Sampling and Analysis Plan for Tank 110-D1 Closure

Eareckson Air Station, Alaska

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U.S. Air Force

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
%R	percent recovery
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AED	automated external defibrillator
Ag	silver
Al	aluminum
AIPG	American Institute of Professional Geologists
AMNWR	Alaska Maritime National Wildlife Refuge
As	arsenic
AST	aboveground storage tank
Ba	barium
Be	beryllium
bgs	below ground surface
Brice	Brice Engineering, LLC
B.S.	Bachelor of Science
CA	corrective action
Ca	calcium
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CCV	continuing calibration verification
Cd	cadmium
CFR	Code of Federal Regulations
Co	cobalt
CoC	chain-of-custody
COC	contaminant of concern
CPR	cardiopulmonary resuscitation
Cr	chromium
Cu	copper
DD	Decision Document
DL	detection limit
DoD	Department of Defense
DOT	Department of Transportation
DQI	data quality indicator
DQO	data quality objective
DRO	diesel range organics
EAS	Eareckson Air Station
EB	equipment blank
EDD	electronic data deliverable

ACRONYMS AND ABBREVIATIONS (CONTINUED)

ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
FD	field duplicate
Fe	iron
FS	Feasibility Study
FSP	Field Sampling Plan
GC	gas chromatography
GC/MS	gas chromatography/mass spectrophotometer
GNSS	Global Navigation Satellite System
GRO	gasoline range organics
HAZWOPER	Hazardous Waste and Emergency Response
HCl	hydrochloric acid
HDPE	high-density polyethylene
Hg	mercury
HNO_3	nitric acid
IBC	Intermediate Bulk Container
IC	institutional control
ICP-MS	inductively coupled plasma-mass spectrometry
ICV	initial calibration verification
IDW	investigation-derived waste
JBER	Joint Base Elmendorf-Richardson
K	potassium
L	liter
LCL	lower control limit
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOD	limit of detection
LOQ	limit of quantitation
MB	method blank
MeOH	methanol
Mg	magnesium
mL	milliliters
Mn	manganese
MPC	measurement performance criteria
M.S.	Master of Science
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
Na	sodium

ACRONYMS AND ABBREVIATIONS (CONTINUED)

ND	non-detect
Ni	nickel
OSHA	Occupational Safety and Health Administration
oz	ounces
PAH	polycyclic aromatic hydrocarbon
Pb	lead
PCB	polychlorinated biphenyl
PG	Professional Geologist
PID	photoionization detector
PM	Project Manager
ppm	parts per million
PAL	project action level
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RPD	relative percent difference
RRO	residual range organics
RTK	real-time kinematic
SAP	Sampling and Analysis Plan
Sb	antimony
SDG	sample delivery group
Se	selenium
SIM	selected ion monitoring
SOP	standard operating procedure
SVOC	semi-volatile organic compound
TB	trip blank
TBD	to be determined
TCLP	toxicity characteristic leaching procedure
Tl	thallium
TLC	Teflon-lined cap
TLS	Teflon-lined septa
TSDF	Treatment, Storage, and Disposal Facilities
TWP	temporary well point
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USFWS	U.S. Fish and Wildlife Service

ACRONYMS AND ABBREVIATIONS (CONTINUED)

UST	underground storage tank
VOA	volatile organic analysis
VOC	volatile organic compound
Zn	zinc

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) presents the sampling design, rationale, and methods for the soil investigation and groundwater sampling (if groundwater is encountered) to be conducted in the area surrounding Tank 110-D1, located adjacent to Building 110 at Eareckson Air Station (EAS) on Shemya Island, Alaska. This work is being performed by Brice Engineering, LLC (Brice) under U.S. Army Corps of Engineers (USACE) Contract W911KB20D0002, Work Order W911KB24F0036. Work will be performed in accordance with 40 CFR 265 Subpart G closure requirements for Treatment, Storage, and Disposal Facilities (TSDF) and 40 CFR 265 Subpart J closure requirements for TSDF hazardous waste tanks.

The purpose of the SAP is to provide instruction and guidance to ensure that the data generated during field activities are of sufficient quality and quantity to meet the established project and data quality objectives (DQOs). The SAP is divided into two main parts: the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP). The FSP describes the procedures for the collection, handling, and analysis of environmental samples, as well as quality control (QC) procedures. The QAPP describes the analytical and documentation protocols to be followed when reviewing and analyzing data collected from the project site.

1.1 Project Goals and Objectives

Fieldwork will be conducted in the area surrounding Tank 110-D1 and Building 110. The primary objective of fieldwork is to collect analytical samples to confirm the presence or absence of contamination in soil and groundwater following the closure of Tank 110-D1, which is described under separate cover.

1.2 Site Location, Description, and History

EAS is approximately 1,500 miles southwest of Anchorage, Alaska, in the Aleutian Islands. It is located on Shemya Island, which is approximately 3.5 miles long by 1.5 miles wide. EAS is under the command of the Pacific Air Forces Regional Support Center, with headquarters located at Joint Base Elmendorf-Richardson (JBER), Alaska.

Building 110 is a former communications structure on the north-central side of EAS and is currently under consideration for future use. It is co-located with site ST039, a U.S. Air Force (USAF) restoration program designation for cleanup activities related to two former underground storage tanks (USTs) removed from the east side of Building 110 in 1993. Site ST039 is subject to institutional controls (ICs) as described in the 2008 Non-Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Decision Document (DD). Long-term monitoring is conducted every 2 years and reported along with other EAS restoration sites. No water or soil sampling is required by the DD. As documented in a separate Record of Decision, no CERCLA methanol contaminants of concern (COCs) were identified for ST039. Based on the administrative record, no pre-existing contamination is known in the surface immediately around Tank 110-D1 or in the Intermediate Bulk Container (IBC) and Tote Storage Area.

Adjacent to Building 110 on the north, Tank 110-D1 is a 10,000-gallon welded-steel aboveground storage tank (AST) that normally contained DF-8 (diesel) or JP-8 (jet fuel), as documented during the 2023 tank inventory conducted by USAF. DF-8 is JP-8 that has not met aviation QC standards but is suitable as a diesel substitute. Tank 110-D1 is a double-walled tank and is of the “covered dike tank” type, with an integral secondary containment. It is constructed with cylindrical primary tank surrounded by a rectangular perimeter.

The AST supplied fuel via pipes through the north wall to a heating system and emergency power generator. The fuel has not been needed for at least 3 years.

As described in Item 26 of the Consent Agreement Final Order, since 2019 approximately 48,000 pounds (6,325 gallons) of a hazardous waste mixture was accumulated and stored in Tank 110-D1. The mixture resulted from adding used non-polychlorinated biphenyl (PCB) transformer oil with DF-8 in the tank for heat recovery. The mixture proved incompatible with heating systems and was then left in the tank to settle.

In 2022, contents from Tank 110-D1 were analyzed for waste disposal characterization. Samples were collected from within the tank and tested for halogens by ion chromatographic analysis (SW9056A), ignitability seta flashpoint (SW1020B), metals by inductively coupled plasma-mass spectrometry (ICP-MS) (SW6020A toxicity characteristic leaching procedure [TCLP]), reactivity (SW846 7.3), semi-volatile TCLP (SW8270D), and PCBs (SW8082). The only detectable result was for ignitability at 110 degrees Fahrenheit (°F; less than 140°F). The contents were thus declared ignitable hazardous waste. The mixture in Tank 110-D1 was removed and transported off-island for disposal by the USAF hazardous waste program.

Use of Tank 110-D1 as a hazardous waste storage tank has been discontinued. The tank has been locked out and tagged out from further use. No leaking or other discharge has been observed.

1.2.1 Land Use

Shemya Island is a military base with access restrictions, only allowing mission essential personnel. Land use primarily consists of military support facilities related to EAS activities such as buildings, runways, tank farms, training areas, and waste disposal areas. The island is also within, and part of, the Alaska Maritime National Wildlife Refuge (AMNWR), managed by the U.S. Fish and Wildlife Service (USFWS) as part of the Aleutian Islands Unit. Activities associated with the AMNWR management are the only non-military regional land uses.

Land use on Shemya Island can be categorized into four groups: open space, industrial/residential, airfield, and recreational. Recreational activities on Shemya include jogging, hiking, biking, wildlife viewing, photography, beachcombing, bonfires, and fishing. Saltwater fishing mostly occurs off the fuel pier while freshwater fishing tends to take place in the various lakes around the island. There is no subsistence or sport hunting on the island.

Approximately 2,750 acres or roughly 75% of Shemya Island is dedicated to areas of open space, including the following:

- **Safety:** Restricted areas where there are potential unexploded ordinance concerns, Cobra Dane, and airfield arrival/departure zones
- **Buffer:** Spatial separation areas where conflict between uses may occur
- **Environmental Protection:** The watershed that serves as the collection gallery and areas of important habitat values, including steep bluffs, unstable soil, or areas subject to coastal flooding
- **Reserve:** Areas and buildings that are currently unoccupied but have the potential to be used in the future, including abandoned former facilities

1.2.2 Previous Investigations in the Vicinity of Tank 110-D1

No pre-existing contamination has been documented immediately around Tank 110-D1 or the IBC Tote Storage Area. Building 110 is co-located with restoration program site ST039, which consists of two former USTs east of Building 110. The USTs were removed in 1993. Multiple environmental investigations have taken place at ST039 since 1988. ST039 was included in island-wide Remedial Investigation/Feasibility Study (FS) (USAF 1996). No CERCLA hazardous substances posing unacceptable risk were identified at ST039; therefore, the CERCLA Record of Decision for site ST039 recommended no further action (USAF 2008a).

ICs are in place to prevent exposure to non-CERCLA substances (e.g., petroleum) above levels allowed by Alaska regulations in surface and subsurface soil by ensuring that contaminants remain undisturbed (USAF 2008b). The ICs also include annual IC inspections, identification of site boundaries, and review of dig permits conducted within the area. Additionally, the site is included in the Non-CERCLA Five-Year Reviews. A separate, non-CERCLA DD was prepared outlining actions and controls in place in accordance with Alaska State laws and regulations along with a complete list of investigations and removal actions for the site (USAF 2008a).

1.3 Key Personnel and Qualifications

Field activities, including the collection of field parameters and analytical samples, will be performed by qualified environmental professionals. Table C-1 presents the key personnel for the project, qualifications, and responsibilities on the project.

Table C-1 Personnel Qualifications

NAME/TITLE	RESPONSIBILITIES	EDUCATION/EXPERIENCE	SPECIALIZED TRAINING/CERTIFICATIONS
Scotty Mann PM	Providing direction to the project team to ensure project objectives are met, project budget is tracked, and project is on schedule.	• Experience: 20 years • Education: B.S., Environmental Science • PG Alaska #717 • Certified PG AIPG #11682	• State of Alaska Professional Geologist • First aid certification • Adult CPR/AED certification • 40-hour HAZWOPER and 8-hour refresher • 30-hour OSHA • ADEC Qualified Environmental Professional
TBD Technical Lead	Implementing, overseeing, and coordinating project activities in the Work Plan and SAP and ensuring project objectives are met.	• TBD	• TBD
Victoria Pennick Project Chemist	Coordinating with the analytical laboratory, reviewing analytical data, and ensuring that DQOs are achieved.	• Over 30 years of experience • Education: B.S., Biological Sciences	• 40-hour HAZWOPER • 8-hour refresher per 29 CFR 1910.120(e) • First aid/CPR/AED certification • ADEC Qualified Environmental Professional
Jamey Smith Health and Safety Manager	Developing, implementing, and overseeing all health and safety aspects of the project.	• Over 15 years of experience • Education: B.S., Applied Science in Occupational Health and Safety • M.S., Management and Leadership	• Certified Safety Professional

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

2.0 DATA QUALITY OBJECTIVES

DQOs are used to guide decisions for collecting, analyzing, and evaluating analytical data so that overall project objectives are achieved. The DQOs for the Tank 110-D1 investigation generating analytical data are to collect soil and groundwater samples to confirm the presence or absence of contamination in the area around Tank 110-D1 and Building 110. Table C-2 presents a summary of the site DQOs.

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Table C-2 Data Quality Objectives

STEP 1: STATE THE PROBLEM	STEP 2: IDENTIFY THE GOALS OF THE STUDY	STEP 3: IDENTIFY INFORMATION INPUTS	STEP 4: DEFINE THE BOUNDARIES OF THE STUDY	STEP 5: DEVELOP THE ANALYTICAL APPROACH	STEP 6: SPECIFY PERFORMANCE ACCEPTANCE CRITERIA	STEP 7: DEVELOP PLAN FOR OBTAINING DATA
DQO 1 – Evaluate presence or absence of contamination in soil in the area around Tank 110-D1 and Building 110						
Whether contamination exists in surface and/or subsurface soil at the Tank 110-D1 project site is unknown.	Determine whether soil contamination is present at the site at concentrations exceeding the PALs in Section 3.	Historical reports were used to determine the proximity of the Tank 110-D1 project site to other contaminated sites. Field screening results obtained from soil borings. Analytical results obtained from sampling soil from soil borings.	Approximately 12 soil borings will be advanced to 20 feet bgs in the area around Tank 110-D1.	Approximately 36 primary soil samples will be collected and analyzed for GRO, DRO, RRO, VOCs, SVOCs, PAHs, PCBs, and target analyte list metals including aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, and zinc.	MPC are presented in Tables C-5 through Table C-11.	Soil borings will be field screened in approximately 2-foot intervals using a PID. Up to three analytical soil samples will be collected per boring. One sample will be collected from 0 to 2 feet bgs. Two samples will be collected from 2 and 20 feet bgs; one from the interval with the highest PID reading, and one from the interval immediately below. If all PID readings are 0 ppm, and there are no other indicators of contamination, then subsurface samples will be collected from the middle depth interval and the bottom depth interval of the soil boring. Soil cuttings remaining after samples have been collected will be placed into a DOT container for characterization.
DQO 2 – Groundwater Sampling						
If groundwater is encountered during the soil investigation, a groundwater sample will be collected.	Determine whether groundwater contamination is present at the site at concentrations exceeding the PALs in Section 3.	Historical reports were used to determine the proximity of the Tank 110-D1 project site to other contaminated sites and the approximate depth to groundwater in the area.	Approximately 12 soil borings will be advanced to 20 feet bgs in the area around Tank 110-D1. A temporary well will be installed in one soil boring.	Groundwater sample analyses will include GRO, DRO, RRO, VOCs, SVOCs, PAHs, PCBs, and RCRA metals.	MPC are presented in Table C-5 through Table C-11.	A temporary well will be installed in one soil boring, if groundwater is encountered, and groundwater samples will be collected.

Notes:

For definitions, refer to the Acronyms and Abbreviations section.

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3.0 PROJECT ACTION LEVELS

Soil, groundwater, and waste characterization samples will be collected during the investigation, and analytical results will be compared to the project action levels (PALs) discussed in Sections 3.1 through 3.3. Soil sample analyses will include gasoline range organics (GRO), diesel range organics (DRO), residual range organics (RRO), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), PCBs, and a target analyte list of metals, which includes aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, and zinc. Groundwater sample analyses will include GRO, DRO, RRO, VOCs, SVOCs, PAHs, PCBs, and Resource Conservation and Recovery Act (RCRA) metals.

3.1 Soil Action Levels

Soil PALs are defined as the most stringent between the Alaska Department of Environmental Conservation (ADEC) Title 18 of the Alaska Administrative Code (AAC) Chapter 75 Method Two, Tables B1 and B2, Migration to Groundwater (ADEC 2023) and the U.S. Environmental Protection Agency (EPA) Regional Screening Levels for Residential Soil (EPA 2024). Attachment C-1 presents target analytes, analytical methods, screening levels, and laboratory reporting limits for soil samples.

3.2 Groundwater Action Levels

Groundwater PALs are defined as the most stringent between ADEC 18 AAC 75 Table C Groundwater Cleanup Levels (ADEC 2023) and the EPA Regional Screening Levels for Tapwater and Maximum Contaminant Levels (EPA 2024). Attachment C-2 presents target analytes, analytical methods, screening levels, and laboratory reporting limits for groundwater samples.

3.3 Waste Characterization

Waste characterization samples will be collected from rinsate generated during tank cleaning and analyzed for TCLP VOCs, TCLP SVOCs, RCRA TCLP metals, PCBs, and flashpoint. Decontamination water and purge water generated during sampling activities will be sampled for characterization and analyzed for TCLP VOCs, TCLP SVOCs, TCLP metals, and PCBs. Results for TCLP analyses will be compared to RCRA regulatory criteria 40 Code of Federal Regulations (CFR) 261.24, and results for total PCBs will be compared to Toxic Substances Control Act criteria in 40 CFR 761 to determine waste status (Attachment C-3) Additionally, soil cuttings will be containerized and waste characterization samples will be collected and analyzed for GRO, DRO, RRO, VOCs, SVOCs, PAHs, PCBs, and target analyte list metals. If results are less than the PALs, the cuttings will be spread on the ground surface onsite. If characterization results are greater than the PALs, the soil will be disposed of offsite.

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4.0 ENVIRONMENTAL SETTING

This section describes the environmental setting of the project site, including the climate, geology, hydrology, and ecology.

4.1 Climate

The climate of Shemya Island is marine, with moist conditions and temperature variances moderated by the Pacific Ocean. As a result, Shemya's climate is milder than expected considering the island's latitude. Local weather conditions are influenced by Shemya's location within a fairly persistent low pressure system, referred to as the "Aleutian Low," which causes North Pacific storms to track through the area and perpetuates constant windy and rainy conditions. Low clouds and high winds frequently interfere with air transportation to and from the island. The most extreme weather occurs during the winter. The warmest month is August, and the coldest is January, with measurable precipitation occurring approximately 330 days per year. Average annual measurements from the island's meteorological record include:

- Mean annual temperature: 39.4°F
- Mean annual precipitation: 30 inches (highest precipitation occurs from August to December
- Mean annual wind speed: 15.3 knots/17 miles per hour (no prevailing direction)

4.2 Geology

Bedrock at Shemya Island consists of a fairly flat, wave-cut platform of sedimentary marine deposits intruded by igneous material, with overlaying layers of igneous rock material. Bedrock is typically found at a depth between 10 and 20 feet below ground surface (bgs). The bedrock surface is highly faulted and fractured, which provides source material for the overlying surface sediments. The unconsolidated surface sediments of natural origin consist of sand and gravel deposits with significant occurrence of organic peat derived from the abundant tundra plant material. Much of the island's natural terrain has been disturbed by many years of military use and construction, which began during World War II. Many areas are covered by fill material placed to provide stable construction and road surfaces. Although many of the old structures have been demolished, the old construction fill and rip rap remain at the surface.

Lithologic information collected during test pit excavation and drilling at ST039 indicates that a gravel layer ranging in thickness from 1 to 12 feet bgs is present throughout much of the area (USAF 1996). The gravel was also used for the parking lot and fill materials. Mixtures of sand, silt, and gravel were observed beneath the fill material in several boreholes. At depths of 6 to 12 feet bgs, silty clay was encountered. Competent bedrock was not encountered during drilling to a maximum depth of 39 feet bgs. It is believed that the geology underlying ST039 is weathered mudstone lenses lying above an andesite bedrock layer at approximately 46 feet bgs.

4.3 Hydrology

Surface water on the island occurs in three forms: lakes and ponds, streams and creeks, or springs and seeps. Most of the numerous streams and creeks present on the island tend to flow in a southward direction, consistent with the general topographic slope. The surface streams are less than 2 miles in length and are typically 2 to 4 feet wide. Many of the island's surface water flow patterns have been altered by the construction of runways, roads, ditches, and culverts.

The geologic setting for many areas in Alaska consists of unconsolidated material overlying fractured bedrock. Frequently, the bedrock and unconsolidated material behave as separate hydrostratigraphic units, with an unsaturated zone in the upper bedrock separating the local aquifer (unconsolidated material) from the regional bedrock aquifer.

On Shemya Island, a separate shallow aquifer occurs in small, laterally discontinuous zones. Most often, a shallow or surficial aquifer was formed when sand and gravel fill was placed on top of the peat that covered the original ground surface. There are large areas of the island, however, where bedrock is the only continuous zone of saturation, and saturated zones in the surficial material are very thin and localized. Areas where bedrock is the primary aquifer are most common in the northern portion of the island. The ground surface slopes from north to south, and groundwater flow is also generally toward the south. Approximately halfway between the north and south shorelines, the water table intersects the top of the bedrock; and south of that point, the base of the surficial material is saturated. Although local conditions can vary, the groundwater flow scenario applies to most of the island.

A northwest-southeast trending groundwater divide exists in the northern portion of Shemya Island. South of the divide, the direction of subsurface flow is generally to the south-southwest toward the Pacific Ocean. North of the divide, subsurface flow is to the north-northeast toward the Bering Sea. A potentiometric surface map for the shallow aquifer on Shemya Island was developed during the 1004 Remedial Investigation/FS (USAF 1996). Based on information from the Remedial Investigation/FS, groundwater generally flows to the south.

Depth to groundwater on Shemya Island varies depending on specific location. Groundwater occurs within sand or gravel along the southern coast. Wells where groundwater occurs in the bedrock, or at the peat/bedrock contact, tend to be located in the interior of the island. Because of the magnitude of disturbance to the surface materials during development of the island and differences in lithologies and structural conditions, groundwater occurrence can vary greatly within a short distance. In one location along the northern cliff area (near the Power Plant site ST009), soil borehole ST009-MW02 was advanced to more than 200 feet bgs without encountering groundwater. Precipitation and tidal influence on groundwater can also be seen in wells and monitoring points closest to the coast.

Previous investigations indicate that groundwater is approximately 140 feet bgs near the Tank 110-D1 site. Estimated groundwater contours identify groundwater between 80 and 90 feet above mean sea level (USAF 1996). The approximate ground surface elevation of 225 feet generally confirms the groundwater depth of 140 feet water depth measured near the site.

4.4 Ecology

Shemya Island's interior natural, undisturbed terrain can be classified as wetlands according to the USACE definition. However, as a result of the island's history of military use, much of the natural interior terrain has been altered in some way, and no longer meets this definition. The two major types of naturally occurring plant communities identified on-island are wet tundra and moist tundra.

Shemya Island does not support any large terrestrial mammal populations. The largest terrestrial mammal residing on-island is the arctic fox, which was introduced by Russians in the 1800s and has had to be controlled by USFWS due to lack of natural predators (USAF 1996).

The island's coastal terrain provides protected habitat for both sea birds and marine mammals. Nesting colonies of approximately 170,000 migratory seabirds use the island's northern coastal cliffs, including pelagic and red-faced cormorants, as well as horned and tufted puffins. Migratory birds use the island as a stopover area on their annual migrations. Aleutian Canadian geese, Asian ducks, emperor geese, glaucous-winged gulls, common eiders, ruddy turnstone, and some species of Asiatic songbirds have been observed. Some raptors and seabird species use the island year-round. None of the migratory birds, including the threatened Aleutian Canadian goose, nest on the island due to the presence of foxes.

All of the coastal areas and marine mammals that inhabit them are federally protected. Several species of marine mammals use the island's protected coastal areas extensively. Sea lions commonly use the northeastern coast and adjacent rocky sea stacks as prime haul out and resting areas. Sea otters prefer the southwest coastline for a resting and pupping area because of the protected coves and bays, as well as the kelp beds located there. Harbor seals commonly use the coastal waters around the island.

Several threatened and endangered species are known to occur on Shemya Island or the surrounding area (USAF 1996). There is one listed endangered bird species, the short-tailed albatross, and one listed threatened species, the Stellar's eider, with ranges that include Shemya Island. The Aleutian Canada Goose was recently listed as a recovered species. The Stellar sea lion and the Northern sea otter, both listed as endangered species, have also been observed.

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5.0 FIELD SAMPLING PLAN

The FSP defines procedures for collection, handling, and analysis of samples associated with soil and groundwater investigation at the Tank 110-D1 project site. Field activities will include advancement of soil borings, field screening, soil sample collection, temporary well installation, and groundwater sample collection; fieldwork will be performed in accordance with the procedures detailed in this SAP and the contractor's approved field standard operating procedures (SOPs; Attachment C-4). Soil and groundwater samples will be submitted to an analytical laboratory with current ADEC and DoD Environmental Laboratory Accreditation Program (ELAP) certification.

5.1 Site Access and Logistics

At least 1 month prior to site work, a Site Access Request will be submitted to coordinate access. The project field team is anticipated to mobilize from Anchorage via government contracted aircraft. Field equipment will be transported via air or barge transportation from Anchorage to Shemya Island. Depending on availability, lodging will be reserved for personnel at EAS. If possible, the investigation may be combined with the annual long-term monitoring event being conducted under a separate project (Contract TBD, Work Order TBD).

5.2 Soil Investigation

A soil investigation will be conducted to determine the presence or absence of contamination in the project area. A combination of hand-operated tools and a Geoprobe direct push, track-driven probe system will be used to advance approximately 12 soil borings to 20 feet bgs and collect field screening and analytical samples. Soil borings will be advanced in a systematic fashion around Tank 110-D1; exact locations will be selected in the field based on the layout of Tank 110-D1 and associated piping and may be adjusted if contamination is encountered.

5.2.1 Field Screening

Soil borings will be field screened continuously using a photoionization detector (PID) and visual and olfactory observations. PID readings will be collected continuously along the soil boring immediately after the Macro-Core sleeve is cut and the boring is exposed. The PID intake will be run along the exposed boring, and the locations where VOCs are detected will be noted. These readings will guide the selection of depth intervals for heated headspace readings and analytical sampling. Soil will be collected immediately for heated headspace readings, then analytical samples will be collected from the same interval. Field screening samples will be placed in a resealable plastic bag for a period of at least 10 minutes, but no more than 1 hour, at an approximate temperature of 40°F to 60°F, allowing hydrocarbons to volatilize and accumulate in the headspace of the bag. The bag will be agitated for 15 seconds to further promote volatilization. The PID probe will be inserted into the bag to measure the organic or combustible vapor concentration in parts per million (ppm). The PID will be calibrated daily prior to use and when erroneous readings are suspected. A two-point calibration of fresh air and isobutylene gas will be performed in accordance with manufacturer instructions.

5.2.2 Analytical Sample Collection

Approximately 36 total primary soil samples will be collected and analyzed for GRO, DRO, RRO, VOCs, SVOCs, PAHs, PCBs, and target analyte list metals (Section 3.1).

Up to three discrete analytical soil samples will be collected per boring. One sample will be collected from 0 to 2 feet bgs. Two samples will be collected between 2 and 20 feet bgs; one from the interval with the highest PID reading, and one from the interval immediately below the impacted area, based on PID reading, to delineate vertical extent. If all PID readings are 0 ppm and there are no other indicators of contamination, then subsurface samples will be collected from the middle depth interval and the bottom depth interval of the soil boring.

5.3 Groundwater Investigation

Groundwater will be sampled if encountered during the soil investigation. Groundwater is not expected to be present at depths likely to be impacted by potential contaminant releases from Tank 110-D1. However, if groundwater is encountered in soil borings, a sample will be collected from one temporary well point (TWP) advanced in the soil boring to 20 feet bgs. One groundwater sample will be collected from the TWP and analyzed for GRO, DRO, RRO, VOCs, SVOCs, PAHs, PCBs, and RCRA metals. If groundwater is not encountered in soil borings, no samples will be collected.

A follow-up groundwater investigation will be conducted if the soil investigation identifies the potential for groundwater contamination.

5.4 Equipment Decontamination

Down-hole drilling equipment (e.g., rods, augers, drill bits) will be decontaminated between borings using potable water and Alconox mixture. Smaller items, including hand tools, soil sampling equipment (e.g., spoons, bowls, trowels), will be disposable or decontaminated between sample locations and samples to prevent cross contamination. Decontamination of these smaller items will consist of washing the equipment with a mixture of deionized water and Alconox, followed by a deionized or distilled water rinse. The water generated during decontamination will be collected in a Department of Transportation (DOT)-approved 55-gallon drums and characterized for offsite disposal.

5.5 Waste Management

All waste generated during the field effort will be managed in compliance with federal and state regulations. Waste streams anticipated during this field effort include:

- **Tank rinsate:** Rinsate from the tank cleanout will be containerized in IBC totes and characterized for disposal at a Subtitle C or Subtitle D landfill, depending on results.
- **Soil cuttings from soil borings:** Soil cuttings remaining after samples have been collected will be placed into a DOT container for characterization. If characterization sample results are less than the PALs, the cuttings will be spread on the ground surface onsite. If characterization results are greater than the PALs, the soil will be disposed of offsite.
- **Decontamination water:** Decontamination water will be collected in a DOT container for characterization and offsite disposal.

- **Investigation-derived waste:** General refuse (e.g., sampling equipment, paper towels, nitrile gloves) will be collected in bulk bags or 55-gallon drums for transport and disposal at a Subtitle D landfill.

5.6 Analytical Methods, Sample Containers, Preservation, and Holding Times

Sample aliquots will be collected in order of volatility with VOCs being collected first, followed by semi-volatiles, then non-volatiles. Environmental samples require various preservatives to minimize degradation of target analytes during shipment and storage. All laboratory samples will be stored in coolers containing frozen gel ice to maintain the proper holding temperature (0 to 6 degrees Celsius [°C]). Table C-3 provides the sample container and preservation requirements for Pace Analytical, TN, for each analytical method.

Table C-3 Containers, Volumes, Preservation, and Holding Times for Laboratory Analysis

PARAMETER	METHOD	CONTAINER[1]	PRESERVATION	HOLDING TIME COLLECTION TO EXTRACTION	HOLDING TIME PREP TO ANALYSIS
Soil					
VOCs	SW8260D	2x40 mL VOA, TLS	0-6°C, MeOH field extraction	N/A	14 days
GRO	AK101	1x60-mL amber glass, TLS		N/A	28 days
DRO/RRO	AK102/AK103	1x8-oz amber glass, TLC	0-6°C	14 days	40 days
PAHs	SW8270E-SIM		0-6°C	14 days	40 days
SVOCs	SW8270E		0-6°C	14 days	40 days
PCBs	SW8082A	1x8-oz amber glass, TLC	0-6°C	365 days	40 days
Target Analyte List Metals[2]	SW6020B		None required	N/A	180 days
Mercury	SW7471B				28 days
Water					
GRO	AK101	3x40-mL VOA, TLS	HCl to pH < 2, 0-6°C, no headspace	N/A	14 days
DRO/RRO	AK102/AK103	2x100-mL to 1-L amber glass, TLC	HCl to pH < 2, 0-6°C	14 days	40 days
VOCs	SW8260D	3x40-mL VOA, TLS	HCl to pH < 2, 0-6°C, no headspace	N/A	14 days
SVOCs	SW8270E	2x100-mL to 1-L amber glass, TLC	0-6°C	14 days	40 days
PAHs	SW8270E-SIM	2x100-mL to 1-L amber glass, TLC	0-6°C	14 days	40 days
PCBs	SW8082A	2x100-mL to 1-L amber glass, TLC	0-6°C	365 days	40 days
RCRA Metals	SW6020B	250-mL HDPE	HNO_3 to pH < 2	N/A	180 days
Mercury	SW7470A			N/A	28 days

Table C-3 Containers, Volumes, Preservation, and Holding Times for Laboratory Analysis

PARAMETER	METHOD	CONTAINER[1]	PRESERVATION	HOLDING TIME COLLECTION TO EXTRACTION	HOLDING TIME PREP TO ANALYSIS
Waste Characterization – Tank Rinsate					
TCLP RCRA Metals	SW1311/SW6020B	1x1-L HDPE, TLC	0-6°C	180 days	180 days
TCLP Mercury	SW1311/SW7470A			28 days	28 days
TCLP VOCs	SW1311-ZHE/ SW8260D	3x40-mL VOA vials with TLS	0-6°C, no headspace	14 days	14 days
TCLP SVOCs	SW1311/SW8270E	1x1-L amber glass, TLC	0-6°C	14 days[3]	40 days
PCBs	SW8082A	2x100-mL amber glass, TLC	0-6°C	365 days	40 days
Flashpoint	SW1010A	1x250-mL amber glass, TLC	0-6°C	28 days	28 days

Notes:

For definitions, refer to the Acronyms and Abbreviations section.

[1] Sample containers and mass/volume required for analyses to be conducted by one laboratory may be consolidated. Alternate sample containers that are appropriate for the analysis may be provided by the laboratories as long as sufficient sample for analysis is submitted.

[2] Metals – aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, and zinc (plus mercury).

[3] TCLP SVOC analysis requires an additional preparative extraction after the TCLP extraction and prior to analysis. Holding time is 7 days.

5.7 Field Quality Control Samples

This section summarizes the types and frequencies of QC samples that will be collected and submitted to the laboratory. QC sample quantities for soil will be based on the number of primary samples collected. QC samples will be collected as described in this section.

At a minimum, one field duplicate (FD) sample will be collected for every 10 primary samples for each matrix, analysis, and target analyte. When possible, FDs will be collected from locations of suspected contamination at the same location as the primary sample. Sample locations with FDs will be collected as a single sample, homogenized, then separated into a primary and FD aliquot. FD samples will be submitted to the laboratory blind with unique sample ID numbers.

Matrix spike (MS)/matrix spike duplicate (MSD) pairs will be collected at a minimum frequency of one set for every 20 or fewer project samples (5%), and one set for every sample delivery group (SDG) of 20 samples or less. These samples will be collected from locations with minimal contamination where possible to assess any matrix interferences. A trip blank (TB) will be included in each cooler containing samples for VOC and GRO analysis. Table C-4 summarizes field and laboratory QC samples.

The Geoprobe uses a disposable plastic Macro-Core sleeve for each soil boring, and single-use spoons will be used to collect samples. Only single-use, disposable sampling equipment is anticipated for soil sampling. If shared equipment is used, equipment blanks (EBs) will be collected.

Table C-4 Field and Laboratory Quality Control Sample Summary

FIELD QC SAMPLE	FREQUENCY/NUMBER
TB	1 per preservation method per cooler containing volatile samples (GRO, VOCs)
Temperature Blank	1 per cooler
Field Duplicate	1 per 10 samples for each sample matrix for each target analyte with a minimum of 1 per sampling day
Equipment Blank	1 per 20 samples, per analysis, per analyte for each sample matrix collected with shared sampling equipment
LABORATORY QC SAMPLES	**FREQUENCY/NUMBER**
MB	1 per preparatory batch (20 samples)
LCS/LCSD (LCSD required for AK101, AK102, and AK103 only)	1 per preparatory batch (20 samples)
MS/MSD	1 per preparatory batch (20 samples)
Surrogates	Every field sample and QC sample (organics only)

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

5.8 Survey

Soil borings and other pertinent site features will be surveyed using Global Navigation Satellite System (GNSS) real-time kinematic (RTK) techniques. In environments where RTK is not suitable, post-processed GNSS static or conventional surveying techniques will be used. A Trimble R10 base/rover kit will be used for GNSS surveying. A Trimble 0.3 millimeter per kilometer digital level will be used to measure elevation differences and establish monitoring well elevations. The differential leveling will be performed to meet closure requirements of third order leveling (Federal Geodetic Control Committee 1984).

