Naval Facilities Engineering Systems Command Northwest
Silverdale, Washington

Final

Sampling and Analysis Plan Addendum Per- and Polyfluoroalkyl Remedial Investigation Outlying Landing Field Coupeville

Naval Air Station Whidbey Island
Oak Harbor, Washington

May 2023

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SAP Worksheet #1—Title and Signature Page

Naval Facilities Engineering Systems Command Northwest
Silverdale, Washington

Final

Sampling and Analysis Plan Addendum Per- and Polyfluoroalkyl Substances Remedial Investigation Outlying Landing Field Coupeville

Naval Air Station Whidbey Island
Oak Harbor, Washington

May 2023

Prepared for NAVFAC Northwest
by CH2M HILL, Inc.
Bellevue, Washington
Contract N62470-16-D-9000
Contract Task Order N4425520F4343

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SAP Worksheet #1—Title and Signature Page (continued)

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Executive Summary

The Department of the Navy (Navy), Naval Facilities Engineering Systems Command (NAVFAC) Northwest has contracted CH2M HILL, Inc. (CH2M), a wholly owned subsidiary of Jacobs, to conduct a second phase of Remedial Investigation (RI) specific to known or suspected releases of per- and polyfluoroalkyl substances (PFAS) to the environment at Outlying Landing Field (OLF) Coupeville in Coupeville, Washington in Island County. This Uniform Federal Policy-Sampling and Analysis Plan (SAP) Addendum describes the activities to be conducted at select off-Base locations adjacent to OLF Coupeville. CH2M prepared this document under the NAVFAC Comprehensive Long-term Environmental Action – Navy 9000 Contract N62470-16-D-9000, Contract Task Order N4425520F4343, for submittal to NAVFAC Northwest and the United States Environmental Protection Agency (USEPA). CH2M prepared this SAP Addendum to help ensure that environmental data collected are scientifically sound, of known and documented quality, and suitable for intended uses.

The first phase of the RI (Phase 1) was conducted in 2022 and consisted of on-Base investigation activities at OLF Coupeville, including well installation and soil, sediment, surface water, and groundwater sampling. As of the writing of this SAP Addendum, data from the Phase 1 RI have not been evaluated completely. The data gathered from the Phase 1 and 2 RI will be compiled into one report.

This Phase 2 RI focuses on off-Base field work and installation of one on-Base well; the Phase 2 investigation is not being conducted in response to off-Base releases; rather, it is a component of the on-Base RI and investigates the potential off-Base transport from on-Base releases. The Phase 2 investigation was scoped in December 2020 with the on-Base Phase 1 RI activities; thus, information regarding work scoping and Conceptual Site Model (CSM) development are described in Worksheets #9 and #10 of the Phase 1 RI SAP, respectively (**Appendix A**), and have not been updated for this document. Description of the Phase 2 RI was planned during the initial scoping to be a standalone addendum to the original RI SAP due to the extended duration required for off-Base access agreements, thus putting Phase 2 work on a later timeline for mobilization and execution. The results from the Phase 1 RI do not alter the locations of this proposed Phase 2 investigation described herein.

The objectives of the Phase 2 RI as described in this SAP Addendum are as follows:

- To determine the presence and nature of PFAS in the soil and groundwater in the off-Base area west of OLF Coupeville near the Keystone Well.
- Augment the data representative of groundwater flow and potential PFAS migration from the known on-Base PFAS release areas to impacted off-Base residential drinking water wells with PFAS concentrations above 70 ppt for PFOA and PFOS, individually or combined[1].
- Confirm the groundwater flow regime east of OLF Coupeville and refine the groundwater flow and transport model in order to improve confidence in the model-depicted forecasts of PFAS migration from sources at OLF Coupeville.
- Determine whether PFAS have migrated from the groundwater to surface water and/or sediment in the wetland area south of OLF Coupeville.

Phase 1 field activities were described in the original SAP (included herein as **Appendix A**) and included fieldwork conducted at on-Base investigation locations. The Phase 2 activities are described within this SAP Addendum, which is specific to off-Base investigation activities and one investigation location on-Base. If additional data are

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[1] The EPA issued lifetime drinking water health advisories for PFOA and PFOS in May 2016 of 70 ppt, individually or combined. In June 2022, the EPA issued new, interim drinking water health advisories for PFOA and PFOS. Because these interim health advisories are below detectable limits and are non-regulatory levels, the Department of Defense (DOD) is instead looking to EPA to propose a regulatory drinking water standard, which was anticipated by the end of 2022. DOD is currently evaluating its efforts to address PFAS in drinking water, and what actions we can take to be prepared to incorporate this standard.

needed to accomplish the RI objectives, additional phases may be performed which will be described under a future SAP.

The Phase 2 investigation described in this SAP Addendum will include the following activities:

- Collection of depth-discrete groundwater grab samples and installation of a shallow/intermediate groundwater monitoring well pair on an off-Base property to the west of OLF Coupeville.
- Collection of depth-discrete groundwater grab samples and installation of a deep groundwater monitoring well on Base, adjacent to the southwest boundary of OLF Coupeville.
- Installation of a groundwater monitoring well targeting the intermediate zone on an off-Base property east of OLF Coupeville.
- Collection of groundwater samples from newly installed groundwater monitoring wells.
- Collection of surface and subsurface (capillary fringe) soil samples during drilling of the shallow groundwater monitoring well off-Base to the west of OLF Coupeville.
- Collection of paired surface water and sediment samples from an off-Base wetland area south of OLF Coupeville.
- Analysis of all samples for the 18 PFAS listed in Method 537.1 via Liquid Chromatography Tandem Mass Spectrometry (USEPA, 2020) in compliance with the Department of Defense Quality Systems Manual Version 5.3 (QSM 5.4) Table B-15.
- Collection of lithologic data from the newly installed groundwater monitoring wells and soil borings for further understanding of the overall CSM for the site.
- Surveying of each newly installed groundwater monitoring well.

Additional samples of groundwater, soil, wetland sediment and surface water (the media described herein) may be collected in locations where data gaps continue to exist to delineate PFAS to project action limits or assess fate and transport pathways, consistent with stakeholder agreement. Such additional samples would be described in a future SAP.

This SAP Addendum was developed in accordance with the following guidance documents:

- Guidance for Quality Assurance Project Plans (USEPA, 2002)
- Uniform Federal Policy for Quality Assurance Project Plans: Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs – Part 1: UFP-QAPP Manual (USEPA, 2005)
- Guidance on Systematic Planning Using the Data Quality Objectives Process (USEPA, 2006)
- Interim Per- and Polyfluoroalkyl Substances (PFAS) Site Guidance for NAVFAC Remedial Project Managers (RPMs)/November 2020 Update (NAVFAC, 2020)

This SAP Addendum includes 16 updated worksheets specific to the scope of work for the Phase 2 RI. The worksheets have been updated as follows:

- **Worksheets #1**, **#11**, **#12, #14 through #21, #23, 30, and #34-36** have been updated to reflect the scope of the RI to be conducted in the Phase 2 RI.
- **Worksheets #2** through **#10**, **#13**, **#22**, **#24** through #**29**, **and #31** through **#33** remain unchanged from the full SAP and are not included in the SAP Addendum.

Updated tables are embedded within the worksheets. Updated figures are included at the end of the document. Updated field SOPs are included as **Appendix B**. Updated Laboratory DoD Environmental Laboratory Accreditation Program (ELAP) Accreditation letter is included as **Appendix C**.

The laboratory information cited in this SAP Addendum is specific to Battelle Analytical Services, the laboratory that has been selected to support the laboratory needs for this project, as described in the original SAP.

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SAP Worksheets

Appendices

Tables

Figures

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Acronyms and Abbreviations

%	percent
µg/kg	microgram(s) per kilogram
11Cl-PF3OudS	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid
9Cl-PF3ONS	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid
ADONA	4,8-dioxa-3H-perfluoronanoic acid
bgs	below ground surface
CAS	Chemical Abstracts Service
CH2M	CH2M HILL, Inc.
CLEAN	Comprehensive Long-term Environmental Action—Navy
CSM	conceptual site model
DL	detection limit
DoD	Department of Defense
EtFOSAA	n-ethyl perfluorooctanesulfonamidoacetic acid
FD	field duplicate
HDPE	high-density polyethylene
HFPO-DA	perfluoro-2-methyl-3-oxahexanoic acid
HQ	hazard quotient
ID	identification
IDW	investigation-derived waste
LC/MS/MS	liquid chromatography – tandem mass spectrometer
LCS	laboratory control sample
LCL	lower confidence limit
LOD	limit of detection
LOQ	limit of quantitation
MeFOSAA	n-methyl perfluorooctanesulfonamidoacetic acid
MMDDYY	Month/Day/Year
MMYY	Month/Year
MPC	measurement performance criteria
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
NAVFAC	Naval Facilities Engineering Systems Command

Navy	Department of the Navy
ng/L	nanogram(s) per liter
OLF	Outlying Landing Field
PAL	project action limit
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutane sulfonate
PFDA	perfluorodecanoic acid
PFDoA	perfluorododecanoic acid
PFHxA	perfluorohexanoic acid
PFHpA	perfluoroheptanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonic acid
PFTeDA	perfluorotetradecanoic acid
PFTrDA	perfluorotridecanoic acid
PFUnA	perfluoroundecanoic acid
PID	photoionization detector
PQO	project quality objective
QAO	Quality Assurance Officer
QC	quality control
QSM	Quality Systems Manual
QSM 5.4	Quality Systems Manual Version 5.4
RI	Remedial Investigation
RPD	relative percent difference
RPM	Remedial Project Manager
RSL	regional screening level
SAP	Sampling and Analysis Plan
SI	Site Investigation
SL	screening level
SLERA	screening level ecological risk assessment
SOP	standard operating procedure
TAT	turnaround time
TBD	to be determined

TDBD	top depth/bottom depth (soil samples)
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency
XX	depth (groundwater grab samples)

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SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements

Problem Statement and Objectives

The project quality objectives, environmental questions, and investigation approach are presented in **Table 11-1. Figure 11-1** shows the decision logic associated with **Table 11-1**. The investigation approach presented in **Table 11-1** applies only to the Phase 2 of this Remedial Investigation (RI). Any additional phases needed to accomplish the objectives of the RI will be described under a future SAP.

The overall objectives of a PFAS RI are as follows:

- Delineate (vertically and horizontally) the extent of PFAS in identified media of concern.
- Evaluate whether PFAS is present in groundwater, soil, surface water, or sediment at concentrations that pose unacceptable risk to human health or ecological receptors.

To address the overall objectives of a PFAS RI, this Phase 2 of the RI being conducted at OLF Coupeville focuses on the environmental questions, investigative approach and project quality objectives (PQOs) presented in Table 11-1.

The rationale for the proposed samples is outlined in **Worksheet #17**. Samples will be submitted to Battelle for analysis of the 18 per- and polyfluoroalkyl substances (PFAS) listed in the United States Environmental Protection Agency (USEPA) Method 537.1 via LC-MS/MS compliant with Department of Defense (DoD) Quality Systems Manual Version 5.3 (QSM 5.4) Table B-15. Groundwater grab samples will have an expedited (72-hour) turnaround time (TAT) to order to inform screen placement for permanent monitoring wells. Groundwater monitoring well samples, soil samples, surface water samples, and sediment samples will be analyzed on a standard TAT.

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SAP Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

Table 11-1. Project Quality Objectives/Systematic Planning Process Statements

Problem Definition/Project Quality Objectives	Environmental Question(s)	General Investigation Approach	PQOs
Perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) have been detected at elevated concentrations in several groundwater monitoring wells near the western boundary of OLF Coupeville including the Town of Coupeville's Keystone Well and on-Base MW15 and MW16 well pairs; however, the extent of PFAS impacts to soil and groundwater in this area is not fully delineated, particularly off-Base. The objective of this step is to determine the presence and nature of PFAS in the soil and groundwater in the off-Base area west of OLF Coupeville near the Keystone Well.	What is the nature of PFAS in soil and groundwater in off-Base areas west of OLF Coupeville near the Keystone Well?	A groundwater monitoring well pair (WI-CV-MW38S/M) will be drilled and installed west of OLF Coupeville near the Keystone Well on land owned by Island County (**Figure 11-2** and **Figure 11-3**). The two groundwater monitoring wells will target the shallow and intermediate zones. Two soil samples will be collected from the surface and from the capillary fringe at groundwater monitoring well pair WI-CV-MW38S/M during advancement of the shallow boring to evaluate the presence and nature of PFAS impacts to soil and augment groundwater data at this location. Depths targeted for analysis will be identified based on boring-specific conditions. During the drilling of the intermediate boring (WI-CV-MW38M), which will be drilled prior to the shallow boring, depth-discrete groundwater grab samples will be collected from discrete water-bearing zones observed during drilling. The analytical results from the grab samples will be evaluated and used to determine screen placement settings for both the intermediate and the shallow groundwater monitoring wells at each location, installing screens in the target aquifer intervals across grab sample depths where PFAS concentrations are most elevated. Screen interval selection will also consider the lithology in the targeted screen zone to ensure that the monitoring well will have sufficient productivity to allow for sample collection. Groundwater samples will be collected from the new groundwater monitoring wells.	In general, soil and groundwater data will be evaluated during the RI in accordance with **Figure 11-1**. If PFAS data generated indicate that PFAS is present above PALs in soil and/or groundwater in the WI-CV-MW38M/S well pair west of OLF Coupeville near the Keystone Well, then horizontal and/or vertical delineation of PFAS is not considered complete. Results will be documented in an RI report with a detailed data gap analysis. A SAP addendum or a new SAP will be prepared for additional phases of the RI. If PFAS results from the well pair show that PFAS is not detected above PALs in soil and groundwater in the WI-CV-MW38S/M well pair, then multiple lines of evidence, including but not limited to potential exposure pathways, nature of upgradient sources, concentration gradients, plus available data will be utilized to further assess the CSM and a path forward to a site management decision. Further horizontal and/or vertical delineation may be needed in the area west of the Base boundary.
Low concentrations of PFOA/PFOS near the southern Base boundary are not consistent with higher concentrations of PFOA/PFOS in off-Base residential wells south of OLF Coupeville. The objective of this step is to augment the data representative of groundwater flow and potential PFAS migration from the known on-Base PFAS release areas to impacted off-Base residential drinking water wells with PFAS concentrations above 70 ppt[a].	How are on-Base concentrations of PFAS in the on-Base release areas (adjacent to Building 2709 and Facilities 1, 2, and 11 and west of the runway) related to PFAS concentrations above 70 ppt[a] at off-Base residential wells?	One deep monitoring well (WI-CV-MW41D) will be drilled and installed near the southwestern Base boundary (**Figure 11-4**). The groundwater monitoring well will target the deep groundwater zone and is being installed in lieu of proposed well WI-CV-MW37D, as described in the initial SAP. WI-CV-MW37D was not installed during the Phase 1 RI because a deep water-bearing zone was not encountered below approximately 180 feet bgs (material was primarily clay); this change is documented in Field Change Request 2, approved 4/7/2022. Well WI-CV-MW41D is not in the same location as the proposed WI-CV-MW37D but data collected here will address the same environmental question as was applicable to that well location. During the drilling of the boring, up to four depth-discrete groundwater grab samples will be collected. The analytical results from the grab samples will be evaluated and used to determine the screen placement settings for the monitoring well, installing the screen in the target aquifer interval across the grab sample depth where PFAS concentration is most elevated. Screen interval selection will also consider the lithology in the targeted screen zone to ensure that the monitoring well will have sufficient productivity to allow for sample collection. A groundwater sample will be collected from the new groundwater monitoring well.	In general, groundwater data will be evaluated during the RI in accordance with **Figure 11-1**. If PFAS data generated indicate that PFAS is present above PALs in groundwater at WI-CV-MW41D along the southwestern Base boundary, then horizontal and/or vertical delineation of PFAS is not considered complete. Results will be documented in an RI report with a detailed data gap analysis. A SAP addendum or a new SAP will be prepared for additional phases of the RI. If PFAS results from the well show that PFAS is not detected above PALs in groundwater in the WI-CV-MW41D, then multiple lines of evidence, including but not limited to potential exposure pathways, nature of upgradient sources, concentration gradients, plus available data will be utilized to further assess the CSM and a path forward to a site management decision. Further horizontal and/or vertical delineation may be needed in the area along the southern Base boundary.

SAP Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

Table 11-1. Project Quality Objectives/Systematic Planning Process Statements

Problem Definition/Project Quality Objectives	Environmental Question(s)	General Investigation Approach	PQOs
There is a lack of groundwater hydraulic data in the area east of OLF Coupeville which represents a data gap in the understanding of groundwater flow in the vicinity of OLF Coupeville. Further, if there is an easterly component of groundwater flow, it would represent a potential flow pathway from on-Base sources of PFAS to off-Base areas. The objective of this step is to confirm the groundwater flow regime east of OLF Coupeville and refine the groundwater flow and transport model in order to improve confidence in the model-depicted forecasts of PFAS migration from sources at OLF Coupeville.	What is the direction of groundwater flow in the area east of OLF Coupeville?	A groundwater monitoring well (WI-CV-MW40M) will be drilled and installed on an off-Base property to the east of OLF Coupeville (**Figure 11-2** and **Figure 11-4**) targeting the intermediate aquifer zone.	Groundwater elevation data will be used to evaluate groundwater flow and solute transport directions, update the CSM, and refine the existing groundwater model. If groundwater hydraulic data indicate that there is no easterly component of flow east of OLF Coupeville, the current groundwater flow and transport model will be confirmed. If there is evidence of an easterly component of groundwater flow from OLF Coupeville, additional groundwater investigation or delineation will be addressed in a future RI phase and described in a future SAP.
PFAS has been detected above PALs in former residential drinking water wells upgradient from the wetland located south of OLF Coupeville. It is unknown whether potential PFAS are present within the wetland south of OLF Coupeville and State Route 20. The objective of this step is to determine whether PFAS have migrated from the groundwater to surface water and/or sediment in the wetland area south of OLF Coupeville.	Are PFAS present in sediment or surface water above the PALs in the wetland area south of OLF Coupeville?	The approach to investigating PFAS in sediment and surface water will be to collect paired sediment and surface water samples from three off-Base locations in the wetland area south of OLF Coupeville (**Figure 11-2** and **Figure 11-5**). The samples and rationale are outlined in Worksheet #17.	If PFAS are present in sediment or surface water samples collected from the wetland south of OLF Coupeville, results will be documented in an RI report, and horizontal and vertical delineation will be investigated in an additional RI phase prior to risk assessment activities and evaluation described in **Figure 11-1**. A SAP Addendum or a new SAP will be prepared for additional phases of the RI. If PFAS are not present in sediment or surface water samples collected from the wetland south of OLF Coupeville, results will be documented in an RI report, which will recommend that no further action be taken to address PFAS in sediment or surface water in the wetland south of OLF Coupeville.

[a] The EPA issued lifetime drinking water health advisories for PFOA and PFOS in May 2016 of 70 ppt, individually or combined. In June 2022, the EPA issued new, interim drinking water health advisories for PFOA and PFOS. Because these interim health advisories are below detectable limits and are non-regulatory levels, the Department of Defense (DOD) is instead looking to EPA to propose a regulatory drinking water standard, which was anticipated by the end of 2022. DOD is currently evaluating its efforts to address PFAS in drinking water, and what actions we can take to be prepared to incorporate this standard.

ng/L = nanogram(s) per liter

PAL = project action limit

PQO = project quality objective

SAP Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

Problem Definition, Environmental Questions, and Project Quality Objectives

The problem definition, environmental questions, general investigation approaches, and PQOs contained in this SAP are described in **Table 11-1** and are based on the USEPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA, 2006) and its seven-step process. The detailed sampling approach, including numbers of samples, is provided in **Worksheet #17**. **Figure 11-1** shows the decision logic that is associated with **Table 11-1**. Planned sample locations are shown on **Figure 11-2** through **11-5**.

What Are the Project Action Limits?

The PALs for data collected at and near OLF Coupeville are presented in **Worksheet #15** and are summarized as follows:

Groundwater and Surface Water

Groundwater and surface water data for PFOA, PFOS, perfluorobutane sulfonate (PFBS), perfluorononanoic acid (PFNA), perfluorohexanesulfonic acid (PFHxS), and perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA) will be compared to tap water PALs, the May 2022 USEPA regional screening levels (RSLs) based on a hazard quotient (HQ) of 0.1 approved for use on DoD sites (USEPA, 2022; DoD, 2022). Surface water data will is being compared to the tapwater RSLs because the allowance of a 10x RSL approach for surface water is USEPA-region specific and is not accepted by USEPA Region 10, where this work is being conducted. PFAS results for constituents without a PAL will be provided in an appendix to the RI report for comparison to appropriate screening values if they are available in the future.

Soil and Sediment

Surface and subsurface soil and sediment data for PFOA, PFOS, PFBS, PFNA, PFHxS, and HFPO-DA will be compared to residential soil PALs, the May 2022 residential soil RSLs based on an HQ of 0.1 approved for use on DoD sites (USEPA, 2022; DoD, 2022). Sediment data is being compared to the residential RSLs because the allowance of a 10x RSL approach for sediment is USEPA-region specific and is not accepted by USEPA Region 10, where this work is being conducted. PFAS results for constituents without a PAL will be provided in an appendix to the RI report for comparison to appropriate screening values if they are available in the future.

While preliminary screening against soil-to-groundwater screening levels (SLs) will be used as a part of the multiple lines of evidence approach to assess leaching potential, soil-to-groundwater SLs are not considered PALs for this project and are not considered clean up goals or intended for use in remedial action or risk assessment decision making.

For What Will the Data Be Used?

Data will be used to address the environmental questions and PQOs listed in **Table 11-1**. Drinking water sampling in off-Base areas surrounding OLF Coupeville is being completed under a separate SAP.

There are uncertainties to be considered with regard to data use. Scientific research and regulatory guidelines related to PFAS are rapidly evolving. As such, the information provided in this SAP Addendum presents the state of the science at the time of issuance of this SAP Addendum. The Navy will re-evaluate changing science and regulations at the time of reporting to ensure that data evaluation and risk assessments presented in this report reflect any changes to toxicology information, regulatory standards, and DoD and Navy policy and guidance. Any changes to the proposed data evaluation and risk assessment approaches will be discussed with stakeholders prior to issuance of the report and any revisions.

SAP Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

What Types of Data Are Needed?

The types of data needed include the following:

Table 11-1 and **Worksheets #17** and **#18** contain detailed information on the types of data needed for this project. The field methodology is included in **Worksheet #14**. The specific target analytes and PALs are included in **Worksheet #15.**

Are There Special Data Quality Needs, Field or Laboratory, to Support Environmental Decisions?

Offsite laboratory analytical data will be of the quantity and quality necessary to provide technically sound and defensible assessments with respect to the aforementioned project objectives. Laboratory detection limits will be suitable for detecting PFOA, PFOS, PFBS, PFNA, PFHxS, and HFPO-DA at or below the PALs in accordance with **Worksheet #15**. Quality control (QC) sample requirements are detailed in **Worksheet #20**. For action decisions, the laboratory will follow the Measurement Performance Criteria (MPC) in Worksheets #24 and #28 (of **Appendix A**) for laboratory QC samples. These MPC are consistent with the DoD Quality Systems Manual (DoD, 2019a) as applicable and laboratory in-house limits where the Quality Systems Manual (QSM) does not apply.

Where, When, and How Should the Data Be Collected and Generated?

Sample locations are shown on **Figures 11-2** through **11-5**. Field activities will be conducted in accordance with **Worksheets #14, #17, and #18**, and the project schedule outlined in **Worksheet #16**. The data will be collected following the standard operating procedures (SOPs) presented in **Worksheet #21**.

SAP Worksheet #12-2—Measurement Performance Criteria Table – Field Quality Control Samples

Matrix: Soil, Sediment

Analytical Group: PFAS by LC-MS/MS Compliant with DoD QSM 5.4a Table B-15

QC Sample[b]	Analytical Group	Frequency	Data Quality Indicators	Measurement Performance Criteria
MS/MSD	PFAS	One per 20 samples	Accuracy/Precision	See **Worksheet #28**
FD		One per 10 samples	Precision	If the native and duplicate results are ≥ 2x the LOQ, relative percent difference (RPD) ≤ 50%. If the native and duplicate result is < 2x the LOQ, use professional judgement.
Equipment Rinsate Blank		One per day of field sampling for decontaminated equipment	Bias/Contamination	No target analytes detected > 1/2 LOQ
Field Blank[c]		One per site	Bias/Contamination	No target analytes detected > 1/2 LOQ, or greater than 1/10 sample concentration, whichever is greater
Cooler Temperature Indicator		One per cooler	Accuracy/Representativeness	Temperature ≤ 10°C, not frozen

[a] QSM 5.4 or the latest version of the QSM for which the laboratory is certified at the time of sampling.

[b] Field QA/QC will be collected separately for each matrix, with the exception of field blanks.

[c] The preservative Trizma is only required for drinking water samples. The field samples are not from drinking water sources; therefore, the laboratory supplied PFAS-free water for the PFAS field blank, as well as sample containers, do not contain Trizma.

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SAP Worksheet #14—Summary of Project Tasks

All project tasks described in this SAP Addendum will be completed under Phase 2 of the RI. Applicable SOPs for project tasks outlined in this section are listed in **Worksheet #21** and provided in **Appendix B**.

Premobilization Tasks

- Work Plan development and approval (SAP Addendum, Accident Prevention Plan – Site Safety and Health Plan updates, as necessary, and Waste Management Plan – Environmental Protection Plan updates, as necessary)
- National Historic Preservation Act Section 106 Consultation with the State Historic Preservation Officer and/or the Advisory Council on Historic Preservation to identify possible conflicts between historic preservation objectives and the proposed activities in the clearance area shown on **Figures 11-2** through **11-6**.
- Fieldwork scheduling
- Coordination with Naval Air Station Whidbey Island for site access and investigation-derived waste (IDW) staging at OLF Coupeville
- Supporting the Navy to obtain all necessary rights-of-entry, leases, and/or easements to install and sample new off-Base groundwater monitoring wells and collect sediment/ surface water samples.

Mobilization

Mobilization for the field effort includes procurement of necessary field equipment and initial transport to the site. Equipment and supplies will be brought to the site when the CH2M HILL, Inc. (CH2M)[1] field team mobilizes for field activities. Before beginning any work, CH2M and its subcontractors will have field meetings to discuss the work items and worker responsibilities, and to familiarize workers with the Accident Prevention Plan and Site Safety and Health Plan. As necessary, excess equipment and supplies will be staged on Base at OLF Coupeville during the implementation of off-Base field investigation.

Utility Locating

Utilities will be cleared before beginning intrusive activities. CH2M will coordinate utility clearance. In addition, a third-party utility clearance subcontractor will be procured by CH2M to clearly mark utilities near the proposed groundwater monitoring well locations. Any proposed groundwater monitoring well locations within 5 feet of utility locations will be relocated to avoid impacts on utilities. If a groundwater monitoring well location needs to be relocated, the field team will consult with the CH2M Project Manager and Naval Facilities Engineering Systems Command (NAVFAC) Northwest Remedial Project Manager (RPM) to establish a new groundwater monitoring well location.

Soil Borings and Groundwater Monitoring Well Installation and Development

Three off-Base soil borings (WI-CV-MW38S, WI-CV-MW38M, and WI-CV-MW40M) and one on-Base soil boring (WI-CV-MW41D) will be advanced, with groundwater monitoring wells installed. Groundwater vertical profile sampling will occur in intermediate groundwater monitoring well WI-CV-MW38M and deep well WI-CV-MW41D. Groundwater vertical profiling depths will be determined in the field and will target first-encountered groundwater and up to three additional depths separated by silt/clay layers.

Soil borings will be advanced via sonic drilling techniques, and groundwater monitoring wells will be installed and developed in accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix B**.

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[1] CH2M is a wholly owned subsidiary of Jacobs.

SAP Worksheet #14—Summary of Project Tasks (continued)

Soil Logging

All soil borings will be logged for lithology and field-screened by a photoionization detector (PID) at every interval in accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix B**.

Surveying

Following installation, the newly installed groundwater monitoring wells will be surveyed by a Washington-licensed surveyor in accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix B**.

Sampling Tasks

Applicable field notes and forms will be filled out completely each day.

- Soil Sampling
  - Soil sampling will be completed in accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix B**.
  - Up to two soil samples will be collected during drilling at WI-CV-MW38S. Soil samples will be sent to Battelle for PFAS analysis at standard TAT.
- Groundwater Vertical Profile Sampling
  - Depth-discrete groundwater vertical profile sampling will be completed, with up to three groundwater samples collected from the WI-CV-MW38M groundwater monitoring well boring and up to four groundwater samples collected from the WI-CV-MW41D groundwater monitoring well boring. All depth-discrete groundwater vertical profile sampling during the RI will be in accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix B**.
  - Groundwater grab samples will be sent to Battelle for PFAS analysis with a 72-hour TAT; groundwater profiling results will be used to determine target groundwater monitoring well settings for the paired groundwater monitoring wells.
- Groundwater Monitoring Well Sampling
  - Groundwater sampling will be completed at the three newly installed off-Base groundwater monitoring wells and one on-Base groundwater monitoring well in accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix B**.
  - Groundwater samples will be sent to Battelle for PFAS analysis on standard TAT.
- Wetland Surface Water and Sediment Sampling
  - Sampling of surface water and sediment is proposed at up to three locations in the wetland area south of OLF Coupeville. Surface water and sampling will be conducted in accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix B**.

Synoptic Water Level Survey

Manual groundwater levels will be measured at all new monitoring wells, in accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix B.**

SAP Worksheet #14—Summary of Project Tasks (continued)

Decontamination

All drilling equipment used during groundwater monitoring well installation and reusable sampling equipment will be decontaminated immediately after each use in accordance with applicable SOPs referenced in **Worksheet #21** and provided in **Appendix B**. Sensitive instrumentation such as equipment used to collect water quality parameters will be decontaminated in accordance with the equipment manufacturer's guidelines.

Investigation-derived Waste Management

IDW is expected to consist of drill cuttings from the soil borings generated during groundwater monitoring well installations, purge water from groundwater monitoring well development and groundwater sampling, and decontamination fluids. Aqueous IDW and solid IDW will be stored in separate roll-off containers, portable tanks, or drums staged on Base at OLF Coupeville. IDW will be managed in accordance with the Interim Per- and Polyfluoroalkyl Substances (PFAS) Site Guidance for NAVFAC RPMs, November 2020 Update (NAVFAC, 2020) and in accordance with SOPs listed in **Worksheet #21** and provided in **Appendix B**. Solid IDW is expected to be non-hazardous. Aqueous IDW with concentrations exceeding 70 ng/L (combined PFOA and PFOS) will be treated to levels less than 70 ng/L prior to disposal. Waste will not be incinerated (ASD, 2022).

Analyses and Testing Tasks

- Battelle will process and prepare soil samples (including wetland sediment) for analysis and analyze samples in accordance with Worksheet #18 and Worksheet #19 of **Appendix A**.
- Soil and sediment samples will be analyzed for 18 PFAS by Battelle using liquid chromatography – tandem mass spectrometer (LC/MS/MS) in compliance with DoD QSM 5.4 Table B-15 in accordance with Worksheet #18 and Worksheet #19 of **Appendix A**.
- Groundwater and surface water samples will be analyzed for 18 PFAS by Battelle by LC/MS/MS in compliance with DoD QSM 5.4 Table B-15 in accordance with Worksheet #18 and Worksheet #19 of **Appendix A**.

Modeling

Data collected during the Phase 2 RI will be used along with Phase 1 data to update the CSM and refine the existing groundwater flow and solute transport models. Lithologic data will support re-interpretation of the subsurface lithology, and the flow model will be re-run with the refined lithologic distribution. One additional contaminant transport simulation using the updated PFOA distribution will be performed. PFOA will be simulated as it is the contaminant with the most widespread extent, laterally and vertically, at the site and will be most useful to support planning decisions for the next phase of field work. Final re-calibration of the groundwater flow model and final simulations of contaminant transport of PFOA, PFOS and PFHxS will be deferred until additional off-site water level data can be obtained following a future RI Phase.

Quality Control Tasks

- Implement SOPs for field and laboratory activities being performed.
- QC samples are described on **Worksheet #20**.

Secondary Data

- Refer to Worksheet #13 of **Appendix A**.

Data Validation, Review, and Management Tasks

- Refer to Worksheets #34 through #36 of **Appendix A** for a discussion of data management procedures.

SAP Worksheet #14—Summary of Project Tasks (continued)

Documentation and Reporting

- A summary of field activities as groundwater monitoring well as a data evaluation will be documented in an RI Report and submitted to the NAVFAC Northwest RPM and stakeholder agencies for review and approval.

Assessment and Audit Tasks

- Worksheets #31 and #32 (**Appendix A**).

Demobilization

Full demobilization will occur when the project is completed, and appropriate quality assurance (QA)/quality control (QC) checks have been performed. Personnel no longer needed during the course of field operations may be demobilized prior to the final project completion date. The following will occur prior to demobilization:

- Chain-of-custody records will be reviewed to verify that all samples were collected as planned and submitted for appropriate analyses.
- Restoration of the site to an appropriate level will be verified by the CH2M Field Team Leader.
- All equipment will be inspected, packaged, and shipped to the appropriate location.

SAP Worksheet #15-1—Reference Limits and Evaluation Tables

Matrix: Groundwater

Analytical Group: PFAS – PFAS by LC-MS/MS Compliant with DoD QSM 5.4 Table B-15

Analyte	CAS Number	PALs		Laboratory Limits (ng/L)			LCS and MS/MSD Recovery Limits and RPD (%)[a]		
		Tapwater PALs (ng/L)	PAL Reference	LOQs (ng/L)	LODs (ng/L)	DLs (ng/L)	LCL	UCL	RPD
Perfluorooctanoic acid (PFOA)	335-67-1	6.0	Tapwater RSL HQ = 0.1[b]	5.00	2.5	1.01	71	133	30
Perfluorooctane Sulfonate (PFOS)	1763-23-1	4.0	Tapwater RSL HQ = 0.1[b]	5.00	2.5	1.07	65	140	30
Perfluorobutanesulfonic acid (PFBS)	375-73-5	600	Tapwater RSL HQ = 0.1[b]	5.00	2.5	0.866	72	130	30
Perfluorohexanoic acid (PFHxA)	307-24-4	--	--	5.00	2.5	0.913	72	129	30
Perfluoroheptanoic acid (PFHpA)	375-85-9	--	--	5.00	2.5	0.941	72	130	30
Perfluorohexanoic fluorohexanesulfonic acid (PFHxS)	355-46-4	39	Tapwater RSL HQ = 0.1[b]	5.00	2.5	0.997	68	131	30
Perfluorononanoic acid (PFNA)	375-95-1	5.9	Tapwater RSL HQ = 0.1[b]	5.00	2.5	0.833	69	130	30
Perfluorodecanoic acid (PFDA)	335-76-2	--	--	5.00	2.5	0.784	71	129	30
Perfluoroundecanoic acid (PFUnA)	2058-94-8	--	--	5.00	2.5	0.752	69	133	30
Perfluorododecanoic acid (PFDoA)	307-55-1	--	--	5.00	2.5	0.76	72	134	30
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	--	--	5.00	2.5	0.742	65	144	30
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	--	--	5.00	2.5	0.791	71	132	30
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (EtFOSAA)	2991-50-6	--	--	5.00	2.5	0.99	61	135	30

SAP Worksheet #15-1—Reference Limits and Evaluation Tables (continued)

Analyte	**CAS Number**	**PALs**		**Laboratory Limits (ng/L)**			**LCS and MS/MSD Recovery Limits and RPD (%)[a]**		
		Tapwater PALs (ng/L)	**PAL Reference**	**LOQs (ng/L)**	**LODs (ng/L)**	**DLs (ng/L)**	**LCL**	**UCL**	**RPD**
N-Methyl Perfluorooctanesulfonamidoacetic Acid (MeFOSAA)	2355-31-9	--	--	5.00	2.5	1.03	65	136	30
Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	13252-13-6	6.0	Tapwater RSL HQ = 0.1[b]	5.00	2.5	0.865	**60**	**126**	30
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	--	--	5.00	2.5	0.869	**61**	**130**	30
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	756426-58-1	--	--	5.00	2.5	1.03	**60**	**126**	30
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	763051-92-9	--	--	5.00	2.5	0.901	**56**	**125**	30

Notes:

Limits are verified on a quarterly basis per DoD QSM and may be subject to change. Any changes to these limits that impact the project SAP objectives, must be approved by the NAVFAC RPM and NAVFAC Atlantic Quality Assurance Officer (QAO) in advance of sample testing.

[a] Accuracy and precision are per DoD QSM 5.4 (DoD, 2021). For analytes not found in DoD QSM 5.4, laboratory in-house limits will be used. Analytes using in-house laboratory limits are bolded.

[b] The PAL is the Tapwater RSL based on an HQ of 0.1 approved for use on DoD sites in the July 6, 2022 Assistant Secretary of Defense Memorandum entitled, Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Clean Up Program.

% = percent
CAS = Chemical Abstract Service
DL = detection limit
LCL = lower control limit
LCS = laboratory control sample
LOD = limit of detection
LOQ = limit of quantitation
MS = matrix spike
MSD = matrix spike duplicate
RPD = relative percent difference
UCL = upper control limit

SAP Worksheet #15-2—Reference Limits and Evaluation Tables

Matrix: Surface Water

Analytical Group: PFAS – PFAS by LC-MS/MS Compliant with DoD QSM 5.4 Table B-15

Analyte	CAS Number	PALs		Laboratory Limits (ng/L)			LCS and MS/MSD Recovery Limits and RPD (%)[a]		
		Tapwater PALs (ng/L)	PAL Reference	LOQs (ng/L)	LODs (ng/L)	DLs (ng/L)	LCL	UCL	RPD
Perfluorooctanoic acid (PFOA)	335-67-1	6.0	Tapwater RSL HQ = 0.1b	5.00	2.5	1.01	71	133	30
Perfluorooctane Sulfonate (PFOS)	1763-23-1	4.0	Tapwater RSL HQ = 0.1 b	5.00	2.5	1.07	65	140	30
Perfluorobutanesulfonic acid (PFBS)	375-73-5	600	Tapwater RSL HQ = 0.1 b	5.00	2.5	0.866	72	130	30
Perfluorohexanoic acid (PFHxA)	307-24-4	--	--	5.00	2.5	0.913	72	129	30
Perfluoroheptanoic acid (PFHpA)	375-85-9	--	--	5.00	2.5	0.941	72	130	30
Perfluorohexanoic fluorohexanesulfonic acid (PFHxS)	355-46-4	39	Tapwater RSL HQ = 0.1 b	5.00	2.5	0.997	68	131	30
Perfluorononanoic acid (PFNA)	375-95-1	5.9	Tapwater RSL HQ = 0.1 b	5.00	2.5	0.833	69	130	30
Perfluorodecanoic acid (PFDA)	335-76-2	--	--	5.00	2.5	0.784	71	129	30
Perfluoroundecanoic acid (PFUnA)	2058-94-8	--	--	5.00	2.5	0.752	69	133	30
Perfluorododecanoic acid (PFDoA)	307-55-1	--	--	5.00	2.5	0.76	72	134	30
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	--	--	5.00	2.5	0.742	65	144	30
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	--	--	5.00	2.5	0.791	71	132	30
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (EtFOSAA)	2991-50-6	--	--	5.00	2.5	0.99	61	135	30

SAP Worksheet #15-2—Reference Limits and Evaluation Tables (continued)

Analyte	CAS Number	PALs		Laboratory Limits (ng/L)			LCS and MS/MSD Recovery Limits and RPD (%)[a]		
		Tapwater PALs (ng/L)	PAL Reference	LOQs (ng/L)	LODs (ng/L)	DLs (ng/L)	LCL	UCL	RPD
N-Methyl Perfluorooctanesulfonamidoacetic Acid (MeFOSAA)	2355-31-9	--	--	5.00	2.5	1.03	65	136	30
Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	13252-13-6	6.0	Tapwater RSL HQ = 0.1b	5.00	2.5	0.865	60	126	30
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	--	--	5.00	2.5	0.869	61	130	30
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	756426-58-1	--	--	5.00	2.5	1.03	60	126	30
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	763051-92-9	--	--	5.00	2.5	0.901	56	125	30

Notes:

Limits are verified on a quarterly basis per DoD QSM and may be subject to change. Any changes to these limits that impact the project SAP objectives, must be approved by the NAVFAC RPM and NAVFAC Atlantic QAO in advance of sample testing.

[a] Accuracy and precision are per DoD QSM 5.4 (DoD, 2021). For analytes not found in DoD QSM 5.4, laboratory in-house limits will be used. Analytes using in-house laboratory limits are bolded.

[b] The PAL is the Tapwater RSL based on an HQ of 0.1 approved for use on DoD sites in the July 6, 2022 Assistant Secretary of Defense Memorandum entitled, Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Clean Up Program.

SAP Worksheet #15-3—Reference Limits and Evaluation Table

Matrix: Surface Soil and Subsurface Soil
Analytical Group: PFAS – PFAS by LC/MS/MS Compliant with DoD QSM 5.4 Table B-15

Analyte	CAS Number	PALs		Laboratory Limits (µg/kg)[a]			LCS and MS/MSD Recovery Limits and RPD (%)[b]		
		Residential Soil PALs (µg/kg)	PAL Reference	LOQs (µg/kg)	LODs (µg/kg)	DLs (µg/kg)	LCL	UCL	RPD
Perfluorooctanoic acid (PFOA)	335-67-1	19	Residential Soil RSL HQ = 0.1[c]	1	0.5	0.214	69	133	30
Perfluorooctane Sulfonate (PFOS)	1763-23-1	13	Residential Soil RSL HQ = 0.1[c]	1	0.5	0.175	68	136	30
Perfluorobutanesulfonic acid (PFBS)	375-73-5	1,900	Residential Soil RSL HQ = 0.1[c]	1	0.5	0.171	72	128	30
Perfluorohexanoic acid (PFHxA)	307-24-4	--	--	1	0.5	0.178	70	132	30
Perfluoroheptanoic acid (PFHpA)	375-85-9	--	--	1	0.5	0.168	71	131	30
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	130	Residential Soil RSL HQ = 0.1[c]	1	0.5	0.173	67	130	30
Perfluorononanoic acid (PFNA)	375-95-1	19	Residential Soil RSL HQ = 0.1[c]	1	0.5	0.157	72	129	30
Perfluorodecanoic acid (PFDA)	335-76-2	--	--	1	0.5	0.158	69	133	30
Perfluoroundecanoic acid (PFUnA)	2058-94-8	--	--	1	0.5	0.156	64	136	30
Perfluorododecanoic acid (PFDoA)	307-55-1	--	--	1	0.5	0.16	69	135	30
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	--	--	1	0.5	0.161	66	139	30
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	--	--	2	0.5	0.162	69	133	30
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (EtFOSAA)	2991-50-6	--	--	2	0.5	0.165	61	139	30

SAP Worksheet #15-3—Reference Limits and Evaluation Table (continued)

Analyte	CAS Number	PALs		Laboratory Limits (µg/kg)[a]			LCS and MS/MSD Recovery Limits and RPD (%)[b]		
		Residential Soil PALs (µg/kg)	PAL Reference	LOQs (µg/kg)	LODs (µg/kg)	DLs (µg/kg)	LCL	UCL	RPD
N-Methyl Perfluorooctanesulfonamidoacetic Acid (MeFOSAA)	2355-31-9	--	--	2	0.5	0.159	63	144	30
Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	13252-13-6	23	Residential Soil RSL HQ = 0.1[c]	2	0.5	0.159	**71**	**153**	30
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	--	--	2	0.5	0.16	**61**	**139**	30
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	756426-58-1	--	--	2	0.5	0.154	**60**	**140**	30
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OudS)	763051-92-9	--	--	2	0.5	0.15	**40**	**160**	30

Notes:

Limits are verified on a quarterly basis per DoD QSM and may be subject to change. Any changes to these limits which impact the project SAP objectives, must be approved by the NAVFAC RPM and NAVFAC Atlantic QAO in advance of sample testing.

[a] Results for nonaqueous samples are reported on a dry-weight basis.

[b] Accuracy and precision limits are per DoD QSM 5.4 (DoD, 2019a). For analytes not found in DoD QSM 5.4, laboratory in-house limits will be used. Analytes using in-house laboratory limits are bolded.

[c] The PAL is the Residential Soil RSL based on an HQ of 0.1 approved for use on DoD sites in the July 6, 2022 Assistant Secretary of Defense Memorandum entitled, “Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Clean Up Program.”

µg/kg = microgram(s) per kilogram

SAP Worksheet #15-4—Reference Limits and Evaluation Table

Matrix: Sediment [a]
Analytical Group: PFAS – PFAS by LC/MS/MS Compliant with DoD QSM 5.4 Table B-15

Analyte	CAS Number	PALs		Laboratory Limits (µg/kg)[b]			LCS and MS/MSD Recovery Limits and RPD (%)[c]		
		Residential Soil PALs (µg/kg)	PAL Reference	LOQs (µg/kg)	LODs (µg/kg)	DLs (µg/kg)	LCL	UCL	RPD
Perfluorooctanoic acid (PFOA)	335-67-1	19	Residential Soil RSL HQ = 0.1[d]	1	0.5	0.214	69	133	30
Perfluorooctane Sulfonate (PFOS)	1763-23-1	13	Residential Soil RSL HQ = 0.1[d]	1	0.5	0.175	68	136	30
Perfluorobutanesulfonic acid (PFBS)	375-73-5	1,900	Residential Soil RSL HQ = 0.1[d]	1	0.5	0.171	72	128	30
Perfluorohexanoic acid (PFHxA)	307-24-4	--	--	1	0.5	0.178	70	132	30
Perfluoroheptanoic acid (PFHpA)	375-85-9	--	--	1	0.5	0.168	71	131	30
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	130	Residential Soil RSL HQ = 0.1[d]	1	0.5	0.173	67	130	30
Perfluorononanoic acid (PFNA)	375-95-1	19	Residential Soil RSL HQ = 0.1[d]	1	0.5	0.157	72	129	30
Perfluorodecanoic acid (PFDA)	335-76-2	--	--	1	0.5	0.158	69	133	30
Perfluoroundecanoic acid (PFUnA)	2058-94-8	--	--	1	0.5	0.156	64	136	30
Perfluorododecanoic acid (PFDoA)	307-55-1	--	--	1	0.5	0.16	69	135	30
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	--	--	1	0.5	0.161	66	139	30
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	--	--	2	0.5	0.162	69	133	30

SAP Worksheet #15-4—Reference Limits and Evaluation Table (continued)

Analyte	CAS Number	PALs		Laboratory Limits (µg/kg)[b]			LCS and MS/MSD Recovery Limits and RPD (%)[c]		
		Residential Soil PALs (µg/kg)	PAL Reference	LOQs (µg/kg)	LODs (µg/kg)	DLs (µg/kg)	LCL	UCL	RPD
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (EtFOSAA)	2991-50-6	--	--	2	0.5	0.165	61	139	30
N-Methyl Perfluorooctanesulfonamidoacetic Acid (MeFOSAA)	2355-31-9	--	--	2	0.5	0.159	63	144	30
Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	13252-13-6	23	Residential Soil RSL HQ = 0.1[d]	2	0.5	0.159	**71**	**153**	30
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	--	--	2	0.5	0.16	**61**	**139**	30
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	756426-58-1	--	--	2	0.5	0.154	**60**	**140**	30
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OudS)	763051-92-9	--	--	2	0.5	0.15	**40**	**160**	30

Notes:

Limits are verified on a quarterly basis per DoD QSM and may be subject to change. Any changes to these limits which impact the project SAP objectives, must be approved by the NAVFAC RPM and NAVFAC Atlantic QAO in advance of sample testing.

[a] If hydric soils, standing water, or wetland vegetation are not present, the sample will be considered surface soil.

[b] Results for nonaqueous samples are reported on a dry-weight basis.

[c] Accuracy and precision limits are per DoD QSM 5.4 (DoD, 2019a). For analytes not found in DoD QSM 5.4, laboratory in-house limits will be used. Analytes using in-house laboratory limits are bolded.

[d] The PAL is the Residential Soil RSL based on an HQ of 0.1 approved for use on DoD sites in the July 6, 2022 Assistant Secretary of Defense Memorandum entitled, “Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Clean Up Program.”

SAP Worksheet #16—Project Schedule/Timeline Table

Phase 2 RI Activities [a]	**Organization**	**Dates**		**Deliverable**
		Anticipated Date(s) of Initiation	**Anticipated Date of Completion**	
Internal Draft SAP Addendum preparation	CH2M	March 2022	June 2022	Internal Draft SAP Addendum
Navy SAP Addendum review	NAVFAC Northwest and NAVFAC Atlantic	September 2022	October 2022	Comments
Draft SAP Addendum preparation	CH2M	October 2022	December 2022	Draft SAP Addendum
Stakeholder review	USEPA Region 10	March 2023	March 2023	Comments
	Town of Coupeville, Washington			
	Washington Department of Ecology			
	Washington Department of Health			
Final SAP Addendum	CH2M	April 2023	April 2023	Final SAP Addendum
Subcontractor procurement	CH2M	To be determined (TBD)	TBD	
Groundwater monitoring well installation and survey	CH2M, Subcontractor	April 2023	May 2023	
Groundwater and soil sampling	CH2M	May 2023	May 2023	
Surface water and sediment sampling	CH2M	May 2023	May 2023	
Laboratory analysis	Subcontractor	Varied turnaround times are detailed on Worksheet #3**0 (Appendix A).**		Analytical data
Data management	CH2M	TBD	TBD	
Data validation	Subcontractor	TBD	TBD	
Reporting	CH2M	TBD	TBD	Internal Draft, Draft, and Final RI Report

[a] Phase 2 of the RI includes off-Base activities only. Additional RI phases, as necessary, will be described under a future SAP.

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SAP Worksheet #17—Sampling Design and Rationale

The objectives of the investigation described in this worksheet are listed in **Worksheet #11**. Media to be investigated for this SAP Addendum include soil from on-Base and off-Base soil borings, groundwater from new groundwater monitoring well borings and new completed on-Base and off-Base monitoring groundwater monitoring wells, and off-Base sediment and surface water (if surface water is present/ observed). The sampling strategy and rationale are detailed in **Table 17-1.** Groundwater, soil, sediment, and surface water samples will be analyzed for PFAS by LC/MS/MS in compliance with DoD QSM 5.4 Table B-15. Actual sample locations may vary from the proposed sample locations presented on **Figures 11-2** through **11-5** because of field conditions.

Table 17-1. Sampling Strategy Table – OLF Coupeville Phase 2 RI

Location	Matrix	Depth of Samples (feet bgs)	Analysis	Laboratory Method	Number of Samples	Sampling Strategy	Rationale
WI-CV-MW38M	Groundwater	TBD ^{a} (between the water table and approximately 200 feet bgs)	PFAS	LC/MS/MS in compliance with DoD QSM 5.4, Table B-15 / SOP 5-369-09	Up to 3 (based on observation of discrete water-bearing zones between the surface and total depth of hole).	Groundwater will be collected as vertical profiling grab samples for in-field water quality parameters and laboratory analysis of PFAS at depths between the surface and 200 feet bgs as determined in the field based on lithology and targeting discrete aquifer intervals observed. Groundwater samples will be collected via a drive-point sampling device and submitted for PFAS analysis with a 72-hour TAT to allow for determination of groundwater monitoring well screen intervals. Discrete sample depths will target the first-encountered groundwater, and up to two additional discrete aquifer zones separated by a low-permeability confining unit between the water table and the total depth of boring.	PFAS have been detected above PALs in several wells near the western boundary of OLF Coupeville, including on-Base wells WI-CV-MW15S/M and WI-CV-MW16S/M and from the Town of Coupeville's off-Base Keystone Well (**Figure 11-3**). Depth-discrete grab groundwater samples will be collected during drilling of WI-CV-MW38M to delineate the vertical distribution of PFAS at this location and provide data to inform well screen placement. Samples, groundwater elevations, and lithologic data from this location will be used to begin to define the presence/absence and nature of PFAS in groundwater in off-Base areas west of OLF Coupeville near the Keystone Well, and west of the existing on-Base MW15 and MW16 well pairs. The data will also be utilized to start delineating the source area west of the runway, where groundwater flow is influenced by pumping at the Keystone Well.
WI-CV-MW38S		Middle of groundwater monitoring well screen; groundwater monitoring well screen settings TBD			1	Groundwater will be collected for in-field water quality parameters and laboratory analysis of PFAS using low-flow sampling techniques.	
WI-CV-MW38M					1		
WI-CV-MW41D		TBD ^{a} (between the water table and approximately 225 feet bgs)			Up to 4 (based on observation of discrete water-bearing zones between the surface and total depth of hole).	Groundwater will be collected as vertical profiling grab samples for in-field water quality parameters and laboratory analysis of PFAS at depths between the surface and 225 feet bgs as determined in the field based on lithology and targeting discrete aquifer intervals observed. Groundwater samples will be collected via a drive-point sampling device and submitted for PFAS analysis with a 72-hour TAT to allow for determination of groundwater monitoring well screen intervals. Discrete sample depths will target the first-encountered groundwater, and up to two additional discrete aquifer zones separated by a low-permeability confining unit between the water table and the total depth of boring.	Low concentrations of PFOA/PFOS have been detected near the southern Base boundary, as observed during the Supplemental SI at deep well WI-CV-MW26D and in intermediate aquifer groundwater grab samples collected at WI-CV-MW22 and WI-CV-MW26 (**Figure 11-4**). These results are not consistent with higher concentrations of PFOA/PFOS in off-Base residential wells south of OLF Coupeville, which are presumably downgradient of these wells. Depth-discrete grab GW samples will be collected during drilling of WI-CV-MW41D to delineate the vertical distribution of PFAS at this location and provide data to inform well screen placement. Samples, GW elevations, and lithologic data from this well location near the southern Base boundary wells will be used refine the understanding of groundwater flow pathways and between on-Base source areas and impacted off-Base residential drinking water wells with PFAS concentrations above 70 ppt for PFOA and PFOS.
WI-CV-MW41D		Middle of groundwater monitoring well screen; groundwater monitoring well screen settings TBD			1	Groundwater will be collected for in-field water quality parameters and laboratory analysis of PFAS using low-flow sampling techniques.	

SAP Worksheet #17—Sampling Design and Rationale (continued)

Table 17-1. Sampling Strategy Table – OLF Coupeville RI

Location	Matrix	Depth of Samples (feet bgs)	Analysis	Laboratory Method	Number of Samples	Sampling Strategy	Rationale
WI-CV-MW38S	Soil	TBD [b] (between the ground surface [0 to 6 inches] and the water table)	PFAS	LC/MS/MS in compliance with DoD QSM 5.4, Table B-15 / SOP 5-369-09	2	Soil samples will be collected for laboratory analysis of PFAS from the WI-CV-MW38S borehole (prior to groundwater monitoring well installation) off-Base near the Keystone Well. Two soil samples will be collected: at the surface (0 to 6 inches bgs) and at the top of the capillary fringe in the unsaturated soil.	Samples will be used to evaluate the nature of PFAS impacts to soil and augment groundwater data off-Base west of WI-CV-MW15S/M and WI-CV-MW16S/M, near the Keystone Well, where PFAS have been detected above the PALs (**Figure 11-3**). Depths targeted for analysis will be identified based on boring-specific conditions.
WI-CV-SW05	Surface Water	N/A			1 at each location[c]	Collect surface water samples (if sufficient water) from the wetland south of Coupeville for laboratory analysis of PFAS (**Figure 11-5**).	PFAS has been detected above PALs in former residential drinking water wells upgradient from this wetland location. Samples will be used to evaluate if PFAS has migrated from the groundwater to surface water and/or sediment in this wetland area south of Coupeville (**Figure 11-5**).
WI-CV-SW06							
WI-CV-SW07							
TBD					TBD [a]	Additional surface water samples may be collected at other drainage ditch locations based on extent of observed surface water at the time of sampling.	
WI-CV-SS05	Sediment	0 to 0.5 foot bgs			1 at each location[c]	Collect sediment samples from the wetland south of Coupeville for laboratory analysis of PFAS (**Figure 11-5**).	
WI-CV-SS06							
WI-CV-SS07							
TBD					TBD [a]	Additional sediment samples may be collected at other wetland locations based on extent of present or potential surface water pathways observed.	

[a] The final number and placement of samples may be modified in the field based on the field team's professional opinion in consultation with CH2M management and technical teams and the NAVFAC Northwest RPM. Sampling will target the first-encountered groundwater (water table) and up to two additional discrete aquifer zones separated by a confining unit.

[b] The final number and placement of samples may be modified in the field based on the field team's professional opinion in consultation with CH2M management and technical teams and the NAVFAC Northwest RPM. Sampling will target surface soil (0 to 0.5 foot below ground surface [bgs]), the top of the capillary fringe in the unsaturated soil, and at up to three additional lithologic interfaces encountered during drilling for laboratory analysis of PFAS from each soil boring.

[c] If surface water is not present in wetland, only sediment will be collected from the specified locations.

N/A = not applicable

SAP Worksheet #18—Location-Specific Sampling Methods/SOP Requirements Table

Station ID	Sample ID	Matrix	Number of Samples (Identify FDs)	Depth (feet bgs)	Analytical Group	Sampling SOP Reference
WI-CV-MW38S	WI-CV-GW38S-MMYY	Groundwater	1	TBD [b]	PFAS (LC/MS/MS compliant in accordance with DoD QSM 5.4, Table B-15 [a])	**Worksheet #21**
	WI-CV-GW38S-MMYY-MS		1 (MS)			
	WI-CV-GW38S-MMYY-MSD		1 (MSD)			
WI-CV-MW38M	WI-CV-GW38M-XX-MMYY	Groundwater	An estimated 3 (grab samples)	TBD [b]		
	WI-CV-GW38M-MMYY	Groundwater	1			
WI-CV-MW41D	WI-CV-GW41D-XX-MMYY		An estimated 4 (grab samples)	TBD [b]		
	WI-CV-GW41D-MMYY		1			
	WI-CV-GW41DP-MMYY		1 (FD)			
WI-CV-MW38S	WI-CV-SO38-TDBD-MMYY	Soil	2	TBD [b]		
	WI-CV-SO38P-TDBD-MMYY	Soil	1 (FD)	TBD [b]		
	WI-CV-SO38-TDBD-MMYY-MS	Soil	1 (MS)	TBD [b]		
	WI-CV-SO38-TDBD-MMYY-MSD	Soil	1 (MSD)	TBD [b]		
WI-CV-SW05/WI-CV-SD05	WI-CV-SW05-MMYY	Surface water	1	N/A		
	WI-CV-SW05P-MMYY		1 (FD)			
	WI-CV-SD05-MMYY	Sediment	1	0 to 0.5		
WI-CV-SW06	WI-CV-SW06-MMYY	Surface water	1	N/A		
	WI-CV-SW06-MMYY-MS		1 (MS)			
	WI-CV-SW06-MMYY-MSD		1 (MSD)			

SAP Worksheet #18—Location-Specific Sampling Methods/SOP Requirements Table (continued)

Station ID	Sample ID	Matrix	Number of Samples (ID FDs)	Depth (feet bgs)	Analytical Group	Sampling SOP Reference
WI-CV-SD06	WI-CV-SD06-MMYY	Sediment	1	0 to 0.5	PFAS (LC/MS/MS compliant in accordance with DoD QSM 5.4, Table B-15 [a])	**Worksheet #21**
	WI-CV-SD06-MMYY-MS		1 (MS)			
	WI-CV-SD06-MMYY-MSD		1 (MSD)			
WI-CV-SW07/WI-CV-SD07	WI-CV-SW07-MMYY	Surface water	1	N/A		
	WI-CV-SD07-MMYY	Sediment	1	0 to 0.5		
	WI-CV-SD07P-MMYY		1 (FD)			
Field QC Samples						
WI-CV-QC [c]	WI-CV-EB01-MMDDYY	QC	1	N/A	PFAS (LC/MS/MS compliant in accordance with DoD QSM 5.4, Table B-15 [a])	**Worksheet #21**
	WI-CV-EB02-MMDDYY		1			
	WI-CV-EBXX-MMDDYY [c]		TBD			
	WI-CV-FB01-MMDDYY		1			
	WI-CV-FB02-MMDDYY		1			
	WI-CV-FBXX- MMDDYY [c]		TBD			

[a] Analytical method is compliant with DoD QSM 5.4 Table B-15.

[b] Depth intervals will be determined during drilling.

