FINAL REPORT

Electrokinetic-Enhanced (EK-Enhanced) Amendment Delivery for Remediation of Low Permeability and Heterogeneous Materials

ESTCP Project ER-201325

MAY 2018

Evan Cox
Dr. James Wang
Dr. David Reynolds
Geosyntec Consultants, Inc.

Dr. David Gent
US Army Engineer and Research Development Center

Michael Singletary
Adrienne Wilson
NAVFAC Southeast

Page Intentionally Left Blank

Page Intentionally Left Blank

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE
19/12/2017

2. REPORT TYPE
ESTCP Final Report

3. DATES COVERED *(From - To)*
9/4/2013 - 9/4/2018

4. TITLE AND SUBTITLE
Electrokinetic-Enhanced Amendment Delivery for Remediation of Low Permeability and Heterogeneous Materials

5a. CONTRACT NUMBER
Contract: 13-C-0076

5b. GRANT NUMBER
ER-201325

5c. PROGRAM ELEMENT NUMBER
ESTCP Environ. Restoration

6. AUTHOR(S)
Evan Cox, James Wang, David Reynolds (Geosyntec Consultants)
David Gent (US Army ERDC)
Michael Singletary (NAVFAC Southeast)

5d. PROJECT NUMBER
ER-201325

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Geosyntec Consultants
10211 Wincopin Circle, 4th FL
Columbia, MD 21044

8. PERFORMING ORGANIZATION REPORT NUMBER
ER-201325

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Environmental Security Technology Certification Program (ESTCP)
Alexandria, VA

10. SPONSOR/MONITOR'S ACRONYM(S)
ESTCP

11. SPONSOR/MONITOR'S REPORT NUMBER(S) ER-201325

12. DISTRIBUTION / AVAILABILITY STATEMENT

Distribution A: Approved for public release; distribution is unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
This project demonstrated and validated electrokinetic(EK)-enhanced amendment delivery for in-situ bioremediation (EK-BIO) via enhanced reductive dechlorination (ERD) of a tetrachloroethene source area in clay. The EK-enhanced amendment delivery technology entails the establishment of an electric field in the subsurface using a network of electrodes. The electrical current and voltage gradient established across a direct-current electric field provide the driving force to transport remediation amendments, including electron donors, chemical oxidants, and even bacteria, through the subsurface. This project showed that EK could achieve relatively uniform transport in low-permeability materials. This technology also represents a remedial alternative with excellent environmental performance.

15. SUBJECT TERMS
Bioremediation, electrokinetic, groundwater

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON** Evan Cox
a. REPORT UNCLASS	**b. ABSTRACT** UNCLASS	**c. THIS PAGE** UNCLASS	UNCLASS	204	**19b. TELEPHONE NUMBER** *(include area code)* 519-514-2235

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

Page Intentionally Left Blank

FINAL REPORT

Project: ER-201325

TABLE OF CONTENTS

Page

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF TABLES

Page Intentionally Left Blank

ACRONYMS AND ABBREVIATIONS

A	amp
AC	*alternate current*
cm	centimeter
cm/sec	centimeter per second
CVOC	chlorinated volatile organic compounds
cDCE	cis-1,2-dichloroethene
k_e	coefficient of electroosmotic permeability
Dhb	*Dehalobacter*
Dhc	*Dehalococcoides*
Dem/Val	Demonstration/Validation
DoD	Department of Defense
DO	dissolved oxygen
dc	*direct-current*
DPT	Direct Push Technology
EK-BIO	EK-enhanced amendment delivery for in situ bioremediation
EK	electrokinetic
K_{eo}	electroosmotic permeability
ERH	electrical resistance heating
ERDC	Engineer Research & Development Center
EISB	enhanced in-situ bioremediation
ERD	enhanced reductive dechlorination
FS	Feasibility Study
ft	feet
ft bgs	feet below ground surface
gal	gallon
g/L	grams per Liter
K_h	hydraulic conductivity
ISCO	in-situ chemical oxidation
kg	kilogram
kW-hr	kilowatt hour
L	Liter

low-K	low-permeability
µg/g	microgram per gram
µg/L	microgram per Liter
mg/kg	milligram per kilogram
mV	millivolts
m	minutes
MMO	mixed metal oxide
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
OU3	Operable Unit 3
ORP	oxidation-reduction potential
POC	points of contact
PVC	Polyvinyl chloride
K_2CO_3	potassium carbonate
PSV	pressure safety valve
PLC	programmable logic controller
qPCR	quantitative polymerase chain reaction
cm^2	square centimeter
TTA	target treatment area
PCE	tetrachloroethene
TCE	trichloroethene
TOC	total organic carbon
USACE	United States Army Corps of Engineers
VC	vinyl chloride
vcrA	vinyl chloride reductase
VFA	volatile fatty acid
VOC	volatile organic compound
V	volts
V/m	Volts per minute
w/w	*weight per weight*
XRD	X-Ray Diffraction

EXECUTIVE SUMMARY

This Demonstration/Validation (Dem/Val) project was conducted at Naval Air Station (NAS) Jacksonville, Florida, to assess and validate the performance of an electrokinetic (EK) technique to promote uniform and effective distribution of remediation amendments (e.g., electron donors, electron acceptors, chemical oxidants) in low-permeability (low-K) and heterogeneous subsurface materials. Recent advances in the understanding of mass distribution in subsurface environments has highlighted that in many cases a significant portion of the source mass is held in storage in low-K materials. The main limitation of current in situ remediation applications in low-K materials using conventional hydraulic recirculation or injection techniques is the inability to effectively deliver the required amendments to the target contaminant mass. The EK-enhanced amendment delivery technology entails the establishment of an electric field in the subsurface using a network of electrodes. The electrical current and voltage gradient established across a direct-current (*dc*) electric field provide the driving force to transport remediation amendments, including electron donors, chemical oxidants, and even bacteria, through the subsurface.

The EK Dem/Val system consists of nine (9) electrode wells and eight (8) supply wells located within a target treatment area (TTA) measuring approximately 40 feet by 40 feet. The remediation amendments distributed by the EK remediation system included electron donor (lactate provided as potassium lactate), pH control reagents (potassium carbonate), and a dechlorinating microbial consortium (KB-1®) containing *Dehalococcoides* (*Dhc*). Following the system startup, initial site conditioning, and bioaugmentation of the site, the Dem/Val included two (2) separate stages, 5-month each, of active operation with a 6-month incubation period between the two active stages.

The overall goal of this Dem/Val is to demonstrate and validate EK-enhanced amendment delivery for in-situ bioremediation (EK-BIO) via enhanced reductive dechlorination (ERD) of a tetrachloroethene (PCE) source area in clay. Several performance objectives were identified and assessed based on the performance monitoring data collected:

I. Demonstrate uniform distribution of the amendments and relative uniformity of the established electrical field.

This Dem/Val met this objective by meeting the success criteria, including:

- At groundwater monitoring locations within the TTA after the completion of active EK operation, post-EK concentration of total organic carbon (TOC) was at least 5x baseline; and
- No local focusing of electric field was observed within the TTA.

II. Demonstrate effectiveness of treatment established by EK-BIO operation within the TTA.

This Dem/Val met this objective by meeting the success criteria, including:

- >60% reduction in average PCE concentrations was achieved in soil and groundwater within the TTA. While groundwater data also showed coupled and comparable increases of dechlorination daughter and end products, no such apparent increases of degradation products were observed in soil samples;
- Ethene was detected at 100% of groundwater monitoring wells within the TTA; and

- >10x increases of *Dhc* from baseline was observed at >60% of soil and groundwater samples collected from within the TTA.

III. Demonstrate suitability of this technology for full-scale implementation.

This Dem/Val met this objective by meeting the success criteria, including:

- System operation conditions (voltage and current) were maintained within ± 50% of the designed target conditions;
- Amendment supply up-time was >75% of target; and
- Energy consumption was within ± 30% of design estimates.

This Dem/Val showed that a critical and distinct advantage of the EK-enhanced amendment delivery over other conventional advective flow-based approaches is that EK can achieve relatively uniform transport in low-K materials. EK-enhanced delivery is a safe and relatively more controllable approach compared to high-pressure/fracturing injection and thermal approaches. This technology also represents a remedial alternative with excellent environmental performance. The electrical energy consumed during the active EK operation period in this Dem/Val was equivalent to operating two 100-W lightbulbs over the same time interval.

Based on the information and experience obtained from this Dem/Val, there are three main cost drivers to consider when evaluating implementation costs in future projects, including: (1) footprint, depth interval, and volume of target treatment zone and contaminant mass; (2) presence and location of above-ground and subsurface utilities; and (3) site geochemistry, particularly pH and iron. These are also the same cost drivers for many other in-situ remediation technologies and not unique to EK technology implementation.

A cost comparison was developed and showed that EK-BIO could be potentially more cost favorable to an in situ thermal treatment approach, electrical resistance heating (ERH). It is also noted that the significant difference in the electrical energy needed for these two technologies indicating a much more favorable environmental performance of EK-BIO over ERH. The cost comparison also showed that EK-BIO approach is slightly more cost favorable to direct-injection enhanced in situ bioremediation (EISB) and fracturing enhanced zero-valent iron (ZVI) direct injection. However, at sites where low-K material and/or high-degree of heterogeneity likely preclude the consideration for direct injection, EK-BIO provides a cost-effective solution for implementing in situ bioremediation.

While EK-BIO is mainly a variation on standard EISB whereby EK is used to more effectively deliver the required amendments through low-K materials, some areas where additional attention, beyond those typically considered for EISB, may be required on a site-specific basis include:

- Safety considerations related to potential stray current/voltage to surface. To address this question, we checked the current and voltage at the manhole steel cover located within the treatment area while the EK system was in operation to confirm that there was no safety concern. Depending on project site, and for sensitive and active facilities with dedicated safety departments, additional design and explanation effort may be required for project approvals.

- Iron fouling of filters and valves along the catholyte (well water from cathode wells) extraction line. In this Dem/Val, we re-plumbed the system to minimize potential flow restriction points. Scaling of the cathodes also required maintenance actions to clean the cathode surface. As indicated above, this issue diminished over the course of the Dem/Val.
- Corrosion of metallic parts in the manifold system & wellhead fittings due to elevated chloride concentrations. In this Dem/Val, we replaced most metallic contacting parts with plastic parts upon discovering that chloride levels were far higher than initially known.
- The technology implementation did not require specialized/proprietary equipment. We used only standard commercial off-the-shelf equipment. We designed the manifold and control system and had a remediation system vendor assemble the system per design, but the overall system was similar to other "typical" in-situ remediation systems.
- If the technology is to be implemented near (laterally and/or vertically) utilities that are "sensitive" to electric interference or corrosion concerns, some protection measures, such as cathodic protection, may be considered.
- No special regulatory requirements or permits beyond what are typical for other EISB or ISCO projects such as UIC permit. Depending on the locality-/facility-specific requirements, local or facility power/electrical departments should be consulted.

Page Intentionally Left Blank

1.0 INTRODUCTION

This Draft Final Report summarizes the approach, methodology and results of a field Demonstration / Validation (Dem/Val) project conducted to assess and validate the performance of an electrokinetic (EK) technique to promote uniform and effective distribution of remediation amendments (e.g., electron donors, electron acceptors, chemical oxidants) in low-permeability (low-K) and heterogeneous subsurface materials, for the purposes of improving remediation success at low-K sites. This project was conducted in collaboration with Naval Facilities Engineering Command (NAVFAC) and the United States Army Corps of Engineers (USACE) Engineer Research & Development Center (ERDC).

1.1 BACKGROUND

Decades of remediation experience have shown that in-situ remediation approaches are more successful and cost effective than most ex-situ remediation methods. However, in-situ remedies, such as enhanced in-situ bioremediation (EISB) and in-situ chemical oxidation (ISCO), while capable of treating various contaminants in permeable sandy aquifers, often fail to effectively target contaminants in silt and clay materials, or combinations of sand and low-K materials. Recent advances in the understanding of mass distribution in subsurface environments has highlighted that in many cases a significant portion of the source mass is held in storage in low-K materials, and that the release rate from low-K storage is many times slower than the original contaminant loading rate. The main limitation of EISB and ISCO applications in low-K materials is the inability to effectively deliver the required amendments to the target contaminant mass contained within the low-K material using conventional hydraulic recirculation or injection techniques.

While hydraulic fracturing has shown some promise in improving amendment distribution in low-K materials, the success of this approach has been limited by site access constraints, surface structure impact concerns, high cost, and consistency and predictability of induced fractures. Other technologies such as large diameter auger mixing and thermal treatment have shown promise in low-K materials. However, these approaches have been expensive and are also limited by site access and re-use limitations. Conventional thermal remediation approaches also face the challenges of removing and treating gaseous phase contaminants. Lower cost, and ideally more environmentally-sustainable remediation approaches or improvements to existing technologies are required to reduce overall remediation costs at Department of Defense (DoD) and defense contractor sites.

The EK-enhanced amendment delivery technology entails the establishment of an electric field in the subsurface using a network of electrodes. The electrical current and voltage gradient established across a direct-current (*dc*) electric field provide the driving force to transport remediation amendments, including electron donors, chemical oxidants, and even bacteria, through the subsurface. One reason why EK represents a fundamentally more effective delivery technique compared to an advective hydraulic approach is the relatively uniform electrical property of various soil materials. As a result, EK-enhanced amendment delivery technology can achieve effective and uniform amendment distribution at sites where heterogeneous subsurface materials often limit the applications of hydraulic methods.

1.2 OBJECTIVE OF THE DEMONSTRATION

The overall goal of this project is to Dem/Val the use of EK-enhanced amendment delivery to achieve uniform and effective distribution of remediation amendments into and through low-K and heterogeneous materials in the subsurface, thereby improving the effectiveness of in-situ remediation (in this case, EISB) and reducing the costs of remediation at DoD sites impacted by chlorinated and recalcitrant contaminants. The specific technical objectives for this Dem/Val project are as follows:

i) demonstrate and quantify the ability to uniformly distribute remediation amendments (in this case, lactate and *Dehalococcoides* (*Dhc*) microorganisms) across a target treatment area (TTA) using a *dc* electric field;

ii) demonstrate the ability to promote and sustain effective biodegradation within the TTA as a result of amendment delivery by EK;

iii) evaluate EK system operational parameters and resolve potential operational issues (e.g., scaling of electrodes) to allow engineering design and implementation of full-scale EK systems; and

iv) develop costing information for technology evaluation by DoD and remediation practitioners.

1.3 REGULATORY/TECHNICAL/COST DRIVERS

In 2011, a SERDP/ESTCP-sponsored workshop on *Investment Strategies to Optimize Research and Demonstration Impacts in Support of DoD Restoration Goals* identified treatment of contaminants in low-K subsurface materials (i.e. silts, clays, and bedrock) as a high-priority area for additional investment. The workshop participants noted that treatment of low-K zones would require adoption of cost-effective techniques that can target delivery of remedial agents to these regions and prevent continued back-diffusion of contaminants.

Estimated costs to DoD for adopting hydraulic containment at more than 3,000 chlorinated hydrocarbon sites could surpass $100 million annually, with estimated life-cycle costs of more than $2 billion (SERDP/ESTCP, 2006). EISB has generally been considered as one of the more cost-effective remedial options available for chlorinated solvent sites. However, there are sites where the effectiveness of EISB is limited by the presence of low-K zones, or sites where more expensive alternatives are the presumed options due to the concerns of low-K materials. Improved delivery of remediation amendments can reduce the overall duration and cost of EISB, as well as allow the consideration of lower cost EISB options at more DoD sites where low-K zones represent a limiting factor in remedy selection and success.

2.0 TECHNOLOGY

This section provides an overview of the EK-enhanced amendment delivery technology that was demonstrated in this project. Advantages and potential limitations associated with this technology are also discussed.

2.1 TECHNOLOGY DESCRIPTION

The EK-enhanced amendment delivery technology entails the use of electrodes and *dc* electrical power to establish an electric field in the subsurface. The voltage gradient established across the *dc* electric field is then the driving force for transporting remediation reagents, including electron donors for microorganisms, chemical oxidants, and even bacteria, through low-K soils or uniformly through heterogeneous formations. The EK transport process relies on three mechanisms which occur with the application of the electric field:

- ***Electromigration*** *(or ion migration)* **–** the movement of charged dissolved ions through an aqueous medium in response to the applied electric field. The direction of ion migration is toward the electrode with a polarity opposite of the ion's charge;
- ***Electroosmosis*** **–** the movement of pore fluid (and dissolved constituents) within a porous medium in response to the applied electric field. The direction of electroosmotic flow is usually from the anode toward the cathode; and
- ***Electrophoresis*** – the movement of charged particles, such as clay particles or bacteria, through an aqueous medium in response to the applied electric field. Similar to electromigration, the direction of ion migration is toward the electrode with a polarity opposite to that of a particle's net charge.

This Dem/Val project focused on the amendment transport facilitated by electromigration and electroosmosis. While ion migration phenomenon is readily apparent and understandable as it reflects basic electrochemistry, electroosmosis is a more complex EK phenomenon. Certain subsurface materials, such as clays, have a negative surface charge due to their mineral contents and crystal lattice structures. Porewater surrounding these soil particles, containing mixtures of cations and anions, forms a boundary layer system (i.e., double layer) around these negatively charged soil particles consisting of an inner immobile zone (Stern layer) and an outer mobile zone (Diffuse layer). The electrical potential at the interface between the two zones is known as the zeta potential. Upon the application of a voltage gradient, the surface of the Stern layer (positively charged layer in this case) allows the movement of cations drawing along the surrounding water molecules toward the negatively charged electrode (i.e., cathode). The value of the zeta potential is dependent on the pore fluid's ionic strength and pH.

The rate of electroosmotic flow is proportional to the coefficient of electroosmotic permeability (k_e), which is a measure of the rate of fluid flow per unit area under a unit voltage gradient. The value of k_e is a function of the zeta potential of the soil particle surface, viscosity of the pore fluid, porosity, and electrical permittivity of the medium.

One reason why EK represents a fundamentally more effective delivery technique for low-K and heterogeneous soils compared to an advective hydraulic approach is the relatively uniform electrical property of various soil materials. For example, as presented in **Figure 2-1**, while the hydraulic conductivity of fine sand and kaoline materials can vary by several orders of magnitude, the coefficient of electroosmotic permeability of fine sand (4.1E-05 cm^2/sec-V) is comparable to that of kaoline (5.7E-05 cm^2/sec-V) and clayey till (5.0E-05 cm^2/sec-V). Therefore, the EK-enhanced amendment delivery technology can achieve effective and uniform amendment distribution at sites where heterogeneous subsurface materials often limit the applications of hydraulic methods.

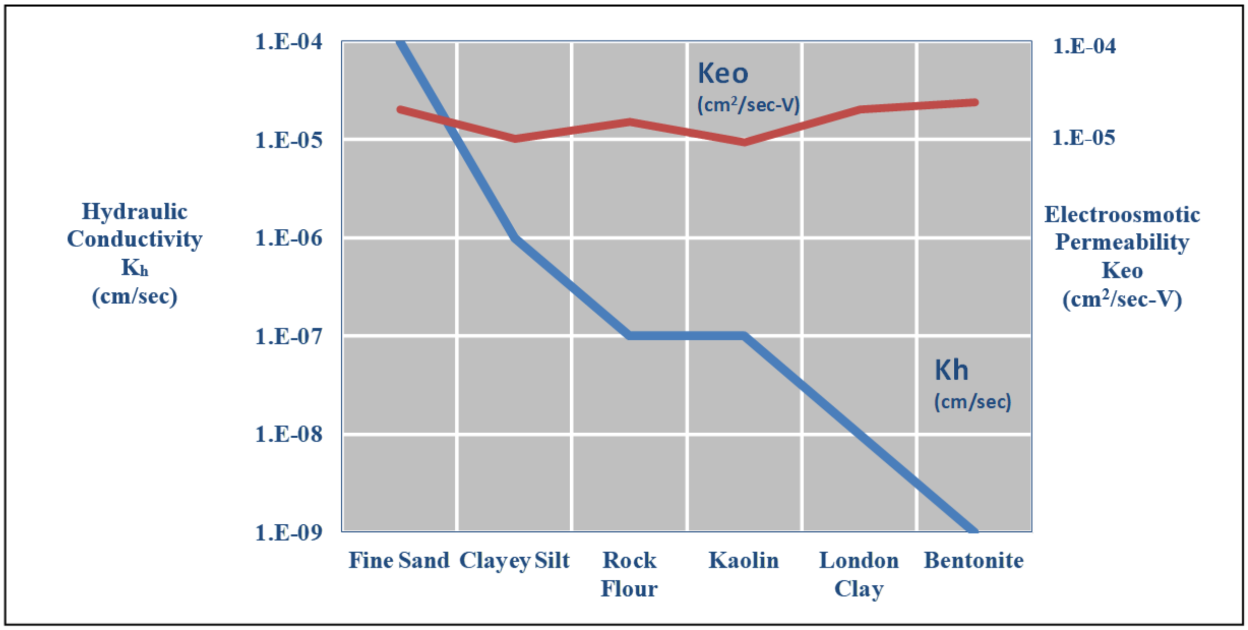


Figure 2-1. Hydraulic and Electrical Properties of Various Soils (rev. Mitchell, 1993)

The application of electric current will also result in electrolytic reactions at the electrodes. If inert electrodes (such as graphite or ceramic-coated electrodes) are used, water oxidation produces oxygen gas and acid (H_3O^+) at the anode (positively charged electrode), while water reduction produces hydrogen gas and base (OH^-) at the cathode (negatively charged electrode). Electrolytic reactions of water are shown below in Equations 1 and 2,

$$2H_2O \implies 4e^- + 4H^+ + O_2 \quad \text{(at Anode)} \qquad (1)$$

$$2H_2O + 2e^- \implies 2OH^- + H_2 \quad \text{(at Cathode)} \qquad (2)$$

Faraday's law for equivalence of mass and charge can be used to calculate the rate of redox reactions that will occur at the electrodes (Koryta and Dvorak, 1987). Therefore, it is possible to engineer and control the electrolytic processes at the electrodes to produce hydrogen (H_2) and oxygen (O_2) or to control pH conditions, depending on the system design objectives.

To implement the EK-enhanced delivery technology in the field, remediation amendments are added to electrode wells and potentially additional supply wells located intermediary to the electrode wells, mainly to shorten amendment travel distance versus consumption rate (**Figure 2-2**). Electrodes of selected inert materials are installed in electrode wells and connected to a *dc* power source. The power supply unit will supply electrical energy to electrodes at designed settings of voltage and/or current. The electrical field will transport the amendments from the electrode wells and supply wells into and through the formation materials to achieve a relatively uniform transport and distribution. Cross-circulation and pH-balancing can be employed at the electrode wells to overcome the effects of water electrolysis, and retain the natural in-situ pH of the system (as required). Slight subsurface heating may occur with application of the electrical field. However, results from field trials have shown that temperature increases are minor (less than 10°C). A modest increase in temperature often results in an improvement in the bioremediation process, as has been shown for *Dhc* during trichloroethene (TCE) dechlorination, where dechlorination was faster at 30°C than 15°C (Friis et al., 2007).

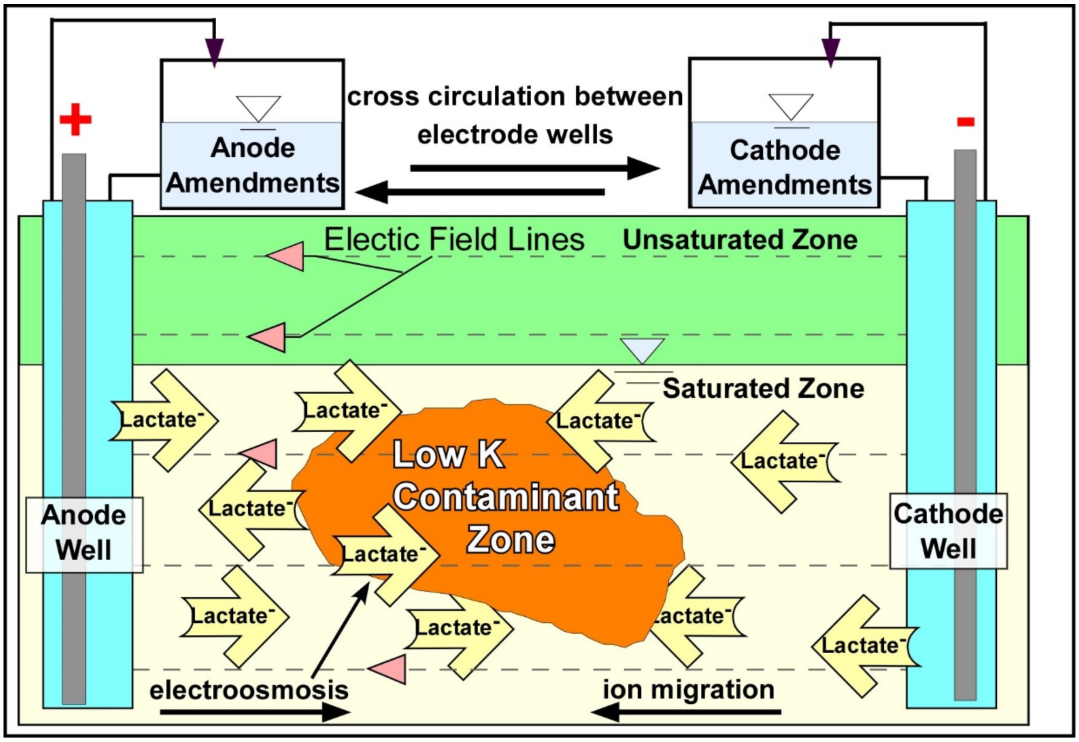


Figure 2-2. Schematic of EK-Enhanced Amendment Delivery Technology

2.2 TECHNOLOGY DEVELOPMENT

Results from many studies conducted at both bench-scale and field-pilot scale have shown the potential of EK-enhanced amendment transport (Mao et al., 2012; Gent, 2001; Wu et al., 2007; Reynolds et al., 2008; Hodges et al., 2011; SERDP ER-1204). Bench-scale studies conducted at ERDC effectively delivered acetate through loess soil ($K=10^{-7}$ cm/s) and vertically deposited clay ($K=10^{-9}$ cm/s) at rates of 2.1 and 2.5 cm/day, respectively, with a voltage gradient near 0.5 V/cm (Gent, 2001).

An average lactate transport rate of 3.4 cm/day under a unit voltage gradient of 1 V/cm was achieved in a bench-scale study conducted using a silty clay (K=10^{-7} cm/s) (SERDP ER-1204). The observed EK-enhanced transport rate in that SERDP study was more than 120 times higher than the transport rate achievable in the same type of soil but under a unit hydraulic gradient. The use of EK-enhancement for ISCO has also been demonstrated at the bench scale in both column and sandbox experiments (Roach et al., 2006; Reynolds et al., 2008; Robertson, 2009; Hodges et al., 2011). Common oxidants such as permanganate and persulfate are charged compounds, and will migrate under the driving force of the imposed electric gradient. Migration rates of mono-valent and divalent oxidants have been measured in the laboratory at levels in excess of 500 times higher than that achievable through diffusion alone.

Geosyntec, in collaboration with ERDC, completed a field pilot test of EK-enhanced delivery for in-situ bioremediation (EK-BIO) at a site in Denmark, which achieved a lactate transport rate between 2.5 and 5 cm/day through clay materials. The pilot test involved simultaneous biostimulation (using lactate) and bioaugmentation (using dechlorinating culture KB-1®) targeting a PCE source area. Active EK operation for lactate distribution was conducted for approximately 8 weeks, followed by 16 weeks of post-EK monitoring. Results from the pilot test (both groundwater samples and clay cores) indicated general uniformity of distribution of electron donor, rapid establishment and growth of the bioaugmented *Dhc* within the clay, and rapid dechlorination of PCE, TCE, and cis-1,2-dichloroethene (cDCE) to vinyl chloride (VC) and ethene. Results from both laboratory studies and the field pilot test for this site showed that the applied electrical field had no deleterious impacts on the microorganisms or subsurface conditions. During the EK field pilot test, the average groundwater temperature in the demonstration area increased from 17°C to 25°C, which was believed to provide improved conditions for PCE dechlorination by the introduced *Dhc*.

2.3 ADVANTAGES AND LIMITATIONS OF THE TECHNOLOGY

A critical and distinct advantage of the EK technology over most other approaches is that EK can achieve relatively uniform transport in inter-bedded clays and sands, even when the hydraulic conductivities of the subsurface materials vary by orders of magnitude. EK-enhanced transport, which relies primarily on the electrical properties of aquifer materials instead of the hydraulic properties, represents a solution to the limitations of preferential pathways facing conventional advective-based hydraulic technologies.

EK-enhanced delivery is a safer, and more controllable approach compared to current high-pressure/fracturing injection and thermal approaches. The migration of remediation reagents is directed by the electrical field established between electrodes, and no high injection pressures are involved.

EK-enhanced delivery also represents a remediation technology with good environmental performance. Unlike other technologies that repeatedly deliver/flush amendments through a small number of preferential pathways in the subsurface, the EK technology can uniformly deliver the amendments, maximizing treatment effectiveness and reducing treatment cost and duration. When coupled with existing in situ remediation technologies (i.e., EISB and ISCO), EK-BIO and EK-ISCO can achieve direct treatment and destruction of target contaminants in situ instead of transferring contaminants to the gas phase, which requires additional containment/collection and treatment.

The electrical energy usage of EK-enhanced delivery is relatively low compared to current thermal remediation technologies. The EK-BIO field pilot test conducted by Geosyntec in Denmark required less than 100 volts (V) and 15 amp (A) of electrical power to sustain the EK operation. The energy usage of the EK-BIO pilot test was equivalent to the energy needed to power approximately ten 100-watt light bulbs, reflecting the small carbon footprint and excellent environmental performance of this technology. As discussed in Section 6.1 of this report, the electrical power used in this Dem/Val (maintained at <30V and <10A) also demonstrated the excellent energy efficiency of this technology.

There are several aspects of this technology that will require appropriate considerations and control measures:

- Safety considerations related to potential stray current/voltage to ground surface.
- If the technology is to be implemented near (laterally and/or vertically) utilities that are sensitive to electric interference or corrosion concerns, some protection measures, such as cathodic (grounding) protection, may be required. Depending on the locality / facility-specific requirements, local or facility power/electrical departments should be consulted.
- Although conceptually there is no depth limit for this technology, shallow treatment zones too close to the ground surface and/or utilities, or in a vadose zone, can limit the feasibility of this technology.
- Certain site hydrogeology or geochemical conditions may limit the applications or impact the costs of this technology, including
  - Very high levels of sulfate or nitrate that challenge the supply of electron donors for promoting and sustaining reductive dechlorination. This limitation is not specific to EK amendment delivery, instead, it is a limitation for anaerobic in situ bioremediation.
  - High natural groundwater flow velocity in the permeable portion of a target treatment zone may potentially limit the EK transport in the direction against the natural groundwater flow.
  - High levels of chloride and/or iron that require particular engineering control measures (e.g., corrosion protection) or more operational maintenance efforts for fouling controls. Iron fouling is also a common challenge to other in situ remediation technologies.

Page Intentionally Left Blank

3.0 PERFORMANCE OBJECTIVES

The overall goal of this Dem/Val is to demonstrate and validate EK-enhanced amendment delivery for in-situ bioremediation via enhanced reductive dechlorination (ERD) of a PCE source area in clay. Performance objectives were identified and approved by ESTCP to provide the basis for evaluating the performance and costs of the Dem/Val technology. **Table 3-1** presents a summary of the quantitative and qualitative performance objectives, which are further discussed in the following subsections.

Table 3-1. Performance Objectives

Performance Objective	Data Requirements	Success Criteria	Assessment
Quantitative Performance Objectives			
I. Demonstrate uniform distribution of the amendments and relative uniformity of the established electrical field	• Pre- and post-EK monitoring of the concentrations of amendments • Monitoring of voltage and electrical current within the EK system during operation	• At groundwater monitoring locations within the TTA after the completion of active EK operation − post-EK concentration of TOC is 5x baseline, or 10x detection limit if baseline is below detection • No local focusing of electric field within the TTA – no electrical potential gradient between any individual pair of cathode-anode is 5x the average electrical gradient between all pairs of electrodes • Electrical potential gradient between electrode pairs maintained at level no more than 5x target gradient at design current	Objective Met (see Section 3.1)
II. Demonstrate effectiveness of treatment established by EK-BIO operation within the TTA	• Pre- and post-EK concentrations of chlorinated ethenes in soil and groundwater • Pre- and post-EK concentrations of ethene in groundwater • Pre- and post-EK concentrations of biomarker (qPCR analysis of *Dhc* and/or vinyl chloride reductase [vcrA]) in soil and groundwater	• > 60% reduction in average PCE concentrations in soil and groundwater within the TTA, with coupled and comparable molar concentration increases of dechlorination daughter and end products • Ethene/ethane detected at > 75% of groundwater monitoring wells within the TTA before the completion of post-EK monitoring • > 10x increases of *Dhc* from baseline at > 50% of soil and groundwater samples collected from within the TTA before the completion of post-EK monitoring	Objective Met (see Section 3.2)
III. Demonstrate suitability of this technology for full-scale implementation	• EK system operational parameters, amendment usage, and energy consumption	• System operation conditions (voltage and current) within ± 50% of the designed target conditions • Amendment supply up-time > 75% of target • Energy consumption within ± 30% of design estimates	Objective Met (see Section 3.3)
Qualitative Performance Objectives			
Performance Objective	**Data Requirements**	**Success Criteria**	**Assessment**
IV. Safe and reliable operation	• Monitoring of system operational parameters	• Operation conditions remain stable within the normal designed ranges over the course of the demonstration period • No lost-time incidents	Objective Met (see Section 3.4)
V. Ease of implementation	• Feedback from field personnel on installation and operation of technology and system	• Ability to construct using conventional techniques and contractors • A single field technician able to effectively monitor and maintain normal system operation	Objective Met (see Section 3.4)

3.1 PERFORMANCE OBJECTIVE: DEMONSTRATE UNIFORM DISTRIBUTION OF AMENDMENT

The main objective of the EK technology is to achieve uniform distribution of the remediation amendments in the subsurface upon injection under the established electric field conditions. The effective distribution of the amendments (electron donor and *Dhc*,) is essential to the success of the technology (EISB via ERD in this project).

3.1.1 Data Requirements

Uniform distribution of remediation amendments was determined by measuring concentrations of remedial reagents at all monitoring locations in the TTA. Groundwater and soil core samples were collected and analyzed in accordance with the sampling plan. Additionally, measurements of electric current and voltage were taken during system operation to assess the uniformity of the electrical field.

3.1.2 Success Criteria

This objective is considered achieved upon observing evidence of amendment (represented by TOC) transport at monitoring locations (5x baseline or 10x detection limit if baseline is below detection). Potential variability associated with the baseline data was assessed through calculating the arithmetic average and standard deviation.

For successful achievement of a uniform electric field at design levels, the electrical gradient between any individual pair of cathode-anode should not be more than 5 times the average electrical gradient between all pairs of electrodes. Moreover, the electrical potential gradient between electrode pairs should be maintained at a level no more than 5 times the target gradient.

3.1.3 Performance Objective Assessment

As presented in **Table 6-4**, every monitoring well within the TTA had TOC concentrations >8x baseline levels (for each well) during Stage 1 and/or Stage 2 operation, with the exception of EKMW-04 where the maximum TOC detected was 1.8x of the baseline. However, at EKMW-04 the maximum VFA detected was >9x its baseline. With respect to VFAs, all but one monitoring well (EKMW-05) had concentrations >9x baseline levels. As such, the Dem/Val has met this criterion in the EK was able to substantially increase electron donor concentrations across the entire TTA.

As presented in **Figure 6-2**, the voltage measured at discrete locations within the TTA were between 5.3V and 6.2V, with a standard deviation of 0.31V (5%). Voltage gradients were calculated between locations of closest pairs shown in **Figure 6-2** and range between 0.1 to 0.26 V/m. The calculated voltage gradients between these pairs are within 3x of each other and within 2x of the average gradients (0.13 V/m) indicating no local focusing of electric field within TTA. The Dem/Val has met this criterion.

The EK system was designed and operated at a constant current, determined after the start-up period, during the Dem/Val. As presented in **Figure 6-1**, during Stage 1 and Stage 2 operation, the voltage required of the power supply unit was generally consistent at between 15V and 30V, except for a few occasions when electrodes were in need of replacement. The electrical current supplied to individual wells during each stage of operation was generally steady (variation within 37% of average).

Given that (1) soil electrical resistivity is a soil property not expected to vary over the course of Dem/Val, and (2) the voltage output by the power supply unit and the current supplied to individual electrodes were generally steady, the electrical potential between electrode pairs within the TTA should maintain within 5x of target during operation. The Dem/Val has met this criterion.

3.2 PERFORMANCE OBJECTIVE: PROMOTE AND SUSTAIN EFFECTIVE BIODEGRADATION

The success of biodegradation depends on a sustained supply of remediation amendments such as electron donor. The benefit of the EK technology is its ability to facilitate transport of the remediation agents into hard-to-reach contaminant storage (low-K) areas/zones, thereby creating conditions that stimulate microbial activity and accomplish contaminant degradation.

3.2.1 Data Requirements

The effectiveness of EK in promoting biodegradation in the TTA was evaluated on the basis of concentrations of chlorinated ethenes in groundwater and soil, and ethene/ethane concentrations in groundwater in the TTA. Pre- and post-EK groundwater and soil core samples were collected and analyzed to assess the changes in chlorinated ethenes and ethene concentrations in the TTA. A baseline characterization event was performed to assess the pre-EK concentrations and establish the baseline conditions within the TTA.

3.2.2 Success Criteria

This objective is considered achieved through the observation of a 60% average reduction in PCE concentrations in groundwater and soil, coupled with comparable molar concentration increases of dechlorination daughter and end products at monitoring locations in the TTA. In addition, detection of ethene/ethane in more than 75% of groundwater monitoring wells within the TTA is indicative of successful attainment of this objective. Sustained biodegradation was successfully demonstrated by observing an increasing trend, or sustained elevated levels, of degradation intermediates and end products in the groundwater monitoring wells within the TTA for as long as sufficient (e.g., greater than 5 times the baseline concentration) electron donor was present.

3.2.3 Performance Objective Assessment

For each of the six monitoring wells located within the TTA, decreases of >80% in PCE concentration were achieved at the end of either Stage 1 and/or Stage 2. Also presented in **Figure 6-3** and **Table 7-1**, the decreases of PCE from baseline at each well within the TTA were coupled with evident increases of dechlorination daughter products and/or ethene. The Dem/Val has met this criterion for groundwater.

Figure 6-5 presents a comparison of soil chlorinated volatile organic compounds (CVOC) at corresponding locations between the three (3) sampling events. The data presented in **Figure 6-5** are arranged per individual locations and sampling depths. Overall, soil PCE concentrations of all samples collected from 18.5 feet below ground surface (ft bgs) at the nine (9) locations within the TTA decreased by 78% (C6) to 99% (C3) from baseline to post-Stage 2, with an average decrease of 88%.

It was also noted that while C6 was the only location with evident baseline PCE concentration at 21 ft bgs (5.5 mg/kg), the PCE concentration at this depth and location decreased to 0.21 mg/kg (96% reduction) and below in subsequent post-operation sampling events. As such, the Dem/Val met the PCE soil reduction criterion.

As presented in **Figure 6-3** and **Table 7-1**, every (100%) monitoring well within the TTA showed increased concentrations of ethene (up to >1,000 µg/L) during the Dem/Val. The Dem/Val has met this criterion. **Figure 6-3** also shows that every monitoring well within the TTA showed significant increases (several orders of magnitude) of *Dhc* and *vcrA*. The Dem/Val has met this criterion for groundwater.

As presented in **Table 6-9**, among the nine post-Stage 2 soil samples collected from within the TAA, six samples were reported with quantifiable levels, plus one with estimated level, of *Dhc*, while all baseline soil samples did not contain detectable levels of *Dhc*. Of the seven samples with detected *Dhc*, five samples (C2, C3, C5, C7, and C9) showed functional genes for VC dechlorination. Thus, while not as impressive as the groundwater results, the Dem/Val has met this criterion for soil.

3.3 PERFORMANCE OBJECTIVE: DEMONSTRATE SUITABILITY FOR FULL-SCALE IMPLEMENTATION

For this project, the application of EK technology is focused on and limited to the TTA. The information obtained from this Dem/Val was used to assess the suitability of EK for full-scale operation at this and other sites.

3.3.1 Data Requirements

The suitability of the EK technology for full-scale implementation was assessed by measuring the electrical input (voltage/current) to achieve and maintain the desired electric field, by measuring operational parameters for maintaining consistent operation, and by determining the overall energy consumption within the TTA.

3.3.2 Success Criteria

This objective is considered achieved if system operational conditions are within ± 50% of the designed target voltage and current. Additionally, successful accomplishment of this objective includes amendment supply up-time to be greater than 75% of target and the energy consumption to be within ± 30% of the design estimate.

3.3.3 Performance Objective Assessment

The EK system was designed and operated at a constant current, determined after the start-up period, during the Dem/Val. As discussed in Section 7.1 (criterion related to electrical gradient) and presented in **Figure 6-1**, the operating voltage and current remained relatively steady except when electrodes were in need of replacement. There were three occasions when different electrodes needed to be replaced: late October/early November 2015 and late January/early February 2016 during Stage 1 operation; and December 2016 during Stage 2 operation. Prior to electrode replacement, the system voltage readings would indicate the operating conditions were becoming unsteady.

As discussed in Section 6.1, excluding the temporary unstable readings during the three periods shortly before the electrode replacement, the overall system operation conditions were steady and within 50% of the average during each normal operation period. The Dem/Val has met this criterion.

Other than the scheduled major O&M events between the two stages of operation, there were only three occasions when the system was shut down to allow replacement of electrodes. Overall, the system up-time was well >75% during the Dem/Val. The Dem/Val has met this criterion.

Figure 6-1 presents cumulative energy consumption during each stage of operation. Given that the energy consumption is a function of voltage and current and as discussed above regarding the steady system operation condition criterion, excluding the temporary unstable voltage conditions during the three short periods before the electrode replacement, the overall system operations were steady within ± 30% and, thus, the energy usage as well. The Dem/Val has met the energy consumption criterion.

3.4 QUALITATIVE PERFORMANCE OBJECTIVES: DEMONSTRATE SAFETY, RELIABILITY, EASE OF IMPLEMENTATION

In addition to quantitative objectives discussed above, qualitative objectives are also identified for this Dem/Val and include demonstrations of the safety, reliability, and ease of technology implementation.

3.4.1 Data Requirements

The suitability of the EK technology for full-scale implementation should include the considerations of safety and reliability of technology implementation. Operation records, including system operation monitoring records and field operators' notes, are the primary data for assessing the safety and reliability. For ease of implementation criterion, field operation logs and records documented the utilization of field technician efforts for system operation and maintenance.

3.4.2 Success Criteria

This objective will be considered achieved if operational conditions remain stable over the course of the demonstration period and no lost-time incidents occur. The ease of technology implementation will be demonstrated if a single field technician is able to effectively monitor and maintain normal system operation.

3.4.3 Performance Objective Assessment

As discussed in Sections 7.1 and 7.3 above, the overall operation conditions remained relatively steady over the course of system operation. The Dem/Val has met this criterion. There were no safety-related lost-time incidents. The Dem/Val has met the safety criterion.

The Dem/Val involved only conventional field construction techniques, including well drilling, well installation, and trenching and piping, as well as remediation system assembly performed by regular, qualified subcontractors. The Dem/Val has met this criterion.

During the operation, one field technician performed routine system O&M tasks twice per week with approximately 2 to 3 hours per visit. During the routine O&M visit, the tasks primarily included system visual inspections, recording the system operational parameters (voltage, current, amendment flow and pressure), and replenishing amendment solutions as needed. Other than sampling groundwater, there were fewer than 5 scheduled O&M events that involved two field technicians. The Dem/Val has met this criterion.

4.0 SITE DESCRIPTION

The target area for this Dem/Val is located within Operable Unit 3 (OU3) at Naval Air Station (NAS) Jacksonville in Duval County, Florida (**Figures 4-1 and 4-2**). The Site Selection Memorandum was accepted by ESTCP on 27 November 2013. This section provides a summary of site information most relevant to this technology Dem/Val.

4.1 SITE LOCATION AND HISTORY

The EK-BIO Dem/Val was conducted at NAS Jacksonville, which is located on the west bank of the St. Johns River in Duval County, Florida (**Figure 4-1**). The Dem/Val area is in OU3 in the vicinity of former Building 106, where the station's dry-cleaning facility once existed (**Figure 4-2**). The results of previous site characterizations in OU3 indicate that a PCE source zone exists in this area above and partially into a clay unit underneath the shallow sand unit.

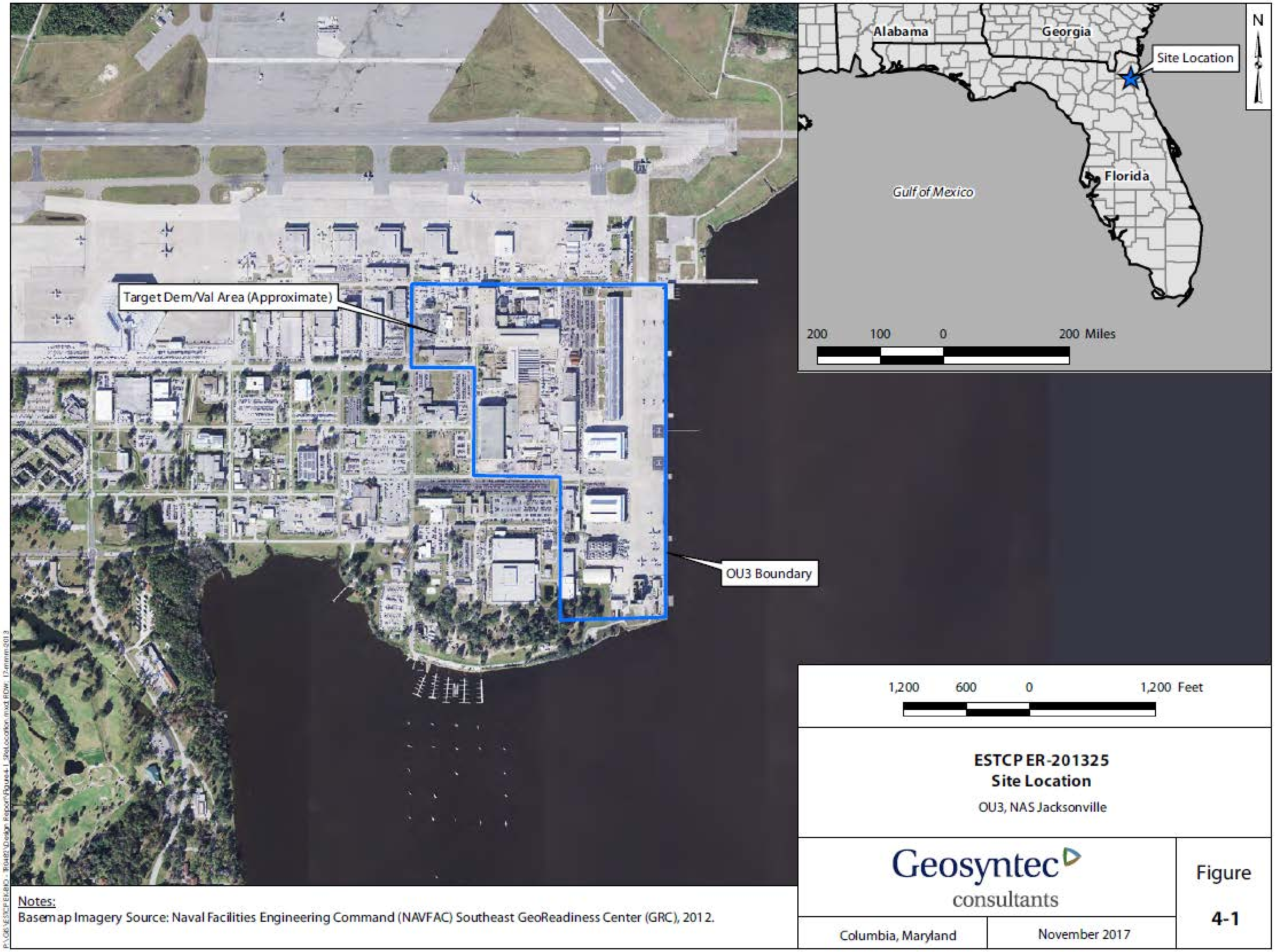
NAS Jacksonville was commissioned in October 1940 to provide facilities for pilot training and a Navy Aviation Trades School for ground crewmen. The buildings in OU3 are industrial, consisting of administrative space, workshops, storage, and aircraft hangars. The majority of the buildings were constructed in the 1940s with several additions and re-fabrications taking place since then. Over 90 percent of OU3 is covered with buildings and thick (greater than 1 foot) concrete pavement.

The contamination within OU3 that is the focus of this Dem/Val is associated with PSC 48, the former station's dry-cleaning facility located in former Building 106. PSC 48 encompasses the footprint and immediate surrounding area of former Building 106. PCE was released at former Building 106 through occasional spills and leaks, resulting in contamination of the shallow aquifer. PCE and its dechlorination daughter products, including TCE, cDCE, and VC, have been detected in this area in permeable sand layers within the shallow aquifer (5 to 16.5 ft bgs). Moreover, site characterization results also indicate that CVOC mass present in the low-K clay layer beneath the shallow sand aquifer can serve as a long-term source of contamination to the shallow aquifer (EISB Workplan, Geosyntec, 2013). This low-K clay layer beneath the shallow sand aquifer is the target for this EK technology Dem/Val.

4.2 SITE GEOLOGY/HYDROGEOLOGY

Site geology was characterized as part of a previous ESTCP Project (ER-0705), as described in the *Data Analysis Report for Field Event 4: NAS Jacksonville* (ESTCP, 2012b). Lithology at OU3 consists of inter-bedded layers of sand, clayey sand, sandy clay, and clay. Soil cores collected and logged at OU3 (ESTCP, 2012a) indicate that the site lithology generally consists of:

- 0.5 to 5 ft bgs: Fine sand with gravel and silt/clay;
- 5 to 7.5 ft bgs: Clay with trace sand and organic matter;
- 7.5 to 16.5 ft bgs: Fine sand/silt to fine sand with silt/clay;
- 16.5 to 18.5 ft bgs: Clay/silt with trace fine sand;
- 18.5 to 25 ft bgs: Clay with trace sand; and
- 25 to 30 ft bgs: Fine sand with silt/clay to fine sand.



Notes:
Basemap Imagery Source: Naval Facilities Engineering Command (NAVFAC) Southeast GeoReadiness Center (GRC), 2012.

Figure 4-1. Site Location

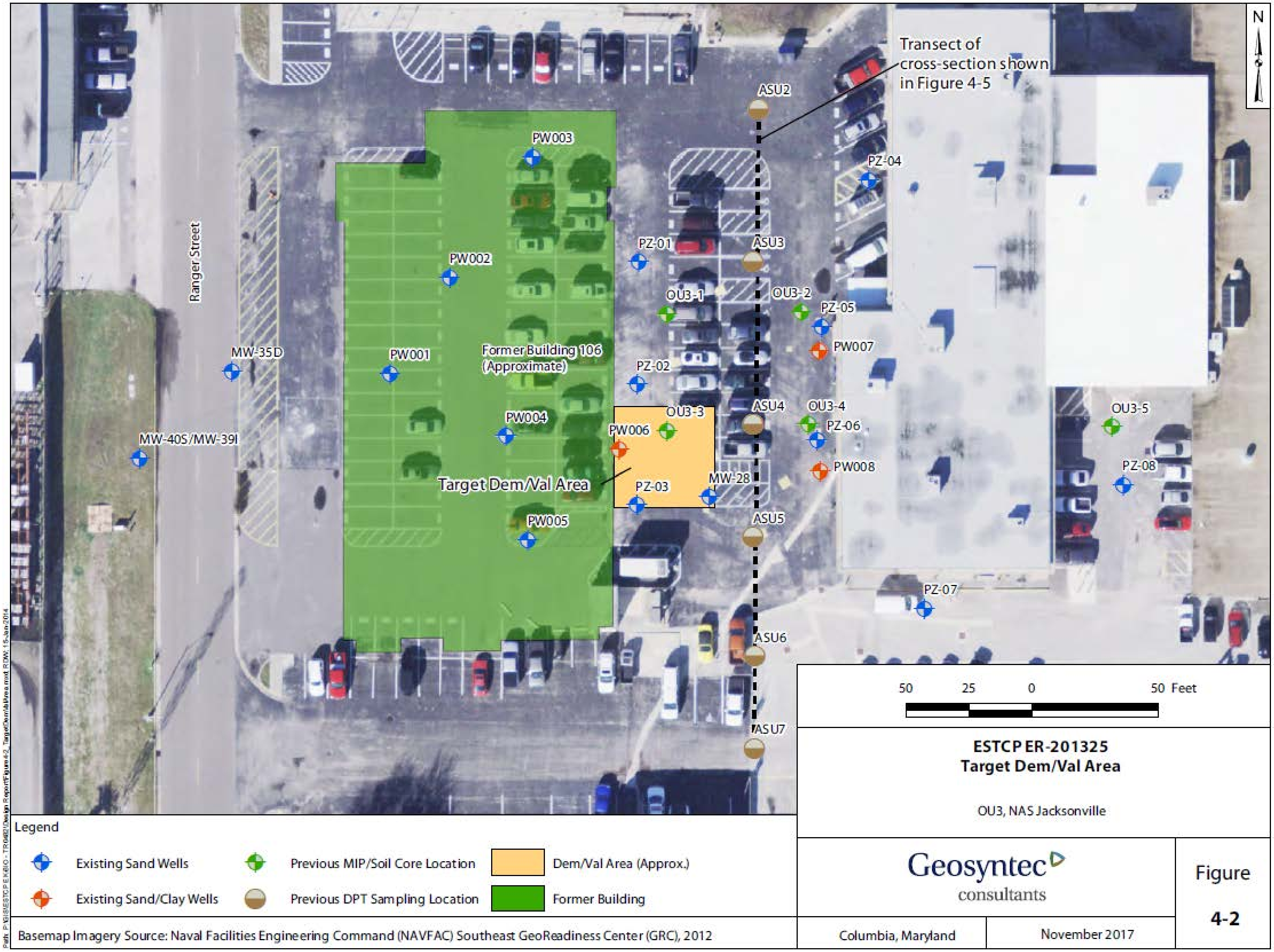


Figure 4-2. Target Dem/Val Area

A transition layer between the shallow sand and clay layers has been observed in some soil cores, generally between 13 and 16.5 ft bgs. A soil core, OU3-4 (location shown in **Figure 4-2**), exhibiting the lithology representative of the target area is presented below in **Figure 4-3**. The same lithology was again observed during this Dem/Val with a representative soil core collected from within the TTA during monitoring well installation (EKMW-02) also presented in **Figure 4-3**. The EK-BIO Dem/Val specifically targeted the CVOCs (predominately PCE) in the clay layer between approximately 16.5 to 24 ft bgs underneath the shallow sand unit in this area.

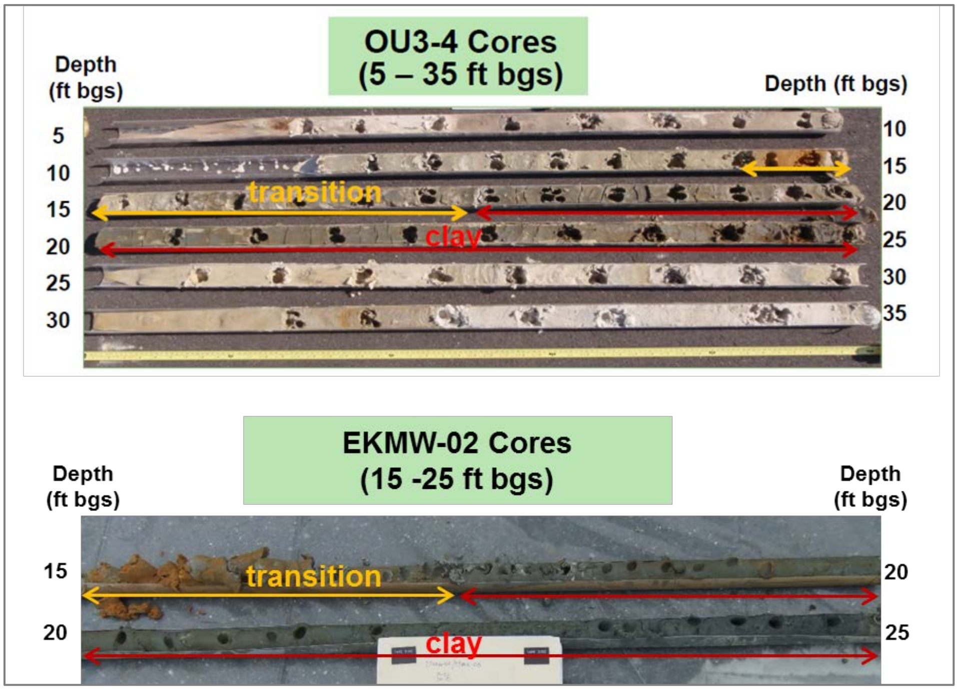


Figure 4-3. Lithology of the Target Dem/Val Area

(OU3-4 from ESTCP ER-201032; EKMW-02 from this Dem/Val)

Prior to the Dem/Val, depth to groundwater measurements local to the test area were collected in August 2009, January 2011, June 2011, and September 2011. Groundwater in this area was first encountered approximately 5 ft bgs, and flows towards the east with gradients ranging from 0.005 to 0.02 (ESTCP, 2012b). Past hydraulic testing estimated the mid-range hydraulic conductivity of the shallow sand aquifer at $5x10^{-3}$ cm/s (ESTCP, 2012b). The linear groundwater velocity was estimated as high as 101 ft/year (using a gradient of 0.005 and the mid-range conductivity).

ESTCP Project ER-0705 conducted depth-discrete, aquifer specific-capacity tests at various locations in this area, including along a transect from ASU-2 through ASU-7 shown in **Figure 4-2**. Depth-discrete hydraulic conductivity estimates for the clay unit beneath the shallow sand aquifer showed that at approximately 17 ft bgs the average K was $4x10^{-5}$ cm/sec (September 2011 data); however, there was not enough water at 6 of the 7 locations tested at the depth of 22 ft bgs to provide steady-state flow rates needed for the specific-capacity testing. Based on the soil core lithology observation and the orders of magnitude decrease of K from the shallow sand ($5x10^{-3}$ cm/s) to the clay at a depth of 17 ft ($4x10^{-5}$ cm/sec), it is believed that the clay material below 17 ft bgs has a hydraulic conductivity lower than 10^{-5} cm/sec.

4.3 CONTAMINANT DISTRIBUTION

Site investigations prior to the Dem/Val showed that PCE and degradation daughter products (TCE, cDCE, and VC) were present in permeable sand layers within the shallow aquifer (5 to 16.5 ft bgs). Chlorinated ethenes have also migrated, in part through molecular diffusion, into the clay layer (generally from 16.5 to 24 ft bgs) present beneath the shallow sandy aquifer. PCE is the dominant groundwater CVOC in this area, with TCE, cDCE and VC detected at lower concentrations. The groundwater quality data collected in January 2013 before this Dem/Val (Tetra Tech, 2013) indicate that groundwater monitoring wells screened in the shallow aquifer within the target area have total chlorinated ethene concentrations ranging from 194 µg/L in well PZ-04 to 51,000 µg/L in well PZ-02 (**Figure 4-4**).

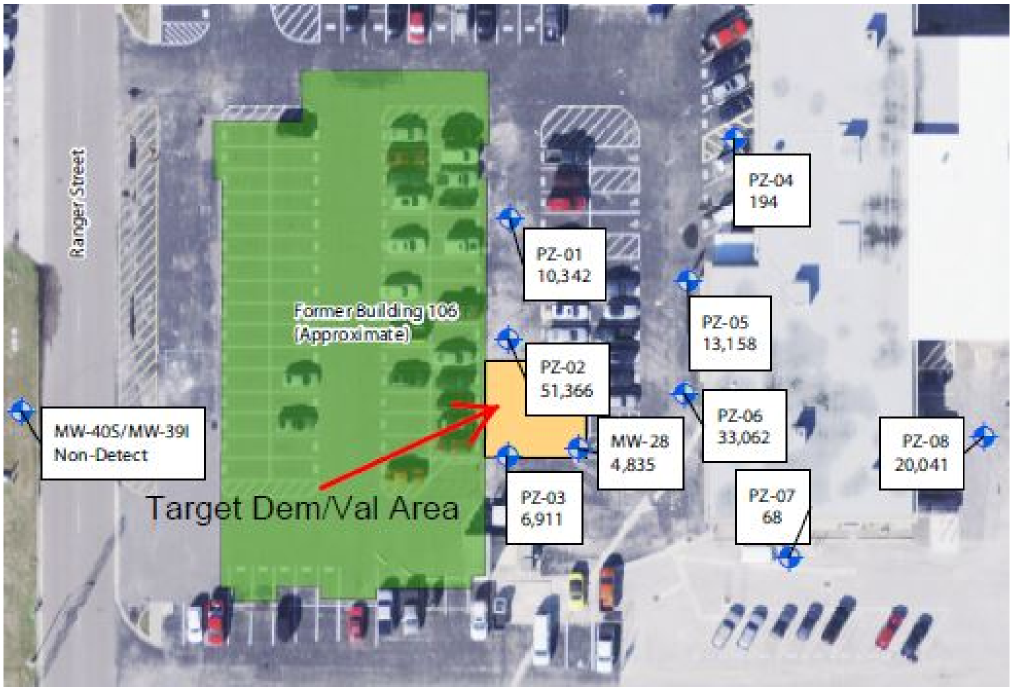
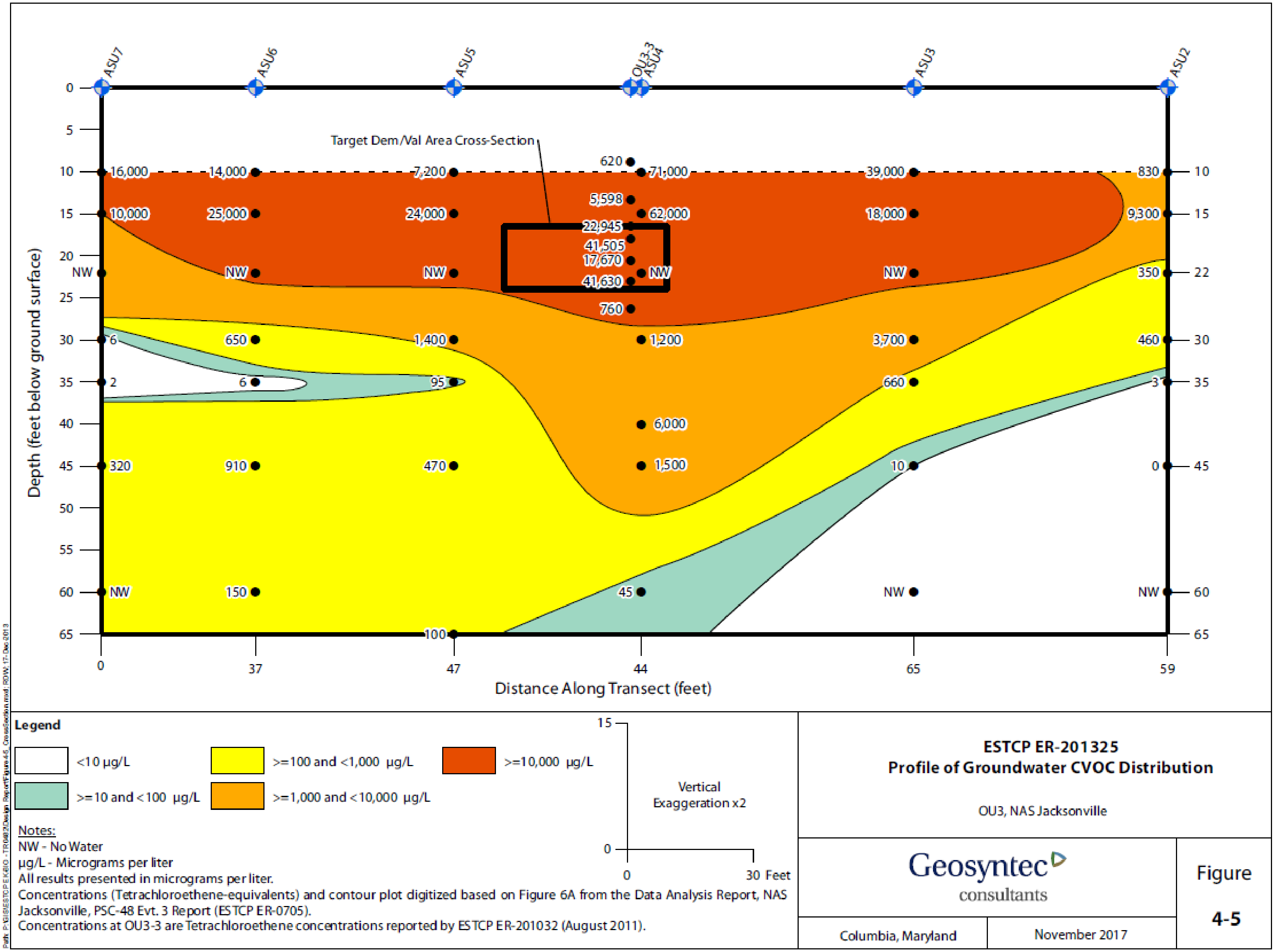


Figure 4-4. Total Chlorinated Ethenes in Select Groundwater Monitoring Wells in Shallow Sand Aquifer

(January 2013; concentration unit: µg/L)

Previous SERDP/ESTCP projects have profiled the distribution of CVOCs across both the sand and clay units in the target Dem/Val area (**Figures 4-5 and 4-6**). **Figure 4-5** presents the distribution of CVOCs in groundwater along a north-south cross section just to the east (downgradient) of the target Dem/Val area (transect along ASU2 through ASU7 shown in **Figure 4-2)**.