Survey data will be provided within the National Spatial Reference System. The horizontal datum will be North American Datum of 1983 (NAD83) (2011) Epoch 2010.0000, and the projected coordinate system will be Alaska State Plane Coordinate, Zone 4. The vertical datum will be North American Vertical Datum of 1988 (NAVD88). Horizontal coordinates and elevation will be expressed in U.S. Survey Feet. The positional and vertical accuracy of measured site features will meet or exceed the minimum survey accuracy requirements listed in Table 4-3 of the *Manual for Electronic Deliverables* (USACE 2017).

5.9 Field Sampling Logbook

Accurate and comprehensive record keeping is critical to documenting sample custody. Bound, sequentially paginated field logbooks will be maintained daily to document sampling, including the collection of every sample. Additionally, appropriate field forms will be completed during sample collection. Field notes will be entered in permanent ink, and each page will be initialed and dated. If any changes are made to the field record, the original notation will be crossed out with a single line, initialed, and dated by the person making the correction. Field logbooks will be completed in accordance with the contractor's approved SOP.

At a minimum, the field sampling logbook will contain the following information:

- Project ID
- Date and time of work

- Name and location of site
- Names of writer and field personnel present
- Description/sketch of work area
- Field observations and weather conditions
- Analytical sample locations, IDs, and corresponding field test results
- Visual/sensory description of sample
- Time of sample collection
- Description of sample container sizes, preservations, special handling procedures, analyses, etc. collected for each sample
- Explanation of deviations from the Work Plan, with rationales for the deviations

5.10 Sample Documentation

The following sections describe the sample numbering system and chain-of-custody (CoC) requirements for this project.

5.10.1 Sample Identification

Samples will be numbered using the following identifiers:

- Two-digit code for the sampling year (“24” for 2024)
- Three-digit code for the project location (EAS for Eareckson AS)
- Four-digit code for the site-specific location (T110 for Tank 110-D1)
- Two- or three-digit code for the sample type (-TWP for temporary well point, -SB for soil boring, -WC for waste characterization)
- Two-digit number that identifies the incremental number of the sample (01, 02, 03, etc.) or well number (SB01, TWP01, etc.)
- For soil samples, the depth interval from which the sample was taken (e.g., “4-5” for the 4 to 5 feet bgs interval)
- FD samples will be identified by a false depth interval of 22-24, as soil borings will not be advanced past 20 feet bgs.

For example, the soil sample taken from the 20th soil boring at the 4 to 5 feet bgs depth interval and its duplicate would be assigned the following identifiers:

Primary: 24-EAS-T110-SB20-4-5 Duplicate: 24-EAS-T110-SB20-22-24

Location identifiers are used to identify the sample location and will be included along with the sample ID on the CoC form(s). Location IDs will include the first four digits (sampling year and site, 24EAS) and the sample location (e.g., -SB01). Location IDs for TBs will be designated on the CoC and will be the same as the sample ID (e.g., 24EAS-TB01, 24EAS-TB02). The technical lead may adjust the sample identification determined in the field.

5.10.2 Sample Labels

Each sample container will have a sample label affixed in a waterproof manner. Sample labels will be water resistant and contain the following information:

- Sample ID
- Preservative, where applicable
- Requested analyses
- Date and time of sample collection

Sample labels will be completed in accordance with the contractor's approved SOP.

5.10.3 Chain-of-Custody Records

The possession and handling of individual samples must be traceable from the time of sample collection until the time the analytical laboratory reports the results of sample analyses to the appropriate parties. The CoC form is designed to document the transfer of samples from the field to the laboratory. One CoC form will be included in each cooler, and the CoC form will reflect the samples that are contained in the cooler. The lead sampler will be responsible for sample security and CoC recordkeeping in the field. CoC procedures specified by the contractor's approved SOP will be followed. To identify the contents of a shipment, request analysis from the laboratory, and track custody transfers, the CoC form will include:

- Unique ID (e.g., 20230701-A)
- North Pacific Division Laboratory (NPDL) work order number (TBD)
- Project/client name and location
- Sample ID (corresponding to the sample container labels)
- Date/time of sample collection
- Requested analyses
- Sample matrix (e.g., soil, water)
- Number and type of containers
- Cooler name or identification number
- Preservative, as applicable
- Notes pertaining to specific samples
- Sampler initials for each sample
- Relinquishment record with signature, name, date, and time
- Receipt record with signature, name, date, and time
- Requested turnaround time
- Laboratory name

5.11 Sample Packaging and Shipping

Sample preservation requirements, hazardous material shipping regulations, cross contamination avoidance, and environmental and physical stresses must be addressed to ensure that samples reach the laboratory intact. Samples will be packaged and shipped in accordance with the contractor's approved SOP.

5.11.1 Sample Preservation

Environmental samples require various methods of preservation to minimize the degradation of analytes during shipment and storage. Table C-3 lists the preservation requirements for each analytical method and matrix. Laboratory samples will be preserved with cool temperatures by placing in an insulated cooler or refrigerator shortly after collection. Ice packs will be used to establish and maintain sample temperatures of 0 to 6°C during storage in coolers and during transport.

5.11.2 Sample Packaging

Sample containers will be labeled in accordance with the contractor's approved SOP. Sample containers will be wrapped with bubble wrap or placed in bubble wrap bags. They will then be placed in a resealable plastic bag and sealed. Coolers will be prepared for shipment by ensuring that the cooler drain, if present, is taped closed from both sides, then spreading an approximately 4-centimeter-thick layer of non-reactive absorbent packing material across the bottom of the cooler. The cooler will then be lined with a plastic garbage bag before adding the bagged samples. A minimum of eight completely frozen gel ice packs will be placed around and among the sample containers to ensure that the samples remain at 0 to 6°C during shipment. More ice packs will be included if temperatures along the shipping route are excessive. A labeled temperature blank will be included in each cooler to measure sample temperature at the laboratory during the login process.

The liner bag will then be tied or taped closed, and additional inert cushioning such as bubble wrap newsprint, and/or non-reactive absorbent packing material will be used to take up the remaining space in the cooler. If the coolers are sealed prior to delivery to the laboratory, then a resealable plastic bag will be taped to the inside lid of the cooler containing the completed and signed CoC. No movement should be detected in the closed cooler with moderate shaking.

The CoC will be completed and sealed inside a resealable plastic bag taped to the lid of the cooler. Custody seals will be placed on opposite corners of the cooler. Clear tape will be placed over the custody seals to protect them from abrasion, and a minimum of two full wraps of strapping tape will be placed around the cooler in two places to secure the lid. The strapping tape should not obscure the package labels but may be used to secure the edges of the labels and seals.

5.11.3 Cross Contamination

While the seals on modern containers are very good, it is possible for volatile compounds from other samples or the environment to migrate into a sample container. To reduce this risk, each sample container (or container set) will be placed in resealable plastic bags. TBs will be included in each cooler containing samples for volatiles analysis to confirm that sample containers have not been impacted during shipment.

5.11.4 Sample Shipping

Once samples are collected, they will be placed in a cooler with ice and moved to an onsite refrigerator pending shipment offsite. Samples will be prepared for shipment to the appropriate laboratory by packing the samples in appropriate coolers with gel ice. Samples will be shipped to JBER via the regularly scheduled passenger flights (rotator flight) from EAS to JBER that are expected to fly 3 days per week. Soil samples that are preserved with methanol (MeOH) will only be shipped to JBER every 2 weeks on the regular scheduled USAF cargo flight as MeOH-preserved soil samples are not permitted on the rotator flights. Once samples arrive at JBER, they will be picked up by project personnel, checked to confirm the sample coolers are sealed, re-iced, and shipped to the laboratory via Alaska Airlines Goldstreak (UPS or FedEx may also be utilized depending on schedules, etc.).

An important element to recognize for this project is that due to the remote location of the sites and the fact that flights to ship the samples from the island only operate on an infrequent, fixed schedule, extraction and analysis hold times may be exceeded for some samples. This is most likely to occur for the soil samples to be analyzed for VOCs (which are not the COCs associated with the primary project objective) as the method requires MeOH preservation and MeOH-preserved samples can only be transported off-island via the twice per month USAF cargo flights. Also of concern are water samples for SVOCs/PAHs, which have a 7-day hold time (and which are not the COCs associated with the primary project objective). In all cases, the field crew will ship samples off the island as soon as possible.

5.11.5 Sample Receipt, Inspection, and Login Procedures

A sample custodian at the laboratory will accept custody of the shipped samples and inspect the shipment. The laboratory will sign and date the cooler receipt form(s) when samples are received. Shipment inspection will include, but not be limited to, discrepancies on the CoC form(s), sample preservation, sample integrity, temperature blank temperature, and cooler temperature. Cooler receipt information, including the signed CoC, custody seals, and the completed cooler receipt form for each cooler will be emailed to the project chemist, and cc'd to the USACE email receipt.cooler@usace.army.mil within 24 hours of receipt. Discrepancies or other data quality issues identified by the laboratory will be forwarded to the laboratory project manager (PM) and/or the contractor project chemist for corrective action (CA).

5.11.6 Sample Custody, Storage, and Disposal Procedures

The laboratory sample custodian will relinquish custody of the samples to the appropriate department for analysis. Laboratory quality assurance (QA) procedures will be followed to ensure CoC when samples are removed from their storage location for preparation and/or analysis. Following sample analysis, laboratory QA/QC checks will be completed, and the final laboratory report will be issued. Unused portions of samples will be stored in accordance with laboratory QA procedures until disposal. Unless otherwise specified, samples will be disposed of in accordance with laboratory QA procedures and federal, state, and local requirements.

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6.0 QUALITY ASSURANCE PROJECT PLAN

The purpose of this QAPP is to establish the analytical and documentation protocols to be used when reviewing and analyzing data collected for the project. The overall QC objectives for the laboratory activities are to develop and implement procedures for obtaining and evaluating data in an accurate, precise, and complete manner so that measurement data and laboratory procedures provide information that is comparable to and representative of actual field conditions. Data quality will be evaluated based on precision, accuracy, representativeness, completeness, and comparability as described in further detail in subsequent sections.

6.1 Data Quality Indicators

The quality of the data collected for this project will be verified through appropriate measurement performance criteria (MPC) established for both sampling procedures and analytical methods. The criteria also relate to data quality indicators (DQIs) consisting of precision, accuracy, representativeness, completeness, comparability, and sensitivity parameters. The quality of the sampling procedures and laboratory results will be evaluated for compliance with project DQOs through a review of overall these parameters in accordance with procedures described in the sections below. In general, the MPC follow those defined in the most current version of the analytical method and the DoD *Quality Systems Manual v.5.4* (QSM; DoD 2021a), where applicable. DQIs are defined in the following subsections.

6.1.1 Precision

Precision is measured by the variability associated with duplicate or replicate analyses. Laboratory precision can be measured using laboratory control samples (LCS) and laboratory control sample duplicates (LCSD). Field precision can be evaluated with primary samples and FD samples. MS/MSD samples are also used to measure precision.

Precision will be evaluated by comparing the following:

- LCS and LCSD (if prepared and analyzed) to determine the precision of the laboratory procedures and verify matrix interference
- MS/MSD samples to determine the effect of the sample matrix on the precision of the results generated using the selected analytical method
- Primary and FD sample results

The required level of precision for FDs is relative percent difference (RPD) of 50% for soils. Field duplicate precision is evaluated by calculating RPD using the following formula:

$$\text{RPD} = \frac{2[|D_1 - D_2|]}{D_1 + D_2} \times 100$$

Where: D_1 – first sample value
D_2 – second sample value (replicate)

6.1.2 Accuracy

Accuracy will be evaluated by reviewing the following:

- Calibrations—initial and continuing, acceptance, and frequency
- Surrogates—recovery and frequency
- LCS and LCSD recoveries
- MS/MSD recoveries
- Method blanks (MBs) (detections in the MB may indicate potential high bias in associated samples)
- Relative response factors and relative standard deviation (appropriate calibration procedures improve accuracy of measurement results)
- Gas chromatography (GC) second-column confirmation (if required)
- Tuning criteria GC/mass spectroscopy (GC/MS)—acceptability and frequency (to ensure accuracy of mass and ion abundance measurements)
- Internal standards (GC and GC/MS)—acceptability and frequency

Percent recovery (%R) for surrogates, LCSs, and MSs is calculated using the following formula:

$$\%R = \frac{(S - U)}{C_{sa}} \times 100$$

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

6.1.3 Representativeness

Representativeness will be achieved through use of the standard field, sampling, and analytical procedures. Representativeness will be evaluated by reviewing the following:

- Sampling design, including sample quantities and locations
- Sampling procedures and equipment
- Sample CoC forms and field logbooks
- Holding times and preservation

6.1.4 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 will be evaluated for each analyte for a particular sampling event or other defined set of samples (such as by site) with respect to each DQO or end data use.

Completeness will be calculated and evaluated for each method, matrix and analyte combination using the following formula:

$$\% \ Completenss = 100 \ x \left(\frac{V}{n} \right)$$

Where: V = number of measurements determined to be valid
n = total number of measurements

Valid data are considered usable in the context of project DQOs and/or end data use(s). The completeness goal is considered met when 95% of the sample data are considered valid and usable in the context of project goals.

6.1.5 Comparability

Comparability is a qualitative indicator of the confidence with which one data set can be compared to another. To ensure data set comparability, the following steps will be taken:

- Using standard methods for sampling and analysis
- Reporting data in standard units
- Operating Instruments within their calibrated range according to established procedures that are based on approved methodology
- Using only standards supplied by the field test kit manufacturer for field screening analysis
- Using standard and comprehensive reporting formats

6.1.6 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 DQOs is evaluated during the planning phase. Laboratory reference limits, including detection limits (DLs), limits of detection (LODs), and limits of quantitation (LOQs), are evaluated against the permit criteria to determine whether the analytical methods and/or laboratory can meet the project DQOs.

If a result is greater than the DL and less than the LOQ, the result will be reported as a detected concentration and flagged as estimated and reported with a J flag by the lab. If no detected concentration is determined down to the DL, the result will be reported to the LOD concentration (with the added calculations of sample dilution, final volume, and sample mass included), reported as a non-detect result. A detected result greater than or equal to the LOQ will be reported without a qualifying flag unless otherwise required by QC exceedance.

Sample dilution due to target and/or non-target compound concentrations or matrix interference could prevent achievement of project sensitivity goals. Samples must be analyzed initially while undiluted, when reasonable. If dilution is necessary, both the original and the diluted results must be reported. 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.

When the screening level criteria is less than the DL, the sample result cannot be used to verify that the chemical is not of potential concern. A high degree of uncertainty exists when the screening level or permit criteria is greater than the DL and less than the LOD for non-detect results, and these non-detect results should be considered potentially greater than the screening level. When the screening level or permit criteria is greater than the LOD and less than the LOQ and the sample result is non-detect, by definition there is a 1% false negative rate, and the result will be considered below the screening level or permit criteria at 99% confidence. For non-detect results with LODs over the screening level or permit criteria, the potential for the presence of those analytes will be evaluated based on site history, uses of the analyte, and professional judgement in coordination with the regulatory agencies.

Table C-5 Measurement Performance Criteria for Method SW8260B/D; SW8260B-SIM for VOCs

DQI	QC SAMPLE OR MEASUREMENT PERFORMANCE ACTIVITY	MEASUREMENT PERFORMANCE CRITERIA
Accuracy/Bias/Contamination	Blanks (MB, TB, EB)	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.[1] Sample results will be qualified if contamination is detected above the DL in the associated MB.
Precision	FD	RPD < 50% for soils[2] RPD < 30% for waters[2]
Accuracy	LCS and MS/MSD Recoveries	Soil: QSM Table C23[1] Water: QSM Table C-24[1]
Precision	MS/MSD Recoveries (and LCS/LCSD, if performed)	RPD ≤ 20%
Accuracy	Surrogate Recoveries	Soil: QSM Table C23[1] Water: QSM Table C-24[1]
Accuracy/Bias	ICV and CCV	≤ 20% difference (≤ 50% for end of analytical batch CCV)[1]
Representativeness/Usability	Collection time/date, extraction time/date, analysis time/date	Samples must be preserved and analyzed within criteria in Table 3
Representativeness/Usability	Cooler temperature and temperature blank	Temperature 0° to 6°C[2]
Sensitivity	Evaluate laboratory LODs and LOQs against project DQOs	LOD for ND results less than the screening level
Completeness	Completeness of samples collected; completeness of analytical requirements per the QAPP	95% for all matrices

Notes:

For definitions, refer to the Acronyms and Abbreviations section.

[1] DoD QSM v.5.4 (DoD 2021a)

[2] *Field Sampling Guidance* (ADEC 2022b)

If DoD QSM criteria are not available, laboratory statistically derived limits will be used.

Table C-6 Measurement Performance Criteria for Method AK101 for GRO

DQI	QC SAMPLE OR MEASUREMENT PERFORMANCE ACTIVITY	MEASUREMENT PERFORMANCE CRITERIA
Accuracy/Bias/Contamination	Blanks (MB, TB, EB)	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.[1] Sample results will be qualified if contamination is detected above the DL in the associated MB.
Precision	FD	RPD < 50% for soils[2] RPD < 30% for waters[2]
Accuracy	LCS and MS/MSD Recoveries	Soil: 60-120% Water: 60-120%
Precision	MS/MSD Recoveries (and LCS/LCSD, if performed)	RPD ≤ 20%
Accuracy	Surrogate Recoveries	Lab QC: 60-120% CCV/ICV: 75-125% Field samples: 50-150%
Accuracy/Bias	ICV and CCV	≤ 25% difference, per method
Representativeness/Usability	Collection time/date, extraction time/date, analysis time/date	Samples must be preserved and analyzed within criteria in Table C-3
Representativeness/Usability	Cooler temperature and temperature blank	Temperature 0° to 6°C[2]
Sensitivity	Evaluate laboratory LODs and LOQs against project DQOs	LOD for ND results less than the screening level
Completeness	Completeness of samples collected; completeness of analytical requirements per the QAPP	95% for all matrices

Notes:

For definitions, refer to the Acronyms and Abbreviations section.

[1] DoD QSM v.5.4 (DoD 2021a)

[2] *Field Sampling Guidance* (ADEC 2022b)

If DoD QSM criteria are not available, laboratory statistically derived limits will be used.

Table C-7 Measurement Performance Criteria for Method AK102/AK103 for DRO/RRO

DQI	QC SAMPLE OR MEASUREMENT PERFORMANCE ACTIVITY	MEASUREMENT PERFORMANCE CRITERIA
Accuracy/Bias/Contamination	Blanks (MB, EB)	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.[1] Sample results will be qualified if contamination is detected above the DL in the associated MB.
Precision	FD	RPD < 50% for soils[2] RPD < 30% for waters[2]
Accuracy	LCS and MS/MSD Recoveries	75-125%
Precision	MS/MSD Recoveries (and LCS/LCSD, if performed)	RPD ≤ 20%
Accuracy	Surrogate Recoveries	Lab QC: 60-120% Field samples: 50-150%
Accuracy/Bias	ICV and CCV	≤ 25% difference, per method
Representativeness/Usability	Collection time/date, extraction time/date, analysis time/date	Samples must be preserved and analyzed within criteria in Table C-3
Representativeness/Usability	Cooler temperature and temperature blank	Temperature 0° to 6°C[2]
Sensitivity	Evaluate laboratory LODs and LOQs against project DQOs	LOD for ND results less than the screening level
Completeness	Completeness of samples collected; completeness of analytical requirements per the QAPP	95% for all matrices

Notes:

For definitions, refer to the Acronyms and Abbreviations section.

[1] DoD QSM v.5.4 (DoD 2021a)

[2] *Field Sampling Guidance* (ADEC 2022b)

If DoD QSM criteria are not available, laboratory statistically derived limits will be used.

Table C-8 Measurement Performance Criteria for Method SW8270E, SW8270E-SIM for SVOCs and PAHs

DQI	QC SAMPLE OR MEASUREMENT PERFORMANCE ACTIVITY	MEASUREMENT PERFORMANCE CRITERIA
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.[1] Sample results will be qualified if contamination is detected above the DL in the associated MB.
Precision	FD	RPD < 50% for soils[2] RPD < 30% for waters[2]
Accuracy	LCS and MS/MSD Recoveries	Soil: QSM Table C-25, C-27 Water: QSM Table C-26, C-28[1]
Precision	MS/MSD Recoveries (and LCS/LCSD, if performed)	RPD ≤ 20%[1] SIM Mode: RPD ≤40%[1]
Accuracy	Surrogate Recoveries	Soil: QSM Table C-25, C-27 Water: QSM Table C-26, C-28[1]
Accuracy/Bias	ICV and CCV	≤ 20% difference (≤ 50% for end of analytical batch CCV)[1]
Representativeness/Usability	Collection time/date, extraction time/date, analysis time/date	Samples must be preserved and analyzed within criteria in Table C-3
Representativeness/Usability	Cooler temperature and temperature blank	Temperature 0° to 6°C[2]
Sensitivity	Evaluate laboratory LODs and LOQs against project DQOs	LOD for ND results less than the screening level
Completeness	Completeness of samples collected; completeness of analytical requirements per the QAPP	95% for all matrices

Notes:

For definitions, refer to the Acronyms and Abbreviations section.

[1] DoD QSM v.5.4 (DoD 2021a)

[2] *Field Sampling Guidance* (ADEC 2022b)

If DoD QSM criteria are not available, laboratory statistically derived limits will be used.

Table C-9 Measurement Performance Criteria for Method SW8082A for PCBs

DQI	QC SAMPLE OR MEASUREMENT PERFORMANCE ACTIVITY	MEASUREMENT PERFORMANCE CRITERIA
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.[1] Sample results will be qualified if contamination is detected above the DL in the associated MB.
Precision	FD	Soils: RPD < 50% for soils[2] RPD < 30% for waters[2]
Accuracy	LCS and MS/MSD Recoveries	Soil: QSM Table C-17 Water: QSM Table C-18[1]
Precision	MS/MSD Recoveries (and LCS/LCSD, if performed)	RPD ≤ 30%
Accuracy	Surrogate Recoveries	Soil: QSM Table C-17 Water: QSM Table C-18[1]
Accuracy/Bias	ICV and CCV	≤ 20% difference[1]
Precision	Second-column confirmation	≤ 40% difference[1]
Representativeness/Usability	Collection time/date, extraction time/date, analysis time/date	Samples must be preserved and analyzed within criteria in Table C-3
Representativeness/Usability	Cooler temperature and temperature blank	Temperature 0° to 6°C[2]
Sensitivity	Evaluate laboratory LODs and LOQs against project DQOs	LOD for ND results less than the screening level
Completeness	Completeness of samples collected; completeness of analytical requirements per the QAPP	95% for all matrices

Notes:

For definitions, refer to the Acronyms and Abbreviations section.

[1] DoD QSM v.5.4 (DoD 2021a)

[2] *Field Sampling Guidance* (ADEC 2022b)

If DoD QSM criteria are not available, laboratory statistically derived limits will be used.

Table C-10 Measurement Performance Criteria for Method SW6020B for ICP-MS Metals

DQI	QC SAMPLE OR MEASUREMENT PERFORMANCE ACTIVITY	MEASUREMENT PERFORMANCE CRITERIA
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.[1] Sample results will be qualified if contamination is detected above the DL in the associated MB.
Precision	FD	RPD < 50% for soils[2] RPD < 30% for waters[2]
Accuracy	LCS and MS/MSD Recoveries	Soil: QSM Table C-3 Water: QSM Table C-6[1]
Precision	MS/MSD Recoveries (and LCS/LCSD, if performed)	RPD ≤ 20%
Accuracy	Post-digestion Spike (PDS)	80-120%[1]
Accuracy/Bias	ICV and CCV	90-110%[1]
Accuracy/Bias	Serial dilution	90-110%[1]
Representativeness/Usability	Collection time/date, extraction time/date, analysis time/date	Samples must be preserved and analyzed within criteria in Table C-3
Representativeness/Usability	Cooler temperature and temperature blank	None required
Sensitivity	Evaluate laboratory LODs and LOQs against project DQOs	LOD for ND results less than the screening level
Completeness	Completeness of samples collected; completeness of analytical requirements per the QAPP	95% for all matrices

Notes:

For definitions, refer to the Acronyms and Abbreviations section.

[1] DoD QSM v.5.4 (DoD 2021a)

[2] *Field Sampling Guidance* (ADEC 2022b)

If DoD QSM criteria are not available, laboratory statistically derived limits will be used.

Table C-11 Measurement Performance Criteria for Method SW7470A/SW7471B for Mercury

DQI	QC SAMPLE OR MEASUREMENT PERFORMANCE ACTIVITY	MEASUREMENT PERFORMANCE CRITERIA
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.[1] Sample results will be qualified if contamination is detected above the DL in the associated MB.
Precision	FD	RPD < 50% for soils[2] RPD < 30% for waters[2]
Accuracy	LCS and MS/MSD Recoveries	Soil: QSM Table C-11[1] Water: QSM Table C-12[1]
Precision	MS/MSD Recoveries (and LCS/LCSD, if performed)	RPD ≤ 20%[1]
Accuracy/Bias	Low-level Calibration Check Standard	80-120%[1]
Accuracy/Bias	ICV and CCV	90-110%[1]
Accuracy/Bias	Post-digestion Spike (PDS)	80-120%[1]
Representativeness/Usability	Collection time/date, extraction time/date, analysis time/date	Samples must be preserved and analyzed within criteria in Table C-3
Representativeness/Usability	Cooler temperature and temperature blank	Temperature 0° to 6°C[2]
Sensitivity	Evaluate laboratory LODs and LOQs against project DQOs	LOD for ND results less than the screening level
Completeness	Completeness of samples collected; completeness of analytical requirements per the QAPP	95% for all matrices

Notes:

For definitions, refer to the Acronyms and Abbreviations section.

[1] DoD QSM v.5.4 (DoD 2021a)

[2] *Field Sampling Guidance* (ADEC 2022b)

If DoD QSM criteria are not available, laboratory statistically derived limits will be used.

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6.2 Laboratory Reporting Requirements

The laboratory used to perform work for this project is required to follow the appropriate program and method requirements to ensure that the data quality is acceptable and can be used to support project decisions.

The project laboratory will be required to have the following certifications:

- Current State of Alaska certificate of approval for Contaminated Sites analyses
- DoD ELAP approval for the fields of testing and matrices proposed on the project

6.2.1 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 an SDG. The results for an SDG will be reported as one analytical data package. Laboratories must provide Level IV data packages that meet the minimum requirements included in the ADEC *Guidelines for Data Reporting* (ADEC 2022c), *Laboratory Data Review Checklist* (ADEC 2022d), and the most current version of the DoD QSM (DoD 2021a), as applicable.

Laboratory analytical reports must meet the following minimum requirements. Case narrative must meet ADEC requirements and will include:

- Project name
- Field sample ID number on CoC
- Abbreviated subcontracted laboratory name
- Subcontracted laboratory report number
- Lab ID number for sample
- Date sample collected
- Date sample received at subcontracted laboratory
- Date sample extracted, prepared, and analyzed
- Extraction or preparation procedures, if appropriate
- Analysis procedure including method numbers
- Analyte of parameter
- DL/LOD/LOQ for all results
- Initial and continuing calibration
- Analytical results and units
- Dilution factor
- Chromatograms for all methods
- Matrix
- Sample description (e.g., multi-phase, non-homogeneous, pebbles, roots, cloudy, viscous)
- Copy of CoC record, custody seals, and sample cooler receipt forms, with all forms properly signed and dated

6.2.2 Laboratory Data Deliverables

When possible, laboratory data deliverables for each SDG will include the following:

- Searchable and bookmarked electronic Level IV data package in PDF for each SDG consistent with the requirements specified in *Guidelines for Data Reporting* (ADEC 2022c) and the DoD QSM (DoD 2021a), as applicable
- Staged electronic data deliverables 5.2a (AK SEDD, compatible with the Pacific Ocean-Alaska [POA] instructional set)
- Environmental Quality Information System (EQuIS) electronic data deliverable (EQEDD) 3-file format with Brice reference values (to be provided)

6.2.3 Laboratory 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.
- Samples should be analyzed undiluted, if possible. non-detect results will be reported to the LOD.

All reported data will reflect any dilutions and/or concentrations. The dilution factor, if applicable, will be noted on the analytical report. Such changes should also be reflected in the reporting limits with footnotes detailing the reason for the dilution. If dilution is required, data from both runs will be recorded and reported; however, one result will be selected and reported as the primary result. If samples must be rerun for any reason, the data will be included in the report. Chemical data results between the DL and the LOQ will be flagged J.

6.2.4 Laboratory Data Review and Evaluation

All analytical data that the laboratory generates will be verified before submittal to the project team. This internal data review process will include all aspects of data generation, reduction, and QC assessment. The laboratory will apply data qualifiers as part of its internal validation activities. The allowable data qualifiers for definitive data are Q, J, B, N, and U, and are defined in the most current version of the DoD QSM (DoD 2021a). Flagging criteria apply when acceptance criteria are not met and when CAs are not successful or not performed.

The project chemist or data reviewer will subsequently evaluate the flags that the laboratory applied as part of its 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.

The project chemist or data reviewer will subsequently evaluate the flags that the laboratory applied as part of its 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. When multiple qualifiers are employed, they will be consolidated. The ranking will follow the most conservative to least conservative: X/R, U, QL, QN, QH, and in cases where biases are opposing, the data will be flagged QN. B and H will remain on data not qualified X/R.

6.2.5 Laboratory Preventative Maintenance and Corrective Actions

Laboratory preventative maintenance will be implemented in accordance with the laboratory QA manual and associated laboratory SOP. At a minimum, all major instrumentation will have associated records and logbooks, including schedules and maintenance criteria.

During the project, data quality issues affecting the analytical results may arise. If a laboratory issue arises that affects data quality, the project chemist will discuss with the PM and the rest of the project team as appropriate.

The PM, project chemist, qualified environmental professional, and contract laboratory analysts may be involved in the CA, which may be immediate or long-term. An immediate CA may involve recalculating, reanalyzing, or repeating sample collection and should be completed as soon as possible. Long-term CAs may be identified through performance evaluation samples, standards, control charts, or other devices. If acceptance criteria were not achieved and a CA was not successful, or a CA was not performed, the appropriate data qualifiers should be applied.

6.3 Data Quality Review and Assessment

The data quality review process consists of data verification, data quality review, and data usability assessment. Data verification confirms that the specified requirements have been performed. Data quality review and assessment is the systematic process of evaluating whether the data comply with the predefined requirements of the project (including method, procedural, and contract requirements) and comparing the data with criteria based on the DQOs documented in this SAP. The data usability assessment is an evaluation based on the results of data verification and quality review in the context of the overall project objectives.

6.3.1 Data Verification Procedures

Data verification inputs include planning documents, field records, and laboratory records. Data verification is a check that all specified activities involved in collecting and analyzing samples have been completed and documented and that the necessary records are available to proceed to data quality review.

Records, documents, and/or procedures that will be reviewed as part of the data verification process include, but are not limited to, the following:

- Field documentation including field logbook(s), Global Positioning System coordinates, and photographs
- Field SOPs (verify that sampling SOPs were followed)
- Analytical SOPs (verify that the analytical SOPs were followed)
- Sample receipt documentation including CoC forms, cooler receipt forms, and laboratory login information
- Field measurements, including field screening results
- Sample summary table (verify accuracy and completeness by comparing with CoC forms and cooler receipt forms)
- Laboratory data packages (verify laboratory QC and raw data were provided in the Level IV PDF report)

- Laboratory electronic data deliverables (EDDs) (verify that EDDs are consistent with contract requirements)
- Analytical results (verify that all data for all samples were provided and that the specified analytical methods were used by the laboratory)
- Field QC sample results (verify all QAPP-required QC samples were collected and analyzed)

6.3.2 Data Review Procedures

All project data will be reviewed on an analytical batch basis by assessing QC samples and associated field sample results. Data quality review will be performed using the QC criteria defined in this SAP, in the order presented below:

- DoD QSM v.5.4 (DoD 2021a)
- *General Data Validation Guidelines Revision 1* (DoD 2019)
- *Data Validation Guidelines Module 1: Data Validation Procedure for Organic Analysis by GCMS* (DoD 2020)
- Data Validation Guidelines Module 4: Data Validation Procedure for Organic Analysis by GC (DoD 2021b)
- *Data Validation Guidelines Module 5: Data Validation Procedure for Metals by ICP-MS* (DoD 2022a)
- *Data Validation Guidelines Modules 1,2,3, and 4 Revised Table for Sample Qualification in the Presence of Blank Contamination* (DoD 2022b)
- *ADEC Guidelines for Data Reporting* (ADEC 2022c)
- Specific method guidance
- Laboratory SOPs

Data quality review and assessment is typically performed by person(s) independent of the activity being evaluated. Data quality review includes completing the *ADEC Laboratory Data Review Checklist* (ADEC 2022d) for each SDG, the review of the analytical data including QC sample results, field and laboratory QA reports, and all data submittals.

The following information will be reviewed during the data quality review and assessment:

- CoC documentation
- Holding time compliance
- QC sample frequencies
- Blanks
- LCS recoveries (and precision, if LCSD performed)
- Surrogate spike recoveries
- MS/MSD recoveries and precision
- Initial and continuing calibration summary information
- Internal standards
- Post-digestion spikes
- FD precision
- Case narrative review, laboratory flagging review, and other method-specific criteria

In general, EDDs will be evaluated for consistency with project and contract requirements. EDDs will be consistent with the Level IV PDF report.

6.3.3 Data Quality Review and Assessment Guidelines

The data quality review and assessment will identify results requiring qualification and potential effects on data usability based on the MPC in Tables C-5 through C-11. Table C-12 defines the qualifiers to be applied to the analytical data set, as appropriate. Direction of bias will be indicated when possible. Table C-13 includes general data qualifying conventions.

Table C-12 Data Qualifiers

QUALIFIER	DESCRIPTION
J	Analyte is considered an estimated value because the result is greater than or equal to the DL and less than the LOQ.
B	Analyte result is considered a high estimated value due to contamination present in an associated blank (e.g., MB or TB).
H	Analyte result is considered a low estimate due to a holding time exceedance.
QH/QL/QN	Analyte result is considered an estimated value biased (high, low, uncertain) due to a QC failure.
X	The sample results (including ND) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project QC criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.
R	Analyte result is rejected – result is not usable. Note that R replaces the chemical result (no result will be reported with an R flag).