[c] One field blank should be collected weekly and one equipment blank should be collected daily with samples from decontaminated equipment.

FD = field duplicate
ID = identification
MMDDYY = Month/Day/Year
MMYY = Month/Year
TDBD = top depth/bottom depth (soil samples)
XX = depth (groundwater grab samples)

SAP Worksheet #19—Analytical Standard Operating Procedure Requirement Table

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Containers	Sample Volume	Preservation Requirements	Maximum Holding Time[a] (Preparation/ Analysis)
Groundwater/ Surface Water	PFAS	PFAS by LC-MS/MS compliant with QSM 5.4 Table B-15[b]/Preparation and Analysis for the Determination of Per and Poly-Fluorinated Compounds	2 times 250 mL HDPE bottle	2 times 250 mL	Temperature must be above freezing and less than or equal to 10°C when received at the laboratory. Samples stored in the laboratory must be held at or below 6°C until extraction but should not be frozen.	14 days to extraction/ 28 days to analysis
Soil/Sediment	PFAS	PFAS by LC-MS/MS compliant with QSM 5.4 Table B-15[b]/Preparation and Analysis for the Determination of Per and Poly-Fluorinated Compounds	One 8-ounce HDPE jar	20 grams	Temperature must be above freezing and less than or equal to 10°C when received at the laboratory. Samples stored in the laboratory must be held at or below 6°C until extraction but should not be frozen.	14 days to extraction/ 28 days to analysis

[a] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

[b] Analytical method is compliant with DoD QSM 5.4 Table B-15 (DoD, 2021) by Battelle Analytical.

HDPE = high density polyethylene
mL = milliliter(s)

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SAP Worksheet #20—Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Field Samples[1]	No. of FDs [a]	No. of MS/MSDs [a]	No. of Field Reagent Blanks [a]	No. of Equipment Blanks [a]	Total No. of Samples to Laboratory [a]
Groundwater	PFAS	10	1	1/1	1	3	17
Soil	PFAS	2	1	1/1	1	1	7
Surface Water	PFAS	3	1	1/1	1	1	8
Sediment	PFAS	3	1	1/1	1	1	8

[a] Samples will be collected as detailed in **Worksheets #14, #17,** and **#18**. Field QA/QC samples will be collected as detailed in Worksheet #12 **(Appendix A)**.

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SAP Worksheet #21—Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Yes/No)	Comments
SOP CH2M-1	Logging of Soil Borings Revised February 2022	CH2M	None	No	Guides staff in accurately and consistently recording the field data necessary to characterize soil borings and recovered soil samples, to guide CH2M staff in accurately and consistently recording the field data necessary to characterize soil borings and recovered soil samples.
SOP CH2M-2	Water Level Measurements Revised February 2022	CH2M	Electronic water level meter and interface probe	No	This SOP includes guidelines for discrete measurements of static water levels. Only PFAS-free equipment will be used.
SOP CH2M-3	Multi RAE Photoionization Detector (PID) Revised February 2022	CH2M	Multi RAE PID	No	Describes procedure for operation and general maintenance of the Multi RAE PID.
SOP CH2M-4	Groundwater Sampling for Per- and Polyfluoroalkyl Substances (PFAS) Revised December 2021	CH2M	Teflon-free tubing, Teflon-free bailer (if using bailer), PFAS-free pump, sample bottles (HDPE bottle with HDPE screw cap), laboratory pre-filled HDPE bottles containing field blank water, loose-leaf paper without waterproof coating, clip board, pen (not Sharpie), nitrile or latex gloves	No	Provides guidance for groundwater sample collection for samples that will be analyzed for PFAS via LC/MS/MS in compliance with QSM 5.3 for CLEAN projects under Contract N62470-16-D-9000.
SOP CH2M-5	Rotosonic Groundwater Sample Collection for Per- and Polyfluoroalkyl Substances Revised March 2019	CH2M	Teflon-free tubing, Teflon-free bailer (if using bailer), PFAS-free pump, sample bottles (HDPE bottle with HDPE screw cap), laboratory pre-filled HDPE bottles containing field blank water, loose-leaf paper without waterproof coating, clip board, pen (not Sharpie), nitrile or latex gloves	No	Provides guidance for groundwater sample collection for samples that will be analyzed for PFAS via LC/MS/MS in compliance with QSM 5.3 for CLEAN projects under Contract N62470-16-D-9000.

SAP Worksheet #21—Project Sampling SOP References Table (continued)

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Yes/No)	Comments
SOP CH2M-6	Soil Sampling for Per- and Polyfluoroalkyl Substances Revised December 2021	CH2M	Sample jars (HDPE bottle with HDPE screw cap), laboratory pre-filled HDPE bottles containing field blank water, loose-leaf paper without waterproof coating, clip board, pen (not Sharpie), nitrile or latex gloves	No	Provides guidance for soil sample collection for samples that will be analyzed for PFAS via LC/MS/MS in compliance with QSM 5.3 for CLEAN projects under Contract N62470-16-D-9000.
SOP CH2M-7	Management of Liquid Waste Containing Per- and Polyfluoroalkyl Substances (PFAS) Revised January 2021	CH2M	Drum, tank, HDPE sample bottles	No	Provides guidelines for managing liquid waste containing PFAS or for CLEAN projects under Contract N62470-16-D-9000.
SOP CH2M-8	Surface Water Sampling for Per- and Polyfluoroalkyl Substances Revised December 2021	CH2M	Sample jars (HDPE bottle with HDPE screw cap), laboratory pre-filled HDPE bottles containing field blank water, loose-leaf paper without waterproof coating, clip board, pen (not Sharpie), nitrile or latex gloves	No	Provides guidelines for surface water sample collection for samples that will be analyzed for PFAS via LC/MS/MS in compliance with QSM 5.3 for CLEAN projects under Contract N62470-16-D-9000.
SOP CH2M-9	Sediment Sampling for Per- and Polyfluoroalkyl Substances Revised December 2021	CH2M	Sample jars (HDPE bottle with HDPE screw cap), laboratory pre-filled HDPE bottles containing field blank water, loose-leaf paper without waterproof coating, clip board, pen (not Sharpie), nitrile or latex gloves	No	Provides guidelines for sediment sample collection for samples that will be analyzed for PFAS via LC/MS/MS in compliance with QSM 5.3 for CLEAN projects under Contract N62470-16-D-9000.
SOP I-A-1	Planning Field Sampling Activities, Revised February 2015	NAVFAC Northwest	None	No	Establishes SOPs for planning and scheduling field sampling activities.

SAP Worksheet #21—Project Sampling SOP References Table (continued)

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Yes/No)	Comments
SOP I-A-7	IDW Management, Revised February 2015	NAVFAC Northwest	None	No	Describes activities and responsibilities of NAVFAC Northwest and its subcontractors regarding management of IDW. Field activities will deviate slightly from the SOP to eliminate use of PFAS-containing materials.
SOP I-A-9	General Field Operation, Revised February 2015	NAVFAC Northwest	All field equipment	No	Defines organization and structure of sample collection, ID, record keeping, field measurements, and data collection.
SOP I-A-10	Monitoring/Sampling Location Recording, Revised February 2015	NAVFAC Northwest	Loose-leaf paper and clipboard	No	Establishes guidelines for generating information to be recorded for each physical location where sampling is conducted.
SOP I-A-11	Sample Naming, Revised February 2015	NAVFAC Northwest	None	No	Describes the naming convention to be used for samples collected, analyzed, and reported for NAVFAC Northwest projects.
SOP 1-C-1	Monitoring Well/Piezometer Installation, Revised March 2015	NAVFAC Northwest	Drilling equipment	No	Describes the methods by which NAVFAC Northwest field personnel and their contractors will conduct groundwater monitoring well installation.
SOP 1-C-2	Monitoring Well Development, Revised March 2015	NAVFAC Northwest	Drilling equipment	No	Describes the methods by which NAVFAC Northwest field personnel and their contractors will conduct groundwater monitoring well development.

SAP Worksheet #21—Project Sampling SOP References Table (continued)

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Yes/No)	Comments
SOP 1-C-5	Low-Flow Groundwater Purging and Sampling, Revised March 2015	NAVFAC Northwest	Bladder or peristaltic pump, water level and water quality meters, and buckets. Compressor and controller required for bladder pump.	No	Describes the conventional groundwater monitoring well sampling procedures to be used by all NAVFAC Northwest personnel and contractors.
SOP 1-D-5	Water Level Measurements, Revised March 2015	NAVFAC Northwest	Water level meters	No	Establishes standard protocols for all NAVFAC Northwest field personnel for use in making water level measurements.
SOP I-D-7	Field Parameter Measurements, Revised March 2015	NAVFAC Northwest	Water quality meters	No	Provides instructions for the calibration, use, and checking of instruments and equipment for field measurements. Field activities will deviate slightly from the SOP to eliminate use of PFAS-containing materials.
SOP I-G-1	Land Surveying, Revised August 2014	NAVFAC Northwest	Surveying equipment	No	Describes the methods by which NAVFAC Northwest field personnel and their contractors will conduct land surveying.
SOP III-B	Field QC Samples (Water, Soil, Sediment, Tissue), Revised April 2015	NAVFAC Northwest	Sample containers	No	Describes the number and types of field QC samples that will be collected during NAVFAC Northwest site fieldwork.
SOP III-D	Logbooks, Revised April 2015	NAVFAC Northwest	Loose-leaf paper and clipboard	No	Describes the activities and responsibilities of NAVFAC Northwest personnel and/or their contractors pertaining to the ID, use, and control of logbooks and associated field data records.

SAP Worksheet #21—Project Sampling SOP References Table (continued)

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Yes/No)	Comments
SOP III-E	Record Keeping, Sample Labeling, and Chain-of-Custody Procedures, Revised April 2015	NAVFAC Northwest	Samples, sample labels, COC	No	Establishes standard protocols for all NAVFAC Northwest field personnel and their contractors for use in maintaining field and sampling activity records, writing sample logs, labeling samples, ensuring that proper sample custody procedures are used, and completing chain-of-custody/analytical request forms.
SOP III-F	Sample Containers and Preservation, Revised April 2015	NAVFAC Northwest	Sample containers	No	Sets forth the methods for use by NAVFAC Northwest field personnel and their contractors engaged in handling, storing, and transporting water, soil, or sediment samples. Field activities will deviate slightly from the SOP to eliminate use of PFAS-containing materials.
SOP III-G	Sample Handling, Storage, and Shipping, Revised April 2015	NAVFAC Northwest	Samples	No	Sets forth the methods for use by NAVFAC Northwest field personnel and their contractors engaged in handling, storing, and transporting water, soil, or sediment samples. Field activities will deviate slightly from the SOP to eliminate use of PFAS-containing materials.
SOP III-I	Equipment Decontamination, Revised April 2015	NAVFAC Northwest	Non-disposable sampling equipment	Yes	Describes general methods of equipment decontamination for use by NAVFAC Northwest field personnel and their contractors during field sampling activities. Field activities will deviate slightly from the SOP to eliminate use of PFAS-containing materials. Rinse water will be certified PFAS-free.

SAP Worksheet #21—Project Sampling SOP References Table (continued)

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Yes/No)	Comments
SOP III-J	Equipment Calibration, Operation, and Maintenance, Revised April 2015	NAVFAC Northwest	Field meters	No	Describes the activities and responsibilities of the NAVFAC Northwest personnel pertaining to the operation, calibration, and maintenance of equipment used to collect environmental data. Field activities will deviate slightly from the SOP to eliminate use of PFAS-containing materials.
N/A	Final Environmental Restoration Program Recordkeeping Manual, February 2017	NAVFAC	None.	No	Provides instructions on how to submit documents for inclusion in the program’s Environmental Document Management System and information about compiling, documenting, managing, and maintaining Comprehensive Environmental Response, Compensation, and Liability Act Environmental Restoration Administrative Record Files; Post-Decision Files; Site Files; and Petroleum, Oil, and Lubricant Files.

CLEAN = Comprehensive Long-term Environmental Action—Navy

HDPE = high-density polyethylene

SAP Worksheet #23—Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work (Yes/No)
5-370-13	*Extraction of Poly and Perfluoroalkyl Substances from Environmental Matrices*, 11/02/2021, Revision 13	Definitive	Soil/Groundwater/Sediment/ Surface Water/PFAS	N/A	Battelle	No
5-369-09	*Analysis of Poly and Perfluoroalkyl Substances in Environmental Samples by Liquid Chromatography and Tandem Mass Spectrometry (LC-MS/MS)*, 11/02/2021, Revision 9	Definitive	Soil/Groundwater/Sediment/ Surface Water/PFAS	LC/MS/MS	Battelle	No
6-010-19	Sample Receipt, Custody, and Handling, 10/16/2018, Revision 19, last reviewed 12/14/2021	N/A	Soil/Groundwater/Sediment/ Surface Water/PFAS	N/A	Battelle	No
5-291-18	*Determination of Method Detection Limits in the Analytical Laboratory*, 10/20/2021, Revision 18	N/A	Soil/Groundwater/Sediment/ Surface Water/PFAS	N/A	Battelle	No

Note:

Laboratory SOPs meet DoD QSM 5.4 (**Appendix C**) requirements for Battelle.

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SAP Worksheet #30—Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID	Analytical Method	Data Package Turnaround Time	Laboratory/ Organization	Backup Laboratory/ Organization[3]
Groundwater	PFAS	Refer to **Worksheet #18**	LC/MS/MS in compliance with DoD QSM 5.3, Table B-15[1]	3 Days/28 Days[2]	Battelle Analytical Services 141 Longwater Drive Suite 202 Norwell, MA 02061 POC: Jonathan Thorn (781) 681-5565	Enthalpy Analytical
Soil				3 Days/28 Days[2]		
Surface Water (if present)				3 Days/28 Days[2]		
Ditch Surface Soil				3 Days/28 Days[2]		

[1] Analytical method is compliant with DoD QSM 5.4 Table B-15 or the most recent version of the DoD QSM for which Battelle has DoD ELAP certification.

[2] A 3-day expedited turn-around time will be required for all groundwater grab samples and select soil samples as detailed in **Worksheet #11**; all other samples will be analyzed at the standard 28-day turn-around time.

[3] If the backup laboratory is used for analysis, applicable SAP worksheets will be submitted to the Navy QAO for review and approval.

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SAP Worksheet #34-36—Data Verification and Validation (Steps I and IIa/IIb) Process Table

Data Review Input	Description[1]	Responsible for Verification or Validation	Step I/IIa/ IIb[2]	Internal/ External[3]
Analytical data for PFAS analyzed for soil, sediment, groundwater and surface water	Analytical methods and laboratory SOPs as presented in this SAP will be used to evaluate compliance against QA/QC criteria. Should adherence to QA/QC criteria yield deficiencies, data may be qualified. Data may be qualified if QA/QC exceedances have occurred. Guidance and qualifiers from United States Department of Defense General Data Validation Guidelines (DoD, 2019c), Data Validation Guidelines Module 3: Data Validation Procedure for Per- and Polyfluoroalkyl substances Analysis by QSM Table B-15 (DoD, 2020), Per- and Polyfluoroalkyl Substances (PFAS): Reviewing Analytical Methods for Environmental Samples Technical brief (USEPA, 2019) and Data Validation Guidelines Module 1, 2, 3, and 4 Revised Table for Sample Qualification in the Presence of Blank Contamination (DoD, 2022a) will be applied as appropriate. If specific guidance is not given for these methods in the General Data Validation Guidelines, the DV may adapt the guidance from USEPA National Functional Guidelines for Superfund Organic Methods Data Review (USEPA, 2017).	DV/EDS	Step IIa and IIb	External

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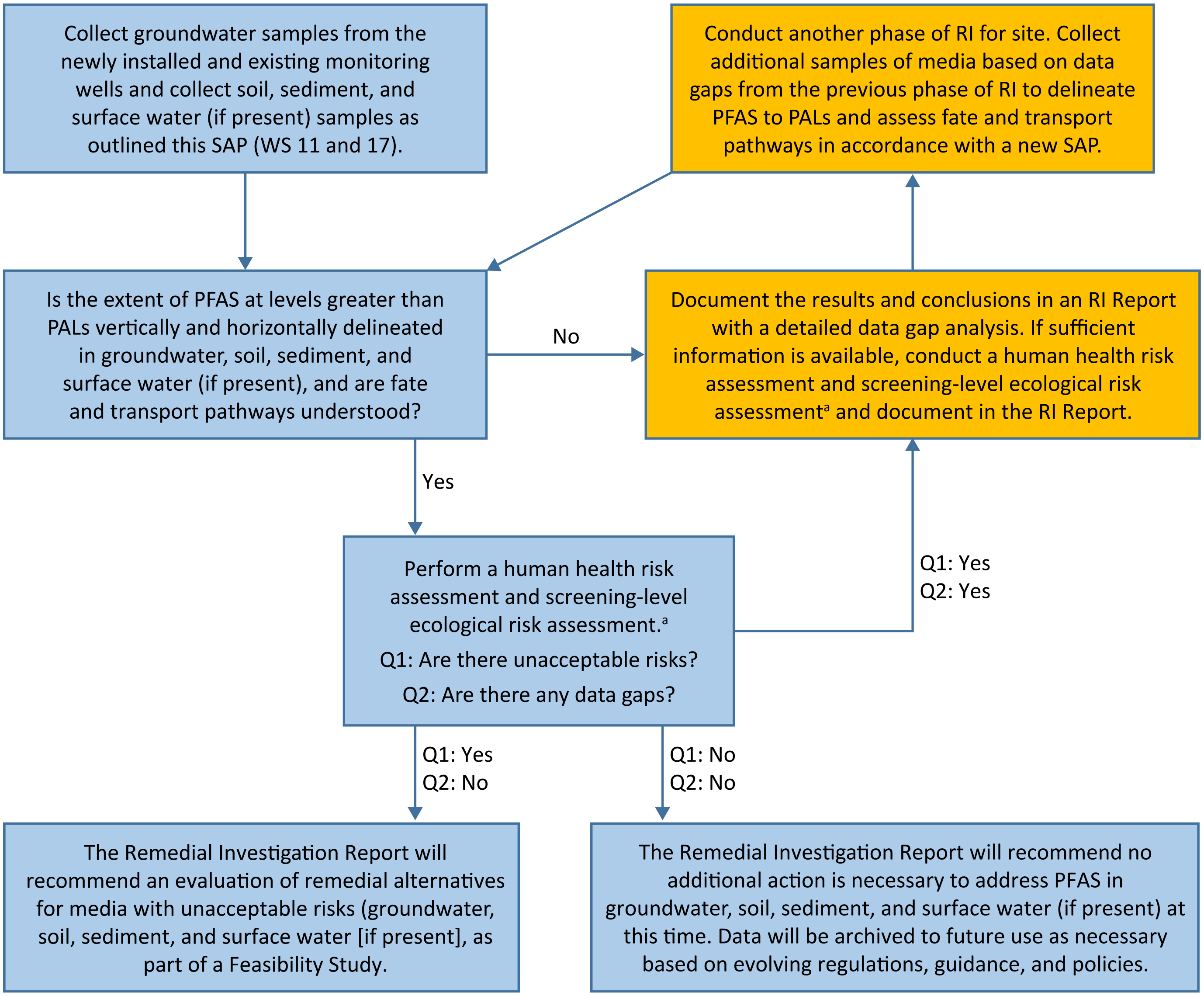
Figures



[a] PFAS will be evaluated within the applicable DoD, Navy, and/or EPA policy, guidance, or directives using the state-of-the science toxicological information available and current at the time the RI is prepared for both the Human Health and Ecological Risk Assessments. Prior to conducting an ecological risk screening, the ecological screening values that will be used for comparison to site media will be reviewed based on current science and relevancy to site-specific receptors (e.g., relevant ecological receptors present). Ecological screening values selected for the screening will be presented in a technical memo or other documented form for regulatory review and acceptance.

Note:
Ongoing sampling and other activities being done to address off-Base drinking water that exceeds the May 2016 USEPA lifetime drinking water health advisories for PFOA and PFOS of 70 ppt, individually or combined, will not be conducted as a part of RI activities at OLF Coupeville.

Figure 11-1.
Decision Logic for Project Quality Objectives
Sampling and Analysis Plan Addendum
Per- and Polyfluoroalkyl Substances
Remedial Investigation
Outlying Landing Field Coupeville
Naval Air Station Whidbey Island
Coupeville, Washington

Sampling and Analysis Plan Addendum
Per- and Polyfluoroalkyl Remedial Investigation
Outlying Landing Field Coupeville
Naval Air Station Whidbey Island
Oak Harbor, Washington

NOTIFICATION: FIGURES 11-2 THROUGH 11-5 CONTAIN SENSITIVE BUT UNCLASSIFIED INFORMATION WHICH IS PROTECTED BY THE FREEDOM OF INFORMATION ACT

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Appendix A

Final Sampling and Analysis Plan, Per- and Polyfluoroalkyl Substances Remedial Investigation, Outlying Landing Field Coupeville, Naval Air Station Whidbey Island, Oak Harbor, Washington

Naval Facilities Engineering Systems Command Northwest
Silverdale, Washington

Final

Sampling and Analysis Plan
Per- and Polyfluoroalkyl Substances Remedial Investigation
Outlying Landing Field Coupeville

Naval Air Station Whidbey Island
Oak Harbor, Washington

January 2022

Distribution authorized to U.S. Government Agencies and their Contractors only, Proprietary Information, 28 January 2022, Other request for this document will be referred to NAVFAC Northwest, 1101 Tautog Circle, Silverdale, WA 98315-1101

SAP Worksheet #1—Title and Signature Page

Naval Facilities Engineering Systems Command Northwest
Silverdale, Washington

Final

Sampling and Analysis Plan
Per- and Polyfluoroalkyl Substances Remedial Investigation
Outlying Landing Field Coupeville

Naval Air Station Whidbey Island
Oak Harbor, Washington

January 2022

Prepared for NAVFAC Northwest
by CH2M HILL, Inc.
Bellevue, Washington
Contract N62470-16-D-9000
CTO N4425520F4343

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SAP Worksheet #1—Title and Signature Page (continued)

Approval Signatures:

TBD
Naval Facilities Engineering Systems Command Atlantic
Quality Assurance Officer

Other Approval Signatures:

CLUBB.KENDRA.R.1374441171 Digitally signed by CLUBB.KENDRA.R.1374441171
Date: 2022.01.25 11:39:13 -08'00'

Kendra Clubb
Naval Facilities Engineering Systems Command Northwest
Remedial Project Manager

CHAN PONGKHAMSING Digitally signed by CHAN PONGKHAMSING
Date: 2022.01.25 18:29:09 -08'00'

Chan Pongkhamsing
United States Environmental Protection Agency Region 10
Remedial Project Manager

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Executive Summary

The Department of the Navy (Navy), Naval Facilities Engineering Systems Command (NAVFAC) Northwest has contracted CH2M HILL, Inc. (CH2M) to conduct a Remedial Investigation (RI) specific to known or suspected releases of per- and polyfluoroalkyl substances (PFAS) to the environment at Outlying Landing Field (OLF) Coupeville in Coupeville, Washington in Island County. This Uniform Federal Policy-Sampling and Analysis Plan/ Quality Assurance Project Plan (SAP) describes the inspection activities, including sampling, to be conducted on-base at the Coupeville property and at selected off-base locations adjacent to OLF Coupeville. CH2M prepared this document under the NAVFAC Comprehensive Long-term Environmental Action – Navy 9000 Contract N62470-16-D-9000, Contract Task Order N4425520F4343, for submittal to NAVFAC Northwest and the United States Environmental Protection Agency (USEPA). CH2M prepared this SAP to help ensure that environmental data collected are scientifically sound, of known and documented quality, and suitable for intended uses.

OLF Coupeville is a military airfield associated with Naval Air Station (NAS) Whidbey Island. It was commissioned for use by the Navy in 1943 and provides support for day and night Field Carrier Landing Practice operations by the Navy for aircraft based out of NAS Whidbey Island. Such operations allow aviators and their crews to fly in patterns as well as practice touch-and-go, simulating carrier landings and take offs. During these practice runs, jet aircraft approach the runway and touch down, immediately taking off again and looping around the field to prepare for another landing and takeoff.

Investigations for PFAS at OLF Coupeville began in 2016. In accordance with Navy policy, off-base drinking water wells were sampled near OLF Coupeville from 2016-2017 (CH2M, 2019a; 2021b). Eight drinking water wells were identified to have perfluorooctane sulfonic acid (PFOS) and/or perfluorooctanoic acid (PFOA) above the USEPA lifetime health advisory. Two expedited Site Inspections (SIs) were conducted from 2016-2018 to better understand the aquifer system and identify the presence of PFAS on-base (CH2M, 2018a); and aquifer testing and groundwater modeling conducted to improve the understanding of aquifer properties and advance the conceptual model of the system (CH2M, 2018b). The results of these previous groundwater investigations at OLF Coupeville identified the presence of PFOS and/or PFOA in groundwater in six on-base groundwater monitoring wells at concentrations exceeding the USEPA lifetime health advisory[1]. Additionally, samples collected from the Town of Coupeville's Keystone Well, a community drinking water well located off-Base to the west of OLF Coupeville, indicate that the Keystone Well temporarily exceeded the lifetime health advisory for PFOA and may exceed the advisory level in the future based on current and future pumping rates.

A preliminary assessment (PA) for OLF Coupeville was issued in November 2018 (CH2M, 2018c). The PA identified two on-Base potential release areas (referred to as potential source areas in the PA) of PFAS that warranted further investigation. The two on-base potential release areas were investigated during the 2019-2020 Supplemental SI (CH2M, 2021a).The Supplemental SI confirmed the presence of PFOA and/or PFOS above the USEPA groundwater SLs in several wells near and downgradient of the two potential release areas (formerly called PSAs). PFOA and PFOS concentrations in new monitoring wells indicated that the migration of PFAS at OLF is predominantly to the south-southwest with a vertically downward trajectory. However, the extent of the PFOA and PFOS impacts in groundwater are not consistent with low soil concentrations at depth near Building 2709 and Facilities 1, 2, and 11. PFOA and PFOS were also detected in monitoring wells west of the runway near the Keystone Well, and these concentrations are likely attributable to a source area near the northwestern end of the runway and may also be contributing to the PFAS concentrations in the Keystone Well. The RI sampling described herein seeks to delineate the horizontal and vertical extent of PFAS in soil, groundwater, and surface water (if

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[1] At the time of the Expedited SI, these concentrations were screened against the USEPA lifetime health advisory of 70 nanograms per liter (ng/L) each for PFOA and PFOS, and 70 ng/L for combined PFOA and PFOS. However, the USEPA lifetime health advisory is no longer used for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) decision making. The Navy's current policy is to use the screening levels for soil and groundwater consistent with the Department of Defense (DoD) technical guidance for PFAS investigations (ASD, 2021) and EPA, 2021.

present) at OLF Coupeville and to address data gaps relating to PFAS transport pathways and suspected additional PFAS release areas. The objectives of the RI are as follows:

- Define the horizontal and vertical extent of PFAS at the on-base release areas (Building 2709 and Facilities 1, 2, and 11) and determine whether there is unacceptable risk to human health and ecological[2] receptors.
- Confirm the presence of an additional on-base release area west of the runway near the Keystone Well and, if identified, define the nature and extent of PFAS concentrations in this area and determine whether there is unacceptable risk to human health and ecological[2] receptors.
- Refine the data representative of groundwater flow and potential PFAS migration directions between the on-base release areas, the release area west of the runway, and impacted on-base groundwater monitoring wells and off-base drinking water wells with exceedances of the USEPA lifetime health advisory for PFOA and PFOS.
- Refine the data demonstrating temporal variability in PFAS concentrations in groundwater at OLF Coupeville.
- Determine whether PFAS are present in ditch surface soil and surface water (if surface water is present/ observed), define the nature and extent of PFAS in ditch surface soil and surface water (if present), and determine whether there is unacceptable risk to human health and ecological[2] receptors.

It is anticipated that the RI will be accomplished during at least two field investigation phases, the first of which will include the on-base fieldwork described herein, with additional phases, including the off-Base field work to be described in an addendum to this SAP. If additional data is needed to accomplish the RI objectives, additional phases may be performed which will be described under future task order work plan documents. The Phase 1 investigation described in this SAP will include the following activities:

- Conduct surface and subsurface soil sampling at or near Building 2709 and Facilities 1, 2, and 11.
- Install an on-base shallow-zone groundwater monitoring well east of Building 2709.
- Collect depth-discrete groundwater grab samples and install an on-base shallow/intermediate groundwater monitoring well pair between the on-base release areas and on-base groundwater monitoring wells to the southwest where PFOA has been detected in exceedance of the SL.
- Conduct surface and subsurface soil sampling west of the runway near the Keystone Well.
- Collect depth-discrete groundwater grab samples and install on-base shallow/intermediate groundwater monitoring well pairs west of the runway near the Keystone Well.
- Collect depth-discrete groundwater grab samples and install on-base intermediate/deep groundwater monitoring well pairs near the southern end of the runway and the southwestern Base boundary.
- Collect paired surface water (if present) and ditch surface soil samples from on-base runway drainage ditches.
- Analyze all samples for the 18 PFAS listed in Method 537.1 via Liquid Chromatography Tandem Mass Spectrometry (USEPA, 2020a) in compliance with the DoD Quality Systems Manual (QSM) Version 5.3 Table B-15 or the most recent version of the DoD QSM for which Battelle has DoD Environmental Laboratory Accreditation Program (ELAP) certification.

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[2] PFAS will be evaluated within the applicable DoD, Navy, and/or EPA policy, guidance, or directives using the state-of-the-science toxicological information available and current at the time the RI is prepared for both the Human Health and Ecological Risk Assessments. Prior to conducting an ecological risk screening, the ecological screening values that will be used for comparison to site media will be reviewed based on current science and relevancy to site-specific receptors (e.g., relevant ecological receptors present). Ecological screening values selected for the screening will be presented in a technical memo or other documented form for stakeholder review and acceptance.

- Collect lithologic data from the newly installed groundwater monitoring wells and soil borings for further understanding of the overall conceptual site model for the site.
- Survey each newly installed groundwater monitoring well and soil boring location.

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

- *Guidance for Quality Assurance Project Plans* (USEPA, 2002)
- *Uniform Federal Policy for Quality Assurance Project Plans: Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs - Part 1: UFP-QAPP Manual* (USEPA, 2005)
- *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA, 2006)
- *Interim Per- and Polyfluoroalkyl Substances (PFAS) Site Guidance for NAVFAC Remedial Project Managers (RPMs)/November 2020 Update* (NAVFAC, 2020)

Additional samples of groundwater, soil, ditch surface soil and surface water (the media described herein) may be collected in locations where data gaps continue to exist to delineate PFAS to PALs or assess fate and transport pathways, consistent with stakeholder agreement and in accordance with procedures outlined in this SAP. Media not explicitly discussed in this SAP, such as drinking water, will not be sampled at this time or under this SAP.

This SAP consists of 37 worksheets specific to the scope of the RI. All tables are embedded within the worksheets. All figures are included at the end of the document. The scoping presentation provided to stakeholders in the December 2020 scoping session is included in **Appendix A**. Field standard operating procedures (SOPs) are included in **Appendix B**. The DoD-ELAP Accreditation letter is included in **Appendix C**. Laboratory SOPs are included in **Appendix D**.

The laboratory information cited in this SAP is specific to Battelle. If additional laboratory services are necessary to meet the project objectives, revised SAP worksheets will be submitted to NAVFAC and regulatory agencies (as appropriate) for approval and appended to this SAP.

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SAP Worksheets

Appendixes

Tables

Figures

Acronyms and Abbreviations

±	plus or minus
%	percent
>	greater than
<	less than
≤	less than or equal to
°C	degree(s) Celsius
µg/kg	microgram(s) per kilogram
11Cl-PF3OUdS	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid
9Cl-PF3ONS	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid
ADONA	4,8-dioxa-3H-perfluoronanoic acid
AFFF	aqueous film-forming foam
AM	Activity Manager
AQM	Activity Quality Manager
ASD	Assistant Secretary of Defense
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
CA	corrective action
CAS	Chemical Abstracts Service
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CH2M	CH2M HILL, Inc.
CLEAN	Comprehensive Long-term Environmental Action—Navy
CSM	conceptual site model
DL	detection limit
DoD	Department of Defense
DV	data validator
Ecology	Washington Department of Ecology
EDD	electronic data deliverable
ELAP	Environmental Laboratory Accreditation Program
ESV	ecological screening value
EtFOSAA	n-ethyl perfluorooctanesulfonamidoacetic acid
FD	field duplicate
FTL	Field Team Leader
H&S	health and safety
HDPE	high-density polyethylene
HFPO-DA	perfluoro-2-methyl-3-oxahexanoic acid
HQ	hazard quotient
HSM	Health and Safety Manager
HSP	Health and Safety Plan
ICAL	initial calibration
ID	identification
IDW	investigation-derived waste
ISC	instrument sensitivity check

LC/MS/MS	liquid chromatography – tandem mass spectrometer
LCS	laboratory control sample
LCL	lower confidence limit
LOD	limit of detection
LOQ	limit of quantitation
MD	matrix duplicate
MeFOSAA	n-methyl perfluorooctanesulfonamidoacetic acid
MPC	measurement performance criteria
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
NAS	Naval Air Station
NAVD88	North American Vertical Datum of 1988
NAVFAC	Naval Facilities Engineering Systems Command
Navy	Department of the Navy
NEtFOSAA	n-ethylperfluoro-1-octancesulfonamidoacetic acid
ng/L	nanogram(s) per liter
NMeFOSAA	n-methylperfluoro-1-octanesulfonamidoacetic acid
NTR	Navy Technical Representative
OLF	Outlying Landing Field
PA	Preliminary Assessment
PAL	project action limit
PC	Project Chemist
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutane sulfonate
PFDA	perfluorodecanoic acid
PFDoA	perfluorododecanoic acid
PFPeA	perfluoropentanoic acid
PFHxA	perfluorohexanoic acid
PFHpA	perfluoroheptanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonic acid
PFTeDA	perfluorotetradecanoic acid
PFTrDA	perfluorotridecanoic acid
PFUnA	perfluoroundecanoic acid
PID	photoionization detector
PM	Project Manager
POC	point of contact
PPR	provisional peer-reviewed
PQL	project quantitation limit
PQO	Project Quality Objective
QA	quality assurance
QAO	Quality Assurance Officer
QC	quality control

QSM	Quality Systems Manual
QSM 5.3	Quality Systems Manual Version 5.3
RI	Remedial Investigation
RPD	relative percent difference
RPM	Remedial Project Manager
RSL	regional screening level
SAP	Sampling and Analysis Plan
SI	site inspection
SL	screening level
SLERA	Screening-Level Ecological Risk Assessment
SME	Subject Matter Expert
SOP	standard operating procedure
SPE	solid phase extraction
SSHO	Site Safety and Health Officer
SSL	soil screening level
STC	Senior Technical Consultant
TAT	turnaround time
TBD	to be determined
TM	Task Manager
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency

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SAP Worksheet #2—Sampling and Analysis Plan Identifying Information

Site Name/Number:	Outlying Landing Field (OLF) Coupeville, Naval Air Station (NAS) Whidbey Island
Operable Unit:	Not Applicable (N/A)
Contractor Name:	CH2M HILL, Inc. (CH2M)
Contract Number:	N62470-16-D-9000, Contract Task Order 4343
Contract Title:	Comprehensive Long-term Environmental Action – Navy (CLEAN) Program 9000
Work Assignment:	Remedial Investigation (RI) specific to releases of per- and polyfluoroalkyl substances (PFAS) to the environment for Naval Facilities Engineering Systems Command (NAVFAC) Northwest at the OLF in Coupeville, Washington

1. **This Sampling and Analysis Plan (SAP) was prepared in accordance with the following guidance documents:**
   - *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988)
   - *Superfund Amendments and Reauthorization Act* (USEPA, 1986)
   - *Guidance for Quality Assurance Project Plans* (USEPA, 2002)
   - *Uniform Federal Policy for Quality Assurance Project Plans: Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs - Part 1: UFP-QAPP Manual* (USEPA, 2005)
   - *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA, 2006)
   - *Naval Facilities Engineering Command - Sampling and Analysis Plans Update on the Uniform Federal Policy Quality Assurance Project Plans (UFP-QAPP) – Navy Sampling and Analysis Plans (SAP) Tiered Approach* (Navy, 2011a)
   - *Interim Per- and Polyfluoroalkyl Substances (PFAS) Site Guidance for NAVFAC Remedial Project Managers (RPMs)/November 2020 Update* (NAVFAC, 2020)
   - *Department of the Navy Environmental Restoration Program Manual* (Navy, 2018)
2. **Identify regulatory Program: Comprehensive Environmental Response, Compensation, and Liability Act of 1980**
3. **This document is a project-specific SAP.**
4. **List dates of scoping sessions that were held:**

Scoping Session	Date
Project Scoping Session with NAVFAC Northwest Remedial Project Manager (RPM), United States Environmental Protection Agency (USEPA), Washington Department of Ecology (Ecology), Washington Department of Health, Island County, and Town of Coupeville	December 10, 2020

SAP Worksheet #2—Sampling and Analysis Plan Identifying Information (continued)

5. **List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation:**

Document	Date
Sampling and Analysis Plan, Investigation of Perfluorinated Compounds in Drinking Water, Ault Field and Outlying Landing Field Coupeville, Naval Air Station Whidbey Island, Oak Harbor and Coupeville, Washington (CH2M, 2017a)	January 2017
Sampling and Analysis Plan, Site Inspection for Perfluorinated Compounds in Groundwater, Outlying Landing Field Coupeville, NAS Whidbey Island, Coupeville, Washington (CH2M, 2017b)	January 2017
Sampling and Analysis Plan, Monitoring Well Installation, Aquifer Testing, Drinking Water Sampling, and Groundwater Sampling, Outlying Landing Field Coupeville, NAS Whidbey Island, Coupeville, Washington (CH2M, 2017c)	December 2017
Sampling and Analysis Plan, Supplemental Site Inspection, Outlying Landing Field Coupeville, NAS Whidbey Island, Oak Harbor, Washington (CH2M, 2019b)	August 2019
Sampling and Analysis Plan Addendum, Supplemental Site Inspection, Outlying Landing Field Coupeville, NAS Whidbey Island, Oak Harbor, Washington (CH2M, 2020a)	August 2020

6. **List organizational partners (stakeholders) and identify the connection with lead organization:**

Organization Partners/Stakeholders	Connection
NAVFAC Northwest – Kendra Clubb	RPM
NAVFAC Atlantic	Quality Assurance Officer (QAO)
USEPA Region 10 – Chan Pongkhamsing	Project Manager (PM)
Washington Department of Ecology – Mike Shaljian	Hydrogeologist - Toxics Cleanup Program

7. **Lead organization:**

- Department of the Navy (Navy) – NAVFAC Northwest

8. **If any required SAP elements and required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion as follows:**

- Crosswalk table is excluded because all required information is provided in this SAP.

SAP Worksheet #3—Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number	Email Address or Mailing Address
Kendra Clubb	RPM/Task Order Contracting Officer's Representative	NAVFAC Northwest	(509) 999-6843	kendra.leibman@navy.mil
Charlie Escola	Navy Technical Representative (NTR)	NAVFAC Northwest	(503) 201-5020	charles.escola@navy.mil
Steve Skeehan	NTR	NAVFAC Northwest	(253) 279-0212	Steve.skeehan@navy.mil
To be determined (TBD)	NAVFAC QAO	NAVFAC Atlantic	TBD	TBD
Chan Pongkhamsing	PM	USEPA Region 10	(206) 553-1806	pongkhamsing.chan@epa.gov
Mike Shaljian	Hydrogeologist - Toxics Cleanup Program	Ecology	(360) 489-2753	mish461@ECY.WA.GOV
Joe Grogan	Utility Manager	Town of Coupeville	(360) 914-0314	utilities1@townofcoupeville.org
Jennifer Madsen	Activity Manager (AM), PM	CH2M	(360) 888-0281	jennifer.madsen@ch2m.com
Rachel Clennon	Task Manager (TM)	CH2M	(978) 387-8171	rachel.clennon@ch2m.com
Peter Lawson	Senior Technical Consultant (STC)	CH2M	(530) 949-0870	peter.lawson@ch2m.com
Paul Townley	Activity Quality Manager (AQM)	CH2M	(206) 295-6904	paul.townley@ch2m.com
Laura Cook	Subject Matter Expert (SME)	CH2M	(757) 671-6214	laura.cook@ch2m.com
Janna Staszak	Program SAP Quality Reviewer	CH2M	(757) 268-6136	janna.staszak@ch2m.com
Anita Dodson	Navy CLEAN Program Chemist/SAP Reviewer	CH2M	(757) 284-9208	anita.dodson@ch2m.com
Travis Pitts	Project Chemist (PC)	CH2M	(541) 768-3727	travis.pitts@ch2m.com
Doug Weaver	Data Validator (DV)	Environmental Data Services, Inc. (EDS)	(757) 564-0090	dweaver@end-data.com
TBD	Field Team Leader (FTL)	CH2M	TBD	TBD
TBD	Site Safety and Health Officer (SSHO)	CH2M	TBD	TBD
Jonathan Thorn	Laboratory PM	Battelle	(781) 681-5565	thorn@battelle.org

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SAP Worksheet #4—Project Personnel Sign-Off Sheet

Name	Organization/Title/Role	Telephone Number	Signature/Email Receipt	SAP Section Reviewed	Date SAP Read
Jennifer Madsen	CH2M/AM, PM	(360) 888-0281			
Peter Lawson	CH2M/STC	(530) 949-0870			
Paul Townley	CH2M/AQM	(206) 295-6904			
Laura Cook	CH2M/SME	(757) 671-6214			
Rachel Clennon	CH2M/Project TM	(978) 387-8171			
Anita Dodson	CH2M/Navy CLEAN Program Chemist/SAP Reviewer	(757) 284-9208			
Travis Pitts	CH2M/PC	(541) 768-3727			
TBD	CH2M/FTL	TBD			
TBD	CH2M/SSHO	TBD			
Jonathan Thorn	Battelle/Laboratory PM	(781) 681-5565			
Doug Weaver	Environmental Data Services, Inc. (EDS)/Data Validation PM	(757) 564-0090			

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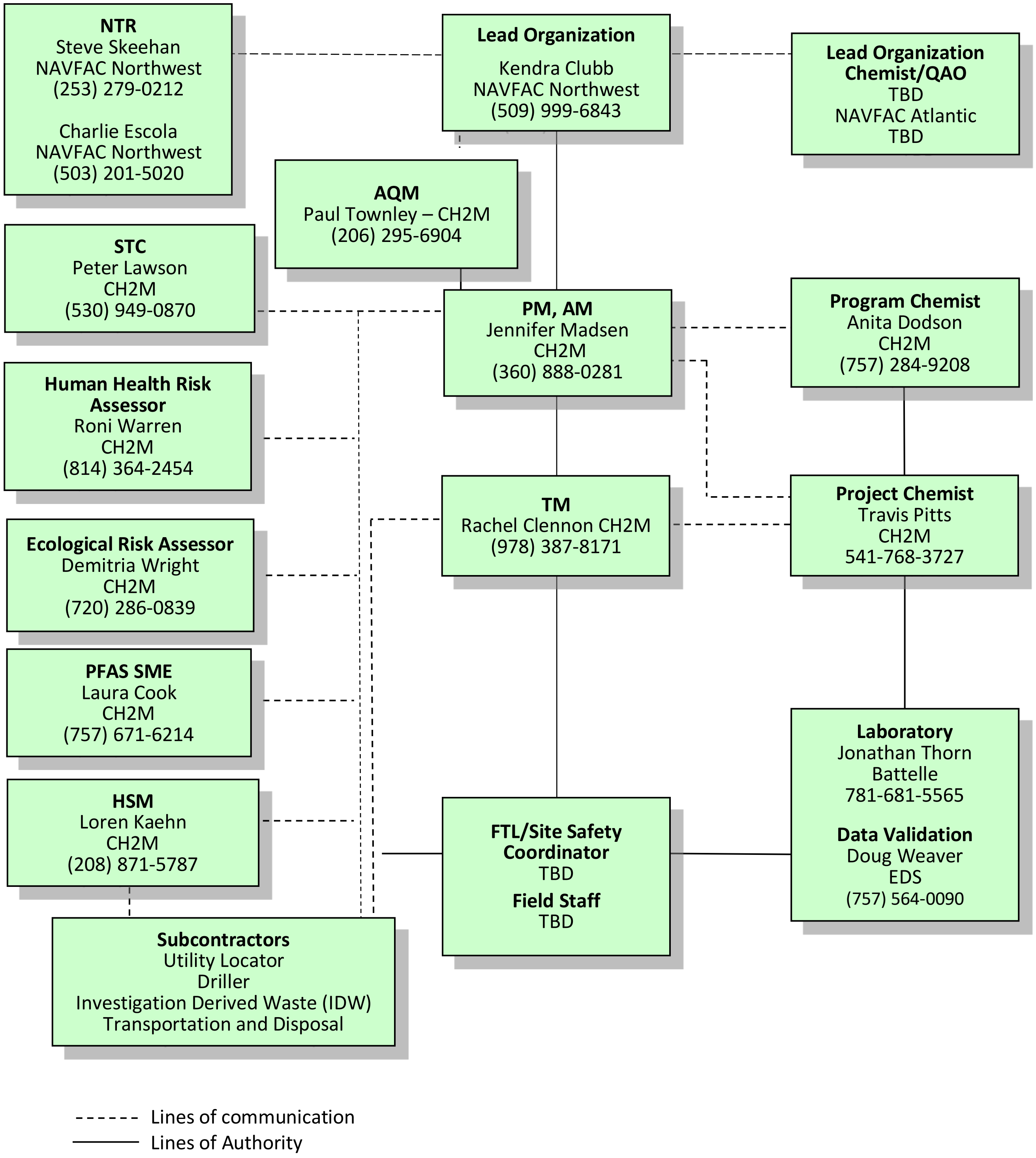
SAP Worksheet #5—Project Organizational Chart



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SAP Worksheet #6—Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure
Communication with Navy (lead agency)	NAVFAC Northwest NTR	Steve Skeehan	steve.skeehan@navy.mil (253) 279-0212	Primary point of contact (POC) for NAVFAC Northwest for the contractor during fieldwork; oversees fieldwork, provides base-specific information, provides coordination with NAS Whidbey Island, and can delegate communication to other internal POCs.
Communication with Navy (lead agency)	NAVFAC Northwest NTR	Charlie Escola	charles.escola@navy.mil (503) 201-5020	Primary POC for NAVFAC Northwest for the contractor during fieldwork; oversees fieldwork, provides base-specific information, provides coordination with NAS Whidbey Island, and can delegate communication to other internal POCs.
Communication with Navy (lead agency)	NAVFAC Northwest RPM	Kendra Clubb	kendra.leibman@navy.mil (509) 999-6843	Primary POC for NAVFAC Northwest; can delegate communication to other internal or external POCs. CH2M PM will notify the NTR, RPM, and NAVFAC Atlantic QAO by email or telephone call within 24 hours for changes affecting the scope or implementation of the SAP.
Communication with Navy (lead agency)	NAVFAC Atlantic QAO	TBD	TBD	Primary POC for NAVFAC LANT.
Communication regarding overall project status Communication regarding overall project status and implementation and primary POC with RPM and project team	AM, PM	Jennifer Madsen	jennifer.madsen@ch2m.com (360) 888-0281	Oversees project and will be informed of project status by the PM and TM. All data results will be communicated to appropriate team members following data receipt and review.
Communication regarding items specific to OLF tasks and primary POC for field team	CH2M TM	Rachel Clennon	rachel.clennon@ch2m.com (978) 387-8171	Oversees the investigation task and will be informed of task status by the FTL. If field changes are necessary, TM will work with the PM and RPM to prepare a Field Change Request to be submitted to the NTR and RPM and will communicate in-field changes to the team by email within 24 hours. All data results will be communicated to appropriate team members following data receipt and review.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure
Technical communications for project implementation, and data interpretation	CH2M STC	Peter Lawson	peter.lawson@ch2m.com (530) 949-0870	Contact STC regarding questions/issues encountered in the field, input on data interpretation, as needed. The STC will have 24 hours to respond to technical field questions as necessary. Additionally, the STC will review the data as necessary prior to discussions with NAVFAC Northwest and reporting review.
Quality issues	CH2M AQM	Paul Townley	paul.townley@ch2m.com (206) 295-6904	Contact AQM regarding quality issues during project implementation. The AQM will report to the PM, RPM, and NTR.
Technical communications for project implementation, and data interpretation	CH2M SME	Laura Cook	laura.cook@ch2m.com (757) 671-6214	Contact SME regarding questions/issues encountered in the field, input on data interpretation, as needed. SME will have 24 hours to respond to technical field questions as necessary. Additionally, SME will review the data as necessary prior to Base and NAVFAC Northwest discussions and reporting review.
Health and safety (H&S)	CH2M Health and Safety Manager (HSM)	Loren Kaehn	loren.kaehn@ch2m.com (208) 871-5787	Responsible for generation of the Health and Safety Plan (HSP) and approval of the activity hazard analyses prior to the start of fieldwork. The PM will contact the HSM as needed regarding questions/issues encountered in the field.
H&S	CH2M SSHO	TBD	TBD	Responsible for the adherence of team members to the site safety requirements described in the HSP. Will report H&S incidents and near losses to the PM as soon as possible.
Stop Work Order	CH2M PM	Jennifer Madsen	jennifer.madsen@ch2m.com (360) 888-0281	Any field member can immediately stop work if an unsafe condition that is immediately threatening to human health is observed. The field staff, FTL, or SSHO should notify the NTR, RPM, and the CH2M PM immediately. Ultimately, the FTL and PM can stop work for a period of time. NAVFAC Northwest can stop work at any time.
	CH2M TM	Rachel Clennon	rachel.clennon@ch2m.com (978) 387-8171	
	CH2M FTL/ SSHO	TBD	TBD	
	Field Team Members	TBD	TBD	

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure
SAP changes in field	FTL	TBD	TBD	Documentation of deviations from the SAP will be made in the field notes, and the PM will be notified immediately. The RPM and Navy QAO will be also be notified, and deviations will be made only with approval from the PM and approval of a field change request by the RPM.
Field changes/field progress reports	FTL	TBD	TBD	Documentation of field activities and SAP deviations (made with the approval of STC and/or QAO) in field notes; provide daily progress reports to PM.
Reporting laboratory data quality issues	Laboratory PM	Jonathan Thorn	thorn@battelle.org (781) 681-5565	All quality assurance (QA)/quality control (QC) issues with project field samples will be reported within 2 days to the PC by the laboratory.
Communication to Navy QAO regarding SAP changes	Navy CLEAN Program Chemist	Anita Dodson	anita.dodson@ch2m.com (757) 284-9208	Changes to the project that would prompt a SAP change that would require Navy QAO approval include the following: the addition of an analytical suite not previously included in the SAP, the addition of an environmental matrix not previously included in the SAP, laboratory accreditation to a new Department of Defense (DoD) Quality Systems Manual (QSM) version, inclusion of a new laboratory into the SAP for any reason, or updates to the conceptual site model (CSM) that prompt new DQOs. Updated laboratory limit of quantitation (LOQ), limit of detection (LOD), and detection limit (DL) values will not prompt a SAP update for Navy QAO approval unless those updates negatively affect the ability to meet project action limits (PALs).
Analytical corrective actions (CAs)	PC	Travis Pitts	travis.pitts@ch2m.com (541) 768-3727	Any CAs for field and analytical issues will be determined by the PC and reported to the PM within 4 hours. The PM will ensure SAP requirements are met by field staff for the duration of the project.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure
Data tracking from field collection to database upload Release of analytical data	PC	Travis Pitts	travis.pitts@ch2m.com (541) 768-3727	Tracks data from sample collection through database upload daily. No analytical data can be released until validation of the data is completed and has been approved by the PC. The PC will review analytical results within 24 hours of receipt for release to the PM. The PC will inform the Navy CLEAN Program Chemist, who will notify the Navy QAO and RPM of any laboratory issues that would prevent the project from meeting project quality objectives (PQOs) or would cause significant delay in the project schedule.
Reporting data quality issues	DV	Doug Weaver	dweaver@end-data.com (757) 564-0090	The DV reviews and qualifies analytical data as necessary. The data along with a validation narrative are returned to the PC within 7 calendar days.
Field CAs	FTL, AM, PM, and Project TM	FTL (TBD) Jennifer Madsen (AM/PM) Rachel Clennon (TM)	TBD jennifer.madsen@ch2m.com (360) 888-0281 rachel.clennon@ch2m.com (978) 387-8171	Field and analytical issues requiring CA will be determined by the FTL, TM and/or PM on an as-needed basis. The PM will ensure SAP requirements are met by field staff for the duration of the project. The FTL will notify the PM via phone of any need for CA within 4 hours. The PM will notify the NTR and RPM of any field issues that would negatively affect schedule or the ability to meet project data quality objectives.

SAP Worksheet #7—Personnel Responsibilities Table

Name	Title/Role	Organizational Affiliation	Responsibilities
Kendra Clubb	RPM	NAVFAC Northwest	Oversees entire project for Navy; reviews and approves SAP and changes to SAP; provides base-specific information and coordinates with NAS Whidbey Island.
Charlie Escola	NTR	NAVFAC Northwest	Oversees fieldwork; provides base-specific information, and coordination with NAS Whidbey Island.
Steve Skeehan	NTR	NAVFAC Northwest	Oversees fieldwork; provides base-specific information, and coordination with NAS Whidbey Island.
TBD	NAVFAC QAO/Chemist	NAVFAC Atlantic	Provides QA oversight and reviews SAPs.
Jennifer Madsen	AM, PM	CH2M	Oversees and manages project activities.
Rachel Clennon	TM	CH2M	Oversees and manages all tasks associated with OLF.
Peter Lawson	STC	CH2M	Provides senior technical support for project approach and execution.
Paul Townley	AQM	CH2M	Provides QA oversight.
Laura Cook	SME	CH2M	Provides senior technical support for project approach and execution.
Janna Staszak	SAP Reviewer	CH2M	Reviews and approves the SAP and changes or makes revisions to the SAP.
Anita Dodson	Navy CLEAN Program Chemist/SAP Reviewer	CH2M	Provides SAP project delivery support, reviews and approves SAPs, and performs final data evaluation and QA oversight.
Travis Pitts	PC	CH2M	Data management: Performs data evaluation and QA oversight, is the POC with laboratory and validator for analytical issues.
Loren Kaehn	HSM	CH2M	Prepares HSP and manages H&S for all field activities.
Doug Weaver	DV	Environmental Data Services, Inc. (EDS)	Validates laboratory data from an analytical standpoint prior to data use.
TBD	FTL	CH2M	Coordinates all field activities and sampling.
TBD	Field Staff	CH2M	Conducts field activities.
Jonathan Thorn	Laboratory PM	Battelle	Manages samples tracking and maintains good communication with PC.
Zachary Willenberg	Laboratory QAO	Battelle	Responsible for audits, CA, and checks of QA performance within the laboratory.

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SAP Worksheet #8—Special Personnel Training Requirements Table

No specialized training beyond standard H&S training is required for this project.

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SAP Worksheet #9—Project Scoping Session Participants Sheet

Project Name: OLF Coupeville RI **Projected Date(s) of Sampling:** September to December 2021 **PM:** Jennifer Madsen/CH2M	**Site Name:** OLF Coupeville **Site Location:** Coupeville, Washington

Date of Session: Thursday, December 10, 2020

Scoping Session Purpose: To obtain consensus on overall objectives of the investigation at OLF Coupeville and discuss proposed investigation scope.

Name	Title/Project Role	Affiliation	Phone Number	Email Address
Kendra Clubb	NAVFAC Northwest RPM	NAVFAC Northwest	(509) 999-6843	kendra.leibman@navy.mil
Melissa Gehrmann	NAS Whidbey Island Public Works Department Installation Environmental Program Director, Acting	NAVFAC Northwest	TBD	melissa.s.gehrmann1@navy.mil
Chan Ponghkamsing	USEPA Region 10 RPM	USEPA	(206) 553-1806	pongkhamsing.chan@epa.gov
Ted Repasky	Hydrogeologist	USEPA	TBD	repasky.ted@epa.gov
Doug Kelly	Hydrogeologist	Island County	(360) 678-7885	d.kelly@islandcountywa.gov
Mike Shaljian	Hydrogeologist	Ecology	(360) 489-2753	mish461@ecy.wa.gov
Steve Hulsman	SME	Washington Department of Health	TBD	steve.hulsman@dlh.wa.gov
Joe Grogan	Utility Superintendent	Town of Coupeville	(360) 914-0314	utilities1@townofcoupeville.org
Jennifer Madsen	PM/AM	CH2M	(360) 888-0281	jennifer.madsen@ch2m.com
Rachel Clennon	TM	CH2M	(978) 387-8171	rachel.clennon@ch2m.com
Peter Lawson	STC	CH2M	(530) 949-0870	peter.lawson@ch2m.com
Heather Perry	Hydrogeologist SME /Groundwater modeler	CH2M	(530) 355-1622	heather.perry@ch2m.com
Gerrit Gardner	SAP Lead Author	CH2M	(609) 769-7302	gerrit.gardner@ch2m.com

Comments

The scoping meeting consisted of two sessions conducted on December 10, 2020. During the first session, NAVFAC Northwest and CH2M presented an overview of the Supplemental Site Inspection (SI) and groundwater modeling results. During the second session, NAVFAC Northwest and CH2M presented preliminary locations for soil borings, new groundwater monitoring wells, and surface water (if present) and ditch surface soil sampling where data gaps persist. **Appendix A** provides the scoping presentation, which was shared with stakeholders during this session.

SAP Worksheet #9—Project Scoping Session Participants Sheet (continued)

USEPA expressed a concern that the preliminary number of soil borings may not be enough to generate a sufficient amount of data to properly evaluate the extent of PFAS in the soil at Building 2709 and Facilities 1, 2, and 11, or at the suspected release area near the Keystone Well and WI-CV-MW15/WI-CV-MW16 well cluster. NAVFAC Northwest acknowledged this concern and explained that the preliminary number of borings for the RI should be seen as an appropriate next step in the process and that the phased approach would allow for additional soil borings in the future.

Fieldwork for Phase 1 of the RI is expected to begin in fall 2021.

Consensus Decisions

USEPA, Ecology, Island County, and the Town of Coupeville agreed with the RI approach that NAVFAC Northwest and CH2M presented, including the RI objectives, implementation of separate investigation phases for on-base and off-base field tasks, and the media to be sampled (soil, groundwater, ditch surface soil, and surface water if present). The stakeholders provided concurrence with regard to general locations of soil borings near confirmed and potential PFAS release areas, proposed on- and off-base monitoring well locations, and proposed on- and off-base surface water and ditch surface soil sampling locations for Phases 1 and 2 of the investigation. Media sampled will be analyzed for PFAS via liquid chromatography – tandem mass spectrometer (LC/MS/MS) in compliance with DoD Quality Systems Manual Version 5.3 (QSM 5.3) Table B-15 or the most recent version of the DoD QSM for which the lab is accredited at the time of analysis.

Action Items

- Refine scope details and schedule for Phases 1 and 2 of the RI field investigation.
- Generate the project SAP, Waste Management Plan-Environmental Protection Plan, and Accident Prevention Plan-Site Safety and Health Plan. Note that the subsequent phases of the RI field investigation will be described in future addenda to this SAP document.
- Begin procurement of access agreements for off-base parcels for off-base phases of the RI field investigation.

SAP Worksheet #10—Conceptual Site Model

OLF Coupeville is located two miles southeast of the Town of Coupeville, Washington, in Island County (**Figure 10-1**). **Figure 10-2** presents the site layout of OLF Coupeville. **Table 10-1** presents the CSM for OLF Coupeville, NAS Whidbey Island, Coupeville, Washington.

