**, grayish brown, cobbles, dry, angular, loose.		fractured, some fines
35							
	38.0				**GRAVEL (GP)**, grayish brown, cobbles, dry, angular, loose.		
40							
	41.0						Boring terminated at 41 feet
45							
50							
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
457958.09.JD.02	CG039-IW-01-3983R SHEET 1 OF 2

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668458.72 EASTING (NAD83 SPZN4 feet):1708849.70 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 304.17 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/16/13 16:08 END : 7/17/13 18:00 LOGGER : Seay

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	0.0				**GRAVELLY SAND (SP)**, grayish brown, coarse, dry, angular, loose.		rock fragments
5							
10	10.0				**GRAVELLY SAND (SP)**, grayish brown, coarse, dry, angular, loose.		rock fragments
15	15.0				**GRAVELLY SAND (SP)**, grayish brown, coarse, moist, angular, medium dense.		rock fragments
20	20.0				**GRAVELLY SAND (SP)**, grayish brown, low plasticity; coarse, moist, stiff, angular, very dense.		rock fragments, some clay, groundwater encountered at 20 feet bgs
25	25.0				**GRAVELLY SAND (SP)**, gray, low plasticity; coarse, wet, soft, angular, very dense.	13Q2CG039-IW01398301-SO-0	rock fragments, silt lenses at 23 and 25 feet bgs
30							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
457958.09.JD.02	CG039-IW-01-3983R SHEET 2 OF 2

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668458.72 EASTING (NAD83 SPZN4 feet):1708849.70 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 304.17 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/16/13 16:08 END : 7/17/13 18:00 LOGGER : Seay

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	30.0				**GRAVELLY SAND (SP)**, gray, coarse, wet, angular, very dense.		rock fragments, organic matter
						13Q2CG039-IW01398302-SO-0	
35	35.0				**GRAVELLY SAND (SP)**, gray, coarse, wet, angular, very dense.		weathered bedrock, rock fragments, organic matter
						13Q2CG039-IW01398303-SO-0	
40	40.0						Boring terminated at 41 feet
45							
50							
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-IW-01-4550	SHEET 1 OF 2

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668396.00 EASTING (NAD83 SPZN4 feet):1708820.74 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 305.69 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/19/13 13:16 END : 7/20/13 13:45 LOGGER : Seay/Frame

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	0.0				**SANDY GRAVEL (GP)**, grayish brown, dry, loose.		Lead rod
5	5.0				**SANDY GRAVEL (GP)**, grayish brown, low plasticity; cobbles, dry, soft, angular, loose.		Lots of fines, compact silt
10	10.0				**SILTY SAND (SM)**, grayish brown, low plasticity; fine, dry, soft, rounded, loose.		
15	15.0				**GRAVELLY SILT (OL)**, grayish brown, low plasticity; cobbles, dry, soft, angular, loose.		rock fragments
20	20.0				**GRAVEL (GP)**, grayish brown, cobbles, wet, angular, loose.		rock fragments
25	25.0				**GRAVEL (GP)**, grayish brown, cobbles, wet, angular, loose.		rock fragments, groundwater encountered at 25 feet bgs
30							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-IW-01-4550	SHEET 2 OF 2

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668396.00 EASTING (NAD83 SPZN4 feet):1708820.74 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 305.69 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/19/13 13:16 END : 7/20/13 13:45 LOGGER : Seay/Frame

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	30.0				**SANDY GRAVEL (GP)**, grayish brown, low plasticity, moist, stiff, angular, dense.		rock fragments, some oxidation, clays throughout interval
35	35.0				**SANDY GRAVEL (GP)**, grayish brown, low plasticity; cobbles, moist, stiff, angular, dense.	13Q2CG039-IW01398303-SO-0	rock fragments, silty clay lenses throughout interval, oxidation throughout
40	40.0				**SANDY GRAVEL (GP)**, grayish brown, moist, angular, dense.	13Q2CG039-IW01455003-SO-1	rock fragments, oxidation throughout
45	45.0						Boring terminated at 45 feet
50							
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-IW-01-4551	SHEET 1 OF 4

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668393.37 EASTING (NAD83 SPZN4 feet):1708830.55 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 305.66 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/22/13 10:00 END : 7/24/13 10:00 LOGGER : Seay/Frame

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	0.0				**GRAVELLY SILT (OL)**, grayish brown, low plasticity; fine, dry, stiff, rounded, loose.		Lead rod
5	5.0				**SILT (OL)**, grayish brown, low plasticity; fine, dry, stiff, rounded, loose.		rock fragments
10	10.0				**SILT (OL)**, grayish brown, low plasticity; fine, dry, stiff, rounded, loose.		rock fragments
15	15.0				**GRAVELLY SILT (OL)**, grayish brown, low plasticity; fine, dry, stiff, rounded, loose.		rock fragments
20	20.0				**GRAVELLY SILT (OL)**, grayish brown, low plasticity; fine, dry, stiff, rounded, loose.		rock fragments
25	25.0				**GRAVELLY SILT (OL)**, grayish brown, low plasticity; fine, dry, stiff, rounded, loose.		rock fragments
30							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-IW-01-4551	SHEET 2 OF 4

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668393.37 EASTING (NAD83 SPZN4 feet):1708830.55 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 305.66 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/22/13 10:00 END : 7/24/13 10:00 LOGGER : Seay/Frame

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	30.0				**GRAVEL (GP)**, gray, cobbles, wet, angular, loose.		rock fragments
35	35.0				**GRAVEL (GP)**, gray, cobbles, wet, angular, loose.		rock fragments
40	40.0				**GRAVEL (GP)**, grayish brown, cobbles, wet, angular, loose.		rock fragments, some fines
45	45.0				**GRAVELLY SAND (SP)**, grayish brown, cobbles, dry, angular, loose.		rock fragments
50	50.0				**SANDY GRAVEL (GP)**, grayish brown, cobbles, dry, angular, loose.		rock fragments
55	55.0				**SANDY GRAVEL (GP)**, grayish brown, cobbles, dry, angular, loose.		rock fragments
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-IW-01-4551	SHEET 3 OF 4

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668393.37 EASTING (NAD83 SPZN4 feet):1708830.55 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 305.66 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/22/13 10:00 END : 7/24/13 10:00 LOGGER : Seay/Frame

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	60.0				**SANDY GRAVEL (GP)**, grayish brown, cobbles, dry, angular, loose.		rock fragments
65	65.0				**SANDY GRAVEL (GP)**, grayish brown, cobbles, dry, angular, loose.		rock fragments
70	70.0				**SANDY GRAVEL (GP)**, grayish brown, cobbles, dry, angular, loose.		rock fragments
75	75.0				**SANDY GRAVEL (GP)**, grayish brown, cobbles, dry, angular, loose.		rock fragments
80	80.0				**SANDY GRAVEL (GP)**, grayish brown, cobbles, dry, angular, loose.		rock fragments
85	85.0				**SANDY GRAVEL (GP)**, grayish brown, cobbles, dry, angular, loose.		rock fragments
90							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-IW-01-4551	SHEET 4 OF 4

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668393.37 EASTING (NAD83 SPZN4 feet):1708830.55 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 305.66 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/22/13 10:00 END : 7/24/13 10:00 LOGGER : Seay/Frame

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	90.0				**SANDY GRAVEL (GP)**, grayish brown, cobbles, dry, angular, loose.		rock fragments, sand lense bottom interval, moisture at 93 feet bgs
95	96.0						Boring terminated at 96 feet
100							
105							
110							
115							
120							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-IW-02-3983R	SHEET 1 OF 2

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668464.46 EASTING (NAD83 SPZN4 feet):1708836.71 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 304.30 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/18/13 13:12 END : 7/19/13 09:50 LOGGER : Seay

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	0.0				**SILT (OL)**, grayish brown, low plasticity; fine, dry, stiff, rounded, dense.		
5	5.0				**SILT (OL)**, grayish brown, low plasticity; fine, dry, stiff, rounded, dense.		
10	10.0				**SILT (OL)**, grayish brown, low plasticity; fine, dry, stiff, rounded, dense.		
15	15.0				**GRAVEL (GP)**, grayish brown, coarse, moist, angular, loose.		rock fragments
20	20.0				**SANDY GRAVEL (GP)**, gray, cobbles, wet, rounded, loose.		rock fragments, groundwater encountered at 20 feet bgs
25	25.0				**SANDY GRAVEL (GP)**, gray, cobbles, wet, rounded, loose.		rock fragments
30							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
457958.09.JD.02	CG039-IW-02-3983R SHEET 2 OF 2

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668464.46 EASTING (NAD83 SPZN4 feet):1708836.71 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 304.30 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/18/13 13:12 END : 7/19/13 09:50 LOGGER : Seay

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	30.0				**SANDY GRAVEL (GP)**, gray, cobbles, wet, rounded, loose.		
35	35.0				**SANDY GRAVEL (GP)**, grayish brown, cobbles, dry, rounded, loose.		
40	40.0						Boring terminated at 40 feet
45							
50							
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-IW-02-4550	SHEET 1 OF 2

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668386.41 EASTING (NAD83 SPZN4 feet):1708831.85 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 305.44 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/26/13 14:00 END : 7/27/13 09:00 LOGGER : Seay

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	0.0				**SILT (OL)**, gray, low plasticity; fine, dry, soft, rounded, loose.		
5	5.0				**GRAVELLY SILT (OL)**, gray, low plasticity; fine, dry, soft, angular, loose.		rock fragments
10	10.0				**GRAVELLY SILT (OL)**, gray, low plasticity; fine, dry, soft, angular, loose.		rock fragments
15	15.0				**GRAVELLY SILT (OL)**, gray, low plasticity; fine, dry, soft, angular, loose.		rock fragments
20	20.0				**SILTY SAND (SM)**, orangeish brown, low plasticity; fine, moist, soft, rounded, loose.		groundwater encountered at 23 feet bgs
25	25.0				**GRAVEL (GP)**, gray, cobbles, wet, angular, loose.		rock fragments, some fines
30							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-IW-02-4550	SHEET 2 OF 2

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668386.41 EASTING (NAD83 SPZN4 feet):1708831.85 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 305.44 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/26/13 14:00 END : 7/27/13 09:00 LOGGER : Seay

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	30.0				**GRAVELLY SILT (OL)**, gray, low plasticity; fine, wet, soft, rounded, medium dense.		rock fragments
35	35.0				**SILTY GRAVEL (GM)**, grayish brown, low plasticity; cobbles, moist, hard, angular, loose.	13Q2CG039-IW02-455101-SC-0	rock fragments
40	40.0				**SILTY GRAVEL (GM)**, grayish brown, low plasticity; cobbles, dry, hard, angular, loose.		rock fragments
45	45.0						Boring terminated at 45 feet
50							
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-IW-02-4551	SHEET 1 OF 4

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668385.33 EASTING (NAD83 SPZN4 feet):1708842.58 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 304.64 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/24/13 14:29 END : 7/26/13 09:10 LOGGER : Seay

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	0.0				**GRAVELLY SILT (OL)**, grayish brown, low plasticity; cobbles, dry, soft, angular, loose.		rock fragments, lead rod
5	5.0				**SILTY GRAVEL (GM)**, grayish brown, low plasticity; cobbles, dry, soft, angular, loose.		rock fragments
10	10.0				**SILTY GRAVEL (GM)**, grayish brown, low plasticity; cobbles, dry, soft, angular, loose.		rock fragments
15	15.0				**GRAVELLY SILT (OL)**, gray, low plasticity; cobbles, dry, soft, angular, loose.		rock fragments
20	20.0				**SILTY GRAVEL (GM)**, grayish black, low plasticity; cobbles, moist, soft, angular, loose.		rock fragments
25	25.0				**SILTY GRAVEL (GM)**, grayish black, low plasticity; cobbles, wet, soft, angular, loose.		rock fragments
30							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-IW-02-4551	SHEET 2 OF 4

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668385.33 EASTING (NAD83 SPZN4 feet):1708842.58 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 304.64 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/24/13 14:29 END : 7/26/13 09:10 LOGGER : Seay

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	30.0				**SILTY GRAVEL (GM)**, gray, low plasticity; cobbles, moist, soft, angular, loose.		rock fragments
35	35.0				**GRAVELLY SILT (OL)**, grayish brown, low plasticity; cobbles, moist, soft, angular, loose.		rock fragments
40	40.0				**GRAVELLY SILT (OL)**, grayish brown, low plasticity; cobbles, dry, soft, angular, loose.		rock fragments
45	45.0				**GRAVELLY SILT (OL)**, grayish brown, low plasticity; cobbles, dry, soft, angular, loose.		rock fragments
50	50.0				**GRAVEL (GP)**, grayish brown, cobbles, dry, angular, loose.		rock fragments
55	55.0				**GRAVEL (GP)**, grayish brown, cobbles, dry, angular, loose.		rock fragments
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-IW-02-4551	SHEET 3 OF 4

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668385.33 EASTING (NAD83 SPZN4 feet):1708842.58 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 304.64 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/24/13 14:29 END : 7/26/13 09:10 LOGGER : Seay

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	60.0				**SILTY GRAVEL (GM)**, grayish brown, low plasticity; cobbles, dry, hard, angular, loose.		rock fragments
65	65.0						
	66.0				**SILTY GRAVEL (GM)**, grayish brown, low plasticity; cobbles, dry, hard, angular, loose.		rock fragments
70	70.0				**SILTY GRAVEL (GM)**, grayish brown, low plasticity; fine, dry, hard, angular, loose.		rock fragments
75	75.0				**SANDY GRAVEL (GP)**, grayish brown, coarse, dry, angular, loose.		rock fragments
80	80.0				**SANDY GRAVEL (GP)**, grayish brown, coarse, dry, angular, loose.		rock fragments
85	85.0				**SANDY GRAVEL (GP)**, grayish brown, fine, dry, angular, loose.		rock fragments
90							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-IW-02-4551	SHEET 4 OF 4

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668385.33 EASTING (NAD83 SPZN4 feet):1708842.58 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 304.64 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/24/13 14:29 END : 7/26/13 09:10 LOGGER : Seay

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	90.0				**SANDY GRAVEL (GP)**, grayish brown, fine, moist, angular, loose.		weathered bedrock
	92.5						Boring terminated at 92.5 feet
95							
100							
105							
110							
115							
120							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-ROI-3983R	SHEET 1 OF 2

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668461.31 EASTING (NAD83 SPZN4 feet):1708843.09 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 304.25 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/15/13 16:42 END : 7/16/13 15:00 LOGGER : Seay

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	0.0				**SILT (OL)**, grayish black, low plasticity; fine, moist, soft, rounded, loose.		Some small rock gravel (less than 1 mm)
5							
	8.0				**SILTY GRAVEL (GM)**, grayish brown, low plasticity; fine, dry, soft, rounded, loose.		Angular rock fragments, some moisture
10							
	13.0				**SANDY GRAVEL (GP)**, grayish brown, fine, dry, rounded, loose.		Some moisture, angular rock fragments
15							
	18.0				**SANDY GRAVEL (GP)**, grayish brown, fine, dry, rounded, loose.		Some moisture and angular cobbles
20							
	23.0				**SANDY GRAVEL (GP)**, grayish brown, fine, dry, rounded, loose.		
25							
30							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:	
457958.09.JD.02	CG039-ROI-3983R	SHEET 2 OF 2

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668461.31 EASTING (NAD83 SPZN4 feet):1708843.09 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 304.25 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/15/13 16:42 END : 7/16/13 15:00 LOGGER : Seay

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	30.0				**SANDY GRAVEL (GC)**, grayish brown, low plasticity; coarse, wet, stiff, angular, dense.		rock fragments, some clay, angular rock fragments
35	35.0						Boring terminated at 35 feet
40							
45							
50							
55							
60							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
457958.09.JD.02	CG039-ROI-4550 SHEET 1 OF 2

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668461.31 EASTING (NAD83 SPZN4 feet):1708843.09 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 304.25 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/11/13 16:45 END : 7/13/13 15:45 LOGGER : Seay/Frame/Horn

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
	0.0				**SILT (OL)**, gray, low plasticity, very soft.		
5							
	8.0				**SILTY GRAVEL (GM)**, gray, low plasticity; cobbles, very soft, angular.		
10							
15							
	18.0				**GRAVELLY SILT (OL)**, gray, low plasticity; cobbles, dry, very soft, angular.		Lots of fines, some brown gravels
20							
	23.0				**SANDY GRAVEL (GP)**, grayish black, cobbles, moist, angular.		groundwater encountered at 23 feet bgs
25							
	28.0				**SANDY GRAVEL (GP)**, grayish black, cobbles, moist, angular.		
30							

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
457958.09.JD.02	CG039-ROI-4550 SHEET 2 OF 2

SOIL BORING LOG

PROJECT : JBER LOCATION : CG039

NORTHING (NAD83 SPZN4 feet):2668461.31 EASTING (NAD83 SPZN4 feet):1708843.09 DRILLING CONTRACTOR : GeoTek Alaska, Inc.

ELEVATION: 304.25 feet NAVD88 DRILLING METHOD AND EQUIPMENT : Geoprobe 8040DT, Direct Push

WATER LEVEL: --- START : 7/11/13 16:45 END : 7/13/13 15:45 LOGGER : Seay/Frame/Horn

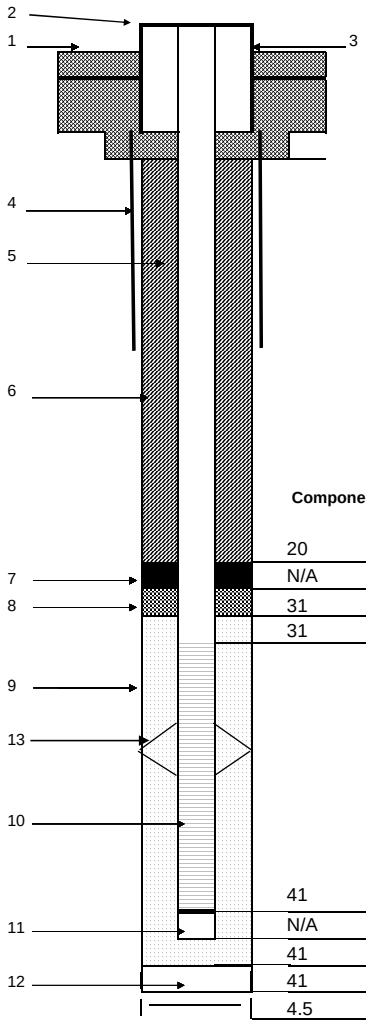
DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	SAMPLE RECOVERY (feet)	PID (ppm)	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SAMPLE ID	DRILLING AND LITHOLOGY NOTES
					SANDY GRAVEL (GP), grayish black, cobbles, moist, angular.(Soil Description Repeated)		
	33.0				**SILTY GRAVEL (GM)**, gray, low plasticity; cobbles, moist, very soft, angular.		Ending dry
35							
	38.0				**SILTY GRAVEL (GM)**, gray, low plasticity; cobbles, dry, very soft, angular.		
40							
	43.0						Boring terminated at 43 feet
45							
50							
55							
60							

CH2MHILL

PROJECT NUMBER	WELL NUMBER
457958	CG039_AP-3983R

WELL COMPLETION DIAGRAM

PROJECT NAME :	JBER-R			LOCATION NAME:	CG039
NORTHING:	6799362.751	EASTING:	360168.230	DRILLING CONTRACTOR:	Geotek
START DATE:	07/15/2013	END DATE:	07/15/2013	DRILLING METHOD:	Air rotary
BOREHOLE DIAMETER:	4.5 inches			DRILLING EQUIPMENT:	Geoprobe
TOTAL BOREHOLE DEPTH:	41 feet bgs			LOGGED BY:	A. Seay



Component Depths BGS

20	Top of transition seal (feet bgs)
N/A	Top of transition sand (feet bgs)
31	Top of filter pack (feet bgs)
31	Top of screen (feet bgs)
41	Bottom of screen (feet bgs)
N/A	Bottom of sump (feet bgs)
41	Bottom of filter pack (feet bgs)
41	Bottom of borehole (feet bgs)
4.5	Borehole Diameter (inches)

NOTE: DRAWING NOT TO SCALE

1- Ground elevation at well	304.20		feet NAVD 88
2- Top of casing elevation	307.40		feet NAVD 88
3- Surface completion type	Above Ground Momument		
a) Diameter	6		inches
b) Concrete pad dimensions	12		inches
c) Bollards	N/A		
4- Conductor casing type	N/A		
a) Diameter	N/A		inches
b) Length	N/A		feet
5- Well casing type	Schedule 40 PVC		
a) Diameter	2		inches
b) Length	31		feet
6- Sanitary seal type	Cement Grout (2% bentonite)		
a) Method of placement	Tremie pipe		
b) Volume used	25		gallons
c) Calculated volume	N/A	$feet^3$	gallons
7- Transition seal type	Bentonite pellets		
a) Quantity used	1		50 lb bags
b) Calculated quantity	N/A	$feet^3$	50 lb bags
8- Transition filter pack type	N/A		
a) Quantity used	N/A		100 lb bags
b) Calculated quantity	N/A	$feet^3$	100 lb bags
9- Filter pack type	Pre-pack filter 20/40 (2x5 ft sections)		
a) Quantity used	N/A		100 lb bags
b) Calculated quantity	N/A	$feet^3$	100 lb bags
10- Screen type / slot size	Mill-slot		
a) Diameter	2		inches
b) Length	10		feet
c) Slot size	0.010		inches
11- Sump / end cap type	PVC Slip-cap		
a) Diameter	2		inches
b) Length	0.00		feet
12- Backfill type	N/A		
a) Quantity used	N/A		
b) Calculated quantity	N/A		
13- Centralizer type	N/A		
a) Depths	N/A		feet bgs

Well Development

Start Date/Time:	7/24/2013 10:23 am	
End Date/Time:	7/24/2013 3:05 pm	
Measured Depth to Water	17.90	feet bgs
Development Method:	Surge & Pump	
Duration:	N/A	hours
Purgevolume:	153	gallons
Volume of water injected:	N/A	gallons
Calculated well volume:	37	gallons

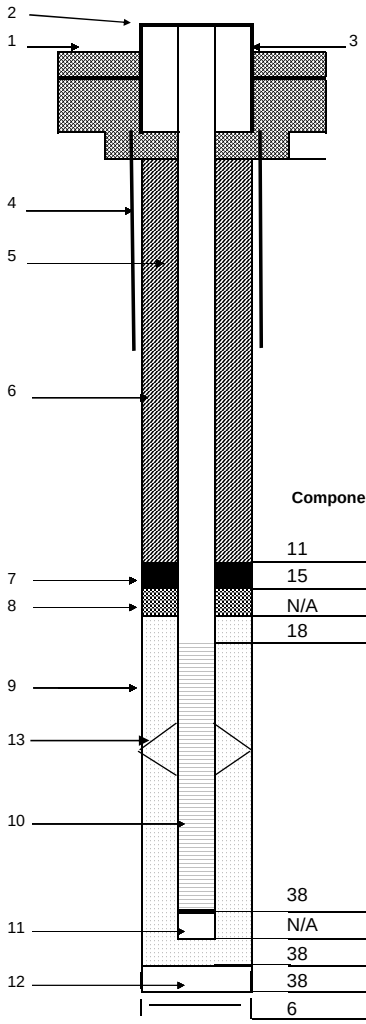
Comments:

CH2MHILL

PROJECT NUMBER	WELL NUMBER
457958	CG039-IW-01-3983

WELL COMPLETION DIAGRAM

PROJECT NAME :	JBER-R			LOCATION NAME:	CG039
NORTHING:	6799358.304	EASTING:	360168.424	DRILLING CONTRACTOR:	Geotek
START DATE:	07/16/2013	END DATE:	07/18/2013	DRILLING METHOD:	Air rotary
BOREHOLE DIAMETER:	6.0 inches			DRILLING EQUIPMENT:	Geoprobe
TOTAL BOREHOLE DEPTH:	38 feet bgs			LOGGED BY:	A. Seay



Component Depths BGS

11	Top of transition seal (feet bgs)
15	Top of transition sand (feet bgs)
N/A	Top of filter pack (feet bgs)
18	Top of screen (feet bgs)
38	Bottom of screen (feet bgs)
N/A	Bottom of sump (feet bgs)
38	Bottom of filter pack (feet bgs)
38	Bottom of borehole (feet bgs)
6	Borehole Diameter (inches)

NOTE: DRAWING NOT TO SCALE

1- Ground elevation at well	304.17	feet NAVD 88
2- Top of casing elevation	307.50	feet NAVD 88
3- Surface completion type	Above Ground Momument	
a) Diameter	6	inches
b) Concrete pad dimensions	12	inches
c) Bollards	Enviroblocks	
4- Conductor casing type	N/A	
a) Diameter	N/A	inches
b) Length	N/A	feet
5- Well casing type	Schedule 80 PVC	
a) Diameter	2	inches
b) Length	18	feet
6- Sanitary seal type	Cement Grout (2% bentonite)	
a) Method of placement	Tremie pipe	
b) Volume used	30	gallons
c) Calculated volume	N/A $feet^3$	gallons
7- Transition seal type	Bentonite pellets	
a) Quantity used	1	50 lb bags
b) Calculated quantity	N/A $feet^3$	50 lb bags
8- Transition filter pack type	N/A	
a) Quantity used	N/A	100 lb bags
b) Calculated quantity	N/A $feet^3$	100 lb bags
9- Filter pack type	8/12 Silica Sand	
a) Quantity used	3.5	100 lb bags
b) Calculated quantity	N/A $feet^3$	100 lb bags
10- Screen type / slot size	Continuous wire wrap PVC	
a) Diameter	2	inches
b) Length	20	feet
c) Slot size	0.065	inches
11- Sump / end cap type	PVC Slip-cap	
a) Diameter	2	inches
b) Length	0.00	feet
12- Backfill type	N/A	
a) Quantity used	N/A	
b) Calculated quantity	N/A	
13- Centralizer type	N/A	
a) Depths	N/A	feet bgs

Well Development

Start Date/Time:	7/31/2013 3:10 pm	
End Date/Time:	7/31/2013 4:40 pm	
Measured Depth to Water	21.40	feet bgs
Development Method:	Surge & Pump	
Duration:	N/A	hours
Purgevolume:	210	gallons
Volume of water injected:	N/A	gallons
Calculated well volume:	32	gallons

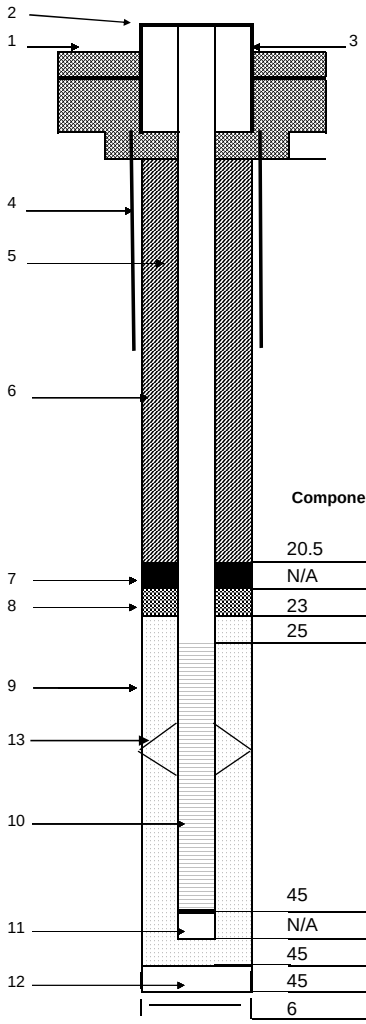
Comments:

CH2MHILL

PROJECT NUMBER	WELL NUMBER
457958	CG039-IW-01-4550

WELL COMPLETION DIAGRAM

PROJECT NAME :	JBER-R			LOCATION NAME:	CG039
NORTHING:	6799339.522	EASTING:	360158.697	DRILLING CONTRACTOR:	Geotek
START DATE:	07/19/2013	END DATE:	07/20/2013	DRILLING METHOD:	Air rotary
BOREHOLE DIAMETER:	6.0 inches			DRILLING EQUIPMENT:	Geoprobe
TOTAL BOREHOLE DEPTH:	45 feet bgs			LOGGED BY:	J. Frame



Component Depths BGS

20.5	Top of transition seal (feet bgs)
N/A	Top of transition sand (feet bgs)
23	Top of filter pack (feet bgs)
25	Top of screen (feet bgs)
45	Bottom of screen (feet bgs)
N/A	Bottom of sump (feet bgs)
45	Bottom of filter pack (feet bgs)
45	Bottom of borehole (feet bgs)
6	Borehole Diameter (inches)

NOTE: DRAWING NOT TO SCALE

1- Ground elevation at well	305.69	feet NAVD 88
2- Top of casing elevation	309.08	feet NAVD 88
3- Surface completion type	Above Ground Momument	
a) Diameter	6	inches
b) Concrete pad dimensions	12	inches
c) Bollards	N/A	
4- Conductor casing type	N/A	
a) Diameter	N/A	inches
b) Length	N/A	feet
5- Well casing type	Schedule 80 PVC	
a) Diameter	2	inches
b) Length	25	feet
6- Sanitary seal type	Cement Grout (2% bentonite)	
a) Method of placement	Tremie pipe	
b) Volume used	20	gallons
c) Calculated volume	N/A $feet^3$	gallons
7- Transition seal type	Bentonite pellets	
a) Quantity used	1	50 lb bags
b) Calculated quantity	N/A $feet^3$	50 lb bags
8- Transition filter pack type	N/A	
a) Quantity used	N/A	100 lb bags
b) Calculated quantity	N/A $feet^3$	100 lb bags
9- Filter pack type	8/12 silica sand	
a) Quantity used	N/A	100 lb bags
b) Calculated quantity	N/A $feet^3$	100 lb bags
10- Screen type / slot size	Continuous wire wrap PVC	
a) Diameter	2	inches
b) Length	20	feet
c) Slot size	0.065	inches
11- Sump / end cap type	PVC Slip-cap	
a) Diameter	2	inches
b) Length	0.00	feet
12- Backfill type	N/A	
a) Quantity used	N/A	
b) Calculated quantity	N/A	
13- Centralizer type	N/A	
a) Depths	N/A	feet bgs

Well Development

Start Date/Time:	8/8/2013 11:46 am	
End Date/Time:	8/8/2013 2:50 pm	
Measured Depth to Water	23.00	feet bgs
Development Method:	Surge & Pump	
Duration:	N/A	hours
Purgevolume:	155	gallons
Volume of water injected:	N/A	gallons
Calculated well volume:	342	gallons

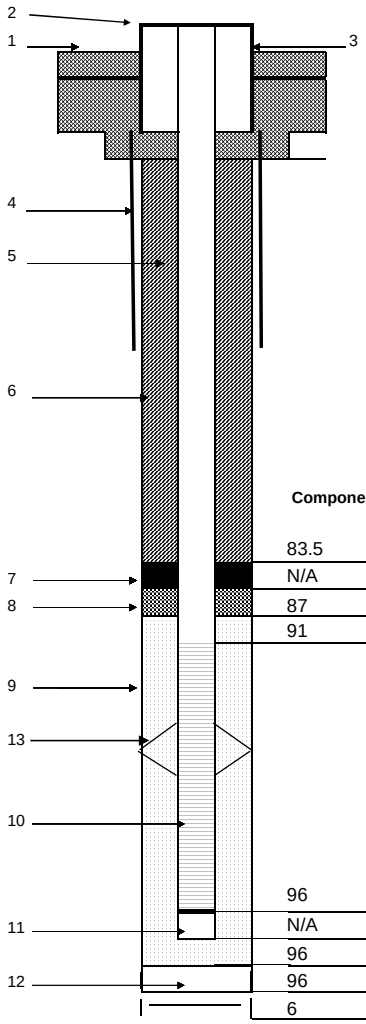
Comments:

CH2MHILL

PROJECT NUMBER	WELL NUMBER
457958	CG039-IW-01-4551

WELL COMPLETION DIAGRAM

PROJECT NAME :	JBER-R			LOCATION NAME:	CG039
NORTHING:	6799338.593	EASTING:	360161.650	DRILLING CONTRACTOR:	Geotek
START DATE:	07/22/2013	END DATE:	07/24/2013	DRILLING METHOD:	Air rotary
BOREHOLE DIAMETER:	6.0 inches			DRILLING EQUIPMENT:	Geoprobe
TOTAL BOREHOLE DEPTH:	96 feet bgs			LOGGED BY:	A. Seay



