FINAL

SITE INSPECTION FOR AQUEOUS FILM FORMING FOAM AREAS KIRTLAND AIR FORCE BASE, NEW MEXICO

Contract No.: W912BV-15-C-0082

Submitted to:
U.S. Army Corps of Engineers, Tulsa District

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SEPTEMBER 2017

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
AAA	Actual AFFF Contamination Area
AFA	AFFF Spray Area
AFB	Air Force Base
AFFF	Aqueous Film Forming Foam
amsl	above mean sea level
bgs	below ground surface
BRAC	Base Realignment and Closure
btoc	below top of casing
DoD	Department of Defense
DOE	Department of Energy
DTW	depth to water
ERPIMS	Environmental Resource Program Information Management System
ELAP	Environmental Laboratory Accreditation Program
ft	feet
FTA	fire training area
GPS	Global Positioning System
HA	health advisory
HDPE	high density polyethylene
HSA	Hollow Stem Auger
ID	identification
IDW	Investigation Derived Waste
IRP	Installation Restoration Program
µS/cm	microsiemens per centimeter
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mV	millivolt
ND	non-detect
NTU	nephelometric turbidity unit
OTIE	Oneida Total Integrated Enterprises
PAA	Potential AFFF Contamination Area
PA	Preliminary Assessment
PAL	Project Action Limit
PFAS	polyfluoroalkyl substances
PFBS	perfluorobutane sulfonate
PFOA	perfluorooctoanoic acid
PFOS	perfluorooctane sulfonate
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act

RFI	RCRA Facility Investigation
RPM	Remedial Project Manager
RSL	regional screening level
SAF/IE	Assistant Secretary of the Air Force for Installation, Environment & Logistics
SI	Site Inspection
SOP	Standard Operating Procedure
SS	split-spoon
STSA	South Taxiway Spill Area
SVOC	semi-volatile organic compound
UFP	Uniform Federal Policy
U.S. EPA	United States Environmental Protection Agency
USACE	United States Army Corps of Engineers
USAF	United States Air Force
VOC	volatile organic compound

1.0 INTRODUCTION

Oneida Total Integrated Enterprises (OTIE), under contract to the United States Army Corps of Engineers (USACE) Tulsa District (Contract No. W912BV-15-C-0082), has conducted site inspections (SIs) at four areas located on Kirtland Air Force Base (AFB) in Albuquerque, New Mexico (**Figure 1-1** and **Figure 2-1**). The purpose of this SI is to evaluate the potential presence or absence of select *per*- and *polyfluorinated alkyl substances* (PFAS) in environmental samples collected from Aqueous Film Forming Foam (AFFF) release areas. PFAS are a class of synthetic fluorinated chemicals used in industrial and consumer products, and were included in defense-related applications, primarily AFFF.

In 1970, the United States Air Force (USAF) began using *perfluorooctane sulfonate* (PFOS)-based AFFF firefighting agents to extinguish petroleum fires. AFFF may have entered the environment during routine fire training, equipment maintenance, storage, and use. The United States Environmental Protection Agency (U.S. EPA) continues to permit the use of PFOS-based AFFF; however, manufacturers have reformulated AFFF to eliminate PFOS and minimize (if not eliminate) *perfluorooctanoic acid* (PFOA). The USAF has an excess inventory of PFOS-based AFFF. The USAF is currently removing PFOS-based AFFF from their inventory and replacing it with formulations containing shorter chain-length PFAS.

Per Department of Defense (DoD) Instruction 4715.18, “*Emerging Contaminants* (DoD, 2009)” and the Interim USAF Guidance on Sampling and Response Actions for Perfluorinated Compounds at Active and Base Realignment and Closure (BRAC) Installations (USAF, 2012), and the Assistant Secretary of the Air Force for Installation, Environment & Logistics (SAF/IE) Policy on Perfluorinated Compounds of Concern (USAF, 2016) the USAF will:

- identify locations where there is a reasonable expectation that there may have been a release of PFAS associated with USAF actions;
- determine if there is unacceptable risk to human health and the environment; and
- identify releases that pose an unacceptable risk, including offsite migration.

This work was performed in accordance with the Revised Final Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) *Site Inspections of Aqueous Film Forming Foam (AFFF) Usage at Multiple United States Air Force Installations in U.S. EPA Regions 6 & 9*, QAPP, [OTIE, 2016] and the UFP-QAPP Addendum “*Site Inspections of Aqueous Film Forming Foam Usage at Kirtland Air Force Base*” (QAPP Addendum, [OTIE, 2017]).

1.1 PROJECT OBJECTIVES

The objectives of this site inspection are to:

- Determine if PFAS are present in environmental media (groundwater, soil, surface water, and/or sediment) at Air Force-mediated AFFF release areas selected for inspection;
- Evaluate if detected concentrations of PFAS are present above the Project Action Limit (PAL) (defined in the following paragraph); and
- Identify potential receptor pathways with potential impacts to human health.

There are no legally enforceable standards for PFAS but a release will be considered for further evaluation if detected concentrations exceed PALs listed below:

PFOS:	0.070 micrograms per liter (µg/L) in groundwater and/or surface water 1.26 milligrams per kilogram (mg/kg) in soil and/or sediment
PFOA:	0.070 µg/L in groundwater and/or surface water 1.26 mg/kg in soil and/or sediment
Sum of PFOS and PFOA:	0.070 µg/L in groundwater and/or surface water
***Perfluorobutane sulfonate* (PFBS):**	380 µg/L in groundwater and/or surface water 1,600 mg/kg in soil and/or sediment

These PALs were derived from the following sources:

Groundwater and Surface Water:

The PFOS and PFOA PALs are the U.S. EPA's 2016 Lifetime health advisories (HAs) (U.S. EPA 2016a, b); and

The PFBS PAL is the U.S. EPA Tap water Regional Screening Level (RSL) (U.S. EPA 2016d).

Soil and Sediment:

The PFOS and PFOA PALs for soils and sediment were derived from the U.S. EPA Superfund program's risk based RSL calculator using a total hazard quotient of 1, default residential and direct contact parameters, reference dose and cancer ingestion slope factor from U.S. EPA (U.S. EPA 2016b, c) health effects support documents for PFOS and PFOA; and

The PFBS PAL is the U.S. EPA Residential Soil RSL (U.S. EPA 2016d).

Additionally, in accordance with U.S. EPA Fact Sheet (U.S. EPA 2016d), when both PFOA and PFOS are found in drinking water, the combined concentrations of PFOA and PFOS will be compared with the 0.070 µg/L HA level.

References are provided at the end of the document.

1.2 PROJECT SCOPE

AFFF areas were selected for further inspection while evaluated during the SI process for Kirtland AFB during the preliminary assessment (PA), the PA report (CH2M Hill, 2015), and the 2015 SI scoping meeting. The four (4) AFFF areas selected for this SI and the rationale for inclusion are listed in **Section 3.0**.

Media evaluated at each of the four (4) AFFF areas included surface soil, collected at 0 to 2 feet (ft) below ground surface (bgs); subsurface soil, collected from 15 and 25 ft bgs; and groundwater, collected from permanent monitoring wells.

Soil and groundwater samples were collected from each AFFF area to determine if detectable PFAS concentrations exist and, if present, are above the PALs. In accordance with the UFP-QAPP and the Site

Specific UFP-QAPP Addendum for Kirtland AFB (OTIE, 2016, 2017), sample locations were chosen by targeting areas with the potential for the highest concentrations of PFAS.

Soil samples were collected using Hollow-Stem Auger (HSA) Drilling and a split-spoon (SS) sampler, while groundwater samples were collected using a combination of Bennett pumps and hydro sleeves. A detailed description of field sampling activities can be found in Section 3.0.

Laboratory analyses of samples in all media were analyzed for a total of 16 PFAS species as well as two species of Fluorotelomer sulfonates. While there are no regulatory advisory limits for thirteen of the PFAS species or any of the fluorotelemers, the data may be useful in the future for mass balance and species transformation studies expected to be performed if a Remedial Investigation is required.

2.0 AQUEOUS FILM FORMING FOAM (AFFF) AREA BACKGROUND

2.1 AREA LOCATION, SETTING, AND HISTORY

The following provides a description and history of Kirtland AFB and the four (4) AFFF Investigation areas (**Figure 2.1**).

2.1.1 Kirtland Air Force Base

Location and Setting

Kirtland AFB occupies approximately 51,558 acres of developed and undeveloped land on the eastern edge of the Rio Grande River in the high desert of New Mexico. The base is located on the southern side edge of the border of Albuquerque, New Mexico (**Figure 1-1**). General topography at Kirtland AFB is primarily flat with a slight rise in elevation from west to east ranging from approximately 5000 ft above mean sea level (amsl) to 6700 ft amsl. Most facilities on Kirtland AFB are located in the northern portion of the base and include, but are not limited to vehicle maintenance support facilities, administrative offices, family housing, an aircraft runway, fuel storage facilities, and other USAF facilities.

Area History

Construction of Albuquerque Army Air Base began in 1941; during World War II training of B-17 and B-24 crews and in 1945 training of crews for the B-29. In 1946 Kirtland AFB was placed under Air Material Command for testing weaponry delivery systems developed by the Manhattan Engineering District. In December 1949 Kirtland AFB became the headquarters for Air Force Special Weapons Center. In 1971 the Kirtland, Manzano and Sandia AFBs were merged. Kirtland AFB is operated by the 377th Air Base Wing whose mission is to execute nuclear, readiness, and support operations for American air power (CH2M Hill, 2015).

2.1.2 AFFF Area 1 Air Force FT-013 (FT013)

Location and Setting

Air Force FT-013 (FT013) is an open area south of the runway and due west of the intersection of Southgate Avenue and Old Tower Road in the northwest portion of Kirtland AFB (**Figure 2-1**). FT013 is southwest of Air Force Fire Station No. 5 (Building 638) and due west of the active current fire training area (FTA). FT013 was historically used by the Kirtland AFB Fire Department. Fire training activities at this location included the use of AFFF from the early 1970s to 1990 (CH2M Hill, 2015).

Area History

FT013 consists of a former fire training area in use from the 1950’s to 1990. It originally consisted of two unlined pits used until 1976. This portion of the site was capped with 18 inches of asphalt in 1992. In 1976, use of the unlined pits ceased and training was conducted at the former jet burn area. This area consisted of a mock plane located on a concrete pad. Training was conducted at this area from 1976 to 1990. Training at both locations on the site utilized AFFF as an extinguishing agent. FT013 was designated as an Installation Restoration Program (IRP) site and was investigated for fuel releases. The site was capped in 1992 and closed under the Resource Conservation and Recovery Act (RCRA) in 2003, but was not investigated for PFAS (CH2M Hill, 2015).

2.1.3 AFFF AREA 2 Department of Energy (DOE) FT-014 (FT014)

Location and Setting

Department of Energy (DOE) FT-014 (FT014) is located in the sparsely developed eastern portion of the installation adjacent to the current and former DOE Manzano facilities (**Figure 2-1**). FT014 is located in an undeveloped field between Vandenberg Road to the east and a Manzano facility security fence to the west. FT014 occupies approximately 1,500 square feet and is due west of a softball field. Little information on location history and operation is available because FT014 has been closed and abandoned for approximately 30 years. FT014 consisted of two unlined earthen bermed fire pits approximately 200 feet apart. The western pit was reportedly 500 square feet and the eastern pit was reportedly 1,000 square feet (CH2M Hill, 2015).

Area History

FT014 use dates from the 1950s to the 1970s are estimated based on land use development and DOE operations at Kirtland AFB. FT014 use is not suspected before construction of the DOE Manzano facility in the 1950s. FT014 was reportedly abandoned in the 1970s according to one document and in 1960 according to another document. The frequency of use and the quantities of AFFF applied to FT014 are unknown (CH2M Hill, 2015).

FT014 has been investigated, remediated, and closed under the IRP. FT014 was investigated in the 1981 Phase I assessment, the Appendix II Stage 2B RCRA Facility Investigation (RFI) in 1993, the Appendix I Phase 2 RFI in 1996, and in the 2002 confirmation sampling. Investigation activities included surface and subsurface soil sampling for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), petroleum hydrocarbon and metal contaminants of concern. Charred and blackened surface soil was observed in the abandoned pits during environmental investigations. Soil contamination associated with petroleum hydrocarbons and metals was detected above screening levels in shallow soils prior to remedial activities (CH2M Hill, 2015).

Interim corrective measures were performed in 1996 and 1997. Remedial activities included soil excavation and stabilization and soil vapor extraction. Confirmation sampling indicated that corrective measures were successful in removing contamination and the location was closed and removed from the RCRA permit. Sampling for PFAS was not included in previous investigations (CH2M Hill, 2015).

2.1.4 AFFF AREA 3 AFFF Spray Area (AFA)

Location and Setting

The AFFF Spray Area (AFA) is a flat area of bare ground located between Echo Taxiway and Hangar 1000 on the north side of the main runway (Figure 2-1). The AFA was identified during interviews with the Air Force Fire Department staff and delineated on Kirtland AFB maps with the assistance of fire department staff. The ground is a slight depression of bare ground surrounded by aircraft pavement on all sides and has no storm drains. Surface water accumulates at this location and does not overflow onto paved areas during applications of up to several hundred gallons of AFFF and water; the water rapidly dissipates by evaporation and infiltration. The location is surrounded by paved military and industrial areas, with no residents or natural habitat (CH2M Hill, 2015).

Area History

The Air Force Fire Department uses the AFA for training and testing of 3 percent AFFF carried on crash trucks. The AFA was designated as such in 1992 after the use of FT013 ceased. Testing at the location with 3 percent AFFF occurs routinely at a frequency of 8 to 10 times per year. During each test, AFFF and water mixtures are sprayed across the area to train staff and test equipment. The quantity of AFFF used was estimated at approximately 20 gallons (and approximately 650 gallons of water), which were typically discharged during each test (CH2M Hill, 2015).

2.1.5 AFFF AREA 4 South Taxiway Spill Area (STSA)

Location and Setting

In 1995 a spill of AFFF occurred from a Fire Department P-19 crash truck. The spill occurred during siphoning of 3 percent AFFF from a holding tank on the crashed vehicle. The spill was not immediately detected and resulted in a spill spreading across more than 4,000 linear feet of runway (CH2M Hill, 2015) (**Figure 2-1**).

Area History

The spill response team was called to clean up and remove the spilled material for offsite disposal. The liquids were covered in sand to absorb them, brushed up, and containerized. Approximately 100 to 125 gallons of 3 percent AFFF were spilled (CH2M Hill, 2015).

3.0 FIELD ACTIVITIES, SAMPLING RATIONALE, AND ANALYTICAL PROTOCOL

SI activities were conducted at Kirtland AFB between 13 and 17 February 2017 at 4 AFFF Areas identified for inspection during the 2015 site scoping visit (**Figure 2-1**). Media sampled during the 2017 AFFF SI included soil and groundwater. Sample quantities are presented in **Table 3-1**. The most likely locations that PFAS constituents would concentrate were identified and used as the rationale for locating soil borings and sediment samples and are referred to throughout this report as either release areas or accumulation areas. For the purposes of this report release areas are defined as specific locations that received AFFF due to fire suppression, equipment testing, equipment leaks, spillage or any other release of AFFF into the environment. Accumulation areas are defined as topographically depressed locations susceptible to runoff and subsequent accumulation of AFFF.

Soil boring placement rationale was decided during a teleconference meeting conducted on 21 June 2016 attended by Kirtland AFB environmental and AFCEC personnel the results of which are reflected in the Technical Memorandum - Summary of Findings (OTIE, 2016).

Table 3.0 Total Samples*

AFFF Area	Soil	Groundwater
AFFF Area 1: Air Force FT-013	9	1
AFFF Area 2: DOE FT-014	9	1
AFFF Area 3: AFFF Spray Area	9	1
AFFF Area 4: South Taxiway Spill	9	1
Total Sample Number*	**36**	**4**

NOTES:
*Exclusive of quality control samples

3.1 FIELD ACTIVITIES

A record of field activities and Daily Field Forms are provided in **Appendix A.1**. Daily Safety and Operations Tailgate Meeting Forms are provided in **Appendix A.2**.

3.1.1 Mobilization

Prior to commencement of field activities, the base Remedial Project Manager (RPM) was notified of OTIE's field mobilization schedule to Kirtland AFB. This notification allowed OTIE, with the assistance of the base RPM, to coordinate dig permits, locate areas for storage of investigative derive waste, and identify general area access for subcontractor to come on base and access suspected AFFF sites. A copy of the dig permits are presented in **Appendix A.1**.

3.1.2 Soil Boring Advancement

Soil borings were completed by Enviro Drill, licensed drillers in the state of New Mexico. Soil borings were initially cleared of utilities to a depth of 5 ft bgs with a hand auger and completed with a 8-inch diameter HSA in accordance with OTIE007A_Drilling Methods and Procedures (Standard Operating Procedure [SOP]) (**Appendix B**). Lithologic boring logs and driller reports are provided in **Appendix A.3**. Soil cores and cuttings were screened with a photoionization detector to evaluate the potential presence of VOCs in the soil for workers safety and in accordance to the OTIE Health and Safety Plan. This information was logged according to OTIE007B Soil and Rock Geologic Logging and Classification SOP **(Appendix B).**

3.1.3 Soil Sample Collection

Soil samples were continuously collected for lithologic logging purposes at 5 ft intervals using 3.5-inch diameter stainless steel split-spoon sampler. Soil cores and cuttings were screened with a photoionization detector to evaluate the potential presence of VOCs in the soil for workers safety and in accordance to the OTIE Health and Safety Plan (OTIE, 2016). This information was logged according to OTIE007B Soil and Rock Geologic Logging and Classification SOP (**Appendix B**). Samples were transferred directly into laboratory-provided high density polyethylene (HDPE) containers in accordance with OTIE007D Subsurface Soil Sampling SOP (**Appendix B**). Sample containers were sealed, labeled, packed into ice-filled coolers and delivered under chain-of-custody to Maxxam Analytics for PFAS analysis (**Appendix A.4**).

3.1.4 Physicochemical Samples

A set of physical/chemical properties were measured by compositing the soil samples from similar depths from the 3 (typical) borings at each area. Representative measurements for Total Organic Carbon, pH, and grain size at each of the sampling depths are provided in **Appendix C.1**. The parameters were collected as part of an ongoing effort by the Air Force to understand fate and transport of PFAS with these physiochemical properties but their significance are not discussed in this SI.

3.1.5 Groundwater Sampling

Permanent wells were used to sample for groundwater. Wells were purged and sampled by Daniel B. Stephens. The permanent existing wells were purged using a Bennett pump or hydro sleeve. Prior to sampling, depth to groundwater was measured in all existing permanent monitoring wells, and is provided in **Appendix A.5** as directed by the OTIE008E Fluid Level Measurement in Wells SOP (**Appendix B**). During the purging process, water quality parameters temperature (degrees Celsius [°C]), pH, specific conductance (microsiemens per centimeter [µS/cm]), dissolved oxygen (milligram/liter [mg/L]), oxidation reduction potential (millivolt [mV]), and turbidity (nephelometric turbidity units [NTU]) were measured using a Horiba multi-parameter water quality meter in accordance with OTIE005A Field Parameter Measurements in Water SOP (**Appendix B**). The wells were sampled for PFAS using direct fill sampling techniques for analysis of PFAS in accordance with OTIE008F Monitoring Well Sampling SOP (**Appendix B**).

The sample containers were sealed, labeled, packed on ice in an insulated cooler, and delivered to Maxxam Analytics under chain-of-custody in accordance with OTIE010C Sample Labeling, Control, and Shipping SOP (**Appendix B**). Groundwater sampling was documented on Groundwater Sample Collection Logs provided in **Appendix A.5**.

3.1.6 PFAS Laboratory Analysis

EPA method 537M is modified drinking water analysis method that was used to analyze for 16 PFAS compounds. The modification of the method was developed for solids, groundwater and other matrices. The Maxxam modification of the method is proprietary; however, in general the changes have to do with the preparation of the samples using solid phase extraction, expanding the number of analytes that can be reported by the method (18 for OTIE) and the use of Isotope Dilution instead of surrogates. More information related to the method can be found in the project QAPP (OTIE, 2016). The Data Usability Summary containing the results of laboratory analyses on PFAS samples and associated field quality control samples is provided in **Appendix D**.

3.1.7 Surveying

The soil boring locations were surveyed by Shields Surveying LTD Co. on 16 February 2017. Soil boring locations were determined in the field using a Global Positioning System (GPS) receiver; following their advancement and abandonment, surveying was conducted. The coordinates were listed in State Plane Coordinates on New Mexico Central Zone (NAD 83) projection. Due to the borings being backfilled after sampling, all vertical data from the surveys are measured from natural ground surface. Survey coordinates and measuring point elevations are reported in **Appendix E**.

3.1.8 Investigation Derived Waste Sampling and Disposal

No Investigation Derived Waste (IDW) was generated from soil borings as the soil was returned to the borehole from which it was taken. One drum of groundwater IDW was generated per site and each drum was sampled and analyzed for RCRA metals and characteristics, VOCs, and SVOCs. Disposable sampling equipment was used to take waste samples in accordance with OTIE012A IDW Management SOP (**Appendix B**). The drum inventory and analytical results are presented in **Appendix F**. The evaluation of the IDW analytical results indicated that the IDW was non-hazardous and water samples collected from the monitoring wells were non-detect for PFAS.

IDW samples were analyzed by Eurofins Laboratories, in Lancaster, Pennsylvania. Eurofins Laboratories is accredited under the DoD Environmental Laboratory Accreditation Program (ELAP) program. With approval from the Air Force and after IDW sample results were analyzed the IDW (groundwater) was disposed on-site near their point of origin.

3.2 AFFF AREA 1 AIR FORCE FT-013 (FT013)

3.2.1 Sample Locations and Rationale

Air Force FT-013 (FT013) is located south of the runway due west of the intersection of Southgate Avenue and Old Tower Road in the northwest portion of Kirtland AFB (**Figure 2-1**). FT013 consists of two former fire pits that have since been capped with 18 inches of concrete. Unimproved land surrounds the concrete cap in all directions. Soil boring locations were located around the concrete cap at potential AFFF source areas and accumulation points (topographically depressed locations susceptible to the gathering and accumulation of AFFF). A groundwater sampling location was identified adjacent to the concrete cap at existing source area groundwater monitoring well (KAFB0417).

3.2.1.1 Soil Samples

Three soil borings, FT013-SB01, FT013-SB02, and FT013-SB03, were each advanced to a depth of 25 ft bgs for lithologic logging and soil sample collection on 14 February 2017. Soil boring FT013-SB01 was located adjacent to the old capped fire training area, soil boring FT013-SB02 was located within a second potential source area in the southwest portion of FT013, and soil boring FT013-SB03 was located adjacent to a potential accumulation point downslope from FT013. Three soil samples were collected from each of the soil borings, for a total of nine soil samples. The rationale for soil sampling depths is presented in **Table 3.2.1.1**.

Table 3.2.1.1 AFFF AREA 1 FT013 Soil Samples*

Sample Location	Sample ID	Depth (ft bgs)	Reasoning
FT013-SB01	DXN398	0 – 1	Surface sampling
	DXN399	15 – 16	Median sampling
	DXN401	24 – 25	Bottom of the boring
FT013-SB02	DXN402	0 – 1	Surface sampling
	DXN403	15 – 16	Median sampling
	DXN404	24 – 25	Bottom of the boring
FT013-SB03	DXN405	0 – 1	Surface sampling
	DXN406	15 – 16	Median sampling
	DXN407	24 – 25	Bottom of the boring

NOTES:
*Exclusive of quality control samples
DEFINITIONS:
bgs = below ground surface
ID = identification
ft = feet

Soil boring sample locations are presented in **Figure 3-2**.

3.2.1.2 Water Samples

One permanent existing groundwater monitoring well, KAFB0417, was sampled. Monitoring well KAFB0417 is located due north of the concrete cap. Well construction information is presented in **Table 3.2.1.2** below**.**

Table 3.2.1.2 AFFF AREA 1 FT013 Water Sample*

Sample Location	Sample ID	DTW(ft btoc)	Screened Interval (ft bgs)	Sample Date
KAFB0417	DXW953	447.94	430-455	2/16/2017

NOTES:
*Exclusive of quality control samples
DEFINITIONS:
btoc = below top of casing
DTW = Depth to Water
ft = feet
ID = identification
[1] Name of the well as named on Environmental Resource Program Information Management System (ERPIMS)

The groundwater sample location is presented in **Figure 3-2**.

3.2.2 Analytical Results

3.2.2.1 Soil Results

PFAS were not detected above their respective PALs in the soil samples from this area.

Figure 3-2 presents the soil boring locations.

Appendix C.2 presents all PFAS analytical soil results.

3.2.2.2 Water Results

PFAS were not detected above their respective PALs in the groundwater sample from this area.

Figure 3-2 presents the well location.

Appendix C.3 presents all PFAS analytical groundwater results.

3.2.3 Conclusions

None of the samples collected from FT013 contained PFAS constituents with concentrations above their respective PALs. Laboratory results and signed chain of custodies are provided in **Appendix G**.

3.3 AFFF AREA 2 DOE FT-014 (FT014)

3.3.1 Sample Locations and Rationale

DOE FT-014 (FT014) is located west of the current and former DOE Manzano facilities in the eastern portion of Kirtland AFB (**Figure 2-1**). FT014 consists of two unlined earthen bermed fire pits used for fire training activities over 30 years ago. Soil boring locations were located adjacent to FT014 at potential AFFF source areas and accumulation points. The groundwater sampling location was identified at an existing groundwater monitoring well (KAFB0622) located downgradient of FT014.

3.3.1.1 Soil Samples

Three soil borings, FT014-SB01, FT014-SB02, and FT014-SB03, were each advanced to a depth of 25 ft bgs for lithologic logging and soil sample collection on 13 February 2017. Soil borings FT014-SB01 and FT014-SB02 were located adjacent to the two former fire pits, and soil boring FT013-SB03 was located at a potential accumulation point downslope from FT014. Three soil samples were collected from each of the soil borings for a total of nine soil samples. The rationale for soil sampling depths is presented in **Table 3.3.1.1**.

Table 3.3.1.1 AFFF AREA 2 FT014 Soil Samples*

Sample Location	Sample ID	Depth (ft bgs)	Reasoning
FT014-SB01	DXH435	0 – 1	Surface sampling
	DXH436	15 – 16	Median sampling
	DXH437	24 – 25	Bottom of the boring
FT014-SB02	DXH438	0 – 1	Surface sampling
	DXH439	15 – 16	Median sampling
	DXH440	24 – 25	Bottom of the boring
FT014-SB03	DXH441	0 – 1	Surface sampling
	DXH442	15 – 16	Median sampling
	DXH444	24 – 25	Bottom of the boring

NOTES:
*Exclusive of quality control samples
DEFINITIONS:
bgs = below ground surface
ft = feet
ID = identification

Soil boring sample locations are presented in **Figure 3-3**.

3.3.1.2 Water Samples

One permanent existing groundwater monitoring well, KAFB0622, was sampled. Monitoring well KAFB0622 is located northwest of FT014. Well construction information is presented in **Table 3.3.1.2**.

Table 3.3.1.2 AFFF AREA 2 FT014 Water Sample*

Sample Location	Sample ID	DTW(ft btoc)	Screened Interval (ft bgs)	Sample Date
KAFB0622	DXW949	538.25	529-554	2/13/2017

NOTES:
*Exclusive of quality control samples

DEFINITIONS:
btoc = below top of casing
DTW = Depth to Water
ft = feet
ID = identification
[1] Name of the well as named on Environmental Resource Program Information Management System (ERPIMS)

The groundwater sample location is presented in **Figure 3-3**.

3.3.2 Analytical Results

3.3.2.1 Soil Results

PFAS were not detected above their respective PALs in the soil samples from this area.

Figure 3-3 presents the soil boring locations.

Appendix C.2 presents all PFAS analytical soil results.

3.3.2.2 Water Results

PFAS were not detected above their respective PALs in the groundwater sample from this area.

Figure 3-3 presents the well location.

Appendix C.3 presents all PFAS analytical groundwater results.

3.3.3 Conclusions

None of the samples collected from FT014 contained PFAS constituents with concentrations above their respective PALs. Laboratory results and signed chain of custodies are provided in **Appendix G**.

3.4 AFFF AREA 3 AFFF SPRAY AREA (AFA)

3.4.1 Sample Location and Rationale

The AFFF Spray Area (AFA) is located between Echo Taxiway and Hangar 1000 on the north side of the main runway in the northwestern portion of Kirtland AFB (**Figure 2-1**). The AFA consists of bare ground surrounded on all sides by paved runway. Soil boring locations were located within the AFA at potential AFFF source areas and accumulation points. The groundwater sampling location was identified at an existing groundwater monitoring well (KAFB_7001) located downgradient of the AFA.

3.4.1.1 Soil Samples

Three soil borings, AFA-SB01, AFA-SB02, and AFA-SB03, were each advanced to a depth of 25 ft bgs for lithologic logging and soil sample collection on 15 February 2017. Soil borings AFA-SB01 and AFA-SB03 were located at potential accumulation points in a topographic low adjacent to the AFA, and soil boring FT013-SB02 was located at a potential source area. Three soil samples were collected from each of the soil borings for a total of nine soil samples. The rationale for sampling depths is presented in **Table 3.4.1.1**.

Table 3.4.1.1 AFFF AREA 3 AFFF Spray Area Soil Samples*

Sample Location	Sample ID	Depth (ft bgs)	Reasoning
AFA-SB01	DXR065	0 – 1.0	Surface sampling
	DXR066	15.0 – 16.0	Median sampling
	DXR067	24.0 – 25.0	Bottom of the boring
AFA-SB02	DXR068	0.0 – 1.0	Surface sampling
	DXR069	15.0 – 16.0	Median sampling
	DXR070	24.0 – 25.0	Bottom of the boring
AFA-SB03	DXR061	0.0 – 1.0	Surface sampling
	DXR063	15.0 – 16.0	Median sampling
	DXR064	24.0 – 25.0	Bottom of the boring

NOTES:

*Exclusive of quality control samples

DEFINITIONS:

bgs = below ground surface
ID = identification
ft = feet

Soil boring sample locations are presented in **Figure 3-4**.

3.4.1.2 *Water Samples*

One permanent existing groundwater monitoring well, KAFB_7001, was sampled. Monitoring well KAFB_7001 is located north of the AFA. Well construction information is presented in **Table 3.4.1.2**.

Table 3.4.1.2 AFFF AREA 3 AFFF Spray Area Water Sample*

Sample Location	Sample ID	DTW(ft btoc)	Screened Interval (ft bgs)	Sample Date
KAFB_7001	DXW950	448.55	454-479	2/15/2017

NOTES:

*Exclusive of quality control samples

DEFINITIONS:

btoc = below top of casing
DTW = Depth to Water
ft = feet
ID = identification
[1] Name of the well as named on Environmental Resource Program Information Management System (ERPIMS)

The groundwater sample location is presented in **Figure 3-4**.

3.4.2 Analytical Results

3.4.2.1 *Soil Results*

PFAS were not detected above their respective PALs in the soil samples from this area.

Figure 3-4 presents the soil boring locations.

Appendix C.2 presents all PFAS analytical soil results.

3.4.2.2 *Water Results*

PFAS were not detected above their respective PALs in the groundwater sample from this area.

Figure 3-4 presents the well location; and

Appendix C.3 presents all PFAS analytical groundwater results.

3.4.3 Conclusions

None of the samples collected from AFA contained PFAS constituents with concentrations above their respective PALs. Laboratory results and signed chain of custodies are provided in **Appendix G**.

3.5 AFFF AREA 4 SOUTH TAXIWAY SPILL AREA (STSA)

3.5.1 Sample Locations and Rationale

The South Taxiway Spill Area (STSA) is located south of the main runway in the northcentral portion of Kirtland AFB (**Figure 2-1**). The STSA consists of bare ground bordered to the north by paved runway and to the south by Kirtland Road SE. Soil boring locations were identified adjacent to potential AFFF source areas and accumulation points. The groundwater sampling location was identified at an existing groundwater monitoring well (KAFB-106027) located downgradient of the STSA.

3.5.1.1 Soil Samples

Three soil borings, STSA-SB01, STSA-SB02, and STSA-SB03, were each advanced to a depth of 25 ft bgs for lithologic logging and soil sample collection on 14-15 February 2017. Soil borings AFA-SB01, AFA-SB02, and AFA-SB03 were located at potential accumulation points in a topographic low adjacent to the taxiway. Three soil samples were collected from each of the soil borings for a total of nine soil samples. The rationale for sampling depths is presented in **Table 3.5.1.1**.

Table 3.5.1.1 AFFF AREA 4 South Taxiway Spill Area Soil Samples*

Sample Location	Sample ID	Depth (ft bgs)	Reasoning
STSA-SB01	DXN426	0 – 1	Surface sampling
	DXN427	15 – 16	Median sampling
	DXN428	24 – 25	Bottom of the boring
STSA-SB02	DXN429	0 – 1	Surface sampling
	DXN431	15 – 16	Median sampling
	DXN432	24 – 25	Bottom of the boring
STSA-SB03	DXR080	0 – 1	Surface sampling
	DXR081	15 – 16	Median sampling
	DXR082	24 – 25	Bottom of the boring

NOTES:
*Exclusive of quality control samples
DEFINITIONS:
bgs = below ground surface
ft = feet
ID = identification

Soil boring sample locations are presented in **Figure 3-5**.

3.5.1.2 Water Samples

One permanent existing groundwater monitoring well, KAFB-106027, was sampled. Monitoring well KAFB-106027 is located north of the STSA. Well construction information is presented in **Table 3.5.1.2**.

Table 3.5.1.2 AFFF AREA 4 South Taxiway Spill Area Water Sample*

Sample Location	Sample ID	DTW(ft btoc)	Screened Interval (ft bgs)	Sample Date
KAFB-106027	DXW952	478.00	481.00-501.00	2/15/2017

NOTES:

*Exclusive of quality control samples

DEFINITIONS:

btoc = below top of casing
DTW = Depth to Water
ft = feet
ID = identification
[1] Name of the well as named on Environmental Resource Program Information Management System (ERPIMS)

3.5.2 Analytical Results

3.5.2.1 Soil Results

PFAS were not detected above their respective PALs in the soil samples from this area.

Figure 3-5 presents the soil boring locations.

Appendix C.2 presents all PFAS analytical soil results.

3.5.2.2 Water Results

PFAS were not detected above their respective PALs in the groundwater sample from this area.

Figure 3-5 presents the well location.

Appendix C.3 presents all PFAS analytical groundwater results.

3.5.3 Conclusions

None of the samples collected from STSA contained PFAS constituents with concentrations above their respective PALs. Laboratory results and signed chain of custodies are provided in **Appendix G**.

4.0 MIGRATION/EXPOSURE PATHWAYS AND TARGETS

4.1 SOIL (SURFACE AND SUBSURFACE) EXPOSURE PATHWAY

4.1.1 Local Geologic Setting

Kirtland AFB is located in the Middle Rio Grande Basin (Albuquerque Basin) of the Rio Grande Rift, which stretches from central Colorado through New Mexico to Mexico and Texas. The Basin is filled with up to 14,000 feet of middle Tertiary to Quaternary Santa Fe Group and Quaternary post-Santa Fe Group sediments. The Santa Fe Group consists of alternating beds of sand, gravel, silt, and clay. Quaternary post-Santa Fe Group sediments are similarly variable, but mainly consist of silts and silty sands typical of stream overbank and basin fill deposition. Bedrock of various geological ages outcrops to the east of Kirtland AFB as the Sandia-Manzano Mountains, which are typically separated from the Basin fill by north-south trending faults (OTIE, 2014).

4.1.2 Actual or Potential Releases in Soil (Surface and Subsurface)

The AFFF Areas where PFAS concentrations exceed the PALs are defined as "*Actual AFFF Contamination Areas*" (AAAs). There are no AAA areas found on Kirtland AFB. AFFF Areas where no PFAS concentrations exceed the PALs are defined as "*Potential AFFF Contamination Areas*" (PAAs). PFAS concentrations were below the PALs for soil at each of the investigated AFFF Areas, thus, the four (4) AFFF Areas have been categorized as PAAs for soil pathway analysis.

Soil samples at each of the AFFF Areas were collected from depths ranging from the ground surface to 25 ft bgs. PFAS concentrations were detected below the PALs in soil samples for all of the AFFF Areas; thus, the four AFFF Areas have been evaluated as PAAs for soil pathway analysis.

Below is a summary of the Potential PFAS impacted Areas for soil evaluated during the investigation. Because of the low analyte concentrations pathways that would affect human health are incomplete.

AFFF Area 1 – PAA Air Force FT-013 (FT013): None of the PFAS were detected above the PALs. Select soil samples had very minor PFAS concentration several orders of magnitude below the PALS at levels that have been measured in the literature occurring in rainwater, likely indicative of anthropogenic background.

AFFF Area 2 – PAA Department of Energy FT-014 (FT014): None of the PFAS were detected above the PALs. Select soil samples had very minor PFAS concentration several orders of magnitude below the PALS at levels that have been measured in the literature occurring in rainwater, likely indicative of anthropogenic background.

AFFF Area 3 – PAA AFFF Spray Area (AFA): None of the PFAS were detected above the PALs. Select soil samples had very minor PFAS concentration several orders of magnitude below the PALS at levels that have been measured in the literature occurring in rainwater, likely indicative of anthropogenic background.

AFFF Area 4 – PAA South Taxiway Spill Area (STSA): None of the PFAS were detected above the PALs. Select soil samples had very minor PFAS concentration several orders of magnitude below the PALS at levels that have been measured in the literature occurring in rainwater, likely indicative of anthropogenic background.

4.1.3 Soil Exposure Targets

No AAAs were identified in **Section 4.1.2**.

4.1.4 Soil Exposure Conclusion

PFAS concentrations did not exceed the PALs for soil at any of the four AFFF Areas investigated. Based on these results the exposure pathway for soil is incomplete.

4.2 GROUNDWATER MIGRATION PATHWAY

4.2.1 Local Hydrogeologic Setting

The groundwater system at Kirtland AFB and in the Albuquerque area lies within the Albuquerque Basin also referred to as the Middle Rio Grande Basin. The basin is part of the Rio Grande Rift. As the Rio Grande Rift spread apart, creating various basins, the Albuquerque Basin is filled with sediments several miles thick, most of which are referred to as the Santa Fe Group. The unit consists of unconsolidated sediments that thin toward the basin boundary. The edges of the basin are marked by normal faults. Overlying the Santa Fe Group are the Pliocene Ortiz gravel and Rio Grande fluvial deposits (CH2M Hill, 2015).

Water supply for Kirtland AFB is primarily derived from five onsite groundwater production wells in the northern portion of the Base which are screened in the Upper and Middle Santa Fe Group. Two additional Base water supply wells have recently been activated, but are not currently operational. Ten historical onsite wells have been decommissioned. Additionally, water may be purchased from the Albuquerque Bernalillo County Water Utility Authority municipal supply if necessary. Municipal supply of the Albuquerque region is from groundwater production wells as well as Rio Grande surface water. Several Albuquerque Bernalillo County Water Utility Authority municipal supply wells are located north and downgradient of Kirtland AFB (CH2M Hill, 2015).

Six water supply wells active on Kirtland AFB were sampled by Bioenvironmental 28 November 2016 as part of a USAF program to evaluate the possible presence of PFAS in water supply wells at USAF facilities nationwide. The results of the subject water sampling activities indicated that PFAS constituents were not detected in samples collected from Kirtland AFB potable water supply wells at concentrations approaching the EPA HAs. The water supply data is found in **Appendix H**.

4.2.2 Actual and Potential Releases to Groundwater

PFAS concentrations were not detected in groundwater samples collected from all AFFF Areas. Groundwater samples were collected from existing monitoring wells at depths ranging from 447.94 to 538.25.

Below is a summary of the Actual and Potential PFAs impacted Areas for groundwater evaluated during the site inspection:

AFFF Area 1 – Air Force FT-013 (FT013): PFAS compounds were not detected in groundwater sample. FT013.

AFFF Area 2 – Department of Energy FT-014 (FT014): PFAS compounds were not detected in groundwater sample.

AFFF Area 3 – AFFF Spray Area (AFA): PFAS compounds were not detected in groundwater sample.

AFFF Area 4 – South Taxiway Spill Area (STSA): PFAS compounds were not detected in groundwater sample.

4.2.3 Groundwater Migration Pathway Target

No AAAs were identified in **Section 4.2.2**.

4.2.4 Groundwater Migration Pathway Conclusions

PFAS concentrations did not exceed the PALs for groundwater at any of the four AFFF Areas. Based on these results the groundwater migration pathway for groundwater is incomplete.

5.0 SAMPLING RESULTS

5.1 CONCLUSIONS

Four AFFF areas were sampled for PFAS in soil and groundwater. **Table 5.1** summarizes the AFFF area results for each type of media. For sampling depths and range of constituent concentrations see tables in **Appendix C**.

Table 5.1 Summary of total number of Samples* with PAL Exceedances

AFFF Area	Surface Soil[1]	Subsurface Soil[2]	Groundwater	PAL Exceedances?
AFFF Area 1 Air Force FT-013 (FT013)	---	---	ND	No
AFFF Area 2 Department of Energy FT-014 (FT014)	---	---	ND	No
AFFF Area 3 AFFF Spray Area (AFA)	---	---	ND	No
AFFF Area 4 South Taxiway Spill Area (STSA)	---	---	ND	No

NOTES:
*Exclusive of quality control samples
ND-Non-Detect
[1] Soil 0 to 1 feet (ft) below ground surface (bgs)
[2] Subsurface soil (collected from an interim depth and 25 ft bgs).
--- = PFAS did not exceed the PALs in the media
ns = media not sampled for PFAS

6.0 DISCUSSION OF RESULTS

AFFF Area 1 – PAA Air Force FT-013 (FT013): One groundwater sample was collected from the existing monitoring well, KAFB-0417 located directly north of FT013. KAFB-0417 is the closest existing downgradient monitoring well located to the potential source area. No PFAS constituents above the PALs were detected in the groundwater sample.

Each of the nine soil samples were either non-detect or detected PFAS constituents below the PALs. Of the three surface soil samples FT013-SB01 detected PFOS concentrations between 0-1 ft bgs that were considerably greater than the other two soil sampling locations.

AFFF Area 2 – PAA Department of Energy FT-014 (FT014): One groundwater sample was collected from existing monitoring well, KAFB-0622 located northwest of FT014. KAFB-0622 is the closest existing downgradient monitoring well located to the potential source area. No PFAS constituents above the PALs were detected in the groundwater sample.

Each of the nine soil samples detected constituents below the PALs. There was not a clear difference in concentrations between the samples.

AFFF Area 3 – PAA AFFF Spray Area (AFA): One groundwater sample was collected from existing monitoring well, KAFB-7001 located north of AFA. KAFB-7001 is the closest existing downgradient monitoring well located to the potential source area. No PFAS constituents above the PALs were detected in the groundwater sample.

Each of the nine soil samples detected constituents below the PALs by several orders of magnitude. There was not a clear difference in concentrations between the samples.

AFFF Area 4 – PAA South Taxiway Spill Area (STSA): One groundwater sample was collected from existing monitoring well, KAFB-10627 located north of STSA. KAFB-10627 is the closest existing downgradient monitoring well located to the potential source area. No PFAS constituents above the PALs were detected in the groundwater sample.

Although soil samples detected constituents below PALs by several orders of magnitude, there was not a clear difference in concentration between samples.

7.0 REFERENCES

CH2M Hill. 2015. *Final Preliminary Assessment Report for Perfluorinated Compounds at Kirtland Air Force Base, Albuquerque, New Mexico*. June.

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______. 2016. *Revised Final Uniform Federal Policy for Quality Assurance Project Plan Site Inspections of Aqueous Film Forming Foam Usage at Multiple United States Air Force Installations in U.S. EPA Regions 6 &9*. August.

______. 2016. Technical Memorandum, Summary of Findings, Kirtland Air Force Base, New Mexico USACE Tulsa District Contract: W912BV-15-C-0082.

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United States Environmental Protection Agency (U.S. EPA). 2016a. Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA), U.S. EPA Document Number 822-R-16-005. May.

______. 2016b. Health Effects Support Document for Perfluorooctanoic Acid (PFOA), U.S. EPA Document Number 822-R-16-003. May.

______. 2016c. Health Effects Support Document for Perfluorooctane Sulfonate (PFOS), U.S. EPA Document Number 822-R-16-002. May.

______. 2016d. U.S. EPA Regional Screening Level (RSL) Summary Table (TR = 1E-06. HQ =1). May.

Figures

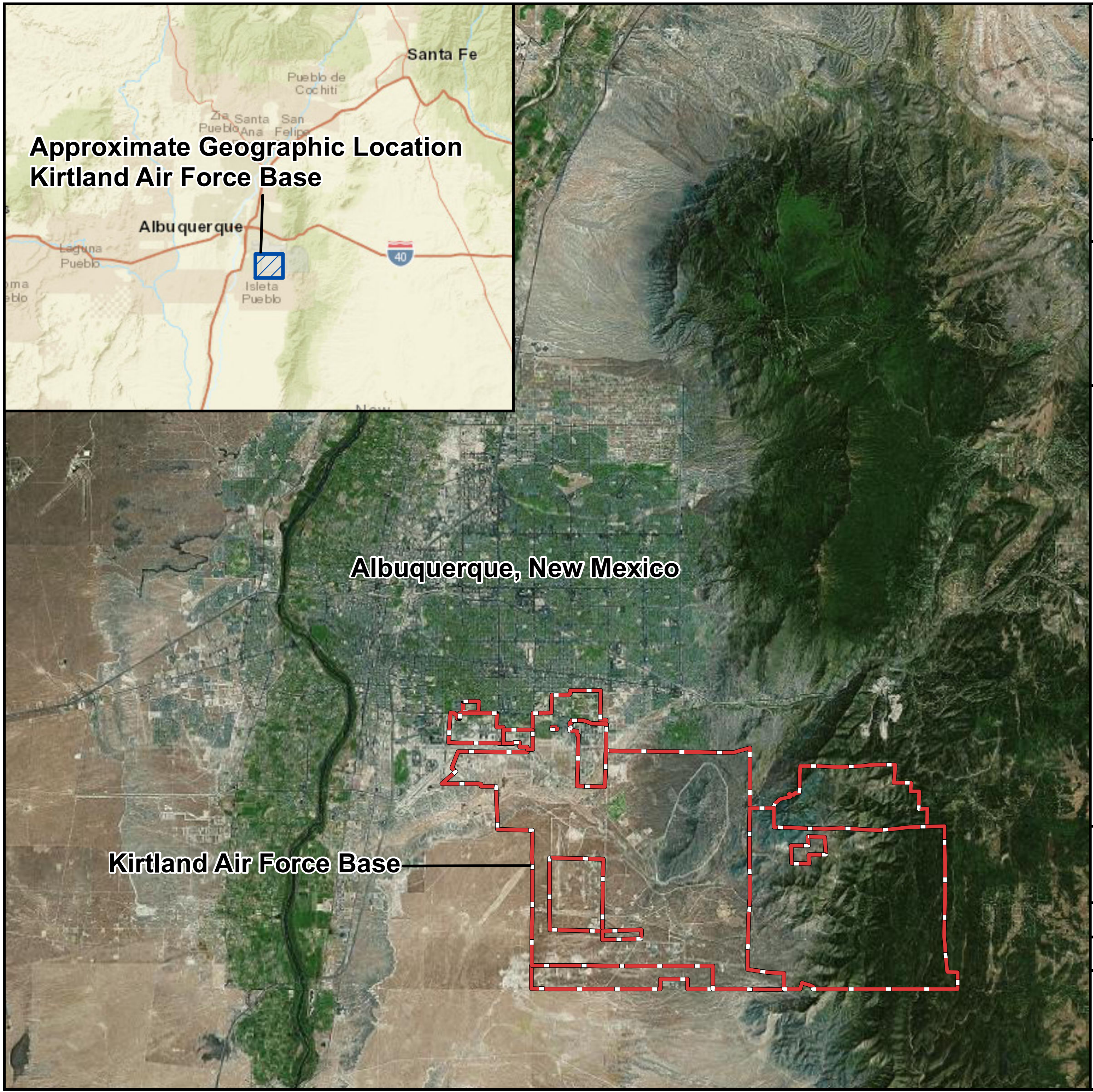

FIGURE 1-1
Installation Location Map
Kirtland Air Force Base
Albuquerque, New Mexico

Site Inspection For Aqueous Film Forming Foam (AFFF) Areas at Kirtland Air Force Base New Mexico

U.S. Army Corps of Engineers
Tulsa District
for
Air Force Civil Engineer Center
2261 Hughes Avenue
Building 1, Suite 155
JBSA Lackland, Texas 78236

Legend

🟥 Kirtland AFB Installation Boundary

Abbreviations

AFB = Air Force Base
AFFF = Aqueous Film Forming Foam

Service Layer Credits: ESRI Digital Globe (2016)
Disclaimer: For general reference purposes only. DO NOT USE to determine, certify, or verify map features, scale and/or other information.

Contract # W912BV-15-C-0082

By: E. Cutler	**6/19/2017**

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OTIE
An Oneida Nation Company

0 10,000 20,000
Approximate Scale in Feet

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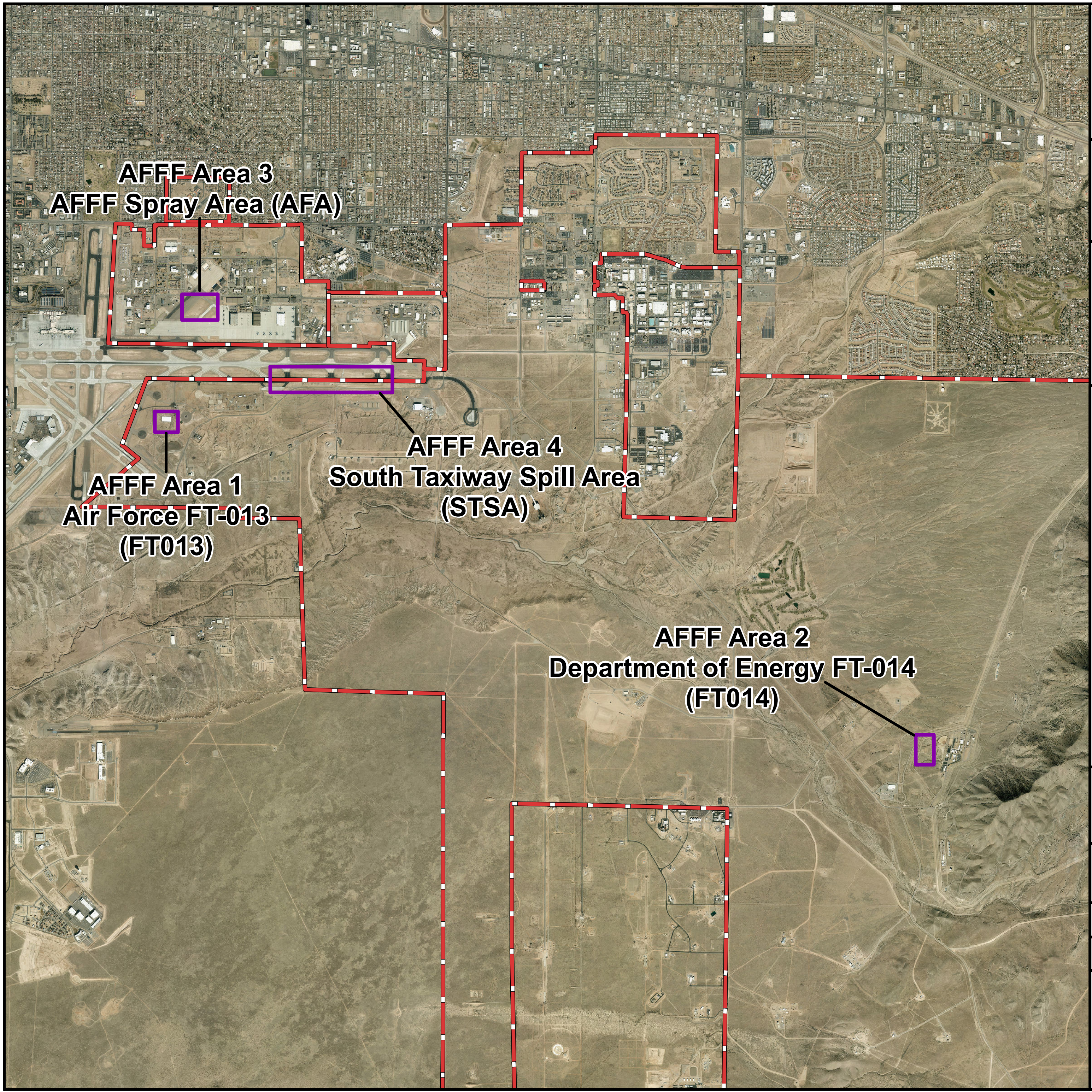

FIGURE 2-1
AFFF Areas
Kirtland Air Force Base
Albuquerque, New Mexico

Site Inspection For Aqueous Film
Forming Foam (AFFF) Areas at
Kirtland Air Force Base
New Mexico

U.S. Army Corps of Engineers
Tulsa District
for
Air Force Civil Engineer Center
2261 Hughes Avenue
Building 1, Suite 155
JBSA Lackland, Texas 78236

Legend

🟪	AFFF Area
🟥	Kirtland AFB Installation Boundary

Abbreviations
AFB = Air Force Base
AFFF = Aqueous Film Forming Foam

Service Layer Credits:
Bernalillo County Mosaic
Kirtland AFB GIS Geodatabase (2016)

Disclaimer: For general reference purposes only. DO NOT USE to determine, certify, or verify map features, scale and/or other information.

Contract # W912BV-15-C-0082

By: E. Cutler **6/19/2017**

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Approximate Scale in Feet

C:\Users\cuteri\Desktop\GIS\Kirtland\Fig 2-1 Area Locations Map.mxd

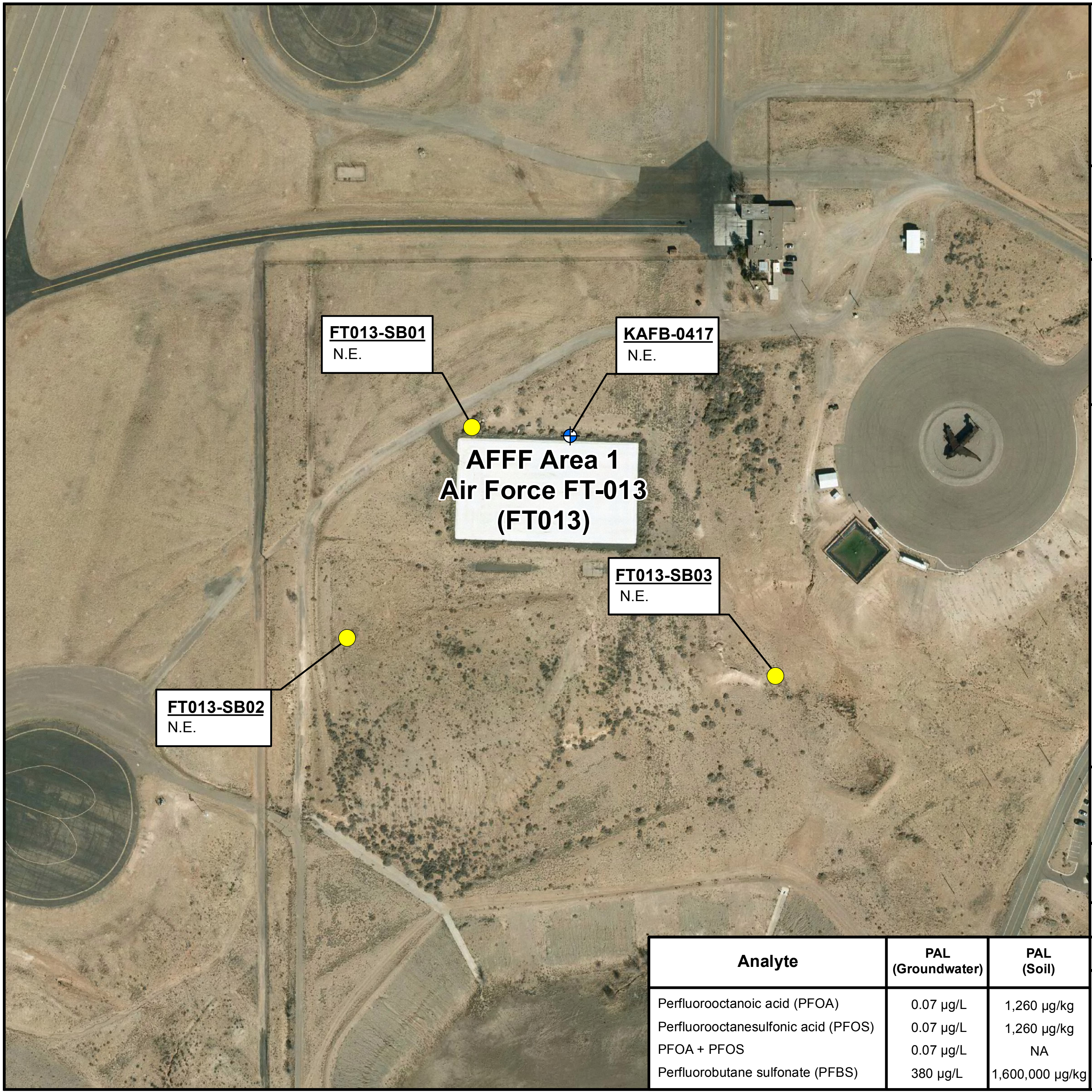

FIGURE 3-2
Sample Locations
AFFF Area 1
Air Force FT-013 (FT013)
Kirtland Air Force Base
Albuquerque, New Mexico

Site Inspection For Aqueous Film Forming Foam (AFFF) Areas at Kirtland Air Force Base New Mexico

U.S. Army Corps of Engineers
Tulsa District
for
Air Force Civil Engineer Center
2261 Hughes Avenue
Building 1, Suite 155
JBSA Lackland, Texas 78236

Legend

⌖ Monitoring Well

● Soil Boring

Notes

- No concentrations exceed PALs

Abbreviations

AFFF = Aqueous Film Forming Foam
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
NA = not available
N.E. = no exceedances
PAL = Project Action Limit
U.S. = United States

Service Layer Credits:
Benalillo County Mosaic
Kirtland AFB Geodatabase (2016)

Disclaimer: For general reference purposes only. DO NOT USE to determine, certify, or verify map features, scale and/or other information.

Contract # W912BV-15-C-0082

By: E. Cutler **6/27/2017**

Analyte	PAL (Groundwater)	PAL (Soil)
Perfluorooctanoic acid (PFOA)	0.07 µg/L	1,260 µg/kg
Perfluorooctanesulfonic acid (PFOS)	0.07 µg/L	1,260 µg/kg
PFOA + PFOS	0.07 µg/L	NA
Perfluorobutane sulfonate (PFBS)	380 µg/L	1,600,000 µg/kg

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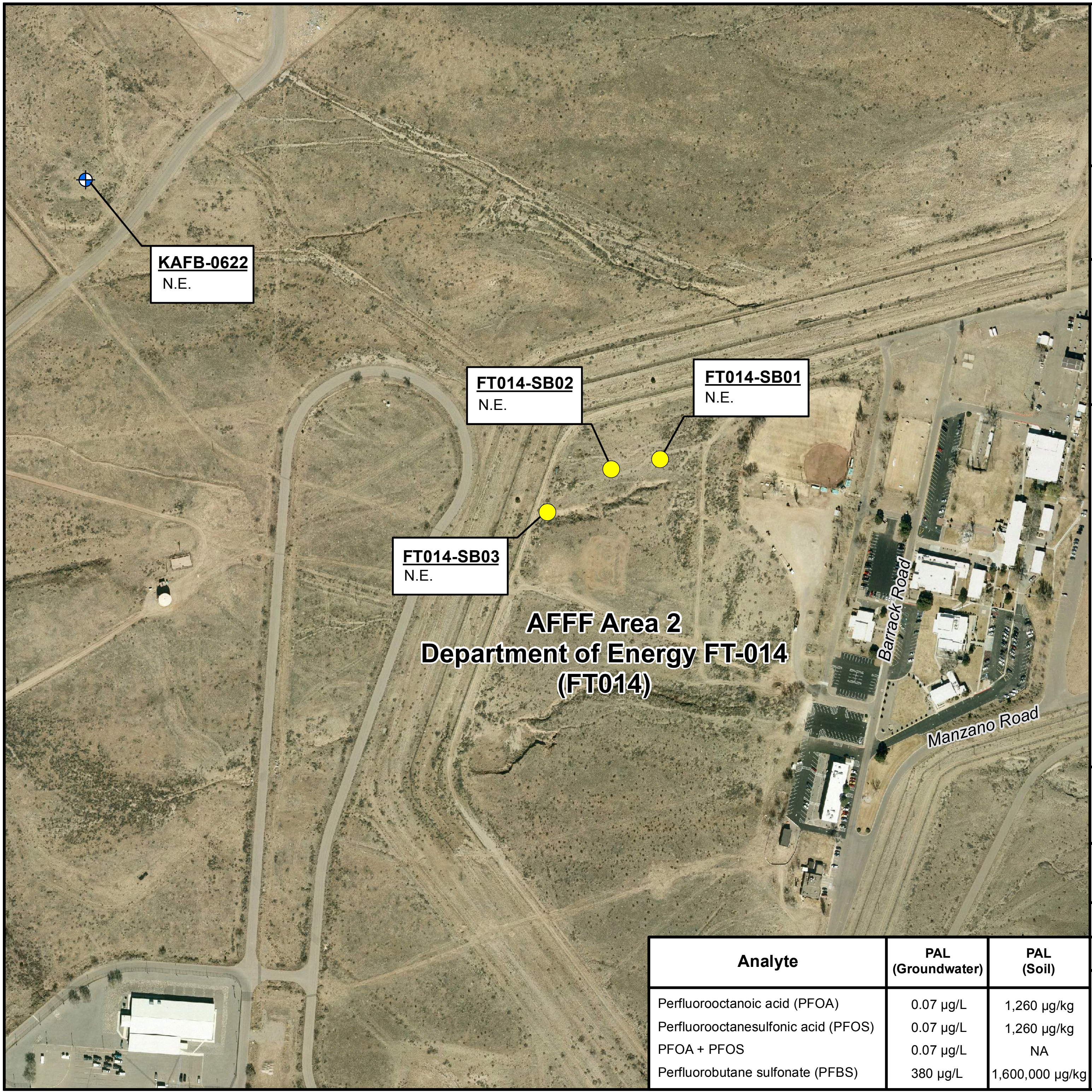

Analyte	PAL (Groundwater)	PAL (Soil)
Perfluorooctanoic acid (PFOA)	0.07 µg/L	1,260 µg/kg
Perfluorooctanesulfonic acid (PFOS)	0.07 µg/L	1,260 µg/kg
PFOA + PFOS	0.07 µg/L	NA
Perfluorobutane sulfonate (PFBS)	380 µg/L	1,600,000 µg/kg

FIGURE 3-3
Sample Locations
AFFF Area 2
Department of Energy FT-014 (FT014)
Kirtland Air Force Base
Albuquerque, New Mexico

Site Inspection For Aqueous Film
Forming Foam (AFFF) Areas at
Kirtland Air Force Base
New Mexico

U.S. Army Corps of Engineers
Tulsa District
for
Air Force Civil Engineer Center
2261 Hughes Avenue
Building 1, Suite 155
JBSA Lackland, Texas 78236

Legend

⊕ Monitoring Well

● Soil Boring

Notes

- No concentrations exceed PALs

Abbreviations

AFFF = Aqueous Film Forming Foam
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
NA = not available
N.E. = no exceedances
PAL = Project Action Limit
U.S. = United States

Service Layer Credits:
Benalillo County Mosaic
Kirtland AFB Geodatabase (2016)

Contract # W912BV-15-C-0082

By: E. Cutler **6/27/2017**

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OTIE
An Oneida Nation Company

0 200 400
Approximate Scale in Feet

FIGURE 3-4
Sample Locations
AFFF Area 3
AFFF Spray Area (AFA)
Kirtland Air Force Base
Albuquerque, New Mexico

Site Inspection For Aqueous Film Forming Foam (AFFF) Areas at Kirtland Air Force Base New Mexico

U.S. Army Corps of Engineers
Tulsa District
for
Air Force Civil Engineer Center
2261 Hughes Avenue
Building 1, Suite 155
JBSA Lackland, Texas 78236

Legend

⊕ Monitoring Well

● Soil Boring

Notes

- No concentrations exceed PALs

Abbreviations

AFFF = Aqueous Film Forming Foam
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
NA = not available
N.E. = no exceedances
PAL = Project Action Limit
U.S. = United States

Service Layer Credits:
Benalillo County Mosaic
Kirtland AFB Geodatabase (2016)

Contract # W912BV-15-C-0082

Analyte	PAL (Groundwater)	PAL (Soil)
Perfluorooctanoic acid (PFOA)	0.07 µg/L	1,260 µg/kg
Perfluorooctanesulfonic acid (PFOS)	0.07 µg/L	1,260 µg/kg
PFOA + PFOS	0.07 µg/L	NA
Perfluorobutane sulfonate (PFBS)	380 µg/L	1,600,000 µg/kg

By: E. Cutler **7/20/2017**

OTIE
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0 100 200
Approximate Scale in Feet

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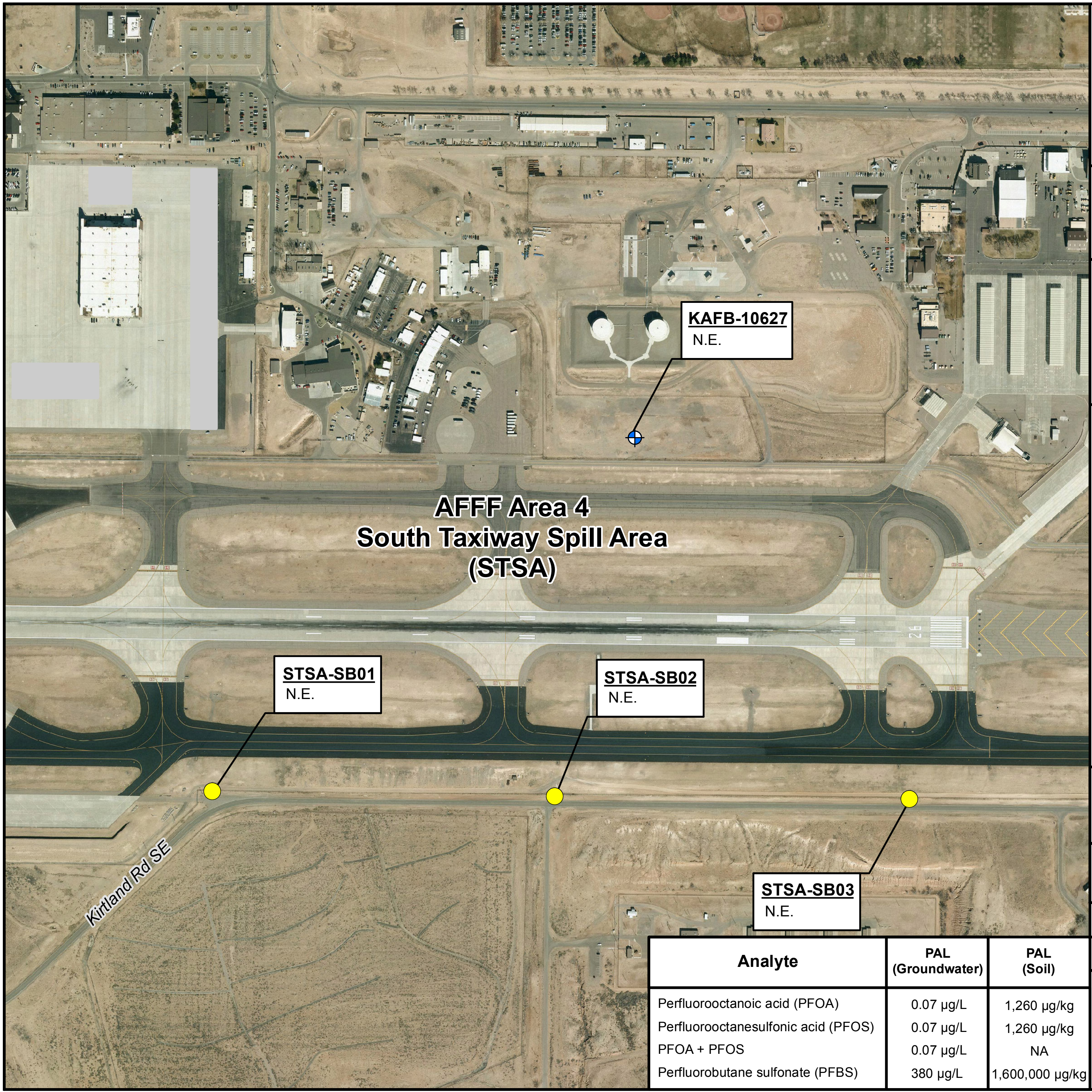

Analyte	PAL (Groundwater)	PAL (Soil)
Perfluorooctanoic acid (PFOA)	0.07 µg/L	1,260 µg/kg
Perfluorooctanesulfonic acid (PFOS)	0.07 µg/L	1,260 µg/kg
PFOA + PFOS	0.07 µg/L	NA
Perfluorobutane sulfonate (PFBS)	380 µg/L	1,600,000 µg/kg

FIGURE 3-5
Sample Locations
AFFF Area 4
South Taxiway Spill Area (STSA)
Kirtland Air Force Base
Albuquerque, New Mexico

Site Inspection For Aqueous Film Forming Foam (AFFF) Areas at Kirtland Air Force Base New Mexico

U.S. Army Corps of Engineers
Tulsa District
for
Air Force Civil Engineer Center
2261 Hughes Avenue
Building 1, Suite 155
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Legend

⊕ Monitoring Well

● Soil Boring

Notes

- No concentrations exceed PALs

Abbreviations

AFFF = Aqueous Film Forming Foam
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
NA = not available
N.E. = no exceedances
PAL = Project Action Limit
U.S. = United States

Service Layer Credits:
Benalillo County Mosaic
Kirtland AFB Geodatabase (2016)

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Contract # W912BV-15-C-0082

By: E. Cutler **7/20/2017**

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OTIE
An Oneida Nation Company

0 200 400
Approximate Scale in Feet

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Appendix A

Field Forms

BASE CIVIL ENGINEER WORK REQUEST *(See Reverse for Instructions)*	Form Approved OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average .3 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to the Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project 0704-0188, Washington DC 20503. Please DO NOT RETURN your form to either of these addresses. Send your completed form to HQ AFESC/DEMG.

SECTION I - TO BE COMPLETED BY REQUESTER

1. FROM *(Organization)* AFCEC - Air Force Civil Engineer Center	2. OFFICE SYMBOL CZO	3. DATE OF REQUEST 20160817	4. WORK REQUEST NO. *(For BCE Use)* 51699
5. NAME AND PHONE NO. OF REQUESTER Contractor (OTIE) Cecil Irby (210) 490-4865 AFCEC - Wayne Bitner - 853-3484		6. REQUIRED COMPLETION DATE 20160930	7. BUILDING, FACILITY OR STREET ADDRESS WHERE WORK IS TO BE ACCOMPLISHED Kirtland Rd SE, FT014, AFFF Spray, FT013

8. DESCRIPTION OF WORK TO BE ACCOMPLISHED *(Include Sketch or Plan, when appropriate)*

Will be advancing three small diameter (approx 6 inch) direct-push soil borings for sampling at 4 seperate locations to collect samples to be analyzed for PerflouroCompound (PFC) contamination related to Aqueous Fire Fighting Foam applications. Samples will be up to 25 feet deep.

4 Areas -- 1) South taxiway spill area off of Kirtland Rd SE; 2) FT014 former Env Restoration site, just to the west of National Training Center/Manzano; 3) FT013 former Env Restoration site, just SW of Fire Station 5; 4) AFFF Spray Area, just west of Randolph inside flighline. (Maps to all areas and proposed sampling locations attached.)

This is for coordination purposes only. No Kirtland AFB programming action required.

9. BRIEF JUSTIFICATION FOR WORK TO BE ACCOMPLISHED *(Not required for maintenance and repair)*

Investigation of PFC contaimation per USAF policy and guidance. Contract is a USACE contract issued for AFCEC CZTE - **THIS IS FOR COORDINATION PURPOSES ONLY**

received 8/17/16

ORIGINAL 332

10. DONATED RESOURCES

☐ FUNDS ☐ LABOR ☐ MATERIAL ☒ CONTRACT BY REQUESTER ☐ NONE

11. NAME OF REQUESTER Ludie W. Bitner	12. GRADE OF REQUESTER GS-13	13. SIGNATURE OF REQUESTER *(See Reverse of Form)*

14. COORDINATION

23 Aug 16 / J.W. 377 MSG/SCXP	Moore 25 Aug 16 377 MSG/CEIE ENVIRONMENTAL MANAGEMENT	C.J. Giannini 377 MSG/CEIAP 25 Aug 2016	JCC 25 Aug 16 377ABW/SEG	8/25/16

SECTION II - FOR BASE CIVIL ENGINEER USE

15. WORK ORDER *(Place an "X" in the appropriate box.)*

☐ IN-SERVICE ☐ SELF-HELP ☐ CONTRACT ☐ SABER

16. DIRECT SCHEDULED WORK *(Place an "X" in the appropriate box.)*

☐ EMERGENCY ☐ URGENT ☐ ROUTINE ☐ SELF-HELP ☐ M/C

17. SELF-HELP *(Place an "X" in the appropriate box.)*

☐ BRIEFING REQUIRED ☐ ADEQUATE COORDINATION ☐ INSPECTION REQUIRED

SECTION III - COMPLETE ONLY IF WORK IS TO BE ACCOMPLISHED BY WORK ORDER

18. WORK CLASS 522	19. PRIORITY R	20. ESTIMATED HOURS	21. ESTIMATED FUNDED COST	22. ESTIMATED TOTAL COST $ 70K

☒ 23. CX26 THERE IS NO NEED FOR AN ENVIRONMENTAL ASSESSMENT (AFR 19-2) ☐ 24. A WRITTEN ASSESSMENT IS BEING/HAS BEEN PROCESSED ☐ 25. APPROVED ☐ 26. DISAPPROVED

27. REMARKS

This is for coordination purposes ONLY. No Kirtland AFB programming action required.