Table 10-1. OLF Coupeville Conceptual Site Model

Site Name	OLF Coupeville, NAS Whidbey Island, Coupeville, Washington
Study Area Description	OLF Coupeville is a military airfield associated with NAS Whidbey Island. It was commissioned for use by the Navy in 1943 and provides support for day and night Field Carrier Landing Practice operations by the Navy for aircraft based out of NAS Whidbey Island. Such operations allow aviators and crew to fly in patterns as well as practice touch-and-go, simulating carrier landings and take offs. During these practice runs, jet aircraft approach the runway and touch down, immediately taking off again and looping around the field to prepare for another landing and takeoff. The areas to be investigated consist of areas near the confirmed release areas of Building 2709 and Facilities 1, 2, and 11, on-base near the Keystone Well (west of the runway), on-base near the southern end of the runway and the southwestern Base boundary, and on-base drainage ditches near the runway. The generalized areas of investigation are outlined on **Figure 10-2**.
Study Area Investigation History	**Sampling of on-base Drinking Water Wells – September 2016** PFAS were first detected in the on-base supply well located in the southwestern portion of the OLF Coupeville near Building 2807 (**Figure 10-2**) during groundwater sampling activities conducted by the Navy in ~~November~~ September 2016 (Navy, 2014, 2016). The on-base wells were resampled in fall 2020; results indicated that concentrations of perfluorooctanoic acid (PFOA) at this location exceeded the USEPA lifetime health advisory of 70 nanograms per liter (ng/L). **Expedited SI – November 2016-March 2017** The detection of PFAS in the on-base supply well prompted initiation of an expedited SI at OLF Coupeville and an off-base drinking water investigation near OLF Coupeville. PFAS were detected in 8 of the 27 well locations installed, and PFOA and/or perfluorooctane sulfonic acid (PFOS) exceeded the SL[1] and the USEPA lifetime health advisory of 70 ng/L for combined PFOA and PFOS at four locations (CH2M, 2018a). **Second Expedited SI – December 2017-September 2018** A second expedited SI was conducted in 2017 and 2018 near the Keystone Well to evaluate PFAS concentrations near the Keystone Well and the potential impacts that increased pumping of the Keystone Well proposed by the Town of Coupeville could have on groundwater conditions at and nearby OLF Coupeville. The expedited SI included installation of two new monitoring well pairs, an aquifer test at the Keystone Well, and development of a groundwater flow model to evaluate aquifer test data (CH2M, 2018b). Groundwater samples indicated that concentrations of PFOA exceeded the SL at three of the four newly installed well locations. The aquifer test indicated that water levels in several groundwater monitoring wells at OLF Coupeville were observed to fluctuate in response to pumping at the Keystone Well. The groundwater modeling indicated that increased production of the Keystone Well would likely expand the Keystone Well capture zone to cover much of the western portion of OLF Coupeville including several wells with PFAS concentrations exceeding the USEPA lifetime health advisory. **Preliminary Assessment – November 2018** A Preliminary Assessment (PA) for PFAS at OLF Coupeville, completed in November 2018, identified Building 2709 and Facilities 1, 2, and 11 as potential PFAS release areas (CH2M, 2018c).

SAP Worksheet #10—Conceptual Site Model (continued)

Table 10-1. OLF Coupeville Conceptual Site Model

Study Area Investigation History **(continued)**	**Supplemental SI – August 2019-May 2020** A Supplemental SI was conducted from August 2019 to May 2020 (CH2M, 2021a, forthcoming). Soil sampling confirmed the presence of PFAS release areas at Buildings 2709 and Facilities 1, 2, and 11. Groundwater samples indicated that concentrations of PFOS or PFOA exceeded the SLs at six new well locations, two near the release areas and four to the northwest, west and southwest of runway. Groundwater flow directions at OLF Coupeville suggest that PFAS detected in on-base monitoring wells southwest of Building 2709 and Facilities 1, 2, and 11 emanated from these release areas. Groundwater flow directions and elevated PFAS concentrations in monitoring wells near the northwestern end of the runway are likely associated with an additional, unidentified release area west of the runway, which has not yet been confirmed. Data collected during the Supplemental SI were used to update and refine the 2018 groundwater flow model and perform solute transport modeling. The Supplemental SI report (CH2M, 2021a) recommended additional investigation during the RI to evaluate the presence of an additional release area west of the runway, delineate the release areas associated with Building 2709 and Facilities 1, 2, and 11 (east of the runway), and investigate the connection between the on-base PFAS impacts with the elevated PFAS concentrations detected at off-base residential wells south of OLF Coupeville. **Off-base Drinking Water Investigation – November 2016-September 2020** From November 2016 through October 2017, the Navy sampled 112 drinking water wells near OLF Coupeville, including the Town of Coupeville's Keystone Well. Eight residential drinking water wells to the south of OLF Coupeville were found to have PFOA concentrations above the USEPA lifetime health advisory (**Figure 10-3**) (CH2M, 2018c, 2019a, 2020b). Biannual sampling of drinking water wells where PFAS were detected and drinking water wells adjacent to properties with PFAS exceedances of the USEPA lifetime health advisory was initiated by the Navy in 2017 (CH2M, 2021b; 2020b).
Release Areas	Release areas for on-base impacts to groundwater and off-base PFAS impacts to drinking water to be considered in this investigation are on-base locations of suspected releases of aqueous film-forming foam (AFFF) (referred to as potential source areas in the PA). At OLF Coupeville they include the following: • Building 2709 (Crash Truck Shelter) – fire trucks containing AFFF are stored and truck washing occurs; off-truck AFFF was stored at this location in the past. • Facilities 1, 2, and 11 (Control Tower, Airfield Operations Building, and Potable Water Well Pump House) – PFAS have been detected in groundwater downgradient of these locations. Groundwater and soil sampling results from the 2019-2020 Supplemental SI (CH2M, 2021a) are consistent with the identification of these facilities as potential release areas. PFAS have been detected in groundwater samples collected from on-base wells, with concentrations exceeding the screening level (SL)[1] of 40 nanograms per liter (ng/L) for PFOA at 11 locations and concentrations exceeding the SL of 40 ng/L for PFOS at three locations (see Nature and Extent section below) (CH2M, 2018b, 2021a). During the 2017-2018 Expedited SI (CH2M, 2018b) and 2019-2020 Supplemental SI (CH2M, 2021a, forthcoming), PFOA and PFOS were detected in groundwater collected from monitoring wells west of the runway. Based on data from the 2019-2020 Supplemental SI, these detections are suspected to be related to a separate release area and not to either of the release areas identified in the PA.

SAP Worksheet #10—Conceptual Site Model (continued)

Table 10-1. OLF Coupeville Conceptual Site Model

Site Conditions	**Physical Characteristics**	OLF Coupeville is located on a broad plateau of Smith Prairie in central Whidbey Island at an elevation of approximately 195 feet North American Vertical Datum of 1988 (NAVD88). The paved runway is approximately 5,400 feet long and is bordered by grass maintained by mowing operations extending to the public roads (Navy, 1994). A runway safety area extends approximately 3,300 feet south of the runway footprint and is bordered by trees and residential parcels (**Figure 10-2**).
	Geology and Hydrogeology	Whidbey Island lies within the Puget Lowland, a topographic and structural depression between the Olympic Mountains and the Cascade Range. The geology of the area is heavily influenced by glacial advances and retreats. The geologic units on Whidbey Island thus consist of a sequence of Quaternary age (less than 2 million years old) glacial and interglacial deposits that may be more than 3,000 feet thick (USGS, 1982). The near-surface deposits are mostly glacial sediment of the most recent Fraser glaciation (10,000 to 20,000 years old). The glacial and post-glacial sediments make up most of the overburden units underlying the Base. Lithology observed in soil borings is consistent with the previous mapping by Polenz et al. (2005). Surficial geology at OLF Coupeville consists of the Partridge Gravel, which was deposited by glacial meltwaters and is composed of sand, gravel, and sand-gravel mixtures with minor interlayered silt and silty sand. Based on soil borings completed in 2017, the Partridge Gravel generally extends to depths of 180 to 200 feet below ground surface (bgs) at OLF Coupeville and is characterized by fine to medium sand with intermittent occurrences of gravel and laterally discontinuous layers of silt and clay, some of which can be up to 30 feet thick (CH2M, 2018a). Pleistocene deposits, including Vashon till, lie beneath the Partridge Gravel. In the vicinity of OLF Coupeville, these deposits consist of heterogeneous clay, claystone, and silt, and frequently contain organic material, such as plant material and peat. The subsurface lithology and hydrogeology at OLF Coupeville are depicted in cross section on **Figure 10-4** (cross section locations) and **Figures 10-5** through **10-10** (cross sections A-A' through F-F'). The unconfined groundwater table at OLF Coupeville generally occurs within the Partridge Gravel between 120 and 140 feet bgs (approximately 50 to 70 feet NAVD88). Perched groundwater may be present above the water table controlled by local occurrences of low-permeability silt and clay layers. With depth, localized layers of silt and clay may promote semiconfined to confined aquifer conditions within the Partridge Gravel. Many local water supply wells are screened in the lower portion of the Partridge Gravel. These wells are typically screened below 150 feet bgs in transmissive sand and gravel. The April 2017 groundwater elevation study of 27 groundwater monitoring wells located within the OLF Coupeville boundary (CH2M, 2018a) indicated groundwater elevation fluctuations of up to 0.6 foot over a 48-hour monitoring period. The groundwater monitoring wells for this study were screened within three general elevation intervals, which were categorized based on their elevation relative to mean sea level: shallow (screened above 50 feet NAVD88), intermediate (screened 0 to 50 feet NAVD88), and deep (screened near or below sea level NAVD88). The shallow, intermediate, and deep elevation zone designations do not indicate three discrete aquifers or water-bearing zones. Rather, with the exception of some shallow wells possibly screened within localized areas of perched groundwater, the shallow, intermediate, and deep elevation zones are located within the single aquifer system within which most local water supply wells, including the Keystone Well (screened from 142 to 182 feet bgs), are screened.

SAP Worksheet #10—Conceptual Site Model (continued)

Table 10-1. OLF Coupeville Conceptual Site Model

Site Conditions **(continued)**	**Geology and Hydrogeology**	The initial aquifer test for the Keystone Well had a yield of 302 gallons per minute with approximately 20 feet of drawdown over a 24-hour period and a transmissivity of 79,000 gallons per day per foot (Robinson Noble, Inc., 2008). During the 2017/2018 Keystone Well aquifer test, drawdown in response to pumping at the Keystone Well was observed at several on-base monitoring wells west of the OLF Coupeville Runway (CH2M, 2018b). Drawdown in response to pumping was not observed at monitoring wells south or east of WI-CV-MW14M. The current yield of the Keystone Well as operated by the Town of Coupeville is approximately 200 to 250 gallons per minute over a 21- to 23-hour period each day. Hydraulic heads near the western boundary of the Base (WI-CV-MW14M, WI-CV-MW15S/M, and WI-CV-MW16S/M) are somewhat depressed by pumping at the Keystone Well, which has induced a westward gradient in that part of the Base toward the Keystone Well. Groundwater flow conditions prior to the installation of the Keystone Well are not well understood, but it is likely that without the hydraulic stress from the pumping of the Keystone Well, groundwater would be expected to migrate to the south without a westerly component. Groundwater levels measured in groundwater monitoring wells screened in the shallow zone are encountered between 90 and 130 feet bgs, which may support the interpretation that some are screened in perched conditions that are laterally discontinuous across the Base. Static water levels in wells screened in the intermediate zone indicate semiconfined conditions, with hydrostatic heads rising 30 to 40 feet above the base of the silt/clay aquitard (where present). Groundwater elevation data and groundwater modeling studies indicate the presence of a groundwater mound (divide) centered in the northern portion of OLF Coupeville. This interpretation is supported by the Island County Water Resource Management Plan (Island County, 2005), which suggests that OLF Coupeville is located on a hydrogeologic divide, and groundwater is likely to be flowing radially away from OLF Coupeville. The dominant flow direction in the intermediate zone over the majority of OLF Coupeville is to the southwest, shifting to the south-southeast in the southern portion of the site. Groundwater flow in the deep zone is inferred to be predominantly to the south/southeast. Vertical gradients on-base at OLF Coupeville are predominantly downward (CH2M, 2018a, 2018b). Groundwater contour maps have been generated for intermediate- and deep-screened monitoring well networks, included on **Figures 10-11** and **10-12**, respectively. Groundwater levels measured in shallow-screened wells are highly variable, suggesting some wells are screened in perched conditions. As such, a groundwater contour map has not been developed for the shallow wells. Groundwater elevation data as well as groundwater modeling results (CH2M, 2018b, forthcoming) indicate the presence of a groundwater mound (divide) northeast of OLF Coupeville.
Chemicals of Potential Concern		18 PFAS (listed in **Worksheet #15**)
Nature and Extent		**Groundwater** PFOA concentrations are present above the SL in shallow zone groundwater at the release areas near Building 2709 and Facilities 1, 2, and 11 (**Figure 10-14**)[2] and are attributed to leaching of PFAS from vadose zone soil in these areas. Downgradient of the release areas, PFOA is present above the SL in groundwater in the shallow and intermediate aquifer zones (**Figure 10-14 and 10-15**), including the base supply well adjacent to Building 2807, and present at concentrations below the SL in the deep aquifer zone (**Figure 10-16**). An inferred southwesterly groundwater flow direction would suggest PFAS emanated from the shallow release areas near Building 2709 and Facilities 1, 2, and 11 and migrated vertically deeper into the aquifer system as groundwater flowed downgradient to the south; this flow scenario provides evidence for potential off-base migration affecting off-base drinking water. However, there are data gaps as to where the highest concentrations of PFOA are located as the plume migrates downgradient. For instance, the PFOA concentration was lower than the SL at WI-CV-MW26D (**Figure 10-16**), the monitoring well closest to the southern site boundary in a downgradient direction from the release areas, yet several deep aquifer off-base residential wells exceed the USEPA lifetime health advisory further downgradient.

SAP Worksheet #10—Conceptual Site Model (continued)

Table 10-1. OLF Coupeville Conceptual Site Model

Nature and Extent (continued)	Low-level to non-detect PFOA concentrations within the shallow, intermediate, and deep aquifer zones to the north, east, and directly west of the release areas (**Figures 10-14** through **10-16**) indicate that the extent of impacts is defined in these directions, but the extent of impacts downgradient to the south and southwest is not yet defined. PFOA is present at concentrations above the SL in groundwater in the intermediate aquifer zone west of the runway near the Keystone Well (**Figures 10-14** and **10-15**). These concentrations appear to represent a separate release area near the northwestern end of the runway that may also be the source of PFOA in the Keystone Well. Because there is limited PFOA data from the shallow and deep aquifer zones in this area (near and downgradient of the WI-CV-MW15 and WI-CV-MW16 well pairs), and limited PFOA data in general to the west and south, the horizontal and vertical extent of PFOA impacts associated with this release area is not yet defined. PFOS concentrations are present above the SL in shallow groundwater at the release areas near Building 2709 and Facilities 1, 2, and 11 (**Figure 10-17**) and are attributed to leaching of PFAS from vadose zone soil in these areas. PFOS is not present above the SL in any of the three aquifer zones downgradient of these release areas (**Figures 10-17** through **10-19**). This suggests that the extent of PFOS impacts associated with these release areas may be limited to the shallow aquifer zone adjacent to the release areas, but additional delineation to the south and east will be necessary to confirm this extent. PFOS is also present above the SL in the shallow aquifer zone at WI-CV-MW23S (downgradient of the WI-CV-MW15 and WI-CV-MW16 well pairs; see **Figures 10-17** and **10-18**). While low concentrations in intermediate and deep aquifer zone groundwater downgradient of this well suggest PFOS impacts may be limited to the area around WI-CV-MW23S (**Figures 10-18** and **10-19**), the extent of PFOS in this area has not been fully delineated. **Soil** PFOA and PFOS are present in vadose zone soil near Building 2709 and Facilities 1, 2, and 11 at depths between 0 and 100 feet bgs (CH2M, 2021a). Soil sampling results are shown on **Figure 10-13**. The horizontal extent of PFOA and PFOS in soil at this area is not fully delineated. Further, there is inconsistency between the depths of the highest PFOA and PFOS concentrations in soil, generally observed at shallow depths well above the water table, and the elevated groundwater concentrations seen in the shallow aquifer at and immediately downgradient of these release areas. Soil concentrations would be expected to be highest in the deepest soil samples in the capillary fringe but were generally low or below DLs in samples collected at greater than 90 feet bgs. Soil samples have not been collected from the release area west of the runway near the Keystone Well; the horizontal and vertical extent of PFAS impacts, if any, to soil in this area is unknown. **Drinking Water** Off-Base Residential Wells: PFOA has been detected at concentrations exceeding the USEPA lifetime health advisory in eight off-base residential wells since the sampling program began in November 2016 (**Figure 10-3**). Beginning in October 2017, these eight off-base residential wells have been sampled biannually for 14 PFAS. The list of PFAS was increased to 18 in October 2019. Results from the May 2020 sampling event indicate that PFOA continues to exceed the lifetime health advisory in all eight wells. PFOS was detected in five of the eight wells, and all concentrations were less than the USEPA lifetime health advisory. While it is understood that off-base drinking water wells have been impacted by PFAS, the focus of this RI is on groundwater impacts at OLF Coupeville that may affect off-base properties, rather than off-base drinking water itself. Keystone Well: The Keystone Well is sampled biannually as part of the off-base drinking water sampling program. During the September 2018 sampling event, the concentration of PFOA exceeded the USEPA lifetime health advisory. These results are consistent with the independent testing results conducted by the Town of Coupeville in summer 2018, where PFOA was detected at concentrations exceeding the USEPA lifetime health advisory. With the exception of these 2018 sampling events, PFOA and PFOS concentrations have been less than the USEPA lifetime health advisory since sampling began in 2016. In May 2020, PFOS was detected in the Keystone Well at a concentration of 1.44 ng/L, below the USEPA lifetime health advisory.

SAP Worksheet #10—Conceptual Site Model (continued)

Table 10-1. OLF Coupeville Conceptual Site Model

Migration Pathways	Because of their chemical structure, PFAS are chemically and biologically stable and resist typical degradation processes; therefore, they persist in the environment. Additionally, PFAS are water-soluble and migrate readily from soil to groundwater where they can be transported long distances (USEPA, 2014). The PFAS PA (CH2M, 2018c) identified the following migration pathways: • Releases to surface or subsurface soil, on-base ditch surface soil, and surface water (if and where present)[3]. • Vertical migration or leaching of PFAS from vadose zone sources to the underlying groundwater system. • Horizontal and vertical transport within the aquifer system via advection (with groundwater flow). • Preferential pathways via nongrouted well casings: The well construction records for the water supply wells at OLF Coupeville show that the steel well casings were not grouted deeper than 18 feet bgs, potentially leaving an open annulus from 18 feet bgs to the bottom of the borehole at 180 feet bgs. The absence of a grout seal could allow shallow groundwater, potentially containing PFAS, to migrate downward and reach the deeper aquifer used locally for water supply purposes. Other potential PFAS migration pathways that may be evaluated further, include the following: • Overland flow of media containing PFAS to downgradient off-base surface water bodies[3].
Human Health Receptors and Exposure Scenarios	**Soil** Workers, visitors, trespassers, residents, and recreators could potentially be exposed to PFAS in soil through incidental ingestion of and dermal contact with surface and/or subsurface soil. Construction or other ground disturbing activities, including landscaping, could result in potential generation of and receptor exposure to dust. There are currently no PFAS toxicity values available to evaluate inhalation exposures. Potential recreational hunters could ingest game that has been exposed to PFAS in on-base soil. **Groundwater** Current and future off-base residents: Ingestion of PFAS in groundwater used as a drinking water supply. Current and future on-base drinking water users (visitors and workers) at OLF Coupeville: Ingestion of PFAS in groundwater. Potential off-base recreational hunters and anglers could ingest game or fish that has been exposed to PFAS in surface water [3] off-base and downgradient of site. Human receptors could also consume crops watered with PFAS-containing water or livestock and poultry that have been exposed to PFAS in surface water. **Surface Water and Ditch Surface Soil** Workers, visitors, trespassers, residents, and recreators could be exposed to PFAS through incidental ingestion of surface water (if present) and ditch surface soil, and dermal contact with ditch surface soil[3].
Ecological Receptors and Exposure Scenarios	PFAS will be evaluated within the applicable DoD, Navy, and/or EPA policy, guidance, or directives using the state-of-the-science toxicological information available and current at the time the RI is prepared for both the Human Health and Ecological Risk Assessments. Prior to conducting an ecological risk screening, the ecological screening values that will be used for comparison to site media will be reviewed based on current science and relevancy to site-specific receptors (e.g., relevant ecological receptors present). Ecological screening values selected for the screening will be presented in a technical memorandum or other documented form for regulatory review and acceptance.

SAP Worksheet #10—Conceptual Site Model (continued)

Table 10-1. OLF Coupeville Conceptual Site Model

Ecological Receptors and Exposure Scenarios **(continued)**	**Soil** Lower trophic level terrestrial ecological receptors (such as terrestrial plants and soil invertebrates) could be exposed to PFAS released to surface soils through root uptake, direct contact, and/or direct ingestion in this area. Because there is evidence that PFAS bioaccumulate in terrestrial food items (such as plants), there is the potential that upper trophic level receptors (such as birds and mammals) could be exposed to these substances via the food web, as well as through incidental ingestion of soil. **Groundwater** While ecological receptors generally do not have direct exposure to groundwater, shallow groundwater at OLF may be hydraulically connected to nearby downgradient surface water bodies to the south, potentially including Crocket Lake and Admiralty Bay, presenting a potential exposure pathway for benthic ecological[4] receptors at the groundwater-to-surface-water interface within the biologically active zones. **Surface Water, Sediment, and Ditch Surface Soil** Lower trophic level ecological receptors (such as plants; aquatic, benthic, or terrestrial invertebrates; and reptiles or amphibians) could be exposed to PFAS released to ditch surface soil, surface water (if present), or sediment (either directly or indirectly via surface runoff and drainage from onsite terrestrial areas or through groundwater discharge), through root uptake, direct contact, or direct ingestion. Because there is evidence that PFAS bioaccumulate in food items, there is the potential that upper trophic level receptors (such as birds and mammals) could be exposed to these compounds via the food web, as well as through incidental ingestion of ditch surface soil and, if the pathway is complete, offsite sediment, and direct ingestion of fresh surface water (if present)[3].
Data Needs	The following data needs were identified based on the previous investigations summarized in **Table 10-1**: • Additional groundwater and soil concentration data are needed to further delineate the horizontal and vertical extent of PFAS in the vadose zone at the confirmed PFAS release areas at Building 2709 and Facilities 1, 2, and 11 and assess the risk to human health and ecological[4] receptors. • Additional groundwater and soil concentration data are needed to confirm the presence of a suspected PFAS release area west of the runway, and if identified, define the nature and extent of this release area, and assess risk to human health and ecological[4] receptors. Determination of the nature and extent of PFAS impacts in this area may require additional sampling as part of future RI phases which have yet to be scoped. • Additional soil and groundwater concentration data are needed as follows: 1) to address data discrepancies between the distribution of PFAS in on-base groundwater and elevated PFAS concentrations in off-base residential wells south of OLF Coupeville, and 2) to refine the existing information about PFAS migration directions from on-base release areas and impacted on-base groundwater monitoring wells to off-base drinking water wells with exceedances of the USEPA lifetime health advisory for PFOA and PFOS. • Additional data are needed to assess temporal variability in PFAS concentrations in groundwater at OLF Coupeville. Concentration data for surface water (if present) and drainage ditch surface soil[3] are needed to define the nature and extent of PFAS and assess risk to ecological receptors[4].

[1] SLs referred to in this SAP are the current USEPA tap water and soil regional screening levels (RSLs) for PFBS (based on a hazard quotient [HQ] of 0.1) and tap water and soil SLs for PFOS and PFOA as described in the Assistant Secretary of Defense Memorandum from October 15, 2019 (ASD, 2021) based on an HQ of 0.1.

[2] PFOA and PFOS concentrations presented on **Figures 10-14** through **10-19** present data from two types of groundwater samples collected from the sampling locations: depth-discrete groundwater grab samples collected from the soil borings at (multiple depths within each boring) during drilling, and low-flow groundwater samples collected from the completed monitoring wells. Refer to note 5 on **Figures 10-14** through **10-19**.

[3] If the extent of PFOA, PFOS, and PFBS extends to areas that are affected by non-Navy sources, additional consideration may be warranted.

[4] PFAS will be evaluated within the applicable DoD, Navy, and/or EPA policy, guidance, or directives using the state-of-the-science toxicological information available and current at the time the RI is prepared for Ecological Risk Assessment.

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SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements

Problem Statement and Objectives

The objectives, environmental questions, investigation approach, and project quality objectives are presented in **Table 11-1. Figure 11-1** shows the decision logic associated with **Table 11-1**. The investigation approach presented in **Table 11-1** applies only to Phase 1 of the RI which includes on-base work only. The scoped off-Base phase of the RI will be described in a future addendum to this SAP. Any additional phases needed to accomplish the objectives of the RI will be described under future task order work plan documents.

Table 11-1. Project Quality Objectives/Systematic Planning Process Statements

Problem Definition/Objectives	Environmental Question(s)	General Investigation Approach	PQOs
PFOA and PFOS have been detected in vadose zone soils at the on-base potential release areas identified in the PA; however, the extent of the release areas is not fully delineated, and there are data gaps in PFAS groundwater concentration data between the release areas and downgradient on-base well locations. The objective of this step is to further define the horizontal and vertical extent of PFAS in soil and groundwater above PFAS PALs at the on-base release areas (Building 2709 and Facilities 1, 2, and 11) and between the release areas and downgradient well locations and determine whether there is unacceptable risk to human health and ecological[1] receptors.	What is the horizontal and vertical extent of PFAS in soil and groundwater at the Building 2709 and Facilities 1, 2, and 11 release areas and between the release areas and downgradient well locations, and are PFAS present at concentrations that pose unacceptable risk to human health and ecological[1] receptors?	Soil borings will be advanced at two locations near Building 2709 and two locations near Facilities 1, 2, and 11 (total of four locations; see **Figure 11-2**). Soil borings will be advanced to the top of the water table (approximately 100 feet bgs). Up to five soil samples will be collected at each of the soil borings (WI-CV-SO11 through WI-CV-SO14). Depths targeted for analysis will be identified based on boring-specific conditions and will focus on air-water and lithologic interfaces. A shallow-zone monitoring well (WI-CV-MW34S) will be drilled (with no soil samples collected) and installed east of WI-CV-MW20S to provide information about PFAS concentrations at the Base boundary east of the release areas and near the base's eastern property boundary. A monitoring well pair (WI-CV-MW35S/M) will be drilled (with no soil sampling) and installed southwest of WI-CV-MW02S/M (**Figure 11-2**) and the Building 2709 release areas. The two groundwater monitoring wells will target the shallow and intermediate zones. During drilling of the intermediate soil boring, which will be drilled prior to the shallow boring, up to three depth-discrete groundwater grab samples will be collected between the water table and approximately 200 feet bgs. The analytical results from the grab samples will be evaluated and used to determine screen placement settings for both the intermediate and the shallow groundwater monitoring wells. Groundwater samples will be collected from completed groundwater monitoring wells following installation. The samples and rationale are outlined in **Worksheet #17**. Soil and groundwater (grab and monitoring well) samples will be submitted to Battelle for analysis of the 18 PFAS listed in USEPA Method 537.1. Groundwater grab samples will have an expedited (72-hour) TAT. Monitoring well and soil samples will be analyzed on a standard TAT.	Groundwater and soil data will be evaluated in accordance with **Figure 11-1**.

SAP Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

Table 11-1. Project Quality Objectives/Systematic Planning Process Statements

Problem Definition/Objectives	Environmental Question(s)	General Investigation Approach	PQOs
PFOA and PFOS have been detected in groundwater monitoring wells west and northwest of the runway near the Town of Coupeville's Keystone Well at concentrations above the PALs for PFOA and PFOS (**Figures 10-14** through **10-19**). PFOA exceeded the USEPA lifetime health advisory in the Keystone Well during the September 2018 biannual drinking water sampling, and concentrations generally range from 55 to 71 ng/L. PFOS was detected above the SL at WI-CV-MW23S. Based on the results of previous basewide monitoring, well sampling, and groundwater modeling, these concentrations are not believed to be related to the release areas at Building 2709 and Facilities 1, 2, and 11 (CH2M, 2021a), and the area west of the runway near the Keystone Well was not identified in the PA as a potential PFAS release area; therefore, the source of PFAS detected in groundwater in the area northwest of the runway is uncertain. The objective of this step is define the nature and extent of this release area above PFAS PALs and determine whether there is unacceptable risk to human health and ecological[1] receptors.	What is the horizontal and vertical extent of PFAS in the soil and groundwater, and are PFAS present at concentrations that pose unacceptable risk to human health or ecological[1] receptors?	Soil borings will be advanced at four locations near groundwater monitoring wells where PFAS has been detected at concentrations above groundwater PALs (**Figure 11-2**, **Figures 10-14** through **10-19**). Soil borings will be advanced to the top of the water table (approximately 100 feet bgs). Up to five soil samples will be collected at each of the soil borings (SO07 through SO10). Depths targeted for analysis will be identified based on boring-specific conditions and will focus on air-water and lithologic interfaces. Two monitoring well pairs (WI-CV-MW32S/M and WI-CV-MW33S/M) will be drilled and installed in the area west of the runway (**Figure 11-2**). These groundwater monitoring wells will target the shallow and intermediate zones at each location. Up to five soil samples will be collected at well pair WI-CV-MW33S/M during advancement of the shallow boring to evaluate this as a release area associated with the runway. Depths targeted for analysis will be identified based on boring-specific conditions and will focus on air-water and lithologic interfaces. During the drilling of the intermediate borings at WI-CV-MW32S/M and WI-CV-MW33S/M, which will be drilled prior to the shallow borings, up to three depth-discrete groundwater grab samples will be collected. The analytical results from the grab samples will be evaluated and used to determine screen placement settings for both the intermediate and the shallow monitoring wells at each location. Groundwater samples will be collected from completed groundwater monitoring wells following installation. The samples and rationale are outlined in **Worksheet #17**. Soil and groundwater (grab and monitoring well) samples will be submitted to Battelle for analysis of the 18 PFAS listed in USEPA Method 537.1. Groundwater grab samples and soil samples from select locations (SO08 through SO10) will be analyzed on an expedited (72-hour) TAT.	Groundwater and soil data will be evaluated in accordance with **Figure 11-1**.

SAP Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

Table 11-1. Project Quality Objectives/Systematic Planning Process Statements

Problem Definition Objectives	Environmental Question(s)	General Investigation Approach	PQOs
Low concentrations of PFOA/PFOS near the southern Base boundary are not consistent with higher concentrations of PFOA/PFOS in off-base residential wells south of OLF Coupeville. The objective of this step is to refine the data representative of groundwater flow and potential PFAS migration from the known on-base PFAS release areas and the release area west of the runway to impacted off-base residential drinking water wells with PFAS concentrations above the USEPA lifetime health advisory for PFOA and PFOS.	How are on-base concentrations of PFAS in the known release areas (adjacent to Building 2709 and Facilities 1, 2, and 11) and the release area west of the runway related to PFAS concentrations above the USEPA lifetime health advisory at off-base residential wells?	Two monitoring well pairs (WI-CV-MW36M/D and WI-CV-MW37M/D) will be drilled (with no soil sampling) and installed near the southwestern Base boundary (**Figure 11-2**). The groundwater monitoring wells will target the intermediate and deep zones at each location. During the drilling of the deep borings, which will be drilled prior to the intermediate borings, up to four depth-discrete groundwater grab samples will be collected. The analytical results will be evaluated and used to determine screen placement settings for both the deep and intermediate monitoring well at each location. Groundwater samples will be collected from completed groundwater monitoring wells following installation. The samples and rationale are outlined in **Worksheet #17**. Groundwater grab samples and monitoring well samples will be submitted to Battelle for analysis of the 18 PFAS listed in USEPA Method 537.1. Groundwater grab samples will be analyzed on an expedited TAT so that data can be evaluated for screen placement. Monitoring well samples will be analyzed on a standard TAT.	The groundwater data will be evaluated in accordance with **Figure 11-1** and will be used to refine the CSM with respect to the distribution of PFAS in groundwater on base and migration pathways on the western side of the runway relative to impacted off-base residential wells.
Multiple groundwater and drinking water sampling events have been performed at or near OLF Coupeville beginning in 2016; however, PFAS concentrations in groundwater may change over time. The objective of this step is to refine the data demonstrating the temporal variability in PFAS concentrations in groundwater at OLF Coupeville.	Have PFAS concentrations in groundwater changed over time at OLF Coupeville?	In addition to the groundwater sampling to be conducted at all new monitoring wells, groundwater sampling will be conducted at all previously existing monitoring wells at OLF Coupeville. Samples will be submitted to Battelle for analysis of the 18 PFAS listed in USEPA Method 537.1 at standard TAT.	Groundwater sampling results from existing wells will be appended to the existing data. If PFAS concentrations are consistent with previous sampling results, this will indicate that no temporal change in concentration has occurred. If PFAS concentrations in existing wells are inconsistent with previous sampling results, the results will be evaluated in accordance with **Figure 11-1** to determine whether the inconsistency is significant enough to warrant a change to the CSM.

SAP Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

Table 11-1. Project Quality Objectives/Systematic Planning Process Statements

Problem Definition Objectives	Environmental Question(s)	General Investigation Approach	PQOs
It is unknown whether PFAS releases have occurred to the drainage ditch system at OLF Coupeville. The objective of this step is to determine whether PFAS are present in ditch surface soil and surface water (if present), define the nature and extent of PFAS in ditch surface soil and surface water (if present) above PFAS PALS, and determine whether there is unacceptable risk to human health and ecological[1] receptors.	Are PFAS present in ditch surface soil or surface water (if present) at OLF Coupeville above the PALs? If yes, what are is the nature and extent of PFAS in ditch surface soil and surface water (if present) at OLF Coupeville? Are concentrations indicative of risks to human health or ecological[1] receptors?	The approach to investigating PFAS in ditch surface soil and surface water (if present) will be to collect paired ditch surface soil and surface water samples (where possible) from four on-base locations in drainage ditches along the runway (**Figure 11-2**). Ditch surface soil and surface water samples will be submitted to Battelle for analysis of the 18 PFAS listed in USEPA Method 537.1 at standard TAT. The samples and rationale are outlined in **Worksheet #17**.	The surface water data (if it can be collected) and ditch surface soil data will be evaluated in accordance with **Figure 11-1**.

[1] PFAS will be evaluated within the applicable DoD, Navy, and/or EPA policy, guidance, or directives using the state-of-the-science toxicological information available and current at the time the RI is prepared for both the Human Health and Ecological Risk Assessments. Prior to conducting an ecological risk screening, the ecological screening values that will be used for comparison to site media will be reviewed based on current science and relevancy to site-specific receptors (e.g., relevant ecological receptors present). Ecological screening values selected for the screening will be presented in a technical memo or other documented form for regulatory review and acceptance.

SAP Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

Problem Definition, Environmental Questions, and Project Quality Objectives

The problem definition, environmental questions, general investigation approaches, and PQOs contained in this SAP are described in **Table 11-1** and are based on the USEPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA, 2006) and its seven-step process. The detailed sampling approach, including numbers of samples, is provided in **Worksheet #17**. **Figure 11-1** shows the decision logic that is associated with **Table 11-1**. Planned sample locations are shown on **Figure 11-2**.

What Are the Project Action Limits?

PALs are media-specific standards and criteria chosen for evaluation to help provide a conservative assessment of site conditions and determine if further evaluation or action is needed to address concentrations of chemicals present onsite. The PALs for data collected at OLF Coupeville are presented in **Worksheet #15** and are summarized as follows:

Groundwater and Surface Water

Groundwater and surface water (if present) data will be screened against the SLs based on a hazard quotient (HQ) of 0.1 for PFOA (40 ng/L), PFOS (40 ng/L), and perfluorobutane sulfonate (PFBS) (600 ng/L) (ASD, 2021; USEPA, 2021). There are no PALs for other PFAS analytes.

Soil

Soil data will be screened against residential soil SLs based on an HQ of 0.1 for PFOA (130 micrograms per kilogram [µg/kg]), PFOS (130 µg/kg), and PFBS (1,900 µg/kg) (ASD, 2021; USEPA, 2021). There are no PALs for other PFAS analytes.

Soil data will also be evaluated for leaching potential based on a multiple lines of evidence approach including assessment of groundwater concentrations, consideration of soil type and PFAS distribution in the vadose zone, solute transport modeling, and state-of-the-science research on PFAS leaching. While preliminary screening against soil-to-groundwater SLs will be used as a part of the multiple lines of evidence approach to assess leaching potential, soil-to-groundwater SLs are not considered PALs for this project and are not considered clean up goals or intended for use in remedial action or risk assessment decision making.

For What Will the Data Be Used?

Data will be used to address the environmental questions and PQOs listed in **Table 11-1**. Ongoing sampling and other activities being done to address off-base drinking water that exceeds the USEPA lifetime health advisory will not be conducted as a part of RI activities at OLF Coupeville.

There are uncertainties to be considered with regard to data use. Scientific research and regulatory guidelines related to PFAS are rapidly evolving. As such, the information provided in this SAP presents the state of the science at the time of issuance of this SAP. The Navy will re-evaluate changing science and regulations at the time of reporting to ensure that data evaluation and risk assessments presented in this report reflect any changes to toxicology information, regulatory standards, and DoD and Navy policy and guidance. Any changes to the proposed data evaluation and risk assessment approaches will be discussed with stakeholders prior to issuance of the report and any revisions.

SAP Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

What Types of Data Are Needed?

The types of data needed include the following:

- Subsurface lithology of the soil borings to determine where semi-confining aquitards and aquifers are located; this information will affect monitoring well installations and provide input for updates to the CSM and the numerical groundwater flow model.
- Synoptic groundwater level surveys from on-base wells to evaluate groundwater flow and solute transport directions, and for use as numerical groundwater flow model calibration targets (to be collected following installation of off-base wells in Phase 2 of RI, not included in this SAP).
- Soil samples from release areas will be submitted for standard turnaround time (TAT) PFAS analysis via LC/MS/MS in compliance with DoD QSM 5.3 Table B-15 or the most recent version of the DoD QSM for which the lab is accredited at the time of analysis to help inform the spatial and vertical distribution of PFAS in the vadose zone, and to assess whether soil source zones represent a potential continuing threat to underlying groundwater quality.
- Ditch surface soil and surface water samples will be submitted for standard TAT PFAS analysis via LC/MS/MS in compliance with DoD QSM 5.3 Table B-15 or the most recent version of the DoD QSM for which the lab is accredited at the time of analysis to determine whether PFAS are present at concentrations warranting further investigation, and if present above PALs, determine the horizontal and vertical extent of PFAS in ditch surface soil and surface water.
- Field measurements of groundwater quality (pH, dissolved oxygen, temperature, conductivity, oxidation-reduction potential, and turbidity) will be completed during both vertical profile sampling and sampling of the monitoring well network.
- Depth-discrete groundwater samples will be submitted for 72-hour TAT PFAS analysis via LC/MS/MS in compliance with DoD QSM 5.3 Table B-15 or the most recent version of the DoD QSM for which the lab is accredited at the time of analysis. Sample results will inform monitoring well construction and improve the team's understanding of the vertical distribution of PFAS in the groundwater system. Following drilling of the borehole, the drill casing will be left in place to maintain an open borehole pending the analytical results. The expedited TAT for groundwater analyses is intended to minimize the timeframe that drilling equipment is left in the ground prior to monitoring well construction.
- Contemporaneous groundwater sampling for PFAS will be used to estimate the horizontal and vertical extent of PFAS in groundwater at OLF Coupeville. Groundwater samples will be analyzed for PFAS via LC/MS/MS in compliance with DoD QSM 5.3 Table B-15 or the most recent version of the DoD QSM for which the lab is accredited at the time of analysis. Analysis of groundwater monitoring well samples will be performed under standard laboratory TAT.
- Numerical three-dimensional groundwater flow modeling and solute transport modeling will be used to improve the understanding of past and potential future PFAS transport at OLF Coupeville.

Samples will be collected and analyzed as described in **Worksheet #17** to meet the project objectives. The field methodology is included in **Worksheet #14**. Justification for individual sample locations is provided in **Worksheet #17**. The specific target analytes and PALs are included in **Worksheet #15**.

SAP Worksheet #11—Project Quality Objectives/ Systematic Planning Process Statements (continued)

Are There Special Data Quality Needs, Field or Laboratory, to Support Environmental Decisions?

Offsite laboratory analytical data will be of the quantity and quality necessary to provide technically sound and defensible assessments with respect to the aforementioned project objectives. Laboratory DLs will be suitable for detecting PFOA, PFOS, and PFBS at or below the PALs in accordance with **Worksheet #15**. QC sample requirements are detailed in **Worksheet #20**. For action decisions, the laboratory will follow the Measurement Performance Criteria (MPC) in **Worksheets #24** and **#28** for laboratory QC samples. These MPC are consistent with the DoD QSM (DoD, 2019a) as applicable and laboratory in-house limits where the QSM does not apply.

Where, When, and How Should the Data Be Collected and Generated?

Sample locations are shown on **Figure 11-2**. Field activities will be conducted in accordance with **Worksheets #14, #17, and #18**, and the project schedule outlined in **Worksheet #16**. The data will be collected following the standard operating procedures (SOPs) presented in **Worksheet #21**.

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SAP Worksheet #12-1—Measurement Performance Criteria Table – Field QC Samples

Matrix: Groundwater/Surface Water
Analytical Group: PFAS
Analytical Method: LC/MS/MS Compliant with QSM 5.3[1] Table B-15

QC Sample	Analytical Group	Frequency	Data Quality Indicators	Measurement Performance Criteria
Matrix Spike (MS)/Matrix Spike Duplicate (MSD)	PFAS	One per 20 samples	Accuracy/Precision	See **Worksheet #28**.
Field Duplicate (FD)		One per 10 samples	Precision	Relative percent difference (RPD) less than (<) 25%
Equipment Rinsate Blank		One per site per day of sampling for decontaminated equipment	Contamination	No analytes detected greater than (>) ½ LOQ or > 1/10 sample concentration, whichever is greater
Field Blank		One per site	Bias/Contamination	No analytes detected > ½ LOQ or > 1/10 sample concentration, whichever is greater
Cooler Temperature Indicator		One per cooler	Accuracy/Representativeness	Temperature less than or equal to (≤) 10°C, storage in the laboratory ≤ 6°C, not frozen

[1] QSM 5.3 or the latest version of the QSM for which the laboratory is certified at the time of sampling

Notes:

°C = degrees Celsius

% = percent

SAP Worksheet #12-2—Measurement Performance Criteria Table – Field QC Samples

Matrix: Surface Soil/Ditch Surface Soil, Soil
Analytical Group: PFAS
Analytical Method: LC/MS/MS Compliant with QSM 5.3[1] Table B-15

QC Sample	Analytical Group	Frequency	Data Quality Indicators	Measurement Performance Criteria
MS/MSD	PFAS	One per 20 samples	Accuracy/Precision	See **Worksheet #28**.
FD		One per 10 samples	Precision	RPD < 35%
Equipment Rinsate Blank		One per day of field sampling for decontaminated equipment	Bias/Contamination	No analytes detected > ½ LOQ or > 1/10 sample concentration, whichever is greater
Field Blank		One per site	Bias/Contamination	No analytes detected > ½ LOQ, or > 1/10 sample concentration, whichever is greater
Cooler Temperature Indicator		One per cooler	Accuracy/Representativeness	Temperature ≤ 10°C, storage in the laboratory ≤ 6°C, not frozen

[1] QSM 5.3 or the latest version of the QSM for which the laboratory is certified at the time of sampling.

SAP Worksheet #13—Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation/ collection dates)	How Data Will Be Used	Limitations on Data Use
Groundwater elevation and analytical data and geology data from monitoring and base supply wells within the OLF Coupeville	CH2M. 2018a. *Final Technical Memorandum, Evaluation of Per- and Polyfluoroalkyl Substances in Groundwater Outlying Landing Field Coupeville.* Naval Air Station Whidbey Island Coupeville, Washington. May 2018.	CH2M. Groundwater and geology. February and March 2017.	Data will be used to assist the placement of groundwater monitoring wells, soil borings, and vertical profiling locations and for human health and ecological^1 risk assessments	None
Groundwater elevation and analytical data and geology data from groundwater monitoring wells within the OLF Coupeville	CH2M. 2018b. *Aquifer Test, Groundwater Sampling, and Drinking Water Sampling Data Evaluation and Groundwater Modeling Report, Per- and Polyfluoroalkyl Substances (PFAS), Outlying Landing Field Coupeville,* Naval Air Station Whidbey Island Oak Harbor and Coupeville, Washington. September 2018.	CH2M. Groundwater and geology. December 2017 and January 2018.	Data will be used to assist the placement of groundwater monitoring wells, soil borings, and vertical profiling locations and for human health and ecological^1 risk assessments	None
	CH2M. 2021a. *Supplemental Site Inspection Report for Per- and Polyfluoroalkyl Substances Outlying Landing Field Coupeville*, Naval Air Station Whidbey Island, Oak Harbor, Washington.	CH2M. Groundwater and geology. August through December 2019, February through March and October 2020.	Data will be used to assist the placement of groundwater monitoring wells, soil borings, and vertical profiling locations and for human health and ecological^1 risk assessments.	None
	CH2M. Forthcoming. *Draft Supplemental Site Inspection Report Addendum for Per- and Polyfluoroalkyl Substances Outlying Landing Field Coupeville*, Naval Air Station Whidbey Island, Oak Harbor, Washington.			None
Details regarding potential release areas of PFAS on-base at OLF Coupeville	CH2M. 2018c. *Preliminary Assessment for Per- and Polyfluoroalkyl Substances (PFAS), Outlying Landing Field Coupeville,* Naval Air Station Whidbey Island Oak Harbor and Coupeville, Washington. November.	CH2M. Geology, historical information through 2018.	Data will be used to assist the placement of groundwater monitoring wells, soil borings, and vertical profiling locations.	None

SAP Worksheet #13—Secondary Data Criteria and Limitations Table (continued)

Secondary Data	**Data Source (originating organization, report title and date)**	**Data Generator(s) (originating organization, data types, data generation/ collection dates)**	**How Data Will Be Used**	**Limitations on Data Use**
Well construction and historical well testing data (pumping test results and water quality testing results) from the Keystone Well	Robinson Noble, Inc. 2008. Town of Coupeville Keystone Hill well Construction and Testing Report. Tacoma, Washington. April 2008.	Robinson Noble, Inc. Well, geology, and groundwater. January through March 2008.	Data will be used as input to the aquifer modeling software and assist in the placement of groundwater monitoring wells, and selection of monitoring well screen intervals.	None
Geohydrology data	USGS. 1982. Preliminary Survey of Ground-water Resources for Island County, Washington.	USGS. Geology. 1979 and 1980.	Data will be used as input to the aquifer modeling software and assist in the placement of groundwater monitoring wells, and selection of monitoring well screen intervals.	None
Off-base Monitoring Well data	Island County. 2016. Island County Hydrogeologic Database Well Search Utility Data. Data Generated on 11/4/2016.	Island County. Well. 1963 to 2016.	Data will be used for input to the groundwater modeling software.	None
Off-base drinking water results	CH2M. 2020b. *Results of Investigation of Per- and Polyfluoroalkyl Substances in Off-Base Drinking Water—Ault Field, Area 6, and Outlying Landing Field Coupeville*, Naval Air Station Whidbey Island, Washington. December 2020.	CH2M. Groundwater. October 2019 through September 2020.	Data will be used to assist in the selection of vertical profiling locations.	None

[1] PFAS will be evaluated within the applicable DoD, Navy, and/or EPA policy, guidance, or directives using the state-of-the-science toxicological information available and current at the time the RI is prepared for both the Human Health and Ecological Risk Assessments..

SAP Worksheet #14—Summary of Project Tasks

All project tasks described in this SAP will be completed under the on-base Phase 1 of the RI. Applicable SOPs for project tasks outlined in this section are listed in **Worksheet #21** and provided in **Appendix B**.

Premobilization Tasks

- Work Plan development and approval (SAP, Accident Prevention Plan – Site Safety and Health Plan, and Waste Management Plan – Environmental Protection Plan)
- National Historic Preservation Act Section 106 Consultation with the State Historic Preservation Officer and/or the Advisory Council on Historic Preservation to identify possible conflicts between historic preservation objectives and the proposed activities in the clearance area shown on **Figure 11-2**
- Subcontractor procurement
  - Analytical laboratory
  - Data Validation
  - Utility locator
  - Driller
  - Surveyor
  - Investigation-derived waste (IDW) transportation and disposal contractor
- Fieldwork scheduling
- Coordination with NAS Whidbey Island for site access and IDW staging at OLF Coupeville

Mobilization

Mobilization for the field effort includes procurement of necessary field equipment and initial transport to the site. Equipment and supplies will be brought to the site when the CH2M field team mobilizes for field activities. Before beginning any work, CH2M and its subcontractors will have field meetings to discuss the work items and worker responsibilities, and to familiarize workers with the Accident Prevention Plan and Site Safety and Health Plan.

Utility Locating

Utilities will be cleared before beginning intrusive activities. CH2M will coordinate utility clearance. In addition, a third-party utility clearance subcontractor will be procured by CH2M to clearly mark the proposed groundwater monitoring well locations. Any proposed well locations within 5 feet of utility locations will be relocated to avoid impacts on utilities. If a monitoring well location needs to be relocated, the field team will consult with the CH2M PM and NAVFAC Northwest RPM to establish a new well location.

Soil Borings and Groundwater Monitoring Well Installation and Development

Eight on-base soil borings will be advanced with soil sampling (up to five soil samples collected at each location, with no groundwater sampling and no groundwater monitoring well installations). Target depth is the water table at each location. Soil sample depths will be determined in the field and will target lithologic transitions observed in the soil cores.

Eleven on-base soil borings (WI-CV-MW32 through WI-CV-MW37) will be advanced with groundwater monitoring wells installed. Groundwater vertical profile sampling will occur in three of the intermediate depth soil borings (WI-CV-MW32M, WI-CV-MW33M, and WI-CV-MW35M) and two of the deep soil borings (WI-CV-MW36D and W-CV-MW37D). Groundwater vertical profiling depths will be determined in the field and will target first-encountered groundwater and up to two additional depths separated by silt/clay layers. At pair WI-CV-

SAP Worksheet #14—Summary of Project Tasks (continued)

WI-CV-MW33S/M, up to five soil samples will be collected during the drilling of the shallow boring. Soil sample depths will be determined in the field and will target lithologic transitions observed in the soil cores.

Soil borings will be advanced via sonic drilling techniques, and groundwater monitoring wells will be installed and developed in accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix B**.

Soil Logging

All soil borings will be logged for lithology and field-screened by a photoionization detector (PID) at every interval in accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix B**.

Surveying

The newly installed groundwater monitoring wells and soil borings, and off-base well WI-CV-MW18M installed during the Supplemental SI, will be surveyed by a Washington-licensed surveyor in accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix B**.

Sampling Tasks

Applicable field notes and forms will be filled out completely each day.

- Soil Sampling
  - Soil sampling will be completed in accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix B**.
  - Up to five soil samples will be collected from each of soil borings SO07 through SO14.
  - Soil samples from selected locations (WI-CV-SO08 through WI-CV-SO10) will be sent to Battelle for PFAS analysis with a 72-hour TAT. Remaining soil samples will be sent to Battelle for PFAS analysis at standard TAT.
- Groundwater Vertical Profile Sampling
  - Depth-discrete groundwater vertical profile sampling will be completed, with up to four groundwater samples collected from each of the following locations: WI-CV-MW32M, WI-CV-MW33M, WI-CV-MW35M, WI-CV-MW36D, and WI-CV-MW37D. All depth-discrete groundwater vertical profile sampling during the RI will be in accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix B**.
  - Groundwater grab samples will be sent to Battelle for PFAS analysis with a 72-hour TAT; groundwater profiling results will be used to determine target well settings for the paired wells.
- Groundwater Monitoring Well Sampling
  - Groundwater sampling will be completed at all new and existing groundwater monitoring wells in accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix B**.
  - Groundwater samples will be sent to Battelle for PFAS analysis on standard TAT.
- Surface Water and Ditch Surface Soil Sampling
  - Sampling of surface water (if present) and ditch surface soil is proposed at up to four locations. Surface water and ditch surface soil sampling will be conducted in accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix B**.

SAP Worksheet #14—Summary of Project Tasks (continued)

Synoptic Water Level Survey

Manual groundwater levels will be measured at all new and existing groundwater monitoring wells, in accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix B.**

Decontamination

All drilling equipment used during groundwater monitoring well installation and reusable sampling equipment will be decontaminated immediately after each use in accordance with applicable SOPs referenced in **Worksheet #21** and provided in **Appendix B**. Sensitive instrumentation such as equipment used to collect water quality parameters will be decontaminated in accordance with the equipment manufacturer's guidelines.

IDW Management

IDW is expected to consist of drill cuttings from the soil borings generated during monitoring well installations, purge water from well development and groundwater sampling, and decontamination fluids. Aqueous IDW and solid IDW will be stored in separate roll-off containers, portable tanks, or drums. IDW will be managed in accordance with the Interim Per- and Polyfluoroalkyl Substances (PFAS) Site Guidance for NAVFAC RPMs, November 2020 Update (NAVFAC, 2020) and in accordance with SOPs listed in **Worksheet #21** and provided in **Appendix B**. Solid IDW is expected to be non-hazardous. Aqueous IDW with concentrations exceeding 70 ng/L (combined PFOA and PFOS) will be treated to levels less than 70 ng/L prior to disposal. Incineration will only be conducted if other treatment options are determined to be infeasible. NAVFAC Headquarters approval must be obtained prior to incineration of any PFAS-containing waste. To minimize the volume of aqueous IDW requiring treatment, all efforts will be made to segregate release area IDW from that generated in downgradient areas where concentrations are likely to be lower.

Analyses and Testing Tasks

- Battelle will process and prepare soil samples (including ditch surface soil) for analysis and analyze samples in accordance with **Worksheets #18** and **#19**.
- Soil samples will be analyzed for 18 PFAS by Battelle using LC/MS/MS in compliance with QSM 5.3 Table B-15 (or the most recent version of the DoD QSM for which the laboratory is accredited) in accordance with **Worksheets #18** and **#19**.
- Groundwater samples will be analyzed for 18 PFAS by Battelle by LC/MS/MS in compliance with QSM 5.3 Table B-15(or the most recent version of the DoD QSM for which the laboratory is accredited) in accordance with **Worksheets #18** and **#19**.
- Surface water samples will be analyzed for 18 PFAS by Battelle using LC/MS/MS in compliance with QSM 5.3 Table B-15(or the most recent version of the DoD QSM for which the laboratory is accredited) in accordance with **Worksheets #18** and **#19**.

Modeling

Data collected during the RI will be used to update the CSM and refine the existing groundwater flow and solute transport models. Model refinement will include, as necessary or applicable, updating the model parameterization, re-evaluation of boundary conditions, recalibration to steady-state conditions, updating initial concentrations for PFOA, PFOS, and PFBS, and using the most up-to-date solute transport parameters available for PFAS. HYDRUS software, or similar, will be used to conceptualize PFAS transport from the soil release areas to shallow groundwater. The solute mass flux values will be used as flux boundary conditions for the solute transport model. The model will be used to evaluate up to three future scenarios (such as changes to pumping rates or distributions).

SAP Worksheet #14—Summary of Project Tasks (continued)

QC Tasks

- Implement SOPs for field and laboratory activities being performed.
- QC samples are described on **Worksheet #20**.

Secondary Data

- See **Worksheet #13**.

DV, Review, and Management Tasks

- See **Worksheets #34** through **#36** for a discussion of data management procedures.

Documentation and Reporting

- A summary of field activities as well as a data evaluation will be documented in an RI Report and submitted to the NAVFAC Northwest RPM and stakeholder agencies for review and approval.

Assessment and Audit Tasks

- **Worksheets #31** and **#32**.

Demobilization

Full demobilization will occur when the project is completed, and appropriate QA/QC checks have been performed. Personnel no longer needed during the course of field operations may be demobilized prior to the final project completion date. The following will occur prior to demobilization:

- Chain-of-custody records will be reviewed to verify that all samples were collected as planned and submitted for appropriate analyses.
- Restoration of the site to an appropriate level will be verified by the CH2M FTL.
- All equipment will be inspected, packaged, and shipped to the appropriate location.

SAP Worksheet #15-1—Reference Limits and Evaluation Tables

Matrix: Groundwater
Analytical Group: PFAS – PFAS by LC/MS/MS Compliant with DoD QSM 5.3 Table B-15

Analyte	Chemical Abstract Service (CAS) Number	PALs		Laboratory Limits (ng/L)			LCS and MS/MSD Recovery Limits and RPD (%)[3]		
		Tapwater SLs (ng/L)	PAL Reference	LOQs (ng/L)	LODs (ng/L)	DLs (ng/L)	LCL	UCL	RPD
PFOA	335-67-1	40	USEPA RSL calculator[1]	5.00	1.50	0.511	49	141	30
PFOS	1763-23-1	40	USEPA RSL calculator[1]	5.00	1.00	0.437	40	144	30
PFBS	375-73-5	600	PPR Toxicity Values for PFBS (USEPA, 2021)[2]	5.00	0.500	0.144	56	134	30
Perfluorohexanoic acid (PFHxA)	307-24-4	--	--	5.00	1.50	0.527	51	137	30
Perfluoroheptanoic acid (PFHpA)	375-85-9	--	--	5.00	1.00	0.263	48	136	30
Per Perfluorohexanoic fluorohexanesulfonic acid (PFHxS)	355-46-4	--	--	5.00	0.400	0.112	52	128	30
Perfluorononanoic acid (PFNA)	375-95-1	--	--	5.00	1.00	0.309	58	122	30
Perfluorodecanoic acid (PFDA)	335-76-2	--	--	5.00	0.500	0.142	59	135	30
Perfluoroundecanoic acid (PFUnA)	2058-94-8	--	--	5.00	0.500	0.219	64	134	30
Perfluorododecanoic acid (PFDoA)	307-55-1	--	--	5.00	0.50	0.192	75	131	30
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	--	--	5.00	0.500	0.154	42	148	30
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	--	--	5.00	2.00	0.733	42	158	30
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (EtFOSAA)	2991-50-6	--	--	5.00	1.00	0.500	51	131	30

SAP Worksheet #15-1—Reference Limits and Evaluation Tables (continued)

Analyte	Chemical Abstract Service (CAS) Number	PALs		Laboratory Limits (ng/L)			LCS and MS/MSD Recovery Limits and RPD (%)[3]		
		Tapwater SLs (ng/L)	PAL Reference	LOQs (ng/L)	LODs (ng/L)	DLs (ng/L)	LCL	UCL	RPD
N-Methyl Perfluorooctanesulfonamidoacetic Acid (MeFOSAA)	2355-31-9	--	--	5.00	1.00	0.350	50	146	30
Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	13252-13-6	--	--	5.00	0.500	0.248	**60**	**126**	30
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	--	--	5.00	1.00	0.265	**61**	**130**	30
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	756426-58-1	--	--	5.00	1.00	0.268	**60**	**126**	30
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	763051-92-9	--	--	5.00	0.500	0.231	**56**	**125**	30

Notes:

[1] SLs for PFOA and PFOS are based on an HQ of 0.1 and were generated using the USEPA RSL calculator as described in the Assistant Secretary of Defense (ASD) September 2021 Memo (ASD, 2021).

[2] SLs for PFBS were generated similarly to PFOA and PFOS, but values were updated from those listed in the 2021 memorandum to reflect reference doses provided in *Provisional Peer-Reviewed Toxicity Values for Perfluorobutane Sulfonic Acid (PFBS) and Related Compound Potassium Perfluorobutane Sulfonate* (PPR Toxicity Values for PFBS) (USEPA, 2021).

[3] Accuracy and precision are in accordance with DoD QSM 5.3. For analytes not found in DoD QSM 5.3, laboratory in-house limits will be used. Analytes using in-house laboratory limits are bolded

Limits are verified on a quarterly basis in accordance with DoD QSM and may be subject to change. Any changes to these limits that affect the project SAP objectives must be approved by the NAVFAC RPM and NAVFAC Atlantic QAO in advance of sample testing.