Notes:
NW - No Water
µg/L - Micrograms per liter
All results presented in micrograms per liter.
Concentrations (Tetrachloroethene-equivalents) and contour plot digitized based on Figure 6A from the Data Analysis Report, NAS Jacksonville, PSC-48 Evt. 3 Report (ESTCP ER-0705).
Concentrations at OU3-3 are Tetrachloroethene concentrations reported by ESTCP ER-201032 (August 2011).

ESTCP ER-201325
Profile of Groundwater CVOC Distribution

OU3, NAS Jacksonville

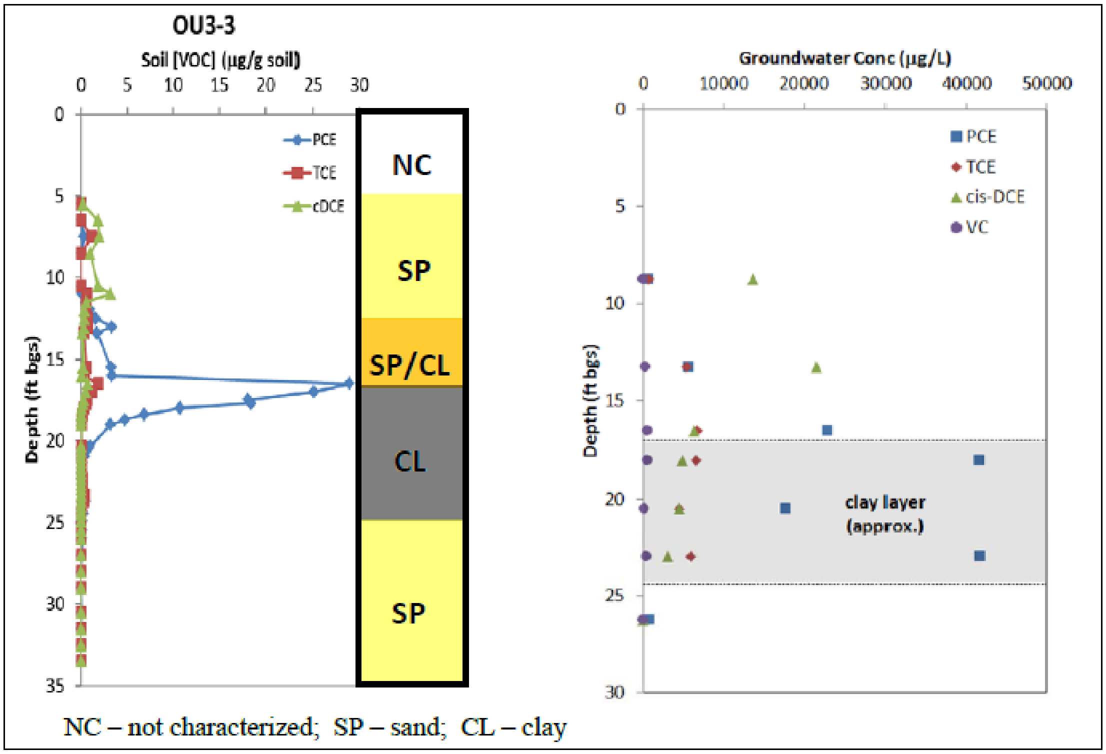
Geosyntec consultants

Columbia, Maryland
November 2017

Figure
4-5

Figure 4-5. Profile of Groundwater CVOC Distribution

As shown in **Figures 4-2** and **4-5**, previous sampling location OU3-3 is located within the target Dem/Val footprint. **Figure 4-6** presents a conceptualized geologic cross section derived from high-resolution coring conducted at OU3-3 (ESTCP project ER-201032). At OU3-3, the vertical distribution of PCE, TCE, and cDCE in soil and groundwater at depths above, within, and below the clay unit depicts a classic PCE diffusion profile, with PCE penetration into approximately the upper 5 feet of the clay unit. Porewater PCE concentrations detected at OU3-3 at various depths across the clay unit ranged from 15,000 to 40,000 µg/L, indicating significant contamination within the depth interval targeted by the Dem/Val (~ 16.5 to 24 ft bgs).



NC – not characterized; SP – sand; CL – clay

Figure 4-6. Profiles of Soil and Groundwater CVOC Concentrations at OU3-3

(Source: ESTCP Project ER-201032)

Based on the site characterization results discussed above, the CVOCs residing in the clay unit in the proximity of OU3-3 represent a long-term continuing source for groundwater CVOC contamination in this area. Previous efforts to obtain water samples from the clay unit using conventional approaches were reported to be difficult, highlighting the expected limitations that would be encountered in an attempt to hydraulically migrate remediation amendments into this clay unit. Therefore**,** the Dem/Val footprint (as shown in **Figure 4-2**) and the target depth interval of 16.5 ft bgs to 24 ft bgs are deemed appropriate for this Dem/Val. Subsequent characterization data collected during the Dem/Val baseline characterization are presented in Section 5.3.

Page Intentionally Left Blank

5.0 TEST DESIGN

This section provides the details pertaining to the design, installation, and implementation of the EK-BIO technology in the target Dem/Val area.

5.1 CONCEPTUAL EXPERIMENTAL DESIGN

As presented in **Figure 5-1**, the overall EK system consists of nine (9) electrode wells [E1 through E9] and eight (8) supply wells [S1 through S8] located within a TTA measuring approximately 40 feet by 40 feet. Also presented in **Figure 5-1**, are seven (7) monitoring wells [EKMW1 through EKMW-7] located within the TTA and four (4) located outside the TTA.

The remediation amendments distributed by the EK system included electron donor (lactate provided as potassium lactate), pH control reagents (potassium carbonate), and a dechlorinating microbial consortium (KB-1$^{®}$) containing *Dhc*. The power supply unit, amendment supply units and manifolds, and system operation monitoring and control unit were housed in a shed located adjacent to an existing utility building approximately 35 feet south of the TTA. Amendment conveyance tubing and electrical wiring conduit were installed along a trenched corridor to connect the EK control/amendment supply system to the well network in the TTA.

Table 5-1 presents a summary of major project milestones for this Dem/Val. To support the Dem/Val design, a bench-scale EK column test was conducted. The bench test and test results are discussed in Section 5.2. A baseline characterization event was conducted prior to the system construction and installation. Baseline characterization results are presented in Section 5.3. After the completion of system construction/installation and system startup, the overall Dem/Val involved two separate stages of EK operations. Each stage was operated with varying anode and cathode configurations to alter the primary direction of electric fields. **Figures 5-2** and **5-3** present conceptual orientations of the electric field established during each EK operational stage. Bioaugmentation of the TTA with reductive dechlorination culture (KB-1$^{®}$) was conducted during Stage 1 operation. There was an incubation period of approximately 6 months between the two stages of active operation. Following the completion of the second EK operation stage in March 2017 and a subsequent incubation period of 3 months, a post-EK performance monitoring event was conducted in June 2017 to complete the Dem/Val.

During each stage of operation, the EK system was operated to achieve and maintain a constant current supplied to the overall electrode network. The voltage that was required to achieve and sustain this constant current is a site-specific characteristic related to the electrical resistance of the subsurface materials.

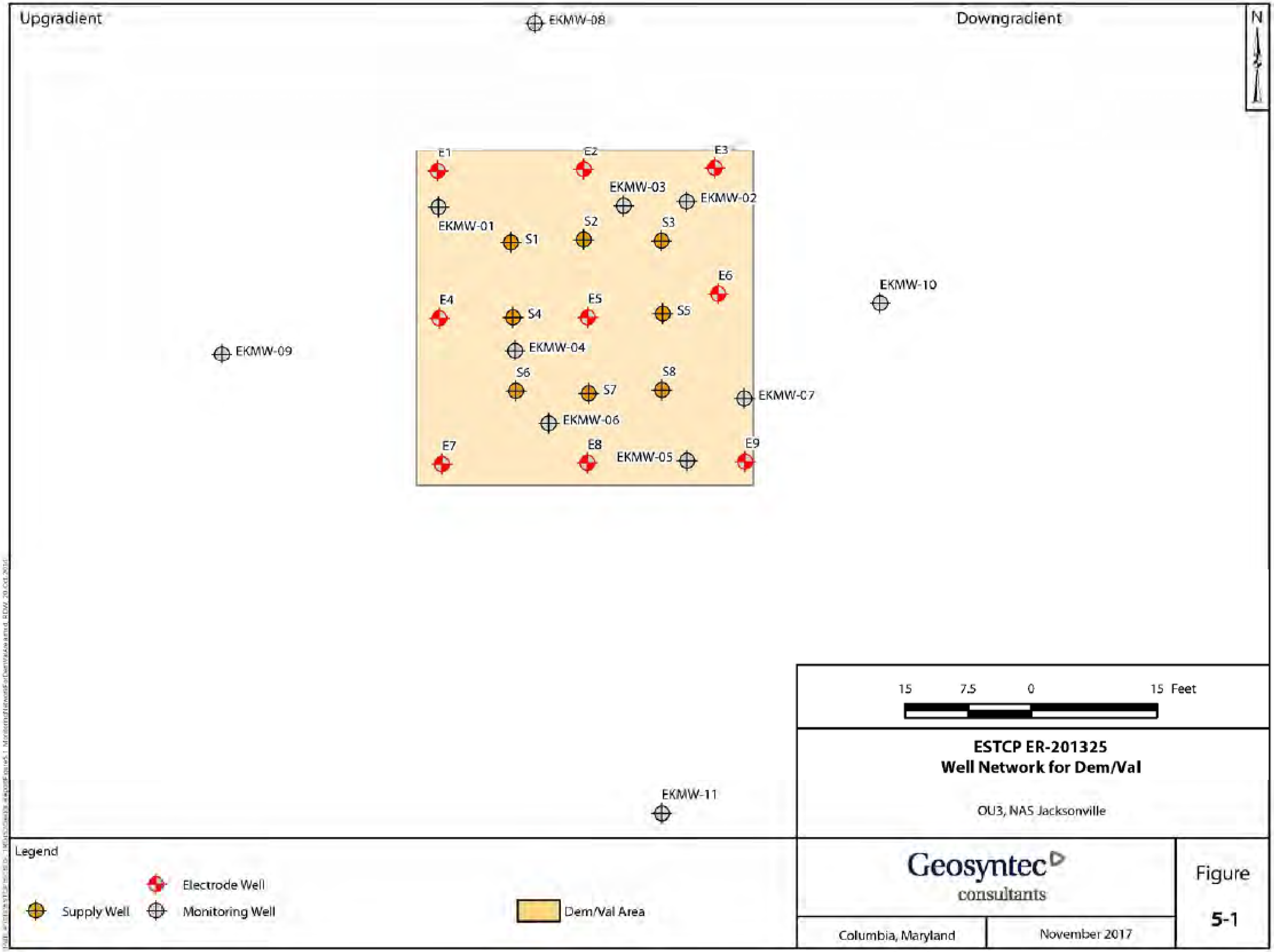


Figure 5-1. Well Network for Dem/Val

Table 5-1. Major Project Milestones

Well Installation	September 2014
Baseline Characterization	October 2014
System Fabrication / Field Construction / System Installation & Shakedown	October 2014 – June 2015
System Startup & Initial Field Conditioning	June – August 2015
Stage 1 Operation Period	August 2015 – Mach 2016
Bioaugmentation (Supply Wells and Electrode Wells)	October 29, 2015
End-of-Stage 1 Monitoring Event	March 2016
Post-Stage 1 Incubation Period	March – September 2016
Stage 2 Operation Period	October 2016 – March 2017
End-of-Stage 2 Monitoring Event	March 2017
Post-Stage 2 Incubation Period	March – June 2017
Final Sampling Event	June 2017

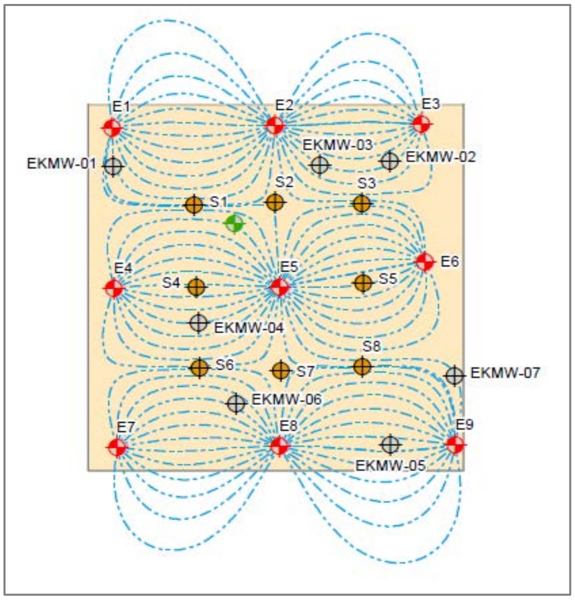


Figure 5-2. Stage 1 Conceptual Electric Field

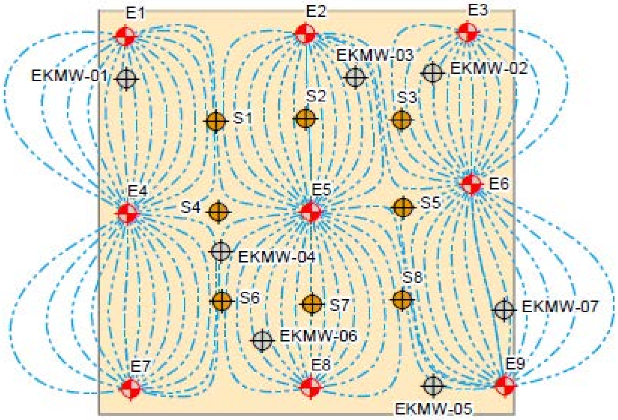


Figure 5-3. **Stage 2 Conceptual Electric Field**

Potassium lactate was used to provide electron donor for ERD of CVOCs. Lactate was supplied to all electrode wells and all supply wells during the system operation. In addition to lactate, potassium carbonate (K_2CO_3) was added to all supply wells during EK operation as a pH buffer due to the low baseline pH (<6) in the TTA (which is not optimal for ERD). The EK system would also cross-circulate electrolytes (fluids in electrode wells) between cathodes and anodes, as well as provide supplemental acid or base, as needed, to individual electrode wells for overall pH control. The following sections provide specific details of individual phases completed under this Dem/Val.

5.2 TREATABILITY OR LABORATORY STUDY RESULTS

Preliminary characterization of the aquifer materials from the target Dem/Val area was performed to support design of the EK system. The descriptions of testing are provided in **Appendix B**. Approximately 24 feet of soil core was obtained from the vicinity of the target area with direct push approaches. Mineralogical analysis of the core through X-Ray Diffraction (XRD) indicated that the clay is predominantly kaolinite (61%), with smaller amounts of illite (1.4%), chlorite (11.9%), and smectite (15.3%). These fractions are within the range of soils encountered at other EK field sites.

Zeta potential measurements were conducted on samples from the soil cores by the University of Toronto. Zeta potential is a soil characteristic affecting electroosmosis of bulk water through soil pores under an applied electric potential. Two sets of testing were performed at various pH values. A flat zeta potential curve was measured, with values of approximately -25 mV above a pH of 4.5, suggesting that the EK system design should target pH control in electrode wells to levels above pH 5 to maintain operational efficiency. The zeta potential of the site soil is similar to that of the materials from sites previously tested for other EK projects.

A bench-scale EK column test was also conducted using the core material from the site to estimate the migration rate of amendments. Three 10-cm sections of the core materials were individually compacted using a piston into a 10-cm PVC column (3-inch diameter). A filter assembly was used at each end of the PVC column to connect the soil column to the electrode cells. A conservative bromide tracer (1 g/L of sodium bromide solution) was added to the cathode cell reservoir. Sodium phosphate solution (1.3 g/L) was added to both cathode and anode cells as electrolyte and buffer. The electrodes were connected to a *dc* power supply unit. A constant current of 25 mA was applied during the EK column test. The voltage needed to sustain this target current varied from the initial reading of 69.8 V after 29 hours to a lower reading of 54.3 V after 72 hours indicating the core material in the column became more electrically conductive.

At the completion of 72 hours of testing, the column was detached from the electrode cells and frozen. The frozen core was subsequently cut into a total of eight 1-cm sections along the direction from anode toward cathode. These samples, plus a background soil sample, were analyzed for bromide concentrations. The results presented in **Table 5-2** show that bromide migrated across the entire length of the 10-cm column from the cathode to the anode within 72 hours. These results suggest a minimum electromigration rate of 3.3 cm/day.

Table 5-2. Bromide Tracer Test Results

Sample	Background Soil	3-cm from cathode	5-cm from cathode	7-cm from cathode	10-cm from cathode
Bromide (mg/kg)	**<1**	**295**	**158**	**157**	**284**

5.3 BASELINE CHARACTERIZATION

As discussed in Section 4, several previous SERDP/ESTCP projects (ER-0705, ER-1740, and ER-201032) have characterized the geology, hydrogeology, and contaminant distribution in the area that encompasses the target Dem/Val area. To establish the baseline geochemical conditions, microbial conditions, and contaminant distribution specifically within the Dem/Val footprint, a baseline characterization event was performed in October 2014 following the completion of well installation. **Table 5-3** presents a summary of the overall monitoring program for the Dem/Val, including the baseline characterization discussed in this section. Specific activities and details for the monitoring activities performed during system operation are discussed in Section 5.5.

5.3.1 Baseline Groundwater Sampling

Groundwater samples were collected from the 11 groundwater monitoring wells (EKMW-01 through EKMW-11; seven within and four outside the TTA) shown on **Figure 5-1**. Baseline geochemical characterization of groundwater included measurements of field parameters (dissolved oxygen [DO], oxidation-reduction potential [ORP], conductivity, and temperature) and laboratory analyses for metals, inorganic anions (chloride, sulfate and nitrate), CVOCs, total organic carbon (TOC), volatile fatty acids (VFAs), and dissolved hydrocarbon gases (DHGs: methane, ethene and ethane). Baseline measurement of various carbon indicators, such as TOC and VFAs, allowed the subsequent tracking of electron donor distribution.

Baseline groundwater microbial characterization included quantitative analysis of *Dhc* and *Dehalobacter* (*Dhb*), as well as the key biomarker, *vcrA*. These microbial characterization data were collected to establish the baseline conditions regarding the specific microbiological capacity within the Dem/Val footprint.

Field sampling and laboratory analyses were performed in accordance with the sampling and analysis methods presented in Section 5.6. Field sampling forms are provided in **Appendix D**. The baseline groundwater sampling results of select key parameters are summarized in **Table 5-4a** and presented in **Figure 5-4a and 5-4b**. Baseline data indicated that groundwater within the TTA was generally acidic and slightly oxidizing with low DO between 0.2 to 0.6 mg/L. Baseline TOC and VFAs were relatively low (mostly below 6 mg/L), and, with the exceptions of EKMW-01 and EKMW-05, there was no detectable levels of *Dhc*, *Dhb*, and *vcrA*. Additional detailed discussions of groundwater baseline characterization results are presented in Section 6.3.

Table 5-3. Summary of Monitoring Program

Phase	Matrix	Frequency	Analyses	Location
Baseline Characterization	Soil	Three depths(1) per boring	VOCs(2), Metals(3), Microbial (*Dhc, Dhb* & *vcrA*), Grain-size	9 locations within the target treatment area (TTA) and 2 locations outside the TTA
	Groundwater	One Time	VOCs, DHGs(4), VFAs(5), Metals, Anions(6), TOC, Field Geochemistry(7), Microbial (*Dhc, Dhb* & *vcrA*)	All 11 monitoring wells (EKMW-01 through EKMW-11)
System Start-up Phase	Groundwater	Weekly	Field Geochemistry, Electric Field (8)	7 Monitoring wells within TTA
Stage 1 Operations	Groundwater	Weekly	Electric Field	6 Monitoring wells within the TTA (EKMW-01 through EKMW-07 except EKMW-06)
		Monthly	TOC, VFAs	
End of Stage 1 Operation & End of Incubation Period between Stage 1 and Stage 2 Operations	Soil	Two depths (1) per boring	VOCs, Microbial (*Dhc, Dhb & vcrA*)	9 select locations within the TTA and 1 location outside the TTA
	Groundwater	One Time	VOCs, DHGs, VFAs, Metals, Anions, TOC, Field Geochemistry, Microbial (*Dhc, Dhb* & *vcrA*)	All 10 monitoring wells (EKMW-01 through EKMW-11 except EKMW-06)
Stage 2 Operations	Groundwater	Weekly	Electric Field	6 Monitoring wells within TTA (EKMW-01 through EKMW-07 except EKMW-06)
		Monthly	TOC, VFAs	
Post-Operation Final Monitoring (3 months)	Soil	End of 3-month post-operation incubation period; Two depths(1) per boring	VOCs, Microbial (*Dhc, Dhb* & *vcrA*); and Metals	9 locations within TTA and 1 location outside TTA
	Groundwater	End of 3-month post-operation incubation period	Field Geochemistry; TOC, VOCs, DHGs Metals, Microbial (*Dhc, Dhb* & *vcrA*)	All 10 monitoring wells, including 6 Monitoring wells in TTA

(1) Baseline event: discrete soil samples collected from approximately 18.5, 21, and 23 ft bgs. Subsequent events: two sampling depths per location at 18.5 and 21 ft bgs.
(2) VOCs: PCE, TCE, cDCE, and VC.
(3) Iron, Manganese, Calcium, and Magnesium.
(4) Methane, Ethene, and Ethane.
(5) Lactate, Acetate, Propionate, Formate, Butyrate, and Pyruvate.
(6) Nitrate, Sulfate, and Chloride.
(7) Conductivity, Temperature, Redox, pH, and Dissolved Oxygen.
(8) Voltage measurements taken at select wells. Readings of electric currents to individual electrodes recorded at wellhead using portable current clamp.

Table 5-4a. Analytical Results in Groundwater-baseline Sampling Event

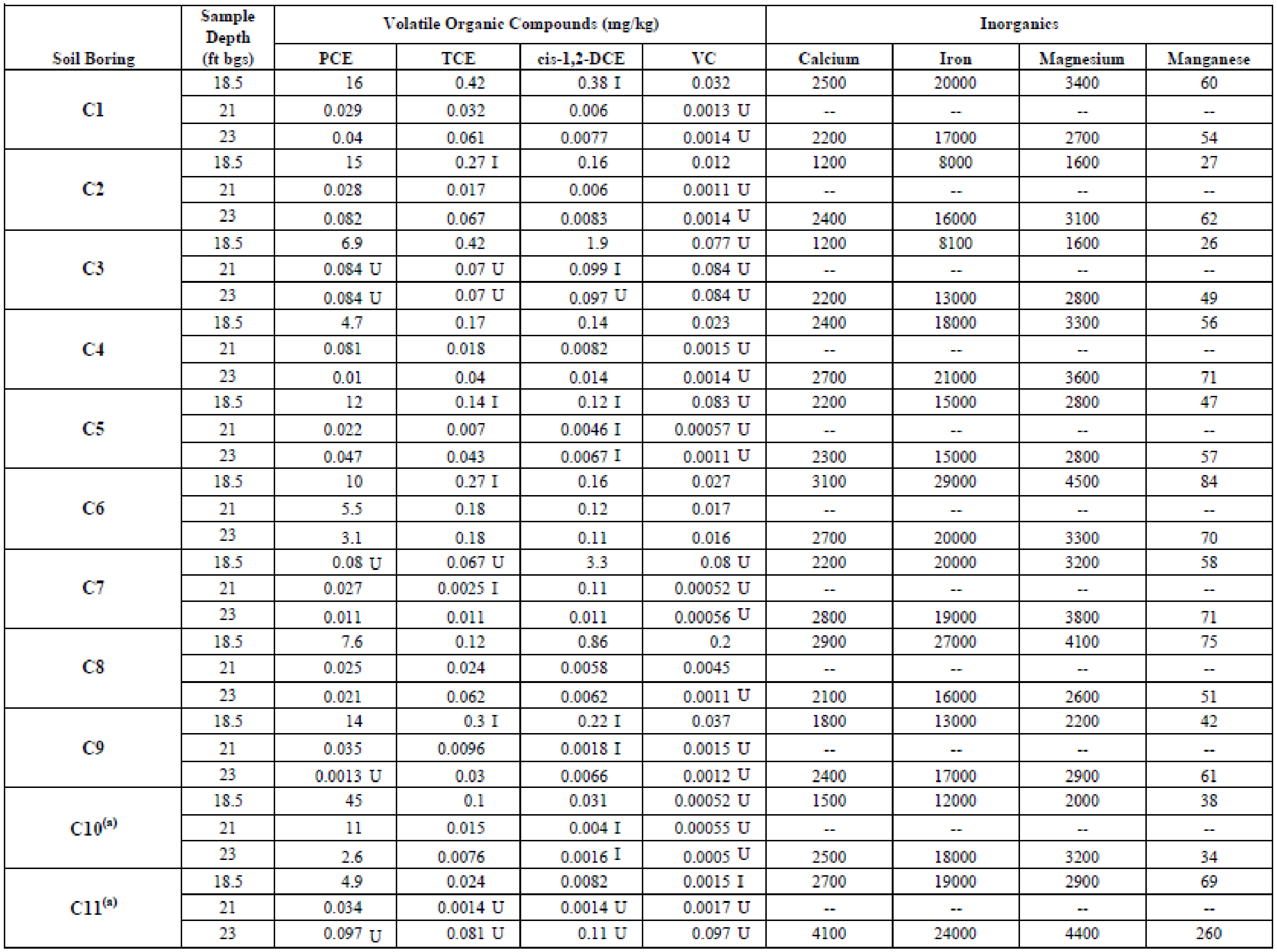
OU3, NAS Jacksonville

Analyte	Units	EKMW-01	EKMW-02	EKMW-03	EKMW-04	EKMW-05	EKMW-06	EKMW-07	EKMW-08	EKMW-09	EKMW-10	EKMW-11
Volatile Organic Compounds												
1,1-DCE	µg/L	25 U	4 I	2 I	1 I	5 U	1 I	2 U	2 U	25 U	2	0.2 U
cis-1,2-DCE	µg/L	1,190	950	760	380	773	120	970	90	288	260	10
PCE	µg/L	7,640	170	190	250	1,800	640	1,300	1,600	5,220	120	160
trans-1,2-DCE	µg/L	323	11	2 I	4	81	21	44	4 I	50	3	0.2 U
TCE	µg/L	1,670	150	150	130	344	130	260	77	482	170	8
VC	µg/L	33 U	6 I	1 U	3	7 U	9	89	2 U	33 U	5	0.4 I
Dissolved Hydrocarbon Gases												
Methane	µg/L	190	1200	330	54	270	29	110	110	120	1300	10 U
Ethene	µg/L	15	10 U	10 U	10 U	73	10 U	11	10 U	10 U	10 U	10 U
Ethane	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Microbial												
Dhc	cell/L	8.0E+05	3.0E+03 U	3.0E+03 U	3.0E+03 U	3.0E+05	3.0E+03 U	4.0E+03 U	3.0E+03 U	4.0E+03 U	3.0E+03 U	4.0E+03 U
Dhb	cell/L	3.0E+03 U	3.0E+03 U	3.0E+03 U	3.0E+03 U	3.0E+03 U	3.0E+03 U	4.0E+03 U	3.0E+03 U	4.0E+03 U	3.0E+03 U	4.0E+03 U
vcrA	gene copy/L	3.0E+03	--	--	--	4.0E+05	--	--	--	--	--	--
Volatile Fatt Acids												
Lactate	mg/L	0.96	0.39 U	0.52	0.39 U	0.39 U	0.41	0.39 U	0.39 U	0.39 U	0.46	0.55
Acetate	mg/L	2.3	1.6	0.54 U	1.9	1.8	4.6	2.2	3.1	2.3	1.3	0.81
Propionate	mg/L	0.31 U	0.31 U	0.74	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U
Formate	mg/L	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	1	0.22 U	0.22 U	0.22 U	0.32	0.22 U
Butyrate	mg/L	0.41 U	0.41 U	0.41 U	0.41 U	0.41 U	0.41 U	0.41 U	0.41 U	0.41 U	0.41 U	0.41 U
Pyruvate	mg/L	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U
Total VFAs	mg/L	3.26	1.6	1.26	1.9	1.8	6.01	2.2	3.1	2.3	2.08	1.36
Other Organics and Inorganics												
TOC	mg/L	2.5	2.5	2.5	3.6	1.7	1.4	6.8	2.3	1.6	1.9	3.1
Chloride	mg/L	3400	550	520	570	1900	1700	790	1000	2800	570	170
Nitrate (as Nitrogen)	mg/L	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.05 U	0.17 U	0.17 U	0.17 U	0.25 U	0.17 U
Sulfate	mg/L	57	27	24 I	45	50	23	140	38	36	21 I	16 I
Calcium	mg/L	350	100	89	120	400	400	150	150	460	140	130
Iron	mg/L	130	57	58	47	160	61	23	67	130	49	2.9
Magnesium	mg/L	98	30	27	31	110	100	21	45	130	42	0.74
Manganese	mg/L	2.8	0.86	0.79	0.99	3.3	3.1	0.48	1.1	4.1	1.2	0.015
Field Parameters												
pH	unit	4.7	5.8	5.8	4.9	5.2	5.1	5.1	5.7	5.0	6.0	10.6
ORP	mV	54	-21	-21	42	64	81	34	12	100	-27	-9
DO	mg/L	0.6	0.2	0.2	0.2	0.3	0.9	0.5	0.4	1.2	0.6	0.1

Notes:

PCE - Tetrachloroethene
TCE - Trichloroethene
1,1-DCE - 1,1-Dichloroethene
cis-1,2-DCE - cis-1,2-Dichloroethene
trans-1,2-DCE - trans-1,2-Dichloroethene
VC - Vinyl Chloride
Dhc - *dehalococcoides*
Dhb - *dehalobacter*
vcrA - vinyl chloride reductase
VFA - volatile fatty acid
TOC - Total organic carbon
ORP - oxidation reduction potential
DO - dissolved oxygen
µg/L - microgram per liter
L - liter
mg/L - milligram per liter
mV - millivolt
U - The compound was analyzed for but not detected
I - The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
(a) gene copy per liter is generally equivalent to cell per liter

Table 5-4b. Analytical Results in Soil – Baseline Sampling Event
OU3, NAS Jacksonville



Soil Boring	Sample Depth (ft bgs)	Volatile Organic Compounds (mg/kg)				Inorganics			
		PCE	TCE	cis-1,2-DCE	VC	Calcium	Iron	Magnesium	Manganese
C1	18.5	16	0.42	0.38 I	0.032	2500	20000	3400	60
	21	0.029	0.032	0.006	0.0013 U	--	--	--	--
	23	0.04	0.061	0.0077	0.0014 U	2200	17000	2700	54
C2	18.5	15	0.27 I	0.16	0.012	1200	8000	1600	27
	21	0.028	0.017	0.006	0.0011 U	--	--	--	--
	23	0.082	0.067	0.0083	0.0014 U	2400	16000	3100	62
C3	18.5	6.9	0.42	1.9	0.077 U	1200	8100	1600	26
	21	0.084 U	0.07 U	0.099 I	0.084 U	--	--	--	--
	23	0.084 U	0.07 U	0.097 U	0.084 U	2200	13000	2800	49
C4	18.5	4.7	0.17	0.14	0.023	2400	18000	3300	56
	21	0.081	0.018	0.0082	0.0015 U	--	--	--	--
	23	0.01	0.04	0.014	0.0014 U	2700	21000	3600	71
C5	18.5	12	0.14 I	0.12 I	0.083 U	2200	15000	2800	47
	21	0.022	0.007	0.0046 I	0.00057 U	--	--	--	--
	23	0.047	0.043	0.0067 I	0.0011 U	2300	15000	2800	57
C6	18.5	10	0.27 I	0.16	0.027	3100	29000	4500	84
	21	5.5	0.18	0.12	0.017	--	--	--	--
	23	3.1	0.18	0.11	0.016	2700	20000	3300	70
C7	18.5	0.08 U	0.067 U	3.3	0.08 U	2200	20000	3200	58
	21	0.027	0.0025 I	0.11	0.00052 U	--	--	--	--
	23	0.011	0.011	0.011	0.00056 U	2800	19000	3800	71
C8	18.5	7.6	0.12	0.86	0.2	2900	27000	4100	75
	21	0.025	0.024	0.0058	0.0045	--	--	--	--
	23	0.021	0.062	0.0062	0.0011 U	2100	16000	2600	51
C9	18.5	14	0.3 I	0.22 I	0.037	1800	13000	2200	42
	21	0.035	0.0096	0.0018 I	0.0015 U	--	--	--	--
	23	0.0013 U	0.03	0.0066	0.0012 U	2400	17000	2900	61
C10(a)	18.5	45	0.1	0.031	0.00052 U	1500	12000	2000	38
	21	11	0.015	0.004 I	0.00055 U	--	--	--	--
	23	2.6	0.0076	0.0016 I	0.0005 U	2500	18000	3200	34
C11(a)	18.5	4.9	0.024	0.0082	0.0015 I	2700	19000	2900	69
	21	0.034	0.0014 U	0.0014 U	0.0017 U	--	--	--	--
	23	0.097 U	0.081 U	0.11 U	0.097 U	4100	24000	4400	260

Notes:
PCE - Tetrachloroethene
TCE - Trichloroethene
cis-1,2-DCE - cis-1,2-Dichloroethene
VC - Vinyl Chloride
Dhc - *dehalococcoides*
mg/kg - milligram per kilogram
U - The compound was analyzed for but not detected
I - The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
-- - not analyzed
(a) Sampling locations C10 and C11 are outside the target treatment area.

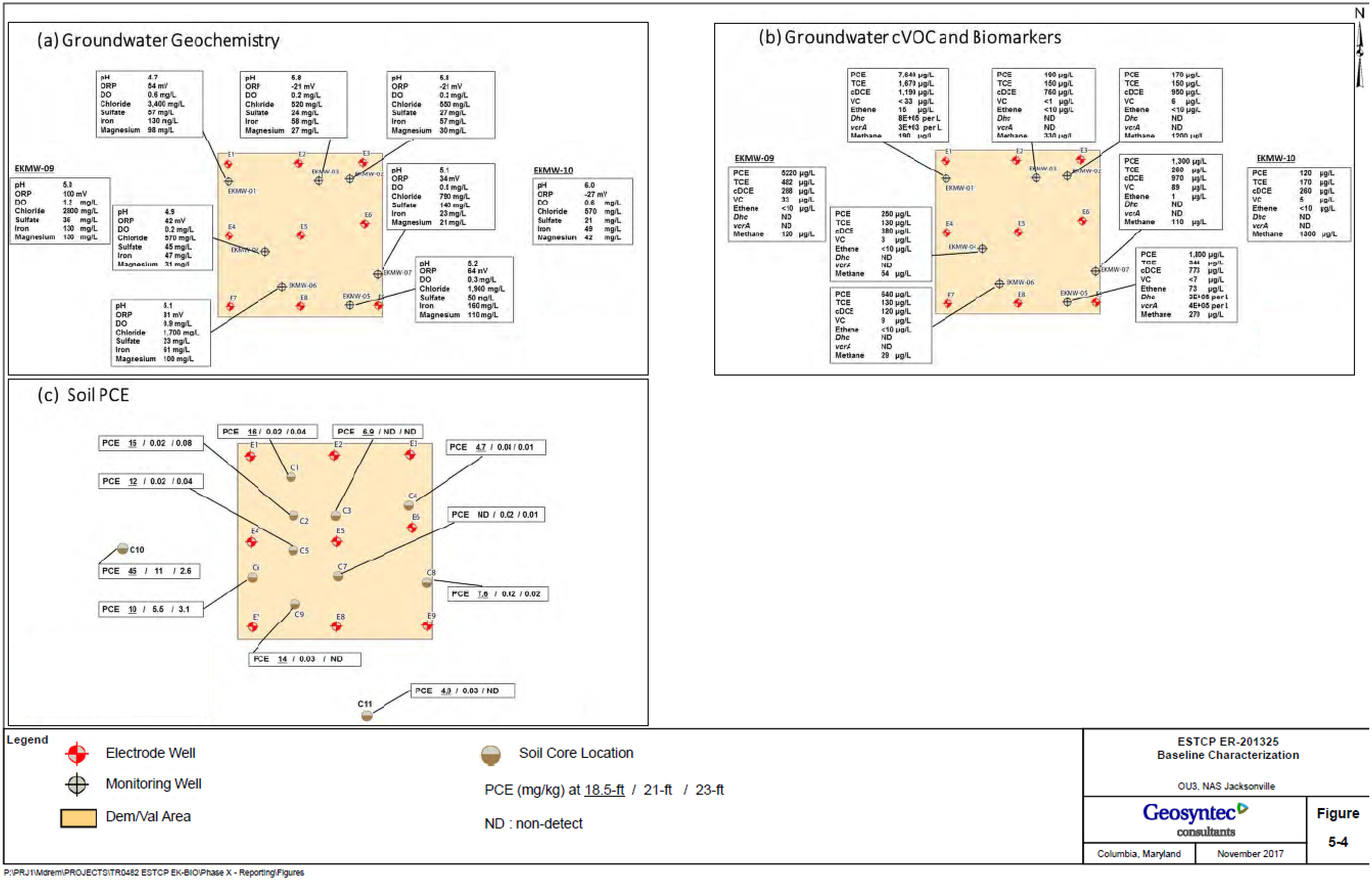


Figure 5-4. Baseline Characterization

5.3.2 Baseline Soil Sampling

Soil cores were collected from nine (9) locations within the TTA and two (2) locations outside the TTA (**Figure 5-4c**). At each location, a soil core was collected using Direct Push Technology (DPT) to a target depth of 24 feet. With each collected soil core, three (3) discrete soil samples were collected from approximately 18.5, 21, and 23 ft bgs.

Baseline soil characterization included laboratory analyses for metals and CVOCs, as well as quantitative analyses of *Dhc, Dhb,* and *vcrA.* In addition, the baseline soil characterization included soil grain size analysis.

Field sampling and laboratory analyses were performed in accordance with the sampling and analysis methods presented in Section 5.6. Field sampling forms and chain of custody forms are provided in **Appendices D & E**. The baseline soil sampling results of select key parameters are summarized in **Table 5-4b** and the soil PCE data are presented in **Figure 5-4c**. The baseline soil characterization data indicated that there was very little apparent reductive dechlorination activities within the TTA prior to the Dem/Val. The data also suggested that the majority of soil PCE within the TTA appeared to be present above the depth of 21 ft. Additional detailed discussions of soil baseline characterization results are presented in Section 6.2.

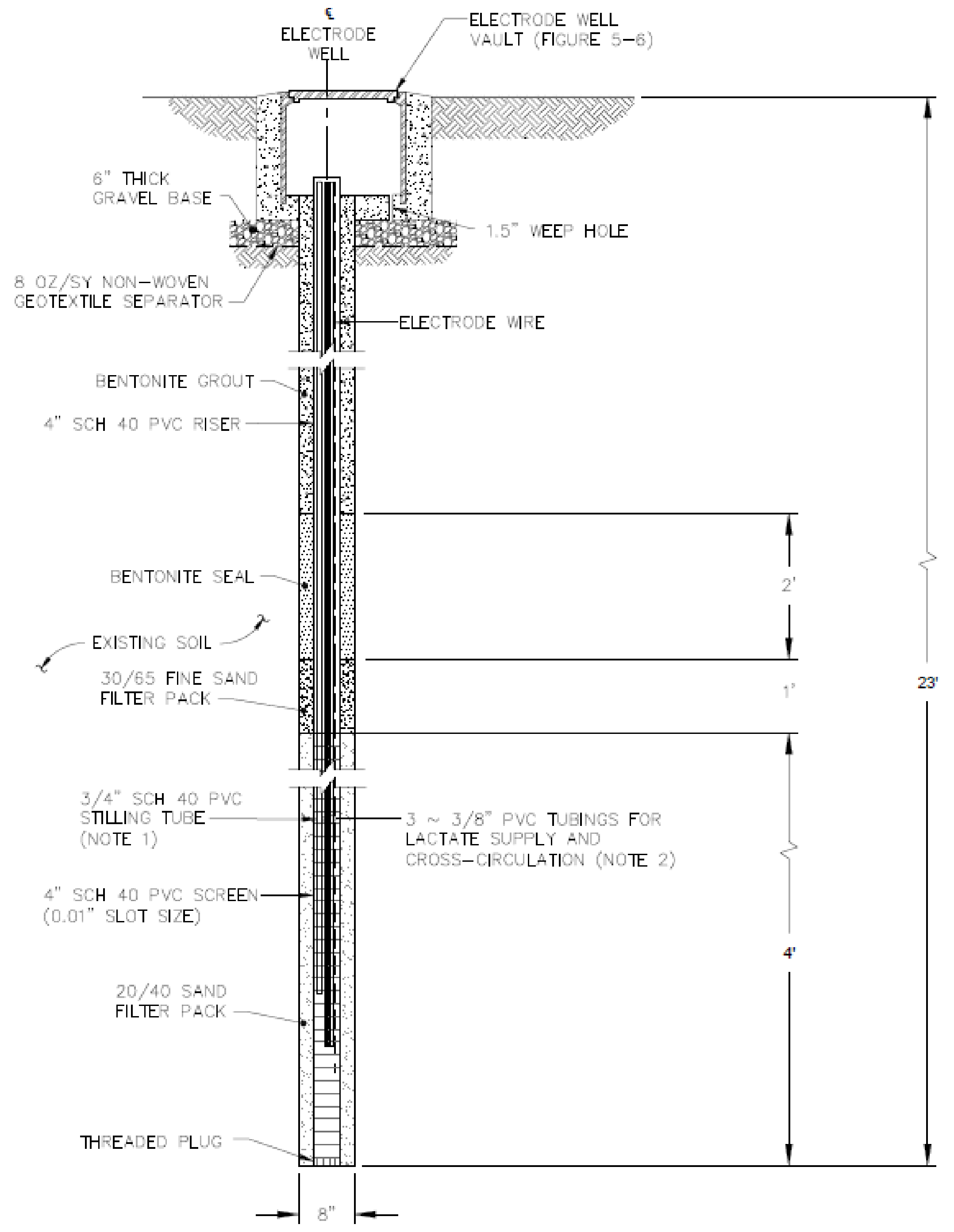
5.4 DESIGN AND LAYOUT OF TECHNOLOGY COMPONENTS

The locations of the electrode wells, supply wells, and monitoring wells are shown in **Figure 5-1.** System components and equipment for amendment supply and cross-circulation were housed in an equipment enclosure located adjacent to an existing utility building to the south of the TTA. Given the operational needs of NAS Jacksonville, the wellhead components and the connections between electrode/supply wells and the equipment enclosure (conveyance piping, electrical wiring, instrumentation wiring) were installed below ground. Prior to field construction and installation, a comprehensive utility locate and survey was conducted in the proposed Dem/Val area. The Dem/Val system design and well network was adjusted based on the results of these surveys. The following sections describe the specifics of individual system components.

5.4.1 Electrode Wells

A total of nine (9) electrode wells (E1 through E9) were installed by hollow-stem auger drilling in the treatment area. Electrode well construction details are provided in **Figure 5-5.** Each electrode well was constructed with 4-inch diameter PVC casing and 0.01-inch slotted screen. The screened interval was generally between 19 and 23 ft bgs across the clay unit (which was expected to be observed between approximately 16.5 to 25 ft bgs). A medium sand filter pack was placed around the screen from the bottom of the borehole up to the top of the screen and topped by a fine sand filter pack up to 1/2 foot above the screened interval. A 2-foot thick (~ 16.5 to 18.5 ft bgs) bentonite seal was installed above the sand pack by placing bentonite chips and hydrating for at least one hour. Grout, consisting of cement and bentonite powder, was then added to fill the remaining annulus up to the bottom of the well vault.

Figure 5-6 presents the details of the electrode well vault. Locking well vaults (traffic-rated, 2-ft x 2-ft x 2-ft) were installed with concrete protection around the vault and a gravel base. The electrode well casing was completed at the top with the installation of a PVC flange.



NO SCALE

NOTES:

1. ELECTRODE WELL LEVEL TRANSDUCER SHALL BE HOUSED IN A 3/4" SCH 40 PVC STILLING TUBE. STILLING TUBE ENDS AT 18' BGS.
2. LACTATE SUPPLY TUBE ENDS AT 20.5' BGS. EXTRACTION LINE ENDS AT 22.5' BGS. INJECTION LINE ENDS AT 19' BGS.

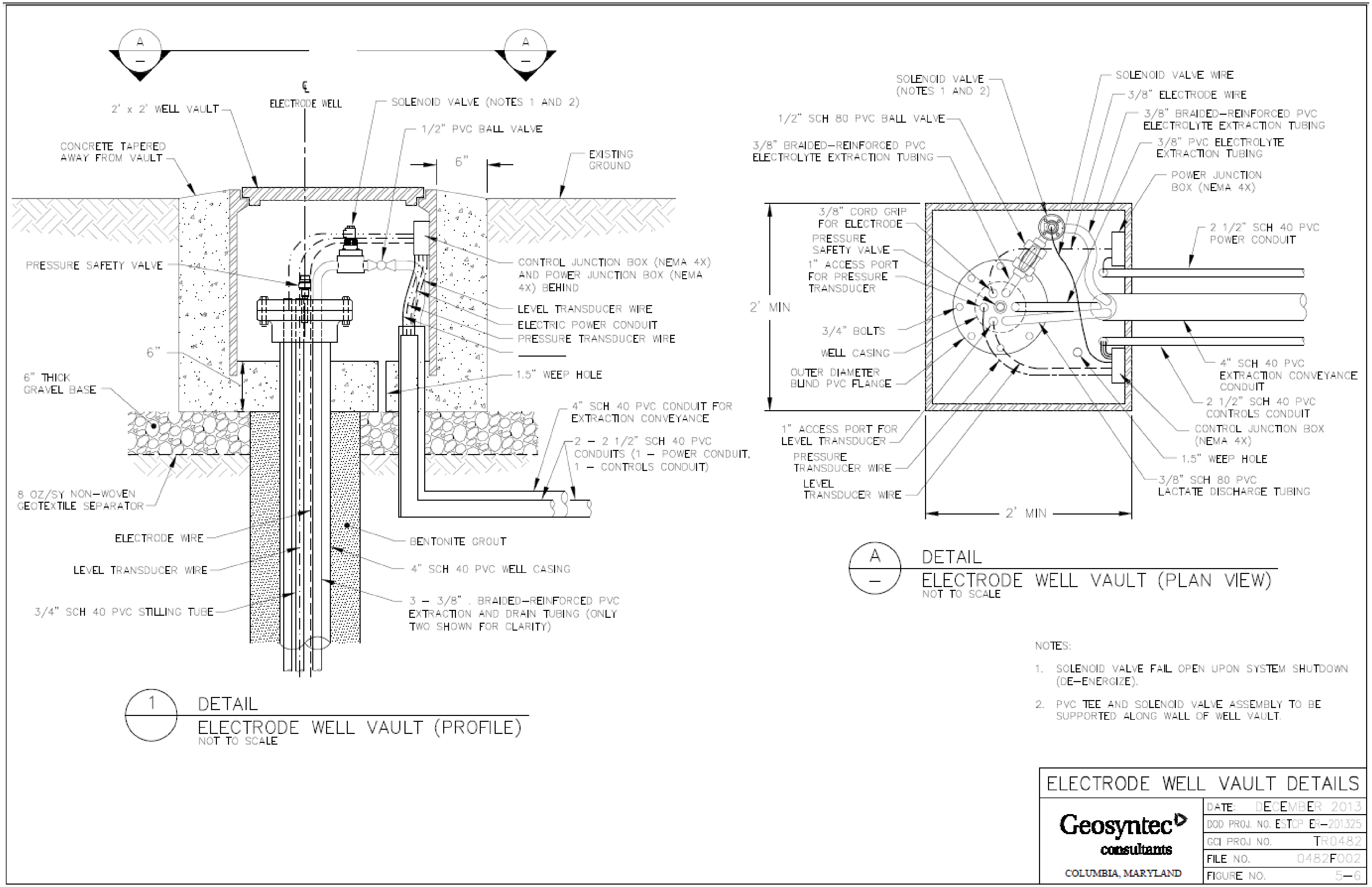
ELECTRODE WELL DETAILS

Geosyntec consultants

COLUMBIA, MARYLAND

DATE: DECEMBER 2013
DOD PROJ. NO. ESTCP ER–201325
GCI PROJ NO. TR0482
FILE NO. 0482F003
FIGURE NO. 5–5

Figure 5-5. Electrode Well Details



NOTES:

1. SOLENOID VALVE FAIL OPEN UPON SYSTEM SHUTDOWN (DE-ENERGIZE).
2. PVC TEE AND SOLENOID VALVE ASSEMBLY TO BE SUPPORTED ALONG WALL OF WELL VAULT.

Figure 5-6. **Electrode Well Vault Details**

Access ports were installed in the flange for installation of the electrode, electrical cable, tubing, and a pressure safety valve (PSV). Additional descriptions of the conveyance system and control instrumentation are provided in Sections 5.4.5 through 5.4.8.

5.4.2 Supply Wells

A total of eight (8) supply wells (S1 through S8) were installed by hollow-stem auger drilling in the treatment area. Supply well construction details are provided in **Figure 5-7.** Each supply well was constructed with 4-inch diameter PVC casing and 0.01-inch slotted screen. The screened interval was across the clay unit at depths between 19 and 23 ft bgs. Construction details for supply wells are the same as electrode wells. **Figure 5-8** presents the details of the supply well vaults. Additional descriptions of the conveyance system and control instrumentation are provided in Sections 5.4.5 through 5.4.8.

5.4.3 Monitoring Wells

A total of 11 monitoring wells were installed by hollow-stem auger drilling within and around the treatment area (**Figure 5-1**). Monitoring wells were constructed as double-casing wells each with a 6-inch PVC surface casing installed to 18 ft bgs and grouted in place (**Figure 5-9).** Each 2-inch diameter monitoring well was then constructed by drilling through the bottom of grouted 6-inch casing to install 0.01-inch slotted screen section at depths between 19 and 23 ft bgs. A medium (20/30) sand filter pack was placed around the screen from the bottom of the borehole up to 1/2 ft above the top of the screened interval. A 2-foot thick bentonite seal was installed above the sand pack by placing bentonite chips and hydrating for at least one hour. Grout, consisting of cement and bentonite powder was then added to fill the remaining annulus up to the bottom of the well vault.

5.4.4 Power Supply and Electrodes

The power supply unit for the EK system was a Magna XR250-24/240 *dc* power supply unit with input power from 3-phase alternate current (*AC*) 240V. This 6kW unit has a capacity to output 0 to 250V and 0 to 24A. The power supply was operated in constant current mode with varying voltage automatically adjusted to the changes in soil conductivity.

During each EK operational stage, six (6) electrode wells were used as cathodes and three (3) electrode wells as anodes. The electrode arrangements for Stage 1 and Stage 2 operations are shown in **Figures 5-2** and **5-3**, respectively. The electrodes consisted of a titanium rod (¾-inch diameter; 4-ft long) with mixed metal oxide (MMO) coating (TELPRO tubular anodes manufactured by Titanium Electrode Products, Inc., Stafford, TX). The coating consists of IrO_2/Ta_2O_5 and is suitable for use in soils, carbonaceous backfill, fresh and brackish water, and seawater.

5.4.5 Amendment Supply System

Electron donor solution was prepared by adding 60% (w/w) potassium lactate (WILCLEAR®) to 250-gallon totes for transfer to supply wells and electrode wells by the amendment supply system. Buffer solution was prepared by adding potassium carbonate (anhydrous power, 99%) to 250-gallon totes for transfer to supply wells by the amendment supply system. The amendment supply was performed as short-duration pulsed injections using feed pumps controlled by timers. The duration and flow rate of each pulse injection cycle were programmed so that each injection event generally introduced less than ½ gallon of solution to each well.

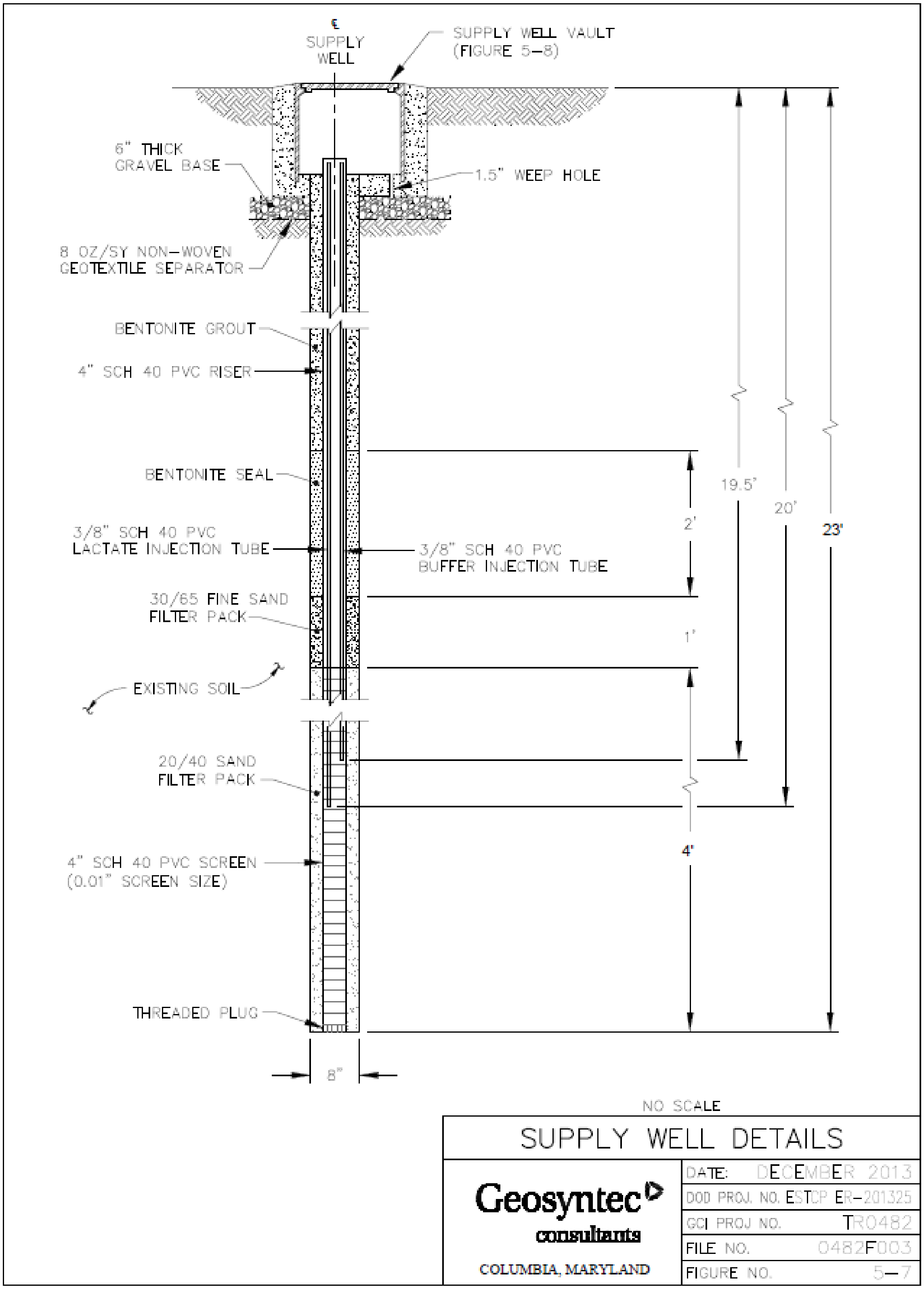


Figure 5-7. Supply Well Details

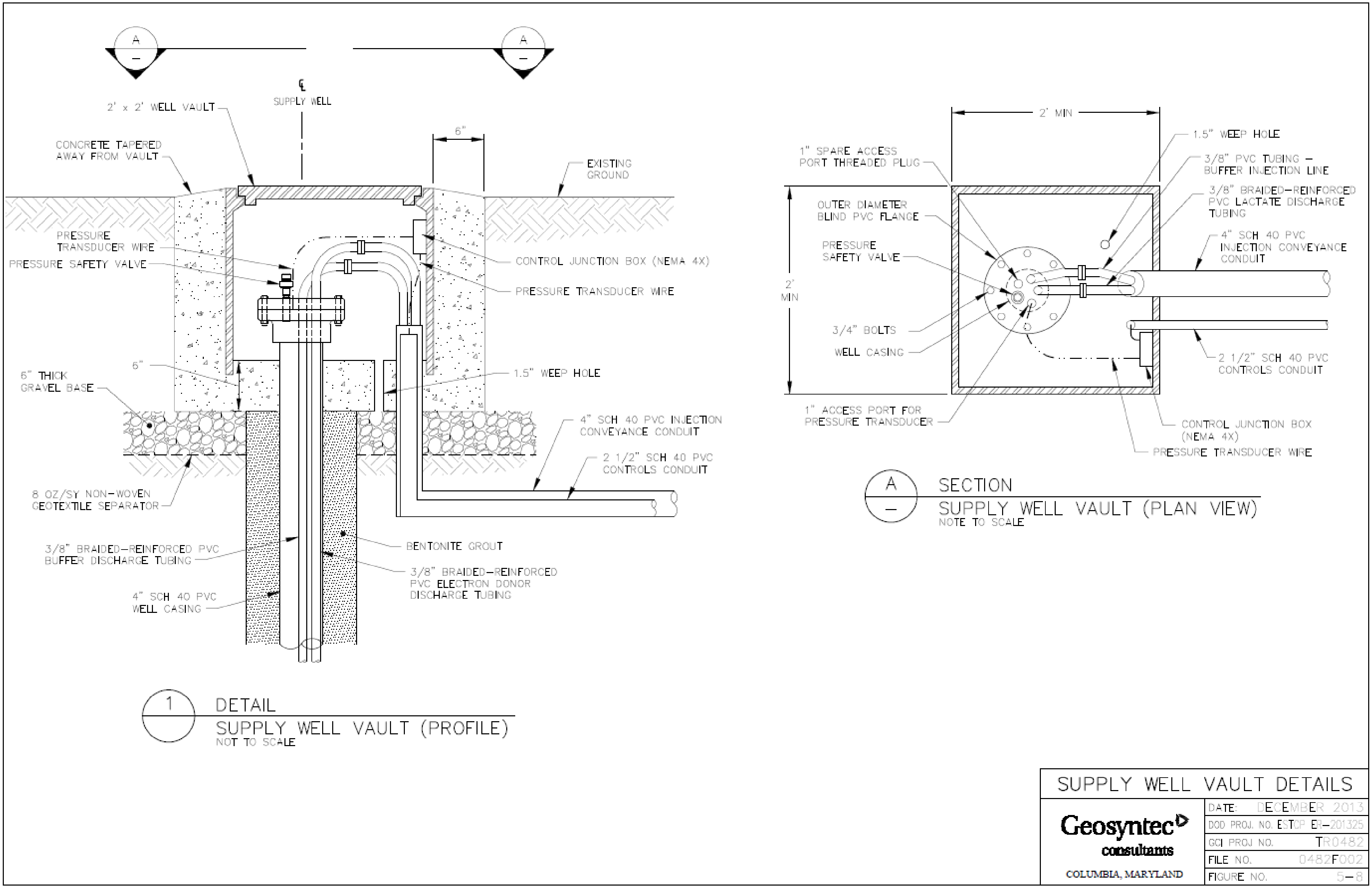
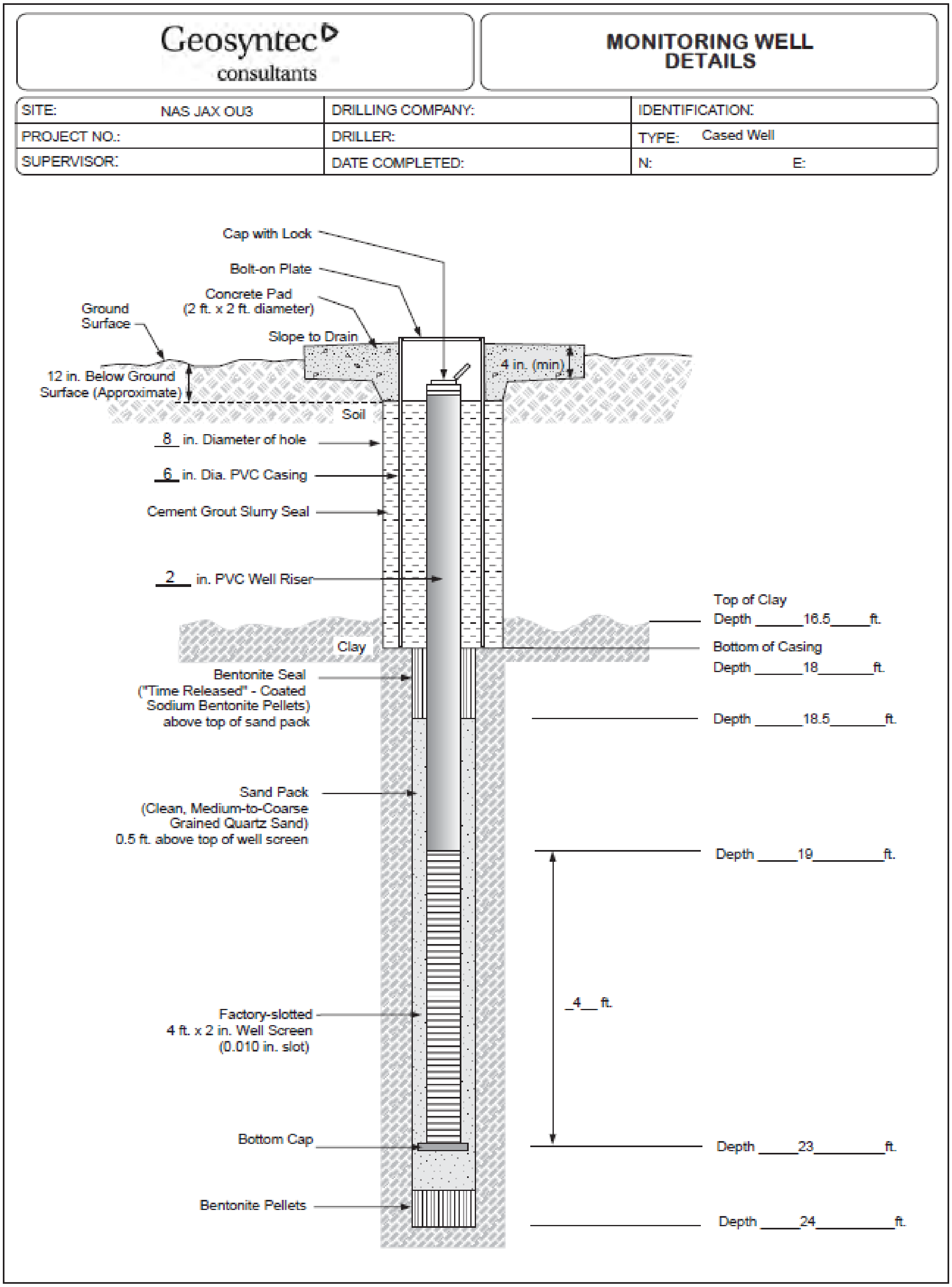


Figure 5-8. Supply Well Vault Details



Geosyntec consultants

MONITORING WELL DETAILS

SITE: NAS JAX OU3	DRILLING COMPANY:	IDENTIFICATION:
PROJECT NO.:	DRILLER:	TYPE: Cased Well
SUPERVISOR:	DATE COMPLETED:	N: E:

Figure 5-9. Monitoring Well Details

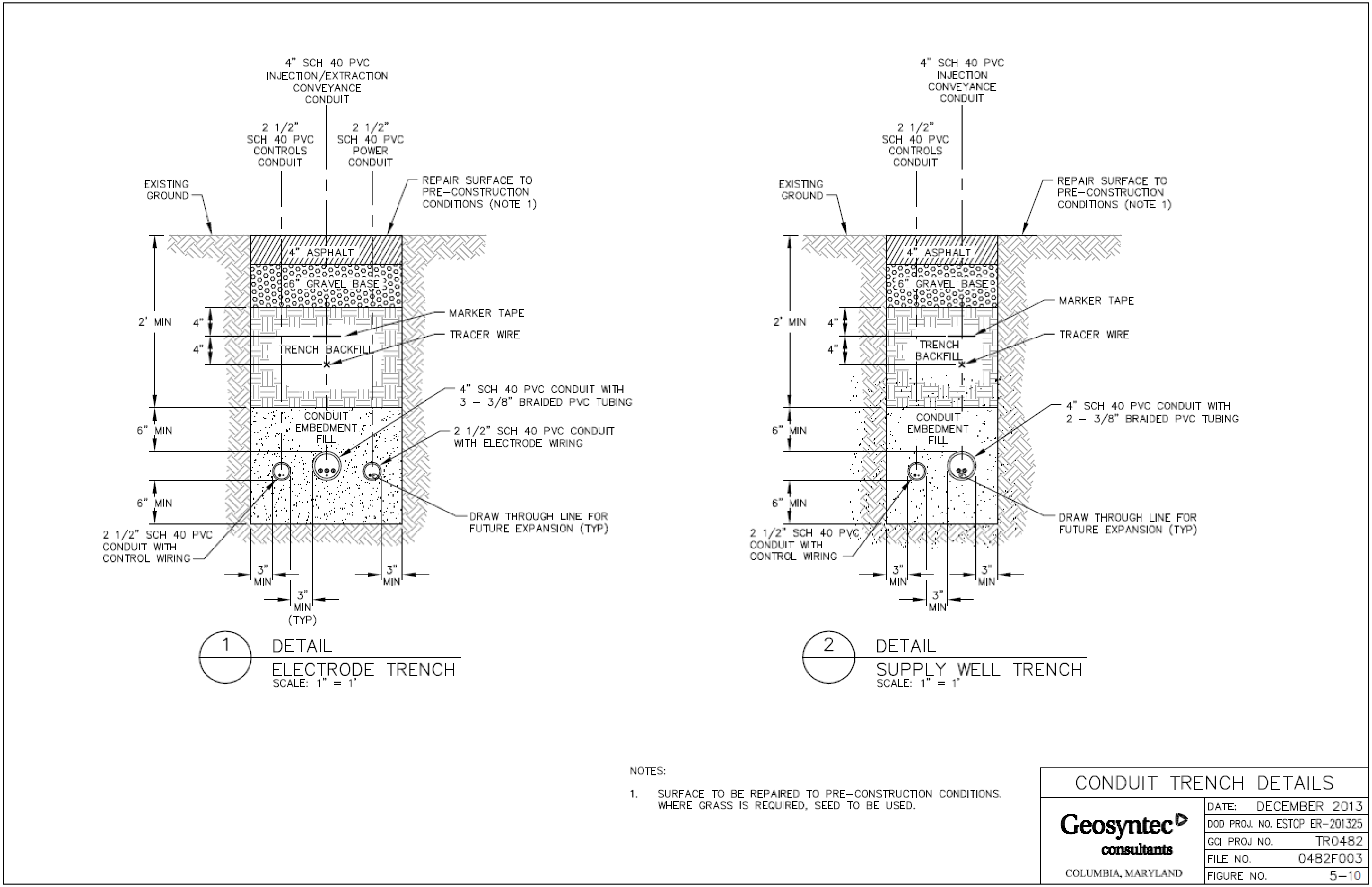


Figure 5-10. Conduit Trench Details

5.4.6 Cross-Circulation and Electrode Well pH Control System

Electrolysis of water in electrode wells produces acid (anode) and base (cathode) resulting in pH changes in the wells. Cross-circulation of electrolytes between anodes and cathodes can balance pH to an extent and reduce the amount of supplemental pH-adjusting reagents needed. Cross-circulation between cathode wells and anode wells was achieved by transferring electrolyte from individual cathode wells to individual anode wells and vice versa. During a given programmed cross-circulation event, the system extracted catholyte from a cathode well to a catholyte holding tank, while at the same time extracting anolyte from an anode well to an anolyte holding tank. Extraction was performed by peristaltic pumps controlled by timers. In-line monitoring stations monitored the pH of the extracted electrolytes. Following the extraction event, the system pumped the extracted electrolyte in the holding tank back to the electrode well of opposite polarity (i.e., catholyte to anode well and vice versa). Depending on the pH reading of the extracted electrolyte, supplemental lactic acid solution (for cathode well) or sodium hydroxide solution (for anode well) was added to the electrolyte injection tubing during the re-injection cycle when electrolyte was pumped from the holding tank back to an electrode well.