Component Depths BGS

83.5	Top of transition seal (feet bgs)	7
N/A	Top of transition sand (feet bgs)	8
87	Top of filter pack (feet bgs)	9
91	Top of screen (feet bgs)	13
96	Bottom of screen (feet bgs)	10
N/A	Bottom of sump (feet bgs)	11
96	Bottom of filter pack (feet bgs)	12
96	Bottom of borehole (feet bgs)	
6	Borehole Diameter (inches)	

NOTE: DRAWING NOT TO SCALE

1- Ground elevation at well	305.66	feet NAVD 88
2- Top of casing elevation	309.33	feet NAVD 88
3- Surface completion type	Above Ground Momument	
a) Diameter	6	inches
b) Concrete pad dimensions	12	inches
c) Bollards	N/A	
4- Conductor casing type	N/A	
a) Diameter	N/A	inches
b) Length	N/A	feet
5- Well casing type	Schedule 80 PVC	
a) Diameter	2	inches
b) Length	91	feet
6- Sanitary seal type	Cement Grout (2% bentonite)	
a) Method of placement	Tremie pipe	
b) Volume used	75	gallons
c) Calculated volume	N/A $feet^3$	gallons
7- Transition seal type	Bentonite pellets	
a) Quantity used	1	50 lb bags
b) Calculated quantity	N/A $feet^3$	50 lb bags
8- Transition filter pack type	N/A	
a) Quantity used	N/A	100 lb bags
b) Calculated quantity	N/A $feet^3$	100 lb bags
9- Filter pack type	8/12 silica sand	
a) Quantity used	1.5	100 lb bags
b) Calculated quantity	N/A $feet^3$	100 lb bags
10- Screen type / slot size	Continuous wire wrap PVC	
a) Diameter	2	inches
b) Length	5	feet
c) Slot size	0.065	inches
11- Sump / end cap type	PVC Slip-cap	
a) Diameter	2	inches
b) Length	0.00	feet
12- Backfill type	N/A	
a) Quantity used	N/A	
b) Calculated quantity	N/A	
13- Centralizer type	N/A	
a) Depths	N/A	feet bgs

Well Development

Start Date/Time:	8/5/2013 9:55 am	
End Date/Time:	8/5/2013 5:00 pm	
Measured Depth to Water	92.11	feet bgs
Development Method:	Surge & Pump	
Duration:	N/A	hours
Purgevolume:	134	gallons
Volume of water injected:	N/A	gallons
Calculated well volume:	134	gallons

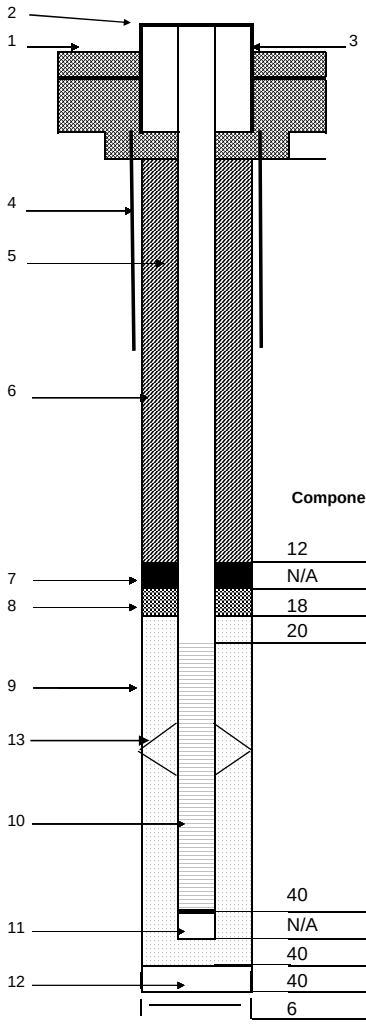
Comments:

CH2MHILL

PROJECT NUMBER	WELL NUMBER
457958	CG039-IW-02-3983

WELL COMPLETION DIAGRAM

PROJECT NAME :	JBER-R			LOCATION NAME:	CG039
NORTHING:	6799360.168	EASTING:	360164.432	DRILLING CONTRACTOR:	Geotek
START DATE:	07/18/2013	END DATE:	07/19/2013	DRILLING METHOD:	Air rotary
BOREHOLE DIAMETER:	6.0 inches			DRILLING EQUIPMENT:	Geoprobe
TOTAL BOREHOLE DEPTH:	40 feet bgs			LOGGED BY:	J. Frame



Component Depths BGS

12	Top of transition seal (feet bgs)
N/A	Top of transition sand (feet bgs)
18	Top of filter pack (feet bgs)
20	Top of screen (feet bgs)
40	Bottom of screen (feet bgs)
N/A	Bottom of sump (feet bgs)
40	Bottom of filter pack (feet bgs)
40	Bottom of borehole (feet bgs)
6	Borehole Diameter (inches)

NOTE: DRAWING NOT TO SCALE

1- Ground elevation at well	304.30	feet NAVD 88
2- Top of casing elevation	307.75	feet NAVD 88
3- Surface completion type	Above Ground Momument	
a) Diameter	6	inches
b) Concrete pad dimensions	12	inches
c) Bollards	N/A	
4- Conductor casing type	N/A	
a) Diameter	N/A	inches
b) Length	N/A	feet
5- Well casing type	Schedule 80 PVC	
a) Diameter	2	inches
b) Length	20	feet
6- Sanitary seal type	Cement Grout (2% bentonite)	
a) Method of placement	Tremie pipe	
b) Volume used	15	gallons
c) Calculated volume	N/A $feet^3$	gallons
7- Transition seal type	Bentonite pellets	
a) Quantity used	1	50 lb bags
b) Calculated quantity	N/A $feet^3$	50 lb bags
8- Transition filter pack type	N/A	
a) Quantity used	N/A	100 lb bags
b) Calculated quantity	N/A $feet^3$	100 lb bags
9- Filter pack type	8/12 Silica Sand	
a) Quantity used	3.5	100 lb bags
b) Calculated quantity	N/A $feet^3$	100 lb bags
10- Screen type / slot size	Continuous wire wrap PVC	
a) Diameter	2	inches
b) Length	20	feet
c) Slot size	0.065	inches
11- Sump / end cap type	PVC Slip-cap	
a) Diameter	2	inches
b) Length	0.00	feet
12- Backfill type	N/A	
a) Quantity used	N/A	
b) Calculated quantity	N/A	
13- Centralizer type	N/A	
a) Depths	N/A	feet bgs

Well Development

Start Date/Time:	7/30/2013 9:30 am	
End Date/Time:	7/31/2013 12:42 pm	
Measured Depth to Water	21.54	feet bgs
Development Method:	Surge & Pump	
Duration:	N/A	hours
Purgevolume:	308	gallons
Volume of water injected:	N/A	gallons
Calculated well volume:	308	gallons

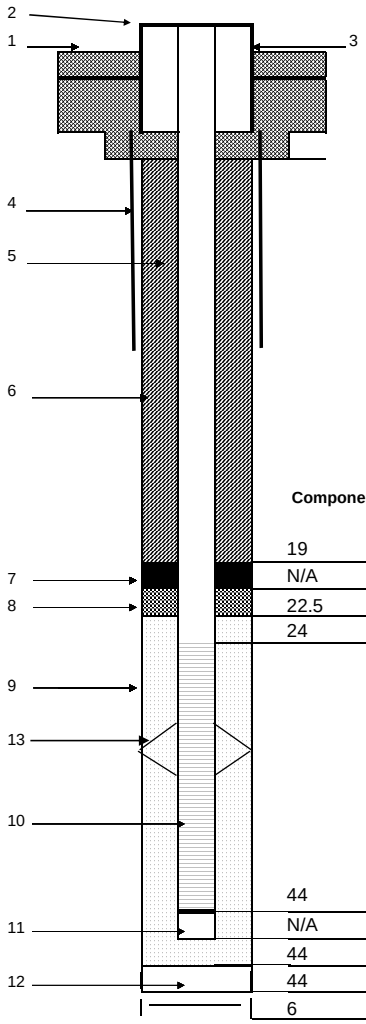
Comments:

CH2MHILL

PROJECT NUMBER	WELL NUMBER
457958	CG039-IW-02-4550

WELL COMPLETION DIAGRAM

PROJECT NAME :	JBER-R			LOCATION NAME:	CG039
NORTHING:	6799336.461	EASTING:	360161.918	DRILLING CONTRACTOR:	Geotek
START DATE:	07/26/2013	END DATE:	07/26/2013	DRILLING METHOD:	Air rotary
BOREHOLE DIAMETER:	6.0 inches			DRILLING EQUIPMENT:	Geoprobe
TOTAL BOREHOLE DEPTH:	44 feet bgs			LOGGED BY:	A. Seay



Component Depths BGS

19	Top of transition seal (feet bgs)
N/A	Top of transition sand (feet bgs)
22.5	Top of filter pack (feet bgs)
24	Top of screen (feet bgs)
44	Bottom of screen (feet bgs)
N/A	Bottom of sump (feet bgs)
44	Bottom of filter pack (feet bgs)
44	Bottom of borehole (feet bgs)
6	Borehole Diameter (inches)

NOTE: DRAWING NOT TO SCALE

1- Ground elevation at well	305.44	feet NAVD 88
2- Top of casing elevation	308.77	feet NAVD 88
3- Surface completion type	Above Ground Momument	
a) Diameter	6	inches
b) Concrete pad dimensions	12	inches
c) Bollards	N/A	
4- Conductor casing type	N/A	
a) Diameter	N/A	inches
b) Length	N/A	feet
5- Well casing type	Schedule 80 PVC	
a) Diameter	2	inches
b) Length	24	feet
6- Sanitary seal type	Cement Grout (2% bentonite)	
a) Method of placement	Tremie pipe	
b) Volume used	20	gallons
c) Calculated volume	N/A $feet^3$	gallons
7- Transition seal type	Bentonite pellets	
a) Quantity used	1	50 lb bags
b) Calculated quantity	N/A $feet^3$	50 lb bags
8- Transition filter pack type	N/A	
a) Quantity used	N/A	100 lb bags
b) Calculated quantity	N/A $feet^3$	100 lb bags
9- Filter pack type	8/12 silica sand	
a) Quantity used	N/A	100 lb bags
b) Calculated quantity	N/A $feet^3$	100 lb bags
10- Screen type / slot size	Continuous wire wrap PVC	
a) Diameter	2	inches
b) Length	20	feet
c) Slot size	0.065	inches
11- Sump / end cap type	PVC Slip-cap	
a) Diameter	2	inches
b) Length	0.00	feet
12- Backfill type	N/A	
a) Quantity used	N/A	
b) Calculated quantity	N/A	
13- Centralizer type	N/A	
a) Depths	N/A	feet bgs

Well Development

Start Date/Time:	8/7/2013 10:00 am	
End Date/Time:	8/7/2013 10:40 am	
Measured Depth to Water	22.63	feet bgs
Development Method:	Surge & Pump	
Duration:	N/A	hours
Purgevolume:	220	gallons
Volume of water injected:	N/A	gallons
Calculated well volume:	350	gallons

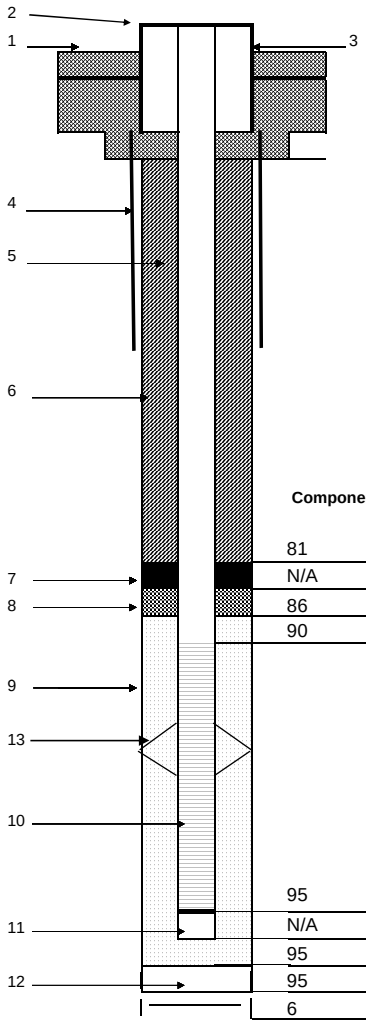
Comments:

CH2MHILL

PROJECT NUMBER	WELL NUMBER
457958	CG039-IW-02-4551

WELL COMPLETION DIAGRAM

PROJECT NAME :	JBER-R			LOCATION NAME:	CG039
NORTHING:	6799336.022	EASTING:	360165.223	DRILLING CONTRACTOR:	Geotek
START DATE:	07/24/2013	END DATE:	07/27/2013	DRILLING METHOD:	Air rotary
BOREHOLE DIAMETER:	6.0 inches			DRILLING EQUIPMENT:	Geoprobe
TOTAL BOREHOLE DEPTH:	95 feet bgs			LOGGED BY:	A. Seay



Component Depths BGS

81	Top of transition seal (feet bgs)
N/A	Top of transition sand (feet bgs)
86	Top of filter pack (feet bgs)
90	Top of screen (feet bgs)
95	Bottom of screen (feet bgs)
N/A	Bottom of sump (feet bgs)
95	Bottom of filter pack (feet bgs)
95	Bottom of borehole (feet bgs)
6	Borehole Diameter (inches)

NOTE: DRAWING NOT TO SCALE

1- Ground elevation at well	304.64		feet NAVD 88
2- Top of casing elevation	308.26		feet NAVD 88
3- Surface completion type	Above Ground Momument		
a) Diameter	6		inches
b) Concrete pad dimensions	12		inches
c) Bollards	N/A		
4- Conductor casing type	N/A		
a) Diameter	N/A		inches
b) Length	N/A		feet
5- Well casing type	Schedule 80 PVC		
a) Diameter	2		inches
b) Length	90		feet
6- Sanitary seal type	Cement Grout (2% bentonite)		
a) Method of placement	Tremie pipe		
b) Volume used	75		gallons
c) Calculated volume	N/A	feet^3	gallons
7- Transition seal type	Bentonite pellets		
a) Quantity used	1		50 lb bags
b) Calculated quantity	N/A	feet^3	50 lb bags
8- Transition filter pack type	N/A		
a) Quantity used	N/A		100 lb bags
b) Calculated quantity	N/A	feet^3	100 lb bags
9- Filter pack type	8/12 silica sand		
a) Quantity used	2.5		100 lb bags
b) Calculated quantity	N/A	feet^3	100 lb bags
10- Screen type / slot size	Continuous wire wrap PVC		
a) Diameter	2		inches
b) Length	5		feet
c) Slot size	0.065		inches
11- Sump / end cap type	PVC Slip-cap		
a) Diameter	2		inches
b) Length	0.00		feet
12- Backfill type	N/A		
a) Quantity used	N/A		
b) Calculated quantity	N/A		
13- Centralizer type	N/A		
a) Depths	N/A		feet bgs

Well Development

Start Date/Time:	8/2/2013 9:00 am	
End Date/Time:	8/2/2013 4:25 pm	
Measured Depth to Water	91.45	feet bgs
Development Method:	Surge & Pump	
Duration:	N/A	hours
Purgevolume:	143	gallons
Volume of water injected:	N/A	gallons
Calculated well volume:	72	gallons

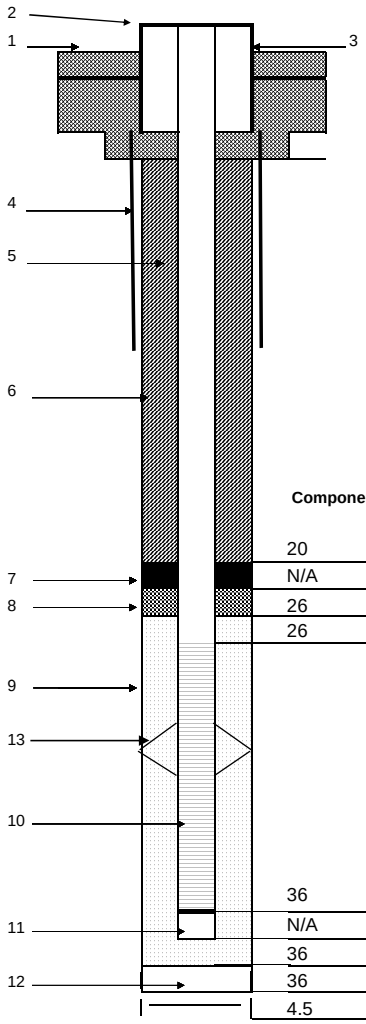
Comments:

CH2MHILL

PROJECT NUMBER	WELL NUMBER
457958	CG039-ROI-3983

WELL COMPLETION DIAGRAM

PROJECT NAME :	JBER-R			LOCATION NAME:	CG039
NORTHING:	6799359.141	EASTING:	360166.473	DRILLING CONTRACTOR:	Geotek
START DATE:	07/15/2013	END DATE:	07/16/2013	DRILLING METHOD:	Air rotary
BOREHOLE DIAMETER:	4.5 inches			DRILLING EQUIPMENT:	Geoprobe
TOTAL BOREHOLE DEPTH:	36 feet bgs			LOGGED BY:	J. Frame



Component Depths BGS

20	Top of transition seal (feet bgs)
N/A	Top of transition sand (feet bgs)
26	Top of filter pack (feet bgs)
26	Top of screen (feet bgs)
36	Bottom of screen (feet bgs)
N/A	Bottom of sump (feet bgs)
36	Bottom of filter pack (feet bgs)
36	Bottom of borehole (feet bgs)
4.5	Borehole Diameter (inches)

NOTE: DRAWING NOT TO SCALE

1- Ground elevation at well	304.25	feet NAVD 88
2- Top of casing elevation	307.35	feet NAVD 88
3- Surface completion type	Above Ground Momument	
a) Diameter	6	inches
b) Concrete pad dimensions	12	inches
c) Bollards	N/A	
4- Conductor casing type	N/A	
a) Diameter	N/A	inches
b) Length	N/A	feet
5- Well casing type	Schedule 40 PVC	
a) Diameter	2	inches
b) Length	26	feet
6- Sanitary seal type	Cement Grout (2% bentonite)	
a) Method of placement	Tremie pipe	
b) Volume used	35	gallons
c) Calculated volume	N/A $feet^3$	gallons
7- Transition seal type	Bentonite pellets	
a) Quantity used	1	50 lb bags
b) Calculated quantity	N/A $feet^3$	50 lb bags
8- Transition filter pack type	N/A	
a) Quantity used	N/A	100 lb bags
b) Calculated quantity	N/A $feet^3$	100 lb bags
9- Filter pack type	Pre-pack filter 20/40 (2x5 ft sections)	
a) Quantity used	N/A	100 lb bags
b) Calculated quantity	N/A $feet^3$	100 lb bags
10- Screen type / slot size	Mill-slot	
a) Diameter	2	inches
b) Length	10	feet
c) Slot size	0.010	inches
11- Sump / end cap type	PVC Slip-cap	
a) Diameter	2	inches
b) Length	0.00	feet
12- Backfill type	N/A	
a) Quantity used	N/A	
b) Calculated quantity	N/A	
13- Centralizer type	N/A	
a) Depths	N/A	feet bgs

Well Development

Start Date/Time:	7/24/2013 3:04 pm	
End Date/Time:	7/25/2013 11:04 pm	
Measured Depth to Water	21.12	feet bgs
Development Method:	Surge & Pump	
Duration:	N/A	hours
Purgevolume:	130	gallons
Volume of water injected:	N/A	gallons
Calculated well volume:	130	gallons

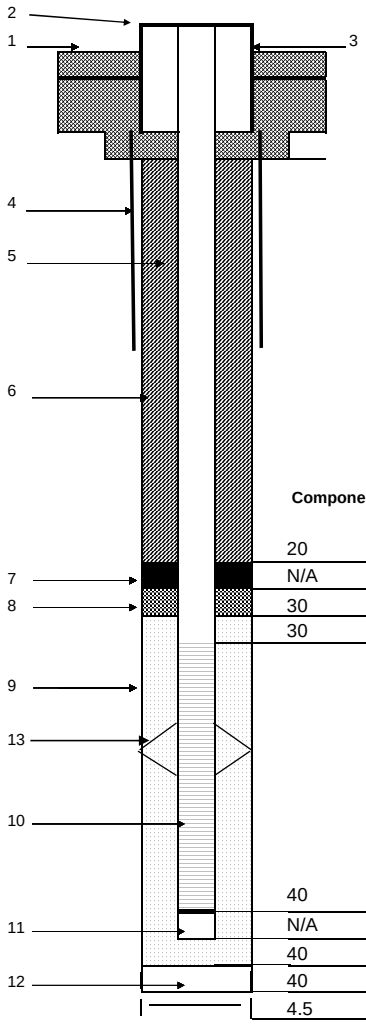
Comments:

CH2MHILL

PROJECT NUMBER	WELL NUMBER
457958	CG039-ROI-4550

WELL COMPLETION DIAGRAM

PROJECT NAME :	JBER-R			LOCATION NAME:	CG039
NORTHING:	6799338.047	EASTING:	360160.336	DRILLING CONTRACTOR:	Geotek
START DATE:	07/12/2013	END DATE:	07/13/2013	DRILLING METHOD:	Air rotary
BOREHOLE DIAMETER:	4.5 inches			DRILLING EQUIPMENT:	Geoprobe
TOTAL BOREHOLE DEPTH:	40 feet bgs			LOGGED BY:	A. Seay



Component Depths BGS

20	Top of transition seal (feet bgs)
N/A	Top of transition sand (feet bgs)
30	Top of filter pack (feet bgs)
30	Top of screen (feet bgs)
40	Bottom of screen (feet bgs)
N/A	Bottom of sump (feet bgs)
40	Bottom of filter pack (feet bgs)
40	Bottom of borehole (feet bgs)
4.5	Borehole Diameter (inches)

NOTE: DRAWING NOT TO SCALE

1- Ground elevation at well	305.77		feet NAVD 88
2- Top of casing elevation	309.35		feet NAVD 88
3- Surface completion type	Above Ground Momument		
a) Diameter	6		inches
b) Concrete pad dimensions	12		inches
c) Bollards	N/A		
4- Conductor casing type	N/A		
a) Diameter	N/A		inches
b) Length	N/A		feet
5- Well casing type	Schedule 40 PVC		
a) Diameter	2		inches
b) Length	30		feet
6- Sanitary seal type	Cement Grout (2% bentonite)		
a) Method of placement	Tremie pipe		
b) Volume used	30		gallons
c) Calculated volume	N/A	$feet^3$	gallons
7- Transition seal type	Bentonite pellets		
a) Quantity used	1		50 lb bags
b) Calculated quantity	N/A	$feet^3$	50 lb bags
8- Transition filter pack type	N/A		
a) Quantity used	N/A		100 lb bags
b) Calculated quantity	N/A	$feet^3$	100 lb bags
9- Filter pack type	Pre-pack filter 20/40 (2x5 ft sections)		
a) Quantity used	N/A		100 lb bags
b) Calculated quantity	N/A	$feet^3$	100 lb bags
10- Screen type / slot size	Mill-slot		
a) Diameter	2		inches
b) Length	10		feet
c) Slot size	0.010		inches
11- Sump / end cap type	PVC Slip-cap		
a) Diameter	2		inches
b) Length	0.00		feet
12- Backfill type	N/A		
a) Quantity used	N/A		
b) Calculated quantity	N/A		
13- Centralizer type	N/A		
a) Depths	N/A		feet bgs

Well Development

Start Date/Time:	12/10/2013 3:00 pm	
End Date/Time:	8/8/2013 4:10 pm	
Measured Depth to Water	26.70	feet bgs
Development Method:	Surge & Pump	
Duration:	N/A	hours
Purgevolume:	88	gallons
Volume of water injected:	N/A	gallons
Calculated well volume:	271	gallons

Comments:

Appendix A-2
Field Notes

This page intentionally left blank.

10/15/13
Tuesday

M. Oakley / J. Brann
JBER GW Monitoring

50°F
Overcast/
Rain & wind

0830 - Monica meets Jenn Frame @ job trailer to pick up 7060 voas, Fe ampules, & decontubes. Review H&S topics.

0900 - Meet Joel @ CG039 - Pole line Rd. Set up on AP-4550. No tubing in the 3 wells. Hilcorp is to sample.

1010 - Jenn delivers tubing.

1100 - Begin purging AP-4550. Water is very turbid, gray/milky in color.

1230 - Collect samples:
13Q4CG039-AP4550-GW-0
13Q4CG039-AP4550-GW-0MS
13Q4CG039-AP4550-GW-0SD

1235 - 13Q4CG039-AP4550-GW-1

1300 - Wind picking up & rain. Pack up gear & demob from CG039.

1330 - Drop off purge water (~7 gal) @ POL Yard.

1400 - Off Base

Monica Oakley
10/15/13

Scale: 1 square = ____________

Rite in the Rain

10/16/13 Wednesday — M Oakley & J. Braun — JBER GW LTM — 50° F Overcast & Wind

0830 - Monica & Joel met at CG039 Poleline Rd. Joel previously calr equipment.
0900 - Set up on AP-4551.
1020 - Collect 13Q4CG039-AP4551-GW-0 for E300M, E376.4, E310.1, E353.2 E376.1, RSK-175, SW6020A-Diss, SW8260C, SW9060
1100 - Decon Pump. Set up on AP-3983R.
1145 - Collect 13Q4CG039-AP3983R-GW-0 for E300M, E375.4, E310.1, E353.2, E376.1, RSK-175, SW6020A-Diss SW8260C, SW9060
1230 - Decon Pump & Collect EB: 13Q4CG039-GWEB01 for E300.0, E353.2, RSK-175, SW6010B-Diss, SW8260C
1250 - Pack up gear and move to DA085
1315 - set up on AP-4413.
1410 - Collect 13Q4DA085-AP4413-GW-0 for E300.0, E310.1, E353.2, E376.1, RSK-175, SW6010B-Diss, SW8260C, 9060

Scale: 1 square = _____

10/16/13 (cont'd) — H. Oakley & J. Braun — JBER GW LTM — 50° F Lt Rain + Wind

Also collect:
13Q4DA085-AP4413-GW-0MS
13Q4DA085-AP4413-GW-0SD
1415 - 13Q4DA085-AP4413-GW-1
1500 - Decon Pump and collect EB: 13Q4DA085-EB01-GW-0 for E300.0, E353.2, RSK-175, SW6010B-Diss, SW8260C, E376.1 and SW9060.
1530 - Pack up gear. Drop off ~10 gallons purge water @ POL Yard.
Drop off pump, decon tubes, compressor, controller, HACH, Fe Ampules at CH2M Hill job trailer. Dedicated tubing also placed in conex #1.
1545 - Switch out Petro-Sock @ AP-
1600 - Off base for day.

Monica Oakley
10-16-13

Scale: 1 square = _____

Rite in the Rain

JBER LTM
AUMA DA089

1/13/14

Scope - Sample T.S. wells @ DA089.
Staff - J. Braun + H. Oakley (Aktrue)
Weather - Overcast ~18°F.
1015 - J. Braun & H. Oakley meet Jen Frame (CH2M Hill) @ DA089 site for H&S briefing
1030 - Set up on AP-413.
Controller for QED bladder pump freezes up. Connections are drained out to wastes.
1200 - Thaw out equip. and try again.
1330 - YSI flow cell is not holding water.
1500 - Pack up gear & depart site. Will work @ office to troubleshoot equip problems.
EOD

Monica Oakley
1/13/14

JBER LTM
AUMA DA089

1/14/14

Scope - Sample AP-4413 @ DA089
Staff - J. Brann & M Oakley (Ahtna)
Weather - Overcast 20°F.
0900 - Pack up gear and mob to site.
1000 - M Oakley & J. Brann onsite.
Set up QED Bladder pump + YSI on AP-4413
1115 - Collect sample:
14QIDA085-AP4413-GW-0 for SO_4 VFA, Alkalinity, Nitrate, Sulfide, Diss. Gases, Fe & Mn, VOC, TOC & Field test for ferrous iron.
→ (Jen Frame bring preserved amber bottles for TOC).
1130 - Decon Pumps.
1200 - Drop off water @ POL Storage Yard ~4 gal purge + decon water.
1230 - Change out Petro sock @ TU058 - AP-5007. No staining observed. Very Faint odor. Flip sock.
1300 - Arrive @ TU103 - Change-out & replace socks in AP-3875 and AP-5013. Both have POL odor & staining.
Attempt to locate AP-5014 but

1/14/14 (cont'd)

buried beneath ~4' of ice and cannot locate.
1400 - Arrive @ TU101.
AP-3876 → Flip Sock. POL odor & stain on one side.
AP-3794 → Change sock. Strong POL odor and Brown sludge-like material.
AP-3796 → Change sock. POL odor & slight staining
AP-3885 → Change sock. Strong POL odor & black/brown sludge.
1500 - Drop off Petrosocks to Hazmat Facility on Elmendorf. Demob from Base.
EOD.

[signature] 1/14/14

JBER LTM
CG039

1/15/14

Scope - Sample at Poleline Rd. CG039.
Staff - M. Oakley + J. Braun (Alutiq)
Weather - Overcast - Snow/Rain 32°F
0900 - Calibrate Equip + Mob to site.
0920 - Meet Jen Frame at entry to Poleline Rd. Conduct H+S Meeting
1020 - Pack gear + walk to site using snowshoes + sleds.
1045 - Set up on AP-3983R
QED system is not working. Disconnect/Reconnect/Troubleshoot equip. Appears that the QED controller is not working properly.
1230 - Pack up gear + depart site.
1500 - Pick up a QED controller at TTT ENV. The tech suggests that the problem may be moisture from the compressor into the controller.
1530 - Set up QED pump system in warehouse using TTT controller + equip. appears to be functioning now.
1630 - EOD

Marco Oakley 1/15/14

(4)

JBER LTM
CG039

1/16/14

Scope - Sample at Poleline Rd. CG039.
Staff - M. Oakley + J. Braun (Alutiq)
Weather - 32°F Overcast
0830 - Pack equipment + mob to site.
0930 - Load sleds and walk to site on snowshoes.
1030 - Set up pump on AP-3983R. Water is not purging from the well. Replace teflon-lined tubing. Water begins purging
1115 - Collect 14QICG039-AP3983R-GW-0
14QICG039-AP3983R-GW-DUS
14QICG039-AP3983R-GW-DSD
for SO_4, Cl VFA, Alkalinity, Nitrate, Sulfide, Diss. Gases, Fe + Mn, VOC, TOC.
- Ferrous Iron HACH Kits field test result = 2.36 mg/L.
- Jen Frame delivers extra 500 mL poly unpres. containers
1315 - Begin purging at AP-4551 after decon. pump.
1345 - Collect 14QICG039-AP4551-GW-0
for SO_4, Cl VFA, Alkalinity, Nitrate

(5)

DURA Rite

4/16/14 (cont'd)
Sulfide, Diss. Gases., Fe+Mn, VOC, +TOC.
- HACH field test for Ferrous Iron >3.30 mg/L. (limit)
1415 - Decon pump and set upon AP-4550.
1500 - Collect 14Q1CG039-AP4550-GW-0
1505 - Collect field duplicate, 14Q1CG039-AP4550-GW-1 for SO4, Cl VFA, Alkalinity, Nitrate Sulfide, Diss. Gases, Fe+Mn, VOC, TOC.
- Hach field test for Ferrous Iron >3.30 mg/L (limit).
1530 - Decon pump + haul equip to truck at end of Poleline Rd.
1600 - Drop off ~ 15 gal purge water + Decon water at PDL storage yard.
1630 - Demob off base
EOD

Maureen Dolly
4/16/14

(E)

JBER LTM
DA089

4/14/13

Scope - Collect GW samples @ DA089 for 3rd Quarterly sampling.
Staff - M. Oakley & L. Hess
Weather - Clear & 40°F
0845 - Calibrate YSI & Turbidimeter.
1000 - Meet Jenn Frame (CH) @ DA089 site. Conduct H&S briefing
1030 - Set up on AP-4413.
Jenn Departs site
1130 - Collect 1402DA089-AP4413-GW-0
1135 - Collect FD 1402DA089-AP4413-GW-0 for E300.0 & E300.0M, E310.1, E353.2, E376.2, RSK-175, SW6010B-DISS, SW8260C, SW9060
HACH field test Fe = 3.18 mg/L
1230 - Decon pump. Drop off purge DW @ JBER POL Yard
1330 - EOD

4/14/14

JBER LTM
CG039

4/15/14

Scope - GW sampling @ Poleline Rd CG039
Staff - M. Oakley, L. Hess, J. Brenn (Antea)
Weather - AM Rain & Overcast & Clearing in afternoon.
0900 - Calibrate YSI, turbidimeter.
0945 - Mob to Poleline Rd. Meet Jenn Frame at driveway into Poleline Rd site & conduct H&S briefing.
1015 - Snowshoe & pull sleds to MW's.
1045 - Set up on AP-3983R & begin purging. Tubing coated in black. Water is relatively clear w/ a few black pieces/sediment.
1125 - Collect 1402CG039-AP3983R-GW-0 for E300.0 & E300.0M, E310.1, E353.2, E376.2, RSK-175, SW-6010 DISS, SW8260C, SW9060
Field HACH Fe = 3.30 mg/L (limit)

Chenny Oakley

DURA Rite WATERPROOF

JBER LTM

4/15/14 (cont'd)

1150 - Set up on AP-4551

1345 - Collect 14Q2CG039-AP4551-GW-0 for E300.0+E300.0M, E310.1, E353.2, E376.2, RSK-175, SW6010B-Diss, SW8260C, SW9060.
HACH Field Test Fe: 2.86 mg/L

1255 - Set up on AP-4550

1400 - Collect: 14Q2CG039-AP4550-GW-0 & 14Q2CG039-AP4550-GW-0MS & OSD for E300.0+E300.0M, E310.1, E353.2, E376.2, RSK-175, SW6010B-Diss, SW8260C, SW9060
HACH Field-test Fe: 3.30 mg/L (limit)

1430 - Decon pump.