SECTION IV - APPROVING AUTHORITY

28. NAME AND GRADE *(Please Type or Print)* Christopher Sipe	29. SIGNATURE	30. DATE 21 Oct 16

AF IMT 332, 19910101, V4 PREVIOUS EDITION IS OBSOLETE. MASTER FILE COPY

OTIE
An Oneida Nation Company

DAILY REPORT

PAGE 1 OF 2

USACE CONTRACT #: W912BV-15-C-0082 DATE: 02/13/17

PROJECT NUMBER: 2015341-06-0604 PROJECT LOCATION: Kirtland AFB

SITE ID: FT014 FIELD PERSONNEL: CR, AG, RK

CLIENT: AFCEC

SUBCONTRACTOR: Envirodrill, Daniel B Stephens

SUBCONTRACTOR PERSONNEL ON SITE: Jerome, Tisker, Juan Barraza, Rodney Begay

VISITOR(S) ON SITE:

BRIEF SUMMARY OF WORK PERFORMED: Drilled and collected SB samples
Hollow stem drilling

WAS A TAILGATE SAFETY MEETING HELD? ☒ YES ☐ NO WERE THERE ANY LOST TIME ACCIDENTS? ☐ YES ☒ NO

WERE INSTRUMENT CALIBRATIONS PERFORMED? ☐ YES ☒ NO WAS HAZARDOUS MATERIAL/WASTE RELEASED INTO THE ENVIRONMENT? ☐ YES ☒ NO

START TIME	STOP TIME	DESCRIPTION OF ACTIVITIES; REMARKS
0825		Arrived on base at The Truman Gate
0900		Met Mr. Khaler at The visitors gate to get passes.
		Pictures: no pictures of buildigs, of The flightline, aircraft.
		Mr. Jesse Khaler will screen all pictures taken.
0920		Discussed all The sampling areas with Mr. Khater We drove
		around to check all The locations.
0930	1035	Robert, Drillers, Mr. Khater went to check all Sampling Ares
1036		Met Jerome from Daniel B Stephens on The other side of
		The contractors gate. Then Drove to Sampling area FT014
		to drop off Alecia at The well.
11:00		Alicia Called because The water level meter Jacome has is not
		deep enough (>500ft) so he needs to go back to The office and
		get a longer meter.
12:00		Arrived at Ft014SB01. Set up drill and sampling station.
1220		Started ~~drilling~~ Digging 0-2 ft with a hand auger.
1230	1235	Collected FT014-SB01-1 and The composite sample
1245	1248	Collected FT014-SB01-15-16 and The Composite Sample
1300		Moved to FT014-SB02
1325	1330	Collected FT014-SB02-1 + composite sample
1335	1333	Collected FT014-SB02-15-16 "
1350	1355	" FT014-SB02-24-16 "
1400		Arrived at FT014-SB03. Started stetting up rig and
		sampling station
1405	1430	Drillers lunch Break
1435		Hand augered to 1.5 feet
1438	1440	Collected FT014-SB03-1 and FT014-SB03-1FD + composite sample

FIELD RESPRSENTATIVE SIGNATURE: DATE: 02/13/17

OTIE

DAILY REPORT

PAGE 2 OF 2

USACE CONTRACT #: W912BV-15-C-0082
DATE: 02/13/17
PROJECT NUMBER: 2015341-06-0604
PROJECT LOCATION: Kirtland AFB
SITE ID: FT014
FIELD PERSONNEL: CR, AG, RK

START TIME	STOP TIME	DESCRIPTION OF ACTIVITIES; REMARKS
1455	1458	Collected FT014-SB03-15-16 + composite sample
1505	1508	Collected FT014-SB03-24-25 + " "
1515		Left FT014 sampling area
1530		Met with Alecia at the well site to pick her up and move
		drums to drum site.
1545		Met Jesse at FT013 to leave the drill rig overnight
1605		Drillers checked-out
1607		OTIE and Daniel B Stephens went to the drum laydown
		area to leave the GW drums.
		Drum Area is located at the 377 ABW/EM Recycling Ops Center
		Left 1 Drum ~~[illegible]~~ 50% full with water from KAFB-0622
		and another empty drum. Both were labeled and pictures
	1630	were taken. Mr. Jesse said drums don't have to be on pellets.
1635		Arrived to a gastation on base and bough 2 bags of ice.
	1655	Packed cooler, and put COC inside.
1658		Left base for FedEx
1715		Arrived ~~at~~ FedEx, Dropped off 1 Cooler
	1725	Tracking # 785599552671
1725		Drove to airport to pick up a second car for Alecia
1750		Returned to Hotel

HOURS WORKED

FIELD PERSONNEL	Robert Kelley	Alecia George	Catalina Restrepo
SUBCONTRACTOR PERSONNEL	Juan Barraza	Rodney Begay	Jerome Fisher

EQUIPMENT / SUPPLIES

Coolers	PFC free Water
PID.	Table, table liner
Horiba	Cooler liners
Gloves	PFC-free bags
Liquinox	Drums + Drum labels
Stakes / Blue tops	Auger
Drill rig and cores	
Drums	

FIELD RESPRSENTATIVE SIGNATURE: CatalinaR

DATE: 02/13/16

OTIE

DAILY REPORT

PAGE 1 OF 1

USACE CONTRACT #:	W912BV-15-C-0082	DATE:	2/13/17
PROJECT NUMBER:	2015341-06-0604	PROJECT LOCATION:	~~FT-014~~ Kirtland
SITE ID:	FT-014	FIELD PERSONNEL:	AG
CLIENT:	AFCEC		
SUBCONTRACTOR:	Daniel B. Stephens		
SUBCONTRACTOR PERSONNEL ON SITE:	Jeremy		
VISITOR(S) ON SITE:			
BRIEF SUMMARY OF WORK PERFORMED:	groundwater sampling		

WAS A TAILGATE SAFETY MEETING HELD? ☐ YES ☐ NO
WERE THERE ANY LOST TIME ACCIDENTS? ☐ YES ☐ NO
WERE INSTRUMENT CALIBRATIONS PERFORMED? ☐ YES ☐ NO
WAS HAZARDOUS MATERIAL/WASTE RELEASED INTO THE ENVIRONMENT? ☐ YES ☐ NO

START TIME	STOP TIME	DESCRIPTION OF ACTIVITIES; REMARKS
1100		arrive @ KAFB-0622. lock on well Robert Kelley
		calling Jesse to ask for combination.
1116 ~~1120~~		Called Cecil and he called Patrick w/ Aecom
		and got the combination for the lock
1120		~~Sta~~ opened well and started gauging. water deeper
		than 500 ft so Jeremy has to head back to the
		warehouse to get a longer gauge.
1129		Called Robert and he and Catalina are picking me
		up. Waiting for Jeremy to get back and sample
1303		Jeremy called and he is back at the ~~contrac~~
		Contractors gate and heading back to the site
1320		gauged well
1345		dropping pump into the well
1409		begin reading
1440		Final reading
		Temp 9.98 DO 6.51
		pH 6.67 ORP 137
		Spec Cond 0.493 Turb 84.2
1445		Sample well KAFB 0622
		also sample ms/msD KAFB0622MS / KAFB0622MSD
1530		finished deconing pump.
		Jeremy putting away his equipment - Catalina
		and Robert on the way to pick me up.
1600		Robert and Catalina picked me up - headed to
		FT-013 to meet Jesse so ~~we~~ he can show
		us where to leave drum~~s~~ w/ water

FIELD RESPRSENTATIVE SIGNATURE: Alicia [illegible] DATE: 2/13/17

OTIE

DAILY REPORT

PAGE 1 OF 2

USACE CONTRACT #: W912BV-15-C-0082
DATE: 02/14/17
PROJECT NUMBER: 2015341-06-0604
PROJECT LOCATION: Kirtland AFB
SITE ID: FT013 & STSA
FIELD PERSONNEL: RK, AG, CR
CLIENT: AFCEC
SUBCONTRACTOR: Envirodrill, Daniel B Stephens
SUBCONTRACTOR PERSONNEL ON SITE: Jerome Fisher, Juan Barraza, Rod Begay
VISITOR(S) ON SITE:
BRIEF SUMMARY OF WORK PERFORMED:

WAS A TAILGATE SAFETY MEETING HELD? ☒ YES ☐ NO
WERE THERE ANY LOST TIME ACCIDENTS? ☐ YES ☒ NO
WERE INSTRUMENT CALIBRATIONS PERFORMED? ☒ YES ☐ NO
WAS HAZARDOUS MATERIAL/WASTE RELEASED INTO THE ENVIRONMENT? ☐ YES ☒ NO

START TIME	STOP TIME	DESCRIPTION OF ACTIVITIES; REMARKS
0800		Arrived on base. Drove to the Current Fire Training Area to
		meet with subcontractors.
0815		Robert performed the H&S meeting.
0830		Arrived at FT013
0840	0845	Started hand augering 0-1 ft at FT013-SB01
0845	0848	Collected sample FT013-SB01-0-1 + Composite sample
0905	0910	Collected sample FT013-SB01-15-16 + FD + Composite sample
0915	0920	Collected sample FT013-SB01-24-25 + composite sample
0925		Moved to FT013-SB02
0930	0935	Started hand augering 0-1 ft
0935	0940	Collected FT013-SB02-0-1 + Composite sample + MS/MSD
0955	0958	Collected FT013-SB02-15-16 + " "
1005	1008	Collected FT013-SB02-24-25 + " "
1012	1045	Moved to FT013-SB03 (We had to drive around to look for it)
1045		Arrived at FT013-SB03
1050		Hand augered 0-1 ft at FT013-SB03
1055		Collected FT013-SB03-0-1 + Composite Sample
1115		" FT013-SB03-15-16 + " "
1130		" FT013-SB03-24-25 + "
1140		Left FT013-SB03.
1145	1230	Lunch Break
1235		Arrived at South Taxiway Spill Area SBO1
1240		Started to hand auger 0-4 feet
1250	1255	Collected STSA-SB01-0-1
1256		There was a water line near our spot so
		Drillers hand augered on top of it to make sure when we

FIELD RESPRSENTATIVE SIGNATURE: Catalina Rey
DATE: 02/14/17

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DAILY REPORT

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USACE CONTRACT #:	W912BV-15-C-0082	DATE:	02/14/16
PROJECT NUMBER:	2015341-06-0604	PROJECT LOCATION:	Kirtland AFB
SITE ID: FT013 and STSA		FIELD PERSONNEL:	CR, RK, AG

START TIME	STOP TIME	DESCRIPTION OF ACTIVITIES; REMARKS
		Start drilling we won't hit the water line.
1320		started drilling
1340	1345	Sampled STSA - SB01-15-16 + MS/MSD + Composite sample
1355	1358	" STSA - SB01 - 24-25 + Composite Samples
1410		Moved to STSA - SB02
1413		Started Hand augering 0-1 feet
1420		Collected STSA - SB02 - 0-1 + composite sample
1423	1440	Hand augered down to 4 feet because there are water lines
		and gas and communications lines around.
1447		Dan with CE utilities stopped by to chat with Robert
		His phone # 505-664-5490 and shop # 505-846-7863
	1450	in case we hit a water line. Robert told him that we hand
		augered down to ~5 feet. Dan said line is at ~3 feet. so we
		should be O.K.
1500	1503	Collected STSA-SB02-15-16 + Composite Sample
1510	1514	Collected STSA-SB02-24-25 + Composite sample
1535		Left STSA
1545	1610	Arrived at Gas station to prep + pack coolers
1615		Left Base
1620	1635	Arrived at FedEx. Arrived at Hotel at 1645

HOURS WORKED Total Hrs 10 hrs

FIELD PERSONNEL	Catalina Restrepo	Robert Kelley	Alecia George	=10 hrs
SUBCONTRACTOR PERSONNEL	Jerome Fisher	Juan Barraza	Rod Begay	

Drill Rig	EQUIPMENT / SUPPLIES	
Auger.	Liquinox	PID
Cooler		Horiba
Plastic liner for table		Plastic bags (PFCs free)
Table		Sharpees
Plastic liner for coolers		Nitrile gloves
Ice		Ziplock bags (composite samples)
Shovel		Papertowels
Plastic bottles 250mL		Brush

FIELD RESPRSENTATIVE SIGNATURE: CatalinaRez

DATE: 02/14/17

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DAILY REPORT

PAGE 1 OF 3

USACE CONTRACT #:	W912BV-15-C-0082	DATE:	2/14/17
PROJECT NUMBER:	2015341.66-0604	PROJECT LOCATION:	Kirtland
SITE ID:		FIELD PERSONNEL:	AG
CLIENT:	AFCEC		
SUBCONTRACTOR:	Daniel B. Stephens		
SUBCONTRACTOR PERSONNEL ON SITE:	Jeremy Fisher		
VISITOR(S) ON SITE:			
BRIEF SUMMARY OF WORK PERFORMED:			

WAS A TAILGATE SAFETY MEETING HELD? ☐ YES ☐ NO

WERE THERE ANY LOST TIME ACCIDENTS? ☐ YES ☐ NO

WERE INSTRUMENT CALIBRATIONS PERFORMED? ☐ YES ☐ NO

WAS HAZARDOUS MATERIAL/WASTE RELEASED INTO THE ENVIRONMENT? ☐ YES ☐ NO

START TIME	STOP TIME	DESCRIPTION OF ACTIVITIES; REMARKS
0800		Arrive @ FT-013
0815		tailgate safety meeting
0840		arrive @ KAFB 0417 - well right next to drill rig
		and Jeremy said he needs to bring some landscaping
		supplies to be able to access the well
0845		Robert called Jesse and asked if he could escort
		us to the AFFF Spray Area well. Jesse coming
		to FT-013 to escort us to the site
0920		Jesse arrived @ FT-013
		- headed over to South Taxiway Spill Area and
		the AFFF Spray Area wells to look at them and
		make sure Jeremy can access them
0945		Arrive at Bulk Fuel. Jesse talked with Ed (the
		contractor from the site) and said that we
		could talk to Kenny @ 1300 to get into the site
		and see the well
		- continued to AFFF Spray Area and found KAFB-7001
1008		headed back to FT-013 to get my car and
		Jeremys equipment
1010		Jeremy opened up the well and a pump is in the
		well.
		- called Cecil and he said to see if we could find
		KAFB 0014 and see if it has a pump.
1018		headed to find the well
1025		the well is ~~not~~ abandoned (no well in the parking
		lot)

FIELD RESPRSENTATIVE SIGNATURE: Albie Gedeage DATE:

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DAILY REPORT

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USACE CONTRACT #: W912BV-15-C-0082
DATE: 2/14/17
PROJECT NUMBER: 2015341-06-0604
PROJECT LOCATION: Kirtland
SITE ID:
FIELD PERSONNEL: AG

START TIME	STOP TIME	DESCRIPTION OF ACTIVITIES; REMARKS
1028		called Catalina and asked for Patrick's number (w/ AECom)
1036		Called Patrick and he indicated that the tubing
		in 7001 is HOPE. He also indicated that well
		KAFB-10627 does have a pump as well.
		- headed back to KAFB-7001 so that Jeremy can see
		what he needs to be able to use the pump.
1040		Called Cecil and told him what was happening
1045		headed back to FT-013.
1100		arrived back @ FT-013 - ~~waiting~~ checked well to
		make sure it doesn't have a pump. waiting for
		Robert and Catalina to finish @ SB03.
1140		meet up w/ Robert and Catalina.
~~1321~~		~~Ro Jeremy called and updat~~ AG
1300		met Jesse @ Bulk Fuel Storage area
		- well not actually in the frenced area but just
		outside of it.
1310		opened up the well. There is a pump in the well.
1321		headed back to meet w/ Robert and Catalina
		- Jeremy called to update me on what was
		happening

HOURS WORKED

FIELD PERSONNEL	~~AG~~ AG	~~9 hrs~~ 9hrs	
SUBCONTRACTOR PERSONNEL			

EQUIPMENT / SUPPLIES

FIELD RESPRSENTATIVE SIGNATURE:

DATE:

OTIE
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DAILY REPORT

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USACE CONTRACT #: W912BV-15-C-0082
DATE: 2/14/17
PROJECT NUMBER: 2015341-06-0604
PROJECT LOCATION: Kirtland
SITE ID:
FIELD PERSONNEL: AG
CLIENT: AFCEC
SUBCONTRACTOR: Daniel B. Stephens
SUBCONTRACTOR PERSONNEL ON SITE: Jeremy Fisher
VISITOR(S) ON SITE:
BRIEF SUMMARY OF WORK PERFORMED:

WAS A TAILGATE SAFETY MEETING HELD?	☐ YES ☐ NO	WERE THERE ANY LOST TIME ACCIDENTS?	☐ YES ☐ NO
WERE INSTRUMENT CALIBRATIONS PERFORMED?	☐ YES ☐ NO	WAS HAZARDOUS MATERIAL/WASTE RELEASED INTO THE ENVIRONMENT?	☐ YES ☐ NO

START TIME	STOP TIME	DESCRIPTION OF ACTIVITIES; REMARKS
1330		meet up w/ Robert and Catalina
~~1402~~ 1452		Jeremy called and he is back on base. meeting
		him @ KAFB7001.
1510		KAFB 7001- the fitting that Jeremy got works
		with the well.
1525		headed to KAFB 106027.
1532		KAFB 106027 well has smaller fittings than
		KAFB 7001. The tubing that Jeremy has works
		with the pump. He will need to get another
		fitting for the compressed air.
1602		headed to FT-013 ~~to~~ double check well and trim
		Some ~~landscape~~ trees so Jeremy can access the
		well.
1615		headed back to the hotel.
1638		Jeremy called and informed me that he had
		talked to Evan Bennett (the creator of the pumps)
		and he indicated that the pumps that he
		sent to Kirtland had teflon components. Unless
		the pumps have been retrofitted the we cannot use
		them.
1530		Informed Robert about what Jeremy said so
		he can tell Cecil.

FIELD RESPRSENTATIVE SIGNATURE: Aldaia George
DATE:

DAILY REPORT

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USACE CONTRACT #: W912BV-15-C-0082

DATE: 02/15/17

PROJECT NUMBER: 2015341-06-0604

PROJECT LOCATION: KIRTLAND AFB

SITE ID: STSA, AFA

FIELD PERSONNEL: CR, RK, AG

CLIENT: AFCEC

SUBCONTRACTOR: Daniel B Stephen's, EnviroDrill

SUBCONTRACTOR PERSONNEL ON SITE: Jerome Fisher, Rod Begay, Juan Barraza

VISITOR(S) ON SITE:

BRIEF SUMMARY OF WORK PERFORMED: Drilled, collected soil and groundwater samples

WAS A TAILGATE SAFETY MEETING HELD? ☒ YES ☐ NO

WERE THERE ANY LOST TIME ACCIDENTS? ☐ YES ☒ NO

WERE INSTRUMENT CALIBRATIONS PERFORMED? ☒ YES ☐ NO

WAS HAZARDOUS MATERIAL/WASTE RELEASED INTO THE ENVIRONMENT? ☐ YES ☒ NO

START TIME	STOP TIME	DESCRIPTION OF ACTIVITIES; REMARKS
0745		Arrived on base
0800		Met contractors at The current Fire Training Area
0805	0815	Performed H&S Tailgate Meeting
0825		Arrived at STSA-SB03 and started hand augering The
		first 0-4 feet due to close proximity to the fence and
		communications line. Could only go down to 3 feet due to gravel
0830	0832	Collected STSA-SB03-0-1 + Composite Samples
0900		Started drilling
0920	0923	Collected STSA-SB03-15-16 + Composite Sample
0925		* Background PID is 0.0 to 0.2 *
0935	0938	Collected Sample STSA-SB03-24-25 + Composite Sample
0945		Jesse called to let us know we had access to the flightline
0950		Left STSA-SB03, went to check on Alecia
1010		Met with Jesse to head over to get The flight line pass
1020		Went to get flightline pass, ~~code~~ gate code, registered
		vehicles and rig. We will only have access to The flightline
		after 1400 hrs. They want us to call Them when we're done
		and again tomorrow when we're ready to go back to survey.
	1050	Ken ⇒ ~~Base~~ Flightline OPS. Will meet drillers back around 1345.
1100		Drove around FT013 and Ira Specter Rd SE looking for well
		KAFB2501. We found it but it's behind a double fence.
1130		Lunch Break. Waited until we had access to The flightline.
1355		Approached flightline gate, Performed FOD tire check
1405		Arrived at AFA-SB03
1410		Hand augered down to 0-1 feet

FIELD RESPRSENTATIVE SIGNATURE: Catalina Roz

DATE: 02/15/17

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FB1DD MMYY

DAILY REPORT

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USACE CONTRACT #: W912BV-15-C-0082
DATE: 02/15/17
PROJECT NUMBER: 2015341-06-0604
PROJECT LOCATION: Kirtland AFB
SITE ID: STSA, AFA
FIELD PERSONNEL: RK, CR, AG

START TIME	STOP TIME	DESCRIPTION OF ACTIVITIES; REMARKS
1425	1428	Collected sample AFA-SB03-0-1 + composite sample
		* sampling points were not marked with white stake, and
		we didn't have GPS points so we estimated location based
		off maps.
1440	1445	Collected a Field Blank # FB1150217 by transfering
		PFC free H2O to a container at AFA-SB03
1447	1450	Collected Sample AFA-SB03-15-16 + Composite Sample
1450	1454	Collected Equipment, Blank EB1150217 from Hand auguer
1455	1458	Collected Sample AFA-SB03-24-25 + " "
1500		Moved to AFA-SB01
1505	1514	Started to hand auger AFA-SB01-0-1
1515	1518	Collected Sample AFA-SB01-0-1 + composite Sample
1520		Started Drilling
1530		Collected sample AFA-SB01-15-16 + Composite sample
1545		Collected sample AFA SB01-24-25 + " "
1555		Moved to AFA-SB02
1558		Started Hand augering AFA-SB02- to 0-1 ft
1612	1615	Collected sample AFA-SB02-0-1 + comp samp.
1628	1631	Collected sample AFA-SB02-15-16 + " "
1640		Collected Sample AFA-SB02-24-25 + " "

EQUIPMENT / SUPPLIES

Drill Rig	Gloves
Auger and hand auger	PFC free bags
Table	Brush
Table liner	Liquinox
Cooler	Ice
Bottles	PFC free water
PID	Camera
Horiba	Tape
Bottles	

FIELD RESPRSENTATIVE SIGNATURE: Catalina Rey

DATE: 02/15/17

OTIE

DAILY REPORT

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USACE CONTRACT #: W912BV-15-C-0082
DATE: 2/15/17
PROJECT NUMBER: 2015341-06 - 0604
PROJECT LOCATION: Kirtland
SITE ID: FT-013
FIELD PERSONNEL: AG
CLIENT: AFCEC
SUBCONTRACTOR: Daniel B. Stephens
SUBCONTRACTOR PERSONNEL ON SITE: Jerome Fisher
VISITOR(S) ON SITE:
BRIEF SUMMARY OF WORK PERFORMED: GW sampling

WAS A TAILGATE SAFETY MEETING HELD? ☒ YES ☐ NO
WERE THERE ANY LOST TIME ACCIDENTS? ☐ YES ☒ NO
WERE INSTRUMENT CALIBRATIONS PERFORMED? ☒ YES ☐ NO
WAS HAZARDOUS MATERIAL/WASTE RELEASED INTO THE ENVIRONMENT? ☐ YES ☒ NO

START TIME	STOP TIME	DESCRIPTION OF ACTIVITIES; REMARKS
0815		arrive @ well KAFB 0417 (site FT-013). Jerome
		cleaning up some more brush before backing his truck
		up to the well.
0828		Cecil Irby called Jerome to ask about the
		pumps in the other 2 wells
0838		Cecil called back after talking to Evan Bennett.
		we will sample other 2 wells with pumps (will
		take 3 well volumes)
0842		setting up on well to ~~begin~~ gauge well
0854		lowering pump into the well
0910		started pump
0918		pump not pulling water. Jerome thinks he may have
		hit bottom. Pulling pump to check if pump is silted.
0928		cleaning pump
0945		dropping pump for a 2nd time
		- ~~th~~ still unable to get water
~~1000~~		~~dropp~~ - pulling pump
1000		dropping for a 3rd time. "measuring" depth
		the pump goes. Only reaching to approx.
		440 ft - water is @ 447 ft.
1032		called Cecil Irby to inform him that the
		well is unable to be sampled. He is
		checking ERPIMS to see if there is another
		well in the area.
1045		pulling pump
1100		cleaning pump

FIELD RESPRSENTATIVE SIGNATURE: Albeiry George
DATE: 2/15/17

462.00
447.94
14.06

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DAILY REPORT

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USACE CONTRACT #: W912BV-15-C-0082
DATE: 2/15/17
PROJECT NUMBER: 2015341-06-0604
PROJECT LOCATION: Kirtland
SITE ID: FT013
FIELD PERSONNEL: AG

START TIME	STOP TIME	DESCRIPTION OF ACTIVITIES; REMARKS
1102		Cecil Irby emailed / called with another possible
		well for FT-013
1104		Robert and Catalina came by. Chuck will drive to
		the location of new well and make sure it is
		accessible.
1125		pulled equipment blank EB15022017
~~1128~~	1134	packing up equipment and trailer
		- well will not lock. Well was unlocked when
		we found it yesterday. "Dummy" locking the
		well
1145		heading to Shopette for snacks
1215		arrive @ KAFB-7001
1217		Jerome setting up fixtures so we can use the
		pump in the well
~~1225~~		~~turning~~ AG
1235		turned on air
1240		getting water
1243		Sampled KAFB-7001-1 for a pre-purge sample
1250		water coming out of the air vent. Jerome adding
		tubing to the vent to capture the water.

HOURS WORKED

FIELD PERSONNEL	~~A~~ AG	10.5 hrs	
SUBCONTRACTOR PERSONNEL			

EQUIPMENT / SUPPLIES

FIELD RESPRSENTATIVE SIGNATURE: ____________________ DATE: ________

~~water 456 TOC 516 1060277~~

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USACE CONTRACT #:	W912BV-15-C-0082	DATE:	2/15/17
PROJECT NUMBER:	2015341-06-0604	PROJECT LOCATION:	Kirtland AFB
SITE ID:	S. Taxiway Spill Area	FIELD PERSONNEL:	AG
CLIENT:	AFCEC		
SUBCONTRACTOR:	Daniel B. Fisher		
SUBCONTRACTOR PERSONNEL ON SITE:	Jerome Fisher		
VISITOR(S) ON SITE:			
BRIEF SUMMARY OF WORK PERFORMED:	well sampling		

WAS A TAILGATE SAFETY MEETING HELD? ☐ YES ☐ NO
WERE THERE ANY LOST TIME ACCIDENTS? ☐ YES ☐ NO
WERE INSTRUMENT CALIBRATIONS PERFORMED? ☐ YES ☐ NO
WAS HAZARDOUS MATERIAL/WASTE RELEASED INTO THE ENVIRONMENT? ☐ YES ☐ NO

START TIME	STOP TIME	DESCRIPTION OF ACTIVITIES; REMARKS
		- Jerome believes there is a hole in the water line
		and that is why the water is coming out the vent.
1321		~26 gallons pumped. Switching out nitrogen tanks
		- extra tubing has stopped "spitting" water. Jerome
		says it could have just been condensation.
1348		Small bits of grease are coming up with the
		water
1401		Three well volumes
1410		~~final~~ third reading
1411		Sample KAFB-7001 + KAFB-7001FD
1422		finished at the site - heading to drop
		of water.
1442		Called Jesse, Gate is open to drop drums.
		Emptying and leaving water
1510		heading to well KAFB-106027
1518		arrived at the well
1535		starting pump on well
1536		sampled pre-purge sample KAFB-106027-1
1810		last reading
1812		sampled KAFB-106027
		- packing up equipment
1817		heading to drop off drums
1825		dropping off drums (Drum #3 + Drum #4)
1833		leaving the base
		AG

FIELD RESPRSENTATIVE SIGNATURE: Alicia George

DATE: 2/15/17

OTIE

DAILY REPORT

PAGE 1 OF 1

USACE CONTRACT #: W912BV-15-C-0082
DATE: 2/16/17
PROJECT NUMBER: 2015341-06-0604
PROJECT LOCATION: Kirtland
SITE ID: FT-013
FIELD PERSONNEL: AG / RK
CLIENT: AFCEC
SUBCONTRACTOR: Daniel B. Stephens
SUBCONTRACTOR PERSONNEL ON SITE: Jerome Fisher
VISITOR(S) ON SITE:
BRIEF SUMMARY OF WORK PERFORMED: GW Sampling

WAS A TAILGATE SAFETY MEETING HELD? ☒ YES ☐ NO
WERE THERE ANY LOST TIME ACCIDENTS? ☐ YES ☒ NO
WERE INSTRUMENT CALIBRATIONS PERFORMED? ☒ YES ☐ NO
WAS HAZARDOUS MATERIAL/WASTE RELEASED INTO THE ENVIRONMENT? ☐ YES ☒ NO

START TIME	STOP TIME	DESCRIPTION OF ACTIVITIES; REMARKS
0830		Arrive on base. Meet w/ Jerome and go over
		tailgate safety meeting
0840		Head to site FT-013
0850		Arrive @ FT-013 / well KAFB-0417
0911		Jerome setting up hydra sleeve
0917		dropping the hydra sleeve in the well
0923		hit water pulling the hydra sleeve up
0926		sampled KAFB-0417
0938		finished packing up equipment and leaving
		site to drop off water. Robert called Jesse
		and he is going to come and let us in
		the gate.
0943		arrived at drum drop off location
0948		~~dr~~ dumped water in Drum #3 (75% full)
1000		leaving base for the day

FIELD RESPRSENTATIVE SIGNATURE: Alicia George
DATE: 2/16/17

DAILY REPORT

PAGE 1 OF 2

USACE CONTRACT #: W912BV-15-C-0082

DATE: 02/16/17

PROJECT NUMBER: 2015341-06-0604

PROJECT LOCATION: Kirtland AFB

SITE ID: All sites

FIELD PERSONNEL: CR, RK

CLIENT: AFCEC

SUBCONTRACTOR: Shields Survey LTD. Co.

SUBCONTRACTOR PERSONNEL ON SITE: Scott Weese, PLS

VISITOR(S) ON SITE: None

BRIEF SUMMARY OF WORK PERFORMED: Surveying

WAS A TAILGATE SAFETY MEETING HELD? ☒ YES ~~☒~~ NO CR

WERE THERE ANY LOST TIME ACCIDENTS? ☐ YES ☒ NO

WERE INSTRUMENT CALIBRATIONS PERFORMED? ☐ YES ☒ NO

WAS HAZARDOUS MATERIAL/WASTE RELEASED INTO THE ENVIRONMENT? ☐ YES ☒ NO

START TIME	STOP TIME	DESCRIPTION OF ACTIVITIES; REMARKS
1255		Arrived on base to meet Surveyor
		Checked again on the status of the IDW coolers and
		bottles from Eurofins. They were supposed to arrive today
		but they're delayed.
1305		Jesse arrived at Visitor's gate, to get a visitor's pass for
		the surveyor.
1325		Arrived at the Drum laydown are for the surveyor to
		set his equipment.
		The coordinates for the Drum location is:
		N 35°02' 27.4" W 106° 35' 36.3"
		And it's called the 377 ABW/EM Recycling Operation Center
		Bldg 00641
1400		Arrived at flightline - AFA-SB03. Surveyed.
1407		Surveyed AFA-SB01
1415		Surveyed AFA-SB02
1420		~~Surveyed~~ left flightline
1425		Surveyed a marker by Hangar 909
1440		~~Arrived and s~~ CR Surveyed FT014-SB01
1448		Surveyed FT014-SB03
1455		Surveyed FT014-SB02
1510		Surveyed STSA-SB03
1515		" STSA-SB01
1521		" FT013-SB01
1525		" FT013-SB02
1530		" FT013-SB03

FIELD RESPRSENTATIVE SIGNATURE: Catalina Rg

DATE: 02/16/17

DAILY REPORT

PAGE 2 OF 2

USACE CONTRACT #: W912BV-15-C-0082

DATE: 02/16/17

PROJECT NUMBER: 2015341-06-0604

PROJECT LOCATION: Kirtland AFB

SITE ID: All sites

FIELD PERSONNEL: RK, CR

START TIME	STOP TIME	DESCRIPTION OF ACTIVITIES; REMARKS
1535		Arrived at laydown area so that the surveyor could
	1545	pickup her equipment.
1600	1610	left Base, went back to hotel
1630		Prepped Coolers for shipment
1800		Delivered Coolers to fedex

CR

EQUIPMENT / SUPPLIES

Surveying equipment
Coolers
Ice
Cooler liners
PFC free water

FIELD RESPRSENTATIVE SIGNATURE: CatalinaRey

DATE: 2/16/17

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Safety and Operations Tailgate Meeting Form

Rev. 2.101713

Date/Time: 02/13/17

Project Number: 2015341- 06 - 0604

Project Name: Site Investigations of Aqueous Film Forming Foam Usage Multiple U.S. AF Installations, U.S. EPA Regions 6 and 9

Contract No: W912BV-15-R-0096; TO#0009

Project Location: Kirtland AFB

Client: AFCEC

Client Phone:

Type of Work: Drilling, Ground water sampling, soil sampling

OPERATIONS and QUALITY	Yes	No	N/A
Tasks to be performed (include the definable features of work)	✓		
Critical path items (schedule, client interaction, project coordination)	✓		
Subcontractors on site today	✓		
Other visitors expected on site		✓	
Material/Equipment deliveries expected and storage areas		✓	
Applicable information from Base Operations or client (as needed)			
Review of As Builts/Layout Plans, if applicable			✓
Operational / Quality Deficiencies to discuss (refer to Daily Quality Control Report from day before and other inspection reports)			✓
Other:			

SAFETY	Yes	No	N/A
Protective Clothing/Equipment Level: [✓ D] C B A (circle appropriate) As applicable, head, eye, ear, respiratory, other protection	✓		
Contaminants and hazardous materials anticipated		✓	
Chemical exposure issues anticipated		✓	
Work zones and methods of security	✓		
Decontamination procedures (equipment and personnel)	✓		
General safe work practices	✓		
GOOD CATCHES and any safety deficiencies or Near Misses (if yes, provide explanation below)			GLR
Other:			✗
Other:			✗

Emergency Procedures: Call base contact and 911

Hospital Name: Presbyterian Hospital

Hospital Phone: 505-841-1234

ENVIRONMENTAL COMPLIANCE	Yes	No	N/A
Environmental Protection Plan			
- Preservation of existing conditions in surrounding water and land	✗		
- Dust quality monitoring		✗	
- Spill prevention and response		✗	
- Promote recycling, waste prevention, minimization and energy conservation	✗		
Waste Management Plan			
- Storage, shipping, disposal of general waste	✗		
- Storage, shipping, disposal of hazardous waste	✗		
- Recordkeeping	✗		
- NO Waste should be kept on site for more than 90 Days	✗		
Stormwater Pollution Prevention Plan			
- Periodic BMP Inspection Checklist			✗
- Post-Rain Inspection			✗
- Other			✗

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Safety and Operations Tailgate Meeting Form

Rev. 2.101713

Date/Time: 02/14/17

Project Number: 2015341-06-0604

Project Name: Site Investigations of Aqueous Film Forming Foam Usage Multiple U.S. AF Installations, U.S. EPA Regions 6 and 9

Contract No: W912BV-15-R-0096; TO#0009

Project Location: Kirtland AFB

Client: AFCEC

Client Phone:

Type of Work: Drilling, sampling at FT013 + STSA

OPERATIONS and QUALITY	Yes	No	N/A
Tasks to be performed (include the definable features of work)	✓		
Critical path items (schedule, client interaction, project coordination)	✓		
Subcontractors on site today	✓		
Other visitors expected on site		X	
Material/Equipment deliveries expected and storage areas			✓
Applicable information from Base Operations or client (as needed)	✓		
Review of As Builts/Layout Plans, if applicable			✓
Operational / Quality Deficiencies to discuss (refer to Daily Quality Control Report from day before and other inspection reports)	✓		
Other:			

SAFETY	Yes	No	N/A
Protective Clothing/Equipment Level: [✓ D] C B A (circle appropriate) As applicable, head, eye, ear, respiratory, other protection	✓		
Contaminants and hazardous materials anticipated	~~✓~~ CR	✓	
Chemical exposure issues anticipated		✓	
Work zones and methods of security	✓		
Decontamination procedures (equipment and personnel)	✓		
General safe work practices	✓		
GOOD CATCHES and any safety deficiencies or Near Misses (if yes, provide explanation below)		X	
Other:		X	
Other:		X	
Emergency Procedures: Call base contact and 911			
Hospital Name: Presbyterian Hospital **Hospital Phone**: 505-841-1234			

ENVIRONMENTAL COMPLIANCE	Yes	No	N/A
Environmental Protection Plan	✓		
• Preservation of existing conditions in surrounding water and land	✓		
• Dust quality monitoring	✓		
• Spill prevention and response			✓
• Promote recycling, waste prevention, minimization and energy conservation	✓		
Waste Management Plan			
• Storage, shipping, disposal of general waste	✓		
• Storage, shipping, disposal of hazardous waste	✓		
• Recordkeeping	✓		
• NO Waste should be kept on site for more than 90 Days	✓		
Stormwater Pollution Prevention Plan			
• Periodic BMP Inspection Checklist			X
• Post-Rain Inspection			X
• Other			X

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Safety and Operations Tailgate Meeting Form
Rev. 2.101713

EXPLANATIONS/NOTES

ATTENDEES
The following personnel were present for discussion of the topics listed above and have read and understand the contents of the Site Accident Prevention Plan/AHAs/Health and Safety Plan.

NAME	COMPANY	SIGNATURE
Catalina Restrepo	OTIE	Catalina R
Aleci a George	OTIE	
Jerome Fisher	DIBSTA	
JUAN BARRAZA	EDI	
RODNEY BEGAY	EDI	

Meeting Conducted By: Rob Kelley

Date: 14 Feb 2017

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Safety and Operations Tailgate Meeting Form
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Date/Time: 02/15/17
Project Number: 2015341-06-0604
Project Name: Site Investigations of Aqueous Film Forming Foam Usage Multiple U.S. AF Installations, U.S. EPA Regions 6 and 9
Contract No: W912BV-15-R-0096; TO#0009
Project Location: KIRTLAND AFB
Client: AFCEC
Client Phone:
Type of Work: Drilling, sampling Soil and Groundwater

OPERATIONS and QUALITY	Yes	No	N/A
Tasks to be performed (include the definable features of work)	X		
Critical path items (schedule, client interaction, project coordination)	X		
Subcontractors on site today	X		
Other visitors expected on site			
Material/Equipment deliveries expected and storage areas		X	
Applicable information from Base Operations or client (as needed)			X
Review of As Builts/Layout Plans, if applicable	X		
Operational / Quality Deficiencies to discuss (refer to Daily Quality Control Report from day before and other inspection reports)	X		
Other:			

SAFETY	Yes	No	N/A
Protective Clothing/Equipment Level: [✓ D] C B A (circle appropriate) As applicable, head, eye, ear, respiratory, other protection	X		
Contaminants and hazardous materials anticipated		X	
Chemical exposure issues anticipated		X	
Work zones and methods of security	X		
Decontamination procedures (equipment and personnel)	X		
General safe work practices	X		
GOOD CATCHES and any safety deficiencies or Near Misses (if yes, provide explanation below)			
Other:			
Other:			

Emergency Procedures: Call Base OPS and 911
Hospital Name: Presbyterian Hospital
Hospital Phone:

ENVIRONMENTAL COMPLIANCE	Yes	No	N/A
Environmental Protection Plan	X		
• Preservation of existing conditions in surrounding water and land	X		
• Dust quality monitoring			X
• Spill prevention and response			X
• Promote recycling, waste prevention, minimization and energy conservation	X		
Waste Management Plan			
• Storage, shipping, disposal of general waste	X		
• Storage, shipping, disposal of hazardous waste	X		
• Recordkeeping	X		
• NO Waste should be kept on site for more than 90 Days	X		
Stormwater Pollution Prevention Plan			
• Periodic BMP Inspection Checklist			X
• Post-Rain Inspection			X
• Other			X

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Safety and Operations Tailgate Meeting Form
Rev. 2.101713

EXPLANATIONS/NOTES

ATTENDEES

The following personnel were present for discussion of the topics listed above and have read and understand the contents of the Site Accident Prevention Plan/AHAs/Health and Safety Plan.

NAME	COMPANY	SIGNATURE
Catalina Restrepo	OTIE	Catalina R
Alecia George	OTIE	Alecia George
RODNEY BEGAY	EDI	
JUAN BARRAZA	EDI	Juan B
JEROME FISHER	DBS&A	

Meeting Conducted By: Rob Kelley

Date: 2/15/16

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Safety and Operations Tailgate Meeting Form
Rev. 2.101713

Date/Time: 02/16/17

Project Number: 2015341- 06/0604

Project Name: Site Investigations of Aqueous Film Forming Foam Usage Multiple U.S. AF Installations, U.S. EPA Regions 6 and 9

Contract No: W912BV-15-R-0096; TO#0009

Project Location: Kirtland AFB

Client: AFCE

Client Phone:

Type of Work: surveying

OPERATIONS and QUALITY	Yes	No	N/A
Tasks to be performed (include the definable features of work)	✓		
Critical path items (schedule, client interaction, project coordination)	✓		
Subcontractors on site today	✓		
Other visitors expected on site		✓	
Material/Equipment deliveries expected and storage areas Coolers - IDW	✓		
Applicable information from Base Operations or client (as needed)	✓		
Review of As Builts/Layout Plans, if applicable	✓		
Operational / Quality Deficiencies to discuss (refer to Daily Quality Control Report from day before and other inspection reports)	✓		
Other:			

SAFETY	Yes	No	N/A
Protective Clothing/Equipment Level: [✓ D] C B A (circle appropriate) As applicable, head, eye, ear, respiratory, other protection	✓		
Contaminants and hazardous materials anticipated		✓	
Chemical exposure issues anticipated		✓	
Work zones and methods of security	✓		
Decontamination procedures (equipment and personnel)			✓
General safe work practices	✓		
GOOD CATCHES and any safety deficiencies or Near Misses (if yes, provide explanation below)		✓	
Other:			
Other:			

Emergency Procedures:

Hospital Name: Presbyterian Hospital **Hospital Phone:**

ENVIRONMENTAL COMPLIANCE	Yes	No	N/A
Environmental Protection Plan			
• Preservation of existing conditions in surrounding water and land	✓		
• Dust quality monitoring		✓	
• Spill prevention and response			✓
• Promote recycling, waste prevention, minimization and energy conservation	✓		
Waste Management Plan			
• Storage, shipping, disposal of general waste	✓		
• Storage, shipping, disposal of hazardous waste	✓		
• Recordkeeping	✓		
• NO Waste should be kept on site for more than 90 Days	✓		
Stormwater Pollution Prevention Plan			
• Periodic BMP Inspection Checklist			✓
• Post-Rain Inspection			✓
• Other			✓

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Safety and Operations Tailgate Meeting Form
Rev. 2.101713

EXPLANATIONS/NOTES

SHIELDS SURVEY LTD. Co.
PROFESSIONAL LAND SURVEYORS
in COLORADO, NEW MEXICO, OKLAHOMA AND TEXAS

SCOTT WEESE, PLS

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CELL: (575) 447-2230
EMAIL: scott@shieldssurvey.com

ATTENDEES

The following personnel were present for discussion of the topics listed above and have read and understand the contents of the Site Accident Prevention Plan/AHAs/Health and Safety Plan.

NAME	COMPANY	SIGNATURE
Catalina Restrepo	OTIE	Catalina Rg
Rob Kelley	OTIE	
Norman Scott Weese	Shields Survey	Norman S. Weese

Meeting Conducted By: Rob Kelley Date: 2/16/17

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Safety and Operations Tailgate Meeting Form

Rev. 2.101713

Date/Time: 2/16/17

Project Number: 2015341- 06-0604

Project Name: Site Investigations of Aqueous Film Forming Foam Usage Multiple U.S. AF Installations, U.S. EPA Regions 6 and 9

Contract No: W912BV-15-R-0096; TO#0009

Project Location: Kirtland AFB

Client: AFCEC

Client Phone:

Type of Work: GW Sampling

OPERATIONS and QUALITY	Yes	No	N/A
Tasks to be performed (include the definable features of work)	✓		
Critical path items (schedule, client interaction, project coordination)			
Subcontractors on site today			
Other visitors expected on site		✓	
Material/Equipment deliveries expected and storage areas			
Applicable information from Base Operations or client (as needed)			
Review of As Builts/Layout Plans, if applicable			
Operational / Quality Deficiencies to discuss (refer to Daily Quality Control Report from day before and other inspection reports)			
Other:			

SAFETY	Yes	No	N/A
Protective Clothing/Equipment Level: [✓ D] C B A (circle appropriate) As applicable, head, eye, ear, respiratory, other protection			
Contaminants and hazardous materials anticipated			
Chemical exposure issues anticipated			
Work zones and methods of security			
Decontamination procedures (equipment and personnel)			
General safe work practices			
GOOD CATCHES and any safety deficiencies or Near Misses (if yes, provide explanation below)			
Other:			
Other:			

Emergency Procedures:

Hospital Name:

Hospital Phone:

ENVIRONMENTAL COMPLIANCE	Yes	No	N/A
Environmental Protection Plan			
• Preservation of existing conditions in surrounding water and land			
• Dust quality monitoring			
• Spill prevention and response			
• Promote recycling, waste prevention, minimization and energy conservation			
Waste Management Plan			
• Storage, shipping, disposal of general waste			
• Storage, shipping, disposal of hazardous waste			
• Recordkeeping			
• NO Waste should be kept on site for more than 90 Days			
Stormwater Pollution Prevention Plan			
• Periodic BMP Inspection Checklist			
• Post-Rain Inspection			
• Other			

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Safety and Operations Tailgate Meeting Form
Rev. 2.101713

EXPLANATIONS/NOTES

ATTENDEES

The following personnel were present for discussion of the topics listed above and have read and understand the contents of the Site Accident Prevention Plan/AHAs/Health and Safety Plan.

NAME	COMPANY	SIGNATURE
Alecia George	OTIE	Alecia George
Jerome Fisher	DBS&A	

Meeting Conducted By: Rob Kelley

Date: 0843

Oneida Total Integrated Enterprises
9601 McAllister Freeway, Suite 310
San Antonio, TX 78216
210-541-0646

AFA-SB01

PAGE 1 OF 1

CLIENT: USACE-Tulsa District

USACE PROJECT NUMBER: W912BV-15-C-0082

DATE STARTED: 2/15/16 **COMPLETED:** 2/15/16

DRILLING CONTRACTOR: Envirodrill

DRILLING METHOD: Hollow Stem Auger

LOGGED BY: Robert Kelley

NOTES: 5' x 3.5" Core Barrel

PROJECT NAME: Site Inspections of Aqueous Film Forming Foam Usage

PROJECT LOCATION: Kirtland Air Force Base, Albuquerque, New Mexico

GROUND ELEVATION: 5,320 ft amsl **HOLE SIZE:** 8 inches (in)

GROUND WATER LEVELS: No groundwater observed within borehole. Approximately depth to groundwater is 300 feet below ground surface (ft bgs).

DEPTH (ft)	SAMPLE ID & RANGE (ft bgs)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth (ft bgs)	Elevation feet above mean sea level (ft amsl)
0	AFA SB01 (0-1)	SW	⁘	(SW) SAND. Light brown to brown, well sorted, well graded. Moist to dry.	3.5	5316.5
5 10		SC	▨	(SC) Clayey SAND. Light brown, well sorted, well graded. Dry, low plasticity fines.	14.0	5306.0
15 20	AFA SB01 (15-16)	SP	░	(SP) SAND. Brown, dry, well sorted, well graded. Approximately 40% gravel (granite, chert), rounded to subangular, approximately 1-2 cm diameter.	22.0	5298.0
25	AFA SB01 (24-25)	SC	▨	(SC) Clayey SAND. Dark brown, moist to dry, well sorted, well graded. Low plasticity fines.	25.0	5295.0

Bottom of borehole at 25.0 feet.

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AFA-SB02

PAGE 1 OF 2

CLIENT: USACE-Tulsa District

USACE PROJECT NUMBER: W912BV-15-C-0082

DATE STARTED: 2/15/16 **COMPLETED:** 2/15/16

DRILLING CONTRACTOR: Envirodrill

DRILLING METHOD: Hollow Stem Auger

LOGGED BY: Robert Kelley

NOTES: 5' x 3.5" Core Barrel

PROJECT NAME: Site Inspections of Aqueous Film Forming Foam Usage

PROJECT LOCATION: Kirtland Air Force Base, Albuquerque, New Mexico

GROUND ELEVATION: 5,321 ft amsl **HOLE SIZE:** 8 inches (in)

GROUND WATER LEVELS: No groundwater observed within borehole.
Approximate depth to groundwater is 300 feet below ground suface (ft bgs).

DEPTH (ft)	SAMPLE ID & RANGE (ft bgs)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth (ft bgs)	Elevation feet above mean sea level (ft amsl)
0	AFA SB02 (0-1)	SW	⁘	(SW) SAND. Light brown to brown, well sorted, well graded. Moist to dry.	3.0	5318.0
		SC	▨	(SC) Clayey SAND. Brown to dark brown, moist, well sorted, well graded. Low plasticity fines.		
5			▨			
10			▨	(SC) SAA grades to light brown, dry		
15	AFA SB02 (15-16)		▨			
20			▨		21.5	5299.5
		SP	⁘	(SP) SAND. Brown, dry. Approximately 40-45% gravel (granite, chert, calcite), well sorted, poorly graded.	24.5	5296.5
25	AFA SB02 (24-25)	SC	▨	(SC) Clayey SAND. Dark brown, dry to moist. Well sorted, well graded, low plasticity fines.	25.0	5296.0

Bottom of borehole at 25 feet.

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Oneida Total Integrated Enterprises
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San Antonio, TX 78216
210-541-0646

AFA-SB03

PAGE 1 OF 1

CLIENT: USACE-Tulsa District

USACE PROJECT NUMBER: W912BV-15-C-0082

DATE STARTED: 2/15/16 **COMPLETED:** 2/15/16

DRILLING CONTRACTOR: Envirodrill

DRILLING METHOD: Hollow Stem Auger

LOGGED BY: Robert Kelley

NOTES: 5' x 3.5" Core Barrel

PROJECT NAME: Site Inspections of Aqueous Film Forming Foam Usage

PROJECT LOCATION: Kirtland Air Force Base, Albuquerque, New Mexico

GROUND ELEVATION: 5,321.3 ft amsl **HOLE SIZE:** 8 inches (in)

GROUND WATER LEVELS: No groundwater observed within borehole.

Approximate depth to groundwater is 300 feet below ground surface (ft bgs).

DEPTH (ft)	SAMPLE ID & RANGE (ft bgs)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth (ft bgs)	Elevation feet above mean sea level (ft amsl)
0	AFA SB03 (0-1)	SW	⁘	(SW) SAND. Light brown to brown, well sorted, well graded. Moist to dry.	3.0	5318.3
5 10 15	AFA SB03 (15-16)	SC	▨	(SC) Clayey SAND. Brown to dark brown, moist, well sorted, well graded. Low plasticity fines. (SC) SAA grades to light brown.	16.5	5304.8
20		SP	⁘	(SP) SAND. Brown, dry. Approximately 40% gravel (granite, chert, calcite), well sorted, poorly graded.	21.0	5300.3
25	AFA SB03 (24-25)	SC	▨	(SC) Clayey SAND. Dark brown, moist. Well sorted, well graded, low plasticity fines.	25.0	5296.3

Bottom of borehole at 25.0 feet.

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9601 McAllister Freeway, Suite 310
San Antonio, TX 78216
210-541-0646

FT013-SB01

PAGE 1 OF 1

CLIENT: USACE-Tulsa District

USACE PROJECT NUMBER: W912BV-15-C-0082

DATE STARTED: 2/14/16 **COMPLETED:** 2/14/16

DRILLING CONTRACTOR: Envirodrill

DRILLING METHOD: Hollow Stem Auger

LOGGED BY: Robert Kelley

NOTES: 5' x 3.5" Core Barrel

PROJECT NAME: Site Inspections of Aqueous Film Forming Foam Usage

PROJECT LOCATION: Kirtland Air Force Base, Albuquerque, New Mexico

GROUND ELEVATION: 5,315.3 ft amsl **HOLE SIZE:** 8 inches (in)

GROUND WATER LEVELS: No groundwater observed within borehole. Approximate depth to groundwater is 300 feet below ground surface (ft bgs).

DEPTH (ft)	SAMPLE ID & RANGE (ft bgs)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth (ft bgs)	Elevation feet above mean sea level (ft amsl)
0	FT013 SB01 (0-1)	SC	▨	(SC) Clayey SAND. Dark brown, wet, well sorted.		
				(SC) Becomes brown to light brown, well sorted with fines.		
5						
				(SC) Trace gravel (<5%). <2cm diameter, rounded to subangular grains.		
10						
15	FT013 SB01 (15-16)			(SC) SAA with calcareous lens, dry, white to gray streaks.		
20						
				(SC) SAA packed with white calcareous streaks.	23.5	5291.8
25	FT013 SB01 (24-25)	SM	⁘	(SM) Silty SAND. Light brown, well sorted, well graded.	25.0	5290.3

Bottom of borehole at 25.0 feet.

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FT013-SB02

PAGE 1 OF 1

CLIENT: USACE-Tulsa District

USACE PROJECT NUMBER: W912BV-15-C-0082

DATE STARTED: 2/14/16 **COMPLETED:** 2/14/16

DRILLING CONTRACTOR: Envirodrill

DRILLING METHOD: Hollow Stem Auger

LOGGED BY: Robert Kelley

NOTES: 5' x 3.5" Core Barrel

PROJECT NAME: Site Inspections of Aqueous Film Forming Foam Usage

PROJECT LOCATION: Kirtland Air Force Base, Albuquerque, New Mexico

GROUND ELEVATION: 5,316.5 ft amsl **HOLE SIZE:** 8 inches (in)

GROUND WATER LEVELS: No groundwater observed within borehole.
Approximate depth to groundwater is 300 feet below ground surface (ft bgs).

DEPTH (ft)	SAMPLE ID & RANGE (ft bgs)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth (ft bgs)	Elevation feet above mean sea level (ft amsl)
0	FT013 SB02 (0-1)	SM	░	(SM) Silty SAND. Brown, moist. Well sorted, well graded.	5.0	5311.5
5		SC	▨	(SC) Clayey SAND. Light brown, dry, well sorted, well graded.		
10				(SC) Grades to brown-dark brown		
				(SC) Becomes trace gravel (<5%), rounded to angular.		
15	FT013 SB02 (15-16)			(SC) SAA with white streaks.		
20					21.0	5295.5
		SP	░	(SP) SAND. Poorly sorted with gravel (approx. 45%), <1cm to 1 in (cherts, granite), rounded to subrounded.	24.0	5292.5
25	FT013 SB02 (24-25)	SC	▨	(SC) SAA at 5-21 ft, brown.	25.0	5291.5

Bottom of borehole at 25.0 feet.

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FT013-SB03

PAGE 1 OF 1

CLIENT: USACE-Tulsa District

USACE PROJECT NUMBER: W912BV-15-C-0082

DATE STARTED: 2/14/16 **COMPLETED:** 2/14/16

DRILLING CONTRACTOR: Envirodrill

DRILLING METHOD: Hollow Stem Auger

LOGGED BY: Robert Kelley

NOTES: 5' x 3.5" Core Barrel

PROJECT NAME: Site Inspections of Aqueous Film Forming Foam Usage

PROJECT LOCATION: Kirtland Air Force Base, Albuquerque, New Mexico

GROUND ELEVATION: 5,299.3 ft amsl **HOLE SIZE:** 8 inches (in)

GROUND WATER LEVELS: No groundwater observed within borehole.
Approximate depth to groundwater is 300 feet below ground surface (ft bgs)

DEPTH (ft)	SAMPLE ID & RANGE (ft bgs)	U.S.C.S.	MATERIAL DESCRIPTION	Depth (ft bgs)	Elevation feet above mean sea level (ft amsl)
0	FT013 SB03 (0-1)	SM	(SM) Silty SAND. Brown, moist. Well sorted, well graded.	4.5	5294.8
5		SC	(SC) Clayey SAND. Brown, dry, well sorted, well graded. Trace gravel (<5%), <1cm diameter, rounded to subangular.	11.0	5288.3
10		CL	(CL) CLAY. Dark brown low plasticity. Stiff to medium stiff, dry.	13.5	5285.8
15 20 25	FT013 SB03 (15-16) FT013 SB03 (24-25)	SC	(SC) Clayey SAND. Brown, dry, well sorted, well graded.	25.0	5274.3

Bottom of borehole at 25.0 feet.

GENERAL BH / TP / WELL - GINT STD US.GDT - 4/28/17 11:35 - C:\USERS\CUTER\DESKTOP\GINT\KIRTLAND\FT013-SB03.GPJ

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FT014-SB01

PAGE 1 OF 1

CLIENT: USACE-Tulsa District

USACE PROJECT NUMBER: W912BV-15-C-0082

DATE STARTED: 2/13/16 **COMPLETED:** 2/13/16

DRILLING CONTRACTOR: Envirodrill

DRILLING METHOD: Hollow Stem Auger

LOGGED BY: Robert Kelley

NOTES: 5' x 3.5" Core Barrel

PROJECT NAME: Site Inspections of Aqueous Film Forming Foam Usage

PROJECT LOCATION: Kirtland Air Force Base, Albuquerque, New Mexico

GROUND ELEVATION: 5,556.4 ft amsl **HOLE SIZE:** 8 inches (in)

GROUND WATER LEVELS: No groundwater observed within borehole.

Approximate depth to water is 300 feet below ground surface (ft bgs).

DEPTH (ft)	SAMPLE ID & RANGE (ft bgs)	U.S.C.S.	GRAPHIC LOG	Depth (ft bgs)	MATERIAL DESCRIPTION	Elevation feet above mean sea level (ft amsl)
0	FT014 SB01 (0-1)	SC	▨		(SC) Clayey SAND. Brown, well sorted, well graded. Low plasticity fines, moist to dry.	
5						
10						
15	FT014 SB01 (15-16)			15.5		5540.9
		SP	░		(SP) SAND. Light brown, poorly sorted, poorly graded. Small gravel (rounded to subangular) <1cm in diameter.	
20						
					(SP) SAA, becomes larger gravel (granitic), approximately 1.5 cm in diameter.	
25	FT014 SB01 (24-25)			25.0		5531.4

Bottom of borehole at 25.0 feet.

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FT014-SB02

PAGE 1 OF 1

CLIENT: USACE-Tulsa District

USACE PROJECT NUMBER: W912BV-15-C-0082

DATE STARTED: 2/13/16 **COMPLETED:** 2/13/16

DRILLING CONTRACTOR: Envirodrill

DRILLING METHOD: Hollow Stem Auger

LOGGED BY: Robert Kelley

NOTES: 5' x 3.5" Core Barrel

PROJECT NAME: Site Inspections of Aqueous Film Forming Foam Usage

PROJECT LOCATION: Kirtland Air Force Base, Albuquerque, New Mexico

GROUND ELEVATION: 5,552.3 ft amsl **HOLE SIZE:** 8 inches (in)

GROUND WATER LEVELS: No groundwater observed in borehole.
Approximate depth to water is 300 feet below ground surface (ft bgs).

DEPTH (ft)	SAMPLE ID & RANGE (ft bgs)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0	FT014 SB02 (0-1)	SC	▨	(SC) Clayey SAND. Light brown
5			▨	
10			▨	(SC) Becomes dark brown. Increased fines.
15	FT014 SB02 (15-16)		▨	(SC) Light brown with trace gravel. Well sorted, approximately 1 inch diameter rounded to subangular gravel (granitic)
20			▨	
25	FT014 SB02 (24-25)		▨	Depth (ft bgs) 25.0 — Elevation feet above mean sea level (ft amsl) 5527.3

Bottom of borehole at 25.0 feet.

Oneida Total Integrated Enterprises
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210-541-0646

FT014-SB03

PAGE 1 OF 1

CLIENT: USACE-Tulsa District

USACE PROJECT NUMBER: W912BV-15-C-0082

DATE STARTED: 2/13/16 **COMPLETED:** 2/13/16

DRILLING CONTRACTOR: Envirodrill

DRILLING METHOD: Hollow Stem Auger

LOGGED BY: Robert Kelley

NOTES: 5' x 3.5" Core Barrel

PROJECT NAME: Site Inspections of Aqueous Film Forming Foam Usage

PROJECT LOCATION: Kirtland Air Force Base, Albuquerque, New Mexico

GROUND ELEVATION: 5,540 ft amsl **HOLE SIZE:** 8 inches (in)

GROUND WATER LEVELS: No groundwater observed within borehole. Approximate depth to groundwater is 300 feet below ground surface (ft bgs).

DEPTH (ft)	SAMPLE ID & RANGE (ft bgs)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth (ft bgs)	Elevation feet above mean sea level (ft amsl)
0	FT014 SB03 (0-1)	SC	▨	(SC) Clayey SAND. Light brown, well sorted, well graded.		
5						
10						
15	FT014 SB03 (15-16)				17.5	5522.5
		GP	○	(GP) GRAVEL lense at 17.5 ft. 1-5 cm diameter gravel (granitic), angular to sub rounded.	18.5	5521.5
20		SC	▨	(SC) Clayey SAND. SAA 0-17.5 ft.	23.0	5517.0
	FT014 SB03 (24-25)	GP	○	(GP) GRAVEL lense SAA at 17.5 ft.	24.0	5516.0
25		SC	▨	(SC) Clayey SAND. SAA 0-17.5 ft.	25.0	5515.0

Bottom of borehole at 25.0 feet.

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STSA-SB01

PAGE 1 OF 1

CLIENT: USACE-Tulsa District
USACE PROJECT NUMBER: W912BV-15-C-0082
DATE STARTED: 2/14/16 **COMPLETED:** 2/14/16
DRILLING CONTRACTOR: Envirodrill
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Robert Kelley
NOTES: 5' x 3.5" Core Barrel

PROJECT NAME: Site Inspections of Aqueous Film Forming Foam Usage
PROJECT LOCATION: Kirtland Air Force Base, Albuquerque, New Mexico
GROUND ELEVATION: 5,329.4 ft amsl **HOLE SIZE:** 8 inches (in)
GROUND WATER LEVELS: No groundwater observed within borehole.
Approximate depth to groundwater is 300 feet below ground surface (ft bgs).

DEPTH (ft)	SAMPLE ID & RANGE (ft bgs)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0	STSA SB01 (0-1)	SP	▩	(SP) SAND. Brown, fill.	
1.0					5328.4
		SC	▨	(SC) Clayey SAND. Light brown, well sorted, well graded.	
5				(SC) White calcareous lens.	
10				(SC) SAA with trace gravel (<5%), approximately 2cm diameter (granite), angular to subrounded.	
15	STSA SB01 (15-16)				
20				(SC) SAA with gray streaks, dry, friable.	
	STSA SB01 (24-25)			(SC) Trace gravel (<5%) (granite, olivine), angular to subrounded.	
25 / 25.0					5304.4

Bottom of borehole at 25.0 feet.

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STSA-SB02

PAGE 1 OF 1

CLIENT: USACE-Tulsa District

USACE PROJECT NUMBER: W912BV-15-C-0082

DATE STARTED: 2/14/16 **COMPLETED:** 2/14/16

DRILLING CONTRACTOR: Envirodrill

DRILLING METHOD: Hollow Stem Auger

LOGGED BY: Robert Kelley

NOTES: 5' x 3.5" Core Barrel

PROJECT NAME: Site Inspections of Aqueous Film Forming Foam Usage

PROJECT LOCATION: Kirtland Air Force Base, Albuquerque, New Mexico

GROUND ELEVATION: 5,329.5 ft amsl **HOLE SIZE:** 8 inches (in)

GROUND WATER LEVELS: No groundwater observed within borehole. Approximate depth to groundwater is 300 feet below ground surface (ft bgs).

DEPTH (ft)	SAMPLE ID & RANGE (ft bgs)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth (ft bgs)	Elevation feet above mean sea level (ft amsl)
0	STSA SB02 (0-1)	SP	▦	(SP) SAND. Brown, fill.	1.0	5328.5
5		SC	▨	(SC) Clayey SAND. Light brown, dry, well sorted, well graded.		
10				(SC) White calcareous lens.		
15	STSA SB02 (15-16)				15.5	5314.0
20		CL	▨	(CL) CLAY. Brown, dry, low plasticity, soft.	22.0	5307.5
25	STSA SB02 (24-25)	SC	▨	(SC) SAA at 1-15.5 ft.		

Bottom of borehole at 25.0 feet.

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STSA-SB03

PAGE 1 OF 1

CLIENT: USACE-Tulsa District

USACE PROJECT NUMBER: W912BV-15-C-0082

DATE STARTED: 2/15/16 **COMPLETED:** 2/15/16

DRILLING CONTRACTOR: Envirodrill

DRILLING METHOD: Hollow Stem Auger

LOGGED BY: Robert Kelley

NOTES: 5' x 3.5" Core Barrel

PROJECT NAME: Site Inspections of Aqueous Film Forming Foam Usage

PROJECT LOCATION: Kirtland Air Force Base, Albuquerque, New Mexico

GROUND ELEVATION: 5,344.2 ft amsl **HOLE SIZE:** 8 inches (in)

GROUND WATER LEVELS: No groundwater observed within borehole. Approximate depth to groundwater is 300 feet below ground surface (ft bgs).

DEPTH (ft)	SAMPLE ID & RANGE (ft bgs)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth (ft bgs)	Elevation feet above mean sea level (ft amsl)
0	STSA SB03 (0-1)	SC	▨	(SC) Clayey SAND. Light brown, dry, well sorted, well graded.		
5			▨			
10			▨	(SC) Grades to dark brown, moist. High plasticity fines.	11.5	5332.7
		SW	○	(SW) SAND. Brown to light brown, dry, well graded, well sorted. Gravel approximately 5%, rounded to angular calcite (1 cm diameter).	15.5	5328.7
15	STSA SB03 (15-16)	SP	·	(SP) SAND. Light brown, dry, poorly graded, poorly sorted. Gravel approximately 15%, angular to subrounded (granitic), 1-6cm diameter.		
20			·		21.0	5323.2
		SC	▨	(SC) Clayey SAND. Brown, well sorted, well graded, dry, with trace gravel (<5%). Low plasticity fines.		
25	STSA SB03 (24-25)		▨		25.0	5319.2

Bottom of borehole at 25.0 feet.

DAILY DRILLING REPORT

JOB COMPLETED ☐ YES ☐ NO

NO. JOBS THIS DAY

Client OTIE
Date 02-13-17 Start: 630 End: 530
Project KIRTLAND AFB
Job No. 2386JH334
Location KIRTLAND AFB
City ALBUQUERQUE NM
Project Type: ☐ Contract ☐ WT ☑ Enviro ☐ Geotech ☐ Labor Only ☐ Other

DRILLING

CLIENT HOLE NO.	DRILL DEPTH FROM –	DRILL DEPTH TO –	PERCOLATION	BIT SIZE	BIT TYPE	NO. OF SAMPLES RING	SPLIT	CA	BN
	0	25'					5		
	0	25'					5		
	0	25'					5		

FOOTAGE DRILLED
DRILL RATE PER HOUR
TOTAL SAMPLES

FORMATION DRILLED AND DEPTH

☑ SAND
☑ SILT
☐ CLAY
☐ CALICHE
☐ GRAVEL
☑ COBBLES
☑ MEDIUM SOFT
☐ MEDIUM HARD
☐ EXTREMELY HARD
☐ REFUSAL

GROUNDWATER TABLE ENCOUNTERED
☐ YES ☑ NO
GROUNDWATER DEPTH

FUNCTION	SERVICE PERFORMED	QTY.	RATE	CHARGE
262	MAKE READY / DECONTAMINATION – BEFORE / AFTER JOB	1.5		
212	MOBILIZE / DEMOBILIZE EQUIPMENT	.5		
212	DRILLING INCLUDES:			
	SAFETY MEETING			
	DRILL OPERATIONS			
	REAMING HOLE(S)			
	MOVING BETWEEN SITE(S)			
	GROUTING, HOURS ____ FEET ____			
	SITE CLEANUP			
212	MISCELLANEOUS LABOR INCLUDES:			
	DECONTAMINATION SERVICES	.5		
	MOVING DRUMS			
	CREW TRAVEL WITHOUT RIG			
212	LABORER			
212	WELL INSTALLATION			
212	WELL DEVELOPMENT			
212	WELL ABANDONMENT			
250	STANDBY & DELAYS (EXPLAIN)	3		
212	CREW OVERTIME			
–	PER DIEM			
212	MEAL / MISC. BREAKS (DOT REQUIRED)			
278	CREW BREAK	.5		
276	PERMITS / REPORTS			
277	SUPERVISORY TIME			

REMARKS: 3 HR WAIT ON SPONSOR, ~~PERMIT~~ PASS, SITE WALK, + GATE INSPECTION

MAN-HOUR ALLOCATION	HOURS
OPERATOR [redacted] JUAN BARRAZA	
ASSISTANT RODNEY BEGAY	
LABORER	

– SIGNATURE APPROVING WORK CONTENT –

CLIENT SIGNATURE:

P.O./W.O./JOB NO.:

RENTALS / SUPPLIES	QTY.	RATE	CHARGE
SUPPORT VEHICLE / TRAILER			
GENERATOR			
TRAILER(S)			
CORING MACHINE / SAW CUT			
BULLET TEETH			
PORTLAND CEMENT			
PRE-MIX			
ASPHALT			
VISQUEEN			
DRUMS			
BRASS SLEEVES, SIZE:			
PVC CASING IN. X 5 FT.			
PVC CASING IN. X 10 FT.			
SCREEN .0____0 SLOT IN. X 5 FT.			
SCREEN .0____0 SLOT IN. X 10 FT.			
TOP LOCKING CAP			
BOTTOM CAP			
SAND-SACKS, GRADE NO.:			
WELL VAULT, SIZE: IN.			
BENTONITE PELLETS, PAILS:			
BENTONITE POWDER, SACKS:			
JACK HAMMER			
AIR COMPRESSOR, SIZE:			

EQUIPMENT	UNIT NO.	STARTING MILEAGE	ENDING MILEAGE	TOTAL MILES	RATE	CHARGE
RIG	979					
SUPPORT VEHICLE	1049					

RIG / TRUCK DOWN TIME, HOURS (EXPLAIN BELOW)

DAMAGED OR LOST EQUIPMENT:

White – Invoicing; Yellow – Client

Enviro-Drill, Inc.

E10 – 1994
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DAILY DRILLING REPORT

JOB COMPLETED ☐ YES ☐ NO

NO. JOBS THIS DAY

Client OTIE
Date 02-15-17 Start: 630 End: 600
Project KIRTLAND AFB
Job No. 2386JH334
Location KIRTLAND AFB
City ALBUQUERQUE NM
Project Type: ☐ Contract ☐ WT ☐ Enviro ☐ Geotech ☐ Labor Only ☐ Other

CLIENT HOLE NO.	DRILL DEPTH FROM –	DRILL DEPTH TO –	PERCOLATION	BIT SIZE	BIT TYPE	NO. OF SAMPLES RING	SPLIT	CA	BN
	0	15'					5		
	0	15'					5		
	0	15'					5		
	0'	15'					5		
							5		
							5		

FOOTAGE DRILLED 100'
DRILL RATE PER HOUR
TOTAL SAMPLES

FORMATION DRILLED AND DEPTH

- ☑ SAND
- ☐ SILT
- ☑ CLAY
- ☐ CALICHE
- ☑ GRAVEL
- ☐ COBBLES
- ☑ MEDIUM SOFT
- ☐ MEDIUM HARD
- ☐ EXTREMELY HARD
- ☐ REFUSAL

GROUNDWATER TABLE ENCOUNTERED ☐ YES ☐ NO
GROUNDWATER DEPTH

FUNCTION	SERVICE PERFORMED	QTY.	RATE	CHARGE
262	MAKE READY / DECONTAMINATION – BEFORE / AFTER JOB	.5		
212	MOBILIZE / DEMOBILIZE EQUIPMENT			
212	DRILLING INCLUDES:			
	SAFETY MEETING			
	DRILL OPERATIONS	6		
	REAMING HOLE(S)			
	MOVING BETWEEN SITE(S)			
	GROUTING, HOURS ____ FEET ____			
	SITE CLEANUP			
212	MISCELLANEOUS LABOR INCLUDES:			
	DECONTAMINATION SERVICES	.5		
	MOVING DRUMS			
	CREW TRAVEL WITHOUT RIG			
212	LABORER			
212	WELL INSTALLATION			
212	WELL DEVELOPMENT			
212	WELL ABANDONMENT			
250	STANDBY & DELAYS (EXPLAIN)	4.5		
212	CREW OVERTIME			
–	PER DIEM			
212	MEAL / MISC. BREAKS (DOT REQUIRED)			
278	CREW BREAK			
276	PERMITS / REPORTS			
277	SUPERVISORY TIME			

REMARKS: 4 HR DELAY WAIT ON ACCESS TO
FLIGHT AREA
.5 HR GATE INSPECTION

MAN-HOUR ALLOCATION	HOURS
OPERATOR JUAN BARRAZA	
ASSISTANT RODNEY BEGAY	
LABORER	

– SIGNATURE APPROVING WORK CONTENT –

CLIENT SIGNATURE:

P.O./W.O./JOB NO.:

RENTALS / SUPPLIES	QTY.	RATE	CHARGE
SUPPORT VEHICLE / TRAILER			
GENERATOR			
TRAILER(S) DECON			
CORING MACHINE / SAW CUT			
BULLET TEETH			
PORTLAND CEMENT			
PRE-MIX			
ASPHALT			
VISQUEEN			
DRUMS			
BRASS SLEEVES, SIZE:			
PVC CASING IN. X 5 FT.			
PVC CASING IN. X 10 FT.			
SCREEN .0___0 SLOT IN. X 5 FT.			
SCREEN .0___0 SLOT IN. X 10 FT.			
TOP LOCKING CAP			
BOTTOM CAP			
SAND-SACKS, GRADE NO.:			
WELL VAULT, SIZE: IN.			
BENTONITE PELLETS, PAILS:			
BENTONITE POWDER, SACKS:			
JACK HAMMER			
AIR COMPRESSOR, SIZE:			

EQUIPMENT	UNIT NO.	STARTING MILEAGE	ENDING MILEAGE	TOTAL MILES	RATE	CHARGE
RIG	979					
SUPPORT VEHICLE	1049					

RIG / TRUCK DOWN TIME, HOURS (EXPLAIN BELOW)

DAMAGED OR LOST EQUIPMENT:

White – Invoicing; Yellow – Client

Enviro-Drill, Inc.

E10 – 1994

Maxxam
A Bureau Veritas Group Company

6740 Campobello Road, Mississauga, Ontario L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266
CAM FCD-01191/2

CHAIN OF CUSTODY RECORD

67309 Page 1 of 1

Invoice Information
Company Name: OTIE
Contact Name: Cecil Irby / Accounts Payable
Address: 1033 N Mayfield St. Ste 200
Milwaukee, WI 53226
Phone: 414-257-4200 Fax:
Email: CIrby@otie.com

Report Information (if differs from invoice)
Company Name: OTIE
Contact Name: OSCAR MARTINEZ
Address: 9601 McAllister FWY #310
San Antonio, TX 78216
Phone: 210-490-4865 Fax: 210-490-4801
Email: OMartinez@otie.com

Project Information (where applicable)
Quotation #: B64666
P.O. #/ AFE#: 10995
Project #: 2015341-06-0604
Site Location: Kirtland AFB
Site #: FT014
Sampled By: RK, CR

Turnaround Time (TAT) Required
☒ Regular TAT (5-7 days) Most analyses
PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Rush TAT (Surcharges will be applied)
☐ 1 Day ☐ 2 Days ☐ 3-4 Days
Date Required:
Rush Confirmation #:

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153
☐ Table 1 ☐ Res/Park ☐ Med/ Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/ Other
☐ Table ______
FOR RSC (PLEASE CIRCLE) Y / [✓ N]

Other Regulations
☐ CCME ☐ Sanitary Sewer Bylaw
☐ MISA ☐ Storm Sewer Bylaw
☐ PWQO Region ______
☐ Other (Specify) ______
☐ REG 558 (MIN. 3 DAY TAT REQUIRED) CR

Include Criteria on Certificate of Analysis: [✓ Y] / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

LABORATORY USE ONLY
CUSTODY SEAL Y / N
Present | Intact
COOLER TEMPERATURES
COOLING MEDIA PRESENT: Y / N

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REFER TO BACK OF COC REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	PFOSALCM-S								HOLD- DO NOT ANALYZE	COMMENTS
1	FT014-SB01-1	2017/02/13	1230	Soil	1								X									
2	FT014-SB01-15-16	2017/02/13	1245	S	1								X									FedEx Tracking #
3	FT014-SB01-24-25	2017/02/13	1255	S	1								X									785599552671
4	FT014-SB02-1	2017/02/13	1325	S	1								X									Shipped on 2/13/17
5	FT014-SB02-15-16	2017/02/13	1335	S	1								X									
6	FT014-SB02-24-25	2017/02/13	1350	S	1								X									
7	FT014-SB03-1	2017/02/13	1438	S	1								X									
8	FT014-SB03-15-16	2017/02/13	1455	S	1								X									
9	FT014-SB03-1FD	2017/02/13	1438	S	1								X									
10	FT014-SB03-24-25	2017/02/13	1505	S	1								X									

CR CR CR

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #
Catalina	2017/02/13	1635	FedEx	2017/02/13	1720	

COC-1004 (10/14) - ENV. ENG.

White: Maxxam ~ Yellow: Client

Maxxam
A Bureau Veritas Group Company

6740 Campobello Road, Mississauga, Ontario L5N 2L8
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CAM FCD-01191/2

CHAIN OF CUSTODY RECORD 67314

Page 1 of 1

Invoice Information

Company Name: OTIE
Contact Name: Accounts Payable
Address: 1033 N Mayfield St Ste 200
Milwaukee, WI 53226
Phone: 414-257-4200 Fax:
Email:

Report Information (if differs from invoice)

Company Name: OTIE
Contact Name: Oscar Martinez
Address: 9601 McAllister Fwy Ste 310
San Antonio, TX 78216
Phone: 210-490-4865 Fax: 210-490-4801
Email: OMartinez@otie.com

Project Information (where applicable)

Quotation #: B64666
P.O. #/ AFE#: 10995
Project #: 2015341-06-0604
Site Location: Kirtland AFB
Site #: FT013
Sampled By: RK, CR

Turnaround Time (TAT) Required

☒ Regular TAT (5-7 days) Most analyses

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)
☐ 1 Day ☐ 2 Days ☐ 3-4 Days

Date Required:
Rush Confirmation #:

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153

☐ Table 1 ☐ Res/Park ☐ Med/ Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/ Other
☐ Table ____
FOR RSC (PLEASE CIRCLE) Y / [✓ N]

Other Regulations

☐ CCME ☐ Sanitary Sewer Bylaw
☐ MISA ☐ Storm Sewer Bylaw
☐ PWQO Region CR
☐ Other (Specify)
☐ REG 558 (MIN. 3 DAY TAT REQUIRED)

Include Criteria on Certificate of Analysis: Y / [✓ N]

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	

COOLING MEDIA PRESENT: Y / N

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REFER TO BACK OF COC REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	PFOSA) CM-5								HOLD- DO NOT ANALYZE	COMMENTS
1	FT013-SB01-0-1	2017/02/14	0845	SOIL	1								X									
2	FT013-SB01-15-16		0905		1								X									
3	FT013-SB01-15-16FD		0905		1								X									
4	FT013-SB01-24-25		0915		1								X									
5	FT013-SB02-0-1		0935		3				CR				X									MS/MSD
6	FT013-SB02-15-16		0955		1								X									
7	FT013-SB02-24-25		1005		1								X									
8	FT013-SB02-0-1		1055		1								X									
9	FT013-SB02-15-16		1115		1								X									
10	FT013-SB02-24-25	↓	1130	↓	1								X									

CR

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #
Catalinakg	2017/02/14	1600	FedEx	2017/02/14	1620	

Maxxam
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Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266
CAM FCD-01191/2

CHAIN OF CUSTODY RECORD 67312

Page 1 of 1

Invoice Information		Report Information (if differs from invoice)		Project Information (where applicable)	
Company Name:	OTIE	Company Name:	OTIE	Quotation #:	B64666
Contact Name:	Accounts Payable	Contact Name:	OSCAR MARTINEZ	P.O. #/ AFE#:	~~90~~ CR 10995
Address:	1033 N Mayfield St Ste200 Milwaukee, WI 53226	Address:	9601 McAllister Fwy #310 San Antonio, TX 78216	Project #:	2015341-06-0604
Phone:	414-257-4200 Fax:	Phone:	210-490-4865 Fax: 210-490-4801	Site Location:	Kirtland AFB
				Site #:	STSA
Email:		Email:	OMartinez@otie.com	Sampled By:	RK, CR

Turnaround Time (TAT) Required

☒ Regular TAT (5-7 days) Most analyses

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)
☐ 1 Day ☐ 2 Days ☐ 3-4 Days

Date Required:

Rush Confirmation #:

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153

☐ Table 1 ☐ Res/Park ☐ Med/ Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/ Other
☐ Table ______
FOR RSC (PLEASE CIRCLE) Y / [✓ N]

Other Regulations

☐ CCME ☐ Sanitary Sewer Bylaw
☐ MISA ☐ Storm Sewer Bylaw
☐ PWQO CR Region
☐ Other (Specify)
☐ REG 558 (MIN. 3 DAY TAT REQUIRED)

Include Criteria on Certificate of Analysis: Y / [✓ N]

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	

COOLING MEDIA PRESENT: Y / N

					Analysis Requested					REFER TO BACK OF COC												
	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	PFOSALCM-S				CR				HOLD- DO NOT ANALYZE	COMMENTS
1	STSA-SB01-0-1	2017/02/14	1250	SOIL	1								X									
2	STSA-SB01-15-16		1340	SOIL	3								X									MS/MSD
3	STSA-SB01-24-25		1355	SOIL	1								X									
4	STSA-SB02-0-1		1420	SOIL	1								X									
5	STSA-SB02-0-1FD		1420	SOIL	1				CR				X					CR				FD
6	STSA-SB02-15-16		1500	SOIL	1								X									
7	STSA-SB02-24-25		1510	SOIL	1								X									
8																						
9	CR																					
10																						

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #
Catalina Rey	2017/02/14	1520	Fed Ex	2017/02/14	1620	

COC-1004 (10/14) - ENV. ENG.

White: Maxxam ~ Yellow: Client

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Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266
CAM FCD-01191/2

CHAIN OF CUSTODY RECORD 67313

Page 1 of 1

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)
Company Name: OTIE	Company Name: OTIE	Quotation #: B64666
Contact Name: Accounts Payable	Contact Name: OSCAR MARTINEZ	P.O. #/ AFE#: 10995
Address: 1033 N Mayfield St. Ste 200 Milwaukee, WI 53226	Address: 9601 McAllister Fwy Ste 310 San Antonio, TX 78216	Project #: 2015341-06-0604
		Site Location: STSA-SB03
Phone: 414-257-4200 Fax:	Phone: 210-490-4865 Fax: 210-490-4801	Site #: KIRTLAND AFB
Email: CIrby@otie.com	Email: OMartinez@otie.com	Sampled By: CR, RK

Turnaround Time (TAT) Required

☒ Regular TAT (5-7 days) Most analyses

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

☐ 1 Day ☐ 2 Days ☐ 3-4 Days

Date Required:

Rush Confirmation #:

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153

☐ Table 1 ☐ Res/Park ☐ Med/ Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/ Other
☐ Table ____

FOR RSC (PLEASE CIRCLE) Y / [✓ N]

Other Regulations

☐ CCME ☐ Sanitary Sewer Bylaw
☐ MISA ☐ Storm Sewer Bylaw
☐ PWQO Region ____
☐ Other (Specify) ____
☐ REG 558 (MIN. 3 DAY TAT REQUIRED)

CR

Include Criteria on Certificate of Analysis: Y / [✓ N]

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested (REFER TO BACK OF COC)

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	PFOSA LCMS-S								HOLD- DO NOT ANALYZE
1	STSA-SB03-0-1	2017/02/15	0830	SOIL	1								X								
2	STSA-SB03-15-16	2017/02/15	0920	SOIL	1								X								
3	STSA-SB03-24-25	2017/02/15	0935	SOIL	1								X								
4																					
5									CR												
6																CR					
7	CR																				
8																					
9																					
10																					

CR

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	

COOLING MEDIA PRESENT: Y / N

COMMENTS

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #
CatalinaRg	2017/02/15	1000	FedEx	2017/02/15	1730	

COC-1004 (10/14) - ENV. ENG.

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CHAIN OF CUSTODY RECORD

67315 Page 1 of 1

Invoice Information		Report Information (if differs from invoice)		Project Information (where applicable)	
Company Name:	OTIE	Company Name:	OTIE	Quotation #:	B64666
Contact Name:	Accounts Payable	Contact Name:	OSCAR MARTINEZ	P.O. #/ AFE#:	10995
Address:	1033 N Mayfield Rd Ste 200 Milwaukee, WI. 53226	Address:	9601 McAllister Fwy Ste 31 San Antonio, TX 78216	Project #:	2015341-06-0604
				Site Location:	~~AFA~~ CR KIRTLAND
Phone:	414-257-4200 Fax:	Phone:	210-490-4865 Fax: 210	Site #:	AFA
Email:	CTiby@otie.com	Email:	OMartinez@otie.com	Sampled By:	CR, RK

Turnaround Time (TAT) Required

☒ Regular TAT (5-7 days) Most analyses

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

☐ 1 Day ☐ 2 Days ☐ 3-4 Days

Date Required:

Rush Confirmation #:

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153

☐ Table 1 ☐ Res/Park ☐ Med/ Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/ Other
☐ Table ______

FOR RSC (PLEASE CIRCLE) Y / [✓ N]

Other Regulations

☐ CCME ☐ Sanitary Sewer Bylaw
☐ MISA ☐ Storm Sewer Bylaw
☐ PWQO Region CR
☐ Other (Specify)
☐ REG 558 (MIN. 3 DAY TAT REQUIRED)

Include Criteria on Certificate of Analysis: Y / [✓ N]

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested CR

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REFER TO BACK OF COC: REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	PFOSALCMS								HOLD- DO NOT ANALYZE
1	AFA-SB03-0-1	2017/02/15	1425	SOIL	1								X								
2	AFA-SB03-0-1FD	2017/02/15	1425	SOIL	1								X								
3	AFA-SB03-15-16	2017/02/15	1447	SOIL	1								X								
4	AFA-SB03-24-25	2017/02/15	1455	SOIL	1								X								
5	AFA-SB01-0-1	2017/02/15	1515	SOIL	1					CR			X			CR					
6	AFA-SB01-15-16	2017/02/15	1530	SOIL	1								X								
7	AFA-SB01-24-25	2017/02/15	1545	SOIL	1								X								
8	AFA-SB02-0-1	2017/02/15	1612	SOIL	1								X								
9	AFA-SB02-15-16	2017/02/15	1628	SOIL	1								X								
10	AFA-SB02-24-25	2017/02/15	1640	SOIL	1								X								

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	

COOLING MEDIA PRESENT: Y / N

COMMENTS

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #
Catalina R	2017/02/15	1700	Fed Ex	2017/02/	1730	

COC-1004 (10/14) - ENV. ENG.

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CAM FCD-01191/2

CHAIN OF CUSTODY RECORD 67310

Page 1 of 1

Invoice Information

Company Name: OTIE
Contact Name: Cecil Irby / Accts Payable
Address: 1033 N Mayfield St Ste 200
Milwaukee, WI 53226
Phone: 414-257-4200 Fax:
Email: cirby@otie.com

Report Information (if differs from invoice)

Company Name: OTIE
Contact Name: OSCAR MARTINEZ
Address: 9601 McAllister Fwy #310
SAN ANTONIO, TX 78216
Phone: 210 490 4865 Fax:
Email: omartinez@otie.com

Project Information (where applicable)

Quotation #: B64666
P.O. #/ AFE#: 10995
Project #: 2015341-06-0604
Site Location: KIRTLAND AFB
Site #:
Sampled By: ~~RK, CR~~ AG

Turnaround Time (TAT) Required

☒ Regular TAT (5-7 days) Most analyses

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

☐ 1 Day ☐ 2 Days ☐ 3-4 Days

Date Required:
Rush Confirmation #:

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153

☐ Table 1 ☐ Res/Park ☐ Med/ Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/ Other
☐ Table ____
FOR RSC (PLEASE CIRCLE) Y / N

Other Regulations

☐ CCME ☐ Sanitary Sewer Bylaw
☐ MISA ☐ Storm Sewer Bylaw
☐ PWQO Region ____
☐ Other (Specify) ____
☐ REG 558 (MIN. 3 DAY TAT REQUIRED)

Include Criteria on Certificate of Analysis: Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested (REFER TO BACK OF COC)

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	PFOS A LCm-S								HOLD- DO NOT ANALYZE
1	KAFB0622	2017/02/13	1445	~~Soil~~ GW	1								X				AG				
2	KAFB0622MS	"	1445	GW	1								X								
3	KAFB 0622 MSD	"	1445	GW	1								X								
4	KAFB-7001	2017/2/15	1411	W	1				AG				X								
5	KAFB-7001 FD	"	"	W	1								X								
6	KAFB-106027	"	1812	W	1								X								
7	KAFB-0417	2/16/17	0926	W	1								X								
8																					
9	AG																				
10																					

LABORATORY USE ONLY

CUSTODY SEAL Y / N

Present	Intact	COOLER TEMPERATURES

COOLING MEDIA PRESENT: Y / N

COMMENTS

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #
Alexa George	2017/02/16	1734	Fed Ex	2017/02/16	1800	

COC-1004 (10/14) - ENV. ENG.