-- = not applicable

LCL = lower control limit

LCS = laboratory control sample

RPD = relative percent difference

UCL = upper control limit

SAP Worksheet #15-2—Reference Limits and Evaluation Table

Matrix: Surface Soil, Ditch Surface Soil, Subsurface Soil
Analytical Group: PFAS – PFAS by LC/MS/MS Compliant with DoD QSM 5.3 Table B-15

Analyte	CAS Number	PALs		Laboratory Limits (µg/kg)[3]			LCS and MS/MSD Recovery Limits and RPD (%)[4]		
		Residential Soil SLs (µg/kg)	PAL Reference	LOQs (µg/kg)	LODs (µg/kg)	DLs (µg/kg)	LCL	UCL	RPD
PFOA	335-67-1	130	USEPA RSL calculator[1]	5.00	2.00	0.607	50	130	30
PFOS	1763-23-1	130	USEPA RSL calculator[1]	5.00	2.00	0.692	56	136	30
PFBS	375-73-5	1,900	PPR Toxicity Values for PFBS (USEPA, 2021)[2]	5.00	1.00	0.350	57	145	30
PFHxA	307-24-4	--	--	5.00	2.00	0.707	45	135	30
PFHpA	375-85-9	--	--	5.00	1.50	0.506	60	128	30
PFHxS	355-46-4	--	--	5.00	2.00	0.808	52	132	30
PFNA	375-95-1	--	--	5.00	1.00	0.491	54	130	30
PFDA	335-76-2	--	--	5.00	1.00	0.463	55	141	30
PFUnA	2058-94-8	--	--	5.00	1.00	0.457	57	137	30
PFDoA	307-55-1	--	--	5.00	2.00	0.612	62	134	30
PFTrDA	72629-94-8	--	--	5.00	1.00	0.280	51	127	30
PFTeDA)	376-06-7	--	--	5.00	2.50	1.08	34	162	30
EtFOSAA	2991-50-6	--	--	5.00	2.00	0.748	54	124	30
MeFOSAA	2355-31-9	--	--	5.00	2.50	1.02	52	146	30
HFPO-DA	13252-13-6	--	--	5.00	2.00	0.641	**71**	**153**	30

SAP Worksheet #15-2—Reference Limits and Evaluation Table (continued)

Analyte	CAS Number	PALs		Laboratory Limits (µg/kg)[3]			LCS and MS/MSD Recovery Limits and RPD (%)[4]		
		Residential Soil SLs (µg/kg)	PAL Reference	LOQs (µg/kg)	LODs (µg/kg)	DLs (µg/kg)	LCL	UCL	RPD
ADONA	919005-14-4	--	--	5.00	2.00	0.830	**61**	**139**	30
9Cl-PF3ONS	756426-58-1	--	--	5.00	1.00	0.482	**60**	**140**	30
11Cl-PF3OUdS	763051-92-9	--	--	5.00	1.50	0.524	**40**	**160**	30

[1] Residential soil SLs for PFOA and PFOS are based on an HQ of 0.1 and were generated using the USEPA RSL calculator as described in the ASD September 2021 Memo (ASD, 2021).

[2] RSLs for PFBS were generated similarly to PFOA and PFOS, but values were updated from those listed in the 2021 memorandum to reflect reference doses provided in PPR Toxicity Values for PFBS (USEPA, 2021).

[3] Results for nonaqueous samples are reported on a dry-weight basis.

[4] Accuracy and precision limits are according to DoD QSM 5.3. For analytes not found in DoD QSM 5.3, laboratory in-house limits will be used. Analytes using in house laboratory limits are bolded.

Limits are verified on a quarterly basis per DoD QSM and may be subject to change. Any changes to these limits which impact the SAP objectives must be approved by the NAVFAC RPM and NAVFAC QAO in advance of sample testing.

-- = not applicable

LCL = lower control limit

LCS = laboratory control sample

RPD = relative percent difference

UCL = upper control limit

SAP Worksheet #15-3—Reference Limits and Evaluation Table

Matrix: Surface Water
Analytical Group: PFAS – PFAS by LC/MS/MS Compliant with DoD QSM 5.3 Table B-15

Analyte	CAS Number	PALs		Laboratory Limits (ng/L)			LCS and MS/MSD Recovery Limits and RPD (%)[3]		
		Tapwater SLs (ng/L)	PAL Reference	LOQs (ng/L)	LODs (ng/L)	DLs (ng/L)	LCL	UCL	RPD
PFOA	335-67-1	40	USEPA RSL calculator[1]	5.00	1.50	0.511	56	136	30
PFOS	1763-23-1	40	USEPA RSL calculator[1]	5.00	1.00	0.437	50	130	30
PFBS	375-73-5	600	PPR Toxicity Values for PFBS (USEPA, 2021)[2]	5.00	0.500	0.144	57	145	30
PFHxA	307-24-4	--	--	5.00	1.50	0.527	45	135	30
PFHpA	375-85-9	--	--	5.00	1.00	0.263	60	128	30
PFHxS	355-46-4	--	--	5.00	0.400	0.112	52	132	30
PFNA	375-95-1	--	--	5.00	1.00	0.309	54	130	30
PFDA	335-76-2	--	--	5.00	0.500	0.142	55	141	30
PFUnA	2058-94-8	--	--	5.00	0.500	0.219	57	137	30
PFDoA	307-55-1	--	--	5.00	0.50	0.192	62	134	30
PFTrDA	72629-94-8	--	--	5.00	0.500	0.154	51	127	30
PFTeDA	376-06-7	--	--	5.00	2.00	0.733	34	162	30
EtFOSAA	2991-50-6	--	--	5.00	1.00	0.500	54	124	30
MeFOSAA	2355-31-9	--	--	5.00	1.00	0.350	52	146	30
HFPO-DA	13252-13-6	--	--	5.00	0.500	0.248	**60**	**126**	30

SAP Worksheet #15-3—Reference Limits and Evaluation Table (continued)

Analyte	**CAS Number**	**PALs**		**Laboratory Limits (ng/L)**			**LCS and MS/MSD Recovery Limits and RPD (%)**[3]		
		Tapwater SLs (ng/L)	**PAL Reference**	**LOQs (ng/L)**	**LODs (ng/L)**	**DLs (ng/L)**	**LCL**	**UCL**	**RPD**
ADONA	919005-14-4	--	--	5.00	1.00	0.265	**61**	**130**	30
9Cl-PF3ONS	756426-58-1	--	--	5.00	1.00	0.268	**60**	**126**	30
11Cl-PF3OUdS	763051-92-9	--	--	5.00	0.500	0.231	**56**	**125**	30

Notes:

[1] SLs for PFOA and PFOS are based on an HQ of 0.1 and were generated using the USEPA RSL calculator as described in the ASD September 2021 Memo (ASD, 2021).

[2] RSLs for PFBS were generated similarly to PFOA and PFOS, but values were updated from those listed in the 2021 memorandum to reflect reference doses provided in PPR Toxicity Values for PFBS (USEPA, 2021).

[3] Accuracy and precision limits are according to DoD QSM 5.3. For analytes not found in DoD QSM 5.3, laboratory in-house limits will be used. Analytes using in house laboratory limits are bolded.

Limits are verified on a quarterly basis per DoD QSM and may be subject to change. Any changes to these limits which impact the project SAP objectives, must be approved by the NAVFAC RPM and NAVFAC Atlantic QAO in advance of sample testing.

-- = not applicable

LCL = lower control limit

LCS = laboratory control sample

RPD = relative percent difference

UCL = upper control limit

SAP Worksheet #16—Project Schedule/Timeline Table

Phase 1 RI Activities[1]	**Organization**	**Dates**		**Deliverable**
		Anticipated Date(s) of Initiation	**Anticipated Date of Completion**	
Internal Draft SAP preparation	CH2M	November 2020	April 2021	Internal Draft SAP
Navy SAP review	NAVFAC Northwest and NAVFAC Atlantic	May 2021	June 2021	Comments
Draft SAP preparation	CH2M	June 2021	July 2021	Draft SAP
Stakeholder review	USEPA Region 10 Island County Public Health, Washington Town of Coupeville, Washington Washington Department of Ecology Washington Department of Health	October 2021	November 2021	Comments
Final SAP	CH2M	December 2021	January 2022	Final SAP
Subcontractor procurement	CH2M	TBD	TBD	
Groundwater monitoring well installation and survey	CH2M, Subcontractor	January 2022	March 2022	
Groundwater and soil sampling	CH2M	January 2022	March 2022	
Surface water and ditch surface soil sampling	CH2M	January 2022	March 2022	
Laboratory analysis	Subcontractor	Varied turnaround times are detailed on **Worksheet #30.**		Analytical data
Data management	CH2M	TBD	TBD	
Data validation	Subcontractor	TBD	TBD	
Reporting	CH2M	TBD	TBD	Internal Draft, Draft, and Final RI Report

[1] Phase 1 of the RI includes on-Base activities only. Off-Base activities will be described in a future addendum to this SAP. Additional RI phases, as necessary, will be described under future task order work plan documents.

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SAP Worksheet #17—Sampling Design and Rationale

The objectives of the investigation described in this worksheet are listed in **Worksheet #11**. Media to be investigated for this SAP include soil from on-base soil borings, groundwater from new well borings and new and existing completed on-base monitoring wells, and on-base ditch surface soil and surface water (if present). The sampling strategy and rationale are detailed in **Table 17-1.** Groundwater, soil, and surface water samples will be analyzed for PFAS by LC/MS/MS in compliance with QSM 5.3 Table B-15 or the latest version of the QSM for which the laboratory is certified at the time of sampling. Actual sample locations may vary from the proposed sample locations presented on **Figure 11-2** because of field conditions.

Table 17-1. Sampling Strategy Table – OLF Coupeville RI

Location	Matrix	Depth of Samples (feet bgs)	Analysis	Laboratory Method	Number of Samples	Sampling Strategy	Rationale
WI-CV-SO07	Soil	TBD[1] (between the ground surface [0 to 6 inches] and the water table)	PFAS	LC/MS/MS in compliance with DoD QSM 5.3, Table B-15/ SOP 5-369-08	Up to 5 at each location[1]	Soil samples will be collected for laboratory analysis of PFAS from an on-base soil boring location near a groundwater monitoring well where PFOS has been detected above the USEPA tap water RSL. Up to 5 soil samples will be collected from this location: at the surface (0 to 6 inches bgs), at the top of the capillary fringe in the unsaturated soil, and at up to three additional lithologic interfaces determined during drilling.	Samples will be used to determine the presence of PFOS in soil near groundwater monitoring well WI-CV-MW23S, where PFOS was previously detected above the USEPA tap water RSL but for which a source is not apparent. Depths targeted for analysis will be identified based on boring-specific conditions and will focus on air-water and lithologic interfaces. Data will be used to determine whether the sampling location is considered an additional vadose zone source and to characterize the vertical distribution of PFAS in the vadose zone.
WI-CV-SO08						Soil samples will be collected for laboratory analysis of PFAS from on-base soil borings and from the WI-CV-MW33S borehole (prior to monitoring well installation) west of the runway near the Keystone Well. Up to five soil samples will be collected from each location: at the surface (0 to 6 inches bgs), at the top of the capillary fringe in the unsaturated soil, and at up to three additional lithologic interfaces determined during drilling. Soil borings will be installed early in the investigation to help drive later decisions on location and screen placement of groundwater monitoring wells in this area.	Samples will be used to determine the presence of PFAS in soil near groundwater monitoring wells west of the runway (WI-CV-MW15S/M, WI-CV-MW16S/M) where PFAS have been detected above the SL (on-base near the Keystone Well), but evidence suggests that PFAS is not related to release areas east of the runway. Depths targeted for analysis will be identified based on boring-specific conditions and will focus on air-water and lithologic interfaces. Data will be used to determine whether the sampling locations are considered an additional vadose zone source.
WI-CV-SO09							
WI-CV-SO10							
WI-CV-MW33S							
WI-CV-SO11						Soil samples will be collected for laboratory analysis of PFAS from the soil borings near confirmed on-base release areas. Up to five soil samples will be collected from each location: at the surface (0 to 6 inches bgs), at the top of the capillary fringe in the unsaturated soil, and at up to three additional lithologic interfaces determined during drilling.	Samples will provide greater delineation of on-base release areas, which were confirmed as PFAS vadose zone sources during the Supplemental SI (Building 2709 and Facility 1, 2, and 11). Depths targeted for analysis will be identified based on boring-specific conditions and will focus on air-water and lithologic interfaces. Data will be used to better define the horizontal and vertical extent of PFAS in the vadose zone at these areas.
WI-CV-SO12							
WI-CV-SO13							
WI-CV-SO14							
TBD					TBD[1]	Additional soil samples may be collected at other soil boring locations or depths for laboratory analysis of PFAS from on-base soil borings advanced at or near release areas. Samples will be collected from surface or subsurface soil as deep as the top of the capillary fringe, targeting lithologic interfaces identified during drilling.	Samples will provide additional data as necessary to delineate the horizontal and vertical extent of PFAS in soil on Base at release areas. Depths targeted for analysis will be identified based on boring-specific conditions and will focus on air-water and lithologic interfaces.

SAP Worksheet #17—Sampling Design and Rationale (continued)

Table 17-1. Sampling Strategy Table – OLF Coupeville RI

Location	Matrix	Depth of Samples (feet bgs)	Analysis	Laboratory Method	Number of Samples	Sampling Strategy	Rationale
WI-CV-MW32M	Groundwater	TBD[1] (between the water table and approximately 200 feet bgs)	PFAS	LC/MS/MS in compliance with DoD QSM 5.3, Table B-15/ SOP 5-369-08	Estimated 3 at each location[2]	Groundwater will be collected as vertical profiling grab samples for in-field water quality parameters and laboratory analysis of PFAS at depths between the surface and 200 feet bgs as determined in the field based on lithology and targeting discrete aquifer intervals observed. Groundwater samples will be collected via a drive-point sampling device and submitted for PFAS analysis with a 72-hour TAT to allow for determination of groundwater monitoring well screen intervals. Up to three groundwater grab samples per location will be collected during advancement of soil borings for wells WI-CV-MW32M, WI-CV-MW33M, and WI-CV-MW35M, targeting the first-encountered groundwater, and up to two additional discrete aquifer zones separated by a low-permeability confining unit between the water table and the total depth of boring. Up to four groundwater grab samples per location will be collected during advancement of soil borings for wells WI-CV-MW36D and WI-CV-MW37D, with up to three samples collected from between the discrete aquifer zones between the water table and the total depth of boring.	Depth-discrete groundwater profiling with PFAS sampling will be conducted at soil borings located west of the runway near the Keystone Well; data will be used to determine well screen intervals for paired shallow/intermediate permanent groundwater monitoring wells (targeting elevated PFAS concentrations and discrete aquifer zones for well installation), and to confirm the presence of an additional suspected release in this area. If no elevated PFAS concentrations are detected, or multiple discrete aquifer zones are not observed during drilling, well construction at this location will be determined based on observed lithology, in consultation with the project technical team and the NAVFAC Northwest RPM.
WI-CV-MW33M							
WI-CV-MW35M							Depth-discrete groundwater profiling with PFAS sampling will be conducted at a soil boring east of the runway, downgradient (southwest) of Building 2709 and Facilities 1, 2, and 11; data will be used to determine well screen intervals for paired shallow/intermediate permanent groundwater monitoring wells (targeting elevated PFAS concentrations and discrete aquifer zones for well installation), and to address PFAS concentration data gaps between vadose zone sources (Building 2709 and Facilities 1, 2, and 11) and impacted downgradient monitoring wells to the west and southwest of the runway. If no elevated PFAS concentrations are detected, or multiple discrete aquifer zones are not observed during drilling, well construction at this location will be determined based on observed lithology, in consultation with the project technical team and the NAVFAC Northwest RPM.
WI-CV-MW36D					Estimated 4 at each location[2]		Depth-discrete groundwater profiling with PFAS sampling will be conducted at soil borings located near the southwestern base boundary; data will be used to determine well screen intervals for paired intermediate/deep permanent groundwater monitoring wells (targeting elevated PFAS concentrations and discrete aquifer zones for well installation), provide bounding data near the southwestern base boundary, and address a PFAS concentration data gap between on-base wells west of the runway and off-base wells where PFAS has been detected in exceedance of the USEPA lifetime health advisory. If no elevated PFAS concentrations are detected, or multiple discrete aquifer zones are not observed during drilling, well construction at this location will be determined based on observed lithology, in consultation with the project technical team and the NAVFAC Northwest RPM.
WI-CV-MW37D							Depth-discrete groundwater profiling with PFAS sampling will be conducted at soil borings located near the tree line in the southwestern part of the Base; data will be used to determine well screen intervals for paired intermediate/deep permanent groundwater monitoring wells (targeting elevated PFAS concentrations and discrete aquifer zones for well installation), and to identify potential PFAS migration pathways between northern on-base wells west of the runway and off-base drinking water wells where PFAS has been detected in exceedance of the USEPA lifetime health advisory. If no elevated PFAS concentrations are detected, or multiple discrete aquifer zones are not observed during drilling, well construction at this location will be determined based on observed lithology, in consultation with the project technical team and the NAVFAC Northwest RPM.
TBD					TBD[1]	Additional groundwater may be collected as vertical profiling grab samples for in-field water quality parameters and laboratory analysis of PFAS at depths between the surface and 200 feet bgs as determined in the field based on lithology and aquifer intervals observed.	Samples will provide additional data as necessary to delineate the vertical extent of PFAS in groundwater at proposed monitoring well locations on-base and to determine well screen intervals for monitoring wells. Depths targeted for analysis will be identified based on boring-specific conditions and will focus collection of samples within discrete water-bearing aquifer zones.

SAP Worksheet #17—Sampling Design and Rationale (continued)

Table 17-1. Sampling Strategy Table – OLF Coupeville RI

Location	Matrix	Depth of Samples (feet bgs)	Analysis	Laboratory Method	Number of Samples	Sampling Strategy	Rationale
WI-CV-MW32S	Groundwater	Middle of well screen; well screen settings TBD[1]	PFAS	LC/MS/MS in compliance with DoD QSM 5.3, Table B-15/ SOP 5-369-08	1 at each location	Groundwater will be collected for in-field water quality parameters and laboratory analysis of PFAS using low-flow sampling techniques.	Groundwater analytical data from a newly installed on-base shallow/intermediate groundwater monitoring well pair south of the WI-CV-MW16 pair and west of WI-CV-MW25M-R will be used to evaluate the connection between the release area near the WI-CV-MW15 and WI-CV-MW16 well pairs and PFOA/PFOS concentrations further south. The data will also be used to provide bounding on PFOA and PFOS exceedances of the SL (40 ng/L) near the western Base boundary. Future groundwater analytical data from these wells may be used to monitor temporal variability in PFAS concentrations in groundwater at OLF Coupeville. However, only one sample collection event is scoped for this investigation.
WI-CV-MW32M							
WI-CV-MW33S							Groundwater analytical data from a newly installed on-base shallow/intermediate groundwater monitoring well pair east of the WI-CV-MW15 well pair will be used to confirm the presence of a release area near the WI-CV-MW15 and WI-CV-MW16 well pairs. Future groundwater analytical data from these wells may be used to monitor temporal variability in PFAS concentrations in groundwater at OLF Coupeville. However, only one sample collection event is scoped for this investigation.
WI-CV-MW33M							
WI-CV-MW34S		Middle of well screen; well screen settings TBD[1]			1 at each location	Groundwater will be collected for in-field water quality parameters and laboratory analysis of PFAS using low-flow sampling techniques.	Groundwater analytical data from a newly installed on-base shallow groundwater monitoring well east of WI-CV-MW20S will be used to establish bounding on PFOA and PFOS exceedances of the SL (40 ng/L) near the eastern Base boundary. Future groundwater analytical data from these wells may be used to monitor temporal variability in PFAS concentrations in groundwater at OLF Coupeville. However, only one sample collection event is scoped for this investigation.
WI-CV-MW35S							Groundwater analytical data from a newly installed on-base shallow/intermediate groundwater monitoring well pair between WI-CV-MW02S and WI-CV-MW05S/M will be used to evaluate the southward/southwesterly migration of PFAS from the vadose zone sources near Building 2709 and Facilities 1, 2, and 11. Future groundwater analytical data from these wells may be used to monitor temporal variability in PFAS concentrations in groundwater at OLF Coupeville. However, only one sample collection event is scoped for this investigation.
WI-CV-MW35M							
WI-CV-MW36M							Groundwater analytical data from a newly installed on-base intermediate/deep groundwater monitoring well pair near the southwestern Base boundary will be used to provide bounding data near the southwestern base boundary, and address a PFAS concentration data gap between on-base wells west of the runway and off-base wells where PFAS has been detected in exceedance of the USEPA lifetime health advisory (70 ng/L). Future groundwater analytical data from these wells may be used to monitor temporal variability in PFAS concentrations in groundwater at OLF Coupeville. However, only one sample collection event is scoped for this investigation.
WI-CV-MW36D							
WI-CV-MW37M							Groundwater analytical data from a newly installed on-base intermediate/deep groundwater monitoring well pair along the tree line in the southwestern part of the Base will be used to identify potential PFAS migration pathways between on-base wells west of the runway and off-base drinking water wells where PFAS has been detected in exceedance of the USEPA lifetime health advisory (70 ng/L). Future groundwater analytical data from these wells may be used to monitor temporal variability in PFAS concentrations in groundwater at OLF Coupeville. However, only one sample collection event is scoped for this investigation.
WI-CV-MW37D							

SAP Worksheet #17—Sampling Design and Rationale (continued)

Table 17-1. Sampling Strategy Table – OLF Coupeville RI

Location	Matrix	Depth of Samples (feet bgs)	Analysis	Laboratory Method	Number of Samples	Sampling Strategy	Rationale
WI-CV-MW01M	Groundwater	Well screened from 148 to 158 feet bgs	PFAS	LC/MS/MS in compliance with DoD QSM 5.3, Table B-15/ SOP 5-369-08	1 at each location	Groundwater will be collected for in-field water quality parameters and laboratory analysis of PFAS using low-flow sampling techniques.	Groundwater analytical data from existing on-base wells at OLF Coupeville will be used to monitor temporal variability in PFAS concentrations in groundwater at OLF Coupeville.
WI-CV-MW01D		Well screened from 202 to 212 feet bgs					
WI-CV-MW02S		Well screened from 91.5 to 101.5 feet bgs					
WI-CV-MW02M		Well screened from 153 to 163 feet bgs					
WI-CV-MW03S		Well screened from 120 to 130 feet bgs					
WI-CV-MW03M		Well screened from 145 to 155 feet bgs					
WI-CV-MW03D		Well screened from 222 to 232 feet bgs					
WI-CV-MW04S		Well screened from 111.6 to 121.6 feet bgs					
WI-CV-MW04M		Well screened from 148.7 to 158.7 feet bgs					
WI-CV-MW05S		Well screened from 114 to 124 feet bgs					
WI-CV-MW05M		Well screened from 160 to 170 feet bgs					
WI-CV-MW06S		Well screened from 130 to 140 feet bgs					
WI-CV-MW06M		Well screened from 174 to 184 feet bgs					
WI-CV-MW07S		Well screened from 129.5 to 139.5 feet bgs					
WI-CV-MW07M		Well screened from 183 to 193 feet bgs					
WI-CV-MW08S		Well screened from 121 to 131 feet bgs					
WI-CV-MW08M		Well screened from 150 to 160 feet bgs					
WI-CV-MW09S		Well screened from 96 to 106 feet bgs					
WI-CV-MW09M		Well screened from 182 to 192 feet bgs					
WI-CV-MW10M		Well screened from 144 to 154 feet bgs					
WI-CV-MW10D		Well screened from 191 to 201 feet bgs					

SAP Worksheet #17—Sampling Design and Rationale (continued)

Table 17-1. Sampling Strategy Table – OLF Coupeville RI

Location	Matrix	Depth of Samples (feet bgs)	Analysis	Laboratory Method	Number of Samples	Sampling Strategy	Rationale
WI-CV-MW11S	Groundwater	Well screened from 130 to 140 feet bgs	PFAS	LC/MS/MS in compliance with DoD QSM 5.3, Table B-15/ SOP 5-369-08	1 at each location	Groundwater will be collected for in-field water quality parameters and laboratory analysis of PFAS using low-flow sampling techniques.	Groundwater analytical data from existing on-base wells at OLF Coupeville will be used to monitor temporal variability in PFAS concentrations in groundwater at OLF Coupeville.
WI-CV-MW11M		Well screened from 155 to 165 feet bgs					
WI-CV-MW12S		Well screened from 97 to 107 feet bgs					
WI-CV-MW12D		Well screened from 183 to 193 feet bgs					
WI-CV-MW13S		Well screened from 105 to 115 feet bgs					
WI-CV-MW13M		Well screened from 173 to 183 feet bgs					
WI-CV-MW14M		Well screened from 161 to 171 feet bgs					
WI-CV-MW15S		Well screened from 132 to 142 feet bgs					
WI-CV-MW15M		Well screened from 164 to 174 feet b					
WI-CV-MW16S		Well screened from 130 to 140 feet bgs					
WI-CV-MW16M		Well screened from 165 to 183 feet bgs					
WI-CV-MW17M		Well screened from 150 to 160 feet bgs					
WI-CV-MW18M		Well screened from 120 to 135 feet bgs					
WI-CV-MW20S		Well screened from 100 to 110 feet bgs					
WI-CV-MW21S		Well screened from 107 to 117 feet bgs					
WI-CV-MW22S		Well screened from 112 to 122 feet bgs					
WI-CV-MW23S		Well screened from 130 to 140 feet bgs					
WI-CV-MW25M-R		Well screened from 150 to 160 feet bgs					
WI-CV-MW26D		Well screened from 189.5 to 199.5 feet bgs					
WI-CV-MW28M		Well screened from 160 to 170 feet bgs					
WI-CV-MW29M		Well screened from 160 to 170 feet bgs					

SAP Worksheet #17—Sampling Design and Rationale (continued)

Table 17-1. Sampling Strategy Table – OLF Coupeville RI

Location	Matrix	Depth of Samples (feet bgs)	Analysis	Laboratory Method	Number of Samples	Sampling Strategy	Rationale
WI-CV-MW30M	Groundwater	Well screened from 160 to 170 feet bgs	PFAS	LC/MS/MS in compliance with DoD QSM 5.3, Table B-15/ SOP 5-369-08	1 at each location	Groundwater will be collected for in-field water quality parameters and laboratory analysis of PFAS using low-flow sampling techniques.	Groundwater analytical data from existing on-base wells at OLF Coupeville will be used to monitor temporal variability in PFAS concentrations in groundwater at OLF Coupeville.
WI-CV-MW31S		Well screened from 107 to 117 feet bgs					
WI-CV-MW31M		Well screened from 140 to 150 feet bgs					
WI-CV-SW01	Surface Water	N/A	PFAS	LC/MS/MS in compliance with DoD QSM 5.3, Table B-15/ SOP 5-369-08	1 at each location	Collect surface water samples (if sufficient water) from drainage ditches along runway[3] (**Figure 11-2**).	Impacts on surface water (if present) and ditch surface soil have not been evaluated at OLF Coupeville. Sample data for ditch surface soil and surface water (if present) will be evaluated to determine whether runoff to on-base ditches from PFAS release areas occurred. If runoff to on-base ditches from PFAS release areas occurred, PFAS may have accumulated in surface water (if present) and/or ditch surface soil and provide a receptor pathway for maintenance and landscape workers as well as an additional transport pathway to groundwater.
WI-CV-SW02							
WI-CV-SW03							
WI-CV-SW04							
TBD		TBD[a]			TBD[a]	Additional surface water samples may be collected at other drainage ditch locations for laboratory analysis of PFAS based on extent of observed surface water at the time of sampling.	
WI-CV-SS01	Ditch Surface Soil	0 to 0.5 foot bgs			1 at each location	Collect ditch surface soil samples from drainage ditches along runway[3] (**Figure 11-2**).	
WI-CV-SS02							
WI-CV-SS03							
WI-CV-SS04							
TBD		TBD[1]			TBD[1]	Additional ditch surface soil samples may be collected at other drainage ditch locations for laboratory analysis of PFAS based on extent of present or potential surface water pathways observed.	

[1] The final number and placement of samples may be modified in the field based on the field team's professional opinion in consultation with CH2M management and technical teams and the NAVFAC Northwest RPM. Sampling will target surface soil (0 to 0.5 foot bgs), the top of the capillary fringe in the unsaturated soil, and at up to three additional lithologic interfaces encountered during drilling for laboratory analysis of PFAS from each soil boring.

[2] The final number and placement of samples may be modified in the field based on the field team's professional opinion in consultation with CH2M management and technical teams and the NAVFAC Northwest RPM. Sampling will target the first-encountered groundwater (water table) and up to two additional discrete aquifer zones separated by a confining unit.

[3] If surface water is not present in runway drainage ditches or wetlands, only ditch surface soil samples will be collected from the specified locations.

SAP Worksheet #18—Location-Specific Sampling Methods/SOP Requirements Table

Station ID	Sample ID	Matrix	Number of Samples (Identify FDs)	Depth (feet bgs)	Analytical Group	Sampling SOP Reference
WI-CV-SO07	WI-CV-SO07-TDBD	Soil	Up to 5	Surface (0 to 0.5 foot bgs), subsurface (at the top of the capillary fringe), and up to three samples at other lithologic interfaces encountered during drilling	PFAS (LC/MS/MS compliant in accordance with DoD QSM 5.3, Table B-15^1)	Worksheet #21
	WI-CV-SO07P-TDBD		1 (FD)			
WI-CV-SO08	WI-CV-SO08-TDBD		Up to 5			
	WI-CV-SO08P-TDBD		1 (FD)			
WI-CV-SO09	WI-CV-SO09-TDBD		Up to 5			
	WI-CV-SO09-TDBD-MS		1 (MS)			
	WI-CV-SO09-TDBD-MSD		1 (MSD)			
WI-CV-SO10	WI-CV-SO10-TDBD		Up to 5			
	WI-CV-SO10P-TDBD		1 (FD)			
WI-CV-SO11	WI-CV-SO11-TDBD		Up to 5			
	WI-CV-SO11P-TDBD		1 (FD)			
WI-CV-SO12	WI-CV-SO12-TDBD		Up to 5			
	WI-CV-SO12P-TDBD		1 (FD)			
WI-CV-SO13	WI-CV-SO13-TDBD		Up to 5			
	WI-CV-SO13-TDBD-MS		1 (MS)			
	WI-CV-SO13-TDBD-MSD		1 (MSD)			
WI-CV-SO14	WI-CV-SO14-TDBD		Up to 5			
	WI-CV-SO14-TDBD-MS		1 (MS)			
	WI-CV-SO14-TDBD-MSD		1 (MSD)			
WI-CV-MW01M	WI-CV-GW01M-MMYY	Groundwater	1	148 to 158		
WI-CV-MW01D	WI-CV-GW01D-MMYY		1	202 to 212		
	WI-CV-GW01DP-MMYY		1 (FD)			
WI-CV-MW02S	WI-CV-GW02S-MMYY		1	91.5 to 101.5		

SAP Worksheet #18—Location-Specific Sampling Methods/SOP Requirements Table (continued)

Station ID	Sample ID	Matrix	Number of Samples (Identify FDs)	Depth (feet bgs)	Analytical Group	Sampling SOP Reference
WI-CV-MW02M	WI-CV-GW02M-MMYY	Groundwater	1	153 to 163	PFAS (LC/MS/MS compliant in accordance with DoD QSM 5.3, Table B-15[1])	Worksheet #21
WI-CV-MW03S	WI-CV-GW03S-MMYY		1	120 to 130		
WI-CV-MW03M	WI-CV-GW03M-MMYY		1	145 to 155		
	WI-CV-GW03M-MMYY-MS		1 (MS)			
	WI-CV-GW03M-MMYY-MSD		1 (MSD)			
WI-CV-MW03D	WI-CV-GW03D-MMYY		1	222 to 232		
WI-CV-MW04S	WI-CV-GW04S-MMYY		1	111.6 to 121.6		
WI-CV-MW04M	WI-CV-GW04M-MMYY		1	148.7 to 158.7		
WI-CV-MW05S	WI-CV-GW05S-MMYY		1	114 to 124		
	WI-CV-GW05SP-MMYY		1 (FD)			
WI-CV-MW05M	WI-CV-GW05M-MMYY		1	160 to 170		
WI-CV-MW06S	WI-CV-GW06S-MMYY		1	130 to 140		
WI-CV-MW06M	WI-CV-GW06M-MMYY		1	174 to 184		
WI-CV-MW07S	WI-CV-GW07S-MMYY		1	129.5 to 139.5		
WI-CV-MW07M	WI-CV-GW07M-MMYY		1	183 to 193		
	WI-CV-GW07M-MMYY-MS		1 (MS)			
	WI-CV-GW07M-MMYY-MSD		1 (MSD)			
WI-CV-MW08S	WI-CV-GW08S-MMYY		1	121 to 131		
WI-CV-MW08M	WI-CV-GW08M-MMYY		1	150 to 160		
WI-CV-MW09S	WI-CV-GW09S-MMYY		1	96 to 106		
WI-CV-MW09M	WI-CV-GW09M-MMYY		1	182 to 192		
WI-CV-MW10M	WI-CV-GW10M-MMYY		1	144 to 154		
	WI-CV-GW10MP-MMYY		1 (FD)			

SAP Worksheet #18—Location-Specific Sampling Methods/SOP Requirements Table (continued)

Station ID	Sample ID	Matrix	Number of Samples (Identify FDs)	Depth (feet bgs)	Analytical Group	Sampling SOP Reference
WI-CV-MW10D	WI-CV-GW10D-MMYY	Groundwater	1	191 to 201	PFAS (LC/MS/MS compliant in accordance with DoD QSM 5.3, Table B-15[1])	Worksheet #21
WI-CV-MW11S	WI-CV-GW11S-MMYY		1	130 to 140		
WI-CV-MW11M	WI-CV-GW11M-MMYY		1	155 to 165		
WI-CV-MW12S	WI-CV-GW12S-MMYY		1	97 to 107		
WI-CV-MW12D	WI-CV-GW12D-MMYY		1	183 to 193		
WI-CV-MW13S	WI-CV-GW13S-MMYY		1	105 to 115		
WI-CV-MW13M	WI-CV-GW13M-MMYY		1	173 to 183		
	WI-CV-GW13MP-MMYY		1 (FD)			
WI-CV-MW14M	WI-CV-GW14M-MMYY		1	161 to 171		
WI-CV-MW15S	WI-CV-GW15S-MMYY		1	132 to 142		
WI-CV-MW15M	WI-CV-GW15M-MMYY		1	164 to 174		
WI-CV-MW16S	WI-CV-GW16S-MMYY		1	130 to 140		
WI-CV-MW16M	WI-CV-GW16M-MMYY		1	164 to 174		
WI-CV-MW17M	WI-CV-GW17M-MMYY		1	150 to 160		
	WI-CV-GW17MP-MMYY		1 (FD)			
WI-CV-MW18M	WI-CV-GW18M-MMYY		1	120 to 135		
WI-CV-MW20S	WI-CV-GW20S-MMYY		1	100 to 110		
WI-CV-MW21S	WI-CV-GW21S-MMYY		1	107 to 117		
WI-CV-MW22S	WI-CV-GW22S-MMYY		1	112 to 122		
WI-CV-MW23S	WI-CV-GW23S-MMYY		1	130 to 140		
WI-CV-MW25M-R	WI-CV-GW25M-MMYY		1	150 to 160		
WI-CV-MW26D	WI-CV-GW26D-MMYY		1	189.5 to 199.5		
WI-CV-MW28M	WI-CV-GW28M-MMYY		1	160 to 170		

SAP Worksheet #18—Location-Specific Sampling Methods/SOP Requirements Table (continued)

Station ID	Sample ID	Matrix	Number of Samples (Identify FDs)	Depth (feet bgs)	Analytical Group	Sampling SOP Reference
WI-CV-MW29M	WI-CV-GW29M-MMYY	Groundwater	1	160 to 170	PFAS (LC/MS/MS compliant in accordance with DoD QSM 5.3, Table B-15[1])	Worksheet #21
WI-CV-MW30M	WI-CV-GW30M-MMYY		1	160 to 170		
WI-CV-MW31S	WI-CV-GW31S-MMYY		1	107 to 117		
WI-CV-MW31M	WI-CV-GW31M-MMYY		1	140 to 150		
WI-CV-MW32S	WI-CV-GW32S-MMYY		1	TBD[2]		
WI-CV-MW32M	WI-CV-GW32M-XX-MMYY		An estimated 3 (grab samples)	TBD[2]		
	WI-CV-GW32MP-XX-MMYY		1 (FD)			
	WI-CV-GW32M-MMYY		1			
WI-CV-MW33S	WI-CV-SO33-TDBD-MMYY	Soil	Up to 5	Surface (0 to 0.5 foot bgs), subsurface (at the top of the capillary fringe), and up to three samples at other lithologic interfaces encountered during drilling		
	WI-CV-GW33S-MMYY	Groundwater	1	TBD[2]		
	WI-CV-GW33SP-MMYY		1 (FD)			
WI-CV-MW33M	WI-CV-GW33M-XX-MMYY	Groundwater	An estimated 3 (grab samples)			
	WI-CV-GW33M-MMYY		1			
WI-CV-MW34S	WI-CV-GW34S-MMYY		1			
	WI-CV-GW34S-MMYY-MS		1 (MS)			
	WI-CV-GW34S-MMYY-MSD		1 (MSD)			
WI-CV-MW35S	WI-CV-GW35S-MMYY		1			

SAP Worksheet #18—Location-Specific Sampling Methods/SOP Requirements Table (continued)

Station ID	Sample ID	Matrix	Number of Samples (Identify FDs)	Depth (feet bgs)	Analytical Group	Sampling SOP Reference
WI-CV-MW35M	WI-CV-GW35M-XX-MMYY	Groundwater	An estimated 3 (grab samples)	TBD[2]	PFAS (LC/MS/MS compliant in accordance with DoD QSM 5.3, Table B-15[1])	Worksheet #21
	WI-CV-GW35MP-XX-MMYY		1 (FD)			
	WI-CV-GW35M-MMYY		1			
WI-CV-MW36M	WI-CV-GW36M-MMYY		1			
WI-CV-MW36D	WI-CV-GW36D-XX-MMYY		An estimated 4 (grab samples)			
	WI-CV-GW36D-XX-MMYY-MS					
	WI-CV-GW36D-XX-MMYY-MSD					
	WI-CV-GW36D-MMYY					
WI-CV-MW37M	WI-CV-GW37M-MMYY		1	TBD[2]		
WI-CV-MW37D	WI-CV-GW37D-XX-MMYY		An estimated 4 (grab samples)			
	WI-CV-GW37D-MMYY		1			
WI-CV-SW01/WI-CV-SS01	WI-CV-SW01-MMYY	Surface water	1	N/A		
	WI-CV-SW01P-MMYY		1 (FD)			
	WI-CV-SS01-MMYY	Ditch surface soil	1	0 to 0.5		
WI-CV-SW02/WI-CV-SS02	WI-CV-SW02-MMYY	Surface water	1	N/A		
	WI-CV-SW02-MMYY-MS		1 (MS)			
	WI-CV-SW02-MMYY-MSD		1 (MSD)			
	WI-CV-SS02-MMYY	Ditch surface soil	1	0 to 0.5		

SAP Worksheet #18—Location-Specific Sampling Methods/SOP Requirements Table (continued)

Station ID	Sample ID	Matrix	Number of Samples (Identify FDs)	Depth (feet bgs)	Analytical Group	Sampling SOP Reference
WI-CV-SW03/WI-CV-SS03	WI-CV-SW03-MMYY	Surface water	1	N/A	PFAS (LC/MS/MS compliant in accordance with DoD QSM 5.3, Table B-15[1])	Worksheet #21
	WI-CV-SS03-MMYY	Ditch surface soil	1	0 to 0.5		
	WI-CV-SS03P-MMYY		1 (FD)			
WI-CV-SW04/WI-CV-SS04	WI-CV-SW04-MMYY	Surface water	1	N/A		
	WI-CV-SS04-MMYY	Ditch surface soil	1	0 to 0.5		
	WI-CV-SS04-MMYY-MS		1 (MS)			
	WI-CV-SS04-MMYY-MSD		1 (MSD)			
Field QC Samples						
WI-CV-QC[3]	WI-CV-EB01-MMDDYY	QC	1	N/A	PFAS (LC/MS/MS compliant in accordance with DoD QSM 5.3, Table B-15[1])	Worksheet #21
	WI-CV-EB02-MMDDYY		1			
	WI-CV-EBXX-MMDDYY[3]		TBD			
	WI-CV-FB01-MMDDYY		1			
	WI-CV-FB02-MMDDYY		1			
	WI-CV-FBXX- MMDDYY[3]		TBD			

[1] Analytical method is compliant with DoD QSM 5.3 Table B-15 or the most recent version of the DoD QSM for which Battelle has DoD ELAP certification.

[2] Depth intervals will be determined during drilling.

[3] One field blank should be collected weekly and one equipment blank should be collected daily with samples from decontaminated equipment.

Notes:
ID = identification
MMDDYY = Month/Day/Year
MMYY = Month/Year
TDBD = top depth/bottom depth (soil samples)
XX = depth (groundwater grab samples)

SAP Worksheet #19—Analytical SOP Requirement Table

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Containers	Sample Volume	Preservation Requirements	Maximum Holding Time[1] (Preparation/Analysis)
Groundwater/surface water	PFAS	PFAS by LC/MS/MS in compliance with DoD QSM 5.3 Table B-15[2]/SOP 5-370-12/SOP 5-369-08	2 x 250-milliliter HDPE bottles	2 x 250 milliliters	Temperature must be above freezing and less than or equal to 10°C when received at the laboratory. Samples stored in the lab must be held at or below 6°C until extraction but should not be frozen.	14 days to extraction/28 days to analysis
Soil (subsurface soil and ditch surface soil)	PFAS	PFAS by LC/MS/MS in compliance with DoD QSM 5.3 Table B-15[2]/SOP 5-370-12/SOP 5-369-08	One 8-ounce HDPE jar	20 grams	Temperature must be above freezing and less than or equal to 10°C when received at the laboratory. Samples stored in the lab must be held at or below 6°C until extraction but should not be frozen.	14 days to extraction/28 days to analysis

[1] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

[2] Analytical method is compliant with DoD QSM 5.3 Table B-15 or the most recent version of the DoD QSM for which Battelle has DoD ELAP certification.

Note:

HDPE = high-density polyethylene

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SAP Worksheet #20—Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Field Samples[1]	No. of FDs[a]	No. of MS/MSDs[1]	No. of Field Reagent Blanks[1]	No. of Equipment Blanks[1]	Total No. of Samples to Laboratory[1]
Groundwater	PFAS	73	8	4/4	1	23	113
Soil	PFAS	45	5	3/3	1	10	67
Surface Water	PFAS	4	1	1/1	1	1	9
Ditch Surface Soil	PFAS	4	1	1/1	1	1	9

[1] Samples will be collected as detailed in **Worksheets #14, #17,** and **#18** of this SAP. Field QA/QC samples will be collected as detailed in **Worksheet #12**.

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SAP Worksheet #21—Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP CH2M-1	Logging of Soil Borings Rev. Sept.2021	CH2M	None	N	Guides staff in accurately and consistently recording the field data necessary to characterize soil borings and recovered soil samples, to guide CH2M staff in accurately and consistently recording the field data necessary to characterize soil borings and recovered soil samples.
SOP CH2M-2	Water-Level Measurements Rev. Feb. 2021	CH2M	Transducer and datalogger	N	Describes procedure for collecting continuous water level measurements. Only PFAS-free equipment will be used.
SOP CH2M-3	Multi RAE Photoionization Detector (PID) Rev. Feb. 2021	CH2M	Multi RAE PID	N	Describes procedure for operation and general maintenance of the Multi RAE PID.
SOP CH2M-4	Groundwater Sampling for Per- and Polyfluoroalkyl Substances (PFAS) Rev. Jan. 2021	CH2M	Teflon-free tubing, Teflon-free bailer (if using bailer), PFAS-free pump, sample bottles (HDPE bottle with HDPE screw cap), laboratory pre-filled HDPE bottles containing field blank water, loose leaf paper without waterproof coating, clip board, pen (not Sharpie), nitrile or latex gloves	N	Provides guidance for groundwater sample collection for samples that will be analyzed for PFAS via LC/MS/MS in compliance with QSM 5.3 (or the most recent version of the QSM for which laboratory has been certified at the time of sampling) for Navy CLEAN projects under Contract N62470-16-D-9000.
SOP CH2M-5	Rotosonic Groundwater Sample Collection for Per- and Polyfluoroalkyl Substances Rev. Mar. 2019	CH2M	Teflon-free tubing, Teflon-free bailer (if using bailer), PFAS-free pump, sample bottles (HDPE bottle with HDPE screw cap), laboratory pre-filled HDPE bottles containing field blank water, loose leaf paper without waterproof coating, clip board, pen (not Sharpie), nitrile or latex gloves	N	Provides guidance for groundwater sample collection for samples that will be analyzed for PFAS via LC/MS/MS in compliance with QSM 5.3 (or the most recent version of the QSM for which laboratory has been certified at the time of sampling) for Navy CLEAN projects under Contract N62470-16-D-9000.

SAP Worksheet #21—Project Sampling SOP References Table (continued)

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP CH2M-6	Soil Sampling for Per- and Polyfluoroalkyl Substances Rev. Jan 2021	CH2M	Sample jars (HDPE bottle with HDPE screw cap), laboratory pre-filled HDPE bottles containing field blank water, loose leaf paper without waterproof coating, clip board, pen (not Sharpie), nitrile or latex gloves	N	Provides guidance for soil sample collection for samples that will be analyzed for PFAS via LC/MS/MS in compliance with QSM 5.3 (or the most recent version of the QSM for which laboratory has been certified at the time of sampling) for Navy CLEAN projects under Contract N62470-16-D-9000.
SOP CH2M-7	Management of Liquid Waste Containing Per- and Polyfluoroalkyl Substances (PFAS) Rev. Jan. 2021	CH2M	Drum, tank, HDPE sample bottles	N	Provides guidelines for managing liquid waste containing PFAS or Navy CLEAN projects under Contract N62470-16-D-9000.
SOP CH2M-8	Surface Water Sampling for Per- and Polyfluoroalkyl Substances Rev. Jan 2021	CH2M	Sample jars (HDPE bottle with HDPE screw cap), laboratory pre-filled HDPE bottles containing field blank water, loose leaf paper without waterproof coating, clip board, pen (not Sharpie), nitrile or latex gloves	N	Provides guidelines for surface water sample collection for samples that will be analyzed for PFAS via LC/MS/MS in compliance with QSM 5.3 (or the most recent version of the QSM for which the lab is certified at the time of analysis). For Navy CLEAN projects under Contract N62470-16-D-9000.
SOP CH2M-9	Sediment Sampling for Per- and Polyfluoroalkyl Substances Rev. Jan 2021	CH2M	Sample jars (HDPE bottle with HDPE screw cap), laboratory pre-filled HDPE bottles containing field blank water, loose leaf paper without waterproof coating, clip board, pen (not Sharpie), nitrile or latex gloves	N	Provides guidelines for sediment sample collection for samples that will be analyzed for PFAS via LC/MS/MS in compliance with QSM 5.3 (or the most recent version of the QSM for which the lab is certified at the time of analysis). For Navy CLEAN projects under Contract N62470-16-D-9000.
SOP I-A-1	Planning Field Sampling Activities, Rev. Feb. 2015	NAVFAC Northwest	None	N	Establishes SOPs for planning and scheduling field sampling activities.

SAP Worksheet #21—Project Sampling SOP References Table (continued)

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP I-A-7	IDW Management, Rev. Feb. 2015	NAVFAC Northwest	None	N	Describes activities and responsibilities of NAVFAC Northwest and its subcontractors regarding management of IDW. Field activities will deviate slightly from the SOP to eliminate use of PFAS-containing materials.
SOP I-A-9	General Field Operation, Rev. Feb. 2015	NAVFAC Northwest	All field equipment	N	Defines organization and structure of sample collection, identification, record keeping, field measurements, and data collection.
SOP I-A-10	Monitoring/Sampling Location Recording, Rev. Feb. 2015	NAVFAC Northwest	Loose leaf paper and clipboard	N	Establishes guidelines for generating information to be recorded for each physical location where sampling is conducted.
SOP I-A-11	Sample Naming, Rev. Feb. 2015	NAVFAC Northwest	None	N	Describes the naming convention to be used for samples collected, analyzed, and reported for NAVFAC Northwest projects.
SOP 1-C-1	Monitoring Well/Piezometer Installation, Rev. Mar. 2015	NAVFAC Northwest	Drilling equipment	N	Describes the methods by which NAVFAC Northwest field personnel and their contractors will conduct groundwater monitoring well installation.
SOP 1-C-2	Monitoring Well Development, Rev. Mar. 2015	NAVFAC Northwest	Drilling equipment	N	Describes the methods by which NAVFAC Northwest field personnel and their contractors will conduct groundwater monitoring well development.

SAP Worksheet #21—Project Sampling SOP References Table (continued)

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP 1-C-5	Low-Flow Groundwater Purging and Sampling, Rev. Mar. 2015	NAVFAC Northwest	Bladder or peristaltic pump, water level and water quality meters, and buckets. Compressor and controller required for bladder pump.	N	Describes the conventional groundwater monitoring well sampling procedures to be used by all NAVFAC Northwest personnel and contractors.
SOP 1-D-5	Water Level Measurements, Rev. Mar. 2015	NAVFAC Northwest	Water level meters	N	Establishes standard protocols for all NAVFAC Northwest field personnel for use in making water level measurements.
SOP I-D-7	Field Parameter Measurements, Rev. Mar. 2015	NAVFAC Northwest	Water quality meters	N	Provides instructions for the calibration, use, and checking of instruments and equipment for field measurements. Field activities will deviate slightly from the SOP to eliminate use of PFAS-containing materials.
SOP I-G-1	Land Surveying, Rev. Aug. 2014	NAVFAC Northwest	Surveying equipment	N	Describes the methods by which NAVFAC Northwest field personnel and their contractors will conduct land surveying.
SOP III-B	Field QC Samples (Water, Soil, Sediment, Tissue), Rev. Apr. 2015	NAVFAC Northwest	Sample containers	N	Describes the number and types of field QC samples that will be collected during NAVFAC Northwest site fieldwork.
SOP III-D	Logbooks, Rev. Apr. 2015	NAVFAC Northwest	Loose-leaf paper and clipboard	N	Describes the activities and responsibilities of NAVFAC Northwest personnel and/or their contractors pertaining to the identification, use, and control of logbooks and associated field data records.

SAP Worksheet #21—Project Sampling SOP References Table (continued)

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP III-E	Record Keeping, Sample Labeling, and Chain-of-Custody Procedures, Rev. Apr. 2015	NAVFAC Northwest	Samples, sample labels, COC	N	Establishes standard protocols for all NAVFAC Northwest field personnel and their contractors for use in maintaining field and sampling activity records, writing sample logs, labeling samples, ensuring that proper sample custody procedures are used, and completing chain-of-custody/analytical request forms.
SOP III-F	Sample Containers and Preservation, Rev. Apr. 2015	NAVFAC Northwest	Sample containers	N	Sets forth the methods for use by NAVFAC Northwest field personnel and their contractors engaged in handling, storing, and transporting water, soil, or sediment samples. Field activities will deviate slightly from the SOP to eliminate use of PFAS-containing materials.
SOP III-G	Sample Handling, Storage, and Shipping, Rev. Apr. 2015	NAVFAC Northwest	Samples	N	Sets forth the methods for use by NAVFAC Northwest field personnel and their contractors engaged in handling, storing, and transporting water, soil, or sediment samples. Field activities will deviate slightly from the SOP to eliminate use of PFAS-containing materials.
SOP III-I	Equipment Decontamination, Rev. Apr. 2015	NAVFAC Northwest	Non-disposable sampling equipment	Y	Describes general methods of equipment decontamination for use by NAVFAC Northwest field personnel and their contractors during field sampling activities. Field activities will deviate slightly from the SOP to eliminate use of PFAS-containing materials. Rinse water will be certified PFAS-free.

SAP Worksheet #21—Project Sampling SOP References Table (continued)

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP III-J	Equipment Calibration, Operation, and Maintenance, Rev. Apr. 2015	NAVFAC Northwest	Field meters	N	Describes the activities and responsibilities of the NAVFAC Northwest personnel pertaining to the operation, calibration, and maintenance of equipment used to collect environmental data. Field activities will deviate slightly from the SOP to eliminate use of PFAS-containing materials.
N/A	Final Environmental Restoration Program Recordkeeping Manual, Feb. 2017	NAVFAC	None.	N	Provides instructions on how to submit documents for inclusion in the program's Environmental Document Management System and information about compiling, documenting, managing, and maintaining CERCLA Environmental Restoration Administrative Record Files; Post-Decision Files; Site Files; and Petroleum, Oil, and Lubricant Files.

SAP Worksheet #22—Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Activity[1]	Frequency	Acceptance Criteria	CA	Resp. Person	SOP Reference[2]	Comments
Horiba U-22 pH probe	Calibration	Daily before use	pH reads 4.0 plus or minus (±) 3%	Clean probe with deionized water and calibrate again. Do not use instrument if not able to calibrate properly.	FTL	SOP-007	**Appendix B**
Horiba U-22 Specific conductance probe	Calibration	Daily before use	Conductivity reads 4.49 ± 3%	Clean probe with deionized water and calibrate again. Do not use instrument if not able to calibrate properly.	FTL	SOP-007	**Appendix B**
Horiba U-22 Turbidity probe	Calibration	Daily before use	Turbidity reads 0 ± 3%	Clean probe with deionized water and calibrate again. Do not use instrument if not able to calibrate properly.	FTL	SOP-007	**Appendix B**
Horiba U-22 DO and Temperature Probes	Testing	Daily before use	Consistent with the current atmospheric pressure and ambient temperature	Clean probe with deionized water and calibrate again. Do not use instrument if not able to calibrate properly.	FTL	SOP-007	**Appendix B**
Horiba U-22	Maintenance - Check mechanical and electronic parts, verify system continuity, check battery, and clean probes Calibration check	Daily before use, at the end of the day, and when unstable readings occur	Stable readings after 3 minutes pH reads 4.0 ± 3% Conductivity reads 4.49 ± 3% Turbidity reads 0 ± 3%	Clean probe with deionized water and calibrate again. Do not use instrument if not able to calibrate properly.	FTL	SOP-007	**Appendix B**

SAP Worksheet #22—Field Equipment Calibration, Maintenance, Testing, and Inspection Table (continued)

Field Equipment	Activity[1]	Frequency	Acceptance Criteria	CA	Resp. Person	SOP Reference[2]	Comments
Multi RAE PID	Calibrate using ambient air and isobutylene 100 parts per million (ppm) calibration gas	Daily and as needed	Isobutylene reads 100 ppm Methane reads 50 percent lower explosive level Oxygen reads 20.9 percent Hydrogen sulfide reads 25 ppm Carbon monoxide reads 50 ppm	Manufacturer technical support for calibration errors	FTL	SOP CH2M-3, SOP-III-J	**Appendix B**
Groundwater sampling pumps and tubing	Inspect pumps, tubing, and air/sample line quick-connects	Regularly	Maintained in good working order according to manufacturer's recommendations	Replace items	FTL	SOP-III-J	**Appendix B**

[1] Activities may include calibration, verification, testing, and maintenance.

[2] Specify the appropriate reference letter or number from the Project Sampling SOP References table (**Worksheet #21**).

SAP Worksheet #23—Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work (Y/N)
5-370-12	*Extraction of Poly and Perfluoroalkyl Substances from Environmental Matrices, 04/06/2021, Rev. 12*	Definitive	Soil/Groundwater/Ditch Surface Soil/Surface Water/PFAS	N/A	Battelle	N
5-369-08	*Analysis of Poly and Perfluoroalkyl Substances in Environmental Samples by Liquid Chromatography and Tandem Mass Spectrometry (LC-MS/MS), 07/28/2020, Rev. 8*	Definitive	Soil/Groundwater/Ditch Surface Soil/Surface Water/PFAS	LC/MS/MS	Battelle	N
6-010-19	Sample Receipt, Custody, and Handling, 12/15/2020, Rev. 19	N/A	Soil/Groundwater/Ditch Surface Soil/Surface Water/PFAS	N/A	Battelle	N
5-291-17	*Determination of Method Detection Limits in the Analytical Laboratory, 09/13/2019, Rev. 17*	N/A	Soil/Groundwater/Ditch Surface Soil/Surface Water/PFAS	N/A	Battelle	N

Note:

Laboratory SOPs meet DoD QSM 5.3 (ASD, 2021, **Appendix D**) requirements for Battelle.

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SAP Worksheet #24—Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
LC/MS/MS (PFAS)	Aqueous Sample Preparation	Each sample and associated batch QC samples	Solid Phase Extraction (SPE) must be used unless samples are known to contain high PFAS concentrations (e.g., AFFF formulations). Inline SPE is acceptable. Entire sample plus bottle rinsate must be extracted using SPE. Known high PFAS concentration samples require serial dilution be performed in duplicate. Documented project approval is needed for samples prepared by serial dilution as opposed to SPE.	N/A	Analyst/Laboratory PM	5-369-08 DoD QSM 5.3
	Solid Sample Preparation	Each sample and associated batch QC samples	Entire sample received by the laboratory must be homogenized prior to subsampling.	N/A		
	Sample Cleanup Procedure	Each sample and associated batch QC samples Not applicable to AFFF and AFFF Mixture Samples	ENVI-CarbTM or equivalent must be used on each sample and batch QC sample.	N/A		
	Mass Calibration	Instrument must have a valid mass calibration prior to any sample analysis Mass calibration is verified after each mass calibration, prior to initial calibration (ICAL)	Calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer. Mass calibration range must bracket the ion masses of interest. The most recent mass calibration must be used for every acquisition in an analytical run. Mass calibration must be verified to be ± 0.5 atomic mass unit of the true value, by acquiring a full scan continuum mass spectrum of a PFAS stock standard.	If the mass calibration fails, then recalibrate. If it fails again, consult manufacturer instructions on corrective maintenance.		

SAP Worksheet #24—Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
LC/MS/MS (PFAS) (cont.)	Mass Spectral Acquisition Rate	Each analyte, Extracted Internal Standard Analyte	A minimum of 10 spectra scans are acquired across each chromatographic peak.	N/A	Analyst/ Laboratory PM	5-369-08 DoD QSM 5.3
	Calibration, Calibration Verification, and Spiking Standards	All analytes	Standards containing both branched and linear isomers must be used when commercially available. PFAS method analytes may consist of both branched and linear isomers, but quantitative standards that contain the linear and branched isomers do not exist for all method analytes. For PFAS that do not have a quantitative branched and linear standard, identify the branched isomers by analyzing a qualitative standard that includes both linear and branched isomers and determine retention times, transitions and transition ion ratios. Quantitate samples by integrating the total response (i.e., accounting for peaks that are identified as linear and branched isomers) and relying on the ICAL that uses the linear isomer quantitative standard.	N/A		

SAP Worksheet #24—Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
LC/MS/MS (PFAS) (cont.)	Sample PFAS Identification	All analytes detected in a sample	The chemical derivation of the ion transitions must be documented. A minimum of two ion transitions (Precursor → quant ion and precursor → confirmation ion) and the ion transitions ratio per analyte are required for confirmation. Exception is made for analytes where two transitions do not exist (PFBA and perfluoropentanoic acid [PFPeA]). Documentation of the primary and confirmation transitions and the ion ratio is required. In-house acceptance criteria for evaluation of ion ratios must be used and must not exceed 50 - 150%. Signal to Noise Ratio (S/N) must be ≥ 10 for all ions used for quantification and must be ≥ 3 for all ions used for confirmation. Quant ion and confirmation ion must be present and must maximize simultaneously (± 2 seconds).	N/A	Analyst/ Laboratory PM	5-369-08 DoD QSM 5.3

SAP Worksheet #24—Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
LC/MS/MS (PFAS) (cont.)	Ion Transitions (Precursor-> Product)	Every field sample, standard, blank, and QC sample.	In order to avoid biasing results high due to known interferences for some transitions, the following transitions must be used for the quantification of the following analytes: PFOA: 413 → 369 PFOS: 499 → 80 PFHxS: 399 → 80 PFBS: 299 → 80 4:2 FTS: 327 → 307 6:2 FTS: 427 → 407 8:2 FTS: 527 → 507 NEtFOSAA: 584 → 419 NMeFOSAA: 570 → 419 If these transitions are not used, the reason must be technically justified and documented (e.g., alternate transition was used due to observed interferences).	N/A	Analyst/ Laboratory PM	5-369-08 DoD QSM 5.3
	Peak Asymmetry	With each calibration	First two eluting peaks in a mid-level calibration standard must have an asymmetry factor between 0.8 and 1.5.	When the asymmetry factor does not pass, perform CA to address the issue. Modification of the standard or extract composition to more aqueous content is not permitted.		