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

Qualification will not be required in the following circumstances:

- Surrogate or MS recoveries were outside QC limits, and dilution of the sample resulted in surrogate or spike dilution to a level beyond quantitation.
- MS recoveries were outside QC limits, and the spiked concentration was less than that of the parent sample.
- An analyte was detected in the associated blank, but there was no detection in the associated sample.
- MS/MSD or LCS/LCSD recoveries exceeded upper control limits and there was no detection in the sample(s).

Data may be rejected on the following grounds:

- Initial calibration (per compound) criteria not met
- Continuing calibration (per compound) not verified
- All non-detects with the continuing calibration recovery less than control limits
- All non-detects with the LCS recovery less than control limits
- Any compound with LCS recovery less than 10%
- Missed holding times greater than two times the method-specified holding time
- Surrogate recovery of less than 10% and a dilution factor of 5 or less

Table C-13 General Data Qualifying Convention

QC REQUIREMENT	CRITERIA	FLAG	FLAG APPLIED TO
Holding time	Time exceeded for extraction or analysis	H for positive results and NDs	All analytes in sample
	Time exceeded for extraction or analysis by a factor of > 2	H for positive results; X for NDs	
Sample preservation	Improper sample preservation	QL for positive results and NDs	Sample
	Temperature > 6°C upon receipt, and > 8 hours from collection	QL for positive results and NDs; professional judgement on a case-by-case basis	
	Temperature < 0°C upon receipt and not frozen or otherwise adversely affected	No flag required	
Sample Integrity (AK101, SW8260D)	Bubbles in VOA vial > 1/4-inch used for analysis	QL for positive results and NDs	Sample
Instrument tuning	Ion abundance method-specific criteria not met	X for all results	All associated samples in analytical batch
Initial calibration	All analytes must be within method-specific criteria	X for all results	All associated samples in analytical batch
Second source check (ICV)	All analytes must be within method-specific criteria	X for all results	All associated samples in analytical batch
Continuing calibration	All analytes must be within method-specific criteria Note: closing CCV for GC/MS must be within 50–150%	QH/QL/QN for positive results and NDs, indicating bias	All associated samples in analytical batch
	Criteria exceeded by more than 2x	QH/QL/QN for positive results; X for NDs	
Low-level calibration check	All analytes must be within 50% of expected value	High bias: QH for positive results Low bias: QL for positive results; and NDs	All associated samples in analytical batch
	Criteria exceeded by more than 2x	QH/QL/QN for positive results; X for NDs	
Internal Standards	Area > UCL	QL for positive results; X for NDs	Sample
	Area < LCL	QH for positive results	
LCS	%R > UCL	QH for positive results	The specific analyte(s) in all samples in associated analytical batch
	%R < LCL	QL for positive results; QL for NDs	
	%R < LCL and < 10%	QL for positive results; X for NDs	
Surrogate spikes	%R > UCL	QH for positive results; no flag for NDs	Sample
	%R < LCL and > 10%	QL for positive results; QL for NDs	

Table C-13 General Data Qualifying Convention

QC REQUIREMENT	CRITERIA	FLAG	FLAG APPLIED TO
Surrogate spikes (continued)	%R < 10%	QL for positive results; X for NDs	Sample
	Dilution > 5x	No flagging required for failed surrogates	
Blanks (MB, TB, EB)	Analyte(s) detected above the DL (use the blank of the highest concentration)	B for positive sample results 10 times blank amounts	All samples in preparation, field or analytical batch, whichever applies
FD samples	RPD > control limit and FDs > LOQ	QN for positive results	The specific analyte(s) in FD pair
	One FD > LOQ, one ND	QN for positive results and NDs	
	One FD > LOQ, one FD > LOD but < LOQ	QN for positive results for RPDs outside QC limits	
	Both results < LOQ	No flagging required for RPDs outside QC limits	
MS/MSD	MS or MSD %R > UCL	QH for positive results	The specific analyte(s) in parent sample
	MS or MSD %R < LCL and > 10%	QL for positive results and NDs	
	MS or MSD %R < LCL and < 10%	QL for positive results; X for NDs	
	MS/MSD RPD > control limit	QN for positive results	
	Sample concentration > spike concentration; excessive dilution (dilution > 5x)	No flag required	
Post-digestion spike	All analytes must be within ±20% of expected value	High bias: QH for positive results Low bias: QL for positive results and NDs	The specific analyte(s) in parent sample
Serial dilutions	All analytes must be within 10% of expected value	If post-spike is not analyzed; QN for positive results	The specific analyte(s) in parent sample
Confirmation	RPD between primary and confirmation results > 40%	QN for positive results; X if no matrix interference present	Sample
Retention time window	Analyte within established window	X for all results if analyte is outside established window	Sample

Notes:

For definitions, refer to the Acronyms and Abbreviations section.

X – The sample results (including ND) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project QC criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended. The data will be replaced with an "R" if rejected is deemed warranted.

QH – sample result is qualified due to high bias QL – sample result is qualified due to low bias

QN – sample result is qualified due to indeterminate bias

The project chemist or data reviewer will evaluate MBs, as well as other FBs, based on the concentration of the analyte in the samples in relation to the concentration in the blank. The project chemist must discuss any blank contamination that may affect data usability in conjunction with project-specific goals. When a data set contains low-level detects in field samples and has associated field or laboratory blanks that have 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. MBs will be evaluated to the DL. If an analyte is detected in the MB above the DL, associated sample results that are less than or equal to 10 times the amount found in the MB will be flagged B at the detected concentration to document the associated blank contamination.

QC measures for precision include FDs, laboratory duplicates, and MSDs. Except for FDs, the laboratory will complete an evaluation of these measures and qualify the data accordingly within their review (Section 6.2.4). The project chemist or data reviewer will review this evaluation and complete an evaluation of FD precision.

To evaluate FD precision, the RPD between duplicate results will be calculated. Duplicate results will be qualified QN if the RPD exceeds the recommended 50% for soils or 30% for waters (Section 6.1.1). Duplicate results will be qualified when one result is greater than the LOQ and one result is non-detect. No calculations will be made when both concentrations are less than the LOQs.

Field duplicate results can be used to assess field sampling precision, laboratory precision, and, potentially, the representativeness of the matrix sampled. 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 field and analytical duplicate sample results. If poor precision is indicated in both the field 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 quality 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.

6.3.4 Data Usability Assessment

The data usability assessment is an evaluation based on the results of data verification and quality review 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 goal of assessing whether the final, qualified results support the decisions to be made with the data.

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 will generate a data quality assessment report to be included with the project report that describes the results of the data verification, data quality review, and usability assessment. The project chemist will work with the PM 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 non-conformance 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 project DQOs and evaluated using the MPC in Tables C-5 through C-11.
- Analytical results, including non-detect values, will be compared against the PALs in Attachments C-1 and C-2 tables.
- Data verification and quality review will be completed following the procedures in Section 6.3.
- Based on the results of data verification and quality review, the usability of the data will be evaluated in the context of project-specific DQOs.

Measurement error will be evaluated by reviewing sampling design, sampling locations, and sample collection methods. The project chemist or data reviewer will evaluate laboratory and field QC sample results (FDs, performance evaluation samples, blanks, LCS, surrogate recoveries, and matrix effect, if any) to assess the overall measurement error associated with the project.

Table C-14 includes specific examples of items that may be evaluated during the usability assessment, as applicable. Information in this table reflects general data usability considerations.

Table C-14 Data Usability Assessment

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.	Project Chemist
Sampling locations, deviation	Determine whether alterations to sampling locations continue to satisfy the project DQOs.	Field Team, PM
CoC, deviation	Establish that any problems with documentation or custody procedures do not prevent the data from being used for the intended purpose.	Project Chemist
Holding times, deviation	Determine the acceptability of data where holding times were exceeded.	Project Chemist
SOPs and methods, deviations	Evaluate the impact of deviations from analytical and field SOPs and specified methods on data quality.	Field Team, 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.	Project Chemist
Matrix	Evaluate matrix effects (interference or bias).	Project Chemist

Table C-14 Data Usability Assessment

ITEM	ASSESSMENT ACTIVITY	RESPONSIBILITY
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.	Field Team
Comparability	Ensure that results from different data collection events achieve an acceptable level of agreement.	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 project DQOs documented in this QAPP).	PM, Field Team, Project Chemist
Critical samples	Establish that critical samples and critical target analytes, as defined in the QAPP, were collected and analyzed. Determine whether the results meet criteria specified in the QAPP.	PM, Field Team, 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.	PM, Field Team, Project Chemist
Usability decision	Determine whether the data can be used to make a specific decision considering the implications of all deviations and CAs.	PM, Field Team, 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.	Project Chemist

Notes:
For definitions, refer to the Acronyms and Abbreviations section.

6.3.5 Analytical Data Quality Report

An analytical data quality report will be prepared that summarizes the findings of the data verification and data quality review and discusses the effect of any variances on data usability. In addition to the overall data quality report, the project chemist or data reviewer will complete the ADEC *Laboratory Data Review Checklist* (ADEC 2022d) for each laboratory data package. A summary of the findings of the data quality report will be included in the text of the report.

The analytical data quality report will present detailed results of the data quality review and assessment, including, but not limited to, a discussion of all QC parameters evaluated; the acceptance criteria used to evaluate each parameter; the extent of the QC exceedance; identification of samples affected by the QC exceedance; and discussion of any qualifiers applied to the samples results, including potential direction of bias and relationship to screening levels and/or cleanup levels (if possible). Significant trends and biases in the data will be evaluated and identified. A detailed description will be provided for any CAs and/or systematic problems that were identified during the data review process.

The completed DQR will include a Sample Summary table and Analytical Data table consistent with the requirements in the *Manual for Electronic Deliverables* (USACE 2017). All analytical results, including duplicate results, will be reported with any appropriate qualifiers in accompanying data tables. Sample LODs for non-detect results will be compared to the PALs established for the method/analyte/matrix in Attachments C-1 and C-2 tables. If the LOD for the non-detect result exceeds the action level, the result will be highlighted.

7.0 REFERENCES

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Attachment C-1
Soil Project Action Levels

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Attachment C-1 Soil Project Action Levels

METHOD	CAS NUMBER	ANALYTE	EPA SSL[1] (mg/kg)	ADEC MTG[2] (mg/kg)
AK101	GRO	GRO (C6-C10)	NS	260
AK102	DRO	DRO (C10-C24)	NS	230
AK103	RRO	RRO (C25-C36)	NS	9700
SW6010	7440-22-4	Silver	0.8	11
SW6010	7429-90-5	Aluminum	30000	NS
SW6010	7440-38-2	Arsenic	0.0015	0.2
SW6010	7440-39-3	Barium	82	2100
SW6010	7440-41-7	Beryllium	3.2	260
SW6010	7440-70-2	Calcium	NS	NS
SW6010	7440-43-9	Cadmium	0.14	9.1
SW6010	7440-48-4	Cobalt	0.27	NS
SW6010	7440-47-3	Chromium	180,000	NS
SW6010	7440-50-8	Copper	28	370
SW6010	7439-89-6	Iron	350	NS
SW6010	9/7/7440	Potassium	NS	NS
SW6010	7439-95-4	Magnesium	NS	NS
SW6010	7439-96-5	Manganese	28	370
SW6010	7440-23-5	Sodium	NS	NS
SW6010	7440-02-0	Nickel	26	340
SW6010	7439-92-1	Lead	14	NS
SW6010	7440-36-0	Antimony	0.27	4.6
SW6010	7782-49-2	Selenium	0.26	6.9
SW6010	7440-28-0	Thallium	0.014	0.19
SW6010	7440-62-2	Vanadium	86	1,100
SW6010	7440-66-6	Zinc	370	4900
SW7471	7439-97-6	Mercury	0.033	0.36
SW8082A	12674-11-2	Aroclor 1016	0.021	NS
SW8082A	11104-28-2	Aroclor 1221	8.00E-05	NS
SW8082A	11141-16-5	Aroclor 1232	8.00E-05	NS
SW8082A	53469-21-9	Aroclor 1242	0.0012	NS
SW8082A	12672-29-6	Aroclor 1248	0.0012	NS
SW8082A	11097-69-1	Aroclor 1254	0.002	NS
SW8082A	11096-82-5	Aroclor 1260	0.0055	NS
SW8082A	37324-23-5	Aroclor 1262	NS	NS
SW8082A	11100-14-4	Aroclor 1268	NS	NS
SW8082A	1336-36-3	Total PCB	0.0068	NS
SW8011	96-18-4	1,2,3-Trichloropropane	3.20E-07	3.10E-05
SW8011	96-12-8	1,2-Dibromo-3-chloropropane	1.40E-07	NS
SW8011	106-93-4	1,2-Dibromoethane	2.10E-06	2.40E-04
SW8260B/D	630-20-6	1,1,1,2-Tetrachloroethane	0.00022	0.022
SW8260B/D	71-55-6	1,1,1-Trichloroethane	0.07	32
SW8260B/D	79-34-5	1,1,2,2-Tetrachloroethane	3.00E-05	0.003
SW8260B/D	79-00-5	1,1,2-Trichloroethane	8.90E-05	0.0014
SW8260B/D	75-34-3	1,1-Dichloroethane	0.00078	0.092
SW8260B/D	75-35-4	1,1-Dichloroethene	0.0025	1.2
SW8260B/D	563-58-6	1,1-Dichloropropene	NS	NS
SW8260B/D	87-61-6	1,2,3-Trichlorobenzene	0.021	0.15
SW8260B/D	96-18-4	1,2,3-Trichloropropane	3.20E-07	0.000031
SW8260B/D	120-82-1	1,2,4-Trichlorobenzene	0.0034	0.082
SW8260B/D	95-63-6	1,2,4-Trimethylbenzene	0.081	0.61
SW8260B/D	96-12-8	1,2-Dibromo-3-chloropropane	1.40E-07	NS
SW8260B/D	106-93-4	1,2-Dibromoethane	2.10E-06	0.00024

Attachment C-1 Soil Project Action Levels

METHOD	CAS NUMBER	ANALYTE	EPA SSL[1] (mg/kg)	ADEC MTG[2] (mg/kg)
SW8260B/D	95-50-1	1,2-Dichlorobenzene	0.3	2.4
SW8260B/D	107-06-2	1,2-Dichloroethane	4.80E-05	0.0055
SW8260B/D	78-87-5	1,2-Dichloropropane	0.00028	0.03
SW8260B/D	108-67-8	1,3,5-Trimethylbenzene	0.087	0.66
SW8260B/D	541-73-1	1,3-Dichlorobenzene	NS	2.3
SW8260B/D	142-28-9	1,3-Dichloropropane	0.13	NS
SW8260B/D	106-46-7	1,4-Dichlorobenzene	0.00046	0.037
SW8260B/D	123-91-1	1,4-Dioxane	9.40E-05	0.012
SW8260B/D	71-36-3	1-Butanol	0.41	5.3
SW8260B/D	78-93-3	2-Butanone	1.2	15
SW8260B/D	95-49-8	2-Chlorotoluene	0.23	NS
SW8260B/D	591-78-6	2-Hexanone	0.0088	0.11
SW8260B/D	106-43-4	4-Chlorotoluene	0.24	NS
SW8260B/D	108-10-1	4-Methyl-2-pentanone	1.4	18
SW8260B/D	67-64-1	Acetone	3.7	38
SW8260B/D	75-05-8	Acetonitrile	0.026	NS
SW8260B/D	107-02-8	Acrolein	8.40E-06	NS
SW8260B/D	107-13-1	Acrylonitrile	1.10E-05	NS
SW8260B/D	71-43-2	Benzene	0.00023	0.022
SW8260B/D	108-86-1	Bromobenzene	0.042	0.36
SW8260B/D	74-97-5	Bromochloromethane	0.021	NS
SW8260B/D	75-27-4	Bromodichloromethane	3.60E-05	0.0043
SW8260B/D	75-25-2	Bromoform	0.00087	0.1
SW8260B/D	74-83-9	Bromomethane	0.0019	0.024
SW8260B/D	75-15-0	Carbon disulfide	0.24	2.9
SW8260B/D	56-23-5	Carbon tetrachloride	0.00018	0.021
SW8260B/D	108-90-7	Chlorobenzene	0.053	0.46
SW8260B/D	75-00-3	Chloroethane	2.4	72
SW8260B/D	67-66-3	Chloroform	6.10E-05	0.0071
SW8260B/D	74-87-3	Chloromethane	0.049	0.61
SW8260B/D	156-59-2	cis-1,2-Dichloroethene	0.0074	0.12
SW8260B/D	110-82-7	Cyclohexane	13	150
SW8260B/D	124-48-1	Dibromochloromethane	0.00023	0.0027
SW8260B/D	74-95-3	Dibromomethane	0.0021	0.025
SW8260B/D	75-71-8	Dichlorodifluoromethane	0.3	3.9
SW8260B/D	60-29-7	Ethyl ether	0.88	NS
SW8260B/D	100-41-4	Ethylbenzene	0.0017	0.13
SW8260B/D	87-68-3	Hexachlorobutadiene	0.00027	0.02
SW8260B/D	78-83-1	Isobutanol	0.15	NS
SW8260B/D	67-63-0	Isopropanol	0.084	1.1
SW8260B/D	98-82-8	Isopropylbenzene	0.74	5.6
SW8260B/D	1634-04-4	Methyl tert-butyl ether	0.0032	0.4
SW8260B/D	75-09-2	Methylene chloride	0.0013	0.33
SW8260B/D	91-20-3	Naphthalene	0.00038	0.038
SW8260B/D	104-51-8	n-Butylbenzene	3.2	23
SW8260B/D	103-65-1	n-Propylbenzene	1.2	9.1
SW8260B/D	135-98-8	sec-Butylbenzene	5.9	42
SW8260B/D	100-42-5	Styrene	0.11	10
SW8260B/D	98-06-6	tert-Butylbenzene	1.6	11
SW8260B/D	127-18-4	Tetrachloroethene	0.0023	0.19
SW8260B/D	109-99-9	Tetrahydrofuran	0.75	NS
SW8260B/D	108-88-3	Toluene	0.69	6.7

Attachment C-1 Soil Project Action Levels

METHOD	CAS NUMBER	ANALYTE	EPA SSL[1] (mg/kg)	ADEC MTG[2] (mg/kg)
SW8260B/D	156-60-5	trans-1,2-Dichloroethene	0.021	1.3
SW8260B/D	10061-02-6	trans-1,3-Dichloropropene	NS	NS
SW8260B/D	79-01-6	Trichloroethene	0.00018	0.011
SW8260B/D	75-69-4	Trichlorofluoromethane	3.3	41
SW8260B/D	108-05-4	Vinyl acetate	0.087	1.1
SW8260B/D	75-01-4	Vinyl chloride	6.50E-06	0.0008
SW8260B/D	95-47-6	o-Xylene	0.19	1.5
SW8260B/D	179601-23-1	m,p-Xylene	NS	NS
SW8260B/D	1330-20-7	Xylenes, Total	0.19	1.5
SW8270D	120-82-1	1,2,4-Trichlorobenzene	0.0034	0.082
SW8270D	95-50-1	1,2-Dichlorobenzene	0.3	2.4
SW8270D	541-73-1	1,3-Dichlorobenzene	NS	2.3
SW8270D	106-46-7	1,4-Dichlorobenzene	0.00046	0.037
SW8270D	90-12-0	1-Methylnaphthalene	0.006	0.41
SW8270D	95-95-4	2,4,5-Trichlorophenol	4	28
SW8270D	88-06-2	2,4,6-Trichlorophenol	0.004	0.092
SW8270D	120-83-2	2,4-Dichlorophenol	0.023	0.21
SW8270D	105-67-9	2,4-Dimethylphenol	0.42	3.2
SW8270D	51-28-5	2,4-Dinitrophenol	0.044	0.34
SW8270D	121-14-2	2,4-Dinitrotoluene	0.00032	0.024
SW8270D	87-65-0	2,6-Dichlorophenol	NS	NS
SW8270D	606-20-2	2,6-Dinitrotoluene	6.70E-05	0.005
SW8270D	91-58-7	2-Chloronaphthalene	3.9	26
SW8270D	95-57-8	2-Chlorophenol	0.089	0.71
SW8270D	91-57-6	2-Methylnaphthalene	0.19	1.3
SW8270D	95-48-7	2-Methylphenol	0.75	6.2
SW8270D	88-74-4	2-Nitroaniline	0.08	NS
SW8270D	88-75-5	2-Nitrophenol	NS	NS
SW8270D	84989-04-8	3 & 4-Methylphenol	NS	NS
SW8270D	91-94-1	3,3´-Dichlorobenzidine	0.00082	0.056
SW8270D	99-09-2	3-Nitroaniline	NS	NS
SW8270D	534-52-1	4,6-Dinitro-2-methylphenol	0.0026	NS
SW8270D	101-55-3	4-Bromophenyl-phenylether	NS	NS
SW8270D	59-50-7	4-Chloro-3-methylphenol	1.7	NS
SW8270D	106-47-8	4-Chloroaniline	0.00016	0.015
SW8270D	7005-72-3	4-Chlorophenyl-phenylether	NS	NS
SW8270D	100-01-6	4-Nitroaniline	0.0016	NS
SW8270D	100-02-7	4-Nitrophenol	NS	NS
SW8270D	83-32-9	Acenaphthene	5.5	37
SW8270D	208-96-8	Acenaphthylene	NS	18
SW8270D	62-53-3	Aniline	0.0046	NS
SW8270D	120-12-7	Anthracene	58	390
SW8270D	103-33-3	Azobenzene as 1,2- Diphenylhydrazine	0.00093	NS
SW8270D	92-87-5	Benzidine	2.80E-07	NS
SW8270D	56-55-3	Benzo(a)anthracene	0.011	0.7
SW8270D	50-32-8	Benzo(a)pyrene	0.029	1.9
SW8270D	205-99-2	Benzo(b)fluoranthene	0.3	20
SW8270D	191-24-2	Benzo(g,h,i)perylene	NS	15,000
SW8270D	207-08-9	Benzo(k)fluoranthene	2.9	190
SW8270D	65-85-0	Benzoic acid	15	200
SW8270D	100-51-6	Benzyl alcohol	0.48	5.7
SW8270D	111-91-1	Bis(2-chloroethoxy)methane	0.013	NS

Attachment C-1 Soil Project Action Levels

METHOD	CAS NUMBER	ANALYTE	EPA SSL[1] (mg/kg)	ADEC MTG[2] (mg/kg)
SW8270D	111-44-4	Bis(2-chloroethyl)ether	3.60E-06	0.00042
SW8270D	108-60-1	Bis(2-chloroisopropyl)ether	0.26	NS
SW8270D	117-81-7	Bis(2-ethylhexyl)phthalate	1.3	88
SW8270D	85-68-7	Butyl benzyl phthalate	0.24	16
SW8270D	86-74-8	Carbazole	NS	NS
SW8270D	218-01-9	Chrysene	9	600
SW8270D	53-70-3	Dibenzo(a,h)anthracene	0.096	6.3
SW8270D	132-64-9	Dibenzofuran	0.15	0.97
SW8270D	84-66-2	Diethyl phthalate	6.1	60
SW8270D	131-11-3	Dimethyl phthalate	NS	48
SW8270D	84-74-2	Di-n-butyl phthalate	2.3	16
SW8270D	117-84-0	Di-n-octyl phthalate	57	370
SW8270D	206-44-0	Fluoranthene	89	590
SW8270D	86-73-7	Fluorene	5.4	36
SW8270D	118-74-1	Hexachlorobenzene	0.00012	0.0082
SW8270D	87-68-3	Hexachlorobutadiene	0.00027	0.02
SW8270D	77-47-4	Hexachlorocyclopentadiene	0.0013	0.0093
SW8270D	67-72-1	Hexachloroethane	0.0002	0.018
SW8270D	193-39-5	Indeno(1,2,3-cd)pyrene	0.98	65
SW8270D	78-59-1	Isophorone	0.026	2.7
SW8270D	91-20-3	Naphthalene	0.00038	0.038
SW8270D	98-95-3	Nitrobenzene	9.20E-05	0.0079
SW8270D	62-75-9	N-Nitrosodimethylamine	2.70E-08	3.30E-06
SW8270D	621-64-7	N-Nitrosodi-n-propylamine	8.10E-06	0.00068
SW8270D	86-30-6	N-Nitrosodiphenylamine	0.067	4.6
SW8270D	930-55-2	N-Nitrosopyrrolidine	1.40E-05	NS
SW8270D	87-86-5	Pentachlorophenol	5.70E-05	0.0043
SW8270D	85-01-8	Phenanthrene	NS	39
SW8270D	108-95-2	Phenol	3.3	29
SW8270D	129-00-0	Pyrene	13	87
SW8270D	110-86-1	Pyridine	0.0068	NS

Notes:

[1] EPA RSL defined by EPA RSL Summary Table, (TR=1E-06, HQ=1) November 2023 risk-based SSL. When a risk-based SSL was not available the EPA RSL for MCL-based SSL was used.

[2] ADEC MTG are defined by 18 AAC 75, Method 2 Tables B1 and B2, MTG levels (ADEC 2024).

Green fill – Most stringent Screening Level
AAC – Alaska Administrative Code
ADEC – Alaska Department of Environmental Conservation
CAS – Chemical Abstracts Service
DRO – diesel range organics
EPA – U.S. Environmental Protection Agency
GRO – gasoline range organics
MCL – maximum contaminant level
mg/kg – milligrams per kilogram
MTG – migration to groundwater
NS – no screening level
RRO – residual range organics
RSL – Regional Screening Level
SSL – soil screening level

Attachment C-2
Groundwater Project Action Levels

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Attachment C-2 Groundwater Screening Levels

METHOD	CAS NUMBER	ANALYTE	EPA RSL[1]	ADEC GROUNDWATER SL[2]
			(µg/L)	(µg/L)
AK101	GRO	GRO (C6-C10)	NS	2200
AK102	DRO	DRO (C10-C24)	NS	1500
AK103	RRO	RRO (C25-C36)	NS	1100
SW6020B	7440-22-4	Silver	94	94
SW6020B	7429-90-5	Aluminum	20000	NS
SW6020B	7440-38-2	Arsenic	10	0.52
SW6020B	7440-39-3	Barium	2000	3800
SW6020B	7440-41-7	Beryllium	4	25
SW6020B	7440-70-2	Calcium	NS	NS
SW6020B	7440-43-9	Cadmium	5	9.2
SW6020B	7440-48-4	Cobalt	6	NS
SW6020B	7440-47-3	Chromium	100	NS
SW6020B	7440-50-8	Copper	1300	800
SW6020B	7439-89-6	Iron	14000	NS
SW6020B	9/7/7440	Potassium	NS	NS
SW6020B	7439-95-4	Magnesium	NS	NS
SW6020B	7439-96-5	Manganese	NS	430
SW6020B	7440-23-5	Sodium	NS	NS
SW6020B	7440-02-0	Nickel	390	390
SW6020B	7439-92-1	Lead	15	15
SW6020B	7440-36-0	Antimony	6	7.8
SW6020B	7782-49-2	Selenium	50	100
SW6020B	7440-28-0	Thallium	2	0.2
SW6020B	7440-62-2	Vanadium	86	86
SW6020B	7440-66-6	Zinc	6000	6000
SW6020B	7439-97-6	Mercury	2	0.52
SW8082	12674-11-2	Aroclor 1016	0.22	NS
SW8082	11104-28-2	Aroclor 1221	0.0047	NS
SW8082	11141-16-5	Aroclor 1232	0.0047	NS
SW8082	53469-21-9	Aroclor 1242	0.0078	NS
SW8082	12672-29-6	Aroclor 1248	0.0078	NS
SW8082	11097-69-1	Aroclor 1254	0.0078	NS
SW8082	11096-82-5	Aroclor 1260	0.0078	NS
SW8082	37324-23-5	Aroclor 1262	NS	NS
SW8082	11100-14-4	Aroclor 1268	NS	NS
SW8082	1336-36-3	Total PCB	0.5	0.44
SW8260D-SIM	96-18-4	1,2,3-Trichloropropane	0.00075	0.0075
SW8260D-SIM	96-12-8	1,2-Dibromo-3-chloropropane	0.2	NS
SW8260D-SIM	106-93-4	1,2-Dibromoethane	0.05	0.075
SW8260D-SIM	123-91-1	1,4-Dioxane	0.46	4.6
SW8260D	630-20-6	1,1,1,2-Tetrachloroethane	0.57	5.7
SW8260D	71-55-6	1,1,1-Trichloroethane	200	8000
SW8260D	79-34-5	1,1,2,2-Tetrachloroethane	0.076	0.76
SW8260D	79-00-5	1,1,2-Trichloroethane	5	0.41
SW8260D	75-34-3	1,1-Dichloroethane	2.8	28
SW8260D	75-35-4	1,1-Dichloroethene	7	280
SW8260D	563-58-6	1,1-Dichloropropene	NS	NS
SW8260D	87-61-6	1,2,3-Trichlorobenzene	7	7
SW8260D	96-18-4	1,2,3-Trichloropropane	0.00075	0.0075
SW8260D	120-82-1	1,2,4-Trichlorobenzene	70	4

Attachment C-2 Groundwater Screening Levels

METHOD	CAS NUMBER	ANALYTE	EPA RSL[1]	ADEC GROUNDWATER SL[2]
			(µg/L)	(µg/L)
SW8260D	95-63-6	1,2,4-Trimethylbenzene	56	56
SW8260D	96-12-8	1,2-Dibromo-3-chloropropane	0.2	NS
SW8260D	106-93-4	1,2-Dibromoethane	0.05	0.075
SW8260D	95-50-1	1,2-Dichlorobenzene	600	300
SW8260D	107-06-2	1,2-Dichloroethane	5	1.7
SW8260D	78-87-5	1,2-Dichloropropane	5	8.2
SW8260D	108-67-8	1,3,5-Trimethylbenzene	60	60
SW8260D	541-73-1	1,3-Dichlorobenzene	NS	300
SW8260D	142-28-9	1,3-Dichloropropane	370	NS
SW8260D	106-46-7	1,4-Dichlorobenzene	75	4.8
SW8260D	594-20-7	2,2-Dichloropropane	NS	NS
SW8260D	78-93-3	2-Butanone	5600	5600
SW8260D	95-49-8	2-Chlorotoluene	240	NS
SW8260D	591-78-6	2-Hexanone	38	38
SW8260D	106-43-4	4-Chlorotoluene	250	NS
SW8260D	99-87-6	4-Isopropyltoluene	NS	NS
SW8260D	108-10-1	4-Methyl-2-pentanone	6300	6300
SW8260D	71-43-2	Benzene	5	4.6
SW8260D	108-86-1	Bromobenzene	62	62
SW8260D	74-97-5	Bromochloromethane	83	NS
SW8260D	75-27-4	Bromodichloromethane	80*	1.3
SW8260D	75-25-2	Bromoform	80*	33
SW8260D	74-83-9	Bromomethane	7.5	7.5
SW8260D	75-15-0	Carbon disulfide	810	810
SW8260D	56-23-5	Carbon tetrachloride	5	4.6
SW8260D	108-90-7	Chlorobenzene	100	78
SW8260D	75-00-3	Chloroethane	8300	21000
SW8260D	67-66-3	Chloroform	80*	2.2
SW8260D	74-87-3	Chloromethane	190	190
SW8260D	156-59-2	cis-1,2-Dichloroethene	70	36
SW8260D	10061-01-5	cis-1,3-Dichloropropene	NS	NS
SW8260D	124-48-1	Dibromochloromethane	80*	8.7
SW8260D	74-95-3	Dibromomethane	8.3	8.3
SW8260D	75-71-8	Dichlorodifluoromethane	200	200
SW8260D	100-41-4	Ethylbenzene	700	15
SW8260D	87-68-3	Hexachlorobutadiene	0.14	1.4
SW8260D	98-82-8	Isopropylbenzene	450	450
SW8260D	179601-23-1	m,p-Xylene	190	NS
SW8260D	1634-04-4	Methyl tert-butyl ether	14	140
SW8260D	75-09-2	Methylene chloride	5	110
SW8260D	91-20-3	Naphthalene	0.12	1.7
SW8260D	104-51-8	n-Butylbenzene	1000	1000
SW8260D	103-65-1	n-Propylbenzene	660	660
SW8260D	95-47-6	o-Xylene	190	NS
SW8260D	135-98-8	sec-Butylbenzene	2000	2000
SW8260D	100-42-5	Styrene	100	1200
SW8260D	98-06-6	tert-Butylbenzene	690	690
SW8260D	127-18-4	Tetrachloroethene	5	41
SW8260D	108-88-3	Toluene	1000	1100
SW8260D	156-60-5	trans-1,2-Dichloroethene	100	360

Attachment C-2 Groundwater Screening Levels

METHOD	CAS NUMBER	ANALYTE	EPA RSL[1]	ADEC GROUNDWATER SL[2]
			(µg/L)	(µg/L)
SW8260D	10061-02-6	trans-1,3-Dichloropropene	NS	NS
SW8260D	79-01-6	Trichloroethene	5	2.8
SW8260D	75-69-4	Trichlorofluoromethane	5200	5200
SW8260D	108-05-4	Vinyl acetate	410	410
SW8260D	75-01-4	Vinyl chloride	2	0.19
SW8260D	1330-20-7	Xylenes, Total	10000	190
SW8270	120-82-1	1,2,4-Trichlorobenzene	70	4
SW8270	95-50-1	1,2-Dichlorobenzene	600	300
SW8270	541-73-1	1,3-Dichlorobenzene	NS	300
SW8270	106-46-7	1,4-Dichlorobenzene	75	4.8
SW8270	90-12-0	1-Methylnaphthalene	1.1	11
SW8270	95-95-4	2,4,5-Trichlorophenol	1200	1200
SW8270	88-06-2	2,4,6-Trichlorophenol	4.1	12
SW8270	120-83-2	2,4-Dichlorophenol	46	46
SW8270	105-67-9	2,4-Dimethylphenol	360	360
SW8270	51-28-5	2,4-Dinitrophenol	39	39
SW8270	121-14-2	2,4-Dinitrotoluene	0.24	2.4
SW8270	87-65-0	2,6-Dichlorophenol	NS	NS
SW8270	606-20-2	2,6-Dinitrotoluene	0.049	0.49
SW8270	91-58-7	2-Chloronaphthalene	750	750
SW8270	95-57-8	2-Chlorophenol	91	91
SW8270	91-57-6	2-Methylnaphthalene	36	36
SW8270	95-48-7	2-Methylphenol	930	930
SW8270	88-74-4	2-Nitroaniline	190	NS
SW8270	88-75-5	2-Nitrophenol	NS	NS
SW8270	91-94-1	3,3´-Dichlorobenzidine	0.13	1.3
SW8270	99-09-2	3-Nitroaniline	NS	NS
SW8270	534-52-1	4,6-Dinitro-2-methylphenol	1.5	NS
SW8270	101-55-3	4-Bromophenyl-phenylether	NS	NS
SW8270	59-50-7	4-Chloro-3-methylphenol	1400	NS
SW8270	106-47-8	4-Chloroaniline	0.37	3.7
SW8270	7005-72-3	4-Chlorophenyl-phenylether	NS	NS
SW8270	100-01-6	4-Nitroaniline	3.8	NS
SW8270	83-32-9	Acenaphthene	530	530
SW8270	208-96-8	Acenaphthylene	NS	260
SW8270	62-53-3	Aniline	13	NS
SW8270	120-12-7	Anthracene	1800	1800
SW8270	103-33-3	Azobenzene as 1,2- Diphenylhydrazine	0.12	NS
SW8270	56-55-3	Benzo(a)anthracene	0.03	0.3
SW8270	50-32-8	Benzo(a)pyrene	0.2	0.25
SW8270	205-99-2	Benzo(b)fluoranthene	0.25	2.5
SW8270	191-24-2	Benzo(g,h,i)perylene	NS	600
SW8270	207-08-9	Benzo(k)fluoranthene	2.5	25
SW8270	65-85-0	Benzoic acid	75000	75000
SW8270	100-51-6	Benzyl alcohol	2000	2000
SW8270	111-91-1	Bis(2-chloroethoxy)methane	59	NS
SW8270	111-44-4	Bis(2-chloroethyl)ether	0.014	0.14
SW8270	108-60-1	Bis(2-chloroisopropyl)ether	710	NS
SW8270	117-81-7	Bis(2-ethylhexyl)phthalate	6	56
SW8270	85-68-7	Butyl benzyl phthalate	16	160

Attachment C-2 Groundwater Screening Levels

METHOD	CAS NUMBER	ANALYTE	EPA RSL[1]	ADEC GROUNDWATER SL[2]
			(µg/L)	(µg/L)
SW8270	86-74-8	Carbazole	NS	NS
SW8270	218-01-9	Chrysene	25	250
SW8270	53-70-3	Dibenzo(a,h)anthracene	0.025	0.25
SW8270	132-64-9	Dibenzofuran	7.9	7.9
SW8270	84-66-2	Diethyl phthalate	15000	15000
SW8270	131-11-3	Dimethyl phthalate	NS	16000
SW8270	84-74-2	Di-n-butyl phthalate	900	900
SW8270	117-84-0	Di-n-octyl phthalate	200	200
SW8270	206-44-0	Fluoranthene	800	800
SW8270	86-73-7	Fluorene	290	290
SW8270	118-74-1	Hexachlorobenzene	1	0.098
SW8270	87-68-3	Hexachlorobutadiene	0.14	1.4
SW8270	77-47-4	Hexachlorocyclopentadiene	50	0.41
SW8270	67-72-1	Hexachloroethane	0.33	3.3
SW8270	193-39-5	Indeno(1,2,3-cd)pyrene	0.25	2.5
SW8270	78-59-1	Isophorone	78	780
SW8270	91-20-3	Naphthalene	0.12	1.7
SW8270	98-95-3	Nitrobenzene	0.14	1.4
SW8270	62-75-9	N-Nitrosodimethylamine	0.00011	0.0011
SW8270	621-64-7	N-Nitrosodi-n-propylamine	0.011	0.11
SW8270	86-30-6	N-Nitrosodiphenylamine	12	120
SW8270	87-86-5	Pentachlorophenol	1	0.41
SW8270	85-01-8	Phenanthrene	NS	170
SW8270	108-95-2	Phenol	5800	5800
SW8270	129-00-0	Pyrene	120	120
SW8270	110-86-1	Pyridine	20	NS

Notes:

[1] EPA RSL defined by EPA RSL Summary Table, (TR=1E-06, HQ=1) November 2023 MCL. When an MCL was not available the EPA RSL for resident tapwater was used.

