FINAL WORK PLAN FOR REMOVAL ACTION AND MONITORING AT SOURCE AREAS CG517 AND CS081, EIELSON AIR FORCE BASE, ALASKA

August 2018

Prepared for:

Air Force Civil Engineer Center

Prepared under:

Contract No. FA8903-17-C-0013
Task Order No. 23

Prepared by:

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ACRONYMS AND ABBREVIATIONS

%	percent
°C	degrees Celsius
°F	degrees Fahrenheit
AAC	Alaska Administrative Code
AAFES	Army Air Force Exchange System
ADEC	Alaska Department of Environmental Conservation
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
AK	Alaska Method
AST	aboveground storage tank
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, xylenes
CES	Civil Engineer Squadron
CEIEC	Civil Engineer Squadron Environmental Compliance
CEOIC	Civil Engineer Squadron Operations Flight Hazardous Waste Facility
CFR	Code of Federal Regulations
CoC	chain of custody
COC	constituent of concern
COPC	contaminant of potential concern
COR	Contracts Officer Representative
cy	cubic yards
DoD	U.S. Department of Defense
DRO	diesel-range organics
EPA	U.S. Environmental Protection Agency
ERP	Environmental Restoration Program
FSP	Field Sampling Plan
GIS	Geographic Information System
GRO	gasoline-range organics
HCL	hydrochloric acid
HSP	Health and Safety Plan
IDW	investigation-derived waste
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliters
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolts

ACRONYMS AND ABBREVIATIONS (CONTINUED)

NGVD	National Geodetic Vertical Datum
NTU	Nephelometric units
oz.	ounce
P.G.	Professional Geologist
PAH	polyaromatic hydrocarbons
PAL	preliminary action level
PCB	polychlorinated biphenyl
PCL	project cleanup level
PCP	pentachlorophenol
PID	photoionization detector
PMP®	Project Management Professional
POL	petroleum, oil, and lubricants
ppm	parts per million
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
QSM	Quality Systems Manual
RA-C	Remedial Action – Construction
RCRA	Resource Conservation and Recovery Act
RRO	residual-range organics
SAP	Sampling and Analysis Plan
SGS	SGS North America, Inc.
SVOC	semivolatile organic compound
SW	Solid Waste
Swift River	Swift River Environmental Services, LLC
TBD	to be determined
TCE	trichloroethene
TLS	Teflon-lined septa
TSD	Treatment, Storage, Disposal
U.S.	United States
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
USAF	U.S. Air Force
UST	underground storage tank
VOA	volatile organic analysis
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbon
Weston	Weston Solutions, Inc.

1. INTRODUCTION

The Air Force Civil Engineer Center (AFCEC) has contracted with Swift River Environmental Services, LLC (Swift River) to conduct environmental actions at two sites located at Eielson Air Force Base (AFB), Alaska, under Contract No. FA8903-17-C-0013. This Work Plan outlines the activities that will be performed to complete Remedial Action – Construction (RA-C), for two Environmental Restoration Program (ERP) sites, CG517 and CS081 (**Figure 1-1**). This document includes the elements of a project-specific Work Plan and Health and Safety Plan (HSP) (as required by 29 Code of Federal Regulations [CFR] 1910.120). The minimum quality assurance/quality control (QA/QC) requirements identified by the current version of the United States (U.S.) Department of Defense (DoD) Quality Systems Manual (QSM) has been incorporated in preparation of the Uniform Federal Policy – Quality Assurance Project Plan UFP-QAPP. Site investigation and reporting activities performed will be in accordance with Alaska Administration Code (AAC) Chapter 75 Section 335 administered by the Alaska Department of Environmental Conservation (ADEC).

Swift River will perform the site investigation activities during the 2018 field season at Source Areas CG517 and CS081 include:

- Excavation of petroleum, oil, and lubricants (POL)-contaminated soils to prevent human exposure to constituents of concern (COCs) in soil and reducing or eliminating further contamination in groundwater.
- Implementation of groundwater monitoring to establish contaminant concentration trends and to ensure that contamination is not migrating off-site.
- Mobilization and demobilization.
- Excavation of 800 cubic yards (cy) of POL-contaminated soils from Source Area CG517 and collection of confirmation soil samples from the excavation.
- Installation of monitoring wells at Source Areas CG517 and CS081 and collection of groundwater samples from newly installed wells.
- Surveying of monitor well locations.
- Management of all investigation-derived waste (IDW).

Following completion of the field activities, the collected information will be summarized and interpreted for development of a Site Investigation Report. This report will include a summary of the site investigation activities, present sample locations and analytical results, and provide recommendations for additional activities, if needed.

1.1. PROJECT LOCATION

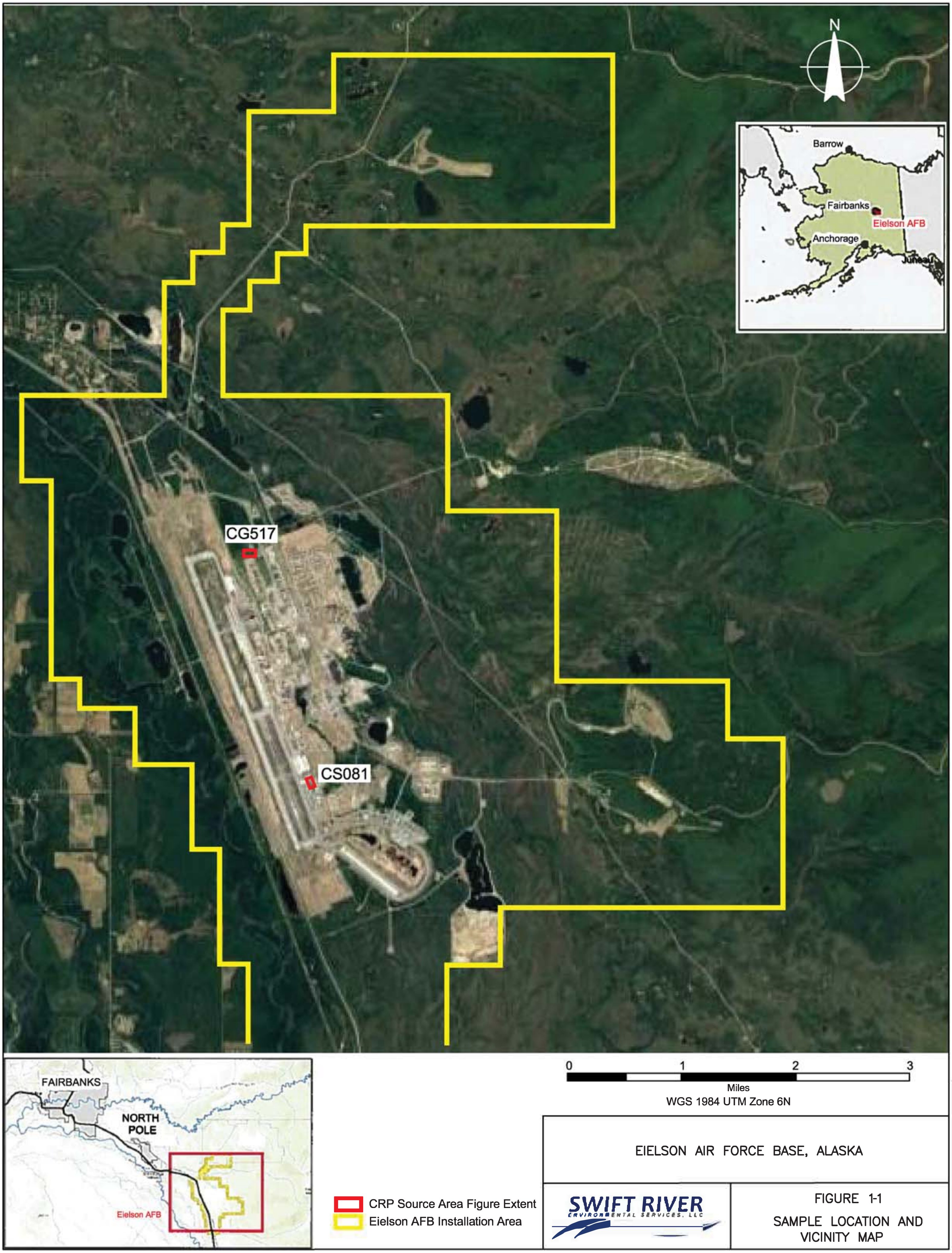
Eielson AFB is located in the east-central portion of interior Alaska, approximately 2 miles east of the Tanana River and approximately 25 miles southeast of Fairbanks, Alaska. Eielson AFB encompasses an area of approximately 19,700 acres. Established in 1944 to train and equip military personnel for air support of ground troops in an arctic environment, operations at Eielson AFB have generated varying quantities of hazardous and nonhazardous wastes from industrial and airfield operations, fire training, and fuel management.

Site CG517 is located north of the intersection of Wabash and Central Avenues at the former Army Air Force Exchange System (AAFES) station (see **Figure 1-2**). Contamination at Site CG517 is associated with fuels storage and distribution.

Site CS081, previously referred to as SER001-2008 and SS-CS523, is located in the southcentral portion of Eielson AFB (**Figure 1-3**).

1.2. PROJECT ORGANIZATION AND RESPONSIBILITY

Table 1-1 will include the contact information for general Swift River personnel responsible for the project. Contact information for contractor or task-specific responsibilities will be included with the appropriate individual task plans. **Figure 1-4** shows the general responsibility and authority organization of the project.



EIELSON AIR FORCE BASE, ALASKA

SWIFT RIVER ENVIRONMENTAL SERVICES, LLC

FIGURE 1-1

SAMPLE LOCATION AND VICINITY MAP

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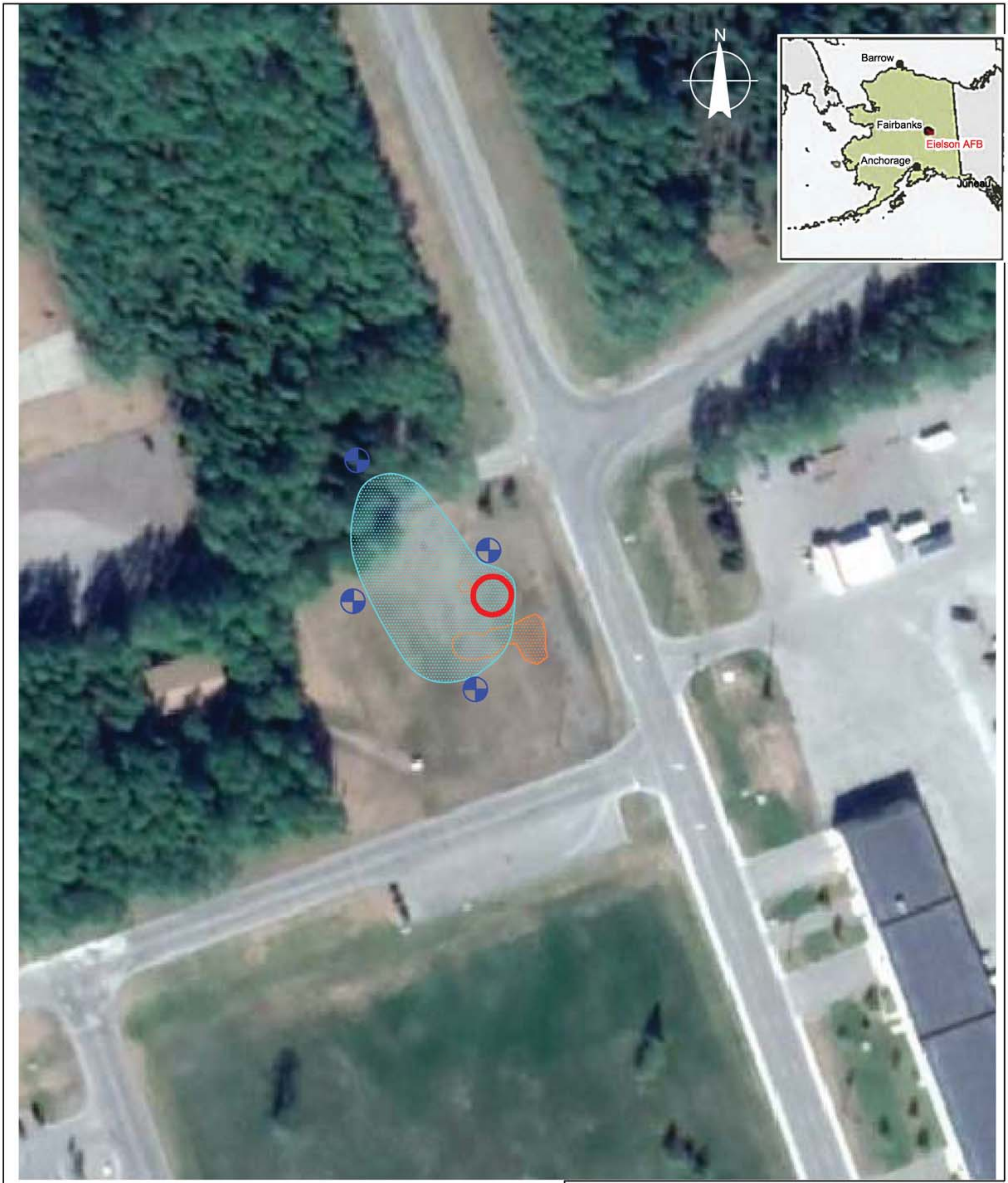

- ◍ Proposed Monitoring Well
- ░ Groundwater Contamination Extent
- ░ Proposed Excavation Area
- ▭ CG517 Historical Source Area Boundary

0 100 ft.
(Approximate)

EIELSON AIR FORCE BASE, ALASKA

SWIFT RIVER
ENVIRONMENTAL SERVICES, LLC

FIGURE 1-2
SOURCE AREA CG517

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0 100 ft.
(Approximate)

◐ Existing Monitoring Well

◐ New Monitoring Well

▭ CS081 Historical Source Area Boundary

EIELSON AIR FORCE BASE, ALASKA

SWIFT RIVER
ENVIRONMENTAL SERVICES, LLC

FIGURE 1-3
SOURCE AREA CS081

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Figure 1-4 Organization Chart

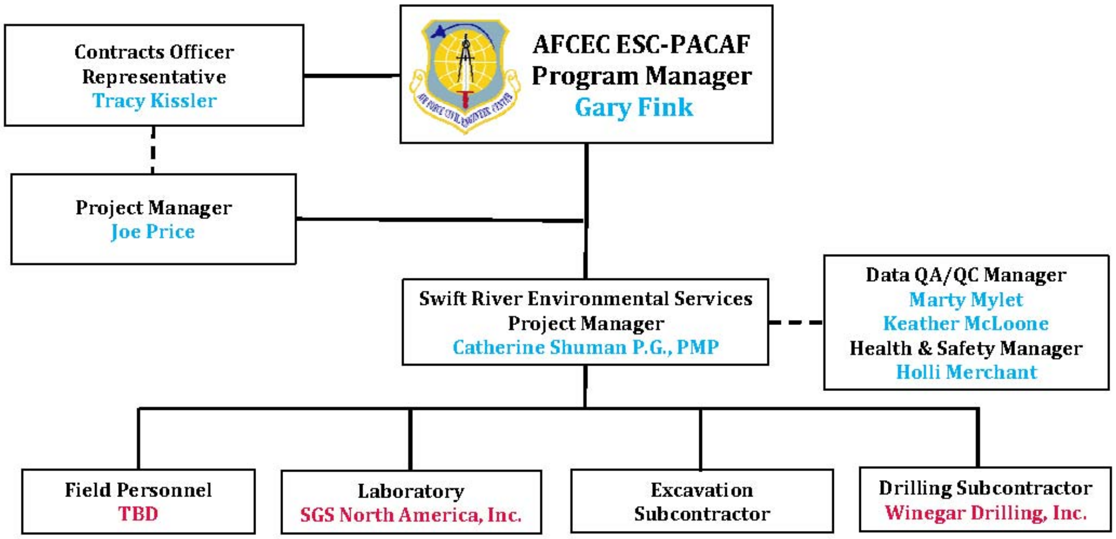

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Table 1-1 Project Contact Information

Name	Organization	Responsibility	Phone No.	Email Address
Gary Fink	USAF	Chief, Eielson Restoration	(907) 552-8757	gary.fink@us.af.mil
Tracy Kissler	USAF	COR	(907) 552-9762	tracy.kissler@us.af.mil
Joseph Price	USAF	Restoration Program Manager	(907) 377-3578	joseph.price.17@us.af.mil
Bobby Hernandez	USAF	AFCEC QA/QC Oversight (seasonal employee)	(214) 543-3578	ryhernandez1945@hotmail.com
Bri Clark	ADEC	ADEC Eielson Alternate Remedial Project Manager	(907) 451-2156	bri.clark@alaska.gov
Catherine Shuman, P.G., PMP®	Swift River	Project Manager	(907) 360-7417	catherine.shuman@swiftriveres.com
Holli Merchant	Swift River	Health and Safety Manager	(303) 695-4660	holly.merchant@swiftriveres.com
Anita Larson	Swift River	General Manager	(720) 232-6221	anita.larson@tumeq.com
Pete Zlatev	Swift River	Field Superintendent	(303) 695-4660	pete.zlatev@swiftriveres.com
Keather McLoone	Weston	Project Chemist	(907) 444-7677 or (480) 477-4908	keather.mcloone@westonsolutions.com

Notes:

ADEC	Alaska Department of Environmental Conservation
AFCEC	Air Force Civil Engineer Center
COR	Contracts Officer Representative
CS	Contaminated Sites
P.G.	Professional Geologist
PMP®	Project Management Professional
QA/QC	quality assurance/quality control
TBD	to be determined
USAF	U.S. Air Force
Weston	Weston Solutions, Inc.

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2. ENVIRONMENTAL SETTING

2.1. GEOGRAPHY

Eielson AFB is located at the edge of the Tanana-Kuskokwim Lowland physiographic province (Wahrhaftig, 1965). This area is a glaciofluvial outwash plain 45 to 50 miles wide and 470 miles long that is bounded by the Alaska Range to the south and the Yukon-Tanana Uplands to the north (Péwé, 1975). The base lies primarily on a 7-mile-wide section of the plain between the Tanana River and the uplands; the main developed area lies approximately 1.5 miles west of the uplands. Within Eielson AFB, the topography is nearly flat: elevations range from approximately 550 feet above mean sea level in the south-southeast to 525 feet above mean sea level in the north-northwest. In the hilly eastern portion of the base, elevations rise as high as 1,125 feet above mean sea level. The eastern portion of the base is largely undeveloped, but contains a few fuel and munitions storage areas, a ski area, and the Trans-Alaska Pipeline.

2.2. GEOLOGY

Eielson AFB occupies part of a tectonic basin that is filled with alluvium, primarily shed from the Alaska Range. Along the eastern edge of the base, metamorphic bedrock (Birch Creek Schist) crops out as the Yukon-Tanana Uplands; Moose Creek Bluff, a metamorphic bedrock inselberg, rises above the floodplain 3.4 miles to the northwest of the base. Tanana River deposits fill the basin beneath Eielson AFB and consist of unconsolidated fluvial sands and gravels with rare silt. These deposits have been estimated to be approximately 250 to 400 feet thick. Unmodified by human activity, the uppermost 10 to 15 feet of basin fill commonly consist of silts and sands (Péwé and Reger, 1983).

Soil borings drilled at CS081 in August and October 2013 consisted of poorly-graded sand with variable amounts of silt and gravel. Generally, the well-graded sand was interlaid with poorly-graded sand, including variable amounts of silt and gravel, from approximately 3 to 5 feet below ground surface (bgs). The well-graded sand and gravel layers extended from near the surface to 3 feet bgs, then from 5 to 7 feet bgs until the boring total depth was reached between 12 to 15 feet bgs (U.S. Air Force [USAF], 2015).

2.3. HYDROGEOLOGY

The Alaska Range forms the southern margin of the Tanana Basin and supplies most of the water to this basin in the form of glacier melt. The low hills of the Yukon-Tanana Uplands (to the north) supply a smaller amount of water, which is derived from snowmelt and summer rains. In the Eielson-Fairbanks area, the floodplain of the Tanana Basin is approximately 11 miles wide, spanning a tectonic basin filled with alluvium shed primarily from the Alaska Range.

The eastern portion of Eielson AFB is underlain by fractured bedrock, which acts as an aquifer. The upper, unconfined aquifer extends from near the ground surface to a depth of approximately 250 to 400 feet. The aquifer’s primary sources of recharge include the Tanana River, its tributaries, and vertical percolation of rainfall and snowmelt. The direction of groundwater flow in the shallow aquifer is north-northwest, which is parallel to the flow of the Tanana River. Flow may be locally influenced by buried stream channels, where the hydraulic conductivity is greater than surrounding sediments; local surface drainages; groundwater production wells; and zones of permafrost. Permafrost was not encountered at CS081, but discontinuous permafrost is present in undeveloped areas of the base (USAF, 2014).

Groundwater at CG517 was observed at approximately 1 to 14 feet bgs during 2014 (USAF, 2017). Groundwater at CS081 was observed at approximately 6 to 9 feet bgs in 2013. The highest groundwater elevations occur during May and early June, when the spring thaw occurs, yielding seasonal fluctuations of approximately 2 feet (USAF, 2017).

Several surface water bodies exist within Eielson AFB, including Garrison Slough, Piledriver Slough, Moose Creek, French Creek, and multiple ponds and lakes. Surface water is neither present at Sites CG517 and CS081 nor located directly adjacent to the sites.

2.4. CLIMATE

Eielson AFB is in a continental climatic zone that covers the interior of Alaska. The climate in this zone is characterized by great diurnal and annual temperature variations, low precipitation, and low humidity. The climate is semiarid as a result of moist maritime air masses being blocked in the south by the Alaska Range and in the north by the Brooks Range (Péwé, 1975). Large annual variations in temperature and solar radiation occur because of the high latitude location. The average summer temperature is approximately 59 degrees Fahrenheit (°F), whereas the average winter temperature is -5°F. Annual rainfall in this area averages approximately 11 inches, in addition to an average of 65 inches of snow. Rainfall is generally highest in July and August (Alaska Climate Research Center, 2017).

3. HISTORY AND SUMMARY OF PREVIOUS INVESTIGATIONS

This section provides background information and summarizes previous site activities and investigations.

3.1. CG517 – AAFES SERVICE STATION

3.1.1. Site Description

Site CG517 is situated near Facility 2375, formerly the Base Exchange Service Station in the north central portion of Eielson AFB, north of the intersection of Wabash Avenue and Central Avenue.

3.1.2. Previous Investigations

Previous activities at CG517 were focused on identifying contamination and data gaps. Information from investigations prior to 2012 was summarized from the *Phase I Source Evaluation Report for Multiple Sites at Eielson Air Force Base* (USAF, 2013). The information from more recent investigations was obtained from the following reports:

- *Phase I Source Evaluation Report for Multiple Sites at Eielson Air Force Base* (USAF, 2013).
- *Site Characterization Report for Multiple Sites, Report 2, Eielson Air Force Base, Alaska* (USAF, 2014a).
- *Report on the Background Study of Metals in Soil, Eielson Air Force Base, Alaska* (USAF, 2014b).
- *Report on the Background Study of Metals in Groundwater, Eielson Air Force Base, Alaska* (USAF, 2014c).
- *Multiple Compliance Restoration Sites Program Interim Activities Report, Eielson Air Force Base (AFB), Alaska* (USAF, 2016a).
- Draft *2016 CG517 Site Characterization Report, Eielson Air Force Base, Alaska* (USAF, 2017).

Three 10,000-gallon gasoline tanks used to store leaded and unleaded gasoline were installed in 1975 approximately 80 feet north of fuel islands. The tanks were connected to the fuel islands via transfer piping. The underground storage tanks (USTs) were approximately 26 feet long and 8 feet wide, and were attached to a concrete pad approximately 10 feet bgs. A former waste oil tank was also present at the site located west of the former Facility 2375. The locations of the site features are shown on **Figure 1-2** (USAF, 2017).

In 1992, the USTs and transfer piping were removed and replaced after two of the tanks failed tightness tests the previous year. During the excavation, petroleum-contaminated soil was observed and 1,300 cy of soil were removed. Sample results indicated that petroleum-impacted soil remained at the fuel island after excavation. Nine soil samples were obtained and analyzed, indicating the presence of benzene, toluene, ethylbenzene, and xylenes (BTEX) and gasoline-range organics (GRO) at maximum concentrations of 449 milligrams per kilogram (mg/kg) and 12,178 mg/kg, respectively. Photoionization detector (PID) field screening of organic vapors at the bottom of the excavation indicated concentrations between 2.5 to 2,500 parts per million (ppm). Three groundwater screening samples were obtained from the excavation and were analyzed for volatile organic compounds (VOCs) and volatile petroleum hydrocarbons (VPHs). Results indicated BTEX and VPH concentrations were above cleanup levels. In addition to 1992 sampling, three monitoring wells were installed on-site at this time (USAF, 2017).

In 1993, a soil organic vapor survey was conducted as part of a site assessment by collecting soil gas samples at 10 locations. These samples were analyzed for BTEX, which was detected in four boreholes north of the USTs. In addition, nine soil borings and five monitoring wells were advanced to investigate the extent of contamination. Soil and groundwater samples were analyzed for BTEX, VPHs, and total and dissolved lead. BTEX concentrations exceeded cleanup levels in soil and groundwater, whereas total lead was detected in groundwater above the U.S. Environmental Protection Agency (EPA) maximum contaminant level (MCL) (0.015 milligram per liter [mg/L]). Benzene concentrations exceeding cleanup levels were localized to the fuel island and former UST area and immediately downgradient (USAF, 2017).

In 1994, additional groundwater samples were collected from five monitoring wells and analyzed for BTEX to evaluate if contamination was still present. One sample exceeded the EPA MCL in drinking water for benzene (0.0029 mg/L). In 2011, Facility 2375 (adjacent to the USTs), fuel islands, the three USTs, and their associated piping were removed (USAF, 2017).

Contamination was encountered beneath the most recently installed tanks. In 2012, 12 soil and 3 groundwater samples were obtained and analyzed to evaluate the presence or absence of contaminants. Soil and groundwater samples were analyzed for GRO, diesel-range organics (DRO), residual-range organics (RRO), VOCs, semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and total metals. Results indicated the presence of metals in both soil and groundwater samples above cleanup levels. In addition, groundwater samples exceeded cleanup levels in GRO, DRO, BTEX, and bis(2-ethylhexyl)phthalate (USAF, 2017).

Contaminants of potential concern (COPCs) were fully developed based on the known historical activities at the site. Metals were thought to be naturally occurring because no site use of arsenic, chromium, cobalt, or iron was documented in the source area history. Lead and thallium were identified in groundwater without corresponding soil exceedances (USAF, 2017).

In 2014, 28 soil samples were collected from 14 soil borings advanced near the former fuel island, former waste oil tank, and former storage tank area. All soil samples were analyzed for GRO, DRO, RRO, VOCs, and polycyclic aromatic hydrocarbons (PAHs); three samples were also analyzed for Resource Conservation and Recovery Act (RCRA) metals and hexavalent chromium. The sample results found that no contamination was found in proximity to the waste oil tank. However, high detections of fuel and fuel-related analytes were found in the other areas of investigation. Metals results indicated that hexavalent chromium was not present. Soil delineation was nearly complete except southeast of the fuel island. Seven groundwater samples were collected from seven temporary groundwater well points advanced during the 2014 field season at Site CG517. All groundwater samples were analyzed for GRO, DRO, RRO, VOCs, and PAHs;

two samples were also analyzed for RCRA metals. Groundwater samples provided delineation of COPCs across the site (USAF, 2017).

In 2015, 12 soil and 7 groundwater samples were obtained to continue the delineation of previous project screening level exceedances in soil and groundwater. Soil and groundwater samples were analyzed for GRO, DRO, RRO, VOCs, and PAHs. Additionally, two groundwater samples were analyzed for RCRA metals. The 2015 soil and groundwater results defined the extent of COPCs exceeding the Preliminary Action Levels (PALs) with the exception of benzene. Benzene in groundwater downgradient of temporary well point TW05 and benzene upgradient of soil boring SB04 remained above the PAL (USAF, 2017).

In 2016, two additional temporary well points were added downgradient of TW05 and two soil borings were added upgradient of SB02. The soil and groundwater samples were analyzed for select VOCs that included benzene. The results from the 2016 samples were below the project screening levels. Re-evaluation of historical results against the new cleanup levels identified that 2015 TW08 benzene levels exceeded the new cleanup levels. Although there were no cross-gradient groundwater data northeast of TW08, the stakeholders did not see this as a significant data gap requiring additional investigation (USAF, 2017).

3.2. CS081 – SER001-2008 UTILITY CORRIDOR EXCAVATION

3.2.1. Site Description

CS081, previously referred to as SER001-2008 and SS-CS523, is located in the southcentral portion of Eielson AFB. Source Area ST13/DP26 is located upgradient of this site, approximately 0.25 mile to the south. The ground cover in the area is a combination of grass-covered, open field, and paved parking; it is a relatively flat site with no topographic features. Facility 4361 is currently used for cold storage. Prior to that, the property was used as a fuel storage and dispensing facility. A review of documents at the Real Property Office on Eielson AFB indicates that two 5,000-gallon aboveground storage tanks (AST) were removed from Building 4361, circa 1996. In addition, a UST and another 5,000-gallon AST were decommissioned in June 1994, but their exact locations are unknown (USAF, 2015). The fuel pipelines and distribution equipment were removed from the property; however, the removal of fuel islands and attendant piping was not documented (USAF, 2012).

3.2.2. Previous Investigations

Contamination was originally identified at CS081 during a 2008 utilidor repair near Building 4361. Release mechanisms for CS081 are presumed to include spills and leaks from the operation of three 5,000-gallon former ASTs, one former UST, and their associated piping. The exact date and time of discharge(s) or release(s) to the environment are unknown, but operation of the fueling system apparently ceased in 1992. The initial discovery of contamination, and subsequent investigation (2008 to 2010), is documented in the *Phase II Source Evaluation Report, SER001-008, Eielson Air Force Base, Alaska* (USAF, 2012) and in Section 2.18 of the *Phase I Source Evaluation Report for Multiple Sites at Eielson Air Force Base* (USAF, 2013). The Phase II study reported that the tanks existed on-site as late as 1996, and the associated pump island existed as late as 1992; however, the study found no information regarding the type of fuel that the system distributed or regarding the removal of the system.

Three soil samples collected during the utilidor repair in 2008 contained GRO, DRO, benzene, and ethylbenzene at concentrations that exceeded the most stringent ADEC Method Two Cleanup Levels. In 2009, the Phase II study investigated potential soil and groundwater contamination through the advancement of 20 soil borings and 9 temporary monitoring wells. In 2010, an additional 28 soil borings and 8 temporary monitoring wells were advanced (USAF, 2014a).

Soil analytical results from the 2009 and 2010 investigations contained arsenic, chromium, lead, BTEX, dichlorodiphenyltrichloroethane, and dichlorodiphenyldichloroethane above project cleanup levels (PCLs).

PCLs are defined as the most stringent ADEC Method Two Cleanup Levels. Arsenic detections above the PCL ranged from 4.1 mg/kg to 13.5 mg/kg. The arsenic found in soil samples was attributed to background levels. Total chromium exceeded the PCL for several soil samples collected in 2009 and 2012, with a maximum detected concentration of 50.7 mg/kg. Lead was detected above the PCL in two samples at 529 mg/kg and 1,880 mg/kg. Although lead did not appear to be widespread, it was included in the 2013 analytical suite for all samples. Lead was not found above the PCL of 400 mg/kg in the soil samples collected in 2013.

In October 2015, four soil samples were collected for chromium speciation from the 0- to 1-foot bgs interval at the same location that yielded the highest total chromium result of 50.7 mg/kg. These samples were analyzed for hexavalent chromium, as well as total chromium. Hexavalent chromium was non-detect at 1.3 mg/kg or less, implying that essentially all chromium at the site is trivalent, which has a much higher cleanup level (152,000 mg/kg). All total chromium results are far below this level, and chromium is, therefore, not a COPC.

BTEX contamination was found to be widespread during the 2009 and 2010 site investigations. Benzene exceeded the PCL in 43 samples and concentrations ranged from 0.033 mg/kg to 270 mg/kg. Ethylbenzene exceeded the PCL in 16 samples and concentrations ranged from 8.5 mg/kg to 1,200 mg/kg. Toluene was detected above the PCL in 21 samples and concentrations ranged from 7.0 mg/kg to 3,700 mg/kg. Total xylenes exceeded the PCL in 18 samples and concentrations ranged from 8.5 mg/kg to 5,200 mg/kg. Soil and groundwater samples for GRO and DRO analyses were not collected during the 2009 and 2010 field activities.

Groundwater analytical results from the 2009 and 2010 investigations reported arsenic, BTEX, n-propylbenzene, 1,2,4-trimethylbenzene, and pentachlorophenol (PCP) above PCLs (USAF, 2012). Arsenic was reported above the PCL in six samples and ranged from 0.014 mg/L to 0.028 mg/L. Benzene was detected above the PCL in six samples and ranged from 0.0061 mg/L to 62 mg/L.

Toluene was reported above the PCL in three samples from 2.4 mg/L to 80 mg/L. Ethylbenzene was detected above the PCL in four samples from 2.2 mg/L to 7.2 mg/L. Total xylenes were detected in three samples above the PCL and concentrations ranged from 13.8 mg/L to 28.4 mg/L. Two samples contained n-propylbenzene and 1,2,4-trimethylbenzene above PCLs. N-propylbenzene was detected at concentrations of 0.66 mg/L and 0.80 mg/L, and 1,2,4-

trimethylbenzene was detected at concentrations of 2.2 mg/L and 2.8 mg/L. PCP was detected in one sample above the PCL at a concentration of 6.2 mg/L.

In 2013, 58 soil samples and 12 groundwater samples were collected at CS081. Historically, VOCs above the PCLs at CS081 were BTEX, 1,2,4-trimethylbenzene, and n-propylbenzene. VOCs exceeded PCLs at four locations during the 2013 investigation (soil borings 81B008, 81B010, 81B013, and 81B227) (USAF, 2014b). Benzene exceedances were most frequent in 2013, with concentrations above the PCL (0.025 mg/kg) ranging from 0.031 mg/kg to 0.51 mg/kg. Trichloroethene (TCE) in soil boring 81B013 exceeded the PCL (0.020 mg/kg) at a concentration of 0.087 mg/kg.

Detections of VOCs above their respective cleanup levels were laterally bounded by samples below cleanup levels in all directions through previous site investigations. The solitary TCE detection was found in the shallow subsurface at 3 feet bgs, and the ADEC-approved 2013 Supplemental Characterization of Source Area CS081 concluded that this isolated detection does not warrant additional investigation.

VOCs, including BTEX, were not detected above the cleanup levels in the 2013 groundwater grab samples. The Source Area CS081 BTEX plume appears to be limited to the 2010 and 2012 detections and does not extend outside of the site boundary.

Samples collected in 2009 and 2010 were not analyzed for DRO and GRO. In 2013, DRO results exceeded the PCL (1.5 mg/L) in one sample (temporary well point 81B021). The single DRO exceedance was reported at a concentration of 2.5 mg/L. This sample was collected from a temporary wellpoint located at the far northern portion of the site outside of the suspected source area. The isolated nature of this groundwater exceedance and proximity to other facilities suggest that the DRO exceedance is not related to historical site use at CS081. A significant DRO plume does not appear to be present at the site.

GRO was not detected in groundwater above the ADEC cleanup level (2.2 mg/L) in the 2013 field samples. A GRO groundwater plume was not identified at Source Area CS081 in the 2013 investigation area, but is likely present in the area of high BTEX exceedances detected during the 2009 and 2010 sampling events.

In one groundwater screening sample, PCP detected above the PCL was also qualified as “estimated” because it was below the calibration range of the instrument. The historical exceedance of PCP in groundwater was limited to one occurrence in a 2010 groundwater grab sample. PCP in groundwater was added to the 2013 analytical suite for all samples, and a laboratory that provided reporting levels one order of magnitude below the cleanup level performed the analyses. PCP was not found above the PCL in any of the 2013 samples, and does not appear to be present in the investigation area.

The selected remedy in the December 2015 Decision Document was soil excavation, long-term groundwater monitoring, and land use controls. Soil excavation was completed in summer 2016.

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4. FIELD SAMPLING PLAN

The Field Sampling Plan (FSP) details the procedures associated with the collection of environmental samples during the 2018 field season at CG517 and CS081 as part of the removal action and monitoring at Eielson AFB, Alaska. This FSP and the Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP) together constitute the Sampling and Analysis Plan (SAP) to be used in conjunction with the Work Plan for the 2018 field program. The UFP-QAPP is provided as **Attachment 1** of this Work Plan, and the Standard Operating Procedures are provided as Appendices A and D of the UFP-QAPP.

The field objectives of the 2018 field effort at Source Areas CG517 and CS081 include:

- Excavation of POL-contaminated soils to prevent human exposure to COCs in soil and reducing or eliminating further contamination in groundwater.
- Implementation of groundwater monitoring to establish contaminant concentration trends and to ensure that contamination is not migrating off-site.

Data collection objectives for 2018 will focus on PID screening, confirmation samples, and analytical testing of soil and groundwater for both confirmation and monitoring purposes.

All environmental sampling activities will be performed by qualified persons as required and defined in 18 AAC 78.995 and 18 AAC 75.990. Soil and water samples will be collected in accordance with regulations set forth by the ADEC as defined in 18 AAC 75 and 18 AAC 78, and the guidelines presented in ADEC's *Field Sampling Guidance* (ADEC, 2017).

4.1. FIELD WORK PREPARATION

Prior to mobilization, Swift River will coordinate with USAF, the off-site laboratory, and subcontractors who will be involved in field work and will mobilize personnel and equipment to the site. Swift River will contact Eielson AFB and provide them with personnel information needed to obtain access to Eielson AFB for contractor and subcontractor field personnel.

Prior to subcontractors arriving at Eielson AFB, Swift River field representatives will complete a Base Civil Engineering Work Clearance Request (dig permit) and request utility locates from Alaska Digline at least 48 hours prior to excavating and drilling. Work will begin within 15 days of obtaining Alaska Digline utility locates or locates will be re-established. Proposed boring/drilling and dig locations will be identified using marking paint or wooden lathe. If a proposed location conflicts with known or suspected underground utilities, a revised location will be selected. The permits and associated documentation will be kept with the Swift River field representative while excavation and sampling is being performed.

4.2. EXCAVATION AND HANDLING OF CONTAMINATED MATERIALS

4.2.1. Site Security

Site security is of the utmost importance to protect the public, protect the installation property, secure equipment and materials left on-site, eliminate the chance of spreading contamination, and ensure worker safety. Site security is summarized in this subsection and has been developed to ensure these objectives are met.

4.2.2. Site Control

The Swift River site superintendent will maintain a list of on-site workers and vehicle types with license numbers. Swift River will coordinate with subcontractors prior to any deliveries by vendors or mobilization to the site.

4.2.3. Work Zones

The work area will be delineated and divided into an exclusion zone, a contamination reduction zone, and a support zone. The exclusion zone will be maintained around the work area by placing signs, barricades, and/or yellow tape as necessary. The size and the shape of the exclusion zone will be determined by the site conditions; it will be large enough to include the potentially hazardous zone around the sites.

4.2.4. Excavation Safety

Swift River will place yellow caution barricade tape around the excavation areas any time the work area is left unattended and until the excavation is backfilled to its original ground surface level. Equipment and materials will be stored inside the barricaded area to secure them after hours.

4.2.5. Excavation Activities

The soil identified with concentrations of COCs above the cleanup goals will be excavated at Source Area CG517. Because the groundwater at the site is located at approximately 10 feet bgs, groundwater should not be encountered during the initial phase of the excavation activities. However, in the unlikely event that groundwater or other liquids are encountered in any of the excavations during the removal action, the liquids will be managed as discussed below.

After the initial excavation activities are completed, soil samples will be collected from the excavation for field screening. If the results of the field screening samples are less than the cleanup goals, confirmation samples will be collected from the area. If the results exceed the cleanup goals, an additional 1 foot of soil will be excavated from the area where the sample was collected. The above process will be repeated as often as needed or until the excavation reaches a depth of 10 feet. Excavated soil will either be placed in the temporary staging area or loaded directly into trucks to be transported to the disposal facility.

If groundwater or other liquids (such as rainwater) are encountered during the removal actions, the source of the liquids will be controlled, if possible. Liquids will be pumped into an appropriately sized container. If source of the liquids cannot be controlled, excavation efforts will cease, and an action plan will be developed with USAF personnel.

4.2.6. Transportation and Disposal of Hazardous Materials

Because the soil will have been accepted at a Treatment, Storage, Disposal (TSD) facility prior to initiating the field activities, the excavated soil can be loaded directly into trucks for transport to the TSD facility. However, the contractor may take the excavated soil to the soil staging area, if it is determined that it is cost effective to store the soil at the staging area and there is sufficient space at the site. Once a truckload of soil has been staged, the soil can be loaded into the truck for transport to the TSD facility. The truck driver shall cover the trailer with tarps and complete the manifests prior to leaving the site.

4.2.7. Backfilling and Compaction

After the results of the confirmation samples show that COCs are below the cleanup goals, a permeable synthetic liner will be placed in the bottom of the excavation areas prior to the placement of any fill material. The excavations will be backfilled with clean fill from an off-site source. The fill will be placed in 6-inch lifts and compacted with equipment suitable for the soil type.

4.2.8. Site Restoration

The surface of the site will be revegetated to match existing grade after the completion of the excavation activities. Minimizing surface water infiltration will help prevent further migration of contaminants within the shallow groundwater zone and will also help prevent further migration of contaminants within the shallow groundwater zone to the deeper groundwater zone.

4.3. FIELD SCREENING

Field screening will be conducted using a PID to test soil sample headspace gases for measurable volatile organic vapors. PID readings are qualitative indicators used to conservatively bias analytical sample locations and depths, and to segregate excavated soils based upon screening indicators for suspected contaminants. For the purpose of soil segregation and determining removal action limits of POL-impacted soils, a PID soil screening action level of 20 ppm will be used. Field screening results for each sample will determine whether the sample should be sent off-site for laboratory analysis and will influence where the next sample should be collected.

Volatile organics in the soil will be screened using headspace analysis. The following headspace screening procedure will be used to obtain and analyze field screening samples using a PID:

1. Calibration of PID field instruments prior to use must follow the procedures outlined in the manufacturer’s operating manual.
2. Collect a freshly uncovered soil sample from the excavation.
3. Partially fill (one-third to one-half) a clean resealable bag with the sample to be analyzed; immediately seal the resealable bag.
4. Headspace vapors must be allowed to develop in the resealable bag for at least 10 minutes, but no longer than 1 hour; containers must be shaken or agitated for 15 seconds at the beginning and end of the headspace development period to assist volatilization;

temperatures of the headspace must be warmed to at least 40°F, with instruments calibrated for the temperature used.

5. After headspace development, the instrument sampling probe must be inserted to a point about one-half the headspace depth; the container opening must be minimized, and care must be taken to avoid uptake of water droplets and soil particulates into the PID probe.
6. After probe insertion, the highest meter reading must be taken and recorded, which normally will occur between 2 and 5 seconds after probe insertion. If erratic meter response occurs at high organic vapor concentrations or conditions of elevated headspace moisture, a note to that effect must accompany the headspace data.
7. All field screening results must be documented in the field record or logbook.

As additional assurance that a removal action is complete according to ADEC criteria, analytical confirmation samples will be collected and analyzed from the excavation limits. Because confirmation results are not immediate, the PID is used to guide the excavation limits in the field using the 20-ppm action level. Although PID methods are qualitative and do not replace laboratory confirmation analyses, they can be used to approximate areas with hydrocarbon contamination and provide semi-quantitative estimates of the contaminated soil area or volume prior to confirmation by analytical sampling.

The PID will be the primary screening tool for soil removal at Site CG517 where petroleum hydrocarbons are the primary COPCs.

4.4. CONFIRMATION SOIL SAMPLING

Confirmation samples will be collected from the limits of excavations as a remedial measure. Confirmation samples will be collected from the bottom and sidewalls of the excavation once suspect soils have been adequately removed as indicated by PID readings. Soil samples will be collected by the methods defined within the ADEC's *Field Sampling Guidance* (ADEC, 2017). Confirmation samples will be submitted to the project laboratory for site-specific COPC analyses.

Excavation bottom samples will be collected at a minimum of one confirmation sample for up to 50 square feet of exposed surface area. If the excavation bottom surface area ranges from 51 to 250 square feet, two samples will be collected from the base areas that would most likely exhibit contamination (according to PID readings). If the bottom surface area of the excavation is greater than 250 square feet, two samples will be collected from the base plus one sample for each additional 250 square feet of exposed surface. The excavation sidewalls will also be sampled at a minimum of one sample per 20 linear feet at the greatest field screening reading in all soil horizons (the area most likely to be contaminated, such as on top of confining layers, at the base of more porous layers, or along any other preferential pathways identified in the field).

All soil samples will be logged, field screened for petroleum hydrocarbons, and sampled for GRO, DRO, RRO, VOCs, and SVOCs. The soil will be logged, and sample jars filled immediately following soil removal from the ground. The soil samples will be handled using clean, disposable plastic spoons or spatulas.

4.5. MONITORING WELL INSTALLATION

Four monitoring wells will be installed at both CG517 and CS081. The monitoring wells will be installed using a hollow-stem auger. The monitoring wells will be installed at a total depth of 20 feet bgs with groundwater estimated to be 10 feet bgs. Each well will be constructed of 2-inch diameter Schedule 40 polyvinyl chloride (PVC) casing with 0.20-inch slot size screens. The filter pack will consist of 16/30 silica sand. Well completions will be stick-up monuments constructed of at least 6-inch diameter steel casing with lockable lids and a set of three protective bollards.

4.6. MONITORING WELL DEVELOPMENT

A minimum of 48 hours after well installation, the wells will be developed in accordance with the ADEC Monitoring Well Guidance. The wells will be developed using a combination of pumping, bailing, and surging. Water quality parameters (turbidity, pH, dissolved oxygen, temperature, and specific conductance) will be measured during development. A minimum of three well volumes will be purged. In instances where a turbidity of less than 10 Nephelometric units (NTU) is unattainable, development will stop when 10 well volumes have been purged and pH and specific conductivity have stabilized to within 10 percent (%) over at least 2 successive pump and tubing volumes purged.

4.7. GROUNDWATER SAMPLING

Groundwater samples will be collected from newly installed monitoring wells using low-flow sampling procedures. The wells will be screened across the groundwater table. One groundwater sample will be collected from each monitoring well. Low-flow sampling will use a submersible pump. Monitoring well purging will be conducted in accordance with EPA and ADEC low-flow guidelines; drawdown during purging will be no more than 0.3 foot, if possible, and flow rates will range from 0.1 to 1.0 liter per minute. Higher flow rates are consistent with low-flow guidelines as long as the drawdown requirement is met. Purging will continue until water quality parameter stabilization within 10% is reached or two pump volumes have been removed. Stability parameters shown in **Table 4-1** will be measured during purging and prior to sample collection.

Table 4-1 Groundwater Parameters

Parameter	Units	Recording Precision
pH	unitless	0.01
Temperature	°C	0.01
Conductivity	µS/cm	1
Turbidity	NTU	0.1
Oxidation Reduction Potential	mV	1
Dissolved Oxygen	mg/L	0.1

Notes:

°C	degrees Celsius
µS/cm	microSiemens per centimeter
mV	millivolts
NTU	Nephelometric turbidity units

Stability criteria from ADEC *Field Sampling Guidance* (ADEC, 2017).

Collected samples from these two sites will be analyzed for GRO, DRO, RRO, VOCs, and SVOCs. Analytical results will be compared to cleanup levels in 18 AAC 75, Table C.

4.8. ANALYTICAL SAMPLE COLLECTION

Remedial actions will be performed through soil screening, confirmation soil sampling, analytical testing of soils and groundwater, and soil removal. Analytical samples will be collected for the purposes of confirmation and monitoring of site conditions. All proposed actions are designed to be protective and meet regulatory requirements or approved agreements for continued actions for restoration and compliance.

SGS North America, Inc. (SGS) will perform the analysis prescribed in this Work Plan solely in their Anchorage, Alaska facility. SGS is located in Anchorage, Alaska, and copies of the Environmental Laboratory Accreditation Program and ADEC certificates and approved analytical parameter and method lists are provided in **Attachment 1**.

Laboratory analytical methods used to identify COPCs for specific environmental media are listed in **Table 4-2**.

Table 4-2 Analytical Methods

Parameters	Analytical Method SOIL	Analytical Method WATER
Gasoline-Range Organics	Alaska Method (AK) 101	AK101
Diesel-Range Organics	AK102	AK102
Residual-Range Organics	AK103	AK103
Benzene, Toluene, Ethylbenzene, and Xylenes	EPA Method SW8260B	EPA Method SW8260B
Volatile Organic Compounds	EPA Method Solid Waste (SW) 8260B	EPA Method SW8260B
Semivolatile Organic Compounds	EPA Method SW8270D	EPA Method SW8270D

4.8.1. Quality Assurance/Quality Control Sample Collection

All analytical sampling conducted during the 2018 work season will be accompanied by appropriate QA/QC sampling. One matrix spike/matrix spike duplicate (MS/MSD) sample will be collected for every 20 project samples per matrix (soil and groundwater), with at least 1 collected for each site. Field duplicates will be collected at a minimum of 1 for every 10 project samples collected, with at least 1 collected from each site and matrix. Trip blanks will accompany all samples analyzed for volatile analytes (i.e., VOCs and GRO). QA/QC sampling and procedures are further discussed in the UFP-QAPP (**Attachment 1**).

4.8.2. Sample Labels

Each sample will receive a unique sample identification number. **Table 4-3** provides sample identification numbering procedures. This sample identification structure is specified for database management purposes and must be followed exactly. Area descriptions and sample types specific to the Work Plan are provided in the table. Note that there are no spaces and no dashes. Capitalization should be as indicated for consistency and reading ease.

Table 4-3 Sample Identification Numbering Procedure

Digit Placement in Sample Number	Description	Code Example
1 and 2	Calendar year	XX (e.g., 18)
3 and 4	Month	XX (e.g., 06)
5 – 9	Sample Number or Well Number	MW01 (monitoring well 1) or CS01 (confirmation soil 1)
10 – 13	Sample Type	GW (Groundwater) SO (Soil) MS (Matrix Spike) MSD (Matrix Spike Duplicate) 10GW (Duplicate Sample)
Example: 1806CS01SO-11 • The date is June 2018 (1806) • The location is Confirmation Sample 01 (CS01) • The sample type is duplicate soil sample (10SO)		

4.8.3. Sample Containers

Sample containers will be provided by the analytical laboratory and will be pre-packaged and, in some instances, pre-tared. **Table 4-4** identifies sample containers, preservation, and holding times for each of the analytical parameters. Additional sample collection and shipping supplies, such as packaging labels, custody chains, temperature blanks, and trip blanks, will also be provided by the project laboratory. Samples will be packaged in coolers with gel ice to keep them at the appropriate temperatures during shipment. The laboratory will provide these.

Table 4-4 Sample Containers, Preservation, and Holding Times

Analysis	Media	Analytical Method	Sample Containers	Preservation	Holding Times
Gasoline-Range Organics	Soil	AK101	4 oz. amber glass, TLS	Methanol; 0-6°C	14 days from sampling
	Water	AK101	3–40 mL VOA glass	HCL; 0-6°C	14 days from sampling
Diesel-Range Organics	Soil	AK102	4 oz. amber glass, TLS	No preservative; 0-6°C	14 days from sampling
	Water	AK102	250 mL amber glass	No preservative; 0-6°C	14 days from sampling
Residual-Range Organics	Soil	AK103	4 oz. amber glass, TLS	No preservative; 0-6°C	14 days from sampling
	Water	AK103	250 mL amber glass	No preservative; 0-6°C	14 days from sampling
Volatile Organic Compounds	Soil	SW8260B	4 oz. amber glass, TLS	Methanol; 0-6°C	14 days from sampling
	Water	SW8260B	3–40 mL VOA glass	HCL; 0-6°C	14 days from sampling
Semivolatile Organic Compounds	Soil	SW8270D	4 oz. amber glass, TLS	No preservative; 0-6°C	14 days from sampling
	Water	SW8270D	250 mL amber glass	No preservative; 0-6°C	14 days from sampling

Table 4-4 Sample Containers, Preservation, and Holding Times (Continued)

Notes:

AK	Alaska method
EPA	U.S. Environmental Protection Agency
HCL	hydrochloric acid
mL	milliliter
oz.	ounce
SW	Solid Waste (EPA Method)
TLS	Teflon-lined septa sonically bonded to screw cap
VOA	volatile organic analysis

The EPA Methods are from EPA's "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," also known as SW-846. The methods, when referenced, will be described as the method number preceded by "SW."

4.8.4. Sample Custody

Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analysis, data generation, and reporting. Records concerning the custody and condition of the samples will be maintained in field and laboratory records.

Chain-of-custody (CoC) records will be maintained for all field and field QC samples. CoC records and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent to verify their completeness, accuracy, and consistency with the field logbook. A copy of the CoC will be retained in the project file, and the original and remaining copies will be taped inside the cooler for shipment.

4.9. DECONTAMINATION

Decontamination of non-disposable sampling equipment will consist of scrubbing with an Alconox wash solution followed by a potable water rinse, then a deionized or distilled water rinse. The wash and rinse water generated during decontamination will be containerized into 55-gallon drums. Mobile equipment and sampling material (e.g., drill stem tooling, cutting shoe) will be decontaminated prior to coming on-site. Reusable investigative equipment and materials will be decontaminated between borings.

4.10. INVESTIGATIVE-DERIVED WASTE

IDW generated during implementation of the CG517 and CS081 remedy will include excavated soil and purge water, and soil cuttings generated during monitoring well installation. No hazardous waste has been identified at this site. Waste with only POL contamination will be characterized, transported, and treated at an approved treatment facility in accordance with 18 AAC 75. Waste generated during investigation activities will be managed in accordance with the *Investigation-Derived Waste Management Plan, Eielson Air Force Base, Alaska* (USAF, 2016b).

Soil IDW will be transported and disposed of at Organic Incineration Technology, Inc., located in Fairbanks, Alaska, for thermal treatment. On-site staging, if necessary, will be coordinated with 354 Civil Engineer Squadron (CES)/ Civil Engineer Squadron Environmental Compliance (CEIEC). When transporting POL-contaminated soils off-site, Swift River will prepare an ADEC Transport, Treatment, and Disposal Approval Form for Contaminated Media (see Appendix B of the UFP-QAPP [**Attachment 1]**), which will be submitted to the 354 CES/CEIEC personnel for review and approval prior to being submitted to ADEC for signature and approval. Any request to ADEC for the transportation of contaminated materials, whether on- or off-site, will include characterization results if available. In addition to the completed approval form, sample results and supporting documentation (i.e., list of waste containers, waste profile sheets, etc.) must also be submitted to 354 CES/CEIEC and Civil Engineer Squadron Operations Flight Hazardous Waste Facility (CEOIC) personnel for review and approval. The ADEC Transport, Treatment, and Disposal Approval Form must be approved before waste can be moved off-site. Additional documentation is also required for POL waste. Soil contaminated with POL will require a Certificate of Treatment.

Liquid IDW will be placed in the appropriate size polyethylene drum. Decontamination rinsate could be collected in a temporary container and consolidated into a larger drum. Based on historical sampling data, groundwater purge, sampling, and equipment decontamination liquids are anticipated to be eligible for disposal as non-hazardous waste by Swift River. When liquid IDW is collected, the drum will be labeled with the site location or well number contributing liquid to each container; the approximate volume of liquid in each container; the date(s) the container was filled; and the names and phone numbers of the Eielson AFB Point of Contact and the Project Manager.

Non-hazardous solid IDW generated during soil sampling activities would consist of used nitrile sampling gloves, Tyvek®, disposable sampling spoons, paper towels, and plastic items. Loose soils will be adequately removed prior to disposal. All non-hazardous solid waste will be disposed at the Fairbanks North Star Borough solid waste landfill.

4.11. SURVEY METHODS

Excavation and monitoring well locations will be surveyed for northing, easting, and elevation data. From selected locations used to tie in other peripheral locations, two types of point data will be collected by a professional surveyor and tied into the geographic information system (GIS) for reporting:

- Northing, easting, and elevation data for the soil excavation locations.
- Northing, easting, and elevation data for monitor well locations.

The location of the well will be surveyed to the nearest 0.1 foot. The ground surface elevation and top of well casing also will be surveyed to the nearest 0.1 foot above National Geodetic Vertical Datum (NGVD) and 0.01 foot, respectively.

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5. REPORTING

Following the field effort, a report documenting the field work will be prepared. The report will include a description of field activities, figures, identification of the locations of the excavated soils and newly installed wells, well construction and development forms, the coordinates of the new well locations, and copies of all field documentation. The report will be submitted AFCEC and ADEC for review and comment.

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6. SCHEDULE

The following schedule is provided as an estimate. The exact timing of these field activities is dependent on-site conditions and weather.

Task	Number of Calendar Days	Proposed Date
Submit Draft Work Plan to ADEC	3	03/30/18
ADEC Review	30	04/12/18
Respond to ADEC Comments on Draft Work Plan	20	05/10/18
Submit Final Work Plan to ADEC	12	05/28/18
Excavation Activities	7	06/25/18
Restoration of Site CG517	2	07/02/18
Monitoring Well Installation and Well Development	4	06/26/18
Monitoring Well Sampling	2	07/01/18
Waste Disposal	1	07/02/18
Submit Draft Report to ADEC	3	10/31/18
ADEC Review	30	12/01/18
Respond to ADEC Comments on Draft Report	20	12/21/19
Submit Final Report	5	01/06/19

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ATTACHMENT 1
UNIFORM FEDERAL POLICY – QUALITY ASSURANCE PROJECT PLAN REMOVAL ACTION MONITORING AT SOURCE AREAS CG517 AND CS081 EIELSON AIR FORCE BASE, ALASKA

UNIFORM FEDERAL POLICY – QUALITY ASSURANCE PROJECT PLAN REMOVAL ACTION AND MONITORING AT SOURCE AREAS CG517 AND CS081, EIELSON AIR FORCE BASE, ALASKA

August 2018

Prepared for:

Air Force Civil Engineer Center

Prepared under:

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Task Order No. 23

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ACRONYMS AND ABBREVIATIONS

%	percent
%R	percent recovery
°C	degrees Celsius
°F	degrees Fahrenheit
µg/L	micrograms per liter
µg/mL	micrograms per milliliter
A.A.S.	Associate of Applied Science
A2LA	American Association of Laboratory Accreditation
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
ASTM	American Society for Testing and Materials International
B.A.	Bachelor of the Arts
B.S.	Bachelor of Science
BFB	4-Bromofluorobenzene
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CA	corrective action
CAS	Chemical Abstract Service
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CL	control limit
CoC	chain-of-custody
COC	constituent of concern
COPC	contaminant of potential concern
COR	Contracting Officer’s Representative
CSM	conceptual site model
cy	cubic yards
DDT	Dichlorodiphenyltrichloroethane
DL	detection limit
DLH	Data Loading Handbook
DO	dissolved oxygen
DoD	U.S. Department of Defense
DQI	data quality indicator
DQO	data quality objective
DRO	diesel-range organics

ACRONYMS AND ABBREVIATIONS (CONTINUED)

EDD	electronic data deliverable
ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
ERPIMS	Environmental Resources Program Information Management System
FD	field duplicate
FID	flame ionization detector
FTL	Field Team Lead
g	gram
GC	gas chromatography
GC/MS	gas chromatography/mass spectroscopy
GIS	geographic information system
GPS	Global Positioning System
GRO	gasoline-range organics
H&S	health and safety
HCl	hydrochloric acid
HSP	Health and Safety Plan
ICAL	initial calibration
ICV	initial calibration verification
IDQTF	Intergovernmental Data Quality Task Force
IDW	Investigation-Derived Waste
IRP	Installation Restoration Program
IS	internal standard
L	liter
LCL	lower control limit
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
LOD	limit of detection
LOQ	limit of quantification
MB	method blank
MCL	maximum contaminant level
MDL	method detection limit
ME	marginal exceedance
MeOH	methanol
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliter
MPC	measurement performance criteria
MS/MSD	matrix spike/matrix spike duplicate

ACRONYMS AND ABBREVIATIONS (CONTINUED)

NA	not applicable
ND	non-detect
NIST	National Institute for Standards and Technology
ORP	oxidation-reduction potential
oz.	ounce
PAH	polycyclic aromatic hydrocarbon
PAL	Preliminary Action Level
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCB	polychlorinated biphenyl
PCL	project cleanup level
PCP	pentachlorophenol
PDF	portable document format
PE	Performance Evaluation
pH	potential hydrogen
PID	photoionization detector
PM	Project Manager
POL	petroleum, oil, and lubricants
PPE	personal protective equipment
ppm	parts per million
PQO	project quality objective
PVC	polyvinyl chloride
QA	quality assurance
QAM	Quality Assurance Manual
QC	quality control
QSM	Quality Systems Manual
RA-C	Remedial Action – Complete
RCRA	Resource Conservation and Recovery Act
RF	response factor
RPD	relative percent difference
RRO	residual-range organics
RSD	relative standard deviation
RT	retention time
SDG	Sample Delivery Group
SGS	SGS North America, Inc.
SIM	selected ion monitoring
SOP	Standard Operating Procedure

ACRONYMS AND ABBREVIATIONS (CONTINUED)

SRM	standard reference material
SVOC	semivolatile organic compound
Swift River	Swift River Environmental Services, LLC
TBD	to be determined
TCE	trichloroethene
TO	task order
U.S.	United States
UCL	upper control limit
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
USAF	U.S. Air Force
UST	underground storage tank
VOA	volatile organic analysis
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbon
Weston	Weston Solutions, Inc.

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EXECUTIVE SUMMARY

The Air Force Civil Engineer Center (AFCEC) has contracted with Swift River Environmental Services, LLC (Swift River) to conduct environmental actions at two sites located at Eielson Air Force Base (AFB), Alaska, under Contract No. FA8903-17-C-0013. The purpose of this Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP) is to describe the tasks, methods, and procedures that will be used during the site investigation of Sites CG517 and CS081 located at Eielson AFB, Alaska. The minimum quality assurance/quality control (QA/QC) requirements identified by the current version of the United States (U.S.) Department of Defense (DoD) Quality Systems Manual (QSM) has been incorporated in preparation of this UFP-QAPP. Site investigation and reporting activities performed will be in accordance with Alaska Administration Code (AAC) Chapter 75 Section 335 (75 AAC 335) administered by the Alaska Department of Environmental Conservation (ADEC).

Swift River will perform the site investigation activities during the 2018 field season at Source Areas CG517 and CS081 include:

- Excavation of petroleum, oil, and lubricants (POL)-contaminated soils to prevent human exposure to constituents of concern (COCs) in soil and reducing or eliminating further contamination in groundwater.
- Implementation of groundwater monitoring to establish contaminant concentration trends and to ensure that contamination is not migrating off-site.
- Mobilization and demobilization.
- Excavation of 800 cubic yards (cy) of POL-contaminated soils from Source Area CG517 and collection of confirmation soil samples from the excavation.
- Install monitoring wells at Source Areas CG517 and CS081 and collect groundwater samples from newly installed wells;
- Surveying of monitor well locations.
- Management of all investigation-derived waste (IDW).

PROJECT APPROACH

The primary objective of these activities is to perform Remedial Action – Construction (RA-C) for Source Areas CG517 and CS081 located at Eielson AFB. The field investigation activities will include excavation of approximately 800 cy of soil for off-site disposal, collection of confirmatory soil samples, and installation of monitoring wells for groundwater monitoring. The locations for each of the site activities are presented on Figures 1-2 and 1-3 presented in the *Work Plan, Removal Action and Monitoring at Source Areas CG517 and CS081, Eielson Air Force Base, Alaska*.

All analytical samples (including QA/QC) collected during this investigation for laboratory analysis will be submitted to SGS North America, Inc. (SGS) located in Anchorage, Alaska, an ADEC and DoD Environmental Laboratory Accreditation Program (ELAP)-approved analytical laboratory.

REPORTING

Following completion of the field activities, the collected information will be summarized and interpreted to prepare a Site Investigation Report for regulatory submission. This report will include a summary of the site investigation activities, present sample locations and analytical results, and provide recommendations for additional activities, if needed. Field data and laboratory analytical data from samples collected during the field investigation will be reviewed against historical results and compared to applicable delineation guidelines and reporting levels for human and ecological receptors as defined in 75 AAC 335. The data collected during the site investigation activities will be fully verified and then validated in accordance with requirements described in this UFP-QAPP and consistent with requirements under AAC. Validated data will be used to make recommendations, such as the need for additional remediation activities or to obtain cleanup complete status.

PROJECT SCHEDULE

The period of performance for this contract is 15 October 2017 through 01 February 2019. Major milestones associated with this Task Order (TO) are detailed on the Project Schedule presented in in Worksheets #14 and 16. The project schedule may be revised in response to changing field conditions. Potential revisions to the project schedule will be communicated to the project team so that the changes can be evaluated and, where appropriate, efficiently accommodated within the overall schedule to minimize impacts on milestone dates.

UFP-QAPP FORMAT AND GUIDANCE

As required by AFCEC, this UFP-QAPP was prepared following the guidance provided in the Intergovernmental Data Quality Task Force (IDQTF) UFP-QAPP, Optimized UFP-QAPP Worksheets, Revision 1 (IDQTF, 2012), which was published as Part 2A to accompany the 2005 UFP-QAPP Manual (Part 1) (IDQTF, 2005). The UFP-QAPP Optimized Worksheets consist of 37 worksheets used to consistently and systematically document various aspects of the environmental investigation process that will serve as guidelines for the project activities. The UFP-QAPP Manual and Worksheets are intended as a tool to guide project teams through the systematic planning process. Although designed for use in support of hazardous waste programs (Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] and Resource Conservation and Recovery Act [RCRA]) at federal facilities, use of the UFP-QAPP is applicable to environmental programs for which data will be collected and analyzed, and worksheets may be customized accordingly. Project teams are encouraged to use the graded approach when developing UFP-QAPPs, giving appropriate consideration to the significance of the environmental problems to be investigated, the types of environmental decisions to be made, the impact on human health and the environment, and available resources.

The worksheets comprising the UFP-QAPP format may be loosely divided into four basic element groups as follows:

1. Project Management and Objectives (Worksheets #1 through #16)
2. Measurement/Data Acquisition (Worksheets #17 through #30)
3. Assessment and Oversight (Worksheets #31 through #33)
4. Data Review (Worksheets #34 through #37)

Revision 1 to Part 2A of the UFP-QAPP Manual optimizes use of the workbook by consolidating redundant information between multiple worksheets and was used as guidance.

The figures referenced in this report are included with the appropriate worksheet. Attachments included in this UFP-QAPP contain the field standard operating procedures (SOPs) and field forms.

This UFP-QAPP was also prepared in consultation of the U.S. Environmental Protection Agency (EPA) *Guidance for Quality Assurance Project Plans* (EPA, 2011). The following table allows a correlation ("crosswalk") between EPA guidance sections and topics to applicable elements of this UFP-QAPP. If any required UFP-QAPP elements and required information are not applicable to the project or are provided elsewhere, then these are noted in this document.

UFP-QAPP Worksheets		2106-G-05 QAPP Guidance Section	
1 & 2	Title and Approval Page	2.2.1	Title, Version, and Approval/Sign-Off
3 & 5	Project Organization and QAPP Distribution	2.2.3	Distribution List
		2.2.4	Project Organization and Schedule
4, 7 & 8	Personnel Qualifications and Sign-Off Sheet	2.2.1	Title, Version, and Approval/Sign-Off
		2.2.7	Special Training Requirements and Certification
6	Communication Pathways	2.2.4	Project Organization and Schedule
9	Project Planning Session Summary	2.2.5	Project Background, Overview, and Intended Use of Data
10	Conceptual Site Model	2.2.5	Project Background, Overview, and Intended Use of Data
11	Project/Data Quality Objectives	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
12	Measurement Performance Criteria	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
13	Secondary Data Uses and Limitations	Chapter 3	QAPP Elements For Evaluating Existing Data
14 & 16	Project Tasks & Schedule	2.2.4	Project Organization and Schedule
15	Project Action Limits and Laboratory-Specific Detection/Quantitation Limits	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
17	Sampling Design and Rationale	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks
18	Sampling Locations and Methods	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks
		2.3.2	Sampling Procedures and Requirements
19 & 30	Sample Containers, Preservation, and Hold Times	2.3.2	Sampling Procedures and Requirements
20	Field QC Summary	2.3.5	Quality Control Requirements
21	Field SOPs	2.3.2	Sampling Procedures and Requirements
22	Field Equipment Calibration, Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
23	Analytical SOPs	2.3.4	Analytical Methods Requirements and Task Description
24	Analytical Instrument Calibration	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
26 & 27	Sample Handling, Custody, and Disposal	2.3.3	Sample Handling, Custody Procedures, and Documentation
28	Analytical Quality Control and Corrective Action	2.3.5	Quality Control Requirements
29	Project Documents and Records	2.2.8	Documentation and Records Requirements
31, 32 & 33	Assessments and Corrective Action	2.4	Assessments And Data Review (Check)
		2.5.5	Reports to Management
34	Data Verification and Validation Inputs	2.5.1	Data Verification and Validation Targets and Methods

UFP-QAPP Worksheets		2106-G-05 QAPP Guidance Section	
35	Data Verification Procedures	2.5.1	Data Verification and Validation Targets and Methods
36	Data Validation Procedures	2.5.1	Data Verification and Validation Targets and Methods
37	Data Usability Assessment	2.5.2	Quantitative and Qualitative Evaluations of Usability
		2.5.3	Potential Limitations on Data Interpretation
		2.5.4	Reconciliation with Project Requirements

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WORKSHEET #1 & #2: TITLE AND APPROVAL PAGE

Site Name/Project Name:	Source Areas CG517 and CS081
Site Location/Number:	Eielson Air Force Base (AFB), Alaska/VNMH20167001
Lead Organization Contracts Officer Representative (COR)	Tracy Kissler
Lead Organization Alternate COR	Glen Verplancke
Lead Organization Restoration Program Manager:	Joseph Price
Alaska Department of Environmental Conservation (ADEC) Alternate Remedial Project Manager – CS Program	Bri Clark
Preparer's Organizational Affiliation:	Weston Solutions, Inc. (Weston) on behalf of Swift River Environmental Services, LLC (Swift River)
Preparer's Organization Information:	Weston Solutions, Inc. 425 G. Street, Suite 300 Anchorage, Alaska 99501
Previous Plans and Reports from Investigations Relevant to this Project:	Relevant plans and reports are listed in the reference section.

This *Uniform Federal Policy – Quality Assurance Project Plan, Removal Action and Monitoring at Source Areas CG517 and CS081, Eielson Air Force Base, Alaska*, was prepared by qualified persons, as required by Title 18 of the Alaska Administrative Code (AAC) Chapter 75 Section 360 (18 AAC 75.360) and defined in 18 AAC 75.380(b)(9)(e). United States (U.S.) Air Force (USAF) and Alaska Department of Environmental Conservation (ADEC) approval of this UFP-QAPP will be provided either by email or letter concurrence with responses to comments. No USAF or ADEC signatures will be required on this page.

Investigative Organization's Senior Project Manager:

Signature ____

Catherine Shuman
Swift River Environmental Services, LLC

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WORKSHEET #3 & #5: PROJECT ORGANIZATION AND QAPP DISTRIBUTION

The information in the distribution list provided in **Table 3/5-1** is applicable to this Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP) only. The project organizational chart, which describes reporting relationships between all of the organizations involved in the project, is provided on **Figure 3/5-1**.

Table 3/5-1 QAPP Distribution List

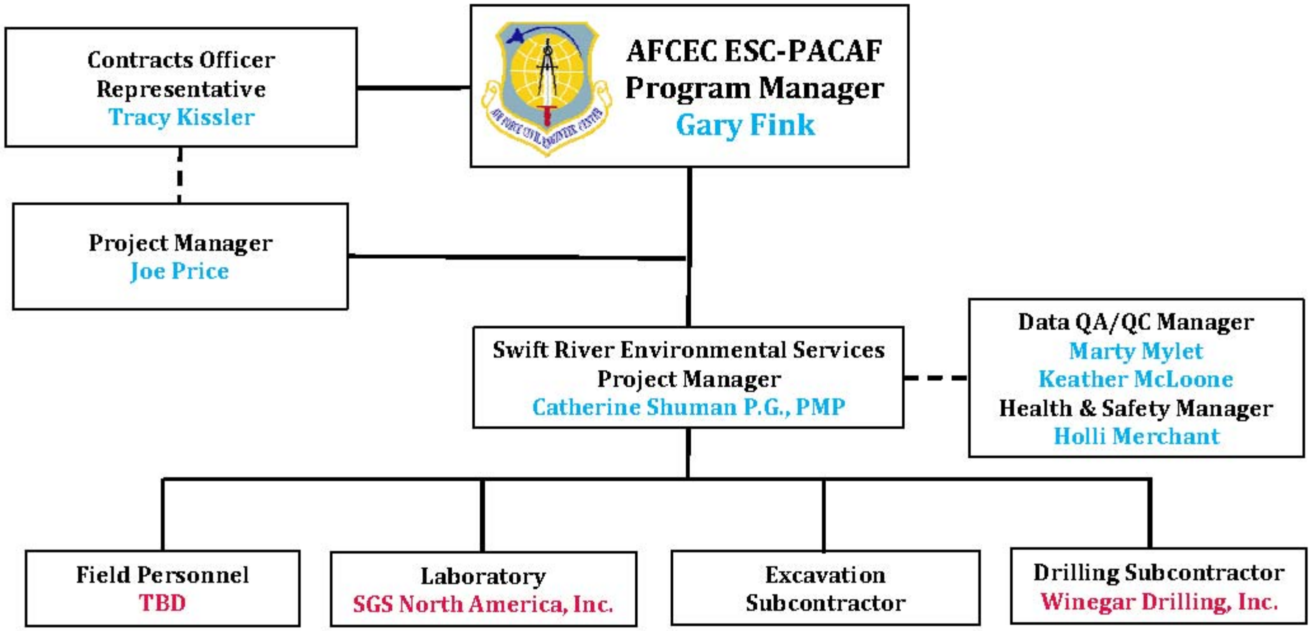
UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Name	Organization	Responsibility	Phone No.	Email Address
Gary Fink	USAF	Chief, Eielson Restoration	(907) 552-8757	gary.fink@us.af.mil
Tracy Kissler	USAF	AFCEC COR	(907) 552-9762	tracy.kissler@us.af.mil
Joseph Price	USAF	Restoration Program Manager	(907) 377-3578	joseph.price.17@us.af.mil
Bobby Hernandez	USAF	AFCEC QA/QC Oversight (seasonal employee)	(214) 543-3578	ryhernandez1945@hotmail.com
Bri Clark	ADEC	ADEC Alternate Remedial Project Manager	(907) 451-2156	bri.clark@alaska.gov
Catherine Shuman	Swift River	Project Manager	(907) 360-7417	catherine.shuman@swiftriveres.com
Holli Merchant	Swift River	Health and Safety Manager	(303) 695-4660	holly.merchant@swiftriveres.com
Anita Larson	Swift River	General Manager	(720) 232-6221	anita.larson@tumeq.com
Pete Zlatev	Swift River	Field Superintendent	(303) 695-4660	pete.zlatev@swiftriveres.com
Martin Mylet	Weston	Project Manager	(907) 231-7903	martin.mylet@westonsolutions.com
Keather McLoone	Weston	Project Chemist	(480) 477-4908	keather.mcloone@westonsolutions.com
Chuck Homestead	SGS Anchorage	Project Manager	(916) 374-4402	charles.homestead@sgs.com

Notes:

ADEC	Alaska Department of Environmental Conservation
AFCEC	Air Force Civil Engineer Center
COR	Contracts Officer Representative
CS	Contaminated Sites
FTL	Field Team Lead
PM	Project Manager
QA	quality assurance
QC	quality control
SGS	SGS North America, Inc.
Swift River	Swift River Environmental Services, LLC
TBD	to be determined
USAF	U.S. Air Force
Weston	Weston Solutions, Inc.

Figure 3/5-1 Project Organization Chart



WORKSHEET #4, #7 & #8: PERSONNEL QUALIFICATION AND SIGN-OFF SHEET

The information in this worksheet and Table 4-1provides personnel names, titles, and roles in order to identify personnel responsible for execution of the work elements in this UFP-QAPP. Resumes, specialized training records, and training certifications for the project team for this UFP-QAPP will be maintained in the project file located at the Weston office. All information will be provided to the members of the project team upon request.

Table 4-1 Personnel Qualifications and Sign-Off

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Organization: Swift River

Name	Project Title/Role	Personnel Qualifications or Special Training	Signature*
Catherine Shuman	Project Manager	B.S., Geology AAS, Chemistry	
Pete Zlatev	Field Geologist	Ph.D., Geological Engineering M.Sc., Geological Engineering B.Sc., Geological Engineering	
Alec Rizzo	Field Environmental Scientist	M. Sc, Geology	
Keather McLoone	Project Chemist	B.A., Chemistry B.S., Biology	

Notes:
*Signatures indicate personnel have read and agree to implement this QAPP as written.

A.A.S.	Associate of Applied Science
B.A.	Bachelor of the Arts
B.S.	Bachelor of Science
TBD	to be determined

Organization: SGS North American, Inc. (SGS) Anchorage

Name	Project Title/Role	Personnel Qualifications or Special Training	Signature*
Chuck Homestead	Project Manger	General Manager at SGS, 17 years	

** Signature will be on file on-site.

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WORKSHEET #6: COMMUNICATION PATHWAYS

Table 6-1 documents specific issues (communication drivers) that will trigger the need to communicate with other project personnel or stakeholders. Its purpose is to ensure there are procedures in place for providing the appropriate notifications and generating the appropriate documentation when handling important communications, including those involving regulatory interfaces, unexpected events, emergencies, nonconformances, and stop-work orders.

Table 6-1 Communication Pathways Table
UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Project scope changes	USAF COR	Tracy Kissler	(907) 552-9762	Swift River Project Manager will notify USAF of any project scope changes and USAF will inform ADEC-assigned representative of any project scope changes.
Approval of UFP-QAPP	USAF COR Chief, Eielson Restoration	Tracy Kissler Gary Fink	(907) 552-9762 (907) 552-8757	Approval of any/all UFP-QAPPs by USAF and ADEC is required prior to the implementation of any modifications to the UFP-QAPP.
Management of required project tasks	Swift River Project Manager	Catherine Shuman	(907) 360-7417	The Swift River PM and Site Manager will inform appropriate project staff (field and non-field) of tasks to complete and required completion date. The Swift River PM will communicate potential scope issues with USAF as well as task progress and resources/information required to complete tasks.
Delay/change to field work and daily field update	Swift River Project Manager	Catherine Shuman	(907) 360-7417	The Swift River Site Manager will provide regular updates on project progress, issues, resolutions, and safety-related issues to the Swift River as they occur. The Site Manager will be the conduit for information transfer from the Swift River PM and Program QA Officer to the field team members.

Table 6-1 Communication Pathways Table (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
H&S issues	Swift River H&S Manager	Holli Merchant	(303) 695-4660	H&S project emergencies will be addressed by the Swift River and the Swift River Field Safety Officer. The H&S Program Officer will also assist with developing modifications to the HSP (as needed); evaluating occupational exposure monitoring/air sampling data and adjusting the HSP (as necessary); review and concurrence of the HSP by signature; coordinating with technical support staff and the FTL for implementation of the Safety Program; providing technical direction to the FTL and project management; maintaining frequent communication with the FTL and project management regarding site activities and implementation of the Safety Program.
Reporting of laboratory data quality issues	Weston Project Chemist	Keather McLoone	(480) 477-4908	Depending on the issue, the Project Chemist will communicate data quality issues with the field crew, Site Manager, and PM. The Project Chemist may also communicate with the analytical laboratory.
Recommendations to stop work and initiation of CAs	USAF COR USAF Restoration Program Manager Swift River Project Manager Swift River Site Manager	Tracy Kissler Joseph Price Catherine Shuman Pete Zlatev	(907) 552-9762 (907) 377-3578 (907) 360-7417 (303) 902-0492	Swift River and USAF have the authority to stop work and initiate CAs should any one person believe there is a reason to do so. Whoever stops work or initiates CAs will inform all other interested parties immediately. ADEC must be notified as soon as possible, but no later than 24 hours after such stoppage of work. The notification requirement will apply to activities undertaken in furtherance of this site-specific UFP-QAPP, or as applicable to the Federal Facility Agreement or any other circumstances or activities at the site creating an imminent and substantial endangerment to the health and welfare of the people on the site or in the surrounding area or to the environment. Swift River and/or USAF shall provide ADEC with documentation of its analysis in reaching this work stoppage determination within 5 days of any such stoppage.

Table 6-1 Communication Pathways Table (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Distribution of analytical data	Weston: Project Chemist Swift River Project Manager	Keather McLoone Catherine Shuman	(480) 477-4908 (907) 360-7417	Swift River will receive all deliverables from the subcontracted laboratory, review/verify the data, and distribute data to USAF and any other interested parties. USAF and/or Weston shall make available to ADEC quality-assured results of sampling, tests, or other data generated by or on behalf of USAF under this site-specific UFP-QAPP within 60 days of the submittal of samples to the laboratory. If QA is not completed within 60 days, preliminary data or results shall be made available within the 60-day period and quality-assured data or results shall be submitted as they become available, but in no event later than 120 days after the submittal of samples to the laboratory. These periods can be extended upon mutual agreement among Swift River, USAF, and ADEC.

Notes:

ADEC	Alaska Department of Environmental Conservation
CA	Corrective Action
COR	Contracts Officer Representative
FTL	Field Team Lead
H&S	Health and Safety
HSP	Health and Safety Plan
PM	Project Manager
QA	Quality Assurance
Swift River	Swift River Environmental Services, LLC
TBD	To Be Determined
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
USAF	U.S. Air Force
Weston	Weston Solutions, Inc.

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WORKSHEET #9: PROJECT PLANNING SESSION SUMMARY

Scoping meetings are generally the first steps in the planning approval process to build the foundation of the project. The planning meetings define the purpose and the desired results of the project, the environmental decisions to be made, and the project quality objectives (PQOs) needed to achieve the expected results. Topics generally considered when planning a scoping meeting are as follows:

1. Site history/background.
2. Results of previous investigations, if applicable.
3. Constituents of concern (COCs).
4. Regulatory requirements.
5. Project goals and strategies.

A summary of scoping meetings conducted to date with respect to developing a technical approach for meeting the site investigation goals and objectives for this project is as follows:

Date of Planning Session: 9 November 2017

Location: Teleconference, 1:30 pm Alaska

Purpose: Project Kickoff Meeting

Participants:

Name	Organization	Title/Role	Email
Gary Fink	USAF	Chief, Eielson Restoration	gary.fink@us.af.mil
Joseph Price	USAF	Restoration Program Manager	joseph.price.17@us.af.mil
Steve Becker	USAF	Restoration PM	steven.becker.8@us.af.mil
Mark Bowers	USAF	Eielson Restoration Support	lewis.bowers.2@us.af.mil
Catherine Shuman	Swift River	PM	catherine.shuman@swiftriveres.com
Marty Mylet	Weston	PM	martin.mylet@westonsolutions.com

Notes:
PM: Project Manager
USAF: United States Air Force
Weston: Weston Solutions, Inc.

Notes/Comments:

General discussion on scope of work. Period of Performance 18 months (21 July 21, 2017 –02 February 2, 2019).

General discussion of project schedule with anticipated field activities is to begin in June 2018. Draft Work Plan and UFP-QAPP anticipated to be submitted to ADEC for review in March 2018. Swift River will provide updates to the project schedule throughout the project.

USAF will submit the following documents to Swift River to assist in preparation of the Work Plan and UFP-QAPP:

- Final Remedial Action Report – CS081
- Final Decision Document – CS081
- Investigation-Derived Waste (IDW) Management Plan for Eielson AFB
- Shapefiles (geographic information system [GIS]) (Steve Becker)
- CG517 Decision Document will be provided once it becomes a Draft

Field Activity:

- Base access (passes) and Dig Permits – coordinate with Mark Bowers
- Field work at CS081 will need to be scheduled around the exercise schedule (red flag). Mark Bowers to provide this information.
- Flight clearance for work being done at CS081 will need to be initiated at least 2 months out.
- Quality assurance (QA) field oversight for USAF will be Bobby Hernandez.

Action Items:

- Final Remedial Action Report – CS081 – Mark Bowers – November 2017
- Final Decision Document – CS081 – Mark Bowers – November 2017
- IDW Management Plan for Eielson AFB – Mark Bowers – November 2017
- Shapefiles (GIS) – Steve Becker – November 2017
- CG517 Decision Document will be provided once it becomes a Draft – Mark Bowers

WORKSHEET #10: CONCEPTUAL SITE MODEL

This worksheet presents the project's conceptual site model (CSM), which will assist in the development of data quality objectives (DQOs). CSMs integrate existing information and working assumptions about the physical site conditions; the nature, occurrence, and distribution of chemicals; fate and transport process; and the possibility of human and ecological exposure to the chemicals at, or potentially released from, a site. Activities and history discussed in this section were summarized from various reports submitted to USAF. The following CSM is the basis for the individual site-specific CSMs that are described in each of the respective sections.

10.1 CG517 – AAFES SERVICE STATION LUST

- Previous activities at CG517 were focused on identifying contamination and data gaps. Information from investigations prior to 2012 was summarized from the *Phase I Source Evaluation Report for Multiple Sites at Eielson Air Force Base* (USAF, 2013a).

Three 10,000-gallon gasoline tanks used to store leaded and unleaded gasoline were installed in 1975 approximately 80 feet north of fuel islands. The tanks were connected to the fuel islands via transfer piping. The underground storage tanks (USTs) were approximately 26 feet long and 8 feet wide, attached to a concrete pad approximately 10 feet bgs. A former waste oil tank was also present at the site located west of the former Facility 2375. The locations of the historical site features are shown on Figure 1-2 presented in the Work Plan.

In 1992, the USTs and transfer piping were removed and replaced after two of the tanks failed tightness tests the previous year. During the excavation, petroleum-contaminated soil was observed and 1,300 cubic yards (cy) of soil was removed. Sample results indicated that petroleum-impacted soil remained at the fuel island after excavation. Nine soil samples were obtained and analyzed, indicating the presence of benzene, toluene, ethylbenzene, and xylenes (BTEX) and gasoline-range organics (GRO) at maximum concentrations of 449 milligrams per kilogram (mg/kg) and 12,178 mg/kg, respectively. Photoionization detector (PID) field screening of organic vapors at the bottom of the excavation indicated concentrations between 2.5 to 2,500 parts per million (ppm). Three groundwater screening samples were obtained from the excavation and analyzed for volatile organic compounds (VOCs) and volatile petroleum hydrocarbons (VPHs). Results indicated BTEX and VPH concentrations were above cleanup levels. In addition to 1992 sampling, three monitoring wells were installed on-site at this time (USAF, 2017).

In 1993, a soil organic vapor survey was conducted as part of a site assessment by collecting soil gas samples at 10 locations. These samples were analyzed for BTEX, which was detected in four boreholes north of the USTs. In addition, nine soil borings and five monitoring wells were advanced to investigate the extent of contamination. Soil and groundwater samples were analyzed for BTEX, VPHs, and total and dissolved lead. BTEX concentrations exceeded cleanup levels in soil and groundwater, whereas total lead was detected in groundwater above the U.S. Environmental Protection Agency (EPA) maximum contaminant level (MCL) (0.015 milligram per liter [mg/L]). It was determined that benzene concentrations exceeding cleanup levels were localized to the fuel island and former UST area and immediately downgradient (USAF, 2017).

In 1994, additional groundwater samples were collected from five monitoring wells and analyzed for BTEX to evaluate if contamination was still present. One sample exceeded the EPA MCL in drinking water for benzene (0.0029 mg/L). In 2011, Facility 2375 (adjacent to the USTs), fuel islands, the three USTs, and their associated piping were removed (USAF, 2017).

Contamination was encountered beneath the most recently installed tanks. In 2012, 12 soil and 3 groundwater samples were obtained and analyzed to evaluate the presence or absence of contaminants. Soil and groundwater samples were analyzed for GRO, diesel-range organics (DRO), residual-range organics (RRO), VOCs, semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and total metals. Results indicated the presence of metals in both soil and groundwater samples above cleanup levels. In addition, groundwater samples exceeded cleanup levels in GRO, DRO, BTEX, and bis(2-ethylhexyl)phthalate (USAF, 2017).

Contaminants of potential concern (COPCs) were fully developed based on the known historical activities at the site. Metals were thought to be naturally occurring because no site use of arsenic, chromium, cobalt, or iron was documented in the source area history. Lead and thallium were identified in groundwater without corresponding soil exceedances (USAF, 2017).

In 2014, 28 soil samples were collected from 14 soil borings advanced near the former fuel island, former waste oil tank, and former storage tank area. All soil samples were analyzed for GRO, DRO, RRO, VOCs, and polycyclic aromatic hydrocarbons (PAHs); three samples were also analyzed for Resource Conservation and Recovery Act (RCRA) metals and hexavalent chromium. The sample results found that no contamination was found in proximity to the waste oil tank. However, high detections of fuel and fuel-related analytes were found in the other areas of investigation. Metals results indicated that hexavalent chromium was not present. Soil delineation was nearly complete except southeast of the fuel island. Seven groundwater samples were collected from seven temporary groundwater well points advanced during the 2014 field season at Site CG517. All groundwater samples were analyzed for GRO, DRO, RRO, VOCs, and PAHs; two samples were also analyzed for RCRA metals. Groundwater samples provided delineation of COPCs across the site (USAF, 2017).

In 2015, 12 soil and 7 groundwater samples were obtained to continue the delineation of previous project screening level exceedances in soil and groundwater. Soil and groundwater samples were analyzed for GRO, DRO, RRO, VOCs, and PAHs. Additionally, two groundwater samples were analyzed for RCRA metals. The 2015 soil and groundwater results defined the extent of COPCs exceeding the Preliminary Action Levels (PALs) with the exception of benzene. Benzene in groundwater downgradient of TW05 and benzene upgradient of boring SB04 remained above the PALs (USAF, 2017).

In 2016, two additional temporary well points were added downgradient of TW05 and two soil borings were added upgradient of SB02. The soil and groundwater samples were analyzed for select VOCs that included benzene. The results from the 2016 samples were below the project action levels. Re-evaluation of historical results against the new cleanup levels identified that 2015 TW08 benzene levels exceeded the new cleanup levels. Although there were no cross-gradient groundwater data northeast of TW08, the stakeholders did not see this as a significant data gap requiring additional investigation (USAF, 2017).

10.2 CS081 – SER001-2008 UTILITY CORRIDOR EXCAVATION

CS081, previously referred to as SER001-2008 and SS-CS523, is located in the southcentral portion of Eielson AFB. Source Area ST13/DP26 is located upgradient of this site, approximately 0.25 mile to the south. The ground cover in the area is a combination of grass-covered, open field, and paved parking; it is a relatively flat site with no topographic features. Facility 4361 is currently used for cold storage. Prior to that, the property was used as a fuel storage and dispensing facility. A review of documents at the Real Property Office on Eielson AFB indicates that two 5,000-gallon aboveground storage tanks (AST) were removed from Building 4361, circa 1996. In addition, a UST and another 5,000-gallon AST were decommissioned in June 1994, but their exact locations are unknown (USAF, 2014b). The fuel pipelines and distribution equipment were removed from the property; however, the removal of fuel islands and attendant piping was not documented (USAF, 2012).

In 2013, 58 soil samples and 12 groundwater samples were collected at CS081. Historically, VOCs above the project cleanup levels (PCLs) at CS081 were BTEX, 1,2,4-trimethylbenzene, and n-propylbenzene. VOCs exceeded PCLs at four locations during the 2013 investigation (soil borings 81B008, 81B010, 81B013, and 81B227) (USAF, 2014b). Benzene exceedances were most frequent in 2013, with concentrations above the PCL (0.025 mg/kg) ranging from 0.031 mg/kg to 0.51 mg/kg. Trichloroethene (TCE) in soil boring 81B013 exceeded the PCL (0.020 mg/kg) at a concentration of 0.087 mg/kg.

Detections of VOCs above their respective cleanup levels were laterally bounded by samples below cleanup levels in all directions through previous site investigations. The solitary TCE detection was found in the shallow subsurface at 3 feet bgs, and the ADEC-approved 2013 Supplemental Characterization of Source Area CS081 concluded that this isolated detection does not warrant additional investigation.

VOCs, including BTEX, were not detected above the cleanup levels in the 2013 groundwater grab samples. The Source Area CS081 BTEX plume appears to be limited to the 2010 and 2012 detections and does not extend outside of the site boundary.

Samples collected in 2009 and 2010 were not analyzed for DRO and GRO. In 2013, DRO results exceeded the PCL (1.5 mg/L) in one sample (temporary well point 81B021). The single DRO exceedance was reported at a concentration of 2.5 mg/L. This sample was collected from a temporary well located at the far northern portion of the site outside of the suspected source area. The isolated nature of this groundwater exceedance, and proximity to other facilities suggest that the DRO exceedance is not related to historical site use at CS081. A significant DRO plume does not appear to be present at the site.

GRO was not detected in groundwater above the cleanup level (2.2 mg/L) in the 2013 field samples. A GRO groundwater plume was not identified at Source Area CS081 in the 2013 investigation area, but is likely present in the area of high BTEX exceedances detected during the 2009 and 2010 sampling events.

In one groundwater screening sample, pentachlorophenol (PCP) detected above the PCL was also qualified as “estimated” because it was below the calibration range of the instrument. The historical exceedance of PCP in groundwater was limited to one occurrence in a 2010 groundwater grab sample. PCP in groundwater was added to the 2013 analytical suite for all samples, and a laboratory that provided reporting levels one order of magnitude below the cleanup level performed the analyses. PCP was not found above the PCL in any of the 2013 samples and does not appear to be present in the investigation area.

The selected remedy in the December 2015 Decision Document was soil excavation, long-term groundwater monitoring, and land use controls. Soil excavation was completed in summer 2016.

10.3 KNOWN OR SUSPECTED CONTAMINANTS OR CLASSES OF CONTAMINANTS

The COCs at sites CG517 and CS081 consist primarily of petroleum-related compounds. Releases are associated with fuel operations, fuel storage, spills, and leaks from, ASTs, USTs, and waste oil tanks.

Site	Spill History Type	Primary COCs
CG517	Three 10,000-gallon USTs for leaded and unleaded fuel storage; one waste oil tank.	GRO, DRO, RRO, VOCs, SVOCs
CS081	Three 5,000-gallon ASTs; (3) UST of unknown quantity for fueling distribution.	GRO, DRO, RRO, VOC, SVOC

Notes:

AST	aboveground storage tank
GRO	gasoline range organics
DRO	diesel range organics
RRO	residual range organics
SVOC	semivolatile organic compounds
UST	underground storage tank
VOC	volatile organic hydrocarbon

10.4 POTENTIAL EXPOSURE PATHWAYS

Access to Eielson AFB is strictly controlled by the DoD and limited to base personnel, support staff, and contractors. A previous CSM has been developed and submitted to ADEC for CG517 in the 2016 CG517 Site Characterization Report (September, 2017). The CSM for CS081 has also been developed and defined in the decision document (DD) Source Area CS081 Eielson Air Force Base, Alaska (December 2015). Potential receptors may include residential personnel, commercial or industrial workers, trespassers, recreational users, construction users, and visitors. There are no farming or subsistence activities conducted on Eielson. Potential pathways and exposure pathways include:

- Human exposure to contaminants in soil from 0 to 15 ft bgs through direct contact (incidental ingestion and dermal absorption). CG517 and CS081.

- Human exposure to volatile contaminants in outdoor air through volatilization from soil and indoor air through volatilization from soil into current and future buildings; (CG517 and CS081.
- Human exposure to contaminants in groundwater through ingestion, dermal absorbtion of groundwater, inhalation of volatile compounds in tapwater. CG517 and CS081.

The CSM’s for CG517 and CS081 will be revised after completion and review of the analytical results for the 2018 field activities.

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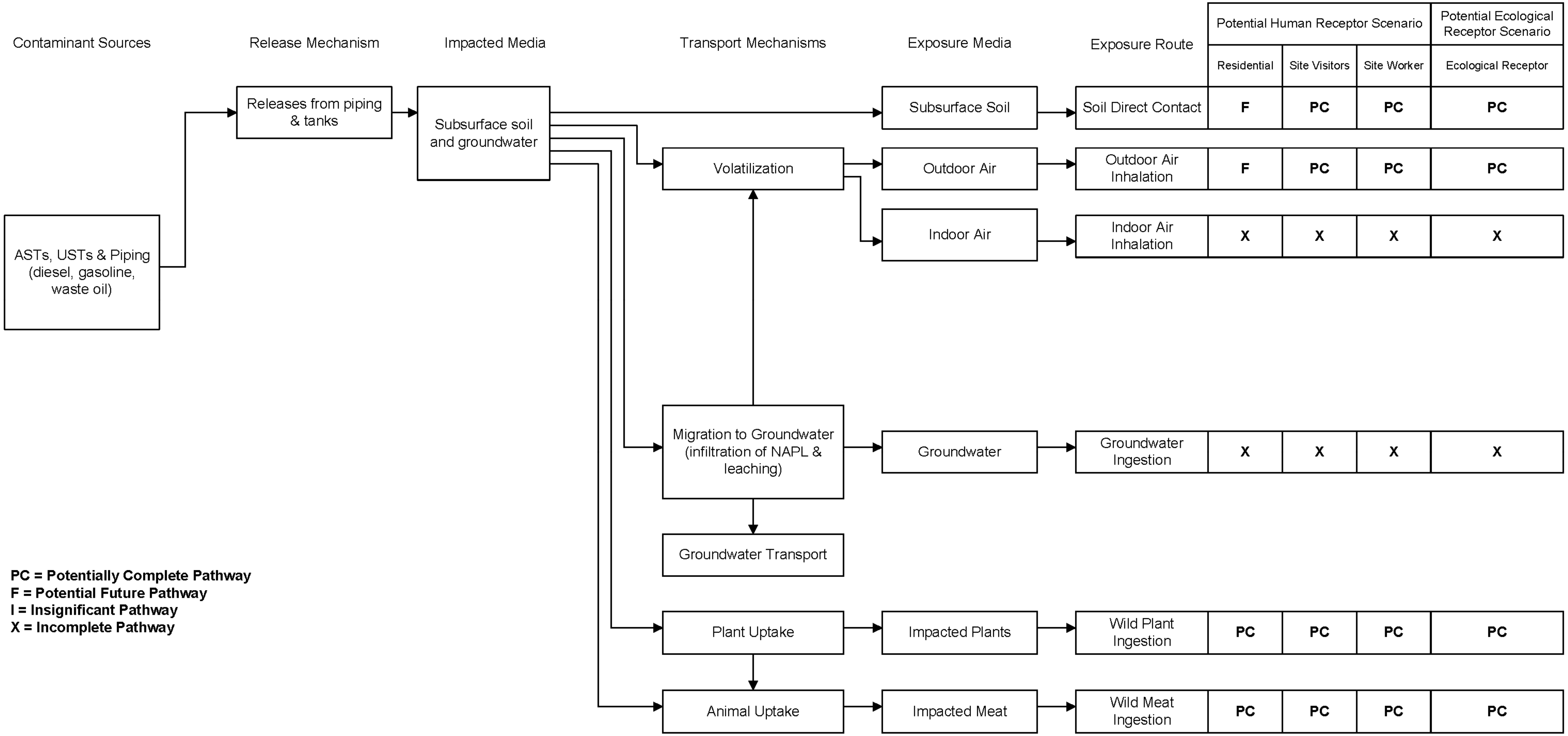
Figure 10-1
Conceptual Site Model for CG517 and CS081



Exposure Route	Residential	Site Visitors	Site Worker	Ecological Receptor
Soil Direct Contact	F	PC	PC	PC
Outdoor Air Inhalation	F	PC	PC	PC
Indoor Air Inhalation	X	X	X	X
Groundwater Ingestion	X	X	X	X
Wild Plant Ingestion	PC	PC	PC	PC
Wild Meat Ingestion	PC	PC	PC	PC

PC = Potentially Complete Pathway
F = Potential Future Pathway
I = Insignificant Pathway
X = Incomplete Pathway

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WORKSHEET #11: PROJECT/DATA QUALITY OBJECTIVES

This worksheet presents the PQOs and DQOs for the site.

PROJECT/DATA QUALITY OBJECTIVES

This worksheet is used to develop and document project data quality objectives (DQOs) using a systematic planning process that follows the EPA DQO process and documents the environmental decisions that need to be made and the level of data quality needed. The DQO process is outlined in the EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA/240/B-06/001, February 2006) (EPA, 2006). The specific QA/QC requirements developed for the site are consistent with those presented in the U.S. Department of Defense (DoD) Quality Systems Manual (QSM), Version 5.1 (DoD QSM V5.1) (DoD, 2017).

1. STATE THE PROBLEM

Soil and groundwater have been identified at Sites CG517 and CS081 with petroleum concentrations that exceed ADEC Tables B1 and B2 Migration to Groundwater criteria and Table C Groundwater Cleanup criteria.

2. IDENTIFY THE GOALS OF THE STUDY

The purpose of this effort is excavate POL-contaminated soils to prevent human exposure to COCs in soil and to reduce or eliminate contaminant migration to groundwater. A groundwater monitoring well network will be installed to establish contaminant concentration trends and monitor that remaining contamination is not migrating off-site.

3. DEFINE THE BOUNDARIES OF THE STUDY

The project boundaries of the 2018 field activities will be sites CG517 and CS081. Sites are shown on Figures 1-2 and 1-3 presented in the Work Plan.

4. DEVELOP THE ANALYTIC APPROACH

Confirmation samples will be collected from the limits of excavations where impacted soils have been removed as a remedial measure. Excavated soil will either be placed in the temporary staging area or loaded directly into trucks to be transported to the disposal facility. Confirmation samples will be collected from the bottom and sidewalls of the excavation once suspect soils have been adequately removed as indicated by PID readings. Soil samples will be collected by the methods defined within the ADEC's *Field Sampling Guidance* (ADEC, 2017a). Confirmation samples will be submitted to the project laboratory for site-specific COPC analyses.

Excavation bottom samples will be collected at a minimum of one confirmation sample for up to 50 square feet of exposed surface area. If the excavation bottom surface area ranges from 51 to 250 square feet, two samples will be collected from the base areas that would most likely exhibit contamination (according to PID readings). If the bottom surface area of the excavation is greater than 250 square feet, two samples will be collected from the base plus one sample for each additional 250 square feet of exposed surface. The excavation sidewalls will also be sampled at a minimum of one sample per 20 linear feet at the greatest field screening reading in all soil horizons (the area most likely to be contaminated, such as on top of confining layers, at the base of more porous layers, or along any other preferential pathways identified in the field).

Following the excavation activities, four monitoring wells will be installed at both CG517 and CS081. The monitoring wells will be installed using a hollow-stem auger. The monitoring wells will be installed at a total depth of 20 feet bgs with groundwater estimated to be 10 feet bgs. Each well will be constructed of 2-inch-diameter Schedule 40 polyvinyl chloride (PVC) casing with 0.20-inch slot size screens. The filter pack will consist of 16/30 silica sand. Well completions will be stick-up monuments constructed of at least 6-inch-diameter steel casing with lockable lids and a set of three protective bollards. Well installation and sampling procedures are documented in Worksheet #17.

For decision-making, laboratory analytical data must be determined to be usable, and laboratory limits of quantification (LOQs) should be at or below cleanup criteria, if possible. During the reporting process, the sample concentrations will be compared to the measurement performance criteria (MPC) shown in Worksheet #12 to determine usability to meet the goals of the investigation.

5. DEVELOP THE DETAILED PLAN FOR OBTAINING DATA

The plan to obtain reliable and usable data from the soil and groundwater samples is discussed in the Field Sampling Plan. The actual number of soil samples will be dependent upon the excavation limits. Groundwater samples will be collected from each of the monitoring wells. The number of QA/QC samples will be collected in accordance with ADEC protocol.

Worksheet #17 provides the sample design and rationale, Worksheet #18 provides additional detail on sample locations, media, suite of analytes, and sample collection tools, and Worksheet #20 provides information on QC samples. Worksheets #19 and #23 and #24 through #28 provide specific details on the analytical requirements.

WORKSHEET #12: MEASUREMENT PERFORMANCE CRITERIA

Tables summarizing the MPC for each matrix and analytical parameter of this project are presented in this worksheet. In general, the MPC follow those defined in the DoD QSM V5.1 (DoD, 2017).

DATA QUALITY INDICATORS

Data quality for this project will be verified through appropriate MPC established for both sampling procedures and analytical methods. The data quality indicators (DQIs) consist of precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS), commonly referred to as PARCCS parameters. The quality of the sampling procedures and laboratory results will be evaluated for compliance with project DQOs through a review of overall PARCCS in accordance with procedures described in Worksheet #37.

The DQIs are defined in the following sections:

Precision

Precision refers to the reproducibility of measurements. Precision is usually expressed as standard deviation, variance, percent difference, or range, in either absolute or relative terms. Precision data are used to evaluate consistency and reproducibility of field sampling and/or analytical procedures. Precision will be evaluated by comparing the following:

- Laboratory control sample/laboratory control sample duplicate (LCS/LCSD) (if prepared and analyzed) to determine the precision of the laboratory procedures.
- Matrix spike/matrix spike duplicate (MS/MSD) samples to determine any effect of the spiked sample matrix on the precision of the results generated using the selected analytical method.
- Primary and field duplicate (FD) sample results.

The required level of precision for FD is relative percent difference (RPD) of 50 percent (%) for soils/sediments and 30% for waters. The FD precision is evaluated by calculating RPD using the following equation:

$$RPD = \frac{2|(D_1 - D_2)|}{D_1 + D_2} x\ 100$$

Where: D_1 = first sample value

D_2 = second sample value (replicate)

RPD = relative percent difference

If more than two FD samples are collected from adjacent locations and analyzed, then they are referred to as co-located field replicates. If a single sample is homogenized and divided into two equal parts for analysis by both the primary project laboratory and a reference laboratory, they are referred to as a split sample (or QA sample).

Accuracy

Accuracy is the degree of agreement between an observed value (such as sample results) and an accepted reference value. A measurement is considered accurate when the reported value agrees with the true value or known concentration of the spike or standard within acceptable limits.

Accuracy is evaluated by reviewing:

- Calibrations – initial and continuing; acceptance; and frequency (deviations will be documented in laboratory report case narratives).
- Surrogates – recovery and frequency.
- LCS and LCSD recoveries.
- MS and MSD recoveries.
- Relative response factors and relative standard deviation (RSD) (appropriate calibration procedures improve accuracy of measurement results; deviations will be documented in laboratory report case narratives).
- Method blanks (detections in the method blank may indicate potential high bias in associated samples).
- Gas chromatography (GC) second-column confirmation (if required).
- Tune criteria (gas chromatography/mass spectroscopy [GC/MS]) – acceptability and frequency (to ensure accuracy of mass and ion-abundance measurements; deviations will be documented in laboratory report case narratives).
- Internal standards (ISs) (GC/MS) – acceptability and frequency (deviations will be documented in laboratory report case narratives).

For measurements where matrix spikes are used:

$$\% \, Recovery = \frac{(S - U)}{C_{sa}} \, x \, 100$$

Where: S = measured concentration in spiked aliquot
U = measured concentration in unspiked aliquot
C_{sa} = actual concentration of spike added

For situations where a standard reference material (SRM) is used instead of, or in addition to, MSs:

$$\%R = 100 \, x \left[\frac{C_m}{C_{sm}} \right]$$

Where: C_m = measured concentration of SRM

C_{sm} = actual concentration of SRM

Representativeness

Representativeness is a qualitative term that refers to the degree that data accurately and precisely depict the characteristics of a population, whether referring to the distribution of a contaminant within a sample, a sample within a matrix, or a contaminant at a site. Representativeness is determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, operations process locations, and sampling locations.

Objectives for representativeness, which are defined for each sampling and analysis task, are a function of the investigative objectives. Assessment of representativeness shall be achieved through use of the standard field, sampling, and analytical procedures. Decisions regarding sample/well/boring locations, sampling procedures, and sample quantities, as well as the statistical sampling design, are documented in Worksheets #10, #17, and #18.

Representativeness will be evaluated by reviewing the following:

- Sample quantities and locations
- Sampling procedures and equipment
- Sample chain-of-custody (CoC) forms and field logbooks
- Holding times and preservation

Comparability

Comparability addresses the degree to which different methods or data agree or can be represented as similar. The objective for this QA/Quality Control (QC) program is to produce data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved by the following:

- Using standard methods for sampling and analysis
- Reporting data in standard units
- Normalizing results to standard conditions
- Operating instruments within their calibrated range according to established procedures based on approved methodology
- Using standard and comprehensive reporting formats

Completeness

Completeness is a measure of the amount of valid data obtained compared with the amount that was expected to be obtained under correct, normal conditions. Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples (such as by site) as set out in the DQOs. Completeness is calculated and reported for each method, matrix, and analyte combination using the formula below:

$$\% \, Completeness = 100 \, x \, (\frac{V}{n})$$

Where: V = number of measurements judged valid
n = total number of measurements

The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified with an R-flag after a usability assessment has been performed. Completeness should not be determined only on the basis of laboratory data qualifiers. The goal for completeness is 95% for aqueous samples and 90% for soil samples.

Sensitivity

Sensitivity is the ability of a method or instrument to detect the target analytes at the level of interest. The capability of analytical laboratory methods and instrumentation to provide data with the sensitivity to meet the site-specific DQOs will be evaluated during the planning phase. The laboratory reference limits will be evaluated against the PALs in order to determine whether the analytical methods and/or laboratory meet the project DQOs.

LABORATORY REFERENCE LIMITS

Sensitivity requirements include the establishment of various limits in accordance with the DoD QSM V5.1 (DoD, 2017).

Detection Limit

The detection limit (DL) is the smallest analyte concentration that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value. The method detection limit (MDL) as defined by Title 40, Code of Federal Regulations (CFR), Part 136, Appendix B, is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The MDL is one way to establish a DL. The MDL will be considered the DL for the purposes of this project and reporting in accordance with the DoD QSM V5.1 (DoD, 2017). The laboratory will establish DLs for each method, matrix, and analyte, and will provide the DLs to the Contractor at the beginning of the project (i.e., before project samples are analyzed) and upon request.

Laboratories participating in this work will demonstrate the MDLs for each instrument, including confirmatory columns, method of analysis, analyte, and matrix, using the following steps:

Estimate the DL using one of the following:

- The concentration value that corresponds to an instrument signal/noise ratio in the range of 2.5 to 5.

- The concentration equivalent of three times the standard deviation of replicate measurement of the analyte in reagent water.
- The region of the standard curve where there is a significant change in sensitivity (i.e., a break in the slope of the standard curve).

Prepare (extract) and analyze seven MS samples (using American Society for Testing and Materials International [ASTM] Type II water for aqueous methods; Ottawa sand for soil organic methods) containing the analyte of interest at a concentration 3 to 5 times the estimated MDL. If more than seven replicates are analyzed, all results must be used to calculate the MDLs unless exclusion of a result is technically justified and documented. MDLs must be established for each extraction/cleanup method combination employed for samples.

Determine the variance (S2) for each analyte as follows:

$$S2 = \frac{1}{n-1}\left[\sum_{i=1}^{n}\left(x_i - \overline{x}\right)^2\right]$$

where:

x_i = the ith measurement of the variable x
$\overline{x}$ = the average value of x
S2 = variance

$$\overline{X} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

Determine the standard deviation(s) for each analyte as follows:

s = (S2)1/2

Determine the DL for each analyte as follows:

MDL = 3.14(s)

(Note: 3.14 is the one-sided t-statistic at the 99% confidence level that is appropriate for determining the DL using seven samples.)

Repeat the process using a smaller spiking level if the spike level used in Step 2 is more than 10 times the calculated DL.

If multiple instruments are used, the DL used for reporting purposes will represent the least sensitive instrument response for each compound or element spiked.

Limit of Detection

The Limit of Detection (LOD) is the smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate is 1%. The DL will be used to determine the LOD for each analyte and matrix and for all preparatory and cleanup methods routinely used on samples in accordance with the DoD QSM V5.1 (DoD, 2017). After each DL determination, the laboratory must immediately establish the LOD by spiking a quality system matrix at approximately two to three times the DL (for a single-analyte standard) or one to four times the DL (for a multi-analyte standard). This spike concentration establishes the LOD; it is specific to each combination of analyte, matrix, method (including sample preparation), and instrument configuration. The LOD must be verified quarterly.

The following requirements apply to the initial DL and LOD determinations and to the quarterly LOD verifications:

- The apparent signal-to-noise ratio at the LOD must be at least 3, and the results must meet all method requirements for analyte identification (e.g., ion abundance, second-column confirmation, or pattern recognition). For data systems that do not provide a noise measurement, the signal produced by the verification sample must produce a result that is at least three standard deviations greater than the mean method blank concentrations.
- If a laboratory uses multiple instruments for a given method, the LOD must be verified for each.
- If the LOD verification fails, the laboratory must repeat the DL determination and LOD verification at a higher concentration, or perform and pass two consecutive LOD verifications at a higher concentration and set the LOD at the higher concentration.
- The laboratory will maintain documentation for all DL determinations and LOD verifications.

LOD verification samples will be prepared and analyzed in the same manner as field samples. Verification of the LOD and will be conducted in accordance with the DoD QSM V5.1 (DoD, 2017).

Limit of Quantitation

The LOQ is the lowest concentration that produces a quantitative result within specified limits of precision and bias. The LOQ will be set at or above the concentration of the lowest initial calibration standard. The laboratory will compare the results of the LOD demonstrations with the LOQs for each method and analyte. The LOD may not be more than one-half the corresponding LOQ. The laboratory will also verify LOQs by including a standard equal to or below the LOQ as the lowest point on the calibration curve.

At a minimum, the LOQ must be verified quarterly. LOQ verification samples will be prepared and analyzed in the same manner as field samples. Precision and accuracy of the LOQ verification are established in accordance with the DoD QSM V5.1 (DoD, 2017). The laboratory procedure for establishing the LOQ must empirically demonstrate precision and bias at the LOQ. In the absence of client requirements, the LOQ must meet LCS control limits (CLs). The LOQ and associated precision and bias must meet project-specific requirements and must be reported. If the method is modified, precision and bias at the new LOQ must be demonstrated and reported.

If a result is greater than the DL and less than the LOQ, the result will be reported as a detected concentration and flagged "J." If no detected concentration is determined down to the DL, the result will be reported to the LOD concentration (with the added variables of sample dilution, final volume, and sample mass included), reported as a non-detect result, and U-flagged. A detected result greater than or equal to the LOQ will be reported without a qualifying flag unless stated otherwise in the QA/QC criteria and instrument calibration tables for each matrix and method. No results below the DL will be reported.

Sample dilution as a result of target and or non-target compound concentrations or matrix interference could prevent achievement of DLs. Samples must be analyzed initially while undiluted, when reasonable. If dilution is necessary, both the original and the diluted results must be reported. A process for the handling of samples that require dilution must be set up prior to the start of sampling. Any samples that are not analyzed undiluted must be supported by matrix interference documentation, such as sample viscosity, color, odor, or results from other analyses of the same sample, to show that undiluted analysis is not possible. Appropriate cleanup procedures must be followed to minimize matrix effects on DLs, LODs, and LOQs. The analytical laboratory must notify the Project Chemist for review and approval of diluted samples and/or non-cleanup samples.

The laboratory DLs, LODs, and LOQs are evaluated against project-specific action limits on **Table 15-1** for soil and **Table 15-2** for groundwater. Measurement performance tables for each analytic method are provided in **Tables 12-1** through **12-4**.