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CAM FCD-01191/2

CHAIN OF CUSTODY RECORD 67316

Page 1 of 1

Invoice Information

Company Name: OTIE
Contact Name: Accts Payable
Address: 1033 N Mayfield St Ste 200
Milwaukee, WI 53226
Phone: 414 257 4200 Fax:
Email:

Report Information (if differs from invoice)

Company Name: OTIE
Contact Name: Oscar Martinez
Address: 9601 McAllister Fwy #310
San Antonio, TX 78216
Phone: 2104904865 Fax:
Email: Omartinez@otie.com

Project Information (where applicable)

Quotation #: B64666
P.O. #/ AFE#: 10995
Project #: 2015341-06-0604
Site Location: Kirtland AFB
Site #:
Sampled By: AG

Turnaround Time (TAT) Required

☒ Regular TAT (5-7 days) Most analyses

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

☐ 1 Day ☐ 2 Days ☐ 3-4 Days

Date Required:

Rush Confirmation #:

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153

☐ Table 1 ☐ Res/Park ☐ Med/ Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/ Other
☐ Table ____

FOR RSC (PLEASE CIRCLE) Y / N

Other Regulations

☐ CCME ☐ Sanitary Sewer Bylaw
☐ MISA ☐ Storm Sewer Bylaw
☐ PWQO Region ____
☐ Other (Specify) ____
☐ REG 558 (MIN. 3 DAY TAT REQUIRED)

Include Criteria on Certificate of Analysis: Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REFER TO BACK OF COC REG 153 METALS & INORGANICS	REFER TO BACK OF COC REG 153 ICPMS METALS	REFER TO BACK OF COC REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	PFOSAlcm-S								HOLD- DO NOT ANALYZE	COMMENTS
1	KAFB-7001-1	2017/02/15	1243	W	1								X									hold for analysis
2	KAFB-106027-1	11	1536	W	1					VR			X				VR					hold for analysis
3																						
4																						
5																						
6	VR																					
7																						
8																						
9																						
10																						

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	

COOLING MEDIA PRESENT: Y / N

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
Allaie Gudiege	2/16/17	1734	Fed Ex	2017/02/16	1800

MAXXAM JOB #

White: Maxxam ~ Yellow: Client

COC-1004 (10/14) - ENV. ENG.

Maxxam
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Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266
CAM FCD-01191/2

CHAIN OF CUSTODY RECORD 67317

Page 1 of 1

Invoice Information

Company Name: OTIE
Contact Name: Account Payable
Address: 1033 N Mayfield St. Ste 200
Milwaukee, WI 53226
Phone: 414-257-4200 Fax:
Email:

Report Information (if differs from invoice)

Company Name: OTIE
Contact Name: Oscar Martinez
Address: 9601 McAllister Fwy #310
San Antonio, TX 78216
Phone: 210-490-4865 Fax:
Email: oMartinez@otie.com

Project Information (where applicable)

Quotation #: B64666
P.O. #/ AFE#: 10995
Project #: 2015341-06-0604
Site Location: Kirtland AFB
Site #: AFA
Sampled By: CR

Turnaround Time (TAT) Required

☒ **Regular TAT (5-7 days)** Most analyses

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

☐ 1 Day ☐ 2 Days ☐ 3-4 Days

Date Required:

Rush Confirmation #:

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153

☐ Table 1 ☐ Res/Park ☐ Med/ Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/ Other
☐ Table ____

FOR RSC (PLEASE CIRCLE) Y / [✓ N]

Other Regulations

☐ CCME ☐ Sanitary Sewer Bylaw
☐ MISA ☐ Storm Sewer Bylaw
☐ PWQO Region CR
☐ Other (Specify)
☐ REG 558 (MIN. 3 DAY TAT REQUIRED)

Include Criteria on Certificate of Analysis: Y / [✓ N]

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

REFER TO BACK OF COC

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	PFOSALCMS-								HOLD- DO NOT ANALYZE
1	FB1150217	2017/02/15	1440	W	1								X								
2	EB1150217	11	1447	W	1								X								
3	EB2150217	11	1645	W	1								X				CR				
4	EB3150217	11	1125	W	1								X								
5									CR												
6																					
7																					
8	CR																				
9																					
10																					

LABORATORY USE ONLY

CUSTODY SEAL Y / N

Present	Intact	COOLER TEMPERATURES

COOLING MEDIA PRESENT: Y / N

COMMENTS

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #
Catalina Rg	2017/02/16	1730	FedEx	2017/02/16	1800	

COC-1004 (10/14) - ENV. ENG.

White: Maxxam ~ Yellow: Client

Environmental Analysis Request/Chain of Custody

382326

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For Eurofins Lancaster Laboratories Environmental use only
Acct. # ________ Group # ________ Sample # ________
Instructions on reverse side correspond with circled numbers.

① Client Information

Client: OTIE	Acct. #: 37016
Project Name/#: 2015341-06-0604	PWSID #:
Project Manager: Cecil Irby	P.O. #: 10976
Sampler: RK, CR	Quote #:

Name of state where samples were collected: Kirtland, New Mexico

④ Matrix

Sediment ☐ Soil ☒
Water: Potable ☐ Ground ☐ NPDES ☐ Surface ☐
Other:

⑤ Analysis Requested

Preservation Codes

② Sample Identification	Collected Date	Collected Time	③ Grab	Composite	Soil	Water	Other	Total # of Containers	Moisture, pH, TOC, solids / sludge	Grain size to 1 µm									⑥ Remarks
FT014-SB04-0-1	02/13/17	1438		X	2			2	X	X									
FT014-SB04-15-16	02/13/17	1455		X	2			2	X	X									
FT014-SB04-24-25	02/13/17	1505		X	2			2	X	X									
FT013-SB04-0-1	02/14/17	1055		X	2			2	X	X									
FT013-SB04-15-16	02/14/17	1115		X	2			2	X	X									
FT013-SB04-24-25	02/14/17	1130		X	2			2	X	X									

CR CR CR CR

For Lab Use Only
FSC: ________
SCR#: ________

Preservation Codes
H=HCl T=Thiosulfate
N=HNO_3 B=NaOH
S=H_2SO_4 O=Other

⑦ Turnaround Time (TAT) Requested (please circle)

[✓ Standard] Rush

(Rush TAT is subject to laboratory approval and surcharge.)

Date results are needed: 14 days

E-mail address: OMartinez@otie.com

⑧ Data Package Options (circle if required) Level IV

Type I (EPA Level 3 Equivalent/non-CLP) Type VI (Raw Data Only)

Type III (Reduced non-CLP) TX TRRP-13

NYSDEC Category A or B MA MCP CT RCP

⑨

Relinquished by	Date	Time	Received by	Date	Time
Catalina Rg	2/16/17	1715	FedEx	02/16/17	1800

EDD Required? [✓ Yes] No
If yes, format: ERPIMS

Site-Specific QC (MS/MSD/Dup)? Yes [✓ No]
(If yes, indicate QC sample and submit triplicate sample volume.)

Relinquished by Commercial Carrier:
UPS ____ FedEx X Other ____

Temperature upon receipt ________ °C

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The white copy should accompany samples to Eurofins Lancaster Laboratories Environmental. The yellow copy should be retained by the client.

7044 0315

Environmental Analysis Request/Chain of Custody

382327

eurofins

Lancaster Laboratories Environmental

For Eurofins Lancaster Laboratories Environmental use only
Acct. # ______ Group # ______ Sample # ______
Instructions on reverse side correspond with circled numbers.

① Client Information

Client: OTIE
Acct. #: 37016
Project Name/#: 2015341-06-0604
PWSID #:
Project Manager: Cecil Irby
P.O. #: 10976
Sampler: RK, CR
Quote #:
Name of state where samples were collected: Kirtland, New Mexico

④ **Matrix**: Sediment ☐ Soil ☒ Water: Potable ☐ Ground ☐ NPDES ☐ Surface ☐ Other:

⑤ **Analysis Requested** / Preservation Codes

For Lab Use Only
FSC:
SCR#:

Preservation Codes
H=HCl T=Thiosulfate
N=HNO_3 B=NaOH
S=H_2SO_4 O=Other

⑥ **Remarks**

② Sample Identification

Sample Identification	Collected Date	Collected Time	③ Grab	Composite	Soil	Sediment	Water	Other	Total # of Containers	Moisture, pH, TOC, solids/sludge	Grain size to 1 µm
STSA-SB04-0-1	02/15/17	0830		X	X				2	X	X
STSA-SB04-15-16	11	0920		X	X				2	X	X
STSA-SB04-24-25	11	0935		X	X				2	X	X
AFA-SB04-0-1	11	1612		X	X				2	X	X
AFA-SB04-15-16	11	1628		X	X				2	X	X
AFA-SB04-24-25	11	1640		X	X				2	X	X

CR

⑦ Turnaround Time (TAT) Requested (please circle)

[✓ Standard] Rush

(Rush TAT is subject to laboratory approval and surcharge.)

Date results are needed: 14 days

E-mail address: OMartinez@otie.com

⑧ Data Package Options (circle if required) [✓ Level IV]

Type I (EPA Level 3 Equivalent/non-CLP)
Type VI (Raw Data Only)
Type III (Reduced non-CLP)
TX TRRP-13
NYSDEC Category A or B
MA MCP
CT RCP

⑨

Relinquished by	Date	Time	Received by	Date	Time
Catalina Rg	02/16/17	1715	FedEx	02/16/17 ~~1800~~	1800

EDD Required? [✓ Yes] No
If yes, format: ERPIMS

Relinquished by Commercial Carrier:
UPS ______ FedEx X Other ______

Site-Specific QC (MS/MSD/Dup)? Yes [✓ No]
(If yes, indicate QC sample and submit triplicate sample volume.)

Temperature upon receipt ______ °C

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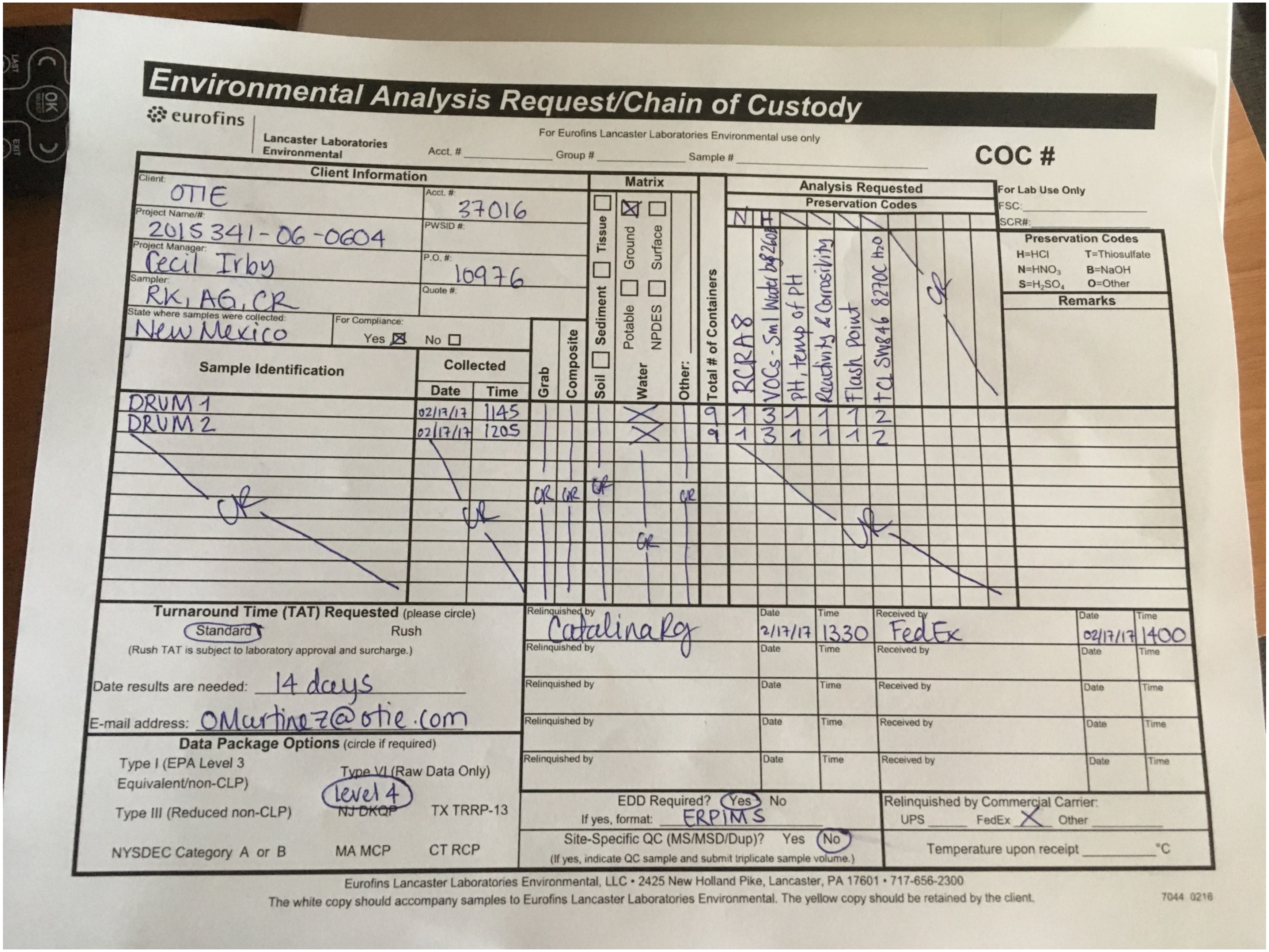
The white copy should accompany samples to Eurofins Lancaster Laboratories Environmental. The yellow copy should be retained by the client.

7044 0315



Environmental Analysis Request/Chain of Custody

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For Eurofins Lancaster Laboratories Environmental use only
Acct. # ______ Group # ______ Sample # ______

COC #

Client Information

Client: OTIE
Acct. #: 37016
Project Name/#: 2015341-06-0604
PWSID #:
Project Manager: Cecil Irby
P.O. #: 10976
Sampler: RK, AG, CR
Quote #:
State where samples were collected: New Mexico
For Compliance: Yes ☒ No ☐

Matrix: Tissue ☐ Sediment ☐ Soil ☐ | Water: Ground ☒ Surface ☐ Potable ☐ NPDES ☐ | Other:

For Lab Use Only
FSC: ______
SCR#: ______

Preservation Codes
H=HCl T=Thiosulfate
N=HNO_3 B=NaOH
S=H_2SO_4 O=Other

Sample Identification	Collected Date	Collected Time	Grab	Composite	Soil	Water	Other	Total # of Containers	RCRA 8 (N)	VOCs - 5ml Water by 8260B (H)	pH, temp of pH	Reactivity & Corrosivity	Flash Point	+CL SW846 8270C H2O				Remarks
DRUM 1	02/17/17	1145				X		9	1	3	1	1	1	2				
DRUM 2	02/17/17	1205				X		9	1	3	1	1	1	2				

Turnaround Time (TAT) Requested (please circle)
[✓ Standard] Rush
(Rush TAT is subject to laboratory approval and surcharge.)

Date results are needed: 14 days

E-mail address: OMartinez@otie.com

Data Package Options (circle if required)
Type I (EPA Level 3 Equivalent/non-CLP)
Type VI (Raw Data Only)
Type III (Reduced non-CLP)
[✓ Level 4] ~~NJ DKQP~~
TX TRRP-13
NYSDEC Category A or B
MA MCP
CT RCP

Relinquished by	Date	Time	Received by	Date	Time
Catalina Rg	2/17/17	1330	FedEx	02/17/17	1400

EDD Required? [✓ Yes] No
If yes, format: ERPIMS
Site-Specific QC (MS/MSD/Dup)? Yes [✓ No]
(If yes, indicate QC sample and submit triplicate sample volume.)

Relinquished by Commercial Carrier:
UPS ______ FedEx X Other ______

Temperature upon receipt ______ °C

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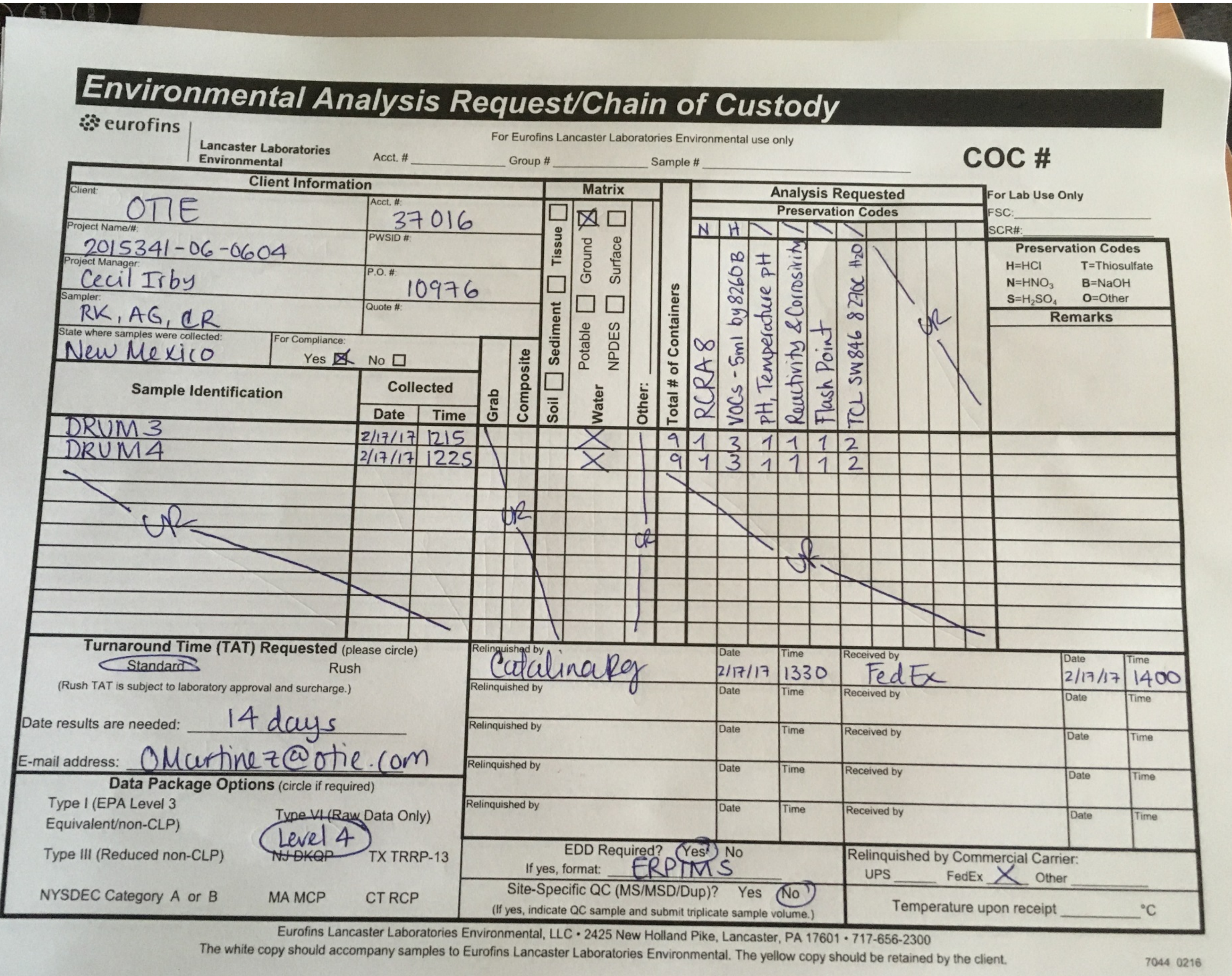
The white copy should accompany samples to Eurofins Lancaster Laboratories Environmental. The yellow copy should be retained by the client.

7044 0216



Environmental Analysis Request/Chain of Custody

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For Eurofins Lancaster Laboratories Environmental use only
Acct. # ________ Group # ________ Sample # ________

COC #

Client Information

Client: OTIE
Acct. #: 37016
Project Name/#: 2015341-06-0604
PWSID #:
Project Manager: Cecil Irby
P.O. #: 10976
Sampler: RK, AG, CR
Quote #:
State where samples were collected: New Mexico
For Compliance: Yes ☒ No ☐

Matrix

Tissue ☐ Sediment ☐ Soil ☐
☒ Ground ☐ Potable — Water
☐ Surface ☐ NPDES
Other:

Analysis Requested

									Preservation Codes: N	H				
Sample Identification	**Collected Date**	**Collected Time**	**Grab**	**Composite**	**Soil**	**Water**	**Other**	**Total # of Containers**	RCRA 8	VOCs - 5ml by 8260B	pH, Temperature pH	Reactivity & Corrosivity	Flash Point	TCL SW846 8270C H2O
DRUM 3	2/17/17	1215				X		9	1	3	1	1	1	2
DRUM 4	2/17/17	1225				X		9	1	3	1	1	1	2

CR CR CR CR CR

For Lab Use Only
FSC: ________
SCR#: ________

Preservation Codes
H=HCl T=Thiosulfate
N=HNO$_3$ B=NaOH
S=H$_2$SO$_4$ O=Other

Remarks

Turnaround Time (TAT) Requested (please circle)
[✓ Standard] Rush
(Rush TAT is subject to laboratory approval and surcharge.)

Date results are needed: 14 days
E-mail address: OMartinez@otie.com

Data Package Options (circle if required)
Type I (EPA Level 3 Equivalent/non-CLP)
Type VI (Raw Data Only)
Type III (Reduced non-CLP)
[✓ Level 4]
NJ DKQP
TX TRRP-13
NYSDEC Category A or B
MA MCP
CT RCP

Relinquished by	Date	Time	Received by	Date	Time
CatalinaRey	2/17/17	1330	FedEx	2/17/17	1400

EDD Required? [✓ Yes] No
If yes, format: ERPIMS
Site-Specific QC (MS/MSD/Dup)? Yes [✓ No]
(If yes, indicate QC sample and submit triplicate sample volume.)

Relinquished by Commercial Carrier:
UPS ____ FedEx X Other ____
Temperature upon receipt ________ °C

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7044 0216

Time
11215- 1422

Page 1 of 1

OTIE
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Groundwater Well Development/Purge/Sample Log

Project Name: Kirtland Project No. 2015341-0 Sampler(s): AG

SITE ID: AFFF Spray Area **LOCATION ID:** KAFB-7001 (well number) Target Purge Volume: 71.5 gallons gal

Purging Method/Equipment: bennett pump Sampling Equipment/ID No:

Well Casing Diameter (a) in: 4" Unit Casing Volume (b):

Diameter:	0.75"	1.5"	2"	[✓ 4"]
Volume:	0.03 gal/ft	0.10 gal/ft	0.16 gal/ft	0.65 gal/ft

Sounding (Depth to Well Bottom from TOC) (c): constructed depth (not measured) 480.00 **Static Water Level** (Depth to Water from TOC) (d): 448.55

Length of Static Water Column in Casing (e) = (c) - (d) = 480.00 - 448.55 = 31.45

Casing Water Volume (f) = (b) x (e) = 0.65 x 31.45 = 20.44 Casing Volumes = three x (f) 20.44 = 61.33

Sample Type Native/DS/ MS/MSD	**Sample ID**	**Sample Date**	**Sample Time**	**Sample Analysis**
native pre purge	KAFB-7001-1	2/15/17	1243	PFOSALCM-S
native	KAFB-7001	2/15/17	1411	"
dup	KAFB-7001 FD	2/15/17	1411	"

Well Inspection Checklist:

	Good	Bad	None	N/A
Well Identification	☒	☐	☐	☐
Vault Cover	☒	☐	☐	☐
Vault Seal	☒	☐	☐	☐
Bolts	☒	☐	☐	☐
Vault Lock	☐	☐	☐	☒
Concrete Completion	☒	☐	☐	☐
Well Lock/Seal	☐	☐	☐	☒

Notes:

Date	Time 24hr	Recovery Time (min)	Purge Rate (gal/min)	Dynamic H_2O Level (ft)	Volume Purged (gl)	Temp (C°)	pH +/- 0.1	Specific Conductivity ms/ ~~(µs/cm)~~ cm +/- 3%	Dissolved oxygen (mg/L) +/- 0.1	ORP (mV) +/- 10	Turbidity (NTU) +/- 10%	Water Description / Comments
2/15/17	1402		1gal/min		61.5	14.61	6.61	0.936	5.76	210	21.8	clear
"	1406		"		66	15.15	6.77	0.929	5.94	199	18.0	
"	1410		"		70	15.76	6.85	0.908	6.79	213	18.2	
		Sample @	1411		-	71.5 gallons		pumped from well				

pumping 3 well volumes

Time

Page 1 of 1

OTIE
Oneida Total Integrated Enterprises

Groundwater Well Development/Purge/Sample Log

1518 – 1817

Project Name: Kirtland AFB Project No. 2015341-06 Sampler(s): AG

SITE ID: S Taxiway Spill Area **LOCATION ID:** KAFB-106027 (well number) Target Purge Volume: 75 gallons gal

Purging Method/Equipment: bennett pump Sampling Equipment/ID No:

Well Casing Diameter (a) in: 4" Unit Casing Volume (b):

Diameter:	0.75"	1.5"	2"	[✓ 4"]
Volume:	0.03 gal/ft	0.10 gal/ft	0.16 gal/ft	0.65 gal/ft

Sounding (Depth to Well Bottom from TOC) (c): not measured / installed depth 516.00 **Static Water Level** (Depth to Water from TOC) (d): 478.00

Length of Static Water Column in Casing (e) = (c) - (d) = 516 - 478 = 38.00

Casing Water Volume (f) = (b) x (e) = 0.65 x 38 = 24.7 Casing Volumes = three x (f) 24.7 = 74.1

Sample Type Native/DS/ MS/MSD	**Sample ID**	**Sample Date**	**Sample Time**	**Sample Analysis**
pre-purge	KAFB-106027-1	2/15/17	1536	PFOSALCM-S
native	KAFB-106027	11	1812	

Well Inspection Checklist:

	Good	Bad	None	N/A
Well Identification	☒	☐	☐	☐
Vault Cover	☒	☐	☐	☐
Vault Seal	☐	☐	☐	☒
Bolts	☐	☐	☐	☒
Vault Lock	☒	☐	☐	☐
Concrete Completion	☒	☐	☐	☐
Well Lock/Seal	☒	☐	☐	☐

Notes:

Date	Time 24hr	Recovery Time (min)	Purge Rate (gal/min)	Dynamic H_2O Level (ft)	Volume Purged (gl)	Temp (C°)	pH +/- 0.1	Specific Conductivity (μs/cm) +/- 3%	Dissolved oxygen (mg/L) +/- 0.1	ORP (mV) +/- 10	Turbidity (NTU) +/- 10%	Water Description / Comments
2/15/17	1804	—	1/2 gal/m	—	71	16.13	7.21	0.328	5.86	120	0.4	
	1809	—	11	—	72.5	15.76	7.31	0.323	5.59	133	0.0	
	1810	—	11	—	74.0	14.32	7.41	0.323	6.81	150	0.0	
	Sample @ 1812 – 75 gallons purged											

Page 1 of

OTIE
Oneida Total Integrated Enterprises

Groundwater Well Development/Purge/Sample Log

Project Name: Kirtland AFB
Project No. 2015 341-06 0604
Sampler(s): AG

SITE ID: FT-013
LOCATION ID: KAFB-0417 (well number)
Target Purge Volume: ____ gal

Purging Method/Equipment: Bennett Pump
Sampling Equipment/ID No: Bennett Pump

Well Casing Diameter (a) in: 4"
Unit Casing Volume (b):

Diameter:	0.75"	1.5"	2"	[✓ 4"]
Volume:	0.03 gal/ft	0.10 gal/ft	0.16 gal/ft	0.65 gal/ft

Sounding (Depth to Well Bottom from TOC) (c): 467.00
Static Water Level (Depth to Water from TOC) (d): 447.94

Length of Static Water Column in Casing (e) = (c) - (d) = 467 - 447.94 = 19.06

Casing Water Volume (f) = (b) x (e) = 19.06 x 0.65 = 12.39
Casing Volumes = three x (f) 12.39 = 37.17

Sample Type Native/DS/ MS/MSD	Sample ID	Sample Date	Sample Time	Sample Analysis
~~native~~	~~KAFB-0417~~	~~2/15/17~~		PFOSALCM-S
~~FD~~	~~KAFB-0417 FD~~	~~2/15/17~~		"
EB	EB1 150217	2/15/17	1725	"
native	KAFB 0417	2/16/17	0926	PFOSALCM-S

Well Inspection Checklist:

	Good	Bad	None	N/A
Well Identification	☒	☐	☐	☐
Vault Cover	☒	☐	☐	☐
Vault Seal	☐	☐	☐	☒
Bolts	☐	☐	☐	☒
Vault Lock	☒	☐	☐	☐
Concrete Completion	☒	☐	☐	☐
Well Lock/Seal	☐	☐	☐	☒

Notes:

Date	Time 24hr	Recovery Time (min)	Purge Rate (gal/min)	Dynamic H_2O Level (ft)	Volume Purged (gl)	Temp (C°)	pH +/- 0.1	Specific Conductivity (µs/cm) +/- 3%	Dissolved oxygen (mg/L) +/- 0.1	ORP (mV) +/- 10	Turbidity (NTU) +/- 10%	Water Description / Comments
2/16/17	0929	—	—	—	2 Liters	16.69	7.24	0.307	10.46	188	12.4	
"	0932	—	—	—	—	17.29	7.23	0.311	6.95	186	11.8	
												well sampled with
												hydra sleeve

→

2/15/17

Only able to get pump down to approx 440ft when it stops. Unable to reach water @ 447ft.

OTIE
Oneida Total Integrated Enterprises

Groundwater Well Development/Purge/Sample Log

Page ___ of ___
[illegible] 1315 - 1545

Project Name: Kirtland AFB Project No. 2015341-06-0604 Sampler(s): AG

SITE ID: FT-014 **LOCATION ID:** KAFB0622 (well number) Target Purge Volume: 5 gallons gal

Purging Method/Equipment: ________ Sampling Equipment/ID No: [illegible] 555 ft

Well Casing Diameter (a) in: 4" Unit Casing Volume (b):

Diameter:	0.75"	1.5"	2"	4"
Volume:	0.03 gal/ft	0.10 gal/ft	0.16 gal/ft	0.65 gal/ft

Sounding (Depth to Well Bottom from TOC) (c): 555 **Static Water Level** (Depth to Water from TOC) (d): 538.25

Length of Static Water Column in Casing (e) = (c) - (d) = ____ - ____ = 16.75

Casing Water Volume (f) = (b) x (e) = 0.65 x 16.75 = 10.89 Casing Volumes = three x (f) 32.67 = ____

Sample Type Native/DS/ MS/MSD	Sample ID	Sample Date	Sample Time	Sample Analysis
nat	KAFB 0622	2/13/17	1445	PFOSALCM-S
ms	KAFB 0622 ms	2/13/17	1445	
msD	KAFB 0622 msD	2/13/17	1445	

Well Inspection Checklist:

	Good	Bad	None	N/A
Well Identification	☑	☐	☐	☐
Vault Cover	☑	☐	☐	☐
Vault Seal	☐	☐	☐	☑
Bolts	☐	☐	☐	☑
Vault Lock	☑	☐	☐	☐
Concrete Completion	☑	☐	☐	☐
Well Lock/Seal	☒	☐	☐	☑
Notes:				

Date	Time 24hr	Recovery Time (min)	Purge Rate (gal/min)	Dynamic H_2O Level (ft)	Volume Purged (gl)	Temp (C°)	pH +/- 0.1	Specific Conductivity (µs/cm) +/- 3%	Dissolved oxygen (mg/L) +/- 0.1	ORP (mV) +/- 10	Turbidity (NTU) +/- 10%	Water Description / Comments
2/13		1409				9.59	6.57	0.512	8.62	166	30.2	
		1414				10.34	6.33	0.480	7.58	113	17.3	
		1419				10.97	6.35	0.484	8.63	126	26.0	
		1424				8.94	5.68	0.488	9.70	157	24.4	
		1429				10.56	6.45	0.489	6.46	136	24.4	
		1434				11.26	6.60	0.489	6.92	134	38.0	
		1437				11.22	6.65	0.489	6.48	132	71.2	
		1440			5 gallons	9.98	6.67	0.493	6.51	137	84.2	

Sample @ 1445

Appendix B

OTIE SOPs

Field Parameter Measurements in Water

TABLE OF CONTENTS

Page

QC Review Signatures		
Name/Role	Signature	Date
John Fleissner, PE Corporate QC Manager	John Fleissner	09/22/12
Nova Clite, PG Sr. Hydrogeologist	Nova Clite	9/24/12
Cecil Irby PG Sr. Geologist/PM-PFC Specific	Cecil	2/22/16

Given the low detection limits associated with PFC analysis and the many potential sources of trace levels of PFCs, field personnel are advised to act on the side of caution by strictly following these protocols, frequently replacing nitrile gloves, and rinsing field equipment to help mitigate the potential for false detections of PFCs. **Do not use Teflon®-containing materials** (e.g., Teflon® tubing, bailers, tape, plumbing paste, or other Teflon® materials) since Teflon® contains fluorinated compounds. Specific items related to field parameter measurements in water are discussed below.

1.0 INTRODUCTION

This Standard Operating Practice (SOP) presents general information on collection of the field parameters associated with aqueous solutions. Accurate measurement of these parameters is critical for the prediction and interpretation of the reactions and migration of dissolved species.

Field measurement practices covered under the SOP include:

- Measurement of multiple parameters during pre-sample purging of groundwater monitoring wells
- Measurement of groundwater parameters in situ (in the well) by downhole deployment of measuring devices
- Measurement of surface water quality parameters
- Measurement of individual parameters (using single purpose meter)
- Measurement of ferrous iron in water samples using field test kits

This SOP may also apply to the testing of wastewater; however the general intent of this SOP is for environmental monitoring sampling of natural waters and is not intended for waste characterization or unknown waste categorization.

The set up and use of any field meters should follow manufacturer's recommended procedures to assure a consistency of use. In addition, all meters should be properly maintained, calibrated, operated, and stored in accordance with the manufacturer's specifications. All field measurement equipment should be properly calibrated prior to use in the field in accordance with the manufacturer instructions.

2.0 FIELD MEASUREMENT USING MULTI-PARAMETER PROBE

2.1. *DESCRIPTION*

Field measurement of several water quality parameters at once is performed using a multi-parameter probe. Different manufactures offer different configurations of meter types; typical meters for groundwater and surface water applications include:

- Temperature,
- Specific conductivity or conductance,
- Oxidation-reduction potential (ORP),
- pH, and

- Dissolved oxygen (DO).

Some multi-parameter probes may include a turbidity meter, but a separate meter for measurement of turbidity is recommended.

The parameters required to be measured should be identified in the project-specific Sampling and Analysis Plan (SAP).

Typical uses of a multi-parameter water probe include:

- Measuring water quality parameters downhole in a well,
- Monitoring of purged groundwater parameters in a flow-through cell that is attached to the outflow tubing of a pump, and
- Directly in a surface water body.

2.2. *PROCEDURE*

The following are general procedures that should be implemented before deploying the multi-parameter water probes:

1. Inspect the exterior of equipment (probe and data logger) for damage (e.g., tears or cuts in cable, cracked probe housing, etc.). If there are cuts in the cable, calibration should indicate whether or not the cut cable affects connections from the probe to the data logger. If damage affects the operation of the probe and/or data logger, the equipment will be replaced with functional equipment and damaged equipment will be returned for repair.
2. Prior to use, the probe should be calibrated for all of the parameters that will be measured in the field (with the exception of temperature, although instrument performance should be checked in ice water).

   Calibration for the instrument shall follow the instructions outlined in the manufacturer instructions which will be stored in the field vehicle, equipment room, or mobile laboratory for reference.

   To check temperature probe performance, place the probe in ice water and check the reading once it has stabilized. Ice water should measure 0°Celsius (32° Fahrenheit).
3. Upon completing calibration, the probe and data logger are ready for use. Special care should be taken in deploying the probe in the various configurations. A discussion on using each configuration follows.

2.3. *DEPLOYING THE MULTIPARAMETER PROBE DOWNHOLE IN A MONITORING WELL*

Check groundwater analytical data for each well you plan to use instrument. Highly contaminated groundwater and free-phase liquids could degrade instrument performance or damage it. Communicate any relevant field observations (strong odors, presence of product) with your Field Team Leader (FTL) or Project Manager. Check available well construction logs or field sampling plan for specific well information before deploying instrument. Measure water levels and total well depths sufficient time before deployment of the probe to allow any disturbed well bottom sediments to resettle (at least one hour).

1. If depth to the top-of-screen is known, then measure sufficient cable length to place the probe within the screened interval of the well. Alternatively, if you are reasonably certain of the well screen length, then estimate the cable length required based on bottom-of-screen depth plus at least 2 feet. If the water column height in the well is less than 2 feet, use of the probe downhole is not recommended (discuss alternative measurements with FTL or Project Manager).

   Do not deploy the probe in the stagnant water column above the screened interval or in the bottom well sump because you will not get accurate readings.
2. Slowly lower the probe into the well. Do not drop the probe down the well or tag the bottom, which can stir up sediments. When lowering the probe, minimize any splashing or disturbance of the water.
3. Secure the cable at the wellhead to ensure that the probe remains at the prescribed depth.
4. Set up the file name and logging parameters on the data logger following manufacturer's instructions.
5. Properly store instrument after decontamination (SOP No. 011A).

2.4. *DEPLOYING MULTIPARAMETER PROBE IN A FLOW-THROUGH CELL*

1. Program the data logger for file name, duration, and sample interval.
2. Connect the inlet line of the flow-through cell with the discharge line (the tubing from a submersible pump that is downhole of a monitoring well).
3. Ensure the outlet line of the flow-through cell is secure and connected to the discharge container. Ensure proper spill prevention/containment for discharge water.
4. When ready to begin measuring field parameters, fill the flow-through cell to the top. Once the flow-through cell is full, insert the probe. Secure the probe with the set screws at the top of the flow-through cell. Start the data logger. Minimize air bubbles in the outflow tubing and flow-through cell during the collection of the measurements by maintaining a sufficient flow rate through the system.
5. Properly store instrument after decontamination (SOP No. 011A).

2.5. *SURFACE WATER MEASUREMENTS WITH A MULTIPARAMETER PROBE*

Follow manufacturer's instructions for probe set-up. Since surface water conditions are highly variable, this SOP provides only general instructions for collection of the data.

1. Program data logger; fill out field data log and/or field logbook with data collection location.
2. Slowly lower the probe into the surface water sampling location, minimize splashing or disturbance of the water. Completely submerse the probe. Generally, for surface water, the measurements will be collected from the top 2 feet of the water unless otherwise specified in a SAP for the site. Note flow conditions, if present.
3. Begin logging parameters/data.
4. Properly store instrument after decontamination (SOP No. 011A).

2.6. *DEPLOYMENT DURATION GUIDELINES*

The duration and intervals for data logging will be dependent on the objectives of collecting the field parameter measurements. The following are suggested instrument deployment duration times and data collection intervals for specific activities requiring field parameter measurements.

Activity	Instrument Deployment Configuration	Instrument Deployment Duration (min.)	Timed Interval for Readings
Pre-purge/development of a monitoring well	Downhole	10	1
Purge/development of a monitoring well	Flow-through cell	Project Specific	3
Post-purge/development of monitoring well	Downhole	10	1
Surface water	Surface water	10	1

2.7. *PRECISION AND ACCURACY*

Instrument calibration and a performance check should be performed before each field day following manufacturer instructions. The following parameters should be accurate to:

- Specific conductance to 0.1 microSiemens per centimeter(uS/cm)
- pH to 0.2 units
- DO to 0.1 ug/l
- Percent DO to 0.5%, and
- ORP to 1 millivolts.
- Temperature to 4°C can be checked in ice water (note: built-in thermometer cannot be adjusted or calibrated. If thermometer is malfunctioning, replace instrument).

3.0 FIELD MEASUREMENT OF SPECIFIC CONDUCTANCE

3.1. *DESCRIPTION*

Specific conductance is a widely used indicator of water quality. It is a measure of the ability of water to conduct or transmit an electrical current, which depends on the presence of ions, their total concentration, mobility, and temperature. For inorganic species, the electrical conductivity of water is directly proportional to the total dissolved salt content. Specific conductance is an indirect way of determining total dissolved solids (TDS), which has a suggested aesthetic water quality limit of 500 mg/L in potable water (Nielsen, 1991). It is an indicator of change within a system and is used as an aid in evaluating whether a sample is representative of the water in the system. It is rapidly and easily measured in the field.

Briefly, the specific conductance is defined as the measure of the quantity of electricity transferred across a unit area, per unit potential gradient, per unit time. A cell constant is determined by measuring a solution of known conductivity. Solutions of known conductivity are purchased or can be made from reagent-grade KCl. Sampling personnel will consult operating instructions for the specific instrument used for the determination of the cell constant. This conductivity is expressed in various units, including micromhos per centimeter (μmhos/cm) and μS/cm.

The following procedure describes the field measurement of the specific conductance of an aqueous sample using a conductance meter and a platinum or stainless steel electrode. This method is applicable to ground and surface waters. The specific conductance of a sample is measured by use of a self-contained conductivity meter, Wheatstone bridge type, or equivalent. Samples are preferably analyzed at 25°C. If not, temperature corrections are made and results reported at 25°C. The specific conductance meter will be calibrated on a daily basis prior to the procedures outlined below. The calibration procedures will conform to the manufacturer's specifications.

3.2. PROCEDURE

Follow the instruction manual for the specific field conductivity meter used.

1. Collect the sample and record its temperature.
2. Set the instrument's temperature adjustment to the temperature of the sample, if required.
3. Immerse the probe in the sample, keeping it away from the sides and bottom of the container. Make sure the probe is entirely submerged.
4. Report the results to the nearest ten units for readings under 1,000 μmhos/cm and the nearest 100 units for readings over 1,000 μmhos/cm.

3.3. DOCUMENTATION

1. Record the source and expiration date of standards used for calibration.
2. List the instrument manufacturer and model number.
3. Record date and time of calibration check.
4. Record temperature and conductivity standard used to check calibration.
5. Record sample temperature and conductivity readings.
6. List the name of the person performing the measurement(s).

3.4. PRECISION AND ACCURACY

Most conductivity meters have an accuracy of ± 2 percent of the reading. With satisfactory equipment, results within one percent of the true value should be obtained.

4.0 FIELD MEASUREMENT OF PH

4.1. DESCRIPTION

The measurement of pH in an aqueous solution uses a reference electrode of known potential (pH meter). The pH of a solution is defined as the negative logarithm to the base 10 of the hydrogen ion activity in moles per liter or grams equivalent per liter ($pH = -\log[H+]$). The pH expresses the relatively acidity or alkalinity of a fluid on a scale from zero to 14. A pH of seven represents a neutral solution. Follow the site-specific safety plan when measuring pH in fluids that may be highly acidic (pH 4 or less) or alkaline (pH 9 or greater).

Natural waters generally have pH values in the range of four to nine. The primary control over pH in natural waters is the carbonate system, including gaseous and dissolved carbon dioxide, bicarbonate, and carbonate ions. Sample degassing may affect pH due to loss of carbon dioxide. Temperature and ionic strength of the fluid are factors that may affect pH measurements.

4.2. *PROCEDURE*

1. Before the field event, calibrate the pH meter using fresh calibration solutions, following manufacturer's instructions.
2. At the job site, allow the pH meter to equilibrate to ambient temperature before use.
3. Thoroughly rinse the electrode with distilled water in between samples.
4. Lower the probe into the water sample and allow it to equilibrate.
5. Record the stabilized reading in the logbook.
6. Rinse the probe with deionized water. If exposed to oily solutions, thoroughly cleanse with laboratory-grade detergent and triple rinse before re-using.
7. Properly store meter according to manufacturer's instructions.

4.3. *DOCUMENTATION*

For each field event:

- Date/time of the last calibration, buffered solutions used, source and expiration date of buffers used, calibration results.
- Instrument manufacturer and model number. For each sample:
- Site name, sample location, sample type
- Person performing the measurement
- Instrument decontamination procedures
- Date, time, sample temperature, sample pH

4.4. *PRECISION AND ACCURACY*

Under normal conditions the accuracy is ± 0.2 pH units.

5.0 FIELD MEASUREMENT OF DISSOVLED OXYGEN

5.1. *DESCRIPTION*

This section is for the use of a dissolved oxygen (DO) meter deployed downhole in a groundwater monitoring well, in a flow-through cell during groundwater pre-sample purging, or in surface water.

The concentration of DO provides an estimate of the oxidation state of the water and hence measures the ability of the water to support aerobic metabolism or geochemical reactions. DO is commonly used as an indicator to evaluate groundwater remedial progress, particularly for enhanced in-situ bioremediation. Two different types of DO meters are now available: the optical DO sensor and the electrochemical cell. Of the two types, the optical DO sensor is preferred as it provides greater accuracy with little measurement "drift" and less interference from groundwater conditions or data collection methods.

5.2. *PROCEDURE FOR OPTICAL DISSOLVED OXYGEN SENSOR*

Follow the manufacturer's instruction manual for the specific DO sensor used. Generally, the optical DO sensor is used with a data logger (e.g., TROLL); follow manufacturer's instructions for set-up and connection of the data logger with the DO sensor (InSitu, 2009).

1. Follow manufacturer's instructions for DO sensor calibration; record calibration results. Rinse the sensor and front end of the instrument very thoroughly with distilled water following completion of all calibration steps. The optical DO sensor should be calibrated at least once every 3 months.
2. Select the oxygen concentration units (e.g., mg/L [ppm], µg/L [ppb], microMolar concentration [µmol/L], or oxygen saturation [%]). The desired units may be specified in the sampling and analysis plan and generally should be consistent for all monitoring events to prevent data interpretation errors.
3. If you are measuring DO in a significantly saline environment (e.g., marine waters, salt-water intrusion areas, landfill leachate zones) a salinity compensation algorithm should be applied during DO sensor setup following manufacturer's instructions. Use the most recent salinity data from the site.
4. Deploy the calibrated optical DO sensor either downhole in a monitoring well, in a flow-through cell, or directly in a surface water body. DO changes rapidly in response to pressure and temperature changes; therefore, DO measurements collected in ways other than those listed may not be valid. For example, readings of DO in a bucket of purge water are unlikely to reflect subsurface aquifer conditions.
5. Record the results in the field logbook and applicable field form or, if using a data logger, download the data logger as soon as practicable following the field event.

5.3. *PROCEDURE FOR ELECTROCHEMICAL CELL DO METER*

Follow manufacturer's instruction manual for the specific DO meter used.

1. Prior to field use, inspect the membrane of the DO meter for air bubbles and/or holes. Replace the membrane if bubbles or holes exist.
2. Make sure the membrane is wet by soaking it in analyte-free water prior to calibration and during storage.
3. Calibrate the DO meter on a daily basis in accordance with to the manufacturer's instructions.
4. Use the DO probe either downhole in a monitoring well, in a flow-through cell, or directly in a surface water body. DO changes rapidly in response to pressure and temperature changes; therefore, DO measurements collected in ways other than those listed may not be valid. For example, readings of DO in a bucket of purge water are unlikely to reflect subsurface aquifer conditions.
5. When deployed downhole, it may be necessary to move the probe slowly up and down in the water column (unless the device is equipped to move water past the sensor). The sensor will deplete the oxygen around it and will yield artificially low DO readings if held steady in still water.

6. Record the results within the field logbook and applicable field form to the nearest 0.1 mg/L.

5.4. *DOCUMENTATION*

1. Record instrument manufacturer and model number.
2. Record date and time of calibration, solutions used, solution expiration dates.
3. Record Site name, sampling location, data and time
4. Record the person performing the measurement
5. Record sample DO readings or down-load data logger as soon as practicable following data collection.

6.0 FIELD MEASUREMENT OF OXIDATION REDUCTION POTENTIAL (ORP)

Oxidation-reduction potential (ORP) is a measure, in millivolts (mV), of the tendency of a chemical substance to oxidize or reduce another chemical substance. An ORP sensor consists of an ORP electrode and a reference electrode, similar to pH meter.

The principle behind the ORP measurement is the use of an inert (noble) metal electrode (platinum or sometimes gold), which, due to its low resistance, will give up electrons to an oxidant or accept electrons from a reductant. The ORP electrode will continue to accept or give up electrons until it develops a potential, due to the charge build up, which is equal to the ORP of the solution. The typical accuracy of an ORP measurement is ±20 mV; however, accuracy specifications are relative to redox standards, such as a Zobell solution, and not to environmental waters (YSI Environmental, 2005).

Terminology: Because oxidation always involves reduction (i.e., gain and loss of electrons), ORP is sometimes referred to as representing “redox” conditions in water. The terms “Eh” and ORP represent the same parameter; however Eh is measured with a different reference electrode which is uncommon in field applications (YSI Environmental, 2005). The term ORP is preferred as it is specific to the meters typically used in environmental water field applications.

6.1. *INFLUENCES ON AND LIMITATIONS OF ORP DATA:*

ORP is a nonspecific measurement: An ORP measurement reflects the combined effects of all dissolved species in the fluid. Unless the dissolved species, and in particular, the predominant redox-active species, are known through geochemical testing, ORP data in relatively clean groundwater or surface water has only limited utility. Users should thus be careful not to “over-interpret” ORP data unless specific information about the site is known (YSI Environmental, 2005).

Temperature: The temperature of the water for which ORP is being determined will affect the voltage output of the sensor. While temperature must be taken into account for calibration and should be considered when reporting field ORP values, the variation is usually not definable since the temperature effect depends on the dissolved species responsible for the ORP reading, and these species are usually not known exactly for environmental water.

Contamination of the ORP Sensor: A slow equilibrium response or erratic response may indicate a fouled ORP sensor. Particularly for routine monitoring (versus long-term monitoring as in installation of the probe in a well), the ORP sensors must be properly maintained and stored to ensure quick equilibrium time and accurate readings.

Low Concentration of Redox-Active Species: Environmental waters can be naturally low in reduction/oxidation species; essentially these waters fall below the detection limit of the ORP meter.

Due to the listed limitations, ORP measurements are best applied when measuring changes in ORP due to completion of redox reactions (Emerson Process Management, 2008).

6.2. *PROCEDURE FOR ORP MEASUREMENT*

1. Follow manufacturer's instructions for the ORP meter used; record calibration results (if calibration performed). Rinse the sensor very thoroughly with distilled water following completion of all calibration steps.
2. Deploy the calibrated ORP meter either downhole in a monitoring well, in a flow-through cell, or directly in a surface water body.
3. Record the results in the field logbook and applicable field form or, if using a data logger, download the data logger as soon as practicable following the field event.
4. Clean and properly store the ORP Meter.

6.3. *DOCUMENTATION*

1. Record instrument manufacturer and model number.
2. Record date and time of calibration, solutions used, solution expiration dates.
3. Record Site name, sampling location, data and time
4. Record the person performing the measurement
5. Record sample DO readings or down-load data logger as soon as practicable following data collection.

7.0 FIELD MEASUREMENT OF TURBIDITY

7.1. *DESCRIPTION*

Turbidity is a measure of the amount of suspended and colloidal organic and inorganic particles that cause opacity ("cloudiness") in water (Nielson, 1991). Elevated turbidity in a sample indicates it contains suspended matter that may affect the quality of analytical data. For instance, a total metals analysis of a turbid sample will detect the concentrations of both the dissolved metals and the metals adsorbed onto the particle surfaces. Elevated turbidity may also indicate biofouling of the monitoring well, which can also affect data quality and reliability.

A turbidity meter (nephelometer or turbidimeter) measures the turbidity of an aqueous sample by comparing the light absorption of the sample liquid and a control liquid. Turbidity is measured in nephelometric turbidity units (NTUs).

The method described in this SOP is applicable to ground and surface waters.

7.2. PROCEDURE

The turbidity of a solution is determined by comparing a sample to a known indexed reference standards provided by the manufacturer as part of the nephelometer test kit. The turbidity meter should be calibrated in accordance with the manufacturer's manual. The following procedures will be used to measure the turbidity of a sample:

1. Place reference container (cuvette) in light well of meter. Take care in handling and storing the cuvette to prevent inaccurate results. Reference should be completely filled; do not uncap.
2. Use the provided sample cuvette for the sample – clean inside and outside surfaces with a lint-free, non-abrasive wipe or soft cloth before use. Do not scratch cuvette surfaces. Make sure that the outside of the cuvette is dry before placing it into the light well. Moisture on the outside of the cuvette can cause false high readings.
3. Fill cuvette approximately three quarters full with water to be sampled. Replace cap onto the cuvette. Place sample in light well of meter and place the light shield over well. Select the appropriate range for best readability. Cuvettes should be handled in accordance with the manufacturer's specifications.
4. Note and record sample turbidity.
5. Clean cuvette thoroughly before measuring the turbidity of the following sample.

7.3. DOCUMENTATION

1. Log the time of last indexing and turbidity of each reference standard.
2. List instrument manufacture and model number.
3. Record the name of the person performing the measurement, date, and time.
4. Record the results of the turbidity measurements.

7.4. PRECISION AND ACCURACY

Under normal conditions:

Linear	±1% of full scale; and
Repeatability	±1% of full scale.

8.0 FIELD MEASUREMENT OF FERROUS IRON

8.1. DESCRIPTION

This section is for measurement of ferrous iron in groundwater using a field test kit. Ferrous iron is preferred to be analyzed immediately following sample collection due to ensure accuracy and representativeness. Ferrous iron data are typically used as part of natural attenuation monitoring in groundwater to determine the predominant terminal electron accepting process.

Ferrous iron field test kits are generally colorimetric tests. The provided reagent reacts with ferrous iron in the sample to form an orange color in proportion to the ferrous iron concentration. Ferric iron does not react. The ferric iron (Fe^{3+}) concentration can be determined by subtracting the ferrous iron concentration from the results of a total iron test.

8.2. PROCEDURE

The following procedures describe the field test method of ferrous iron in an aqueous sample. This method is applicable to natural waters (surface water, groundwater).

1. Fill the test-kit provided viewing tube to the first (5-mL) line with sample water. This is the blank. Place this tube in the top left opening of the color comparator.
2. Fill the measuring vial to the 25-mL mark with sample water.
3. Add the contents of one Ferrous Iron Reagent Powder Pillow to the measuring vial
4. Swirl to mix. An orange color will develop if ferrous iron is present. Allow three minutes for full color development
5. Fill another viewing tube to the first (5-mL) mark with the prepared sample
6. Place the second tube in the top right opening of the color comparator
7. Hold comparator up to a light source such as the sky, a window or a lamp. Look through the openings in front
8. Rotate the color disc until the color matches in the two openings
9. Read the mg/L ferrous iron in the scale window.

8.3. DOCUMENTATION

1. Site name, sampling location, source of sample, sample type.
2. Person performing the measurement.
3. Date and time of the sample collection.
4. Sample turbidity in NTUs.

9.0 REFERENCES

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STANDARD OPERATING PRACTICE OTIE 006A

Sediment Sampling

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QC Review Signatures		
Name/Role	**Signature**	**Date**
John Fleissner, PE Corporate QC Manager	John Fleissner	September 17, 2013
Nova Clite, PG Sr. Hydrogeologist	Nova Clite	17 September 2013
Cecil Irby PG Sr. Geologist/PM-PFC Specific	Cecil Irby	29 July 2016

Given the low detection limits associated with PFC analysis and the many potential sources of trace levels of PFCs, field personnel are advised to act on the side of caution by strictly following protocols below and those in SOP Addendum No. 1 for PFC Sampling, frequently replacing nitrile gloves, and rinsing field equipment to help mitigate the potential for false detections of PFCs.

1.0 INTRODUCTION

1.1 Objective

The objective of this SOP is to present the basic techniques and methods to be used to obtain representative sediment samples from stream beds, drainage systems, basins, ponds, pits, and other sediment accumulation locations. The samples may be used to define the chemical, physical and/or biological composition of the sediments and/or sludge, and for characterization and risk assessment evaluation.

1.2 Applicability and Limitations

This standard operating practice (SOP) describes general practices for obtaining data to be used to characterize sediment and sludge quality. Refer to the project-specific Sampling and Analysis Plan (SAP) for information regarding the data quality objectives and specific sediment sampling procedures.

The term “sediment” refers to solids that have accumulated as a result of deposition in natural or artificial water bodies or containers. The procedures in this SOP may be applicable to natural sediments (e.g., lake sediments) and to contaminated media such as sediments in tanks, lagoons, or pits.

2.0 SEDIMENT SAMPLE COLLECTION

2.1 Preparations

Sediment collection procedures and equipment used will vary depending on the sampling objectives, nature of water body or sediment accumulation point, and other factors. In general, sediment samples may be collected by a technician standing on the bank or a fixed structure (such as a bridge), standing in the water, or from a boat or other floating device. Sediment samples can be collected from smaller fixed containers (e.g., sediment traps, pits, or vaults) following many of the same procedures described in this SOP.

The sample locations may be determined by traditional survey techniques or Global Positioning System (GPS) techniques. At a minimum, the sample location should be established by triangulation with permanent surface features (e.g., buildings, dams, rock outcrops) and approximated or measured distances. If possible, stake the sample location with a labeled marker and/or mark locations on a site plan.

At locations where both surface water and sediment samples are collected, the surface water sample should be collected before the sediment sample to avoid affecting the surface water sample quality. In moving water, work from downstream to upstream to avoid contamination of downstream samples with suspended sediments transported in the current and ensure collecting representative samples.

2.1.1 Health and Safety Considerations

Appropriate personal protective equipment (PPE) should be worn as required by the site-specific Safety and Health Plan (SSHP). If sampling from a boat or near water bodies with a depth of three feet or more, additional safety and health requirements (per OSHA, USACE, and USGS) are required. Work should be performed in accordance with SSHP and with proper safety oversight.

Generally, sampling conducted from a boat should be performed by a minimum of two (2) field staff (one individual to conduct sampling and one individual to steady the boat and assist the sampler) plus one person on shore to monitor the boat team. Sampling of sediments during high flow or flood stage conditions is prohibited because of high safety risks. In waterways subject to tidal flows, the local tide charts should be consulted during the planning stage and pre-sampling observations made to ensure samples are collected at the appropriate time to reduce safety hazards.

2.1.2 Equipment Suitability

All equipment or sample containers that will come into contact with a sediment sample for chemical analysis will be constructed of materials that will not affect the concentration of contaminants in the sediment sample. In general, sediment samples to be analyzed for metals should not contact metallic surfaces (other than stainless steel), and samples for organic analysis should not contact materials that can react with organic substances. The data quality objectives (DQOs) should be listed in the Sampling and Analysis Plan (SAP).

When selecting sampling equipment, consider the anticipated water content, texture, density, and cohesiveness of the target sediments. It may be necessary to use a variety of equipment to obtain the required samples, even at a single site. Refer to ASTM Standard E1391-03(2008)If benthic organisms are to be collected and for general information on sampling equipment.

2.1.3 Equipment List

Do not use Teflon®-containing materials (e.g., Teflon® tubing, bailers, tape, plumbing paste, or other Teflon® materials) since Teflon® contains fluorinated compounds. Additional equipment precautions, as described in SOP Addendum No. 1 for PFC Sampling, should be followed. Sampling equipment needs will vary depending on site conditions and sampling objectives. The following is a suggested list of equipment:

- Stainless steel, HDPE or polypropylene-lined sampling tray or bowl
- Stainless steel dip sampler, scoops, trowels, spoons, and ladles
- Polyvinyl chlorinated (PVC) pipe, two inches in diameter
- Hand core sediment sampler
- Ponar dredge sampling device
- Soil samplers such as hand-auger, slide-hammer sampler, etc.
- Appropriate sample bottles
- Sample cooler with ice

- Rubber boots/waders (No clothing or boots containing Gore-Tex™)
- Plastic sheeting
- Utility knife
- Braided nylon rope
- Flat-bottomed boat, barge, or pontoon boat
- PPE (as required in the SSHP)
- Field notebook (No waterproof lined pages)
- Decon equipment
- Plastic buckets with lids (for rinse water/solvents, decant and/or spoils)
- Appropriate sample data forms (e.g., chain-of-custody forms)
- Clear tape
- Pen, pencil, magic marker, etc. (No waterproof pens)
- Sample labels
- Paper towels
- Garbage bag for PPE
- Buoyant safety vests and other safety equipment for work in deep water and from boats

2.1.4 Field Documentation Checklist

The following is a suggested documentation checklist:

- Sediment Sample Collection form (optional)
- Surface water Sample Collection Form (if collecting both surface water and sediment) (optional)
- Chain-of-Custody form
- Field logbook
- Field map

2.2 Sediment Sampling Procedures

2.2.1 Sample Collection in Shallow Water Using a Hand Auger or Corer

Sediment samples can be collected from shallow water using a stainless-steel hand auger or coring device. Different types of coring devices may be used depending upon the character of the substrate, length of sample desired, and depth of water. These devices vary from hand push tubes to gravity-driven devices. To supplement the information contained herein, the Hand Auger Drilling Method is outlined in OTIE SOP No. 007C. The following procedures outline the collection of shallow water sediment samples using a hand auger sampling device:

1. Cut a section of plastic sheet to be placed on the ground to use as a clean staging area for sampling equipment.
2. Label each sample container properly, cover label with clear tape, fill out appropriate chain-of-custody information, wipe outside of container with paper towel or Kim wipe, and place in iced cooler.
3. Using a weighted measuring tape (if necessary), make detailed measurements of the sampling location and record in the field logbook. Details should include the following: location references, depth of water, stream velocity estimates (e.g., stagnant, slow, moderate, fast), bottom description, litter, vegetation, wildlife, etc.

4. The sampling personnel should stand downstream away from the sample point and exercise caution to prevent disturbance of bottom materials in the sample collection area.
5. Set the pre-cleaned core/hand auger barrel into the sampling location and advance to an approximate depth of 6 to 12 inches.
6. If possible, before removing the sampler from the substrate, close the top of the sampling tube (using the air escape vent) to allow suction to assist in sample retention.
7. Once the sampler is removed from the water, decant the supernatant liquid, taking care to prevent sample loss.
8. Place sample onto a stainless steel tray and remove the sediment contents with a pre-cleaned stainless steel spoon or equivalent. Immediately place VOC samples into the appropriate containers. Homogenize remaining material and divide into remaining sample containers.
9. If methanol is to be used to preserve VOC samples (OTIE SOP No. 010B), vials will be weighed before sample is added to assess any loss during transportation. Vial will be weighed after sample is added to verify weight of material added.
10. Immediately after the sample is collected, label the sample containers per the Sample Labeling procedures defined in the SAP.
11. Place sample in cooler immediately. After the cooler is filled with samples, it will be secured in a sampling vehicle or other secure storage facility pending sample shipment. All samples will be packaged in a manner consistent with Sample Packaging procedures outlined in the SAP.
12. If no map of the sampling locations is available prior to sampling, a drawing of the site (not to scale) will be included in the field logbook to provide an illustration of all sampling points. Refer to OTIE SOP No. 002A for field documentation procedures.
13. Fill out sample Chain-of-Custody Form to maintain an accurate record of sample collection, transport, analysis and disposal. Refer to the SAP for Chain-of-Custody procedures.
14. Decontaminate sampling device in accordance with procedures in OTIE SOP No. 011A.
15. Discard contaminated personal protective clothing, as required.

2.2.2 Sample Collection in Deep Water Using a Hand Corer

Sediment samples can be collected with a hand corer device typically deployed from boats, docks, or riverbanks. The hand corer does not work well in very firm clay, sandy, or rocky substrates. In moderate water depths of approximately 10 feet, samples can be taken using extension lengths and the corer can be pushed into the bottom sediments using the handles on the head assembly. In deeper water, the sampler can be dropped by attaching a line to a clevis, located on the head assembly between the handles. Using either of these methods, the corer penetrates the bottom, and is twisted or pulled free. The following procedures outline the collection of deep-water sediment samples using hand corer deployed by an attached line from a boat:

1. Label each sample container properly, cover label with clear tape, fill out appropriate chain-of-custody information, wipe outside of container with paper towel or Kim wipe, and place in iced cooler.
2. Using a weighted measuring tape (if necessary), make detailed measurements of the

sampling location and record in the field logbook. Details should include the following: location references, depth of water, stream velocity estimates (e.g., stagnant, slow, moderate, fast), bottom description, litter, vegetation, wildlife, etc.

3. Attach a length of clean braided nylon line to the sampler. The length must be sufficient to reach the sediment to be sampled, plus have enough slack to release the mechanism.
4. Attach the appropriate amount of weight (if necessary) to the collar of the corer for the type of sediments that are being cored.
5. Insert a core catcher tube into the end of the core liner and attach the nosepiece core cutter to the end of the core barrel.
6. Lower the corer to the sediments. The weight of the corer or additional attached weight will drive it into the sediments.
7. Slowly raise the sampler to the surface; unscrew the cutter, and insert a rubber stopper into the bottom of the core liner.
8. Slide the core liner out of the core barrel keeping it as vertical as possible.
9. Stopper and cap the ends of the core tube shut and tie to a railing to keep it vertical until returning a shoreline station or laboratory.
10. If the core is to be extruded on board, insert a rubber stopper into the bottom of the core liner that is slightly smaller than the liner.
11. Push on this stopper with a stick or rod until the core starts to move up the tube. When it reaches the top of the liner, begin sectioning the core into the desired increments or push the whole core out onto a stainless steel tray. In addition, observe and take notes on any banding, color, texture, etc.
12. Remove the sediment contents with a pre-cleaned stainless steel lab spoon or equivalent. Immediately place VOC samples into the appropriate containers. Homogenize remaining material and divide into remaining sample containers.
13. If methanol is to be used to preserve VOC samples (OTIE SOP No. 010B), vials will be weighed before sample is added to assess any loss during transportation. Vial will be weighed after sample is added to verify weight of material added.
14. Immediately after the sample is collected, label the sample containers per the Sample Labeling procedures defined in the SAP.
15. Place sample in cooler immediately. After the cooler is filled with samples, it will be secured in a sampling vehicle or other secure storage facility pending sample shipment. All samples will be packaged in a manner consistent with Sample Packaging procedures outlined in the SAP.
16. If no map of the sampling locations is available prior to sampling, a drawing of the site (not to scale) will be included in the field logbook to provide an illustration of all sampling points. Refer to OTIE SOP No. 002A for field documentation procedures.
17. Fill out sample Chain-of-Custody Form to maintain an accurate record of sample collection, transport, analysis and disposal. Refer to the SAP for Chain-of-Custody procedures.
18. Decontaminate sampling device in accordance with procedures in OTIE SOP No. 011A.
19. Discard contaminated personal protective clothing, as required by the site-specific SAP.

2.2.3 Sample Collection in Deep Water Using a Dredge

Sediment samples can be collected from deep water using a variety of dredging devices typically deployed from boats, bridges, or riverbanks. Among the available devices, the Ponar dredge can be used on a variety of substrates and collects a relatively large sample. The following procedures outline the collection of deep-water sediment samples using the Ponar sampling device:

1. Label each sample container properly, cover label with clear tape, fill out appropriate chain-of-custody information, wipe outside of container with paper towel or Kim wipe, and place in iced cooler.
2. Using a weighted measuring tape (if necessary), make detailed measurements of the sampling location and record in the field logbook. Details should include the following: location references, depth of water, stream velocity estimates (e.g., stagnant, slow, moderate, fast), bottom description, litter, vegetation, wildlife, etc.
3. Attach a length of clean braided nylon line to the sampler. The length must be sufficient to reach the sediment to be sampled, plus have enough slack to release the mechanism.
4. Mark the distance to the bottom on the line and attach the free end to a fixed object to prevent loss of the sampler. Set the mechanism on the sampler, keeping aware of any pinch hazard.
5. Lower the sampler to the streambed, slowing the descent before contact with the bottom to prevent burial of the device.
6. Release tension on the line, allowing sufficient slack for the latching mechanism to release, when the sampler contacts the streambed.
7. Slowly raise the sampler out of the water, drain excess water (being careful not to pour off sediment), and place it in a stainless steel tray.
8. Remove the sediment contents with a pre-cleaned stainless steel lab spoon or equivalent. Immediately place VOC samples into the appropriate containers. Homogenize remaining material and divide into remaining sample containers.
9. If methanol is to be used to preserve VOC samples (OTIE SOP No. 010B), vials will be weighed before sample is added to assess any loss during transportation. Vial will be weighed after sample is added to verify weight of material added.
10. Immediately after the sample is collected, label the sample containers per SAP.
11. Place sample in cooler immediately. After the cooler is filled with samples, it will be secured in a sampling vehicle or other secure storage facility pending sample shipment. All samples will be packaged in a manner consistent with Sample Packaging procedures outlined in the SAP.
12. If no map of the sampling locations is available prior to sampling, a drawing of the site (not to scale) will be included in the field logbook to provide an illustration of all sampling points. Refer to OTIE SOP No. 002A for field documentation procedures.
13. Fill out sample Chain-of-Custody Form to maintain an accurate record of sample collection, transport, analysis and disposal. Refer to the SAP for Chain-of-Custody procedures.
14. Decontaminate sampling device in accordance with procedures in OTIE SOP No. 011A.
15. Discard contaminated personal protective clothing, as required.

2.2.4 Sample Collection using PVC Pipe

Sediment samples can be collected from shallow water using a clean section of 2-inch (or smaller) PVC pipe. This method is employed when sampling the upper 6 to 12 inches of soft to very soft sediments from surface water bodies. The length of the PVC pipe section will be dependent on the depth to which the pipe will be advanced below the water and into the sediment. The following procedures outline the collection of shallow water sediment samples using the PVC pipe sample collection method:

1. Cut a section of plastic sheet to be placed on the ground to use as a clean staging area for sampling equipment.
2. Label each sample container properly, cover label with clear tape, fill out appropriate chain-of-custody information, wipe outside of container with paper towel or Kim wipe, and place in iced cooler.
3. Using a weighted measuring tape (if necessary), make detailed measurements of the sampling location and record in the field logbook. Details should include the following: location references, depth of water, stream velocity estimates (e.g., stagnant, slow, moderate, fast), bottom description, litter, vegetation, wildlife, etc.
4. Gently push pipe into sediment with a smooth continuous motion to an approximate depth of 6 to 12 inches.
5. Cap the top of the pipe, forming an airtight seal, to create a vacuum as it is withdrawn from the sediment.
6. Remove the sediment contents with a pre-cleaned stainless steel lab spoon or equivalent. Immediately place VOC samples into the appropriate containers. Homogenize remaining material and divide into remaining sample containers.
7. If methanol is to be used to preserve VOC samples (OTIE SOP No. 010B), vials will be weighed before sample is added to assess any loss during transportation. Vial will be weighed after sample is added to verify weight of material added.
8. Immediately after the sample is collected, label the sample containers per the Sample Labeling procedures defined in the SAP.
9. Place sample in cooler immediately. Once the cooler is filled with samples, it will be secured in a sampling vehicle or other secure storage facility pending shipment to the laboratory. All samples will be packaged in a manner consistent with Sample Packaging procedures outlined in the SAP.
10. If no map of the sampling locations is available prior to sampling, a drawing of the site (not to scale) will be included in the field logbook to provide an illustration of all sampling points. Refer to OTIE SOP No. 002A for field documentation procedures.
11. Fill out sample Chain-of-Custody Form to maintain an accurate record of sample collection, transport, analysis and disposal. Refer to the SAP for Chain-of-Custody labeling procedures.
12. Decontaminate sampling device in accordance with procedures in OTIE SOP No. 011A.
13. Discard contaminated personal protective clothing, as required.

3.0 INVESTIGATION DERIVED WASTE

Dispose of all sampling waste and PPE in properly labeled containers in accordance with the project SAP. Additional sediment not used for sample analysis will be managed in accordance with OTIE SOP No. 012A and/or the project-specific SAP.

4.0 QUALITY ASSURANCE / QUALITY CONTROL

The order of sampling the various locations will be dependent on expected levels of contamination in each location, if known, and will be estimated prior to sampling. Sampling should progress from the least contaminated area to the most contaminated area, if known. QA/QC samples will be collected during sediment sampling according to the SAP.

QA/QC samples may be labeled with QA/QC identification numbers (or fictitious identification numbers if blind submittal is desired), and sent to the laboratory with the other samples for analyses.

A discussion of the various types of QA/QC samples (field blanks, trip blanks, equipment [rinsate] blanks, ambient blanks, split samples, duplicate samples, and matrix spike/matrix spike duplicates) is provided in the SAP and the QAPP.

5.0 REFERENCES

American Society for Testing and Materials (ASTM) Standard D4687-95(2006) “Standard Guide for General Planning of Waste Sampling” ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D4547-06 “Standard Guide for Sampling Waste and Soils for Volatile Organic Compounds” ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D6418-09 “Standard Practice for Using the Disposable En Core Sampler for Sampling and Storing Soil for Volatile Organic Analysis” ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard E1391-03(2008) “Standard Guide for Collection, Storage, Characterization, and Manipulation of Sediments for Toxicological Testing and for Selection of Samplers Used to Collect Benthic Invertebrates” ASTM International, West Conshohocken, PA, www.astm.org.

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STANDARD OPERATING PRACTICE OTIE006D

SURFACE WATER SAMPLING

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QC Review Signatures

Name/Role	Signature	Date
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Given the low detection limits associated with PFC analysis and the many potential sources of trace levels of PFCs, field personnel are advised to act on the side of caution by strictly following protocols below and those in SOP Addendum No. 1 for PFC Sampling, frequently replacing nitrile gloves, and rinsing field equipment to help mitigate the potential of false detections of PFCs. Specific items related to surface water sampling are discussed below.

1.0 SCOPE AND OBJECTIVES

The objective of this Standard Operating Practice (SOP) is to provide general guidelines for obtaining representative samples from various types of surface water bodies including lakes and streams, springs or seeps, impoundments, and wastewater treatment plant access points, outfalls, pipes, and drains. Because data quality objectives (DQOs), contaminant types, and surface-water body configurations will vary from project to project, a site-specific Sampling and Analysis Plan (SAP) should be prepared to define project DQOs, samples, methods and procedures, and equipment. Similarly, a site-specific Health and Safety Plan (HASP) must be prepared to analyze and mitigate potentials risks associated with surface water sample collection.

When selecting surface water sampling locations:

- Consider the DQOs, equipment needs, and sampling methods;
- Obtain all available historical information;
- Consider physical characteristics of the Site, including size and shape, land use, runoff characteristics, climate (i.e., precipitation), geology, sources of contamination, hydraulic conditions, water depth, and fluvial-sediment transport characteristics; and
- Consider chemical and biological characteristics of the area (aquatic and terrestrial).

2.0 DEFINITIONS

Surface water is defined as water that flows over (lotic) or rests on (lentic) the land and is open to the atmosphere. For the purpose of this SOP, a surface water body is defined as naturally occurring or man-made drainages, impoundments or other surface features containing or discharging water.

Lotic Sites refer to streams (fast or slow, ephemeral or perennial), canals, ditches, and flumes of all sizes and shapes or to any other surface water feature in which water moves unidirectional.

Lentic Sites refer to all sizes and shapes of lakes, reservoirs, ponds, wetlands, or any other body of surface water where water generally does not move unidirectional.

Grab samples are defined as discrete aliquots representing a single location at a given point in time. The sample is collected all at once and at only one particular point in the sample medium. Grab samples are not mixed or composited with other samples.

Composite samples are samples collected in one container composed of more than one aliquot (or subsample) collected at various locations and/or at different points in time. Analytical results from this type sample represent an average value for the locations or time periods incorporated into the sample.

Integrated samples are samples of continuously collected subsamples from a water column or across a cross-section of waterbody; differs from composite as samples are collected “continuously”.

Intermediate sampling containers are temporary sampling vessels used to directly sample water and transfer to a primary sample container. Temporary containers should be composed of material compatible with site water quality and be larger than the primary sample container(s) to preserve sample quality/integrity to meet DQOs.

3.0 EQUIPMENT

Do not use Teflon-containing materials (e.g., Teflon tubing, bailers, tape, plumbing paste, or other Teflon materials) since Teflon contains fluorinated compounds. Additional equipment precautions, as described in SOP Addendum No. 1 for PFC Sampling, should be followed.

A wide variety of surface-water sampling equipment is available, depending on the DQOs and procedures to be employed. All or part of the following equipment may be required at any specific site, depending on the site-specific SAP.

- Personal protective equipment as required by the site-specific HASP,
- Rubber boots and/or rubberized waders;
- Sample collection devices and equipment;
- Flow measurement equipment (if needed);
- Depth sounding equipment (if needed);
- Thermistor and/or clinometer to measure temperature and salinity changes with depth, respectively (if needed);
- Water quality meters for field measurement of parameters such as temperature, electrical conductivity, pH, oxidation-reduction potential (ORP), dissolved oxygen (DO), turbidity, etc.;
- Data logging equipment (as needed) or field data sheets;
- Sample containers, preservatives, coolers and ice; and
- Decontamination equipment and supplies.

A wide-range of surface water sampling equipment is available; some possibilities include:

- Dipper with an extended handle (“pond sampler”) – the portions in contact with water should be constructed of material compatible with site water quality;
- Sampling extension pole;
- Weighted bottle sampler (1-liter capacity) - Wheaton bottle or Kemmerer bottle;
- DH-81 (or similar) integrated sampler;
- Submersible or peristaltic pump – pump components and tubing should be constructed of materials compatible with site water quality;
- Bailer with weighted end;
- Intermediate non-preserved sample container (e.g., polypropylene) used to collect sample to transfer to preserved sample container; and
- Sample container (e.g., glass jar) used to collect the sample with a gloved hand.

4.0 SAMPLING PROCEDURES

4.1 PREPARATION

In preparation of the sampling effort, the project and field leaders should determine the sampling methods to be employed and the types and amounts of equipment and supplies needed as established in the SAP. All necessary equipment should be decontaminated or pre-cleaned and in working order. A

Site survey should be performed as part of the HASP and to assess sampling locations and access points. Safety during sample collection is always the first concern; the second concern is obtaining a representative sample, or set of samples. Follow the site-specific HASP; do not sample alone, wear the proper gear, and carefully evaluate seen and unseen potential risks before collecting a sample from a water body.

4.2 GENERAL CONSIDERATIONS FOR LENTIC SITES

In order to collect a representative surface sample from a lentic body, such as lake, pond, or other impoundment, any possible stratification needs to be assessed to determine the appropriate sampling location(s) and depth(s). Field measurements such as DO, pH, conductivity, ORP, temperature, turbidity, and thermistors/clinometers can identify possible stratification that would affect analytical results. Measurement should be collected at 3-foot intervals from the surface to the bottom using the appropriate instrument (e.g., hydrolab or equivalent). Water quality measurements will assist in selecting sampling locations and depths. If multiple sampling events are scheduled, depth characterization should be performed prior to each sampling event to account for seasonal fluctuations, such as thermal overturn, spring runoff, etc., that could influence water quality.

Special considerations for sampling from a large lentic body requiring a boat (offshore locations) include: (1) site-specific HASP outlining correct use and requirements of operation of a boat and (2) to reduce gas/oil contamination, collect samples from near the bow and upwind, avoid surface debris and the boat wake.

Onshore samples should be collected within 2.5 feet of the shoreline by using an extending pole or from a wharf/pier. Wading into the water to collect a sample within a lentic site should be avoided due to substrate disturbance that can contaminant the sample. Samples should be collected upwind and avoid any surface debris. Samples collected from a dock/pier should avoid areas with moored boats and utilities, unless it is part of the SAP.

4.3 GENERAL CONSIDERATIONS FOR LOTIC SITES

Lotic sites are those with organisms or habitats in rapidly moving fresh water. The selection of the surface water sample locations at lotic sites will depend on the type of surface water body being sampled. Sampling locations where mixing is incomplete should be avoided if an average composition is required. Often, areas of poor lateral or vertical mixing can be visually identified. For example, color or turbidity differences may be apparent immediately below the confluence of a tributary and the main river or at a wastewater discharge point. Avoid back eddies and side channels that would not be representative of the water quality affecting downstream sites. Field conductivity measurements are recommended for determining the uniformity of the water composition across the width and depth of the water body. Field salinity measurements may be taken to determine sample locations in estuaries and lagoons. Unless otherwise specified in the project-specific SAP, samples should be collected at the mid-section or deepest flow channel of the stream (e.g. thalweg). In addition, samples should be collected from the downstream sample location to the upstream location to prevent sediment disturbance and sample contamination.

Wading into a water body should only be done following a site-specific HASP. If wading is required, one should approach the sample site from downstream, being careful not to disturb any bottom sediment. The mouth of the sample container should be positioned so it faces upstream while the sampling personnel are standing downstream.

Surface water bodies deeper than two feet or with perceptible current may be hazardous to sample by the wading-in method. If possible, collect samples from the shore, a bridge, pier or other stable structure. Use of a boat or raft may also be required to obtain a representative sample.

A vertical composite sample consisting of subsamples collected just below the surface, at mid-depth, and just above the bottom will be collected from the thalweg. For large rivers, several vertical composites across the channel may be required to characterize the water quality. Generally, sample locations will be closer together towards the thalweg where most flow occurs as opposed to the edges where less flow occurs. Consult the project SAP for sampling requirements.

Collection devices must be constructed of materials that will not react with contaminants of concern. Metals other than stainless steel should not be used if metal samples will be collected. Materials that will react with organic contaminants should not be used when collecting samples for organic and/or semi-organic contaminants.

Once the sampling point has been selected, it must be fixed by detailed description with a global position system location, maps, photos, or with the aid of stakes, buoys, or other landmarks so that subsequent visits to the site will allow the identification of the sampling point. When locating sampling points in a stream or river, the reference to the bank of the river will be from the vantage of looking upstream.

At locations where surface water and sediment samples may be collected, the surface water sample will be collected before the sediment sample to avoid disturbing the sediments and possibly affecting the surface water quality.

4.4 SAMPLING SEEPS, SPRINGS, OR DISCHARGE POINTS

Samples should be collected from as close to the point of water discharge as possible. Disturbance of any materials surrounding the sample should be minimized to avoid introducing suspended sediment into the sample. If the discharge is inadvertently contaminated with suspended sediment, wait until the discharge has become cleared of suspended sediment or approximately 5-minutes if the discharge naturally contains suspended sediment.

4.5 GENERAL SAMPLING STEPS

Samples collected for analysis of volatile organic compounds and semivolatile organic compounds must not be composited. When collecting samples from surface waters, the following procedures will be followed:

1. Remove the sample bottles to be used at the Site from the coolers. Fill in all information indicated on the bottle label with an indelible ink marker or permanent ink ballpoint pen;
2. Do not mix the caps or rinse the sample containers;
3. Measure in situ field parameters and record data in the field log book. Where possible, take field measurements (pH, temperature, conductivity, etc.) directly from the surface water body (not the sample) in the location from which the sample was collected;
4. Remove the stopper/lid from the container and collect the surface water sample, either directly (Section 4.5.1) or with an intermediate container/device (Section 4.5.2);
5. Replace cap and seal container tightly. Place the sample container in a sealed plastic bag;

6. After the samples have been collected, they should immediately be placed in an ice-filled cooler for shipment to the appropriate laboratory. All samples will be packaged in a manner consistent with Sample Packaging procedures outlined in the QAPP;
7. If a map of the sampling locations is not available prior to sampling, a drawing of the location of the sample relative to known site features (not to scale) will be included in the field log book to provide an illustration of each sampling point;
8. Fill out a sample Chain-of-Custody Form, in order to maintain an accurate record of sample collection, transport, analysis and disposal. Refer to the QAPP for Chain-of-Custody labeling procedures;
9. Decontaminate equipment after each sample as described in SOP OTIE011A, "*Decontamination Procedures*"; and
10. Discard contaminated personal protective clothing (e.g., nitrile gloves, Tyvek suits, etc.), as required.