[2] Groundwater Screening Levels (SL) are defined by 18 AAC 75, Table C Groundwater Cleanup Levels (ADEC 2023).

[3] Laboratory limits provided by SGS North America, Alaska

* The MCL for total trihalomethanes is presented.

Green fill – Most stringent SL

µg/L – micrograms per liter

AAC – Alaska Administrative Code

ADEC – Alaska Department of Environmental Conservation

CAS – Chemical Abstracts Service

DRO – diesel range organics

EPA – U.S. Environmental Protection Agency

GRO – gasoline range organics

MCL – maximum contaminant level

NS – no screening level

RRO – residual range organics

RSL – Regional Screening Level

SIM – selected ion monitoring

SL – groundwater screening level

Attachment C-3

Soil and Tank Rinsate IDW Screening Levels

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Attachment C-3 Soil and Tank Rinsate IDW Screening Levels

METHOD	CAS NUMBER	ANALYTE	EPA TCLP[1] (mg/L)
SW1311/SW6010D	7440-38-2	Arsenic	5
SW1311/SW6010D	7440-39-3	Barium	100
SW1311/SW6010D	7440-43-9	Cadmium	1
SW1311/SW6010D	7440-47-3	Chromium	5
SW1311/SW6010D	7439-92-1	Lead	5
SW1311/SW7470A	7439-97-6	Mercury	0.2
SW1311/SW6010D	7782-49-2	Selenium	1
SW1311/SW6010D	7440-22-4	Silver	5
SW1311/SW8260D	75-35-4	1,1-Dichloroethene	0.7
SW1311/SW8260D	107-06-2	1,2-Dichloroethane	0.5
SW1311/SW8260D	78-93-3	2-Butanone	200
SW1311/SW8260D	71-43-2	Benzene	0.5
SW1311/SW8260D	56-23-5	Carbon Tetrachloride	0.5
SW1311/SW8260D	108-90-7	Chlorobenzene	100
SW1311/SW8260D	67-66-3	Chloroform	6
SW1311/SW8260D	127-18-4	Tetrachloroethene	0.7
SW1311/SW8260D	79-01-6	Trichloroethene	0.5
SW1311/SW8260D	75-01-4	Vinyl Chloride	0.2
SW1311/SW8270E	106-46-7	1,4-Dichlorobenzene	7.5
SW1311/SW8270E	95-95-4	2,4,5-Trichlorophenol	400
SW1311/SW8270E	88-06-2	2,4,6-Trichlorophenol	2
SW1311/SW8270E	121-14-2	2,4-Dinitrotoluene	0.13
SW1311/SW8270E	95-48-7	2-Methylphenol	200
SW1311/SW8270E	NS	3&4-Methylphenol	200
SW1311/SW8270E	87-68-3	Hexachlorobutadiene	0.5
SW1311/SW8270E	118-74-1	Hexachlorobenzene	0.13
SW1311/SW8270E	67-72-1	Hexachloroethane	3
SW1311/SW8270E	98-95-3	Nitrobenzene	2
SW1311/SW8270E	87-86-5	Pentachlorophenol	100
SW1311/SW8270E	110-86-1	Pyridine	5
SW1010A	N/A	Flashpoint	140°F

METHOD	CAS NUMBER	ANALYTE	TSCA[2] (mg/kg)
SW8082A	12674-11-2	Aroclor 1016	50
SW8082A	11104-28-2	Aroclor 1221	50
SW8082A	11141-16-5	Aroclor 1232	50
SW8082A	53469-21-9	Aroclor 1242	50
SW8082A	12672-29-6	Aroclor 1248	50
SW8082A	11097-69-1	Aroclor 1254	50
SW8082A	11096-82-5	Aroclor 1260	50
SW8082A	37324-23-5	Aroclor 1262	50
SW8082A	11100-14-4	Aroclor 1268	50
SW8082A	1336-36-3	Total PCB	50

Notes:

[1] EPA MCL for toxicity characteristic per 40 CFR § 261.24.

[2] EPA TSCA maximum concentration for PCBs.

µg/L – micrograms per liter
°F – degrees Fahrenheit
CAS – Chemical Abstracts Service
CFR – Code of Federal Regulations
EPA – U.S. Environmental Protection Agency
IDW – investigation-derived waste
MCL – maximum contaminant level
mg/kg – milligrams per kilogram
mg/L – milligrams per liter
PCB – polychlorinated biphenyl
TCLP – toxicity characteristic leaching procedure
TSCA – Toxic Substances Control Act

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Attachment C-4

Field Standard Operating Procedures

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STANDARD OPERATING PROCEDURE

BE-SOP-01

Logbook Documentation and Field Notes

1.0 SCOPE AND PURPOSE

This Standard Operating Procedure (SOP) describes the criteria for the content and format of field logbooks and data sheets. This SOP should be used to direct field personnel in the requirements for recording information in logbooks to ensure that field activities are properly documented.

Adequate documentation is necessary to describe the work performed. Attention to detail is vital as field logbooks are useful in the reporting process as well as in administrative and judicial proceedings. As a result, it is important that documentation be factual, complete, accurate, consistent, and clear.

2.0 PERSONNEL RESPONSIBILITIES

All site personnel who make logbook entries are responsible for maintaining the required documentation. The Field Team Lead will inform personnel as to who will be responsible for field notebook and form entries, care, and maintenance.

3.0 FIELD NOTEBOOK PROCEDURE

Field logbooks are bound, sequentially paginated, weatherproof notebooks used to record daily field activities. All notes will be entered in permanent ink.

3.1 Front Cover

The front cover of each logbook must include the following information:

- Project name and Site ID
- Project Month(s) and Year
- Name(s) of field logbook author(s)

3.2 Project Contact Information

Include project contact information on the inside front cover or first page of the logbook. Contact information includes names and phone numbers of subcontractors, project assistants, field team members, and emergency numbers from the Accident Prevention Plan and/or Site-Specific Health and Safety Plan.

3.3 Daily Entries

Logbook entries should abide by the following guidelines:

- Pages should never be removed from the logbook.
- All information must be printed legibly and in permanent ink.

- Entries should be written using objective and factual language and should be made in chronological order.
- Entries will be made on subsequent lines such that no blank lines exist on any page.
- If any space remains on the bottom of the last page of field entries at the conclusion of the day's entries, a diagonal line will be drawn and signed to obscure any additional entries on that page.
- If corrections are necessary, a single line may be drawn through the original entry. The corrected information may then be added and should be initialized and dated.

Each logbook page should include the following:

- Job name or number, date, and personnel at the top of each page.
- Date and signature at the bottom of each page, with a line through any remaining blank lines.

The daily standard logbook entries will include the following:

- The project name, Site ID, and date
- Daily objectives
- Relevant weather conditions and changing weather that may impact site conditions
- Full names and affiliations of onsite personnel and visitors including time of arrival and departure from the site
- Date and time of each activity (including work start/stop times); time will be based on the 24-hour clock (i.e., 2100 instead of 9 pm)
- Location of activity
- Pertinent observations and comments
- Level of Personal Protective Equipment
- Field measurements and screening results not included on field data sheets
- Daily equipment calibrations, checks, and maintenance not included on field data sheets
- Deviations from the project-specific Work Plan
- Site sketches with reference to north direction (with approximate scale or "not to scale" noted), sample and field screening locations and depths, and onsite groundwater flow direction (if known)
- Survey and/or location of any sampling points, including swing-tie measurements
- A description of each sample collected including date, time, sampler(s), sample ID, media, sample location, sample depth below ground surface, and whether any associated quality control (dup/MS/MSD) samples were collected. If not recorded on field data sheets, container(s), preservatives, and analyses will also be recorded
- Sample shipments (when, what, destination)
- Waste tracking and inspections (accumulation start, quantities, staging area and containers conditions, and transporter and destination, if applicable)
- References to relevant data sheets and documentation preserved outside of the logbook such as groundwater sampling data sheets, soil boring logs, and calibration logs. Do not duplicate information from the referenced sheets in the logbook

- Decontamination times and methods
- Daily summary of activities (e.g., number of samples collected)
- Date and signature at the end of each daily entry, with a line through any remaining blank lines at the bottom of the final page of the day

Correct erroneous logbook entries with a single line through the error. Do not erase incorrect information. Date and initial revised entries.

3.4 Field Data Sheets

All other supportive unbound data documentation that is a part of the field records should be maintained as part of the field forms. These records should be recorded in weatherproof ink and on weatherproof paper as necessary. Once back into the office, the unbound records will be scanned to create an electronic record to ensure document preservation. Correct erroneous data sheet entries with a single line through the error. Do not erase incorrect information. Date and initial revised entries.

3.5 Electronic Data Sheets

Electronic data documents include photographs, Global Positioning System (GPS), and survey data, etc. All electronic data that are part of the field records will be downloaded to a designated location and maintained for project use. Take care when downloading, storing, and managing data. Naming conventions (according to the project-specific work plan) should be used to indicate the project, date, and other relevant information to ensure accurate use.

3.6 Document Control

At the conclusion of a task or project, all field documentation should be submitted to the Project Administrator for record retention. All original documents should be kept in the project file.

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STANDARD OPERATING PROCEDURE

BE-SOP-02

Sample Chain-of-Custody

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) describes the guidelines for sample handling and custody and has been generated in accordance with the Alaska Department of Environmental Conservation (ADEC) *Field Sampling Guidance* (January 2022). This SOP will be used to direct field personnel in sample chain-of-custody (CoC) management. The purpose of the CoC is to demonstrate accountability and document sample integrity from the time of sample collection until sample analysis by the laboratory.

2.0 CHAIN-OF-CUSTODY ELEMENTS

The elements of a CoC include the following:

- Sample labels
- Laboratory receipt forms
- Field custody forms (CoC form)
- Custody seals
- Inter-laboratory transfer documentation, if applicable

3.0 SAMPLE HANDLING PROCEDURE

The following sections describe sample CoC documentation, field custody procedures, sample packaging, custody seals, transfer of custody, and laboratory custody procedures.

3.1 Sample Chain-of-Custody Documentation

Sample identification documents are carefully prepared so that sample identification and CoC are maintained. Sample identification documents include the field logbook, sample labels, custody seals, and CoC records.

A sample is in custody if it meets one of the following conditions:

- In an authorized person’s physical possession.
- In an authorized person’s view after being in possession.
- In an authorized person’s possession and then secured (locked up).
- Kept in a secured area that is restricted to authorized personnel.

3.2 Field Custody Procedures

The following procedures are used by field personnel:

- The sample collector is personally responsible for the care and custody of samples collected until they are properly transferred to another company representative or relinquished to the laboratory.

- The sample collector records sample data (time of collection, sample number, analytical requirements, and matrix) in the field logbook and/or on the appropriate field form.
- Sample labels are completed for each sample, using weatherproof ink.

3.3 Chain-of-Custody Record

The CoC record is fully completed prior to sample shipment. When possible, an electronic CoC record should be used. Required information on the CoC includes the following:

- Client (contractor name)
- Reporting Information (Chemist name and contact information)
- Project Name
- Invoice information
- PO Number
- CoC number
- Cooler ID
- Page number
- North Pacific Division Laboratory (NPDL) number
- Field Sample ID
- Location ID
- Collection date
- Collection time (in 24-hour format)
- Sampler initials
- Quantity (number of containers)
- Container types (volatile organic analysis [VOA], amber, 40 mL, etc.)
- Container volumes
- Preservative
- Sample matrix (soil, water, other)
- Requested laboratory analysis methods required for each jar
- Quality control (trip blanks and MS/MSD)
- Turn-around-time (TAT)
- Notes
- Special instructions

3.4 Sample Packaging

Samples are labeled and packaged according to the Labeling, Packaging, and Shipping Samples SOP (BE-SOP-03). The CoC record accompanies all sample shipments. Two CoC records are prepared for each shipment. One CoC record is placed in a re-sealable plastic bag with the bag sealed shut to prevent water intrusion from moisture in the cooler, and the bag is taped inside the cooler lid. The duplicate or electronic copy of the CoC record is retained by the sampler and provided to the Project Chemist and other sample coordinators. Airway bills are retained with the CoC record and provided to the Project Chemist, so sample pickup can be coordinated with the laboratory. Airway bills must be scanned and placed in a designated location, typically the “Field” folder, and maintained for project use.

3.5 Custody Seals

Custody seals are preprinted, adhesive-backed seals with security slots designed to break if the seals are disturbed. Seals are signed and dated at the time of use. Sample shipping containers (coolers) are sealed in as many places as necessary to ensure that the container cannot be opened without tearing the custody seals. Typically, one custody seal is placed along the front corner of the cooler, and a second is placed along the opposite back corner of the cooler. Clear tape is placed over the seals to ensure that seals are not accidentally broken during shipment. If the custody seal was broken at some point during transport, the reason for breaking the seal, condition of the container contents, the cooler temperature, and anything added to or removed from the container must be documented on the CoC form. The container must then be sealed with a new custody seal.

If a sample handler transports the samples to the laboratory without sample shipment, custody seals are not required but are recommended.

3.6 Transfer of Custody

When transferring the possession of samples from the field sampler to a transporter or to the laboratory, the sampler must sign, date, and note the time as “relinquished by” on the CoC record. The receiver also signs, dates, and notes the time as “received by” on the CoC record; however, when samples are transported by a common commercial carrier, such as Alaska Airlines or Federal Express, the carrier does not sign the CoC record; rather, the CoC record is signed by the sampler as “relinquished by” prior to closing the sample coolers for shipment and relinquishing them to the commercial carrier.

3.7 Laboratory Custody Procedures

A designated sample custodian accepts custody of the shipped samples and verifies that the sample identification number matches the CoC record. The laboratory completes a cooler receipt form when samples are received. The cooler receipt form documents any discrepancies identified between the sample labels and CoC, cooler temperature(s), sample preservation, and sample integrity. Cooler receipt information, including a signed CoC, custody seals, and a completed cooler receipt form, are provided to the Project Chemist within 24 hours of cooler receipt.

4.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC). 2022. *Field Sampling Guidance*. January.

ATTACHMENTS

Chain-of-Custody Form

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Brice

3700 Centerpoint Drive, Suite 800, Anchorage, AK 99503
Report to:
Phone:
Email:

Invoicing:	Accounts Payable
Address:	5015 Business Park Blvd., #3000, Anchorage, AK 99503
Email:	accountspayable@calistacorp.com
PO/WO:	
Project #:	NPDL WO#

TAT:
☐ Rush
☐ Stndrd

Lab #	Sample ID	Date	Time	Sampler	Matrix	# Cont	MS/MSD												Location ID

Deliverables:

Relinquished by (sign) Date/Time Received by (sign) Date/Time
Printed Name: Printed Name:

Relinquished by (sign) Date/Time Received by (sign) Date/Time
Printed Name: Printed Name:

Relinquished by (sign) Date/Time Received by (sign) Date/Time
Printed Name: Printed Name:

STANDARD OPERATING PROCEDURE

BE-SOP-03

Labeling, Packaging, and Shipping Samples

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) will be used to direct field personnel in the techniques and requirements for labeling, packaging, and shipping samples from the field to the laboratory for analysis.

2.0 MATERIALS

The term "environmental sample" refers to any sample that has less than reportable quantities of any hazardous constituents according to U.S. Department of Transportation (DOT) 49 Code of Federal Regulations Section 172. Equipment required for labeling, packaging, and shipping environmental samples includes:

- Weatherproof labels for sample containers
- Coolers
- Gel ice packs
- Sorbent pads
- Contractor-grade plastic bags
- Bubble wrap and/or foam inserts
- Plastic zip-top bags, quart and gallon
- Clear tape
- Strapping tape
- Cooler labels: "Keep Cool/Refrigerate/Do Not Freeze," "This End Up," "Fragile," dangerous goods, excepted quantities, shipping address, etc.

3.0 PROCEDURES

This section describes the procedures for labeling, packaging, and shipping collected samples.

3.1 Labeling

Samples must be labeled using nomenclature defined in the project-specific work plan. All sample labels must be weatherproof and contain the following information:

- Project or project number
- Sampler name or initials
- Sample identification
- Sample date and time (in 24-hour format)
- Laboratory analysis methods required for sample jar
- Preservatives added to sample jar

Adhesive sample labels are placed directly on the sample containers. If the labels do not adequately adhere due to moisture, secure the label by placing clear packaging tape over the label. Sample containers that are weighed by the laboratory prior to use **should not** have any additional labels or tape placed on the container as it affects the weight. For those containers, use the label that is already provided on the jar. Only one label should be placed on each sample container.

3.2 Packaging

When packing sample containers for shipment, the steps below must be followed.

1. Choose a cooler with structural integrity to withstand shipment. Secure and tape the drain plug with duct tape.
2. Be sure that container lids are tight and will not leak. Make sure not to over-tighten and/or break the cap.
3. Ensure that the sample labels are intact, fully completed with the correct information, and that the sample identification exactly matches the chain-of-custody (CoC)record.
4. Place sample containers in bubble wrap, bubble bags, in their original boxes, or in re-sealable bags with sorbent pads, depending on the type of container. Wrap and package containers sufficiently to prevent cross contamination and ensure that containers remain intact during shipment (bubble wrap and plastic zip-top bags).
5. Place a layer of frozen gel ice packs, along the bottom of the cooler. Cover the ice packs with a layer of bubble wrap and then place a sorbent pad over the bubble wrap.
6. Line the cooler with a contractor-grade plastic bag.
7. Place the containers inside the contractor-grade plastic bag with caps up.
8. Ensure that a temperature blank is included in each cooler. The temperature blank should be placed at the same level and next to the samples, preferably in the center of the cooler.
9. If the cooler contains volatile samples, ensure that a trip blank is included.
10. Fill excess space between sample containers with additional bubble wrap or gel ice.
11. Tape the top of the contractor-grade plastic bag shut once all sample containers, trip blanks, and the temp blank are inside.
12. Place another layer of bubble wrap along the top of the cooler, and if possible, place a layer of gel ice packs along the top of the cooler. **Use sufficient ice in packaging to ensure that samples are received by the laboratory at the proper temperature of 0 to 6 degrees Celsius. Note that partially melted or soft gel ice packs should not be used to pack coolers for transport. A minimum of 8 frozen gel ice packs should be used to maintain sample temperature during transit for 24 hours.**
13. Fill remaining headspace with additional packing material.
14. Place the completed CoC record for the laboratory and a Brice Cooler Receipt Form into a plastic zip-top bag, tape the bag to the inner side of the cooler’s lid, and then close the cooler.
15. Conduct a “shake test” by gently shaking the cooler to determine if the containers are shifting in the cooler. If so, add additional packing material until there are no sounds of shifting when shaken.

16. Wrap strapping tape around each end of the cooler two times to secure the lid. Place completed custody seals on the front and back of the cooler so that the cooler cannot be opened without breaking the seals. Place clear tape over custody seals.
17. Attach an address label containing the name and address of the shipper to the top of the cooler. Attach other markings such as “Refrigerate” or “Keep Cool,” “Do Not Freeze,” and “Fragile.” For samples with liquid (including preserved soil samples), place “up arrow” stickers on opposite sides of the cooler pointing in the same direction as the containers containing liquids.

3.3 Sample Shipping

Environmental samples are shipped as non-hazardous materials unless the samples meet the established DOT criteria for a “hazardous material” or the International Air Transport Association (IATA)/International Civil Aviation Organization (ICAO) air definition of “Dangerous Goods.” If the samples meet criteria for hazardous materials or dangerous goods, then DOT and IATA/ICAO regulations must be followed, which includes having qualified personnel send shipments.

Samples shipped as “Dangerous Goods in Excepted Quantities” must have the appropriate labeling and be declared as dangerous goods to the shipping carrier; however, a dangerous goods “candy-striped” form and Notification to Caption are not required (IATA 2020).

3.3.1 Soil Sample Shipments

Soil samples preserved with methanol, and any excess methanol vials, must be shipped as “Dangerous Goods in Excepted Quantities” per the IATA regulations. The volume for excepted quantities of methanol is 30 milliliters (mL) per container and 500 mL per cooler. The hazard class number is 3, flammable liquid, UN 1230. Sample jars with methanol in excess of 30 mL and coolers with methanol in excess of 500 mL require shipment as “Dangerous Goods” and require the completion of a “candy-striped” form.

3.3.2 Water Sample Shipments

Water samples preserved with hydrochloric acid or other insignificant amounts of preservative are not shipped as dangerous goods once filled; however, pre-preserved sample containers with preservative and no water added must be shipped as “Dangerous Goods in Excepted Quantities” per IATA regulations. The volume for excepted quantities of hydrochloric acid or nitric acid is 30 mL per container and 500 mL per cooler, respectively. The hazard class number is 8, corrosive. Sample jars with hydrochloric acid or nitric acid in excess of 30 mL and coolers with hydrochloric acid or nitric acid in excess of 500 mL require shipment as “Dangerous Goods” and require the completion of a “candy-striped” form.

Upon shipping samples, notify the laboratory contact that samples have been shipped and provide the airway bill number.

4.0 REFERENCES

International Air Transport Association (IATA). 2020. *Dangerous Goods Regulations (DGR) Limited/ Excepted Quantities Labels.* 61st Edition. January.

ATTACHMENTS

Brice Cooler Receipt Form

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COOLER RECEIPT FORM
(ONE PER COOLER)

Please email this form and the completed CoC records to the Brice Project Chemist within 24 hours of sample receipt.

COC Number ______________________________
Cooler Number/Name on COC ______________________________
Temperature (temp blank, °C) ______________________________
Temperature (cooler, °C) ______________________________
Thermometer type/ID ______________________________
Laboratory/Location ______________________________
Laboratory SDG ______________________________

			Circle:	
1.	Were custody seals present? **Yes** **No** If no, were samples hand del?		**Yes**	**No**
	If yes, how many and where? Front __________ Back __________ Intact?		**Yes**	**No**
	Signature/date present on custody seals?		**Yes**	**No**
2.	Were custody papers taped to lid inside cooler?		**Yes**	**No**
3.	Were custody papers properly filled out (ink, signed, etc.)?		**Yes**	**No**
4.	Custody forms signed/dated and properly accepted/relinquished?		**Yes**	**No**
5.	Has the shipper/tracking number been documented on the paperwork?		**Yes**	**No**
6.	Was sufficient ice used (if appropriate)?	**N/A**	**Yes**	**No**
	Type used: ☐ Wet ☐ Gel Still frozen? **Yes** **No**			
7.	Were all samples/bottles sealed in separate plastic bags?	**N/A**	**Yes**	**No**
8.	Did all bottles arrive in good condition? (intact, not leaking, etc.)		**Yes**	**No**
9.	Were all bottle labels complete (sample ID, date, analysis, preservative, etc.) ?		**Yes**	**No**
10.	Did all bottle labels agree with the custody papers?		**Yes**	**No**
11.	Were the appropriate containers used for the analyses?		**Yes**	**No**
12.	Are all VOA vials free of headspace > 6mm in diameter?	**N/A**	**Yes**	**No**
	If no, note samples and number of vials affected below.			
	If no, are there vials without headspace to perform the analysis?	**N/A**	**Yes**	**No**
13.	Was sufficient volume sent in each bottle to perform analysis?	**N/A**	**Yes**	**No**
14.	If there are volatiles present, is there a trip blank present in this cooler?	**N/A**	**Yes**	**No**
15.	Is the temperature within 0-6°C?	**N/A**	**Yes**	**No**
16.	Were labels correctly associated with pre-tared containers (not placed directly on jars for methanol-preserved volatiles)?	**N/A**	**Yes**	**No**
17.	Were non-volatile sample checked for appropriate preservation?	**N/A**	**Yes**	**No**
18.	Were methanol-preserved soil containers accompanied by an unpreserved aliquot for percent moisture content?	**N/A**	**Yes**	**No**
	(If checked at the bench, include prep logs or narrative with final report.)			

Explain any discrepancies/deficiencies (attach additional sheets if required).

If discrepancies/deficiencies are noted, was the Brice chemist contacted*?

Chemist: ____________________ Date/Time: ________________ Contact Method: phone email

Email or phone notes should be included with final report, if applicable, or at a minimum documented in the case narrative.

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STANDARD OPERATING PROCEDURE

BE-SOP-04

Quality Control Samples

1.0 INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to direct field personnel in the requirements necessary for collecting field quality control (QC) samples from certain matrixes. Field QC samples are collected to ensure the reliability and validity of field and laboratory data.

2.0 SAMPLING PROCEDURE

The following sections describe different QC sample types that may be required in project-specific work plans.

2.1 Field Duplicate

A field duplicate is collected to evaluate whether sample matrix heterogeneity, contaminant distribution, or sample collection methods affect analytical precision. The field sampler ensures that primary and duplicate samples are effectively identical by collecting the samples from the same location, at the same time, with the same techniques, and from the same matrix. Non-volatile samples should be homogenized in a metal bowl or sealable zip-top bag prior to sample collection. Volatile samples should not be homogenized to minimize loss of volatile constituents; however, an effort should be made to collect samples from the same matrix and part of the sample interval.

At a minimum, 1 blind field duplicate should be collected per day and per 10 samples for each analytical method and matrix for offsite laboratory analysis. In some cases, such as when only 1 monitoring well per day can be sampled because of low yielding groundwater, it is not feasible to achieve the 1 field duplicate per day requirement. If anticipated prior to conducting project work, these site-specific deviations should be included in the site-specific work plan. If multiple sample coolers are shipped together, an effort should be made during sample packaging to include a duplicate in each cooler.

Field duplicates are submitted as blind samples with a unique sample number and collection time to the approved laboratory for analysis (Alaska Department of Environmental Conservation [ADEC] 2022). A duplicate sample collection time of one hour before the primary sample time is recommended to ensure there are no holding time issues.

2.2 Matrix Spike and Matrix Spike Duplicate

Matrix spike and matrix spike duplicate (MS/MSD) samples are collected to evaluate the precision and accuracy of laboratory procedures in the project sample matrix. The MS/MSD compound is added at the laboratory. This sample is collected at the same time as the primary sample using the same procedure, equipment, and type of container. The MS/MSD sample should be labeled the same as the primary sample with a matching sample identification and time denoted on the chain-of-custody (CoC) form to ensure that the project MS/MSD pair is used in the laboratory report. The MS/MSD should be noted in the QC column of the CoC. At a minimum, the frequency of MS/MSD samples collected is one for each analytical batch. Note that the analytical laboratory often batches samples in the same cooler together for shipments containing multiple coolers, so an effort should be made during sample packaging to include an MS/MSD in each cooler. The MS/MSD evaluation process is specified in the Quality Assurance Project Plan (QAPP).

2.3 Temperature Blank

A temperature blank must be included in each sample cooler. A temperature blank is measured by the laboratory to verify and document that the cooler temperature is received between 0 and 6 degrees Celsius. Temperature blanks consist of plastic bottles filled with water, typically prepared by the laboratory. Once shipments are received by the laboratory, the temperature is recorded on the CoC to document that preservation requirements were met.

2.4 Trip Blanks

Trip blanks must accompany volatile samples, including gasoline range organics (GRO), benzene, toluene, ethylbenzene, and total xylenes (BTEX), and volatile organic compounds (VOCs). Trip blanks are prepared by the laboratory and are used to establish that the sample has not been contaminated by external sources during sample bottle transport to and from the field. Trip blanks are samples of reagent-grade water, properly preserved in a controlled environment by the laboratory prior to field mobilization. Trip blanks are kept with the sample containers throughout the sampling process and returned to the laboratory with the analytical samples. One trip blank must accompany each cooler containing volatile samples. All trip blanks must be labeled and included on the CoC. Trip blank sample times will be recorded as 0800 on the CoC. The trip blank evaluation process is specified in the QAPP.

2.5 Equipment Blanks

Equipment blanks may be used to evaluate the effectiveness of a decontamination procedure. The equipment rinsate blank is collected by pouring or pumping deionized water onto or into the sampling equipment after the equipment has been decontaminated, and then collecting the rinsate water for analysis of an analytical suite identical to that performed for the associated sample(s). The required equipment rinsate blank collection frequency and evaluation process are specified in the QAPP. Decontamination procedures must be performed according to the Equipment Decontamination SOP (BE-SOP-14).

3.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC). 2022. *Field Sampling Guidance*. January.

STANDARD OPERATING PROCEDURE

BE-SOP-05

Soil Logging

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) describes a standard process for classifying and logging soils recovered using a drill rig or other mechanized equipment.

2.0 MATERIALS

Field materials include, but are not limited to the following:

- Clipboard
- Description aids (Munsell color and Unified Soil Classification charts)
- Soil Boring Logs
- Permanent ink pen
- Plastic folding table
- Core cutter with extra blades
- Tape measure
- Duct tape
- White board with erasable markers
- Camera
- Nitrile gloves
- Hand tools (trowels, spoons, rock hammer, etc.)
- Hand broom and dustpan
- 5-gallon bucket

3.0 PROCEDURES

Soil lithology will be determined and documented in general accordance with standards established by the Unified Soil Classification System (USCS), as described in ASTM International (ASTM) Method D2488 (Attachment 1). In general, the process involves visual observation of the soils and documentation on soil boring logs (Attachment 2). All fields on the soil boring log will be used or an “N/A” will be inserted to indicate a field that is not applicable.

3.1 Photograph

Upon opening the Macro-core, dual tube, or split spoon sampler, photograph the sampler. Ensure that the tape measure indicating sample recovery is visible in the photograph. Use a whiteboard with erasable markers to indicate important information about each sample, including:

- LocID
- Depth range

- Top and bottom of sample
- Date

3.2 Soil Boring Log

General information included on each soil boring log must include:

- Project
- Project number
- Client
- Boring No.
- Address, city, and state
- Drilling contracting
- Drill crew
- Logged by
- The start, completion, and backfill date and method
- Drilling method and equipment used, including borehole dimeter
- Groundwater depth
- Elevation
- Total depth of boring

Specific information included on each log must include:

- Sample interval
- Inches driven
- Inches recovered
- Photoionization detector (parts per million)
- Time
- Soil description (soil name, USCS group symbol, color, relative density or consistency, plasticity (silt and clay only), moisture content, secondary grain size, odor, additional facts)
- Sample information (sample ID, time, analytes, number and type of containers, preservatives, quality control – Duplicate or matrix spike/matrix spike duplicate, for volatile containers tare weights and total container weights, methanol lot numbers)
- Blow counts for split spoon sampling (the number of hammer blows to push the split spoon 6, 12, 18, and 24 inches)
- Total boring depth or refusal depth

3.3 Soil Description

Since samples are collected mostly for environmental sampling and contaminant characterization purposes, strict adherence to the USCS may not be required, unless specified in the project-specific Work Plan. The following characteristics should be described in the soil description.

3.3.1 Soil Name and USCS Group Symbol

The first step in soil logging is determining if the soil is primarily coarse-grained or fine-grained. Coarse-grained deposits consist of gravel and sand, while fine-grained deposits consist of silt and clay. For coarse-grained deposits, the second step is determining the sand to gravel ratio. Sand particle sizes are classified as fine (0.07 millimeters [mm] to 0.43 mm), medium (0.43 mm to 2.0 mm), and coarse (2.0 mm to 5.0 mm). Gravel is defined as fine (0.5 centimeters [cm] to 1.9 cm) and coarse (1.9 cm to 7.6 cm). Once the ratio of sand and gravel is determined, the estimated percentages are used to select a soil name and USCS group symbol using the USCS classification system chart (refer to Attachment 1). For fine-grained deposits, the plasticity must be evaluated before selecting a soil name and USCS group symbol. Silts range from non-plastic to low plasticity, lean clay ranges from low plasticity to medium plasticity, and fat clay is high plasticity.