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Table 12-1 Measurement Performance Table (GRO)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Matrix: Water/Soil
Analytical Group or Method: GRO by AK101
Concentration Level: Low-High

Data Quality Indicator	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Precision	Field duplicate	Soil: RPD <50% Water: RPD <30%
Accuracy/Bias/ Contamination	Blanks (MB, trip blank)	No analytes detected >1/2 LOQ and >1/10 the amount found in any sample. For common laboratory contaminants, no analytes detected >LOQ and >1/10 the amount measured in any sample.
Accuracy	LCS/LCSD recoveries	60 to 130% recovery (use LCS limits for MS/MSD)
Precision	LCS/LCSD recoveries	RPD ≤ 20% (RPD ≤ 40% for MS/MSD)
Accuracy	Surrogate recoveries for MB/LCS/LCSD	60 to 120% recovery of surrogate: 4-Bromofluorobenzene
Accuracy	Surrogate recoveries for field samples including MS/MSD	50 to 150% recovery for surrogate: 4-Bromofluorobenzene
Accuracy/Bias	ICV and continuing CCV	≤25% difference
Representativeness/Usability	Collection time/date, extraction time/date, analysis time/date	Samples must be extracted and analyzed within holding times (Soils: 28 days, Waters: 14 days)
Representativeness/Usability	Cooler temperature and temperature blank	Temperature 4±2°C
Sensitivity	Evaluate laboratory LODs and LOQs against project DQOs	LOD for non-detect results less than the PAL (Soil—**Table 15-1** and Groundwater—**Table 15-2**)
Completeness	Completeness of samples collected; completeness of analytical requirements per the UFP-QAPP	95% for waters 90% for soils

Notes:

%	Percent	LCS	Laboratory Control Sample	MS	Matrix Spike
°C	degrees Celsius	LCSD	Laboratory Control Sample Duplicate	MSD	Matrix Spike Duplicate
CCV	Continuing calibration verification	LOD	Limit of Detection	PAL	Project Action Limit
DQO	Data Quality Objective	LOQ	Limit of Quantification	RPD	Relative Percent Difference
ICV	Initial calibration verification	MB	Method Blank	UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan

Table 12-2 Measurement Performance Table (DRO/RRO)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Matrix: Water/Soil
Analytical Group or Method: DRO/ RRO by AK102/AK103
Concentration Level: Low-High

Data Quality Indicator	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Precision	Field duplicate	Soil: RPD <50% Water: RPD <30%
Accuracy/Bias/ Contamination	Blanks (MB)	No analytes detected >1/2 LOQ and >1/10 the amount found in any sample. For common laboratory contaminants, no analytes detected >LOQ and >1/10 the amount measured in any sample.
Accuracy	LCS/LCSD recoveries	DRO (Carbon range C10-C25): 75 to 125% Recovery (use LCS limits for MS/MSD) RRO (Carbon range C25-C36): 60 to 120% Recovery (use LCS limits for MS/MSD)
Precision	LCS/LCSD recoveries	DRO (Carbon range C10-C25): RPD ≤ 20% (RPD ≤ 40% for MS/MSD) RRO (Carbon range C25-C36): RPD ≤ 20% (RPD ≤ 40% for MS/MSD)
Accuracy	Surrogate recoveries for MB/LCS/LCSD	DRO: o-Terphenyl (or equivalent) Recovery 60 to 120% RRO: n-Triacontane-d62 (or equivalent) Recovery 60 to 120%
Accuracy	Surrogate recoveries for field samples including MS/MSD	DRO: o-Terphenyl (or equivalent) Recovery 50 to 150% RRO: n-Triacontane-d62 (or equivalent) Recovery 50 to 150%
Accuracy/Bias	ICV and CCV	≤25% difference
Representativeness/ Usability	Collection time/date, extraction time/date, analysis time/date	Samples must be extracted and analyzed within holding times (14 days to extraction, 40 days to analysis)
Representativeness/ Usability	Cooler temperature and temperature blank	Temperature 0-6°C
Sensitivity	Evaluate laboratory LODs and LOQs against project DQOs	LOD for non-detect results less than the project action limit (Soil—**Table 15-1** and Groundwater—**Table 15-2**)
Completeness	Completeness of samples collected; completeness of analytical requirements per the UFP-QAPP	95% for waters 90% for soils

Notes:

%	Percent	LCS	Laboratory Control Sample	MSD	Matrix Spike Duplicate
°C	degrees Celsius	LCSD	Laboratory Control Sample Duplicate	RPD	Relative Percent Difference
CCV	Continuing calibration verification	LOD	Limit of Detection	RRO	Residual-range organics
DQO	Data Quality Objective	LOQ	Limit of Quantification	UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
DRO	diesel-range organics	MB	Method Blank		
ICV	Initial calibration verification	MS	Matrix Spike		

Table 12-3 Measurement Performance Table (VOCs)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Matrix:	Water/Soil
Analytical Group or Method:	VOCs by SW8260C
Concentration Level:	Low-High

Data Quality Indicator	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Precision	Field duplicate	Soil: RPD <50% Water: RPD <30%
Accuracy/Bias/Contamination	Blanks (MB, trip blank)	No analytes detected >1/2 LOQ and >1/10 the amount found in any sample. For common laboratory contaminants, no analytes detected >LOQ and >1/10 the amount measured in any sample.
Accuracy	LCS and MS/MSD recoveries	Soil: Percent recovery limits, Table 23 of DoD QSM V5.1 (Appendix C) Water: Percent recovery limits, Table 24 of DoD QSM V5.1 (Appendix C)
Precision	MS/MSD recoveries (and LCS/LCSD, if performed)	RPD ≤ 30%
Accuracy	Surrogate recoveries	Soil: Percent recovery limits, Table 23 of DoD QSM V5.1 (Appendix C) Water: Percent recovery limits, Table 24 of DoD QSM V5.1 (Appendix C)
Accuracy/Bias	ICV and CCV	≤ 20% difference
Accuracy	Tune criteria consistent with SW8260C	Mass spectrometer tuning check, 4-Bromofluorobenzene
Sensitivity	ISs	Retention time ±10 seconds from retention time of the IS of the calibration midpoint and extracted ion current profile area within -50% to +100% of area from IS calibration midpoint standard
Representativeness/Usability	Collection time/date, extraction time/date, analysis time/date	Samples must be extracted and analyzed within holding times (Soil & Water: 14 days to analysis)
Representativeness/Usability	Cooler temperature and temperature blank	Temperature 0-6°C
Sensitivity	Evaluate laboratory LODs and LOQs against project DQOs	LOD for non-detect results less than the project action limit (Soil—**Table 15-1** and Groundwater—**Table 15-2**)
Completeness	Completeness of samples collected; completeness of analytical requirements per the UFP-QAPP	95% for waters 90% for soils

Notes:

%	Percent	IS	Internal Standard	MS	Matrix Spike
°C	degrees Celsius	LCS	Laboratory Control Sample	MSD	Matrix Spike Duplicate
CCV	Continuing calibration verification	LCSD	Laboratory Control Sample Duplicate	QSM	Quality Systems Manual
DoD	U.S. Department of Defense	LOD	Limit of Detection	RPD	Relative Percent Difference
DQO	Data Quality Objective	LOQ	Limit of Quantification	UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
ICV	Initial calibration verification	MB	Method Blank	VOC	volatile organic compound

Table 12-4 Measurement Performance Table (SVOCs)

UFP-QAPP Removal Action and Monitoring at Source Areas CG517 and CS081

Matrix: Water/Soil
Analytical Group or Method: SVOCs by SW8270D
Concentration Level: Low-High

Data Quality Indicator	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Precision	Field duplicate	Soil: RPD <50% Water: RPD <30%
Accuracy/Bias/ Contamination	Blanks (MB)	No analytes detected >1/2 LOQ and >1/10 the amount found in any sample. For common laboratory contaminants, no analytes detected >LOQ and >1/10 the amount measured in any sample.
Accuracy	LCS and MS/MSD recoveries	Soil: Percent recovery limits, Table 25 of DoD QSM V5.1 (Appendix C) Water: Percent recovery limits, Table 26 of DoD QSM V5.1 (Appendix C)
Precision	MS/MSD recoveries (and LCS/LCSD, if performed)	RPD ≤ 30%
Accuracy	Surrogate recoveries	Soil: Percent recovery limits, Table 25 of DoD QSM V5.1 (Appendix C) Water: Percent recovery limits, Table 26 of DoD QSM V5.1 (Appendix C)
Accuracy/Bias	ICV and CCV	≤ 20% difference
Accuracy	Tune criteria consistent with SW8270D	Mass spectrometer tuning check, decafluorotriphenylphosphine
Sensitivity	ISs	Retention time ±10 seconds from retention time of the IS of the calibration midpoint and extracted ion current profile area within -50% to +100% of area from IS calibration midpoint standard
Representativeness/Usability	Collection time/date, extraction time/date, analysis time/date	Samples must be extracted and analyzed within holding times (Soil: 14 days to extraction, 40 days to analysis; Water: 7 days to extraction, 40 days to analysis)
Representativeness/Usability	Cooler temperature and temperature blank	Temperature 0- °C
Sensitivity	Evaluate laboratory LODs and LOQs against project DQOs	LOD for non-detect results less than the project action limit (Soil—Table 15-1 and Water—Table 15-2)
Completeness	Completeness of samples collected; completeness of analytical requirements per the UFP-QAPP	95% for waters 90% for soils

Notes:

%	Percent
°C	degrees Celsius
CCV	Continuing calibration verification
DQO	Data Quality Objective
ICV	Initial calibration verification
IS	Internal Standard
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOD	Limit of Detection
LOQ	Limit of Quantification
MS	Matrix Spike
MSD	Matrix Spike Duplicate
QSM	Quality Systems Manual
RPD	Relative Percent Difference
SVOC	semivolatile organic compound
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan

WORKSHEET #13: SECONDARY DATA USES AND LIMITATIONS

Secondary data include data collected from previous investigations as well as regional, local, and reference materials that may be used to increase the understanding of current site conditions. The table below identifies the limitations of previously collected data.

Secondary Data	Data Source	Data Uses Relative to Current Project	Factors Affecting the Reliability of Data and Limitations on Data Use
Chemical laboratory data	Previous site reports	Data will be used for applicable DQO purposes, including nature and extent determinations and risk assessment evaluations.	Changes in site conditions since data was collected (e.g., volatilization); changes in analytical methods; analyte DLs appropriate to meet project goals.
Screening-level field data (including field meter readings or field kit analysis)	Previous site reports	Data will be used as screening-level data to assist with CSM development and guide placement of samples to fill potential data gaps.	Review of data and professional judgment will be required to determine applicability and usability of data.
GIS mapping layers and coordinates	Previous site reports and DoD reference database	Data will be used to determine well, boring, sample, and site feature locations to support CSMs and nature and extent evaluations.	Review of data and professional judgment will be required to determine applicability and usability of data.
Photographs, aerial photography, interviews with site personnel, or other source data	Previous site reports; published literature	Data will be used to support CSMs.	Review of data and professional judgment will be required to determine applicability and usability of data.

Notes:

CSM	Conceptual Site Model
DL	Detection Limit
DoD	Department of Defense
DQO	Data Quality Objective
GIS	Geographic Information System

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WORKSHEET #14 & #16: PROJECT TASKS & SCHEDULE

This worksheet provides a summary of project tasks to be completed during the project activities. The overall project tasks include pre-investigation activities, field investigation, and post-investigation activities.

PRE-INVESTIGATION ACTIVITIES

Activities that will occur before the field activities begin include:

- Site research of available documents and reports.
- Work Plan and UFP-QAPP approval from ADEC.
- Acquiring subcontractors and materials needed for project completion.
- Coordinating site access with appropriate personnel.

Activities will be coordinated with the Air Force Civil Engineer Center (AFCEC) (USAF) and appropriate installation points of contact. Work clearances and permits will be obtained for the field activities. The appropriate utility and/or private company will be contacted to help locate buried utility lines at the site before any subsurface drilling or sampling occurs. Refer to Worksheet #21 of this UFP-QAPP for the list of field standard operating procedures (SOPs) and to **Appendix A** for the full text of the field SOPs.

FIELD INVESTIGATION

Field investigation activities will be conducted by "qualified persons" for site investigation purposes. A list of the "qualified persons" shall be provided with the draft and final copies of the reports. Any person listed that is not identified as a "qualified person" must submit information to ADEC that demonstrates that they meet the requirements of 18 AAC 75.990(100). Field SOPs are provided in **Appendix A** and field forms are in **Appendix B**.

Activities that will occur during the 2018 field investigation will include:

- Utility locates and acquiring dig permits
- Vegetation clearance and site preparation
- Equipment calibration
- Sample (soil, groundwater) collection tasks
- Sample identification
- Surveying monitoring well locations
- Equipment decontamination
- IDW tasks

DECONTAMINATION

Decontamination consists of physically removing contaminants from the surface of reusable sampling equipment in order to prevent cross-contamination of environmental samples and to prevent the transport of contaminants at the site. Whenever possible, disposable sampling equipment will be used. In the event that reusable sampling equipment must be used, the decontamination procedures identified in SOP-24 will be followed. Decontamination of personnel and personal protective equipment (PPE) will follow the procedures outlined in the Health and Safety Plan (HSP). Management and disposal of IDW will follow procedures identified in the *Investigation-Derived Waste Management Plan, Eielson Air Force Base, Alaska* (USAF, 2016).

WASTE MANAGEMENT

Potential wastes include, but are not limited to, the following:

- General refuse
- Personal PPE and disposable sampling equipment
- Soil cuttings
- Spent drums
- IDW, including purge water from wells and decontamination water
- Liquid Waste – Liquid waste will consist of monitoring well purge water and equipment decontamination fluids. Liquids will be treated on-site using a portable granulated activated carbon system. Treated water will be discharged on-site.

Waste will be managed in accordance with all federal, state, and local waste regulations. Procedures for managing IDW are included in the *Investigation-Derived Waste Management Plan, Eielson Air Force Base, Alaska* (USAF, 2016).

POST-INVESTIGATION ACTIVITIES

- Lab analysis
- Data management and review tasks
- Data usability assessment tasks
- Data reduction and interpretation
- Environmental Resources Program Information Management System (ERPIMS) data reporting
- Reporting

LABORATORY ANALYSIS

- Subcontract laboratory must hold current DoD Environmental Laboratory Accreditation Program (ELAP) accreditation and ADEC Laboratory Certification Program approval for the required fields of testing. Laboratory certifications are included in **Appendix C**.
- Laboratory analyses will be performed according to the DoD QSM V5.1 and analytical SOPs included in **Appendix D**.

REPORTING

Reporting will be conducted in accordance with ADEC's *Site Characterization Work Plan and Reporting Guidance for Investigation of Contaminated Sites* (ADEC, 2017b). Documents and deliverables will receive both a technical and clerical review by designated personnel that are independent from the actual document preparation to allow for independent and objective review. Document versions will be labeled as follows:

- Pre-draft version – The initial version of documents that will be reviewed by USAF. Pre-draft documents will be complete; substantively correct and consistent with applicable laws, regulations, DoD/USAF policies; in proper format; and free of grammatical and typographical errors. Pre-draft documents shall not be submitted to regulatory agencies for review. USAF review is 28 days with 10-day comment resolution, 10-day USAF concurrence, and up to 10-day completion of draft version.
- Draft version – A draft document incorporating USAF comments will be submitted in both hard copy and electronic formats for regulatory agency review. Regulatory review is 30 days. Comment resolution is 8 days including comment resolution meeting (if required), document revision, and USAF concurrence of draft version. The USAF will notify the regulatory agencies if the comment resolution period will exceed 30 days.
- Final version – Final documents are the version of the document that has received USAF and regulatory concurrence. The final documents will include the ADEC comment matrix with all comment responses accepted by ADEC. Both hard copy and electronic formats of final documents will be provided to ADEC. At least one electronic copy of the final document, consisting of original productivity software files and all QC data, drawings, and GIS-type information, shall be provided to USAF. Electronic copies should be compatible with the current USAF Microsoft® Office Suite and GIS software versions. All figures shall be delivered in original application files GIS format as fulfills the contract requirements. In addition, an electronic version of the final document shall be submitted in a single portable document format (PDF) approved by USAF complete with electronic bookmarks.

Draft and final versions of reports will include all field documentation, including (but not limited to) scanned field logbook notes, groundwater sampling sheets, land use control inspection forms, photographs, survey data, and field screening results.

Laboratory data will be received from the analytical laboratory in electronic data deliverable (EDD) and hard copy formats. EDDs will include a PDF of the correct and complete Level IV data package and correct and complete ERPIMS deliverable compatible with the most recent version of ERPTools X.

ENVIRONMENTAL RESTORATION PROGRAM INFORMATION MANAGEMENT SYSTEM

The Weston Project Manager (PM) shall ensure that field and laboratory analytical data collected from this investigation are entered into the latest version of ERPIMS. Weston will be responsible for recording field and laboratory data into a computerized format as required by the most current version of the ERPIMS Data Loading Handbook (DLH).

ERPIMS is the USAF system for validation and management of data from environmental projects at all USAF bases. These data contain analytical chemistry samples, tests, and results, as well as hydrogeological information, site/location descriptions, and monitoring well characteristics. USAF maintains the latest and official version of the ERPIMS specification and data structure.

Weston will submit ERPIMS deliverables to USAF within timeframes specified in the applicable contract requirements.

Each ERPIMS deliverable will be evaluated by Weston and USAF for format compliance and data integrity to verify acceptance. All files delivered are required to be error-free and in compliance with the DLH. Any errors identified by USAF in the submission shall be corrected by Weston

Subcontracted laboratories will be responsible for recording laboratory data into a computerized format as required by the most current version of the ERPIMS DLH. Individual ERPIMS data files (analytical results, etc.), including re-submissions, will be delivered with a transmittal letter by the laboratory to Weston in sequence, according to a controlled time schedule as identified in the current version of the ERPIMS DLH. The laboratory must include a detailed explanation of any ERPTools warnings or errors for each ERPIMS file submission. The error report will be submitted as a hard copy with the transmittal letter.

The laboratory will be responsible for the accuracy and completeness of all data submitted. All data entered into the ERPIMS data files and submitted will correspond exactly with the data contained in the original laboratory reports and other documents associated with sampling and laboratory contractual tasks.

PROJECT SCHEDULE

The table below presents the general project schedule. The schedule will be updated as appropriate. Changes to this schedule will be communicated to the project team as outlined in Worksheet #6.

Activity	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)	Deliverable Due Date
Prepare UFP-QAPP	Weston	7/2017	06/2018	Final UFP-QAPP	06/2018
Site Characterization Work Plan	Swift River	7/2017	06/2018	Site Characterization Work Plan	06/2018
Conduct Characterization Fieldwork	Swift River	06/2018	07/2018	NA	NA
Data Evaluation & Prepare Site Characterization Report	Swift River	06/2018	01/2019	Final Site Characterization Report	01/2019

Notes:

NA	Not Applicable
Swift River	Swift River Environmental Services, LLC
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
Weston	Weston Solutions, Inc.

WORKSHEET #15: PROJECT ACTION LIMITS AND LABORATORY-SPECIFIC DETECTION/QUANTITATION LIMITS

One of the primary goals of the site-specific UFP-QAPP is to select the appropriate analytical methods to achieve the DLs and/or LOQs to satisfy the overall project DQOs (as defined in Worksheet #11). **Table 15-1** lists the soil DLs, LODs, and LOQs compared to the Method Two Soil Cleanup Levels (Under 40-inch Zone) in Table B1/B2 of 18 AAC 75, *Oil and Other Hazardous Substances Pollution Control* (ADEC, 2017c). **Table 15-2** lists the groundwater DLs, LODs, and LOQs compared to Groundwater Cleanup Levels in Table C of 18 AAC 75, *Oil and Other Hazardous Substances Pollution Control* (ADEC, 2017c). Analytical results of the samples collected during this investigation will be compared to ADEC cleanup levels listed in **Tables 15-1** and **Table 15-2**. Soil and groundwater conditions at CG517 and CS081 will be evaluated for remedial remedies (additional investigation or site closure) based upon results of this Source Areas CG517 and CS081 activity.

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Table 15-1 Project Action Limits and Laboratory-Specific Detection/Quantitation Limits, ADEC Tables B1/B2 Method Two Soil Cleanup/Screening Levels

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Method	Analyte	CAS	LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)	Migration to Groundwater (mg/kg)	Human Health (mg/kg)
AK101	Gasoline-Range Organics	--	2.5	1.25	0.75	300	1400
AK102	Diesel-Range Organics	--	20	10	6.2	250	12500
AK103	Residual-Range Organics	--	20	10	6.2	11,000	22000
SW8260C	1,1,1,2-Tetrachloroethane	630-20-6	0.020	0.010	0.0062	0.022	21
SW8260C	1,1,1-Trichloroethane	71-55-6	0.025	0.0125	0.0078	32	360
SW8260C	1,1,2,2-Tetrachloroethane	79-34-5	0.0125	0.00625	0.0039	0.0030	6.1
SW8260C	1,1,2-Trichloroethane	79-00-5	0.010	0.005	0.0031	0.0014	1.6
SW8260C	1,1-Dichloroethane	75-34-3	0.025	0.0125	0.0078	0.092	46
SW8260C	1,1-Dichloroethene	75-35-4	0.025	0.0125	0.0078	1.2	330
SW8260C	1,1-Dichloropropene	563-58-6	0.025	0.0125	0.0078	--	--
SW8260C	1,2,3-Trichlorobenzene	87-61-6	0.050	0.025	0.015	0.15	81
SW8260C	1,2,3-Trichloropropane[1]	96-18-4	0.025	0.0125	0.0078	3.1 x 10-5	0.066
SW8260C	1,2,4-Trichlorobenzene[2]	120-82-1	0.025	0.0125	0.0078	0.082	45
SW8260C	1,2,4-Trimethylbenzene	95-63-6	0.050	0.025	0.015	0.16	43
SW8260C	1,2-Dibromo-3-chloropropane	96-12-8	0.100	0.050	0.0310	--	--
SW8260C	1,2-Dibromoethane[1]	106-93-4	0.010	0.005	0.0031	0.00024	0.42
SW8260C	1,2-Dichlorobenzene	95-50-1	0.025	0.0125	0.0078	2.4	78
SW8260C	1,2-Dichloroethane	107-06-2	0.010	0.005	0.0031	0.0055	5.5
SW8260C	1,2-Dichloropropane	78-87-5	0.010	0.005	0.0031	0.016	11
SW8260C	1,3,5-Trimethylbenzene	108-67-8	0.025	0.0125	0.0078	1.3	37
SW8260C	1,3-Dichlorobenzene	541-73-1	0.025	0.0125	0.0078	2.3	62
SW8260C	1,3-Dichloropropane[1]	142-28-9	0.010	0.005	0.0031	--	--
SW8260C	1,4-Dichlorobenzene	106-46-7	0.025	0.0125	0.0078	0.037	21
SW8260C	2,2-Dichloropropane	594-20-7	0.025	0.0125	0.0078	--	--

Table 15-1 Project Action Limits and Laboratory-Specific Detection/Quantitation Limits, ADEC Table B1/B2 Method Two Soil Cleanup Levels (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Method	Analyte	CAS	LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)	Migration to Groundwater (mg/kg)	Human Health (mg/kg)
SW8260C	2-Butanone	78-93-3	0.250	0.125	0.0780	15	23000
SW8260C	2-Chlorotoluene	95-49-8	0.025	0.0125	0.0078	--	--
SW8260C	2-Hexanone	591-78-6	0.100	0.050	0.031	0.11	270
SW8260C	4-Chlorotoluene	106-43-4	0.025	0.0125	0.0078	--	--
SW8260C	4-Isopropyltoluene	99-87-6	0.025	0.0125	0.0078	--	--
SW8260C	4-Methyl-2-pentanone	108-10-1	0.250	0.125	0.0780	18	2200
SW8260C	Benzene	71-43-2	0.0125	0.00625	0.0039	0.022	11
SW8260C	Bromobenzene	108-86-1	0.025	0.0125	0.0078	0.36	160
SW8260C	Bromochloromethane	74-97-5	0.025	0.0125	0.0078	--	--
SW8260C	Bromodichloromethane	75-27-4	0.025	0.0125	0.0078	0.0043	3.6
SW8260C	Bromoform	75-25-2	0.025	0.0125	0.0078	0.10	240
SW8260C	Bromomethane	74-83-9	0.200	0.100	0.062	0.024	10
SW8260C	Carbon disulfide	75-15-0	0.100	0.050	0.031	2.9	500
SW8260C	Carbon tetrachloride	56-23-5	0.0125	0.00625	0.0039	0.021	9.1
SW8260C	Chlorobenzene	108-90-7	0.025	0.0125	0.0078	0.46	180
SW8260C	Chloroethane	75-00-3	0.200	0.100	0.0620	72	1400
SW8260C	Chloroform	67-66-3	0.025	0.0125	0.0078	0.0071	4
SW8260C	Chloromethane	74-87-3	0.025	0.0125	0.0078	0.61	170
SW8260C	Cis-1,2-Dichloroethene	156-59-2	0.025	0.0125	0.0078	0.12	200
SW8260C	Cis-1,3-Dichloropropene	10061-01-5	0.0125	0.0063	0.0039	--	--
SW8260C	Dibromochloromethane	124-48-1	0.025	0.0125	0.0078	0.0027	110
SW8260C	Dibromomethane	74-95-3	0.025	0.0125	0.0078	0.025	31
SW8260C	Dichlorodifluoromethane	75-71-8	0.050	0.025	0.0150	3.9	150
SW8260C	Ethylbenzene	100-41-4	0.025	0.0125	0.0078	0.13	49

Table 15-1 Project Action Limits and Laboratory-Specific Detection/Quantitation Limits, ADEC Table B1/B2 Method Two Soil Cleanup Levels (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Method	Analyte	CAS	LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)	Migration to Groundwater (mg/kg)	Human Health (mg/kg)
SW8260C	Freon-113	76-13-1	0.100	0.050	0.031	1700	740
SW8260C	Hexachlorobutadiene	87-68-3	0.020	0.010	0.0062	0.020	3.3
SW8260C	Isopropylbenzene	98-82-8	0.025	0.0125	0.0078	5.6	54
SW8260C	Methyl tert-butyl ether	1634-04-4	0.100	0.050	0.031	0.40	670
SW8260C	Methylene chloride	75-09-2	0.100	0.050	0.031	0.33	460
SW8260C	Naphthalene	91-20-3	0.025	0.0125	0.0078	0.038	29
SW8260C	n-Butylbenzene	104-51-8	0.025	0.0125	0.0078	23	20
SW8260C	n-Propylbenzene	103-65-1	0.025	0.0125	0.0078	9.1	52
SW8260C	o-Xylene	95-47-6	0.050	0.025	0.015	--	--
SW8260C	m-Xylene & p-Xylene	108-38-3 & 106-42-3	0.025	0.0125	0.0078	--	--
SW8260C	Xylenes (total)	1330-20-7	0.075	0.0375	0.0228	1.5	57
SW8260C	sec-Butylbenzene	135-98-8	0.025	0.0125	0.0078	42	28
SW8260C	Styrene	100-42-5	0.025	0.0125	0.0078	10	180
SW8260C	tert-Butylbenzene	98-06-6	0.0125	0.00625	0.0039	11	35
SW8260C	Tetrachloroethene	127-18-4	0.025	0.0125	0.0078	0.19	68
SW8260C	Toluene	108-88-3	0.025	0.0125	0.0078	6.7	200
SW8260C	trans-1,2-Dichloroethene	156-60-5	0.0125	0.00625	0.0039	1.3	960
SW8260C	trans-1,3-Dichloropropene	10061-02-6	0.010	0.005	0.0031	--	--
SW8260C	Trichloroethene	79-01-6	0.050	0.025	0.0150	0.011	4.9
SW8260C	Trichlorofluoromethane	75-69-4	0.020	0.010	0.0062	41	980
W8260C	Vinyl acetate	108-05-4	0.100	0.050	0.0310	1.1	1400
SW8260C	Vinyl chloride	75-01-4	0.010	0.005	0.0031	0.00080	0.65
SW8270D	1,2,4-Trichlorobenzene[2]	120-82-1	0.25	0.125	0.078	0.082	45

Table 15-1 Project Action Limits and Laboratory-Specific Detection/Quantitation Limits, ADEC Table B1/B2 Method Two Soil Cleanup Levels (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Method	Analyte	CAS	LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)	Migration to Groundwater (mg/kg)	Human Health (mg/kg)
SW8270D	1,2-Dichlorobenzene	95-50-1	0.25	0.125	0.078	2.4	78
SW8270D	1,3-Dichlorobenzene	541-73-1	0.25	0.125	0.078	2.3	62
SW8270D	1,4-Dichlorobenzene	106-46-7	0.25	0.125	0.078	0.037	21
SW8270D	1-Chloronaphthalene	90-13-1	0.25	0.125	0.078	--	--
SW8270D	1-Methylnaphthalene	90-12-0	0.25	0.125	0.078	0.41	68
SW8270D	2,4,5-Trichlorophenol	95-95-4	0.25	0.125	0.078	28	8200
SW8270D	2,4,6-Trichlorophenol	88-06-2	0.25	0.125	0.078	0.092	82
SW8270D	2,4-Dichlorophenol	120-83-2	0.25	0.125	0.078	0.21	250
SW8270D	2,4-Dimethylphenol	105-67-9	0.25	0.125	0.078	3.2	1600
SW8270D	2,4-Dinitrophenol	51-28-5	3	1.5	0.94	0.34	160
SW8270D	2,4-Dinitrotoluene	121-14-2	0.25	0.125	0.078	0.024	23
SW8270D	2,6-Dichlorophenol	87-65-0	0.25	0.125	0.078	--	--
SW8270D	2,6-Dinitrotoluene	606-20-2	0.25	0.125	0.078	0.0050	4.7
SW8270D	2-Chloronaphthalene	91-58-7	0.25	0.125	0.078	26	6200
SW8270D	2-Chlorophenol	95-57-8	0.25	0.125	0.078	0.71	510
SW8270D	2-Methyl-4,6-dinitrophenol	534-52-1	2	1	0.62	--	--
SW8270D	2-Methylnaphthalene	91-57-6	0.25	0.125	0.078	1.3	310
SW8270D	2-Methylphenol	95-48-7	0.25	0.125	0.078	6.2	4100
SW8270D	2-Nitroaniline	88-74-4	0.25	0.125	0.078	--	--
SW8270D	2-Nitrophenol	88-75-5	0.25	0.125	0.078	--	--
SW8270D	3 & 4 Methylphenol	65794-96-9	1	0.5	0.31	--	--
SW8270D	3,3'-Dichlorobenzidine	91-94-1	0.5	0.25	0.15	0.056	16
SW8270D	3-Nitroaniline	99-09-2	0.5	0.25	0.15	--	--
SW8270D	4-Bromophenyl phenyl ether	101-55-3	0.25	0.125	0.078	--	--

Table 15-1 Project Action Limits and Laboratory-Specific Detection/Quantitation Limits, ADEC Table B1/B2 Method Two Soil Cleanup Levels (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Method	Analyte	CAS	LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)	Migration to Groundwater (mg/kg)	Human Health (mg/kg)
SW8270D	4-Chloro-3-methylphenol	59-50-7	0.25	0.125	0.078	--	--
SW8270D	4-Chloroaniline	106-47-8	0.5	0.25	0.15	0.015	35
SW8270D	4-Chlorophenyl phenyl ether	7005-72-3	0.25	0.125	0.078	--	--
SW8270D	4-Nitroaniline	100-01-6	3	1.5	0.94	--	--
SW8270D	4-Nitrophenol	100-02-7	1	0.5	0.31	--	--
SW8270D	Acenaphthene	83-32-9	0.25	0.125	0.078	37	4600
SW8270D	Acenaphthylene	208-96-8	0.25	0.125	0.078	18	2300
SW8270D	Aniline	62-53-3	2	1	0.62	--	--
SW8270D	Anthracene	120-12-7	0.25	0.125	0.078	390	23000
SW8270D	Azobenzene	103-33-3	0.25	0.125	0.078	--	--
SW8270D	Benzo[a]anthracene	56-55-3	0.25	0.125	0.078	0.28	2.0
SW8270D	Benzo[a]pyrene	50-32-8	0.25	0.125	0.078	0.27	0.20
SW8270D	Benzo[b]fluoranthene	205-99-2	0.25	0.125	0.078	2.7	2.0
SW8270D	Benzo[g,h,i]perylene	191-24-2	0.25	0.125	0.078	15000	2300
SW8270D	Benzo[k]fluoranthene	207-08-9	0.25	0.125	0.078	27	20
SW8270D	Benzoic acid	65-85-0	1.5	0.75	0.47	200	1.0×10^5
SW8270D	Benzyl alcohol	100-51-6	0.25	0.125	0.078	5.7	8200
SW8270D	2,2'-oxybis[1-chloropropane]	108-60-1	0.25	0.125	0.078	--	--
SW8270D	bis(2-Chloroethoxy)methane	111-91-1	0.25	0.125	0.078	--	--
SW8270D	Bis(2-chloroethyl)ether	111-44-4	0.25	0.125	0.078	0.00042	2.8
SW8270D	bis(2-Ethylhexyl) phthalate	117-81-7	0.25	0.125	0.078	88	500
SW8270D	Butyl benzyl phthalate	85-68-7	0.25	0.125	0.078	16	3700
SW8270D	Carbazole	86-74-8	0.25	0.125	0.078	--	--
SW8270D	Chrysene	218-01-9	0.25	0.125	0.078	82	200

Table 15-1 Project Action Limits and Laboratory-Specific Detection/Quantitation Limits, ADEC Table B1/B2 Method Two Soil Cleanup Levels (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Method	Analyte	CAS	LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)	Migration to Groundwater (mg/kg)	Human Health (mg/kg)
SW8270D	Dibenz(a,h)anthracene	53-70-3	0.25	0.125	0.078	0.87	0.20
SW8270D	Dibenzofuran	132-64-9	0.25	0.125	0.078	0.97	95
SW8270D	Diethyl phthalate	84-66-2	0.25	0.125	0.078	60	66000
SW8270D	Dimethyl phthalate	131-11-3	0.25	0.125	0.078	48	66000
SW8270D	Di-n-butyl phthalate	84-74-2	0.25	0.125	0.078	16	8200
SW8270D	Di-n-octyl phthalate	117-84-0	0.5	0.25	0.15	370	820
SW8270D	Fluoranthene	206-44-0	0.25	0.125	0.078	590	3100
SW8270D	Fluorene	86-73-7	0.25	0.125	0.078	36	3100
SW8270D	Hexachlorobenzene	118-74-1	0.25	0.125	0.078	0.0082	2.0
SW8270D	Hexachlorobutadiene	87-68-3	0.25	0.125	0.078	0.020	3.3
SW8270D	Hexachlorocyclopentadiene	77-47-4	0.7	0.35	0.2	0.0093	1.4
SW8270D	Hexachloroethane	67-72-1	0.25	0.125	0.078	0.018	17
SW8270D	Indeno[1,2,3-cd]pyrene	193-39-5	0.25	0.125	0.078	8.8	2.0
SW8270D	Isophorone	78-59-1	0.25	0.125	0.078	2.7	7400
SW8270D	Naphthalene	91-20-3	0.25	0.125	0.078	0.038	29
SW8270D	Nitrobenzene	98-95-3	0.25	0.125	0.078	0.0079	43
SW8270D	N-Nitrosodimethylamine	62-75-9	0.25	0.125	0.078	3.3×10^{-6}	0.026
SW8270D	N-Nitrosodi-n-propylamine	621-64-7	0.25	0.125	0.078	0.00068	1.0
SW8270D	N-Nitrosodiphenylamine	86-30-6	0.25	0.125	0.078	4.6	1400
SW8270D	Pentachlorophenol	87-86-5	2	1	0.62	0.0043	13
SW8270D	Phenanthrene	85-01-8	0.25	0.125	0.078	39	2300
SW8270D	Phenol	108-95-2	0.25	0.125	0.078	29	25000
SW8270D	Pyrene	129-00-0	0.25	0.125	0.078	87	2300

Table 15-1 Project Action Limits and Laboratory-Specific Detection/Quantitation Limits, ADEC Table B1/B2 Method Two Soil Cleanup Levels (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Notes:
[1] ADEC 18AAC75 Under 40 inch zone
[2] This compound is reported by both 8260 and 8270

--	No cleanup level.
CAS	Chemical Abstract Service
DL	Detection Limit
LOD	Limit of detection
LOQ	Limit of quantitation
mg/kg	milligram per kilogram

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Table 15-2 Project Action Limits and Laboratory-Specific Detection/Quantitation Limits, ADEC Table C Groundwater Cleanup Levels

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Method	Analyte	CAS	LOQ (mg/L)	LOD (mg/L)	DL (mg/L)	Cleanup Level (mg/L)
AK101	Gasoline-Range Organics	--	0.1	0.05	0.031	2.2
AK102	Diesel-Range Organics	--	0.6	0.3	0.18	1.5
AK103	Residual-Range Organics	--	0.5	0.25	0.15	1.1
SW8260C	1,1,1,2-Tetrachloroethane	630-20-6	0.0005	0.00025	0.00015	0.0057
SW8260C	1,1,1-Trichloroethane	71-55-6	0.001	0.0005	0.00031	8.0
SW8260C	1,1,2,2-Tetrachloroethane	79-34-5	0.0005	0.00025	0.00015	0.00076
SW8260C	1,1,2-Trichloroethane	79-00-5	0.0004	0.0002	0.00012	0.00041
SW8260C	1,1-Dichloroethane	75-34-3	0.001	0.0005	0.00031	0.028
SW8260C	1,1-Dichloroethene	75-35-4	0.001	0.0005	0.00031	0.28
SW8260C	1,1-Dichloropropene	563-58-6	0.001	0.0005	0.00031	--
SW8260C	1,2,3-Trichlorobenzene	87-61-6	0.001	0.0005	0.00031	0.0070
SW8260C	1,2,3-Trichloropropane	96-18-4	0.001	0.0005	0.00031	0.0000075
SW8260C	1,2,4-Trichlorobenzene[1]	120-82-1	0.001	0.0005	0.00031	0.0040
SW8260C	1,2,4-Trimethylbenzene	95-63-6	0.001	0.0005	0.00031	0.015
SW8260C	1,2-Dibromo-3-chloropropane	96-12-8	0.010	0.005	0.0031	--
SW8260C	1,2-Dibromoethane	106-93-4	0.000075	0.0000375	0.000018	0.000075
SW8260C	1,2-Dichlorobenzene	95-50-1	0.001	0.0005	0.00031	0.30
SW8260C	1,2-Dichloroethane	107-06-2	0.0005	0.00025	0.00015	0.0017
SW8260C	1,2-Dichloropropane	78-87-5	0.001	0.0005	0.00031	0.0044
SW8260C	1,3,5-Trimethylbenzene	108-67-8	0.001	0.0005	0.00031	0.12
SW8260C	1,3-Dichlorobenzene	541-73-1	0.001	0.0005	0.00031	0.30
SW8260C	1,3-Dichloropropane[1]	142-28-9	0.0005	0.00025	0.00015	--
SW8260C	1,4-Dichlorobenzene	106-46-7	0.0005	0.00025	0.00015	0.0048
SW8260C	2,2-Dichloropropane	594-20-7	0.001	0.0005	0.00031	--
SW8260C	2-Butanone	78-93-3	0.010	0.005	0.0031	5.6

Table 15-2 Project Action Limits and Laboratory-Specific Detection/Quantitation Limits, ADEC Table C Groundwater Cleanup Levels (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Method	Analyte	CAS	LOQ (mg/L)	LOD (mg/L)	DL (mg/L)	Cleanup Level (mg/L)
SW8260C	2-Chlorotoluene	95-49-8	0.001	0.0005	0.00031	--
SW8260C	2-Hexanone	591-78-6	0.010	0.005	0.0031	0.038
SW8260C	4-Chlorotoluene	106-43-4	0.001	0.0005	0.00031	--
SW8260C	4-Isopropyltoluene	99-87-6	0.001	0.0005	0.00031	--
SW8260C	4-Methyl-2-pentanone	108-10-1	0.010	0.005	0.0031	6.3
SW8260C	Benzene	71-43-2	0.0004	0.0002	0.00012	0.0046
SW8260C	Bromobenzene	108-86-1	0.001	0.0005	0.00031	0.062
SW8260C	Bromochloromethane	74-97-5	0.001	0.0005	0.00031	--
SW8260C	Bromodichloromethane	75-27-4	0.0005	0.00025	0.00015	0.0013
SW8260C	Bromoform	75-25-2	0.001	0.0005	0.00031	0.033
SW8260C	Bromomethane	74-83-9	0.005	0.0025	0.0015	0.0075
SW8260C	Carbon disulfide	75-15-0	0.010	0.005	0.0031	0.81
SW8260C	Carbon tetrachloride	56-23-5	0.001	0.0005	0.00031	0.0046
SW8260C	Chlorobenzene	108-90-7	0.0005	0.00025	0.00015	0.078
SW8260C	Chloroethane	75-00-3	0.001	0.0005	0.00031	21
SW8260C	Chloroform	67-66-3	0.001	0.0005	0.00031	0.0022
SW8260C	Chloromethane	74-87-3	0.001	0.0005	0.00031	0.19
SW8260C	cis-1,2-Dichloroethene	156-59-2	0.001	0.0005	0.00031	0.036
SW8260C	cis-1,3-Dichloropropene	10061-01-5	0.0005	0.00025	0.00015	0.0047
SW8260C	Dibromochloromethane	124-48-1	0.0005	0.00025	0.00015	0.0087
SW8260C	Dibromomethane	74-95-3	0.001	0.0005	0.00031	0.0083
SW8260C	Dichlorodifluoromethane	75-71-8	0.001	0.0005	0.00031	0.20
SW8260C	Ethylbenzene	100-41-4	0.001	0.0005	0.00031	0.015
SW8260C	Freon-113	76-13-1	0.010	0.005	0.0031	55
SW8260C	Hexachlorobutadiene	87-68-3	0.001	0.0005	0.00031	0.0014

Table 15-2 Project Action Limits and Laboratory-Specific Detection/Quantitation Limits, ADEC Table C Groundwater Cleanup Levels (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Method	Analyte	CAS	LOQ (mg/L)	LOD (mg/L)	DL (mg/L)	Cleanup Level (mg/L)
SW8260C	Isopropylbenzene	98-82-8	0.001	0.0005	0.00031	0.45
SW8260C	Methyl tert-butyl ether	1634-04-4	0.005	0.0025	0.001	0.14
SW8260C	Methylene chloride	75-09-2	0.010	0.005	0.0031	0.11
SW8260C	Naphthalene	91-20-3	0.001	0.0005	0.00031	0.0017
SW8260C	n-Butylbenzene	104-51-8	0.001	0.0005	0.00031	1.0
SW8260C	n-Propylbenzene	103-65-1	0.001	0.0005	0.00031	0.66
SW8260C	o-Xylene	95-47-6	0.001	0.0005	0.00031	--
SW8260C	m-Xylene & p-Xylene	108-38-3 & 106-42-3	0.002	0.001	0.00062	--
SW8260C	Xylenes (total)	1330-20-7	0.003	0.0015	0.001	0.19
SW8260C	sec-Butylbenzene	135-98-8	0.001	0.0005	0.00031	2.0
SW8260C	Styrene	100-42-5	0.001	0.0005	0.00031	1.2
SW8260C	tert-Butylbenzene	98-06-6	0.001	0.0005	0.00031	0.69
SW8260C	Tetrachloroethene	127-18-4	0.001	0.0005	0.00031	0.041
SW8260C	Toluene	108-88-3	0.001	0.0005	0.00031	1.1
SW8260C	trans-1,2-Dichloroethene	156-60-5	0.001	0.0005	0.00031	0.36
SW8260C	trans-1,3-Dichloropropene	10061-02-6	0.001	0.0005	0.00031	0.0047
SW8260C	Trichloroethene	79-01-6	0.001	0.0005	0.00031	0.028
SW8260C	Trichlorofluoromethane	75-69-4	0.001	0.0005	0.00031	5.2
SW8260C	Vinyl acetate	108-05-4	0.010	0.005	0.0031	0.41
SW8260C	Vinyl chloride	75-01-4	0.00015	0.000075	0.00005	0.00019
SW8270D	1,2,4-Trichlorobenzene[1]	120-82-1	0.01	0.005	0.0031	0.0040
SW8270D	1,2-Dichlorobenzene	95-50-1	0.01	0.005	0.0031	0.30
SW8270D	1,3-Dichlorobenzene	541-73-1	0.01	0.005	0.0031	0.30
SW8270D	1,4-Dichlorobenzene	106-46-7	0.01	0.005	0.0031	0.0048
SW8270D	1-Chloronaphthalene	90-13-1	0.01	0.005	0.0031	--

Table 15-2 Project Action Limits and Laboratory-Specific Detection/Quantitation Limits, ADEC Table C Groundwater Cleanup Levels (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Method	Analyte	CAS	LOQ (mg/L)	LOD (mg/L)	DL (mg/L)	Cleanup Level (mg/L)
SW8270D	1-Methylnaphthalene	90-12-0	0.01	0.005	0.0031	0.11
SW8270D	2,4,5-Trichlorophenol	95-95-4	0.01	0.005	0.0031	1.2
SW8270D	2,4,6-Trichlorophenol	88-06-2	0.01	0.005	0.0031	0.012
SW8270D	2,4-Dichlorophenol	120-83-2	0.01	0.005	0.0031	0.046
SW8270D	2,4-Dimethylphenol	105-67-9	0.01	0.005	0.0031	0.36
SW8270D	2,4-Dinitrophenol	51-28-5	0.05	0.025	0.015	0.039
SW8270D	2,4-Dinitrotoluene	121-14-2	0.01	0.005	0.0031	0.0024
SW8270D	2,6-Dichlorophenol	87-65-0	0.01	0.005	0.0031	--
SW8270D	2,6-Dinitrotoluene	606-20-2	0.01	0.005	0.0031	0.00049
SW8270D	2-Chloronaphthalene	91-58-7	0.01	0.005	0.0031	0.75
SW8270D	2-Chlorophenol	95-57-8	0.01	0.005	0.0031	0.091
SW8270D	2-Methylnaphthalene	91-57-6	0.05	0.025	0.015	0.036
SW8270D	2-Methylphenol	95-48-7	0.01	0.005	0.0031	0.93
SW8270D	2-Nitroaniline	88-74-4	0.01	0.005	0.0031	--
SW8270D	2-Nitrophenol	88-75-5	0.01	0.005	0.0031	--
SW8270D	3,3'-Dichlorobenzidine	91-94-1	0.01	0.005	0.0031	0.0013
SW8270D	3 & 4 Methylphenol	65794-96-9	0.02	0.01	0.0062	--
SW8270D	3-Nitroaniline	99-09-2	0.01	0.005	0.0031	--
SW8270D	4,6-Dinitro-2-methylphenol	534-52-1	0.01	0.005	0.0031	--
SW8270D	4-Bromophenyl phenyl ether	101-55-3	0.01	0.005	0.0031	--
SW8270D	4-Chloro-3-methylphenol	59-50-7	0.01	0.005	0.0031	--
SW8270D	4-Chloroaniline	106-47-8	0.01	0.005	0.0031	0.0037
SW8270D	4-Chlorophenyl phenyl ether	7005-72-3	0.01	0.005	0.0031	--
SW8270D	4-Nitroaniline	100-01-6	0.01	0.005	0.0031	--
SW8270D	4-Nitrophenol	100-02-7	0.05	0.025	0.015	--

Table 15-2 Project Action Limits and Laboratory-Specific Detection/Quantitation Limits, ADEC Table C Groundwater Cleanup Levels (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Method	Analyte	CAS	LOQ (mg/L)	LOD (mg/L)	DL (mg/L)	Cleanup Level (mg/L)
SW8270D	Acenaphthene	83-32-9	0.01	0.005	0.0031	0.53
SW8270D	Acenaphthylene	208-96-8	0.01	0.005	0.0031	0.26
SW8270D	Anthracene	120-12-7	0.05	0.025	0.015	0.043
SW8270D	Azobenzene	103-33-3	0.01	0.005	0.0031	--
SW8270D	Benzo[a]anthracene	56-55-3	0.01	0.005	0.0031	0.00012
SW8270D	Benzo[a]pyrene	50-32-8	0.01	0.005	0.0031	0.000034
SW8270D	Benzo[b]fluoranthene	205-99-2	0.01	0.005	0.0031	0.00034
SW8270D	Benzo[g,h,i]perylene	191-24-2	0.01	0.005	0.0031	0.00026
SW8270D	Benzo[k]fluoranthene	207-08-9	0.01	0.005	0.0031	0.00080
SW8270D	Benzoic acid	65-85-0	0.01	0.005	0.0031	75
SW8270D	Benzyl alcohol	100-51-6	0.05	0.025	0.015	2.0
SW8270D	bis(2-Chloroethoxy)methane	111-91-1	0.01	0.005	0.0031	--
SW8270D	Bis(2-chloroethyl)ether	111-44-4	0.01	0.005	0.0031	0.00014
SW8270D	2,2'-oxybis[1-chloropropane]	108-60-1	0.01	0.005	0.0031	--
SW8270D	bis(2-Ethylhexyl) phthalate	117-81-7	0.01	0.005	0.0031	0.056
SW8270D	Butyl benzyl phthalate	85-68-7	0.01	0.005	0.0031	0.16
SW8270D	Carbazole	86-74-8	0.01	0.005	0.0031	--
SW8270D	Chrysene	218-01-9	0.01	0.005	0.0031	0.0020
SW8270D	Dibenz(a,h)anthracene	53-70-3	0.01	0.005	0.0031	0.000034
SW8270D	Dibenzofuran	132-64-9	0.01	0.005	0.0031	0.0079
SW8270D	Diethyl phthalate	84-66-2	0.005	0.0025	0.0015	15
SW8270D	Dimethyl phthalate	131-11-3	0.01	0.005	0.0031	16
SW8270D	Di-n-butyl phthalate	84-74-2	0.01	0.005	0.0031	0.90
SW8270D	Di-n-octyl phthalate	117-84-0	0.01	0.005	0.0031	0.022
SW8270D	Fluoranthene	206-44-0	0.01	0.005	0.0031	0.26

Table 15-2 Project Action Limits and Laboratory-Specific Detection/Quantitation Limits, ADEC Table C Groundwater Cleanup Levels (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Method	Analyte	CAS	LOQ (mg/L)	LOD (mg/L)	DL (mg/L)	Cleanup Level (mg/L)
SW8270D	Fluorene	86-73-7	0.01	0.005	0.0031	0.29
SW8270D	Hexachlorobenzene	118-74-1	0.01	0.005	0.0031	0.000098
SW8270D	Hexachlorobutadiene	87-68-3	0.01	0.005	0.0031	0.0014
SW8270D	Hexachloroethane	67-72-1	0.01	0.005	0.0031	0.0033
SW8270D	Indeno[1,2,3-cd]pyrene	193-39-5	0.03	0.015	0.0094	0.00019
SW8270D	Isophorone	78-59-1	0.01	0.005	0.0031	0.78
SW8270D	Naphthalene	91-20-3	0.01	0.005	0.0031	0.0017
SW8270D	Nitrobenzene	98-95-3	0.01	0.005	0.0031	0.0014
SW8270D	N-Nitrosodimethylamine	62-75-9	0.01	0.005	0.0031	0.0000011
SW8270D	N-Nitrosodi-n-propylamine	621-64-7	0.01	0.005	0.0031	0.00011
SW8270D	N-Nitrosodiphenylamine	86-30-6	0.01	0.005	0.0031	0.12
SW8270D	Pentachlorophenol	87-86-5	0.01	0.005	0.0031	0.00041
SW8270D	Phenanthrene	85-01-8	0.01	0.005	0.0031	0.17
SW8270D	Phenol	108-95-2	0.05	0.025	0.015	5.8
SW8270D	Pyrene	129-00-0	0.01	0.005	0.0031	0.12

Notes:

[1] This compound is reported under both 8260 and 8270

--	No cleanup level
CAS	Chemical Abstract Service
DL	Detection Limit
LOD	Limit of detection
LOQ	Limit of quantitation
mg/L	milligram per liter

WORKSHEET #17: SAMPLING DESIGN AND RATIONALE

This worksheet describes the approach and methods that will be used to assess Sources Areas CG517 and CS081 at Eielson, AFB. The field activities will be documented in a field logbook and/or field form. Photographs and global positioning system (GPS) coordinates may also be collected at each location or documentation.

Worksheet #18 detail the samples to be collected and analyses to be performed under this Work Plan, and also identifies the sampling rationale and methods used for the planned samples. Field sampling activities include collecting soil and groundwater samples. Worksheet #15 and **Tables 15-1** and **15-2** call out the PALs, as well as any applicable site-specific cleanup levels.

17.1 CONFIRMATORY SOIL SAMPLING

Confirmation samples will be collected from the limits of excavations where impacted soils have been removed as a remedial measure. Confirmation samples will be collected from the bottom and sidewalls of the excavation once suspect soils have been adequately removed as indicated by PID readings. Soil samples will be collected by the methods defined within the ADEC's *Field Sampling Guidance* (ADEC, 2017a). Confirmation samples will be submitted to the project laboratory for site-specific COPC analyses.

Excavation bottom samples will be collected at a minimum of one confirmation sample for up to 50 square feet of exposed surface area. If the excavation bottom surface area ranges from 51 to 250 square feet, two samples will be collected from the base areas that would most likely exhibit contamination (according to PID readings). If the bottom surface area of the excavation is greater than 250 square feet, two samples will be collected from the base plus one sample for each additional 250 square feet of exposed surface. The excavation sidewalls will also be sampled at a minimum of one sample per 20 linear feet at the greatest field screening reading in all soil horizons (the area most likely to be contaminated, such as on top of confining layers, at the base of more porous layers, or along any other preferential pathways identified in the field).

17.2 GROUNDWATER MONITORING WELL INSTALLATION

Monitoring wells will be installed using a hollow stem auger drill rig and will consist of 2-inch-diameter PVC solid riser pipe and slotted prepacked sanded screens that are 10 feet in length. The depth of the well and screen will be determined during installation to ensure the screened interval encompasses the soil and groundwater interface. Sand will fill the annulus space between the well and borehole wall from the bottom to approximately 2 feet above the pre-packed screen. Bentonite chips or a slurry bentonite/grout mixture will seal the remaining void to the approximately 1 foot bgs. A concrete well pad will protect the monitoring well at each location.

Flush mounted wells will be used as much as possible throughout the area, especially where traffic will be encountered. Stick-up wells will be installed as field conditions (location, proximity to buildings, traffic areas) are determined.

Monitoring wells will be developed using a either a Grundfos Redi-flo, Hurricane ProActive pump, and/or surge block approximately 24 hours after installation. The Grundfos pump will be used as a surge block to surge the water column and loosen sediments within the screened interval and surrounding sand pack. The well be surged throughout the development (beginning, midway, near completion) process and be pumped at various speeds and depth intervals to remove sediments from the water column. This process will continue as described in ADEC guidance until the water is visually clear of sediments and at least three well volumes worth of water has been removed.

17.3 GROUNDWATER SAMPLING

Depth to water levels will be collected from monitoring wells using a Solinst® water level indicator or equivalent. Measurements will be recorded to the nearest 0.01 foot from the top of the previously surveyed PVC riser pipe. All monitoring wells at Eielson AFB will be gauged using an oil water interface probe to measure the thickness of the product. Measurements and observations (free product, odor) will be recorded in the field logbook and groundwater sampling form. Depth to groundwater levels will be used to construct the site-wide inferred groundwater contour map.

Monitoring wells will be purged and sampled using a Hurricane ProActive Stainless Steel Pump (or equivalent) following EPA low-flow sampling procedures. The pump will be placed approximately 1 to 2 feet below the top of the water column. If water levels are above the constructed screened interval, the pump will be placed at a depth to coincide with the screened interval. Prior to collection of groundwater samples, the monitoring well will be purged of three well volumes, and then purged at a flow rate of 0.1 to 0.5 liter per minute. Flow rates will be adjusted as necessary to ensure the minimum drawdown on the water column is less than 0.5 foot below the recorded static water level. Water levels will be measured periodically during the purging process to monitor the drawdown.

During the low-flow purging process, groundwater will be monitored for parameters such as temperature, potential hydrogen (pH), conductivity, oxidation-reduction potential (ORP), and dissolved oxygen (DO) using a YSI 556 flow-through cell water quality meter. Turbidity will also be measured using a Hach turbidity meter. Purging of the monitoring well will continue until the groundwater parameters have stabilized or a minimum of three well case volumes are removed. Water quality parameters are considered stable when three consecutive readings, collected 3 to 5 min apart, are within:

- ±3% for temperature (minimum of ±0.2 °C)
- ±0.1 for pH
- ±3% for conductivity
- ±10 mv for ORP
- ±10% for DO
- ±10% for turbidity

Once the groundwater parameters have stabilized (or a minimum volume of three well casings removed), groundwater samples will be collected for laboratory analysis in accordance to ADEC *Field Sampling Guidance* (ADEC, 2017a). If the well is purged dry, it will be sampled once it has recharged to approximately 80% of its initial volume. Groundwater samples will be collected from new dedicated HPDE tubing installed in each well. Laboratory-supplied containers will be direct filled from the dedicated tubing. Sample containers will be labeled and immediately stored in a cooler packed with ice. The reusable downhole equipment, such as sampling pumps and water level meters, will be decontaminated between wells using a solution of clean distilled water and Alconox solution. Equipment will be rinsed with distilled water after the decontamination process.

WORKSHEET #18: SAMPLING LOCATIONS AND METHODS

This worksheet and Table 18-1 summarizes the sampling matrix, number of samples to be collected, analytical parameters, and the rationale for sampling location that fills the data gaps/uncertainties described in Worksheet #10.

Table 18-1 Sampling Locations and Methods
UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Sampling Location/Identification Number[1]	Matrix	Analytical Group(s)[2]	Number of Samples	Sampling SOP Reference	Rationale
CG517	Soil	GRO, DRO, RRO, VOCs, SVOCs	TBD	Worksheets #14 & #16	Confirmatory excavation sidewalls and base.
CS081	Groundwater	GRO, DRO, RRO, VOCs, SVOCs	4 plus QC	Worksheets #14 & #16	Groundwater monitoring
CG517	Groundwater	GRO, DRO, RRO, VOCs, SVOCs	4 plus QC	Worksheets #14 & #16	Groundwater monitoring

Notes:
[1] Sample IDs may vary based on the number of samples of collected.
[2] Methods: GRO by AK101, DRO by AK102, RRO by AK103, VOCs by SW8260C, SVOCs by SW8270D

DRO	diesel-range organics
GRO	gasoline-range organics
QC	quality control
RRO	residual-range organics
SOP	standard operating procedure
SVOC	semivolatile organic compound
TBD	to be determined (will follow ADEC guidance for excavation confirmation sample frequency)
VOC	volatile organic compound

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WORKSHEET #19 & #30: SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES

This worksheet and Tables 19/30-1 and 19/30-2 summarizes the analytical methods for each sampling matrix, including the required sample volume, containers, preservation, and holding time requirements. Analytical SOPs and information specific to the laboratories (names, contact information, accreditation, and data deliverable schedules) are provided on Worksheet #23.

Table 19/30-1 Sample Containers, Preservation, and Hold Times – Soil

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Laboratory:
SGS North America Inc. – Alaska Division
200 W Potter
Anchorage, Alaska 99518
(907) 562-2343
PM: Chuck Homestead

Certification: ADEC Laboratory Approval UST-005 (Exp. 12/31/2019)
DoD ELAP Certification (Exp. 12/31/2019)
Backup Lab: SGS network laboratories
Shipment: Drop off at SGS Anchorage or ship direct
Turnaround Time: Soil (24-hour)

Matrix	Analyte/ Analyte Group	Method/SOP	Container(s) (number, size, & type per sample)	Minimum Sample Volume	Preservation	Preparation Holding Time	Analytical Holding Time
Soil	DRO/RRO	AK102/103 & SW3550C/ # 712r14 & #761r19	1x 4-oz. amber glass jar with Teflon®-lined lid	60 g	Cool to 0-6° C	14 days	40 days
	VOCs	SW5035A & SW8260C/ # 767r11/# 783r02	1x4 oz. prewt'd amber (second 4-oz. unpreserved % solids jar if no other analyses)	25 g 25 g MeOH	Methanol &BFB surr, Cool to 0-6° C	14 days from sampling to analysis	14 days from sampling to analysis
	SVOCs	SW8270D / #721r14	1x 4-oz. glass jar with Teflon®-lined lid	60 g	Cool to 0-6°C	14 days	40 days
	GRO	AK101&SW5035A/ # 710r15	1x4 oz. prewt'd amber (second 4-oz. unpreserved % solids jar if no other analyses)	25 g soil 25 g MeOH	MeOH+BFB; chill recommended	28 days from sampling to analysis	28 days from sampling to analysis

Notes:

%	percent
°C	degrees Celsius
BFB	4-Bromofluorobenzene
DRO	diesel-range organics
GRO	gasoline-range organics
RRO	residual range organics
g	gram
MeOH	methanol
oz.	ounce
SOP	standard operating procedure
SVOC	semivolatile organic compound
VOC	volatile organic compound

Table 19/30-2 Sample Containers, Preservation, and Hold Times - Waters

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Laboratory: SGS North America Inc. – Alaska Division
200 W Potter
Anchorage, Alaska 99518
(907) 562-2343
PM: Chuck Holmstead

Certification: ADEC Laboratory Approval UST-005 (Exp. 12/31/2019)
DoD ELAP Certification (Exp. 12/31/2019)
Backup Lab: SGS network laboratories
Shipment: Drop off at SGS Fairbanks or ship direct
Turnaround Time: 10 business days

Matrix	Analyte/ Analyte Group	Method/SOP	Container(s) (number, size, & type per sample)[1]	Minimum Sample Volume	Preservation	Preparation/Analysis Holding Time	
Water	GRO	AK101 & SW5030B/ # 710r15	3x40-mL amber VOA vials w/ septa	120 mL	pH < 2 with HCl, Cool to 0-6°C	14 days from sampling to analysis	14 days from sampling to analysis
	DRO/RRO	AK102/103 & SW3520C/ # 712r14 & #759r16	2x250-mL Amber Glass	250 mL	Cool to 0-6°C, HCl to pH<2	14 days	40 days
	VOCs	SW5030B & SW8260C/ # 767411/# 783r02	3x40-mL amber VOA vials w/ septa	120 mL	pH < 2 with HCl, Cool to 0-6°C	14 days from sampling to analysis	14 days from sampling to analysis
	SVOCs	SW8270D / #721r14	2x1-L Amber Glass	1 L	Cool to 0-6°C	7 days	40 days

Notes:

°C	degrees Celsius
DRO	diesel-range organics
GRO	gasoline-range organics
HCl	hydrochloric acid
RRO	residual-range organics
L	liter
mL	milliliter
pH	potential hydrogen
SVOC	semivolatile organic compound
VOA	volatile organic analysis
VOC	volatile organic compound

WORKSHEET #20: FIELD QC SUMMARY

This worksheet and Table 20-1 summarizes the field QC samples that will be collected at Eielson AFB. Field QC samples will be collected at the frequencies specified in the ADEC Technical Memorandum: Data Quality Objectives, Checklists, Quality Assurance Requirements for Laboratory Data, and Sample Handling (ADEC, 2017d), the most current version of the DoD QSM V5.1 (DoD, 2017), and ADEC *Field Sampling Guidance* (ADEC, 2017a). Worksheet #12 includes the MPC for field QC sampling results that may be used to evaluate project DQIs such as accuracy/bias and precision.

The following field QC samples will be collected at Eielson AFB:

- FDs will be collected at a frequency of 1 per 10 or fewer primary samples for each analyte and matrix.
- MS and MSD samples will be collected for every preparatory/analytical batch of 20 or fewer samples, or 1 MS/MSD for every 20 or fewer samples, whichever is more frequent.
- Trip blanks will be submitted with every cooler for every shipment containing volatile samples.
- Temperature blanks will be submitted with every cooler containing analytical samples.

FIELD DUPLICATE SAMPLES

An FD is a generic term for two (or more) field samples collected at the same time in the same location. FD samples are submitted as blind samples to the laboratory and are taken through all steps of the analytical preparation and analysis process in an identical manner. These samples are used to assess precision of the entire data collection activity, including sampling, analysis, and site heterogeneity.

There are two categories of FD samples defined by the collection method: co-located FDs and subsample FDs. Co-located FDs are two or more independent samples collected from side-by-side locations at the same point in time and space, and are considered identical. Co-located FDs are samples collected from adjacent locations or liners (e.g., laterally or vertically, in separate containers) or water samples collected from the same well at the same time that have not been homogenized. Subsample FDs are obtained from one sample collection at one sample location. Soil duplicate samples may be homogenized and subsampled in the field (or at the laboratory) to form an original and duplicate sample, or may be an additional volume of sample collected in a separate sample container to form a co-located sample.

The interpretation of co-located duplicate data may be more complex than subsample duplicate data because of the number of variables associated with the results of this type of duplicate sample. Duplicate soil samples for VOC analysis shall always be co-located (i.e., not homogenized or otherwise processed or subsampled). Duplicates will be analyzed for the same analytical parameters as their associated parent sample. Collection of both co-located and subsampled versions of the same sample may be performed to aid in approximating sampling and analysis error. FDs are generally collected at a frequency of 10% (1 per 10 or fewer primary samples, per analyte, per matrix). Evaluation of FD results is performed by calculation of the RPD between the parent sample and its FD for every analyte of interest and matrix. The acceptance criteria for analyte-specific RPDs are developed during the DQO development process on a site-specific basis; in general, acceptance criteria have RPD less than 50% for soils and 30% for waters.

MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SAMPLES

The MS is used to access the performance of the method as applied to a particular matrix. MS and MSD samples are aliquots of samples spiked with known amounts of all target analytes. The spiking occurs in the laboratory prior to sample preparation and analysis. The spiking level should be greater than the lowest concentration standard used for calibration and less than or equal to the midpoint of the linear range calibration.

A minimum of 1 MS sample and 1 MSD sample shall be collected per 20 or fewer site samples per media collected or each preparation batch of samples must contain an associated MS and MSD using the same matrix collected for the specific DoD project. Sampling locations selected for assigning an MS/MSD should be an area anticipated to be free from contamination or with low concentrations of targeted analytes. During the acquisition of soil MS/MSD samples, field personnel should avoid areas where staining is observed or areas that are known to have high levels of target analytes. Similar precautions should be taken for aqueous samples; wells containing free product or having a history of high concentrations of target analytes should be avoided for MS/MSD samples.

Only site-specific samples shall be used for spiking. The MS/MSD is designated on the CoC form. The MS/MSD is used to document the bias of a method due to sample matrix. These sample results are not used to control the analytical process. The acceptance criteria for the MS and MSD are evaluated against the QC acceptance limits developed during the DQO development process. In general, the QC acceptance limits for MS sample recoveries will be the same as the LCS recovery acceptance criteria. If performance criteria are not being met by the MS and MSD samples, then the analytical procedures and methods must be re-evaluated for appropriateness and correctness. For example, cleanup procedures may be needed to remove matrix interferences.

TRIP BLANKS

A trip blank consists of uncontaminated material in a container identical to the container used for sample collection. Water trip blanks are samples that originate from ASTM Type II, organic-free water prepared by the laboratory, shipped to the sampling site, and returned to the laboratory with samples to be analyzed for VOCs. One set of two 40-milliliter (mL) vials forms a trip blank. Prior to using the analyte-free water as trip blanks, it is recommended that the organic-free water certification results be evaluated against the site-specific cleanup levels and quantitation limits to ensure the water contains no organic analytes above these criteria. Ideally, the analytical laboratory will analyze the source water for trip blanks routinely (once per week) as part of their internal QA/QC program.

Trip blanks for volatile soil samples consist of matrix-specific, methanol-preserved jars prepared by the laboratory. The laboratory shall place trip blanks in sample coolers prior to transport to the site so that they accompany the VOA vials throughout the sample collection/handling/transport process. All trip blanks are transported to the sampling site, handled like an environmental sample, and returned to the laboratory for analysis. Once prepared, trip blanks should not be opened until they reach the laboratory for analysis. One trip blank will accompany each cooler containing water samples to be analyzed for GRO and VOCs. Trip blanks are only analyzed for VOC and GRO analyses. Results of trip blank analyses are used to assess whether samples have been contaminated by VOCs and GRO during sample handling and transport to the laboratory. Trip blanks should not contain any detected analytes greater than half the LOQ. Detections of VOCs or GRO in the trip blank and their possible impacts to the investigation are evaluated on a site-specific basis, typically during the data quality review and assessment.

TEMPERATURE BLANKS

A temperature blank is a container of water that is packed and shipped to the laboratory with the field samples requiring preservation by cooling 6°C. Upon arrival of a cooler at the laboratory, the laboratory measures the temperature of the blank. This temperature reading is used to represent the conditions of the field samples during shipment to the laboratory. This information is used by both the laboratory and by the data reviewer. If the temperature blank exceeds the criteria of less than 0-6°C, then the laboratory must notify the Field Team Lead (FTL) or Project Chemist immediately for guidance.

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Table 20-1 Field QC Summary

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Matrix	Analyte/ Analytical Group	Method Reference	Field Samples	10% Field Duplicates (per site)	5% MS/MSD (per site)	5% Trip Blank	Total # Analyses
Soil	GRO	AK101	35	4	2	2	43
Soil	DRO/RRO	AK102/103	35	4	2	2	43
Soil	VOCs	SW8260C	35	4	2	2	43
Soil	SVOCs	SW8270D	35	4	2	2	43
Groundwater	GRO	AK101	8	2	2	1	13
Groundwater	DRO/RRO	AK102/103	8	2	2	0	12
Groundwater	VOCs	SW8260C	8	2	2	1	13
Groundwater	SVOCs	SW8270D	8	2	2	0	12

Notes:
Samples analyzed for EPA SW8260C will be collected in methanol-preserved containers for sediment and hydrochloric acid (Hl)-preserved containers for surface water.

%	percent
DRO	diesel-range organics
GRO	gasoline-range organics
MS	matrix spike
MSD	matrix spike duplicate
RRO	residual-range organics
SVOC	semivolatile organic compound
VOC	volatile organic compound

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WORKSHEET #21: FIELD SOPS

Field SOPs are presented in **Appendix A** of this UFP-QAPP. **Table 21-1** below indicates the SOPs that are likely to be used during the field activities.

Table 21-1 Field SOPs

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Applicable to the Site (Yes/No)	SOP #	Title	Originating Entity	SOP Option or Equipment Type	Modified for Project? (Yes/No)	Field
Yes	SOP-01	Logbook Documentation and Field Notes	Swift River	All	No	Yes
Yes	SOP-02	Sample Handling and CoC	Swift River	All	No	Yes
Yes	SOP-03	Utility Clearance	Swift River	All	No	Yes
Yes	SOP-04	Site Reconnaissance, Preparation and Restoration	Swift River	All	No	Yes
Yes	SOP-05	Packing and Shipping of Environmental Samples	Swift River	All	No	Yes
Yes	SOP-06	Groundwater Well Sampling	Swift River	Low-Flow Sampling	No	Yes
Yes	SOP-07	Water Level Measurements	Swift River	All	No	Yes
Yes	SOP-08	Water Quality Measurements and Calibrations	Swift River	All	No	Yes
Yes	SOP-09	Monitoring Well Installation	Swift River	All	No	Yes
Yes	SOP-10	Surface and Subsurface Soil Sampling	Swift River	All	No	Yes
Yes	SOP-11	Surveying Environmental Soil Sampling Locations	Swift River	All	No	Yes
Yes	SOP-12	Operations and Maintenance of PID	Swift River	All	No	Yes
Yes	SOP-13	Equipment Decontamination Procedures	Swift River	All	No	Yes
Yes	SOP-14	Well Development	Swift River	All	No	Yes

Notes:

CoC	chain-of-custody
PID	photoionization detector
SOP	standard operating procedure
Swift River	Swift River Environmental Services, LLC

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WORKSHEET #22: FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION

Generalized field equipment calibration, maintenance, testing, and inspection protocol for activities to be conducted at Eielson AFB are discussed below.

FIELD INSTRUMENT CALIBRATION

All field personnel shall be aware of and follow appropriate manufacturer's maintenance and calibration requirements for measuring and test equipment under their control. Compliance with maintenance, calibration/standardization, and recordkeeping procedures ensures the quality of the data collected. Field instruments requiring calibration or calibration verification may include, but are not limited to, those listed in **Table 22-1**.

Calibration and preventive maintenance procedures apply to government-furnished, leased, and rented equipment. Calibration standards shall be traceable to reference standards commonly used by industry, such as the National Institute for Standards and Technology (NIST), where appropriate. These calibration and maintenance procedures do not apply to rulers, tape measures, levels, or other such devices when normal commercial standards provide acceptable accuracy.

FIELD INSTRUMENT STORAGE, MAINTENANCE, TESTING, AND INSPECTION

Equipment will be stored in accordance with its operation manual. While in storage, each piece of measuring and test equipment shall contain a unique number or marking that is readily legible and traceable to calibration and maintenance records.

Upon receipt and prior to the acceptance of government-furnished, leased, or rented equipment, a designated field crewmember shall perform an initial instrument inspection consisting of a maintenance document review and a functional or operational check to ensure that the equipment is in proper working order. Field personnel will review maintenance records to verify that periodic maintenance activities are current and equipment-specific QC procedures are included with the instrument. In addition, field personnel will complete an inspection of measuring equipment to verify that it is working consistently and appears to be in satisfactory condition for its intended use, as specified in its operation manual or vendor-supplied QC procedures.

All equipment deficiencies will be noted, addressed, and resolved during initial instrument inspection and prior to equipment acceptance. Equipment replacement or an equivalent substitution will be required in cases where equipment deficiencies are not resolved during the initial inspection.

An item discovered to be out of calibration or in need of maintenance will not be used until the required service is completed. If equipment does not conform to its operation criteria as specified in its operation manual, then the nonconformance shall be documented in the project field logbook and the equipment returned to its source. Data generated from field instruments with calibrations outside manufacturer's or project-specified calibration criteria will not be used.

Upon returning measuring and test equipment to the government property custodian or vendor, personnel shall provide written documentation of any and all maintenance or calibration problems encountered during use of the item.

All measuring and test equipment shall be inspected and calibrated by the Site Manager or designee prior to use in the field. The appointed field QA/QC officer or Site Manager will periodically review calibration logs to confirm that equipment calibration procedures and equipment performance are within operation standards, as specified in the equipment's operation manual.

FIELD EQUIPMENT DOCUMENTATION

Recordkeeping for government-furnished, leased, or rented equipment must comply with procedures for documenting periodic maintenance and associated calibration. Personnel shall maintain records of all field maintenance and calibration performed. Specific calibration standards (i.e., calibration gas) and calibration methods will be recorded. Such records will be entered directly into the field logbook.

An item discovered to be out of calibration or in need of maintenance will not be used until the required service is completed. If equipment does not to conform to its operation criteria as specified in its operation manual, then the nonconformance shall be documented in the project field logbook and the equipment returned to its source. Data generated from field instruments with calibrations outside manufacturer's or project-specified calibration criteria will not be used.

Upon returning measuring and test equipment to the government property custodian or vendor, personnel shall provide written documentation of any and all maintenance or calibration problems encountered in using the item.

Table 22-1 Field Equipment Calibration, Maintenance, Testing, and Inspection

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Field Equipment	Activity	SOP Reference[1]	Title or Position of Responsible Person	Frequency	Acceptance Criteria	Corrective Action
PID	Calibrate using isobutylene gas	SOP-23	FTL	Daily prior to use	SOP-23 Check operations manual for acceptable range of calibrated probe for the specific lamp model.	Recalibrate as necessary. If acceptable calibration cannot be obtained, return equipment to vendor for repair. Replace if necessary.
	Bump test after calibration	SOP-23	FTL	Daily prior to use	±5%	
YSI 556 Multimeter (or equivalent)	Calibrate pH (3-point), specific conductance, DO, ORP	SOP-13	FTL	Daily prior to use	SOP-13 Manufacturer’s instructions.	If unstable or erroneous readings are observed, clean probes and recalibrate as required. Repair or replace instrument if necessary.
	Verify and record check standard reading after calibration	SOP-13	FTL	Daily prior to use	SOP-13 ± 20% or manufacturer’s specifications, whichever is more stringent.	
Hach Portable Turbidimeter (or equivalent)	Calibration will be performed by vendor	None	Vendor	Prior to use.	Manufacturer’s instructions.	If variation or erroneous readings are observed, check calibration. Repair or replace instrument if necessary.
	Calibration check	SOP-13	FTL	Daily prior to use	±5% of previously established value for each standard	

Notes:

[1] Field SOPs are provided in **Appendix A**.

DO	dissolved oxygen
FTL	Field Team Lead
ORP	oxidation-reduction potential
pH	potential hydrogen
PID	photoionization detector
SOP	standard operating procedure

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WORKSHEET #23: ANALYTICAL SOPS

The following SGS Anchorage SOPs presented in Table 23-1 will be used for the analysis of soil and water samples. Laboratory SOPs are supplemented by internal communication systems within the laboratory to disseminate the project requirements to technical staff. The information provided therein is applicable to this UFP-QAPP. Copies of the analytical SOPs are in **Appendix D**.

Table 23-1 Analytical Standard Operating Procedures

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

SOP #	Title	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option or Equipment Type	Modified for Project Work? (Y/N)
710r15	Gasoline Range Organics/BTEX (AK101/AK101AA/8021B/EPA602/8015C)	Definitive	Water & Soil Volatiles	GC/FID	N
783r08	Purgeable Organic Compounds Analysis by GC/MS (8260C and 624)	Definitive	Water & Soil Volatiles	GC/MS	N
767r10	Purge and Trap Extraction, Non-aqueous (SW846 5035A)	Definitive	Soil Volatiles	Prep	N
764r11	Purge and Trap Aqueous (SW846 8000B & 5030B)	Definitive	Water Volatiles	Prep	N
712r14	Diesel Range Organics/ Residual Range Organics (DRO/RRO) (AK102 & AK103 & 8015C)	Definitive	Water & Soil Semivolatiles	GC/FID	N
759r17	Continuous Liquid-Liquid Extraction for Semi-Volatile Compounds (SW846 3520C)	Definitive	Water Semivolatiles	Prep	N
761r19	Sonication Extraction of Semi-Volatile Compounds in Soil (SW846 3550C)	Definitive	Soil Semivolatiles	Prep	N
721r14	Extractable Semi-Volatile Compounds by GCMS (SW846 8270D and 625)	Definitive	Water & Soil Semivolatiles	GC/MS	N

Notes:

BTEX	benzene, toluene, ethylbenzene, and xylenes
DRO	diesel-range organics
FID	flame ionization detector
GC/MS	gas chromatography/mass spectroscopy
RRO	residual-range organics
SOP	standard operating procedure

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WORKSHEET #24: ANALYTICAL INSTRUMENT CALIBRATION

To ensure that the analytical methods and the selected instrumentation meet the project requirements, each analytical instrument shall be calibrated following the procedures and frequency specified by the SGS Quality Manual (**Appendix E**), analytical method, and in accordance with Appendix B of the DoD QSM V5.1 (DoD, 2017). Specific analytical method SOP references are provided in Worksheet #23, and SGS SOPs are included in **Appendix D** of this UFP-QAPP. Laboratory calibration requirements are presented on Table 24-1 and 24-2.

INSTRUMENT CALIBRATION REQUIREMENTS

The calibrations and QA/QC shall meet the acceptance criteria specified in the tables below. For calibrations, the following standards must be met:

- All results reported shall be within the calibration range. Results outside the calibration range are unsuitable for quantitative work and show only an estimate of the true concentration.
- Results shall be within the working range determined by the daily initial calibration (ICAL).
- Samples shall be diluted, if necessary, to bring analyte responses within the calibration range. Data that exceed the calibration range must be reported by the laboratory with the dilution results.
- Records of standard preparation and instrument calibration shall be maintained. Records shall unambiguously trace the preparation of standards and their use in the calibration and quantitation of sample results.
- Calibration standards shall be traceable to standard materials.

Instrument calibration shall be achieved by beginning with the simplest approach (the linear model through the origin), and shall then progress through other options (nonlinear) until the acceptance criteria are met. When an analyte has more than one acceptable calibration model, results shall be reported from the simplest calibration model.

The ICAL must be verified by a second-source standard. Multipoint calibrations shall contain the minimum number of calibration points specified in the applicable tables, with all points used for the calibration being contiguous. If more than the minimum number of standards is analyzed for the ICAL, all of the standards analyzed shall be included in the ICAL. The only exception is that a standard at either end of the calibration curve can be dropped from the calibration if the requirement for the minimum number of standards is met and the low point of the calibration curve is at or below the LOQ for each analyte.

Analyte concentrations are determined with either calibration curves or response factors (RFs). Nonlinear calibration should be considered only when a linear approach cannot be applied. It is not acceptable to use an alternative calibration procedure when a compound fails to perform in the usual manner. Nonlinear calibration may be necessary to achieve low DLs or to address specific instrument techniques. However, it is not the intent of the EPA methods to allow nonlinear calibration to be used to compensate for detector saturation at higher concentrations or to avoid proper instrument maintenance. When this type of nonlinear calibration occurs, it is indicative of instrument issues or operator error. When multipoint calibration is specified, the concentrations of the calibration standards shall bracket those expected in the samples.

For GC and GC/MS methods, when using RFs to determine analyte concentrations, the average RF from the ICAL shall be used. The continuing calibration shall not be used to update the RFs from the ICAL.

CONTINUING CALIBRATION VERIFICATION

The continuing calibration verification (CCV) cannot be used as the LCS. A CCV is to be performed daily before sample analysis (unless an ICAL and second-source standard verification are performed immediately before sample analysis) and as required by the applicable method. In addition, the DoD QSM V5.1 (DoD, 2017) requires that the concentration used for the CCV sample shall be between the low calibration standard and the midpoint of the calibration range. Finally, the lowest standard used must be the lowest concentration for which quantitative data are to be reported.

Table 24-1 Analytical Instrument Calibration (Gas Chromatography-Flame Ionization Detector [GC/FID])

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Instrument/ Equipment	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Title/Position Responsible for Corrective Action	SOP Reference
GC-FID	Minimum five-point ICAL for single eluting target analytes. Single-level ICAL for non-routine hydrocarbon mixtures (i.e., jet fuels, etc.)	ICAL after instrument set-up and after ICV/CCV failure, prior to sample analysis.	One of the options below: 1): RSD for each analyte ≤ 20%; 2) Linear least squares regression: r ≥ 0.995; 3) Non-linear regression: COD (r^2) ≥ 0.99, minimum of six points for second order.	Evaluate standards, chromatography, and detector response. If problem found with above, correct as appropriate, then repeat ICAL.	Lab Manager / GC-FID Analyst	710r15 & 712r14
	Retention Time Window Position Establishment	Once per ICAL, for each analyte and surrogate.	Set position using the mid-point standard of the ICAL when ICAL is performed. On days when ICAL is not performed, use initial CCV.	NA	Lab Manager / GC Analyst	
	ICV	Once after each ICAL, analysis of a second source standard prior to sample analysis.	All reported analytes within established RT windows and within ± 20% of the expected value from the ICAL.	Evaluate data. If problem (e.g., concentrated standard, plugged injector needle) found, correct, then repeat second source verification. If still fails, repeat ICAL.	Lab Manager / GC Analyst	

Notes:

%	percent	NA	not applicable
COD	coefficient of determination	r	regression
CCV	continuing calibration verification	r^2	regression squared
GC	gas chromatography	RSD	relative standard deviation
GC-FID	gas chromatography-flame ionization detector	RT	retention time
ICAL	initial calibration	SOP	standard operating procedure
ICV	instrument calibration verification		

Table 24-1 Analytical Instrument Calibration (Gas Chromatography-Flame Ionization Detector [GC-FID]) (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Instrument/ Equipment	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Title/Position Responsible for Corrective Action	SOP Reference
GC-FID	Daily calibration verification	Prior to sample analysis, after every 20 field samples, and at the end of the sequence. CCVs for non-routine hydrocarbon mixtures multi-eluting pesticides (i.e., jet fuels, etc.) are required only before sample analysis.	All reported analytes and surrogates within established RT windows and within ± 20% of the expected value from the ICAL.	Evaluate standard - if response is elevated and associated samples are non-detect for that analyte, narrate. If ending CCV and second analysis of samples due to non-compliant ending CCV, narrate. Otherwise, recalibrate and reanalyze all affected samples since the last acceptable CCV; or immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take CA(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV. CAs include: evaluate standard, chromatography, and detector response. Correct as appropriate (instrument maintenance, remake standards), then repeat ICAL.	Lab Manager / GC-FID Analyst	710r15 & 712r14

Notes:

%	percent	ICV	Initial calibration verification
CA	corrective action	RT	retention time
CCV	continuing calibration verification	SOP	standard operating procedure
GC-FID	gas chromatography-flame ionization detector		

Table 24-2 Analytical Instrument Calibration (Gas Chromatography/Mass Spectrometry [GC/MS])

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Instrument/ Equipment	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Title/Position Responsible for Corrective Action	SOP Reference
GC/MS	Check of mass spectral ion intensities (tuning procedure) using BFB (8260C), 1,000 µg/mL in acetone, analytical standard (DFTPP) (8270D), and PFTBA (8270D SIM)	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method/SOP for specific ion criteria.	Retune instrument and verify.	Lab Manager / GC/MS Analyst	783r08 & 721r14
	Performance Check (8270D only)	At the beginning of each 12-hour period, prior to sample analysis	Degradation ≤20% for DDT. Benzidine and PCP present at their normal responses, and tailing factor for each < 2.	Correct problem (inspect/change liner, clip front end of column, or other maintenance as indicated), then repeat the performance check.	Lab Manager / GC/MS Analyst	
	Minimum five-point ICAL for target analytes, lowest concentration standard at or near the reporting limit.	ICAL prior to sample analysis	Each analyte must meet one of the three options below: Option 1: RSD for each analyte ≤ 15% Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$ Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2 \geq 0.99$.	Terminate analysis; correct the problem; recalibrate. Problem must be corrected. No samples may be run until ICAL has passed.	Lab Manager / GC/MS Analyst	
	Second-source calibration verification	Once after each ICAL	All project analytes within ±20% of true value; Poor performing analytes within ±30% of true value.	Correct problem, and verify second source standard. Rerun verification. If still fails, repeat initial calibration.	Lab Manager / GC/MS Analyst	

Table 24-2 Analytical Instrument Calibration (Gas Chromatography/Mass Spectrometry [GC/MS]) (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Instrument/ Equipment	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Title/Position Responsible for Corrective Action	SOP Reference
GC/MS	Retention Time Window Position Establishment	Once per ICAL, for each analyte and surrogate.	Set position using the mid-point standard of the ICAL when ICAL is performed. On days when ICAL is not performed, use initial CCV.	NA	Lab Manager / GC/MS Analyst	783r08 & 721r14
	Daily calibration verification	Daily, prior to sample analysis and every 12 hours of analysis time.	All reported analytes and surrogates within ± 20% of true value (± 30% for poor performing analytes).	Correct problem, then rerun two additional CCVs. If that fails, then repeat ICAL. Reanalyze all samples since the last successful CCV.	Lab Manager / GC/MS Analyst	

Notes:

%	percent
µg/mL	microgram per milliliter
BFB	4-Bromofluorobenzene
CCV	continuing calibration verification
DDT	Dichlorodiphenyltrichloroethane
DFTPP	1,000 µg/mL in acetone, analytical standard
GC/MS	gas chromatography/mass spectroscopy
ICAL	initial calibration
NA	not applicable
PCP	pentachlorophenol
RSD	relative standard deviation
r^2	regression squared
SIM	selected ion monitoring
SOP	standard operating procedure

WORKSHEET #25: ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION

This worksheet and Table 25-1 identifies the analytical instrumentation that requires maintenance, testing, or inspection and provides the SOP reference number. Laboratory analytical instrumentation and equipment will be maintained, tested, and inspected following the procedures and frequency specified by the DoD ELAP-evaluated laboratory Quality Manual (**Appendix E**), by analytical methods used, and in accordance with the DoD QSM V5.1 (DoD, 2017). The information provided therein is applicable to this site-specific UFP-QAPP.

Table 25-1 Analytical Instrument and Equipment Maintenance, Testing, and Inspection
UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC-FID	Change septum, clean injection port, change or clip column, install new liner	Detector signals and chromatogram review	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Reinspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	GC-FID Analyst	# 710r15 / # 712r14
GC/MS	Clean sources, maintain vacuum pumps	Tuning	Instrument performance and sensitivity	Service vacuum pumps twice per year, other maintenance as needed	Tune and CCV pass criteria	Recalibrate instrument	GC/MS Analyst	# 783r03 / #721r14
	Change septum, clean injection port, change or clip column, install new liner, change trap	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	Tune and CCV pass criteria	Reinspect injector port, cut additional column, reanalyze CCV, recalibrate instrument		

Note:

CCV	continuing calibration verification
GC-FID	Gas chromatography-flame ionization detector
GC/MS	gas chromatography/mass spectroscopy
SOP	standard operating procedure

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WORKSHEET #26 & #27: SAMPLE HANDLING, CUSTODY, AND DISPOSAL

To ensure sample authentication and data defensibility, a proper sample handling system will be followed from the time of sample collection to final sample disposal.

Sampling Organization: Swift River
Laboratory: SGS Anchorage
Method of Sample Delivery (shipper/carrier): Hand delivery to SGS Fairbanks or direct ship to SGS Anchorage.
Number of days from until sample disposal: 30 days past.

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Sample labeling	Field Samplers Swift River	SOP-02
CoC	Field Samplers, Project Chemist Swift River	SOP-02
Packaging	Field Samplers, Swift River, SGS	SOP-07
Shipping coordination	Field Samplers, Project Chemist Swift River	SOP-07
Sample receipt, inspection, and log-in	Project Chemist Swift River, Sample Custodian, Subcontract Laboratory (SGS Anchorage or SGS Fairbanks)	SOP-02
Sample custody and storage	Swift River Sample Custodian and Analyst, Subcontract Laboratory (SGS Anchorage or SGS Fairbanks)	SOP-02
Sample disposal	Sample Custodian and Analyst, Subcontract Laboratory (SGS Anchorage)	SOP-02

Note:

CoC	chain-of custody
SGS	SGS North America, Inc.
SOP	standard operating procedure
Swift River	Swift River Environmental Services, LLC

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WORKSHEET #28: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION

The purpose of the laboratory QC sample activities is to produce data of known quality that satisfy the project-specific DQOs. This worksheet provides additional discussions relevant to the analytical QC requirements that laboratories producing definitive data will be required to follow.

ANALYTICAL QUALITY CONTROL SAMPLES

Method Blank

A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is carried through the complete sample preparation and analytical procedure and is used to assess possible contamination resulting from the analytical process.

A method blank shall be included in every analytical batch. The presence of analytes in a method blank above the DL indicates the need for further assessment of the data. The source of contamination should be investigated, and measures must be taken to correct, minimize, or eliminate the problem if the concentration exceeds one-half the LOQ. For common laboratory contaminants (e.g., methylene chloride, acetone, or phthalates), the method blank concentration must not exceed the LOD (or if greater than the LOD, less than 1/10 of the higher of the amount measured in any sample or the regulatory limit). No analytical data shall be corrected for the presence of analytes in blanks.

If an analyte is detected in the method blank and at similar concentrations in the associated samples, and corrective actions (CAs) are not performed or are ineffective, an appropriate flag shall be applied to the sample results.

Laboratory Control Sample

An LCS is a sample of known composition that is spiked with all target analytes. The LCS is used with each analytical batch to determine whether the method is in control. Each analyte in the LCS shall be spiked at a level less than or equal to the midpoint of the calibration curve, which is defined as the median point of the curve instead of the middle of the range. The LCS shall be carried through the complete sample preparation and analysis procedure. The LCS cannot be used as the CCV.

At least one LCS shall be included in every analytical batch. If more than one LCS is analyzed in an analytical batch, results from all LCSs shall be reported. A failure of an analyte in any of the LCSs shall require appropriate CA, including qualification of the failed analyte in all of the samples, as required.

Laboratory Control Sample Control Limits

The LCS limits specified in Appendix C of DoD QSM V5.1 (DoD, 2017) shall be used unless the laboratory determines that the limit cannot be met (in which case laboratory historical CLs will be used). The performance of the LCS is evaluated against the QC acceptance limits. Whenever an analyte in the LCS is outside the acceptance limit, CA shall be performed. If an analyte in the LCS exceeds the upper or lower CL and no CA is performed or the CA is ineffective, an appropriate flag shall be applied to all affected results.

Marginal Exceedance

A marginal exceedance (ME) is defined as one beyond the LCS CLs, but within the ME limits, which are set at four standard deviations around the mean. MEs must be sporadic (random). If the same analyte exceeds the LCS CLs repeatedly (e.g., two out of three consecutive LCSs), it indicates that the problem is systematic, not random. The source of error should be located, and appropriate CAs should be taken.

A number of sporadic MEs of the LCS CLs are allowed, ***but may be used only by the Project Chemist as part of the data evaluation and flagging process***. The laboratory may not use this process as part of its data review practice, but is encouraged to contact the Project Chemist to discuss compound-specific failures as needed. The number of MEs is based on the total number of analytes spiked into the LCS and may not exceed 5% of the total number of analytes in the LCS. The allowable number of MEs for a given number of analytes in the LCS is specified in **Table 28-1**.

Table 28-1 Allowable Number of Marginal Exceedances

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Number of Analytes in LCS	Allowable Number of Marginal Exceedances of LCS CLs
> 90	5
71 to 90	4
51 to 70	3
31 to 50	2
11 to 30	1
< 11	0

Notes:
CL control limit
LCS laboratory control sample

Laboratory Control Sample Failure

Each LCS must be evaluated against the LCS CLs and ME limits before being accepted. The recoveries for the analytes spiked into the LCS should first be compared with the LCS CLs. If a recovery is less than the lower CL or greater than the upper CL, that is an exceedance. The laboratory should note which analytes exceeded the CLs and compare them with the list of project-specific analytes of concern. Once an LCS fails, CA is required. LCS failure occurs in the event of any of the following:

- Exceedance of an LCS CL by any project-specific analyte of concern.
- ME of the LCS CLs by more than the allowable number of analytes.
- Exceedance of the ME limits by one or more analytes.

Corrective Action

If a LCS fails, an attempt must be made to determine the source of error and find a solution. All findings and CAs should be documented. After the system problems have been resolved and system control has been reestablished, all samples in the analytical batch shall be prepared again and reanalyzed for the out-of-control analyte(s), or the batch shall be rerun with a new LCS. The CA applied shall be based on professional judgment in the review of other QC measures (such as surrogates). If an analyte falls outside the LCS CLs a second time, or if sufficient sample material is not available to be reanalyzed, then all the results in the analytical batch for that analyte must be flagged. The recoveries of those analytes subject to CA must be documented in the case narrative, whether flagging is needed or not.

Matrix Spike/Matrix Spike Duplicate

An MS/MSD is an aliquot of sample collected in the field and spiked with known concentrations of all target analytes. The spiking occurs before sample preparation and analysis. Each analyte in the MS/MSD shall be spiked at a level less than or equal to the midpoint of the calibration curve for that analyte. The MS/MSD is used to document potential matrix effects associated with a site and will not be used to control the analytical process. The MS/MSD results and flags will not be associated with or related to samples that are collected from the same site where the MS/MSD set was collected, with the exception of an FD. Additional volume will be collected for samples selected for MS/MSDs, and the laboratory will use those samples to prepare the appropriate MS/MSDs.

The performance of the MS/MSD is evaluated against the QC acceptance limits outlined in Appendix C of DoD QSM V5.1 (DoD, 2017). If either the MS or the MSD is outside the QC acceptance limits, the data shall be evaluated to determine whether there is a matrix effect or analytical error. The analytes in the parent sample and associated samples collected at the same site (if applicable) shall be appropriately flagged.

If the sample concentration exceeds the spike concentration by a factor of four or more, the data shall be reported unflagged. The laboratory should communicate potential matrix difficulties to the Project Chemist so an evaluation can be made with respect to the project-specific DQOs.

Surrogates

Surrogates are compounds similar to the target analytes in chemical composition and behavior, but not normally found in environmental samples. Surrogates are used to evaluate accuracy, method performance, and extraction efficiency. Surrogates shall be added to environmental samples, controls, and blanks in accordance with the method requirements.

If a surrogate recovery is outside the acceptance limit, CA must be performed. After the system problems have been resolved and system control has been re-established, the sample should be prepared again and reanalyzed. If CAs are not performed or are ineffective, an appropriate flag shall be applied to the sample results.

Internal Standards

ISs are known amounts of standards that are added to a portion of a sample or sample extract and carried through the entire determination procedure. ISs are used as a reference for calibration and for controlling the precision and bias of the analytical method. ISs shall be added to environmental samples, controls, and blanks, in accordance with the method requirements.

If the IS results are outside of the acceptance limits, CAs shall be performed. After the system problems have been resolved and system control has been re-established, all samples analyzed while the system was malfunctioning shall be reanalyzed. If CAs are not performed or are ineffective, an appropriate flag shall be applied to the sample results.

Retention Time Windows

Retention time (RT) windows are used in GC analysis for qualitative identification of analytes. RT windows are calculated from replicate analyses of a standard on multiple days. The procedure and calculation method are given in SW-846, Method 8000D. The center of the RT window is established for each analyte and surrogate using the RT of the midpoint standard of the ICAL. For non-mass spectrometry methods, these are updated daily using the absolute RT in the ICV.

If the RT is outside of the acceptance limits, CA shall be performed. This applies to all CCV subsequent to the initial calibration verification (ICV) and to LCSs. If CAs are not performed or are ineffective, an appropriate flag shall be applied to the sample results.

QUALITY CONTROL CHECKS

Analytical Batch Requirements

Laboratory QC samples shall be included in an analytical batch with the field samples. An analytical batch is a group of samples (not exceeding 20 environmental samples plus associated laboratory QC samples) that are similar in composition (matrix); extracted at the same time and with the same lot of reagents; and analyzed together as a group.

The analytical batch also extends to cover samples that do not need separate extraction (e.g., VOC analysis by purge and trap). The identity of each analytical batch shall be unambiguously reported with the analyses so that a reviewer can identify the laboratory QC samples and the associated environmental samples. The type of laboratory QC samples and the frequency of use of these samples are discussed in the following sections.

Holding Time Compliance

All sample preparation and analysis shall be completed within the method-required holding times. Some methods have more than one holding time requirement (e.g., Method SW8270D). For methods not requiring sample preparation, the holding time is calculated from the time of sample collection to the time of completion of all analytical runs. For methods requiring sample preparation before analysis:

- Preparation holding time is calculated from the time of sample collection to the time of completion of preparation.
- Analytical holding time is calculated from the time of completion of preparation to the time of completion of all analytical runs.

Holding times are determined on the basis of days, hours, and minutes. If the time of sample collection is not provided, the laboratory must assume the most conservative time of day. If holding times are exceeded and the analyses are performed, the results shall be flagged according to the procedures described in **Appendix E** and identified in the data package case narrative.

Control Charts

Control charts are used to track laboratory performance over time. It is recommended that all analytes spiked into the LCS be tracked via control charts. These charts are useful for identifying trends and problems in an analytical method. The laboratory shall use these charts to establish in-house LCS CLs. The control charts should be updated as needed (e.g., when there is a significant change to the analytical system). At a minimum, the charts should be updated annually and reviewed each time a data point is generated so that CA can be taken in a timely manner. These charts can also be used to benchmark a laboratory's performance against this UFP-QAPP's requirements to determine possible areas for improvement.

Standard Materials

Standard materials (including second-source materials) used in calibration and to prepare samples shall be traceable to a NIST, EPA, American Association of Laboratory Accreditation (A2LA), or other equivalent approved source, if available. If NIST, EPA, or A2LA standard material is not available, the standard material proposed for use shall be approved before use.

The standard materials shall be current, and the following expiration policy shall be followed:

- Expiration dates for ampulated solutions shall not exceed the manufacturer's expiration date or 1 year from the date of receipt, whichever comes first.
- Expiration dates for laboratory-prepared stock and diluted standards shall be no later than the expiration date of the stock solution or material or the date calculated from the holding time allowed by the applicable analytical method, whichever comes first.

- Expiration dates for pure chemicals shall be established by the laboratory and be based on chemical stability, possibility of contamination, and environmental and storage conditions.

Expired standard materials shall be either revalidated before use or discarded. Revalidation may be performed through assignment of a true value and error window statistically derived from replicate analyses of the material as compared to an unexpired standard. The laboratory shall label standard and QC materials with expiration dates.

A second-source standard is used to independently confirm the ICAL. A second-source standard is a standard purchased from a vendor different from that supplying the material used in the ICAL. The second-source material can be used for the continuing calibration standards and/or for the LCS. Two different lot numbers from the same vendor do not normally constitute a second source. However, when a project requires analyses for which there is not a separate vendor source available, the use of different lot numbers from the same vendor will be acceptable to verify calibration.

Supplies and Consumables

The laboratory shall inspect supplies and consumables before their use in analysis. The materials description in the methods of analysis shall be used as a guideline for establishing the acceptance criteria for these materials. Purity of reagents shall be monitored and documented. An inventory and storage system for these materials shall ensure that the materials are used before manufacturers' expiration dates and are stored under safe and chemically compatible conditions.

WORKSHEET #29: PROJECT DOCUMENTS AND RECORDS

The required data package deliverables for every aspect of the project are identified in this worksheet. These include, but are not limited to: (1) sample collection and field measurement records; (2) analytical records; and (3) data assessment records.

SAMPLE COLLECTION AND FIELD MEASUREMENT RECORDS

Sample collection and field measurement records generally include: field logbooks, photo documentation, equipment decontamination records, sampling instrument calibration records, soil boring logs, well development logs, well sampling logs, CoC forms, and air bills. **Table 29-1** includes a list of the types of records that may be generated during the course of the study, the entities responsible for generating and verifying the records, and the location where the records will be stored.

ANALYTICAL RECORDS

Analytical Data Deliverables

The case narrative along with sample and QC data on data summary forms will be presented as a PDF report. The data provided by the laboratory must be legible, properly labeled, and correctly paginated. Electronic data package files shall be "bookmarked" in the PDF to aid the data validator.

ERPIMS Electronic Data Reports

Weston will provide an electronic deliverable report in the ERPIMS format. ERPIMS is a data management system designed to accommodate the types of data collected at Installation Restoration Program (IRP) sites. Specific codes and data forms have been developed to allow consistent and efficient input of information to the system. Weston shall record and enter field and laboratory data and submit this data as specified in the latest ERPIMS DLH using the latest version of the ERPIMS software utility (ERPTools)). The information transferred will include required technical data, such as site information; well characteristics; and hydrogeologic, geologic, physical, and chemical analysis results. Electronic data reporting formats and requirements are provided in the most current version (currently 6.0) of the *ERPIMS 2013 Data Loading Handbook* (USAF, 2013b).

Data Assessment Records

Data assessment records include, but are not limited to, data validation reports and ADEC QA checklists.

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Table 29-1 Project Documents and Records

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Sample Collection and File Records:

Record	Generation	Verification	Storage Location/Archival
H&S certifications, training documentation	Project Staff	H&S Manager / Field Team	Project files
Field logbook(s)	Field Team	Field Team Lead or Site Manager	Electronic PDF copies in the project file. Hard copy (bound notebook) in the project file. Archived at project closeout.
Data collection sheets	Field Team	FTL or Site Manager	Project files
Sample documentation (e.g., sample labels, CoCs, sample summary table)	Field Team	FTL or Site Manager	Project files
Figures	Project Staff	PM/FTL	Project files
Survey data	Field Team	FTL or Site Manager	Project files
Field instrument calibration logs	Field Team	FTL or Site Manager	Recorded in field logbook.
CoC receipts	Field Team	FTL or Site Manager	Project files
Photographs	Field Team	FTL or Site Manager	Project files
Airway bills	Site Manager	FTL	Project files
Daily QC reports	FTL	Site Manager	Project files
Waste manifests or other documentation of waste disposal	FTL	PM/Site Manager	Project files
Deviations	Project Staff, FTL	PM/Site Manager	Project files
CA reports	Project Staff, FTL	PM/Site Manager	Project files
Correspondence	Project Staff	PM	Project files
Field audit documentation	FTL	Site Manager	Project files
Analytical sample records (CoC forms, cooler receipt information)	Field Team	Project Chemist	Project files

Table 29-1 Project Documents and Records (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Sample Collection and File Records:

Record	Generation	Verification	Storage Location/Archival
Analytical laboratory data packages	Laboratory	Project Chemist	Project Files Laboratories maintenance records in accordance with the QAM and State of Alaska requirements.
EDDs	Laboratory	Project Chemist	Project Files Laboratories maintenance records in accordance with the QAM and State of Alaska requirements.
ERPTools files	Laboratory	Project Chemist	USAF houses the ERPIMS database. Data are stored and managed using a commercially available relational database management system.
ADEC Laboratory Data Review Checklist	Project Chemist/Data Validator	Project Chemist	Project Files
QA/QC summary report	Project Chemist/Data Validator	Project Chemist	Project Files
Data usability assessment	Project Chemist / Data Validator	Project Team	Project Files

Notes:

Weston will maintain the project files in electronic and/or hard copy formats for the duration of the TO.

ADEC	Alaska Department of Environmental Conservation
CA	corrective action
CoC	chain-of-custody
EDD	electronic data deliverable
ERPIMS	Environmental Resources Program Information Management System
FTL	Field Team Lead
H&S	Health and Safety
PDF	Portable Document Format
PM	Project Manager
QA	Quality Assurance
QAM	Quality Assurance Manual
QC	Quality Control
TO	task order
USAF	U.S. Air Force
Weston	Weston Solutions, Inc.

WORKSHEETS #31, #32, AND #33: ASSESSMENTS AND CORRECTIVE ACTION

These worksheets detail the different types of assessments for evaluating project activities. Examples include, but are not limited to, laboratory assessments, field audits, and field documentation review. **Table 31-1** provides general guidance for planned project assessments and their frequencies.

FIELD AUDITS

Field Performance Audits

Field performance audits are self-assessments that will be conducted periodically by Swift River. The audit may include a check of the number of samples collected versus those planned to verify the following:

- The correct analytical methods were requested.
- The correct number of field QC samples were collected.
- The appropriate sample collection techniques were used.

DATA AUDITS

Data audits are required to verify the accuracy of data collection, storage, and management systems. Data review audits are discussed below.

Data Review Audits

A thorough review of the complete data review process, including a review of the sampling and analysis verification, sampling and analysis validation, and data usability assessment steps will be performed to confirm that the process conforms to the procedures specified in this UFP-QAPP. The data review audit may also include an audit of the performance of the data reviewer.

Data Performance Audits

Data performance audits will be performed as part of data validation steps IIa and IIb (see Worksheet #36) to verify the integrity of electronic and hard copy data. The following are required tasks:

1. Screen EDDs for reasonableness. This check will consist of reviewing data, such as verifying that numbers are delivered in fields designed for numbers and text in fields designed for text.
2. Verify that units are mg/L, micrograms per liter (µg/L), mg/kg, or micrograms per kilogram (µg/kg); confirm that values less than 0 are not reported.
3. Verify that the analytes specified in the laboratory statement of work are presented in the laboratory report for each sample collected.
4. Verify that each sample requested is returned by the laboratory.

5. When shortcomings of the data are noted during inspection of the EDD, the laboratory is notified promptly.

A generalized Worksheet #31 is shown in **Table 31-1** below and provides most of the types of assessments to be required and conducted for the study.

This worksheet also describes the activities for identifying and correcting problems encountered during the project that have the potential to impact data quality (e.g., sampling error). For each type of assessment, the procedures for handling site-specific deviations and CAs are detailed. **Table 31-1** provides a general guidance for the types and frequencies of assessment findings and CA responses.

CAs will be required if the audits identify non-compliance problems with the laboratory, field procedures, or the data. Specifically, CAs for field nonconformance issues will require addressing the audit findings as described above. Depending on the severity of the finding, a follow-up audit may be performed to verify the CA has successfully been implemented.

CAs for laboratory issues identified as a result of performance audits will require the following actions:

1. Document the nonconformance issues on a laboratory nonconformance form.
2. Record the cause of the nonconformance.
3. Document the CAs taken.

Verify the CAs taken were sufficient to address the concern.

CAs for database issues identified as a result of data performance audits will require the Database Manager to consult with the Project Chemist, PM, Data Validator, or laboratory to develop CAs. If the issues identified are laboratory-based, then the laboratory will be contacted in writing by the Project Chemist, Database Manager, or Data Validator of the required CAs to be taken (typically a resubmittal of the pertinent data package).

Table 31-1 Planned Project Assessments Table

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Assessments:

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
Planning documents	Project Staff and QA Manager/ Swift River	To be prepared prior to initiation of activities at the site(s)	Planning documents, including site-specific UFP-QAPPs, will be finalized prior to project mobilization. Dates are provided in the DST on the TeamLink® website.	QC checklist for each document 5 electronic, 5 hard copy reports (See also Worksheet #16)	7 to 10 business days after response to comments
Technical project reports	Project Staff and QA Manager/ Swift River	To be prepared upon completion of activities at the site(s)	Reports will be completed following the completion of field activities and the receipt and validation of laboratory data deliverables.	QC checklist for each document 5 electronic, 5 hard-copy reports (See also Worksheet #16)	7 to 10 business days after response to comments
Internal and external project reporting reviews	Project Staff/ Swift River	After receiving comments	7 to 10 business days	Internal and external CA reports, updated case narratives, and corrected data submissions (See also Worksheet #16)	7 to 10 business days
Laboratory technical evaluation	PM and Project Chemist/ Weston	Once, prior to laboratory subcontract award	During work plan development	Laboratory subcontract award based on evaluation of the technical proposal	Prior to project mobilization
Subcontractor technical evaluation	PM/ Swift River/Weston	Once, prior to subcontract award	During work plan development	Subcontract award based on evaluation of the technical proposal	Prior to project mobilization
Readiness review	PM/ Swift River	Once, prior to project mobilization	Prior to field work	Meeting minutes, email, or other correspondence to document action items that remain to be addressed	Prior to project mobilization
Daily QC audit	PM/Site Manager/ Swift River	Daily, during field activities	During field work	Document variances in logbook notes, daily QC report, or correspondence	Within 24 hours of audit
Review of written or electronic field documentation (logbook notes, sampling data sheets, etc.)	PM/Site Manager/ Swift River	Weekly, during field activities	During field work	Document variances in logbook notes, daily QC report, or correspondence	Within 5 days of audit

Table 31-1 Planned Project Assessments Table (Continued)

UFP-QAPP Removal Action and Monitoring at Source Areas CG517 and CS081

Assessments:

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
Review of field instrument calibration logs	PM or Site Manager/ Swift River	Daily, during field activities	During field work	Document variances in logbook notes, daily QC report, or correspondence	Within 24 hours of audit
Review of CoC forms	Site Manager or Project Chemist/ Swift River, Weston	Daily or as CoC forms are generated	During sampling events	Corrected CoC form Laboratory notification of changes	Within 24 hours of review
Review of laboratory cooler receipt information	Project Chemist/ Weston	One for each SDG (CoC form) received	Within 24 hours of sample receipt	Written documentation or correspondence to appropriate parties regarding variances or potential data quality issues found during the review. Correspondence with laboratory if corrections are required (e.g., sample identification number changes).	Within 24 hours of Review
Field performance audit	Field Team, Site Manager/ Swift River	Once, during each field event	During field work	Document variances in logbook notes, daily QC report, or correspondence	Within 5 days of audit
Laboratory system audit	QA Manager or Project Chemist/ Swift River	Once, prior to subcontract award	Prior to project mobilization	Audit findings	Prior to project mobilization
Laboratory performance assessment	QA Manager or Project Chemist/ Weston	Once, during the course of the project	Following data validation and usability assessment	Written documentation or correspondence, or internal subcontractor evaluation	Within 5 days of audit
Data quality and usability assessment	Project Chemist/ Weston	After all laboratory data deliverables have been received and validated	30 days after data has been validated	Recipients listed in the Distribution Memo	After data have been generated and validated
Independent data validation	Project Chemist/ Weston	100% of SDGs	Within 60 days following receipt of laboratory data for all sample delivery groups	Data validation report	Validation reports will be completed for inclusion in the pre-draft version of the report
H&S audit	H&S Manager/ Swift River	Once, during field activities	3 to 5 business days	Written report	24 hours after notification

Table 31-1 Planned Project Assessments Table (Continued)

UFP-QAPP Removal Action and Monitoring at Source Areas CG517 and CS081

Assessment Response and CA:

Assessment Type	Responsibility for Responding to Assessment Findings	Assessment Response Documentation	Timeframe for Response	Responsibility for Implementing Corrective Action	Responsible for Monitoring Corrective Action Implementation
Review of planning documents (e.g., site-specific UFP-QAPPs)	Lead Author or Project Team/ Weston	Responses to comments	7 to 10 business days	Lead author(s), or as directed by PM	QA Manager or PM/ Swift River
Technical project reports (e.g., after-action reports, remedial action reports, annual reports)	Lead Author or Project Team/ Swift River	Responses to comments	7 to 10 business days	Lead author(s), or as directed by PM/ Swift River	QA Manager or PM/ Swift River
Laboratory technical evaluation	Project Chemist/ Weston	Verbal debriefing after audit or written documentation of evaluation	Within 5 business days from receipt of technical proposal	Project Chemist requests additional information from bidder if needed, otherwise no CA required	PM/ Swift River
Subcontractor technical evaluation	PM or designee/ Swift River	Verbal debriefing after audit or written documentation of evaluation	Within 5 business days from receipt of technical proposal	PM or designee requests additional information from bidder if needed, otherwise no CA required	PM/ Swift River
Readiness review	PM/ Swift River	Verbal debriefing or written CA response	Prior to planned activities	As directed by the PM/ Swift River	PM/ Swift River
Daily QC audit	PM or Site Manager/ Weston	Daily QC report, internal memo, or correspondence	As appropriate based on findings	Site Manager or designee/ Weston	PM/ Swift River
Review of written or electronic field documentation (logbook notes, sampling data sheets, etc.)	Site Manager/ Swift River	Daily QC report, internal memo, or correspondence	As appropriate based on findings	Field Team/ Swift River	PM/ Swift River
Review of field instrument calibration logs	Field Team or Site Manager/ Swift River	Daily QC report, internal memo, or correspondence	Within 24 hours of review	Field Team/ Swift River	PM/ Swift River
Review of CoC forms	Project Chemist/ Weston	Daily QC report, internal memo, or correspondence	Within 24 hours of review	Project Chemist/ Weston	PM/ Swift River
Review of laboratory cooler receipt information	Project Chemist/ Weston	Internal correspondence or correspondence with subcontract laboratory	Within 24 hours of review	Project Chemist/ Weston	PM/ Swift River
Field performance audit	Field Team/ Swift River	Verbal debriefing after audit and/or written CA plan	As appropriate based on findings	Field Team or Site Manager/ Swift River	Field Team or Site Manager/ Swift River
Laboratory system audit	Project Chemist/ Weston	Verbal debriefing after audit and/or written documentation	Prior to the start of field activities	Project Chemist/ Weston	QA Manager/ Weston

Table 31-1 Planned Project Assessments Table (Continued)

UFP-QAPP Removal Action and Monitoring at Source Areas CG517 and CS081

Assessment Response and CA:

Assessment Type	Responsibility for Responding to Assessment Findings	Assessment Response Documentation	Timeframe for Response	Responsibility for Implementing Corrective Action	Responsible for Monitoring Corrective Action Implementation
Laboratory performance assessment	Project Chemist/ Weston	Verbal debriefing after audit and/or written report	As appropriate based on findings	Project Chemist/ Weston/Swift River	PM/ Weston/Swift River
Data quality and usability assessment	Project Chemist/ Weston	Data validation report ADEC Laboratory Data Review Checklist(s) CA (if required)	For inclusion in pre-draft and draft reports, or as determined by CA	Project Chemist/ Weston/Swift River	PM/ Weston/Swift River
Independent data validation	Project Chemist/ Weston	Data validation report CA (if required)	As determined by CA	Project Chemist/ Weston/Swift River	PM/ Weston
Laboratory PE	QA Manager or Project Chemist/ Weston	Written report	As determined by report results	Project Chemist/ Weston/Swift River	QA Manager/ Weston/Swift River
H&S audit	H&S Manager/ Swift River	Verbal debriefing after audit and/or written report CA (if required)	As determined by audit results or CA	H&S Manager or designee/ Swift River	H&S Manager/ Swift River

Notes:

CoC	chain-of-custody
H&S	health and safety
PE	Performance Evaluation
PM	Project Manager
QA	Quality Assurance
QC	quality control
SDG	Sample Delivery Group
Swift River	Swift River Environmental Services, LLC
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
Weston	Weston Solutions, Inc.

WORKSHEET #34: DATA VERIFICATION AND VALIDATION INPUTS

Data verification is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual requirements. The process involves a review of data inputs to verify they are present. Data inputs may include planning documents, analytical data packages, sampling documents, and external reports. The goal of data verification is to confirm and document that the data are what they purport to be (i.e., the reported results reflect what was actually performed). If data deficiencies are identified, then those deficiencies must be documented for the data user's review and, where possible, resolved by CA. Data verification applies to activities in the field as well as in the analytical laboratory.

The term "data validation" is an analyte- and sample-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e., data verification) to determine the analytical quality of a specific data set. Data validation is based upon the measurement quality objectives developed in the UFP-QAPP or similar planning document, or those presented in the sampling or analytical method. Data validation includes a determination, where possible, of the reasons for a failure to meet method, procedural, or contractual requirements, as well as an evaluation of the impact of such failure on the overall data set. Data validation applies to activities in the field as well as in the analytical laboratory.