5.4.7 Process Monitoring and Controls

The EK system was constructed with instrumentation and controls to monitor and operate the system automatically using a programmable logic controller (PLC). Overall operation of the pumps for amendment supply and electrolyte cross-circulation was controlled by timers in the PLC. The PLC also controlled solenoid valves at the central manifold in the equipment shed to direct flows from and to individual wells.

In-line water quality stations installed on the electrolyte extraction lines monitored the pH of the electrolyte coming from an individual electrode well. A data acquisition system was used to record the pH monitoring data collected.

5.4.8 Conveyance Piping and Utilities

Dedicated conveyance piping was run between the system equipment enclosure and the well network through a combined conduit. The conduit was installed in shallow trenches as shown in a typical trench detail (**Figure 5-10**). Additional conduits were placed in the trenches for the installation of electrical wires to electrodes.

5.5 FIELD TESTING

This section provides a description of each significant phase of operation and the activities conducted during that phase. A schedule illustrating the sequence and duration of individual phases of operation is presented in **Table 5-5**.

Table 5-5. Dem/Val Field Testing Phases

System Startup & Initial Field Conditioning	June 2015 – August 2015
Stage 1 Operation	August 2015 – Mach 2016
* During Stage 1 Operation – Bioaugmentation (Supply Wells and Electrode Wells)	* October 29, 2015
* End-of-Stage 1	* March 2016
Post-Stage 1 Incubation Period (no operation)	March 2016 – September 2016
Stage 2 Operation	October 2016 – March 2017
* End-of-Stage 2	* March 2017
Post-Stage 2 Incubation Period (no operation)	March 2017 – June 2017

5.5.1 System Start-Up

EK system Start-Up commenced following the installation and shakedown of the system components described above in Section 5.4. During the start-up, carbonate (Na_2CO_3) solution was delivered to the supply wells in order to condition the pH in the formation around the supply wells prior to the addition of electron donor in the next phase. The duration of the start-up period for buffer addition was approximately 60 days. Buffer addition continued during the subsequent two active EK operational phases (Stage 1 and Stage 2) together with lactate amendment supply.

During the start-up operation, daily remote-monitoring of PLC data and weekly system field inspections were conducted to monitor system operations. The distribution of the electric field within the TTA was confirmed by lowering an insulated reference electrode into a given monitoring well and using a hand-held voltage meter to measure the voltage difference between that location and a universal reference cathode, which in our case was the power supply unit in the system shed. The field personnel wore rubber boots and rubber gloves when performing this task. As discussed in Section 6.1, relatively uniform electric field was confirmed based on the voltage measurements taken at all monitoring wells within the TTA.

5.5.2 Stage 1 EK Operations and Monitoring

Following system start-up, electron donor (lactate solution) was added to the TTA during Stage 1 EK operation. This operational stage included 2 segments – before bioaugmentation and after. The electrode polarity arrangement for Stage 1 operation is shown in **Figure 5-2** with E2, E5, and E8 as anodes.

Lactate solution was supplied to all electrode wells and all supply wells as individual short pulses several times a day. Other system operation activities included buffer amendment to supply wells, cross-circulation between electrodes, and supplemental acid and base addition, as needed, to electrode wells.

Bioaugmentation

Bioaugmentation of the TTA with dechlorination microbial culture containing *Dhc* was performed to establish adequate reductive dechlorinating populations. After approximately 75 days of active operation when geochemistry monitoring data indicated anaerobic and reducing conditions at supply wells and monitoring wells within the TTA, the system was shut down 48 hours prior to the bioaugmentation event, which occurred on 29 October 2015. To bioaugment the TTA, 4 liters of KB-1® culture (SiREM Laboratory, Ontario, Canada) was added to each supply well, and 1.5 liters to each electrode well. The KB-1® culture selected for this project contain *Dhc* that are capable of fully degrading chlorinated ethenes under mildly acidic (i.e., pH <6.0) conditions. The system operation resumed 48 hours after the bioaugmentation event.

The Stage 1 operation continued for approximately 5 months following bioaugmentation and was completed in March 2016. During the operation, system inspections were conducted generally twice a week by a field operator to monitor and record system operational conditions and perform routine maintenance, mainly related to filter cleaning/replacement and amendment stock solution replenishment. The distribution of electric field within the TTA was confirmed by measuring voltages at monitoring wells as described above. Groundwater sampling and analysis for performance monitoring was conducted in accordance with **Table 5-3** and the sampling methods presented in Section 5.6.

5.5.3 Post-Stage 1 Incubation

Following the completion of Stage 1 operations, the system was shut down and the project entered a 6-month post-Stage 1 incubation period. An end-of-Stage 1 monitoring event was completed in March 2016 immediately following the system shut down. An end-of-post Stage 1 incubation monitoring event was completed in September 2016. Sampling and analysis for these monitoring events were performed in accordance with **Table 5-3** and the methods presented in Section 5.6.

5.5.4 Stage 2 EK Operations and Monitoring

After the 6-month post-Stage 1 incubation, the electrode polarity arrangement was adjusted to start Stage 2 operation (**Figure 5-3)** with E4, E5, and E6 as anodes. The system operational program for electron donor amendment, buffer addition, cross-circulation between electrodes, and supplemental acid and base addition essentially followed the same approach as that of Stage 1 operation. There was no bioaugmentation in Stage 2 operation.

The Stage 2 operation continued for approximately 5 months from October 2016 through March 2017. During the operation period, system inspections and maintenance, as well as field measurements, were conducted following the same program and procedures as described above for the Stage 1 operation.

5.5.5 Post-Stage 2 Incubation

Following the completion of Stage 2 operations, the system was shut down and the project entered a 3-month post-Stage 2 incubation period. An end-of-Stage 2 monitoring event was completed in March 2017 immediately following the system shut down. An end-of-post Stage 2 incubation monitoring event (also as the final performance monitoring event) was completed in June 2017.

Sampling and analysis for these monitoring events were performed in accordance with **Table 5-3** and the methods presented in Section 5.6.

5.5.6 Decommissioning

NAS Jacksonville and NAVFAC are currently in the process of preparing a Feasibility Study (FS) for remediation of the OU3 area, which encompasses the Dem/Val TTA. It is anticipated that EK-BIO will be retained in the FS as a technology in consideration for treatment of impacts in the clay layer outside of the Dem/Val TTA. As such, the Dem/Val infrastructure will remain in place until the FS is completed, and a decision rendered on remedy, in the event that the decision is to expand the EK-BIO remedy to the wider source zone. Should EK-BIO not proceed further, Geosyntec will then remove the surface infrastructure (i.e., EK Control Center and solution tanks) from the site, while NAS Jacksonville will complete final disposition of the wells. Details will be provided in a separate letter.

5.6 SAMPLING METHODS

In addition to operational data related to the system (i.e., electrical current and voltage, flow rates of amendments and cross-circulation), an overall field monitoring and sampling program for the Dem/Val is presented in **Table 5-3**. **Table 5-3** presents the sample matrix (i.e., soil and groundwater), the locations and frequencies, and the analytical parameters performed during each phase of this Dem/Val.

5.6.1 Sampling and Analytical Methods

As presented in **Table 5-3**, the Dem/Val monitoring program included both measurements of field parameters and collection of environmental samples (soil and groundwater) for laboratory analyses. **Table 5-6** summarizes the laboratory analytical methods. The methods for field sample collection and field parameter measurements are described in this section.

Table 5-6. Analytical Methods for Sample Analysis

Matrix	Analyte	Method	Container	Preservative[1]	Holding Time
Soil	VOCs	8260B	3x 10-gram Terra Cores	2 with NaHSO4; 1 with methanol; 4 ± 2ºC	14 days
	Metals (Ca, Fe, Mn, Mg)	6010B	2-oz glass jar	4 ± 2ºC	6 months
	Tracer (Br$^-$)	300.0	2-oz glass jar	4 ± 2ºC	28 days
	Biomarkers (*Dhc*, *Dhb*, and *vcrA*)	Gene-Trac® Method	50 mL conical tube provided by laboratory	4 ± 2ºC	14 days
Groundwater	VOCs	8260B	40 mL VOA vial	HC1; 4 ± 2ºC	14 days
	VFAs	Ion Chromatography	40 mL VOA vial	4 ± 2ºC	14 days
	DHGs (methane, ethane, ethane)	RSK-175	40 mL VOA vial	HC1; 4 ± 2ºC	14 days
	Total Metals (Ca, Fe, Mn, Mg)	6010B	250mL polyethylene	HNO_3; 4 ± 2ºC	6 months
	Anions (NO_3-, SO4^{-2}, Cl$^-$) and Tracer (Br$^-$)	300.0	250mL polyethylene	4 ± 2ºC	28 days (except NO_3- at 48 hours)
	TOC	9060A	125 mL amber glass	HC1, 4 ± 2ºC	28 days
	Biomarkers (*Dhc*, *Dhb*, and *vcrA*)	Gene-Trac® Method	500 mL polyethylene	4 ± 2ºC	14 days

For soil sampling, soil cores were collected using DPT tooling. For each soil sampling event, one continuous core from ground surface to approximately 24 feet bgs was collected from each of the 11 soil sampling locations (C1 through C11) shown in **Figure 5-11**. Soil cores were collected in acetate sleeves for observation and sampling. Discrete soil samples were collected for laboratory analyses from the selected depths. For the baseline event, samples were collected at each location from approximately 18.5, 21, and 23 ft bgs. The field personnel documented that clay was the predominant geologic material at all the locations and all these sampling depths. As discussed in Section 6.2, based on the baseline soil sampling results, subsequent soil sampling events only collected samples from 18.5 and 21 ft bgs, since CVOCs were not typically present below 21 ft bgs. For VOC analysis, Terra Core samplers were used to minimize volatilization loss. Upon completion of soil sampling, each borehole was backfilled with bentonite chips and surface repaired in accordance with NAS Jacksonville requirements.

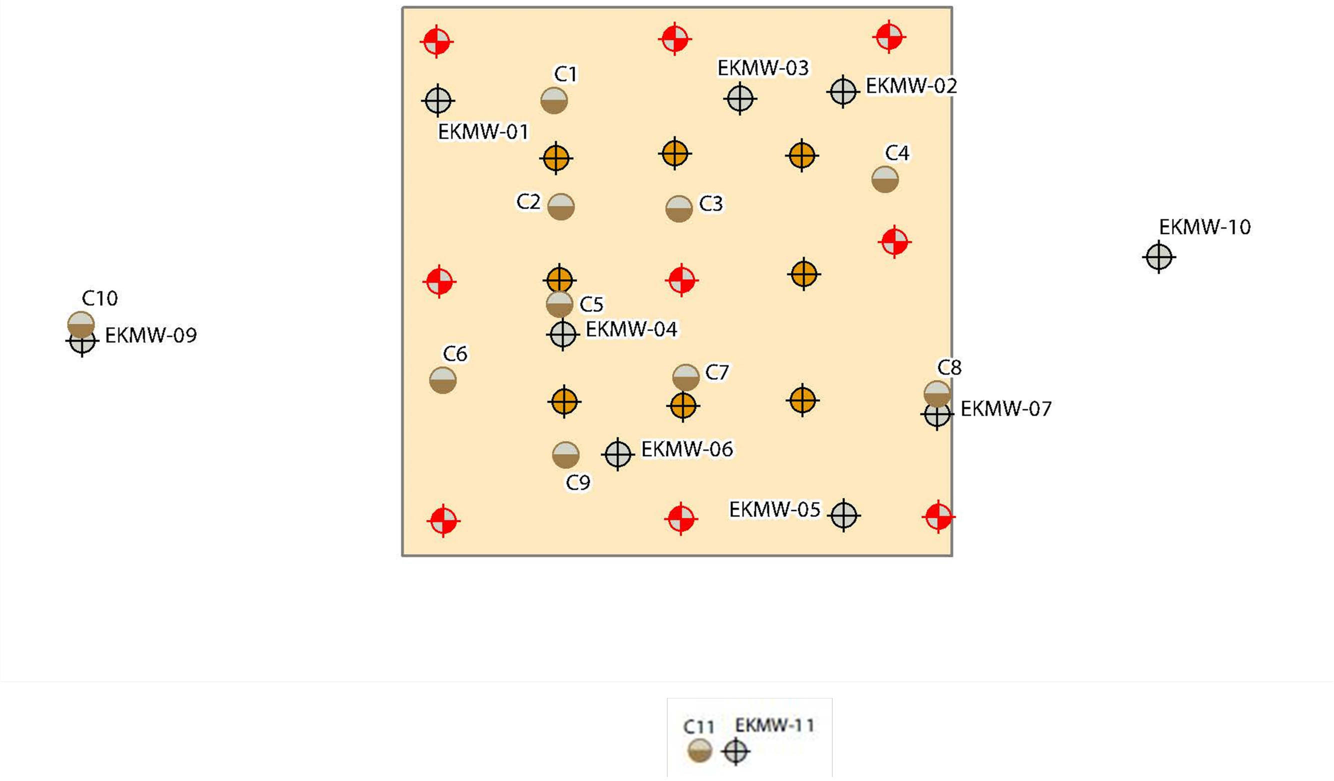


Figure 5-11. Soil Sampling Locations (C1 through C11)

The groundwater monitoring well network for the Dem/Val is presented in **Figure 5-1**. Groundwater elevation was measured for each monitoring well prior to sampling. After opening each well, the groundwater elevation was allowed to equilibrate with atmospheric conditions before taking a water level measurement. The depth to groundwater was measured using a Solinst interface meter (or equivalent) in 0.01-foot increments, relative to a permanently marked survey point located at the top of the well casing and recorded on the purge log field form. The water level meter was decontaminated between wells.

Groundwater sampling was conducted following low-flow purging protocols with the use of a peristaltic pump and dedicated tubing. With the low-flow sampling, the intake of the sampling tube was placed mid-way between the top and bottom of the well screen. The water level was monitored during purging to measure drawdown and determine the appropriate flow rate for the well. During purging, in-line water quality parameters were monitored continuously in a flow-through cell for temperature, pH, specific conductance, DO, and ORP. Purging was considered complete when a minimum of one casing volume of water had been removed with collection of at least three sets of field measurements spaced at two (2) to three (3) minute intervals, or when groundwater field parameters stabilized. The indicator parameters were considered stabilized when three consecutive readings met the following criteria:

- Temperature ± 0.2°C
  (i.e., the second and third reading must be within 0.2°C of the first reading);
- pH ± 0.2 pH units;
- Specific Conductance ± 5% units; and
- DO ± 0.2 mg/L or ±10% (whichever is greater).

Readings of stabilized parameters were recorded on the field sampling log forms. Following stabilization of indicator parameters, groundwater samples were collected into the appropriate laboratory prepared and preserved sample containers. Sampling containers, holding times, and preservation methods associated with each method are presented in **Table 5-6**. The sample containers were clearly labeled and placed in an insulated cooler with ice for shipping to laboratories following proper chain-of-custody protocols.

Page Intentionally Left Blank

6.0 SAMPLING RESULTS AND DISCUSSIONS

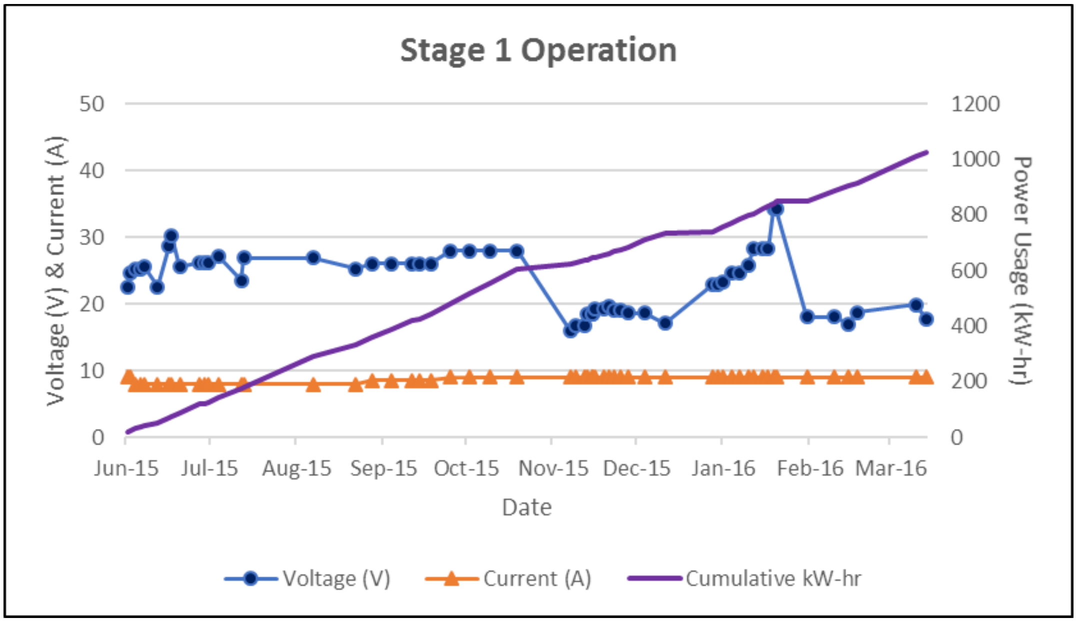
This section presents a detailed summary and discussions of all monitoring/sampling results. While baseline characterization results have already been presented in Section 5.2, select baseline characterization data are incorporated in this section, as appropriate, with other performance monitoring data to support analyses and discussions related to changes of soil and groundwater conditions during the Dem/Val.

6.1 SYSTEM OPERATION MONITORING

Figure 6-1 presents the power usage over the course of Stage 1 and Stage 2 operations. The voltage (V) and current (A) readings recorded at the power supply unit over the duration of operation are used to calculate the electrical power usage (kilowatt-hour [kW-hr]). The system was designed and operated to supply a constant current, determined after the start-up phase, and the power supply unit would then operate at a voltage level that was required in response to field electrical resistivity in order to maintain the supply of constant current.

Figure 6-1 shows that the power supply unit's voltage output remained generally steady between approximately 18V and 28V (Stage 1) and 12V and 20V (Stage 2). There were three occasions when different electrodes needed to be replaced, including late October/early November 2015 and late January/early February 2016 during Stage 1 operation, as well as December 2016 during Stage 2 operation. Prior to the electrode replacement, the system voltage readings would indicate the operating conditions were becoming unsteady. By inspecting the electrodes, it was determined that the initial shakedown/start-up operations at the start of Stage 1 operation, particularly an initial conservative electrode polarity reversal program, overly stressed the anode leading to damage of the electrode surface coatings. The polarity reversal program was corrected after the start-up operation in June/July 2015, however, the initial damages to the electrodes shortened the life-span of the anodes leading to the need to replace them during the operation. Other than the periods when electrodes were in need of replacement, the power supply unit operating conditions were relatively steady.

The total power consumption was calculated for Stage 1 at 1,037 kW-hr and Stage 2 at 548 kW-hr. Calculations for Stage 1 include the initial start-up operation (June-July 2015) and the initial buffering/conditioning operation (July-October 2015) preceding the 5-month Stage 1 full EK-BIO operation (October 2015-March 2016) counting after the TTA bioaugmented with the dechlorination culture. Stage 2 operation included only the 5-month full operation (October 2016-March 2017). As a comparison, the total energy usage by the EK system during the 14 active months of the Dem/Val (1,585 kW-hr) is equivalent to operating two 100-W lightbulbs over the same time interval, or operating a single 100-W lightbulb for approximately 660 days (22 months).



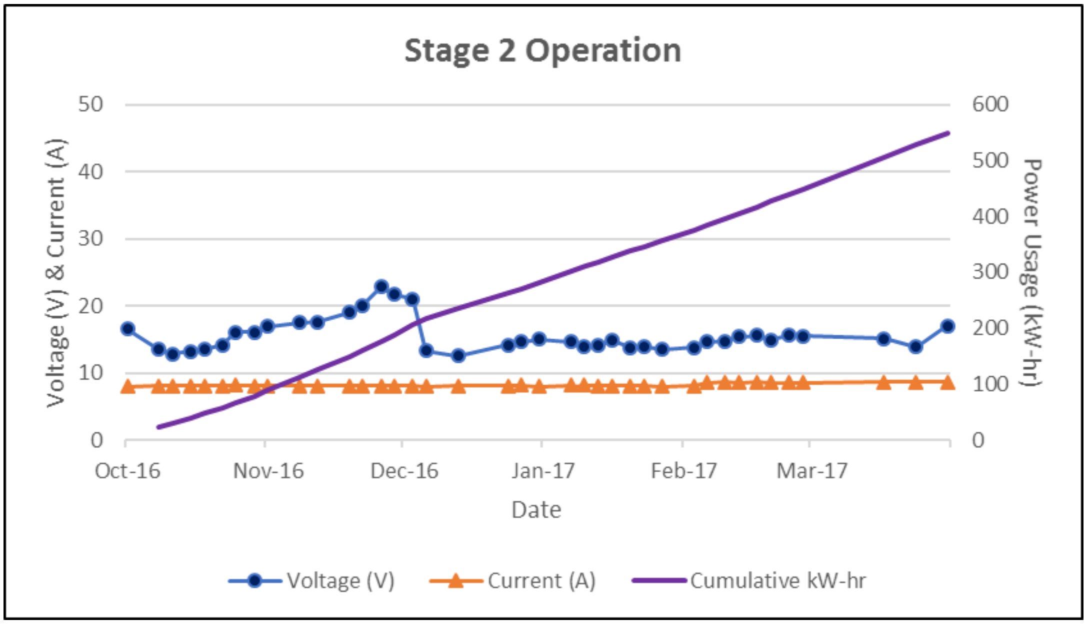


Figure 6-1. Power Usage During System Operation

In addition to monitoring the power supply unit, field measurements were taken to confirm the establishment of electric field within the TTA. **Figure 6-2** presents the field measurements made in October 2015 when electrode wells, E2, E5, and E8 were anodes.

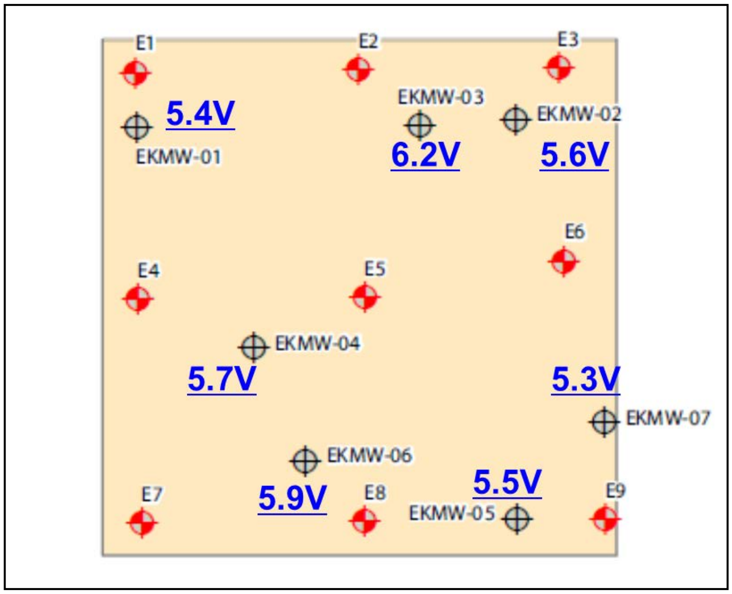


Figure 6-2. Voltage Measurements (V) at Monitoring Wells Within TTA

The voltage measurements taken at individual monitoring wells were used to assess if a uniform electric field was established within the TTA. Voltage measurements at individual wells relative to a common cathode reference at the EK control system were between 5.3V and 6.2V with an average of 5.6V and a standard deviation of 0.31V (5% variation from the average) indicating that an electric field was established in the area between electrode wells. Voltage gradients between discrete locations of closest pairs are also calculated and summarized below.

Well Pairs	MW-1 & MW-3	MW-2 & MW-3	MW-4 & MW-6	MW-5 & MW-6	MW-5 & MW-7
Voltage Gradient (V/m)	0.12	0.26	0.1	0.1	0.1

The calculated voltage gradients between these pairs are within 2x of the average gradients (0.13 V/m) measured also suggesting no local focusing of electric field within TTA.

Table 6-1 below presents the average and standard deviation calculated for the electrical current to individual wells during each stage of operation. The data show that the current supply to individual electrode well was generally steady (variation within 37% of average). Given that (1) soil electrical resistivity is a soil property not expected to vary over the course of Dem/Val, and (2) the voltage output by the power supply unit and the current supplied to individual electrodes were generally steady, the electrical potential between electrode pairs within the TTA should maintain within 5x of target during operation.

Table 6-1. Electrical Current to Electrode Wells

Stage 1	Cathodes						Anodes		
	E1	E3	E4	E6	E7	E9	E2	E5	E8
Avg	1.5	1.0	1.4	1.5	1.8	1.3	3.2	2.3	3.1
Std Dev	0.2	0.3	0.1	0.3	0.3	0.2	0.5	0.6	0.4
Stage 2	**Cathodes**						**Anodes**		
	E1	**E2**	**E3**	**E7**	**E8**	**E9**	**E4**	**E5**	**E6**
Avg	1.4	1.7	0.8	1.5	1.7	1.1	2.3	2.9	2.2
Std Dev	0.1	0.3	0.2	0.2	0.1	0.2	0.8	0.3	0.6

Table 6-2 summarizes the amendment supplied to the TTA and the energy usage throughout the Dem/Val. The duration and quantity reported for Stage 1 operation include the initial start-up operation and buffering/conditioning operation prior to bioaugmentation of the field when the 5-month full EK-BIO remediation operation was considered to start.

Table 6-2. EK System Operation Summary

Stage 1 Operation	Lactate to 8 Supply Wells	Lactate to 9 Electrode Wells	K-Carbonate to All Wells	Energy Usage
June 2015 – March 2016	80 kg via 370 gal	158 kg via 620 gal	35 kg via 655 gal	985 kW-hr
	10 kg/well via 47 gal/ well	17.5 kg/well via 69 gal/well		
Stage 2 Operation	**Lactate to 8 Supply Wells**	**Lactate to 9 Electrode Wells**	**K-Carbonate to All Wells**	**Energy Usage**
October 2016 – March 2017	105 kg via 520 gal	212 kg via 1,038 gal	16 kg via 305 gal	548 kW-hr
	13.1 kg/well via 65 gal/ well	23.5 kg/well via 115 gal/well		
Dem / Val Total	**Lactate to 8 Supply Wells** 185 kg / 890 gal (23 kg/well via 112 gal/well)	**Lactate to 9 Electrode Wells** 370 kg / 1,658 gal (41 kg/well via 184 gal/well)	**K-Carbonate to All Wells** 51 kg / 960 gal	**Total Energy Usage** 1,533 kW-hr

It should be noted that in this Dem/Val, amendment delivery was driven by electric field and not hydraulic pressure. The total volume of lactate amendment solution delivered throughout the Dem/Val was approximately 2,550 gallons. This accounts for only 16% to 22% of the total pore volume within a treatment zone of 35 ft x 35 ft x 5 ft at 25% to 35% total porosity.

Therefore, amendment distribution and the resulted biotreatment achieved within the TTA, as discussed below based on the monitoring data collected, should be recognized as the results of enhanced amendment delivery beyond diffusion mechanism.

6.2 GROUNDWATER SAMPLING RESULTS

Groundwater monitoring data are summarized, per sampling event, and provided in **Appendix F**. The locations of groundwater monitoring wells are presented in **Figure 5-1**. One monitoring well within the TTA, EKMW-06, was later found to not produce sufficient groundwater volume for sampling likely due to blockage. Therefore, EKMW-06 was not included in the monitoring program.

6.2.1 Groundwater Geochemistry

Groundwater geochemistry data, including the baseline characterization results, are summarized in **Table 6-3**. The baseline groundwater geochemistry data are also presented in **Figure 5-4**. The discussion in this section is organized by three separate areas – upgradient of the TTA, within the TTA, and downgradient of the TTA. For each area, data collected from the baseline event and subsequent performance monitoring events are discussed.

Monitoring well EKMW-09 is located upgradient of the TTA. Baseline data indicated that groundwater in this area was acidic (pH at 5), oxidizing (ORP at 100 mV and DO at 1.2 mg/L), with high chloride (2,800 mg/L), and high iron (130 mg/L). Throughout the Dem/Val, groundwater remained acidic (pH below 5.2) and slightly oxidizing (ORP above 60 mV with low DO). The chloride concentration decreased from baseline to below 1,800 mg/L post-Stage 2, the reasons for the decline are unknown. Iron concentrations decreased from baseline to below 80 mg/L.

Within the TTA, baseline characterization data showed that groundwater was acidic (pH 4.7 at EKMW-01 to pH 5.8 at EKMW-02 and EKMW-03), slightly oxidizing (ORP at 34 to 64 mV, except -21 mV at EKMW-02 and EKMW-03) with low DO at 0.2 to 0.6 mg/L. Other notable baseline geochemical conditions included:

- Three relatively distinct baseline chloride levels – EKMW-01 at 3,400 mg/L; EKMW-05 and EKMW-07 at 1,900 and 790 mg/L, respectively; and EKMW-02, -03, and -04 at 520 – 570 mg/L.
- Sulfate at 140 mg/L at EKMW-07, while at 24 to 57 mg/L at all other wells.
- Relatively high iron at EKMW-01 (130 mg/L) and EKMW-05 (160 mg/L), while generally at 60 mg/L for iron at other wells.

Based on baseline chloride, and iron concentrations, groundwater at EKMW-01 and EKMW-05 seemed to have similar geochemistry as that of upgradient well EKMW-09. While EKMW-01 is located near the upgradient edge of the TTA, EKMW-05 is near the down-/side-gradient edge of the TTA.

Table 6-3. Groundwater Geochemistry Data Summary

EKMW-01		Baseline (October 2014)	July 2015	October 2015	December 2015	March 2016	September 2016	December 2016	March 2017	June 2017
pH	S.U.	4.7	5.1	5.0	6.4	5.6	5.74	5.9	5.5	5.7
ORP	mV	54	130	-170	-50	-103	-120	-76	-79	-161
Dissolved Oxygen	mg/L	0.6	2.1	0.1	0.6	0.2	0.13	0.1	0.1	1.1
Analyte	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Bromide	mg/L	4.0 I	NA	NA	NA	2.3	NA	NA	NA	4.5 I
Chloride	mg/L	3400	NA	NA	NA	1450	NA	NA	NA	1950
Nitrate (as N)	mg/L	0.17 U	NA	NA	NA	0.1	NA	NA	NA	NA
Sulfate	mg/L	57	NA	NA	NA	13.2	NA	NA	NA	15 U
Calcium	mg/L	350	NA	NA	NA	210	NA	NA	NA	229
Iron	mg/L	130	100	NA	NA	87.4	NA	NA	NA	93.4
Magnesium	mg/L	98	NA	NA	NA	61.9	NA	NA	NA	57.7
Manganese	mg/L	2.8	NA	NA	NA	1.96	NA	NA	NA	NA
Potassium	mg/L	NA	8.1	5.7	5.2	5.43 I	NA	NA	NA	5.9 I

EKMW-02		Baseline (October 2014)	July 2015	October 2015	December 2015	March 2016	September 2016	December 2016	March 2017	June 2017
pH	S.U.	5.8	6	6.0	6.6	5.9	6.3	5.8	5.0	6.4
ORP	mV	-21	51	-21	-35	-34	-22	13	-58	-70
Dissolved Oxygen	mg/L	0.2	0.3	0.1	0.5	0.1	0.1	0.1	0.2	0.7
Analyte	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Bromide	mg/L	0.06 U	NA	NA	NA	3.3 I	NA	NA	NA	2.6 I
Chloride	mg/L	550	NA	NA	NA	664	NA	NA	NA	756
Nitrate (as N)	mg/L	0.17 U	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	mg/L	27	NA	NA	NA	10.7	NA	NA	NA	6 U
Calcium	mg/L	100	NA	NA	NA	177	NA	NA	NA	202
Iron	mg/L	57	9.5	NA	NA	121	NA	NA	NA	103
Magnesium	mg/L	30	NA	NA	NA	53.7	NA	NA	NA	54.4
Manganese	mg/L	0.86	NA	NA	NA	1.74	NA	NA	NA	NA
Potassium	mg/L	NA	2.1	4.1	4	4.46 I	NA	NA	NA	4.94 I

Table 6-3. Groundwater Geochemistry Data Summary (Continued)

EKMW-03		Baseline (October 2014)	July 2015	October 2015	December 2015	March 2016	September 2016	December 2016	March 2017	June 2017
pH	S.U.	5.8	5.8	5.8	6.5	5.6	5.8	6.1	5.8	6.3
ORP	mV	-21	0.4	-1.3	-53	-5	-56	-77	-43	-79
Dissolved Oxygen	mg/L	0.2	1.1	0.1	0.5	0.1	0.1	0.1	0.1	1.4
Analyte	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Bromide	mg/L	0.06 U	NA	NA	NA	1.2 U	NA	NA	NA	1.2 U
Chloride	mg/L	520	NA	NA	NA	674	NA	NA	NA	717
Nitrate (as N)	mg/L	0.17 U	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	mg/L	24 I	NA	NA	NA	15.6	NA	NA	NA	7.7
Calcium	mg/L	89	NA	NA	NA	208	NA	NA	NA	174
Iron	mg/L	58	70	NA	NA	101	NA	NA	NA	99
Magnesium	mg/L	27	NA	NA	NA	62.9	NA	NA	NA	53
Manganese	mg/L	0.79	NA	NA	NA	1.85	NA	NA	NA	NA
Potassium	mg/L	NA	4.2	4.1	4.2	6.16 I	NA	NA	NA	5.86 I

EKMW-04		Baseline (October 2014)	July 2015	October 2015	December 2015	March 2016	September 2016	December 2016	March 2017	June 2017
pH	S.U.	4.9	5.8	5.7	6.3	5.9	5.6	5.8	5.5	6.9
ORP	mV	42	3	-54	-27	-20	0.1	-3	4.5	-173
Dissolved Oxygen	mg/L	0.2	0.7	0.2	0.5	3.5	1.2	0.1	0.1	1.5
Analyte	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Bromide	mg/L	0.06 U	NA	NA	NA	0.6 U	NA	NA	NA	0.6 U
Chloride	mg/L	570	NA	NA	NA	462	NA	NA	NA	465
Nitrate (as N)	mg/L	0.17 U	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	mg/L	45	NA	NA	NA	15.3	NA	NA	NA	17
Calcium	mg/L	120	NA	NA	NA	126	NA	NA	NA	115
Iron	mg/L	47	56	NA	NA	59.6	NA	NA	NA	56.3
Magnesium	mg/L	31	NA	NA	NA	35.6	NA	NA	NA	31.3
Manganese	mg/L	0.99	NA	NA	NA	1.28	NA	NA	NA	NA
Potassium	mg/L	NA	4.5	5.3	6.3	7.1 I	NA	NA	NA	3.6 I

Table 6-3. Groundwater Geochemistry Data Summary (Continued)

EKMW-05		**Baseline (October 2014)**	**July 2015**	**October 2015**	**December 2015**	**March 2016**	**September 2016**	**December 2016**	**March 2017**	**June 2017**
pH	S.U.	5.2	5.4	5.5	5.9	6.2	5.6	5.3	4.8	5.7
ORP	mV	64	74	17	NA	-118	-1	-10	4.9	-39
Dissolved Oxygen	mg/L	0.3	0.4	0.1	0.5	4	1.0	0.1	0.3	0.4
Analyte	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Bromide	mg/L	1.2 U	NA	NA	NA	1.2 U	NA	NA	NA	3.0 U
Chloride	mg/L	1900	NA	NA	NA	1240	NA	NA	NA	1570
Nitrate (as N)	mg/L	0.17 U	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	mg/L	50	NA	NA	NA	11.5 I	NA	NA	NA	27.3 I
Calcium	mg/L	400	NA	NA	NA	259	NA	NA	NA	229
Iron	mg/L	160	130	NA	NA	131	NA	NA	NA	92.4
Magnesium	mg/L	110	NA	NA	NA	72.5	NA	NA	NA	55.8
Manganese	mg/L	3.3	NA	NA	NA	2.39	NA	NA	NA	NA
Potassium	mg/L	NA	7.4	3.8	3.5	6.12 I	NA	NA	NA	6.2 I

EKMW-07		**Baseline (October 2014)**	**July 2015**	**October 2015**	**December 2015**	**March 2016**	**September 2016**	**December 2016**	**March 2017**	**June 2017**
pH	S.U.	5.1	6.5	6.0	6.6	6.2	6.6	5.8	5.9	6.2
ORP	mV	34	67	-63	NA	-114	-56	-53	-75	-88
Dissolved Oxygen	mg/L	0.5	0.3	0.1	0.5	3.1	0.1	0.1	0.1	0.9
Analyte	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Bromide	mg/L	0.06 U	NA	NA	NA	1.2 U	NA	NA	NA	3.0 U
Chloride	mg/L	790	NA	NA	NA	975	NA	NA	NA	1670
Nitrate (as N)	mg/L	0.17 U	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	mg/L	140	NA	NA	NA	8.9 I	NA	NA	NA	15 U
Calcium	mg/L	150	NA	NA	NA	275	NA	NA	NA	419
Iron	mg/L	23	30	NA	NA	52.9	NA	NA	NA	85.1
Magnesium	mg/L	21	NA	NA	NA	34	NA	NA	NA	56.9
Manganese	mg/L	0.48	NA	NA	NA	1.09	NA	NA	NA	NA
Potassium	mg/L	NA	8.4	4.9	5.7	9.9 I	NA	NA	NA	16.3

Table 6-3. Groundwater Geochemistry Data Summary (Continued)

EKMW-08		Baseline (October 2014)	September 2016	June 2017
pH	S.U.	5.7	5.5	5.4
ORP	mV	12	NA	-57
Dissolved Oxygen	mg/L	0.4	0.1	1.2
Analyte	Units	Result	Result	Result
Bromide	mg/L	0.06 U	NA	1.2 U
Chloride	mg/L	1000	NA	1300
Nitrate (as N)	mg/L	0.17 U	NA	NA
Sulfate	mg/L	38	NA	15.5
Calcium	mg/L	150	NA	258
Iron	mg/L	67	NA	80.9
Magnesium	mg/L	45	NA	72
Manganese	mg/L	1.1	NA	NA
Potassium	mg/L	NA	NA	NA

EKMW-09		Baseline (October 2014)	July 2015	March 2016	September 2016	December 2016	March 2017	June 2017
pH	S.U.	5.0	4.5	4.5	4.8	4.9	3.8	5.2
ORP	mV	100	163	201	102	74	62	109
Dissolved Oxygen	mg/L	1.2	0.8	4.1	0.1	1.7	1.4	0.5
Analyte	Units	Result	Result	Result	Result	Result	Result	Result
Bromide	mg/L	6.0 U	NA	0.38 I	NA	NA	NA	3.0 U
Chloride	mg/L	2800	NA	2190	NA	NA	1790	1630
Nitrate (as N)	mg/L	0.17 U	NA	NA	NA	NA	NA	NA
Sulfate	mg/L	36	NA	18.4	NA	NA	22.8 I	23.4 I
Calcium	mg/L	460	NA	431	NA	NA	295	296
Iron	mg/L	130	NA	125	NA	NA	79.2	78.1
Magnesium	mg/L	130	NA	128	NA	NA	85.3	77.8
Manganese	mg/L	4.1	NA	4.48	NA	NA	2.9	NA
Potassium	mg/L	9.4	9	8.55 I	10.3	7.4 I	6.3 I	5.9 I
Total Dissolved Solids (Filterable)	mg/L	5700	6900	5760	6190	4400	2950	3890

Table 6-3. Groundwater Geochemistry Data Summary (Continued)

EKMW-10		Baseline (October 2014)	July 2015	March 2016	September 2016	December 2016	March 2017	June 2017
pH	S.U.	6.0	6	5.8	7.2	5.7	5.3	6.3
ORP	mV	-27	10	-5.9	-630	-92	30	-101
Dissolved Oxygen	mg/L	0.6	0.6	3.6	0.1	0.1	0.2	0.1
Analyte	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Bromide	mg/L	0.06 U	NA	0.32 I	NA	NA	NA	1.2 U
Chloride	mg/L	570	NA	788	NA	NA	NA	793
Nitrate (as N)	mg/L	0.25 U	NA	NA	NA	NA	NA	NA
Sulfate	mg/L	21 I	NA	12	NA	NA	NA	22.9
Calcium	mg/L	140	NA	193	NA	NA	NA	166
Iron	mg/L	49	NA	53.3	NA	NA	NA	49.5
Magnesium	mg/L	42	NA	59.3	NA	NA	NA	47.7
Manganese	mg/L	1.2	NA	1.62	NA	NA	NA	NA
Potassium	mg/L	7.8	6.1	16.1	11.7	23.6	12.4	21.4
Total Dissolved Solids (Filterable)	mg/L	1700	3000	2290	2280	1980	1230	2040

EKMW-11		Baseline (October 2014)	September 2016	March 2017	June 2017
pH	S.U.	10.6	5.6	5.2	5.6
ORP	mV	-9.2	35	114	11
Dissolved Oxygen	mg/L	0.1	1.4	0.1	0.1
Analyte	**Units**	**Result**	**Result**	**Result**	**Result**
Bromide	mg/L	0.06 U	NA	NA	6.0 U
Chloride	mg/L	170	NA	2430	2220
Nitrate (as N)	mg/L	0.17 U	NA	NA	NA
Sulfate	mg/L	16 I	NA	36.5 I	41.8 I
Calcium	mg/L	130	NA	386	345
Iron	mg/L	2.9	NA	95.5	104
Magnesium	mg/L	0.74	NA	86.3	73.7
Manganese	mg/L	0.02	NA	4.1	NA
Potassium	mg/L	NA	NA	8.1 I	NA

Notes:

S.U. Standard Units
mV millivolts
mg/L milligrams per Liter
NTU Nephelometric Turbidity Unit

NA Not analyzed.
U The compound was analyzed for but not detected.
I The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit

Geochemistry data collected from within the TTA in October 2015 following approximately 3 months of system operation adding buffering reagent showed pH increases at all wells from baseline to between pH 5.5 and pH 6, except at EKMW-01 where pH increased from baseline pH 4.7 to pH 5. The data showed negative ORP at all wells, except at EKMW-05 where ORP changed from 64 mV baseline to 17 mV. DO was at or below 0.2 mg/L at all wells. Bioaugmentation with low-pH KB-1® dechlorination culture was conducted at the end of October 2015.

Within the TTA following bioaugmentation and through Stage 1 and Stage 2 operations, groundwater pH generally remained between 5.5 and 6.6 and ORP was mostly negative after the Stage 1 and Stage 2 operations. Notable changes of certain geochemical conditions over the duration of Dem/Val include:

- Chloride – At EKMW-01, the concentration decreased from a baseline of 3,400 mg/L to 1,950 mg/L post-Stage 2, and at EKMW-05 from 1,900 to 1,570 mg/L. However, at EKMW-02 and -03, concentrations increased from baseline levels of 520–550 mg/L to 717–750 mg/L, and at EKMW-07 from 790 to 1,670 mg/L. Relatively smaller changes were observed at EKMW-04 (570 to 465 mg/L). These data suggest that some migration and redistribution of chloride (and likely other anions) might have occurred within the TTA as a result of the EK application.

- Sulfate – concentrations at all wells decreased from baseline levels of around 50 mg/L (except 140 mg/L baseline at EKMW-07) to 9 to 15 mg/L, including at EKMW-07, at end of Stage 1 operation. Sulfate concentrations generally remained low thereafter. These data are indicative of sulfate reduction in the TTA.

- Iron – concentrations decreased from baseline at EKMW-01 and EKMW-05, the two wells with the highest baseline iron, to approximately 90 mg/L at post-Stage 2 incubation. However, at EKMW-02, -03, and -07, iron concentrations doubled or more from their baseline levels to 85 – 100 mg/L. These data suggest that some migration and redistribution of iron (and likely other cations) occurred within the TTA as a result of the EK application.

At downgradient well EKMW-10, baseline conditions were slightly acidic (pH at 6) and reducing (ORP at -27 mV and DO at 0.6 mg/L). Baseline chloride (570 mg/L), sulfate (21 mg/L), and iron (49 mg/L) concentrations were consistent with those observed in most of the wells in the TTA. Over the duration of Dem/Val, groundwater pH generally remained close to pH 6, while ORP became more reducing (-101 mV post-Stage 2). Chloride increased from 570 mg/L baseline to over 780 mg/L post-operation. Sulfate decreased after Stage 1 operation, but increased to baseline level after Stage 2. Relatively minimum changes (less than 8 mg/L in changes) in iron concentrations occurred throughout the Dem/Val.

6.2.2 Groundwater Chemical and Microbial Analytical Results

The discussion of groundwater sampling results is organized in this section with respect to assessment of (1) amendment distribution and (2) reductive dechlorination of CVOCs.

Amendment Distribution

Groundwater TOC and VFA concentrations at monitoring wells provided an assessment of amendment distribution across the TTA. While lactate was provided as the amendment, it was expected that lactate would biodegrade as it was transported in the subsurface. Therefore, total VFAs were considered as an appropriate indicator of amendment distribution. **Table 6-4** presents a summary comparing the baseline TOC and VFA concentrations detected at individual monitoring wells to the maximum concentrations of each detected during the Dem/Val.

Table 6-4. Groundwater TOC and VFA Summary

(Baseline vs. Maximum During Stage 1 / Stage 2)

Well ID	TOC (baseline)	TOC (max S1/S2)	VFA* (baseline)	VFA* (max S1/S2)
EKMW-01	2.5	12.8 / 20.1	3.2	60.7 / 57.6
EKMW-02	2.5	36.2 / 4.30	1.6	141 / 2.50
EKMW-03	2.5	57.9 / 4.60	1.2	233 / 11.3
EKMW-04	3.6	6.70 / 3.50	1.9	18.3 / 8.20
EKMW-05	1.7	15.9 / 2.30	1.8	6.60 / 1.00
EKMW-07	6.8	12.5 / 57.0	2.2	21.7 / 204.7
EKMW-09	1.6	1.40 / 1.90	2.3	1.40 / NA
EKMW-10	1.9	1.50 / 10.1	2.1	1.40 / NA

* VFA = total of lactate, acetate, propionate, formate, butyrate, and pyruvate.

Units: mg/L.

With respect to TOC data, every monitoring well within the TTA saw an increase in TOC concentration >8x baseline levels, with the exception of EKMW-04 where the maximum TOC detected was 1.8x the baseline. With respect to VFA data, every monitoring well within the TTA saw an increase in VFA concentration >9x baseline levels, with the exception of EKMW-05 where the maximum VFA detected was 4x the baseline. These data show substantial increase in TOC and VFA concentrations across the TTA affected by EK application.

TOC and VFA concentrations at the two background monitoring wells, EKMW-09 and EKMW-10, did not show apparent increases from their baseline levels, with the exception of TOC detected at 10.1 mg/L at EKMW-10 during the final post-Stage 2 sampling event. EKMW-10 is located downgradient of the TTA approximately 20 ft from electrode well E6. It is possible that some migration of TOC from the TTA occurred to affect this well in its final sampling event.

It is recognized that concentrations of TOC and VFA at certain locations within the TTA may be dynamic in nature given the microbial activities occurring in the subsurface. While it is apparent that amendment provided from the supply wells and electrode wells was distributed to all the monitoring well locations during the Dem/Val, the data suggest that certain monitoring well locations received different amounts of amendment between Stage 1 and Stage 2 operations.

For example, EKMW-02 and EKMW-03 appeared to receive more amendment in Stage 1 than in Stage 2, while EKMW-07 received more in Stage 2 than in Stage 1. This is likely due to the different orientations of electric fields established during the two stages of operations affecting the amendment transport patterns within the TTA. This observation suggests that future design should consider electrode network arrangements that will allow operations of various electric field orientations to enhance amendment delivery efficiency.

Noting that there was not a monitoring well located between the supply well network and electrode well E5, which was an anode during both Stage 1 and Stage 2 (i.e., electron donor would have always been migrating from the supply wells towards E5 in each stage), grab groundwater samples were collected during the final post-Stage 2 sampling event at several DPT soil sampling locations (C2, C3, C6, C7, and C9 in **Figure 5-11**). These samples were collected at each location generally from the depth of 21 ft, which approximately corresponded to the mid-screen interval of the monitoring wells within the TTA. The TOC results of these grab groundwater samples are presented in **Table 6-5** below.

Table 6-5. Groundwater TOC at Select DPT Sampling Locations (from 21 ft bgs)

Location	C2	C3	C6	C7	C9
TOC (mg/L)	950	160	3.4	820	790

Significant TOC concentrations (160 to 950 mg/L) were detected at all three sample locations (C2, C3, and C7) between the supply wells and electrode well E5. These data confirmed that significant amendment had been distributed to this interior area. As a comparison, location C6 at the upgradient edge of the TTA did not appear to receive much amendment, likely due to its exterior position relative to supply wells and electric field orientation.

TOC concentrations in the sample collected from C9, located in the vicinity of unused monitoring well EKMW-06, indicate that the area received substantial electron donor. Thus, while EKMW-06 failed to provide data, C9 provided valuable replacement data confirming the amendment distribution to this portion of the TTA.

Enhanced Reductive Dechlorination

Figure 6-3 presents a comparison of groundwater CVOC and biomarker monitoring results at six monitoring wells within the TTA and two outside the TTA. The overall tabulated groundwater monitoring data are provided in **Appendix F**. **Figure 6-3** presents the data collected from five (5) milestone events: baseline event in October 2014; end of Stage 1 operation in March 2016; end of post-Stage 1 incubation in September 2016; end of Stage 2 operation in March 2017; and end of post-Stage 2 incubation in June 2017.

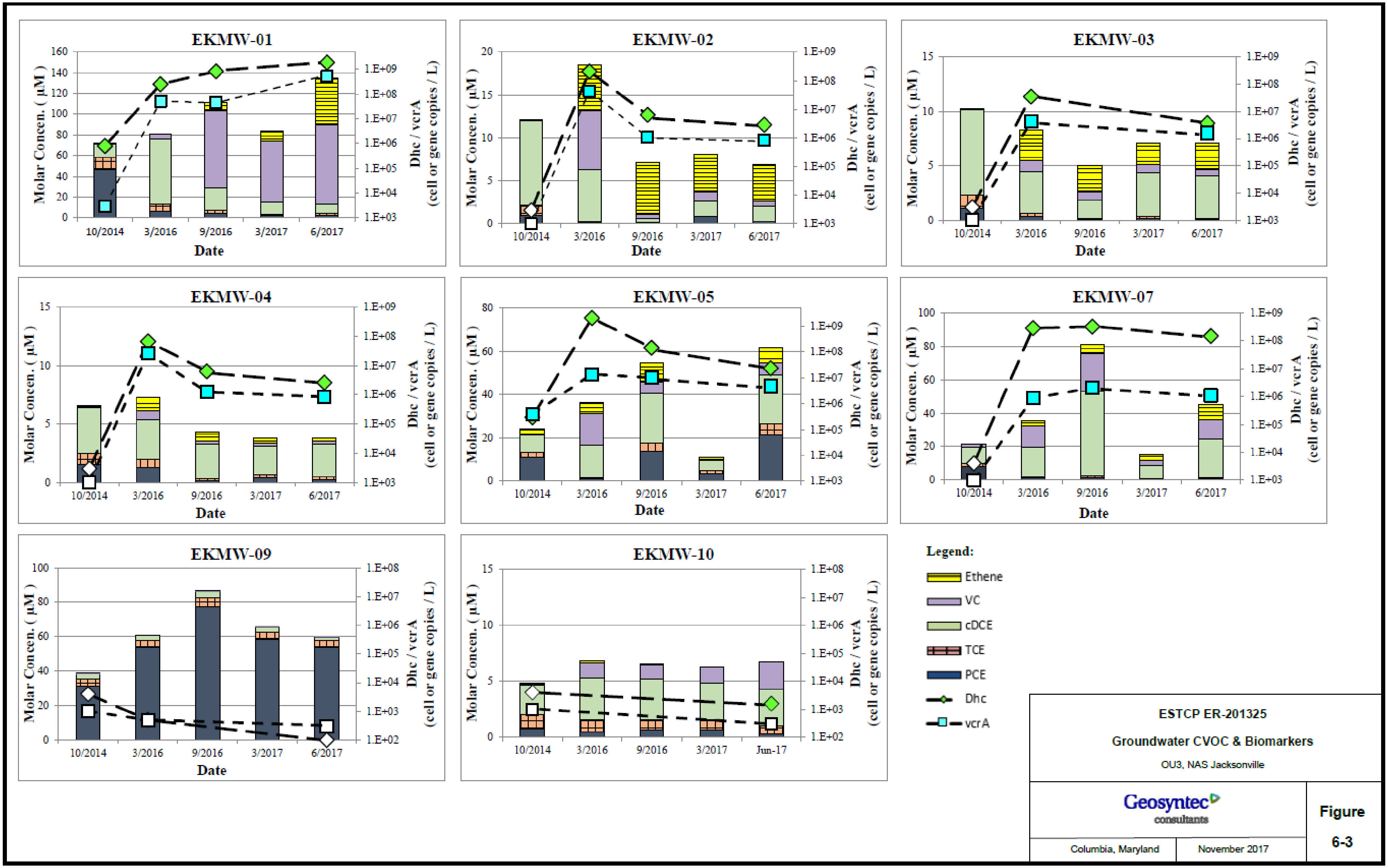


Figure 6-3. Groundwater CVOC & Biomarkers

EKMW-09 and EKMW-10 are located outside the TTA (**Figure 5-1**). The upgradient well, EKMW-09, is in the general area of the suspected PCE source (the former Building 106 area). The PCE concentrations at EKMW-09 remained above the baseline level during the Dem/Val, with no apparent increase of reductive dechlorination intermediates, and no detectable levels of biomarkers (below 1E+03 cell/L) throughout the Dem/Val.

At downgradient well EKMW-10, the baseline cis-1,2-DCE concentration was 260 µg/L, while the baseline methane concentration was 1,300 µg/L, both indicative of some natural reductive biological activity in this area prior to the Dem/Val. Between the baseline event and the post-Stage 2 event, no significant changes in PCE and other PCE dechlorination intermediate concentrations were observed, with the exception of an increase in vinyl chloride from 5 µg/L to 157 µg/L. It is also noted that while biomarkers were below detection in the baseline event, a low level of *Dhc* (1.6E+03 cell per L) was detected at EKMW-10 in the post-Stage 2 event. This level of *Dhc* was close to the method detection limit, and *vcrA* in that sample was still below detection limit. Overall, the data at EKMW-10 appear to suggest slight influence from the operation in the TTA approximately 20 ft away (to electrode well E6). As a comparison, the upgradient well EKMW-09 is located approximately 25 ft away from the closest electrode well E4.

Among the monitoring wells within the TTA, EKMW-01, located closest to the upgradient edge of the TTA, contained the highest baseline PCE concentration at 7,640 µg/L. While there were baseline PCE dechlorination intermediates (cis-1,2-DCE >1,000 µg/L and VC at 33 µg/L) at EKMW-01, low levels of baseline methane (190 µg/L), ethene (15 µg/L), and VFAs (2.3 mg/L) suggested limited reductive dechlorination activities in the vicinity prior to the Dem/Val. It is noted that *Dhc* and *vcrA* were detected in the baseline event at 8E+05 cell/L and 3E+03 gene copies/L, respectively. As presented in **Figure 6-3**, significant PCE dechlorination at EKMW-01 was observed in both post-Stage 1 and post-Stage 2 monitoring events. PCE concentrations decreased from the baseline level by 90% and 95% in the two events, respectively, while dissolved ethene concentrations were 15x and 85x (228 µg/L and 1,280 µg/L, respectively) the baseline level. There was a transitory increase of cis-1,2-DCE from baseline to end of Stage 1 operation followed by its continuing decrease through the post-Stage 2 sampling event. Methane concentrations remained generally at a similar level as baseline throughout the Dem/Val (75 to 399 µg/L). Both biomarkers increased by 1,000x or more from the baseline levels to the post-Stage 1 detections (10^7 and 10^8 cell/gene copies per L), with continued increases through the post-Stage 2 event (10^8 and 10^9 cell/gene copies per L).

The data for monitoring wells EKMW-02, -03, and -04, were relatively similar, with baseline PCE concentrations ranging from 170 to 250 µg/L, and low to no detectable baseline VC (<6 µg/L), ethene (all below detection), and biomarkers (all below detection). While enhanced reductive dechlorination was evident at all these wells, one noticeable difference between this group of wells and EKMW-01 was the significant increases of methane throughout the Dem/Val (see below).

Methane at	Baseline	End of Stage 1	Post-Stage 1	End of Stage 2	Post-Stage 2
EKMW-01	190	102	132	164	399
EKMW-02	1,200	1,850	6,380	7,890	8,740
EKMW-03	330	2,850	6,270	5,480	7,930
EKMW-04	54	401	1,930	4,100	5,010

Unit: µg/L

Both biomarkers at all these three wells increased by >1,000x from non-detect baseline levels to above 1E+06 at the end of Stage 1 operation, and were generally maintained at such levels throughout the Dem/Val. Dissolved ethene concentrations increased from non-detect baseline levels to the ranges of 120 to 170 µg/L at EKMW-02, 50 to 78 µg/L at EKMW-03, and up to 32 µg/L at EKMW-04. The sum of chlorinated ethenes decreased by 78% at EKMW-02, 54% at EKMW-03, and 46% at EKMW-04 over the course of Dem/Val.

EKMW-05 and EKMW-07 had relatively high baseline PCE concentrations at 1,800 and 1,300 µg/L, respectively. At EKMW-07 PCE concentrations significantly decreased from baseline to the end of Stage 1 operation (1,300 µg/L to 202 µg/L) and remained relatively stable during the 6-month post-Stage 1 incubation period (slight increase to 253 µg/L). In Stage 2, PCE concentrations decreased further (253 µg/L to 55 µg/L) during active EK, and rebounded slightly during post-Stage 2 incubation (up to to 92 µg/L). Methane concentrations at EKMW-07 increased significantly throughout the Dem/Val (110 µg/L baseline to over 7,000 µg/L post-Stage 1 and over 8,000 µg/L post-Stage 2), while *Dhc* and *vcrA* increased from non-detect levels to over 1E+08 cell/L and 1E+06 gene copies/L, respectively, and dissolved ethene continued to increase from baseline (11 µg/L) through post-Stage 1 incubation (161 µg/L) and again through post-Stage 2 incubation (260 µg/L).

At EKME-05, PCE concentrations significantly decreased from baseline (1,800 µg/L) to end of Stage 1 operation (180 µg/L) but then rebounded during the 6-month post-Stage 1 incubation period (to 2,280 µg/L). During the post-Stage 1 incubation (no active EK operation) when PCE rebounded, methane and ethene both increased from 210 to 587 µg/L and 144 to 255 µg/L, respectively, indicating continuing methanogenic and reductive dechlorination activities in the area. During Stage 2 operation, PCE concentrations decreased from 2,280 µg/L to 603 µg/L, but again rebounded (to 3,540 µg/L) during post-Stage 2 incubation. The reason for this rebound is unclear, but may indicate the presence of some residual PCE mass in this area. Methane concentrations further increased from post-Stage 1 incubation to post-Stage 2 incubation (from to 987 µg/L). Both biomarkers increased by almost 100x to 10,000x from baseline (1E+05 cell/gene copies per L) through Stage 1 operation, and remained above 1E+06 to 1E+07 cell/gene copies per L throughout the Dem/Val.