3.3.2 Color

Color is important in identifying organic soils and materials from similar geologic units. The material's representative color and any layers with different colors should be described on the soil boring log.

3.3.3 Relative Density or Consistency

Density is used to describe coarse-grained deposits (sand and gravel). Soil density is described by the following criteria:

- Very loose
- Loose
- Medium dense
- Dense
- Very dense

Consistency is used to describe fine-grained deposits (silt and clay). Soil consistency is described using the following criteria:

- Very soft – thumb will penetrate more than 1-inch
- Soft – thumb will penetrate soil approximately 1-inch
- Medium – thumb will indent soil approximately 0.5-inch
- Stiff – thumb will indent soil approximately 0.25-inch
- Very stiff – thumb will indent soil approximately 0.125-inch
- Hard – thumb will not indent soil but can be indented by thumbnail

3.3.4 Plasticity

Plasticity is a characteristic of fine-grained soils (silt and clay). Soil that passes through a No. 200 sieve and is non-plastic or low plasticity is silt. Soil that passes through a No. 200 sieve, is plastic over a range of water contents, and has strength when dry is clay. Plasticity should be classified according to the following criteria:

- Non-plastic – A 3 mm or 0.125-inch thread cannot be rolled at any water content
- Low – thread can barely be rolled
- Medium – thread is easy to roll to the plastic limit, but the thread cannot be rerolled
- High – takes a long time rolling to reach plastic limit and the thread can be rerolled multiple times

3.3.5 Moisture Content

The relative soil moisture content is important for determining water table depth and if zones of perched water are present. Soil moisture is described by the following terminology:

- Dry – moisture absent, dusty, dry to the touch
- Moist – damp but no visible water
- Wet – visible water (usually soil below water table)

3.3.6 Secondary and Tertiary Components

The estimated percentages of secondary and tertiary soil components are described using the following terminology:

- Trace less than 5 percent (%)
- Little 6% to 15%
- Few 16% to 30%
- Some 31% to 49%

3.3.7 Odor

Note any odors observed, including organic or unusual odors (petroleum hydrocarbon).

3.3.8 Additional Descriptors

Note any unusual characteristics, such as the presence of roots and debris. Other descriptors that are commonly used follow.

3.3.9 Angularity

Angularity is used to describe coarse-grained soils only (coarse sand, gravel, cobbles, and boulders). The following descriptors are used to describe angularity:

- Angular – sharp edges and plane sides
- Subangular – similar to angular got with rounded edges
- Subrounded – have plane sides with well-rounded corners sand edges
- Rounded – particles have smooth sides and no edges

3.3.10 Lensed

The lensed descriptor indicates that the soil includes small pockets of different soils.

3.3.11 Stratified

The stratified descriptor indicates that there are alternating layers of different materials or colors.

3.4 Examples

- Poorly graded sand with gravel (SP), fine sand, brown, loose, moist, few gravel
- Well graded sand with gravel (SW), fine to coarse sand, gray, medium dense, wet, some gravel
- Poorly graded gravel with sand (GP), subrounded fine gravel, gray, dense, moist, few sand
- Silty sand (SM), fine to medium sand, brown, loose

- Sandy silt (ML), gray, stiff, moist, trace subangular gravel, slight petroleum odor
- Silt (ML), brown, medium, moist, trace fine sand

4.0 REFERENCES

ASTM International (ASTM). 2017. *Standard Practice for Description and Identification of Soils Visual-Manual Procedure.* D2488. West Conshocken, Pennsylvania. July.

ATTACHMENTS

Attachment 1	Standard Terminology for Soil Descriptions
Attachment 2	Soil Boring Log

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Standard Terminology for Soil Descriptions

SOIL DESCRIPTION FORMAT

USCS SOIL NAME: angularity (coarse sand or greater), soil description (order of abundance), cobbles and boulders, *Munsell color (optional),* color, density, moisture, *odor strength and type (optional*), *structure (optional), other comments (optional*), USCS symbol, *geologic environment (optional).*

EXAMPLES

WELL-GRADED GRAVELLY SAND: angular coarse sand, some gravel, trace silt/clay, 3-5 inch cobbles, 5Y 3/1 gray, very dense, moist, no odor, lensed, with trace fine organics and fine roots, SW, (GLACIAL TILL).

POORLY GRADED GRAVEL: angular fine gravel, some silt/clay, trace sand, 12-18 inch boulders, gray, dense, dry, weak petroleum odor, homogenous, GP.

SILT WITH SAND: silt, with fine to coarse sand, trace gravel, 5Y 3/1, gray, medium dense, wet, ML.

SILT/CLAY: silt, trace sand and gravel, tan, moderate organic odor, hard, wet, laminated, fine organics and roots, ML-CL, (LACUSTRINE).

NOTES:

- Descriptions are in general accordance with ASTM D2488, moisture content and particle abundance descriptors have been modified from the ASTM specification.
- Descriptions may include but are not limited to the information described in this procedure.
- Abundances of gravel, sand, and silt are estimated visually; sieve analysis is not performed typically.
- Blows should be counted when possible (e.g., pounding a split spoon on an auger or mud-rotary drill rig), but direct-push drill rigs typically lack a 140-pound hammer.

PARTICLE ABUNDANCE

Descriptor	Criteria
Some	> 30%
With	15-30%
Little	5-15%
Trace	<5%

Notes: Boulders and cobbles should be listed as present with the range of size in inches.

GRAIN SIZES

Component	Particle Size
Boulders	>12 inches (30cm)
Cobbles	12 to 3 inches (30 to 7.6 cm)
Gravel	3 inch to #4 sieve (75 to 4.75 mm)
Sand	#4 to #200 sieve (4.75 to 0.075 mm)
Silt/Clay	<#200 sieve(<0.075mm)

MOISTURE CONTENT

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Damp	Slight amount of water
Moist	No visible water, sand will hold together
Wet	Visible free water with effort, glistens
Saturated	Pore space filled (below water table)

SAND AND GRAVEL SIZE

Description	Sand Range	Gravel Range
Fine	0.07 to 0.43 mm	0.5 to 1.9 cm
Medium (Sand Only)	0.43 to 2 mm	N/A
Coarse	2 to 5 mm	1.9 to 7.6 cm

Notes: Boulders and cobbles should be listed as present with the range of size in inches.

RELATIVE DENSITY

Fine-Grained Soil		Coarse-Grained Soil	
Density	**N-Value**	**Density**	**N-Value**
Very Soft	0 to 1	Very Loose	0 to 3
Soft	2 to 4	Loose	4 to 9
Medium Stiff	5 to 8	Medium Dense	10 to 29
Stiff	9 to 15		
Very Stiff	16 to 30	Dense	30 to 49
Hard	>30	Very Dense	>50

Notes: N-Value (Standard Penetration or Blow Count) is considered the number of blows to advance a 2-inch O.D. split-spoon sampler the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches (ASTM D1586). Any variation should be noted. If no blow counts are measured, density should be estimated.

SIMPLIFIED USCS CLASSIFICATION SYSTEMS

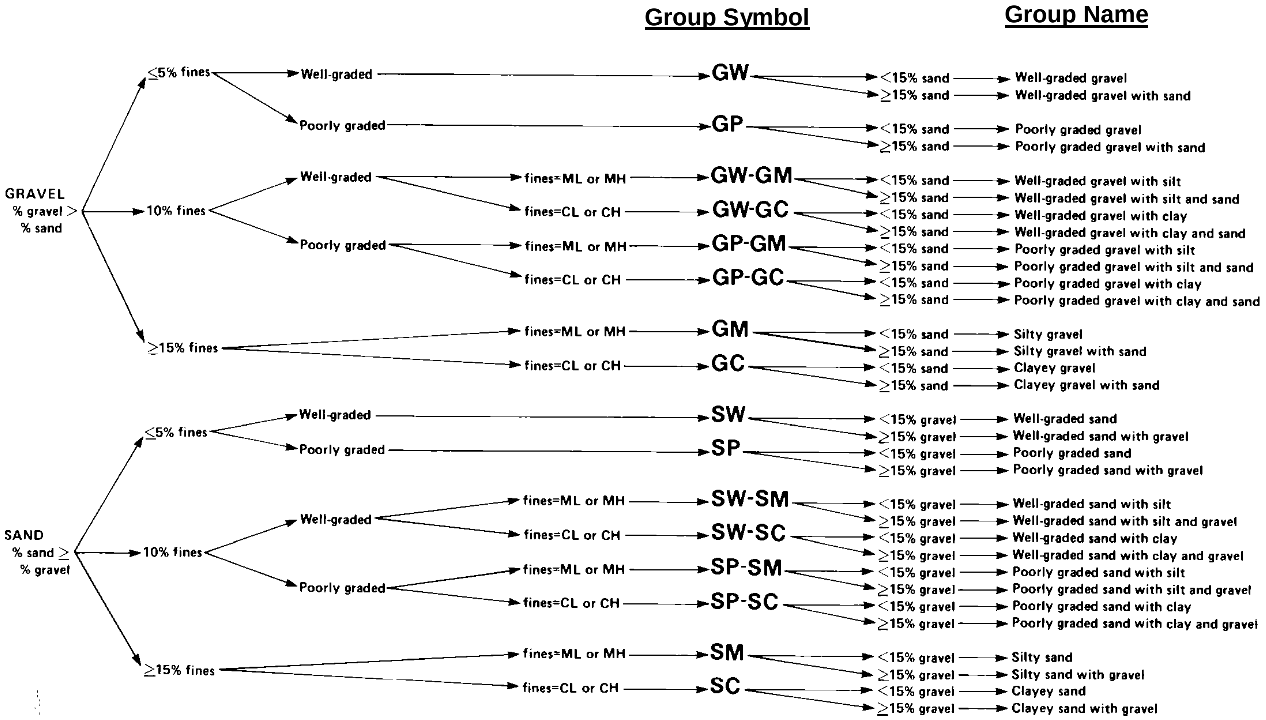
COARSE-GRAINED SOILS <50% passes #200 sieve	GRAVEL <50% coarse fraction passes #4 sieve	GRAVEL <5% pass the #200 sieve	GW	Well-graded gravel, gravel-sand mixture, little or no fines
			GP	Poorly-graded gravel, gravel-sand mixtures, little or no fines
		GRAVEL 5-15%pass the #200 sieve	GW-GM	Well-graded gravel with fines
			GP-GM	Poorly-graded gravel with fines
		GRAVEL >15% pass the #200 sieve	GM	Silty gravel, poorly-graded gravel-sand-silt mixture
			GC	Clayey gravels, poorly-graded gravel-sand-clay mixture
	SANDS >50% coarse fraction passes #4 sieve	SAND <5% pass the #200 sieve	SW	Well-graded sand, gravelly sand, little or no fines
			SP	Poorly-graded sands, gravelly sands, little or no fines
		SAND 5-15% pass the #200 sieve	SW-SM	Well-graded sand with fines
			SP-SM	Poorly-graded sand with fines
		SAND >15% pass the #200 sieve	SM	Silty sand, poorly-graded sand-gravel-silt mixture
			SC	Clayey sand, poorly-graded sand-gravel-clay mixture
FINE-GRAINED SOILS >50% passes #200 sieve	SILT/CLAY Liquid Limit <50%		ML	Inorganic silt & very fine sand, silty or clayey fine sands, clayey silt with slight plasticity
			CL	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay, silty clay, lean clay
			OL	Organic silt & clay of low plasticity
	SILT/CLAY Liquid Limit >50%		MH	Inorganic silt, micaceous or diatomaceous fine sand or silt
			CH	Inorganic clay of high plasticity, fat clay
			OH	Organic silt & clay of medium to high plasticity
HIGHLY ORGANIC SOILS			PT	Peat, humus, swamp soils with high organic content

Notes: If coarse-grained soil contains >10% fines use a dual symbol, e.g. GP-GM. Full USCS chart on page 2.

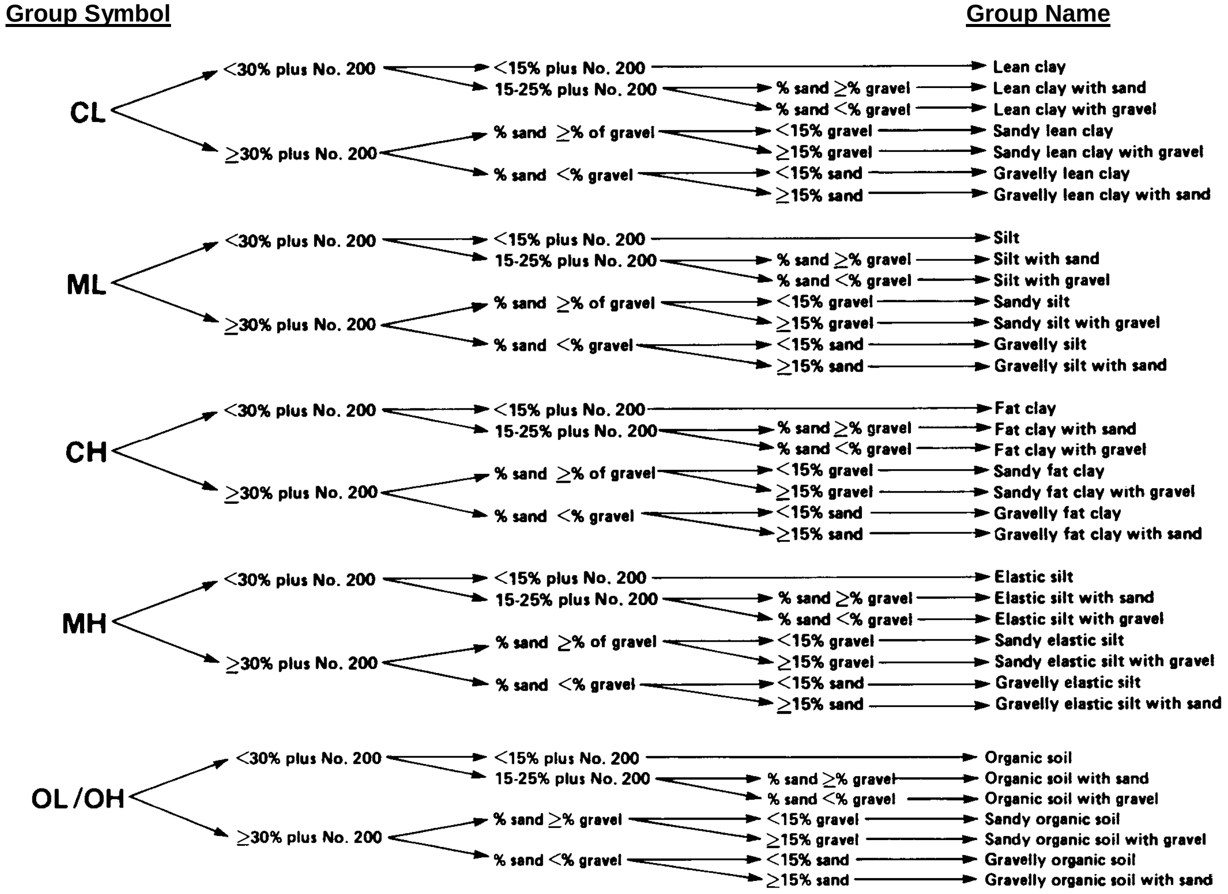
UNIFIED SOIL CLASSIFICATION SYSTEM

(from ASTM D2488)

COARSE-GRAINED SOILS



FINE-GRAINED SOILS



SOIL BORING LOG

Sheet______ of ______

Project:

Project Number:

Client:

Boring No.

Address, City, State

Drilling Contractor:

Logged By:

Date

Started:

Completed:

Backfilled:

Drilling Method and Equipment Used:

Drill Crew:

Groundwater Depth:

Elevation:

Total Depth of Boring:

Depth (feet)	**Sample Interval**	**Inches Driven**	**Inches Recovered**	**PID (ppm)**	**Time**	<u>**Soil Description:**</u> **Soil Name, USCS Group Symbol, Color, Relative Density or Consistency, Plasticity, Moisture Content, Secondary Grain Size, Odor, Additional Descriptors**	**Sample**
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							

SOIL BORING LOG

Sheet ______ of ______

Project:	Project Number:	Client:	Boring No.

Depth (feet)	Sample Interval	Inches Driven	Inches Recovered	PID (ppm)	Time	**Soil Description:** Soil Name, USCS Group Symbol, Color, Relative Density or Consistency, Plasticity, Moisture Content, Secondary Grain Size, Odor, Additional Descriptors	Sample
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
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32							
33							
34							
35							
36							

STANDARD OPERATING PROCEDURE

BE-SOP-06

Soil Sampling

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) will be used to guide surface and subsurface soil sample collection. The methods described in this SOP are in accordance with the Alaska Department of Environmental Conservation (ADEC) *Field Sampling Guidance* (ADEC 2022).

2.0 EQUIPMENT AND MATERIALS

Field materials include, but are not limited to the following:

- Clipboard
- Description aids (Munsell color and Unified Soil Classification charts)
- Soil boring logs
- Field logbook
- Permanent ink pen
- Plastic folding table
- Core cutter with extra blades
- Tape measure
- Duct tape
- Trash bags
- White board with erasable markers
- Camera
- Personal protective equipment (PPE) – nitrile gloves, safety glasses, hard hat, safety vest, safety-toed boots, hearing protection
- Hand auger with extension rods, as necessary
- Shovel, pickax, pick mattock, or other excavating tools
- Hand tools (trowels, spoons, rock hammer, etc.)
- Stainless steel homogenization bowl
- Hand broom and dustpan
- 5-gallon bucket
- Photoionization detector for field screening (BE-SOP-15) with isobutylene calibration gas
- Survey stakes, flags, or whiskers to mark sample locations
- Zip-top plastic bags
- Scales
- Laboratory-supplied sample jars, preservatives, labels, custody seals, and temperature blanks
- Gel ice
- Decontamination supplies/equipment (Alconox, deionized water, brushes, 5-gallon bucket)

Refer to the attachment, Soil Sampling Checklist, for a more detailed equipment list.

3.0 SOIL SAMPLE TYPES

Soil samples may be collected using a variety of methods and equipment, depending on the depth of the soil profile, type of sample required, contaminants present, and soil classification. Soil samples may be collected from surface or subsurface soils. Under State of Alaska regulation 18 Alaska Administrative Code (AAC) 75.390(127), surface soil is defined as soil that extends no more than 2 feet below ground surface (bgs). Subsurface soil is defined under State of Alaska regulation 18 AAC 75.390(123) as soil that is more than 2 feet bgs. The expected sampling depths and methodologies should be defined in the site-specific Work Plan. The three most common sampling methodologies include discrete sampling, composite sampling, and incremental sampling methodology. These methods are described in the following subsections.

3.1 Discrete Sampling

Discrete soil samples are single samples collected from a specific location and depth interval. Sample locations and depths are selected based on information available about the site (previous analytical data, site history and use, field screening results, etc.). Discrete sampling is often used to determine the presence or absence of contamination and identify contaminant boundaries.

3.2 Composite Sampling

Composite samples consist of multiple subsamples that are combined into a single homogenized sample. Typical applications for composite sampling include Toxic Substances Control Act 9-point and 8-point composites for polychlorinated biphenyls, and Resource Conservation and Recovery Act waste characterization samples. Subsample aliquots for volatile samples should be placed directly into laboratory-supplied jars and preserved immediately. Non-volatile sample aliquots should be homogenized and then placed into laboratory-supplied jars.

3.3 Incremental Sampling Methodology

Incremental sampling methodology (ISM) is a systematic composite sampling process designed to reduce data variability. ISM sampling provides a representative sample for a specified volume of soil. Typically, it is used to determine risk associated with contaminant exposure over a specified area. BE-SOP-08 details ISM soil sampling procedures.

4.0 SAMPLE RETRIEVAL AND COLLECTION PROCEDURES

Soil samples may be collected from surface or subsurface soils using drilling equipment, hand tools, shovels, a hand auger, or heavy-equipment (excavator). When retrieving samples from the ground, follow these general steps:

1. Ensure that the sampling area is safe for entry and obstacles impeding drill rig access have been removed. If the sample is to be collected from within an excavation, ensure that the excavation meets all criteria for safe entry, or collect the sample directly from the excavator bucket.
2. Use drilling equipment or hand tools to retrieve samples from the desired depth.
3. Don new pair of nitrile gloves.
4. Properly label the sample according to the project-specific Work Plan.

5. Open sampler (Macro-core, split spoon) and place on sampling table.
6. Remove bits of vegetation and large gravel from the sample as these items are not analyzed and reduce the available sample volume for analysis.
7. Take care to prevent cross-contamination and misidentification of samples.
8. Fill volatile sample jars first within two minutes of opening the sampler.
    a. Remove lid on laboratory-supplied pre-tared jar and place jar on scale.
    b. Zero jar on scale.
    c. Use a clean sampling spoon to transfer the required amount of soil (25 grams [g] to 50 g depending on lab) from the target depth interval directly from the sample retrieval device (Macro-core, split spoon, auger, window sampler) to the sample jar with the least disturbance possible.
    d. Cover soil with 25 milliliters (mL) of methanol (MeOH) (50 mL can be used if needed to cover sample but must be noted on chain-of-custody and shipped as “dangerous good”).
    e. Using clean paper towels, wipe down the jar threads to remove any soil, close the jar with the lid, and wipe the outside of the jar.
9. Fill non-volatile sample jars next.
    a. Using the sample spoon, transfer additional soil from the target depth interval into a resealable plastic bag or decontaminated metal bowl to homogenize the soil. Take care to avoid gravel and rocks.
    b. To homogenize the soil, seal the plastic bag and mix and/or stir the soil with the spoon.
    c. Place the homogenized soil directly into the laboratory-supplied jar.
    d. Pack soil into jars until filled.
10. Record sample information (sample identification, time, analytes, number and type of jar, preservatives, quality control – Duplicate or matrix spike/matrix spike duplicate, for volatile jars tare weights and total weights, methanol lot numbers) on the soil boring logs and the logbook.
11. Record MeOH lot numbers.
12. Place jars in bubble bags and sealable zip-top bags.
13. Put sample in cooler with gel ice.
14. Make notes on the boring log regarding the soil characterization and geologic features, including any staining or olfactory observations (see BE-SOP-05 for soil logging). Note that samples generally will be collected prior to soil characterization to preserve volatile sample integrity.
15. Decontaminate any non-dedicated, reusable sampling equipment according to Equipment Decontamination procedures (BE-SOP-14), prior to collecting the next sample.

If composite sampling techniques are employed, subsamples are placed into a container constructed of inert material (sealable zip-top bag or metal bowl), homogenized, and transferred to a sample jar.

5.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC). 2022. *Field Sampling Guidance.* January.

ATTACHMENTS

Soil/Sediment Sampling Checklist

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Soil/Sediment Sampling Checklist

Prior to Sampling	Initial
Safety tailgate meeting	
Obtain permits	
Obtain sample containers from lab	

Soil Sampling	Initial
Ekman or Ponar dredge device	
Spade/Trowel	
Shovel, pick ax, pick mattock	
Hand auger with extension rods	
Survey stakes, flags, or whiskers	
Tape measure	
Sample kits	
Gel Ice	
Sample sheets	
DI & Alconox	
Paper towels	
Shovel	
Full socket set (14mm)	
Tool to open well lids	
Zip lock bags	
Laboratory supplied containers	
Preservatives, labels, custody seals	
Temperature blanks	
Plastic sheeting	
Coolers	
Trash bags	
Decontamination equipment	
Sample kits	
Gel ice	
Sample sheets	
DI and Alconox	
Paper towels	
Stainless steel homogenization bucket	
Stainless steel lab spoon or equivalent	
Scale	

PPE/Misc.	Initial
Nitrile gloves	
Shades	
Tailgate form	
Knee pads	
Safety gear (hard hat, gloves, vest, etc.)	
Water	
Laminated site map	
Garbage bags	
PEP/HSE Plan	
Camera	
Whiteboard and marker	

After Sampling	Initial
Address Waste	
Closeout permits	
CoC and Samples in cooler	
Download cameras	
Charge harmony	
QC, chill, and secure samples	
Complete field notes	
Debrief (tailgate form)	

Last Updated: 9/23/2015

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STANDARD OPERATING PROCEDURE

BE-SOP-09

Groundwater Sample Collection

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) provides methodology for planning groundwater sampling events and collection of groundwater samples.

This SOP was developed in accordance with the following guidance documents:

- *Field Sampling Guidance* (Alaska Department of Environmental Conservation [ADEC] 2022)
- *Ground-Water Sampling Guidelines for Superfund and Resource Conservation and Recovery Act (RCRA) Project Managers* (U.S. Environmental Protection Agency [EPA] 2002)
- *Low Stress (Low Flow)-Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells* (EPA 2017)
- *Standard Practice for Low-Flow-Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations* (ASTM International [ASTM] 2018)
- *Underground Storage Tanks Procedures Manual: Guidance for Treatment of Petroleum-Contaminated Soil and Groundwater and Standard Sampling Procedure* (ADEC 2017)

This SOP focuses on the most commonly used monitoring well sampling tasks and should be used in conjunction with other applicable SOPs, including the following:

- BE-SOP-01: Logbook Documentation and Field Notes
- BE-SOP-02: Sample Chain-of-Custody
- BE-SOP-03: Labeling, Packaging, and Shipping Samples
- BE-SOP-04: Quality Control Samples
- BE-SOP-05: Drilling and Core Logging
- BE-SOP-14: Equipment Decontamination
- BE-SOP-20: Water Quality Measurements
- BE-SOP-22: Monitoring Well Installation, Development, and Decommissioning
- BE-SOP-66: Breathing Zone Air Monitoring

Groundwater sampling consists of collecting a water sample that is representative of the aquifer. Representative samples can be analyzed for groundwater contamination and/or naturally occurring analytes. Three common methods for well sampling include:

1. Low-Flow Method
2. Well-Volume Method
3. Low-Permeability Formation Method

Monitoring well sampling can be initiated as soon as the groundwater has re-equilibrated, is free of visible sediment, water quality parameters have stabilized, or 24 hours have passed following development (ADEC 2022).

Disturbance of the well, water column, and samples must be minimized, and only discrete grab samples may be collected. If multiple wells are to be sampled, the wells should be sampled from the least contaminated well progressing to higher levels of contamination. Groundwater samples need to be collected and analyzed for all appropriate contaminants of concern based on the field sampling guidance and the project-specific work plan. Samples must be collected in the order of volatility (ADEC 2022):

1. Volatile organic compounds (VOCs) and gasoline range organics (GRO)
2. Semi-volatile organic compounds (SVOCs); including diesel range organics/residual range organics (DRO/RRO), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, and herbicides
3. Total organic carbon
4. Inorganic compounds (total metals, dissolved metals, nitrate/nitrite, and sulfide)

2.0 EQUIPMENT AND SUPPLIES

Groundwater sampling can be performed using several devices including submersible pumps, bladder pumps, peristaltic pumps, and bailers. Groundwater sampling devices must support the intended data use and site decisions, and selected groundwater purging and sampling equipment must minimize increases in sample temperature, water column agitation, and sample agitation (ADEC 2022).

Groundwater sampling equipment may include, but is not limited to, the following:

- Appropriate level of personal protective equipment
- Well keys
- Camera
- Logbook, weatherproof pen, sharpie, etc.
- Groundwater Sampling Form (Attachment 1)
- Sample labels
- Sampling containers and packing materials
- Oil/water interface probe or water level indicator
- Submersible (e.g., Proactive Monsoon pump with low-flow controller, or equivalent), bladder (e.g., QED Sample Pro), or peristaltic pump (e.g., MasterFlex Easy-Flow)
- Disposable Teflon bailers and twine
- Graduated cylinder or beaker
- YSI water quality meter or similar multimeter
- Hach turbidimeter
- Potable water and/or deionized water
- Tubing (Teflon, high-density polyethylene [HDPE] and/or silicone)
- Liquinox, Alconox, or equivalent
- RAE Systems MiniRAE photoionization detector (PID) (or similar), if necessary
- Colorimetric gas detector tubes, if necessary

3.0 PROCEDURES

3.1 Recording Field Observations

The Groundwater Sampling Form (Attachment 1) is intended to capture all of the information routinely collected during the sampling process for established monitoring wells. The field logbook is intended to record all equipment calibration checks, the wells sampled, sampling start and end times, or any other pertinent information not captured on the Groundwater Sampling Form.

3.2 Field Equipment Decontamination

Clean and/or decontaminate all equipment and materials used during groundwater sampling before use, as discussed in Equipment Decontamination (BE-SOP-14). Groundwater sampling equipment that typically requires decontamination includes all measurement devices before and between measurements at each well, groundwater sampling pumps between sampling at each well, water quality meters and probes and the inside of flow-through cells (ADEC 2022). Used decontamination solution will be managed as investigation-derived waste, according to the project-specific work plan.

3.3 Field Instrument Calibration

Field instruments will be calibrated in accordance with the manufacturer's recommended procedures and frequency for each instrument. Refer to Water Quality Measurements SOP (BE-SOP-20) and Field Screening with PID SOP (BE-SOP-15) for related procedures.

3.4 Air Monitoring

Air monitoring will be conducted to screen for the presence of VOCs using a PID, or colorimetric gas detector tubes, if necessary. PID readings will be monitored until stable and then recorded in the field logbook. Procedures in the project-specific Site Safety and Health Plan (SSHP) and Breathing Zone Air Monitoring SOP (BE-SOP-66) will be followed if organic vapors are detected above concentrations listed in the air monitoring section of the SSHP.

Prior to removing the well plug, remove any standing water in the well annulus. Collect PID readings in situations as follows:

- To monitor the ambient conditions in the breathing zone when opening the well or removing the well plug.
- To monitor the headspace immediately after removing the well plug.
- To monitor the breathing zone after the well plug has been removed.

3.5 Free Product and Water Level Measurement

Measure the depth to groundwater (DTW), depth to product (DTP) if present, and total depth (TD) with an oil/water interface probe (or water level meter if no product) to the nearest 0.01-foot. Interface probes provide distinct responses when immersed in nonconductive product or conductive water. If non-aqueous phase liquid (NAPL) is encountered in a well, unless otherwise specified in the project-specific work plan, do not collect laboratory samples (ADEC 2022). If samples are to be collected, remove the product with a bailer and make a note on the chain-of-custody (CoC) that free product is present.

DTW, DTP, and TD are measured relative to an established reference mark from the top of the casing (TOC). The reference mark should be permanent, such as a small notch cut into the TOC or a permanent ink mark at the TOC. If a reference mark is not present, place a mark on the outside of the top north side of the well casing with indelible ink.

TD of a monitoring well should be compared to the well construction log to determine the thickness of silt present on the bottom, if present.

3.6 Purging

Purging is the process by which stagnant water is removed from the well casing prior to sampling and replaced with groundwater from the adjacent formation. This allows for a representative sample to be collected from the actual aquifer condition.

Purging will be conducted in accordance with EPA and ADEC low-flow guidelines (EPA 2017, ADEC 2022). Monitoring wells will be purged, at a minimum, the equivalent of three times the well volume, or until a minimum of three (four, if using temperature) water quality parameters stabilize, or for low-yield wells, the entire well casing is evacuated.

The formula to calculate one well casing volume is as follows:

(TD of Casing – DTW) * Gallons per Foot of Casing

Refer to Attachment 1 for the various gallons per foot of casing based on the diameter of the well.

All measurements, except turbidity, must be obtained using a flow-through cell. Water quality parameter stabilization is reached when three consecutive changes between successive readings at approximately 3 to 5 minute intervals are within:

- Plus or minus (±) 3 percent (%) for temperature
- ± 0.1 for pH
- ± 3% for conductivity
- ± 10 millivolts for oxidation reduction potential
- ± 10% for dissolved oxygen
- ± 10% or less than or equal to 10 nephelometric turbidity unit for turbidity

3.7 Groundwater Sampling

3.7.1 Low-Flow Method

The low-flow sampling method uses groundwater quality parameters as indicators to determine when formation water is being discharged. Sampling at low-flow rates provides more accurate and reproducible samples of the formation water by minimizing hydraulic stress compared to high flow/high volume purging, while also reducing purge water volume. Low-flow sampling is not suitable for very low-yield wells, sampling in wells known to contain NAPL, and may require longer purge times (ASTM 2018).

Low-flow sampling is typically conducted using bladder pumps (positive displacement pumps), submersible pumps or peristaltic pumps. The use of Teflon-lined polyethylene tubing is preferred for the sample collection of organic compounds. For the analysis of per- and polyfluoroalkyl substances (PFAS) HDPE tubing is to be used; however, the use of HDPE equipment should be minimized to the extent practical (ADEC 2022).

Sampling of wells in order of increasing chemical concentrations (known or anticipated) is preferred. If wells contain free product, alternate wells that are representative of the affected groundwater should be sampled instead. Samples will be collected using the following steps:

- Measure and record the initial water level before installing the pump.
- Lower the pump or peristaltic pump tubing to the target depth below the static water level.
    - Record the depth of the pump on the Groundwater Field Data Form.
    - Consult the project-specific work plan for pump placement. Typically:
        - For wells screened across the groundwater interface, a pump intake of 1 to 2 feet below the static water level is typically used (ADEC 2017).
        - For wells with submerged screens, set the pump intake at the middle of the screened interval (ASTM 2018).
- Begin purging water into a graduated bucket. Adjust the flow rate, for low-flow sampling, the goal is minimum drawdown (less than 0.3 feet) during purging, but this is not always possible with slow recharge aquifers (EPA 2002, ADEC 2022).
    - Flow rates typically range from 50 to 500 milliliters per minute (mL/min) (0.01 to 0.13 gallons per minute [gal/min]), but higher rates are consistent with low-flow guidelines as long as the drawdown requirement is met (ADEC 2022).
    - Flow adjustments are best made in the first 15 minutes of pumping in order to minimize purging time.
- After observable turbidity decreases, connect the flow-through cell to begin measuring and recording stabilization parameters and DTW on Attachment 1.
- Continue to purge and record measurements until stabilization criteria are met (Section 3.6) or a minimum of three or maximum of six well casing volumes are removed (EPA 2002).
- When collecting samples, disconnect the tubing from the flow-through cell and collect samples directly from the pump's tubing.
- Begin filling laboratory-supplied analytical sample containers in order of volatility as described in Section 1.0.
- Record sample information on the sample bottle labels and Attachment 1.