1445 - Deliver field equip to CH jet trailer on JBER.

1500 - Drop off ~12 gal IDW to POL Yard.

1530 - Return to office to prep samples. EOD

Whitney Talley
4/15/14

JBER GW LTM | Treat Studies (CG039) 9/5/14

TASK: continue sampling @ site CG039.

Personnel: Jennifer ~~Ulrich (JU)~~ Frame (Ulrich) (JUF) qualified sampler
Mike Landon (ML) - technician

Project Number: 457958.09.JB.05

Weather: Rain, 54°F

0830 - JUF & ML onsite field office. Calibrate YSI (see calibration form) pack for days' sampling effort. Conduct H2S briefing.

0914 - Head to CG039. Call to check in w/ Range control

0925 - onsite CG039 AP-4344 (LTM well)

0935 - collect DTW: 146.86 & TD: 166.00

0946 - begin purging

0958 - water present. Check flow rate ~250 mL/min.

1010 - begin collecting parameters

1100 - parameters stabilize * Turbidity was high initially likely due to pump slipping & hitting bottom of well during setup

DTW	pH	mS/cm Cond	NTU	mg/L *DO	°C Temp	mV ORP
146.86	7.94	0.225	16.0	30.64	5.33	237.6

* DO probe malfunctions ↳ "out of range" try trouble shooting to no avail

1105 - Collect sample 14Q3CG039-AP4344-GW-0 for:
- chloride/sulfate
- Nitrite/nitrate
- methane, ethane, ethene
- Diss. Fe & Mn
- SW8260C

1120 - decon pump. demobe & move to next location

1150 - onsite CG039 AP-3748 (LTM well)

1155 - collect DTW: 130.66 & TD: 174.30

* well has no lock & needs sand in annular space *
Team replaces lock & adds ~3/4 bag of ~~sand~~ (JUF) Pea gravel

1210 - begin purging.

1218 - water present. Check flow rate ~200 mL/min.

1230 - begin collecting parameters

1250 - parameters stabilize

DTW	pH	mS/cm COND	NTU	mg/L DO	°C Temp	mV ORP
130.68	7.65	0.396	13.81	1.49	7.19	230.0

1255 - Collect sample 14Q3CG039-AP3748-GW-0 for:
- same analytes as ~~above~~ (JUF) previous well (AP-4344)

1320 - decon pump. ~~Move to next location~~ (JUF). Change out bladder. Move to next location.

1340 - onsite CG039 AP-3747 (LTM & + Treat Study well [2014 4th Qrt. Only])
* well includes analytes for both LTM & Treat. Studies *

1345 - Collect DTW: 21.19 & TD: 33.60

1347 - begin purge

1348 - water present. Check flow rate ~500 mL/min

JBER GW LTM | Treat Studies 9/5/14

1355 - begin collecting parameters

1410 - parameters stabilize

DTW	pH	mS/cm Cond	NTU	mg/L DO	°C Temp	mV ORP
21.44	7.60	0.212	5.19	1.86	4.71	250.3

1415 - collect sample 14Q3CG039-AP3747-GW-0 for:

- Chloride | sulfate | VFA
- Alkalinity
- Nitrite | nitrate
- Sulfide
- methane, ethane, ethene
- Diss. Fe & Mn
- SW8260C
- TOC SW9060
- * Ferrous iron field test = 0.00 mg/L

1430 - decon pump. Demobe to next location.

1455 - onsite CG039 AP-4353 (LTM well)

1500 - collect DTW: 32.01 & TD: 70.10 * replace well cap *

1510 - begin purge

1514 - water present. Check flow rate ~ 400 mL/min

1520 - begin collecting parameters

1540 - parameters stabilize

DTW	pH	mS/cm Cond	NTU	mg/L DO	°C Temp	mV ORP
33.11	6.76	0.258	0.61	1.5	5.95	-37.2

1545 - collect sample 14Q3CG039-AP4353-GW-0 for:

- chloride | sulfate
- Nitrite | nitrate
- methane, ethane, ethene
- Diss. Fe & Mn
- SW8260C

1550 - decon pump. Demobe from site. Will return to site next Monday.

1610 - checkout of CG039 w/ Range control

1630 - onsite POL yard. Transfer 15 gals of purge water into yellow poly, 55 gal drum & label.

1730 - ~~offsite~~. End of day

Jennifer Frame 9/5/14

JBER GW LTM/Treat Studies 9/8/14

TASK: Continue LTM/Treatability studies sampling effort at CG039. - LATE ENTRY - Team moved to DA089 in afternoon.

Personnel: Jennifer ~~H~~Frame (Ulrich) (JUF) - qualified sampler, SM
Mike Landon (ML) - technician

Project number: 457958.09.JB.05 (CG039); 457958.09.LC.04 (DA089)

Weather: overcast, ~~et~~ JUF, 57°F

0800 - JUF onsite TTT to pickup YSI rental. ~~Turbidity~~ JUF DO meter on DWH YSI is malfunctioning & cannot be fixed by field trouble shooting efforts. Will return to DWH after talking w/ P. Lundberg (CH2M HILL warehouse contact).

0840 - onsite JBER check point. Vehicle requires search - OK

0900 - onsite field office. ML already onsite. TTT rental YSI was just calibrated this morning by TTT techs, however ML will check to be sure calibrations adequate (see calibration form). JUF packs up supplies/bottleware for sampling.

0930 - JUF discusses YSI problem w/ P. Lundberg (was unable to reach on Friday while trouble-shooting). P. Lundberg will ship out replacement YSI model ~~6820~~ JUF. This model has up-graded DO probe cover which should be more resiliant & provide less trouble shooting for field team.

1000 - onsite Poleline Rd. Call & check in w/ Range control

1025 - onsite CG039 AP-3744 (+Treat study well [2014 Qrt. 4 only])

1028 - collect DTW: ~~38.70~~ 24.89 JUF TD: 38.70

1030 - begin purge

1033 - water present. Check flow rate ~ 400mL/min.

1040 - begin collecting parameters.
* DO reading jumping from 9.8 mg/L to 21.7 mg/L. Check air line & flow through cell for tight fittings/leaks. Nothing visible. No air bubbles in flow through cell or water line.

1045 - reattempt. DO readings still varying substantially.
* call TTT to ask about trouble shooting options. TTT tech indicates that probe calibrated fine today & last Friday. Only potential trouble shooting is to change-out film & solution on probe, though this was done this morning. Team trys to recalibrate.
- DO mg/L: 10.17 %: 99.86

1100 - retry → still jumps. JUF talks w/ Treat Studies PM to assess next step. Team will head back to field office, replace film/solution on probe & head to DA089 to see if problem is resolved

1110 - JUF contacts P. Lundberg & requests a stand alone DO meter also be shipped for field effort to alleviate any further DO reading concerns

JBER GW LTM/Treat Studies 9/8/14

1135 - contact Range Control & check out of Poleline Road.
1145 - onsite field office. ML replaces filter/solution. Recalibrate. DO mg/L 10.23 (hi). Set up & test w/ clean water run through flow-through cell. Still fluctuating.
1220 (JUE) - call TTT. Arrange to have courier deliver replacement YSI. Team will meet courier @ main gate.
1324 - TTT courier onsite. Exchange units. Team will head to DA089 to test rather than heading back to Poleline due to remoteness of site.
1335 - onsite [DA089 AP3870]. New bladder. (LTM well)
1340 - check DTW: 95.94 & TD: 112.10
* well needs replacement interior & outer casing caps, new lock, & sand. Team adds sand & will replace caps & lock upon return to site.
1350 - begin purge
1400 - water present. check flow rate ~ 250 mL/min
1405 - begin collecting parameters. DO appears normal.
1430 - parameters stabilize

DTW	pH	mS/cm Cond	NTU	mg/L DO	°C Temp	mV ORP
95.96	7.12	0.504	63.7	6.24	7.53	2.6

1435 - Collect sample 14Q3DA089-AP3870-GW-0 for:
- sulfate
- nitrite/nitrate
- methane, ethane, ethene
- Diss. Fe & Mn
- VOCs (8260C)

1445 - decon pump. Mobe to next location
1500 - onsite [DA089 AP-3871] (LTM well)
1505 - collect DTW: 106.97 & TD: 122.00
* well requires additional sand/pea gravel in annular space. Team adds*
1517 - begin purge
1523 - water present. check flow rate ~ 250mL/min
1530 - begin parameter collection
1555 - parameters stabilize

DTW	pH	mS/cm COND	NTU	mg/L DO	°C Temp	mV ORP
106.97	7.36	0.557	16.0	6.06	6.78	-5.7

1600 - Collect sample 14Q3DA089-AP3871-GW-0 for:
- Same analytes as previous location (AP-3870)

1610 - decon pump. Demobe for the day. Samples will be sent on Weds night along w/ Tues & Weds. samples (will remain in site-specific coolers) Team will head back to CG039 tomorrow morning.

JBER GW LTM/Treat Studies 9/8/14

1630 - return to field office. End of day

Jennifer Rame 9/8/14

JBER GW LTM | Treat Studies 9/9/14

Task: return to CG039 to continue sampling at the site.
Personnel: Jennifer Frame (Ulrich) (JUF) - qualified sampler, & Mike Landon (ML) - technician
Project Number: 457958.09.JB.05
Weather: overcast, rain, 57°F

0800 - JUF to main ANC office to pick up additional glassware & supplies received from ASL & DWH.
0855 - onsite field office. ML already onsite. Calibrate YSI (see calibration form). All measurements ok. Conduct H&S brief.
0945 - Call Range control to check in to ~~pole~~ JUF Poleline Road.
0958 - Onsite [CG039 AP-3744] (+ Treatability Study well [2014 4th Q only])
1000 - Collect DTW: 24.90 & TD: 38.71
1008 - begin purge
1012 - water present. Check flow rate ~400 mL/min
1015 - begin collecting parameters
1030 - parameters stabilize

DTW	pH	ms/cm cond	NTU	DO mg/L	°C Temp	mV ORP
24.91	7.08	0.318	6.45	6.92	4.63	6.4

1035 - collect sample 14Q3CG039-AP3744-GW-0 for:
- Chloride, sulfate, VFA
- Alkalinity
- nitrate/nitrite
- sulfide
- methane, ethane, ethene
- Diss. Fe & Mn
- VOCs
- TOCs

* Ferrous iron field test = 0.00 mg/L

1055 - decon pump. Mobe to next location
1115 - onsite ~~[CG039 AP-3989]~~ JUF [CG039 AP-3989] (+ Treat Study well [2014 4th Q])
1200 - Collect DTW: 25.55 & TD: 36.80
* No dedicated tubing present. Team cuts Teflon-lined tubing to fit well. Will leave in well when done
- Added pea gravel to annular space
1132 - begin purge. check flow rate ~250 mL/min
1140 - collect parameters
1205 - parameters stabilize

DTW	pH	ms/cm cond	NTU	mg/L DO	°C Temp	mV ORP
25.66	7.43	0.712	2.02	1.03	5.89	-119.0

1210 - Collect sample 14Q3CG039-AP3989-GW-0 for:
- Same analytes as ~~above~~ JUF previous well

* Ferrous iron field test = 3.30 mg/L

JBER GW LTM / Treatability Studies 9/9/14

1223 - decon pump. Demobe. move to next location.
1235 - onsite CG039 AP-3983R (Treatability Study Well)
1242 - Collect DTW: 23.70 & TD: 45.50
* upon removing tubing, observed thick black coating/staining on outside of tubing. Able to wipe some off, but much is stained. Interval of black staining appears to ~~co~~ INF correlate to water column length.
1255 - begin purge
1303 - water present. check flow rate ~ 300 mL/min
* black particulate present in water, not impacting NTUs
1310 - begin collecting parameters
1325 - parameters stabilize

DTW	pH	ms/cm cond	NTU	mg/L DO	°C Temp	mV ORP
24.01	7.05	1.362	21.0	1.20	7.34	-94.2

1330 - Collect sample 14Q3CG039-AP3983R-GW-0 for:
• same analytes as previous well
* Ferrous iron field test = 3.30 mg/L
1345 - decon pump. Mobe next location.
1405 - onsite ~~CG039 AP-3983R~~ INF CG039 AP-4550 (Treat Study Well)
1413 - Collect DTW: 22.63 & TD: 43.50 * White substance (likely EVOs) observed on tubing
1417 - begin purge
1420 - water present. Check flow rate ≈ 400 mL/min
1425 - begin collecting parameters
1450 - parameters stabilize

DTW	pH	ms/cm cond	NTU	mg/L DO	°C Temp	mV ORP
22.65	6.76	0.370	49.2	0.90	6.00	-96.2

1455 - Collect sample 14Q3CG039-AP4550-GW-0
↳ collect MS sample 14Q3CG039-AP4550-GW-0MS
↳ collect MSD sample 14Q3CG039-AP4550-GW-0SD
1500 - collect DUP sample 14Q3CG039-AP4550-GW-1
for:
• Same analytes as previous well
* Ferrous iron field ~~test~~ = 3.01 mg/L
1580 - Decon pump. Demobe for day.
1625 - back to field office.
1645 - end of day

Jennifer Frame 9/9/14

JBER GW LTM | Treat Studies 9/10/14

TASK: Complete GW sampling @ CG039. Conduct water level survey @ CG039. Ship samples. Prep for sampling @ DA089.

Personnel: Jennifer Frame (JUF) → qualified sampler, SM
Annika Seay (AS) → qualified sampler, ~~tech~~ (JUF)
Mike Landon (ML) → technician

Project number: 457958.09.JB.05

Weather: rain, 55°F

0730 - JUF onsite main ANC office to pick up replacement YSI multimeter & DO probe (backup if experience DO issues in field), & additional TBs (original batch had large air bubbles [>pea size] in majority of TBs).

0800 - pick up weather proof labels from Ice Depot.

0805 - drop-off TT YSI rental

0840 - JUF onsite field w/ ice. AS & ML already onsite. Conduct H&S brief. Calibrate New YSI. Pack for days effort. Change out bladder.

0950 - check in w/ Range control

1005 - onsite [CG039 AP-4525] (+ Treat Study [2014 4th Qrt. Only])

~~1035~~ (JUF) / 1015 - collect DTW: 126.58 & TD: 129.00
* no tubing present. Team cuts tubing & dedicates to well.

~~1040~~ (JUF) · Very little water present in well. Will attempt to run bladder pump.

1018 - begin purge. No water in line. Not enough head pressure to pull (intake is @ ~1 ft from bottom of pump).

~~1040~~ 1038 - Call Treatability Studies SM, A. Castor to discuss. This well was added for additional data & support treatability studies efforts. Team will try bailer to see if any volume can be recovered.

~~1052~~ (JUF)

1043 - bailer pulled. ~ 4 inches of water recovered. Water is brown & very turbid. Run in YSI to check ORP, Temp, cond, etc.

045 - team continues to bail.
- 2nd attempt → no water recovered
- 3rd attempt → no water recovered
- 4th attempt → no water recovered.

1052 - Call Treat Study SM back & relay. Team will move on to next location. Will return to AP-4525 after & try bailing once more.

1105 - onsite [CG039 AP-4551] (Treatability Study well)
- collect DTW: 95.57 & TD: 99.40
* add pea gravel & new lock

1123 - begin purging

1138 - ~~water~~ (JUF) water present. Check flow rate = 100 mL/min

JBER GW LTM/Treat Studies 9/10/14

* Turbidity high (240 NTUs), black particulate present. Will wait for turbidity to drop prior to connecting to YSI.

1148 - Turb. dropped to ~60 NTUs. Connect to YSI.

1150 - ~~bottle~~ (JE) begin collecting parameter

1215 - parameters stabilize

DTW	pH	mS/cm Cond	NTU	mg/L DO	°C Temp	mV ORP
95.60	7.07	0.508	6.56	1.02	8.3	-41.3

1220 - collect sample 14CG039-AP4551-GW-0 for:

- Nitrite/nitrate
- sulfide
- Diss Fe & Mn
- VOCs
- TOC
- chloride/sulfate/VFA
- Alkalinity
- Methane, ethane, ethene

* • Ferrous iron field test = 2.97 mg/L

- drop JE @ field w/ ice

1334 - AS & MH return to CG039 to conduct water level survey

CG039 WL Survey

DATE	TIME	WELL #	DTW	TOTAL DEPTH	NOTES
9-10-14	1405	AP-3744	24.95	~~38.40~~ 38.2	
↓	1435	AP-3747	21.34	33.20	4" well, needs cap
	1440	AP-3746	130.81	174.0	
	1400	AP-3989	25.54	36.35	
	1105	AP-4525	126.58	129.00	
	1455	AP-4344	147.02	166.34	
	1340	AP-4353	32.07	70.4	
9-10-14	1445	AP-~~4550~~ 5246	147.37	163.15	
9-10-14	1545	AP-~~5246~~ 4550	22.65	43.50	
↓	1430	AP-5683	134.69	145.20	
	1425	AP-3745	19.18	30.35	
	1345	AP-3981	20.03	42.0	tubing dropped in well needs fished out
	1410	AP-3982	23.80	37.7	
	1200	~~AP-3569~~ AP-4551	95.60	99.40	
	1500	AP-4350	145.09	191.48	tubing fell in well needs bonded tubing and gravel
	1415	AP-4347	34.90	46.55	
	1450	AP-4349	75.70	85.18	needs bonded tubing and gravel
	1350	AP-3983R	23.74	45.3	

JBER | CGØ39 (ML) | 9.10.14

DATE	TIME	WELL #	~~DTW~~	~~TD~~	NOTES
~~9-10-14~~		AP-4551			

1355 - Bail AP4525. Record measurements:
Temperature 7.8
SC 575
pH 7.79
ORP 153.8 AKS

1500 - Complete CGØ39 WL Survey. Mobe to CH field office.
1510 - Arrive at CH field office. Unload van
~~1515 - ATS mobes to TUØ53 to dig in area to comply with dig permit.~~ AKS
1600 - Collect equipment blank 14B3CGØ39-GWSEBØ1 for analysis of:
- E3ØØ.Ø E3ØØ.ØM
- E31Ø.1
- E353.2
- E376.2
- RSKE175
- SW6Ø1ØB-DISS
- SW8260C
- SW9Ø6Ø

1630 - re ice samples and prepare to ship.
1700 - ML takes samples to airport. End of day.

9.10.14

Appendix A-3
Groundwater Sampling Logs

This page intentionally left blank.

Groundwater Sampling Record

Project Name: JBER GW LTM
Project Location: CG039 - Poleline Rd
Project Number:
Date/Time: 10/16/13 1110
Well ID: AP-3983R
Sample No.: BQ4CG039-AP3983R-GW-0
Sampler(s): M. Oakley & J. Brann
Weather: 50°F Overcast, Winds

Water Level Measurements and Purge Data

Time	Depth of Well (TOC)	Depth to Water (TOC)	Feet of Water in Well	Gallons per Well Volume (2" dia. =0.163 gal/ft, 4" dia.=0.653 gal/ft)
1110	44.85 ☒ Meas. ☐ Hist.	20.16 Initial	24.69	4.02

Water Level Measurement Method: ☒ Electric Tape ☐ Other:
Well Evacuation Method: ☐ Peristaltic Pump ☒ Submersible Pump ☐ Bailer ☐ Other:
Purge Rate: ~250 mL/min
Begin Purge: Time: 1110 Total Volume Purged: ~2 gal
End Purge: Time: 1145 Well Volumes Purged: <1
Purge Water Disposed: ☒ 55-gal Drum POL Yard ☐ Storage Tank ☐ Ground ☐ Liquabin ☐ Other:

Sample Collection Method & Analysis

Sample Type: ☒ Groundwater ☐ Surface Water ☐ Other:
Sample Time: 1145
Sample Collection Method: ☒ Pump Type: QED Bladder Dedicated ☐ Y ☒ N ☐ Bailer ☐ Other:
Decon Procedure: ☐ N/A ☒ Alconox Wash ☒ Tap Rinse ☐ DI Water ☐ Other:
Sample Description (color, turbidity, odor, sheen, etc.): gray, turbid, no odor, no sheen

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis
3	125mL (un-pres)	☐ Glass ☒ Plastic	E300.0, E375.4, E310.1
1	125mL (H_2SO_4)	☐ Glass ☒ Plastic	E353.2
1	125 mL (NaOH+ZnAc)	☐ Glass ☒ Plastic	E376.1
6	40mL (HCl)	☒ Glass ☐ Plastic	RSK-175 + SW8260C
1	125 mL (HNO_3)	☐ Glass ☒ Plastic	SW6020A - Dissolved
2	40mL (H_2SO_4)	☒ Glass ☐ Plastic	SW9060

Notes:
0.0 in well
>3.30 mg/L (exceeds reading capability of HACH) Fe

Sampler Signature: Monica Oakley

Date: 10/16/13 Well ID: AP-3983R

Well Evacuation / Field Parameters

Time	Depth to Water (TOC)	Volume (gallons)	Temp (°C)	Cond (µS/cm)	DO (mg/L)	pH	ORP (mV)	Color/ Turbidity
1120	20.18	0.25	6.49	1004	9.87	6.31	77.6	Grey/ Milky 804.4
1124	20.18	~~0.75~~ 0.5	6.87	994	7.63	6.29	73.8	921.8
1128	20.18	~~1.25~~ 0.75	6.95	1001	7.02	6.30	71.2	692.8
1132	20.18	~~1.75~~ 1.0	6.64	1010	7.94	6.34	65.7	403.9
1136	20.18	~~2.25~~ 1.25	6.66	1012	6.17	6.35	63.8	387.8
1140	20.18	~~2.75~~ 1.5	6.50	1014	7.12	6.36	61.9	380.3
1144	20.18	1.75	6.45	1014	6.37	6.36	60.1	342.7

Notes :

WESTON SOLUTIONS

Groundwater Sampling Record

Project Name: JBER GW LTM
Project Location: CG039- Poleline Rd
Project Number:
Date/Time: 10/15/13 10:00
Well ID: AP-4550
Sample No.: 13Q4CG039-AP4550-GW-0
Sampler(s): M Oakley & J Braun
Weather: Wind + Rain 50°F

Water Level Measurements and Purge Data

Time	Depth of Well (TOC)	Depth to Water (TOC)	Feet of Water in Well	Gallons per Well Volume (2" dia. = 0.163 gal/ft, 4" dia.=0.653 gal/ft)
10:00	43.75 ☒ Meas. ☐ Hist.	20.10 Initial	23.65	3.85

Water Level Measurement Method: ☒ Electric Tape ☐ Other:

Well Evacuation Method: ☐ Peristaltic Pump ☒ Submersible Pump ☐ Bailer ☐ Other:

Purge Rate: ~250 ml/min

Begin Purge: Time: 11:00 Total Volume Purged: ~3 gal

End Purge: Time: 11 45 Well Volumes Purged: <1

Purge Water Disposed: ☒ 55-gal Drum ☐ Storage Tank ☐ Ground ☐ Liquabin ☐ Other:
@ POL Yard

Sample Collection Method & Analysis

Sample Type: ☒ Groundwater ☐ Surface Water ☐ Other:

Sample Time: 1230 & 1235

Sample Collection Method: ☒ Pump Type: QED Bladder Dedicated ☐ Y ☒ N ☐ Bailer ☐ Other:

Decon Procedure: ☐ N/A ☒ Alconox Wash ☒ Tap Rinse ☐ DI Water ☐ Other:

Sample Description (color, turbidity, odor, sheen, etc.): Very turbid, gray/Milky color

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis
1 x 4	500 mL	☐ Glass ☒ Plastic	~~[illegible]~~ ale E300.0 Cl & SO4
1 x 4	125 mL	☐ Glass ☒ Plastic	E 353.2
3 x 4	40 mL	☒ Glass ☐ Plastic	RSK-175
1 x 4	125 mL	☐ Glass ☒ Plastic	SW6010B-Diss
3 x 4	40 mL	☒ Glass ☐ Plastic	SW8260C
		☐ Glass ☐ Plastic	

Notes: Collected 13Q4CG039-AP4550-GW-0 @ 1230 Fe: >3.30 mg/L - limit HACH DR-890 Field test
also collected 13Q4CG039-AP4550-GW-0MS "
-0SD "
-1 @ 1235
1.1 ppm in well

Sampler Signature: [signature]

Date: 10/15/13 Well ID: AP-4550

Well Evacuation / Field Parameters

Time	Depth to Water (TOC)	Volume (gallons)	Temp (°C)	Cond (mS/cm)	DO (mg/L)	pH	ORP (mV)	Color/ Turbidity
1118	19.90	0.5	5.97	0.573	13.07	6.58	39.5	Gray 166.1
1123	19.90	1.0	5.89	0.571	13.02	6.68	40.0	163.7
1126	19.90	1.25	5.83	0.577	11.63	6.68	40.4	221.1
1130	19.90	1.75	5.77	0.592	9.01	6.62	40.7	607.2
1137	19.90	2.25	5.70	0.620	6.78	6.55	41.2	Too high to Read
1145	19.90	2.75	5.69	0.637	5.01	6.54	40.7	"

Notes :

Groundwater Sampling Record

Project Name: JBER GW LTM
Project Location: CG039 - Poleline Rd
Project Number:
Date/Time: 10/16/13 0900
Well ID: AP-455I
Sample No.: 13Q4CG039-AP455I-GW-0
Sampler(s): M. Oakley & J. Braun
Weather: 50°F Overcast, winds

Water Level Measurements and Purge Data

Time	Depth of Well (TOC)	Depth to Water (TOC)	Feet of Water in Well	Gallons per Well Volume (2" dia. = 0.163 gal/ft, 4" dia.=0.653 gal/ft)
0900	98.18 ☒ Meas. ☐ Hist.	95.7 Initial	2.48	0.4

Water Level Measurement Method: ☒ Electric Tape ☐ Other:
Well Evacuation Method: ☐ Peristaltic Pump ☒ Submersible Pump ☐ Bailer ☐ Other:
Purge Rate: ~100 mL/min
Begin Purge: Time: 0900
End Purge: Time: 1020
Total Volume Purged: ~1 gal
Well Volumes Purged: 2.5
Purge Water Disposed: ☒ 55-gal Drum ☐ Storage Tank ☐ Ground ☐ Liquabin ☐ Other:
POL Yard

Sample Collection Method & Analysis

Sample Type: ☒ Groundwater ☐ Surface Water ☐ Other:
Sample Time: 1020
Sample Collection Method: ☒ Pump Type: QED Bladder Dedicated ☐ Y ☒ N ☐ Bailer ☐ Other:
Decon Procedure: ☐ N/A ☒ Alconox Wash ☒ Tap Rinse ☐ DI Water ☐ Other:
Sample Description (color, turbidity, odor, sheen, etc.): Gray, turbid, No odor, No Sheen

Sample Containers

Quantity	Size	Bottle Type		Laboratory Analysis
3	125 mL (Non-pres)	☐ Glass	☒ Plastic	E300M, E375.4, E 310.1
1	125mL (H_2SO_4)	☐ Glass	☒ Plastic	E353.2
1	125 mL (NaOH, ZnAc)	☐ Glass	☒ Plastic	E 376.1
6	40mL (HCl)	☒ Glass	☐ Plastic	RSK-175 & 8260C
1	125 mL (HNO_3)	☐ Glass	☒ Plastic	SW6020A - Diss
2	40mL (H_2SO_4)	☒ Glass	☐ Plastic	SW9060

Notes:

00 ppm in well & BZ.
Fe: 0.05 mg/L w/ HACH DR-890

Sampler Signature: Maureen Oakley

Date: 10/16/13 Well ID: AP-4551

Well Evacuation / Field Parameters

Time	Depth to Water (TOC)	Volume (gallons)	Temp (°C)	Cond (µS/cm)	DO (mg/L)	pH	ORP (mV)	Color/ Turbidity
0940	95.7	0.25	9.42	1.394 m	~~11.34~~	6.67	81.1	>1100
0944	95.7	0.35	9.08	1.302	11.45	6.71	73.1	>1100
0948	95.7	0.45	8.51	1.155	11.62	6.78	62.3	1077
0952	95.7	0.55	8.16	0.982	11.84	6.88	53.1	1008
0956	95.7	0.65	8.07	0.921	11.92	6.94	51.4	645.7
1000	95.7	0.75	8.01	0.843	11.97	7.03	48.3	487.8
1004	95.7	0.85	7.99	0.812	11.98	7.07	48.1	414.7
1008	95.7	0.95	7.96	0.786	11.98	7.11	48.6	297.5

Notes :

WELL PURGE AND SAMPLING FIELD SHEET

CH2MHILL

Well ID: AP-3983R

Project: JBER: LTM - Ptarmigan Rd. CG039 Date: 11/5/14

Project #: Start Time: 1045

Field Team: End Time: 1145

Sample ID: 14Q1CG039-AP3983R-GW-0 Time: 1115 (primary) dup other:

Sample ID: 14Q1CG039-AP3983R-GW-0M Time: 1115 primary dup other: MS

Sample ID: 14Q1CG039-AP3983R-GW-0SD Time: 1115 primary dup other: MSD

Filtered? Y/N 0.45um/1.0um

Depth to Top of Product (FTOC):	/	Depth to Water (FTOC):	21.03
Depth to Oil/Water Interface (FTOC):	/	Total Depth (FTOC):	44.62
Casing diameter: 1 in	2 in.	Water Column (Ft):	23.59
gal/Ft of casing: 0.041	0.163	Casing Volume (gal)	3.85
Pump Intake Depth	40	Screen Interval	unknown
Stable DTW (FTOC):	21.55	Measured Stickup	not measured

Method of Purging (circle one)

Pump: SUB (BLDR) PERIST OTHER:	Bailer: TEFLON SS OTHER:
Pump Type: QED Flow Rate (gpm): 0.1	Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Pump Time: 30 Vol. Purged (gals): 2	Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*
Temperature	>0.00 °C	± 1.0 °C	Time 1106 DTW 21.55
pH	0-14	± 0.1	1106 21.55
Conductivity	0-9.99 S/m	± 3%	1106 21.55
Dissolved Oxygen	0-19.99 mg/L	± 10% or 0.2 mg/L	
Turbidity	0-800 NTU	± 10% or <10 NTU	

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm) µ	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1	1048	21.45	0.25	6.59	967	38.10	7.45	5.17	-55.1
2	1051	21.55	0.50	6.71	955	23.96	6.56	5.12	-61.8
3	1056	21.55	1.00	6.73	946	8.09	4.78	5.11	-78.7
4	1100	21.55	1.50	6.73	940	4.97	4.89	5.11	-78.5
5	1106	21.55	2.0	6.73	939	4.23	4.56	5.11	-79.0
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color:	Clear, Amber, Tan, Brown, (Grey), Milky White, Other:
Odor:	(None), Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity:	None, (Low), (Medium), High, Very Turbid, Heavy Silts

Comments:

Ferrous Iron: 2.36 mg/L

PID= 0.1 ppm in well, 0.0 in B.Z.