Examples of data input records subject to verification and validation are listed in **Table 34-1**. The actual inputs required should be based on the graded approach, as defined during site-specific project planning. The information provided therein is applicable to this UFP-QAPP.

Table 34-1 Data Verification and Validation Inputs

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Item	Description	Verification (Completeness)	Validation (Conformance to Specifications)
Planning Documents/Records			
	Approved UFP-QAPP	X	
	Contract	X	
	Field SOPs	X	
	Laboratory certifications, SOPs, and reporting limits	X	X
	Statement(s) of work	X	
Field Records			
	Field logbook(s)	X	X
	Field instrument calibration logs	X	X
	CoC and cooler receipt form	X	X
	Sampling diagrams/surveys	X	X
	Daily quantity reports	X	X
	Waste manifests and/or disposal records	X	X
	Correspondence	X	X
	Change orders/deviations	X	X
	Field audit reports	X	X
	Field CA reports	X	X
Analytical Data Package			
	Case narrative	X	X
	Internal CoC form	X	X
	Cooler receipt form(s) for each cooler of samples	X	X
	Sample date/time of receipt, date/time of prep, date/time of analysis	X	X
	Initial and continuing calibration	X	X
	Field sample and field QC sample results	X	X
	Laboratory QC sample results	X	X
	DL, LOD, and LOQ reported	X	X
	DL, LOD, and LOQ establishment and verification	X	X
	Raw data	X	X
	Benchsheets/worksheets	X	X
	Instrument analytical run logs	X	X

Table 34-1 Data Verification and Validation Inputs (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Item	Description	Verification (Completeness)	Validation (Conformance to Specifications)
Analytical Data Package			
	Instrument maintenance and operations logs	X	X
	Definition of laboratory qualifiers	X	X
	PE/PT sample results/reports (if any)	X	X
	ERPIMS deliverable	X	X
	Hard copy and electronic versions of the laboratory report	X	X
	Communication records	X	X
	Documentation of data quality issues and their resolution, including CAs	X	X

Notes:

CA	corrective action
CoC	chain-of-custody
DL	detection limit
ERPIMS	Environmental Resources Program Information Management System
LOD	limit of detection
LOQ	limit of quantitation
PE	performance evaluation
QC	quality control
SOP	standard operation procedure
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan

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WORKSHEET #35: DATA VERIFICATION PROCEDURES

This worksheet describes the processes that will be followed to verify project data. It describes how each item will be verified, when the activity will occur, what documentation is necessary, and the identity of the person responsible. "Internal" or "external" is in relation to the data generator. The purpose of the assessment (Worksheets #31, #32 and #33) is to evaluate the effectiveness of project activities to verify that the resultant data quality is adequate for its intended use, whereas verification (Worksheet #35) is to confirm that the specified requirements (sampling and analytical) have been completed. Verification inputs for this worksheet include items such as those listed in Table 9 on Page 112 of the UFP-QAPP Manual (Intergovernmental Data Quality Task Force [IDQTF], 2005). The description should detail how each item will be verified, when the activity will occur, and what documentation is necessary.

Upon completion of the verification process, a "certification statement" is generated, certifying the data have been verified. The statement must be signed by the responsible personnel (Project Chemist), either within the organization or as part of external data verification. Data verification records may also include a narrative that identifies technical non-compliance issues or shortcomings of the data produced during field or laboratory activities. If data verification identifies non-compliance issues, then the narrative must identify the records involved and indicate CAs taken in response. The records routinely produced during field activities and at the analytical laboratory (commonly referred to as a data package) and other documentation, such as checklists, handwritten notes, or tables, must also be included as part of the data verification records. Definitions and supporting documentation for laboratory qualifiers assigned must also be included.

Table 35-1 lists the data deliverables and verification aspects for the site investigation at Eielson AFB.

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Table 35-1 Data Verification (Step I) Process Table

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Field documentation including field logbook(s), CoC forms	UFP-QAPP Field SOPs	Verify accuracy and completeness for each day of field activities. Verify that all planned samples, including field QC samples, were collected and documented in accordance with the field SOPs and UFP-QAPP requirements. Verify that deviations from planned activities were documented. Verify that field monitoring and field measurements were recorded.	FTL, Swift River
Field SOPs	UFP-QAPP Field SOPs	Verify that the sampling SOPs were followed.	FTL, Swift River
Analytical SOPs	UFP-QAPP Analytical SOPs	Verify that the analytical SOPs were followed.	Laboratory QA Manager, Subcontract Laboratory Project Chemist, Weston/Swift River
Sample receipt documentation (cooler receipt forms, laboratory log-in information)	UFP-QAPP Field SOPs	Verify accuracy and completeness. Verify that discrepancies were documented and resolution of any potential data quality issues.	Laboratory QA Manager, Subcontract Laboratory FTL, Weston Project Chemist, Weston
Sample summary table(s)	UFP-QAPP	Verify accuracy and completeness of the sample summary by comparing against the planned samples and the CoCs and cooler receipt forms for samples actually submitted to the laboratory.	FTL, Weston Project Chemist, Weston
Field measurements, including field screening results	UFP-QAPP Field SOPs	Verify that field measurements meet the QA/QC requirements established in this UFP-QAPP. Verify accuracy and completeness.	FTL, Weston
Laboratory analytical report(s) and electronic deliverable(s)	UFP-QAPP	Verify accuracy and completeness. Verify that report and EDDs meet contract requirements. Verify that the EDDs are consistent with the hard copy data package.	Laboratory QA Manager, Subcontract Laboratory Project Chemist, Weston
Analytical results, including DL/LOD/LOQ, and laboratory data qualifiers	UFP-QAPP	Verify that reporting limits meet DQOs specified in this UFP-QAPP. Verify that method and required QC samples were analyzed. Verify that soil sample results are corrected for dry-weight.	Laboratory QA Manager Project Chemist, Weston
Field QC sample results	UFP-QAPP Field SOPs	Verify that all UFP-QAPP-required QC samples were collected and analyzed.	FTL, Weston Project Chemist, Weston

Table 35-1 Data Verification (Step I) Process Table (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Field documentation including field logbook(s), CoC forms	UFP-QAPP Field SOPs	Verify accuracy and completeness for each day of field activities. Verify that all planned samples, including field QC samples, were collected and documented in accordance with the field SOPs and UFP-QAPP requirements. Verify that deviations from planned activities were documented. Verify that field monitoring and field measurements were recorded.	FTL, Swift River
Field SOPs	UFP-QAPP Field SOPs	Verify that the sampling SOPs were followed.	FTL, Swift River
Analytical SOPs	UFP-QAPP Analytical SOPs	Verify that the analytical SOPs were followed.	Laboratory QA Manager, Subcontract Laboratory Project Chemist, Weston/Swift River
Sample receipt documentation (cooler receipt forms, laboratory log-in information)	UFP-QAPP Field SOPs	Verify accuracy and completeness. Verify that discrepancies were documented and resolution of any potential data quality issues.	Laboratory QA Manager, Subcontract Laboratory FTL, Weston Project Chemist, Weston
Sample summary table(s)	UFP-QAPP	Verify accuracy and completeness of the sample summary by comparing against the planned samples and the CoCs and cooler receipt forms for samples actually submitted to the laboratory.	FTL, Weston Project Chemist, Weston
Field measurements, including field screening results	UFP-QAPP Field SOPs	Verify that field measurements meet the QA/QC requirements established in this UFP-QAPP. Verify accuracy and completeness.	FTL, Weston
Audit reports, CA reports	UFP-QAPP	Verify accuracy and completeness. Verify that CAs were documented and implemented.	Site Manager, Weston Laboratory QA Manager, Subcontract Laboratory Project Chemist, Weston

Notes:

CA	corrective action	FTL	Field Team Lead	SOP	standard operating procedure
CoC	chain-of-custody	LOD	Limit of Detection	Swift River	Swift River Environmental Services, LLC
DL	Detection Limit	LOQ	Limit of Quantification	UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
DQO	Data Quality Objective	QA	Quality Assurance	Weston	Weston Solutions, Inc.
EDD	Electronic Data Deliverable	QC	Quality Control		

WORKSHEET #36: DATA VALIDATION PROCEDURES

The objective of data validation is to assess the performance associated with the analysis to determine the quality of the data. This will be accomplished by evaluating whether the collected data comply with the pre-defined requirements of the project (including method, procedural, and contractual requirements) and by comparing the collected data with criteria established based on the project DQOs. The validation process is summarized in **Table 36-1**.

Table 36-1 Validation Process Summary

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Level	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator
Minimum Stage 2A	Soil	All methods (IDW sample analyses will not be validated)	All	Defined in Worksheet #36	Project Chemist, Weston
Minimum Stage 2A	Water	All methods (IDW sample analyses will not be validated)	All	Defined in Worksheet #36	Project Chemist, Weston

Notes:

IDW	investigation-derived waste
Weston	Weston Solutions, Inc.

All types of data, including screening data and definitive data, are relevant to the usability assessment. The following sections focus on the data review requirements for definitive data only.

DATA REVIEW REQUIREMENTS FOR DEFINITIVE DATA

Scientifically-sound data of known and documented quality that meet DQOs are essential for use in the decision-making process. Data review is the process whereby a variety of personnel who have different responsibilities within the data management process examine and evaluate data to varying levels of detail and specificity. This process includes verification, validation, and usability assessment. The records that document data review activities to effectively assess the data for quality and usability must be complete and robust. The data can then move forward with associated qualifiers that indicate the overall usability of the data.

Data verification is the first step in data review. Data verification confirms that the specified requirements have been performed. Data verification and validation inputs are included in Worksheet #34, and data verification procedures are included in Worksheet #35.

Data validation extends data verification and is used to confirm that the requirements for a specific intended use are fulfilled. Data validation is the systematic process of evaluating whether the data comply with the pre-defined requirements of the project (including method, procedural, and contractual requirements) and comparing the data with criteria based on the DQOs documented in this UFP-QAPP. The purpose of data validation is to assess the performance associated with the analysis to determine the quality of the data. Data validation includes a determination, to the extent possible, of the reasons for any failure to meet performance requirements, and an evaluation of the effect of such failures on the usability of the data.

Data usability assessment is an evaluation based on the findings of data validation and verification in the context of the overall project decisions or objectives. The assessment determines whether the project execution and resulting data meet the DQOs. Both the sampling and analytical activities must be considered with the ultimate goal of assessing whether the final, qualified results support the decisions to be made with the data.

LABORATORY REPORTING REQUIREMENTS

Analytical Data Package Requirements

A group of samples submitted to the laboratory at the same time and included on the same CoC will be considered a Sample Delivery Group (SDG). The results for an SDG will be reported as one analytical data package. The analytical data package must contain adequate information and be presented in a clear and concise manner. Laboratories must provide Level IV data packages that meet the minimum requirements included in the ADEC Technical Memorandum: Data Quality Objectives, Checklists, Quality Assurance Requirements for Laboratory Data, and Sample Handling (ADEC, 2017d) and the DoD QSM V5.1 (DoD, 2017), which include, but are not limited to, the following:

- Cover sheet identifying the project
- Table of contents
- Case narrative, which summarizes samples, provides analyses, and discusses any issues that may affect data usability
- Definition of laboratory qualifiers
- Analytical results
- Laboratory DLs and LOQs
- Instrument performance check summary
- Calibration summaries (ICAL linearity and relative RFs, continuing calibration, second-source verification, IS areas, and retention time check summaries)
- Sample management records
- Internal laboratory QA/QC information (method blanks, surrogate recoveries, MS/MSD, LCS/LCSD, duplicate runs, Performance Evaluation (PE) results, or SRMs [if any])
- Raw data (e.g., chromatograms, mass spectrum results)

The laboratory’s analytical data package should be organized so that the analytical results are reported on a per-analytical-batch basis, unless otherwise specified.

Using the information contained in the data package, a reviewer should be able to determine the quality of the data. Additional information may be required, depending on the level of detail related to the data review performed.

The case narrative of the analytical data package shall include, but not be limited to, the following:

- Table summarizing samples received and correlating field sample numbers, laboratory sample numbers, and laboratory tests completed.
- Discussion of sample appearance and integrity issues that may affect data usability (such as temperature, preservation, pH, sample containers, air bubbles, and multi-phases).
- Samples received but not analyzed and the explanations for non-analysis.
- Discussion of holding-time deviations for sample preparation and analyses.
- Analysis of all exceedances or discrepancies of calibrations, continuing calibrations, or QC sample results; raw data/chromatograms; and CAs taken.
- Identification of samples and analytes for which manual integration was necessary.
- Discussion of all qualified data and definition of qualifying flags.
- Discussion and recommendations of potential data usability of qualified data.

Laboratory Data Reporting Requirements

The following sections describe laboratory reporting requirements for reporting limits, manual integrations, and method blanks.

Result Reporting Requirements

The following result reporting requirements will be met for laboratory data:

- DLs and sample results should be reported to one decimal place more than the corresponding LOQ, unless the appropriate number of significant figures for the measurement dictates otherwise.
- Results for soil samples should be reported on a dry-weight basis. DLs, LODs, and LOQs will be adjusted for moisture.
- Samples should be analyzed undiluted, if possible. Non-detect results should be reported to the LOQ.

Manual Integration Requirements

Manual integrations, which are an integral part of the chromatographic analysis process, shall be performed only as CA measures. Examples of instances where manual integration would be warranted include, but are not limited to, co-eluting compounds resulting in poor-peak resolution, a misidentified peak, an incorrect retention time, or a problematic baseline.

When manual integrations are used, the following procedures shall be implemented for documenting the event and for consistency in performing the manual integration:

- A laboratory SOP shall be followed for manual integrations. This SOP shall specify: (1) when automated integrations by the instrument are likely to be unreliable; (2) what constitutes an unacceptable automated integration; (3) how the problems should be resolved by the analyst; and (4) the procedures for the analyst to follow in documenting any required manual integrations.
- Raw data records shall include a complete audit trail for those manipulations, including: (1) results of both the automated and manual integrations; (2) notation of the cause and justification for performing the manual integrations; (3) date; and (4) signature or initials of person performing the manual integration.
- The chromatogram of the peak before and after manual integration shall be provided in both the electronic and hard copy laboratory deliverables.
- All manual integrations must be reviewed and approved by the section supervisor and/or the QA officer.
- All manual integrations must be identified in the case narrative.

Laboratory Data Deliverables

At minimum, the following data deliverables will be requested from the subcontract laboratories:

- Level IV data package in PDF and/or hard copy for each SDG containing the elements specified in this worksheet (including raw data) and consistent with the requirements specified in ADEC Technical Memorandum: Data Quality Objectives, Checklists, Quality Assurance Requirements for Laboratory Data, and Sample Handling (ADEC, 2017d) and the DoD QSM V5.1 (DoD, 2017).
- ERPIMS EDD validated using the most current version of ERPTools and the ERPIMS DLH.

Additional EDDs (e.g., in Microsoft® Excel format) may be requested on a project-specific basis.

Laboratory Data Review Requirements

All analytical data that the laboratory generates shall be verified before submittal. This internal data review process, which is multi-tiered, shall include all aspects of data generation, reduction, and QC assessment. All definitive data shall be reviewed first by the analyst, and then by the supervisor of the respective analytical section using the same criteria. Elements for review or verification at each level must include, but are not limited to, the following:

- Sample receipt procedures and conditions
- Sample preparation
- Appropriate analytical SOPs and methodologies
- Accuracy and completeness of analytical results
- Correct interpretation of all raw data, including all manual integrations
- Appropriate application of QC samples and compliance with established CLs
- Verification of data transfers

- Documentation completeness
- Accuracy and completeness of data deliverables (hard copy and electronic)

Laboratory Data Evaluation

The laboratory shall apply data qualifiers as part of its internal validation activities. The data qualifiers for definitive data are Q, J, B, U, and N as defined in **Table 36-2**. Flagging criteria apply when acceptance criteria are not met and when CAs are not successful or not performed. The supervisor of the respective analytical sections shall review the data qualifiers.

Table 36-2 Laboratory Data Qualifiers
UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Qualifier	Description
Q	One or more QC criteria have failed. Data will be carefully assessed with respect to the project-specific requirements and evaluated for usability. Subsequent assessment by the data validator may affect usability of the associated results.
J	The analyte was positively identified, but the associated concentration is estimated above the DL and below the LOQ, or the quantitation is an estimated value because of discrepancies in meeting certain analyte-specific QC criteria.
B	The analyte was found in an associated blank above 1/2 the LOQ, as well as in the sample.
U	The analyte was analyzed for, but not detected.
N	The analyte is a tentatively identified compound (for mass spectrometry methods only).

Notes:

DL	Detection Limit
LOQ	Limit of Quantitation
QC	Quality Control

The laboratory's QA section shall perform a 100% review of 10% of the completed data packages, and the laboratory project representative shall complete a final review on all of the completed data packages.

The flags applied at the laboratory will be reviewed during the data validation and usability assessment activities. The flags may be accepted, modified, or rejected. For all data qualifiers that are changed, clear justification must be provided.

Method Blank Evaluation Guidance

For method blanks, the source of contamination will be investigated. If 1/2 the LOQ for common laboratory contaminants is exceeded, the laboratory will evaluate whether the samples need to be reprocessed using the following criteria: (1) the method blank contamination exceeds a concentration greater than 1/10 of the measured concentration of any sample in the associated preparation batch, or (2) there is evidence that the blank contamination otherwise affects the sample results. Except when sample analysis results in a non-detect, all samples associated with method blank contamination and meeting these criteria will be reprocessed in a subsequent preparation batch. If insufficient sample volume remains for reprocessing, the results will be reported with a B flag, along with any other appropriate data qualifier. If an analyte is detected only in the method blank and not in any batch samples, no flagging is necessary. Method blank contamination must be addressed in the case narrative.

WESTON DATA VALIDATION REQUIREMENTS

Weston has overall responsibility for data quality. External organizations, third-party subcontractors not associated with Weston, may assist with the review. Regardless of who performs the data review, the individual(s) must possess the disciplinary expertise, experience, and theoretical knowledge to perform the task, as well as a complete understanding of the intended use of the data and the relationship of the QC results to the usability of the data.

Data Verification Guidelines

Data verification is the first step in data review. Data verification confirms that the specified requirements have been performed. Data verification and validation inputs are included in Worksheet #34, and data verification procedures are included in Worksheet #35.

Data Validation Guidelines

The data validation process builds on data verification. The laboratory case narrative and data validation results should be reviewed, with data qualifiers removed or added if needed. All project data will be validated (except for IDW sample analyses) on an analytical-batch basis by assessing QC samples and associated field sample results. Data validation guidelines have been developed with guidance from DoD QSM V5.1 (DoD, 2017); *National Functional Guidelines for Inorganic Superfund Data Review* (EPA, 2017a); *National Functional Guidelines for Superfund Organic Methods Data Review* (EPA, 2017b); and specific method guidance, such as the *Underground Storage Tank Procedures Manual* (ADEC, 2017e) and *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA, 1996).

In general, EDDs will be evaluated for consistency with project and contract requirements. EDDs will be consistent with the hard copy data package.

During data verification and validation, a partially automated process using a data management system (not commercially available) may be used to compare the QC values provided in the EDD against the limits specified in this UFP-QAPP. The partially automated process will include data flagging for issues related to method blanks, equipment blanks, trip blanks, LCS (and LCSD, if performed), MS/MSD samples, FDs, surrogate recoveries, holding time, and reconciliation of dilutions and re-extractions. All of the elements of QC, their limits, and the logic for applying flags will be incorporated in the computer application. Data flags, as well as the reason for each flag, will be entered into an electronic database and will be made available to the data users. The Data Validator/Project Chemist will apply a final flag to the data after evaluating all flags entered into the database and selecting the most conservative flags.

Data Analysis and Interpretation

The assessment phase of the data validation process may include, but is not limited to, the following:

- Laboratory and field blank contamination and parallel contamination in samples
- Duplicate sample analyses
- MS data
- LCS data
- Effect of multiple data issues on the final analytical results
- Deficiencies identified during data verification and assessment of their effect on the sample results
- Assessment of data usability and assignment of final data qualifiers, as necessary
- Discussion of completeness, representativeness, and comparability

A data validation report will be prepared summarizing the findings and discussing their effect on overall data usability. This report will be incorporated into the final usability assessment. In addition to the overall validation report, the Project Chemist or Data Validator will complete the ADEC Laboratory Data Review Checklist for each laboratory data package (ADEC, 2017d).

Blank Evaluation Guidelines

Method blanks, as well as other field blanks, will be evaluated based on the concentration of the analyte in the samples in relation to the concentration in the blank. When a data set contains low-level detects in field samples with an associated field or laboratory blank that has detects at similar concentrations, this suggests that the low-level detects in these field samples may be artifacts because of either field or laboratory practices. A sample detect that is ≤5 times the blank contamination will be B flagged at the detected concentration to document the associated blank contamination (≤10 times for common laboratory contaminants including, but not limited to, acetone, 2-butanone, carbon disulfide, methylene chloride, and phthalate esters).

Duplicate Evaluation Guidance

QC measures for precision include FDs, laboratory duplicates, and MSDs. With the exception of FDs, the laboratory will evaluate QC samples. FDs will be sent to the laboratory as blind samples and will be given unique sample identification numbers. These sample results can be used to assess field sampling precision, laboratory precision, and, potentially, the representativeness of the matrix sampled. Flagging of results associated with FDs should be assigned so that the level of uncertainty required, as provided by the project-specific objectives, is taken into account.

Poor overall precision may result from one or more of the following:

- Field instrument variation
- Analytical measurement variation

- Poor sampling technique
- Sample transport problems
- Spatial variation (heterogeneous sample matrices)

To identify the cause of imprecision, the project team should evaluate the field sampling design rationale and sampling techniques, as well as review both FD and analytical duplicate sample results. If poor precision is indicated in both the FDs and analytical duplicates, then the laboratory may be the source of error. If poor precision is limited to the FD results, then the sampling technique, field instrument variation, sample transport, and/or spatial variability may be the source of error. If data validation reports indicate that analytical imprecision exists for a particular data set or SDG, then the reports must discuss the effect of that imprecision on usability.

Matrix Interference Evaluation Guidance

In the case of matrix interference, J flags or UJ flags should be applied to the associated parent sample and FD, as applicable.

Flagging Conventions

The allowable final data qualifiers for definitive data and the hierarchy of data qualifiers listed in order of the most severe to the least severe are R, B, J, UJ, U, and NJ. **Table 36-3** describes these validation and usability assessment data qualifiers.

Table 36-3 Validation and Usability Assessment Data Qualifiers
UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Qualifier	Description
R	The data are rejected because of deficiencies in meeting QC criteria and may not be used for decision making.
B	The analyte was detected in the sample at a concentration less than or equal to 5 times (10 times for common laboratory contaminants) the blank concentration.
J	The analyte was positively identified, and the quantitation is an estimated value because of discrepancies in meeting certain analyte-specific QC criteria. Or the analyte was positively identified, but the associated concentration is estimated greater than or equal to the DL and below the LOQ.
UJ	The analyte was not detected; however, the result is estimated because of discrepancies in meeting certain analyte-specific QC criteria.
U	The analyte was analyzed for, but not detected.
NJ	The analyte is a tentatively-identified compound.

Notes:
Data validation will indicate when performance criteria are not met. The final rejection of data (qualified "R") and their use must be decided by the project team and not based solely on the assessment performed by the data validator.

DL	detection limit
LOQ	limit of quantitation
QC	Quality Control

Data qualifying conventions based on result quantitation are summarized in **Table 36-4**.

Table 36-4 Data Qualifying Conventions Based on Quantitation of Results

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Criteria	Flag
< DL	U, UJ at the LOD
≥ DL < LOQ	J
≥ LOQ	As needed
≥ High standard/linear range	J

Notes:

DL	detection limit
LOD	limit of detection
LOQ	limit of quantitation

For example:

DL = 2, LOD = 4, LOQ = 15, sample is undiluted.

Sample #1: Analytical result: not detected; reported result: < 4 U.

Sample #2: Analytical result: 2; reported result: 2 J.

Sample #3: Analytical result: 10; reported result: 10 J.

Sample #4: Analytical result: 15; reported result: 15.

Table 36-5 presents general guidelines for applying the data validation and usability assessment qualifiers.

Table 36-5 General Data Qualifying Conventions

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

QC Requirement	Criteria	Flag	Flag Applied to
Holding times	Time exceeded for extraction or analysis	J for positive results; UJ for non-detects	All analytes in sample
	Time exceeded for extraction or analysis by a factor of >2	J for positive results; R for non-detects	
Sample integrity (SW8260C)	Bubbles in VOA vial > 0.25 inch used for analysis	J for positive results; UJ for non-detects	Sample
Instrument tuning	Ion abundance method-specific criteria not met	R for all results	All associated samples in analytical batch
ICAL	All analytes must be within method-specified criteria	J for positive results; R for non-detects	All associated samples in analytical batch
Sample preservation	Improper sample preservation	J for positive results; UJ for non-detects (all results for volatile soil samples not preserved in the field will be rejected)	Sample

Table 36-5 General Data Qualifying Conventions (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

QC Requirement	Criteria	Flag	Flag Applied to
Low-level calibration check	All analytes must be within 50% of expected value	High bias: J for positive results Low bias: J for positive results; UJ for non-detects	All associated samples in analytical batch
	Criteria exceeded by more than 2x	J for positive results; R for non-detects	
Interference check sample	All analytes must be within 20% of expected value	High bias: J for positive results Low bias: J for positive results; UJ for non-detects	All associated samples in analytical batch
	Criteria exceeded by more than 2x	J for positive results; R for non-detects	
LCS	%R > UCL %R < LCL %R < LCL and <10%	J for positive results J for positive results; UJ for non-detects J for positive results; R for non-detects	The specific analyte(s) in all samples in associated analytical batch
ISs	Area > UCL Area < LCL	J for positive results; UJ for non-detects J for positive results	Sample
Surrogate spikes	%R > UCL %R < LCL and >10% %R <10%	J for positive results J for positive results; UJ for non-detects J for positive results; R for non-detects	Sample
	Dilution >10x	No flagging required for failed surrogates	
Blanks (method, equipment, or trip)	Analyte(s) detected (use the blank of the highest concentration)	B for positive sample results ≤ 5 times highest blank concentration (10 times for common lab contaminants)	All samples in preparation, field, or analytical batch, whichever applies
FD	RPD > CL and FDs > LOQs or One FD > LOQ, one ND	J for positive results J for positive results; UJ for non-detects	The specific analyte(s) in FD pair Note: No flagging is required for RPDs based on both concentrations less than the LOQs
MS/MSD	MS or MSD %R > UCL MS or MSD %R < LCL MS or MSD %R < LCL and <10% MS/MSD RPD > CL Sample concentration > 4 times spike concentration; excessive dilution	J for positive results J for positive results; UJ for non-detects J for positive results; R for non-detects J for positive results No flag required	The specific analyte(s) in parent sample and associated samples collected at the same site.
Confirmation	RPD between primary and confirmation results > 40%	J for positive results	Sample

Table 36-5 General Data Qualifying Conventions (Continued)

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

QC Requirement	Criteria	Flag	Flag Applied to
RT window	Analyte within established window	R for all results	Sample
Estimated maximum possible concentration	Instrument response meets some but not all of the criteria required to positively identify a particular congener (RT, signal-to-noise ratio, ion abundance ratio, etc.)	J for all results	Sample

Notes:

Spike criteria are not applicable for analytes detected at more than 4 times the spike concentration in the original sample.

Information in this table reflects flagging criteria from guidance documents, as well as criteria applied based on professional judgment.

%	percent
%R	percent recovery
CL	control limit
FD	field duplicate
ICAL	initial calibration
LCL	lower control limit
LCS	Laboratory Control Sample
LOQ	limit of quantitation
IS	Internal Standard
MS	matrix spike
MSD	matrix spike duplicate
ND	non-detect
RPD	relative percent difference
RT	retention time
UCL	upper control limit
VOA	volatile organic analysis

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WORKSHEET #37: DATA USABILITY ASSESSMENT

The data usability assessment is an evaluation based on the results of data verification and validation in the context of the overall project decisions or objectives. The assessment determines whether the project execution and resulting data meet the project DQOs. The sampling and analytical activities must be considered, with the ultimate goal of assessing whether the final, qualified results support the decisions to be made with the data.

The following sections summarize: (1) the processes used to determine whether the collected data are of the right type, quality, and quantity to support project decision making; (2) how data quality issues will be addressed; and (3) how limitations of the use of the data will be handled. The Data Usability Assessment Tables (**Table 37-1 and 37-2)** includes specific examples of items that will be evaluated during the usability assessment, as applicable.

SUMMARY OF USABILITY ASSESSMENT PROCESSES

A usability assessment is performed to determine how well the data collected for a particular project support the project objectives.

Data gaps may be present if: (1) a sample is not collected; (2) a sample is not analyzed for the requested parameters; or (3) the data are determined to be unusable. The need for further investigation will be determined on a case-by-case basis. This determination will depend on whether data can be extrapolated from adjacent sample locations and whether the data are needed based on the results from adjacent sample locations.

The Project Chemist and the analytical laboratory subcontractor will ensure that the collected data meet the DLs, LODs, LOQs, and laboratory QC limits specified in this UFP-QAPP. During the data validation assessment, nonconformances will be documented and validation qualifiers will be applied in accordance with the validation procedures in Worksheet #36. Potential effects on data usability will be determined based on the context of the project objectives.

With the exception of rejected data, all data will be considered usable. Estimated and/or biased results are usable. Outliers, if present, can be addressed on a case-by-case basis. There is no generic formula for determining whether a result is an outlier. Potential outliers will be referred to a statistician and/or senior consultant, who will determine which formulas are appropriate for classifying data points in a statistically appropriate and defensible manner. Data will not be eliminated from consideration on the basis of statistical outlier testing. Outliers will be determined by ProUCL and addressed separately on a site-specific basis in consultation with ADEC. Final determination regarding the handling of outliers and site management decisions will be per ADEC approval.

Table 37-1 Data Usability Assessment Process Summary

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Steps	Process Description
Step 1	**Review the project's objectives and sampling design** The site-specific DQOs and MPC will be reviewed to verify that they are still applicable. The site-specific sampling design will be reviewed and evaluated for consistency with project objectives. Identify any deviations in procedures and evaluate in the context of project DQOs.
Step 2	**Review the data verification and data validation outputs** The project data will be verified and validated in accordance with Worksheets #34, #35, and #36. The MPC are included in Worksheet #12. Following the data verification and validation, project staff and the Project Chemist will perform a data usability assessment following the procedures in this worksheet. The QA/QC summary report, or data validation and usability report, will be reviewed to identify results that did not meet project DQOs and those for which the usability of the data is affected. Summarize the data using figures and tables. Identify results that are unexpected or otherwise appear to be anomalous. Identify trends in the results. Review deviations from planned activities and determine the effects on the project data. Identify those data that are not acceptable for use. Determine the cause, evaluate the effects on the project, and take appropriate CA (e.g., resample or limit the use of data).
Step 3	**Verify the assumptions of the selected statistical method** Statistical methods, including distribution of data, comparability of results, and precision of sampling and analysis, will be verified and the acceptability of the amount of error will be evaluated. Overall measurement error may be associated with sampling design and field measurements, as well as laboratory analytical procedures. If serious deviations from the assumptions for the planned statistical methods are identified, another statistical method may need to be selected.
Step 4	**Implement the statistical method** If necessary, implement the statistical methods with the sample data. For projects that do not require statistical methods to be used, the uncertainty in measurements must be evaluated for consistency with the project DQOs.
Step 5	**Document data usability and draw conclusions** Data usability will be documented in the report and the data validation and usability assessment. It will be determined whether the data can be used as intended based on the results of deviations, CAs, and impacts of QC failures. The sampling design will be evaluated, and the results of statistical methods will be documented in the report (if applicable). Valid data will be used to update the CSM and any data gaps will be identified.

Notes:

CSM	conceptual site model
DQO	data quality objective
MPC	measurement performance criteria
QA	quality assurance
QC	quality control

PERSONNEL RESPONSIBLE FOR PERFORMING THE USABILITY ASSESSMENT

Weston personnel will be responsible for performing the analytical data usability assessment. Results of the usability assessments will be used to determine whether the data generated during the investigation can be used to answer the principal study questions. Additional personnel, such as geologists, statisticians, risk assessors, and others, will also perform usability assessment as it relates to project specific DQOs.

USABILITY ASSESSMENT DOCUMENTATION

The Project Chemist will generate a data quality assessment report (or QA/QC data summary report) to be included with the project completion report describing the results of the data verification, validation, and usability assessment. The Project Chemist will work with the PM, FTL, and other project staff to discuss conclusions drawn and determine any potential limitations on the usability of the project data as a result of the assessment. The data quality assessment will document all data nonconformance and usability determinations, even in cases where it is determined that the usability of the data is not affected.

The usability of the data collected during field activities will be assessed in several ways:

- Any deviations from proposed field activities and sampling and handling procedures will be reviewed and their effect on data usability evaluated.
- Field screening and analytical results for field samples and field and laboratory QC samples will be compared against the PQOs in Worksheet #11 and evaluated using the MPC in Worksheet #12.
- Analytical results, including non-detect values, will be compared against the project cleanup levels in Worksheet #15.
- Data verification and validation will be completed following the procedures in Worksheets #34, #35, and #36.

Based on the results of data verification and validation, the usability of the data will be evaluated in the context of project-specific DQOs following the procedures in this worksheet.

Measurement error will be evaluated by reviewing sampling design, sampling locations, and sample collection methods. The Project Chemist or Data Validator will evaluate laboratory and field QC sample results (FDs, PE samples, blanks, LCSs, surrogate recoveries, and matrix effect, if any) to assess the overall measurement error associated with the project.

Bias Contamination

The analytical results for blanks (including method blanks, trip blanks, and equipment rinsate blanks) will be checked against the MPC in Worksheet #12 to evaluate possible bias as a result of contamination.

Precision and Accuracy

Laboratory precision is measured by the variability associated with duplicate (two) or replicate (more than two) analyses. One type of sample that can be used to assess laboratory precision is the LCS. Multiple LCS analyses over the duration of the project can be used to evaluate the overall laboratory precision for the project. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch, but between LCSs analyzed in multiple batches.

Precision and accuracy will be evaluated using DQIs such as FDs, MS/MSDs, LCSs, RSDs, and surrogates. Precision and accuracy of the data set will be considered acceptable after integration of qualified results (i.e., estimated [J] and non-detect estimated [UJ] results).

Representativeness

All samples for each method and matrix will be evaluated for holding time compliance. Representativeness of the project data is evaluated by reviewing qualified results with regard to the use of standard methods and sampling procedures, sampling locations and quantities, and sampling design.

Sensitivity

Analytical methods and laboratory instrumentation will be selected for use based on the ability of the method to detect target analytes at or below the PALs. Worksheet #15 includes project cleanup levels and screening criteria as well as laboratory detection limits.

The capability of analytical laboratory methods and instrumentation to provide data with the sensitivity to meet the site-specific DQOs in the project sample matrix will be evaluated as part of the usability assessment. The DLs, LODs, and LOQs will be evaluated against the PALs in order to determine whether the analytical methods and/or laboratory meet the project DQOs.

Comparability

Data comparability will be evaluated through the collection and analysis of FDs and field blanks. The laboratory use of standard analytical methods for their analyses and operation of instruments within their range of calibration will be reviewed. The analytical results will be reported in correct standard units. Holding times, sample preservation, and sample integrity will be evaluated for compliance with QC criteria.

Complete field documentation using standardized data collection forms shall support the assessment of comparability. Historical comparability shall be achieved through consistent use of methods and documentation procedures throughout the project. Assessment of comparability is primarily subjective. Experienced environmental professionals with a clear knowledge of the DQOs and project decisions should interpret the results.

Completeness

Once all analytical data has been validated, a completeness check will be performed based on the MPC in Worksheet #12. Valid data are data that are usable in the context of the project goals. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set.

For completeness requirements, valid results are all results not qualified with an R flag after the usability assessment has been performed. Completeness should not be determined only on the basis of laboratory data qualifiers. The goal for completeness is 95% for aqueous samples and 90% for soil samples.

Uncertainty Based on Laboratory Limits of Quantitation

LOQs, LODs, and DLs for sample results will be evaluated against those listed in Worksheet #15 of this UFP-QAPP. The LODs for non-detect results will be evaluated against the laboratory limits and cleanup levels in Worksheet #15. If the LOD exceeds the cleanup level or screening criteria, the DL may be evaluated. Worksheet #15 represents the achievable limits for analytes in a laboratory matrix. However, analysis of field samples may result in sample dilutions that cause elevation of laboratory reporting limits above cleanup levels or screening criteria.

The magnitude of the laboratory LODs will be evaluated for usability of the results within the context of the project objectives. For instance, if an analyte is present at concentrations below the highest LODs and below the screening criteria, then project decisions are not affected for that analyte. However, it is also possible that an analyte is present below the LOD and above the screening criteria; as such, the assumption that the analyte is not present would potentially result in an underestimation of the potential contamination impact. As a result, the result for this analyte requires further evaluation (i.e., comparison of the DL for that analyte against screening criteria or evaluation of alternate analytical methods).

Table 37-2 Data Usability Assessment Table

UFP-QAPP: Removal Action and Monitoring at Source Areas CG517 and CS081

Item	Assessment Activity	Responsibility
Laboratory data deliverables and Work Plan	Ensure that all necessary information was provided, including (but not limited to) QC sample results and data validation results.	Swift River PM Weston Project Chemist
Sampling locations, deviation	Determine whether alterations to sampling locations continue to satisfy the PQOs.	Swift River Field Team, Swift River Site Manager, Swift River PM
CoC, deviation	Establish that any problems with documentation or custody procedures do not prevent the data from being used for the intended purpose.	Weston Project Chemist
Holding times, deviation	Determine the acceptability of data where holding times were exceeded.	Weston Project Chemist
SOPs and methods, deviations	Evaluate the impact of deviations from analytical and field SOPs and specified methods on data quality.	Swift River Field Team, Swift River Site Manager, Weston Project Chemist
QC samples	Evaluate the implications of unacceptable QC sample results on the data usability for the associated samples. For example, consider the effects of observed blank contamination.	Weston Project Chemist
Matrix	Evaluate matrix effects (interference or bias).	Weston Project Chemist
Meteorological data and site conditions	Evaluate the possible effects of meteorological (e.g., wind, rain, temperature) and site conditions on sample results. Review field reports to identify whether any unusual conditions were present and how the sampling plan was executed.	Weston Field Team, Weston Site Manager
Comparability	Ensure that results from different data collection events achieve an acceptable level of agreement.	Weston Project Chemist
Completeness	Evaluate the impact of missing information. Ensure that enough information was obtained for the data to be usable (completeness as defined in the PQOs documented in this UFP-QAPP).	Swift River Field Team, Swift River Site Manager, Weston Project Chemist
Critical samples	Establish that critical samples and critical target analytes, as defined in the UFP-QAPP, were collected and analyzed. Determine whether the results meet criteria specified in the UFP-QAPP.	Swift River Field Team, Swift River Site Manager, Weston Project Chemist
Data restrictions	Describe the exact process for handling data that do not meet project DQOs (i.e., when MPC are not met). Depending on how those data will be used, specify the restrictions on use of those data for environmental decision making.	Swift River PM, Swift River Field Team, Weston Project Chemist
Usability decision	Determine whether the data can be used to make a specific decision considering the implications of all deviations and CAs.	Swift River PM, Swift River Field Team, Weston Project Chemist
Usability report	Discuss and compare overall precision, accuracy/bias, representativeness, comparability, completeness, and sensitivity for each matrix, analytical group, and concentration level. Describe limitations on the use of project data if criteria for DQIs are not met.	Weston Project Chemist

Notes:
Information in this table reflects general data usability considerations.

CA	corrective action	PM	Project Manager	Swift River	Swift River Environmental Services, LLC
CoC	chain-of-custody	PQO	project quality objective	UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
DQI	data quality indicator	QC	quality control		
MPC	measurement performance criteria	SOP	standard operating procedure	Weston	Weston Solutions, Inc.

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APPENDIX A

FIELD STANDARD OPERATING PROCEDURES

Provided on CD

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SOP INDEX

Note: The above listed SOPs may contain and describe more procedures and/or equipment than anticipated to be used on this project; however, these are deliberately left in to accommodate the potential for changing field conditions.

SOP – 01 Logbook Documentation and Field Notes

PURPOSE

This SOP provides criteria for the content and format of field logbooks.

SCOPE

This procedure applies to all Swift River team personnel and subcontractors engaged in note taking and data collection to be recorded in field logbooks for project in Alaska. The field documentation will be recorded per the following ADEC documents:

- *Draft Field Sampling Guidance* (ADEC, 2010)
- *Site Characterization Work Plan and Reporting Guidance for Investigation and Contaminated Sites* (ADEC, 2009)
- *Underground Storage Tanks Procedures Manual; Guidance for Treatment of Petroleum-Contaminated Soil and Groundwater and Standard Sampling Procedures* (ADEC, 2002)

GENERAL

An essential part of any environmental field project is proper documentation. The primary form of documentation used to record site data is the field logbook, which describes the history of field activities. This record of field activities is necessary to demonstrate that the data have been obtained according to required procedures. The logbooks may be used as evidence in legal proceedings to defend procedures and techniques employed during site investigations. As a result, it is important that documentation be factual, complete, accurate, consistent, and clear.

DOCUMENT SOURCES

Field documents consist of the following hard copies or electronic types:

- Field notebooks
- Field datasheets
- Soil boring logs
- Field calibration sheets
- Photographs and photographic logs
- Global positioning system (GPS) and Geographic Survey Coordinate Data
- Field instrument data (such as water-quality instruments, PID units, and test kits)
- Laboratory chain-of-custody forms
- Shipping waybill and manifest documents
- Field health and safety records

RESPONSIBLITIES

Site Personnel

All site personnel who make logbook entries are required to read this procedure before engaging in this activity. The Field Team Lead will inform personnel who will be responsible for field notebook and form entries, care, and maintenance.

FIELD NOTEBOOK PROCEDURE

Front Cover

Field notebooks will be bound with lined, consecutively numbered pages. Record the following information on the outside front cover of all field notebooks:

- Project name
- Client name and contract number
- Logbook activity title (such as “Drilling and Soil Sampling” or “Groundwater Sampling”)
- Project number

Project Contact Information

Reserve Pages 1 and 2 of the field notebook for project related contacts (such as contact names and phone numbers of subcontractors, project assistance, field team, and emergency use) and special instructions.

Daily Entries

Following the Project Contact Information, enter details of all field activities, events, data, and other relevant project task information daily (at minimum), throughout the course of field activities.

Enter daily activities within field notebooks according to the following minimum requirements:

- Record the <u>**field activity and date**</u> at the top of each page.

- Consecutively number the top of page corner of each page (if logbook is not already numbered).

- Precede all entries in the field logbook with the time, written following the 24-hour clock (0915, 1320, and similar). Record the time frequently and at the point of events or measurements that are critical to the activity being logged.

- Make entries in waterproof ink (unless inclement weather prevents pens from working).

- Write entries clearly and legibly enough so that any reviewer can read and understand the entry.
- Draw a diagonal line or similar through any space left at the bottom of the last page of field entries at the conclusion of daily site activities.
- Sign and date the bottom of each page.
- Do not remove any pages from the field logbook.

At a minimum, record events and observations according to the following:

- Current weather and any changing weather conditions that might impact field activities.
- The location(s) and field conditions in which the field task will be conducted.
- The names and organization(s) of all task field staff and/or visitors, including the field team lead, subcontractors, clients, and regulators.
- Site conditions (upon arrival and departure) and any changes in site conditions.
- All relevant field observations, major task decisions, comments, or other valuable site investigation information throughout the course of the site activities (make entries as specific and detailed as possible and practical).
- Reference to relevant documentation type and/or forms (for example, field datasheets, soil boring log sheets, photographs, or sample location coordinates) specified by another SOP (do not duplicate information; include references only).
- Documentation of field instrument calibration or reference to any appropriate field calibration sheets.
- Field map sketches drawn with a North arrow and approximate scale.
- Boring or sample locations with measurements (swing ties) to at least two fixed objects to locate points for mapping.
- Changes and/or deviations from task protocols (such as sampling procedures) outlined in any governing planning documents.
- Reason(s) for any noted deviations, and whom the deviations was discussed with and authorized by.
- Any problems, downtime, or delays and the reasons for the problem or delay.
- Upgrade or downgrade of personal protective equipment.

- All equipment make, model, and property numbers or serial numbers used at the site.
- Health and safety monitoring equipment, including calibration procedures and results and actual and background readings.
- Start and end times of sampling.
- Sampling steady-state parameters or reference to applicable datasheet.
- Decontamination times and methods.
- Type, amount, and disposal methods used for any IDW.

Field Datasheets and Forms

Other unbound data documentation types (including field datasheets, soil boring/test pit log sheets, field calibration sheets, photographic logs, laboratory chain-of-custody forms, shipping waybill and manifest documents, field health and safety forms and similar documents) are part of the field form records. Generally, the use of these documentation types is task-specific and, when used, should be referenced within the field logbook. However, specific data entered on these types of documents will not typically be documented in the logbooks; perform document handling and archiving in the same manner as the logbooks.

Electronic Data Documents

Electronic data documents consist of photographs, GPS and survey coordinate data, field instrument data, and other electronic data files. Investigation field instruments and tools such as digital cameras, GPS units, water quality meters, PIDs, pressure-transducers, and hand-held computers all store investigation data in electronic formats that can be later downloaded and stored electronically for future reference. Take care when retrieving, storing, and managing these electronic data. Consult the field team lead or designee for electronic data management instruction before using any unfamiliar electronic instrument or tool requiring electronic data retrieval and storage. At a minimum, manage electronic data documents according to the following:

- After collection, retrieve (download) all electronic data from the field instrument daily and store all electronic data files at a digital location specifically reserved for that data document type. Store the data at a location that can be readily accessed by multiple team members as necessary (that is, on a Swift River project server for file transfer protocol [FTP] site).
- Back up all electronic data documents on a USB drive for use in the event of data loss.

- Name electronic files appropriately to easily identify the content and data of collection or download (for example, **TO#0001_EAS_(insert site)_FieldNotes_(insert your initials].pdf**).

DOCUMENT CONTROL

At the conclusion of a task or when a field document is completed, submit all field documentation for records retention. Keep all documents in the project files. Project personnel may keep their own duplicate files, but all original documents will be placed in the official project file. Field or boring logs, sampling, and well installation activities will be maintained by the field team lead and submitted to the PM after field efforts.

REFERENCES

Alaska Department of Environmental Conservation (ADEC), 2010. *Draft Field Sampling Guidance.* May.

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SOP – 02 Sample Handling and Chain of Custody

PURPOSE

This SOP outlines protocols for sample handling and chain of custody. Laboratory provided chain-of-custody forms will be used.

SCOPE

This SOP applies to all Swift River team personnel and subcontractors engaged in collecting and handling environmental samples on AFCEC projects in Alaska, and was developed using the following ADEC documents:

- *Draft Field Sampling Guidance* (ADEC, 2010)
- *Underground Storage Tanks Procedures Manual: Guidance for Treatment of Petroleum-Contaminated Soil and Groundwater and Standard Sampling Procedures* (ADEC, 2002)

This SOP focuses on the most commonly used environmental sampling handling and custody tracking tasks and applications anticipated and should be used in conjunction with other applicable project SOPs, including the following:

- *SOP-01, Logbook Documentation and Field Notes*
- *SOP-08, Groundwater Well Sampling*
- *SOP-09, Surface Water Sampling*
- *SOP-11, Hydropunch Groundwater Sampling*
- *SOP-16, Surface and Subsurface Soil Sampling*
- *SOP-17, Sediment Sampling*
- *SOP-18, Boring Log Completion, Soil Classification and Logging*
- *SOP-25, Drum Classification, Removal, and Disposal*

Qualified persons, as defined by 18 AAC 75.990(100), will be engaged in or directly supervise the collection and handling of environmental samples (i.e., Project Manager, Site Manager, Field Team Lead, Project Chemist, Field Sampler).

GENERAL

An essential part of the sampling activities of any environmental project is assuring the integrity of the samples from collection through data reporting. Sample labels and chain-of-custody forms are used to document identification and handling of samples from the time of collection through the completion of chemical and/or physical analysis. Documentation of the history of a sample will be prepared and maintained to demonstrate that the data are a true representation of the environmental media. In some projects, analytical data may be used in litigation. The chain-of-custody record is used as evidence in legal proceedings to demonstrate that a sample was not tampered with or altered in any way that may bias the analytical accuracy of the laboratory results. It is extremely important that chain-of-custody records be complete, accurate, and consistent.

RESPONSIBILITIES

Project Manager

The Project Manager is responsible for providing adequate resources and verifies that field staff has adequate experience and training to successfully comply with, and execute, project specific SOPs and implement the project HSE program. The Project Manager will solicit the appropriate technical expertise and adequately identify the best methods and technology for the job given the current understanding of the site and project goals. In addition, the Project Manager should be consulted if any complications arise with following these critical sample handling and custody procedures.

Site Manager

The Site Manager coordinates and schedules daily field activities. In addition, the Site Manager verifies compliance with this SOP and ensures that all field staff engaged in this activity are trained in this SOP.

Project Chemist

The Project Chemist should verify that the systems are maintained to create chain-of-custody forms from the Sample Tracking and Scheduling Program. The Sample Tracking and Scheduling Program is a database that has the sample identification and sample analytes entered into it from and site specific field sampling plans.

The Project Chemist should alert the laboratory that samples have been shipped, and follow up with the laboratory to verify that samples have been received in compliance with paperwork and temperature requirements. The Project Chemist should also confirm with the laboratory any special analytical requests (such as rapid turnaround times).

Health and Safety Manager

The Health and Safety Manager oversees site specific HSE requirements and verifies overall compliance with the project HSE requirements. The Health and Safety Manager conducts HSE evaluations, selects the appropriate safety procedures for the project, lists the requirements in the project specific HASP, and coordinates with the Site Manager to complete and certify the HSE program.

Field Team Lead

The Field Team Lead maintains compliance with sample handling and custody requirements, particularly the procedures to be used. The Field Team Lead should know the requirements of sampling handling and custody, and should maintain adequate documentation of sampling shipping activities. The Field Team Lead must be aware of these sampling handling procedures and schedule accordingly, taking into account that sample packing and custody requirements or potentially hazardous samples that may require more time and materials (ex. properly labeled paint cans and manifests) than handling nonhazardous samples. The Field Team Lead should take responsibility for correctly completing chain-of-custody forms and for coordinating with the Project Chemist to successfully handle, packaging, and shipping of samples as described *SOP-01*, *Packing and Shipping of Environmental Samples.* The Field Team Lead should also determine or seek guidance as to which samples are potentially hazardous and handle them accordingly.

Field Sampler

The Field Sampler, under the supervision of the Field Team Lead (who may be the same person), confirms that samples are correctly collected, labeled, tracked by chain of custody, and sorted until they are delivered to the Field Team Lead, laboratory, or carrier that will transport them to the laboratory. The Field Sampler maintains custody of the samples until they are relinquished to the Field Team Lead, laboratory, or transport carrier. The Field Sampler informs the Field Team Lead and/or Project Chemist of Sampling conditions and if any of the samples are potentially hazardous.

The Field Sampler produces chain-of-custody forms and sample labels for field samplers, and verifies that all information, including labels and chain-of-custody forms, is correct. Labels and chain-of-custody forms are typically generated by the Sample Tracking and Scheduling Program, which the Project Chemist manages. Once the information is entered, the Field Sampler generates labels and chains of custody based upon specifications in the site-specific field sampling plans.

Sample Custodian

The Sample Custodian is any individual who is responsible for the custody of samples and completion of associated documentation.

PROCEDURES

Sample Custody

Follow procedures to preserve and verify the integrity of all samples from the time of collection through analysis. A critical aspect of sample collection and analysis protocols is the maintenance of strict chain-of-custody procedures, as described in this technical procedure. Chain-of-custody procedures include tracking and documentation during sample collection, shipment, and laboratory processing.

A sample is considered to be in an individual’s custody if any of the following apply:

1. It is in the physical possession of the responsible party.
2. It is in view of the responsible party after being in their possession.
3. It is placed in a designated, secure area that is controlled and restricted by the responsible party.

Maintain records of the custody of samples, both in the field and in the laboratory. Document custody throughout all sampling activities on the chain-of-custody record for each day of sampling, and verify that this record accompanies the samples from the site to the laboratory. Transfer sample custody according to **Transfer of Custody and Shipment** section below.

Ship samples to subcontractor laboratories via expeditor or air courier. Use air waybills as custody documentation during this time; they should be retained as part of the permanent sample custody documentation. If the situation warrants, hand-deliver samples to an on-site field laboratory; in these cases, note the hand delivery on the chain-of-custody form.

Place custody seals across the front and back edges of each sample cooler lid to maintain its integrity during shipping until it is opened by the laboratory, according to *SOP-07, Packing and Shipping of Environmental Samples.* In addition, seal sample coolers with a custody seal any time they are not in possession or view before shipping. The responsible sampling custodian should sign and date all custody seals.

The laboratory (TestAmerica) is responsible for sample custody after receiving samples. Custody must be maintained at the laboratory once samples are received until all tests are completed. This will be accomplished using an internal custody system that requires samples to be kept in a secured and restricted area when not in use, and to be checked out and checked back in by the analysts who use them. Internal custody records must be maintained by the laboratory as part of the documentation file for each sample.

Transfer of Custody and Shipment

All personnel with sample custody must sign, date, and record the time on the chain-of-custody form when receiving and relinquishing samples from their immediate custody. Note any discrepancies at this time. If the samples must be shipped, the Project Chemist will notify the laboratory project manager or coordinator of when and how the samples were shipped. Notification will include the following information:

- Date of shipment
- Name of shipping company
- Air waybill number
- Number of coolers
- Name and phone number of point of contact
- Estimated date of shipment arrival

- Type of samples (water, sediment, or soil)

Upon receipt of each sample cooler and after verification of chain-of-custody records, the laboratory will provide a cooler receipt form documenting any discrepancies such as, but not limited to, the following:

- Inappropriate sample containers or preservation
- Broken sample containers
- Cooler temperature outside range of 2 to 6 °C (where applicable)
- Missing chain-of-custody form or QA sample form
- Errors on chain-of-custody or QA sample form
- Missing and broken custody seals

The laboratory should notify the Swift River team of any such discrepancies within 24 hours of its receipt of the samples.

Laboratory Sample Custody Procedures

A designated sample custodian will receive the samples and verify that they match those on the chain-of-custody record. The condition, temperature, and preservation of the samples shall be checked and documented on the chain-of-custody form. The occurrence of any anomalies in the received samples and their resolution shall be documented in the laboratory records. All sample information shall then be entered into a tracking system, and unique analytical sample identifiers shall be assigned. A copy of this information shall be reviewed by the laboratory for accuracy.

Sample holding time begins with the collection of samples and continues until the analysis is complete. Holding times for analytical methods required for this project are specified in Worksheet #19. Analyses shall be documented with the chain-of-custody form. Procedures ensuring internal laboratory chain of custody shall also be implemented and documented by the laboratory. Specific instructions concerning the analysis specified for each sample shall be communicated to the analysts. Analytical batches shall be created, and laboratory QC samples shall be introduced into each batch.

Samples shall be stored in limited-access, temperature-controlled areas. Refrigerators, coolers, and freezers shall be monitored for temperature 7 days a week or during use. Acceptance criterion for the temperature of the refrigerators and coolers is 4±2°C. Acceptance criteria for the temperature of the freezers shall be lower than -7°C. All of the cold storage areas shall be monitored by thermometers that have been calibrated with a National Institute of Standards and Technology (NIST)-traceable thermometer. As indicated by the findings of the calibration, correction factors shall be applied to each thermometer. Records that include acceptance criteria shall be maintained.

Samples for VOC analysis shall be stored separately from other samples and/or sample extracts. Refrigerators storing VOC samples shall contain a blank that is analyzed at a minimum of every

2 weeks. Samples shall be properly stored after analysis until disposed. The samples will be disposed of in accordance with applicable local, state, and federal regulations. Disposal records shall be maintained by the laboratory. SOPs describing sample control and custody shall be maintained by the laboratory.

Chain-of-Custody Record

Chain-of-custody forms document sample collection and shipment to the laboratory. Chains of custody are legal documents that record the transfer and disposition of collected environmental samples. The chain-of-custody form will identify the contents of each shipment and maintain the custodial integrity of the samples. Fill out chain-of-custody forms at each sampling location for each sample/analysis to maintain a record of sample collection, transfer of samples between personnel, shipment of samples, and receipt of samples at the laboratory. The Field Sampler will generate the chain-of-custody form using the Sample Tracking and Scheduling Program, or by hand on laboratory provided forms.

Information entered by the Project Chemist includes the following:

- Project Name and project number
- Name, address, and phone number of the laboratory to receive the samples
- Chain-of-custody control number
- Sample type/sample collection method
- Location ID
- Unique sample ID
- Matrix type
- Analytical methods requested
- Field duplicate, if applicable
- Field QC for MS/MSD samples, if applicable
- Container type, size and number
- Preservatives used
- TAT for laboratory analysis
- Air waybill number or Bill of Landing number
- Special instruction or comments to laboratory or Field Sampler, if applicable

The Field Team Lead or Field Sampler will enter the following information using indelible black or blue ink:

- Date of sample collection
- Time of sample collection (in 24-hour military format)
- Depths, if applicable sampler’s initials
- Void reason, if applicable
- Special instructions or comments to laboratory or Field Sampler, if applicable

The Field Team Lead and Project Chemist should verify that the chain-of-custody record is complete, accurate in all aspects, and consistent with all other sample documentation (for example, number of samples, sample labels, and field logs). The Field Sampler or Field Team Lead will sign the “Sampled By” and “Relinquished By” fields on the chain-of-custody record, marking the date and time of custody is transferred to the laboratory, transport carrier, or other authorized person.

The Field Team Lead or Field Sampler will perform the following duties:

- Obtain the signature of the Field Sampler or Field Team Lead to transfer sample custody
- Prepare the samples for shipment from the field to the laboratory
- Record the carrier service and air waybill number on the chain-of-custody form
- Sign and enter the date and time relinquished to the expeditor or air carrier

Every transfer of physical custody shall be documented on the chain-of-custody record.

Make any corrections to the chain-of-custody form entries by creating a single-line strike mark through the incorrect item, and then entering the correct entry adjacent to the strikeout item according to *SOP-01, Logbook Documentation and Field Notes*. The person making the change will initial and date corrections. After the form has been inspected and determined to be satisfactorily complete, the Field Team Lead or Field Sampler will sign, date, and note the time of transfer and will reference a shipper tracking number (such as an air waybill number) on the form.

Complete chain-of-custody forms in duplicate for each sampling event, at a minimum. Deliver the original, completed chain-of-custody form with the sample shipping cooler, and retain a field copy (such as a carbon copy, PDF, or photocopy) in the field project files. Place the original chain-of-custody form in a re-sealable plastic bag and place it inside the cooler according to *SOP-07, Packing and Shipping of Environmental Samples.*

Sample Labels

Attach sample labels to all sample containers at the time of sample collection. Generate the label along with the chain-of-custody form using a Sample Tracking and Scheduling Program, or similar appropriate database method, depending on the sample container. For certain types of samples (such as Summa gas canisters), use the blank labels provided by the laboratory when the lab provides sample containers. Verify that labels generated by the Sample Tracking and Scheduling Program are preprinted with the following information:

- Project name and number
- Unique sample ID
- Site
- Sample location
- Matrix

- Container
- Laboratory
- Preservative used
- Number of containers
- Analytical methods requested

Handwrite the same information listed above on labels not preprinted by the Sample Tracking and Scheduling Program, if necessary.

When the sample collection is complete, the Field Sampler fills in the following information in indelible waterproof ink:

- Date and time of sample collection
- Sampler's initials

Once complete, cover the sample labels with clear tape, unless the sample container is pre-weighted for laboratory analysis (such as for GROs, VOCs, or VPHs), and prepared for shipment following *SOP-07, Packing and Shipping of Environmental Samples.* Follow laboratory specified procedures identified by the Project Chemist, Site Manager, or Field Team Lead for labeling for other types of containers, such as soil gas and air samples.

Sample Identification

Verify that all samples are identified with a unique naming convention that identifies the sample area, location type, location number media matrix, sample depth, and any special designation (for example, MS/MSD samples). Identify samples using the following sample naming convention:

YYSITEFREQ-LOC(or QC)##(A)-MEDIA-0/1

- YY = year (12 for 2012, 13 for 2013, etc.)
- SITE = Site ID (CG509, ST041, DP098, XU022, etc.)
- FREQ = Frequency of sampling (Q1 for first quarter, etc.)
- LOC(or QC)## = The sample number based on its location or whether it is a QC blank (41755WL01 for monitoring wells, SB01 for soil boring, TB01 for trip blank, EB01 for equipment blank, etc.)
- (A) = Depth of sample based on interval from which it is collected (A for 0-5 feet bgs, B for 5-10 feet bgs, etc.)
- MEDIA = GW for groundwater, SO for soil, SW for surface water, SD for sediment, DR for drum sample etc.
- -0/-1 = 0 for primary samples and 1 for field duplicates

Sample Handling and Storage

Take care when handling environmental samples. Handle samples only while wearing new, disposable nitrile gloves, and keep empty sample containers and collected samples clean, dry and away from potential cross-contaminant sources (such as vehicle exhausts, fuel sources, and contaminated equipment). Transport collected samples separately from other sampling equipment and tools, and store the transfer samples in an upright position and sealed tightly. Handle and preserve all samples according to the preservation and holding times summarized in Worksheet #19.

If samples cannot be shipped immediately to a laboratory and must be temporarily stored until arrangements can be made for delivery, place the samples in a secured Swift River facility area with sufficient refrigeration or ice in order to maintain 2 to 6 °C storage temperatures (if required for preservation of the samples). Verify that a temperature blank and chain-of-custody form accompanies samples during storage. Samples may be stored in a secure, temperature-controlled refrigerator as long as reliable power is provided to the refrigerator and the refrigerator is designed for environmental samples only. Do not store samples in refrigerators potentially used for food storage. Use storage custody seals to maintain sample security in refrigerated storage.

Samples temporarily stored overnight must be received by the custodian that placed them in storage, and may in turn be relinquished to the appropriate laboratory, or another sample custodian. Record each transfer of custody on the appropriate laboratory, or another sample custodian. Record each transfer of custody on the appropriate chain-of-custody form(s).

RECORDS

Record sample handling and custody information in a field logbook and on a chain-of-custody form according to *SOP-01, Logbook Documentation and Field Notes*. Complete chain-of-custody forms, air waybills, and any other shipping documentation according to SOP-07 and retain a copy in the project files.

REFERENCES

Alaska Department of Environmental Conservation (ADEC), 2010. *Draft Field Sampling Guidance.* January.

ADEC, 2002. *Underground Storage Tanks Procedures Manual; Guidance for Treatment of Petroleum-Contaminated Soil and Groundwater and Standard Sampling Procedures.* November.

American Society for Testing and Materials (ASTM), 1999. *Standard Guide for Sampling Chain-of-Custody Procedures.* ASTM Standard D4840. December.

United States Environmental Protection Agency (EPA), 1996. *Sampler's Guide to the Contract Laboratory Program. Office of Emergency and Remedial Response.* EPA/540/R-96/0. December.

EPA, 1994. *User's Guide to the Contract Laboratory Program.* Office of Emergency and Remedial Response. EPA/540/R-941/013. February.

DEFINITIONS

- air waybill – The shipping document that identifies the sender and addressee, transport carrier, size, and priority of a shipment transported by aircraft.
- custody – Physical possession or control. A sample is under custody if it is in possession or under control so as to prevent tampering or alteration of its characteristics.
- sample label – A record attached to samples to verify legal documentation of traceability.
- chain-of-custody form – A legal document that records the transfer and disposition of collected environmental samples (Appendix C).
- sampling tracking and scheduling program – A database program that the Project Chemist uses to record and track field sample collection. The program is also used to generate chain-of-custody forms before and after sample collection.
- turnaround time (TAT) – The duration for laboratory sample analysis from the time the sample receiving to the time a laboratory data report is produced.

SOP-03 Utility Clearance

PURPOSE

This SOP describes procedures for positively identifying and verifying the location of aboveground and buried utility lines in and around proposed work areas. The purpose of this SOP is to establish operating requirements that will permit personnel to work safely in the vicinity of electrical, gas, steam, fuel, water/sewer, and other utilities and utility installations. A secondary purpose is to prevent damage and disruption to existing utilities.

SCOPE

This procedure applies to Swift River team personnel engaged in utility clearance to support AFCEC projects in Alaska. Utilities covered under this SOP include overhead, surface, and subsurface, and utilities imbedded in floors, walls, and ceilings.

The term “clearance” indicates the following:

- The positive locating of utility systems in or near the work area.
- A signed statement by an appropriate representative attesting to the location of underground utilities and the positive de-energizing (including lockout) and testing of electrical utilities that may be encountered.

Utility clearance is required before conducting any of the following work:

- Intrusive work of any nature, including but not limited to, excavation, drilling, trenching, installing soil boreholes or Hydropunch boreholes, or penetrating the components of a building structure.
- Use of heavy equipment or undertaking raising or hoisting operations.
- Work in the vicinity of electrical lines or utility installations.

All utility clearance should at a minimum be conducted in accordance with Alaska Statute Title 42, Chapter 30 Public Utilities and Carriers; and if in Anchorage, Anchorage Municipal Code, Chapter 26, Damage to Underground Utility Facilities (Alaska Statutes, 2009; Anchorage Municipal Code, 2010) and the Occupational Safety and Health Administration (OSHA) standards for selection and use of electrical work practices (1910.333), excavation (1926.650 through 1926.652), and overhead lines (1926.955). Intrusive work must be coordinated through the Base Civil Engineer Work Clearance Request Form located in Appendix D.

GENERAL

Identify all utilities that may be affected by proposed activities. Be sure to collect sufficient information to verify that field operations maintain the required separations from utilities and that site safety requirements are reflected in project planning documents. This approach will also prevent data gaps that may result from utility conflicts.

The potential for encountering unknown utilities is a hazard to be recognized. This SOP is to be used in conjunction with the project-specific HASP and the GIF Utility Clearances Safety Management Standard provided below.

Make all inquiries regarding electrical utilities in writing using a Base Civil Engineer Work Clearance Request Form and wait to receive written confirmation of the utility clearance before the start of work. The use of as-built drawings to locate subsurface utilities for clearance will require independent confirmation by land survey or geophysical methods. Clearly mark the location and orientation of all subsurface utilities on the closest surface, maintain those markings during performance of site work.

RESPONSIBILITIES

Site Manager

The Site Manager verifies that utility clearances are obtained for all areas before field activities commence. The Site Manager is also responsible for ensuring that crews are trained in this procedure.

Field Team Lead

The Field Team Lead, or their designee, verifies that utility clearances are obtained for any work described above before field activities begin. In addition, the Field Team Lead, or designee, will confirm that all utility clearance documentation is complete, the documentation is available on-site during field activities, and all site personnel have been briefed on the location of site utilities.

Health and Safety Manager

The Health and Safety Manager is responsible for providing guidance and approval for all activities involving utility clearance.

PROCEDURES

Preparation and Initial Notification

1. The USAF and other necessary installation organizations will be contacted at least 10 business days prior to any intrusive activities to begin to obtain necessary utility locate and dig permits required on USAF property. The installation RPM will be contacted prior to beginning the dig permit and utility locate application process to clarify the necessary application steps and points of contact to complete the required Base Work Clearance Request Form.

2. **Call the Alaska Dig Line**. This is the initial notification. Alaska law requires that locates be completed within two working days, or within 10 working days in remote areas, from the date of request. Note that not all public utilities and often most private utilities are not included in the Alaska Dig Line notification list of utility organizations. Membership in the Alaska Dig Line Utility Locates is voluntary. When an Alaska Dig Line request is initiated, the operator will list the member utilities that will be notified. If not, ask for a copy of the member utility list. Therefore, depending on the locate

location, it may be necessary to independently contact individual non-member utility service providers in the area to conduct utility locates.

Alaska Dig Contact Information

Telephone numbers: 811 or (800) 478-3121 or (907) 278-3121

Fax: (907) 334-1480 or (907) 278-0696

Email: Icc@akonecall.com

Website: http://www.akonecall.com/index.htm
Visit their Alaska Dig Line website and complete an E-ticket.

3. Initiate a utility locate form for each site or contiguous group of sites. The utility locate form should be completely filled out to include the following:

    a. A description of the lateral extent of the work area

    b. A sketch or map of the areal extent of the work area (if possible)

    c. The type of work being conducted

    d. For intrusive work the proposed location and depth

    e. Notes regarding the review of as-built drawings

    f. Notes of interviews with facility owners, occupants, or employees

    g. The name of the facility manager/owner or other points of contact

    h. The owner of any utilities at or adjacent to the work site

    The utility locate form is to be routed to the Alaska Dig Line when completing a Base Civil Engineer Work Clearance Request Form and provided to the owner, manager, and users of affected facilities. The date of an on-site locate is to be established and shared with the facility manager and owners.

Initial Utility Locate and Survey

With utility representatives, complete an initial utility locate and survey to physically locate known utilities. Participants may include the facility owners, mangers, employees, representatives of the site utility owners, subcontractors, and others. Review site activities and the extent of intrusive activities. While on-site, review as-built drawings and identify surface features.

As needed, discuss potential utility outage requirements and complete an inventory of affected facilities. Identify outage notification requirements and lead times.

Identify and document potential lockout/tagout locations, procedures, outage notification and lead time requirements. When information is insufficient, it is important that the potential for concealed utilities are in the area be identified, and actions necessary to protect the affected systems be discussed and identified in the utility clearance form.

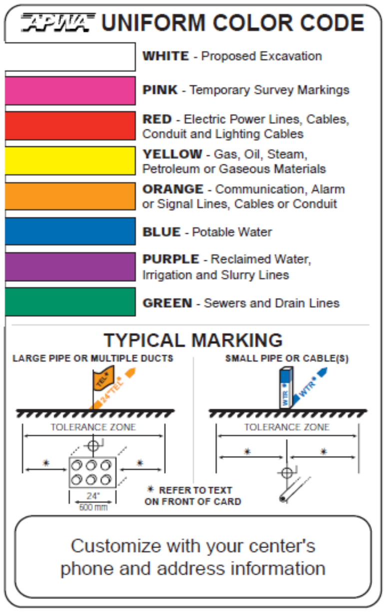
Utility Verification

Verification of utilities by geophysical and/or a survey by a licensed land surveyor is required when utility location information is limited to as-built drawings or the location of features such as valve boxes, manholes/handholes, and conduit and electrical components observed n the field. Geophysical methods may include toning, ground-penetrating radar, pipe and cable location, electromagnetic survey, and magnetometry. The Field Team Lead or designee should be present during work conducted for the purposes of utility verification.

A licensed land surveyor will survey the location of subsurface or concealed utilities on as-built drawings or apparent only through visual observations of surface features; the survey should achieve a horizontal and vertical accuracy of 0.1 feet.

Field Markings

Mark the presence and type of buried utilities on the ground according to American Public Works Association (APWA) color coding:



APWA UNIFORM COLOR CODE

WHITE - Proposed Excavation
PINK - Temporary Survey Markings
RED - Electric Power Lines, Cables, Conduit and Lighting Cables
YELLOW - Gas, Oil, Steam, Petroleum or Gaseous Materials
ORANGE - Communication, Alarm or Signal Lines, Cables or Conduit
BLUE - Potable Water
PURPLE - Reclaimed Water, Irrigation and Slurry Lines
GREEN - Sewers and Drain Lines

TYPICAL MARKING

* REFER TO TEXT ON FRONT OF CARD

Customize with your center's phone and address information

White – Proposed excavation/work location

Pink – Temporary survey markings

Red – Electric power lines, cables or conduits, and lighting cables

Yellow – Gas, oil, steam, petroleum or other hazardous liquid or gaseous materials

Orange – Communications, cable TV, alarm or signal lines, cables, or conduits

Blue – Potable water

Purple – Reclaimed water, irrigation and slurry lines

Green – Sewers, storm sewer facilities, or other drain lines

It is the responsibility of the Swift River Team to protect and preserve the markings of approximate locations of facilities until the markings are no longer required for safe and proper excavations or survey. If the markings of utility locations are destroyed or removed before activities commence or is completed, the Project Manager must notify the utility company or utility protection service to inform them that the markings have been destroyed. Note that under Alaska state law, there is no charge to the excavator for the first underground facility marking before excavation on a project. Subsequent requests will be charged.

Positive Response

Utilities in Alaska do not have "positive response" and therefore the Alaska Dig Line or utility service providers may not confirm that the locate has been completed. **Locates are required by law to be completed in 2 working days, or within 10 working days in remote areas.**

Surface and Overhead Utilities

Note the presence of surface and overhead utilities and potential limitations and impact to site operations, as well as potential impacts to site operations and equipment requirements which may result.

For planning purposes, the minimum clearances from energized overhead lines are shown in the table below.

Powerlines Nominal System kV	Minimum Required Distance, Feet
0-50	10
51-100	12
101-200	15
201-300	20
301-500	25
501-750	35
751-1000	45

The minimum clearances for working near overhead power lines are as follows:

Nominal Voltage	Minimum Clearances
0 - 50 kV	10 feet or one mast length, whichever is greater
50 kV +	10 feet plus 0.5 inch for every 1 kV over 50 kV or 1.5 mast lengths, whichever is greater

Site Operations

Before initiating site operations, the FTL will verify that a Base Civil Engineer Work Clearance Request Form (Appendix D) is completed and includes signatures from appropriate representatives. In addition, the utility locate form and base civil engineer work clearance request must be available on-site during work activities.

Brief personnel working on-site on the location and status of utilities that may potentially be affected by site activities. The briefing should include the hazards associated with working near the utilities and the means by which the operation will maintain a safe working environment.

The Field Team Lead should verify that work is planned and conducted according to the project-specific HASP and the *GFI Utility Clearances Safety Management Standard* presented below.

RECORDS

The following records are found in Appendix D of this UFP-QAPP and are to be maintained in the project file and on-site during work activities:

- Utility Locate Request Form
- Base Civil Engineer Work Clearance Request Form with signatures of the required parties
- A completed Building Penetration Permit if work includes attaching fasteners to or otherwise penetrating any building components such as floors, walls, decks, and ceilings

REFERENCES

Alaska Statutes. 2009. Alaska Statutes Title 42, *Chapter 30 Public Utilities and Carriers*.

Occupational Safety and Health Organization (OSHA). 1910.333 – Selection and Use of Work Practices in Subpart S – Electrical.

Occupational Safety and Health Organization (OSHA). 1926.650 through 1926.652 – Excavations.

Occupational Safety and Health Organization (OSHA). 1926.955 – Provisions for Preventing Accidents Due to Proximity to Overhead Lines.

SOP-04 Site Reconnaissance, Preparation, and Restoration

PURPOSE

The SOP sets programmatic criteria to support proper planning for sites before field activities, and establishes expectations for restoring sites to satisfactory conditions upon completion of field activities.

SCOPE

This procedure applies to all Swift River team personnel engaged in site reconnaissance, preparation, and restoration for projects in Alaska.

GENERAL

An essential component of the fieldwork portion of any environmental project is proper planning before field activities. Site reconnaissance (when possible) should be conducted during the planning stages of a project to ensure that there are no site-specific conditions that will need to be addressed before or during field activities. In addition, the site reconnaissance visit should be used to consider staging areas and to notify potentially impacted community members before starting field activities.

RESPONSIBILITIES

This section outlines the responsibilities of Field Team Leads and Site Personnel under this SOP.

Project Manager

The Project Manager is responsible for providing adequate resources and verifies that field staff has adequate experience and training to successfully comply with, and execute, project-specific SOPs and implement the project HSE program. The Project Manager will solicit the appropriate technical expertise and adequately identify the best methods and technology for the job given the current understanding of the site and project goals. In addition, the Project Manager should be consulted if any complications arise with following these critical sample handling and custody procedures.

Site Manager

The Site Manager coordinates and schedules daily field activities. In addition, the Site Manager verifies compliance with this SOP and ensures that all field staff engaged in this activity are trained in this SOP.

Health and Safety Manager

The Health and Safety Manager oversees site-specific HSE requirements and verifies overall compliance with the project HSE requirements. The Health and Safety Manager conducts HSE evaluations, selects the appropriate safety procedures for the project, lists the requirements in the project-specific HASP, and coordinates with the Site Manager to complete and certify the HSE program.

Field Team Lead

Each Field Team Lead, in conjunction with the Project Manager and Site Manager, is responsible for overall compliance with this technical procedure. The Field Team Lead is responsible for verifying that field preparation activities comply with these procedures.

Site Personnel

All site personnel who are involved in site reconnaissance, preparation, and restoration activities are required to read this SOP beforehand.

PROCEDURES

Site reconnaissance, preparation, and restoration procedures include pre-planning activities, site reconnaissance, housekeeping, traffic and public safety management, and restoration of the site to pre-work conditions.

Pre-planning Activities

Secure all necessary clearances and approvals before beginning fieldwork; if necessary, obtain written clearances and approvals. Determine vehicle access routes and keys or gate combinations to sampling locations and staging areas before any field activities. Survey areas designated for intrusive sampling for the presence of underground utilities. Conduct utility locations according to *SOP-04, Utility Clearance.*

Complete the following tasks before the beginning of field activities:

- Prepare a site-specific HASP.
- Perform a brief site reconnaissance
- Plan personnel and equipment mobilization
- Locate nearby essential facilities, such as communication and emergency facilities
- Verify that archeological monitoring and endangered species work approvals have been secured, if necessary (ask the PM)
- Mark and map proposed sampling locations

- Obtain all fieldwork permits

- Anticipate and document potential real property damage that could result from fieldwork, and how permanent damage will be mitigated

- Conduct physical clearance for utilities and, if necessary, unexploded ordnance

- Coordinate site access with operations such as Security, Liquid fuels, Base Operations, and Emergency Response (as necessary).

RECORDS

Documentation should follow guidelines contained in *SOP-01, Logbook Documentation and Field Notes.*

Layout and Marking of Sampling Locations

The primary means of laying out borings is using swing-tie measurements from existing site features (e.g., building corners, foundations, fencing, pavement corners, telephone/power poles, and fire hydrants). Mapping-grade GPS will be used (1) as a secondary measurement in cases where reliable site features are available and (2) as the primary means of measurement when they are not. In both cases, the user will verify that the positional dilution of precision **(**PDOP) at each investigation location is adequate (i.e., less than 5.0) and will document the PDOP in the field notebook. In addition, the locations of three nearby site features with known coordinates (e.g., monitoring wells) will be measured and documented in field notes, along with the PDOP at each location. GPS accuracy will be reviewed following each day of laying out borings. After the installation of soil borings/monitoring wells, a registered professional surveyor will survey the final locations.

Site Reconnaissance

Each field team member should bring the following items:

- Waterproof logbook
- Ink pens
- Digital camera
- Suitable clothing for rain or freezing weather

When conducting the site reconnaissance, pay particular attention to physical site features, such as locations and dimensions of buildings, and current site uses. For residences, schools, and daycare facilities, inquire about or estimate the number of people who may use each site. Record any observations that differ from available site maps (for example, demolished buildings).

Record all observations in a field logbook. Use the logbook to record such things as, but not limited to, the following:

- Visual observations of the site and its surroundings
- Descriptions of photographs taken
- Conversations with site personnel or neighbors
- Visits to local authorities and information obtained
- House counts and other observations related to potential exposure assessments
- Freehand site sketches

Record the time of day for each activity or observation entered. Complete the logbook in waterproof ink (unless inclement weather prevents pens from working). Ensure that each person who enters information into the logbook must sign and date after the last entry on the page.

At each site, document potential source areas, including location of tanks, floor drains, stained soil, or stressed vegetation, using color photographs. Take a series of photographs showing a panoramic view of the entire site. Document other aspects of the site such as fencing, proximity of residences, signs of current usage, and proximity to surface water.

Document all photographs in sequential order in the logbook or photo log form. For each site, generate a table with photograph number, time taken, description of subject, and direction the photograph was taken. Mark the location and direction of each photograph on the site sketch or map.

Document site features pertinent to contamination migration on the site sketch or map. Document the location and distance to nearby residences. Discuss typical use patterns with local authorities. Determine drinking water supply sources and location of any private wells, if located in the vicinity of the site.

Housekeeping

Maintain the site with good housekeeping at all times in all project work areas, according to the following guidelines.

- Establish common paths of travel and keep them free from spills and the accumulation of equipment and materials. Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions and slip hazards and adequately illuminated during work activities.

- **Store tools, equipment, materials, and supplies in an orderly manner.** Designate specific areas, as appropriate, for the proper storage of materials.

- Clean up spills and leaks quickly.

Traffic and Public Safety Management

If fieldwork is going to be conducted where traffic may pose a hazard (for example, in or on parking lots, roadways, or flight lines), implement traffic controls. Discuss traffic controls with the project-specific Health and Safety Officer before mobilizing to the field, and prepare a Team Traffic Control Checklist. Stage barricades, safety cones, and personnel as needed to direct traffic in an orderly and safe manner.

Be sure to address public safety during the planning phases of any field activities. If fieldwork is going to result in a temporary increase of noise in an area, notify residents and workers before the start of field activities. Mitigate public safety by setting up exclusion zones during field activities to protect the public from inadvertently becoming exposed to field equipment or potentially hazardous materials.

Restoration of Work Areas to Pre-fieldwork Conditions

Return each work site or sampling location as close to its original condition as possible. Make efforts to minimize impacts to work sites and sampling locations, particularly those in or near sensitive environments, such as wetlands or high-security areas. Following the completion of work at a site, remove and manage all IDW (such as drums, trash, and other waste) according to project requirements (ask the PM).

SOP-05 Packing and Shipping of Environmental Samples

PURPOSE

This SOP provides guidance for packing and shipping environmental samples in accordance with applicable transportation regulations and sample storage requirements.

SCOPE

This SOP applies to all Swift River team personnel engaged in the packing and shipping of environmental samples in Alaska. It is intended to comply with recommended practices in the following documents:

- *Draft Field Sampling Guidance* (ADEC, 2010)
- *Underground Storage Tanks Procedures Manual: Guidance for Treatment of Petroleum-Contaminated Soil and Groundwater and Standard Sampling Procedures* (ADEC, 2002)
- ASTM Standard D6911, *Standard Guide for Packing and Shipping Environmental Samples for Laboratory Analysis* (ASTM, 2003)

This SOP focuses on the most commonly used environmental sample packing and shipping tasks and applications and should be used in conjunction with other applicable project SOPs, including*:*

- *SOP-01, Logbook Documentation and Field Notes*
- *SOP-08, Groundwater Well Sampling*
- *SOP-09, Surface Water Sampling*
- *SOP-11, Hydropunch Groundwater Sampling*
- *SOP-15, Drilling Methods*
- *SOP-16, Surface and Sub-surface Soil Sampling*
- *SOP-17, Sediment Sampling*

This SOP describes shipping considerations, including preparation of shipping manifests and instructions on determining whether shipments are hazardous waste and need to be identified as Accepted Quantities or Dangerous Goods.

GENERAL

Proper shipment of environmental samples from the field to the laboratory is a critical part of sample management. If not packaged in accordance with this SOP, samples may reach the laboratory without proper documentation. In addition, the data quality of valuable environmental samples may be diminished or the samples may become unusable if they become warm and are received at the laboratory out of temperature compliance. Improper sample packing may also result in sample containers breaking, causing loss of data or data quality, compromising other samples within the shipment, or stopping or delaying the entire shipment because of leaking shipping containers.

If the articles or substances will be shipped by air, they must be properly identified, classified, packed, marked, labeled, and documented according to applicable regulations.

All sample shipments to be transported by air must meet the requirements of the IATA and the International Civil Aviation Organization for air transportation of dangerous goods (IATA, 2012). Anyone who violates the regulations for shipping articles or substances may be subject to civil or criminal penalties.

Complete an original manifest or shipping manifest (air waybill) to accompany each shipment. Original manifests or air waybills can be obtained either directly from the transporter or from the Swift River team's office.

RESPONSIBILITIES

Project Manager

The Project Manager is responsible for providing adequate resources and verifying that field staff have adequate experience and training to successfully comply with and execute project-specific SOPs and implement the project HSE program. The Project Manager solicits the appropriate technical expertise to verify that the project has identified the best sampling methods and technology for the job, given the current understanding of the site and project goals.

Site Manager

The Site Manager is responsible for the coordination and scheduling of daily field activities with the Field Team Lead. In addition, the Site Manager is consulted on decisions concerning shipping costs and any complications or uncertainties with following these procedures.

Field Team Lead

The Field Team Lead is responsible for verifying compliance with this SOP and that all field staff engaged in this activity have been trained in this SOP. The Field Team Lead, or designee, knows the requirements for packing and shipping samples and maintains adequate documentation of sample shipping activities. The Field Team Lead, in coordination with the sample shipper and Project Chemist, determines which samples are potentially hazardous and ships them accordingly. The Field Team Lead coordinates scheduling with the laboratories and the Project Chemist before each sampling event and before shipping samples. In addition, the Field Team Lead coordinates with the Project Chemist to verify that the samples have arrived at the laboratory without complications.

Project Chemist

The Project Chemist should verify that the systems are maintained to create chain-of-custody forms from the Sample Tracking and Scheduling Program. The Sample Tracking and Scheduling Program is a database that has the sample identification and sample analytes entered into it from and site specific field sampling plans.

The Project Chemist should alert the laboratory that samples have been shipped, and follow up with the laboratory to verify that samples have been received in compliance with paperwork and temperature requirements. The Project Chemist should also confirm with the laboratory any special analytical requests (such as rapid turnaround times).

Health and Safety Manager

The HSM is assigned to oversee the site-specific HSE program and verifies overall compliance with project HSE requirements. The HSM conducts HSE evaluations, selects the appropriate safety procedures for the project, identifies the requirements in the project-specific HASP, and coordinates with the Field Team Lead to complete and certify the HSE program.

Field Team Lead

The Field Team Lead maintains compliance with sample handling and custody requirements, particularly the procedures to be used. The Field Team Lead should know the requirements of sampling handling and custody, and should maintain adequate documentation of sampling shipping activities. The Field Team Lead must be aware of these sampling handling procedures and schedule accordingly, taking into account that sample packing and custody requirements or potentially hazardous samples that may require more time and materials (ex. properly labeled paint cans and manifests) than handling nonhazardous samples. The Field Team Lead should take responsibility for correctly completing chain-of-custody forms and for coordinating with the Project Chemist to successfully handle, packaging, and shipping of samples as described *SOP-07, Packing and Shipping of Environmental Samples.* The Field Team Lead should also determine or seek guidance as to which samples are potentially hazardous and handle them accordingly.

Field Sampler

The Field Sampler, under the supervision of the Field Team Lead (who may be the same person), confirms that samples are correctly collected, labeled, tracked by chain-of-custody, and sorted until they are delivered to the Field Team Lead, laboratory, or carrier that will transport them to the laboratory. The Field Sampler maintains custody of the samples until they are relinquished to the Field Team Lead, laboratory, or transport carrier. The Field Sampler informs the Field Team Lead and/or Project Chemist of Sampling conditions and if any of the samples are potentially hazardous.

The Field Sampler produces chain-of-custody forms and sample labels for field samplers, and verifies that all information, including labels and chain-of-custody forms, is correct. Labels and chain-of-custody forms are typically generated by the Sample Tracking and Scheduling Program, which the Project Chemist manages. Once the information is entered, the Field Sampler generates labels and chains-of-custody based upon specifications in the site specific field sampling plans.

Sample Shipper

The sample shipper (who may also be the Project Chemist or Field Team Lead) prepares and packs the coolers for shipping and verifies that the chain-of-custody forms are correct, as described in the procedures below. The sample shipper coordinates with the project expediting subcontractor to ship the samples effectively. If shipping hazardous materials, the sample shipper completes Dangerous Goods and Waste Management training before sample shipping. In addition, the sample shipper coordinates with the Project Chemist to verify that the laboratory is alerted that samples have been shipped and that other necessary follow-up tasks are completed.

Sample Custodian

The sample custodian is any individual who is responsible for the custody of samples and completion of associated documentation.

PROCEDURES

Determining Whether Samples Are Classified as Hazardous Waste

The sample shipper must complete Dangerous Goods and Waste Management training, which requires that the trainee become familiar with U.S. DOT and federal regulations for shipping dangerous goods before shipping any samples.

The 40 CFR, Part 261, Section 4, delineates sample shipping requirements, which are included in *SOP HSE-417, Hazardous Materials Transportation*, as follows:

> *... a sample of solid waste or a sample of water, soil, or air, which is collected for the sole purpose of testing its characteristics or composition, is not subject to any requirements of this part (hazardous materials shipping requirements)... when:*
>
> *(i) The sample is being transported to a laboratory for the purpose of testing; or*
>
> *(ii) The sample is being transported back to the sample collector after testing.*
>
> *In order to qualify for the(se) exemption(s)..., a sample collector shipping samples to a laboratory and a laboratory returning samples to a sample collector must:*

- *(i) Comply with Department of Transportation (DOT), U.S. Postal Service (USPS), U.S. Department of Agriculture, or any other applicable shipping requirements; or*
- *(ii) Comply with the following requirements if the sample collector determines that DOT, U.S. Postal Service (USPS), or other shipping requirements do not apply to the shipment of the sample:*
  - *(A) Assure that the following information accompanies the sample:*
    - *(1) the sample collector's name, mailing address, and telephone number;*
    - *(2) the laboratory's name, mailing address, and telephone number;*
    - *(3) the quantity of the sample;*
    - *(4) the date of shipment; and*
    - *(5) a description of the sample.*
  - (B) *Package the sample so that it does not leak, spill, or vaporize from its packing.*

To establish compliance with this requirement, assess samples to determine potential hazards. Potentially hazardous samples are required by law to be properly handled and labeled. If the coolers will not be delivered by hand but will be shipped to the laboratory, the samples must be packaged for shipment in accordance with DOT/IATA regulations; ship hazardous samples according to the requirements of the shipper (e.g., FedEx) and the Swift River team. Verify that marking and labeling procedures are consistent with DOT/IATA regulations. Enter the method of shipment, courier names, and other pertinent information on the chain-of-custody form. After properly completing air waybills, make a copy and place copies in the project file.

Packing and Shipping Samples

Environmental Samples (Nonhazardous)

Label, package, and ship nonhazardous (as determined by the Field Team Lead) environmental samples within insulated sample coolers as described below. Environmental samples do not require DOT marking, labeling, or shipping papers, and there are no DOT restrictions on the mode of transportation.

Packing Samples

- Determine the approximate shipping duration for the sample to be sent. If the shipping duration will be extensive (for example, greater than 24 hours), consider shipping the samples in extended-use 5-day or 6-day coolers.
- Determine the maximum allowable weight of each cooler.

- Remove all inappropriate or old marks and labels when reusing packing material. If the labels and marks cannot be removed, the labels will be crossed out so that they are not visible.

- Legibly and durably mark each piece of the shipment with the name and address of the shipper and the consignee (to be done by the shipper). A consignee phone number is required if the shipment is perishable. Markings should include the application of special handling stickers, such as “THIS SIDE UP,” “FROZEN,” or “COOL.”

- Properly prepare the shipment. Most shippers will not accept a shipment for transportation when it appears that the shipment is in a condition deemed by the shipper to be unacceptable, as follows:

    - Improperly packed or packaged

    - Of a kind or type likely to incur damage from high or low temperatures under normal air transportation conditions

    - Of an inherent nature or defect that indicates transportation could not be furnished without loss or damage to the shipment or damage to the shipper’s facilities or equipment

- Check the sample container caps to make sure they are tightened properly. Discard and re-collect samples of volatile components if the caps are loose.

- Tape the drain plug on the inside and outside of the cooler.

- Place a minimum of 2 inches of cushioning material (such as asbestos-free vermiculite, perlite, or bubble wrap sheets) in the bottom of the cooler.

- Place a large plastic bag (such as a trash bag) in the bottom of the cooler to contain samples. Allowed the top edges of the plastic bag to hang over the outside of the cooler while filling.

- Place each sample container in a resealable bag and sealed, squeezing as much air as possible from the bag before sealing. Wrap any glass containers in bubble wrap.

- Place all bottles upright in the cooler so that they will not touch each other during shipment. Allow enough room for ice bags and cushioning material to be placed among and around the containers.

- Place a temperature blank in every cooler to allow the receiving laboratory to accurately assess the temperature of samples.

- Place additional cushioning material around sample bottles, filling the voids between bottles. Ensure that the samples are insulated with enough bubble wrap to prevent breakage.

- Place a minimum of six to eight ice substitute bags (such as gel ice) between samples and over the containers to preserve them at approximately 4°C. Ensure that the ice substitute is evenly placed along the walls and top of each cooler.

- Fill the remaining spaces within the cooler with additional ice substitute and/or cushioning material such that the contents cannot shift and move inside the cooler. Additional ice or fewer samples per cooler may be needed so that all samples arrive at the laboratory within the accepted temperature range of 2 to 6°C—particularly important during periods of warmer weather and/or longer shipping durations.

- Pull up and together the top edges of the large plastic bag before tying them into a knot by twisting edges together while forcing out extra air.

Shipping Samples

- If shipping via a commercial carrier (such as FedEx, Alaska Air Cargo, or Frontier Alaska Cargo), write the carrier's name and the air waybill number on the chain-of-custody form.

- Place the completed chain-of-custody form inside a re-sealable bag, then tape the bag to the inside lid of the cooler. Each cooler must have a copy of the chain-of-custody inside the cooler. Retain an original carbon copy or photocopy of the completed chain-of-custody form and submit it to the Project Chemist or Field Team Lead for project archiving.

- The chain-of-custody form sent to the laboratory must be completed with all designated information, and the form must be unique to the samples contained within each specific cooler according to *SOP-02, Sample Handling and Chain-of-Custody*.

- Close and seal the cooler with a strong adhesive tape. Wrap nylon-reinforced strapping tape completely around the ends of the cooler multiple times to secure it; fill any open space between the lid and the cooler. Tape the cooler latch closed with strapping tape. Using clear packing tape or duct tape on the cooler is not acceptable.

- Complete two custody seals, then seal the cooler by placing the seals on the front and the rear of the cooler across the edge where the cooler and cooler lid meet. The signature on the custody seals should match the signature on the chain-of-custody form. Tape over the custody seals with clear packing tape around the entire cooler.

- Attach the completed shipping label to the top of the cooler, then print the words "Laboratory Samples" on the label. Print the laboratory and Swift River team office addresses and telephone numbers on the top of the cooler.

- Attach "THIS SIDE UP" labels on all four sides of the cooler, and place "FRAGILE," "CHILL," or "COOL" labels on at least two sides.

- Complete the appropriate air waybill (or manifest) with all designated information, including:

    - Shipper service requested (for example, Express, Goldstreak, and Priority)
    - Laboratory addresses and telephone numbers
    - Swift River team office addresses and telephone numbers
    - Project number (as the internal reference number or purchase order number)
    - Sender/shipper account number or customer identification number
    - Special handling requests for "Notify upon Arrival" with laboratory contact name and phone number, "Cool - Place in Cooler," and "Do Not Freeze" – special handling requests may need to be made in person when dropping off shipments with the carrier

- Attach an original copy of the air waybill to the sample cooler. Retain and submit an original carbon copy or photocopy of the air waybill with the chain-of-custody to the Project Chemist or Field Team Lead for project archiving. Multiple coolers may be shipped under a single air waybill if each cooler is appropriately labeled with the laboratory and Swift River team office addresses and telephone numbers.

- Notify the laboratory when the samples have been shipped, and provide it with the name of the carrier, air waybill number, and shipment date from the retained copy or photocopy of the air waybill. The laboratory must be prepared to receive and check the samples and sign the chain-of-custody form. In some cases, the laboratory may need to pick up the sample shipment from the carrier directly. The sample shipper or sample coordinator will coordinate with the laboratory to successfully deliver the samples to the laboratory.

<u>Hazardous Samples</u>

Pack and ship hazardous samples using the same procedures as those used for nonhazardous samples, except for the following:

- Consult the Field Team Lead and/or Health and Safety Manager whenever hazardous sample shipping is expected. Shipment of hazardous samples should follow the procedures outlined in the section below on Hazardous Materials Transportation.

- Place the sample container inside a 1-quart or 1-gallon steel, hazardous materials shipping can, and fill the void space with vermiculite. Place the can in a cooler and pack as described above.

- Complete a carrier-approved air waybill or shipper's certification for restricted articles, providing the following information in the order listed:

    - "Flammable Liquid, No. UN 1993" or "Flammable Solid, No. UN 1325"
    - "Limited Quantity" (or "Ltd. Qty.")
    - Net weight or net volume of total sample material in cooler
    - "Laboratory Samples"
    - "Cargo Aircraft Only"

- Affix a corporate address label to the cooler with the address of the laboratory.

Note that DOT regulations do not apply to transport by government-owned vehicles, including aircraft (IATA, 2012).

RECORDS

Log sample shipments on a sample shipment log (Appendix C) or in a field notebook. Complete chain-of-custody forms, air waybills, manifests, IATA Dangerous Goods Declaration forms, DOT shipping paperwork, and any other shipping documentation according to *SOP-01, Logbook Documentation and Field Notes*; store any documentation in the project files.

REFERENCES

Alaska Department of Environmental Conservation (ADEC). 2010. *Field Sampling Guidance*. Draft. May.

Alaska Department of Environmental Conservation (ADEC). 2002. *Underground Storage Tanks Procedures Manual: Guidance for Treatment of Petroleum-Contaminated Soil and Groundwater and Standard Sampling Procedures*. November.

ASTM International (ASTM). 2003. *Standard Guide for Packing and Shipping Environmental Samples for Laboratory Analysis*. ASTM Standard D 6911, ASTM International, West Conshohocken, PA. July.

International Air Transport Association (IATA). 2012. *Dangerous Goods Regulations.* International Air Transport Association Regulation 618, Attachment "A." 53rd edition.

SOP – 06 Groundwater Well Sampling

PURPOSE

This SOP describes the methodology for planning groundwater sampling events, well purging, and collection of groundwater samples through the use of positive displacement, submersible and peristaltic pumps, and bailers.

SCOPE

This SOP applies to all Swift River team personnel engaged in groundwater sampling on all projects in Alaska and tasks and was developed using the following ADEC documents:

- *Field Sampling Guidance* (ADEC, 2016)
- *Monitoring Well Guidance* (ADEC, 2011)
- *Underground Storage Tanks Procedures Manual: Guidance for Treatment of Petroleum-Contaminated Soil and Groundwater and Standard Sampling Procedures* (ADEC, 2014)

This SOP focuses on the most commonly used monitoring well development tasks and applications anticipated and should be used in conjunction with other applicable project SOPs, including the following:

- *SOP-01, Logbook Documentation and Field Notes*
- *SOP-10, Water Level Measurements*
- *SOP-11, Hydropunch Groundwater Sampling*
- *SOP-12, Monitoring Well Decommissioning and Borehole Abandonment*
- *SOP-13, Water Quality Measurements and Calibration*
- *SOP-14, Monitoring Well Installation*
- *SOP-15, Drilling Methods*
- *SOP-23, Operations and Maintenance of Photoionization Detector*
- *SOP-24, Equipment Decontamination Procedures*

Qualified persons, as defined by 18 AAC 75.990(100), will be engaged in or directly supervise the collection and handling of environmental samples (i.e., Project Manager, Site Manager, Field Team Lead, Project Chemist, Field Sampler).

All project field forms including sampling datasheets are included in Appendix D.

RESPONSIBILITIES

Project Manager

The Project Manager is responsible for providing adequate resources and verifying that field staff have adequate experience and training to successfully comply with and execute project-specific SOPs and implement the project HS&E program. The Project Manager will solicit the appropriate technical expertise to verify that the project has identified the best sampling methods and technology for the job given the current understanding of the site and project goals.

Site Manager

The Site Manager is responsible for the coordination and scheduling of daily field activities. In addition, the Site Manager is responsible for verifying compliance with this SOP and that all field staff engaged in this activity are trained in this SOP.

Field Team Lead

The Field Team Lead should develop or direct the preparation of a detailed sampling plan that includes the specifics of groundwater sampling, particularly the procedures to be used. The Field Team Lead or their designee should know the requirements for groundwater sampling and should maintain adequate documentation of groundwater sampling measurements and calibration activities.

Health and Safety Manager

The Health and Safety Manager is assigned to oversee site-specific HSE and verify overall compliance with project HSE requirements. The Health and Safety Manager conducts PPE evaluations, selects the appropriate PPE for the project, lists the requirements in the project-specific HASP, coordinates with the Site Manager and/or Safety Coordinator to complete and certify the PPE program, and conducts project H&S audits on the effectiveness of HS&E program.

Field Safety Officer

The Field Safety Officer assists in implementing the project HASP; the role of Field Safety Officer is either taken by the Site Manager or is designated to Field Team Lead by the Site Manager. The Field Safety Officer assists the Health and Safety Manager with the HSE program, implements the PPE requirements described in the project HASP, and receives input from project staff on the effectiveness of the assigned PPE requirements and ongoing HSE procedures.

Field Sampler

The Field Sampler, under the supervision of the Field Team Lead (who may be the same person), confirms that samples are correctly collected, labeled, tracked by chain of custody, and sorted until they are delivered to the Field Team Lead, laboratory, or carrier that will transport them to the laboratory. The Field Sampler maintains custody of the samples until they are relinquished to the Field Team Lead, laboratory, or transport carrier. The Field Sampler informs the Field Team Lead and/or Project Chemist of Sampling conditions and if any of the samples are potentially hazardous.

The Field Sampler produces chain-of-custody forms and sample labels for field samplers, and verifies that all information, including labels and chain-of-custody forms, is correct. Labels and chain-of-custody forms are typically generated by the Sample Tracking and Scheduling Program, which the Project Chemist manages. Once the information is entered, the Field Sampler generates labels and chains of custody based upon specifications in the site-specific field sampling plans.

Sample Custodian

The Sample Custodian is any individual who is responsible for the custody of samples and completion of associated documentation.

GENERAL

Groundwater sampling consists of collecting a water sample representative of the in situ conditions and chemistry of a specific aquifer or portion of an aquifer. Five methods for well sampling are addressed in this SOP, including the following

1. No-purge method
2. Low-flow method
3. Well volume method
4. Low-permeability formation method
5. Passive methods

The following sections include summaries and procedures for each method. Under normal circumstances, groundwater samples can be collected as soon as the groundwater has re-equilibrated following well development (when the groundwater is primarily sediment-free and water quality parameters have stabilized) or at least 24 hours after development (ADEC, 2010). Disturbance of the well, water column, and samples must be minimized, and only discrete grab samples may be obtained. Composite groundwater samples are unacceptable. If multiple groundwater monitoring wells are to be sampled during the same sampling event, samples must be collected from the monitoring wells expected to be uncontaminated or to have only low levels of contamination first, and then progressing to wells expected to have higher levels of contaminant last. This practice helps reduce the potential for cross-contamination between monitoring wells.

Groundwater samples must be collected as close as possible to the vadose zone/saturated zone interface (that is, water table) unless analysis indicates that contamination is at a different depth (ADEC, 2014). If further vertical delineation of contaminant concentration(s) is necessary, groundwater samples will be collected at the interval(s) within the water column based on the physical characteristics of the contaminant (ADEC, 2010). This should be a consideration especially for LNAPLs and DNAPLs (such as chlorinated solvents). If multiple different contaminant analytes are to be sampled from the same well, samples must be transferred to sample containers in the order of volatility.

Contaminant analytes should be collected in the following order:

1. In-field water quality parameters (*SOP-13 Water Quality Measurements and Calibration*)
2. VOCs, GRO, BTEX, methane, and carbon dioxide (CO_2)
3. SVOCs, DRO, RRO, PAHs, PCBs, pesticides, and herbicides
4. TOC
5. Inorganic compounds (such as total metals, dissolved metals, nitrate/nitrite, and sulfide)

Equipment and Materials

Groundwater sampling may be performed using several sampling devices including submersible pumps, peristaltic pumps, inertial pumps, and bailers. The choice of sampling device will be based on site-specific considerations including the well diameter, depth of groundwater, and well sampling method. Groundwater sampling devices must compliment the intended data use and site decisions, and selected groundwater purging and sampling equipment should minimize increases in sample temperature, water column agitation, and sample agitation (ADEC, 2010).

Materials used during groundwater sampling must not absorb, desorb, or leach contaminants of concern from or into a potential groundwater sample (ADEC, 2010). The materials used must be resistant to chemical and biological degradation. If bailers are used, the bailer must be made of glass, stainless steel, other suitable materials, or of disposable materials such as Teflon® or polyethylene (ADEC, 2014). Polyvinyl chloride (PVC) bailers are not acceptable for sampling of VOCs.

Groundwater and LNAPL Level Measurement

Before groundwater sampling, conduct a site-wide groundwater-level survey to determine the current site hydrogeologic conditions. Measure the depth to groundwater in each well to within 0.01 feet. If the possibility of LNAPL is suspected, check the monitoring well for the presence of LNAPL using an oil-water indicator probe. If LNAPL is encountered in a well, measure the product thickness and record it on the well purge and sampling datasheet. Unless otherwise specified by the site-specific sampling plan or the Site Manager, do not collect laboratory samples from wells that contain LNAPL.

Historical Groundwater Level Information

The initial step in developing a groundwater sampling plan for a particular site is to acquire historic groundwater elevation data from monitoring wells at the site, if available. If no monitoring wells currently exist, acquire groundwater level data for wells at or as close as possible to the site. Evaluate these data to determine the range of seasonal water level fluctuations that occur at the site and the shallowest and deepest observed water levels over the period of record. This information defines the depth interval of the intermittently saturated zone, or potential “smear zone,” that is created as an LNAPL layer rises and falls with seasonal water level fluctuations.

RECORDS

Record details regarding the pumping method, parameter readings, purge volumes, and samples collected in the field logbook and on a groundwater monitoring datasheet (Appendix D).

PROCEDURES

This section describes groundwater sampling procedures including Pre-sampling tasks, pump setup, well purging, sample collection preparation, potential sample collection techniques, sample collection, and investigation derived waste.

Pre-sampling Tasks

This section describes tasks that occur prior to purging and sampling a well including planning tasks, field equipment decontamination and calibration, and equipment selection.

Planning Tasks

The Field Team Lead should work with the Project Manager and Site Manager to obtain historical information on which wells have historically had contaminants present, so that wells with the greatest concentrations may be sampled last to minimize potential cross contamination.

Site background information (historical Well Purge and Sampling Datasheets), including depth to water, well total depth, and water quality parameters from previous events (if available), should be obtained before the field sampling event to augment data quality and allow for verification of data consistency.

Expected purge volumes should be estimated before field deployment such that proper pumps may be selected and purge water management may be planned.

Field Equipment Decontamination

Decontaminate groundwater sampling equipment and materials before use. Groundwater sampling equipment that typically requires decontamination before purging a well includes the water level or oil-water interface probe, water quality meters and probes, and the inside of flow-through cells (SOP-24). Decontaminate submersible pumps between sampling at each well. Portable decontamination supplies (for example, decontamination water containers, spray bottles, Alconox, and deionized water containers) should be available during sampling so that all appropriate accessory equipment can be decontaminated in the field. Place used decontamination solutions in the purged well water containers and manage as IDW, according to the Waste Management Plan (Appendix C).

Field Equipment Calibration

Before going into the field, the Field Team Lead or designee should verify that field instruments are operating properly and that there are no obvious defects that could prevent proper operation. Calibrate all instruments before obtaining field data to within an acceptable range (SOP-13). Minimize field sampling time or data quality lost because of malfunctioning equipment through proper pre-event planning and by using adequate backup equipment, as necessary. Collect field measurements for temperature, pH, turbidity, specific conductance, DO, temperature, and ORP.

Air monitoring may be necessary during groundwater sampling activities, as specified in the HASP. Calibration and operation of air monitoring equipment (PIDs or FIDs) (SOP-23). If instrument readings become erratic during normal operations, recalibrate the equipment.

Equipment Selection

Obtaining a representative sample depends greatly on the methodology and technology used to obtain the sample. Five methods for well sampling are addressed in this SOP: the no-purge method, the low-flow method, the well volume method, low-permeability formation method, and passive methods. Each method uses different sampling technology and equipment, as necessary to accommodate the appropriate well installation and construction, drilling, and sampling methods (such as conventional or DPS methods) employed and project objectives.

To obtain the best sample and geochemical parameter data, use positive displacement pumps. These types of pumps include bladder, gear, and piston pumps.

- Bladder pumps are the simplest of these pumps (which makes them easiest to decontaminate) and have diameters as small as 0.625 inch, which can sample 3/4-inch I.D. or greater wells.

- Submersible pumps are acceptable for most analytes; however, take care to select the proper submersible pump for the estimated sample depth so that the pump does not become overheated and alter the well chemistry.

- Because of potential loss of the volatile fraction from negative pressure gradients, peristaltic pumps are generally not recommended for purging and sampling for the following analyses: VOCs, SVOCs, DO, ORP, CO_2, pH, and dissolved iron. If the depth to water is less than approximately 25 to 27 feet bgs, the monitoring well has low recovery, the sampled analyses do not include VOCs and SVOCs, and/or the well or DPS sample point is constructed such that no other pumping method is feasible or practical, you may use peristaltic pumps as specified in the site-specific sampling plan.

Pump Setup

Groundwater sample pumping equipment setup differs slightly depending on the method of sampling and the types of equipment employed. Different types of pumps have different requirements; therefore, pumping equipment should always be set up according to the manufacture's recommendations. However, there are general similarities in equipment setup no matter what type of pump is used. Figures 1 and 2 summarize the typical setup for a low-flow bladder pump and peristaltic groundwater sampling set.

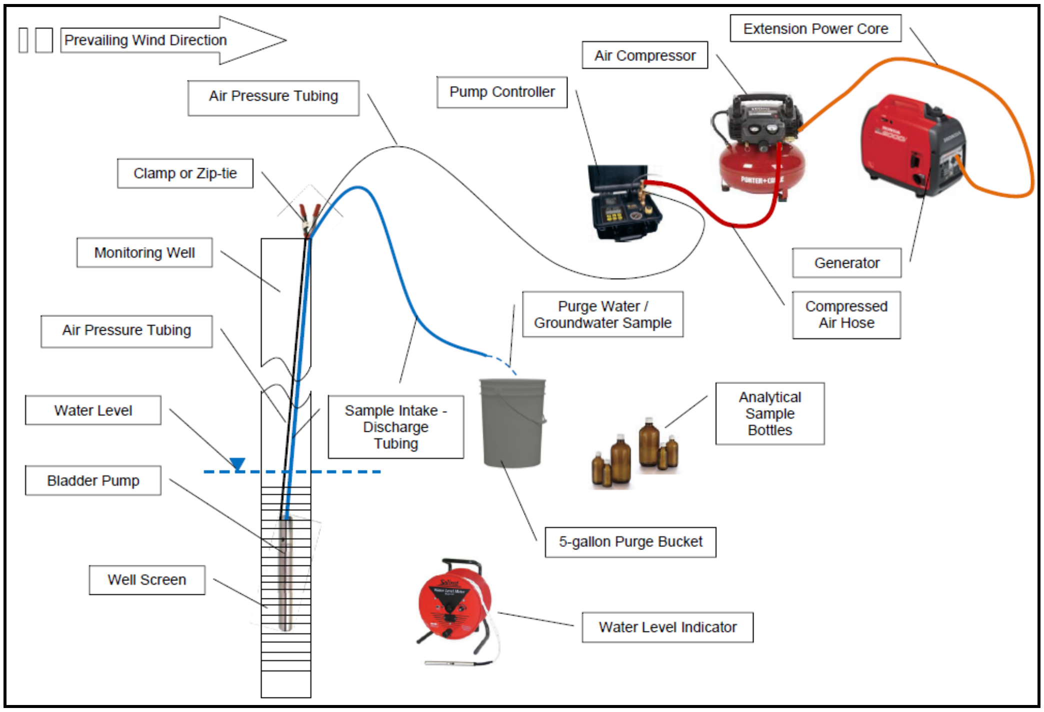


Figure 1. Typical Bladder Pump Sampling Equipment Setup

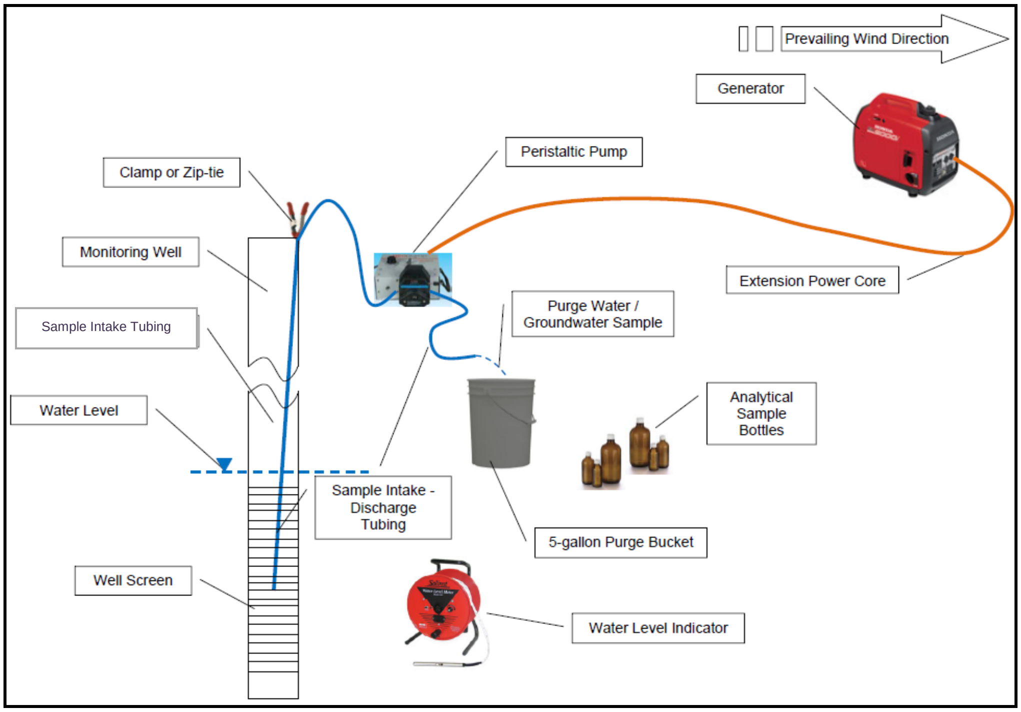


Figure 2. Typical Peristaltic Pump Sampling Equipment Setup

Follow these basic equipment setup guidelines for the most commonly used pumps when setting up groundwater sampling equipment.

Bladder and Submersible Pumps

- Connect the pump to the sample intake-discharge tubing. Connect either the air pressure tubing (bladder pumps) or the pump power control cable (submersible pumps) to the pump. Tightly secure the tubing to the pump with one or two zip-tie fasteners. If the well is very deep, connect a separate deployment cable or line to the pump.

- Slowly and carefully lower the pump with tubing (and cable) into the well to the desired well depth. Lower the pump with the deployment cable (if used) or the most secure and largest diameter tubing or cable attached.

- Secure the pump and tubing to the top of the casing by the deployment cable (if used) or the most secure and largest diameter tubing or cable attached. Use with multiple zip-tie fasteners or a spring clamp if the pump is relatively light and the well is shallow.

- Connect the opposite end of the air pressure tubing or the pump power control cable to the pump controller. Both bladder and submersible pumps have some kind of pump controller.

- Clamp the other end of the sample intake-discharge tubing to the purge bucket in a way that discharging purge water will flow into the bucket. Often, the flow from the well will first be directed through a flow-through cell (intake generally at the bottom of the cell) for the collection of field parameters and the discharge tube from the flow-through cell will then be directed into the discharge bucket.

- Connect the pump controller to either an air compressor (bladder pump) or directly to a generator (submersible pump) using a compressed air hose or extension power cord as appropriate.
- If a bladder pump and air compressor are used, connect the compressor to the generator using an extension power cord.
- Place the generator downwind of the sampling area a significant distance away (~20 feet or more). If a bladder pump is used, the generator should not be operating while a sample is being collected.
- Make sure that the generator supplying power to the pump is sufficiently fueled before purging and sampling to avoid power loss.

Peristaltic Pumps

- Connect an appropriate length of sample intake tubing to one end of an approximately 8- to 12-inch piece of Masterflex or similar silicone tubing. Connect the other end of the silicone tubing to a 3- to 4-foot piece of pump discharge tubing. Try to minimize the length of sample tubing whenever possible to reduce sample turbulence and aeration during pumping.
- Slowly and carefully lower the sample intake tubing into the well to the desired sample intake depth.
- Secure the sample intake tubing to the top of the casing using multiple zip-tie fasteners or a spring clamp.
- Insert the 8- to 12-inch silicone tubing section into the peristaltic pump head and lock the tubing within the pump head.
- Clamp the other end of the discharge tubing to the purge bucket in a way that discharging purge water will flow into the bucket.
- Connect the peristaltic pump directly to the generator (or battery if available) using an extension power cord.
- Place the generator downwind of the sampling area a significant distance away (~20 feet or more). If a battery is available, it should used while a sample is being collected.
- Make sure that the generator supplying power to the pump is sufficiently fueled before purging and sampling to avoid power loss.