SAP Worksheet #24—Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
LC/MS/MS (PFAS) (cont.)	Calibration, Calibration Verification, and Spiking Standards	All analytes	Standards containing both branched and linear isomers must be used when commercially available. If not available, the total response of the analyte must be integrated (i.e., accounting for peaks that are identified as linear and branched isomers) and quantitated using a calibration curve which includes the linear isomer only for that analyte (e.g., PFOA).	N/A	Analyst/ Laboratory PM	5-369-08 DoD QSM 5.3
	Ion Transitions (Parent-> Product)	Prior to method implementation	The chemical derivation of the ion transitions, both those used for quantitation and those used for confirmation, must be documented. Two transitions and the ion transition ratio per analyte shall be monitored and documented with the exception of PFBA and PFPeA. In order to avoid biasing results high due to known interferences for some transitions, the following transitions must be used for the quantification of the following analytes: PFOA: 413 —› 369 PFOS: 499 —› 80 PFHxS: 399 —› 80 PFBS: 299 —› 80 4:2 FTS: 327 —› 307 6:2 FTS: 427 —› 407 8:2 FTS: 527 —› 507 NEtFOSAA: 584 —› 419 NMeFOSAA: 570 —› 419 If these transitions are not used, the reason must be technically justified and documented (e.g., alternate transition was used due to observed interferences).	N/A		

SAP Worksheet #24—Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
LC/MS/MS (PFAS) (cont.)	Instrument Blank	Following highest calibration point	≤ 1/2 the LOQ	If acceptance criteria are not met after the highest calibration standard, calibration must be performed using a lower concentration for the highest standard until acceptance criteria is met. If acceptance criteria are not met after the highest standard which is not included in the calibration, the standard cannot be used to determine the highest concentration in samples at which carryover does not occur. If acceptance criteria are not met after sample, additional instrument blanks must be analyzed until acceptance criteria are met. Additional samples shall not be analyzed until acceptance criteria are met.	Analyst/ Laboratory PM	5-369-08 DoD QSM 5.3
	Instrument Sensitivity Check (ISC)	Prior to analysis and at least once every 12 hours.	Analyte concentrations must be at LOQ; concentrations must be within ± 30% of their true values.	Correct problem, rerun ISC. If problem persists, repeat ICAL. No samples shall be analyzed until ISC has met acceptance criteria. ISC can serve as the initial daily continuing calibration verification (CCV).		

Notes:

The specifications in this table meet the requirements of DoD QSM 5.3.

NEtFOSAA = n-ethylperfluoro-1-octancesulfonamidoacetic acid

NMeFOSAA = n-methylperfluoro-1-octanesulfonamidoacetic acid

SAP Worksheet #25—Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
LC/MS/MS	AM	PFAS	N/A	6 Months	N/A	N/A	Analyst/supervisor	5-369
Balance	Verification	Weight	N/A	Daily	± 0.02 gram or ± 0.1% of calibration weight used (whichever is greater)	Refer to manufacturer’s instruction manual	Analyst/supervisor	3-160
Balance	Calibration	Weight	N/A	Annually	Per manufacturer	Remove from service, repair, replace	Analyst/supervisor	3-160
Pipette	Verification	Volume	N/A	Daily	± 2% difference from true value, <1% relative standard deviation (n=3)	Remove from service, repair, replace	Analyst/supervisor	3-181
Pipette	Calibration	Volume	N/A	Quarterly	Per manufacturer	Remove from service, repair, replace	Analyst/supervisor	3-181

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SAP Worksheet #26—Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Project Field Team, FTL/CH2M. Field SOPs are in **Appendix B**.
Sample Packaging (Personnel/Organization): Project Field Team, FTL/CH2M. Field SOPs are in **Appendix B**.
Coordination of Shipment (Personnel/Organization): FTL/CH2M
Type of Shipment/Carrier: FedEx Priority Overnight: Samples will be shipped directly to Battelle
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Receiving/Battelle
Sample Custody and Storage (Personnel/Organization): Sample Receiving/Battelle
Sample Preparation (Personnel/Organization): Sample Preparation Staff/Battelle
Sample Determinative Analysis (Personnel/Organization): Battelle
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 60 days from receipt
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 28 days after extraction/digestion
Biological Sample Storage (No. of days from sample collection): N/A
SAMPLE DISPOSAL
Personnel/Organization): Sample Disposal/Battelle
Number of Days from Analysis: 60 days after final sample results are reported, unless there is a hold on a particular sample or previous arrangements have been made

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SAP Worksheet #27—Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

Field sample collection procedures will follow the PFAS SOPs (listed in **Worksheet #21**), and team members will use PFAS free materials while sampling. Samples will be collected by field team members under the supervision of the FTL. As samples are collected, they will be placed into containers and labeled. Labels will be taped to the jar to ensure labels do not separate from the jars. Samples will be cushioned with packaging material and placed into coolers containing enough ice to keep the samples 0 to 6° C (but not frozen; requirements for USEPA 537.1 are less than 10°C for the first 48 hours) until they are received by the laboratory.

The chain-of-custody record will be placed into the cooler in a resealable zip-top plastic bag. Coolers will be taped up and shipped to the laboratories via FedEx overnight, with the air bill number indicated on the chain of custody (to relinquish custody). Upon delivery, the laboratory will log each cooler and report the status of the samples to CH2M.

See **Worksheet #21** for SOPs containing sample custody guidance.

The CH2M field team will ship all environmental samples directly to the laboratory performing the analysis. This will require shipment to Battelle.

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal):

Laboratory custody procedures can be found in the laboratory SOPs, which will be provided upon request.

Sample ID Procedures:

Sample labels will include, at a minimum, client name, site, sample ID, date/time collected, analysis group or method, preservation, and sampler’s initials. The field notes will identify the sample ID with the location and time collected and the parameters requested. The laboratory will assign each field sample a laboratory sample ID based on information in the chain of custody. The laboratory will send sample log-in forms to the CH2M PC to check that sample IDs and parameters are correct.

Chain-of-Custody Procedures:

Chain-of-custody records will include, at a minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information. Sample information will include sample ID. Date/time collected, number and type of containers, preservative information, analysis method, and comments. The chain-of-custody record will link location of the sample from the field notes to the laboratory receipt of the sample. The laboratory will use the sample information to populate the Laboratory Information Management Systems database for each sample.

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SAP Worksheet #28—Laboratory QC Sample Table

Matrix: Soil/Groundwater

Analytical Group: PFAS

Analytical Method/SOP Reference: PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15/SOP 5-369-08

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria
Extracted Internal Standard Analytes	Every field sample, standard, blank, and QC sample.	Added to solid sample prior to extraction. Added to aqueous samples, into the original container, prior to extraction. For aqueous samples prepared by serial dilution instead of SPE, added to final dilution of samples prior to analysis. Extracted Internal Standard Analyte recoveries must be within 50% to 150% of ICAL midpoint standard area or area measured in the initial CCV on days when an ICAL is not performed.	Correct problem. If required, re-extract and reanalyze associated field and QC samples. If recoveries are acceptable for QC samples, but not field samples, the field samples must be re-extracted and analyzed (greater dilution may be needed).Samples may be reextracted and analyzed outside of hold times, as necessary for CA associated with QC failure.		Precision/ Accuracy/Bias	
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ or > 1/10 the amount measured in any sample or > 1/10 regulatory limit, whichever is greater.	Correct problem. If required, re-extract and reanalyze method blank and all QC samples and field samples processed with the contaminated blank. Samples may be reextracted and analyzed outside of hold times, as necessary for CA associated with QC failure. Examine the project specific requirements. Contact the client as to additional measures to be taken.		Bias/ Contamination	

SAP Worksheet #28—Laboratory QC Sample Table (continued)

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria
Laboratory Control Sample	One per preparatory batch.	Blank spiked with all analytes at a concentration ≥LOQ and ≤ the mid-level calibration concentration. DoD QSM 5.3 limits (**Worksheet #15**) If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Correct problem, then re-extract and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available. Samples may be reextracted and analyzed outside of hold times, as necessary for CA associated with QC failure. Examine the project specific requirements. Contact the client as to additional measures to be taken.		Precision/ Accuracy/Bias	
Matrix Spike	One per preparatory batch. Not required for aqueous samples prepared by serial dilution instead of SPE.	Sample spiked with all analytes at a concentration ≥LOQ and ≤ the mid-level calibration concentration. DoD QSM 5.3 limits (See **Worksheet #15** for control limits) If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Examine the project specific requirements. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.		Precision/ Accuracy/Bias	
Matrix Spike Duplicate or Matrix Duplicate (MD)	For MSD: One per preparatory batch. For MD: Each aqueous sample prepared by serial dilution instead of SPE.	For MSD: Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. DoD QSM 5.3 limits (See **Worksheet #15** for control limits). If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. RPD ≤ 30% (between MS and MSD or sample and MD).	Examine the project specific requirements. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.		Precision/ Accuracy/Bias	

SAP Worksheet #28—Laboratory QC Sample Table (continued)

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria
Post Spike Sample	Only applies to aqueous samples prepared by serial dilution instead of SPE that have reported value of "<LOQ" for analyte(s).	Spike all analytes reported as < LOQ into the dilution that the result for that analyte is reported from. The spike must be at the LOQ concentration to be reported for this sample as < LOQ. When analyte concentrations are calculated as < LOQ, the post spike for that analyte must recover within 70 to 130% of its true value.	When analyte concentrations are calculated as < LOQ, and the spike recovery does not meet the acceptance criteria, the sample, sample duplicate, and post spike sample must be reanalyzed at consecutively higher dilutions until the criteria is met.		Bias/ Contamination	
LOD verification	Quarterly for every analyte.	Spike a quality system matrix at concentration 2 to 4x the DL. Must meet 3:1 signal-to-noise ratio, or for data systems that do not measure noise, results must be at least 3 standard deviations greater than the mean method blank concentration.	If verification fails, the DL determination must be repeated and a LOD verification. Alternatively pass two consecutive LOD verification at a higher spike and at the LOD at the higher concentration.		Accuracy	
LOQ verification	Quarterly for every analyte.	Spike a quality system matrix at a concentration equal to or greater than the low point of the calibration curve.	Must meet laboratory-specified precision and bias limits. If LOQ fails, repeat at a higher level until limits are met.		Precision/Bias	

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SAP Worksheet #29—Project Documents and Records Table

Document	Where Maintained
• Field Notebooks • Chain-of-Custody Records • Air Bills • Telephone Logs • Custody Seals • CA Forms • Electronic data deliverables (EDDs) • ID of QC Samples • Meteorological Data from Field • Sampling Instrument Calibration Logs • Sampling Locations and Sampling Plan • Sampling Notes and Drilling Logs • Water Quality Parameter • Sample Receipt, Chain of Custody, and Tracking Records • Standard Traceability Logs • Equipment Calibration Logs • Sample Preparation Logs • Run Logs • Equipment Maintenance, Testing, and Inspection Logs • CA Forms • Reported Field Sample Results • Reported Result for Standards, QC Checks, and QC Samples • Instrument printouts (raw data) for Field Samples, Standards, QC Checks, and QC Samples • Data Package Completeness Checklists • Sample disposal records • Extraction/Clean-up Records • Raw Data (archived per Navy CLEAN contract) • DV Reports • CA Forms • Laboratory QA Plan • Field Performance Audit Checklists	• Field data deliverables (e.g., field notes entries, chains of custody, air bills, and EDDs) will be kept on CH2M’s network server. • Field parameter data will be loaded with the analytical data into the Navy database. • Analytical laboratory hardcopy deliverables and DV reports will be saved on the network server and archived per the Navy CLEAN contract. • Electronic data from the laboratory will be loaded into Navy database. • Following project completion, hardcopy deliverables (e.g., field notes, chains of custody) will be archived at Iron Mountain: Iron Mountain Headquarters 745 Atlantic Avenue Boston, MA 02111 (800) 899-IRON • Following project completion, hardcopy deliverables, including chains of custody and raw data, will be archived at the Washington National Records Center: Washington National Records Center 4205 Suitland Road Suitland, Maryland 20746-8001 301-778-1550

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SAP Worksheet #30—Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID	Analytical Method	Data Package Turnaround Time	Laboratory/ Organization	Backup Laboratory/ Organization[3]
Groundwater	PFAS	Refer to **Worksheet #18**	LC/MS/MS in compliance with DoD QSM 5.3, Table B-15[1]	3 Days/28 Days[2]	Battelle Analytical Services 141 Longwater Drive Suite 202 Norwell, MA 02061 POC: Jonathan Thorn (781) 681-5565	Vista Analytical
Soil				3 Days/28 Days[2]		
Surface Water (if present)				3 Days/28 Days[2]		
Ditch Surface Soil				3 Days/28 Days[2]		

[1] Analytical method is compliant with DoD QSM 5.3 Table B-15 or the most recent version of the DoD QSM for which Battelle has DoD ELAP certification.

[2] A 3-day expedited turn-around time will be required for all groundwater grab samples and select soil samples as detailed in **Worksheet #11**; all other samples will be analyzed at the standard 28-day turn-around time.

[3] If the backup laboratory is used for analysis, applicable SAP worksheets will be submitted to the Navy QAO for review and approval.

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SAP Worksheet #31—Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing CA (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Field Performance Audit	One during sampling event	Internal	CH2M	AM CH2M	FTL CH2M	PM CH2M	PM CH2M
Field Document Review	Daily during sampling event	Internal	CH2M	PM or TM CH2M	FTL CH2M	PM CH2M	PM CH2M

SAP Worksheet #32—Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response (name, title, organization)	Timeframe for Response
Field Performance Audit	Checklist and Written Audit Report	TBD, FTL, CH2M	Within 1 day of audit	Verbal and Memorandum	FTL CH2M	Within 1 day of receipt of CA Form
Field Document Review	Markup copy of field documentation	TBD, FTL, CH2M	Within 1 day of review	Verbal and Memorandum	FTL CH2M	Within 1 day of receipt of markup
Offsite Laboratory Technical Systems Audit	TBD by Perry Johnson Laboratory Accreditation, Inc.	TBD, Battelle	Within 2 months of audit	Memorandum	TBD by Perry Johnson Laboratory Accreditation, Inc.	Within 2 months of receipt of initial notification

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SAP Worksheet #32-1—Laboratory Corrective Action Form

Person initiating Corrective Action (CA): ________________________________ Date: _____________

Description of problem and when identified:

____
____
____
____
____

Cause of problem, if known or suspected:

____
____
____
____
____

Sequence of CA (including date implemented, action planned, and personnel/data affected):

____
____
____
____
____

CA implemented by: _____________________________________ Date: _________________________
CA initially approved by: _____________________________________ Date: _________________________
Follow-up date: _____________________________________
Final CA approved by: _____________________________________ Date: _________________________

Information copies to:

Anita Dodson, CH2M Navy CLEAN Program Chemist

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SAP Worksheet #32-2—Field Performance Audit Checklist

Project Responsibilities

Project No.: ________________ Date: ________________

Project Location: ________________ Signature: ________________

Team Members

Yes No 1) Is the approved work plan being followed?
Comments ________________

____

Yes No 2) Was a briefing held for project participants?
Comments ________________

____

Yes No 3) Were additional instructions given to project participants?
Comments ________________

____

Sample Collection

Yes No 1) Is there a written list of sampling locations and descriptions?
Comments ________________

____

Yes No 2) Are samples collected as stated in the Master SOPs?
Comments ________________

____

Yes No 3) Are samples collected in the type of containers specified in the work plan?
Comments ________________

____

Yes No 4) Are samples preserved as specified in the work plan?
Comments ________________

____

Yes No 5) Are the number, frequency, and type of samples collected as specified in the work plan?
Comments ________________

____

SAP Worksheet #32-2—Field Performance Audit Checklist (continued)

Yes No 6) Are QA checks performed as specified in the work plan?
Comments ______________________________
____

Yes No 7) Are photographs taken and documented?
Comments ______________________________
____

Document Control

Yes No 1) Have any accountable documents been lost?
Comments ______________________________
____

Yes No 2) Have any accountable documents been voided?
Comments ______________________________
____

Yes No 3) Have any accountable documents been disposed of?
Comments ______________________________
____

Yes No 4) Are the samples identified with sample tags?
Comments ______________________________
____

Yes No 5) Are blank and duplicate samples properly identified?
Comments ______________________________
____

Yes No 6) Are samples listed on a chain-of-custody record?
Comments ______________________________
____

Yes No 7) Is chain of custody documented and maintained?
Comments ______________________________
____

SAP Worksheet #33—QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, and so forth)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Field Audit Report	One during sampling event	TBD	PM CH2M	Included in project files
QA Management Report/Technical Memorandum	Once results have been assessed for data usability	To be submitted with Final RI Report	CH2M PC	NAVFAC Northwest RPM and will be posted in project file

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SAP Worksheet #34-36—Data Verification and Validation (Steps I and IIa/IIb) Process Table

Data Review Input	Description[1]	Responsible for Verification or Validation	Step I/IIa/ IIb[2]	Internal/ External[3]
Field Notebooks	Field notebooks will be reviewed internally and placed into the project file for archival at project closeout.	FTL/CH2M	Step I	Internal
Chains of Custody and Shipping Forms	Chain-of-custody forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the chain-of-custody forms will be initialed by the reviewer, a copy of the chain-of-custody forms retained in the site file, and the original and remaining copies taped inside the cooler for shipment. Chain-of-custody forms will also be reviewed for adherence to the SAP by the PC.	FTL/CH2M PC/CH2M	Step I	Internal and External
Sample Condition upon Receipt	Any discrepancies and missing or broken containers will be communicated to the PC in the form of laboratory logins.	PC/CH2M	Step I	External
Documentation of Laboratory Method Deviations	Laboratory method deviations not included in the lab SOP and therefore not included in the DoD ELAP accreditation letter are not permitted for this project work. Any laboratory method deviation not covered under the current DoD ELAP accreditation letter will be resubmitted to the accrediting body for review and approval prior to sample collection and resubmitted to Navy QAO for review.	PC/CH2M	Step I	External
EDDs	EDDs will be compared against hardcopy laboratory results (10 percent check). If errors are found during the 10% check, an additional 25% of the EDDs will be checked against hardcopy laboratory results.	PC/CH2M	Step I	External
Case Narrative	Case narratives will be reviewed by the DV during the DV process. This is verification that case narratives were generated and applicable to the data packages.	DV/EDS	Step I	External
Laboratory Data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	Laboratory QAO	Step I	Internal
Laboratory Data	The data will be verified for completeness by the PC. To ensure completeness, EDDs will be compared to the SAP. This is a verification that all samples were included in the laboratory data and that correct analyte lists were reported.	PC/CH2M	Step I	External
Audit Reports	Upon report completion, a copy of all audit reports will be placed in the site file. If CAs are required, a copy of the documented CA taken will be attached to the appropriate audit report in the QA site file. Periodically, and at the completion of site work, site file audit reports and CA forms will be reviewed internally to ensure that all appropriate CAs have been taken and that CA reports are attached. If CAs have not been taken, the site manager will be notified to ensure action is taken.	PM/CH2M PC/CH2M	Step I	Internal

SAP Worksheet #34-36—Data Verification and Validation (Steps I and IIa/IIb) Process Table (continued)

Data Review Input	Description[1]	Responsible for Verification or Validation	Step I/IIa/ IIb[2]	Internal/ External[3]
CA Reports	CA reports will be reviewed by the PC or PM and placed into the project file for archival at project closeout.	PM/CH2M PC/CH2M	Step I	External
Laboratory Methods	During the pre-validation check, ensure that the laboratory analyzed samples using the correct methods specified in the SAP. If methods other than those specified in the SAP were used, the reason will be determined and documented.	PC/CH2M	Step IIa	External
Target Compound List and Target Analyte list	During the pre-validation check, ensure that the laboratory reported all analytes from each analysis group in accordance with **Worksheet #15**. If the target compound list is not correct, then it must be corrected prior to sending the data for validation. Once the checks are complete, the PM is notified via email	PC/CH2M	Step IIa	External
Laboratory Limits (DL/LOD/LOQ)	During the pre-validation check, the laboratory limits (DL/LOD/LOQ) will be compared to those listed in the project SAP. If limits were not met, the laboratory will be contacted and asked to provide an explanation, which will then be discussed in the associated project report. Oftentimes, the cause for minor laboratory limit deviation from those presented in the SAP is a result of the quarterly update of the laboratory LOD.	PC/CH2M	Step IIb	External
Laboratory SOPs	Ensure that approved analytical laboratory SOPs were followed. Any discrepancies will be discussed first in the data validation narrative and will be included in the associated project report.	Laboratory QAO	Step I	Internal
Sample Chronology	Holding times from collection to extraction or analysis and from extraction to analysis will be considered during the data validation process.	DV/EDS	Step IIa and IIb	External
Raw Data	Ten percent review of raw data to confirm laboratory calculations. For a recalculated result, the DV attempts to recreate the reported numerical value. The laboratory is asked for clarification if a discrepancy is identified that cannot reasonably be attributed to rounding. In general, this is outside of a 5 percent difference. Conduct a 10 percent review of laboratory calculations. For a recalculated result, the DV attempts to recreate the reported numerical value. The laboratory is asked for clarification if a discrepancy is found, which cannot be reasonably attributed to rounding. If errors are found during the 10 percent check, an additional 20 percent of the raw data will be checked to confirm calculations. Any discrepancies will be addressed in the data validation narrative.	DV/EDS	Step IIa	External
Onsite Screening	All nonanalytical field data will be reviewed against SAP requirements for completeness and accuracy based on the field calibration records. Screening data will be included in the project report.	FTL/CH2M	Step IIb	Internal

SAP Worksheet #34-36—Data Verification and Validation (Steps I and IIa/IIb) Process Table (continued)

Data Review Input	Description[1]	Responsible for Verification or Validation	Step I/IIa/ IIb[2]	Internal/ External[3]
Documentation of Method QC Results	Establish that all required QC samples were run and met limits. Any deviations will be reported in the data validation narrative.	DV/EDS	Step IIa	External
Documentation of Field QC Sample Results	Establish that all required QC samples were run and met limits and discuss QC sampling in the associated project report.	PC/CH2M	Step IIa	Internal
DoD ELAP Evaluation	Ensure that each laboratory is DoD ELAP-certified for the analyses they are to perform. Ensure evaluation timeframe does not expire.	PC/CH2M	Step I	External
Analytical data for PFAS analyzed for soil, groundwater and surface water[4]	Analytical methods and laboratory SOPs as presented in this SAP will be used to evaluate compliance against QA/QC criteria. Should adherence to QA/QC criteria yield deficiencies, data may be qualified. Data may be qualified if QA/QC exceedances have occurred. Guidance and qualifiers from *United States Department of Defense General Data Validation Guidelines* (DoD, 2019b), *Data Validation Guidelines Module 3: Data Validation Procedure for Per- and Polyfluoroalkyl substances Analysis by QSM Table B-15* (DoD, 2020), and *Per- and Polyfluoroalkyl Substances (PFAS): Reviewing Analytical Methods for Environmental Samples* Technical brief (USEPA, 2019) will be applied as appropriate. If specific guidance is not given for these methods in the General Data Validation Guidelines, the DV may adapt the guidance from *USEPA National Functional Guidelines for Superfund Organic Methods Data Review* (USEPA, 2017).	DV/EDS	Step IIa and IIb	External

Notes:

[1] Should CH2M find discrepancies during the verification or validation procedures above, an email documenting the issue will be circulated to the internal project team, and a Corrections to File Memo will be prepared identifying the issues and the CA needed. This memo will be sent to the laboratory, or applicable party, and maintained in the project file.

[2] Verification (Step I) is a completeness check that is performed before the data review process continues to determine whether the required information (complete data package) is available for further review. Validation (Step IIa) is a review that the data generated is in compliance with analytical methods, procedures, and contracts. Validation (Step IIb) is a comparison of generated data against MPC in the SAP (both sampling and analytical).

[3] Internal or external is in relation to the data generator.

[4] Stage 4 data validation will be performed on 10 percent of all definitive analyses, which will include recalculated results from the raw data to verify calculations. The remaining (90 percent) of the definitive data will have Stage 2B data validation performed.

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SAP Worksheet #37—Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

- Nondetected site chemicals will be evaluated to ensure that project-required PQLs in **Worksheet #15** were achieved. If PQLs were achieved and the verification and validation steps yielded acceptable data, then the data are considered usable.
- During verification and validation steps, data may be qualified as estimated with the following qualifiers: J or UJ. The qualifiers represent minor QC deficiencies, which will not affect the usability of the data. When major QC deficiencies are encountered, the DV will qualify data with an X as recommended for rejection, and in most cases, data qualified with an X are not considered usable for project decisions. The data validation narrative will be reviewed along with the data quality objectives, and the X qualifier may be replaced with an R qualifier as rejected data.
  - J = Analyte present. Reported value may or may not be accurate or precise.
  - J+ = Analyte present. Reported value is estimated and may be biased high.
  - J- = Analyte present. Reported value is estimated and may be biased low.
  - UJ = Analyte not detected. Associated nondetect value may be inaccurate or imprecise.
  - R = Rejected result, team discussion. Result not reliable.
  - X = Result recommended for rejection by the validator. Result not reliable.
- The following additional qualifiers may be given by the DV:
  - N = Tentative ID. Consider Present. Special methods may be needed to confirm the chemical's presence or absence in future sampling efforts.
  - NJ = Qualitative ID questionable because of poor resolution. Chemical presumptively present at approximate quantity.
  - U = Not Detected.
- Analytical data will be checked to ensure the values and any qualifiers are appropriately transferred to the electronic database. The checks include comparison of hardcopy data and qualifiers to the EDD. Once the data have been uploaded into the electronic database, another check will be performed to ensure that all results were loaded accurately.
- Field and laboratory precision will be compared as RPD between the two results.
- Deviations from the SAP will be reviewed to assess whether CA is warranted and to assess impacts on achievement of project objectives.

Describe the evaluative procedures used to assess overall measurement error associated with the project:

- To assess whether enough acceptable data are available for decision making, the data will be compared to the 95 percent completeness goal and reconciled with MPC following validation and review of data quality indicators.
- If significant biases are detected with laboratory QA/QC samples, they will be evaluated to assess impacts on decision making. Low biases will be described in greater detail because they represent a possible inability to detect compounds that may be present at the site.
- If significant differences are noted between laboratory and field precision, the cause will be further evaluated to assess impacts on decision making.

SAP Worksheet #37—Usability Assessment (continued)

Describe the documentation that will be generated during the usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

The following will be prepared by CH2M and submitted to NAVFAC Northwest for review for use in making decisions on the path forward for the site:

- Data tables will be produced to reflect detected and nondetected site analytes. Data qualifiers will be presented in the tables and discussed in the data quality evaluation, and overall results will be provided in the RI Report.

Identify the personnel responsible for performing the usability assessment:

The CH2M team, including the PM and PC, will review the data and present a usability assessment to NAVFAC Northwest for review and approval.

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Figures

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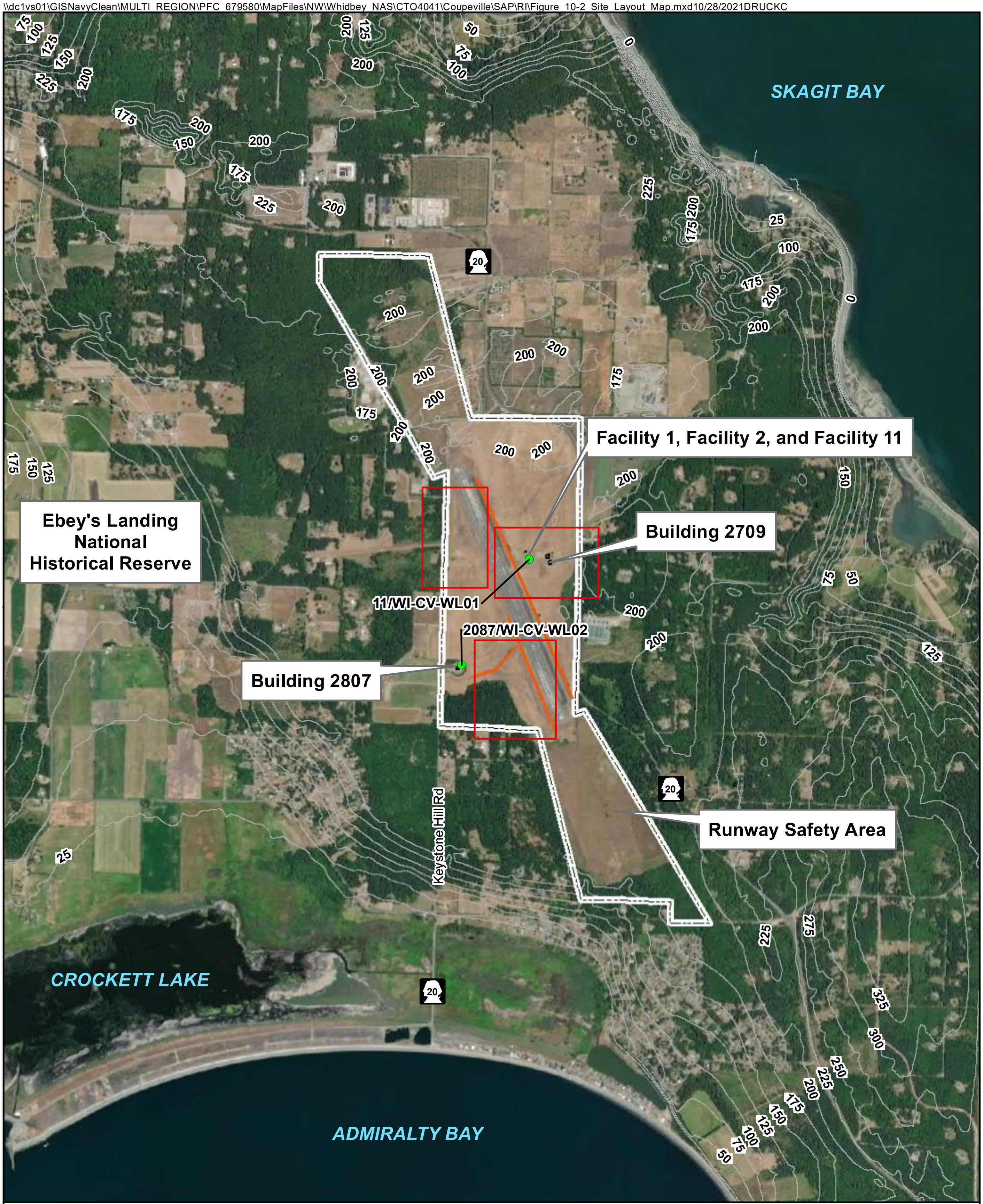
Figure 10-1
Base Location Map
Naval Air Station Whidbey Island
Coupeville, Washington

\\dc1vs01\GISNavyClean\MULTI_REGION\PFC_679580\MapFiles\NW\Whidbey_NAS\CTO4041\Coupeville\SAP\RI\Figure_10-2_Site_Layout_Map.mxd10/28/2021DRUCKC



Legend

- ● Base Supply Well
- Drainage Ditch (approximate location)
- Elevation Contour (25 ft Interval)
- 🟥 Investigation Areas
- ☐ Building/Structure Location
- ⬚ Base Boundary

N

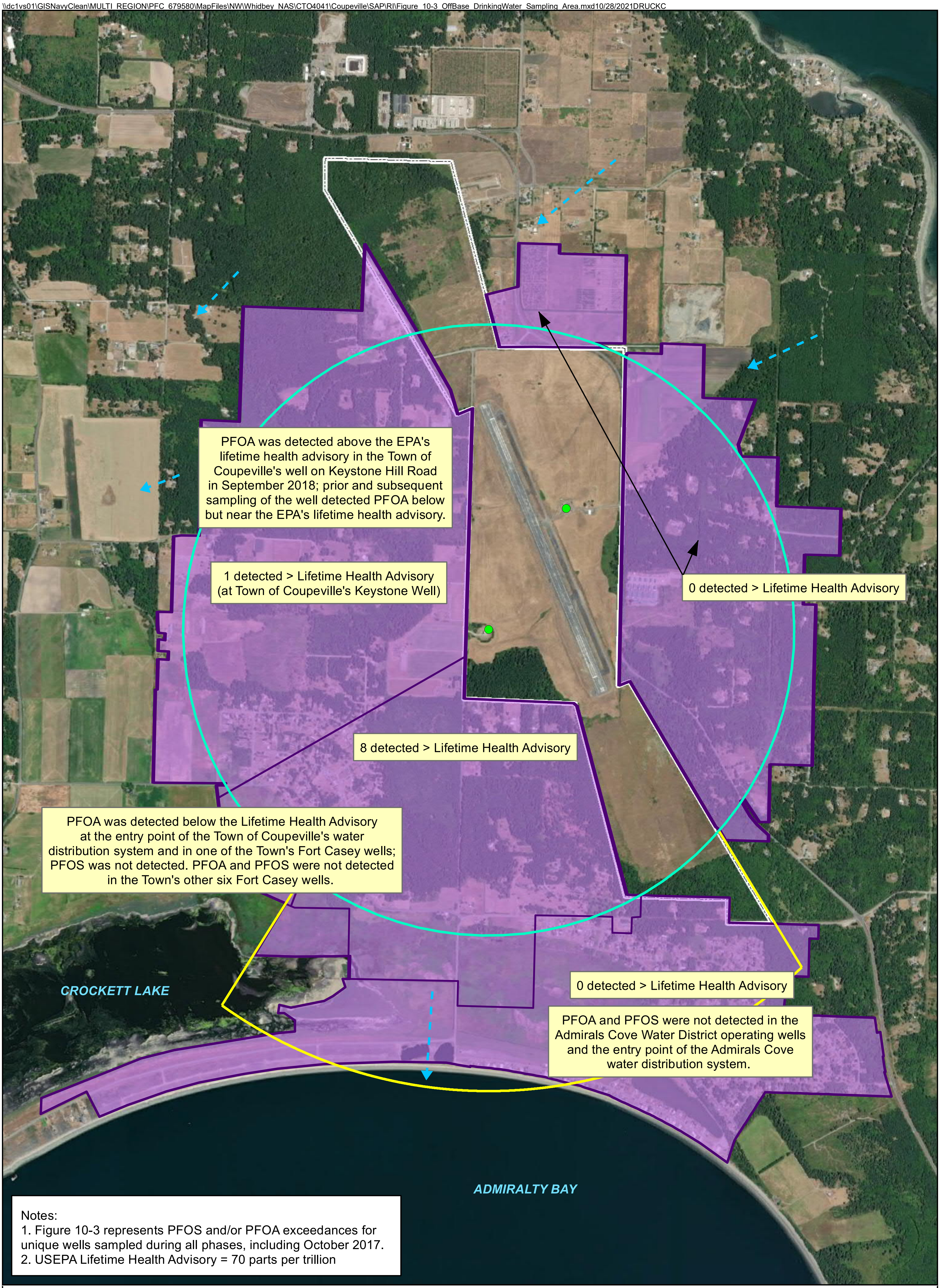
0 0.25 0.5 Mile

1 inch = 0.5 mile

Imagery Source: Esri

Figure 10-2
Site Layout Map
Outlying Landing Field Coupeville
Coupeville, Washington

\\dc1vs01\GISNavyClean\MULTI_REGION\PFC_679580\MapFiles\NW\Whidbey_NAS\CTO4041\Coupeville\SAP\RI\Figure_10-3_OffBase_DrinkingWater_Sampling_Area.mxd10/28/2021DRUCKC



PFOA was detected above the EPA's lifetime health advisory in the Town of Coupeville's well on Keystone Hill Road in September 2018; prior and subsequent sampling of the well detected PFOA below but near the EPA's lifetime health advisory.

1 detected > Lifetime Health Advisory (at Town of Coupeville's Keystone Well)

0 detected > Lifetime Health Advisory

8 detected > Lifetime Health Advisory

PFOA was detected below the Lifetime Health Advisory at the entry point of the Town of Coupeville's water distribution system and in one of the Town's Fort Casey wells; PFOS was not detected. PFOA and PFOS were not detected in the Town's other six Fort Casey wells.

0 detected > Lifetime Health Advisory

PFOA and PFOS were not detected in the Admirals Cove Water District operating wells and the entry point of the Admirals Cove water distribution system.

Notes:
1. Figure 10-3 represents PFOS and/or PFOA exceedances for unique wells sampled during all phases, including October 2017.
2. USEPA Lifetime Health Advisory = 70 parts per trillion

Legend

- ● Base Supply Well
- ▭ 1-mile zone
- ▨ Phases 1 and 2 and October 2017 Combined Sampling Area
- ― Half-mile Step-out Downgradient
- ⇢ Approximate Groundwater Flow Direction
- ⬚ Base Boundary

N

0 0.15 0.3 Miles

1 inch = 0.3 miles

Imagery Source: Esri

Figure 10-3
Off-Base Drinking Water Sampling Area and Results
Outlying Landing Field Coupeville
Coupeville, Washington

NAVFAC
Naval Facilities Engineering Systems Command

Sampling and Analysis Plan
Per- and Polyfluoroalkyl Substances Remedial Investigation
Outlying Landing Field Coupeville
Naval Air Station Whidbey Island
Oak Harbor, Washington

NOTIFICATION: FIGURE 10-4 CONTAINS SENSITIVE BUT UNCLASSIFIED INFORMATION WHICH IS PROTECTED BY THE FREEDOM OF INFORMATION ACT

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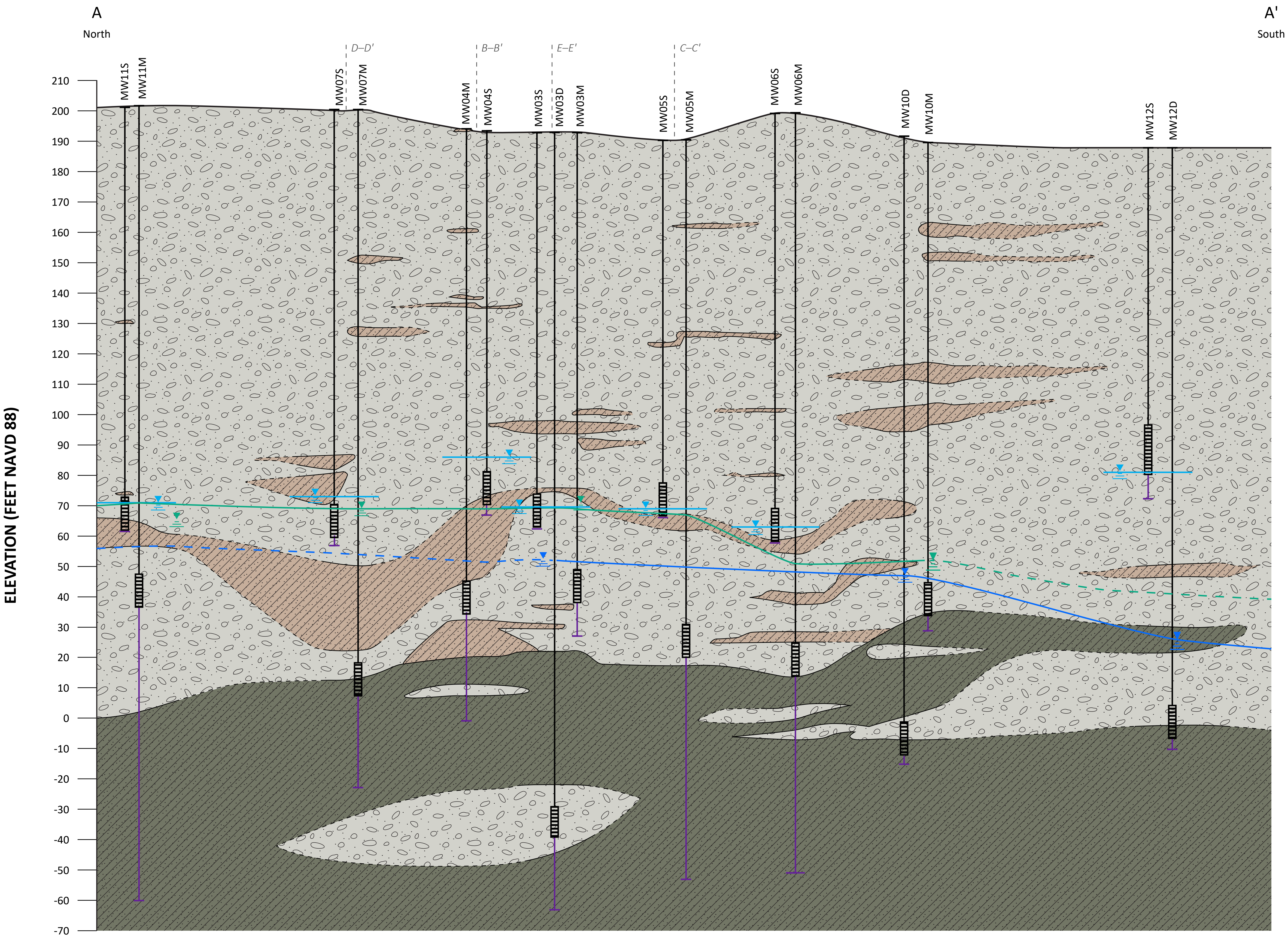


LEGEND

- ▨ Sand and Gravel, Some Silt and Clay
- ▨ Clay and Silt
- ▨ Clay/Silt, Claystone, Some Organics and Peat
- ▼ Water Table Shallow-Screened Interval (April 2020)
- ▼ Potentiometric Surface Intermediate-Screened Interval (April 2020)
- ▼ Potentiometric Surface Deep-Screened Interval (April 2020)

Wells

- MW00X ← Boring Identification Number
- ← Permanent Monitoring Well
- ← Well Screen
- ← Portion of Boring Completed for Lithology Only

0 .25 .5
Approximate horizontal scale in miles

Notes:

1. Cross section is vertically exaggerated for visualization purposes.
2. Cross section is conceptual in nature; predominant soil type was generally used for stratigraphic interpretation, however, in some cases similar units were combined for the purpose of simplification.
3. Geologic contacts are dashed where inferred.
4. Shallow water elevations are presumed to be noncontinuous, perched water tables.
5. Some wells are associated with other cross-sections. Intersections of this cross-section with other cross-sections are noted above the well labels as applicable.
6. NAVD 88 = North American Vertical Datum of 1988

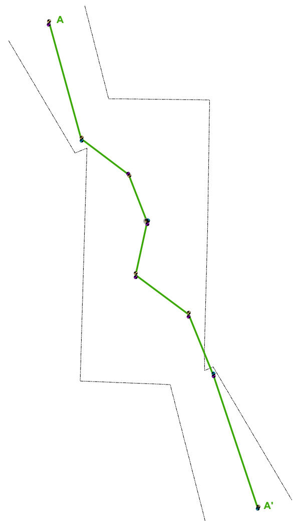
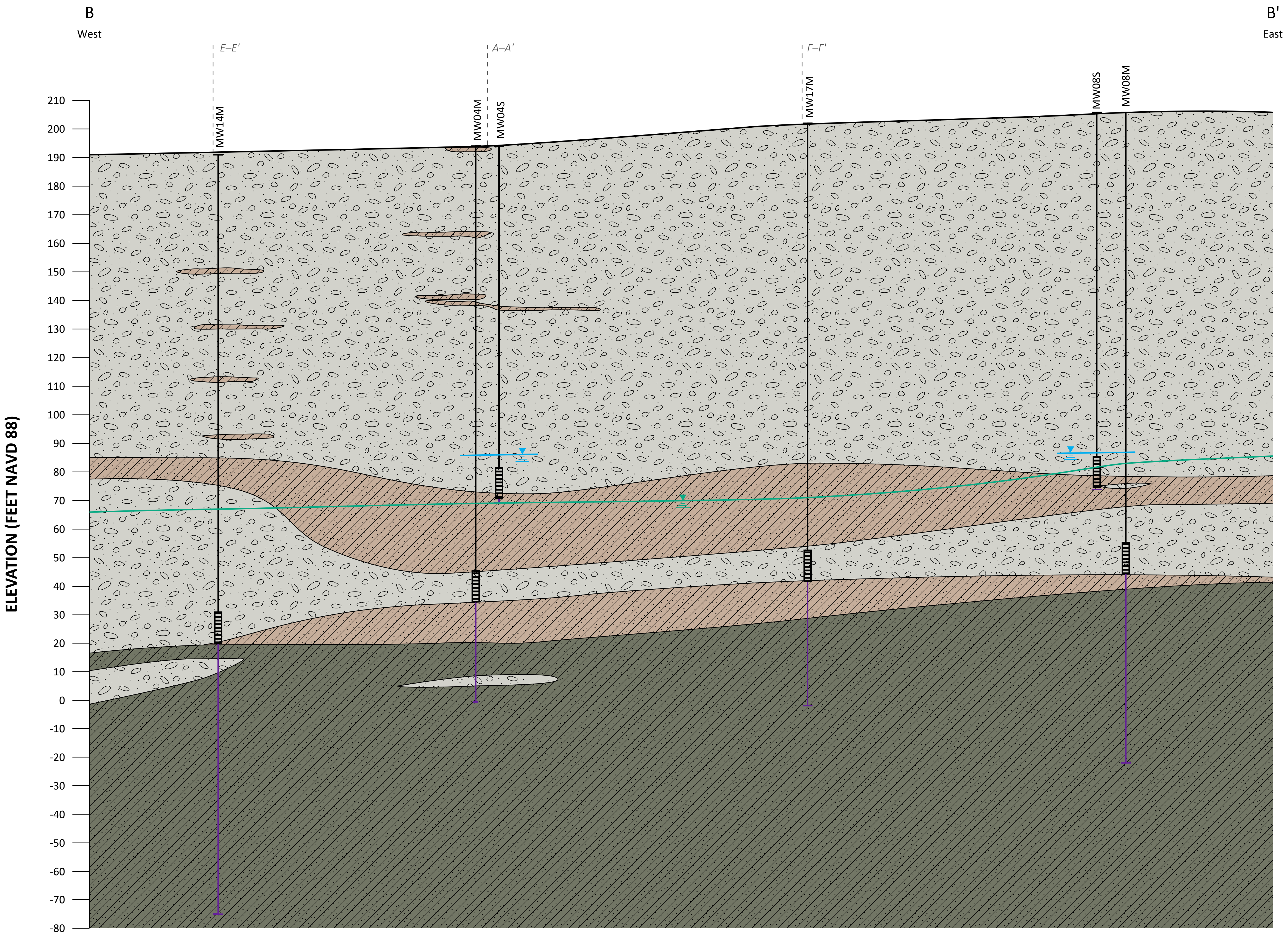


Figure 10-5
Geologic Cross Section A–A'
Outlying Landing Field Coupeville
Coupeville, Washington



LEGEND

- ▨ Sand and Gravel, Some Silt and Clay
- ▨ Clay and Silt
- ▨ Clay/Silt, Claystone, Some Organics and Peat
- ▼ Water Table Shallow-Screened Interval (April 2020)
- ▼ Potentiometric Surface Intermediate-Screened Interval (April 2020)

Wells

MW00X ← Boring Identification Number
← Permanent Monitoring Well
← Well Screen
← Portion of Boring Completed for Lithology Only

0 .0625 .125
Approximate horizontal scale in miles

Notes:

1. Cross section is vertically exaggerated for visualization purposes.
2. Cross section is conceptual in nature; predominant soil type was generally used for stratigraphic interpretation, however, in some cases similar units were combined for the purpose of simplification.
3. Geologic contacts are dashed where inferred.
4. Shallow water elevations are presumed to be noncontinuous, perched water tables.
5. Some wells are associated with other cross-sections. Intersections of this cross-section with other cross-sections are noted above the well labels as applicable.
6. NAVD 88 = North American Vertical Datum of 1988

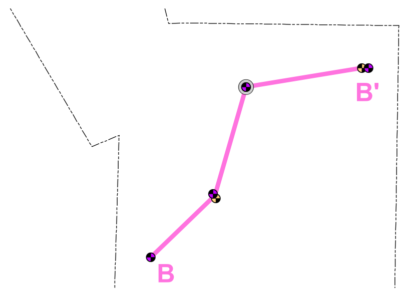
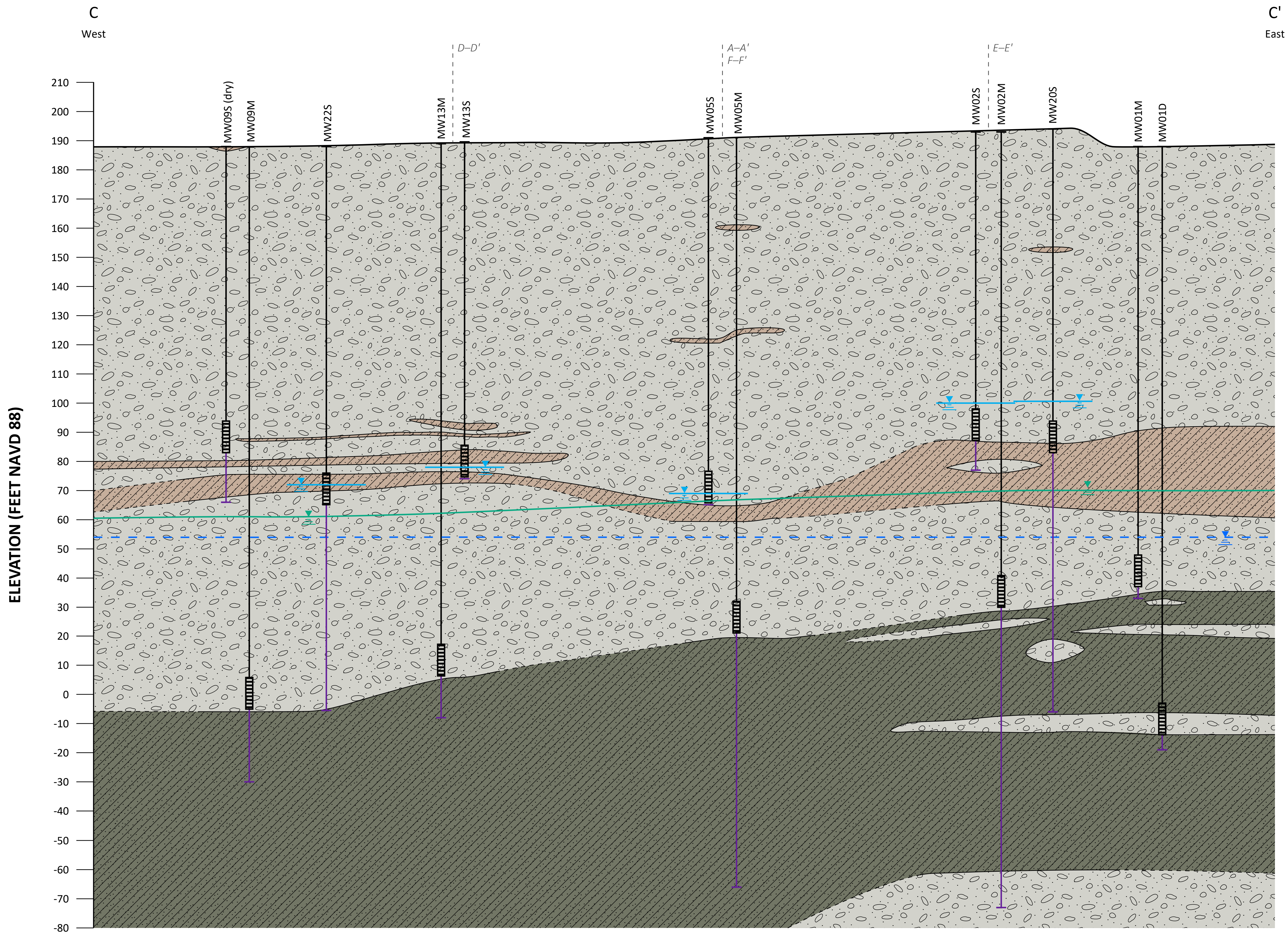


Figure 10-6
Geologic Cross Section B–B'
Outlying Landing Field Coupeville
Coupeville, Washington



LEGEND

▨ Sand and Gravel, Some Silt and Clay

▨ Clay and Silt

▨ Clay/Silt, Claystone, Some Organics and Peat

▼ Water Table Shallow-Screened Interval (April 2020)

▼ Potentiometric Surface Intermediate-Screened Interval (April 2020)

▼ Potentiometric Surface Deep-Screened Interval (April 2020)

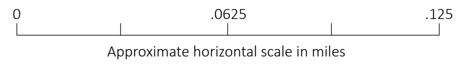
Wells

MW00X ← Boring Identification Number

← Permanent Monitoring Well

← Well Screen

← Portion of Boring Completed for Lithology Only



Notes:

1. Cross section is vertically exaggerated for visualization purposes.
2. Cross section is conceptual in nature; predominant soil type was generally used for stratigraphic interpretation, however, in some cases similar units were combined for the purpose of simplification.
3. Geologic contacts are dashed where inferred.
4. Shallow water elevations are presumed to be noncontinuous, perched water tables.
5. Some wells are associated with other cross-sections. Intersections of this cross-section with other cross-sections are noted above the well labels as applicable.
6. NAVD 88 = North American Vertical Datum of 1988

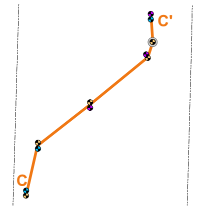


Figure 10-7

Geologic Cross Section C–C'

Outlying Landing Field Coupeville

Coupeville, Washington

Naval Facilities Engineering Systems Command

Sampling and Analysis Plan
Per- and Polyfluoroalkyl Substances Remedial Investigation
Outlying Landing Field Coupeville
Naval Air Station Whidbey Island
Oak Harbor, Washington

NOTIFICATION: FIGURE 10-8 CONTAINS SENSITIVE BUT UNCLASSIFIED INFORMATION WHICH IS PROTECTED BY THE FREEDOM OF INFORMATION ACT

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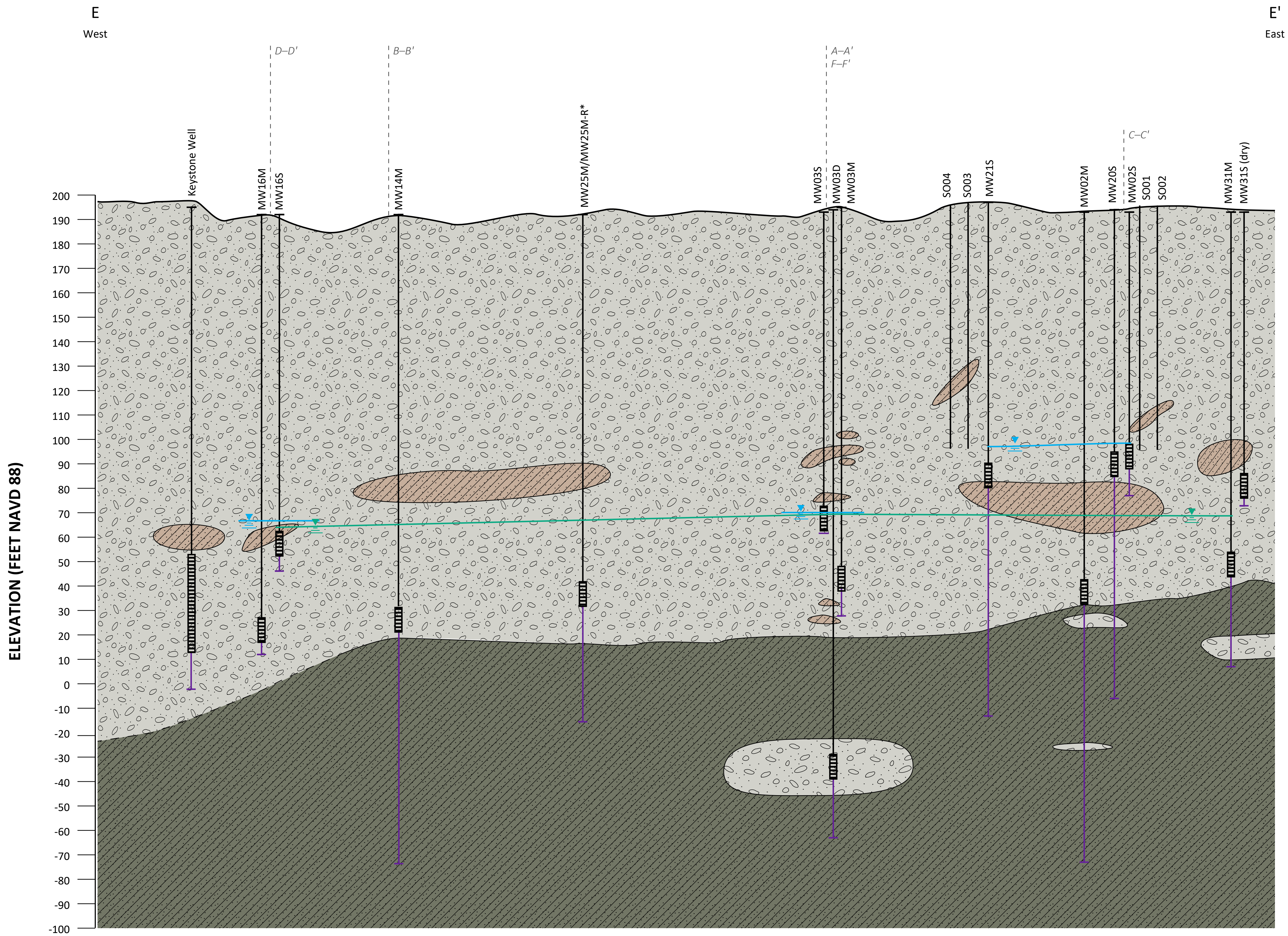


LEGEND

▨ Sand and Gravel, Some Silt and Clay

▨ Clay and Silt

▨ Clay/Silt, Claystone, Some Organics and Peat

▼ Water Table Shallow-Screened Interval (April 2020)

▼ Potentiometric Surface Intermediate-Screened Interval (April 2020)

Wells

MW00X ← Boring Identification Number

← Permanent Monitoring Well

← Well Screen

← Portion of Boring Completed for Lithology Only

0 .0625 .125

Approximate horizontal scale in miles

Notes:

* Well WI-CV-MW25M-R drilled as replacement well for WI-CV-MW25M, which was damaged following construction. Well WI-CV-MW25M-R was advanced to the screen depth of 162 ft bgs; however the soil boring it replaced was advanced to 208 ft bgs. Known lithology and collection of groundwater grab samples is depicted to this depth for the collocated borings.

1. Cross section is vertically exaggerated for visualization purposes.

2. Cross section is conceptual in nature; predominant soil type was generally used for stratigraphic interpretation, however, in some cases similar units were combined for the purpose of simplification.

3. Geologic contacts are dashed where inferred.

4. Shallow water elevations are presumed to be noncontinuous, perched water tables.

5. Some wells are associated with other cross-sections. Intersections of this cross-section with other cross-sections are noted above the well labels as applicable.