WELL PURGE AND SAMPLING FIELD SHEET

CH2MHILL

Well ID: AP-4550

Project: JBER LTM

Date: 1/16/14

Project #:

Start Time: 1425

Field Team: M. Dalley r.J Braun (HNTB)

End Time: 1515

Sample ID: 14QICG039-AP4550-GW-0 Time: 1500 (primary) dup other:

Sample ID: 14QICG039-AP4550-GW-1 Time: 1505 primary (dup) other:

Sample ID: Time: primary dup other:

Filtered? Y/N 0.45um/1.0um

Depth to Top of Product (FTOC):	/	Depth to Water (FTOC):	20.51
Depth to Oil/Water Interface (FTOC):	/	Total Depth (FTOC):	42.99
Casing diameter: 1 in 2 in.		Water Column (Ft):	22.48
gal/Ft of casing: 0.041 (0.163)		Casing Volume (gal)	3.66
Pump Intake Depth	37	Screen Interval	Unknown
Stable DTW (FTOC):	21.22	Measured Stickup	Not measured

Method of Purging (circle one)

Pump: SUB (BLDR) PERIST OTHER:	Bailer: TEFLON SS OTHER:
Pump Type: QED Flow Rate (gpm): ~0.6	Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Pump Time: 30min Vol. Purged (gals): 2	Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*
Temperature	>0.00 °C	± 1.0 °C	Time 1442 DTW 21.21
pH	0-14	± 0.1	1453 21.22
Conductivity	0-9.99 S/m	± 3%	1453 21.22
Dissolved Oxygen	0-19.99 mg/L	± 10% or 0.2 mg/L	
Turbidity	0-800 NTU	± 10% or <10 NTU	

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1	1430	21.18	0.25	6.37	432	150.2	10.95	4.63	-57.8
2	1434	21.19	0.50	6.43	441	130.4	4.64	4.81	-77.4
3	1438	21.18	0.75	6.42	478	78.75	4.69	4.88	-74.2
4	1442	21.21	1.0	6.34	517	38.90	4.85	4.92	-63.8
5	1446	21.22	1.25	6.27	536	19.40	5.16	4.92	-52.2
6	1449	21.22	1.5	6.26	533	18.54	4.52	4.92	-50.3
7	1453	21.22	1.75	6.27	526	17.29	4.21	4.92	-50.5
8									
9									

Notes Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well

Sensory Observations

Color:	Clear, Amber, Tan, Brown, (Grey), Milky White, Other:
Odor:	(None), Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity:	None, Low, (Medium), High, Very Turbid, Heavy Silts

Comments:

Ferrous Iron = 23.30 mg/L (limit)

PID = 0.2 ppm

WELL PURGE AND SAMPLING FIELD SHEET

CH2MHILL

Well ID: AP-4551

Project: J.BER LTM

Date: 11/12/14

Project #:

Start Time: 1315

Field Team: M.Dakeyo & J.Braun (Alutiiq)

End Time: 1400

Sample ID: 14QICG03AP4551-GW-0 Time: 1345 primary dup other:

Sample ID: Time: primary dup other:

Sample ID: Time: primary dup other:

Filtered? Y/N 0.45um/1.0um

Depth to Top of Product (FTOC):	/	Depth to Water (FTOC):	95.62
Depth to Oil/Water Interface (FTOC):	/	Total Depth (FTOC):	98.18
Casing diameter:	1 in / 2 in.	Water Column (Ft):	2.56
gal/Ft of casing:	0.041 / 0.163	Casing Volume (gal)	0.42
Pump Intake Depth	~97.5'	Screen Interval	/ unknown
Stable DTW (FTOC):	95.65	Measured Stickup	not measured

Method of Purging (circle one)

Pump: SUB BLDR PERIST OTHER:

Pump Type: QED Flow Rate (gpm): 0.5

Pump Time: 30 Vol. Purged (gals): ~1.4

Bailer: TEFLON SS OTHER:

Required Pulls: Bailer Vol. (gals): 0.25/ 0.33

Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*
Temperature	>0.00 °C	± 1.0 °C	Time 1342 DTW 95.65
pH	0-14	± 0.1	1342 95.65
Conductivity	0-9.99 S/m	± 3%	
Dissolved Oxygen	0-19.99 mg/L	± 10% or 0.2 mg/L	1342 95.65
Turbidity	0-800 NTU	± 10% or <10 NTU	

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm) µ	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1	1324	95.63	0.1	~~4.05~~ 6.67	656	77.96	12.23	2.29	-97.2
2	1327	95.63	0.25	6.68	740	116.4	11.66	2.35	-104.8
3	1330	95.65	0.4	6.72	788	98.31	11.56	2.35	-105.4
4	1333	95.65	0.65	6.74	796	108.8	11.61	2.43	-106.2
5	1336	95.65	0.8	6.76	759	103.0	11.67	2.49	-106.5
6	1339	95.65	0.95	6.78	721	98.26	11.75	2.54	-104.7
7	1342	9565	1.1	6.79	697	84.38	11.76	2.53	-102.3
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approxmately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: Clear, Amber, Tan, Brown to Grey, Milky White, Other:

Odor: None, Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown

Turbidity: None, Low, Medium, High, Very Turbid, Heavy Silts

Comments:

Ferrous Iron >3.30 mg/L (limit)

PID = 0.2 ppm

WELL PURGE AND SAMPLING FIELD SHEET

CH2MHILL

Well ID: AP-3983R

Project: JBER LTM

Date: 4/15/14

Project #:

Start Time: 1045

Field Team: M. DeVoy, Weiss, J. Braun (Ahtna)

End Time: 1140

Sample ID: 1492CG039-AP3983R-GW Time: 1125 primary dup other:

Sample ID: Time: primary dup other:

Sample ID: Time: primary dup other:

Filtered? Y/N 0.45um/1.0um

Depth to Top of Product (FTOC):		Depth to Water (FTOC):	23.99
Depth to Oil/Water Interface (FTOC):		Total Depth (FTOC):	44.65
Casing diameter: 1 in	2 in.	Water Column (Ft):	20.56
gal/Ft of casing: 0.041	0.163	Casing Volume (gal)	3.35
Pump Intake Depth	~40'	Screen Interval	
Stable DTW (FTOC):		Measured Stickup	

Method of Purging (circle one)

Pump: SUB (BLDR) PERIST OTHER:	Bailer: TEFLON SS OTHER:
Pump Type: Teflon Flow Rate (gpm):	Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Pump Time: QED Vol. Purged (gals):	Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	>0.00 °C	± 1.0 °C		
pH	0-14	± 0.1	1108	24.62
Conductivity	0-9.99 S/m	± 3%	1108	24.62
Dissolved Oxygen	0-19.99 mg/L	± 10% or 0.2 mg/L	1118	24.62
Turbidity	0-800 NTU	± 10% or <10 NTU		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	1053	24.45	0.2	6.68	1.342	17.05	0.76	5.15	-50.9
2	1056	24.46	0.5	6.72	1.356	12.99	0.59	4.97	-83.4
3	1100	24.51	~~0.75~~ 1.0	6.75	1.383	6.97	0.55	4.94	-96.2
4	1104	24.51	1.5	6.77	1.392	5.42	0.41	4.90	-101.9
5	1108	24.62	2.0	6.78	1.402	6.05	0.32	4.92	-105.6
6	1113	24.62	2.5	6.81	1.414	4.02	0.27	4.95	-111.1
7	1118	24.62	3.0	6.79	1.419	4.32	-0.25	4.97	-111.9
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: (Clear) Amber, Tan, Brown, Grey, Milky White, Other:

Odor: (None), Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown

Turbidity: None, (Low) Medium, High, Very Turbid, Heavy Silts

Comments: Tubing coated in black. Depth to bottom of well was difficult to determine due to soft sediment at bottom

Fe = 3.30 mg/L (Limit of HACH)

0.0 ppm in well

WELL PURGE AND SAMPLING FIELD SHEET

CH2MHILL

Well ID: AP-4550

Project: JBER LTM

Date: 4/15/14

Project #:

Start Time: 1255

Field Team: J. Oakley, L. Hess, J. Braun

End Time:

Sample ID: 14Q2CG039-AP4550-GW-0 Time: 1400 (primary) dup other:

Sample ID: 14Q2CG039-AP4550-GW-0MS Time: 1400 primary dup other: MS

Sample ID: 14Q2CG039-AP4550-GW-0SD Time: 1400 primary dup other: MSD

Filtered? Y/N 0.45um/1.0um SW6010B-DISS

Depth to Top of Product (FTOC):		Depth to Water (FTOC):	22.79
Depth to Oil/Water Interface (FTOC):		Total Depth (FTOC):	42.75
Casing diameter: 1 in	2 in.	Water Column (Ft):	19.96
gal/Ft of casing: 0.041	0.163	Casing Volume (gal)	3.25
Pump Intake Depth	~40'	Screen Interval	
Stable DTW (FTOC):		Measured Stickup	

Method of Purging (circle one)

Pump: SUB BLDR PERIST OTHER:	Bailer: TEFLON SS OTHER:
Pump Type: Flow Rate (gpm):	Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Pump Time: Vol. Purged (gals):	Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization* Time	DTW
Temperature	>0.00 °C	± 1.0 °C		
pH	0-14	± 0.1		
Conductivity	0-9.99 S/m	± 3%		
Dissolved Oxygen	0-19.99 mg/L	± 10% or 0.2 mg/L		
Turbidity	0-800 NTU	± 10% or <10 NTU		

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1	1310	23.11	0.25	6.74	0.335	155.9	0.72	5.28	-54.8
2	1315	23.03	0.50	6.68	0.333	177.4	0.34	4.94	-61.9
3	1320	23.03	0.75	6.69	0.338	101.2	0.25	4.94	-64.8
4	1325	23.15	1.0	6.70	0.344	57.6	0.22	4.98	-67.3
5	1330	23.15	1.25	6.70	0.349	28.6	0.20	4.96	-69.8
6	1335	23.20	1.5	6.68	0.354	14.68	0.18	5.00	-71.1
7	1340	23.22	1.75	6.69	0.356	11.56	0.18	5.01	-71.8
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: Clear, Amber, Tan, Brown, (Grey), Milky White, Other:

Odor: (None), Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown

Turbidity: None, Low, (Medium), High, Very Turbid, Heavy Silts

Comments:

Appears to be a very small hole in air tube @ 2.5' from the top. We are able to sample, but tube may need to be replaced 0.2 ppm in well & 0.0 in BZ.

Fe: 3.30 (Limit)

WELL PURGE AND SAMPLING FIELD SHEET

CH2MHILL

Well ID: AP-455I

Project: JBER UTM

Project #:

Field Team: M. Oakley, L. Hess, J. Brann (Antea)

Date: 4/15/14

Start Time: 1155

End Time:

Sample ID: 14Q2CG039-AP455I-GW-0 Time: 1245 (primary) dup other:

Sample ID: Time: primary dup other:

Sample ID: Time: primary dup other:

Filtered? Y/N 0.45um/1.0um

Depth to Top of Product (FTOC):		Depth to Water (FTOC):	95.45
Depth to Oil/Water Interface (FTOC):		Total Depth (FTOC):	97.95
Casing diameter: 1 in	(2 in.)	Water Column (Ft):	2.50
gal/Ft of casing: 0.041	(0.163)	Casing Volume (gal)	0.42
Pump Intake Depth	~97'	Screen Interval	
Stable DTW (FTOC):		Measured Stickup	

Method of Purging (circle one)

Pump: SUB BLDR PERIST OTHER:	Bailer: TEFLON SS OTHER:
Pump Type: Flow Rate (gpm):	Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Pump Time: Vol. Purged (gals):	Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	>0.00 °C	± 1.0 °C		
pH	0-14	± 0.1	1235	95.55
Conductivity	0-9.99 S/m	± 3%		
Dissolved Oxygen	0-19.99 mg/L	± 10% or 0.2 mg/L		
Turbidity	0-800 NTU	± 10% or <10 NTU		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	1210	95.54	0.2	6.67	0.558	31.32	1.35	4.86	-78.9
2	1215	95.55	0.4	6.81	0.480	8.42	0.95	4.72	-78.6
3	1220	95.55	0.6	6.91	0.476	4.88	0.72	4.65	-74.4
4	1225	95.55	0.8	6.94	0.470	2.86	0.66	4.66	-71.0
5	1230	95.55	1.0	6.95	0.468	2.29	0.61	4.68	-69.9
6	1235	95.55	1.2	6.97	0.466	1.82	0.58	4.68	-68.8
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: (Clear), Amber, Tan, Brown, Grey, Milky White, Other:

Odor: (None), Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown

Turbidity: None, (Low), Medium, High, Very Turbid, Heavy Silts

Comments: Fe - 2.86 mg/L

12.6 ppm in well & 0.0 ppm in breathing zone

WELL PURGE AND SAMPLING FIELD SHEET

CH2MHILL

Well ID: AP-3744

Project: Fort Richardson Compliance Sites GW Monitoring CG039

Project #: 457958.09.JB.05

Field Team: Jennifer Ulrich & Mike Landon

Sample ID: 14Q3CG039-AP3744-GW-0 Time: 1035 (prim.) dup other:

Sample ID: Time: primary dup other:

Sample ID: Time: primary dup other:

Filtered? Yes (0.45um/1.0um)

Date: 9/9/14

Start Time: 1008

End Time: 1108

Depth to Top of Product (FTOC):	N/A	Depth to Water (FTOC):	24.90
Depth to Oil/Water Interface (FTOC):	N/A	Total Depth (FTOC):	38.71
Casing diameter:	~~2 in.~~ 4 in.	Water Column (Ft):	13.81
gal/Ft of casing:	~~0.153~~ 0.653	Casing Volume (gal)	9.02
Pump Intake Depth	30	Screen Interval	26.5-36.5
Stable DTW (FTOC):	24.91	Measured Stickup	2.8ft

Method of Purging (circle one)

Pump: SUB ~~BLDR~~ PERIST OTHER:	Bailer: TEFLON SS OTHER:
Pump Type: QED Flow Rate (gpm): 0.1	Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Pump Time: 1008/1108 Vol. Purged (gals): 2.0	Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	>0.00 °C	± 1.0 °C	1015	24.91
pH	0-14	± 0.2	1020	24.91
Conductivity	0-9.99 S/m	± 3%	1025	24.91
Dissolved Oxygen	0-19 99 mg/L	± 10%	1030	24.91
Turbidity	0-800 NTU	± 10% (≥10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*	
1	1015	24.91	~0.5	7.15	0.574	10.6	8.64	4.96	8.7	
2	1020	24.91	~1.0	7.08	0.314	9.20	7.54	4.78	6.0	
3	1025	24.91	~1.5	7.06	0.315	8.07	7.19	4.65	5.7	
4	1030	24.91	~2.0	7.06	0.318	6.45	6.92	4.63	6.4	SAMPLE COLLECT
5	1035									
6										
7										
8										
9										

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or 1 gal/min) and 2) continually measuring water levels in the well

Sensory Observations

Color: (Clear) ~~Amber~~ Tan, Brown, Grey, Milky White, Other:

Odor: (None) Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown

Turbidity: None, (Low), Medium, High, Very Turbid, Heavy Silts

Comments: Collected Ferrous Iron field test = 0.00 mg/L

WELL PURGE AND SAMPLING FIELD SHEET

CH2MHILL

Well ID: AP-3747

Project: Fort Richardson Compliance Sites GW Monitoring C6039

Project #: 457958.09. JB.05

Date: 9/5/14

Start Time: 1347

End Time: 1437

Field Team: Jennifer Ulrich & Mike Landon

Sample ID: 14Q3C6D39-AP3747-GW-0 Time: 1415 (PRI) dup other:

Sample ID: Time: primary dup other:

Sample ID: Time: primary dup other:

Filtered? Yes (0.45um) 1.0um

Depth to Top of Product (FTOC):	N/A	Depth to Water (FTOC):	21.29
Depth to Oil/Water Interface (FTOC):	N/A	Total Depth (FTOC):	33.60
Casing diameter:	~~2 in.~~ 4 in.	Water Column (Ft)	12.41
gal/Ft of casing:	~~0.163~~ 0.653	Casing Volume (gal)	JUF ~~2.02~~ 8.10
Pump Intake Depth	38	Screen Interval	
Stable DTW (FTOC):	21.44	Measured Stickup	~3 ft

Method of Purging (circle one)

Pump: SUB BLDR PERIST OTHER:
Pump Type: QED Flow Rate (gpm): ~0.1
Pump Time: 50 min Vol. Purged (gals): 2

Bailer: TEFLON SS OTHER:
Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization* Time	DTW
Temperature	>0.00 °C	± 1.0 °C	1355	21.32
pH	0-14	± 0.2	1400	21.42
Conductivity	0-9.99 S/m	± 3%	1405	21.44
Dissolved Oxygen	0-19.99 mg/L	± 10%	1410	21.44
Turbidity	0-800 NTU	± 10% (≥10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	1355	21.32	0.5 ~	7.64	0.219	6.66	1.56	4.46	240.1
2	1400	21.42	~1.0	7.61	0.216	6.47	1.81	4.43	242.9
3	1405	21.44	~1.5	7.60	0.213	5.63	1	4.65	247.3
4	1410	21.44	~2.0	7.60	0.212	5.19		4.71	250.3
5	1415								
6									
7									
8									
9									

Sample

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or 1 gal/min) and 2) continually measuring water levels in the well

Sensory Observations

Color: (Clear) ~~Amber~~ Tan, Brown, Grey, Milky White, Other:
Odor: (None) Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity: (None) ~~Low~~ Medium, High, Very Turbid, Heavy Silts

Comments:

WELL PURGE AND SAMPLING FIELD SHEET

CH2MHILL

Well ID: AP-3983R

Project: Fort Richardson Compliance Sites GW Monitoring CG039 Date: 9/9/14

Project #: 457958.09.JB.05 Start Time: 1255

Field Team: Jennifer Ulrich & Mike Landon End Time: 1345

Sample ID: 14G03CG039-AP3983R-GW-0 Time: 1330 (prim) dup other: —

Sample ID: _____ Time: _____ primary dup other: _____

Sample ID: _____ Time: _____ primary dup other: _____

Filtered? Yes (0.45um/1.0um)

Depth to Top of Product (FTOC):	N/A	Depth to Water (FTOC):	23.70
Depth to Oil/Water Interface (FTOC):	N/A	Total Depth (FTOC):	45.50
Casing diameter:	(2 in.) 4 in.	Water Column (Ft):	21.80
gal/Ft of casing:	(0.163) 0.653	Casing Volume (gal)	3.55
Pump Intake Depth	35.-	Screen Interval	30-40.
Stable DTW (FTOC):	24.01	Measured Stickup	~4 ft

Method of Purging (circle one)

Pump: SUB (BLDR) PERIST OTHER:	Bailer: TEFLON SS OTHER:
Pump Type: QED Flow Rate (gpm): 0.08	Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Pump Time: ~1hr. Vol. Purged (gals): 1.6	Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	>0 00 °C	± 1.0 °C	1310	23.91
pH	0-14	± 0.2	1315	24.01
Conductivity	0-9.99 S/m	± 3%	1320	24.01
Dissolved Oxygen	0-19 99 mg/L	± 10%	1325	24.01
Turbidity	0-800 NTU	± 10% (≥10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*	
1	1310	23.91	~0.4	7.02	1.353	34.7	1.70	7.57	-102.6	
2	1315	24.01	~0.8	7.04	1.360	23.1	1.24	7.33	-105.0	
3	1320	24.01	~1.2	7.05	1.362	22.1	1.24	7.17	-96.9	
4	1325	24.01	~1.6	7.05	1.362	21.0	1.20	7.34	-94.2	Sample Collect
5	1330									
6										
7										
8										
9										

Notes: Draw-down should ideally be less than 0 3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by 1) pumping at a low rate (approximately 1 liter/ 3 minutes or 1 gal/min) and 2) continually measuring water levels in the well

Sensory Observations

Color: Clear, ~~Amber~~, Tan, Brown, (Grey), Milky White, Other: BLACK PARTICLES

Odor: ~~None~~, Low, (Medium), High, Very Strong, H2S, Fuel Like, Chemical, (Unknown) FISHY

Turbidity: None, (Low), ~~Medium~~, High, Very Turbid, Heavy Silts

Comments: Ferrous Iron field test collected here = 3.30 mg/L

* Black staining/coating on outside of tubing (same length as water column).

~~Slight~~ (Just) Black particulate in water, not impacting NTUs much

WELL PURGE AND SAMPLING FIELD SHEET

CH2MHILL

Well ID: AP-3989

Project: Fort Richardson Compliance Sites GW Monitoring CG039 Date: 9/9/14

Project #: 457958.09. JB.05 Start Time: 1132

Field Team: Jennifer Ulrich & Mike Landon End Time: 1223

Sample ID: 14DJCG039-AP3989-GW-0 Time: 1210 dup other:

Sample ID: Time: primary dup other:

Sample ID: Time: primary dup other:

Filtered? Yes (0.45um)/1.0um

Depth to Top of Product (FTOC):	N/A	Depth to Water (FTOC):	25.55
Depth to Oil/Water Interface (FTOC):	N/A	Total Depth (FTOC):	36.80
Casing diameter:	(2 in.) 4 in.	Water Column (Ft)	11.25
gal/Ft of casing:	(0.163) 0.653	Casing Volume (gal)	1.83
Pump Intake Depth	30.-	Screen Interval	24-34
Stable DTW (FTOC):	25.66	Measured Stickup	2.5ft

Method of Purging (circle one)

Pump: SUB (BLDR) PERIST OTHER:
Pump Type: QED Flow Rate (gpm): 0.06 ~
Pump Time: ~1hr Vol. Purged (gals): 1.8

Bailer: TEFLON SS OTHER:
Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	>0.00 °C	± 1.0 °C	1140	25.65
pH	0-14	± 0.2	1145	25.66
Conductivity	0-9.99 S/m	± 3%	1150	25.66
Dissolved Oxygen	0-19.99 mg/L	± 10%	1155	25.66
Turbidity	0-800 NTU	± 10% (≥10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	1140	25.65	0.3 ~	7.38	0.676	13.6	2.06	6.49	-99.1
2	1145	25.66	~0.6	7.41	0.691	11.8	1.52	6.20	-113.6
3	1150	25.66	~0.9	7.43	0.699	7.71	1.35	6.10	-107.8
4	1155	25.66	~1.2	7.43	0.706	4.77	1.15	6.10	-128.3
5	1200	25.66	~1.5	7.42	0.709	2.73	1.06	5.99	-116.0
6	1205	25.66	~1.8	7.43	0.712	2.02	1.03	5.89	-119.0
7	1210								
8									
9									

Sample ~~Time~~ Collection

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by 1) pumping at a low rate (approximately 1 liter/ 3 minutes or 1 gal/min) and 2) continually measuring water levels in the well

Sensory Observations

Color: (Clear) ~~Amber~~ Tan, Brown, Grey, Milky White, Other:
Odor: (None) Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity: None, (Low), Medium, High, Very Turbid, Heavy Silts

Comments: Collect Ferrous Iron field test here = 3.30 mg/L

WELL PURGE AND SAMPLING FIELD SHEET

CH2MHILL

Well ID: AP-4525

Project: Fort Richardson Compliance Sites GW Monitoring CG039 Date: 9/10/14

Project #: 457958.09 JB.05 Start Time 10.40

Field Team: Jennifer Ulrich & Mike Landon End Time: 1105

Sample ID: _____ Time: _____ dup other: _____

Sample ID: _____ Time: _____ primary dup other: _____

Sample ID: _____ Time: _____ primary dup other: _____

Filtered? Yes (0.45um/) 0.0um

Depth to Top of Product (FTOC):	N/A	Depth to Water (FTOC):	126.58
Depth to Oil/Water Interface (FTOC):	N/A	Total Depth (FTOC):	129.00
Casing diameter:	2 in. (4 in.)	Water Column (Ft):	2.42 ~~2.72~~
gal/Ft of casing:	(0.163) 0.653	Casing Volume (gal)	~~0.44~~ 0.39
Pump Intake Depth	129	Screen Interval	
Stable DTW (FTOC):		Measured Stickup	

Method of Purging (circle one)

Pump: SUB ~~BLDR~~ PERIST OTHER:		Bailer: TEFLON SS OTHER:	
Pump Type:	Flow Rate (gpm):	Required Pulls:	Bailer Vol. (gals): 0.25/ 0.33
Pump Time:	Vol. Purged (gals):	~~Vol Purged (gals):~~	

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	>0.00 °C	± 1.0 °C		
pH	0-14	± 0.2		
Conductivity	0-9.99 S/m	± 3%		
Dissolved Oxygen	0-19.99 mg/L	± 10%		
Turbidity	0-800 NTU	± 10% (≥10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	10:55	126.32	1L	7.85	~~240.38~~ 0.6826	>1000	—	8.6	240.38
2									
3									
4									
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater. Minimal draw-down achieved and measured by 1) pumping at a low rate (approximately 1 liter/ 3 minutes or 1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color:	Clear, ~~Amber~~, Tan, Brown, Grey, Milky White, Other: milky brown
Odor:	(None), Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity:	None, ~~Low~~, Medium, High, Very Turbid, Heavy Silts

Comments:

WELL PURGE AND SAMPLING FIELD SHEET

CH2MHILL

Well ID: AP-4550

Project: Fort Richardson Compliance Sites GW Monitoring CG039

Project #: 457958.09. JB.05

Field Team: Jennifer Ulrich & Mike Landon

Date: 9/9/14

Start Time: 1417

End Time: 1545

Sample ID: 14Q3CG039-AP4550-GW-0 Time: 1455 primary dup other:

Sample ID: 14Q3CG039-AP4550-GW-1 Time: 1500 primary dup other:

Sample ID: 14Q3CG039-AP4550-GW0MS Time: 1455 primary dup other: MS

Sample ID: 14Q3CG039-AP4550-GW-0SD Filtered? Yes 0.45um 1.0um Time: 1455 other: MSD

Depth to Top of Product (FTOC):	N/A	Depth to Water (FTOC):	22.63
Depth to Oil/Water Interface (FTOC):	N/A	Total Depth (FTOC):	43.50
Casing diameter:	2 in. (0.163) / 4 in. 0.653	Water Column (Ft)	20.87
gal/Ft of casing:		Casing Volume (gal)	3.40
Pump Intake Depth	38.	Screen Interval	32-42
Stable DTW (FTOC):	22.65	Measured Stickup	3ft

Method of Purging (circle one)

Pump: SUB BLDR PERIST OTHER:
Pump Type: QED Flow Rate (gpm): 0.1
Pump Time: ~1.5hrs Vol. Purged (gals): 3

Bailer: TEFLON SS OTHER:
Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization* Time	DTW
Temperature	>0.00 °C	± 1.0 °C	1425	22.65
pH	0-14	± 0.2	1430	22.65
Conductivity	0-9.99 S/m	± 3%	1435	22.65
Dissolved Oxygen	0-19.99 mg/L	± 10%	1440	22.65
Turbidity	0-800 NTU	± 10% (≥10 NTU)		

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)	
1	1425	22.65	0.5	6.78	0.354	137	1.43	6.24	-80.3	
2	1430	22.65	~1.0	6.78	0.357	114	1.15	6.15	-81.9	
3	1435	22.65	~1.5	6.78	0.365	67.6	1.07	6.03	-83.4	
4	1440	22.65	~2.0	6.78	0.366	53.9	1.01	6.05	-86.7	
5	1445	22.65	~2.5	6.77	0.370	*51.3	0.93	6.00	-89.5	
6	1450	22.65	~3.0	6.76	0.370	49.2	0.90	6.00	-96.2	PRIMARY, MS/MS
7	1455									SAMPLE
8	~~1500~~ 1500									FD SAMPLE
9										

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or 1 gal/min) and 2) continually measuring water levels in the well

Sensory Observations

Color: Clear, Amber, Tan, Brown, Grey, Milky White, Other:
Odor: None, Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity: None, Low, Medium, High, Very Turbid, Heavy Silts

Comments: Ferrous iron field test collected here = 3.01 mg/L
* White substance (likely EVOs) observed on tubing.

* TURBIDIMETER MALFUNCTIONING

CH2MHILL

WELL PURGE AND SAMPLING FIELD SHEET

Well ID: AP-4551

Project: Fort Richardson Compliance Sites GW Monitoring CG039 Date: 9/10/11

Project #: 457958.09. JB.05 Start Time: 1123

Field Team: Jennifer Ulrich & Mike Landon & Annika Seay End Time: 1300

Sample ID: 14Q3CG039-AP4551-GW-0 Time: 1220 (primary) dup other: —

Sample ID: ______ Time: ______ primary dup other: ______

Sample ID: ______ Time: ______ primary dup other: ______

Sample ID: ______ Time: ______ primary dup other: ______

Filtered? Yes (0.45um)/1.0um

Depth to Top of Product (FTOC): N/A

Depth to Oil/Water Interface (FTOC): N/A

Casing diameter: (2 in.) 4 in.

gal/Ft of casing: (0.163) 0.653

Pump Intake Depth 99

Stable DTW (FTOC): 95.60

Depth to Water (FTOC): 95.57

Total Depth (FTOC): 99.40

Water Column (Ft): 3.83

Casing Volume (gal): 0.624

Screen Interval: JWR N/A

Measured Stickup: ~3.2 ft

Method of Purging (circle one)

Pump: SUB, (BLDR) PERIST OTHER:

Pump Type: QED

Pump Time:

Flow Rate (gpm): 0.03

Vol. Purged (gals): 1.0

Bailer: TEFLON SS OTHER:

Required Pulls:

Vol Purged (gals):

Bailer Vol. (gals): 0.25/ 0.33

Criteria for Stable Parameters

Parameter	Working Range	Stability Criteria
Temperature	>0.00 °C	± 1.0 °C
pH	0-14	± 0.2
Conductivity	0-9.99 S/m	± 3%
Dissolved Oxygen	0-19.99 mg/L	± 10%
Turbidity	0-800 NTU	± 10% (≥10 NTU)

Depth to Water Stabilization (TURBIDITY-STI)

Time	~~DTW~~ ~~NTU~~ DTW
1150	95.60
1155	95.60
1200	95.60
1205	95.60

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1	1150	95.60	~0.5	6.80	0.547	62.7	2.79	8.8	24.8
2	1155	95.60	~0.6	6.87	0.534	36.8	1.74	8.5	-33.0
3	1200	95.60	~0.7	6.93	0.521	19.2	1.45	8.4	-36.8
4	1205	95.60	~0.8	6.97	0.513	9.97	1.17	8.4	-38.0
5	1210	95.60	~0.9	7.03	0.510	8.23	1.12	8.3	-39.9
6	1215	95.60	~1.0	7.07	0.508	6.56	1.02	8.3	-41.3
7	1220								
8									
9									

SAMPLE COLLECTION

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater. Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or 1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: Clear, ~~Amber~~, Tan, Brown, (Grey), Milky White, Other:

Odor: (None), Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown Soft SR

Turbidity: None, ~~Low~~, Medium, High, (Very Turbid), Heavy Silts

Comments: * SUDS IN WATER (AIR/WF) - potentially from EVOs

* TURBIDITY @ 240 NTU - 1140 AM / WAIT FOR TURBIDITY TO DROP BEFORE USING YSI

* Field Ferrous iron test collected = 2.97 mg/L

Appendix A-4
Resume

This page intentionally left blank.