4.5.1 Direct Sampling

Direct sampling involves collecting the water sample directly into the laboratory sampling container. Whenever possible, surface-water samples should be collected directly into the sample container. This procedure reduces loss of volatiles, cross-contamination, or other alteration that could occur during transfer from a collection vessel into the sample container. The following steps should be added after Step 4 in Section 4.5:

1. If no preservative is present in the container, face upwind in lentic water and face upstream in lotic waters.
    a. Hold the container near its base, reach out in front of your body, and plunge it (mouth down) below the surface to about mid-water column. However, if the water is shallow this may disturb the substrate and contaminate the sample, then collect a sample at the water surface. Make note of any changes in methodology, if any;
    b. Fill the container to the appropriate level depending on laboratory requirements; and
    c. If an extension pole or pond dipper is used from a dock/pier or from shore, securely attached the sample container (with its lid in place) to the holder with claps or bands. Remove the container lid and follow the above procedure. Do not use this method if the container has a preservative, use method outlined below.
2. If preservative is present in the container and you can reach the water with your hand, use the following procedure.
    a. Hold the container upright and place the lid over the mouth so that only a small area forms an opening.
    b. Immerse the container about 6-inches under the water surface while holding the cap in position with your fingers as far away from the opening as possible.
    c. Carefully observe the rate the container is filling and remove it from the water before the headspace area is reached. If overfilling occurs, get a new sample container and repeat.
    d. This procedure does not work well in fast moving, shallow water, in which an intermediate container will need to be used (Section 4.5.2).

4.5.2 Sampling with Intermediate Containers and Devices

1. Rinse an intermediate container with Site water and pour the rinsate away from or downstream of the sampling location. The intermediate container should be larger than the number of samples needed so that they can be considered grab samples. If the intermediate container needs to be filled numerous times, this sample is considered an integrated sample. For turbid sites, inspect and rinse out any sediment or organic debris that may have collected at the bottom of the container.
2. Fill the intermediate container with water following the technique described for direct samples as closely as possible, noting any variances. Submerge the container to a depth that does not disturb the substrate, but also avoids sampling the surface layer.
3. Gently mix the water in the intermediate container by swirling before pouring it into the sample containers if using an open-top container or slowly inverting three times if using a closed-top container. From the intermediate container, carefully fill the sample containers, leaving headspace, if required. Do not overfill.
4. Samples collected at depth using a device such as Kemmerer or Van Dorn bottles should follow the following general procedure:

    a. Test Kemmerer or other sampling device for complete seal and ease of closure before lowering into water body;
    b. Securely attach nylon or PVC string to device. Gently lower into water body until desired depth is reached. Tie off string to ensure device remains at desired depth;
    c. Wait approximately 30 seconds for water to flow through sampler at depth, to ensure sample will not contain water from upper strata;
    d. Attach signal weight to string. Send signal weight down to close sample device;
    e. Gently, but quickly raise device;
    f. Release the first 50-100 milliliters from the Kemmerer or Van Dorn device outlet before beginning to fill sample containers; and
    g. Fill all sample containers equally. Collect any other field measurements required (temperature, turbidity, etc.).

4.6 HEALTH AND SAFETY CONSIDERATIONS

The project HASP should be reviewed for particular procedures related to obtaining surface water samples. In general, a personal flotation device should be worn if samples are being collected from a raft or boat, or if wading into a water body. Other health and safety precautions as specified by the site HASP should be complied with during collection of samples.

5.0 REFERENCES

American Society for Testing and Materials. 2014. D4687-14: Standard Guide for General Planning of Waste Sampling.

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________. 2014. D5358-93(2014). Standard Practice for Sampling with a Dipper or Pond Sampler.

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STANDARD OPERATING PRACTICE OTIE007B

Soil and Rock Geologic Logging and Classification

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QC Review Signatures		
Name/Role	**Signature**	**Date**
John Fleissner, PE Corporate QC Manager		April 11, 2011
Nova Clite, PG Sr. Hydrogeologist	Nova Clite	April 11, 2011
Cecil Irby PG Sr. Geologist/PM- PFC Specific	Cecil Irby	February 22, 2016

STANDARD OPERATING PRACTICE
OTIE007B

Soil and Rock Geologic Logging and Classification
(Modified for PFC specific procedures)

Given the low detection limits associated with PFC analysis and the many potential sources of trace levels of PFCs, field personnel are advised to act on the side of caution by strictly following these protocols, frequently replacing nitrile gloves, and rinsing field equipment to help mitigate the potential for false detections of PFCs. **Do not use Teflon®-containing materials** (e.g., Teflon® tubing, bailers, tape, plumbing paste, or other Teflon® materials) since Teflon® contains fluorinated compounds. Specific items related to soil and rock geologic logging and classification are discussed below.

1.0 INTRODUCTION

The general objective of this Standard Operating Practice (SOP) is to provide procedures for conducting activities for description, investigation, and characterization of soils, residuum, and bedrock. The discussion includes methods to complete the following: describe the collection of soil and bedrock samples obtained during drilling operations, advance soil and bedrock test borings, and collect subsurface soil and bedrock samples.

2.0 FIELD PROCEDURE FOR SOIL AND BEDROCK CLASSIFICATION

Exploratory borings typically represent the single most important source of information used for characterizing subsurface conditions for environmental or geotechnical studies. The analysis and interpretation of subsurface conditions is greatly affected by the quality of the lithologic logs used.

This SOP is intended to provide a basis for consistency among practitioners responsible for documenting subsurface conditions encountered in exploratory borings. It provides a discussion of general observations that should be routinely made and documented on every boring log. It also presents standardized terminology and definitions for describing soils, sediments, and bedrock. The intent of this discussion is to promote the recognition that consistent logging provides the foundation for all subsequent analysis and design, and to encourage greater care and standardization in all phases of log preparation.

2.1 GENERAL CONSIDERATIONS

As a general rule, subsurface data will be of sufficient detail and quality to support both environmental and geotechnical analyses. It is critical that an adequate understanding of subsurface conditions is developed prior to the installation of groundwater monitoring wells, or prior to design for environmental restoration or site development, to help ensure further activities are based on sound, reliable data.

This SOP presents detailed procedures for classifying and describing soil and bedrock based upon the Unified Soil Classification System (USCS) and standard practices developed by the American Society for Testing and Materials (ASTM). The USCS is the most widely accepted system within the engineering community.

2.2 EQUIPMENT

Appropriate equipment shall be maintained on-site to classify, describe, and log soil samples and subsurface conditions. At a minimum, this should include the following equipment:

- Log book,
- Indelible black ink pens,
- Clipboard,
- Straightedge,
- Retractable steel tape with increments in 10ths and 100ths of feet,
- Appropriate field forms (e.g., hazardous toxic waste drilling logs),
- Water-level tape,
- 10X magnifying glass, and
- Munsell® soil color chart

Additional items which may be helpful include:

- Pocket penetrometer,
- Torvane (field),
- Stainless steel weight (tag bar),
- Permanent indelible felt-tip marking pens (Sharpie® or equivalent),
- Dilute (10 percent) hydrochloric acid, and
- No. 10 to 200 sieves.

Boring logs will be prepared in the field on the appropriate drilling log form. Each log will be signed by the geologist or geotechnical engineer.

2.3 FIELD CLASSIFICATION OF SOILS

This section establishes guidelines for consistent field classification of naturally-occurring soils and sediments based upon the USCS and ASTM Standards D 2487 and D 2488 (ASTM, 1993a; ASTM, 1993b).

- The USCS provides the primary framework for this soil classification scheme. Using the USCS, soils/sediments are divided into 15 soil groups, based upon observations and prescribed manual and/or laboratory tests. The USCS grouping is intended to minimize the number of laboratory tests required for definitive soil classification.
- ASTM D 2487 presents criteria for classifying soils/sediments based on laboratory determination of gradation (particle-size distribution) and behavioral (engineering) characteristics.
- ASTM D 2488 (Standard Practice for Description and Identification of Soils, Visual-Manual Procedure) describes methods for identifying soils/sediments based on visual examination and simple manual tests. ASTM D 2488 also provides standardized terminology for describing other attributes of soils/sediments that should be documented to adequately characterize hydrogeologic and geotechnical conditions. Detailed site-specific analysis of factors such as color, weathering, and geochemical characteristics may be required to provide a thorough understanding of site stratigraphy.

The objectives of this discussion are to provide the following:

- Standard criteria for identifying and classifying soils and/or sediments,
- Standard terminology for describing key attributes of soils and sediments,
- A system that will result in logs that are useful for both engineering and hydrogeologic purposes, and
- A classification system that will allow for reliable comparison of logs prepared by different practitioners.

2.3.1 Procedure

The process for developing consistent soil/sediment descriptions is summarized below:

- Identify the soil components present.
- Determine whether the sample is composed primarily of coarse-grained, fine-grained, or organic soils, or whether a mixture is present.
- Evaluate soil gradation and/or behavioral properties (estimate the degree of plasticity) through a combination of visual inspection and field tests (described in section 2.3.5, below).
- Classify and describe the soils using the results of visual inspection and field tests.
- Assign a USCS group name and symbol.
- Prepare a detailed description of the sample using prescribed (ASTM) terms and definitions.
- Assign a geologic descriptor based upon origin (genetic or formation).

Soils rarely exist in nature as individual components (gravel, sand, silt, or clay). Mixtures of the individual components in varying proportions are much more common. Each component contributes to the characteristics of the soil mixture. In order to classify a soil mixture, the relative percentages of the component grain sizes must be determined. The first step is to determine whether the soil is predominantly coarse-grained (gravel and/or sand) or fine-grained (silt and/or clay). Although the USCS is based on percentage by weight, estimation of the relative percentage of soil components in the field must be based upon visual assessment of the relative volumes of materials present.

A rough determination of the relative weight percentages of the components present can be made by spreading the sample out in the palm of the hand and making a visual estimate.

Carefully washing the fines from a portion of a sample, by mixing the soil with water and pouring off the clouded suspension of fines and water, will aid in estimating the percentage of fines present by comparison with an unaltered portion. Mixing a sample with water in a jar and allowing the mixture to settle is also helpful. The coarse-grained components will fall completely out of suspension in 20 to 30 seconds.

When describing bulk samples or soils exposed in an excavation, the percentages of cobbles and boulders should be estimated by volume. The remaining soil matrix should be described independently.

2.3.2 Identification

The USCS groups soils into three major divisions: coarse-grained soils, fine-grained soils, and highly organic soils. The characteristics that define these soil groups, and procedures involved in identifying the individual components, are described in the following paragraphs.

Coarse-Grained Soils

Coarse-grained soil components are defined as materials that would pass through a 3-inch sieve and which would be retained by a No. 200 sieve (0.075 millimeters [mm]). Coarse-grained soil components are further subdivided by grain. Soil is considered coarse-grained if 50 percent or more of a sample (by dry weight) is larger than 0.075 mm. The range of both fine- and coarse-grained soil components present in a sample should be determined by careful examination.

Fine-Grained Soils

Soil is considered fine-grained if 50 percent or more of a sample (by dry weight) is smaller than 1.75 mm (No. 200 sieve). Fines can be further subdivided into silt and clay. Classification of fine-grained soil components may be based upon mineralogy, grain-size, or physical behavior. Mineralogy is difficult to determine in the field without previous geologic information based upon laboratory techniques, such as X-ray diffraction. Grain-size is difficult to estimate because of the size classes involved and the limitations imposed by field equipment such as hand lenses. Additionally, textural classification of fines can be misleading in terms of geotechnical properties. For these reasons, the USCS defines the terms “silt” and “clay” solely on the basis of the plasticity characteristics of material finer than 0.075 mm.

Organic Soils

Organic soils contain sufficient organic matter, living or in the process of decay, to significantly affect the engineering properties of the soil. Most organic soils can be considered a special category of fine-grained soils. Topsoil, humus, peat, organic silt, organic clay, and diatomaceous earth are common examples. The water content of organic soils is typically very high. Organic soils invariably have very low shear strength in their natural state, but may exhibit high tensile strength in certain directions because of fibrous materials.

Observations of color and odor are of particular value for the identification of soils. Dark gray, black, and various shades of brown are characteristic colors. Organic soils frequently change color when exposed to air. Many organic soils, particularly marine peats and silts, have a distinctive odor of hydrogen sulfide. This odor is especially apparent in fresh samples. Heating the sample intensifies the odor.

Organic silts and clays typically exhibit slight to medium plasticity and form threads that are very weak, soft, and spongy near the plastic limit. Less effort is required to pull fine-grained non-fibrous organic soils apart than inorganic fines. A clean break is generally formed. The smear of organic silts and clays, although smooth, is very dull.

Peat is an organic soil characterized by the presence of vegetable matter (e.g., leaves, sticks, grass, wood, and/or moss) in various stages of decomposition. These components generally impart a fibrous texture to the soil. Peat is typically brown or black in color. Peat and organic silt are common components of fresh water swamps, bogs, and tidal flats.

Diatomaceous earth is an organic soil commonly found in the lower stratum of peat bogs. Diatomaceous earth is composed primarily of the siliceous skeletal remains of diatoms that accumulated in lakes and swamps. The amount and nature of impurities is highly variable and may include sponge spicules and radiolarian remains as well as organic and inorganic silt and clay. Diatomaceous earth reacts rapidly to the dilatancy test and typically dries to a highly friable soil. Color ranges from white to yellow to various shades of brown and gray.

Another important consideration in the identification of organic soils may be the location with respect to topography. Low-lying swampy areas frequently contain highly organic soils.

2.3.3 Descriptive Format and Terminology

The USCS provides useful information about soil gradation and plasticity. However, critical information necessary for site interpretation and evaluation are not included in the USCS. The USCS should therefore be supplemented with additional information. The following discussion identifies features, which should be evaluated and described to supplement the USCS.

Order of Description

The descriptive format begins with the USCS group name and symbol, which will be discussed in more detail below. A detailed description, based upon ASTM standards, follows the USCS classification. For consistency, the primary descriptive elements, listed below, should be included in all soil descriptions in the following standardized order:

- USCS group name,
- Descriptive USCS classification in accordance with ASTM-2488-84,
- Density or consistency (plasticity and cohesiveness),
- Moisture condition,
- Color,
- Stratification and structure, and
- Deposition environment.

A description of other pertinent properties should be included, as needed, following the primary descriptive elements listed above.

Following the detailed soil description, the probable geologic origin should be provided (in capital letters as shown). Several typical descriptions are presented below:

CH- Clay with some gravel, very stiff, low plasticity, saturated, 10YR 5/4 Yellowish Brown, fractured with silt filling fractures

Silty clay with trace gravel, soft, medium plasticity, moist, 2.5 YR 4/3 Olive Brown, Glacial Till

SP- Poorly graded sand with trace clay, fine to medium grain, well rounded, medium dense, moist, Alluvial deposit.

Soil/sediment descriptions should be as comprehensive as possible, without excessive emphasis on insignificant details. Good judgment and common sense based on an understanding of geology and engineering behavior of soils is required.

2.3.4 Primary Descriptive Elements

Soil Type (Group Name and Symbol)

If a soil is classified as a gravel or sand and it contains 12 percent or less fines, it is considered to be well-graded or poorly graded, depending upon the distribution of grain sizes (gradation) present.

"Well-graded" is an engineering term that indicates a continuous distribution of particle sizes from the coarsest to finest particle size of the relevant fraction. "Poorly-graded" pertains to sediments that lack a continuous distribution of grain sizes. Poorly graded include uniformly-graded (predominantly one particle size or well sorted) and gap-graded or step-graded (one or more particle sizes absent) sediments. These terms may be included as secondary descriptive elements.

These terms should not be confused with the geologic terms used to describe sorting. A uniformly graded sediment would be described as well-sorted using this terminology.

Guidelines for the use of modifiers and other descriptive terms which may be included in the USCS group name are presented below.

Use of "with":

1. If a soil is predominantly sand or gravel but contains an estimated 15 percent or more of the other granular component, add "with sand" or "with gravel" to the group name.
2. If a soil contains any cobbles or boulders, add "with cobbles" or "with boulders" to the group name.
3. If a fine-grained soil contains (little) 15 to 25 percent sand, gravel or both, add "with sand" or "with gravel" to the group name (whichever is more predominant). Use "with sand" if the related percentages are equal.
4. If a granular soil contains 10 percent (few) fines, add "with silt" or "clay" to the group name.

Use of adjective modifier:

1. If a fine-grained soil contains 30 percent or more sand or gravel (some), add "sandy" or "gravelly" to the group name (e.g., SANDY SILT, GRAVELLY LEAN CLAY).
2. If a granular soil contains more than 15 percent (little) fines, use an adjective modifier (e.g., SILTY SAND, CLAYEY GRAVEL).

Use of dual symbols:

1. If a granular soil is estimated to contain 10 percent fines use a dual symbol.
   a) the first symbol shall correspond to a clean gravel or sand,
   b) the second symbol shall correspond to a gravel or sand with fines (e.g., GW - GC, SP - SM).
2. CL-ML (see USCS Plasticity Chart - do not use this combination unless substantiated by laboratory analyses).

Use of borderline symbols:

1. Use to indicate a soil with properties that do not distinctly place the soil into a specific group (e.g., CL/CH, GM/SM, ML/SM).
2. Using the USCS, "and" may be used to indicate that soils are interbedded by linking group names (e.g., LEAN CLAY [CL] AND POORLY GRADED SAND [SP])

Density or Consistency

Density relates to cohesionless (predominantly coarse-grained) materials, while consistency relates to cohesive (predominantly fine-grained) soil. Both can be estimated from the standard penetration test. The standard penetration test is defined as the number of blows required to drive a standard 2-inch outside diameter split-barrel (spoon) sampler through 18 or 24-inches of undisturbed soil using a free falling 140 pound weight. The blow count is recorded in 6-inch increments. The first 6 inches is considered to be a seating drive. The sum of the blows required for the second and third 6-inch increments is defined as the penetration resistance (N-value).

Standard penetration tests should be performed in accordance with procedures described in ASTM D 1586. It is essential to ensure that standard penetration test procedures adhere to this ASTM standard so that blow counts yield meaningful N-values.

Consistency can also be readily evaluated by feel or with a pocket penetrometer (PP) or vane shear instrument such as a torvane (TV). When using these methods to estimate consistency, sample disturbance should be considered.

Terms for describing the density or consistency of a soil are presented in Tables1 and 2.

Table 1: Density or Consistency of a Soil

Cohesionless (Predominantly Coarse-Grained) Soils	
N-Value	**Density**
0-4	Very loose
5-10	Loose
11-30	Medium Dense
31-50	Dense
50+	Very Dense

Table 2: Cohesive (Predominantly Fine-Grained) Soils

N-Value	Consistency	Manual Criteria	Undrained Compressive Strength, qu (Tons/Sq. Ft.)*	Undrained Shear Strength, SU (Tons/Sq. Ft.)**
<2	Very Soft	Thumb will easily penetrate soil more than 1 inch	<0.25	<0.12
2-4	Soft	Thumb will easily penetrate soil about 1 inch	0.25 - 0.5	0.12 - 0.25
5-8	Medium Stiff	Thumb will easily indent soil about ¼ inch	0.5 - 1	0.25 - 0.5

N-Value	Consistency	Manual Criteria	Undrained Compressive Strength, qu (Tons/Sq. Ft.)*	Undrained Shear Strength, SU (Tons/Sq. Ft.)**
9-15	Stiff	Indented by thumb ¼ inch only with great effort	1 - 2	0.5 - 1
16-30	Very Stiff	Thumb will not indent soil. Readily indented with fingernail	2 - 4	1 - 2
31+	Hard	Indented with difficulty with thumbnail	>4	>2

*Measured with pocket penetrometer.
**Measured with TV or similar vane shear instrument.

Moisture Condition

The moisture condition of the soil shall be described on the field boring log. Soils are described as being dry, moist, or wet with increasing degrees of saturation based on the following criteria:

Table 3: Description of Soil Moisture

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Damp	Slight visible evidence of moisture
Moist	Moisture clearly evident
Saturated	Visible free water, pores filled with water; commonly soils collected from below water table

Color

For consistency purposes color should be identified using the Munsell Soil Color Charts. The charts provide a semi-quantitative aid to correlate color across a site. It also aids in the assessment of secondary weathering zones and moisture relationships.

When naturally wet soils are described after being allowed to dry, it should be noted on the log. The color description should not be capitalized and should be followed by the alpha-numeric Munsell code in parentheses as shown in the following examples:

- Pale red (2.5 YR 6/2), and
- Very dark brown (7.5 YR/2).

Variations due to mottling in the soil color should also be noted using the Munsell soil color notation.

Gradation

The soil components present in a sample should be identified as described at the beginning of this section. The relative percentages of the different fractions present should be described based on estimates to the nearest 5 percent, using the terms from ASTM D2488, as summarized in Table 4.

Table 4: Soil Component Terms

Description	Percentages
Mostly	50 - 100 percent
Some	30 - 45 percent
Little	15 - 25 percent
Few	5 - 10 percent
Trace	Particles are present but estimated to be less than 5 percent

The component with the highest percentage should be recorded first with the next highest percentage recorded next.

Gradation within the sand and gravel fractions must be defined or it is assumed that all fractions are present. When recording gradation, always begin with the coarser fraction, (e.g., mostly coarse to fine gravel, and mostly medium to fine sand).

Plasticity and Cohesiveness

If a sediment sample is predominantly fine-grained, a plasticity designation should be provided (see section 2.3.5) Additionally, the cohesiveness of soils including both fine- and coarse-grained components should be noted. Soils in which the adsorbed water and particle attraction work together to produce a mass that holds together and deforms plastically at varying water contents are known as cohesive soils. A predominantly coarse-grained soil could be cohesive in character with as little as 20 percent fines, depending upon the overall gradation of the material and the plasticity characteristics of the fines. A soil accurately classified as GC or SC would always be cohesive.

Mixtures of coarse- and fine-grained soils should be described as cohesive or cohesionless.

Stratification/Structure

Most geologic structures may be characterized as stratified, massive, or some variation of the two. Some terminology for describing soil structure or stratification are defined in Table 5.

Table 5: Soil Stratification Terms

Description	Criteria
Stratified	Alternating layers of varying material or color with layers at least 6 mm thick; note thickness.
Laminated	Alternating layers of varying material or color with the layers less than 6 mm thick; note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps that resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.
Massive (Homogeneous)	Same color and appearance throughout.

Description	Criteria
Bedding Attitude	Horizontal or Inclined (with angle).
Lithologic Contact	Sharp or Gradational (with nature of gradation).

The identification of naturally occurring fractures or planes of weakness (as opposed to those that may have been produced by the drilling or sampling process) can be made through the recognition of surface coatings, changes in oxidation state of adjacent materials, or stress surfaces such as slickensides. Common surface coatings include carbonates, organics, secondary iron, manganese oxide, and silt or clay. Changes or mottling in color adjacent to a fracture surface are generally indicative of a change in oxidation state associated with a naturally occurring fracture.

Geologic Interpretation

A geologic interpretation may be provided with each description. This may include a generic interpretation (such as alluvium or saprolite), geologic age, and/or formation name. Accurate field interpretation of geologic origin may support geologic evaluations conducted later in the office. Identification of the geologic origin or depositional environment is often necessary to support interpretations of the distribution, uniformity, or variability of subsurface soils and sediments. The geographic position of individual boring locations (e.g., crest of a hill, terrace, edge of a flood plain, etc.) should be considered when making this determination.

Other Descriptive Elements

Understanding of subsurface conditions at a site is dependent upon detailed descriptions of soil or sediment samples. The following additional characteristics should be considered and described, if pertinent. It is the responsibility of the field geologist and project staff to determine the extent of detail required. These additional elements should be appended to the primary description, separated by a semicolon:

- Angularity, size, and shape of coarse-grained components.
- Hardness of coarse-grained components.
- Presence of boulders or cobbles.
- Fossils.
- Accessory minerals.
- Lithology of coarse-grained components.
- Cementation or presence of calcareous materials.
- Odor.
- Weathering zone.
- Presence of roots, root holes, animal burrows or other macro-pores.

Angularity and Shape of Coarse-Grained Components

A description of the angularity of coarse-grained sand, gravel, cobbles and boulders may provide a basis for interpretation of geologic origin and correlation of geologic units encountered at different locations. The terminology in Table 6 should be used.

Table 6: Grain Angularity and Shape Terms

Description	Criteria
Angular	Particles have sharp edges and relatively planar sides with unpolished surfaces.
Sub-angular	Particles are similar to angular description but have rounded edges.
Sub-rounded	Particles have nearly planar sides but have well-rounded edges.
Rounded	Particles have smoothly curved sides, no edges.

The shape of gravel, cobbles, and boulders should be described as follows:

Description	Criteria
Flat	Particles with width/thickness of >3 inches
Elongated	Particles with length/width of >3 inches.
Flat and elongated	Particles meet criteria for both flat and elongated.

Hardness of Coarse-Grained Components

Coarse sand and larger particles may be described as "hard" if particles do not crack, fracture, or crumble under a hammer blow. Alternatively, state what happens when particles are hit with a hammer.

Presence of Cobbles and Boulders

The presence of cobbles or boulders should be noted. This may be evident through observation of drill advance or by fragments recovered in samples. If possible (such as in a test pit), a volumetric estimate of the percent of cobbles or boulder present should be made. Alternatively, a qualitative description such as "occasional" or "numerous" cobbles or boulders should be provided. If any cobbles or boulders are present, "with cobbles" or "with boulders" should be appended to the USCS group name.

Fossils, Accessory Minerals, or Lithology of Coarse-Grained Components

Fossils are generally fragmented in cores and drill holes; however, some whole fossils may be found in cores. The fossils present in a sample may be difficult to classify, depending on the type and quality of the specimen.

Accessory minerals constitute only a minor percentage of the bulk of a sediment sample. However, these minerals provide significant indicators of depositional environment and are useful in correlation.

Common accessory minerals include:

- Glauconite,
- Heavy minerals,
- Sulfides (pyrite and marcasite),
- Manganese oxide,
- Feldspar,
- Chert,
- Mica,

- Kaolin,
- Siderite,
- Gypsum,
- Lignite, and
- Iron oxide.

Lignite and manganese oxide are frequently encountered and frequently confused with each other.

The lithology of coarse-grained soil components can also provide a valuable clue to assist with interpretations of depositional history and stratigraphic correlation. Notations such as "sand predominantly quartz" or "gravel predominantly shale fragments" may be appended to the primary description.

Cementation or Presence of Calcareous Materials

The degree of cementation of coarse grained soils should be described, if relevant to the sample. The criteria for this description is summarized in Table 7.

Table 7: Degree of Cementation Terms

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

Calcium carbonate is a common cementing agent. The amount of calcareous material present in a sample can be classified according to the reaction with dilute hydrochloric acid. The classification is summarized in Table 8.

Table 8: Presence of Calcareous Materials

Description	Criteria
None	No visible reaction.
Weak	Some reaction with bubbles forming slowly.
Strong	Violent reaction with bubbles forming immediately.

Weathering

The recognition and correlation of weathered zones can provide valuable clues for deciphering site stratigraphy. It is important to recognize, however, that soils, in the engineering sense,encompasses a wide range of materials, all of which represent various stages in the weathering of bedrock. Additionally, a clear distinction must be made between the weathering of transported superficial deposits and the in-place development of residual soils from a bedrock mass. The recognition and description of buried weathered zones is particularly useful in terrain characterized by transported soils and sediments.

Weathering involves two basic processes: mechanical disintegration and chemical decomposition. By decomposition, chemical changes take place that result in the dissolution and leaching of soluble materials. These changes are often manifested by changes in color and the development of zones of cementation that can be readily recognized in the field. Although weathering processes are strongly dependent on local (historic) climatic conditions and the physical and chemical characteristics of the parent materials, color can provide a general indicator of some important chemical weathering processes, such as oxidation, reduction, and hydration. It is also important to remember that the forces of weathering generally lose their intensity with depth below the land surface (at the time the weathering profile developed).

A good example of the effects of oxidation and hydration is the variations in the color of soils in the Southeastern United States (Buckman and Brady, 1969). Red soils are the product of the development of hematite, resulting from oxidation of ferrous oxide. As soils become hydrated, hematite is readily changed to limonite, resulting in a noticeable color change to yellow. When the products of hydration dry out, dehydration may occur and the reaction will reverse itself.

Interpretation based upon color and other field observations should be considered a preliminary interpretation, which may not necessarily delineate zones of past or present weathering.

Roots, Root Holes, Animal Burrows, or Other Macro-Pores

Any potential source of secondary porosity that could be significant in terms of the infiltration and movement of water or the migration of contaminants should be described. This may include root channels (relic or active); animal burrows (krotovinas); cracks related to desiccation and wetting, freezing and thawing, subsidence; or other features not discussed herein.

Odor

Odors should be described if unusual or organic. Soils containing sufficient amount of organic material usually have a distinctive odor. If the samples are dried, odor may be revived by wetting the sample.

2.3.5 Field Tests for Classifying Fines

Several tests can be performed in the field to help determine the plasticity, and hence the assignment, of a group name to a soil sample. These tests, which include the dilatancy test, soil thread test, toughness, dry strength, smear and stickiness, and the test tube test, are described below. Prior to performing these tests, particles larger than the No. 40 sieve (0.42 mm - medium sand and larger) should be removed.

Dilatancy Test

Select a representative sample approximately 0.5 cubic inch in volume and add water, if necessary, until the soil has a soft but not sticky consistency. Form a pat of the wet soil in the palm of one hand and shake it horizontally, vigorously striking the side of the hand with the other hand several times. Alternately squeeze and release the pat of wet soil. Note the rate at which water appears while shaking and disappears while squeezing. Materials that are predominantly silt will show a dull-dry surface upon squeezing and a glassy-wet surface upon releasing the pressure and upon shaking or vibrating the pat. With increasing clay content this phenomenon becomes less pronounced due to lower mobility of pore water. Rapid reaction to the shaking test is typical for uniform fine sand and diatomaceous earth, as well as for inorganic silts.

Soil Thread Test

Following completion of the dilatancy test, attempt to roll the test specimen into a thread between the palms or by hand on a smooth surface. Roll the sample into the smallest thread possible, adjusting the water content as needed. If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation. If it is too dry, add water a few drops at a time, thoroughly kneading the soil to assure a uniform moisture content. Note the final minimum diameter attained before the thread breaks or crumbles.

The very fact that a soil can be rolled into threads indicates plasticity and the presence of clay. The smallest thread diameter possible without crumbling is indicative of the degree of plasticity.

Toughness

Fold the sample thread from the test above and reroll the sample into a thread about 1/8-inch in diameter. Repeat this procedure until the thread crumbles at a diameter of approximately 1/8- inch. The thread will crumble at a diameter of 1/8-inch when the soil is near the plastic limit (the boundary between the plastic and semi-solid state). Note the strength of the thread and the pressure required to roll the thread near the plastic limit.

After the thread crumbles, lump the pieces together and knead the sample until the lump crumbles. Note the toughness of the material during kneading.

The higher the degree of plasticity of the soil, the stiffer are the threads as their water content approaches the plastic limit and the tougher are the lumps as the soil is remolded after rolling. The distinction in the toughness of the threads can only be felt at water contents close to the plastic limit. The greater the number of times the soil can be rolled prior to reaching the plastic limit for soils started at the same water content, the more plastic is the material. Cohesive soils containing significant amounts of organic material or mica form threads that are very soft or spongy near the plastic limit.

Dry Strength

Mold the test sample to the consistency of putty, adding water if necessary. Shape the test specimen into a ball or angular fragment about 0.5 inch in diameter. Allow the sample to dry completely by air-drying, sun or oven, as long as the temperature does not exceed 60 degrees Centigrade. Test the strength of the fragment by crushing between the fingers. The dry strength increases with increasing plasticity. Occasionally, the presence of high-strength water-soluble cementing materials, such as calcium carbonate, may cause exceptionally high dry strength. The presence of calcium carbonate can be detected with dilute hydrochloric acid. Silty fine sands and silts have about the same slight dry strength, however, they can be distinguished by the feel upon crushing. Fine sand feels gritty, whereas silt typically has the smooth feel of flour.

Smear and Stickiness

A high degree of stickiness and a very smooth smear in the natural state are indicative of high plasticity.

Although the primary basis for classification of fines is soil plasticity as discussed previously, the procedure described below for estimating the grain-size distribution of fine-grained soil components can also be helpful.

Test Tube Test

Silt and clay size particles may also be differentiated by determining their approximate settling rates in water. The settling rate may be measured in the field by shaking a small sample of the soil to be identified in a test tube, or an 8-ounce clear glass jar, filled with water and then allowing the particles to settle. The time required for particles to fall a distance of 4 inches is about 30 seconds for 0.074 mm size (the boundary between sand and silt) and about 50 minutes for particles 0.005 mm in size (the boundary between silt and clay). An approximate idea of the grain sizes present in a sample of fined-grained soil may be obtained by this method.

An additional aid in distinguishing silt and clay is by visual inspection under a hand lens. If grains are visible to indistinctly visible under 6.3x magnification, the sample is silt. If the sample has no visible grains under 6.3x magnification, then the sample is clay. Since most hand lenses are equipped with 10x magnification, this method is approximate as some clay grains may be indistinctly visible under 10x magnification.

The above tests are approximate and may not correlate precisely to results of laboratory grain size or mineralogical analyses. The tests do provide a method for consistent field classification, however.

The use of all of these tests provides a more accurate determination of the fine-grained material present in a soil sample; however, some of these tests are time consuming and may not be practical in many field situations. At a minimum, the thread test and smear test should be performed. The dilatancy test should be performed whenever possible. If, however, a number of borings are to be drilled through a fine-grained stratum, it may be advisable to perform all of the tests on a few selected, representative samples of each distinct lithologic unit from different boring locations. The results can then be used as a benchmark for classification of samples collected throughout the field program.

2.4 FIELD CLASSIFICATION OF BEDROCK

The purpose of bedrock classification logs is to define subsurface conditions. It is important that classification provide a concise, consistent, and complete representation of subsurface conditions. The following sections discuss the outline for classifying bedrock encountered during a field investigation program. Bedrock classification must be performed by an experienced, professional OTIE geologist.

2.4.1 Rock Quality Designation (RQD)

The RQD is the total length of core pieces (unweathered bedrock) greater than or equal to four inches (10 centimeters) in length divided by the total length of the core run. RQD shall be expressed as a percentage and recorded in the PERCENT RQD column for each core run.

Care must be taken to correctly identify natural bedrock breaks from mechanical breaks (breaks caused by drilling). Mechanical breaks are often, but not always, accompanied by fresh bedrock appearance. Generally, natural breaks should first be considered as caused by a joint.

Other natural breaks of the core may be due to:

- Irregular and rounded surfaces that reflect considerable grinding of the core due to rotation during drilling along a plane of weakness.
- Rather smooth surfaces that cannot be rejoined but which show no signs of weathering.
- Weathered surfaces.

Include all pieces of core which are greater than or equal to four inches (10 centimeters) in length and bounded by natural surfaces. As a general guideline, if a core segment can be rejoined with only a hairline separation, it should be included in computing the percent RQD.

2.4.2 Hardness

Hardness, or induration, shall be described per Table 9. If there is no specific column for hardness, it shall be included in the DESCRIPTION column.

Table 9: Bedrock Hardness Terms

DESCRIPTIVE TERMS	DEFINING CHARACTERISTICS	
Extremely Soft	RO	Indented by thumbnail
Very Soft	R1	Crumbles under firm blows with point of geologist's pick, can be peeled with pocket knife
Soft	R2	Can be peeled with pocket knife with difficulty, shallow indentations made by firm blows of
Average	R3	Cannot be scraped or peeled with pocket knife, can be fractured with a single blow from a
Hard	R4	Requires more than one blow with geologist's hammer to break into pieces with sharp edges
Extremely Hard	R6	Can only be chipped with geologist's hammer

All personnel must refer to the OTIE Safety Policies and follow Safety Procedures before and during handling potentially hazardous and contaminated soil or bedrock.

2.4.3 Description

Bedrock core descriptions shall be recorded in the DESCRIPTION column for every core run. Consistency is important in describing the core. Describe the major petrologic aspects of the bedrock first. Add minor constituents as needed. Finally, describe structural features of the bedrock.

An acceptable order of description is described below.

Order of Description

The descriptive format begins with the bedrock type, which will be discussed in more detail below. A detailed description will be based upon ASTM standards. For consistency, the primary descriptive elements, listed below, should be included in all bedrock descriptions in the following standardized order:

- Bedrock type,
- Relative hardness,
- Density,
- Texture,
- Color,
- Weathering,
- Bedding,
- Stratification and structure,
- Rock quality designation,
- Other descriptive features, and
- Deposition environment.

Terms such as " AS ABOVE " and "AS BELOW" or drawing a continuous arrow down the drill log to indicate similarity in bedrock descriptions are not acceptable on classification log sheets.

Bedrock Type

The first item in the description should be the bedrock type. Be specific and use the major bedrock classification (e.g., sandstone, basalt, etc.)

When necessary, modify the primary bedrock type with a secondary characteristic descriptions (e.g., silty limestone or lime siltstone). All bedrock should be modified by grain or crystal size. Table 10. lists grain size classifications.

Hardness

If there is no specific column for hardness (Section 4.2) on the classification, it shall be included as part of the DESCRIPTION.

Table 10: Grain-Size Classification (ASTM D2487-10)

Particle Diameter (mm)	Sediments (Soils And Unconsolidated Bedrock)	Consolidated Bedrock
256 or more (10 inches or more)	Boulder	Boulder conglomerate
64-256 (2.5 to 10 inches)	Cobble	Cobble conglomerate
4-64	Pebble	Pebble conglomerate
2-4	Granule	Granule conglomerate
1-2	Very coarse sand	Very coarse sandstone
0.5-1	Coarse sand	Coarse sandstone
0.25-0.5	Medium sand	Medium sandstone
0.125- 0.25	Fine sand	Fine sandstone
0.0625- 0.125	Very fine sand	Very fine sandstone
0.4- 0.0625	Silt	Siltstone
0.4 or less	Clay	Claystone or shale

Color

Describe the color of the core when it is wet. The color shall be modified by using adjectives such as light, dark, mottled, or shades and tones of each other (e.g., grayish blue). As an alternative, the Geological Society of America or the Munsell color charts may be used. If color charts are used, the name of the chart should be noted on the log form.

Fracturing

The concentration and fracture spacing shall be described in accordance with Table 11. As an alternative, the observed fracture spacing may be listed on the log.

Bedding Thickness

Bedding thickness modifiers shall be classified in accordance with Table 12. As an alternative, the actual bedding thickness may be listed on the log. If there is no specific column for weathering (Section 2.4.8) on the classification log form, it shall be included as part of the description.

Table 11: Bedding Thickness Bedrock Description

THICKNESS (English)	THICKNESS (Metric)	BEDDING CLASSIFICATION
Over 3.3 feet	Over 1 m	Very thickly bedded
3.3 feet - 1 foot	1m - 30 cm	Thickly bedded
1 foot - 4 inches	30cm - 10cm	Medium bedded
4 inches - 1 inch	10 cm - 3 cm	Thinly bedded
1 inch - 2/5 inch	3 cm - 1 cm	Very thinly bedded
2/5 inch - 1/8 inch	1cm - 3 mm	Laminated
1/8 inch - 1/32 inch	3mm - 1mm	Thinly laminated
less than 1/32 inch	less than 1mm	Microlaminated

Table 12: Fracture Spacing Description Of Bedrock

BEDROCK DESCRIPTIVE TERMS	FRACTURE SPACING
Very broken	Less than 1 in.
Broken	1 in. to 3 in.
Slightly broken	3 in. to 6 in.
Massive (unbroken)	6 in. and greater

Other Terms

Other observations are usually necessary to accurately describe the core. These observations should include zones where t+he core is very broken, where grinding of the core is apparent, cementation and/or friability, zones of mineralization indicating the minerals present, intervals where core samples have been taken for laboratory testing, etc.

2.4.4 Weathering

The degree of weathering shall be described using the following terms:

- **Fresh** - Crystals bright, joints rarely show staining. Bedrock rings with hammer if crystalline.

- **Very slight** - Some joints strained, some joints may show clay if open, crystals in broken face show bright. Bedrock rings with hammer if crystalline.
- **Slight** - Joints strained and discoloration extends into bedrock up to one inch. Open joints contain clay. Some feldspar are dull and discolored. Crystalline rocks ring with hammer.
- **Moderate** - Significant portions of bedrock show discoloration decomposition and disintegration. Most feldspars are dull and discolored; some show kaolinization. Bedrock has dull sound with hammer and shows significant loss of strength as compared with fresh bedrock.
- **Moderately Severe** - all minerals except quartz are discolored or stained. All feldspars are dull and discolored and majority show kaolinization. Bedrock shows severe loss of strength and can be easily picked with a hammer. Dull sound with hammer. Decomposition and/or disintegration at least 50 percent.
- **Severe** - All minerals except quartz are discolored or stained. Bedrock fabric clear and evident, but reduced in strength to very dense soil. All feldspars kaolinized to some extent. Some fragments of strong bedrock scattered throughout.
- **Very Severe** - All minerals except quartz are discolored or stained. Bedrock fabric discernible, but mass effectively reduced to soil with only fragments of strong bedrock remaining. Decomposition and/or disintegration 100 percent with structure/fabric intact.
- **Complete** - Bedrock reduced to “soil.” Bedrock “fabric” not discernible or discernible only in small scattered locations. Quartz may be present as dikes or stringers. All minerals in relic form. Decomposition and/or disintegration 100 percent with structure/fabric destroyed.

If there is no specific column for weathering, it shall be included in the DESCRIPTION column.

2.4.5 Joint Spacing

All joints, fractures, bedding breaks, etc., should be depicted in Section A of the boring log at the exact depth they exist and the attitude they exhibit. Depending upon the classification log form used, the following information shall be provided:

- Maximum, minimum, and average joint spacing for each run. The maximum joint spacing is the length of the longest piece of core bounded at both ends by joint surfaces. The minimum joint spacing is the length of the shortest piece of core bounded at both ends by joint surfaces. Average joint spacing for each core run is determined by dividing the total length of all pieces bounded at both ends by joint surfaces by the total number of these pieces.
- Graphic illustration of joint pattern including orientation and a description of the joint surface (rough, smooth, shiny, dull, etc.).

2.4.6 Remarks

The REMARKS column should include pertinent information such as volume of gain or loss of water, the performance of in situ tests, the time each day’s activities begin, tool drops, soft zones, cavities, core losses, secondary minerals, fossils, casing sizes and depths (if no specific space provided), ground water levels (if no specific space provided), artesian conditions, etc.

2.4.7 Notes

NOTES should include items which pertain to the entire drill hole such as the type of drilling equipment used, drilling contractor and personnel, approximate distance drill hole was offset from original location, project-specific bedrock profile symbols (final log only), bit changes, drilling rate, etc. Other information may warrant being recorded at the discretion of field personnel.

In the absence of a NOTES space, the above items should be included in the REMARKS column.

2.4.8 Abbreviations

Abbreviations should be kept to a minimum. However, when expedient, the abbreviations suggested in Table 13 may be used individually or in combination.

Table 13: Soil and Bedrock Logging Abbreviations

/	And
@	At
Abdt	Abundant
Ang	Angular
Blk	Black
Brn	Brown
Calc	Calcareous
Cgr	Coarse Grained
Cly	Clay
Dk	Dark
Fgr	Fine Grained
Frg	Fragments
Gfy	Gray
Grn	Green
Intbd	Interbedded
Lam	Laminated
Lt	Light
Mrg	Medium Grained
Slt	Silt
Snd	Sand
TD	Total Depth of Boring or Drill Hole
Tr	Trace
V	Very
w/	With
w/o	Without
Wh	White
Yel	Yellow

2.5 PROCEDURES FOR LOGGING EXPLORATORY BORINGS

2.5.1 General Requirements

All drilling logs shall be prepared in the field, as borings are drilled, by experienced geologists trained in geologic logging and interpretation of subsurface conditions. Each log shall be signed by the geologist. Entries shall be printed neatly in indelible ink. Printing should be dark enough for copying. As a general rule, abbreviations should not be used. When necessary, they should be kept to a minimum to avoid confusion. Abbreviations used should be defined in the log. All lines shall be drawn with a straight edge, not by free hand.

All general information blanks in the log heading shall be completed before drilling, including:

If surveyed horizontal control is not available at the time of drilling, a location sketch with references to measured distances from prominent surface features shall be included on the back of the first page of the log.

The borehole numbering system has been determined in advance to facilitate communications between field and office staff, and avoid inconsistencies between final boring logs and field documentation.

A note should be added to indicate the disposition of the borehole. For example, "Note: Installed 2.0 inch Schedule 40 PVC monitoring well. Screened interval 21.6 to 30.6 feet bls." or "Note: The borehole was abandoned by tremie grouted from 25.0 feet to the ground surface."

Upon completion, all blanks in the log shall be completed. If information for a particular blank is not applicable to that boring, then an "NA" will be inserted.

2.5.2 Description of Surface Conditions

Each drilling log should include a description of surface conditions in the vicinity of the borehole location. This should include geomorphic position (e.g., ridge top, swale, etc.), vegetative characteristics (e.g., prairie sage), and proximity to potential sources of contaminants (e.g., 20 feet south of petroleum underground storage tank, adjacent to drainage ditch, etc.).

2.5.3 Documentation of Drilling Procedures and Performance

The manufacturer's designation of the drill rig should be recorded on the boring log, including notation of the type of vehicle on which the drill is mounted (e.g., truck mounted, rubber tired all terrain vehicle, etc.). Sizes and types of drilling equipment used should be recorded on each boring log. This should include the diameters and lengths of samplers and other equipment.

Depths at which drilling or sampling equipment are changed should also be included. The logs should show depths (in feet) and types of temporary casing used.

The behavior of drilling tools provides valuable information for interpreting geologic conditions and planning future drilling projects. This should include observations made by the driller or geologist. Occurrences such as changes in penetration rate and the degree of chattering of the bit provide indirect evidence of soil or sediment types and the depths of stratigraphic contacts. This information is particularly important when sample recoveries are low. Adjustments made to improve sample recovery should be noted. Any special drilling or sampling problems shall be recorded, including descriptions of problem resolutions. A good and continual rapport with the driller is essential to maximize the value of these indirect observations. The amount of water introduced into the boring and the amount not recovered must be noted on the boring log.

2.5.4 Sampling Data

Soil sampling data shall include the sample name, interval sampled, the type of sampler used, and the length of sample recovered for each sample collected. The interval over which sampling was attempted should always be recorded, even if no sample is retrieved. The logs shall clearly show the depth interval retained. If a scheduled sampling interval was 2 feet in length (24-inch split spoon) and due to refusal the total interval was not sampled, then the depth of penetration (e.g., 1.5 feet) becomes the sample interval. For example, if a planned sample interval was from 20 to 22 feet bgs and the split spoon was only advanced 1.2 feet, the recorded interval will be 20 to 21.2 feet bgs. Horizontal lines should be drawn across the appropriate columns at the scaled depths to document sampling intervals. Sample type may be identified using sequential numbers, with a prefix identifying the type of sampler used. Refer tot the Field Sampling Plan for sample nomenclature.

2.5.5 Description of Soils and Bedrock

Refer to Section 2.3 and 2.4 of this SOP.

2.5.6 Stratigraphic Contacts and Lithologic Changes

Identifying stratigraphic contacts and lithologic changes is a field responsibility. Changes in the nature of subsurface materials should be identified by a horizontal line at the appropriate scaled depth. A solid horizontal line should be used to denote the depth of distinct changes identified in samples or identified based upon drill advance. If a contact is gradational, or inferred between two consecutive but separated samples, a dashed line should be used. Inferred or gradational contacts should also be defined as such (e.g., write "inferred contact" or "gradational change"). If the actual depth between two separated samples is unknown, the contact line shall be drawn at half the distance between the samples.

2.5.7 Groundwater Observations

Logs shall identify the depth at which the geologic material is either dry, damp, or saturated, as described in Section 2.3.4 of this SOP. Record the depth to water observed in the borehole during, at the completion of drilling, and the stabilized depth to groundwater (whenever possible). Stabilized water level data shall include the time allowed for levels to stabilize. The absence of water in borings shall also be indicated. If a borehole is left open overnight, water level observations should be taken before leaving the site and prior to starting work the next day.

2.5.8 Environmental Field Measurements and Observations

Evidence of the presence of contaminants in samples or cuttings should be provided. Comments should describe any unusual discoloration, coatings (sheens), odors, or other potential evidence of contamination. The results of field headspace screening or other field screening test results should be included in the appropriate space in the boring log.

2.5.9 Borehole Stability

Logs shall identify any interval of borehole instability. Conditions such as running or heaving sands should be described; including the depths at which such conditions were encountered.

2.5.10 Quality Assurance

Key elements of QA applicable to borehole logging and characterization of subsurface conditions include:

- Planning/definition and communication of procedures and standards,
- Training/staffing,
- Independent review, and
- Laboratory testing of representative samples.

Planning should include review of available site-specific data and selection of appropriate logging criteria, based upon those data and project-specific requirements. Use of a log template with project specific headers will help minimize subsequent editing and facilitate log preparation in the field. As mentioned previously, the borehole/well numbering system should be established in advance. A kick-off meeting is recommended prior to the initiation of field activities to clarify project requirements.

The successful implementation of standards requires training and/or utilization of experienced staff. All staff responsible for borehole logging should review this SOP periodically as a reminder and a basis for continual improvement. At the onset, new staff should be accompanied by experienced personnel in the field until a reasonable level of proficiency is demonstrated. This will, of course, depend upon project specific considerations. Experience has shown that it is cheaper and more efficient in the long run to obtain accurate and consistent records in the field than to try to reconcile discrepancies after the work has been accomplished. In the field, logs should be reviewed on a daily basis to check for completeness and consistency.

Following completion of the field program, field logs should be reviewed and edited prior to preparation of final logs for presentation. The level of review should depend upon the experience level of field staff and project considerations. All logs should be checked for completeness, accuracy, and consistency between soil descriptions. Normally, this review should be performed by a trained and qualified person other than the project field representative(s). When using the USCS, detailed descriptions should be reviewed for consistency with USCS designations. Whenever possible, the review should involve detailed examination of representative samples in conjunction with the logs. It is helpful to lay samples out in a systematic manner, based upon site geology (i.e., based upon local depositional environments).

This process can provide a powerful tool for developing generalized descriptions of geologic units and interpreting site stratigraphy. This also provides a good opportunity to select samples for physical testing. Following completion of physical testing, field descriptions should be compared with test results. If the laboratory classification differs from the field description, the laboratory classification should be included on the final log, in addition to the field classification. It is also important to ensure that the results of laboratory tests are routed back to field personnel to provide a basis for improvement.

Final logs may be edited for presentation to eliminate redundancy. If appropriate, a disclaimer, such as that presented below, should be added to the final log:

> "This log may be an edited version of the field log, incorporating laboratory data and interpretations/correlations based upon in-office review. Additional information that may be contained on the field logs is available upon request."

"Interpretations" provided on final logs should be based upon observations and factual data documented on the original field log. Edited copies of original field logs should be placed in the file for future reference. In addition to technical information, each log should include the complete job number, client name, project location, name of the drilling contractor, name of the field representative, name of the reviewer, drilling dates, and date edited.

3.0 REFERENCES

American Society for Testing and Materials (*see* ASTM)

ASTM Standard D 1586-08a, "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils," ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D 2487-10, "Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)," ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D 2488-09a, "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)," ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D 6032-08, "Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Core," ASTM International, West Conshohocken, PA, www.astm.org.

Buckman, H.O. and Brady, N.C., The Nature and Properties of Soils, 1969.

EnNovative Technologies, Inc., EnCore Sampler sampling procedures, Green Bay, Wisconsin.

Travis, R.B. 1955. "Classification of Rocks" in Colorado School of Mines Quarterly, vol. 50, no. 1.

U.S. Environmental Protection Agency (U.S. EPA). 1984. *Characterization of Hazardous Waste Sites - A Methods Manual: Volume II, Available Sampling Methods.* April.

U.S. Environmental Protection Agency (U.S. EPA). 1991. *Description and Sampling of Contaminated Soils: A Field Pocket Guide*

U.S. Environmental Protection Agency (U.S. EPA). 1996. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, Environmental Services Division, May.

STANDARD OPERATING PRACTICE OTIE007D

Subsurface Soil Sampling

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QC Review Signatures		
Name/Role	**Signatures**	**Date**
John Fleissner, PE Corporate QC Manager	John Fleissner	06/28/2013
Nova Clite, PG Sr. Hydrogeologist		06/26/2013
Cecil Irby PG Sr. Geologist/PM-PFC Specific	Cecil	29 July 2016

STANDARD OPERATING PRACTICE OTIE007D

Subsurface Soil Sampling
(Modified for PFC specific procedures)

Given the low detection limits associated with PFC analysis and the many potential sources of trace levels of PFCs, field personnel are advised to act on the side of caution by strictly following protocols below and those in SOP Addendum No. 1 for PFC Sampling, frequently replacing nitrile gloves, and rinsing field equipment to help mitigate the potential for false detections of PFCs. Specific items related to subsurface soil sampling are discussed below.

1.0 OBJECTIVE

The objective of this procedure is to define the requirements for collecting subsurface soil samples.

2.0 BACKGROUND

For the purpose of this document, subsurface soil samples are those samples collected in the unconsolidated zone at a depth of 1-foot (ft) or greater below ground surface. Samples collected from ground surface down to 1 ft below ground surface are addressed in OTIE's Standard Operating Practice (SOP) OTIE006B, "Surface Soil Sampling." Sample collection for volatile organic compounds (VOCs) should be consistent with SOP OTIE010B "Soil Sample Preservation." Soil field screening methods are provided in SOP OTIE005B.

All operations at hazardous waste sites must be conducted in compliance with the provisions of Occupational Safety and Health Act (OSHA) 29 Code of Federal Regulations (CFR) 1910.120, EM 385-1-1 (USACE, 2003), and all other state, local, and federal regulations. ASTM Methods provide a key resource for more detailed explanation of the various methods for subsurface sampling presented in this SOP.

3.0 REQUIRED EQUIPMENT

The site-specific SAP should define the sampling tools to be deployed. ASTM D6169098 (2005) Standard Guide for Selection of Soil and Rock Sampling Devices Used with Drill Rigs for Environmental Investigations (see Section 5.0, references) provides guidance on selection of the appropriate tools for subsurface soil sampling.

3.1 GENERAL

Do not use Teflon®-containing materials (e.g., Teflon® tubing, bailers, tape, plumbing paste, or other Teflon® materials) since Teflon® contains fluorinated compounds. Additional equipment precautions, as described in SOP Addendum No. 1 for PFC Sampling should be followed. The following general equipment is required:

- approved site Work Plan,
- approved site Sampling and Analysis Plan (SAP),
- approved site Health and Safety Plan,
- personal protective equipment (PPE) as required by the site Health and Safety Plan,
- nitrile inner gloves, outer gloves (as needed) of material resistant to suspected contaminants,

- appropriate equipment and meters for obtaining field measurements specified in the SAP and the Health and Safety Plan,
- field logbook, soil sampling form (if used),
- chain-of-custody forms and security seals,
- camera
- indelible ink pen, blue or black (waterproof pens and notebooks prohibited),
- indelible markers
- sample tags/labels and appropriate forms/documentation,
- appropriate sample containers as specified in the site SAP,
- insulated cooler(s) and ice,
- plastic resealable bags and sealing tape,
- rinse bottles and ASTM Type II deionized water,
- decontamination equipment and supplies (see SOP OTIE011A),
- plastic sheeting
- IDW containment (drums, roll-off containers, etc.)

3.2 HAND AUGERING

The following equipment is needed for hand augering:

- hand auger (i.e., flighted-, bucket-, or tube-type augers) and/or slide hammer sampler,
- extension rods as needed,
- wrench(es),
- stainless steel hand trowel or sampling spoon,
- large [minimum 12-inch (in.) diameter] stainless steel or glass mixing bowl,
- sufficient sampler liners for collecting definitive VOC samples,
- stainless steel blade to trim excess soil from end of liners (if used),
- silicon tape,
- sufficient end caps to cover both ends of sampler liners (if used), and
- sufficient plastic sheeting to contain all cuttings.

3.3 EQUIPMENT FOR SAMPLING EXCAVATIONS, TRENCHES, AND TEST PITS

The following equipment is needed for excavations, trenches, test pits:

- backhoe or other excavation equipment (as specified in the site Work Plan),
- extension ladder(s) (capable of extending from bottom of excavation to above ground surface),
- trench/pit shoring and bracing equipment (as required for excavation engineering plan),
- stainless steel hand trowel or sampling spoon for shallow excavation wall/floor samples, “slam sampler” for collecting soil cores, hand-auger, or other sampling devices as specified in the project-specific SAP,
- large (minimum 12-in.-diameter) stainless steel mixing bowl (if compositing),
- sampler to be used to collect VOC samples for definitive analyses (see SOP OTIE010B),
- sufficient sampler liners, end caps for collecting geotechnical cores (as required by SAP)

3.4 SPLIT-SPOON SAMPLING (BASED ON ASTM METHOD D1586)

The following equipment is needed for split-spoon sampling (including California-modified):

- drilling rig equipped with a 140-pound (lb) drop hammer and sufficient hollow-stem augers to drill to the depths required by the site Work Plan,
- sufficient numbers and type of split-spoon samplers so that at least one is always decontaminated and available for use; three split-spoon samplers are generally the minimum necessary,
- sufficient plastic sheeting to contain all cuttings
- sufficient waste containers (e.g., 55-gallon (gal) steel drums) as specified in the site Work Plan to containerize all cuttings and investigation-derived waste (IDW)

3.5 THIN-WALLED SAMPLING (BASED ON ASTM METHOD D1587)

The following equipment is needed for thin-walled sampling:

- drilling rig equipped with a 140-lb drop hammer and sufficient hollow-stem augers to drill to the depths required by the site Work Plan;
- sufficient numbers and type of thin-walled samplers so that at least one is always decontaminated and available for use; thin-walled samplers generally are used only once;
- sufficient plastic sheeting to contain all cuttings;
- sufficient waste containers (e.g., 55-gal steel drums) as specified in the site Work Plan to containerize all cuttings and IDW;
- sufficient number and types of plastic end caps to cover both ends of all thin-walled samplers;
- Allen wrenches; and
- silicon tape.

3.6 DIRECT PUSH TECHNOLOGIES

The following equipment is needed for use with direct push technologies (DPT), such as the Geoprobe™ system:

- DPT truck capable of pushing sampler to depths required by the site Work Plan;
- assembled DPT sampler (standard or large bore as described in the site SAP);
- sufficient extension rods to reach the depths required by the site Work Plan;
- extension rod couplers;
- extension rod handle;
- stop pin;
- sampler liners (as needed) in accordance with site SAP (e.g., stainless steel, acetate, or brass);
- stainless steel safety blade or liner cutting system to open acetate liners for soil sample collection
- sufficient plastic end caps to cover both ends of sampler liners (if used for geotechnical samples),
- silicon tape to secure liner caps.

3.7 CONTINUOUS CORE SAMPLER

The following equipment is needed for continuous core sampling:

- drilling rig with continuous coring capability (i.e., hollow-stem auger or rotosonic drill),
- sufficient plastic sheeting to contain all cuttings and cover the ground surface under the drill rig,

- sufficient clear plastic sleeves to hold rotosonic drill cores; sufficient waste containers (e.g., 55-gal steel drums), as specified in the site Work Plan, to containerize all cuttings and IDW,
- drive sleeves (if used to collect samples for off-site laboratory VOC analyses) in accordance with the site SAP,
- stainless steel blade to trim excess soil from end of drive sleeves (if used),
- silicon tape, and
- sufficient vinyl end caps to cover both ends of the drive sleeves (if used).

4.0 PROCEDURES

4.1 SUBSURFACE SAMPLING PREPARATIONS

The collection of subsurface soil samples is an intrusive event and requires knowledge of the site and careful planning before commencing. Several standard steps should be taken before beginning any subsurface sampling activity.

1. Perform utility clearance and obtain dig permits for each area to be subsurface sampled (see SOP OTIE001A).
2. Verify that all logbooks are on the site, up to date, and ready to be used. (See SOP OTIE002A).
3. Photograph the site before commencing work (only with the approval of the Sponsor and the facility).
4. Verify (in writing) that all personnel including subcontractors have read, understood, and signed the approved site Health and Safety Plan and Accident Prevention Plan.
5. Verify that all personnel involved in the subsampling activity have the proper training and certifications required under OSHA 29 CFR 1910.120 and 29 CFR 1910.134.
6. Verify the site location by existing maps and surface features. Check for surface features or artifacts (e.g., manhole covers and overhead power lines) that could impede movement on the site or indicate a previously unidentified hazard.
7. Mark off the boundaries of the work site with flagging or other means to prohibit access to unauthorized personnel. All sites should have a single, clearly marked entrance through which all personnel should enter and exit. Sites having a high contamination level or where activities may unearth highly contaminated materials must also have an exclusion zone, contamination reduction zone, and support zone clearly marked and properly maintained. All personnel exiting the work area should pass through a decontamination procedure for their own protection and to prevent the spread of contamination. Personnel decontamination procedures should be described in the approved site Health and Safety Plan.
8. Check to see that all the necessary equipment (including PPE and samplers) is available at the site, is in good working condition, and has been properly decontaminated.
9. Check that all monitoring equipment is properly calibrated and operating.
10. Set up the IDW management system (e.g., spread plastic, position drums, etc.) as outlined in the site Work Plan. (See SOP OTIE012A.)

At no time should samples, decontaminated sample sleeves, or decontaminated samplers be touched by unprotected (i.e., ungloved) hands. A fresh or decontaminated pair of gloves must be used for each sample collected. Great care should be exercised to ensure that no contaminated tool or device is inserted into the borehole. All downhole tools and samplers must be kept off the ground and/or free from contamination from decontamination until they are used in the boring.

4.2 HAND AUGERING

Hand augering consists of manually advancing the auger into the soil to collect subsurface soil samples, generally at depths of 10 ft or less. There are several types of hand augers available (e.g., Iwan, ship, closed spiral, and open spiral). All these devices are used in much the same way. The auger is attached to the bottom of a length of steel rods that have a crossbar (handle) at the top. The operator advances the auger by rotating the crossbar while pressing the auger into the ground. As the auger advances, it fills with soil. When the auger is filled with soil, the unit is removed from the hole, cleared, and reinserted. Additional rods are added until the desired depth is reached.

4.2.1 Restrictions and Limitations

The restrictions and limitations for hand augering are:

- The strength of the operator and the quality of the samples required generally limit the use of hand augers to a depth of less than 10 ft.
- Dense, highly compacted soils or soils with high clay content and/or abundant gavel will significantly increase the difficulty of hand augering. Loose dry, sandy, non-compacted soils will be easier to auger through but are more likely to slough into the hole and may not be retained in the auger.
- Hand-augured samples should only be collected above (or slightly below) the water table to avoid mixed samples and to reduce the likelihood of borehole collapse.

4.2.2 Method for Hand Auger Sampling

The steps for hand-auger sampling are:

1. Complete the preparatory steps for subsurface sampling (Section 4.1).
2. Don PPE as required by the site Health and Safety Plan.
3. Using a decontaminated auger, auger to the desired depth.
4. Place drill cuttings on a length of plastic sheeting spread out next to the boring. Cuttings should be placed in stratigraphic order to show changes as the boring progresses.
5. After reaching the desired sampling depth, remove the auger from the boring and decontaminate before re-inserting into the borehole to collect the sample. Alternative sampling devices may be used to collect the sample.
6. Insert the decontaminated auger into the boring and advance until full. If definitive samples are required for VOC analyses, an auger or slide hammer sampler with a properly positioned sampling sleeve will be used. The type and material of the sleeve will be specified in the SAP.
7. Remove auger from borehole and field screen with the method and equipment specified in the site SAP. (See SOP OTIE005B)
8. Extract sample and place in appropriate containers as specified in the site SAP and as per state specific requirements. If a liner was used, remove liner from auger/slide hammer and

place aluminum foil on ends (shiny side away from sample), cap and seal both ends of the liner with silicon tape, and place appropriate label on the liner. (See SOP OTIE006B and SOP OTIE010B)

9. Place sample container (e.g., liner and jar) in resealable plastic bag and place bag containing sample into an insulated cooler with ice. Samples should be maintained at 4º± 2ºC from the time of collection until received at the laboratory in accordance with project SAP.
10. Draw a sketch of the sampling location in the field logbook. Note the sample identification number, depth, time of collection, field screening result, and laboratory analysis requested for the sample in the site sampling logbook. (See SOP OTIE002A)
11. Remove contaminated gloves and don fresh gloves for each new sample. Decontaminate re-used sampling equipment in between each sample. Collect equipment rinsate samples at the frequency required by the project-specific SAP.
12. Repeat steps 1 through 10 until sampling is completed.
13. Dispose of cuttings and disposable equipment as outlined in the site Work Plan.
14. Plug and abandon completed boreholes as specified in site Work Plan. (See SOP OTIE008I.)
15. Decontaminate all equipment and personnel. (See SOP OTIE011A.)

4.3 EXCAVATIONS, TRENCHES AND TEST PITS

The purpose of this section of this SOP is to address soil sampling from opening in the earth such as a soil removal excavation, test pit, trench, or similar. This SOP may also apply to the collection of soil samples from naturally occurring openings or sloped surfaces such as stream banks, fissures, or slumps. For convenience in this section of the SOP, the term “excavation” refers to test pits, trenches, soil removal excavations, natural openings such as slumps, etc. from which a soil sample is to be collected for chemical and geotechnical analyses.

4.3.1 Restrictions and Limitations

The restrictions and limitations of sample from excavations are:

- The depths that can be economically reached by test pits/trenches are limited. For sample depths greater than 15 ft, soil borings are recommended over trenches.
- Large volumes of potentially contaminated material must be handled in excavating and reclaiming the test pit/trench. All fluids removed from the excavation must be assumed to be contaminated and must be tested before disposal.
- There is always the possibility of catastrophic failure of a wall and the collapse of the trench.

4.3.2 Excavation, Trench, Test Pit Safety Considerations

This SOP does not cover excavation safety in detail; refer to the project specific Accident Prevention Plan and the OTIE Corporate Safety and Health Manual (see Section 7.9 of the Manual) before implementing sampling in excavations. Some key provisions are restated here:

- All excavation work will be conducted in accordance with Federal OSHA excavation regulations as described in 29 CFR 1926.651 and Section 25 of EM 385-1-1. All excavations will be inspected daily for hazardous conditions by a competent person.
- Personnel will not enter excavations deeper than 4 ft. unless the excavations have been properly shored or sloped. If it is necessary to enter an excavation greater than 4 ft. in depth a trench box or other approved shoring or sloping system will be used to shield the workers

from possible cave-ins. Entering excavations 25 feet or greater in depth will require a shoring system designed and approved by a registered professional engineer. Ladders will be placed at least every twenty feet along the length of the excavation to facilitate access by the work crews. Personnel in an excavation should always have oversight from the surface.

- Materials, equipment, and stockpiled soil will not be placed closer than two feet from the edge of the excavation and adjacent surface structures are not undermined while digging. Water will not be allowed to accumulate in excavations.
- The excavation will be barricaded or backfilled when unattended; barriers will be kept in place to route traffic away from any open excavations.

Other provisions of the Corporate Safety and Health Manual and the site-specific Accident Prevention Plan and Health and Safety Plan may apply; review these documents prior to any work in or around excavations.

4.3.3 Method for Excavation Sampling

1. Complete the preparatory steps for subsurface sampling (Section 4.1); complete all necessary health and safety preparations (atmospheric screening, competent person assessment of excavation wall stability, provide ingress/egress, etc. in accordance with the site-specific Accident Prevention Plan).
2. Don PPE as required by the project-specific Health and Safety Plan.
3. The location and depth of the required samples will be outlined in the SAP. Sampling equipment will also be specified in the SAP.
4. Find each sample location by measuring off a monument, excavation corner starting point, etc. For systematic random or grid sampling, ensure sample locations are selected in accordance with the approved SAP. Layout sampling grid indicators, such as marked pin flags at certain foot intervals, prior to entry into the excavation. Global position system (GPS) survey equipment may be used to locate and/or survey sampling locations on large excavation bottoms.
5. If possible, collect samples without entering excavations greater than 4 feet deep. During excavation, soil samples may be collected from the excavator bucket at the surface. A protocol for sampling soils from an excavator bucket must be defined in the site SAP.
6. Collect sufficient sample material to fill the laboratory-provided sample containers.
7. Place sample container (e.g., liner and jar) in resealable plastic bag and place bag containing sample immediately into an insulated cooler with ice. Samples should be maintained at 4º± 2º Celsius (C) ±2ºC from the time of collection until received at the laboratory in accordance with the project SAP.
8. Record sampling information in the field logbook or sampling forms (if used). Use a to-scale site plan or draw a sketch of the excavation record sample locations. Note the sample identification number, sample depth (from ground surface), time of collection, field screening result, and laboratory analysis requested for each sample (See SOP OTIE002A).
9. Remove contaminated gloves and don fresh gloves for each new sample. Decontaminate re-used sampling equipment in between each sample. Collect equipment rinsate samples at the frequency required by the project-specific SAP.
10. Repeat steps 2 through 7 until sampling is completed.

11. Decontaminate all reused equipment and personnel (See SOP OTIE011A).

4.4 SPLIT-SPOON SAMPLING

The split-spoon sampler consists of a threaded steel pipe that is split in two pieces along the axis of the pipe. A hardened steel driving shoe is screwed onto the downhole end and a threaded "head" with a check valve is screwed onto the top. The sampler is driven (ASTM Method D1586) into undisturbed soil. The sampler collects the soil sample in the enclosed tube, which prevents mixing and contamination of the sample by up-hole soils. Soil samples may be collected for geotechnical information and/or chemical analyses. When done properly, this method will result in samples for screening and definitive data for all analytes except VOCs. Screening samples for VOC analyses may be collected directly from the sampler. To obtain definitive samples for VOCs, liner sleeves must be used in the sampler.

4.4.1 Restrictions and Limitations

The restrictions and limitations for split-spoon sampling are:

- Loose, dry, non-compacted, and/or highly saturated materials may not be retained in the sampler. This condition may require the use of a basket (sand catcher) or spring retainer in the cutting shoe of the sampler.
- Soils with a high cobble or rock fragment content may clog the sampler and prevent adequate collection of sample or result in refusal of sampler.

4.4.2 Method for Split-Spoon Sampling

The steps for split-spoon sampling are:

1. Complete the preparatory steps for subsurface sampling (Section 4.1).
2. Don PPE as required by the site Health and Safety Plan.
3. Using decontaminated augers, auger to the desired depth.
4. Place drill cuttings on plastic sheeting spread next to the boring or handle as specified in the site Work Plan.
5. Upon reaching the desired sampling depth, attach a decontaminated split spoon to the sampling rods and insert into boring. If definitive analyses are required for VOCs, a split spoon with properly positioned sampling liners will be used. The type and material of the liners will be specified in the SAP.
6. Position the drive hammer on the sampling rods and lightly tap the rods to seat the sampler.
7. Drive the sampler in accordance with ASTM Method D1586 (i.e., a 140-lb hammer is repeatedly dropped 30 in. while counting the number of blows required to drive the sampler each 6-in. interval). Cease driving when the sampler is full, or when 50 blows of the hammer have moved the sampler less than 1 inch.
8. Remove the split spoon from the boring. Carefully open the split spoon and immediately field screen the sample with the equipment specified in the site SAP. Collect VOC samples first following SAP specified procedures. Extract the sample and place it in appropriate containers, as specified in the site SAP.
9. Immediately after collection, place sample containers in resealable plastic bags and place bags containing samples into an insulated cooler. Samples should be maintained at 4° ± 2°C from the time of collection until received at the laboratory in accordance with project

SAP.

10. Note the sample identification number, depth, time of collection, field screening result, lithological description, and laboratory analyses requested for the samples in the site sampling logbook.
11. Remove contaminated gloves and don fresh gloves for each new sample. Decontaminate re-used sampling equipment in between each sample. Collect equipment rinsate samples at the frequency required by the project-specific SAP.
12. Repeat steps 3 through 11 until total required depth is reached.
13. Remove the augers from the boring. Note: When the boring is completed and the augers have been removed, it is sometimes advisable to leave the borehole open for several hours to check for groundwater inflow. This information can be valuable later in the project.
14. Dispose of cuttings and disposable equipment as outlined in the site Work Plan.
15. Plug and abandon borehole as specified in the site Work Plan (See SOP OTIE08I).
16. Decontaminate all equipment and personnel (See SOP OTIE011A).

4.5 THIN-WALLED SAMPLER

The thin-walled sampler (also known as a Shelby tube) consists of a one-piece hollow steel tube that is usually 2 to 5 in. in diameter and from 1 to 3 ft in length. The thin-walled sampler is mechanically pushed or driven (ASTM Method D1587) into undisturbed soil. The sampler collects a column of relatively undisturbed soil in the tube. This method generally is used to collect samples for geotechnical information, but it can also be used to collect soil for chemical analyses. When done properly, this method will result in samples for screening and definitive analyses for all analytes. Screening samples for VOC analyses may be collected directly from the sampler in the field. For definitive VOC samples, the entire sampler must be properly sealed and sent to the laboratory.

4.5.1 Restrictions and Limitations

The restrictions and limitations for thin-walled sampling are:

- Loose, dry, non-compacted, and/or highly saturated materials may not be retained in the sampler.
- Soils with significant cobble or rock fragment content may clog or damage the sampler or cause refusal of sampler.
- It can be difficult or impossible to properly extrude soils from the sampler on-site. When samples are needed for chemical analyses, another sampling device should be used.

4.5.2 Method for Using the Thin-Wall Sampler

The steps for using the thin wall sampler are:

1. Complete the preparatory steps for subsurface sampling (Section 4.1).
2. Don PPE as required by the site Health and Safety Plan.
3. Using decontaminated augers, auger to the desired depth.
4. Place drill cuttings on plastic sheeting or handle as specified in the site Work Plan.
5. After reaching the desired sampling depth, attach a decontaminated thin wall sampler

to the sampling head and screw onto the sampling rods. Insert the sampler into the boring.

6. Position the drill head (ram) on the sampling rods and, using the rig hydraulics, push the sampler to the required depth (i.e., fill the tube) or until refusal. A smooth, sustained push will generally yield the best sample. If the rig hydraulics cannot push the tube, it can be driven using the drive hammer. The weight of the hammer, height of drop, and number of blows should be recorded in the field logbook (See SOP OTIE002A).
7. Twist the drill rods clockwise to break loose the sample. Withdraw the sampler from the boring.
8. Detach the sampler from the sample rods and remove the tube from the sampling head.
9. For geotechnical analyses, trim off excess soil from either end of the tube until it is at least flush with the rim of the tube. Cap and seal both ends of the tube and mark the "up" end. The sealed tube should be handled carefully to minimize vibration or impacts and should be transported to the laboratory in the upright position.
10. If geotechnical analyses are not desired, the sample may be extruded from the tube on-site, field screened, and placed in appropriate containers. The VOC screening sample must be collected first and as soon after extruding the soil from the container as possible. Proceed to fill the other containers as necessary. Immediately after collection, place sample containers in resealable plastic bags and place bags containing samples into an insulated cooler. Samples should be maintained at 4º± 2ºC from the time of collection until received at the laboratory in accordance with project SAP.
11. Note the sample identification number, depth, time of collection, field screening result, lithological description (if known), and laboratory analyses requested for the samples in the site sampling logbook (See SOP OTIE002A).
12. Remove contaminated gloves and don fresh gloves for each new sample. Decontaminate re-used sampling equipment in between each sample. Collect equipment rinsate samples at the frequency required by the project-specific SAP.
13. Repeat steps 2 through 11 until total required depth is reached.
14. Remove the augers from the boring. Note: When the boring is completed and the augers have been removed, it is sometimes advisable to leave the borehole open for several hours to check for groundwater inflow. This information can be valuable later in the project.
15. Dispose of cuttings and disposable equipment as outlined in the site Work Plan.
16. Plug and abandon borehole as specified in the site Work Plan (See SOP OTIE008I).
17. Decontaminate all equipment and personnel (See SOP OTIE011A).

4.6 DIRECT PUSH SOIL SAMPLING

This section of the SOP provides information on subsurface soil sampling using direct push techniques (DPT). This section is based in part on ASTM D6282 - 98(2005) Standard Guide for Direct Push Soil Sampling for Environmental Site Characterizations. OTIE’s SOP OTIE007E provides more information on all the various sampling methods available using direct-push sampling techniques. Additional information for this section was based on Geoprobe® systems information (Geoprobe, 2008).

DPT rigs advance a hollow sampling probe into the subsurface by applying static pressure (relying on vehicle weight), percussion, vibration, or any combination thereof, to the above ground portion of the sampler. Extensions are added to the probe system until the sampler has been advanced to the desired sampling depth. The sampler is recovered from the borehole and the sample removed from the sampler. The sampler is cleaned and the procedure repeated for the next desired sampling interval. Sampling can be continuous for full depth borehole logging or incremental for specific interval sampling. Samplers used can be protected type for controlled specimen gathering or unprotected for general soil specimen

4.6.1 Restrictions and Limitations

The restrictions and limitations for direct-push sampling are:

- The standard 1-inch diameter soil probe sampler can collect only 100 grams of soil. Larger diameter cores (e.g., the Geoprobe Macro-Core® system) are available. If large sample volumes are required, two (or more) DPT holes may have to be drilled and sampled
- Different DPT rigs have different depth capabilities; the project data quality objectives (for sample depth and considering anticipated soil types) must be considered when selecting the appropriate DPT rig.
- DPT is not appropriate for sampling in consolidated materials (rock, weathered rock, cemented soils), highly compacted soils (heavy clays), gravelly soils (unconsolidated tills, alluvium) that prevent penetration of the sampler. Additionally, sticky wet soils (saturated "fat" clays) may be penetrable, but create friction that prevents efficient extraction of the probe.

4.6.2 Method for Direct-Push Sampling

The steps for direct-push subsurface soil sampling are:

1. Complete the preparatory steps for subsurface sampling (Section 4.1).
2. Don PPE as required by the site Health and Safety Plan.
3. Attach a decontaminated sampler to the lead probe rod. For definitive samples for VOC analyses, the large-bore sampler must be used (the large-bore sampler allows the use of liner sleeves). A 12-in. probe rod is recommended to start the standard 24-in. and large-bore samplers.
4. Drive or push the sampler to the desired depth. Some soil conditions may warrant using a retractable or solid drive point to pre-probe the hole to the desired depth. Note: Do not attempt to drive the sampler into bedrock or other impenetrable layer.
5. After reaching the desired sampling depth, remove the drive cap and lower extension rods into the inside diameter of the probe rods using couplers to join the rods.
6. Disengage the stop-pin from the drive head with the extension rods.
7. Remove the extension rods and attached stop-pin from the probe rods.
8. If the top of the probe rod is already in the lowest driving position, attach another probe rod before driving. Replace the drive cap onto the top probe rod.
9. Mark the top probe rod with a marker or tape at the appropriate distance above the ground surface (allow 24 in. for the large-bore sampler). Drive the probe rods and sampler the designated distance. Be careful not to over-drive the sampler, which would compact the soil sample in the tube and make sample extrusion difficult.

10. Extract the probe rods from the hole and recover the sampler. Examine the sampler to confirm that a sample has been recovered.
11. When using the standard sampler, extrude the soil from the sampler, field screen as specified in the site SAP, and place in appropriate, labeled containers. This method yields both screening and definitive samples for all analytes except VOCs. This method yields screening samples for VOCs. When using the large-bore sampler, remove the cutting shoe and withdraw the sample sleeves. Immediately field screen the sleeves as specified in the site SAP. Place aluminum foil on ends of sample, cap and seal both ends of the sleeves with silicon tape (the sleeve for VOC analyses first) and label appropriately. This method yields screening and definitive samples for all analytes.
12. Place sample containers (e.g., liners and jars) in resealable plastic bags and place bags containing samples into an insulated cooler with ice. Samples should be maintained at 4º± 2ºC from the time of collection until received at the laboratory. (See SOP OTIE010A.)
13. Note the sample identification number, depth, time of collection, field screening result, and laboratory analysis requested for the sample in the site sampling logbook. (See SOP OTIE002A.)
14. Remove contaminated gloves and don fresh gloves for each new sample. Decontaminate re-used sampling equipment in between each sample. Collect equipment rinsate samples at the frequency required by the project-specific SAP.
15. Repeat steps 1 through 14 until sampling is completed.
16. Plug and abandon borehole as specified in the site Work Plan. (See SOP OTIE008I.)
17. Dispose of non-salvageable equipment as outlined in the site Work Plan.
18. Decontaminate all equipment and personnel. (See SOP OTIE011A.)

4.7 CONTINUOUS CORE SAMPLER

The continuous core sampler is a steel tube that may be split in half and held together by threaded collars or may be in one piece. The sampler is usually 5 or 10 ft in length with a 3- to 5-in. diameter. The device may be driven ahead of hollow-stem augers or advanced into the soil by vibration and/or rotary action.

4.7.1 Restrictions and Limitations

The restrictions and limitations for using the continuous core sampler are:

- Loose dry, non-compacted and/or highly saturated loose organic materials may not be retained in the sampler or may break apart when extruded from the sampler.
- Gravelly soils may prevent adequate recovery of sample or cause refusal of the sampler.
- Dense and/or highly compacted soils may be difficult to extrude from the sampler. A split-spoon sampler with sleeves is a better choice if highly compact soils may be encountered and VOC samples are needed.

4.7.2 Continuous Core Sampler Methodology

The steps for continuous core sampling are:

1. Complete the preparatory steps for subsurface sampling (Section 4.1).
2. Don PPE as required by the site Health and Safety Plan.
3. Using the approved drilling method and a decontaminated continuous core

sampler, advance to the desired depth.