As presented in **Table 6-6**, DPT groundwater samples collected from select interior locations during the post-Stage 2 event were analyzed for CVOCs, dissolved gases, and biomarkers to supplement the monitoring data collected at monitoring wells. The three samples from the interior locations (C2, C3, and C7; see **Figure 5-11**) between the supply wells and anode E5 showed the most significant methanogenesis and reductive dechlorination. Methane concentration were more than 2,400 µg/L, and dissolved ethene concentrations ranged between 474 and 1,880 µg/L. Biomarkers, *Dhc* and *vcrA*, were detected at levels between 1E+05 and 2E+07 cell/gene copies per liter. These observations are consistent with the soil sampling results for these three locations discussed in Section 6.3 below (see **Figure 6-5** for soil CVOC and **Table 6-9** for soil microbial analyses).

Table 6-6. Groundwater CVOC and Biomarker at Select DPT Sampling Locations

(from 21 ft bgs)

	Location	C2	C3	C6	C7	C9
PCE	µg/L	11	160	1,400	28	250
TCE	µg/L	5	430	660	29	67
cis-1,2-DCE	µg/L	86	3,700	2,600	220	1,900
VC	µg/L	1,200	570	380	330	5,000
Methane	µg/L	2,490	3,840	634	4,090	259
Ethene	µg/L	1,710	474	100	1,880	402
Ethane	µg/L	18	12	5	6	3
Dhc	cell / L	5.E+06	2.E+05	2.E+03	2.E+07	<4E+04
tce	gene copies / L	1.E+06	5.E+04	<3E+04	4.E+06	NA
bvc	gene copies / L	5.E+05	4.E+03	<3E+04	1.E+06	NA
vcr	gene copies / L	4.E+06	1.E+05	<3E+04	1.E+07	NA
Dhb	cell / L	1.E+04	<4E+03	<3E+04	3.E+05	<4E+04

With the C6 sample, although methane concentrations over 600 µg/L, together with low levels of ethene (100 µg/L) and *Dhc* (2E+03 cell/L), were detected, overall the data suggest that the area near the upgradient edge of the TTA likely received less treatment due to the location relative to the supply well network and electric field orientation, which would move the amendment more effectively towards the interior of the TTA.

Location C9 was in the vicinity of a former monitoring well EKMW-06 which was not included in the monitoring program. The DPT groundwater data of C9 showed significant TOC concentration (790 mg/L) and evident reductive dechlorination with ethene concentration at 402 µg/L. As discussed below in Section 6.3, soil CVOC and soil microbial analyses of C9 also indicated reductive dechlorination activities in that area.

Collectively, with the evident reductive dechlorination observed in the groundwater samples collected from the interior portion of the TTA (C2, C3, and C7 locations) and the area of C9, as well as the network of Dem/Val monitoring wells, EK application clearly promoted substantial dichlorination and treatment within the overall TTA.

6.3 SOIL SAMPLING RESULTS

There were three (3) rounds of soil sampling over Dem/Val: baseline event (September 2014), post-Stage 1 event (April 2016), and post-Stage 2 event (June 2017). The 11 soil sampling locations are presented in **Figure 5-11**.

6.3.1 Soil Chemical Analyses Results

Table 6-7 presents a summary of soil chemical analytical results, including the baseline characterization results. For the baseline event, at each sampling location three (3) samples were collected each from discrete depths. The baseline data showed that within the TTA, PCE was the only chlorinated ethene detected at a concentration above 1 mg/kg, with the exception of cis-1,2-DCE at 1.9 mg/kg and 3.3 mg/kg at locations C3 (18.5 ft bgs) and C7 (18.5 ft bgs), respectively. The baseline data indicated that there was no apparent reductive dechlorination activity within the TTA soil prior to the Dem/Val. It was also noted that PCE concentrations decreased significantly with depth from 18.5 ft to 23 ft. PCE concentrations were below 0.08 mg/kg in all samples collected from the 21 and 23 ft bgs depths, with the exception of location C6 (5.5 mg/kg at 21 ft bgs and 3.1 mg/kg at 23 ft bgs) located on the upgradient limit of the TTA and closest to the expected PCE source in the general area of former Building 106 (**Figure 5-11**). Based on the finding that PCE was overwhelmingly present only at the 18.5 ft bgs sample interval, subsequent soil sampling events collected samples only from 18.5 ft bgs and 21 ft bgs.

The baseline soil sampling event also included soil grain size analysis to allow an assessment of whether the initial soil CVOC distribution was related to the heterogeneity of soil grain sizes. This was conducted, in response to a request by ESTCP during Demonstration Plan development, to assess whether CVOC concentrations, electron donor migration, and CVOC treatment could be correlated to grain size (a question related to uniformity of treatment). **Table 6-8** presents the grain size analysis of the samples from within the TTA at 18.5 and 21 ft bgs.

Table 6-7. Summary of Soil Chemical Analytical Results

Analyte (mg/kg)	C1-18.5			C1-21			C1-23	C2-18.5			C2-21			C2-23
	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)
Tetrachloroethene	16	11	1.9	0.029	0.41	0.056 U	0.04	15	0.63	1.9	0.028	0.043	0.11	0.082
Trichloroethylene	0.42	0.077	0.31	0.032	0.081	0.047 U	0.061	0.27 I	0.054	0.19	0.017	0.004 U	0.015	0.067
cis-1,2-Dichloroethene	0.38 I	0.084	0.75	0.006	0.1	0.31	0.0077	0.16	0.37	1.1	0.006	0.051	0.19	0.0083
Vinyl Chloride	0.032	0.0045 U	0.043 U	0.0013 U	0.0044 U	0.056 U	0.0014 U	0.012	0.0039 U	0.24	0.0011 U	0.0048 U	0.036	0.0014 U
Calcium	2500	2700	2400	NA	NA	NA	2200	1200	NA	NA	NA	NA	NA	2400
Iron	20000	19000	15000	NA	NA	NA	17000	8000	NA	NA	NA	NA	NA	16000
Magnesium	3400	3300	2600	NA	NA	NA	2700	1600	NA	NA	NA	NA	NA	3100
Manganese	60	59	55	NA	NA	NA	54	27	NA	NA	NA	NA	NA	62
Total Organic Carbon	NA	520	91 I	NA	430 I	NA	NA	NA	NA	170 I	NA	NA	NA	NA

Analyte (mg/kg)	C3-18.5			C3-21			C3-23	C4-18.5			C4-21			C4-23
	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)	Baseline (October 2014)	April 2016 [1]	June 2017 [1]	Baseline (October 2014)	April 2016 [1]	June 2017 [1]	Baseline (October 2014)
Tetrachloroethene	6.9	0.037	0.009	0.084 U	0.0047 U	0.2	0.084 U	4.7	0.31	0.075	0.081	0.011	0.23	0.01
Trichloroethylene	0.42	0.0045 U	0.001 U	0.07 U	0.0039 U	0.084	0.07 U	0.17	0.015	0.015	0.018	0.0027 U	0.03	0.04
cis-1,2-Dichloroethene	1.9	0.87	0.007	0.099 I	0.28	0.31	0.097 U	0.14	0.027	1.2	0.0082	0.0037 U	0.037	0.014
Vinyl Chloride	0.077 U	0.029	0.67	0.084 U	0.0047 U	0.063 U	0.084 U	0.023	0.0022 U	0.22	0.0015 U	0.0032 U	0.008	0.0014 U
Calcium	1200	NA	NA	NA	NA	NA	2200	2400	NA	NA	NA	NA	NA	2700
Iron	8100	NA	NA	NA	NA	NA	13000	18000	NA	NA	NA	NA	NA	21000
Magnesium	1600	NA	NA	NA	NA	NA	2800	3300	NA	NA	NA	NA	NA	3600
Manganese	26	NA	NA	NA	NA	NA	49	56	NA	NA	NA	NA	NA	71
Total Organic Carbon	NA	360 I	120 I	NA	400 I	NA	NA	NA	NA	440 I	NA	NA	NA	NA

Analyte (mg/kg)	C5-18.5			C5-21			C5-23	C6-18.5			C6-21			C6-23
	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)
Tetrachloroethene	12	2	0.73	0.022	0.06	0.099	0.047	10	9.6	2.2	5.5	0.088	0.21	3.1
Trichloroethylene	0.14 I	0.031	0.23	0.007	0.004 U	0.015	0.043	0.27 I	0.028	0.21	0.18	0.01 I	0.044	0.18
cis-1,2-Dichloroethene	0.12 I	0.032	1.1	0.0046 I	0.0056 U	0.065	0.0067 I	0.16	0.015 J4	0.27	0.12	0.0049 U	0.055	0.11
Vinyl Chloride	0.083 U	0.0028 U	0.34	0.00057 U	0.0048 U	0.009	0.0011 U	0.027	0.0053 U	0.053 U	0.017	0.0042 U	0.023	0.016
Calcium	2200	NA	NA	NA	NA	NA	2300	3100	3000	2200	NA	NA	NA	2700
Iron	15000	NA	NA	NA	NA	NA	15000	29000	21000	11000	NA	NA	NA	20000
Magnesium	2800	NA	NA	NA	NA	NA	2800	4500	3500	2200	NA	NA	NA	3300
Manganese	47	NA	NA	NA	NA	NA	57	84	63	46	NA	NA	NA	70
Total Organic Carbon	NA	420 I	52 U	NA	480 I	NA	NA	NA	NA	73 I	NA	NA	NA	NA

Analyte (mg/kg)	C7-18.5			C7-21			C7-23	C8-18.5			C8-21			C8-23
	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)
Tetrachloroethene	0.08 U	0.1	0.012	0.027	0.0025 U	0.001 U	0.011	7.6	1.9	1.6	0.025	0.058	0.13	0.021
Trichloroethylene	0.067 U	0.0045 U	0.001 U	0.0025 I	0.0021 U	0.001 U	0.011	0.12	0.046	0.24	0.024	0.0068 U	0.02	0.062
cis-1,2-Dichloroethene	3.3	0.81	0.024	0.11	0.087	0.17	0.011	0.86	0.15	0.63	0.0058	0.0094 U	0.047	0.0062
Vinyl Chloride	0.08 U	0.0054 U	0.096	0.00052 U	0.0025 U	0.061	0.00056 U	0.2	0.026	0.058 U	0.0045	0.0081 U	0.025	0.0011 U
Calcium	2200	NA	NA	NA	NA	NA	2800	2900	NA	NA	NA	NA	NA	2100
Iron	20000	NA	NA	NA	NA	NA	19000	27000	NA	NA	NA	NA	NA	16000
Magnesium	3200	NA	NA	NA	NA	NA	3800	4100	NA	NA	NA	NA	NA	2600
Manganese	58	NA	NA	NA	NA	NA	71	75	NA	NA	NA	NA	NA	51
Total Organic Carbon	NA	NA	480 I	NA	NA	NA	NA	NA	350 I	490 I	NA	360 I	NA	NA

Table 6-7. Summary of Soil Chemical Analytical Results (Continued)

Analyte (mg/kg)	C9-18.5			C9-21			C9-23	C10-18.5 [2]			C10-21 [2]			C10-23 [2]
	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)	April 2016	June 2017	Baseline (October 2014)
Tetrachloroethene	14	0.28	1.9	0.035	0.039	0.13	0.0013 U	45	48	8.2	11	14	0.99	2.6
Trichloroethylene	0.3 I	0.0068 U	0.086	0.0096	0.0019 U	0.019	0.03	0.1	0.19	0.58	0.015	0.037	0.04 U	0.0076
cis-1,2-Dichloroethene	0.22 I	0.0095 U	0.21	0.0018 I	0.0026 U	0.025	0.0066	0.031	0.034	0.55	0.004 I	0.0035 U	0.055 U	0.0016 I
Vinyl Chloride	0.037	0.0081 U	0.014	0.0015 U	0.0023 U	0.007	0.0012 U	0.00052 U	0.0047 U	0.11	0.00055 U	0.003 U	0.048 U	0.0005 U
Calcium	1800	NA	NA	NA	NA	NA	2400	1500	2600	620	NA	NA	NA	2500
Iron	13000	NA	NA	NA	NA	NA	17000	12000	15000	4500	NA	NA	NA	18000
Magnesium	2200	NA	NA	NA	NA	NA	2900	2000	3000	850	NA	NA	NA	3200
Manganese	42	NA	NA	NA	NA	NA	61	38	49	15	NA	NA	NA	34
Total Organic Carbon	NA	NA	480 I	NA	NA	NA	NA	NA	510	510	NA	460 I	NA	NA

Analyte (mg/kg)	C11-18.5 [2]	C11-21 [2]	C11-23 [2]
	Baseline (October 2014)	Baseline (October 2014)	Baseline (October 2014)
Tetrachloroethene	4.9	0.034	0.097 U
Trichloroethylene	0.024	0.0014 U	0.081 U
cis-1,2-Dichloroethene	0.0082	0.0014 U	0.11 U
Vinyl Chloride	0.0015 I	0.0017 U	0.097 U
Calcium	2700	NA	4100
Iron	19000	NA	24000
Magnesium	2900	NA	4400
Manganese	69	NA	260
Total Organic Carbon	NA	NA	NA

Notes:

mg/kg milligram per kilogram
NA Not analyzed.
U The compound was analyzed for but not detected.
I The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
J4 Estimated result.
[1] Baseline (October 2014) C4 location corresponds to the C12 location in 2016 and 2017 events.
[2] Sampling locations C10 and C11 are outside the target treatment area.

Table 6-8. Soil Grain Size Analysis (Baseline Event)

Location / Depth	% Fines (Silt + Clay)		% Silt		% Clay	
	18.5 ft	21 ft	18.5 ft	21 ft	18.5 ft	21 ft
C1	61.0	76.8	16.2	31.2	44.8	45.6
C2	53.8	77.8	18.1	35.0	35.7	42.8
C3	80.7	80.5	26.4	30.1	54.3	50.4
C4	88.8	71.0	20.6	22.9	68.2	48.1
C5	77.5	84.5	22.1	34.3	55.4	50.2
C6	80.1	85.0	23.1	35.9	57.0	49.1
C7	76.5	75.4	21.3	24.7	55.2	50.7
C8	75.0	90.0	18.8	30.2	56.2	59.8
C9	80.2	88.4	19.7	36.0	60.5	52.4
Avg.	74.6	81.0	20.6	31.1	54.0	49.9
Std. Dev.	11.5	6.40	3.20	4.80	9.90	4.70

As presented in **Figure 6-4**, no evident linear relationships between soil PCE concentrations and % fine-grained materials were observed, with R^2 values ranging between 0.33 and 0.57. Furthermore, the correlation coefficients between these parameters did not indicate any strong correlation with coefficients of 0.75 between PCE concentration and % Fines, 0.57 between PCE concentration and % Silt, and 0.69 between PCE concentration and % Clay. Given these analyses, soil grain size analysis was not included in the subsequent soil sampling events.

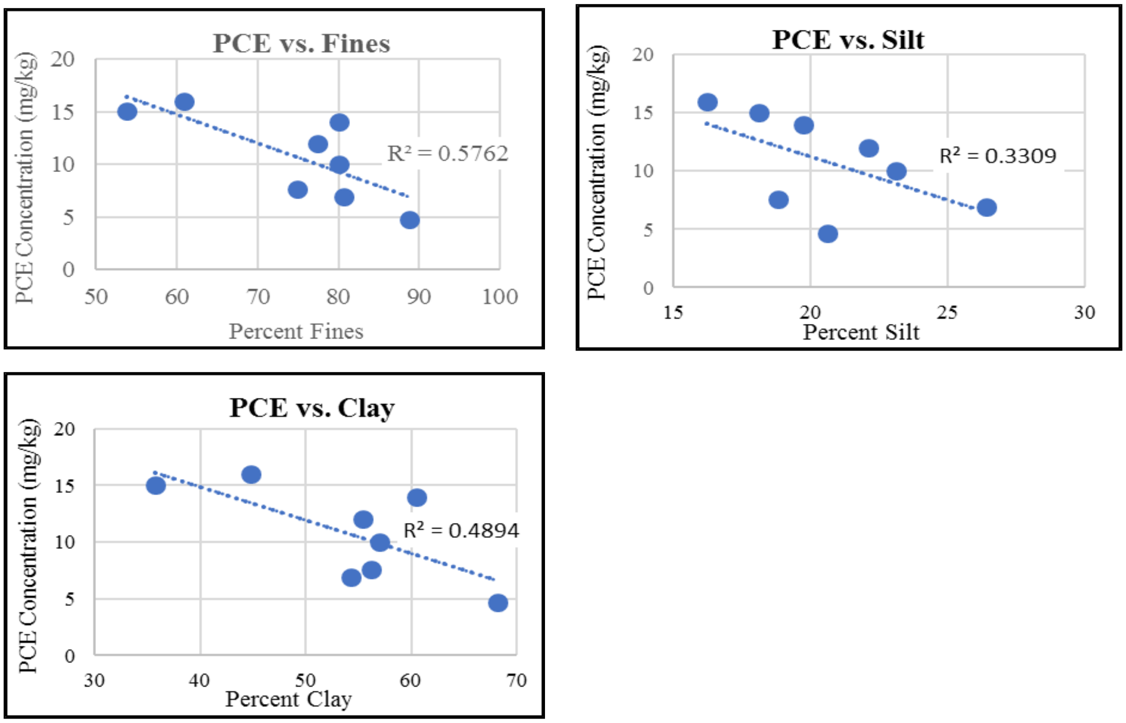
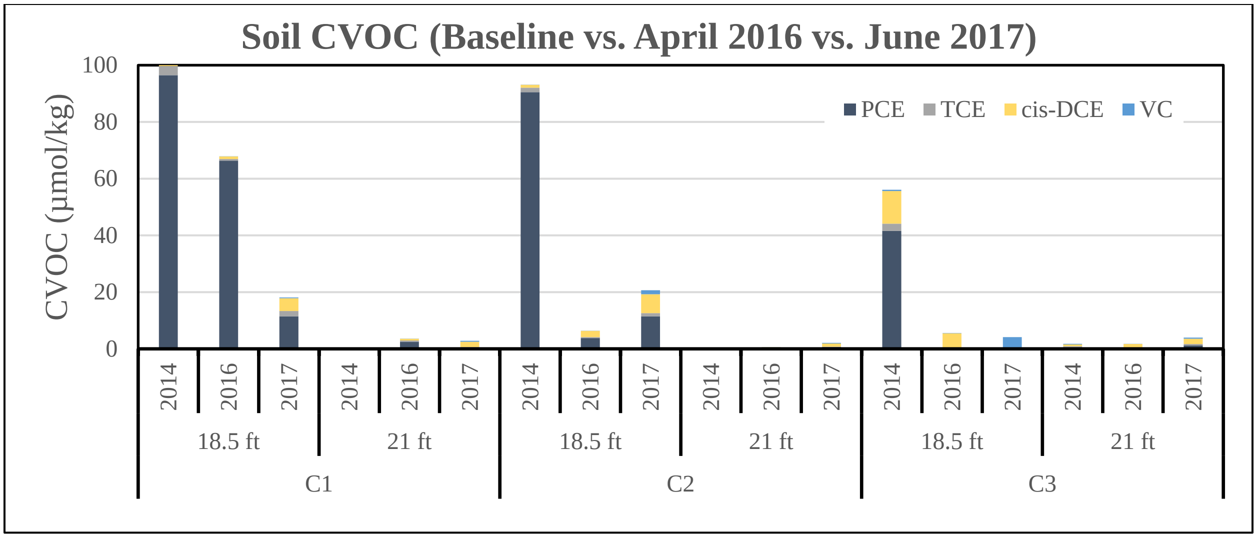


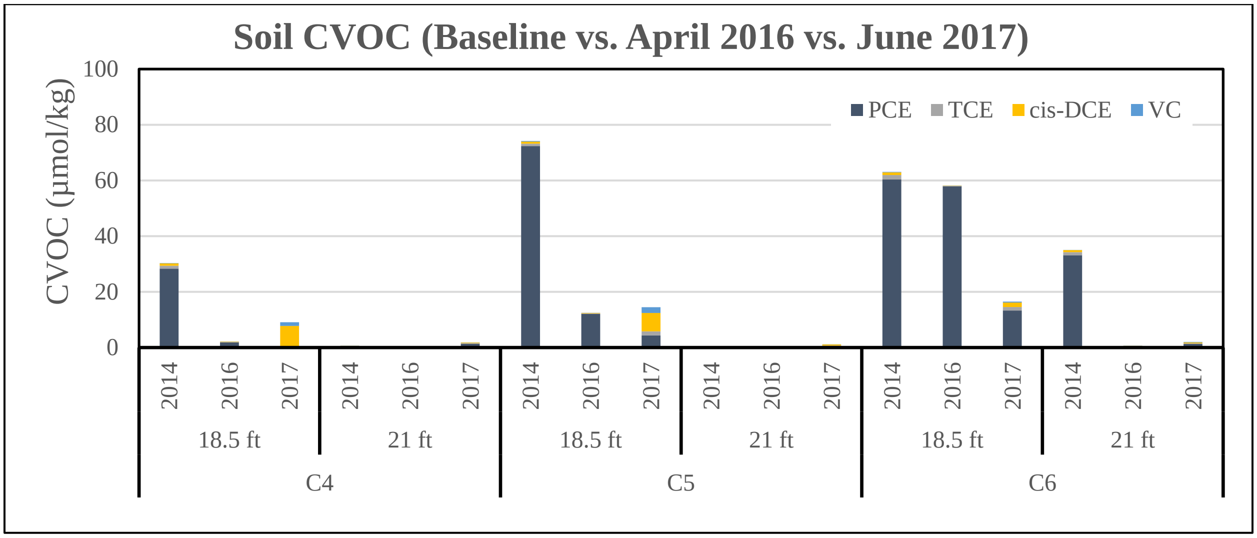
Figure 6-4. Soil PCE Concentration vs. Soil Grain Size (Baseline; 18.5 ft bgs)

Figure 6-5 below presents a comparison of soil CVOC concentrations at corresponding locations between the three (3) sampling events. The data presented in **Figure 6-5** are arranged per individual locations and sampling depths. Overall, soil PCE concentrations of all samples collected from 18.5 ft bgs at the nine (9) locations within the TTA decreased by 78% (C6) to 99% (C3) from baseline to post-Stage 2, with an average decrease of 88%. With the exceptions of C1 and C6, the decreases of PCE concentrations were already significant (75% at C8 to 99% at C3) from the baseline event to the post-Stage 1 event. Both C1 and C6 showed evident PCE decrease from the post-Stage 1 event to the post-Stage 2 event. It was also noted that while C6 was the only location with a significant baseline PCE concentration at 21 ft bgs (5.5 mg/kg), the PCE concentration at 21 ft bgs of the C6 corresponding sampling location decreased to 0.21 mg/kg and below in subsequent post-operation sampling events.

Location C10 was in the general area of former Building 106 and approximately 35 ft from the upgradient edge of the TTA. No decreases in PCE concentrations were observed at C10 at 18.5 ft bgs or 21 ft bgs between the baseline and post-Stage 1 events. PCE concentrations declined at both depths at this location from the post-Stage 1 event to the post-Stage 2 event. While the reason for the decline is unclear and may be due to heterogeneity (attempts were made to repeat boreholes as close as possible to prior co-located borings), a slight increase in dichlorination intermediates was observed in the 18.5 ft bgs sample, suggesting some increase in biological activity in this area over time.

While the decreases in soil PCE concentrations over the Dem/Val are evident, significant, and generally consistent among all sampling locations within the TTA, there were no clear, corresponding increases of dechlorination intermediates in the soil samples. Additional assessment of the effects of EK-BIO remediation on soil quality is further discussed below based on soil microbial analysis.





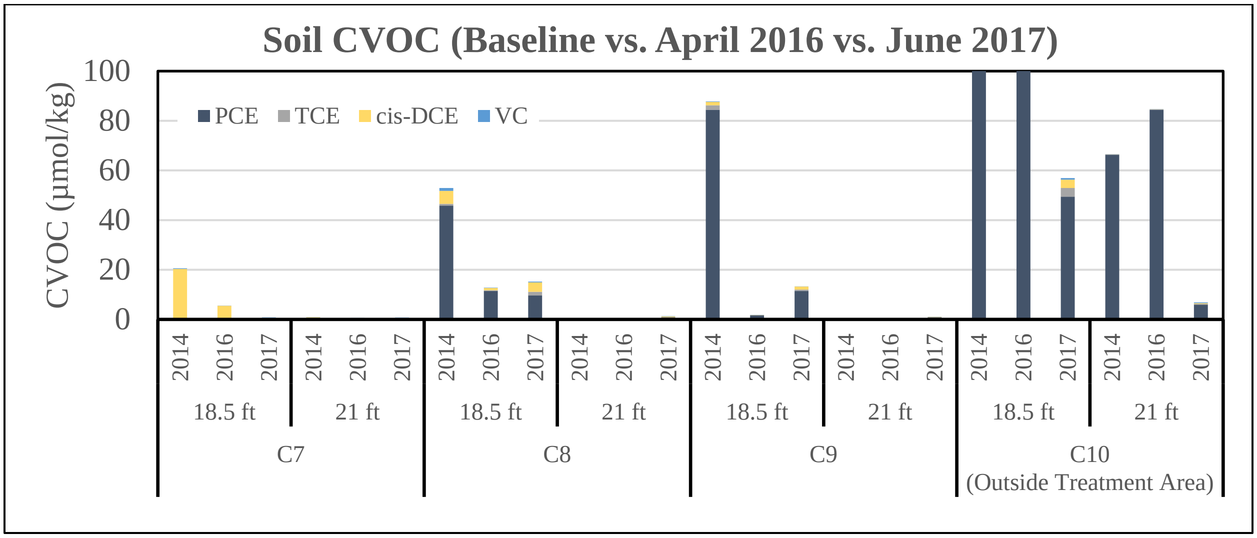


Figure 6-5. Soil CVOC Data – Comparisons Between Events

6.3.2 Soil Microbial Analytical Results

Soil samples from all three (3) events were analyzed for multiple biomarkers: reductive dechlorination bacteria Dehalococcoides (*Dhc*) and functional genes for TCE and VC dechlorination. The analyses of all soil samples collected during the baseline and post-Stage 1 events did not detect any of these biomarkers above the detection limit (6E+03 to 8E+03 enumeration or gene copies per gram). Given the observed PCE distributions and the lack of biomarkers in the first two events, only the soil samples from 18.5 ft bgs from the post-Stage 2 event were submitted for biomarker analyses and the results are summarized in **Table 6-9**.

Table 6-9. Soil Microbial Analytical Data (Post-Stage 2 Samples; 18.5 ft bgs)

Location / Parameter	*Dhc* (baseline)*	*vcrA*	*bvcA*	*tceA*
C1	2E+03 J (below 8E+03)	Below 7E+03	Below 7E+03	Below 7E+03
C2	7E+04 (below 8E+03)	1E+04	2E+04	3E+03 J
C3	9E+05 (below 8E+03)	1E+05	1E+05	3E+05
C4	7E+03 (below 8E+03)	Below 8E+03	Below 8E+03	Below 8E+03
C5	5E+04 (below 8E+03)	4E+04	2E+03 J	7E+03
C6	Below 8E+03	NA	NA	NA
C7	4E+04 (below 7E+03)	Below 8E+03	1E+04	Below 8E+03
C8	Below 7E+03	NA	NA	NA
C9	7E+03 (below 6E+03)	1E+03 J	Below 7E+03	Below 7E+03
C10	Below 8E+03	NA	NA	NA

* For the samples with detected *Dhc*, the baseline *Dhc* data were provided in ( ).

Dhc: Dehalococcoides (enumeration/gram); *vcrA : VC Reductase* (gene copies/gram)

bcvA : BAV1 VC Reductase (gene copies/gram) *tceA : TCE Reductase* (gene copied/gram)

J : Estimated quantity between the method detection limit and quantitation limit.

NA : Not applicable because *Dhc* was not detected.

Among the nine (9) post-Stage 2 samples from within the TAA, six (6) samples were reported with quantifiable levels, plus one with estimated level, of *Dhc*. Of these seven (7) samples with detected *Dhc*, five (5) samples, C2, C3, C5, C7, and C9, were detected with functional genes for VC dechlorination. Among all the locations within the TTA, location C3 appeared to have the most established *Dhc* populations with VC reductase genes, followed by locations C2 and C5.

It is noted that these are the locations in the interior of the TTA generally between supply wells and electrode well E5 which was an anode during both Stage 1 and Stage 2 operation. Electron donor would have been consistently migrating towards electrode well E5 during both Stages, and as such, it is not unexpected that the best electron donor availability and microbial growth would be detected in this area.

Overall, the soil sampling results presented in this section indicate that the EK-BIO operation resulted in significant decreases of PCE in clay soil across the TTA. The data also showed that microbial populations capable of reductive dechlorination of chlorinated ethenes, including VC, were established within the clay materials in at least part of the TTA.

Page Intentionally Left Blank

7.0 PERFORMANCE ASSESSMENT

This section provides an assessment of the performance of the Dem/Val relative to the performance objectives previously discussed in Section 3. Each subsection discusses the performance relative to an individual performance objective.

7.1 DEMONSTRATE UNIFORM DISTRIBUTION

The success criteria for this performance objective include:

Criterion

At groundwater monitoring locations within the TTA, groundwater TOC is at least 5x baseline, or 10x detection limit if baseline is below detection.

As presented in **Table 6-4**, every monitoring well within the TTA had TOC concentrations >8x baseline levels (for each well) during Stage 1 and/or Stage 2 operation, with the exception of EKMW-04 where the maximum TOC detected was 1.8x of the baseline. However, at EKMW-04 the maximum VFA detected was >9x its baseline. With respect to VFAs, all but one monitoring well (EKMW-05) had concentrations >9x baseline levels. As such, the Dem/Val has met this criterion in the EK was able to substantially increase electron donor concentrations across the entire TTA. Of note, TOC concentrations were more than 100x average baseline levels in groundwater samples located between the supply wells and central anode (E5), indicating the electrode layout and electrical field design as important parameters in achieving optimal electron donor distribution across the TTA.

Criterion

No local focusing of electric field within the TTA – no electrical potential gradient between any individual pair of cathode-anode is 5x the average electrical gradient between all pairs of electrodes.

As presented in **Figure 6-2**, the voltage measured at discrete locations within the TTA were between 5.3V and 6.2V, with a standard deviation of 0.31V (5%). Voltage gradients were calculated between locations of closest pairs shown in **Figure 6-2** and range between 0.1 to 0.26 V/m. The calculated voltage gradients between these pairs are within 3x of each other and within 2x of the average gradients (0.13 V/m) indicating no local focusing of electric field within TTA. The Dem/Val has met this criterion.

Criterion

Electrical potential gradient between electrode pairs maintained at level no more than 5x target gradient at design current.

The EK system was designed and operated at a constant current, determined after the start-up period, during the Dem/Val. As presented in **Figure 6-1**, during Stage 1 and Stage 2 operation, the voltage required of the power supply unit was generally consistent at between 15V and 30V, except for a few occasions when electrodes were in need of replacement. The electrical current supplied to individual wells during each stage of operation was generally steady (variation within 37% of average).

Given that (1) soil electrical resistivity is a soil property not expected to vary over the course of Dem/Val, and (2) the voltage output by the power supply unit and the current supplied to individual electrodes were generally steady, the electrical potential between electrode pairs within the TTA should maintain within 5x of target during operation. The Dem/Val has met this criterion.

7.2 DEMONSTRATE TREATMENT EFFECTIVENESS

The success criteria for this performance objective include:

Criterion

> 60% reduction in average PCE concentrations in soil and groundwater within the TTA, with coupled and comparable molar concentration increases of dechlorination daughter and end products.

Figure 6-3 presents a comparison of groundwater CVOC and biomarker monitoring results. The % decrease of PCE concentration and % increases of concentrations of dechlorination daughter products and ethene from the baseline levels are summarized in **Table 7-1**.

Table 7-1. Changes of Groundwater CVOC and Ethene Concentrations*

	EKMW-01		**EKMW-02**		**EMKW-03**		**EKMW-04**		**EKMW-05**		**EKMW-07**	
	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2
PCE Decrease	90%	95%	86%	74%	70%	83%	89%	72%	90%	67%	84%	93%
Increase of Products	310%	410%	65%	-41%	-13%	-24%	-18%	-34%	160%	200%	140%	200%
Increase of Ethene**	14x	84x	58x	47x	30x	26x	11x	3.8x	1x	1.6x	13x	22x

* Calculations for each well are based on molar concentrations and comparing between Baseline to End-of-Stage 1 and Baseline to End-of-Stage 2. Calculations for increases of products include TCE, cis-1,2-DCE, VC, and ethene.

For each of the six monitoring wells located within the TTA, decreases of >80% in PCE concentration were achieved at the end of either Stage 1 and/or Stage 2. Also presented in **Figure 6-3** and **Table 7-1**, the decreases of PCE from baseline at each well within the TTA were coupled with evident increases of dechlorination daughter products and/or ethene. The Dem/Val has met this criterion for groundwater.

Figure 6-5 presents a comparison of soil CVOC at corresponding locations between the three (3) sampling events. The data presented in **Figure 6-5** are arranged per individual locations and sampling depths. Overall, soil PCE concentrations of all samples collected from 18.5 ft bgs at the nine (9) locations within the TTA decreased by 78% (C6) to 99% (C3) from baseline to post-Stage 2, with an average decrease of 88%. It was also noted that while C6 was the only location with evident baseline PCE concentration at 21 ft bgs (5.5 mg/kg), the PCE concentration at this depth and location decreased to 0.21 mg/kg (96% reduction) and below in subsequent post-operation sampling events. As such, the Dem/Val met the PCE soil reduction criterion.

While the decreases of soil PCE concentrations over the period of Dem/Val were evident, significant, and generally consistent among all sampling locations within the TTA, there were no corresponding increases of dechlorination intermediates in the soil samples. The reason for the general lack of intermediates in the soil samples is unclear, particularly since these degradation intermediates were clearly present in the groundwater samples. Thus, while this criterion was not clearly met for soils, this may not be an appropriate performance metric for the soils.

Criterion

Ethene/ethane detected at > 75% of groundwater monitoring wells within the TTA before the completion of post-EK monitoring.

As presented in **Figure 6-3** and **Table 7-1**, every (100%) monitoring well within the TTA showed increased concentrations of ethene (up to >1,000 µg/L) during the Dem/Val. The Dem/Val has met this criterion.

Criterion

> 10x increases of Dhc from baseline at > 50% of soil and groundwater samples collected from within the TTA before the completion of post-EK monitoring.

For the groundwater, **Figure 6-3** shows that every monitoring well within the TTA showed significant increases (several orders of magnitude) of *Dhc* and *vcrA*. The Dem/Val has met this criterion for groundwater.

As presented in **Table 6-9**, among the nine post-Stage 2 soil samples collected from within the TAA, six samples were reported with quantifiable levels, plus one with estimated level, of *Dhc*, while all baseline soil samples did not contain detectable levels of *Dhc*. Of the seven samples with detected *Dhc*, five samples (C2, C3, C5, C7, and C9) showed functional genes for VC dechlorination. Thus, while not as impressive as the groundwater results, the Dem/Val has met this criterion for soil.

7.3 DEMONSTRATE SUITABILITY FOR FULL-SCALE IMPLEMENTATION

The success criteria for this performance objective include:

Criterion

System operation conditions (voltage and current) within ± 50% of the designed target conditions.

The EK system was designed and operated at a constant current, determined after the start-up period, during the Dem/Val. As discussed in Section 7.1 (criterion related to electrical gradient) and presented in **Figure 6-1**, the operating voltage and current remained relatively steady except when electrodes were in need of replacement. There were three occasions when different electrodes needed to be replaced: late October/early November 2015 and late January/early February 2016 during Stage 1 operation; and December 2016 during Stage 2 operation. Prior to electrode replacement, the rising system voltage readings would indicate the operating conditions were becoming unsteady. As discussed in Section 6.1, excluding the temporary unstable readings during the three periods shortly before the electrode replacement, the overall system operation conditions were steady and within 50% of the average during each normal operation period. The Dem/Val has met this criterion.

Criterion

Amendment supply up-time > 75% of target.

Other than the scheduled major O&M events between the two stages of operation, there were only three occasions when the system was shut down to allow replacement of electrodes. Overall, the system up-time was well >75% during the Dem/Val. The Dem/Val has met this criterion.

Criterion

Energy consumption within ± 30% of design estimates.

The EK system was designed and operated at a constant current, determined after the start-up period, during Stage 1 and Stage 2 operation. **Figure 6-1** presents cumulative energy consumption during each stage of operation. Given that the energy consumption is a function of voltage and current and as discussed above regarding the steady system operation condition criterion, excluding the temporary unstable voltage conditions during the three short periods before the electrode replacement, the overall system operations were steady and, thus, the energy usage as well. The Dem/Val has met this criterion.

7.4 SAFE AND RELIABLE OPERATION

The success criteria for this performance objective include:

Criterion

Operation conditions remain stable within the normal designed ranges over the course of the demonstration period.

As discussed in Sections 7.1 and 7.3 above, the overall operation conditions remained relatively steady over the course of system operation. The Dem/Val has met this criterion.

Criterion

No lost-time incidents.

There were no safety-related lost-time incidents. The Dem/Val has met this criterion.

7.5 EASE OF IMPLEMENTATION

The success criteria for this performance objective include:

Criterion

Ability to construct using conventional techniques and contractors.

The Dem/Val involved only conventional field construction techniques, including well drilling, well installation, and trenching and piping, as well as remediation system assembly performed by regular, qualified subcontractors. The Dem/Val has met this criterion.

Criterion

A single field technician is able to effectively monitor and maintain normal system operation.

During the operation, one field technician performed routine system O&M tasks twice per week with approximately 2 to 3 hours per visit. During the routine O&M visit, the tasks primarily included system visual inspections, recording the system operational parameters (voltage, current, amendment flow and pressure), and replenishing amendment solutions as needed. Other than sampling groundwater, there were fewer than 5 scheduled O&M events that involved two field technicians. The Dem/Val has met this criterion.

Page Intentionally Left Blank

8.0 COST ASSESSMENT

This section provides cost information that a remediation professional could use to reasonably estimate the costs for implementing EK-BIO at a given site. The cost analysis is based on actual costs of the tasks completed for this Dem/Val, and supplemented with reasonable estimates based on team's experience from similar projects.

8.1 COST MODEL

Table 8-1 presents a summary of cost elements and the cost tracking. Select cost elements are briefly discussed.

Table 8-1. Cost Model for EK-enhanced Amendment Delivery In-Situ Remediation

(for a Source Area Measuring 35 ft by 35 ft by 5 ft Thick)

Cost Element	Tracked During the Demonstration	Costs
Bench-scale EK tracer test	• Aquifer sediment materials provided by NAS Jacksonville. • Laboratory bench-scale EK column tracer tests – $25K	$25K
Remedial Design	• System design and demonstration plan – professional labor $80K	$80K
Remediation Construction	• Well driller – 17 electrode/supply wells and 10 monitoring wells; $40K • EK system construction subcontractor - $120K • Site construction subcontractor - $127K • Field construction oversight and system shakedown professional labor (~ 7 weeks) – $40K	$327K
Baseline characterization	• Field staff labor - $6K • Laboratory analytical costs - $28K	$34K
Remediation System Operation & Maintenance	• Field O&M subcontractor – over 14 months of active operation, $45K • Materials – lactate, $6K • Materials - buffer and other chemicals, $3K • Materials - system parts & consumables, $4K • Professional labor for startup and scheduled O&M visits - $20K	78K (about $6K/month)
Field Sampling (soil / groundwater)	• 4 rounds of comprehensive sampling events and 4 rounds of limited scale sampling events • Standard soil and groundwater sampling activities • Field sampling staff labor (partially provided by NAS Jacksonville) • Laboratory analytical costs (partially provided by NAS Jacksonville)	-
Waste disposal	• NAS Jacksonville provided waste disposal; no cost tracking	-
Reporting & Other Compliance Requirements	• Project reporting and meetings.	-

Cost Element – Bench-scale EK Column Testing

For this Dem/Val, the team conducted a bench-scale EK column tracer test to estimate the transport rate as a design basis. It is recommended that such bench-scale testing be considered as part of the remedial design for an EK-enhanced remedy. The scope of bench testing can vary depending on the test objectives. For example, the bench test can be designed to estimate EK transport rate only or to include assessment of treatment effectiveness facilitated by the enhanced amendment delivery, and the need for bioaugmentation. The costs of bench testing, therefore, vary based on the scope and objectives, but will typically range in cost between $15,000 to $40,000.

Cost Element – Remediation Construction

For this Dem/Val, no special drilling or field construction methods were required. The EK system, including an amendment supply system, a power supply system, and electrolyte cross-circulation system, was constructed by a remediation system vendor in accordance with the project-specific design. No special equipment or parts, other than off-the-shelf commercial products, were required for the EK system. The electrodes and power supply unit were also commercially available products. The EK system construction costs will vary depending on the project scale (e.g. number of electrode wells needed to cover a treatment area, number of electrodes used, etc.) and site conditions (e.g., the extent of instrument automation due to site access, iron fouling and control measures due to geochemistry, etc.). However, the cost increase for expanding the EK system constructed for this Dem/Val will only be marginal, primarily related to additional parts (e.g., electrode ($240 each), valves, and pipe fittings, etc.). The EK control center used for this Dem/Val could have been capable of incorporating up to 13 electrodes, thereby expanding the treatment footprint (on the electrode spacing used) by approximately 45%.

Cost Element – Remediation System Operation & Maintenance

The system O&M costs can vary depending on the extent of instrument automation and site conditions and restrictions. For this Dem/Val, routine O&M tasks were performed by regular remediation field technicians without needing special personnel. The material costs for chemicals and system consumables are project-specific but generally scalable. Professional labor costs for this Dem/Val were related to initial system start-up operation and a system conditioning during the re-start transition from the end of Stage 1 incubation to Stage 2 operation.

8.2 COST DRIVERS

Based on the information and experience obtained from this Dem/Val, there are three main cost drivers to consider when evaluating implementation costs in future projects, including: (1) footprint, depth interval, and volume of target treatment zone and contaminant mass; (2) presence and location of above-ground and subsurface utilities; and (3) site geochemistry, particularly pH and iron. These are also the same cost drivers for many other in-situ remediation technologies and not unique to EK technology implementation. Each of these cost drivers is discussed below.

Cost Driver – Target Treatment Zone and Contaminant Mass

As for most remediation technologies, the size and volume of the target treatment zone as well as the amount of contaminant requiring treatment significantly affects the overall remediation costs.

Particularly, the drilling and well installation costs for system wells (electrode wells and supply wells) vary based on the number and depth of these wells needed to adequately address the treatment zone. The spacing between electrode wells designed for this Dem/Val was approximately 18 ft, with supply wells located within the electrode well network. This level of well spacing, coupled with the phased operation program and the duration of operations, can be considered as within ranges of normal design for this technology. For this Dem/Val, active EK operation following bioaugmentation lasted approximately 10 months (two separate 5-month stages) and achieved an average soil PCE reduction of 88%. The overall duration of an EK remedy implementation will depend on the contaminant mass and the required mass reduction goal.

While there is no technical limit for applying EK technology in terms of depth, the costs for well construction increase as the depth of target treatment zone. The depth interval (thickness) of target treatment zone may affect the number of electrodes within an electrode well and, therefore, the overall number of electrodes needed. A target treatment zone of shallow depth may need additional measures and costs related to utility protection as discussed below. This technology is suitable mainly in saturated formations; treatment within the vadose zone represents a challenge which is discussed in Section 9.

Utilities

As with other active remediation technologies, a power source is required for this technology. Although not yet tested, the energy demand and the electrical operation conditions (voltage and current) demonstrated in this Dem/Val suggest that solar energy with battery units may be a feasible option.

Special considerations are warranted at sites with metallic subsurface infrastructure or subsurface utilities that may be electrically conductive. This evaluation should take into account the vertical separation of the electric field and the utility of concern. If needed, cathodic protection measures can be considered which can increase the implementation costs. In general, the EK technology is best suited for sites where the target treatment zone is deeper than 8 ft bgs (i.e., below utilities and conduits) and the groundwater table below 5 ft bgs, otherwise special design considerations are needed.

Site Geochemistry

Concentrations of iron and other major cations (e.g., calcium and magnesium) in groundwater is an important factor that can affect the costs of system construction and O&M. While this geochemical parameter is an important factor for most in-situ remediation technologies, it requires a special consideration when implementing an EK remedy because the electric field will result in, at least temporarily, concentrated iron and cations in cathode wells which attract cations in groundwater. The EK system for sites with elevated concentrations of these cations will need to be sized and equipped with adequate units for handling the anticipated amount of precipitates. More robust O&M programs and efforts will also need to be considered for such sites. Over the course of implementation, the O&M issues related to these do diminish.

8.3 COST ANALYSIS

For cost assessment, **Table 8-2** provides a cost comparison between EK-BIO, conventional direct-injection EISB, hydraulic fracturing DPT injection of ZVI, and electrical resistance heating (ERH) thermal treatment for a typical CVOC source site in low-K materials. The key characteristics of the framework site are as follows:

- The site characterization and conceptual site model have been completed. The characterization of the target treatment area is sufficient and no additional pre-design investigation data are needed to support the remedial design;
- The footprint of target treatment zone is approximately 80 ft x 80 ft;
- The depth interval of target treatment zone is between 10 and 30 ft bgs;
- Geology consisting of mainly fine-grained clayey material with low permeability (<1.0E-06 cm/sec);
- CVOC mass (chlorinated ethenes) is approximately 500 lbs;
- Treatability testing is already completed to support bioremediation design. The site will require bioaugmentation of dechlorination cultures, which will completely dechlorinate target CVOCs to innocuous end product;
- The site has available potable water supply and adequate power utility; and
- No concerns for site access, subsurface obstruction, electrical interference or corrosion.

Table 8-2 presents estimated full-scale implementation costs and key assumptions associated with each technology on which the estimated costs are developed. Given that performance monitoring requirement is highly project-specific, the estimated costs are presented as with and without the costs for performance monitoring. These estimates are prepared at the level of a feasibility study (e.g., +50%/-30%) for a cleanup site.

For baseline comparison, the costs of excavation with offsite disposal was also estimated. The feasibility-level cost estimate for an excavation-disposal option is in the range of $1,300,000 to $1,500,000. One variable in cost estimation for excavation is the quantity of excavated soil that may need to be managed as hazardous waste. This can significantly increase the cost of this option.

Based on the cost estimates presented in **Table 8-2**, EK-BIO can be potentially more cost favorable to ERH remedy ($688K to $1,183K before accounting for monitoring costs) and excavation-disposal. The cost saving of EK-BIO compared to ERH is smaller when factoring in the monitoring costs because ERH can complete the remediation within a shorter timeframe (~ 6 months with ERH compared to ~ 2 to 3 years with EK-BIO for the framework site). It is noted the significant difference in the electrical energy needed for these two technologies indicating a much more favorable environmental performance of EK-BIO over ERH.

The feasibility and effectiveness of direct-injection EISB approach is highly dependent on whether direct injection can achieve a reasonable injection rate and a reasonable radius of influence (ROI). For cost estimating purpose, an injection rate of 0.75 gpm to 1 gpm and a ROI of 7 ft are assumed.

The estimated costs for direct-injection EISB are presented in **Table 8-2** as a range based on injection rates. It should be noted that it is possible that at certain low-K sites these assumed injection rates and ROI may not be achievable. As presented in **Table 8-2**, the estimated cost for EK-BIO approach is comparable to that of direct-injection EISB when factoring in the costs for reinjections (assumed two reinjections over five years). When further accounting the performance monitoring costs, which depends on the overall timeframe of individual remedy, EK-BIO is potentially a more cost favorable alternative to direct-injection EISB. Therefore, at sites where low-K material and/or high-degree of heterogeneity limits the feasibility of applying direct injection, EK-BIO provides a cost-effective solution for implementing in situ bioremediation.

Fracturing DPT injection has an overall estimated cost slightly higher than EK-BIO. Certain site conditions may present more constraints for fracturing DPT injection than EK-BIO, such as sensitive subsurface utilities, shallow treatment zone close to the ground surface, or oxidizing geochemical conditions requiring more site conditioning to facilitate reductive treatment. While fracturing DPT technology can enhance aquifer permeability, if a target treatment zone is in a heterogeneous formation, the fracturing technique may still result in non-uniform distribution of injected amendment. Alternately, the depth interval for fracturing will need to be reduced, with associated increased costs to achieve uniform distribution.

Table 8-2. Cost Model for Full-Scale Implementation of Select Source Area Remediation Technologies

Cost Element	Tasks	Excavation - Disposal	EK-BIO	Injection EISB	Hydraulic Fracturing ZVI Injection	ERH	Descriptions / Assumptions
Remedial Design and Permitting	Design, project workplans, UIC permit ERH – also needs air permit, water discharge permit	$50K	$70K	$50K	$65K	$80K	NA
Remedial Construction (* Excavation-disposal and hydraulic fracturing ZVI injection costs presented only in Remediation System Operation & Maintenance below)	EK-BIO – 1. Well installations 2. Site construction; utilities 3. EK system & control center fabrication / mobilization / field connections 4. Professional field oversight and system shakedown/startup		1. $53K 2. $140K 3. $160K 4. $60K				• 25 electrode wells and 15 supply wells; all 4-inc PVC wells • Electrode well spacing at ~ 18 ft • Two electrodes vertically spaced in each electrode well • One EK control / amendment supply system
	Injection EISB – 1. Well installations 2. Site construction; utilities 3. Injection system mobilization / field connections 4. Professional field oversight and system shakedown/startup			1. $70K 2. $35K 3. $20K 4. $40K			• 49 injection wells; 2-inch PVC wells • Injection well spacing at ~ 13 ft • Injection ROI at ~ 7 ft • Up to three injection manifolds are constructed • Area is accessible during injection, and no trenching is required
	ERH – 1. Well installations 2. Site construction; utilities 3. ERH system mobilization / field connection / system shakedown/startup 4. Professional field oversight					1. $92K 2. $180K 3. $190K 4. $60K	• 25 electrode wells and 25 co-located vapor recovery wells • Electrode well spacing at ~ 18 ft • A surface cap will not be required • Include a 20-hp vapor extraction blower • Adequate power supply is available for a 500-kW power unit
Remediation System Operation & Maintenance	Excavation with Off-site Disposal – 1. Excavation 2. Dewatering 3. Off-site disposal of soil and water 4. Backfill 5. Professional field oversight	$1,250K – $1,450K					• 7,000 CY excavated volume • 150,000 gallons dewater volume • 50% excavated volume as hazardous • 25 miles to disposal facility

Remedial System Operation & Maintenance	EK-BIO – 1. Materials – chemicals 2. Materials – parts and supplies 3. Labor – O&M operator 4. Labor – professional 5. Utilities – water and electrical power		1. $60K-$75K 2. $25K-$40K 3. $65K-$95K 4. $50K-$75K 5. $5K-$8K				- Lactate as electron donor; also supply buffer and bioaugmentation culture - Approximately up to 3A current between each pair of cathode and anode - Four stages of operation over two years; each stage is four months of active EK operation followed by two months of incubation; alternate electric field orientation between each stage; a 3rd year is assumed for contingency - Less than 5,000 kW-hr electrical energy required for EK operation - Weekly visit by a system operator; up to three major O&M events
	Injection EISB – (injection rate from 1 gpm to 0.75 gpm*) 1. Injection system rental * 2. Materials – chemicals 3. Labor – field injection * 4. Utilities – water and electrical power 5. Reinjection – 2 reinjection events*			1. $20K to $26K* 2. $55K 3. $60K to $90K* 4. $5K 5. $120K to $180K* x 2 events			- Emulsified vegetable oil (EVO) as the electron donor; also inject buffer and bioaugmentation culture - Achievable injection rate from 1 gpm to 0.75 gpm - Up to two re-injection events over a period of five years
	DPT Hydraulic Fracturing ZVI Injection – 1. Injection vendor all labor/material inclusive costs 2. Professional oversight				1. $695K to $845K 2. $30K		- 25 DPT injection points; ROI ~12 ft; spacing ~ 20 ft - 7 fractures per DPT location (~ 3 ft depth interval per fracturing) - 1.5% wt ZVI to soil mass (total ZVI mass = 210,000 lbs) - 20 to 25 days of field injection
	ERH – 1. System rental and system operator 2. Labor – professional oversight 3. Utilities – electrical power 4. Permit monitoring (air and condensate) 5. Waste (activated carbon) disposal					1. $360K 2. $24K 3. $114K 4. $30K 5. $53K	- Total heating time of 180 days - Approximately 142,000 kW-hr electrical energy needed - Approximately 8,000 lb of activated carbon for regeneration/disposal - Vapor and condensate sampling and analysis in compliance with permits
Estimated Total (no performance monitoring costs)		**$1,300K - $1,500K**	**$688K - $776K**	**$355K to $386K* + 2 reinjections $595K to $746K***	**$790K - $940K**	**$1,183K**	

Remediation Performance Monitoring	EK-BIO – Semi-annual groundwater monitoring for 3 to 4 years; Final soil sampling Injection EISB – Semi-annual groundwater monitoring for 5 years; Final soil sampling Hydraulic fracturing DPT ZVI Injection – Semi-annual groundwater monitoring for 3 years; Final soil sampling ERH – Two semi-annual groundwater following the active operation; Final soil sampling		$190K - $240K	$290K	$190K	$90K	For costing purpose, assuming $25K per semi-annual groundwater monitoring event; $40K for final soil sampling event.
Estimated Total (with performance monitoring costs)		**$1,300K - $1,500K**	**$878K - $1,016K**	**$885K - $1,036K***	**$980K - $1,130K**	**$1,273K**	

9.0 IMPLEMENTATION ISSUES

EK-BIO is mainly a variation on standard EISB whereby EK is used to more effectively deliver the required amendments (electron donors, buffers and microbes) through low-K materials. As such, there are very few additional requirements or implementation issues that needed to be addressed beyond those typically encountered with a standard EISB implementation. Some areas where additional attention may be required, on a site-specific basis, include:

- Safety considerations related to potential stray current/voltage to surface. To address this question, we checked the current and voltage at the manhole steel cover located within the treatment area while the EK system was in operation to confirm that there was no safety concern. Depending on project site, and for sensitive and active facilities with dedicated safety departments, additional design and explanation effort may be required for project approvals.
- Iron fouling of filters and valves along the catholyte (well water from cathode wells) extraction line. In this Dem/Val, we re-plumbed the system to minimize potential flow restriction points. Scaling of the cathodes also required maintenance actions to clean the cathode surface. As indicated above, this issue diminished over the course of the Dem/Val.
- Corrosion of metallic parts in the manifold system & wellhead fittings due to elevated chloride concentrations. In this Dem/Val, we replaced most metallic contacting parts with plastic parts upon discovering that chloride levels were far higher than initially known.
- The technology implementation did not require specialized/proprietary equipment. We used only standard commercial off-the-shelf equipment. We designed the manifold and control system and had a remediation system vendor assemble the system per design, but the overall system was similar to other “typical” in-situ remediation systems.
- If the technology is to be implemented near (laterally and/or vertically) utilities that are “sensitive” to electric interference or corrosion concerns, some protection measures, such as cathodic protection, may be considered.
- No special regulatory requirements or permits beyond what are typical for other EISB or ISCO projects such as UIC permit. Depending on the locality-/facility-specific requirements, local or facility power/electrical departments should be consulted.

Page Intentionally Left Blank

10.0 REFERENCES

ESTCP (2012a). Interim results reported in: Summary of Low Permeability Investigations Completed at Naval Air Station Jacksonville, ESTCP ER-201032. February 2012.

ESTCP (2012b). Data Analysis Report, Field Event 4: NAS Jacksonville (ESTCP Project ER-0705). May 2012.

ESTCP ER-1740. Basic Research Addressing Contaminants in Low Permeability Zones.

Friis A.K., Heimann, A. C., Jakobsen, R., Albrechtsen, H. J., Cob, E., and Bjerg, P. L. (2007), "Temperature dependence of anaerobic TCE-dechlorination in a highly enriched *Dehalococcoides*-containing culture," *Water Research* 41: 355 – 364.

Gent, D. B., R. Bricka, R. Mark,. Truax,D. D, and Zappi, Mark (2001), Electrokinetic Movement of Biological Amendments Through Natural Soils to Enhance In-Situ Bioremediation, *In Situ and On-Site Bioremediation, Sixth International Symposium.* San Diego, CA, June 4-7, 2001.

Geosyntec Consultants, Inc. (2013), Enhanced In Situ Bioremediation Pilot Test Workplan, Operable Unit 3 (OU3), Naval Air Station Jacksonville, Florida.

Hodges, D., Fourie, A., Reynolds, D., and Thomas, D. (2011), "Development of an Apparatus for pH-Isolated Electrokinetic In Situ Chemical Oxidation," *J. Environ. Eng.*, 137(9), 809-816.

Koryta, J. and Dvorak, J. (1987). *Principles of Electrochemistry*, Wiley & Sons Ltd.

Mao, X., Wang, J., Ciblak, A., Cox, E., Riis, C., Terkelsen, M., Gent, D., and Alshawabkeh, A. (2012), "Electrokinetic-enhanced Bioaugmentation for Remediation of Chlorinated Solvents Contaminated Clay," *J. of Hazardous Materials* 213-214: 311-317.

Reynolds, David A. Jones Edward H., Gillen Mike, Yusoff Ismail, David G. Thomas (2008), "Electrokinetic Migration of Permanganate through Low-Permeability Media, *Ground Water*," Volume 46 Issue 4, Pages 629 – 637.

Roach, N. and Reddy, K.R. (2006), "Electrokinetic delivery of permanganate into low permeability soils," *International Journal of Environment and Waste Management*, 1(1), 4-19.

Robertson, TJ. (2009), *Electrokinetic transport of persulfate under voltage gradients*, ME dissertation, University of Technology Sydney.

SERDP ER-1204. Innovative Electrochemical Injection and Mixing Strategies for Stimulation of In-Situ Bioremediation. http://www.serdp.org/research/er-chlorinated-solvents.cfm

SERDP (2006) Final Report: SERDP and ESTCP Expert Panel Workshop on Reducing The Uncertainty of DNAPL Source Zone Remediation, September 2006

Tetra Tech (2013). Analytical Groundwater Dataset, delivered electronically to Geosyntec Consultants, Inc. (received by David Reynolds). May 2013.

Wu, X., Alshawabkeh, A. N., Gent, D. B., Larson, S. L., and Davis, J. L. (2007), "Lactate Transport in Soil by DC Fields, J. Geotech. and Geoenviron. Eng.," Volume 133, Issue 12, pp. 1587-1596.

APPENDIX A POINTS OF CONTACT

Point of Contact Name	Organization Name Address	Phone Fax Email	Role in Project
Evan Cox	Geosyntec Consultants, Guelph, ON, Canada	519-514-2235 ECox@Geosyntec.com	PI Supervising the project
David Gent	US Army ERDC Environmental Lab Vicksburg, MS	601-634-4822 David.B.Gent@usace.army.mil	Co-PI Technical direction
James Wang	Geosyntec Consultants Columbia, MD	410-910-7622 JWang@Geosyntec.com	Performer Technical design and execution
David Reynolds	Geosyntec Consultants Kingston, ON, Canada	519-515-0883 DReynolds@Geosyntec.com	Performer Data analysis
Michael Singletary	NAVFAC Southeast Jacksonville, FL	904-542-4204 Michael.a.singletary@navy.mil	Site coordination, technical review

Page Intentionally Left Blank

APPENDIX B TREATABILITY TEST MEMORANDUM

Page Intentionally Left Blank

Geosyntec consultants

427 Princess St., Suite 429
Kingston, Ontario, Canada K7L 5S9
PH 613.542.0228
FAX 613.542.0588
www.geosyntec.com

Memorandum

Subject: Results of Laboratory Testing of NAS Jacksonville Samples for Potential Application of Electrokinetic Remediation

ESAT TOA 601218

BACKGROUND

Geosyntec Consultants Inc. (Geosyntec), in conjunction with Naval Facilities Engineering Command (NAVFAC) and the Army Engineer Research and Development Center (ERDC), submitted a proposal to ESTCP for pilot testing electrokinetic–enhanced remediation at Operable Unit 3 (OU3) NAS Jacksonville. To develop site-specific data supporting the preparation of the ESTCP proposal, soil samples were collected from the vicinity of proposed pilot test area at OU3, and sent to Geosyntec for bench-scale laboratory testing. The bench-scale testing was funded through a Rapid Response Task (task order number 601218-03). Geosyntec has developed this memorandum to document the test completed and report the test results.

SCOPE OF WORK

The scope of work for the bench-scale electrokinetic (EK) testing program included the following tasks:

1) Mineralogical analysis of the supplied soil
2) Zeta potential testing of the supplied soil
3) Non-reactive tracer testing of the supplied soil

RESULTS

Mineralogical Analysis

A sample of the soil from NAS Jacksonville was sent to GR Petrology Consultants Inc. (GRP) in Calgary, Alberta, Canada for bulk and glycolated clay x-ray diffraction (XRD) analysis. The sample was found to contain 80.1% non-clay minerals and 19.9% clay minerals in the bulk XRD fraction. Quartz was the principal mineral detected, forming 61.3% of the bulk fraction. The high percentage of non-clay minerals is likely due to the selected subsample containing multiple sand grains, as the overall visual bulk soil was classified as sandy-clay.

The clay fraction was primarily composed of kaolinite (63% of the clay fraction), with smaller portions of illite, chlorite, and smectite.

Zeta Potential Testing

A sample of the soil from NAS Jacksonville was sent to the University of Toronto for measurement of zeta potential. Zeta potential is a key parameter which in part controls the rate of electroosmosis of bulk water through soil pores under an applied electric potential. Two sets of measurements were performed at various pH values, the first (run 1) immediately after pH adjustment and the second (run 2) after the solutions had been allowed to equilibrate overnight. The results are presented in Figure 1.

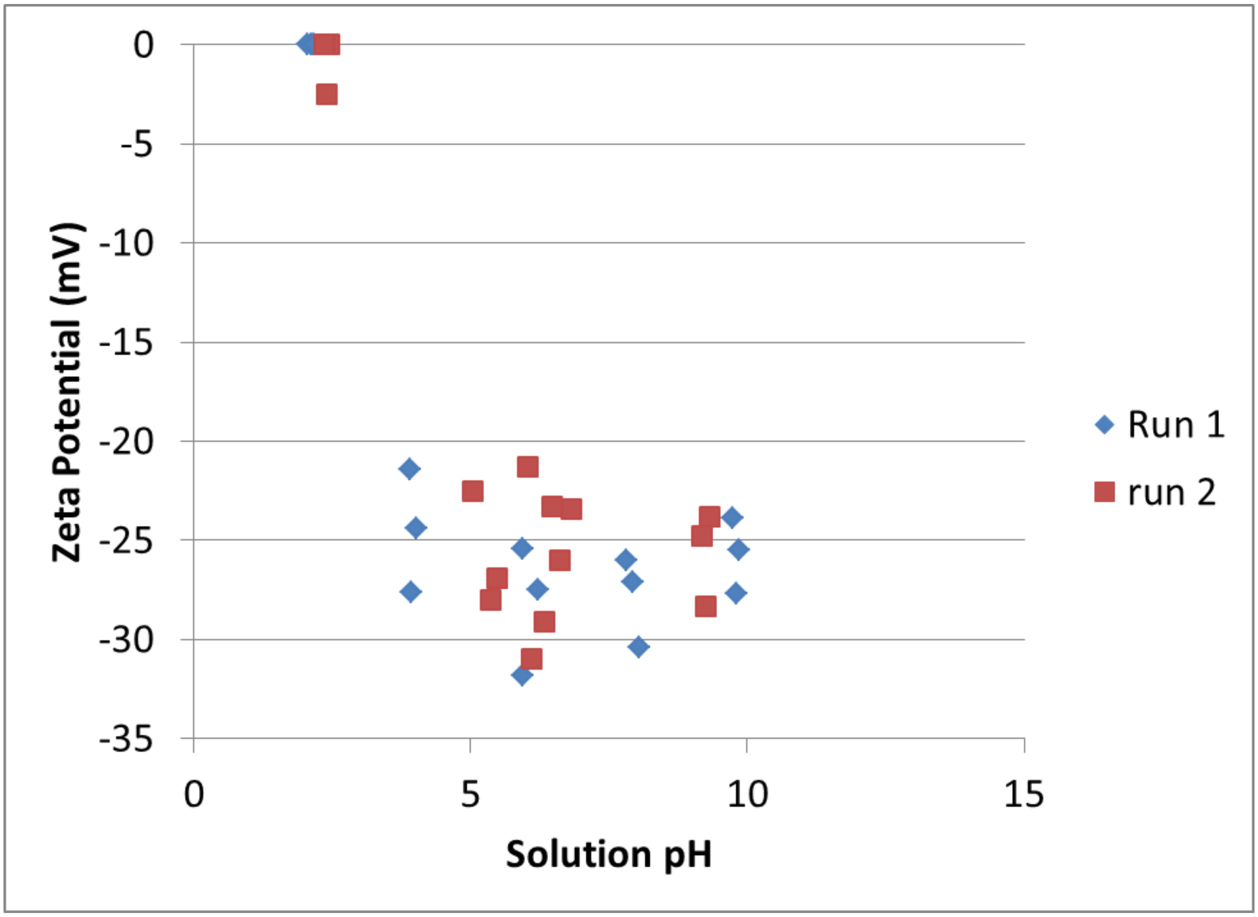


Figure 1 – Zeta Potential Results

Tracer Testing

A conservative tracer test was conducted on a 10-cm long soil core using the EK testing apparatus (Figure 2). Under a process known as electromigration, anions and cations in bulk solution will migrate towards the oppositely charged electrode when an electrical potential is applied (independent of the effects of electroosmosis). Bromide was added to the cathode reservoir of the EKTA at a concentration of 1.0 g/L (as NaBr), and a constant current of 25 mA was applied to the soil core. The test was run for 72 hours. Following the test, the soil core was frozen and then sectioned into 1-cm long increments. The samples were sent to Maxxam Analytics (Maxxam) for analysis of bromide concentrations in the soil. Table 1 presents the distribution of bromide in the soil as a function of distance from the cathode reservoir.