Jennifer Frame

Staff Geologist

Education

B.S., Geosciences, Fort Lewis College Durango, CO, June, 2012

Relevant Coursework:

- Groundwater/ Geochemistry
- Engineering Geology/ Structural Geology
- Environmental Geology/ Environmental Resources
- Mineralogy/Petrology
- Sedimentology/Stratigraphy /Geomorphology
- Geographic Information Systems
- Geology Field Methods
- Geology Field Camp/ Senior Thesis Seminar

Relevant Experience

Ms. Frame is a staff geologist with the Environmental Services Business Group in CH2M HILL's Anchorage office. She has been responsible for sampling crews on projects within Alaska and Washington. Her experience includes site and remedial investigations including evaluating soil and groundwater impacts and conducting long-term monitoring and operations.

Representative Projects

Staff Geologist; Joint Base Elemendorf-Richardson; Anchorage, Alaska, November 2012 – present. Site Manager of Long Term Monitoring (LTM) sites on JBER-Richardson, including State and CERCLA regulated sites. Manage sub-contractors conducting groundwater monitoring and associated Annual report writing tasks. Help to develop and manage budgets for 2013-2014 field work. Worked with Client to ensure deadlines and quality objectives are met. Served as Safety Coordinator and lead geologist on site investigation and characterization efforts at 37 different sites situated on JBER-Richardson. Served as field team lead supporting LTM sampling efforts at four State-regulated (petroleum hydrocarbon) sites, and two CERCLA regulated (chlorinated solvents) sites. Responsible for authoring annual LTM reports, decision documents, and site characterization reports.

Staff Geologist; Alaska Army National Guard Federal Scout Readiness Centers (FSRCs) February – October 2012. Participated in writing work plans to identify the gaps in the data necessary to complete site characterization requirements with the Alaska Department of Environmental Conservation. Help conduct site investigation efforts at 8 different Alaska Army National Guard FSRCs situated in the Yukon-Kuskokwim Delta. Authored characterization reports identifying the nature and extent of contamination, evaluating cumulative risk, and where necessary, proposing alternative cleanup levels.

Project Experience Prior to CH2M HILL

Staff Scientist/Environmental Field Technician, Sealaska Environmental Services, Poulsbo, Washington, April 2011-March 2012. Conducted long-term monitoring and operations on Department of Defense contracts throughout Washington State Naval Facilities. Provided field support for all of the Northwest Contracts serviced by Sealaska Environmental Services (SES). Locations include, but are not limited to: Sub-Base Bangor, Jackson Park Housing Complex (JPHC), Bremerton Naval Complex (BNC), Naval Air Station Whidbey Island (NASWI), and Keyport, Washington. Field support includes groundwater, surface and sediment sampling, institutional controls, reporting and various maintenance tasks. Performed groundwater sampling tasks associated with bio-venting, air sparging, injection well, and monitoring well remediation techniques. Provided support with core logging (hollow auger system) during shallow monitor well installations and decommissioning. Compiled field data for Naval Installation Restoration Information Solutions (NIRIS) submissions using Microsoft excel. Assisted with task order report writing and editing using Microsoft Office software.

REU Intern, Organization for Tropical Studies-Duke University, Las Cruces Biological Station, San Vito, Costa Rica, June-August 2010. Designed and implemented research project assessing nitrate loading/leaching and evaluation of potential contamination risks within tropical top soils in the Rio Java Watershed, located within the Las Cruces Biological Research Station reforestation project. Evaluated long-term impacts of varying land-use types (urban, agricultural, primary and secondary forests) based on nitrate concentrations, soil moisture and percolation rates. Conducted sample collection and analysis, report writing based on results and oral presentation of findings via power point for peers and mentors within the program.

Site Health and Safety Supervisor, Sealaska Environmental Services, Northwest Washington and Alaska, 2005-2009. Performed duties of Site Safety and Health Supervisor on paving project at Sub-base Bangor, Washington. Conducted daily health and safety briefings with all onsite personnel and sub-contractors. Provide information regarding onsite hazards. Reviewed Site Health and Safety Plan with individuals prior to work, collected and filed all pertinent certificates and training documents for onsite personnel. Maintained daily field logbook and weekly checklists. Observed construction techniques, equipment and health and safety compliance.

Performed duties of Site Health and Safety Supervisor, as well as field support on Long Term Monitoring/Operations (LTM/O) annual sampling event on remote location of Former Naval Complex Adak, Alaska. Conducted daily health and safety briefings with onsite personnel concerning hazards associated with daily tasks. Evaluated hazards on location such as volcanic eruptions and associated gases, generator usage, UXO potential, basic topography of area and limited medical assistance availability. Provided support as team lead for designated sampling locations which included groundwater, surface water, sediment and surface soil sampling, collecting GPS coordinates, and assuring proper protocol during sample collection.

Organized and conducted Long Term Monitoring/Operations (LTM/O) events at Naval Air Station Whidbey Island (NASWI) in Oak Harbor, Washington, as Project Field Lead and Site Safety and Health Supervisor. Each LTM/O event was conducted within the scope of a specific Task Order, consisting of both Sampling and Monitoring. Responsible for all necessary sample

coordination, including ordering of supplies (lab and field equipment), organizing personnel, contacting designated Naval Technical Representative (NTR) regarding progress of events, and creating sample matrices is carried out per each event. All events scheduled met or exceeded specific projected completion goals relative to each assigned task.

Provided field support for all of the Northwest Contracts serviced by Sealaska Environmental Services (SES). Locations include, but are not limited to: Former Naval Complex Adak, AK, Sub-Base Bangor, Jackson Park Housing Complex (JPHC), Bremerton Naval Complex (BNC), Naval Air Station Whidbey Island (NASWI), and Keyport, Washington. Field support includes groundwater, surface and sediment sampling, institutional controls, reporting and various maintenance tasks.

Provided support as Assistant Task Order Manager for Project Manager regarding Task Order 33 (NASWI). Conducted research for development of new wells along SR-20 Oak Harbor, WA, including creation of Traffic Control Plan based on WASHDOT requirements and project objectives. Composition of CPR/CQC reports required for submittal to the Program Manager, Project Manager, NTR, and Quality Control Supervisor while field work was being conducted. All documents generated during the project (such as field forms, field logbook, chains of custody, and any deviations) were organized, filed and submitted to the Project Manager, Chemist, and other applicable personnel.

Composition of quarterly and annual Long Term Monitoring/Operations reports for various sites such as NASWI Area 6, 31, and 42, NASWI Fuel Farms (1,2,3 and 4), JPCH, Keyport and Former Naval Complex Adak, AK.

Certifications

- 40 hr. HAZWOOPER Cert. (Complies with OSHA 29 CFR 1910.120) November 2005
- 8 hr. C4 HAZWOOPER refresher Cert. (OSHA 29 CFR 1910.120) Current (2013)
- First Aid/CPR/AED/BBP Cert. Current (2013)
- Construction Safety and Health Cert. (OSHA compliance) July 2006

Training

- DOT Training (DOT/HM-126F HAZMAT 49 CFR 172, Subpart H) June 2006
- Waste Management Training (40 CFR 265.16) June 2006
- C4 HAZWOPER Supervisor Training August 2006
- Project Management Training December 2006

Educational Awards

- American Geological Institute Minority Participation Program Fall 2011
- Fort Lewis College Writing Program Essay Contest-
  Technical and Professional Writing Category; Honorable Mention Winter 2010
- Inductee; Native American Honor Society of Fort Lewis College Winter 2010
- CO-AMP Academic Achievement Award, Fort Lewis College Fall 2009
- CO-AMP Academic Excellence Award, Fort Lewis College Fall 2009

Volunteer Experience

- President; Geology Club (2011-2012 Fort Lewis College, Durango, CO)
- President; Native American Honor Society (2010-2011 Fort Lewis College, Colorado)
- Presenter; Native American Leadership Forum, Fort Lewis College-Presentation representing Native American Honor Society (2010)
- Collaboration of Leadership in Legislation Impacting Native American Communities.
- Bio-Chemistry Senior Seminar Project, Fort Lewis College (2010)
- Volunteer member of study for diabetes research among Native American students
- Participant; Environmental Science Club, Southern Oregon University- Geology Field Studies
- Explored and sampled locations along Southern Oregon Coastline (2002)

Employment History

February 2012 - Current, CH2M HILL, Anchorage, Alaska, Staff Geologist

April 2011- March 2012, Sealaska Environmental Services, Poulsbo, Washington, Staff Scientist and Environmental Field Technician

June-August 2010, Duke University, Las Cruces Biological Station, San Vito, Costa Rica, REU Intern.

2005-2009, Sealaska Environmental Services, Northwest Washington and Alaska, Site Health and Safety Supervisor.

Appendix B
Analytical Results Tables

This page intentionally left blank.

Groundwater Raw Analytical Results
November 2014

Table B-1: Groundwater Sample Results - AP-3983R

Analyte	Location Sample ID / Sample Depth (ft) / Sample Date / Screening Level	Screening Level Source	AP-3983R			
			13Q4CG039-AP3983R-GW-0	14Q1CG039-AP3983R-GW-0	14Q2CG039-AP3983R-GW-0	14Q3CG039-AP3983R-GW-0
			30 - 40	30 - 40	30 - 40	30 - 40
			10/16/2013	1/16/2014	4/15/2014	9/9/2014
Metals (MG/L)						
Iron, dissolved	NA	NA	**64.7**	**27.5**	**60.9**	**50.9**
Manganese, dissolved	NA	NA	**5.11**	**4.24**	**4.31**	**2.73**
VOCs (ug/L)						
1,1,1,2-Tetrachloroethane	NA	NA	0.25 U	0.3 U	3 U	0.3 U
1,1,1-Trichloroethane	200	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
1,1,2,2-Tetrachloroethane	4.3	2012 ADEC Table C GW	**472**	**521**	**301**	**332**
1,1,2-Trichloroethane	5	EPA MCL	**12.4**	**65.5**	**71.6**	**24.4**
1,1,2-Trichlorotrifluoroethane	1100000	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
1,1-Dichloroethane	7300	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
1,1-Dichloroethene	7	EPA MCL	**3.62**	**6.71**	**6.74**	**8.12**
1,1-Dichloropropene	NA	NA	0.25 U	0.3 U	3 U	0.3 U
1,2,3-Trichlorobenzene	NA	NA	0.25 U	0.3 U	3 U	0.3 U
1,2,3-Trichloropropane	0.12	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
1,2,4-Trichlorobenzene	70	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
1,2,4-Trimethylbenzene	1800	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
1,2-Dibromo-3-Chloropropane	0.2	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
1,2-Dichlorobenzene	600	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
1,2-Dichloroethane	5	EPA MCL	**0.81**	**0.87**	**1.67 J**	**1.06**
1,2-Dichloropropane	5	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
1,3,5-Trimethylbenzene	1800	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
1,3-Butadiene	NA	NA	0.25 U	0.3 U	3 U	0.3 U
1,3-Dichlorobenzene	3300	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
1,3-Dichloropropane	NA	NA	0.25 U	0.3 U	3 U	0.3 U
1,4-Dichlorobenzene	75	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
2,2-Dichloropropane	NA	NA	0.25 U	0.3 U	3 U	0.3 U
2-Butanone (MEK)	200000	EPA MCL	**34.1**	**28.9**	10 U	**11.4**
2-Chlorotoluene	NA	NA	0.25 U	0.3 U	3 U	0.3 U
2-Hexanone	NA	NA	1 U	1 U	10 U	1 U
4-Chlorotoluene	NA	NA	0.25 U	0.3 U	3 U	0.3 U
4-Methyl-2-Pentanone (MIBK)	2900	2012 ADEC Table C GW	1 U	1 U	10 U	1 U
Acetone	33000	2012 ADEC Table C GW	**7.58 B**	**9.06**	10 U	**4.21 B**
Benzene	5	EPA MCL	**0.98**	**1.25**	3 U	**0.9**
Bromobenzene	NA	NA	0.25 U	0.3 U	3 U	0.3 U
Bromochloromethane	NA	NA	0.25 U	0.3 U	3 U	0.3 U
Bromodichloromethane	80	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
Bromoform	80	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
Bromomethane	51	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.5 U
Carbon Disulfide	3700	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
Carbon Tetrachloride	5	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
Chlorobenzene	100	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
Chloroethane	290	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
Chloroform	80	EPA MCL	**3.93**	**0.93**	3 U	0.3 U
Chloromethane	66	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
cis-1,2-Dichloroethene	70	EPA MCL	**207**	**1470**	**2260**	**4070**
cis-1,3-Dichloropropene	8.5	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
Cyclohexane	NA	NA	0.25 U	0.3 U	3 U	0.3 U
Dibromochloromethane	80	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
Dibromomethane	NA	NA	0.25 U	0.3 U	3 U	0.3 U
Dichlorodifluoromethane	7300	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
Ethylbenzene	700	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
Ethylene Dibromide (EDB)	0.05	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
Hexachlorobutadiene	7.3	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
Isopropylbenzene	3700	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
m- & p-Xylene	10000	EPA MCL	0.5 U	0.6 U	6 U	0.6 U

Groundwater Raw Analytical Results
November 2014

Table B-1: Groundwater Sample Results - AP-3983R

Analyte	Location Sample ID / Sample Depth (ft) / Sample Date	Screening Level Source	Screening Level	AP-3983R			
				13Q4CG039-AP3983R-GW-0	14Q1CG039-AP3983R-GW-0	14Q2CG039-AP3983R-GW-0	14Q3CG039-AP3983R-GW-0
				30 - 40	30 - 40	30 - 40	30 - 40
				10/16/2013	1/16/2014	4/15/2014	9/9/2014
Methyl tert-Butyl Ether (MTBE)	470	2012 ADEC Table C GW		0.25 U	0.3 U	3 U	0.3 U
Methylene Chloride	5	EPA MCL		0.25 U	0.3 U	3 U	0.3 U
n-Butylbenzene	370	2012 ADEC Table C GW		0.25 U	0.3 U	3 U	0.3 U
n-Hexane	NA	NA		0.25 U	0.3 U	3 U	0.3 U
n-Propylbenzene	370	2012 ADEC Table C GW		0.25 U	0.3 U	3 U	0.3 U
Naphthalene	730	2012 ADEC Table C GW		0.25 U	0.3 U	3 U	0.3 U
o-Xylene	10000	EPA MCL		0.25 U	0.3 U	3 U	0.3 U
p-Isopropyltoluene	NA	NA		0.25 U	0.3 U	3 U	0.3 U
sec-Butylbenzene	370	2012 ADEC Table C GW		0.25 U	0.3 U	3 U	0.3 U
Styrene	100	EPA MCL		0.25 U	0.3 U	3 U	0.3 U
tert-Butylbenzene	370	2012 ADEC Table C GW		0.25 U	0.3 U	3 U	0.3 U
Tetrachloroethene (PCE)	5	EPA MCL		**20.9**	**27.8**	**3.44 J**	**0.79**
Toluene	1000	EPA MCL		0.25 U	0.3 U	3 U	0.3 U
Total Xylenes	10000	EPA MCL		0.75 U	0.75 U	7.5 U	0.75 U
trans-1,2-Dichloroethene	100	EPA MCL		**71.4**	**113**	**99.9**	**98.8**
trans-1,3-Dichloropropene	8.5	2012 ADEC Table C GW		0.25 U	0.3 U	3 U	0.3 U
Trichloroethene (TCE)	5	EPA MCL		**1820**	**1190**	**118**	**12.4**
Trichlorofluoromethane	11000	2012 ADEC Table C GW		0.25 U	0.3 U	3 U	0.3 U
Vinyl Acetate	37000	2012 ADEC Table C GW		0.5 U	0.3 U	3 U	0.5 U
Vinyl Chloride	2	EPA MCL		**0.32 J**	**14.1**	**16.5**	**43.7**
Dissolved Gases (UG/L)							
Ethane	NA	NA		**0.226 J**	**0.0936 J**	**0.242 J**	**0.943**
Ethylene	NA	NA		**0.252 J**	**0.253 J**	**0.501**	**2.36**
Methane	NA	NA		**15.8**	**11.8**	**29.9**	**720**
General Chemistry (MG/L)							
Alkalinity, bicarb. (as CaCO3)	NA	NA		**194**	**506**	**289**	**1590**
Alkalinity, carb. (as CaCO3)	NA	NA		5 U	5 U	5 U	5 U
Alkalinity, bicarb. (as CaCO3)	NA	NA		**194**	**506**	**289**	**1590**
Chloride	NA	NA		- -	**3.56**	**6.66**	**7.77**
Nitrogen, Nitrate-Nitrite	10	EPA MCL		**0.191**	**0.0847**	**0.155**	**0.173**
Sulfate	NA	NA		**369**	**84.5**	**3.01**	**0.557**
Sulfide	NA	NA		**0.705**	**0.264**	**5.16**	**2.05**
Total Alkalinity	NA	NA		**194**	**506**	**289**	**1590**
Total Organic Carbon	NA	NA		**3.96**	**61.6**	**93.2**	**138**
Organic Acids by IC (ug/L)							
Acetic Acid	NA	NA		**15700**	**148000**	**152000**	**179000**
Butyric Acid	NA	NA		**1210**	200 U	**2890**	**7230**
Formic Acid	NA	NA		**872**	60 U	100 U	40 U
Lactic Acid	NA	NA		60 U	1200 U	2000 U	400 U
Propionic Acid	NA	NA		**33400**	4000 U	**34900**	**72100**
Pyruvic Acid	NA	NA		100 U	200 U	200 U	80 U

Notes:

NA = No screening level exists

"--" = sample not collected

B = The analyte was detected in the associated method and/or calibration blank.

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

mg/l = Milligrams per Liter

ug/l = Micrograms per Liter

Bold indicates the analyte was detected

Shading indicates the result exceeded screening criteria

Groundwater Raw Analytical Results
November 2014

Table B-2: Groundwater Sample Results - AP-4550

Analyte	Location	Screening Level Source	AP-4550						
	Sample ID		13Q4CG039-AP4550-GW-0	13Q4CG039-AP4550-GW-1	14Q1CG039-AP4550-GW-0	14Q1CG039-AP4550-GW-1	14Q2CG039-AP4550-GW-0	14Q3CG039-AP4550-GW-0	14Q3CG039-AP4550-GW-1
	Sample Depth (ft)		32 - 42	32 - 42	32 - 42	32 - 42	32 - 42	32 - 42	32 - 42
	Sample Date		10/15/2013	10/15/2013	1/16/2014	1/16/2014	4/15/2014	9/9/2014	9/9/2014
	Screening Level								
Metals (MG/L)									
Iron, dissolved	NA	NA	**14.7**	**14**	**35.8**	**35.9**	**27.3**	**25.6**	**25.3**
Manganese, dissolved	NA	NA	**1.18**	**1.19**	**1.75**	**1.75**	**1.07**	**0.983**	**0.973**
VOCs (ug/L)									
1,1,1,2-Tetrachloroethane	NA	NA	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
1,1,1-Trichloroethane	200	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
1,1,2,2-Tetrachloroethane	4.3	2012 ADEC Table C GW	**164**	**157**	**362**	**355**	**150**	**97.2 J**	**92.1**
1,1,2-Trichloroethane	5	EPA MCL	**6.33**	**6.08**	**13.6**	**12.6**	**6.18**	**3.39**	**3.35**
1,1,2-Trichlorotrifluoroethane	1100000	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
1,1-Dichloroethane	7300	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
1,1-Dichloroethene	7	EPA MCL	**1.94 J**	1.25 UJ	**7.94**	**7.9**	**3.94**	**3.14**	**3.06**
1,1-Dichloropropene	NA	NA	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
1,2,3-Trichlorobenzene	NA	NA	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
1,2,3-Trichloropropane	0.12	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
1,2,4-Trichlorobenzene	70	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
1,2,4-Trimethylbenzene	1800	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
1,2-Dibromo-3-Chloropropane	0.2	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
1,2-Dichlorobenzene	600	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
1,2-Dichloroethane	5	EPA MCL	1.25 U	1.25 U	**0.43 J**	**0.41 J**	1.5 U	0.3 U	0.3 U
1,2-Dichloropropane	5	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
1,3,5-Trimethylbenzene	1800	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
1,3-Butadiene	NA	NA	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
1,3-Dichlorobenzene	3300	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
1,3-Dichloropropane	NA	NA	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
1,4-Dichlorobenzene	75	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
2,2-Dichloropropane	NA	NA	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
2-Butanone (MEK)	200000	EPA MCL	**26.7**	**25.4**	1 U	1 U	5 U	3.4 U	3.4 U
2-Chlorotoluene	NA	NA	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
2-Hexanone	NA	NA	5 U	5 U	1 U	1 U	5 U	1 U	1 U
4-Chlorotoluene	NA	NA	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
4-Methyl-2-Pentanone (MIBK)	2900	2012 ADEC Table C GW	5 U	5 U	1 U	1 U	5 U	1 U	1 U
Acetone	33000	2012 ADEC Table C GW	5 U	5 U	1 U	**0.95 J**	5 U	1 U	1 U
Benzene	5	EPA MCL	1.25 U	1.25 U	**0.72**	**0.69**	1.5 U	**0.28 J**	**0.29 J**
Bromobenzene	NA	NA	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Bromochloromethane	NA	NA	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Bromodichloromethane	80	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Bromoform	80	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Bromomethane	51	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.5 U	0.5 U
Carbon Disulfide	3700	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Carbon Tetrachloride	5	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Chlorobenzene	100	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Chloroethane	290	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Chloroform	80	EPA MCL	**3.02 J**	1.25 UJ	**0.31 J**	**0.31 J**	1.5 U	0.3 U	0.3 U
Chloromethane	66	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
cis-1,2-Dichloroethene	70	EPA MCL	**115**	**110**	**2040**	**2030**	**1130**	**924**	**836**
cis-1,3-Dichloropropene	8.5	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Cyclohexane	NA	NA	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Dibromochloromethane	80	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Dibromomethane	NA	NA	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Dichlorodifluoromethane	7300	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Ethylbenzene	700	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Ethylene Dibromide (EDB)	0.05	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Hexachlorobutadiene	7.3	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Isopropylbenzene	3700	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
m- & p-Xylene	10000	EPA MCL	2.5 U	2.5 U	0.6 U	0.6 U	3 U	0.6 U	0.6 U
Methyl tert-Butyl Ether (MTBE)	470	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Methylene Chloride	5	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
n-Butylbenzene	370	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
n-Hexane	NA	NA	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
n-Propylbenzene	370	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Naphthalene	730	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
o-Xylene	10000	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
p-Isopropyltoluene	NA	NA	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
sec-Butylbenzene	370	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Styrene	100	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
tert-Butylbenzene	370	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Tetrachloroethene (PCE)	5	EPA MCL	**8.76**	**8.69**	**1.68**	**1.51**	1.5 U	**0.52**	**0.51**
Toluene	1000	EPA MCL	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Total Xylenes	10000	EPA MCL	3.75 U	3.75 U	0.75 U	0.75 U	3.75 U	0.75 U	0.75 U

Table B-2: Groundwater Sample Results - AP-4550

Analyte	Screening Level	Screening Level Source	AP-4550						
Location			AP-4550						
Sample ID			13Q4CG039-AP4550-GW-0	13Q4CG039-AP4550-GW-1	14Q1CG039-AP4550-GW-0	14Q1CG039-AP4550-GW-1	14Q2CG039-AP4550-GW-0	14Q3CG039-AP4550-GW-0	14Q3CG039-AP4550-GW-1
Sample Depth (ft)			32 - 42	32 - 42	32 - 42	32 - 42	32 - 42	32 - 42	32 - 42
Sample Date			10/15/2013	10/15/2013	1/16/2014	1/16/2014	4/15/2014	9/9/2014	9/9/2014
trans-1,2-Dichloroethene	100	EPA MCL	**38.6**	**36.6**	**62.2**	**62**	**37.5**	**31.8**	**31**
trans-1,3-Dichloropropene	8.5	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Trichloroethene (TCE)	5	EPA MCL	**801**	**822**	**34.9**	**27**	**6.89**	**10.2 J**	**10.6**
Trichlorofluoromethane	11000	2012 ADEC Table C GW	1.25 U	1.25 U	0.3 U	0.3 U	1.5 U	0.3 U	0.3 U
Vinyl Acetate	37000	2012 ADEC Table C GW	2.5 U	2.5 U	0.3 U	0.3 U	1.5 U	0.5 U	0.5 U
Vinyl Chloride	2	EPA MCL	1.25 U	1.25 U	**40.3**	**39.3**	**11.1**	**5.25**	**5.04**
Dissolved Gases (UG/L)									
Ethane	NA	NA	**0.958**	**0.805**	**0.344 J**	**0.384 J**	**0.334 J**	**0.444 J**	**0.418 J**
Ethylene	NA	NA	**0.537**	**0.441**	**1.11**	**1.29**	**0.261 J**	**0.303 J**	**0.302 J**
Methane	NA	NA	**36.1**	**44.2**	**216**	**220**	**1060**	**5860**	**5460**
General Chemistry (MG/L)									
Alkalinity, bicarb. (as CaCO3)	NA	NA	- -	- -	**289**	**287**	**217**	**144**	**143**
Alkalinity, carb. (as CaCO3)	NA	NA	- -	- -	5 U	5 U	5 U	5 U	5 U
Alkalinity, bicarb. (as CaCO3)	NA	NA	- -	- -	**289**	**287**	**217**	**144**	**143**
Chloride	NA	NA	**2.84**	**2.72**	**3.61**	**3.6**	**2.46**	**1.73**	**1.76**
Nitrogen, Nitrate-Nitrite	10	EPA MCL	**0.15**	**0.137**	**0.113**	**0.114**	**0.154**	**0.14**	**0.156**
Sulfate	NA	NA	**113**	**115**	**0.202**	**0.222**	**0.353**	0.1 U	0.1 U
Sulfide	NA	NA	- -	- -	**0.124**	**0.141**	**0.148**	**0.0664**	**0.0839**
Total Alkalinity	NA	NA	- -	- -	**289**	**287**	**217**	**144**	**143**
Total Organic Carbon	NA	NA	- -	- -	**131**	**134**	**41.3**	**50.5**	**51.9**
Organic Acids by IC (ug/L)									
Acetic Acid	NA	NA	- -	- -	**129000**	**127000**	**52900**	**98100**	**94900**
Butyric Acid	NA	NA	- -	- -	**19400**	**19500**	**5450**	**4280**	**4410**
Formic Acid	NA	NA	- -	- -	600 U	600 U	**61.2 J**	**32.7 J**	**40.7 J**
Lactic Acid	NA	NA	- -	- -	60 U	60 U	1000 U	400 U	400 U
Propionic Acid	NA	NA	- -	- -	**64300**	**67100**	**4760**	**1480**	**1330**
Pyruvic Acid	NA	NA	- -	- -	2000 U	2000 U	200 U	80 U	80 U

Notes:
NA = No screening level exists
"--" = sample not collected
B = The analyte was detected in the associated method and/or calibration blank.
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.
mg/l = Milligrams per Liter
ug/l = Micrograms per Liter
Bold indicates the analyte was detected
Shading indicates the result exceeded screening criteria

Groundwater Raw Analytical Results
November 2014

Table B-3 Groundwater Sample Results - AP-4551

Analyte	Location	Sample ID	Sample Depth (ft)	Sample Date	Screening Level Screening Level	Screening Level Source	AP-4551			
							13Q4CG039-AP4551-GW-0	14Q1CG039-AP4551-GW-0	14Q2CG039-AP4551-GW-0	14Q3CG039-AP4551-GW-0
							85.2 - 95.2	85.2 - 95.2	85.2 - 95.2	85.2 - 95.2
							10/16/2013	1/16/2014	4/15/2014	9/10/2014
Metals (MG/L)										
Iron, dissolved					NA	NA	**0.13**	**21.9**	**7.27**	**5.46**
Manganese, dissolved					NA	NA	**19.3**	**19.2**	**12.5**	**10.5**
VOCs (ug/L)										
1,1,1,2-Tetrachloroethane					NA	NA	0.25 U	0.3 U	3 U	0.3 U
1,1,1-Trichloroethane					200	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
1,1,2,2-Tetrachloroethane					4.3	2012 ADEC Table C GW	**51.6**	**121**	**108**	**119**
1,1,2-Trichloroethane					5	EPA MCL	**5.09**	**7.85**	**15.3**	**12.9**
1,1,2-Trichlorotrifluoroethane					1100000	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
1,1-Dichloroethane					7300	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
1,1-Dichloroethene					7	EPA MCL	**2.11**	**4.76**	**15.2**	**16.7**
1,1-Dichloropropene					NA	NA	0.25 U	0.3 U	3 U	0.3 U
1,2,3-Trichlorobenzene					NA	NA	0.25 U	0.3 U	3 U	0.3 U
1,2,3-Trichloropropane					0.12	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
1,2,4-Trichlorobenzene					70	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
1,2,4-Trimethylbenzene					1800	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
1,2-Dibromo-3-Chloropropane					0.2	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
1,2-Dichlorobenzene					600	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
1,2-Dichloroethane					5	EPA MCL	0.25 U	0.3 U	3 U	**0.44 J**
1,2-Dichloropropane					5	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
1,3,5-Trimethylbenzene					1800	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
1,3-Butadiene					NA	NA	0.25 U	0.3 U	3 U	0.3 U
1,3-Dichlorobenzene					3300	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
1,3-Dichloropropane					NA	NA	0.25 U	0.3 U	3 U	0.3 U
1,4-Dichlorobenzene					75	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
2,2-Dichloropropane					NA	NA	0.25 U	0.3 U	3 U	0.3 U
2-Butanone (MEK)					200000	EPA MCL	**16.4**	1 U	10 U	3.4 U
2-Chlorotoluene					NA	NA	0.25 U	0.3 U	3 U	0.3 U
2-Hexanone					NA	NA	**2.3**	1 U	10 U	1 U
4-Chlorotoluene					NA	NA	0.25 U	0.3 U	3 U	0.3 U
4-Methyl-2-Pentanone (MIBK)					2900	2012 ADEC Table C GW	1 U	1 U	10 U	1 U
Acetone					33000	2012 ADEC Table C GW	**26.9**	**6.35**	10 U	1 U
Benzene					5	EPA MCL	**0.34 J**	**0.69**	3 U	**0.7**
Bromobenzene					NA	NA	0.25 U	0.3 U	3 U	0.3 U
Bromochloromethane					NA	NA	0.25 U	0.3 U	3 U	0.3 U
Bromodichloromethane					80	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
Bromoform					80	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
Bromomethane					51	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.5 U
Carbon Disulfide					3700	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
Carbon Tetrachloride					5	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
Chlorobenzene					100	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
Chloroethane					290	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
Chloroform					80	EPA MCL	**2.03**	**1.24**	3 U	**0.97**
Chloromethane					66	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
cis-1,2-Dichloroethene					70	EPA MCL	**82.7**	**730**	**2370**	**2520**
cis-1,3-Dichloropropene					8.5	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
Cyclohexane					NA	NA	0.25 U	0.3 U	3 U	0.3 U
Dibromochloromethane					80	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
Dibromomethane					NA	NA	0.25 U	0.3 U	3 U	0.3 U
Dichlorodifluoromethane					7300	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
Ethylbenzene					700	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
Ethylene Dibromide (EDB)					0.05	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
Hexachlorobutadiene					7.3	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
Isopropylbenzene					3700	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
m- & p-Xylene					10000	EPA MCL	0.5 U	0.6 U	6 U	0.6 U