Well Purging

Most groundwater methods (except no-purge sampling methods) require purging of the well before groundwater sampling in order to remove stagnant water from the well and obtain a water sample representative of the aquifer being sampled with a minimum of disturbance to the water column. Using the low-flow or the well volume approach methodology, purge the well until field parameters (such as DO, ORP, conductivity, pH, turbidity, and temperature) have stabilized, until three well casing volumes are purged, or until the well is purged dry according to *SOP-13, Water Quality Measurements and Calibration*. When possible, do not collect a groundwater sample until the groundwater level and the groundwater parameters have stabilized according to the criteria indicated in SOP-13.

Sample the well immediately following purging, without moving or adjusting the position of the pump or sample intake line. Containerize purge water and manage as IDW according to the Waste Management Plan (Appendix C).

Preparation for Groundwater Sampling

Perform the following procedures at each well in preparation for groundwater sampling. All air monitoring readings and observations should be recorded on the Groundwater Sampling Datasheet and/or in a field logbook.

- Ensure that all remediation systems (soil vapor extraction and bioventing) operating within 250 feet of the monitoring well to be sampled have been shut down at least 24 hours in advance of groundwater sampling activities.
- Wear PPE and take any other precautions as specified in the HASP.
- Monitor the ambient air and any vapors within or near a well while opening the well and during sampling. Check the area around the well for organic vapors (background reading) using the PID or FID. Open the well cap and immediately checking for organic vapors in the well casing and breathing zone. Take appropriate readings in the breathing zone during purging and sampling with air monitoring equipment (PID or FID) according to the HASP (generally every 30 minutes).
- Inspect the condition any permanent monitoring wells for any unusual site or well conditions. Record the condition of the well monument, concrete well pad, protective posts (if present), or other well condition. Any deficiencies encountered should be reported to the Field Team Lead and Site Manager as soon as possible.
- If the well is sealed with an airtight cap, allow time for pressure to equilibrate after the cap is removed before measuring water levels. Measure the depth of the static water level and the total well depth with a water level or oil-water indicator probe to the nearest 0.01 foot from the measurement reference point on the well casing pipe. Take measurements until three consecutive readings are within 0.01 foot.
- If previous total well depth information is available from either well construction or previous sampling events), compare the current total well depth with the previously measured total well depth and note any differences greater than 0.5 foot. Notify the Field Team Lead and/or Site Manager of the observation.

Groundwater Sampling Techniques

No-Purge Sampling

No-purge groundwater sampling is a method for obtaining representative groundwater samples under natural flow conditions without purging the well beforehand (ADEC, 2010). This procedure is directed primarily at monitoring wells that have a screen, or an open interval of 10 feet or less. This method may be appropriate for wells that are unconfined and screened through the water table, do not contain NAPL, and have been previously sampled using conventional sampling techniques to provide data for comparison (API, 2000).

Advantages to this method include that less time is needed for sampling and elimination of purge water management and disposal costs. Samples obtained using this procedure are also suitable for the analysis of groundwater contaminants such as VOCs, SVOCs, herbicides, pesticides, PCBs, metals, and naturally occurring compounds. Disadvantages include potentially low-biased results for volatile and redox-sensitive parameters if groundwater is stagnant in the well and in contact with air.

No-purge groundwater sampling can be conducted using either bailers or pumps and is commonly used for direct-push Hydropunch groundwater sampling as discussed in SOP-11. No-purge groundwater sampling is expected when using the Geoprobe Screen Point 16 Groundwater Sampler and is potentially used during sampling of DPS well points (Kejr Inc., 2006). No-purge groundwater sampling should be conducted as follows using bailers and pumps.

No-Purge Method with a Bailer

1. Measure the water level within well using a water level meter and record the depth to water.
2. Securely connect a bottom-filling bailer to a retrieval line or cord. The bailer line and any leader used that comes in contact with the water should be constructed of PTFE-coated stainless steel or new polyethylene cord. Fit reusable bailers with a new bailer line for each well sampled; the bailer and line may be handled only by personnel wearing clean disposable gloves. Prevent the new bailing line from contacting the outside of the well, equipment, and clothing before or during sampling.
3. Lower the bailer down the well and below the water table, taking care to not disturb the water column or stir up sediment in the bottom of the well as the bailer fills with water from the bottom.
4. Obtain samples as close as possible to the water table unless analysis indicates that contamination is at a different depth.
5. Lift the bailer slowly and transfer, with minimum disturbance and agitation, approximately one to two pints of water into a decontaminated flow through cell; measure the pH, temperature, conductivity, DO, ORP, and turbidity.
6. Slowly transfer the remaining water in the bailer into analytical sample containers with a minimum of disturbance and agitation to prevent loss of volatile compounds.
7. Repeat Steps 3 through 5, recording water quality parameters each time and filling analytical sample containers.

No-Purge Method with a Pump

1. Measure an initial water level within the well using a water level meter and record the depth to water.
2. Set up the sampling equipment and pump according to the manufacturer's instructions.
3. Lower the pump at a moderate, controlled rate until a little above the groundwater table. As the groundwater surface is approached, lower the pump or pump intake tubing very slowly into the groundwater to the desired sample intake depth (preferably within the screened interval). Record the approximate pump or pump intake tubing depth.
4. Start the pump on the lowest setting. Adjust the flow slowly until water begins to discharge. Continue pumping and begin low-flow sampling the well at a flow rate of

approximately one liter (0.25 gallons) every three minutes or 0.1 gal/min, such that the pumping rate does not lower the water level more than 0.3 foot. Initially monitor the drawdown frequently, to establish a steady pumping rate that minimizes drawdown. If the minimal drawdown exceeds 0.3 foot *but remains stable,* continue sampling. Record the drawdown and stable depth to water.

5. First fill approximately one to two pints of water into a decontaminated flow through cell and measure the pH, temperature, conductivity, DO, ORP, and turbidity. Record the initial water quality parameters on the groundwater datasheet.
6. Next, slowly fill the required analytical sample containers with a groundwater sample, taking care to minimize disturbance and agitation of the sample and prevent loss of volatile compounds. Fill the analytical sample containers in order as previously discussed.
7. After filling sample containers, repeat Step 1 and record the final water quality parameters on the groundwater datasheet.
8. Remove the pump and pump intake tubing from the well and disassemble the sampling equipment and pump as necessary.

Low-Flow Sampling

Low-flow sampling is a method of collecting samples from a well that does not require purging large volumes of water from the well and relies on natural flow of formation water through the well. Using this method, the water flowing into and through the well is representative of the groundwater with the formation surrounding the screen and thus representative groundwater samples can be obtained by slowly pumping.

“Low flow” refers to the velocity with which water enters the pump intake and is imparted during pumping to the formation pore water adjacent to the well screen (ASTM D6771). Low flow does not necessarily refer to the flow rate of water discharged by a pump at the surface, which can be affected by valves, connections, and discharge tubing restrictions. However, typical low-flow surface discharger rates should be limited to less than 0.5 L/min (0.13 gal/min). Low-flow sampling methods emphasize minimal stress to the groundwater by low water-level drawdown and low pumping rates in order to collect samples with minimal alterations to water chemistry (EPA, 2002; ASTM D6771). This is the preferred method for natural attenuation monitoring, which requires careful measurements of DO and oxidation-reduction sensitive analytes, such as iron and manganese. Low-flow sampling is the most recommended sampling method for collecting groundwater samples and should be used whenever possible and practical, including at conventional, permanent wells, microwells, and at DPS well points if possible. Wells with low recharge rates may require special pumps capable of very-low-flow rates, such as bladder or peristaltic pumps. If the well is dewatered during purging, then it should be sampled as discussed in Section 5.5.4 for low-permeability formations.

Low-flow sampling is typically conducted using positive displacement pumps, submersible pumps, or peristaltic pumps. Commonly used low-flow pumps include the QED Sample Pro bladder pump, Geotech bladder pumps, Grundfos Redi-Flo 2 submersible pump, and the Geotech Geopump Series II peristaltic pump.

Low-flow groundwater sampling should be conducted as follows and should be used along with *SOP-13, Water Quality Measurements and Calibration*.

Setup

1. Measure an initial water level within the well using a water level meter, if possible. Record the depth to water on the groundwater datasheet.
2. Set up the sampling equipment and pump according to the manufacturer’s instructions.
3. Secure the water quality meter to the flow-through cell and connect a short discharge tube to the effluent connector at the top of the flow-through cell and run the other end of the discharge tube into a five-gallon graduated purge water discharge bucket. Securing the discharge tube to the five-gallon bucket with a metal spring clamp is recommended.
4. Lower the pump at a moderate, controlled rate until a little above the groundwater table. As the groundwater surface is approached, lower the pump or pump intake tubing very slowly into the groundwater to the desired sample intake depth (preferably within the screened interval). Record the approximate pump or pump intake tubing depth.
5. Run the aboveground end of the intake tube from the pump directly into the five-gallon purge water bucket.

Purging

1. Turn on the pump and start to pump on the lowest setting. Adjust the flow slowly until water begins to discharge. Slowly pump at a flow rate of approximately one liter (0.25 gallons) every five minutes or 0.1 gal/min for approximately one to two minutes, or until the purge water begins to visually clear up. The intent is to limit any initial high turbidity water from filling and settling in the flow-through cell.
2. Once most of the observable turbidity has cleared, briefly turn off the pump and secure the tube from the pump to the influent connector at the bottom of the flow-through cell. Turn on the pump again and then allow the flow-through cell to completely fill with water. Make a continuous effort to keep air bubbles and significant air volume from collecting in the flow-through cell. To remove any collected air volume within the flow-through cell, partially unscrew the multimeter sonde from the flow-through cell while pumping until all the air escapes and water begins to slowly leak from the sonde/flow-through cell connection.
3. Continue pumping and begin low-flow purging the monitoring well at a flow rate of approximately one liter (0.25 gallons) every three minutes or 0.1 gal/min, such that the pumping rate does not lower the water level more than 0.3 foot. Initially monitor the drawdown frequently, to establish a steady pumping rate that minimizes drawdown. If the minimal drawdown exceeds 0.3 foot, *but remains stable*, continue purging.
4. Purge the water through the flow-through cell and into a five-gallon graduated purge water discharge bucket. Observe the purge rate and cumulative total discharge volume based on the graduated marks on the purge bucket. Empty the purge bucket into an IDW drum or dispose of the purge water according to the Waste Management Plan (Appendix C).
5. Routinely measure and record the DO, ORP, conductivity, pH, turbidity, temperature, current groundwater level, and cumulative total purge volume throughout the purge at approximately three- to five-minute intervals. Measurement frequency should be (at minimum) three minutes or the length of time required to completely fill the flow-through cell, whichever is greater. A minimum of three of groundwater parameter measurements should be monitored and recorded. The groundwater level should be measured frequently

during purging to verify that the water level has not dropped lower than the desired 0.3 foot. Record the groundwater parameters, groundwater level, and cumulative total purge volume.

6. Stabilization of water quality parameters is the primary criterion for sample collection by this method. Continue to measure and record the groundwater parameters and current groundwater level until the parameters stabilize according to the following stabilization criteria. Groundwater parameters are considered stable after purging if three successive readings are within the following parameters:

   a. ±0.2 (minimum) degrees Celsius for temperature
   b. ± 0.1 pH
   c. ± 3% conductivity
   d. ± 10 mV ORP
   e. ± 10% DO
   f. ± 10% turbidity or ≤ 5 NTUs

   A minimum of three (minimum of four if using temperature as an indicator) of these parameters should be monitored and recorded.

7. If it does not appear that the groundwater parameters are approaching stabilization after the removal of two well volumes, check the calibration of the field instrument or try using a different water quality instrument. If the instrument check or recalibration shows that the field instruments are working properly and parameter stabilization is still not occurring, the Field Team Lead may elect to collect the sample after a minimum of three or maximum of six well casing volumes have been purged (EPA, 2002). The Field Team Lead will contact the Site Manager when this behavior is observed and will record on the groundwater datasheet that parameter stabilization could not be achieved.

8. If and once groundwater parameters have stabilized or a minimum of three well casing volumes have been purged, record the final parameter measurements, water level, total purge volume, and any other purge observations.

Sampling

1. Following purging, collect groundwater samples without altering the flow rate or extensively interrupting the flow. Disconnect the aboveground end of the pump intake tube from water quality meter and flow-through cell before sampling. Do not sample from the discharge of the flow-through-cell.

2. While sampling, discharge any groundwater pumped between filling sample containers in a five-gallon groundwater purge bucket. Dispose of this water along with other purge water accumulated.

3. Begin filling the laboratory-supplied analytical sample containers in the order of volatility as previously described in Section 3.0. Fill the analytical sample containers, as discussed in Section 5.6, until complete.

4. Record the sample ID, date and time, sampler, analytes, and other sample information on the sample bottle labels, the sample COC, and on the groundwater datasheet.

Optional – Field Filtered Samples

1. If field filtered samples are required (for dissolved metals, phosphate, nitrate/nitrite, or perchlorate, for example), connect the field filtering apparatus or an in-line filter capsule to the aboveground end of the pump intake tube per the laboratory analytical method and/or filter equipment manufacturer's instructions. A 0.45-micron disposable in-line filter capsule is typically used for field filtering dissolved metals. Consult the laboratory analytical method for the correct filter size and type for the analytes sampled.

5. Once connected, pre-rinse the field filter apparatus or capsule with approximately 25 to 50 ml of pumped groundwater. To do this, pump water through the filter for approximately 30 seconds to flush and rinse the filter media.

6. Begin filling the laboratory-supplied analytical sample containers with filtered water until complete.

7. Record the sample ID, date and time, sampler, analytes, and other sample information on the sample bottle labels, the sample chain-of-custody form, and Appendix D - *Well Purge and Sampling Field Datasheet*, as required (see *SOP-02, Sample Handling and Chain of Custody*).

Well Volume Approach

The well volume approach method is based on purging three to six well volumes before sampling. This method can be conducted with either a bailer or pump and will only be used if groundwater stabilization parameters cannot be met and/or other purging and sampling methods cannot be employed.

One well casing volume of water (gallons) may be calculated using the following formulas:

$$V_1 = A \cdot (D_T - D_W)$$

where:

D_T = Total depth of the well (feet below top of casing [BTOC])

D_W = Depth to groundwater (feet BTOC)

D_I = Inside diameter of the well casing (inches)

A = Volume of water per linear foot of water column (gallon/foot). See Table 2.

$$A = 7.48 \cdot \pi \cdot \left(\frac{D_I}{24}\right)^2$$

Table 2. Unit Casing Volume per Linear Foot for Schedule 40 PVC Pipe.

Nominal Casing Size *(inches)*	0.75	1	1.5	2	2.5	3	4	5	6	8	10	12
Casing D_I (inches)	0.82	1.05	1.61	2.07	2.47	3.07	4.02	5.04	6.06	7.98	10	11.9
Unit Casing Volume (A) (gal/ft)	0.02	0.04	0.1	0.17	0.25	0.38	0.66	1.04	1.5	2.6	4.09	5.81

Well volume approach sampling should be conducted in the following way:

1. Measure the water level within well using a water level meter. Record the depth to water on the groundwater monitoring datasheet.

2. Securely connect a bottom-filling bailer to a retrieval line or cord or setup the sampling equipment and pump according to the manufacturer’s instructions.

3. Very slowly lower the bailer, pump, or pump intake tubing to the desired sample intake depth.

4. Begin bailing or pumping the well, starting at low rate and then increasing the flow.

5. Routinely measure and record the DO, ORP, conductivity, pH, turbidity, temperature, and current groundwater level throughout the purge at approximately every one-half well volume interval. Record the groundwater parameters, groundwater level, and cumulative total purge volume.

6. Continue to measure and record the groundwater parameters and current groundwater level until the parameters stabilize according to the stabilization criteria.

7. Once the groundwater parameters have stabilized and a minimum of three well casing volumes have been purged, record the final parameter measurements, final water level, total purge volume, and any other purge observations.

8. If parameters have not stabilized within six well volumes, stop purging and record the final parameter measurements, final water level, total purge volume, and any other purge observations.

9. Disconnect the aboveground end of the pump intake tube from the water quality meter and flow-through cell. <u>Do not sample from the discharge of the flow-through cell</u>. While sampling, discharge any groundwater pumped between filling sample containers in a

five-gallon groundwater purge bucket. Dispose of this water along with other purge water accumulated.

10. If bailing, very slowly lower the bailer down the well and below the water table, taking care to minimize disturbing the water column or stir up sediment in the bottom of the well as the bailer fills with water from the bottom. Then lift the bailer slowly from the water column and out of the well.

11. Begin filling the laboratory-supplied analytical sample containers in the order of volatility as previously described. Fill the analytical sample containers, as discussed in below, until complete. Water should be transferred to the sample containers with minimum disturbance and agitation.

12. Record the sample ID, date and time, sampler, analytes, and other sample information on the sample bottle labels and the sample chain of custody.

Low-Permeability Formations

If a well is screened in a low permeability zone (such as silts and clay layers), natural recharge flow into the well maybe so low that there may be no way to avoid pumping or bailing the well dry. Low-flow purging and sampling are particularly useful for wells that purge dry or take one hour or longer to recharge (ADEC, 2010). If a well is purged dry, a minimum of two hours between purging and sampling should be observed and groundwater samples should not be collected until the well has recharged to approximately 80% of its pre-purge volume (EPA, 2002; ADEC, 2010). For this method, a bailer may be used, since many sampling pumps have tubing capacities that would exceed the water volume in the well and cause it to be pumped dry again. A very low-flow device, such as a peristaltic pump, can also be used if the groundwater depth is less than approximately 25 feet.

The following procedures apply for purging low-permeability formations, where it is not possible to obtain stabilization of field parameter data:

- Purge the well dry and allow the well to recover until it meets at least one of the following criterion:
  - A minimum of two hours has elapsed since purging
  - There is sufficient water volume present to fill all required analytical containers
  - The water in the well has recovered to 80% of the pre-purge volume
- Begin filling the laboratory-supplied analytical sample containers in the order of volatility until complete. Water should be transferred to the sample containers with minimum of disturbance and agitation.
- Record the sample ID, date and time, sampler, analytes, and other sample information on the sample bottle labels, the sample CoC.

Passive Sampling Method

Passive groundwater sampling allows a sample to be collected from a discrete location without active media transport induced by pumping or purge techniques (ITRC, 2006; ADEC, 2010). Passive technologies rely on the sampling device being exposed to media in ambient equilibrium during the sampler deployment period. For example, well water is expected to be in natural exchange with the formation water. All passive sampling devices provide a sample from a specific location (that is, point samples).

Some of these sampling technologies are relatively mature and accepted for appropriate applications by regulators. Nonetheless, they are still considered to be innovative technologies and few if any specific policies governing their use have been written into official regulations. Passive samplers are classified on the basis of the sampling mechanism and nature of the collected sample, as follows (ITRC, 2006; CEPA, 2008):

- Grab Sample Devices. Samples are an instantaneous representation of conditions at the sampling point at the moment of sample collection.
    - Simulprobe Technologies Mini SimulProbe
    - GeoInsight HydraSleeve Samplers
    - ProHydro Snap Sample
- Diffusion-to-Equilibrium Devices. These samplers rely on diffusion of the analytes into the sampler until equilibrium with the sampled medium is obtained. Samples are time-weighted toward conditions at the sampling point during the latter portion of the deployment period. The degree of weighting depends on analyte and device-specific diffusion rates. Typically, conditions during the last few days of sampler deployment are represented.
    - Regenerated-Cellulose Dialysis Membrane Samplers
    - Nylon-Screen Passive Diffusion Sampler (NSPDS)
    - Passive Vapor Diffusion Sampler (PVDs)
    - Peeper Samplers
    - Passive Diffusion Bag Sampler (PDBs)
    - Rigid Porous Polyethylene Sampler (RPPS)
- Diffusion/Sorption Accumulation Devices. These samplers rely on diffusion and sorption to accumulate analytes into or onto the sampler. Samples are a time-integrated representation of conditions at the sampling point over the entire deployment period. The accumulated mass and duration of deployment are used to calculate analyte concentrations in the sampled medium.
    - Semi-Permeable Membrane Device (SPMDs)
    - GORE Sorber Module
    - Polar Organic Chemical Integrative Sampler (POCIS)
    - Passive In Situ Concentration Extraction Sampler (PISCES)

Passive Diffusion Bag Samplers

PDBs can be used for sampling a select list of VOCs (as defined in Table 3). Metals, other organics, semi-volatile contaminants and petroleum hydrocarbons cannot be sampled by this method (ADEC, 2010). ADEC suggest the use of PDBs when confronted with sampling a monitoring well that displays little or virtually no recharge capability during well evacuation or in instances where long term monitoring during the operation and maintenance phase of remediation justifies their use (ADEC, 2010). PDB samplers take advantage of semi-permeable membrane technology to gather contaminants from groundwater (EPA, 2009). When the sampler is placed in contact with an ambient medium (contaminated groundwater), the contaminants diffuse across the semi-permeable membrane into reagent-grade organic-free water contained with the sampler. The number of contaminants that PDB samplers are capable of detecting is limited; therefore, these devices are not recommended for initial investigations where a more complete understanding of the contaminants of concern remains to be determined (ADEC, 2010). In addition, PDB samplers are not recommended for sampling sentinel wells.

Table 3. Contaminants Where Field Data Suggest that PDBs May or May Not Be Acceptable for Collection (EPA, 2009)

Contaminants Potentially Acceptable for Collection

Benzene
Bromobenzene*
Bromochloromethane*
n-Butylbenzene
1,2,3-sec-Butylbenzene
1,2,4- tert-Butylbenzene
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloromethane
Dibromochloromethane
1,2-Dibromoethane*
Dibromomethane*

1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Dichlorodifluoromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
trans-1,2-Dichloroethene
1,2-Dichloropropane
Ethylbenzene
Hexachlorobutadiene*
p-Isopropyltoluene

1,1,2,2-Tetrachloroethane*
Tetrachloroethene
Toluene
Trichlorobenzene*
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Trichlorofluoromethane
1,1,2-Trichloro-1,2,2-trifluoroethane
Vinyl chloride
m,p-Xylene
o-Xylene
Xylenes, total

Contaminants Potentially Not Acceptable for Collection

tert-Amyl methyl ether*
Bromoform*

Naphthalene
n-Propylbenzene

1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene

*Note: The data set for this compound was relatively small (fewer than five instances of comparison), so the power of the classification (that is, acceptable or unacceptable) is fairly low.

PDB samplers are typically about 18 to 20 inches in length, are made of low-density polyethylene plastic tubing (typically 4 mil) (ADEC, 2010), and are deployed as described in the paragraphs below.

Fill the sampler with between 220 ml to 350 ml of laboratory grade ASTM Type II) de-ionized water and seal at both ends. Suspend the sampler at the desired depth interval within the well and left to equilibrate within the well. Teflon®-coated stainless steel wire is preferable for deploying the samplers within a well; however, synthetic cord (such as white, 3/16-inch cord) may also be used as the deployment line for single-use applications. Allow the PDB sampler to equilibrate in the well for at least two weeks for the most representative samples (many VOCs equilibrate within 48 to 72 hours, but the sampler should be left for the full two-week period) (ADEC, 2010). This equilibrium period is necessary to allow the formation water and well water to restabilize after deployment of the samplers, and to allow diffusion between the stabilized well water and the PDB sampler to occur. In low-yielding formations, take additional time for the well to restabilize.

If quarterly sampling is being conducted, it is acceptable to leave PDB samplers in the well for up to a maximum of three months so that samplers can be retrieved and deployed for the next monitoring round during the same mobilization; however, longer periods of deployment are not recommended (ADEC, 2010).

Once the acceptable deployment period is complete, carefully retrieve the bag from the well and slowly drain the water within the sampler in the laboratory-supplied analytical sample containers, taking care to minimize agitation or aeration, in the order of volatility as previously described in Section 3.0, until complete.

Sample Collection

VOC groundwater samples should be collected according the following:

- Fill sample containers so that the sample is allowed to flow gently along the inside wall of the container. Take care to minimize turbulence, agitation, and aeration of the sample.
- Minimize the headspace in the sample container by filling the sample jar until a positive meniscus is present (ADEC, 2014).
- Quickly and adequately seal the containers. Unless otherwise specified, seal the jar using Teflon®-lined screw caps.
- Clean rims before tightening lids.
- Label and handle sample containers as outlined in *SOP-02, Sample Handling and Chain of Custody*.
- Preserve containers immediately according to the procedures in *SOP-02, Sample Handling and Chain of Custody*. Unless specified otherwise, at a minimum, immediately cool the samples to 4±2°C and maintain this temperature through delivery to laboratory until the samples are analyzed (ADEC, 2014).

Investigation-derived Waste

If any IDW or free product is generated during purging or sampling, store and dispose of according to the Waste Management Plan in Appendix C of this UFP QAPP.

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SOP-07 Water Level Measurements

PURPOSE

This SOP provides guidance on the methods and equipment used to determine water levels, depth to floating product, or total depth in a groundwater monitoring well, production well, or piezometer.

SCOPE

This SOP applies to all Swift River team personnel and subcontractors engaged in measuring water levels, floating product, and total depths in wells on AFCEC projects in Alaska. This SOP was developed using the following guidance documents:

- ADEC *Monitoring Well Guidance* (ADEC, 2011)
- "Accuracy of Depth to Ground Water Measurements," *EPA Superfund Ground Water Issue* (Thornhill, 1989)
- ASTM Standard D 4750, *Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well).* (ASTM, 1987)
- *Groundwater and Wells* (Driscoll, 1986)
- *Groundwater Manual, A Water Resource Technical Publication* (U.S. Department of the Interior, 1981)

This SOP is applicable to the sampling of monitoring wells and must be performed before any activities that may disturb the groundwater table level, such as pumping, purging, or aquifer testing. This SOP should be used in conjunction with other project SOPs, including the following:

- SOP-08, Groundwater Well Sampling
- SOP-14, Monitoring Well Installation

Qualified persons, as defined by 18 AAC 75.990(100), will be engaged in or directly supervise the collection and handling of environmental samples (i.e., Project Manager, Site Manager, Field Team Lead, Project Chemist, Field Sampler).

GENERAL

Groundwater level data can be used for several purposes during site investigations, including the following:

- To determine the magnitude of horizontal and vertical hydraulic gradients in an aquifer system
- To measure changes in groundwater levels over time

- To estimate the magnitude of surface water/groundwater interaction that occurs during various flow conditions
- To estimate aquifer properties after aquifer testing
- To calculate the purge volume of standing water in the well
- To establish whether wells have fully recharged after purging and aquifer testing

A water level meter will typically be used to measure the groundwater level and total depth in wells. If LNAPL is present in the well, an oil-water interface probe will be used.

Water level meters use a battery-powered probe assembly attached to a cable marked in 0.01-foot increments. When the probe contacts the water surface, a circuit is closed and electricity is transmitted through the cable to sound an audible and/or visual alarm. The equipment has a sensitivity adjustment switch that enables the operator to distinguish between actual and false readings caused by the presence of conductive, immiscible components (such as LNAPL floating on the groundwater) or condensation inside the well casing. Consult the manufacturer's operating manual for instructions on adjusting sensitivity.

Measure static groundwater level DTW, DTP, and TD relative to an established measurement reference point (generally the top of the casing). For easy reference, mark the point with a permanent surveyor's reference mark, such as a small notch cut into the casing or a permanent ink mark at the top of casing. If a reference mark is not present at the time of water level measurement, use and mark the north side of the casing. Decontaminate all equipment before and after introducing it to the well, following procedures in *SOP-24, Equipment Decontamination Procedures*.

RESPONSIBILITIES

Project Manager

The Project Manager is responsible for providing adequate resources and engaging field staff with adequate experience and training to successfully comply with and execute project-specific SOPs and implement the project HSE program. The Project Manager will solicit the appropriate technical expertise to adequately identify the best sampling methods and technology for the job given the current understanding of the site and project goals.

Health and Safety Manager

The HSM is responsible for site-specific and overall compliance with project HSE requirements. The HSM conducts PPE evaluations, selects the appropriate PPE for the project, lists the requirements in the project-specific Health and Safety Plan, coordinates with the Site Manager and/or Field Safety Officer to complete and certify the PPE program, and conducts audits on the effectiveness of the HSE program.

Site Manager

The Site Manager is assigned to oversee all project field operations and is responsible for verifying that the field SOPs are effectively communicated and appropriately implemented. The Site Manager will assist the Project Manager, Health and Safety Manager, and Field Team Lead regarding onsite activities.

Field Safety Officer

The Field Safety Officer assists in implementing the project Health and Safety Manager; the role of Field Safety Officer is either taken by the Field Team Lead or is designated to a field team member by the Field Team Lead. The Field Safety Officer assists the Health and Safety Manager with the HSE program, implements the PPE requirements described in the project HASP, and receives input from project staff on the effectiveness of the assigned PPE requirements and ongoing HSE procedures.

Field Team Lead

The Field Team Lead is responsible for determining that staff measuring water levels know the procedures in this SOP and that this SOP is implemented effectively and accurately. The Field Team Lead will also confirm that applicable requirements of the HASP are followed.

PROCEDURES

General

Decontaminate all measurement devices according to *SOP-24, Equipment Decontamination Procedures* before and between measurements.

Equipment

Use the following equipment for groundwater and NAPL level measurement:

- Water level meter with audible alarm and a cable marked in 0.01-foot increments. The point on the probe that triggers the alarm corresponds to the zero point. Calibrate the water level meter according to the manufacturer’s instructions.

- Oil-water interface probe and a cable marked in 0.01-foot increments, if a floating LNAPL layer is suspected in the well.

- Decontamination equipment (one spray bottle containing Alconox or Liquinox solution, one spray bottle containing deionized water, paper towels, five-gallon poly bucket, and absorbent pads).

- Additional weight may be necessary at depths deeper than 80 feet because of the buoyancy of the cable when the weight of the tape is approximately equal to or greater than the weight of the probe.

Depth to Water/Depth to LNAPL Measurement

If the well is sealed with an airtight cap, allow time for pressure to equilibrate after the cap is removed before measuring water levels. Take measurements until consecutive readings are within 0.01 foot.

Measure DTW and DTP as follows:

1. With the water level indicator switched on, wet the tip of the probe in potable water to test whether the meter is working properly. If no audible alarm is observed, the meter is not working properly.

2. Slowly lower the water level meter or oil-water indicator probe down the monitoring well until the probe contacts the groundwater or LNAPL surface, as indicated by the audible alarm. Do not let the probe tip and tape free-fall down the well. Always hold onto the meter's reel handle.

3. Raise the probe out of the water or LNAPL until the audible alarm stops. Continue raising and lowering the probe until a precise level is determined within 0.01 foot.

4. If LNAPL is present in the well, measure and record the depth from the TOC reference point to the top surface of the LNAPL layer (that is, DTP). The oil-water indicator probe alarm will sound a continuous tone when LNAPL is detected.

5. Continue to lower the probe until the meter indicates the presence of groundwater. The alarm will typically emit a beep when water is detected. Measure the first static groundwater level and record the measurement (DTW) from the reference point to the top of the static groundwater level.

6. Record the measurements in the field logbook or groundwater sampling datasheet according to *SOP-01, Logbook Documentation and Field Notes*.

Total Depth Measurement

Use the following procedures to measure the TD of a groundwater monitoring well:

1. Slowly lower the water level meter until the cable goes slack. Do not let the probe tip and tape free-fall down the well. Always hold onto the meter's reel handle.

2. Gently raise and lower the water level meter probe to tap the bottom of the well.

3. Record the reading on the cable at the established reference point to the nearest 0.01 foot. If there is an offset between the bottom of the probe and the water level sensor, adjust the measurement accordingly. Record the TD measurement in the field logbook or groundwater sampling datasheet according to *SOP-01, Logbook Documentation and Field Notes.*

RECORDS

Document all measurements in the field notebook and/or on a groundwater sampling datasheet according to *SOP-01, Logbook Documentation and Field Notes.*

REFERENCES

Alaska Department of Environmental Conservation (ADEC). 2011. *Monitoring Well Guidance.*

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SOP-08 Water Quality Measurements and Calibrations

PURPOSE

This SOP describes general methods for calibrating, maintaining, and operating water quality meters and probes used for groundwater sampling.

SCOPE

This SOP applies to all Swift River team personnel responsible for collecting water quality parameters during well development, sampling, or for other purposes in projects in Alaska. The SOP was developed per the following ADEC guidance documents:

- Draft Field Sampling Guidance (ADEC, 2010)
- Underground Storage Tanks Procedures Manual: Guidance for Treatment of Petroleum-Contaminated Soil and Groundwater and Standard Sampling Procedures (ADEC, 2002)

This SOP focuses on the most commonly used field water quality measurement tasks and applications anticipated and should be used in conjunction with other applicable project SOPs, including the following:

- *SOP-01, Logbook Documentation and Field Notes*
- *SOP-08, Groundwater Well Sampling*
- *SOP-09, Surface Water Sampling*
- *SOP-11, Hydropunch Groundwater Sampling*
- *SOP-24, Equipment Decontamination Procedures*

Qualified persons, as defined by 18 AAC 75.990(100), will be engaged in or directly supervise the collection and handling of environmental samples (i.e., Project Manager, Site Manager, field Team Lead, Project Chemist, Field Sampler).

GENERAL

Water quality meters are typically used in the field to measure the following parameters:

- DO
- ORP
- Conductivity
- pH
- Turbidity
- Temperature

Instructions for maintenance and operation of these field instruments are described in the operation manuals provided by the manufacturer.

RESPONSIBILITIES

Project Manager

The Project Manager is responsible for providing adequate resources and verifying that field staff have adequate experience and training to successfully comply with and execute project-specific SOPs and implement the project health, safety, and environment program. The Project Manager will solicit the appropriate technical expertise to verify that the project has identified the best sampling methods and technology for the job given the current understanding of the site and project goals.

Field Team Lead

The Field Team Lead is responsible for implementation of a detailed sampling plan that includes the specifics of field water quality measurement, particularly the procedures to be used. The Field Team Lead, or their designee, should know the requirements for field water quality measurement and should maintain adequate documentation of field water quality measurements and calibration activities. The Field Team Lead is also responsible for verifying compliance with this SOP and that all field staff engaged in this activity are trained in this SOP.

Health and Safety Manager

The Health and Safety Manager is assigned to oversee site-specific HSE and verify overall compliance with project HSE requirements. The Health and Safety Manager conducts PPE evaluations, selects the appropriate PPE for the project, lists the requirements in the Project HASP, coordinates with the Field Team Lead and/or Field Safety Officer to complete and certify the PPE program, and conducts project health and safety audits on the effectiveness of the HSE program.

PROCEDURES

Instruments and Supplies

Water quality meters and instruments vary in their manufacturer and model number. Below is a list of commonly used meters and instruments and other related supplies that can be used for field water quality measurements:

- MPS Multi-parameter Instrument
- YSI 650 MDS Multi-parameter Datalogger
- YSI 6-Series sonde or similar multiparameter probe
- YSI 5083 Flow Cell or similar flow-thru cell
- Hach 2100P Portable Turbidimeter

- Data transfer connector cables
- Discharge hoses (two)
- Fittings to attach sample tubing to-flow through cell (barbs and master flex pump tubing)
- Distilled water
- Calibration solutions and buffers (ORP, conductance, pH, and confidence)

Calibration

Calibration or verification of calibration using a confidence solution or standard, of all instruments for all field parameters daily before collecting water quality data, according to the manufacturer calibration specifications developed for the instrument being calibrated. In addition, if there are anomalous readings during sample collection, stop sample collection and recalibrate, if possible. Document field calibration in the field logbook.

If a field instrument will not calibrate, perform troubleshooting as described in the manufacturer's manual. Check that the calibration standards have not expired. If the issue cannot be resolved, use a backup instrument. If one is not available, consult with the PM on whether data collection should continue and on any other corrective actions to be taken. Flag any data recorded from a meter with calibration problems on the groundwater purge and sampling field datasheet as discussed and provided in *SOP-08, Groundwater Well Sampling Procedures* and *SOP-09, Surface Water Sampling.*

pH Calibration (2-point or 3-point calibration)

Calibrate using at minimum a 2-point calibration method. A 2-point calibration uses only two pH buffer calibration solutions (for example, pH 4 and pH 7 or pH 7 and pH 10) and is valuable only if the water being monitored is known to be either basic or acidic. For example, if the pH is known to vary between 5.5 and 7, a 2-point calibration with a pH 7 and pH 4 buffer solutions is sufficient.

If the pH of water being measured is unknown, use a 3-point calibration method. Using this calibration, the pH sensor is calibrated with a pH 7 buffer and two additional buffers (such as pH 4 and pH 10). The 3-point calibration method accounts for the full pH range and assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. Typically, the procedure for a 3-point calibration is the same as for a 2-point calibration, but the instrument may prompt you to select a third pH buffer. Follow the recommended manufacturer pH calibration instructions for additional detailed instruction. Enter all pH calibration values based on the appropriate temperature as labeled on the pH calibration solutions used or according to Table 1. Record the final pH calibration reading, with the corresponding temperature, on the Field Calibration Sheet.

Table 1. pH Buffer Solution Values Based on Temperature

Temperature	pH Buffers			Temperature	pH Buffers		
°C	4.01	7	10.01	°C	4.01	7	10.01
0	4	7.11	10.32	26	4.01	6.99	10
1	4	7.11	10.31	27	4.01	6.99	9.99
2	4	7.1	10.29	28	4.01	6.99	9.98
3	4	7.09	10.28	29	4.01	6.99	9.98
4	4	7.09	10.26	30	4.02	6.98	9.97
5	4	7.08	10.25	31	4.02	6.98	9.96
6	4	7.08	10.23	32	4.02	6.98	9.95
7	4	7.07	10.22	33	4.02	6.98	9.94
8	4	7.07	10.21	34	4.02	6.98	9.93
9	4	7.06	10.2	35	4.02	6.97	9.93
10	4	7.06	10.18	36	4.03	6.97	9.92
11	4	7.05	10.17	37	4.03	6.97	9.91
12	4	7.05	10.16	38	4.03	6.97	9.9
13	4	7.04	10.14	39	4.03	6.97	9.9
14	4	7.04	10.13	40	4.03	6.97	9.89
15	4	7.03	10.12	41	4.04	6.97	9.88
16	4	7.03	10.11	42	4.04	6.97	9.88
17	4	7.02	10.1	43	4.04	6.96	9.87
18	4	7.02	10.09	44	4.04	6.96	9.86
19	4	7.02	10.08	45	4.04	6.96	9.86
20	4	7.01	10.06	46	4.05	6.96	9.85
21	4.01	7.01	10.05	47	4.05	6.96	9.85
22	4.01	7.01	10.04	48	4.05	6.96	9.84
23	4.01	7	10.03	49	4.05	6.96	9.84
24	4.01	7	10.02	50	4.06	6.96	9.83
25	4.01	7	10.01	51	4.06	6.96	--

Conductivity Calibration

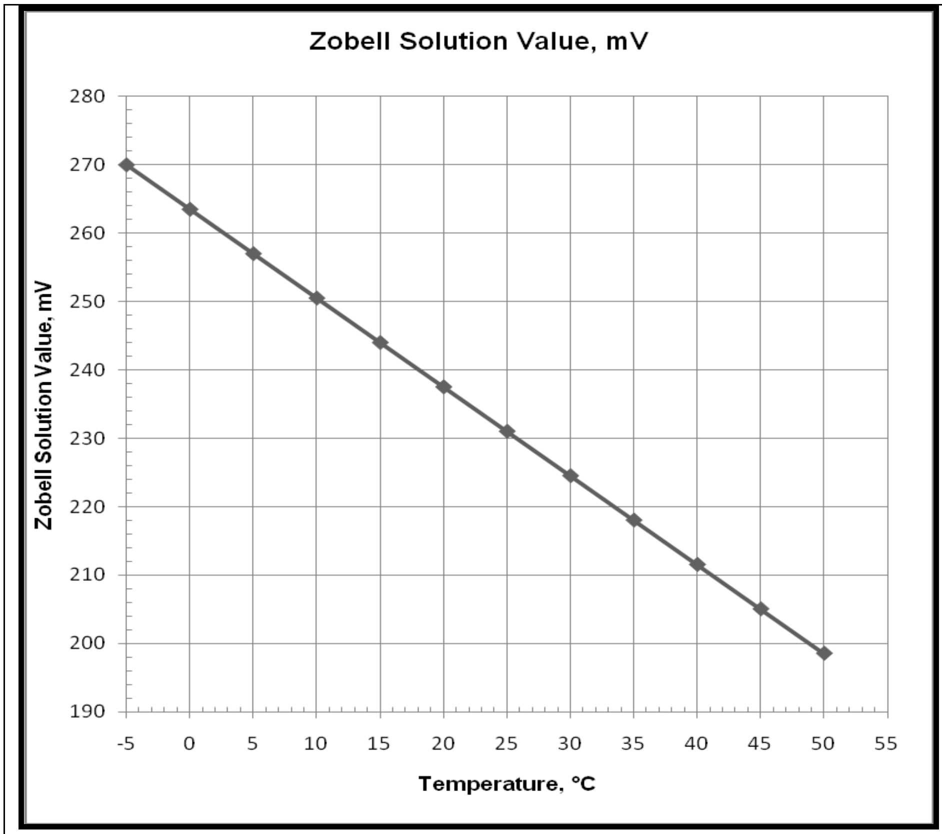
Perform calibration for conductivity according to the recommended manufacturer’s calibration instructions. Conductivity should be calibrated for specific conductance and is typically entered as mS/cm at 25 ºC. Typical conductivity standard solution has a specific conductance value of 1.413 mS/cm; which is equivalent to 1413 µS/cm or 1413 µmho/cm. Table 2 summarizes the value relationship of a 1413 µS/cm (1.413 mS/cm) standard solution to temperature and should be referenced following calibration to verify an accurate final conductivity calibration at the appropriate temperature of the calibration solution used. Record the final conductivity calibration reading, with the corresponding temperature, on the Field Calibration Sheet.

Table 2. Conductivity Standard Solution Values Based on Temperature

Temperature	**1413 µS/cm Conductivity Standard**	**Temperature**	**1413 µS/cm Conductivity Standard**
˚C	(µS/cm)	˚C	(µS/cm)
0	776	26	1441
1	799	27	1468
2	822	28	1496
3	846	29	1524
4	870	30	1552
5	894	31	1580
6	918	32	1608
7	943	33	1636
8	968	34	1665
9	992	35	1693
10	1017	36	1722
11	1043	37	1751
12	1068	38	1780
13	1094	39	1808
14	1119	40	1837
15	1145	41	1866
16	1171	42	1896
17	1198	43	1925
18	1224	44	1954
19	1251	45	1983
20	1277	46	2013
21	1304	47	2042
22	1331	48	2071
23	1358	49	2101
24	1386	50	2130
25	1413		

Calibration Check of the Oxidation Reduction Potential Probe

A calibration check of the ORP probe can be performed by placing it into a Zobell solution that is within approximately 10°C of the expected groundwater temperature, or as close to groundwater temperature as practical. Groundwater temperatures ranging from approximately 3°C to 10°C can generally be expected in Alaska. This is not a calibration solution, but a check that the probe is working properly. Zobell solution has a short shelf life, typically lasting only 3 months. If expired, make or obtain new solution before measurement. The Zobell reading is dependent upon temperature and should fall within 20% of the value shown in Figure 1 before taking measurements. If readings are out of this range, then take a second reading with a backup electrode. If both instruments fail, replace the Zobell solution, and repeat the measurements. Record the Zobell solution ORP reading, with the corresponding temperature, on the field calibration sheet.



Temperature °C	Zobell Solution Value, mV
-5	270
0	263.5
5	257
10	250.5
15	244
20	237.5
25	231
30	224.5
35	218
40	211.5
45	205
50	198.5

Figure 1. Zobell Solution ORP Dependence on Temperature for a Silver Chloride (Ag:AgCl) Electrode

Turbidity Calibration Check

Perform routine calibration check of the turbidity instrument using the standards provided by the rental company. Record the calibration standard value and the calibrated turbidity value of each standard in the field logbook.

Water Quality Instrument Field Measurement and Usage

The general procedures for measuring groundwater quality parameters and flow-through cell setup are as follows:

1. Before taking any field measurements, calibrate instruments according to the manufacturer’s procedures and record the calibration on the Field Calibration Sheet.
2. Perform a saturated air check of the DO probe by placing a wet piece of cloth or paper towel in the cap that covers the probe. If the instrument is not reading in the proper range, it should be recalibrated, or the DO probe membrane should be replaced.
3. Secure the multi-meter sonde (or analyte-specific probes) to the flow-through cell. Connect a short discharge tube to the effluent connector at the top of the flow-through cell and run the other end of the discharge tube into a 5-gallon purge water capture bucket.
4. Place the tube from the pump directly into the 5-gallon purge water bucket and start to purge (pump) for approximately 1 to 2 minutes or until the purge water begins to visually clear up. The intent is to limit any initially high turbidity water from filling and settling in the flow-through cell.
5. Once the turbidity has stabilized, briefly turn off the pump and secure the tube from the pump to the influent connector at the bottom of the flow-through cell. Turn on the pump again and allow the flow-through cell to completely fill with water. Try to keep air bubbles from collecting in the flow-through cell. To remove any collected air from the cell, disconnect the probes from the cell while pumping until all the air escapes and then reconnect the probes.
6. Continue pumping and begin low-flow purging of the monitoring well at a flow rate of approximately 1 liter (0.25 gallons) every 3 minutes or 0.1 gal/min.
7. Routinely measure and record the DO, ORP, conductivity, pH, turbidity, temperature, and current groundwater level throughout the purge at approximately 3- to 5-minute intervals. A minimum of three (minimum of four if using temperature as an indicator) of these parameters should be monitored and recorded. Record the purge groundwater parameters on Attachment 3: Groundwater Purge and Sampling Field Datasheet.
8. Continue to measure and record the groundwater parameters and current groundwater level until the parameters stabilize according to the following stabilization criteria, or until three well casing volumes are purged. Groundwater parameters are considered stable after purging if three successive readings are within the following parameters:

    - ± 3% temperature (minimum of ± 0.2 ^{o}C)
    - ± 0.1 pH
    - ± 3% conductivity
    - ± 10 mV ORP
    - ± 10% ppm DO or 0.2 mg/L
    - ± 10% turbidity or ≤ 5 NTUs

9. Note the following before and during water quality measurement and groundwater purging:

    - Obtain the typical ranges for the water quality parameters at a well (or site) prior to measurement and purging, if possible, and bring these values to the field for reference during sampling. Water quality parameter ranges can often be obtained from historical groundwater purging and sampling events. These previous values should be used as clues to determine if an instrument is reading correctly and/or if it is drifting during water quality measurement.
    - ORP and DO measurements should always correlate with each other. Generally ORP should be negative whenever DO is near or less than 1 mg/L; likewise, DO should be greater than 1 mg/L if ORP is positive.
    - DO measurement <u>should always be positive</u> and should range between 0 and 14.62 mg/L.
    - ORP measurements should range between -500 mV and 275 mV.
    - The pH of environmental samples will typically range from 6 to 8 pH units.
    - When measuring turbidity, be sure to clear any moisture or dust off of the turbidity sample cell and emplace the sample cell and light cover completely and securely. Keep the turbidity instrument out of direct sunlight (it should be shadowed) to avoid false readings from light interference.

10. When parameters have stabilized, record final measurements and collect samples as specified in *SOP-08, Groundwater Well Sampling Procedures* and *SOP-09, Surface Water Sampling.*

Storage

Perform the following tasks each day after using any water quality measurement instrument:

1. Decontaminate the instrument(s): rinsing with distilled water, a dilute solution of Alconox or Liquinox (or similar), and rinsing again with distilled water as specified in *SOP-24, Equipment Decontamination Procedures*.
2. Moisten protective caps (that protect the tips of probes or sensors) with fresh water and return them to their probes or sensors for storage.
3. Recharge or replace batteries on any instruments and meters to ensure full battery charge for next use.
4. Store the instrument or meter in the protective case provided with the instrument or meter.
5. Take any additional storage and maintenance steps recommended by the manufacturer as specified in the instruments operations and maintenance manual.

Service and Maintenance

Perform service and maintenance according to manufacturer's instructions.

RECORDS

Record all instrument calibration information on the Instrument Calibration Log, provided in Appendix D. Calibration information that should be recorded into the logbook for each instrument calibrated includes the brand and model number, unique identification number, type, lot number, expiration date of any calibration solutions, and results of the calibration. Record all field data collected during groundwater sampling on a Groundwater Sampling Record and Well Evacuation / Field Parameters Forms provided in Appendix D.

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SOP-09 Monitoring Well Installation

PURPOSE

This SOP provides the methodology for installing and constructing groundwater monitoring wells during the monitoring and soil removal for CG 517 and CS081 at Eielson Air Force Base.

SCOPE

This SOP applies to all Swift River team personnel and subcontractors engaged in installation and construction of groundwater monitoring wells at Eielson AFB. This SOP was developed in accordance with this guidance document:

- *Monitoring Well Guidance* (ADEC, 2013)

This SOP focuses on the most common tasks for monitoring well installation anticipated and will be used in conjunction with other applicable project SOPs, including:

- *SOP-01, Logbook Documentation and Field Notes*
- *SOP-15, Drilling Methods*
- *SOP-24, Equipment Decontamination Procedures*

Qualified persons, as defined by 18 AAC 75.990(100), will be engaged in or directly supervise the collection and handling of environmental samples (i.e., Project Manager, Site Manager, field Team Lead, Project Chemist, Field Sampler).

GENERAL

Data collected from monitoring wells during investigation activities support various site characterization objectives, including (1) delineation of the nature and extent of contaminant plumes, (2) development of a conceptual model of the subsurface lithology, (3) assessment of aquifer properties, and (4) development of a long-term monitoring network to detect trends in site groundwater elevations and contaminant concentrations. Wells installed for each of these purposes must satisfy different requirements and may require different strategies for well design and installation. Representative groundwater samples and groundwater-level measurements depend on proper monitoring well design and construction, which should reflect anticipated contaminant types and concentrations, project objectives, and site conditions. Selection of monitoring well type, construction materials, and drilling methodology is commonly a site-specific determination. Site logistics and economics also influence well design and installation choices.

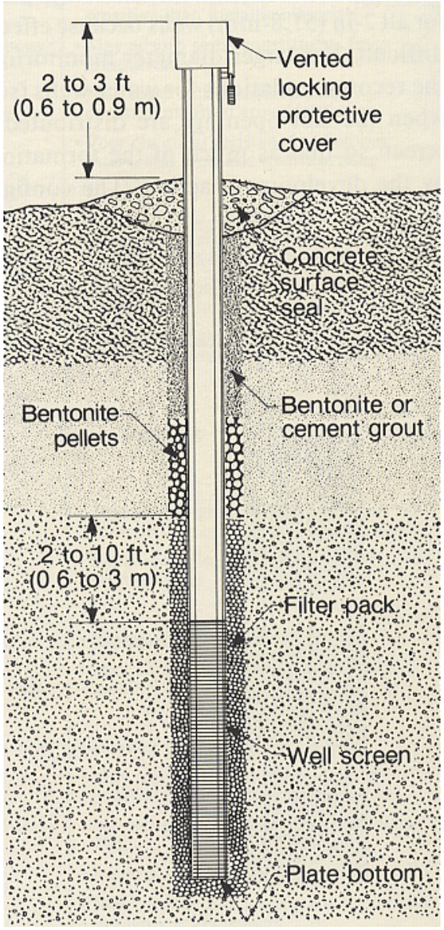
Well design and installation must prevent the introduction of surface contaminants into the groundwater and prevent the transfer of groundwater or contaminants between stratigraphic intervals within the well borehole or along the well annulus. Monitoring wells will not be installed in locations where they are subject to periodic or seasonal inundation by floodwaters unless the well has special watertight construction. Monitoring well integrity will be protected from soil erosion, soil settlement, shrink-swell soil conditions, frost-heaving of soils, damage by vehicles or heavy equipment, and other site-specific hazards. Monitoring wells be completed at grade or below grade.

Drilling techniques anticipated for use during the Eielson site investigation include hollow stem auger (HAS) which will be used to install 2-inch-diameter permanent groundwater monitoring wells or when consolidated geologic conditions are expected.

Successful installation of a monitoring well requires that the procedures for installing each component of the well are followed and well documented. A well installation has nine essential components:

- Well casing
- Well screen
- Filter pack
- Annular seals (lower and upper surface seals)
- Surface completion
- Well protection
- Field logbooks
- Well completion report
- Records management

Figure 1 illustrates the design of a typical groundwater monitoring well.



RESPONSIBILITIES

Project Manager

The Project Manager verifies that monitoring well installation procedures comply with this SOP and the requirements of the enforcing agencies. The Project Manager also documents and approves alternative installation requirements and procedures required by local agencies, or other modifications.

Site Manager

The Site Manager is responsible for the coordination and scheduling of daily field activities and for ensuring that monitoring wells are installed in compliance with this SOP and that all field staff engaged in monitoring well installation are trained in this SOP.

Field Team Lead

The Field Team Lead develops or directs the development of a detailed sampling plan that includes the specifics of the well design and installation, particularly the materials and procedures to be used. The Field Team Lead, or that person's designee, knows the requirements for well installations and maintains adequate documentation of the installation process and materials used to demonstrate that the well has been properly installed.

Health and Safety Manager

The Health and Safety Manager oversees site-specific HSE protocols and overall compliance with project HSE requirements. The Health and Safety Manager conducts PPE evaluations, selects the appropriate PPE, identifies requirements in the project-specific HASP, coordinates with the Site Manager and Field Safety Officer to certify the PPE, and conducts project health and safety audits to evaluate the effectiveness of the HSE program.

Field Safety Officer

The Field Safety Officer assists in implementing the project HASP; the role of Field Safety Officer is either taken by the Site Manager or is designated to Field Team Lead by the Site Manager. The Field Safety Officer assists the Health and Safety Manager with the HSE program, implements the PPE requirements described in the project HASP, and receives input from project staff on the effectiveness of the assigned PPE requirements and ongoing HSE procedures.

PROCEDURE

Monitoring wells will be installed under the direct supervision of a qualified geologist, engineer, or other professional. Permanent monitoring wells will be constructed in accordance with *Monitoring Well Guidance* (ADEC, 2013).

A monitoring well is generally composed of a well casing, well screen, filter pack, and sanitary or grout seal. Install permanent monitoring wells in open boreholes advanced by an HSA drill rig. Advance soil borings until the desired depth is obtained and the subsurface soil demonstrates saturated soil conditions. Once the desired borehole depth is obtained, remove all drill tooling from the borehole and install the monitoring well. Ensure the diameter of the HSA borehole is at least 4 inches larger than the outside diameter of the blank casing and screen; this dimension allows for proper installation of materials within the annular space to create an adequate annular seal.

Follow these general guidelines to properly complete each monitoring well to the desired depth:

1. Properly decontaminate well construction materials before installation.
2. Prevent contamination when casings are being joined and the screens are being attached.

3. Pour the filter pack into the annulus to a minimum of 2 feet above the top of the screen and 1 foot beneath the well end cap.
4. Use bottom caps or end plugs.
5. Use permanent or temporary surface casing if contamination or sloughing is a potential issue.
6. Apply filter packs very slowly to avoid bridging (unless a prepacked filter is used).
7. After installation, sound the filter pack for proper placement.
8. Place a fine-grain sand filter (0.5 to 2 feet thick) at the top of the filter pack and below the annular seal, to help prevent infiltration of bentonite into the filter pack.
9. Apply bentonite pellets or granules, to seal the annular space.
10. If the well is 40 feet or deeper, pump grout or slurry into the annular space using a tremie pipe.
11. For wells less than 40 feet deep, pour grout or slurry freely into the annular space, with or without the use of a tremie pipe.
12. If more than 10 feet of standing water is present, use a tremie pipe to install neat cement and bentonite-cement grouts.
13. Submerge the end of the tremie pipe in the sealing material when a slurry or grout is being installed.
14. When using a slurry or grout, allow 24 hours between installation of the annular space seal and installation of the protective pipe cover. Fill any settlement in the annular space seal before the protective cover is installed.
15. Install a cement surface seal at the ground surface.

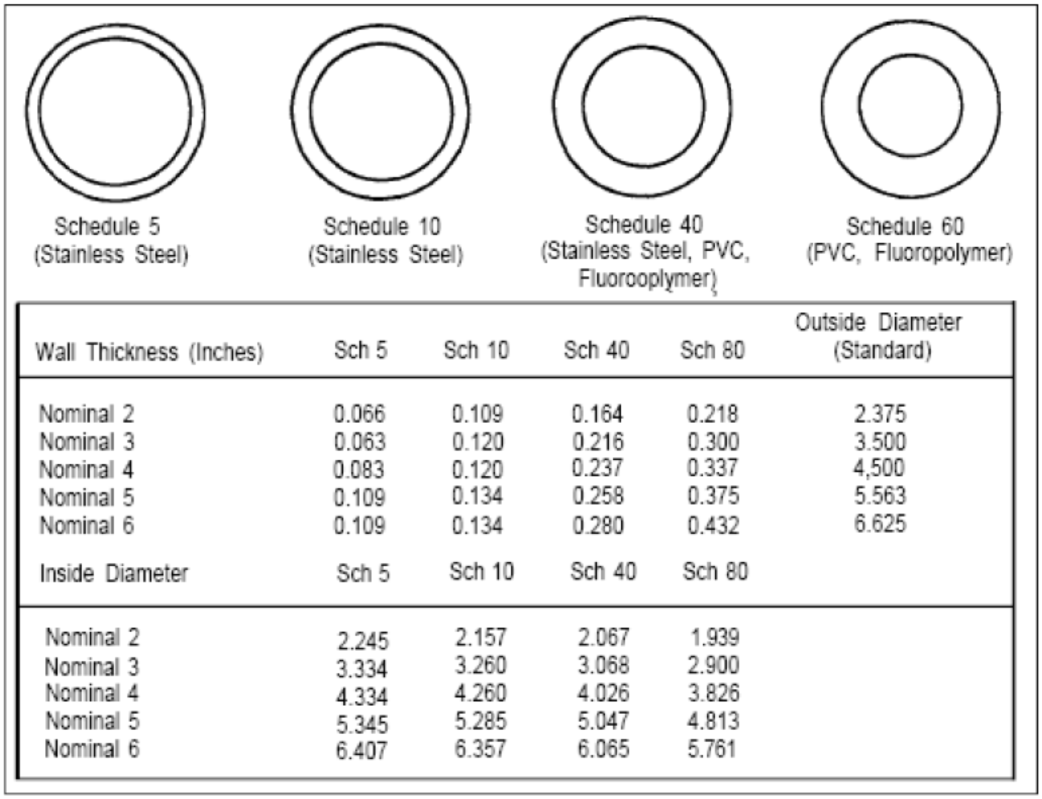
Well Casings and Well Screens

Well Casing

The well casing allows access to groundwater from the ground surface. To eliminate the introduction of adhesive contaminants into the groundwater when sampling, join casing sections with threaded couplings rather than glues. Use O-rings to complete the seal for threaded couplings, and complete the well casing to be flush, on the inside.

Allow an inside diameter for the well casing of at least 1.9 inches. Monitoring wells in Alaska commonly use Schedule 40 PVC, nominal 2-inch-diameter casing. Deeper wells, or wells that need large, dedicated pumps or tubing, may require 4-, 6-, or 8-inch-diameter casing. However, most monitoring wells will use a smaller casing (2 or 4 inches diameter) to minimize the amount of water generated during sampling events. Table 1 lists the inside diameters of various well casings.

TABLE 1
Casing Thickness and Diameter for Monitoring Well Materials (EPA, 1991a)

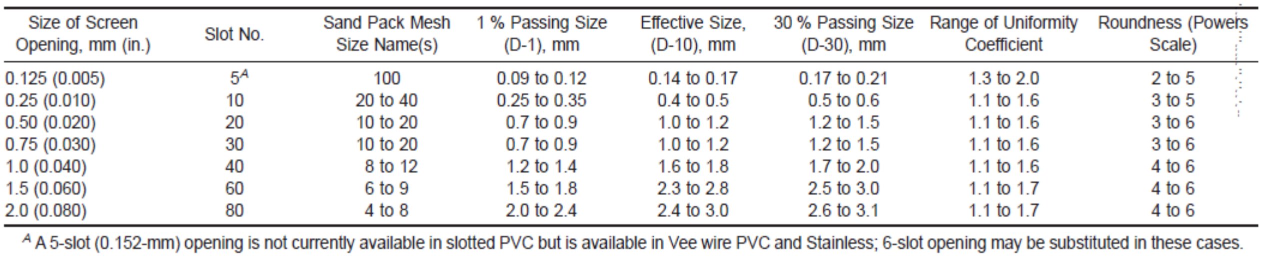


Wall Thickness (Inches)	Sch 5	Sch 10	Sch 40	Sch 80	Outside Diameter (Standard)
Nominal 2	0.066	0.109	0.164	0.218	2.375
Nominal 3	0.063	0.120	0.216	0.300	3.500
Nominal 4	0.083	0.120	0.237	0.337	4,500
Nominal 5	0.109	0.134	0.258	0.375	5.563
Nominal 6	0.109	0.134	0.280	0.432	6.625
Inside Diameter	Sch 5	Sch 10	Sch 40	Sch 80	
Nominal 2	2.245	2.157	2.067	1.939	
Nominal 3	3.334	3.260	3.068	2.900	
Nominal 4	4.334	4.260	4.026	3.826	
Nominal 5	5.345	5.285	5.047	4.813	
Nominal 6	6.407	6.357	6.065	5.761	

Well Screen

The well screen is the part of the well that allows groundwater to enter into the monitoring well and allows access to the aquifer. Determining the slot size and well screen length characteristics of a well screen depends on the purpose of the monitoring well and aquifer characteristics. Determine the proper slot size of the well screen based on the filter pack selected for the monitoring well and the formation material. Monitoring wells typically installed in Alaska within unconsolidated soil use a 20-slot (0.020-inch) well screen with a No. 10-20 silica sand pack or 10-slot (0.010-inch) well screen with a No. 20-40 silica sand pack. Size screen slots to prevent 90 percent of the filter pack from entering the well. Monitoring wells will use commercially manufactured, machine-slotted well screens. Table 2 lists the recommended screen slot size and filter pack characteristics.

TABLE 2
Recommended Filter Pack Characteristics for Common Screen Slot Sizes (ASTM D5092)



Size of Screen Opening, mm (in.)	Slot No.	Sand Pack Mesh Size Name(s)	1 % Passing Size (D-1), mm	Effective Size, (D-10), mm	30 % Passing Size (D-30), mm	Range of Uniformity Coefficient	Roundness (Powers Scale)
0.125 (0.005)	5[A]	100	0.09 to 0.12	0.14 to 0.17	0.17 to 0.21	1.3 to 2.0	2 to 5
0.25 (0.010)	10	20 to 40	0.25 to 0.35	0.4 to 0.5	0.5 to 0.6	1.1 to 1.6	3 to 5
0.50 (0.020)	20	10 to 20	0.7 to 0.9	1.0 to 1.2	1.2 to 1.5	1.1 to 1.6	3 to 6
0.75 (0.030)	30	10 to 20	0.7 to 0.9	1.0 to 1.2	1.2 to 1.5	1.1 to 1.6	3 to 6
1.0 (0.040)	40	8 to 12	1.2 to 1.4	1.6 to 1.8	1.7 to 2.0	1.1 to 1.6	4 to 6
1.5 (0.060)	60	6 to 9	1.5 to 1.8	2.3 to 2.8	2.5 to 3.0	1.1 to 1.7	4 to 6
2.0 (0.080)	80	4 to 8	2.0 to 2.4	2.4 to 3.0	2.6 to 3.1	1.1 to 1.7	4 to 6

[A] A 5-slot (0.152-mm) opening is not currently available in slotted PVC but is available in Vee wire PVC and Stainless; 6-slot opening may be substituted in these cases.

in. = inch(es)

The type of well screen and slot size controls the amount of open area in a well intake (EPA, 1991a). In addition, the depth of the screened interval and the well screen length can affect the water quality and hydraulic characteristic results. Minimize the length of the well screen to avoid dilution during sampling. Increase the open area in the monitoring well screen to allow effective development and easy flow of water from the formation into the well. Determine the well screen depth and length on a site-specific basis in consideration of water table variations, site stratigraphy, expected contaminant behavior, and groundwater flow. Typically, well screens are 1 to 10 feet long and only rarely equal or exceed 20 feet (EPA, 1991a). Conventional monitoring well screens at petroleum-contaminated sites in Alaska are typically 10 feet long and are installed with a portion of the screen above the high-water table to allow for seasonal water table fluctuations.

Materials

Various construction materials are used for the well casings and well screens. The material used for well screens is generally selected based on the same guidelines used for selecting well casing. Many different casing materials are used in design of a monitoring well; thermoplastic materials (such as PVC) and stainless steel are the most widely used. Typically in Alaska, PVC well screens are used because they provide a strong monitoring well with good chemical resistance (EPA, 1991a). The type of well casing and well screen material to be used, screening intervals, screen slot sizes, and specific material decontamination procedures are provided in the site-specific field sampling plans.

Installation Procedures

Follow these general procedures when installing well casings and well screens:

- Keep the well casing sealed in plastic until it is ready to be installed into the borehole.
- Carefully assemble and install well casings and screens to prevent damage to the sections and joints.
- Ensure mechanical connection of sections of well casing and screen, such as with flush threading. Do not use glue or solvents to connect or seal casing.
- Secure an end cap at the bottom of the well screen before one or more sections of well screen are installed into the well boring.

- If prepack well screens are being used, take care not to tear or damage the outer fabric or screen holding the prepack filter sand to the well screen.
- Install the well casing and well screen straight and plumb and center it within the middle of the borehole.
- Install the filter pack from the bottom of the borehole to at least 2 feet (up to 5 feet) above the top of the well screen. At locations that have shallow groundwater, place the filter pack to extend to at least 1 foot above the top of the screen.
- During installation, place a cap on top of the casing to prevent well materials from entering the well casing.
- Verify that the completed monitoring well is sufficiently straight to allow passage of pumps or sampling devices.
- Document the calculated and actual quantities of materials used in the well installation and the condition of well materials in the field logbook as described in *SOP-01, Logbook Documentation and Field Notes*.

Filter Pack

The well screen of each monitoring well will be surrounded by a permeable, course-grained sand known as the filter pack. Fill the annular space surrounding the well screen with a filter pack of uniform-grain-size sand that is coarser and has a higher permeability than the natural, surrounding formation. This will allow groundwater to flow freely into the well from adjacent formation material and minimize or eliminate fine-grain material from entering the well. Do not use of natural formation material as the only filter pack.

In Alaska, most monitoring wells within unconsolidated soils are installed with either a No. 10-20 or 20-40 silica sand filter pack. Verify that the filter pack extends above the well screen to a length of 20 percent of the well screen length, but no less than 2 feet. The thickness of the filter pack between the borehole and the well screen will be at least 2 inches but no greater than 8 inches (EPA, 1991a).

Materials

Filter pack materials will be poorly graded (well-sorted) to provide good permeability and hydraulic conductivity of the materials near the screen. Check that the filter pack material is clean, chemically inert, and well-rounded siliceous material, slightly coarser than the surrounding formation. Use of coarser material increases the effective well diameter. The sand or gravel used for filter packs will be of uniform size, will be hard and durable, and will have an average specific gravity of 2.50 or greater. Obtain the filter pack material from known clean sources; check that it is well washed and free of clay, dust, and organic matter. Do not allow more than 5 percent of the sand or gravel to be soluble in hydrochloric acid.

Verify that filter pack material meets NSF standards and is packaged in properly sealed and marked packages. Record the NSF label information and any associated lot or identification numbers in the field logbook.

The filter pack will be designed for the anticipated and tested grain-size distribution in the screened formation and the size of well screen openings (Table 2). The filter pack will have a grain-size distribution and uniformity coefficient compatible with the formation materials and the screen (Driscoll, 1986). Check that the filter pack does not extend across more than one water-bearing unit (or aquifer), and that it is installed in all wells (deep or shallow) in a manner that minimizes bridging and void spaces in the filter pack.

Fill any open annular space outside of a prepack filter to the maximum extent practical with additional filter pack material, as previously described. If applicable, use natural collapse to fill annular space around a prepack filter.

Installation Procedures

Follow these general procedures to optimize the installation of the filter pack and the quality of the well:

- Calculate the volume of the well annulus (the filter pack required), and document in the field logbook the type and volume of the filter pack material installed.
- Record in the field logbook the NSF label information and any associated lot or identification numbers from the filter pack material.
- Periodically measure the filter pack during installation by using a sounder or weighted measuring tape to confirm uniform placement and prevent bridging.
- Measure the depth of the top of the filter pack to verify the thickness of the pack and to confirm proper depth placement above the well screen (at least 2 feet above the screen).
- Do not allow the filter pack to extend into any aquifer other than the aquifer to be monitored, under any circumstance.

Annular (Bentonite) Seal

Annular seals prevent vertical movement of water or contaminants among the filter pack, the adjacent soil formation, and the natural backfill material above the screen.

Standard monitoring wells have two annular seals: one above the filter pack (lower seal) and one at the ground surface (upper seal). All permanent monitoring wells will be constructed with a lower annular seal at the top of the filter pack to confine the well screen within the desired sampling interval. Ensure that the lower annular seal is installed at least 2 feet thick on the top of the filter pack to prevent seal material from leaching into the filter pack. Pelletized bentonite is preferred for this application; however, a bentonite slurry or similar material may also be used, if appropriate.

Install the upper annular seal near the ground surface to protect the well from infiltration of surface runoff and potential aboveground contaminants. Install the upper annular seal at least 2 feet thick and will extend from approximately 1 to 2 feet below ground surface (bgs) to 3 to 4 feet bgs. This annular seal will be composed of bentonite pellets, bentonite slurry, or similar material.

For shallow wells constructed with approximately only 5 to 6 feet between the top of the filter pack and the ground surface, it is acceptable to combine the upper and lower annular seals into a single annular bentonite seal approximately 3 to 4 feet thick from the top of the filter pack to approximately 1 to 2 feet bgs. For deeper wells, fill the annular space between the two seals with soil cuttings, a bentonite slurry, or coarse bentonite chips.

When using bentonite pellets to seal the filter pack, install the pellets sequential, one-foot-thick layers. Hydrate each layer by pouring an approximately equal volume of clean, potable water into the borehole before the next layer of pellets is placed. Continue this process until the required minimum 2-foot seal thickness is installed. Use a weighted tape measure, measuring rod, or similar measurement device to check that the filter pack seal is installed in the proper depth interval. Bentonite grout is suggested when freeze-thaw processes may affect the well.

Materials

Pelletized bentonite is preferred for application of the annular bentonite seal; however, you may also use the following:

- Neat cement grout (not recommended for use with Schedule 40 PVC well casing or where shrinkage might allow leakage along the casing)
- Sodium-based bentonite slurry with a mud weight of at least 10 pounds per gallon
- Sodium-based bentonite granules
- Sodium-based bentonite pellets
- Bentonite-cement grout

Measure the thickness of the bentonite before hydration. Check that the permeability of the seal will be one to two orders of magnitude less than that of the surrounding formation and that the seal is chemically compatible with the anticipated contaminants and chemically inert so that the seal does not affect the quality of groundwater samples.

Use fine-grain bentonite, such as granules and powder, for seals placed above the existing water level. If necessary, use a bentonite slurry for the bentonite seal below the existing water level, or coarse bentonite, such as pellets and chips, for bentonite seals located just below the groundwater level.

Installation Procedures

Follow these procedures for placement of the annular seals:

- When installing an annular seal, determine the type and volume of annular seal material needed by referring to the information in the well borehole log. Record in the field logbook the type, calculated volume, and actual volume of annular seal material used.
- Install at least 2 feet of lower annular seal material above the filter pack.
- Install at least 2 feet of upper annular seal material at least 1 to 2 feet bgs.

- If applicable, at locations where there is shallow groundwater, combine the upper and lower annular seal so that there is 2 feet of filter pack above the well screen and 3 to 4 feet of annular seal. Document such alternative procedures in the field logbook.
- Install the annular seal in 1-foot layers or less and hydrate with clean, potable water between layers.
- Verify that water used for bentonite hydration or for mixing bentonite slurry is from an approved potable source, of suitable quality, and free of pollutants and contaminants. Document in the field logbook the volume of water used.
- Measure the depth to the seal using a weighted tape measure, measuring rod, or similar measurement device to confirm that the thickness and depth of the seal meet the design requirements.
- Allow the bentonite to completely hydrate in accordance with the manufacturer's instructions before filling the remainder of the annular space with bentonite/cement grout.
- For deep wells, install the seal material using a tremie pipe to prevent bridging. When cased borehole drilling methods (such as HSA) are used, if applicable, use the annulus between the monitoring well casing and drill stem as the tremie pipe.
- Record in the field logbook the actual volumes of bentonite and grout used during well construction, and explain any discrepancy between the calculated and actual volume.
- Record in the field logbook the details of the well construction, including annular seal depth, thickness, seal material type, and installation methods.

Surface Completion and Well Protection

Two types of surface completions are typical for monitoring well installations: aboveground completion and flush-mounted completion. Surface completion and well protection prevent surface runoff from infiltrating the well annulus and protect the well from accidental damage or vandalism. Properly survey the well installation after completion, and document the survey measurements.

Surface Seal Completion

Provide a surface seal of concrete around the protective well casing at each well that fills the upper annular space. The surface seal will be a separate upper annular seal installed above, but not connected to, the bentonite seal (except in very shallow monitoring wells).

Surface Completion and Monuments

Construct each monitoring well with a surface monument to protect the well casing from damage. Depending on site conditions, use concrete to create a secure monument foundation and provide an additional surface seal. Slope constructed concrete monument foundations (slabs) away from the well so that the foundations shed rain and surface water. On a site-specific basis, use alternative well construction designs if approved by the Project Manager (for example, in areas of permafrost, frequent frost-jacking, or shallow groundwater).

If an aboveground monitoring well monument is installed, construct the well monument with a protective casing, preferably made of steel. Extend the protective casing at least 6 inches above the top of the well casing and at least 2 feet into the ground. In areas that experience frost-heaving, extend the protective casing from below the depth of frost penetration (3 to 5 feet below grade, depending on local conditions) to approximately 6 inches above the top of the well casing, or use non frost susceptible material when installing the protective casing. Install the protective casing before the upper annular seal sets. Seal and immobilize the protective casing within the concrete monument foundation. Allow sufficient clearance, usually 6 inches, between the lid of the protective casing and the top of the riser to accommodate sampling equipment. Drill an approximately 0.25-inch-diameter weep hole in the protective casing approximately 6 inches above ground surface to permit water to drain out of the annular space between the protective casing and the riser. In winter, this hole will also prevent water freezing between the protective casing and the well casing. Place coarse sand or pea gravel (or both) in the annular space within 6 to 12 inches below the top of the well casing to allow water to drain from within the protective casing and prevent insect habitation.

If a flush-mounted monument is installed for a monitoring well, construct the well monument with a steel protective cap with a subsurface casing that extends approximately 2 feet bgs. Construct the top of the steel protective cap and protective casing flush with the ground. Install the protective casing before the upper annular seal sets. Seal the protective casing in a concrete, flush-mounted foundation, and immobilize if possible. Allow sufficient clearance, usually 6 inches, between the steel protective cap and the top of the well casing, to accommodate sampling equipment. Place coarse sand or pea gravel (or both) in the annular space within the protective casing to within 2 to 3 inches below the top of the well casing, to allow water to drain from within flush-mounted monument and prevent insect habitation.

Regardless of the type of monument, fit each well with a locking well casing cap that easily fits below the protective well monument cap. Install a leak-proof, locking well casing cap on the top of each well casing to prevent vandalism and to prevent water from entering the well casing. Check that the protective well monument cap is leak-proof, and secure with multiple bolts for additional protection.

Document all construction details and materials used in the field logbook. Clearly mark monitoring wells with a unique well identifier on the inside and outside of the protective casing.

Aboveground Completions

Follow these basic procedures for aboveground completions:

- Extend the well casing approximately 2 to 3 feet above the ground surface.
- Install a protective casing around the aboveground well casing, in a plumb, vertical position. Place concrete (surface seal) above and around the base of the protective casing up to and becoming part of the surface concrete pad. Do not extend the concrete seal below the base of the protective casing; this configuration will allow trapped water during installation and sampling events to drain.

- If requested by the client, paint the protective casing.
- Install a weatherproof, locking well monument cap on the top of the protective casing to provide adequate clearance between the top of the well casing cap and the bottom of the well monument cap.
- If needed, place a concrete surface pad around the well protective casing. Verify that the pad is approximately 3 feet square by 4 inches thick and slopes away from the protective casing.
- Install bollards around wells where traffic might threaten the integrity of the well.
- When possible, attach a stainless-steel well identification tag to the outside of the protective casing or use a paint pen to label the well and identify the screen interval.

Flush-Mounted Completions

Follow these procedures for flush-mounted completions:

- Cut off the well casing below grade, leaving enough space to install a leak-proof, locking well casing cap.
- Install a subgrade, protective casing with a steel protective cap around the top of the well casing to approximately 2 feet bgs. Install the top of the steel protective cap and protective casing flush with the ground.
- Allow sufficient clearance (typically 6 inches) between the steel protective cap and the top of the well casing to accommodate sampling equipment.
- Place coarse sand or pea gravel (or both) in the annular space within the protective casing, to allow water drainage and insect habitation.
- Place a concrete flush-mounted foundation around the well protective casing. Slope the concrete foundation away from the protective casing.
- For flush-mounted completions located in high-traffic areas, follow the procedures previously outlined, but use traffic-rated cement or a steel vault and cement flush with the traffic surface.
- For flush-mounted completions, take care to construct watertight bonds between the protective structure and the cement surface seal.
- Install a weatherproof, locking well monument cap on the top of the protective casing, and then a weatherproof, locking well casing cap on top of the well casing.
- Where significant amounts of runoff occur, take additional protection measures.
- When possible, attach a stainless-steel well identification tag to the inside of the protective casing or use a paint pen to label the well and identify the screen interval.

Well Protection

Monitoring wells can have either aboveground or flush-mounted completions. If the well casing is composed of metal and completed above the ground surface, attach a lockable cap to the top of the protective well casing and lock the cap with a padlock. If the well is not cased with metal and is completed above the ground surface, install a metal protective casing around the well. For flush-mounted wells, install a protective well monument vault (or equivalent) around the well with a lockable or bolt-on cover that has a waterproof seal. Install the cover level with the ground surface to help prevent the inflow of surface water.

Construct flush-mounted well covers to withstand the maximum expected loadings (such as vehicular traffic or material staging). Install bollards around aboveground wells where traffic might threaten the integrity of the well. Install three or four bollards in a triangular or rectangular array at least 2 feet from the casing. Use 3-inch-diameter steel or wooden bollards that extend at least 4 feet above and 3 feet below the ground surface; the bollards will be tall enough to be easily visible to traffic. Do not place bollards in the concrete surface pads around the wells.

Paint the aboveground portion of the bollards with bright colors (such as yellow or orange), and place photo-reflective tape on the bollards if they are potentially hazardous during low-light conditions. In areas where there is a high probability of damage to the well (such as where there is high traffic, heavy equipment, or poor visibility), if needed, install posts, markers, signs, or other safety features. The level of protection will adequately mitigate the potential risk of damage to the well.

Monitoring Wells in Frozen Ground

Monitoring wells are designed and constructed to minimize the effects on subsurface thermal behaviors and to withstand freeze-thaw forces creating frost-heaving or frost-jacking. Frost-heaving or frost-jacking is the upward movement of a well, caused by freezing and upward expansion of the soil. Frost-heaving can change the height of the well casing and, in some cases, separate casing sections. Design and construct monitoring wells installed into seasonally frozen ground (for example, screened in the seasonal active layer) so that representative groundwater samples can be collected throughout the year, including during periods of thaw. Screen wells in seasonally frozen soil deeper than the greatest expected depth of thaw to prevent them from going dry in the thawing season. Provide special attention to wells installed in a permafrost layer. Use caution when installing a well through permafrost that may act as a confining unit because flowing artesian conditions may occur. Firmly seal the thawed annulus between the pipe and the permafrost to prevent upward seepage from the confined aquifer. Minimize well damage by installing a surface outer casing to a depth of 5 to 10 feet bgs and a steeply inclined cement cap around the surface protective casing (Driscoll, 1986). When frost-heaving occurs and pressure is exerted on the cement cap, the surface protective casing must be able to rise without affecting the monitoring well casing (Driscoll, 1986).

Records

Document all materials and procedures used during installation of wells in the field logbook, the Monitoring Well Installation Report (Appendix D), or both, as described in *SOP-01, Logbooks Documentation and Field Notes*. Submit well completion reports to regulatory agencies as required, and maintain all copies of field notes and well completion reports in the project files.

REFERENCES

Alaska Department of Environmental Conservation (ADEC). 2011. *Monitoring Well Guidance*. February.

ASTM International (ASTM). 2004d. *Standard Practice for Design and Installation of Ground Water Monitoring Wells*. ASTM Standard D5092. West Conshohocken, Pennsylvania: ASTM International. January 1.

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U.S. Environmental Protection Agency (EPA). 1991a. *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells*. Office of Research and Development.

SOP-10 Surface and Subsurface Soil Sampling

PURPOSE

This SOP provides the methodology for collecting the following types of soil samples (discrete samples, unless specified):

- Surface soil sampling
- Subsurface soil sampling
- Excavation and stockpile soil sampling
- Composite soil sampling
- Sampling soils for VOCs
- QA/QC soil sampling

SCOPE

This SOP applies to all Swift River team personnel and subcontractors engaged in collecting or otherwise handling surface or subsurface soil samples on AFCEC projects in Alaska. This SOP was developed using the following ADEC guidance documents:

- Draft Field Sampling Guidance (ADEC, 2010)
- Underground Storage Tanks Procedures Manual: Guidance for Treatment of Petroleum-Contaminated Soil and Groundwater and Standard Sampling Procedures (ADEC, 2002)

This SOP focuses on the most commonly used soil sampling tasks and applications anticipated and should be used in conjunction with other applicable project SOPs, including the following:

- *SOP-01, Logbook Documentation and Field Notes*
- *SOP-02, Sample Handling and Chain of Custody*
- *SOP-07, Packing and Shipping of Environmental Samples*
- *SOP-15, Drilling Methods*
- *SOP-18, Boring Log Completion, Soil Classification and Logging*
- *SOP-24, Equipment Decontamination Procedures*

Qualified persons, as defined by 18 AAC 75.990(100), will be engaged in or directly supervise the collection and handling of environmental samples (i.e., Project Manager, Site Manager, Field Team Lead, Project Chemist, Field Sampler).

GENERAL

Selecting the proper methods and tools for surface and subsurface soil sampling is a critical part of field investigations. This SOP describes the methods generally used for surface and subsurface soil sampling, as well as the tools commonly used.

All soil sample collection activities should adhere to the note taking, decontamination, labeling, packaging, shipping, storage, and chain-of-custody requirements applicable to the soil sampling activities being conducted according to the SOPs. Refer to technical procedure *SOP-02, Sample Handling and Chain of Custody* for details on sample container labeling, handling, and chain-of-custody requirements. Sample packaging and shipping requirements are outlined in technical procedure *SOP-07, Packing and Shipping of Environmental Samples*.

All personnel who collect or handle the soil samples should wear, at a minimum, disposable nitrile gloves to prevent cross-contamination and provide personal protection. New gloves should be donned for sample collection at each location, or whenever gloves are torn or otherwise compromised. The project-specific HASP provides information on site-specific PPE requirements.

RESPONSIBILITIES

Project Manager

The Project Manager provides adequate resources and ensures that field staff have adequate experience and training to successfully comply with and execute project-specific SOPs and implement the HSE program. The Project Manager will solicit the appropriate technical expertise to ensure that the project has identified the best sampling methods and technology for the job given the current understanding of the site and project goals.

Health and Safety Manager

The Health and Safety Manager oversees site-specific health and safety activities and ensures overall compliance with project HSE requirements. The Health and Safety Manager conducts PPE evaluations, selects the appropriate PPE for the project, lists the requirements in the HASP, coordinates with the Field Team Lead and/or Field Safety Officer to complete and certify the PPE program, and conducts project H&S audits on the effectiveness of the HSE program.

Site Manager

The Site Manager coordinates and schedules daily field activities. In addition, the Site Manager verifies compliance with this SOP and ensures that all field staff engaged in this activity are trained in this SOP.

Field Safety Officer

The Field Safety Officer assists in implementing the project Health and Safety; the role of Field Safety Officer is either taken by the Field Team Lead or is designated to a field team member by the Field Team Lead. The Field Safety Officer assists the Field Team Lead and Health and Safety Manager with the HSE program, implements the PPE requirements described in the project HASP, and receives input from project staff on the effectiveness of the assigned PPE requirements and ongoing HSE procedures.

Field Team Lead

The Field Team Lead ensures that soil samples are collected according to this procedure and other SOPs. The Field Team Lead must also make rational and justifiable decisions when deviations from this procedure are necessary because of field conditions or unforeseen problems. The Field Team Lead consults the Project Manager if significant deviations from the sample and analysis plan are necessary because of field conditions. The Field Team Lead also ensures that the applicable requirements of the HASP and Waste Management Plan are met. IDW will be handled according to the procedures outlined in the Waste Management Plan (Appendix C).

PROCEDURES

General Guidelines

The following procedures should be used to collect soil samples for laboratory analysis:

- Unless approved by the ADEC project manager on a site specific basis, all laboratory soil samples must be discrete samples and may not be composited before analysis, except when required by federal regulations, e.g. Toxic Substances Control Act (TSCA) for Polychlorinated Biphenyls (PCBs or Resource Conservation and Recovery Act (RCRA) waste disposal characterization.
- Collect soil samples according to the method specifications appropriate for the laboratory parameters to be analyzed.
- Collect all soil samples with disposable or clean tools that have been decontaminated as outlined in *SOP-24, Equipment Decontamination Procedures*.
- At a minimum, wear disposable nitrile gloves and change them between sample collections.
- Place soil samples in containers quickly and in the order of volatility: VOCs GRO next, heavier range organics next (DRO, RRO, SVOCs, PAHs), and the heaviest compounds last (e.g., PCBs and metals).
- Quickly and adequately seal all sample containers must, and clean rims before tightening lids. Use tape only if known not to affect sample analysis.
- Label and handle the sample containers as outlined in *SOP-07, Packing and Shipping of Environmental Samples* and *SOP-02, Sample Handling and Chain of Custody*.
- Immediately preserve samples according to the method specifications appropriate for the laboratory parameters to be analyzed. And unless specified otherwise, at a minimum, immediately chill the samples to 4±2 °C and maintain this temperature through delivery to the laboratory for analysis.
- Use the method specifications of the required analytical methods to determine sample holding times.
- Use alternative methods to obtain soil samples only if the alternative methods have been approved by the Project Manager and documented in the logbook.

- Because of their volatile nature, use special precautions when collecting samples for analysis of VOCs, GRO, and/or VPH as detailed below.
- Using a sampling spoon or trowel, thoroughly homogenize each soil sample fraction collected for analyses other than VOCs, GRO, or VPH. Divide the homogenized material equally among the appropriate sample containers and seal the containers tightly. Ensure that the sampling tools and containers (such as a spoons and bowls) used for sample collection and homogenization do not interfere with the analytes of interest.
- Collect multi-incremental (MI) samples by placing equal amounts (or aliquots) of soil collected from multiple locations into a decontaminated, dedicated collection container. Homogenize the aliquots using a sample collection tool such as a scoop or spoon. Divide the homogenized material equally among the appropriate sample containers, and seal the sample containers tightly.

Sample Tools and Equipment

To facilitate the collection of surface or subsurface soil samples, use equipment that includes, but is not limited to, the following items:

- PID or FID
- Stainless steel trowel, scoop, or spoon
- Stainless steel hand (bucket) auger
- Stainless steel split spoon, split barrel, or continuous sampler
- Shovels, pickaxes, pick mattocks, or similar excavating tools
- Soil core samplers (En Core sampler, TerraCore, or equivalent)
- Stainless steel bowls or pans
- Field logbook
- Soil boring log datasheet or other field datasheet
- Waterproof and permanent pens and markers
- Digital camera
- Paper towels
- Aluminum foil
- Decontamination equipment (buckets, brushes, Liquinox detergent, etc.)
- PPE
- Sample cooler
- Ice or gel-ice
- Sample jars and labels
- Chain-of-custody forms
- Soil classification charts
- Ziploc (or similar) resealable bags
- Survey stakes or flags
- Hammer

Decontamination

Before collecting any soil samples, decontaminate all reusable, non-disposable sampling equipment. Maintain sufficient decontamination supplies on hand to decontaminate equipment in the field if sampling equipment will be reused. Decontaminate each piece of reusable sampling equipment between each sample location or interval. Manage spent decontamination fluids according to Worksheet #14. Follow the procedures presented in *SOP-24, Equipment Decontamination Procedures,* for decontamination of re-usable field equipment and for personnel decontamination.

Whenever feasible, use disposable sampling equipment to minimize decontamination and the potential for cross-contamination. Inspect all disposable sample equipment before use to confirm that it is clean and free of potential contaminant.

Surface Soil Sampling

Under Alaska regulation 18 AAC 75.990(127), surface soil is defined as soil that extends to 2 feet bgs. However, the depth that is considered surface soil may vary depending on project DQOs and investigation approaches, as defined in Worksheet #17 or the site-specific UFP QAPP.

Surface soil samples can be collected in paved and unpaved areas. In paved locations, remove surface asphalt or concrete mechanically or by hand, along with pavement base material located beneath the paving. In unpaved locations, remove surface vegetation such as a muskeg layer before sampling.

Collect surface soil samples as either discrete or MI samples. Use a stainless steel scoop, spoon, or other appropriate tools to collect each surface soil sample. Collect samples for VOC analysis directly from the soil column at the specified sampling depth interval bgs if possible. For non-VOC samples, remove materials, including pebbles and roots, from the mixture as the sample is collected. Collect each non-VOC sample by thoroughly homogenizing material from the appropriate depth interval bgs (as stated in the site-specific sampling plans) from the respective sampling location. Use a clean, decontaminated stainless steel scoop or spoon to collect the soil sample and fill all laboratory-supplied analytical sample containers.

Subsurface Soil Sampling

Under Alaska regulation 18 AAC 75.990(123), subsurface soil is defined as soil that is more than 2 feet bgs. Before subsurface soil sampling, check and clear each sample location for buried utilities before intrusive activities begin, according to *SOP-04, Utility Clearance*.

Shallow Subsurface Soil Sampling with Hand Tools

Collect shallow subsurface soil samples as discrete samples. Shallow subsurface soil samples can be collected by hand using a wide variety of sampling equipment and devices. Common equipment for collecting shallow subsurface soil samples includes soil coring devices, various types of hand augers (bucket-type, continuous-flight, and posthole), and other common hand tools such as shovels and pickaxes. Depending on field conditions or sampling objectives, use several types of sample collection equipment to collect soil samples at a single location. Of the equipment listed, only soil coring devices collect an undisturbed soil sample and thus are recommended for sampling of volatile organics. Bucket augers and other common hand tools are not recommended when an undisturbed soil sample for volatile organics is desired. Sampling personnel should choose the sampling equipment that is best suited for project requirements and task needs.

Using a decontaminated hand auger (or similar equipment), advance the soil borehole to the depth immediately above the sampling interval, and remove all cuttings from the borehole. Before advancing a borehole, remove all unnecessary rocks, twigs, and other non-soil materials from the selected sampling location. Assemble the sampling equipment, if necessary, per the manufacturer's specifications and place the sampler in position with the bit or cutting shoe touching the ground. Begin turning the auger with a clockwise motion or driving the soil core device with the slide hammer until the desired sampling depth is obtained.

During advancement of the auger or coring device, periodically remove cuttings from within and around the borehole and place them next to the borehole. If the sample is to be collected using the same hand auger or soil coring device, the auger bucket or core sampler will be decontaminated (or replaced with a decontaminated bucket or sampler) before collecting the soil sample. Collect the discrete sample collected by advancing the sampling equipment to the appropriate depth interval and retrieving the soil sample. When collecting samples at depths greater than 12 inches, it is advisable to discard approximately the upper 1 inch of material in the top portion of the auger or sampler because of borehole slough and cave-in. Immediately transfer the sample into laboratory-cleaned sample containers using a decontaminated stainless steel spoon or trowel.

Deep Subsurface Soil Sampling

Deep subsurface soil samples are typically collected using split-spoon samplers. A split-spoon sampler is a soil coring device that consists of a length of carbon or stainless steel tubing, split longitudinally and equipped with a sample shoe and a drive head. Split-spoon samplers are used in conjunction with a power auger or drill rig, and are usually either hammered or hydraulically pushed into the interval to be sampled. The interval(s) to be sampled may be either predetermined or determined according to criteria observed during advancement of the drilling equipment as specified in the site-specific sampling plans. The following procedures focus on sampling soil for chemical analysis, using a split-spoon or DPS continuous tube sampler. Soil samples obtained for physical characterization are typically collected using similar procedures.

Hollow-Stem Auger, Air Rotary/ARCH Drilling

Using a hollow-stem auger and air rotary drilling equipment, advance the soil borehole to the depth immediately above the sampling interval as described in *SOP-15, Drilling Methods*. During advancement of the auger, periodically remove cuttings from around the augers and shovel them into a pile near the borehole or into appropriately labeled drums. Attach a split-spoon sampler to the end of a series of drive rods and lower it down the center of the hollow auger drill string. Advance the split-spoon sampler ahead of the drill bit to collect a relatively undisturbed, representative soil sample. Record SPT blow counts for that sample, as well as the interval from which the sample was obtained, in the soil boring log datasheet. Depending on the size of the split-spoon employed, typically 18 to 24 inches of soil should be recovered in advance of the drill bit. Remove the split-spoon sampler from the borehole and open it to expose the soil core for sample collection and examination. Collect soil samples for laboratory analysis from the undisturbed, middle portion of the soil core and discard soil from the very ends of the soil core as they often contain disturbed soils. Immediately and quickly transfer the sample into clean, laboratory sample containers using a decontaminated stainless steel spoon or scoop. A field geologist should examine the soil core to screen for VOCs using a PID or FID, and then log the core for lithology (see *SOP-18, Boring Log Completion, Soil Classification, and Logging).*

Direct-Push System Drilling

DPS soil samples are typically collected using a continuous tube sampler with PVC liners such as Geoprobe's DT325 Dual Tube Sampling System sampler, using the DPS drilling procedures described in *SOP-15, Drilling Methods*. At the top of each sample interval, drive the continuous tube sampler into the substrate to a depth equal to the length of the sampler. After advancing the sampler, retrieve it from the borehole and place the PVC liner containing the soil core on a firm, horizontal surface, for opening, inspection, and sampling. Cut open the PVC liner for each sample core to expose the core for soil sampling and examination. Immediately transfer samples for laboratory analysis into clean laboratory sample containers using a decontaminated stainless steel spoon or scoop, as described above in previous sections. The field geologist will then examine the soil core to screen for VOCs using a PID or FID, and log it for lithology. Per SOP-01, sampling personnel should also photograph and record observations of the soil cores. Pay special attention to labeling and storage of individual core samples when continuous soil samples are collected from a single boring. In many instances, sampling personnel may produce soil cores faster than they can be opened, logged, screened and sampled by a technician. In those instances when a backlog of cores is being generated, take care m to protect the cores from direct sunlight, excessive ambient temperatures, and rain. These conditions may have an adverse effect on highly sensitive volatile organics within the core or the instruments used for screening. Always keep the cores labeled so that the up/down orientation is not lost. Proceed carefully, but quickly when field screening. If necessary, log soils for lithology information after sample collection.

Sonic Drilling

Collect subsurface samples from borings drilled using a rotosonic drill rig, which vibrates the cored material into a steel core barrel for continuous recovery. Rotosonic cores will be 2 to 8 inches in diameter and collected and bagged in 3- to 5-foot-long intervals for the length of the boring. The onsite field geologist or geotechnical engineer should continuously log cores in accordance with SOP-18 (Boring Log Completion, Soil Classification and Logging). Drive a continuous tube sampler into the substrate to a depth equal to the length of the sampler. After advancing the sampler, retrieve it from the borehole and place the PVC liner containing the soil core on a firm, horizontal surface, for opening, inspection, and sampling. Cut open the PVC liner to expose the core for soil sampling and examination. Immediately transfer samples for laboratory analysis into clean laboratory sample containers using a decontaminated stainless steel spoon or scoop, as described previously in Section 5.1. The field geologist will examine the soil core to screen for VOCs using a PID or FID, and then log it for lithology. Per SOP-01, sampling personnel should also photograph and record observations of the soil cores. Pay special attention to labeling and storage of individual core samples when continuous soil samples are collected from a single boring. In many instances, sampling personnel may produce soil cores faster than they can be opened, logged, screened and sampled by a technician.

Excavation and Stockpile Sampling

Conduct soil sampling of excavations and stockpiles using similar techniques as described above in previous sections.

Excavation Sampling

When collecting soil samples from excavations including test pits, collect soil samples from freshly uncovered soil. Remove 4 to 6 inches of soil immediately before sample collection. If the excavation has been open for longer than 1 hour, remove at least 12 inches of soil immediately before collection. Do not collect samples from disturbed soil that has fallen into the bottom of the excavation pit. If the depth of the excavation is such that sampling cannot be safely conducted within the excavation, collect soil samples directly from the excavator bucket. When collecting soil samples from an excavator bucket, collect samples from the center of the bucket and away from the bucket sides. Refer to the project-specific HASP, and/or consult the project Heath and Safety Manager regarding excavation safety before entering any open excavation.

Stockpile Sampling

Field screen stockpiled soil with a PID before sample collection. Collect field screening and analytical soil samples at least 18 inches beneath the exposed surface of the stockpile, unless additional shallower field screening samples are needed to represent soil contaminant heterogeneity. Contamination can be persistent near the bottom of long-term stockpiles, so it is important to collect some samples near the base. Collect soil samples from the surface, within, and near the bottom of a stockpile using the methods previously discussed above in previous sections.

Composite Soil Sampling

Collect composite soil samples from the surface to a depth of 6 inches at each sampling location designated in the site-specific UFP QAPP. Each sample will consist of a mixture, or "composite," of five grab samples collected from locations within 35 feet of the specified location.

Based on the location conditions, use one of the four methods identified above to collect approximately 200 grams of soil from each subsampling location. If the soil contains a range of grain sizes, collect a subsample to represent the sand-size and finer materials present (that is, do not collect gravel, cobbles, and boulders). Use approximately the same mass of soil collected for each subsample to generate a single composite sample, and estimate the mass by visual assessment of soil volume if necessary.

To create each composite sample, place the five subsamples together in a watertight resealable plastic bag. Selectively remove any coarse organic debris, such as sticks, leaves, or aquatic vegetation, from the composite sample. Remove such debris by hand, using gloves, or with a plastic or stainless steel scoop or spoon. Thoroughly mix the remaining soil within the sealed bag by massaging and rotating the sealed bag for a minimum of 2 minutes. For duplicates, split the sample into two aliquots after homogenization, and place each aliquot directly into a new sample bag.

After homogenization, double bag and label the composite sample, and place it in a cooler for storage and later shipping. Refer to *SOP-07, Packing and Shipping of Environmental Samples* and *SOP-02, Sample Handling and Chain of Custody* for instructions.

Decontaminate sampling equipment after use at each of the sampling locations in accordance with *SOP-24, Equipment Decontamination Procedures*.

Soil Sampling for Volatile Organic Compounds

If VOCs are among the analytes to be investigated at a particular site, collect discrete soil samples as soon as possible following exposure of the soil core. Collect all soil samples for VOC analysis in a way that minimizes sample volatilization through excessive atmospheric exposure, mixing, and/or other disturbance. It is recommended to collect VOC samples using core-type samples such as split-spoons, continuous tube samplers, and soil coring devices that reduce the loss of volatiles during sampling. Use soil core samplers constructed of non-reactive materials that will minimize the loss of volatile organics from the sample.

Collect GRO and VOC soil samples analyzed using ADEC analytical method AK101 and USEPA Method SW8260B as follows:

- Collect a minimum of 25 grams of soil with minimum disturbance directly into a 4-oz or larger jar with a Teflon®-lined septum fused to the lid. Interim storage/containers (such as resealable plastic bags) are not allowed.
- Immediately after collection, carefully add 25 mL of methanol (for method AK101, methanol must include a surrogate) until the sample is submerged. Complete this step within approximately 10 seconds of placing the soil in the sample jar. Collect VOC

samples by Method SW8260B in TerraCore kits that will include the 4-oz jar preserved with methanol described in this section, and non-methanol preserved containers described in the next section. Collect all soil samples in containers at the same time.

- After sealing, gently agitate the sample so that entire sample is submerged.
- Do not place tape, including evidence tape, on the sample container directly.
- Cool and retain samples at 4°C ± 2 °C Collect a sample of the same material from the same location in an unpreserved jar for percent moisture determination.
- Collect appropriate field and laboratory quality control samples including field duplicates and matrix spike/matrix spike duplicate (MS/MSD) samples.
- Collect analytical samples in the following order:
    - VOCs, GRO, VPH, and BTEX
    - SVOCs, including pesticides, herbicides, DRO, RRO, and PCBs
    - TOC
    - Metals
- Use an appropriate trip blank to accompany all VOC samples from the time of collection until analysis at the project laboratory.

Collect VOC samples analyzed using EPA SW-846 Method 5035A as follows:

- Collect the discrete soil sample using a 5-gram- soil core sampler with a new, dedicated, and disposable sample syringe or tip as described in ASTM standard D6418-09. These devices collect a specific soil sample mass for volatile organic analysis in a manner that minimizes loss of contaminants because of volatilization or biodegradation. Below is a list of frequently accepted soil core samplers.
    - En Core sampler
    - TerraCore sampler
    - EasyDraw Syringe with PowerStop Handle sampler
    - Core N' One sampler
    - Lock N' Load sampler
- Collect soil samples from a specified location and soil depth as determined by field screening or as determined in the site-specific UFP QAPP. After determining the sample location, plunge the soil core sampler into the soil core to collect a sample.
- To collect a sample, have ready a pre-weighed, pre-preserved, and labeled 40-mL VOA vial. With the syringe or plunger seated in the handle, push the soil core sampler into freshly exposed soil until the sample chamber is filled. Do not pull the syringe or plunger back before use.
- Wipe all soil or debris from the outside of the soil core sampler and remove any excess soil that extends beyond the end of the sampler, so that the soil plug is flush with the end of the sampler. A filled chamber will deliver approximately 5 grams of soil.
- Place the mouth of the soil core sampler into the 40-ml VOA vial and extrude the 5-gram sample into the VOA vial by pushing the syringe or plunger down. Collect these VOC

samples in TerraCore kits that include the 4-oz jar preserved with methanol described in the previous section. Collect all soil samples in containers at the same time.

- Quickly seal the lid back on the 40-ml VOA vial.
- Take care not to leave any soil grains along the threaded cap area of the VOA vial so that the lid can be screwed on tightly forming a tight seal. Be sure to remove any soil or debris from the top and/or threads of the vial.
- Immediately following collection, label samples with a unique sample identification, package them appropriately, and keep the samples at a temperature of approximately 4°C inside a cooler for preservation.
- Ensure that VOA containers are padded so that the glass walls of the containers do not come into direct contact with ice or other samples, thereby reducing the risk of cracking the glass containers.
- Use an appropriate trip blank to accompany all volatile organics samples from the time of collection until analysis at the project laboratory.
- Note all sample collection details in the field notebook and soil boring log datasheet, according to SOP-01.

Quality Assurance/Quality Control Procedures and Samples

Collect QA/QC samples during soil sampling according to the field QC sample summary and Worksheets #17 and #20of the UFP QAPP. Assign unique sample identification to QA/QC samples and handle and submit them to the laboratory the same as field samples.

Equipment Blanks

Collect equipment blanks at a frequency specified in Worksheets #17 and #20. Collect an equipment blank sample in the field by running ASTM Type II Reagent-Grade water (or deionized water with less than 15µS conductivity) across the surface of re-usable, decontaminated sampling equipment (typically the split-spoon or drive shoe of the direct-push system continuous tube sampler) and into appropriate sample containers.

Field Duplicate Samples

Field duplicates will be collected at a frequency of one per ten samples. Field duplicate samples will be collected simultaneously or in immediate succession to the normal samples using identical sampling techniques.

Matrix Spikes and Matrix Spike Duplicates

MS/MSD samples will be collected at a frequency of one per 20 or one per batch. Collect MS/MSD samples simultaneously or in immediate succession to the normal samples using identical sampling techniques.

Sampling Identification, Handling, and Documentation

Identify, handle and record samples as described in this SOP and according to *SOP-01, Logbook Documentation and Field Notes*; *SOP-07, Packing and Shipping of Environmental Samples*; and *SOP-02, Sample Handling and Chain of Custody*.

Investigation-Derived Waste

IDW will be handled according to the procedures outlined in the Waste Management Plan (Appendix C).

RECORDS

Document all records in a bound field notebook according to *SOP-01, Logbook Documentation and Field Notes* and/or the soil boring log datasheets provided in *SOP-15, Drilling Methods*.

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SOP-11 Surveying Environmental Soil Sampling Locations

PURPOSE

This SOP outlines the protocols and general procedures for operating a mapping grade GPS handheld instrument.

SCOPE

This SOP applies to all Swift River team personnel and subcontractors engaged in environmental investigation activities in Alaska. This SOP focuses on the most commonly used environmental surveying and sampling tasks and applications anticipated should be used in conjunction with other applicable project SOPs, including the following:

- *SOP-01, Logbook documentation and Field Notes*
- *SOP-08, Groundwater Well Sampling*
- *SOP-11, Hydropunch Groundwater Sampling*
- *SOP-15, Drilling Methods*
- *SOP-16, Surface and Subsurface Soil Sampling*

GENERAL

It is the position of the Swift River team that establishing standardized protocols for collecting environmental data in the field using GPS technology is imperative to the success of any project. The guidelines in this section have been developed to ensure consistent GPS data collection and post-processing techniques across projects, staff, and geographic locations. The methods described are based on Trimble submeter mapping grade GPS devices and Trimble Pathfinder Office software. Calibration of GPS units will be in accordance with manufacturer's instructions located in the user manual (attached to this SOP). These procedures are to be used as a reference tool in conjunction with specific GPS and job procedure training.

GPS Basics

GPS is divided into three fundamental aspects: **control, space, and user** (Trimble, 2006).

- **Control** is the central "brain" of the GPS system. A GPS controller monitors the satellites' transmission of navigation messages and sends adjustments, if necessary. The DoD operates this segment from Falcon Air Force Base in Colorado Springs, Colorado. Control also includes four monitoring and upload stations distributed throughout the world, with each satellite passing over a monitoring station twice a day.
- **Space** is the NAVSTAR constellation of satellites that broadcast GPS signals. When the system is at full operational capacity, there are 24 operational satellites. This number

changes constantly as satellites are commissioned and decommissioned. These satellites orbit 20,200 kilometers above the earth and make one complete revolution approximately every 12 hours.

- **Users** include all civilian and military personnel worldwide, who use GPS to calculate global spatial positions using many applications. Civilian users currently outnumber military users worldwide for applications such as agriculture, aviation, emergency services, recreation, and vehicle tracking.

GPS is based on satellite ranging, which is the measurement of how much time it takes a radio signal to reach the GPS receiver from a satellite and then a calculation of distance using that time. In satellite ranging, the GPS receiver compares digital codes generated at precisely the same time by a GPS satellite and the GPS receiver (Trimble, 2006). Identical “pseudorandom” codes are generated by all GPS equipment (satellites and receivers) every millisecond. Time is calculated as the difference between when the satellite generated the code and when the receiver receives the code. Trilateration is then used to measure the distance from at least three satellites to establish a position on Earth. However, the accuracy of a measurement based on three satellites may be diminished because of non-synchronization of clocks in the GPS satellites and the receiver (Trimble, 2006).

An accurate position is calculated by using four satellites. Four imperfect measurements can eliminate timing offsets. Microprocessors in the GPS receiver can recognize timing offset when it receives a series of measurements that it cannot intersect at one point (Trimble, 2006). The GPS receiver then automatically starts subtracting the same amount of time from all of the measurements until a position on Earth is determined. Trimble GeoXT and GeoXH receivers have at least twelve parallel channels to receive radio transmissions from up to twelve GPS satellites simultaneously.

The DoD constantly measures the orbits of all GPS satellites, which determines satellite ranging and calculates the exact location of each satellite as ephemeris data (Trimble, 2006). The ephemeris information is a data file that contains orbit information for one particular satellite. The DoD then transmits the ephemeris data to the satellites, which then transmit it to GPS receivers. This information is used by the GPS receivers along with their internal almanac to establish precisely the position of the satellite.

Differential GPS is used to determine the precise measurement of the relative positions of two receivers tracking the same GPS signals (Trimble, 2006). This requires a receiver to be placed as a base station over a known coordinate benchmark. The base station determines what errors the satellite data contains, along with that of other GPS rovers, and then uses this corrected information to eliminate error in the measurements. Differential GPS measurements are much more accurate than standard GPS measurements and when taking measurements in the differential mode, GPS spatial accuracy of less than one meter can be achieved. However, the ultimate accuracy of a GPS position is determined by the sum of several sources of error, the contribution of which varies depending on atmospheric and equipment conditions (Trimble, 2006). **Sources of error that affect the results of GPS data collection include atmospheric conditions and physical objects causing obstructions and reflected signals.** Source errors can be minimized by applying rigorous data collection techniques to equipment setup and obtaining satellite lock.

RESPONSIBILITIES

Project Manager

The Project Manager provides adequate resources, and verifies that field staff have adequate experience and training to successfully comply with and execute project-specific SOPs and implement the HSE program. The Project Manager solicits the appropriate technical expertise to adequately identify the best methods and technology for the job given the current understanding of the site and project goals. In addition, the Project Manager should be consulted if any complications arise with following these critical sample handling and custody procedures.

Site Manager

The coordinates and schedules daily field activities. In addition, the Site Manager verifies compliance with this SOP and ensures that all field staff engaged in this activity are trained in this SOP.

Health and Safety Manager

The Health and Safety Manager oversees site-specific HSE and verifies overall compliance with project HSE requirements. The Health and Safety Manager conducts HSE evaluations, selects the appropriate safety procedures for the project, lists the requirements in the HASP, and coordinates with the Site Manager to complete and certify the HSE program.

Field Team Lead

Each Field Team Lead, in conjunction with the Site Manager, is responsible for overall compliance with this SOP. The Field Team Lead is responsible for following these procedures or delegating drilling tasks to team members. The Field Team Lead verifies that subcontractors adequately comply with this SOP and that air monitoring is adequately conducted by or provided for subcontractors in accordance with the HASP.

Project Surveyor

The Project Surveyor is responsible for maintaining compliance with GPS data collection, data downloading, and file maintenance (that is, backing up data on a server and mailing data files to GIS personnel), in particular, for maintaining consistency in the procedures to be used. The Project Surveyor, or their designee, must know the GPS data collection, data downloading, and file maintenance techniques and should maintain adequate documentation of GPS data collection activities. The Project Surveyor should take responsibility for collecting, downloading, and regular storage of collected GPS data in the project data files. The Project Surveyor will also coordinate with the Site Manager and/or Field Team Lead and GIS Manager to appropriately plan GPS data collection task and post-process collected data. The Project Surveyor or Site Manager will provide the GIS Manager with the collected data for post-processing and data usage on a scheduled basis (such as daily, every other day, or weekly).

Geographical Information System Manager

The GIS Manager will facilitate and coordinate with the Field Team Lead and Site Manager regarding GPS data planning and data post-processing. The GIS Manager will acquire the required GPS technology, facilitate development of all data dictionaries, and conduct all data post-processing. The GIS Manager will work closely with the Field Team Lead and Site Manager to conduct all GPS surveying tasks.

Field Sampler

The Field Sampler, under the supervision of the Field Team Lead (who may be the same person), collects the GPS survey data according to this SOP. The Field Sampler will be adequately trained in the use and data recovery of the GPS tools provided. The Field Sampler documents all GPS surveying activities in a field notebook according to *SOP-01, Logbook Documentation and Field Notes*.

PROCEDURES

Equipment and Software

A GPS system has three components: data collector, GPS receiver, and TerraSync or similar control software. A GPS handheld device that combines the GPS receiver and data collector is known as a rover (Trimble, 2006). A rover with the Trimble TerraSync software makes up a complete GPS data collection system. A Trimble GeoXT combines all these elements into one unit.

Hardware

There are a number of different GPS system configurations available; this SOP focuses on the handheld Trimble GPS Pathfinder receivers such as the Trimble GeoXT and GeoXH GPS rovers. These 12-channel devices allow for 2D RMS sub-meter accuracy (within 1 meter of the indicated position 95 percent of the time) following post-processed differential correction.

TerraSync Software

Trimble GeoXT and GeoXH GPS rovers running Trimble TerraSync software are designed for collecting and updating GIS and spatial data by transferring files between a GPS rover and an office computer. The TerraSync software acts as the controlling software (user interface) and communicates with the Trimble GeoXT or GeoXH to set GPS parameters in the receiver, record

GPS positions on the data collector, and maintain existing GIS data (Trimble, 2006). Transferring TerraSync software files between a GPS rover and an office computer requires the Microsoft ActiveSync software and either GPS Pathfinder Office Software (version 3.10 or later) or the Trimble Data Transfer utility, which is available for free download from the Trimble website (Trimble, 2010b; Microsoft, 2007).

GPS Pathfinder Office Software

After collecting GPS data and transferring it to a computer, process and export the information using the GPS Pathfinder Office software (Trimble, 2006). The GPS Pathfinder Office software provides the tools needed to effectively do the following:

- Use task planning software to find the best times of day to collect data
- Create data dictionaries that describe the features you want to collect
- Edit attributes and offsets and delete erroneous positions
- Importing data updates from GIS
- Transfer data files between a field computer and an office computer
- Differentially correct data
- Export data to a CAD system or GIS.

Pre-Field Planning

Project planning is critical to a team's success in GPS data collection. Several steps should be completed before deployment to the field. Many items need to be considered before field data collection, including the incorporation of existing data resources and the preparation of field tools towards appropriate integration into future data deliverables. Before field data collection, consider and plan for the following data requirements.

Data Standards

Determine the GPS data collection data standards before using the GPS in the field. The SDSFIE is the common standard for U.S. military and other federal clients and is a template for creating standardized geospatial information.

Data Dictionaries

The GISM should assist in developing all data dictionaries before field data collection.

Develop data dictionaries before field data collection to help increase data collection efficiency and integrity of the data. Data dictionaries can supply order to GPS data collection tasks. As an example, data dictionaries use dropdown menus with defined attributes to standardize data collection. Other examples include required fields, automated fields for date and time generation, standardized symbology, and standard logging (recording) intervals to meet specific accuracy requirements. SDSFIE data dictionaries can automatically be generated using the SDS2DDF application. The SDS2DDF application imports data into the Trimble Data Dictionary Editor, which can then be uploaded into a Trimble GPS unit for field collection.

Transfer the proper data dictionary file from a computer to the GPS device before any data collection. Whenever possible, do not use the default data dictionary on a GPS rover. The WESTON Team has standardized data dictionaries for environmental investigation projects in addition to customized dictionaries that can be tailored to project or client specific requirements. Use of the correct and current data dictionary will directly affect the entire data collection process. In addition, it is important to note that if multiple field teams will be collecting data on a project, it is critical for each team to be using the identical data dictionary. If all teams are not using identical data dictionaries, it will substantially increase the post data collection processing time and delay project deliverables. Because of this, it is highly recommended to coordinate GPS needs with the GISM early during the planning stages of a GPS data collection task. Develop all data dictionaries by or with the assistance of the GISM before field data collection.

Photograph Collection

Based on the project needs, photographs can be linked to the corresponding spatial data locations via both X and Y coordinates, as well as by time. A variety of GPS/software/camera combinations are available; consult the GISM before field data collection if this feature is necessary.

Data Management Guidelines

Reliable and secure data management practice is essential to quality data collection and future data use and should be maintained during all preparation, data collection, and post-processing stages. If quality data management practices are not followed, significant amounts of valuable and often irreplaceable data can be lost or significant effort may be required to post-process data.

GPS data management includes managing data within the standardized directory structure, setting up the GPS device, and verifying data backup as well as data flow from project planning though correction and export to GIS production data. Generally, proper data management includes daily downloading and delivery of GPS files to the GISM. The GISM should be consulted regarding any data management procedures or issues.