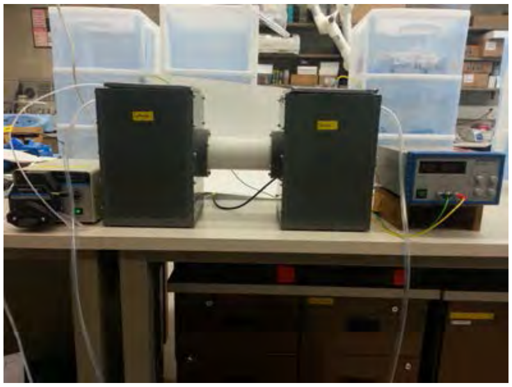


Figure 2 – EK Column Test Apparatus

Table 1 – Bromide Analytical Results in Samples Collected Along the Soil Column

Sample	Background Soil	3-cm from cathode	5-cm from cathode	7-cm from cathode	10-cm from cathode
Bromide (mg/kg)	**< 1**	**295**	**158**	**157**	**284**

****

Page Intentionally Left Blank

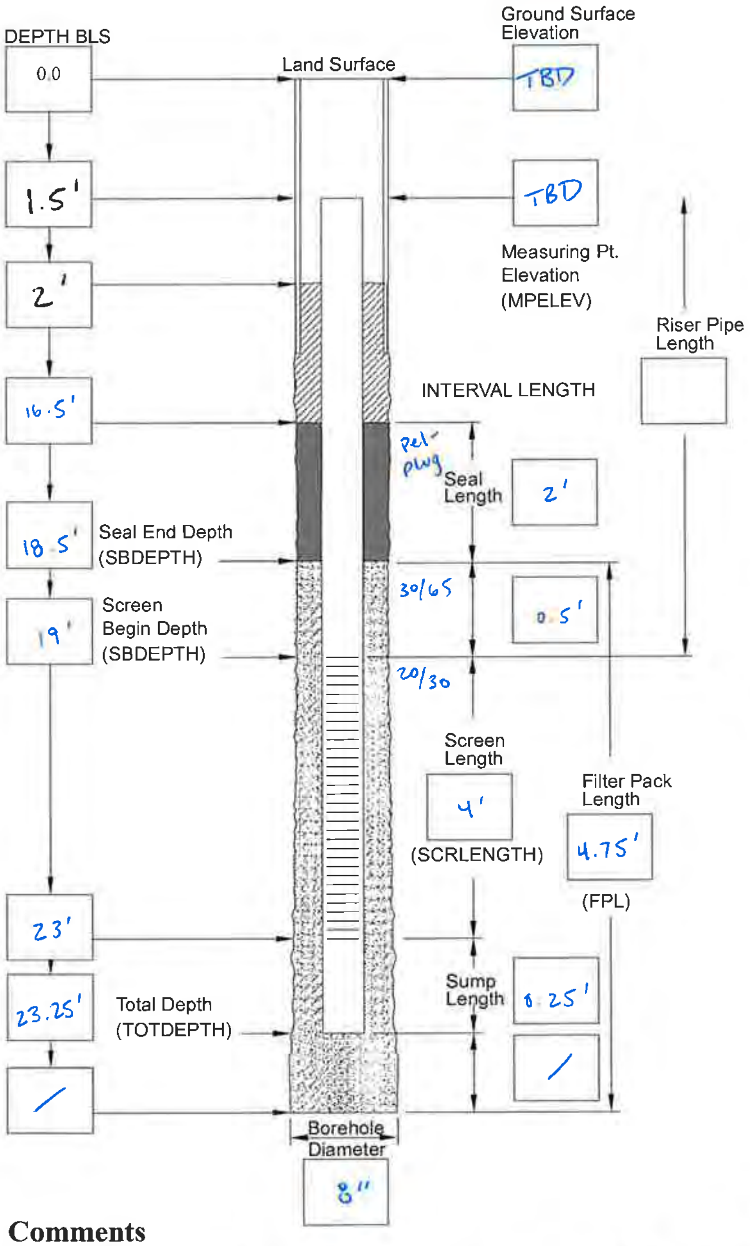
APPENDIX C BORING LOGS AND WELL CONSTRUCTION LOGS

Page Intentionally Left Blank

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: S1
Drilling Company: EDS
Driller(s): J.R., Mitch, Sean
Geologist/[✓ Eng.]/Tech.: Bryce Zinckgraf
Signature:

Site: NAS Jax
Project Number: TR0482
Installation Method: HSA
Casing Installation Date: 10/15/14
Well Type: supply
Well Completion Method: flush mount



Well Completion

Guard Posts (Y / [✓ N]) Date: 11/7/14
Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover

Diameter/Type: 2' x 2' steel vault
Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout

Composition/Proportions: portland cement type I

Placement Method: tremmie pipe

Seal Date: 10/15/14

Type: Pel-Plug Bentonite Pellets
Source: 5 gal bucket
Set-up/Hydration Time: 30 min
Placement Method: direct pour
Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack

Type: 20/30 silica sand; 30/65 silica sand
Source: 50 lb bags
Amount Used: 3 bags 20/30; 1 bag 30/65
Placement Method: tremmie pipe

Well Riser Pipe

Casing Material: schedule 40 PVC
Casing Inside Diameters: 4 in.

Screen

Material: schedule 40 PVC
Inside Diameter: 4 in.
Screen Slot Size:: 0.010 in.
Percent Open Area: 0
Sump or Bottom Cap ([✓ Y] / N)
Type/Length: cap / 0.25'

Total Water Volume During Construction

Introduced (Gal): 0 Recovered (Gal): 0

Reviewed

By: Date:

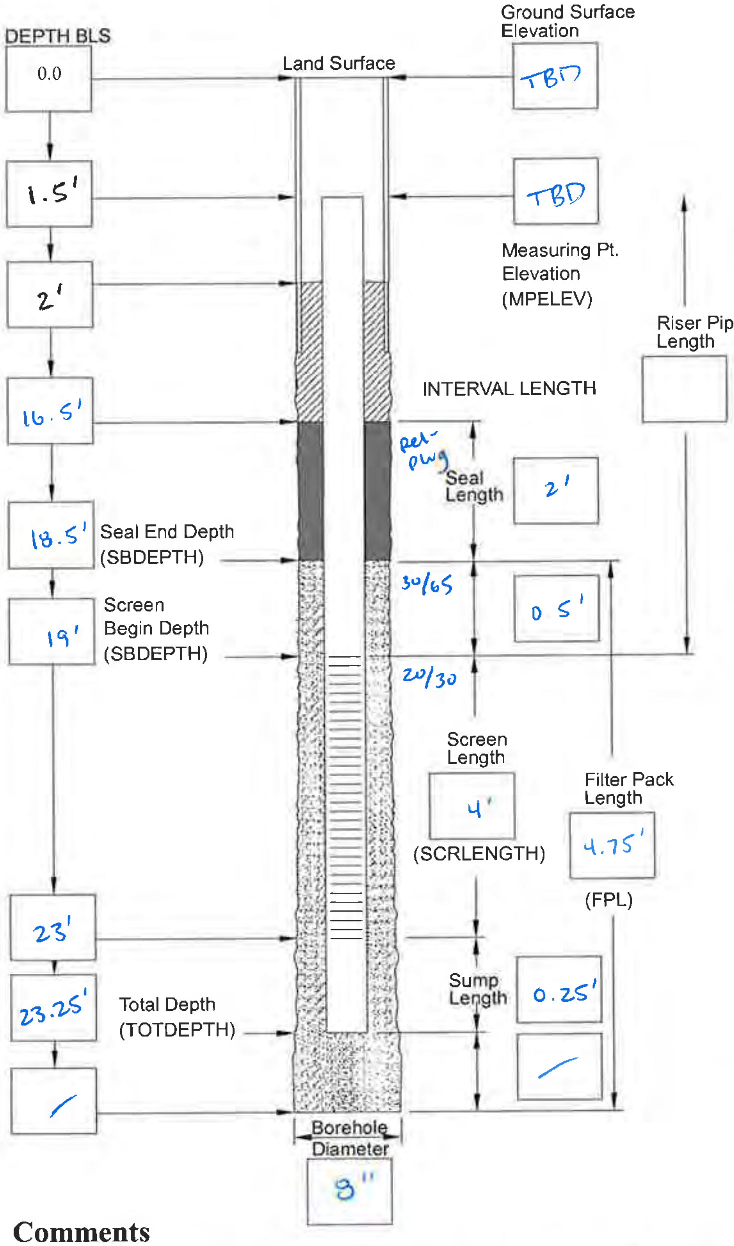
Comments

10/17/14 13:25 Development begins. ~20 gal milky brown to clear, then goes dry
10/20/14 16:11 Development continues. ~8 gal clear

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: S2
Drilling Company: EDS
Driller(s): J.R., Mitch, Sean
Geologist/~~Eng~~./Tech.: Bryce Zinckgraf
Signature:

Site: NAS Jax
Project Number: TR0482
Installation Method: HSA
Casing Installation Date: 10/15/14
Well Type: supply
Well Completion Method: flush mount



Well Completion

Guard Posts (Y / [✓ N]) Date: 11/7/14

Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover

Diameter/Type: 2' x 2' steel vault

Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout

Composition/Proportions: portland cement type I

Placement Method: tremmie pipe

Seal Date: 10/15/14

Type: Pel-Plug Bentonite pellets

Source: 5 gal bucket

Set-up/Hydration Time: 30 min

Placement Method: direct pour

Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack

Type: 20/30 silica sand, 30/65 silica sand

Source: 50 lb bags

Amount Used: 3 bags 20/30; 1 bag 30/65

Placement Method: tremmie pipe

Well Riser Pipe

Casing Material: schedule 40 PVC

Casing Inside Diameters: 4 in.

Screen

Material: schedule 40 PVC

Inside Diameter: 4 in.

Screen Slot Size:: 0.010 in.

Percent Open Area: 0

Sump or Bottom Cap ([✓ Y] / N)

Type/Length: cap / 0.25'

Total Water Volume During Construction

Introduced (Gal): 0 Recovered (Gal): 0

Reviewed

By: Date:

Comments

10/17/14 13:05 Development begins. ~18 gal, milky brown to clear then goes dry

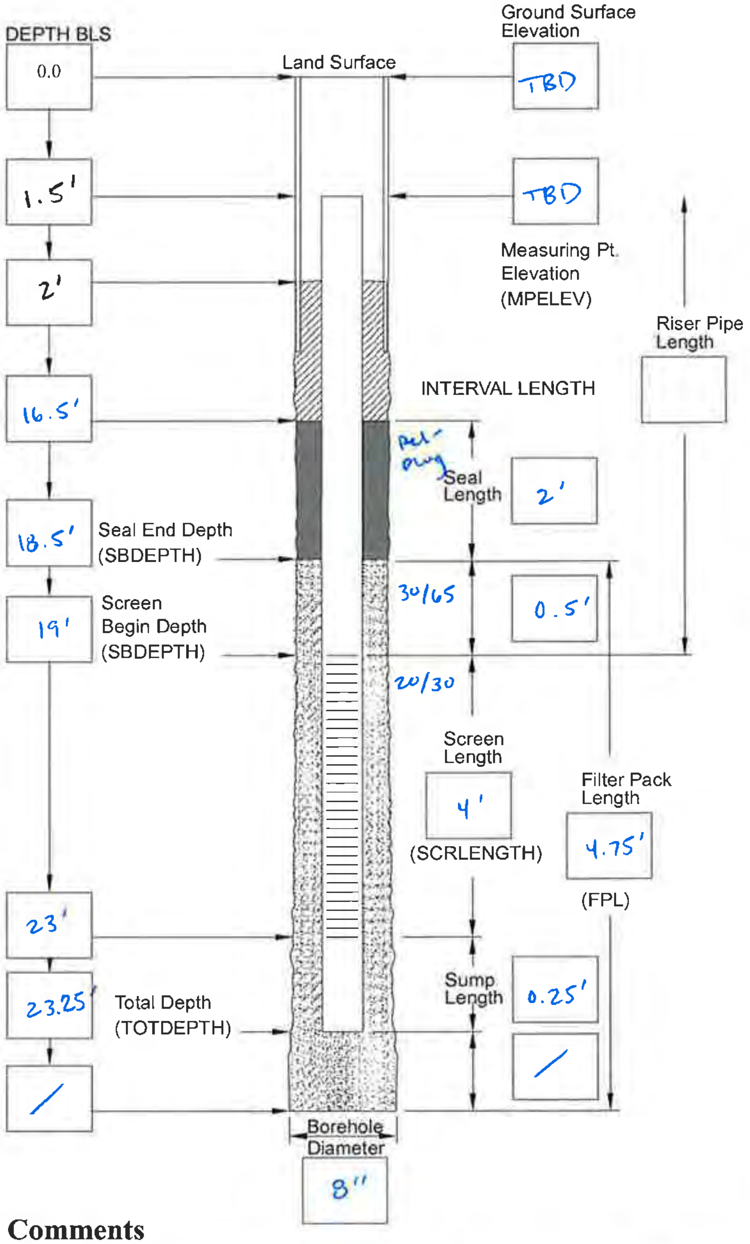
10/20/14 16:00 Development continues. ~10 gal clear.

FLWP/Forms/Field Forms/Well Construction/Well Construction Logs/well construction log-flushA.doc

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: S3
Drilling Company: EDS
Driller(s): J.R., Sean, Mitch
Geologist/[✓ Eng.]/Tech.: Bryce Zinckgraf
Signature: B Z

Site: NAS Jax
Project Number: TR0482
Installation Method: HSA
Casing Installation Date: 10/15/14
Well Type: supply
Well Completion Method: flush mount



Well Completion
Guard Posts (Y / [✓ N]) Date: 11/7/14
Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover
Diameter/Type: 2' × 2' steel vault
Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout
Composition/Proportions: portland cement type I

Placement Method: tremmie pipe

Seal Date: 10/15/14
Type: Pel-Plug Bentonite Pellets
Source: 5 gal bucket
Set-up/Hydration Time: 30 min
Placement Method: direct pour
Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack
Type: 20/30 silica sand; 30/65 silica sand
Source: 50 lb bags
Amount Used: 3 bags 20/30; 1 bag 30/65
Placement Method: tremmie pipe

Well Riser Pipe
Casing Material: schedule 40 PVC
Casing Inside Diameters: 4 in.

Screen
Material: schedule 40 PVC
Inside Diameter: 4 in.
Screen Slot Size:: 0.010 in.
Percent Open Area: 0
Sump or Bottom Cap ([✓ Y] / N)
Type/Length: cap / 0.25'

Total Water Volume During Construction
Introduced (Gal): 0 Recovered (Gal): 0

Reviewed
By: Date:

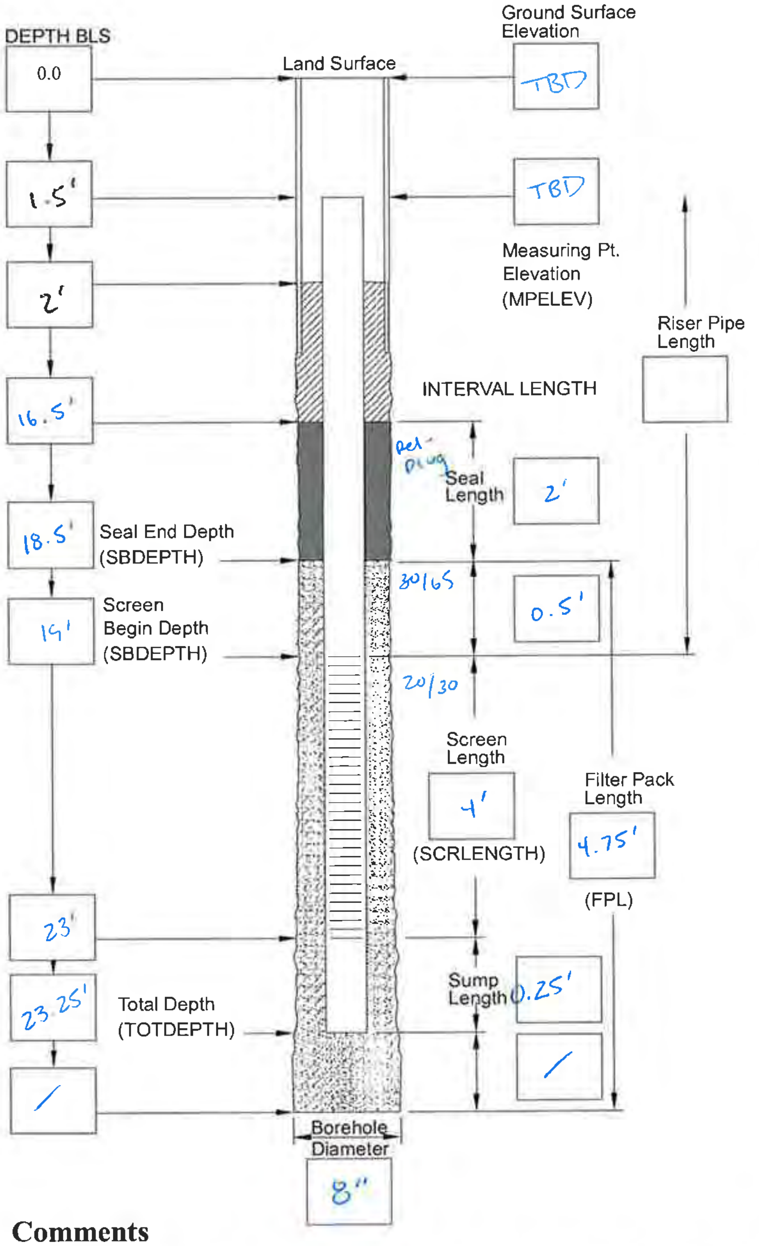
Comments

10/17/14 12:45 Development begins. ~10 gal, milky brown to light brown, then goes dry
10/20/14 15:49 Development continues. ~10 gal, light brown to clear.

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: S4
Drilling Company: EDS
Driller(s): J.R., Mitch, Sean
Geologist/Eng./Tech.: Bryce Zinckgraf
Signature: B ZZf

Site: NAS Jax
Project Number: TR0482
Installation Method: HSA
Casing Installation Date: 10/16/14
Well Type: supply
Well Completion Method: flush mount



Well Completion

Guard Posts (Y / [✓ N]) Date: 11/7/14
Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover

Diameter/Type: 2' x 2' steel vault
Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout

Composition/Proportions: portland cement type 1

Placement Method: tremmie pipe

Seal

Date: 10/16/14
Type: Pel-Plug Bentonite Pellets
Source: 5 gal bucket
Set-up/Hydration Time: 30 min
Placement Method: direct pour
Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack

Type: 20/30 silica sand; 30/65 silica sand
Source: 50 lb bags
Amount Used: 3 bags 20/30; 1 bag 30/65
Placement Method: tremmie pipe

Well Riser Pipe

Casing Material: schedule 40 PVC
Casing Inside Diameters: 4 in.

Screen

Material: schedule 40 PVC
Inside Diameter: 4 in.
Screen Slot Size:: 0.010 in.
Percent Open Area: 0
Sump or Bottom Cap ([✓ Y] / N)
Type/Length: cap / 0.25'

Total Water Volume During Construction

Introduced (Gal): 0 Recovered (Gal): 0

Reviewed

By: Date:

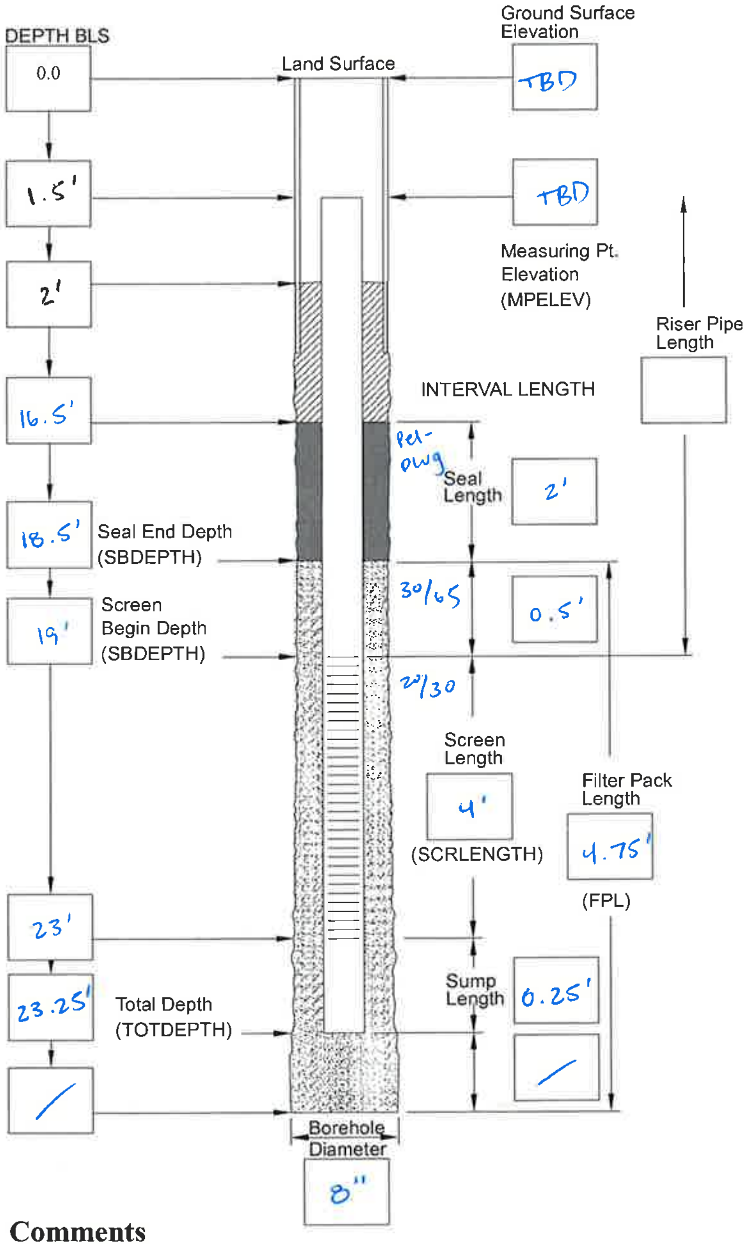
Comments

10/17/14 10:55 Development begins. ~15 gal, milky brown to light brown, then goes dry
10/20/14 14:30 Development continues. ~10 gal, light brown to clear. Development ends.

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: S5
Drilling Company: EDS
Driller(s): J.R., Mitch, Sean
Geologist/[✓ Eng.]/Tech.: Bryce Zinckgraf
Signature: Bz Zgf

Site: NAS Tax
Project Number: TR0482
Installation Method: HSA
Casing Installation Date: 10/15/14
Well Type: supply
Well Completion Method: flush mount



Well Completion

Guard Posts (Y / [✓ N]) Date: 11/7/14

Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover

Diameter/Type: 2' x 2' steel vault

Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout

Composition/Proportions: portland cement type I

Placement Method: tremmie pipe

Seal Date: 10/15/14

Type: Pel-Plug Bentonite Pellets

Source: 5 gal buckets

Set-up/Hydration Time: 30 min

Placement Method: direct pour

Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack

Type: 20/30 silica sand; 30/65 silica sand

Source: 50 lb bag

Amount Used: 3 bags 20/30; 1 bag 30/65

Placement Method: tremmie pipe

Well Riser Pipe

Casing Material: schedule 40 PVC

Casing Inside Diameters: 4 in.

Screen

Material: schedule 40 PVC

Inside Diameter: 4 in.

Screen Slot Size:: 0.010 in.

Percent Open Area: 0

Sump or Bottom Cap ([✓ Y] / N)

Type/Length: cap / 0.25'

Total Water Volume During Construction

Introduced (Gal): 0 Recovered (Gal): 0

Reviewed

By: Date:

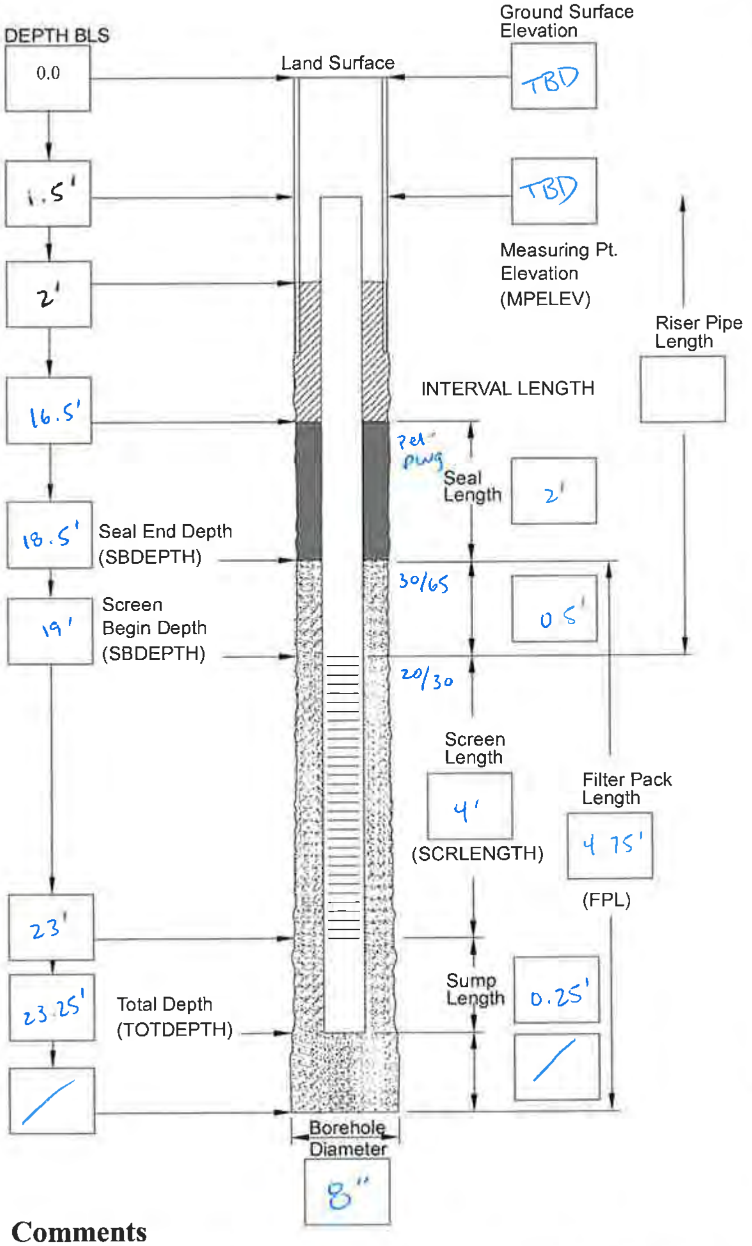
Comments

10/17/14 11:23 Development begins. ~12 gal, milky brown to light brown, then goes dry
10/20/14 15:12 Development continues. ~ 10 gal, light brown to clear. Development ends.

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: S6
Drilling Company: EDS
Driller(s): J.R., Mitch, Sean
Geologist/Eng./Tech.: Bryce Zinckgraf
Signature: Bryce Zgf

Site: NAS Jax
Project Number: TR0482
Installation Method: HSA
Casing Installation Date: 10/16/14
Well Type: supply
Well Completion Method: flush mount



Well Completion

Guard Posts (Y / [✓ N]) Date: 11/7/14
Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover

Diameter/Type: 2' x 2' steel vault
Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout

Composition/Proportions: portland cement type I

Placement Method: tremmie pipe

Seal

Date: 10/16/14
Type: Pel-Plug Bentonite Pellets
Source: 5 gal bucket
Set-up/Hydration Time: 30 min
Placement Method: direct pour
Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack

Type: 20/30 silica sand, 30/65 silica sand
Source: 50 lb bags
Amount Used: 3 bags 20/30; 1 bag 30/65
Placement Method: tremmie pipe

Well Riser Pipe

Casing Material: schedule 40 PVC
Casing Inside Diameters: 4 in.

Screen

Material: schedule 40 PVC
Inside Diameter: 4 in.
Screen Slot Size:: 0.010 in.
Percent Open Area: 0
Sump or Bottom Cap ([✓ Y] / N)
Type/Length: ~~cap~~ 32 cap / 0.25'

Total Water Volume During Construction

Introduced (Gal): 0 Recovered (Gal): 0

Reviewed

By: Date:

Comments

10/17/14 10:32 Development begins. ~12 gals, milky brown to light brown then goes dry
10/20/14 13:46 Development continues. ~15 gal, light brown to clear. Development ends.

FLWP/Forms/Field Forms/Well Construction/Well Construction Logs/well construction log-flushA.doc

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: S7

Drilling Company: EDS

Driller(s): J.R., Mitch, Sean

Geologist/[✓ Eng.]/Tech.: Bryce Zindgraf

Signature:

Site: NAS Jax

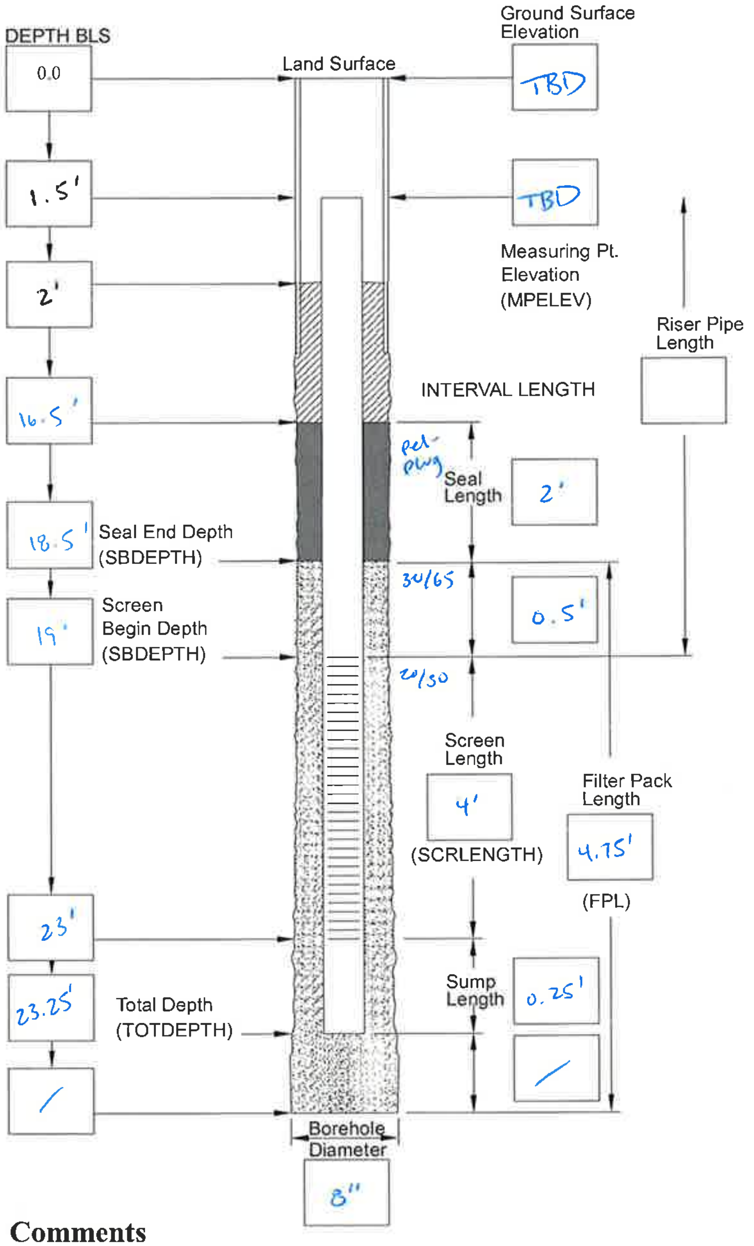
Project Number: TR0482

Installation Method: HSA

Casing Installation Date: 10/16/14

Well Type: supply

Well Completion Method: flush mount



Well Completion

Guard Posts (Y / [✓ N]) Date: 11/7/14

Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover

Diameter/Type: 2' x 2' steel vault

Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout

Composition/Proportions: portland cement type I

Placement Method: tremmie pipe

Seal

Date: 10/16/14

Type: Pel - Plug Bentonite Pellets

Source: 5 gal bucket

Set-up/Hydration Time: 30 min

Placement Method: direct pour

Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack

Type: 20/30 silica sand; 30/65 silica sand

Source: 50 lb bags

Amount Used: 3 bags 20/30; 1 bag 30/65

Placement Method: tremmie pipe

Well Riser Pipe

Casing Material: schedule 40 PVC

Casing Inside Diameters: 4 in.

Screen

Material: schedule 40 PVC

Inside Diameter: 4 in.

Screen Slot Size:: 0.010 in.

Percent Open Area: 0

Sump or Bottom Cap ([✓ Y] / N)

Type/Length: cap / 0.25'

Total Water Volume During Construction

Introduced (Gal): 0 Recovered (Gal): 0

Reviewed

By: Date:

Comments

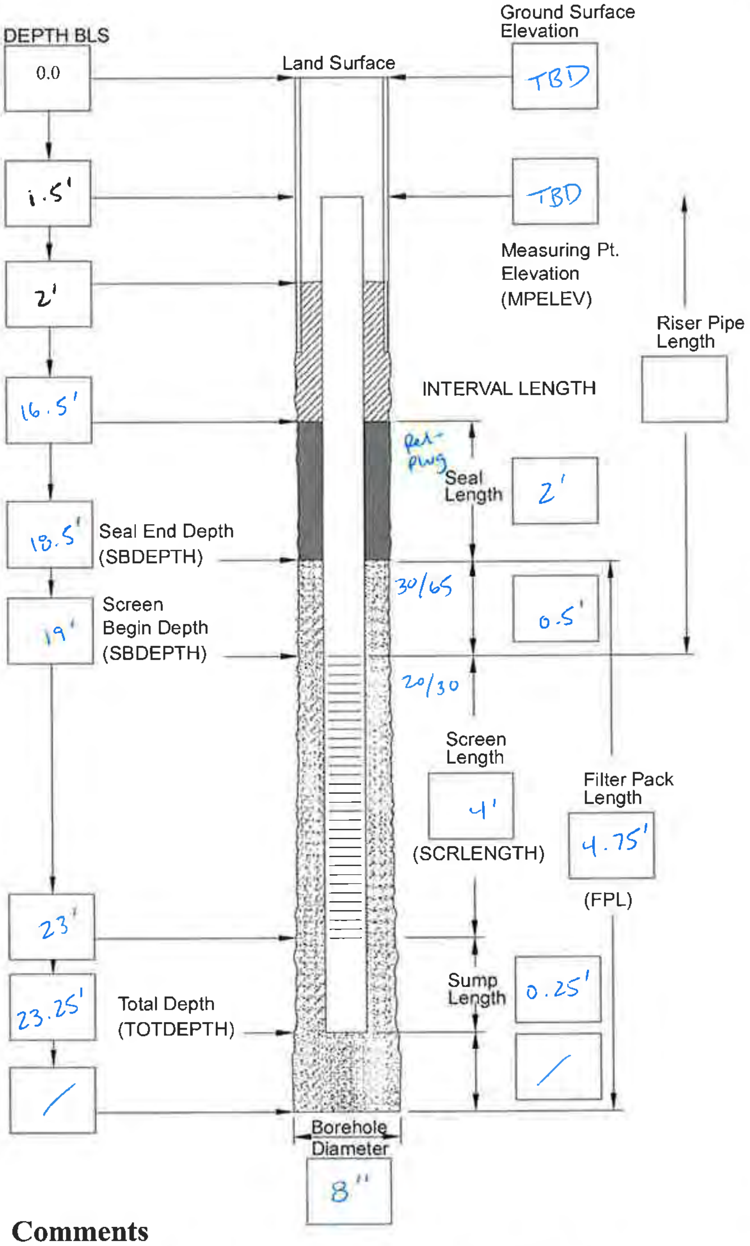
10/17/14 10:10 Development begins. ~12 gal, dark milky brown to clear, then goes dry

10/20/14 13:25 Development continues. ~15 gal, brown to clear, then goes dry. Development ends.

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: SB
Drilling Company: EDS
Driller(s): J.R., Mitch, Sean
Geologist/Eng./Tech.: Bryce Zinckgraf
Signature: B Z

Site: NAS Jax
Project Number: TR0482
Installation Method: HSA
Casing Installation Date: 10/16/14
Well Type: supply
Well Completion Method: flush mount



Well Completion

Guard Posts (Y / [✓ N]) Date: 11/7/14
Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover

Diameter/Type: 2' x 2' steel vault
Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout

Composition/Proportions: portland cement type I

Placement Method: tremmie pipe

Seal Date: 10/16/14

Type: Pel-Plug Bentonite Seal
Source: 5 gal bucket
Set-up/Hydration Time: 30 min
Placement Method: direct pour
Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack

Type: 20/30 silica sand; 30/65 silica sand
Source: 50 lb bags
Amount Used: 3 bags 20/30; 1 bag 30/65
Placement Method: tremmie pipe

Well Riser Pipe

Casing Material: schedule 40 PVC
Casing Inside Diameters: 4 in.

Screen

Material: schedule 40 PVC
Inside Diameter: 4 in.
Screen Slot Size:: 0.010 in.
Percent Open Area: 0
Sump or Bottom Cap ([✓ Y] / N)
Type/Length: cap / 0.25'

Total Water Volume During Construction

Introduced (Gal): 0 Recovered (Gal): 0

Reviewed

By: ______ Date: ______

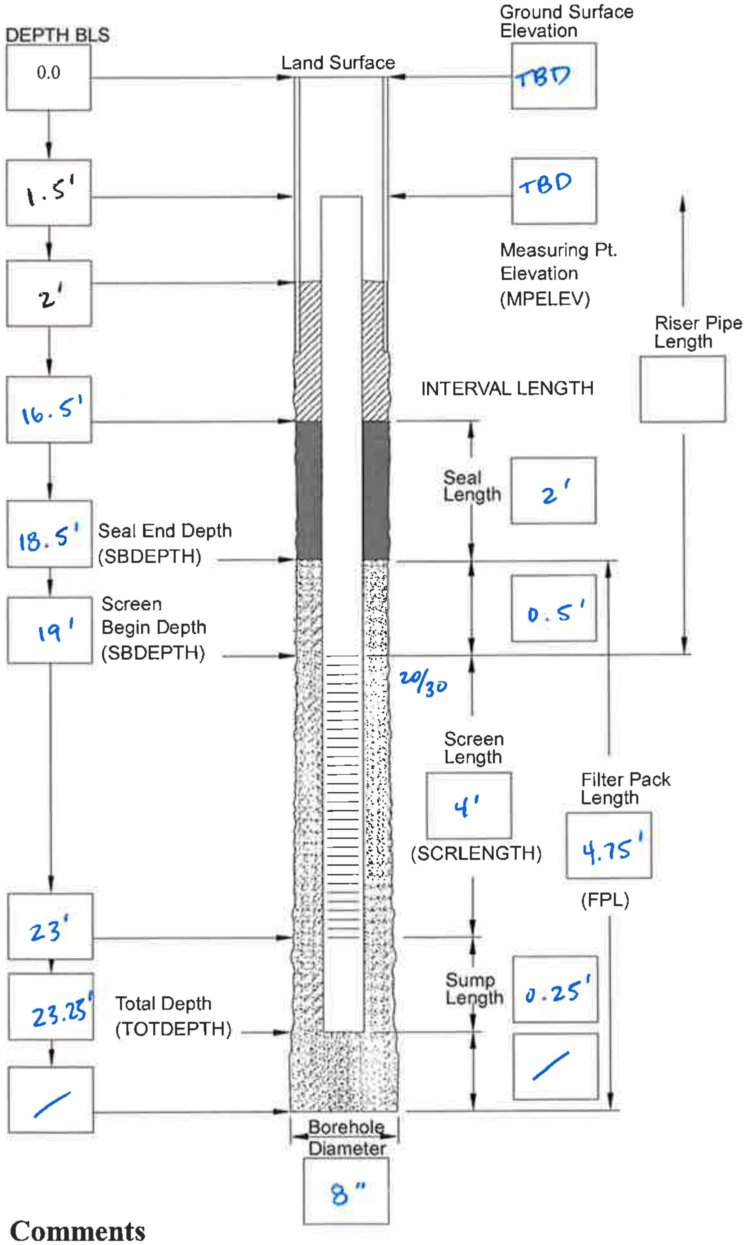
Comments

10/17/14 09:55 Developments begins w/ submersible. ~15 gal pumped, milky brown to clear, then goes dry.
10/20/14 17:08 Development continues. ~10 gal, light brown to clear

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: E1
Drilling Company: EDS
Driller(s): J.R., Mitch, Sean
Geologist/~~Eng~~./Tech.: Bryce Zinckgraf
Signature:

Site: NAS Jax
Project Number: TR0482
Installation Method: HSA
Casing Installation Date: 10/14/14
Well Type: electrode
Well Completion Method: flush mount



Ground Surface Elevation: TBD
Measuring Pt. Elevation (MPELEV): TBD
1.5'
2'
16.5'
Seal End Depth (SBDEPTH): 18.5'
Screen Begin Depth (SBDEPTH): 19'
23'
Total Depth (TOTDEPTH): 23.25'
Seal Length: 2'
0.5'
Screen Length (SCRLENGTH): 4'
Filter Pack Length (FPL): 4.75'
Sump Length: 0.25'
Borehole Diameter: 8"

Well Completion
Guard Posts (Y [✓ N]) Date: 11/7/14
Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover
Diameter/Type: 2' x 2' steel vault
Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout
Composition/Proportions: portland cement type I
Placement Method: tremmie pipe

Seal Date: 10/14/14
Type: Pel-Plug Bentonite pellets
Source: 5 gal bucket
Set-up/Hydration Time: 30 min
Placement Method: direct pour
Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack
Type: 20/30 silica sand; 30/65 silica sand
Source: 50 lb bags
Amount Used: 3 bags 20/30; 1 bag 30/65
Placement Method: tremmie pipe

Well Riser Pipe
Casing Material: schedule 40 PVC
Casing Inside Diameters: 4 in.

Screen
Material: schedule 40 PVC
Inside Diameter: 4 in.
Screen Slot Size:: 0.010 in.
Percent Open Area: 0
Sump or Bottom Cap ([✓ Y] / N)
Type/Length: cap / 0.25'

Total Water Volume During Construction
Introduced (Gal): 0 Recovered (Gal): 0

Reviewed
By: Date:

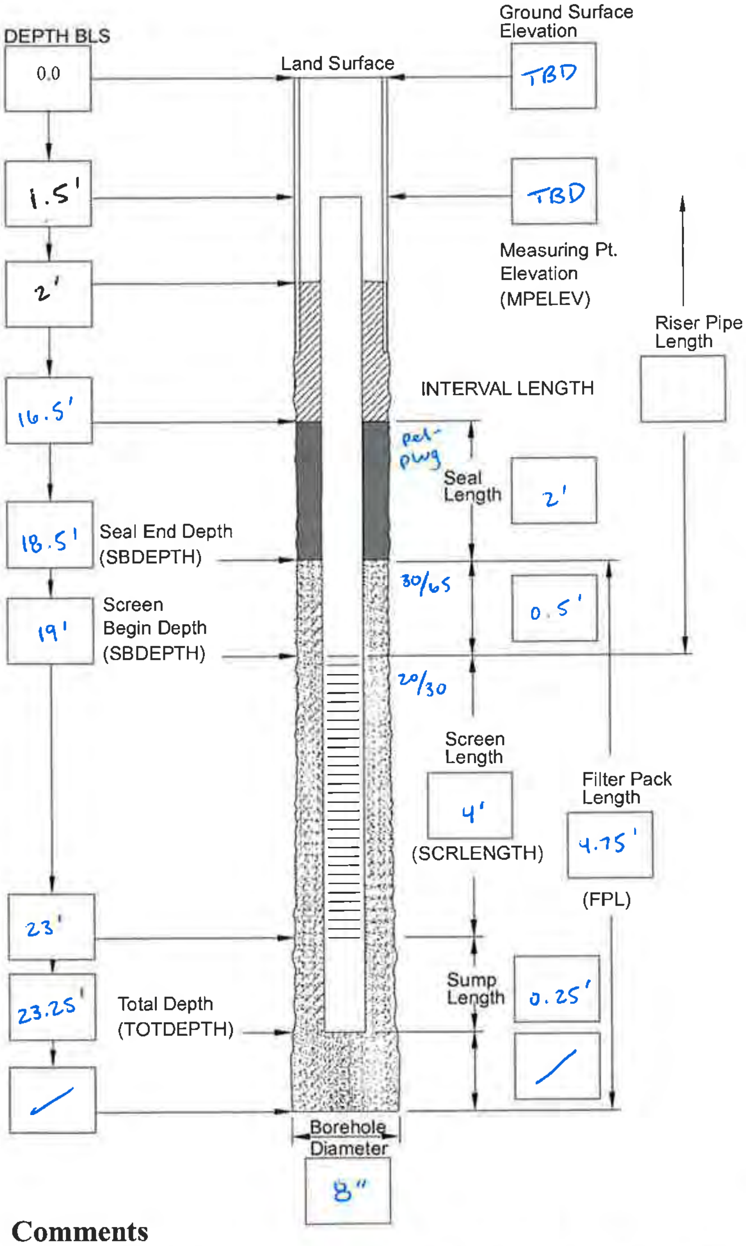
Comments

10/17/14 14:50 Development begins. ~20 gal milky brown to clear. Development ends.

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: E2
Drilling Company: EDS
Driller(s): J.R., Sean, Mitch
Geologist/~~Eng~~./Tech.: Bryce Zinckgraf
Signature:

Site: NAS Jax
Project Number: TR0482
Installation Method: HSA
Casing Installation Date: 10/14/14
Well Type: Electrode
Well Completion Method: flush mount



Well Completion
Guard Posts (Y / [✓ N]) Date: 11/7/14
Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover
Diameter/Type: 2' x 2' steel vault
Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout
Composition/Proportions: portland cement type I
Placement Method: tremmie pipe

Seal Date: 10/14/14
Type: Pel-Plug Bentonite Pellets
Source: 5 gal bucket
Set-up/Hydration Time: 30 min
Placement Method: direct pour
Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack
Type: 20/30 silica sand; 30/65 silica sand
Source: 50 lb bags
Amount Used: 4 bags 20/30; 1 bag 30/65
Placement Method: tremmie pipe

Well Riser Pipe
Casing Material: schedule 40 PVC
Casing Inside Diameters: 4 in.

Screen
Material: schedule 40 PVC
Inside Diameter: 4 in.
Screen Slot Size:: 0.010 in.
Percent Open Area: 0
Sump or Bottom Cap ([✓ Y] / N)
Type/Length: cap / 0.25'

Total Water Volume During Construction
Introduced (Gal): 0 Recovered (Gal): 0

Reviewed
By: Date:

Comments

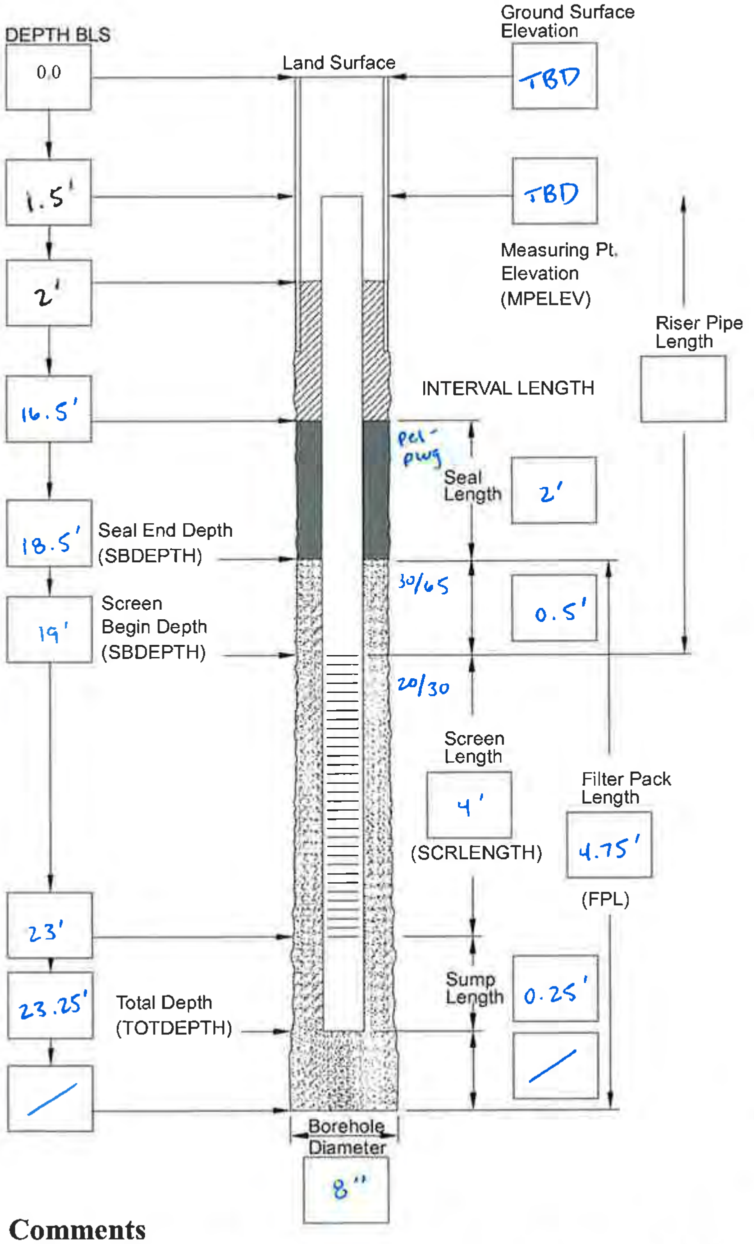
10/17/14 14:27 Development begins. ~15 gal, milky brown to clear then goes dry.

10/20/14 16:32 Development continues. ~10 gal, clear

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: E3
Drilling Company: EDS
Driller(s): J.R., Mitch, Sean
Geologist/[✓ Eng.]/Tech.: Bryce Zinckgraf
Signature:

Site: NAS Jax
Project Number: TR0482
Installation Method: HSA
Casing Installation Date: 10/14/14
Well Type: Electrode
Well Completion Method: flush mount



Well Completion

Guard Posts (Y / [✓ N]) Date: 11/7/14
Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover

Diameter/Type: 2' × 2' steel vault
Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout

Composition/Proportions: portland cement type 1
Placement Method: tremmie pipe

Seal Date: 10/14/14

Type: Pel Plug Bentonite Pellets
Source: 5 gal bucket
Set-up/Hydration Time: 30 min
Placement Method: direct pour
Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack

Type: 20/30 silica sand; 30/65 silica sand
Source: 50 lb bags
Amount Used: 4 bags 20/30, 1 bag 30/65
Placement Method: tremmie pipe

Well Riser Pipe

Casing Material: schedule 40 PVC
Casing Inside Diameters: 4 in.

Screen

Material: Schedule 40 PVC
Inside Diameter: 4 in.
Screen Slot Size:: 0.010 in.
Percent Open Area: 0
Sump or Bottom Cap ([✓ Y] / N)
Type/Length: cap / 0.25'

Total Water Volume During Construction

Introduced (Gal): 0 Recovered (Gal): 0

Reviewed

By: Date:

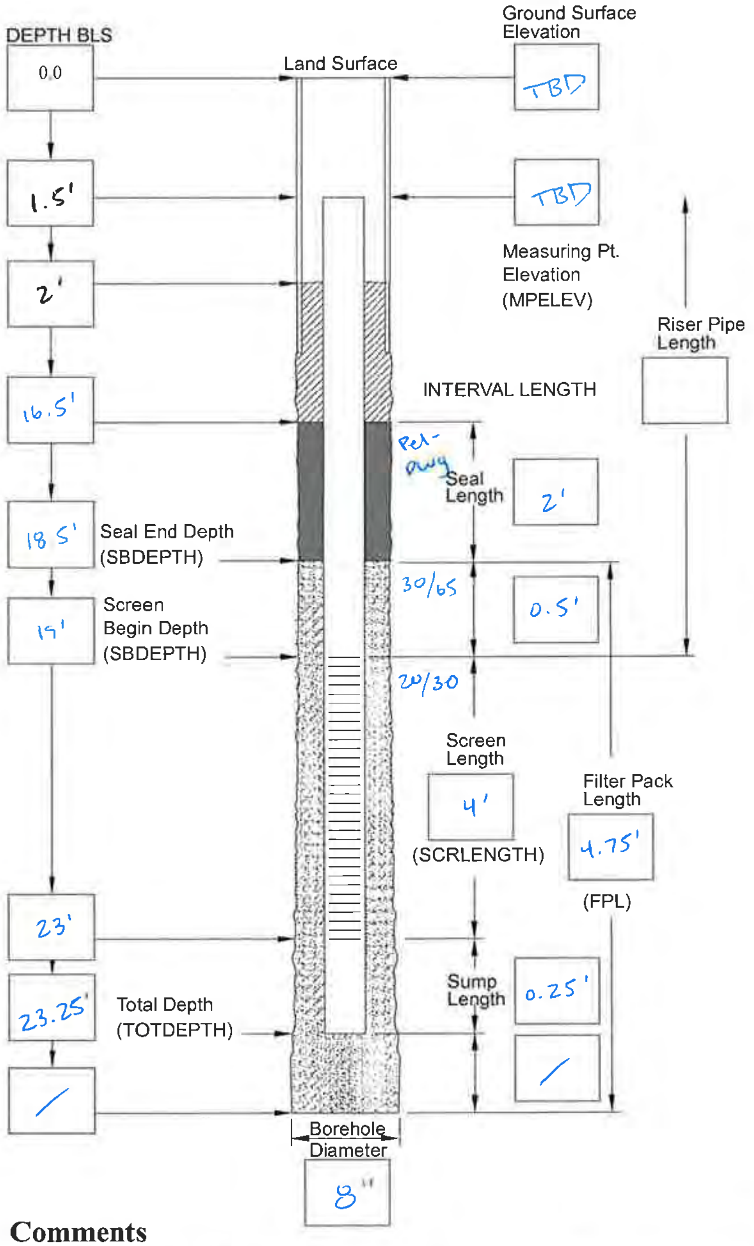
Comments

10/17/14 14:05 Development begins. ~22 gal milky brown to clear. Development ends.

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: E4
Drilling Company: EDS
Driller(s): J R. Mitch, Sean
Geologist/[✓ Eng.]/Tech.: Bryce Zinckgraf
Signature: Bryce Zgf

Site: NAS Jax
Project Number: TR0487
Installation Method: HSA
Casing Installation Date: 10/16/14
Well Type: electrode
Well Completion Method: flush mount



Well Completion

Guard Posts (Y / [✓ N]) Date: 11/7/14

Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover

Diameter/Type: 2' x 2' steel vault

Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout

Composition/Proportions: portland cement type I

Placement Method: tremmie pipe

Seal Date: 10/16/14

Type: Pel-Plug Bentonite Pellets

Source: 5 gal bucket

Set-up/Hydration Time: 30 min

Placement Method: direct pour

Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack

Type: 20/30 silica sand; 30/65 silica sand

Source: 50 lb bags

Amount Used: 3 bags 20/30; 1 bag 30/65

Placement Method: tremmie pipe

Well Riser Pipe

Casing Material: schedule 40 PVC

Casing Inside Diameters: 4 in.

Screen

Material: schedule 40 PVC

Inside Diameter: 4 in.

Screen Slot Size:: 0.010 in.

Percent Open Area: 0

Sump or Bottom Cap ([✓ Y] / N)

Type/Length: cap / 0.25'

Total Water Volume During Construction

Introduced (Gal): 0 Recovered (Gal): 0

Reviewed

By: Date:

Comments

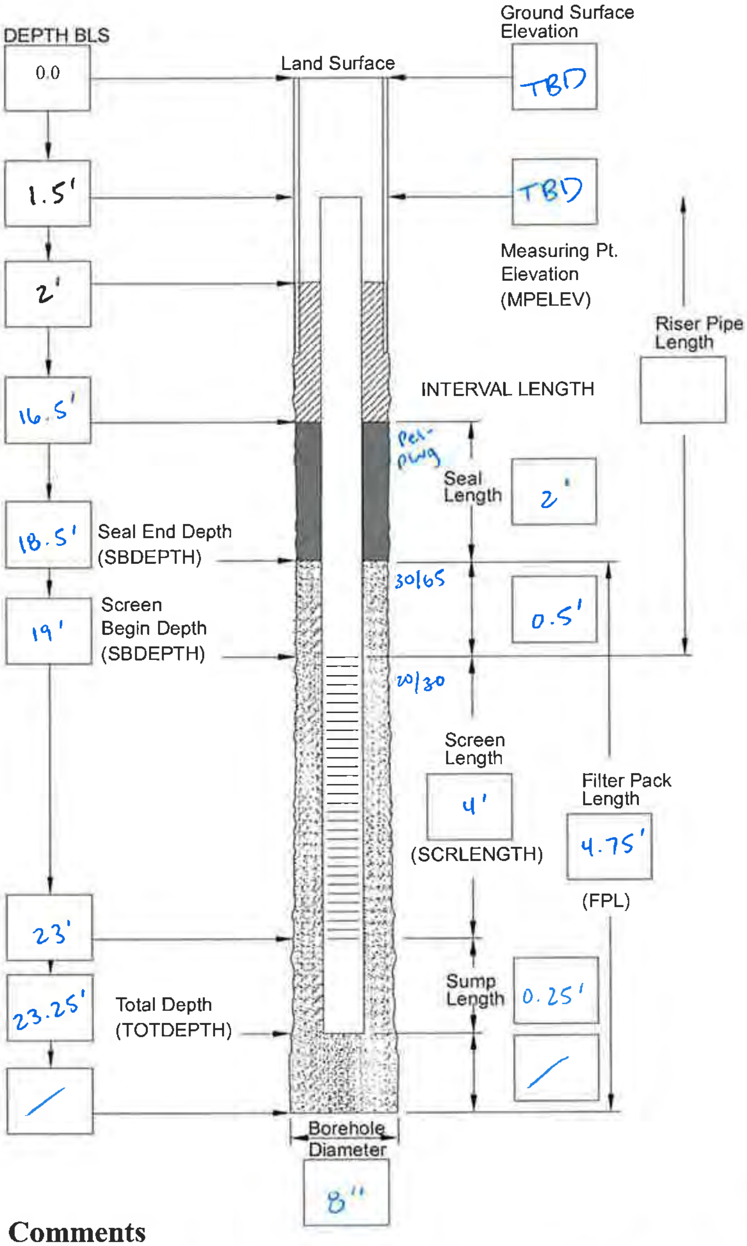
10/17/14 10:45 Development begins. ~ 8 gal milky brown then goes dry

10/20/14 14:05 Development continues. ~ 15 gal. light brown to clear. Development ends.

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: E5
Drilling Company: EDS
Driller(s): J.R., Mitch, Sean
Geologist/Eng./Tech.: Bryce Zinckgraf
Signature: B Z

Site: NAS Jax
Project Number: TR0482
Installation Method: HSA
Casing Installation Date: 10/16/14
Well Type: electrode
Well Completion Method: flush mount



Well Completion

Guard Posts (Y / [✓ N]) Date: 11/7/14
Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover

Diameter/Type: 2' x 2' steel vault
Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout

Composition/Proportions: portland cement type I

Placement Method: tremmie pipe

Seal

Date: 10/16/14
Type: Pel-Plug Bentonite Pellets
Source: 5 gal buckets
Set-up/Hydration Time: 30 min
Placement Method: direct pour
Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack

Type: 20/30 silica sand; 30/65 silica sand
Source: 50 lb bags
Amount Used: 3 bags 20/30; 1 bag 30/65
Placement Method: tremmie pipe

Well Riser Pipe

Casing Material: schedule 40 PVC
Casing Inside Diameters: 4 in.

Screen

Material: schedule 40 PVC
Inside Diameter: 4 in.
Screen Slot Size:: 0.010 in.
Percent Open Area: 0
Sump or Bottom Cap ([✓ Y] / N)
Type/Length: cap / 0.25'

Total Water Volume During Construction

Introduced (Gal): 0 Recovered (Gal): 0

Reviewed

By: Date:

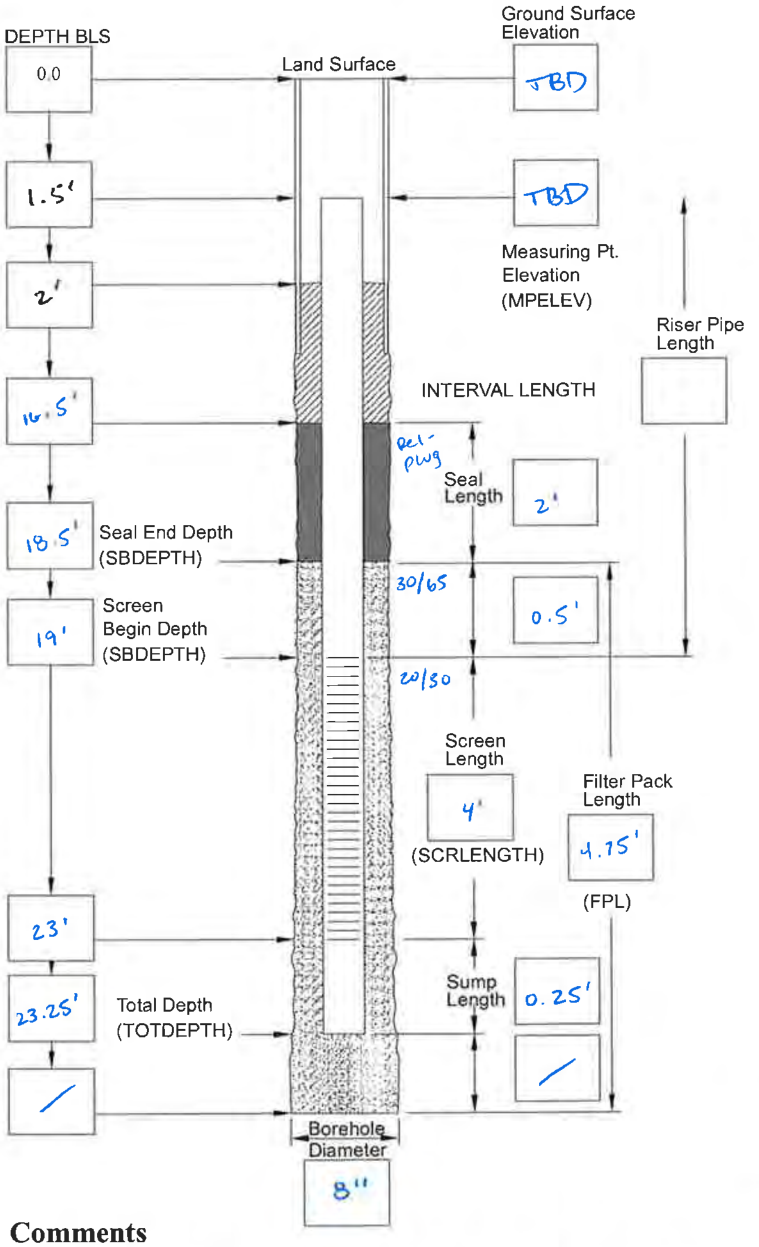
Comments

10/17/14 11:12 Development begins. ~ 8 gal milky brown to light brown, then dry
10/20/14 14:48 Development continues. ~15 gal light brown to clear, Development ends.