6. NAVD 88 = North American Vertical Datum of 1988

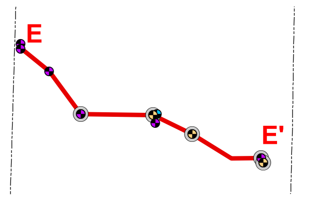
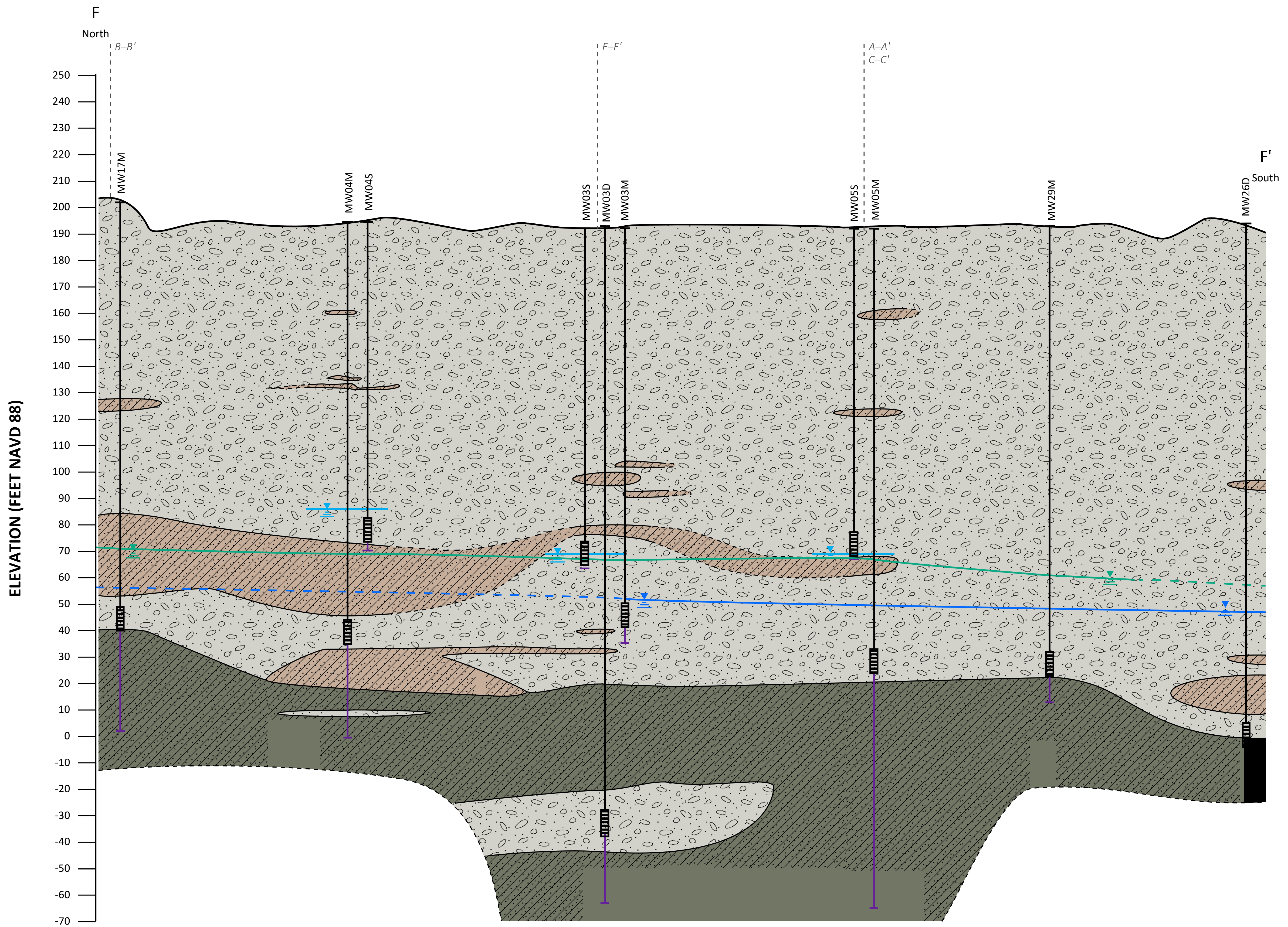


Figure 10-9

Geologic Cross Section E–E'

Outlying Landing Field Coupeville

Coupeville, Washington



LEGEND

- ░ Sand and Gravel, Some Silt and Clay
- ▨ Clay and Silt
- ▨ Clay/Silt, Claystone, Some Organics and Peat
- ▼ Water Table Shallow-Screened Interval (April 2020)
- ▼ Potentiometric Surface Intermediate-Screened Interval (April 2020)
- ▼ Potentiometric Surface Deep-Screened Interval (April 2020)

Wells

- MW00X ← Boring Identification Number
- ← Permanent Monitoring Well
- ← Well Screen
- ← Portion of Boring Completed for Lithology Only

0 .125 .25

Approximate horizontal scale in miles

Notes:

1. Cross section is vertically exaggerated for visualization purposes.
2. Cross section is conceptual in nature; predominant soil type was generally used for stratigraphic interpretation, however, in some cases similar units were combined for the purpose of simplification.
3. Geologic contacts are dashed where inferred.
4. Shallow water elevations are presumed to be noncontinuous, perched water tables.
5. Some wells are associated with other cross-sections. Intersections of this cross-section with other cross-sections are noted above the well labels as applicable.
6. NAVD 88 = North American Vertical Datum of 1988

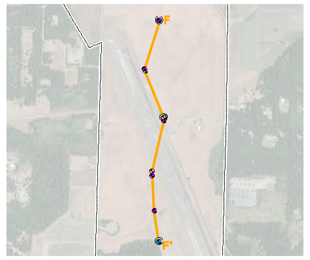
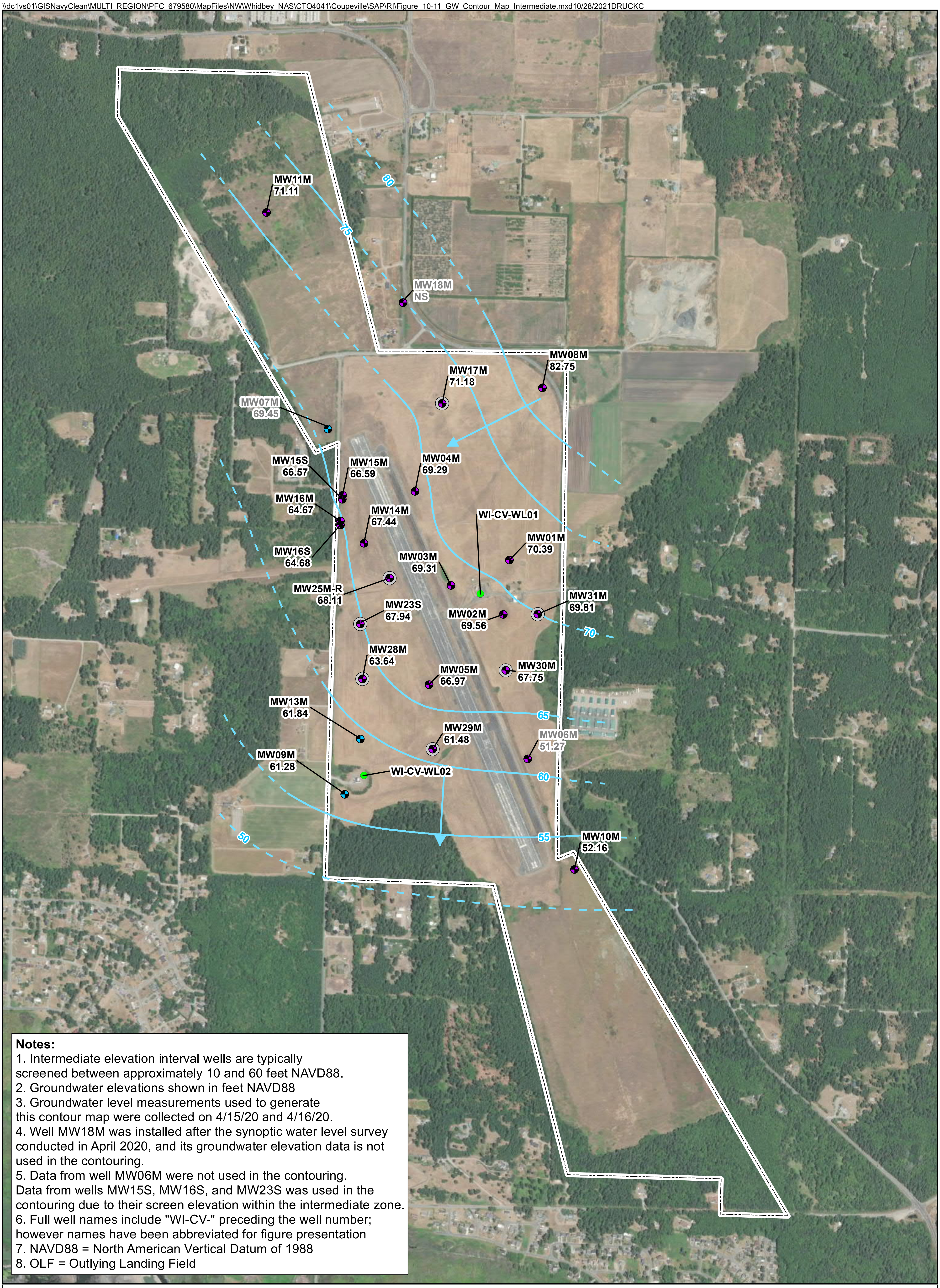


Figure 10-10
Geologic Cross Section F–F'
Outlying Landing Field Coupeville
Coupeville, Washington

\\dc1vs01\GISNavyClean\MULTI_REGION\PFC_679580\MapFiles\NW\Whidbey_NAS\CTO4041\Coupeville\SAP\RI\Figure_10-11_GW_Contour_Map_Intermediate.mxd10/28/2021DRUCKC



Notes:

1. Intermediate elevation interval wells are typically screened between approximately 10 and 60 feet NAVD88.
2. Groundwater elevations shown in feet NAVD88
3. Groundwater level measurements used to generate this contour map were collected on 4/15/20 and 4/16/20.
4. Well MW18M was installed after the synoptic water level survey conducted in April 2020, and its groundwater elevation data is not used in the contouring.
5. Data from well MW06M were not used in the contouring. Data from wells MW15S, MW16S, and MW23S was used in the contouring due to their screen elevation within the intermediate zone.
6. Full well names include "WI-CV-" preceding the well number; however names have been abbreviated for figure presentation
7. NAVD88 = North American Vertical Datum of 1988
8. OLF = Outlying Landing Field

Legend

- 5-foot Contour Interval (dashed where inferred)
- ➤ Direction of Intermediate-Screened Interval Groundwater Flow
- ● Middle Elevation Interval Monitoring Well
- ● Deep Elevation Interval Monitoring Well
- ● Base Supply Well
- ○ Supplemental Site Investigation Monitoring Well Installation
- ☐ Base Boundary

N

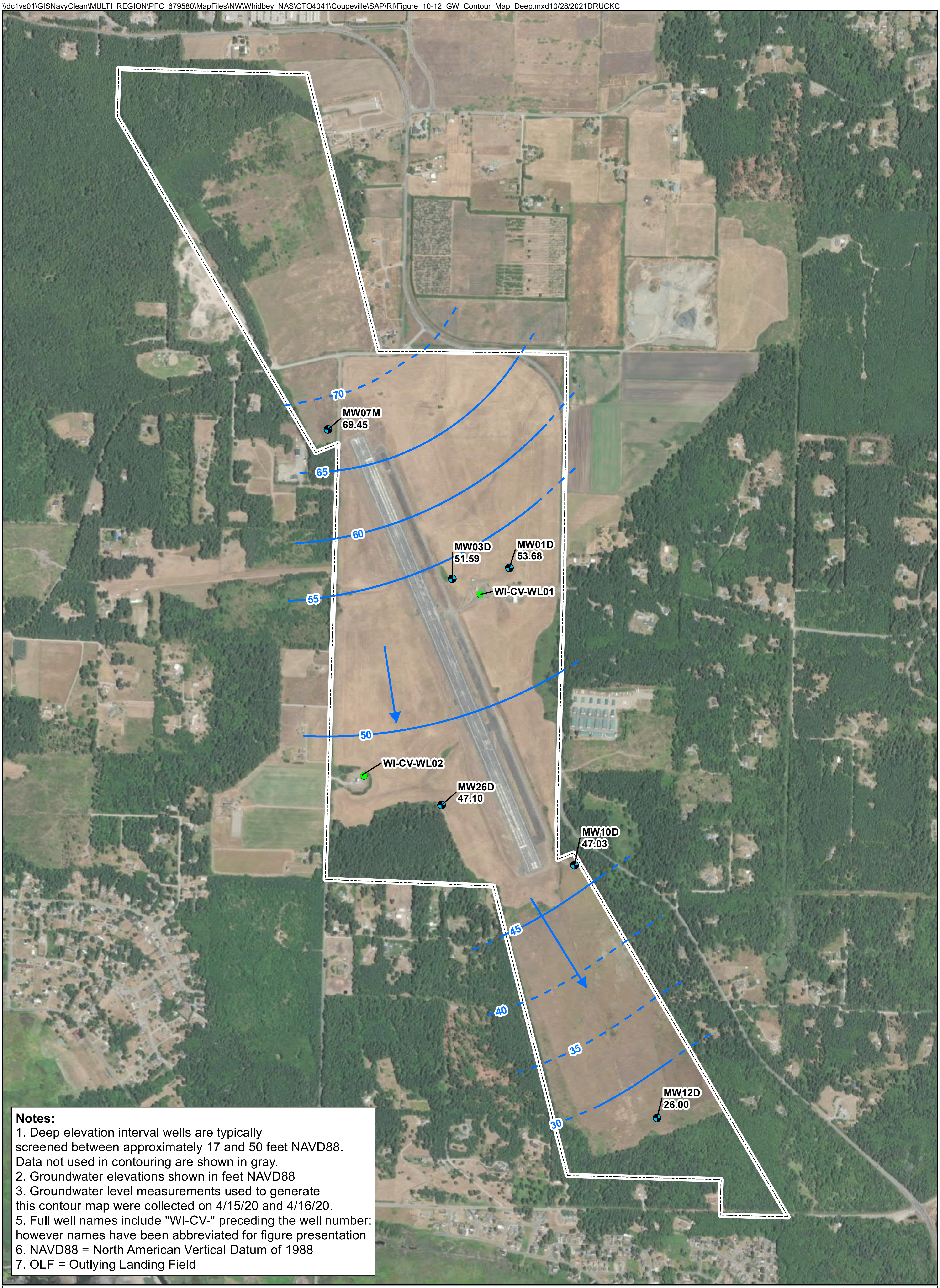
0 0.1 0.2 Miles

1 inch = 0.2 mile

Imagery Source: Esri

Figure 10-11
Groundwater Elevation Contour Map
Intermediate Elevation Interval
Outlying Landing Field Coupeville
Coupeville, Washington

\\dc1vs01\GISNavyClean\MULTI_REGION\PFC_679580\MapFiles\NW\Whidbey_NAS\CTO4041\Coupeville\SAP\RI\Figure_10-12_GW_Contour_Map_Deep.mxd10/28/2021DRUCKC



Notes:
1. Deep elevation interval wells are typically screened between approximately 17 and 50 feet NAVD88. Data not used in contouring are shown in gray.
2. Groundwater elevations shown in feet NAVD88
3. Groundwater level measurements used to generate this contour map were collected on 4/15/20 and 4/16/20.
5. Full well names include "WI-CV-" preceding the well number; however names have been abbreviated for figure presentation
6. NAVD88 = North American Vertical Datum of 1988
7. OLF = Outlying Landing Field

Legend

— 5-foot Contour Interval (dashed where inferred)

→ Direction of Deep-Screened Interval Groundwater Flow

● Deep Elevation Interval Monitoring Well

● Base Supply Well

○ Supplemental Site Investigation Monitoring Well Installation

⬚ Base Boundary

N

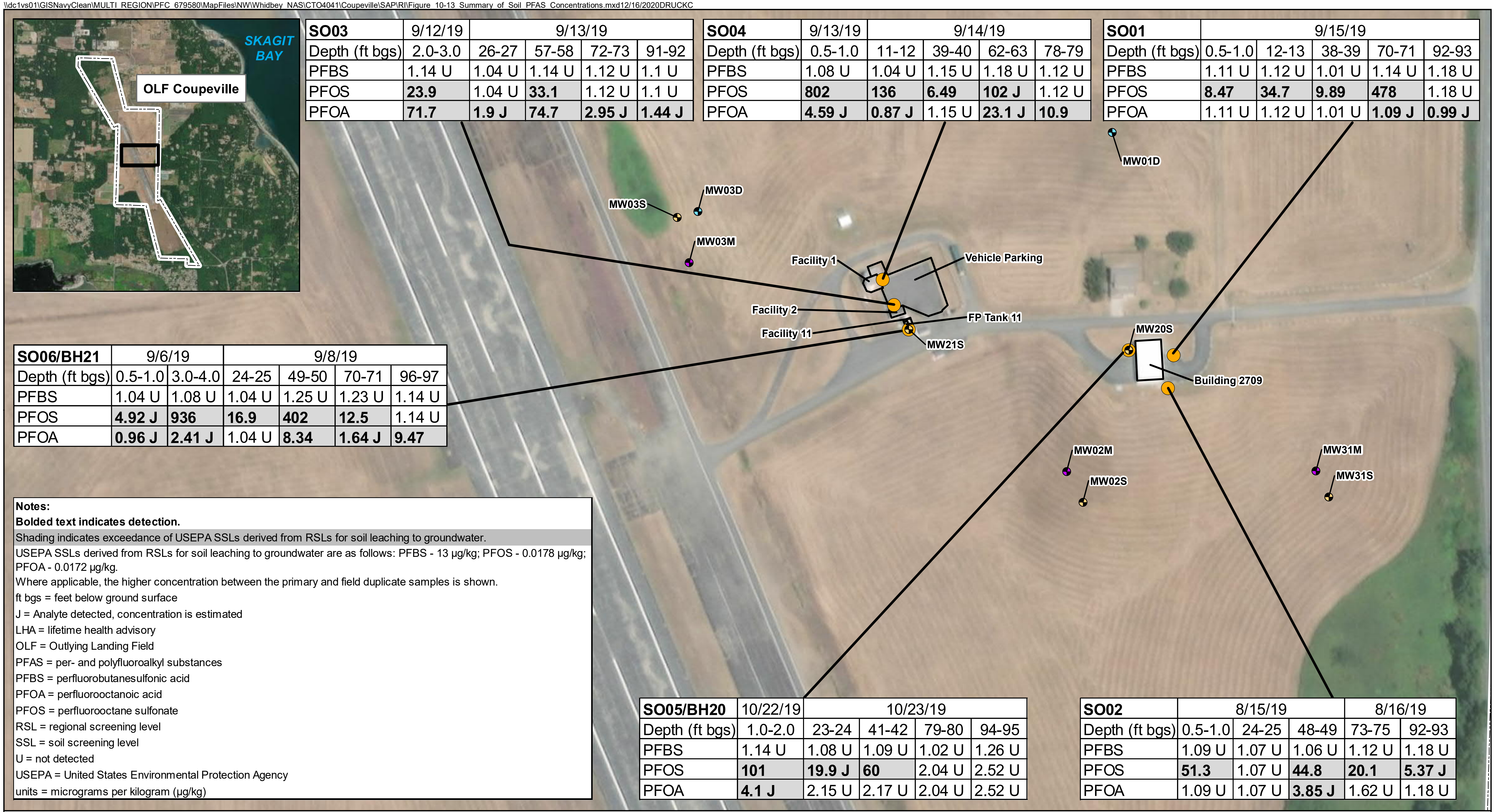
0 0.1 0.2 Miles

1 inch = 0.2 mile

Imagery Source: Esri

Figure 10-12
Groundwater Elevation Contour Map
Deep Elevation Interval
Outlying Landing Field Coupeville
Coupeville, Washington

\\dc1vs01\GISNavyClean\MULTI_REGION\PFC_679580\MapFiles\NW\Whidbey_NAS\CTO4041\Coupeville\SAP\RI\Figure_10-13_Summary_of_Soil_PFAS_Concentrations.mxd12/16/2020DRUCKC



SO03	9/12/19	9/13/19			
Depth (ft bgs)	2.0-3.0	26-27	57-58	72-73	91-92
PFBS	1.14 U	1.04 U	1.14 U	1.12 U	1.1 U
PFOS	**23.9**	1.04 U	**33.1**	1.12 U	1.1 U
PFOA	**71.7**	**1.9 J**	**74.7**	**2.95 J**	**1.44 J**

SO04	9/13/19	9/14/19			
Depth (ft bgs)	0.5-1.0	11-12	39-40	62-63	78-79
PFBS	1.08 U	1.04 U	1.15 U	1.18 U	1.12 U
PFOS	**802**	**136**	**6.49**	**102 J**	1.12 U
PFOA	**4.59 J**	**0.87 J**	1.15 U	**23.1 J**	**10.9**

SO01	9/15/19				
Depth (ft bgs)	0.5-1.0	12-13	38-39	70-71	92-93
PFBS	1.11 U	1.12 U	1.01 U	1.14 U	1.18 U
PFOS	**8.47**	**34.7**	**9.89**	**478**	1.18 U
PFOA	1.11 U	1.12 U	1.01 U	**1.09 J**	**0.99 J**

SO06/BH21	9/6/19		9/8/19			
Depth (ft bgs)	0.5-1.0	3.0-4.0	24-25	49-50	70-71	96-97
PFBS	1.04 U	1.08 U	1.04 U	1.25 U	1.23 U	1.14 U
PFOS	**4.92 J**	**936**	**16.9**	**402**	**12.5**	1.14 U
PFOA	**0.96 J**	**2.41 J**	1.04 U	**8.34**	**1.64 J**	**9.47**

SO05/BH20	10/22/19	10/23/19			
Depth (ft bgs)	1.0-2.0	23-24	41-42	79-80	94-95
PFBS	1.14 U	1.08 U	1.09 U	1.02 U	1.26 U
PFOS	**101**	**19.9 J**	**60**	2.04 U	2.52 U
PFOA	**4.1 J**	2.15 U	2.17 U	2.04 U	2.52 U

SO02	8/15/19			8/16/19	
Depth (ft bgs)	0.5-1.0	24-25	48-49	73-75	92-93
PFBS	1.09 U	1.07 U	1.06 U	1.12 U	1.18 U
PFOS	**51.3**	1.07 U	**44.8**	**20.1**	**5.37 J**
PFOA	1.09 U	1.07 U	**3.85 J**	1.62 U	1.18 U

Notes:

Bolded text indicates detection.

Shading indicates exceedance of USEPA SSLs derived from RSLs for soil leaching to groundwater.

USEPA SSLs derived from RSLs for soil leaching to groundwater are as follows: PFBS - 13 µg/kg; PFOS - 0.0178 µg/kg; PFOA - 0.0172 µg/kg.

Where applicable, the higher concentration between the primary and field duplicate samples is shown.

ft bgs = feet below ground surface
J = Analyte detected, concentration is estimated
LHA = lifetime health advisory
OLF = Outlying Landing Field
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
RSL = regional screening level
SSL = soil screening level
U = not detected
USEPA = United States Environmental Protection Agency
units = micrograms per kilogram (µg/kg)

Legend

- ◐ Shallow Elevation Interval Monitoring Well
- ◐ Middle Elevation Interval Monitoring Well
- ◐ Deep Elevation Interval Monitoring Well
- ● Soil Boring
- ☐ Building/Structure Location

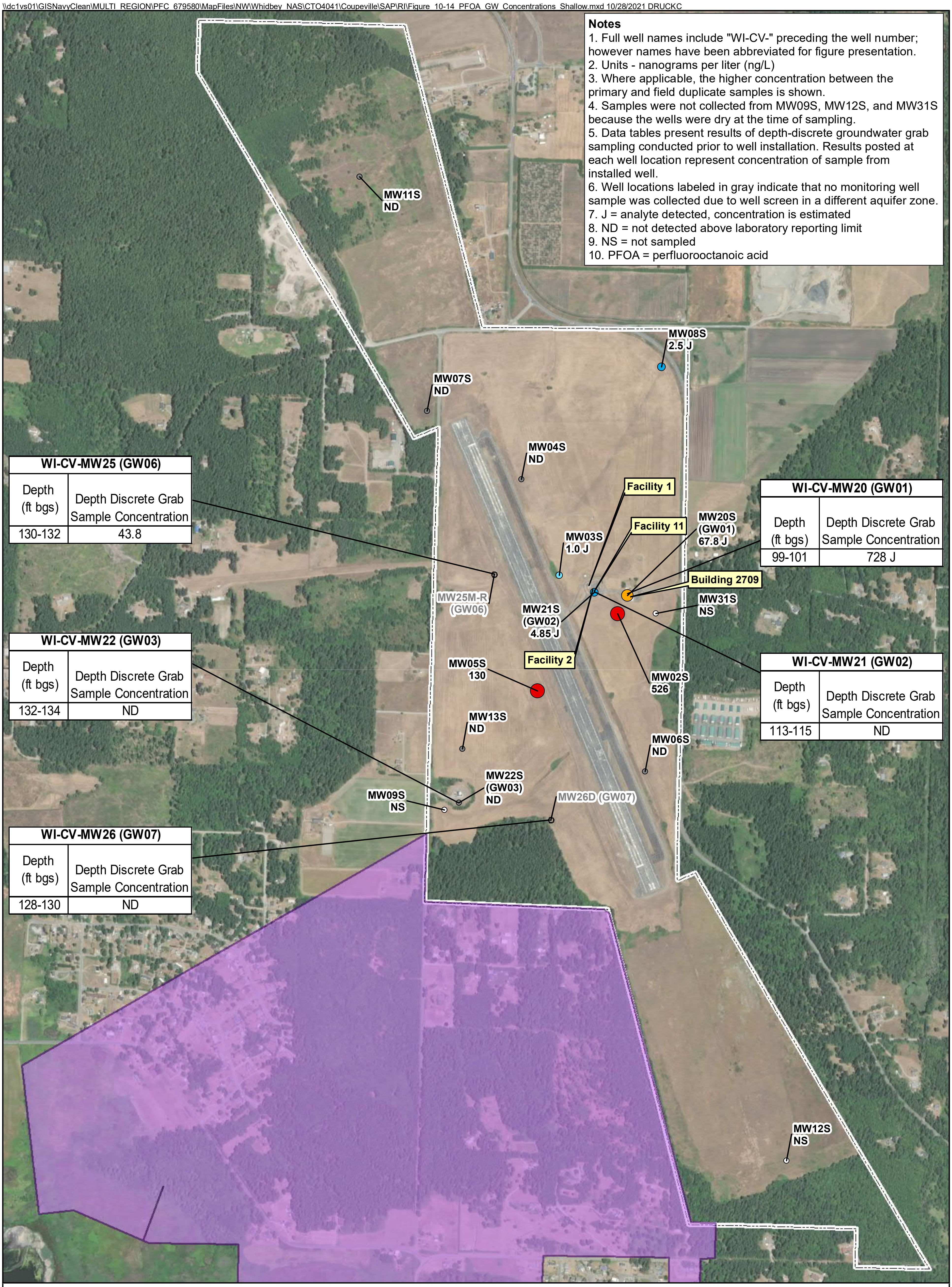
N

0 75 150 Feet

1 inch = 150 feet

Imagery Source: Esri

Figure 10-13
Summary of Soil PFAS Concentrations
Outlying Landing Field Coupeville
Coupeville, Washington



Notes

1. Full well names include "WI-CV-" preceding the well number; however names have been abbreviated for figure presentation.
2. Units - nanograms per liter (ng/L)
3. Where applicable, the higher concentration between the primary and field duplicate samples is shown.
4. Samples were not collected from MW09S, MW12S, and MW31S because the wells were dry at the time of sampling.
5. Data tables present results of depth-discrete groundwater grab sampling conducted prior to well installation. Results posted at each well location represent concentration of sample from installed well.
6. Well locations labeled in gray indicate that no monitoring well sample was collected due to well screen in a different aquifer zone.
7. J = analyte detected, concentration is estimated
8. ND = not detected above laboratory reporting limit
9. NS = not sampled
10. PFOA = perfluorooctanoic acid

WI-CV-MW25 (GW06)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
130-132	43.8

WI-CV-MW20 (GW01)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
99-101	728 J

WI-CV-MW22 (GW03)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
132-134	ND

WI-CV-MW21 (GW02)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
113-115	ND

WI-CV-MW26 (GW07)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
128-130	ND

Legend

🟪 Combined Residential Sampling Area - portion of off-Base Drinking Water Sampling Area where 8 wells exceed the Lifetime Health Advisory of 70 parts per trillion for PFOA and/or PFOS

⬚ Base Boundary

PFOA concentration of monitoring well groundwater sample

- ○ Not Sampled
- ● Not Detected
- ● <2.0
- ● 2.1 - 5.0
- ● 5.1 - 10.0
- ● 10.1 - 40.0
- ● 40.1 - 70.0
- ● 70.1 - 100.0
- ● >100.1

Depth-discrete Groundwater Grab Sample Result

WI-CV-MW20 (GW01)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
99-101	728 J

N

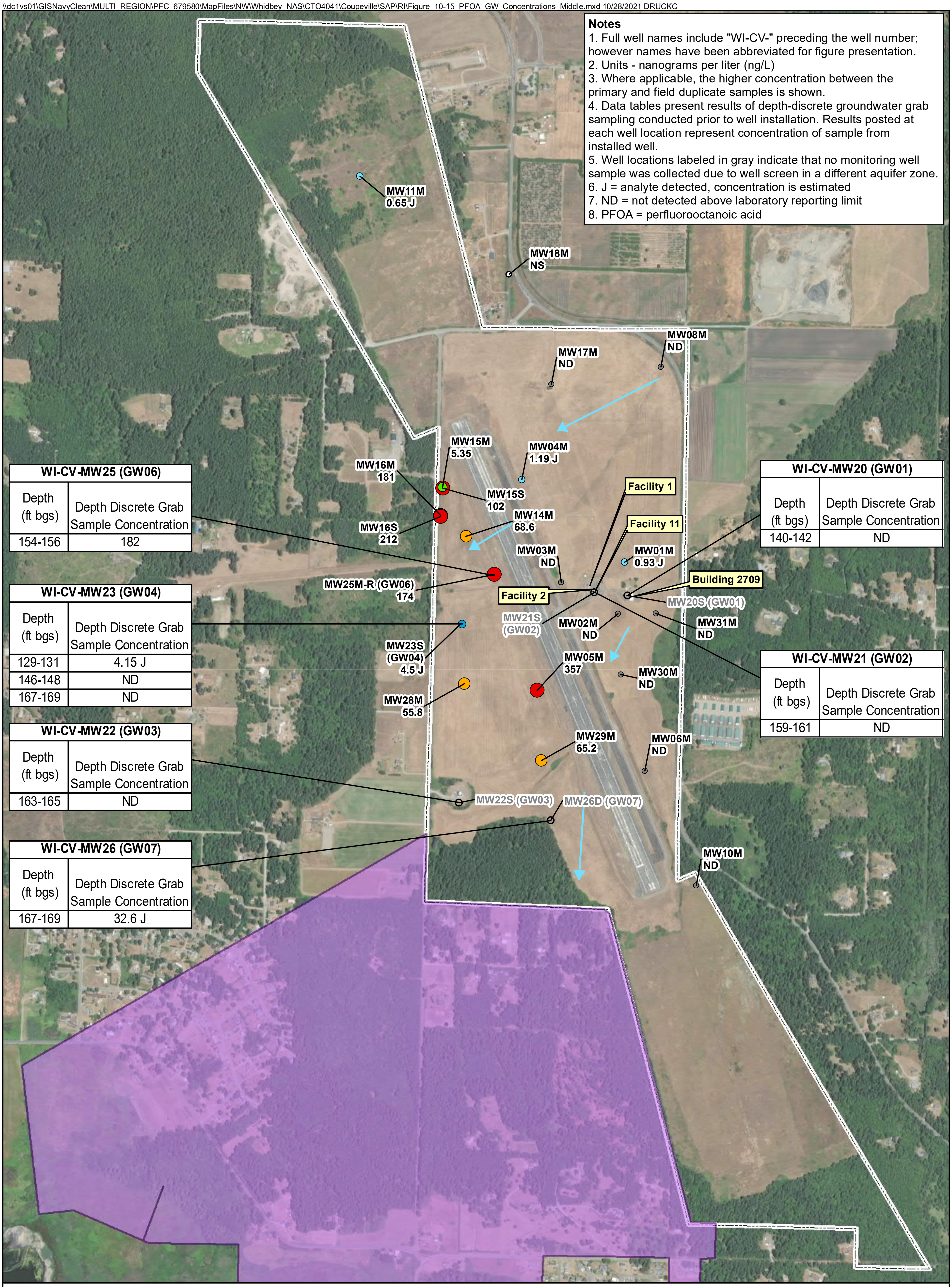
0 500 1,000 Feet

1 inch = 1,000 feet

Imagery Source: Esri

Figure 10-14
PFOA Concentrations in Groundwater -
Shallow Aquifer Zone
Outlying Landing Field Coupeville
Coupeville, Washington

\\dc1vs01\GISNavyClean\MULTI REGION\PFC 679580\MapFiles\NW\Whidbey NAS\CTO4041\Coupeville\SAP\RI\Figure 10-15 PFOA GW Concentrations Middle.mxd 10/28/2021 DRUCKC



Notes
1. Full well names include "WI-CV-" preceding the well number; however names have been abbreviated for figure presentation.
2. Units - nanograms per liter (ng/L)
3. Where applicable, the higher concentration between the primary and field duplicate samples is shown.
4. Data tables present results of depth-discrete groundwater grab sampling conducted prior to well installation. Results posted at each well location represent concentration of sample from installed well.
5. Well locations labeled in gray indicate that no monitoring well sample was collected due to well screen in a different aquifer zone.
6. J = analyte detected, concentration is estimated
7. ND = not detected above laboratory reporting limit
8. PFOA = perfluorooctanoic acid

WI-CV-MW25 (GW06)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
154-156	182

WI-CV-MW23 (GW04)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
129-131	4.15 J
146-148	ND
167-169	ND

WI-CV-MW22 (GW03)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
163-165	ND

WI-CV-MW26 (GW07)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
167-169	32.6 J

WI-CV-MW20 (GW01)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
140-142	ND

WI-CV-MW21 (GW02)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
159-161	ND

Legend

- Intermediate Zone Groundwater Flow Direction
- Combined Residential Sampling Area - portion of off-Base Drinking Water Sampling Area where 8 wells exceed the Lifetime Health Advisory of 70 parts per trillion for PFOA and/or PFOS
- Base Boundary

PFOA concentration of monitoring well groundwater sample

- ○ Not Sampled
- ● Not Detected
- ● <2.0
- ● 2.1 - 5.0
- ● 5.1 - 10.0
- ● 10.1 - 40.0
- ● 40.1 - 70.0
- ● 70.1 - 100.0
- ● >100.1

Depth-discrete Groundwater Grab Sample Result

WI-CV-MW20 (GW01)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
99-101	728 J

N

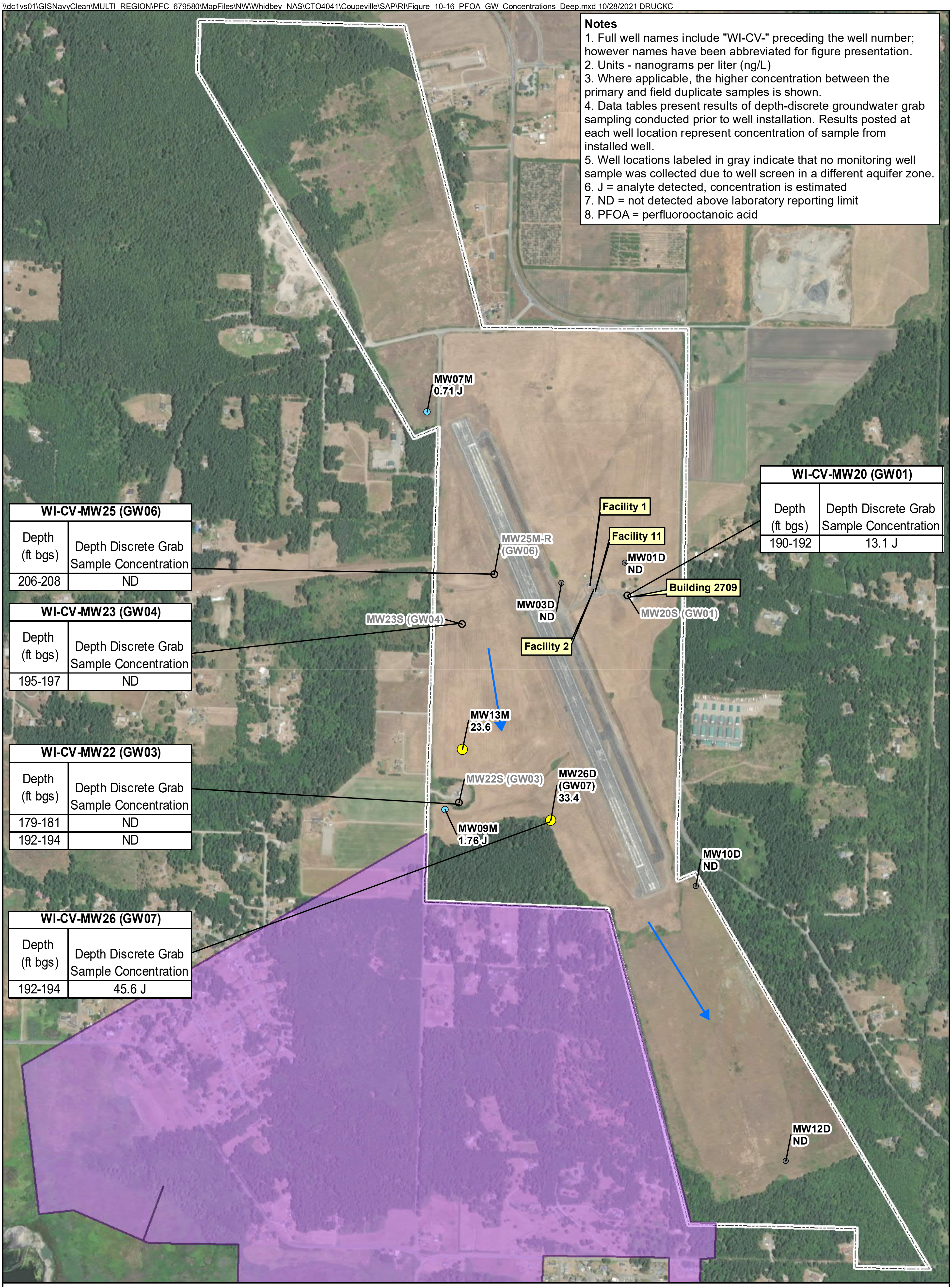
0 500 1,000 Feet

1 inch = 1,000 feet

Imagery Source: Esri

Figure 10-15
PFOA Concentrations in Groundwater - Intermediate Aquifer Zone
Outlying Landing Field Coupeville
Coupeville, Washington

\\dc1vs01\GISNavyClean\MULTI_REGION\PFC_679580\MapFiles\NW\Whidbey_NAS\CTO4041\Coupeville\SAP\RI\Figure_10-16_PFOA_GW_Concentrations_Deep.mxd 10/28/2021 DRUCKC



Notes
1. Full well names include "WI-CV-" preceding the well number; however names have been abbreviated for figure presentation.
2. Units - nanograms per liter (ng/L)
3. Where applicable, the higher concentration between the primary and field duplicate samples is shown.
4. Data tables present results of depth-discrete groundwater grab sampling conducted prior to well installation. Results posted at each well location represent concentration of sample from installed well.
5. Well locations labeled in gray indicate that no monitoring well sample was collected due to well screen in a different aquifer zone.
6. J = analyte detected, concentration is estimated
7. ND = not detected above laboratory reporting limit
8. PFOA = perfluorooctanoic acid

WI-CV-MW20 (GW01)	
Depth (ft bgs)	Depth Discrete Grab Sample Concentration
190-192	13.1 J

WI-CV-MW25 (GW06)	
Depth (ft bgs)	Depth Discrete Grab Sample Concentration
206-208	ND

WI-CV-MW23 (GW04)	
Depth (ft bgs)	Depth Discrete Grab Sample Concentration
195-197	ND

WI-CV-MW22 (GW03)	
Depth (ft bgs)	Depth Discrete Grab Sample Concentration
179-181	ND
192-194	ND

WI-CV-MW26 (GW07)	
Depth (ft bgs)	Depth Discrete Grab Sample Concentration
192-194	45.6 J

Legend

- → Deep Zone Groundwater Flow Direction
- ▨ Combined Residential Sampling Area - portion of off-Base Drinking Water Sampling Area where 8 wells exceed the Lifetime Health Advisory of 70 parts per trillion for PFOA and/or PFOS
- ⬚ Base Boundary

PFOA concentration of monitoring well groundwater sample

- ○ Not Sampled
- ● Not Detected
- ● <2.0
- ● 2.1 - 5.0
- ● 5.1 - 10.0
- ● 10.1 - 40.0
- ● 40.1 - 70.0
- ● 70.1 - 100.0
- ● >100.1

Depth-discrete Groundwater Grab Sample Result

WI-CV-MW20 (GW01)	
Depth (ft bgs)	Depth Discrete Grab Sample Concentration
99-101	728 J

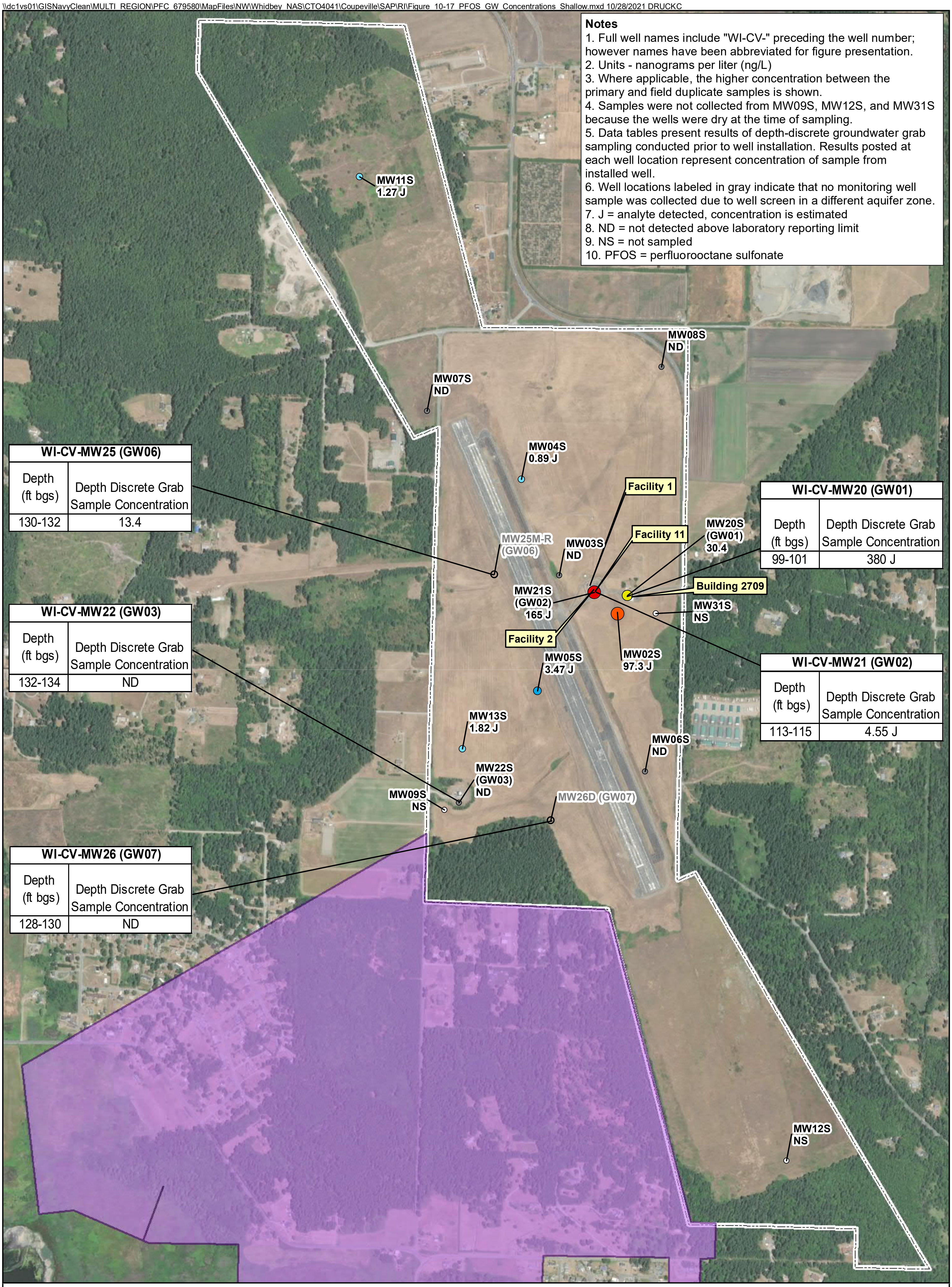
Figure 10-16
PFOA Concentrations in Groundwater -
Deep Aquifer Zone
Outlying Landing Field Coupeville
Coupeville, Washington

N

0 500 1,000
Feet

1 inch = 1,000 feet
Imagery Source: Esri

\\dc1vs01\GISNavyClean\MULTI REGION\PFC 679580\MapFiles\NW\Whidbey NAS\CTO4041\Coupeville\SAP\RI\Figure 10-17 PFOS GW Concentrations Shallow.mxd 10/28/2021 DRUCKC



Notes

1. Full well names include "WI-CV-" preceding the well number; however names have been abbreviated for figure presentation.
2. Units - nanograms per liter (ng/L)
3. Where applicable, the higher concentration between the primary and field duplicate samples is shown.
4. Samples were not collected from MW09S, MW12S, and MW31S because the wells were dry at the time of sampling.
5. Data tables present results of depth-discrete groundwater grab sampling conducted prior to well installation. Results posted at each well location represent concentration of sample from installed well.
6. Well locations labeled in gray indicate that no monitoring well sample was collected due to well screen in a different aquifer zone.
7. J = analyte detected, concentration is estimated
8. ND = not detected above laboratory reporting limit
9. NS = not sampled
10. PFOS = perfluorooctane sulfonate

WI-CV-MW25 (GW06)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
130-132	13.4

WI-CV-MW20 (GW01)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
99-101	380 J

WI-CV-MW22 (GW03)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
132-134	ND

WI-CV-MW21 (GW02)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
113-115	4.55 J

WI-CV-MW26 (GW07)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
128-130	ND

Legend

Combined Residential Sampling Area - portion of off-Base Drinking Water Sampling Area where 8 wells exceed the Lifetime Health Advisory of 70 parts per trillion for PFOA and/or PFOS

Base Boundary

PFOS concentration of monitoring well groundwater sample

- ○ Not Sampled
- ● Not Detected
- ● <2.0
- ● 2.1 - 5.0
- ● 5.1 - 10.0
- ● 10.1 - 40.0
- ● 40.1 - 70.0
- ● 70.1 - 100.0
- ● >100.1

Depth-discrete Groundwater Grab Sample Result

WI-CV-MW20 (GW01)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
99-101	728 J

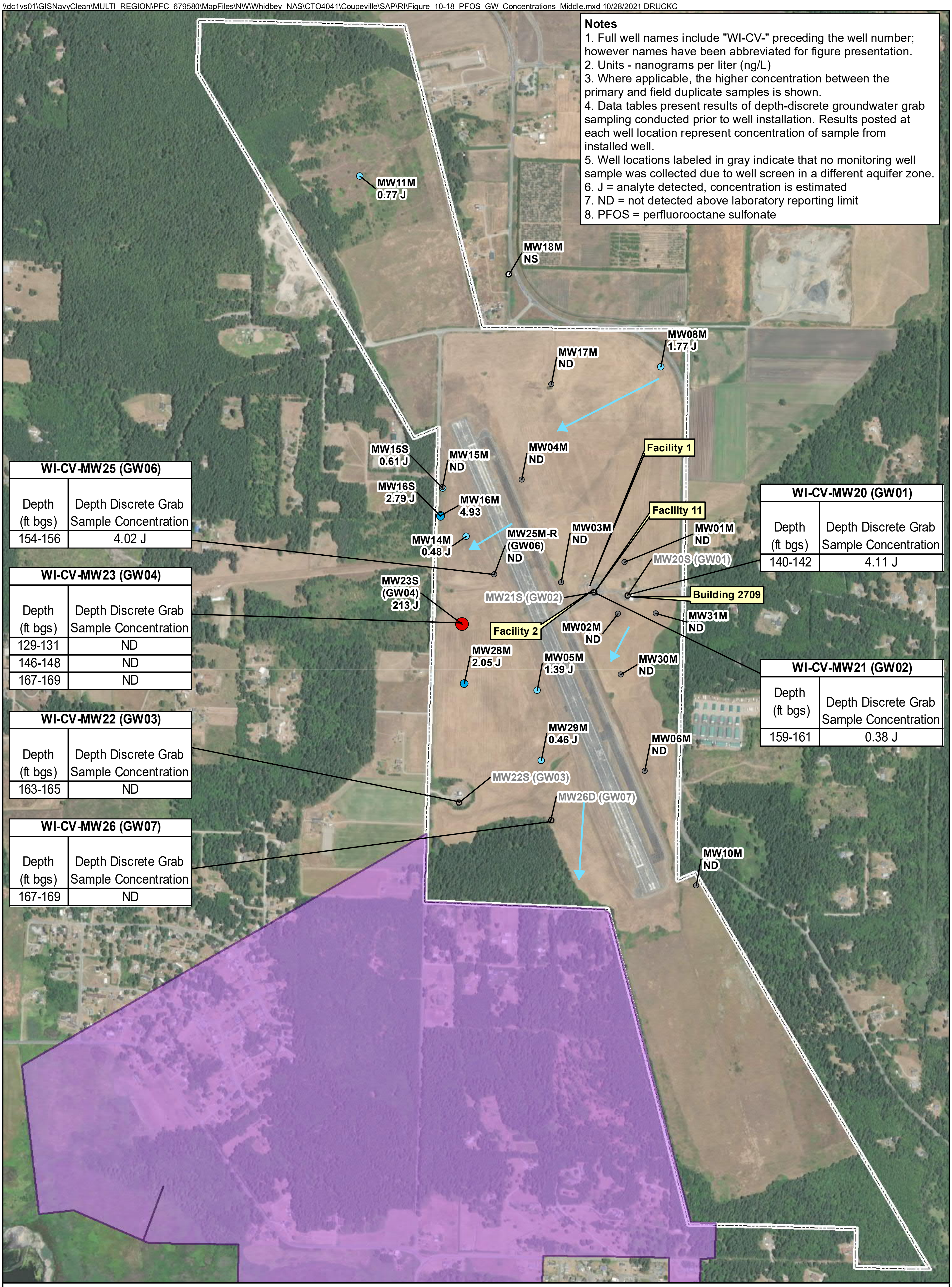
N

0 500 1,000 Feet

1 inch = 1,000 feet

Imagery Source: Esri

Figure 10-17
PFOS Concentrations in Groundwater - Shallow Aquifer Zone
Outlying Landing Field Coupeville
Coupeville, Washington



Notes

1. Full well names include "WI-CV-" preceding the well number; however names have been abbreviated for figure presentation.
2. Units - nanograms per liter (ng/L)
3. Where applicable, the higher concentration between the primary and field duplicate samples is shown.
4. Data tables present results of depth-discrete groundwater grab sampling conducted prior to well installation. Results posted at each well location represent concentration of sample from installed well.
5. Well locations labeled in gray indicate that no monitoring well sample was collected due to well screen in a different aquifer zone.
6. J = analyte detected, concentration is estimated
7. ND = not detected above laboratory reporting limit
8. PFOS = perfluorooctane sulfonate

WI-CV-MW25 (GW06)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
154-156	4.02 J

WI-CV-MW23 (GW04)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
129-131	ND
146-148	ND
167-169	ND

WI-CV-MW22 (GW03)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
163-165	ND

WI-CV-MW26 (GW07)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
167-169	ND

WI-CV-MW20 (GW01)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
140-142	4.11 J

WI-CV-MW21 (GW02)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
159-161	0.38 J

Legend

→ Intermediate Zone Groundwater Flow Direction

▨ Combined Residential Sampling Area - portion of off-Base Drinking Water Sampling Area where 8 wells exceed the Lifetime Health Advisory of 70 parts per trillion for PFOA and/or PFOS

☐ Base Boundary

PFOS concentration of monitoring well groundwater sample

- ○ Not Sampled
- ● Not Detected
- ● <2.0
- ● 2.1 - 5.0
- ● 5.1 - 10.0
- ● 10.1 - 40.0
- ● 40.1 - 70.0
- ● 70.1 - 100.0
- ● >100.1

Depth-discrete Groundwater Grab Sample Result

WI-CV-MW20 (GW01)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
99-101	728 J

Figure 10-18
PFOS Concentrations in Groundwater -
Intermediate Aquifer Zone
Outlying Landing Field Coupeville
Coupeville, Washington

1 inch = 1,000 feet
Imagery Source: Esri

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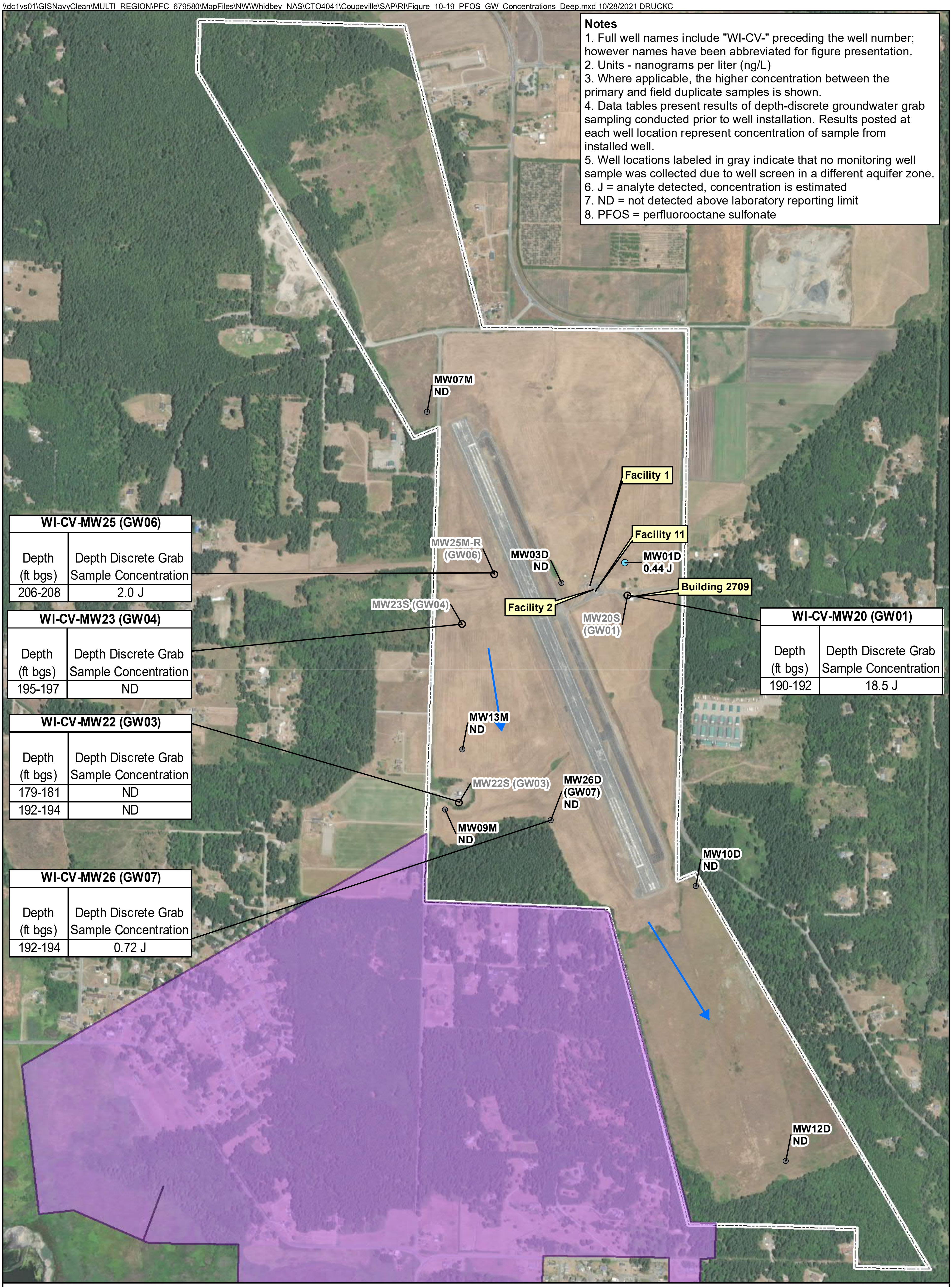


Notes

1. Full well names include "WI-CV-" preceding the well number; however names have been abbreviated for figure presentation.
2. Units - nanograms per liter (ng/L)
3. Where applicable, the higher concentration between the primary and field duplicate samples is shown.
4. Data tables present results of depth-discrete groundwater grab sampling conducted prior to well installation. Results posted at each well location represent concentration of sample from installed well.
5. Well locations labeled in gray indicate that no monitoring well sample was collected due to well screen in a different aquifer zone.
6. J = analyte detected, concentration is estimated
7. ND = not detected above laboratory reporting limit
8. PFOS = perfluorooctane sulfonate

WI-CV-MW25 (GW06)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
206-208	2.0 J

WI-CV-MW23 (GW04)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
195-197	ND

WI-CV-MW22 (GW03)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
179-181	ND
192-194	ND

WI-CV-MW26 (GW07)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
192-194	0.72 J

WI-CV-MW20 (GW01)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
190-192	18.5 J

Legend

- ➔ Deep Zone Groundwater Flow Direction
- 🟪 Combined Residential Sampling Area - portion of off-Base Drinking Water Sampling Area where 8 wells exceed the Lifetime Health Advisory of 70 parts per trillion for PFOA and/or PFOS
- ⬚ Base Boundary

PFOS concentration of monitoring well groundwater sample

- ○ Not Sampled
- ● Not Detected
- ● <2.0
- ● 2.1 - 5.0
- ● 5.1 - 10.0
- ● 10.1 - 40.0
- ● 40.1 - 70.0
- ● 70.1 - 100.0
- ● >100.1

Depth-discrete Groundwater Grab Sample Result

WI-CV-MW20 (GW01)

Depth (ft bgs)	Depth Discrete Grab Sample Concentration
99-101	728 J

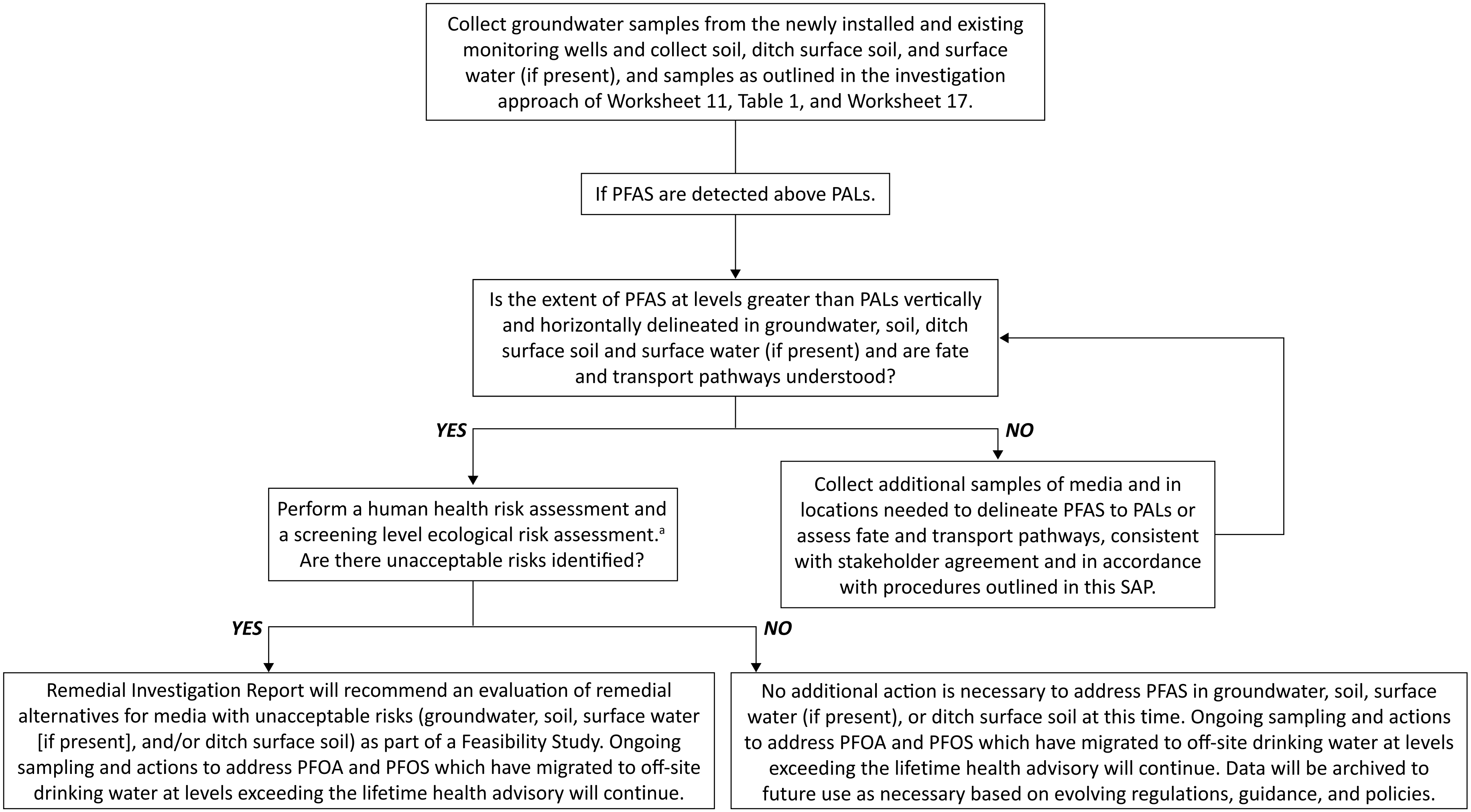
N

0 500 1,000 Feet

1 inch = 1,000 feet

Imagery Source: Esri

Figure 10-19
PFOS Concentrations in Groundwater - Deep Aquifer Zone
Outlying Landing Field Coupeville
Coupeville, Washington



Collect groundwater samples from the newly installed and existing monitoring wells and collect soil, ditch surface soil, and surface water (if present), and samples as outlined in the investigation approach of Worksheet 11, Table 1, and Worksheet 17.