Groundwater Raw Analytical Results
November 2014

Table B-3 Groundwater Sample Results - AP-4551

Analyte	Location ID / Sample ID / Sample Depth (ft) / Sample Date / Screening Level	Screening Level Source	AP-4551			
			13Q4CG039-AP4551-GW-0	14Q1CG039-AP4551-GW-0	14Q2CG039-AP4551-GW-0	14Q3CG039-AP4551-GW-0
			85.2 - 95.2	85.2 - 95.2	85.2 - 95.2	85.2 - 95.2
			10/16/2013	1/16/2014	4/15/2014	9/10/2014
Methyl tert-Butyl Ether (MTBE)	470	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
Methylene Chloride	5	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
n-Butylbenzene	370	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
n-Hexane	NA	NA	0.25 U	0.3 U	3 U	0.3 U
n-Propylbenzene	370	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
Naphthalene	730	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
o-Xylene	10000	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
p-Isopropyltoluene	NA	NA	0.25 U	0.3 U	3 U	0.3 U
sec-Butylbenzene	370	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
Styrene	100	EPA MCL	0.25 U	0.3 U	3 U	0.3 U
tert-Butylbenzene	370	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
Tetrachloroethene (PCE)	5	EPA MCL	**0.64**	**2.42**	3 U	0.3 U
Toluene	1000	EPA MCL	0.25 U	**0.63**	3 U	0.3 U
Total Xylenes	10000	EPA MCL	0.75 U	0.75 U	7.5 U	0.75 U
trans-1,2-Dichloroethene	100	EPA MCL	**8.92**	**14.2**	**24.1**	**28.2**
trans-1,3-Dichloropropene	8.5	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
Trichloroethene (TCE)	5	EPA MCL	**698**	**1190**	**14.7**	**8.43**
Trichlorofluoromethane	11000	2012 ADEC Table C GW	0.25 U	0.3 U	3 U	0.3 U
Vinyl Acetate	37000	2012 ADEC Table C GW	0.5 U	0.3 U	3 U	0.5 U
Vinyl Chloride	2	EPA MCL	0.25 U	**2.43**	**7.87**	**5.55**
Dissolved Gases (UG/L)						
Ethane	NA	NA	0.123 U	0.116 U	**0.129 J**	**0.4**
Ethylene	NA	NA	**0.293 J**	**0.0858 J**	**0.115 J**	**0.219 J**
Methane	NA	NA	**0.364 B**	**0.849**	**119**	**840**
General Chemistry (MG/L)						
Alkalinity, bicarb. (as CaCO3)	NA	NA	**307**	**283**	**444**	**257**
Alkalinity, carb. (as CaCO3)	NA	NA	5 U	5 U	5 U	5 U
Alkalinity, bicarb. (as CaCO3)	NA	NA	**307**	**283**	**444**	**257**
Chloride	NA	NA	- -	**4.83**	**4.34**	**4.06**
Nitrogen, Nitrate-Nitrite	10	EPA MCL	**0.0302 B**	**0.0976**	**0.0656**	**0.0416**
Sulfate	NA	NA	**117**	**12**	**0.289**	**1.11**
Sulfide	NA	NA	**0.112**	**0.0197 J**	**0.258**	**0.032**
Total Alkalinity	NA	NA	**307**	**283**	**444**	**257**
Total Organic Carbon	NA	NA	**4.13**	**38**	**28.1**	**24.1**
Organic Acids by IC (ug/L)						
Acetic Acid	NA	NA	60 U	**16100**	**27300**	400 U
Butyric Acid	NA	NA	60 U	**1310**	**486**	**1250**
Formic Acid	NA	NA	60 U	60 U	100 U	40 U
Lactic Acid	NA	NA	60 U	60 U	100 U	**31800**
Propionic Acid	NA	NA	**45.8 J**	**9690**	**2050**	**594**
Pyruvic Acid	NA	NA	**363**	200 U	200 U	80 U

Notes:
NA = No screening level exists
"--" = sample not collected
B = The analyte was detected in the associated method and/or calibration blank.
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.
mg/l = Milligrams per Liter
ug/l = Micrograms per Liter
Bold indicates the analyte was detected
Shading indicates the result exceeded screening criteria

CG039

Groundwater Raw Analytical Results
October 2014

Table B-4 Groundwater Sample Results - Downgradient Monitoring Wells

Analyte	Location	Sample ID	Sample Depth (ft)	Sample Date	Screening Level	Screening Level Source	AP-3744	AP-3747	AP-3989
							14Q3CG039-AP3744-GW-0	14Q3CG039-AP3747-GW-0	14Q3CG039-AP3989-GW-0
							26.5 - 36.5	20 - 30	24 - 34
							9/9/2014	9/5/2014	9/9/2014
Metals (MG/L)									
Iron, dissolved					NA	NA	0.02 U	0.02 U	**32.5**
Manganese, dissolved					NA	NA	**0.0227**	**0.000529 B**	**2.66**
VOCs (ug/L)									
1,1,1,2-Tetrachloroethane					NA	NA	0.3 U	0.3 U	0.3 U
1,1,1-Trichloroethane					200	EPA MCL	0.3 U	0.3 U	0.3 U
1,1,2,2-Tetrachloroethane					4.3	2012 ADEC Table C GW	**9.31**	**27.8**	**97.4**
1,1,2-Trichloroethane					5	EPA MCL	**0.29 J**	**1.57**	**3.73**
1,1,2-Trichlorotrifluoroethane					1100000	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
1,1-Dichloroethane					7300	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
1,1-Dichloroethene					7	EPA MCL	0.3 U	**0.79**	**3.2**
1,1-Dichloropropene					NA	NA	0.3 U	0.3 U	0.3 U
1,2,3-Trichlorobenzene					NA	NA	0.3 U	0.3 U	0.3 U
1,2,3-Trichloropropane					0.12	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
1,2,4-Trichlorobenzene					70	EPA MCL	0.3 U	0.3 U	0.3 U
1,2,4-Trimethylbenzene					1800	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
1,2-Dibromo-3-Chloropropane					0.2	EPA MCL	0.3 U	0.3 U	0.3 U
1,2-Dichlorobenzene					600	EPA MCL	0.3 U	0.3 U	0.3 U
1,2-Dichloroethane					5	EPA MCL	0.3 U	0.3 U	**0.27 J**
1,2-Dichloropropane					5	EPA MCL	0.3 U	0.3 U	0.3 U
1,3,5-Trimethylbenzene					1800	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
1,3-Butadiene					NA	NA	0.3 U	0.3 U	0.3 U
1,3-Dichlorobenzene					3300	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
1,3-Dichloropropane					NA	NA	0.3 U	0.3 U	0.3 U
1,4-Dichlorobenzene					75	EPA MCL	0.3 U	0.3 U	0.3 U
2,2-Dichloropropane					NA	NA	0.3 U	0.3 U	0.3 U
2-Butanone (MEK)					200000	EPA MCL	3.4 U	3.4 U	3.4 U
2-Chlorotoluene					NA	NA	0.3 U	0.3 U	0.3 U
2-Hexanone					NA	NA	1 U	1 U	1 U
4-Chlorotoluene					NA	NA	0.3 U	0.3 U	0.3 U
4-Methyl-2-Pentanone (MIBK)					2900	2012 ADEC Table C GW	1 U	1 U	1 U
Acetone					33000	2012 ADEC Table C GW	1 U	1 U	1 U
Benzene					5	EPA MCL	0.3 U	0.3 U	**1.03**
Bromobenzene					NA	NA	0.3 U	0.3 U	0.3 U
Bromochloromethane					NA	NA	0.3 U	0.3 U	0.3 U
Bromodichloromethane					80	EPA MCL	0.3 U	0.3 U	0.3 U
Bromoform					80	EPA MCL	0.3 U	0.3 U	0.3 U
Bromomethane					51	2012 ADEC Table C GW	0.5 U	0.5 U	0.5 U
Carbon Disulfide					3700	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
Carbon Tetrachloride					5	EPA MCL	**0.51**	**1.85**	0.3 U
Chlorobenzene					100	EPA MCL	0.3 U	0.3 U	0.3 U
Chloroethane					290	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
Chloroform					80	EPA MCL	**0.21 J**	**2.11**	0.3 U
Chloromethane					66	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
cis-1,2-Dichloroethene					70	EPA MCL	**13.7**	**13.4**	**1250**
cis-1,3-Dichloropropene					8.5	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
Cyclohexane					NA	NA	0.3 U	0.3 U	0.3 U
Dibromochloromethane					80	EPA MCL	0.3 U	0.3 U	0.3 U
Dibromomethane					NA	NA	0.3 U	0.3 U	0.3 U
Dichlorodifluoromethane					7300	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
Ethylbenzene					700	EPA MCL	0.3 U	0.3 U	0.3 U
Ethylene Dibromide (EDB)					0.05	EPA MCL	0.3 U	0.3 U	0.3 U
Hexachlorobutadiene					7.3	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
Isopropylbenzene					3700	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
m- & p-Xylene					10000	EPA MCL	0.6 U	0.6 U	0.6 U

Groundwater Raw Analytical Results
October 2014

Table B-4 Groundwater Sample Results - Downgradient Monitoring Wells

Analyte	Location ID / Sample ID / Sample Depth (ft) / Sample Date / Screening Level	Screening Level Source	AP-3744 14Q3CG039-AP3744-GW-0 26.5 - 36.5 9/9/2014	AP-3747 14Q3CG039-AP3747-GW-0 20 - 30 9/5/2014	AP-3989 14Q3CG039-AP3989-GW-0 24 - 34 9/9/2014
Methyl tert-Butyl Ether (MTBE)	470	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
Methylene Chloride	5	EPA MCL	0.3 U	0.3 U	0.3 U
n-Butylbenzene	370	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
n-Hexane	NA	NA	0.3 U	0.3 U	0.3 U
n-Propylbenzene	370	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
Naphthalene	730	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
o-Xylene	10000	EPA MCL	0.3 U	0.3 U	0.3 U
p-Isopropyltoluene	NA	NA	0.3 U	0.3 U	0.3 U
sec-Butylbenzene	370	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
Styrene	100	EPA MCL	0.3 U	0.3 U	0.3 U
tert-Butylbenzene	370	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
Tetrachloroethene (PCE)	5	EPA MCL	**0.33 J**	**1.96**	0.3 U
Toluene	1000	EPA MCL	0.3 U	0.3 U	0.3 U
Total Xylenes	10000	EPA MCL	0.75 U	0.75 U	0.75 U
trans-1,2-Dichloroethene	100	EPA MCL	**0.82**	**3.17**	**39.9**
trans-1,3-Dichloropropene	8.5	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
Trichloroethene (TCE)	5	EPA MCL	**47.2**	**209**	**2.47**
Trichlorofluoromethane	11000	2012 ADEC Table C GW	0.3 U	0.3 U	0.3 U
Vinyl Acetate	37000	2012 ADEC Table C GW	0.5 U	0.5 U	0.5 U
Vinyl Chloride	2	EPA MCL	0.3 U	0.3 U	**8.71**
Dissolved Gases (UG/L)					
Ethane	NA	NA	0.109 U	0.11 U	**0.17 J**
Ethylene	NA	NA	0.118 U	0.119 U	**0.368 J**
Methane	NA	NA	**0.104 B**	**0.0961 B**	**1700**
General Chemistry (MG/L)					
Alkalinity, bicarb. (as CaCO3)	NA	NA	**149**	**131**	**303**
Alkalinity, carb. (as CaCO3)	NA	NA	5 U	5 U	5 U
Alkalinity, bicarb. (as CaCO3)	NA	NA	**149**	**131**	**303**
Chloride	NA	NA	**1.83**	**2.52**	**3.69**
Nitrogen, Nitrate-Nitrite	10	EPA MCL	**0.394**	**0.334**	**0.228**
Sulfate	NA	NA	**13.1**	**11.4**	0.1 U
Sulfide	NA	NA	0.0193 U	0.0193 U	**0.0304**
Total Alkalinity	NA	NA	**149**	**131**	**303**
Total Organic Carbon	NA	NA	**1.01 B**	**0.859 B**	**63.3**
Organic Acids by IC (ug/L)					
Acetic Acid	NA	NA	80 U	80 U	**116000**
Butyric Acid	NA	NA	80 U	80 U	**1740**
Butyric Acid	NA	NA	80 U	80 U	**1740**
Formic Acid	NA	NA	40 U	40 U	40 U
Lactic Acid	NA	NA	40 U	40 U	400 U
Propionic Acid	NA	NA	80 U	80 U	**10200**
Pyruvic Acid	NA	NA	80 U	80 U	80 U

Notes:
NA = No screening level exists
"--" = sample not collected
B = The analyte was detected in the associated method and/or calibration blank.
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
mg/l = Milligrams per Liter
ug/l = Micrograms per Liter
Bold indicates the analyte was detected
Shading indicates the result exceeded screening criteria

Appendix C
Data Quality Evaluation Report

This page intentionally left blank.

JOINT BASE ELMENDORF-RICHARDSON – AUTO VEHICLE MAINTENANCE AREA SITE DA089 AND POLELINE LINE ROAD SITE CG039 LONG-TERM MONITORING AND TREATABILITY STUDY OCTOBER 2013 – SEPTEMBER 2014 DATA QUALITY EVALUATION REPORT

Introduction

The objective of this data quality evaluation (DQE) report is to assess the data quality of analytical results for groundwater samples collected at the Joint Base Elmendorf-Richardson (JBER) Auto Vehicle Maintenance Area Site DA089 and Poleline Road Site CG039. Samples were collected and analyzed in support of the Preliminary Assessment/Site Investigation at this site. The data may also be used to support future activities such as feasibility studies, risk assessments, fate and transport modeling and remedial actions. Individual method requirements and guidelines from *the United States Air Force, Joint Base Elmendorf-Richardson, Alaska, Environmental Restoration Program, Basewide Uniform Federal Policy Quality Assurance Project Plan (March 2013) (*JBER QAPP) were used in this assessment.

This report is intended as a general data quality assessment designed to summarize data issues.

Analytical Data

This DQE report covers 33 primary samples, 6 field duplicates (FD), 4 equipment blanks (EB) and 13 trip blanks (TB). All samples were collected October 15, 2013 through September 15, 2014. A list of samples associated with this DQE is included in Attachment C1-1.

The Work Plan requires a collection frequency of 10 percent for FDs and 5 percent for MS/MSD sets and EBs; collection frequencies are outlined by method in Table C1-1 below. The required frequency was met for each method with the following exceptions:

- A FD and MS/MSD were not collected for Methods AK101 and AK102.
- The laboratory does not perform MS/MSD analysis for Methods E310.1 or RSK175.

Table C1-1: Percentage of FD, EB and MS/MSD Collected by Method

Method	Matrix	Count of Primary Samples	Count of FD	Percent of FD	Count of MS/MSD	Percent of MS/MSD	Count of EB	Percent of EB
AK101	Groundwater	1	0	0	0	0	1	100
AK102	Groundwater	1	0	0	0	0	1	100
E300.0	Groundwater	33	6	18	6	18	4	12
E300.0M	Groundwater	17	3	18	3	18	2	12
E310.1	Groundwater	18	2	11	0	0	2	11
E353.2	Groundwater	33	6	18	7	21	4	12
E376.2	Groundwater	18	4	22	5	28	3	17
RSK-175	Groundwater	33	6	18	0	0	4	12

Table C1-1: Percentage of FD, EB and MS/MSD Collected by Method

Method	Matrix	Count of Primary Samples	Count of FD	Percent of FD	Count of MS/MSD	Percent of MS/MSD	Count of EB	Percent of EB
SW6010B/C	Groundwater	33	6	18	6	18	4	12
SW8260C	Groundwater	33	6	18	5	15	4	12
SW9060	Groundwater	18	4	22	5	28	3	17

The sample results were reported as 12x sample delivery groups (SDG) presented in Table C1-2. The analyses were performed by Applied Sciences Laboratory in Corvallis, Oregon (CH2M HILL-Corvallis laboratory, UST-079).

Table C1-2: Sample Delivery Groups

M3042
M3043
N1080
N1081
N1694
N1695
N2614
N2617
N2648
N2655
N2664
N2692

Eleven methods were used to analyze the environmental samples. Samples were collected and shipped via overnight carrier to the laboratory. Selected samples were analyzed for one or more of the following analytes/methods in Table C1-3.

Table C1-3: Analytical Parameters

Parameter	Method
Gasoline Range Organics (GRO)	AK101
Diesel Range Organics (DRO)	AK102
Chloride and Sulfate	E300
Volatile Fatty Acids	E300.0M
Alkalinity	E310.1
Nitrate+Nitrite	E353.2

Table C1-3: Analytical Parameters

Parameter	Method
Sulfide	E376.2
Dissolved Gases	RSK-175
Iron and Manganese	SW6010B
Volatile Organic Compounds	SW8260C
Total Organic Carbon (TOC)	SW9060

The assessment of data includes a review of: (1) the chain-of-custody (COC) documentation; (2) holding-time compliance; (3) the required quality control (QC) samples at the specified frequencies; (4) method blanks; (5) laboratory control sample/laboratory control sample duplicates (LCS/LCSD); (6) surrogate spike recoveries; (7) matrix spike/matrix spike duplicate (MS/MSD) samples; and (8) initial and continuing calibration information and other method-specific criteria as defined by the JBER QAPP.

Field samples were also reviewed to ascertain field compliance and data quality issues. This included a review of FDs, EBs and TBs.

Data flags were assigned according to the JBER QAPP. Multiple flags are routinely applied to specific sample method/matrix/analyte combinations, but there will be only one final flag. A final flag is applied to the data and is the most conservative of the applied validation flags. The final flag also includes matrix and blank sample impacts.

The data flags are defined below:

- **J** = The analyte was positively identified, and the quantitation is an estimation because of discrepancies in meeting certain analyte-specific quality control criteria. Or the analyte was positively identified, but the associated concentration is estimated above the method detection limit and below the limit of quantitation (LOQ).

- **R** = The data are rejected because of deficiencies in meeting QC criteria and may not be used for decision making.

- **B** = The analyte was detected in the sample at a concentration less than or equal to five times (10 times for common laboratory contaminants) the blank concentration.

- **U** = The analyte was analyzed for, but the analyte was not detected.

- **UJ** = The analyte was not detected; however, the result is estimated because of discrepancies in meeting certain analyte-specific QC criteria.

Findings

The overall summaries of the data validation findings are contained in the following sections and Table C1-4.

Also included as documentation of data validation findings is the Alaska Department of Environmental Conservation Laboratory Data Review Checklist (Version 2.7, January 2010). A checklist is provided for each laboratory SDG and can be found in Attachment C1-2 to this DQE.

Holding Times

All holding-time criteria were met.

Calibration

All initial and continuing calibration criteria were met with one exception.

- The recovery of bromoform was greater than JBER QAPP criteria in a continuing calibration verification for Method SW8260C. All associated samples were not detected for bromoform and no data were qualified.

Method Blanks

Method blanks were analyzed at the required frequency and were free of contamination with the following exceptions:

- GRO was detected below the LOQ in a method blank for Method AK101. One associated sample result detected less than five times the blank concentration was qualified as estimated and flagged "B".

- Methane was detected below the LOQ in the method blanks for Method RSK-175. Sixteen associated sample results detected less than five times the blank concentrations were qualified as estimated and flagged "B". Sixteen associated results detected greater than five times the blank concentrations were not qualified.

- Hexachlorobutadiene was detected below the LOQ in the method blanks for Method SW8260C. Twenty-nine associated nondetected results were not qualified.

Calibration Blanks

Lactic acid was detected below and above the LOQ in the continuing calibration blanks (CCB) for Method E300.0M. One associated result detected greater than five times the blank concentrations, and 16 associated nondetected results, were not qualified.

TOC was detected below the LOQ in a CCB for Method SW9060. Three associated results detected greater than five times the blank concentration were not qualified.

Trip Blanks

Thirteen TBs were collected and were free of contamination with the following exceptions:

- GRO was detected below the LOQ in a TB for Method AK101. One associated sample result detected less than five times the blank concentration was qualified as estimated and flagged "B".

- Methane was detected below the LOQ in the TBs for Method RSK-175. Three associated sample results detected less than five times the blank concentrations were qualified as estimated and flagged "B". Eight associated results detected greater than five times the blank concentrations were not qualified.

- Acetone was detected below the LOQ in a TB for Method SW8260C. Four associated nondetected results were not qualified.

Equipment Blanks

Two EBs were collected and were free of contamination with the exceptions listed below.

- GRO was detected below the LOQ in an EB for Method AK101. One associated sample result detected less than five times the blank concentration was qualified as estimated and flagged "B".

- Sulfate and chloride were detected above the LOQ in the EBs for Method E300.0. Three associated sample results detected less than five times the blank concentrations were qualified as estimated and flagged "B". One associated sample result detected greater than five times the blank concentrations, and six associated nondetected results, were not qualified.

- Nitrate+nitrite was detected above the LOQ in the EBs for Method E353.2. Five associated sample results detected less than five times the blank concentrations were qualified as estimated and flagged "B". Twenty-one associated sample results detected greater than five times the blank concentrations, and one associated nondetected result, were not qualified.

- Sulfide was detected above the LOQ in an EB for Method E376.2. One associated sample result detected less than five times the blank concentration was qualified as estimated and flagged "B". One associated nondetected result was not qualified.

- Methane was detected below the LOQ in the EBs for Method RSK-175. Fifteen associated sample results detected less than five times the blank concentration were qualified as estimated and flagged "B". Twelve associated sample results detected greater than five times the blank concentrations were not qualified.

- Dissolved manganese and dissolved iron were detected below and/or above the LOQ in the EBs for Method SW6010B/C. Nine associated sample results detected less than five times the blank concentrations were qualified as estimated and flagged "B". Seventeen associated

sample results detected greater than five times the blank concentrations, and three associated nondetected results, were not qualified.

- Acetone, chloromethane, ethylbenzene, m,p-xylene, o-xylene, tetrachloroethene, total xylenes and toluene were detected below or above the LOQ in the EBs for Method SW8260C. Two associated sample results detected less than five times (10 times for acetone) the blank concentrations were qualified as estimated and flagged "B". Five associated sample results detected greater than five times (10 times for acetone) the blank concentrations, and 122 associated nondetected results, were not qualified.

- TOC was detected above and below the LOQ in the EBs for Method SW9060. Four associated sample results detected less than five times the blank concentrations were qualified as estimated and flagged "B". Six associated sample results detected greater than five times the blank concentrations were not qualified.

Field Duplicates

Six FD sets were collected. Precision was acceptable with the following exceptions:

- The relative percent differences (RPD) of 1,1-dichloroethene and chloroform were greater than JBER QAPP criteria in FD set 13Q4CG039-AP4550-GW-0/13Q4CG039-AP4550-GW-1 for Method SW8260C. Two associated detected results were qualified as estimated and flagged "J"; two associated nondetected results were qualified as estimated and flagged "UJ".

- The RPDs of chloride and sulfate were greater than JBER QAPP criteria in FD set 13Q4DA085-AP4413-GW-0/13Q4DA085-AP4413-GW-1 for Method E300.0. Three associated detected results were qualified as estimated and flagged "J"; one associated nondetected result was qualified as estimated and flagged "UJ".

- The RPD of sulfide was greater than JBER QAPP criteria in FD set 13Q4DA085-AP4413-GW-0/13Q4DA085-AP4413-GW-1 for Method E376.2. One associated detected result was qualified as estimated and flagged "J"; one associated nondetected result was qualified as estimated and flagged "UJ".

Matrix Spike Samples

The results of MS/MSD analyses provide information about the possible influence of the matrix on either accuracy or precision of the measurements. The field crew designated samples for MS/MSD analysis. All acceptance criteria were met with the following exceptions:

- The recovery dissolved iron was outside of JBER QAPP criteria in the MSs and or MSDs of samples 14Q3CG039-AP4550-GW-0, 14Q2CG039-AP4550-GW-0 and 14Q1CG039-AP3983R-GW-0 for Method SW6010B/C. The associated detected results were not qualified because the sample concentrations were greater than four times the spike concentrations.
- The recoveries of 1,1,2,2-tetrachloroethane and cis-1,2-dichloroethene were less than JBER QAPP criteria in the MS and MSD of sample 14Q3CG039-AP4550-GW-0 for Method

SW8260C. The associated detected results were not qualified because the sample concentrations were greater than four times the spike concentrations.

- The recovery of trichloroethene was less than JBER QAPP criteria in the MSD of sample 14Q3CG039-AP4550-GW-0 for Method SW8260C. The associated detected result was qualified as estimated and flagged "J".
- The RPD of chloroethane was greater than JBER QAPP criteria in the MS/MSD set of sample 14Q3DA089-AP4413-GW-0 for Method SW8260C. The associated nondetected result was not qualified.
- The recoveries of cis-1,2-dichloroethene, trichloroethene and 1,1,2,2-tetrachloroethane were outside of JBER QAPP criteria in the MS and MSD of sample 14Q1CG039-AP3983R-GW-0 for Method SW8260C. The associated detected results were not qualified because the sample concentrations were greater than four times the spike concentrations.
- The recovery of tetrachloroethene was greater than JBER QAPP criteria in the MS of sample 13Q4DA085-AP4413-GW-0 for Method SW8260C. The associated detected result was qualified as estimated and flagged "J".
- The recovery of hexachlorobutadiene was greater than JBER QAPP criteria in the MS and MSD of sample 13Q4DA085-AP4413-GW-0 for Method SW8260C. The associated nondetected result was not qualified.
- The recovery of TOC was greater than JBER QAPP criteria in the MSD of sample 14Q1CG039-AP3983R-GW-0 for Method SW9060. The associated detected result was not qualified because the sample concentration was greater than four times the spike concentration.
- The recovery of TOC was greater than JBER QAPP criteria in the MS and MSD of sample 13Q4DA085-AP4413-GW-0 for Method SW9060. The associated detected result was qualified as estimated and flagged "J".

Surrogates

Surrogates were added to all samples for the methods requiring their use. Surrogate recoveries met criteria.

Laboratory Control Samples

LCS/LCSDs were analyzed and all accuracy and precision criteria were met with the following exception:

- The recovery of chloroethane was greater than JBER QAPP criteria in a LCS for Method SW8260C. The associated nondetected results were not qualified.

Internal Standards

All internal standard acceptance criteria were met.

Tentatively Identified Compounds

Tentatively identified compounds were not reported.

Chain-of-Custody and Sample Receipt Discrepancies

- **SDG M3042.** No discrepancies noted.
- **SDG M3043.** No discrepancies noted.
- **SDG N1080.** The chain of custody requested Method E376.1 for sulfide; samples analyzed by equivalent method E376.2.
- **SDG N1081.** The chain of custody requested Method E376.1 for sulfide; samples analyzed by equivalent method E376.2.
- **SDG N1694.** The chain of custody was not relinquished.
- **SDG N1695.** The chain of custody was not relinquished.

The chain of custody requested Method E376.1 for sulfide; samples analyzed by equivalent method E376.2.

- **SDG N2614.** No discrepancies noted.
- **SDG N2617.** No discrepancies noted.
- **SDG N2648.** No discrepancies noted.
- **SDG N2655.** No discrepancies noted.
- **SDG N2664.** No discrepancies noted.
- **SDG N2692.** The containers for SW6010B for sample 14Q3DA089-AP4413-GW-1 and E353.2 for sample 14Q3DA089-AP4413-GW-0 were received frozen. The associated data were qualified as estimated and flagged "J".

Overall Assessment

The final activity in the data quality evaluation is an assessment of whether the data meet the data quality objectives. The goal of this assessment is to demonstrate that a sufficient number of representative samples were collected and the resulting analytical data can be used to support the decision making process. The precision, accuracy, representativeness, completeness and comparability are addressed in the JBER QAPP. The following summary highlights the data evaluation findings for the above defined events:

1. No data were rejected and completeness was 100 percent for all method/matrix/analyte combinations.
2. One hundred percent of the AK101 data were qualified due to low-level detections in the laboratory blank, TBs and EBs. The degree to which blank contamination was observed is within reasonable method expectations considering the small size of the dataset.

3. Approximately five percent of the E300.0 data, and five percent of the E376.2 data, were qualified due to low-level detections in the EBs. The degree to which blank contamination was observed is within reasonable method expectations considering the small size of the dataset.

4. Approximately nine percent of the E353.2 data were qualified due to low-level detections in the EBs. The degree to which blank contamination was observed suggests a contamination issue during sample collection.

5. Approximately 16 percent of the RSK-175 data were qualified due to low-level detections in the laboratory blanks, TBs and EBs. The degree to which blank contamination was observed suggests a contamination issue at the laboratory and/or during sample collection.

6. Approximately 11 percent of the SW6010B data were qualified due to low-level detections in the EBs. The degree to which blank contamination was observed suggests a contamination issue during sample collection.

7. Less than one percent of the SW8260C data were qualified due to low-level detections in the EBs. The degree to which blank contamination was observed is within reasonable method expectations.

8. Approximately 18 percent of the SW9060 data were qualified due to low-level detections in the EBs. The degree to which blank contamination was observed suggests a contamination issue during sample collection.

9. Two sample containers were received frozen; three results were qualified as estimated.

10. FD RPD exceedances were observed for Methods E300.0, E376.2 and SW8260C; 11 results were qualified as estimated.

11. MS/MSD recovery exceedances were observed for Methods SW9060 and SW8260C; three results were qualified as estimated.

12. Although data were qualified as estimated due to QC exceedances as noted, overall precision and accuracy of the data, as measured by field and laboratory QC indicators suggest that data are usable for projects objectives.