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: E6
Drilling Company: EDS
Driller(s): J.R., Mitch, Sean
Geologist/Eng./Tech.: Bryce Zinckgraf
Signature:

Site: NAS Jax
Project Number: TR0482
Installation Method: HSA
Casing Installation Date: 10/15/14
Well Type: electrode
Well Completion Method: flush mount



Well Completion

Guard Posts (Y / [✓ N]) Date: 11/7/14
Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover

Diameter/Type: 2' × 2' steel vault
Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout

Composition/Proportions: portland cement type I

Placement Method: trennie pipe

Seal

Date: 10/15/14
Type: Pel-Plug Bentonite Pellets
Source: 5 gal bucket
Set-up/Hydration Time: 30 min
Placement Method: direct pour
Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack

Type: 20/30 silica sand; 30/65 silica sand
Source: 50 lb bags
Amount Used:
Placement Method: tremmie pipe

Well Riser Pipe

Casing Material: schedule 40 PVC
Casing Inside Diameters: 4 in.

Screen

Material: schedule 40 PVC
Inside Diameter: 4 in.
Screen Slot Size:: 0.010 in.
Percent Open Area: 0
Sump or Bottom Cap ([✓ Y] / N)
Type/Length: cap / 0.25'

Total Water Volume During Construction

Introduced (Gal): 0 Recovered (Gal): 0

Reviewed

By: Date:

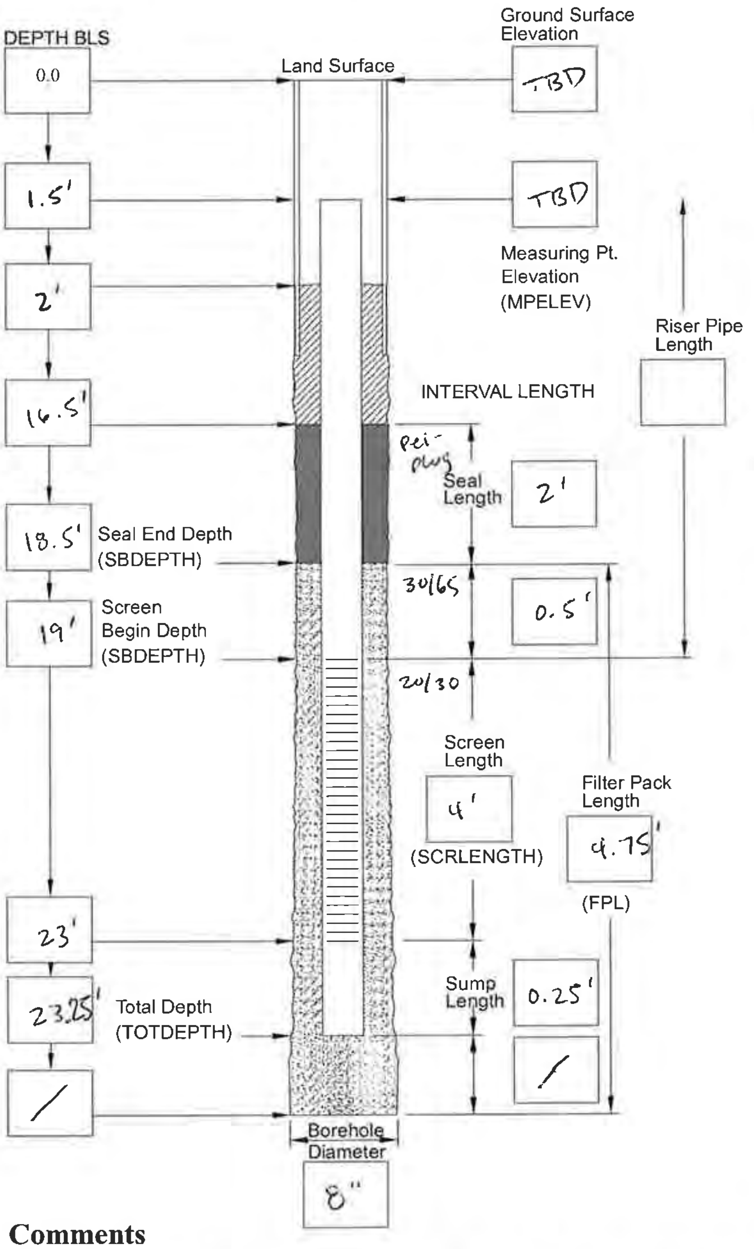
Comments

10/17/14 11:44 Development begins. ~ 8 gal, milky brown to light brown, then goes dry.
10/20/14 15:25 Development continues. ~ 20 gal, light brown to clear.

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: E7
Drilling Company: EDS
Driller(s): J.R., Mitch, Sean
Geologist/[✓ Eng.]/Tech.: Bryce Zinckgraf
Signature:

Site: NAS Jax
Project Number: TR0482
Installation Method: HSA
Casing Installation Date: 10/17/14
Well Type: electrode
Well Completion Method: flush mount



Depth BLS: 0.0 — Ground Surface Elevation: TBD
1.5' — Measuring Pt. Elevation (MPELEV): TBD
2'
16.5'
18.5' — Seal End Depth (SBDEPTH)
19' — Screen Begin Depth (SBDEPTH)
23'
23.25' — Total Depth (TOTDEPTH)
/
Riser Pipe Length:
Pel-plug Seal Length: 2'
30/65: 0.5'
20/30
Screen Length: 4' (SCRLENGTH)
Filter Pack Length: 4.75' (FPL)
Sump Length: 0.25'
/
Borehole Diameter: 8"

Well Completion
Guard Posts (Y / [✓ N]) Date: 11/7/14
Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover
Diameter/Type: 2' × 2' steel vault
Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout
Composition/Proportions: portland cement type 1

Placement Method: tremmie pipe

Seal
Date: 10/17/14
Type: Pel-Plug Bentonite Pellets
Source: 5 gal buckets
Set-up/Hydration Time: 30 min
Placement Method: direct pour
Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack
Type: 20/30 silica sand; 30/65 silica sand
Source: 50 lb bags
Amount Used: 3 bags 20/30; 1 bag 30/65
Placement Method: tremmie pipe

Well Riser Pipe
Casing Material: schedule 40 PVC
Casing Inside Diameters: 4 in.

Screen
Material: schedule 40 PVC
Inside Diameter: 4 in.
Screen Slot Size:: 0.010 in.
Percent Open Area: 0
Sump or Bottom Cap ([✓ Y] / N)
Type/Length: cap / 0.25'

Total Water Volume During Construction
Introduced (Gal): 0 Recovered (Gal): 0

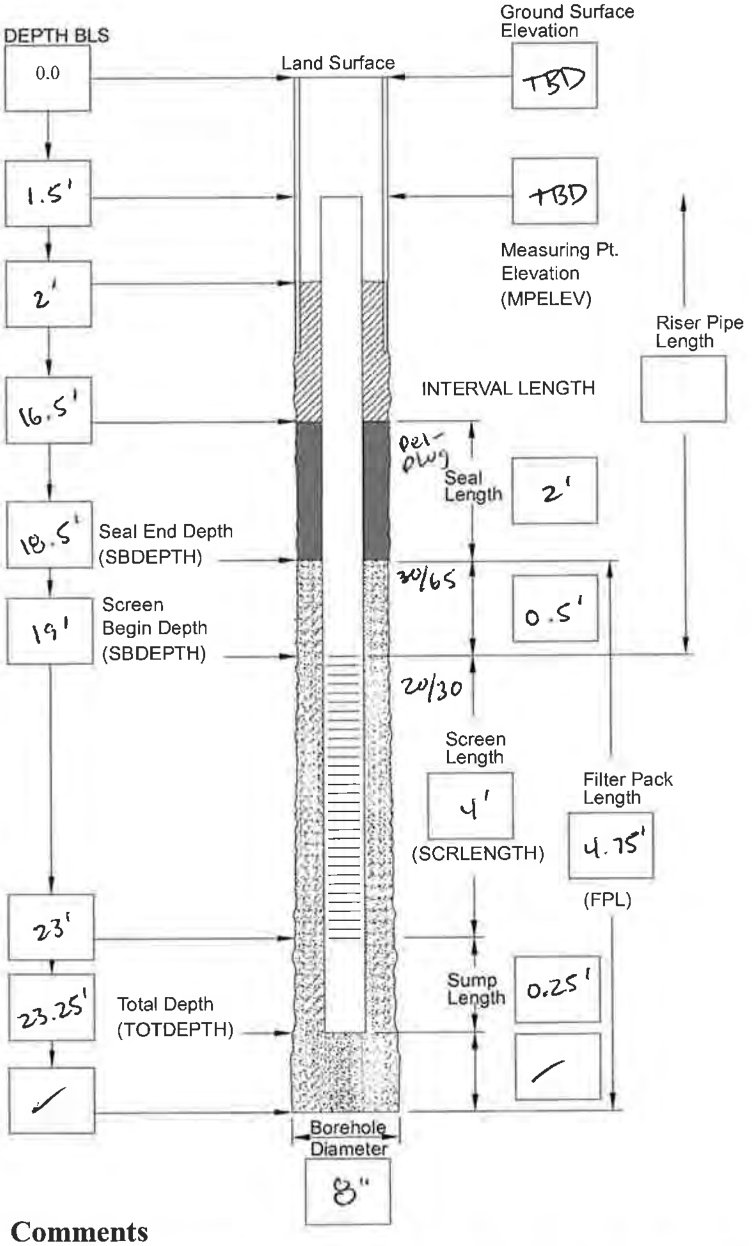
Reviewed
By: Date:

Comments
10/20/14 11:42 Development begins. ~20 gal milky brown to light brown, then goes dry
10/20/14 16:57 Development continues. ~7 gal, clear

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: F8
Drilling Company: EDS
Driller(s): J.R., Mitch, Sean
Geologist/[✓ Eng]/Tech.: Bryce Zinckgraf
Signature:

Site: NAS Jax
Project Number: TR0482
Installation Method: HSA
Casing Installation Date: 10/17/14
Well Type: electrode
Well Completion Method: flush mount



Well Completion

Guard Posts (Y / [✓ N]) Date: 11/17/14

Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover

Diameter/Type: 2' x 2' steel vault

Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout

Composition/Proportions: portland cement type I

Placement Method: tremmie pipe

Seal Date: 10/17/14

Type: Pel-Plug Bentonite pellets

Source: 5 gal bucket

Set-up/Hydration Time: 30 min

Placement Method: direct pour

Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack

Type: 20/30 silica sand; 30/65 silica sand

Source: 50 lb bags

Amount Used: 3 bags 20/30; 1 bag 30/65

Placement Method: tremmie pipe

Well Riser Pipe

Casing Material: schedule 40 PVC

Casing Inside Diameters: 4 in.

Screen

Material: schedule 40 PVC

Inside Diameter: 4 in.

Screen Slot Size:: 0.010 in.

Percent Open Area: 0

Sump or Bottom Cap ([✓ Y] / N)

Type/Length: cap / 0.25'

Total Water Volume During Construction

Introduced (Gal): 0 Recovered (Gal): 0

Reviewed

By: Date:

Comments

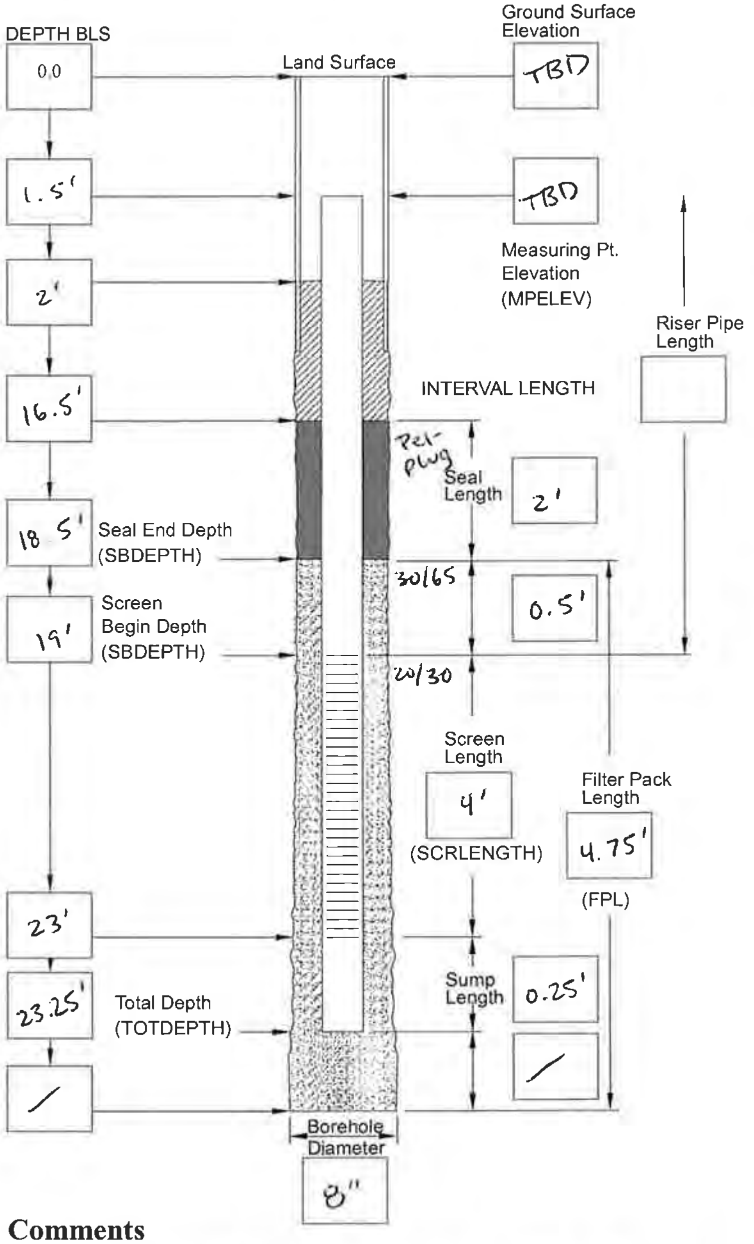
10/20/14 11:15 Development begins. ~15 gal pumped; milky brown to light brown; then goes dry

10/20/14 16:54 Development continues. ~7 gal pumped; light brown to clear; then dry

WELL CONSTRUCTION LOG
STANDARD FLUSH MOUNT

Well I.D.: E9
Drilling Company: EDS
Driller(s): J.R., Sean, Mitch
Geologist/[✓ Eng]/Tech.: Bryce Zinchuk F
Signature:

Site: NAS Jax
Project Number: TR0482
Installation Method: HSA
Casing Installation Date: 10/17/14
Well Type: electrode
Well Completion Method: flush mount



Well Completion
Guard Posts (Y / [✓ N]) Date: 11/7/14
Surface Pad Size: 3 ft x 3 ft

Protective Casing or Cover
Diameter/Type: 2' × 2' steel vault
Depth BGS: 2' Weep Hole (Y / [✓ N])

Grout
Composition/Proportions: portland cement type I

Placement Method: tremmie pipe

Seal
Date: 10/17/14
Type: Pel-Plug Bentonite Pellets
Source: 5 gal bucket
Set-up/Hydration Time: 30 min
Placement Method: direct pour
Vol. Fluid Added: no fluid added due to existing water in borehole

Filter Pack
Type: 20/30 silica sand; 30/65 silica sand
Source: 50 lb bags
Amount Used: 3 bags 20/30; 1 bag 30/65
Placement Method: tremmie pipe

Well Riser Pipe
Casing Material: Schedule 40 PVC
Casing Inside Diameters: 4 in.

Screen
Material: schedule 40 PVC
Inside Diameter: 4 in.
Screen Slot Size:: 0.010 in.
Percent Open Area: 0
Sump or Bottom Cap ([✓ Y] / N)
Type/Length: cap / 0.25'

Total Water Volume During Construction
Introduced (Gal): 0 Recovered (Gal): 0

Reviewed
By: Date:

Comments

10/20/14 10:45 Development begins. ~15 gal, milky brown to light brown, then goes dry
10/20/14 16:36 Development continues. ~8 gal, light brown to clear, then goes dry

FLWP/Forms/Field Forms/Well Construction/Well Construction Logs/well construction log-flushA.doc

Page Intentionally Left Blank

APPENDIX D GROUNDWATER SAMPLING FORMS

Page Intentionally Left Blank

0.60

Form FD 9000-24

GROUNDWATER SAMPLING LOG

SITE NAME: NAS Jax

SITE LOCATION: Jacksonville, FL

WELL NO: EKMW-01

SAMPLE ID: EKMW-01

DATE: 10/01/2014

PURGING DATA

WELL DIAMETER (inches): 2

TUBING DIAMETER (inches): 1/4

WELL SCREEN INTERVAL DEPTH: 18 feet to 23 feet

STATIC DEPTH TO WATER (feet): 4.33

PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY
(only fill out if applicable)
= (feet – feet) X gallons/foot = gallons

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= 0 gallons + (0.0026 gallons/foot X 25 feet) + 0.132 gallons = 0.20 gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 20.5

FINAL PUMP OR TUBING DEPTH IN WELL (feet): 20.5

PURGING INITIATED AT: 09:20

PURGING ENDED AT: 09:33

TOTAL VOLUME PURGED (gallons): 1.00

TIME	VOLUME PURGED (gallons)	CUMUL. VOLUME PURGED (gallons)	PURGE RATE (gpm)	DEPTH TO WATER (feet)	pH (standard units)	TEMP. (°C)	COND. (circle units) μmhos/cm or [✓ μS/cm]	DISSOLVED OXYGEN (circle units) [✓ mg/L] or % saturation	TURBIDITY (NTUs)	COLOR (describe)	ORP (mV)
09:26	0.5	0.5	0.08	6.43	4.73	27.84	10838	0.72	8.08	clear	49.4
09:29	0.25	0.75	0.08	6.60	4.78	27.80	11005	0.65	8.33	"	50.6
09:32	0.25	1.00	0.08	6.76	4.73	27.75	11157	0.57	9.75	"	53.6

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Bryce Zinckgraf / Geosyntec

SAMPLER(S) SIGNATURE(S):

SAMPLING INITIATED AT: 09:35

SAMPLING ENDED AT: 09:42

PUMP OR TUBING DEPTH IN WELL (feet): 20.5

TUBING MATERIAL CODE: PE, S

FIELD-FILTERED: Y [✓ N]
Filtration Equipment Type:

FILTER SIZE: ______ µm

FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N (replaced)]

DUPLICATE: Y [✓ N]

SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH			
EKMW-01	1	PE	1L	none	—	—	Gene Trac	APP	<100
"	2	CG	40mL	none	—	—	VFAs	APP	<100
"	3	CG	40mL	none	—	—	DHGs	APP	<100
"	1	PE	250mL	HNO_3	—	—	metals	APP	<100
"	1	PE	150mL	none	—	—	anions	APP	<100
"	1	PE	150mL	none	—	—	Iodide	APP	<100

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump;
RFPP = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.

2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

Revision Date: February 12, 2009

Form FD 9000-24

D-60

GROUNDWATER SAMPLING LOG

SITE NAME: NAS Jax
SITE LOCATION: Jacksonville, FL

WELL NO: EKMW-02
SAMPLE ID: EKMW-02
DATE: 10/01/14

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 1/4
WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet
STATIC DEPTH TO WATER (feet): 5.02
PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY
(only fill out if applicable)
= (feet – feet) X gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= 0 gallons + (0.0026 gallons/foot X 25 feet) + 0.132 gallons = 0.20 gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21
PURGING INITIATED AT: 11:50
PURGING ENDED AT: 12:05
TOTAL VOLUME PURGED (gallons): 1.00

TIME	VOLUME PURGED (gallons)	CUMUL. VOLUME PURGED (gallons)	PURGE RATE (gpm)	DEPTH TO WATER (feet)	pH (standard units)	TEMP. (^{o}C)	COND. (circle units) µmhos/cm or [✓ µS/cm]	DISSOLVED OXYGEN (circle units) [✓ mg/L] or % saturation	TURBIDITY (NTUs)	COLOR (describe)	ORP (mV)
11:58	0.50	0.50	0.06	6.51	5.79	27.75	1874	0.33	14.6	clear	-8.3
12:01	0.25	0.75	0.08	6.60	5.80	27.79	1869	0.28	11.8	"	-13.1
12:04	0.25	1.00	0.08	6.71	5.82	27.70	1883	0.21	13.6	"	-18.8

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Bryce Zinckgraf / Geosyntec
SAMPLER(S) SIGNATURE(S): Bryce Zinckgraf
SAMPLING INITIATED AT: 12:07
SAMPLING ENDED AT: 12:19

PUMP OR TUBING DEPTH IN WELL (feet): 21
TUBING MATERIAL CODE: PE, S
FIELD-FILTERED: Y [✓ N]
Filtration Equipment Type:
FILTER SIZE: _____ µm

FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N (replaced)]
DUPLICATE: Y [✓ N]

SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH			
EKMW-02	1	PE	1L	none	–	-	Gene Trac	APP	< 100
"	2	CG	40 mL	none	–	-	VFAs	"	"
"	3	CG	40 mL	HCl	–	-	VOCs	"	"
"	2	CG	40 mL	HCl	–	-	TOC	"	"
"	3	CG	40 mL	none	–	-	DHGs	"	"
"	1	PE	250 mL	HNO3	–	-	metals	"	"

REMARKS:

1	PE	150 mL	none	–	–	anions, bromide	"	"
" 1	PE	150 mL	none	–	–	iodide	"	"

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**

2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

Revision Date: February 12, 2009

0 60

Form FD 9000-24
GROUNDWATER SAMPLING LOG

SITE NAME: NAS Jax	SITE LOCATION: Jacksonville, FL

WELL NO: EKMW-03 | SAMPLE ID: EKMW-03 | DATE: 10/01/14

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 1/4	WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet	STATIC DEPTH TO WATER (feet): 3.75	PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY
(only fill out if applicable)
= (feet – feet) X gallons/foot = gallons

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= 0 gallons + (0.0026 gallons/foot X 25 feet) + 0.132 gallons = 0.20 gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21	PURGING INITIATED AT: 10:10	PURGING ENDED AT: 11:20	TOTAL VOLUME PURGED (gallons): 4.80

TIME	VOLUME PURGED (gallons)	CUMUL. VOLUME PURGED (gallons)	PURGE RATE (gpm)	DEPTH TO WATER (feet)	pH (standard units)	TEMP. (°C)	COND. (circle units) µmhos/cm or [✓ µS/cm]	DISSOLVED OXYGEN (circle units) [✓ mg/L] or % saturation	TURBIDITY (NTUs)	COLOR (describe)	ORP (mV)
10:15	0.50	0.50	0.10	6.50	5.78	27.77	1770	0.38	31.9	clear	-18.8
10:18	0.25	0.75	0.08	6.82	5.81	27.73	1781	0.29	40.2	"	-19.8
10:30	1.00	1.75	0.08	7.10	5.87	27.10	1854	0.60	173	light brown	-32.7
10:40	0.75	2.50	0.075	7.14	4.99	27.08	1811	0.22	95.7	"	17.5
10:50	0.50	3.00	0.05	7.14	5.72	26.95	1781	0.33	64.8	"	-10.4
11:05	1.00	4.00	0.067	7.03	5.78	27.11	1785	0.15	31.6	clear	-23.0
11:10	0.25	4.25	0.05	7.01	5.78	27.11	1783	0.15	29.3	"	-24.6
11:15	0.25	4.50	0.05	6.97	5.78	27.18	1783	0.15	19.6	"	-25.9
11:17	0.15	4.65	0.075	6.94	5.78	27.18	1783	0.16	18.4	"	-22.3
11:19	0.15	4.80	0.075	6.91	5.78	27.19	1782	0.16	18.3	"	-21.7

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Bryce Zinckgraf / Geosyntec	SAMPLER(S) SIGNATURE(S):	SAMPLING INITIATED AT: 11:23	SAMPLING ENDED AT: 11:35
PUMP OR TUBING DEPTH IN WELL (feet): 21	TUBING MATERIAL CODE: PE, S	FIELD-FILTERED: Y [✓ N] Filtration Equipment Type:	FILTER SIZE: ______ µm
FIELD DECONTAMINATION: PUMP ~~Y~~ [✓ N]	TUBING Y [✓ N (replaced)]	DUPLICATE: Y [✓ N]	

SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH			
EKMW-03	1	PE	1L	none	—	—	Gene Trac	APP	<100
"	2	CG	40mL	none	—	—	VFAs	APP	<100
"	3	CG	40mL	HCl	—	—	VOCs	APP	<100
"	2	CG	40mL	HCl	—	—	TOC	APP	<100
"	3	CG	40mL	none	—	—	DHGs	APP	<100
"	1	PE	250mL	HNO_3	—	—	metals	APP	<100
REMARKS:	1	PE	150mL	none	—	—	anions, bromide	APP	<100
"	1	PE	150mL	none	—	—	iodide	APP	<100

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.

2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

Revision Date: February 12, 2009

0.60

Form FD 9000-24

GROUNDWATER SAMPLING LOG

SITE NAME: NAS Jax | SITE LOCATION: Jacksonville, FL

WELL NO: EKMW-04 | SAMPLE ID: EKMW-04 | DATE: 10/01/2014

PURGING DATA

WELL DIAMETER (inches): 2 | TUBING DIAMETER (inches): 1/4 | WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet | STATIC DEPTH TO WATER (feet): 4.31 | PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: 1 **WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY
(only fill out if applicable)
= (feet – feet) X gallons/foot = gallons

EQUIPMENT VOLUME PURGE: 1 **EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= 0 gallons + (0.0026 gallons/foot X 25 feet) + 0.132 gallons = 0.20 gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21 | FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21 | PURGING INITIATED AT: 12:40 | PURGING ENDED AT: 13:07 | TOTAL VOLUME PURGED (gallons): 2.00

TIME	VOLUME PURGED (gallons)	CUMUL. VOLUME PURGED (gallons)	PURGE RATE (gpm)	DEPTH TO WATER (feet)	pH (standard units)	TEMP. (°C)	COND. (circle units) µmhos/cm or [✓ µS/cm]	DISSOLVED OXYGEN (circle units) [✓ mg/L] or % saturation	TURBIDITY (NTUs)	COLOR (describe)	ORP (mV)
12:50	0.50	0.50	0.05	7.12	4.72	28.93	1797	0.33	29.1	light brown	105.2
12:53	0.25	0.75	0.08	7.55	4.68	28.46	1801	0.25	21.5	clear	79.6
12:56	0.25	1.00	0.08	7.84	4.72	28.31	2088	0.19	18.3	"	73.3
12:59	0.25	1.25	0.08	8.07	4.84	28.21	2255	0.18	17.5	"	56.6
13:02	0.25	1.50	0.08	8.35	4.88	28.13	2209	0.16	15.7	"	42.7
13:05	0.25	1.75	0.08	8.55	4.86	28.19	2145	0.15	17.9	"	41.7

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Bryce Zinckgraf / Geosyntec | SAMPLER(S) SIGNATURE(S): | SAMPLING INITIATED AT: 13:10 | SAMPLING ENDED AT: 13:20

PUMP OR TUBING DEPTH IN WELL (feet): 21 | TUBING MATERIAL CODE: PE, S | FIELD-FILTERED: Y [✓ N] Filtration Equipment Type: | FILTER SIZE: ____ µm

FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N (replaced)] | DUPLICATE: Y [✓ N]

SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH			
EKMW-04	1	PE	1L	none	–	–	Gene Trac	APP	<100
"	2	CG	40 mL	none	–	–	VFAs	"	"
"	3	CG	40 mL	HCl	–	–	VOCs	"	"
"	2	CG	40 mL	HCl	–	–	TOC	"	"
"	3	CG	40 mL	none	–	–	DHGs	"	"
"	1	PE	250 mL	HNO3	–	–	metals	"	"
REMARKS: "	1	PE	150 mL	none	–	–	anions, bromide	"	"
"	1	PE	150 mL	none	–	–	iodide	"	"

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

Revision Date: February 12, 2009

0.60

Form FD 9000-24
GROUNDWATER SAMPLING LOG

SITE NAME: NAS Jax
SITE LOCATION: Jacksonville, FL
WELL NO: EKMW-05
SAMPLE ID: EKMW-05
DATE: 10/01/2014

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 1/4
WELL SCREEN INTERVAL DEPTH: 19 feet to 24 feet
STATIC DEPTH TO WATER (feet): 4.19
PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY
(only fill out if applicable)
= (feet – feet) X gallons/foot = gallons

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= 0 gallons + (0.0026 gallons/foot X 25 feet) + 0.132 gallons = 0.20 gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21.5
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21.5
PURGING INITIATED AT: 13:40
PURGING ENDED AT: 13:55
TOTAL VOLUME PURGED (gallons): 1.00

TIME	VOLUME PURGED (gallons)	CUMUL. VOLUME PURGED (gallons)	PURGE RATE (gpm)	DEPTH TO WATER (feet)	pH (standard units)	TEMP. (°C)	COND. (circle units) µmhos/cm or [✓ µS/cm]	DISSOLVED OXYGEN (circle units) [✓ mg/L] or % saturation	TURBIDITY (NTUs)	COLOR (describe)	ORP (mV)
13:48	0.50	0.50	0.06	4.96	5.23	27.23	9788	0.71	10.4	clear	59.2
13:51	0.25	0.75	0.08	4.98	5.21	27.18	9807	0.50	11.3	"	61.1
13:54	0.25	1.00	0.08	5.00	5.19	27.10	9610	0.26	9.19	"	63.6

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Bryce Zinckgraf / Geosyntec
SAMPLER(S) SIGNATURE(S):
SAMPLING INITIATED AT: 14:00
SAMPLING ENDED AT: 14:08
PUMP OR TUBING DEPTH IN WELL (feet): 21.5
TUBING MATERIAL CODE: PE, S
FIELD-FILTERED: Y [✓ N]
Filtration Equipment Type:
FILTER SIZE: _____ µm
FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N (replaced)]
DUPLICATE: Y [✓ N]

SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH			
EKMW-05	1	PE	1L	none	—	—	Gene Trac	APP	<100
"	2	CG	40mL	none	—	—	VFAs	"	"
"	1	PE	250mL	HNO3	—	—	metals	"	"
"	1	PE	150mL	none	—	—	anions	"	"
"	1	PE	150mL	none	—	—	iodide	"	"
"	3	CG	40mL	none	—	—	DHGs	"	"

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.

2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

Revision Date: February 12, 2009

0.60

Form FD 9000-24

GROUNDWATER SAMPLING LOG

SITE NAME: NAS Jax	SITE LOCATION: Jacksonville, FL

WELL NO: EKMW-07	SAMPLE ID: EKMW-07	DATE: 10/02/2014

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 1/4	WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet	STATIC DEPTH TO WATER (feet): 4.06	PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: **1 WELL VOLUME =** (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY
(only fill out if applicable)
= (feet – feet) X gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= 0 gallons + (0.0026 gallons/foot X 25 feet) + 0.132 gallons = 0.20 gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21	PURGING INITIATED AT: 09:30	PURGING ENDED AT: 09:41	TOTAL VOLUME PURGED (gallons): 1.00

TIME	VOLUME PURGED (gallons)	CUMUL. VOLUME PURGED (gallons)	PURGE RATE (gpm)	DEPTH TO WATER (feet)	pH (standard units)	TEMP. (°C)	COND. (circle units) μmhos/cm or [✓ μS/cm]	DISSOLVED OXYGEN (circle units) [✓ mg/L] or % saturation	TURBIDITY (NTUs)	COLOR (describe)	ORP (mV)
09:34	0.50	0.50	0.125	6.91	5.13	27.64	1609	0.70	14.7	clear	38.2
09:37	0.25	0.75	0.08	7.15	5.12	27.59	1608	0.54	13.7	"	35.3
09:40	0.25	1.00	0.08	7.18	5.12	27.46	1615	0.48	12.5	"	34.2

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Bryce Zinckgraf / Geosyntec	SAMPLER(S) SIGNATURE(S):	SAMPLING INITIATED AT: 09:45	SAMPLING ENDED AT: 09:57
PUMP OR TUBING DEPTH IN WELL (feet): 21	TUBING MATERIAL CODE: PE, S	FIELD-FILTERED: Y [✓ N] Filtration Equipment Type:	FILTER SIZE: ______ µm
FIELD DECONTAMINATION: PUMP Y [✓ N]	TUBING Y [✓ N (replaced)]	DUPLICATE: Y [✓ N]	

SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH			
EKMW-07	1	PE	1L	none	–	–	Gene Trac	APP	<100
"	2	CG	40mL	none	–	–	VFAs	"	"
"	3	CG	40mL	HCl	–	–	VOCs	"	"
"	2	CG	40mL	HCl	–	–	TOC	"	"
"	3	CG	40mL	none	–	–	DHGs	"	"
"	1	PE	250mL	HNO3	–	–	metals	"	"
REMARKS:	1	PE	150mL	none	–	–	anions, bromide	"	"
"	1	PE	150mL	none	–	–	iodide	"	"

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump;
RFPP = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: **1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.**

2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

Revision Date: February 12, 2009

0.60

Form FD 9000-24

GROUNDWATER SAMPLING LOG

SITE NAME: NAS Jax	SITE LOCATION: Jacksonville, FL

WELL NO: EKMW-08	SAMPLE ID: EKMW-08	DATE: 10/02/2014

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 1/4	WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet	STATIC DEPTH TO WATER (feet): 7.98	PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY
(only fill out if applicable)
= (feet – feet) X gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= 0 gallons + (0.0026 gallons/foot X 25 feet) + 0.132 gallons = 0.20 gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21	PURGING INITIATED AT: 12:18	PURGING ENDED AT: 14:45	TOTAL VOLUME PURGED (gallons): 4.20

TIME	VOLUME PURGED (gallons)	CUMUL. VOLUME PURGED (gallons)	PURGE RATE (gpm)	DEPTH TO WATER (feet)	pH (standard units)	TEMP. (°C)	COND. (circle units) µmhos/cm or [✓ µS/cm]	DISSOLVED OXYGEN (circle units) [✓ mg/L] or % saturation	TURBIDITY (NTUs)	COLOR (describe)	ORP (mV)
14:40	4.00	4.00	0.03	16.46	5.64	27.84	2796	0.67	30.3	clear	12.3
14:42	0.10	4.10	0.03	16.46	5.67	27.98	2747	0.50	25.4	"	10.9
14:44	0.10	4.20	0.03	16.46	5.68	28.02	2728	0.37	18.5	"	11.6

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Bryce Zinckgraf / Geosyntec	SAMPLER(S) SIGNATURE(S):	SAMPLING INITIATED AT: 14:48	SAMPLING ENDED AT: 15:05
PUMP OR TUBING DEPTH IN WELL (feet): 21	TUBING MATERIAL CODE: PE, S	FIELD-FILTERED: Y [✓ N] Filtration Equipment Type:	FILTER SIZE: ____ µm
FIELD DECONTAMINATION: PUMP Y [✓ N]	TUBING Y [✓ N (replaced)]	DUPLICATE: Y [✓ N]	

SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH			
EKMW-08	1	PE	1L	none	–	–	Gene Trac	APP	<100
"	2	CG	40 mL	none	–	–	VFAs	"	"
"	3	CG	40 mL	HCl	–	–	VOCs	"	"
"	2	CG	40 mL	HCl	–	–	TOC	"	"
"	3	CG	40 mL	none	–	–	DHGs	"	"
"	1	PE	250 mL	HNO_3	–	–	metals	"	"
REMARKS:	1	PE	150 mL	none	–	–	anions, bromide	"	"
"	1	PE	150 mL	none	–	–	iodide	"	"

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump;
RFPP = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**

2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

Revision Date: February 12, 2009

0.60

Form FD 9000-24
GROUNDWATER SAMPLING LOG

SITE NAME: NAS Jax	SITE LOCATION: Jacksonville, FL	
WELL NO: EKMW-09	SAMPLE ID: EKMW-09	DATE: 10/02/14

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 1/4	WELL SCREEN INTERVAL DEPTH: 19.5 feet to 24.5 feet	STATIC DEPTH TO WATER (feet): 4.77	PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY
(only fill out if applicable)
= (feet – feet) X gallons/foot = gallons

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= 0 gallons + (0.0026 gallons/foot X 25 feet) + 0.132 gallons = 0.20 gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 22	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 22	PURGING INITIATED AT: ~~14:08~~ 13:50 BZ	PURGING ENDED AT: 14:04	TOTAL VOLUME PURGED (gallons): 1.25

TIME	VOLUME PURGED (gallons)	CUMUL. VOLUME PURGED (gallons)	PURGE RATE (gpm)	DEPTH TO WATER (feet)	pH (standard units)	TEMP. (°C)	COND. (circle units) µmhos/cm or [✓ µS/cm]	DISSOLVED OXYGEN (circle units) [✓ mg/L] or % saturation	TURBIDITY (NTUs)	COLOR (describe)	ORP (mV)
13:54	0.50	0.50	0.125	8.89	5.09	28.37	7286	0.28	13.2	clear	94.3
13:57	0.25	0.75	0.08	9.48	5.03	28.51	6967	0.19	19.7	"	99.6
14:00	0.25	1.00	0.08	10.30	5.01	28.60	6982	0.16	15.6	"	99.6
14:03	0.25	1.25	0.08	10.83	5.00	28.63	7029	0.15	15.3	"	100.1

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Bryce Zinckgraf / Geosyntec	SAMPLER(S) SIGNATURE(S):	SAMPLING INITIATED AT: 14:08	SAMPLING ENDED AT: 14:20
PUMP OR TUBING DEPTH IN WELL (feet): 22	TUBING MATERIAL CODE: PE, S	FIELD-FILTERED: Y [✓ N] Filtration Equipment Type:	FILTER SIZE: ______ µm

FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced) DUPLICATE: Y [✓ N]

SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH			
EKMW-09	1	PE	1L	none	—	—	Gene Trac	APP	<100
"	2	CG	40mL	none	—	—	VFAs	"	"
"	3	CG	40mL	none	—	—	DHGs	"	"
"	1	PE	250mL	HNO3	—	—	metals, K	"	"
"	1	PE	150mL	none	—	—	anions	"	"
"	1	PE	150mL	none	—	—	iodide	"	"
REMARKS:	1	PE	500mL	none	—	—	TDS	"	"

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

Revision Date: February 12, 2009

Form FD 9000-24

GROUNDWATER SAMPLING LOG

0.60

SITE NAME: NAS Jax

SITE LOCATION: Jacksonville, FL

WELL NO: EKMW-11

SAMPLE ID: EKMW-11

DATE: 10/02/2014

PURGING DATA

WELL DIAMETER (inches): 2

TUBING DIAMETER (inches): 1/4

WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet

STATIC DEPTH TO WATER (feet): 4.14

PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY
(only fill out if applicable)
= (feet – feet) X gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= 0 gallons + (0.0026 gallons/foot X 25 feet) + 0.132 gallons = 0.20 gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21

FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21

PURGING INITIATED AT: 15:16

PURGING ENDED AT: 15:32

TOTAL VOLUME PURGED (gallons): 1.50

TIME	VOLUME PURGED (gallons)	CUMUL. VOLUME PURGED (gallons)	PURGE RATE (gpm)	DEPTH TO WATER (feet)	pH (standard units)	TEMP. (°C)	COND. (circle units) µmhos/cm or [✓ µS/cm]	DISSOLVED OXYGEN (circle units) [✓ mg/L] or % saturation	TURBIDITY (NTUs)	COLOR (describe)	ORP (mV)
15:23	0.50	0.50	0.07	7.55	10.00	28.35	333	0.22	19.7	clear	7.2
15:25	0.25	0.75	0.125	8.78	10.41	28.45	385	0.18	16.8	"	0.6
15:27	0.25	1.00	0.125	9.79	10.52	28.47	414	0.16	17.3	"	-1.4
15:29	0.25	1.25	0.125	10.76	10.59	28.52	419	0.12	17.1	"	-5.0
15:31	0.25	1.50	0.125	11.70	10.60	28.58	421	0.15	19.4	"	-9.2

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Bryce Zindgraf / Geosyntec

SAMPLER(S) SIGNATURE(S):

SAMPLING INITIATED AT: 15:35

SAMPLING ENDED AT: 15:45

PUMP OR TUBING DEPTH IN WELL (feet): 21

TUBING MATERIAL CODE: PE, S

FIELD-FILTERED: Y [✓ N]
Filtration Equipment Type:

FILTER SIZE: _____ µm

FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N (replaced)]

DUPLICATE: Y [✓ N]

SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH			
EKMW-11	1	PE	1L	none	—	—	Gene Trac	APP	<100
"	2	CG	40mL	none	—	—	VFAs	"	"
"	3	CG	40mL	HCl	—	—	VOCs	"	"
"	2	CG	40mL	HCl	—	—	TOC	"	"
"	3	CG	40mL	none	—	—	DHGs	"	"
"	1	PE	250mL	HNO3	—	—	metals,	"	"
REMARKS:	1	PE	150mL	none	—	—	anions, bromide	"	"
"	1	PE	150mL	none	—	—	iodide	"	"

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump;
RFPP = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**

2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

Revision Date: February 12, 2009

Geosyntec Consultants
Water Quality Instrument Calibration Form

Project/Site: NAS Jax

Project #: TR0482

Field Personnel: Bryce Zinckgraf

Water Quality Meter - Model/Serial #: YSI 556 MPS 12C101848

Turbidimeter - Model/Serial #

Dissolved Oxygen	DEP SOP FT 1500	Date	Time	Temp (°C)	Saturation (mg/L)[1]	Reading (mg/L)	Reading (%)	Pass or Fail
						Acceptance Criteria: +/-0.3mg/L		
[✓ CAL] ICV CCV		10/01/14	08:22	23.10	8.562	8.56	100.0	[✓ P] F
CAL ICV [✓ CCV]		10/02/14	08:17	21.70	8.794	8.76	99.6	[✓ P] F
CAL ICV CCV								P F
CAL ICV CCV								P F

Specific Conductance	DEP SOP FT 1200	Date	Time	Standard (mS/cm)	Standard Lot #	Standard Exp. Date	Reading (mS/cm)	Pass or Fail
						Acceptance Criteria: +/- 5%		
[✓ CAL] ICV CCV		10/01/14	08:28	1.0	117/1000-E	12/2015	1.000	[✓ P] F
CAL ICV [✓ CCV]		10/02/14	08:20	1.0	" "	" "	0.976	[✓ P] F
CAL ICV CCV								P F
CAL ICV CCV								P F
CAL ICV CCV								P F
CAL ICV CCV								P F

pH	DEP SOP FT 1100	Date	Time	Standard (SU)	Standard Lot #	Standard Exp. Date	Reading (SU)	Pass or Fail
						Acceptance Criteria: +/-0.2 SU		
[✓ CAL] ICV CCV		10/01/14	08:32 ~~3080673~~ 82	7.0	3080673	8/30/15	6.98	[✓ P] F
[✓ CAL] ICV CCV		11/01/14	08:35	4.0	3082078	8/30/15	4.00	[✓ P] F
CAL ICV [✓ CCV]		10/02/14	08:25	7.0	308673	8/30/15	6.85	[✓ P] F
CAL ICV [✓ CCV]		10/02/14	08:29	4.0	3082078	8/30/15	4.11	[✓ P] F
CAL ICV CCV								P F
CAL ICV CCV								P F

ORP	SOP N/A	Date	Time	Std. mV @ Temp °C	Standard Lot #	Standard Exp. Date	Reading (mV)	Pass or Fail
						Geosyntec Acceptance Criteria: +/- 5%		
[✓ CAL] ICV CCV		10/01/14	08:42	231.0	14F100388	07/2016	231.0	[✓ P] F
CAL ICV [✓ CCV]		10/02/14	08:32	231.0	" "	" "	230.2	[✓ P] F
CAL ICV CCV								P F
CAL ICV CCV								P F

Specific Conductance Probe Cleaned? Yes No Disolved Oxygen membrane Changed? Yes No

0.1 - 10 NTU Std 10 NTU	Date	Reading (NTU)	Pass or Fail
	Acceptance Criteria: +/- 10%		
CAL [✓ ICV] CCV	10/01/14	9.25	[✓ P] F
CAL ICV [✓ CCV]	10/02/14	9.19	[✓ P] F
CAL ICV CCV			P F
CAL ICV CCV			P F

11 - 40 NTU Std ___NTU	Date	Reading (NTU)	Pass or Fail
	Acceptance Criteria: +/- 8%		
CAL ICV CCV			P F
CAL ICV CCV			P F
CAL ICV CCV			P F
CAL ICV CCV			P F
CAL ICV CCV			P F
CAL ICV CCV			P F

41 - 100 NTU Std ___NTU	Date	Reading (NTU)	Pass or Fail
	Acceptance Criteria: +/- 6.5%		
CAL ICV CCV			P F
CAL ICV CCV			P F
CAL ICV CCV			P F
CAL ICV CCV			P F
CAL ICV CCV			P F
CAL ICV CCV			P F

>100 NTU Std ___NTU	Date	Reading (NTU)	Pass or Fail
	Acceptance Criteria: +/- 5%		
CAL ICV CCV			P F
CAL ICV CCV			P F
CAL ICV CCV			P F
CAL ICV CCV			P F

1. See Table FS 2200-2 on the back of this form

CAL - Initial Calibration

ICV - Initial Calibration Verification

CCV - Continuing Calibration Verification

Allow adequate time for the dissolved oxygen sensor to equilibrate during air calibration

Calibrate specific conductance using at least two standards that bracket the range of expected sample readings (unless readings < 0.1 mS/cm then one standard of 0.1 mS/cm is acceptable)

Calibrate pH using at least two standards (typ. pH 4 and 7) that bracket the range of expected sample readings; always start with pH 7; add a third calibration point if needed (i.e. pH > 7)

If parameter fails to calibrate within SOP acceptance criteria then append sample results with a "J" qualifier

Comments:

Geosyntec consultants

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11, Blg 103	SITE LOCATION: NAS JAX		DATE: 3/15/16
WELL NO: EKMW-01	SAMPLE ID: EKMW-01	FREE PRODUCT: Y N DEPTH TO PRODUCT (ft BTOC):	FIELD DUPLICATE: Y [✓ N] DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 1/4	WELL SCREEN INTERVAL DEPTH: 18 feet to 23 feet	STATIC DEPTH TO WATER (feet): 4.75	PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet):	FINAL PUMP OR TUBING DEPTH IN WELL (feet):	PURGING INITIATED AT: 0825	PURGING ENDED AT: 0950	TOTAL VOLUME PURGED (gallons): 4.60

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity ~~(‰)~~ PPT	ORP (mV)	Color/ Odor (describe)	Turbidity (NTUs)
0825	0.55	0.55	0.055	5.74	5.40	25.5	11.21	0.67		-68.0	Clear / None	
0845	0.55	1.10	0.055	5.91	5.42	25.7	9.98	0.11		-85.6	" "	
0855	0.55	1.65	0.055	6.08	5.48	25.9	8.17	0.09	4.50	-95.8	" "	4.05
0905	0.55	2.20	0.055	6.20	5.53	26.0	7.21	0.09	3.94	-100.6	" "	1.27
0915	0.55	2.75	0.055	6.27	5.58	26.1	6.41	0.09	3.49	-107.8	" "	1.39
0925	0.55	3.30	0.055	6.43	5.45	26.0	5.93	0.28	3.22	-91.0	" "	1.74
0935	0.55	3.85	0.055	6.65	5.52	26.3	5.71	0.30	3.08	-94.3	" "	2.01
0940	0.25	4.10	0.050	6.41	5.57	26.2	5.49	0.29	2.95	-98.5	" "	1.94
0945	0.25	4.35	0.050	6.38	5.56	26.1	5.45	0.28	2.94	-100.4	" "	1.71
0950	0.25	4.60	0.050	6.39	5.58	26.2	5.39	0.25	2.89	-103.4	" "	1.06

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016
PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Tony Schmucker (Trinity ADC)	SAMPLER(S) SIGNATURE(S): Ty		SAMPLE TIME: 0950
PUMP OR TUBING DEPTH IN WELL (feet): 21	TUBING MATERIAL CODE: PE	FIELD-FILTERED: Y [✓ N] Filtration Equipment Type:	FILTER SIZE: _____ µm

FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED			
3	CG	40mL	HCL	VOC	APP	200
2	AC	40mL	HCL	TOC		
3	CG	40mL	HCL	MEE		
2	CG	40mL	None	VFA		
1	PE	500mL	None	NO3/SO4/Cl		
1	PE	250mL	HNO3	Fe, Mn, Mg, Ca		

FIELD EQUIPMENT IDENTIFICATION	
H20 QUALITY PARAMETER	
Model: YSI	SN#: 16A102711
TURBIDIMETER	
Model: LaMotte	SN#: 6224-0116
OTHER	

REMARKS: Put in new tubing - 24'

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair 1 PE 250mL ☐ needs well tag HNO3 K ☐ locking cap: ☐ other comment:
☐ DI Water Lot # 1 PE 250mL ☐ MS/MSD None ☐ Equip blk Bromide ☐ Ambient blk ☑ Trip blk TB-1
1 PE 500mL Iodide None
2012_1102
1 PE 1L None Microbial

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11 Bldg 103	SITE LOCATION: NAS JAX	DATE: 3-15-16
WELL NO: EKMW-02 / SAMPLE ID: EKMW-02	FREE PRODUCT: Y N DEPTH TO PRODUCT (ft BTOC):	FIELD DUPLICATE: Y [✓ N] DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 1/4	WELL SCREEN INTERVAL DEPTH: feet to feet	STATIC DEPTH TO WATER (feet): 5.16	PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21	PURGING INITIATED AT: 1510	PURGING ENDED AT: 1645	TOTAL VOLUME PURGED (gallons): 4.15

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color/ Odor (describe)	Turbidity (NTUs)
1520	0.55	0.55	0.055	6.72	5.48	25.6	2.97	0.20	1.54	16.2	Clear / None	
1530	0.40	0.95	0.04	6.92	5.71	26.0	2.96	0.15	1.53	4.1	" "	10.19
1540	0.40	1.35	0.04	7.13	5.76	26.0	2.94	0.12	1.52	-2.4	" "	9.95
1550	0.40	1.75	0.04	7.22	5.85	26.1	2.92	0.12	1.51	-16.5	" "	8.62
1600	0.40	2.15	0.04	7.30	5.87	25.9	2.92	0.11	1.51	-23.9	" "	8.41
1610	0.40	2.55	0.04	7.35	5.88	26.3	2.91	0.10	1.50	-30.6	" "	4.67
1620	0.40	2.95	0.04	7.42	5.90	26.2	2.90	0.10	1.50	-33.8	" "	4.60
1630	0.40	3.35	0.04	7.40	5.93	26.2	2.90	0.10	1.50	-35.6	" "	4.87
1640	0.40	3.75	0.04	7.42	5.93	26.2	2.90	0.10	1.50	-33.9	" "	3.91

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Tony Schmucker (Trinity)	SAMPLER(S) SIGNATURE(S):	SAMPLE TIME: 1645
PUMP OR TUBING DEPTH IN WELL (feet): 21	TUBING MATERIAL CODE:	FIELD-FILTERED: Y N FILTER SIZE: ____ µm Filtration Equipment Type:

FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED			
3	CG	40 mL	HCL	VOC	APP	≤ 200
2	AG	40 mL	HCL	TOC		
3	CG	40 mL	~~H~~HCL	MEE		
2	CG	40 mL	None	VFA		
1	PE	500 mL	None	NO3/SO4/Cl		
1	PE	250 mL	HNO3	Fe/Mn/Mg/Ca		

FIELD EQUIPMENT IDENTIFICATION	
H20 QUALITY PARAMETER	
Model: YSI	SN#: 16A102711
TURBIDIMETER	
Model: LaMotte	SN#: 6224-0116
OTHER	

REMARKS: 1 PE 250mL HNO3 K

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair__________ ☐ needs well tag __________ ☐ locking cap: __________ ☐ other comment: __________
☐ DI Water Lot # __________ ☐ MS / MSD __________ ☐ Equip blk __________ ☐ Ambient blk __________ ☑ Trip blk TB-1

1	PE	250mL	None	Bromide
1	PE	500 mL	None	Iodide
1	PE	1-L	None	Microbial

Page 2 of 2

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME:

SITE LOCATION:

DATE:

WELL NO: EKMW-02

SAMPLE ID: EKMW-02

FREE PRODUCT: Y N
DEPTH TO PRODUCT (ft BTOC):

FIELD DUPLICATE: Y N
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches):

TUBING DIAMETER (inches):

WELL SCREEN INTERVAL DEPTH: feet to feet

STATIC DEPTH TO WATER (feet):

PURGE PUMP TYPE OR BAILER:

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet):

FINAL PUMP OR TUBING DEPTH IN WELL (feet):

PURGING INITIATED AT:

PURGING ENDED AT:

TOTAL VOLUME PURGED (gallons):

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (^{o}C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color/ Odor (describe)	Turbidity (NTUs)
1645	0.40	4.15	0.040	7.41	5.93	26.3	2.90	0.10	1.50	-34.7	" "	4.11

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION:

SAMPLER(S) SIGNATURE(S):

SAMPLE TIME:

PUMP OR TUBING DEPTH IN WELL (feet):

TUBING MATERIAL CODE:

FIELD-FILTERED: Y N
Filtration Equipment Type:

FILTER SIZE: _____ μm

FIELD DECONTAMINATION: PUMP Y N TUBING Y N (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED			

See Page

FIELD EQUIPMENT IDENTIFICATION	
H20 QUALITY PARAMETER	
Model:	SN#:
TURBIDIMETER	
Model:	SN#:
OTHER	

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair__________ ☐ needs well tag __________ ☐ locking cap: __________ ☐ other comment: __________

☐ DI Water Lot # __________ ☐ MS / MSD __________ ☐ Equip blk __________ ☐ Ambient blk __________ ☐ Trip blk __________

Page 1 of 2

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11, Bldg 103
SITE LOCATION: NAS JAX
DATE: 3-15-16
WELL NO: EK MW-03
SAMPLE ID: EKMW-03
FREE PRODUCT: Y N
DEPTH TO PRODUCT (ft BTOC):
FIELD DUPLICATE: [✓ Y] N
DUPLICATE ID: EKMW-Dup-1

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 1/4
WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet
STATIC DEPTH TO WATER (feet): 4.71
PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21
PURGING INITIATED AT: 1250
PURGING ENDED AT: 1425
TOTAL VOLUME PURGED (gallons): 4.57

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color/ Odor (describe)	Turbidity (NTUs)
1300	0.60	0.60	0.06	7.12	5.17	25.2	3.10	0.13	1.61	101.6	Clear / None	
1310	0.55	1.15	0.055	7.86	5.15	25.6	3.11	0.10	1.62	102.3	" "	
1320	0.55	1.70	0.055	9.01	5.19	25.8	3.16	0.08	1.64	91.6	" "	7.21
1330	0.45	2.15	0.045	8.90	5.29	26.3	3.22	0.09	1.68	58.9	" "	7.16
1340	0.45	2.60	0.045	8.90	5.41	26.6	3.21	0.07	1.67	35.0	" "	5.98
1350	0.45	3.05	0.045	9.20	5.48	26.4	3.13	0.08	1.63	19.6	" "	5.47
1355	0.22	3.26	0.045	9.31	5.50	26.4	3.10	0.08	1.62	14.7	" "	4.15
1400	0.22	3.47	0.045	9.40	5.53	26.5	3.08	0.09	1.60	8.3	" "	3.13
1405	0.22	3.69	0.045	9.42	5.56	26.7	3.04	0.09	1.59	-0.7	" "	3.20
1410	0.22	3.91	0.045	9.43	5.56	26.7	3.01	0.09	1.56	-3.4	" "	3.21
1415	0.22	4.13	0.045	9.44	5.58	26.5	3.00	0.09	1.55	-4.2	" "	3.46

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; O = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Tony Schmucker (Trinity)
SAMPLER(S) SIGNATURE(S):
SAMPLE TIME: 1425
PUMP OR TUBING DEPTH IN WELL (feet): 21
TUBING MATERIAL CODE: PE
FIELD-FILTERED: Y [✓ N] FILTER SIZE: _____ µm
Filtration Equipment Type:
FIELD DECONTAMINATION: PUMP Y ~~N~~ TUBING Y ~~N~~ (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED			
3	CG	40 mL	HCL	VOC	APP	< 200
2	AG	40 mL	HCL	TOC		
3	CG	40 mL	HCL	MEE		
2	CG	40 mL	None	VFA		
1	PE	500 mL	None	NO3/SO4/Cl		
1	PE	250 mL	HNO3	Fe/Mn/Mg/Ca		

FIELD EQUIPMENT IDENTIFICATION

H20 QUALITY PARAMETER	
Model: YSI	SN#: 16A102211
TURBIDIMETER	
Model: LaMotte	SN#: 6224-0116
OTHER	

REMARKS: 1 PE 250 mL HNO3 K

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)

SAMPLING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); O = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair ☐ needs well tag ☐ locking cap: ☐ other comment:
☐ DI Water Lot # ☐ MS / MSD ☐ Equip blk ☐ Ambient blk ☑ Trip blk TB-1

1	PE	250 mL	None	Bromide
1	PE	500 mL	None	Iodide
1	PE	1-L	None	Microbial

Page 2of2

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME:	SITE LOCATION:	DATE:
WELL NO: EKMW-03	SAMPLE ID:	FREE PRODUCT: Y [✓ N] DEPTH TO PRODUCT (ft BTOC):
		FIELD DUPLICATE: Y N DUPLICATE ID:

See Page 1

PURGING DATA

WELL DIAMETER (inches):	TUBING DIAMETER (inches):	WELL SCREEN INTERVAL DEPTH: feet to feet	STATIC DEPTH TO WATER (feet):	PURGE PUMP TYPE OR BAILER:

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet):	FINAL PUMP OR TUBING DEPTH IN WELL (feet):	PURGING INITIATED AT:	PURGING ENDED AT:	TOTAL VOLUME PURGED (gallons):

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color/ Odor (describe)	Turbidity (NTUs)
1420	0.22	4.35	0.045	9.45	5.58	26.6	2.94	0.09	1.54	-4.3	" "	3.56
1425	0.22	4.57	0.045	9.46	5.58	26.6	2.98	0.09	1.53	-4.5	" "	3.71

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION:	SAMPLER(S) SIGNATURE(S):	SAMPLE TIME:
PUMP OR TUBING DEPTH IN WELL (feet):	TUBING MATERIAL CODE:	FIELD-FILTERED: Y N FILTER SIZE: _____ μm Filtration Equipment Type:

FIELD DECONTAMINATION: PUMP Y N TUBING Y N (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED			

FIELD EQUIPMENT IDENTIFICATION	
H20 QUALITY PARAMETER	
Model:	SN#:
TURBIDIMETER	
Model:	SN#:
OTHER	

See Page 1

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair ____________ ☐ needs well tag ____________ ☐ locking cap: ____________ ☐ other comment: ____________
☐ DI Water Lot # ____________ ☐ MS / MSD ____________ ☐ Equip blk ____________ ☐ Ambient blk ____________ ☐ Trip blk ____________

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☑ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: NAS JACKSONVILLE - EK BIO STUDY	SITE LOCATION: JACKSONVILLE, FLORIDA		DATE: 3/15/2014
WELL NO: EKMW 04	SAMPLE ID: EKMW-04	FREE PRODUCT: Y [✓ N] DEPTH TO PRODUCT (ft BTOC):	FIELD DUPLICATE: Y [✓ N] DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 0.25"x0.17"	WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet	STATIC DEPTH TO WATER (feet): 4.82	PURGE PUMP TYPE OR BAILER: PERISTALTIC PUMP

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (24 feet – 4.82 feet) x 0.16 gallons/foot = 3.07 gallons

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
/ = / gallons + (/ gallons/foot x / feet) + / gallons = / gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21'	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21'	PURGING INITIATED AT: 1305 ~~1505~~ SM	PURGING ENDED AT: 1425	TOTAL VOLUME PURGED (gallons): 4.00

Time	GALS Volume Purged ~~(gallons)~~ Approx	Cum. Volume Purged (gallons) Approx	Purge Rate ~~(gpm)~~ mL/min	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (~~m~~S/cm) µ	Dissolved Oxygen (mg/L)	Salinity ~~(‰)~~ PPT	ORP (mV)	Color/ Odor (describe)	Turbidity (NTUs)
1320 1520	0.75	0.75	200	7.95	6.35	26.2	902	0.91	0.44	89.1	CLEAR | NO ODOR	20.0
1330 1530	0.50	1.25	200	8.75	6.12	26.6	1640	1.23	0.83	-9.7	CLEAR | NO ODOR	9.67
1340 (SM) 1540	0.50	1.75	205	9.20	5.96	26.8	1831	1.99	0.92	-7.2	CLEAR | NO ODOR	5.78
1350 1550	0.50	1.25	200	9.28	5.89	26.9	1949	2.68	0.99	-12.6	CLEAR | NO ODOR	4.65
1400 1600	0.50	2.75	200	9.33	5.89	27.1	1998	3.07	1.01	-16.9	CLEAR | NO ODOR	3.90
1410 1610	0.50	3.25	205	9.35	5.86	27.1	2023	3.35	1.02	-19.6	CLEAR | NO ODOR	3.70
1415 1615	0.25	3.50	200	9.35	5.87	27.0	2037	3.42	1.03	-19.7	CLEAR | NO ODOR	2.04
1420 1620	0.25	3.75	200	9.35	5.86	27.2	2049	3.50	1.04	-20.8	CLEAR | NO ODOR	1.66
1425	0.25	4.00	200	9.35	5.85	27.3	2048	3.52	1.04	-20.1	CLEAR | NO ODOR	1.23

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: SAMUEL MCINTYRE / SIGS	SAMPLER(S) SIGNATURE(S): Samuel A. M		SAMPLE TIME: 1430
PUMP OR TUBING DEPTH IN WELL (feet): 21'	TUBING MATERIAL CODE: HDPE	FIELD-FILTERED: Y [✓ N] Filtration Equipment Type:	FILTER SIZE: — µm

FIELD DECONTAMINATION: PUMP Y N [✓ N/A] TUBING Y [✓ N] (replaced) 28'

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED			
3	CG	40mL	HCl	VOCs	APP	200
1	PE	500mL	–	NO3, SO4, Cl	|	|
2	AG	40mL	HCl	TOC	|	|
1	PE	250mL	HNO3	FE, MN, CA, Mg	|	|
3	CG	40mL	HCl	DHG	|	|
1	PE	250mL	HNO3	K	|	|

FIELD EQUIPMENT IDENTIFICATION

H20 QUALITY PARAMETER	
Model: YSI PRO PLUS	SN#: 15L102933
TURBIDIMETER	
Model: LAMOTTE 2020WE	SN#: 5239-0515
OTHER	

REMARKS:
ADDITIONAL ANALYSIS ON REVERSE

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair__________ ☐ needs well tag __________ ☐ locking cap: __________ ☐ other comment: __________
☐ DI Water Lot # __________ ☐ MS / MSD __________ ☐ Equip blk __________ ☐ Ambient blk __________ ☑ Trip blk TB-1

# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE	ANALYSIS	SAMPLING EQ. CODE	FLOW RATE
1	PE	250mL	—	BROMIDE	App	200
1	PE	500mL	—	IODIDE	│	│
2	CG	40mL	—	VFA	│	│
1	PE	1L	—	MICROBIAL	│	↓

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☑ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: NAS JACKSONVILLE EK BIO STUDY		SITE LOCATION: JACKSONVILLE, FL	DATE: 3/15/2016
WELL NO: EKMW-05	SAMPLE ID: EKMW-05	FREE PRODUCT: Y [✓ N] DEPTH TO PRODUCT (ft BTOC):	FIELD DUPLICATE: Y [✓ N] DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2"	TUBING DIAMETER (inches): 0.25" x 0.17"	WELL SCREEN INTERVAL DEPTH: 19.5 feet to 24.5 feet	STATIC DEPTH TO WATER (feet): 4.63	PURGE PUMP TYPE OR BAILER: PERISTALTIC PUMP

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (24.5 feet – 4.63 feet) x 0.16 gallons/foot = 3.18 gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
— = — gallons + (— gallons/foot x — feet) + — gallons = — gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 22'	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 22' BGS	PURGING INITIATED AT: 1510	PURGING ENDED AT: 1620	TOTAL VOLUME PURGED (gallons): 4.00

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color/ Odor (describe)	Turbidity (NTUs)
1525	0.90	0.90	230	5.79	5.79	26.9	5368	0.53	2.89	-25.9	CLEAR / NO ODOR	17.0
1535	0.60	1.50	230	5.81	6.06	27.5	5897	2.30	3.18	-91.7	CLEAR / NO ODOR	4.38
1545	0.60	2.10	230	5.82	6.13	26.9	5382	3.30	2.89	-105.1	CLEAR / NO ODOR	2.90
1555	0.60	2.70	230	5.82	6.14	26.9	5175	3.75	2.77	-111.9	CLEAR / NO ODOR	2.11
1605	0.60	3.10	230	5.82	6.16	27.0	3226	3.93	2.67	-116.4	CLEAR / NO ODOR	2.08
1615	0.60	3.70	230	5.82	6.16	26.9	4905	3.99	2.61	-117.1	CLEAR / NO ODOR	1.63
1620	~~0.60~~ 0.30	4.00	230	5.82	6.16	27.1	4815	4.00	2.57	-118.4	CLEAR / NO ODOR	2.01

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: SAMUEL MCINTYRE / SIGS	SAMPLER(S) SIGNATURE(S):	SAMPLE TIME: 1620
PUMP OR TUBING DEPTH IN WELL (feet): 22' BGS	TUBING MATERIAL CODE:	FIELD-FILTERED: Y [✓ N] FILTER SIZE: — µm Filtration Equipment Type:

FIELD DECONTAMINATION: PUMP Y N [✓ NA] TUBING Y [✓ N] (replaced) 22'

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED			
3	CG	40mL	HCl	VOCs	APP	230
1	PG	500mL	—	NO_3, SO_4, Cl	|	|
2	AG	40mL	HCl	TOC	|	|
1	PG	250mL	HNO_3	FE, MN, CA & Mg	|	|
3	CG	40mL	HCl	DHG	|	
1	PG	250mL	HNO_3	K	|	

FIELD EQUIPMENT IDENTIFICATION	
H20 QUALITY PARAMETER	
Model: YSI PRO PLUS	SN#: 15H02933
TURBIDIMETER	
Model: LAMOTTE 2020WE	SN#: 5239-0515
OTHER	

REMARKS:
ADDITIONAL ANALYSIS ON REVERSE

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES:
1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair ☐ needs well tag ☐ locking cap: ☐ other comment:
☐ DI Water Lot # ☑ MS / MSD EKMW-05-MS / -MSD ☐ Equip blk ☐ Ambient blk ☒ Trip blk TB-1

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☑ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: NAS JACKSONVILLE GK BLD
SITE LOCATION: JACKSONVILLE, FL
DATE: 3/15/2016
WELL NO: GKMW-07
SAMPLE ID: GKMW-07
FREE PRODUCT: Y [✓ N]
DEPTH TO PRODUCT (ft BTOC): N/A
FIELD DUPLICATE: Y [✓ N]
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 0.25"x0.17"
WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet
STATIC DEPTH TO WATER (feet): 4.70
PURGE PUMP TYPE OR BAILER: PERISTALTIC PUMP

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (23.25 feet – 4.70 feet) x 0.16 gallons/foot = 2.97 gallons

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21'
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21'
PURGING INITIATED AT: 1015
PURGING ENDED AT: 1130
TOTAL VOLUME PURGED (gallons): 4.5

Time	Volume Purged (gallons) APPROX	Cum. Volume Purged (gallons) APPROX	Purge Rate (~~gpm~~) mL/min	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (~~mS/cm~~) µS	Dissolved Oxygen (mg/L)	Salinity (~~‰~~) PPT	ORP (mV)	Color/ Odor (describe)	Turbidity (NTUs)
1025	0.50	0.50	200	6.86	6.62	24.1	6126	1.13	3.48	-42.5	~~32.1~~ SLIGHT SILTY NO ODOR	32.1
1035	0.50	1.00	200	7.39	6.71	24.2	7836	0.46	4.35	-92.8	SLIGHT SILTY | NO ODOR	43.5
1045	0.45	1.45	210	7.60	6.66	24.3	8019	0.21	4.43	-95.1	SLIGHT SILTY | NO ODOR	49.0
1055	0.55	2.00	205	7.70	6.40	24.5	7104	0.32	3.89	-91.0	MOSTLY CLEAR | NO ODOR	23.0
1105	0.50	2.50	200	7.76	6.30	24.6	6149	1.19	3.34	-98.1	BROWN CLOUDY | NO ODOR	66.5
1115	0.50	3.00	200	7.81	6.23	24.8	5090	2.50	2.73	-107.3	BROWN CLOUDY | NO ODOR	54.9
1120	0.250	3.250	205	7.81	6.22	24.9	4714	2.74	2.51	-110.7	BROWN CLOUDY | NO ODOR	50.9
1125	0.250	3.75	200	7.81	6.21	24.9	4580	2.85	2.44	-112.4	MOSTLY CLEAR | NO ODOR	45.5
1130	0.250	4.00	200	7.81	6.19	25.1	4481	3.12	2.23	-114.2	MOSTLY CLEAR | NO ODOR	33.1

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: SAMUEL MCINTYRE / SIES
SAMPLER(S) SIGNATURE(S): Samuel A. M
SAMPLE TIME: 1130
PUMP OR TUBING DEPTH IN WELL (feet): 21' BGS
TUBING MATERIAL CODE: HDPE
FIELD-FILTERED: Y [✓ N]
FILTER SIZE: — µm
Filtration Equipment Type:

FIELD DECONTAMINATION: PUMP Y N [✓ N/A] TUBING Y [✓ N] (replaced) APPROX 28'

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED			
3	CG	40mL	HCl	VOCs	APP	200
1	PE	500mL	–	NO3, SO4, Cl		
2	AG	40mL	HCl	TOC		
1	PE	250mL	HNO3	Fe, Mn, Ca & Mg		
3	CG	40mL	HCl	DHG		
1	PE	250mL	HNO3	K		

FIELD EQUIPMENT IDENTIFICATION

H20 QUALITY PARAMETER	
Model: YSI PRO PLUS	SN#: 15L102933
TURBIDIMETER	
Model: LAMOTTE 2020WE	SN#: 5239-0515
OTHER	

REMARKS: ADDITIONAL ANALYSIS ON REVERSE SIDE - WATCH TIME 2 HOURS AHEAD, PURGE INITIATED AT 0815 EST. ALL SUBSEQUENT READINGS 2HRS FAST.