Configuring Critical Setting sin the TerraSync Software

There are some critical settings in the TerraSync software that must be configured before collecting GPS data; these critical settings include GPS settings, logging settings, real-time settings, coordinate settings, and unit settings. Critical settings can be configured in the office or in the field, and non-critical settings can be set to suit the task-specific application or needs. However, it is recommended that the critical settings be configured by or with assistance from the GISM before field data collection. In addition, the critical setting should remain the same throughout the project or task and should not be altered before each data collection session.

Pre-Event PDOP Planning

To gain the most accurate GPS data possible, determine times for best satellite coverage before GPS data collection. Use Trimble Planning Software (or the Quickplan application in previous versions of the Trimble GPS Pathfinder Office software) to predict if any downtime will occur, based on satellite ephemeris data (Trimble, 2008). These applications will graph the number of satellites available at any given time during the day as well as the PDOP (Position Dilution of Precision) for the satellite configuration. When the satellites are spread around the sky, the PDOP is low and GPS accuracy is higher. When the satellites are close together, the PDOP is high and GPS accuracy is lower. A PDOP below 6 is required for submeter accuracy on a Trimble GeoXT or GeoXH GPS rover; therefore, a PDOP reading of less than 6.0 will be required to collect rover data. For the most accurate planning, download the latest ephemeris data file from the Trimble website (Trimble, 2010a)

Field Use, Data Collection, and Data Download

General procedures and guidelines are provided in the *TerraSync and GPS Pathfinder Office Software Guide* (Trimble, 2006).

RECORDS

Document all GPS data collection activities in a Field Notebook according to *SOP-01*, *Logbook Documentation and Field Notes*. Download GPS data files daily, including rover files, and manage them according to SOP-01. Store GPS data files at a digital location specifically reserved for that data document type and name them appropriately, so that the content and date of collection or download can be easily identified.

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ATTACHMENT 1 – GPS USER MANUALS:

Garmin GPSMAP 62SC
Garmin GPSMAP 76CSX

SOP-12 Operations and Maintenance of Photoionization Detector (PID)

PURPOSE

This SOP provides guidance for conducting field screening organic vapor monitoring, and air monitoring procedures to identify when potentially hazardous atmospheres are encountered during field activities.

SCOPE

This SOP applies to all Swift River team personnel (including subcontractors) engaged in organic vapor or air monitoring activities on AFCEC projects in Alaska, and was developed per the following guidance documents:

- *Draft Field Sampling Guidance* (ADEC, 2010)
- *Underground Storage Tanks Procedures Manual: Guidance for Treatment of Petroleum-Contaminated Soil and Groundwater and Standard Sampling Procedures* (ADEC, 2002)

Monitoring requirements that are not identified in this SOP will be discussed with the Health and Safety Manager before starting field activities. Should instrumentation or procedures be added to a project task that is not included in this SOP, they must be added to the project-specific UFP-QAPP.

In addition, the Swift River teams Health and Safety Plan should be referred to for further details on the types of monitoring, monitoring requirements, calibration, troubleshooting, exposure levels, and air monitoring terminology.

Qualified persons, as defined by 18 AAC 75.990(100), will be engaged in or directly supervise the collection and handling of environmental samples (i.e., Project Manager, Site Manager, Field Team Lead, Project Chemist, Field Sampler).

GENERAL

Organic vapor monitoring and air monitoring serve two primary functions:

- Evaluating organic vapor concentrations in site media to assist in characterization of site contamination
- Monitoring potential airborne chemical contaminant exposures to site workers according to the project’s HASP

The rapid detection of VOCs at field sites allows on-site analytical screening of air, water, sediment, and soils. Screening results can also be used to anticipate potential petroleum and other VOC contamination and select locations for sample collection for laboratory analysis. In addition to monitoring for VOCs during sample collection, air monitoring for explosive atmospheres, oxygen levels, toxic gas, and airborne dust may be necessary to identify potentially hazardous atmospheres encountered during field activities.

Air screening measurements can be used to evaluate the exposure risk and be used as a basis for setting health and safety levels of protection. Instrument calibration and air monitoring should be conducted according to, and at the frequency specified in, the approved project-specific HASP. **At a minimum, air monitoring instruments will be calibrated daily, before obtaining measurements, using the form in Appendix D Field Calibration Sheet.** Air monitoring results compared to specifications in the project-specific HASP provide documentation that overexposure has not occurred, compliance with legal standards has been achieved, and most importantly, the real-time determination of whether engineering controls or PPE are needed to control exposure.

RESPONSIBILITIES

Project Manager

The Project Manager is responsible for providing adequate resources, and verifying that field staff has adequate experience and training for project-specific implementation of the HSE management process and project SOPs. The Project Manager and Health and Safety Manager cooperatively have overall HSE program responsibility; however, specific tasks may be delegated to other project staff. The Project Manager retains ultimate HSE responsibility for the project.

Field Safety Officer

The Field Safety Officer assists in implementing the project HASP; the role of Field Safety Officer is either taken by the Field Manager or is designated to Field Team Lead by the Field Manager. The Field Safety Officer assists the Health and Safety Manager with the HSE program, implements the PPE requirements described in the project HASP, and receives input from project staff on the effectiveness of the assigned PPE requirements and ongoing HSE procedures.

Field Team Lead

Each Field Team Lead, in conjunction with the Field Safety Officer, is responsible for overall compliance with this technical procedure. The Field Team Lead is responsible for following these procedures or delegating tasks to team members to perform vapor and air monitoring tasks. The Field Team Lead should verify that subcontractors are adequately complying with this technical procedure and that air monitoring is adequately conducted by or provided to subcontractors per the HASP.

Health and Safety Manager

The project Health and Safety Manager is responsible for identifying the need for organic vapor monitoring or the potential for hazardous atmospheres during the planning stages of the project and development of the HASP describing monitoring requirements. In addition, the Health and Safety Manager is responsible for developing or authorizing alternative monitoring requirements if notified that conditions encountered in the field have changed from those identified in the HASP.

PROCEDURES

This SOP will focus on conducting air monitoring and headspace soil vapor monitoring using the PID.

The PID used for organic vapor and air monitoring include the following:

- MiniRae 2000 PID (most commonly used)
- Thermo Scientific 580B OVM Datalogger PID
- Thermo Scientific TVA 1000A FID/PID
- MultiRae Plus Multi-gas Meter (PID, oxygen, combustible vapor, hydrogen sulfide)
- RKI Eagle 6 Gas Multi-gas Monitor (six custom gases, including oxygen, carbon dioxide, hydrogen sulfide, methane, as well as up to two other toxic gases as indicated on the manufacturer’s list in Attachment 3)
- Thermo Scientific pDR1000AN Dust/Aerosol Meter (dust and particulate)
- FROG-4000 Chemical Analysis System (Portable Gas Chromatograph(GC)/PID)

Equipment Calibration

To ensure that field air monitoring equipment will be properly calibrated and remain operable in the field, **calibrate all field air monitoring equipment daily before use.** If necessary, calibrate other air monitoring equipment at a greater frequency according to project-specific requirements. Calibrate all field air monitoring equipment on site and verify that all calibration standards used meet the minimum requirements for source and purity recommended by the instrument manufacturer. PIDs typically calibrated with 100 ppm isobutylene and 500 ppm methane calibration standards, respectively; however, other project-specific calibration standard concentrations maybe required. Calibrate PIDs to detect total organic vapor concentrations in ppm benzene equivalent. The PID must be capable of ionizing the expected contaminants of concern.

Calibrate all field air monitoring equipment within calibration acceptance criteria, based on contaminants of concern potentially encountered and within the instruments operational limits. If instrument readings appear to be irregular or drifting, attempt to recalibrate instruments before collecting additional data. Flag apparent instrument drift or erratic instrument readings on any field datasheets used to record data and in the field logbook (see *SOP-01*, *Logbook*

Documentation and Field Notes). If the instrument cannot be recalibrated, take the instrument out of service and replace it with a different unit that is capable of being calibrated and used with reliability.

Before starting any air monitoring, document the following calibration information in the *Field Calibration Sheet* provided as Appendix D, for routine instrument calibration:

- Calibration date and time
- Instrument type, name, serial number, and owner
- Lamp type (PID only)
- Type of regulator
- Type of tubing (such as direct tubing or T-connection)
- Calibration gas type, canister lot number, and expiration date
- Zero gas calibration reading
- Calibration gas (span gas) reading
- Ambient weather condition (for example, temperature and wind direction)
- Operators initials
- Other notes and comments

Organic Vapor Monitoring with a Photoionization Detector

To ensure that field air monitoring equipment will be properly calibrated and remain operable in the field, **calibrate all field air monitoring equipment daily before use**. If necessary, calibrate other air monitoring equipment at a greater frequency according to project-specific requirements. Calibrate all field air monitoring equipment on site and verify that all calibration standards used meet the minimum requirements for source and purity recommended by the instrument manufacturer. are typically calibrated with 100 ppm isobutylene and 500 ppm methane calibration standards, respectively; however, other project-specific calibration standard concentrations maybe required. Calibrate PIDs to detect total organic vapor concentrations in ppm benzene equivalent. Both PIDs must be capable of ionizing the expected contaminants of concern.

Calibrate all field air monitoring equipment within calibration acceptance criteria, based on contaminants of concern potentially encountered and within the instruments operational limits. If instrument readings appear to be irregular or drifting, attempt to recalibrate instruments before collecting additional data. Flag apparent instrument drift or erratic instrument readings on any field datasheets used to record data and in the field logbook (see *SOP-01, Logbook Documentation and Field Notes*). If the instrument cannot be recalibrated, take the instrument out of service and replace it with a different unit that is capable of being calibrated and used with reliability.

Before starting any air monitoring, document the following calibration information in the *Field Calibration Sheet* provided in Appendix D, for routine instrument calibration:

- Calibration date and time
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- Type of regulator
- Type of tubing (such as direct tubing or T-connection)
- Calibration gas type, canister lot number, and expiration date
- Zero gas calibration reading
- Calibration gas (span gas) reading
- Ambient weather condition (for example, temperature and wind direction)
- Operators initials
- Other notes and comments

Organic Vapor Monitoring of Site Media

Monitoring of organic vapors in site media can help identify potentially contaminated areas to assist with site characterization. Organic vapor monitoring is typically conducted using a PID for analytical screening of soil by **screening soil cores, small test pits, soil headspace**. The PID can also be used to evaluate organic vapors **inside monitoring wells and excavations**.

For volatile and semi-volatile compounds, knowing the PIP is critical in determining the appropriate instrument to use when organic vapor screening. Consult the QAPP and manufacturer’s manual to determine that the proper instrument has been selected for the contaminate vapors of interest. If an expected compound at a site has a PIP less than 11.7 eV, it is possible to use a PID. If the ionization potential is greater than 11.7eV, an FID is required.

Soil Core Screening for Organic Vapors

Soil cores are typically obtained during drilling activities and should be screened for the presence of organic vapors using a PID. Immediately following extraction and opening of a lithologic core sample during drilling, screen the core by slowly passing the tip of the PID along the lithologic core and into the void space, collecting an in-situ reading at every 0.5 foot increment. Record readings along the soil core in 0.5 foot increments and additionally target any zones of high odor or staining. Record the readings on the soil boring log field datasheet and field notebook.

Soil Screening Using a FROG-4000 GC/PID

A FROG-4000 can be used to field screen soil samples for VOCs. The U.S. Environmental Protection Agency (EPA) recommends purge-and-trap for VOC analysis in soil; however, the sample preparation for purge-and-trap will vary depending on the concentration of the target analytes in the soil. There are two preparation methods for purge-and-trap with the FROG-4000; one is for high concentrations in soil and the other is for low concentrations. The EPA defines high concentration as samples containing VOC levels greater than 200 micrograms of VOC per kg of soil (µg/kg). If the VOC levels are anticipated to be below that concentration then 5 milligrams of soil will be placed directly into the sparging tube with 5 milliliters of deionized water and analyzed in accordance with the FROG-4000 user's manual (Defiant, 2012). For the high concentration soil method, 5 grams of a soil sample is added to a pre-weighed VOA vial containing 10mL of a water miscible organic solvent (i.e., methanol); this technique is commonly referred to as methanol extraction. The process for analyzing soil with a FROG-4000 using the methanol extraction is described in the *Application Note: Methanol Extraction of Soils* (Defiant, 2013) for the FROG-4000.

Soil Headspace Screening for Organic Vapors

Use headspace organic vapor monitoring to measure petroleum vapors emitted from soil samples in a sealed container. Warm the headspace of the container and then test for volatile organic vapors using PID techniques. As the results generated by this method are qualitative to semi-quantitative, limit use to organic compounds that readily volatilize.

Collect soil for headspace screening from various sources, including lithologic soil cores during drilling, soil stockpiles, or from excavations and test pits. For soil cores, screen soil headspace from 1-foot intervals at zones of where contamination is expected.

Use the following procedures when conducting soil headspace screening for organic vapors:

- Calibrate the headspace screening instrument(s) according to the manufacturer's specifications and requirements and as discussed in sections above.
- Headspace screening (ppm) will typically be analyzed using clean, resealable 1-quart Ziploc (or similar) plastic bags.
- To begin collection of headspace screening samples, collect a small amount of soil (about the equivalent of a softball) and immediately place it inside a clean, resealable 1-quart Ziploc (or similar) plastic bag until the plastic bag is about one-third to one-half full; then immediately seal the bag completely. Do not use larger plastic bags, to prevent vapor diffusion and stratification effects from significantly affecting the sample. Immediately transfer samples from soil cores, excavations, or soil piles into the sample bag once the soil core is opened or the soil sample is uncovered and exposed to the atmosphere.
- Shake the bag for 15 seconds and let it rest for at least 10 minutes but no longer than one hour. Warm the temperature of the headspace to at least 40 °F (5°C) before testing. If the soil and/or outdoor temperature is low (<40°F) or is frozen/freezing, place the headspace sample in a warm location at approximately room temperature (that is, indoors) to slowly warm the sample to an acceptable temperature.
- Before testing, shake the bag for another 15 seconds to further assist volatilization.
- Insert the sample tip of the PID into the bag at a point approximately one-half the headspace depth, taking care not to foul the sample tip with soil particulates or uptake water droplets. Minimize the sample bag insertion opening to minimize vapors from escaping.

- After probe insertion, record the maximum detector reading on the soil boring log field datasheet or in the field notebook.
    - The maximum detector reading normally occurs between 2 and 5 seconds after probe insertion.
    - If erratic instrument response occurs at high VOC concentrations or conditions of elevated headspace moisture, record the instrument behavior along with the maximum detected reading(s). Under these conditions, headspace data may be discounted.

Screening for Organic Vapors in the Monitoring Well Casing

When conducting groundwater monitoring and/or sampling, screen the air inside the monitoring well casing for organic vapors using a PID. To screen for organic vapors inside or exiting the monitoring well casing, stand next to and not over the well approximately arms reach away from the well. Slowly open the well cap and immediately checking for organic vapors in the well casing by positioning the tip of the PID at the top of the open well casing. Record this reading on the Groundwater Monitoring/Sampling Datasheet or in the field logbook.

Air Monitoring for Potential Contaminant Exposure

Conduct air monitoring for potential exposure to airborne contaminants using a PID (measuring oxygen level and explosive atmosphere). Other types of air monitoring equipment that could be used include, but not limited to, FID, CGI, MultiRAE Plus meter (measuring oxygen level, explosive atmosphere, PID, and hydrogen sulfide), or Thermo Scientific pDR1000AN dust/aerosol meter.

Conduct air monitoring at one or more of the following areas for the given reasons:

- At the source. Monitoring at this location gives a worst-case assessment of the situation. If concentrations at the source are below the action levels, then a potential exposure problem is unlikely.
- In the employee breathing zone. Monitoring should be conducted in the employees' breathing zones to determine the actual conditions that they may potentially be exposed to. Since employees doing different tasks may have different potential exposures, monitoring should be conducted for the worst case scenario for each task.
- At the perimeter. Perimeter monitoring is used to document any background condition and that the surrounding community is not being adversely affected by the operations. This type of monitoring is typically only conducted if elevated levels are seen in the employees' breathing zones or at the perimeter of the exclusion zone, or if it is warranted as a means of documenting that no offsite releases occur.

Conduct monitoring before entering any potentially hazardous area, according to requirements in the HASP.

Monitoring of Oxygen, Combustible, Hydrogen Sulfide Gas, and Airborne Particulates

The following instruments to monitor oxygen levels, combustible atmosphere, hydrogen sulfide, or airborne dust: MultiRAE plus meter (measuring oxygen level, explosive atmosphere, PID, and hydrogen sulfide), CGI (measuring oxygen level and explosive atmosphere), or Thermo Scientific pDR1000AN dust/aerosol meter.

Depending on the requirements made in the HASP, take oxygen, combustible, hydrogen sulfide gas, and airborne dust measurements during field activities to ensure that breathing atmospheres do not become hazardous.

Conduct entry into any confined space or any other area where hazardous atmospheres may possibly be a concern under direct consultation with the project Health and Safety Manager and according to the requirements in the HASP. Always consult the Project Manager and/or Health and Safety Manager with any questions or concerns regarding instrument monitoring and work situations involving confined spaces and/or potentially hazardous atmospheres.

Monitoring of Oxygen Levels

The oxygen level in a confined space or other area of little to no air circulation is of prime concern to anyone about to enter that space. Removal of oxygen by combustion, reduction reactions, or displacement by other gases or vapors may be a hazard. Likewise, elevated levels of combustible or toxic gases may also pose a hazard to health. Elevated levels of oxygen may also result in an explosive hazard.

MultiRAE Plus meters are commonly used to monitor oxygen levels. Perform operation, maintenance, and calibration of oxygen monitoring instruments according to the manufacturer specifications and the HASP. Calibrate oxygen monitoring instruments daily.

Because some instruments do not operate properly without sufficient oxygen and others can cause explosions, the monitoring of oxygen will be the initial concern when working in an environment where there is potential for oxygen levels to be below 19.5 percent or greater than 25 percent. The normal oxygen concentration at sea level is 21 percent.

Monitoring for Explosive Atmosphere

The MultiRAE Plus meter is commonly used to monitor for a flammable and explosive atmosphere. Perform operation, maintenance, and calibration of explosive atmosphere monitoring instruments according to the manufacturer specifications and the HASP. Calibrate explosive atmosphere monitoring instruments daily.

Conduct monitoring for flammable or explosive environments at the same locations as monitoring of oxygen levels. Work can proceed as normal if the air conditions are less than 10 percent of the LEL. If the conditions are between 10 percent and 20 percent of LEL, proceed with extreme caution and continuous monitoring**. If the atmosphere is greater than 20 percent**

LEL, stop work immediately. Evacuate the site or implement engineering controls to reduce the LEL to acceptable levels.

Monitoring for Toxic Gases

The MultiRAE plus meter and Drager colorimetric tubes are commonly used to monitor for toxic gases. Perform operation, maintenance, and calibration of toxic gas monitoring instruments according to the manufacturer specifications and the HASP. Calibrate or inspect toxic monitoring instruments (as required) daily.

Toxic gases include organic and inorganic vapors and gases. The MultiRAE Plus meter is capable of monitoring the odorless and colorless toxic gas hydrogen sulfide, which is a common gas found at contaminated sites.

Monitoring for Airborne Dust

A Thermo Scientific pDR1000AN dust/aerosol meter is typically used to monitor for airborne aerosol particles and dust. Perform operation, maintenance, and calibration of airborne dust monitoring instruments according to the manufacturer specifications and the HASP. Calibrate airborne dust monitoring instruments (as required) daily.

Non-volatile contaminants (such as metals or PCBs) can become airborne as particulates and typically require monitoring at sites where there is a potential for dusty environments. If necessary, use a passive aerosol monitor to monitor for airborne dust as a proxy for the contaminant. Total dust action levels will be determined in the HASP.

RECORDS

Record all field measurements in the field notebook according to *SOP-01, Logbook Documentation and Field Notes.*

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SOP – 13 Equipment Decontamination Procedures

PURPOSE

This SOP provides the step-by-step procedures for field decontamination of environmental sampling equipment and PPE. Decontamination of equipment and PPE is designed to ensure that sample cross-contamination, human health exposure, and contamination transport are minimized.

SCOPE

This procedure applies to all Swift River team personnel and subcontractors engaged in collecting environmental samples and/or operating in environments in which hazardous or contaminating substances are expected to be present. All decontamination procedures will be conducted according to the following guidance documents:

- Field Sampling Guidance (ADEC, 2017)
- Underground Storage Tanks Procedures Manual: Guidance for Treatment of Petroleum-Contaminated Soil and Groundwater and Standard Sampling Procedures (ADEC, 2002)

GENERAL

Decontamination consists of physically removing contaminants from the surface of sampling equipment and cleaning materials potentially exposed to those contaminants. A decontamination plan should be based on the most conservative, worst-case scenario, using all available information about the work area. The plan can be modified, if justified by supplemental information. Initially, the decontamination plan assumes that all protective clothing and equipment that leave the exclusion zone are contaminated. Based on this assumption, a system is established to wash and rinse all non-disposable equipment and dispose of all disposable equipment.

The type of decontamination procedures and solutions needed at each site should be determined after considering the following site-specific conditions:

- Type of equipment to be decontaminated
- Type of contaminants present
- Extent of contamination
- Potential human and ecological risk scenarios

RESPONSIBILITIES

Project Manager

The Project Manager is responsible for overall compliance with this procedure and for verifying that field staff are properly trained and meet project HSE requirements.

Site Manager

The Site Manager coordinates and schedules daily field activities. In addition, the Site Manager verifies compliance with this SOP and ensures that all field staff engaged in this activity are trained in this SOP.

Field Team Lead

The Field Team Lead is responsible for following these procedures or delegating tasks to technicians to perform decontamination tasks. The Field Team Lead verifies that subcontractors are taking necessary precautions to decontaminate field equipment before and throughout field activities. The Field Team Lead also verifies that decontamination waste and PPE are disposed of appropriately according to Waste Management Plan (Appendix C).

Health and Safety Manager

The Health and Safety Manager is assigned to oversee the site-specific HSE program and overall compliance with project HSE requirements. The Health and Safety Manager conducts PPE evaluations, selects the appropriate PPE for the project, lists the requirements in the project-specific HASP, coordinates with the Site Manager, Field Team Lead, and/or Field Safety Officer to complete and certify the PPE program, and conducts project health and safety audits on the effectiveness of the HSE program.

Field Safety Officer

The Field Safety Officer assists in implementing the project HASP; the role of Field Safety Officer is either taken by the Site Manager or is designated to Field Team Leads by the Site Manager. The Field Safety Officer assists the Health and Safety Manager with the HSE program, implements the PPE requirements described in the project HASP, and receives input from project staff on the effectiveness of the assigned PPE requirements and ongoing HSE procedures.

PROCEDURE

- Decontaminate all non-disposable sampling equipment used at the site **before activities begin** and **after each sample is collected**.

- Decontaminate all drilling and excavation equipment before activities begin and between each investigation location.

- Take care that materials and solutions used for decontamination procedures are not hazardous and will not potentially contaminate samples (i.e., acids and solvents).

Decontamination Area

Identify a localized decontamination area for drill rigs and other sampling equipment. Select the decontamination so that decontamination fluids and soil wastes can be managed in a controlled area with minimal risk to the surrounding environment. The decontamination area should be large enough to allow temporary storage of cleaned equipment and materials before use and to stage drums of decontamination IDW. In the case of large decontamination areas (ex. hollow-stem auger decontamination), line each area with heavy-gauge plastic sheeting and include a collection system designed to capture potential decontamination IDW. Lay out all decontamination areas in such a way as to prevent overspray while performing equipment and personnel decontamination.

Smaller decontamination tasks, such as surface water and sediment equipment decontamination, may occur at the sampling locations. In this case, mobilize all required decontamination supplies and equipment to the site, and provide smaller decontamination areas for personnel and portable equipment as necessary. Include basins, buckets, or tubs to capture decontamination IDW at these locations, and transfer to larger containers as necessary.

Decontamination Equipment

The following is a list of equipment and materials that may be needed to perform decontamination:

- Concrete or synthetic material-lined decontamination pad
- Plastic sheeting/membrane to serve as secondary containment for liquids
- Brushes and flat-bladed scrapers
- Garden-type water sprayers (without oil-lubricated, moving parts)
- High-pressure washer
- Portable steam cleaner
- Sump or collection system for contaminated liquid
- Wash basins and buckets
- Spray and rinse bottles
- Potable water, deionized water, and laboratory-grade detergent (Liquinox, Alconox, or similar)

- Plastic waste bags
- Leak-tight liquid waste containers (55-gallon drums or similar)
- Bulk solid waste containers (super-sacks, 55-gallon drums, or similar)

Decontamination Procedures

Personnel and Personal Protective Equipment

Decontamination of personnel and PPE will prevent undesired human health exposure to contaminants via ingestion, absorption, and inhalation. Decontaminate all personnel and PPE as outlined in the HASP. Address any further concerns regarding personnel and PPE decontamination procedures directly to the Site Manager, Project Manager, or Health and Safety Manager.

Sampling Equipment

Consistently conduct decontamination of sampling equipment to ensure the quality of the samples collected. Decontaminate all equipment that contacts potentially contaminated samples. Disposable equipment intended for one-time use that is factory wrapped generally does not need to be decontaminated before use, unless evidence of contamination is present. Use disposable equipment, such as disposable bailers, spoons, or volatile organic compound samplers over reusable equipment whenever appropriate. Decontaminate sampling equipment, including split-barrel samplers, hand augers, reusable bailers, spoons, trowels, shovels, and pumps used to collect samples for chemical analyses before each use and before sampling at a new location.

Take the following steps to decontaminate non-dedicated sampling equipment:

- Wear the appropriate PPE as required by the HASP.
- Use the following sequence for actual decontamination:
    1. Remove as much gross contamination (such as pieces of soil or residual groundwater remaining in a pump) as possible from equipment at the sampling site.
    2. If heavy petroleum residuals are encountered during sampling, use an appropriate solvent such as methanol to remove petroleum residues from sampling equipment. If a solvent is used, properly use, collect, store, and dispose of it according to the Waste Management Plan (Appendix C). If heavy petroleum residuals are not encountered, omit this step.
    3. Wash water-resistant equipment thoroughly and vigorously with potable water containing nonphosphate laboratory-grade detergent such as Liquinox, Alconox, or equivalent. Use a bristle brush or similar utensil to remove remaining residual contamination.

4. Thoroughly rinse equipment with potable, distilled, or deionized water (first rinse).
5. Thoroughly rinse equipment with distilled or deionized water (second rinse).
6. For sensitive field instruments, rinse equipment with distilled, deionized, or ASTM reagent-grade water (third rinse).
7. Perform air drying at a location where dust or other fugitive contaminants may not contact the sample equipment. Alternatively, use a clean, disposable paper towel to assist the drying process of wet. All equipment should be dry before reuse.

- If the equipment is not used soon after decontamination, cover or wrap it in new, oil-free aluminum foil or new, unused plastic bags to protect the decontaminated equipment from fugitive contaminants before reuse.
- Store decontaminated equipment at a secure, unexposed location out of the weather and potential contaminant exposure.
- Replace rinse and detergent water with new solutions between borings or sample locations, depending on site conditions and the number of samples collected at each location.

Groundwater Sampling

Proper decontamination between wells is essential to avoid introducing contaminants from the sampling equipment. For sampling with decontamination of peristaltic pumps, replace the pump head tubing after sampling each well. If sampling with a submersible bladder or a similar pump in which mechanisms of the pump directly contact contaminated water, or if sampling with a reusable stainless steel bailer, decontaminate the pump or bailer. Use the following steps for pumps and bailers contaminated with dissolved phase contamination only:

1. Thoroughly and vigorously wash the exterior of the pump or bailer and associated cable with potable water containing non-phosphate laboratory-grade detergent such as Liquinox, Alconox, or equivalent. Decontaminate using a dedicated wash bristle brush or similar brush.
2. Place the pump into a potable water wash basin/reservoir containing non-phosphate laboratory-grade detergent, making sure the pump intake is fully submerged and the pump outlet is allowed to flow directly back into the wash reservoir. Set the pump w to a very low flow rate and turn on, allowing the wash water to recirculate through the pump mechanism for a minimum of 5 minutes. Disregard this step if reusable bailers are used.
3. Rinse the pump or bailer by repeating Steps 1 and 2 using potable water, a dedicated rinse bristle brush, and a rinse basin/reservoir containing only potable water (first rinse).

4. Give the pump or bailer a final rinse by duplicating Step 3 using distilled, deionized, or ASTM reagent-grade water (second rinse).

5. Dry off any excess water with a clean, disposable paper towel and allow to air dry at a location where dust or other fugitive contaminants may not contact the sample pump or bailer.

If the pump or bailer is used to sample groundwater containing NAPL or other heavy petroleum contamination, field-strip the equipment according to the manufacturer's guidelines, and decontaminate the interior and exterior surfaces of the pump or bailer using the wash, double rinse, and dry steps outlined in Steps 1, 3, 4, and 5. If significant heavy petroleum residue is encountered during decontamination, use an appropriate solvent such as methanol to remove petroleum residues from pump or bailer surfaces. If a solvent is used, it must be properly used, collected, stored, and disposed of according to the WMP. If heavy petroleum residuals are not encountered, omit this step.

Measurement Devices and Monitoring Equipment

Water quality instruments, oil-water interface indicators, water level indicators, continuous water level dataloggers, and other field instruments that have the potential to contact site media will be washed, at a minimum, with diluted laboratory-grade detergent (Liquinox or similar) and will be double-rinsed with potable and distilled/deionized water before and after each use using the procedure discussed, as outlined above. If heavy petroleum residuals are encountered during sampling, use an appropriate solvent such as methanol to remove petroleum residues according to the manufacturer's maintenance guidelines.

Drilling and Subsurface Soil Sampling Equipment

The drilling contractor will decontaminate drilling equipment and associated materials before drilling operations and between borings. Decontaminate tools used for soil sampling (for example, split spoon samplers) before and between collecting analytical samples, as outlined above. Thoroughly clean external and internal surfaces of drilling equipment (that is, drill bits, auger, drilling stem, and hand tools) before drilling operations and between borings using the following basic sequence:

1. Remove as much gross contamination as possible from equipment at the sampling site.

2. Thoroughly and vigorously wash equipment with high-temperature potable water using a high-pressure washer and/or steam cleaner. Use a bristle brush to remove any persistent gross contamination.

3. Thoroughly rinse equipment twice with potable water (first and second rinses).

4. Air dry at a location where dust or other fugitive contaminants may not contact the sample equipment. Equipment must be dried before reuse.

5. Store decontaminated equipment at a location away from potential exposure to fugitive contamination.

Decontamination of Earthwork Equipment

Wash earthwork equipment (excavators, backhoes, and trucks) with high-pressure potable water, if possible, before leaving a contaminated area, using the steps outlined above. Portable steam cleaners and hand washing with a brush and detergent, followed by a potable water rinse, can also be used. In some instances, tires and tracks of equipment may only need to be thoroughly brushed with a dry brush. Take care with the components in direct contact with contaminants, such as tires and backhoe buckets. Thoroughly decontaminate any part of earthwork equipment that directly contacts analytical samples (that is, sampling from the excavator bucket) before excavation activities and between sample locations.

Investigation-Derived Waste

Depending on the contaminant, potentially hazardous IDW (such as wash water or rinsate solutions) should be accumulated in 55-gallon drums and transported to a waste storage area designated by the client, according to project-specific and installation-wide procedures for management of IDW as described in the Waste Management Plan, and in accordance with all federal, state, and local waste regulations (ADEC, 2010).

RECORDS

Sampling personnel will be responsible for documenting decontamination of sampling and drilling equipment. Documentation will be recorded in the field notebook or on a field datasheet as discussed in *SOP-01*, *Logbook Documentation and Field Notes*.

REFERENCES

Alaska Department of Environmental Conservation (ADEC). 2010. Draft Field Sampling Guidance. January.

Alaska Department of Environmental Conservation (ADEC). 2002. Underground Storage Tanks Procedures Manual: Guidance for Treatment of Petroleum-Contaminated Soil and Groundwater and Standard Sampling Procedures. November 7.

ASTM International (ASTM). 2008. Standard D5088-02: Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites.

Nielsen, D.M. 1991. Practical Handbook of Ground-Water Monitoring. Lewis Publishers. Pages 625-636.

U.S. Environmental Protection Agency (EPA). 1999. Procedures to Schedule and Complete Sampling Activities in Cooperation with EPA Region VII Environmental Services Division. February.

U.S. Environmental Protection Agency (EPA), Region VII. 1991. Environmental Services Division Operations *and Quality Assurance Manual.* February 1.

U.S. Environmental Protection Agency (EPA). 1987. *A Compendium of Superfund Field Operations Methods.* Volumes I and II. EPA/540/P 87/001a and b. August.

DEFINITIONS

- decontamination area - an area that is not expected to be contaminated and is upwind of suspected contaminants

- decontamination equipment - equipment used during the process of decontamination of personnel or sampling equipment drilling and subsurface soil sampling equipment: equipment and tools used during the process of drilling or subsurface soil sampling

- earthwork equipment - heavy earthmoving equipment typically used for excavation and test pit investigations

- health and safety plan - a plan developed to ensure that all hazards associated with a site are evaluated prior to site entry

- measurement/monitoring equipment - equipment used to check or evaluate site conditions

- personal protective equipment (PPE) - personal health and safety equipment used to protect the individual from contaminant exposure, physical injury, or death

- potable - water acceptable for drinking and washing

- sampling equipment - equipment used during the process of sample collection

SOP – 14 Monitoring Well Development

PURPOSE

This SOP provides guidance for developing temporary and permanent monitoring wells after their installation and before their designated use.

SCOPE

This SOP applies to all Swift River team personnel and subcontractors engaged in well development procedures in monitoring wells on AFCEC projects and tasks in Alaska, and was developed according to ADEC and other reference documents, including the following:

- *Field Sampling Guidance* (ADEC, 2017)
- *Monitoring Well Guidance* (ADEC, 2013)

This SOP focuses on the most commonly used monitoring well development methods and applications anticipated and should be used in conjunction with other applicable project SOPs, including the following:

- *SOP-01, Logbook Documentation and Field Notes*
- *SOP-10, Water Level Measurements*
- *SOP-13, Water Quality Measurements and Calibration*
- *SOP-14, Monitoring Well Installation*

GENERAL

The primary function of a monitoring well is to provide a representative sample of groundwater as it exists in the formation (ADEC, 2013). The overall objectives of monitoring well development are as follows:

- Restoring the aquifer properties near the well boring that had been disturbed during drilling or direct push emplacement
- Removing the finer-grained materials from the surrounding filter pack that may otherwise interfere with water quality analyses
- Improving the hydraulic characteristics of the filter pack and hydraulic communication between the well and the hydrologic unit adjacent to the well screen
- Removing all water introduced into the borehole while drilling

Formation characteristics change during drilling and well installation, and usually include the compaction of unconsolidated particles surrounding the annulus. In fine-grained soils, this can result in a mudwall around the boring annulus, which can impede free flow of formation water into the well (ADEC, 2013). Monitoring well development physically agitates the formation around the well boring by pushing and pulling water through the filter pack and surrounding formation. Thus flushes fine-grained soils into the well, where they either settle within the filter pack or are removed from the well during development and purging.

Common well development methods include combinations of surging, pumping, and bailing. The most effective well development method is alternating between using a surge block and pumping or bailing, so that multidirectional flow occurs through the filter pack and native formation around the well.

RESPONSIBILITIES

Project Manager

The PM is responsible for providing adequate resources and engaging field staff with adequate experience and training to successfully comply with and execute project-specific SOPs and implement the project HS&E program. The PM will solicit the appropriate technical expertise to adequately identify the best sampling methods and technology for the job given the current understanding of the site and project goals.

Site Manager

The SM is responsible for coordinating and scheduling daily field activities. In addition, the SM is responsible for training field staff engaged in this activity in this SOP and for compliance with this SOP.

Field Team Lead

The FTL directs well development activities. The FTL (or their designee) should know the requirements and procedures for well development, and should maintain adequate documentation of well development activities.

Health and Safety Manager

The HSM is responsible for site-specific HS&E and overall compliance with project HS&E requirements. The HSM conducts PPE evaluations, selects the appropriate PPE for the project, lists the requirements in the Project-specific HASP, coordinates with the FM and/or SC to complete and certify the PPE program, and conducts audits on the effectiveness of the HS&E program.

Field Safety Officer

The SC assists in implementing the project HASP; the role of SC is either taken by the FM or is designated to FTLs by the FM. The SC assists the HSM with the HS&E program, implements the PPE requirements described in the project HASP, and receives input from project staff on the effectiveness of the assigned PPE requirements and ongoing HS&E procedures.

PROCEDURES

Equipment

Well development commonly involves using equipment to surge, pump, and/or bail a monitoring well. Typical equipment includes the following:

- Surge block on a cable or line
- Submersible sampling pump (i.e., Mega Monsoon or Grundfos pump). A pump may be used to assist with surging however damage may occur to the pump from fine sediments.
- Water quality monitoring instrument(s) capable of measuring DO, ORP, conductivity, pH, turbidity, and temperature
- Water level indicator. A water level indicator will not work with a Grundfos pump due to electrical interference. Take initial depth to water and total depth measurements only if using a Grundfos during development.
- Groundwater purge container, tank, or drum
- Field notebook or Well Development Datasheet
- PPE

Conventional Monitoring Well Development

The primary goal of well development is to remove sediment and fines and repair the damage caused during installation in order to ensure a proper hydraulic connection to the aquifer (ADEC 2013). By surging the water column sediments and fines become suspended and are removed during the purging process.

Newly installed conventional monitoring wells will be developed no sooner than 24 hours after well installation, according to ADEC Monitoring Well Guidance (ADEC, 2013). Use a surge and purge method to develop conventional monitoring wells whenever feasible. The entire vertical screened interval should be developed using surge blocks, bailers, pumps, or other equipment, which frequently reverse the flow of water through the well screen and prevent bridging of formation or filter pack particles. Newly developed wells should be sampled no sooner than 24 hours after development in order to let fines settle.

Use the following instructions to develop monitoring wells:

Prior to surging or purging measure and record the water level and total depth of the well using a water level indicator. Note any accumulated sediment thickness, and record all information in a field notebook or on a Well Development Datasheet. Take an initial water quality measurement of pH, temperature, specific conductance, DO, ORP, and turbidity.

After each surge interval purge for approximately 5 to 10 minutes.

Surging

Begin well development by surging the bottom of the monitoring using either a submersible pump, which is not operating, or a surge block well for 5 to 10 minutes removing sediment from the bottom of the well. To do this, slowly lower a decontaminated pump or surge block into the well so that the surge block is within approximately 0.5 to 1 foot from the bottom of the well or measured sediment accumulation. Slowly raise and lower the surge block approximately 1 to 2 feet to create a mild surging effect at the bottom of the well; this will suspend any sediment that has settled at the bottom. Do not agitate the water violently. A general rule for well development is to start slowly and gently, and gradually increase agitation as the well is developed. After surging, immediately begin to pump or bail the sediment-laden water.

Next, develop the middle of the column by alternately using the surge block and the bailer or pump. This will account for settlement that occurs as the filter pack is reworked through surging. Lower the surge block to the base of the well screen interval and rapidly raise and lower the surge block across a 2- to 3-foot interval for approximately 3 to 5 minutes. Record the surge interval and duration of surging. After surging, immediately begin to pump or bail the sediment-laden water.

Next, develop the well from the middle of the screened interval to the top of the column by alternately using the surge block and the bailer or pump in the same manner. Continue purging at a sustainable flow rate and record water quality parameters at regular intervals. Repeat development of column intervals as necessary to ensure development of the entire well screen interval.

Purging

After each surge interval purge for 5 to 10 minutes prior to surging again. At a minimum, 10 well volumes should be purged during well development. If the well is purged dry at any point during development, approximately one well casing of clean, potable water can be introduced into the well and surging can continue (ADEC, 2013). Add water only as a last resort and only add non-formation water as necessary. After surging, purge the well dry again to complete the development process by removing at least the amount of potable water added to the well. If the well will recover naturally, continue development with formation water only.

Water Quality Measurements

Measure and record the water quality parameters every 5 to 10 minutes initially during pumping or bailing for each developed screen interval. Continue to alternate between surging and purging until the turbidity decreases. Once turbidity drops below 100 NTU and the water begins to clear start recording measurements every 5 minutes until measurements stabilize for at least three consecutive water quality parameter readings, according to the following criteria:

- ± 1.0 degrees Celsius (°C) temperature
- ± 0.1 pH
- ± 3 percent conductivity
- ± 10 millivolts (mV) ORP
- ± 10 percent DO or 0.2 milligram per liter (mg/L)

- ± 10 percent turbidity or ≤ 10 nephelometric turbidity units (NTUs)

The well will be considered adequately developed and development can stop after water quality parameters have stabilized and/or turbidity drops below 10 NTU. If none of these conditions have been achieved after 4 hours of well development, the FTL or SM will decide whether or not to continue development.

Record all well development data in a field logbook or on a Well Development Datasheet.

Direct Push Groundwater Sampler and Well Point Development

Like conventionally installed wells, DPS groundwater samplers and well points (see SOP-21, Hydropunch Groundwater Sampling) may be developed if necessary, depending on project-specific goals. Because of the way some DPS samplers and well points are constructed and used, they may not accommodate surging, and only pumping or bailing may be feasible (EPA, 2005). DPS samplers and well points that require development should be developed similarly to the methods described in Section 5.2 for conventional wells; however, because of the generally smaller diameters of DPS samplers and well points, smaller-diameter pumps, bailers, and, occasionally, surge blocks will be needed. Because most DPS groundwater samplers and DPS well points do not have filter packs to prevent fine-grained formation materials from entering the well casing, obtaining low-turbidity purge water during and after development may be difficult. In addition, in fine-grained formations, attempting to develop direct push wells may not improve well yield, and may result in increases in suspended sediment, well screen clogging, and/or screen damage. Purging the DPS groundwater sampler or well point at a low flow rate (≤0.1 gallon per minute), to the point at which pump discharge is free of suspended sediment (using a peristaltic pump, bladder pump, or gas-displacement pump), is often effective for developing wells installed in fine-grained formations. If DPS samplers and well points will be developed beyond usual purging during groundwater sampling, use the development techniques described in ASTM D5521, ASTM D6724, and ASTM D5092.

Development Water Management

Manage water generated during well development as IDW, according to Worksheet #14 of this UFP QAPP.

RECORDS

Record all data collected during well development activities in a Field Notebook or on a Well Development Datasheet, according to SOP-01, Note Taking and Field Log Books.

REFERENCES

Alaska Department of Environmental Conservation (ADEC). 2013. *Monitoring Well Guidance*. September.

Alaska Department of Environmental Conservation (ADEC). 2010. *Draft Field Sampling Guidance*. January.

American Society for Testing and Materials (ASTM). 2006. *Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers - Reinstated*. ASTM Standard D5521, ASTM International, West Conshohocken, PA. November 1.

American Society for Testing and Materials (ASTM). 2004a. *Standard Guide for Installation of Direct Push Ground Water Monitoring Wells*. ASTM Standard D6724, ASTM International, West Conshohocken, PA. July 1.

American Society for Testing and Materials (ASTM). 2004b. *Standard Practice for Design and Installation of Ground Water Monitoring Wells*. ASTM Standard D5092, ASTM International, West Conshohocken, PA. January 1.

U.S. Environmental Protection Agency (EPA). 2005. *Groundwater Sampling and Monitoring with Direct Push Technologies*. Office of Solid Waste and Emergency Response, Washington, DC. EPA 540/R-04/005. August.

DEFINITIONS

Bailer: a long, narrow tubular device with an open top and a check valve at the bottom that is used to remove water and sediment from a borehole or well.

Bailing: a well development technique using a bailer that is raised and lowered in the well to create a strong inward and outward movement of water from the formation, to break sand bridges and to remove water and fine-grained materials from the well.

Surging: a well development technique in which a surge block is alternately raised and lowered within the well casing or screen, or both, to create a strong inward and outward movement of water through the well screen.

Surge block: a weighted tool that is slightly smaller than the inside diameter of the well casing. Most surge blocks are 6 to 12 inches in length, as are some in-well pumps (Grundfos pumps) commonly used as surge blocks.

Mechanical surging: a process that uses a plunging motion (surge block) to force water to flow through a well screen. A pump or bailer is then used to remove dislodged sediment.

Mudwall: a layer of fine-grained soils formed around the boring annulus during drilling that can impede free flow of the formation water into the well.

Turbidity: cloudiness in water resulting from suspended and colloidal material.

Well casing: a durable pipe placed in a borehole to prevent the walls of the borehole from caving in, and to seal off surface drainage or undesirable water, gas, or other fluids and prevent their entrance into the well.

Well development: the act of repairing damage to the borehole caused by the drilling process and removing fine-grained materials or drilling fluids, or both, from formation materials so that natural hydraulic conditions are restored and well yields are enhanced.

Well screen: a filtering device that allows groundwater to flow freely into a well from the adjacent formation, while minimizing or eliminating the entrance of fine-grained material into the well.

APPENDIX B

FIELD FORMS

Provided on CD

FIELD FORMS INDEX

- Base Civil Engineering Work Clearance Request
- Borehole Soil Core Sample Log
- Daily Photo Log
- Daily Production & Quality Control Report
- Field Tailgate Safety Meeting Report
- Monitoring Well Boring Log
- Monitoring Well Installation Report
- Sampling Daily Blank
- Well Development Log

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BASE CIVIL ENGINEERING WORK CLEARANCE REQUEST

(See Instructions on Reverse)

DATE PREPARED

1. Clearance is requested to proceed with work at ______________________________

on Work Order No. ______________, Contract No. ______________, involving excavation or utility disturbance per

attached sketch. This area ☐ has ☐ has not been staked or clearly marked.

2. TYPE OF FACILITY/WORK INVOLVED

☐ A. PAVEMENTS	☐ D. FIRE DETECTION & PROTECTION SYSTEMS	☐ G. AIRCRAFT OR VEHICULAR TRAFFIC FLOW
☐ B. DRAINAGE SYSTEMS	☐ E. UTILITY ☐ OVERHEAD ☐ UNDERGROUND	☐ H. SECURITY
☐ C. RAILROAD TRACKS	☐ F. COMM ☐ OVERHEAD ☐ UNDERGROUND	☐ I. OTHER

3. DATE CLEARANCE REQUIRED	4. DATE OF CLEARANCE	
5. SIGNATURE OF REQUESTING OFFICIAL	6. TELEPHONE NO.	7. ORGANIZATION

ORGANIZATION		REMARKS *(Use Reverse for additional comments)*	REVIEWER'S NAME AND INITIALS
8. BASE CIVIL ENGINEERING	A. ELECTRICAL DISTRIBUTION		
	B. STEAM DISTRIBUTION		
	C. WATER DISTRIBUTION		
	D. POL DISTRIBUTION		
	E. SEWER DISTRIBUTION		
	F. ENVIRONMENTAL		
	G. PAVEMENTS/ GROUNDS		
	H. FIRE PROTECTION		
	I. ZONE ______		
	J. OTHER *(Specify)*		
9. SECURITY POLICE			
10. SAFETY			
11. COMMUNICATIONS			
12. BASE OPERATIONS			
13. CABLE TV			
14. COMMERCIAL UTILITY COMPANY ☐ TELEPHONE ☐ GAS ☐ ELECTRIC			

15. OTHER *(Specify)* ______________________________

16. REQUESTED CLEARANCE ☐ APPROVED ☐ DISAPPROVED

17. TYPED NAME AND SIGNATURE OF APPROVING OFFICER *(Chief of Operations Flight or Chief of Engineering Flight)*	17a. DATE SIGNED

AF IMT 103, 19940801, V3 PREVIOUS EDITIONS ARE OBSOLETE.

INSTRUCTIONS

The BCE work clearance request is used for any work (contract or in-house) that may disrupt aircraft or vehicular traffic flow, base utility services, protection provided by fire and intrusion alarm system, or routine activities of the installation. This form is used to coordinate the required work with key base activities and keep customer inconvenience to a minimum. It is also used to identify potentially hazardous work conditions in an attempt to prevent accidents. The work clearance request is processed just prior to the start of work. If delays are encountered and the conditions at the job site change (or may have changed) this work clearance request must be reprocessed.

18. REMARKS. *(This section must describe specific precautionary measure to be taken before and during work accomplishment. Specific comments concerning the approved method of excavation, hand or powered equipment, should be included.)*

BORING LOCATION ID: ____________

Page __ of __

Project Name: ____________
Site Location: ____________
____
Project Number: ____________
Approved By: ____________
Logged By: ____________
Date(s) Drilled: ____________
Start/End Time: ____________

Drilling Method: Direct Push Tech.
Drilling Contractor: ____________
Driller's Name: ____________
Drilling Rig: ____________
Total Depth: ____________
Borehole Diameter: ____________
Initial W. Level: ____________
Backfilled: Hydrated Bentonite Chips

Easting:
Northing:
Datum:
Ground Elevation:

Depth (ft)	Sample Type	Interval Recovery	Organic Vapor (PPM)	***Lithologic Description***	Water Level	USCS Code	Graphic Log	Analysis Interval

ID # of Screening Instr.:
RFW

Collected Soil Sample IDs:

Cutting Disposal:
55 gal steel drum

This log should not be used seperately from the original report.

Sample Type Symbol defined byASTM D1586: SS- Split Spoon D-Dennison ST-Shelby Tube
MC-Macro Core CS-Contiuous Sampler OT-Other CT-Cuttings

Page __ of __

BORING LOCATION ID: ____________________

Project Name: ____________________

Site Location: ____________________

Drilling Method: Direct Push Tech.

Drilling Contractor: ____________________

Sample Type Symbol defined byASTM D1586: SS- Split Spoon D-Dennison ST-Shelby Tube
MC-Macro Core CS-Contiuous Sampler OT-Other CT-Cuttings

WESTON SOLUTIONS

BORING LOCATION ID: ____________

Page __ of __

Project Name: ____________

Site Location: ____________

Drilling Method: Direct Push Tech.

Drilling Contractor:

ID # of Screening Instr.: RFW

Depth (ft)	Sample Type	Interval Recovery	Organic Vapor (PPM)	***Lithologic Description***	Water Level	USCS Code	Graphic Log	Analysis Interval

Collected Soil Sample IDs:

Cutting Disposal:

This log should not be used seperately from the original report.

Sample Type Symbol defined byASTM D1586: SS- Split Spoon D-Dennison ST-Shelby Tube
MC-Macro Core CS-Contiuous Sampler OT-Other CT-Cuttings

Weston Solutions, Inc
425 G Street, Suite 300
Anchorage Alaska 99501
Phone: 907.276.6610
Fax: 907.276.6694

Saturday, January 00, 1900

DAILY PRODUCTION & QUALITY CONTROL REPORT

Project No./Contract No. 0 0	Project Title / Location 0	Day of Report 00-Jan-00	Report No. **0**

DAILY PHOTO LOG

Weston Solutions, Inc
425 G Street, Suite 300
Anchorage Alaska 99501
Phone: 907.276.6610
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Saturday, January 00, 1900

DAILY PRODUCTION & QUALITY CONTROL REPORT

Project No./Contract No.	Project Title / Location	Day of Report	Report No.

Site Manager	Phone	E-Mail
Project Manager	Phone	E-Mail

WEATHER CONDITIONS

Temp (F)		Wind (Dir-MPH)		Precip. (In/Hr.)		Humidity (%)		Comments

WESTON PERSONNEL

Name	Position	Trade / Work Performed	Hrs	Signed HASP
		Total WESTON Man-Hours	-	

OTHER PERSONNEL/Subcontractors

Name	Company	Trade / Work Performed (Driver/Labor/Oper/Technician)	Hrs	Signed HASP
		Total SUBCONTRACTOR Man-Hours	-	

ON-SITE EQUIPMENT

Equipment	Vendor / Tag No.		Operator(s) Name	Operating Hours & Fuel (gal)			
				Diesel	Gas	Repair	hrs
				-			

Material	Cost	Delivery Verification			
		Condtn	Qty	Spec	Tags

WORK COMPLETED

Description of Work Executed Today

DAILY PRODUCTION & QUALITY CONTROL REPORT

Project No./Contract No.	Project Title / Location	Day of Report	Report No.

HEALTH & SAFETY

Description of Health & Safety Actions Taken Today / Safety Inspections Conducted: SEE TAILGATE SAFETY SIGN IN ATTACHED

.

QUALITY CONTROL

Description of Quality Control Actions Taken Today / Quality Inspections Conducted

ISSUES AND/OR ITEMS OF DISCUSSION

Discussion of Issues / Concerns / Conversations / Topics

DAILY PRODUCTION & QUALITY CONTROL REPORT

Project No./Contract No.	Project Title / Location	Day of Report	Report No.

SITE VISITORS

Name	Organization		In	Out	Signed HASP

Contractor Verification: On behalf of WESTON SOLUTIONS, INC., I certify this report is complete and correct, and all work performed and materials and equipment used during this reporting period are in compliance with the contract requirements, specifications, and standards, to the best of my knowledge, except as noted herein.

Report Prepared By / Title	Date Prepared	Signature

Weston Solutions, Inc
425 G Street, Suite 300
Anchorage Alaska 99501
Phone: 907.276.6610
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Saturday, January 00, 1900

FIELD TAILGATE SAFETY MEETING REPORT

Project No./Contract No.	**Project Title / Location**	**01/00/00**

Hospital Name	Address/Phone	**Nearest Phone**	Safety Every Minute of Every Day WESTON

WORK ACTIVITIES (THIS SHIFT)

Refer to Health & Safety Plan / Activities Hazard Analysis

Act. No.	Task Description	HASP Page	Risk Level		PPE Requirement		Topic Covered
			Chem	Phys	Level	Modifications	
1							
2							
3							
4							
6							
7							

ADDITIONAL SITE HAZARDS

Risks not identified within Health & Safety Plan / Activities Hazard Analysis

CHEMICAL HAZARDS

Description of Potential Hazards / Risks	Safety Procedures & Special Equipment/Techniques	Topic Covered

PHYSICAL HAZARDS

Description of Potential Hazards / Risks	Safety Procedures & Special Equipment/Techniques	Topic Covered

SPECIAL TOPICS

Additional / Special Topics (Incidents, Actions Taken, Items of Concerns, Etc.) Discussed Today

ATTENDEES

Print Name	Company/Organization	Sign Name

FIELD TAILGATE SAFETY MEETING REPORT

Project No./Contract No.	**Project Title / Location**	**01/00/00**

Meeting Conducted By	Phone	**Signature**	**Start Time**	**Completed**

WESTON SOLUTIONS

WELL LOCATION ID: **MW-** ____________

Page __ of __

BORING LOCATION ID: ____________

Project Name: ____________
Site Location: ____________
Project Number: ____________
Approved By: ____________
Logged By: ____________
Date(s) Drilled: ____________
Start/End Time:

Drilling Method: ____________
Drilling Contractor: ____________
Driller's Name: ____________
Drilling Rig: ____________
Total Depth: ____________
Completed Depth: ____________
Borehole Diameter: ____________

Easting	Northing

Top of Casing El.:
Ground Elevation:
Datum:
Static W. Depth:
Initial W. Level:

Remarks:
ID # of Screening
Instr.: RFW

Cutting Disposal: 55 gal steel drum

Collected Sample IDs:

Depth (ft)	Sample Type	Interval Recovery	Organic Vapor (ppm)	***Lithologic Description***	Analysis Interval	USCS Code	Graphic Log	Water Level	***Well Completion***	***Installation Notes:***

Blank Casing
Diameter:
Casing:pvc
From:

Annular Fill:
Grout Type:
Gel:
Bags:
Portland:
Bags:
From:
Bentonite Type:

From:
Bags:
Sand Pack Type:

From:
Bags:

Screen
Size:0.010"
Diameter: 2"
Type:pvc
From:

This log should not be used seperately from the original report.

Sample Type Symbols defined by ASTM D1586: SS- Split Spoon D-Dennison ST-Shelby Tube
MC-Macro Core CS-Contiuous Sampler OT-Other CT-Cuttings

T:\AETC FA3002\0001_EAS and PL Charact Studies\QAPP\Draft PTL\Pre-Draft\Appendices\App D Field Forms\1 MW BORING LOG.xls

WELL LOCATION ID: **MW-**

Page __ of __

BORING LOCATION ID:

Project Name:
Site Location:

Drilling Method:
Drilling Contractor:
Driller's Name:

Collected Sample IDs:

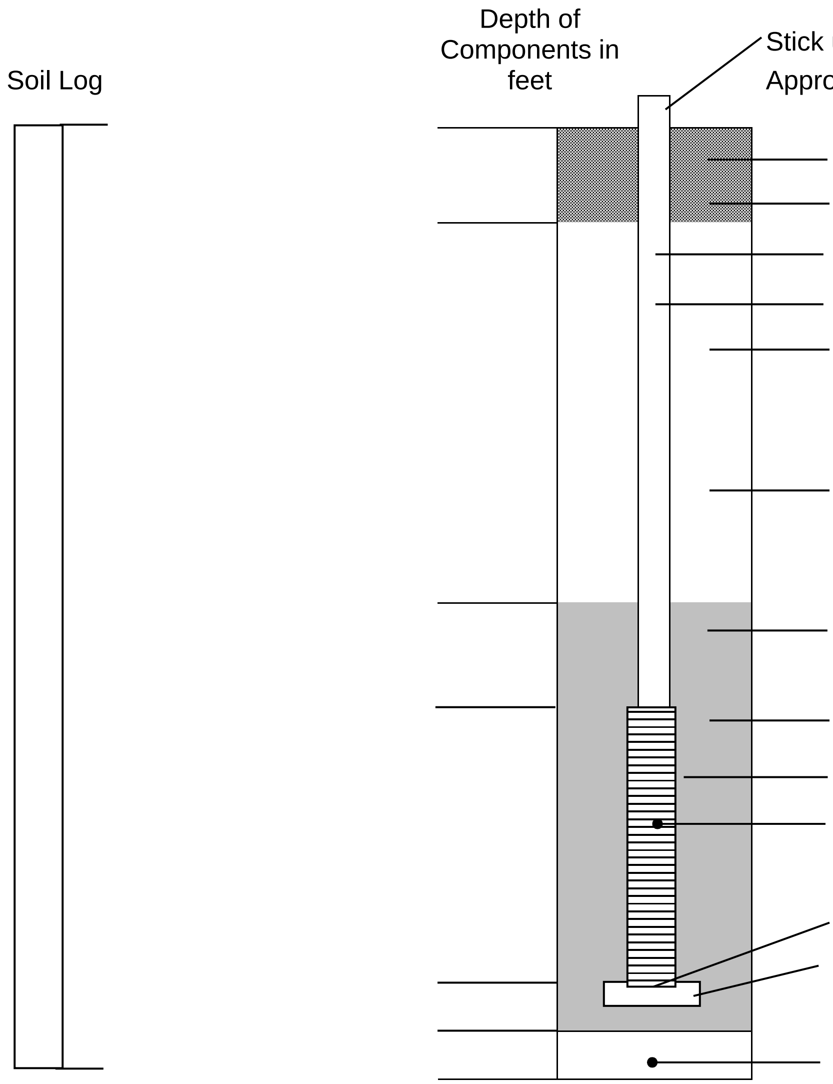
Depth (ft)	Sample Type	Interval Recovery	Organic Vapor (ppm)	***Lithologic Description***	Analysis Interval	USCS Code	Graphic Log	Water Level	***Well Completion***	***Installation Notes:***

This log should not be used seperately from the original report.
Sample Type Symbols defined by ASTM D1586: SS- Split Spoon D-Dennison ST-Shelby Tube
MC-Macro Core CS-Contiuous Sampler OT-Other CT-Cuttings

T:\AETC FA3002\0001_EAS and PL Charact Studies\QAPP\Draft PTL\Pre-Draft\Appendices\App D Field Forms\1 MW BORING LOG.xls

MONITORING WELL INSTALLATION REPORT

Project Name:	Well No.:
Project No.:	Observer:
Date/Time:	Drilling Method:



Stick up (feet)

Approximate ground surface elevation (feet)

Diameter of borehole (inches)

Type of surface seal

I.D. of riser pipe (inches)

Type of riser pipe

Type of backfill around riser

Type of well seal

Type of sand

Length of top screen blank

Screen size and type

Water level

Length of bottom screen blank

Length of end cap

Type of backfill material

Remarks:

Amount of	Sand	Monument	
Materials:	Cement	Riser	
	Bentonite pellets	Screen	
	Bentonite/Volclay	Other	

Sampling Daily Report

Project Number: ______ **Date:** ______

Personnel	Hours

Site Conditions

Temp ______ °F **Wind** ______

Sunny	☐	**Partly Cloudy**	☐
Cloudy	☐	**Foggy**	☐
Rainy	☐	**Snowy**	☐

Sampling Activities

Areas Sampled ______

Delineation ☐ **Confirmation** ☐ **MI** ☐ **Waste** ☐ **Decon** ☐

Samples Collected: ______ **Samples to mobile lab:** ______

COC Numbers ______

Samples Shipped ______
Coolers Shipped ______ **Cooler Numbers:** ______

Site Monitoring/Readings

MultiRAE plus ☐ **MiniRae (PID)** ☐ **Other** ☐

Locations Monitored: ______
Exceedances: ______
Calibrations: ______

Supplies/Consumables

Received (quantity)	
Ordered (quantity)	
To Order (quantity)	

Comments:

CLIENT: ______________________________
PROJECT: ______________________________
SITE: ______________________________
WELL ID: ______________________________
DATE:

MEASURED BY: ______________________________
DEVELOPMENT
METHOD: ______________________________
____
COMMENTS:

Well Development Log

ONE WELL VOLUME: _______________ gallons
WELL TD: ______________ ft TOC

Well Volume (gallons/foot)	2-inch = 0.16	6-inch = 1.47
	4-inch = 0.65	8-inch = 2.51

TIME	WELL DEV. CODE	DEPTH TO WATER (ft)	PURGE RATE (gpm)	PURGE VOLUME (gal)	FIELD MEASUREMENTS				TURBIDITY	COMMENTS
	FINAL									

WELL DEVELOPMENT CODES		FIELD MEASUREMENT CODES	TURBIDITY
DOB – Begin Overpumping	DAB – Begin Air Surging	MTP – Temperature	Enter Turbidity Meter Reading
DOE – End Overpumping	DAE – End Air Surging	MSC – Specific Conductance	(Final should be < 5 NTU)
DRB – Begin Rawhiding	DCB – Begin Recirculation	MPD – Photoionizer (eg., HNu)	OR
DRE – End Rawhiding	DCE – End Recirculation	MFD – Flame Ionizer (eg., OVA)	Enter Qualitative Observations
DSB – Begin Surge Blocking	DBB – Begin Bailing	MDO – Dissolved Oxygen	
DSE – End Surge Blocking	DBE – End Bailing	MPH – pH	H – High: Muddy/Silty
DJB – Begin Hydraulic Jetting	DXB – Begin Other	MEH – eH	M – Medium: Cloudy/Translucent
DJE – End Hydraulic Jetting	DXE – End Other	MOT – Other: ______________	L – Low: Transparent
DFM – Field Measurements	Other: _________________		N – None: Clear/No Sediment

APPENDIX C

LABORATORY CERTIFICATIONS

Provided on CD

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SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

SGS NORTH AMERICA INC. – ALASKA DIVISION
200 W Potter Dr.
Anchorage, AK 99518
Mary McDonald Phone: (907)-550-3203
mary.mcdonald@sgs.com

ENVIRONMENTAL

Valid To: December 31, 2019 Certificate Number: 2944.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2009 TNI Environmental Testing Laboratory Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 5.1 of the DoD Quality Systems Manual for Environmental Laboratories) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

Inductively Coupled Plasma Mass Spectroscopy, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Ion Chromatography, Hazardous Waste Characteristics Tests, Total Organic Carbon

Parameter/Analyte	**Solid & Chemical Materials**	
	Aqueous	**Solid**
Metals		
Aluminum	EPA 6020A	EPA 6020A
Antimony	EPA 6020A	EPA 6020A
Arsenic	EPA 6020A	EPA 6020A
Barium	EPA 6020A	EPA 6020A
Beryllium	EPA 6020A	EPA 6020A
Boron	EPA 6020A	EPA 6020A
Cadmium	EPA 6020A	EPA 6020A
Calcium	EPA 6020A	EPA 6020A
Chromium	EPA 6020A	EPA 6020A
Cobalt	EPA 6020A	EPA 6020A
Copper	EPA 6020A	EPA 6020A
Iron	EPA 6020A	EPA 6020A
Lead	EPA 6020A	EPA 6020A
Magnesium	EPA 6020A	EPA 6020A
Manganese	EPA 6020A	EPA 6020A
Mercury	EPA 6020A EPA 7470A	EPA 6020A EPA 7471A
Molybdenum	EPA 6020A	EPA 6020A
Nickel	EPA 6020A	EPA 6020A

Parameter/Analyte	**Solid & Chemical Materials**	
	Aqueous	**Solid**
Potassium	EPA 6020A	EPA 6020A
Selenium	EPA 6020A	EPA 6020A
Silver	EPA 6020A	EPA 6020A
Sodium	EPA 6020A	EPA 6020A
Thallium	EPA 6020A	EPA 6020A
Vanadium	EPA 6020A	EPA 6020A
Zinc	EPA 6020A	EPA 6020A
Metals digestion methods toxicity characteristic leaching procedure	EPA 3010A EPA 1311	EPA 3050B EPA 1311
Nutrients		
Nitrate (as N)	EPA 9056A	EPA 9056A
Nitrate-Nitrite (as N)	EPA 9056A	EPA 9056A
Nitrite (as N)	EPA 9056A	EPA 9056A
Demands		
Total Organic Carbon	EPA 9060A	EPA 9060A
Wet Chemistry		
Bromide	EPA 9056A	EPA 9056A
Chloride	EPA 9056A	EPA 9056A
Fluoride	EPA 9056A	EPA 9056A
Sulfate	EPA 9056A	EPA 9056A
Purgeable Organics (volatiles)		
Acetone	EPA 8260C	EPA 8260C
Benzene	EPA 8260C EPA 8021B	EPA 8260C EPA 8021B
Bromobenzene	EPA 8260C	EPA 8260C
Bromochloromethane	EPA 8260C	EPA 8260C
Bromodichloromethane	EPA 8260C	EPA 8260C
Bromoform	EPA 8260C	EPA 8260C
Bromomethane	EPA 8260C	EPA 8260C
2-Butanone	EPA 8260C	EPA 8260C
n-Butylbenzene	EPA 8260C	EPA 8260C
sec-Butylbenzene	EPA 8260C	EPA 8260C
tert-Butylbenzene	EPA 8260C	EPA 8260C
Carbon disulfide	EPA 8260C	EPA 8260C
Carbon tetrachloride	EPA 8260C	EPA 8260C
Chlorobenzene	EPA 8260C	EPA 8260C
Chloroethane	EPA 8260C	EPA 8260C
Chloroform	EPA 8260C	EPA 8260C
Chloromethane	EPA 8260C	EPA 8260C
2-Chlorotoluene	EPA 8260C	EPA 8260C
4-Chlorotoluene	EPA 8260C	EPA 8260C

Parameter/Analyte	**Solid & Chemical Materials**	
	Aqueous	**Solid**
Dibromochloromethane	EPA 8260C	EPA 8260C
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260C EPA 8260B SIM	EPA 8260C
Dibromomethane	EPA 8260C	EPA 8260C
1,2-Dibromoethane (EDB)	EPA 8260C EPA 8260B SIM	EPA 8260C
1,2-Dichlorobenzene	EPA 8260C	EPA 8260C
1,3-Dichlorobenzene	EPA 8260C	EPA 8260C
1,4-Dichlorobenzene	EPA 8260C	EPA 8260C
Dichlorodifluoromethane	EPA 8260C	EPA 8260C
1,1-Dichloroethane	EPA 8260C	EPA 8260C
1,2-Dichloroethane	EPA 8260C	EPA 8260C
1,1-Dichloroethene	EPA 8260C	EPA 8260C
cis-1,2-Dichloroethene	EPA 8260C	EPA 8260C
trans-1,2-Dichloroethene	EPA 8260C	EPA 8260C
1,2-Dichloropropane	EPA 8260C	EPA 8260C
1,3-Dichloropropane	EPA 8260C	EPA 8260C
2,2-Dichloropropane	EPA 8260C	EPA 8260C
1,1-Dichloropropene	EPA 8260C	EPA 8260C
cis-1,3-Dichloropropene	EPA 8260C	EPA 8260C
trans-1,3-Dichloropropene	EPA 8260C	EPA 8260C
Ethyl benzene	EPA 8260C EPA 8021B	EPA 8260C EPA 8021B
Freon 113	EPA 8260C	EPA 8260C
2-Hexanone	EPA 8260C	EPA 8260C
Hexachlorobutadiene	EPA 8260C	EPA 8260C
Isopropylbenzene	EPA 8260C	EPA 8260C
4-Isopropyltoluene	EPA 8260C	EPA 8260C
Methylene chloride	EPA 8260C	EPA 8260C
4-Methyl-2-pentanone	EPA 8260C	EPA 8260C
Methyl tert-butyl ether	EPA 8260C	EPA 8260C
Naphthalene	EPA 8260C	EPA 8260C
n-Propylbenzene	EPA 8260C	EPA 8260C
Styrene	EPA 8260C	EPA 8260C
1,1,1,2-Tetrachloroethane	EPA 8260C	EPA 8260C
1,1,2,2-Tetrachloroethane	EPA 8260C	EPA 8260C
Tetrachloroethene	EPA 8260C	EPA 8260C
Toluene	EPA 8260C EPA 8021B	EPA 8260C EPA 8021B
1,2,3-Trichlorobenzene	EPA 8260C	EPA 8260C
1,2,4-Trichlorobenzene	EPA 8260C	EPA 8260C
1,1,1-Trichloroethane	EPA 8260C	EPA 8260C
1,1,2-Trichloroethane	EPA 8260C	EPA 8260C
Trichloroethene	EPA 8260C	EPA 8260C
Trichlorofluoromethane	EPA 8260C	EPA 8260C

Parameter/Analyte	**Solid & Chemical Materials**	
	Aqueous	**Solid**
1,2,3-Trichloropropane	EPA 8260C EPA 8260B SIM	EPA 8260C
1,2,4-Trimethylbenzene	EPA 8260C	EPA 8260C
1,3,5-Trimethylbenzene	EPA 8260C	EPA 8260C
Vinyl acetate	EPA 8260C	EPA 8260C
Vinyl chloride	EPA 8260C	EPA 8260C
Xylenes, total	EPA 8260C EPA 8021B	EPA 8260C EPA 8021B
1,2-Xylene (O-Xylene)	EPA 8260C EPA 8021B	EPA 8260C EPA 8021B
1,3-Xylene & 1,4-Xylene (M+P-Xylene)	EPA 8260C EPA 8021B	EPA 8260C EPA 8021B
Volatiles Preparation Methods Toxicity Characteristic Leaching Procedure Zero Headspace Extraction	EPA 1311 EPA 3511 EPA 5030B	EPA 1311 EPA 3511 EPA 5035A
Total Petroleum Hydrocarbons (TPH)		
Gasoline Range Organics	EPA 8015C AK 101 (AK State Method)	EPA 8015C AK 101 (AK State Method)
GRO Preparation Methods	EPA 5030B	EPA 5035A
Diesel Range Organics	EPA 8015C AK 102 (AK State Method)	EPA 8015C AK 102 (AK State Method)
Residual Range Organics	EPA 8015C AK 103 (AK State Method)	EPA 8015C AK 103 (AK State Method)
DRO/RRO Preparation Methods	EPA 3520C Modified	EPA 3550C
Extractable Organics (semivolatiles)		
Acenaphthene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Acenaphthylene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Aniline	EPA 8270D	EPA 8270D
Anthracene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Azobenzene	EPA 8270D	EPA 8270D
Benzoic acid	EPA 8270D	EPA 8270D
Benzo(a)anthracene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Benzo(b)fluoranthene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Benzo(k)fluoranthene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Benzo(ghi)perylene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Benzo(a)pyrene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM

Parameter/Analyte	**Solid & Chemical Materials**	
	Aqueous	**Solid**
Benzyl alcohol	EPA 8270D	EPA 8270D
Bis (2-chloroethoxy) methane	EPA 8270D	EPA 8270D
Bis (2-chloroethyl) ether	EPA 8270D	EPA 8270D
Bis (2-chloroisopropyl) ether	EPA 8270D	EPA 8270D
Bis (2-ethylhexyl) phthalate	EPA 8270D	EPA 8270D
4-bromophenylphenyl ether	EPA 8270D	EPA 8270D
Butyl benzyl phthalate	EPA 8270D	EPA 8270D
Carbazole	EPA 8270D	EPA 8270D
4-Chloroaniline	EPA 8270D	EPA 8270D
4-Chloro-3-methylphenol	EPA 8270D	EPA 8270D
1-Chloronaphthalene	EPA 8270D	EPA 8270D
2-Chloronaphthalene	EPA 8270D	EPA 8270D
2-Chlorophenol	EPA 8270D	EPA 8270D
4-Chlorophenyl phenyl ether	EPA 8270D	EPA 8270D
Chrysene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Dibenzo(a,h)anthracene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Dibenzofuran	EPA 8270D	EPA 8270D
1,2-Dichlorobenzene	EPA 8270D	EPA 8270D
1,3-Dichlorobenzene	EPA 8270D	EPA 8270D
1,4-Dichlorobenzene	EPA 8270D	EPA 8270D
3,3’-Dichlorobenzidine	EPA 8270D	EPA 8270D
2,4-Dichlorophenol	EPA 8270D	EPA 8270D
2,6-Dichlorophenol	EPA 8270D	EPA 8270D
Diethyl phthalate	EPA 8270D	EPA 8270D
2,4-Dimethylphenol	EPA 8270D	EPA 8270D
Dimethyl phthalate	EPA 8270D	EPA 8270D
di-n-Butyl phthalate	EPA 8270D	EPA 8270D
di-n-Octyl phthalate	EPA 8270D	EPA 8270D
2,4-Dinitrophenol	EPA 8270D	EPA 8270D
2,4-Dinitrotoluene	EPA 8270D	EPA 8270D
2,6-Dinitrotoluene	EPA 8270D	EPA 8270D
Fluoranthene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Fluorene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Hexachlorobenzene	EPA 8270D	EPA 8270D
Hexachlorobutadiene	EPA 8270D	EPA 8270D
Hexachlorocyclopentadiene	EPA 8270D	EPA 8270D
Hexachloroethane	EPA 8270D	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Isophorone	EPA 8270D	EPA 8270D
1-Methylnaphthalene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM

Parameter/Analyte	**Solid & Chemical Materials**	
	Aqueous	**Solid**
2-Methylnaphthalene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
2-Methyl-4,6-dinitrophenol	EPA 8270D	EPA 8270D
2-Methylphenol (As O cresol)	EPA 8270D	EPA 8270D
3 & 4-Methylphenol (As P & M cresol)	EPA 8270D	EPA 8270D
Naphthalene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
2-Nitroaniline	EPA 8270D	EPA 8270D
3-Nitroaniline	EPA 8270D	EPA 8270D
4-Nitroaniline	EPA 8270D	EPA 8270D
Nitrobenzene	EPA 8270D	EPA 8270D
2-Nitrophenol	EPA 8270D	EPA 8270D
4-Nitrophenol	EPA 8270D	EPA 8270D
n-Nitrosodimethylamine	EPA 8270D	EPA 8270D
n-Nitrosodi-n-propylamine	EPA 8270D	EPA 8270D
n-Nitrosodiphenylamine	EPA 8270D	EPA 8270D
Pentachlorophenol	EPA 8270D	EPA 8270D
Phenanthrene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Phenol	EPA 8270D	EPA 8270D
Pyrene	EPA 8270D EPA 8270D SIM	EPA 8270D EPA 8270D SIM
Pyridine	EPA 8270D	EPA 8270D
1,2,4-Trichlorobenzene	EPA 8270D	EPA 8270D
2,4,5-Trichlorophenol	EPA 8270D	EPA 8270D
2,4,6-Trichlorophenol	EPA 8270D	EPA 8270D
Pesticides/Herbicides/PCBs		
Aldrin	EPA 8270D SIM	EPA 8270D SIM
alpha-BHC	EPA 8270D SIM	EPA 8270D SIM
alpha Chlordane	EPA 8270D SIM	EPA 8270D SIM
beta-BHC	EPA 8270D SIM	EPA 8270D SIM
delta-BHC	EPA 8270D SIM	EPA 8270D SIM
gamma-BHC	EPA 8270D SIM	EPA 8270D SIM
gamma Chlordane	EPA 8270D SIM	EPA 8270D SIM
Chlordane (technical)	EPA 8270D SIM	EPA 8270D SIM
4,4’-DDD	EPA 8270D SIM	EPA 8270D SIM
4,4’-DDE	EPA 8270D SIM	EPA 8270D SIM
4,4’-DDT	EPA 8270D SIM	EPA 8270D SIM
Dieldrin	EPA 8270D SIM	EPA 8270D SIM
Endosulfan I	EPA 8270D SIM	EPA 8270D SIM
Endosulfan II	EPA 8270D SIM	EPA 8270D SIM
Endosulfan sulfate	EPA 8270D SIM	EPA 8270D SIM
Endrin	EPA 8270D SIM	EPA 8270D SIM
Endrin aldehyde	EPA 8270D SIM	EPA 8270D SIM
Endrin ketone	EPA 8270D SIM	EPA 8270D SIM

Parameter/Analyte	**Solid & Chemical Materials**	
	Aqueous	**Solid**
Heptachlor	EPA 8270D SIM	EPA 8270D SIM
Heptachlor epoxide	EPA 8270D SIM	EPA 8270D SIM
Methoxychlor	EPA 8270D SIM	EPA 8270D SIM
PCB-1016 (Aroclor)	EPA 8082A	EPA 8082A
PCB-1221 (Aroclor)	EPA 8082A	EPA 8082A
PCB-1232 (Aroclor)	EPA 8082A	EPA 8082A
PCB-1242 (Aroclor)	EPA 8082A	EPA 8082A
PCB-1248 (Aroclor)	EPA 8082A	EPA 8082A
PCB-1254 (Aroclor)	EPA 8082A	EPA 8082A
PCB-1260 (Aroclor)	EPA 8082A	EPA 8082A
Toxaphene	EPA 8270D SIM	EPA 8270D SIM
Semivolatile extraction methods Toxicity characteristic leaching procedure	EPA 1311 EPA 3520C Modified	EPA 1311 EPA 3550C EPA 3665A
Hazardous Waste Characteristics		
Corrosivity	EPA 9040C	EPA 9045D
Ignitability	EPA 1020B	----------------------------

Parameter/Analyte	**Potable Water**
HPC	SM 9215B
Colilert *Escherichia coli* (MPN)	SM 9223B
Colilert *E. coli*/Total Coliform (P/A)	SM 9223B
Colilert-18 *E. coli* (MPN)	SM 9223B
Colilert-18 *E. coli*/Total Coliform (P/A)	SM 9223B

Accredited Laboratory

A2LA has accredited

SGS NORTH AMERICA INC. - ALASKA DIVISION

Anchorage, AK

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2009 TNI Environmental Testing Laboratory Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 5.1 of the DoD Quality System Manual for Environmental Laboratories (QSM), accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Presented this 20th day of December 2017.

President and CEO
For the Accreditation Council
Certificate Number 2944.01
Valid to December 31, 2019

For the tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

APPENDIX D

ANALYTICAL STANDARD OPERATING PROCEDURES

Provided on CD

Controlled copy distributed to Catherine Shuman with Swift River Environmental Services, LLC.

SGS	SGS North America, Inc. - Alaska Division Standard Operating Procedure

NOTE: This document contains CONFIDENTIAL business information and is not intended for distribution.

S.O.P. Title: Gasoline Range Organics/BTEX	**Revision Date:** August 2015
Method No: AK101/AK101AA/8021B/EPA602/8015C	**SOP No:** 710r15
Page: 1 of 26	**Supersedes:** 710r14

Signatures below reflect periodic review of Standard Operating Procedures. If the procedure is found adequate with little or no editing necessary, this page is signed and dated. An Addendum may be issued for minor changes that need to be implemented immediately. If it is determined that major edits are required, a new revision will be released with a new signature page.

Technical Director	Date	Quality Assurance (QA) Manager, QA Staff or their Designee	Date
Steph C. Ede	8/21/15		8/21/15
Steph C. Ede	3/22/17		3/22/17

Original cover pages with wet signatures and the digitally signed electronic SOP versions are available in the Quality Assurance Office.

A limited number of controlled hard copies will be issued for the Section Method SOPs & Technical Director's offices.

This document will be converted into a PDF file with the QA Manager's, QA Staff's or QA Designee's electronic signature and posted on the network: \\usfs700\ANK_GroupData\Public\DOCUMENT\SOP\~Approved_SOPs~

This electronically signed PDF will be considered the controlled copy for staff. Any printouts or photocopies are invalid.

Each staff member responsible for this SOP will print & sign this coverpage upon successful review, retaining it as a record in their training folder.

I have reviewed and understand the method reference(s) and this version of the SOP.
I agree to use only this currently approved version of the SOP.

Signature: ______________________ Printed Name: ______________________ Date: __________

Addendum 2 added 10/6/17

SGS	SGS North America, Inc. - Alaska Division Standard Operating Procedure
NOTE: This document contains CONFIDENTIAL business information and is not intended for distribution.	
S.O.P. Title: Gasoline Range Organics/BTEX	**Revision Date**: November 2015
Method No: AK101/AK101AA/8021B/602/8015C	**SOP No**: 710r15_Add#2
Page: 1 of 1	**Supersedes**: 710r15

Signatures below reflect approval for the following changes to the current SOP. These changes will be incorporated into the SOP during the next review. This addendum will be incorporated into the electronic SOP (i.e., PDF file).

Technical Director	Date	Quality Assurance (QA) Manager, QA Staff or their Designee	Date
Stephen C. Ede	10/6/17		10/6/17

I have reviewed and understand the method reference(s) and this version of the SOP.
I agree to use only this currently approved version of the SOP.

Signature: ______________________ Printed Name: ______________________ Date: _________

The above referenced SOP should be modified as follows:

Changed from:

9.1.1.1.1. **Soil Sample BMS/BMSD (and MS/MSD) Preparation:** Fill a 50 mL volumetric flask half full with acidified water. Add the same amount of sample that was added for the parent sample. Spike with 25 μL CCV2 Solution (section 8.11.2) for BTEX ~~or 20 μL CCV Solution~~ (section 8.13.2) for GRO. Dilute to volume with acidified water. The flask is then inverted three times and the solution is transferred to a 40 mL vial. Alternatively, use a 100 mL volumetric flask, twice the amount used for the parent sample and 50 μL CCV2 ~~or 40 μL CCV~~ and transfer to two 40 mL vials. The final concentration is 50 μg/L for each BTEX component and 400 μg/L for GRO.

Changed to:

9.1.1.1.1. **Soil Sample BMS/BMSD (and MS/MSD) Preparation:** Fill a 50 mL volumetric flask half full with acidified water. Add the same amount of sample that was added for the parent sample. Spike with 25 μL CCV2 Solution (section 8.11.2) for BTEX or 25 μL CCV Solution (section 8.13.2) for GRO. Dilute to volume with acidified water. The flask is then inverted three times and the solution is transferred to a 40 mL vial. Alternatively, use a 100 mL volumetric flask, twice the amount used for the parent sample and 50 μL CCV2 or 50 μL CCV and transfer to two 40 mL vials. The final concentration is 50 μg/L for each BTEX component and 400 μg/L for GRO.

SGS	SGS North America, Inc. - Alaska Division Standard Operating Procedure
NOTE: This document contains CONFIDENTIAL business information and is not intended for distribution.	
S.O.P. Title: Gasoline Range Organics/BTEX	**Revision Date**: November 2015
Method No: AK101/AK101AA/8021B/602/8015C	**SOP No**: 710r15_Add#1
Page: 1 of 2	**Supersedes**: 710r15

Signatures below reflect approval for the following changes to the current SOP. These changes will be incorporated into the SOP during the next review. This addendum will be incorporated into the electronic SOP (i.e., PDF file).

Technical Director	Date	Quality Assurance (QA) Manager, QA Staff or their Designee	Date
Stephen C. Ede Steph C. Ede	11/12/15 3/22/17		11/12/15 3/22/17

I have reviewed and understand the method reference(s) and this version of the SOP.
I agree to use only this currently approved version of the SOP.

Signature: ______________________ Printed Name: ______________________ Date: __________

The above referenced SOP should be modified as follows:

To Section 12.2.2, add the following: All methods for DOD samples: In the event of a recovery failure for analytes of interest in continuing or closing CCV samples, the Analyst may immediately (within 1 hr of the failing CCV and before any other samples have acquired) rerun 2 successive CCVs. If both meet QC criteria for all analytes of interest, then the samples already analyzed may be reported and the run sequence may be continued. Samples following the two passing CCVs are also valid. **All CCVs must be reported in LIMS.** Refer to SOP#101 for nomenclature (e.g., CCCV, CVC, CVCA, etc.)

Change Section 21 – Corrective Action Table – from:

Continuing Calibration Verification	AK101: Beginning, every 20 injections, and at the end.	AK101: GRO Recovery within ± 25% of true value	~~Evaluate the data.~~ ~~Correct source of problem.~~ ~~Repeat analysis if needed.~~ ~~Recalibrate if needed.~~	1. If recovery is biased high: report if target analytes not present, rerun if present. 2. If recovery is biased low: perform instrument corrective action and rerun.
	8015C: Beginning, after every 10 injections, and at the end.	8015C: GRO Recovery within ± 20% of true value		
	BTEX: Beginning, every 12 hours, and at the end.	BTEX: Recovery within ± 20% of true value		

To read:

(Continue to next page)

Continuing Calibration Verification	AK101: Beginning, every 20 injections, and at the end.	AK101: GRO Recovery within ± 25% of true value	**For non-DOD samples:** 1. Repeat analysis once. 2. If QC criteria not met, then recalibrate and reanalyze. **For DOD samples:** 1. Immediately (within 1 hr and before any other samples have acquired) run two successive CCVs. 2. If both meet QC criteria, then samples already analyzed may be reported and the run may continue.	1. If recovery is biased high: report if target analytes not present, rerun if present. 2. If recovery is biased low: perform instrument corrective action and rerun.

Summary of Changes from Previous Revision:

- 13.1.2. Updated
- Delete Section 8.8.4 in its entirety. Refer to 8.9.2.2 for DFB.
- 8.9.2.2 Updated
- Table 1 Updated to operating standards
- Table 2 Updated to operating standards
- 8.16.4.3 LCS Spike amount updated

Table of Contents

1.0. OBJECTIVE:

This method is used to determine the concentration of gasoline range organics (GRO), GRO Aliphatics, BTEX compounds (benzene, toluene, ethylbenzene, m-, p- and o-xylenes), and GRO Aromatics (BTEX, plus n-propylbenzene, 3&4-ethyltoluene, 1,3,5-trimethylbenzene, 2-ethyltoluene, 1,2,4-trimethylbenzene, and 1,2,3-trimethylbenzene) in water, soil, sludge, oils and air samples.

2.0. SCOPE AND APPLICATION:

This method employs a gas chromatograph for the determination of the purgeable volatile petroleum hydrocarbon fractions of gasoline, benzene, toluene, ethylbenzene, p&m-xylene and o-xylene. Nitrogen, an inert gas, is bubbled through a water sample or a sample extract in reagent water contained in a specially designed purging chamber. This serves to transfer purgeable aromatic and aliphatic compounds from the liquid to the vapor phase. The vapor is then swept to a sorbent trap where the target compounds are trapped. Once purging is complete, the trap is then heated and back-flushed with nitrogen, desorbing the compounds onto the gas chromatograph column. The gas chromatograph is temperature programmed to separate the compounds that are then detected with a photo ionization detector (PID) and flame ionization detector (FID) in series. Quantification of gasoline range organics (GRO) is performed by comparing the total chromatographic area of all peaks between and including C6 (hexane) and C9 (nonane) to the peak start time of C10, based on FID response to a blended unweathered gasoline standard and by using a forced baseline integration. BTEX compounds are individually identified and quantified by PID based on retention times and relative response of the target analyte to that of the internal standard.

3.0. DEVIATIONS FROM REFERENCE METHOD:

Stock standards are stored in a freezer at –10 to –20^{o}C. Working standards are stored in a refrigerator at 0-6^{o}C.
If second column confirmation is required for BTEX, clients are advised to request GC/MS (e.g., 8260).
Retention Time Windows for AK101/8015C for BFB is ± 0.05 min.
Soil sample preparations are made in acidified water and stable while refrigerated for 14 days from sample collection date.

4.0. RESPONSIBILITIES:

4.1 The QA Office maintains a master list of this SOP to ensure review on a timely basis. This system serves as an accounting of SOP distribution and ensures that distributed SOPs are current and complete. This includes destruction of controlled copies of expired and retired SOPs. The QA Office also maintains a historical file of original cover pages with wet signatures and digitally signed electronic versions of this SOP; including the current revision and any versions archived within the past 5 years.

4.2 The electronic (Word Document) versions of this SOP, both current and any prior versions, are maintained on the computer network in a secure location as a “read only” file.

4.3 It is the responsibility of all personnel to follow this SOP as written, document and gain QA or Technical Director approval for deviations to the SOP, and submit needed SOP revisions to the QA Office.

4.4 This SOP is scheduled for review on an annual basis. Any required revisions will be incorporated into the SOP. The new revision of the SOP will be distributed by QA and the superseded version returned to the QA Office. If no revisions are required, the SOP cover page is signed and dated to document the review, and the updated cover page will be distributed.

4.5 A PDF version of each SOP (generated in Adobe or scanned) is digitally signed by a member of the QA Office as a security measure. The digitally signed PDF, used online, is considered to be a controlled copy of the SOP and is stored on the network.

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All staff have "read" access to these SOPs. Only QAQC has access to "write" on SOPs. Staff is directed to use the controlled electronic versions of SOPs. A limited number of controlled hardcopies are to be distributed by the QA Office.

5.0. INTERFERENCES:

5.1. Samples can be contaminated by diffusion of volatile organics through the septum seal during shipment and storage. A trip blank (prepared from acidified reagent water for water samples, and Ottawa sand with BFB methanol for soil samples) carried through the sampling and handling protocol can serve as a check on such contamination.

5.2. Carry-over contamination can occur during sample preparation with high-level samples. Syringes used for QC and sample preparation are rinsed with methanol three times before preparation and between samples. Flasks are rinsed once with methanol, then three times with water.

5.3. Carry-over contamination can also occur during instrument operation. The autosampler needle and sparge tubes are rinsed with reagent water between samples. Following suspected concentrated samples a rinse is run to check for cross contamination. The trap and other parts of the system are also subject to contamination. Bake-out of the entire system should be done periodically. Replacement of the trap may also be necessary.

5.4. High levels of heavy petroleum products such as diesel fuel may contain volatile components producing a response within the retention time range for gasoline. Other organic compounds including chlorinated solvents, alcohols, ketones, and ethers are measurable and GRO results may include these compounds.

6.0. SAMPLE HANDLING:

6.1 Sample Matrix – Matrices include water, soil, oils, and air.

6.2 Sample Collection –

6.2.1. Water Samples: Refer to SGS SOP#764 for specifics regarding water samples for volatile analyses of GRO and BTEX. Samples should be collected by clients in HCl pre-preserved VOA vials.

6.2.2. Soil Samples: Refer to SGS SOP#767 for specifics regarding soil samples for volatiles analyses of GRO and BTEX. Soil samples should be field-preserved using collection techniques outlined in SW-846 method 5035A. SGS practice is for clients to collect 50 g of soil in a tared 4 oz. wide-mouth glass jar with a Teflon-lined septum lid and add 25 mL methanol with 2.5 µg/mL BFB field surrogate. Sample kits will be prepared in the laboratory and sent to the client for sample collection.

6.2.2.1. Soils and solids submitted without field-extraction must be extracted by the laboratory. This procedure involves opening the sample container and removing a portion of the sample. Some volatile constituents may be lost during sample handling. In such cases, a sample comment must be added (per SOPs#007 & #101) to indicate that the results may be biased low.

6.3 Sample Size – The usual requested sample size for water samples is three 40 mL vials, for soil samples one 4-ounce wide-mouth amber jar, for oil samples at least one 40 mL vial, and for air samples either steel gas cylinders or Tedlar bags.

6.4 Sample Preservation – Samples are to be shipped, received and refrigerated upon arrival at 0-6°C until analysis. Samples should be preserved as described during sample collection. Soil samples received unpreserved from the field should be preserved as soon as possible with methanol. To minimize the impact, soil aliquots for volatile analyses should be removed and extracted before any other analyses. Samples for volatiles analyses (including GRO and BTEX) are stored in a location isolated from other standards and solvents. Sample control has separate reach-in refrigerators for the segregation of water VOAs versus soil VOAs versus all non-VOA containers.

6.5 Holding Times –

6.5.1 Water Samples: Water samples preserved to a pH < 2 with 1:1 HCl will be analyzed within 14 days of collection. Specific projects may submit unpreserved waters for analysis. In such instances, samples should be analyzed within 7 days of collection.

6.5.2 Soil Samples: Soils for BTEX and GRO by 8015 must be analyzed within 14 days of collection. Soils for GRO by AK101 must be analyzed within 28 days of collection.

6.5.3 Air Samples: Samples in cylinders do not have a specific holding time; however, air samples in Tedlar bags must be analyzed within 24 hours from collection time.

7.0. APPARATUS:

7.1. Glassware

7.1.1. 40 mL and 4 mL glass VOA vials with Teflon-lined septa and screw caps.

7.1.2. 4 oz. wide-mouth glass jars with a Teflon-lined septum screw lid.

7.1.3. 10 mL, 50 mL, and 100 mL glass class A volumetric flasks with ground glass stoppers.

7.2. Syringes and Needles

7.2.1. 5 mL Hamilton 1005TLL Syringe. (Part #2-0999, or equivalent)

7.2.2. Micro syringes: 5, 10, 25, 50, 100, 250, 500, and 1000 µL. (Supelco, Hamilton 1000 Series Gas Tight, High Performance, or equivalent)

7.2.3. 5 mL SGE Headspace Syringe, 5MAX-HSV (Supelco, cat. no. 2-3984, or equivalent); Probe, MAH-P (cat no. 2-3985, or equivalent); SGE Luer Lock Replacement Needle, 23x50mm, Point #2 (cat. no. 2-6270-U, or equivalent)

7.2.4. Three 10 mL Brinkman bottle top dispenser (cat# 022-22-020-9)

7.3. Analytical balance capable of accurately weighing to the nearest 0.001 g for extractions and top loading balance capable of weighing to the nearest 0.01 g for field samples.

7.4. Stainless steel spatula for scooping out soil samples.

7.5. Gas Chromatograph, Hewlett Packard 5890 Series II, or equivalent.

7.6. Capillary column, J&W VRX, 30 m x 0.45 mm ID (or equivalent). Capillary columns are used to achieve necessary resolution. The column must resolve hexane from a methanol solvent front in a midrange LCS standard and must resolve ethylbenzene from p&m-xylene.

7.7. Photo ionization Detector, OI Corporation 4430, or equivalent.

7.8. Flame Ionization Detector, OI Corporation 4410, or equivalent.

7.9. HP Chemstation for data collection, archiving and manual integration, or equivalent.

7.10. Swagelok connector (7/16" Swagelok to 9/16" NPT).

7.11. Autosampler; EST Centurion or equivalent.

7.12. Purge and Trap Concentrator, Tekmar/Dohrmann 3100 with BTEX J-trap (Supelco cat. no. 24919 or equivalent). The recommended purging chamber (Tekmar 5mL Sparger p/n 14-2337-024) is designed to accept 5 mL samples with a water column at least 7 cm deep. Purge bubbles can be no more than 3 mm in diameter with the purge gas no more than 5 mm from the base of the water column. The trap must be capable of retaining components at the highest concentration of the calibration curve. Before initial use, the trap should be conditioned as specified by the manufacturer.

7.13. pH paper: Low range pH paper (0-6) with divisions of ≤ 0.5 pH units.

8.0. REAGENTS:

8.1. Reagent Water: Deionized water (DI).

8.2. Acidified Water: Adjust the pH of reagent water to less than 2 by adding about 1 drop of 1:1 HCl (Prepped as per SOP #118 by Kit Prep) for every 100 mL DI water or about 4 mL of 1:1 HCl to a 4 L bottle of DI water.

8.3. Methanol: High purity for purge and trap analysis (Burdick and Jackson, or equivalent). Tested to insure no components are above the LOQ (DOD requires no detects ≥ ½ LOQ).

8.4. All standards prepared must be recorded in the Volatile Working Standards Logbook with all pertinent data such as date prepared, standard name, concentration, expiration date, reagent used with its lot number, how it was prepared and initials of the person who prepared it. All standards are labeled according to SGS SOP #112 "Standards Labeling and Traceability" and SGS SOP #500 "Analytical Chemistry Quality SOP".

8.5. Stock Standard Solutions: Commercially prepared standards can be used at any concentration, if they are certified by the manufacturer or an independent source. All standards are prepared in methanol by diluting neat products (which are valid for one year) by mass or certified standards by volume. All standards are prepared according to the guidelines in SW846. A prepared stock standard expires one year from the date it was made or when signs of degradation are observed. Stock standards are stored in the GC freezer at -10 to -20°C.

8.6. Working Solutions: Working solutions are prepared by volumetrically diluting commercial certified products or stock standards. Working solutions expire one year from the date it was made, when signs of degradation are observed, or when the stock standard expires, whichever is sooner. Working standards are stored in a refrigerator at 0-6°C.

8.7. GRO Neat Stock: Each spring, after the summer formulation of gasoline becomes available; gas must be collected from 2 different local gas stations. From each gas station, collect a jar of regular, plus, and premium grades of unleaded gasoline.

8.8. **Internal Standard or IS (ααα-trifluorotoluene or ααα-TFT) and 1,4-difluorobenzene (DFB Surrogate) Solutions for Centurion : BTEX/AROMATIC**

8.8.1. **Internal Standard Stock:** Use Supelco Cat # 47582-U ααα-Trifluorotoluene @ 10,000 µg/mL in Methanol, or equivalent.

8.8.2. **DFB Standard Stock:** Use Restek cat# 30032 1,4-difluorobenzene (DFB) @ 2,000 µg/mL in methanol, or equivalent.

8.8.3. **IS Solution for Centurion:** Using a 1000-µL syringe, add 500 µL of the Internal Standard Stock to a 100 mL volumetric flask which is half full with methanol. Fill the flask to the mark with additional methanol. Gently invert the flask three times. The remaining solution is then placed into two 40 mL Teflon-lined screw cap borosilicate vials for storage, labeled and recorded for daily use. The final concentration of the solution is 50 µg/mL for ααα-TFT.

8.9. **4-Bromofluorobenzene (BFB) and 1,4-difluorobenzene (DFB) Surrogate standards**

8.9.1. **BFB for AK101/AK101AA:**

8.9.1.1. **BFB Standard Stock**: Use Restek cat# 30082 4-bromofluorobenzene (BFB) @ 10,000 µg/mL in methanol or equivalent.

8.9.1.2 **BFB Working Solution @ 50 µg/mL:** Add 500 µL of BFB Standard Stock to a 100 mL volumetric flask which is half full of methanol. Fill the flask to the mark with additional methanol. The flask is inverted three times. The remaining solution is then placed into two 40 mL vials for storage, labeled and recorded. A 4 mL storage vial with a mininert valve top, labeled and recorded, is used for calibration. The final concentration of the solution is 50 µg/mL for BFB.

8.9.2. **DFB for BTEX by 8021B:**

8.9.2.1. **DFB Standard Stock:** Use Restek cat # 30032 1, 4-difluorobenzene (DFB) @ 2,000 µg/ml in methanol, or equivalent.

8.9.2.2 **DFB Working Solution @ 50 µg/mL:** Using a 5ml syringe, add 2.5 mL of DFB Standard stock to a 100 mL volumetric flask which is half full with methanol. Fill the flask to the mark with additional methanol. Gently invert the flask three times. The remaining solution is then placed into two 40 mL Teflon-lined screw cap borosilicate vials for storage, labeled and recorded for daily use. The final concentration of the solution is 50 µg/mL for DFB.

8.9.3. **AK101 BFB MeOH for field preserved samples:** This solution is prepared in the laboratory at a concentration of 2.5 µg/mL BFB in MeOH. Fill a 2,000 mL flask more than halfway with methanol. Using a 1.0 mL syringe, add 1.0 mL BFB Standard Stock, and fill to the mark with additional methanol. The flask is then carefully inverted three times, and placed into a 4 L storage container. The flask is filled a second time to the mark with methanol, and added into the 4 L container. Before the BFB MeOH may be used, a test vial must be prepared and analyzed. To prepare the test, inject 1.0 mL of the BFB MeOH into a 50 mL flask filled up to the neck with reagent water, then fill to the mark with additional reagent water. That solution is then poured into a 40mL amber vial and given to the analyst for evaluation. Once analyzed, the analyst will approve that lot of BFB MeOH by completing the “Approved by” section of the label on the 4L container.

8.10. **Normal Alkane Standards:**

8.10.1. **Normal Alkane Standard Stock (NAS):** Use AccuStandard Cat. # AK-101.0-NAS-10X, or equivalent (2000 µg/mL in methanol).

8.10.2. **NAS Working Solution:** Using a 1.0 mL syringe, add 0.5 mL Normal Alkane Standard Stock to a 10 mL volumetric flask. Fill the 10 mL flask with additional methanol to the mark. Invert the flask three times. The remaining solution is then placed into 4 mL storage vials with a mininert valve top. The final concentration of this solution is about 100 µg/mL for each alkane. This standard is used to evaluate retention time windows for GRO.

8.11. **Primary BTEX Standard Solutions**

8.11.1. **Primary BTEX Stock Standard:** Use Revised PVOC BTEX standard from ULTRA Scientific, cat# UST-141, or equivalent (1000 µg/mL in methanol).

8.11.2. **Primary BTEX Standard Working Solution (CCV2):** Using a 1.0 mL syringe, add 1.0 mL of the Primary BTEX Stock Standard to a 10 mL volumetric flask which is half full of methanol. Fill the flask to the mark with additional methanol. The flask is inverted three times to mix. The solution is then placed into 4 mL vials with mininert valve tops and ready for daily use. The final concentration of this solution is 100 µg/mL for each component.

8.12. **Secondary BTEX Standard Solutions**

8.12.1. **Secondary BTEX Stock Standard:** Use Revised PVOC BTEX standard from Restek, cat# 30231, or equivalent (1000 µg/mL in methanol).

8.12.2. **Secondary BTEX Standard Working Solution (BTEX ICV)**: Using a 1.0 mL syringe, add 1.0 mL of the Secondary BTEX Stock Standard to a 10 mL volumetric flask which is half full of methanol. Fill the flask to the mark with additional methanol. The flask is inverted three times to mix. The solution is then placed into 4 mL vials with mininert valve tops. The final concentration of this solution is 100 µg/mL for each component.

8.13. **Primary GRO Standard Solutions**

8.13.1. **Primary GRO Neat Combined Solution**: This solution is an equal mixture of local regular, plus and premium unleaded gasoline. Use the regular and plus from gasoline source 1 and the premium from source 2. Using 10 mL disposable volumetric pipets, combine 10 mL of each gasoline into a 40 mL vial. The neat combined solution is stored in the freezer.

8.13.2. **Primary GRO Standard Working Solution (CCV):** Using a 250 µL syringe, add 100 mg (about 150 µL) of the Primary GRO Neat Combined Solution to a 100 mL volumetric flask which is half full of methanol. Fill the flask to the mark with additional methanol. The flask is inverted three times to mix. The solution is transferred to 40 mL storage vials. A portion of solution is also placed into a 4 mL vial with a mininert valve top and ready for daily use. The final concentration is 1000 µg/mL of gasoline.

8.14. **Secondary GRO Standard Solutions**

8.14.1. **Secondary GRO Neat Combined Solution**: This solution is an equal mixture of local regular, plus and premium unleaded gasoline. Use the regular and plus from gasoline source 2 and the premium from source 1. Using 10 mL disposable volumetric pipets, combine 10 mL of each gasoline into a 40 mL vial. The neat combined solution is stored in the freezer.

8.14.2. **Secondary GRO Standard Working Solution (GRO ICV):** Using a 500 µL syringe, add 350 mg of the Secondary GRO Neat Combined Solution to a 100 mL volumetric flask which is half full of methanol. Fill the flask to the mark with additional methanol. The flask is inverted three times to mix. The solution is transferred to 40 mL storage vials. A portion of solution is also placed into a 4 mL vial with a mininert valve top and used for daily use. The final concentration is 3500 µg/mL of gasoline.

8.15. **Matrix Spike Standard:** Use the Primary Standard Solutions. Refer to section 8.13.2 for GRO and section 8.11.2 for BTEX.

8.16. **Analysis Prep:** Aqueous standards should be prepared daily. Extraction QC should be prepared at the same time as the extraction batch.

8.16.1. **NAS Preparation:** Fill a 50 mL volumetric flask half full with acidified water. Add 50 µL NAS Working Solution (section 8.10.2) and dilute to volume with acidified water.

8.16.2. **CCV2 Preparation:** Fill a 50 mL volumetric flask half full with acidified water. Add 50 µL CCV2 Solution (section 8.11.2) and dilute to volume with acidified water. Alternatively, dilute 100 µL CCV2 to 100.0 mL with acidified water. The final concentration is 100 µg/L for each component.

8.16.3. **CCV Preparation:** Fill a 50 mL volumetric flask half full with acidified water. Add 50 µL CCV Solution (section 8.13.2) and dilute to volume with acidified water. Alternatively, dilute 100 µL CCV to 100.0 mL with acidified water. The final concentration is 1000 µg/L.

8.16.4. **Soil Extraction QC Preparation:**

8.16.4.1. **Method Blank (MB)**: Fill a 50 mL volumetric flask half full with acidified water and add 1 mL of methanol. Dilute to volume with acidified water. Transfer the solution to a 40 mL vial. Alternatively, add about 0.82 mL methanol to a 40 mL vial partially filled with acidified water. Top off the vial with acidified water.

8.16.4.2. **LCS/LCSD BTEX:** Fill a 50 mL volumetric flask half full with acidified water and add 1 mL of methanol. Add 25 µL CCV2 Solution (section 8.11.2) and dilute to volume with acidified water. The flask is then inverted three times and the solution is transferred to a 40 mL vial. Alternatively, use a 100 mL volumetric flask, 2 mL of methanol, and 50 µL CCV2 and transfer to two 40 mL vials. The final concentration is 50 µg/L for each component.

8.16.4.3. **LCS/LCSD GRO:** Fill a 50 mL volumetric flask half full with acidified water and add 1 mL of methanol. Add 25 µL CCV Solution (section 8.13.2) and dilute to volume with acidified water. The flask is then inverted three times and the solution is transferred to a 40 mL vial. Alternatively, use a 100 mL volumetric flask, 2 mL of methanol, and 50 µL CCV and transfer to two 40 mL vials. The final concentration is 500 µg/L.

8.16.5. **Water/Oil Method Blank (MB) and LCS/LCSD Preparation:** To prepare a MB fill a 40 mL vial with acidified water. The IB can be used for an initial water MB. CCV2 and CCVs are used for LCS/LCSDs for water and oil samples.

8.16.6. **Instrument Calibration Verification Standard (ICV):** Fill a 50 mL volumetric flask half full with acidified water. Add 100 µL BTEX ICV Solution (section 8.12.2) or 30 µL GRO ICV Solution (section 8.14.2) and dilute to volume with acidified water. The final concentration is 200 µg/L for each BTEX component and 2100 µg/L for GRO.

9.0. EXTRACTION:

9.1. **In-house extracted soil:** In-house extracted soil samples are extracted at the laboratory with methanol according to SGS SOP# 767 "Purge-and-Trap, Extraction Non-Aqueous".

9.2. **Oil:** Oil samples are extracted in the same manner as soils as per SOP#767. Weigh out approximately one gram or less of sample and add 5 mL of 2.5µg/mL BFB MeOH solution.

9.3. **AK101 field methanol-preserved soil samples:** After receipt of samples, initial sample weights are determined. See SGS SOP#143 for current weighing practices. As a backup, the logbook may be used. Weigh each jar with lid on and record total weight. Record corresponding tare weights for each jar. The jar tare weights were determined and written on the jars prior to sample collection. To calculate initial sample weights subtract the jar's tare weight and methanol weight (25 mL methanol is approximately 19.78 g) from the corresponding total jar weight.

9.4. **Sample Preparation:**

9.4.1. Samples with concentrations exceeding the calibration range must be diluted. Estimate a dilution that yields a concentration in the upper half of the linear range of the calibration curve. All steps in dilution must be done without delays, eliminate bubbles in the syringe and minimize transfers to avoid possible loss of components. Use the syringe with a volume close to the desired amount of sample extract to minimize errors. Always rinse syringes three times with methanol after every use to avoid cross-contamination in the samples.

9.4.2. If a sample is suspected to contain high levels of gasoline, it should be diluted before running to prevent any contamination of the analytical system.

9.4.3. For sample dilutions of air or water, BFB surrogate will be added by the autosampler after dilution is made (soil and oil samples contain BFB methanol so no surrogate is needed). For all samples, DFB surrogate is added by the autosampler. This prevents the problem of true surrogate concentration being below the LOQ.

9.4.4. **Soil Sample Preparation:** It has been demonstrated that Soil Samples prepared in acidified water are stable while refrigerated for 14 days from the sample collection date.

9.4.4.1. **Soil Sample Preparation:** Fill a 50 mL volumetric flask half full with acidified water. Add 1.0 mL of the sample methanol extract and dilute to volume with acidified water. The flask is then inverted three times and the solution is transferred to a 40 mL vial.

9.4.4.2. **Soil Sample BMS/BMSD (and MS/MSD) Preparation:** Fill a 50 mL volumetric flask half full with acidified water. Add the same amount of sample that was added for the parent sample. Spike with 25 µL CCV2 Solution (section 8.11.2) for BTEX or 20 µL CCV Solution (section 8.13.2) for GRO. Dilute to volume with acidified water. The flask is then inverted three times and the solution is transferred to a 40 mL vial.

Alternatively, use a 100 mL volumetric flask, twice the amount used for the parent sample and 50 µL CCV2 or 40 µL CCV and transfer to two 40 mL vials. The final concentration is 50 µg/L for each BTEX component and 400 µg/L for GRO.

9.4.5. **Water and Water-Soluble Waste Sample Preparation:**

9.4.5.1. Water Sample Preparation: Water samples are received in 40 mL Teflon-lined screw cap borosilicate vials. If no dilution is required, the 40 mL sample vial can be placed directly on the autosampler.

9.4.5.2. **Water Sample BMS/BMSD (and MS/MSD) Preparation**: Fill a 100 mL volumetric flask half full with sample. Spike with 100 µL CCV2 Solution (section 8.11.2) for BTEX or 100 µL CCV Solution (section 8.13.2) for GRO. Dilute to volume with sample. Invert the flask three times and then transfer the solution to two 40 mL vials.

9.4.6. **Oil Preparation:** To prepare a 1X dilution fill a 50 mL volumetric flask half full with acidified water. Add 250 µL of the oil methanol extract to the 50 mL volumetric flask. Fill the flask with acidified water to obtain a final volume of 50 mL. The flask is then inverted three times and the solution is transferred to a 40 mL vial. Generally, oils are first run with at least a 100X dilution.

9.4.7. **Air Sample Preparation:** Air samples come in either gas steel cylinders or Tedlar bags. Heat cylinder in an oven at 105°C for about 10 minutes to ensure volatilization of compounds in the cylinder. For Tedlar bags, heat up in the same manner, but for only for 1 minute. Blank a 5 mL Headspace syringe and Probe (bevel tip replacement needle for Tedlar bags) with ambient air. Replace the Swagelok connector on the cylinder with the one with a septum. Insert the needle with the valve locked (black knob in) through the septum and lightly unscrew the cylinder valve. Unlock the syringe valve (white knob in) and take in gas sample to 5 mL. Push in the black knob of the syringe valve, close the cylinder valve and pull out the syringe. Insert the needle into a vial half-filled with water. Push in the white knob and push the barrel to the 2 mL mark, then immediately push back in the black knob. Remove the needle from syringe, screw syringe Luer lock into the concentrator sample valve, open top valve, unlock syringe valve then immediately introduce the sample through the purge needle into the tube that contains 5 mL of water spiked with Internal Standard and surrogate. The sample must be introduced immediately after the sparge tube is filled with the blank sample. Air blank (MB), is 2 mL ambient air added to water spiked with surrogate. Samples are 2 mL air sample added to water spiked with surrogates. An air blank and sample duplicate are run for every set of a maximum of 20 air samples. CCV2 is used as LCS BTEX.

9.4.7.1. A 1x dilution for air samples consists of 2 mL of the sample injected through the sample valve assembly into the purge vessel containing 5 mL of water with 5 µL of Internal Standard and 5 µL of 50 µg/mL BFB/DFB surrogate. Solution concentration is converted in terms of concentration in gas phase. See Section 13.0 for calculations. To dilute an air sample, adjust volume of sample accordingly. Volumes of water, Internal Standard and surrogate remain the same.

10.0. CALIBRATION:

10.1. It is helpful to run a series of blank waters overnight before calibrating to ensure no system contamination. At a minimum, about 10 rinses should be run prior to starting the calibration.

10.2. An Instrument Blank (IB) and a Normal Alkane Standard (NAS) must be analyzed prior to the calibration curves. An IB is acidified water spiked with surrogate and IS. NAS is analyzed to set the Retention Time

Group/Window for GRO. The GRO range begins at the peak start of C6 and ends with the peak start of C10. Retention time group/window for GRO is not reset each day of analysis. The aforementioned parameters allow for a daily shift of retention times of approximately 0.4 minutes for group start and approximately 0.4 minutes for group end, before the group/window would be invalid.

10.3. Each initial calibration curve (BTEX, BFB, DFB & GRO) must cover the linear range of the instrument with a minimum of five points (1). One of the calibration points must have a level at or below the LOQ. The calibration is usually processed using Average Response Factor. The response factor definition in the processing method is set to Area/Concentration. All calibration points should be included in the curve. During the ICAL, retention time is established for each analyte using the mid-level point.

10.4. **BTEX, DFB and BFB surrogate Initial Calibration Curves:** Using the BTEX CCV2 Solution (Section 8.11.2), DFB Surrogate solution (Section 8.9.2.1) and Surrogate BFB Solution (Section 8.9.1.2), run a BTEX, Surrogate DFB and BFB curve using the Internal Standard calibration procedure (refer to Table 1).

10.5. **GRO Initial Calibration Curve:** Using the GRO CCV Solution (Section 8.13.2) run a GRO curve using the external standard calibration procedure (refer to Table 2).

10.6. **Calibration Dilution Preparation:** Dilutions are prepped in volumetric flasks, and then poured into 40 mL vials. These steps should be performed as quickly as possible to reduce loss of volatiles. See Table 1 and Table 2 for suggested standard volumes.

TABLE 1. BTEX INITIAL CALIBRATION DILUTIONS

BTEX Calibration Level*	BFB and DFB Surrogate Calibration Level	BTEX CCV2 Added (100 µg/mL)	BFB Surrogate Added (50 µg/mL)	DFB Surrogate Added (50 µg/mL)	Final Volume with Acidified H_2O	Internal Standard Added ** (50 µg/mL)
(µg/L)	**(µg/L)**	**(µL)**	**(µL)**	**(µL)**	**(mL)**	**(µL)**
0.5	**-**	0.5	-	-	100.0	5.0
1.0	**1.0**	1.0	2.0	2.0	100.0	5.0
10.0	**12.5**	10.0	25	25	100.0	5.0
50.0	**25**	50	50	50	100.0	5.0
100	**50**	100	100	100	100.0	5.0
150	**75**	150	150	150	100.0	5.0
200	**125**	200	250	250	100.0	5.0
240	**-**	240	-	-	100.0	5.0

***NOTE:** The concentration for p&m-xylenes is twice the above amounts.
****NOTE:** The internal standard is added by the instrument.

TABLE 2. GRO INITIAL CALIBRATION DILUTIONS

GRO Calibration Level (µg/L)	GRO CCV Added (1000 µg/mL) (µL)	Final Volume with Acidified H_2O (mL)
100	10.0	100.0
400	40.0	100.0
1000	100.0	100.0
2000	200.0	100.0
3000	300.0	100.0
4000	400.0	100.0

10.7. Initial Calibration Acceptance Criteria:

10.7.1. **Method 8021B (BTEX) Calibration**: Percent Relative Standard Deviation (%RSD) must be less than or equal to 20% over the working range to assume linearity through the origin(2). If the %RSD is greater than 20% over the calibration range, then linearity through the origin cannot be assumed. In this case, a regression equation that is not forced through the origin may be used and the correlation coefficient (r^2) must be greater than or equal to 0.995 to be able to use it for quantitation(3).