4. After reaching the desired sampling depth, remove the sampler from the boring and extrude the sample into a holding tray. It may also be desirable to extrude the sample into a clear, resealable plastic bag as it is being placed in the holding tray.
5. Select the desired sampling point on the core. Lightly scrape the core with a decontaminated stainless steel scoop or spoon to remove surface soil and place samples into the appropriate containers. This method yields screening and definitive samples for all analytes except VOCs. This method yields screening samples for VOCs. If definitive samples are required for VOC analyses, a 2-in.-diameter, 4-in.-long stainless-steel or brass sleeves should be driven into the core at the desired sampling point. The length of the sampling sleeve should be equal to or smaller than the diameter of the core to ensure that no headspace exists in the VOC sample. The sleeve can then be extracted and immediately capped and sealed.
6. Place sample containers (e.g., liners and jars) in resealable plastic bags and place bags containing samples into an insulated cooler with ice. Samples should be maintained at 4º± 2ºC from the time of collection until received at the laboratory. (See SOP OTIE010A.)
7. Note the sample identification number, depth, time of collection, field screening result, and laboratory analysis requested for the sample in the site sampling logbook. (See SOP OTIE002A.)
8. Remove contaminated gloves and don fresh gloves for each new sample. Decontaminate re-used sampling equipment in between each sample. Collect equipment rinsate samples at the frequency required by the project-specific SAP.
9. Repeat steps 3 through 8 until sampling is completed.
10. Plug and abandon borehole as specified in the site Work Plan. (See SOP OTIE008I.)
11. Dispose of cuttings and non-salvageable equipment as outlined in the site Work Plan.
12. Decontaminate all equipment and personnel. (See SOP OTIE011A.)

4.8 COLLECTION AND HOMOGENIZATION OF COMPOSITE SAMPLES

Composite samples consist of a series of discrete grab samples that are mixed together to characterize the average composition of a given material. The discrete samples used to make up a composite sample are of equal volume and are collected in an identical fashion. There are two basic types of composite soil samples: areal and vertical. Areal composites are collected from individual grab samples from the same horizontal strata or depth; vertical composites are collected from individual grab samples from within a single vertical profile (i.e., one borehole).

It is important that a composite sample be truly representative if the various sample locations or intervals making up the composite. Therefore, proper homogenization techniques should be followed to generate a composite sample. In addition, the equipment used to composite the sample must not affect the sample quality. A stainless steel bowl and stainless steel spoon, properly decontaminated (SOP OTIE011A), are typically used for field compositing of soil samples.

The following steps must be followed when compositing soil samples.

1. Determine where composite sample(s) will be obtained as indicated in the site-specific SAP or comparable plan document.

2. VOC and, in some cases, SVOC samples must be collected and contained immediately as discrete samples and, therefore, cannot be composited directly. An alternative approach is to composite known volume discrete VOC sample increments into a pre-measured volume of extractant fluid (e.g., methane) in a single container. The site-specific SAP should detail the procedures for this approach.
3. Obtain samples by the methods outlined in this SOP.
4. For split-spoon or Shelby-tube or other cores methods from a specified depth or range of depths, extract or extrude the sample from the split spoon or Shelby tube onto a stainless steel tray or bowl.
5. For hand-auger samples: The sample is acquired directly from the withdrawn auger by using a clean stainless steel spatula or spoon. Extract or extrude the sample from the hand auger onto a clean stainless steel tray or bowl.
6. Divide the soil in the sample tray or bowl into quarters. Each quarter is mixed separately and then all quarters are mixed together into the center of the pan. Follow this procedure several times until the sample is thoroughly mixed. The extent of mixing will depend on the nature of the material and should be done to achieve a consistent (homogenous) physical appearance (texture, color, moisture level, etc.) prior to filling sample containers.
7. Once mixing is completed, divide the sample material in half and fill containers by scooping sample material alternately from each half. Transfer subsamples of the composited sample into the appropriate sample containers. Seal, wipe clean, and label sample containers. Use the same care in handling these samples as that used for other samples from the site.
8. Note on the chain-of-custody form that the sample is a composite. Record homogenization procedures on the sample log form or in the field notebook. Photographs before and after sample homogenization may be helpful documentation.

5.0 REFERENCES

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STANDARD OPERATING PRACTICE OTIE007E

Direct Push Technologies

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QC Review Signatures

Name/Role	Signature	Date
John Fleissner, PE Corporate QC Manager	John Fleissner	June 28, 2013
Nova Clite, PG Sr. Hydrogeologist		June 26, 2013
Cecil Irby PG Sr. Geologist/PM-PFC Specific	Cecil Irby	February 22, 2016

Given the low detection limits associated with PFC analysis and the many potential sources of trace levels of PFCs, field personnel are advised to act on the side of caution by strictly following these protocols, frequently replacing nitrile gloves, and rinsing field equipment to help mitigate the potential for false detections of PFCs. Specific items related to direct push technologies are discussed below.

1.0 SCOPE AND OBJECTIVES

The objective of this Standard Operating Practice (SOP) is to define techniques and requirements for use and operation of direct push technologies (DPT) for collection of subsurface soil, groundwater, and soil gas samples and data. DPT refers to tools and sensors that are "pushed" into the ground without the use of drilling to collect soil or to make a path for the tool.

While other manufacturers make similar equipment, Geoprobe® is considered by some to be the industry-standard for soil probing and is the focus of this SOP.

2.0 BACKGROUND

2.1 DPT USES, ADVANTAGE AND DISADVANTAGES

DPT can be used in nearly any condition amenable to hollow-stem-auger drilling and provides a cost-effective alternative to traditional subsurface investigative methods. Depending on site conditions, typically 15 to 25 soil gas, soil, or groundwater samples can be collected in a day.

DPT is particularly suited to the site characterization process. The samples collected using this technique are commonly analyzed using on-site gas chromatography for rapid analytical turnaround time and in-field decision making. By using DPT in combination with appropriate on-site analytical equipment (gas chromatograph/mass spectrometer, atomic absorption, X-ray fluorescence, immunoassay, etc.), the sampling plan can be adjusted in the field to ensure the vertical and lateral extent of soil and/or groundwater contamination is determined before demobilization. DPT is also used for a wide range of other environmental applications such as remedial action installation (e.g., injection of bioremediation materials), remediation system monitoring, cleanup confirmation sampling, hydrologic studies, and geotechnical studies.

A typical DPT rig is the Geoprobe®, a vehicle-mounted, hydraulically powered, percussion and probing machine manufactured by Geoprobe Systems, Inc. of Salina, Kansas. Other manufactures offer similar or different features. A DPT rig relies on a relatively small amount of static (vehicle) weight combined with percussion as the energy for advancement of a tool string to collect soil gas, soil, and/or groundwater samples. Static forces are used to push the probe to depths of more than 40 feet (ft) in some soils. With the addition of percussion to the static force, probes can be driven to depths in excess of 100 ft.

The advantages of DPT systems are:

- Lower cost;
- Ease of mobilization, versatility of use, can be used in limited access areas where larger and taller drilling equipment will not fit,
- Rapid sample collection;
- Absence of borehole cuttings, thus minimizing investigation-derived waste and risk to

workers associated with contaminated soils or vapors;
- Ability to collect undisturbed soil and groundwater samples without constructing permanent monitoring wells;
- Access to much greater depths than those achieved with hand-driven probing equipment; and
- Ability to rapidly obtain a continuous record of stratigraphy using the soil conductivity logging system.

Disadvantages of DPT systems are:

- Depth limitations and difficulty or inability to drive probes through larger size gravels or boulders, semi-consolidated soils, and hard rock;
- Smaller diameter probes and wells can limit options for purging/sampling equipment and methodology; and
- Small diameter cores limit the amount of sample material produced for extensive laboratory analyses.

2.2 DPT TOOLS

Geoprobe Systems also offers the following tools and add-ons for sample and data collection (listed to provide information, not endorsement of any particular tool or product):

1. **Large Bore Soil Sampler**. A closed piston sampler for soil sampling at discrete depths. The design allows the sampler to remain completely sealed while driven to depth. It recovers 22-inch long x 1.0625-inch diameter (559 mm x 27 mm) core to depths of over 60 feet (depending on soil conditions).
2. **Macro-Core® Soil Sampler**. Uses a variety of liner materials in a hollow steel corer. It is typically used to depths of 30 to 60 feet. Can be used as an open sampler (continuous core) or fitted with a closed piston (discrete sampler). It recovers a 1.5-inch diameter by 2- to 4-foot long core.
3. **Dual Tube Sampling Systems**. Uses two sets of probe rods to collect continuous soil cores. One set of rods is driven into the ground as an outer casing, providing a sealed hole from which soil samples may be recovered without the threat of cross-contamination. The second, smaller set of rods are placed inside the outer casing, hold a sampler liner in place as the out casing is driven one sampling interval. The small rods are then retracted to retrieve the filled liner. (Not covered in this SOP.)
4. **Membrane Interface Probe**. Provides near real-time total volatiles data from subsurface soil probe to on-board PID or FID or both detectors in series. (Not covered in this SOP.)
5. **GeoTech Cone Penetrometer**. Cordless cone penetration testing (CPT) technology that uses acoustic transmission of soil resistance data for real-time assessment of subsurface soil conditions. (Not covered in this SOP.)
6. **Small diameter monitoring wells**, which are prepacked well screens in two sizes (0.5-inch ID x 1.375-inch OD or 1.0-inch ID x 2.5-inch OD).
7. **Screen Point 15 Groundwater Sampler**. The “Screen Point 15” is a 1.0-inch OD steel groundwater sampling point with an exposed screen length of 41 inch (longer screens may be custom ordered). This commonly referred to as a “Hydropunch.”
8. **Groundwater Profiler**. Discrete interval sampling using a 6-inch or 12-inch screen

lengths. The tool is advanced through Geoprobe's 2.125-inch probe rods. Large screen openings allow pre-sample development and hydraulic conductivity testing as well as discrete zone sampling.

Variations and customizations of the tools listed above are also available for Geoprobe Systems Inc. and other vendors.

3.0 REQUIRED EQUIPMENT

3.1 DECONTAMINATION EQUIPMENT

Do not use Teflon®-containing materials (e.g., Teflon® tubing, bailers, tape, plumbing paste, or other Teflon® materials) since Teflon® contains fluorinated compounds. The following decontamination equipment is required:

- plastic buckets and/or troughs;
- laboratory-grade detergent (phosphate free);
- high-pressure hot water cleaner;
- stiff bristle brushes capable of cleaning the inside and outside of equipment;
- plastic sheeting;
- disposable wipes or rags;
- aluminum foil;
- potable water;
- deionized, organic-free water [American Society for Testing and Materials (ASTM) Type II or equivalent];
- pesticide-grade or better methanol, or pesticide-grade or better isopropanol if required by the state or region (Note: Use of methanol is preferred to isopropanol because of the potential for generation of acetone as a photodegradation product of isopropanol); and
- latex gloves, goggles, and other protective clothing as specified in the site-specific Health and Safety Plan.

3.2 DPT EQUIPMENT

The following equipment is required:

- heavy-duty, four-wheel-drive pickup, van, or all-terrain vehicle (ATV);
- rear-mounted hydraulic probe driving and removal system;
- rotary impact drill for asphalt/concrete penetration;
- vacuum volume pump system for soil gas sampling and groundwater purging;
- hardened steel sampling probes and accessories.

3.3 SMALL DIAMETER MONITORING WELL EQUIPMENT

The following equipment is required:

- casing drive seat,
- expendable drive point,
- drive-point O-ring (per manufacturer specification),
- prepacked screen,
- polyvinyl chloride protective casing,
- service cap,

- stainless steel casing, and
- casing O-ring (per manufacturer specification).

3.4 SAMPLING EQUIPMENT

The following equipment is required:

- retractable soil gas points for vertical profiling;
- expendable soil gas points for discrete depth-interval sampling;
- 3/16-inch (in.) polyethylene, or polypropylene tubing and soil gas points;
- appropriate sample containers, ice, cooler, and sample labels;
- glass soil gas bulbs with stopcocks and replaceable septa, stainless steel canister, or sample syringes;
- Tedlar® bags for gas samples;
- screen point samplers or mill-slotted well points for shallow groundwater sampling;
- water trap for vacuum pump purging or semivolatile sampling;
- for groundwater purging and sampling: small-diameter inertial foot-valve pumps, peristaltic pumps, minibailers, or tubing bottom check valve; and small-diameter, flexible water level indicator;
- granular or powdered bentonite;
- plastic sheeting, garbage bags, caution tape and posts;
- Geoprobe® operator's manual;
- permanent implants for soil gas sampling, air sparging, or performance monitoring;
- soil conductivity tools for stratigraphic definition;
- field analytical equipment (gas chromatograph/mass spectrometer, atomic absorption, x-ray fluorescence, and immunoassay);
- closed-piston Large-bore and/or Macro-Core soil samplers for discrete depth soil sampling with liners, extruders and dowels for discharging soil, and other soil sampling accessories;
- small diameter well materials; and
- probing tools including sufficient numbers of probe rods to avoid extensive decontamination, drive caps, pull caps, drive points, extension rods, cleaning accessories, subassemblies, and adapters.

4.0 PRACTICE FOR DPT SITE STUDIES

4.1 PRE-FIELD PLANNING

Review all project plan documents including the Safety and Health Plan, Work Plan, and Sampling and Analysis Plan (SAP). Be aware of any site specific hazards related to subsurface drilling. Ensure that geologic conditions at the site are amenable for DPT drilling.

4.2 MOBILIZATION

Before initiating any DPT survey, the following items must be completed:

- Secure site access (permissions) and any required personnel clearance (SOP OTIE001A)
- Field check each location for drilling rig accessibility
- Stake all initial and optional/potential sampling locations

- Clear utilities and secure dig permits for on each location (SOP OTIE001A)
- Estimate or measure at nearby monitoring wells the depth to groundwater (vadose zone thickness)
- Plot sampling locations and other information, such as approximate surface elevation and estimated depth to groundwater, on a map for field use.

4.3 DECONTAMINATION

All downhole DPT sampling equipment and all equipment directly contacting the samples will be decontaminated (following SOP OTIE011A) before reuse and between drilling locations.

4.4 SOIL GAS SAMPLING

There are three types of Geoprobe® sampling tools that can be used for sampling soil gas:

(1) sampling through probe rods using an expendable point, (2) sampling through probe rods using a retractable point, and (3) sampling through inner tubing using the post-run tubing (PRT) system. The PRT system is the preferred sampling method for the following reasons:

- increases speed and accuracy of soil gas sampling,
- eliminates problems associated with rod leakage and sample carryover (preserves sample integrity),
- reduces the probe rod decontamination time,
- uses a simple design for ease of use and vacuum-tight sealing, and
- requires no management of inner tubing during probing.

4.4.1 Post-Run Tubing Soil Gas Sampling Procedure

The following section describes the primary steps that must be followed when sampling soil gas using the PRT method. Field staff should carefully review Appendix D (and any subsequent updates/revisions) of the Geoprobe® Tools and Equipment Catalog (Geoprobe Systems, 1999) for additional details regarding operation and procedures for soil gas sampling with the PRT system.

<u>Preparation</u>

1. Decontaminate all parts before use following the decontamination procedures outlined in SOP OTIE011A.
2. Install O-rings on the expendable point holder and the PRT adapter.
3. Check the probe rods for any obstructions and test fit the adapter with the PRT fittings on the expendable point holder.
4. Connect adapter to the end of the tubing; secure with silicon tape, if necessary.

<u>Probing</u>

1. Drive the PRT tip configuration into the ground. Connect probe rods as necessary to reach the desired depth.
2. Disengage the expendable point by pulling probe rods up about 1 foot (ft) when the desired depth is reached. Remove the push cap from the top probe rod.

Connection

1. Insert the adapter end of the tubing inside the probe rods.
2. Push the evacuation tubing down the probe rods until it reaches the bottom. Leave 2 feet (ft) of tubing extending out of the top of the probe rods.
3. Twist the tubing in a counterclockwise direction until the adapter threads have threaded into the expendable point holder.
4. Check the connection by pulling up lightly on the tubing.

Sampling

1. Connect the evacuation tubing and the in-line glass bulb or stainless steel canister to the vacuum pump system.
2. Purge the tubing and glass soil gas bulb or stainless steel canister by pumping at least three probe rod and canister volumes before collecting a sample.
3. The gas flow rates will be monitored with a ball-type flow meter attached to the exit port of the vacuum pump.
4. Close the stopcocks in the glass bulb or stainless steel canister.
5. If the soil gas sample is collected with a syringe, puncture a silicon rubber segment in the evacuation line.
6. If the soil does not yield vapor to the applied vacuum, either pull the probe rod back farther from the tip or apply a greater vacuum pressure.

Removal

1. After collecting a sample, pull up firmly on the tubing until it releases from the PRT adapter.
2. Remove the tubing from the probe rods. Dispose of the tubing.
3. Retrieve the probe rods from the ground.
4. Visually inspect the O-ring at the base of the PRT to verify a proper seal was achieved.
5. Plug the hole as specified in Section 5.7 of this procedure.

Documentation

The following information, as a minimum, will be recorded in the field logbook or on a Soil Gas Sample Log (if used): date and time, site and sample location, sample collection personnel, probe/sample depth, flow rate, purge, and sample volume. SOP OTIE002A describes field documentation practices and requirements.

4.4.2 Vertical Profiling

Vertical profiling consists of collecting soil gas samples from various depths at a single location. The depth of the soil gas sample with the most significant response will indicate the optimum soil sampling depth. Vertical profiling should generally be done at a number of locations during the soil gas survey to assess the variability of contaminants in the vadose zone. Knowledge of the subsurface lithology can also assist in determining the optimum depth to collect soil gas samples. New tubing must be used for each sample to prevent cross-contamination.

4.5 SOIL SAMPLING

The Geoprobe system has two different types of soil-sampling tools: (1) the Large Bore soil sampler—a closed piston (discrete interval) sampler and (2) the Macro-Core soil sampler—a longer and larger-diameter sampler that can be used in an open tube mode for ground surface sampling and in a closed piston mode for depth discrete subsurface sampling. Both types of samplers are pushed or driven and do not generate any cuttings.

4.5.1 Large Bore and Macro-Core Sampler Use and Specifications

The Large Bore sampler is generally more applicable to intermittent depth-discrete sampling while the Macro-Core with its greater length and volume is more appropriate for shallower continuous coring and/or when greater sample volume is needed for extensive laboratory analysis. The Macro-Core sampler is now equipped with a closed-piston tip for discrete sample collection. Except for surface coring (i.e., 0 to 4 ft depth), the Macro-Core sampler must always be used in the closed piston mode to ensure depth discrete sample integrity. Equipment specifications are provided in the following table for each of these soil-sampling devices.

Geoprobe® Drive Soil Samplers

Name of sampler	Sample tube dimensions (in.)	Core dimensions (in.)	Volume [milliliters (mL)]	Liners	Depth capability (ft)a
Large Bore	24 by 1.375	22 by 1.0625	320	Yes	60+
Macro-Core	48 by 2	45 by 1.5	1303	Yes	30+

Liners are available for the Large Bore sampler in clear plastic (CAB), brass, and stainless steel. Liners are available for the Macro-Core sampler in clear plastic (PVC and PETG) and stainless steel. When cores are retrieved, the plastic liners can be cut longitudinally to screen soils for contaminants and lithologic logging and to remove soils for laboratory analysis. In addition, the plastic liners can be cut circumferentially to isolate and cap segments for later analysis of volatile organic compounds (VOCs).

4.5.2 Soil Sampling Procedures

The following steps must be followed when sampling soil with the Geoprobe® system. Field staff should carefully review Appendix A and B (and any subsequent updates/revisions) of the Geoprobe® Tools and Equipment Catalog (Geoprobe Systems, 1999) for additional details regarding operation and procedures for soil sampling using the Large Bore and Macro-Core samplers, respectively.

Assembly

1. Decontaminate all parts before use following the decontamination procedures outlined in SOP OTIE011A.
2. Assemble all of the parts as shown in the Geoprobe® operator's manual.
3. Replace the O-ring on the piston stop-pin each time the sampler is assembled. Make sure the pin is tightened down with a wrench.

Probing

1. Attach the assembled sampler onto the leading Geoprobe® probe rod.
2. Drive the sampler into the ground and retighten the stop-pin.
3. Drive the sampler to the top of the desired sampling interval. Note: A 12-in.-diameter drive rod for initial drilling is often helpful in placing the sampler below the surface.

Stop-Pin Removal

1. Remove the drive cap and lower the extension rods down the inside diameter of the probe rods; use couplers to join rods together.
2. Attach the extension rod handle to the top extension rod and rotate the handle clockwise to remove the stop-pin.
3. Remove the extension rods from the probe rods. The stop-pin should be attached to the last extension rod.

Sampling

1. Replace the drive cap onto the top probe rod.
2. Mark the length of the sampler used on the top probe rod.
3. Drive the sampler the marked distance. Do not over-drive the sampler.
4. Remove the probe rods from the hole to recover the sampler.
5. Remove the soil core from the sampler sheath. Samples may require a machine extruder to separate soils from liners or sampling sheaths.
6. If contaminants of concern include VOCs, then the soil core should immediately be sampled for laboratory samples, then head-space screening samples, and screened for VOCs by a hand-held organic vapor analyzer (OVA) across the entire length of core. Refer to SOP OTIE005B for VOC head-space screening methods.
    a. Instrument readings should be recorded in field book and/or boring log.
    b. VOC samples volumes should be collected from as undisturbed area of the samples as possible. The sample volume should be quickly containerized for OVA headspace analysis of VOCs, and for on-site and/or off-site analysis of VOCs per specifications in site-specific SAP. Refer to SOP OTIE010B for soil sample collection and preservation for VOC analysis.
    c. Sample liner section ends should be immediately capped for off-site VOC laboratory samples.
    d. Sampling for other analytes (e.g., inorganics and SVOCs) should follow VOC sampling. Samples volumes should be collected from the remainder of the soil sample after it has been thoroughly homogenized.
7. Label all samples completely immediately upon sampling.

4.5.3 Documentation

The soil sampling process must be fully documented using a soil boring log form and related requirements of SOP OTIE002A. Soil lithology should be logged according to the requirements of SOP OTIE007B. All screening measurements, sample identification numbers, and other relevant information identified on the soil boring log must be recorded for each boring.

4.6 GROUNDWATER SAMPLING

There are three types of well point configurations that can be used with the Geoprobe® to collect groundwater samples. All three types of well points are driven into the saturated zone with the Geoprobe®, and a sample of the groundwater is collected through the hollow probe rods.

The different well points available are:

- An expendable point (which is disconnected by pulling up on the probe rods to expose the open bore of the probe rod),
- A mill-slotted well point, and
- A screen point sampler.

The expendable point is generally not recommended because sand and silt can flow up the probe rod and clog the sampling apparatus. The mill-slotted well point is recommended for relatively clean unconsolidated sand aquifers where silts and clays are minor or nonexistent. The screen point sampler, which contains a fine screen within a perforated steel sheath, is recommended for most hydrogeological settings.

To avoid potential cross-contamination and mixing, multiple groundwater samples should never be taken vertically at different depths from within the same borehole. The lateral swing lever allows groundwater sampling from separate, adjacent probes without moving the vehicle.

This mode should be used to preserve sample integrity from each depth during vertical profiling of groundwater contamination.

4.6.1 Screen Point Sampler Procedure

The Geoprobe® screen point sampler consists of an expendable stainless steel probe point, a 1.0- inch OD screen and riser attached to the probe point, a stainless steel sheath that covers the screen during probing, and a head assembly. The 41-inch long screens are wire-wound stainless steel or slotted PVC. Screens can be custom fabricated up to a length of 48 in. The screen section remains totally enclosed in the sheath until it is pushed out into the formation at the desired depth. Groundwater samples can be bailed using minibailers and/or pumped from the probing rods or pumped directly from the screen section using flexible tubing, a PRT adapter, and a peristaltic pump.

The following steps must be followed when using the screen point sampler. Field staff should carefully review Appendix C (and any subsequent updates/revisions) of the Geoprobe® Tools and Equipment Catalog (Geoprobe® Systems, 1999) for additional details regarding operation and procedures for groundwater sampling with the Screen Point 15 Groundwater Sampler.

Assembly

1. Decontaminate all parts before use following the decontamination procedures in SOP OTIE011A.
2. An uncontaminated screen insert should be used for each new sample.
3. New O-rings must be installed at each O-ring location before each sample is taken.
4. Follow the assembly procedures outlined in the Geoprobe® operator's manual.

Probing

1. Place a drive cap on the assembled sampler and drive into the ground.
2. Continue to drive the sampler with probe rods until the sampler tip has been driven about 1 ft below the target sampling depth.
3. Disengage the expendable drive point by pulling rods back about 2 ft.

Exposing Screen

1. The 3/8-in. tubing affixed with a PRT adapter is lowered to the top end of the screen assembly.
4. The threads on the PRT adapter are engaged with the threads on the screen connector by pushing gently downward on the tubing and rotating it counterclockwise.
5. In a stable formation, it should be possible to push the screen assembly out into the open borehole by pushing down on the tubing.
6. If the screen cannot be pushed into the open borehole with the tubing, remove the tubing and push the screen—with the extension rods inserted—down the inside of the probe rods. Care should be taken to prevent damage to the sample and probe rods.

Sampling

1. Attach a peristaltic or bladder pump (or a vacuum pump with an in-line trap) to the 3/8-in. tubing and collect a water sample. This method of sampling can be used at depths of 25 ft or less. Do not use a vacuum or peristaltic pump if sampling for VOCs. A bailer should be used in this case.
2. At depths greater than 25 ft, lower the 3/8-in. tubing equipped with a bottom check valve to the water level. By oscillating the tubing up and down, water will be pushed upward into the tubing. Remove the tubing from the probe rods and collect the sample. The 3/8-in. O.D. by 1/4-in.-I.D. well tubing recovers 9.64 mL/ft. Discard tubing after each sample.
3. A stainless steel bailer attached to clean nylon line can also be used to collect water samples. The bailer is lowered down the hollow drive rods to the water table. Note that all 40-mL vials collected for VOC analysis should be devoid of air bubbles. Refer to SOP 008F for monitoring well sampling procedures.

Removal

1. Remove the tubing if the PRT system was used.
2. Remove the probe rods and sampler.

4.6.2 Temporary Piezometers

For some hydrogeologic settings, where aquifer transmissivity is very low, substantial time is needed for enough groundwater sample volume to enter the screen point or similar type sampler. Temporary piezometers should be installed where this occurs. The installation of a temporary piezometer allows the sampling rig to move on to the next location in situations where slow recharge would cause excessive stand-by time.

A temporary piezometer is constructed of a 1-inch inner diameter by 5-feet long slotted PVC screen connected to a 1-inch diameter blank as necessary for the boring depth.

1. The PVC piezometer is manually pushed down into the borehole after all the sampling rods and screen points have been removed from the borehole.
2. The temporary piezometer can sit in the borehole as long as needed for sufficient groundwater sample volume to be collected.
3. Groundwater samples are collected using the same methods as described above for Screen Point Samplers.
4. After the sample is collected from the temporary piezometer, the piezometer can be manually removed and discarded.
5. The associated borehole can then be backfilled per Section 4.7 (see below).

4.6.3 Small Diameter Wells

A permanent groundwater sampling point, known as a small-diameter well or microwell, can be installed using the Geoprobe®. The well is installed using an expendable drive point attached to stainless steel casing. After driving conventional probe rods to the desired screen depth, the casing is driven around the probe rods to total depth. The probe rods are then removed and a pre-packed stainless steel screen is placed at the base of the hole while the casing is retracted, leaving the screen exposed to the aquifer in the lower section of the hole. An alternative approach is to use an expendable point with the Macro Core Sampler and install a 2- inch PVC well in the hole. These methods are further described below.

The advantages of small-diameter wells are:

- No drill cuttings or other investigation-derived wastes are generated during the installation of a small diameter well.
- A small diameter well is less expensive to install than a conventional well, and requires no seals and grout above the screen.
- The small diameter well can be developed, purged, and sampled just like a conventional monitoring well.
- The water produced during development and purging is minimal because of the small diameter (volume) of the small diameter well.

For further information, see SOP OTIE008D and Attachments 1 and 2.

4.6.4 Small Diameter Wells Using Prepacked Well Screens

This method uses a prepacked stainless steel screen that is placed at the base of the hole while the casing is retracted to up above the top of screen. Geoprobe® prepacked screens come in two sizes: 0.5-inch ID x 1.375-inch OD x 36-inch length and 1.0 inch ID x 2.5-inch OD x 5 foot length. Other companies offer prepacked screens of various lengths and diameters that can be installed similar to the Geoprobe® products.

The following steps must be followed when installing the prepacked screen small diameter well. Field staff should obtain and carefully review the Geoprobe® Technical Bulletin 95-1000 (Geoprobe® Systems, October 1995, and any subsequent updates/revisions) for additional details regarding operation and procedures for small diameter well installation.

Decontamination

1. Decontaminate all parts before use following decontamination procedures in SOP OTIE011A.

Pilot Hole

1. A pilot hole is made by probing with a retractable pilot point threaded onto the end of the probe rod. The pilot hole should be pushed to within 2 to 4 ft of the planned total depth of the well.

Initial Assembly and Insertion

1. Ensure that an O-ring is in the proper slot on the expendable drive point and insert the expendable drive point into the drive shoe.
2. Thread the point driver into a section of probe rod and insert the probe rod (driver end first) into the casing assembly.
3. Thread the drive collar into the casing and the skirted drive cap onto the probe rod.
4. Insert the casing assembly into the pilot hole. Do not retract the assembly before the sampling depth has been reached.

Driving

1. Drive the assembly to the planned total depth.

2. When adding probe rods and casing joints, ensure the threads are tight and the shoulder of the probe rod threads is even with, or above, the top of the drive collar. Ensure that each casing joint is equipped with O-rings.

Prepacked Screen Installation

1. Remove all probe rods from the inside of the installed casing. Reinstall the casing drive collar.
2. Attach the prepacked screen to a section of extension rod using a screen connector.
3. Lower the screen/rod assembly down the casing until the screen reaches the bottom of the casing. Leave at least 25 in. of extension rod above the casing.

Casing Retraction

1. Retract the casing using the casing puller on the hammer of the Geoprobe®.
2. As the casing rises, press the extension rod handle down so that the prepacked screen remains stationary.
3. After the casing has been pulled up the length of the screen (3 or 5 feet), rotate the handle of the extension rod clockwise at least six turns. Remove the extension rods from the casing.
4. Install a service cap on the top of the casing and install a protective casing with a locking cap and lock to prevent tampering.

For further information, see SOP OTIE008D and Attachments 1 and 2.

4.6.5 Two-Inch Diameter PVC Wells

The basic installation procedure is similar to above, except that an expendable point is used and the well is installed through a 2 5/8-inch ID Macro Core Sampler. The Macro Core is used to advance a continuous core boring to the desired depth. A two-inch ID Schedule-40 PVC well screen is placed into the inner diameter of the Macro Core which is fitted with an expendable endpoint.

As the Macro Core is pulled up, the expendable point and the PVC well screen stay at depth. Because the expendable point is only slightly larger than the two-inch PVC, it creates a very small annulus around the PVC. It may be possible to install a sand filter pack and a granulated bentonite seal with a small diameter tremie pipe after the Macro Core casing is pulled up, although some bridging should be anticipated.

This application performs best in sandy soil conditions where there is relatively little resistance to DPT advancement of the sampler and formation collapse will occur around the screen. Depth limitations are site specific, but are generally 30 feet or less. Once installed, the two-inch PVC can be used for groundwater sampling, air sparging, or SVE systems. Because this well installation is non-standard, check with local well installation regulations regarding use of data from these wells. The well should be completed at the surface using standard wellhead completion procedures (see SOP OTIE008D and Attachments 1 and 2).

4.6.6 Sampling Small Diameter and Two-Inch Diameter PVC Wells

The small diameter wells can be developed, purged, and sampled by using a peristaltic bladder, tubing with bottom check valve, or a bailer. The 2-inch PVC wells can be developed, purged, and sampled using standard monitoring well techniques. SOP OTIE008D provides information regarding the methods and requirements for development/purging. SOP OTIE008F provides information regarding the methods and requirements for groundwater sampling.

4.6.7 Documentation

The small diameter or microwell installation process must be fully documented in the field logbook and (if used) the appropriate field forms, in accordance with SOP OTIE002A. Development, purging, and sampling of small diameter or microwells should be completely documented. The locations and elevations of each well should be accurately surveyed.

4.7 PLUGGING AND ABANDONMENT

All probed holes—whether soil gas, soil, or groundwater test holes—must be plugged and abandoned. Holes should be filled with bentonite slurry, granular bentonite, or 3% bentonite cement from total depth to the surface. The plugging material can be poured into shallow holes less than 5 ft in depth. Deeper holes will require tremie placement of the plugging material.

When plugging a small diameter well, the casing is retracted a few inches and extension rods are used to push out the grout plug and expendable point. A grout tube is then inserted out of the grout hole at the end of the screen, and a high-pressure grout pump is used to pump grout into the boring as the casing rods and screen are withdrawn using the Casing Puller Assembly.

4.8 QUALITY CONTROL

Any departure from the specified SOPs must be submitted and approved before deviating from the requirements. Deviations shall be sufficiently documented to allow repetition of the activity as actually performed.

5.1 RESTRICTIONS/LIMITATIONS

The following restrictions/limitations apply to the procedures described in this SOP:

- Soil gas results are a secondary indicator of other media (soil and water) contamination. The results are semiquantitative. Soil gas release is affected by many variables including the chemical and physical properties of the contaminant, soil permeability, temperature, barometric pressure, precipitation, and fluctuating water table. Actual soil and/or groundwater samples are required for definitive confirmation.
- DPT is limited to sampling depths up to approximately 100 ft in unconsolidated, sandy soils and to shallower depths in compacted clayey or gravelly soils and tills.
- Small diameter well installations may not meet well installation requirements in some states and, therefore, groundwater data collected from this type of well are not accepted as definitive data. Always check with your local regulatory agency for well installation requirements.

6.0 REFERENCES

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STANDARD OPERATING PRACTICE OTIEOOSE

Fluid Level Measurement in Wells

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	QC Review Signatures	Date
Name/Role	**Signature**	
Carolann Wolfgang, Ph.D. Corporate QC Manager		December 12, 2013
Nova Clite, PG Sr. Hydrogeologist		December 12, 2013

STANDARD OPERATING PRACTICE OTIE008E

Fluid Level Measurement in Wells

1.0 SCOPE AND APPLICATION

This Standard Operating Practice (SOP) describes equipment and procedures for accurate measurement and recording of fluid levels in wells. This SOP provides practices for static and dynamic fluid measurement using tapes and data loggers. Site-specific procedures will depend on project objectives and local geologic conditions.

2.0 HEALTH & SAFETY PRECAUTIONS

1. Review the Site Safety and Health Plan (SSHP) prior to mobilizing to the field and be aware of potential hazards of working around wells, well vaults, and contaminated media.
2. Well head vapors and volatiles in the breathing zone may need to be monitored during the measurement of water levels at a contaminated site.
3. Wear appropriate personal protective equipment (PPE) for all gauging activities, such as chemically-resistant disposable gloves, steel-toed boots, hard hats, safety glasses, and traffic vests in accordance with the SSHP.
4. Change disposable gloves after gauging each well or before any possible cross- contamination.
5. If possible, fluid level measurements should be collected from monitoring wells in the order of clean to most-contaminated to reduce the possibility of cross-contamination between wells.
6. Use a buddy system for entering deep well vaults or handling heavy well vault lids; do not take unnecessary chances, comply with all health and safety requirements and use common sense.

3.0 WELL MEASURING REFERENCE POINT

1. Fluid level measurements are to be made from the same surveyed mark on the top of the permanent well casing.
2. The reference point should be notched or permanently marked at the north side of the casing. All fluid levels and total well depth are measured as depths from the reference point.
3. When water level measurements are to be collected from a well that does not have a marked and surveyed reference point, the measurements will be referenced to the north top of casing.
4. Have the new reference point surveyed for vertical elevation as soon as possible to ensure timely use of the level data.

4.0 PRACTICE FOR STATIC FLUID LEVEL MEASUREMENT

4.1 PURPOSE OF STATIC FLUID LEVEL MEASUREMENT

Groundwater and product fluid levels are measured to determine the elevation of fluids in subsurface aquifer systems.

1. Groundwater level measurements collected under non-pumping conditions are considered "static." In reality, aquifers are dynamic systems and so it is critical to collect data in a timely fashion to get an accurate "snap shot" of the system.
2. Water-level measurements to be used to define a potentiometric surface should be collected within a single 12-hour period. This is because groundwater elevations can change rapidly in response to various environmental conditions (see Section 8.0).
3. Depth to groundwater measurements are converted to groundwater elevations, based on the surveyed reference point on each well casing.
4. The elevation (hydraulic head) data are then contoured on a to-scale base map to represent the potentiometric surface (distribution of hydraulic head) of the aquifer.
5. Hydraulic head data are also used to develop estimates of groundwater flow direction, horizontal and vertical gradients, movement of water between hydrologic units, and velocity, as well as contaminant plume migration. These calculations rely on *accurate* groundwater elevation data.

4.2 EQUIPMENT AND MATERIALS

1. Health and safety plan and other site plans and documents as required.
2. Site base map showing well locations and table of well construction information including total well depth and screen heights.
3. Decontamination equipment (buckets, plastic sheeting, brushes, etc.)
4. Electronic tape of sufficient length to measure all scoped wells and constructed of materials that are chemically inert and that are not prone to stretching, sorption or desorption. (See Section 4.2.1 for more information.)
5. Field forms and field logbook.
6. Well vault and cap opening tools, keys, etc.
7. Vapor monitoring device such as photoionization detector (PID) or flame-ionization detector (FID), calibration gas, and log forms.
8. Measuring tape, GPS, and/or metal detector to help locate monitoring wells where necessary.

4.3 PRACTICE FOR ELECTRIC WATER LEVEL SOUNDING

The use of electrical water level indicator to measure fluid levels is simple and convenient. The device consists of an electrode suspended by a pair of insulated wires. An ammeter, indicator light, or audible signal is used to indicate when the electrode touches the water surface.

Batteries supply the current. This method is also known as the electric sounder method.

The procedures for this method are as follows:

1. Check batteries before going to the field.

2. Decontaminate the tape and probe before arrival to a site and between measurements in different wells or piezometers in accordance with SOP No.011A.
3. Turn power switch to "on." Some models provide a test switch to check operation.
4. Lower the probe into the well until a sharp deflection is noted on the meter, the indicator light is illuminated, or the audible tone is activated. You may have to adjust sensitivity of instrument.
5. Verify that the electrode is functioning properly and is indicating the water surface at the same depth each time by moving the probe up and down several times. Try to keep tape away from well casing as moisture that accumulates on the casing wall can cause the tape to stick to the casing and trigger the electrode.
6. Hold probe cable or tape at the reference location on the well pipe at the exact depth where probe indicates water surface to be. Record reading to the nearest 0.01 feet.
7. Lower the probe until a definite decrease in cable tension indicates reaching the bottom of the well (turn power to “off” to avoid signal sounding during total depth measurement).
8. Verify reaching bottom depth by repeatedly lowering and slowly retrieving the probe cable just until you “feel” the bottom. You should also be able distinguish a soft bottom versus a hard bottom with the probe. A soft bottom indicates the presence of silt (make a note of it in field logbook and/or field form). Most instruments have the sensor at the bottom of the probe so the depth reading is accurate without an adjustment.
9. Hold the probe cable at the measuring reference point on the well pipe at the exact depth where the probe indicates well bottom to be. Record the reading to the nearest 0.01 feet.
10. Remove the probe from the well and decontaminate, as necessary (see SOP OTIE011A).

4.4 OTHER SOUNDING METHODS

Other sounding methods using older technologies are not covered in this SOP.

5.0 PRACTICE FOR DYNAMIC FLUID LEVEL MEASUREMENT

5.1 PURPOSE OF DYNAMIC FLUID LEVEL MEASUREMENT

Periodic or continuous monitoring of groundwater levels is an essential task in aquifer pumping tests or slug tests. The relative change and rate of change in groundwater levels are used to develop estimates of aquifer hydraulic conductivity (See SOP OTIE008H).

5.2 EQUIPMENT AND MATERIALS

5.2.1 Pressure Transducers and Data Loggers

Pressure transducers are used to collect continuous or periodic water level data in wells or surface water bodies reliably and accurately. They may be used to collect water level measurements as part of an aquifer pumping test, for long term monitoring of aquifers or surface water bodies, or for a controlled field experiment requiring hydrologic monitoring.

Pressure transducers may have built-in data loggers (more common) or be cable-linked to a surface data logger (less common). Several transducers may be linked to one data logger.

Check with the manufacture for equipment specifications and setups.

Note that pressure transducers may be "open cable" which automatically corrects for barometric pressure, or standard, which requires separate collection of barometric pressure data and later normalization of hydraulic and barometric pressure data sets.

5.2.2 Equipment List

The following equipment is required for continuous water level monitoring:

- Manual water level indicator, pressure transducers sized for the well diameter, and data logger(s)
- Decontamination equipment
- Equipment to shelter the data logger (if surface mounted)
- Portable computers (lap top, hand-held) and data storage devise
- Communication cables for data linking (if not built into transducer/data logger)
- Stopwatch (if required)
- Field logbook or field forms
- Recording barometer and recording tide gauge (if required by conditions),
- Site-specific sampling plan
- Operations Manual for data logger and/or pressure transducers, and
- Hand-held radios and/or cellular telephones

5.3 PRACTICE FOR CONTINUOUS RECORDING USING TRANSDUCERS

General procedures, pre-test and post-test activities, and the specific activities for the test are outlined below. Consult with the transducer/datalogger user manual and your site-specific work plan for site specific procedures.

5.3.1 Pre-test/Post-test Activities and General Procedures

1. All downhole equipment (e.g., pressure transducers and water level monitoring devices) must be decontaminated before and after use as per SOP OTIE011A.

2. Pressure transducers and data loggers should be calibrated and tested before actually using them in the test program.

    a. Run an inherent self-test program in the unit to test the operational integrity and the configuration of the data logger. Pressure transducers are calibrated by the manufacture prior to shipment.
    b. Pressure transducers should be connected to the data logger and checked for operation by placing the pressure transducer below the water table at a known depth and taking a reading, moving the pressure transducer up or down a measured distance and taking another reading.
    c. During the field check of factory calibration, the expected water level must match the transducer-recorded water level within less than one percent.

   d. Testing information will be recorded in the field logbook or field form. If the transducer does not appear to recording properly, it will be sent back to the manufacture for replacement.

3. Pressure transducers should be assigned to individual monitoring well locations for test duration. Record serial numbers of pressure transducers and what wells they were used in.
4. Setup the pressure transducer in accordance with the manufacturer's operations manual. Most transducers can be pre-programmed with the well's reference elevation, well name, time of measurements, time between measurements, averaging methods, etc.
5. All time recording devices should be calibrated to a master clock before the test.
6. Water levels in all wells should be taken manually and recorded in the field logbook, immediately before emplacing the transducer and before beginning a test.
7. All data and events will be recorded in logbooks or on data sheets specified for the recording of data.

5.3.2 Field Installation

1. Pressure transducers should be lowered gently down the well and should be installed below the lowest anticipated change in water level, but not so low that the range of the transducer might be exceeded at the highest anticipated change in level.
2. Pressure transducers should be secured in place and allowed to stabilize for approximately one hour prior to initiating programmed data collection to insure accuracy of measurements.

5.3.3 Test Activities

1. As back-up to data logger or transducer failure, downloads of partial data from the automatic data recorders should be made periodically.
2. In addition, manual water level readings will be conducted periodically throughout the test. Manual water level readings may disturb the water column.
   a. The time that the manual reading was taken should be recorded and referenced with the reading collected by the data logger.
   b. Manual water level measurements are a required part of the test as a periodic backup in the event of data logger or transducer failure and to provide QA/QC data.

6.0 FREE PRODUCT MEASUREMENT USING INTERFACE PROBE

Light non-aqueous phase liquid (LNAPL) floating on the water table may be present in a well. Dense non-aqueous phase liquid (DNAPL) sink through water and may be present in the bottom of a well. LNAPL or DNAPL also may be referred to as immiscible fluid or free product. Free product levels are measured using an oil/water interface probe following similar procedures as described above in this section.

1. Follow health and safety precautions in Section 2.0 and the general practice for measuring static fluid levels outlined in Section 4.0.

2. Always follow the site-specific health and safety plan for working around open wells containing free product.
3. The oil/water interface probe is lowered into the well casing until the point of contact with water or immiscible fluids. When the interface probe is in contact with immiscible fluids, a solid audible tone is activated.
4. The probe should be slowly moved up and down several times to get the exact depth measurement at the top of the immiscible fluid.
5. The interface between water and immiscible fluid will be determined when an oscillating audible tone is activated.
6. Record both readings on the field form or in field logbook
7. If an audible signal is heard, but no measureable free product thickness found, you may be detecting "sheen" levels of product; note as such in the field record.
8. Upon removal of the probe from the well, the interface probe will require decontamination in accordance with Equipment Decontamination Procedures in SOP OTIE011A.
    a. Use of an approved cleaning solvent (e.g., isopropanol) may be required to removal product from the interface probe.
    b. Care should be taken to perform a thorough decontamination of the interface probe to decrease the likelihood of cross contamination between well locations.

7.0 OTHER PURPOSES OF WATER LEVEL DATA

7.1 WELL CONSTRUCTION AND WELL DEVELOPMENT WATER LEVEL MEASUREMENT

1. Measure water levels in the borehole before well construction to determine placement of well screen (verify with water level measurements in other nearby wells)
2. Measure water levels immediately following well construction and before development to check for the presence of groundwater.
3. Periodically measure water levels during over-pumping (well development) to collect data for well performance evaluation (see SOP OTIE008D).

7.2 PRE-SAMPLE WELL PURGING

1. Water levels should be frequently measured during pre-sample purging particularly for the low-flow sampling method (see SOP OTIE008F).
2. The water level and total depth measurements are used to calculate the volume of static water in the well.
3. Static water volume is used to estimate the total volume of water to be purged from a well prior to sample collection and to establish when a well has fully recharged following purging.

8.0 INFLUENCES ON WATER LEVEL DATA

Field personnel should be aware of potential influences on groundwater level data to ensure the resulting measurements are an accurate "snap shot" of the potentiometric surface. Some of the influences on groundwater levels in wells are listed below. Site-specific conditions vary and influences other than those listed may need to be considered in the analysis of groundwater level data.

- **Localized disturbance of the aquifer and borehole "skin" caused by drilling**. Groundwater levels cannot be relied on as representative of aquifer conditions until after well development is completed (see SOP 008D). The water levels in wells should be allowed to recover for a minimum of 12 hours after well development activities to ensure that static water levels are measured.
- **Disequilibrium with atmospheric pressure**. Wells sealed with vacuum caps should be allowed to sit open (without cap, or capped loosely) to allow the water level in the well to equilibrate to atmospheric pressure. Allow wells to "breath" until water levels are static. ***Note***: wells in tight formations under confining conditions can build up considerable air pressure within the well casing. Remove vacuum-seal caps with caution.
- **Pressure changes during well-field measurement**. Water levels in wells can respond relatively quickly to influences such as barometric pressure changes (such as a storm front passing through), tidal influences, or periodic pumping from a nearby water supply well. Make a note of site conditions that could affect water levels during the field event.
- **Frost heave or other damage to well head or top-of-casing**. For groundwater elevation data to be comparable over time, the reference point must remain the same. Improperly completed wells may be subject to frost heave (in cold climates), invalidating prior surveyed elevations. Wells completed in soft soils may sink. Well casings or well vaults that are damaged by heavy traffic or during construction activities should be repaired and the well casing resurveyed. It's a good idea to re-survey monitoring wells at least once every five years.
- **Equipment**. Use non-stretching tapes only. Water level measurement devices should be accurate to ± 0.01 feet.

Check the reliability of your field data by making quick contour maps or comparing new data to prior data before you demobilize from the field. Re-measure depth to water at any well locations that appears to be inconsistent with prior data. However, keep in mind that potentiometric data should be collected within a single day.

9.0 DATA REPORTING

All water level field data shall be entered in field logbooks and/or on the appropriate field form and will include the following information:

- Date of measure (at top of page)
- Time water level is measured at each well
- Weather conditions, especially any significant change in atmospheric pressure
- Station location (monitoring well or piezometer identification)
- Serial number of any measurement or recording device; if more than one device is used, indicate which device is used for each measurement.
- Comments about well condition (surface completion integrity, etc.)
- Measuring point, usually top of casing at marked location or north on casing
- Depth to product (if present), to nearest 0.01 foot
- Depth to water, to nearest 0.01 foot, and

- Depth to bottom of well, to nearest 0.01 foot.

10.0 REFERENCES

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STANDARD OPERATING PRACTICE OTIE008F

Monitoring Well Sampling

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Attachments

Attachment 1 Groundwater Sampling Equipment and Supplies Checklist

QC Review Signatures

Name/Role	**Signature**	Date
Carolann Wolfgang, Ph.D. Corporate QC Manager		03/25/2014
Nova Clite, PG Sr. Hydrogeologist	Nova Clite	03/25/2014
Cecil Irby PG Sr. Geologist/PM-PFC Specific	Cecil	2/22/16

Given the low detection limits associated with PFC analysis and the many potential sources of trace levels of PFCs, field personnel are advised to act on the side of caution by strictly following these protocols, frequently replacing nitrile gloves, and rinsing field equipment to help mitigate the potential for false detections of PFCs. Specific items related to direct push technologies are discussed below.

1.0 SCOPE AND APPLICATION

This standard operating procedure (SOP) addresses the supplies, equipment, and procedures to be used to purge wells and collect groundwater samples for chemical and natural attenuation parameters. A consistently implemented groundwater sampling procedure will help ensure data comparability between different sampling events. However, in all cases, the methods, equipment, and procedures in this SOP should be tailored to site-specific conditions and project data quality objectives.

The procedures in this SOP apply to permanent monitoring wells but may be followed for sampling of temporary wells, extraction wells, and other types of wells with some modifications. This SOP addresses procedures for collection of aqueous samples only.

Procedures for collection of light or dense non-aqueous phase liquids (LNAPL or DNAPL) samples or collection of aqueous samples when LNAPL or DNAPL are present in a well are not covered.

2.0 OBJECTIVE

The objective of groundwater sampling is to produce groundwater quality data that is representative of the current groundwater conditions in specified volume of an aquifer (U.S. EPA, 2002). To ensure that this objective is achieved, sampling equipment, sampling methods, and sample handling procedures should not alter the chemistry of the groundwater.

3.0 SAMPLING PREPARATIONS

Do not use Teflon®-containing materials (e.g., Teflon® tubing, bailers, tape, plumbing paste, or other Teflon® materials) since Teflon® contains fluorinated compounds. The following is a list of equipment recommended for hand auger soil boring:

3.1 Document and Information Review

Prior to obtaining equipment and supplies, review the site-specific plans and historical information. Field personnel or at least the Field Team Leader(s) should review:

- Site-specific Safety and Health Plan (SSHP), Material Safety Data Sheets (MSDS), and other safety related information. Consider what personal protective equipment (PPE) is necessary and what decontamination procedures must be followed.
- Sampling objectives and procedures specified in the Sampling and Analysis Plan (SAP) (or equivalent work plan document). The SAP will include the data quality objectives, sample analyses, and quality assurance project plan among other information. The SAP must be reviewed and understood by the sampling team before the sampling event.

- Historical sampling data (if available) and well information (location, depth, recharge rates, etc.). Determine the order of well sampling so that the least contaminated wells at the site will be sampled first, progressing to the most contaminated wells last.
- Monitoring well construction logs and available water level data for all wells to be sampled to evaluate the conditions that will be encountered and the approximate volume of water to be purged.
- Chemical analytical sample container requirements, preservatives, holding times, etc. so that you are prepared for collection, preservation, and shipping of samples. Consider where to collect Quality Control (QC) samples such as duplicates, matrix spike (MS), and matrix spike duplicate (MSD) samples.
- Department of Transportation (DOT) hazardous material sampling requirements that may apply to chemical reagents, calibration supplies, and/or samples that contain reportable quantities of hazardous substances.

3.2 Order Equipment & Supplies

Use the attached equipment and supplies checklist (or a project-specific checklist) as a guide when preparing for a groundwater-sampling event. At least 10 days before the sampling event, prepare purchase requisitions and place orders for:

- All necessary sampling equipment and expendable supplies.
- Decontamination supplies; spill response supplies (if necessary)
- Appropriate purge and decon water containment vessels (plastic or steel drums, poly tanks, etc.).
- Sample bottles from the laboratory including sufficient bottles for blanks, duplicates, MS/MSD, and extras to cover breakage.
- Deionized (DI) water for equipment blanks from the laboratory or an appropriate vendor. Check the SAP or QAPP for the grade of DI water that is required for the project; typically Oneida Total Integrated Enterprises, LLC’s (OTIE) clients require ASTM II grade DI water.

3.3 Pre-Sampling Field Activities

3.3.1 Check Equipment and Supplies

Prior to beginning sampling, inspect and check all equipment and supplies.

- Check sample bottles to ensure that all necessary bottles, preservatives, and blanks have been provided.
- Inspect all sampling equipment to confirm it is functional and in good repair. If renting equipment, have supplier’s contact information handy. Document any equipment repair/maintenance in the field logbook.
- Check expendable field supplies to make sure there are adequate quantities for the entire event.

- Check all chemical reagents required for performed decontamination, sample collection, and sample preservation. Make sure calibration fluids required for field instruments are fresh (not beyond the label expiration date).

3.3.2 Well Gauging and Inspection

Inspect all wells to be gauged and/or sampled to determine the condition of the surface casings, surface seals, well identification, and condition of the casing. The general condition of the wells and any conditions that could affect water level data or sample integrity must be noted in the field logbook and/or sampling forms. If the observed well conditions indicate that data obtained from the well could be comprised, notify the OTIE Project Manager who will determine if the well should be sampled.

Measure water levels following the procedures in OTIE SOP 008E. Well gauging is a separate task to complete across the site prior to sampling to ensure accuracy of the water level data. Measure and record all data prior to insertion of sampling equipment. If unanticipated LNAPL is encountered in a well, contact the OTIE Project Manager for further instruction.

Measure the total depth of each well in accordance with procedures defined in SOP No. 008E unless otherwise specified in a site-specific sampling plan. The measurement will be used in the calculation of the volume of water standing in the well casing. Additionally, comparison of the measured depth to bottom and the well construction log may indicate the presence of sediment on the bottom of the well.

If depth to water indicates water is present below the screen depth in the well sump, a representative sample will not be possible. The well should be identified on the field log as "dry". Inform the project manager of this finding.

3.3.3 Individual Wellhead Preparations

Upon opening the well, check the well head for the presence of volatile chemicals or gases with an organic vapor analyzer (photoionization detector) or similar as required by the SSHP. Follow SSHP requirements and procedures for vapor monitoring in the breathing zone during sampling.

3.3.4 Estimate Well Volume

Low-flow sampling procedures rely on water quality parameter stabilization to determine when to collect sample (see Section 4.4). However, other sampling methods may require removal of specific well volumes, in which case you need to calculate the purge volume.

To determine the volume of water in a well, considering both water in the well and water in the saturated sand pack, the following formula may be used:

$V = V1 + V2$

Where $V1 = [h1\ (r1)^2\ \pi] \times 7.48$

V1 is the well casing volume in gallons

h1 is the height of the water column in the well in feet
r1 is the inner radius of the well in feet

π (pi) approximately 3.14

7.48 is conversion factor for cubic feet to gallons

and $V_2 = \{[h_2\ (r_2)^2\ \pi]/0.30\} \times 7.48$

V2 is the well casing volume in gallons

h2 is the height of the saturated filter pack in feet

r2 is the radius of the borehole minus the radius of the well in feet

π (pi) approximately 3.14

0.30 is the estimated porosity of the typical filter pack

7.48 is conversion factor for cubic feet to gallons

4.0 LOW-FLOW GROUNDWATER SAMPLING PROCEDURES

4.1 Method Summary

The goal of low-flow groundwater sampling is to collect representative groundwater samples and geochemical data from a well while minimizing investigative-derived waste (IDW). Low-flow sampling is accomplished by purging a well at the lowest sustainable pumping rate in that well until monitored groundwater quality parameters indicate representative groundwater is available for sampling. Whether using a down-hole pump or surface pump (e.g., peristaltic pump), the target pumping rate is generally 100 to 500 milliliters per minute (ml/ min); however the sustainable low-flow pumping rate must be established for each well.

4.1.1 Limitations

The low-flow purge and sampling techniques described in this section are not appropriate at all wells. Low-yield wells may not be suitable for low-flow sampling, as the minimal sustainable pumping rate may still generate significant drawdown or completely dewater the well. Wells suited for low-flow procedures are those that are screened below the water table in moderate to highly permeable material.

4.1.2 Low-Flow Sampling Objectives

The objectives of low-flow sampling are to:

- Minimize drawdown in the well during purging so that geochemical changes caused by filter pack and aquifer aeration are avoided; generally a head-loss of 0.3 feet or less is considered acceptable. Minimized drawdown also prevents mixing of stagnant well casing water (water above the screened interval) with aquifer water.
- Maintain a low, but sustainable flow rate. Typical low-flow pumping rates are 100 to 500 milliliters per minute (ml/ min) but the sustainable low-flow pumping rate must be established at each well.
- Minimize well disturbance caused by high velocity flows, dewatering, water cascading through the well screen, tagging the well bottom, etc.
- Minimize sample turbidity to 10 NTUs or less (see Section 4.4).
- Minimize purge water volume by relying on water quality parameter stabilization to determine when to collect the sample.

- Obtain reliable water quality parameters by using a calibrated multi-parameter probe with an in-line flow-through cell.
- Maintain laminar flow throughout the sample tubing and flow-through cell; keep all lines and the cell completely filled (air free) during parameter measurement and sampling.

Samples are collected when field-measured water quality parameters (Section 4.4) have stabilized indicating the presence of formation water. Therefore, low-flow purging does not include an objective for removal of a specified number of well volumes. Hence, low-flow sampling techniques tend to minimize the volume of purge water that needs to be properly managed and disposed.

4.1.3 Equipment

Generally, a submersible pump (bladder pump, Grundfos, Fultz, or other) is used with the pump intake set within the saturated well-screen interval at least 2 feet off the bottom of the well. A peristaltic pump with appropriate controller may be used for low-flow sampling in wells less than 25 feet deep. However, specific sample collection methods for VOC samples must be followed as peristaltic pumping might induce loss of VOCs due to pressure changes at the pump head (See Section 4.3).

Pump discharge tubing is connected to an in-line flow-through cell equipped with water quality probes (temperature, pH, dissolved oxygen, etc.). Sample volume is collected after water quality parameters have stabilized. Disconnect the intake tubing from the flow-through cell; do not collect samples from the discharge line after the flow-through cell.

Low-flow sampling techniques for different pumps are described in Sections 4.2 and 4.3. Water quality parameter stabilization criteria are described in Section 4.4.

4.2 Submersible Pumps Procedures

4.2.1 Pump Selection

Submersible pumps are suitable for wells that have yields greater than 0.3 gpm and a total purge volume of greater than 5 gallons. Basic types of submersible pumps that are suitable for low-flow sampling include bladder pumps and positive displacement pumps. Common brand names include QED Micropurge™ (bladder), Grundfos Redi-Flo 2 (positive displacement), Fultz (progressive cavity), and Keck (progressive cavity) pumps. Other pumps are available.

Pre-field planning should include careful consideration of pump parameters, well-field conditions and data quality objectives. Selection of a pump that is not suited to site conditions can affect sample quality and result in unnecessary time delays and costs.

4.2.2 Grundfos Redi-Flo

This section describes the procedure for use of the Grundfos Redi-Flo 2 submersible pump. Equipment requirements include properly sized tubing, a generator (minimum 3500 watt), pump and controller. An in-line flow-through cell and multi-parameter probe (YSI 3500 or equivalent) is attached to the pump discharge line. Discharge tubing from the in-line flow-through cell should be positioned over a bucket or drum to capture purge water. A graduated liter beaker and stopwatch will be used to measure the flow rate.

The Grundfos Redi-Flo 2 is most suitable for moderate- to high-yield wells where water quality parameters stabilize quickly. However, it should be noted that this pump generates heat at low-flow rates, which degrades sample quality. This factor should be considered during pump selection.

To setup for use, connect the safety cable and appropriate length of Silicon-lined tubing to the discharge port of the Grundfos pump. Roll out pump and cable and mark desired pump depth (minimum 2 feet above bottom of well) on the cable with a wire-tie or sampling tape. Measure sufficient tubing to setup the flow-through cell. Cut tubing and attach to pump. Use nylon wire-ties to bind safety cable, power line, and discharge tubing together to prevent tangling of lines downhole.

Review the performance history of the well to estimate the purge rate and pumping conditions that can be expected. Insert the pump into the well. Maintain a slight tension on the controller wire and the safety cable. Slowly lower the pump and complete surface setup.

With the pump in place at least 2 feet off the bottom of the well, measure depth to water with a level indicator and compare the water level to the static reading (allow well to return to static water level before beginning pumping for accurate drawdown measurement). Make the proper connection, hook up the pump discharge tubing to the flow-through cell, and place the flow-through cell discharge tubing into the purge drum. Start the generator, plug in the controller, and check all tubing and instruments to ensure proper connection. Begin purging the well by slowly increasing the frequency knob on the controller. Monitor the pump discharge rate by using a graduated container. Follow the purging and sampling procedures described in Sections 4.2 and 4.3.

For wells less than 100 feet in depth, the frequency is generally less than 200 hertz (Hz). For wells greater than 200 feet in depth, the frequency may be adjusted up to 320 Hz. As a general rule, the discharge rate is proportional to the controller setting. This is not the case if the well is slow to recharge.

4.2.3 Impeller-Type Pumps

This section describes the procedure for use of an impeller-type submersible pump, such as Fultz or similar. An impeller pump uses a positive displacement pump head; the pump head should be constructed of non-reactive materials such as stainless steel. The following is a description of operation of a typical impeller pump, using the Fultz as an example.

Water is introduced into the pump through a 60-mesh screen into the stainless steel pump cavity. Once in the pump cavity, two rotors transfer the water up the tubing. The Fultz pump comes equipped with a hose barb and typically uses ½-inch polyethylene or silicon-lined polyethylene tubing. Typically, the tubing is used once and discarded after each sampling point.

Equipment requirements include properly sized tubing, pump, controller, hose, hose reel (optional, but recommended for deep wells), and a power inverter so that pump can be powered from car/truck 12-volt battery. An in-line flow-through cell and multi-parameter probe (YSI 3500 or equivalent) is attached to the discharge line. Discharge tubing from the in-line flow-through cell should be positioned over a bucket or drum to capture purge water. A graduated liter beaker and stopwatch will be used to measure the flow rate.

Follow the Grundfos pump set-up procedure described in Section 4.2.2 except the pump power cable will be attached through a power inverter to a 12-volt battery (plug into vehicle's cigarette lighter).

4.2.4 Bladder Pumps

A bladder pump operates using compressed air to pressurize the pump chamber, which squeezes an internal bladder filled with groundwater. The cyclical pumping action creates a pulsing flow of water out the pump discharge tube. The pressurized air does not come into contact with the water. This pumping method is considered to be among the best for VOC sampling. Equipment requirements include properly sized tubing, pump, controller, and compressed air supply (compressed air tanks or oil-less air compressor). An in-line flow-through cell and multi-parameter probe (YSI 3500 or equivalent) is attached to the discharge line. Discharge tubing from the in-line flow-through cell should be positioned over a bucket or drum to capture purge water. A graduated liter beaker and stopwatch will be used to measure the flow rate.

Generally, bladder pumps are difficult to decontaminate and are typically installed as well-dedicated pumps for on-going monitoring programs (such as at landfills). However, portable bladder pumps with removable disposable bladders are available.

Follow the Grundfos set-up procedure described in Section 4.2.2 except the pump is powered with compressed air from a tank or from an oil-less air compressor.

4.2.5 Low-Flow Purging with a Submersible Pump

For standard low-flow well purging, the following procedures shall be performed at each well:

- Don personal protective equipment (PPE) as specified in the Health and Safety Plan (HSP).
- The condition of the outer well casing, concrete well pad, protective posts (if present), and any unusual conditions of the area around the well shall be noted in the field logbook. The well may also be photographed. Any deficiencies in well integrity shall be reported immediately to the Project Manager.
- After opening the well, check the atmosphere in the well and the area around the well for volatile organic chemicals (VOCs) using a photoionization detector (PID) or flame ionization detector (FID). Record this reading on the field data form or in field logbook (background reading). If measured levels of VOC vapors and/or methane exceed action levels as given in the HSP, take appropriate actions.
- If necessary during purging/sampling, monitor VOCs in the breathing zone. If measured levels of VOC vapors exceed action levels as given in the HSP, take appropriate actions.
- The depth-to-static water level shall be measured with a water level indicator to the nearest 0.01-foot and recorded from the measuring point on the well casing, and recorded. Calculate the volume of water in the well (per Section 3.3.4) and record on purge/sample log.
- Assemble the pump and sampling line components taking care not to contact any of the components with potentially contaminated media, and ensure that the discharge line is

affixed so that the initial discharge is captured in either a graduated 5-gallon bucket or a purge water collection/disposal drum.

- Slowly lower the pump into the well casing to a point in the middle of the screened interval (generally at least 2 feet above the bottom of the well). Avoid tagging the bottom of the well. Maintain the pump at the desired depth level by tying the supporting cable off in some manner. Measure depth to water after deployment of the pump; allow the well to recover to static water levels before pumping. Keep the water level indicator in the well to monitor water levels during purging.
- Set up the flow-through cell with multiparameter probe and connect to the pump discharge line. Attach the flow-through cell discharge line to a bucket to capture purged water.
- Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check water levels in the well frequently (once every 5 minutes). Adjust the pump until there is less than 0.3 to 0.5 feet of drawdown. If the minimal drawdown that can be achieved exceeds 0.5 feet but remains stable, continue purging until indicator field parameters stabilize. Pumping rates should be adjusted to the minimum rate required to maintain a steady flow of water through all tubing and the flow-through cell and to prevent formation of air bubbles in the pump discharge line.
- Using a stopwatch and a graduated cylinder or container, periodically measure the pumping rate. Monitor the water level, pumping rate, cumulative withdrawal, and field parameters every 3 to 5 minutes. Record the pumping rate and field indicator parameters.

When the indicator field parameters (pH, temperature, specific conductance, dissolved oxygen, and turbidity) are stabilized, purging is complete and samples may be collected. See Section 4.4 for discussion of issues related to stability of field parameters and decision-making.

If head loss in a well during low-flow purging does not stabilize, is greater than 0.3 feet (from static) using the lowest-possible flow rate of the pump, or if the well dewaters, then low-flow sampling may not be feasible for that well. The sampling team should inform the Field Team Leader and/or Project Manager if this is the case. An alternative procedure for sampling the well may need to be approved by the Client Representative and the change in procedure noted as a variance to the work plan (see project specific SAP or QAPP).

Avoid aerating a previously submerged well screen, as this can lead to chemical changes in the groundwater. If it appears that low-flow purging will draw the water column down below the top of the screened interval, the sampling team may need to adjust the purging procedure to allow recovery between purging events. In this case, leave the pump in position and continue to monitor depth to water. Use professional judgment to balance time, length of purging, stability of water quality parameters, and the need to collect a sample.

Manage purge water in accordance with the project QAPP and Work Plan. Take necessary precautions to prevent spilling potentially contaminated water.

4.2.6 Low-Flow Sampling with a Submersible Pump

The following sampling procedures shall be used at each well where low-flow sampling procedures are applicable:

- When field parameters are stabilized (Section 4.4) and turbidity is at or below the required limit, begin to collect the groundwater samples. The pump should not be moved or adjusted between purging and sampling.
- Measure and record field parameters in the flow-through cell one final time, including pH, temperature, specific conductance, oxidation/reduction potential (ORP), and dissolved oxygen. Also measure turbidity.
- Disconnect the flow-through cell and collect the samples from the pump discharge tube. Collect VOC samples first. If necessary, attach a disposable filter and follow the field-filtering procedure discussed in Section 8.0 of this SOP.
- The typical sampling flow rate is 100 ml/min, but should be as low as possible while still maintaining laminar flow through completely water-filled tubing (no air bubbles) for collection of VOC samples. Record the sampling flow rate on the purge/sample log.
- Completely fill VOC sample vials so the water forms a convex meniscus at the top, then capped so that no air space (bubble) is present in the vial. Turn the vial over and tap it smartly to check for bubbles that indicate air space. If bubbles are observed, open the vial, fill the septum cap with additional sample and slowly pour into the vial to form a convex meniscus again at the top and attempt to recap the vial. If the first attempt to generate an air-free VOA is unsuccessful, discard the vial and collect another sample vial. If sample is spilled during this procedure, discard the vial and collect another sample vial.
- Completely fill the containers for all other analyses.

After the samples have been collected, they should immediately be placed in an ice-filled cooler. The sampling team will keep the coolers in their possession until relinquished to the on-site laboratory or to the Sample Coordinator, or until shipped to an off-site fixed-base laboratory.

4.2.7 Sample Collection Order

When using a submersible pump, samples are usually collected in the following order (as applicable):

1. VOCs
2. Gasoline range organics (GRO), diesel range organics (DRO)
3. SVOCs, total petroleum hydrocarbons (TPH)
4. PCBs and pesticides
5. Metals
6. Other organics
7. Other inorganics

Refer to the project-specific SAP for sampling order, sample containers, preservatives, and holding times.

After the laboratory-supplied sample containers are filled, labeled, and placed in a cooler on ice, field analyses may begin, if required. Field analyses of groundwater may be performed for ferrous iron, sulfide, or other parameters using field test kits. Follow the manufacturers' instructions included with the test kits to conduct the field analyses. Record the field test results in the field logbook or sampling log.

4.3 Peristaltic Pump Procedures

A peristaltic pump may be used for low-flow sampling for wells that are 25 feet or less in depth. Peristaltic pumps offer distinct advantages over submersible pumps, being highly portable and easy to use. However, peristaltic pumps cause a pressure change in the sample at the pump head which is believed to result in sample degassing. To avoid this problem, use the procedures in Section 4.3.3 for VOC sampling.

4.3.1 Equipment

The peristaltic pump should include a forward and reverse switch and a speed controller. Intake tubing (before pumping mechanism) and discharge tubing (from pumping mechanism) should be ½-inch diameter silicon or silicon-lined polyethylene tubing; and, pliable silicon tubing (such as Tygon™) is required for the pump head to function properly. Some peristaltic pumps (e.g., Barnant™) can accept various tubing diameters and provide a lever mechanism for the pump head, making installation of the tubing easy. Record the make and serial number of the equipment you use on the sampling log.

The in-line flow-through cell with multi-parameter probe is attached to the discharge line after the rotor heads. Discharge tubing from the in-line flow-through cell should be positioned over a bucket or drum to capture purge water. Use a graduated liter beaker and stopwatch to measure the flow rate. The pump is generally powered by connecting the power cables to an inverter plugged into a battery or vehicle electrical port.

4.3.2 Low-Flow Purging with Peristaltic Pumps

Attach intake tubing to Tygon (or equivalent) tubing that goes through pump mechanism. Carefully insert the intake tubing down into the well to minimize disturbance of the water column. Lower the intake tubing end to the middle of the saturated screened interval or at least 2 feet off the bottom. Avoid tagging the bottom of the well. Attach the discharge tubing to the flexible pump-head tubing and attach in-line flow-through cell. Position flow-through cell discharge tubing in bucket or drum to contain purge water.

Connect power and turn the pump on (forward direction) at a low pumping rate setting. While measuring water levels in the well, adjust the pumping speed until the lowest sustainable rate with minimal steady-state drawdown is attained. The pumping rate should induce no more than 0.3 foot of drawdown. If excessive drawdown or well dewatering is noted, then low-flow sampling procedures may not be feasible at this well. Refer to procedures for slow-recharging wells in Section 4.3.4.

Continue purging until water quality parameters have stabilized, as discussed in Section 4.4. After field parameters have stabilized, collect the sample as described in Section 4.3.3, below.

4.3.3 Low-Flow Sampling with Peristaltic Pump

After parameters have stabilized, disconnect the flow-through cell and collect groundwater samples into the appropriate containers.

Turn off the pump. Disconnect the flow-through cell from the pump discharge tubing and place sample container at tubing end. Turn on the pump and fill sample containers. See Section 4.3.5

for sample collection order. ***Note that VOCs samples are collected last because the intake tubing must be pulled from the well***.

For VOC samples, use the following procedures:

- With the intake tubing completely filled with groundwater, turn the pump off.
- Carefully pull the intake tubing out of the well and position the tubing end over the VOA sample vials. The water will stay in the tubing because of a pressure differential created by the pumping action (there is less pressure in the tubing than in the surrounding atmosphere).
- Reverse the pump flow direction at a very low flow rate and pump water out of tubing into VOAs.
- Because this procedure involves removing the tubing from the well, collect VOC samples last in the sampling order. Take care to not contaminate your tubing if replacing into the well. Use plastic sheeting around the well head to protect the tubing from contact with the surface.

When metals analysis is required, determine if field filtering before sample preservation is required. Generally, if turbidity in the sample is 10 NTUs or less, the groundwater sample will be considered representative of total metals and does not need to be filtered prior to preservation. If low-flow sampling produces a sample with turbidity greater than 10 NTUs, then the sample may need to be filtered, use an in-line disposable 0.45 μm filter prior to sampling (Section 8.0). The project SAP should specify the turbidity targets for unfiltered metals samples.

4.3.4 Peristaltic Pump Procedures for Slow Recharge Wells

Slow recharge wells that go dry even with low-flow purging may be sampled using low-flow procedures adjusted to prevent well dewatering and aeration.

In a slow-recharge well with a submerged screen (static water level above screened interval), slowly pump out the well casing water until about 6 inches of water remains above the well screen top. Do not pump the water below the screen level to avoid aeration of the screen. Allow the well to recover to at least 80 percent of the measured static water level. Repeat this procedure at least twice to ensure influx of aquifer water into the screened interval and then collect the sample.

For sampling, lower the tubing intake to mid-screen depth (or minimum 2 feet above well bottom) and pump using as low a flow rate as possible. Collect VOC samples last, following the procedure described in Section 4.3.3. Monitor water levels to prevent drawdown into the screen, if possible. Maintain a pumping rate that prevents air bubble formation in the intake tubing.

For water table wells (static water level within screened interval) with slow recharge rates, if excessive drawdown occurs then low-flow sampling procedures are not applicable and an alternative sampling method will be necessary. Refer to the project-specific SAP or contact the OTIE project manager for instructions.

4.3.5 Sample Collection Order When Using A Peristaltic Pump

When using a peristaltic pump, samples are usually collected in the following order (as applicable):

1. DRO and GRO
2. SVOCs, TPH
3. PCBs and pesticides
4. Metals
5. Other organics
6. Other inorganics
7. VOCs (see Section 4.3.3)

Refer to the project-specific SAP for sample containers, preservatives, and holding times.

After the laboratory-supplied sample containers are filled, labeled, and placed in a cooler on ice, field analyses may begin if required. Field analyses of groundwater may be performed for ferrous iron, sulfide, or other parameters using field test kits. Follow the manufacturer's instructions included with the test kits to conduct the field analyses. The field test results will be recorded in the field logbook and/or the groundwater-sampling log.

4.4 Water Quality Parameter Measurement

The low-flow sampling procedure requires monitoring of groundwater quality parameters monitored in a flow-through cell equipped with a multi-parameter probe. Typically, monitor and record pH, temperature, specific conductance, oxygen reduction potential (ORP), dissolved oxygen (DO), and turbidity at 5- to 10-minute intervals during purging; use of a data logger is recommended. Collect grab samples for turbidity measurement. When water quality parameters have stabilized, collect the samples. "Stability" is defined as four consecutive readings within the criteria listed in Table 1 or as defined in the project SAP.

Table 1: Example Parameter Stabilization Criteria

Measurement	Criteria
pH	±0.1 pH unit
Temperature	±10 percent
Specific conductance	±3 percent
ORP	±10 millivolts (mV)
Dissolved oxygen	±10 percent
Turbidity	Target of 10 NTUs or less for metals samples, 50 NTUs or less for organics samples

Collect groundwater samples after field parameters have stabilized. If you can perform low-flow purging with minimal drawdown, but indicator parameters do not stabilize (or turbidity remains above the target level) after a 30 minutes of purging, consult with the project manager regarding when to collect the sample. Note that down-hole pumps can heat up and raise water temperature, thus defeating the primary goal of low-flow sampling (representative groundwater sample/data).

Professional judgment will be required in certain circumstances. For example, if DO readings are in the 5 to 7 milligrams per liter (mg/L) range, then 10 percent is a reasonable fluctuation. But if DO is in the 0.5 to 1 mg/L range, then fluctuations within 10 percent are perhaps overly stringent. The same is true for conductivity and the 10-mV goal for ORP. If, after 20 minutes, all but one or two parameters have stabilized but are relatively close to their respective target bounds, then this may be an adequate indication that formation water is being removed. If certain parameters show a definite decreasing trend, then additional purging may continue in an effort to attain the respective parameter stability goal. Consult with the project manager and always document your rationale for samples collected when field parameters are not stabilized on the sample collection logs.

Meeting the turbidity target is more important that attaining stability of turbidity readings. The turbidity target for metals sampling is 10 NTUs and for organic sampling is 20 NTUs. However, in both cases, these turbidity goals may not be attainable due to silty or clayey aquifer matrix or biofouling of the well. If each parameter has stabilized but turbidity is still above the target NTU value, then purging may continue in an effort to attain the target NTU or to see if a downward trend in turbidity is evident. Decisions to continue purging will be based on how far out of compliance the values are (e.g., 15 versus 100 NTUs), and whether NTU values are constant or show a decreasing trend. Consult with the project manager and document rationale for collecting samples outside the target turbidity range.

5.0 POLYETHYLENE-BASED PASSIVE DIFFUSION BAG SAMPLERS

5.1 Method Description and Limitations

Polyethylene-based Passive Diffusion Bag (PDB) samplers are an alternative to traditional pump or bailer groundwater sampling methods for VOCs. The samplers consist of a low-density polyethylene (LDPE) sleeve containing deionized (DI) water. The LDPE sleeve acts as a semi-permeable membrane allowing chemical equilibrium between the internal and surrounding fluid (groundwater). The PDB sampler is suspended within the screened interval of the well and allowed to equilibrate with groundwater for a standard time period (typically two weeks). The PDB sampler is then retrieved from the well and emptied into standard 40-ml vials for VOC analyses. The resulting concentration represents an integration of chemical concentrations over the most recent part of the equilibration period before sample retrieval (Vroblesky, 2001).

The PDB method provides cost savings by reducing the labor required for pre-sample purging, eliminating purge water handling and treatment, and reducing IDW and decontamination wastes. PDB samplers are relatively inexpensive and are discarded after use.

The method is not suitable for certain ketones, ethers (e.g., MTBE), and alcohols; inorganic compounds; semi-volatile organic compounds (SVOCs); pesticides; or polychlorinated biphenyls. Deployment of PDB samplers in wells containing non-aqueous phase liquids (NAPLs) requires special procedures that are not discussed in this SOP.

The underlying principal of the PDB method is that groundwater within the screened interval of the well is in dynamic equilibrium with the aquifer; in other words, groundwater is flowing freely through the well. Therefore, placement and condition of the well will influence the quality or representativeness of the PDB sample. The method may not provide representative samples in stagnant flow situations or where well efficiency is compromised by improper development or fouling. Wells with screened intervals of 5- to 10-feet or greater length should be evaluated for vertical stratification of contamination (Vroblesky, 2001). Vertical gradients within a well can influence sample results. PDB samplers can be deployed in a vertical array and the resultant data used to adjust future sampling plans.

As with any sampling method, proper understanding of site conditions is crucial to obtaining representative and accurate results. The site-specific sampling plan and data quality control procedures should take into consideration potential influences on PDB sample results. Pre-sampling planning should consider the need for two mobilization events, one to install the samplers and a second event to retrieve them.

5.2 Equipment Storage

Before deployment, PDB samplers should be kept away from potentially cross-contaminating circumstances such as long-term storage with chemicals or fuels. Follow manufacturer's instructions for storage conditions and shelf-life.

5.3 PDB Sampler Procedures

5.3.1 PDB Deployment

The following procedures are taken from the U. S. Geological Survey user's guide for PDB samplers (Vroblesky, 2001).

- PDB samplers can be obtained either pre-filled (field ready) or unfilled. The unfilled samplers are equipped with a plug and funnel to allow for field filling of DI water and sample recovery. To fill the sampler, remove the plug from the sampler bottom, insert the short funnel into the sampler, and pour laboratory-grade deionized water into the sampler. The sampler should be filled until water rises and fills the funnel half-way. Remove excess bubbles from the sampler. Reattach the plug.
- The PDB Samplers are placed directly into the well and allowed to equilibrate to the groundwater flowing through the well. Pre-sample purging is not required. If measurement of groundwater quality parameters (e.g., dissolved oxygen, pH, oxidation-reduction potential) is required, these data can be collected using a down-hole multi-parameter probe following PDB sampler retrieval.
- The PDB sampler may be attached to a weighted line or weights can be attached directly to the sampler. If the well screen interval is shallow and the PDB contains an attachment ring, the weights can be directly attached. If the well screen interval is deep, consider using a weighted line approach. The weights attached to the bottom of the line should be stainless steel and can be reused for future sampling events with proper decontaminated. Braided polyester line is appropriate for one-time use.
- Sufficient weight should be added to counterbalance the buoyancy of the PDB samplers. One approach is to have the weight resting on the bottom of the well with the line taut above the weight. If this method is used, careful calculations must be made to ensure the PDB is placed within the correct screen interval. Note that turbidity in the well will not affect the PDB sample quality.
- Calculate the distance from the bottom of the well up to the point where the PDB sampler is to be placed. The PDB sampler must be completely submerged during the entire deployment period. Check groundwater elevations (water column height) and fluctuation trends (e.g., seasonal effects) before selecting this method.
- For 5 ft long or shorter well screens, the center point of the PDB sampler should be the vertical midpoint of the saturated well-screen length.

- For 5-10 ft long well screens, it is common to utilize multiple PDB samplers vertically along the length of the well screen for at least the initial sampling to determine whether contaminant stratification is present and to locate the zone of highest concentration.
- Lower the weight and weighted line down the well until the weight rests on the bottom of the well and the line above the weight is taught. The PDB samplers should now be positioned at the expected depth.
- Secure the assembly in this position. A suggested method is to attach the weighted line to a hook on the inside of the well cap. The well should be sealed in a way to prevent surface water invasion.
- Allow the system to remain undisturbed as the PDB sampler equilibrates.
- QA/QC duplicate procedures still apply to PDB samplers (typically 1 field duplicate for every 10 field samples). Duplicate bag samples should be set at the same vertical depth if the well diameter allows, this can be done with a clip attachment.