If PFAS are detected above PALs.

Is the extent of PFAS at levels greater than PALs vertically and horizontally delineated in groundwater, soil, ditch surface soil and surface water (if present) and are fate and transport pathways understood?

Perform a human health risk assessment and a screening level ecological risk assessment.[a] Are there unacceptable risks identified?

Collect additional samples of media and in locations needed to delineate PFAS to PALs or assess fate and transport pathways, consistent with stakeholder agreement and in accordance with procedures outlined in this SAP.

Remedial Investigation Report will recommend an evaluation of remedial alternatives for media with unacceptable risks (groundwater, soil, surface water [if present], and/or ditch surface soil) as part of a Feasibility Study. Ongoing sampling and actions to address PFOA and PFOS which have migrated to off-site drinking water at levels exceeding the lifetime health advisory will continue.

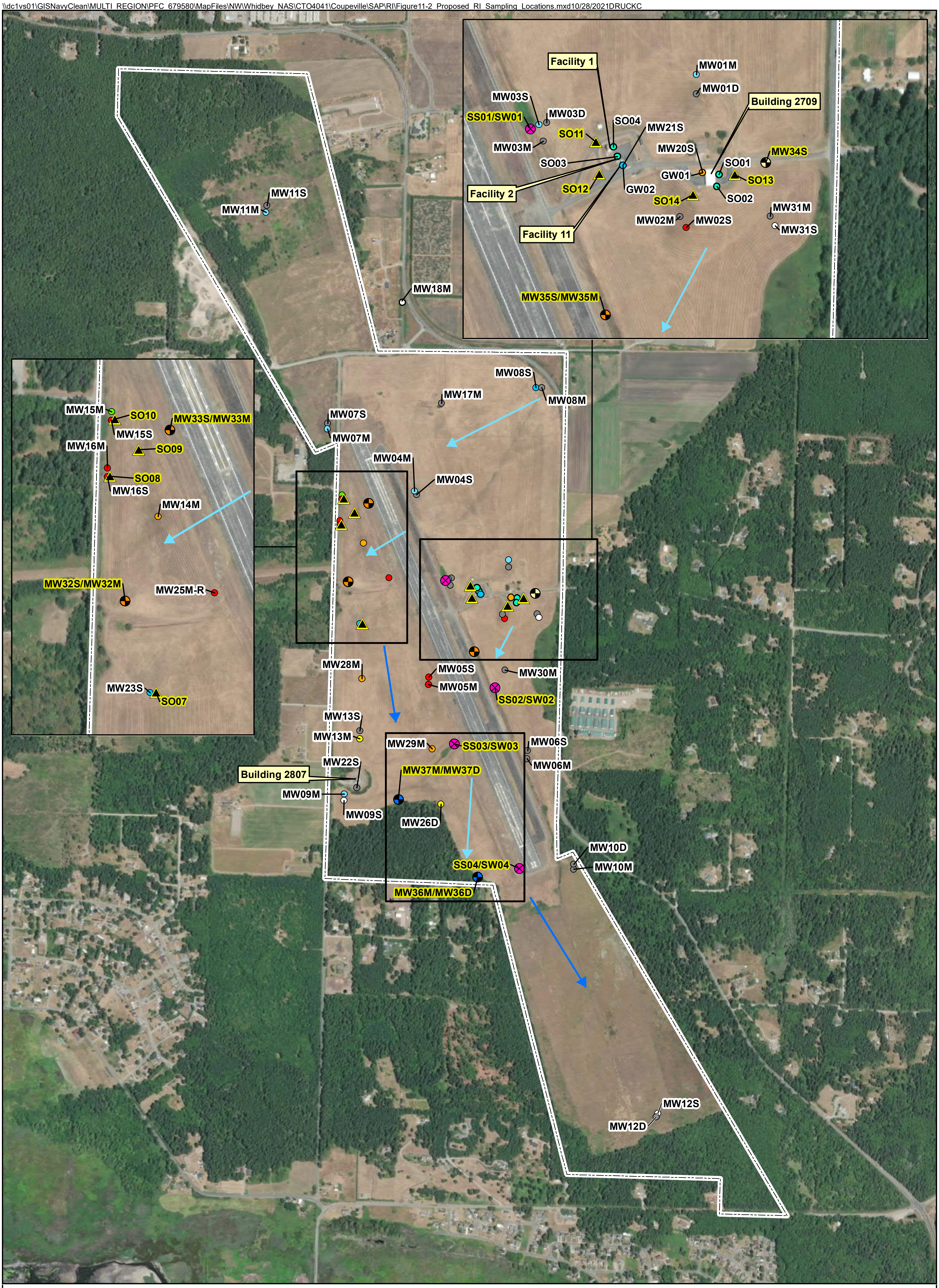
No additional action is necessary to address PFAS in groundwater, soil, surface water (if present), or ditch surface soil at this time. Ongoing sampling and actions to address PFOA and PFOS which have migrated to off-site drinking water at levels exceeding the lifetime health advisory will continue. Data will be archived to future use as necessary based on evolving regulations, guidance, and policies.

[a] PFAS will be evaluated within the applicable DoD, Navy, and/or EPA policy, guidance, or directives using the state-of-the-science toxicological information available and current at the time the RI is prepared for both the Human Health and Ecological Risk Assessments. Prior to conducting an ecological risk screening, the ecological screening values that will be used for comparison to site media will be reviewed based on current science and relevancy to site-specific receptors (e.g., relevant ecological receptors present). Ecological screening values selected for the screening will be presented in a technical memo or other documented form for regulatory review and acceptance.

Note:
Ongoing sampling and other activities being done to address off-base drinking water that exceeds the USEPA lifetime health advisory will not be conducted as a part of RI activities at OLF Coupeville.

Figure 11-1.
Decision Logic for Project Quality Objectives
Naval Air Station Whidbey Island –
Outlying Landing Field Coupeville
Coupeville, Washington

\\dc1vs01\GISNavyClean\MULTI_REGION\PFC_679580\MapFiles\NW\Whidbey_NAS\CTO4041\Coupeville\SAP\RI\Figure11-2_Proposed_RI_Sampling_Locations.mxd10/28/2021DRUCKC



Legend

- ➡ Intermediate Zone Groundwater Flow Direction
- ➡ Deep Zone Groundwater Flow Direction
- ● 2019 Soil Boring (Supplemental SI)

Proposed Locations (highlighted)

- ⊗ Drainage Ditch Surface Soil and Surface Water Sample Location
- ▲ Soil Boring
- ⊕ Shallow Monitoring Well
- ⊕ Shallow/Intermediate Monitoring Well Pair
- ⊕ Intermediate/Deep Monitoring Well Pair

PFOA concentration of monitoring well groundwater sample

- ○ Not Sampled
- ● Not Detected
- ● <2.0
- ● 2.1 - 5.0
- ● 5.1 - 10.0
- ● 10.1 - 40.0
- ● 40.1 - 70.0
- ● 70.1 - 100.0
- ● >100.1

- ▭ Investigation Areas
- ⬚ Base Boundary

Note:
Full well names include "WI-CV-" preceding the well number; however names have been abbreviated for figure presentation.

N

0 0.1 0.2
Miles

1 inch = 0.2 mile

Imagery Source: Esri

Figure 11-2
Proposed RI Drilling and Sampling Locations
Outlying Landing Field Coupeville
Coupeville, Washington

Appendix A
RI Scoping Session Presentation

OLF Coupeville PFAS Remedial Investigation – Stakeholder Scoping Meeting Part 1 & 2

NAS Whidbey Island

December 10, 2020

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Safety Minute – Holiday Light Safety

1. Never leave lights unattended (use timers, remotes, apps)
2. LED instead of incandescent – more efficient, safer
3. Candle placement (or don’t use!)
4. Use the right type of lights - indoor and outdoor lights are not interchangeable
5. Only three light strands per outlet at most
6. Get rid of old lights
7. Securely fasten outdoor light strings, keep indoor lights out or reach from pets/ small children
8. Avoid electric lights on metallic trees
9. Be smart with extension cords – keep cords dry/ above ground, use surge protectors
10. Keep Christmas tree from becoming fire hazard – non-flammable decorations, keep watered

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PART 1 – BACKGROUND AND SUPPLEMENTAL SITE INSPECTION RESULTS

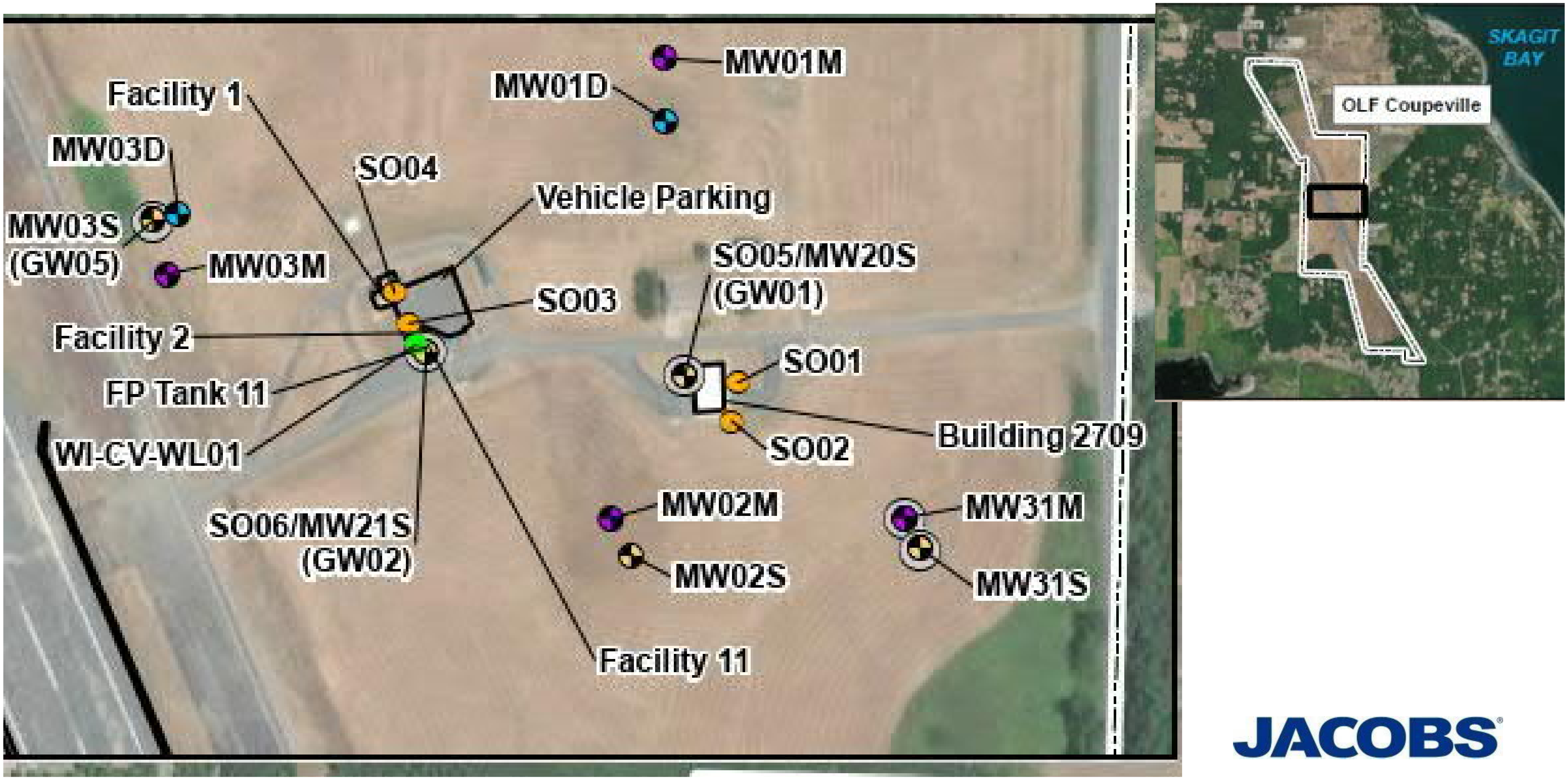
Site Background

- Located on broad plateau, approx. 195 ft elevation
- Runway bordered by grass, runway safety area
- Admiralty Bay to south, Skagit Bay to NE
- Town of Coupeville community drinking water well (Keystone Well) just west of OLF; also obtain water from Ft. Casey wellfield (0.4 mi. SW of OLF)
- Other private community or individual drinking water wells near OLF
- No evidence of AFFF use at OLF Coupeville; PFAS detected in 2016 in on-Base sample, below EPA's lifetime health advisory
- GW/ DW investigations conducted following PFAS detection on-Base (detailed in next slide)

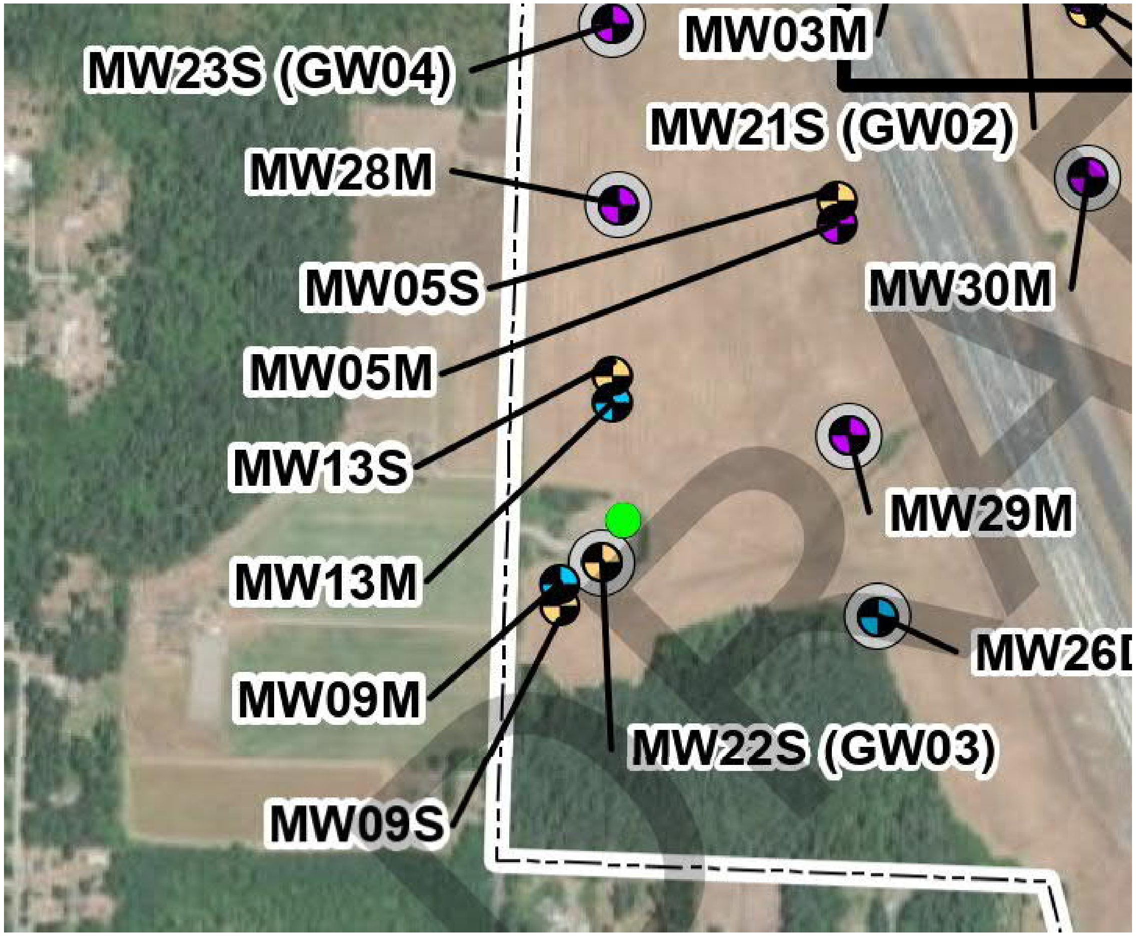
Investigation History

- **Drinking Water Investigation – (2016-2017):**
  - PFOA detected above lifetime health advisory in 8 residential wells south of OLF
- **Expedited Site Inspection (SI) (2016-2017):**
  - 27 MWs installed, across 3 elevation intervals
  - Groundwater mound identified in intermediate aquifer interval
  - PFOA detected in 5 samples (3 above lifetime health advisory), PFOS in 5 samples
- **Preliminary Assessment (2017-2018):**
  - Evaluation of potential source areas, migration pathways, potential receptors
  - Identified three on-Base potential source areas:
    - Building 2709 (Crash Truck Shelter)
    - Facilities 1, 2, and 11 (Control Tower, Airfield Ops Building, and Potable Water Well Pump House)
    - Building 2807 (OLF Electronic Warfare Signal Emitter Building) – not recommended for additional site Inspection

PFAS Source Areas Identified in Preliminary Assessment



Potential 'New' PFAS Source Area Identified in Supplemental Site Inspection



Investigation History

- **Focused Site Inspection (2017-2018)**
  - 2 new well pairs (MW15M/S and MW16M/S), aquifer testing, develop GW Model
  - Sampled select on-Base wells and Keystone Well; 5 exceed LHA for PFOA
  - Confirmed presence of GW mound north of runway, with radial flow outward
  - Keystone Well capture zone includes PFAS exceedances in intermediate interval
- **Supplemental SI (2019-present):**
  - Phase 1 – on-Base soil borings (6); soil, GW, geotechnical sampling, depth-discrete GW sampling; MW installs (8)
  - Phase 2 – 5 additional wells, aquifer testing (May 2020)
  - Phase 3 – 1 off-Base well NE of OLF (for hydraulic data) – Oct. 2020
  - Update to GW model and conduct solute transport modeling

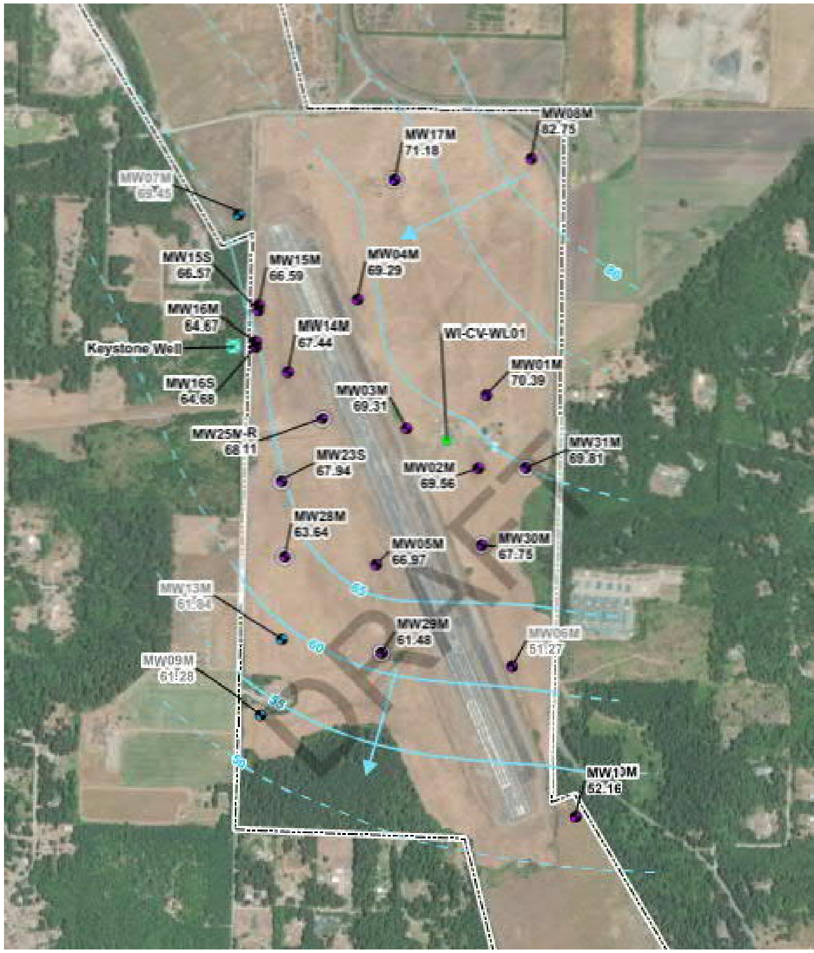
Supplemental SI Investigation Results

- **Soil data**
  - Overall, heterogeneous depth distribution
  - PFOS more frequent, at relatively higher concentrations
  - Detections above PALs indicates likely release, confirms source areas (Bldg. 2709 and Facilities 1, 2, and 11)
  - PFOA detected in 18 samples, concentrations ranged from 0.87 – 74.7 µg/kg
  - PFOS detected in 22 samples, concentrations ranged from 4.92 – 936 µg/kg
- **Groundwater data**
  - Depth-discrete samples used to determine well screen placement
  - PFBS – detected in 26 MWs; none above PAL
  - PFOA – detected in 23 MWs; 11 exceeded PAL (40 ng/L) – most frequently detected
    - Shallow zone: highest near Bldg. 2709, near Keystone Well, and west of runway
    - Intermediate zone: highest near Keystone Well and west of runway
    - Deep zone: only exceeded PAL at MW26D, south of runway
  - PFOS – detected in 16 MWs; 3 exceeded PAL (40 ng/L)
    - Shallow zone: highest near Bldg. 2709, Facilities 1, 2, 11, and due west (MW23S)
    - No PAL exceedances intermediate and deep wells

Supplemental SI Investigation Results

Conceptual Site Model (CSM) Update

- **Groundwater flow:**
  - Discontinuous perched shallow GW 90-130 ft bgs
  - Discontinuous clay/silt layer below, pinches out in south
  - Semiconfined intermediate aquifer unit, 124 to145 ft bgs
  - Intermediate aquifer underlain by confining layer
  - Flow in intermediate zone to S-SW, Deep GW flow to S-SE
  - GW mound further to NE than previously thought
  - Heads near west Base boundary are influenced by Keystone Well
- **PFAS Pathways**
  - PFOA most prominent; above PALs in shallow, intermediate aquifer zones downgradient of source areas
  - Likely downward migration along flow direction
  - High PFOA west of runway suggest secondary source
  - Elevated PFOS confined to shallow zone – near source areas



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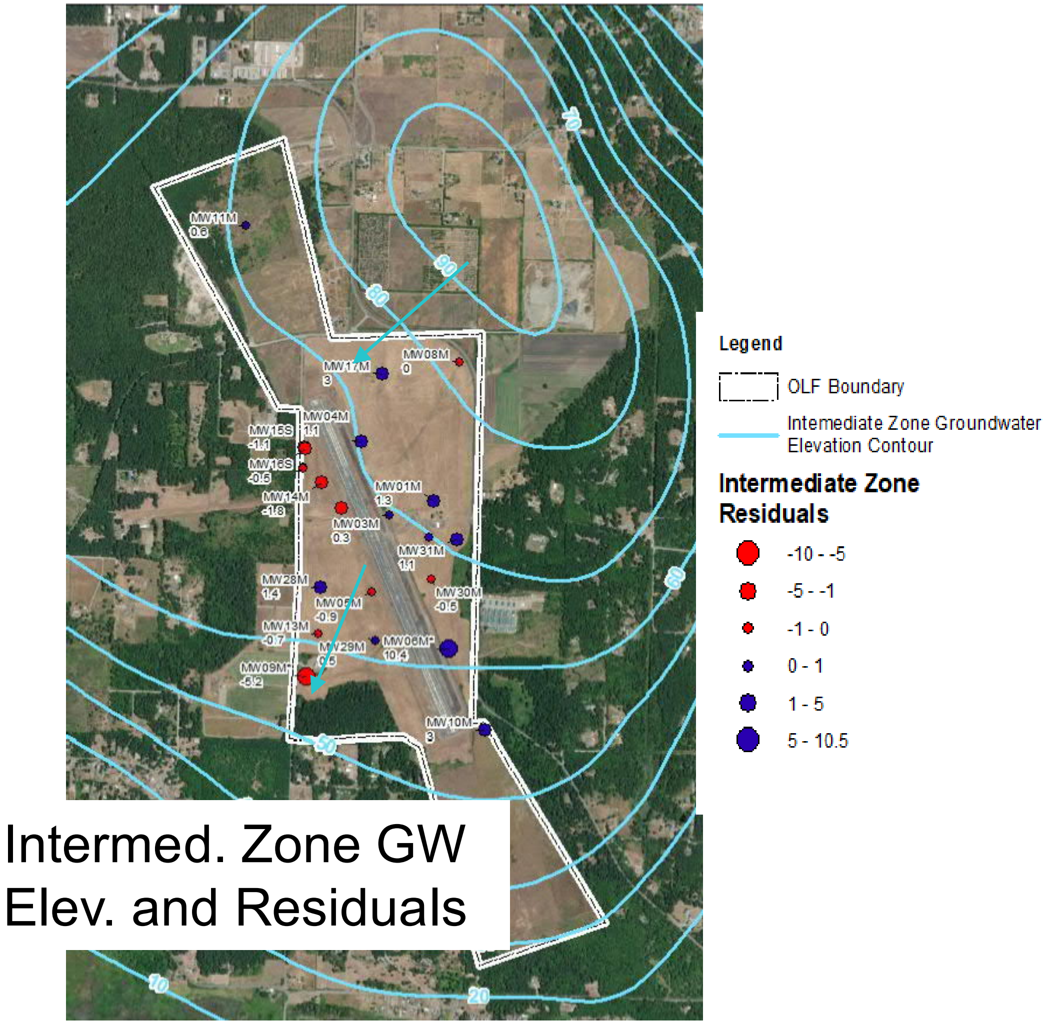
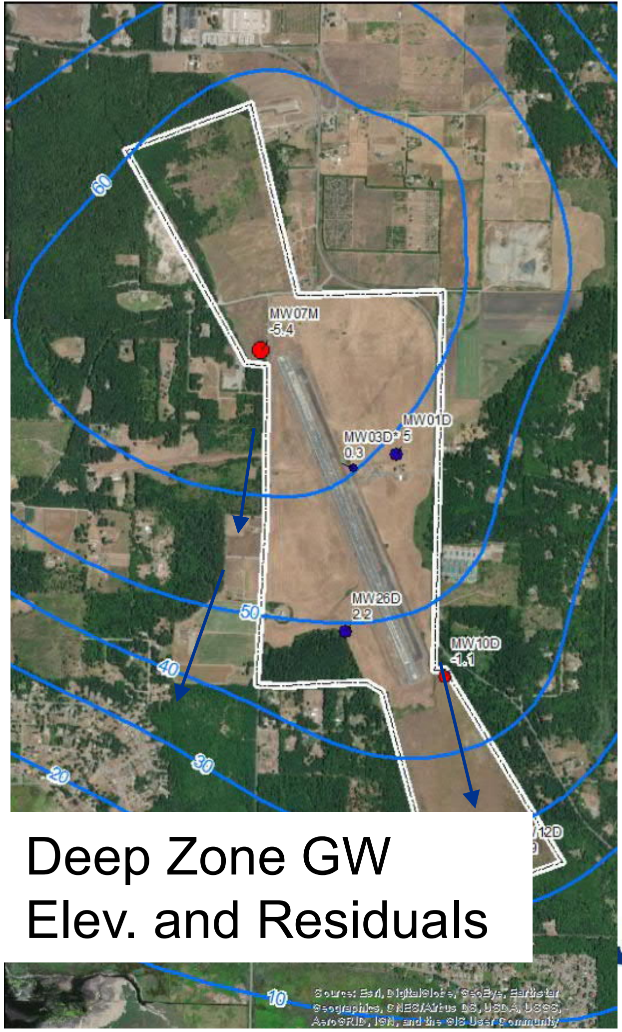
Supplemental SI Investigation Results – Groundwater Model

- **GW flow model**
  - Recalibration / update to 2018 3-D GW flow model using Supplemental SI data
  - Retains most design and construction elements of 2018 model
  - Increased number of model layers (from 5 to 7 layers)
  - Updated subsurface hydraulic parameters, boundary conditions, evapotranspiration and recharge rates
  - Evaluation of pre-Keystone Well flow field
- **Solute transport modeling for PFOA and PFOS**
  - Simulates loading of PFOA and PFOS to groundwater from vadose zone soils at on-Base source areas
  - Selection of boundary conditions, subsurface hydraulic parameters, and solute transport parameters
  - Solute transport parameters for PFOA, PFOS based on literature review
  - Current PFOA and PFOS soil concentrations with depth from Supplemental SI soil sampling data
  - Vadose zone model output is simulated PFOA, PFOS porewater concentrations reaching water table over time (initial conditions through 100 years of transport)

Groundwater Flow Modeling Results



Intermed. Zone GW
Elev. and Residuals



Deep Zone GW
Elev. and Residuals

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Sampling and Analysis Plan
Per- and Polyfluoroalkyl Substances Remedial Investigation
Outlying Landing Field Coupeville
Naval Air Station Whidbey Island
Oak Harbor, Washington

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Solute Transport Modeling - Conclusions

- Simulated PFOA plume migration is consistent with current CSM and observations of elevated PFAS in drinking water wells south of OLF
- Simulated future migration of PFOS is dependent on assumed solute transport parameters
- Continued mass flux from vadose zone PSAs has a strong influence on plume migration distance and persistence
- High degree of uncertainty in the scientific understanding of PFAS solute transport parameters

Data Gaps and Remaining Uncertainties

- Source Areas
  - On-Base near Bldg. 2709, Facility 1, 2, 11 – additional delineation
    - Lag in loading: PFOS vs. PFOA
    - Need for additional soil borings, delineation and vadose zone work
    - Current PFAS plume extents inconsistent with low soil concentrations at depth
- Potential New Source Area
  - On- and off-Base near Keystone Well
- On-Base data gaps at south end of Base
- Connectivity between on-Base sources / PAL exceedances and off-Base exceedances south of Base
- Groundwater flow and quality off-Base
  - Uncertainty to east and west of OLF

PART 2 – REMEDIAL INVESTIGATION APPROACH

Objectives of OLF Coupeville RI

- Install, sample, and survey up to 15 new groundwater wells on-Base to refine the vertical and horizontal extent of PFOS, PFOA, and PFBS and confirming source areas;
- Collect soil data to refine source area information;
- Install, sample, and survey up to 5 new groundwater wells off-Base to refine the vertical and horizontal extent of PFOS, PFOA, and PFBS off-Base, originating from OLF Coupeville;
- Sample all previously installed groundwater monitoring wells on-Base;
- Conduct aquifer testing after all new wells installed, as appropriate, to refine CSM;
- Update fate and transport groundwater model with new and existing data;
- Collect and analyze up to 10 sediment and surface water samples, as necessary, to support the human health risk assessments;
- Conduct human health risk assessments for PFAS, as appropriate;
- Determine if Feasibility Study is necessary or if more data needed to refine RI.

RI Approach

- Work planning and field work in two phases:
  - RI SAP (on-Base)
  - RI Field Work (on-Base)
  - RI SAP Addendum (off-Base)
  - Real Estate documents for off-Base access
  - RI Field Work (off-Base)
  - RI Report (on- and off-Base)

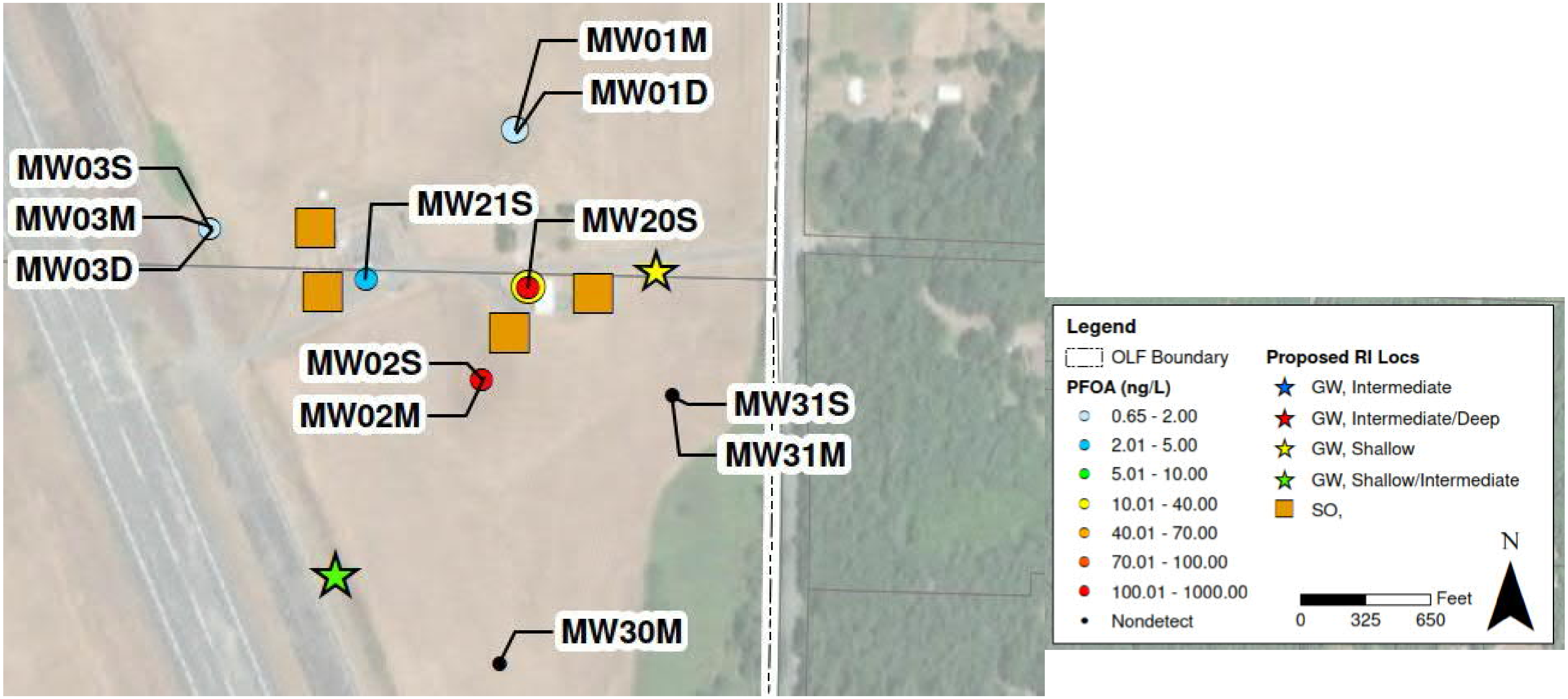
Data Gaps and Remaining Uncertainties

- Source Areas
  - On-Base near Bldg. 2709, Facility 1, 2, 11 – additional delineation
    - Lag in loading: PFOS vs. PFOA
    - Need for additional soil borings, delineation and vadose zone work
    - Current PFAS plume extents inconsistent with low soil concentrations at depth
- Potential New Source Area
  - On- and off-Base near Keystone Well
- On-Base data gaps at south end of Base
- Connectivity between on-Base sources / PAL exceedances and off-Base exceedances south of Base
- Groundwater flow and quality off-Base
  - Uncertainty to east and west of OLF

Proposed RI Locations – on-Base Source Areas and Data Gaps

Item/ Task	Location	Rationale	Comments
Monitoring Well Pair	Downgradient of MW02S, between MW02S, MW05 wells	Data gap between source areas at 02S, 20S, 21S and runway/ downgradient locations (MW05 PFOA exceedances)	Paired shallow, intermediate wells GW vertical profile sampling on intermediate location
Monitoring Well (single)	East of MW20S	Bounding to shallow PFOA/ PFOS exceedances at east Base boundary	Targeting shallow aquifer only No GW vertical profiling
Soil Boring	East of MW20S	Provide greater delineation of source areas near Building 2709 and Facilities 1, 2, and 11	Assumes soil boring to water table, collection of 4-5 soil samples at each location
Soil Boring	Southwest of MW20S		
Soil Boring	Northwest of MW21S		
Soil Boring	Southwest of MW21S		

Proposed RI Locations – on-Base Source Areas and Data Gaps



JACOBS

NAVFAC
Naval Facilities Engineering Systems Command

Sampling and Analysis Plan
Per- and Polyfluoroalkyl Substances Remedial Investigation
Outlying Landing Field Coupeville
Naval Air Station Whidbey Island
Oak Harbor, Washington

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Proposed RI Locations – Sediment/ Surface Water (on-Base)

🟥 Approximate sediment/ surface water sample location

Naval Facilities Engineering Systems Command

Sampling and Analysis Plan
Per- and Polyfluoroalkyl Substances Remedial Investigation
Outlying Landing Field Coupeville
Naval Air Station Whidbey Island
Oak Harbor, Washington

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Schedule (approximate)

- Generate RI SAP (on-Base) – now to May 2021
- RI SAP Stakeholder Review – May/June 2021
- Field work (on-Base) – Fall 2021 (Sept – Nov)
- Generate RI SAP Addendum (off-Base) – Jan – Apr 2021
- RI SAP Addendum Stakeholder Review – May 2021
- Field work (off-Base) – Fall 2021 (Oct – Nov)
- RI Report – Dec 2021 - June 2022
- RI Report Stakeholder Review – June/July 2022

Thank you for your time

Appendix B
Field Standard Operating Procedures

STANDARD OPERATING PROCEDURE

Logging of Soil Borings

I. Purpose and Scope

This SOP provides guidance to obtain accurate and consistent descriptions of soil characteristics during soil-sampling operations. The characterization is based on visual examination and manual tests, not on laboratory determinations.

II. Equipment and Materials

- Indelible pens
- Tape measure or ruler
- Field logbook
- Spatula
- HCL, 10 percent solution
- Squirt bottle with water
- Rock- or soil-color chart (e.g., Munsell)
- Grain-size chart
- Hand lens
- Unified Soil Classification System (USCS) index charts and tables to help with soil classification (attached)

III. Procedures and Guidelines

This section covers several aspects of soil characterization: instructions for completing the soil boring log form (attached), field classification of soil, and standard penetration test procedures.

A. Instructions for Completing Soil Boring Logs

Soil boring logs will be completed in the field log books or on separate soil boring log sheets. Information collected will be consistent with that required for ASTM D1586, a standard soil boring log form (attached), or an equivalent form that supplies the same information.

The information collected in the field to perform the soil characterization is described below.

Field personnel should review completed logs for accuracy, clarity, and thoroughness of detail. Samples also should be checked to see that information is correctly recorded on both sample jar labels and on the log sheets.

B. Heading Information

Boring/Well Number. Enter the boring/well number. A numbering system should be chosen that does not conflict with information recorded for previous exploratory work done at the site. Number the sheets consecutively for each boring.

Location. If station, coordinates, mileposts, or similar project layout information is available, indicate the position of the boring to that system using modifiers such as “approximate” or “estimated” as appropriate.

Elevation. Elevation will be determined at the conclusion of field activities through a survey.

Drilling Contractor. Enter the name of the drilling company and the city and state where the company is based.

Drilling Method and Equipment. Identify the bit size and type, drilling fluid (if used), and method of drilling (e.g., rotary, hollow-stem auger, sonic). Information on the drilling equipment (e.g., CME 55, Mobile B61) also is noted.

Water Level and Date. Enter the depth below ground surface to the apparent water level in the borehole. The information should be recorded as a comment. If free water is not encountered during drilling or cannot be detected because of the drilling method, this information should be noted. Record date and time of day (for tides, river stage) of each water level measurement.

Date of Start and Finish. Enter the dates the boring was begun and completed. Time of day should be added if several borings are performed on the same day.

Logger. Enter the first and last name.

C. Technical Data

Depth Below Surface. Use a depth scale that is appropriate for the sample spacing and for the complexity of subsurface conditions.

Sample Interval. Note the depth at the top and bottom of the sample interval.

Sample Type and Number. Enter the sample type and number. SS-1 = split spoon, first sample. Number samples consecutively regardless of type. Enter a sample number even if no material was recovered in the sampler.

Sample Recovery. Enter the length to the nearest 0.1-foot of soil sample recovered from the sampler. Often, there will be some wash or caved material above the sample; do not include the wash material in the measurement. Record soil recovery in feet.

Standard Penetration Test Results. In this column, enter the number of blows required for each 6 inches of sampler penetration and the "N" value, which is the sum of the blows in the middle two 6-inch penetration intervals. A typical standard penetration test involving successive blow counts of 2, 3, 4, and 5 is recorded as 2-3-4-5 and (7). The standard penetration test is terminated if the sampler encounters refusal. Refusal is a penetration of less than 6 inches with a blow count of 50. A partial penetration of 50 blows for 4 inches is recorded as 50/4 inches. Penetration by the weight of the slide hammer only is recorded as “WOH.”

Samples should be collected using a 140-pound hammer and 2-inch diameter split spoons. Samples may be collected using direct push sampling equipment. However, blow counts will not be available. A pocket penetrometer may be used instead to determine relative soil consistency of fine grained materials (silts and clays).

Sample also may be collected using a 300-pound hammer or 3-inch-diameter split-spoon samples at the site. However, use of either of these sample collection devices invalidates standard penetration test results and should be noted in the comments section of the log. The 300-pound hammer should only be used for collection of 3-inch-diameter split-spoon samples. Blow counts should be recorded for collection of samples using either a 3-inch split-spoon, or a 300-pound hammer. An “N” value need not be calculated.

Soil Description. The soil classification should follow the format described in the “Field Classification of Soil” subsection below.

Comments. Include all pertinent observations (changes in drilling fluid color, rod drops, drilling chatter, rod bounce as in driving on a cobble, damaged Shelby tubes, and equipment malfunctions). In addition, note if casing was used, the sizes and depths installed, and if drilling fluid was added or changed. You should instruct the driller to alert you to any significant changes in drilling (changes in material, occurrence of boulders, and loss of drilling fluid). Such information should be attributed to the driller and recorded in this column.

Specific information might include the following:

- The date and the time drilling began and ended each day
- The depth and size of casing and the method of installation
- The date, time, and depth of water level measurements
- Depth of rod chatter
- Depth and percentage of drilling fluid loss
- Depth of hole caving or heaving
- Depth of change in material
- Health and safety monitoring data
- Drilling interval through a boulder

D. Field Classification of Soil

This section presents the format for the field classification of soil. In general, the approach and format for classifying soils should conform to ASTM D 2488, Visual-Manual Procedure for Description and Identification of Soils.

The Unified Soil Classification System is based on numerical values of certain soil properties that are measured by laboratory tests. It is possible, however, to estimate these values in the field with reasonable accuracy using visual-manual procedures (ASTM D 2488). In addition, some elements of a complete soil description, such as the presence of cobbles or boulders, changes in strata, and the relative proportions of soil types in a bedded deposit, can be obtained only in the field.

Soil descriptions should be precise and comprehensive without being verbose. The correct overall impression of the soil should not be distorted by excessive emphasis on insignificant details. In general, similarities rather than differences between consecutive samples should be stressed.

Soil descriptions must be recorded for every soil sample collected. The format and order for soil descriptions should be as follows:

1. Soil name (synonymous with ASTM D 2488 Group Name) with appropriate modifiers. Soil name should be in all capitals in the log, for example "POORLY-GRADED SAND."
2. Group symbol, in parentheses, for example, "(SP)."
3. Color, using Munsell color designation
4. Moisture content
5. Relative density (coarse grained) or consistency (fine grained)
6. Soil structure, mineralogy, or other descriptors

This order follows, in general, the format described in ASTM D 2488.

E. Soil Name

The basic name of a soil should be the ASTM D 2488 Group Name on the basis of visual estimates of gradation and plasticity. The soil name should be capitalized.

Examples of acceptable soil names are illustrated by the following descriptions:

- A soil sample is visually estimated to contain 15 percent gravel, 55 percent sand, and 30 percent fines (passing No. 200 sieve). The fines are estimated as either low or highly plastic silt. This visual classification is SILTY SAND WITH GRAVEL, with a Group Symbol of (SM).
- Another soil sample has the following visual estimate: 10 percent gravel, 30 percent sand, and 60 percent fines (passing the No. 200 sieve). The fines are estimated as low plastic silt. This visual classification is SANDY SILT. The gravel portion is not included in the soil name because the gravel portion was estimated as less than 15 percent. The Group Symbol is (ML).

The gradation of coarse-grained soil (more than 50 percent retained on No. 200 sieve) is included in the specific soil name in accordance with ASTM D 2488. There is no need to further document the gradation. However, the maximum size and angularity or roundness of gravel and sand-sized particles should be recorded. For fine-grained soil (50 percent or more passing the No. 200 sieve), the name is modified by the appropriate plasticity/elasticity term in accordance with ASTM D 2488.

Interlayered soil should each be described starting with the predominant type. An introductory name, such as “Interlayered Sand and Silt,” should be used. In addition, the relative proportion of each soil type should be indicated (see Table 1 for example).

Where helpful, the evaluation of plasticity/elasticity can be justified by describing results from any of the visual-manual procedures for identifying fine-grained soils, such as reaction to shaking, toughness of a soil thread, or dry strength as described in ASTM D 2488.

F. Group Symbol

The appropriate group symbol from ASTM D 2488 must be given after each soil name. The group symbol should be placed in parentheses to indicate that the classification has been estimated.

In accordance with ASTM D 2488, dual symbols (e.g., GP-GM or SW-SC) can be used to indicate that a soil is estimated to have about 10 percent fines. Borderline symbols (e.g., GM/SM or SW/SP) can be used to indicate that a soil sample has been identified as having properties that do not distinctly place the soil into a specific group. Generally, the group name assigned to a soil with a borderline symbol should be the group name for the first symbol. The use of a borderline symbol should not be used indiscriminately. Every effort should be made to first place the soil into a single group.

G. Color

The color of a soil must be given. The color description should be based on the Munsell system. The color name and the hue, value, and chroma should be given.

H. Moisture Content

The degree of moisture present in a soil sample should be defined as dry, moist, or wet. Moisture content can be estimated from the criteria listed on Table 2.

I. Relative Density or Consistency

Relative density of a coarse-grained (cohesionless) soil is based on N-values (ASTM D 1586 [attached]). If the presence of large gravel, disturbance of the sample, or non-standard sample collection makes determination of the in situ relative density or consistency difficult, then this item should be left out of the description and explained in the Comments column of the soil boring log.

Consistency of fine-grained (cohesive) soil is properly based on results of pocket penetrometer or torvane results. In the absence of this information, consistency can be estimated from N-values. Relationships for determining relative density or consistency of soil samples are given in Tables 3 and 4.

J. Soil Structure, Mineralogy, and Other Descriptors

Discontinuities and inclusions are important and should be described. Such features include joints or fissures, slickensides, bedding or laminations, veins, root holes, and wood debris.

Significant mineralogical information such as cementation, abundant mica, or unusual mineralogy should be described.

Other descriptors may include particle size range or percentages, particle angularity or shape, maximum particle size, hardness of large particles, plasticity of fines, dry strength, dilatancy, toughness, reaction to HCl, and staining, as well as other information such as organic debris, odor, or presence of free product.

K. Equipment and Calibration

Before starting the testing, the equipment should be inspected for compliance with the requirements of ASTM D 1586. The split-barrel sampler should measure 2-inch or 3-inch OD, and should have a split tube at least 18 inches long. The minimum size sampler rod allowed is “A” rod (1-5/8-inch OD). A stiffer rod, such as an “N” rod (2-5/8-inch OD), is required for depths greater than 50 feet. The drive weight assembly should consist of a 140-pound or 300-pound hammer weight, a drive head, and a hammer guide that permits a free fall of 30 inches.

IV. Attachments

Soil Boring Log (Sample Soil Boring Log.xls)

Soil Boring Log Form with a completed example (Soil_Log_Examp.pdf)

Tables 1 through 4 (Tables 1-4.pdf)

V. Key Checks and Preventive Maintenance

- Check entries to the soil-boring log and field logbook in the field; because the samples will be disposed of at the end of fieldwork, confirmation and corrections cannot be made later.
- Check that sample numbers and intervals are properly specified.
- Check that drilling and sampling equipment is decontaminated using the procedures defined in SOP *Decontamination of Drilling Rigs and Equipment*.

VI. References

ASTM D2488-17e1, Standard Practice for Description and Identification of Soils (Visual-Manual Procedures), ASTM International, West Conshohocken, PA, 2017, www.astm.org

ASTM D1586 / D1586M-18, Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils, ASTM International, West Conshohocken, PA, 2018, www.astm.org

JACOBS	PROJECT NUMBER	BORING NUMBER
	SOIL BORING LOG	

PROJECT :
LOCATION :
ELEVATION :
DRILLING CONTRACTOR :
DRILLING METHOD AND EQUIPMENT USED :
ATD WATER LEVEL :
START :
END :
LOGGER :

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS PID Readings: Breathing Zone: Above Hole:

CH2M HILL

PROJECT NUMBER	BORING NUMBER SHEET OF

SOIL BORING LOG

PROJECT ______ LOCATION ______

ELEVATION ______ DRILLING CONTRACTOR ______

DRILLING METHOD AND EQUIPMENT ______

WATER LEVELS ______ START ______ FINISH ______ LOGGER ______

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION

Figure 1
SOIL BORING LOG,
FORM D1586

REV 11/89 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	SHEET 1 OF 3
DEN 22371.G5	BL-3	

SOIL BORING LOG

PROJECT Howard Ave Landslide LOCATION Howard & 24th Ave, Centennial, CO.
ELEVATION 5136 Feet DRILLING CONTRACTOR Kendall Explorations, Ashcan, Colorado
DRILLING METHOD AND EQUIPMENT 4"-inch H.S. Augers, Mobil B-61 rotary drill rig
WATER LEVELS 3.2 Feet, 8/5/89 START August 4, 1989 FINISH August 8, 1989 LOGGER J.A.Michner

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	2.5				Surface material consist of 4 inches AC underlain by 6 inches of 3/4 inch minus base rock	Start Drilling @ 3:00
	4.0	1-S	1.5	2-3-4 (7)	POORLY-GRADED SAND WITH SILT, (SP-SM), fine, light brown, wet, loose	Driller notes water at 4 feet
5	5.0 6.5	2-S	0.9	WOH/12"-1	ORGANIC SILT, (OL), very dark, gray to black, wet, very soft; strong H_2S odor, many fine roots up to about 1/4 inch	Driller notes very soft drilling 4ft. dark grey, wet silty cuttings.
	8.0 10.0	3-ST	1.3	—	ORGANIC SILT, similar to 2-S, except includes fewer roots (by volume)	
10	11.5	4-S	1.3	2-2-2 (4)	SILT, (ML), very dark gray to black, wet, soft	water level @ 3.2 feet on 8/5/89 @ 0730 Driller notes rough drilling action and chatter @ 13ft
15	15.0 15.5	5-S	0.5	60/6"	SILTY GRAVEL, (GM), rounded gravel up to about 1 inch maximum observed size, wet, very dense	
20	20.0 21.0	6-S	1.0	12-50/6"	LEAN CLAY WITH SAND, (CL), medium to light green, moist, very stiff	Driller notes smoother, firm drilling @ 19 ft some angular rock chips @ bot tip of 6-S, poss boulders or rock Driller notes very hard, slow grinding, smooth drilling action from 21 to 23 ft, possibly bedrock
	23.0 23.1	7-S	~~0~~	50/1"	NO RECOVERY	
					END SOIL BORING @ 23.1 FEET SEE ROCK CORE LOG FOR CONTINUATION OF BL-3	

Figure 2
EXAMPLE OF COMPLETED LOG FORM

REV 11 89 FORM D1586

Table 1
EXAMPLE SOIL DESCRIPTIONS

POORLY GRADED SAND (SP), light brown, moist, loose, fine sand size

FAT CLAY (CH), dark gray, moist, stiff

SILT (ML), light greenish gray, wet, very loose, some mica, lacustrine

WELL-GRADED SAND WITH GRAVEL (SM), reddish brown, moist, dense, subangular gravel to 0.6 inches max

POORLY GRADED SAND WITH SILT (SP-SM), white, wet, medium dense

ORGANIC SOIL WITH SAND (OH), dark brown to black, wet, firm to stiff but spongy undisturbed, becomes soft and sticky when remolded, many fine roots, trace of mica

SILTY GRAVEL WITH SAND (GM), brownish red, moist, very dense, subrounded gravel to 1.2 inches max

INTERLAYERED SILT (60 percent) AND CLAY (40 percent): SILT WITH SAND (ML), medium greenish gray, nonplastic, sudden reaction to shaking, layers mostly 1.5 to 8.3 inches thick; LEAN CLAY (CL), dark gray, firm and brittle undisturbed, becomes very soft and sticky when remolded, layers 0.2 to 1.2 inches thick

SILTY SAND WITH GRAVEL (SM), light yellowish brown, moist, medium dense, weak gravel to 1.0 inches max, very few small particles of coal, fill

SANDY ELASTIC SILT (MH), very light gray to white, wet, stiff, weak calcareous cementation

LEAN CLAY WITH SAND (CL/MH), dark brownish gray, moist, stiff

WELL-GRADED GRAVEL WITH SILT (GW-GM), brown, moist, very dense, rounded gravel to 1.0 inches max

Table 2
CRITERIA FOR DESCRIBING MOISTURE CONDITION

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp, but no visible water
Wet	Visible free water, usually soil is below water table

Table 3
RELATIVE DENSITY OF COARSE-GRAINED SOIL
(Developed from Sowers, 1979)

Blows/Ft	Relative Density	Field Test
0-4	Very loose	Easily penetrated with ½-in. steel rod pushed by hand
5-10	Loose	Easily penetrated with ½-in. steel rod pushed by hand
11-30	Medium	Easily penetrated with ½-in. steel rod driven with 5-lb hammer
31-50	Dense	Penetrated a foot with ½-in. steel rod driven with 5-lb hammer
>50	Very dense	Penetrated only a few inches with ½-in. steel rod driven with 5-lb hammer

Table 4
CONSISTENCY OF FINE-GRAINED SOIL
(Developed from Sowers, 1979)

Blows/Ft	Consistency	Pocket Penetrometer (TSF)	Torvane (TSF)	Field Test
<2	Very soft	<0.25	<0.12	Easily penetrated several inches by fist
2-4	Soft	0.25-0.50	0.12-0.25	Easily penetrated several inches by thumb
5-8	Firm	0.50-1.0	0.25-0.5	Can be penetrated several inches by thumb with moderate effort
9-15	Stiff	1.0-2.0	0.5-1.0	Readily indented by thumb, but penetrated only with great effort
16-30	Very stiff	2.0-4.0	1.0-2.0	Readily indented by thumbnail
>30	Hard	>4.0	>2.0	Indented with difficulty by thumbnail

STANDARD OPERATING PROCEDURE

Water-Level Measurements

I. Purpose and Scope

The purpose of this procedure is to provide a guideline for the measurement of the depth to groundwater in piezometers and monitoring wells, even where a second phase of floating liquid (e.g., gasoline) is encountered, and on staff gauges in surface-water bodies. This SOP includes guidelines for discrete measurements of static water levels and does not cover the use of continuously recording loggers (see SOP *Use of Data Loggers and Pressure Transducers)*.

II. Equipment and Materials

- Electronic water-level meter (Solinst® or equivalent) with a minimum 100-foot tape; the tape should have graduations in increments of 0.01 feet or less
- Interface probe (Solinst® Model 122 Interface Meter or equivalent)

III. Procedures and Guidelines

Verify that the unit is turned on and functioning properly. Slowly lower the probe on its cable into the piezometer or well until the probe just contacts the water surface; the unit will respond with a solid tone or light signal. Note the depth from a reference point indicated on the piezometer or well riser. Typically, this is the top of the PVC casing. If no reference is clearly visible, measure the depth to water from the northern edge of the PVC casing. If access to the top of the PVC casing is difficult, sight across the top of the locking casing adjacent to the measuring point, recording the position of the cable when the probe is at the water surface.

Measure the distance from this point to the closest interval marker on the tape and record the water level reading in the logbook. Water levels will be measured to the nearest 0.01-foot. Also, when specified in the project plans, measure and record the depth of the piezometer or well. The depth of the piezometer or well may be measured using the water-level probe with the instrument turned off.

Free product light or dense nonaqueous phase liquid may be present in the piezometer or well. If the presence of free product is suspected, the thickness of the product should be determined using appropriate equipment (e.g., Solinst® Model 122 Interface Meter). The depth to water also is determined with this equipment and the water-level meter should not be used in the piezometer or well as long as product is present. Typically, a constant sound is emitted from the device when free product is encountered and an alternating on/off beep sound is emitted when water is encountered.

The apparent elevation of the water level in the well or piezometer is determined by measuring both the apparent depth to water and the thickness of free product. The corrected water-level elevation is calculated by the following equation:

$$WL_c = Wl_a + (\text{Free-product thickness x } 0.80)$$

Where WL_c = Corrected water-level elevation

Wl_a = Apparent water-level elevation

0.80 = Typical value for the density of petroleum hydrocarbon products.

If free product is detected on the surface of the water in the piezometer or well, the value of sampling should be reconsidered because of the potential for contaminating the sampling equipment.

Staff gauges may be installed in some surface-water bodies. These facilities typically are constructed by attaching a calibrated, marked staff gage to a wood or metal post, driving the post into the bottom of the surface-water body, and surveying the elevation of the top of the post to a resolution or 0.01-foot. The elevation of the water in the surface-water body then can be determined by reading off the distance the water level is from the top of the post. A shield or other protection may be needed to calm the fluctuations in water level if the gauge is installed at a location exposed to wind or wave.

IV. Attachments

None.

V. Key Checks

- Before each use, verify that the battery is charged by pressing the test button on the water-level meter.
- Verify that the unit is operating correctly by testing the probe in distilled or de-ionized water. Leave the unit turned off when not in use.

STANDARD OPERATING PROCEDURE

Multi RAE Photoionization Detector (PID)

I. Purpose

The purpose of this SOP is to provide general reference information for using the Multi RAE PID in the field. Calibration and operation, along with field maintenance, will be included in this SOP.

II. Scope

This procedure provides information on the field operation and general maintenance of the Multi RAE PID. Review of the information contained herein will ensure that this type of field monitoring equipment will be properly utilized. Review of the owner's instruction manuals is a necessity for more detailed descriptions.

III. Definitions

Carbon Monoxide Sensor (CO) - Carbon Monoxide concentration in ppm.

Volatile Organic Compound (VOC) – VOC concentration in ppm

Lower Explosive Limit (LEL) - Combustible gas is expressed as a percent of the lower explosive limit.

Hydrogen Sulfide Sensor (H_2S) - Hydrogen Sulfide concentration in ppm.

Oxygen Sensor (OXY) - Oxygen concentration as a percentage.

ppm - parts per million: parts of vapor or gas per million parts of air by volume.

IV. Procedures

The PID operates on the principle that most organic compounds and some inorganic compounds are ionized when they are bombarded by high-energy ultraviolet light. The air sample is drawn across a UV lamp using a pump or a fan. The energy of the lamp determines whether a particular chemical will be ionized. Each chemical compound has a unique photoionization potential (PIP). When the UV light energy is greater than the ionization potential of the chemical, ionization will occur. All PID readings are relative to the calibration gas, usually isobutylene.

It is important to calibrate the PID in the same temperature and elevation that the equipment will be used, and to determine the background concentrations in the field before taking measurements. For environments where background readings are high, factory zero calibration gas should be used.

Note: For volatile and semi-volatile compounds, knowing the PIP is critical in determining the appropriate instrument to use when organic vapor screening. Consult the QAPP and manufacturer's manual to determine that the proper instrument has been selected for the contaminate vapors of interest. If an expected compound at a site has a PIP less than 11.7 eV, it is possible to use a PID. If the ionization potential is greater than 11.7eV, a flame-ionization detector is required.

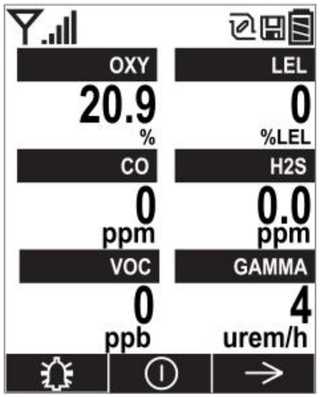
The following subsections will discuss Mini RAE calibration, operation, and maintenance. These sections, however, do not take the place of the instruction manual.

A. Calibration

For Multi RAE configured with O_2, LEL, H_2S, CO, sensors and a 10.6 eV PID Lamp.