10.7.2. **Method 602 (BTEX)**: %RSD must be less than or equal to 10% over the working range(4). If the %RSD is greater than 10% over the calibration range, then linearity through the origin cannot be assumed. In this case, a regression equation that is not forced through the origin may be used and the correlation coefficient (r^2) must be greater than or equal to 0.995 to be able to use it for quantitation(3).

10.7.3. **AK101 (GRO) Calibration**: %RSD must be less than or equal to 25% over the working range in order to assume linearity through the origin, and the average response factor can be used in place of a calibration curve(5).

10.7.4. **Method 8015C (GRO)**: %RSD must be less than or equal to 20% over the working range in order to assume linearity through the origin, and the average response factor can be used in place of a calibration curve(2).

10.8. **Initial Calibration Verification (ICV)**: At the completion of the initial calibrations and prior to analysis of samples an ICV Solution is prepared at a level within the range of the calibration and analyzed. The ICV standard is from a separate source than the calibration standards.

10.8.1. M**ethods 602 and 8021B (BTEX):** components must fall within ± 20% of the expected concentrations.

10.8.2. **Method AK101 (GRO):** GRO must be within ± 25% of the expected concentration.

10.8.3. **Method 8015C (GRO):** GRO must be within ± 20% of the expected concentration.

10.9. **Data Processing**: If an outlier is present in the calibration curve, the solution may be prepared again and reran. Only one point can be reanalyzed, and this point may only be rerun once. The new value may then be substituted into the calibration curve. The point may not be reanalyzed after the ICV has been run. Calibration points may also be removed from the curve to obtain a better fit. However, any point between the removed point and end value must also be removed, and samples analyzed using the calibration are limited to a reduced calibration range.

10.10. **Retention Time Width Study**. Retention time studies are to be performed yearly or whenever instrument conditions, such as flow and temperature programs, are changed. Additional guidance is provided in method 8000C and SGS SOP #500.

10.10.1. **For Method AK101 and 8015C:** Be certain the GC system is within optimum operating conditions. The GRO range begins at the peak start of C6 and ends at the peak start of C10. Make three injections of the normal alkane working standard (NAS) and three injections of the GRO field surrogate (4-bromofluorobenzene or BFB) throughout the course of a 72 hour period; less than a 72 hour period will result in windows that are too tight. Calculate the standard deviation of the three absolute retention times for C6, and C10, and BFB. The retention time window for the individual peaks is defined as the average RT plus or minus 3 times the standard deviation of the absolute retention time for each component. In those cases where 3 times the standard deviation is less than 0.05 minutes, the laboratory should use ± 0.05 minutes as the retention time window.(6)

10.10.2. **For BTEX by 602 and 8021B:**

10.10.2.1. For the Internal Standard: Obtain the retention time of the internal standard for 3 replicate standards over a 72 hour period. Calculate the standard deviation of the Internal Standard. The retention time window is defined as the average RT plus or minus 3 times the standard deviation of the absolute retention time. In those cases where 3 times the standard deviation is less than 0.03 minutes, the laboratory should use ± 0.03 minutes as the retention time window.(7)

10.10.2.2. For BTEX and DFB: Obtain the RT of the compounds for 3 replicate standards over a 72 hour period. The relative retention time (RRT) of a sample component shall be within ± 0.06 RRT units of the standard component.

Definition: RRT = RT of compound ÷ RT of Internal Standard

10.11. Reportable results are those between the Limit of Quantitation and that which corresponds to the highest calibration standard used. When a dilution is required, keep the in-solution concentration at the higher end of the calibration range to avoid a high bias from being introduced due to baseline effects of the temperature ramp. This biasing effect could be especially evident on highly diluted extracts, due to the larger multiplier. Results between the LOD and LOQ will be reported at client request with an appropriate data qualifier (see SGS SOP # 136).

11.0. ANALYSIS:

11.1. Bake out trap daily for three minutes prior to running any samples. This may be done by running an initial rinse sample.

11.2. Data is acquired using Chemstation software. All samples need to be listed and set to acquire in the instrument project by sequence in the order in which they are set up on the autosampler.

11.3. Prior to starting the autosampler, check to ensure standard vials are full, water jug is full and the nitrogen is turned on.

11.3.1. **CENTURION:** Delivery of the internal standard, DFB surrogate and BFB surrogate is controlled by the Centurion. Ensure that each vial has the correct method assigned in order to inject the correct amounts of IS, DFB and BFB surrogate.

11.4. The Gas Chromatograph will begin when the concentrator is in the desorb mode and runs through the temperature program. The autosampler holds the next sample in desorb ready mode until the GC program is complete and the oven cools to the initial temperature.

11.5. Chemstation acquires, integrates and saves the results for each sample. If any components are not within the calibration range, another dilution must be run if possible without contaminating the GC system.

11.6. Manual Integration: See SGS SOP #144 “Manual Integration” and SGS SOP #500 “Analytical Chemistry Quality SOP”.

11.7. Retention Time Check:

11.7.1. For the GRO Range, if NAS is not within previously set range, check to make sure parameters (instrument, operating, and data reduction) are correct. If the operating parameters are correct and the alkanes are not within the set windows, save a new method, and reset the retention time windows for the current processing method. Name the subsequent methods alphabetically: RTA, RTB, RTC, etc. Document on the runlog 'Reset NAS.'

11.7.2. If in the opening CCV2, the surrogates peaks (Tri-α and DFB) or the BTEX named peaks are not within previously set retention time windows, make sure the operating parameters for the instrument are correct and if they are still not within the set windows, save a new method, and reset the retention time for the current processing method. Name the subsequent methods alphabetically: RTA, RTB, RTC, etc. Document on the run log 'Reset RT's.'

11.8. Data Reduction or Reprocessing: Chromatographic results of standards and extracts should be reviewed and reprocessed (if necessary) in the order they are analyzed. Look for any problems, instrumental or otherwise, or biasing from sample carry-over.

11.8.1. Projecting a horizontal baseline (parallel to the time axis) performs integration with the peak groups defined by the retention time window set forth by NAS for GRO. Integration for BTEX components and surrogates are performed using valley-to-valley integration. Data reduction reprocessing for samples must be consistent with calibration integration.

11.8.2. If sample response areas do not fall within the current calibration range, rerun the sample using an appropriate dilution.

11.8.3. If the chromatogram indicates carry-over from the previous injection, document in the analytical run log, and rerun the sample when the baseline indicates the column is free of analyte or contaminants, which is demonstrated by running rinses.

11.8.4. For cases where samples do not meet QC criteria, investigate possible sources of the problem. The following alternatives may be considered. If instrument malfunction is suspected, rerun the affected sample. Perform instrument maintenance where applicable. Run the standards used to check for biased recoveries. Check reagents and/or standards added for suspected interference. Consider type or nature of the sample analyzed for possible matrix interference. If these factors are ruled out, re-extraction will be necessary.

11.8.5. Calculate percent recovery of the lab standard in the LCS/LCSD and BMS/BMSD, and relative percent difference (RPD) between the LCS and LCSD, as well as the BMS and BMSD. If insufficient sample volume is available to perform a BMS/BMSD, analyze an LCSD sample and enter a comment in LIMS for the LCSD sample documenting the insufficient sample volume. If recovery of the standard and/or RPD does not meet requirements of 20% (See Quality Control section) and instrument malfunction are suspected, rerun the extract. Otherwise take appropriate corrective action measures, such as re-extraction of individual sample or entire sample set, or check the spike standard solution used.

11.8.6. Review percent recovery of surrogates in all samples and QC.

11.8.6.1. Note the nature of the sample matrix as out of control recoveries may be due to matrix interference. If poor surrogate recoveries in the sample are suspected to be due to mal-injection, rerun the extract. Otherwise take appropriate corrective measures, such as re-extraction of individual sample or entire sample set.

11.8.6.2. The surrogate 1,4-Difluorobenzene (DFB) need only be evaluated and reported for analysis of the BTEX compounds. 4-Bromofluorobenzene (BFB) need only be evaluated and reported for analysis of GRO. These surrogates should be reported off their associated detectors, PID for DFB and FID for BFB. Exceptions may be made when matrix interferences are present and the alternate detector provides a more accurate quantitation. In such a case, proper documentation in the raw data and sample remarks is required, specifically noting that the surrogate is reported off a detector other than the target analyte(s).

11.9. **Water Sample pH:** After analysis, check the pH of the remaining sample with pH paper and record it in the analysis run log. When the sample is run at a dilution, the pH can be checked at the time of preparation. Sample pH must be less than 2. If sample pH is greater than 2, the results must be flagged as possible low bias. Use narrow range pH paper (pH 0-6).

11.10. Post Analysis: All samples are returned to the sample custodian for archiving and disposal. Soils should be returned on a daily basis, while waters are returned after analysis and review are complete.

12.0. QUALITY CONTROL:

12.1 Accuracy and Precision Measurements

12.1.1 Normal Alkane Standard (NAS): The NAS Solution is analyzed daily to confirm the GRO retention time. The NAS is injected at the beginning of every analytical run, which must be concluded within 24 hrs.

12.1.2 **LCS/LCSD Criteria:** A laboratory control sample is analyzed with every soil and water extraction batch consisting of up to 20 samples to demonstrate that the extraction procedure is in control for the specific matrix type. QC samples such as method blanks do not count towards the 20 sample set. The extraction batch should be completed within 2 days (48 hours) or after the last sample of the defined batch is loaded onto the instrument, whichever comes first. If an LCS or LCSD does not meet QC criteria and the bias is high, any samples below LOQ for the affected analytes can be reported. If the affected analytes are detected above the LOQ, then the sample must be re-extracted

12.1.2.1 The recovery for AK101 and 8015C GRO must be within 60-120% of the true concentration.

12.1.2.2 The recovery limits for all BTEX components are laboratory established.

12.1.2.3 RPD criteria is $\leq$ 20%.(8)

12.1.3 A matrix spike and matrix spike duplicate are analyzed as required assuming sufficient sample volume is available for generating a spike and spike duplicate set. Performance based limits are used to generate matrix spike recovery criteria. If MS/MSD is biased high or low and LCS meets QC criteria, make a note in LIMS. For 8015C MS/MSD is required when samples received allow for this.

12.1.4 For every extraction batch of up to twenty paying samples, a MB, LCS/LCSD and MS/MSD are analyzed as shown in Table 3.

Table 3. Extraction QC Requirements

Method	MB	LCS	LCSD	MS/MSD
8015C (GRO)	Required	Required	In Lieu of MS/MSD if insufficient sample available.	Required unless there's insufficient sample available.
AK101 (GRO)	Required	Required	Required	As requested by the client.
BTEX by 8021B	Required	Required	In Lieu of MS/MSD if insufficient sample available.	Required unless there's insufficient sample available.
BTEX by 602	Required	Required	In Lieu of MS/MSD if insufficient sample available.	Required unless there's insufficient sample available.

12.1.5 Surrogate recoveries must meet target analyte CCV criteria for all QC samples (CCV2, CCV). For all paying samples, see criteria below.

12.1.5.1 Laboratory surrogate recovery for DFB (PID) should be within the performance based limits. The surrogate 1,4-diflourobenzene need only be evaluated and reported for analysis of BTEX compounds.

12.1.5.2 Surrogate BFB (FID) recovery limits are set at 50-150% for AK101 and 8015C methods. BFB need only be evaluated and reported for analysis of GRO.

12.1.6 Acceptance criteria for ααα-trifluorotoluene (or tri-alpha) internal standard response is 50 – 200% of the tri-alpha response of the current calibration.

12.2 Calibration Criteria

12.2.1 See Calibration Section 10.7 and 10.8 for initial calibration criteria.

12.2.2 **Daily Continuing Calibration Verification (CCVs)**: Calculate the percent recovery against the true value for each of the CCVs. If a CCV is outside of acceptance criteria, a new CCV may be prepared and analyzed. If the second fails as well, the initial calibration may need to be rerun.

12.2.2.1 A GRO CCV is analyzed, as a minimum:

12.2.2.1.1 **For Method AK101 (GRO)**: At the beginning of a sequence, after *every 20* non-Instrument QC injections, and at the end of the analytical run that spans less than or equal to *24 hours* from the time of the NAS to the ending CCV. The GRO recovery must be within ± 25% of the expected concentration (1000 µg/L).

12.2.2.1.2 **For Method 8015C (GRO)**: At the beginning of a sequence, after *every 10* non-Instrument QC injections, and at the end of the analytical run that spans less than or equal to *12 hours* from the time of the NAS to the ending CCV. The GRO recovery must be within ± 20% of the expected concentration (1000 µg/L).

12.2.2.2 **For Method 602 and 8021B (BTEX)**: A BTEX CCV2 is analyzed, as a minimum, at the beginning of the analytical run, subsequently every 12 hours and at the end of the analytical run. The BTEX recovery for the CCV2 must be within ± 20% of the expected concentration for each analyte (100 µg/L for benzene, ethylbenzene, toluene, and o-xylene; 200 µg/L for p&m-xylenes).

12.3 Blank Criteria

12.3.1 An Instrument Blank (IB) is water spiked with surrogate/internal standard and is analyzed at the start of each working day. A rinse is also run after suspected high concentration samples and at the analyst discretion to show the GC system is free of contamination. All components should be below the LOQ.

12.3.2 A Method Blank (MB) is analyzed with each extraction batch of 20 samples or less. The MB should have concentrations of target analytes less than the LOQ. For DOD, the MB should have a concentration of less than one half the LOQ.

12.3.3 If Method Blank does not meet the QC requirement of having concentrations of target analyte less than the LOQ, or less than half the LOQ for DOD samples, either flag results in QC summary report (if validity of sample results is justifiable) or take appropriate corrective action measures. Bake the trap for ten minutes and allow the gas chromatograph to run one temperature cycle. Reanalyze the blank and any samples associated with the noncompliant blank.

12.4 A typical analysis sequence will be as follows: Rinse, Instrument Blank, Alkane standard, Opening CCV2/CCV for BTEX/GRO, Extraction QC {MB, LCS/LCSD}, and Field samples (up to 10 or 20 depending upon the method). This sequence will repeat in the analytical run and the analysis run will end with CCVs for BTEX and/or GRO. Although extraction QC (MB, LCS/LCSD) may be ran at any point within the batch, they need to be kept within the run time of the extraction batch (all extraction QC may not be run at one point). MS/MSD is required for 8015C or by client request.

12.5 See Attachment A for QC criteria and corrective actions. Any corrective action(s) needed to address a QC outlier or other technical challenges that are not listed in this SOP require the prior approval of the QA Manager or Technical Director.

13.0. CALCULATIONS, REVIEW AND REPORTING:

13.1. Units/Significant Figure

13.1.1. Soil: µg/Kg

13.1.2. Water: µg/L

13.1.3. Oil: mg/Kg

13.1.4. Air: ppb

13.2. Equations

13.2.1. **External Standard Calibration Procedure: (For GRO quantitation)**

13.2.1.1. *Calibration Factor*, CF =

$$CF = \frac{\text{Total area within Retention Time Range}}{\text{Concentration } (\mu g/L)}$$

13.2.1.2. *Average Calibration Factor*, CF_{ave} =

$$CF_{ave} = \frac{\text{Total CFs (all cal. points)}}{\text{number of cal. Points}}$$

13.2.1.3. *GRO Daily CCV CF,* $CF_{gro} = \frac{\text{(Total area - Surrogates and I.S. areas)}}{\text{Standard Concentration (= 1000 µg/L)}}$

13.2.1.4. *% Difference* = $(100)\ ((CF_{ave} - CF_{gro}) / (CF_{ave}))$

13.2.1.5. *GRO concentration* = $\frac{\text{(Total area - Surrogates and I.S. areas)(DF)}}{CF_{ave}}$

13.2.2. **Internal Standard Calibration Procedure: (For BTEX quantitation)**

13.2.2.1. *Response Factor*, $RF = \frac{A_S \times C_{IS}}{A_{IS} \times C_S}$

Where, As = Peak area of the compound.
A_{IS} = Peak area of the Internal Standard.
Cs = Conc. of the compound, in µg/L.
C_{IS} = Conc. of the Internal Standard, in µg/L.

13.2.2.2. *Average Response Factor,* $RF_{ave} = \frac{\text{Total RFs (all cal. points)}}{\text{number of cal. Points}}$

13.2.2.3. *% Difference* = $100 \times ((RF_{ave} - RF) / (RF_{ave}))$

13.2.2.4. *BTEX analyte concentration in µg/L,* $C_S = \frac{A_S \times C_{IS} \times DF}{A_{IS} \times RF_{ave}}$

13.2.3. **Dilution Factors, DF : DF = Final Volume, mL/Initial weight, g (or volume, mL)**

13.2.3.1. ***Soils*:**

13.2.3.1.1. Dry weight (g) = wet weight(g) x $\frac{\text{\% solids}}{100}$

13.2.3.1.2. Method 5035:

$$DF = \frac{\text{5 mL MeOH extract}}{\text{Dry weight}} \times \frac{\text{50 mL final volume (with water)}}{\text{volume (mL) of extract*}}$$

13.2.3.1.3. AK101, Field preserved:

$$DF = \frac{\text{25 mL methanol extract}}{\text{Dry weight}} \times \frac{\text{50 mL final volume (with water)}}{\text{volume (mL) of extract*}}$$

*1000 µl is the default extract volume.

13.2.3.1.4. **Moisture content correction:**

$$\frac{\text{(Conc. of sur (µg/L)) / (Vol of methanol (mL))}}{\text{(methanol vol (mL)) + ((sample weight (g)) (\% moisture/100))}} = \text{Corrected concentration (µg/mL)}$$

13.2.3.2. ***Oils*:**

$$\text{DF} = \frac{\text{5 mL methanol extract}}{\text{wt of sample(g)}} \text{ X } \frac{\text{50 mL final volume (with water)}}{\text{volume (mL) of extract**}}$$

**250 µL for a straight dilution

13.2.3.3. ***Waters*:**

$$\text{DF} = \frac{\text{5 mL final volume}}{\text{volume (mL) of sample***}}$$

***5 mL for a straight dilution

13.2.3.4. **Air samples:**

$$\text{Conc. ppm} = \frac{\text{(Soln. Conc. ng/mL)(Purge Vol. mL)(Molar Vol 24,450,000 µL/mol)}}{\text{(1.0E+09 ng/g)(Analyte atomic wt. g/mol)(sample vol. injected, L)}}$$

For a 1x dilution, sample volume injected = 2 mL.
Purge Volume = 5 mL.

14.0. HEALTH AND SAFETY:

14.1. Samples shall be returned to the approved storage location until such time as it is determined that no further analysis will be required.

14.2. Once it has been established that no more analysis of a sample will be required, acid and alkaline preserved samples may be neutralized using the Elementary Neutralization Hood located in GC Prep, unless it is considered to be hazardous (i.e. mercury waste, cyanide waste). Refer to the current version of SOP 108 for further instruction. The Sample Custodian may accomplish performance of this step.

14.3. All surplus reagent acids shall be neutralized on a daily basis using the Elementary Neutralization Hood located in GC Prep.

14.4. Small volumes of surplus volatile reagents may be allowed to evaporate in a hood at the end of the analytical session.

14.5. Proper Personal Protective Equipment (PPE) must be worn at all times. Proper PPE when handling samples include a lab coat, gloves and safety glasses. In addition, when handling any samples or solutions with any acid or base preservative a face shield and apron must be worn.

14.6. The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. However, each chemical compound should be treated as a potential health hazard. Exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material safety data sheets and other safety information is available in the QC office.

15.0. POLLUTION PREVENTION:

SGS is committed to evaluate all areas of the lab with regard to current and potential pollution prevention. Pollution prevention is described as any technique that reduces or eliminates waste at the point of generation. Further discussion on pollution prevention programs in the laboratory can be found in *SGS Pollution Prevention Plan* (Form F053).

16.0. METHOD PERFORMANCE:

There are no method performance measures to report at this time.

17.0. DETECTION LIMIT (DL) STUDY:

17.1 DL studies are performed when a significant change in instrument response is observed or when a new instrument is purchased for analysis. The DL is intended to demonstrate the capability of this method as it is implemented at SGS. An update to the DL does not necessitate an update to this document. Further guidance on performing a DL study can be found in SOP 116.

17.2 Refer to Table 4 for the suggested DL spiking levels.

TABLE 4. DL STUDY DATA

	DL	**Suggested Spiking Level**
Soils	**(µg/Kg)**	**(µg/kg)**
GRO	750	1250
BFB (Surrogate)	7.8	25.0
Benzene	4.0	12.5
Toluene	7.8	12.5
Ethylbenzene	7.8	12.5
p & m-xylene	15	25.0
o-xylene	7.8	12.5
DFB (Surrogate)	7.8	25.0
Water	**(µg/L)**	**(µg/L)**
GRO	31	50
BFB (Surrogate)	0.31	1.0
Benzene	0.15	0.5
Toluene	0.31	0.5
Ethylbenzene	0.31	0.5
p & m- xylene	0.62	1.0
o-xylene	0.31	0.5
DFB (Surrogate)	0.31	1.0

NOTE: The DL for samples is dependent on sample matrix. Matrix effects can cause the DL to be elevated.

18.0. LIMIT OF DETECTION (LOD):

The LOD is defined per SOP 116; LOD verification shall be performed quarterly according to the schedule set by the QA Office.

19.0. LIMIT OF QUANITATION (LOQ):

19.1 The LOQ is defined per SOP 116; LOQ verification shall be performed quarterly according to the schedule set by the QA Office.

19.2 Current LOQ levels and regulatory limits can be found in Table 5.

TABLE 5. LOQ STUDY DATA

Soils	**LOQ (µg/Kg)**	**Regulatory Limits (µg/Kg)**
GRO	2500	260,000
Benzene	12.5	25
Toluene	25	6500
Ethylbenzene	25	6900
p & m-xylene	50	63000
o-xylene	25	63000
Water	**(µg/L)**	**(µg/L)**
GRO	100	2,200
Benzene	0.5	5
Toluene	1.0	1000
Ethylbenzene	1.0	700
p & m- xylene	2.0	10,000
o-xylene	1.0	10,000

NOTE: The LOQ for samples is dependent on sample matrix. Matrix effects can cause the LOQ to be elevated.

20.0. REFERENCES:

(1)USEPA Method 8000B Determinative Chromatographic Separations, Rev. 2, 12/1996, Sec 7.4, p. 15
(2)USEPA Method 8000B Determinative Chromatographic Separations, Rev. 2, 12/1996, Sec 7.5.1, p. 18
(3)*Environmental Quality – Validation of Analytical Chemistry Laboratories*, USACE Engineer Manuals, Pub. EM 200-1-1, Ch. 3, App. I, July 1994, pp. 58 and 86.
(4)40 CFR Part 136, App. A, Method 602, Sec. 7.3.2
(5)Method AK101 for the Determination of Gasoline Range Organics, 04/08/02, Sec. 9.8.4, p 14
(6)Method AK101 for the Determination of Gasoline Range Organics, 04/08/02, Sec. 9.9, p 15
(7)USEPA Method 8000B Determinative Chromatographic Separations, Rev. 2, 12/1996, Sec 7.6.4
(8)Method AK101 for the Determination of Gasoline Range Organics, 04/08/02 table 3 p. 30.

21.0. ATTACHMENTS:

Attachment A: Corrective Action Table

Attachment A: Corrective Action Table

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria
Initial Calibration for all analytes	Periodic	cal CF RSD ≤25 % for AK101 GRO cal CF RSD ≤20 % for 8015C GRO cal RF RSD ≤20 % for 8021B BTEX cal RF RSD ≤10 % for 602 BTEX OR: $r^2 \geq 0.99$ or $r \geq 0.995$	Correct source of problem. Repeat analysis. Recalibrate if needed.	Do not proceed with sample analysis.
Second Source Calibration Verification	Once per initial cal.	AK101 GRO within ± 25% 8015C GRO within ± 20% BTEX within ± 20%	Correct source of problem. Repeat analysis. Recalibrate if needed.	Do not proceed with sample analysis.
Continuing Calibration Verification	AK101: Beginning, every 20 injections, and at the end.	AK101: GRO Recovery within ± 25% of true value	Evaluate the data. Correct source of problem. Repeat analysis if needed. Recalibrate if needed.	1. If recovery is biased high: report if target analytes not present, rerun if present. 2. If recovery is biased low: perform instrument corrective action and rerun.
	8015C: Beginning, after every 10 injections, and at the end.	8015C: GRO Recovery within ± 20% of true value		
	BTEX: Beginning, every 12 hours, and at the end.	BTEX: Recovery within ± 20% of true value		
Method Blank	One MB per extraction batch	Less than the LOQ DOD: less than ½ LOQ	Evaluate the data/prep info. Correct source of problem.	1. If analytes are not detected or ≥ 10 times concentration of method blank, report with a comment. 2. Identify source of contamination (instrumental or extraction), re-extract and rerun.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria
LCS	One LCS per 20 client samples.	60-120% Recovery for AK101 and 8015C GRO Performance Based Limits for BTEX RPD ≤ 20	Repeat analysis or re-extract entire prep batch if needed.	1. If recovery is biased high: report if target analytes not present, rerun LCS if present. Re-extract entire batch if LCS does not pass the second time. 2. If recovery is biased low: rerun LCS. Re-extract entire batch if LCS does not pass the second time.
LCSD	One LCSD per 20 client samples for AK101 and/or BTEX by EPA602.			
	One LCSD per 20 client samples for BTEX by SW8021B when there is insufficient volume available to perform MS/MSD.			
MS/MSD	One MS/MSD per 20 client samples by client request for AK101 and/or BTEX by EPA602. MS/MSD is required for **8015C** when samples submitted allows.	60-120% Recovery for GRO Performance Based Limits for BTEX RPD ≤ 20		Comment in LIMS.
	One MS/MSD per 20 client samples for BTEX by SW8021B where there is sufficient sample volume available. MS/MSD is required for **8015C** when samples submitted allows.			
Surrogate Spike	Every Sample	50%-150% Recovery for BFB field surrogate Performance Based limits for lab surrogate	Evaluate the data/prep info. Repeat analysis or re-extract the sample.	1. If recovery is biased high: • Report if target analytes not present. • Report if present but there is obvious matrix interference and comment as such. • If there is no obvious interference, rerun to confirm. 2. If recovery is biased low: rerun sample to confirm.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria
Instrument Blank	Daily	Less than the LOQ	Repeat analysis if needed.	
Retention time Window	Integration windows must be verified each day.	Analyte RT should be within the window.	Correct source of problem. Repeat analysis. Recalibrate if needed. Adjust RT of analytes per section 11.7.	
Demonstration of capability (IDC) acceptable precision and accuracy	Once per analyst per Method	4 successful LCSs	Repeat analysis or re-extract if needed.	

RF= Response Factor

LOQ = Reporting limit

SGS	SGS North America, Inc. - Alaska Division Standard Operating Procedure
NOTE: This document contains CONFIDENTIAL business information and is not intended for distribution.	
S.O.P. Title: Diesel Range Organics/ Residual Range Organics (DRO/RRO)	**Revision Date**: March 2014
Method No: AK102 & AK103 & 8015C	**SOP No**: 712r14
Page: 1 of 20	**Supersedes**: 712r13

Signatures below reflect periodic review of Standard Operating Procedures. If the procedure is found adequate with little or no editing necessary, this page is signed and dated. An Addendum may be issued for minor changes that need to be implemented immediately. If it is determined that major edits are required, a new revision will be released with a new signature page.

Technical Director	Date	Quality Assurance (QA) Manager, QA Staff or their Designee	Date
C. Ede	7/26/17		7/26/17
Stephen C. Ede	3/13/14		3/13/14
C. Ede	6/18/15		6/18/15

Original cover pages with wet signatures and the digitally signed electronic SOP versions are available in the Quality Assurance Office.
A limited number of controlled hard copies will be issued for the Section Method SOPs & Technical Director's offices.

This document will be converted into a PDF file with the QA Manager's, QA Staff's or QA Designee's electronic signature and posted on the network: \\usfs700\ANK_GroupData\Public\DOCUMENT\SOP\~Approved_SOPs~

This electronically signed PDF will be considered the controlled copy for staff. Any printouts or photocopies are invalid.

Each staff member responsible for this SOP will print & sign this coverpage upon successful review, retaining it as a record in their training folder.

I have reviewed and understand the method reference(s) and this version of the SOP.
I agree to use only this currently approved version of the SOP.

Signature: ________________________ Printed Name: ________________________ Date: __________

Document Control Number __________ Issued by __________ Date __________

SGS	SGS North America, Inc. - Alaska Division Standard Operating Procedure
NOTE: This document contains CONFIDENTIAL business information and is not intended for distribution.	
S.O.P. Title: Diesel Range Organics/Residual Range Organics (DRO/RRO)	**Revision Date:** November 2015
Method No: AK102/103 and 8015D	**SOP No:** 712r14_Add#1
Page: 1 of 1	**Supersedes:** 712r14

Signatures below reflect approval for the following changes to the current SOP. These changes will be incorporated into the SOP during the next review. This addendum will be incorporated into the electronic SOP (i.e., PDF file).

Technical Director	Date	Quality Assurance (QA) Manager, QA Staff or their Designee	Date
Steph C. Ede	7/26/17		7/26/17
Stephen C. Ede	11/12/15		11/12/15

I have reviewed and understand the method reference(s) and this version of the SOP.
I agree to use only this currently approved version of the SOP.

Signature: ______________________ Printed Name: ______________________ Date: __________

The above referenced SOP should be modified as follows:

To Section 11.14.1, add the following: All methods for DOD samples: In the event of a recovery failure for analytes of interest in continuing or closing CCV samples, the Analyst may immediately (within 1 hr of the failing CCV and before any other samples have acquired) rerun 2 successive CCVs. If both meet QC criteria for all analytes of interest, then the samples already analyzed may be reported and the run sequence may be continued. Samples following the two passing CCVs are also valid. **All CCVs must be reported in LIMS.** Refer to SOP#101 for nomenclature (e.g., CCCV, CVC, CVCA, etc.)

Change Section 21 (Corrective Action Table) from:

Calibration Verification (CCV)	At the start and end of the run. **AK102/103:** after every 20 field samples. **8015C**: after every 10 field samples.	**AK102/103**: DRO/RRO ± 25% recovery **8015C**: DRO/RRO ± 20% recovery	~~1. Repeat once with new aliquot.~~ ~~2. Evaluate data.~~ ~~3. Correct source of problem.~~ ~~4. Recalibrate if needed.~~	CCV with high bias: Report ND samples with appropriate comment.

To read:

Calibration Verification (CCV)	At the start and end of the run. **AK102/103:** after every 20 field samples. **8015C**: after every 10 field samples.	**AK102/103**: DRO/RRO ± 25% recovery **8015C**: DRO/RRO ± 20% recovery	**For non-DOD samples:** 1. Repeat analysis once. 2. If QC criteria not met, then recalibrate and reanalyze. **For DOD samples:** 1. Immediately (within 1 hr and before any other samples have acquired) run two successive CCVs. 2. If both meet QC criteria, then samples already analyzed may be reported and the run may continue.	CCV with high bias: Report ND samples with appropriate comment.

Summary of Changes from Previous Revision:

- SOP add #1 was incorporated
- Section 8.4.6.1 was updated to reflect current practice
- Table 2 was updated to reflect the current practice
- Section 12.9 was added
- Section 10.4 was added

Table of Contents

1.0. OBJECTIVE:

This standard operating procedure provides conditions for the analysis of diesel range and residual range organics and other extractable petroleum hydrocarbons. Upon completion of extraction procedures, the concentrations of diesel range and residual range organics are determined by Gas Chromatography employing a Flame Ionization Detector (FID).

2.0. SCOPE AND APPLICATION:

This SOP provides a GC method for determining the concentration of diesel range organics (DRO) and residual range organics (RRO). These analyses are applicable to aqueous, soil, and oil matrices. All products identified by this method will be quantified using diesel fuel #2 (DRO) and/or oil blend (RRO) calibration curves.

2.1 **DRO by AK102** measures the area response of the instrument from C10 through to the beginning of C25. **RRO by AK103** is measured from the beginning of C25 through C36.

2.2 **DRO by 8015C** measures the area response of the instrument from C10 through to the beginning of C28. **RRO by 8015C** is measured from the beginning of C28 through C36.

3.0. DEVIATIONS FROM REFERENCE METHOD:

Note: Sections referenced are as published in AK 102/103 Version 4/8/2002:

3.11 The LOQs for soils and waters are less than 5X the method detection limit.

9.2.2.2. Performance criteria of mass discrimination and separation number will not be calculated.

AK102-3.3. SGS uses 5-alpha-androstane instead of o-terphenyl for the surrogate.
NOTE: Alternate is allowed by method.

AK102-8.1 SGS preserves samples to a pH of less than 2, as well as maintaining them at 4ºC until extraction.
NOTE: This is a NELAP deviation; however, it is recommended by the reference method.

9.5.2 Surrogates are not calibrated with DRO/RRO standards; they are calibrated separately.
NOTE: This is a NELAP deviation; however, it is permitted by the reference method.

4.0. RESPONSIBILITIES:

4.1 The QA Office maintains a master list of this SOP to ensure review on a timely basis. This system serves as an accounting of SOP distribution and ensures that distributed SOPs are current and complete. This includes destruction of controlled copies of expired and retired SOPs. The QA Office also maintains a historical file of original cover pages with wet signatures and digitally singed electronic versions of this SOP; including the current revision and any versions archived within the past 5 years.

4.2 The electronic (Word Document) versions of this SOP, both current and any prior versions, are maintained on the computer network in a secure location as a "read only" file.

4.3 It is the responsibility of all personnel to follow this SOP as written, document and gain QA or Technical Director approval for deviations to the SOP, and submit needed SOP revisions to the QA Office.

4.4 This SOP is scheduled for review on an annual basis. Any required revisions will be incorporated into the SOP. The new revision of the SOP will be distributed by QA and the superseded version returned to the QA Office. If no revisions are required, the SOP cover page is signed and dated to document the review, and the updated cover page will be distributed.

4.5 A PDF version of each SOP (generated in Adobe or scanned) is digitally signed by a member of the QA Office as a security measure. The digitally signed PDF, used online, is considered to be a controlled copy of the SOP and is stored on the network.

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All staff have “read” access to these SOPs. Only QAQC has access to “write” on SOPs. Staff is directed to use the controlled electronic versions of SOPs. A limited number of controlled hardcopies are to be distributed by the QA Office.

5.0. INTERFERENCES:

5.1. Contamination due to sample carry-over can occur whenever high-level and low-level sample extracts are sequentially analyzed. Biogenic sample extracts or heavy oil sample extracts may also result in sample carry-over. To reduce carryover, the sample syringe is rinsed between sample runs with solvent (methylene chloride). When an extract is suspected to have a high concentration (or other suspect matrices), solvent blanks are subsequently analyzed to check for cross contamination (or carry-over). See SOP #500 for further guidance on determining carry over.

5.2. Other organic compounds including, but not limited to, animal and vegetable oil, grease, chlorinated hydrocarbons, phenols, phthalate esters and biogenic terpenes are measurable under the conditions of this method. Heavier petroleum products such as lubricating oil and crude oils also produce a response within the retention time range for DRO. As defined by this method, the DRO/RRO results may include these compounds.

6.0. SAMPLE HANDLING:

6.1. **Sample Matrix** – Methylene chloride extractions of waters, soils and oils.

6.2. **Sample Collection and Preparation** – See individual extraction SOPs for sample handling and preparation criteria. Continuous Liquid-Liquid Extraction: SW 3520C, SOP #759; Sonication Extraction on Solids by SW 3550C, SOP #761; and Waste Dilution on Oils by SW 3580A, SOP #762.

6.3. **Sample Size** – Final extraction volume is determined by the sample preparation methods.

6.4. **Sample Preservation** – Extracts are stored ≤ -10˚C.

6.5. **Holding Times** – Extracts must be analyzed within 40 days of sample preparation. Sample extracts outside of the hold time are disposed of as chlorinated waste.

6.6. **Criteria for Acceptance/Rejection of Samples** – If any discrepancies are found between a sample and the extraction bench sheet then the batch should not be analyzed until the issue is resolved.

7.0. APPARATUS:

7.1 Gas Chromatograph: HP 7890, HP 6890 Plus, 7683 Agilent autosampler and tray, 7683 Agilent injection towers, or equivalents, and a Flame Ionization Detector.

7.2 A data system capable of determining peak areas by baseline-baseline integration and forced baseline integration, and of storing chromatographic data. HP Chemstation or equivalent.

7.3 Other Equipment: Assorted Class A volumetric glassware, 5 – 1000 µL gas-tight syringes, 11 mm aluminum crimp caps, 2 mL wide top crimp vials, crimper, de-capper, fused silica wool, glass inlet liners, ¼ inch thermo ‘o’ ring seals or equivalents.

7.4 Performance Criteria: GC run conditions and columns must be chosen to meet the following criteria:

7.4.1. The methylene chloride solvent front must be resolved from C10.

7.4.2. Resolution between C24 and C25 and C28 and C29 must be achieved.

7.4.3. Column compensation is considered an acceptable practice by the State of Alaska, but is not currently employed at this laboratory.

8.0. REAGENTS:

8.1 **Solvents**: Methylene chloride, carbon disulfide. ACS reagent grade solvents must be used in all tests unless otherwise indicated. The date opened, date of expiration, and date received must be written on the bottle.

8.2 **Stock Standards**: Stock standards are prepared by diluting neat products by mass or certified standards by volume. Transfer the stock standard solution to a vial with a Teflon-lined screw cap and store at ≤ -10˚C. Stock standard solutions should be checked frequently for signs of degradation or evaporation, especially prior to preparing calibration standards. Stock standards are replaced after one year or when the neat standard expires, whichever is sooner, or if comparison with check standards indicates a problem. (See Standards Labeling and Traceability SOP #112 for standards documentation.)

8.3 **Working Solutions**: Working solutions are prepared by diluting neat products, certified standards, or stock standards. Working solutions are replaced after one year or when the neat standard expires, whichever is sooner, or if comparison with check standards indicates a problem.

8.4 **Standard Descriptions**:

8.4.1 **Normal Alkane Standards (NAS)**

8.4.1.1 Normal Alkane Standard Solution (NAS) Stocks: Use Ultra Scientific (UST-210 or equivalent) n-C10 through n-C25 DRO mixture in methylene chloride (at 1000 µg/mL per alkane) for diesel range alkanes. Use Ultra custom alkane mixture (CUS-3999) in methylene chloride/carbon disulfide (9:1) for residual range alkanes (at 1000 µg/mL per alkane) n-C26, n-C28, n-C30, n-C32, n-C34, and n-C36.

8.4.1.2 Working NAS Solution: Combine 1mL of each stock with 2 mL of methylene chloride.

8.4.2 **DRO Standards**

8.4.2.1 DRO Neat Stock Standard**:** Use diesel fuel #2 (summer diesel) from a local gas station. Diesel must be collected annually while summer diesel is available for the season.

8.4.2.2 DRO Stock Standard: Dilute 10 g of DRO Neat Stock to a final volume of 500 mL with methylene chloride. The final concentration is 20,000 µg/mL.

8.4.2.3 **DRO Continuing Calibration Verification Standard (CCVB)** / 8015 Matrix Spike Solution: Dilute 50 mL DRO Stock Standard to 200 mL with methylene chloride. The final concentration is 5,000 µg/mL.

8.4.2.4 Initial Calibration Verification Standard for DRO (ICVB)**:** Use Ultra part # RGO-616 diesel fuel #2 at 50,000 µg/mL (or equivalent). Dilute 1 mL of diesel fuel #2 with methylene chloride to a final volume of 10 mL. The final concentration is 5,000 µg/mL.

8.4.3 **RRO Standards**

8.4.3.1 RRO Neat Stock Standard: Use a commercial brand of SAE 30 motor oil and SAE 40 motor oil. These lube oils are given a shelf life of 10 years.

8.4.3.2 RRO Stock Blend**:** Create an equal blend (1:1) by weight of the RRO Neat Stocks. For example: combine 5.0 g of each RRO Neat Stock.

8.4.3.3 RRO Stock Standard: Dilute 10.0 g of the RRO Blend to 500 mL with methylene chloride. The final concentration is 20,000 µg/mL. Alternatively, weigh the RRO Neat Stocks directly for dilution. For example: weigh 5.0 g of each RRO Neat Stock and dilute to 500 mL with methylene chloride.

Note: Let the RRO Neat Stock oils sit overnight to thaw prior to use.

8.4.3.4 **RRO Continuing Calibration Verification Standard (CCVR):** Dilute 50 mL of RRO Stock Standard (20,000 µg/mL) to 200 mL with methylene chloride. The final concentration is 5,000 µg/mL.

8.4.3.5 Initial Calibration Verification RRO Neat Stock (ICVR Neat Stock): Use a secondary commercial brand of SAE 30 motor oil and SAE 40 motor oil. These lube oils are given a shelf life of 10 years.

8.4.3.6 ICVR Blend Standard: Create an equal blend (1:1) by weight of the ICVR Neat Stocks. For example: combine 0.5 g of each ICVR Neat Stock.

8.4.3.7 ICVR: Dilute 0.5 g of the ICVR Blend to 100 mL with methylene chloride. The final concentration is 5,000 µg/mL. Alternatively, weigh the ICVR Neat Stocks directly for dilution. For example: weight 0.5 g of each ICVR Neat Stock and dilute to 200 mL with methylene chloride.

Note: Let the ICVR Neat Stock oils sit overnight to thaw prior to use.

8.4.4 Calibration Standards for DRO and RRO**:** The Calibration standards are diluted from DRO and RRO Stock Standards (See Table 2).

8.4.5 **DRO/RRO Matrix Spike:** This standard is used in the extraction process to spike the LCS, LCSD, MS and MSD. Use the DRO and RRO Stock Standards at 20,000 µg/mL (see Sections 8.4.2.2 and 8.4.3.3) to make a working solution by combining the Stock Standards and diluting with methylene chloride. For example: combine 250 mL of each DRO and RRO Stock Standard and dilute to 1000 mL. The final concentration is 5,000 µg/mL for DRO and RRO.

8.4.6 **Surrogate Standards**

8.4.6.1 Surrogate Standard Stock Solution**:** Use Sigma Chemical Company or equivalent certified product. Dissolve 0.100 g of 5α-androstane and 0.100 g of triacontane-d_{62} (DTC) into 5 mL of carbon disulfide and sonicate in a warm water bath. Dilute this solution with methylene chloride to a final volume of 100 mL. Let this solution sit over night. The concentration is 1000 µg/mL. This standard is further diluted for use as Surrogate Calibration Stock or Surrogate Working Solution.

8.4.6.2 Surrogate Working Solution (100 µg/mL): Dilute the 100 mL of the Surrogate Stock Solution to 1000 mL with methylene chloride. Final concentration is 100 µg/mL for each surrogate. This standard is used as the Instrument Blank (IB) and in the extraction process for most samples.

Note: During the summer season it is recommended to double this solution preparation.

8.4.6.3 Surrogate Calibration Stock / Silica Gel (SG) Surrogate Working Solution (200 µg/mL): Dilute the 100 mL of the Surrogate Stock Solution to 500 mL with methylene chloride. The final concentration is 200 µg/mL. This standard is used to prepare the surrogate calibration curve (See Table 2) and in the extraction process for surrogate spiking solution for silica gel cleanup samples.

8.5 **Reagent Storage and Shelf Life**

8.5.1 All stock, working, and calibration solutions are stored ≤ -10˚C, or at the manufacturer's recommended storage conditions, when not in use. All standards must be stored with minimal headspace and protected from light.

8.5.1.1 Working standards and stock standards will be discarded if they are older than one year, if signs of degradation/concentration are noticed, or when the parent standard expires.

8.5.1.2 Certified products will expire according to the manufacturer's expiration date.

8.5.1.3 Solid standards are given an expiration of one year from the date they are opened, or sooner if signs of degradation are noticed.

8.5.1.4 Carbon disulfide is given an expiration of five years from opening.

8.6. **Standard Verification**

Standard verification shall be within ± 10% of instrument response of the previously made/verified solution (the solution you are retiring) **AND** shall not be outside of ± 25% of the true value of the curve (the recovery shall not be below 75% or above 125%). The ± 10% criterion may be waived if no prep batches are waiting to be analyzed and the ± 25% of the true value requirement is still met. Record the data files used to determine the acceptance criteria in the secondary standard log, as well as the percent recovery.

9.0. EXTRACTION:

See individual extraction SOPs criteria. Continuous Liquid-Liquid Extraction: SW 3520C, SOP #759; Sonication Extraction on Solids by SW 3550C, SOP #761; Waste Dilution on Oils by SW 3580A, SOP #762.

10.0. CALIBRATION:

10.1. **Establish gas chromatographic operating parameters:** See maintenance log book for individual instrument(s).

10.2. **Calibration Standards:** Prepare calibration standards as indicated in Table 2. The low calibration point must be at or below the Limit of Quantitation (LOQ). Refer to the Analytical Chemistry Quality SOP #500 for additional specifications regarding the allowable number of calibration points.

10.3. The sequence for the calibration will start with an IB and NAS followed by the calibration curves and finally the ICVs.

10.4. Surrogate DRO/RRO Calibration Dilutions calculation form can be found here: \\usfs700\ANK_Groupdata\Public\DOCUMENT\Calculations\Fuels\DRO_RRO_Sur_Cal_Dilutions

10.5. **Setting Retention Time Group/Windows**

10.5.1. **For Method AK102/103:** The DRO range begins at the peak start of C10. The RRO range ends with the peak end of C36. The end of DRO range and corresponding beginning of the RRO range lies at the peak start of C25.

10.5.2. **For Method 8015C:** The DRO range begins at the peak start of C10. The RRO range ends with the peak end of C36. The end of DRO range and corresponding beginning of the RRO range lies at the peak start of C28.

10.5.3. **For surrogates**: Set the retention time of the surrogates using the instrument blank or the mid-point of the surrogate calibration curve.

10.6. **Calibration Acceptance Criteria**: (*Note*: Linear Regression is the preferred curve fit for DRO and RRO.)

10.6.1. **For Method AK102/103**:

10.6.1.1. The percent relative standard deviation (%RSD) of the response factors must be less than or equal to 25% to assume linearity through the origin so an average response factor can be used for quantitation.

10.6.1.2. If a linear regression or quadratic fit are used for quantitation, the curve fit must be $r^2 \geq 0.995$. If a quadratic fit is used for quantitation, the curve must have six calibration points.

10.6.1.3. Initial verification of calibration is accomplished by running the ICV (see Section 8.4.2.4 and 8.4.3.7). Acceptance criteria range is defined as 75% - 125% recovery.

10.6.2. **For Method 8015C**:

10.6.2.1. If the percent relative standard deviation (%RSD) of the calibration factors is less than 20% over the working range, then linearity through the origin can be assumed, and the average calibration factor can be used in place of a calibration curve.

10.6.2.2. If a linear regression or quadratic fit are used for quantitation, the curve fit must be $r^2 \geq 0.99$. If a quadratic fit is used for quantitation, the curve must have six calibration points.

10.6.2.3. Initial verification of calibration is accomplished by running the ICV (see Section 8.4.2.4 and 8.4.3.7). Acceptance criteria range is defined as 80% - 120% recovery.

11.0. ANALYSIS:

11.1. **Run a minimum of two blanks** (rinses) to ensure no artifacts are present.

11.2. **Inject the Instrument Blank (IB).** See Section 12.2 and Table 1 for acceptance criteria. The Instrument Blank is a solvent blank that has been spiked with surrogate. At a minimum, the IB is run at the beginning of every analytical sequence.

11.3. **Inject NAS.** If the NAS is not within the previously set range, check to make sure parameters (both instrument and data processing) are correct. If the operating parameters are correct and the alkanes are not within the set windows, save a new method and reset the retention time windows for the current processing method. Name the subsequent methods alphabetically: A, B, C, etc. Document on the runlog (F0050) “Updated RT’s”. The retention times (RT’s) of the surrogates should also be updated at this time.

11.3.1. For Method AK102/103: Verify each day (*or every 24 hours of analysis*) that the retention times for *C10, C25, and C36* are within the integration windows set during calibration.

11.3.2. For Method 8015C: Verify each day (*or every 12 hours of analysis*) that the retention times for *C10, C28, and C36* are within the integration windows set during calibration.

11.4. **Inject CCVB and CCVR.**

11.4.1. **For Method AK102/103**: The CCVB and CCVR must be subsequently analyzed *after every 20 field samples* and at the end of the analytical run. The final CCVB and CCVR must be analyzed *within 24 hours* of the NAS analysis.

11.4.2. **For Method 8015C:** The CCVB and CCVR must be subsequently analyzed *after every 10 field samples* and at the end of the analytical run. The final CCVB and CCVR must be analyzed *within 12 hours* of the NAS analysis.

11.5. If the opening IB, CCVB and/or CCVR are outside of acceptance criteria, re-inject using a new aliquot of the standard. This will confirm that the response for the analyte is accurate and mis-injection or concentration of the standard aliquot did not occur. If the reanalysis meets criteria, discard the aliquot that was not within acceptance criteria and document in the analytical run log. If a second failure occurs, instrument maintenance and possibly recalibration will be necessary.

11.6. **Extraction Sheet Review:** At the time of creating a sequence, the analyst is responsible for checking the extraction bench sheet against the samples presented. Extraction batch comments should be reviewed at this point also, as well as final volumes of the extracts. If a discrepancy is found between a sample and the extraction bench sheet, then the batch should not analyzed until the issue is resolved.

11.7. **Analysis Sequence:** Extracts and instrument QC are placed into autosampler vials, sealed and loaded into the sample trays. IB, NAS and CCVs precede sample extract injections. Recommended sequence order for sample extracts is as follows: Method Blank (MB), Laboratory Control Sample (LCS), Laboratory Control Sample Duplicate (LCSD), and for MS/MSDs, if needed: Parent Sample (PS), Matrix Spiked Sample (MS), and Duplicate Matrix Spiked Sample (MSD).

11.8. Silica Gel Split batches: Biogenic compounds may contribute to the residual range and may be present at higher than regulatory cleanup levels, depending on soil matrix. Biogenic compounds may be polar or semi-polar in nature. Silica gel cleanup preferentially removes polar and semi-polar compounds. When queuing silica gel cleanup samples in a run sequence it is preferred to label the silica cleaned-up samples with 'SG' to prevent confusion with the non-silica cleanup portion.

11.9. **Dilutions:** The analyst dilutes the extracts and determines extract injection order based on the extract color and sample descriptions. It is recommended to periodically inject an instrument blank or rinse to check for carry-over. The following guidelines are intended as suggestions only.

11.9.1. For samples that appear to be biogenic (chunky or applesauce-like appearance), have a greenish tinge, or that the extraction sheet indicates were high in some type of organic content, start with a 4X and run extra rinses subsequent to each sample. Biogenic compounds are very prone to carryover in the RRO range.

11.9.2. For samples that appear dark chocolate color or a dark amber color, start with a 4X dilution and label them 'Dark'. Run at least one rinse after these samples if the dilution is still dark.

11.9.3. For samples that are dark and appear to stick to the inside of the glass vial, start with a 10X dilution. Run at least one rinse after these samples.

11.9.4. For oils, a screening run is necessary to establish the correct dilution as well as to establish column tolerance of the sample. Especially if the extract is colored, start with a 50X and several subsequent rinses to establish what the final dilution will be, taking into account any carryover present in the rinses. Consultation with the Project Manager may be necessary to establish the LOQ needed.

11.9.5. For samples that have been identified on the prep sheet as having a fuel odor, start with a 4X dilution. If they are identified as having a 'strong fuel odor' start with a 10X dilution.

11.9.6. Any other suspect samples, such as brightly colored extracts suspected of being glycols, transformer fluids, etc., should be run at a screening dilution with rinses to establish the final dilution.

11.9.7. For soil samples, if the shaken vial produces a lot of bubbles or a foam-like appearance, the sample may be high in DROs. Start with a 4X dilution for these samples.

11.10. **Narrating Dilutions:** The analyst is required to label the sample with its dilution in the analytical sequence and on the vial containing the diluted extract (x4, etc.). The dilution will also be narrated in the description section of the run log.

11.11. **Maintenance of Sequence Order:** The analyst is to insure that all sample extract vials are placed in the autosampler tray in the order reflected in the instrument sequence. After the samples are run and are removed from instrument, they are placed on trays in the same order as they were on the autosampler. The trays are then labeled with the instrument name and run date. Autosampler vials are recapped and retained for forty days. Dispose of extracts over 40 days old as chlorinated waste.

11.12. **Data Analysis:**

11.12.1. **AK102/103**: All peaks that fall within the C10 to the start of C25 group (excluding the 5α-androstane surrogate) are identified as diesel range organics. All peaks that fall within the start of C25 through C36 group (excluding the DTC surrogate) are identified as residual range organics.

11.12.2. **8015C**: All peaks that fall within the C10 to the start of C28 group (excluding the 5α Androstane surrogate) are identified as diesel range organics. All peaks that fall within the start of C28 through C36 group (excluding the DTC surrogate) are identified as residual range organics.

11.13. **Reportable Results** are those between the limit of quantitation (LOQ) and that which corresponds to the highest calibration standard used. Sample results less than the LOQ are reported as not detected (ND) unless otherwise requested by a client. (Refer to SOP #136 for additional information.) Samples with concentrations above the highest calibration standard are diluted to a level estimated to be near the mid-point of the calibration curve and reanalyzed. Alternately, if a sample is <LOQ when analyzed at a dilution, then the sample must be reanalyzed at a lesser or no dilution. The maximum recommended dilution for non-detect DRO soil samples is ≤ 4X. The maximum recommended dilution for non-detect RRO soil samples is ≤ 100X. Exceptions may be made for the sake of the instrument, but the Project Manager should be notified and the data must be reported with a sample comment regarding the reason for the elevated LOQ.

11.14. **Data Reduction or Processing**: Processing of standards and extracts should be reviewed sequentially, i.e., alkane standard, CCVs, QC, extracts, LCSs, MSs, extracts, etc. (especially to evaluate for any problems, mechanical or otherwise, or biasing from sample carry-over). **For acceptance criteria see Table 1.**

11.14.1. Valley-to-valley integration will be performed on the surrogate of any field sample or QC sample where the software does not set an appropriate integration. For further guidance on Manual Integration, see SOP #144. It is preferred to report surrogates at the same dilution as their associated analyte. For example, if DRO is being reported at a 1x and RRO is reported at a 10x, 5α-androstane will be reported at the 1x and DTC will be reported at the 10x.

11.14.2. **QC Failures:** If any QC (IB, CCV, MB, LCS/D, Sample Surrogates) does not meet requirements re-inject once to confirm sample carryover or mis-injection has not occurred. If the reanalysis confirms the failure, take appropriate corrective actions. Document appropriately in the run log. It is recommended to also record the critical percent recovery values for all extraction QC in the run log. Any sample not bracketed by passing CCVs must be reanalyzed.

Note: Surrogate recovery may be biased high or low due to matrix interference. If it is biased high due to matrix, the sample does not need to be re-run.

11.14.3. **LCS, LCSD, MS and MSD Relative Percent Difference (RPD):** If recovery of a standard and/or RPD does not meet requirements and the run has completed, rerun the pair of extracts together for the purpose of the RPD calculation in LIMS.

11.15. If the chromatogram indicates carry-over from the previous injection, document the carryover in the analytical run log, and rerun the sample extract when the baseline indicates the system is free of analyte or other contaminants.

11.16. When reporting a data value for DRO and/or RRO, an attempt is made to identify the product qualitatively through pattern recognition. The sample chromatogram is compared to with a library of chromatograms generated at SGS through the analysis of various petroleum products. When a sample pattern is not identifiable, a comment indicating that an unknown hydrocarbon is present is added to the sample.

Retention Time Window Width Studies:

11.17.1. Retention time window width studies are to be performed yearly or whenever instrument conditions, such as flow and temperature programs, are changed. Refer to SOP #500 for further guidance on reporting and submission of retention time window width studies.

11.17.2. **Determining Retention Time ~~Windows~~ Widths:**

11.17.2.1. **For Method AK102/103:** Be certain the GC system is within optimum operating conditions. Make three injections of the normal alkane working standard (NAS) and the IB throughout the course of a 72 hour period. Calculate the standard deviation of the three absolute retention times for C10, C25, and C36, 5-α, and DTC. The retention time window width for the individual peaks is defined as the average RT plus or minus 3 times the standard deviation of the absolute retention time for each component. In those cases where 3 times the standard deviation is less than 0.05 minutes, the laboratory should use ± 0.05 minutes as the retention time window width. Retention Time Window Width Studies are completed yearly as a minimum.

11.17.2.2. **For Method 8015C:** Be certain the GC system is within optimum operating conditions. Make three injections of the normal alkane working standard (NAS) and the IB throughout the course of a 72 hour period. Calculate the standard deviation of the three absolute retention times for C10, C28, and C36, 5-α, and DTC. The retention time window width for the individual peaks is defined as the average RT plus or minus 3 times the standard deviation of the absolute retention time for each component. In those cases where 3 times the standard deviation is less than 0.03 minutes, the laboratory should use ± 0.03 minutes as the retention time window width.

12.0. QUALITY CONTROL:

For quality control criteria, see also the Quality Control Criteria and Corrective Action Summary (Table 1).

12.1. The experience of the analyst performing gas chromatography is invaluable to the success of the methods. Each day that analysis is performed, the response from the calibration check standards should be evaluated to determine if the chromatographic system is operating properly. Questions that should be asked are: Do the peaks look normal? Is the response obtained comparable to the response from previous runs?

12.2. The extraction procedure and analytical system must be free of contamination. The instrument blank (IB) and method blank (MB) must have DRO and/or RRO values less than the LOQ. For DOD projects, the MB must have analyte concentrations below ½ LOQ.

12.2.1. If the IB or MB concentration is above the LOQ, but the sample extracts are either non-detect or the concentration of the contamination is not significant (i.e. sample concentration is >10x the contamination in the blank value), the samples may be qualified on reporting and flagged in the QC report.

12.2.2. If the IB or MB concentration is above LOQ and the concentration of the contamination is significant (i.e. sample concentration is <10x the blank value), re-extraction will most likely be necessary. If hold time has been exceeded contact the Project Manager and Production Manager to determine whether to re-extract beyond the hold time or report the original data with a B-flag.

12.3. Surrogates (5α-androstane and DTC) are used to monitor the performance of the extraction, the instrumental system, and the effectiveness of the method in dealing with each matrix. The surrogates in the instrument blank (IB) verify instrument response to the surrogates; surrogates in the field samples and QC samples verify the performance of the extraction.

12.4. LCS/LCSD: The LCS/LCSD set are used to verify the extraction efficiency of the method. Known concentrations of the diesel #2 and oil blend RRO are added to a blank matrix. The relative percent difference (RPD) must be ≤ 20%. If the RPD is outside this criterion, reanalyze the set once.

12.4.1. **For Method AK102/103**: An LCS/LCSD set are performed with every extraction batch of up to 20 field samples.

12.4.2. **For Method 8015C**: One LCS is required with every extraction batch of up to 20 field samples. If sample is unavailable for MS/MSD extraction, an LCSD may be prepared in lieu of the MS/MSD pair.

12.5. MS/MSD: A known concentration of diesel #2 and oil blend RRO are added to two aliquots of a field sample in the extraction batch. The relative percent difference (RPD) must be ≤ 30% for waters and ≤ 50% for soils. If the RPD is outside this criterion, reanalyze the set once. If the RPD is still outside criterion, flag the MS/MSD as non-homogenous. These limits are for guidance in data interpretation only.

12.5.1. **For Method AK102/103**: An MS/MSD set are extracted at the client's request.

12.5.2. **For Method 8015C**: An MS/MSD pair is required for 8015C; in the event of insufficient sample, an LCSD may also be prepared in lieu of the MS/MSD pair.

12.6. The Continuing Calibration Verification Standards (CCVB and CCVR) are used to monitor the performance of the instrument and the validity of the respective calibrations. These check standards are run on a daily, as well as an intermittent basis (see 11.4), to confirm the accuracy of the calibrations and the performance of the analytical system.

12.7. Initial Demonstration of Capability: Consists of four passing LCSs and is performed once by a new analyst and thereafter updated yearly. Limits are the same as LCS limits.

12.8. Any corrective action(s) needed to address a QC outlier or other technical challenges that are not listed in this SOP require the prior approval of the QA Office or Technical Department.

12.9. Data Archiving should be done according to SOP 142.

13.0. CALCULATIONS, REVIEW AND REPORTING:

13.1. **Accuracy:** % Recovery of True Value

$$\%R = \frac{(SSR-SR)}{SA} \times 100$$

Where: %R = Percent Recovery
SSR = the analytically determined spiked sample concentration (µg/mL)
SR = the analytically determined sample concentration (µg/mL)
SA = the true concentration of the spike (µg/mL)

(Where SSR or SR equals the solution concentration of the analyte times the corresponding dilution factor)

13.2. **Calibration Factor or Response Factor:**

$$CF \text{ or } RF = \frac{\text{Total Area of All Peaks in Integration Window}}{\text{Theoretical Concentration } (\mu g/mL)}$$

13.3. **Precision:** Relative Percent Difference (RPD)

$$RPD = \frac{|D1 - D2|}{(D1 + D2) \div 2} \times 100$$

Where: D1 = Sample value (µg/mL)
D2 = Sample duplicate value (µg/mL)

13.4. **Dry Weight (Mass):**

DW = (% Solids/100) * (Wet Weight or Mass)

13.5. **Dilution Factor:**

Solid DF = Final Extract Volume ÷ Dry Weight or Mass of Sample Used
Liquid DF = Final Extract Volume ÷ Volume of Sample Used

Where volume is in milliliters and mass is in grams.

13.6. **Hand Calculation of Solution Concentration from Area Counts:**

Area ÷ RF (response factor) = Solution Concentration (µg/mL)

14.0. HEALTH AND SAFETY:

14.1. Samples shall be returned to the approved storage location until such time as it is determined that no further analysis will be required.

14.2. Once it has been established that no more analysis of a sample will be required, acid and alkaline preserved samples may be neutralized using the Elementary Neutralization Hood located in GC Prep, unless it is considered to be hazardous (i.e. mercury waste, cyanide waste). Refer to the current version of SOP #108 for further instruction.

14.3. All surplus acids shall be neutralized on a daily basis using the Elementary Neutralization Hood located in GC Prep.

14.4. Small volumes of surplus volatile reagents may be allowed to evaporate in a hood at the end of the analytical session.

14.5. Proper Personal Protective Equipment (PPE) must be worn at all times. Proper PPE when handling samples include a lab coat, gloves and safety glasses. In addition, when handling any samples or solutions with any acid or base preservative a face shield and apron must be worn.

15.0. POLLUTION PREVENTION:

SGS is committed to evaluate all areas of the lab with regard to current and potential pollution prevention. Pollution prevention is described as any technique that reduces or eliminates waste at the point of generation. Further discussion on pollution prevention programs in the laboratory can be found in *SGS Pollution Prevention Plan* (Form F053).

16.0. METHOD PERFORMANCE:

There are no method performance measures to report at this time.

17.0. DETECTION LIMIT (DL) STUDY:

17.1. Detection Limit (DL) studies are performed when a new instrument is purchased, a new method is developed, or if there are significant modifications to the instrument. The DL is intended to demonstrate the capability of this method as it is implemented at SGS. An update to the DL does not necessitate an update to this document. Further guidance on performing a DL study can be found in SOP #116 or SOP #500.

17.2. Suggested DL spiking levels: See section 19.2 and refer to the suggested LOQ spiking levels for guidance on DL spiking levels.

18.0. LIMIT OF DETECTION (LOD):

The LOD is defined per SOP #116; LOD verification shall be performed according to the schedule set by the QA Office.

19.0. LIMIT OF QUANITATION (LOQ):

The LOQ is defined per SOP #116; LOQ verification shall be performed quarterly according to the schedule set by the QA Office. An update to LOQ does not necessitate an update to this document.

19.1. For the 8015 quarterly LOQ check samples, 2 extracts must be used. DRO is reported off an extract spiked with the 8015 matrix spike. RRO is reported off an extract spiked with the regular AK102/103 matrix spike. As such, the RRO portion can be posted from the AK102/103 soil extract and the AK102/103 high volume water extract.

19.2. Suggested LOQ spiking levels:

- DRO/RRO High Volume Waters: 100 µL of 5000 µg/mL DRO/RRO spike [0.5 mg/L]
- DRO/RRO Soils: 120 µL of 5000 µg/mL DRO/RRO spike [20 mg/kg]
- DRO/RRO Low Volume Waters: 25 µL of 5000 µg/mL DRO/RRO spike [0.5 mg/L]

- RRO 8015 Waters: 100 µL of 5000 µg/mL DRO/RRO spike [0.5 mg/L]
- DRO 8015 Waters: 100 µL of 5000 µg/mL DRO by 8015 spike [0.5 mg/L]
- RRO 8015 Soils: 120 µL of 5000 µg/mL DRO/RRO spike [20 mg/kg]
- DRO 8015 Soils: 120 µL of 5000 µg/mL DRO by 8015 spike [20 mg/kg]

- DRO/RRO Silica Gel High Volume Waters: 200 µL of 5000 µg/mL DRO/RRO spike [0.5 mg/L]
- DRO/RRO Silica Gel Soils: 240 µL of 5000 µg/mL DRO/RRO spike [20 mg/kg]
- DRO/RRO Silica Gel Low Volume Waters: 50 µL of 5000 µg/mL DRO/RRO spike [0.5 mg/L]

20.0. REFERENCES:

ADEC Method AK102, Nov 7, 2002 Version 4/8/02
ADEC Method AK103, Nov 7, 2002 Version 4/8/02
USEPA "SW-846 Test Methods for Evaluating Solid Waste"; Method 8000 & 8000A
ADEC Underground Storage Tank Procedures Manual, Nov 7, 2002
8015C Revision 3, Feb. 2007

21.0. ATTACHMENTS:

Table 1: Quality Control Criteria and Corrective Action Summary
Table 2: Calibration Dilution Summary

Table 1:

Quality Control Criteria and Corrective Action Summary

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Reporting Criteria
Initial Calibration for all analytes	Periodic, prior to sample analysis.	**AK102/103**: %RSD ≤ 25% or $r^2 \ge 0.995$ **8015C**: %RSD ≤ 20% or $r^2 \ge 0.99$	1. Correct source of problem. 2. Recalibrate.	Do not proceed with sample analysis without a passing calibration.
Second Source Initial Calibration Verification (ICV)	Once following initial calibration.	**AK102/103**: All analytes within ± 25% **8015C**: All analytes within ± 20%	1. Correct source of problem. 2. Repeat analysis once. 3. Recalibrate if needed.	Do not proceed with sample analysis without a passing ICV.
Instrument Blank (IB)	Once at the beginning of the day's run.	All analytes below the instrument LOQ **AK102/103**: Surrogates ± 25% **8015C**: Surrogates ± 20%	1. Correct source of problem. 2. Repeat analysis once. 3. Evaluate data 4. Recalibrate if needed.	1. If associated samples >10x IB, or non-detect, post and apply appropriate comment. 2. If associated samples <10x IB, re-analyze with passing IB. 3. If IB has a surrogate(s) that is biased low, and MB surrogates are within criteria, post with comment.
Normal Alkane Standard (NAS)	At the start of a run. **AK102/103:** a minimum of every 24 hours. **8015C:** a minimum of every 12 hours.	Range bars set correctly. Peaks all present. No significant tailing.	1. If ranges have shifted, update method. 2. Significant tailing: perform instrument maintenance.	Do not proceed until method update/instrument maintenance is complete.
Calibration Verification (CCV)	At the start and end of the run. **AK102/103:** after every 20 field samples. **8015C**: after every 10 field samples.	**AK102/103**: DRO/RRO ± 25% recovery **8015C**: DRO/RRO ± 20% recovery	1. Repeat once with new aliquot. 2. Evaluate data. 3. Correct source of problem. 4. Recalibrate if needed.	CCV with high bias: Report ND samples with appropriate comment.
Method Blank (MB)	One MB per extraction batch of 20 field samples.	All analytes below LOQ **For DOD**: < ½ LOQ	If greater than the LOQ, evaluate the data/prep. 1. If problem is instrumental, correct problem and reanalyze QC and samples. 2. If problem is prep, re-extract affected samples.	1. If associated samples >10x MB or ND, post and apply appropriate comment. 2. If associated samples <10x MB, re-extract. *RP of silica gels require original AND silica cleanup be re-extracted.
Laboratory Control Sample (LCS / LCSD)	**AK102/103:** One LCS/LCSD pair per extraction batch of 20 field samples. **8015C:** One LCS per extraction batch of 20 field samples or one LCS/LCSD pair in lieu of an MS/MSD.	Recoveries: **AK102/103 & 8015C:** 75 - 125% for DRO 60 - 120% for RRO RPD ≤ 20 **Silica Gel Cleanups:** 70-125% for DRO/RRO RPD ≤ 20	1. Evaluate the data/prep info. 2. Correct source of problem. 3. Repeat analysis once of both LCS and LCSD.	1. Failing RPD or high recovery: report ND samples 2. Low recovery: Re-extract samples. If re-extraction was performed outside of hold time, report originals and comment on confirmation. *RP of silica gels require original AND silica cleanup be re-extracted.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Reporting Criteria
MS/MSD or BMS/BMSD	**AK102/103:** One set per extraction batch at client request. **8015C:** One set required per extraction batch or an LCSD may be used if sample volume is not sufficient	Recoveries: 75 - 125% DRO (water) 60 - 140% RRO (water) 60 - 140% DRO (soil) 60 - 140% RRO (soil) RPD: ≤ 30% (water) ≤ 50% (soil)	None. *NOTE: MS/MSD Limits are for guidance in data interpretation only.*	Apply appropriate comment in LIMS.
Surrogate Spike: Extraction QC Samples	Every Extraction QC Sample	Recoveries: 60 - 120% 70 - 125% for Silica Gel	1. Evaluate the data/prep info. 2. Correct source of problem. 3. Repeat analysis once. 4. Refer to Reporting Criteria or Consult QA. Re-extract and rerun entire batch if needed.	1. If biased high and sample surrogates pass: Post and apply comment in LIMS to QC sample as well as all affected paying samples. 2. If batch QC surrogates are biased low: re-extract associated samples. 3. If sample was re-extracted outside of hold time, report original data and comment on confirmation. *RP of silica gels require original AND silica cleanup be re-extracted.
Surrogate Spike: Field Samples	Every field sample	Recoveries: 50 - 150%	1. Evaluate the data/prep info. 2. Correct source of problem. 3. Repeat analysis once. 4. If problem is instrumental, correct source of problem and reanalyze sample. 5. Refer to Reporting Criteria for further information. Re-extract and rerun sample if needed.	1. If surrogate recovery is biased high and sample is ND, apply appropriate comment. 2. If surrogate is biased high due to matrix, report and apply appropriate comment. 3. If surrogate is biased low due to dilution, report and apply appropriate comment. 4. If the above criteria are not met, re-extract and rerun the sample. 5. If sample was re-extracted outside of hold time, report original data and comment on confirmation. *RP of silica gels require original AND silica cleanup be re-extracted.

TABLE 2: CALIBRATION DILUTIONS

DRO/RRO/Surrogate Calibration Dilutions

MeCl$_2$ Lot # : XXXX Date: X/XX/XXXX Analyst: XXX

Surrogates	Standard ID:	XXX-XXX-X		Expires:	XXX-XXX-X
SGS Lot #		Stock Added (µL)	MeCl$_2$ (µL)	Conc. (µg/mL)	Final Vol. (mL)
XXX-XXX-X		100*	900	15	1
XXX-XXX-X		250	750	50	1
XXX-XXX-X		500	500	100	1
XXX-XXX-X		750	250	150	1
XXX-XXX-X		500	0	200	0.5
* The concentration of the stock standard is 150 µg/mL.					
DRO	Standard ID:	XXX-XXX-X		Expires:	XXX-XXX-X
SGS Lot #		Stock Added (µL)	MeCl$_2$ (µL)	Conc. (µg/mL)	Final Vol. (mL)
XXX-XXX-X		100**	900	100	1
XXX-XXX-X		60*	940	300	1
XXX-XXX-X		50	950	1000	1
XXX-XXX-X		250	750	5000	1
XXX-XXX-X		500	500	10000	1
XXX-XXX-X		500	0	20000	0.5
* The concentration of stock is 5000 µg/mL. ** The concentration of stock standard is 1000 µg/mL.					
RRO	Standard ID:	XXX-XXX-X		Expires:	XXX-XXX-X
SGS Lot #		Stock Added (µL)	MeCl$_2$ (µL)	Conc. (µg/mL)	Final Vol. (mL)
XXX-XXX-X		250***	750	125	1
XXX-XXX-X		250**	750	250	1
XXX-XXX-X		100*	900	500	1
XXX-XXX-X		50	950	1000	1
XXX-XXX-X		250	750	5000	1
XXX-XXX-X		500	500	10000	1
XXX-XXX-X		500	0	20000	0.5
***The concentration of stock standard is 500 µg/ml **The concentration of stock standard is 1000 µg/mL. *The concentration of stock standard is 5000 µg/mL.					
ICVB	Standard ID:	XXX-XXX-X		Expires:	XXX-XXX-X
		500	0	5000	0.5
ICVR	Standard ID:	XXX-XXX-X		Expires:	XXX-XXX-X
		500	0	5000	0.5

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S.O.P. Title: Extractable Semi-Volatile Compounds by GCMS	**Revision Date**: October 2015
Method No: SW846 8270D and 625	**SOP No**: 721r14
Page: 1 of 19	**Supersedes:** 721r13

Signatures below reflect periodic review of Standard Operating Procedures. If the procedure is found adequate with little or no editing necessary, this page is signed and dated. An Addendum may be issued for minor changes that need to be implemented immediately. If it is determined that major edits are required, a new revision will be released with a new signature page.

Technical Director	Date	Quality Assurance (QA) Manager, QA Staff or their Designee	Date
Stephen C. Ede	10/2/15		10/2/15
Stephen C. Ede	11/23/16		11/23/16

Original cover pages with wet signatures and the digitally signed electronic SOP versions are available in the Quality Assurance Office.

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I have reviewed and understand the method reference(s) and this version of the SOP.
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Signature: ____________________ Printed Name: ____________________ Date: __________

SGS	SGS North America, Inc. - Alaska Division Standard Operating Procedure
NOTE: This document contains CONFIDENTIAL business information and is not intended for distribution.	
S.O.P. Title: Extractable Semi-Volatiles Compounds by GC/MS	**Revision Date**: November 2016
Method No: SW846 8270D and 625	**SOP No**: 721r14#2
Page: 1 of 1	**Supersedes**: 721r14

Signatures below reflect approval for the following changes to the current SOP. These changes will be incorporated into the SOP during the next review. This addendum will be incorporated into the electronic SOP (i.e., PDF file).

Technical Director	Date	Quality Assurance (QA) Manager, QA Staff or their Designee	Date
Stephen C. Ede	11/21/16		11/21/16

I have reviewed and understand the method reference(s) and this version of the SOP.
I agree to use only this currently approved version of the SOP.

Signature: ____________________ Printed Name: ____________________ Date: __________

The above referenced SOP should be modified as follows:

Add to:

10.2.2 The retention time of all analytes is input into a controlled spreadsheet (CS-0004_RRT_8270_Calibration_Check_2016012) to determine if all analytes are within the 0.06 RRT units.

Add to:

10.4 The results of the ICV are input into a controlled spreadsheet (CS-005_8270_ICV_Verification_r20150918) to determine if all analytes are within the ICV criteria.

SGS	SGS North America, Inc. - Alaska Division Standard Operating Procedure
NOTE: This document contains CONFIDENTIAL business information and is not intended for distribution.	
S.O.P. Title: Extractable Semi-Volatiles Compounds by GC/MS	**Revision Date**: December 2015
Method No: SW846 8270D and 625	**SOP No**: 721r14 Add#1
Page: 1 of 1	**Supersedes**: 721r14

Signatures below reflect approval for the following changes to the current SOP. These changes will be incorporated into the SOP during the next review. This addendum will be incorporated into the electronic SOP (i.e., PDF file).

Technical Director	Date	Quality Assurance (QA) Manager, QA Staff or their Designee	Date
Stephen C Ede Stephen C. Ede	12/30/15 11/23/16		1/5/16 ~~1/4/16~~ 11/23/16 1/5/16

I have reviewed and understand the method reference(s) and this version of the SOP.
I agree to use only this currently approved version of the SOP.

Signature: ______________________ Printed Name: ______________________ Date: __________

The above referenced SOP should be modified as follows:

Change Section from:

10.2.1 All compounds have met the recommended minimum response factor for the target analytes, as noted in Table 4. ~~For DOD projects the system performance check compounds (SPCC's) N-nitroso-di-n-proplyamine, hexachlorocyclopentadiene, 2,4-dinitrophenol and 4-nitrophenol must have a minimum RF of 0.05.~~

Change Section to:

10.2.1 All compounds have met the recommended minimum response factor for the target analytes, as noted in Table 4.

Summary of Changes from Previous Revision:

- Add 1-Methylnaphtalene to Target compounds.
- Add 1-Methylnaphtalene to Table 3.
- Add Section 12.4.1 – DOD CCV criteria.
- Update Table 5 – DOD closing CCV criteria.
- Update Table 5 – LCS/LCSD, MS/MSD RPD criteria.
- Update Section 12.2.1 – MS/MSD and 12.2.2 LCS/LCSD RPD criteria.
- Update wording of 12.3.1 – CCV criteria.
- Update Table 4 – 2,4-Dinitrophenol and 4-nitrophenol to RF reference method.
- Remove bullet point from Section 10.2.3.
- Remove Sections 3.8 and 3.9.

Table of Contents

1.0. OBJECTIVE:

This procedure is used to determine the concentration of semi-volatile organic compounds in prepared extracts and is applicable to several types of matrices including soil, water, liquids, and solids.

Internal Standards

1,4-Dichlorobenzene-d4, Naphthalene-d8, Acenaphthene-d10, Phenanthrene-d10, Chrysene-d12, Perylene-d12

Surrogates

Acid Surrogates: 2-Fluorophenol, Phenol-d6, 2,4,6-Tribromophenol
Base/Neutral Surrogates: Nitrobenzene-d5, 2-Fluorobiphenyl, p-Terphenyl-d14

Target Compounds

N-Nitrosodimethylamine	Pyridine	Aniline	Phenol
Bis(2-chloroethyl)ether	2-Chlorophenol	1,3-Dichlorobenzene	1,4-Dichlorobenzene
Benzyl alcohol	1,2-Dichlorobenzene	2-Methylphenol	Bis(2-chloro-isopropyl)ether
3&4-Methylphenol	N-Nitroso-di-n-propylamine	Hexachloroethane	Nitrobenzene
Isophorone	2-Nitrophenol	2,4-Dimethylphenol	Benzoic Acid
Bis(2-chloroethoxy)methane	2,4-Dichlorophenol	1,2,4-Trichlorobenzene	Naphthalene
2,6-Dichlorophenol	4-Chloroaniline	Hexachlorobutadiene	4-Chloro-3-methyl-phenol
1-Methylnaphtalene	2-Methylnaphtalene	Hexachlorocyclopentadiene	2,4,6-Trichlorophenol
2,4,5-Trichlorophenol	2-Chloronaphthalene	1-Chloronaphthalene	2-Nitroaniline
Dimethylphthalate	2,6-Dinitrotoluene	Acenaphthylene	3-Nitroaniline
Acenaphthene	2,4-Dinitrophenol	4-Nitrophenol	2,4-Dinitrotoluene
Dibenzofuran	Diethylphthalate	Fluorene	4-Chlorophenylphenylether
4-Nitroaniline	4,6-Dinitro-2-methylphenol	N-Nitrosodiphenylamine	Azobenzene 4-
Bromophenylphenyl-ether	Hexachlorobenzene	Pentachlorophenol	Phenanthrene Anthracene
Di-n-Butylphthalate	Fluoranthene	Pyrene	Butylbenzylphthalate
3,3'-Dichlorobenzidine	Benzo(a)anthracene	Chrysene	Bis(2-ethylhexyl)-phthalate
Di-n-octylphthalate	Benzo[b]fluoranthene	Benzo[k]fluoranthene	Benzo[a]pyrene
Indeno(1,2,3-c,d)pyrene	Dibenzo[a,h]anthracene	Benzo[g,h,i]perylene	

Custom Compounds

Carbazole

2.0. SCOPE AND APPLICATION:

A measured weight or volume of sample (approximately 22.5 grams or 1 liter) is extracted with methylene chloride using method 3520C, 3550C or 3580A. The extracts are concentrated to a volume of 1 mL and analyzed by GCMS. Qualitative identification of the analytes is achieved using the relative abundance of their characteristic fragmentation patterns (m/z). Quantitative analysis is performed using the internal standard technique with a single quantitation ion.

3.0. DEVIATIONS FROM REFERENCE METHOD:

3.1. Method 8270D indicates that matrix spike/matrix spike duplicate (MS/MSD) are part of the minimum batch method QC. SGS performs this QC set only if sufficient sample volume is received; otherwise, an LCS/LCSD is performed.

3.2. Method 8270D states that the relative retention times of each analyte in each calibration standard should agree within 0.06 RRT units. SGS requires each calibration standard to agree within 0.06 RRT units from the mid point of the calibration.

3.3. The ICV recovery goal will be ± 20 %, as per DOD QSM. Recoveries greater than ± 20 %, but less than ± 30% will be allowed for non-DOD samples.

3.4. Internal standard areas are monitored only from the mid point of the most recent calibration.

3.5. The surrogates and internal standards used do not appear in Table 8 of method 625.

3.6. The tune criteria is not the same as Table 9 in method 625, but is taken from Table 3 in method 8270D.

3.7. Tailing criteria is taken from method 8270D, not method 625.

3.8. Abundance of characteristic ions is taken from method 8270D, not method 625.

4.0. RESPONSIBILITIES:

4.1 The QA Office maintains a master list of this SOP to ensure review on a timely basis. This system serves as an accounting of SOP distribution and ensures that distributed SOPs are current and complete. This includes destruction of controlled copies of expired and retired SOPs. The QA Office also maintains a historical file of original cover pages with wet signatures and digitally signed electronic versions of this SOP; including the current revision and any versions archived within the past 5 years.

4.2 The electronic (Word Document) versions of this SOP, both current and any prior versions, are maintained on the computer network in a secure location as a “read only” file.

4.3 It is the responsibility of all personnel to follow this SOP as written, document and gain QA or Technical Director approval for deviations to the SOP, and submit needed SOP revisions to the QA Office.

4.4 This SOP is scheduled for review on an annual basis. Any required revisions will be incorporated into the SOP. The new revision of the SOP will be distributed by QA and the superseded version returned to the QA Office. If no revisions are required, the SOP cover page is signed and dated to document the review, and the updated cover page will be distributed.

4.5 A PDF version of each SOP (generated in Adobe or scanned) is digitally signed by a member of the QA Office as a security measure. The digitally signed PDF, used online, is considered to be a controlled copy of the SOP and is stored on the network.

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All staff have “read” access to these SOPs. Only QAQC has access to “write” on SOPs. Staff is directed to use the controlled electronic versions of SOPs.

5.0. INTERFERENCES:

5.1. Solvents, reagents, glassware and other samples processing hardware may yield discrete artifacts that affect the quantitation of samples. All materials involved in the analysis of the samples must be demonstrated to be free from interferences under the conditions of the analysis by running method and instrument blanks.

5.2. Interferences by phthalate esters may pose a problem with analysis. Minimizing contact with any type of plastic material will help avoid this problem.

5.3. Matrix interference may be caused by co-extraction of contaminants from the sample. The interference varies depending on matrix and source of the environment being sampled.

5.4. Samples with high concentrations of acids or glycols may cause damage to the column, which may lead to reduced responses for some analytes. Clipping the column and/or recalibration may be necessary after such samples.

6.0. SAMPLE HANDLING:

6.1 This procedure is applicable to several types of matrices including soil, water, liquids, solids, and oils.

6.2 The samples should be collected in accordance with the project QAP.

6.3 The usual requested sample size is two 1-liter amber jars for water samples and one 4-ounce amber jar for soil samples.

6.4 After collection, the samples must be protected from light and stored at 0-6°C until extraction.

6.5 The holding time for water samples is seven days from collection. The holding time for soils is 14 days from collection. The extraction must occur within the listed hold time. The hold time for the sample extract is 40 days after extraction.

6.6 Criteria for Acceptance/Rejection of Samples – In addition to the above criteria, samples are compromised if they have been preserved with acid.

7.0. APPARATUS:

7.1. A Hewlett Packard 5890 series II (or equivalent) gas chromatograph with a split/splitless injector and a 5971/5973 mass selective detector with ionization energy of 70 ev and capable of scanning 35 to 500 amu every second or less.

7.2. A Restek Rxi-5Sil MS (Restek, P/N 12738-124 or equivalent) 30 m x 0.25 mm x 0.5 um or 20 m x 0.18 mm x 0.36 um column is used in the analysis of the extracts.

7.3. Syringes: 5 µL Autosampler (Hamilton part # 87990, or equivalent). Micro syringes: 5 µL, 10 µL, 25 µL, 100 µL, 2.5 mL, 5.0 mL (Supelco, Hamilton 1000 series (or equivalent), gas tight, high performance).

7.4. Glassware: 5.0 mL, 10.0 mL, 25.0 mL, 50.0 mL, 100.0 mL glass volumetric, class A (Kimax, or equivalent).

7.5. Autosampler vials: 2.0-mL amber crimp vial (HP part # 5181-3376, or equivalent), with autosampler crimp caps (Kimble part #73825-11, or equivalent).

8.0. REAGENTS:

8.1 Refer to SOP 112 (Standards Labeling and Traceability) for guidance on standard and reagent labeling.

8.2 Methylene Chloride ($MeCl_2$), GC grade (EM Science), or equivalent.

8.3 Stock standards are prepared by diluting purchased standard solutions in methylene chloride. Stock standards are stored at ≤ -10°C. All standards are disposed of as chlorinated waste.

8.4 Initial Calibration Standards: Allow stock standards to come to room temperature. Sonicate any that appear to have precipitated. A minimum of five calibration levels for each analyte is needed. Using volumetric syringes mix appropriate volumes to yield the working calibration standards. See Table 1 for dilution instructions and part numbers. Internal standard must be added to every standard and sample.

8.5 Continuous Calibration Verification (CCV): The CCV standard is made at 50 µg/mL (per Table 1). Compounds with higher LOQs are present at a greater concentration than 50 µg/mL. The calibration verification is made from the same source as the initial calibration. The calibration verification must be checked frequently for signs of evaporation or degradation. The calibration verification must be stored in the freezer when not in use. The calibration verification standard is made frequently to limit the effects of evaporation and degradation.

8.6 Surrogate Standard: The surrogate standard is a mixture of three acid surrogates and three base surrogates. The surrogate working standard is diluted from a certified stock to yield 200 µg/mL for the acid surrogates and 100 µg/mL for the base surrogates in the final extract. The certified surrogate stock standard is diluted for addition to the working calibration standards. Prep working surrogate: **Dilute 10 mL of Restek #33028 and 10 mL of Restek # 33029 to 500 mL with methylene chloride.**

8.7 Laboratory Control Standard (LCS): The laboratory control standard is a mixture of all reported compounds. The working LCS is diluted from certified stocks. The LCS is made from a different source than the initial calibration standard. The working LCS is made to yield a concentration of 100 µg/mL for most compounds in an extracted sample. Compounds with higher LOQs are present at a greater concentration than 100 µg/mL. The working LCS is also used for spiking client samples. See Table 3 for part numbers and prep instructions.

8.8 Initial Calibration Verification (ICV): The working laboratory control standard is also run directly for the initial calibration verification. The extracted laboratory control sample is not used as the initial calibration verification.

8.9 Tuning Standard: The working tuning standard is diluted from a certified stock. The tuning standard includes Pentachlorophenol, DFTPP, benzidine, and 4,4'-DDT. The working tuning standard has a concentration of 50 µg/mL for all compounds. Tune standard – Ultra GCM-150 1000 ng/µL of Pentachlorophenol, DFTPP, Benzidine, and 4-4'-DDT. 50 µL is added to 950 µL of methylene chloride to yield a 50 ng/µL working solution.

8.10 Internal Standard: The working internal standard solution is purchased from Ultra scientific (US 108). 10 µl of internal standard is added to all samples and standards. If the response for any quantitation ion exceeds the initial calibration range of the GC/MS system, the sample extract must be diluted and reanalyzed. Additional internal standard solution must be added to the diluted extract to maintain the same concentration as in the calibration standards. Internal Standard: Ultra US-108 4000 ug/ml.

9.0. EXTRACTION:

See Appropriate Preparation SOP

10.0. CALIBRATION:

10.1 A tune evaluation is run to begin the analytical shift. The peaks in the tune evaluation should show minimal tailing. The tailing factor for Benzidine and for Pentachlorophenol must be ≤ 2, DDT must not show breakdown over 20% (see formulas below for determining DDT breakdown). DFTPP must meet the tune criteria in Table 2. Use the autofind tune macro (average of apex, apex+1, and apex-1 and minus a background scan not within the DFTPP peak). If the autofind macro does not locate the correct peak or if the autofind is not using the appropriate scans (due to peak shape), the analyst will use a single scan located within one scan number of the apex, and background subtraction is included only to eliminate column bleed or instrument background ions. Alternatively, using the average of the scans for the peak with appropriate background subtraction is allowed. Identical mass spectrometer settings that were used to analyze the DFTPP tune criteria are used for all subsequent injections; see section 13.2.5 for equation.

10.2 Calibration is established using the internal standard technique. The area of the characteristic ion for each compound is tabulated vs. the concentration for each standard. A calibration curve is constructed from the response factors, using the calibration standards outlined in Table 1. The calibration is considered acceptable if the following criteria are met:

10.2.1 All compounds have met the recommended minimum response factor for the target analytes, as noted in Table 4. For DOD projects the system performance check compounds (SPCC's) N-nitroso-di-n-proplyamine, hexachlorocyclopentadiene, 2,4-dinitrophenol, and 4-nitrophenol must have a minimum RF of 0.05.

10.2.2 Relative retention times for all analytes must agree within 0.06 RRT units from the mid point of the calibration curve or updated for the ongoing continuing calibration. RRT=Analyte RT (minutes)/Internal Standard RT(minutes).

10.2.3 Linearity of Target Analytes: If the RSD of any target analyte is 15% or less, then the relative response factor is assumed to be constant over the calibration range and linearity through the origin can be assumed. The average response factor may then be used for quantitation. The average RF should not be used for compounds that have a RSD greater than 15% unless the concentration is reported as estimated. **If the RSD of any target analyte is greater than 15% than one of the following options will be used:**

- Linear (first order) least squares regression. This option requires a minimum r^2 value of 0.99 (or r value of 0.995). The linearity through the origin is assumed not forced through the origin.

- Non-linear (2nd or 3rd order) least squares regression. This option requires a minimum r^2 value of 0.99 (or r value of 0.995). Analyst employs a regression equation that does not pass through the origin.

10.2.4 The use of equal weighted least squares regression may be used. The deciding factor in the use of these techniques will be the residuals for the calibration points (which fit best matches the points). The residual is the difference between the known concentration of the calibration point and the calculated value based on the calibration curve. The analyst should strive to reduce the residual error at each point in the calibration to less than 20%.

10.3 Analyte retention times and qualifier ion responses are updated with every calibration using the 50 mg/L standard. The reference spectra will be updated as needed.

11.0. ANALYSIS:

11.1. **Analyte identification:** The qualitative identification of compounds in a sample is based on retention time and comparison of mass spectrum with characteristic ions in a reference spectrum after background subtraction. The reference spectrum must be generated using the same conditions as the calibration. The characteristic ions from the reference mass spectrum are defined as the three ions of greatest intensity, or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum.

11.1.1. All extracts and standards are allowed to come to room temperature. The autosampler is set to inject a 1 µl aliquot onto the chromatographic column.

11.1.2. Positive identification of target compounds is confirmed when the following criteria are met:

- The compound component should elute within 0.06 RRT units of the retention time of the authentic compound (or alkyl homologue) grouping determined by the midpoint of the initial calibration or the current continuing calibration verification.

- The relative intensities of the characteristic ions should agree within 30% from the reference spectrum. Analyst judgment should be used when interferences are observed.

11.1.3. Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. The identification criteria may be met, but each compound spectrum will contain extraneous ions. Appropriate selection of compound spectra and background spectra is important.

11.1.4. For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The most recent versions of the NIST library should be available. See SOP 500 for guidance.

11.1.5. The software will not always correctly identify or properly integrate the analyte peaks. When this occurs manual integration will be necessary to accurately identify and quantitate target analytes. See SOP 144 for manual integration guidance.

11.2. Quantitation:

11.2.1. Once a target compound has been identified, the quantitation of a compound is based on the integrated abundance from the extracted ion profile (EIP) of the primary characteristic ion.

11.2.2. Internal standards are used for quantitation and generally the ISs are assigned as indicated in Method 8270D. Exceptions may occur depending on the chromatography of specific columns and/or instruments. IS assignments are generally based on retention time proximity (0.80-1.20). Exceptions to this rule must be obtained from the Technical Director.

11.2.3. If the response of the quantitation ion exceeds the calibration range, the sample extract must be diluted and reanalyzed. All dilutions should keep the response of the major constituents (previously saturated peaks) in the upper half of the linear range of the curve. Internal standards must be added so that the concentration of the IS in the dilution matches that of the undiluted samples and calibration standards.

11.2.4. If there is interference with the primary quantitation ion of the internal standard, a secondary ion can be used for quantitation.

12.0. QUALITY CONTROL:

12.1 Accuracy Measurements:

12.1.1 A laboratory control sample is analyzed with every soil and water extraction batch consisting of up to 20 samples to demonstrate that the extraction procedure is in control for the specific matrix type. Performance based limits are used to determine LCS acceptance criteria. Any LCS failure may be re-analyzed once to confirm the failure. If the failure is confirmed and the bias is high, any samples below LOQ for the affected analytes can be reported. If the failing analytes are detected above the LOQ, or if the failing analytes are biased low, the batch must be re-extracted.

12.1.2 A matrix spike and matrix spike duplicate are analyzed with every extraction batch assuming sufficient sample volume is available for generating a spike and spike duplicate set. Performance based limits are used to generate matrix spike recovery criteria. If the MS/MSD is biased high or low and the LCS meets QC criteria note in LIMS.

12.1.3 The continuous calibration verification standard (CCV) is analyzed at the beginning of each 12 hour analytical shift after the tune verification. The CCV is analyzed near the mid-point of the calibration curve (typically 50 mg/L). The CCV is considered acceptable if the recoveries are within ± 20% and the minimum response factors for each compound are met. If the CCV is outside of criteria check the system, correct the source of any problems and re-analyze the CCV. If the failure persists, any analytes that are biased high in the CCV but not detected above the LOQ in the samples may be reported. If the analytes are detected above the LOQ, or if the CCV bias is low, the affected samples must be re-analyzed with a valid CCV.

12.1.4 For DOD samples – The continuous calibration verification standard (CCV) is analyzed at the beginning of each 12 hour analytical shift after the tune verification. The CCV is analyzed near the mid-point of the calibration curve (typically 50 mg/L). The CCV is considered acceptable if the recoveries are within ± 20% and the minimum response factors for each compound are met. If the CCV is outside of criteria, check the system, the analyst may immediately (within 1 hour and before any additional samples have been acquired) reanalyze 2 successive CCV's. If both are within QC criteria for all analytes then the samples that have already acquired may be reported and the sequence may continue. A closing CCV is required at the end of the analytical sequence and must meet ± 50% recovery criteria for the analytes of interest. If any analytes are biased high in the closing CCV but are not detected above the LOQ in the samples they may be reported. If the analytes are detected above the LOQ, or the CCV is biased low, the affected samples must be re-analyzed with valid bracketing CCV's.

12.2 Precision Measurements:

12.2.1 Matrix Spike/Matrix Spike Duplicate (MS/MSD) – Spike two sample aliquots with the primary solution. The analytes should be within the LCS lab generated control limits for each analyte and the relative percent difference (RPD) criteria is 20%. MS recoveries are not used to control the acceptability of a batch. A footnote is to be generated discussing any outliers. If there is insufficient sample volume to perform a MS/MSD then a LCSD must be analyzed as part of the extraction batch.

12.2.2 RPD criteria for the LCS/LCSD is 20%. If the RPD fails QC criteria and the affected analytes are not detected above the LOQ then the analytes may be reported. If the analytes are detected above the LOQ, then the affected samples must be re-extracted.

12.3 Calibration Quality Control: Once the criteria for calibration of this SOP have been met, the following quality control must be met.

12.3.1 The initial calibration verification (ICV) must be analyzed after the successful calibration and before sample analysis. The initial calibration verification is considered acceptable if the recoveries are within ± 20%, 30% is allowed for non-DOD samples.

12.4 Blank Criteria:

12.4.1 A method blank is analyzed with every soil and water extraction batch consisting of 20 samples or less to demonstrate that the extraction procedure is free of contamination and interferences. The method blank is carried through all stages of preparation and analysis. No analytes may be detected above the LOQ (1/2 LOQ for DOD). If the MB is outside of QC criteria, re-analyze the sample to confirm. Samples with the affected analytes less than the LOQ, or greater than ten times the blank contamination, may be reported (see SOP #102). Other samples must be re-extracted.

12.4.2 An instrument blank is analyzed during each analytical shift to demonstrate that the analytical system is free from interferences or contamination. The instrument blank is made from methylene chloride fortified with the internal standards and surrogates. All target analytes in the instrument blank must be below the LOQ. The instrument blank can be run at any time during the analytical shift, especially after high concentration samples. If the IB is outside of QC criteria re-analyze the sample to confirm. Samples with the affected analytes less than the LOQ or greater than ten times the blank contamination may be reported. Other samples must be re-extracted.

12.5 Tune Criteria: The tune criteria in section 10.1 must be met prior to every analytical run and every twelve hours.

12.6 Internal Standard (IS) Criteria: Internal standard responses must be within 50-200% of the mid point of the most recent calibration. If the IS responses are outside of QC criteria, check the chromatography for any indication that a matrix component may be affecting the IS responses. Re-analysis of the sample is required. If review of the chromatogram indicates an obvious matrix effect, the re-analysis should be performed at a dilution. If the IS responses are non-compliant in the re-analysis, further dilutions must be made. If the IS responses are compliant in the re-analysis, report the data from the re-analysis. No analytes may be reported with failing internal standard responses.

12.7 Any corrective action(s) needed to address a QC outlier or other technical challenges that are not listed in this SOP require the prior approval of the QA Office or Technical Department.

12.8 Spike and surrogate standards for sample prep will be tested prior to use by the analyst. The recoveries must meet the second source calibration verification criteria ± 20% for the LCS solution, and ± 20% for the surrogate solution.

13.0. CALCULATIONS, REVIEW AND REPORTING:

13.1 Units:

Soil: mg/Kg

Water: mg/L
Oil: mg/Kg
TCLP: mg/L

13.2 Equations:

13.2.1 Response factor:

$$RF = \frac{As \times Cis}{Ais \times Cs}$$

Where As = area of the standard and Ais = area of the internal standard.
Where Cs = concentration of the standard and Cis = concentration of the internal standard

13.2.2 Relative Standard Deviation:

$$RSD = \frac{SD}{Ave.} \times 100$$

Where SD = standard deviation and ave = average.

13.2.3 Linear regression equation derived for the internal standard technique:

$$\frac{AsCis}{Ais} = aCs + b$$

Where As = area of the standard and Ais = area of the internal standard.
Where Cs = concentration of the standard and Cis = concentration of the internal standard.
Where a = slope of the line and b = y intercept.

13.2.4 Peak Tailing Factors:

Peak Tailing Factor = BC/AB
10% Peak Height = BD
Peak Height = DE
Peak Width at 10% Peak Height = AC

13.2.5 DDT Breakdown:

$$\text{DDT Breakdown} = \frac{\text{Total DDT degradation peak area (DDD + DDE)}}{\text{Total degradation peak area (DDD+DDE+DDT)}} \times 100$$

13.2.6 Relative Retention Times:

$$RRT = \frac{\text{Retention time of analyte}}{\text{Retention time of IS}}$$

13.3 Review/Peer Review Steps: Peer review will be done in accordance with SOP 101.

13.4 Data Qualifiers/Flags: Data will be appropriately flagged in accordance to SOP 136.

13.5 Archive Policy (hardcopy and electronic): Data will be archived in accordance with SOP 125.

14.0. HEALTH AND SAFETY:

14.1. Samples shall be returned to the approved storage location until such time as it is determined that no further analysis will be required.

14.2. Once it has been established that no more analysis of a sample will be required, acid and alkaline preserved samples may be neutralized using the Elementary Neutralization Hood located in GC Prep, unless it is considered to be hazardous (i.e. mercury waste, cyanide waste). Refer to the current version of SOP 108 for further instruction.

14.3. All surplus reagent acids shall be neutralized on a daily basis using the Elementary Neutralization Hood located in GC Prep.

14.4. Small volumes of surplus volatile reagents may be allowed to evaporate in a hood at the end of the analytical session.

14.5. Proper Personal Protective Equipment (PPE) must be worn at all times. Proper PPE when handling samples include a lab coat, gloves and safety glasses. In addition, when handling any samples or solutions with any acid or base preservative a face shield and apron must be worn.

14.6. Many of the solvents and target analytes used in this procedure are known or suspected carcinogens. The analyst must take the responsibility to know the potential risks and use adequate protection. All extracts and standards should be diluted in the fume hood. The use of a personal respirator mask is suggested when work must be done outside of a fume hood. Frequent washing of hands is also recommended.

15.0. POLLUTION PREVENTION:

15.1 SGS is committed to evaluate all areas of the lab with regard to current and potential pollution prevention. Pollution prevention is described as any technique that reduces or eliminates waste at the point of generation. Further discussion on pollution prevention programs in the laboratory can be found in *SGS Pollution Prevention Plan* (Form F053).

15.2 Pollution prevention techniques utilized in this method are the consolidation of all sample extracts, standards, and waste material as chlorinated waste, which is disposed of by trained personnel in accordance with SOP 108.

16.0. METHOD PERFORMANCE:

There are no method performance measures to report at this time.

17.0. DETECTION LIMIT (DL) STUDY:

17.1 DL studies are performed when a significant change in instrument response is observed or when a new instrument is purchased for analysis. The DL is intended to demonstrate the capability of this method as it is implemented at SGS. An update to the DL does not necessitate an update to this document. Further guidance on performing a DL study can be found in SOP 116.

17.2 The suggested DL spiking levels are: 5 µg/L, 10 µg/L, and 50 µg/L for waters and 0.222 mg/Kg and 0.444 mg/Kg for soils. **Note - The DL for samples is highly dependent on sample matrix. Matrix effects can cause the DL to be elevated.**

18.0. LIMIT OF DETECTION (LOD):

18.1 The LOD is defined per SOP 116; LOD verification shall be performed quarterly according to the schedule set by the QA Office.

19.0. LIMIT OF QUANITATION (LOQ):

19.1 The LOQ is defined per SOP 116; LOQ verification shall be performed quarterly according to the schedule set by the QA Office.

19.2 Suggested spiking guidance for quarterly LOQ verification is as follows:

Analysis	Matrix	LOQ Spike Amount
8270	soil	50uL
		150uL
		250uL
		500uL
8270	water	100uL
		200uL
		300uL
		500uL

20.0. REFERENCES:

SW846 rev. 5 July 2014 8270D
EPA 625
DOD QSM (current version)

21.0. ATTACHMENTS:

Table 1: Standards Preparation
Table 2: Tune Criteria
Table 3: Laboratory Control Sample part numbers and dilution instructions
Table 4: Minimum response factor criteria
Table 5: Corrective Action Table

TABLE 1 - 8270 Calibration Standards

	INDV. STD VOL*	TOTAL STD VOL	INT STD VOL	MECL2 VOL	FINAL VOL	FINAL CONC
SGS lot #	µL	µL	µL	µL		
STD 1	5	20	10	970	1 mL	5 ng/µL
STD 2	10	40	10	950	1 mL	10 ng/µL
STD 3	20	80	10	910	1 mL	20 ng/µL
STD 4	50	200	10	790	1 mL	50 ng/µL
STD 5	80	320	10	670	1 mL	80 ng/µL
STD 6	100	400	10	590	1 mL	100 ng/µL
STD 7	160	640	10	350	1 mL	160 ng/µL
STD 8 IB**	50	50	10	940	1 mL	0 ng/µL

*STANDARDS USED= 8270-2, 8270-3, 8270-4, 8270-5

**STANDARD USED= 8270-1

8270-1	Amount	Final Conc.	8270-2	Amount	Final Conc.
Acid Surrogates	400 µL	4000	SVW14-2-9	500 µL	
Base Neutral Surrogates	400 µL	2000	3,3'-Dichlorobenzidine	500 µL	1000
Mecl2	200 µL			1 mL	
	1 mL				
8270-3			8270-4		
MegaMix	500/1000		Benzoic Acid	2000	
8270-5					
Custom standard	1000/2000				

Acid Surrogates = Restek #33029 10000 µg/mL
Base/Neutral Surrogates = Restek #3308 5000 µg/mL
MegaMix = Restek #31850 500/1000 µg/mL
Internal Standard = Ultra Scientific #US-108N 4000 µg/mL

3,3-Dichlorobenzidine = Restek #31835 2000 µg/mL
Benzoic Acid = Restek #31879 2000 µg/mL
Custom STD = Restek #565054 1000/2000 µg/mL

TABLE 2 - Tune Criteria

Mass	Ion Abundance Criteria
51	10% to 80% of mass 198
68	< 2% of mass 69
70	< 2% of mass 69
127	10% to 80% of mass 198
197	< 2% of mass of 198
198	Base peak, or>50% of Mass 442
199	5% to 9% of mass 198
275	10% to 60% of mass 198
365	> 1% of mass 198
441	Present but less than 24% of mass 442
442	> 50% of mass 198
443	15% to 24% of mass 442

TABLE 3 - Laboratory Control Sample part numbers and dilution instructions

Supplier : NSI Environmental Solutions (Protocol for CTE-8A).

Part #	Description	Concentration
C-385HP	PNA Mix	2000 ug/ml
C-395P	Acid Extractables	2000 ug/ml
C-404P	Base/Neutrals 1	2000 ug/ml
C-405P	Base/Neutrals 2	2000 ug/ml
C-403P	Base Extractables	2000 ug/ml
C-402P	Benzidines Mix	2000 ug/ml
0541P	Benzoic Acid	5000 ug/ml
0271	Pyridine	5000 ug/ml
CTE-9A	Custom Mix	1000/2000 ug/ml
1288-1-11	1-Methylnaphthalene	5000 ug/ml

Supplier: Absolute Standards

8270 LCS: In a 50 mL class A volumetric flask combine the following and dilute to the mark with methylene chloride:

2.0 mL of CTE-9A
1.0 mL of Benzoic Acid, 1.0 mL of Pyridine
2.5 mL of PNA mix, 2.5 mL Acid Extractables, 2.5 mL Base/Neutrals 1, 2.5 mL Base/Neutrals 2
2.5 mL of Base extractables, 2.5 mL of Benzidines.
1.0 mL of 1-Methylnaphthalene

TABLE 4

RECOMMENDED MINIMUM RESPONSE FACTOR CRITERIA FOR INITIAL AND CONTINUING CALIBRATION VERIFICATION USING THE SUGGESTED IONS

Semivolatile Compounds	Minimum Response Factor (RF)
Benzaldehyde	0.010
Phenol	0.800
Bis(2-chloroethyl)ether	0.700
2-Chlorophenol	0.800
2-Methylphenol	0.700
2,2'-Oxybis-(1-chloropropane)	0.010
Acetophenone	0.010
4-Methylphenol	0.600
N-Nitroso-di-n-propylamine	0.500
Hexachloroethane	0.300
Nitrobenzene	0.200
Isophorone	0.400
2-Nitrophenol	0.100
2,4-Dimethylphenol	0.200
Bis(2-chloroethoxy)methane	0.300
2,4-Dichlorophenol	0.200
Naphthalene	0.700
4-Chloroaniline	0.010
Hexachlorobutadiene	0.010
Caprolactam	0.010
4-Chloro-3-methylphenol	0.200
2-Methylnaphthalene	0.400
Hexachlorocyclopentadiene	0.050
2,4,6-Trichlorophenol	0.200
2,4,5-Trichlorophenol	0.200
1,1'-Biphenyl	0.010
2-Chloronaphthalene	0.800
2-Nitroaniline	0.010
Dimethyl phthalate	0.010
2,6-Dinitrotoluene	0.200
Acenaphthylene	0.900
3-Nitroaniline	0.010
Acenaphthene	0.900
2,4-Dinitrophenol	0.010
4-Nitrophenol	0.010
Dibenzofuran	0.800
2,4-Dinitrotoluene	0.200
Diethyl phthalate	0.010
1,2,4,5-Tetrachlorobenzene	0.010
4-Chlorophenyl-phenyl ether	0.400

TABLE 4: (continued)

Semivolatile Compounds	Minimum Response Factor (RF)
Fluorene	0.900
4-Nitroaniline	0.010
4,6-Dinitro-2-methylphenol	0.010
4-Bromophenyl-phenyl ether	0.100
N-Nitrosodiphenylamine	0.010
Hexachlorobenzene	0.100
Atrazine	0.010
Pentachlorophenol	0.050
Phenanthrene	0.700
Anthracene	0.700
Carbazole	0.010
Di-n-butyl phthalate	0.010
Fluoranthene	0.600
Pyrene	0.600
Butyl benzyl phthalate	0.010
3,3'-Dichlorobenzidine	0.010
Benzo(a)anthracene	0.800
Chrysene	0.700
Bis-(2-ethylhexyl)phthalate	0.010
Di-n-octyl phthalate	0.010
Benzo(b)fluoranthene	0.700
Benzo(k)fluoranthene	0.700
Benzo(a)pyrene	0.700
Indeno(1,2,3-cd)pyrene	0.500
Dibenz(a,h)anthracene	0.400
Benzo(g,h,i)perylene	0.500
2,3,4,6-Tetrachlorophenol	0.010

TABLE 5: CORRECTIVE ACTION TABLE

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Initial Calibration for all analytes	Periodic	See Table 4 minimum response factor criteria for analytes and SPCCs % RSD Analytes ≤ 15% or $r^2 \geq 0.99$ or $r \geq 0.995$	1. Correct source of problem. 2. Repeat analysis. 3. Recalibrate if needed.
Second Source Cal. Verification. (ICV)	Once per initial calibration	All analytes within ± 20% ± 30% allowed for non-DOD projects	1. Correct source of problem. 2. Repeat analysis once. 3. Recalibrate if needed.
Continuous Calibration Verification (CCV) **DOD**	Before sample analysis, Immediately after tuner Every 12 hours **Closing CCV**	Table 4 minimum response factor criteria and all analytes ± 20% recovery **±50% recovery**	1. Evaluate the data. 2. Correct source of problem. 3. Repeat analysis if needed. 4. Recalibrate if needed 5. **DOD** – Re-analyze 2 successive CCV's
Method Blank (MB)	One MB per extraction batch	Analytes < LOQ **For DOD: < ½ LOQ**	1. Evaluate the data/prep info. 2. See section 12.4.1
LCS/LCSD	One LCS per extraction batch; If insufficient volume for MS/MSD, then run LCSD	Performance-based limits RPD: 20%	Repeat analysis. If recoveries or RPD is biased high and samples are non-detect, note in LIMS. If analytes are detected or recoveries are biased low, re-extract the prep batch if possible.
MS/MSD	One MS/MSD per 20 client samples; LCSD if insufficient volume	Performance-based limits RPD: 20%	I If MS/MSD is biased high or low and LCS meets QC criteria note in LIMS. If RPD is outside of criteria, note that the results in the parent sample are estimated for any effected analytes.
Surrogate Spike	Every Sample	Performance-based limits	If surrogates are biased high and sample is non-detect note in LIMS. If surrogates are biased low, re-extract. If sample has been analyzed at a dilution and surrogates are biased note in LIMS.
Tune Standard	Prior to Initial Calibration and Calibration Verification Every 12 hours	See Table 2	1. Retune 2. recalibrate if needed 3. Re-analyze samples after 4. failing tune
Internal Standard	Every sample post extraction	See section 12.6	Evaluate the data. Correct source of problem. Dilute samples if needed
Instrument Blank (IB)	Every 12 hours	Analytes < LOQ	See section 12.4.2
Demonstration of Capability	Once per analyst initially And repeated annually	Performance-based limits	Repeat analysis or re-extract if needed.

SGS	SGS North America, Inc. - Alaska Division Standard Operating Procedure
NOTE: This document contains CONFIDENTIAL business information and is not intended for distribution.	
S.O.P. Title: **Continuous Liquid-Liquid Extraction for Semi-Volatile Compounds**	**Revision Date:** October 2017
Method No: SW846 3520C	**SOP No:** 759r17
Page: 1 of 17	**Supersedes:** 759r16

Signatures below reflect periodic review of Standard Operating Procedures. If the procedure is found adequate with little or no editing necessary, this page is signed and dated. An Addendum may be issued for minor changes that need to be implemented immediately. If it is determined that major edits are required, a new revision will be released with a new signature page.

Technical Director	Date	Quality Assurance (QA) Manager, QA Staff or their Designee	Date
Stephen C. Ede	10/6/17		10/6/17

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I have reviewed and understand the method reference(s) and this version of the SOP.
I agree to use only this currently approved version of the SOP.

Signature: ______________________ Printed Name: ______________________ Date: __________

Summary of Changes from Previous Revision:

- Addendum 1, 2, and 3 have been incorporated into this revision
- Multiple changes have been made in this revision. The SOP should be reread in its entirety.

Table of Contents

1.0. OBJECTIVE:

This method is used to isolate organic compounds from aqueous samples. This method is applicable to the isolation and concentration of water soluble and slightly soluble organics in preparation for a variety of chromatographic procedures.

2.0. SCOPE AND APPLICATION:

This SOP is suitable for subsequent analysis with method SW8270D, EPA625, PAH by 8270D-SIMS, 8270D Pest SIMS, 1625B Sulfolane Isotopic Dilution, Thiolane, 8015C, AK102/103, and, 8082A. A measured volume of sample, usually 1 liter, is placed into continuous liquid/liquid extractor, adjusted to a specific pH (see extraction summary page), and extracted with organic solvent that has a greater density then the sample, for 4-6 hours. The extracts are then concentrated and analyzed with gas chromatography or gas chromatography/mass spectroscopy.

3.0. DEVIATIONS FROM REFERENCE METHOD:

3.1. The continuous liquid to liquid extraction run time is at least 4 hrs and a maximum of 6 hrs. DRO/RRO spike compounds degrade after 4 hours. The reference method states that the extraction system may run for 18-24 hours. Method based performance (e.g. LCS recoveries, PT studies) supports the efficiency of SGS procedure.

3.2. 8270D samples are extracted 2.5 hours at pH <2 and then for at least 1.5 hours at pH>11, for a combined time of 4 hours. Extraction should go no longer than 6 hours. Method 3520C specifies an extraction period of 18-24 hours at pH of <2 and at the second pH level of >11 an additional 18-24 hours extraction is required. Method based performance (e.g. LCS recoveries, PT samples) supports the efficiency of SGS procedure.

3.3. The continuous liquid to liquid extraction currently uses 250mL of methylene chloride to each extractor body. Method 3520C states to add 300-500mL of methylene chloride to each extractor body. Industry standards and best practices use smaller amounts to reduce chlorinated solvent waste.

3.4. The drying column used has a salt ball chamber with fritted glass disc, which is baked at 400°C for a minimum of 4 hours. The reference method uses a drying column with Pyrex® glass wool at the bottom and a PTFE stopcock.

3.5. The continuous liquid to liquid extraction apparatus, all related glassware, and the technique were custom made for the extraction process.

3.6. The concentration apparatus used is XcelVap by Horizon Technology using compressed nitrogen gas. The reference method lists the use of a Kuderna-Danish (K-D) apparatus for sample concentration using a heated water bath with concentric ring covers.

3.7. DRO/RRO samples, for both AK102/103 and 8015C, are collected in HCl-preserved bottles; therefore, associated extraction QC are adjusted to pH <2 with 4.0 mL of HCl.

4.0. RESPONSIBILITIES:

4.1 The QA Office maintains a master list of this SOP to ensure review on a timely basis. This system serves as an accounting of SOP distribution and ensures that distributed SOPs are current and complete. This includes destruction of controlled copies of expired and retired SOPs. The QA Office also maintains a historical file of original cover pages with wet signatures and digitally signed electronic versions of this SOP; including the current revision and any versions archived within the past 5 years.

4.2 The electronic (Word Document) versions of this SOP, both current and any prior versions, are maintained on the computer network in a secure location as a "read only" file.

4.3 It is the responsibility of all personnel to follow this SOP as written, document and gain QA or Technical Director approval for deviations to the SOP, and submit needed SOP revisions to the QA Office.