Table C1-4: Validation Flags

NativeID	Method	Analyte	Final Result	Units	Final Flag	Reason
13Q4CG039-AP3983R-GW-0	SW8260C	Acetone	7.58	µg/L	B	EB<LOQ
13Q4CG039-AP4550-GW-0	SW8260C	1,1-DCE	1.94	µg/L	J	FD>RPD
13Q4CG039-AP4550-GW-0	SW8260C	Chloroform	3.02	µg/L	J	FD>RPD
13Q4CG039-AP4550-GW-1	SW8260C	1,1-DCE	1.25	µg/L	UJ	FD>RPD
13Q4CG039-AP4550-GW-1	SW8260C	Chloroform	1.25	µg/L	UJ	FD>RPD
13Q4CG039-AP4551-GW-0	E353.2	Nitrate/Nitrite-N	0.0302	mg/L	B	EB<LOQ
13Q4CG039-AP4551-GW-0	RSK-175	Methane	0.364	µg/L	B	TB<LOQ
13Q4DA085-AP4413-GW-0	E300.0	Chloride	38.9	mg/L	B	FD>RPD
13Q4DA085-AP4413-GW-0	E300.0	Chloride	38.9	mg/L	B	EB>LOQ
13Q4DA085-AP4413-GW-0	E300.0	Sulfate	21.8	mg/L	B	EB>LOQ
13Q4DA085-AP4413-GW-0	E300.0	Sulfate	21.8	mg/L	B	FD>RPD
13Q4DA085-AP4413-GW-0	E353.2	Nitrate/Nitrite-N	0.0195	mg/L	B	EB>LOQ
13Q4DA085-AP4413-GW-0	E376.2	Sulfide	0.241	mg/L	B	FD>RPD
13Q4DA085-AP4413-GW-0	E376.2	Sulfide	0.241	mg/L	B	EB>LOQ
13Q4DA085-AP4413-GW-0	RSK-175	Methane	0.0417	µg/L	B	EB<LOQ
13Q4DA085-AP4413-GW-0	RSK-175	Methane	0.0417	µg/L	B	LB<LOQ
13Q4DA085-AP4413-GW-0	RSK-175	Methane	0.0417	µg/L	B	TB<LOQ
13Q4DA085-AP4413-GW-0	SW6010B	Manganese, dissolved	543	µg/L	B	EB>LOQ
13Q4DA085-AP4413-GW-0	SW8260C	Tetrachloroethylene	125	µg/L	J	MS>UCL
13Q4DA085-AP4413-GW-0	SW9060	Total Organic Carbon	1.34	mg/L	B	MS>UCL
13Q4DA085-AP4413-GW-0	SW9060	Total Organic Carbon	1.34	mg/L	B	SD>UCL
13Q4DA085-AP4413-GW-0	SW9060	Total Organic Carbon	1.34	mg/L	B	EB>LOQ
13Q4DA085-AP4413-GW-1	E300.0	Chloride	0.05	mg/L	UJ	FD>RPD
13Q4DA085-AP4413-GW-1	E300.0	Sulfate	4.09	mg/L	B	EB>LOQ
13Q4DA085-AP4413-GW-1	E300.0	Sulfate	4.09	mg/L	B	FD>RPD
13Q4DA085-AP4413-GW-1	E353.2	Nitrate/Nitrite-N	0.0223	mg/L	B	EB>LOQ
13Q4DA085-AP4413-GW-1	E376.2	Sulfide	0.015	mg/L	UJ	FD>RPD
13Q4DA085-AP4413-GW-1	RSK-175	Methane	0.0436	µg/L	B	TB<LOQ
13Q4DA085-AP4413-GW-1	RSK-175	Methane	0.0436	µg/L	B	LB<LOQ
13Q4DA085-AP4413-GW-1	RSK-175	Methane	0.0436	µg/L	B	EB<LOQ
13Q4DA085-AP4413-GW-1	SW6010B	Manganese, dissolved	1.26	µg/L	B	EB>LOQ
13Q4DA085-AP4413-GW-1	SW9060	Total Organic Carbon	1.25	mg/L	B	EB>LOQ
14Q2DA085-AP4413-GW-0	RSK-175	Methane	0.198	µg/L	B	LB<LOQ
14Q2DA085-AP4413-GW-1	RSK-175	Methane	0.218	µg/L	B	LB<LOQ
14Q3CG039-AP3744-GW-0	RSK-175	Methane	0.104	µg/L	B	EB<LOQ

Table C1-4: Validation Flags

NativeID	Method	Analyte	Final Result	Units	Final Flag	Reason
14Q3CG039-AP3744-GW-0	RSK-175	Methane	0.104	µg/L	B	LB<LOQ
14Q3CG039-AP3744-GW-0	SW9060	Total Organic Carbon	1.01	mg/L	B	EB<LOQ
14Q3CG039-AP3747-GW-0	RSK-175	Methane	0.0961	µg/L	B	EB<LOQ
14Q3CG039-AP3747-GW-0	RSK-175	Methane	0.0961	µg/L	B	LB<LOQ
14Q3CG039-AP3747-GW-0	SW6010B	Manganese, dissolved	0.000529	mg/L	B	EB<LOQ
14Q3CG039-AP3747-GW-0	SW9060	Total Organic Carbon	0.859	mg/L	B	EB<LOQ
14Q3CG039-AP3748-GW-0	RSK-175	Methane	0.0662	µg/L	B	LB<LOQ
14Q3CG039-AP3748-GW-0	RSK-175	Methane	0.0662	µg/L	B	EB<LOQ
14Q3CG039-AP3983R-GW-0	SW8260C	Acetone	4.21	µg/L	B	EB<LOQ
14Q3CG039-AP4344-GW-0	RSK-175	Methane	0.0356	µg/L	B	LB<LOQ
14Q3CG039-AP4344-GW-0	RSK-175	Methane	0.0356	µg/L	B	EB<LOQ
14Q3CG039-AP4550-GW-0	SW8260C	Trichloroethene (TCE)	10.2	µg/L	J	SD<LCL
14Q3CG039-AP5246-GW-0	RSK-175	Methane	0.0607	µg/L	B	EB<LOQ
14Q3CG039-AP5246-GW-0	SW6010B	Manganese, dissolved	0.00112	mg/L	B	EB<LOQ
14Q3CG039-AP5683-GW-0	RSK-175	Methane	0.0915	µg/L	B	EB<LOQ
14Q3CG039-AP5683-GW-0	SW6010B	Manganese, dissolved	0.00067	mg/L	B	EB<LOQ
14Q3DA089-AP3486-GW-0	RSK-175	Methane	0.054	µg/L	B	LB<LOQ
14Q3DA089-AP3486-GW-0	RSK-175	Methane	0.054	µg/L	B	EB<LOQ
14Q3DA089-AP3486-GW-0	SW6010B	Manganese, dissolved	0.00311	mg/L	B	EB<LOQ
14Q3DA089-AP3534-GW-0	RSK-175	Methane	0.0599	µg/L	B	EB<LOQ
14Q3DA089-AP3534-GW-0	RSK-175	Methane	0.0599	µg/L	B	LB<LOQ
14Q3DA089-AP3774-GW-0	RSK-175	Methane	0.111	µg/L	B	EB<LOQ
14Q3DA089-AP3774-GW-0	RSK-175	Methane	0.111	µg/L	B	LB<LOQ
14Q3DA089-AP3774-GW-0	SW6010B	Manganese, dissolved	0.00082	mg/L	B	EB<LOQ
14Q3DA089-AP3871-GW-0	RSK-175	Methane	0.177	µg/L	B	LB<LOQ
14Q3DA089-AP3893-GW-0	RSK-175	Methane	0.229	µg/L	B	LB<LOQ
14Q3DA089-AP3893-GW-0	RSK-175	Methane	0.229	µg/L	B	EB<LOQ
14Q3DA089-AP4341-GW-0	AK101	TPH-Gasoline	52.1	µg/L	B	EB<LOQ
14Q3DA089-AP4341-GW-0	AK101	TPH-Gasoline	52.1	µg/L	B	TB<LOQ
14Q3DA089-AP4341-GW-0	AK101	TPH-Gasoline	52.1	µg/L	B	LB<LOQ
14Q3DA089-AP4341-GW-0	RSK-175	Methane	0.0425	µg/L	B	EB<LOQ
14Q3DA089-AP4341-GW-0	RSK-175	Methane	0.0425	µg/L	B	LB<LOQ
14Q3DA089-AP4341-GW-0	SW6010B	Manganese, dissolved	0.00134	mg/L	B	EB<LOQ
14Q3DA089-AP4411-GW-0	RSK-175	Methane	0.122	µg/L	B	EB<LOQ
14Q3DA089-AP4411-GW-0	RSK-175	Methane	0.122	µg/L	B	LB<LOQ

Table C1-4: Validation Flags

NativeID	Method	Analyte	Final Result	Units	Final Flag	Reason
14Q3DA089-AP4411-GW-0	SW6010B	Manganese, dissolved	0.00122	mg/L	B	EB<LOQ
14Q3DA089-AP4413-GW-0	E353.2	Nitrate/Nitrite-N	0.0375	mg/L	B	FROZEN
14Q3DA089-AP4413-GW-0	E353.2	Nitrate/Nitrite-N	0.0375	mg/L	B	EB>LOQ
14Q3DA089-AP4413-GW-0	RSK-175	Methane	0.0454	µg/L	B	EB<LOQ
14Q3DA089-AP4413-GW-0	RSK-175	Methane	0.0454	µg/L	B	LB<LOQ
14Q3DA089-AP4413-GW-1	E353.2	Nitrate/Nitrite-N	0.0386	mg/L	B	EB>LOQ
14Q3DA089-AP4413-GW-1	SW6010B	Iron, dissolved	4.22	mg/L	J	FROZEN
14Q3DA089-AP4413-GW-1	SW6010B	Manganese, dissolved	9.98	mg/L	J	FROZEN

Notes:
mg/L = milligrams per liter
µg/L = micrograms per liter
EB<LOQ = Equipment blank concentration less than the limit of quantitation
EB>LOQ = Equipment blank concentration greater than the limit of quantitation
FD>RPD = Field duplicate relative percent difference criterion exceeded
FROZEN = Sample received frozen
LB<LOQ = Laboratory blank concentration less than the limit of quantitation
MS>UCL = Matrix spike recovery greater than the upper control limit
SD<LCL = Matrix spike duplicate recovery less than the lower control limit
SD>UCL = Matrix spike duplicate recovery greater than the upper control limit
TB<LOQ = Equipment blank concentration less than the limit of quantitation

Attachment C1-1 – Samples Associated with DQE

Sample ID	Sample Type	Sample Date
13Q4CG039-GWEB01	EB	10/16/2013
13Q4DA085-EB01-GW-0	EB	10/16/2013
14Q3CG039-GWEB01	EB	9/10/2014
14Q3DA089-GWEB01	EB	9/15/2014
13Q4CG039-AP4550-GW-1	FD	10/15/2013
13Q4DA085-AP4413-GW-1	FD	10/16/2013
14Q1CG039-AP4550-GW-1	FD	1/16/2014
14Q2DA085-AP4413-GW-1	FD	4/14/2014
14Q3CG039-AP4550-GW-1	FD	9/9/2014
14Q3DA089-AP4413-GW-1	FD	9/15/2014
13Q4CG039-AP4550-GW-0	N	10/15/2013
13Q4CG039-AP3983R-GW-0	N	10/16/2013
13Q4CG039-AP4551-GW-0	N	10/16/2013
13Q4DA085-AP4413-GW-0	N	10/16/2013
14Q1DA085-AP4413-GW-0	N	1/14/2014
14Q1CG039-AP3983R-GW-0	N	1/16/2014
14Q1CG039-AP4550-GW-0	N	1/16/2014
14Q1CG039-AP4551-GW-0	N	1/16/2014
14Q2DA085-AP4413-GW-0	N	4/14/2014
14Q2CG039-AP3983R-GW-0	N	4/15/2014
14Q2CG039-AP4550-GW-0	N	4/15/2014
14Q2CG039-AP4551-GW-0	N	4/15/2014
14Q3CG039-AP5246-GW-0	N	9/4/2014
14Q3CG039-AP5683-GW-0	N	9/4/2014
14Q3CG039-AP3747-GW-0	N	9/5/2014
14Q3CG039-AP3748-GW-0	N	9/5/2014
14Q3CG039-AP4344-GW-0	N	9/5/2014
14Q3CG039-AP4353-GW-0	N	9/5/2014
14Q3DA089-AP3870-GW-0	N	9/8/2014
14Q3DA089-AP3871-GW-0	N	9/8/2014
14Q3CG039-AP3744-GW-0	N	9/9/2014
14Q3CG039-AP3983R-GW-0	N	9/9/2014
14Q3CG039-AP3989-GW-0	N	9/9/2014
14Q3CG039-AP4550-GW-0	N	9/9/2014
14Q3CG039-AP4551-GW-0	N	9/10/2014

Attachment C1-1 – Samples Associated with DQE

Sample ID	Sample Type	Sample Date
14Q3DA089-AP3486-GW-0	N	9/11/2014
14Q3DA089-AP3534-GW-0	N	9/11/2014
14Q3DA089-AP3774-GW-0	N	9/11/2014
14Q3DA089-AP3893-GW-0	N	9/12/2014
14Q3DA089-AP4341-GW-0	N	9/12/2014
14Q3DA089-AP4411-GW-0	N	9/12/2014
14Q3DA089-AP4342-GW-0	N	9/15/2014
14Q3DA089-AP4413-GW-0	N	9/15/2014
13Q4CG039-TB01-GW-0	TB	10/16/2013
13Q4DA085-GWTB01	TB	10/16/2013
14Q1DA085-GWTB01	TB	1/14/2014
14Q1CG039-GWTB01	TB	1/16/2014
14Q2DA085-TB01-SO-0	TB	4/15/2014
14Q3CG039-GWTB01	TB	9/4/2014
14Q3CG039-GWTB02	TB	9/5/2014
14Q3DA089-GWTB01	TB	9/8/2014
14Q3CG039-GWTB03	TB	9/9/2014
14Q3CG039-GWTB04	TB	9/10/2014
14Q3DA089-GWTB02	TB	9/11/2014
14Q3DA089-GWTB03	TB	9/12/2014
14Q3DA089-GWTB04	TB	9/15/2014

Notes:
EB = equipment blank
FD = field duplicate
N = primary sample
TB = trip blank

Attachment C1-2 – ADEC Checklists

This page intentionally left blank.

Laboratory Data Review Checklist

CompletedBy	Jamie Beckett		
Title	Chemist	Date	Dec 31, 2013
CS Report Name		ReportDate	Dec 03, 2013
Consultant Firm	CH2M Hill		
Laboratory Name	Applied Sciences Laboratory	Laboratory Report Number	M3042
ADEC File Number		ADECRecKeyNumber	

1. Laboratory

a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No samples transferred.

2. Chain of Custody (COC)

a. COC information completed, signed, and dated (including released/received by)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Correct analyses requested?

◉ Yes ○ No ○ NA (Please explain.) Comments:

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

2.6C

b. Sample preservation acceptable - acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. Sample condition documented - broken, leaking (Methanol), zero headspace (VOC vials)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. If there were any discrepancies, were they documented? - For example, incorrect sample containers/ preservation, sample temperature outside of acceptance range, insufficient or missing samples, etc.?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No discrepancies.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

4. Case Narrative

a.Present and understandable?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Discrepancies, errors or QC failures identified by the lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

SW8260C:
FD RPD exceedances.
Target analytes detected in the EB and method blank.
RSK-175:
Target analytes detected in the EB, TB and method blank.
SW6010B:
Target analytes detected in the EB.
E300.0:
Target analtyes detected in the EB.
E353.2:
Nitrate detected in the EB.

c. Were all corrective actions documented?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

Some data qualified as estimated;usable as qualified.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. All applicable holding times met?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. All soils reported on a dry weight basis?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No soil samples reported.

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?

○ Yes ○ No ◉ NA (Please explain.) Comments:

For details, see site-specific report.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. All method blank results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Method Blank detects: Methane for RSK-175.

These analytes had Method Blank detects: Hexachlorobutadiene for SW8260C.

iii. If above PQL, what samples are affected?

Comments:

No samples affected

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

v. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics - One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Precision - All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/DMSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?
Comments:

vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

vii. Data quality or usability affected? (Please explain)
Comments:

All data are usable as reported.

c. Surrogates - Organics Only

i. Are surrogate recoveries reported for organic analyses - field, QC and laboratory samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No surrogate exceedances.

iv. Data quality or usability affected? (Use the comment box to explain.).
Comments:

d. Trip Blank - Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. All results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Trip Blank detects: Methane for RSK-175.

iv. If above PQL, what samples are affected?

Comments:

13Q4CG039-AP4551-GW-0

v. Data quality or usability affected? (Please explain.)

Comments:

Associated sample results less than five times the blank concentration were flagged "B". Associated results detected greater than five times the blank concentration were not qualified.

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Submitted blind to lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Precision - All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

$$RPD\ (\%) = \text{Absolute Value of: } \frac{(R1 - R2) \times 100}{((R1 + R2)/2)}$$

Where R1 = Sample Concentration
R2 = Field Duplicate Concentration

○ Yes ◉ No ○ NA (Please explain.) Comments:

These samples were out of control for SW8260C: 1,1-DCE (13Q4CG039-AP4550-GW-0/13Q4CG039-AP4550-GW-1, RPD 43 vs 30), Chloroform (13Q4CG039-AP4550-GW-0/13Q4CG039-AP4550-GW-1,

RPD 83 vs 30), associated sample results were flagged J and UJ.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

Data qualified as estimated; usable as qualified.

f. Decontamination or Equipment Blank (if applicable)

◉ Yes ○ No ○ NA (Please explain.) Comments:

i. All results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Equipment Blank detects: Chloride, Sulfate for E300.

These analytes had Equipment Blank detects: Nitrate/Nitrite-N for E353.2.

These analytes had Equipment Blank detects: Methane for RSK-175.

These analytes had Equipment Blank detects: Iron, dissolved, Manganese, dissolved for SW6010B.

These analytes had Equipment Blank detects: Acetone, Chloromethane for SW8260C.

ii. If above PQL, what samples are affected?

13Q4CG039-AP3983R-GW-0, 13Q4CG039-AP4551-GW-0

iii. Data quality or usability affected? (Please explain.)

Associated sample results less than five times (10 times for acetone) the blank concentration were flagged "B". Associated results detected greater than five times (10 times for acetone) the blank concentration were not qualified.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No other flags applied.

Laboratory Data Review Checklist

CompletedBy	Jamie Beckett		
Title	Chemist	Date	Dec 31, 2013
CS Report Name		ReportDate	Dec 03, 2013
Consultant Firm	CH2M Hill		
Laboratory Name	Applied Sciences Laboratory	Laboratory Report Number	M3043
ADEC File Number		ADECRecKeyNumber	

1. Laboratory

a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No samples transferred.

2. Chain of Custody (COC)

a. COC information completed, signed, and dated (including released/received by)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Correct analyses requested?

◉ Yes ○ No ○ NA (Please explain.) Comments:

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

4.2C

b. Sample preservation acceptable - acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. Sample condition documented - broken, leaking (Methanol), zero headspace (VOC vials)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. If there were any discrepancies, were they documented? - For example, incorrect sample containers/ preservation, sample temperature outside of acceptance range, insufficient or missing samples, etc.?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No discrepancies.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

4. Case Narrative

a.Present and understandable?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Discrepancies, errors or QC failures identified by the lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

SW8260C:
On analysis day 10/22/13, matrix spike/spike duplicate analysis in analytical batch 102213E1 was performed on JBER sample 13Q4TU073-SB1105-SO-1ST (M302109MS/M302110MSD).
Some compounds did not meet percent recovery acceptance criteria.
SW9060:
Matrix Spike/Matrix Spike Duplicate(s):
SW9060: MS recovery of Total Organic Carbon(252%) in 13Q4DA085-AP4413-GW-0MS did not meet acceptance criteria of 85-115%.
MSD recovery of Total Organic Carbon(265%) in 13Q4DA085-AP4413-GW-0SD did not meet acceptance criteria of 85-115%.

c. Were all corrective actions documented?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

Some data qualified as estimated; usable as qualified.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. All applicable holding times met?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. All soils reported on a dry weight basis?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No soil samples reported.

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?

○ Yes ○ No ◉ NA (Please explain.) Comments:

For details, see site-specific report.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. All method blank results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Method Blank detects: Methane for RSK-175.

These analytes had Method Blank detects: Hexachlorobutadiene for SW8260C.

iii. If above PQL, what samples are affected?

Comments:

13Q4DA085-AP4413-GW-0, 13Q4DA085-AP4413-GW-1

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Associated sample detects less than five times the blank concentration were flagged 'B'. Associated sample detects greater than five times the blank concentration and non-detects were not qualified.

v. Data quality or usability affected? (Please explain)

Comments:

Some data qualified as estimated; usable as qualified.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics - One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Precision - All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/DMSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?
Comments:

vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

vii. Data quality or usability affected? (Please explain)
Comments:

All data are usable.

c. Surrogates - Organics Only

i. Are surrogate recoveries reported for organic analyses - field, QC and laboratory samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No surrogate exceedances.

iv. Data quality or usability affected? (Use the comment box to explain.).

Comments:

d. Trip Blank - Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. All results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Trip Blank detects: Methane for RSK-175.

iv. If above PQL, what samples are affected?

Comments:

13Q4DA085-AP4413-GW-0, 13Q4DA085-AP4413-GW-1

v. Data quality or usability affected? (Please explain.)

Comments:

Associated sample detects less than five times the blank concentration were flagged 'B'.

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

○ Yes ◉ No ○ NA (Please explain.) Comments:

ii. Submitted blind to lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Precision - All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

$$RPD\ (\%) = \text{Absolute Value of: } \frac{(R1 - R2) \times 100}{((R1 + R2)/2)}$$

Where R1 = Sample Concentration
R2 = Field Duplicate Concentration

○ Yes ◉ No ○ NA (Please explain.) Comments:

These samples were out of control for E300.0: Chloride (13Q4DA085-AP4413-GW-0/3Q4DA085-AP4413-GW-1, %RPD 199.49 vs 30), Sulfate (13Q4DA085-AP4413-GW-0/13Q4DA085-AP4413-GW-1, %RPD = 136.81 vs 30), associated sample results were flagged J and UJ.

These samples were out of control for E376.2: Sulfide (13Q4DA085-AP4413-GW-0/13Q4DA085-AP4413-GW-1, %RPD = 176 vs 30), associated sample results were flagged J and UJ.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

Data qualified as estimated; usable as qualified.

f. Decontamination or Equipment Blank (if applicable)

◉ Yes ○ No ○ NA (Please explain.) Comments:

i. All results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Equipment Blank detects: Chloride, Sulfate for E300.0.

These analytes had Equipment Blank detects: Nitrate/Nitrite-N for E353.2.

These analytes had Equipment Blank detects: Sulfide for E376.2.

These analytes had Equipment Blank detects: Methane for RSK-175.

These analytes had Equipment Blank detects: Manganese, dissolved for SW6010B.

These analytes had Equipment Blank detects: Acetone, Tetrachloroethylene for SW8260C.

These analytes had Equipment Blank detects: Total Organic Carbon for SW9060.

ii. If above PQL, what samples are affected?

13Q4DA085-AP4413-GW-0, 13Q4DA085-AP4413-GW-1

iii. Data quality or usability affected? (Please explain.)

Associated sample detects less than five times (10 times for acetone) the blank concentrations were flagged 'B'. Associated sample detects greater than five times (10 times for acetone) the blank concentrations and non-detects were not qualified.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Matrix:

These samples were flagged for Matrix spike duplicate recovery criteria greater than the upper control limit:
Total Organic Carbon (13Q4DA085-AP4413-GW-0, %R = 265 LCL=75 UCL=125) for SW9060.
Data qualified as estimated and detected result flagged J.

Hexachlorobutadiene (13Q4DA085-AP4413-GW-0, %R = 190 LCL=50 UCL=140) for SW8260C. Associated nondetected result was not qualified.

These samples were flagged for Matrix spike recovery greater than the upper control limit:
Hexachlorobutadiene (13Q4DA085-AP4413-GW-0, %R = 183 LCL=50 UCL=140) for SW8260C. Associated nondetected result was not qualified.

Tetrachloroethylene (13Q4DA085-AP4413-GW-0, %R = 207 LCL=45 UCL=150) for SW8260C. Data qualified as estimated and detected result flagged J.

Total Organic Carbon (13Q4DA085-AP4413-GW-0, %R = 252 LCL=75 UCL=125) for SW9060. Data qualified as estimated and detected result flagged J.

Laboratory Data Review Checklist

CompletedBy	Berney Kidd		
Title	Project Chemist	Date	11/19/2014
CS Report Name		ReportDate	2/18/2014
Consultant Firm	CH2M Hill		
Laboratory Name	Applied Sciences Laboratory	Laboratory Report Number	N1080
ADEC File Number		ADECRecKeyNumber	

1. Laboratory

a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No samples transferred.

2. Chain of Custody (COC)

a. COC information completed, signed, and dated (including released/received by)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Correct analyses requested?

○ Yes ◉ No ○ NA (Please explain.) Comments:

COC requested Method E376.1 for sulfide; samples analyzed by equivalent method E376.2.

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Samples received at 5.5C.

b. Sample preservation acceptable - acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. Sample condition documented - broken, leaking (Methanol), zero headspace (VOC vials)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. If there were any discrepancies, were they documented? - For example, incorrect sample containers/ preservation, sample temperature outside of acceptance range, insufficient or missing samples, etc.?

◉ Yes ○ No ○ NA (Please explain.) Comments:

No discrepancies.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

4. Case Narrative

a.Present and understandable?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Discrepancies, errors or QC failures identified by the lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

SW8260C:
Matrix Spike/Matrix Spike Duplicate(s):
Recovery of cis-1,2-Dichloroethene (0%) in 14Q1CG039-AP3983R-GW-0MS did not meet acceptance criteria of 70-125%. Recovery of cis-1,2-Dichloroethene (0%) in 14Q1CG039-AP3983R-GW-0SD did not meet acceptance criteria of 70-125%. Recovery of 1,1,2,2-Tetrachloroethane (137%) in 14Q1CG039-AP3983R-GW-0MS did not meet acceptance criteria of 65-130%. Recovery of 1,1,2,2-Tetrachloroethane (182%) in 14Q1CG039-AP3983R-GW-0SD did not meet acceptance criteria of 65-130%.
Surrogate Standard(s):
Analytical Exception(s):
Due to high levels of analytes in the native samples, matrix spike/spike duplicate analysis in batch 012214P1 could not be performed on a JBER sample. Another client sample was selected and acceptance criteria were met.
SW6010B:
Matrix Spike/Matrix Spike Duplicate(s):
SW6010C: MS and MSD recovery of Iron in 14Q1CG039-AP3983R-GW-0MS and 14Q1CG039-AP3983R-GW-0SD did not meet acceptance criteria of 80-120% because the concentration of Iron in the sample was significantly higher than the added spike concentration.
SW9060:
Matrix Spike/Matrix Spike Duplicate(s):
SW9060A: MSD recovery of Total Organic Carbon(287%) in 14Q1CG039-AP3983R-GW-0SD did not meet acceptance criteria of 80-120%.

c. Were all corrective actions documented?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

All data are usable as reported.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. All applicable holding times met?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. All soils reported on a dry weight basis?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No soil samples reported.

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?

○ Yes ◉ No ○ NA (Please explain.) Comments:

See site-specific report for details.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. All method blank results less than PQL?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. If above PQL, what samples are affected?

Comments:

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No data affected.

v. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics - One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Precision - All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/DMSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?
Comments:

vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

vii. Data quality or usability affected? (Please explain)
Comments:

All data are usable as reported.

c. Surrogates - Organics Only

i. Are surrogate recoveries reported for organic analyses - field, QC and laboratory samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No surrogate exceedances.

iv. Data quality or usability affected? (Use the comment box to explain.).
Comments:

d. Trip Blank - Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. All results less than PQL?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. If above PQL, what samples are affected?
Comments:

v. Data quality or usability affected? (Please explain.)
Comments:

All data are usable as reported.

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Submitted blind to lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Precision - All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

$$RPD\ (\%) = \text{Absolute Value of: } \frac{(R1 - R2) \times 100}{((R1 + R2)/2)}$$

Where R1 = Sample Concentration
R2 = Field Duplicate Concentration

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

○ Yes ○ No ◉ NA (Please explain.) Comments:

No field duplicate Relative Percent Difference exceedences.

f. Decontamination or Equipment Blank (if applicable)

○ Yes ○ No ◉ NA (Please explain.) Comments:

Equipment blank not reported in this SDG.

i. All results less than PQL?

○ Yes ○ No ◉ NA (Please explain.) Comments:

ii. If above PQL, what samples are affected?

iii. Data quality or usability affected? (Please explain.)

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)
a. Defined and appropriate?

○ Yes ◉ No ○ NA (Please explain.) Comments:

Matrix:

The recoveries of cis-1,2-dichloroethene, trichloroethene and 1,1,2,2-tetrachloroethane were outside of criteria in the MS and MSD of sample 14Q1CG039-AP3983R-GW-0 for Method SW8260C. The associated detected results were not qualified because concentrations were greater than four times the spike concentrations.

The recovery of dissolved iron was outside of criteria in the MS and MSD of sample 14Q1CG039-AP3983R-GW-0 for Method SW6010B. The associated detected result was not qualified because the concentration was greater than four times the spike concentration.

The recovery of total organic carbon was outside of criteria in the MSD of sample 14Q1CG039-AP3983R-GW-0 for Method SW9060. The associated detected result was not qualified because the concentration was greater than four times the spike concentration.

Laboratory Data Review Checklist

CompletedBy	Berney Kidd		
Title	Project Chemist	Date	11/19/2014
CS Report Name		ReportDate	2/18/2014
Consultant Firm	CH2M Hill		
Laboratory Name	Applied Sciences Laboratory	Laboratory Report Number	N1081
ADEC File Number		ADECRecKeyNumber	

1. Laboratory

a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No samples transferred.

2. Chain of Custody (COC)

a. COC information completed, signed, and dated (including released/received by)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Correct analyses requested?

○ Yes ◉ No ○ NA (Please explain.) Comments:

COC requested sulfide by Method E376.1; samples were analyzed by equivalent method E376.2.

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Samples received at 4.7C.

b. Sample preservation acceptable - acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. Sample condition documented - broken, leaking (Methanol), zero headspace (VOC vials)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. If there were any discrepancies, were they documented? - For example, incorrect sample containers/ preservation, sample temperature outside of acceptance range, insufficient or missing samples, etc.?

◉ Yes ○ No ○ NA (Please explain.) Comments:

No discrepancies.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

4. Case Narrative

a.Present and understandable?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Discrepancies, errors or QC failures identified by the lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

SW8260C:
Due to high levels of analytes in the native samples, matrix spike/spike duplicate analysis in batch 012214P1 could not be performed on a JBER sample. Another client sample was selected and acceptance criteria were met.

c. Were all corrective actions documented?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

All data are usable as reported.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. All applicable holding times met?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. All soils reported on a dry weight basis?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No soil samples reported.

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?

○ Yes ◉ No ○ NA (Please explain.) Comments:

See site-specific report for details.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. All method blank results less than PQL?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. If above PQL, what samples are affected?

Comments:

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No data affected.

v. Data quality or usability affected? (Please explain)

Comments:

All data are usable.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics - One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Precision - All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/DMSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?
Comments:

vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

vii. Data quality or usability affected? (Please explain)
Comments:

All data are usable as reported.

c. Surrogates - Organics Only

i. Are surrogate recoveries reported for organic analyses - field, QC and laboratory samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No surrogate exceedances.

iv. Data quality or usability affected? (Use the comment box to explain.).
Comments:

d. Trip Blank - Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. All results less than PQL?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. If above PQL, what samples are affected?

Comments:

v. Data quality or usability affected? (Please explain.)

Comments:

All data are usable as reported.

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No FD in this SDG.

ii. Submitted blind to lab?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No FD in this SDG.

iii. Precision - All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

$$RPD\ (\%) = \text{Absolute Value of: } \frac{(R1 - R2) \times 100}{((R1 + R2)/2)}$$

Where R1 = Sample Concentration
R2 = Field Duplicate Concentration

○ Yes ○ No ◉ NA (Please explain.) Comments:

No FD in this SDG.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

○ Yes ○ No ◉ NA (Please explain.) Comments:

No FD in this SDG.

f. Decontamination or Equipment Blank (if applicable)

○ Yes ○ No ◉ NA (Please explain.) Comments:

Equipment blank not reported in this SDG.

i. All results less than PQL?

○ Yes ○ No ◉ NA (Please explain.) Comments:

ii. If above PQL, what samples are affected?

iii. Data quality or usability affected? (Please explain.)

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)
   a. Defined and appropriate?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No other flags applied.

Laboratory Data Review Checklist

CompletedBy	Berney Kidd		
Title	Project Chemist	Date	11/19/2014
CS Report Name		ReportDate	5/6/2014
Consultant Firm	CH2M Hill		
Laboratory Name	Applied Sciences Laboratory	Laboratory Report Number	N1694
ADEC File Number		ADECRecKeyNumber	

1. Laboratory

a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No samples transferred.

2. Chain of Custody (COC)

a. COC information completed, signed, and dated (including released/received by)?

○ Yes ◉ No ○ NA (Please explain.) Comments:

COC not relinquished.

b. Correct analyses requested?

◉ Yes ○ No ○ NA (Please explain.) Comments:

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Samples received at 3.8C.

b. Sample preservation acceptable - acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. Sample condition documented - broken, leaking (Methanol), zero headspace (VOC vials)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. If there were any discrepancies, were they documented? - For example, incorrect sample containers/ preservation, sample temperature outside of acceptance range, insufficient or missing samples, etc.?

◉ Yes ○ No ○ NA (Please explain.) Comments:

No discrepancies.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

4. Case Narrative

a.Present and understandable?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Discrepancies, errors or QC failures identified by the lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

SW8260C:
Calibration Verification(s):
The %D for Bromoform (23%) in CV1-0421 exceeded acceptance criteria of 20%.
Matrix Spike/Matrix Spike Duplicate(s):
Due to high levels of compounds in the native sample, 14Q2CG039-AP4550-GW-0, client specified Matrix
Spike and Matrix Spike Duplicate samples could not be analyzed for risk of instrument contamination. MS/MSD analysis was performed on another client sample. All acceptance criteria were met.
SW6010B:
Matrix Spike/Matrix Spike Duplicate(s):
SW6010C: MS recovery of Iron(0%) in 14Q2CG039-AP4550-GW-0MS did not meet acceptance criteria of 80-120%. MSD recovery of Iron(0%) in 14Q2CG039-AP4550-GW-0SD did not meet acceptance criteria of 80-120%.

c. Were all corrective actions documented?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

All data are usable as reported.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. All applicable holding times met?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. All soils reported on a dry weight basis?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No soil samples reported.

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?

○ Yes ◉ No ○ NA (Please explain.) Comments:

See site-specific report for details.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. All method blank results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

Methane was detected in a method blank for Method RSK175.

iii. If above PQL, what samples are affected?