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES:
1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair ______ ☐ needs well tag ______ ☐ locking cap: ______ ☐ other comment: ______
☐ DI Water Lot # ______ ☐ MS / MSD ______ ☐ Equip blk ______ ☐ Ambient blk ______ ☑ Trip blk TB-1

# CONTAINERS	MAT. CODE	VOLUME	PRESERVATIVE	ANALYSIS	SAMP. EQ. CODE	FLOW RATE
1X BROMIDE	PE	250mL	–	BROMIDE	App	200
1X IODIDE	PE	500 ~~250~~mL	–	IODIDE		
2X VFA	CG	40mL	–	VFA		
1X MICROBIAL	PE	1L	–	MICROBIAL		

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11 Bldg 103	SITE LOCATION: NAS JAX		DATE: 3-12-16
WELL NO: EKMW-09	SAMPLE ID: EKMW-09	FREE PRODUCT: Y [✓ N] DEPTH TO PRODUCT (ft BTOC):	FIELD DUPLICATE: Y [✓ N] DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 1/4	WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet	STATIC DEPTH TO WATER (feet): 6.09	PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21	PURGING INITIATED AT: 1025	PURGING ENDED AT: 1205	TOTAL VOLUME PURGED (gallons): 4.10

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color/ Odor (describe)	Turbidity (NTUs)
1035	0.50	0.50	0.05	8.47	2.94	25.3	7.09	2.90	3.89	413.1	Clear/None	12.8
1045	0.50	1.00	0.05	10.42	3.02	25.4	7.70	2.62	4.27	392.1	" "	9.91
1055	0.50	1.50	0.05	12.14	3.15	25.7	8.13	2.97	4.50	380.4	" "	11.4
1105	0.50	2.00	0.05	13.30	3.22	25.9	8.42	3.39	4.73	367.6	" "	8.99
1115	0.30	2.30	0.03	13.98	3.48	26.2	8.78	3.67	4.89	335.8	" "	11.00
1125	0.30	2.60	0.03	14.25	3.66	26.4	8.75	3.98	4.87	309.0	" "	15.8
1135	0.30	2.40	0.03	14.56	3.80	26.7	8.45	4.06	4.69	297.9	" "	20.2
1145	0.30	3.20	0.03	14.73	4.08	26.8	8.18	4.10	4.52	259.5	" "	32.0
1155	0.30	3.50	0.03	14.88	4.54	26.9	7.96	4.05	4.39	186.8	" "	29.1
1200	0.30	3.80	0.03	14.89	4.49	26.9	7.52	4.17	4.14	207.7	" "	26.3
1205	0.30	4.10	0.03	14.91	4.52	26.9	7.64	4.14	4.04	201.1	" "	24.2

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Tony Schroeder (Trinity)	SAMPLER(S) SIGNATURE(S):	SAMPLE TIME: 1205
PUMP OR TUBING DEPTH IN WELL (feet): 21	TUBING MATERIAL CODE: PE	FIELD-FILTERED: Y [✓ N] FILTER SIZE: ____ µm Filtration Equipment Type:

FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING ~~Y~~ [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED			
3	CG	40 mL	HCL	VOC	APP	<200
2	AG	40 mL	HCL	TOC		
3	CG	40 mL	HCL	MEE		
2	CG	40 mL	None	VFA		
1	PE	500 mL	None	NO3/SO4/Cl/TDS		
1	PE	250 mL	HNO3	Fe/Mg/Mn/Ca		

FIELD EQUIPMENT IDENTIFICATION	
H20 QUALITY PARAMETER	
Model: YSI	SN#: 15L102933
TURBIDIMETER	
Model: LaMotte	SN#: 6224-0116
OTHER	

REMARKS: 1 PE 250 mL HNO3 K

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: **1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair________ ☐ needs well tag________ ☐ locking cap:________ ☐ other comment:________
☐ DI Water Lot #________ ☐ MS / MSD________ ☐ Equip blk________ ☐ Ambient blk________ ☑ Trip blk TB-2

1 PE 250 mL None Bromide
1 PE 500 mL None Iodide

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

-Page 1 of 2

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11 Bldg 103	SITE LOCATION: NAS JAX	DATE: 3-16-16
WELL NO: EKMW-10	SAMPLE ID: EKMW-10	FREE PRODUCT: Y [✓ N] DEPTH TO PRODUCT (ft BTOC):	FIELD DUPLICATE: Y [✓ N] DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 1/4	WELL SCREEN INTERVAL DEPTH: 14 feet to 23 feet	STATIC DEPTH TO WATER (feet): 4.88	PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21	PURGING INITIATED AT: 0750	PURGING ENDED AT: 0945	TOTAL VOLUME PURGED (gallons): 4.15

Switched drives on PP to lower gear ->

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color/ Odor (describe)	Turbidity (NTUs)
0800	0.50	0.50	0.05	7.56	7.31	24.0	3.32	0.10	1.73	-180.2	Cloudy / None	56.7
0810	0.50	1.00	0.05	8.73	7.19	24.3	3.35	0.09	1.75	-160.6	" "	—
0820	0.45	1.45	0.045	9.34	6.54	23.4	3.31	0.16	1.73	-77.2	Clear "	—
0830	0.45	1.90	0.045	9.96	6.10	24.4	3.09	1.45	1.61	-15.0	" "	27.4
0840	0.3	2.20	0.03	9.90	6.01	24.0	2.99	2.73	1.56	-20.5	" "	15.6
0850	0.3	2.50	0.03	9.90	5.94	23.9	2.91	2.96	1.51	-16.2	" "	14.6
0900	0.3	2.80	0.03	9.91	5.88	24.1	2.78	3.12	1.45	-12.1	" "	14.7
0910	0.3	3.10	0.03	9.93	5.86	24.2	2.74	3.31	1.42	-13.9	" "	14.1
0920	0.3	3.40	0.03	9.92	5.81	24.2	2.66	3.37	1.37	-8.1	" "	13.8
0925	0.15	3.55	0.03	9.89	5.82	24.2	2.64	3.42	1.37	-7.9	" "	12.5
0930	0.15	3.70	0.03	9.92	5.81	24.2	2.64	3.43	1.36	-7.4	" "	12.2

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; O = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Tony Schmucker (Trinity)	SAMPLER(S) SIGNATURE(S):	SAMPLE TIME: ~~0930~~ 0945
PUMP OR TUBING DEPTH IN WELL (feet): 21	TUBING MATERIAL CODE: PE	FIELD-FILTERED: Y [✓ N] FILTER SIZE: ____ µm Filtration Equipment Type:

FIELD DECONTAMINATION: PUMP Y N TUBING Y N (replaced)

# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
3	CG	40mL	HCL	VOC	APP	<200
2	AG	40 mL	~~TOC~~ HCL	TOC		
3	CG	40 mL	HCL	MEE		
2	CG	40mL	None	VFA		
1	PE	500mL	None	NO3/SO4/Cl/TDS		
1	PE	250mL	HNO3	Fe/Mg/Mn/Ca		
1	PE	250mL	HNO3	K		
1	PE	250mL	None	Bromide		
	PE	500mL	None	Iodide		
~~1~~	~~PE~~	~~1L~~	~~None~~	~~M~~		

REMARKS:

FIELD EQUIPMENT IDENTIFICATION	
H20 QUALITY PARAMETER	
Model: YSI	SN#: 15L102933
TURBIDIMETER	
Model: LaMotte	SN#: 6224-0116
OTHER	

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)

SAMPLING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); O = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair ______ ☐ needs well tag ______ ☐ locking cap: ______ ☐ other comment: ______

☐ DI Water Lot # ______ ☐ MS / MSD ______ ☐ Equip blk ______ ☐ Ambient blk ______ ☑ Trip blk TB-2

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

Page 2 of 2

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME:	SITE LOCATION:	DATE:
WELL NO: EKMW-10	SAMPLE ID: EKMW-10	FREE PRODUCT: Y N DEPTH TO PRODUCT (ft BTOC):
FIELD DUPLICATE: Y N DUPLICATE ID:		

PURGING DATA

See Page 1

WELL DIAMETER (inches):	TUBING DIAMETER (inches):	WELL SCREEN INTERVAL DEPTH: feet to feet	STATIC DEPTH TO WATER (feet):	PURGE PUMP TYPE OR BAILER:

WELL VOLUME PURGE: **1 WELL VOLUME =** (TOTAL WELL DEPTH − STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet − feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet):	FINAL PUMP OR TUBING DEPTH IN WELL (feet):	PURGING INITIATED AT:	PURGING ENDED AT:	TOTAL VOLUME PURGED (gallons):

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (^{o}C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color/ Odor (describe)	Turbidity (NTUs)
0935	0.15	3.85	0.03	9.90	5.80	24.5	2.63	3.43	1.34	-5.2	" "	12.1
0940	0.15	4.60	0.03	9.86	5.79	24.4	2.62	3.47	1.32	-4.1	" "	12.2
0945	0.15	4.15	0.03	9.87	5.76	24.5	2.57	3.63	1.32	-5.9	" "	12.4

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: B = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

See Page 1

SAMPLED BY (PRINT) / AFFILIATION:	SAMPLER(S) SIGNATURE(S):	SAMPLE TIME:
PUMP OR TUBING DEPTH IN WELL (feet):	TUBING MATERIAL CODE:	FIELD-FILTERED: Y N FILTER SIZE: _____ µm Filtration Equipment Type:

FIELD DECONTAMINATION: PUMP Y N TUBING Y N (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)	FIELD EQUIPMENT IDENTIFICATION	
# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED				H20 QUALITY PARAMETER	
							Model:	SN#:
							TURBIDIMETER	
							Model:	SN#:
							OTHER	

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair ____________ ☐ needs well tag ____________ ☐ locking cap: ____________ ☐ other comment: ____________
☐ DI Water Lot # ____________ ☐ MS / MSD ____________ ☐ Equip blk ____________ ☐ Ambient blk ____________ ☐ Trip blk ____________

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☑ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: NAS JACKSONVILLE EK BIO STUDY
SITE LOCATION: JACKSONVILLE FL
DATE: 3/16/16
WELL NO: PZ-3
SAMPLE ID: PZ-3
FREE PRODUCT: Y [✓ N]
DEPTH TO PRODUCT (ft BTOC):
FIELD DUPLICATE: Y [✓ N]
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 0.25"x0.17"
WELL SCREEN INTERVAL DEPTH: n/a feet to 12.5 feet
STATIC DEPTH TO WATER (feet): 4.39
PURGE PUMP TYPE OR BAILER: peristaltic pump

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (12.5 feet – 4.39 feet) x 0.16 gallons/foot = 1.30 gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
/ = / gallons + (/ gallons/foot x / feet) + / gallons = / gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 11.5'
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 11.5'
PURGING INITIATED AT: 0745
PURGING ENDED AT: 0905
TOTAL VOLUME PURGED (gallons): 4.00

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate ~~(gpm)~~ mL/min	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity ~~(‰)~~ ppt	ORP (mV)	Color/ Odor (describe)	Turbidity (NTUs)
0800	0.75	0.75	200	4.48	6.00	24.0	2.11	0.13	1.09	-168.8	BROWN SEDIMENT / NO ODOR	30.8
0810	0.50	1.25	200	4.50	6.04	24.1	2.07	0.11	1.05	-188.7	MOSTLY CLEAR / NO ODOR	24.6
0820	0.50	1.75	205	4.50	6.05	24.1	1.86	0.09	0.94	-192.4	CLEAR / NO ODOR	12.5
0830	0.50	2.25	200	4.50	6.10	24.1	1.90	0.10	0.97	-194.3	CLEAR / NO ODOR	8.60
0840	0.50	2.75	200	4.50	6.10	24.2	1.83	0.11	0.92	-197.5	CLEAR / NO ODOR	8.04
0850	0.50	3.25	200	4.50	6.10	24.2	1.84	0.09	0.93	-195.9	CLEAR / NO ODOR	8.14
0855	0.25	3.50	200	4.50	6.12	24.2	1.84	0.09	0.93	-196.4	CLEAR / NO ODOR	5.12
0900	0.25	3.75	200	4.50	6.14	24.3	1.90	0.09	0.97	-198.1	CLEAR / NO ODOR	5.02
0905	0.25	4.00	200	4.50	6.14	24.3	1.88	0.08	0.96	-198.4	CLEAR / NO ODOR	4.96

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016
PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: SAMUEL MCINTYRE / SIGS
SAMPLER(S) SIGNATURE(S): Samuel A. M
SAMPLE TIME: 0905
PUMP OR TUBING DEPTH IN WELL (feet):
TUBING MATERIAL CODE: HDPE
FIELD-FILTERED: Y [✓ N]
FILTER SIZE: — µm
Filtration Equipment Type:
FIELD DECONTAMINATION: PUMP Y N [✓ NA] TUBING Y [✓ N] (replaced) ~~20~~ 18'

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED			
3	CG	40mL	HCl	VOCs	APP	200
1	PE	500mL	–	NO3/SO4/Cl		
2	AG	40mL	HCl	TOC		
1	PE	250mL	HNO3	FE, MN, CA & Mg		
3	CG	40mL	HCl	DHG		
1	PE	250mL	HNO3	K		

FIELD EQUIPMENT IDENTIFICATION

H20 QUALITY PARAMETER	
Model: YSI PRO PLUS	SN#: 15A101477
TURBIDIMETER	
Model: LAMOTTE 2020WE	SN#: 5239-0515
OTHER	

REMARKS: ADDITIONAL ANALYSIS ON REVERSE

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES:
1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair________ ☐ needs well tag ________ ☐ locking cap: ________ ☐ other comment: ________
☐ DI Water Lot # ________ ☐ MS / MSD ________ ☐ Equip blk ________ ☐ Ambient blk ________ ☑ Trip blk TB-2

2012_1102

# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE	ANALYSIS	SAMPLING EQ. CODE	FLOW RATE
1	PE	250mL	—	BROMIDE	APP	200
1	PE	500mL	—	IODIDE	│	│
2	CG	40mL	—	VFA	│	│

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityade.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: SITE 11
SITE LOCATION: NAS JACKSONVILLE
DATE: 3/23/2017
WELL NO: EKMW-01
SAMPLE ID: EKMW-01
FREE PRODUCT: Y [✓ N]
DEPTH TO PRODUCT (ft BTOC):
FIELD DUPLICATE: Y [✓ N]
DUPLICATE ID: -

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 3/16
WELL SCREEN INTERVAL DEPTH: 18 feet to 23 feet
STATIC DEPTH TO WATER (feet): 5.11
PURGE PUMP TYPE OR BAILER: P. Pump

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21
PURGING INITIATED AT: 1020
PURGING ENDED AT: 1135
TOTAL VOLUME PURGED (gallons): 4.5

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
1030	0.6	0.6	0.06	6.55	5.40	26.1	7.53	0.11	4.15	-62.5	CLEAR	NONE	25.2
1040	0.6	1.2	0.06	6.78	5.40	26.4	6.28	0.08	3.41	-69.1	W/ BLACK SPECKS.	|	6.61
1050	0.6	1.8	0.06	6.78	5.43	26.2	5.56	0.08	2.99	-72.8	|	|	4.26
1100	0.6	2.4	0.06	6.78	5.45	26.1	4.91	0.08	2.62	-76.6	|	|	1.46
1110	0.6	3.0	0.06	6.78	5.47	26.1	4.53	0.07	2.43	-78.1	|	|	1.28
1120	0.6	3.6	0.06	6.78	5.48	26.2	4.26	0.07	2.25	-80.6	|	|	1.06
1125	0.3	3.9	0.06	6.78	5.48	26.2	4.10	0.08	2.19	-80.3	|	|	1.29
1130	0.3	4.2	0.06	6.78	5.49	26.3	4.02	0.08	2.17	-80.0	|	|	1.36
1135	0.3	4.5	0.06	6.78	5.49	26.2	4.00	0.08	2.10	-79.2	|	|	1.01

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: DANIEL BEALL SIES-DAA
SAMPLER(S) SIGNATURE(S): Daniel Beall
SAMPLE TIME: 1135
PUMP OR TUBING DEPTH IN WELL (feet): 21
TUBING MATERIAL CODE: PE
FIELD-FILTERED: Y [✓ N]
FILTER SIZE: - µm
Filtration Equipment Type: -
FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
2	PE	1L	NONE	NGS	APP	230
3	CG	40		CSIA	|	|
2	~~40~~G	40		VFA	|	|
3	CG	40	HCL	8260	|	|
3	CG	40	HCL	MEE	|	|
2	AG	40		TOC	|	|

FIELD EQUIPMENT IDENTIFICATION

H20 QUALITY PARAMETER	
Model: YSI PRO PLUS	SN#: 15L101068
TURBIDIMETER	
Model: 2100Q	SN#: 4123
OTHER	

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% ~~**Dissolved Oxygen**~~: all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) ~~**Turbidity:** all~~ readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater) ORP ± 10 %

☐ well needs repair N ☐ needs well tag N ☐ locking cap: Y ☐ other comment:
☐ DI Water Lot # NA ☐ MS / MSD NA ☐ Equip blk NA ☐ Ambient blk NA ☐ Trip blk NA

2012_1102

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11
SITE LOCATION: NAS Jacksonville
DATE: 23 March 17
WELL NO: EKMW-02
SAMPLE ID: EKMW-02
FREE PRODUCT: Y [✓ N]
DEPTH TO PRODUCT (ft BTOC):
FIELD DUPLICATE: Y [✓ N]
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 3/16
WELL SCREEN INTERVAL DEPTH: feet to feet
STATIC DEPTH TO WATER (feet): 5.34
PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21
PURGING INITIATED AT: 1200
PURGING ENDED AT: 1310
TOTAL VOLUME PURGED (gallons): 4.20

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
1210	0.60	0.60	0.06	7.39	4.65	23.69	3.54	0.34	1.86	-10.9	Clear	NA	19.7
1220	0.60	1.20	0.06	8.18	4.77	23.36	3.38	0.27	1.77	-24.2			11.6
1230	0.60	1.80	0.06	8.44	4.79	23.45	3.28	0.27	1.72	-26.0			8.56
1240	0.60	2.40	0.06	8.57	4.87	23.61	3.19	0.27	1.67	-37.6			8.27
1250	0.60	3.00	0.06	8.56	4.91	23.79	3.00	0.26	1.56	-48.6			6.07
1300	0.60	3.60	0.60	8.61	4.98	24.03	2.93	0.24	1.52	-55.3			6.67
1305	0.30	3.90	0.60	8.58	4.93	24.17	2.90	0.24	1.51	-56.2			6.80
1310	0.30	4.20	0.60	8.56	5.05	24.35	2.28	0.24	1.46	-58.2			7.59

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: A. Hayes / Trinity
SAMPLER(S) SIGNATURE(S): AHayes
SAMPLE TIME: 1311
PUMP OR TUBING DEPTH IN WELL (feet): 21
TUBING MATERIAL CODE: PE
FIELD-FILTERED: Y [✓ N]
Filtration Equipment Type:
FILTER SIZE: _____ µm
FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
2	PE	1L	—	NGS	APP	220
3	CG	40	HCl	CSIA	↓	↓
2	CG	40	—	VFA		
3	CG	40	HCl	8260B		
3	CG	40	HCl	MEE		
2	AG	40	HCl	TOC		

FIELD EQUIPMENT IDENTIFICATION

H20 QUALITY PARAMETER	
Model: YSI 556	SN#: 06G2421
TURBIDIMETER	
Model: HAWK	SN#: 13110C029438
OTHER	

REMARKS: OK to sample

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Perislaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair —
☐ needs well tag —
☐ locking cap: y
☐ other comment: —
☐ DI Water Lot # —
☐ MS / MSD —
☐ Equip blk —
☐ Ambient blk —
☐ Trip blk —

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☑ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11	SITE LOCATION: NAS JAX	DATE: 3/23/17
WELL NO: GKMW-03	SAMPLE ID: GKMW-03	FREE PRODUCT: Y [✓ N] DEPTH TO PRODUCT (ft BTOC):
		FIELD DUPLICATE: Y [✓ N] DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 3/16	WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet	STATIC DEPTH TO WATER (feet): 6.14	PURGE PUMP TYPE OR BAILER: PP

~~**WELL VOLUME PURGE:** 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY~~
(only fill out if applicable)
~~= (feet – feet) x gallons/foot = gallons~~ JBo

~~**EQUIPMENT VOLUME PURGE:** 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME~~
~~(only fill out if applicable)~~
~~= gallons + (gallons/foot x feet) + gallons = gallons~~ JBo

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21	PURGING INITIATED AT: 1138	PURGING ENDED AT: 1304	TOTAL VOLUME PURGED (gallons): 5.10

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
1148	0.6	0.6	0.06	8.56	5.68	25.1	2.28	0.10	1.16	0.2	Colorless	None	49.04
1158	0.6	1.2	0.06	9.66	5.71	25.2	2.28	0.08	1.16	41.1	|	|	50.66
1208	0.6	1.8	0.06	10.20	5.76	25.4	2.21	0.07	1.13	49.0	|	|	38.50
1218	0.6	2.4	0.06	10.63	5.78	25.4	2.13	0.06	1.08	99.6	|	|	20.97
1228	0.6	3.0	0.06	10.73	5.80	25.4	2.07	0.06	1.05	98.2	|	|	19.14
1238	0.6	3.6	0.06	10.88	5.81	25.6	2.02	0.05	1.03	149.8	|	|	14.87
1243	0.3	3.9	0.06	10.88	5.82	25.5	1.98	0.05	1.01	157.0	|	|	12.65
1248	0.3	4.2	0.06	10.88	5.81	25.7	2.01	0.05	1.02	127.1	|	|	11.65
1251	0.18	4.38	0.06	10.88	5.82	25.8	2.00	0.05	1.01	-42.5			10.91

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: John Bowman Trinity	SAMPLER(S) SIGNATURE(S): John Bowman	SAMPLE TIME: 1304
PUMP OR TUBING DEPTH IN WELL (feet): 21	TUBING MATERIAL CODE: PE	FIELD-FILTERED: Y [✓ N] FILTER SIZE: _____ μm Filtration Equipment Type:

FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
3	CG	40	HCl	CSIA	APP	220
2	CG	40	—	VFA	|	|
3	CG	40	HCl	VOC	|	|
3	CG	40	HCl	MEE	|	|
2	AG	40	HCl	TOC	|	

FIELD EQUIPMENT IDENTIFICATION	
H20 QUALITY PARAMETER	
Model: YSI Pro+	SN#: 16A102711
TURBIDIMETER	
Model: MicroTPW	SN#: 201609036
OTHER	

REMARKS: Page 1/2

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**

2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair ~~____~~ ☐ needs well tag ~~____~~ ☐ locking cap: Yes ☐ other comment: ~~____~~

☐ DI Water Lot # ~~____~~ ☐ MS / MSD ~~____~~ ☐ Equip blk ~~____~~ ☐ Ambient blk ~~____~~ ☐ Trip blk ~~____~~

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11
SITE LOCATION: ~~Elmmw-0~~ NAS JAX
DATE: 3/23/17
WELL NO: Elmmw·03
SAMPLE ID: Elmmw-03
FREE PRODUCT: Y N
DEPTH TO PRODUCT (ft BTOC):
FIELD DUPLICATE: Y N
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches):
TUBING DIAMETER (inches):
WELL SCREEN INTERVAL DEPTH: feet to feet
STATIC DEPTH TO WATER (feet):
PURGE PUMP TYPE OR BAILER:

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

See Pg 1

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet):
FINAL PUMP OR TUBING DEPTH IN WELL (feet):
PURGING INITIATED AT:
PURGING ENDED AT:
TOTAL VOLUME PURGED (gallons):

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
1254	0.18	4.56	0.06	10.88	5.83	25.8	1.97	0.05	1.00	-48.2			9.02
1257	0.18	4.74	0.06	10.88	5.83	25.8	1.97	0.05	1.00	-43.0			8.59
1300	0.18	4.92	0.06	10.88	5.84	25.8	1.97	0.05	1.00	-39.6			8.75
1303	0.18	5.10	0.06	10.88	5.84	25.9	1.96	0.05	1.00	40.7			8.94

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016
PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: See PG
SAMPLER(S) SIGNATURE(S):
SAMPLE TIME: 1304
PUMP OR TUBING DEPTH IN WELL (feet):
TUBING MATERIAL CODE:
FIELD-FILTERED: Y N
Filtration Equipment Type:
FILTER SIZE: _____ μm
FIELD DECONTAMINATION: PUMP Y N TUBING Y N (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
			See	PG. 1		

FIELD EQUIPMENT IDENTIFICATION
H20 QUALITY PARAMETER
Model: SN#:
TURBIDIMETER
Model: SN#:
OTHER

REMARKS: Page 2/2

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)
SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair__________ ☐ needs well tag __________ ☐ locking cap: __________ ☐ other comment: __________
☐ DI Water Lot # __________ ☐ MS / MSD __________ ☐ Equip blk __________ ☐ Ambient blk __________ ☐ Trip blk __________

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☑ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11
SITE LOCATION: NAS JAX
DATE: 3/23/17
WELL NO: ЗИМW04
SAMPLE ID: ЗИМW-04
FREE PRODUCT: Y [✓ N]
DEPTH TO PRODUCT (ft BTOC): 0
FIELD DUPLICATE: Y [✓ N]
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 3/16
WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet
STATIC DEPTH TO WATER (feet): 5.33
PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: **1 WELL VOLUME =** (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21
PURGING INITIATED AT: 0951
PURGING ENDED AT: 1101
TOTAL VOLUME PURGED (gallons): 4.2

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
1001	0.6	0.6	0.06	7.52	5.36	25.5	1.83	0.36	0.93	77.2	Particle	none	27.44
1011	0.6	1.2	0.06	8.63	5.37	25.7	1.84	0.14	0.93	66.0	Particle	none	44.27
1021	0.6	1.8	0.06	9.30	5.59	25.9	1.92	0.11	0.97	1.1	Particles	none	24.18
1031	0.6	2.4	0.06	10.66	5.62	26.0	1.79	0.09	0.90	-6.4	Particle	none	15.95
1041	0.6	3.0	0.06	9.87	5.57	26.2	1.70	0.08	0.86	2.9	Particle	none	12.80
1051	0.6	3.6	0.06	9.94	5.55	26.2	1.64	0.08	0.82	2.1	Particle	none	8.84
1056	0.3	3.9	0.06	9.97	5.52	26.2	1.63	0.07	0.82	5.8	Particle	none	8.91
1101	0.3	4.2	0.06	10.00	5.52	26.2	1.61	0.07	0.80	4.5	Particle	none	8.70

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: John Bauman Trinity
SAMPLER(S) SIGNATURE(S): John Bauman
SAMPLE TIME: 1102
PUMP OR TUBING DEPTH IN WELL (feet): 21
TUBING MATERIAL CODE: PE
FIELD-FILTERED: Y [✓ N]
Filtration Equipment Type:
FILTER SIZE: ______ μm

FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
2	CG	40	—	VFA	APP	220
3	CG	40	HCl	VOC	|	|
3	CG	40	HCl	MEE	|	|
2	AG	40	HCl	TOC		

FIELD EQUIPMENT IDENTIFICATION

H20 QUALITY PARAMETER	
Model: YSI Pro +	SN#: 16A102711
TURBIDIMETER	
Model: MicroTPW	SN#: 201609036
OTHER	

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: **1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair —
☐ needs well tag —
☐ locking cap: yes
☐ other comment: —
☐ DI Water Lot # —
☐ MS / MSD —
☐ Equip blk —
☐ Ambient blk —
☐ Trip blk —

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11
SITE LOCATION: NAS Jacksonville
DATE: 23 March17
WELL NO: EKMW-05
SAMPLE ID: EKMW-05
FREE PRODUCT: Y [✓ N]
DEPTH TO PRODUCT (ft BTOC):
FIELD DUPLICATE: Y [✓ N]
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 3/16
WELL SCREEN INTERVAL DEPTH: feet to feet
STATIC DEPTH TO WATER (feet): 5.29
PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – NA feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21
PURGING INITIATED AT: 0800
PURGING ENDED AT: 0910
TOTAL VOLUME PURGED (gallons): 4.20

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (ºC)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
0810	0.60	0.60	0.06	5.79	4.88	23.07	5.62	0.85	3.05	27.4	Clear	NA	20.8
0820	0.60	1.20	0.06	5.83	4.74	23.68	5.25	0.55	2.82	9.4	Clear	NA	15.9
0830	0.60	1.80	0.06	5.92	4.80	24.08	4.15	0.40	2.19	4.6	↓	↓	9.74
0840	0.60	2.40	0.06	5.99	4.87	24.04	3.29	0.34	1.71	1.5			5.58
0850	0.60	3.00	0.06	6.06	4.76	24.40	2.54	0.31	1.31	4.76			4.74
0900	0.60	3.60	0.06	6.17	4.80	24.73	2.24	0.31	1.55	1.20			4.47
0905	0.30	3.90	0.06	6.17	4.81	24.83	2.13	0.29	1.09	4.40			3.93
0910	0.30	4.20	0.06	6.18	4.80	24.90	2.08	0.27	1.06	4.90			3.30

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: A. Hayes / Trinity
SAMPLER(S) SIGNATURE(S): AHayes
SAMPLE TIME: 0911
PUMP OR TUBING DEPTH IN WELL (feet): 21
TUBING MATERIAL CODE: PE
FIELD-FILTERED: Y [✓ N] Filtration Equipment Type:
FILTER SIZE: _____ µm
FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
2	PE	1L	—	NGS	APP	220
3	CG	40	HCl	CSIA	↓	↓
2	CG	40	—	VFAs		
3	CG	40	HCl	8260B		
3	CG	40	HCl	MEE		
2	AG	40	HCl	TOC		

FIELD EQUIPMENT IDENTIFICATION
H20 QUALITY PARAMETER
Model: YSI 556 SN#: 06G2421
TURBIDIMETER
Model: M-HAWK SN#: 13110C029438
OTHER

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 ºC **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair — ☐ needs well tag — ☐ locking cap: y ☐ other comment: —
☐ DI Water Lot # — ☐ MS / MSD — ☐ Equip blk — ☐ Ambient blk — ☐ Trip blk —

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☑ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11	SITE LOCATION: NAS JAX	DATE: 3/23/17
WELL NO: EKMW-7	SAMPLE ID: ~~JAXH~~ EKMW-07	FREE PRODUCT: Y [✓ N] DEPTH TO PRODUCT (ft BTOC):
FIELD DUPLICATE: Y [✓ N] DUPLICATE ID:		

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 3/16	WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet	STATIC DEPTH TO WATER (feet): 5.18	PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21	PURGING INITIATED AT: 0800	PURGING ENDED AT: 0913	TOTAL VOLUME PURGED (gallons): 4.38

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
0810	0.6	0.6	0.06	8.66	5.48	25.1	3.68	0.43	1.93	15.8	CLR	none	20.64
0820	0.6	1.2	0.06	8.78	5.52	25.2	3.68	0.22	1.94	4.9	CLR	none	19.21
0830	0.6	1.8	0.06	9.57	5.65	25.4	3.76	0.16	1.98	-24.9	CLR	none	27.49
0840	0.6	2.4	0.06	9.92	5.72	25.6	3.75	0.14	1.97	-45.5	CLR	none	33.07
0850	0.6	3.0	0.06	10.14	5.78	25.7	3.64	0.12	1.91	-56.8	Particles	none	38.18
0900	0.6	3.6	0.06	10.31	5.84	25.7	3.47	0.11	1.82	-67.4	Particles	none	34.62
0905	0.3	3.9	0.06	10.41	5.85	25.8	3.38	0.11	1.77	-70.9	Particles	none	28.43
0910	0.3	4.2	0.06	10.49	5.85	25.8	3.33	0.11	1.74	-72.2	Particles	none	25.56
0913	0.18	4.38	0.06	10.49	5.87	25.7	3.26	0.10	1.70	-74.5	Particles	none	23.88

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: John Bowman Trinity	SAMPLER(S) SIGNATURE(S): John Bowman	SAMPLE TIME: 0914
PUMP OR TUBING DEPTH IN WELL (feet): 21	TUBING MATERIAL CODE: PE	FIELD-FILTERED: Y [✓ N] FILTER SIZE: ____ µm Filtration Equipment Type:

FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
2	~~1000~~	1000	—	NGS	APP	220
2	~~40G~~	40	—	VFA	|	|
3	CG	40	HCl	VOC	|	|
3	CG	40	HCl	MEE	|	|
2	AG	40	HCl	TOC	|	|

FIELD EQUIPMENT IDENTIFICATION	
H20 QUALITY PARAMETER	
Model: YSI Pro+	SN#: 16A102711
TURBIDIMETER	
Model: MicroTPW	SN#: 201609036
OTHER	

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair — ☐ needs well tag — ☐ locking cap: yes ☐ other comment: —
☐ DI Water Lot # — ☐ MS / MSD — ☐ Equip blk — ☐ Ambient blk — ☐ Trip blk —

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11
SITE LOCATION: NAS Jacksonville
DATE: 23 March 17
WELL NO: EKMW-09
SAMPLE ID: EKMW-09
FREE PRODUCT: Y [✓ N]
DEPTH TO PRODUCT (ft BTOC):
FIELD DUPLICATE: Y [✓ N]
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 3/16
WELL SCREEN INTERVAL DEPTH: feet to feet
STATIC DEPTH TO WATER (feet): 5.53
PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

NA

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21
PURGING INITIATED AT: 0945
PURGING ENDED AT: 1055
TOTAL VOLUME PURGED (gallons): 4.20

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
0955	0.60	0.00	0.06	9.02	4.03	24.86	3.55	2.86	1.84	84.3	Clear	NA	26.5
1005	0.60	1.20	0.06	10.38	4.11	24.93	3.86	2.51	2.04	70.4	↓	↓	26.4
1015	0.60	1.80	0.06	11.46	3.92	25.04	4.66	2.12	2.49	69.2			19.1
1025	0.60	2.40	0.06	12.21	3.90	25.17	5.02	1.86	2.69	68.9			22.4
1035	0.60	3.00	0.06	12.74	3.78	25.09	5.68	1.54	3.07	70.5			25.2
1045	0.60	3.60	0.06	13.42	3.83	25.64	5.49	1.66	2.96	67.1			60.7
1050	0.30	3.90	0.06	13.95	3.85	25.68	5.55	1.53	3.00	63.6			63.2
1055	0.30	4.20	0.06	14.19	3.83	25.67	5.65	1.46	3.05	62.3			61.9

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016
PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: A. Hayes / Trinity
SAMPLER(S) SIGNATURE(S):
SAMPLE TIME: 1056
PUMP OR TUBING DEPTH IN WELL (feet): 21
TUBING MATERIAL CODE: PE
FIELD-FILTERED: [✓ Y] N
FILTER SIZE: _____ µm
Filtration Equipment Type:
FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
4	PE	1L	—	NGS	APP	220
3	CG	40	HCl	8260B	↓	↓
2	AG	40	HCl	TOC		
1	PE	1L	—	TDS, Alk 300 EPA		
1	PE ~~250~~	250	HNO3	6010C		
3	CG	40	HCl	1-4 Dioxane		

REMARKS: 1 PE / 250 / HNO3 / Diss Fe Mn
OK to sample

FIELD EQUIPMENT IDENTIFICATION
H20 QUALITY PARAMETER
Model: YSI 556 SN#: 06G2421
TURBIDIMETER
Model: HAWK SN#: 13110C029438
OTHER

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; O = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair — ☐ needs well tag — ☐ locking cap: y ☐ other comment: —
☐ DI Water Lot # — ☐ MS / MSD — ☐ Equip blk — ☐ Ambient blk — ☐ Trip blk —

1 PE 250 — ortho ~~or TOTP~~ APP 220 / 1 PE 125 H2SO4 Tot P
2 PE 250 NaOH ZnAc S ↓ ↓

2012_1102

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: SITE 11
SITE LOCATION: NAS JACKSONVILLE
DATE: 3/23/2017
WELL NO: EKMW-10
SAMPLE ID: EKMW-10
FREE PRODUCT: Y [✓ N]
DEPTH TO PRODUCT (ft BTOC):
FIELD DUPLICATE: Y [✓ N]
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 3/16
WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet
STATIC DEPTH TO WATER (feet): 5.30
PURGE PUMP TYPE OR BAILER: P. Pump

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21
PURGING INITIATED AT: 0815
PURGING ENDED AT: 0930
TOTAL VOLUME PURGED (gallons): 4.5

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
0825	0.6	0.6	0.06	7.80	6.11	24.8	3.10	0.63	1.61	-15.4	CLOUDY	NONE	75.8
0835	0.6	1.2	0.06	9.22	5.86	25.0	2.01	0.55	1.57	1.1	|	|	37.6
0845	0.6	1.8	0.06	10.64	5.57	25.1	2.89	0.52	1.50	20.5	|	|	18.5
0855	0.6	2.4	0.06	11.47	5.46	25.1	2.80	0.50	1.43	25.6	|	|	18.9
0905	0.6	3.0	0.06	12.50	5.38	25.2	2.70	0.51	1.39	28.3	CLEAR	|	19.2
0915	0.6	3.6	0.06	13.08	5.34	25.3	2.59	0.29	1.33	28.3	|	|	9.85
0920	0.3	3.9	0.06	13.22	5.34	25.2	2.59	0.27	1.33	29.5	|	|	12.7
0925	0.3	4.2	0.06	13.22	5.32	25.1	2.55	0.24	1.31	30.1	|	|	10.5
0930	0.3	4.5	0.06	13.22	5.30	25.2	2.53	0.24	1.20	29.8	|	|	10.4

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: DANIEL BEALL SIES-DAA
SAMPLER(S) SIGNATURE(S): Daniel Beall
SAMPLE TIME: 0930
PUMP OR TUBING DEPTH IN WELL (feet): 21
TUBING MATERIAL CODE: PE
FIELD-FILTERED: Y [✓ N]
Filtration Equipment Type: —
FILTER SIZE: — µm
FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
3	CG	40	HCL	8260	APP	220
1	PE	1L	NONE	TDS	|	|
1	PE	250	HNO3	6010	|	|
4	PE	1L	NONE	NGS	|	|

FIELD EQUIPMENT IDENTIFICATION

H20 QUALITY PARAMETER	
Model: YSI PRO PLUS	SN#: 15L101068
TURBIDIMETER	
Model: 2100Q	SN#: 4123
OTHER	

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: **1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% ~~**Dissolved Oxygen**~~: all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
~~**Turbidity**~~: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater) ORP ± 10%

☐ well needs repair N ☐ needs well tag N ☐ locking cap: Y ☐ other comment:
☐ DI Water Lot # NA ☐ MS / MSD NA ☐ Equip blk NA ☐ Ambient blk NA ☐ Trip blk NA

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: SITE 11
SITE LOCATION: NAS JACKSONVILLE
DATE: 3/23/2017
WELL NO: EKMW-11
SAMPLE ID: EKMW-11
FREE PRODUCT: Y [✓ N]
DEPTH TO PRODUCT (ft BTOC):
FIELD DUPLICATE: Y [✓ N]
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 3/16
WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet
STATIC DEPTH TO WATER (feet): 5.26
PURGE PUMP TYPE OR BAILER: P. Pump

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH − STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet − feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21
PURGING INITIATED AT: 1245
PURGING ENDED AT:
TOTAL VOLUME PURGED (gallons):

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
1255	0.6	0.6	0.06	7.61	5.03	25.1	6.30	0.22	3.45	100.6	CLEAR	NONE	78.8
1305	0.6	1.2	0.06	10.15	4.99	25.0	6.33	0.17	3.45	101.5	W/ BROWN SPECKS		69.7
1315	0.6	1.8	0.06	11.86	5.05	25.2	6.30	0.10	3.43	102.8			45.9
1325	0.6	2.4	0.06	12.58	5.09	25.3	6.28	0.09	3.42	104.2			40.8
1335	0.6	3.0	0.06	13.09	5.13	25.3	6.37	0.09	3.49	106.8			31.3
1345	0.6	3.6	0.06	13.66	5.17	25.3	6.46	0.09	3.52	108.6			23.0
1350	0.3	3.9	0.06	13.87	5.20	25.4	6.80	0.09	3.64	110.8			19.7
1355	0.3	4.2	0.06	14.12	5.22	25.4	6.82	0.09	3.73	112.6			15.8
1400	0.3	4.5	0.06	14.26	5.23	25.4	6.79	0.09	3.78	113.5			13.9

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Daniel BEALL SIES-DAA
SAMPLER(S) SIGNATURE(S): Daniel Beall
SAMPLE TIME:
PUMP OR TUBING DEPTH IN WELL (feet): 21
TUBING MATERIAL CODE: PE
FIELD-FILTERED: [✓ Y] N
FILTER SIZE: 0.45 µm
Filtration Equipment Type: INLINE
FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
3	CG	40	HCL	8260	APP	240
2	AG	40	HCL	TOC		
1	PE	1L	NONE	TDS SULFATE CHLORIDE BROMIDE, NITRITE, NITRATE		
1	PE	250	HNO_3	6010 K Na Ca Mg		
3	CG	40	HCL	1-4 DIOXANE		
1	PE	250	HNO_3	6010 FILTERED		
REMARKS: 1 1	250 125	PE PP	NONE	4500 P-6		

FIELD EQUIPMENT IDENTIFICATION

H20 QUALITY PARAMETER
Model: YSI PRO PLUS
SN#: 15L101068

TURBIDIMETER
Model: 2100 a
SN#: 4123

OTHER

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair N ☐ needs well tag N ☐ locking cap: Y ☐ other comment: –
☐ DI Water Lot # NA ☐ MS / MSD NA ☐ Equip blk NA ☐ Ambient blk NA ☐ Trip blk NA

2 | PE | 250 | NaOH | SULFIDE | APP | 240 |

2012_1102

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF [✓ NOT APPLICABLE (NO SYSTEM)]

SITE NAME: Site 11
SITE LOCATION: NAS Jacksonville
DATE: 6/13/17
WELL NO: Ehkqw - 01
SAMPLE ID: Ehmw - 01
FREE PRODUCT: Y [✓ N]
DEPTH TO PRODUCT (ft BTOC):
FIELD DUPLICATE: Y [✓ N]
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 3/16
WELL SCREEN INTERVAL DEPTH: 18 feet to 23 feet
STATIC DEPTH TO WATER (feet): 4.05
PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons JB

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons JB

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21
PURGING INITIATED AT: 0814
PURGING ENDED AT: 0924
TOTAL VOLUME PURGED (gallons): 4.2

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
0824	0.6	0.6	0.06	5.69	6.32	28.1	3.41	0.12	1.79	-136	light brown	none	44.6
0834	0.6	1.2	0.06	5.63	5.77	28.1	6.31	0.27	3.44	-155	clear	none	19.3
0844	0.6	1.8	0.06	5.69	5.67	27.9	6.30	1.07	3.41	-161	clear	none	15.5
0854	0.6	2.4	0.06	5.74	5.67	28.0	6.13	1.12	3.32	-161	clear	none	13.7
0904	0.6	3.0	0.06	5.79	5.69	28.0	6.05	1.14	3.27	-161	clear	none	12.5
0914	0.6	3.6	0.06	5.96	5.72	28.1	5.91	1.16	3.19	-162.5	clear	none	9.85
0919	0.3	3.9	0.06	5.96	5.74	28.3	5.86	1.16	3.16	-164	clear	none	9.63
0924	0.3	4.2	0.06	5.96	5.76	28.3	5.81	1.16	3.12	-161	clear	none	11.1

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016
PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: John Bowman Trinity
SAMPLER(S) SIGNATURE(S): John Bowman
SAMPLE TIME: 0925
PUMP OR TUBING DEPTH IN WELL (feet): 21
TUBING MATERIAL CODE: PE
FIELD-FILTERED: [✓ Y] N
FILTER SIZE: 0.1 µm
Filtration Equipment Type:
FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
4	CG	40	NaOH	CSIA	APP	230.
1	PE	1000	—	NGS		
1	PE	1000	—	Dhc, Dhb, VrcA		
2	CG	40	—	VFA		
1	PE	500	HNO3	Diss Fe Mn		
1	PE	500	HNO3	Ca Mg K		
REMARKS: 1	PE	250	—	Chl, Bro, SO4		

FIELD EQUIPMENT IDENTIFICATION
H20 QUALITY PARAMETER
Model: YSI Pro+ SN#: 15A101477
TURBIDIMETER
Model: LaMotte SN#: 5239-0815
OTHER

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair — ☐ needs well tag ☐ locking cap: — ☐ other comment: —
☐ DI Water Lot # — ☐ MS / MSD — ☐ Equip blk — ☐ Ambient blk ☐ Trip blk —

2	AG	40	HCl	TOC
3	CG	40	HCl	MEE
3	CG	40	HCl	VOC

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☒ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11
SITE LOCATION: NAS Jacksonville
DATE: 12 Jun 17
WELL NO: EKMW-02
SAMPLE ID: EKMW-02
FREE PRODUCT: Y [✓ N]
DEPTH TO PRODUCT (ft BTOC):
FIELD DUPLICATE: Y [✓ N]
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 3/16
WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet
STATIC DEPTH TO WATER (feet): 5.83
PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only ~~fill out if applicable~~)
= (feet – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = ~~PUMP VOLUME + (TUBING~~ CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = ~~gallons~~

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21
PURGING INITIATED AT: 1013
PURGING ENDED AT: 1123
TOTAL VOLUME PURGED (gallons): 4.20

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
1033	1.20	1.20	0.06	7.15	6.03	27.9	3.12	0.56	1.62	-48.6	Clear	NA	13.28
1043	0.60	1.80	0.06	7.10	6.10	28.0	3.01	0.57	1.56	-46.7	↓	↓	14.50
1053	0.60	2.40	0.06	7.21	6.26	28.2	2.91	0.62	1.50	-90.5			6.50
1103	0.60	3.00	0.06	7.22	6.23	28.1	2.87	0.61	1.48	-82.6			7.33
1113	0.60	3.60	0.06	7.23	6.30	28.2	2.75	0.65	1.42	-71.5			6.07
1118	0.30	3.90	0.06	7.28	6.38	28.2	2.71	0.70	1.39	-69.2			3.21
1123	0.30	4.20	0.06	7.30	6.42	28.2	2.66	0.69	1.37	-70.0			3.62

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016
PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: A. Hays / Trinity
SAMPLER(S) SIGNATURE(S): AHays
SAMPLE TIME: 1124 ~~15L102933~~
PUMP OR TUBING DEPTH IN WELL (feet): 21
TUBING MATERIAL CODE: PE
FIELD-FILTERED: [✓ Y] N
Filtration Equipment Type: 0.1 µm
FILTER SIZE: _____ µm
FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
3	CG	40	HCl	VOC	APP	330
3	CG	↓	↓	MEE	↓	↓
2	AG			TOC		
1	PE	500	HNO3	Ca Mg K		
1	PE	500	HNO3	Diss MnFe		
1	PE	250	~~CHL BROW~~	CHL BRO SO4		

REMARKS: 2 CG 40 — VFA ↓ ↓

FIELD EQUIPMENT IDENTIFICATION
H20 QUALITY PARAMETER
Model: YSI proplus SN#: 15L102933
TURBIDIMETER
Model: Micro SN#: 201609036
OTHER

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES:
1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair — ☐ needs well tag — ☐ locking cap: — ☐ other comment: —
☐ DI Water Lot # — ☐ MS / MSD — ☐ Equip blk — ☐ Ambient blk — ☐ Trip blk —

4 CG 40 — CSIA ↓ ↓
1 PE 1L — Dhc Dhb VCrA

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☒ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11
SITE LOCATION: NAS JAX
DATE: 6/12/17
WELL NO: EKMW-03
SAMPLE ID: EKMW-03
FREE PRODUCT: Y [✓ N]
DEPTH TO PRODUCT (ft BTOC): 0
FIELD DUPLICATE: Y [✓ N]
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 3/16
WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet
STATIC DEPTH TO WATER (feet): 5.63
PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons NA

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons NA

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21
PURGING INITIATED AT: 1017
PURGING ENDED AT: 1127
TOTAL VOLUME PURGED (gallons): 4.2

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
1027	0.6	0.6	0.06	6.91	5.82	28.3	2.80	0.52	1.44	-69.8	clear	none	115
1037	0.6	1.2	0.06	7.53	5.90	28.2	2.76	1.27	1.42	-70.9	clear	none	18.1
1047	0.6	1.8	0.06	7.82	6.01	28.3	2.74	1.33	1.41	-74.6	clear	none	17.0
1057	0.6	2.4	0.06	8.02	6.06	28.6	2.69	1.41	1.38	-80.6	clear	none	15.8
1107	0.6	3.0	0.06	8.10	6.18	28.2	2.61	1.46	1.34	-784	clear	none	16.6
1117	0.6	3.6	0.06	8.10	6.21	28.4	2.48	1.45	1.27	-77.2	clear	none	15.9
1122	0.3	3.9	0.06	8.10	6.28	28.4	2.41	1.44	1.23	-77.8	clear	none	8.90
1127	0.3	4.2	0.06	8.10	6.29	28.4	2.35	1.44	1.20	-787	clear	none	18.5

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016
PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: John Bowman Trinity
SAMPLER(S) SIGNATURE(S): John Bowman
SAMPLE TIME: 1128
PUMP OR TUBING DEPTH IN WELL (feet): 21
TUBING MATERIAL CODE: PE
FIELD-FILTERED: Y [✓ N] Filtration Equipment Type:
FILTER SIZE: 0.1 µm
FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
3	CG	40	HCl	VOC	APP	>400
3	CG	40	HCl	MEE		
2	AG	40	HCl	TOC		
1	PE	500	HNO3	Ca, Mg, K		
1	PE	250		[illegible]		
1	PE	500	HNO3	Diss Fe, Mn		
	CG	40	None	VFA		
4	CG	40	NaOH	CSIA		

REMARKS:

FIELD EQUIPMENT IDENTIFICATION
H20 QUALITY PARAMETER
Model: YSI Pro+ SN#: 15A101477
TURBIDIMETER
Model: LaMotte SN#: 5239-0518
OTHER

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump;
RFPP = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES:
1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair ☐ needs well tag ☐ locking cap: ☐ other comment:
☐ DI Water Lot # ☐ MS / MSD ☐ Equip blk ☐ Ambient blk ☐ Trip blk

1 PE 1000 none Dhc Dhb, vcrA, APP >400

2012_1102

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☒ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11
SITE LOCATION: NAS JAX
DATE: 6/12/17
WELL NO: 11MW-04
SAMPLE ID: 11MW-04
FREE PRODUCT: Y [✓ N]
DEPTH TO PRODUCT (ft BTOC): 0
FIELD DUPLICATE: Y [✓ N]
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 3/16
WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet
STATIC DEPTH TO WATER (feet): 4.52
PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = JB gallons

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = JB gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21
PURGING INITIATED AT: 1229
PURGING ENDED AT: 1339
TOTAL VOLUME PURGED (gallons): 4.2

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
1239	0.6	0.6	0.06	6.91	7.39	27.7	1.06	1.08	0.52	-94.7	clear	none	24.03
1249	0.6	1.2	0.06	7.70	7.81	27.5	1.14	1.10	0.56	-172.8	clear	none	19.16
1259	0.6	1.8	0.06	8.34	7.75	27.5	1.48	1.26	0.74	-187	clear	none	19.19
1309	0.6	2.4	0.06	8.63	7.54	27.6	1.54	1.30	0.77	-182.5	clear	none	18.85
1319	0.6	3.0	0.06	8.82	7.30	27.5	1.52	1.30	0.76	-180.6	clear	none	10.92
1329	0.6	3.6	0.06	8.93	7.14	27.3	1.52	1.41	0.76	-177.8	clear	none	8.08
1334	0.3	3.9	0.06	8.97	7.05	27.4	1.52	1.48	0.76	-176	clear	none	8.54
1339	0.3	4.2	0.06	8.97	6.95	27.4	1.52	1.52	0.76	-173.1	clear	none	7.96

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: John Brown Trinity
SAMPLER(S) SIGNATURE(S): John Brown
SAMPLE TIME: 1340
PUMP OR TUBING DEPTH IN WELL (feet): 21
TUBING MATERIAL CODE: PE
FIELD-FILTERED: [✓ Y] N
FILTER SIZE: 0.1 μm
Filtration Equipment Type:
FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

FIELD EQUIPMENT IDENTIFICATION

H20 QUALITY PARAMETER
Model: YSI Prof SN#: 15C102933
TURBIDIMETER
Model: MicroTPW SN#: 201609B6
OTHER

# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED	INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
3	CG	40	HCl	VOC	APP	> 400
3	CG	40	HCl	MEE		
2	AG	40	HCl	TOC		
1	PE	500	HNO3	Ca, Mg, K		
1	PE	250	—	Chl, Br, SO4		
1	PE	500	HNO3	Diss Fe, Mn		

REMARKS:

2	CG	40		VFA
4	CG	40	NaOH	CSIA

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is gr
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair — ☐ needs well tag — ☐ locking cap: — ☐ other comment: —
☐ DI Water Lot # — ☐ MS / MSD — ☐ Equip blk — ☐ Ambient blk ✓ ☐ Trip blk —

1 PE 1000 none Dhc, Dhb, vcrA APP >400

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☒ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11	SITE LOCATION: NAS Jacksonville		DATE: 12 June 17
WELL NO: EKMN-05	SAMPLE ID: EKMN-05	FREE PRODUCT: Y [✓ N] DEPTH TO PRODUCT (ft BTOC):	FIELD DUPLICATE: Y [✓ N] DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 3/16	WELL SCREEN INTERVAL DEPTH: 10 feet to 24 feet	STATIC DEPTH TO WATER (feet): 4.77	PURGE PUMP TYPE OR BAILER: PP

~~WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY (only fill out if applicable) = (feet – feet) x gallons/foot = gallons~~

~~EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME (only fill out if applicable) = gallons + (gallons/foot x feet) + gallons = gallons~~ BN

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21	PURGING INITIATED AT: 0812	PURGING ENDED AT: 0922	TOTAL VOLUME PURGED (gallons): 4.20

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
0822	0.60	0.60	0.06	5.10	5.40	27.8	7.04	1.56	3.84	11.1	Clear	NA	23.8
0832	0.60	0.00	0.06	5.16	5.44	27.8	6.94	0.73	3.78	-0.5	↓	↓	17.16
0842	0.60	1.80	0.06	5.21	5.51	27.7	6.68	0.55	3.68	-11.3			20.04
0852	0.60	2.40	0.06	5.21	5.59	27.7	6.32	0.47	3.43	-20.5			18.93
0902	0.60	3.00	0.06	5.21	5.69	27.7	5.90	0.46	3.19	-29.1			26.97
0912	0.60	3.60	0.06	5.21	5.70	27.6	5.58	0.45	3.00	-35.6			8.74
0917	0.30	3.90	0.06	5.21	5.72	27.6	5.31	0.44	2.87	-38.6			19.56
0922	0.30	4.20	0.06	5.21	5.71	27.6	5.25	0.45	2.80	-39.3			14.08

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: A. Hayes / Trinity	SAMPLER(S) SIGNATURE(S):	SAMPLE TIME: 0923
PUMP OR TUBING DEPTH IN WELL (feet): 21	TUBING MATERIAL CODE:	FIELD-FILTERED: [✓ Y] N FILTER SIZE: ____ µm Filtration Equipment Type: 0.1µm

FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N](replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
4	CG	40	NaOH	CSIA	APP	230
1	PE	1L	—	NGS	↓	↓
1	PE	1L	—	DNC Dhb VFCA		
2	CG	40	—	VFA		
1	PE	500	HNO3	Diss MnFe		
1	PE	500	HNO3	CaMgK		
1	PE	250	—	CHL BRO SO4		

FIELD EQUIPMENT IDENTIFICATION

H20 QUALITY PARAMETER
Model: YSI proplus SN#: 15L102933

TURBIDIMETER
Model: Micro SN#: 201609036

OTHER

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair ______ ☐ needs well tag ______ ☐ locking cap: ______ ☐ other comment: ______
☐ DI Water Lot # ______ ☐ MS / MSD ______ ☐ Equip blk ______ ☐ Ambient blk ______ ☐ Trip blk ______

2	AG	40	HCl	TOC	↓	↓	0
3	CG	40	HCl	MEE			
3	CG	40	HCl	VOC			

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityade.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☑ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11	SITE LOCATION: NAS JAX	DATE: 6/12/17
WELL NO: 4UMW-07 SAMPLE ID: 4UMW-07	FREE PRODUCT: Y [✓ N] DEPTH TO PRODUCT (ft BTOC):	FIELD DUPLICATE: Y [✓ N] DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 3/16	WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet	STATIC DEPTH TO WATER (feet): 3.40	PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons JB

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons JB

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 23	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 23	PURGING INITIATED AT: 0813	PURGING ENDED AT: 0923	TOTAL VOLUME PURGED (gallons): 4.2

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
0823	0.6	0.6	0.06	6.42	6.30	27.4	6.32	0.29	3.43	-76.9	clear	none	3.82
0833	0.6	1.2	0.06	8.10	6.30	27.3	6.30	0.17	3.55	-88.7	clear	none	2.03
0843	0.6	1.8	0.06	8.05	6.25	27.4	6.65	0.28	3.61	-93.4	clear	none	3.41
0853	0.6	2.4	0.06	8.13	6.20	27.4	6.58	0.65	3.58	-94.7	clear	none	5.11
0903	0.6	3.0	0.06	8.26	6.20	27.4	6.42	0.84	3.48	-95.9	clear	none	4.08
0913	0.6	3.6	0.06	8.30	6.20	27.3	6.13	0.96	3.30	-93.4	clear	none	5.86
0918	0.3	3.9	0.06	8.30	6.23	27.4	5.96	0.98	3.21	-90.8	clear	none	3.98
0923	0.3	4.2	0.06	8.30	6.25	27.4	5.84	0.98	3.15	-88.4	clear	none	4.64

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016
PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: John Bowman Trinity	SAMPLER(S) SIGNATURE(S): John Bowman	SAMPLE TIME: 0924
PUMP OR TUBING DEPTH IN WELL (feet): 21	TUBING MATERIAL CODE: PE FIELD-FILTERED: [✓ Y] N Filtration Equipment Type:	FILTER SIZE: 0.1 µm

FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
3	CG	40	HCl	VOCs	APP	>400
3	CG	40	HCl	MEE	APP	>400
2	AG	40	HCl	TOC	APP	>400
1	PE	250	HNO3	Ca, Mg, K	APP	>400
1	PE	250	None	Chl, Br, SO4	APP	>400
1	PE	250	HNO3	Fe(aq) Mn	APP	>400
4	CG	40	none	VFA	APP	>400
	CG	40	NaOH	CSIA	APP	>400

REMARKS:

FIELD EQUIPMENT IDENTIFICATION

H20 QUALITY PARAMETER	
Model: YSI Pro+	SN#: 15A101477
TURBIDIMETER	
Model: LaMotte	SN#: 5239-0515
OTHER	

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)

SAMPLING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); O = Other (Specify)

NOTES:
1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair ____ ☐ needs well tag ____ ☐ locking cap: ____ ☐ other comment: ____
☐ DI Water Lot # ____ ☐ MS / MSD ____ ☐ Equip blk ____ ☐ Ambient blk ____ ☐ Trip blk ____

1 PE 1000 none ~~Alk~~ Alk, Sulf, VFA APP >400

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☒ NOT APPLICABLE (NO SYSTEM)

SITE NAME: Site 11
SITE LOCATION: NAS Jacksonville
DATE: 12Jun17
WELL NO: EKMW-08
SAMPLE ID: EKMW-08
FREE PRODUCT: Y [✓ N]
DEPTH TO PRODUCT (ft BTOC):
FIELD DUPLICATE: Y [✓ N]
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 3/16
WELL SCREEN INTERVAL DEPTH: 10 feet to 23 feet
STATIC DEPTH TO WATER (feet): 4.51
PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out ~~if applicable)~~
~~= (feet – feet) x gallons/foot = gallons~~

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (~~TUBING CAPACITY x TUBING LENGTH~~) + FLOW CELL VOLUME
(only fill out if applicable)
~~= gallons + (gallons/foot x feet) + gallons = gallons~~

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21
PURGING INITIATED AT: 1257
PURGING ENDED AT: 1407
TOTAL VOLUME PURGED (gallons): 4.20

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
1307	0.60	0.60	0.06	6.41	5.32	27.4	5.82	0.99	3.13	2.6	Clear	NA	27.6
1317	0.60	1.20	0.06	7.05	5.47	27.4	4.95	1.06	4.97	-25.6	│	│	28.8
1327	0.60	1.80	0.06	7.50	5.49	27.3	4.25	1.08	2.24	-42.6	│	│	40.5
1337	0.60	2.40	0.06	8.15	5.46	27.3	3.95	1.11	2.07	-50.6	│	│	34.1
1347	0.60	3.00	0.06	8.71	5.42	274	3.78	1.15	1.98	-56.4	│	│	22.4
1357	0.60	3.60	0.06	9.37	5.40	27.1	3.68	1.17	1.93	-54.8	│	│	21.3
1402	0.30	3.90	0.06	9.51	5.40	27.0	3.61	1.19	1.89	-54.5	│	│	19.1
1407	0.30	4.20	0.06	9.55	5.38	27.0	3.58	1.19	1.88	-57.0	↓	↓	13.4

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016
PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: A. Hays | Trinity
SAMPLER(S) SIGNATURE(S): AHays
SAMPLE TIME: 1408
PUMP OR TUBING DEPTH IN WELL (feet): 21
TUBING MATERIAL CODE: PE
FIELD-FILTERED: [✓ Y] N
FILTER SIZE: ____ µm
Filtration Equipment Type: 0.1µm
FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION # CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED	INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
3	CG	40	HCl	VOC	APP	230
2	AG	40	~~TOC~~ HCl	TOC	│	│
1	PE	500	HNO3	CaMg	│	│
1	PE	250	—	Cl Br SO4	│	│
1	PE	500	HNO3	Diss Fe, Mn	↓	↓
~~1~~	~~PE~~	~~1L~~		~~NGS~~	AH	

FIELD EQUIPMENT IDENTIFICATION
H20 QUALITY PARAMETER
Model: YSI proplus SN#: 15A101477
TURBIDIMETER
Model: Micro SN#: 201609036
OTHER

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; O = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair ____—____ ☐ needs well tag ____—____ ☐ locking cap: ____—____ ☐ other comment: ____—____
☐ DI Water Lot # ____—____ ☐ MS / MSD ____—____ ☐ Equip blk ____—____ ☐ Ambient blk ____—____ ☐ Trip blk ____—____

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: SITE 11	SITE LOCATION: NAS JACKSONVILLE	DATE: 6/12/17
WELL NO: EKMW-09	SAMPLE ID: EKMW-09	FREE PRODUCT: Y [✓ N] DEPTH TO PRODUCT (ft BTOC):
		FIELD DUPLICATE: Y [✓ N] DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 3/16	WELL SCREEN INTERVAL DEPTH: feet to feet	STATIC DEPTH TO WATER (feet): 5.32	PURGE PUMP TYPE OR BAILER: PP

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

DB

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21	PURGING INITIATED AT: 0825	PURGING ENDED AT: 0945	TOTAL VOLUME PURGED (gallons): 4.8

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
0835	0.6	0.6	0.06	8.93	5.63	27.8	3.05	0.13	1.57	62.2	CLEAR	NONE	12.6
0845	0.6	1.2	0.06	10.38	5.53	27.8	3.48	0.43	1.82	75.0	|	|	15.8
0855	0.6	1.8	0.06	11.07	5.26	27.9	4.76	0.51	2.54	93.4	|	|	12.1
0905	0.6	2.4	0.06	11.77	5.24	27.8	4.76	0.50	2.53	102.2	|	|	15.2
0915	0.6	3.0	0.06	12.31	5.21	27.8	4.88	0.55	2.56	103.3	|	|	16.6
0925	0.6	3.6	0.06	12.94	5.08	27.7	5.39	0.40	2.91	114.4	|	|	14.9
0935	0.6	4.2	0.06	13.43	5.19	27.7	4.33	0.54	2.29	108.3	|	|	12.7
0940	0.3	4.5	0.06	13.69	5.13	27.7	4.50	0.52	2.28	110.4	|	|	15.4
0945	0.3	4.8	0.06	13.90	5.16	27.7	4.44	0.54	2.31	109.6	|	|	13.9

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016
PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: DANIEL BEALL SIES PAA	SAMPLER(S) SIGNATURE(S): Daniel Beall	SAMPLE TIME: 0945
PUMP OR TUBING DEPTH IN WELL (feet): 21	TUBING MATERIAL CODE: PE	FIELD-FILTERED: [✓ Y] N FILTER SIZE: 1 µm Filtration Equipment Type: INLINE

FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
3	CG	40	HCL	8260	APP	200
2	AG	40	HCL	TOC	|	|
1	PE	1L	—	TDS	|	|
1	PE	500	HNO_3	6010 C	|	|
1	PE	500	HNO_3	DIS METAL	|	|
1	PE	1L		SIREM	|	|

FIELD EQUIPMENT IDENTIFICATION	
H20 QUALITY PARAMETER	
Model: YSI PRO	SN#: 12F100664
TURBIDIMETER	
Model: 2100 Q	SN#: 5111
OTHER	

REMARKS: 4 CG 40 CSIA
1 PE 1L MICROBIAL

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair — ☐ needs well tag — ☐ locking cap: X ☐ other comment: —
☐ DI Water Lot # — ☐ MS / MSD — ☐ Equip blk — ☐ Ambient blk — ☐ Trip blk —

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

PAGE 1

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: SITE 11
SITE LOCATION: NAS JACKSONVILLE
DATE: 6/12/17
WELL NO: EKMW-10
SAMPLE ID: EKMW-10
FREE PRODUCT: Y [✓ N]
DEPTH TO PRODUCT (ft BTOC):
FIELD DUPLICATE: Y [✓ N]
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 3/16
WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet
STATIC DEPTH TO WATER (feet): 4.48
PURGE PUMP TYPE OR BAILER: P. Pump

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21
PURGING INITIATED AT: 1050
PURGING ENDED AT: 1300
TOTAL VOLUME PURGED (gallons): 6.6

	Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color/ Odor (describe)	Turbidity (NTUs)
1120	~~1100~~	0.6	0.6	0.06	~~8.00~~ 9.41	11.17	28.5	2.20	0.01	1.11	-212.0	MILKY CLEAR/NONE	166
1130	~~1110~~	0.6	1.2	0.06	9.86	9.78	28.4	2.11	0.01	1.07	-431.2	|	23.5
1140	~~1120~~	0.6	1.8	0.06	10.55	8.34	28.4	2.16	0.01	1.09	-627.4	|	77.3
1150	~~1130~~	0.6	2.4	0.06	11.07	7.61	28.4	2.17	0.01	1.10	-644.4	CLEAR/NONE	470
1200	~~1140~~	0.6	3.0	0.06	11.32	6.70	28.5	2.12	0.03	1.08	-632.2	|	61.3
1210	1210	0.6	3.6	0.06	11.44	6.42	27.5	2.18	0.02	1.11	-555.0	|	86.8
	1215	0.3	3.9	0.06	11.44	6.31	27.0	2.21	0.04	1.11	-489.7	|	93.4
	1220	0.3	4.2	0.06	11.44	6.25	27.1	2.22	0.05	1.13	-423.0	|	109
	1225	0.3	4.5	0.06	11.44	6.26	27.2	2.23	0.05	1.14	-394.0	|	97.3

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: DANIEL BEALL SIEC PAA
SAMPLER(S) SIGNATURE(S): Daniel Beall
SAMPLE TIME: 1300
PUMP OR TUBING DEPTH IN WELL (feet): 21
TUBING MATERIAL CODE: PE
FIELD-FILTERED: [✓ Y] N
Filtration Equipment Type:
FILTER SIZE: — µm
FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
3	CG	40	HCL	8260	APP	200
2	AG	40	HCL	TOC	|	|
1	PE	1L	NONE	TDS	|	|
1	PE	250		6010	|	|
1	PE	250	HNO3	DIS METAL	|	|
1	PE	1L	NONE	NGS	|	|
REMARKS: 1	PE	1L	NONE	MICROBIAL	|	|

FIELD EQUIPMENT IDENTIFICATION

H20 QUALITY PARAMETER	
Model: YSI PRO	SN#: 12F100664
TURBIDIMETER	
Model: 2100 Q	SN#: S111
OTHER	

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: **1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair — ☐ needs well tag — ☐ locking cap: Y ☐ other comment: —
☐ DI Water Lot # — ☐ MS / MSD — ☐ Equip blk — ☐ Ambient blk — ☐ Trip blk —

YSI READING HIGH (10.07) @ 11 READING, CONTACT ASHLEY, CHECK CALIBRAT... WAS OK, CLEAN PROBE + FLOW THRU CELL START BACK @ 1110

2012_1102

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: SITE 11
SITE LOCATION: NAS Jacksonville
DATE: 6/2/17
WELL NO: EKMW-11
SAMPLE ID: EKMW-11
FREE PRODUCT: Y [✓ N]
DEPTH TO PRODUCT (ft BTOC):
FIELD DUPLICATE: Y [✓ N]
DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches): 2
TUBING DIAMETER (inches): 3/16
WELL SCREEN INTERVAL DEPTH: 19 feet to 23 feet
STATIC DEPTH TO WATER (feet): 4.38
PURGE PUMP TYPE OR BAILER: P Pump

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only fill out if applicable)
= (feet – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 21
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 21
PURGING INITIATED AT: 1430
PURGING ENDED AT: 1550
TOTAL VOLUME PURGED (gallons): 4.8

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
1440	0.6	0.6	0.06	8.68	5.56	26.4	5.31	0.08	2.85	17.4	clear	none	25.7
1450	0.6	1.2	0.06	9.47	5.55	26.4	5.31	0.08	2.85	15.6			16.4
1500	0.6	1.8	0.06	11.26	5.54	26.1	5.28	0.08	2.84	15.3			10.7
1510	0.6	2.4	0.06	11.43	5.54	25.9	5.27	0.08	2.83	14.8			12.4
1520	0.6	3.0	0.06	11.81	5.55	26.1	5.33	0.07	2.87	15.1			7.49
1530	0.6	3.6	0.06	12.31	5.52	26.1	5.66	0.10	3.01	16.6			6.42
1540	0.6	4.2	0.06	12.52	5.55	26.3	5.66	0.09	3.16	11.8			8.88
1545	0.3	4.5	0.06	12.69	5.56	26.3	5.69	0.09	3.20	10.9			5.56
1550	0.3	4.8	0.06	12.80	5.58	26.4	5.70	0.09	3.21	10.7			7.76

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Daniel Beall SPES PAA
SAMPLER(S) SIGNATURE(S): Daniel Beall
SAMPLE TIME: 1550
PUMP OR TUBING DEPTH IN WELL (feet): 21
TUBING MATERIAL CODE: PE
FIELD-FILTERED: [✓ Y] N
Filtration Equipment Type:
FILTER SIZE: 1 μm
FIELD DECONTAMINATION: PUMP Y [✓ N] TUBING Y [✓ N] (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
3	CG	40	HCL	8260	APP	200
2	AG	40	HCL	TOC		
1	PE	1L	NONE	TDS		
1	PE	250	HNO3	6010		
1	PE	250	HNO3	Dis metal		

FIELD EQUIPMENT IDENTIFICATION
H20 QUALITY PARAMETER
Model: YSI Pro SN#: WF100664
TURBIDIMETER
Model: 2100Q SN#: 5111
OTHER

REMARKS:

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)

SAMPLING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); O = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair — ☐ needs well tag — ☐ locking cap: — ☐ other comment: —
☐ DI Water Lot # — ☐ MS / MSD ☐ Equip blk — ☐ Ambient blk — ☐ Trip blk —

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services
www.trinityadc.com

Modified FDEP Form FD 9000-24

PAGE 2

GROUNDWATER SAMPLING LOG

☐ SYSTEM ON ☐ SYSTEM OFF ☐ NOT APPLICABLE (NO SYSTEM)

SITE NAME: SITE 11	SITE LOCATION: NAS JACKSONVILLE		DATE: 6/12/17
WELL NO: EKMW-10	SAMPLE ID: EKMW-10	FREE PRODUCT: Y N DEPTH TO PRODUCT (ft BTOC):	FIELD DUPLICATE: Y N DUPLICATE ID:

PURGING DATA

WELL DIAMETER (inches):	TUBING DIAMETER (inches):	WELL SCREEN INTERVAL DEPTH: feet to feet	STATIC DEPTH TO WATER (feet):	PURGE PUMP TYPE OR BAILER:

WELL VOLUME PURGE: **1 WELL VOLUME** = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) x WELL CAPACITY
(only ~~fill out if applicable~~)
= (~~feet~~ – feet) x gallons/foot = gallons

EQUIPMENT VOLUME PURGE: **1 EQUIPMENT VOL.** = PUMP VOLUME + (TUBING ~~CAPACITY~~ x TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot x feet) + ~~gallons~~ = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet):	FINAL PUMP OR TUBING DEPTH IN WELL (feet):	PURGING INITIATED AT:	PURGING ENDED AT: 1300	TOTAL VOLUME PURGED (gallons): 6.6

Time	Volume Purged (gallons)	Cum. Volume Purged (gallons)	Purge Rate (gpm)	Depth to Water (ft BTOC)	pH (SU)	Temp. (°C)	Spec. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Salinity (‰)	ORP (mV)	Color (describe)	Odor (describe)	Turbidity (NTUs)
1230	0.3	4.8	0.06	11.44	6.30	27.0	2.19	0.18	1.10	-383.7	CLEAR	NONE	99.2
1235	0.3	5.1	0.06	11.44	6.19	26.5	2.24	0.08	1.14	-340.1			98.2
1240	0.3	5.4	0.06	11.44	6.16	26.2	2.22	0.08	1.14	-208.1			104
1245	0.3	5.7	0.06	11.44	6.08	26.6	2.21	0.06	1.13	-116.9			96.6
1250	0.3	6.0	0.06	11.44	6.06	26.7	2.19	0.05	1.10	-110.7			98.4
1255	0.3	6.3	0.06	11.44	6.18	26.7	2.14	0.05	1.09	-105.8			101
1300	0.3	6.6	0.06	11.44	6.21	26.7	2.15	0.05	1.11	101.3			102

WELL CAPACITY (gal/ft): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (gal/ft): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

PURGING EQUIPMENT CODES: **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **O** = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: DANIEL BELL CIES PGA	SAMPLER(S) SIGNATURE(S):		SAMPLE TIME: 1300
PUMP OR TUBING DEPTH IN WELL (feet):	TUBING MATERIAL CODE:	FIELD-FILTERED: Y N Filtration Equipment Type:	FILTER SIZE: _____ µm

FIELD DECONTAMINATION: PUMP Y N TUBING Y N (replaced)

SAMPLE CONTAINER SPECIFICATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
# CONTAINERS	MATERIAL CODE	VOLUME (mL)	PRESERVATIVE USED			
		See page 1				

FIELD EQUIPMENT IDENTIFICATION	
H20 QUALITY PARAMETER	
Model:	SN#:
TURBIDIMETER	
Model:	SN#:
OTHER	

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **O** = Other (Specify)

NOTES: 1. **The above do not constitute all of the information required by Chapter 62-160, F.A.C.**
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or ± 10% (whichever is greater)

☐ well needs repair ______ ☐ needs well tag ______ ☐ locking cap: ______ ☐ other comment: ______
☐ DI Water Lot # ______ ☐ MS / MSD ______ ☐ Equip blk ______ ☐ Ambient blk ______ ☐ Trip blk ______

APPENDIX E LABORATORY ANALYSES CHAIN OF CUSTODY FORMS

Page Intentionally Left Blank

Advanced Environmental Laboratories, Inc.

☐ **Altamonte Springs:** 528 S. Northlake Blvd., Ste. 1016 • Altamonte Springs, FL 32701 • 407.937.1594 • Fax 407.937.1597
☐ **Gainesville:** 4965 SW 41st Blvd. • Gainesville, FL 32608 • 352.377.2349 • Fax 352.395.6639
☒ **Jacksonville:** 6681 Southpoint Pkwy. • Jacksonville, FL 32216 • 904.363.9350 • Fax 904.363.9354
☐ **Miramar:** 10200 USA Today Way, Miramar, FL 33025 • 954.889.2288 • Fax 954.889.2281
☐ **Tallahassee:** 1288 Cedar Center Drive, Tallahassee, FL 32301 • 850.219.6274 • Fax 850.219.6275
☐ **Tampa:** 9610 Princess Palm Ave. • Tampa, FL 33619 • 813.630.9616 • Fax 813.630.4327

Client Name: Geosyntec
Address: 1200 Riverplace Blvd
Jacksonville, FL 32207
Phone: 904-858-1818
FAX: 904-396-1143
Contact: Rachel Klinger
Sampled By: Bryce Zinckgrad
Turn Around Time: ☐ STANDARD ☐ RUSH
Page: 1 of: 2

Project Name: NAS JAX
P.O. Number/Project Number: TR0482
Project Location: Jacksonville, FL

REMARKS/SPECIAL INSTRUCTIONS:
AEL to rush VOC and Bromide analytical. Analyze for Anions and Iodide immediately due to short hold times. Questions, call Rachel Klinger

							ANALYSIS REQUIRED	VOCs	DHGs	Metals (Fe, Mn, Ca, Mg)	Anions (nitrite, sulfate, chloride)	TOC	Iodide	Bromide	TDS	Potassium		LABORATORY I.D. NUMBER
							BOTTLE SIZE & TYPE	3	3	1	1	2	1	1	1	1		
SAMPLE ID	SAMPLE DESCRIPTION	Grab Comp	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. COUNT	PRESER-VATION	H	I	N	I	H	I	I	I	N		
EKMW-01	EKMW-01	Grab	10/1/14	09:35	GW	6			X	X	X		X					
EKMW-02	EKMW-02	Grab	10/1/14	12:07	GW	11		X	X	X	X	X	X	X				
EKMW-03	EKMW-03	Grab	10/1/14	11:23	GW	11		X	X	X	X	X	X	X				
EKMW-04	EKMW-04	Grab	10/1/14	13:10	GW	11		X	X	X	X	X	X	X				
EKMW-05	EKMW-05	Grab	10/1/14	14:00	GW	6			X	X	X		X					
	EKMW-06	Grab			GW			X	X	X	X	X	X	X				
~~EKMW-07~~	~~EKMW-07~~	~~Grab~~	~~10/2/14~~	~~09:45~~	~~GW~~	~~11~~	BZ	X	X	X	X	X	X	X				
	EKMW-08	Grab	10/2/14		GW			X	X	X	X	X	X	X				
	EKMW-09	Grab	10/2/14		GW				X	X	X		X		X	X		
	EKMW-10	Grab	10/2/14		GW			X	X	X	X	X	X	X	X	X		

Matrix Code: WW = wastewater SW = surface water GW = ground water DW = drinking water O = oil A = air SO = soil SL = sludge **Preservation Code:** I = ice H=(HCl) S = (H2SO4) N = (HNO3) T = (Sodium Thiosulfate)

Received on Ice ☑ Yes ☐ No ☑ Temp taken from sample ☐ Temp from blank ☐ Where required, pH checked Temperature when received 3 (in degrees celcius)

Form revised 09/19/2012 Device used for measuring Temp by unique identifier (circle IR temp gun used) J: 9A G: LT-1 LT-2 T: 10A A: 3A M: 1A S: 1V

	Relinquished by:	Date	Time	Received by:	Date	Time
1		10/1/14	16:03		10/1/14	1603
2						
3						
4						

FOR DRINKING WATER USE (When PWS information not otherwise supplied)

PWS ID:
Contact Person: Phone:
Supplier of Water:
Site-Address:

Advanced Environmental Laboratories, Inc.

☐ **Altamonte Springs:** 528 S. Northlake Blvd., Ste. 1016 • Altamonte Springs, FL 32701 • 407.937.1594 • Fax 407.937.1597
☐ **Gainesville:** 4965 SW 41st Blvd. • Gainesville, FL 32608 • 352.377.2349 • Fax 352.395.6639
☒ **Jacksonville:** 6681 Southpoint Pkwy. • Jacksonville, FL 32216 • 904.363.9350 • Fax 904.363 9354
☐ **Miramar:** 10200 USA Today Way, Miramar, FL 33025 • 954.889.2288 • Fax 954.889.2281
☐ **Tallahassee:** 1288 Cedar Center Drive, Tallahassee, FL 32301 • 850.219.6274 • Fax 850.219.6275
☐ **Tampa:** 9610 Princess Palm Ave. • Tampa, FL 33619 • 813.630.9616 • Fax 813.630.4327

Client Name: Geosyntec
Address: 1200 Riverplace Blvd
Jacksonville, FL 32207
Phone: 904-858-1818
FAX: 904-396-1143
Contact: Rachel Klinger
Sampled By: Bryce Zinckgrad
Turn Around Time: ☐ STANDARD ☐ RUSH
Page: 2 of: 2

Project Name: NAS JAX
P.O. Number/Project Number: TR0482
Project Location: Jacksonville, FL

REMARKS/SPECIAL INSTRUCTIONS:
AEL to rush VOC and Bromide analytical. Analyze for Anions and Iodide immediately due to short hold times. Questions, call Rachel Klinger

								ANALYSIS REQUIRED	VOCs	DHGs	Metals (Fe, Mn, Ca, Mg)	Anions (nitrite, sulfate, chloride)	TOC	Iodide	Bromide	TDS	Potassium		LABORATORY I.D. NUMBER
								BOTTLE SIZE & TYPE	3	3	1	1	2	1	1	1	1		
SAMPLE ID	SAMPLE DESCRIPTION	Grab Comp	SAMPLING		MATRIX	NO. COUNT		PRESER-VATION	H	I	N	I	H	I	I	I	N		
			DATE	TIME															
EKMW-11	EKMW-11	Grab	10/2/14	15:35	GW	11			X	X	X	X	X	X	X				
~~EKMW-06~~	~~EKMW-06~~	~~G~~	~~10/2/14~~		~~GW~~				X	X	X	X	X	X	X				
EKMW-07	EKMW-07	G	10/2/14	09:45	GW	11			X	X	X	X	X	X	X				
EKMW-08	EKMW-08	G	10/2/14	14:48	GW	11			X	X	X	X	X	X	X				
EKMW-09	EKMW-09	G	10/2/14	14:08	GW	7				X	X	X		X		X	X		
~~EKMW-10~~	~~EKMW-10~~	~~G~~	~~10/2/14~~		~~GW~~				X	X	X	X	X	X	X	X	X		

Matrix Code: WW = wastewater SW = surface water GW = ground water DW = drinking water O = oil A = air SO = soil SL = sludge

Preservation Code: I = ice H=(HCl) S = (H2SO4) N = (HNO3) T = (Sodium Thiosulfate)

Received on Ice ☒ Yes ☐ No ☒ Temp taken from sample ☐ Temp from blank

☐ Where required, pH checked

Temperature when received 24 (in degrees celcius)

Form revised 09/19/2012

Device used for measuring Temp by unique identifier (circle IR temp gun used) J: 9A [✓ G] LT-1 LT-2 T: 10A A: 3A M: 1A S: 1V

	Relinquished by:	Date	Time	Received by:	Date	Time
1		10/02/14	16:30		10-2-14	16:30
2						
3						
4						

FOR DRINKING WATER USE (When PWS Information not otherwise supplied)
PWS ID:
Contact Person: Phone:
Supplier of Water:
Site-Address:

SiREM Site Recovery & Management

Chain-of-Custody Form

130 Research Lane, Suite 2 · Guelph, Ontario, Canada N1G 5G3 · Phone (519) 822-2265 or toll free 1-866-251-1747 Fax (519) 822-3151
www.siremlab.com

No 3949

Page 2 of 4

Lab #

Project Name [illegible]
Project # [illegible]
Project Manager [illegible]
Email Address [illegible]
Company
Address [illegible]
Phone # [illegible]
Fax # [illegible]
Sampler's Signature
Sampler's Printed Name [illegible]

Analysis

Preservative Key
0. None
1. HCl
2. Other ________
3. Other ________

Customer Sample ID	Sampling Date	Sampling Time	Matrix	# of Containers	Gene-Trac Dhc	Gene-Trac VC	Gene-Trac Dhb	VFA								Other Information
Preservative																
[illegible]			[illegible]	[illegible]												
[illegible]	[illegible]	[illegible]	GW	3	X	X	X	X								
[illegible]	[illegible]	[illegible]	[illegible]		X	X	X	X								
[illegible]					X	X	X	X								
[illegible]			[illegible]													
[illegible]	[illegible]	[illegible]	GW	3	X	X	X	X								
[illegible]	[illegible]	[illegible]	GW	3	X	X	X	X								
[illegible]	[illegible]	[illegible]	GW	3	X	X	X	X								
[illegible]	[illegible]	[illegible]	GW	3	X	X	X	X								

Sample Receipt
Cooler Condition:
Cooler Temperature:
Custody Seals: Yes ☐ No ☐

Billing Information
P.O. #
Bill To:

Turnaround Time Requested
Normal ☒
Rush ☐

For Lab Use Only
Proposal #: ________

Relinquished By:	**Received By:**	**Relinquished By:**	**Received By:**	**Relinquished By:**	**Received By:**
Signature	Signature	Signature	Signature	Signature	Signature
Printed Name [illegible]	Printed Name	Printed Name	Printed Name	Printed Name	Printed Name
Firm [illegible]	Firm	Firm	Firm	Firm	Firm
Date/Time [illegible]	Date/Time	Date/Time	Date/Time	Date/Time	Date/Time

Distribution: White - Return to Originator: Yellow - Lab Copy: Pink - Retained by Client

ACCUTEST.
LABORATORIES

Accutest Laboratories Southeast
Chain of Custody

4405 Vineland Road, Suite C-15 Orlando, Fl 32811
TEL. 407-425-6700 • FAX: 407-425-0707
www.accutest.com

Accutest JOB # FA32283 PAGE 1 OF 1

Accutest Quote #
SKIFF#

Client / Reporting Information

Company Name Trinity Analysis + Development
Address 1002 N Eglin Pkwy
City Shalimar State FL Zip
Project Contact Alec Macbeth E-mail amacbeth@trinityadc.com
Phone# 850-613-6800
Sampler(s) Name(s) (Printed) Tony Schmucker, Sam McIntyre

Project Information

Project Name: GW Monitoring - Site 11 NAS JAX
Street
City State
Project # A016-110
Fax #
Client Purchase Order #

Analytical Information

Accutest Sample #	Field ID / Point of Collection	COLLECTION DATE	TIME	SAMPLED BY:	MATRIX	TOTAL # OF BOTTLES	OTHER	NONE	HCl	NaOH	HNO3	H2SO4	NAOH+ZNAC	DI WATER	MEOH	MEE (RSK175)	Potassium	Bromide	Iodide	VOCs (8260B)	NO3/SO4/CHL	TOC	Metals* Fe, Mn, Mg, Ca				LAB USE ONLY
1	EKMW-01	3/15/16	0950	TS/SM	GW	13		3	8		2					X	X	X	X	X	X	X	X				
2	EKMW-02	3/15/16		TS/SM	GW	13		3	8		2					X	X	X	X	X	X	X	X				
3	EKMW-03	3/15/16	1425	TS/SM	GW	13		3	8		2					X	X	X	X	X	X	X	X				
4	EKMW-04	3/15/16	1430	TS/SM	GW	13		3	8		2					X	X	X	X	X	X	X	X				
5	EKMW-05	3/15/16	1620	TS/SM	GW	13		3	8		2					X	X	X	X	X	X	X	X				
6	EKMW-07	3/15/16	0930	TS/SM	GW	13		3	8		2					X	X	X	X	X	X	X	X				
7	EKMW-TB-1	3/15/16	0930	TS/SM	W	2			2											X							
8	EKMW-DUP-1	3/15/16	—	TS/SM	GW	6			5		1									X		X	X				
5	EKMW-05-MS	3/15/16	1620	TS/SM	GW	5		1	3		1									X	X		X				
5	EKMW-05-MSD	3/15/16	1620	TS/SM	GW	5		1	3		1									X	X		X				

Matrix Codes

DW - Drinking Water
GW - Ground Water
WW - Water
SW - Surface Water
SO - Soil
SL - Sludge
OI - Oil
LIQ - Other Liquid
AIR - Air
SOL - Other Solid
WP - Wipe

TURNAROUND TIME (Business Days)

Approved By: / Rush Code

☑ 10 Days Standard
☐ 7 Day RUSH
☐ 5 Day RUSH
☐ 3 Day EMERGENCY
☐ 2 Day EMERGENCY
☐ 1 Day EMERGENCY
☐ OTHER

Emergency or Rush T/A Data Available VIA Email or Lablink

Data Deliverable Information

☐ COMMERCIAL "A" (RESULTS ONLY)
☐ COMMERCIAL "B" (RESULTS PLUS QC)
☐ REDT1 (EPA LEVEL 3)
☐ FULT1 (EPA LEVEL 4)
☐ EDD'S

Comments / Remarks

*Iron, Manganese, Magnesium, Calcium Only

Sample Custody must be documented below each time samples change possession, including courier delivery.

Relinquished by Sampler:	Date Time:	Received By:	Relinquished by:	Date Time:	Received By:
1	03/15/16 1800	2	3 2110	03/15/16	4 3/16/16 800
Relinquished by: 5	Date Time:	Received By: 6	Relinquished by: 7	Date Time:	Received By: 8

Lab Use Only: Custody Seal in Place: Y N Temp Blank Provided: Y N Preserved where Applicable: Y N Total # of Coolers: 2 Cooler Temperature (s) Celsius: 2.6, 2.8

ACCUTEST
LABORATORIES

Accutest Laboratories Southeast
Chain of Custody

4405 Vineland Road, Suite C-15 Orlando, Fl 32811
TEL. 407-425-6700 • FAX: 407-425-0707
www.accutest.com

FA32320
Accutest JOB #
PAGE____OF____

Accutest Quote #
SKIFF#

Client / Reporting Information

Company Name Trinity Analysis + Development
Address 1002 N. Eglin Pkwy
City Shalimar State FL Zip 32579
Project Contact Alec Macbeth E-mail amacbeth@trinityaod.
Phone# 850-613-6800
Sampler(s) Name(s) (Printed) Tony Schmoker/Sam McIntyre

Project Information

Project Name: Site 11 NAS JAX
Street
City State
Project # A016-110
Fax #
Client Purchase Order #

Accutest Sample #	Field ID / Point of Collection	DATE	TIME	SAMPLED BY:	MATRIX	TOTAL # OF BOTTLES	OTHER	NONE	HCl	NaOH	HNO3	H2SO4	NAOH+ZNAC	DI WATER	MEOH	MEE	Potassium	Bromide	Iodide	VOCs	NO3/SO4/Chl	TAS	TOC	Metals* Fe, Mn, Mg, Ca			LAB USE ONLY
1	PZ-03	3/16/16	0905	TS/SM	GW	13		3	8		2					X	X	X	X	X	X	[illegible]	X	X			
2	EKMW-10	3/16/16	0945	TS/SM	GW	13		3	8		2					X	X	X	X	X	X	X	X	X			
3	EKMW-09	3/16/16	1205	TS/SM	GW	13		3	8		2					X	X	X	X	X	X	X	X	X			
4	FB-1	3/16/16	0730	TS/SM	W	3			3											X							
5	TB-2	3/16/16	0735	TS/SM	W	3			3											X							

COLLECTION: DATE, TIME, SAMPLED BY, MATRIX. CONTAINER INFORMATION: TOTAL # OF BOTTLES through MEOH. Analytical Information: MEE through Metals.

Matrix Codes

DW - Drinking Water
GW - Ground Water
WW - Water
SW - Surface Water
SO - Soil
SL - Sludge
OI - Oil
LIQ - Other Liquid
AIR - Air
SOL - Other Solid
WP - Wipe

TURNAROUND TIME (Business Days)

Approved By: / Rush Code

- ☑ 10 Days Standard
- ☐ 7 Day RUSH ________
- ☐ 5 Day RUSH ________
- ☐ 3 Day EMERGENCY ________
- ☐ 2 Day EMERGENCY ________
- ☐ 1 Day EMERGENCY ________
- ☐ OTHER ________

Emergency or Rush T/A Data Available VIA Email or Lablink

Data Deliverable Information

- ☐ COMMERCIAL "A" (RESULTS ONLY)
- ☑ COMMERCIAL "B" (RESULTS PLUS QC)
- ☐ REDT1 (EPA LEVEL 3)
- ☐ FULT1 (EPA LEVEL 4)
- ☐ EDD'S

Comments / Remarks

*Iron, Manganese, Magnesium Calcium Only

Sample Custody must be documented below each time samples change possession, including courier delivery.

Relinquished by Sampler:	Date Time:	Received By:	Relinquished by :	Date Time:	Received By:
1	3-16-16 1400	2 James Llorca 3-16-16 1730	3 James Llorca	3-16-16 2100	4 3/17/16 8:00
Relinquished by:	Date Time:	Received By:	Relinquished by:	Date Time:	Received By:
5		6	7		8

Lab Use Only: Custody Seal in Place: Y N Temp Blank Provided: Y N Preserved where Applicable: Y N Total # of Coolers: 1 Cooler Temperature (s) Celsius: 3.2

FA423~~41~~55 ①

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services

Chain of Custody and Analytical Request

1 of 1

Project Number: A016.000.110

Chain of Custody Number (1): Site 11 20170323-01

FA423~~55~~ ② 41

Facility: NAS Jacksonville

Project Name / Site Name: Site 11

Client Name: Geosyntec

Project Manager: Jordan Gibson 850-613-6800

Collected by: A. Hayes, D. Beall, J. Bowman

① DR 3/24/17

Field Sample ID (30 Characters Max)	Date Collected (dd-mm-yyyy)	Time Collected (Military) (hhmm)	Sample Depth (beginning - ending) (soil only)	SA Code (2)	Sample Number (3)	Sample Matrix (4)	Number of containers	VOCs SW846 8260B	Methane, Ethene, Ethane RSKSOP-147/175	Total Organic Carbon SM5310 B-11/SW9060A	Total Dissolved Solids	Potassium SW846 6010C	Na, Ca, Mg 6010C	Sulfate, Bromide, Nitrate, Nitrite, Chloride, EPA 300.0	Alkalinity SM 2320B	1,4-Dioxane 8260	Diss. Metals- Iron, Manganese SW846 6010B	Orthophosphate SM 4500-E and Total P EPA 365.2/SM 4500P-E	Sulfide SM4500S2-AD EPA 9030B	Ambient Blank Lot Control Number	Equipment Blank Lot Control Number	Trip Blank Lot Control Number	Cooler ID
1 EKMW-01	3/23/17	1135	--	N	1	WG	8	X	X	X													
2 EKMW-02	3/23/17	1811	--	N	1	WG	8	X	X	X													
3 EKMW-03	3/23/17	1304	--	N	1	WG	8	X	X	X													
4 EKMW-04	3/23/17	1102	--	N	1	WG	8	X	X	X													
5 EKMW-05	3/23/17	0911	--	N	1	WG	8	X	X	X													
6 EKMW-07	3/23/17	0914	--	N	1	WG	8	X	X	X													
~~EKMW-09~~			~~--~~	~~N~~	~~1~~	~~WG~~		~~X~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~				
~~EKMW-10~~				~~N~~	~~1~~	~~WG~~		~~X~~			~~X~~	~~X~~											
~~EKMW-11~~				~~N~~	~~1~~	~~WG~~		~~X~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~				

Comments * To be billed to Trinity ADC *

Custody Transfers Prior to Receipt by Laboratory

Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1.	3/23/17	1700	1. James Llorca	3-23-17	1800
2. James Llorca	3-23-17	2030	2.	3/24/17	~~0800~~ 1255
3.			3.		

Sample Delivery Details / Laboratory Receipt

Delivered Directly to Lab: yes

Method of Shipment: Courier

Analytical Lab: Accutest

Lab Recipient:

Shipped: No.: 1

Airbill Number: —

Delivery Location: Orlando, FL

Delivery Date/Time:

1.) Chain of Custody Number = site name (e.g., SS125) and then date (yyyymmdd) collected + custody number (e.g. SS125-20110902-01)…September 2, 2011.

2.) Sample Type (SA) Codes: N = Normal Sample, TB = Trip Blank, FD = Field Duplicate, FR = Field Replicate, EB = Equipment Blank, MS = Matrix Spike (-MS), SD = Matrix Spike Duplicate (-MSD), AB = Ambient Blank

3.) Sample Number: Unique sample number collected from a particular location per day. (e.g. Groundwater sample collected from MW-1 on 10/10/11 = 01, if sampled again on 10/10/11 = 02, etc.)

4.) Matrix Codes: GS = Soil Gas, WG = Ground Water , WS = Surface Water SO = Soil, SE = Sediment, SL = Sludge, SS= Suface Soil Samples, WQ = Aqueous Blank Samples (trip, equipment, ambient, etc.), SQ= Soil Blanks

5.) Sample Analysis Requested: Analytical method requested and number of containers provided for each.

6.) Quality assurance samples are assigned by date (ddmmyy) and the number of the associated QC sample (01, 02, etc). (E.g., The first equipment blank, trip blank, or ambient blank collected on May 10, 2011 in association with samples on the COC will be designated 10051101 in the Blank Lot Control Number field).

7.) Trip Blanks shall correspond to the first well sampled with VOCs, for example: ST069-MW-08S-c

4.6

FA42341: Chain of Custody
Page 1 of 2

~~FA42344~~ ①

FA42355

Page 1 of 1

Project Number: A016.000.110

Chain of Custody Number (1): Sit11-20170323-0

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services

Chain of Custody and Analytical Request

Facility: NAS Jacksonville

Project Name / Site Name: Site 11

Client Name: Geosyntec

Project Manager: Jordan Gibson 850-613-6800

Collected by: A. Hayes, D. Beall + J. Bowman

① PA 3/24/17

	Field Sample ID (30 Characters Max)	Date Collected (dd-mm-yyyy)	Time Collected (Military) (hhmm)	Sample Depth (beginning - ending) (soil only)	SA Code (2)	Sample Number (3)	Sample Matrix (4)	Number of containers	VOCs SW846 8260B	Methane, Ethene, Ethane RSKSOP-147/175	Total Organic Carbon SM5310 B-11/SW9060A	Total Dissolved Solids	Potassium SW846 6010C	Na, Ca, Mg 6010C	Sulfate, Bromide, Nitrate, Nitrite, Chloride, EPA 300.0	Alkalinity SM 2320B	1,4-Dioxane 8260 SIM	Diss. Metals- Iron, Manganese SW846 6010B	Orthophosphate SM 4500-E and Total P EPA 365.2/SM 4500P-E	Sulfide SM4500S2-AD EPA 9030B	Ambient Blank Lot Control Number	Equipment Blank Lot Control Number	Trip Blank Lot Control Number	Cooler ID
	~~EKMW-01~~	~~—~~	~~—~~	--	N	1	WG	~~—~~	~~X~~	~~X~~	~~X~~													
	~~EKMW-02~~	~~—~~	~~—~~	--	~~N~~	~~1~~	~~WG~~	~~—~~	~~X~~	~~X~~	~~X~~													
	~~EKMW-03~~	~~—~~	~~—~~	--	~~N~~	~~1~~	~~WG~~	~~—~~	~~X~~	~~X~~	~~X~~													
	~~EKMW-04~~	~~—~~	~~—~~	--	~~N~~	~~1~~	~~WG~~	~~—~~	~~X~~	~~X~~	~~X~~													
	~~EKMW-05~~	~~—~~	~~—~~	--	~~N~~	~~1~~	~~WG~~	~~—~~	~~X~~	~~X~~	~~X~~													
	~~EKMW-07~~	~~—~~	~~—~~	--	N	1	WG	~~—~~	~~X~~	~~X~~	~~X~~													
1 ~~7~~	EKMW-09	3/23/17	1056	--	N	1	WG	15	X		X	X	X	X	X	X	X	X	X	X				
2 ~~8~~	EKMW-10	3/23/17	0930	--	N	1	WG	5	X			X	X											
3 ~~9~~	EKMW-11	3/23/17	1400	--	N	1	WG	15	X		X	X	X	X	X	X	X	X	X	X				
①																								
	① 03/24/17																							

Comments * to be billed to Geosyntec *

Custody Transfers Prior to Receipt by Laboratory

Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1. A. Hayes	3/23/17		1. James Lloyd	3-23-17	1800
2. James Lloyd	3-23-17	2030	2.	3/24/17	0800 RSC
3.			3.		

Sample Delivery Details / Laboratory Receipt

Delivered Directly to Lab: yes

Method of Shipment: Courier

Analytical Lab: Accutest

Lab Recipient:

Shipped: No.: 1

Airbill Number: —

Delivery Location: Orlando, FL

Delivery Date/Time:

1.) Chain of Custody Number = site name (e.g., SS125) and then date (yyyymmdd) collected + custody number (e.g. SS125-20110902-01)…September 2, 2011.

2.) Sample Type (SA) Codes: N = Normal Sample, TB = Trip Blank, FD = Field Duplicate, FR = Field Replicate, EB = Equipment Blank, MS = Matrix Spike (-MS), SD = Matrix Spike Duplicate (-MSD), AB = Ambient Blank

3.) Sample Number: Unique sample number collected from a particular location per day. (e.g. Groundwater sample collected from MW-1 on 10/10/11 = 01, if sampled again on 10/10/11 = 02, etc.)

4.) Matrix Codes: GS = Soil Gas, WG = Ground Water, WS = Surface Water SO = Soil, SE = Sediment, SL = Sludge, SS= Surface Soil Samples, WQ = Aqueous Blank Samples (trip, equipment, ambient, etc.), SQ= Soil Blanks

5.) Sample Analysis Requested: Analytical method requested and number of containers provided for each.

6.) Quality assurance samples are assigned by date (ddmmyy) and the number of the associated QC sample (01, 02, etc). (E.g., The first equipment blank, trip blank, or ambient blank collected on May 10, 2011 in association with samples on the COC will be designated 10051101 in the Blank Lot Control Number field).

7.) Trip Blanks shall correspond to the first well sampled with VOCs, for example: ST069-MW-08S-c

4.6

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services

Chain of Custody and Analytical Request

FA44858

Page 1 of 1
Project Number: A016.000.110
Chain of Custody Number (1) Site11 20170612-01

Facility: NAS Jacksonville

Project Name / Site Name: Site 11

Client Name: Geosyntec

Project Manager: Jordan Gibson 850-613-6800

Collected by: A. Hayes; J. Bowman, D. Beall

	Field Sample ID (30 Characters Max)	Date Collected (dd-mm-yyyy)	Time Collected (Military) (hhmm)	Sample Depth (beginning - ending) (soil only)	SA Code (2)	Sample Number (3)	Sample Matrix (4)	Number of containers	VOCs SW846 8260B	Methane, Ethene, Ethane RSKSOP-147/175	Total Organic Carbon SM5310 B-11/SW9060A	Total Dissolved Solids	Potassium SW846 6010C	Ca, Mg 6010C	Sulfate, Bromide, Chloride, EPA 300.0	Diss. Metals- Iron, Maganese SW846 6010B	Ambient Blank Lot Control Number	Equipment Blank Lot Control Number	Trip Blank Lot Control Number	Cooler ID
1	EKMW-05	6/12/17	0923	—	N	01	WG	19	X	X	X		X	X	X	X				
2	EKMW-07	6/12/17	0924	—	N	01	WG	11	X	X	X		X	X	X	X				
3	EKMW-09	6/12/17	0945	—	N	01	WG	9	X		X	X	X	X	X	X				
4	EKMW-02	6/12/17	1124	—	N	01	WG	11	X	X	X		X	X	X	X				
5	EKMW-03	6/12/17	1128	—	N	01	WG	11	X	X	X		X	X	X	X				
6	EKMW-10	6/12/17	1300	—	N	01	WG	9	X		X	X	X	X	X	X				
7	EKMW-04	6/12/17	1340	—	N	01	WG	11	X	X	X		X	X	X	X				
8	EKMW-08	6/12/17	~~a44~~ 1408	—	N	01	WG	8	X		X			X	X	X				
9	EKMW-11	6/12/17	1550	—	N	01	WG	8	X		X			X	X	X				

Comments Dissolved metals filtered in field * invoice to Trinity ADC

Custody Transfers Prior to Receipt by Laboratory

	Relinquished By (Signed)	Date	Time		Received by (signed)	Date	Time
1.		6/12/17	1430	1.		6-12-17	1645
2.	ALSB			2.	J. Coone (ALSB)	06-13-17	08:00
3.				3.			

Sample Delivery Details / Laboratory Receipt

Delivered Directly to Lab:
Shipped: No.: 2
Method of Shipment: Courier
Airbill Number:
Analytical Lab: Accutest
Delivery Location: Orlando, FL
Lab Recipient:
Delivery Date/Time:

1.8 2.0

1.) Chain of Custody Number = site name (e.g., SS125) and then date (yyyymmdd) collected + custody number (e.g. SS125-20110902-01)…September 2, 2011.
2.) Sample Type (SA) Codes: N = Normal Sample, TB = Trip Blank, FD = Field Duplicate, FR = Field Replicate, EB = Equipment Blank, MS = Matrix Spike (-MS), SD = Matrix Spike Duplicate (-MSD), AB = Ambient Blank
3.) Sample Number: Unique sample number collected from a particular location per day. (e.g. Groundwater sample collected from MW-1 on 10/10/11 = 01, if sampled again on 10/10/11 = 02, etc.)
4.) Matrix Codes: GS = Soil Gas, WG = Ground Water, WS = Surface Water SO = Soil, SE = Sediment, SL = Sludge, SS= Suface Soil Samples, WQ = Aqueous Blank Samples (trip, equipment, ambient, etc.), SQ= Soil Blanks
5.) Sample Analysis Requested: Analytical method requested and number of containers provided for each.
6.) Quality assurance samples are assigned by date (ddmmyy) and the number of the associated QC sample (01, 02, etc). (E.g., The first equipment blank, trip blank, or ambient blank collected on May 10, 2011 in association with samples on the COC will be designated 10051101 in the Blank Lot Control Number field).
7.) Trip Blanks shall correspond to the first well sampled with VOCs, for example: ST069-MW-08S-c

FA44858: Chain of Custody
Page 1 of 2

APPENDIX F GROUNDWATER MONITORING DATA SUMMARY

Page Intentionally Left Blank

Baseline Event - October 2014

		EKMW-01		EKMW-02		EKMW-03		EKMW-04		EKMW-05		EKMW-06		EKMW-07		EKMW-08		EKMW-09		EKMW-10		EKMW-11	
pH	unit	**4.7**		**5.8**		**5.8**		**4.9**		**5.2**		**5.1**		**5.1**		**5.7**		**5.0**		**6.0**		**10.6**	
ORP	mV	**54**		**-21**		**-21**		**42**		**64**		**81**		**34**		**12**		**100**		**-27**		**-9**	
Dissolved oxygen	mg/l	**0.6**		**0.2**		**0.2**		**0.2**		**0.3**		**0.9**		**0.5**		**0.4**		**1.2**		**0.6**		**0.1**	
Analyte	Units	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
BROMIDE (AS BR)	mg/L	4.0	I	0.06	U	0.06	U	0.06	U	1.2	U	0.3	I	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
TOTAL ORGANIC CARBON	mg/L	2.5		2.5		2.5		3.6		1.7		1.4		6.8		2.3		1.6		1.9		3.1	
CHLORIDE (AS Cl)	mg/L	3400		550		520		570		1900		1700		790		1000		2800		570		170	
SULFATE (AS SO4)	mg/L	57		27		24	I	45		50		23		140		38		36		21	I	16	I
CALCIUM	mg/L	350		100		89		120		400		400		150		150		460		140		130	
IODIDE	mg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
IRON	mg/L	130		57		58		47		160		61		23		67		130		49		2.9	
MAGNESIUM	mg/L	98		30		27		31		110		100		21		45		130		42		0.74	
POTASSIUM	mg/L											11						9.4		7.8			
TDS (FILTERABLE)	mg/L																	5700		1700			
1,1-DICHLOROETHENE	ug/L	25	U	4	I	2	I	1	I	5	U	1	I	2	U	2	U	25	U	2		0.2	U
cis-1,2-DICHLOROETHENE	ug/L	1,190		950		760		380		773		120		970		90		288		260		10	
TETRACHLOROETHENE	ug/L	7,640		170		190		250		1,800		640		1,300		1,600		5,220		120		160	
trans-1,2-DICHLOROETHENE	ug/L	323		11		2	I	4		81		21		44		4	I	50		3		0.2	U
TRICHLOROETHYLENE	ug/L	1,670		150		150		130		344		130		260		77		482		170		8	
VINYL CHLORIDE	ug/L	33	U	6	I	1	U	3		7	U	9		89		2	U	33	U	5		0.4	I
METHANE	ug/L	190		1200		330		54		270		29		110		110		120		1300		10	U
ETHENE	ug/L	15		10	U	10	U	10	U	73		10	U	11		10	U	10	U	10	U	10	U
ETHANE	ug/L	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U
Total VFAs	mg/L	3.26		1.6		1.26		1.9		1.8		6.01		2.2		3.1		2.3		2.08		1.36	
Dehalococcoides	cell / L	8.0E+05		ND		ND		ND		3.0E+05		ND		ND		ND		ND		ND		ND	
Dehalobacter	cell / L	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
vcrA	gene copy / L	3.0E+03		ND		ND		ND		4.0E+05		ND		ND		ND		ND		ND		ND	

First Comprehensive Event (March 2016) - 8 months of full system operaiton; 5 months since bioaugmentation

		EKMW-01		EKMW-02		EKMW-03		EKMW-04		EKMW-05		EKMW-07		EKMW-08		EKMW-09		EKMW-10		EKMW-11	
pH	unit	**5.6**		**5.9**		**5.6**		**5.9**		**6.2**		**6.2**		**5.0**		**4.5**		**5.8**		**5.6**	
ORP	mV	**-103**		**-34**		**-5**		**-20**		**-118**		**-114**		**73**		**201**		**-6**		**8**	
Dissolved oxygen	mg/l	**0.2**		**0.1**		**0.1**		**3.5** ?		**4** ?		**3.1** ?		**1.6**		**4.1** ?		**3.6** ?		**0.2**	
Analyte	Units	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
BROMIDE	mg/L	2.3		3.3	I	1.2	U	0.6	U	1.2	U	1.2	U			0.38	I	0.32	I		
TOTAL ORGANIC CARBON	mg/L	12.8		36.2		57.9		4.7		15.9		6.3		1.5		1.2		1.5		5.1	
CHLORIDE	mg/L	1450		664		674		462		1240		975				2190		788			
SULFATE	mg/L	13.2		10.7		15.6		15.3		11.5	I	8.9	I			18.4		12			
CALCIUM	mg/L	210		177		208		126		259		275				431		193			
IRON	mg/L	87.4		121		101		59.6		131		52.9				125		53.3			
MAGNESIUM	mg/L	61.9		53.7		62.9		35.6		72.5		34				128		59.3			
POTASSIUM	mg/L	5.43	I	4.46	I	6.16	I	7.1	I	6.12	I	9.9	I	6.1	I	8.55	I	16.1		8.1	I
TDS (FILTERABLE)	mg/L															5760		2290			
1,1-DICHLOROETHENE	ug/L	17		2	I	1	U	1	U	4	U	11	I	3	I	22	U	2	I	22	U
cis-1,2-DICHLOROETHENE	ug/L	6,070		586		372		327		1,440		1,700		979		310		356		7,220	
TETRACHLOROETHENE	ug/L	1,100		25		56		211		180		202		464		8,880		83		4,120	
trans-1,2-DICHLOROETHENE	ug/L	201		13		5	I	5		106		26		33		58	I	8		33	U
TRICHLOROETHYLENE	ug/L	873		22		39		98		70		110		38		525		147		958	
VINYL CHLORIDE	ug/L	313		425		64		49		920		814		33		31	U	88		64	I
METHANE	ug/L	102		1850		2850		401		211		1860		109		86		1130		384	
ETHENE	ug/L	9.9		149		77.5		31.9		144		80.7		2.3		1.3		5.3		1.4	
ETHANE	ug/L	0.32	U	0.32	U	0.32	U	0.32	U	0.9	I	0.9	I	0.3	U	0.3	U	0.3	U	0.6	I
Total VFAs	mg/L	60.7		141.3		233		18.3		6.6		21.7		<1		1.4		1.4		<1	
Dhc	cell / L	2.5E+08		2.1E+08		3.5E+07		6.6E+07		2.0E+09		2.9E+08									
tce	cell / L	5.0E+06		7.9E+06		4.4E+05		3.7E+06		7.1E+07		1.3E+07									
bvc	cell / L	1.2E+08		6.5E+07		1.1E+07		2.5E+07		1.3E+07		1.1E+08									
vcr	cell / L	5.2E+07		4.4E+07		4.2E+06		2.6E+07		1.3E+07		8.8E+05									
Dhb	cell / L	8.7E+07		5.0E+06		5.0E+06		2.1E+06		5.1E+06		4.1E+06									

Re-Baseline Event (September 2016) - 6 months since shutdown after Stage 1 operation; before system re-start for Stage 2

		EKMW-01		EKMW-02		EKMW-03		EKMW-04		EKMW-05		EKMW-07		EKMW-08		EKMW-09		EKMW-10		EKMW-11	
pH	unit	**5.7**		**6.3**		**5.8**		**5.6**		**5.6**		**6.6**		**5.5**		**4.8**		**7.2**		**5.6**	
ORP	mV	**-120**		**-22**		**-56**		**0.1**		**-1**		**-56**		**34**		**102**		**-630**		**35**	
Dissolved oxygen	mg/l	**0.1**		**0.1**		**0.1**		**1.2**		**1.0**		**0.1**		**0.1**		**0.1**		**0.1**		**1.4**	
Analyte	Units	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
BROMIDE	mg/L																				
TOTAL ORGANIC CARBON	mg/L	10.7		25.1		12.2		2.4		2.4		12.5		1.4		1.4		1.5		3.1	
CHLORIDE	mg/L																				
SULFATE	mg/L																				
CALCIUM	mg/L																				
IRON	mg/L																				
MAGNESIUM	mg/L																				
POTASSIUM	mg/L															10.3		11.7			
TDS (FILTERABLE)	mg/L															6190		2280			
1,1-DICHLOROETHENE	ug/L	11	U	0.5	I	0.9	I	1.1	U	4.3	U	26.5				22	U	1.6	I		
cis-1,2-DICHLOROETHENE	ug/L	2100		45		164		286		2250		4910				331		351			
TETRACHLOROETHENE	ug/L	742		16		10		27		2280		253				12800		114			
trans-1,2-DICHLOROETHENE	ug/L	241		2		2.5		2.5		148		84				60		9			
TRICHLOROETHYLENE	ug/L	387		8		13		27		479		143				714		119			
VINYL CHLORIDE	ug/L	4660		28		48		15		321		1400				31	U	77			
METHANE	ug/L	132		6380		6270		1930		587		7110									
ETHENE	ug/L	228		170		68		22		255		161									
ETHANE	ug/L	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	1.1									
Total VFA	mg/L																				
Dhc	cell / L	8.3E+08		6.3E+06				6.2E+06		1.4E+08		3.2E+08									
tce	cell / L	1.1E+07		8.6E+04				1.5E+05		3.5E+06		4.4E+06									
bvc	cell / L	4.0E+08		4.3E+05				2.1E+06		1.5E+07		1.6E+08									
vcr	cell / L	4.4E+07		1.0E+06				1.2E+06		1.0E+07		2.0E+06									
Dhb	cell / L	1.9E+08		2.2E+06				2.2E+06		2.3E+07		1.8E+07									

March 2017 - End of 5-month Stage 2 operation

		EKMW-01	EKMW-02	EKMW-03	EKMW-04	EKMW-05	EKMW-07	EKMW-09	EKMW-10	EKMW-11
pH	unit	**5.5**	**5.0**	**5.8**	**5.5**	**4.8**	**5.9**	**3.8**	**5.3**	**5.2**
ORP	mV	**-79**	**-58**	**-43**	**4.5**	**4.9**	**-75**	**62**	**30**	**114**
Dissolved oxygen	mg/l	**0.1**	**0.2**	**0.1**	**0.1**	**0.3**	**0.1**	**1.4**	**0.2**	**0.1**
Analyte	Units									
BROMIDE	mg/L									
TOTAL ORGANIC CARBON	mg/L	6.3	3.2	3.5	2.1	2.0	53.0	1.1		3.3
CHLORIDE	mg/L							1790		2430
SULFATE	mg/L							22.8		36.5
CALCIUM	mg/L							295		386
IRON	mg/L							79.2		95.5
MAGNESIUM	mg/L							85.3		86.3
POTASSIUM	mg/L							6.3	12.4	8.1
TDS (FILTERABLE)	mg/L							2950	1230	3770
1,1-DICHLOROETHENE	ug/L	19.9 I	1.2	1.6 U	1.6 U	2.0 I	4.0 I	32 U	1.6 U	11
cis-1,2-DICHLOROETHENE	ug/L	1140	164	384	237	444	755	310	318	6890
TETRACHLOROETHENE	ug/L	400	144	32	70	603	55	9690	104	4660
trans-1,2-DICHLOROETHENE	ug/L	104	2	3 I	3 I	36	19	44	10	45
TRICHLOROETHYLENE	ug/L	168	8	23	37	159	53	533	129	1210
VINYL CHLORIDE	ug/L	3640	68	51	12	57	191	31	86	55
METHANE	ug/L	164	7890	5480	4100	339	7120			
ETHENE	ug/L	294	123	54	12	23	106			
ETHANE	ug/L	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U			
Total VFA	mg/L	14.1	<1	7.5	1.1	0.1	204.7			

June 2017 - 3 Months post Stage 2 operation

		EKMW-01		EKMW-02		EKMW-03		EKMW-04		EKMW-05		EKMW-07		EKMW-08		EKMW-09		EKMW-10		EKMW-11	
pH	unit	**5.7**		**6.4**		**6.3**		**6.9**		**5.7**		**6.2**		**5.4**		**5.2**		**6.3**		**5.6**	
ORP	mV	**-161**		**-70**		**-79**		**-173**		**-39**		**-88**		**-57**		**109**		**-101**		**11**	
Dissolved oxygen	mg/l	**1.1**		**0.7**		**1.4**		**1.5**		**0.4**		**0.9**		**1.2**		**0.5**		**0.1**		**0.1**	
Analyte	Units	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
BROMIDE	mg/L	4.5	I	2.6	I	1.2	U	0.6	U	3.0	U	3.0	U	1.2	U	3.0	U	1.2	U	6.0	U
TOTAL ORGANIC CARBON	mg/L	20.1		3.9		3.0		2.6		2.1		57		2.1		1.9		10.1		3.3	
CHLORIDE	mg/L	1950		756		717		465		1570		1670		1300		1630		793		2220	
SULFATE	mg/L	15	U	6	U	7.7		17		27.3	I	15	U	15.5		23.4	I	22.9		41.8	I
CALCIUM	mg/L	229		202		174		115		229		419		258		296		166		345	
IRON	mg/L	93.4		103		99		56.3		92.4		85.1		80.9		78.1		49.5		104	
MAGNESIUM	mg/L	57.7		54.4		53		31.3		55.8		56.9		72		77.8		47.7		73.7	
POTASSIUM	mg/L	5.9	I	4.94	I	5.86	I	3.6	I	6.2	I	16.3				5.9	I	21.4			
TDS (FILTERABLE)	mg/L															3890		2040			
1,1-DICHLOROETHENE	ug/L	21		0.7	I	1.6	U	0.8	U	6	I	8	I	3	U	32	U	1.6	U	32	U
cis-1,2-DICHLOROETHENE	ug/L	783		167.0		376		277		2,160		2,250		813		204		312		5,920	
TETRACHLOROETHENE	ug/L	406		44.9		13.8		41.1		3,540		92.4		593		8,930		55.3		5,850	
trans-1,2-DICHLOROETHENE	ug/L	94.1		2.0		2.1	I	2.7		170		34.8		28.4		37.9		11.3		22	U
TRICHLOROETHYLENE	ug/L	311		7.9		15		27.4		699		75.2		64.3		499		93.1		1,430	
VINYL CHLORIDE	ug/L	4780		36.2		36		12		379		724		32.3		41	U	157		62.1	
METHANE	ug/L	399		8740		7930		5010		987		8200									
ETHENE	ug/L	1280		119		69		7.6		192		260									
ETHANE	ug/L	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U								
Dhc	cell / L	1.96E+09		2.98E+06		3.70E+06		2.60E+06		2.44E+07		1.52E+08				<5000		1.60E+03			
tce	cell / L	2.66E+08		7.33E+04		2.23E+05		5.03E+05		3.76E+06		1.11E+07				<5000		2.00E+03	J		
bvc	cell / L	2.08E+08		9.13E+04		6.12E+04		2.30E+05		8.01E+05		7.22E+06				<5000		<5000			
vcr	cell / L	5.23E+08		8.37E+05		1.69E+06		8.59E+05		4.80E+06		1.11E+06				<5000		<5000			
Dhb	cell / L	6.60E+07		4.39E+05		1.72E+06		2.33E+04		2.36E+06		<5000				<4000		<5000			
Total VFA	mg/L	57.6		<1		<1		3.1		<1		195.9									

Grab Groundwater From Soil Core Locations (June 2017)

		C1		C2		C3		C6		C7		C9	
Analyte	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
TOTAL ORGANIC CARBON	mg/L	6.1		950		160		3.4		820		790	
1,1-DICHLOROETHENE	ug/L	6		0.2	U	5		3		0.4	U	4	
cis-1,2-DICHLOROETHENE	ug/L	4300		86		3700		2600		220		1900	
TETRACHLOROETHENE	ug/L	3500		11		160		1400		28		250	
trans-1,2-DICHLOROETHENE	ug/L	630		31		470		410		35		140	
TRICHLOROETHYLENE	ug/L	1300		5		430		660		29		67	
VINYL CHLORIDE	ug/L	290		1200		570		380		330		5000	
METHANE	ug/L	458		2490		3840		634		4090		259	
ETHENE	ug/L	65		1710		474		100	I	1880		402	
ETHANE	ug/L	2		18		12		5		6		3	
Dhc	cell / L	<3E+04		5.00E+06		2.00E+05		2.00E+03	J	2.00E+07		<4E+04	
tce	cell / L	NA		1.00E+06		5.00E+04		<3E+04		4.00E+06		NA	
bvc	cell / L	NA		5.00E+05		4.00E+03		<3E+04		1.00E+06		NA	
vcr	cell / L	NA		4.00E+06		1.00E+05		<3E+04		1.00E+07		NA	
Dhb	cell / L	<3E+04		1.00E+04		<4E+03		<3E+04		3.00E+05		<4E+04	