4.4 This SOP is scheduled for review on an annual basis. Any required revisions will be incorporated into the SOP. The new revision of the SOP will be distributed by QA and the superseded version returned to the QA Office. If no revisions are required, the SOP cover page is signed and dated to document the review, and the updated cover page will be distributed.

4.5 A PDF version of each SOP (generated in Adobe or scanned) is digitally signed by a member of the QA Office as a security measure. The digitally signed PDF, used online, is considered to be a controlled copy of the SOP and is stored on the network.

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All staff have "read" access to these SOPs. Only QAQC has access to "write" on SOPs. Staff is directed to use the controlled electronic versions of SOPs. A limited number of controlled hardcopies are to be distributed by the QA Office.

5.0. INTERFERENCES:

5.1. Samples that contain high hydrocarbon content may emulsify or otherwise interfere with surrogate/spike recovery.

5.2. Organochlorine pesticides may dechlorinate, phthalate esters may exchange, and phenols may react to form tannates. These reactions increase with increasing pH, and decrease with shorter extraction time.

5.3. Samples containing a significant amount of solids may interfere with the extraction process.

6.0. SAMPLE HANDLING:

6.1. Sample Collection – Samples should be unaltered prior to extraction. Aqueous samples are stored at 0-6ºC until extraction.

6.2. Sample Size – 1L amber glass jars with Teflon-lined lids. Small volume DRO/RRO and PAH or samples with a history of high concentrations of the analyte of interest, may be submitted in 250-ml amber glass jars with Teflon-lined lids.

6.3. Sample Preservation – Water samples are stored at 0-6°C until extraction. Prior to extraction water sample collection should include preservation as follows:

Method	Preservative
8270D / EPA625/ Sulfolane/Thiolane	Cool 0-6°C
8270D-SIM	Cool 0-6°C,
8082A /EPA608	Cool 0-6°C,
8015C / AK102 / AK103	Cool 0-6°C, acidic pH (less than 2) by 1:3 HCl

Hexane extracts are refrigerated at 0-6ºC. Methylene chloride extracts are cooled to ≤ -10ºC.

6.4. Holding Times – Unpreserved water samples for all analysis except PCB must be extracted within 7 days of sample collection. There is a 1 year holding time for extraction of PCBs. Water samples collected for AK 102 and/or AK103 that have been acid preserved must be extracted within 14 days of sample collection. Extracts (except PCBs) must be analyzed within 40 days. PCB extracts have a cumulative 1 year hold time.

6.5. Criteria for Acceptance/Rejection of Samples – If samples have broken hold time, were not preserved properly, or were not stored at 0-6ºC, notify the Project Manager (PM) before proceeding with extraction.

7.0 APPARATUS:

7.1. 1500 ml-Glass extractor body with Teflon® stop-cocks

7.2. Coil condensers

7.3. Salt ball chambers (“salt balls”)

7.4. Jacketed concentrators (“bells”)

7.5. Teflon® chips (for use as boiling chips)

7.6. Pyrex glass concentrator tubes with a 1mL (ungraduated) tip

7.7. Concentrator Apparatus: XcelVap by Horizon Technologies (compressed nitrogen gas source), or equivalent.

7.8. Circulating glycol refrigeration unit (used in coil condenser)

7.9. Circulating heated glycol system (used in jacketed concentrators)

7.10. 1mL syringes: Hamilton gastight, certificate of conformance stored in CDS, as stated in SOP 104

7.11. Autosampler vials: Virtuoso, amber and clear, with Teflon®-lined crimp tops

7.12. Graduated cylinders class A.

7.13. pH paper: 0 -14 range (with $\leq$0.5 pH unit increments)

7.14. Disposable glass pipettes: 1, 5, and 10-mL

7.15. Disposable Pasteur pipettes, 7 and 9 inch

7.16. Permanent, solvent-resistant marker (Sharpie Industrial)

7.17. Teflon wash bottles, 500mL, labeled ‘methylene chloride’ or ‘D.I water’ accordingly: FILLED DAILY

7.18. Plastic and metal Keck clips

7.19. FisherBrand screw top vial, 17X60mm, 2 dram, w/rubber lined cap. (5mL vial)

8.0. REAGENTS:

8.1. Dichloromethane (CH_2Cl_2 or DCM): Fisher Optima (or equivalent) chromatographic grade.

8.2. n-Nonane: Acros 99% or equivalent (PAH analysis keeper)

8.3. De-ionized water (organic free)

8.4. Granular anhydrous sodium sulfate (Na_2SO_4): JT Baker or Fisher (or equivalent), received and opened dates must be recorded on the side of container. Heat at 400°F for ≥4 hours in a shallow tray, record in the Prep working reagents book. Label jars with ID number, date, and initials.

8.5. Sodium hydroxide solution (10N): Dissolve 40g NaOH in 100mL organic-free water. Record information in the Prep Working Reagents log book.

8.6. Hydrochloric acid solution 1:1 HCl: Add 500mL HCl to 500mL organic-free water. Record lot number information in the Prep Working Reagents log book. (Only applicable to DRO/RRO extraction)

8.7. Sulfuric acid solution 1:1- Add 500mL H_2SO_4 to 500mL organic-free water. Record lot number information in the Prep Working Reagents log book.

8.8. Hexane (C_6H_{14}): Fisher Optima (or equivalent) high purity Pesticide grade

9.0. EXTRACTION: *(Attachment B: Flow Chart)*

9.1. (#1) Approximately thirty minutes before extraction, turn the red knob on the heater control box to "**on**."

9.2. (#2) Turn the yellow flow control levers under the extraction benches being used to "**extraction**."

9.3. (#3) Check to make sure all green A & B valves under the extraction benches are turned OFF. Turn the yellow flow control handles inside the pump cabinet to "**extraction".**

9.4. (#4) Flip the switch located on the end of the cabinet to "**fill**".

9.5. (#5) Prepare all glassware, according to the SGS SOP#117 "Glassware Cleaning and Preparation."

9.6. Assemble stopcocks and add 250mL of methylene chloride to the bottom of each extractor body. Add one Teflon® chip to each jacketed concentrator and ½ inch of granular Na_2SO_4 to all salt chambers. Attach the bottom of the salt chamber to the jacketed concentrator using a Keck clip and the top of the salt chamber to the arm of the extractor body using another clip. Thread the two heated glycol hoses into the jacketed concentrators and tighten the hoses by hand only. The top hose goes to the top threaded stem and the bottom hose goes to the bottom threaded stem.

9.7. Pull the batch to be extracted from the reach in fridge. Samples are sent in 1L or 250mL amber bottles. Set each jar to the right of the extractor body that will be used for the samples extraction. Scan the sample number into the ELN to build the batch. Ensure that all samples in a work order are together in the batch, unless the number of samples exceeds 20. Verify that samples are assembled on the bench in order by WO/sample number. Sample IDs should be transcribed onto the jacketed concentrators with a solvent resistant permanent marker.

9.8. All containers will be marked with a solvent resistant permanent marker at the bottom of the meniscus. Then all volumes must be measured to the marked point.

9.9. To prepare the method blank, LCS or LCS Duplicate, use 1000mL de-ionized water (organic free). Add the room temperature spike standard to the QC (Quality Control) samples - LCS, LCSD, MS, and MSD - using the designated syringe. Add the room temperature surrogate standard to all of the samples containers, including all QC samples. Some sample jars will come filled to the rim. In those situations, decant a portion of the sample into the extractor body, making room to introduce the spiking mixes into the sample in the jar. *Note: refer to Attachment A "Spiking Requirement Table" for method specific spiking requirements.*

9.9.1. Spiking solutions must be introduced into the sample in the original sample container.

9.10. (#6) Turn chiller ON.

9.11. Verify the sample ID on the container matches what is written on the jacketed concentrator ("bell") before pouring the entire spiked sample into the designated, clean extractor body. Carefully pour the liquid so it does not go into the arm of the extractor body leading to salt chamber. If the sample volume is significantly greater than 1 liter (e.g., larger than 1-liter sample container) measure 1 liter of sample with a solvent rinsed graduated cylinder. If the volume of the sample to be extracted is significantly less than 1 liter, dilute to 1 liter with de-ionized water. After pouring the sample into the extractor body rinse the sample container with DI water to remove any sediment, followed by 3 methylene chloride rinses, decanting each rinse into the extractor body. Rinse the cap to each jar with methylene chloride to ensure hydrocarbons present on the Teflon lid are extracted with the sample. Finally, rinse the neck of the extractor body to remove any sediment impeding the condenser from sealing properly: first with DI water and then with methylene chloride.

9.12. **SIM PAH:** After pouring the spiked sample into the extractor body add 100µl of nonane using a 100 µl syringe.

9.13. Adjust the initial sample pH, if needed, and make a notation in "sample comments" in ELN logbook.

9.14. Cap the extractor body by lowering the coil condenser into the neck of the extractor body. Be sure that the chiller is approximately 2°C and that cold glycol is circulating through the condensers.

9.15. (#7) Start circulating heated glycol through the jacketed concentrators by rotating the ***TOP (A)*** green valve (underneath the bench) horizontally, followed by opening the ***BOTTOM (B)*** green valve. Reversing this order will cause hot glycol back pressure in the system & glassware. Before starting extraction, check the heater control box to ensure that the glycol temperature is at least 160°F.

9.16. (#8) Open the stop-cock to allow solvent to flow through the salt chamber and down into the jacketed concentrator. Be sure not to flood salt chamber, while maintaining a constant flow to jacketed concentrator. The methylene chloride level should not exceed the neck of jacketed concentrator or go below the Teflon® chips. Allow the continuous extraction system to cycle for a minimum of 4 hours and a maximum of 6 hours.

9.17. Approximately 10 minutes after extraction begins, check all joints on extraction apparatus. This is achieved by checking the stopcock for leaks, verifying the condenser is set securely into the top joint of the body, and all ground glass connections are together. i.e. condenser to body, body to salt ball, salt ball to jacketed concentrator.

9.18. As stated in SW846 3520C – 3, section 7.1. "It is recommended that if high analyte concentrations are anticipated, samples should be collected in smaller sample bottles and the whole sample used."

Note: If there is more than ¼ inch of sediment in the bottom of the container, it is considered to be multi-phasic. If sample is multi-phasic, the supervisor and the Project Manager must be contacted to determine which phase should be analyzed.

9.19. If more than one bench is to be set up, completely set up the 1st bench (set up through section 9.14 of this SOP) before starting set up of the 2nd bench. When setting up the 2nd bench, follow the same steps as above.

9.20. If more than one analyst is setting up the benches, follow Attachment C for efficient setup and extraction procedures.

9.21. **Extraction pH requirements:**

9.21.1. AK 102/103 – 8015, DRO/RRO: adjust to <2 with 4mL of 1:1 HCL

9.21.1.1. Some clients send PAH samples preserved with acid. Extract those PAH samples as described in section 9.21.3:(*Extract 2.5 hours at acidic pH and add 10mL 10N NaOH to bring the extraction to a basic pH. Continue extracting for 1.5 additional hours; extraction should not exceed 6 hours.)*.

9.21.2. 8270 Pest SIM & 8082 PCB: check and record that pH is 5 - 9 and adjust if necessary with 1:1 H_2SO_4 or 10N NaOH, to 5 – 9.

9.21.3. 8270 SVOC: Adjust pH with 1.5mL 1:1 H_2SO_4 to encourage acidic extraction. Extract 2.5 hours at acidic pH and add 10mL 10N NaOH to bring the extraction to a basic pH. Continue extracting for 1.5 additional hours; extraction should not exceed 6 hours.

9.21.3.1. TCLP leachates require ~ 15 mL of 10N NaOH due to the TCLP extraction fluid.

9.22. **For SW846 methods (i.e., 8270D-SIM, 8270D, 8082A, 8015C)**, each batch of twenty field samples or less requires a method blank (MB), a laboratory control sample (LCS), a matrix spike (MS), and a matrix spike duplicate (MSD). If insufficient sample is provided to perform a MS/MSD, then a laboratory control sample (LCSD) must be included.

9.22.1. Sulfolane requires a method blank (MB) and laboratory control samples (LCS) for every batch of twenty field samples or less. ***In addition:***

9.22.2. Sulfolane batches of 1-9 samples will include a field duplicate (DUP) sample. If insufficient sample is provided to perform a duplicate, then a laboratory control sample (LCSD) must be included.

9.22.3. Sulfolane batches of 10-20 samples will have a matrix spike(MS) and a matrix spike duplicate (MSD). If insufficient sample is provided to perform an MS/MSD, then a laboratory control sample (LCSD) must be included.

9.23. **For AK-series methods** (i.e., AK102/103), each batch of twenty samples or less requires a method blank (MB), a laboratory control sample (LCS) and a laboratory control sample duplicate (LCSD). The client may also request a matrix spike (MS) and matrix spike duplicate (MSD); in which case, they are prepared in addition to the LCS and LCSD. **Note:** ***ADEC requires AK102/103 batches to have both an LCS and an LCSD, even if the client provides sufficient sample for an MS/MSD.*** To prepare the method blank, LCS or LCS Duplicate, use 1000mL de-ionized water (organic free).

9.24. Measure the initial sample volume (section 9.8.) by filling the sample bottle to the meniscus mark with tap water. Pour the water into a graduated cylinder and record this volume as the initial sample volume in the extraction logbook.

9.24.1. Be sure to keep samples in the order that they are set up on the bench when moving the containers to measure sample volume. Verify the container IDs with those in the ELN – samples should appear in the same order in both places. If something doesn't match up, do a double check to ensure correct information is being recorded (i.e. make sure a sample switch is not occurring).

9.25. After the extraction is complete, close the stop-cock and allow the solvent to concentrate in jacketed concentrator to less than 10mL before turning off system.

9.26. To turn off extraction system:

1. Turn the heater power knob to **"off"**
2. Flip the switch on the end of cabinet to **"off"**
3. Turn the yellow flow control levers under the bench to **"drain"**
4. Turn the yellow lever in the pump cabinet to **"drain"**
5. Flip the switch on the end of cabinet to **"drain"** & loosen the top glycol hose attached to each concentrator to vent the system
6. Once the glycol has drained, turn the switch on the end of the cabinet to **"off"**
7. Rotate all green A & B valves to vertical
8. Turn the chiller **"off"**. Allow samples to equilibrate to room temperature before removing jacketed concentrators.

9.27. Concentration:

9.27.1. Check the water level in the XcelVap and adjust the temperature to 38ºC.

9.25.2 To collect the extraction solvent, unscrew both glycol hoses from the jacketed concentrator and remove the remove the "bell" & "salt ball" together. After rinsing the salt chamber with methylene chloride, gently knock the salt ball against a gloved hand hard enough to disturb the Na2SO4 and allow the DCM to drain into the concentrator. Ensure the label on the concentrator tube has been accurately transcribed (i.e. the sample ID matches the ID on the "bell"). Remove the "salt ball" and pour the contents of the bell into a labeled concentrator tube. Rinse the bell three times with methylene chloride and pour the rinse directly into a labeled concentrator tube. After the extraction solvent has been transferred into the concentrator tube rinse the sides of the concentrator tube with methylene chloride. Repeat this process for all samples in batch.

9.27.2. Start the nitrogen flow at about 5 PSI and place the concentrator tubes containing the sample into the XcelVap. The XcelVap can be programmed to ramp the nitrogen flow pressure up as the sample volume goes down. The maximum flow must not exceed 22psi. The surface of the solvent should be moving gently, not splashing.

9.27.3. Monitor the samples closely. When the sample level is down to ~10mL, thoroughly rinse the sides of the tube with methylene chloride. For samples that are analyzed in methylene chloride, continue concentrating until the sample level is in the tube nipple (~1mL). Rinse the slanted tube bottom with methylene chloride and concentrate to about 1mL.

9.27.4. Samples with a high concentration of oil or other heavy organic compounds will not concentrate to 1mL. When the sample volume is obviously not reducing, or the concentrate is viscous and black, do not try to concentrate as low as it will go. If the volume is less than 5mL, bring it up to 5.0mL using the calibrated 5.0mL reference vial. Record the final dilution volume (i.e., 5.0mL) in the ELN and on the side of the vial. Extracts that are more than 5mL can be measured with a class A graduated cylinder. DO NOT adjust the volume by (blowing down with nitrogen gun or adding solvent) once the final volume has been recorded. Transfer 1mL of the extract to an auto sampler vial. Record the total final volume on the side of the vial using a black marker and put a dot on the edge of the vial cap top. Contact the project manager and record the reason for the deviation in "comments" in the ELN.

9.27.5. Calibrate 1.0mL, 2.0mL, and 5.0mL reference vials daily by measuring methylene chloride using a gas tight syringe into each vial (i.e., a crimp top auto sampler vial for the 1.0mL and a 21x70 septum lidded vial for the 2.0mL and 5.0mL reference vial).

NOTE: *The following procedures must be used to prevent mixing sample ID during transfer from concentration tube to sample vial. This is the final critical step to insure the validity of the extract.*

9.27.6. To assure samples are not switched, confirm labeling on the concentrator tube and GC vial match. Rinse the slanted tube bottom with a few drops of methylene chloride and concentrate to ~0.75 mL. *No less than 0.5mL.* Transfer the sample from the tube to the labeled vial, (in a vial tray with the vials lined up to correspond with the tube position in the tube rack), using a 1mL glass pipette. Rinse the tube with a few drops of methylene chloride and add to the vial. The now empty concentrator tube is replaced in the tube rack in the same corresponding x-y position. If the sample volume is over 1.0mL by comparison with the reference vial use the nitrogen gun to reduce the volume to 1.0mL. If the sample volume is under 1.0mL, adjust to proper volume by adding methylene chloride using glass transfer pipettes. **Cap the vial and record the final volume**. (The final volume **must** be entered in ELN at the time the vial is capped.) When all samples have been transferred to vials, check the sample vial numbers with the empty tube numbers to assure that no errors have been made.

9.27.7. In the event that a sample vial needs to be relabeled (for example a poorly printed label or the sample placed in an incorrect vial) make sure that the vial's barcode is unreadable, and the new sample ID is clearly written. This will require immediate peer review and a note placed in the ELN.

NOTE: *Use of the nitrogen gun to reduce the sample volume in the vial creates an exothermic reaction that causes water condensation on & in the vial. Therefore it is to be used sparingly.*

9.27.8. Sulfolane extracts: Minimize use of the nitrogen gun as this analysis is extremely sensitive to moisture.
9.27.9. SVOC & PAH extracts: must never go below 0.5mL because lighter compounds will be lost.

9.27.10. Never under any circumstance allow a sample to concentrate to dryness.

9.27.11. **For 8082 PCB** samples that are analyzed in hexane, a solvent exchange to hexane must be done.

9.27.11.1. Monitor the sample in the XcelVap closely and when the sample level is down to ~1mL, rinse the sides of the tube with about 15mL of hexane and continue concentrating the sample. When the volume reaches 0.5mL, (1cm from the bottom of the tube) add 10mL of hexane. Repeat the 10mL hexane rinse again, reducing the sample volume to 0.5mL after each hexane rinse. Transfer the final concentrate (~0.75mL) to a sample vial and bring to the proper volume by adding hexane with a pasteur pipette. The following are the concentrate and rinse volumes for the hexane exchange process:

9.27.11.2.

Sample Volume	Hexane Rinse
(First) 1.0mL	15mL
0.5mL	10mL
0.5mL	10mL
~0.75mL	Done

9.27.11.3. For 8082 PCB analysis, the sample is brought to 1.0mL with hexane and is ready for analysis. Of note is the difference from Sonication 8082 PCB analysis (see SOP 761) which rinses with hexane a final time for a final volume of 5.0mL.

9.28. Deliver extracts to instrumentation lab

9.28.1. For 8015, AK102/103, DRO/RRO, and PCB, deliver in clear glass auto sampler 1mL vials

9.28.2. For Sulfolane, 8270 SVOC, 8270 SIMS, PEST SIM, use amber glass auto sampler 1 mL vials

9.29. Make sure that any & all sample oddities & deviations are documented and all blank entries in the ELN are filled, including the XcelVap ID and temperature, and the lot numbers of all solvents, standards and materials used. Post the data into LIMS. Double check entries. Print the ELN preview page and send to the analyst with the sample extracts.

10.0. CALIBRATION:

N/A

11.0. ANALYSIS:

N/A

12.0. QUALITY CONTROL:

12.1. For each batch of up to twenty extracted: if there is not sufficient volume for an MS/MSD, a LCS duplicate sample is extracted. **All batches for AK102/103 require both LCS and LCSD.** These samples are used to evaluate extraction efficiency and ensure that the extraction process is not contributing to sample results. Sample spikes and sample spike duplicates (MS/MSD set) may be requested by the client to evaluate site specific effects on the extraction/analysis process.

12.2. All samples, method blanks, LCS/LCSD and MS/MSD are fortified with the surrogate solutions.

12.3. Samples can be added to an active batch (samples still in the extraction process), with less than 20 samples, to the full 20 sample batch size. Examples would be, RUSH samples or samples broken or spilled. The process end time must be the same for all samples in the batch, no less than 4 hours or more than 6 hours.

12.4. Any corrective action(s) needed to address a QC outlier or other technical challenges that are not listed in this SOP require the prior approval of the QA Office or Technical Department.

13.0. CALCULATIONS, REVIEW AND REPORTING:

Refer to the Peer Review SOP 101.

14.0. HEALTH AND SAFETY:

14.1. Samples shall be returned to the approved storage location until such time as it is determined that no further analysis will be required.

14.2. Once it has been established that no more analysis of a sample will be required, acid and alkaline preserved samples may be neutralized using the Elementary Neutralization Hood located in GC Prep, unless it is considered to be hazardous (i.e. mercury waste, cyanide waste). Refer to the current version of SOP 108 for further instruction.

14.3. All surplus reagent acids shall be neutralized on a daily basis using the Elementary Neutralization Hood located in GC Prep.

14.4. Small volumes of surplus volatile reagents may be allowed to evaporate in a hood at the end of the analytical session.

14.5. Proper Personal Protective Equipment (PPE) must be worn at all times. Proper PPE when handling samples include a lab coat, gloves and safety glasses. In addition, when handling any solutions with concentrated acid or base preservative, a face shield, arm sleeves, and an apron must be worn.

15.0. POLLUTION PREVENTION:

15.1 SGS is committed to evaluate all areas of the lab with regard to current and potential pollution prevention. Pollution prevention is described as any technique that reduces or eliminates waste at the point of generation. Further discussion on pollution prevention programs in the laboratory can be found in *SGS Pollution Prevention Plan* (Form F053).

15.2 This custom made, automated system for continuous liquid-liquid extraction reduces solvent use.

16.0. METHOD PERFORMANCE:

N/A

17.0. DETECTION LIMIT (DL) STUDY:

N/A

18.0. LIMIT OF DETECTION (LOD):

N/A

19.0. LIMIT OF QUANTITATION (LOQ):

N/A

20.0. REFERENCES:

SW846, Revision 3, December 1996
Method 3520C, Revision 3, December 1996
Method 3500C, Revision 3, February 2007

21.0. ATTACHMENTS:

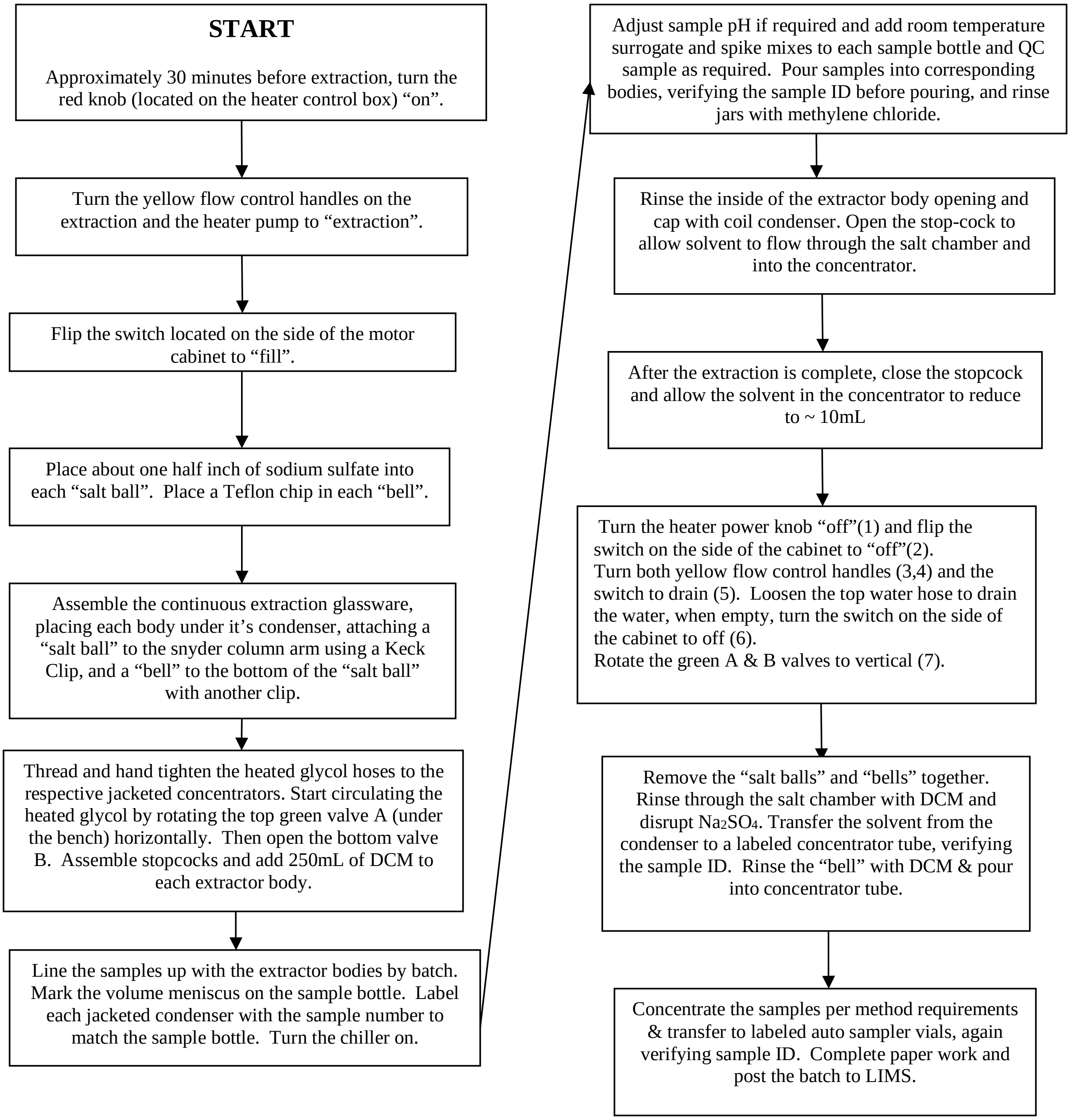
ATTACHMENT A: Spiking Requirements Table

Method	Surrogate	Volume	Spike	Volume	QC ID
8270D Semi-vol.	**8270**(100/200µg/mL acid & BN Cpds)	1.0mL			MB
	8270(100/200µg/mL acid & BN Cpds)	1.0mL	8270 spike (100µg/mL)	1.0mL	LCS
	8270(100/200µg/mL acid & BN Cpds)	1.0mL	8270 spike (100µg/mL)	1.0mL	MS/MSD
	8270(100/200µg/mL acid & BN Cpds)	1.0mL			PS
8082 PCB	Tetra/Deca (1µg/mL)	1.0mL			MB
	Tetra/Deca (1µg/mL)	1.0mL	Aroclor 1016/1260(1µg/mL)	1.0mL	LCS
	Tetra/Deca (1µg/mL)	1.0mL	Aroclor 1016/1260(1µg/mL)	1.0mL	MS/MSD
	Tetra/Deca (1µg/mL)	1.0mL			PS
8270D-PAH SIMS (also for Low Volume)	PAH (0.5µg/mL)	1.0mL			MB
	PAH (0.5µg/mL)	1.0mL	PAH Spike (0.5µg/mL)	1.0mL	LCS
	PAH (0.5µg/mL)	1.0mL	PAH Spike (0.5µg/mL)	1.0mL	MS/MSD
	PAH (0.5µg/mL)	1.0mL			PS
	All samples and QC spiked	**with**	**100µl nonane**		
Sulfolane	Sulfolane d_8 (80µg/mL) w/ 8270(100µg/mL acid & BN Cpds)	1.0mL			MB
	Sulfolane d_8 (80µg/mL) w/ 8270(100µg/mL acid & BN Cpds)	1.0mL	Sulfolane Spike (15µg/mL)	1.0mL	LCS
	Sulfolane d_8 (80µg/mL) w/ 8270(100µg/mL acid & BN Cpds)	1.0mL	Sulfolane Spike (15µg/mL)	1.0mL	MS/MSD
	Sulfolane d_8 (80µg/mL) w/ 8270(100µg/mL acid & BN Cpds)	1.0mL			PS
8270D-Pest SIMS	Pst (0.5µg/mL)	1.0mL			MB
	Pst (0.5µg/mL)	1.0mL	Pest spike (0.25µg/mL)	1.0mL	LCS/LCSD
	Pst (0.5µg/mL)	1.0mL	Pest spike (0.25µg/mL)	1.0mL	MS/MSD
	Pst(0.5µg/mL)	1.0mL			PS

Method	Surrogate	Volume	Spike	Volume	QC ID
Thiolane	**8270**(100µg/mL acid & BN Cpds)	1.0 mL			MB
	8270(100µg/mL acid & BN Cpds)	1.0 mL	Thiolane Spike (15 µg/mL)	1.0 mL	LCS/LCSD
	8270(100µg/mL acid & BN Cpds)	1.0 mL	Thiolane Spike (15 µg/mL)	1.0 mL	MS/MSD
	8270(100µg/mL acid & BN Cpds)	1.0 mL			PS/DUP
AK102/103 DRO/RRO (also for Low Volume)	**5-Alpha & DTC (100µg/mL)**	1.0mL			MB
	5-Alpha & DTC (100µg/mL)	1.0mL	LSB / LSR (5000µg/mL)	1.0mL	LCS/LCSD
	5-Alpha & DTC (100µg/mL)	1.0mL	LSB / LSR (5000µg/mL)	1.0mL	MS/MSD
	5-Alpha & DTC (100µg/mL)	1.0mL			PS

Silica Gel AK 102/103 DRO/RRO	**5-Alpha & DTC (200µg/mL)**	1.0mL			MB
	5-Alpha & DTC (200µg/mL)	1.0mL	LSB / LSR (5000µg/mL)	2.0mL	LCS/LCSD
	5-Alpha & DTC (200µg/mL)	1.0mL	LSB / LSR (5000µg/mL)	2.0mL	MS/MSD
	5-Alpha & DTC (200µg/mL)	1.0mL			PS
8015C DRO/RRO	**5-Alpha & DTC (100µg/mL)**	1.0mL			MB
	5-Alpha & DTC (100µg/mL)	1.0mL	DRO by 8015 (5000µg/mL)	1.0mL	LCS/LCSD
	5-Alpha & DTC (100µg/mL)	1.0mL	DRO by 8015 (5000µg/mL)	1.0mL	MS/MSD
	5-Alpha & DTC (100µg/mL)	1.0mL	LSB / LSR (5000µg/mL)	1.0mL	LCS/LCSD
	5-Alpha & DTC (100µg/mL)	1.0mL	LSB / LSR (5000µg/mL)	1.0mL	MS/MSD
	5-Alpha & DTC (100µg/mL)	1.0mL			PS

Attachment B: Flow Chart



START

Approximately 30 minutes before extraction, turn the red knob (located on the heater control box) "on".

Turn the yellow flow control handles on the extraction and the heater pump to "extraction".

Flip the switch located on the side of the motor cabinet to "fill".

Place about one half inch of sodium sulfate into each "salt ball". Place a Teflon chip in each "bell".

Assemble the continuous extraction glassware, placing each body under it's condenser, attaching a "salt ball" to the snyder column arm using a Keck Clip, and a "bell" to the bottom of the "salt ball" with another clip.

Thread and hand tighten the heated glycol hoses to the respective jacketed concentrators. Start circulating the heated glycol by rotating the top green valve A (under the bench) horizontally. Then open the bottom valve B. Assemble stopcocks and add 250mL of DCM to each extractor body.

Line the samples up with the extractor bodies by batch. Mark the volume meniscus on the sample bottle. Label each jacketed condenser with the sample number to match the sample bottle. Turn the chiller on.

Adjust sample pH if required and add room temperature surrogate and spike mixes to each sample bottle and QC sample as required. Pour samples into corresponding bodies, verifying the sample ID before pouring, and rinse jars with methylene chloride.

Rinse the inside of the extractor body opening and cap with coil condenser. Open the stop-cock to allow solvent to flow through the salt chamber and into the concentrator.

After the extraction is complete, close the stopcock and allow the solvent in the concentrator to reduce to ~ 10mL

Turn the heater power knob "off"(1) and flip the switch on the side of the cabinet to "off"(2).
Turn both yellow flow control handles (3,4) and the switch to drain (5). Loosen the top water hose to drain the water, when empty, turn the switch on the side of the cabinet to off (6).
Rotate the green A & B valves to vertical (7).

Remove the "salt balls" and "bells" together. Rinse through the salt chamber with DCM and disrupt Na_2SO_4. Transfer the solvent from the condenser to a labeled concentrator tube, verifying the sample ID. Rinse the "bell" with DCM & pour into concentrator tube.

Concentrate the samples per method requirements & transfer to labeled auto sampler vials, again verifying sample ID. Complete paper work and post the batch to LIMS.

Attachment C: Multi-Person Process for GC Prep

Before Liquid-Liquid extraction has started:

- Collect samples for the batch
- Build Batch in LIMS
- Retrieve Spikes and Surrogates
- Mark sample volumes
- Fill bodies
- Label concentrators
- Fill out ELN comments if necessary
- Spike Witness

After Liquid-Liquid extraction has started:

- Fill out ELN start date and Spike IDs
- Measure sample volumes
- Label XcelVap Tubes
- Print Vials
- Routinely check DCM level in concentrators
- Adjust stopcocks as necessary

Once Liquid-Liquid extraction time has elapsed:

- Turn stopcocks on each side of bench off
- Watch each side of bench for concentration <10mL
- Perform Shutdown Procedure
  - Refer to Attachment B
- Concentrate batch
- Complete ELN documentation
- Review ELN for Posting

Special Attention Needed

- Watch XcelVaps
  - Raise Pressure
  - Rinse tubes at ~2mL
  - Remove tubes at ~0.8mL
  - Record XcelVap Temperatures in ELN
- Communicate as tasks are completed
- Document ELN at each step
  - Do not fill out final volume in advance of concentration
    - Enter final volume as concentration is completed
  - Do not fill out Analyst initials until step has been completed
  - Add comments to samples and batches when analysis differs from normal

SGS

SGS North America, Inc. - Alaska Division
Standard Operating Procedure

NOTE: This document contains CONFIDENTIAL business information and is <u>not</u> intended for distribution.

S.O.P. Title: Sonication Extraction of Semi-Volatile Compounds in Soil	**Revision Date**: April 2017
Method No: SW846 3550C	**SOP No**: 761r19
Page: 1 of 14	**Supersedes:** 761r18

Signatures below reflect periodic review of Standard Operating Procedures. If the procedure is found adequate with little or no editing necessary, this page is signed and dated. An Addendum may be issued for minor changes that need to be implemented immediately. If it is determined that major edits are required, a new revision will be released with a new signature page.

Technical Director	Date	Quality Assurance (QA) Manager, QA Staff or their Designee	Date
Stephen C. Ede	4/12/17		4/12/17

Original cover pages with wet signatures and the digitally signed electronic SOP versions are available in the Quality Assurance Office.
A limited number of controlled hard copies will be issued for the Section Method SOPs & Technical Director's offices.

This document will be converted into a PDF file with the QA Manager's, QA Staff's or QA Designee's electronic signature and posted on the network: \\usfs700\ANK_GroupData\Public\DOCUMENT\SOP\~Approved_SOPs~

This electronically signed PDF will be considered the controlled copy for staff. Any printouts or photocopies are invalid.

Each staff member responsible for this SOP will print & sign this coverpage upon successful review, retaining it as a record in their training folder.

I have reviewed and understand the method reference(s) and this version of the SOP.
I agree to use only this currently approved version of the SOP.

Signature: ______________________ Printed Name: ______________________ Date: __________

Document Control Number __________ Issued by __________ Date __________

SGS	SGS North America, Inc. - Alaska Division Standard Operating Procedure
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S.O.P. Title: Sonication Extraction of Semi-Volatile Compounds in Soil	**Revision Date**: July 2017
Method No: SW846 3550C	**SOP No**: 761r19 add # 3
Page: 1 of 1	**Supersedes**: 761r19

Signatures below reflect approval for the following changes to the current SOP. These changes will be incorporated into the SOP during the next review. This addendum will be incorporated into the electronic SOP (i.e., PDF file).

Technical Director Date Quality Assurance (QA) Manager, QA Staff or their Designee Date

Stephen C. Ede 7/31/17 7/31/17

I have reviewed and understand the method reference(s) and this version of the SOP.
I agree to use only this currently approved version of the SOP.

Signature: ____________ Printed Name: ____________ Date: ________

The above referenced SOP should be modified as follows:

9.10. **Wipes:**

CHANGE:

9.10.1. Samples are received with 25mL hexane ~~in jar~~. Wipe and hexane are transferred to a 250mL amber jar for extraction. ~~Original container is rinsed with methylene chloride and poured into extraction container. Do not discard original container, for it is used during the extraction process.~~

TO:

9.10.1. Samples are received **in a jar** with 25mL hexane. Wipe and hexane are transferred to a 250mL amber jar for extraction~~.~~

CHANGE:

~~9.10.3.~~ Dispense 50mL methylene chloride to the 4-oz amber bottle that the wipe was preserved in and pour into ~~500mL~~ extraction jar. The final volume of the first extraction should be 75 mL of methylene chloride and hexane combined.

TO:

9.10.2. Dispense 50mL methylene chloride to the 4-oz amber bottle that the wipe was preserved in and pour into **the** extraction jar. The final volume of the first extraction should be 75 mL of methylene chloride and hexane combined.

CHANGE:

~~9.10.4.~~ Proceed with the extraction procedure for the normal 3 sonication periods, and complete the extraction / concentration per normal process.

TO: 9.10.3. Proceed with the extraction procedure for the normal 3 sonication periods, and complete the extraction / concentration per normal process.

CHANGE:

~~9.10.2.~~ Required QC: LCS / LCSD (This matrix will not be available in sufficient quantities for MS/MSD.) All QC samples are clean, sterile gauze pads, cut in half.

TO:

9.10.4. Required QC: **MB, &** LCS/LCSD (This matrix will not be available in sufficient quantities for MS/MSD.) All QC samples are ½ of a clean, sterile gauze pads, cut in half with 75mL of methylene chloride. **Introduce surrogate & spiking solutions into the extraction jar.**

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S.O.P. Title: Sonication Extraction of Semi-Volatile Compounds in Soil	**Revision Date**: July 2017
Method No: SW846 3550C	**SOP No**: 761r19 add #2
Page: 1 of 1	**Supersedes**: 761r19

Signatures below reflect approval for the following changes to the current SOP. These changes will be incorporated into the SOP during the next review. This addendum will be incorporated into the electronic SOP (i.e., PDF file).

Technical Director	Date	Quality Assurance (QA) Manager, QA Staff or their Designee	Date
Stephen C. Ede	7/10/17		7/10/17

I have reviewed and understand the method reference(s) and this version of the SOP.
I agree to use only this currently approved version of the SOP.

Signature: ____________ Printed Name: ____________ Date: ______

The above referenced SOP should be modified as follows:

Edit Section 9.11.5. by adding 2.0mL:

9.11.5. Calibrate 1.0mL, **2.0mL**, and 5.0mL reference vials daily by measuring methylene chloride using a gas tight syringe into each vial (i.e., a crimp cap autosampler vial for the 1.0mL and a 5 dram septum lined screw cap vial for the **2.0mL** and 5.0mL reference vial).

SGS	SGS North America, Inc. - Alaska Division Standard Operating Procedure
NOTE: This document contains CONFIDENTIAL business information and is not intended for distribution.	
S.O.P. Title: Sonication Extraction of Semi-Volatile Compounds in soil	**Revision Date:** May 2017
Method No: SW846 3550C	**SOP No:** 761r19 add # 1
Page: 1 of 1	**Supersedes:** 761r19

Signatures below reflect approval for the following changes to the current SOP. These changes will be incorporated into the SOP during the next review. This addendum will be incorporated into the electronic SOP (i.e., PDF file).

Technical Director	Date	Quality Assurance (QA) Manager, QA Staff or their Designee	Date
Stephen C. Ede	6/30/17		6/30/17

I have reviewed and understand the method reference(s) and this version of the SOP.
I agree to use only this currently approved version of the SOP.

Signature: ______________________ Printed Name: ______________________ Date: __________

The above referenced SOP should be modified as follows:

ADD TO:

12.3. PAH requirements:
  12.3.1. PAH Method Blank and LCS/ LCSD are spiked with 2mL of DI before adding surrogates or spike compounds.
  12.3.2. All PAH samples and QC are spiked with 100µl of Nonane after surrogate & spike fortification.

  12.3.3. PAH soil samples are concentrated to a final volume of 5.0mL. 1.0mL of this concentrate is sent for analysis.

AMMEND Attachment A as follows:

Method	**Surrogate**	**Volume**	**Spike**	**Volume**	**QC ID**
8270D-PAH SIMS	PAH ***(2.5µg/mL)***	1.0mL			MB
	ADD 2 mL DI to MB & LCS				
	PAH ***(2.5µg/mL)***	1.0mL	PAH Spike ***(2.5µg/mL)***	1.0mL	LCS, MS/MSD
	PAH ***(2.5µg/mL)***	1.0mL			PS
	nNonane (Keeper)	100µl			QC & all samples

Edit Section 9.10.1.
Samples are received with 25mL hexane in jar. Wipe and hexane are transferred to a ~~250~~mL ~~amber~~ jar for extraction. Original container is rinsed with methylene chloride and poured into extraction container. Do not discard original container, for it is used during the extraction process.

TO:
9.10.1. Samples are received with 25mL hexane in jar. Wipe and hexane are transferred to a **500mL** jar for extraction. Original container is rinsed with methylene chloride and poured into extraction container. Do not discard original container, for it is used during the extraction process.

Summary of Changes from Previous Revision:

- Addendum #1, section 9.11.4.1
- Addendum #2, section 9.5.2
- Attachment B
- Section 6.6 updated

Table of Contents

1.0. OBJECTIVE:

This method can be used to isolate organic compounds from soil, solid, and wipe samples. This method is applicable to the isolation and concentration of semi-volatile organics in preparation for a variety of chromatographic procedures.

2.0. SCOPE AND APPLICATION:

This SOP is suitable for use with methods SW8 8270D, PAH by 8270D-SIMS, 8270 Pest SIMS, 1625B / 8270D Sulfolane Isotopic Dilution, 8015C, AK 102, AK 103, and 8082A. A wipe or measured mass of sample approximately 22.5 to 30 grams is serially extracted by sonication with methylene chloride. The extract is dried, concentrated, and, if necessary, exchanged into a solvent compatible with the cleanup or the analysis being employed. The extracts are then analyzed with gas chromatography or gas chromatography/mass spectroscopy.

3.0. DEVIATIONS FROM REFERENCE METHOD:

3.1. Total extraction solvent volume for DRO/RRO and wipes is 200mL. The reference method states that 300mL should be used for 30 grams of sample. Industry standards use smaller volumes to minimize chlorinated solvent waste.

3.2. The initial sample weight is approximately 22.5 grams for 8270D, 8270D-SIM, and 8082A. The reference method states that a 30-gram sample will be used. Since the concentration device has a maximum volume of 260mL, the lab is keeping the same solvent-to-sample ratio as stated in the reference method.

3.3. Horn tip size used is one size- ¾”. Method 3550C states that a smaller tip needs to be used for samples with high concentration. Samples are extracted at low levels to meet Alaska state requirements for detection limits.

3.4. Sodium sulfate is added to achieve a grainy consistency. Method 3550C states that wet samples and nonporous samples should at a minimum have 60g added to the samples. Industry standards use smaller volumes to minimize chlorinated solvent waste.

3.5. Methylene chloride is used for all analysis extractions. Method 3550C has three options for different solvents and solvent mixtures for 8082A. Method based performance (e.g. PT studies and LCS recoveries) supports efficiency of practice.

3.6. Hexane solvent exchanges use one 15mL, two 10 mL, and one 4.5 mL exchanges. Method 3550C states one exchange at 50 ml. Industry standards use smaller volumes to minimize solvent waste. Method based performance (i.e. PT studies and LCS recoveries) supports efficiency of practice.

3.7. XcelVap and TurboVap baths are maintained at 38ºC for all analysis. Method 3550C states that baths used in the concentration step are to be set at 30ºC. Method based performance (e.g. PT studies and LCS recoveries) supports efficiency of practice.

3.8. QC compounds, (MS, LCS, surrogates), are added to the samples at the time of extraction after they have been processed in the weight room & dried with sodium sulfate. Method 3550C states that samples are to be spiked before the use of sodium sulfate. Method based performance (e.g. PT studies and LCS recoveries) supports efficiency of practice.

4.0. RESPONSIBILITIES:

4.1 The QA Office maintains a master list of this SOP to ensure review on a timely basis. This system serves as an accounting of SOP distribution and ensures that distributed SOPs are current and complete. This includes destruction of controlled copies of expired and retired SOPs. The QA Office also maintains a historical file of original cover pages with wet signatures and digitally signed electronic versions of this SOP; including the current revision and any versions archived within the past 5 years.

4.2 The electronic (Word Document) versions of this SOP, both current and any prior versions, are maintained on the computer network in a secure location as a "read only" file.

4.3 It is the responsibility of all personnel to follow this SOP as written, document and gain QA or Technical Director approval for deviations to the SOP, and submit needed SOP revisions to the QA Office.

4.4 This SOP is scheduled for review on an annual basis. Any required revisions will be incorporated into the SOP. The new revision of the SOP will be distributed by QA and the superseded version returned to the QA Office. If no revisions are required, the SOP cover page is signed and dated to document the review, and the updated cover page will be distributed.

4.5 A PDF version of each SOP (generated in Adobe or scanned) is digitally signed by a member of the QA Office as a security measure. The digitally signed PDF, used online, is considered to be a controlled copy of the SOP and is stored on the network.

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All staff have "read" access to these SOPs. Only QAQC has access to "write" on SOPs. Staff is directed to use the controlled electronic versions of SOPs. A limited number of controlled hardcopies are to be distributed by the QA Office.

5.0. INTERFERENCES:

5.1. Samples that contain high hydrocarbon content may interfere with surrogate/spike recovery.

5.2. Phthalate esters from laboratory equipment (e.g., gloves, soaps, plastic, and rubber) may contaminate samples. Phenols may react to form tannates.

6.0. SAMPLE HANDLING:

6.1 Sample Matrix – Soil, solid, and wipe samples.

6.2 Sample Size – 4 or 8oz amber glass jars with Teflon-lined lids. Wipes – 4 oz amber glass jars with Hexane.

6.3 Sample Preservation – Soil samples are stored at 0-6°C until extraction. Wipe samples should be stored at ambient temperature in the flam room until extraction. Hexane extracts are refrigerated at 0-6ºC. Methylene chloride extracts are stored at ≤ -10ºC.

6.4 Holding Times – Soil samples (with the exception of PCB analysis) must be extracted within 14 days of sample collection. Soil and wipe samples for PCB analysis have a hold time of 1 year. Samples must be analyzed within 40 days after extraction.

6.5 Criteria for Acceptance/Rejection of Samples – If samples have broken hold time or were not stored at 0-6ºC, notify the Project Manager (PM) before proceeding with extraction.

6.6. Multi-Incremental Sample Handling: Select clients/projects may require special handling as outlined by The Interstate Technology & Regulatory Council (ITRC), February 2012. **Sample aliquots designated for multi-incremental (MI) handling will be identified by Sample Receiving (based on Project Notice and**

client COC), clearly labeled for "MI" handling. As outlined in ITRC, the client will submit a field-prepared aliquot for each organic extraction *(Duplicate containers will be submitted for each analysis.)* which has already been sieved and homogenized. A separate, full container for Total Solids determination should also be submitted for each sample. MI samples for both volatiles and semi-volatiles will have been received as two separate samples, each with their own jar for total solids determination. ***If no other containers are submitted, the aliquot required for Total Solids determination may be removed from the "MI" labeled container prior to extraction, provided the mass for extraction still meets the method requirement*. (Note: The "MI" labeled container must be used in its entirety and may not, under any circumstances, be used for any other analysis.)** Each client requesting laboratory support for MI projects is reminded that **the maximum sample size which can be extracted is 30 grams**. If sample aliquots exceed this limit, contact the Project Manager immediately.

7.0. APPARATUS:

7.1. Sonicator: Misonix Corporation, Model S 4000 (or equivalent); 300 watts minimum, ¾ inch horn

7.2. Virtuoso autosampler vial bar code printer.

7.3. Pyrex glass concentrator tubes with a 1mL tip not graduated.

7.4. Concentrator Apparatus: TurboVap, XcelVap or equivalent.

7.5. Short-stem or stemless glass funnels

7.6. 500mL jars with Teflon®-lined lids

7.7. 1mL syringes: Hamilton gastight, in house certified calibrated, as stated in SOP 104

7.8. Virtuoso autosampler vials: amber and clear, with Teflon®-lined crimp tops

7.9. Disposable glass pipettes: 1, 5, and 10mL

7.10. Disposable Pasteur pipettes, 7 and nine inch.

7.11. FisherBrand screw cap vial, 2 dram, w/rubber lined cap. (5mL vial)

7.12. Glass Wool: (heated at 400°C for ≥4 hours)

7.13. Pipette bulbs and pumps

7.14. Vial cap crimper

7.15. Teflon wash bottles, 500mL, labeled: Methylene Chloride FILLED DAILY

8.0. REAGENTS:

8.1. Dichloromethane (CH2Cl2 / DCM): Fisher Optima (or equivalent) chromatographic grade.

8.2. Hexane: B&J -GC2 (or equivalent) high purity Pesticide grade

8.3. Sodium sulfate: Granular, Anhydrous (heated at 400°C for ≥4 hours)
8.4. Sand: Industrial quartz, 40 mesh (heated at 400°C for ≥4 hours)

8.5. Teflon boiling chips

8.6. n-Nonane: Acros 99% or equivalent. Used as PAH keeper.

9.0. EXTRACTIONS:

9.1. The procedure for weighing and preparing the sample for extraction is found in SOP 143. All weighed sub-samples must be extracted within regulatory hold times, 14 days for all analysis with the exception of PCB. The hold time for PCBs is 1 year.

9.2. Obtain the weighed sub-samples from the Sample Control, allow samples to reach room temperature and **verify that they are free flowing**. Some matrices, such as peat, muskeg, or non-soil solids, may not actively mix. If sample is not free flowing make sure adequate sodium sulfate was added to dry the sample and mix to free flowing consistency. If there is a problem, enter the deviation in “comments” in the ELN and contact the Project Manager. Weighed soil samples will be organized in batches which include QC (Refer to SOP 143). Use the bar code reader to enter weights into the ELN. Wipes are extracted as received (that is, in their entirety), so their weights are not determined. For wipe QC samples, use large sterile gauze pads.

9.3. Label concentrator tubes and sample jars with sample ID for all samples and QC in the extraction batch. Fill the short stem funnels with glass wool and baked sodium sulfate. Enter all reagent lot numbers in ELN at this time. All glassware is kiln baked or solvent rinsed according to the SGS “Glassware Cleaning and Preparation” SOP #117.

9.4. The Misonix Model S 4000 sonicators do not require tuning. They have a diagnostic program that is used at the beginning of each day.

9.4.1. sonicator is set to achieve:
- 3 minutes with at 100% X 475 w = >(300 watts minimum per method)
- Mode: Pulse
- Duty Cycle: 50%

9.5. Add appropriate room temperature surrogate standards to the samples and all quality control (QC) samples with a gas tight syringe. A laboratory standard spike solution is added to the LCS/LCSD and MS/MSD.

9.5.1. For PAH SIM sample extraction, add 100µl of nonane (as a keeper) using a 100µl gas tight syringe.

9.5.2. For PAH SIM sample extraction, add 2.0mL of DI water to **QC samples that only contain Teflon chips** before adding there surrogates and spike.

9.6. Add the first aliquot of methylene chloride immediately after spiking. For AK102/103 extractions, add 100mL of methylene chloride to each sample. For all other analyses, add 75mL of methylene chloride to each sample. Record identification of the standards used in ELN. **NOTE: Some samples may be slightly aqueous (ex. muddy samples) and require additional sodium sulfate to produce a dry, free flowing aliquot. This can result in the volume of sample/salt mixture exceeding the surface of the added solvent. In this case, add additional solvent until the solid material is at least 1cm beneath the solvent level and record the extra volume in the ELN.**

9.7. Place the horn in the sample container (approximately 1cm beneath the surface of the solvent, above the solid material) and start the sonicator program. **Active mixing of the sample to the bottom of the jar must occur when the ultrasonic pulse is activated.**

9.8. Confirm labeling on the concentrator tubes and the sample containers to ensure samples are not switched. Once the sonicator program has finished, decant the solvent through the sodium sulfate funnel into the concentrator tube.

9.9. After pouring extract into tube, add 50mL of methylene chloride to AK102/103 samples or 75mL of methylene chloride to all other samples. This step is repeated once to give a total of three sonication / pour off cycles. Once the solvent has completely drained after each extraction, rinse the funnels with a small amount of methylene chloride using the Teflon squeeze bottles. (The horn is rinsed between samples with methylene chloride and wiped with a KimWipe. A green scrubbie pad can be used if the horn cannot be cleaned easily.)

NOTE: ***Any deviations of procedure or sample reaction during extraction and concentration of samples MUST be documented in the ELN in the "comments" section provided.***

9.10. **Wipes**:

9.10.1. Samples are received with 25mL hexane in jar. Wipe and hexane are transferred to a 250mL amber jar for extraction. Original container is rinsed with methylene chloride and poured into extraction container. Do not discard original container, for it is used during the extraction process.

9.10.2. Required QC: LCS / LCSD (This matrix will not be available in sufficient quantities for MS/MSD.) All QC samples are clean, sterile gauze pads, cut in half.

9.10.3. Dispense 50mL methylene chloride to the 4-oz amber bottle that the wipe was preserved in and pour into 500mL extraction jar. The final volume of the first extraction should be 75 mL of methylene chloride and hexane combined. Perform steps 9.6 through 9.9 for all samples, and QC.

9.10.4. Proceed with the extraction procedure for the normal 3 sonication periods, and complete the extraction / concentration per normal process.

9.11. CONCENTRATION*:*

9.11.1. Check the water level in the XcelVap and adjust the temperature to 38ºC.

9.11.2. Adjust the nitrogen flow to about 5 PSI and place the concentrator tubes containing the sample into the XcelVap. The surface of the solvent should be moving gently, not splashing. The PSI can be programmed to ramp up as the solvent volume decreases, up to a maximum PSI of 22 when the sample volume is below the half way point.

9.11.3. Monitor the samples closely; when the sample level is down to ~10mL, rinse the sides of the tube with methylene chloride. For analysis that are analyzed in methylene chloride, continue concentrating until the sample level is in the tube nipple. Rinse the slanted tube bottom with methylene chloride and concentrate to about 1mL, taking care to not concentrate below 0.5mL.

9.11.4. Samples with a high concentration of oil or other heavy organic compounds, will not concentrate to 1mL. When the sample volume is obviously not reducing, **do not try to concentrate as low as**

it will go. If the volume is less than 5.0mL, bring the volume up to 5.0mL using a calibrated 5.0mL reference vial. The volume of extracts that are more than 5mL can be determined **with a class A graduated cylinder. DO NOT** adjust the volume by (blowing down with a nitrogen gun or adding solvent). Record the final volume and reason for the increased extract volume into the
ELN. Transfer a 1.0mL portion of the sample to a labeled vial and cap~~,~~ record the total final volume on the side of the vial using a black marker and put a dot on the edge of the vial cap top. Contact the project manager.

9.11.4.1. **PCB extracts that will not concentrate to less than 1mL are a common occurrence. Proceed as follows for these extracts to hexane exchange:**

9.11.4.1.1. Concentrate the DCM extract to 5mL, 10mL, 15mL or 20mL only. The sample matrix determines the volume. If the sample will not concentrate 20mL notify production manager.(NOTE the regulatory action limit is met at 20mL)

9.11.4.1.2. Only 5mL of sample concentrate is used for solvent exchange. For the samples that concentrate to 10, 15, or 20mL, remove 5.0mL for solvent exchange. Add an extra hexane exchange to maximize DCM removal, (see section 9.11.3.) Bring the sample back to 5.0mL volume for acid cleanup.

9.11.4.1.3. Follow the acid cleanup procedure (SOP 765).

9.11.4.1.4. Record the final volume in ELN. In comments record the portion used for solvent exchange and volume submitted for analysis. For example: if a sample concentrated to 20.0mL:

Enter the final volume in ELN – 20.0mL
Comment: 5 of 20 mL solvent exchanged
& acid cleanup. 1 of 5.0mL submitted for analysis.

9.11.5. Calibrate 1.0 and 5.0mL reference vials daily by measuring methylene chloride using a gas tight syringe into each vial (i.e., a crimp cap autosampler vial for the 1.0mL and a 5 dram septum lined screw cap vial for the 5.0mL reference vial).

NOTE: *The following procedures must be used to prevent mixing sample ID during transfer from concentration tube to sample vial. This is the final critical step to insure the validity of the extract.*

9.11.6. To assure samples are not switched, confirm labeling on the concentrator tube and GC vial match. Rinse the slanted tube bottom with a few drops of methylene chloride and concentrate to ~3/4 of a mL. *No less than 0.5mL.* Transfer the sample from the tube to the labeled vial, (in a vial tray with the vials lined up to correspond with the tube position in the tube rack), using a 1mL glass pipette. Rinse the tube with a few drops of methylene chloride and add to the vial. The now empty concentrator tube is replaced in the tube rack in the same corresponding x-y position. If the sample volume is over 1.0mL by comparison with the reference vial use the nitrogen gun to reduce the volume to 1.0mL. If the sample volume is under 1.0mL, adjust to proper volume by adding methylene chloride using glass transfer pipettes. **Cap the vial and record the final volume**. (The final volume **must** be entered in ELN at the time the vial is capped.) When all samples have been transferred to vials, check the sample vial numbers with the empty tube numbers to assure that no errors have been made.

NOTE: *Use of the nitrogen gun to reduce the sample volume in the vial creates an exothermic reaction that causes water condensation on & in the vial. Therefore it is to be used sparingly.*

9.11.6.1. Sufolane extracts: Minimize use of the nitrogen gun as this analysis is extremely sensitive to moisture.
9.11.6.2. SVOC & PAH extracts: must never go below 0.5mL because lighter compounds will be lost.
9.11.6.3. Never in any circumstance allow a sample to concentrate to dryness.

9.11.7. In the event that a sample vial needs to be relabeled, for example a poorly printed label or the sample placed in an incorrect vial. Make sure that the vial's barcode is unreadable, and the new sample ID is clearly written. This will require immediate peer review and a note placed in the ELN.

9.11. **CLEANUP**:

9.11.1. Silica Gel samples are concentrated to about 2mL and split for silica gel clean up. Transfer ½ of the well mixed homogenous concentrate into an autosampler vial for analysis. The remaining ½ of the concentrate is used for silica Gel cleanup. ***The two sample aliquots must be equal in concentration and volume.*** Refer to SOP 765 for silica gel procedure.

9.11.2. For PCB samples that are analyzed in hexane, a solvent exchange to hexane must be done.

9.11.3. Solvent Exchange:
Monitor the sample in the XcelVap closely, when the sample level is down to ~1mL, rinse the sides of the tube with about 15mL of hexane. Concentrate to 0.5mL, (1cm from the bottom of the tube), and add 10mL of hexane. Again, concentrate to 0.5mL and rinse with 10mL hexane. Concentrate to 0.5mL, remove from XcelVap, and rinse with 4.5mL hexane. Final volume is adjusted to exactly 5.0mL and transferred to a scintillation vial for acid clean-up (refer to SOP#765). If no acid clean up is required then a 1.0mL aliquot is measured and transferred to the auto sampler vial.

9.12. Deliver extracts to semi-volatile sample storage for 8015, AK 102/103, DRO/RRO and PCB in clear glass auto sampler 1mL vials.

9.13. Deliver extracts to semi-volatile sample storage for Sulfolane, 8270 SVOC, 8270 SIMS, and PST SIM in amber glass auto sampler 1mL vials.

9.14. Fill in all blank entries in the ELN including the XcelVap temperature, and the lot numbers of all solvents, standards and materials used. Post the data into LIMS. Double check your entries, submit a copy of the ELN to the analyst with the sample extracts.

10.0. CALIBRATION:

N/A

11.0. ANALYSIS:

N/A

12.0. QUALITY CONTROL:

12.1. For each batch of up to twenty samples (excluding matrix spikes/spike duplicates and other extraction QC) a method blank, LCS and MS/MSD is extracted. If the client does not specify a sample for spiking, one sample in the batch is selected. If there is not sufficient volume for an MS/MSD, a LCS duplicate sample is extracted. **All batches for AK102/103 require both LCS and LCSD.** These samples are used to evaluate extraction efficiency and ensure the extraction process is not contributing to sample results. Sample spikes and sample spike duplicates (MS/MSD set) may be requested by the client to evaluate site specific effects on the extraction/analysis process.

12.2. Sulfolane required batch QC:

- 12.2.1. Batches of 9 or less samples, extract a MB, LCS, and a duplicate sample.
- 12.2.2. Batches of 10 -20 samples, extract a MB, LCS, and a MS/MSD.

12.3. PAH requirements:

- 12.3.1. PAH Method Blank and LCS/ LCSD are spiked with 2mL of DI before adding surrogates or spike compounds.
- 12.3.2. All PAH samples and QC are spiked with 100µl of Nonane after surrogate & spike fortification.

12.4. Surrogate solutions are added to all samples, method blanks, LCS/LCSD and MS/MSD for all analysis.

12.5. Samples can be added to an active batch (samples are still being concentrated), with less than 20 samples, to the full 20 sample batch size. Examples would be, RUSH samples or samples broken or spilled.

Any corrective action(s) needed to address a QC outlier or other technical challenges that are not listed in this SOP require the prior approval of the QA Office or Technical Department.

13.0. CALCULATIONS, REVIEW AND REPORTING:

Refer to the Peer Review SOP 101.

14.0. HEALTH AND SAFETY:

14.1. Samples shall be returned to the approved storage location until such time as it is determined that no further analysis will be required.

14.2. Once it has been established that no more analysis of a sample will be required, acid and alkaline preserved samples may be neutralized using the Elementary Neutralization Hood located in GC Prep, unless it is considered to be hazardous (i.e. mercury waste, cyanide waste). Refer to the current version of SOP 108 for further instruction.

14.3. All surplus reagent acids shall be neutralized on a daily basis using the Elementary Neutralization Hood located in GC Prep.

14.4. Small volumes of surplus volatile reagents may be allowed to evaporate in a hood at the end of the analytical session.

14.5. Proper Personal Protective Equipment (PPE) must be worn at all times. Proper PPE when handling samples include a lab coat, gloves and safety glasses. In addition, when handling any solutions with concentrated acid or base preservative, a face shield and apron must be worn.

15.0. POLLUTION PREVENTION:

SGS is committed to evaluate all areas of the lab with regard to current and potential pollution prevention. Pollution prevention is described as any technique that reduces or eliminates waste. Further discussion on pollution prevention programs in the laboratory can be found in *SGS Pollution Prevention Plan* (Form F053).

16.0. METHOD PERFORMANCE:

N/A

17.0. DETECTION LIMIT (DL) STUDY:

N/A

18.0. LIMIT OF DETECTION (LOD):

N/A

19.0. LIMIT OF QUANITATION (LOQ):

N/A

20.0. REFERENCES:

SW846, Revision 3, December 1996
Method 3500C, Revision 3, February 2007
Method 3660B, Revision 3, December 1996
Method 3665A, Revision 1, December 1996
The Interstate Technology & Regulatory Council Incremental Sampling Methodology, February 2012

21.0. ATTACHMENTS:

ATTACHMENT A: SPIKING REQUIREMENT TABLE

Method	Surrogate	Volume	Spike	Volume	QC ID
Sulfolane	Sulfolane d_8 & B/N Surrogate (25& 5µg/mL)	1.0mL			MB
	Sulfolane d_8 & B/N Surrogate (25& 5µg/mL)	1.0mL	Sulfolane Spike (1.5µg/mL)	1.0mL	LCS/LCSD
	Sulfolane d_8 & B/N Surrogate (25& 5µg/mL)	1.0mL	Sulfolane Spike (1.5µg/mL)	1.0mL	MS/MSD
	Sulfolane d_8 & B/N Surrogate (25& 5µg/mL)	1.0mL			PS
8270D Semi-vol.	8270 (100µg/mL BN & 200 µg/mL acid surrogates)	1.0mL			MB
	8270 (100µg/mL BN & 200 µg/mL acid surrogates)	1.0mL	8270 spike (100µg/mL)	1.0mL	LCS
	8270 (100µg/mL BN & 200 µg/mL acid surrogates)	1.0mL	8270 spike (100µg/mL)	1.0mL	MS/MSD
	8270 (100µg/mL BN & 200 µg/mL acid surrogates)	1.0mL			PS
8270D-PAH SIMS	PAH (0.50µg/mL)	1.0mL			MB
	PAH (0.50µg/mL)	1.0mL	PAH Spike (0.50µg/mL)	1.0mL	LCS
			ADD 2mL DI to MB & LCS		
	PAH (0.50µg/mL)	1.0mL	PAH Spike (0.50µg/mL)	1.0mL	MS/MSD
	PAH (0.50µg/mL)	1.0mL			PS
		100µl	n Nonane (Keeper)	QC &	All Samples
8270D-Pest SIMS	PST (0.5µg/mL)	1.0mL			MB
	PST (0.5µg/mL)	1.0mL	Pest spike (0.250µg/mL)	1.0mL	LCS
	PST (0.5µg/mL)	1.0mL	Pest spike (0.250µg/mL)	1.0mL	MS/MSD
	PST (0.5µg/mL)	1.0mL			PS
8082 PCB	Tetra/Deca (10µg/mL)	0.5mL			MB
	Tetra/Deca (10µg/mL)	0.5mL	Aroclor 1260/1016 spike 10µg/mL)	0.5mL	LCS/LCSD
	Tetra/Deca (10µg/mL)	0.5mL	Aroclor 1260/1016 spike (10µg/mL)	0.5mL	MS/MSD
	Tetra/Deca (10µg/mL)	0.5mL			PS
AK102/103 DRO/RRO	5-Alpha & DTC (100µg/mL)	1.0mL			MB
	5-Alpha & DTC (100µg/mL)	1.0mL	LSB / LSR (5000µg/mL)	1.0mL	LCS
	5-Alpha & DTC (100µg/mL)	1.0mL	LSB / LSR (5000µg/mL)	1.0mL	MS/MSD
	5-Alpha & DTC (100µg/mL)	1.0mL			PS
8015C DRO/RRO	5-Alpha & DTC (100µg/mL)	1.0mL			MB
	5-Alpha & DTC (100µg/mL)	1.0mL	DRO by 8015 (5000µg/mL)	1.0mL	LCS/LCSD
	5-Alpha & DTC (100µg/mL)	1.0mL	DRO by 8015 (5000µg/mL)	1.0mL	MS/MSD
	5-Alpha & DTC (100µg/mL)	1.0mL	LSB / LSR (5000µg/mL)	1.0mL	LCS/LCSD
	5-Alpha & DTC (100µg/mL)	1.0mL	LSB / LSR (5000µg/mL)	1.0mL	MS/MSD
	5-Alpha & DTC (100µg/mL)	1.0mL			PS
Silica Gel AK102/103 DRO/RRO	5-Alpha & DTC (200µg/mL)	1.0mL			MB
	5-Alpha & DTC (200µg/mL)	1.0mL	LSB / LSR (5000µg/mL)	2.0mL	LCS/LCSD
	5-Alpha & DTC (200µg/mL)	1.0mL	LSB / LSR (5000µg/mL)	2.0mL	MS/MSD
	5-Alpha & DTC (200µg/mL)	1.0ml			PS

ATTACHMENT B: Process for GC Prep-Soils

Before a Sonication batch has been started:

- Retrieve Spike and Surrogates
- Set out batch for spiking
- Create batch in LIMS
- Build batch in ELN
- Shake samples and loosen lids
- Spike Witnessing

After a Sonication batch has been started:

- Label TurboVap/Xcel Vap Tubes
- Print Vials
- Prepare next Sonication batch

After a Sonication batch has been blown down

- Concentrate batch
- Complete ELN documentation
- Review ELN for Posting

Special Attention Needed

- Watch TurboVaps/Xcel Vaps
    - Raise Pressure
    - Rinse tubes at ~2mL
    - Remove tubes at ~0.8mL
    - Record TurboVap/Xcel Vap Temperatures in ELN
- **Communicate as tasks are completed**
- **Document ELN at each step**
    - Do not fill out final volume in advance of concentration
        - Enter final volume as concentration is completed
    - Do not fill out Analyst initials until step has been completed
    - **Do add comments to samples and batches when analysis differs from normal**

SGS	SGS North America, Inc. - Alaska Division Standard Operating Procedure
***NOTE:* This document contains CONFIDENTIAL business information and is not intended for distribution.**	
S.O.P. Title: Purge and Trap Aqueous	**Revision Date:** November 2014
Method No: SW846 8000B & 5030B	**SOP No:** 764r11
Page: 1 of 7	**Supersedes:** 764r10

Signatures below reflect periodic review of Standard Operating Procedures. If the procedure is found adequate with little or no editing necessary, this page is signed and dated. An Addendum may be issued for minor changes that need to be implemented immediately. If it is determined that major edits are required, a new revision will be released with a new signature page.

Technical Director	Date	Quality Assurance (QA) Manager, QA Staff or their Designee	Date
Stephen C. Ede	3/10/16	Phyllis Woods	3/10/2016
Stephen C. Ede	11/11/14		11/11/14
Stephen C. Ede	4/5/17		4/5/17

Original cover pages with wet signatures and the digitally signed electronic SOP versions are available in the Quality Assurance Office.
A limited number of controlled hard copies will be issued for the Section Method SOPs & Technical Director's offices.

This document will be converted into a PDF file with the QA Manager's, QA Staff's or QA Designee's electronic signature and posted on the network: \\usfs700\ANK_GroupData\Public\DOCUMENT\SOP\~Approved_SOPs~

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Summary of Changes from Previous Revision:

- Add#1 incorporated into SOP- Added section 11.2.

Table of Contents

1.0. OBJECTIVE:

This SOP provides the guidance for purge and trap analysis for aqueous samples.

2.0. SCOPE AND APPLICATION:

This method is used to analyze water and water miscible samples, for volatile organic compounds by purge and trap prep gas chromatograph analysis methods by SW846. (Refer to method SOPs for analytical details.) An inert gas is bubbled through a water sample, reagent water, or methanol extract (for oil, sludge, and soils) contained in a specially designed purging chamber. Heated purging may be used to increase analyte transfer. The purging of the sample transfers purgeable compounds from the liquid to the vapor phase. The vapor is then swept to a porous polymer trap where they are collected. Once purging is complete, the trap is then rapidly heated and back flushed with the inert gas desorbing the analytes onto a gas chromatographic column. The gas chromatograph is temperature programmed to separate the compounds, which are then detected.

3.0. DEVIATIONS FROM REFERENCE METHOD:

This SOP contains no deviations from method 5030B.

4.0. RESPONSIBILITIES:

4.1 The QA Office maintains a master list of this SOP to ensure review on a timely basis. This system serves as an accounting of SOP distribution and ensures that distributed SOPs are current and complete. This includes destruction of controlled copies of expired and retired SOPs. The QA Office also maintains a historical file of original cover pages with wet signatures and digitally signed electronic versions of this SOP; including the current revision and any versions archived within the past 5 years.

4.2 The electronic (Word Document) versions of this SOP, both current and any prior versions, are maintained on the computer network in a secure location as a “read only” file.

4.3 It is the responsibility of all personnel to follow this SOP as written, document and gain QA or Technical Director approval for deviations to the SOP, and submit needed SOP revisions to the QA Office.

4.4 This SOP is scheduled for review on an annual basis. Any required revisions will be incorporated into the SOP. The new revision of the SOP will be distributed by QA and the superseded version returned to the QA Office. If no revisions are required, the SOP cover page is signed and dated to document the review, and the updated cover page will be distributed.

4.5 A PDF version of each SOP (generated in Adobe or scanned) is digitally signed by a member of the QA Office as a security measure. The digitally signed PDF, used online, is considered to be a controlled copy of the SOP and is stored on the network.

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5.0. INTERFERENCES:

5.1. Samples can be contaminated by diffusion of volatiles (particularly methylene chloride and fluorocarbons) through the septum seal of the sample vial during shipment and storage.

5.2. The laboratory where volatile analysis is performed should be completely free of solvents, which are part of the target analyte list.

5.3. The majority of sample contamination occurs at the instrument (purge gas, outgassing ahead of the trap etc.) The instrument must be demonstrated to be free from contamination under the conditions of analysis.

5.4. Contamination due to carryover can occur when high concentration samples and low concentration samples are analyzed sequentially. High concentration samples should be followed by a blank to check for carryover. The system may need to be baked out to eliminate contamination.

6.0. SAMPLE HANDLING:

6.1. Samples are tracked by the sample custodian. TCLP leachates are relinquished to the VOC Analyst by the EPTOX Analyst, along with the associated leachate blank(s) and a copy of the bench sheet for the batch that documents the leaching of the samples, blanks, and their batch assignments. A HSN QC number will be assigned to blanks and noted on the leach log. This number is required in order to track leach blanks from the preparation through the analytical process. LIMS Sample types specific to the different types of leach fluid blanks are available in the analytical queues to post leach blank data.

6.2. Holding Times: Volatile organic analysis of water and water miscible samples pre-preserved with HCl must be performed within 14 days after sample collection. Unpreserved water and water miscible samples, including unpreserved TCLP leachates and blanks must be analyzed within 7 days of the end of the leaching period (fourteen days if the leachate is preserved to pH<2 with 1:1 HCL:water).

6.3. Samples should be stored at 0-6^{o}C with minimal headspace in an area free of solvent fumes.

6.4. The size of any bubble caused by degassing upon cooling should not exceed 5-6 mm ^{2} if a bubble is present, check the vial's cap and septum to ensure a proper seal was made at time of sampling. If there is evidence of leaking the sample should be discarded.

7.0. APPARATUS:

7.1. See method specific SOP for instrumentation (e.g., 8021, 8260, 524, 602)

7.2. Microsyringes for spiking of sample

7.3. Class A volumetric flasks

8.0. REAGENTS:

8.1. Organic free water defined as water in which contamination is not observed at the LOQ value of the parameters of interest. (**Note:** For DOD, the water must be free of contaminants to < ½ LOQ.) Deionized (DI) water is dispensed from the volatiles RO system before using it for sample dilutions, standard preparation, trip blank preparation, and quality control sample preparation.

8.1.1. Acidic RO, (used to prepare samples and calibrations), is prepared by adding ~1mL of 50% HCL per one liter of reagent water to obtain a pH of ≤ 2.

8.2. Purge and Trap grade Methanol

9.0. EXTRACTION:

N/A

10.0. CALIBRATION:

N/A

11.0. ANALYSIS:

11.1 Samples to be analyzed are obtained from the sample custodian.

11.2 Allow samples to come to room temperature prior to analysis.

11.3 Place samples into auto sampler tray. Record any observations of sample color, sediment or bubbles.

11.4 Internal standards or surrogates are added automatically.

11.5 Check sample pH on the remaining volume with narrow range paper after acquisition has finished. If the pH is greater than 2 it must be noted in sample comments in LIMS. Record pH check in the run log.

11.6 Send remaining sample to post analysis

12.0. QUALITY CONTROL:

12.1. Water used for extraction is analyzed in each analytical batch to check for contamination. This check is the instrument blank, which can also serve as the tune (for GC/MS analysis) and a method blank for a water sample batch.

12.2. Each instrument with a purge and trap unit must have a valid calibration curve established, which is verified before use by the analysis of a second source standard. The curve is verified at the beginning of each analytical batch by the analysis of a mid-range calibration standard. Each analytical method contains acceptance criteria for the analysis of these two standards. An average of the response factors or calibration factors from the initial calibration curve is used for surrogate and target analyte calculations.

12.3. MB, LCS, MS and MSD must be associated with each preparation batch of 20 field samples or less. If sufficient field sample volume is not available to create an MS/MSD set, an LCSD sample is added to the batch. See method specific SOP for QC acceptance criteria.

12.4. Dilutions - If dilutions are necessary the amount of purged water must remain constant.

Example (10-fold dilution) - Use 4.5 mL of reagent water and 0.5 mL of sample for a final volume of 5.0 mL. The addition of any surrogates, internal standards, and matrix spike analytes (as applicable) are added after the dilution step.

12.5. Any corrective action(s) needed to address a QC outlier or other technical challenges that are not listed in this SOP require the prior approval of the QA Office or Technical Department.

13.0. CALCULATIONS, REVIEW AND REPORTING:

See method specific SOP for information (e.g., 8021, 8260, 524, 602).

14.0. HEALTH AND SAFETY:

14.1. Samples shall be returned to the approved storage location until such time as it is determined that no further analysis will be required.

14.2. Once it has been established that no more analysis of a sample will be required, acid and alkaline preserved samples may be neutralized using the Elementary Neutralization Hood located in GC Prep, unless it is considered to be hazardous (i.e. mercury waste, cyanide waste). Refer to the current version of SOP 108 for further instruction.

14.3. All surplus reagent acids shall be neutralized on a daily basis using the Elementary Neutralization Hood located in GC Prep.

14.4. Small volumes of surplus volatile reagents may be allowed to evaporate in a hood at the end of the analytical session.

14.5. Proper Personal Protective Equipment (PPE) must be worn at all times. Proper PPE when handling samples include a lab coat, gloves and safety glasses. In addition, when handling any samples or solutions with any acid or base preservative a face shield and apron must be worn.

15.0. POLLUTION PREVENTION:

SGS is committed to evaluate all areas of the lab with regard to current and potential pollution prevention. Pollution prevention is described as any technique that reduces or eliminates waste at the point of generation. Further discussion on pollution prevention programs in the laboratory can be found in *SGS Pollution Prevention Plan* (Form F053).

16.0. METHOD PERFORMANCE:

Method performance does not apply to this SOP.

17.0. DETECTION LIMIT (DL) STUDY:

N/A

18.0. LIMIT OF DETECTION (LOD):

N/A

19.0. LIMIT OF QUANITATION (LOQ):

N/A

20.0. REFERENCES:

SW846 5030B Dec. 1996 Rev. 2, Pg. 1 Sec 2.0
SW846 5030B Dec. 1996 Rev. 2, Pg. 5 Sec. 6.1

21.0. ATTACHMENTS:

N/A

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S.O.P. Title: Purge and Trap Extraction, Non-aqueous	**Revision Date**: September 2017
Method No: SW846 5035A	**SOP No**: 767r10
Page: 1 of 9	**Supersedes**: 767r09

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Technical Director	Date	Quality Assurance (QA) Manager, QA Staff or their Designee	Date
Stephen C. Ede	9/26/17		9/26/17

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Summary of Changes from Previous Revision:

- Changed reference of -10 to -20°C to -7 to -20°C.
- Adjusted section 6.4.3. to reflect current practices.
- Added additional apparatus being used.
- Added manufacturer of Methanol to section 8.1.
- Adjusted section 8.2. to reflect current practices.
- Adjusted section 9.1.2. to reflect current practices.
- Removed section 9.3.
- Updated attachment extraction QC.
- Added attachment B.

Table of Contents

1.0. OBJECTIVE:

This method is used to extract sediment/soil, solid waste and oil samples for volatile gas chromatograph methods by SW846 5035A.

2.0. SCOPE AND APPLICATION:

2.1 Soil and solid waste samples are typically preserved in the field with methanol. They may be sodium bisulfate preserved or collected and frozen for low level analysis. The preserved/extracted sample is then sent to the laboratory for analysis. At the time of writing this SOP, the State of Alaska Department of Environmental Conservation has not approved the use of sodium bisulfate preservation technique. SGS recommends the use of the low level freezing technique (i.e., 5 grams of soil in 5 ml DI water with stir bar). This SOP will cover the procedure for extracting samples with methanol at the laboratory.

2.2 A portion of sample is weighed, spiked and extracted with methanol. Due to the volatile nature of the components of interest this procedure must be done before the sample is used in any other analysis. Samples extracted by this technique at the laboratory may be considered invalid due to volatile loss before the sample arrives at the laboratory or during the transfer procedure. **Samples received at the laboratory for extraction will be flagged as biased low on the Sample Receipt Form**. Extraction efficiency for solid waste and oil samples may not be the same as for the LCS/LCSD that are extracted with them.

3.0. DEVIATIONS FROM REFERENCE METHOD:

Oil analysis quality control will consist of: An acceptable curve, Initial tune, Initial calibration blank, and a Continuing Calibration Verification.

4.0. RESPONSIBILITIES:

4.1 The QA Office maintains a master list of this SOP to ensure review on a timely basis. This system serves as an accounting of SOP distribution and ensures that distributed SOPs are current and complete. This includes destruction of controlled copies of expired and retired SOPs. The QA Office also maintains a historical file of original cover pages with wet signatures and digitally signed electronic versions of this SOP; including the current revision and any versions archived within the past 5 years.

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5.0. INTERFERENCES:

Samples can be contaminated by diffusion of volatiles (particularly methylene chloride and fluorocarbons) through the septum seal of the sample vial during shipment and storage. Trip blanks which accompany the samples during shipment should be analyzed as a check of such contamination.

6.0. SAMPLE HANDLING:

6.1. Jars for field preserved methanol samples are weighed before they are sent in the client sample kit. These jars must be weighed again when the sample is received at the lab, prior to any analysis, to determine sample mass per SGS Weighing SOP#143. In the event that a non-tared jar is received, the sample jar may be emptied and weighed post analysis for an estimated jar weight; however, this technique is not recommended.

6.2. All samples for volatile analyses should be stored in a location free from volatile contaminants. Field extracted and in-house extracted soils are stored at 0-6° C in Sample Control’s GC reach-in for methanol extracted soils to segregate them from all other samples. Encores and low level frozen vials are stored at -7 to -20° C in Sample Control’s freezer to segregate them from other samples, etc.

6.3. Samples sent to the laboratory in Encore sampling containers (samples preserved by freezing), will be handled per section 8 of this SOP.

6.4. Holding Times:

6.4.1. Samples preserved/extracted in the laboratory: Volatile organic analysis of soils, oils and solid/sludge samples must be performed within 14 days after sample collection. The extraction/preservation should occur as soon as possible after sample receipt.

6.4.2. Encore sample containers: Encore samples have a hold time of 48 hours at 0-6 ºC. If the samples are frozen (-7° to -20°C) before shipment to the lab, the hold time is extended to 14 days before preservation. All analysis must be completed with 14 days from sampling.

6.4.3. Samples preserved/extracted in the field (methanol and sodium bisulfate): Analysis for soil samples must be performed within 14 days (depending on analysis method). Check backlog for the holding time status. Best results are obtained by allowing the preserved sample to stand under the methanol for at least 24 hours.

7.0. APPARATUS:

7.1. Balance - Analytical, capable of accurately weighing 0.01 g.

7.2. Glass vials – 17-mL, 40mL, and 4-oz with Teflon-lined caps.

7.3. Disposable Pasteur pipettes.

7.4. Small squeeze bulb.

7.5. Refrigerator for extract storage located in Volatile Department.

7.6. Class A volumetric flasks: 25mL, 50mL, 100mL, and 500mL and gas tight syringes: 5, 10, 50, 100, 250, 500µL, 1, 2.5, 5, and 10mL.

8.0. REAGENTS:

8.1. Methanol – Purge and Trap grade, Fisher Chemical High Quality Solvent – Methanol.

8.2. BFB MeOH for field preserved samples: This solution is prepared in the laboratory at a concentration of 2.5 µg/mL BFB in MeOH. Fill a 2,000 mL flask more than halfway with methanol. Using a 1.0 mL syringe, add 1.0 mL Restek Car #30082 4-Bromofluorobenzene Standard (initial concentration 10,000 µg/mL), and fill to the mark with additional methanol. The flask is then carefully inverted three times, and placed into a 4 L storage container. The flask is filled a second time to mark with methanol, and added into the 4 L container. Before the BFB MeOH may be used, a test vial must be prepared and analyzed. To prepare the test, inject 1.0 mL of the BFB MeOH into a 50 mL flask filled up to the neck with reagent water, then fill to the mark with additional reagent water. That solution is then poured into a 40mL amber vial and given to the analyst for evaluation. Once analyzed, the analyst will approve that lot of BFB MeOH by completing the "Approved by" section of the label on the 4L container.

9.0. EXTRACTION:

9.1 Refer to SOP#143 for weighing procedures. Prepare containers for extraction of quality control samples.

9.1.1. Remove the cap, place the jar (4-oz) on the balance, shut the balance door and tare the balance.

9.1.2. Weigh out 50g of sample for preservation/extraction. Add 25mL of 2.5µg/mL BFB methanol as quickly as possible, and cap vial quickly. The methanol extract is then stored at 0-6ºC for 24hrs before analysis.

9.2. All samples should be refrigerated a minimum of 24 hours after methanol addition.

9.3. Samples should be allowed to come to room temperature prior to analysis.

9.4. OILS/ORGANIC LIQUID WASTE EXTRACTION

9.4.1. Weigh 1.0 g (± 0.1g) of the sample, (matrix 3 oil) into a screw capped septa sealed vial. Record the weight to two decimal places. Immediately add 5.0 ml BFB methanol.

9.4.2. If the sample dissolves in methanol it is ready for analysis. Excessive sample handling will result in loss of volatile compounds.

9.4.3. Samples that are not miscible in methanol must be stored at 0-6º C for 24 hours before analysis.

9.4.4. Record anything unusual about the sample or any apparent odors.

9.4.5. For additional dilutions the standard used dilution is: 100µl/50mL, post as 5X.

10.0. CALIBRATION:

N/A

11.0. ANALYSIS:

See method specific SOP. (8021, 8260, BTEX, 601,602)

12.0. QUALITY CONTROL:

12.1. For soil samples, a separate aliquot will be provided for percent solids determinations per SOP#115.

12.2. Each soil batch will have a MB, LCS, and MS/MSD. A LCSD may be used if insufficient sample is available for MS/MSD.

12.3. Any corrective action(s) needed to address a QC outlier or other technical challenges that are not listed in this SOP require the prior approval of the QA Office or Technical Department.

13.0. CALCULATIONS, REVIEW AND REPORTING:

13.1. Moisture Adjustment for Methanol Preserved Soils:

% Moisture = 100 – % Solid EQUATION 1

Final Volume = ((Mass of sample * % Moisture) / 1000 + Volume of MeOH EQUATION 2

13.2. Dilution Factor: Soil

(wet wt, g)(% Solid) = Dry weight, g EQUATION 3

$$\text{High level D.F.} = (5\text{ mL MEOH} / \text{Dry weight, g}) * \frac{5\text{ mL water}}{\text{Amount injected, mL}} \qquad \text{EQUATION 4}$$

* Note for low level soil methods 8260:

Low level D.F. = (5 g water / Dry weight of sample, g) EQUATION 5

13.3. Dilution Factor: oil

(Weight of oil, g) / Density of oil, g/mL = Volume of oil, mL (if required) EQUATION 6

Oil DF = 5 mL of MEOH / volume of oil, mL * 5 mL water / Amount injected, mL
or Oil DF = 5 mL MEOH / mass of oil, g * 5 mL water / Amount injected, mL EQUATION 7

14.0. HEALTH AND SAFETY:

14.1. Samples shall be returned to the approved storage location until such time as it is determined that no further analysis will be required.

14.2. Once it has been established that no more analysis of a sample will be required, acid and alkaline preserved samples may be neutralized using the Elementary Neutralization Hood located in GC Prep, unless it is considered to be hazardous (i.e. mercury waste, cyanide waste). Refer to the current version of SOP 108 for further instruction.

14.3. All surplus reagent acids shall be neutralized on a daily basis using the Elementary Neutralization Hood located in GC Prep.

14.4. Small volumes of surplus volatile reagents may be allowed to evaporate in a hood at the end of the analytical session.

14.5. Proper Personal Protective Equipment (PPE) must be worn at all times. Proper PPE when handling samples include a lab coat, gloves and safety glasses. In addition, when handling any samples or solutions with any acid or base preservative a face shield and apron must be worn.

15.0. POLLUTION PREVENTION:

SGS is committed to evaluate all areas of the lab with regard to current and potential pollution prevention. Pollution prevention is described as any technique that reduces or eliminates waste at the point of generation. Further discussion on pollution prevention programs in the laboratory can be found in *SGS Pollution Prevention Plan* (Form F053).

16.0. METHOD PERFORMANCE:

Method performance does not apply to this SOP.

17.0. DETECTION LIMIT (DL) STUDY:

N/A

18.0. LIMIT OF DETECTION (LOD):

N/A

19.0. LIMIT OF QUANTITATION (LOQ):

N/A

20.0. REFERENCES:

SW846 8000B (Dec. 1996)
SW846 5035A (July 2002)

21.0. ATTACHMENTS:

ATTACHMENT A: EXTRACTION Q.C.

BTEX/GRO Soil QC setup	Standard added	MeOH (µL)	Final Volume
IB/MB		2mL	100mL
NAS	100µL NAS		100mL
CCV2/CCV	100µL CCV2/CCV		100mL
LCS/LCSD BTEX/GRO	50µL CCV2/CCV	2mL	100mL
MS/MSD soil BTEX/GRO	50µL CCV2/CCV	2mL sample	100mL

BTEX/GRO Water QC setup	Standard added	MeOH (µL)	Final Volume
IB/MB		2mL	100mL
NAS	100µL NAS		100mL
CCV2/CCV	100µL CCV2/CCV		100mL
MS/MSD water	100µL CCV2/CCV	All Sample	100mL

8260 Water samples QC setup	Internal Standard / Surrogate	Primary CCV/ Early Gas	MeOH (µL)	Final Volume
IB / MB	Added by system			100mL
CCV / LCSD	Added by system	60µL	160µL	100mL
Matrix Spike	Added by system	60µL	160µL	100mL
Matrix spike Dup	Added by system	60µL	160µL	100mL
ICV	Added by system	60µL second source	160µL	100mL

8260 Soil samples QC setup	Internal Standard / Surrogate	Primary CCV/ Early Gas	MeOH (mL)	Final Volume
IB / MB	Added by system		2mL	100mL
CCV / LCS	Added by system	60 L each mix	1.8mL	100mL
Matrix Spike	Added by system	60 L each mix	2mL sample	100mL
Matrix Spike Dup	Added by system	60 L each mix	2mL sample	100mL
ICV	Added by system	60µL second source	1.8mL	100mL

ATTACHMENT B: VOLUMES TO USE FOR VARIOUS DILUTIONS

	OIL (500µL)	**TCLP** (500µL)	**SOIL** (1000µL)	**H20** (50,000µL)
5X	100µL	100µL	200µL	10mL
10X	50µL	50µL	100µL	5mL
20X	25µL	25µL	50µL	2.5mL
50X	10µL	10µL	20µL	1mL
100X	5µL	5µL	10µL	500µL
200X	2.5µL	2.5µL	5µL	250µL
500X	1µL	1µL	2µL	100µL

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S.O.P. Title: Purgeable Organic Compounds Analysis by GC/MS	**Revision Date**: September 2017
Method No: 8260C and 624	**SOP No**: 783r03
Page: 1 of 21	**Supersedes**: 783r02

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Technical Director	Date	Quality Assurance (QA) Manager, QA Staff or their Designee	Date
Stephen C. Ede	9/26/17		9/26/17

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Signature: ________________________ Printed Name: ________________________ Date: __________

Summary of Changes from Previous Revision:

- Changed 8260-modified compound list to reflect current practice.
- Changed comment in section 2.5. to reflect correct temperature.
- Changed section 3.1. to reflect current practices.
- Change section 7.3. reference of 5mL purge to 5mL/25mL purge.
- Changed name of gas chromatograph to current one being used.
- Changed name of software being used to current.
- Added the different flask and syringes being used.
- Changed all pH strip references of ≤ 0.5 to 0.5 - 5.5.
- Changed preparation of acidified water to current practices.
- Changed Methanol manufacturer to current one being used.
- Changed steps to make different sources of CCV and Early Gas to reflect current practices.
- Indicated section 8.8. was for Soil, and section 8.9. was for water.
- Changed instrument examples to current examples.
- Adjusted section 10.5.2., section 10.5.3., and 10.7.
- Changed section 11.6. temperature reference to current practice.
- Removed section 11.8.
- Changed section 12.2. to reflect current practice.
- Adjusted section 12.3. and section 12.6.5.
- Changed comment in Attachment A about average RF acceptance criteria and MS/MSD corrective action.

Table of Contents

1.0. OBJECTIVE:

This document outlines a technique and control parameters for identifying and determining the concentrations of volatile organic compounds in various sample matrices. The instrument used for analysis is a GCMS (gas chromatograph/mass spectrometer).

2.0. SCOPE AND APPLICATION:

2.1. Method 8260C is used to determine volatile organic compounds in a variety of waste matrices. This method is applicable to nearly all types of samples, regardless of water content, including ground water, aqueous sludge, waste solvents, oily wastes, mousses, tars, fibrous waste, polymeric emulsions, filter cakes, spent carbons, spent catalysts, soils, and sediments.

2.2. The following analytes can be determined by this method. It is possible to add analytes to this list on a project-by-project basis upon client request; however, special arrangements may be required.

Analyte	CAS Number	Analyte	CAS Number
Chloromethane	74-87-3	Vinyl chloride	75-01-4
Bromomethane	74-83-9	Chloroethane	75-00-3
1,1-Dichloroethane	75-34-3	Carbon Disulfide	75-15-0
Methylene chloride	75-09-2	*trans*-1,2-Dichloroethene	156-60-5
1,2 - Dichloroethane	107-06-2	*cis*-1,2-Dichloroethene	156-59-2
Chloroform	67-66-3	1,1,1-Trichloroethane	71-55-6
1,1-Dichloroethene	75-35-4	Benzene	71-43-2
2-Butanone	78-93-3	1,2-Dichloropropane	78-87-5
Carbon tetrachloride	56-23-5	Methyl-tert-butyl ether	1634-04-4
Trichloroethene	79-01-6	*cis*-1,3-Dichloropropene	10061-01-5
Bromodichloromethane	75-27-4	1,1,2-Trichloroethane	79-00-5
trans-1,3-dichloropropene	10061-02-6	Bromoform	75-25-2
Dibromochloromethane	124-48-1	MIBK	108-10-1
2-Hexanone	591-78-6	Tetrachloroethene	127-18-4
Toluene	108-88-3	Ethylbenzene	100-41-4
Chlorobenzene	108-90-7	*o*-Xylene	95-47-6
p&m-Xylene	108-38-3, 106-42-3	1,1,2,2-Tetrachloroethane	79-34-5
Styrene	100-42-5	1,3-Dichlorobenzene	541-73-1
1,2-Dichlorobenzene	95-50-1	1,4-Dichlorobenzene	106-46-7
Bromochloromethane	74-97-5	1,3-Dichloropropane	142-28-9
Dichlorodifluoromethane	75-71-8	Dibromomethane	74-95-3
2,2'-Dichloropropane	591-20-7	Trichlorofluoromethane	75-69-4
1,2,3-Trichlorobenzene	87-61-6	1,1-Dichloropropene	563-58-6
Isopropylbenzene	98-82-8	1,1,1,2-Tetrachloroethane	630-20-6
1,2,3-Trichloropropane	96-18-4	Bromobenzene	108-68-1
2-Chlorotoluene	95-49-8	*n*-Propylbenzene	103-65-1
1,3,5-Trimethylbenzene	108-67-8	4-Chlorotoluene	106-43-4
1,2,4-Trimethylbenzene	95-63-6	*tert*-Butylbenzene	98-06-6
1,2-Dibromo-3-chloropropane	96-12-8	*sec*-Butylbenzene	135-98-8
Hexachlorobutadiene	87-68-3	1,2,4-Trichlorobenzene	120-82-1
n-Butylbenzene	104-51-8	Naphthalene	91-20-3
1-Chlorohexane	544-10-5	Acetone	67-64-1
Vinyl acetate	158-05-04	Freon 113	76-13-1

2.3. Method 624 is used determine volatile organic compounds in a water matrix. The following analytes can be determined, and are routinely analyzed, by this method. It is possible to add analytes to this list upon client request.

Analyte	CAS Number	Analyte	CAS Number
Chloromethane	74-87-3	Vinyl chloride	75-01-4
Bromomethane	74-83-9	Chloroethane	75-00-3
1,1-Dichloroethane	75-34-3	*cis*-1,2-Dichloroethene	156-59-2
Methylene chloride	75-09-2	*trans*-1,2-Dichloroethene	156-60-5
1,2 - Dichloroethane	107-06-2	1,1,1-Trichloroethane	71-55-6
Chloroform	67-66-3	Benzene	71-43-2
1,1-Dichloroethene	75-35-4	1,2-Dichloropropane	78-87-5
Carbon tetrachloride	56-23-5	*cis*-1,3-Dichloropropene	10061-01-5
Trichloroethene	79-01-6	1,1,2-Trichloroethane	79-00-5
Bromodichloromethane	75-27-4	Bromoform	75-25-2
trans-1,3-dichloropropene	10061-02-6	Tetrachloroethene	127-18-4
Dibromochloromethane	124-48-1	Ethylbenzene	100-41-4
Toluene	108-88-3	*o*-Xylene	95-47-6
Chlorobenzene	108-90-7	1,1,2,2-Tetrachloroethane	79-34-5
p&m-Xylene	108-38-3, 106-42-3	1,3-Dichlorobenzene	541-73-1
Styrene	100-42-5	1,4-Dichlorobenzene	106-46-7
1,2-Dichlorobenzene	95-50-1	Trichlorofluoromethane	75-69-4
Total Xylenes			

2.4. The following compounds (8260-Modified) can be run when special project arrangements are made in advance. If requested, these compounds will be reported as method “8260M”:

Analyte	CAS Number
Cyclohexane	110-82-7
n-Hexane	110-54-3

2.5. An autosampler is used to move a 5-mL or 25-mL aliquot of a sample into a specially designed purging tube. An inert gas, helium is bubbled through the tube at 40°C. This transfers purgeable compounds as a vapor phase. The vapor passes through a sorbent trap. Once purging is complete, the trap is then heated and back flushed with inert gas desorbing onto a gas chromatographic column. The gas chromatograph is temperature programmed to separate the compounds, which are then detected with a mass spectrometer.

3.0. DEVIATIONS FROM REFERENCE METHOD:

3.1. 8260: Surrogates are spiked by the instrument, into all calibration levels, blanks, and all analysis at 30µg/L. For soils, BFB is spiked into all calibration level, blanks, and all analysis at 80µg/L.

3.2. 8260: The CCV, LCS, LCSD, MS, & MSD will be prepared using the primary standards.

3.3. A second source ICV is run to verify each calibration acceptance criteria per the DOD QSM. The recovery for all 8260 compounds should be ±20%. Compounds included in the 8260-modified list should be ±50%.

3.4. 624: The trap material and temperatures. Note: There have been substantial improvements to instrumentation and trap packing material since Method 624 was revised.

3.5. 624: Internal standards and surrogates are as listed in this document in section 8.8.

3.6. 624 QC from published method sections (8.1.–8.7.) will be replaced by these SOP sections (8.5. - 8.12.) and section 9.0

3.7. BFB Key Ion Abundance Criteria for MS Tuning will be as listed in section 12.1 of this SOP and will replace section 10 of method 624.

4.0. RESPONSIBILITIES:

4.1. The QA Office maintains a master list of this SOP to ensure review on a timely basis. This system serves as an accounting of SOP distribution and ensures that distributed SOPs are current and complete. This includes destruction of controlled copies of expired and retired SOPs. The QA Office also maintains a historical file of original cover pages with wet signatures and digitally signed electronic versions of this SOP; including the current revision and any versions archived within the past 5 years.

4.2. The electronic (Word Document) versions of this SOP, both current and any prior versions, are maintained on the computer network in a secure location as a “read only” file.

4.3. It is the responsibility of all personnel to follow this SOP as written, document and gain QA or Technical Director approval for deviations to the SOP, and submit needed SOP revisions to the QA Office.

4.4. This SOP is scheduled for review on an annual basis. Any required revisions will be incorporated into the SOP. The new revision of the SOP will be distributed by QA and the superseded version returned to the QA Office. If no revisions are required, the SOP cover page is signed and dated to document the review, and the updated cover page will be distributed.

4.5. A PDF version of each SOP (generated in Adobe or scanned) is digitally signed by a member of the QA Office as a security measure. The digitally signed PDF, used online, is considered to be a controlled copy of the SOP and is stored on the network.

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All staff have “read” access to these SOPs. Only QAQC has access to “write” on SOPs. Staff is directed to use the controlled electronic versions of SOPs. A limited number of controlled hardcopies are to be distributed by the QA Office.

5.0. INTERFERENCES:

There are three primary sources of contamination:

5.1. Impurities in the purge gas and organic compounds out-gassing from the plumbing ahead of the trap account for the majority of contamination problems. The analytical system must be demonstrated to be free from contamination under the conditions of analysis by running laboratory reagent blanks each day. The use of non-Teflon plastic tubing, non-Teflon threads sealant, or flow controllers with rubber components in the purge and trap system should be avoided.

5.2. Samples can be contaminated by diffusion of volatile organics through the septum seal into the sample during shipment and storage. A field reagent blank prepared from reagent water and carried through the sampling and handling protocol can serve as a check on such contamination.

5.3. Contamination by carry-over can occur whenever high level and low-level samples are analyzed sequentially. To reduce carry-over, the purging device and sample syringe must be rinsed with reagent water between sample analyses. Unusually concentrated samples should be followed by analysis of reagent water to check for cross contamination. Since the trap and other parts of the system are also subject to contamination, baking and purging of the entire system may be required.

5.4. Some liquid samples foam up with agitation. This causes contamination in the lines going from the sparge tube. Antifoam is used to inhibit foam production.

6.0. SAMPLE HANDLING:

6.1. Proper Handling: The samples must be iced or refrigerated at 0 – 6°C from the time of collection until analysis. Frozen soil in 40ml purge vials and Encore samples must be kept at less than or equal to -10°C until analysis or, in the case of Encores, extraction with methanol.

6.2. Holding Time: All properly preserved water, soil, oils, and sludge samples must be analyzed within 14 days of collection. Water samples not preserved to a pH of less than two must be analyzed within 7 days of collection.

6.3. Storage Procedures: Sample bottles must remain hermetically sealed and stored in a location free from any solvents and isolated from all standards and standard solutions.

6.4. Preservation: Water samples are collected in vials containing 0.5mL of 50% HCl as a preservative. This adjusts the pH of the sample to less than 2. Sodium thiosulfate or ascorbic acid must be added prior to acidification if source is chlorinated. Soil samples should be preserved with methanol for medium-high concentration samples or, for low concentration samples, sodium bisulfate or DI water before freezing (refer to SGS SOP#767). In the case of the latter, a methanol preserved sample volume must also be collected in the event concentrations above the calibration range are encountered in the analysis of the sodium bisulfate or frozen aliquot.

6.5. When prepping samples for volatile analysis the only type of gloves that can be used is neoprene. Latex and nitrile gloves will result in carbon disulfide contamination.

7.0. APPARATUS:

7.1. Sample Vials (aqueous samples) – 40mL capacity equipped with a screw cap with a Teflon-faced silicone septum.

7.2. Sample jars (solid samples) - glass jars equipped with a Teflon-lined screw cap lid.

7.3. The Closed System Autosampler, Centurion has vial trays designed to hold 40mL vials. The Centurion holds 100 vials. The system automatically transfers a 5mL/25mL aliquot of sample to a purge vial for purging. The gaseous headspace between the water column and the inlet should be a total volume of less then 15mL. The purge gas must pass through the water column as finely divided bubbles with a diameter of less than 3mm at the origin. The purge gas must be introduced no more than 5mm from the base of the water column.

7.4. Purge and Sample Concentrator Module - The hydrocarbon trap must be at least 25cm long and have an inside diameter of at least 0.105in. The desorber must be capable of rapidly heating the trap.

7.5. Gas Chromatograph - An analytical system complete with a temperature programmable gas chromatograph suitable for on-column injection and all required accessories including syringes, analytical columns, gases, and detector. (Agilent Technologies 7890B/7890A)

7.6. Mass Spectrometer - Capable of scanning from 35 - 300amu every 1 seconds or less, using 70 volts (nominal) electron energy in the electron impact mode and producing a mass spectrum that meets all the criteria in Table 1 when 5-50ng gets to the detector by purging 4-Bromofluorobenzene (BFB) as part of the instrument blank. If 3uL of 50ng/uL SURR solution is added to the samples, that equals 15ng of 4-BFB to the detector assuming a 10:1 injector split.

7.7. Software: MSD Chemstation and Mass Hunter are used for data analysis.

7.8. Class A volumetric flasks: 25mL, 50mL, 100mL, and 500mL and gas tight syringes: 5, 10, 50, 100, 250, 500µL, 1, 2.5, 5, and 10mL.

7.9. Narrow range pH test strips: pH 0.5-5.5

7.10. For instrument specific operating parameters see the instrument maintenance manual.

8.0. REAGENTS:

*****Note: All in-house standards have an expiration date of one year from production; providing it does not surpass the vendor's expiration date*****

8.1. Reagent water – organic free RO water in which the analytes of interest are not observed at ½ the LOQ values.

8.1.1. Acidic RO, (used to prepare samples and calibrations), is prepared by adding ~4mL of 1:1 HCL to 4 liters of reagent water to obtain a pH of ≤ 2.

8.2. Hydrochloric acid (1:1) - Add 50mL of concentrated HCl to 50mL of reagent water.

8.3. Methanol – Purge and Trap grade, Fisher Chemical High Quality Solvent – Methanol

8.4. 20% Sodium Bisulfate solution – Add 100g of sodium bisulfate (Fisher Scientific part # 5240-500) to 500mL of reagent water.

8.5. Calibration and quality control standards for 8260: Certified solutions are purchased from two venders, to be used as calibration and second source standards. The vendors will be chosen from the "ISO Guide 34" list when possible.

8.5.1. Primary 8260 Early Gas Solution: Using a gas tight syringe transfer 1.25 mL each Restek (2000µg/L) vinyl acetate standard, Supelco (2000µg/L) volatile organic compound, and NSI (2000µg/L) 1,3-butadiene into a 50mL volumetric flask filled up to the neck with methanol. Bring to volume with methanol and invert three times. This yields 50/50µg/mL solution.

8.5.2. Primary 8260 CCV Solution: Using a gas tight syringe transfer 1.25mL Restek (2000µg/L) 502.2 Cal 2000 mega-mix, 0.75m/L of Restek (5000µg/L) custom SGS-8 primary standard, and 0.75mL of ECS (10,000µg/L) ketone mixture into a 50mL volumetric flask filled up to the neck with methanol. Bring to volume with methanol and invert three times. This yields a 50/75/150µg/mL solution.

8.5.3. Second Source 8260, Early Gas Solution: Using a gas tight syringe transfer 1.25 mL each Ultra (2000µg/L) voc gas mixture, NSI (2000µg/L) vinyl acetate, and Restek (2000µg/L) 1,3-butadiene standard into a 50mL volumetric flask filled up to the neck with methanol. Bring to volume with methanol and invert three times. This yields 50/50µg/mL solution.

8.5.4. Second Source 8260 CCV Solution: Using a gas tight syringe transfer 1.25mL Supelco (2000µg/L) SS 502/524 volatile organics calibration mix, 0.75m/L of Restek (5000µg/L) custom SGS-8 secondary standard, and 1.25mL of Restek (5,000µg/L) VOA calibration mix #1 into a 50mL volumetric flask filled up to the neck with methanol. Bring to volume with methanol and invert three times. This yields a 50/75/150µg/mL solution.

8.6. Spike solution (SPK) – Use the appropriate Primary Standard to spike samples (MS and MSD) when required.

8.7. Surrogate solution (SUR) - Certified solution purchased from Supelco #49112-U at a concentration of 10,000µg/mL (toluene-D$_8$, 4-bromofluorobenzene, and 1,2-dichloroethene-D$_4$).

8.7.1. Prepared by dilution. Place approximately 80mL of methanol in a 100mL class A volumetric flask. Inject 0.5mL of the surrogate solution into the methanol. Bring to volume with methanol. Invert three times. This yields a 50µg/mL surrogate solution.

8.8. Internal Standard Solution (INT) for Soil - certified solutions purchased from Restek Custom Internal Standard Mix at a concentration of 10,000µg/mL (fluorobenzene, 1-chloro-3-fluorobenzene, and 1,2-dichlorobenzene-D_4).

8.8.1. Prepared by dilution. Place approximately 40mL of methanol in a 50mL class A volumetric flask. Inject 250µL of the internal standard solution into the methanol. Bring to volume with methanol. Invert three times. This yields a 50µg/mL internal standard solution.

8.8.2. A combined internal standard / surrogate solution for manual injection is prepared by diluting 0.5mL of Surrogate solution (8.10) and 0.5mL Internal Standard mix (8.11) into 100mL of methanol. This mix is 50µg/mL and is used 3.0µl per 5.0mL sample.

8.9. Combined Internal Standard and Surrogate mix for Water, Closed System Centurions.

8.9.1. Prepared by dilution using the purchased standards Restek Custom Internal Standard Mix 555809 (10,000ug/mL) and Supelco 8260 surrogate mix 20557902 (10,000mg/mL). Place approximately 80mL of methanol in a 100mL class A volumetric flask. Inject 1.5mL of Restek Custom Internal Standard Mix and 1.5mL of Supelco surrogate mix into the methanol. Bring to volume with methanol. Invert three times. This yields a 150µg/mL solution for the 25 mL purge.

8.9.2. To prepare the Internal Standard and Surrogate mixes for the Centurion, place approximately 15mL of methanol in a 25mL, class A, volumetric flask. Dilute the 150µg/mL solution prepared above (8.9.1) by diluting 5.0mL of the 150µg/mL solution to 25mL with methanol. Invert three times. This yields a 30µg/mL solution that is used for the 5 mL purge.

8.10. Purchased standards should not be used past manufacturer's expiration date. Standards prepared from stock solutions are valid for one year from creation, manufacturer's expiration date, or when signs of degradation are observed.

8.10.1. Transfer each stock standard solution into its own Teflon-sealed screw cap bottle and store in the freezer protected from light with minimal head space. Label and date bottle in accordance with the Laboratory Standards Labeling SOP #112.

8.12. BFB MeOH for field preserved samples: This solution is prepared in the laboratory at a concentration of 2.5 µg/mL BFB in MeOH. Fill a 2,000 mL flask more than halfway with methanol. Using a 1.0 mL syringe, add 1.0 mL Restek Car #30082 4-Bromofluorobenzene Standard (initial concentration 10,000 µg/mL), and fill to the mark with additional methanol. The flask is then carefully inverted three times, and placed into a 4 L storage container. The flask is filled a second time to mark with methanol, and added into the 4 L container. Before the BFB MeOH may be used, a test vial must be prepared and analyzed. To prepare the test, inject 1.0 mL of the BFB MeOH into a 50 mL flask filled up to the neck with reagent water, then fill to the mark with additional reagent water. That solution is then poured into a 40mL amber vial and given to the analyst for evaluation. Once analyzed, the analyst will approve that lot of BFB MeOH by completing the "Approved by" section of the label on the 4L container.

8.13. Antifoam: liquid polymer without volatile compound interferences, used to reduce surface tension.

9.0. EXTRACTION:

Please refer to SGS SOPs 764 and 767.

10.0. CALIBRATION:

10.1. Before recalibrating, each instrument shall be tuned using PFTBA. Compare abundance of ion 69 to ratios of ions 131 & 219, and peak widths of each ion to previous tune print outs. If out of control values are observed, perform MS autotune and then retune manually. When acceptable results are gained, the tune (along with parameters) will be printed and filed in instrument specific binders.

10.1.1. Calibration Setup – Calibration standards are prepared from the primary solutions in the previous section.

10.1.2. The 8260-Modified list of compounds (refer to section 2.) methyl-tert-butyl ether and carbon disulfide are calibrated at 1.5 times the "normal" concentration of 0.4 – 70µg/mL. Calibrated at 2 times the "normal" concentration are: p&m xylene. Calibrated at 3 times the "normal" concentration are: acetone, 2-butanone, 4-methyl-2-pentanone, and 2-hexanone.

Waters Table:
For 5mL purge

Prepared in acidic DI water

Conc. (µg/L)	CCV Std. and Early Gas Std. (µL in 100mL)	Methanol (µL in 100mL)
0.075	0.15	400
0.4	0.8	398
1.0	2.0	396
3	6.0	388
10	20	360
30	60	280
50	100	200
70	140	120
200	400	0

Transfer to two 40mL vial. The IS and Surrogate are added automatically (30 g/L) by the system.

Soils Table:
For 5mL purge

Prepared in DI water

Conc. (µg/L)	CCV Std. and Early Gas Std. (µL of each)	Methanol (mL in 100mL)
0.4	0.8	1.998
1.0	2.0	1.996
4.0	8.0	1.984
8.0	16	1.968
30	60	1.88
50	100	1.8
70	140	1.72
200	400	1.2

Transfer to two 40mL vial. The IS and surrogate are added automatically (30 g/L) by the system.

Low Level Soils Table:
For methanol 25mL purge

Prepared in DI water

Conc. (µg/L)	CCV Std. and Early Gas Std. (µL of each)	Methanol (mL in 100mL)
0.02	0.2 (in 500mL)	10 (in 500mL)
0.08	0.8 (in 500mL)	10 (in 500mL)
0.4	0.8	1.998
1.0	2.0	1.996
4.0	8.0	1.984
8.0	16	1.968
30	60	1.88
50	100	1.8
100	200	1.6

Transfer to two 40mL vial. The IS and surrogate are added automatically (30 g/L) by the system.

Low Level Soils Table
For 5mL in-vial purging

Conc. (µg/L)	CCV/Early Gas Std. (µL/ea)	Final vol. (mL)	MeOH (µL)
0.4µg/L	0.8	100	279
1.0µg/L	2	100	278
3.0µg/L	6	100	268
10µg/L	1	5	12
30µg/L	3	5	8
50µg/L	5	5	4
70µg/L	7	5	0

A 5mL aliquot is then added to a 40mL vial containing blank sand and fitted with a stir-bar. The IS and Surrogate are added automatically (30 g/L) by the system.

10.2. Calibration Processing Steps:

10.2.1. Load the current calibration for the instrument of interest. (VRA, VQA, etc.)

10.2.2. Save the method to the date run. (VSA2008-0512.M)

10.2.3. Load the data file. Load the 30 point for 8260.

10.2.4. Quant the 30 point.

10.2.5. Init. Cal. – update levels – retention times

10.2.6. Init. Cal. – Clear all calibration responses.

10.2.7. Init. Cal. – update levels – responses

10.2.8. Init. Cal. – Global Update – set curve fit – average response

10.2.9. Save Method

10.2.10. Quant 30 point.

10.2.11. Con. Cal. – Save ISTD responses

10.2.12. Q Edit 30 point. All values should be 30.00, 45.00, or 90.00 respectively. Save Method.

10.2.13. If all values do not meet the exact value, repeat the process, after saving the method.

10.2.14. Save the method.

10.2.15. Quant each of the other points of the curve, Q Edit, Save, Update responses in Init. Cal., Save Method.

10.2.16. Review each analyte to meet QC criteria per section 10.5.

10.3. To evaluate the calibration, a response factor report is prepared. The report calculates the average response factor for each analyte and the relative standard deviation between response factors for the different concentrations.

10.3.1. Each of the most common analytes in the calibration verification standard should meet the minimum response factors as noted in Attachment B.

10.3.2. If the minimum response factors are not met the system should be evaluated and corrective action should be taken before samples are analyzed.

10.3.3. All target compounds of interest must be evaluated using a 15% variability criterion. Use percent difference when performing the average response factor model calibration.

10.4. System performance check compounds (SPCC) -8260C does not have SPCCs.

10.5. The criteria used for curve fit is as follows:

10.5.1. Average Response Factor (RRF): (Preferred), Analytes with an RSD less than or equal to 15% for their average response factor are quantitated using the average factor. A minimum of 5 points are required. If the RSD is greater than 15% then one of the following options will be used.

10.5.2. Linear (1st order) least squares regression: This option requires a minimum r^2 value of 0.990 (or a r value of 0.995). A minimum of 5 points are required. As per method 8000C, forcing through zero is not permitted.