Comments:

No samples affected.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

v. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics - One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Precision - All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/DMSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?
Comments:

vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

vii. Data quality or usability affected? (Please explain)
Comments:

All data are usable as reported.

c. Surrogates - Organics Only

i. Are surrogate recoveries reported for organic analyses - field, QC and laboratory samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No surrogate exceedances.

iv. Data quality or usability affected? (Use the comment box to explain.).

Comments:

d. Trip Blank - Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

◉ Yes ○ No ○ NA (Please explain.) Comments:

TB associated to samples in this SDG is in N1695.

iii. All results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

Methane was detected in the TB for Method RSK175.

iv. If above PQL, what samples are affected?

Comments:

No samples affected.

v. Data quality or usability affected? (Please explain.)

Comments:

All data are usable as reported.

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No FD in this SDG.

ii. Submitted blind to lab?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No FD in this SDG.

iii. Precision - All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

$$RPD\ (\%) = \text{Absolute Value of: } \frac{(R1 - R2) \times 100}{((R1 + R2)/2)}$$

Where R1 = Sample Concentration

R2 = Field Duplicate Concentration

○ Yes ○ No ◉ NA (Please explain.) Comments:

No FD in this SDG.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

○ Yes ○ No ◉ NA (Please explain.) Comments:

No FD in this SDG.

f. Decontamination or Equipment Blank (if applicable)

○ Yes ○ No ◉ NA (Please explain.) Comments:

Equipment blank not collected.

i. All results less than PQL?

○ Yes ○ No ◉ NA (Please explain.) Comments:

ii. If above PQL, what samples are affected?

iii. Data quality or usability affected? (Please explain.)

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

○ Yes ◉ No ○ NA (Please explain.) Comments:

Calibration:

The recovery of bromoform was greater than criteria in a continuing calibration verification for Method SW8260C. All associated results were not detected and were not qualified.

Total organic carbon was detected in a continuing calibration blank for Method SW9060. Associated detected results were not qualified because concentrations were greater than five times the blank concentration.

Lactic acid was detected in a continuing calibration blank for Method E300.0M. Associated results were not detected and were not qualified.

Matrix:

The recovery of dissolved iron was less than criteria in the MS and MSD of sample 14Q2CG039-AP4550-GW-0 for Method SW6010B. Associated detected results were not qualified because concentrations were greater than four times the spike concentration.

Laboratory Data Review Checklist

CompletedBy	Berney Kidd		
Title	Project Chemist	Date	11/19/2014
CS Report Name		ReportDate	5/6/2014
Consultant Firm	CH2M Hill		
Laboratory Name	Applied Sciences Laboratory	Laboratory Report Number	N1695
ADEC File Number		ADECRecKeyNumber	

1. Laboratory

a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No samples transferred.

2. Chain of Custody (COC)

a. COC information completed, signed, and dated (including released/received by)?

○ Yes ◉ No ○ NA (Please explain.) Comments:

COC not relinquished.

b. Correct analyses requested?

○ Yes ◉ No ○ NA (Please explain.) Comments:

COC requested sulfide by E376.1; samples were analyzed by equivalent method E376.2.

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Samples received at 3.8C.

b. Sample preservation acceptable - acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. Sample condition documented - broken, leaking (Methanol), zero headspace (VOC vials)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. If there were any discrepancies, were they documented? - For example, incorrect sample containers/ preservation, sample temperature outside of acceptance range, insufficient or missing samples, etc.?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Sample 14Q2DA085-AP4413-GW-1 was received but not listed on COC. We received 3 VOC vials, 3 MEE vials, 2 TOC vials, 1 metals bottle, 1 nutrient bottle, 1 unpreserved bottle, and 1 sulfide bottle. Samples logged in and analyzed per containers received.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

4. Case Narrative

a.Present and understandable?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Discrepancies, errors or QC failures identified by the lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

SW8260C:
The %D for Bromoform (23%) in CV1-0421 exceeded acceptance criteria of 20%.

c. Were all corrective actions documented?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

All data are usable as reported.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. All applicable holding times met?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. All soils reported on a dry weight basis?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No soil samples reported.

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?

○ Yes ◉ No ○ NA (Please explain.) Comments:

See site-specific report for details.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. All method blank results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Method Blank detects: Methane for RSK-175.

iii. If above PQL, what samples are affected?

Comments:

14Q2DA085-AP4413-GW-0, 14Q2DA085-AP4413-GW-1

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Associated sample detects less than five times the blank concentration were flagged 'B'.

v. Data quality or usability affected? (Please explain)

Comments:

Some data qualified as estimated; usable as qualified.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics - One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Precision - All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/DMSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?
Comments:

vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

vii. Data quality or usability affected? (Please explain)
Comments:

All data are usable as reported.

c. Surrogates - Organics Only

i. Are surrogate recoveries reported for organic analyses - field, QC and laboratory samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No surrogate exceedances.

iv. Data quality or usability affected? (Use the comment box to explain.).
Comments:

d. Trip Blank - Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. All results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Trip Blank detects: Methane for RSK-175.

iv. If above PQL, what samples are affected?

Comments:

No samples affected.

v. Data quality or usability affected? (Please explain.)

Comments:

All data are usable as reported.

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Submitted blind to lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Precision - All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

$$RPD\ (\%) = \text{Absolute Value of: } \frac{(R1 - R2) \times 100}{((R1 + R2)/2)}$$

Where R1 = Sample Concentration
R2 = Field Duplicate Concentration

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

○ Yes ○ No ◉ NA (Please explain.) Comments:

No field duplicate Relative Percent Difference exceedences.

f. Decontamination or Equipment Blank (if applicable)

○ Yes ○ No ◉ NA (Please explain.) Comments:

Equipment blank not collected.

i. All results less than PQL?

○ Yes ○ No ◉ NA (Please explain.) Comments:

ii. If above PQL, what samples are affected?

iii. Data quality or usability affected? (Please explain.)

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)
   a. Defined and appropriate?

○ Yes ◉ No ○ NA (Please explain.) Comments:

Calibration:

The recovery of bromoform was greater than criteria in a continuing calibration verification for Method SW8260C. All associated results were not detected and were not qualified.

Lactic acid was detected in a continuing calibration blank for Method E300.0M. Associated results were not detected and were not qualified.

Laboratory Data Review Checklist

CompletedBy	Berney Kidd		
Title	Project Chemist	Date	11/5/2014
CS Report Name		ReportDate	9/19/2014
Consultant Firm	CH2M Hill		
Laboratory Name	Applied Sciences Laboratory	Laboratory Report Number	N2614
ADEC File Number		ADECRecKeyNumber	

1. Laboratory

a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No samples transferred.

2. Chain of Custody (COC)

a. COC information completed, signed, and dated (including released/received by)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Correct analyses requested?

◉ Yes ○ No ○ NA (Please explain.) Comments:

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Samples received at 2.0C.

b. Sample preservation acceptable - acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. Sample condition documented - broken, leaking (Methanol), zero headspace (VOC vials)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. If there were any discrepancies, were they documented? - For example, incorrect sample containers/ preservation, sample temperature outside of acceptance range, insufficient or missing samples, etc.?

○ Yes ◉ No ○ NA (Please explain.) Comments:

No discrepancies.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

4. Case Narrative

a.Present and understandable?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Discrepancies, errors or QC failures identified by the lab?

○ Yes ◉ No ○ NA (Please explain.) Comments:

c. Were all corrective actions documented?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No corrective actions.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

All data are usable as reported.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. All applicable holding times met?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. All soils reported on a dry weight basis?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No soil samples reported.

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?

○ Yes ◉ No ○ NA (Please explain.) Comments:

See site-specific report for details.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. All method blank results less than PQL?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. If above PQL, what samples are affected?

Comments:

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

v. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics - One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Precision - All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/DMSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

vii. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

c. Surrogates - Organics Only

i. Are surrogate recoveries reported for organic analyses - field, QC and laboratory samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No surrogate exceedances.

iv. Data quality or usability affected? (Use the comment box to explain.).

Comments:

d. Trip Blank - Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. All results less than PQL?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. If above PQL, what samples are affected?

Comments:

v. Data quality or usability affected? (Please explain.)

Comments:

No data affected.

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Submitted blind to lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Precision - All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

$$RPD\ (\%) = \text{Absolute Value of: } \frac{(R1 - R2) \times 100}{((R1 + R2)/2)}$$

Where R1 = Sample Concentration
R2 = Field Duplicate Concentration

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

○ Yes ○ No ◉ NA (Please explain.) Comments:

No field duplicate Relative Percent Difference exceedences.

f. Decontamination or Equipment Blank (if applicable)

◉ Yes ○ No ○ NA (Please explain.) Comments:

i. All results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Equipment Blank detects: Methane for RSK-175.

These analytes had Equipment Blank detects: Manganese, dissolved for SW6010B.

These analytes had Equipment Blank detects: nitrate/nitrite for E353.2.

These analytes had Equipment Blank detects: Acetone, Ethylbenzene, hexachlorobutadiene, m,p-xylene, o-xylene, Toluene, Total Xylense for SW8260C.

ii. If above PQL, what samples are affected?

14Q3CG039-AP5246-GW-0, 14Q3CG039-AP5683-GW-0

iii. Data quality or usability affected? (Please explain.)

Associated sample results detected less than five times (10 times for acetone) the blank concentrations were qualified as estimated and flagged "B". Associated results detected greater than five times (10 times for acetone) the blank concentrations, and nondetects, were not qualified.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No other flags applied.

Laboratory Data Review Checklist

CompletedBy	Berney Kidd		
Title	Project Chemist	Date	11/5/2014
CS Report Name		ReportDate	9/24/2014
Consultant Firm	CH2M Hill		
Laboratory Name	Applied Sciences Laboratory	Laboratory Report Number	N2617
ADEC File Number		ADECRecKeyNumber	

1. Laboratory

a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No samples transferred.

2. Chain of Custody (COC)

a. COC information completed, signed, and dated (including released/received by)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Correct analyses requested?

◉ Yes ○ No ○ NA (Please explain.) Comments:

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Samples received at 1.4C.

b. Sample preservation acceptable - acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. Sample condition documented - broken, leaking (Methanol), zero headspace (VOC vials)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. If there were any discrepancies, were they documented? - For example, incorrect sample containers/ preservation, sample temperature outside of acceptance range, insufficient or missing samples, etc.?

◉ Yes ○ No ○ NA (Please explain.) Comments:

No discrepancies.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

4. Case Narrative

a.Present and understandable?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Discrepancies, errors or QC failures identified by the lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

SW8260C:
On analysis day 9/09/2014, matrix spike/spike duplicate analysis in batch 090914E1 was performed on JBER 14Q3CG039-AP5246-GW-0 (N261401MS/N261401MSD). On analysis day 9/11/2014 (batch 091114E1), a JBER sample was not available for matrix spike/spike duplicate analysis. Another client sample was selected
E300.0M:
E300.0M: Closing Blank (CCB2-0730) contained 0.101 mg/L Lactic Acid. This analyte was non detect in the sample and in the Method Blank (WB1-0919).

c. Were all corrective actions documented?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

All data are usable as reported.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. All applicable holding times met?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. All soils reported on a dry weight basis?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No soil samples reported.

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?

○ Yes ◉ No ○ NA (Please explain.) Comments:

See site-specific report for details.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. All method blank results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Method Blank detects: Methane for RSK-175.

These analytes had Method Blank detects: Hexachlorobutadiene for SW8260C.

These analytes had Method Blank detects: Manganese, dissolved for SW6010B.

iii. If above PQL, what samples are affected?

Comments:

14Q3CG039-AP3747-GW-0, 14Q3CG039-AP3748-GW-0, 14Q3CG039-AP4344-GW-0

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Associated sample detects less than five times the blank concentrations were flagged 'B'. Associated sample detects greater than five times the blank concentration and non-detects were not qualified.

v. Data quality or usability affected? (Please explain)

Comments:

Some data qualified as estimated; usable as qualified.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics - One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Precision - All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/DMSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?
Comments:

vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

vii. Data quality or usability affected? (Please explain)
Comments:

All data are usable as reported.

c. Surrogates - Organics Only

i. Are surrogate recoveries reported for organic analyses - field, QC and laboratory samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No surrogate exceedances.

iv. Data quality or usability affected? (Use the comment box to explain.).
Comments:

d. Trip Blank - Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. All results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Trip Blank detects: Acetone for SW8260C.

iv. If above PQL, what samples are affected?

Comments:

No samples affected.

v. Data quality or usability affected? (Please explain.)

Comments:

All data are usable as reported.

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Submitted blind to lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Precision - All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

$$RPD\ (\%) = \text{Absolute Value of: } \frac{(R1 - R2) \times 100}{((R1 + R2)/2)}$$

Where R1 = Sample Concentration
R2 = Field Duplicate Concentration

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

○ Yes ○ No ◉ NA (Please explain.) Comments:

No field duplicate Relative Percent Difference exceedences.

f. Decontamination or Equipment Blank (if applicable)

◉ Yes ○ No ○ NA (Please explain.) Comments:

i. All results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Equipment Blank detects: Methane for RSK-175.

These analytes had Equipment Blank detects: Manganese, dissolved for SW6010B.

These analytes had Equipment Blank detects: Total Organic Carbon for SW9060.

These analytes had Equipment Blank detects: Nitrate/nitrite for E353.2.

These analytes had Equipment Blank detects: Acetone, Ethylbenzene, m,p-Xylene, o-Xylene, Toluene, Total Xylenes for SW8260C.

ii. If above PQL, what samples are affected?

14Q3CG039-AP3747-GW-0, 14Q3CG039-AP3748-GW-0, 14Q3CG039-AP4344-GW-0

iii. Data quality or usability affected? (Please explain.)

Associated sample results detected less than five times (10 times for acetone) the blank concentrations were qualified as estimated and flagged "B". Associated sample results detected greater than five times (10 times for acetone) the blank concentrations, and nondetects, were not qualified.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

○ Yes ◉ No ○ NA (Please explain.) Comments:

Lactic acid was detected below the LOQ in a continuing calibration blank for Method E300.0M. No samples were affected.

Laboratory Data Review Checklist

CompletedBy	Berney Kidd		
Title	Project Chemist	Date	11/5/2014
CS Report Name		ReportDate	9/25/2014
Consultant Firm	CH2M Hill		
Laboratory Name	Applied Sciences Laboratory	Laboratory Report Number	N2648
ADEC File Number		ADECRecKeyNumber	

1. Laboratory

a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No samples transferred.

2. Chain of Custody (COC)

a. COC information completed, signed, and dated (including released/received by)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Correct analyses requested?

◉ Yes ○ No ○ NA (Please explain.) Comments:

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Samples received at 3.0C.

b. Sample preservation acceptable - acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. Sample condition documented - broken, leaking (Methanol), zero headspace (VOC vials)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. If there were any discrepancies, were they documented? - For example, incorrect sample containers/ preservation, sample temperature outside of acceptance range, insufficient or missing samples, etc.?

◉ Yes ○ No ○ NA (Please explain.) Comments:

No discrepancies.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

4. Case Narrative

a.Present and understandable?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Discrepancies, errors or QC failures identified by the lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

SW8260C:
Matrix Spike/Matrix Spike Duplicate(s):
Some compounds did not meet acceptance criteria.
SW6010B:
Matrix Spike/Matrix Spike Duplicate(s):
SW6010C: The matrix spike recovery for iron in client sample "14Q3CG039-AP4550-GW-0MS" was outside acceptance criteria because the analyte concentration in the sample was significantly higher than the added spike concentrations.

c. Were all corrective actions documented?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

All data are usable as reported.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. All applicable holding times met?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. All soils reported on a dry weight basis?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No soil samples reported.

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?

○ Yes ◉ No ○ NA (Please explain.) Comments:

See site-specific report for details.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. All method blank results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Method Blank detects: Methane for RSK-175.

These analytes had Method Blank detects: Hexachlorobutadiene for SW8260C.

iii. If above PQL, what samples are affected?

Comments:

14Q3CG039-AP3744-GW-0, 14Q3DA089-AP3871-GW-0

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Associated sample detects less than five times the blank concentrations were flagged 'B'. Associated sample detects greater than five times the blank concentration and non-detects were not qualified.

v. Data quality or usability affected? (Please explain)

Comments:

Some data qualified as estimated; usable as qualified.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics - One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Precision - All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/DMSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?
Comments:

vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

vii. Data quality or usability affected? (Please explain)
Comments:

All data are usable as reported.

c. Surrogates - Organics Only

i. Are surrogate recoveries reported for organic analyses - field, QC and laboratory samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No surrogate exceedances.

iv. Data quality or usability affected? (Use the comment box to explain.).
Comments:

d. Trip Blank - Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. All results less than PQL?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. If above PQL, what samples are affected?

Comments:

v. Data quality or usability affected? (Please explain.)

Comments:

All data are usable as reported.

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Submitted blind to lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Precision - All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

$$RPD\ (\%) = \text{Absolute Value of: } \frac{(R1 - R2) \times 100}{((R1 + R2)/2)}$$

Where R1 = Sample Concentration
R2 = Field Duplicate Concentration

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

○ Yes ○ No ◉ NA (Please explain.) Comments:

No field duplicate Relative Percent Difference exceedences.

f. Decontamination or Equipment Blank (if applicable)

◉ Yes ○ No ○ NA (Please explain.) Comments:

i. All results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Equipment Blank detects: Methane for RSK-175.

These analytes had Equipment Blank detects: Acetone, Ethylbenzene, m,p-Xylene, o-Xylene, Toluene, Total Xylenes for SW8260C.

These analytes had Equipment Blank detects: Total Organic Carbon for SW9060.

These analytes had Equipment Blank detects: Nitrate/nitrite for E353.2.

These analytes had Equipment Blank detects: Dissolved Manganese for SW6010B.

ii. If above PQL, what samples are affected?

14Q3CG039-AP3744-GW-0, 14Q3CG039-AP3983R-GW-0,

iii. Data quality or usability affected? (Please explain.)

Associated sample detects less than five times (10 times for acetone) the blank concentrations were flagged 'B'. Associated sample detects greater than five times (10 times for acetone) the blank concentration and non-detects were not qualified.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Calibration:
Lactic acid was detected below the LOQ in a continuing calibration blank for Method E300.0M. No data were affected.

Matrix:

These samples were flagged for Matrix spike duplicate recovery criteria less than the lower control limit: Trichloroethene (TCE) (14Q3CG039-AP4550-GW-0, %R = 69 LCL=70 UCL=125) for SW8260C. Associated detected result was qualified as estimated and flagged "J".

The recovery dissolved iron was less than criteria in the MS of sample 14Q3CG039-AP4550-GW-0 for Method SW6010B. The associated detected result was not qualified because the sample concentration was greater than four times the spike concentration.

The recoveries of 1,1,2,2-tetrachloroethane and cis-1,2-dichloroethene were less than criteria in the MS and MSD of sample 14Q3CG039-AP4550-GW-0 for Method SW8260C. The associated detected results were not qualified because the sample concentrations were greater than four times the spike concentrations.

Laboratory Data Review Checklist

CompletedBy	Berney Kidd		
Title	Project Chemist	Date	11/5/2014
CS Report Name		ReportDate	9/26/2014
Consultant Firm	CH2M Hill		
Laboratory Name	Applied Sciences Laboratory	Laboratory Report Number	N2655
ADEC File Number		ADECRecKeyNumber	

1. Laboratory

a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No samples transferred.

2. Chain of Custody (COC)

a. COC information completed, signed, and dated (including released/received by)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Correct analyses requested?

◉ Yes ○ No ○ NA (Please explain.) Comments:

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Samples received at 1.6C

b. Sample preservation acceptable - acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. Sample condition documented - broken, leaking (Methanol), zero headspace (VOC vials)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. If there were any discrepancies, were they documented? - For example, incorrect sample containers/ preservation, sample temperature outside of acceptance range, insufficient or missing samples, etc.?

◉ Yes ○ No ○ NA (Please explain.) Comments:

No discrepancies.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

4. Case Narrative

a.Present and understandable?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Discrepancies, errors or QC failures identified by the lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

SW6010B:
The native results for iron and manganese in client sample "14Q3DA089-AP3534-GW-0" were less than 50 times the LOQ, so a post digestion spike was performed. All acceptance criteria were met.

c. Were all corrective actions documented?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

All data are usable as reported.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. All applicable holding times met?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. All soils reported on a dry weight basis?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No soil samples reported.

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?

○ Yes ◉ No ○ NA (Please explain.) Comments:

See site-specific report for details.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. All method blank results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Method Blank detects: Methane for RSK-175.

These analytes had Method Blank detects: Hexachlorobutadiene for SW8260C.

iii. If above PQL, what samples are affected?

Comments:

14Q3DA089-AP3486-GW-0, 14Q3DA089-AP3534-GW-0, 14Q3DA089-AP3774-GW-0

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Associated sample detects less than five times the blank concentrations were flagged 'B'. Associated non-detects were not qualified.

v. Data quality or usability affected? (Please explain)

Comments:

Some data qualified as estimated; usable as qualified.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics - One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Precision - All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/DMSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

vii. Data quality or usability affected? (Please explain)

Comments:

All data are usable.

c. Surrogates - Organics Only

i. Are surrogate recoveries reported for organic analyses - field, QC and laboratory samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No surrogate exceedances.

iv. Data quality or usability affected? (Use the comment box to explain.).

Comments:

d. Trip Blank - Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. All results less than PQL?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. If above PQL, what samples are affected?

Comments:

v. Data quality or usability affected? (Please explain.)

Comments:

No data affected.

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Submitted blind to lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Precision - All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

$$RPD\ (\%) = \text{Absolute Value of: } \frac{(R1 - R2) \times 100}{((R1 + R2)/2)}$$

Where R1 = Sample Concentration
R2 = Field Duplicate Concentration

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

○ Yes ○ No ◉ NA (Please explain.) Comments:

No field duplicate Relative Percent Difference exceedences.

f. Decontamination or Equipment Blank (if applicable)

◉ Yes ○ No ○ NA (Please explain.) Comments:

i. All results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Equipment Blank detects: Methane for RSK-175.

These analytes had Equipment Blank detects: Manganese, dissolved for SW6010B.

These analytes had Equipment Blank detects: Nitrate/nitrite for E353.2.

These analytes had Equipment Blank detects: Ethylbenzene, m,p-Xylene, o-Xylene, Toluene, Total Xylenes for SW8260C.

ii. If above PQL, what samples are affected?

14Q3DA089-AP3486-GW-0, 14Q3DA089-AP3534-GW-0, 14Q3DA089-AP3774-GW-0

iii. Data quality or usability affected? (Please explain.)

Associated sample detects less than five times the blank concentrations were flagged 'B'. Associated sample results detected greater than five times the blank concentrations and non-detects were not qualified.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No other flags applied.

Laboratory Data Review Checklist

CompletedBy	Berney Kidd		
Title	Project Chemist	Date	11/5/2014
CS Report Name		ReportDate	11/4/2014
Consultant Firm	CH2M Hill		
Laboratory Name	Applied Sciences Laboratory	Laboratory Report Number	N2664
ADEC File Number		ADECRecKeyNumber	

1. Laboratory

a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No samples transferred.

2. Chain of Custody (COC)

a. COC information completed, signed, and dated (including released/received by)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Correct analyses requested?

◉ Yes ○ No ○ NA (Please explain.) Comments:

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Samples received at 2.1C.

b. Sample preservation acceptable - acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. Sample condition documented - broken, leaking (Methanol), zero headspace (VOC vials)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. If there were any discrepancies, were they documented? - For example, incorrect sample containers/ preservation, sample temperature outside of acceptance range, insufficient or missing samples, etc.?

◉ Yes ○ No ○ NA (Please explain.) Comments:

No discrepancies.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

4. Case Narrative

a.Present and understandable?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Discrepancies, errors or QC failures identified by the lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

SW6010B:
The native results for iron and manganese in client sample "14Q3DA089-AP4341-GW-0" were less than 50 times the LOQ, so a post digestion spike was performed. All acceptance criteria were met.

c. Were all corrective actions documented?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

All data are usable as reported.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. All applicable holding times met?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. All soils reported on a dry weight basis?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No soil samples reported.

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?

○ Yes ◉ No ○ NA (Please explain.) Comments:

See site-specific report for details.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. All method blank results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Method Blank detects: TPH-Gasoline for AK101.

These analytes had Method Blank detects: Methane for RSK-175.

These analytes had Method Blank detects: Hexachlorobutadiene for SW8260C.

iii. If above PQL, what samples are affected?

Comments:

14Q3DA089-AP3893-GW-0, 14Q3DA089-AP4341-GW-0, 14Q3DA089-AP4411-GW-0

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Associated sample detects less than five times the blank concentrations were flagged 'B'. Associated non-detects were not qualified.

v. Data quality or usability affected? (Please explain)

Comments:

Some data qualified as estimated; usable as qualified.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics - One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Precision - All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/DMSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

vii. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

c. Surrogates - Organics Only

i. Are surrogate recoveries reported for organic analyses - field, QC and laboratory samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No surrogate exceedances.

iv. Data quality or usability affected? (Use the comment box to explain.).

Comments:

d. Trip Blank - Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. All results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Trip Blank detects: TPH-Gasoline for AK101.

iv. If above PQL, what samples are affected?

Comments:

14Q3DA089-AP4341-GW-0

v. Data quality or usability affected? (Please explain.)

Comments:

Associated sample detects less than five times the blank concentrations were flagged 'B'.

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Submitted blind to lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Precision - All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

$$RPD\ (\%) = \text{Absolute Value of: } \frac{(R1 - R2) \times 100}{((R1 + R2)/2)}$$

Where R1 = Sample Concentration
R2 = Field Duplicate Concentration

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

○ Yes ○ No ◉ NA (Please explain.) Comments:

No field duplicate Relative Percent Difference exceedences.

f. Decontamination or Equipment Blank (if applicable)

◉ Yes ○ No ○ NA (Please explain.) Comments:

i. All results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes had Equipment Blank detects: TPH-Gasoline for AK101.

These analytes had Equipment Blank detects: Methane for RSK-175.

These analytes had Equipment Blank detects: Manganese, dissolved for SW6010B.

These analytes had Equipment Blank detects: Nitrate/nitrite for E353.2.

These analytes had Equipment Blank detects: Ethylbenzene, m,p-Xylene, o-Xylene, Toluene, Total Xylenes for SW8260C.

ii. If above PQL, what samples are affected?

14Q3DA089-AP3893-GW-0, 14Q3DA089-AP4341-GW-0, 14Q3DA089-AP4411-GW-0

iii. Data quality or usability affected? (Please explain.)

Associated sample detects less than five times the blank concentrations were flagged 'B'. Associated sample results detected greater than five times the blank concentrations and non-detects were not qualified.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No other flags applied.

Laboratory Data Review Checklist

CompletedBy	Berney Kidd		
Title	Project Chemist	Date	11/5/2014
CS Report Name		ReportDate	10/7/2014
Consultant Firm	CH2M Hill		
Laboratory Name	Applied Sciences Laboratory	Laboratory Report Number	N2692
ADEC File Number		ADECRecKeyNumber	

1. Laboratory

a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No samples transferred.

2. Chain of Custody (COC)

a. COC information completed, signed, and dated (including released/received by)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Correct analyses requested?

◉ Yes ○ No ○ NA (Please explain.) Comments:

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Samples received at 2.4C.

b. Sample preservation acceptable - acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. Sample condition documented - broken, leaking (Methanol), zero headspace (VOC vials)?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. If there were any discrepancies, were they documented? - For example, incorrect sample containers/ preservation, sample temperature outside of acceptance range, insufficient or missing samples, etc.?

○ Yes ○ No ◉ NA (Please explain.) Comments:

The containers for SW6010B for sample 14Q3DA089-AP4413-GW-1 and E353.2 for sample 14Q3DA089-AP4413-GW-0 were received frozen. The associated data were qualified as estimated and flagged "J".

e. Data quality or usability affected? (Please explain)

Comments:

Some data qualified as estimated; usable as qualified.

4. Case Narrative

a.Present and understandable?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. Discrepancies, errors or QC failures identified by the lab?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No discrepancies.

c. Were all corrective actions documented?

◉ Yes ○ No ○ NA (Please explain.) Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

All data are usable as reported.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

◉ Yes ○ No ○ NA (Please explain.) Comments:

b. All applicable holding times met?

◉ Yes ○ No ○ NA (Please explain.) Comments:

c. All soils reported on a dry weight basis?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No soil samples reported.

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?

○ Yes ◉ No ○ NA (Please explain.) Comments:

See site-specific report for details.

e. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. All method blank results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes were detected in the method blank: Hexachlorobutadiene for Method SW8260C.

These analytes were detected in the method blank: Methane for RSK175.

iii. If above PQL, what samples are affected?

Comments:

14Q3DA089-AP4413-GW-0

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

◉ Yes ○ No ○ NA (Please explain.) Comments:

Associated sample results less than five times the blank concentrations were qualified as estimated and flagged "B". Associated sample results detected greater than five times the blank concentrations and nondetects were not qualified.

v. Data quality or usability affected? (Please explain)

Comments:

Some data qualified as estimated; usable as qualified.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics - One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Metals/Inorganics - One LCS and one sample duplicate reported per matrix, analysis and 20 samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

○ Yes ◉ No ○ NA (Please explain.) Comments:

The recovery of chloromethane was greater than the upper control limit in a LCS for Method SW8260C.

iv. Precision - All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/DMSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

No samples affected; all associated results not detected.

vi. Do the affected samples(s) have data flags? If so, are the data flags clearly defined?

○ Yes ◉ No ○ NA (Please explain.) Comments:

vii. Data quality or usability affected? (Please explain)

Comments:

All data are usable as reported.

c. Surrogates - Organics Only

i. Are surrogate recoveries reported for organic analyses - field, QC and laboratory samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Accuracy - All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

○ Yes ○ No ◉ NA (Please explain.) Comments:

No surrogate exceedances.

iv. Data quality or usability affected? (Use the comment box to explain.).

Comments:

d. Trip Blank - Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. All results less than PQL?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. If above PQL, what samples are affected?

Comments:

v. Data quality or usability affected? (Please explain.)

Comments:

No data affected.

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

◉ Yes ○ No ○ NA (Please explain.) Comments:

ii. Submitted blind to lab?

◉ Yes ○ No ○ NA (Please explain.) Comments:

iii. Precision - All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

$$RPD\ (\%) = \text{Absolute Value of: } \frac{(R1 - R2) \times 100}{((R1 + R2)/2)}$$

Where R1 = Sample Concentration
R2 = Field Duplicate Concentration

◉ Yes ○ No ○ NA (Please explain.) Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

○ Yes ○ No ◉ NA (Please explain.) Comments:

No field duplicate Relative Percent Difference exceedences.

f. Decontamination or Equipment Blank (if applicable)

◉ Yes ○ No ○ NA (Please explain.) Comments:

i. All results less than PQL?

○ Yes ◉ No ○ NA (Please explain.) Comments:

These analytes were detected in the Equipment Blank: Nitrate/nitrite for E353.2.

These analytes were detected in the Equipment Blank: Methane for RSK175.

These analytes were detected in the Equipment Blank: Dissolved Manganese for SW6010B.

These analytes were detected in the Equipment Blank: Ethylbenzene, m,p-Xylene, o-Xylene, Toluene, Total Xylenes for SW8260C.

These analytes were detected in the Equipment Blank: Total Organic Carbon for SW9060.

ii. If above PQL, what samples are affected?

14Q3DA089-AP4413-GW-1, 14Q3DA089-AP4413-GW-0

iii. Data quality or usability affected? (Please explain.)

Associated sample results less than five times the blank concentrations were qualified as estimated and flagged "B". Associated sample results detected greater than five times the blank concentrations and nondetects were not qualified.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

○ Yes ◉ No ○ NA (Please explain.) Comments:

Calibration:
Lactic acid was detected below the LOQ in a continuing calibration blank. No samples were affected.

Matrix:
The RPD of chloroethane was greater than criteria in the MS/MSD set of sample 14Q3DA089-AP4413-GW-0 for Method SW8260C. The associated nondetected result was not qualified.

Appendix D
Laboratory Analytical Reports (electronic only)

This page intentionally left blank.