3.7.2 Well-Volume Method

This method is the default method used during low-flow sampling if groundwater stabilization parameters cannot be achieved. The well-volume method is based on purging three to six well volumes before sampling (EPA 2002). One well casing volume of water may be calculated using the formula in Section 3.6.

Well-volume method sampling should be conducted as above in the Low-Flow Method, but:

- The purge rate should not be great enough to produce excessive turbulence in the well.
    - Flow rates typically range from 500 mL/min to 3.8 liters per minute (L/min) (0.13 to 1 gal/min) in a 2-inch well (EPA 2002).
- Routinely measure and record groundwater parameters and DTW at approximately every 0.5 to 1 well volume interval on Attachment 1 (EPA 2002).

- Once groundwater parameters have stabilized and a minimum of three well casing volumes have been removed, record the final measurements.
- If parameters have not stabilized within six well volumes, stop purging and record the final measurements.
- Reduce the flow rate of the pump to about 0.13 gal/min and collect samples as above (EPA 2002).

3.7.3 Low-Permeability Formation Method

If a well is screened in low hydraulic conductivity aquifers (silt and clay) there may be no way to avoid pumping or bailing a well dry. Low-flow purging and sampling are useful for wells that purge dry or take one hour or longer to recover (ADEC 2022).

If a low-yield well is purged dry, and it is not possible to obtain groundwater stability parameters:

- Purge the well dry and allow the well to recover until at least one of the following is met:
    - If full recovery exceeds one hour, collect samples as soon as the well has recharged to 80% of the DTW (ADEC 2022).
    - A minimum of 2 hours has passed since purging (EPA 2002).
    - There is sufficient water volume present to obtain a sample.
- Collect samples in order of volatility, as described in Section 1.0.
    - Bailers or a peristaltic pump may be used; however, analytical results may be biased low for VOCs if using a peristaltic pump or biased high for metals if using a bailer due to increased turbidity (EPA 2002).

4.0 POTENTIAL INTERFERENCES

Two potential interferences associated with groundwater sampling are cross-contamination and a lack of sample representation due to improper well purging or stabilization. Cross-contamination can be a significant problem when attempting to characterize low concentrations of organic compounds or when soils are highly contaminated (ADEC 2017). To prevent cross-contamination between wells, dedicated tubing can be placed in each well and all non-disposable equipment that may directly or indirectly come in contact with samples will be decontaminated prior to use at a different location. The Equipment Decontamination SOP (BE-SOP-14) outlines the decontamination procedure. To ensure that representative conditions within the aquifer are captured during sample collection, the purge rate will be maintained at a rate that produces minimal drawdown until three well casings have been removed or until water quality parameters have stabilized, as described in Section 3.6.

5.0 SAMPLE HANDLING, PRESERVATION, AND STORAGE

The following procedure will be followed for sampling handling, preservation, and storage:

1. Transfer the sample into a labeled container.
2. Preserve the sample or use pre-preserved sample bottles (if required by analytical method).
3. Cap the container and place into a cooler to maintain 4 ± 2degrees Celsius (if required by analytical method).

4. Record all pertinent data in the site logbook and/or on the field data sheet.
5. Complete the CoC form.
6. Attach the custody seals to the cooler prior to shipment.

Refer to the Labeling, Packaging, and Shipping SOP (BE-SOP-03) for procedures on labeling, packaging, and shipping samples.

6.0 DATA AND RECORD MANAGEMENT

The CoC form is signed over to the laboratory. A copy is kept with the sampling records. Refer to Sample Chain-of-Custody SOP (BE-SOP-02) for procedures on sample CoC.

7.0 QUALITY CONTROL AND QUALITY ASSURANCE

All field quality control (QC) sample requirements in the project-specific work plan must be followed. These may involve trip blanks, equipment blanks, field duplicates, and the collection of additional sample volumes for the laboratory's QC (matrix spike and matrix spike duplicates). The frequency of QC samples will be outlined in the project-specific work plan. Refer to the Quality Control SOP (BE-SOP-04) for procedures on quality control samples.

8.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC). 2017. *Underground Storage Tanks Procedures Manual: Guidance for Treatment of Petroleum-Contaminated Soil and Groundwater and Standard Sampling Procedure.* March.

ADEC. 2022. *Field Sampling Guidance.* January.

ASTM International (ASTM). 2018. *D6671 - Standard Practice for Low-Flow-Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations.* September.

U.S. Environmental Protection Agency (EPA). 2002. *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. Office of Solid Waste and Emergency Response. EPA 542-S-02-001.* May.

EPA. 2017. *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells.* EPA 540-S-95-504. September.

ATTACHMENTS

Groundwater Sampling Data Form

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GROUNDWATER SAMPLING DATA FORM

Well ID:______________________

Project Name:
Date:
Project Number:
Start Time:
Sampling Team:
End Time:
Sample ID: Time: primary dup other:
Sample ID: Time: primary dup other:
Sample ID: Time: primary dup other:

Depth to Top of Product (BTOC):
Total Depth (BTOC):
Depth to Oil/Water Interface (BTOC):
Depth to Water (BTOC)

Casing Diameter:	*1 in.*	*2 in.*	*4 in.*
gal/ft of casing:	*0.041*	*0.163*	*0.653*

Water Column (ft)
Casing Volume (gal)
Pump Intake Depth:
Screen Interval
Stable DTW (BTOC):
Measured Stick-up

Method of Purging (circle one):

Pump: SUB BLDR PERIST OTHER:
Pump Type: Flow Rate (gpm):
Pump Time:

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

WELL STABILIZATION DATA

Time	Total Volume Purged (gallons)	Water Level (ft BTOC)	Draw Down	Temp. (°F or °C)	pH	Conductivity (µS/cm)	ORP (mV)	D.O. (mg/L)	Turbidity (NTU)
				± 3%	± 0.1	± 3%	± 10mV	± 10%	± 10% or <10 NTU

Notes: Drawdown should be less than 0.3 feet from the original DTW. Minimal drawdown achieved and measured by: 1) pumping at a low rate (approx. 1 liter/3 minutes or 0.26 gallons/3 minutes or 50-500 mL/min) **and** 2) continually measuring water levels in the well.
Sample after 1) removing min. of 3 casing volumes **or** 2) min. of 3 parameters stabilize (4, if using temp.), **or** 3) for low yield wells, entire well casing is evacuated (ADEC, 2013).

Sensory Observations

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

Comments:

Reference: ADEC, 2013. Monitoring Well Guidance, September.

WELL STABILIZATION DATA

Time	Total Volume Purged (gallons)	Water Level (ft BTOC)	Draw Down	Temp. (°F or °C)	pH	Conductivity (µS/cm)	ORP (mV)	D.O. (mg/L)	Turbidity (NTU)
				± 3%	± 0.1	± 3%	± 10mV	± 10%	± 10% or <10 NTU

STANDARD OPERATING PROCEDURE

BE-SOP-14

Equipment Decontamination

1.0 INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures for decontamination of reusable equipment.

2.0 MATERIALS

Materials used for decontamination may include:

- Level D personal protective equipment (PPE) – nitrile or rubber gloves, safety glasses, safety toed boots, hard hat, and safety vest (if decontaminating drilling or heavy equipment)
- Hand tools for bulk contamination removal (shovels, brooms, etc.)
- Liquinox or Alconox
- Spray or rinse bottles, or pump sprayer
- Pressure washer/steam cleaner
- Potable water
- Distilled or deionized water
- Bristle brushes
- Plastic tubs
- Plastic sheeting
- Department of Transportation (DOT)-approved, 5-gallon buckets with screw top lids
- DOT-approved, 55-gallon open-top drums
- Contractor-grade plastic bags
- Paper towels

3.0 PROCEDURE

Reusable sampling equipment must be decontaminated between samples and at the end of each workday. Drilling and excavation equipment should be decontaminated prior to beginning site activities, before collecting each sample when non-dedicated sampling equipment is used, and after completing site activities. Decontamination procedures are detailed in the following subsections.

3.1 Decontamination Area

Identify a localized decontamination area for larger drilling and excavation equipment. Select an area with easy access and level ground to minimize slip, trip, and fall hazards. The decontamination area should be large enough to temporarily store clean equipment and materials. When decontaminating larger drilling tooling, such as hollow-stem augers, line each area with a heavy-gauge plastic sheeting and include a collection system designed to capture potential decontamination wastes (water and residual soil). Containerize decontamination water and residual soil in approved containers, such as DOT-approved 55-gallon drums, before treating/disposing the water and residual soil as specified in the approved project-specific Work Plan (WP). Decontamination areas should be set up to minimize overspray and risk to the surrounding environment.

Smaller equipment (spoons, trowels, groundwater sampling pumps, etc.) may be decontaminated near the sampling locations. In this case, all required decontamination supplies must be mobilized to the sampling location. A 5-gallon bucket with a screw top lid or a plastic tub should be used to capture decontamination water, which should be transferred to larger containers, as necessary.

3.2 Sampling Equipment Decontamination

Improper decontamination can cause cross-contamination. To prevent cross-contamination, sampling equipment must be either disposed of after one use or decontaminated after each use. Disposable or dedicated sampling equipment should be used whenever possible. When non-dedicated, reusable equipment is used, it should be decontaminated in stages in a way that minimizes contaminant discharge to the environment. The following procedures should be used:

1. Remove as much bulk contamination as possible from equipment at the point of origin.
2. Wash equipment thoroughly with potable water containing a laboratory-grade detergent, such as Liquinox or Alconox. Use a bristle brush to remove any remaining residual contamination.
3. Rinse equipment thoroughly with potable water.
4. Rinse equipment thoroughly with distilled or deionized water. Note that some instruments can be damaged by deionized water, such as YSI 556 and Aqua TROLL 500 probes.
5. Air dry equipment in clean area free of dust or other fugitive contaminants. Alternatively, wet equipment may be dried with a clean, disposable paper towel to assist the drying process. All equipment should be dry before reuse.
6. Store clean and dry sampling equipment within a protective medium (plastic bag, carrying case, etc.).

3.3 Heavy Equipment Decontamination

Equipment decontamination must be performed prior to transporting or walking equipment between contaminated areas. Decontamination will focus on minimizing the spread of contaminated media resulting from equipment movement or transport. This decontamination process will use dry methods (brooms, brushes, shovels, etc.) within the exclusion zone to remove large, easily dislodged deposits of soil and other contaminated media from equipment (tracks, buckets, etc.) prior to exiting the exclusion zone. The Field Lead may alter decontamination procedures based on dry decontamination effectiveness.

Final decontamination should be conducted when equipment is no longer needed onsite. A decontamination area should be established to collect decontamination materials, sludge, and water. Bulk contamination should be removed using shovels and brushes, and the equipment should be further cleaned using a pressure washer with a detergent wash, followed by a potable water rinse, if needed.

3.4 Personnel and PPE Decontamination

During environmental investigations and removal actions, boots and gloves are commonly the most contaminated types of PPE. Contaminated solids such as mud should be scraped and wiped from boots. Personnel decontamination involves removal of bulk contamination first. Any remaining contamination should be removed using soapy water and brushes. Once all debris is removed, rinse the boots with clean water. If boots are not laden with solid materials, a brush can be used to knock off or remove any residual solid materials. If the boots have contacted liquid-phase contaminants, it is important that the contaminants be removed using soapy water and a brush, followed by a clean water rinse. If the contaminants have adsorbed into the boots, the boots must be replaced. Gloves should be removed rolling the glove off from the top down to avoid contact with contaminated soil.

Following removal and cleaning of reusable PPE, field personnel should wash their hands or any exposed body parts which may have been in contact with the associated contaminated substances.

4.0 INVESTIGATION-DERIVED WASTE MANAGEMENT

Typical investigation-derived wastes (IDW) consist of soil cuttings, decontamination water, and solid wastes. Wastes will be managed based on media type following the procedures specified in the Alaska Department of Environmental Conservation-approved project-specific WP and in accordance with the federal, state, and local regulations. Typical methods of managing IDW are described in the Waste Management SOP (BE-SOP-79).

5.0 QUALITY CONTROL

Quality control (QC) samples may be collected to verify that the decontamination process is effective. QC samples include equipment rinsate blanks and equipment wipe samples, which are described in the Quality Control Samples SOP (BE-SOP-04).

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STANDARD OPERATING PROCEDURE

BE-SOP-15

PID Field Screening

1.0 INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to describe photoionization detector (PID) field screening procedures. The procedure is applicable to the MiniRae 2000 PID model.

2.0 EQUIPMENT

The following equipment is needed for field screening:

- Appropriate personal protective equipment (PPE) nitrile gloves, safety glasses, hard hat, safety vest, safety-toed boots, hearing protection
- PID calibration form
- Logbook
- Camera
- Permanent ink pen
- Quart-size zip-top bags
- Moisture filters
- Lamp cleaning kit
- Clean sampling spoons or trowels
- PID
- Isobutylene calibration gas 100 parts per million (ppm) and regulator
- Tedlar bag

3.0 PID OVERVIEW

The MiniRae 2000 Portable Volatile Organic Compound (VOC) Monitor (Model PGM 7600) is a nonspecific, vapor/gas detector that is used to detect a variety of organic compounds in air. It utilizes an electrodeless discharge ultraviolet (UV) lamp as the high-energy photon source. When organic vapors pass by the lamp, they are photoionized and the ejected electrons are detected as a current. Three UV lamps with different photon energies are available: 9.8 electron volt (eV), 10.6 eV, or 11.7 eV. The 11.7eV lamp measures the widest range of analytes while the 9.8 eV lamp is selective to easily ionizable compounds like aromatics. The 10.6 eV lamp is the most commonly used lamp and will measure compounds with ionization energy lower than that of the lamp.

The instrument is designed to continuously monitor VOC vapors between 0 and 10,000 ppm. An audio alarm and a flashing light-emitting diode (LED) display are activated when these limits are exceeded. Default preset alarm thresholds are programmed in the PID before leaving the factory. Alarm limits for the STEL, TWA, and low- and high-level peak values can be reset following the instructions in the Operational and Maintenance Manual.

4.0 INSTRUMENT CALIBRATION

The PID should be calibrated daily prior to beginning work and as needed during operation. The calibration process includes a fresh air calibration to determine the zero point of the sensor calibration curve followed by a span calibration using a standard reference gas to determine a second point of the sensor calibration curve. These calibration procedures are detailed in the following subsections.

4.1 Fresh Air Calibration

The fresh air calibration is performed in clean ambient air away from any possible contaminants using the following procedures:

1. Use a clean moisture filter or carbon filter.
2. Turn on PID and allow it to cycle through the warmup process. The unit is ready when it displays a reading.
3. Press and hold [Mode] and [N/-] buttons together until the “Calibration/Select Gas?” menu appears. Press the [Y/+] button.
4. The “Fresh air Cal?” menu will appear. Once ready to begin the calibration, press the [Y/+] button. The display will show “zero in progress” followed by “wait...” and a countdown timer.
5. After approximately 15 seconds, the display will show the message “zeroed... reading = X.X ppm.” Press any key or wait approximately 20 seconds and the monitor will return to the “Fresh air Calibration?” menu.
6. Record the fresh air calibration reading on the PID Calibration Form.

4.2 Span Calibration

The span calibration is performed using a standard reference gas (100 ppm Isobutylene) fitted with a 500-cubic centimeter per minute flow-limiting regulator or a flow-matching regulator (required to match the pump flow rate). Alternatively, a Tedlar bag can be filled with calibration gas. Use the following procedures to complete the span calibration:

1. Open valve on regulator or Tedlar bag and connect the PID.
2. Press the [Y/+] on the “Span Cal?” menu to start the calibration. The display will show the gas name and the span value of the corresponding gas.
3. The calibration can be started manually by pressing any key while the “Apply gas now!” is displayed.
4. The display will show “wait.... 30” with a countdown timer showing the number of remaining seconds while the monitor performs the calibration.
5. During calibration, the monitor waits for an increased signal before starting the countdown timer. If a minimal response is not obtained after 35 seconds, the monitor displays “No Gas!” Check that the span gas valve is open and for lamp or sensor failure before trying again.
6. When the countdown timer reaches 0, the display shows the calibrated value, which should be within 5 percent (%) of the span gas value.
7. After a span calibration is completed, the display will show the message “Span Cal Done! Turn Off Gas.”

8. It is recommended that you bump check the PID at this point to confirm that the calibration was successful.
9. Turn off the flow of gas. Disconnect the calibration adapter from the MiniRAE 2000 monitor.
10. Press any key to return to the “Span Gas Cal?” menu.
11. Record the span calibration reading on the PID Calibration Form.

4.3 Equipment Testing

The PID should be bump checked with 100 ppm Isobutylene gas at frequent intervals using the following procedures:

1. Turn on PID and allow it to warm up.
2. While the pump is on and collecting air, use a regulator or Tedlar bag to deliver the calibration gas to the instrument probe.
3. Record the reading in the field logbook.
4. Assess whether the reading is within the acceptance criteria (typically 5%).

If the bump check indicates that the instrument is not reading within the acceptance criteria, recalibrate the PID and re-check. If the reading remains outside the acceptance criteria, perform maintenance, or replace the unit.

5.0 SCREENING

PIDs can be used to monitor ambient air for contaminant exposure, or to screen soils for organic vapors.

5.1 Contaminant Exposure Air Monitoring

For contaminant exposure monitoring, use the hygiene mode to ensure that the unit runs continuously and hold the PID in the area of interest. Areas of interest may include the breathing zone for employee exposure, within a contaminant source area, or around the perimeter of contamination. Monitor the concentrations displaying on the PID screen. If concentrations exceed 20 ppm in the breathing zone, work should be stopped and site conditions should be re-evaluated. Additional PPE may need to be donned to ensure that the Occupational Safety and Health Administration and National Institution for Occupational Safety and Health exposure limits are not exceeded.

5.2 Heated Headspace Screening

To screen soils for organic vapors using the heated headspace method, follow these procedures:

1. Collect soil from the sample retrieval device using a clean sampling spoon.
2. Place the soil in a clean, quart-size, re-sealable plastic bag until the bag is one-third to one-half full and seal the bag completely. It is important to use a quart-sized bag as larger bags effect vapor diffusion and stratification. Consistent soil volumes must be placed in the bag to ensure comparable screening results (when adequate soil volumes area available).
3. Warm the bagged sample to at least 40 degrees Fahrenheit to enhance volatilization. Warming should occur for at least 10 minutes, but it should not exceed 1 hour. Agitate the sample for 15 seconds at the beginning and end of warming to assist volatilization.

4. Once the sample is adequately warmed, insert the PID probe into the bag by puncturing the bag at a point approximately one-half of the headspace depth. Take care to prevent uptake of soil particles or moisture droplets. Use a moisture filter on the PID probe to prevent damage to the instrument.
5. Record the highest concentration reading on the soil boring log. The maximum reading typically occurs between 2 and 5 seconds after inserting the probe. Note erratic readings in the field logbook.

6.0 MAINTENANCE

Routine maintenance must be performed by qualified personnel. Maintenance should include inspection of the following components:

- Battery pack
- Sensor module
- PID lamp
- Sampling pump
- Inlet connectors and filters

Any components that are not functioning as intended should be repaired or replaced.

6.1 Battery Charging and Replacement

When the PID display shows a flashing message “Bat”, the battery requires recharging. The PID should be recharged daily after returning from the field. A fully charged battery will last for approximately 10 hours of continuous monitoring. The built-in charging circuit is controlled by the micro-controller to prevent over-charging. The battery may be replaced in the field, if required. Refer to the Operational and Maintenance Manual for instructions on “Replacing the Battery Pack and Replacing the Alkaline Battery Adapter.”

6.2 Troubleshooting

Common troubleshooting procedures are listed in the following table.

PROBLEM	REASONS AND SOLUTIONS
Cannot turn on power after charging the battery	**Reasons:** Discharged battery; defective battery; microcomputer hang-up. **Solutions:** Charge or replace battery; disconnect, then connect the battery to reset computer.
Reading abnormally high	**Reasons:** Dirty sensor module; dirty water trap filter; excessive moisture and water condensation. **Solutions:** Clean sensor module and lamp housing; replace water trap filter; blow dry the sensor module.
Reading abnormally low	**Reasons:** Incorrect calibration; low sensitivity to the specific gas; weak or dirty lamp; air leakage. **Solutions:** Calibrate the monitor; replace sensor; clean or replace lamp; check air leakage.
“Lamp” message during operation	**Reasons:** Lamp drive circuit; lamp threshold set too high; weak or defective PID lamp. **Solutions:** Check and reset lamp threshold; replace the UV lamp.
Calibration error message	**Reasons:** No standard gas input; weak PID lamp; unit zeroed with gas present. **Solutions:** Make sure standard gas flows into the monitor; zero sensor and recalibrate; replace lamp.

PROBLEM	REASONS AND SOLUTIONS
Random readings	**Reasons:** Incorrect calibration gas value; low sensitivity to calibration gas; weak or dirty lamp. **Solutions:** Calibrate the sensor; use different calibration gas; clean or replace lamp; check air leakage.

7.0 REFERENCES

RAE Systems. 2005. *MiniRAE 2000 Portable VOC Monitor PGM-7600, Operational and Maintenance Manual. Document No. 011-4001-000.* May.

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STANDARD OPERATING PROCEDURE

BE-SOP-20

Water Quality Measurements

1.0 INTRODUCTION

The purpose of the Standard Operating Procedure (SOP) is to describe the methods of calibrating, maintaining and operating water quality meters and probes used for groundwater sampling. The YSI 556 Multi-Probe System (MPS) and Aqua TROLL 500 are common multimeters used which will simultaneously measure temperature, conductivity, pH, dissolved oxygen (DO), and oxidation reduction potential (ORP). This SOP also describes the guidelines for calibration and operation of the Hach Portable Turbidity Meter. The manufacturer's operator's manual should be referred to for specific calibration, operation procedures and troubleshooting.

This SOP was developed in accordance with the following guidance documents:

- *Field Sampling Guidance* (Alaska Department of Environmental Conservation [ADEC] 2022)
- *Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations* (ASTM International [ASTM] 2018)

This SOP focuses on the mostly commonly used collection methods of field water quality parameters and should be used in conjunction with other applicable SOPs, including the following:

- BE-SOP-01: Logbook Documentation and Field Notes
- BE-SOP-09: Groundwater Sampling
- BE-SOP-10: Surface Water Sampling
- BE-SOP-14: Equipment Decontamination
- BE-SOP-21: Groundwater and Light Non-Aqueous Phase Liquid (LNAPL) Measurements

2.0 EQUIPMENT AND SUPPLIES

Calibration and water quality measurement equipment will include, but is not limited to the following:

- Multimeter, which may include:
    - YSI 556 MPS (or similar)
    - YSI 5563 Probe Module
    - Aqua TROLL 600 Multi-parameter Sonde, Wireless TROLL Com communication device, and Aqua TROLL tablet with VuSitu App
- Flow-through cell
- Discharge hoses and fittings to attach sample tubing to the flow-through cell
- Calibration standards (pH 4, 7, and 10, ORP, and conductance)
- Aqua TROLL Quick-Cal Multiple Sensor Solution, if using Aqua TROLL
- Rugged DO (RDO) calibration sponge or 100 percent (%) saturation bubbler, if using Aqua TROLL
- Deionized water (DI)

- Spray bottle
- Graduated cylinder or beaker, if needed
- 5-gallon buckets
- Portable turbidity meter (e.g., Hach 2100P or Hach 2100Q) and turbidity standards (less than 0.1, 20, 100, and 800 nephelometric turbidity units [NTU])
- Appropriate level of personal protective equipment
- Logbook, weatherproof pen, sharpie, etc.
- Multi-parameter and turbidimeter calibration logs (Attachment 1 and 2)

3.0 PROCEDURES

Calibrate or perform a calibration check on equipment daily. Calibration readings should be documented in the field logbook and/or calibration logs (Attachment 1 and 2). If a field instrument will not calibrate, perform troubleshooting as described in the manufacturer's manual. If the issue cannot be resolved, use a backup instrument. If that is not an option, contact the Project Manager on whether data collection will continue or if any other corrective actions should be taken. Flag any data recorded from a meter with suspected calibration problems on the field forms. If anomalous field readings are given during sample collection, stop and recalibrate the instrument.

3.1 Calibration of YSI 556 MPS

The transport/calibration cup that comes with the probe module serves as the calibration chamber and minimizes the volume of calibration reagents required. The key to successful calibration is to ensure that the sensors are completely submersed when calibration values are entered. For maximum accuracy, use a small amount of calibration solution to pre-rinse the probe module (YSI 2009). Consult the YSI operations manual for further information.

3.1.1 pH

Always calibrate pH using the 3-point calibration method. 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. To calibrate pH:

- Select the 3-point option to calibrate the pH sensor using three calibration solutions.
- When calibrating pH, always calibrate with buffer 7 first.
- Place 30 milliliters (mL) of pH buffer into a clean, dry, or pre-rinsed transport/calibration cup, and securely tighten the cup on the threaded end of the probe module.
- Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.
- Enter the calibration value of the buffer at the current temperature.
- Press **Enter**. The pH Calibration screen is displayed.
- Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

- When the readings show no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to continue.
- After returning to the Calibrate screen, rinse the probe module and sensors with tap or purified water and dry.
- Repeat these steps using a second pH buffer, and then repeat again using a third pH buffer.
- After returning to the Calibrate screen, rinse the probe module and sensors with tap or purified water and dry.

3.1.2 Conductivity

For maximum accuracy, the conductivity standard should be within the same conductivity range as the samples you are preparing to measure.

- For fresh water use a 1 milliSiemens per centimeter (mS/cm) conductivity standard.
- For brackish water use a 10 mS/cm conductivity standard.
- For seawater use a 50 mS/cm conductivity standard.

Always calibrate conductivity for specific conductance. Calibrating for specific conductance will automatically calibrate for conductivity and salinity. To calibrate specific conductance:

- Place 55 mL of conductivity standard into a clean, dry, or pre-rinsed transport/calibration cup, and securely tighten the cup on the threaded end of the probe module.
- Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.
- Enter the calibration value of the standard you are using in mS/cm at 25degrees Celsius (°C) and press **Enter**.
- Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
- When the readings show no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to continue.
- After returning to the Calibrate screen, rinse the probe module and sensors with tap or purified water and dry.

3.1.3 ORP

To calibrate for ORP:

- Place 30 mL of a known ORP solution into a clean, dry, or pre-rinsed transport/calibration cup, and securely tighten the cup on the threaded end of the probe module.
- Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.
- Enter the correct value of the calibration solution at the current temperature. Refer to the solution values on the calibration standard bottle.
- Press **Enter**. The ORP calibration screen will be displayed.

- Allow at least one minute for temperature equilibration before proceeding. Verify that the temperature reading matches the value you used.
- Observe the reading under ORP. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to continue.
- After returning to the Calibrate screen, rinse the probe module and sensors with tap or purified water and dry.

3.1.4 DO

Always calibrate for % DO. Calibrating for % DO will automatically calibrate for milligrams per liter. The instrument must be on for at least 10 to 15 minutes to polarize the DO sensor before calibrating. To calibrate DO:

- Place 1/8 inch (3 mm) of water in the bottom of the transport/calibration cup.
- Place the probe module into the transport/calibration cup.
  - Make sure the DO and temperature sensors are **not** immersed in the water.
- Engage only 1 or 2 threads of the transport/calibration cup to ensure the DO sensor is vented to the atmosphere.
- Use the keypad to enter the current local barometric pressure in mmHg.
  - If the unit has the optional barometer, no manual entry is required.
- Press **Enter**. The DO % saturation calibration screen will be displayed.
- Allow approximately 10 minutes for the air in the transport/calibration cup to become water saturated and for the temperature to equilibrate before proceeding.
- Observe the reading under DO %. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to continue.
- After returning to the Calibrate screen, rinse the probe module and sensors with tap or purified water and dry.

3.2 Aqua TROLL 500 Multi-Parameter Sonde

The restrictor attached in storage/calibration mode serves as the calibration chamber and minimizes the volume of calibration reagents required. For best calibration, it is recommended to rinse twice with the calibration solution to ensure all contaminants have been removed (In Situ 2019). Aqua TROLL may be calibrated using single sensor calibration standards for pH, conductivity, and ORP. However, the Aqua TROLL sonde may also be calibrated using a multi-sensor calibration standard, Quick-Cal Solution, for these three parameters.

3.2.1 Solution-Based Calibration

Refer to the Aqua TROLL operator's manual if using single sensor calibration standards. The following procedures will be used for performing a multi-sensor calibration using Quick-Cal Solution:

- Ready the instrument for calibration
  - Remove the rubber bumper and blue top cap from the restrictor.
  - Remove the restrictor and reattach in calibration mode to form the calibration cell.
  - Invert the instrument, so the sensors are facing up.
  - Rinse the sensors with DI or tap water. Ensure the sensor face and inside of calibration cell are clean and free of debris.
- Ready the tablet for calibration
  - From the main menu, select **Connected Instrument.**
  - Select **Calibrations**.
  - Select **Quick-Cal (multi-sensor)**.
    - All available sensors are selected by default. If one or more sensors are not installed properly, an error message will pop up.
  - Select **Next**.
- Solution Rinse Procedure
  - Pour 10 to 20 mL (1/2-inch above the sensor face) of the calibration standard onto the sensors to perform the first rinse.
  - Ensure the solution comes in contact with the sensors by moving the solution around in the calibration cell. Reinstall the blue top cap and shake gently, if necessary.
  - Discard the calibration standard.
  - Repeat solution rinse procedure. Aqua TROLL recommends two rinses to ensure the best calibration of the instrument.
- Sensor Calibration Procedure
  - Fill the calibration cell with 40 to 50 mL (to the bottom of the threads inside the restrictor) with fresh calibration solution.
    - Check the sensor for bubbles and gently tap to remove any bubbles.
  - Select **Next**.
  - After the calibration is stable, select **Accept**.
  - The calibration values applied to the sensor will appear on-screen. Select **Done** to return to the calibration menu.

3.2.2 DO 100% Saturation Calibration

The RDO sensor is typically calibrated using a 1-point calibration method. The water-saturated air method is most commonly used, while the saturation bubbler method requires an additional calibration chamber. Other calibration methods are available in the owner's manual. The factory calibration of the RDO sensor should produce readings within 3% accuracy (In Situ 2019). If greater accuracy is required, In Situ recommends performing a 1-point 100% water-saturated air calibration using the following procedure:

- From the main menu, select **Connected Instrument**.
- Select **Calibrations**.
- Select **RDO Saturation**.
- For a 1-point calibration, select **100% Saturation**.
- Set up the instrument for one of the following methods:
  - Option 1 – Water-Saturated Air
    - Remove the restrictor and thoroughly dry the RDO sensing foil and temperature sensor.
    - Saturate a small sponge with water (does not need to be dripping).
    - Place the sponge in the bottom of the restrictor and attach the end cap, turning one full rotation.
      - Do not fully seal the bottom of the restrictor.
  - Wait 5 to 10 minutes for 100% water saturation of the air within the calibration chamber before starting the calibration.
  - After the calibration chamber has stabilized, select **Next**.
  - After calibration is stable, select **Next**.
  - The calibration values will be applied to the sensor and appear on-screen. Select **Done** to return to the Calibration Menu.
- Option 2 – Bubbler
  - Fill at 100% saturation bubbler half full of tap water.
  - Turn on the bubbler.
  - Wait 5 to 10 minutes for the bubbler to reach 100% saturation.
  - Install the restrictor in deployment mode, remove blue end cap and place the sonde in the bubbler.
  - After the calibration chamber or bubbler has stabilized, select **Next**.
  - After calibration is stable, select **Next**.
  - The calibration values will be applied to the sensor and appear on-screen. Select **Done** to return to the Calibration Menu.

3.3 Hach Portable Turbidimeter

The Hach Model 2100P or 2100Q Portable Turbidimeter measures turbidity from 0.01 to 1,000 NTU in automatic range mode with automatic decimal point placement. For more information, consult the Hach user manual. Use the following procedure for turbidity measurements:

- Collect a representative sample in a clean container. Fill a sample cell to the line (about 15 mL), taking care to handle the sample cell by the top. Cap the cell.
- Wipe the cell with a soft cloth to remove water spots and fingerprints.
- Apply a thin film of silicone oil. Wipe with a soft cloth to obtain an even film over the entire surface.

- Turn the instrument on and place on a flat sturdy surface.
- Insert the sample cell in the instrument call compartment so the diamond or orientation mark aligns with the raised orientation mark in from of the cell compartment.
- Press **Read** and the result will show in units of NTU.

3.3.1 Calibration of Hach 2100Q Portable Turbidimeter

For best consistency and accuracy, calibrate using the StablCal Calibration Set and always insert the cell so the orientation mark on the cell is correctly aligned with the mark on the front of the cell compartment (Hach 2017).

- Push the **Calibration** key to enter the Calibration mode.
  - Gently invert each standard before insertion.
- Insert the 20 NTU StablCal Standard and close the lid.
- Push **Read**. The display shows Stabilizing and then shows the result.
- Repeat with the 100 NTU and 800 NTU StablCal Standard.
- Push **Done** to review the calibration details.
- Push **Store** to save the results.

3.4 Collection of Water Quality Measurements

Water quality parameters (DO, ORP, pH, and conductivity) are chemical properties measured to determine when discharged groundwater is considered representative of the formation water and sampling can begin (ASTM 2018). Water quality parameters are measured using a multi-parameter instrument coupled with an in-line flow-through cell. The typical volume of the flow-through cell is 500 mL.

3.4.1 Groundwater Parameters

Follow this general procedure for collecting water quality parameters using a flow-through cell:

- Secure the instrument 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 this discharge tube into a 5-gallon purge water bucket.
- Place the tube from the pump directly into the 5-gallon purge water bucket and purge for approximately half a minute or until the purge water begins to visually clear up. The intent is to limit any initially highly turbid water from accumulating in the flow-through cell.
- Once visually clear, secure the tube from the pump to the influent connector at the bottom of the flow-through cell.
- Continue low-flow purging at a flow rate of approximately 1 liter (0.26 gallons) every 3 to 5 minutes, or 50 to 500 mL/minute (ADEC 2022).
- Routinely measure and record required parameters and the depth to groundwater every 3 to 5 minutes. A minimum of three recordings will be monitored and recorded.
- Continue to monitor until parameters stabilize or until three well casing volumes have been purged. Use the following stabilization parameters (ADEC 2022):
  - Plus or minus (±) 3% for temperature (minimum of ± 0.2°C)

  - ± 0.1 for pH
  - ± 3% for conductivity
  - ± 10 mv for redox potential
  - ± 10% for DO
  - ± 10% for turbidity
- When parameters have stabilized, record final measurements, and collect samples per the project-specific Work Plan.

Note: Low-flow purging and sample collection are particularly useful for wells that purge dry or take one hour or longer to recover. If a well is purged dry or recovery exceeds one hour, collect a sample as soon as the well has recharged to approximately 80% of its pre-purge volume, when practical (ADEC 2022).