10.5.2.1. When calculating the calibration curves using the linear regression model, a minimum quantitation check on the viability of the lowest calibration point should be performed by re-fitting the response from the low concentration calibration standard back into the curve. It is not necessary to re-analyze a low concentration standard, rather the data system can recalculate the concentrations as if it were an unknown sample. The recalculated concentration of the low calibration point should be within ±30% of the standard's true concentration.

10.5.2.2. Analytes which do not meet the minimum quantitation calibration refitting criteria should be considered "out of control" and corrective action such as redefining the lower limit of quantitation and/ or reporting those "out of control" target analytes as estimated when concentration is at of near the lowest calibration point may be appropriate.

10.5.3. Quadratic non-linear (2nd order) regression: This option requires a minimum r^2 value of 0.990 (or an r value of 0.995). A minimum of 6 points are required. As per method 8000C, forcing through zero is not permitted.

10.5.4. The use of weighted least squares regression may be used. The deciding factor in the use of these techniques will be the residuals for the calibration points (which fit best matches the points). The residual is the difference between the known concentration of the calibration point and the calculated value based on the calibration curve. The analyst should strive to reduce the residual error at each point in the calibration to less than 20%.

10.6. Relative retention times (RRT) for all calibration points must agree within 0.06 RRT units from the mid point of the calibration curve. RRT= RT Analyte (minutes)/RT Internal Standard (minutes).

10.7. After a calibration is complete, initial calibration verification (ICV) is run using a Second Source Solution (sections 8.5.3. and 8.5.4). Goals are achieved if all analytes are ± 20% of the calculated true value of the solution. **Note: For 8260-Modified compounds (refer to section 2.0.), ICV criteria are ± 50%.**

11.0. ANALYSIS:

11.1. Initial screening of samples is done by visually inspecting the appearance of the sample. The LIMS queue backlog is checked for the required analysis and special QA/QC requirements.

11.1.1. Liquid samples that demonstrate a tendency to foam with agitation are treated with antifoam to inhibit the formation of foam in the sparge tube. A blank sample, with antifoam added, is processed with any samples analyzed with the addition of antifoam.

11.2. For water samples – After allowing the sample to come to ambient temperature place the 40mL vial on the Centurion autosampler. The Centurion will remove a 5mL aliquot from the vial and before transferring will inject IS/Surr mix to yield a final concentration of 30 µg/L. After the analysis, the pH of the sample is taken using narrow range pH indicator strips (pH 0.5 - 5.5) from the sample remaining in the vial, and recorded on runlog.

11.3. All TCLP leachates and 100% liquid TCLP samples must come to ambient temperature before analysis. These samples are analyzed at a 50X dilution or per client request. This meets the regulatory TCLP limits. 100% liquid TCLP samples must be filtered prior to analysis using a syringe filter. Matrix “6” samples that are not TCLP analyses are diluted 50X before analysis. Matrix “6” samples that are not TCLP analyses may or may not be filtered prior to analyses per client request. Matrix “6” TCLP samples are filtered and analyzed at a 50X dilution.

11.4. For methanol preserved soil samples – Preparation of this matrix requires dilution prior to analysis. After allowing the sample to come to ambient temperature a 1.0mL aliquot of the methanol extract is diluted to 50mL. Transfer solution to a 40mL vial and place on the autosampler for analysis. The Centurion will remove a 5mL or 25mL aliquot from the vial and before transferring will inject IS and surrogate to yield a final concentration of 30 µg/L.

11.5. Frozen (thawed soil/DI water) and sodium bisulfate preserved soil samples are set-up on the closed system instrument as received from the field. Refer to SOPs # 764, & 767 (methods 5030C and 5035A) for purge and trap extraction.

11.6. Soil samples not extracted in the field will be treated as field extracts. {Refer to SOP # 764, & # 767 (methods 5030C & 5035A) for extraction.} Weigh out approximately 50g of sample and add 25mL of BFB-methanol into a pre-weighed 4.0 oz. jar. Both the initial weight and final weight will be stored in LIMS or recorded in the AK101/8260C logbook (refer to SOP#143 for weighing procedures). The extracted samples must be iced or refrigerated at 0 - 6°C for 24 hours before analysis can be performed.

11.7. Qualitative Analysis. The qualitative identification of compounds in a sample is based on retention time and comparison of mass spectrum with characteristic ions in a reference spectrum. The reference spectrum must be generated using the same conditions as the calibration. The characteristic ions from the reference mass spectrum are typically the three ions of greatest intensity, or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum. Positive identification of target compounds is confirmed when the following criteria are met:

11.7.1. The compound elutes within the retention time window set during calibration.

11.7.2. The relative intensities of the characteristic ions agree within 30% from the reference spectrum.

11.7.3. Identification is hampered when individual analytes are not resolved chromatographically and produce mass spectra containing ions contributed by more than one compound. The identification criteria may be met, but each compound spectrum will contain extraneous ions. Analyst judgment is imperative while deciding to assign or eliminate peaks that are target analytes.

11.7.4. For samples containing impurities not associated with the calibration standards, a library search may be performed for the purpose of tentative identification. For guidance regarding Tentatively Identified Compounds (TICs), refer to SGS SOP 500.

11.7.5. Quantitation of calibrated compounds: Once a compound has been identified, quantitation is based on the integrated abundance of the primary characteristic ion. The internal standard used is the one closest in retention to that of the compound. The average RRF or calibration equation from the most recent initial calibration is used for the calculation.

11.7.6. Batches that are run in tandem with 2 concentrators must be screened by the analyst to identify samples that may present cross contamination due to the concentration of analytes in that sample. Those samples must be documented in the run log for both concentrators as well as all samples that could be affected. This must be completed before any samples are reported from either “side” of the run. Samples so identified must be evaluated by the analyst for carryover contamination before reporting. The Peer Reviewer will insure that the noted samples have been evaluated for cross contamination.

11.7.6.1. When evaluating this type of data, check run times to determine the order of analysis. The standard alternation of concentrators can be changed when one instrument has down time and the other does not (e.g. failed QC for one of the two instruments).

12.0. QUALITY CONTROL:

12.1. At the beginning of each 12-hour period the GC\MS must be tune must be checked to meet BFB specifications see Table 1. The instrument blank or CCV is used to evaluate the tune. The primary method for BFB tuning is to use the software’s autotune feature which takes the apex, the scan prior, and the scan following averages them, and performs a background subtraction. The secondary method of tune (manual) evaluation is to pick the apex, the scan prior, or the scan following and have the software evaluate BFB for that scan.

Table 1
BFB Key Ion Abundance Criteria for MS Tuning

Mass	Ion Abundance Criteria
50	15 to 40% of m/z 95
75	30 to 60% of m/z95
95	base peak, 100% relative abundance
96	5 to 9% of m/z 95
173	less than 2% of m/z 174
174	>50% of m/z 95
175	5 to 9% of m/z 174
176	95% to 101% of m/z 174
177	5 to 9% of m/z 176

Note that autotune is routinely used and the manual procedure is used in a minority of circumstances.

When manually performing the BFB tune, follow these steps to subtract the background:

A. Choose the area to be scanned, using the left mouse button.
B. Double click inside the chosen area.
C. Double click outside the peak area.
D. Choose the “subtract” option under the “TUNER” macro box.

12.2. Before processing any samples the analyst analyzes an instrument blank. The instrument blank can serve as the tune blank and shows that interferences from the analytical system and reagents are under control. If any analytes are detected above the LOQ in the blank, and are detected in the associated samples above the LOQ for non-DOD and ½ the LOQ for DOD, then those compounds must be reanalyzed. If the analytes detected in the blank are not detected in the samples above the LOQ or ½ LOQ, reanalysis is recommended, but not necessary.

12.3. One method blank is run per batch. This shows that interference from glassware and reagents is under control.

12.4. **The ICV is prepared using the second source standards.**

12.5. Oil Quality Control:

An acceptable curve, Initial tune, initial blank and continuing calibration verification.

DAILY QC SETUP

Water samples QC setup	Internal Standard / Surrogate	Primary Source 8260	Primary Source Early Gases	MeOH (µL)	Final Volume
IB / MB	Added by system				100mL
CCV / LCSD	Added by system	60µL	60µL	160µL	100mL
Matrix Spike	Added by system	60µL	60µL	160µL	100mL
Matrix spike Dup	Added by system	60µL	60µL	160µL	100mL

Soil samples QC setup	Internal Standard / Surrogate	Primary Gas/Early Gas	MeOH (mL)	Final Volume
IB / MB	Added by system		2mL	100mL
CCV / LCS	Added by system	60 L each mix	1.8mL	100mL
Matrix Spike	Added by system	60 L each mix	2mL sample	100mL
Matrix Spike Dup	Added by system	60 L each mix	2mL sample	100mL

12.6. OILS/ORGANIC LIQUID WASTE EXTRACTION:

12.6.1. Weigh 1.0 g (± 0.1g) of the sample, (matrix 3 oil) into a screw capped septa sealed vial. Record the weight to two decimal places. Immediately add 5.0 ml BFB methanol.

12.6.2. If the sample dissolves in methanol it is ready for analysis. Excessive sample handling will result in loss of volatile compounds.

12.6.3. Samples that are not miscible in methanol must be stored at 0-6º C for 24 hours before analysis.

12.6.4. Record anything unusual about the sample or any apparent odors.

12.6.5. For additional dilutions the standard used dilution is 100µg/L/50mL post as 5X.

12.7. The experience of the analyst performing GC\MS analysis is invaluable to the success of the methods. Each day that analyses are performed, the daily calibration standard should be evaluated to determine if the chromatographic system is operating properly. Questions that should be asked are: Do the peaks look normal? Is the response obtained comparable to the response from previous calibrations? Careful examination of the standard chromatogram can indicate whether the column is still usable, the injector is leaking, etc. If any changes are made to the system (e.g. column changed), recalibration of the system should take place. **Note:** For manual integration guidance, please refer to SOP#144.

12.8. The calibration verification is run at the beginning of each 12-hour period in the analytical lot after the tune check. The calibration verification standard (CCV) is used to check the validity of the initial calibration. The percent drift for a CCV and all other analytes (calculated as the percent difference between the true and recovered CCV concentrations) must be less than +/- 20%. If the CCV recovery is low, all data for that analyte will not be reported and will be reanalyzed the following day. In the event of a high bias, every attempt will be made to reanalyze the samples with recoveries for the affected analyte in an additional analytical run. If this is not possible due to hold time expiration or insufficient sample volume the results may be posted as estimated. (Refer to SOP#136 for Data Flagging.)

12.8.1. Internal Standard Retention Time- The retention times for the internal standards in the CCV must be evaluated. If the retention time for any internal standard changes by more than 10 seconds from that of the midpoint standard level of the most recent calibration sequence then the chromatographic system must be inspected for malfunctions and corrections must be made. When the corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.

12.8.2. **All methods for DOD samples:** In the event of a recovery failure for analytes of interest in continuing or closing CCV samples, the Analyst may immediately (within 1 hr of the failing CCV and before any other samples have acquired) rerun 2 successive CCVs. If both meet QC criteria for all analytes of interest, then the samples already analyzed may be reported and the run sequence may be continued. Samples following the two passing CCVs are also valid. **All CCVs must be reported in LIMS.** Refer to SOP#101 for nomenclature (e.g., CCCV, CVC, CVCA, etc.)

12.9. The minimum response factors listed in Table 4 must be met. Internal Standard area counts must not change by more than a factor of two (-50 % to +100%) from the mid-point standard in the most recent initial calibration. Internal standard retention time of the CCV must not change by more than 10 seconds from the mid-point standard in the initial calibration. If the criteria are not met, investigate the problem. Reanalyze the standard or analyze a new calibration curve.

12.10. Laboratory Control Sample (LCS) - Each analyte should be within lab generated control limits. When analytes fall outside of control limits refer to Peer Review SOP#101 for sample comments. If problem persists corrective action should be taken to return the instrument to proper control.

12.11. Matrix spikes / Matrix Spike Duplicate (MS / MSD) - Spike two sample aliquots with the primary solution. The analytes should be within the LCS lab generated control limits for each analyte, and the relative percent difference (RPD) between the spikes must be less than or equal to 20%. MS recoveries are not used to control the acceptability of a batch. A footnote is to be generated discussing any outliers. If there is insufficient sample volume to perform an MS/MSD an LCSD must be analyzed as part of the extraction batch.

12.12. Initial Demonstration of Proficiency. – Once per Analyst. Four replicate standards are analyzed and evaluated for recovery and RPD per EPA 8000C section 8.0.

12.13. Refrigerator/storage blanks are used to monitor for potential cross contamination in temporary and long-term storage units. (Refer to SOP#104 for details.) These storage blanks will be logged into LIMS and treated on a RUSH basis. Those analyzed by 8260C will be evaluated to ½ LOQ. Anything in excess will be rerun to confirm.

12.14. Section 16 outlines QC criteria and corrective actions. Any corrective action required to address a QC outlier or technical problem which not listed in this SOP requires the prior approval of the QA Manager or Technical Director.

13.0. CALCULATIONS, REVIEW AND REPORTING:

13.1. **% Solid** = $\frac{(\text{g. of dry sample + pan}) - (\text{pan weight}) \times 100}{(\text{g. of wet sample})}$

Example $\frac{(3.034\text{ gm}) - (1.567) \times 100}{(5.034)} = 29.14\%$

13.2. **Moisture Adjustment for Methanol Preserved Soil :**

% Moisture = 100 - % Solid

Final Volume = (Mass of sample * % Moisture) / 100 + MeOH Volume

13.3. **Dilution factor for soils**:

[wet weight (g.)] $\left[\frac{\%\text{ solid}}{100}\right]$ = True weight (g.)

$\frac{5\text{ mL methanol}}{\text{True weight}} \times \frac{5\text{ mL water}}{\text{mL of samples}}$ = Dilution Factor

Example(5 gm sample) $\frac{(92\%\text{ solids})}{100}$ = 4.6 gm true weight

$\frac{(5\text{ mL MEOH})}{(4.6\text{ gm true weight})} \times \frac{(5\text{ mL water})}{(0.100\text{ mL sample})}$ = 58.69 dilution factor

13.4. **Dilution factor for oil/sludges**:

$$\frac{\text{5 mL methanol}}{\text{wt (g) of sample}} \quad \text{X} \quad \frac{\text{5 mL water}}{\text{0.050 mL MeOH ext.}} = \text{Dilution factor}$$

Example for a 1 gm sample, injected at 50 µL

$$\frac{\text{5 mL}}{\text{1.0 gm}} \ \text{X} \ \frac{\text{5 mL}}{\text{.050 mL}} = \quad \text{500 dilution factor}$$

Note: All oil samples for TCLP must be density corrected.

13.5. **Dilution factor for oil/sludges w / Density correction**.

Example $$\frac{\text{2.1360 gm of sample}}{\text{0.956 gm/mL}} = \quad \text{2.2343 mL}$$

Example for a 2.1360 gm sample, injected at 50 µL

$$\frac{\text{5 mL}}{\text{2.2343 mL}} \ \text{X} \ \frac{\text{5 mL}}{\text{0.050 mL}} = \quad \text{223.78 dilution factor}$$

13.6. **Estimated concentration for noncalibrated compounds**

$$\left(\frac{\text{(Area of Sample from) Total Ion Chromatogram}}{\text{(Area of IS from Total) Ion Chromatogram)}}\right)\left(\frac{\text{Conc Internal Standard(ug/mL)}}{\text{(Response Factor=1.00)}}\right)\left(\text{Dilution Factor}\right) = \text{Conc ug/L}$$

13.7. **Example calculation for compound concentration**

$$RF = \frac{As \ X \ Cis}{Ais \ X \ Cs} \qquad \text{RF is generated from calibration}$$

$$Cs = \frac{As \ X \ Cis}{RF \ X \ Ais} \qquad \text{Cs is generated daily}$$

Cis = Concentration of internal standard.
Ais = Area of Internal Standard
Cs = Concentration of Analyte
As = Area of Analyte

14.0. HEALTH AND SAFETY:

14.1. Samples shall be returned to the approved storage location until such time as it is determined that no further analysis will be required.

14.2. Once it has been established that no more analysis of a sample will be required, acid and alkaline preserved samples may be neutralized using the Elementary Neutralization Hood located in GC Prep, unless it is considered to be hazardous (i.e. mercury waste, cyanide waste). Refer to the current version of SOP#108 for further instruction.

14.3. All surplus reagent acids shall be neutralized on a daily basis using the Elementary Neutralization Hood located in GC Prep.

14.4. Small volumes of surplus volatile reagents may be allowed to evaporate in a hood at the end of the analytical session.

14.5. Proper Personal Protective Equipment (PPE) must be worn at all times. Proper PPE when handling samples include a lab coat, gloves and safety glasses. In addition, when handling any samples or solutions with any acid or base preservative a face shield and apron must be worn.

15.0. POLLUTION PREVENTION:

SGS is committed to evaluate all areas of the lab with regard to current and potential pollution prevention. Pollution prevention is described as any technique that reduces or eliminates waste at the point of generation. Further discussion on pollution prevention programs in the laboratory can be found in *SGS Pollution Prevention Plan* (Form F053).

16.0. METHOD PERFORMANCE:

There are no method performance measures to report at this time.

17.0. DETECTION LIMIT (DL) STUDY:

DL studies are performed when a significant change in instrument response is observed, when a new instrument is purchased for analysis. The DL is intended to demonstrate the capability of this method as it is implemented at SGS. An update to the DL does not necessitate an update to this document. Further guidance on performing a DL study can be found in SOP 116.

18.0. LIMIT OF DETECTION (LOD):

The LOD is defined per SOP 116; LOD verification shall be performed quarterly according to the schedule set by the QA Office.

19.0. LIMIT OF QUANTITATION (LOQ):

19.1. The LOQ is defined per SOP 116; LOQ verification shall be performed quarterly according to the schedule set by the QA Office.

20.0. REFERENCES:

SW846 8000C and 8260C SW846 5030C and 5035A (August 2006)

EPA624 (October 1984)

DOD QSM, current version

21.0. ATTACHMENTS:

Attachment A: Corrective Action Table
Attachment B: Recommended Minimum Relative Response Factor Criteria for initial and continuing calibration verification

Attachment A: CORRECTIVE ACTION TABLE

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Initial Calibration for all analytes (ICAL)	Periodic	Average RF analytes $\leq$15% Linear/non-linear analytes $r^2 \geq 0.99$ or $r \geq 0.995$	Troubleshoot Repeat calibration.
Second Source Cal. Verification. (ICV)	Once per initial cal.	All analytes within 20 % true value. 8260-Modified analytes (section 2.0.) ± 50 % true value	Repeat analysis once. If criteria is still out, Troubleshoot, Repeat Calibration
Calibration Verification (CCV)	At the beginning of each 12 Hour period, and the end of the run for DOD samples only	SPCC average RF $\geq$ section 10.4. RPD for all analytes $\leq$ 20 **For DOD** samples: Closing CCV +/- 50%	**For non-DOD samples:** 1. Repeat analysis once. 2. If QC criteria not met, then recalibrate and reanalyze. **For DOD samples:** 1. Immediately (within 1 hr and before any other samples have acquired) run two successive CCVs. If both meet QC criteria, then samples already analyzed may be reported and the run may continue.
Method blank	One MB per extraction batch	< LOQ for analytes of interest. For DOD clients, <½ the LOQ.	If associated sample result > 10X the blank contamination, note in LIMS and apply "B" flag to all affected results. If associated sample result < 10X the blank contamination, re-analyze and or re-extract. Note in LIMS and apply "B" flag to all results.
LCS LCSD	One per extraction batch	LCS: Based on laboratory control limits, RPD ≤ 20% LCSD: Used only for sample duplicate RPD. Based on laboratory control limits, RPD ≤ 20%	Repeat analysis once. If target analytes are outside control, high, and not detected in sample, report the data with qualification. If target analytes are outside control, low, repeat analysis.
MS/MSD(Recovery) MS/MSD(RPD)	1 set per batch of 20samples or less	Recovery based on LCS criteria. RPD ±20%	Review / report data. MS recoveries not used for batch control.
Surrogates	Every Sample	Water and soil criteria dependent on in-house control limits.	If analyte is not detected, report. Rerun samples with positive results.
Tune Standard: Prior to Calibration And at the beginning of each 12-hour analytical period.		Method specific see SOP Section 11.1. and table 1	Rerun the tune If condition continues, Retune instrument and recalibrate.
Internal Standard	Every sample post extraction.	From 50% to 200% of midpoint calibration values. One client requires 50 – 130%	Troubleshoot Repeat analysis.
12 hour clock	Each analytical period	Passing Tune, IB, and CCV and the beginning of each analytical run.	Samples outside of the 12 hour clock cannot be reported.

Attachment B: RECOMMENDEDED MINIUMUM RELATIVE RESPONSE FACTOR

Volatile Compounds	Minimum Response Factor (RF)	Typical Response Factor (RF)
Dichlorodifluoromethane	0.100	0.327
Chloromethane	0.100	0.537
Vinyl chloride	0.100	0.451
Bromomethane	0.100	0.255
Chloroethane	0.100	0.254
Trichlorofluoromethane	0.100	0.426
1,1-Dichloroethene	0.100	0.313
1,1,2-Trichloro-1,2,2-trifluoroethane	0.100	0.302
Acetone	0.100	0.151
Carbon disulfide	0.100	1.163
Methyl Acetate	0.100	0.302
Methylene chloride	0.100	0.380
trans-1,2-Dichloroethene	0.100	0.351
cis-1,2-Dichloroethene	0.100	0.376
Methyl tert-Butyl Ether	0.100	0.847
1,1-Dichloroethane	0.200	0.655
2-Butanone	0.100	0.216
Chloroform	0.200	0.557
1,1,1-Trichloroethane	0.100	0.442
Cyclohexane	0.100	0.579
Carbon tetrachloride	0.100	0.353
Benzene	0.500	1.368
1,2-Dichloroethane	0.100	0.443
Trichloroethene	0.200	0.338
Methylcyclohexane	0.100	0.501
1,2-Dichloropropane	0.100	0.382
Bromodichloromethane	0.200	0.424
cis-1,3-Dichloropropene	0.200	0.537
trans-1,3-Dichloropropene	0.100	0.515
4-Methyl-2-pentanone	0.100	0.363
Toluene	0.400	1.577
1,1,2-Trichloroethane	0.100	0.518
Tetrachloroethene	0.200	0.606
2-Hexanone	0.100	0.536
Dibromochloromethane	0.100	0.652
1,2-Dibromoethane	0.100	0.634
Chlorobenzene	0.500	1.733
Ethylbenzene	0.100	2.827
meta-/para-Xylene	0.100	1.080
ortho-Xylene	0.300	1.073
Styrene	0.300	1.916
Bromoform	0.100	0.413
Isopropylbenzene	0.100	2.271
1,1,2,2-Tetrachloroethane	0.300	0.782
1,3-Dichlorobenzene	0.600	1.408
1,4-Dichlorobenzene	0.500	1.427
1,2-Dichlorobenzene	0.400	1.332
1,2-Dibromo-3-chloropropane	0.050	0.129
1,2,4-Trichlorobenzene	0.200	0.806

Reference: Table 4 8260C Revision 3 (August 2006)

APPENDIX E

LABORATORY QUALITY ASSURANCE MANUAL

Provided on CD

SGS North America Inc. – Alaska Division

SGS NORTH AMERICA INC. - QUALITY MANUAL

Written in accordance with the requirements of ISO/IEC 17025:2005 – General Requirements For The Competence Of Calibration and Testing Laboratories

REVISION: 8.6

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This electronically signed PDF will be considered the controlled copy for staff.

Table of Contents

1. Introduction

This Quality Manual outlines the Quality System of the Alaska Division of SGS North America Inc (hereafter referred to as SGS Alaska or SGS). As the principal manual, used in conjunction with a set of standard operating procedures (SOPs), it describes the laboratory's commitment to Quality Management.

SGS aims to provide a safe and healthy working condition to all employees, visitors, and contractors through:

- Protecting the environment and the communities where we work and live, by the prevention of pollution and minimization of our impact
- Complying with all applicable HSE (Health, Safety, Environmental) national and local regulations and laws
- Continuously improve the HSE working conditions and environment towards out “Zero incident” target
- Increasing all SGS employees HSE awareness and safe behavior

This Manual describes the approach of SGS with regard to Quality Management through:

- Continuous upgrading of SGS services;
- Permanent Quality Management to prevent and/or eliminate nonconformities;
- Allocating the necessary resources to maintain and continually improve the organization;
- Conducting reviews of all elements of the system;
- Producing accurate, precise and complete legally defensible data; and
- Communicating to the staff the importance of meeting customer and regulatory requirements.

1.1. Application

- The policies in this Manual apply to all levels of the organization of SGS Alaska at the Anchorage laboratory (200 W. Potter Drive) and the Fairbanks receiving facility (3180 Peger Road). Corporate Policies and Procedures related to Human Resources, Finance and Accounting, Management Information Systems and General Administration are covered in separate documents.
- Implementation of the Quality System is achieved by means of this Quality Manual and documented procedures that are developed and followed by SGS Alaska.
- This Manual and supporting procedures are revised as necessary, to meet changing requirements and needs. The QA Office maintains a master file of this manual to insure review on a annual basis. The filing system serves as an accounting of the distribution of the manual. The accounting includes destruction of controlled copies of expired manuals. The QA Office also maintains a historical file of original and electronic versions of this manual; including the current revision and any versions archived within the past 5 years. Any changes to the Manual may be made only by authorization of the QA Office.
- This Manual is readily available to all SGS staff and is available to all SGS clients upon their request.

2. Normative References

2.1. Reference Standards

2.1.1. Quality System

The Quality System of SGS has been designed in accordance with A2LA accreditation for ISO/IEC 17025:2005, the 2009 National Environmental Laboratory Accreditation Conference (NELAC) Chapter 5 standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DOD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (latest version). SGS will follow the established advertising policy to control the use of the A2LA symbol.

Reference:

A2LA Document P101 (www.a2la.org)

SGS SOP 140 (Review of Requests for Quotes, Proposals and Contracts)

2.1.2. Other Standards

A large amount of the analytical work performed by the laboratory is completed to support the regulatory requirements of our clients. This work may be performed to satisfy the provisions in one or more of the following regulatory areas:

- **Clean Water Act (CWA):** Under the CWA, an organization that discharges wastewater into a river system is subject to regulation under the *National Pollution Discharge Elimination System (NPDES)*, as well as the *Alaska Pollution Discharge Elimination System (APDES)*. Various analytical methods are approved or mandated by this act.
- **Resource Conservation and Recovery Act (RCRA):** Under RCRA, any organization that wishes to dispose of solid waste must determine if it is potentially hazardous or exhibits toxic characteristics. Specific methods exist for making such a determination. Also, any organization that is operating a hazardous waste storage facility must have in place a groundwater protection plan. The analyses performed to support this type of plan may use the methods outlined in SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, as published by the Environmental Protection Agency (EPA) of the United States in support of the RCRA program.
- **Safe Drinking Water Act (SDWA):** Under the SDWA, the analysis of drinking water must be analyzed by specific established methodologies. The *Alaska Department of Environmental Conservation Drinking Water (ADEC DW)* programs regulate both Microbiology and Chemistry.
- **Alaska Department of Environmental Conservation Contaminated Sites Program (ADEC CS):** This program mandates the use of specific methods and preservation techniques for contaminated sites and underground storage tanks within Alaska.
- In addition, many projects the laboratory is involved with have oversight by the Air Force Center for Engineering and Environment (AFCEE), Brooks AFB (AFIOH/SCD), the Naval Facilities Engineering Service Command (NFESC), or the US Army Corps of Engineers (USACE). These agencies have jointly developed the Department of Defense (DOD) Quality System Manual (QSM). The DoD QSM is a guidance document which defines specific data quality objectives and other special considerations required in all aspects of data collection. The QSM is built upon ISO 17025 and NELAC standards, with the addition of clarifications and appendices from the DOD EM/DQ (Environmental Monitoring/Data Quality) Workgroup, composed of members from all DOD branches. Throughout this document and the associated SOPs, the term "DOD" will be used generically to refer to AFCEE, Navy and/or Army Corps of Engineers.

Note: It is critical to the success of any project that the laboratory is aware of which regulatory program(s) is(are) involved and if any special considerations have been imposed by either the regulatory agency or client. DOD QSM criteria (using the latest approved version) can be applied in those instances when the laboratory is notified in advance, has the opportunity to review project specific data quality objectives, and had the opportunity to negotiate variance requests (if applicable). Otherwise, all work performed by SGS will be analyzed using the most appropriate methodology (including Standard Methods for the Analysis of Water and Wastewater (SM), EPA, SW846 or methods developed/modified by the laboratory) in accordance with this laboratory QAP. Whenever feasible, SGS will adopt the most recently approved method. Clients should confirm current capabilities with SGS Business Development or their assigned Project Manager and may verify the laboratories current scope(s) of certification or accreditation at the accrediting body's website:

ISO 17025/DOD ELAP scope of accreditation:

http://www.a2la.org/scopepdf/2944-01.pdf?CFID=834475&CFTOKEN=5a009576ef32e090-76FE8574-1851-9E57-47EC77967DA1C036&jsessionid=8430513eebc78f2180af801c6a7b7d871144

ADEC Contaminated Sites scope of certification:

**http://dec.alaska.gov/applications/eh/ehllabreports/USTLabs.aspx

ADEC Drinking Water Chemistry scope of certification:

https://dec.alaska.gov/applications/eh/EHLabStatus/Home/Index

ADEC Drinking Water Microbiology scope of certification:

http://dec.alaska.gov/applications/eh/ehlabstatus/microreport/index

2.1.3. Other Quality System Manuals

This is the only Quality Manual used by SGS Alaska.

3. Terms & Definitions

- "Supplier" and "Vendor" are synonymous and refer to the external source used to acquire purchased products and/or services by the organization.
- Throughout the text of this Quality Manual whenever the term "product" occurs, it can also mean service.
- "Analyst" refers to any member of the staff who prepares or analyzes samples and may refer to any individual who peer reviews data.
- "Customer" can refer to the customer (internal or external), accrediting body, or regulatory authority.
- "General Manager" is used to describe the top level of management at which decisions regarding the lab are made.
- "Production Manager" is used to describe the position at which the overall responsibility for production (a.k.a. Operations) occurs.
- "Quality Assurance (QA) Manager" is used to describe the position at which the overall responsibility for the Quality System occurs.
- "QA/QC Officer" is used to describe staff who assist the QA Manager to implement, maintain and improve the laboratory's quality system.

- “Supervisor” is used to describe the position at which the overall responsibility for approving work schedules, overtime, and allocating labor resources occurs.
- The management team includes the General Manager, Production Manager, Technical Director, and QA Manager.

4. Management Requirements

4.1. Organization

4.1.1. Legal Entity

SGS Alaska is appropriately registered for legal process. All (original) business licenses are held by the SGS legal department.

Reference:

SGS North America Inc. Alaska Business License

4.1.2. Laboratory Responsibility

The mandate of SGS Alaska is to deliver the highest quality analysis and reporting of waters (including drinking water, wastewater, surface water, groundwater, etc.), soils and other materials in a timely manner in accordance with the needs of the customer, regulatory authorities and accrediting bodies, including (but not limited to):

- ADEC
- A2LA

The certifications and approvals include on-site evaluations of the laboratory by each agency to ensure that equipment, personnel, and laboratory techniques are in conformance with the EPA and program guidelines. Regulators generally schedule audits at two or three year intervals. More frequent audits may occur when a new method is implemented; a new instrument technology is acquired, as a requirement of a project-specific work plan; or as part of a client’s service procurement procedure.

Reference:

ISO/IEC 17025:2005, General Requirements for the Competence of Testing and Calibration Laboratories

DoD Quality Systems Manual for Environmental Laboratories (latest version)

2009 National Environmental Laboratory Accreditation Conference (NELAC)

18 AAC 70 (ADEC Water Quality Standards)

18 AAC 75 (ADEC Oil and other Hazardous Substances)

18 AAC 78 (ADEC Underground Storage Tanks)

18 AAC 80 (ADEC Drinking Water)

4.1.3. Scope of Management System

The laboratory management system covers work carried out at SGS Alaska (i.e., the fixed laboratory in Anchorage and the receiving facility in Fairbanks).

4.1.4. Conflict of Interest

SGS Alaska is a member of the SGS group – the world's leading inspection, testing, certification and verification company with more than 90,000 employees in a network of more than 2000 offices around the world.

The core services offered by SGS Global can be divided into these categories:

- **Inspection and Verification Services**. SGS inspects and verifies the quantity, weight and quality of traded goods. Inspection typically takes place at the manufacturer's/supplier's premises or at time of loading or at destination during discharge/off-loading.
- **Testing Services**. SGS tests product quality and performance against various health, safety and regulatory standards. SGS operates state of the art laboratories on or close to customers' premises.
- **Certification Services**. SGS certifies that products, systems or services meet the requirements of standards set by governments, standardization bodies (e.g. ISO 9000) or by SGS customers. SGS also develops and certifies its own standards.

SGS Alaska offers testing services and is governed by management (as outlined in the organizational chart) which ensures that both real and potential conflicts of interest are prevented. The responsibilities of key personnel (i.e., management and supervisors) are outlined in the job descriptions, which are maintained by senior management.

All SGS employees are expected to avoid any situation where there is or could be a conflict between their own personal interests and the interests of the organization. It is equally important to avoid the appearance of a conflict of interest. These principles are covered in the SGS Code of Integrity which is reviewed with all staff upon hire and annually.

Reference:

SGS Organization Charts (Alaska Division and NAM Region)

SGS Code of Integrity

SGS North America Employee Handbook

4.1.5. Laboratory Responsibilities

4.1.5.1. Management and Technical Personnel

The goal of SGS Alaska is to provide quality determinations in a timely manner. This can only be realized by fostering excellence in its staff, through training, and provision of a workplace that is safe, adequately sized, results-oriented, and operates with due regard for the quality management system in place.

SGS Alaska has managerial and technical personnel who, irrespective of other duties, have the authority and resources needed to carry out their duties, including the implementation, maintenance, and improvement of the management system, to identify the occurrence of departures from the quality system, and to initiate actions to prevent or minimize such departures.

In order to function smoothly and generate data of the required quality all personnel must:

- Understand SGS's Code of Integrity, Quality Policy, and Company Policy on Health, Safety and Environment.
- Understand the necessity for quality control

- Accept their level of responsibility for quality control
- Obtain the skill to perform assigned analyses

Job descriptions for management and technical personnel are maintained by Senior Management and include the above as functions of the respective positions.

Reference:

Sections: 4.10. (Improvement), 4.11. (Corrective Action) and 4.12. (Preventive Action) of this document

4.1.5.2. Undue Pressure

SGS Alaska adheres to the Human Resource Management policies laid down by both SGS and the Government of the United States of America, which helps ensure that management and personnel are free from internal and external commercial, financial and other pressures that might adversely affect the quality of their work. Copies of this documentation are retained in the Human Resources office.

Reference*:*

SGS North America Employee Handbook

4.1.5.3. Customer Confidentiality

SGS is committed to protecting the privacy and information of its customers. A copy of our General Conditions of Services is made available to all customers, and governs their relationship with SGS. All data generated by SGS is to be held in the strictest confidence, and care must be taken to ensure that data is reported and discussed only with the client or an authorized representative. Details of any analysis should never be discussed with anyone outside of the laboratory unless such discussion has been specifically approved by management and/or client.

Reference:

SGS Code of Integrity

SGS General Conditions of Service

4.1.5.4. Operational Integrity

Integrity is at the core of the business of the SGS Group, it is the common thread through all activities. A Code of Integrity has been established to lay down rules of behavior in all dealings for the SGS Group (including SGS North America Inc. – Alaska Division) and to provide guidance in day-to-day business. In addition, laboratory procedures have been developed to further support the corporate code.

SGS maintains published documents, including the “Code of Integrity,” which outline the professional demeanor expected from every employee. All employees are required to sign and keep on file these forms, which documents each employee’s acceptance and understanding of these requirements. A copy of the signed form is also kept in each employee’s personnel file. Initial and annual ethics training is provided by the General Manager. Initial training regarding manual integration is provided for applicable staff; both Analysts and data reviewers.

As outlined in the SGS North America Employee Handbook, disciplinary measures may include a verbal warning, written warning, unpaid suspension, and/or termination; however, there is no guarantee of, or expectation that, progressive disciplinary measures will be followed. Each case is evaluated on its own merits and potential punishment for improper, unethical or illegal actions may not be limited to suspension or termination of employment.

Failure to report suspected improper, unethical or illegal actions is considered a serious offense and may also result in disciplinary action. Prompt reporting of any suspected infractions will not result in disciplinary action. It is SGS's policy, therefore, to require staff to report any matters of concern. Channels for reporting include the direct supervisor, General Manager, Technical Director, QA Manager and the corporate Compliance Officer. All reports must be documented and thoroughly investigated by management.

Reference:

SGS Code of Integrity

SGS SOP 144 (Manual Integration)

DOD QSM (latest version)

EPA Inspector General Letter (dated September 5, 2001)

4.1.5.4.1. Corporate Integrity

All SGS services are to be provided in a professional, independent and impartial manner, honestly and in full compliance with Group approved methods, practices and policies. SGS does not surrender to any pressure from clients in one are of business in order to obtain a favorable treatment in another area.

Reference:

SGS Code of Integrity

4.1.5.4.2. Data Integrity

All SGS employees receive data integrity training as part of their initial Orientation & General Training program and annual refresher training is provided. In addition, analysts and reviewers for methods which may involve manual integration are given initial and annual training.

Reference:

SGS Code of Integrity

DOD QSM (latest version)

SGS SOP 144 (Manual Integration)

4.1.5.4.3. Conflict of Interest

A conflict of interest is any situation where the interests of the SGS Group overlap with personal employee interests or with those of close relatives or persons with whom the employee is in close personal or business contact. The mere appearance of impropriety is to be avoided because it creates the impression of a lack of impartiality.

Employees who find themselves in conflict are obligated to promptly discuss such situations with their Supervisor so that prompt and swift resolution which is amenable to all parties can be achieved. When a conflict of interest does manifest, the Supervisor will promptly resolve the situation in concert with the client so that an informed decision can be made before pursuing a course of action. All approaches to solving conflicts of interest will be transparent to all parties involved. Objectivity will remain at the forefront in all decisions.

Reference:

SGS Code of Integrity

4.1.5.5. Organization Charts

The Organization Chart for SGS Alaska is updated regularly, under the direction of the Human Resources department and is accessible through the SGS intranet (\\usfs700\ank_groupdata\Public\DOCUMENT\RFP). Information on the structure of SGS globally, can be found on the SGS website (www.sgs.net).

The laboratory organization includes three teams:

- Operations (i.e., analytical, sample receiving/login and sample control staff)
- Operational Support (i.e., accounting, IT and data management staff)
- Client Services (i.e., project management and QA/QC staff)

The management team includes the General Manager, Production Manager, Technical Director, and Quality Service Manager.

Reference:

SGS Organization Chart (Alaska Division)

4.1.5.6. Responsibility and Authority

SGS Alaska operates under the direction of the General Manager, who is responsible for developing and maintaining the organizational structure, the description of the responsibilities of senior personnel, providing scientific leadership, project planning, equipment maintenance and requisition, laboratory supplies, laboratory production, ensuring overall timely delivery of project results and overall responsibility for the Quality System within the laboratory. The General Manager is responsible for balancing the demands of the internal and external customer groups. Some authority is delegated to appropriate individuals depending upon their specific areas of responsibility and expertise.

Reference:

SGS Organization Chart (Alaska Division)

SGS SOP 126 (Procurement, Receipt of Supplies and Processing Vendor Invoices)

SGS SOP 140 (RFP/Proposal Review)

4.1.5.7. Production Manager

The Production Manager provides adequate supervision of all staff as outlined in the SGS Organization Chart, and is directly responsible for the supervision of the operations and sample control staff. Including oversight responsibility of daily activities to ensure the generation of timely data that meets industry accepted practices and project-specific requirements. Oversees documentation practices supporting the tests performed, instrument maintenance, and decision making processes affecting the data.

Reference:

SGS Organization Chart (Alaska Division)

4.1.5.8. Technical Management

The Technical Director is ultimately responsible for the technical operation of all departments. The Technical Director reviews all analytical procedures utilized by Analysts and is directly responsible for the accuracy of test results, acquisition of new instruments, method development and modification, laboratory quality control, and is ultimately responsible for the implementation and training of staff in the techniques detailed in SOPs and elements of the laboratory QAP. This position advises clients in proper techniques, methods necessary to properly fulfill the requirements of regulatory agencies, and address routine questions from clients or analytical staff regarding the validity or reliability of specific analytical data. Performs the periodic review of the generated data packages.

The Technical Director has a minimum of a Bachelors Degree in Chemistry or other Natural Science discipline and a minimum of 2 years of analytical chemistry laboratory experience.

Note: Per the DOD QSM (latest version), a Technical Director who is absent for a period of time exceeding 15 consecutive calendar days shall designate another full-time staff member meeting their qualifications to temporarily perform the functions. If the absence exceeds 35 consecutive calendar days, the primary accrediting authority must be notified in writing.

Reference:

SGS Organization Chart (Alaska Division)

4.1.5.9. Quality Assurance Manager

The Quality Assurance (QA) Manager has the authority and responsibility for ensuring the quality system is implemented and followed at all times, with direct access to the highest level of management at which decisions are made. The QA Manager reports to the General Manager, but works independently and is able to evaluate data objectively, free of managerial influence. A working knowledge of general statistical concepts is required to provide a basis for reviewing data to determine method performance.

The QA Manager is responsible for following:

- Develop and update the overall QA Plan for the laboratory.
- Serve as the focal point for QA/QC and be responsible for the oversight of QC data.
- Aid in the documenting and addressing corrective actions and/or client concerns, as well as to track the long-term effectiveness of corrective actions.
- Oversee proficiency sample testing and evaluation.
- Assist Analysts and administrative staff in preparing and updating SOPs.
- Distribute current SOPs to appropriate personnel via the document control program.
- Issue monthly reports to the corporate Technical and local Management Team (including the General Manager and Technical Director) outlining QA/QC activities and initiatives.
- Establish effective and efficient internal and external communication channels.
- Maintain current, and explore new, certification or approval programs.
- Facilitate internal and external audit programs, including lab responses and corrective actions.
- Assist Business Development by reviewing Data Quality Objectives (DQOs) during the quote review and, if applicable, outlining variance requests.

The QA Manager is assisted by the QA/QC Officer(s) and several key staff which comprise the Quality Team. Each person on the Quality Team has oversight responsibility for a specific function of the QA/QC systems (e.g., SOPs, PT samples, DL studies, internal audits, certification/accreditation applications and renewal, corrective actions, training, etc.). Each member of the Quality Team reports to the QA Manager and QA Officer, who oversee progress and deadlines for the QA/QC system. Consequently, where the

QA Manager is referenced throughout this document, their designee may carry out the duties under their direct supervision.

4.1.5.10. Operational Support

- The Office Manager over sees the accounts payable, accounts receivable and data management
- The Informational Technician maintains all servers and computers along with the Oracle data base. All hardware and software maintenance for the desk/lap tops. Oversees daily backup of data.

Reference:

SGS Organization Chart (Alaska Division)

4.1.5.11. Client Service Team

- Consists of Project Managers who serve as the liaison between the laboratory and its clientele
- Business Development reviews requests for proposal(RFP) and creating quotes.

Reference:

SGS Organization Chart (Alaska Division)

Reference:

SGS Organization Chart (Alaska Division)

SGS Monthly QA Reports

SGS SOP 006 (Preparation of Standard Operating Procedures)

SGS SOP 103 (Performance Test Program)

SGS SOP 105 (Corrective Actions)

SGS SOP 111 (Document Control)

SGS SOP 113 (Audits, Assessments and Managerial Review Program)

SGS SOP 116 (DL/LOD/LOQ)

SGS SOP 140 (RFP/Proposal Review)

SGS SOP 145 (Control Charts & Control Limits)

4.1.5.12. Managerial Substitution

When a member of the Management staff of the laboratory is away from the laboratory, their core duties would be delegated as follows:

- Technical Director:
  - Technical Direction – Production Manager

- General Manager:
    - Administrative Duties (e.g., hiring/firing) – Production Manager
    - Finance (e.g., budgeting, capital expenditures) – Production Manager
    - Client Services – Technical Manager
    - Contracts – SGS Legal
    - Facilities (e.g., HVAC) – Production Manager
- Production Manager:
    - Manage Backlog and Approve Rush Requests – Section Leads
    - Day to Day Technical Decisions – Section Leads
- QA Manager:
    - QA Calls – Technical Director
    - SOPs, DL/LOD/LOQ Studies, PE Studies, etc – QA/QC Officers

4.1.5.13. Place of Staff in Organization Objectives

Laboratory staff are made aware of the relevance and importance of their activities and how they contribute to the achievement of the objectives of the management system through regularly scheduled status meetings. Each analytical section has a representative attend status meetings and serve as a liaison for their operational section (e.g., Sample Preparation, Waters, Microbiology, Metals, Volatiles and Semivolatiles).

Reference:

SGS Organization Charts (Alaska Division)

SGS SOP 007 (Laboratory Communications)

4.1.6. Responsibility for Communication

Appropriate communication procedures have been established and implemented by top management. Regularly scheduled status meetings have been established,

Reference:

SGS SOP 007 (Laboratory Communications)

4.2. Quality System

4.2.1. Policies and Procedures

SGS Alaska Quality Assurance Program is directed by the QA Manager who is responsible for its effectiveness and efficiency. Achievement of these objectives with respect to quality is the responsibility of all personnel. The management system established to implement the Quality Assurance Policy satisfies the requirements of ISO/IEC 17025:2005 (General Requirements for the Competence of Testing and Calibration Laboratories).

Understanding of the management system is demonstrated by all laboratory staff through a quiz, which is based on the principles of the Management System in place. It is taken by all lab staff at the end of their

Quality Management System training. When changes are made to the QAP that modify a procedure, and/or policy to an extent that the staff would be reasonably expected to be affected by the change, a new quiz will be given to all staff and records of the test maintained. (Note: Where a written quiz is not practical and/or appropriate, an alternate method of verification may be implemented, (e.g. observation and documentation of the successful performance of tasks specific to the quality management system, etc.).

Implementation of the management system is demonstrated through data processing and record keeping.

Reference:

SGS Form FT-017 (QAP Training Quiz)

4.2.2. Quality Manual

The QA Manager is responsible for developing, implementing and updating the Quality Manual (otherwise referred to as the Quality Assurance Plan). The Quality Manual documents top management commitment to the development and implementation of the management system (see section 4.1.2), documents top management's commitment to continually improving its effectiveness (see section 4.15); documents the importance of meeting customer requirements as well as statutory and regulatory requirements (see section 4.1.2); documents a quality policy statement authorized by top management, and supporting quality objectives (see section 4.2.3); includes or makes reference to all procedures within a defined document structure (see section 4.3); defines the roles and responsibilities of technical management and the quality manager (see section 4.1.5.8 and 4.1.5.9); and outlines the structure of documentation used in the management system (see section 4.3).

4.2.2.1. Quality Policy Statement

Sound management practices and commitment to good professional practice and quality of service are important responsibilities in the conduct of our business.

As an employer, SGS Alaska will work to deliver the following:

- High quality analysis of waters, soils and other materials in a timely manner.
- A program of scheduled quality activity that ensures the requirements of the management system are documented and includes the following:
    - Service that is fit-for-purpose, which includes quality and responsiveness.
    - Prevention rather than correction.
    - The use of internationally recognized methods wherever possible.
    - An effective and documented training program.
    - A comprehensive validation program, including accuracy and short & long-term precision; Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantification (LOQ); linearity, and estimation of uncertainty of measurement.
    - Participation in proficiency evaluation studies (where available).
    - Competent, trained personnel assigned to carry out duties in a timely manner and in accordance with the mandate of the Management System, while ensuring that the work is done safely and with due regard to the environment.
- Compliance with ISO/IEC 17025:2005 – General requirements for the competence of testing and calibration laboratories and with all applicable legal and regulatory legislation requirements and the DOD QSM standards as defined in applicable accreditation scopes.

- Regular review, audit and internal quality control procedures to continually improve the effectiveness of the management system.
- Communication of the objectives of the management system to ensure understanding by all personnel.

Reference:

SGS Certifications and Accreditations

SGS SOP 007 (Laboratory Communications)

SGS SOP 102 (Training and Certification)

SGS SOP 103 (Performance Test Program)

SGS SOP 113 (Audits, Assessments and Managerial Review Program)

SGS SOP 116 (DL/LOD/LOQ)

SGS SOP 141 (Uncertainty)

SGS SOP 145 (Control Charts & Control Limits)

4.2.3. Top Management Roles & Responsibilities

Top management is committed to the development and implementation of the management system and to continually improving its effectiveness through the provision of resources to support and develop the system. This includes (but is not limited to) a Management Team which meets regularly to review the lab operations – including the management system – and identify areas of needed improvement.

Reference:

SGS SOP 113 (Audits, Assessments and Managerial Review Program)

4.3. Document Control

4.3.1. Policies and Procedures

SGS Alaska controls all documents that form part of its quality system through defined procedures. Locations are designated for all controlled documents to ensure access by the appropriate people. Both the forms used to gather information and the actual recorded information are controlled with the objective that the personnel developing the method, performing and approving the analysis can be identified if required. All controlled documentation is property of SGS and must be left behind at the termination of employment.

The analytical procedures and associated quality control criteria for the tests performed by SGS are outlined in the laboratory's written SOPs. Additionally, SOPs are prepared for administrative or operational activities that affect data collection activities or sample integrity. Each SOP contains sufficient detail to ensure that specific procedures can be clearly followed and duplicated. The SOPs are issued as controlled documents by the Quality Assurance Office to ensure that only the most recent revisions are in circulation and are distributed to all pertinent staff.

Reference*:*

SGS SOP 006 (Preparation of Standard Operating Procedures)

SGS SOP 111 (Document Control)

4.3.2. Approval and Issue

Analytical SOPs are scheduled for review on an annual basis by the primary user, at which time the SOP may be updated to incorporate the most recent promulgated/approved source method and/or technological advancements. The SOP is generally only updated if scheduled review indicates corrections and additions to the document are necessary; otherwise, the cover page will be signed to indicate that the document remains current and correct. Minor changes may be made to the document at any time through a controlled "Addendum" with approval of the Technical Director and/or QA Manager (or designee).

Internally generated documents are reviewed by appropriate staff members and, upon approval, are control by the QA Manager (or designee). All SOPs, logbooks, and internal forms handled in this manner and electronic, read-only versions are kept on the network.

Reference:

SGS SOP 006 (Preparation of Standard Operating Procedures)

SGS SOP 111 (Document Control)

4.3.3. Master List

A master list of all internal SOPs (current revision and archived SOP numbers) is maintained by the QA Office; a copy of the master list of current SOP revisions is available to all staff on the Network:

\\usfs700\ank_groupdata\Public\DOCUMENT\SOP\~Approved_SOPs~

Note: SGS Alaska does not control all external documents (e.g. regulations). Rather, the lab maintains web links to documents that are made available by the issuing authority and staff access the on-line version/most up-to-date version at all times

Reference:

SGS SOP Tracking

4.3.4. Availability

All quality documentation (including instructions, standards, manuals, and reference methods) is available where required through the (write-protected) SGS network and in hard copy. All staff have access to the network.

Reference:

SGS Intranet

SGS SOP 006 (Preparation of Standard Operating Procedures)

SGS SOP 111 (Document Control)

4.3.5. Obsolete Documents

It is the responsibility of the QA Office to ensure that all obsolete documentation, (resulting from a document change/update), is removed from the point of use folder and is archived electronically on the SGS network, which is not accessible to anyone outside of the QA Office (or designee).

Electronic documentation that is retained for any reason is marked as archived and/or stored in the appropriate archived documents folder on the SGS Network.

Reference:

SGS SOP 006 (Preparation of Standard Operating Procedures)

SGS SOP 111 (Document Control)

4.3.6. Identification

All quality documentation is identified by a date of issue and/or revision number; page numbering (where appropriate), total number of pages or a mark to signify the end of the document (where appropriate), and the issuing and/or authorizing authority(ies) (where appropriate).

Reference:

SGS SOP 006 (Preparation of Standard Operating Procedures)

SGS SOP 111 (Document Control)

4.3.7. Document Changes

Changes to quality documentation are reviewed and approved by the same function that performed the original review (or designee). Designees have the appropriate access to all pertinent information, as established through the job description.

Reference:

SGS Organization Chart (Alaska Division)

SGS SOP 006 (Preparation of Standard Operating Procedures)

SGS SOP 111 (Document Control)

4.3.8. Altered or New Text

Altered or new text within a SOP is listed under “Summary of Changes from Previous Revision” and the document is assigned a new revision number. All documents are issued beginning with version number 1. Subsequent revisions are in whole number increments (i.e. 1 is modified to 2, etc.) Re-issue of a previously altered document will only contain the revision history of the most recent amendments. (Obsolete copies are stored as per section 4.3.5.)

Reference:

SGS SOP 006 (Preparation of Standard Operating Procedures)

SGS SOP 111 (Document Control)

4.3.9. Hand-written Amendments

The SGS Alaska QA Manager (or designee) is the only person that may authorize hand-written amendments to any controlled document. The amendment shall be made in a permanent form and the change must be signed and dated by the QA Manager (or designee). Hand edits on controlled documents are limited to correcting minor errors and must be extended to all controlled versions of the document (i.e., electronic and hardcopy).

Reference:

SGS SOP 003 (Error Correction Procedures)

SGS SOP 006 (Preparation of Standard Operating Procedures)

4.3.10. Computerized Amendments

The QA Manager (or designee) is the only authorized person with modification rights to all controlled documents issued under the quality system and held on the SGS network. Notification to all affected personnel is made immediately following the change via supervisor and/or e-mail or through the re-issuing of the document.

Reference:

SGS SOP 006 (Preparation of Standard Operating Procedures)

SGS SOP 111 (Document Control)

4.4. Review of Requests, Tenders, and Contracts

4.4.1. Policies and Procedures

SGS issues quotations on a regular basis. All laboratory tenders and/or contracts are released in accordance with the requirements of SGS SOP 140. The laboratory (generally under the direction of the General Manager or designee) verifies that the laboratory has the capability and resources to meet the requirements and to confirm the appropriate method selection.

Reference:

SGS SOP 140 (RFP/Proposal Review)

4.4.2. Records of Review

Records of review and pertinent discussions with the customer (including, but not limited to) subcontracted work and significant changes are retained as part of the quote file.

Reference:

SGS SOP 007 (Laboratory Communications)

SGS SOP 125 (Archiving of Raw Data and Work Order Files)

SGS SOP 140 (RFP/Proposal Review)

4.4.3. Notification of Customer

Records of notification of any deviations from the contract are maintained in the client folder(s), specific to the request, tender, or contact.

Reference:

SGS SOP 007 (Laboratory Communications)

SGS SOP 140 (RFP/Proposal Review)

4.4.4. Contract Amendments

Contract amendments are subject to the same policies and procedures, outlined above, and amendments are communicated to all (affected) personnel.

Reference:

SGS SOP 007 (Laboratory Communications)

SGS SOP 140 (RFP/Proposal Review)

4.5. Subcontracting of Tests

4.5.1. Competency

SGS Alaska provides an abundant number of tests for clients; however, occasionally it is requested that we perform certain analyses for which we do not have the capabilities. In such cases, as a service to our clients, SGS may arrange for such analyses to be conducted at a subcontract laboratory. SGS does not intentionally solicit work it does not perform, but this service is offered when such a test is relatively small component to the overall scope of a project or at the request of the client. Tests performed at SGS may also be subcontracted to another laboratory during periods of high sample volume or instrument down times, when an alternate instrument or method is either not available or unable to satisfy data quality objectives, in order to meet client needs.

Selection of a subcontract laboratory is based on the specific project requirements (e.g., ADEC DW, ADEC CS, DOD-ELAP, USDA foreign soil importation permit). The subcontract lab must be certified by the appropriate regulatory agency. SGS will require subcontracted laboratories to demonstrate that they meet DOD-ELAP requirements where applicable. Records of all subcontract labs used are maintained by Reference Lab Coordinator and are stored on the SGS Network. If an appropriately accredited lab cannot be utilized, it will be the responsibility of the client to make the final determination on which facility to use.

Where a subcontracted lab has been used, a copy of the subcontract lab report will be issued directly to the client to ensure clarity on which lab performed the work.

Reference:

SGS SOP 132 (Reference Lab (Subcontracting))

4.5.2. Customer Notification

The SGS Business Development or Project Manager will advise the client of the need for subcontracting work. This should be done in writing (preferably when the quote is issued) and client approval (in writing) should be secured before the work begins.

The Production Manager will notify the assigned Project Manager in the event that in-house work must be rescheduled for subcontracting in the event of capacity or instrumentation issues. In such an event, the Project Manager will contact the client for approval to subcontract the work. Copies of customer approval and/or notification – written and/or verbal – are retained as part of the Chain of Custody (CoC) record.

Reference:

SGS SOP 122 (Login and Package Review)

SGS SOP 132 (Reference Laboratories (Subcontracting))

SGS SOP 140 (Review of Requests for Quotes, Proposals and Contracts)

4.5.3. Responsibility

SGS Alaska is responsible for the contracted work, unless the customer or regulatory authority specifies the subcontractor to use. Records of customer or regulatory authority specifications are retained in the quote file.

Reference:

SGS SOP 132 (Reference Laboratories (Subcontracting))

SGS SOP 140 (Review of Requests for Quotes, Proposals and Contracts)

4.5.4. Results

SGS Alaska requires subcontract results to be reported in writing or electronically.

4.6. Purchasing Services and Supplies

4.6.1. Policies and Procedures

Procurement of supplies and services for SGS NAM (including the environmental division) is governed by strict purchasing policies, laid down by the SGS Corporation. All purchases require approval from Management (or designee), to ensure that the supplies or equipment purchased are of adequate quality to sustain confidence in the work. Selection of a supplier is done in accordance with the policies of the SGS Procurement Division. Where possible (or required by the lab) preference is given to suppliers with ISO certification or accreditation and the use of materials that are traceable to international standards. However, the purchasing department may have contracts that were established on an overall service basis, which may or may not include certification or accreditation. Records of suppliers used are maintained by the Purchasing department.

When at all possible, all references materials will be obtained from a vendor with ISO Guide 34 approval.

Reference:

SGS SOP 104 (Equipment Monitoring)

SGS SOP 126 (Procurement, Receipt of Supplies and Processing Vendor Invoices)

4.6.2. Verification

All purchased supplies that affect the quality are utilized only when verified compliant with specifications. Upon receipt of all purchased items for the laboratory, part numbers are checked against the Purchase Order; expiration dates, (if applicable), are verified to ensure a suitable period of usage; all materials that are traceable to a national standard are checked to insure they have a certificate of analysis/production information. In the event that any of the pre-requisites are not supplied, the lab contact notifies the purchasing department and the supplier is contacted for immediate replacement and/or submission of all required documentation. Where necessary, the following information is retained: date received and/or date opened.

4.6.3. Purchasing Documents

All routinely ordered items (e.g., reagents, standards, consumables) are pre-approved through the Lean Purchasing program. These items have been reviewed for technical content, as well as trigger levels and order quantities, and are tracked in a database: \\usfs700\scans\NewScans\cw_scan\data\users\CDS\~Purchasing

Non-routine items will be reviewed and approved by the Production Manager before orders are submitted to the General Manager (or designee) for finalization.

Reference:

SGS SOP 112 (Standards Labeling & Traceability)

SGS SOP 126 (Procurement, Receipt of Supplies and Processing Vendor Invoices)

4.6.4. Approved Suppliers

SGS Alaska procures goods and services from reputable organizations with which they have a historical relationship, or which have been investigated and approved for use. Records of approved suppliers are maintained by the Procurement department.

Reference:

SGS SOP 126 (Procurement, Receipt of Supplies and Processing Vendor Invoices)

4.7. Service to Customer

4.7.1. Cooperation with Customers

SGS Alaska maintains a customer service department whose sole responsibility is to service the customer. SGS Alaska makes allowances for client access for monitoring of work, while at all times ensuring the confidentiality of other customers. This is achieved through guided tours and on-going communication. Records of client access are recorded in the Visitor's Logbook and/or part of the client file(s), where pertinent communications are maintained. Procedures are in place to ensure that the confidentiality of all customers is protected at all times.

Reference:

SGS Visitor's Logbook

SGS SOP 007 (Laboratory Communications)

SGS SOP 113 (Audits, Assessments and Managerial Review Program)

4.7.2. Feedback

SGS Alaska solicits feedback from customers on a regular basis. Feedback includes (but is not limited to) formal surveys, phone calls, and e-mails. Annually, a formal survey is conducted with results reviewed at the completion of the survey (within 1 month of sending out the survey). All customer feedback requiring follow-up is done as received with a general review of all customer feedback done annually during the Management Review.

Records of customer feedback are maintained by the QA Office.

Reference:

SGS SOP 113 (Audits, Assessments and Managerial Review)

4.8. Complaints

4.8.1. Policies and Procedures

SGS Alaska investigates all complaints made in person, on the telephone, or in writing. The investigation into a concern by a client occurs in a manner similar to Analyst recognition of a nonconformance event. The client is consulted to identify the procedure or data point(s) in question, the reason for the concern, and the expectation for the result or procedure. The documentation and technique of the subject procedure are reviewed to verify that SGS's SOPs were followed and that the SOPs are in line with EPA approved or industry accepted standards. The subject data are reviewed to determine the accuracy of the initial acquisition, calculations, and reporting. This review includes evaluating how the event affected the result(s) (e.g. positive bias).

All client complaints must be reported to management. The Technical Director must be consulted for technical matters outside of the Project Manager's scope of knowledge. Issues relating to data quality and/or method/project compliance must also be directed to the QA Manager. Additionally, the General Manager must be involved in any situations with financial consequences.

The evaluation of feedback and any necessary action required is given **top priority** by all concerned. The customer is kept informed of the investigation and is involved in setting time-lines for resolution of problems.

Reference:

SGS SOP 007 (Laboratory Communications)

SGS SOP 105 (Corrective Actions)

4.8.2. Records

Documentation of the investigation and findings can occur by one of several means, depending on the nature of the concern. Example forms of documentation are a letter to the client, completion of a Corrective Action Report (CAR), or phone records from telephone/ conference calls.

4.9. Control of Nonconforming Testing

4.9.1. Policies and Procedures

Where a non-conforming result or action is discovered or suspected internally, the occurrence is reported immediately to the appropriate supervisors and the following remedial actions (where necessary) are taken immediately: confirm finding, stop work or withhold test report if necessary, determine if other areas affected by the nonconformance, and stop work or withhold test reports for any other work affected. Where necessary, customers may be notified and work may be recalled. The Quality Manager or Technical Director may review the circumstances of all non-conforming actions and determine whether corrective action should be taken.

Where the evaluation of the significance indicates that the nonconforming work could recur, or that there is doubt about the compliance of the lab's operations with its own policies and procedures, the corrective action procedures given in section 4.11 shall be promptly followed and resumption of work shall occur after authorization given by the QA Manager and/or Technical Director.

Reference:

SGS SOP 105 (Corrective Actions)

4.10. Improvement

4.10.1. Policies and Procedures

SGS Alaska has a continual improvement plan in place, within the quality policy, and with quality objectives, with inputs from analysis of data, internal and external audits; corrective and preventive actions, and management reviews.

Reference:

SGS SOP 105 (Corrective Actions)

SGS SOP 113 (Audits, Assessments and Managerial Review)

4.11. Corrective Action

4.11.1. Policies and Procedures

The corrective action investigation documents an out of control event (OCE) or systematic deficiency that adversely affects data quality objectives or fails to meet method/project requirements. This process further serves to identify the root cause, recommend specific actions to prevent a similar occurrence, and include a follow-up to verify a return to control. The resultant corrective action creates a change in some element in the testing or analytical system to reduce the risk that a quality system failure will recur. This procedure is used as a tool for improving elements of the Quality System and may also involve client participation or notification as necessary.

Corrective action reports (CAR) describe responses to an OCE, including client notification procedures, procedures for repeating or stopping work, and the incorporation of proposed solutions and subsequent verification of its effectiveness. They may be initiated by an Analyst, Project Manager, the Technical Department, or the QA Office. CARs are tracked, investigated and reported by the Corrective Action Team (CAT). The process generally starts with initial interviews of the person(s) involved, with an emphasis on determining the root cause and opportunities for continuous improvement. Members of the CAT may invite involved staff to the CAT meeting for further discussion and/or initiate training, as warranted.

CARs are not initiated when standard corrective action procedures as outlined in the written SOPs are followed to address isolated OCEs. Documentation for these instances may be found on the QC sample summary reports, case narrative, and/or sample comments for the associated batch. Examples of corrective actions outlined in the analytical SOPs include:

- QC sample or calibration data are outside the acceptance windows.
- Blanks contain contamination above acceptable levels.

Non-conformances that are evidence of systematic error or breakdown in a procedure or for situations that are not typical to day-to-day operations require documentation with a CAR. Examples are:

- Performance Evaluation (PE) sample outliers
- Changes in SOPs due to an external audit
- A problem or non-conformance not under a person’s direct control (e.g. inter-departmental)
- Recurring problems fixable by the employee or failure to follow the approved SOP.
- Undesirable trends in spike recoveries, RPDs, sensitivity capabilities or control charts.
- Customer complaints regarding lab error or deficiency, especially for corrected reports.

The Corrective Action Team (CAT), which includes the QA Manager and the Technical Director, reviews all CARs. A summary is provided to the Management Team via the QA monthly report.

Reference:

SGS Analytical SOPs

SGS SOP 105 (Corrective Actions)

4.12. Preventive Action

4.12.1. Action Identification

Needed improvements and potential sources of non-conformances, either technical or concerning the quality system are identified through the internal audit and/or the corrective action procedures.

CAR forms are reviewed and evaluated to ensure that there are no repeat occurrences of significant and/or preventable non-conformances. Where a recurrence is noted, additional actions will be taken.

Reference:

SGS SOP 105 (Corrective Actions)

SGS SOP 113 (Audits, Assessments and Managerial Review)

4.12.2. Action Plans

The Corrective Action Team (CAT) evaluates the CAR and, where appropriate, assigns action items for implementation. A signed copy of the CAR is maintained on the Network.

The Internal Audit Coordinator verifies that internal audit findings are effectively closed out. An electronic copy of internal audits reports is maintained on the Network.

Reference:

SGS SOP 105 (Corrective Actions)

SGS SOP 113 (Audits, Assessments and Managerial Review)

4.13. Control of Records

4.13.1. Procedures

SGS Alaska has procedures for identification, collection, indexing, access, filing, storage, maintenance, protection, backup and access of electronic records, and disposal of quality and technical records. Quality records shall include reports from internal audits and management reviews as well as records of corrective and preventive actions.

As technology permits, data may be retained in hardcopy and/or electronic format (e.g., Portable Data Format (PDF) or raw instrument data files). Data pertaining to sample analyses, quality control analyses, instrument or method studies (e.g., DL, IDL, RT windows, IDC) are retained for a minimum of 5 years. All analytical and calibration batches, final reports and data packages have been scanned, maintained and backed-up on the Network. Quality records not scanned electronically will be retained in hard copy for five years.

In the event that the facility changes ownership or location, or the facility is to be permanently closed, the DOD-ELAP accrediting body and relevant state certifying bodies will be notified in writing. In the event of closure of the facility, clients will be notified in writing so that records may be transferred according to their instructions. All appropriate regulatory and state legal requirements concerning laboratory records will be followed. The laboratory will be accountable and liable for analyses of all samples received before and after a change of ownership.

SGS is committed to providing customers with service excellence, which includes a strong emphasis and respect for customers' right to privacy. All personal information is collected only for the purpose of performing the requested service or of adding the customer name and contact information to our database or mailing list, so that we can provide them with information, or respond to a request they have made. By requesting services from SGS, customers consent to the collection and use of this information in accordance with the SGS Privacy Statement. SGS does not disclose any personal information to third parties, except as required by law or upon the customer's request. Specifically, confidentiality is maintained through Employee Agreements, and Human Resources specific policies for electronic storage and transmission of results.

Reference:

SGS SOP 125 (Archiving of Raw Data and Work Order Files)

SGS SOP 142 (Electronic Data Storage)

4.13.2. Record Integrity

All records shall be legible and shall be stored and retained in such a way that they are readily retrievable in facilities that provide a suitable environment to prevent damage or deterioration and to prevent loss. Retention times of records shall be maintained.

Reference:

SGS SOP 142 (Electronic Data Storage)

4.13.3. Technical Records

SGS Alaska maintains technical records of:

- All original observations;
- Derived data;
- Sufficient information to establish an audit trail;
- Calibration records;
- Copies of each test report;
- Personnel responsible for the test;
- Personnel responsible for reviewing the results;

Reference:

SGS SOP 003 (Documentation and Error Correction)

SGS SOP 111 (Document Control)

SGS SOP 112 (Standards Labeling & Traceability)

4.13.4. Record Information

The records retained identify factors affecting uncertainty and contain sufficient information such that the method could be repeated under the original conditions.

Reference:

SGS SOP 003 (Documentation and Error Correction)

SGS SOP 111 (Document Control)

SGS SOP 141 (Uncertainty)

4.13.5. Recording

Observations, data, and calculations are recorded at the time they are made and are identifiable to the specific task; all runs will be documented.

Reference:

SGS SOP 003 (Documentation and Error Correction)

SGS SOP 111 (Document Control)

4.13.6. Corrections to Records

Where it is necessary to make a correction to a record, it shall be done in such a way to ensure the following:

- Original record is not obscured;
- Correct values are entered alongside;
- Alterations authorized by initial (or suitable electronic tracking system);

Reference:

SGS SOP 003 (Documentation and Error Correction)

4.13.7. Corrections to Electronic Records

SGS Alaska utilizes a Laboratory Information Management System (LIMS), Horizon, which is accessed through unique user login and password. In addition, where modifications to an electronic record are made through the data management system, it is retained in the system. Where applicable, instrument software maintains an audit trail of any deletions or manual integrations. All other quality records are retained on the write-protected folder of the SGS network, with only the QA Office having modification rights.

4.14. Internal Audits

4.14.1. Requirements

Audit reports are provided to the Production Manager, Technical Director, and General Manager by the QA Manager (or designee), who serves as the audit facilitator. Changes in laboratory SOPs as a result of an audit are communicated to the appropriate staff and implementation of changes is ensured via follow-up by the QA Manager, Technical Director and/or Production Manager.

In addition to external audits conducted by certifying agencies or clients, SGS conducts the following internal audits.

- Internal Audits are conducted by the QA Manager (or designee) in each area of the lab to assess method and program analytical areas are identified annually for the internal audit schedule. Audit reports are issued with corrective action plans (if necessary) and follow-up audits are performed as needed.
- Blind samples are introduced into the analysis stream to evaluate personnel and methods on an ongoing basis.
- Blind samples are also introduced on an as-needed basis when concerns arise about a particular analysis, the method, the instrument, or the Analyst via quick response testing services offered by ISO 17025 accredited vendors of PE or PT sample materials. This often includes blank samples to test for false positive results.

Reference:

SGS SOP 113 (Audits, Assessments and Managerial Review Program)

4.15. Management Review

4.15.1. Objectives

SGS Alaska senior management reviews the quality system annually, in accordance with a predetermined schedule to ensure the continuing suitability and effectiveness, and to introduce changes or improvements.

The internal audit program, the corrective action system, the training program, issuance of the monthly QA reports and regular management meetings are all central elements of managerial review.

On an annual basis, the management team will review the previous year and develop action plans for the coming year. Their findings will be recorded in the Annual management Review (AMR) Report which is distributed to the corporate Vice President and local Management Team. Action items resulting from the AMR are monitored during Management Meetings held throughout the year to ensure progress and closure.

The laboratory's Management Team meets regularly in round-table discussions to review concerns regarding lab operations and to consider ideas for improvements.

The laboratory's General Manager and Production Manager track key performance indicators (KPIs) and changes in the volume and type of work. Lab resources, capacity and the ability to satisfy project turn-around-times are also reviewed during frequent status meetings involving the General Manager, Project Managers (PMs), Technical Director, QA Manager, Business Development, Production Manager and representatives from each analytical section.

Client feedback, in the form of Data Quality Reviews, inquiries, and/or complaints, is in most cases initially provided to the Project Manager. It is the PM's responsibility to notify management of any concerns and facilitate a prompt resolution.

Quality Assurance Reports to management are intended to keep management abreast of QA/QC activities and developments. Corporate QA KPIs (e.g., CARs, PEs, Complaints) are tracking monthly and submitted to the General Manager, who forwards them to SGS Laboratory Excellence. QA reports, distributed to the local Management Team, will generally include:

- Review of SOP status
- Status of DL, LOD & LOQ studies
- Results of control charts evaluations
- Performance test study status and scores.
- Status of various certification programs
- Results of external and internal audits
- CARs
- Comments and recommendations regarding other concerns affecting the quality of the data generated within the laboratory.

Additionally, the QA Manager issues monthly or quarterly reports tracking:

- Training and staff development opportunities
- Continuous Improvement activities

Originals are digitally signed, dated and maintained on the network (\\usfs700\ANK_GroupData\Public\QAQC\~QA_Reports), along with a record of their distribution.

Reference:

SGS SOP 113 (Audits, Assessments and Managerial Review Program)

4.15.2. Contents

The AMR takes account of:

- suitability of policies and procedures
- reports from managerial and supervisory personnel
- outcome of recent internal audits
- corrective and preventive actions
- assessments by external bodies
- results of interlaboratory comparisons or proficiency tests
- changes in the volume and type of work
- customer feedback
- complaints
- recommendations for improvement
- other relevant factors such as quality control activities, resources and staff training

All findings and necessary actions that arise from reviews are recorded and maintained.

4.15.3. Actions Taken

All actions identified are carried out within an appropriate and agreed time scale.

4.15.4. Records

Records of the management review are distributed to the management team.

5. Technical Requirements

5.1. General

SGS Alaska makes every attempt to ensure that the many factors affecting the correctness and reliability of the tests performed by the lab are controlled. Control is achieved through Analyst training and proficiency, appropriate environmental conditions and a rigorous and on-going QA/QC program.

5.2. Personnel

5.2.1. Qualifications

The objective of SGS Alaska is to provide quality analytical determinations in a timely manner. This can only be realized by fostering excellence in its staff, through training, and provision of a workplace that is safe, adequately sized, and results-oriented.

It is the responsibility of the Technical Director, to ensure that staff has the necessary qualifications and experience to produce quality analytical data and to provide appropriate training as required to achieve this.

Reference*:*

SGS Organization Chart (Alaska Division)

5.2.2. Trainees & Training

New hires begin with the onboarding program. In addition to norms and expectations outlined in the Welcome Packet, new hires are guided through the Orientation & General Training program. The goal of this program is to provide a common basis of knowledge for all staff and each module is facilitated by an experienced staff member. Topics include (for example): Training Manuals & the training program, Quality System Orientation, Introduction to the Ethics Program, Laboratory Communication, Introduction to LIMS, etc. For laboratory staff, modules also include (for example): General Chemistry, Use & Calibration of Balances, Use & Calibration of Pipettors, Foreign Soils, Waste Disposal, Peer Review Reports, etc.

Analysts are trained by an experienced Analyst on an individual basis using the procedures outlined in the SGS Training and Certification SOP. All documentation is filled in the individual's training record, maintained by QA. A Demonstration of Capability Record is completed annually for each method an Analyst is performing. Only Analysts who have completed training may run analyses independently. Analysts in training work directly with a trained Analyst.

The Technical Director, QA Manager, Safety Officer or their designee will coordinate the training and documentation thereof. Intra-laboratory training programs and on-the-job training include:

- Study of SOPs and references, including MSDS forms, reference methods, initial and ongoing training for safety precautions, etc.
- Observing experienced Analyst
- Performing the procedure under direct supervision of experienced personnel
- Analyzing blind QC samples prepared by the experienced trainer
- Completing Initial Demonstration of Capability (IDC), DL and PE studies (as applicable)

Each new hire is escorted through the laboratory by the Safety Officer for training in the location and use of the lab's safety equipment. Follow-up laboratory safety walk-through tours are also performed annually. Additional safety training is provided on an ongoing basis as coordinated by the Safety Officer. The Safety Officer maintains records of attendance.

Additional training from outside short courses or seminars (i.e. the SGS Sexual Harassment Policy, SGS Ethics Training, Manual Integration Policies and Practices, etc.) is also documented in the training record.

The laboratory maintains a comprehensive Training Program, managed by the QA Manager. The QA Manager (or designee) and Technical Director review documentation in support of an Analyst's certification to perform a particular test method. The qualification records are maintained on the network in the Central Data Storage (CDS) directory or with the QA office (as appropriate).

Reference:

SGS SOP 102 (Training and Certification)

5.2.3. Employees

The Company seeks to provide employees with meaningful and challenging work, as well as with development opportunities to prepare for new responsibilities. Supervisors provide feedback and review employee development plans annually through the SGS Employee Review. Employees are expected to take primary responsibility for their own careers, showing initiative, taking job training when necessary, and working with supervisors to achieve Company objectives while moving toward their own career goals. SGS Alaska encourages employees to continue to develop their skills through work experience, education and cross-training.

All training is documented and employees must pass a background check (which verifies degrees conferred). Additional training (e.g., course/seminar certificates) should be provided for inclusion in their personnel file.

SGS Alaska are primarily regular (with benefits) or temporary (seasonal without benefits) staff.

Reference*:*

SGS SOP 102 (Training and Certification)

5.2.4. Job Descriptions

The laboratory shall use personnel who are qualified on the basis of appropriate education, training, experience and/pr demonstrated skills, as required. The Senior Management maintains job descriptions for all staff. In addition to the General Manager (refer to Section 4.1.5.6) and the Technical Director (refer to Section 4.1.5.8), core job descriptions are as follows:

Project Manager: The PM serves as the liaison between the laboratory and its clientele. The PM is responsible for understanding the needs of the client and communicating this information to the operational staff. He or she handles all daily client interactions regarding project specifications and also tracks the status of all project analyses during testing and review.

Sample Control Staff: The sample receiving procedure is viewed as one of the most critical elements of the legal defensibility of the analytical process. It is essential that the client documents complete and accurate information on the CoC and sample bottles. Sample Control staff is responsible for the following tasks:

- Provide clients with proper sample containers and preservatives.
- Receive samples from clients; inspect them for proper preservation/volume and not irregularities.
- Receive and review the CoC record for collection dates and sample identifications.
- Assign unique sample IDs for each container and complete sample receiving records.
- Maintain the storage and handling of samples to ensure easy retrieval and compliance with storage requirements for the requested test methods.
- Track and perform sample disposal.
- The Fairbanks Manager will be responsible for forwarding samples to the Anchorage facility expeditiously, ensuring valid CoC.

Production Manager: Directly responsible for the supervision of the operations and sample control staff, including oversight responsibility of daily activities to ensure the generation of timely data that meets industry accepted practices and project-specific requirements. Oversees documentation practices supporting the tests performed, instrument maintenance, and decision making processes affecting the data.

Organic Chemist: Performs gas chromatographic analysis of volatile and/or semivolatile organic contaminants, fuels, pesticides, and polychlorinated biphenyls in water, soil, wipe, and oil samples.

Cold Vapor/AA/ICP-MS Chemist: Performs chemical analysis for metals in drinking water, wastewater, oil, and soil by cold vapor, AA and ICP-MS technology.

Inorganic Chemist: Performs analysis of water and wastewater for minerals, nutrients, solids, etc., by specific reference methods.

Organic Extraction and Metals Digestion Specialist: Performs extractions for analysis by the Organic Chemist and metals digestions for analysis by the Metals Chemist.

Microbiology Analyst: Performs microbiological analysis of drinking water and wastewater.

Hazardous Materials Specialist: Directs the technical operation of the proper disposal of laboratory generated hazardous waste.

5.2.5. Authorized Personnel

SGS Alaska operates under the direction of the General Manager, who is responsible for developing and maintaining the proper organizational structure to include authorized personnel for specific testing, issuing test reports, giving opinions and interpretations, and the operation of certain equipment types. In addition, the General Manager, is responsible for the description of the responsibilities of senior personnel, providing scientific leadership, project planning, ensuring overall timely delivery of project results and overall responsibility for the quality system within their departments.

5.2.6. Records

The QA Office maintains technical records of training; the QA Manager (or designee) maintains documents specific to the Quality Management System, the Human Resources department maintains academic and professional training records for all personnel (including contract staff), and the Safety Officer(s) maintain records of safety training. The records retained include training, skills and experience, educational and professional qualifications, proficiency records, authorizations, letters of commendation, and significant scientific reports.

All personnel files maintained by the Human Resource department are treated as confidential in so far as the individual (under the Freedom of Information Act) can access the contents.

Reference*:*

SGS Organization Chart (Alaska Division)

5.3. Accommodation and Environmental Conditions

5.3.1. Technical Requirements

SGS Alaska is a facility offering analytical functions. This requires a highly customized building with many specialized functions. Where necessary, the environmental conditions of the lab that can affect results are monitored and documented by the department personnel to ensure the integrity of the test work is not adversely affected.

5.3.2. Facility

The SGS Alaska Anchorage office is currently utilizing two buildings for its operation. The combined size of these buildings totals approximately 22,000 square feet. Building One houses most of the administrative offices which include: reception area, accounting, computer information systems management, purchasing office, data management, quality control, and all of the analytical facilities excluding volatile and semi-volatile gas chromatography. Building Two houses the volatiles and semivolatile gas chromatography departments, walk-in sample storage, and the warehouse.

Sample Storage: SGS Alaska has a walk-in refrigerator (>1000 ft^3) and two reach-in refrigerators (each 48 ft^3) to segregate samples for volatile analyses. There are two point-of-use refrigerators located in GC prep and the waters department (each 32 ft^3). In addition, there is one reach-in refrigerator (>100 ft^3) in sample receiving area to maintain controlled temperatures during temporary sample storage.

Sample Preparation Areas: The organics preparation area is supplied with a separate air handler to supply adequate ventilation. The metals preparation area has been upgraded to include a semi-clean room for low level metals analysis. A separate clean room is maintained for low level mercury analysis.

Volatiles Analysis: Instrumentation for GC/MS volatiles analysis is located in an isolated room to control potential laboratory contamination of samples.

The SGS Alaska Fairbanks receiving office consists of two rented rooms that total 976 square feet and includes: reception area, sample kit preparation area and storage. There are two refrigerators (each >20 ft^3) available for overnight sample storage.

Additionally, SGS Alaska owns a customized trailer which can serve as the on-site facility for select mobile laboratories.

5.3.3. Monitoring

Laboratory rooms containing fume hoods have air exhausted through fume hoods as well as through a general exhaust system to maintain minimum airflow requirements. Rooms not containing fume hoods are exhausted through the general exhaust system.

The Sample Control staff monitors fume hood velocities on a weekly basis. They determine a pass or fail if the fume hood based on the standard 100 fpm velocity for our fume hoods. All fume hoods are on a preventive maintenance schedule to ensure efficient operating parameters are maintained.

The laboratory monitors the DI water systems to ensure that the DI water is free from reagents or contaminants that would otherwise interfere with testing.

All laboratory areas are supplied with proper and adequate lighting. The water and power supply is gauged to the demands of the equipment and instrumentation in each laboratory area.

Reference:

SGS SOP 104 (Laboratory Equipment Monitoring)

5.3.4. Incompatible Activities

There is effective separation between incompatible activities in the SGS Alaska laboratory. This is accomplished through the use of space to physically separate specific areas.

5.3.5. Access

Access to the facilities is restricted at all times. All visitors are required to sign in at the front counter and are escorted by laboratory personnel while in the building.

5.3.6. Housekeeping

SGS Alaska maintains contract personnel to ensure good housekeeping in the lab. All staff are responsible for the housekeeping in their respective lab workspaces, using cleaning products that are compatible with the work done in the lab.

5.4. Test Methods and Method Validation

5.4.1. Methods and Procedures

SGS Alaska uses appropriate methods and procedures for testing (which include as necessary) estimation of uncertainty and statistical techniques for the analysis of data.

Reference:

SGS SOP 141 (Uncertainty)

SGS SOP 145 (Control Charts & Control Limits)

5.4.2. Equipment Instructions

All supporting documents for method performance, including SOPs for equipment, are in place and are available electronically on the SGS network. Where appropriate, they are either included or referenced in the test methods or supporting operating procedures. Alternatively, equipment operating instructions are located in the manufacture's guide, located in the laboratory.

Reference:

SGS SOP 006 (Preparation of SOPs)

5.4.3. Method Deviations

Where deviation from a test method is required, the deviation is documented, technically justified, authorized by Technical Director, and accepted by the customer prior to implementation. Records of method deviations are retained as part of the final report.

5.4.4. Method Selection

SGS Alaska performs its testing operations according to the most current, up-to-date-methods and procedures (where appropriate), which meet the needs of the customer and are appropriate for the test. Deviations, if any, from the reference method and regulatory guidance will be documented in the method SOP.

Where applicable (e.g., if in-house control limits do not meet DOD QSM, sample mass varies from reference method, etc.), deviations to the DOD QSM will be submitted in the DOD QSM Variance Request template and provided to clients requesting proposals for DOD projects.

5.4.5. Non-Customer Specified Method Selection

Where methods are not specified, methods are selected from those published by international or national bodies, reputable technical organizations or in scientific texts or journals and that have been validated, or that have been developed and validated in-house. Method selection is based upon the media of the sample (e.g. solid vs. liquid), the amount available, and the concentration range expected for the contaminant being tested.

5.4.6. Inappropriate Methods

If laboratory staff feels that the customer has specified an inappropriate method, this fact is documented, the customer is notified, and a valid method is selected from those published by international or national bodies, reputable organizations or in scientific texts or journals. Records of notification to customer are retained as part of the quote file and/or the CoC.

5.4.7. Published Reference Methods

Where SGS Alaska performs testing operations based on published standard methods, the performance characteristics of the standard method are verified and recorded (with the method). The verification of validation is repeated if the standard method changes.

5.4.8. Laboratory Developed Methods

Where it is necessary to employ performance based methods that have not been established as standard, SGS Alaska will endeavor to ensure that these methods are precise and accurate. The methods are assigned to qualified personnel, fully documented and validated if possible and fit-for-purpose through customer consultation.

Where it is necessary to modify or establish a lab developed method, this will be, with the Technical Director's approval, listed as a deviation in the applicable SOP.

5.4.9. Non-Standard Methods

Where it is necessary to employ methods that have not been established as standard, SGS Alaska endeavors to ensure that these methods are precise and accurate. Prior to use of a non-standard method, SGS Alaska will get customer approval (retained as part of the quote file and/or CoC). Non-standard methods are fully documented and validated if possible and deemed fit-for-purpose prior to use in the lab.

5.4.10. Method Validation

Method validation is the process of establishing performance characteristics and the fitness for the intended use of a method. SGS Alaska will retain documents relating to method development.

Reference:

SGS SOP 111 (Document Control)

SGS SOP 148 (Method Development)

5.4.11. Range and Accuracy

The range and accuracy (the closeness of the assessment between the result of a measurement and a true value of the measurement) of a method employed by the laboratory must be relevant to the customer's needs. Range and accuracy of all methods is established prior to use in the lab.

5.4.12. Measurement Uncertainty

Measurement Uncertainty is an estimate, attached to a test result, which characterizes the range of values within which the true value is asserted to lie. Potential sources of uncertainty include all parameters associated with sample preparation, sample analysis and computational effects. SGS Alaska has an uncertainty of measurement policy, which is applied to all analytical methods.

Reference:

SGS SOP 141 (Uncertainty)

SGS SOP 145 (Control Charts & Control Limits)

5.4.13. Reasonable Estimates

Where test methods do not allow for a statistical estimation of measurement uncertainty, SGS Alaska will make a reasonable estimation and reports this estimate in a way that does not give a wrong impression of the uncertainty.

5.4.14. Calibrations

SGS Alaska performs in-house calibrations for thermometers, mechanical pipettors and balances. Calibrations of reference thermometers and weights are contracted out to ISO 17025 accredited calibration laboratories.

Reference:

SGS SOP 104 (Laboratory Equipment Monitoring)

5.4.15. Calculations and Data Transfers

Calculations and data transfers are checked by laboratory staff authorized to preview and release of the final report. This is performed before the final report is generated and sent to the customer.

Reference:

SGS SOP 101 (Peer Review)

SGS SOP 122 (Login and Package Review)

5.4.16. Computers or Automated Equipment

Where computers or automated equipment are used:

- that have lab developed software and/or calculations, these are verified and records of verification maintained by the QA Office.
- these are maintained to ensure proper functioning through routine maintenance as required/planned
- appropriate environmental and operating conditions are provided.

5.4.17. Protection of Data

SGS Alaska has procedures in place for the protection of data and includes the following:

- Integrity and confidentiality of data entry or collection - Data integrity and confidentiality are maintained through proper training of employees and the use of security protocols. Two levels of password authentication are used to control user activity with customer data. To gain access to the network, each PC must be logged in using a valid Windows domain account. Access to various areas of the network, as well as the LIMS database, is restricted based on the account used. The second security level controls access into the LIMS, a specific LIMS logon ID and password combination is required and access levels are restricted based on this logon ID. Every user of the LIMS must log in using their own logon ID and password combination to gain access to the LIMS. Access to the LIMS system is fully audited and can be traced back to individual users. All user classes in LIMS have defined idle time allowances, after which the system will terminate the session.
- Storage - All critical data are stored on either the LIMS server, which holds the LIMS database as well as the worksheet files, or on the main file server. These servers are maintained in a secure climate controlled room. Each server has a redundant power supply for fault tolerance, as well as UPS battery backup. The LIMS database is backed up nightly to tape. Transaction logs are copied onto multiple locations on the server and are archived to tape weekly. File and database servers have a nightly incremental back up to tape, full backup to tape is performed weekly. The backup tape sets are taken from the primary location to a secure secondary location the next day for further recoverability in the event of a major catastrophe.
- Transmission - Electronic data transmissions are routinely sent out in PDF format to reduce the possibility of tampering with the data. Data authenticity and integrity can also be maintained and enforced using digital signatures and encryption of emails and attachments when required. *Note: all email transmissions are screened for viruses at the server level, as well as at the desktop level. This helps reduce the risk of infection resulting in data loss, as well as the sending out of infected emails to our customers.

Reference*:*

SGS SOP 142 (Electronic Data Storage)

5.5. Equipment

5.5.1. Operation

SGS Alaska ensures that all of the equipment required for performing all test work is maintained in good working order, is compliant with specifications, is checked and calibrated before use (where appropriate), is operated by authorized personnel, is operated using available current instructions on use and maintenance, and is uniquely identified. It also meets the accuracy necessary for performing the test work and is checked on a regular basis to ensure compliance with the specifications. All available equipment is checked (and calibrated if necessary) before use to ensure proper functioning and is capable of achieving accuracy required for the test method.

SOPs, together with the manufacturer's instructions are in place to ensure proper use and maintenance of the equipment.

The SGS Alaska Production Manager assigns a unique identification (e.g., VKA and VNA are GC/MS instruments for volatiles; SOA and SQA are GC/MS instruments for semivolatiles) to each piece of equipment.

5.5.2. Records

It is the responsibility of the Production Manager to ensure that a maintenance log is kept for each piece for major analytical equipment. At a minimum, these logs must document the following.

- Each entry is dated and initialed by the person making the entry.
- Each time the instrument is taken out of service and the type of repair made.
- Any non-compliant behavior in the instrument that required the maintenance/repair (i.e. a cause and corrective action format).
- Each time the instrument receives routine maintenance from either SGS staff or instrument company representatives.
- Each time an instrument is returned to service.

Additionally, it is the responsibility of the analytical staff and Production Manager to implement preventive maintenance on the analytical equipment as necessary, to avoid instrument failures which could impact data quality.

SGS Alaska maintains records of equipment, which include the following information:

- Date purchased or put into service;
- Identity of the equipment and its software;
- Manufacturer's name, model, and serial number or other unique identification;
- Checks that the equipment complies with the lab requirements and standard specifications;
- Current location, where appropriate;
- The manufacturer's instructions, if available, or reference to their location;
- Calibration history and due date of next calibration;
- The maintenance plan, where appropriate, and maintenance carried out to date;
- Any damage, malfunction, modification or repair to the equipment;

Reference*:*

F072 - Equipment List

5.5.3. Procedures

Analytical instruments and equipment require routine and non-routine maintenance. The instrumentation employed in sample analysis is maintained by the primary Analyst to ensure that the data generated is of the utmost quality. The Production Manager is responsible for ensuring that preventive maintenance is performed. Records of preventive maintenance are part of the permanent record for each instrument. Analysts are responsible for monitoring an inventory of spare parts for each instrument. Spare parts are defined as: *Expendable parts as well as those parts subject to wear and/or breakage.* A sufficient inventory will be kept on hand to reduce down-time.

Routine maintenance is performed by the instrument operator as described in the preventive maintenance procedures of the operator's manual or instrument SOP. Typically, the following preventive maintenance activities will be performed:

1. Check instrument sensitivity and response daily or prior to each use as described in the operator's manual, SOP, or analytical method. This may include:
    - Tuning and Daily Calibration
    - Gas Flow Measurements/Leak Checks
    - Proper Energy Levels
    - Zeroing and Full Scale Operation
2. Incubators, refrigerators and freezers are checked daily for proper temperature. Liquid filled thermometers are calibrated annually and digital thermometers are calibrated on a quarterly basis.
3. Balances are checked daily for proper calibration. All readings are entered into a logbook.
4. Exhaust hoods are checked weekly to verify that they are functioning properly and flow rates are recorded in a logbook.
5. The waste storage area is also inspected weekly for safety.
6. Storage blanks, for volatile organic contaminants, (water and/or soil depending on matrix of samples stored in the refrigerator) are rotated and analyzed biweekly to monitor for laboratory contamination.
7. Annual DI Water Suitability Testing is performed to verify suitability for microbiology testing along with monthly checks.

Non-routine maintenance may be performed by vendor service technicians, Analysts, or the Technical Department. All non-routine maintenance must be recorded in the instrument maintenance logs with sufficient detail, noting the problem, corrective action, and the date on which the instrument returned to operational service.

Reference*:*

SGS Analytical SOPs

SGS SOP 104 (Laboratory Equipment Monitoring)

5.5.4. Out-of-Service

Out of service equipment is isolated (if appropriate) clearly labeled as "Out-of-Service" or "Not-in-Service" or "Do-Not-Use", examined for the effects of the problem and addressed appropriately.

Reference*:*

SGS SOP 104 (Laboratory Equipment Monitoring)

5.5.5. Calibration Status

For equipment not calibrated on an as-used basis, the calibration status of equipment is identified, including (where practicable) date when last calibrated and expiry date or recalibration date. DOD-ELAP requires that a calibration be performed annually at a minimum.

5.5.6. Return to Service

If equipment goes outside the direct control of the lab, it is checked and validated before being returned to service. Records of return to service are maintained in the equipment files.

5.5.7. Adjustments

Access to the lab is controlled, preventing unauthorized access by anyone into the lab area. The main doors to the facility are locked at all times (excluding the front door and GC prep doors during business hours) and visitors or non-SGS personnel are escorted while in the lab to further ensure no unauthorized adjustments are made to any equipment.

Internally, all equipment that could be affected by adjustments is monitored daily to ensure conformance to specifications. Records of monitoring (e.g. balance checks, incubators, etc.) are maintained.

5.6. Measurement Traceability

5.6.1. Calibration Program

Balances calibrations are checked at the start of the day and more frequently if necessary. The readings for each balance are entered into the equipment monitoring log as per the Equipment Monitoring SOP. Class S weights (calibrated and certified by a third party at least once every 5 years) are used in the calibration of the balances. The balances calibrations are verified monthly by SGS Staff and the balances are serviced annually by an ISO 17025 accredited provider.

Non-digital thermometers are calibrated annually using an NIST Certified reference thermometer. Sample receiving and other digital thermometers are calibrated quarterly. The temperature for each thermostatically controlled device is maintained and recorded daily (twice a day for Microbiology). Corrective actions for temperatures that are out of control are addressed according to the Equipment Monitoring SOP. The NIST-traceable reference thermometer is sent out for calibration from an independent source at least once every year.

In accordance with many of the regulatory protocols for analytical procedures, the temperatures of ovens, incubators, refrigerators, and freezers must be checked to ensure control. The verification data is recorded in logbook and reviewed for exceedance which may affect date quality by the QA Manager (or designee). Sample refrigerators and freezers are monitored 7 days a week. Microbiology equipment is monitored twice daily; once a day on weekends and holidays.

Mechanical Eppendorf (or equivalent) pipettors are all verified, and documented in the pipette log. Disposable volumetric pipettors are verified on a per lot basis. All calibration checks are recorded in the pipette logs.

All other Environmental Services equipment requiring calibration has a calibration procedure in place, which is referenced in the method.

Reference:

SGS SOP 104 (Laboratory Equipment Monitoring)

5.6.2. Traceability to International System of Units

Balances are calibrated monthly by SGS staff using reference weights that are calibrated by an external calibration laboratory that is accredited to ISO/IEC 17025. Thermometers are calibrated by SGS staff using a reference thermometer that is calibrated by an external calibration laboratory accredited to ISO/IEC 17025. External calibration services have a demonstrated competence, measurement capability and traceability with certificates that contain the measurement results and measurement uncertainty and/or compliance statement.

Reference:

SGS SOP 104 (Laboratory Equipment Monitoring)

SGS SOP 112 (Standards Labeling and Traceability)

5.6.3. Traceability

Where traceability cannot be strictly made to International System (SI) units, traceability is established through the use of certified reference materials, agreed methods (validated with interlaboratory comparisons where appropriate), and consensus standards (validated with interlaboratory comparisons where appropriate).

Reference:

SGS SOP 104 (Laboratory Equipment Monitoring)

SGS SOP 112 (Standards Labeling and Traceability)

5.6.4. Reference Standards

SGS Alaska has procedures in place for handling reference standards. A set of reference standards (i.e. a weight set and a thermometer) are stored the QA Office (or other designated area) and are reserved for verification purposes only.

Reference:

SGS SOP 104 (Laboratory Equipment Monitoring)

5.6.5. Reference Materials

Reference Materials used in the laboratory are traceable to SI units where possible, or to certified reference materials. Internal reference materials are checked as far as is technically and economically practicable. Intermediate checks are carried out to maintain confidence in the calibration status of reference materials according to defined procedures and schedules. Procedures for the transport and storage of reference materials are in place.

Solvents (e.g., methylene chloride) are analyzed for purity by subjecting a solvent blank to the analytical method corresponding to its intended use. The solvent's purity is then monitored periodically through the analysis of method blanks. Any reagent will be discarded at the first sign of decomposition or contamination. The Analyst is responsible for checking expiration dates and discarding expired reagents/standards.

Water is considered to be laboratory grade (equivalent to EPA Type II) when it has been passed through a charcoal filter to remove organic constituents and then through a deionizing column. Deionizing cartridges are changed when conductivity exceeds 2 µmhos/cm. The quality of the water is routinely monitored against established acceptance criteria for each analysis. Monitoring for use by the Microbiology Section consists of periodic measurements of the conductivity, pH, residual chlorine, HPC, and an annual water suitability test. To further ensure the quality of water, method blanks are performed with each analysis.

Standard solutions are generally purchased. If prepared by Analysts for in-house use, they are recorded in a logbook along with supplier identity, lot number, grade, concentration, method of preparation, Analyst name, the date of preparation, and the expiration date. Standard solutions are then validated prior to use. Standard solutions are monitored for deterioration and discarded if such signs as color changes, precipitation, or concentration changes are detected. Solutions known to be light sensitive are stored in amber glass bottles.

SGS has procedures in place to ensure traceability of the purchase, receipt, and use of consumable materials used for the technical operation of the laboratory. These procedures consist of:

- Maintaining the vendor's certificate of analysis or purity, if available.
- Labeling the original container with a unique identifier, date received, and expiration date.
- Documenting the receipt and preparation indicating traceability to purchased stock or neat compounds by lot number or other unique identifier, method or preparation, dates, preparer's initials, expiration dates.
- Standards and solvents used in an analysis are recorded in the preparation and/or run logs to ensure traceability.

Stock standards traceable to NIST standards are purchased from approved vendors. Staff will purchase standards from ISO Guide 34 vendors whenever available.

The quality of data generated in an analytical laboratory is directly related to the quality and purity of the reagents/solvents used in preparing samples and calibrating instruments. These reagents/solvents fall into four categories:

- Solvents used in sample extraction
- Reagents used in sample digestion
- Internal spike/surrogate compounds
- Instrument tuning/calibration reagents

Unyielding efforts are made to acquire, maintain and verify reagents of the highest quality. In order to ensure the highest quality and purity, all chemicals and reagents acquired by SGS are of an appropriate grade, purchased through reliable commercial sources. If it is necessary for a particular method or procedure, "Ultrex" or spectrochemical grade reagents are purchased. Lower grade reagents may be acceptable for some procedures. The method objectives and availability determine the grade. When a particular method requires reagents, it is the responsibility of the Analyst to order the proper grade through the purchasing agent.

All chemicals are inspected, initialed, and dated at the time of arrival. These are four areas of storage:

- Those items currently in use for analytical needs are stored in the lab area.
- Flammables, solvents, and liquid hazardous materials are stored in a regulated room meeting code requirements (i.e. explosion proof lighting, ventilation, spill kit, etc.)
- Reagents chemicals in powder form are stored in a separate room in storage cabinets marked with the appropriate safety information, hazard classification, and identification.
- Temperature sensitive reagents and standards are stored in a refrigerator or freezer.

The purchasing agent is responsible for the transfer of all MSDS forms (Material Safety Data Sheet) to the laboratory Safety Officer to be added to the employee MSDS library.

Reference:

A2LA Document P102 (www.a2la.org)

SGS SOP 112 (Standards Labeling and Traceability)

SGS SOP 126 (Procurement, Receipt of Supplies and Processing Vendor Invoices)

SGS SOP 500 (Analytical Chemistry Quality SOP)

5.7. Sampling

5.7.1. Procedures and Plan

There is a sampling procedure in place for taking sub-samples for analysis, which includes a sampling plan (based on appropriate statistical methods, wherever reasonable) and includes factors to be controlled to verify the validity of the results, the selection of samples, and the withdrawal and preparation of samples.

The responsibility for collecting and transporting samples to SGS resides with the client. In cases where SGS personnel perform the sampling, a sampling plan is first reviewed and approved by the client. Data quality is directly related to proper sampling procedures. SGS will provide consultation and assistance in designing sampling protocols to see that field procedures assure the following;

- Samples contain no foreign material and accurately represent the site where samples are collected.
- Samples are:
  - of adequate size
  - collected in containers of appropriate type and quality for the matrix and analysis requested
  - properly preserved in terms of pH and temperature during transport
- Airborne or sample cross-contamination does not occur during transport.
- Accurate records are generated and kept regarding on-site conditions, such as maps of sampling sites, labeling of samples and weather conditions.
- Field monitoring instruments are working properly.
- Samples arrive at SGS in a timely manner.
- If site-specific quality control (QC) sample analyses are required, sufficient sample bottles will be provided with instructions regarding sample volume requirements in order to achieve the QC objectives for the site.

SGS will supply containers that are properly cleaned, labeled, and preserved for sample collection. Extra bottles are provided upon client request or for projects of sufficient sample size for the collection of extra volume to fulfill method and/or site requirements for laboratory quality control sample analyses. The client will complete the label with information that matches the information on the CoC record. Sample holding times begin at the time of sample collection and determinations of the time held is based on the time of the test method by the bench chemist. For composite samples, the holding time assessment begins with the end date and time of the composite period. For trip blanks, the collection date and time assigned by the client should coincide with the collection of the first sample in the set.

In the event that SGS collects samples, the following will apply: samples should provide a fair representation of the media being sampled; the sampling supervisor/project manager should try to determine the quantity and type of samples and the sample location prior to actual field work. As few people as possible should handle samples to minimize potential variables. The field sampler will be solely responsible for the care and custody of all samples collection until the time of transfer to the laboratory via commercial courier or hand delivery.

A written record will be kept of sampling activities in a bound book. In addition to a log of all samples collected and all field instruments readings, information on items such as weather conditions, sampling techniques, and on-site conditions at the site of sampling will be recorded. Changes in the visual appearance of samples, odors, notable characteristics of the materials being samples, and other observations made during sampling will be recorded. Sample labels will be completed for each sample container with waterproof ink.

Reference:

SGS SOP 106 (Sample Receiving)

SGS SOP 107 (Sample Custody)

SGS SOP 118 (Sample Kit Preparation)

5.7.2. Deviations

All customer-requested deviations are noted in the client file and are communicated to the lab personnel.

5.7.3. Records

The CoC form used by SGS Alaska, allows for a record of the following, where supplied by the customer:

- Sampling procedure;
- Sampler identification;
- Environmental conditions (if relevant);
- Sampling location;
- Basis for sampling procedure statistics (if appropriate);

The sub-sampling procedure used in-house is maintained on the network and is the procedure followed by all staff. Where deviations from this method occur, they will be noted in LIMS via sample comments.

Reference:

SGS SOP 143 (The Weighing of Soils and Solids)

5.8. Handling of Test Items

5.8.1. Procedures

Sample custody begins at the time of collection and concludes with disposal or complete consumption of the raw sample, extracts and/or digestates during laboratory procedures. Legal custody records should provide a continuous record of possession or storage of samples in the field and the laboratory. Commercial shipping couriers are not required to sign the custody records; however, documentation must be made that identifies the courier and the airbill number or copy of the bill of lading.

The original CoC Record will identify the transported contents and will accompany the shipment. The field services supervisor will retain a copy of the CoC. Samples shall be properly packaged for shipment and dispatched to the laboratory. Shipment via commercial couriers (other than USPS) must be accompanied by a bill of lading or airbill. All postal receipts, bills of lading or airbills must be retained as part of the permanent project file record. A sample is considered to be in the possession of a person if:

  - It is in that person’s physical possession.

- It is in view of that person after they accepted receipt of it and have physical possession of it.
- That person has placed it in a secure area.
- The three previous items are all qualifiers until that person has relinquished it to someone else who fulfills any of the above requirements.
    - The Sample Control personnel will accept custody of the shipped samples and will verify that the information on the sample bottle labels and CoC agree. Discrepancies are noted on the Sample Receipt form. CoC forms must accompany all samples. No more than one project may be recorded per CoC.

The internal CoC begins at the time of receipt and is completed upon sample disposal. The Sample Custodian will distribute samples to the appropriate storage locations. Laboratory personnel will be responsible for the care and custody of samples while in their possession. When sample analysis and necessary quality assurance checks have been completed in the laboratory, the unused portion of the sample will be retained for 14 days after release of the final report or data deliverables (whichever is later) unless prior arrangements are made. Other arrangements can be made if necessary. For samples transferred from the Fairbanks facility, condition upon receipt in Anchorage will be documented on an additional form.

Reference:

SGS SOP 106 (Sample Receiving)

SGS SOP 107 (Sample Custody)

5.8.2. Identification

All samples submitted to SGS Alaska are assigned a unique identification through the LIMS system.

5.8.3. Deficiencies

All abnormalities and deficiencies identified upon receipt of the test items are recorded and, if appropriate, the customer is notified. Records are maintained in the associated batch peer review report and/or final report.

Any changes to the CoC submitted (e.g., changes to sample ID and/or collection information, addition/deletion of rush requests) must be documented. The Change Order Form should be initiated by the PM and completed by the client. Alternatively, e-mail or fax directives from the client may be used. Any change order received must be scanned with the CoC and sample receipt forms as part of the official work request and the laboratory must be notified of the changes.

5.8.4. Facilities

All non-monitored exterior doors are locked, preventing the unauthorized entry of an individual into the laboratory. Entry is gained by use of a master key and a pass code, which is issued to each employee. Specific areas within the lab where there is controlled access have their own keys.

5.8.5. Environmental Conditions

Records of the environmental conditions are monitored and recorded, (as appropriate). Records of non-compliance with required conditions are communicated to the customer via the final report.

5.8.6. Handling Instructions

Where handling instructions are provided by the customer, these instructions are transcribed into LIMS, and records of instructions are retained as part of the CoC.

5.9. Assuring the Quality of Test Results

5.9.1. Quality Control

SGS Alaska has a method validation program to establish the performance characteristics of a method to demonstrate “fitness for use”. The performance characteristics are established over the short term and long term; all data generated by the lab is evaluated against the performance characteristics to determine if the results are acceptable (or fit-for-use).

SGS Alaska has quality control procedures for monitoring data validity, which may include but not limited to: use of reference materials (certified wherever possible); participation in interlaboratory comparison or proficiency testing programs; replicates; re-testing of retained items; correlation of results for different characteristics of an item.

Reference*:*

SGS SOP 145 (Control Charts and Control Limits)

5.9.2. Quality Control Data

All quality controls in place in the laboratory are recorded using the on-line LIMS system and reviewed to detect trends, and, where practicable, statistical techniques are applied. Acceptance criteria is based on validation, reference methods, or control charting, or as determined by the Technical Director.

Where applicable, the QA Manager (or designee) will engage in routine electronic review of electronic data via the MintMiner software program.

Reference:

SGS SOP 101 (Peer Review)

SGS SOP 145 (Control Charts and Control Limits)

5.9.3. Quality Control Data Analyzed

Monitoring of quality control data is done by all groups through the data approval process, by use of the quality control program and by comparison of the result to established performance characteristics. Where practicable, data may be charted.

Where results do not fall within the specified tolerances, action is taken to correct the deficiency. Detailed steps on actions to be taken if results are unacceptable can be found in the Corrective Action Table of analytical SOPs. Any corrective actions needed to address QC outlier or other technical challenges that are not listed in the SOP require the prior approval of the QA Office or Technical Department. In the event that data quality is impacted, the Project Manager will be notified and a corrective action will be initiated as specified in the Corrective Action SOP.

In order to maintain quality control on an ongoing basis, laboratory control samples (LCSs) prepared from NIST-traceable sources are analyzed with each batch. Full compound list spikes are performed for all DOD projects. Data must fall within specified control limits in order for sample analyses to proceed.

Reference:

SGS SOP 101 (Peer Review)

SGS SOP 145 (Control Charts and Control Limits)

5.10. Reporting the Results

5.10.1. Test Reports

Hold times are monitored to the hour for analyses with hold times greater than 72 hours. Analyses with short hold times (i.e., less than or equal to 72 hours) are monitored to the minute.

It is the responsibility of each Analyst to assure that adequate written records are kept of each analysis performed.

SGS Alaska provides test reports that contain, (where appropriate), the following information:

- Work Order number
- Name and address of laboratory;
- Location where test carried out (if different);
- Unique identification of the report on each page, and a clear identification of the end of the report;
- Name and address of customer;
- Unique item identification;
- Date and time of sample receipt;
- Date and time of sample extraction/digestion and analysis;
- Sampling plan and procedure used (where relevant);
- Test result with units;
- Name(s), function(s) and signature(s) or equivalent identification of person(s) authorizing the report;
- Statement to the effect that the results relate only to the items tested, where relevant;
- Subcontracted results clearly identified;

The QA Manager and Technical Department regularly review data packages (including at least 10% of all DOD packages) and calibration activities to ensure their adherence to SGS QA/QC standards.

5.10.2. Test Result Interpretation

Upon request SGS Alaska will provide all information necessary for the interpretation of test results that include the following:

- Variances from test methods;
- Information on specific test conditions;
- Statement of compliance;
- Statement on the estimated uncertainty when it is relevant to the validity or application of the result, a customer requires it, or when the uncertainty affects compliance to a specification limit;
- Opinions and interpretations, which are clearly marked;
- Additional requested information;
- Date of sampling, where available;

- Identification of the substance, material, or product sample;
- Sampling location, (where available);
- Environmental conditions during sampling (where available);
- Sampling method or procedure used and deviations, (where available);

SGS offers four levels of PDF data packages, generated directly from LIMS. PDF reports, with authenticated electronic signatures, are considered official reports and intended to be used in their entirety. SGS provided all reports and deliverables online. This secure web portal, Engage, can be accessed at https://engage.sgs.com.

After peer review of all analyses is complete, LIMS will generate a final report. (A partial or preliminary report may be issued at the discretion of the Project Manager.) The PM will review the report for consistency and specific project and/or client requirements. With the completion of this final review stage, the report is issued to the client..

Reference:

SGS Statement of Qualifications – Data Deliverables Options

SGS SOP 122 (Login and Package Review)

5.10.3. Opinions and Interpretations

Where SGS Alaska provides opinions and interpretations, the lab shall document the basis upon which these have been made.

5.10.4. Amendments

All amendments made to test reports are identified by a change in revision number in the report and contains all information as required by section 5.10.1. Records of amendment are maintained in the customer file(s) and tracked through Engage. The customer is notified prior to the re-issue of any amended document.

5.10.5. Simplified Reporting

Where results are reported to the customer in a simplified way, all information normally reported is retained.

6. SUMMARY OF CHANGES FROM PREVIOUS REVISION

Effective 10/13/17:

- Section 2.1.1 Update reference to the 2009 TNI standard.
- Section 2.1.2 Links corrected to ADEC scopes of certification
- Section 4.1.2 Reference to 2009 TNI standard included
- Section 4.1.5.8 Update Technical Director who is absent in excess of 35 days the accrediting authority must be notified.
- Section 4.1.5.10 Added
- Section 4.1.5.11 Added

REFERENCES

International Standard ANSI/ISO/IEC 17025, Second Edition 2005(E), General Requirements for the Competence of Testing and Calibration Laboratories.

ATTACHMENT 2
ADEC RESPONSE TO COMMENTS ON WORK PLAN FOR REMOVAL ACTION AT SOURCE AREAS CG517 AND CS081, EIELSON AIR FORCE BASE, ALASKA. AUGUST 23, 2018

DEC Comments on
Work Plan for Removal Action and Monitoring at Source Areas CG517 and CS081
Eielson Air Force Base, Alaska

August 24, 2018

Reviewer: Alaska Department of Environmental Conservation
Recommended By: John O'Brien

Comment No.	Page	Section	Comment / Recommendation	Response	DEC Accept/Reject
1.	1-11	Table 1-1	Suggest including the DEC Eielson AFB Alternate Remedial Project Manager, John O'Brien, in the Project Contact Information. Also, change responsibility for Monte Garroutte to "Remedial Project Manager". Swift River Field Superintendent and Health and Safety Manager contact information must be completed.	Concur, contact information for John O'Brien has been added and Monte Garroutte's title revised in Table 1-1 and the UFP-QAPP WS#3 & 5 as suggested. Concur, Field Superintendent and H&S Manager have been identified and contact information provided.	Reject (8/23/208): please replace both Monte Garroutte and John O'Brien with Bri Clark DEC Eielson Alternate Remedial Project Manager.
2.	5-1	5.0	Please indicate in the text of Section 5 that the report will be submitted to AFCEC ***AND*** DEC for review and comments. DEC review comments must be fully addressed and a completed DEC comment matrix showing that the responses to all DEC comments are acceptable must be attached to the end of the Final document before the work plan can be approved.	Concur, the text was added as suggested. It is understood that DEC review comments must be fully addressed and a completed DEC comment matrix showing that the responses to all DEC comments are acceptable must be attached to the end of the Final document before the work plan can be approved.	Accept

Comment No.	Page	Section	Comment / Recommendation	Response	DEC Accept/Reject
3.	9	WS#3 &5	Contact information in table is incomplete.	Concur, information for SGS was added. Contact information for Swift River was added.	Accept
4.	11	WS#4,7 &8	Table 4-1 is incomplete	Concur, table has been completed	Accept
5.	14	WS#6	Table 6-1 is incomplete	Concur, table has been completed	Accept
6.	25	WS#10	Background information on geography, geology, hydrogeology and climate is redundant to Section 2 and probably unnecessary. Please consult the ADEC guidance on developing conceptual site models (ADEC 2017). Consider including the CSM graphic form in place of Figure 10-1 and in the text of WS#10 describe how the background information from Section 2 helped develop the CSM. Please discuss in the text the complete pathways and the potential receptors.	Worksheet 10 will be revised to reference the CSMs previously submitted to ADEC in the 2016 CG517 Site Characterization Report and the CS081 Decision Document (December 2015). There have been no change in site conditions since the CG517 CSM was developed. Swift River will develop a new CSM for CG517 and CS081 upon completion of the 2018 field activities and submitted as part of the 2019 reports.	Accept

Comment No.	Page	Section	Comment / Recommendation	Response	DEC Accept/Reject
7.	47	WS#14 &16	It should be noted in the text of the 3rd bullet point or immediately after that the final document must include the DEC comment matrix with all comment responses accepted by DEC.	Concur, the text was added to the 3rd bullet as suggested. The 3rd bullet now reads as: "*Final version – Final documents are the version of the document that has received USAF and regulatory concurrence. The final documents will include the ADEC comment matrix with all comment responses accepted by ADEC. Both hard copy and electronic formats of final documents will……*"	Accept

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