5.3.2 PDB Recovery

- The amount of time that the sampler should be left in the well depends on site conditions. Conditions that affect the sample equilibrium time include the target chemicals, chemical concentrations, groundwater temperature, and local groundwater flow velocity. Very low-flow velocity and cold temperature conditions have not yet been evaluated for this method.
- From various field studies, it appears that 2 weeks of equilibration probably is adequate for many applications. Site specific studies can be conducted to optimize the equilibration period.
- The samplers maintain equilibrium concentrations with the ambient water until recovery, so there is no specified maximum time for sample recovery. However, leaving the samplers in the well for too long may result in biofouling of the sampler.
- Remove the PDB samplers from the well by using the attached line. Avoid agitating the samplers or exposing them to heat.
- Examine the surface of the PDB for evidence of algae, iron, or other coatings and for tears in the membrane (note in field book). If there is a tear in the membrane, the sample should be rejected. If the PDB is coated, that condition should be noted in the data validation report.
- Detach and remove the PDB sampler from the weighted line. Remove excess liquid from the exterior of the bag to minimize the potential for cross contamination.

5.3.3 PDB Sample Transfer

- Have all required bottles ready for filling (pre-preserved 40-ml VOAs). Transfer water from sampler immediately upon recovery.
- Remove the hanger and weight assembly from the sampler. Invert the sampler so that the fill plug is pointed upward, then remove the plug. The water can be recovered by directly pouring in a manner that minimizes agitation or by pouring through a VOC discharge accessory inserted in place of the plug. Control discharge rate by tilting or manipulating the sampler.
- Place sample containers immediately on ice to ensure sample preservation.

5.3.4 Comparison Sampling for VOCs

If comparison sampling (to verify PDB sample results) is to be performed using conventional sampling methods, the sample should be collected as soon as possible after the PDB is retrieved from the well. Comparison samples should be, if possible, shipped in the same cooler as the PDB samples and analyzed within the same sample data group.

6.0 HYDRASLEEVETM SAMPLERS

6.1 Method Description and Limitations

Polyethylene-based HydraSleeve™ samplers are an alternative to traditional pump or bailer groundwater sampling methods for all analytical parameters. The disposable sampler is designed to collect a representative water sample from a monitoring well without purging, by collecting a discreet sample from only the “fresh formation” water in the screened interval of the well. The sampler is suspended within the screened interval of the well and allowed to equilibrate with groundwater for a standard time period (usually a minimum of one day). The sampler is then retrieved from the well and emptied into standard laboratory provided containers for analyses.

The HydraSleeve™ method provides cost savings by reducing the labor required for pre-sample purging, eliminating purge water handling and treatment, and reducing IDW and decontamination wastes. The samplers are relatively inexpensive and are discarded after use.

Deployment of the HydraSleeve™ samplers in wells containing non-aqueous phase liquids (NAPLs) may require special procedures that are not discussed in this SOP.

The underlying principal of the HydraSleeve™ method is that groundwater within the screened interval of the well is in dynamic equilibrium with the aquifer; in other words, groundwater is flowing freely through the well. Therefore, placement and condition of the well will influence the quality or representativeness of the sample. The method may not provide representative samples in stagnant flow situations or where well efficiency is compromised by improper development or fouling. Vertical gradients within a well can influence sample results.

HydraSleeve™ samplers can be deployed in a vertical array and the resultant data used to adjust future sampling plans.

As with any sampling method, proper understanding of site conditions is crucial to obtaining representative and accurate results. The site-specific sampling plan and data quality control procedures should take into consideration potential influences on HydraSleeve sample results.

Water quality parameters such as pH, temperature, dissolved oxygen, and specific conductance cannot be measured using this sampling device. However, these data may be acquired down-hole with the appropriate instruments prior to sampling with this device.

6.2 Equipment Storage

Before deployment, HydraSleeve™ samplers should be kept away from potentially cross-contaminating circumstances such as long-term storage with chemicals or fuels. Follow manufacturer’s instructions for storage conditions and shelf-life.

6.3 HydraSleeveTM Sampler Procedures

The following procedures are taken from a published field manual for use of the HydraSleeve™ (GeoInsight, 2006). A web-link is provided in References for this manual.

6.3.1 HydraSleeve™ Assembly

- Remove HydraSleeve™ from package and grasp top to "pop" open.
- Squeeze side fins together at top to bend reinforcing strips outward.
- Attach line to hole at top of HydraSleeve™.
- Fold the two holes at bottom of HydraSleeve™ together and attach weight.
- Sampler is ready to insert into the well.

6.3.2 HydraSleeve™ Deployment

To collect a representative groundwater sample without purging, the well must be allowed time to re-equilibrate after placement of the sampler. When any device is lowered into a well, some mixing of the water column occurs. The diameter of the device and its shape greatly affect the degree of mixing. The flat cross-section of the empty HydraSleeve™ minimizes the disturbance to the water column as the sampler is lowered into position, reducing the time needed for the well to return to equilibrium.

There are three basic methods for holding a HydraSleeve™ in position as the well equilibrates.

- **TOP DOWN DEPLOYMENT:** Measure the correct amount of suspension line needed to "hang" the top of the HydraSleeveTM (s) at the desired sampling depth (in most cases, this will be at the bottom of the sampling zone). The upper end of the tether can be connected to the well cap to suspend the HydraSleeveTM at the correct depth until activated for sampling.
- **BOTTOM DEPLOYMENT:** Sound the well to determine the exact depth. Lower the weighted HydraSleeve™ into the well and let it touch the bottom. Very slowly (less than 1/2 foot per second [fps]) raise the sampler to the point where the check valve is at the depth the sample is to be collected. Attach the suspension line to the top of the well to suspend it at this depth. (It is often easier to measure a few feet from the bottom of the well up to the sample point, than it is to measure many feet from the top of the well down.) Alternately, the sampler can be left on the bottom until the well re-equilibrates. For sampling, it can be very slowly pulled (< 1/2 fps) to sampling depth, then activated to collect the sample, and retrieved to the surface.
- **BOTTOM ANCHOR:** Determine the exact depth of the well. Calculate the distance from the bottom of the well to the desired sampling depth. Attach an appropriate length anchor line between the weight and the bottom of the sampler and lower the assembly until the weight rests on the bottom of the well, allowing the top of the sampler to float at the correct sampling depth.
- **MULTIPLE INTERVAL DEPLOYMENT:** There are two basic methods for placing multiple HydraSleeves™ in a well to collect samples from different levels simultaneously.
    - **Attached to a Single Tether:** To use 3 or more samplers simultaneously, we recommend attaching them all to a tether for support to prevent the sampling string from pulling apart. The weight is attached to a single length of suspension line and

allowed to rest on the bottom of the well. The top and bottom of each HydraSleeve™ are attached to the tether at the desired sample intervals. Cable tie or stainless steel clips (supplied) work well for attaching the HydraSleeves to the line. Simply push one end of the clip between strands of the rope at the desired point before attaching the clip to the HydraSleeve™.

- **Attached End to End:** To place 2 or 3 stacked HydraSleeves for vertical profiling, use one of the methods described above to locate the bottom sampler. Attach the bottom of the top sampler to the top of the following HydraSleeve(s) with a carefully measured length of suspension cable. Connect the weight to the bottom sampler. Note: if many HydraSleeves are attached to a tether, more weight may be required than with a single sampler.

6.3.3 HydraSleeveTM Recovery

The HydraSleeve™ must move upward at a rate of one foot per second or faster (about the speed a bailer is usually pulled upward) for water to pass through the check valve into the sample sleeve. The total upward distance the check valve must travel to fill the sample sleeve is about 1 to 2 times the length of the sampler. For example, a 24-inch HydraSleeve™ needs a total upward movement of 24 to no more than 48 inches to fill. The upward motion can be accomplished using one long continuous pull, several short strokes, or any combination that moves the check valve the required distance in the open position. A special technique is used for sampling low-yield wells.

- **CONTINUOUS PULL:** Pull the HydraSleeve™ continuously upward from its starting point at a constant 1 to 2 feet per second until full. This method usually provides the least turbid samples and is analogous to coring the water column from the bottom up. Note: When using this method, the screen interval should be long enough so the sampler fills before exiting the top of the screen.
- **SHORT STROKES:** Pull the sampler upward at about 1 to 2 feet per second for the length of the sampler and let it drop back to the starting point. Repeat the cycle 3 to 5 times. This method provides a shorter sampling interval than the continuous pull method (above), and usually reduces the turbidity levels of the sample below that of numerous rapid, short cycles (below). The sample comes from between the top of the cycle and the bottom of the sampler at its lowest point.
- **RAPID, SHORT CYCLES:** Cycle the HydraSleeve™ up and down using rapid, short strokes (6-inch cycle at a minimum of 1 cycle per second) 5 to 8 times. This method provides the shortest sampling interval. Dye studies have shown that when using this method the sample flows into the check valve from along the length of the sampler and immediately above the check valve. The sample interval is from the bottom the sampler at its lowest point in the cycle to the top of the check valve at the peak of the cycle.
- **SAMPLING LOW-YIELD WELLS:** HydraSleeve™ provides the best available technology for sampling low yield wells. When pulled upward after the well re-equilibrates, the HydraSleeve will collect a water core from the top of the sampler to about its own length above that point. The sample is collected with no drawdown in the well and minimal sample agitation. An optional top weight can be attached to compress the sampler in the

bottom of the well if needed for an extremely short water column. With a top weight, the check valve is pushed down to within a foot of the bottom of the well.

6.3.4 HyrdaSleeveTM Sample Transfer

- Have all required bottles ready for filling (pre-preserved 40-ml VOAs). Transfer water from sampler immediately upon recovery.
- The best way to remove a sample from the HydraSleeve™ with the least amount of aeration and agitation is with the short plastic discharge tube (included).
- Squeeze the full sampler just below the top to expel water resting above the flexible check valve.
- Push the pointed discharge tube (provided) through the outer polyethylene sleeve about 3-4 inches below the white reinforcing strips.
- Discharge the sample into the desired laboratory provided containers. Raising and lowering the bottom of the sampler or pinching the sample sleeve just below the discharge tube will control the flow of the sample. The sample sleeve can also be squeezed, forcing fluid up through the discharge tube.
- Place sample containers immediately on ice to ensure sample preservation.

7.0 PURGING AND SAMPLING PROCEDURE USING A BAILER

7.1 Method Limitations and Precautions

The use of bailers to purge and sample wells offers a low-cost, simple method of sampling; however this method may provide poor quality samples. The typical practice for using bailers is to purge out three well volumes, or until the well is dry, and then allow the well to recover before sampling. Sample quality is affected by aeration and agitation of the water column, mixing of stagnant water from the well casing with groundwater in the screened interval, generation of turbidity due to the surging action of the bailer, and other problems (Nielsen and Nielsen, 2002). Use of bailers may also increase exposure of field personnel to contaminants and may not be advisable for sampling highly contaminated wells. For these reasons, bailer sampling is now generally considered to be the sampling method of "last resort." Other sampling devices such as the diffusion bag sampler or whole-water samplers should be considered first.

Conditions where bailer sampling may be applicable include leachate or other non-groundwater monitoring wells, or to collect a sample of floating free-phase liquid present in a monitoring well.

Bailers are constructed of PVC, PFTE, or other plastics and consist of a cylinder with a bottom check valve and a means for attaching twine or rope at the top. The bailer is lowered into the well, allowed to fill with water, and is then removed. Bailers can be ordered in various diameters and lengths. Only single-use disposable bailers should be used for sampling.

The groundwater sample data from a bailer sample should always be qualified as "qualitative" due to the afore-mentioned potential influences on the sample.

7.2 Bailer Purging Procedure

- Pre-sample purging will be performed prior to collecting groundwater samples. It is not necessary (or advisable) to purge before sampling separate-phase liquids from a well.

- Spread plastic sheeting over the top of the well casing, cutting an access hole in the plastic at the well opening. The plastic will keep the bailer and twine from touching the ground and well casing, thus preventing cross-contamination of the sample.
- Measure depth to water and total well depth. Attach the appropriate length of twine to the bailer (use non-tangling type of twine) and loop the other end to your wrist.
- For water quality/chemical samples, remove the equivalent of 3-well volumes prior to sampling and allow well to recover.
- Gently and slowly lower the bailer into the well and avoiding tagging the bottom to minimize sediment disturbance and water column aeration. Allow the bailer to fill with water and slowly remove.
- Use a “windmill” motion of the arms to reel up the bailer and keep the line from tangling. A tripod and reel or a mechanical winch (i.e. a Smeal Rig) can be used to raise and lower a bailer if the well is deep.
- Discharge purged water into bucket or drum. Record volumes removed on the purge/sample log. After removal of one well volume, measure the well recharge rate by periodically measuring and recording depth to water.

7.3 Bailer Sampling Procedure

After pre-sample purging is completed, allow the well to recover before sampling.

- Water quality parameters such as pH, temperature, etc. may be obtained by measuring water quality parameters down-hole before or after sampling is completed using a multi-parameter instrument. If measured after sampling, allow the well to recover first.
- Prepare bottles and chain-of-custody form for sample collection.
- Once the well has recovered to at least 80% of static (recovery percentage allowed may depend on your sample volume needs), slowly lower the bailer into the water column.
- The bailer should be lowered so that it is within the screened portion of the well. Slowly remove the bailer to minimize disturbance to the well.
- Once at the surface, transfer the bailer contents to your sample containers. The preferred method is to insert a bottom-emptying device into the bottom of the bailer. The device is pressed into the hole in the bottom of the bailer, which unseats the bailer check ball. The preferred device has a valve or other mechanism that allows you to start/stop the flow. A second person or a bailer stand makes use of the bottom-emptying device easier.

When using a bailer, samples should be collected in the following order (as applicable):

1. VOCs
2. DRO and GRO
3. SVOCs, TPH
4. PCBs and pesticides
5. Metals
6. Other organics
7. Other inorganics

Refer to project-specific QAPP and SAP for sample containers, preservatives, and holding times.

After the laboratory-supplied sample containers are filled, labeled, and placed in a cooler on ice, field analyses may begin if required. Field analyses of groundwater may be performed for ferrous iron, sulfide, or other parameters using field test kits. The guidelines in OTIE SOP 009 and the manufacturer's instructions included with the test kits outline the procedure that will be used to conduct the field analyses. The information will be recorded in the field logbook.

8.0 FIELD FILTERING OF SAMPLES

Field filtering of groundwater samples may be required for samples to be analyzed for "dissolved metals." Field filtering is appropriate for samples with turbidity of greater than

5 to 10 NTUs (depending on project-specific QAPP), but is unnecessary for samples with equal to or less than 5 NTUs. Groundwater samples should be filtered immediately upon collection and prior to chemical preservation of the sample. Filtration should be completed in as short a time as possible while minimizing sample aeration, agitation, pressure changes, temperature changes, and prolonged contact with ambient air.

The project-specific SAP should specify if and when (for which wells) field filtering will be performed. The SAP should also specify the type of filter that will be used. Typically, 0.45-micron disposable capsule filters are used for groundwater sampling. The samples should be filtered before being preserved. If you are using a bailer for sampling, transfer the sample to a clean container and filter the sample using a peristaltic pump with an in-line filter.

Alternatively, there are apparatuses to pressurize a transfer container or the bailer, which forces the sample through a filter. If using a pump to sample the well, attach the filter to the outflow tubing and fill the sample containers from the outflow end of the filter.

Follow manufacturer's instructions for use of the filters. ***Pre-condition*** the filter prior to filtering the sample by pumping a sufficient volume of sample water through the filter to completely saturate it. ***Discard*** the "preconditioning" filtrate (place in purge water container). Collect sample after the filter has been pre-conditioned.

After collection of the filter sample, add the appropriate field preservative. Field preservation information should be included in the project-specific SAP and/or QAPP.

9.0 BIO-TRAP® SAMPLERS

Bio-Trap® samplers are passive sampling tools that contain Bio-Sep® beads that are deployed in monitoring wells to collect microbes over time to determine if biodegradation is occurring in the subsurface. The procedures outlined in this SOP for Bio-Trap® samplers are specific to the samplers manufactured by Microbial Insights, Inc. located in Rockford, TN (www.microbe.com) and were adopted from the manufacturer's protocol.

Other manufacturers may provide similar methods and equipment for meeting the sampling objective; the project-specific SAP should indicate the specific sampling equipment to be used for the project.

9.1 Method Description and Limitations

The Bio-Sep® beads collect microbes over time to determine if biodegradation is occurring in the subsurface. The beads are 2 to 4 millimeters in diameter and are an engineered composite of Nomex® and powdered activated carbon (PAC). The Bio-Sep® beads absorb contaminants and nutrients present in the aquifer and therefore create an *in situ* microcosm with a very large surface area (~600 square meters per gram) that is readily colonized by subsurface microorganisms. When the sampler is removed from the well, DNA and phospholipid fatty acids (PLFA) can be extracted from the beads for CENSUS® or PLFA assays to evaluate the microbial community.

Bio-Trap® samplers can also be baited with ^{13}C-labeled contaminants to conclusively demonstrate that biodegradation is occurring in the subsurface. Stable isotope probing (SIP) analyses will demonstrate biodegradation of a specific contaminant by measuring the ^{13}C levels in end products of biodegradation (microbial biomass and dissolved inorganic carbon).

The sampler is suspended within the well screen for 30 days (non-baited) to 60 days (baited). The Bio-Trap® is removed from the well, transferred to a zippered bag, placed on ice in a cooler, and sent to the laboratory for analysis.

Sterile gloves must be worn at all times when handling the Bio-Trap® samplers.

9.2 Equipment Storage

Bio-Trap® samplers should be purchased no earlier than 2 weeks prior to the intended deployment date to minimize potential microbial contamination, chemical contamination, and drying. The samplers must remain sealed and refrigerated until they can be deployed in the field. The samplers should be kept in a cooler on ice in the field prior to deployment.

9.3 Bio-Trap® Sampler Procedures

9.3.1 Bio-Trap® Sampler Deployment

The following procedures are from the Microbial Insights, Inc.'s Bio-Trap® Sampler Protocol.

- If the monitoring well into which the Bio-Trap® sampler will be deployed has not been purged recently, purging three well volumes is recommended to ensure contact with formation water and to reduce the well bore effect.
- Wearing sterile gloves, remove the Bio-Trap® sampler from the zippered bag and attach the nylon attachment loop to a nylon line.
- Suspend the sampler where significant contaminant concentrations exist. If no data are available on the vertical distribution of contaminants, suspend the sampler 1 to 1.5 feet below the top of the water table if the contaminants of concern are petroleum hydrocarbons or in the middle of the saturated screen if the contaminants of concern are chlorinated hydrocarbons.
- If large fluctuations in the water level are anticipated during the incubation period, the Bio-Trap® sampler should be suspended from a float per the manufacturer's directions. The float should be made of a non-reactive inert material to both groundwater and subsurface contaminants.

9.3.2 Bio-Trap® Sampler Recovery

- Remove the Bio-Trap® sampler from the well and cut off the braided nylon line used to suspend the sampler.
- Transfer the sampler to a labeled, zippered bag and double bag it in a one-gallon zippered bag.
- Immediately place the bagged sampler on ice (which must be double-bagged) in a cooler and ship the samplers to the laboratory for next day delivery.

10.0 SAMPLE MANAGEMENT AND CHAIN-OF-CUSTODY PROCEDURES

After each sample is collected, samples will be labeled and handled in accordance with methods specified in the project-specific SAP and QAPP. Guidelines for sample labeling, chain-of-custody procedures, sample packaging, and sample shipping procedures are provided in OTIE SOP 010C. Note that DOT hazardous material sampling requirements may apply to samples that contain reportable quantities of hazardous substances.

11.0 GROUNDWATER QUALITY CONTROL SAMPLES

All QA/QC sampling activities must comply with the requirements of the project QAPP and SAP. Several types of QC samples can be collected including equipment (rinsate) blanks, field blanks, material blanks, duplicates, matrix spike and matrix spike duplicates, and trip blanks.

Equipment rinsate samples (equipment blanks) are usually collected after sampling a known or suspected contaminated well to assess the effectiveness of decontamination procedures.

Equipment blanks are taken in the field by pouring laboratory-grade (ASTM II) DI water through the decontaminated pump or other sampling device, collecting the rinsate into the proper sample containers. The equipment blank is preserved, labeled, and stored exactly the same as a groundwater sample.

Field blanks are collected to assess if ambient sources of contamination, such as fumes from internal combustion engines, may affect groundwater sample quality. Collect a field blank while at a groundwater sampling location in an area where an ambient atmospheric source is present. Pour laboratory-grade DI water into the samples containers (typically VOC vials) and treat exactly the same as a groundwater sample.

Duplicate samples are collected to evaluate the accuracy and precision of the contract laboratory. Duplicate samples are collected at the same time as the associated environmental samples (called field or original samples). All of the sample bottles for a particular analysis for both the duplicate and the environmental samples will be filled before filling the sample bottles for the next analysis. For instance, fill all the VOC bottles prior to filling the SVOC bottles.

Trip blanks are submitted to the laboratory to evaluate the potential for cross-contamination of VOCs within the shipping cooler. Appropriate sample containers filled with analyte-free water will be sealed and provided by the laboratory. Trip blanks accompany sample shipments containing VOC samples (see project SAP for frequency of trip blanks). Keep trip blanks with sample containers during all stages of the sampling effort.

12.0 FIELD EQUIPMENT CLEANING PROCEDURES

Sampling equipment, including electrical water level tapes, flow-through cell, pumps, etc. should be decontaminated upon arrival on-site (unless guaranteed clean by supplier) and between each well. Field decontamination procedures may be specified in the project QAPP. Otherwise, use the decontamination procedures in OTIE SOP 011A.

Generally, sample the least contaminated wells first (if known) as an additional precaution against introducing contaminants into the wells and samples. If decontamination is performed in the field, all rinse water must be contained in a manner that prevents the introduction of contamination to the site environment. See OTIE SOP 012A for investigation-derived wastes (IDW) management.

13.0 FIELD DOCUMENTATION

Thoroughly document groundwater sampling procedures, equipment, and events to ensure the legal defensibility of the data. Additional field documentation procedures are presented in OTIE SOP 002A.

Maintain field notes in a bound "weather-rite" logbook to provide a daily record of sampling and events. Follow site-specific requirements for completing daily field activities logs, purge logs, and groundwater sampling logs.

14.0 REFERENCES

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Sampling and Minimum-Purge Sampling, Second Edition. The Nielsen Environmental Field School. Galena, Ohio.

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United States Environmental Protection Agency (U.S. EPA). 1996. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, Region 4, Environmental Services Division. May

U.S. EPA. November 1992. RCRA Ground-Water Monitoring Draft Technical Guidance, Office of Solid Waste.

U.S. EPA. 2002. Ground-water Sampling Guidelines for Superfund and RCRA Project Managers. May. EPA 542-S-02-001.

ATTACHMENT 1

GROUNDWATER SAMPLING EQUIPMENT AND SUPPLIES CHECKLIST

Tools

- ☐ ¾″ and 9/16 socket or wrench
- ☐ 15/16″ socket wrench (for drums)
- ☐ Screwdriver, Pliers
- ☐ Mallet
- ☐ Wire cutters and/or knife
- ☐ Crescent wrench

Decontamination/IDW Supplies

- ☐ Isopropyl and DIW spray bottles
- ☐ DI water (4 x 5 gallon carboys)
- ☐ 30 gallon vessel w/20 gallon potable water
- ☐ 20 gallon carboy with decontamination solution
- ☐ 30 gallon vessel with 20 gallons soapy water
- ☐ Brushes
- ☐ Liquinox
- ☐ Trash bags
- ☐ Plastic wash tubs
- ☐ Fluid containment (drums or poly tanks)

Personal Protective Equipment

- ☐ Tyvek
- ☐ Hardhat (if required)
- ☐ Safety glasses, splash guard
- ☐ Steel-toed boots and booties
- ☐ Ear plugs
- ☐ First aid kit
- ☐ Caution tape (if needed)
- ☐ Traffic cones (if needed)
- ☐ Nitrile gloves
- ☐ Work gloves
- ☐ 2-way radio
- ☐ Fire extinguisher

Miscellaneous Supplies

- ☐ Well keys and caps
- ☐ Extra locks
- ☐ Nylon wire ties
- ☐ Bolt cutters
- ☐ Extra bolts
- ☐ Tubing cutter

Sample Equipment / Instruments

- ☐ Water quality probe (YSI or equivalent)
- ☐ Calibration fluids, fresh
- ☐ PID and calibration kit
- ☐ ASTM II deionized water
- ☐ Turbidity Meter
- ☐ Disposable bailer, bailer twine
- ☐ Pump, tubing, reel, related supplies
- ☐ Pump converter/inverter (if needed)
- ☐ Water level and/or Oil/Water indicator
- ☐ Generator (if needed)
- ☐ Compressed air or air compressor (if needed)
- ☐

Field Logs and Documentation

- ☐ Field activity daily log (if required)
- ☐ Groundwater elevation logs
- ☐ Purge/Sample Logs
- ☐ Sample Container Labels
- ☐ Task-Specific Work Plan
- ☐ Real time air monitoring log
- ☐ COC
- ☐ Site well map
- ☐ Master sample data sheet
- ☐ Equipment list

Sample Supplies

- ☐ Poly sheeting
- ☐ Duct tape, Clear plastic tape
- ☐ Paper towels
- ☐ Resealable baggies – all sizes
- ☐ Coolers w/ice
- ☐ Sample preservatives
- ☐ String for bailers
- ☐ Tubing adapters and fittings
- ☐ Buckets and funnels
- ☐ Appropriate sample bottles
- ☐ Appropriate drums
- ☐ Graduated plastic container (liter)

STANDARD OPERATING PRACTICE OTIE010C

Sample Labeling, Control, and Shipping

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QC Review Signatures

Name/Role	Signature	Date
John Fleissner, PE Corporate QC Manager	John Fleissner	June 28, 2013
Nova Clite, PG Sr. Hydrogeologist		June 26, 2013

STANDARD OPERATING PRACTICE OTIE010C

Sample Labeling, Control, and Shipping

1.0 INTRODUCTION

The general objective of this SOP is to present procedures for sample identification (ID), sample control and chain-of-custody, and sample handling.

2.0 SAMPLE LABELING PROCEDURES

All sample identification, field records, and chain-of-custody records will be recorded in black waterproof, ballpoint non-erasable ink. Under no circumstances will "Sharpie" markers be used on field forms or chain-of-custody forms. If errors are made on any of these documents, personnel will cross a single line through the error and enter the correct information. All corrections shall be initialed and dated by the person performing the correction. If possible, all corrections should be made by the individual who made the error.

If information is entered using stick-on labels on sample tags, logbooks, or sample containers, subsequent removal of these labels should not be possible without leaving obvious indications of the attempt. Labels should never be placed over previously recorded information.

Corrections to information recorded on stick-on labels should be made as stated in the previous paragraph.

2.1 PROCEDURES

All soil, sediment, surface water, groundwater, waste, ambient air, and vapor emission samples collected will be labeled according to the following procedures.

1. Label each sample container with the following information:
    - Date and time
    - Sample ID number
    - Project number
    - Sampler (name), and
    - Preservative
2. Enter sample collection information in the field logbook. Begin the sample collection entry with the time at which the sample is collected (or collection is begun). Make the entry chronologically in the logbook (SOP No. 002A).
3. If no map of sampling locations is available prior to sampling, sketch a drawing of the site (not to scale) in the field logbook to provide an illustration of all sampling points. Provide measured distances from sampling points to a fixed reference point to allow accurate placement of sample locations on figures or maps.

3.0 SAMPLE NOMENCLATURE

The sample numbering protocol used for field samples and quality control (QC) samples is defined in the project-specific Sampling and Analysis Plan, Field Sampling Plan, or comparable document.

4.0 CHAIN OF CUSTODY PROCEDURES

Chain-of-custody (COC) is a continuous possession of samples from their origin to completion of analysis and archiving/disposal in the laboratory. This uninterrupted possession is required to maintain integrity of samples. The chain-of-custody record is the documentation of this uninterrupted possession of the samples. The following procedures are recommended for ensuring preservation of chain-of-custody in the field:

- To simplify the chain-of-custody record and eliminate potential litigation problems, as few people as possible should handle the samples during the investigation.
- Each field team member is responsible for the proper handling and custody of the samples collected until they are properly and formally transferred to another person or facility. If the project has a Field Sample Coordinator (FSC), the field team will deliver all samples to the FSC as soon as possible, who then assumes responsibility for completing the chain-of-custody record.
- Prior to or immediately following sample collection, sample labels shall be completed for each sample container, using black waterproof, non-erasable ink, and affixed to the sample container. Labels should be affixed to each sample container and completely covered with a clear waterproof tape to prevent the labels from separating from the sample containers or water damage to the labels.
- Sample containers should be placed in resealable plastic bags before placement on ice to prevent moisture from contacting the sample jars, which could affect the legibility of the sample container labels.
- All samples collected (date, time of collection, sample ID, location and other information as necessary) must be documented in bound field logbook at the time of sample collection.

To complete the chain-of-custody and to maintain an accurate record of sample collection, transport, analysis and disposal, the following methodology will be used:

1. Samples will be accompanied by a chain-of-custody form at all times. A chain-of-custody record will be completed for all samples or materials collected. A separate chain-of-custody record will be used for each final destination or laboratory used during for analysis of samples.
2. The chain-of-custody form will be used by personnel responsible for ensuring the integrity of samples from the time of collection until shipment to the laboratory.
3. The chain-of-custody record shall accompany all samples to the final destination. The original of the record will be placed in a sealed plastic bag taped to the inside top cover of the cooler. One copy of the record will be retained by the Field Sample Coordinator, and faxed to the Project Chemist and Project Manager. The original record will be transmitted to the Project Manager after samples are accepted by the laboratory. This copy will become

a part of the project file.

4. The chain-of-custody form will be signed by each individual who has the samples in his or her possession.
5. The chain-of-custody form will be initialed in the field by the person collecting the sample, for every sample. If needed, several COC forms or COC continuation forms can be used to group samples under one COC. The continuation forms will reference the original COC number and all pages will be numbered.
6. The chain-of-custody will be completed in the field to indicate project, date, location, sampler, client, etc.
7. If the person collecting the sample does not transport the samples to the laboratory or deliver the sample containers for shipment, the first block for "Relinquished by" and "Received by" will be completed in the field by the sampler and transporter, respectively.
8. The person transporting the samples to the laboratory or delivering them for shipment will sign the record form as "Relinquished by" at the time the samples are handed off to the laboratory (which will sign the “Received by” section).
9. If the samples are transported directly to the laboratory, the chain-of-custody form will be kept in the possession of the person delivering the samples.
10. If the samples are shipped to the laboratory by commercial carrier, the chain-of-custody form will be sealed in a watertight container, taped on the inside lid, and the shipping container sealed with custody seals (two on each shipping container) and tape prior to being given to the carrier.
    a. For samples shipped by commercial carrier, the waybill or air bill will serve as an extension of the chain-of-custody record between the final field custodian and receipt in the laboratory. The sender's copy of the waybill must be stapled to the sender's copy of the chain-of-custody form and filed with the original. The waybill tracking number must be entered into the logbook. Sample sender must sign with date and time as “Relinquished by” just before sealing coolers.
    b. Following receipt in the laboratory, the sample recipient will open the shipping containers, compare the contents with the chain-of-custody record, ensure that document control information is accurate and complete, and sign and date the record as “Received by.” Any discrepancies will be noted on the chain-of-custody form.
    c. In the event of the discrepancies, the samples in question will be segregated from normal sample storage and the Project Chemist immediately notified.
    d. The chain-of-custody form is completed upon receipt of the samples by the analytical service laboratory. The completed chain-of-custody form will be returned to the Project Manager and maintained in the project file.

5.0 SAMPLE HANDLING PROCEDURES

5.1 GENERAL

Upon collection, all samples will be immediately placed on ice and taken to a proper location for packing, re-icing, and shipment. At all times, sufficient ice must be in the coolers to maintain a temperature of 4° C. All void spaces in the cooler should be filled with ice.

Estimate no more than two to one ratio of samples to ice, except during hot weather when a one to one ratio should be used (e.g., one pound of ice per one pound of sample). This will insure samples are stored at the proper temperature.

5.2 SAMPLE PACKAGING FOR SHIPMENT

When preparing the samples for shipment to the laboratory, the following procedures will be employed:

1. Proper packing is necessary to ensure that samples arrive at the laboratory in good condition. The following protocol will be used for packaging of samples:
    a. Only waterproof metal or equivalent strength plastic ice chests and coolers will be used. Tapes that may emit VOCs will not be used within the container.
    b. Two large garbage bags or drum liners will be placed in the cooler to prevent leakage.
    c. Approximately 2 inches of inert cushioning material (vermiculite or similar absorbent material) will be placed in the bottom of the inner drum liner.
    d. All sample containers will be placed in clear, plastic, resealable (e.g. Ziploc ™) bags. Glass containers should be wrapped in bubble wrap or cushioning material to prevent breakage.
    e. Samples will be packed properly for shipment so that the bottles will not move around and/or break during shipment.
    f. Sufficient ice to maintain 4° C during shipment will be placed beneath, around, and on top of the sample containers. Additional cushioning materials will be added to prevent movement of samples during shipment.
    g. The chain-of-custody form will be placed in a resealable plastic bag and attached to the lid of the cooler with clear plastic packing tape. Laboratory name and contact, courier name(s), and other pertinent information will be recorded on the form.
    h. If the cooler is equipped with a drain plug, it will be taped shut.
    i. The completed shipping label will be attached to the cooler.
    j. "This Side Up" arrow labels will be placed on two sides of the cooler, and "Fragile" labels will be placed on all four sides.
    k. Numbered and signed custody seals will be placed on the front right and back left of each cooler. These seals will be covered with clear plastic packing tape.
    1. Samples will be transported by courier in an approved, cooled shipping container, ensuring that the maximum holding times between sample collection and analysis will not be violated. In general, all samples should be shipped priority overnight.
2. The weight limit of the shipper will be observed.
3. All records pertaining to the shipment of a sample will be retained in the project file (e.g., freight bills, post office receipts, and bills of lading).

5.3 SAMPLE SHIPMENT CONSIDERATIONS (DOT REGULATIONS)

Samples in general can be classified in to hazardous materials/dangerous goods for shipment per DOT regulations. If we believe that the sample does not contain hazardous materials above reportable quantities or above TCLP hazardous characteristics, or above listed concentrations in the 40 CFR hazardous waste table including pH, corrosivity, and ignitability criteria, we can ship them as regular materials, i.e., not under DOT requirements.

IF YOU ARE NOT DOT-TRAINING CERTIFIED, YOU CANNOT SHIP HAZARDOUS MATERIAL/DANGEROUS GOODS. To do so risks large fines against the individual who signs the shipping bill. Contact your project manager to discuss.

For some chemicals and compressed gases, the quantity, limitations, shipment requirements are given in 49 CFR 172.101, especially in the Hazardous Materials Table 172.101. Field personnel cannot classify samples based on the source or origin according to these regulations. The shipper is required to know about actual or expected chemical concentrations of the material in the shipping container. Field personnel who are unsure about shipping anything from the field should call a qualified person in the office and have the regulations reviewed for each situation.

6.0 REFERENCES

Department of Transportation, Final National Guidance Package for Compliance with Department of Transportation Regulations in the Shipment of Laboratory Samples, March 1981.

United States Environmental Protection Agency Region 4, Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, May 1996.

STANDARD OPERATING PRACTICE OTIE012A

Investigative Derived Materials Management Procedures

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QC Review Signatures		
Name/Role	**Signature**	**Date**
John Fleissner, PE Corporate QC Manager	John Fleissner	06/28/2013
Nova Clite, PG Sr. Hydrogeologist		06/27/2013

1.0 OBJECTIVE

The objective of this Standard Operating Practice (SOP) is to define the procedural requirements for managing and sampling investigation-derived waste (IDW) materials generated during the site investigation process while striving for three goals:

- **Minimization**: All site investigations shall be conducted in a way as to generate the least amount of IDW. Every effort will be made to return (or leave in place) as much material to the site of generation as is permitted by law and protective of personnel and environment.
- **Management**: The IDW that cannot be disposed of on-site shall be managed in a manner consistent with the final method of remediation of the site, if known. If the final remediation method for the site is not known, the IDW generated will be managed, stored, transported, and disposed of in a manner consistent with appropriate laws and regulatory requirements.
- **Mediation**: Each site and each client is unique. The most important goal is to assist each client in successfully negotiating with the controlling regulatory agencies. This negotiation should result in an IDW handling method that is the most time efficient, cost-effective, and appropriate. The IDW handling method must also be in accordance with all regulations and cause the least adverse impact to the facility, the community surrounding the facility, and the environment.

2.0 BACKGROUND

In the process of conducting field operations in the pre-remedial and remedial phases of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) investigations, IDW is often generated. IDWs consist of fluids from well development, purging, and pump tests; drilling fluids and cuttings from well installations; soil cuttings from borings; soils from test pits; residues from testing treatment technologies; personal protective equipment (PPE); decontamination solutions used to clean non-disposable equipment; and any other material or equipment that may be contaminated to the point it cannot be sufficiently cleaned to permit further safe use.

The National Contingency Plan (NCP) states "the field investigation team should, when handling, treating or disposing of investigation-derived waste on-site, conduct such activities in compliance with applicable or relevant and appropriate requirements (ARARs) to the extent practicable, considering the exigencies of the situation" (NCP, 55 FR 8756). In addition, operations should, at all times, be conducted with the central idea of maximum protection for the workers at the site, the population around the site, and the environment in general.

Ten major concerns control the disposition of IDW at a site:

- types and concentrations of contaminants present at the site,
- volume or quantity (tons) of IDW,
- matrix affected by the contaminants (e.g., groundwater and for soil),
- location of the site (e.g., rural, residential, industrial),
- prior knowledge of site conditions (e.g., known as opposed to suspected contamination),
- potential worker exposure,
- potential environmental impact from disposal,

- state and federal regulatory requirements, and
- cost.

3.0 RESPONSIBILITIES

Oneida Total Integrated Enterprises (OTIE): OTIE is responsible for the identification of potential contaminants and for the characterization of IDW. The ultimate responsibility for proper determination of IDW waste status and proper disposal lies with OTIE's client.

Site Manager: The Site Manager, or Field Team Leader, is responsible for ensuring that field activities are completed to meet the project objectives, are conducted in accordance with the project plans and requirements, and all activities are performed according to the respective procedures. The Site Manager is responsible for ensuring all site personnel are trained in the procedures, the procedures are adhered to, and all activities are documented.

Field Team: All members of the field team (samplers, technicians, field geologists, engineers, etc.) are responsible for understanding and implementing this field procedure as well as ensuring all team members also perform work in accordance with this procedure.

Client: The client (e.g., private landowner, federal agency, etc.) is responsible for establishing the status of the waste material as it relates to federal, state, and local regulations. Designated representatives of the client are responsible for signing all invoices, manifests, and bills of lading to transport and for dispose of waste material.

It is the responsibility of all field personnel to identify, document, and submit recommendations to improve the quality, usability, and implementability of this procedure.

4.0 REQUIRED PLANS AND EQUIPMENT

Required approved plans that must be present in the field during field activities include:

- Sampling and Analysis Plan (SAP) that specifies waste characterization sample collection methods and analyses
- IDW Management Plan that identifies wastes, waste characterization, management, and disposal practices for the site
- Accident prevention plan with activity hazard analyses and site safety and health plan (herein collectively referred to as the Health and Safety Plan or HASP).

Equipment required for characterizing and handling the material includes:

- Field screening equipment such as a photoionization detector, organic vapor analyzer (OVA), or an on-site gas chromatograph (GC).
- Personal protective equipment (PPE). Level of protection is based on the type and expected concentration of contaminants. The minimum protective equipment includes Occupational Safety and Health Act (OSHA)-approved hard hat, safety glasses, protective gloves, and hard-toed boots or shoes. (The specific requirements for PPE are specified in the site-specific Health and Safety Plan or Accident Prevention Plan.)
- Sample collection equipment. The type required is dependent on the waste type as well as the container type. Generally disposable equipment is the most efficient to use.

5.0 PROCEDURES

5.1 IDW CHARACTERIZATION

The first step in selecting the method of material handling to use is to determine the potential contaminants of concern by reviewing site records, information gathered during site assessment activities, and interviews with persons knowledgeable about activities at the site. Early sampling results also can be used to indicate whether the wastes generated will exhibit hazardous characteristics. Published Environmental Protection Agency (EPA) guidance [EPA, Office of Solid Waste and Emergency Response (OSWER) Directive 9345.3-02, *Management of Investigation-Derived Waste During Site Investigations,* May 1991] discourages the containerizing and sampling of IDW just to establish hazardous components because of the resulting increase in investigation costs.

The next step in selecting the material handling method is to establish which federal, state, or local regulations apply to the material and which are the corresponding ARARs. Establishing the status of the IDW with regard to RCRA is critical. A waste material is hazardous under RCRA if it exhibits one of four characteristics: ignitability, corrosivity, reactivity, or toxicity as defined in 40 *Code of Federal Regulations* (CFR) 261.20 through 261.24. Identified contaminants may also be considered hazardous under RCRA if they are listed in 40 CFR 261.30 through 261.33. EPA guidance [EPA, Office of Solid Waste and Emergency Response Directive 9345.3-02FS, *Management of Investigation-Derived Waste,* February 1991] states it is permissible to handle a material as nonhazardous with regard to RCRA until it is proved to be a RCRA hazardous waste. Nevertheless, if available information and best professional judgment indicate that, to maximize protection, a material should be managed as RCRA hazardous waste, regardless of known status, RCRA Subtitle C requirements should be followed.

Even if a material is not considered hazardous waste under RCRA, it may still contain hazardous substances regulated by federal, state, and local laws and regulations. It is the responsibility of the client to determine the status of the material as it relates to RCRA and other statutes. Other potential ARARs include the Clean Water Act, which contains the requirements for the discharge of aqueous IDW to surface water and treatment facilities, and the Toxic Substance Control Act, which contains the requirements for handling IDW contaminated with polychlorinated biphenyls (PCBs) in concentrations of 50 parts per million (ppm) or greater.

After the potential contaminants are identified, it is the responsibility of the client to consult the appropriate state and federal regulatory agencies to ensure all local, state, and federal laws and regulations are followed. The IDW issue must be addressed and resolved for each project before initiating field activities.

5.2 PLACEMENT OF WASTES

If there is any possibility of the waste material containing a RCRA hazardous substance and being restricted under the Land Disposal Restrictions (LDRs), the material must not be "placed." To assist in defining "placement" at CERCLA sites, EPA uses the concept of Areas of Contamination (AOC). EPA Superfund LDR Guide 5 states, "An AOC is delineated by the areal extent (or boundary) of contiguous contamination. Such contamination must be continuous, but may contain varying types and concentrations of hazardous substances" (EPA, 1989).

Placement as defined by EPA occurs when waste material:

- is moved off-site,
- is moved out of an AOC for treatment or storage then returned to the same or a different AOC and returned to the environment,
- is stored in a container within the AOC then returned to the same AOC and returned to the environment, or
- is consolidated from several AOCs into a single AOC and returned to the environment.

If placement does not occur, the LDRs are not applicable to the CERCLA action regardless of the contaminants in the material. Therefore, before containerizing material or moving it outside an AOC, the status of the material, as it relates to RCRA and the LDRs, must be determined.

5.3 GENERATION AND HANDLING OF IDW

All the IDW will fall into one of four categories:

- non-RCRA regulated (nonhazardous),
- non-RCRA regulated (hazardous),
- RCRA regulated (nonhazardous), or
- RCRA regulated (hazardous).

6.0 NON-RCRA REGULATED MATERIALS

Waste materials that do not exhibit one of the four characteristics (ignitability, corrosivity, reactivity, or toxicity) as defined in 40 CFR 261.20 through 261.24 or do not contain contaminants listed in 40 CFR 261.30 through 261.33 are not regulated under RCRA.

Provision should be made for those cases in which it is logistically more convenient for OTIE to move the waste material to a central collection point for storage before determination of disposal method. Should this be necessary, extreme care must be exercised to segregate those materials that field screen "clean" from those that show contamination.

Any and all containers in which IDW is stored must be clearly labeled as to the contents, the locations at which the material was generated, the date, and a person to contact including the telephone number. There may also be facility-specific labeling requirements. At no time shall a container be labeled as containing hazardous material until a determination is made as to whether the material is hazardous.

In any case, the material must be removed from public access and stored in clean, sealed containers at a single, secure collection point at the facility until a final disposal method is determined. No IDW shall be removed from the facility or released to the environment without permission from the client and the controlling regulatory agencies.

6.1 IDW CONSISTING OF SOIL AND/OR OTHER SOLIDS

IDW soils include drill cuttings, surface soils, and sediments. If in accordance with an approved IDW management plan, and pre-approved by the client, drill cuttings may be placed back into boreholes. Otherwise, IDW soils awaiting the results of IDW waste characterization analyses, should be stockpiled on-site in a plastic-lined and plastic-covered area, placed in labeled containers or, if moved to a central collection point, kept segregated from other material until contaminant levels are established. Labels shall be affixed to all containers, or a sign posted adjacent to covered stockpiles, and shall include a contact name and telephone number.

- If waste characterization analytical results indicate the IDW soil are below established limits established for the site with regulatory approval, the soils can be thin-spread back on the site or used as clean fill material.
- If analytical results show levels of contamination exceeding established limits, then the material shall be containerized and disposed of as directed by the client.

6.2 IDW FLUIDS

IDW fluids may include drilling fluids, well development fluids, pre-sample purge water, groundwater, and decontamination fluids; manage, characterize, and dispose of IDW fluids in accordance with an approved site-specific IDW management plan. Segregate IDW fluids by source of generation (e.g., keep drilling fluids separate from well development fluids) and by characteristics that may require extra processing, such as filtration to remove solids.

If allowed by the approved IDW management plan and with client pre-approval, pre-sample purge water, groundwater, and decontamination fluids maybe discharged to the ground at an approved on-site location to allow for infiltration. Otherwise, all IDW fluids will be containerized in labeled containers and stored at the site or at a central collection point until waste characterization testing is completed. Labels should include a contact name and telephone number.

A representative sample of the fluid shall be collected and analyzed for contaminants of concern. If analytical samples were collected (such as from a monitoring well), the results of these analyses can be used to indicate the status of the fluids, but a waste disposal or treatment facility may require additional analyses. The IDW shall be disposed of as directed by the client.

6.3 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) includes all gloves, Tyvek® suits, and other disposable equipment. All PPE that cannot be adequately decontaminated to permit safe reuse will be double plastic-bagged, collected, and placed in an approved industrial waste bin.

7.0 RCRA REGULATED MATERIALS

A waste material is regulated under RCRA if it exhibits one of four characteristics: ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261.20 through 261.24 or the identified contaminants listed in 40 CFR 261.30 through 261.33. The "mixture rule" and the "contained-in" rules apply to situations where a RCRA listed or characteristic waste is mixed with, or contained in soil, groundwater, surface water, or debris, then that resulting material must also be regulated under RCRA. In the case of the "derived-from rule", a waste that is generated from treatment, storage, or disposal of a RCRA listed or characteristic waste (for example leachate, ash, or emissions dusts) is also a hazardous waste unless specifically exempted, per 40 CFR 261.3 (b).

7.1 IDW CONSISTING OF SOILS OR OTHER SOLIDS

Soils include drill cuttings, surface soils, and sediments. For areas in which there are known or suspected RCRA-regulated contaminants, permission will be sought from the controlling regulatory agencies to bury disturbed soils in shallow, plastic-lined pits on-site, cover them with surface soils, and reseed. If in accordance with an approved IDW management plan and with client pre-approval, drill cuttings may be backfilled into boreholes. The location and size of the pits will be included in the field logbook and project reports for future reference. This procedure is in accordance with published Environmental Protection Agency (EPA) guidance (EPA, OSWER Directive 3945.3-02, May 1991, *Management of Investigation-Derived Waste During Site Inspections).*

If on-site burial is not permitted or is logistically inconvenient, soils will be field screened for volatile contaminants as described above and stockpiled at the site in an area lined with, and covered by, plastic sheeting, preferably black to resist breakdown of the plastic from exposure to sunlight. Stockpiling the soil at the site without containerization will prevent placement (as defined by EPA) from occurring and thus avoid activating potential land disposal restrictions. Soils that field screen less than the established field screening limit can be spread back on the site with the approval of the controlling regulatory agencies.

If it is logistically impossible to stockpile the material at the site, or if contaminants are such that field screening would be inconclusive, the material shall be collected in approved containers, preferably a steel roll-off box. These containers must be labeled as to the contents, the date(s) of collection, and the location at which the material was generated. If the IDW will be submitted to a disposal facility, representative samples will be collected and submitted to an approved laboratory to be analyzed for ignitability, corrosivity, reactivity, and for Toxicity Characteristic Leachate Procedure, as well as any other contaminants requested by the controlling regulatory agencies.

If the results of the analyses are below established ARARs, the soils can be spread back on the site or used by the client as fill material with the regulatory agencies' permission. If analytical results indicate the IDWs are RCRA regulated, the approved on-site treatment facility should be used (if available), or the containers shall be disposed at an RCRA-permitted disposal/treatment facility (TSD). RCRA regulated IDW may remain stored on-site for the time period allowed by the client's generator status. State time requirements may be slightly different so be sure to check with the state regulatory agency.

- **Large Quantity Generator** (>1,000 kg hazardous waste per month): 90 days.
- **Small Quantity Generator** (100-1,000 kg hazardous waste per month): 180 days or 270 days if TSD is greater than 200 miles away.
- **Conditionally Exempt Small Quantity Generator** (<100 kg hazardous waste per month): no time restrictions.

7.2 IDW FLUIDS

IDW fluids may include drilling fluids, development/purge water, and decontamination fluids. For areas in which known or suspected RCRA-regulated contaminants exist, all fluids will be containerized in properly labeled containers (i.e., drums or tanks) and stored at the site. At the end of the generation process, if no samples of the fluids have been collected, a representative sample will be collected and analyzed for contaminants of concern. If analytical samples were collected (such as from a monitoring well), the results of these analyses can be used in place of collecting and analyzing additional samples to indicate the status of the fluids. If analytical results show levels of contamination below established ARARs, the fluids can be released to the storm water or sanitary sewer system of the facility with the controlling regulatory agencies' approval. If analytical results indicate the IDW is RCRA regulated or other contaminants are present at levels exceeding established ARARs, the on-site treatment facility should be used (if available), or the containers shall be disposed of at a RCRA TSD Facility.

RCRA regulated IDW may remain stored on-site for the time period allowed by the client's generator status. State time requirements may be slightly different so be sure to check with the state regulatory agency.

- **Large Quantity Generator** (>1,000 kg hazardous waste per month): 90 days.
- **Small Quantity Generator** (100-1,000 kg **hazardous waste** per month): 180 days or 270 days if TSD is greater than 200 miles away.
- **Conditionally Exempt Small Quantity Generator** (<100 kg hazardous waste per month): no time restrictions.

7.3 PERSONAL PROTECTIVE EQUIPMENT

PPE to be used during handling or sampling of IDW or site–related wastes should be specified in the Site-Specific Safety and Health Plan (SSHP). The required PPE should be present at the site and generally will include at least Level D PPE (gloves, steel-toed boots, eye protection, hard-hat, and protective clothing as necessary). All used PPE that cannot be adequately decontaminated to permit safe reuse will be double plastic-bagged, collected, and placed in approved containers at a central collection point.

8.0 IDW DISPOSAL OPTIONS

Table 1 presents various disposal options for the five most common types of IDW.

Table 1. IDW Disposal Options

Type of IDW	Generation process	Disposal options
Soil	Borehole drilling Test pits Surface soil sampling	Re-use onsite in accordance with client requirements Return to borehole (per IDW plan, preapproved) Send to an existing on-site treatment/disposal unit (TDU) Containerize and dispose of appropriately Store for future disposal
Sludges and sediments	Sludge pit Sediment sampling	Return to pit immediately after generation Containerize and dispose of appropriately Store for future disposal
Aqueous liquids	Well installation Well purging during sampling /development	Pour onto ground (per IDW plan, preapproved) Send to Publicly-Owned Treatment Works (POTW) or facility treatment works

Table 1. IDW Disposal Options

Type of IDW	Generation process	Disposal options
Disposal personal protective equipment (PPE)	Sampling procedures	Send to on-site TDU Place in on-site industrial dumpster Containerize and dispose of appropriately Store for future
Decontamination fluids	Decontamination of PPE and other equipment	Send to on-site TDU Containerize and dispose of appropriately Store for future disposal

8.1 ON-SITE TREATMENT

If on-site disposal of the material is not permitted, a method of treating the material on-site, or at a central location at the facility, should be selected. It should be recognized that the effectiveness of a treatment method is a function of the suite of contaminants involved and, therefore, must be chosen on a case-by-case basis. In addition, approved treatment methods will vary from state to state, and a list of approved methods should be obtained from the controlling regulatory agencies. In any case, a preferred treatment option should be established before initiating field operations.

8.2 OFF-SITE DISPOSAL

If on-site disposal is prohibited and no treatment method is viable or permitted, the alternative would be to have the material handled under the waste disposal contracts in place at the facility. Because this would likely mean the use of either sanitary or hazardous waste landfills for disposal, it is the least attractive option on the basis of cost, environmental stewardship, and future potential liability for the client. In addition, in the case of RCRA hazardous materials, the client's RCRA waste-generating status must be kept in mind and the permitted amounts of RCRA waste must not be exceeded as a result of an influx of IDW from site investigations.

9.0 IDW CONTAINER MANAGEMENT

- OTIE will request a centralized location for IDW container storage prior to beginning of field work.
- IDW container labels will include both OTIE and Base RPM contact information.
- OTIE's IDW container inventory field tracking form (**Attachment 1**) includes quality control checks of at least two OTIE field personnel for every IDW container, when possible.
- For all IDW containers (used and empty) stationed on-site, locations will be marked on a field map and included in our daily report. OTIE personnel will regularly forward IDW container location information to Base RPM
- Photographs of each accumulated IDW container will be taken and included in all daily field activity reports.
- All OTIE IDW containers on-site will have completed labels affixed. Any empty IDW container stationed on-site will be labeled as empty.

10.0 RESTRICTIONS/LIMITATIONS

This Standard Operating Practice does not address those areas in which material contains radionuclide contamination. Should this be suspected, a health physicist must be involved to develop waste-handling procedures and on-site to monitor activities at all times.

11.0 REFERENCES

Code of Federal Regulations, 40 CFR, Parts 261.20 through 261.33. Available from: http://www.gpo.gov/fdsys/granule/CFR-2012-title40-vol27/CFR-2012-title40-vol27-sec261-20/content-detail.html

U.S. Environmental Protection Agency(U.S. EPA). 1986. Memorandum, *Discharge of Wastewater from CERCLA Sites into POTWs,* OSWER Directive 9330.2-04, April 15.

______.1990. *Guidance on Remedial Actions for Superfund Sites with PCB Contamination,* Office of Emergency and Remedial Response, EPA/540/G-90/007, August 1990.

_______. 1990. *CERCLA Compliance with the CWA and SDWA,* Fact Sheet 9234.2-06/FS, Office of Solid Waste and Emergency Response, February.

_______. 1991. *Management of Investigation-Derived Waste,* Superfund Publication 9345.3-02FS, Office of Solid Waste and Emergency Response, February.

_______. 1991. *Management of Investigation-Derived Waste During Site Inspections,* OSWER Directive 9345.3-02, Office of Solid Waste and Emergency Response, May.

_______. 1989. Superfund LDR Guide 5*, Determining When LDRs Are Applicable to CERCLA Response Actions,* OSWER Directive 9347.3-05FS, 1989.

Attachment 1

IDW CONTAINER INVENTORY RECORD

Project No. ______________________________ Phase________ Task___________ Date: _______________

	Site ID – Drum #	Label FTL[2]	Label Tech[3]	Date Generated[1]	Date Final Inspection	Content *	Volume	[4]Comments/Photo #/Location Stored Consolidated Location/Figure #
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

Page_____of _____

* **C**=CONCRETE, **G**=GROUT, **M**=DRILLING MUD, **PPE**=EXPENDABLES/PPE, **S**=SOIL, **T**=TRASH, **W**=WATER **O**=OTHERS

[1] Waste Collection Start Date [2] Field Team Lead Initials [3] Technician Initials [4] Photograph Label on drum.

Form to be scanned and included with daily report.

Appendix C

Tables

Appendix C.1
Summary of Geotechinal Testing Results
Site Inspection of AFFF Usage
Kirtland Air Force Base, New Mexico

Location	Sample Date	Sample Depth (ft)	TOC Solids/Sludges Combustion	pH	Moisture	% Gravel	% Sand	% Silt	% Clay
		Units:	mg/kg	---	%	%	%	%	%
AFFF Area 1 Air Force FT-013									
FT013-SB04	2/14/2017	0.0 - 1.0	3,300	9.03	6.1	N.D.	66.4	22.1	11.0
	2/14/2017	15.0 - 16.0	1,860	8.67	6.8	0.6 J	52.6	33.8	13.0
	2/14/2017	24.0 - 25.0	N.D.	8.86	3.7	N.D.	70.4	24.3	5.0
AFFF Area 2 Department of Energy FT-014									
FT014-SB04	2/13/2017	0.0 - 1.0	1,740	9.01	3.8	18.1	65.0	16.5	0.5 J
	2/13/2017	15.0 - 16.0	2,110	8.67	2.5	7.6	69.6	18.3	4.5
	2/13/2017	24.0 - 25.0	1,410	8.69	2.6	16.1	58.3	21.6	4.0
AFFF Area 3 AFFF Spray Test Area									
AFA-SB04	7/29/2016	0.0 - 1.0	4,100	8.71	11.2	N.D.	51.7	29.0	19.0
	7/29/2016	15.0 - 16.0	1,850	8.80	8.2	9.9	58.2	25.4	6.5
	7/29/2016	24.0 - 25.0	325 J	8.65	3.2	3.9	74.7	18.9	2.5
AFFF Area 4 South Taxiway Spill Area									
STSA-SB04	2/14/2017	0.0 - 1.0	2,710	7.71	6.0	0.7 J	73.3	18.1	8.0
	2/14/2017	15.0 - 16.0	1,190	8.55	4.4	9.5	66.8	13.7	10.0
	2/14/2017	24.0 - 25.0	1,250	8.77	9.9	N.D.	50.6	31.5	17.5

Notes:

ft = feet

mg/kg = milligrams per kilograms

N.D. = not detected

Appendix C.2
Summary of Soil Analytical Testing Results
Site Inspection of AFFF Usage
Kirtland Air Force Base, New Mexico

				Analyte	Perfluorobutanoic acid (PFBA)	Perfluorobutane Sulfonate (PFBS)	Perfluoropentanoic Acid (PFPeA)	Perfluorohexanoic Acid (PFHxA)	Perfluorohexane Sulfonate (PFHxS)	6:2 Fluorotelomer Sulfonate	Perfluoroheptanoic Acid (PFHpA)	Perfluoro-n-Octanoic Acid (PFOA)	Perfluorooctane Sulfonate (PFOS)	Perfluorooctane Sulfonamide (PFOSA)	8:2 Fluorotelomer Sulfonate	Perfluorononanoic Acid (PFNA)	Perfluorodecanoic Acid (PFDA)	Perfluorodecane Sulfonate (PFDS)	Perfluoroundecanoic Acid (PFUnA)	Perfluorododecanoic Acid (PFDoA)	Perfluorotridecanoic Acid (PFTrDA)	Perfluorotetradecanoic Acid (PFTeDA)
				EPA RSL:	na	1600000	na	na	na	na	na	1260	1260	na	na	na	na	na	na	na	na	na
Location	Sample ID	Sample Date	Sample Depth (ft)	Sample Type	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
AFFF Area 1 Air Forece FT013																						
FT013-SB01	DXN398	2/14/2017	0.0 -1.0	N	3.9 U	3.9 U	3.9 U	3.9 U	11	170	3.9 U	9.3 J	980	1.7 J	26	7.8 J	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U
	DXN399	2/14/2017	15.0-16.0	N	1.4	1.7 J	1.9	2.8 J	0.40 U	0.27 J	0.40 U	0.20 U	0.45 J	0.40 U	0.40 U	0.20 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
	DXN400	2/14/2017	15.0-16.0	FD	0.78 J	1.2 J	1.5	1.6 J	0.38 U	0.38 U	0.38 U	0.19 U	0.43 J	0.38 U	0.38 U	0.19 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U
	DXN401	2/14/2017	24.0-25.0	N	0.38 U	0.38 U	0.21 J	0.38 U	0.38 U	0.38 U	0.38 U	0.19 U	0.34 J	0.38 U	0.38 U	0.19 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U
FT013-SB02	DXN402	2/14/2017	0.0 -1.0	N	0.27 J	0.38 U	0.39 J	0.57 J	6.1	0.38 U	0.54 J	2.1	11	0.38 U	0.38 U	0.19 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U
	DXN403	2/14/2017	15.0-16.0	N	0.38 U	0.25 J	0.34 J	1.2	2.9	0.38 U	0.38 U	0.34 J	2.8	0.38 U	0.38 U	0.19 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U
	DXN404	2/14/2017	24.0-25.0	N	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.18 U	0.68 J	0.36 U	0.36 U	0.18 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U
FT013-SB03	DXN405	2/14/2017	0.0 -1.0	N	0.40 U	0.40 U	0.40 U	0.40 U	0.95 J	0.40 U	0.40 U	0.41 J	7.0	0.40 U	0.40 U	0.20 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
	DXN406	2/14/2017	15.0-16.0	N	0.40 U	0.40 U	0.32 J	0.99 J	1.9	0.40 U	0.40 U	0.69 J	3.2	0.40 U	0.40 U	0.20 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
	DXN407	2/14/2017	24.0-25.0	N	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.18 U	0.20 J	0.36 U	0.36 U	0.18 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U
AFFF Area 2 Air Forece FT014																						
FT014-SB01	DXH435	2/13/2017	0.0 -1.0	N	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.19 U	0.24 J	0.38 U	0.38 U	0.19 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U
	DXH436	2/13/2017	15.0-16.0	N	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.20 U	0.39 U	0.39 U	0.39 U	0.20 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U
	DXH437	2/13/2017	24.0-25.0	N	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.18 U	0.36 U	0.36 U	0.36 U	0.18 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U
FT014-SB02	DXH438	2/13/2017	0.0 -1.0	N	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.16 U	0.14 J	0.33 U	0.33 U	0.16 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U
	DXH439	2/13/2017	15.0-16.0	N	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.18 U	0.36 U	0.36 U	0.36 U	0.18 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U
	DXH440	2/13/2017	24.0-25.0	N	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.19 U	0.38 U	0.38 U	0.38 U	0.19 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U
FT014-SB03	DXH441	2/13/2017	0.0 -1.0	N	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.16 U	0.22 J	0.31 U	0.31 U	0.16 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U
	DXH443	2/13/2017	0.0 -1.0	FD	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U	0.16 U	0.28 J	0.32 U	0.32 U	0.16 U	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U
	DXH442	2/13/2017	15.0-16.0	N	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.19 U	0.17 J	0.39 U	0.39 U	0.19 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U
	DXH444	2/13/2017	24.0-25.0	N	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.16 U	0.33 U	0.33 U	0.33 U	0.16 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U
AFFF Area 3 AFFF Spray Area																						
AFA-SB01	DXR065	2/15/2017	0.0 -1.0	N	0.34 U	0.34 U	0.30 J	0.38 J	2.3	0.27 J	0.58 J	0.58 J	1.3	0.34 U	0.34 U	0.17 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
	DXR066	2/15/2017	15.0-16.0	N	0.37 U	0.37 U	0.37 U	0.37 U	0.37 U	0.37 U	0.37 U	0.18 U	0.61 J	0.37 U	0.37 U	0.18 U	0.37 U	0.37 U	0.37 U	0.37 U	0.37 U	0.37 U
	DXR067	2/15/2017	24.0-25.0	N	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.19 U	0.34 J	0.39 U	0.39 U	0.19 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U
AFA-SB02	DXR068	2/15/2017	0.0 -1.0	N	0.36 U	0.36 U	0.59 J	0.75 J	0.48 J	0.36 U	0.33 J	0.32 J	0.35 J	0.36 U	0.36 U	0.18 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U
	DXR069	2/15/2017	15.0-16.0	N	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.26 J	0.34 U	0.17 U	0.26 J	0.34 U	0.34 U	0.17 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
	DXR070	2/15/2017	24.0-25.0	N	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U	0.16 U	0.32 U	0.32 U	0.32 U	0.16 U	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U
AFA-SB03	DXR061	2/15/2017	0.0 -1.0	N	0.29 J	0.37 U	0.61 J	0.71 J	2.3	0.33 J	0.49 J	1.1	130.00	1.1	0.28 J	4.3	0.85 J	1.4	0.38 J	0.37 U	0.37 U	0.37 U
	DXR062	2/15/2017	0.0 -1.0	FD	0.30 J	0.40 U	0.67 J	0.77 J	2.4	0.36 J	0.54 J	1.1	140.00	1.1	0.29 J	3.8	0.92 J	1.5	0.42 J	0.40 U	0.40 J	0.40 U
	DXR063	2/15/2017	15.0-16.0	N	0.34 U	0.34 U	0.26 J	0.28 J	4.2	0.36 J	0.32 J	0.86	21	0.24 J	0.34 U	0.56 J	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
	DXR064	2/15/2017	24.0-25.0	N	0.37 U	0.37 U	0.37 U	0.32 J	5.7	0.84 J	0.45 J	1.6	4.2	0.37 U	0.37 U	0.23 J	0.37 U	0.37 U	0.37 U	0.37 U	0.37 U	0.37 U

Appendix C.2
Summary of Soil Analytical Testing Results
Site Inspection of AFFF Usage
Kirtland Air Force Base, New Mexico

				Analyte	Perfluorobutanoic acid (PFBA)	Perfluorobutane Sulfonate (PFBS)	Perfluoropentanoic Acid (PFPeA)	Perfluorohexanoic Acid (PFHxA)	Perfluorohexane Sulfonate (PFHxS)	6:2 Fluorotelomer Sulfonate	Perfluoroheptanoic Acid (PFHpA)	Perfluoro-n-Octanoic Acid (PFOA)	Perfluorooctane Sulfonate (PFOS)	Perfluorooctane Sulfonamide (PFOSA)	8:2 Fluorotelomer Sulfonate	Perfluorononanoic Acid (PFNA)	Perfluorodecanoic Acid (PFDA)	Perfluorodecane Sulfonate (PFDS)	Perfluoroundecanoic Acid (PFUnA)	Perfluorododecanoic Acid (PFDoA)	Perfluorotridecanoic Acid (PFTrDA)	Perfluorotetradecanoic Acid (PFTeDA)
				EPA RSL:	na	1600000	na	na	na	na	na	1260	1260	na	na	na	na	na	na	na	na	na
Location	**Sample ID**	**Sample Date**	**Sample Depth (ft)**	**Sample Type**	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
AFFF Area 4 South Taxiway Spill Area																						
STSA-SB01	DXN426	2/14/2017	0.0 -1.0	N	0.36 U	0.36 U	0.30 J	1.1	6.2	0.36 U	0.44 J	2.5	2.0	0.36 U	0.36 U	0.18 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U
	DXN427	2/14/2017	15.0-16.0	N	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.20 U	0.37 J	0.40 U	0.40 U	0.20 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
	DXN428	2/14/2017	24.0-25.0	N	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 UJ	0.38 U	0.19 U	0.38 U	0.38 U	0.38 U	0.19 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U
STSA-SB02	DXN429	2/14/2017	0.0 -1.0	N	0.34 U	0.34 U	0.34 U	0.34 U	0.31 J	0.34 U	0.34 U	0.17 U	3.0 J	0.34 U	0.34 U	0.17 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
	DXN430	2/14/2017	0.0 -1.0	FD	0.44 U	0.44 U	0.44 U	0.44 U	0.27 J	0.44 U	0.44 U	0.22 U	1.3 J	0.44 U	0.44 U	0.22 U	0.44 U	0.44 U	0.44 U	0.44 U	0.44 U	0.44 U
	DXN431	2/14/2017	15.0-16.0	N	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.19 U	0.38 U	0.38 U	0.38 U	0.19 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U
	DXN432	2/14/2017	24.0-25.0	N	0.40 U	0.40 U	0.40 U	0.40 U	0.26 J	0.40 U	0.40 U	0.20 U	0.40 U	0.40 U	0.40 U	0.20 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
STSA-SB03	DXR080	2/15/2017	0.0 -1.0	N	0.34 U	0.34 U	0.34 U	0.34 U	0.24 J	0.34 U	0.34 U	0.19 J	1.1	0.34 U	0.34 U	0.17 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
	DXR081	2/15/2017	15.0-16.0	N	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.16 U	0.20 J	0.33 U	0.33 U	0.16 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U
	DXR082	2/15/2017	24.0-25.0	N	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.17 U	0.34 U	0.34 U	0.34 U	0.17 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U

Notes:

EPA = Environmental Protection Agency
FD = Field Duplicate Sample
ft = feet
ID = Identification
J = Estimated detect at concentration shown
N = Normal Field Sample
na = not applicable
RSL = Regional Screening Level
U = non-dectect at reporting limit shown
µg/kg = micrograms per kilograms

Appendix C.3
Summary of Groundwater Analytical Testing Results
Site Inspection of AFFF Usage
Kirtland Air Force Base, New Mexico

				Analyte	**Perfluorobutanoic Acid (PFBA)**	**Perfluorobutane Sulfonate (PFBS)**	**Perfluoropentanoic Acid (PFPeA)**	**Perfluorohexanoic Acid (PFHxA)**	**Perfluorohexane Sulfonate (PFHxS)**	**6:2 Fluorotelomer Sulfonate**	**Perfluoroheptanoic Acid (PFHpA)**	**Perfluoro-n-Octanoic Acid (PFOA)**	**Perfluorooctane Sulfonate (PFOS)**	**Perfluorooctane Sulfonamide (PFOSA)**	**8:2 Fluorotelomer Sulfonate**	**Perfluorononanoic Acid (PFNA)**	**Perfluorodecanoic Acid (PFDA)**	**Perfluorodecane Sulfonate (PFDS)**	**Perfluoroundecanoic Acid (PFUnA)**	**Perfluorododecanoic Acid (PFDoA)**	**Perfluorotridecanoic Acid (PFTrDA)**	**Perfluorotetradecanoic Acid (PFTeDA)**
				EPA HA:	na	380	na	na	na	na	na	0.07	0.07	na	na	na	na	na	na	na	na	na
Location	**Sample ID**	**Sample Date**	**Sample Depth (ft)**	**Sample Type**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
AFFF Area 1 Air Forece FT013																						
FT013	KAFB0417	2/17/2017	447.94	N	0.014 U	0.0070 U	0.010 U	0.010 U	0.010 U	0.014 U	0.010 U	0.014 U	0.0044 J	0.014 U	0.014 U	0.010 U	0.014 U	0.010 U	0.010 U	0.014 U	0.010 U	0.014 U
AFFF Area 2 Air Forece FT014																						
FT014	KAFB0622	2/13/2017	538.25	N	0.014 U	0.0070 U	0.010 U	0.010 U	0.010 U	0.014 U	0.010 U	0.014 U	0.010 U	0.014 U	0.014 U	0.010 U	0.014 U	0.010 U	0.010 U	0.014 UJ	0.010 U	0.014 U
AFFF Area 3 AFFF Spray Area																						
AFA	KAFB_7001	2/15/2017	448.55	N	0.014 U	0.0085 J	0.012 J	0.0060 J	0.010 U	0.014 U	0.010 U	0.014 U	0.014 U	0.014 U	0.014 U	0.010 U	0.014 U	0.010 U	0.010 U	0.014 U	0.010 U	0.014 U
	KAFB_7001FD	2/15/2017	448.55	FD	0.014 U	0.0078 J	0.011 J	0.0048 J	0.010 U	0.014 U	0.010 U	0.014 U	0.014 U	0.014 U	0.014 U	0.010 U	0.014 U	0.010 U	0.010 U	0.014 U	0.010 UJ	0.014 UJ
AFFF Area 4 South Taxiway Spill Area																						
STSA	KAFB-106027	2/15/2017	478.00	N	0.014 U	0.0070 U	0.0048 J	0.010 U	0.0042 J	0.014 U	0.010 U	0.014 U	0.010 U	0.014 U	0.014 U	0.010 U	0.014 U	0.010 U	0.010 U	0.014 U	0.010 U	0.014 U

Notes:

EPA = Environmental Protection Agency
FD = Field Duplicate Sample
ft = feet
HA = Health Advisory
ID = Identification
J = Estimated detect at concentration shown
N = Normal Field Sample
na = not applicable
U = non-dectect at reporting limit shown
µg/kg = micrograms per kilograms

Appendix D

Data Validation Report

TABLE OF CONTENTS

TABLES (IN TEXT)

1.0 INTRODUCTION

The Data Validation Report presents findings for validation of environmental samples associated with this project that were analyzed for PFASs by United States Environmental Protection Agency (U.S. EPA) Method 537 Modified. Maxxam Laboratories analyzed all samples and has current accreditations from Department of Defense Environmental Laboratory Accreditation Program (DOD ELAP). Data were validated by Oneida Total Integrated Enterprise's (OTIE's) Senior Chemist. Analytical data were validated in accordance with the following documents:

- *Final Uniform Federal Policy for Quality Assurance Project Plan (QAPP) Addendum, Site Inspections of Aqueous Film Forming Foam Usage at Kirtland AFB, Kirtland AFB, New Mexico*(OTIE, 2017a);
- *U.S. EPA National Functional Guidelines for Superfund Organic Methods Data Review* dated August 2014 (U.S. EPA 2014a); and
- *U.S. EPA SW846, Third Edition, Test Methods for Evaluating Solid Waste, update 1*, July 1992; *update IIA*, August 1993; *update II*, September 1994; *update IIB*, January 1995; *update III*, December 1996; update IIIA, April 1998; IIIB, November 2014; update IV, February 2007; *update V*, July 2014 (U.S. EPA 2014c).

Analytical results from 7 Maxxam Laboratory sample delivery groups (SDGs) were validated; samples consisted of a total of 36 soil and 4 groundwater normal samples, 5 duplicate samples, 3 matrix spike/ matrix spike (MS/MSD) pairs and field QC samples. Samples were collected in accordance with the QAPP (OTIE 2017a) and analyzed for PFASs by U.S. EPA Method 537 modified. Maxxam Laboratory SDGs underwent a Level II data validation review, while 10% underwent a Level IV data validation review. Level II and level IV quality control (QC) forms are summarized in the Laboratory Review Checklists (LRC). These LRCs are included as an attachment to this Data Validation Report.

The following are definitions of the data qualifiers used during data validation:

Qualifier	Definition
U	Not detected. Analysis for the analyte was performed but the analyte was not detected above the limit of detection (LOD).
J	Estimated. The analyte was detected between the detection limit (DL) and limit of quantitation (LOQ). The numerical value is the approximate concentration of the analyte in the sample. Analytical result is has some Quality Control Issue.
UJ	Not detected. The analyte was not detected above the reported LOD. The numerical value of the LOD is estimated and may be inaccurate.
R	Rejected. The data are unusable.
Bias Codes	
H	Bias in the sample result is believed to be high.
L	Bias in the sample result is believed to be low.

NOTE:
No data were rejected, biased high, or biased low.

A cross reference table correlating field sample identifications (IDs) and laboratory IDs is provided in **Table 1** (end of document). Analytical results summary tables are included in **Appendix A**.

2.0 DATA REVIEW / VALIDATION RESULTS

2.1 DATA PACKAGE 1 – B730538

Nine soil normal samples and one field duplicate sample were analyzed for PFASs by U.S. EPA Method 537 Modified.

2.1.1 Preservation and Holding Times

Samples were collected, shipped, and received by lab in accordance with their respective method requirements. Analytical technical holding times were met.

2.1.2 Calibrations

According to the LRC, initial calibration and continuing calibration data met the method requirements for all analyses.

2.1.3 Field QC Blanks

No field blank samples were collected and analyzed to assess potential cross-contamination introduced during sample collection or sample shipment. All method blanks were below method specific quantitation limits.

2.1.4 Isotope Surrogate Recoveries and Internal Standards

Laboratory isotope surrogate and internal standards recoveries were within acceptance criteria.

2.1.5 Laboratory QC Blank Sample

Laboratory blank samples were analyzed as required by the method. PFAS was not detected above the LOD in the laboratory blank sample.

2.1.6 Laboratory Control Samples

Laboratory control samples (LCS) recoveries were analyzed as required by the method. Percent recoveries (%R) and relative percent differences (RPD) were within their respective QC limits.

2.1.7 Matrix Spikes/Matrix Spike Duplicates

No project specific Matrix Spike/Matrix Spike Duplicates (MS/MSD) samples were collected during the sampling event.

2.1.8 Field Duplicates

Field duplicates were collected and analyzed as an indication of overall precision. Evaluation of the precision was accomplished by calculating the RPD of detected compounds in the parent and duplicate sample. For this SDG, one field duplicate pair was collected and the RPD calculated was below the established control limit of 30%.

2.1.9 Other

None.

2.2 DATA PACKAGE 2 – B731881

Nine normal, one duplicate and one pair of MS/MSD samples were analyzed for PFASs by U.S. EPA Method 537 Modified.

2.2.1 Preservation and Holding Times

Samples were collected, shipped, and received by lab in accordance with their respective method requirements. Analytical technical holding times were met.

2.2.2 Calibrations

According to the LRC, initial calibration and continuing calibration data met the method requirements for all analyses.

2.2.3 Field QC Blanks

No field blank samples were collected. All method blanks were below method specific quantitation limits.

2.2.4 Isotope Surrogate Recoveries and Internal Standards

Laboratory isotope surrogate and internal standards recoveries were within acceptance criteria.

2.2.5 Laboratory QC Blanks

Laboratory blank samples were analyzed as required by the method. PFAS was not detected above the LOD in the laboratory blank sample.

2.2.6 Laboratory Control Samples

LCS recoveries were analyzed as required by the method. All %R and RPD were within their respective QC limits.

2.2.7 Matrix Spikes/Matrix Spike Duplicates

One project specific MS/MSD sample was collected as part of this SDG. The MS/MSD %R and RPDs were within their respective QC limits.

2.2.8 Field Duplicates

Field duplicates were collected and analyzed as an indication of overall precision. Evaluation of the precision was accomplished by calculating the RPD of detected compounds in the parent and duplicate sample. For this SDG, one field duplicate pair was collected and the RPD calculated for each was below the established control limit of 30% with the following exception:

- The RPD between sample FT013-SB01-15-16 and FT013-SB01-15-16FD was >30% for the following analytes: PFBS and PFHxA. As a result, the PFBS and PFHxA detections in the above samples were qualified as estimated and denoted with data qualifier “J.”

2.2.9 Other

Sample FT013-SB01-0-1 (DXN398) had high concentrations of target analytes. This sample was diluted 10x for all analytes except for PFOS which required a 100x dilution. The lab adjusted the detection limits accordingly.

2.3 DATA PACKAGE 3 – B731889

Six normal samples, one field duplicate and one MS/MSD pair samples were analyzed for PFASs by U.S. EPA Method 537 Modified.

2.3.1 Preservation and Holding Times

Samples were collected, shipped, and received by lab in accordance with their respective method requirements. Analytical technical holding times were met.

2.3.2 Calibrations

According to the LRC, initial calibration and continuing calibration data met the method requirements for all analyses.

2.3.3 Field QC Blanks

No field blank samples were collected. All method blanks were below method specific quantitation limits.

2.3.4 Isotope Surrogate Recoveries and Internal Standards

Laboratory isotope surrogate and internal standards recoveries were within acceptance criteria with the following exceptions:

Isotopically labeled 13C2-6:2 Fluorotelomersulfonate (M2-6:2FTS) is used as an internal standard to quantify native 6:2 Fluorotelomersulfonate (6:2FTS). The instrument response observed for this labeled compound was below the defined lower control limit (LCL) for the following sample:

- DXN428 STSA-SB01-24-25
- The analyte was flagged this analyte UJ.

2.3.5 Laboratory QC Sample

Laboratory blank samples were analyzed as required by the method. PFAS was not detected above the LOD in the laboratory blank sample.

2.3.6 Laboratory Control Samples

LCS recoveries were analyzed as required by the method. All %R and RPD were within their respective QC limits.

2.3.7 Matrix Spikes/Matrix Spike Duplicates

One project specific MS/MSD sample was collected as part of this SDG. The MS/MSD %R and RPDs were within their respective QC limits.

2.3.8 Field Duplicates

Field duplicates were collected and analyzed as an indication of overall precision. Evaluation of the precision was accomplished by calculating the RPD of detected compounds in the parent and duplicate sample. For this SDG, one field duplicate pair was collected and the RPD calculated was below the established control limit of 30% with the following exception:

The RPD between sample STSA-SB02-0-1 and STSA-SB02-0-1FD was the limit for PFOS. As a result, the PFOS detections in the above samples were qualified as estimated and denoted with data qualifier “J.”

2.3.9 Other

None.

2.4 DATA PACKAGE 4 – B732757

Nine normal samples, one field duplicate and one MS/MSD pair samples were analyzed for PFASs by U.S. EPA Method 537 Modified.

2.4.1 Preservation and Holding Times

Samples were collected, shipped, and received by lab in accordance with their respective method requirements. Analytical technical holding times were met.

2.4.2 Calibrations

According to the LRC, initial calibration and continuing calibration data met the method requirements for all analyses.

2.4.3 Field QC Blanks

Field QC blank samples were not collected.

2.4.4 Isotope Surrogate Recoveries and Internal Standards

Laboratory isotope surrogate and internal standards recoveries were within acceptance criteria.

2.4.5 Laboratory QC Blank

Laboratory blank samples were analyzed as required by the method. PFAS was not detected above the LOD in the laboratory blank sample.

2.4.6 Laboratory Control Samples

LCS recoveries were analyzed as required by the method. All %R and RPD were within their respective QC limits.

2.4.7 Matrix Spikes/Matrix Spike Duplicates

One project specific MS/MSD sample was collected as part of this SDG. The MS/MSD %R and RPDs were within their respective QC limits with the following exception:

- Sample AFA-SB03-0-1FD, both the MS and MSD recoveries for Perfluorotridecanoic Acid were within limits. However, the RPD between the MS and MSD was >30 for Perfluorotridecanoic Acid. As a result, the Perfluorotridecanoic Acid detections in the above samples were qualified as estimated and denoted with data qualifier “J.”

2.4.8 Field Duplicates

One field duplicate pair was collected and the RPD calculated for each was below the established control limit of 30%.

2.4.9 Other

Soil samples were initially analyzed on QC batch 4872302 (2017/03/09). The concentrations of PFOS exceeded the upper calibration range for the following samples:

- DXR061 AFA-SB03-0-1
- DXR062 AFA-SB03-0-1FD

These samples were re-analyzed with 10x dilutions for these analytes. Detection limits were adjusted accordingly. Detection limits were adjusted accordingly. Data quality was not impacted no flags were applied.