3.4.2 Surface Water Parameters

Water quality measurements should be taken when collecting surface water samples, when specified in the project-specific Work Plan. Additional parameters (stream discharge rate, salinity, etc.) may be necessary when collecting surface water samples (ADEC 2022). Section 8.0 of the ADEC *Field Sampling Guidance* (2022) contains additional information for surface water sampling and parameter collection.

4.0 DATA AND RECORD MANAGEMENT

The Multi-Parameter Calibration Log (Attachment 1) and the Turbidimeter Bump Check Log (Attachment 2) are intended for use in the field during groundwater sampling and monitoring well development activities. Complete these datasheets according to this SOP and the Logbook Documentation and Field Notes (BE-SOP-01).

5.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC). 2022. *Field Sampling Guidance.* January.

ASTM International (ASTM). 2018. *Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations. D6771.* West Conshohocken, Pennsylvania. September.

Hach Company. 2017. *Hach 2100Q and 2100Qis User Manual.* December.

In-Situ. 2020. *Aqua TROLL 500 Multiparameter Sonde Operator's Manual.* November.

YSI Environmental. 2009. *YSI 556 Multi Probe System Operations Manual.* August.

ATTACHMENTS

Multi-Parameter Calibration Log
Turbidity Meter Calibration Verification Check

Multi-Parameter Calibration Log

Project Name/Location: ______________________________

Project Number: ______________________________

Equipment Make and Model(s): ______________ & ______________

Serial Number(s): ______________ & ______________

SERIAL NUM.	DATE	TEMP.	PH (3 PT.)		COND. (µS/cm)		ORP (mV)		DO (100%)		INITIALS
			STANDARD	READING	STANDARD	READING	STANDARD	READING	ATM. PRESS. (mmHG)	READING (%)	

SERIAL NUM.	DATE	TEMP.	PH (3 PT.)		COND. (µS/cm)		ORP (mV)		DO (100%)		INITIALS
			STANDARD	READING	STANDARD	READING	STANDARD	READING	ATM. PRESS. (mmHG)	READING (%)	

Turbidity Meter Calibration Verification Check

Project Name/Location: ______________________________

Project Number: ______________________________

Equipment Make and Model(s): ____________________ & ____________________

DATE	**TIME**	**SERIAL #:**			**SERIAL #:**			**INITIALS**
		_____NTU	**_____NTU**	**_____NTU**	**_____NTU**	**_____NTU**	**_____NTU**	

DATE	TIME	SERIAL #:			SERIAL #:			INITIALS
		______NTU	______NTU	______NTU	______NTU	______NTU	______NTU	

STANDARD OPERATING PROCEDURE

BE-SOP-21

Groundwater and LNAPL Measurements

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) describes the procedures and equipment that should be used to determine water levels, depth to floating product, or total depth in a groundwater monitoring well. Groundwater measurements can be used for several purposes during field activities, including but not limited to, measuring changes in time, and determining the magnitude of horizontal and vertical hydraulic gradients in an aquifer system.

A water level meter will typically be used to measure depth to groundwater (DTW), depth to product (DTP), and total depth (TD) in wells. If light non-aqueous phase liquid (LNAPL) is present in the well, an oil-water interface probe will be used.

2.0 EQUIPMENT

Groundwater and LNAPL measurement equipment will include:

- Water Level meter with audible alarm and a cable marked in 0.01-foot increments
- Oil-water interface meter (only if LNAPL layer is suspected)
- Decontamination equipment

2.1 Depth to Water/Depth to LNAPL Measurement

If the well is sealed with an airtight cap, allow time for the pressure to equilibrate after the cap is removed before measuring water levels. Take measurements until consecutive readings are within 0.01 foot.

Before taking measurements, ensure a reference point is established. 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 the casing. If no reference mark is present, mark the north side of the monitoring well casing.

Measure DTW and DTP as follows:

- With the water level indicator switched on, 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.
- 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.
- If LNAPL is present in the well, measure and record the depth from the top of casing 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.

- 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.
- Record the measurements in the field logbook or on the Well Purge and Sampling Form.

2.2 Total Depth Measurement

Use the following procedures to measure the TD of a groundwater monitoring well:

- 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.
- Gently raise and lower the water level meter probe to tap the bottom of the well.
- 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 on the Well Purge and Sampling Form.

STANDARD OPERATING PROCEDURE

BE-SOP-22

Monitoring Well Installation, Development, and Decommissioning

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) is to be used as reference to describe the process for constructing, installing, and developing groundwater monitoring wells provided by a drilling subcontractor via drill-rig operation. This SOP provides a standard set of procedures applicable under typical site conditions and may vary based on actual site conditions and/or equipment characteristics. This SOP is consistent with *Monitoring Well Guidance* issued by the Alaska Department of Environmental Conservation (ADEC 2013). Specific monitoring well design and installation procedures depend on project objectives and subsurface conditions and should be discussed in the project-specific Work Plan (WP).

Monitoring wells can be installed as long-term monitoring wells, which can be repeatedly sampled over several years, or as temporary well points, which allow for a one-time groundwater sampling event. Following development, purging, and sampling – a temporary well point is usually removed and backfilled in accordance with ADEC regulations.

2.0 EQUIPMENT AND MATERIALS

The driller will supply all materials and equipment necessary to perform drilling activities in accordance with the Drilling and Core Logging SOP (BE-SOP-05) and will install monitoring wells in locations based on field observations, the Statement of Work, and in the project-specific WP.

Temporary well points are most commonly 1- to 2-inch diameter screened polyvinyl chloride (PVC) or stainless steel pipe, which can be pre-packed with filter material, or used without a filter pack. Temporary well points can be installed using a direct push drill rig or by hand, if in unconsolidated material with a shallow water table.

Monitoring wells are usually installed with pre-packed screens.

Equipment and materials needed for monitoring well installation include, but are not limited to, the following:

- Geoprobe® 66 series drill rig or equivalent
- Well casing and screen
- Filter pack materials
- Bentonite
- Surface seal materials (concrete)
- Potable water and/or deionized water
- Weighted tape measure

Monitoring well development equipment may include, but is not limited to the following:

- Water level meter or oil/water interface probe
- Surge block (with foot valve)

- Peristaltic pump
- Submersible pump
- Sprinkler pump (useful for removing large volumes of silt and fine sand laden water)
- Inertial pump and tubing (optional-consider for deep wells greater than 30 feet)
- Disposable polyethylene or Teflon bailers
- 5-gallon buckets
- Graduated cylinder or beaker
- YSI water-quality meter or Aqua-TROLL
- Hach portable turbidity meter
- Potable water and/or deionized water
- Disposable polyethylene tubing

3.0 DOCUMENTATION

Fill out the attached *Well Installation and Well Development Forms* following installation and when developing the monitoring well. All fields on the installation form must be completed for long-term monitoring wells as well as temporary well points. All fields on applicable field forms will be used or an "NA" will be inserted to indicate a field that is not applicable. The field form sections are outlined below:

- Well designation
- Date of well installation
- Date of development
- Static water level before and after development
- Quantity of drilling fluid lost during drilling (if applicable)
- Well volume
- Depth from top of well casing to bottom of well
- Screen length
- Depth from top of well casing to top of sediment inside well, before and after development, if present
- Physical characteristics of removed water, including changes during development in clarity, color, particulates, and odor
- Type and size/capacity of pump and/or bailer used
- Height of well casing above/below ground surface (bgs)
- Typical pumping rate
- Estimate of recharge rate
- Quantity of water removed and time of removal

The *Drilling and Core Logging* SOP (BE-SOP-05) will be followed in compliance with the ASTM International (ASTM) D2488 Unified Soil Classification standards (ASTM 2009). The Core Log SOP (BE-SOP-05 Attachment) field form must be completed during installation and before leaving the site to ensure all details are captured and are complete and accurate.

Monitoring wells will be surveyed within a horizontal accuracy of 1 foot and a vertical accuracy of 0.01 foot. The top of the well casing will be surveyed as well as ground surface for use as a reference point to determine water level elevation, sampling depths, and groundwater flow direction. All survey information will be documented in the field logbook.

4.0 WELL INSTALLATION PROCEDURES

This section describes drilling, borehole, casing, well screen, bentonite seal, and monitoring well completion requirements.

Prior to monitoring well installation, ADEC recommends developing a conceptual model of the site geology and hydrology. This allows for a better understanding of the distribution of aquifers and aquitards at or near the site, hydrologic boundaries, the water surface table, and other hydrogeographic properties. This is a working model to be updated as new data is obtained.

4.1 Drilling Requirements

Several drilling methods are available for creating a borehole for well installation. Primary methods include hollow stem, direct push, air rotary, mud rotary, and cable tool. The drilling method is chosen based on physical subsurface properties.

All drilling activities will be supervised by a qualified environmental professional. The drill rig will be decontaminated appropriately before it enters and leaves the site in accordance with the Equipment Decontamination SOP (BE-SOP-14). All leaks will be repaired prior to coming to the site or as soon as they are discovered at the site. The drill rig will not leak any fluids that may enter the borehole or contaminate equipment placed in the hole. The use of rags or absorbent materials to soak up leaking fluids is unacceptable. Brice, or the drilling subcontractor, will have spill response equipment on site at all times to ensure constant preparedness in case fluids begin to drip from the rig so they do not impact the site.

Drilling mud, synthetic drilling fluids, petroleum or metal-based pipe joint compounds, and other potential contaminants will not be used unless necessary. Only high yield sodium bentonite clay free of organic polymer additives will be used if drilling mud is needed to stabilize the hole. Decontamination water must be potable and obtained from a known water source. A monitoring well construction form will be completed for each monitoring well. Each well point will be surveyed.

4.2 Borehole Requirements

The completed monitoring well must be straight and plumb to allow passage of pumps or sampling devices.

4.3 Casing Requirements

The following lists requirements for the casings of monitoring wells:

- All casing will be new, unused, and pre-cleaned (if necessary).
- Glue or solvent will not be used to join casing; casings will be joined only with water-tight flush-joint threads or thermal welds that will not interfere with the planned use of the well.
- Pop rivets or screws should not be used on casings or other monitoring well components.

- All monitoring wells will conform to the ASTM F-480-06b. PVC is a durable monitoring well material with good chemical resistance (U.S. Environmental Protection Agency [EPA] 1991). Diameters will be identified in the WP.
- The casing will be straight and plumb within the tolerance stated for the borehole.
- A notch in the top of the casing will be cut or marked to be used as a measuring point for water levels and survey activities. Boring location will be noted based on the identification number.
- The addition of bentonite surrounding the PVC casing will be visually verified during well installation activities to ensure that bridging is not occurring during withdrawal of the drill string/equipment.

4.4 Well Screen Requirements

The following are the requirements that must be met for well screens:

- All requirements that apply to casing will also apply to well screen, except for strength requirements.
- Monitoring wells will not be screened across more than one water-bearing unit. Screens will be factory slotted or wrapped.
- Screen slots will be sized to prevent 90 percent (%) of the filter pack from entering the well, and for wells where no filter pack is used, the screen slot size will be selected to retain 60 to 70% of the formation materials opposite the screen.
- The bottom of the screen is to be capped, and the cap will be joined to the screen by threads.

In most hydrogeologic settings, screen lengths should not exceed 10 feet. The use of shorter well screens may allow for contaminant detection by reducing excessive dilution.

4.5 Filter Pack Requirements

Surrounding the monitoring well intake with materials that are coarser, of uniform grain size, and have a higher permeability than natural formation material allows the groundwater to flow freely into the well from adjacent formation material while minimizing or eliminating the entrance of fine-grained materials. Determine the appropriate filter pack (natural or artificial) application for a given well. An artificial filter pack typically meets these conditions. Deciding between natural and artificial filter pack depends on the grain size distribution of the natural formation materials in the monitored zone. The filter pack should extend above the well screen to a length of 20% of the well screen length, but no less than 2 feet (ASTM D5092 2005). The thickness of the filter pack should be at least 2 inches between the borehole and the well screen, and no greater than 8 inches (EPA 1991).

4.6 Seal Requirements

An annular seal should be installed to restrict vertical movement of water or contaminants by sealing the well casing to the adjacent soil formation. The annular seal consists of bentonite chips from the filter pack to approximately 2 feet bgs.

The bentonite seal requirements for wells installed deeper than 12 feet bgs, are as follows:

- The bentonite seal will consist of at least 2 feet of bentonite between the filter pack and the silica sand used to fill the borehole to the ground surface.

- The bentonite will be hydrated after placement.
- Only 100% sodium bentonite will be used.

The bentonite seal will be terminated 2 feet from the ground surface. The remainder of the annulus will be backfilled using silica sand to minimize bentonite intrusion into the well monument and to promote drainage of water from inside the monument. If the monitoring well is advanced in frozen ground, the annular space between the casing and any permafrost should be sealed to minimize effects on the subsurface thermal regime and to prevent water within the well from freezing.

Seal requirements for wells with submerged screens or screened in deep confined aquifers will be described in the site-specific WP.

4.7 Soil Boring and Logging

Soil borings will be logged at each site where monitoring wells will be installed. Refer to BE-SOP-05 for the drilling and core logging procedure.

4.8 Monitoring Well Surface Completion Requirements

Surface completion is not necessary for temporary well points.

If flush-mounted completions, cut the casing approximately 6 inches bgs and provide a water-tight casing cap to prevent surface water from entering the well. A freely draining surface monument with a locking cover should be placed over the casing. The surface monument should be placed in well-sorted sand to allow water drainage. If the well is located on a gravel pad, the top of the monument must be completed at least 3 inches below pad grade to protect it from snow removal equipment. The top of the casing will be at least 1 foot above the bottom of the surface monument. The identity of the well should be permanently marked on the monument lid and the casing cap.

For aboveground monitoring well completions, extend the well casing 2 or 3 feet above ground surface. Provide a casing cap for each well and shield the extended casing with a steel sleeve that is placed over the casing and cap and seated in a 3-foot by 3-foot by 4-inch concrete surface pad. To allow for the escape of gas, a small diameter (e.g., 1/4-inch) vent hole must be placed in the well casing, or a ventilated well cap will be used. The diameter of the sleeve should be at least 6 inches greater than the diameter of the casing. Install a lockable cap or lid on the guard pipe. The identity of the well should be permanently marked on the casing cap and the protective sleeve.

Well locations must be designed to ensure groundwater samples and water level measurements characterize discrete stratigraphic intervals. This is achieved by positioning the screened interval relative to the water table elevation.

Well locations and designs must prevent surface contaminants from entering the groundwater as well as leakage of groundwater or contaminants between the stratigraphic intervals in the well bore or along the well annulus. Complete wells above grade to decrease potential of surface contaminants entering the well.

Install monitoring wells where there is no chance of seasonal inundation by floodwaters unless the wells have special water-tight construction.

Long-term monitoring well development:

- A drilled, long-term monitoring well is typically composed of well casing, well screen, and filter pack.
- Place the filter pack into the annulus to a minimum of 2 feet above the top of the screen and 1 foot beneath the well endcap.
- Reduce the required filter pack height to allow for annular space sealant.
- Apply bentonite chips to seal the annular space.

5.0 WELL DEVELOPMENT PROCEDURES

Monitoring wells should not be developed for **at least 24 hours after installation**.

Wells can be developed using a submersible pump, peristaltic pump, and/or bailer. Bailers are more commonly used in wells where there is a small volume of water.

Monitoring wells can be developed by first purging the well dry, if possible, then allowing the monitoring well to refill with formation water. If the recovery rate by the formation water is too slow, up to one well casing volume of potable water can be added to the well. The well should be surged vigorously for approximately 10 minutes using either a surge block or bailer. Add more water as necessary. Purge the well dry again to complete the development process (ADEC 2013).

For a well with sufficient water supply, there is no minimum volume of purge water identified in guidance for well development, but a minimum of three casing volumes is recommended; A clear, steady flow of water is the development target.

Removing twice the volume of water added during drilling and construction is often a workplan requirement.

After initial surging and pumping, groundwater parameters will be monitored for stability criteria (described below).

Groundwater parameter stability is reached when three changes between successive readings at approximately 5-minute intervals at a low-flow pumping rate (drawdown recommended to be less than 0.3 feet) are less than the criteria provided in Table 1.

Table 1 Stability Criteria for Low-Flow Purging

PARAMETER[1]	UNITS	RECORDING PRECISION	STABILITY CRITERION
pH	—	0.01	± 0.1
Temperature	°C	0.01	± 0.2
Conductivity	µS/cm	1	± 3%
Turbidity	NTU	0.1	± 10% or ± 1 NTU (whichever is greater)
Oxidation Reduction Potential (ORP)	mV	1	± 10
Dissolved Oxygen (DO)	mg/L	0.1	± 10% or 0.3 mg/L (whichever is greater)

Notes:
Stability criteria from ADEC *Field Sampling Guidance* (ADEC 2022).
[1] Only three parameters are required to stabilize, four when using temperature.
°C – degrees Celsius
± – plus or minus
% – percent
µS/cm – microSiemens per centimeter
NTU – nephelometric turbidity units
mg/L – milligrams per liter
mV – millivolts

Low-yielding wells are exceptions to the above criteria. Such wells should be purged dry, then either be allowed to recover or be filled with potable water to the static water level for surging. Add water as needed to maintain the water level during surging. Satisfactory recovery is defined as 80% of the well volume. After the initial recovery period, such wells will be surged and pumped dry again to complete the development process.

Alternative development procedures may be used if they will not affect the ability of the well to provide representative samples. Wells installed with an annular seal must not be developed until 24 hours after well installation to allow annular seal materials to set or cure. ADEC recognizes that remote site work may make this impractical. Contact your ADEC project manager for site-specific approval if development is to be conducted prior to the 24-hour waiting period. Sample the monitoring well in accordance with the ADEC *Field Sampling Guidance* (ADEC 2022). Additionally, temporary wells are often not developed; this will be described in the project-specific WP.

The well purge water will be collected into buckets or drums and treated on site or shipped off for disposal as identified in the project-specific WP.

A well is considered fully developed when the following criteria are met:

- The well water is clear to the unaided eye (based on observations of water clarity through a clear glass jar)
- If stability cannot be achieved, the well is considered developed when the total volume of water removed from the well equals five times the standing water volume in the well plus the volume of drilling fluid lost or potable water added (if fluids were added)

6.0 WELL DECOMMISSIONING

The purpose of decommissioning monitoring wells and temporary well points is to protect the aquifer. Monitoring wells and temporary well points should be decommissioned as soon as ADEC has determined they are no longer needed. This SOP is consistent with the decommissioning section of the *Monitoring Well Guidance* issued by ADEC (2013). Specific monitoring well decommissioning procedures depend on project objectives and subsurface conditions and must be discussed and presented in the project-specific WP. ADEC approval of the WP is required prior to decommissioning the wells.

1. Knock the bottom of the screen out with a steel drill rod/ pipe, which allows the well to be used as a tremie pipe.
2. Remove the well casing and screen until the screened interval is above the groundwater interface. This allows the material surrounding the well to collapse into the borehole. Keep a 1:1 ratio when pulling out the screen (i.e., if you have a 10-foot screen, pull the well out 10 feet).
3. After the casing is withdrawn above the groundwater interface, add some bentonite chips to the well. Withdraw the casing further and continue adding bentonite chips. Continue this iterative process (pull the casing, fill the borehole, pull the casing, fill the borehole) to within 2 feet of the ground surface.
4. If the well is shallow, add water to hydrate the bentonite chips. Add additional bentonite chips as necessary to seal the well to within 2 feet of the ground surface.
5. If the well is located in a confined aquifer, bentonite chips should begin to be placed within the confining stratum.
6. Fill the remaining 2 feet of the borehole with sand or gravel and restore the site as necessary.
7. Record decommissioning procedures and report to ADEC.

If the well casing and screen are unable to be removed at the time of decommissioning, and it is known that the well construction included a competent annular seal of bentonite chips surrounding the well casing, the screen should be filled with sand and the casing should be completely sealed in-place with bentonite chips up to the casing cutoff point located near the ground surface.

If the monitoring well is damaged, broken, filled, or plugged with soil or other extraneous material preventing successful decommissioning efforts by the methods described previously, decommissioning can be achieved by digging to 2 feet bgs, cutting off the well at that depth, the backfilling with sand and bentonite.

7.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC). 2013. *Monitoring Well Guidance.* September.

ADEC. 2022. *Field Sampling Guidance.* January.

ASTM International (ASTM). 2009. *Standard Practice for Description and Identification of Soils Visual-Manual Procedure.* D2488. West Conshocken, Pennsylvania. July.

U.S. Environmental Protection Agency (EPA). 1991. *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells.* Office of Research and Development.

EPA. 2008. *Region 4 Design and Installation of Monitoring Wells, Science and Ecosystem Support Division.* February.

ATTACHMENTS

Record of Well Construction
Well Development Data Sheets

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Record of Well Construction

Project	Project Number	Client	Boring No.
Address, City, State		Drilling Contractor	
Logged by	Date: Started	Drilling Method and Equipment Used	
Drill Crew	Date: Completed		
	Groundwater Depth	Elevation	Total Depth

Depth (feet)	Diagram	Field Installation Information
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

_____ Surface Monument (material _____)

_____ Surface Seal

_____ Bentonite Seal

_____ Casing (material _____)

_____ Screen (material _____)

_____ Screen Filter (material _____)

_____ Surface Elevation

_____ Casing Elevation

_____ Casing Stickup

_____ Depth of Well

_____ Depth of Boring

_____ Depth to Groundwater from _____ on (date) _____

Development Method _____

Development Time and Purge Volume _____

Record of Well Construction

Field Notes from Drilling

Date	End Time	Start Time
Note-Taker Name		Boring Number
Surface Conditions		

WELL DEVELOPMENT FORM

PROJECT NO: **SITE ID:** **WELL ID:** **SHEET** **of**

PROJECT NAME		**WELL CONSTRUCTION DATA**		**BOREHOLE VOLUME FACTORS [BVF]**			
CLIENT		**TIME/DATE WELL COMPLETED**		**CASING MATERIAL**	**CASING I.D. (in)**	**BOREHOLE DIAMETER (in)**	**CV / BVF (gal/lin ft)**
		AS-BUILT TOTAL DEPTH OF WELL(ft BTOC)		1” Sch40 PVC	1.049	4.5	**0.041 / 0.279**
EVENT		**CASING MATERIAL AND DIMENSIONS**		2” Sch40 PVC	2.067	4.5	**0.163 / 0.370**
DEVELOPER(S)		**SCREEN LENGTH (ft)/ SCREEN TYPE**		2” Sch40 PVC	2.067	6	**0.163 / 0.370**
WEATHER/ TEMPERATURE		**DEPTH TO TOP FILTER PACK (ft BTOC)/FILTER PACK TYPE**		2” Sch40 PVC	2.067	8	**0.163 / 0.370**
DATE		**DEPTH TO WATER AT TIME OFDRILLING (ft BTOC)**		2” Sch40 PVC	2.067	10	**0.163 / 0.370**
START TIME		**HEIGHT OF WATER COLUMN ATTIME OF DRILLING (ft)**		4” Sch40 PVC	4.026	8	**0.653 / 0.370**
END TIME		**BOREHOLE DIAMETER (in)**		4” Sch40 PVC	4.026	10	**0.653 / 0.370**
TOTAL PURGE VOLUME		**VOLUME OF WATER ADDED DURING DRILLING (gal)**		All BVF calculations assume a filter pack porosity of 0.3.			

PRE-PURGE DEVELOPMENT DATA

PURGING EQUIPMENT:		**IF PRODUCT IS PRESENT**	
(PUMP TYPE AND MATERIAL, OTHER APPARATUS)		**DEPTH TO PRODUCT (ft FROM TOC):**	**THICKNESS OF PRODUCT (ft):**
		PRODUCT DESCRIPTION:	
EQUIPMENT DECON PROCEDURE:		**PURGE WATER DISPOSAL METHOD:**	
EQUIPMENT SERIAL NUMBERS:	**TURBIDIMETER**	**OTHER**	

PRE-PURGE WATER COLUMN OBSERVATIONS AND RECOVERY CALCULATIONS		**PURGE VOLUME CALCULATIONS**		
DEPTH TO WATER (ft BTOC)		**For screen across the water table:** Borehole + Casing Volume (BV) = [Casing Total Depth - Depth to Water] * BVF	**For a drowned screen:** Borehole + Casing Volume (BV) = [Casing Total Depth - Depth to Top Filter Pack] * BVF	For borehole volume factors (BVF), see uppermost section on the right side of this form, above.
TOTAL DEPTH (ft BTOC)				
HEIGHT OF WATER COLUMN (ft)			**BOREHOLE VOLUME (BV, gal)** Calculated using the appropriate formula above.	
80% HEIGHT OF WATER COLUMN (ft BTOC)			**Casing Volume (CV, gal)**	
DROWNED SCREEN?			**3X Casing Volume (CV, gal)** Recommended minimum purge volume	

PURGE DATA

ACTIVITY (Surge, Purge, Recovery)	**TIME**	**WATER LEVEL (ft BTOC)**	**TOTAL DEPTH (ft BTOC)**	**PURGED VOLUME (gallons or liters)**		**TURBIDITY (Qualitative or NTU)**	**NOTES (Flow data: pump intake depth, approximate flowrate, purged dry) (Water quality: color, odor, sheen, sediment in purge water or at TD)**
				THIS CYCLE	**CUMULATIVE**		

WELL DEVELOPMENT FORM

PROJECT NO: **SITE ID:** **WELL ID:** **SHEET** **of**

ADDITIONAL PURGE DATA

ACTIVITY (Surge, Purge, Recovery)	TIME	WATER LEVEL (ft BTOC)	DRAW DOWN (ft)	TOTAL DEPTH (ft BTOC)	PURGED VOLUME (gallons or liters)		TURBIDITY (Qualitative or NTU)	NOTES (Flow data: pump intake depth, approximate flowrate, purged dry) (Water quality: color, odor, sheen, sediment in purge water or at TD)
					THIS CYCLE	CUMULATIVE	IDEAL <50 NTU	

STABILIZATION DATA

START TIME:	**END TIME:**	**TOTAL VOLUME PURGE (gal):**	**Stability Achieved: Y / N**

STABILIZATION EQUIPMENT:

PUMP TYPE AND MATERIAL, OTHER APPARATUS

PURGE WATER DISPOSAL METHOD

EQUIPMENT DECON PROCEDURE

PUMP INTAKE DEPTH: (ft BTOC or ft BTOW)

MAX FLOWRATE: (mL/min or gal/min)

STABILIZE DRAWDOWN AT THIS FLOWRATE?

DEDICATED TUBING LEFT?

EQUIPMENT SERIAL NUMBERS: YSI	**TURBIDIMETER**	**OTHER**

CONVERSIONS: 1,000 mL/min = 0.264 gal/min 1 gal/min = 1,893 mL/min 1 gal = 3.785 L 1 L = 0.264 gal

FIELD WATER QUALITY PARAMETERS

TIME	WATER LEVEL (ft BTOC)	DRAW DOWN (ft)	CUMULATIVE PURGED VOLUME (gallons or liters)	TEMPERATURE (°C or °F)	pH	CONDUCTIVITY (µS/cm)	ORP (mV)	D.O. (mg/L)	TURBIDITY (NTU)	COLOR	ODOR
				± 3% (min ± 0.2°C/0.36°F)	± 0.1	± 3%	± 10 mV	± 10%	± 10% or <10 NTU		

STANDARD OPERATING PROCEDURE

BE-SOP-25

Underground Utility Locates

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) describes the guidelines that will be used during underground utility locates. This SOP will be used to direct field personnel in the techniques and requirements for underground utility identification and clearance.

Underground utility identification and clearance is critical prior to subsurface investigation, drilling, and construction activities. Underground line locations must be known to ensure safe operations. Many states have laws that require all excavators or contractors engaging in subsurface work to notify utility companies at least 48 hours before beginning the work. The location and identification of these lines by the utility companies reduces the contractor's liability should lines be mis-located and damaged during subsurface activities. Underground utility lines are preferential pathways for organic vapor and liquid migration; therefore, knowing their location may aid in the site investigation and remediation processes.

2.0 PROCEDURES

When excavation, trenching, drilling, or other subsurface activities are anticipated, **a project team member must submit notification to the Alaska Digline (811 anywhere in Alaska or 1-800-478-3121)** and local utility companies where applicable. Proposed excavation and soil boring areas should be marked prior to the utility locate. In areas with known utilities, the utility company will conduct a survey of all proposed sample locations for underground utilities. Identified utilities will be marked according to the type of utility present. Typical markings include:

- Red – electric
- Yellow – gas line
- Orange – communication
- Blue – potable water
- Green – sewers and drain lines

Regardless of what method is used to locate underground utilities, never take their exact location for granted. Always begin each excavation and borehole slowly and cautiously, taking care to check for the presence of underground structures, lines, or indicator tape for at least the first 3 feet of depth; however, note that many utilities may be located deeper than 3 feet. If the soil is not too hard (i.e., gravelly), hand auger the first 3 feet of the borehole. Once drilled, check the first 3 feet with a (non-conductive) probe to make sure that no utilities are present in the sidewall of the borehole. If drilling on active military installations, follow their protocol, which will likely include completion of dig permits and obtaining signatures from facility engineering units.

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STANDARD OPERATING PROCEDURE

BE-SOP-51

Material Handling/Manual Lifting

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) describes the procedures that will be used when material handling/manual lifting at and around a job site.

2.0 GENERAL POLICY

Back injuries are one of the most common and most preventable injuries. After determining an object is within lifting capabilities, warm up by stretching before doing any lifting or strenuous work. Use proper lifting procedures - bend at the knees rather than the waist, and use your leg muscles, not your back. Keep a wide support base by standing with legs hip distance apart, and never twist while lifting. Take proper breaks during repetitive tasks and get help when moving heavy or awkward objects. Use lifting devices when possible. If necessary, have a competent worker or supervisor demonstrate the proper method of bending and lifting.

It is important to identify when materials require lifting equipment, such as slings and chokers, and to determine the proper equipment to assist in lifting the object if manual lifting techniques are not safe.

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STANDARD OPERATING PROCEDURE

BE-SOP-52

Driver Safety Program

1.0 INTRODUCTION

This standard operating procedure (SOP) applies to all individuals operating motorized vehicles for work.

2.0 DRIVER SAFETY AND POLICIES

Statistics show that many accidents involve company vehicles. The purpose of this SOP is to avoid injuries, possible loss of life, and costs related to accidents involving company vehicles.

2.1 Company Auto Usage Policies

The following policies are applicable to company vehicles:

- Company vehicles are for company business only and must be driven by active employees (unless permission is given by a supervisor) who are appropriately licensed, certified, and/or trained for the vehicle that they are operating.
- Vehicles must be maintained in good operating condition. A vehicle inspection form should be completed daily for vehicles used on project sites. Any noted deficiencies should be corrected as soon as possible.
- Drivers must conduct a complete safety walk-around prior to entering the vehicle.
- Occupants must wear seatbelts when vehicles are in motion.
- Vehicles may not be operated while using cell phones. This includes sending or receiving calls, texting, emailing or any other application on the phone. This includes personal vehicles on company business).
- Vehicles are strictly prohibited from use while under the influence of alcohol.
- Vehicles may not be operated while eating or drinking, reading, or using other devices that distract from driving.
- Vehicles must be driven within the laws and regulations for operating motorized vehicles (i.e. valid license, posted speed limits, etc.) and within the manufacturer’s operating guidelines.
- Vehicles may not be used to transport alcohol.
- Vehicles must be clean of all garbage, paper, boxes, etc. when no longer in use.
- Smoking is prohibited in company vehicles.
- Vehicle loads must be secured and within the manufacturer’s specs and the legal size/weight limits.
- If involved in an accident while on company business, it must be reported to the Safety Officer as soon as possible. All required forms must be completed in a timely manner.

2.2 Near Miss Policy

Company site personnel and subcontractors are required to immediately report all incidents or near misses to their immediate supervisor, SSHO, and/or Site Superintendent. The SSHO/Site Superintendent will evaluate the incident, determine if an emergency exists, and direct response activities as necessary. If necessary, injured workers will be accompanied to the medical facility by the SSHO or Project Manager for proper case management.

After rendering first aid or summoning emergency services and securing the accident scene, all accidents will be immediately reported as required by the SSHO or Site Superintendent to the Company Project Manager and Company Safety Manager, who will then contact applicable Client Representatives, security personnel, law enforcement or any other involved parties.

The SSHO/Superintendent will then complete and submit an Initial Notice of Incident (and Immediate Report of Accident USACE Form POD 265 for USACE projects) to the Company Safety Manager, Project Manager, and USACE or client representatives within 24-hours of any incident or near miss.

STANDARD OPERATING PROCEDURE

BE-SOP-59

Site Traffic

1.0 INTRODUCTION

This standard operating procedure (SOP) applies to all individuals working in and around roadways while conducting job related activities that may need to set up work zones as protection from vehicular traffic. It also applies to response and recovery workers operating or working near heavy equipment who will need to establish and follow traffic safety procedures to avoid injury and equipment damage.

While OSHA requires that operators be familiar with the pieces of machinery they operate, there is also a need to implement controls to ensure these activities are performed safely. Controls are needed where multiple pieces of heavy equipment, vehicles, and response and recovery workers are in close proximity.

2.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The following PPE is required:

- Hard hat
- Eye protection with side shields
- Gloves appropriate for job hazards expected (e.g., heavy-duty leather work gloves for handling debris with sharp edges and/or chemical protective gloves appropriate for potential chemical contact)
- ANSI-approved protective footwear
- High visibility safety vest

Additional PPE may be warranted depending on site conditions. This evaluation should be made prior to commencing work activities.

3.0 PROTECTING WORKERS FROM VEHICULAR TRAFFIC

When working around traffic, the following should be used to warn oncoming traffic that there are people working in the area:

- Flaggers
- Traffic cones
- Flood Lights
- “Reduce Speed” signs and/or message boards to warn approaching vehicles of the work area

Ensure that the work zone is well lit, but control glare to avoid temporarily blinding passing motorists.

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STANDARD OPERATING PROCEDURE

BE-SOP-61

Working around Drill Rigs

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) describes the guidelines that should be followed when working around a drill rig, traveling to and from a drilling site, moving the drill rig and tools from one location to another onsite, or providing maintenance on a drill rig or drilling tool. This SOP should be used to direct field personnel in the techniques and requirements for working with and maintaining drill rigs.

2.0 FIELD SAFETY OFFICER (FSO)

Every drill crew will have a designated Field Safety Officer (FSO - often the drill rig operator). The FSO has the authority to enforce safety on the drilling site. A rig worker's first safety responsibility is to listen to the safety directions of the FSO. Responsibilities specific to the FSO include:

- Understanding and communicating proper maintenance of tools and equipment and general "housekeeping" on the drill rig to promote and ensure a safe work environment.
- Ensuring the operator (who may be the safety supervisor) has had adequate training and exposure to the drill rig, operating controls, and operating capabilities.
- Inspecting the drill rig daily for structural damage, loose bolts and nuts, proper tension of chain drives, loose or missing guards or protective covers, fluid leaks, damaged hoses, and or damaged pressure gauges and pressure relief valves.
- Checking and testing all safety devices, such as emergency shutdown switches, at least daily and preferably at the start of a drilling shift. Drilling should not be permitted until all emergency shutdown and warning systems are working correctly.
- Ensuring that emergency devices are not wire-grounded, bypassed, or removed.
- Checking that all gauges, warning lights, and control levers are functioning properly and listening for unusual sounds upon starting the engine.
- Ensuring that all new drill rig workers are informed of safe operating practices on and around the drill rig and that each new employee reads and understands the safety and operations and maintenance manuals.
- Instructing a crew worker in drilling safety and observing the new worker's progress towards understanding safe operating practices.
- Ensuring that there is a first-aid kit, blood borne pathogen kit, and a fire extinguisher on each drill rig and on each additional vehicle and ensuring that they are properly maintained.
- Ensuring that crew members are well trained and capable of using first-aid kits, fire extinguisher, and all other safety devices and equipment.

3.0 SAFETY DURING START-UP AND DRILLING OPERATIONS

The Brice project manager (PM) and safety personnel are responsible for determining the appropriate procedures to be followed to ensure drilling work is performed safely, and must review local, state, and federal laws and regulations that are applicable to each project. If required, client drilling guidelines and/or procedures will be implemented.

Prior to drilling, the PM and FSO will ensure that an Accident Prevention Plan and/or Site-Specific Health and Safety Plan and Activity Hazard Analyses have been developed. Drill rigs must be operated safely in accordance with manufacturer’s operating procedures.

The FSO observes drilling start-up and operations to ensure adherence to safety requirements. The operator must not attempt to exceed manufacturers' ratings of speed, force, torque, pressure, flow, etc. The drill rig and tools must be used only for the purposes for which they are intended and designed.

3.1 Utilities

Safety requirements established in the *Underground Utilities Locate* SOP (BE-SOP-25) must be observed during drilling operations.

3.2 Personal Protective Equipment (PPE)

For most drilling projects, PPE will include a safety hard hat, safety shoes, safety glasses, and close-fitting but comfortable clothes, without loose ends, straps, draw strings, belts, or otherwise unfastened parts that might catch on some rotating or translating component of the drill rig. Rings and jewelry should not be worn during work shifts.

For some drilling operations, the environment or regulations may dictate additional PPE be used. The design and composition of the PPE must be determined jointly by the management of the drilling organization and the FSO. Such equipment might include, but is not limited to, face, ear, or reflective clothing protection. Each drill rig worker should wear noise reducing ear protectors when appropriate. When drilling is performed in chemically-or radiologically- contaminated ground, special protective equipment and clothing may be required. Additional information regarding PPE is provided in the project Accident Prevention Plan and/or Site-Specific Health and Safety Plan. The client can also have specific requirements concerning PPE. This must be addressed prior to any work and included in the Site-Specific Health and Safety Plan.

3.3 Housekeeping and Drill Rig Maintenance

It is critical for safe field operations that the FSO understands and fulfills the responsibility for maintenance and housekeeping on and around the drill rig. General housekeeping requirements are established in the *Housekeeping* SOP (BE-SOP-57).

3.4 Clearing the Work Area

Prior to drilling, adequate site clearing and leveling should be performed in accordance with the *Clearing, Grubbing Operations* SOP (BE-SOP-58) to provide a safe working area.

3.5 Saftey During Travel

The individual who transports a drill rig on and off a drilling site must observe traffic safety requirements established in the *Site Traffic* SOP (BE-SOP-59).

3.6 First Aid

A first-aid kit will be available and well maintained on each drill site. At least one or more members of each drill crew will be trained to perform first aid. Training should be provided or sponsored by the American Red Cross or a similar organization. For drilling operations, it is particularly important that the individual responsible for first aid be able to recognize the symptoms and be able to provide first aid for electrical shock, heart attack, stroke, broken bones, eye injury, and cuts or abrasions to the skin.

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STANDARD OPERATING PROCEDURE

BE-SOP-64

Working with Hand Tools

1.0 INTRODUCTION

This standard operating procedure (SOP) is for all individuals who will work with hand tools.

2.0 GUIDELINES

Hand tools must be kept in proper working order. All tools must be inspected before each use and all employees must be trained to use tools with proper safety.

3.0 TOOL USE

Hand tools will be kept in good condition (undamaged handles and proper working edges) that are not cracked or mushroomed with the potential to chip or create flying objects.

When using hand tools, the tools will:

- Be used within their designated capacity,
- Not be carried or left in a position that could cause injury to employees,
- Be put in storage when work is finished,
- Disconnected from their sources and pressures in lines released prior to any repair work.

4.0 PERSONAL PROTECTIVE EQUIPMENT

It is critical to use proper personal protective equipment (PPE) when using hand tools. When using hand tools, proper PPE will be implemented:

- Glove selection based on hand tool: leather work gloves versus cut resistant; and
- Safety glasses with side shields

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STANDARD OPERATING PROCEDURE

BE-SOP-75

Managing Fatigue at Work

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) for Brice Environmental Services Corporation (Brice) describes the procedures and guidelines for recognizing and managing fatigue in the workplace. This SOP applies to employees, contractors, visitors, clients, trainees, and volunteers while they are working or visiting a Brice site, property, or workplace.

This SOP relates to an individual's ability to manage fatigue when physical or mental limits have been reached. Fatigue is associated with physical exertion, mental exertion, and inadequate or disturbed sleep. Long term health problems have been associated with prolonged fatigue.

Fatigue management allows for steps to be taken towards ensuring a safe work environment, eliminating unsafe conditions and work practices that could potentially lead to illness, personal injury, equipment or other property damage.

2.0 PURPOSE AND OBJECTIVES

This procedure aims to provide an overview of Brice's process for controlling the occupational risks associated with fatigue. The following provides guidance for the stringent monitoring of personnel, specifically when they have been exceeded. These are consistent with the metrics outlined in EM 385-1-1 (2014).

- Exceed 10 hours a day for more than 4 consecutive days
- Exceed 50 hours in a 7 day work week
- Exceed 12 hours a day for more than 3 consecutive days, or
- Exceed 58-hours a week of sedentary work (to include office work)

2.1 Operator Work Hour Limitations

- Operators of equipment such as hoisting equipment and draglines, mobile construction equipment, electrical power systems, hydropower plants, industrial manufacturing systems, hydraulically operated equipment, powered vessels, and boats will not be permitted to exceed 12-hours of duty time in any 24 hour period, including time worked at another occupation. A minimum of 8 consecutive hours of rest between shifts in a 24 hour period is required.
- All floating plant personnel will be scheduled to receive a minimum of 8 hours rest in any 24 hour period except when quarters are provided immediately adjacent to, or aboard, the work site. These hours of rest may be divided into no more than 2 periods, one of which must be at least 6 continuous hours in length.
- Rest periods may be interrupted in case of emergency, drill, or other overriding operational necessity

3.0 FATIGUE MANAGEMENT

This section discusses the signs and consequences of fatigue, and how to manage it.

3.1 Fatigue Signs

Fatigue signs and symptoms include, but are not limited to:

- Blurred vision
- Difficulty keeping eyes open
- Head nodding
- Drowsy, relaxed feeling
- Irritability
- Tired feeling
- Falling asleep at work

3.2 Fatigue Consequences

Safety consequences associated with fatigue include, but are not limited to:

- Decreased awareness
- Slowed reaction time
- Poor hand-eye coordination

3.3 Poor communication

- Higher error rates
- Reduced vigilance
- Reduced error rates
- Reduced decision making abilities
- Poor judgement of performance, epically when assessing risks
- Focus reduced
- Difficulty responding in emergencies
- Inability to recount events sequentially

3.4 Managing Fatigue

Fatigue management is a shared responsibility between management and workers monitoring each other as well as themselves.

Management responsibilities include, but is not limited to:

- Ensuring workers are provided enough time for a continuous 7 to 8 hours of sleep in each 24 hours.
- Ensuring sufficient cover for workers on annual or sick leave.
- Limiting the amount of overtime so workers do not exceed 12 hour per work day.
- Limiting night shifts.
- Developing creative work schedules to prevent repetitive work breaks at critical times in the work cycle, control of environmental factors (heat, cold, use of personal protective equipment), buddy check-in for individuals working alone, and alternate transportation for long commutes.

- Providing training to employees to better recognize signs and symptoms of fatigue, and how to communicate concerns to management.

Employee/contractor responsibilities include, but are not limited to:

- Ensuring they are fit for work, in particular, not adversely affected by lack of sleep, physical, or mental fatigue.
- Raising concerns if they perceive themselves as being effected by fatigue or unable to perform their job functions.
- Raising concerns if they perceive their co-workers are being affected by fatigue or unable to perform their job functions.

Management will provide training to employees that relate to recognizing the signs and symptoms of fatigue, and how to mitigate it in the workplace. The training will focus on communication methods between co-workers, and also between management and employees so concerns can be raised in a safe environment. The training will also include topics such as creative work scheduling and tracking of work/break hours.

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STANDARD OPERATING PROCEDURE

BE-SOP-79

Waste Management

1.0 INTRODUCTION

This standard operating procedure (SOP) includes general procedures for managing wastes generated during environmental investigation and removal activities. The primary objective of this SOP is to provide general guidance and management tools for managing wastes generated during investigation and removals in accordance with applicable regulatory requirements. This plan provides general procedures for characterizing, accumulating, tracking, transporting, and disposing of waste consistent with regulations and contractual agreements.

The following guidelines have been developed for collecting, storing, and disposing of wastes derived from investigation activities. Investigation-derived waste (IDW) generated during typical field work may include the following:

- IDW soil, consisting of drill cuttings and soil produced during soil boring
- Aqueous IDW from equipment decontamination
- Other IDW consisting of personal protective equipment (PPE), spent sampling materials (e.g., direct-push liners), plastic sheeting, and general refuse (e.g., paper towels and plastic)
- Excavated Soil
- Inert Debris
- Hazardous materials
- Demolition debris
- Tanks
- Tank and Pipeline Contents
- Recyclable materials

This document describes general waste management requirements, as well as procedures for handling IDW, offsite shipment of waste and materials, and recordkeeping.

2.0 REGULATORY PROGRAM

Site work will be conducted in a manner consistent with the ADEC regulations, Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) regulations, RCRA, TSCA, USDOT, and other bodies of regulation as applicable. Under CERCLA, onsite activities must meet applicable or relevant and appropriate requirements (ARARs) of federal and state regulations and laws. CERCLA Section 121 further states that only substantive requirements of these regulations and laws are ARARs for onsite activities.

Offsite activities (e.g., offsite waste transportation and disposal) must meet all substantive and administrative requirements.

The regulations considered in the development of this SOP include, but are not limited to, those described in the following sections.

2.1 RESOURCE CONSERVATION AND RECOVERY ACT

The regulations set forth in Title 40, Code of Federal Regulations (40 CFR), Parts 239 through 299 are known as the Resource Conservation and Recovery Act (RCRA) or the Solid Waste Disposal Act. These regulations set forth requirements for determining whether a waste is considered a RCRA-hazardous waste based on the process generating the waste (listed hazardous waste) or determined by analyses (characteristic hazardous waste). RCRA further defines federal waste management requirements, including storage, labeling, transport, and disposal.

The following parts apply to wastes that will be generated during the investigation activities:

- 40 CFR 260 defines solid and hazardous waste under RCRA.
- 40 CFR 261 provides federal regulations for hazardous identification and classification for RCRA hazardous waste.
- 40 CFR 262 provides federal regulations for storing, shipping, labeling, and reporting for RCRA hazardous waste.

2.2 U.S. DEPARTMENT OF TRANSPORTATION

Requirements under 49 CFR 171 to 178 will apply to all offsite shipments of United States Department of Transportation (DOT) hazardous materials or hazardous waste. It is the responsibility of an appropriately trained individual to verify that the requirements of 49 CFR 171 to 178 are met. All personnel involved with packaging and transportation of hazardous materials (as defined by 49 CFR 171) must be trained in accordance with 49 CFR 172.700 to 800. The Project Manager will verify that staff handling and managing waste have the appropriate training.

2.3 TOXIC SUBSTANCES CONTROL ACT

The United States Environmental Protection Agency (EPA) regulates multiple chemicals through regulations provided in 40 CFR 761 (i.e., Toxic Substances Control Act [TSCA]).

3.0 INVESTIGATION-DERIVED WASTE

Wastes will be managed based on media type. The sections below establish these management practices. All IDW will be managed in accordance with the federal, state, and local regulations.

3.1 SOIL

Soil cuttings generated during field activities will be managed following an approved method as specified in the project-specific Work Plan. For work conducted at contaminated sites, with Alaska Department of Environmental Conservation (ADEC) approval, contaminated soil cuttings may be managed accordingly:

- Returned to the borehole the cuttings originated from or spread on the land surface for soil that is not known or suspected to be contaminated.
- Stockpiled or containerized and sampled to determine disposal options if soil comes from an area of suspected contamination due to knowledge of nearby releases or contaminant migration.

- Returning soils that are suspected to be contaminated to a borehole may be evaluated on a project-specific basis, with consideration of the creation of preferential pathways, soil heterogeneity, and other fate and transport concerns.

  At locations downgradient of known or suspected releases, soil from the vadose zone may be treated as uncontaminated (unless evidence suggests it is) and disposed by spreading on the surface nearby. Soil from the smear zone or below should be sampled prior to disposal.

3.2 LIQUIDS

All monitoring well development and purge water should be treated or disposed of using methods described in the ADEC approved project-specific Work Plan.

Unless specified otherwise in the work plan, purge and decontamination water will be treated with a granular activated carbon (GAC) treatment system, and the water will be collected in 55-gallon drums or 5-gallon buckets. The treated water will be checked for odor and sheen, and if no odor or sheen is present, discharged to the ground surface in a vegetated area within site boundaries at a minimum of 100 feet from any drinking water wells and/or surface water bodies and in a manner so as not to cause erosion. After completion of field activities, used GAC will be containerized and labeled (Section 5.2) for offsite disposal.

3.3 METAL AND GENERAL DEBRIS

Metal and general debris collected onsite will be handled as specified in the approved ADEC project-specific Work Plan. Metal collected onsite, including drums or drum carcasses, removed aboveground storage tanks (ASTs) and underground storage tanks (USTs), and removed buried fuel piping and components, will be confirmed empty, with a PID reading noted for each. General debris will be consolidated and stored until transfer for recycling and/or disposal at an appropriate offsite facility.

3.4 OTHER WASTE

It is expected that PPE, disposable sampling equipment (direct-push liners), and other field-related items will be generated during field activities. These may include, but are not limited to, the following items:

- Gloves (nitrile or otherwise)
- Chemical-resistant coveralls (Tyvek or otherwise)
- Disposable plastic direct-push liners
- Plastic buckets
- Paper towels
- Plastic sheeting

These materials will be generated in small quantities during field activities. It is assumed that used materials will be municipal solid waste and will be accumulated and disposed of as such. Unused equipment or equipment that can be decontaminated will be reused to the extent practicable. If any of the above noted items come into contact with hazardous wastes, they will be containerized separately and disposed of using generator knowledge along with the hazardous waste media

4.0 WASTE CHARACTERIZATION

Waste classification determinations will be made using process knowledge and laboratory analysis. Brice field personnel will be responsible for segregating potentially hazardous wastes from nonhazardous wastes onsite. Additionally, incompatible wastes (e.g., flammable and corrosive wastes) will be segregated. Wastes of the same matrix, compatible contamination, similar contaminant concentrations, and source may be aggregated to facilitate accumulation and disposal. Do not mix wastes with different expected contaminants or contaminant concentrations; this could cause additional wastes to be disposed of as hazardous waste.

Uncontaminated waste such as general trash will be characterized using process knowledge and generally will be classified as municipal solid waste.

4.1 WASTE CHARACTERIZATION SAMPLING

Waste characterization will be conducted during the field investigations at the sampling frequency and analyses specified in the approved project-specific Work Plan.

5.0 GENERAL WASTE MANAGEMENT REQUIREMENTS

IDW will be accumulated in containers in an area identified or approved by the facility point-of-contact. IDW accumulation areas will contain appropriate emergency response equipment. The Project- specific Accident Prevention Plan identifies the specific emergency response procedures and equipment. Spill control equipment (e.g., sorbent pads) will be available in the IDW accumulation areas and where liquids are transferred from one vessel to another.

Containers will be inspected upon arrival at the site to confirm that the equipment is not in disrepair and does not contain any contamination or contents. If a container is in disrepair, is contaminated, or already contains a waste, it will be immediately rejected and documented.

5.1 SUPERSACKS AND OTHER SOIL CONTAINERS

Supersacks will be labeled on at least two sides with a unique ID that will be tracked daily. Supersacks will be stored at each site or accumulated in a central area as identified in the site specific workplan. If any tears or rips are observed in the outside layer of the supersacks, they will be overbagged in a new supersack as soon as possible, which will be relabeled with the same ID.

Large accumulations of supersacks (>50) must be tracked by location, so that hazardous supersacks can be pulled from the accumulation area and stored separately. Supersacks that are expected to be hazardous must be stored separately and labeled with a Hazardous Waste sticker, with all relevant information included. Spray adhesive may be used to adhere Hazardous Waste stickers.

5.2 SMALL CONTAINERS/DRUMS

The following guidelines relate to drums and small non-bulk containers:

- Only new drums will be used. Do not use reconditioned drums purchased from an outside source. It is acceptable to reuse new drums from the site that are in good condition and have been steam cleaned.

- Drum will have UN approval numbers embossed on the bottom or stenciled on the side.
- Drums should either be 1A1 non-removable-head-type drums with bungs for liquids or 1A2 removal-head-type drums without bungs for solids or liquids. Bung holes in the lid are acceptable for special applications, but bung holes in the side of the drum are never acceptable.
- No penetrating dents are allowed that could affect the integrity of the drum. Pay special attention to any dents at the drum seams. Use the highest level of integrity standards for drums intended to contain liquids.
- Each drum will be provided with its own label, and labels will be visible.
- Drums will remain covered/closed except when removing or adding waste to the drum. Lids should fit correctly, and the gasket must be in good condition. Lids will be properly secured at the end of each workday. Closed means rings on, bolts tightened down.
- All bungs are tight and closed when not adding or removing waste.
- Drums will be disposed of with the contents. If the contents are removed from the drums for offsite transportation and treatment or disposal, then the drums will be decontaminated prior to reuse or before leaving the site.
- Drums containing liquids or hazardous waste will be provided with secondary containment and may not be located near a storm water inlet or conveyance.
- The outside of the drums must be free of any residues.
- Adequate aisle space (e.g., 30 inches) will be provided for containers such as 55-gallon drums or Super Sacks to allow the unobstructed movement of personnel and equipment. A row should be no more than two containers wide.
- When possible, containers will be segregated by waste type and accumulation dates.

Brice field personnel responsible for the work at each site will perform the following tasks:

- Inspect all drums on arrival and document the inspection on the Drum Inspection Checklists (Attachment 1). All drums not meeting the necessary standards will be rejected by field personnel, and any rejections will be documented on the Container Inspection Checklists.
- Document the delivery of drums containing waste to the accumulation area on a waste tracking log.
- Confirm that drums are not filled greater than two-thirds capacity.
- Once filled, inspect drums to verify that lids are closed and secured when not actively being filled.

5.3 CONTAINER LABELING

Brice field personnel will be responsible for labeling waste containers in accordance with RCRA. Labels will include the type of waste, location from which the waste was generated, and the accumulation start date.

Brice field personnel will be responsible for labeling waste containers and stockpiles as follows:

- At the point of generation, waste will be labeled as “Analysis Pending” or “Waste Material” (or similar). This label will be used until the analytical results are received and reviewed. This label will include the accumulation start date, site/source location, project name, project number, IDW type (contaminants), and field observations.
- Waste drums will be transferred to the facility-identified temporary location **daily**, when a drum becomes three-quarters full of compatible material, at the completion of work at a site where multiple drums have been generated, and prior to receipt of analytical results. Once the analytical

results are received and a waste classification is made, “Analysis Pending” labels will immediately be replaced with one of the following labels:

- EXAMPLE:
  - “Hazardous Waste”: Preprinted or handwritten labels with the following information:
    - Accumulation start date (date waste first placed into the container)
    - Generator name
    - Generator address
    - Phone number (Brice Project Manager)
    - United States Environmental Protection Agency (EPA) identification (ID) number:
    - RCRA waste code(s) (to be determined)
    - Proper DOT shipping name (to be determined)
    - Before transport, the manifest number must be added (for containers of less than 110-gallon capacity)
  - “Non-Hazardous Waste”: Handwritten or pre-printed labels with the following information:
    - Generator name
    - Generator address
    - Phone number (Brice Project Manager)
    - Waste-specific information (e.g., contaminated soil)

Examples of nonhazardous and hazardous waste labels are shown below:

NON-HAZARDOUS WASTE

GENERATOR INFORMATION (Optional)

SHIPPER ____

ADDRESS ____

CITY, STATE, ZIP ____

CONTENTS ____

NON-HAZARDOUS WASTE

HAZARDOUS WASTE

FEDERAL LAWS PROHIBIT IMPROPER DISPOSAL.

IF FOUND, CONTACT THE NEAREST POLICE OR PUBLIC SAFETY AUTHORITY, OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY.

GENERATOR INFORMATION:

NAME ____

ADDRESS ____

CITY ____ STATE ____ ZIP ____

EPA ID NO. ____ EPA WASTE NO. ____

ACCUMULATION START DATE ____ MANIFEST TRACKING NO. ____

D.O.T. PROPER SHIPPING NAME AND UN OR NA NO. WITH PREFIX

HANDLE WITH CARE!

5.4 WASTE ACCUMULATION TIME LIMITS

Hazardous wastes may only be accumulated for 90 days from the accumulation start date (the date that first waste is placed into a container). Other wastes will be removed from the site as soon as possible.

The date of generation (or accumulation start date) is the day that a waste is first placed in a container (e.g., drum, roll-off box, or portable tank, or in a stockpile outside of the Area of Contamination).

In situ sample results used for waste characterization will be obtained as soon as possible after the waste is generated to prevent exceeding the 90-day limit in the event that waste is characterized as hazardous.

5.5 IDW ACCUMULATION AREA INSPECTIONS

IDW accumulation areas will be inspected at least weekly for malfunctions, deterioration, discharges, and leaks that could result in a release. Any deficiencies observed or noted during inspection will be corrected immediately. Appropriate measures may include transfer of waste from a leaking container to a new container, replacement of liner or cover, or repair of containment berm.

Inspections will be recorded. Any deficiency and an explanation of the deficiency correction(s) will be documented. Copies of the report will be maintained onsite and available for review. An accumulation area inspection form is provided in Attachment 1.

5.6 WASTE TRACKING LOG

A project-specific waste tracking log will be used to track waste from generation to final disposition.Wastes will be logged on this form the day waste is generated and placed into containers. Transportation of wastes will be inventoried the day of transportation from the site using the waste tracking log.

6.0 OFFSITE SHIPMENT OF WASTE AND MATERIALS

Hazardous or nonhazardous wastes or recyclable materials generated during project activities will be handled in accordance with industry standards and state and federal regulations as specified in the approved project-specific Work Plan. Applicable regulations include, but are not limited to, the following:

- RCRA: 40 CFR 260, 261, 262, 263, 268, and 279
- TSCA: 40 CFR 761
- Hazardous Materials Transportation Act: 49 CFR 171-179
- 18 AAC 60, Solid Waste Management
- 18 AAC 62, Hazardous Waste

6.1 SHIPPING REQUIREMENTS

Prior to offsite disposal of any waste, an approval package for each waste stream will be prepared. This package will include a waste profile naming the generator of the waste, analytical summary table(s) applicable to the waste, land disposal restriction (LDR) notification for any hazardous wastes, a completed waste manifest (when possible), and any other applicable information necessary for the generator to complete its review and sign the disposal package.

The signed profile will then be submitted to the designated offsite facility operator for acceptance and approval. Once the approval letter is received from the designated facility operator, transportation can be scheduled.

RCRA hazardous wastes must be transported using a uniform hazardous waste manifest and must be manifested separately from non-RCRA wastes. A nonhazardous waste manifest will be used for non-RCRA wastes. When possible, manifests will be preprinted before mobilization to the field. The generator requires 72 hours to review and approve pre-printed manifests.

When items are added or changed in the field, a copy of the manifest will be transmitted to the generator by fax, allowing reasonable time for review and approval. At the discretion of the generator, some nonhazardous wastes can be shipped on a bill-of-lading only. Wastes (hazardous or nonhazardous) that cannot be recycled or otherwise used will be manifested to a treatment, storage, and disposal facility (TSDF) permitted by EPA. The TSDF will meet the requirements for TSDFs as identified in 40 CFR 264–268.

Additionally, each shipment of waste will have a weight ticket. An LDR notification/certification is also required for hazardous wastes. This form also requires the generator's signature and submission to the designated facility.

6.2 MANIFESTS

Hazardous and nonhazardous materials, substances, or wastes identified for handling and removal from the site will be packaged, labeled, marked, and manifested according to applicable state and federal regulations (40 CFR 263). The generator will sign the manifest after verifying its accuracy and completeness.

Brice will submit generator copies of manifests to the facility owner/operator. The original generator copy of the hazardous waste manifest signed by transporters and the TSDF, as well as certificates of disposal, destruction, and/or treatment, will be provided to the owner/operator.

- The manifest form will also include the following information:
- Transporter information including name, address, contact name and telephone number, and EPA ID number
- Designated facility information including name, address, telephone number, and EPA ID number
- Site name including street and mailing address (if different)
- DOT proper shipping name (e.g., UN 3077, Hazardous Waste Solid, n.o.s., 9, PG III [D008])
- Type and number of container(s)
- Quantity of waste (volumetric estimate)
- Task order or job number
- Profile number
- 24-hour emergency phone number

Brice will be responsible for the following:

- Obtaining necessary profiles
- Preparing exception reports when required by 40 CFR 262.42 and 40 CFR 761.215
- Preparing LDR notification forms (required for hazardous waste)
- Confirming that the waste (both hazardous and nonhazardous) is ultimately disposed of at the designated facility

RCRA and non-RCRA wastes will be manifested separately. TSCA wastes will also be manifested separately. Manifests, shipping papers, and profiles will be submitted to the generator for review a minimum of 3 full working days before shipping offsite. The contractor will provide the generator a copy of the manifest.

The generator and the transporter must sign the manifest prior to the load of waste leaving the site. The original signed manifest will be returned to the address of the generator.

If the signed hazardous waste manifest from the designated facility is not received within 35 days, the generator must contact the transporter or the designated facility to determine the status of the waste.

6.3 TRANSPORTATION

Each transportation vehicle and load of waste will be inspected and documented before it leaves the site. The quantities of waste leaving the site should be recorded on a transportation and disposal log. A contractor licensed for commercial transportation will transport nonhazardous wastes. When wastes are hazardous, the transporter will have an EPA identification number, and will comply with transportation requirements outlined in 49 CFR 171-179 (DOT) and 40 CFR 263.11 and 263.31 (Hazardous Waste Transportation).

The transporter will be responsible for weighing loads at a certified scale. For each load of material, weight measurements will be obtained for each full and empty container, dump truck, or tanker truck. Disposal quantities will be calculated as the difference between the weight of the full and empty container or dump truck. Weights will be recorded on the waste manifest.

The transporter must notify Brice immediately of any delays, problems, or violations of transport regulations that may occur during transport of materials. Additionally, the transporter will observe the following practices when hauling and transporting wastes offsite:

- Minimize impacts to general public traffic
- Repair road damage caused by construction and/or hauling traffic
- Clean up waste spilled in transit
- Line and cover trucks and trailers used for hauling contaminated waste to prevent releases
- Decontaminate vehicles prior to reuse
- Personnel involved in offsite disposal activities will follow safety and spill response procedures outlined in the Health and Safety Plan.
- No materials from other projects will be combined with materials from these sites.

7.0 SECURITY/EMERGENCY/RESPONSE

Site access in all working areas will be limited to authorized personnel during work activities. A sign-in log will be maintained by the Brice Field Team Leader for documenting entry and exit of all personnel.

Waste accumulation areas (temporary waste staging at the work area) will contain emergency response equipment and spill equipment appropriate to the wastes' hazards. Signage will be included that provides 24-hour emergency response contact and phone number. The Accident Prevention Plan identifies the project emergency response procedures and equipment, including emergency response contacts and phone numbers.

In addition to the Accident Prevention Plan procedures, hazardous waste accumulation areas, if needed, will be provided with (1) fire extinguishers if wastes known or suspected to be flammable or ignitable are present, (2) decontamination equipment, and (3) radio equipment available to all staff working in accumulation areas. Spill control equipment (e.g., sorbent pads) will be available in the waste accumulation areas and where liquids are transferred from one vessel/container to another.

8.0 SPILLS DURING WASTE HANDLING

All spills will be reported internally as indicated in the Site-specific Health and Safety Plan. Refer to this plan for emergency response procedures and additional reporting requirements. The definition of a release includes any “spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discarding of barrels, containers, and other closed containers)” of any potentially hazardous chemical, substance, and/or material.

It is important that the Project Manager also be immediately notified of spills/releases and other environmental compliance-related incidents (e.g., permit exceedance, notice of violation, and regulatory violation) or near-loss environmental incidents. The Project Manager will evaluate the spill or release to determine agency reporting requirements (e.g., National Response Center or state agency). Immediate internal spill reporting is critical to assure compliance applicable agency spill reporting requirements because EPA requires that certain spills/releases be reported within 15 minutes.

Spill control equipment (e.g., sorbent pads) will be available in the waste accumulation areas and where liquids are transferred from one vessel to another. Sorbent used on spills of ignitable wastes/materials should not be used past their capacity and will be containerized with additional sorbent or overpacked to prevent draining of liquid. Any fire protection provisions outlined in the Site-Specific Accident Prevention Plan must be adhered to.

9.0 TRAINING

Field staff who will manage hazardous or potentially hazardous IDW, including the preparation of shipping documents (e.g., manifests), will meet the hazardous waste generator training requirements of 40 CFR 265.16 and DOT (49 CFR 171 – 179) through the following:

- Occupational Safety and Health Administration 1910.120 Hazardous Waste Operations and Emergency Response training
- On-the-job training, including the following:
    - Site-Specific Accident Prevention Plan review, which requires each site worker and guest to review and sign the plan
    - Activity hazard analysis and daily safety meetings
    - Project-Specific Work Plan review

10.0 RECORDKEEPING

The following records and documents will be maintained:

- Transportation and offsite disposal documentation, including:
    - Copies of the profiles and associated characterization data
    - The transporter-signed manifest as well as the fully executed manifests, and copies of the following: LDR notifications and certifications, bills of lading, and weight tickets
    - Designated offsite facility waste receipts and certificates of disposal or destruction
- Training records
- Inspection records

REFERENCES

ADEC. 2022. *Field Sampling Guidance.* January.

ATTACHMENTS

Inspection Forms

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INCOMING DRUM INSPECTION FORM

Project: ______________________________

Drum arrival date: ______________________________

Number of drums: ______________________________

Inspector/company: ______________________________

Inspection date: ______________________________

	Y	N
Drum is in good condition, no rusts or holes		
Residual contamination/waste/material in or on drum (look under liner if installed):		
Drum has UN Code on bottom		
Drum has lid that fits		
Drum ring and bolt are in place and function		

Example of Full UN code: 1A1/Y1.4/150/10
USA/M1234
3 mm

1A1 = Packaging identification code
Y1.4 = Y = performance code
1.4 = maximum specific gravity
150 = hydrostatic test pressure
10 = year manufactured
USA = country of origin
M1234 = manufacturers registered symbol
3 mm = minimum thickness for reuse

Please include photos of any unsatisfactory items.

Comments (if rejected include why) :

Drums accepted: signature of inspector ______________________________

Drums rejected: signature of inspector ______________________________

WASTE STORAGE INSPECTION FORM

INSPECTION DATE:

PROJECT NAME/LOCATION:

PROJECT NUMBER:	**INSPECTOR:**

Are all containers clearly and properly labeled (Analysis Pending, Haz/Non-Haz, Non-Potable Water, PCB, etc) and labels visible?	YES	NO	N/A
Accumulation start date marked on containers?	YES	NO	N/A
Hazardous Wastes are stored in designated area for 90 days or less	YES	NO	N/A

IF NO, *Provide container ID#:* ______________________

Confirm the status of the container and affix the appropriate label IMMEDIATELY.

Drums: in good condition (no holes, rust, etc?) Are lids in place and bolted? YES NO N/A

IF NO, *Provide container ID#:* ______________________

Describe corrective action or

explain why drum is not closed: ______________________

Portable tanks: in good condition? Are lids in place, valves closed? YES NO N/A

IF NO, *Provide container ID#:* ______________________

Describe corrective action or

explain why is not closed: ______________________

Roll-off boxes: in good condition? Are the tarps/covers in good condition and securely fastened? YES NO N/A

IF NO, *Provide container ID#:* ______________________

Describe corrective action or

explain why roll-off not closed: ______________________

Soil stockpiles, is liner and berm secure and intact? **IF NO,** *Provide container ID#: Describe*

Cover is in place and secure?

corrective action or why YES NO N/A

YES NO N/A

stockpile not lined & covered YES NO N/A

Secondary containment, are there signs of failure? (ripped liner, liquids on ground around tank, stained soil)

IF YES, *Provide container ID#:*

Estimate quantity of material released:

Affected surface:

Describe corrective action:

REPORT TO PM; COMPLETE HITS REPORT

Is there evidence of release from the waste containers (liquid in secondary containment, etc)? YES NO N/A

IF YES, *Provide container ID#:*

Estimate quantity of material released:

Describe corrective action taken:

Emergency Response Equipment:

Telephones/radios easily accessible in case of emergency and working?	YES	NO	N/A
Is unused absorbent material nearby for spill control?	YES	NO	N/A
Decontamination equipment available? PPE available?	YES	NO	N/A
Is fire extinguisher accessible, fully charged and seal intact?	YES	NO	N/A

IF NO, *Provide area:*

Describe corrective action:

Confirm that there is unobstructed access to all containers. YES NO N/A

IF NO, *Describe corrective action taken:*

Are the areas around the containers free of material or other debris? YES NO N/A

IF NO, *Provide container ID#:*

Describe corrective action taken:

Is the Waste Tracking Log up to date and reflect what is in the waste storage area? YES NO N/

If no, please update the waste tracking log immediately.

Notes:

Containers = drums, rolloffs, frac tanks, poly tanks, etc