2.5 DATA PACKAGE 5 – B733153

Three normal samples were analyzed for PFASs by U.S. EPA Method 537 Modified.

2.5.1 Preservation and Holding Times

Samples were collected, shipped, and received by lab in accordance with their respective method requirements. Analytical technical holding times were met.

2.5.2 Calibrations

According to the LRC, initial calibration and continuing calibration data met the method requirements for all analyses.

2.5.3 Field QC Blanks

No field blank samples were collected. All method blanks were below method specific quantitation limits.

2.5.4 Isotope Surrogate and Internal Standard Recoveries

Laboratory isotope surrogate and internal standards recoveries were within acceptance criteria.

2.5.5 Laboratory QC Blank

Laboratory blank samples were analyzed as required by the method. PFAS was not detected above the LOD in the laboratory blank sample.

2.5.6 Laboratory Control Samples

LCS recoveries were analyzed as required by the method. All %R and RPD were within their respective QC limits

2.5.7 Matrix Spikes/Matrix Spike Duplicates

No project specific MS/MSD samples were collected for this SDG.

2.5.8 Field Duplicates

No field duplicate pairs were collected for this SDG.

2.5.9 Other

None.

2.6 DATA PACKAGE 6 – B734065

One field blank and three equipment blank sample were analyzed for PFASs by U.S. EPA Method 537 Modified.

2.6.1 Preservation and Holding Times

Samples were collected, shipped, and received by lab in accordance with their respective method requirements. Analytical technical holding times were met.

2.6.2 Calibrations

According to the LRC, initial calibration and continuing calibration data met the method requirements for all analyses.

2.6.3 Field QC Blanks

No analyst were detected above the LOD in the field QC sample.

2.6.4 Isotope Surrogate Recoveries and Internal Standards

Laboratory isotope surrogate and internal standards recoveries were within acceptance criteria.

2.6.5 Laboratory QC Blank

Laboratory blank samples were analyzed as required by the method. PFAS was not detected above the LOD in the laboratory blank sample..

2.6.6 Laboratory Control Samples

LCS recoveries were analyzed as required by the method. All %R and RPD were within their respective QC limits.

2.6.7 Matrix Spikes/Matrix Spike Duplicates

No project specific MS/MSD samples were collected for this SDG.

2.6.8 Field Duplicates

No field duplicate pairs were collected for this SDG.

2.6.9 Other

None.

2.7 DATA PACKAGE 7 – B734076

Four normal samples, one field duplicate sample and one MS/MSD sample were analyzed for PFASs by U.S. EPA Method 537 Modified.

2.7.1 Preservation and Holding Times

Samples were collected, shipped, and received by lab in accordance with their respective method requirements. All technical holding times were met.

2.7.2 Calibrations

According to the LRC, initial calibration and continuing calibration data met the method requirements for all analyses.

2.7.3 Field QC Blanks

PFAS was not detected above the LOD in the field QC sample.

2.7.4 Isotope Surrogate and Internal Standard Recoveries

Laboratory isotope surrogate and internal standards recoveries were within acceptance criteria with the following exception:

- DXW949 KAFB 0622 (MPFDoA)

- DXW951 KAFB-7001FD (MPFTeDA)

Isotopically labeled 13C2-Perfluorododecanoic acid (MPFDoA) and 13C2-Perfluorotetradecanoic acid (MPFTeDA) are used as internal standards to quantify native Perfluorododecanoic acid (PFDoA) and Perfluorotridecanoic acid (PFTrDA) & Perfluorotetradecanoic acid (PFTeDA) respectively. The instrument responses observed for selected labeled compounds were below the defined lower control limit (LCL).

As a result, the analyte detections in the above samples were qualified as estimated and denoted with data qualifier “UJ.”

2.7.5 Laboratory QC Blank

Laboratory blank samples were analyzed as required by the method. PFAS was not detected above the LOD in the laboratory blank sample.

2.7.6 Laboratory Control Samples

LCS recoveries were analyzed as required by the method. All %R and RPD were within their respective QC limits.

2.7.7 Matrix Spikes/Matrix Spike Duplicates

Samples were within method acceptance criteria.

2.7.8 Field Duplicates

One field duplicate pair was collected and the RPD calculated for each was below the established control limit of 30%.

2.7.9 Other

None.

2.8 FIELD PROCEDURES

Soil and groundwater samples were collected in accordance with the approved QAPP (OTIE 2016a). Field documentation, including COCs, were reviewed and deemed acceptable.

3.0 SUMMARY

Analytical data are usable for the purpose of determining current project Chemicals of Concern (COC) concentrations in groundwater at the affected property.

In general, the soil and groundwater results reviewed for these 7 SDGs met acceptance criteria and are usable. Laboratory QC performance was generally within criteria. Continuing calibration standards and LCS were within acceptance criteria.

3.1 PRECISION

Analytical requirements precision can be found in Tables 12 and 28 in the project specific QAPP (OTIE 2017a). With the few exceptions listed above the acceptance criteria of 30%RPD was met. Five sets of field duplicates were collected during the sampling event. Analytical results for PFOS were outside the acceptance criteria on 1 set of duplicates. In addition one set of duplicates were outside the acceptance range for PFBS and PFHxA. All laboratories LCD were within acceptance criteria. Results outside of the 30% RPD were flagged ‘J’.

3.2 ACCURACY

The accuracy/bias goals were met by comparing percent recoveries of LCS, LCSD, MS, MSD, and surrogate compounds to accuracy goals identified in Worksheet # 28 of the QAPP (OTIE 2017a). The acceptance criteria were met with the few exceptions noted in the individual SDGs. The data were qualified based accordingly.

3.3 REPRESENTATIVENESS

The reviewing chemist determined that the data adequately represented the intended goals of the project. All samples were collected in accordance with the standard operating practices (SOPs) outlined in the QAPP (OTIE 2017a).

3.4 COMPLETENESS

Under this program 100% completeness was obtained.

Table 1 Cross-Referenced Field Sample Identifications and Laboratory Identifications

Field Identification	Laboratory Identification
Report B730538	
FT014-SB01-0-1	DXH435
FT014-SB01-15-16	DXH436
FT014-SB01-24-25	DXH437
FT014-SB02-0-1	DXH438
FT014-SB02-15-16	DXH439
FT014-SB02-24-25	DXH440
FT014-SB03-0-1	DXH441
FT014-SB03-0-1FD	DXH442
FT014-SB03-15-16	DXH443
FT014-SB03-24-25	DXH444

Table 1 Cross-Referenced Field Sample Identifications and Laboratory Identifications

Field Identification	Laboratory Identification
Report B731881	
FT013-SB01-0-1	DXN398
FT013-SB01-15-16	DXN399
FT013-SB01-15-16FD	DXN400
FT013-SB01-24-25	DXN401
FT013-SB02-0-1	DXN402
FT013-SB02-0-1MS	DXN402
FT013-SB02-15-16	DXN403
FT013-SB02-24-25	DXN404
FT013-SB03-0-1	DXN405
FT013-SB03-15-16	DXN406
FT013-SB03-24-25	DXN407
Report B731889	
STSA-SB01-0-1	DXN426
STSA-SB01-15-16	DXN427
STSA-SB01-15-16MS	DXN427
STSA-SB01-15-16SD	DXN427
STSA-SB01-24-25	DXN428
STSA-SB02-0-1	DXN429
STSA-SB02-0-1FD	DXN430
STSA-SB02-15-16	DXN431
STSA-SB02-24-25	DXN432
Report B732757	
AFA-SB01-0-1	DXR065
AFA-SB01-15-16	DXR066
AFA-SB01-24-25	DXR067
AFA-SB02-0-1	DXR068
AFA-SB02-15-16	DXR069
AFA-SB02-24-25	DXR061
AFA-SB03-0-1	DXR061
AFA-SB03-0-1FD	DXR062
AFA-SB03-15-16	DXR063
AFA-SB03-24-25	DXR064
Report B733153	
STSA-SB03-0-1	DXR080
STSA-SB03-15-16	DXR081
STSA-SB03-24-25	DXR082
Report B6734065	
FB1150217	DXW905
EB115022017	DXW906

Table 1 Cross-Referenced Field Sample Identifications and Laboratory Identifications

Field Identification	Laboratory Identification
EB215022017	DXW907
EB315022017	DXW908
Report B734076	
KAFB-0622	DXW949
KAFB-0622MS	DXW949
KAFB-0622MSD	DXW949
KAFB-7001	DXW950
KAFB-7001FD	DXW951
KAFB-106027	DXW952
KAFB-0417	DXW953

3.5 CONCLUSION

The reviewed soil, sediment, and groundwater results met the acceptance criteria and are deemed usable. Validated data were used to evaluate PFAS at the AFFF SI Areas.

Appendix E

Survey Report

SHIELDS SURVEY LTD. CO.
LAND SURVEYORS IN COLORADO, NEW MEXICO, TEXAS & OKLAHOMA

P.O. Box 639
619 South Second Street
Raton, New Mexico 87740
Phone: (575)445-1232
Fax: (575)445-3648

July 5, 2017

Oneida Total Integrated Enterprises
1033 North Mayfair Road, Suite 200
Milwaukee, WI 53226
Attn: Cecil Irby

Dear Mr. Irby~

This letter is regarding the survey completed by Shields Survey Ltd. Co. on February 16, 2017. The survey was completed and meets the standards set forth in the SOW for the project.

The attached list of survey points was collected on the said date then processed and adjusted. They were adjusted to the closest NGS point called Hangar (PID FO0354) and scaled to ground from said point with a Combined Scale Factor of 1.00034007277249. The list contains State Plane coordinates being New Mexico Central Zone, NAD83 projection, elevations are NAVD88 and U.S. Survey Feet. The points were shot at the actual hole location. In the description of the points is the point location name and number. If you have any questions, please don't hesitate to call or email.

I, Lee Shields, a Registered Professional Land Surveyor in the State of New Mexico certify that I conducted and am responsible for this survey. That this survey is true and correct to the best of my knowledge and belief.

Lee Shields

Lee Shields
Professional Land Surveyor
New Mexico Registration No. 5103

Thank you for choosing Shields Survey for your surveying needs. We appreciate your business!

PNT No	N NMC NAD83	E NMC NAD83	Elev NAVD88	DESC
1001	1473817.31	1536187.06	5321.3	AFA-SB03
1003	1473416.13	1535689.80	5320.0	AFA-SB01
1005	1473446.43	1536378.86	5321.0	AFA-SB02
1007	1457707.89	1562758.80	5556.4	FTO14-SB01
1009	1457553.51	1562428.40	5540.0	FTO14-SB03
1011	1457679.65	1562615.32	5552.3	FTO14-SB02
1013	1470705.28	1542709.46	5344.2	STSA-SB03
1015	1470717.87	1541048.45	5329.5	STSA-SB02
1017	1470740.77	1539443.53	5329.4	STSA-SB01
1019	1469639.65	1534637.80	5315.3	FTO13-SB01
1021	1469269.43	1534418.15	5316.5	FTO13-SB02
1023	1469202.56	1535171.01	5299.3	FTO13-SB03

Appendix F

Waste Documentation

OTIE
An Oneida Nation Company

DRUM INVENTORY RECORD

Project No. 2015341-06 Phase 06 Task 0604 Date: 2/13/17

	Site ID – Drum #	Label FTL[2]	Label Tech[3]	Date Generated[1]	Date Final Inspection	Content *	Volume	[4]Comments/Photo #/Location Stored Consolidated Location/Figure #
1	Drum 1		CR	02/13/17	02/16/17	water	100%	KAFB-0622/7001
2	Drum 2		AG	02/15/17	02/16/17	water	100%	KAFB-7001
3	Drum 3		AG	02/15/17	02/16/17	water	75%	KAFB-106027 / 0417
4	Drum 4		AG	02/15/17	02/16/17	water	100%	KAFB-106027
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

Page 1 of 1

* C=CONCRETE, G=GROUT, M=DRILLING MUD, PPE=EXPENDABLES/PPE, S=SOIL, T=TRASH, W=WATER O=OTHERS

[1] Waste Collection Start Date [2] Field Team Lead Initials [3] Technician Initials [4] Photograph Label on drum .

ANALYTICAL RESULTS

Prepared by:	Prepared for:
Eurofins Lancaster Laboratories Environmental 2425 New Holland Pike Lancaster, PA 17601	Oneida Total Integration Ent. 1033 N. Mayfair Road Suite 200 Milwaukee WI 53226-3442

Report Date: March 05, 2017

Project: 2015341-06-0604

Site:

Submittal Date: 02/18/2017
Group Number: 1767808
SDG: OTI35
PO Number: 10976
State of Sample Origin: NM

Client Sample Description	Lancaster Labs (LL) #
DRUM 1 Groundwater	8844834
DRUM 2 Groundwater	8844835

The specific methodologies used in obtaining the enclosed analytical results are indicated on the Laboratory Sample Analysis Record.

Regulatory agencies do not accredit laboratories for all methods, analytes, and matrices. Our current scopes of accreditation can be viewed at http://www.eurofinsus.com/environment-testing/laboratories/eurofins-lancaster-laboratories-environmental/resources/certifications/ . To request copies of prior scopes of accreditation, contact your project manager.

Electronic Copy To	Oneida Total Integration Ent.	Attn: Oscar Martinez

Respectfully Submitted,

Angela M. Miller

Angela M. Miller
Specialist

(717) 556-7260

Case Narrative

Project Name: 2015341-06-0604
LL Group #: 1767808

General Comments:

All analyses have been performed in accordance with DOD QSM Version 5.0 unless otherwise noted below.

See the Laboratory Sample Analysis Record section of the Analysis Report for the method references.

All QC met criteria unless otherwise noted in an Analysis Specific Comment below. Refer to the QC Summary for specific values and acceptance criteria.

Project specific QC samples are not included in this data set

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

Surrogate recoveries (if applicable) which are outside of the QC window are confirmed unless attributed to a dilution or otherwise noted in an Analysis Specific Comment below.

The samples were received at the appropriate temperature and in accordance with the chain of custody unless otherwise noted.

Analysis Specific Comments:

SW-846 6010B, Metals

Batch #: 170531848004 (Sample number(s): 8844834-8844835 UNSPK: 8844835 BKG: 8844835)

The recovery(ies) for the following analyte(s) in the LCS exceeded the acceptance window indicating a positive bias: Silver

SW-846 Chapter 7.3, Wet Chemistry

Sample #s: 8844834, 8844835

Reactivity:
This sample was extracted and analyzed by the interim method described in SW-846 Revision 3, December 1996 - Chapter 7.3. The Interim Guidance for Reactive Cyanide and Reactive Sulfide (SW-846 Sections 7.3.3 and 7.3.4 of Chapter 7 - December 1996) identifies a reactive material as generating more than 250 mg/kg of hydrogen cyanide or 500 mg/kg of hydrogen sulfide. This waste is not considered hazardous due to reactivity based on that standard. These results do not reflect total cyanide or total sulfide. On July 14, 2005, EPA published a rule in the Federal Register that removed the Interim Guidance and the method referenced above. At this time there is no specific guidance or a method to be used to evaluate "Reactivity".

Batch #: 17060112101A (Sample number(s): 8844834-8844835 UNSPK: P851149)

The recovery(ies) for the following analyte(s) in the MS and/or MSD was outside the acceptance window: Sulfide (Reactivity)

Batch #: 17061104201A (Sample number(s): 8844834-8844835 UNSPK: P851149)

The recovery(ies) for the following analyte(s) in the MS and/or MSD was outside the acceptance window: Cyanide (Reactivity)

ASTM D93- 07, Wet Chemistry

Sample #s: 8844835

No flash observed below 185F.
Test flame extinguished at 165F.
Flash point was determined using Pensky Martens closed cup apparatus.

Sample #s: 8844834

No flash observed below 187F.
Test flame extinguished at 167F.
Flash point was determined using Pensky Martens closed cup apparatus.

SW-846 Chapter 7, Wet Chemistry

Sample #s: 8844835

The pH of the sample is 7.65 indicating that the sample is not corrosive. A sample is corrosive if it exhibits a pH equal to or less than 2 or equal to or greater than 12.5.

Sample #s: 8844834

The pH of the sample is 7.96 indicating that the sample is not corrosive. A sample is corrosive if it exhibits a pH equal to or less than 2 or equal to or greater than 12.5.

SW-846 Chapter 7.3, Wet Chemistry

Sample #s: 8844834, 8844835

Reactivity:
This sample was extracted and analyzed by the interim method described in SW-846 Revision 3, December 1996 - Chapter 7.3. The Interim Guidance for Reactive Cyanide and Reactive Sulfide (SW-846 Sections 7.3.3 and 7.3.4 of Chapter 7 - December 1996) identifies a reactive material as generating more than 250 mg/kg of hydrogen cyanide or 500 mg/kg of hydrogen sulfide. This waste is not considered hazardous due to reactivity based on that standard. These results do not reflect total cyanide or total sulfide. On July 14, 2005, EPA published a rule in the Federal Register that removed the Interim Guidance and the method referenced above. At this time there is no specific guidance or a method to be used to evaluate "Reactivity".

Batch #: 17060112101A (Sample number(s): 8844834-8844835 UNSPK: P851149)

The recovery(ies) for the following analyte(s) in the MS and/or MSD was outside the acceptance window: Sulfide (Reactivity)

Batch #: 17061104201A (Sample number(s): 8844834-8844835 UNSPK: P851149)

The recovery(ies) for the following analyte(s) in the MS and/or MSD was outside the acceptance window: Cyanide (Reactivity)

Sample Description: DRUM 1 Groundwater
2015341-06-0604

LL Sample # WW 8844834
LL Group # 1767808
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 11:45 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60401 SDG#: OTI35-01

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
GC/MS	**Volatiles SW-846 8260B**		ug/l	ug/l	ug/l	ug/l	
10335	Acetone	67-64-1	N.D.	6	20	20	1
10335	Benzene	71-43-2	N.D.	0.5	1	1	1
10335	Bromodichloromethane	75-27-4	N.D.	0.5	1	1	1
10335	Bromoform	75-25-2	N.D.	0.5	1	4	1
10335	Bromomethane	74-83-9	N.D.	0.5	1	1	1
10335	2-Butanone	78-93-3	N.D.	3	8	10	1
10335	Carbon Disulfide	75-15-0	N.D.	1	2	5	1
10335	Carbon Tetrachloride	56-23-5	N.D.	0.5	1	1	1
10335	Chlorobenzene	108-90-7	N.D.	0.5	1	1	1
10335	Chloroethane	75-00-3	N.D.	0.5	1	1	1
10335	Chloroform	67-66-3	N.D.	0.5	1	1	1
10335	Chloromethane	74-87-3	N.D.	0.5	1	1	1
10335	Cyclohexane	110-82-7	N.D.	2	4	5	1
10335	1,2-Dibromo-3-chloropropane	96-12-8	N.D.	2	4	5	1
10335	Dibromochloromethane	124-48-1	N.D.	0.5	1	1	1
10335	1,2-Dibromoethane	106-93-4	N.D.	0.5	1	1	1
10335	1,2-Dichlorobenzene	95-50-1	N.D.	1	2	5	1
10335	1,3-Dichlorobenzene	541-73-1	N.D.	1	2	5	1
10335	1,4-Dichlorobenzene	106-46-7	N.D.	1	2	5	1
10335	Dichlorodifluoromethane	75-71-8	N.D.	0.5	1	1	1
10335	1,1-Dichloroethane	75-34-3	N.D.	0.5	1	1	1
10335	1,2-Dichloroethane	107-06-2	N.D.	0.5	1	1	1
10335	1,1-Dichloroethene	75-35-4	N.D.	0.5	1	1	1
10335	cis-1,2-Dichloroethene	156-59-2	N.D.	0.5	1	1	1
10335	trans-1,2-Dichloroethene	156-60-5	N.D.	0.5	1	1	1
10335	1,2-Dichloropropane	78-87-5	N.D.	0.5	1	1	1
10335	cis-1,3-Dichloropropene	10061-01-5	N.D.	0.5	1	1	1
10335	trans-1,3-Dichloropropene	10061-02-6	N.D.	0.5	1	1	1
10335	Ethylbenzene	100-41-4	3	0.5	1	1	1
10335	Freon 113	76-13-1	N.D.	2	4	10	1
10335	2-Hexanone	591-78-6	N.D.	3	8	10	1
10335	Isopropylbenzene	98-82-8	N.D.	1	2	5	1
10335	Methyl Acetate	79-20-9	N.D.	1	2	5	1
10335	Methyl Tertiary Butyl Ether	1634-04-4	N.D.	0.5	1	1	1
10335	4-Methyl-2-pentanone	108-10-1	N.D.	3	8	10	1
10335	Methylcyclohexane	108-87-2	N.D.	1	2	5	1
10335	Methylene Chloride	75-09-2	N.D.	2	4	4	1
10335	Styrene	100-42-5	N.D.	1	2	5	1
10335	1,1,2,2-Tetrachloroethane	79-34-5	N.D.	0.5	1	1	1
10335	Tetrachloroethene	127-18-4	N.D.	0.5	1	1	1
10335	Toluene	108-88-3	N.D.	0.5	1	1	1
10335	1,2,4-Trichlorobenzene	120-82-1	N.D.	1	2	5	1
10335	1,1,1-Trichloroethane	71-55-6	N.D.	0.5	1	1	1
10335	1,1,2-Trichloroethane	79-00-5	N.D.	0.5	1	1	1
10335	Trichloroethene	79-01-6	N.D.	0.5	1	1	1
10335	Trichlorofluoromethane	75-69-4	N.D.	0.5	1	1	1
10335	Vinyl Chloride	75-01-4	N.D.	0.5	1	1	1
10335	Xylene (Total)	1330-20-7	17	0.5	1	1	1

*=This limit was used in the evaluation of the final result

Sample Description: DRUM 1 Groundwater
2015341-06-0604

LL Sample # WW 8844834
LL Group # 1767808
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 11:45 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60401 SDG#: OTI35-01

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
GC/MS	**Semivolatiles SW-846 8270C**		ug/l	ug/l	ug/l	ug/l	
14240	Acenaphthene	83-32-9	N.D.	0.1	0.4	0.5	1
14240	Acenaphthylene	208-96-8	N.D.	0.1	0.4	0.5	1
14240	Acetophenone	98-86-2	N.D.	0.5	1	1	1
14240	Anthracene	120-12-7	N.D.	0.1	0.4	0.5	1
14240	Atrazine	1912-24-9	N.D.	2	4	5	1
14240	Benzaldehyde	100-52-7	N.D.	1	4	5	1
14240	Benzo(a)anthracene	56-55-3	N.D.	0.1	0.4	0.5	1
14240	Benzo(a)pyrene	50-32-8	N.D.	0.1	0.4	0.5	1
14240	Benzo(b)fluoranthene	205-99-2	N.D.	0.1	0.4	0.5	1
14240	Benzo(g,h,i)perylene	191-24-2	N.D.	0.1	0.4	0.5	1
14240	Benzo(k)fluoranthene	207-08-9	N.D.	0.1	0.4	0.5	1
14240	1,1'-Biphenyl	92-52-4	N.D.	0.5	1	1	1
14240	4-Bromophenyl-phenylether	101-55-3	N.D.	0.5	1	1	1
14240	Butylbenzylphthalate	85-68-7	N.D.	2	4	5	1
14240	Di-n-butylphthalate	84-74-2	N.D.	2	4	5	1
14240	Caprolactam	105-60-2	N.D.	5	15	15	1
14240	Carbazole	86-74-8	N.D.	0.5	1	1	1
14240	4-Chloro-3-methylphenol	59-50-7	N.D.	0.5	1	1	1
14240	4-Chloroaniline	106-47-8	N.D.	0.5	1	1	1
14240	bis(2-Chloroethoxy)methane	111-91-1	N.D.	0.5	1	1	1
14240	bis(2-Chloroethyl)ether	111-44-4	N.D.	0.5	1	1	1
14240	2-Chloronaphthalene	91-58-7	N.D.	0.4	1	1	1
14240	2-Chlorophenol	95-57-8	N.D.	0.5	1	1	1
14240	4-Chlorophenyl-phenylether	7005-72-3	N.D.	0.5	1	1	1
14240	2,2'-oxybis(1-Chloropropane)	108-60-1	N.D.	0.5	1	1	1

Bis(2-chloroisopropyl) ether CAS #39638-32-9 and 2,2'-Oxybis(1-chloropropane) CAS #108-60-1 cannot be separated chromatographically. The reported result represents the combined total of both compounds.

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
14240	Chrysene	218-01-9	N.D.	0.1	0.4	0.5	1
14240	Dibenz(a,h)anthracene	53-70-3	N.D.	0.1	0.4	0.5	1
14240	Dibenzofuran	132-64-9	N.D.	0.5	1	1	1
14240	3,3'-Dichlorobenzidine	91-94-1	N.D.	2	4	5	1
14240	2,4-Dichlorophenol	120-83-2	N.D.	0.5	1	1	1
14240	Diethylphthalate	84-66-2	N.D.	2	4	5	1
14240	2,4-Dimethylphenol	105-67-9	N.D.	0.5	1	1	1
14240	Dimethylphthalate	131-11-3	N.D.	2	4	5	1
14240	4,6-Dinitro-2-methylphenol	534-52-1	N.D.	5	15	15	1
14240	2,4-Dinitrophenol	51-28-5	N.D.	10	30	30	1
14240	2,4-Dinitrotoluene	121-14-2	N.D.	1	4	5	1
14240	2,6-Dinitrotoluene	606-20-2	N.D.	0.5	1	1	1
14240	bis(2-Ethylhexyl)phthalate	117-81-7	N.D.	2	4	5	1
14240	Fluoranthene	206-44-0	N.D.	0.1	0.4	0.5	1
14240	Fluorene	86-73-7	N.D.	0.1	0.4	0.5	1
14240	Hexachlorobenzene	118-74-1	N.D.	0.1	0.4	0.5	1
14240	Hexachlorobutadiene	87-68-3	N.D.	0.5	1	1	1
14240	Hexachlorocyclopentadiene	77-47-4	N.D.	5	15	15	1
14240	Hexachloroethane	67-72-1	N.D.	1	4	5	1
14240	Indeno(1,2,3-cd)pyrene	193-39-5	N.D.	0.1	0.4	0.5	1

*=This limit was used in the evaluation of the final result

Sample Description: DRUM 1 Groundwater
2015341-06-0604

LL Sample # WW 8844834
LL Group # 1767808
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 11:45 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60401 SDG#: OTI35-01

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
GC/MS	**Semivolatiles SW-846 8270C**		ug/l	ug/l	ug/l	ug/l	
14240	Isophorone	78-59-1	N.D.	0.5	1	1	1
14240	2-Methylnaphthalene	91-57-6	N.D.	0.1	0.4	0.5	1
14240	2-Methylphenol	95-48-7	N.D.	0.5	1	1	1
14240	4-Methylphenol	106-44-5	N.D.	0.5	1	1	1
	3-Methylphenol and 4-methylphenol cannot be resolved under the chromatographic conditions used for sample analysis. The result reported for 4-methylphenol represents the combined total of both compounds.						
14240	Naphthalene	91-20-3	N.D.	0.1	0.4	0.5	1
14240	2-Nitroaniline	88-74-4	N.D.	0.5	1	1	1
14240	3-Nitroaniline	99-09-2	N.D.	0.5	1	1	1
14240	4-Nitroaniline	100-01-6	N.D.	0.5	1	1	1
14240	Nitrobenzene	98-95-3	N.D.	0.5	1	1	1
14240	2-Nitrophenol	88-75-5	N.D.	0.5	1	1	1
14240	4-Nitrophenol	100-02-7	N.D.	10	30	30	1
14240	N-Nitroso-di-n-propylamine	621-64-7	N.D.	0.5	1	1	1
14240	N-Nitrosodiphenylamine	86-30-6	N.D.	0.5	1	1	1
	N-nitrosodiphenylamine decomposes in the GC inlet forming diphenylamine. The result reported for N-nitrosodiphenylamine represents the combined total of both compounds.						
14240	Di-n-octylphthalate	117-84-0	N.D.	2	4	5	1
14240	Pentachlorophenol	87-86-5	N.D.	1	4	5	1
14240	Phenanthrene	85-01-8	N.D.	0.1	0.4	0.5	1
14240	Phenol	108-95-2	N.D.	0.5	1	1	1
14240	Pyrene	129-00-0	N.D.	0.1	0.4	0.5	1
14240	2,4,5-Trichlorophenol	95-95-4	N.D.	0.5	1	1	1
14240	2,4,6-Trichlorophenol	88-06-2	N.D.	0.5	1	1	1
Metals		**SW-846 6010B**	mg/l	mg/l	mg/l	mg/l	
07035	Arsenic	7440-38-2	N.D.	0.0097	0.0200	0.0200	1
07046	Barium	7440-39-3	0.103	0.0011	0.0025	0.0050	1
07049	Cadmium	7440-43-9	N.D.	0.00049	0.0013	0.0050	1
07051	Chromium	7440-47-3	N.D.	0.0018	0.0038	0.0150	1
07055	Lead	7439-92-1	N.D.	0.0062	0.0150	0.0150	1
07036	Selenium	7782-49-2	N.D.	0.0097	0.0200	0.0200	1
07066	Silver	7440-22-4	N.D.	0.0019	0.0050	0.0050	1
		SW-846 7470A	mg/l	mg/l	mg/l	mg/l	
00259	Mercury	7439-97-6	N.D.	0.000050	0.00010	0.00020	1
Wet Chemistry		**SW-846 Chapter 7.3**	mg/kg	mg/kg	mg/kg	mg/kg	
01123	Cyanide (Reactivity)	n.a.	N.D.	19.2	57.5	57.5	1
		ASTM D93- 07	Degrees F	Degrees F	Degrees F	Degrees F	
00430	Flash Point	n.a.	No Flash Observed	50	50	50	1
	No flash observed below 187F. Test flame extinguished at 167F. Flash point was determined using Pensky Martens closed cup apparatus.						

*=This limit was used in the evaluation of the final result

Sample Description: **DRUM 1 Groundwater**
2015341-06-0604

LL Sample # WW 8844834
LL Group # 1767808
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 11:45 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60401 SDG#: OTI35-01

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
Wet Chemistry	**EPA 170.1**		**Degrees C**	**Degrees C**	**Degrees C**	**Degrees C**	
12151	Temperature of pH	n.a.	20.1	0.010	0.010	0.010	1
	SM 4500-H+ B-2000		**Std. Units**	**Std. Units**	**Std. Units**	**Std. Units**	
12152	pH	n.a.	8.0	0.010	0.010	0.010	1
	SW-846 Chapter 7						
00496	Corrosivity	n.a.	See Below	0	0	0	1
	The pH of the sample is 7.96 indicating that the sample is not corrosive. A sample is corrosive if it exhibits a pH equal to or less than 2 or equal to or greater than 12.5.						
	SW-846 Chapter 7.3		**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	
01122	Sulfide (Reactivity)	n.a.	N.D.	53.6	150	160	1
	SW-846 Chapter 7.3		**see below**	**see below**	**see below**	**see below**	
01121	Reactivity	n.a.	See Below	0	0	0	1
	Reactivity: This sample was extracted and analyzed by the interim method described in SW-846 Revision 3, December 1996 - Chapter 7.3. The Interim Guidance for Reactive Cyanide and Reactive Sulfide (SW-846 Sections 7.3.3 and 7.3.4 of Chapter 7 - December 1996) identifies a reactive material as generating more than 250 mg/kg of hydrogen cyanide or 500 mg/kg of hydrogen sulfide. This waste is not considered hazardous due to reactivity based on that standard. These results do not reflect total cyanide or total sulfide. On July 14, 2005, EPA published a rule in the Federal Register that removed the Interim Guidance and the method referenced above. At this time there is no specific guidance or a method to be used to evaluate "Reactivity".						

Sample Comments

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10335	TCL VOCs 4.3 8260B	SW-846 8260B	1	Y170581AA	02/27/2017 15:53	Matthew S Krause	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	Y170581AA	02/27/2017 15:53	Matthew S Krause	1
14240	TCL SVOCs 8270C	SW-846 8270C	1	17054WAD026	02/24/2017 12:07	Holly B Ziegler	1
00813	BNA Water Extraction	SW-846 3510C	1	17054WAD026	02/23/2017 17:00	Kate E Lutte	1
07035	Arsenic	SW-846 6010B	1	170531848004	02/24/2017 15:50	Suzanne M Will	1
07046	Barium	SW-846 6010B	1	170531848004	02/24/2017 15:50	Suzanne M Will	1
07049	Cadmium	SW-846 6010B	1	170531848004	02/24/2017 15:50	Suzanne M Will	1
07051	Chromium	SW-846 6010B	1	170531848004	02/24/2017 15:50	Suzanne M Will	1
07055	Lead	SW-846 6010B	1	170531848004	02/24/2017 15:50	Suzanne M Will	1
07036	Selenium	SW-846 6010B	1	170531848004	02/28/2017 11:29	Eric L Eby	1

*=This limit was used in the evaluation of the final result

Sample Description: DRUM 1 Groundwater
2015341-06-0604

LL Sample # WW 8844834
LL Group # 1767808
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 11:45 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60401 SDG#: OTI35-01

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
07066	Silver	SW-846 6010B	1	170531848004	02/24/2017 15:50	Suzanne M Will	1
00259	Mercury	SW-846 7470A	1	170535713005	02/24/2017 11:25	Damary Valentin	1
01848	ICP-WW, 3005A (tot rec) - U3	SW-846 3005A	1	170531848004	02/24/2017 08:05	Denise L Trimby	1
05713	WW SW846 Hg Digest	SW-846 7470A	1	170535713005	02/24/2017 08:15	Denise L Trimby	1
01123	Cyanide (Reactivity)	SW-846 Chapter 7.3	1	17061104201A	03/02/2017 07:01	Dein K Bernot	1
00430	Flash Point	ASTM D93- 07	1	17058043001A	02/27/2017 14:20	Susan A Engle	1
12151	Temperature of pH	EPA 170.1	1	17056121521A	02/25/2017 12:20	Luz M Groff	1
12152	pH	SM 4500-H+ B-2000	1	17056121521A	02/25/2017 12:20	Luz M Groff	1
00496	Corrosivity	SW-846 Chapter 7	1	17056121521A	02/25/2017 12:20	Luz M Groff	1
01121	Reactivity	SW-846 Chapter 7.3	1	17060112101A	03/01/2017 08:20	Susan E Hibner	1
01122	Sulfide (Reactivity)	SW-846 Chapter 7.3	1	17060112101A	03/01/2017 08:20	Susan E Hibner	1

*=This limit was used in the evaluation of the final result

Sample Description: DRUM 2 Groundwater
2015341-06-0604

LL Sample # WW 8844835
LL Group # 1767808
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 12:05 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60402 SDG#: OTI35-02

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
GC/MS	**Volatiles**	**SW-846 8260B**	ug/l	ug/l	ug/l	ug/l	
10335	Acetone	67-64-1	N.D.	6	20	20	1
10335	Benzene	71-43-2	N.D.	0.5	1	1	1
10335	Bromodichloromethane	75-27-4	N.D.	0.5	1	1	1
10335	Bromoform	75-25-2	N.D.	0.5	1	4	1
10335	Bromomethane	74-83-9	N.D.	0.5	1	1	1
10335	2-Butanone	78-93-3	N.D.	3	8	10	1
10335	Carbon Disulfide	75-15-0	N.D.	1	2	5	1
10335	Carbon Tetrachloride	56-23-5	N.D.	0.5	1	1	1
10335	Chlorobenzene	108-90-7	N.D.	0.5	1	1	1
10335	Chloroethane	75-00-3	N.D.	0.5	1	1	1
10335	Chloroform	67-66-3	0.7 J	0.5	1	1	1
10335	Chloromethane	74-87-3	N.D.	0.5	1	1	1
10335	Cyclohexane	110-82-7	N.D.	2	4	5	1
10335	1,2-Dibromo-3-chloropropane	96-12-8	N.D.	2	4	5	1
10335	Dibromochloromethane	124-48-1	N.D.	0.5	1	1	1
10335	1,2-Dibromoethane	106-93-4	N.D.	0.5	1	1	1
10335	1,2-Dichlorobenzene	95-50-1	N.D.	1	2	5	1
10335	1,3-Dichlorobenzene	541-73-1	N.D.	1	2	5	1
10335	1,4-Dichlorobenzene	106-46-7	N.D.	1	2	5	1
10335	Dichlorodifluoromethane	75-71-8	N.D.	0.5	1	1	1
10335	1,1-Dichloroethane	75-34-3	N.D.	0.5	1	1	1
10335	1,2-Dichloroethane	107-06-2	N.D.	0.5	1	1	1
10335	1,1-Dichloroethene	75-35-4	N.D.	0.5	1	1	1
10335	cis-1,2-Dichloroethene	156-59-2	N.D.	0.5	1	1	1
10335	trans-1,2-Dichloroethene	156-60-5	N.D.	0.5	1	1	1
10335	1,2-Dichloropropane	78-87-5	N.D.	0.5	1	1	1
10335	cis-1,3-Dichloropropene	10061-01-5	N.D.	0.5	1	1	1
10335	trans-1,3-Dichloropropene	10061-02-6	N.D.	0.5	1	1	1
10335	Ethylbenzene	100-41-4	2	0.5	1	1	1
10335	Freon 113	76-13-1	N.D.	2	4	10	1
10335	2-Hexanone	591-78-6	N.D.	3	8	10	1
10335	Isopropylbenzene	98-82-8	N.D.	1	2	5	1
10335	Methyl Acetate	79-20-9	N.D.	1	2	5	1
10335	Methyl Tertiary Butyl Ether	1634-04-4	N.D.	0.5	1	1	1
10335	4-Methyl-2-pentanone	108-10-1	N.D.	3	8	10	1
10335	Methylcyclohexane	108-87-2	N.D.	1	2	5	1
10335	Methylene Chloride	75-09-2	N.D.	2	4	4	1
10335	Styrene	100-42-5	N.D.	1	2	5	1
10335	1,1,2,2-Tetrachloroethane	79-34-5	N.D.	0.5	1	1	1
10335	Tetrachloroethene	127-18-4	N.D.	0.5	1	1	1
10335	Toluene	108-88-3	N.D.	0.5	1	1	1
10335	1,2,4-Trichlorobenzene	120-82-1	N.D.	1	2	5	1
10335	1,1,1-Trichloroethane	71-55-6	N.D.	0.5	1	1	1
10335	1,1,2-Trichloroethane	79-00-5	N.D.	0.5	1	1	1
10335	Trichloroethene	79-01-6	N.D.	0.5	1	1	1
10335	Trichlorofluoromethane	75-69-4	N.D.	0.5	1	1	1
10335	Vinyl Chloride	75-01-4	N.D.	0.5	1	1	1
10335	Xylene (Total)	1330-20-7	7	0.5	1	1	1

*=This limit was used in the evaluation of the final result

Sample Description: DRUM 2 Groundwater
2015341-06-0604

LL Sample # WW 8844835
LL Group # 1767808
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 12:05 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60402 SDG#: OTI35-02

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
GC/MS	**Semivolatiles SW-846 8270C**		ug/l	ug/l	ug/l	ug/l	
14240	Acenaphthene	83-32-9	N.D.	0.1	0.4	0.5	1
14240	Acenaphthylene	208-96-8	N.D.	0.1	0.4	0.5	1
14240	Acetophenone	98-86-2	N.D.	0.5	1	1	1
14240	Anthracene	120-12-7	N.D.	0.1	0.4	0.5	1
14240	Atrazine	1912-24-9	N.D.	2	4	5	1
14240	Benzaldehyde	100-52-7	N.D.	1	4	5	1
14240	Benzo(a)anthracene	56-55-3	N.D.	0.1	0.4	0.5	1
14240	Benzo(a)pyrene	50-32-8	N.D.	0.1	0.4	0.5	1
14240	Benzo(b)fluoranthene	205-99-2	N.D.	0.1	0.4	0.5	1
14240	Benzo(g,h,i)perylene	191-24-2	N.D.	0.1	0.4	0.5	1
14240	Benzo(k)fluoranthene	207-08-9	N.D.	0.1	0.4	0.5	1
14240	1,1'-Biphenyl	92-52-4	N.D.	0.5	1	1	1
14240	4-Bromophenyl-phenylether	101-55-3	N.D.	0.5	1	1	1
14240	Butylbenzylphthalate	85-68-7	N.D.	2	4	5	1
14240	Di-n-butylphthalate	84-74-2	N.D.	2	4	5	1
14240	Caprolactam	105-60-2	N.D.	5	15	15	1
14240	Carbazole	86-74-8	N.D.	0.5	1	1	1
14240	4-Chloro-3-methylphenol	59-50-7	N.D.	0.5	1	1	1
14240	4-Chloroaniline	106-47-8	N.D.	0.5	1	1	1
14240	bis(2-Chloroethoxy)methane	111-91-1	N.D.	0.5	1	1	1
14240	bis(2-Chloroethyl)ether	111-44-4	N.D.	0.5	1	1	1
14240	2-Chloronaphthalene	91-58-7	N.D.	0.4	1	1	1
14240	2-Chlorophenol	95-57-8	N.D.	0.5	1	1	1
14240	4-Chlorophenyl-phenylether	7005-72-3	N.D.	0.5	1	1	1
14240	2,2'-oxybis(1-Chloropropane)	108-60-1	N.D.	0.5	1	1	1

Bis(2-chloroisopropyl) ether CAS #39638-32-9 and 2,2'-Oxybis(1-chloropropane) CAS #108-60-1 cannot be separated chromatographically. The reported result represents the combined total of both compounds.

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
14240	Chrysene	218-01-9	N.D.	0.1	0.4	0.5	1
14240	Dibenz(a,h)anthracene	53-70-3	N.D.	0.1	0.4	0.5	1
14240	Dibenzofuran	132-64-9	N.D.	0.5	1	1	1
14240	3,3'-Dichlorobenzidine	91-94-1	N.D.	2	4	5	1
14240	2,4-Dichlorophenol	120-83-2	N.D.	0.5	1	1	1
14240	Diethylphthalate	84-66-2	N.D.	2	4	5	1
14240	2,4-Dimethylphenol	105-67-9	N.D.	0.5	1	1	1
14240	Dimethylphthalate	131-11-3	N.D.	2	4	5	1
14240	4,6-Dinitro-2-methylphenol	534-52-1	N.D.	5	15	15	1
14240	2,4-Dinitrophenol	51-28-5	N.D.	10	30	30	1
14240	2,4-Dinitrotoluene	121-14-2	N.D.	1	4	5	1
14240	2,6-Dinitrotoluene	606-20-2	N.D.	0.5	1	1	1
14240	bis(2-Ethylhexyl)phthalate	117-81-7	N.D.	2	4	5	1
14240	Fluoranthene	206-44-0	N.D.	0.1	0.4	0.5	1
14240	Fluorene	86-73-7	N.D.	0.1	0.4	0.5	1
14240	Hexachlorobenzene	118-74-1	N.D.	0.1	0.4	0.5	1
14240	Hexachlorobutadiene	87-68-3	N.D.	0.5	1	1	1
14240	Hexachlorocyclopentadiene	77-47-4	N.D.	5	15	15	1
14240	Hexachloroethane	67-72-1	N.D.	1	4	5	1
14240	Indeno(1,2,3-cd)pyrene	193-39-5	N.D.	0.1	0.4	0.5	1

*=This limit was used in the evaluation of the final result

Sample Description: DRUM 2 Groundwater
2015341-06-0604

LL Sample # WW 8844835
LL Group # 1767808
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 12:05 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60402 SDG#: OTI35-02

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
GC/MS Semivolatiles		**SW-846 8270C**	**ug/l**	**ug/l**	**ug/l**	**ug/l**	
14240	Isophorone	78-59-1	N.D.	0.5	1	1	1
14240	2-Methylnaphthalene	91-57-6	N.D.	0.1	0.4	0.5	1
14240	2-Methylphenol	95-48-7	N.D.	0.5	1	1	1
14240	4-Methylphenol	106-44-5	N.D.	0.5	1	1	1
	3-Methylphenol and 4-methylphenol cannot be resolved under the chromatographic conditions used for sample analysis. The result reported for 4-methylphenol represents the combined total of both compounds.						
14240	Naphthalene	91-20-3	N.D.	0.1	0.4	0.5	1
14240	2-Nitroaniline	88-74-4	N.D.	0.5	1	1	1
14240	3-Nitroaniline	99-09-2	N.D.	0.5	1	1	1
14240	4-Nitroaniline	100-01-6	N.D.	0.5	1	1	1
14240	Nitrobenzene	98-95-3	N.D.	0.5	1	1	1
14240	2-Nitrophenol	88-75-5	N.D.	0.5	1	1	1
14240	4-Nitrophenol	100-02-7	N.D.	10	30	30	1
14240	N-Nitroso-di-n-propylamine	621-64-7	N.D.	0.5	1	1	1
14240	N-Nitrosodiphenylamine	86-30-6	N.D.	0.5	1	1	1
	N-nitrosodiphenylamine decomposes in the GC inlet forming diphenylamine. The result reported for N-nitrosodiphenylamine represents the combined total of both compounds.						
14240	Di-n-octylphthalate	117-84-0	N.D.	2	4	5	1
14240	Pentachlorophenol	87-86-5	N.D.	1	4	5	1
14240	Phenanthrene	85-01-8	N.D.	0.1	0.4	0.5	1
14240	Phenol	108-95-2	N.D.	0.5	1	1	1
14240	Pyrene	129-00-0	N.D.	0.1	0.4	0.5	1
14240	2,4,5-Trichlorophenol	95-95-4	N.D.	0.5	1	1	1
14240	2,4,6-Trichlorophenol	88-06-2	N.D.	0.5	1	1	1
Metals		**SW-846 6010B**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	
07035	Arsenic	7440-38-2	N.D.	0.0097	0.0200	0.0200	1
07046	Barium	7440-39-3	0.208	0.0011	0.0025	0.0050	1
07049	Cadmium	7440-43-9	N.D.	0.00049	0.0013	0.0050	1
07051	Chromium	7440-47-3	0.0030 J	0.0018	0.0038	0.0150	1
07055	Lead	7439-92-1	N.D.	0.0062	0.0150	0.0150	1
07036	Selenium	7782-49-2	N.D.	0.0097	0.0200	0.0200	1
07066	Silver	7440-22-4	N.D.	0.0019	0.0050	0.0050	1
		SW-846 7470A	**mg/l**	**mg/l**	**mg/l**	**mg/l**	
00259	Mercury	7439-97-6	N.D.	0.000050	0.00010	0.00020	1
Wet Chemistry		**SW-846 Chapter 7.3**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	
01123	Cyanide (Reactivity)	n.a.	N.D.	19.4	58.1	58.1	1
		ASTM D93- 07	**Degrees F**	**Degrees F**	**Degrees F**	**Degrees F**	
00430	Flash Point	n.a.	No Flash Observed	50	50	50	1
	No flash observed below 185F. Test flame extinguished at 165F. Flash point was determined using Pensky Martens closed cup apparatus.						

*=This limit was used in the evaluation of the final result

**Sample Description: DRUM 2 Groundwater
2015341-06-0604**

**LL Sample # WW 8844835
LL Group # 1767808
Account # 37016**

Project Name: 2015341-06-0604

Collected: 02/17/2017 12:05 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60402 SDG#: OTI35-02

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
Wet Chemistry	**EPA 170.1**		**Degrees C**	**Degrees C**	**Degrees C**	**Degrees C**	
12151	Temperature of pH	n.a.	20.0	0.010	0.010	0.010	1
	SM 4500-H+ B-2000		**Std. Units**	**Std. Units**	**Std. Units**	**Std. Units**	
12152	pH	n.a.	7.7	0.010	0.010	0.010	1
	SW-846 Chapter 7						
00496	Corrosivity	n.a.	See Below	0	0	0	1

The pH of the sample is 7.65 indicating that the sample is not corrosive. A sample is corrosive if it exhibits a pH equal to or less than 2 or equal to or greater than 12.5.

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
	SW-846 Chapter 7.3		**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	
01122	Sulfide (Reactivity)	n.a.	N.D.	53.6	150	160	1
	SW-846 Chapter 7.3		**see below**	**see below**	**see below**	**see below**	
01121	Reactivity	n.a.	See Below	0	0	0	1

Reactivity:
This sample was extracted and analyzed by the interim method described in SW-846 Revision 3, December 1996 - Chapter 7.3. The Interim Guidance for Reactive Cyanide and Reactive Sulfide (SW-846 Sections 7.3.3 and 7.3.4 of Chapter 7 - December 1996) identifies a reactive material as generating more than 250 mg/kg of hydrogen cyanide or 500 mg/kg of hydrogen sulfide. This waste is not considered hazardous due to reactivity based on that standard. These results do not reflect total cyanide or total sulfide. On July 14, 2005, EPA published a rule in the Federal Register that removed the Interim Guidance and the method referenced above. At this time there is no specific guidance or a method to be used to evaluate "Reactivity".

Sample Comments

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10335	TCL VOCs 4.3 8260B	SW-846 8260B	1	Y170581AA	02/27/2017 13:19	Brett W Kenyon	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	Y170581AA	02/27/2017 13:19	Brett W Kenyon	1
14240	TCL SVOCs 8270C	SW-846 8270C	1	17054WAD026	02/24/2017 12:37	Holly B Ziegler	1
00813	BNA Water Extraction	SW-846 3510C	1	17054WAD026	02/23/2017 17:00	Kate E Lutte	1
07035	Arsenic	SW-846 6010B	1	170531848004	02/24/2017 15:32	Suzanne M Will	1
07046	Barium	SW-846 6010B	1	170531848004	02/24/2017 15:32	Suzanne M Will	1
07049	Cadmium	SW-846 6010B	1	170531848004	02/24/2017 15:32	Suzanne M Will	1
07051	Chromium	SW-846 6010B	1	170531848004	02/24/2017 15:32	Suzanne M Will	1
07055	Lead	SW-846 6010B	1	170531848004	02/24/2017 15:32	Suzanne M Will	1
07036	Selenium	SW-846 6010B	1	170531848004	02/24/2017 15:32	Suzanne M Will	1

*=This limit was used in the evaluation of the final result

Sample Description: **DRUM 2 Groundwater**
2015341-06-0604

LL Sample # WW 8844835
LL Group # 1767808
Account # 37016

Project Name: **2015341-06-0604**

Collected: 02/17/2017 12:05 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60402 SDG#: OTI35-02

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
07066	Silver	SW-846 6010B	1	170531848004	02/24/2017 15:32	Suzanne M Will	1
00259	Mercury	SW-846 7470A	1	170535713005	02/24/2017 11:33	Damary Valentin	1
01848	ICP-WW, 3005A (tot rec) - U3	SW-846 3005A	1	170531848004	02/24/2017 08:05	Denise L Trimby	1
05713	WW SW846 Hg Digest	SW-846 7470A	1	170535713005	02/24/2017 08:15	Denise L Trimby	1
01123	Cyanide (Reactivity)	SW-846 Chapter 7.3	1	17061104201A	03/02/2017 07:02	Dein K Bernot	1
00430	Flash Point	ASTM D93- 07	1	17058043001A	02/27/2017 14:20	Susan A Engle	1
12151	Temperature of pH	EPA 170.1	1	17056121521A	02/25/2017 12:20	Luz M Groff	1
12152	pH	SM 4500-H+ B-2000	1	17056121521A	02/25/2017 12:20	Luz M Groff	1
00496	Corrosivity	SW-846 Chapter 7	1	17056121521A	02/25/2017 12:20	Luz M Groff	1
01121	Reactivity	SW-846 Chapter 7.3	1	17060112101A	03/01/2017 08:20	Susan E Hibner	1
01122	Sulfide (Reactivity)	SW-846 Chapter 7.3	1	17060112101A	03/01/2017 08:20	Susan E Hibner	1

Quality Control Summary

Client Name: Oneida Total Integration Ent.
Group Number: 1767808
Reported: 03/05/2017 12:22

Matrix QC may not be reported if insufficient sample or site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

All Inorganic Initial Calibration and Continuing Calibration Blanks met acceptable method criteria unless otherwise noted on the Analysis Report.

Method Blank

Analysis Name	**Result** **ug/l**	**DL**** **ug/l**	**LOD** **ug/l**	**LOQ** **ug/l**
Batch number: Y170581AA	Sample number(s): 8844834-8844835			
Acetone	N.D.	6	20	20
Benzene	N.D.	0.5	1	1
Bromodichloromethane	N.D.	0.5	1	1
Bromoform	N.D.	0.5	1	4
Bromomethane	N.D.	0.5	1	1
2-Butanone	N.D.	3	8	10
Carbon Disulfide	N.D.	1	2	5
Carbon Tetrachloride	N.D.	0.5	1	1
Chlorobenzene	N.D.	0.5	1	1
Chloroethane	N.D.	0.5	1	1
Chloroform	N.D.	0.5	1	1
Chloromethane	N.D.	0.5	1	1
Cyclohexane	N.D.	2	4	5
1,2-Dibromo-3-chloropropane	N.D.	2	4	5
Dibromochloromethane	N.D.	0.5	1	1
1,2-Dibromoethane	N.D.	0.5	1	1
1,2-Dichlorobenzene	N.D.	1	2	5
1,3-Dichlorobenzene	N.D.	1	2	5
1,4-Dichlorobenzene	N.D.	1	2	5
Dichlorodifluoromethane	N.D.	0.5	1	1
1,1-Dichloroethane	N.D.	0.5	1	1
1,2-Dichloroethane	N.D.	0.5	1	1
1,1-Dichloroethene	N.D.	0.5	1	1
cis-1,2-Dichloroethene	N.D.	0.5	1	1
trans-1,2-Dichloroethene	N.D.	0.5	1	1
1,2-Dichloropropane	N.D.	0.5	1	1
cis-1,3-Dichloropropene	N.D.	0.5	1	1
trans-1,3-Dichloropropene	N.D.	0.5	1	1
Ethylbenzene	N.D.	0.5	1	1
Freon 113	N.D.	2	4	10
2-Hexanone	N.D.	3	8	10
Isopropylbenzene	N.D.	1	2	5
Methyl Acetate	N.D.	1	2	5
Methyl Tertiary Butyl Ether	N.D.	0.5	1	1
4-Methyl-2-pentanone	N.D.	3	8	10
Methylcyclohexane	N.D.	1	2	5
Methylene Chloride	N.D.	2	4	4
Styrene	N.D.	1	2	5
1,1,2,2-Tetrachloroethane	N.D.	0.5	1	1
Tetrachloroethene	N.D.	0.5	1	1

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.
(3) The surrogate spike amount was less than the LOD.
P###### is indicative of a Background or Unspiked sample that is batch matrix QC and was not performed using a sample from this submission group.

Quality Control Summary

Client Name: Oneida Total Integration Ent. Group Number: 1767808
Reported: 03/05/2017 12:22

Method Blank (continued)

Analysis Name	**Result** **ug/l**	**DL**** **ug/l**	**LOD** **ug/l**	**LOQ** **ug/l**
Toluene	N.D.	0.5	1	1
1,2,4-Trichlorobenzene	N.D.	1	2	5
1,1,1-Trichloroethane	N.D.	0.5	1	1
1,1,2-Trichloroethane	N.D.	0.5	1	1
Trichloroethene	N.D.	0.5	1	1
Trichlorofluoromethane	N.D.	0.5	1	1
Vinyl Chloride	N.D.	0.5	1	1
Xylene (Total)	N.D.	0.5	1	1
Batch number: 17054WAD026	Sample number(s): 8844834-8844835			
Acenaphthene	N.D.	0.1	0.4	0.5
Acenaphthylene	N.D.	0.1	0.4	0.5
Acetophenone	N.D.	0.5	1	1
Anthracene	N.D.	0.1	0.4	0.5
Atrazine	N.D.	2	4	5
Benzaldehyde	N.D.	1	4	5
Benzo(a)anthracene	N.D.	0.1	0.4	0.5
Benzo(a)pyrene	N.D.	0.1	0.4	0.5
Benzo(b)fluoranthene	N.D.	0.1	0.4	0.5
Benzo(g,h,i)perylene	N.D.	0.1	0.4	0.5
Benzo(k)fluoranthene	N.D.	0.1	0.4	0.5
1,1'-Biphenyl	N.D.	0.5	1	1
4-Bromophenyl-phenylether	N.D.	0.5	1	1
Butylbenzylphthalate	N.D.	2	4	5
Di-n-butylphthalate	N.D.	2	4	5
Caprolactam	N.D.	5	15	15
Carbazole	N.D.	0.5	1	1
4-Chloro-3-methylphenol	N.D.	0.5	1	1
4-Chloroaniline	N.D.	0.5	1	1
bis(2-Chloroethoxy)methane	N.D.	0.5	1	1
bis(2-Chloroethyl)ether	N.D.	0.5	1	1
2-Chloronaphthalene	N.D.	0.4	1	1
2-Chlorophenol	N.D.	0.5	1	1
4-Chlorophenyl-phenylether	N.D.	0.5	1	1
2,2'-oxybis(1-Chloropropane)	N.D.	0.5	1	1
Chrysene	N.D.	0.1	0.4	0.5
Dibenz(a,h)anthracene	N.D.	0.1	0.4	0.5
Dibenzofuran	N.D.	0.5	1	1
3,3'-Dichlorobenzidine	N.D.	2	4	5
2,4-Dichlorophenol	N.D.	0.5	1	1
Diethylphthalate	N.D.	2	4	5
2,4-Dimethylphenol	N.D.	0.5	1	1
Dimethylphthalate	N.D.	2	4	5
4,6-Dinitro-2-methylphenol	N.D.	5	15	15
2,4-Dinitrophenol	N.D.	10	30	30
2,4-Dinitrotoluene	N.D.	1	4	5
2,6-Dinitrotoluene	N.D.	0.5	1	1
bis(2-Ethylhexyl)phthalate	N.D.	2	4	5
Fluoranthene	N.D.	0.1	0.4	0.5

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Quality Control Summary

Method Blank (continued)

Analysis Name	**Result**	**DL****	**LOD**	**LOQ**
	ug/l	**ug/l**	**ug/l**	**ug/l**
Fluorene	N.D.	0.1	0.4	0.5
Hexachlorobenzene	N.D.	0.1	0.4	0.5
Hexachlorobutadiene	N.D.	0.5	1	1
Hexachlorocyclopentadiene	N.D.	5	15	15
Hexachloroethane	N.D.	1	4	5
Indeno(1,2,3-cd)pyrene	N.D.	0.1	0.4	0.5
Isophorone	N.D.	0.5	1	1
2-Methylnaphthalene	N.D.	0.1	0.4	0.5
2-Methylphenol	N.D.	0.5	1	1
4-Methylphenol	N.D.	0.5	1	1
Naphthalene	N.D.	0.1	0.4	0.5
2-Nitroaniline	N.D.	0.5	1	1
3-Nitroaniline	N.D.	0.5	1	1
4-Nitroaniline	N.D.	0.5	1	1
Nitrobenzene	N.D.	0.5	1	1
2-Nitrophenol	N.D.	0.5	1	1
4-Nitrophenol	N.D.	10	30	30
N-Nitroso-di-n-propylamine	N.D.	0.5	1	1
N-Nitrosodiphenylamine	N.D.	0.5	1	1
Di-n-octylphthalate	N.D.	2	4	5
Pentachlorophenol	N.D.	1	4	5
Phenanthrene	N.D.	0.1	0.4	0.5
Phenol	N.D.	0.5	1	1
Pyrene	N.D.	0.1	0.4	0.5
2,4,5-Trichlorophenol	N.D.	0.5	1	1
2,4,6-Trichlorophenol	N.D.	0.5	1	1
	mg/l	**mg/l**	**mg/l**	**mg/l**
Batch number: 170531848004	Sample number(s): 8844834-8844835			
Arsenic	N.D.	0.0097	0.0200	0.0200
Barium	N.D.	0.0011	0.0025	0.0050
Cadmium	N.D.	0.00049	0.0013	0.0050
Chromium	N.D.	0.0018	0.0038	0.0150
Lead	N.D.	0.0062	0.0150	0.0150
Selenium	N.D.	0.0097	0.0200	0.0200
Silver	N.D.	0.0019	0.0050	0.0050
Batch number: 170535713005	Sample number(s): 8844834-8844835			
Mercury	N.D.	0.000050	0.00010	0.00020
	mg/kg	**mg/kg**	**mg/kg**	**mg/kg**
Batch number: 17061104201A	Sample number(s): 8844834-8844835			
Cyanide (Reactivity)	N.D.	20.0	60.0	60.0
Batch number: 17060112101A	Sample number(s): 8844834-8844835			
Sulfide (Reactivity)	N.D.	53.6	150	160

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(3) The surrogate spike amount was less than the LOD.
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Quality Control Summary

Client Name: Oneida Total Integration Ent. Group Number: 1767808
Reported: 03/05/2017 12:22

LCS/LCSD

Analysis Name	LCS Spike Added ug/l	LCS Conc ug/l	LCSD Spike Added ug/l	LCSD Conc ug/l	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Max
Batch number: Y170581AA	Sample number(s): 8844834-8844835								
Acetone	150	208.05	150	181.22	139	121	39-160	14	20
Benzene	20	20.27	20	20.09	101	100	79-120	1	20
Bromodichloromethane	20	17.8	20	17.56	89	88	79-125	1	20
Bromoform	20	14.48	20	14.41	72	72	66-130	0	20
Bromomethane	20	16.09	20	15.68	80	78	53-141	3	20
2-Butanone	150	146.87	150	141.27	98	94	56-143	4	20
Carbon Disulfide	20	17.33	20	16.86	87	84	64-133	3	20
Carbon Tetrachloride	20	17.68	20	16.98	88	85	72-136	4	20
Chlorobenzene	20	20	20	19.87	100	99	82-118	1	20
Chloroethane	20	16.64	20	16.19	83	81	60-138	3	20
Chloroform	20	19.65	20	19.53	98	98	79-124	1	20
Chloromethane	20	18.4	20	17.86	92	89	50-139	3	20
Cyclohexane	20	18.48	20	18.24	92	91	71-130	1	20
1,2-Dibromo-3-chloropropane	20	15.83	20	15.69	79	78	62-128	1	20
Dibromochloromethane	20	17.11	20	17.03	86	85	74-126	0	20
1,2-Dibromoethane	20	19.69	20	19.79	98	99	77-121	1	20
1,2-Dichlorobenzene	20	18.89	20	18.71	94	94	80-119	1	20
1,3-Dichlorobenzene	20	18.85	20	18.7	94	94	80-119	1	20
1,4-Dichlorobenzene	20	19.04	20	18.94	95	95	79-118	1	20
Dichlorodifluoromethane	20	16.4	20	15.84	82	79	32-152	3	20
1,1-Dichloroethane	20	20.15	20	20.11	101	101	77-125	0	20
1,2-Dichloroethane	20	20.12	20	19.88	101	99	73-128	1	20
1,1-Dichloroethene	20	19.12	20	18.44	96	92	71-131	4	20
cis-1,2-Dichloroethene	20	19.73	20	19.3	99	97	78-123	2	20
trans-1,2-Dichloroethene	20	20.06	20	19.45	100	97	75-124	3	20
1,2-Dichloropropane	20	20.38	20	20.22	102	101	78-122	1	20
cis-1,3-Dichloropropene	20	18.1	20	18.11	90	91	75-124	0	20
trans-1,3-Dichloropropene	20	18.52	20	18.75	93	94	73-127	1	20
Ethylbenzene	20	20.24	20	19.95	101	100	79-121	1	20
Freon 113	20	18.1	20	17.61	91	88	70-136	3	20
2-Hexanone	100	98.77	100	97.95	99	98	57-139	1	20
Isopropylbenzene	20	18.89	20	18.61	94	93	72-131	2	20
Methyl Acetate	20	20.07	20	20.49	100	102	56-136	2	20
Methyl Tertiary Butyl Ether	20	18.36	20	18.61	92	93	71-124	1	20
4-Methyl-2-pentanone	100	96.82	100	97.15	97	97	67-130	0	20
Methylcyclohexane	20	17.62	20	17.31	88	87	72-132	2	20
Methylene Chloride	20	19.77	20	19.4	99	97	74-124	2	20
Styrene	20	18.08	20	17.99	90	90	78-123	1	20
1,1,2,2-Tetrachloroethane	20	19.05	20	19.22	95	96	71-121	1	20
Tetrachloroethene	20	24.78	20	24.83	124	124	74-129	0	20
Toluene	20	20.26	20	19.98	101	100	80-121	1	20
1,2,4-Trichlorobenzene	20	17.34	20	17.65	87	88	69-130	2	20
1,1,1-Trichloroethane	20	16.35	20	15.86	82	79	74-131	3	20
1,1,2-Trichloroethane	20	19.93	20	19.97	100	100	80-119	0	20
Trichloroethene	20	19.95	20	19.52	100	98	79-123	2	20
Trichlorofluoromethane	20	16.94	20	16.45	85	82	65-141	3	20
Vinyl Chloride	20	17.34	20	16.95	87	85	58-137	2	20

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Quality Control Summary

Client Name: Oneida Total Integration Ent.　　Group Number: 1767808
Reported: 03/05/2017 12:22

LCS/LCSD (continued)

Analysis Name	**LCS Spike Added ug/l**	**LCS Conc ug/l**	**LCSD Spike Added ug/l**	**LCSD Conc ug/l**	**LCS %REC**	**LCSD %REC**	**LCS/LCSD Limits**	**RPD**	**RPD Max**
Xylene (Total)	60	57.96	60	57.57	97	96	79-121	1	20
	ug/l	**ug/l**	**ug/l**	**ug/l**					
Batch number: 17054WAD026	Sample number(s): 8844834-8844835								
Acenaphthene	50	41.46	50	46.42	83	93	47-122	11	30
Acenaphthylene	50	43.48	50	46.32	87	93	41-130	6	30
Acetophenone	50	42.77	50	44.38	86	89	46-118	4	30
Anthracene	50	49.29	50	48.58	99	97	57-123	1	30
Atrazine	50	47.98	50	48.02	96	96	44-142	0	30
Benzaldehyde	50	45.81	50	42.27	92	85	45-111	8	30
Benzo(a)anthracene	50	53.17	50	52.76	106	106	58-125	1	30
Benzo(a)pyrene	50	49.07	50	48.28	98	97	54-128	2	30
Benzo(b)fluoranthene	50	51.56	50	49.98	103	100	53-131	3	30
Benzo(g,h,i)perylene	50	50.47	50	53.47	101	107	50-134	6	30
Benzo(k)fluoranthene	50	50.83	50	49.11	102	98	57-129	3	30
1,1'-Biphenyl	50	38.99	50	43.78	78	88	49-115	12	30
4-Bromophenyl-phenylether	50	46.5	50	47.73	93	95	55-124	3	30
Butylbenzylphthalate	50	45.9	50	43.7	92	87	53-134	5	30
Di-n-butylphthalate	50	47.5	50	41.26	95	83	59-127	14	30
Caprolactam	50	13.66	50	15.12	27	30	13-37	10	30
Carbazole	50	51.46	50	48.6	103	97	60-122	6	30
4-Chloro-3-methylphenol	50	54.99	50	47.27	110	95	52-119	15	30
4-Chloroaniline	50	40.76	50	39.72	82	79	33-117	3	30
bis(2-Chloroethoxy)methane	50	53.94	50	50.91	108	102	48-120	6	30
bis(2-Chloroethyl)ether	50	45.53	50	47.05	91	94	43-118	3	30
2-Chloronaphthalene	50	37.85	50	43.32	76	87	40-116	13	30
2-Chlorophenol	50	45.57	50	47.46	91	95	38-117	4	30
4-Chlorophenyl-phenylether	50	37.99	50	44.02	76	88	53-121	15	30
2,2'-oxybis(1-Chloropropane)	50	39.08	50	37.37	78	75	43-115	4	30
Chrysene	50	53.24	50	51.16	106	102	59-123	4	30
Dibenz(a,h)anthracene	50	52.46	50	55.11	105	110	51-134	5	30
Dibenzofuran	50	41.38	50	46.27	83	93	53-118	11	30
3,3'-Dichlorobenzidine	50	38.79	50	38	78	76	27-129	2	30
2,4-Dichlorophenol	50	54.06	50	49.2	108	98	47-121	9	30
Diethylphthalate	50	43.94	50	44.87	88	90	56-125	2	30
2,4-Dimethylphenol	50	42.5	50	37.51	85	75	31-124	12	30
Dimethylphthalate	50	40.71	50	39.15	81	78	45-127	4	30
4,6-Dinitro-2-methylphenol	50	50.22	50	50.47	100	101	44-137	0	30
2,4-Dinitrophenol	100	90.54	100	93.18	91	93	23-143	3	30
2,4-Dinitrotoluene	50	49.17	50	51.27	98	103	57-128	4	30
2,6-Dinitrotoluene	50	54.67	50	54.53	109	109	57-124	0	30
bis(2-Ethylhexyl)phthalate	50	47.27	50	47.62	95	95	55-135	1	30
Fluoranthene	50	49.95	50	45.42	100	91	57-128	9	30
Fluorene	50	40.86	50	45.6	82	91	52-124	11	30
Hexachlorobenzene	50	48.61	50	48.27	97	97	53-125	1	30
Hexachlorobutadiene	50	28.92	50	34.11	58	68	22-124	16	30
Hexachlorocyclopentadiene	100	31.05	100	38.92	31	39	10-81	22	30
Hexachloroethane	50	27.41	50	34.02	55	68	21-115	22	30

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.
(3) The surrogate spike amount was less than the LOD.
P###### is indicative of a Background or Unspiked sample that is batch matrix QC and was not performed using a sample from this submission group.

Quality Control Summary

Client Name: Oneida Total Integration Ent. Group Number: 1767808
Reported: 03/05/2017 12:22

LCS/LCSD (continued)

Analysis Name	**LCS Spike Added ug/l**	**LCS Conc ug/l**	**LCSD Spike Added ug/l**	**LCSD Conc ug/l**	**LCS %REC**	**LCSD %REC**	**LCS/LCSD Limits**	**RPD**	**RPD Max**
Indeno(1,2,3-cd)pyrene	50	51.05	50	53.98	102	108	52-134	6	30
Isophorone	50	55.3	50	45.93	111	92	42-124	19	30
2-Methylnaphthalene	50	44.31	50	40.89	89	82	40-121	8	30
2-Methylphenol	50	44.14	50	41.79	88	84	30-117	5	30
4-Methylphenol	50	38.51	50	40.9	77	82	25-120	6	30
Naphthalene	50	39.86	50	41.4	80	83	40-121	4	30
2-Nitroaniline	50	53.65	50	54.27	107	109	55-127	1	30
3-Nitroaniline	50	45.28	50	47.95	91	96	41-128	6	30
4-Nitroaniline	50	43.62	50	44.87	87	90	57-114	3	30
Nitrobenzene	50	47.62	50	41.36	95	83	45-121	14	30
2-Nitrophenol	50	56.26	50	52.59	113	105	47-123	7	30
4-Nitrophenol	50	24.69	50	29.48	49	59	22-78	18	30
N-Nitroso-di-n-propylamine	50	44.05	50	45.37	88	91	49-119	3	30
N-Nitrosodiphenylamine	50	51.42	50	49.9	103	100	51-123	3	30
Di-n-octylphthalate	50	47.76	50	46.14	96	92	51-140	3	30
Pentachlorophenol	50	54.17	50	54.21	108	108	35-138	0	30
Phenanthrene	50	47.61	50	46.73	95	93	59-120	2	30
Phenol	50	28.11	50	29.24	56	58	16-74	4	30
Pyrene	50	49.66	50	48.28	99	97	57-126	3	30
2,4,5-Trichlorophenol	50	52.35	50	52.28	105	105	53-123	0	30
2,4,6-Trichlorophenol	50	50.94	50	53.21	102	106	50-125	4	30
	mg/l	**mg/l**	**mg/l**	**mg/l**					
Batch number: 170531848004	Sample number(s): 8844834-8844835								
Arsenic	0.150	0.160			107		87-113		
Barium	2.00	2.05			103		88-113		
Cadmium	0.0500	0.0529			106		88-113		
Chromium	0.200	0.208			104		90-113		
Lead	0.150	0.159			106		86-113		
Selenium	0.150	0.145			97		83-114		
Silver	0.0500	0.0583			117*		84-115		
Batch number: 170535713005	Sample number(s): 8844834-8844835								
Mercury	0.00100	0.000842			84		80-120		
	mg/kg	**mg/kg**	**mg/kg**	**mg/kg**					
Batch number: 17061104201A	Sample number(s): 8844834-8844835								
Cyanide (Reactivity)	1000	964.81			96		77-113		
Batch number: 17056121521A	Sample number(s): 8844834-8844835								
Corrosivity	7.00	7.00			100		89-110		
	Degrees F	**Degrees F**	**Degrees F**	**Degrees F**					
Batch number: 17058043001A	Sample number(s): 8844834-8844835								
Flash Point	81	81.7	81	81.7	101	101	97-103	0	4

*- Outside of specification
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(3) The surrogate spike amount was less than the LOD.
P###### is indicative of a Background or Unspiked sample that is batch matrix QC and was not performed using a sample from this submission group.

Quality Control Summary

Client Name: Oneida Total Integration Ent. Group Number: 1767808
Reported: 03/05/2017 12:22

LCS/LCSD (continued)

Analysis Name	**LCS Spike Added mg/kg**	**LCS Conc mg/kg**	**LCSD Spike Added mg/kg**	**LCSD Conc mg/kg**	**LCS %REC**	**LCSD %REC**	**LCS/LCSD Limits**	**RPD**	**RPD Max**
Batch number: 17060112101A	Sample number(s): 8844834-8844835								
Sulfide (Reactivity)	570	435.35			76		68-102		
	Std. Units	**Std. Units**	**Std. Units**	**Std. Units**					
Batch number: 17056121521A	Sample number(s): 8844834-8844835								
pH	7.00	7.00			100		95-105		

MS/MSD

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike

Analysis Name	**Unspiked Conc mg/l**	**MS Spike Added mg/l**	**MS Conc mg/l**	**MSD Spike Added mg/l**	**MSD Conc mg/l**	**MS %Rec**	**MSD %Rec**	**MS/MSD Limits**	**RPD**	**RPD Max**
Batch number: 170531848004	Sample number(s): 8844834-8844835 UNSPK: 8844835									
Arsenic	N.D.	0.150	0.161	0.150	0.162	107	108	87-113	0	20
Barium	0.208	2.00	2.27	2.00	2.27	103	103	88-113	0	20
Cadmium	N.D.	0.0500	0.0518	0.0500	0.0520	104	104	88-113	0	20
Chromium	0.00298	0.200	0.210	0.200	0.209	104	103	90-113	0	20
Lead	N.D.	0.150	0.154	0.150	0.154	103	103	86-113	0	20
Selenium	N.D.	0.150	0.152	0.150	0.147	102	98	83-114	3	20
Silver	N.D.	0.0500	0.0568	0.0500	0.0562	114	112	84-115	1	20
Batch number: 170535713005	Sample number(s): 8844834-8844835 UNSPK: 8844834									
Mercury	N.D.	0.00100	0.000867	0.00100	0.000838	87	84	80-120	3	20
	mg/kg	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**					
Batch number: 17061104201A	Sample number(s): 8844834-8844835 UNSPK: P851149									
Cyanide (Reactivity)	N.D.	1000	N.D.	1000	N.D.	0*	0*	77-113	0	11
	mg/kg	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**					
Batch number: 17060112101A	Sample number(s): 8844834-8844835 UNSPK: P851149									
Sulfide (Reactivity)	N.D.	549	361.29	549	332.02	66*	60*	68-102	8	24

Laboratory Duplicate

Background (BKG) = the sample used in conjunction with the duplicate

Analysis Name	**BKG Conc mg/l**	**DUP Conc mg/l**	**DUP RPD**	**DUP RPD Max**

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.
(3) The surrogate spike amount was less than the LOD.
P###### is indicative of a Background or Unspiked sample that is batch matrix QC and was not performed using a sample from this submission group.

Quality Control Summary

Client Name: Oneida Total Integration Ent. Group Number: 1767808
Reported: 03/05/2017 12:22

Laboratory Duplicate

Background (BKG) = the sample used in conjunction with the duplicate

Analysis Name	**BKG Conc**	**DUP Conc**	**DUP RPD**	**DUP RPD Max**
	mg/l	**mg/l**		
Batch number: 170531848004	Sample number(s): 8844834-8844835 BKG: 8844835			
Arsenic	N.D.	N.D.	0 (1)	20
Barium	0.208	0.203	2	20
Cadmium	N.D.	N.D.	0 (1)	20
Chromium	0.00298	0.00277	7 (1)	20
Lead	N.D.	N.D.	0 (1)	20
Selenium	N.D.	N.D.	0 (1)	20
Silver	N.D.	N.D.	0 (1)	20
Batch number: 170535713005	Sample number(s): 8844834-8844835 BKG: 8844834			
Mercury	N.D.	N.D.	0 (1)	20
Batch number: 17056121521A	Sample number(s): 8844834-8844835 BKG: P844610			
Corrosivity	7.54	7.49	1	2
	Degrees C	**Degrees C**		
Batch number: 17056121521A	Sample number(s): 8844834-8844835 BKG: P844610			
Temperature of pH	20	20	0	5
	Degrees F	**Degrees F**		
Batch number: 17058043001A	Sample number(s): 8844834-8844835 BKG: P846689			
Flash Point	139.7	136.7	2 (1)	20
	Std. Units	**Std. Units**		
Batch number: 17056121521A	Sample number(s): 8844834-8844835 BKG: P844610			
pH	7.54	7.49	1	3

Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: TCL VOCs 4.3 8260B
Batch number: Y170581AA

	Dibromofluoromethane		1,2-Dichloroethane-d4		Toluene-d8		4-Bromofluorobenzene	
	%Rec	LOD (ug/l)	%Rec	LOD (ug/l)	%Rec	LOD (ug/l)	%Rec	LOD (ug/l)
8844834	99	1	103	1	103	1	98	1
8844835	97	1	103	1	102	1	97	1
Blank	97	1	103	1	102	1	97	1
LCS	98	1	102	1	103	1	100	1
LCSD	98	1	102	1	103	1	100	1

*- Outside of specification
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(3) The surrogate spike amount was less than the LOD.
P###### is indicative of a Background or Unspiked sample that is batch matrix QC and was not performed using a sample from this submission group.

Quality Control Summary

Client Name: Oneida Total Integration Ent. Group Number: 1767808
Reported: 03/05/2017 12:22

Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: TCL VOCs 4.3 8260B
Batch number: Y170581AA

Limits: 80-119 81-118 89-112 85-114

Analysis Name: TCL SVOCs 8270C
Batch number: 17054WAD026

	2-Fluorophenol		Phenol-d6		2,4,6-Tribromophenol		Nitrobenzene-d5		2-Fluorobiphenyl		Terphenyl-d14	
	%Rec	LOD (ug/l)	%Rec	LOD (ug/l)	%Rec	LOD (ug/l)	%Rec	LOD (ug/l)	%Rec	LOD (ug/l)	%Rec	LOD (ug/l)
8844834	46	81	34	81	96	81	79	40	75	40	94	40
8844835	43	81	31	81	89	81	68	41	61	41	83	41
Blank	37	80	28	80	88	80	71	40	57	40	92	40
LCS	64	80	50	80	100	80	90	40	77	40	93	40
LCSD	66	80	53	80	101	80	76	40	76	40	94	40
Limits:	19-119		10-71		43-140		44-120		44-119		50-134	

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.
(3) The surrogate spike amount was less than the LOD.
P###### is indicative of a Background or Unspiked sample that is batch matrix QC and was not performed using a sample from this submission group.

Environmental Analysis Request/Chain of Custody

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For Eurofins Lancaster Laboratories Environmental use only
Acct. # 37016 Group # 81767808 Sample # 8844834-36
P 2/20/17 (3)

COC

Client Information

Client: OTIE
Acct. #: 37016
Project Name/#: 2015341-06-0604
PWSID #:
Project Manager: Cecil Irby
P.O. #: 10976
Sampler: RK, AG, CR
Quote #:
State where samples were collected: New Mexico
For Compliance: Yes ☒ No ☐

Matrix

☐ Tissue ☒ Ground ☐ Surface
☐ Sediment ☐ Potable ☐ NPDES
☐ Soil
Water
Other:

Analysis Requested

Preservation Codes: N, H

Sample Identification	Collected Date	Collected Time	Grab	Composite	Soil	Water	Other:	Total # of Containers	RCRA 8	VOCs - 5ml Water by 8260B	pH, temp of pH	Reactivity & Corrosivity	Flash Point	TCL SW846 8270C H2O
DRUM 1	02/17/17	1145				X		9	1	3	1	1	1	2
DRUM 2	02/17/17	1205				X		9	1	3	1	1	1	2

CR

For Lab Use Only
FSC:
SCR#:

Preservation Codes
H=HCl T=Thiosulfate
N=HNO_3 B=NaOH
S=H_2SO_4 O=Other

Remarks

Turnaround Time (TAT) Requested (please circle)

[✓ Standard] Rush
(Rush TAT is subject to laboratory approval and surcharge.)

Date results are needed: 14 days

E-mail address: OMartinez@otie.com

Data Package Options (circle if required)

Type I (EPA Level 3 Equivalent/non-CLP)
Type III (Reduced non-CLP)
NYSDEC Category A or B
Type VI (Raw Data Only)
~~NJ DKQP~~ [✓ Level 4]
MA MCP
TX TRRP-13
CT RCP

Relinquished by	Date	Time	Received by	Date	Time
Catalina Roy	2/17/17	1330	FedEx	02/17/17	1400
Relinquished by	Date	Time	Received by	Date	Time
Relinquished by	Date	Time	Received by	Date	Time
Relinquished by	Date	Time	Received by	Date	Time
Relinquished by	Date	Time	Received by	Date	Time

EDD Required? [✓ Yes] No
If yes, format: ERPIMS

Site-Specific QC (MS/MSD/Dup)? Yes [✓ No]
(If yes, indicate QC sample and submit triplicate sample volume.)

Relinquished by Commercial Carrier:
UPS ____ FedEx X Other ____

Temperature upon receipt 0.6 °C

The white copy should accompany samples to Eurofins Lancaster Laboratories Environmental. The yellow copy should be retained by the client.

Angela Miller

1767808

From: Oscar Martinez <OMartinez@otie.com>
Sent: Monday, February 20, 2017 9:57 AM
To: Angela Miller; Catalina Restrepo
Subject: RE: OTIE samples 02-16-17

No we will not need the trip blanks.

Oscar A. Martinez
Oneida Total Integrated Enterprises (OTIE)
210.54-06465 x2230 office
www.otie.com

-----Original Message-----
From: Angela Miller [mailto:AngelaMiller@eurofinsUS.com]
Sent: Monday, February 20, 2017 8:56 AM
To: Catalina Restrepo
Cc: Oscar Martinez
Subject: RE: OTIE samples 02-16-17

Hi Catalina,

Thank you; we received these samples on Saturday. Did you want us to analyze the trip blanks?

Thank you,
Angela

Angela Miller
Specialist

Eurofins Lancaster Laboratories Environmental, LLC
2425 New Holland Pike
Lancaster, PA 17601
USA
Phone: +1 717-556-7260

-----Original Message-----
From: Catalina Restrepo [mailto:CRestrepo@otie.com]
Sent: Friday, February 17, 2017 9:17 PM
To: Angela Miller
Cc: Oscar Martinez
Subject: Re: OTIE samples 02-16-17

Hi Angela,
Today we shipped 2 coolers with 4 IDW kits. They are scheduled to be delivered tomorrow Saturday. The tracking # are : 809586653763 and 809586653652. Below are the COCs. I only realized after I had already taped the coolers that I didn't include de two trip blanks you sent us on the COCs. Just FYI.

eurofins | Lancaster Laboratories Environmental

Sample Administration Receipt Documentation Log

Doc Log ID: 176027
Group Number(s): 1762808

Client: OTIE

2015341-06-0604

Delivery and Receipt Information

Delivery Method:	Fed Ex	Arrival Timestamp:	02/18/2017 9:50
Number of Packages:	1	Number of Projects:	1
State/Province of Origin:	NM		

Arrival Condition Summary

Shipping Container Sealed:	Yes	Sample IDs on COC match Containers:	Yes
Custody Seal Present:	Yes	Sample Date/Times match COC:	Yes
Custody Seal Intact:	Yes	VOA Vial Headspace ≥ 6mm:	No
Samples Chilled:	Yes	Total Trip Blank Qty:	1
Paperwork Enclosed:	Yes	Trip Blank Type:	HCl
Samples Intact:	Yes	Air Quality Samples Present:	No
Missing Samples:	No		
Extra Samples:	No		
Discrepancy in Container Qty on COC:	No		

Unpacked by William Richardson (12178) at 16:35 on 02/18/2017

Samples Chilled Details: 2015341-06-0604

Thermometer Types: *DT = Digital (Temp. Bottle)* *IR = Infrared (Surface Temp)* *All Temperatures in °C.*

Cooler #	Thermometer ID	Corrected Temp	Therm. Type	Ice Type	Ice Present?	Ice Container	Elevated Temp?
1	DT121	0.6	DT	Wet	Y	Loose/Bag	N

Explanation of Symbols and Abbreviations

The following defines common symbols and abbreviations used in reporting technical data:

BMQL	Below Minimum Quantitation Level	**mg**	milligram(s)
C	degrees Celsius	**mL**	milliliter(s)
cfu	colony forming units	**MPN**	Most Probable Number
CP Units	cobalt-chloroplatinate units	**N.D.**	none detected
F	degrees Fahrenheit	**ng**	nanogram(s)
g	gram(s)	**NTU**	nephelometric turbidity units
IU	International Units	**pg/L**	picogram/liter
kg	kilogram(s)	**RL**	Reporting Limit
L	liter(s)	**TNTC**	Too Numerous To Count
lb.	pound(s)	**µg**	microgram(s)
m3	cubic meter(s)	**µL**	microliter(s)
meq	milliequivalents	**umhos/cm**	micromhos/cm

<	less than
>	greater than
ppm	parts per million - One ppm is equivalent to one milligram per kilogram (mg/kg) or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter per liter of gas.
ppb	parts per billion
Dry weight basis	Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture. All other results are reported on an as-received basis.

Laboratory Data Qualifiers:

C - Result confirmed by reanalysis
E - Concentration exceeds the calibration range
J (or G, I, X) - estimated value ≥ the Method Detection Limit (MDL or DL) and < the Limit of Quantitation (LOQ or RL)
P - Concentration difference between the primary and confirmation column >40%. The lower result is reported.
U - Analyte was not detected at the value indicated
V - Concentration difference between the primary and confirmation column >100%. The reporting limit is raised due to this disparity and evident interference…
W - The dissolved oxygen uptake for the unseeded blank is greater than 0.20 mg/L.

Additional Organic and Inorganic CLP qualifiers may be used with Form 1 reports as defined by the CLP methods.
Qualifiers specific to Dioxin/Furans and PCB Congeners are detailed on the individual Analysis Report.

Analytical test results meet all requirements of the associated regulatory program (i.e., NELAC (TNI), DoD, and ISO 17025) unless otherwise noted under the individual analysis.

Measurement uncertainty values, as applicable, are available upon request.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff.

This report shall not be reproduced except in full, without the written approval of the laboratory.

Times are local to the area of activity. Parameters listed in the 40 CFR Part 136 Table II as “analyze immediately” are not performed within 15 minutes.

WARRANTY AND LIMITS OF LIABILITY - In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL EUROFINS LANCASTER LABORATORIES ENVIRONMENTAL, LLC BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF EUROFINS LANCASTER LABORATORIES ENVIRONMENTAL AND (B) WHETHER EUROFINS LANCASTER LABORATORIES ENVIRONMENTAL HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Eurofins Lancaster Laboratories Environmental which includes any conditions that vary from the Standard Terms and Conditions, and Eurofins Lancaster Laboratories Environmental hereby objects to any conflicting terms contained in any acceptance or order submitted by client.

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Analysis Report

ANALYTICAL RESULTS

Prepared by:	Prepared for:
Eurofins Lancaster Laboratories Environmental 2425 New Holland Pike Lancaster, PA 17601	Oneida Total Integration Ent. 1033 N. Mayfair Road Suite 200 Milwaukee WI 53226-3442

Report Date: March 05, 2017

Project: 2015341-06-0604

Site:

Submittal Date: 02/18/2017
Group Number: 1767809
SDG: OTI36
PO Number: 10976
State of Sample Origin: NM

Client Sample Description	Lancaster Labs (LL) #
DRUM 3 Groundwater	8844837
DRUM 4 Groundwater	8844838

The specific methodologies used in obtaining the enclosed analytical results are indicated on the Laboratory Sample Analysis Record.

Regulatory agencies do not accredit laboratories for all methods, analytes, and matrices. Our current scopes of accreditation can be viewed at http://www.eurofinsus.com/environment-testing/laboratories/eurofins-lancaster-laboratories-environmental/resources/certifications/ . To request copies of prior scopes of accreditation, contact your project manager.

Electronic Copy To Oneida Total Integration Ent. Attn: Oscar Martinez

Respectfully Submitted,

Angela M. Miller

Angela M. Miller
Specialist

(717) 556-7260

Project Name: 2015341-06-0604
LL Group #: 1767809

General Comments:

All analyses have been performed in accordance with DOD QSM Version 5.0 unless otherwise noted below.

See the Laboratory Sample Analysis Record section of the Analysis Report for the method references.

All QC met criteria unless otherwise noted in an Analysis Specific Comment below. Refer to the QC Summary for specific values and acceptance criteria.

Project specific QC samples are not included in this data set

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

Surrogate recoveries (if applicable) which are outside of the QC window are confirmed unless attributed to a dilution or otherwise noted in an Analysis Specific Comment below.

The samples were received at the appropriate temperature and in accordance with the chain of custody unless otherwise noted.

Analysis Specific Comments:

SW-846 6010B, Metals

Batch #: 170531848004 (Sample number(s): 8844837-8844838 UNSPK: P844835 BKG: P844835)

The recovery(ies) for the following analyte(s) in the LCS exceeded the acceptance window indicating a positive bias: Silver

SW-846 Chapter 7.3, Wet Chemistry

Sample #s: 8844837, 8844838

Reactivity:
This sample was extracted and analyzed by the interim method described in SW-846 Revision 3, December 1996 - Chapter 7.3. The Interim Guidance for Reactive Cyanide and Reactive Sulfide (SW-846 Sections 7.3.3 and 7.3.4 of Chapter 7 - December 1996) identifies a reactive material as generating more than 250 mg/kg of hydrogen cyanide or 500 mg/kg of hydrogen sulfide. This waste is not considered hazardous due to reactivity based on that standard. These results do not reflect total cyanide or total sulfide. On July 14, 2005, EPA published a rule in the Federal Register that removed the Interim Guidance and the method referenced above. At this time there is no specific guidance or a method to be used to evaluate "Reactivity".

Batch #: 17060112101A (Sample number(s): 8844837-8844838 UNSPK: P851149)

The recovery(ies) for the following analyte(s) in the MS and/or MSD was outside the acceptance window: Sulfide (Reactivity)

Batch #: 17061104201A (Sample number(s): 8844837-8844838 UNSPK: P851149)

The recovery(ies) for the following analyte(s) in the MS and/or MSD was outside the acceptance window: Cyanide (Reactivity)

ASTM D93- 07, Wet Chemistry

Sample #s: 8844837

No flash observed below 182F.
Test flame extinguished at 162F.
Flash point was determined using Pensky Martens closed cup apparatus.

Sample #s: 8844838

No flash observed below 184F.
Test flame extinguished at 164F.
Flash point was determined using Pensky Martens closed cup apparatus.

SW-846 Chapter 7, Wet Chemistry

Sample #s: 8844838

The pH of the sample is 8.02 indicating that the sample is not corrosive. A sample is corrosive if it exhibits a pH equal to or less than 2 or equal to or greater than 12.5.

Sample #s: 8844837

The pH of the sample is 8.07 indicating that the sample is not corrosive. A sample is corrosive if it exhibits a pH equal to or less than 2 or equal to or greater than 12.5.

SW-846 Chapter 7.3, Wet Chemistry

Sample #s: 8844837, 8844838

Reactivity:
This sample was extracted and analyzed by the interim method described in SW-846 Revision 3, December 1996 - Chapter 7.3. The Interim Guidance for Reactive Cyanide and Reactive Sulfide (SW-846 Sections 7.3.3 and 7.3.4 of Chapter 7 - December 1996) identifies a reactive material as generating more than 250 mg/kg of hydrogen cyanide or 500 mg/kg of hydrogen sulfide. This waste is not considered hazardous due to reactivity based on that standard. These results do not reflect total cyanide or total sulfide. On July 14, 2005, EPA published a rule in the Federal Register that removed the Interim Guidance and the method referenced above. At this time there is no specific guidance or a method to be used to evaluate "Reactivity".

Batch #: 17060112101A (Sample number(s): 8844837-8844838 UNSPK: P851149)

The recovery(ies) for the following analyte(s) in the MS and/or MSD was outside the acceptance window: Sulfide (Reactivity)

Batch #: 17061104201A (Sample number(s): 8844837-8844838 UNSPK: P851149)

The recovery(ies) for the following analyte(s) in the MS and/or MSD was outside the acceptance window: Cyanide (Reactivity)

Sample Description: DRUM 3 Groundwater
2015341-06-0604

LL Sample # WW 8844837
LL Group # 1767809
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 12:15 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60403 SDG#: OTI36-01

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
GC/MS Volatiles	**SW-846 8260B**		ug/l	ug/l	ug/l	ug/l	
10335	Acetone	67-64-1	N.D.	6	20	20	1
10335	Benzene	71-43-2	N.D.	0.5	1	1	1
10335	Bromodichloromethane	75-27-4	N.D.	0.5	1	1	1
10335	Bromoform	75-25-2	N.D.	0.5	1	4	1
10335	Bromomethane	74-83-9	N.D.	0.5	1	1	1
10335	2-Butanone	78-93-3	N.D.	3	8	10	1
10335	Carbon Disulfide	75-15-0	N.D.	1	2	5	1
10335	Carbon Tetrachloride	56-23-5	N.D.	0.5	1	1	1
10335	Chlorobenzene	108-90-7	N.D.	0.5	1	1	1
10335	Chloroethane	75-00-3	N.D.	0.5	1	1	1
10335	Chloroform	67-66-3	N.D.	0.5	1	1	1
10335	Chloromethane	74-87-3	N.D.	0.5	1	1	1
10335	Cyclohexane	110-82-7	N.D.	2	4	5	1
10335	1,2-Dibromo-3-chloropropane	96-12-8	N.D.	2	4	5	1
10335	Dibromochloromethane	124-48-1	N.D.	0.5	1	1	1
10335	1,2-Dibromoethane	106-93-4	N.D.	0.5	1	1	1
10335	1,2-Dichlorobenzene	95-50-1	N.D.	1	2	5	1
10335	1,3-Dichlorobenzene	541-73-1	N.D.	1	2	5	1
10335	1,4-Dichlorobenzene	106-46-7	N.D.	1	2	5	1
10335	Dichlorodifluoromethane	75-71-8	N.D.	0.5	1	1	1
10335	1,1-Dichloroethane	75-34-3	N.D.	0.5	1	1	1
10335	1,2-Dichloroethane	107-06-2	N.D.	0.5	1	1	1
10335	1,1-Dichloroethene	75-35-4	N.D.	0.5	1	1	1
10335	cis-1,2-Dichloroethene	156-59-2	N.D.	0.5	1	1	1
10335	trans-1,2-Dichloroethene	156-60-5	N.D.	0.5	1	1	1
10335	1,2-Dichloropropane	78-87-5	N.D.	0.5	1	1	1
10335	cis-1,3-Dichloropropene	10061-01-5	N.D.	0.5	1	1	1
10335	trans-1,3-Dichloropropene	10061-02-6	N.D.	0.5	1	1	1
10335	Ethylbenzene	100-41-4	0.6 J	0.5	1	1	1
10335	Freon 113	76-13-1	N.D.	2	4	10	1
10335	2-Hexanone	591-78-6	N.D.	3	8	10	1
10335	Isopropylbenzene	98-82-8	N.D.	1	2	5	1
10335	Methyl Acetate	79-20-9	N.D.	1	2	5	1
10335	Methyl Tertiary Butyl Ether	1634-04-4	N.D.	0.5	1	1	1
10335	4-Methyl-2-pentanone	108-10-1	N.D.	3	8	10	1
10335	Methylcyclohexane	108-87-2	N.D.	1	2	5	1
10335	Methylene Chloride	75-09-2	N.D.	2	4	4	1
10335	Styrene	100-42-5	N.D.	1	2	5	1
10335	1,1,2,2-Tetrachloroethane	79-34-5	N.D.	0.5	1	1	1
10335	Tetrachloroethene	127-18-4	N.D.	0.5	1	1	1
10335	Toluene	108-88-3	N.D.	0.5	1	1	1
10335	1,2,4-Trichlorobenzene	120-82-1	N.D.	1	2	5	1
10335	1,1,1-Trichloroethane	71-55-6	N.D.	0.5	1	1	1
10335	1,1,2-Trichloroethane	79-00-5	N.D.	0.5	1	1	1
10335	Trichloroethene	79-01-6	N.D.	0.5	1	1	1
10335	Trichlorofluoromethane	75-69-4	N.D.	0.5	1	1	1
10335	Vinyl Chloride	75-01-4	N.D.	0.5	1	1	1
10335	Xylene (Total)	1330-20-7	3	0.5	1	1	1

*=This limit was used in the evaluation of the final result

Sample Description: DRUM 3 Groundwater
2015341-06-0604

LL Sample # WW 8844837
LL Group # 1767809
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 12:15 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60403 SDG#: OTI36-01

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
GC/MS	**Semivolatiles SW-846 8270C**		ug/l	ug/l	ug/l	ug/l	
14240	Acenaphthene	83-32-9	N.D.	0.1	0.4	0.5	1
14240	Acenaphthylene	208-96-8	N.D.	0.1	0.4	0.5	1
14240	Acetophenone	98-86-2	N.D.	0.5	1	1	1
14240	Anthracene	120-12-7	N.D.	0.1	0.4	0.5	1
14240	Atrazine	1912-24-9	N.D.	2	4	5	1
14240	Benzaldehyde	100-52-7	N.D.	1	4	5	1
14240	Benzo(a)anthracene	56-55-3	N.D.	0.1	0.4	0.5	1
14240	Benzo(a)pyrene	50-32-8	N.D.	0.1	0.4	0.5	1
14240	Benzo(b)fluoranthene	205-99-2	N.D.	0.1	0.4	0.5	1
14240	Benzo(g,h,i)perylene	191-24-2	N.D.	0.1	0.4	0.5	1
14240	Benzo(k)fluoranthene	207-08-9	N.D.	0.1	0.4	0.5	1
14240	1,1'-Biphenyl	92-52-4	N.D.	0.5	1	1	1
14240	4-Bromophenyl-phenylether	101-55-3	N.D.	0.5	1	1	1
14240	Butylbenzylphthalate	85-68-7	N.D.	2	4	5	1
14240	Di-n-butylphthalate	84-74-2	N.D.	2	4	5	1
14240	Caprolactam	105-60-2	N.D.	5	15	15	1
14240	Carbazole	86-74-8	N.D.	0.5	1	1	1
14240	4-Chloro-3-methylphenol	59-50-7	N.D.	0.5	1	1	1
14240	4-Chloroaniline	106-47-8	N.D.	0.5	1	1	1
14240	bis(2-Chloroethoxy)methane	111-91-1	N.D.	0.5	1	1	1
14240	bis(2-Chloroethyl)ether	111-44-4	N.D.	0.5	1	1	1
14240	2-Chloronaphthalene	91-58-7	N.D.	0.4	1	1	1
14240	2-Chlorophenol	95-57-8	N.D.	0.5	1	1	1
14240	4-Chlorophenyl-phenylether	7005-72-3	N.D.	0.5	1	1	1
14240	2,2'-oxybis(1-Chloropropane)	108-60-1	N.D.	0.5	1	1	1
	Bis(2-chloroisopropyl) ether CAS #39638-32-9 and 2,2'-Oxybis(1-chloropropane) CAS #108-60-1 cannot be separated chromatographically. The reported result represents the combined total of both compounds.						
14240	Chrysene	218-01-9	N.D.	0.1	0.4	0.5	1
14240	Dibenz(a,h)anthracene	53-70-3	N.D.	0.1	0.4	0.5	1
14240	Dibenzofuran	132-64-9	N.D.	0.5	1	1	1
14240	3,3'-Dichlorobenzidine	91-94-1	N.D.	2	4	5	1
14240	2,4-Dichlorophenol	120-83-2	N.D.	0.5	1	1	1
14240	Diethylphthalate	84-66-2	N.D.	2	4	5	1
14240	2,4-Dimethylphenol	105-67-9	N.D.	0.5	1	1	1
14240	Dimethylphthalate	131-11-3	N.D.	2	4	5	1
14240	4,6-Dinitro-2-methylphenol	534-52-1	N.D.	5	15	15	1
14240	2,4-Dinitrophenol	51-28-5	N.D.	10	30	30	1
14240	2,4-Dinitrotoluene	121-14-2	N.D.	1	4	5	1
14240	2,6-Dinitrotoluene	606-20-2	N.D.	0.5	1	1	1
14240	bis(2-Ethylhexyl)phthalate	117-81-7	N.D.	2	4	5	1
14240	Fluoranthene	206-44-0	N.D.	0.1	0.4	0.5	1
14240	Fluorene	86-73-7	N.D.	0.1	0.4	0.5	1
14240	Hexachlorobenzene	118-74-1	N.D.	0.1	0.4	0.5	1
14240	Hexachlorobutadiene	87-68-3	N.D.	0.5	1	1	1
14240	Hexachlorocyclopentadiene	77-47-4	N.D.	5	15	15	1
14240	Hexachloroethane	67-72-1	N.D.	1	4	5	1
14240	Indeno(1,2,3-cd)pyrene	193-39-5	N.D.	0.1	0.4	0.5	1

*=This limit was used in the evaluation of the final result

Sample Description: DRUM 3 Groundwater
2015341-06-0604

LL Sample # WW 8844837
LL Group # 1767809
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 12:15 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60403 SDG#: OTI36-01

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
GC/MS Semivolatiles		**SW-846 8270C**	**ug/l**	**ug/l**	**ug/l**	**ug/l**	
14240	Isophorone	78-59-1	N.D.	0.5	1	1	1
14240	2-Methylnaphthalene	91-57-6	N.D.	0.1	0.4	0.5	1
14240	2-Methylphenol	95-48-7	N.D.	0.5	1	1	1
14240	4-Methylphenol	106-44-5	N.D.	0.5	1	1	1
	3-Methylphenol and 4-methylphenol cannot be resolved under the chromatographic conditions used for sample analysis. The result reported for 4-methylphenol represents the combined total of both compounds.						
14240	Naphthalene	91-20-3	N.D.	0.1	0.4	0.5	1
14240	2-Nitroaniline	88-74-4	N.D.	0.5	1	1	1
14240	3-Nitroaniline	99-09-2	N.D.	0.5	1	1	1
14240	4-Nitroaniline	100-01-6	N.D.	0.5	1	1	1
14240	Nitrobenzene	98-95-3	N.D.	0.5	1	1	1
14240	2-Nitrophenol	88-75-5	N.D.	0.5	1	1	1
14240	4-Nitrophenol	100-02-7	N.D.	10	30	30	1
14240	N-Nitroso-di-n-propylamine	621-64-7	N.D.	0.5	1	1	1
14240	N-Nitrosodiphenylamine	86-30-6	N.D.	0.5	1	1	1
	N-nitrosodiphenylamine decomposes in the GC inlet forming diphenylamine. The result reported for N-nitrosodiphenylamine represents the combined total of both compounds.						
14240	Di-n-octylphthalate	117-84-0	N.D.	2	4	5	1
14240	Pentachlorophenol	87-86-5	N.D.	1	4	5	1
14240	Phenanthrene	85-01-8	N.D.	0.1	0.4	0.5	1
14240	Phenol	108-95-2	N.D.	0.5	1	1	1
14240	Pyrene	129-00-0	N.D.	0.1	0.4	0.5	1
14240	2,4,5-Trichlorophenol	95-95-4	N.D.	0.5	1	1	1
14240	2,4,6-Trichlorophenol	88-06-2	N.D.	0.5	1	1	1
Metals		**SW-846 6010B**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	
07035	Arsenic	7440-38-2	N.D.	0.0097	0.0200	0.0200	1
07046	Barium	7440-39-3	0.249	0.0011	0.0025	0.0050	1
07049	Cadmium	7440-43-9	N.D.	0.00049	0.0013	0.0050	1
07051	Chromium	7440-47-3	0.0028 J	0.0018	0.0038	0.0150	1
07055	Lead	7439-92-1	N.D.	0.0062	0.0150	0.0150	1
07036	Selenium	7782-49-2	N.D.	0.0097	0.0200	0.0200	1
07066	Silver	7440-22-4	N.D.	0.0019	0.0050	0.0050	1
		SW-846 7470A	**mg/l**	**mg/l**	**mg/l**	**mg/l**	
00259	Mercury	7439-97-6	N.D.	0.000050	0.00010	0.00020	1
Wet Chemistry		**SW-846 Chapter 7.3**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	
01123	Cyanide (Reactivity)	n.a.	N.D.	19.1	57.4	57.4	1
		ASTM D93- 07	**Degrees F**	**Degrees F**	**Degrees F**	**Degrees F**	
00430	Flash Point	n.a.	No Flash Observed	50	50	50	1
	No flash observed below 182F. Test flame extinguished at 162F. Flash point was determined using Pensky Martens closed cup apparatus.						

*=This limit was used in the evaluation of the final result

Sample Description: DRUM 3 Groundwater
2015341-06-0604

LL Sample # WW 8844837
LL Group # 1767809
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 12:15 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60403 SDG#: OTI36-01

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
Wet Chemistry	**EPA 170.1**		**Degrees C**	**Degrees C**	**Degrees C**	**Degrees C**	
12151	Temperature of pH	n.a.	20.0	0.010	0.010	0.010	1
	SM 4500-H+ B-2000		**Std. Units**	**Std. Units**	**Std. Units**	**Std. Units**	
12152	pH	n.a.	8.1	0.010	0.010	0.010	1
	SW-846 Chapter 7						
00496	Corrosivity	n.a.	See Below	0	0	0	1
	The pH of the sample is 8.07 indicating that the sample is not corrosive. A sample is corrosive if it exhibits a pH equal to or less than 2 or equal to or greater than 12.5.						
	SW-846 Chapter 7.3		**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	
01122	Sulfide (Reactivity)	n.a.	N.D.	53.6	150	160	1
	SW-846 Chapter 7.3		**see below**	**see below**	**see below**	**see below**	
01121	Reactivity	n.a.	See Below	0	0	0	1
	Reactivity: This sample was extracted and analyzed by the interim method described in SW-846 Revision 3, December 1996 - Chapter 7.3. The Interim Guidance for Reactive Cyanide and Reactive Sulfide (SW-846 Sections 7.3.3 and 7.3.4 of Chapter 7 - December 1996) identifies a reactive material as generating more than 250 mg/kg of hydrogen cyanide or 500 mg/kg of hydrogen sulfide. This waste is not considered hazardous due to reactivity based on that standard. These results do not reflect total cyanide or total sulfide. On July 14, 2005, EPA published a rule in the Federal Register that removed the Interim Guidance and the method referenced above. At this time there is no specific guidance or a method to be used to evaluate "Reactivity".						

Sample Comments

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10335	TCL VOCs 4.3 8260B	SW-846 8260B	1	Y170581AA	02/27/2017 13:41	Brett W Kenyon	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	Y170581AA	02/27/2017 13:41	Brett W Kenyon	1
14240	TCL SVOCs 8270C	SW-846 8270C	1	17054WAD026	02/24/2017 13:06	Holly B Ziegler	1
00813	BNA Water Extraction	SW-846 3510C	1	17054WAD026	02/23/2017 17:00	Kate E Lutte	1
07035	Arsenic	SW-846 6010B	1	170531848004	02/24/2017 15:54	Suzanne M Will	1
07046	Barium	SW-846 6010B	1	170531848004	02/24/2017 15:54	Suzanne M Will	1
07049	Cadmium	SW-846 6010B	1	170531848004	02/24/2017 15:54	Suzanne M Will	1
07051	Chromium	SW-846 6010B	1	170531848004	02/24/2017 15:54	Suzanne M Will	1
07055	Lead	SW-846 6010B	1	170531848004	02/24/2017 15:54	Suzanne M Will	1
07036	Selenium	SW-846 6010B	1	170531848004	02/24/2017 15:54	Suzanne M Will	1

*=This limit was used in the evaluation of the final result

Sample Description: DRUM 3 Groundwater
2015341-06-0604

LL Sample # WW 8844837
LL Group # 1767809
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 12:15 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60403 SDG#: OTI36-01

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
07066	Silver	SW-846 6010B	1	170531848004	02/24/2017 15:54	Suzanne M Will	1
00259	Mercury	SW-846 7470A	1	170535713005	02/24/2017 11:35	Damary Valentin	1
01848	ICP-WW, 3005A (tot rec) - U3	SW-846 3005A	1	170531848004	02/24/2017 08:05	Denise L Trimby	1
05713	WW SW846 Hg Digest	SW-846 7470A	1	170535713005	02/24/2017 08:15	Denise L Trimby	1
01123	Cyanide (Reactivity)	SW-846 Chapter 7.3	1	17061104201A	03/02/2017 07:03	Dein K Bernot	1
00430	Flash Point	ASTM D93- 07	1	17058043001A	02/27/2017 14:20	Susan A Engle	1
12151	Temperature of pH	EPA 170.1	1	17056121521A	02/25/2017 12:20	Luz M Groff	1
12152	pH	SM 4500-H+ B-2000	1	17056121521A	02/25/2017 12:20	Luz M Groff	1
00496	Corrosivity	SW-846 Chapter 7	1	17056121521A	02/25/2017 12:20	Luz M Groff	1
01121	Reactivity	SW-846 Chapter 7.3	1	17060112101A	03/01/2017 08:20	Susan E Hibner	1
01122	Sulfide (Reactivity)	SW-846 Chapter 7.3	1	17060112101A	03/01/2017 08:20	Susan E Hibner	1

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*=This limit was used in the evaluation of the final result

Sample Description: **DRUM 4 Groundwater**
2015341-06-0604

LL Sample # WW 8844838
LL Group # 1767809
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 12:25 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60404 SDG#: OTI36-02

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
GC/MS	**Volatiles SW-846 8260B**		ug/l	ug/l	ug/l	ug/l	
10335	Acetone	67-64-1	N.D.	6	20	20	1
10335	Benzene	71-43-2	N.D.	0.5	1	1	1
10335	Bromodichloromethane	75-27-4	N.D.	0.5	1	1	1
10335	Bromoform	75-25-2	N.D.	0.5	1	4	1
10335	Bromomethane	74-83-9	N.D.	0.5	1	1	1
10335	2-Butanone	78-93-3	N.D.	3	8	10	1
10335	Carbon Disulfide	75-15-0	N.D.	1	2	5	1
10335	Carbon Tetrachloride	56-23-5	N.D.	0.5	1	1	1
10335	Chlorobenzene	108-90-7	N.D.	0.5	1	1	1
10335	Chloroethane	75-00-3	N.D.	0.5	1	1	1
10335	Chloroform	67-66-3	N.D.	0.5	1	1	1
10335	Chloromethane	74-87-3	N.D.	0.5	1	1	1
10335	Cyclohexane	110-82-7	N.D.	2	4	5	1
10335	1,2-Dibromo-3-chloropropane	96-12-8	N.D.	2	4	5	1
10335	Dibromochloromethane	124-48-1	N.D.	0.5	1	1	1
10335	1,2-Dibromoethane	106-93-4	N.D.	0.5	1	1	1
10335	1,2-Dichlorobenzene	95-50-1	N.D.	1	2	5	1
10335	1,3-Dichlorobenzene	541-73-1	N.D.	1	2	5	1
10335	1,4-Dichlorobenzene	106-46-7	N.D.	1	2	5	1
10335	Dichlorodifluoromethane	75-71-8	N.D.	0.5	1	1	1
10335	1,1-Dichloroethane	75-34-3	N.D.	0.5	1	1	1
10335	1,2-Dichloroethane	107-06-2	N.D.	0.5	1	1	1
10335	1,1-Dichloroethene	75-35-4	N.D.	0.5	1	1	1
10335	cis-1,2-Dichloroethene	156-59-2	N.D.	0.5	1	1	1
10335	trans-1,2-Dichloroethene	156-60-5	N.D.	0.5	1	1	1
10335	1,2-Dichloropropane	78-87-5	N.D.	0.5	1	1	1
10335	cis-1,3-Dichloropropene	10061-01-5	N.D.	0.5	1	1	1
10335	trans-1,3-Dichloropropene	10061-02-6	N.D.	0.5	1	1	1
10335	Ethylbenzene	100-41-4	3	0.5	1	1	1
10335	Freon 113	76-13-1	N.D.	2	4	10	1
10335	2-Hexanone	591-78-6	N.D.	3	8	10	1
10335	Isopropylbenzene	98-82-8	N.D.	1	2	5	1
10335	Methyl Acetate	79-20-9	N.D.	1	2	5	1
10335	Methyl Tertiary Butyl Ether	1634-04-4	N.D.	0.5	1	1	1
10335	4-Methyl-2-pentanone	108-10-1	N.D.	3	8	10	1
10335	Methylcyclohexane	108-87-2	N.D.	1	2	5	1
10335	Methylene Chloride	75-09-2	N.D.	2	4	4	1
10335	Styrene	100-42-5	N.D.	1	2	5	1
10335	1,1,2,2-Tetrachloroethane	79-34-5	N.D.	0.5	1	1	1
10335	Tetrachloroethene	127-18-4	N.D.	0.5	1	1	1
10335	Toluene	108-88-3	N.D.	0.5	1	1	1
10335	1,2,4-Trichlorobenzene	120-82-1	N.D.	1	2	5	1
10335	1,1,1-Trichloroethane	71-55-6	N.D.	0.5	1	1	1
10335	1,1,2-Trichloroethane	79-00-5	N.D.	0.5	1	1	1
10335	Trichloroethene	79-01-6	N.D.	0.5	1	1	1
10335	Trichlorofluoromethane	75-69-4	N.D.	0.5	1	1	1
10335	Vinyl Chloride	75-01-4	N.D.	0.5	1	1	1
10335	Xylene (Total)	1330-20-7	15	0.5	1	1	1

*=This limit was used in the evaluation of the final result

Sample Description: DRUM 4 Groundwater
2015341-06-0604

LL Sample # WW 8844838
LL Group # 1767809
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 12:25 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60404 SDG#: OTI36-02

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
GC/MS	**Semivolatiles SW-846 8270C**		ug/l	ug/l	ug/l	ug/l	
14240	Acenaphthene	83-32-9	N.D.	0.1	0.4	0.5	1
14240	Acenaphthylene	208-96-8	N.D.	0.1	0.4	0.5	1
14240	Acetophenone	98-86-2	N.D.	0.5	1	1	1
14240	Anthracene	120-12-7	N.D.	0.1	0.4	0.5	1
14240	Atrazine	1912-24-9	N.D.	2	4	5	1
14240	Benzaldehyde	100-52-7	N.D.	1	4	5	1
14240	Benzo(a)anthracene	56-55-3	N.D.	0.1	0.4	0.5	1
14240	Benzo(a)pyrene	50-32-8	N.D.	0.1	0.4	0.5	1
14240	Benzo(b)fluoranthene	205-99-2	N.D.	0.1	0.4	0.5	1
14240	Benzo(g,h,i)perylene	191-24-2	N.D.	0.1	0.4	0.5	1
14240	Benzo(k)fluoranthene	207-08-9	N.D.	0.1	0.4	0.5	1
14240	1,1'-Biphenyl	92-52-4	N.D.	0.5	1	1	1
14240	4-Bromophenyl-phenylether	101-55-3	N.D.	0.5	1	1	1
14240	Butylbenzylphthalate	85-68-7	N.D.	2	4	5	1
14240	Di-n-butylphthalate	84-74-2	N.D.	2	4	5	1
14240	Caprolactam	105-60-2	N.D.	5	15	15	1
14240	Carbazole	86-74-8	N.D.	0.5	1	1	1
14240	4-Chloro-3-methylphenol	59-50-7	N.D.	0.5	1	1	1
14240	4-Chloroaniline	106-47-8	N.D.	0.5	1	1	1
14240	bis(2-Chloroethoxy)methane	111-91-1	N.D.	0.5	1	1	1
14240	bis(2-Chloroethyl)ether	111-44-4	N.D.	0.5	1	1	1
14240	2-Chloronaphthalene	91-58-7	N.D.	0.4	1	1	1
14240	2-Chlorophenol	95-57-8	N.D.	0.5	1	1	1
14240	4-Chlorophenyl-phenylether	7005-72-3	N.D.	0.5	1	1	1
14240	2,2'-oxybis(1-Chloropropane)	108-60-1	N.D.	0.5	1	1	1
	Bis(2-chloroisopropyl) ether CAS #39638-32-9 and 2,2'-Oxybis(1-chloropropane) CAS #108-60-1 cannot be separated chromatographically. The reported result represents the combined total of both compounds.						
14240	Chrysene	218-01-9	N.D.	0.1	0.4	0.5	1
14240	Dibenz(a,h)anthracene	53-70-3	N.D.	0.1	0.4	0.5	1
14240	Dibenzofuran	132-64-9	N.D.	0.5	1	1	1
14240	3,3'-Dichlorobenzidine	91-94-1	N.D.	2	4	5	1
14240	2,4-Dichlorophenol	120-83-2	N.D.	0.5	1	1	1
14240	Diethylphthalate	84-66-2	N.D.	2	4	5	1
14240	2,4-Dimethylphenol	105-67-9	N.D.	0.5	1	1	1
14240	Dimethylphthalate	131-11-3	N.D.	2	4	5	1
14240	4,6-Dinitro-2-methylphenol	534-52-1	N.D.	5	15	15	1
14240	2,4-Dinitrophenol	51-28-5	N.D.	10	30	30	1
14240	2,4-Dinitrotoluene	121-14-2	N.D.	1	4	5	1
14240	2,6-Dinitrotoluene	606-20-2	N.D.	0.5	1	1	1
14240	bis(2-Ethylhexyl)phthalate	117-81-7	N.D.	2	4	5	1
14240	Fluoranthene	206-44-0	N.D.	0.1	0.4	0.5	1
14240	Fluorene	86-73-7	N.D.	0.1	0.4	0.5	1
14240	Hexachlorobenzene	118-74-1	N.D.	0.1	0.4	0.5	1
14240	Hexachlorobutadiene	87-68-3	N.D.	0.5	1	1	1
14240	Hexachlorocyclopentadiene	77-47-4	N.D.	5	15	15	1
14240	Hexachloroethane	67-72-1	N.D.	1	4	5	1
14240	Indeno(1,2,3-cd)pyrene	193-39-5	N.D.	0.1	0.4	0.5	1

*=This limit was used in the evaluation of the final result

Sample Description: DRUM 4 Groundwater
2015341-06-0604

LL Sample # WW 8844838
LL Group # 1767809
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 12:25 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60404 SDG#: OTI36-02

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
GC/MS Semivolatiles	**SW-846 8270C**		**ug/l**	**ug/l**	**ug/l**	**ug/l**	
14240	Isophorone	78-59-1	N.D.	0.5	1	1	1
14240	2-Methylnaphthalene	91-57-6	N.D.	0.1	0.4	0.5	1
14240	2-Methylphenol	95-48-7	N.D.	0.5	1	1	1
14240	4-Methylphenol	106-44-5	N.D.	0.5	1	1	1
	3-Methylphenol and 4-methylphenol cannot be resolved under the chromatographic conditions used for sample analysis. The result reported for 4-methylphenol represents the combined total of both compounds.						
14240	Naphthalene	91-20-3	N.D.	0.1	0.4	0.5	1
14240	2-Nitroaniline	88-74-4	N.D.	0.5	1	1	1
14240	3-Nitroaniline	99-09-2	N.D.	0.5	1	1	1
14240	4-Nitroaniline	100-01-6	N.D.	0.5	1	1	1
14240	Nitrobenzene	98-95-3	N.D.	0.5	1	1	1
14240	2-Nitrophenol	88-75-5	N.D.	0.5	1	1	1
14240	4-Nitrophenol	100-02-7	N.D.	10	30	30	1
14240	N-Nitroso-di-n-propylamine	621-64-7	N.D.	0.5	1	1	1
14240	N-Nitrosodiphenylamine	86-30-6	N.D.	0.5	1	1	1
	N-nitrosodiphenylamine decomposes in the GC inlet forming diphenylamine. The result reported for N-nitrosodiphenylamine represents the combined total of both compounds.						
14240	Di-n-octylphthalate	117-84-0	N.D.	2	4	5	1
14240	Pentachlorophenol	87-86-5	N.D.	1	4	5	1
14240	Phenanthrene	85-01-8	N.D.	0.1	0.4	0.5	1
14240	Phenol	108-95-2	N.D.	0.5	1	1	1
14240	Pyrene	129-00-0	N.D.	0.1	0.4	0.5	1
14240	2,4,5-Trichlorophenol	95-95-4	N.D.	0.5	1	1	1
14240	2,4,6-Trichlorophenol	88-06-2	N.D.	0.5	1	1	1
Metals	**SW-846 6010B**		**mg/l**	**mg/l**	**mg/l**	**mg/l**	
07035	Arsenic	7440-38-2	N.D.	0.0097	0.0200	0.0200	1
07046	Barium	7440-39-3	0.0957	0.0011	0.0025	0.0050	1
07049	Cadmium	7440-43-9	N.D.	0.00049	0.0013	0.0050	1
07051	Chromium	7440-47-3	0.0036 J	0.0018	0.0038	0.0150	1
07055	Lead	7439-92-1	N.D.	0.0062	0.0150	0.0150	1
07036	Selenium	7782-49-2	N.D.	0.0097	0.0200	0.0200	1
07066	Silver	7440-22-4	N.D.	0.0019	0.0050	0.0050	1
	SW-846 7470A		**mg/l**	**mg/l**	**mg/l**	**mg/l**	
00259	Mercury	7439-97-6	N.D.	0.000050	0.00010	0.00020	1
Wet Chemistry	**SW-846 Chapter 7.3**		**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	
01123	Cyanide (Reactivity)	n.a.	N.D.	19.7	59.2	59.2	1
	ASTM D93- 07		**Degrees F**	**Degrees F**	**Degrees F**	**Degrees F**	
00430	Flash Point	n.a.	No Flash Observed	50	50	50	1
	No flash observed below 184F. Test flame extinguished at 164F. Flash point was determined using Pensky Martens closed cup apparatus.						

*=This limit was used in the evaluation of the final result

Sample Description: DRUM 4 Groundwater
2015341-06-0604

LL Sample # WW 8844838
LL Group # 1767809
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 12:25 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60404 SDG#: OTI36-02

CAT No.	Analysis Name	CAS Number	Result	Detection Limit*	Limit of Detection	Limit of Quantitation	DF
Wet Chemistry	**EPA 170.1**		**Degrees C**	**Degrees C**	**Degrees C**	**Degrees C**	
12151	Temperature of pH	n.a.	20.0	0.010	0.010	0.010	1
	SM 4500-H+ B-2000		**Std. Units**	**Std. Units**	**Std. Units**	**Std. Units**	
12152	pH	n.a.	8.0	0.010	0.010	0.010	1
	SW-846 Chapter 7						
00496	Corrosivity The pH of the sample is 8.02 indicating that the sample is not corrosive. A sample is corrosive if it exhibits a pH equal to or less than 2 or equal to or greater than 12.5.	n.a.	See Below	0	0	0	1
	SW-846 Chapter 7.3		**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	
01122	Sulfide (Reactivity)	n.a.	N.D.	53.6	150	160	1
	SW-846 Chapter 7.3		**see below**	**see below**	**see below**	**see below**	
01121	Reactivity Reactivity: This sample was extracted and analyzed by the interim method described in SW-846 Revision 3, December 1996 - Chapter 7.3. The Interim Guidance for Reactive Cyanide and Reactive Sulfide (SW-846 Sections 7.3.3 and 7.3.4 of Chapter 7 - December 1996) identifies a reactive material as generating more than 250 mg/kg of hydrogen cyanide or 500 mg/kg of hydrogen sulfide. This waste is not considered hazardous due to reactivity based on that standard. These results do not reflect total cyanide or total sulfide. On July 14, 2005, EPA published a rule in the Federal Register that removed the Interim Guidance and the method referenced above. At this time there is no specific guidance or a method to be used to evaluate "Reactivity".	n.a.	See Below	0	0	0	1

Sample Comments

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
10335	TCL VOCs 4.3 8260B	SW-846 8260B	1	Y170581AA	02/27/2017 14:03	Brett W Kenyon	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	Y170581AA	02/27/2017 14:03	Brett W Kenyon	1
14240	TCL SVOCs 8270C	SW-846 8270C	1	17054WAD026	02/24/2017 13:35	Holly B Ziegler	1
00813	BNA Water Extraction	SW-846 3510C	1	17054WAD026	02/23/2017 17:00	Kate E Lutte	1
07035	Arsenic	SW-846 6010B	1	170531848004	02/24/2017 16:03	Suzanne M Will	1
07046	Barium	SW-846 6010B	1	170531848004	02/24/2017 16:03	Suzanne M Will	1
07049	Cadmium	SW-846 6010B	1	170531848004	02/24/2017 16:03	Suzanne M Will	1
07051	Chromium	SW-846 6010B	1	170531848004	02/24/2017 16:03	Suzanne M Will	1
07055	Lead	SW-846 6010B	1	170531848004	02/24/2017 16:03	Suzanne M Will	1
07036	Selenium	SW-846 6010B	1	170531848004	02/24/2017 16:03	Suzanne M Will	1

*=This limit was used in the evaluation of the final result

Sample Description: **DRUM 4 Groundwater**
2015341-06-0604

LL Sample # WW 8844838
LL Group # 1767809
Account # 37016

Project Name: 2015341-06-0604

Collected: 02/17/2017 12:25 by RK

Submitted: 02/18/2017 09:50
Reported: 03/05/2017 12:22

Oneida Total Integration Ent.
1033 N. Mayfair Road
Suite 200
Milwaukee WI 53226-3442

60404 SDG#: OTI36-02

Laboratory Sample Analysis Record

CAT No.	Analysis Name	Method	Trial#	Batch#	Analysis Date and Time	Analyst	Dilution Factor
07066	Silver	SW-846 6010B	1	170531848004	02/24/2017 16:03	Suzanne M Will	1
00259	Mercury	SW-846 7470A	1	170535713005	02/24/2017 11:37	Damary Valentin	1
01848	ICP-WW, 3005A (tot rec) - U3	SW-846 3005A	1	170531848004	02/24/2017 08:05	Denise L Trimby	1
05713	WW SW846 Hg Digest	SW-846 7470A	1	170535713005	02/24/2017 08:15	Denise L Trimby	1
01123	Cyanide (Reactivity)	SW-846 Chapter 7.3	1	17061104201A	03/02/2017 07:05	Dein K Bernot	1
00430	Flash Point	ASTM D93- 07	1	17058043001A	02/27/2017 14:20	Susan A Engle	1
12151	Temperature of pH	EPA 170.1	1	17056121521A	02/25/2017 12:20	Luz M Groff	1
12152	pH	SM 4500-H+ B-2000	1	17056121521A	02/25/2017 12:20	Luz M Groff	1
00496	Corrosivity	SW-846 Chapter 7	1	17056121521A	02/25/2017 12:20	Luz M Groff	1
01121	Reactivity	SW-846 Chapter 7.3	1	17060112101A	03/01/2017 08:20	Susan E Hibner	1
01122	Sulfide (Reactivity)	SW-846 Chapter 7.3	1	17060112101A	03/01/2017 08:20	Susan E Hibner	1

Quality Control Summary

Client Name: Oneida Total Integration Ent. Group Number: 1767809
Reported: 03/05/2017 12:22

Matrix QC may not be reported if insufficient sample or site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

All Inorganic Initial Calibration and Continuing Calibration Blanks met acceptable method criteria unless otherwise noted on the Analysis Report.

Method Blank

Analysis Name	**Result** **ug/l**	**DL**** **ug/l**	**LOD** **ug/l**	**LOQ** **ug/l**
Batch number: Y170581AA	Sample number(s): 8844837-8844838			
Acetone	N.D.	6	20	20
Benzene	N.D.	0.5	1	1
Bromodichloromethane	N.D.	0.5	1	1
Bromoform	N.D.	0.5	1	4
Bromomethane	N.D.	0.5	1	1
2-Butanone	N.D.	3	8	10
Carbon Disulfide	N.D.	1	2	5
Carbon Tetrachloride	N.D.	0.5	1	1
Chlorobenzene	N.D.	0.5	1	1
Chloroethane	N.D.	0.5	1	1
Chloroform	N.D.	0.5	1	1
Chloromethane	N.D.	0.5	1	1
Cyclohexane	N.D.	2	4	5
1,2-Dibromo-3-chloropropane	N.D.	2	4	5
Dibromochloromethane	N.D.	0.5	1	1
1,2-Dibromoethane	N.D.	0.5	1	1
1,2-Dichlorobenzene	N.D.	1	2	5
1,3-Dichlorobenzene	N.D.	1	2	5
1,4-Dichlorobenzene	N.D.	1	2	5
Dichlorodifluoromethane	N.D.	0.5	1	1
1,1-Dichloroethane	N.D.	0.5	1	1
1,2-Dichloroethane	N.D.	0.5	1	1
1,1-Dichloroethene	N.D.	0.5	1	1
cis-1,2-Dichloroethene	N.D.	0.5	1	1
trans-1,2-Dichloroethene	N.D.	0.5	1	1
1,2-Dichloropropane	N.D.	0.5	1	1
cis-1,3-Dichloropropene	N.D.	0.5	1	1
trans-1,3-Dichloropropene	N.D.	0.5	1	1
Ethylbenzene	N.D.	0.5	1	1
Freon 113	N.D.	2	4	10
2-Hexanone	N.D.	3	8	10
Isopropylbenzene	N.D.	1	2	5
Methyl Acetate	N.D.	1	2	5
Methyl Tertiary Butyl Ether	N.D.	0.5	1	1
4-Methyl-2-pentanone	N.D.	3	8	10
Methylcyclohexane	N.D.	1	2	5
Methylene Chloride	N.D.	2	4	4
Styrene	N.D.	1	2	5
1,1,2,2-Tetrachloroethane	N.D.	0.5	1	1
Tetrachloroethene	N.D.	0.5	1	1

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.
(3) The surrogate spike amount was less than the LOD.
P###### is indicative of a Background or Unspiked sample that is batch matrix QC and was not performed using a sample from this submission group.

Quality Control Summary

Client Name: Oneida Total Integration Ent. Group Number: 1767809
Reported: 03/05/2017 12:22

Method Blank (continued)

Analysis Name	**Result** ug/l	**DL**** ug/l	**LOD** ug/l	**LOQ** ug/l
Toluene	N.D.	0.5	1	1
1,2,4-Trichlorobenzene	N.D.	1	2	5
1,1,1-Trichloroethane	N.D.	0.5	1	1
1,1,2-Trichloroethane	N.D.	0.5	1	1
Trichloroethene	N.D.	0.5	1	1
Trichlorofluoromethane	N.D.	0.5	1	1
Vinyl Chloride	N.D.	0.5	1	1
Xylene (Total)	N.D.	0.5	1	1
Batch number: 17054WAD026	Sample number(s): 8844837-8844838			
Acenaphthene	N.D.	0.1	0.4	0.5
Acenaphthylene	N.D.	0.1	0.4	0.5
Acetophenone	N.D.	0.5	1	1
Anthracene	N.D.	0.1	0.4	0.5
Atrazine	N.D.	2	4	5
Benzaldehyde	N.D.	1	4	5
Benzo(a)anthracene	N.D.	0.1	0.4	0.5
Benzo(a)pyrene	N.D.	0.1	0.4	0.5
Benzo(b)fluoranthene	N.D.	0.1	0.4	0.5
Benzo(g,h,i)perylene	N.D.	0.1	0.4	0.5
Benzo(k)fluoranthene	N.D.	0.1	0.4	0.5
1,1'-Biphenyl	N.D.	0.5	1	1
4-Bromophenyl-phenylether	N.D.	0.5	1	1
Butylbenzylphthalate	N.D.	2	4	5
Di-n-butylphthalate	N.D.	2	4	5
Caprolactam	N.D.	5	15	15
Carbazole	N.D.	0.5	1	1
4-Chloro-3-methylphenol	N.D.	0.5	1	1
4-Chloroaniline	N.D.	0.5	1	1
bis(2-Chloroethoxy)methane	N.D.	0.5	1	1
bis(2-Chloroethyl)ether	N.D.	0.5	1	1
2-Chloronaphthalene	N.D.	0.4	1	1
2-Chlorophenol	N.D.	0.5	1	1
4-Chlorophenyl-phenylether	N.D.	0.5	1	1
2,2'-oxybis(1-Chloropropane)	N.D.	0.5	1	1
Chrysene	N.D.	0.1	0.4	0.5
Dibenz(a,h)anthracene	N.D.	0.1	0.4	0.5
Dibenzofuran	N.D.	0.5	1	1
3,3'-Dichlorobenzidine	N.D.	2	4	5
2,4-Dichlorophenol	N.D.	0.5	1	1
Diethylphthalate	N.D.	2	4	5
2,4-Dimethylphenol	N.D.	0.5	1	1
Dimethylphthalate	N.D.	2	4	5
4,6-Dinitro-2-methylphenol	N.D.	5	15	15
2,4-Dinitrophenol	N.D.	10	30	30
2,4-Dinitrotoluene	N.D.	1	4	5
2,6-Dinitrotoluene	N.D.	0.5	1	1
bis(2-Ethylhexyl)phthalate	N.D.	2	4	5
Fluoranthene	N.D.	0.1	0.4	0.5

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Quality Control Summary

Client Name: Oneida Total Integration Ent. Group Number: 1767809
Reported: 03/05/2017 12:22

Method Blank (continued)

Analysis Name	**Result**	**DL****	**LOD**	**LOQ**
	ug/l	**ug/l**	**ug/l**	**ug/l**
Fluorene	N.D.	0.1	0.4	0.5
Hexachlorobenzene	N.D.	0.1	0.4	0.5
Hexachlorobutadiene	N.D.	0.5	1	1
Hexachlorocyclopentadiene	N.D.	5	15	15
Hexachloroethane	N.D.	1	4	5
Indeno(1,2,3-cd)pyrene	N.D.	0.1	0.4	0.5
Isophorone	N.D.	0.5	1	1
2-Methylnaphthalene	N.D.	0.1	0.4	0.5
2-Methylphenol	N.D.	0.5	1	1
4-Methylphenol	N.D.	0.5	1	1
Naphthalene	N.D.	0.1	0.4	0.5
2-Nitroaniline	N.D.	0.5	1	1
3-Nitroaniline	N.D.	0.5	1	1
4-Nitroaniline	N.D.	0.5	1	1
Nitrobenzene	N.D.	0.5	1	1
2-Nitrophenol	N.D.	0.5	1	1
4-Nitrophenol	N.D.	10	30	30
N-Nitroso-di-n-propylamine	N.D.	0.5	1	1
N-Nitrosodiphenylamine	N.D.	0.5	1	1
Di-n-octylphthalate	N.D.	2	4	5
Pentachlorophenol	N.D.	1	4	5
Phenanthrene	N.D.	0.1	0.4	0.5
Phenol	N.D.	0.5	1	1
Pyrene	N.D.	0.1	0.4	0.5
2,4,5-Trichlorophenol	N.D.	0.5	1	1
2,4,6-Trichlorophenol	N.D.	0.5	1	1
	mg/l	**mg/l**	**mg/l**	**mg/l**
Batch number: 170531848004	Sample number(s): 8844837-8844838			
Arsenic	N.D.	0.0097	0.0200	0.0200
Barium	N.D.	0.0011	0.0025	0.0050
Cadmium	N.D.	0.00049	0.0013	0.0050
Chromium	N.D.	0.0018	0.0038	0.0150
Lead	N.D.	0.0062	0.0150	0.0150
Selenium	N.D.	0.0097	0.0200	0.0200
Silver	N.D.	0.0019	0.0050	0.0050
Batch number: 170535713005	Sample number(s): 8844837-8844838			
Mercury	N.D.	0.000050	0.00010	0.00020
	mg/kg	**mg/kg**	**mg/kg**	**mg/kg**
Batch number: 17061104201A	Sample number(s): 8844837-8844838			
Cyanide (Reactivity)	N.D.	20.0	60.0	60.0
Batch number: 17060112101A	Sample number(s): 8844837-8844838			
Sulfide (Reactivity)	N.D.	53.6	150	160

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Quality Control Summary

Client Name: Oneida Total Integration Ent. Group Number: 1767809
Reported: 03/05/2017 12:22

LCS/LCSD

Analysis Name	**LCS Spike Added ug/l**	**LCS Conc ug/l**	**LCSD Spike Added ug/l**	**LCSD Conc ug/l**	**LCS %REC**	**LCSD %REC**	**LCS/LCSD Limits**	**RPD**	**RPD Max**
Batch number: Y170581AA	Sample number(s): 8844837-8844838								
Acetone	150	208.05	150	181.22	139	121	39-160	14	20
Benzene	20	20.27	20	20.09	101	100	79-120	1	20
Bromodichloromethane	20	17.8	20	17.56	89	88	79-125	1	20
Bromoform	20	14.48	20	14.41	72	72	66-130	0	20
Bromomethane	20	16.09	20	15.68	80	78	53-141	3	20
2-Butanone	150	146.87	150	141.27	98	94	56-143	4	20
Carbon Disulfide	20	17.33	20	16.86	87	84	64-133	3	20
Carbon Tetrachloride	20	17.68	20	16.98	88	85	72-136	4	20
Chlorobenzene	20	20	20	19.87	100	99	82-118	1	20
Chloroethane	20	16.64	20	16.19	83	81	60-138	3	20
Chloroform	20	19.65	20	19.53	98	98	79-124	1	20
Chloromethane	20	18.4	20	17.86	92	89	50-139	3	20
Cyclohexane	20	18.48	20	18.24	92	91	71-130	1	20
1,2-Dibromo-3-chloropropane	20	15.83	20	15.69	79	78	62-128	1	20
Dibromochloromethane	20	17.11	20	17.03	86	85	74-126	0	20
1,2-Dibromoethane	20	19.69	20	19.79	98	99	77-121	1	20
1,2-Dichlorobenzene	20	18.89	20	18.71	94	94	80-119	1	20
1,3-Dichlorobenzene	20	18.85	20	18.7	94	94	80-119	1	20
1,4-Dichlorobenzene	20	19.04	20	18.94	95	95	79-118	1	20
Dichlorodifluoromethane	20	16.4	20	15.84	82	79	32-152	3	20
1,1-Dichloroethane	20	20.15	20	20.11	101	101	77-125	0	20
1,2-Dichloroethane	20	20.12	20	19.88	101	99	73-128	1	20
1,1-Dichloroethene	20	19.12	20	18.44	96	92	71-131	4	20
cis-1,2-Dichloroethene	20	19.73	20	19.3	99	97	78-123	2	20
trans-1,2-Dichloroethene	20	20.06	20	19.45	100	97	75-124	3	20
1,2-Dichloropropane	20	20.38	20	20.22	102	101	78-122	1	20
cis-1,3-Dichloropropene	20	18.1	20	18.11	90	91	75-124	0	20
trans-1,3-Dichloropropene	20	18.52	20	18.75	93	94	73-127	1	20
Ethylbenzene	20	20.24	20	19.95	101	100	79-121	1	20
Freon 113	20	18.1	20	17.61	91	88	70-136	3	20
2-Hexanone	100	98.77	100	97.95	99	98	57-139	1	20
Isopropylbenzene	20	18.89	20	18.61	94	93	72-131	2	20
Methyl Acetate	20	20.07	20	20.49	100	102	56-136	2	20
Methyl Tertiary Butyl Ether	20	18.36	20	18.61	92	93	71-124	1	20
4-Methyl-2-pentanone	100	96.82	100	97.15	97	97	67-130	0	20
Methylcyclohexane	20	17.62	20	17.31	88	87	72-132	2	20
Methylene Chloride	20	19.77	20	19.4	99	97	74-124	2	20
Styrene	20	18.08	20	17.99	90	90	78-123	1	20
1,1,2,2-Tetrachloroethane	20	19.05	20	19.22	95	96	71-121	1	20
Tetrachloroethene	20	24.78	20	24.83	124	124	74-129	0	20
Toluene	20	20.26	20	19.98	101	100	80-121	1	20
1,2,4-Trichlorobenzene	20	17.34	20	17.65	87	88	69-130	2	20
1,1,1-Trichloroethane	20	16.35	20	15.86	82	79	74-131	3	20
1,1,2-Trichloroethane	20	19.93	20	19.97	100	100	80-119	0	20
Trichloroethene	20	19.95	20	19.52	100	98	79-123	2	20
Trichlorofluoromethane	20	16.94	20	16.45	85	82	65-141	3	20
Vinyl Chloride	20	17.34	20	16.95	87	85	58-137	2	20

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Quality Control Summary

Client Name: Oneida Total Integration Ent.   Group Number: 1767809
Reported: 03/05/2017 12:22

LCS/LCSD (continued)

Analysis Name	LCS Spike Added ug/l	LCS Conc ug/l	LCSD Spike Added ug/l	LCSD Conc ug/l	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Max
Xylene (Total)	60	57.96	60	57.57	97	96	79-121	1	20
	ug/l	ug/l	ug/l	ug/l					
Batch number: 17054WAD026	Sample number(s): 8844837-8844838								
Acenaphthene	50	41.46	50	46.42	83	93	47-122	11	30
Acenaphthylene	50	43.48	50	46.32	87	93	41-130	6	30
Acetophenone	50	42.77	50	44.38	86	89	46-118	4	30
Anthracene	50	49.29	50	48.58	99	97	57-123	1	30
Atrazine	50	47.98	50	48.02	96	96	44-142	0	30
Benzaldehyde	50	45.81	50	42.27	92	85	45-111	8	30
Benzo(a)anthracene	50	53.17	50	52.76	106	106	58-125	1	30
Benzo(a)pyrene	50	49.07	50	48.28	98	97	54-128	2	30
Benzo(b)fluoranthene	50	51.56	50	49.98	103	100	53-131	3	30
Benzo(g,h,i)perylene	50	50.47	50	53.47	101	107	50-134	6	30
Benzo(k)fluoranthene	50	50.83	50	49.11	102	98	57-129	3	30
1,1'-Biphenyl	50	38.99	50	43.78	78	88	49-115	12	30
4-Bromophenyl-phenylether	50	46.5	50	47.73	93	95	55-124	3	30
Butylbenzylphthalate	50	45.9	50	43.7	92	87	53-134	5	30
Di-n-butylphthalate	50	47.5	50	41.26	95	83	59-127	14	30
Caprolactam	50	13.66	50	15.12	27	30	13-37	10	30
Carbazole	50	51.46	50	48.6	103	97	60-122	6	30
4-Chloro-3-methylphenol	50	54.99	50	47.27	110	95	52-119	15	30
4-Chloroaniline	50	40.76	50	39.72	82	79	33-117	3	30
bis(2-Chloroethoxy)methane	50	53.94	50	50.91	108	102	48-120	6	30
bis(2-Chloroethyl)ether	50	45.53	50	47.05	91	94	43-118	3	30
2-Chloronaphthalene	50	37.85	50	43.32	76	87	40-116	13	30
2-Chlorophenol	50	45.57	50	47.46	91	95	38-117	4	30
4-Chlorophenyl-phenylether	50	37.99	50	44.02	76	88	53-121	15	30
2,2'-oxybis(1-Chloropropane)	50	39.08	50	37.37	78	75	43-115	4	30
Chrysene	50	53.24	50	51.16	106	102	59-123	4	30
Dibenz(a,h)anthracene	50	52.46	50	55.11	105	110	51-134	5	30
Dibenzofuran	50	41.38	50	46.27	83	93	53-118	11	30
3,3'-Dichlorobenzidine	50	38.79	50	38	78	76	27-129	2	30
2,4-Dichlorophenol	50	54.06	50	49.2	108	98	47-121	9	30
Diethylphthalate	50	43.94	50	44.87	88	90	56-125	2	30
2,4-Dimethylphenol	50	42.5	50	37.51	85	75	31-124	12	30
Dimethylphthalate	50	40.71	50	39.15	81	78	45-127	4	30
4,6-Dinitro-2-methylphenol	50	50.22	50	50.47	100	101	44-137	0	30
2,4-Dinitrophenol	100	90.54	100	93.18	91	93	23-143	3	30
2,4-Dinitrotoluene	50	49.17	50	51.27	98	103	57-128	4	30
2,6-Dinitrotoluene	50	54.67	50	54.53	109	109	57-124	0	30
bis(2-Ethylhexyl)phthalate	50	47.27	50	47.62	95	95	55-135	1	30
Fluoranthene	50	49.95	50	45.42	100	91	57-128	9	30
Fluorene	50	40.86	50	45.6	82	91	52-124	11	30
Hexachlorobenzene	50	48.61	50	48.27	97	97	53-125	1	30
Hexachlorobutadiene	50	28.92	50	34.11	58	68	22-124	16	30
Hexachlorocyclopentadiene	100	31.05	100	38.92	31	39	10-81	22	30
Hexachloroethane	50	27.41	50	34.02	55	68	21-115	22	30

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Quality Control Summary

Client Name: Oneida Total Integration Ent. Group Number: 1767809
Reported: 03/05/2017 12:22

LCS/LCSD (continued)

Analysis Name	LCS Spike Added ug/l	LCS Conc ug/l	LCSD Spike Added ug/l	LCSD Conc ug/l	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Max
Indeno(1,2,3-cd)pyrene	50	51.05	50	53.98	102	108	52-134	6	30
Isophorone	50	55.3	50	45.93	111	92	42-124	19	30
2-Methylnaphthalene	50	44.31	50	40.89	89	82	40-121	8	30
2-Methylphenol	50	44.14	50	41.79	88	84	30-117	5	30
4-Methylphenol	50	38.51	50	40.9	77	82	25-120	6	30
Naphthalene	50	39.86	50	41.4	80	83	40-121	4	30
2-Nitroaniline	50	53.65	50	54.27	107	109	55-127	1	30
3-Nitroaniline	50	45.28	50	47.95	91	96	41-128	6	30
4-Nitroaniline	50	43.62	50	44.87	87	90	57-114	3	30
Nitrobenzene	50	47.62	50	41.36	95	83	45-121	14	30
2-Nitrophenol	50	56.26	50	52.59	113	105	47-123	7	30
4-Nitrophenol	50	24.69	50	29.48	49	59	22-78	18	30
N-Nitroso-di-n-propylamine	50	44.05	50	45.37	88	91	49-119	3	30
N-Nitrosodiphenylamine	50	51.42	50	49.9	103	100	51-123	3	30
Di-n-octylphthalate	50	47.76	50	46.14	96	92	51-140	3	30
Pentachlorophenol	50	54.17	50	54.21	108	108	35-138	0	30
Phenanthrene	50	47.61	50	46.73	95	93	59-120	2	30
Phenol	50	28.11	50	29.24	56	58	16-74	4	30
Pyrene	50	49.66	50	48.28	99	97	57-126	3	30
2,4,5-Trichlorophenol	50	52.35	50	52.28	105	105	53-123	0	30
2,4,6-Trichlorophenol	50	50.94	50	53.21	102	106	50-125	4	30
	mg/l	**mg/l**	**mg/l**	**mg/l**					
Batch number: 170531848004	Sample number(s): 8844837-8844838								
Arsenic	0.150	0.160			107		87-113		
Barium	2.00	2.05			103		88-113		
Cadmium	0.0500	0.0529			106		88-113		
Chromium	0.200	0.208			104		90-113		
Lead	0.150	0.159			106		86-113		
Selenium	0.150	0.145			97		83-114		
Silver	0.0500	0.0583			117*		84-115		
Batch number: 170535713005	Sample number(s): 8844837-8844838								
Mercury	0.00100	0.000842			84		80-120		
	mg/kg	**mg/kg**	**mg/kg**	**mg/kg**					
Batch number: 17061104201A	Sample number(s): 8844837-8844838								
Cyanide (Reactivity)	1000	964.81			96		77-113		
Batch number: 17056121521A	Sample number(s): 8844837-8844838								
Corrosivity	7.00	7.00			100		89-110		
	Degrees F	**Degrees F**	**Degrees F**	**Degrees F**					
Batch number: 17058043001A	Sample number(s): 8844837-8844838								
Flash Point	81	81.7	81	81.7	101	101	97-103	0	4

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Quality Control Summary

Client Name: Oneida Total Integration Ent. Group Number: 1767809
Reported: 03/05/2017 12:22

LCS/LCSD (continued)

Analysis Name	LCS Spike Added mg/kg	LCS Conc mg/kg	LCSD Spike Added mg/kg	LCSD Conc mg/kg	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Max
Batch number: 17060112101A	Sample number(s): 8844837-8844838								
Sulfide (Reactivity)	570	435.35			76		68-102		
	Std. Units	**Std. Units**	**Std. Units**	**Std. Units**					
Batch number: 17056121521A	Sample number(s): 8844837-8844838								
pH	7.00	7.00			100		95-105		

MS/MSD

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike

Analysis Name	Unspiked Conc mg/l	MS Spike Added mg/l	MS Conc mg/l	MSD Spike Added mg/l	MSD Conc mg/l	MS %Rec	MSD %Rec	MS/MSD Limits	RPD	RPD Max
Batch number: 170531848004	Sample number(s): 8844837-8844838 UNSPK: P844835									
Arsenic	N.D.	0.150	0.161	0.150	0.162	107	108	87-113	0	20
Barium	0.208	2.00	2.27	2.00	2.27	103	103	88-113	0	20
Cadmium	N.D.	0.0500	0.0518	0.0500	0.0520	104	104	88-113	0	20
Chromium	0.00298	0.200	0.210	0.200	0.209	104	103	90-113	0	20
Lead	N.D.	0.150	0.154	0.150	0.154	103	103	86-113	0	20
Selenium	N.D.	0.150	0.152	0.150	0.147	102	98	83-114	3	20
Silver	N.D.	0.0500	0.0568	0.0500	0.0562	114	112	84-115	1	20
Batch number: 170535713005	Sample number(s): 8844837-8844838 UNSPK: P844834									
Mercury	N.D.	0.00100	0.000867	0.00100	0.000838	87	84	80-120	3	20
	mg/kg	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**					
Batch number: 17061104201A	Sample number(s): 8844837-8844838 UNSPK: P851149									
Cyanide (Reactivity)	N.D.	1000	N.D.	1000	N.D.	0*	0*	77-113	0	11
	mg/kg	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**					
Batch number: 17060112101A	Sample number(s): 8844837-8844838 UNSPK: P851149									
Sulfide (Reactivity)	N.D.	549	361.29	549	332.02	66*	60*	68-102	8	24

Laboratory Duplicate

Background (BKG) = the sample used in conjunction with the duplicate

Analysis Name	BKG Conc mg/l	DUP Conc mg/l	DUP RPD	DUP RPD Max

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Quality Control Summary

Client Name: Oneida Total Integration Ent. Group Number: 1767809
Reported: 03/05/2017 12:22

Laboratory Duplicate

Background (BKG) = the sample used in conjunction with the duplicate

Analysis Name	**BKG Conc**	**DUP Conc**	**DUP RPD**	**DUP RPD Max**
	mg/l	**mg/l**		
Batch number: 170531848004	Sample number(s): 8844837-8844838 BKG: P844835			
Arsenic	N.D.	N.D.	0 (1)	20
Barium	0.208	0.203	2	20
Cadmium	N.D.	N.D.	0 (1)	20
Chromium	0.00298	0.00277	7 (1)	20
Lead	N.D.	N.D.	0 (1)	20
Selenium	N.D.	N.D.	0 (1)	20
Silver	N.D.	N.D.	0 (1)	20
Batch number: 170535713005	Sample number(s): 8844837-8844838 BKG: P844834			
Mercury	N.D.	N.D.	0 (1)	20
Batch number: 17056121521A	Sample number(s): 8844837-8844838 BKG: P844610			
Corrosivity	7.54	7.49	1	2
	Degrees C	**Degrees C**		
Batch number: 17056121521A	Sample number(s): 8844837-8844838 BKG: P844610			
Temperature of pH	20	20	0	5
	Degrees F	**Degrees F**		
Batch number: 17058043001A	Sample number(s): 8844837-8844838 BKG: P846689			
Flash Point	139.7	136.7	2 (1)	20
	Std. Units	**Std. Units**		
Batch number: 17056121521A	Sample number(s): 8844837-8844838 BKG: P844610			
pH	7.54	7.49	1	3

Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed
unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: TCL VOCs 4.3 8260B
Batch number: Y170581AA

	Dibromofluoromethane		1,2-Dichloroethane-d4		Toluene-d8		4-Bromofluorobenzene	
	%Rec	LOD (ug/l)	%Rec	LOD (ug/l)	%Rec	LOD (ug/l)	%Rec	LOD (ug/l)
8844837	98	1	104	1	103	1	97	1
8844838	98	1	105	1	103	1	99	1
Blank	97	1	103	1	102	1	97	1
LCS	98	1	102	1	103	1	100	1
LCSD	98	1	102	1	103	1	100	1

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.
(3) The surrogate spike amount was less than the LOD.
P###### is indicative of a Background or Unspiked sample that is batch matrix QC and was not performed using a sample from this submission group.

Quality Control Summary

Client Name: Oneida Total Integration Ent. Group Number: 1767809
Reported: 03/05/2017 12:22

Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: TCL VOCs 4.3 8260B
Batch number: Y170581AA

Limits:	80-119	81-118	89-112	85-114

Analysis Name: TCL SVOCs 8270C
Batch number: 17054WAD026

	2-Fluorophenol		Phenol-d6		2,4,6-Tribromophenol		Nitrobenzene-d5		2-Fluorobiphenyl		Terphenyl-d14	
	%Rec	LOD (ug/l)	%Rec	LOD (ug/l)	%Rec	LOD (ug/l)	%Rec	LOD (ug/l)	%Rec	LOD (ug/l)	%Rec	LOD (ug/l)
8844837	45	81	32	81	93	81	75	41	75	41	87	41
8844838	44	81	30	81	89	81	76	41	69	41	90	41
Blank	37	80	28	80	88	80	71	40	57	40	92	40
LCS	64	80	50	80	100	80	90	40	77	40	93	40
LCSD	66	80	53	80	101	80	76	40	76	40	94	40
Limits:	19-119		10-71		43-140		44-120		44-119		50-134	

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.
(3) The surrogate spike amount was less than the LOD.
P###### is indicative of a Background or Unspiked sample that is batch matrix QC and was not performed using a sample from this submission group.

Environmental Analysis Request/Chain of Custody

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For Eurofins Lancaster Laboratories Environmental use only

Acct. # 37016 Group # 1767809 Sample # 884483?-39

COC #

Client Information

Client: OTIE

Acct. #: 37016

Project Name/#: 2015341-06-0604

PWSID #:

Project Manager: Cecil Irby

P.O. #: 10976

Sampler: RK, AG, CR

Quote #:

State where samples were collected: New Mexico

For Compliance: Yes ☒ No ☐

Matrix: Tissue ☐ Sediment ☐ Soil ☐ Ground ☒ Potable ☐ Water Surface ☐ NPDES ☐ Other:

Analysis Requested

Preservation Codes

Sample Identification	Collected Date	Collected Time	Grab	Composite	Soil	Water	Other:	Total # of Containers	RCRA 8	VOCs - 5ml by 8260B	pH, Temperature pH	Reactivity & Corrosivity	Flash Point	TCL SW846 8270C H2O				
Preservation Codes									N	H	/	/	/	/				
DRUM3	2/17/17	1215				X		9	1	3	1	1	1	2				
DRUM4	2/17/17	1225				X		9	1	3	1	1	1	2				

For Lab Use Only

FSC:

SCR#:

Preservation Codes

H=HCl T=Thiosulfate

N=HNO$_3$ B=NaOH

S=H$_2$SO$_4$ O=Other

Remarks

Turnaround Time (TAT) Requested (please circle)

[✓ Standard] Rush

(Rush TAT is subject to laboratory approval and surcharge.)

Date results are needed: 14 days

E-mail address: OMartinez@otie.com

Data Package Options (circle if required)

Type I (EPA Level 3 Equivalent/non-CLP)

~~Type VI (Raw Data Only)~~

Type III (Reduced non-CLP)

[✓ Level 4] ~~NJ DKQP~~

TX TRRP-13

NYSDEC Category A or B

MA MCP

CT RCP

Relinquished by	Date	Time	Received by	Date	Time
Catalina Rey	2/17/17	1330	FedEx	2/17/17	1400
				2/18/17	9:50

EDD Required? [✓ Yes] No

If yes, format: ERPIMS

Site-Specific QC (MS/MSD/Dup)? Yes [✓ No]

(If yes, indicate QC sample and submit triplicate sample volume.)

Relinquished by Commercial Carrier:

UPS ____ FedEx X Other ____

Temperature upon receipt 0.4 °C

17602809

From: Oscar Martinez <OMartinez@otie.com>
Sent: Monday, February 20, 2017 9:57 AM
To: Angela Miller; Catalina Restrepo
Subject: RE: OTIE samples 02-16-17

No we will not need the trip blanks.

Oscar A. Martinez
Oneida Total Integrated Enterprises (OTIE)
210.54-06465 x2230 office
www.otie.com

-----Original Message-----
From: Angela Miller [mailto:AngelaMiller@eurofinsUS.com]
Sent: Monday, February 20, 2017 8:56 AM
To: Catalina Restrepo
Cc: Oscar Martinez
Subject: RE: OTIE samples 02-16-17

Hi Catalina,

Thank you; we received these samples on Saturday. Did you want us to analyze the trip blanks?

Thank you,
Angela

Angela Miller
Specialist

Eurofins Lancaster Laboratories Environmental, LLC
2425 New Holland Pike
Lancaster, PA 17601
USA
Phone: +1 717-556-7260

-----Original Message-----
From: Catalina Restrepo [mailto:CRestrepo@otie.com]
Sent: Friday, February 17, 2017 9:17 PM
To: Angela Miller
Cc: Oscar Martinez
Subject: Re: OTIE samples 02-16-17

Hi Angela,
Today we shipped 2 coolers with 4 IDW kits. They are scheduled to be delivered tomorrow Saturday. The tracking # are : 809586653763 and 809586653652. Below are the COCs. I only realized after I had already taped the coolers that I didn't include de two trip blanks you sent us on the COCs. Just FYI.

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Lancaster Laboratories
Environmental

Sample Administration
Receipt Documentation Log

Doc Log ID: 176029
Group Number(s): 1767809

Client: OTIE

2015341-06-0604

Delivery and Receipt Information

Delivery Method:	Fed Ex	Arrival Timestamp:	02/18/2017 9:50
Number of Packages:	1	Number of Projects:	1
State/Province of Origin:	NM		

Arrival Condition Summary

Shipping Container Sealed:	Yes	Sample IDs on COC match Containers:	Yes
Custody Seal Present:	Yes	Sample Date/Times match COC:	Yes
Custody Seal Intact:	Yes	VOA Vial Headspace ≥ 6mm:	No
Samples Chilled:	Yes	Total Trip Blank Qty:	1
Paperwork Enclosed:	Yes	Trip Blank Type:	HCl
Samples Intact:	Yes	Air Quality Samples Present:	No
Missing Samples:	No		
Extra Samples:	No		
Discrepancy in Container Qty on COC:	No		

Unpacked by William Richardson (12178) at 16:51 on 02/18/2017

Samples Chilled Details: 2015341-06-0604

Thermometer Types: *DT = Digital (Temp. Bottle)* *IR = Infrared (Surface Temp)* *All Temperatures in °C.*

Cooler #	Thermometer ID	Corrected Temp	Therm. Type	Ice Type	Ice Present?	Ice Container	Elevated Temp?
1	DT121	0.4	DT	Wet	Y	Loose/Bag	N

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Environmental

Explanation of Symbols and Abbreviations

The following defines common symbols and abbreviations used in reporting technical data:

BMQL	Below Minimum Quantitation Level	**mg**	milligram(s)
C	degrees Celsius	**mL**	milliliter(s)
cfu	colony forming units	**MPN**	Most Probable Number
CP Units	cobalt-chloroplatinate units	**N.D.**	none detected
F	degrees Fahrenheit	**ng**	nanogram(s)
g	gram(s)	**NTU**	nephelometric turbidity units
IU	International Units	**pg/L**	picogram/liter
kg	kilogram(s)	**RL**	Reporting Limit
L	liter(s)	**TNTC**	Too Numerous To Count
lb.	pound(s)	**µg**	microgram(s)
m3	cubic meter(s)	**µL**	microliter(s)
meq	milliequivalents	**umhos/cm**	micromhos/cm

<	less than
>	greater than
ppm	parts per million - One ppm is equivalent to one milligram per kilogram (mg/kg) or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter per liter of gas.
ppb	parts per billion
Dry weight basis	Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture. All other results are reported on an as-received basis.

Laboratory Data Qualifiers:

C - Result confirmed by reanalysis
E - Concentration exceeds the calibration range
J (or G, I, X) - estimated value ≥ the Method Detection Limit (MDL or DL) and < the Limit of Quantitation (LOQ or RL)
P - Concentration difference between the primary and confirmation column >40%. The lower result is reported.
U - Analyte was not detected at the value indicated
V - Concentration difference between the primary and confirmation column >100%. The reporting limit is raised due to this disparity and evident interference…
W - The dissolved oxygen uptake for the unseeded blank is greater than 0.20 mg/L.

Additional Organic and Inorganic CLP qualifiers may be used with Form 1 reports as defined by the CLP methods.
Qualifiers specific to Dioxin/Furans and PCB Congeners are detailed on the individual Analysis Report.

Analytical test results meet all requirements of the associated regulatory program (i.e., NELAC (TNI), DoD, and ISO 17025) unless otherwise noted under the individual analysis.

Measurement uncertainty values, as applicable, are available upon request.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff.

This report shall not be reproduced except in full, without the written approval of the laboratory.

Times are local to the area of activity. Parameters listed in the 40 CFR Part 136 Table II as “analyze immediately” are not performed within 15 minutes.

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Appendix G

Data Validation Reports

(Located in Sharepoint File)

Appendix H

Water Supply Well Report

DEPARTMENT OF THE AIR FORCE
377TH AEROSPACE MEDICINE SQUADRON (AFGSC)
KIRTLAND AIR FORCE BASE, NEW MEXICO

2 Feb 17

MEMORANDUM FOR HQ AFGSC SG/SGPB
245 Davis Ave E
Barksdale AFB LA, 71101

FROM: 377 AMDS/SGPB
2050A 2nd Street SE
Kirtland AFB NM, 87117-5559

SUBJECT: Perfluorooctanoic Acid (PFOA) & Perfluorooctane Sulfonate (PFOS) Sample Results: Wells 3, 4, 14, 15, 20 & Entry Point 08.

1. Bioenvironmental Engineering (BE) conducted sampling on 28 Nov 16 for PFOA & PFOS compounds at the wells that provide drinking water for Kirtland AFB. Sampling was accomplished in wells 3, 4, 14, 15 & 20. A sample for PFOA & PFOS compounds was also taken at the distribution sampling point (EP08). This sampling was conducted IAW EPA guidelines and SAF/IEE Policy.

2. Results of this sampling indicate that Kirtland Air Force Base (KAFB) drinking water **does not** exceed the Health Advisory (HA) level of **70 ng/L** (or 70 parts per trillion) established by the EPA. PFOA & PFOS compounds are commonly found in industrial processes, firefighting foam and numerous commercial products.

3. Results are listed below:

Sample ID	**Location**	**Sample Collected**	**Sample Result (ng/L)**	**Detection Limit (ng/L)**
Post Chlorination Samples	EP08	PFOA/PFOS	**2.2**	2.0
Pre & Post Chlorination Samples	Well 3	PFOA/PFOS	ND	2.0
Pre & Post Chlorination Samples	Well 4	PFOA/PFOS	ND	2.0
Pre & Post Chlorination Samples	Well 14	PFOA/PFOS	ND	2.0
Pre & Post Chlorination Samples	Well 15	PFOA/PFOS	ND	2.0
Pre & Post Chlorination Samples	Well 20	PFOA/PFOS	ND	2.0

ND=None Detected or below the Detection Limit.

4. If you have any questions regarding the PFOA and PFOS sampling or the results, please do not hesitate to contact the undersigned at 505-846-4259.

PAUL J. HAGARTY, GS-12, DAF
Environmental Protection Specialist

2 Attachments:
1. PFOA/PFOS Sample Results
2. EPA PFOA & PFOS Fact Sheet

cc: 377 MDG/CC
377 AMDS/CC
377 MSG/CEI (Mr. John Pike)
377 MSG/CEIE (Ms. Melissa Clarke)
AFCEC/CZO (Mr. Scott Clark)
377 MSG/CEOIW (Mr. Mark Dalzell)
DOE/NNSA/SNL Field Office (Mr. Steven Black)