Start up Instrument

- Press **Mode** button
- A RAE Systems logo (or a company name) should appear first. This is followed by a progression of screens that tell you the MultiRAE's current settings:
    - Product name and model number, air flow type, and serial number
    - Application firmware version, build date, and build time
    - Sensor firmware, build date, build time
    - Installed sensors (including serial number/production/expiration/calibration date and alarm limit settings)
    - Current date, time, temperature, and relative humidity
    - User mode and operation mode
    - Battery type, voltage, shutoff voltage
    - Alarm mode and alarm settings
    - Datalog period (if it is activated) and interval
    - Policy Enforcement settings (whether calibration and/or bump testing are enforced)
- Then the MultiRAE's main reading screen appears. It may take a few minutes for sensors to show a reading, so if any have not warmed up by the time the main screen is shown, you will see "- - -" instead of a numerical value until the sensor provides data (typically less than 2 minutes). Then it displays instantaneous readings similar to the following screen (depending on the sensors installed) and is ready for use.

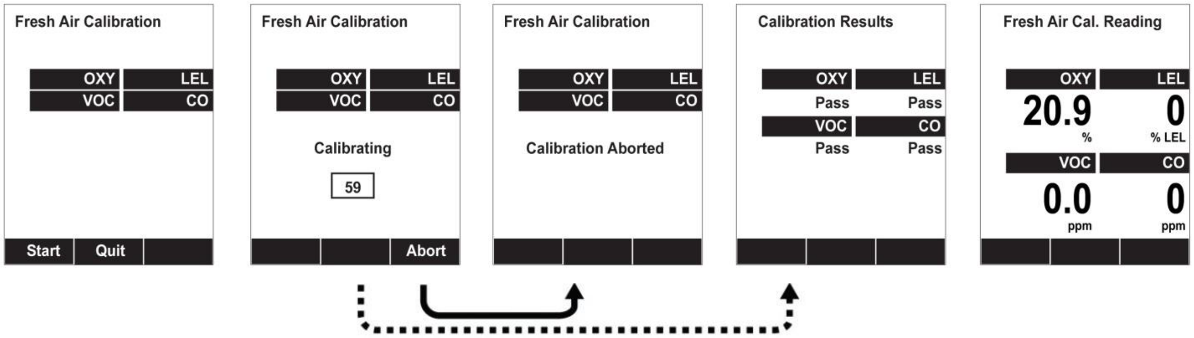


Calibration Check and Adjustment

Zero Calibration

- At the Calibration Menu, select "Fresh Air." Press [Y/+] once to enter the fresh air calibration sub-menu.

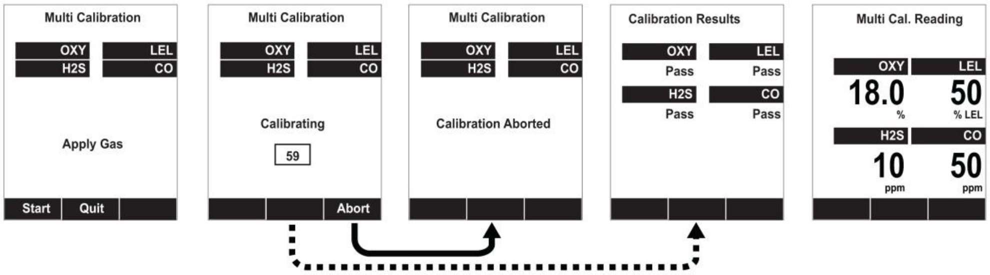
- Press **[Y/+]** to start fresh air calibration
- A countdown screen appears. You can abort the calibration at any time during the countdown by pressing [N/-].

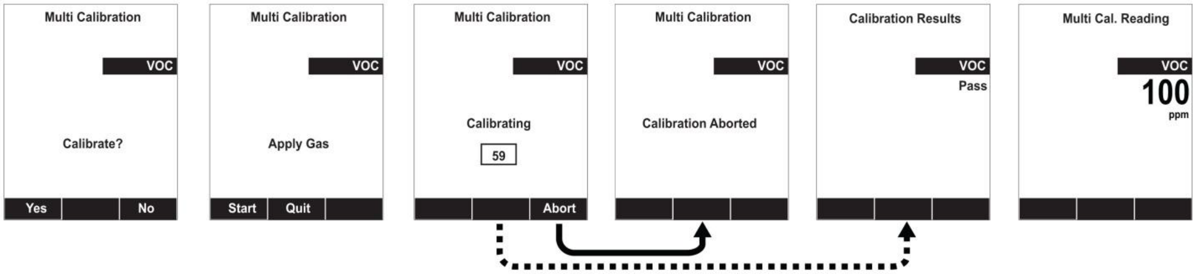


- Note: Dotted line indicates automatic progression
- If the calibration is not aborted, the display shows the sensor names and tells you whether the fresh air calibration passed or failed, followed by the sensors' fresh air readings

Multi Sensor Span Calibration

- Depending on the configuration of your MultiRAE and span gas you have, you can perform a span calibration simultaneously on multiple sensors. You can define which sensors are calibrated together using the Multi Cal Select menu described in section 8.3.2.9.
- In case all sensors in the instrument cannot be calibrated with the same gas, the MultiRAE will intelligently split the span calibration process into several steps and will provide menu prompts accordingly.
- At the Calibration Menu, select "Multi Sensor Span."
- Install the calibration adapter and connect it to a source of calibration gas.
- Start the flow of calibration gas.
- Press **[Y/+]** to start calibrating or wait for calibration to start automatically.
- A countdown screen is shown. You can abort the calibration at any time during the countdown by pressing **[N/-]**.



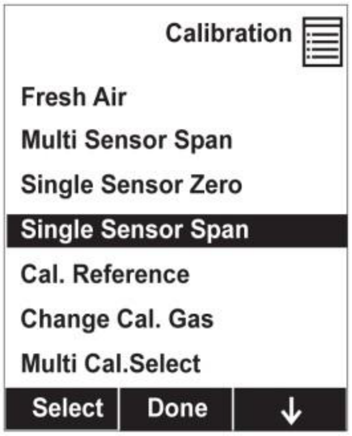


- Note: Dotted line indicates automatic progression
- If the calibration is not aborted, the display shows the sensor names and tells you whether the calibration passed or failed, followed by the sensor readings.

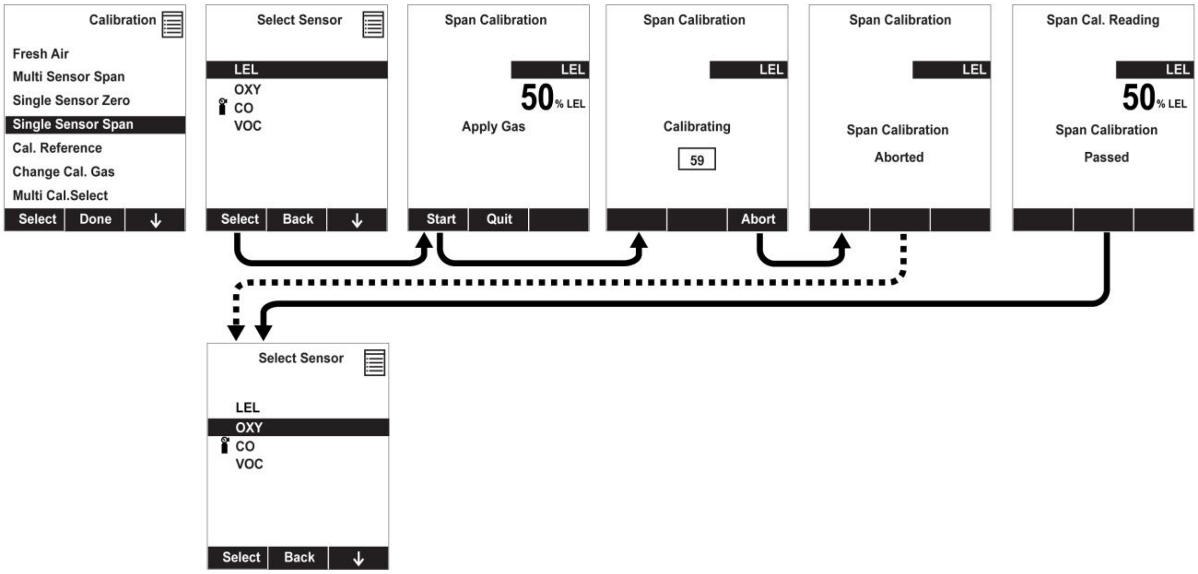
Single Sensor Span Calibration

- Instead of performing a span calibration on multiple sensors simultaneously, you can select a single sensor and perform a span calibration.
- To perform span calibration of an individual sensor, follow these steps:
- At the Calibration Menu, select "Single Sensor Span."
- Select a sensor to calibrate from the list.
- Install the calibration adapter and connect it to a source of calibration gas.
- Verify that the displayed calibration value meets the concentration specified on the gas cylinder.

- Start the flow of calibration gas.



- Press [Y/+] to start calibrating or wait for calibration to start automatically.
- A countdown screen appears. You can abort the calibration at any time during the countdown by pressing [N/-].



- Note: Dotted line indicates automatic progression
- Select the done button when calibration is complete.
- **CALIBRATION IS COMPLETE!**

B. Operation

Due to the Multi RAE having many functions in terms of operation, it is recommended that you follow the operational procedures as outlined in the instruction manual.

C. Site Maintenance

After each use, the meter should be recharged and the outside of the instruments should be wiped clean with a soft cloth.

D. Scheduled Maintenance

Function	Frequency
Check alarm and settings	Monthly/before each use
Clean screens and gaskets around sensors	Monthly
Replace sensors	Biannually or when calibration is unsuccessful

V. Quality Assurance Records

Quality assurance records will be maintained for each air monitoring event. The following information shall be recorded in the field logbook.

- Identification - Site name, date, location, CTO number, activity monitored, (surface water sampling, soil sampling, etc), serial number, time, resulting concentration, comments and identity of air monitoring personnel.
- Field observations - Appearance of sampled media (if definable).
- Additional remarks (e.g, Multi RAE had wide range fluctuations during air monitoring activities.)

VI. References

Multi RAE User's Guide, RAE Systems, Revision C, May 2013.

Groundwater Sampling for Per- and Polyfluoroalkyl Substances (PFAS)

I. Purpose and Scope

This SOP provides guidelines for groundwater sample collection for samples that will be analyzed for per- and polyfluoroalklyl substances (PFAS) via LC/MS/MS Compliant with the most recent version of the Quality Systems Manual (QSM) for which the lab is certified. This SOP should be used in conjunction with approved region-specific groundwater sampling SOPs which provide methods for general and low-flow groundwater sampling. In cases in which information in this SOP conflicts with region-specific groundwater sampling SOPs, this SOP will supersede the information in the general SOPs.

Standard techniques for collecting representative samples are summarized. These procedures are specific to the Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program. Materials, equipment, and procedures may vary; refer to the Sampling and Analysis Plan and operator's manuals for specific details.

II. Equipment and Materials

A. Equipment and Materials Required

- If installing wells, ensure driller does not use polytetrafluoroethylene (PFTE)-containing drill lube or other drilling lubes containing PFAS. Biolube has been determined to be an acceptable drilling lube for installing wells where PFAS may be of concern. Additionally, Waterra surge blocks have been confirmed to not contain PFAS and may be used for development.
- Groundwater sampling equipment
  - PFAS-free tubing (avoid Teflon, Viton, PTFE and other fluorinated compounds)
    - High density polyethylene tubing (unlined)
    - If Masterflex tubing is needed for peristaltic pumps, Cole Parmer C-Flex (06424 series) and Tygon E-3603 (06509 series) are suitable options
  - PFAS-free Bailer (if using a bailer[1])

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[1] Geotech and Waterra offer PFAS free bailer options

  - PFAS-free Pump such as:
    - Geotech PFAS-free Portable Bladder Pump (note, most bladder pumps include a Teflon-lined bladder, but Geotech currently has one model which is Teflon-free).
    - Panacea P120 or P125. The P200 Stainless Steel Pump may also be used, but the standard model contains Teflon at the tube connection. If you are using this Panacea model, you must request one with the "PTFE-free thread sealant option."
    - Waterra stainless foot-valve
    - QED Sample Pro
    - Monsoon or Mega Monsoon submersible pump
    - Grundfos Rediflo2 (this pump contains small Teflon components, but has not been shown to leach, it is less preferable than the other options)
    - Peristaltic pump (may be suitable for shallow locations)
- Groundwater sample containers (high density polyethylene [HDPE] bottle with HDPE screwcap), sample bottles should not be glass as glass may sorb PFAS. Sample bottle caps should not contain Teflon. Notify your project manager (PM) if bottles provided by the lab are glass or contain Teflon parts.
- Laboratory prepared deionized, certified PFAS-free water for field blank collection
- PFAS-free shipping supplies (labels [if available][2], coolers, and ice)
- Loose leaf paper without waterproof coating or a spiralbound notebook (not waterproof) or tablet (see tablet use notes below)
- Metal clip board (if using loose-leaf paper)
- Pen (not Sharpie)
- Nitrile or latex gloves

B. Equipment and Materials to Avoid During Sampling

Equipment and materials used to collect groundwater samples should not contain any fluorinated compounds, Teflon, or synthetic rubber with fluoropolymer elastomers (e.g., Viton).

Specifically, the following material should be avoided during sampling:

- Gore-Tex brand or similar high-performance outdoor clothing, clothing treated with ScotchGuard brand or similar water repellent, fluoropolymer-coated Tyvek, wrinkle-resistant fabrics, and fire-resistant clothing with fluorochemical treatment or anything advertised as water repellant.
- Weather-proof log books with fluorochemical coatings.
- New clothing that has been washed fewer than six times.

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[2] Efforts will be made to obtain PFAS-free labels; however, information on labels is scarce and labels are frequently mounted on PFAS-coated paper to allow for easy removal.

The sample collection area should be clear of the following items:

- Pre-packaged food wrappers (e.g., fast food sandwich wrappers, pizza boxes, etc.)
- Microwave popcorn bags
- Blue ice containers
- Non-Stick aluminum foil
- Kim-Wipes
- Sunscreen, insect repellant and other personal hygiene products that may contain PFAS

Research which has not yet been published has allowed us to generate a list of sunscreens and insect repellents which do not contain fluorine. Check with Bill Diguiseppi or Laura Cook on recommendations (because the research is not ours, it cannot be released externally at this time).

The use of electronics (e.g., cell phones and tablets) should be avoided without the implementation of precautionary measures outlined below:

  - All devices should be used with clean, ungloved hands and an approved stylus (if desired).

Following the use of a device, hands must be washed with soap and water and clean gloves should be used prior to contact with sampling equipment (bottleware, tubing, etc.).

III. Procedures and Guidelines

Wash hands with dish detergent before sampling and don nitrile gloves. Do not use Kleen Guard powder free nitrile gloves which were shown in research to contain fluorine

Follow Navy CLEAN SOPs for low-flow or conventional groundwater sample collection, depending on site requirements.

A. Sample Collection

Once water quality parameters have stabilized for low-flow purging, samples can be collected. For conventional purging, if water quality parameters do not stabilize, a minimum of 3 well volumes must be purged prior to sample collection.

The steps to be followed for sample collection are as follows:

1. Ensure that the end of the tubing does not touch the ground or equipment. Remove the cap from the sample bottle. Position the sample bottle under the end of the tubing.
2. Fill the bottle. Do not fill the bottle past the middle of the bottle shoulder. Samples do not need to be collected headspace free.
3. Affix labels after bottles have been closed; collect only one sample at a time to avoid mislabeling. Pack the sample on ice immediately for shipment to the offsite laboratory. Avoid packing materials that may contain fluorine. Unpublished research has allowed us to generate a list of packing materials which do not contain fluorine. Please contact Bill Diguiseppi or Laura Cook for recommendations (because the research is not ours, it cannot be released externally at this time).

B. Equipment Decontamination

Whenever possible, use disposable equipment when collecting groundwater samples. If reusable equipment must be used, the equipment must be cleaned/decontaminated between uses. Alconox and Liquinox soap are acceptable for cleaning/decontaminating reusable equipment at PFAS sites. Any water used for cleaning/decontamination must be certified PFAS-free by a laboratory. Consider triple-rinsing. Once decontaminated, wrap equipment in plastic bags (such as Ziploc) or un-coated aluminum foil, and store away from potential PFAS sources.

Use of Water Quality Equipment and Water Level Indicators

Water quality meters typically do not contain PFAS. However, consistent with general sampling SOPs, disconnect the water quality meter prior to sampling. Some water level indicators do contain small polyvinylidene fluoride (a PFAS constituent for which we do not currently monitor) or less frequently, Teflon, components, but we have not noted cross contamination from water level indicators at any sites. The Durham Geoslope Water Level Indicators and the Solinst Model 101 with the P2 meter have been shown to be fluorine free.

IV. References

United States Environmental Protection Agency (USEPA), 2009. *Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/ Tandem Mass Spectrometry (LC/MS/MS).* September.

United States Navy, 2020. *Interim Per- and Polyfluoroalkyl Substances (PFAS) Site Guidance for NAVFAC Remedial Project Managers (RPMs)/November 2020 Update*. November.

United States Navy, 2015. *Navy Drinking Water Sampling Policy for Perfluorochemicals: Perfluorooctane Sulfonate and Perfluorooctanoic Acid.* September.

DRAFT FINAL STANDARD OPERATING PROCEDURE – Navy CLEAN PROGRAM

Rotosonic Groundwater Sample Collection for Per- and Polyfluoroalkyl Substances

I. Purpose and Scope

This SOP provides guidelines for groundwater sample collection using rotosonic drilling technology for samples that will be analyzed for per- and polyfluoroalklyl substances (PFAS) via LC/MS/MS Compliant with QSM 5.1 Table B-15.

Standard techniques for collecting representative samples are summarized. These procedures are specific to the Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program under Contract N62470-16-D-9000. Materials, equipment, and procedures may vary; refer to the Sampling and Analysis Plan and operator’s manuals for specific details.

II. Equipment and Materials

Equipment and Materials Required

- Sonic drill sampling rods and retractable stainless-steel screen without PFAS-containing components (Avoid Teflon, Viton, PTFE and all other fluorinated compounds)
- PFAS-free tubing (avoid Teflon, Viton, PTFE and other fluorinated compounds)
    - High density polyethylene tubing (unlined)
    - Masterflex tubing, Cole Parmer C-Flex (06424 series) and Tygon E-3603 (06509 series) are suitable options
- Water quality meter (Horiba® or YSI®)
- PFAS-free bladder pump
- Pre-cleaned sample containers
- Air monitoring and water quality instruments (as needed)
- Personal protective equipment
- Groundwater sample containers (high density polyethylene [HDPE] with HDPE screw cap [no Teflon caps])
- PFAS-free shipping labels (if available[1]) materials
- Loose leaf paper or a wire-bound notebook without waterproof coating
- Metal clipboard
- Pen (not Sharpie)
- Nitrile or Latex gloves
- Laboratory prepared deionized, certified PFAS-free water for field blank collection
- PVC casing and screen for temporary well

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[1] Efforts will be made to obtain PFAS-free labels; however, information on labels is scarce and labels are frequently mounted on PFAS-coated paper to allow for easy removal.

Ensure the driller has not used and will not use drilling lube containing polytetrafluoroethylene (PFTE) or any other fluorine-containing substance. Biolube has been determined to be an acceptable substitute.

Equipment and Materials to Avoid During Sampling

Equipment and materials used to collect groundwater samples should not contain any fluorinated compounds, Teflon, or synthetic rubber with fluoropolymer elastomers (e.g., Viton).

Specifically, the following material should be avoided during sampling:

- Gore-Tex brand or similar high-performance outdoor clothing, clothing treated with ScotchGuard brand or similar water repellent, fluoropolymer-coated Tyvek, wrinkle-resistant fabrics, and fire-resistant clothing with fluorochemical treatment or anything advertised as water repellant.
- Weather-proof log books with fluorochemical coatings
- New clothing that has been washed fewer than six times

The sample collection area should be clear of the following items:

- Pre-packaged food wrappers (e.g., fast food sandwich wrappers, pizza boxes, etc.)
- Microwave popcorn bags
- Blue ice containers
- Non-stick aluminum foil
- Kim-Wipes
- Sunscreen, insect repellant and other personal hygiene products that may contain PFAS

Research which has not yet been published has allowed us to generate a list of sunscreens and insect repellents which do not contain fluorine. Check with Bill Diguiseppi or Laura Cook on recommendations (because the research is not ours, it cannot be released externally at this time).

III. Procedures and Guidelines

Wash hands with dish detergent before sampling and don nitrile gloves. Do not use Kleen Guard powder free nitrile gloves which were shown in research to contain fluorine.

Once the area has been determined to be free of materials potentially containing PFAS, these steps can be followed to collect the sonic groundwater sample:

1) Decontaminate slotted lead rod and other downhole equipment in accordance with SOP *Decontamination of Personnel and Equipment* and this SOP.

2) Advance the drive-ahead sampler to the desired sampling depth and withdraw the rods 2 to 3 feet to expose the retractable screen to the aquifer formation. Ensure that the screened lead rod has been inserted to the desired sampling depth. If using temporary well casing, deploy PVC screen and casing to desired sampling depth.

3) Deploy your sampling pump to mid-screen.

4) Purge the volume of water added to the well during drilling. If no water has been used, purge three well volumes from the casing. When using the drive-ahead sampler, calculate

the well volume as the volume of water in the drill rod (bullet a). When using a temporary well, calculate the well volume as the volume of water in the casing plus the volume of water in the sand pack (bullet b).

a) To calculate the volume of water in the drill rod, use the appropriate coefficient for the rod diameter given under "Well Casing Volume per Foot of Depth" on the attached reference sheet (Geotech, 2019). Then use the following formula:

   V (gallons) = coefficient * *h* (where *h* is the height of the water column in feet)

b) To calculate the volume of the temporary well casing and sand pack, first calculate the volume of the casing as above. Then calculate the volume of the annulus using the coefficients given under "Volume of Annulus" on the reference sheet (Geotech, 2019). The volume of the annulus is then multiplied by the porosity of the sand pack (a porosity of 0.35 can be assumed for this case). This is summarized in the following formula:

   V (gallons) = V_casing + (0.35 * V_annulus)

c) Note: If the sample interval / well is unable to produce enough water to generate three well volumes or if it goes dry, then the volume purge method will not be used. In this case, the casing will be pumped dry and allowed to recharge to 90% of the static water level (time permitting) before sampling.

5) Collect and record one set of water quality parameters prior to sampling.

6) Fill all sample containers. Samples should be collected in accordance with SOP *Groundwater Sampling when Analyzing for Per- and Polyfluoroalkyl Substances (PFAS)***.** Affix labels after bottles have been closed; collect only one sample at a time to avoid mislabeling.

7) Remove and discard polyethylene sampling tubing from the rods. Withdraw PVC temporary PVC screen and casing.

Equipment Decontamination

Ensure that the sonic rig operator thoroughly completes the decontamination process between sampling locations. Do not use water from the facility (e.g. fire hydrants) if there is a possibility that the water available is contaminated with PFAS.

Whenever possible, use disposable equipment when collecting groundwater samples. If reusable equipment must be used, the equipment must be cleaned/decontaminated between uses. Alconox and Liquinox soap are acceptable for cleaning/decontaminating reusable equipment at PFAS sites. Any water used for cleaning/decontamination must be certified PFAS-free by a laboratory. Consider triple-rinsing. Once decontaminated, wrap equipment in plastic bags (such as Ziploc), and store away from potential PFAS sources.

Use of Water Quality Equipment

Water quality meters typically do not contain PFAS. However, consistent with general sampling SOPs, disconnect the water quality meter prior to sampling.

References

Geotech, 2019. *Water Measure Tables*. Web. 28 March 2019.

United States Environmental Protection Agency (USEPA), 2009. *Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)*. September.

United States Navy, 2015. *Navy Drinking Water Sampling Policy for Perfluorochemicals: Perfluorooctane Sulfonate and Perfluorooctanoic acid.* September.

Soil Sampling for Per- and Polyfluoroalkyl Substances

I. Purpose

This SOP provides guidelines for soil sample collection and handling for samples that will be analyzed for per- and polyfluoroalkyl substances (PFAS) via LC/MS/MS Compliant with the most recent version of the Quality Systems Manual (QSM) for which the lab is certified at the time of analysis. Standard techniques for collecting representative samples are summarized. These procedures are specific to the Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program. Materials, equipment, and procedures may vary; refer to the Sampling and Analysis Plan and operator's manuals for specific details.

II. Equipment and Materials

A. Equipment and Materials Required

A hand auger or other device that can be used to remove the soil from the ground. Stainless steel tools, carbon steel tools, or steel DPT tooling with acetate sleeves are preferred for PFAS sampling. Avoid any sampling materials containing PFAS (such as Teflon, Viton, PTFE, or other fluorinated compounds). Any plastic sampling materials should be evaluated thoroughly before selection to ensure they are fluorine-free.

A stainless steel spatula or fluorine-free disposable plastic scoop should be used to remove material from the sampling device.

Unpainted wooden stakes or pin flags

Fiberglass measuring tape (at least 200 feet in length)

GPS Unit

- PFAS-free labels (if available[1]) shipping materials
- Loose leaf paper or a wire-bound notebook without waterproof coating or tablet (see notes on tablet use below)
- Metal clipboard (if using loose-leaf paper)
- Pen (not Sharpie)

Personal protection equipment (rubber or latex gloves, boots, etc.). Check with your SME prior to selecting PPE to ensure there are no fluorine-containing components.

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[1] Efforts will be made to obtain PFAS-free labels; however, information on labels is scarce and labels are frequently mounted on PFAS-coated paper to allow for easy removal.

Sample jars (sample jars should be made of high density polyethylene (HDPE) as glass jars may sorb PFAS, please notify the project manager [PM] if glass jars are provided by the lab). Sample containers should not contain Teflon lids.

Laboratory-prepared deionized, certified PFAS-free water for field blank collection

B. Equipment and Materials to Avoid During Sampling

Equipment and materials used to collect soil samples should not contain any fluorinated compounds including Teflon or synthetic rubber with fluoropolymer elastomers (e.g. Viton).

If a driller is supporting collection of soil samples in split spoons or acetate DPT sleeves, ensure the driller has not used and will not use drilling lube containing polytetrafluoroethylene (PTFE) or any other fluorine-containing substance. Biolube has been determined to be an acceptable substitute.

Specifically, the following material should be avoided during sampling:

- Gore-Tex brand or similar high-performance outdoor clothing, clothing treated with ScotchGuard brand or similar water repellent, fluoropolymer-coated Tyvek, wrinkle-resistant fabrics, and fire-resistant clothing with fluorochemical treatment or anything advertised as water repellant.
- Weather-proof log books with fluorochemical coatings.
- New clothing that has been washed fewer than six times.

The sample collection area should be clear of the following items:

- Pre-packaged food wrappers (e.g., fast food sandwich wrappers, pizza boxes, etc.)
- Microwave popcorn bags
- Blue ice containers
- Non-stick aluminum foil
- Kim-Wipes
- Sunscreen, insect repellant and other personal hygiene products that may contain PFAS

Contact your PFAS SME for an approved list of sunscreens and insect repellants.

The use of electronics (e.g., cell phones and tablets) should be avoided without the implementation of precautionary measures outlined below:

  - All devices should be used with clean, ungloved hands and an approved stylus (if desired).

Following the use of a device, hands must be washed with soap and water and clean gloves should be used prior to contact with sampling equipment (bottleware, tubing, etc.).

III. Procedures and Guidelines

Once the area has been determined to be free of materials potentially containing PFAS, these steps can be followed to collect the soil samples:

Wear protective gear, as specified in the Health and Safety Plan.

To locate samples, identify the correct location using the pin flags or stakes. Proceed to collect a sample from the undisturbed soil adjacent to the marker following steps C and D. If markers are not present, the following procedures will be used.

A. Samples On A Grid

1. Use measuring tape to locate each sampling point on the first grid line as prescribed in the sampling plan. As each point is located, drive a numbered stake in the ground and record its location on the site map and in the field notebook/clipboard.
2. Proceed to sample the points on the grid line.
3. Measure to location where next grid line is to start and stake first sample. For subsequent samples on the line take two orthogonal measurements: one to the previous grid line, and one to the previous sample on the same grid line.
4. Proceed to sample the points on the grid line as described in Section C below.
5. Make sure to stake location after sample collection in case professional surveying is to be completed.
6. Repeat 1c and 1e above until all samples are collected from the area.
7. Or, a GPS unit can be used to identify each location based on map coordinates, if available.

B. Non-Grid Samples

1. Use measuring tape to position sampling point at location described in the sampling plan by taking two measurements from fixed landmarks (e.g., corner of house and fence post).
2. Note measurements, landmarks, and sampling point on a sketch in the field notebook, and on a site location map.
3. Proceed to sample as described in Section C below.
4. Make sure to stake location after sample collection in case professional surveying is to be completed.
5. Repeat 2a through 2d above until all samples are collected from the area.
6. Or, a GPS unit can be used to identify each location based on map coordinated, if available.

To the extent possible, differentiate between fill and natural soil. If both are encountered at a boring location, sample both as prescribed in the field sampling plan. Do not locate samples in debris, tree roots, or standing water. In residential areas, do not sample in areas where residents' activities may impact the sample (e.g., barbecue areas, beneath eaves of roofs, driveways, garbage areas). If an obstacle prevents sampling at a measured grid point, move as close as possible, but up to a distance of one half the grid spacing in any direction to locate an appropriate sample. If an appropriate location cannot be found, consult with the Field Team Leader (FTL). If the FTL concurs, the sampling point may be deleted from the program. The FTL will contact the CH2M HILL PM immediately. The PM and Navy Technical Representative (NTR) will discuss whether the point should be deleted from the program. If it is deleted, the PM will follow-up with the NTR in writing.

C. Collecting Samples Using Hand Tools

1. Use a decontaminated stainless steel scoop/trowel or disposable plastic scoop to scrape away surficial organic material (grass, leaves, etc.) adjacent to the stake. New disposable scoops or trowels may also be used to reduce the need for equipment blanks if the disposable scoops have been confirmed by your project PFAS subject matter expert (SME) to be PFAS free.

2. If sampling:
    - Surface soil: Obtain soil sample by scooping soil using the augering scoop/trowel, starting from the surface and digging down to a depth of about 6 inches, or the depth specified in the workplan.
    - Subsurface soil: Obtain the subsurface soil sample using an auger down to the depths prescribed in the field sampling plan.
3. Record lithologic description and any pertinent observations (such as discoloration) in the field notebook/clipboard.
4. Empty the contents of the scoop/trowel into a decontaminated stainless steel pan or dedicated sealable bag.
5. Repeat this procedure until sufficient soil is collected to meet volume requirements.
6. Homogenize cuttings in the pan using a decontaminated stainless steel utensil.
7. Transfer sample for analysis into appropriate containers with a decontaminated utensil. Affix labels after bottles have been closed; collect only one sample at a time to avoid mislabeling.
8. Immediately upon collection, all samples for chemical analysis are to be placed in a closed container on ice unless it is not possible to do so. Although unusual and uncommon, there may be instances where it is not possible to have containers with ice at the sample location. In these instances, the samples should be placed on ice as soon as practical and during the time between collection and placing the samples on ice, the samples should be kept as cool as possible.
9. Backfill the hole with soil removed from the borehole. To the extent possible, replace topsoil and grass and attempt to return appearance of sampling area to its pre-sampled condition. For samples in non-residential, unmowed areas, mark the sample number on the stake and leave stake in place. In mowed areas, remove stake.

To Collect Samples Using DPT Methods

1. Decontaminate sampling tubes and other non-dedicated downhole equipment in accordance with SOP *Decontamination of Personnel and Equipment*. Ensure that decontamination water used is PFAS free (do not use water from fire hydrants on-base for steam cleaning unless the water has been demonstrated to be free of PFAS). Additionally, ensure that all decontaminated tools are wrapped in un-coated aluminum foil as needed.
2. Drive sampling tube to the desired sampling depth using the truck-mounted hydraulic percussion hammer. If soil above the desired depth is not to be sampled, first drive the lead rod, without a sampling tube, to the top of the desired depth.
3. Remove the rods and sampling tube from the borehole and remove the sampling tube from the lead rod.
4. Cut open the acetate liner using a specific knife designed to slice the acetate liners (see below).

5. Fill all sample containers, using a decontaminated or dedicated sampling implement. Label the containers and immediately place samples on ice for shipment to the laboratory.
6. Decontaminate all non-dedicated downhole equipment (rods, sampling tubes, etc.) in accordance with SOP Decontamination of Personnel and Equipment and ensure decontamination water is from a PFAS-free water source and if equipment is wrapped in aluminum foil that un-coated aluminum foil is used.
7. Backfill borehole at each sampling location with grout or bentonite and repair the surface with like material (bentonite, asphalt patch, concrete, etc.), as required.

D. Equipment Decontamination

Whenever possible, use disposable equipment when collecting soil samples. If reusable equipment must be used, the equipment must be cleaned/decontaminated between uses. Alconox and Liquinox soap are acceptable for cleaning/decontaminating reusable equipment at PFAS sites. Any water used for cleaning/decontamination must be certified PFAS-free by a laboratory. Consider triple-rinsing. Once decontaminated, wrap equipment in plastic bags (such as Ziploc) or un-coated aluminum foil, and store away from potential PFAS sources.

IV. References

United States Environmental Protection Agency (USEPA), 2009. *Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS).* September.

United States Navy, 2020. *Interim Per- and Polyfluoroalkyl Substances (PFAS) Site Guidance for NAVFAC Remedial Project Managers (RPMs)/November 2020 Update.* November.

United States Navy, 2015. *Navy Drinking Water Sampling Policy for Perfluorochemicals: Perfluorooctane Sulfonate and Perfluorooctanoic Acid.* September

STANDARD OPERATING PROCEDURE – Navy CLEAN PROGRAM

Management of Liquid Waste Containing Per- and Polyfluoroalkyl Substances (PFAS)

I. Purpose and Scope

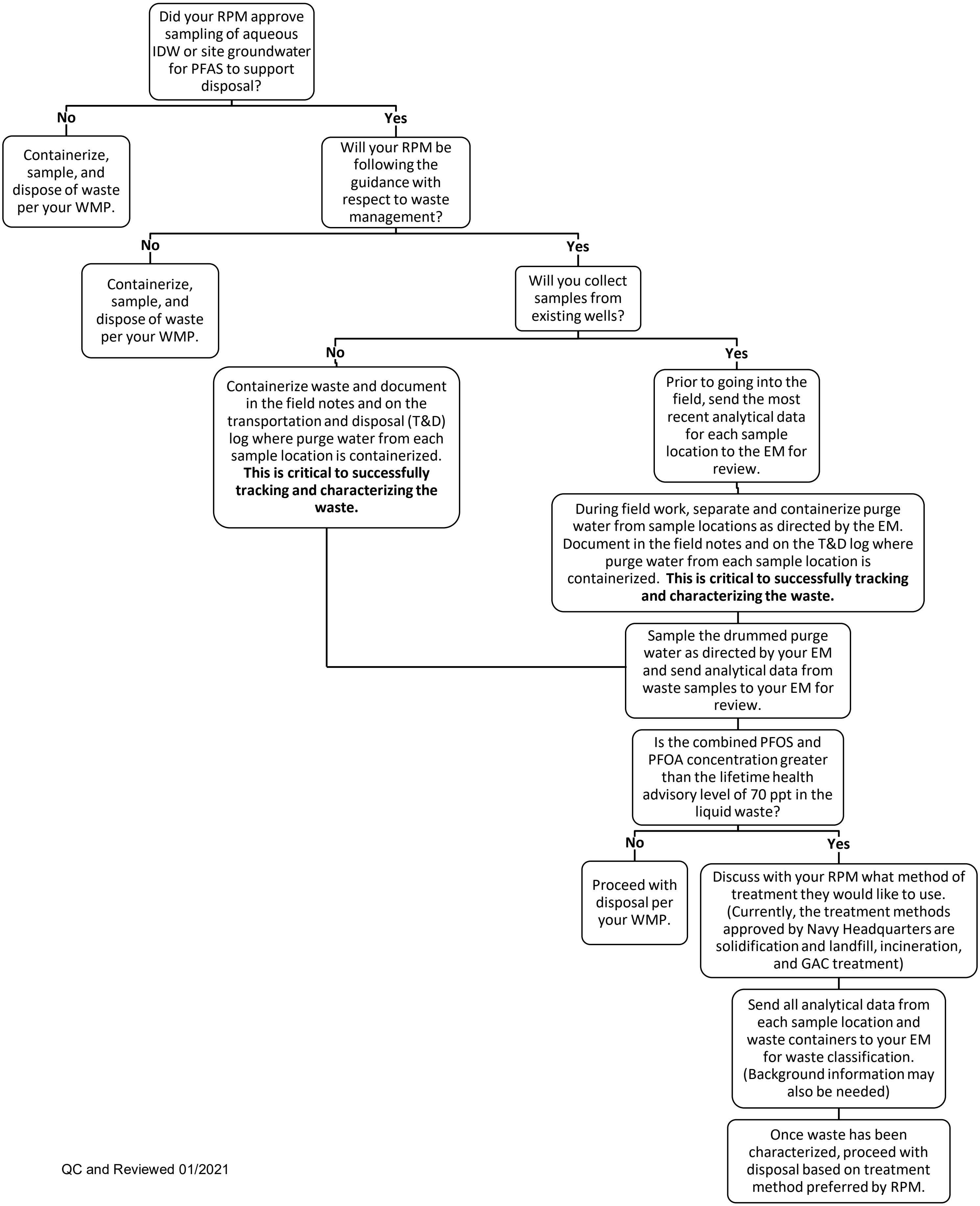
This SOP provides guidelines for managing waste containing per- and polyfluoroalkyl substances (PFAS) in accordance with the *Interim Per- and Polyfluoroalkyl Substances (PFAS) Site Guidance for NAVFAC Remedial Project Managers (RPMs)/November 2020 Update* (guidance). This SOP should be used in conjunction with an Environmental and/or Waste Management Plan (EMP and/or WMP) approved by your Environmental Manager (EM). If you do not have a site-specific EMP, please contact your EM.

Standard procedures for managing liquid waste during PFAS investigation are summarized. These procedures are specific to the Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program.

Currently, PFAS are not regulated as a hazardous waste in US EPA regulations (state and territory rules may vary). Treatment of liquid waste containing PFAS, as recommended by the guidance, is a client directed action. When and how it is implemented will be left to the discretion of the individual RPMs. These project specific actions will be communicated with the Project Manager (PM) and/or Activity Manager (AM).

II. Procedures and Guidelines

The following flowchart outlines the procedures required to manage liquid waste during PFAS investigations. Any deviations from this procedure must be approved by the EM.



Did your RPM approve sampling of aqueous IDW or site groundwater for PFAS to support disposal?

No

Containerize, sample, and dispose of waste per your WMP.

Yes

Will your RPM be following the guidance with respect to waste management?

No

Containerize, sample, and dispose of waste per your WMP.

Yes

Will you collect samples from existing wells?

No

Containerize waste and document in the field notes and on the transportation and disposal (T&D) log where purge water from each sample location is containerized. **This is critical to successfully tracking and characterizing the waste.**

Yes

Prior to going into the field, send the most recent analytical data for each sample location to the EM for review.

During field work, separate and containerize purge water from sample locations as directed by the EM. Document in the field notes and on the T&D log where purge water from each sample location is containerized. **This is critical to successfully tracking and characterizing the waste.**

Sample the drummed purge water as directed by your EM and send analytical data from waste samples to your EM for review.

Is the combined PFOS and PFOA concentration greater than the lifetime health advisory level of 70 ppt in the liquid waste?

No

Proceed with disposal per your WMP.

Yes

Discuss with your RPM what method of treatment they would like to use. (Currently, the treatment methods approved by Navy Headquarters are solidification and landfill, incineration, and GAC treatment)

Send all analytical data from each sample location and waste containers to your EM for waste classification. (Background information may also be needed)

Once waste has been characterized, proceed with disposal based on treatment method preferred by RPM.

QC and Reviewed 01/2021

STANDARD OPERATING PROCEDURE
NAVY CLEAN PROGRAM

Surface Water Sampling for Per- and Polyfluoroalkyl Substances

I. Purpose and Scope

This SOP provides guidelines for surface water sample collection for samples that will be analyzed for per- and polyfluoroalklyl substances (PFAS) via LC/MS/MS Compliant with the most recent version of the Quality Systems Manual (QSM) for which the lab is certified at the time of analysis. Standard techniques for collecting representative samples are summarized. These procedures are specific to the Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program. Materials, equipment, and procedures may vary; refer to the Sampling and Analysis Plan and operator's manuals for specific details.

II. Materials and Equipment

A. Equipment and Materials Required

- Open tube sampler
- Dip sampler
- Weighted bottle sampler (no glass)
- Hand pump without Teflon components
- Van Dorn sampler (Kemmerer cannot be used as it has Teflon caps)
- Depth-integrating sampler
- Peristaltic pump and PFAS-free tubing
- High density polyethylene tubing (unlined)
- Masterflex tubing such as Cole Parmer C-Flex (06424 series) and Tygon E-3603 (06509 series) are suitable options
- Sample containers (high density polyethylene [HDPE] with HDPE screw cap [no Teflon caps])
- PFAS-free labels (if available[1]) and shipping materials
- Loose leaf paper or a wire-bound notebook without waterproof coating or tablet (see notes about tablet use below)

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[1] Efforts will be made to obtain PFAS-free labels; however, information on labels is scarce and labels are frequently mounted on PFAS-coated paper to allow for easy removal.

- Metal clipboard (if using loose leaf paper)
- Pen (not Sharpie)
- Nitrile or Latex gloves (Do not use Kleen Guard powder free nitrile gloves which were shown in research to contain fluorine)
- Meters for specific conductance, temperature, pH, and dissolved oxygen

Equipment and materials used to collect surface water samples should not contain any fluorinated compounds including Teflon or synthetic rubber with fluoropolymer elastomers (e.g. Viton). Neoprene and rubber waders should not be an issue, however, check with your PFAS subject matter expert (SME) during field preparation to ensure all equipment is free of fluorine-containing components.

B. Equipment and Materials to Avoid During Sampling

Equipment and materials used to collect groundwater samples should not contain any fluorinated compounds, Teflon, or synthetic rubber with fluoropolymer elastomers (e.g., Viton).

Specifically, the following material should be avoided during sampling:

- Gore-Tex brand or similar high-performance outdoor clothing, clothing treated with ScotchGuard brand or similar water repellent, fluoropolymer-coated Tyvek, wrinkle-resistant fabrics, and fire-resistant clothing with fluorochemical treatment or anything advertised as water repellant.
- Weather-proof log books with fluorochemical coatings.
- New clothing that has been washed fewer than six times.

The sample collection area should be clear of the following items:

- Pre-packaged food wrappers (e.g., fast food sandwich wrappers, pizza boxes, etc.)
- Microwave popcorn bags
- Blue ice containers
- Non-stick aluminum foil
- Kim-Wipes
- Sunscreen, insect repellant and other personal hygiene products that may contain PFAS

Contact your PFAS SME for an approved list of sunscreens and insect repellants.

The use of electronics (e.g., cell phones and tablets) should be avoided without the implementation of precautionary measures outlined below:

  - All devices should be used with clean, ungloved hands and an approved stylus (if desired).

Following the use of a device, hands must be washed with soap and water and clean gloves should be used prior to contact with sampling equipment (bottleware, tubing, etc.).

III. Procedures and Guidelines

Wash hands with dish detergent before sampling and don nitrile gloves. Do not use Kleen Guard powder free nitrile gloves which were shown in research to contain fluorine.

Before surface water samples are taken, all sampler assemblies and sample containers are cleaned and decontaminated as described in SOP *Decontamination of Personnel and Equipment* as well as this SOP (see below). Surface water samples collected from water bodies tidally influenced should be collected at low tide and under low flow conditions to minimize the dilution of potential contaminants. Once the area has been determined to be free of materials potentially containing PFAS, follow the methods for surface water sample collection described below.

Surface water samples are collected manually by submerging a clean stainless steel or polypropylene container into the water body. Samples may be collected at depth with a covered bottle that can be removed with a tripline provided the bottle or bottle cap does not contain Teflon. The most common sampler types are sealable bottles, pond samplers, peristaltic pumps, and weighted bottle samplers. Pond samplers have a fixed or telescoping pole attached to the sample container. Weighted bottle samplers are lowered below water surface, where the attached bottle is opened, allowed to fill, and pulled out of the water. When retrieved, the bottle is tightly capped and removed from the sampler assembly. A specific type of weighted bottle sampler is the Van Dorn and is acceptable in most instances. The Kemmerer weighted bottle sampler cannot be used for PFAS sampling due to the Teflon caps.

A sample is taken with the following specific steps:

1. The location and desired depth for water sampling are selected.
2. The sample site is approached from downstream in a manner that avoids disturbance of bottom sediments as much as possible. The sample bottle is gently submerged with the mouth pointed upstream and the bottle tilted slightly downstream. Bubbles and floating materials should be prevented from entering the bottle. If using a Peristaltic pump, lower the tubing into the water to the desired depth.
3. For weighted bottle samplers, the assembly is slowly lowered to the desired depth. The bottle stopper is unseated with a sharp tug and the bottle is allowed to fill until bubbles stop rising to the surface.
4. When the bottle is full, it is gently removed from the water. If sample transfer is required, it should be performed at this time. Fill all sample containers to the middle of the bottle shoulder. Do not fill bottles completely. Affix labels after sample containers are closed; collect only one sample at a time to avoid mislabeling.
5. Measure dissolved oxygen, specific conductance, temperature, and pH at the sampling location.

A. Equipment Decontamination

Whenever possible, use disposable equipment when collecting surface water samples. If reusable equipment must be used, the equipment must be cleaned/decontaminated between uses. Alconox and Liquinox soap are acceptable for cleaning/decontaminating reusable equipment at PFAS sites. Any water used for cleaning/decontamination must be certified PFAS-free by a laboratory. Consider triple-rinsing. Once decontaminated, wrap equipment in plastic bags (such as Ziploc) or un-coated aluminum foil, and store away from potential PFAS sources.

Use of Water Quality Equipment

Water quality meters typically do not contain PFAS. However, consistent with general sampling SOPs, disconnect the water quality meter prior to sampling.

IV. References

United States Environmental Protection Agency (USEPA), 2009. *Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS).* September.

United States Navy, 2015. *Navy Drinking Water Sampling Policy for Perfluorochemicals: Perfluorooctane Sulfonate and Perfluorooctanoic Acid.* September.

STANDARD OPERATING PROCEDURE
NAVY CLEAN PROGRAM

Sediment Sampling for Per- and Polyfluoroalkyl Substances

I. Purpose and Scope

This SOP provides guidelines for sediment sample collection and handling for samples that will be analyzed for per- and polyfluoroalklyl substances (PFAS) via LC/MS/MS Compliant with the most recent version of the Quality Systems Manual (QSM) for which the lab is certified at the time of analysis. Standard techniques for collecting representative samples are summarized. These procedures are specific to the Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program. Materials, equipment, and procedures may vary; refer to the Sampling and Analysis Plan and operator's manuals for specific details.

II. Equipment and Materials

A. Equipment and Materials Required

- Sample collection device (hand corer, scoop, dredge, grab sampler, or other suitable device). Check with your PFAS subject matter expert (SME) during field preparation to ensure all equipment is free of fluorine-containing components.
- Stainless steel spoon or spatula or fluorine-free plastic disposable scoop for media transfer
- Measuring tape
- GPS Unit
- PFAS-free labels (if available[1]) shipping materials
- Loose leaf paper or a wire-bound notebook without waterproof coating
- Metal clipboard (if using loose-leaf paper)
- Pen (not Sharpie)
- Personal protection equipment (rubber or latex gloves, boots, hip waders, etc.). Check with your SME prior to selecting PPE to ensure there are no fluorine-containing components.
- Materials for classifying soils, particularly the percentage of fines
- Sample jars (high density polyethylene [HDPE] with HDPE screw cap [no Teflon caps])
- Laboratory prepared deionized, certified PFAS-free water for field blank collection

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[1] Efforts will be made to obtain PFAS-free labels; however, information on labels is scarce and labels are frequently mounted on PFAS-coated paper to allow for easy removal.

B. Equipment and Materials to Avoid During Sampling

Equipment and materials used to collect soil samples should not contain any fluorinated compounds including Teflon or synthetic rubber with fluoropolymer elastomers (e.g. Viton).

Specifically, the following material should be avoided during sampling:

- Gore-Tex brand or similar high-performance outdoor clothing, clothing treated with ScotchGuard brand or similar water repellent, fluoropolymer-coated Tyvek, wrinkle-resistant fabrics, and fire-resistant clothing with fluorochemical treatment or anything advertised as water repellant.
- Weather-proof log books with fluorochemical coatings.
- New clothing that has been washed fewer than six times.

The sample collection area should be clear of the following items:

- Pre-packaged food wrappers (e.g., fast food sandwich wrappers, pizza boxes, etc.)
- Microwave popcorn bags
- Blue ice containers
- Non-Stick aluminum foil
- Kim-Wipes
- Sunscreen, insect repellant and other personal hygiene products that may contain PFAS

Contact your PFAS SME for an approved list of sunscreens and insect repellants.

The use of electronics (e.g., cell phones and tablets) should be avoided without the implementation of precautionary measures outlined below:

  - All devices should be used with clean, ungloved hands and an approved stylus (if desired).

Following the use of a device, hands must be washed with soap and water and clean gloves should be used prior to contact with sampling equipment (bottleware, tubing, etc.).

III. Procedures and Guidelines

Wash hands with dish detergent before sampling and don nitrile gloves. Do not use Kleen Guard powder free nitrile gloves which were shown in research to contain fluorine.

Once the area has been determined to be free of materials potentially containing PFAS, these steps can be followed to collect the sediment samples:

1. Field personnel will start downstream and work upstream to prevent contamination of unsampled areas. In surface water bodies that are tidally influenced, sampling will be performed at low tide and under low flow conditions to minimize the dilution of possible contaminants. Sediment sampling activities will not occur immediately after periods of heavy rainfall.
2. Make a sketch of the sample area that shows important nearby river features and permanent structures that can be used to locate the sample points on a map. Whenever possible, include measured distances from such identifying features. Also include depth and width of waterway, rate of flow, type and consistency of sediment, and point and depth of sample removal (along shore, mid-channel, etc.).
3. Note in the field book any possible outside sources of contamination; for example, the outlet to a drainage culvert in the water body near your sampling location.

4. Transfer sample into appropriate sample jars with a stainless steel utensil or plastic disposable scoop confirmed to be fluorine-free. Be especially careful to avoid the loss of the very fine clay/silt particles when collecting the sample. The fine particles have a higher adsorption capacity than larger particles. Minimize the amount of water that is collected within the sample matrix. Decant the water off the sample slowly and carefully to maximize retention of the very fine particles. The sampler's fingers should never touch the sediment. Classify the soil type of the sample using the Unified Soil Classification System, noting particularly the percentage of silt and clay. Affix the sample label to the container after the container has been closed; collect only one sample at a time to avoid mislabeling.
5. Rocks and other debris should be removed before placement in jars.
6. For channel sampling, be on the alert for submerged hazards (rocks, tree roots, drop-offs, loess silt and muck) which can make wading difficult.
7. Immediately upon collection, all samples are to be placed in a closed container on ice. Although unusual and uncommon, there may be instances where it is not possible to have containers with ice at the sample location. In these instances, the samples should be placed on ice as soon as practical and during the time between collection and placing the samples on ice, the samples should be kept as cool as possible.
8. Equipment Decontamination
    - Whenever possible, use disposable equipment when collecting sediment samples. If reusable equipment must be used, the equipment must be cleaned/decontaminated between uses. Alconox and Liquinox soap are acceptable for cleaning/decontaminating reusable equipment at PFAS sites. Any water used for cleaning/decontamination must be certified PFAS-free by a laboratory. Consider triple-rinsing. Once decontaminated, wrap equipment in plastic bags (such as Ziploc) or un-coated aluminum foil, and store away from potential PFAS sources.

IV. References

United States Environmental Protection Agency (USEPA), 2009. *Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS).* September.

United States Navy, 2015. *Navy Drinking Water Sampling Policy for Perfluorochemicals: Perfluorooctane Sulfonate and Perfluorooctanoic Acid.* September.

PLANNING FIELD SAMPLING ACTIVITIES

1.0 PURPOSE

This section sets forth standard operating procedures (SOPs) for planning and scheduling field sampling activities. This SOP shall also be used to determine the number and type of laboratory and field Quality Control (QC) samples required while working on U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) sites/projects, and to prepare and implement Task Order Field Sampling Plans (FSP). For information on the number and type of QC samples required for the various QC Levels, see SOPs III-A, *Laboratory QC Samples (Water and Soil),* III-B, *Field QC Samples (Water and Soil)*, III-C *Field and Laboratory QC Samples (Air)*.

2.0 PROCEDURES

To prepare a field sampling plan, designated personnel must identify the objectives of the sampling program, determine the number of samples to be collected for each matrix (see SOP I-A-2, *Development of Data Quality Objectives*), and select the analyses to be performed on each sample (see SOPs I-A-3, *Selection of Analytes* and I-A-4, *Analytical Methods Selection*). The duration of sampling for each matrix, the preferred sampling method, the method of shipment, and the type and quantity of supplies (such as coolers, coolant and packing material that will be needed for sample storage and transport) must also be determined. Finally, the number and type of decontamination water sources to be used for each phase of sampling must be identified. The methods of determining each of these elements are addressed below.

2.1 NUMBER OF SAMPLES

Designated project personnel shall determine the number of samples to be collected from each sample matrix (e.g., soil, water), and specify the type of sample analysis. SOPs I-A-2, *Development of Data Quality Objectives*, I-A-3, *Selection of Analytes*, and I-A-4, *Analytical Methods Selection*, shall be used to determine numbers and locations of samples, as well as appropriate analytical methods. These figures will be used to estimate the costs of sample analysis. They will also help determine the number and types of sample containers required; number of field duplicates, field replicates, equipment rinsates, performance evaluation (PE) samples, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks to be collected, and the analyses to be performed on them for each matrix and analytical method; and the number of days required to perform sampling activities.

Sampling intervals for soil borings shall be selected on the basis of potential sources of contamination, the geologic and hydrologic complexity of the site, and the objectives of the sampling program. Areas of high contamination (for example, contamination in the capillary fringe) or complex geology or hydrogeology may require continuous sampling.

2.2 DURATION OF SAMPLING ACTIVITIES

The anticipated number of working days needed to complete field sampling activities shall be determined before fieldwork commences. A schedule should be developed that outlines the approximate number of samples to be collected each day, categorized by sample matrix, method of sample collection, and sample analysis (e.g., 28 soil samples collected using a hand auger and analyzed for organochlorine pesticides and chlorinated herbicides; 15 water samples collected using a bailer—7 analyzed for volatile organics and 8 analyzed for organic lead). This information will be used to determine the number of field equipment rinsate samples that will be collected (if any), the types of analyses to be performed on them, the number of MS/MSDs and field duplicates, equipment needs, and personnel.

2.3 NUMBER OF SAMPLES TO BE ANALYZED FOR VOLATILE ORGANICS

Prior to initiation of site sampling activities, designated personnel shall determine the number of samples to be analyzed for volatile organic compounds (VOCs). This information will be used to determine the approximate number of coolers that will contain samples to be analyzed for VOCs, which will in turn, dictate the number of VOC trip blanks needed, as specified in SOP III-B, *Field QC Samples (Water, Soil).*

2.4 DECONTAMINATION WATER SOURCES

Prior to initiation of sampling activities, designated personnel shall determine the number and type of decontamination water sources. Decontamination water includes both potable water used for equipment washing, and deionized or distilled water used during the final equipment rinse. The locations of potable water supplies for field decontamination activities shall be identified and designated as the only sources to be used during site sampling activities. Similarly, the source(s) of deionized or distilled water shall be identified and designated as the only source(s) to be used during site sampling activities. The intent of this procedure is to reduce variability in equipment decontamination procedures and to make it possible to easily identify the source of contamination in the event that analysis of field blanks reveals the presence of contaminants of concern.

3.0 DOCUMENTATION

The number of samples to be collected, the proposed duration of sampling activities, the number of samples that will be analyzed for VOCs, and the number and type of decontamination water sources that will be used for field activities will be specified in the FSP and QAPP portions of the Work Plan prepared for each NAVFAC NW Task Order. Records of how this information is actually implemented during field activities will be maintained in field logbooks, as specified in SOP III-D, *Logbooks*.

4.0 REFERENCES

SOP I-A-2, *Development of Data Quality Objectives*

SOP I-A-3, *Selection of Analytes*

SOP I-A-4, *Analytical Methods Selection*

SOP II-B, *Field QC Samples (Water and Soil)*

SOP III-A, *Laboratory QC Samples (Water and Soil)*

SOP III-B, *Field QC Samples (Water, Soil)*

SOP III-C *Field and Laboratory QC Samples (Air)*

SOP III-D, *Logbooks*

5.0 ATTACHMENTS

None.

IDW MANAGEMENT

1.0 PURPOSE

This standard operating procedure (SOP) describes the activities and responsibilities of the U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) and their subcontractors with regard to management of investigation-derived waste (IDW). The purpose of this procedure provides guidance for the minimization, handling, labeling, temporary storage, and inventory of IDW generated during site investigations and remediation projects conducted under the direction of NAVFAC NW. **Each base may have specific required procedures**. These procedures are made available to the contractor through the NAVFAC Naval Technical Representative (NTR) or other government point of contact. This SOP is also applicable to personal protective equipment (PPE), sampling equipment, decontamination fluids, non-IDW trash, non-indigenous IDW, and hazardous waste and other regulated wastes generated during implementation of site investigations and removal or remedial actions. The information presented will be used to prepare and implement Work Plans (WP), Field Sampling Plans (FSP), and Waste Management Plans (WMPs) for IDW-related field activities.

2.0 PROCEDURES

The procedures for IDW management in the field are described below in Sections 2.1 to 2.5. The implementation of these procedures requires Remedial Project Managers (RPMs), Field Managers, their designates and subcontractors to perform the following tasks:

- Minimize generation of IDW,
- Segregate IDW,
- Properly handle IDW containers,
- Properly label IDW containers,
- Apply good management practices in storing IDW drums and containers,
- Prepare IDW drum inventories,
- Update and Report changes to IDW drum inventories,
- Perform inspections of IDW containers and storage areas, as required,
- Prepare IDW containers for proper off-site transportation and disposition, as required.

2.1 IDW MINIMIZATION

Field Managers and their designates shall minimize the generation of onsite IDW to reduce the need for special storage or disposal requirements that may result in substantial additional costs and provide little or no reduction in site risks (EPA 1992). The volume of IDW shall be reduced, by applying minimization practices throughout the course of site investigation activities. These minimization strategies include: 1) material substitution; 2) using proper low-volume drilling techniques; 3) using disposable sampling and PPE; 4) using bucket and drum liners; and 5) segregating non-contaminated IDW and trash from contaminated IDW. Waste minimization strategies and types of IDW expected to be generated shall be documented in the appropriate project plans.

2.1.1 Material Substitution

Material substitution consists of selecting materials that degrade readily or have reduced potential for chemical impacts to the site and the environment. An example of this practice is the use of biodegradable detergents (e.g., Alconox® or non-phosphate detergents) for decontamination of non-consumable PPE and sampling equipment. In addition, field equipment decontamination can be conducted using isopropyl alcohol rather than hexane or other solvents (for most analytes of concern), to reduce the potential onsite chemical impacts of the decontamination solvent. Decontamination solvents shall be selected carefully so that solvents, and their known decomposition products, do not result in generation of RCRA hazardous waste.

2.1.2 Drilling Methods

Drilling methods that minimize potential IDW generation should be given priority. Sonic, Hollow stem auger and air rotary methods should be selected, where feasible, over mud rotary methods. Mud rotary drilling produces waste drilling mud, while hollow stem and air rotary drilling methods produce relatively low volumes of soil waste. Sonic drilling produces the least amount of waste. Small diameter borings and cores shall be used when soil is the only matrix to be sampled at the boring location; the installation of monitoring wells requires the use of larger diameter borings.

Soil, sludge, or sediment removed from borings, containment areas, and shallow test trenches shall not be returned to the source, unless allowed by regulation and included in the approved WP, FSP, or WMP.

2.1.3 Decontamination Fluids

The use of disposable sampling equipment, such as plastic bailers, trowels, and drum thieves (which do not require decontamination) minimizes the quantity of decontamination fluids generated. In general, decontamination fluids, and well development and purge water, should not be minimized because the integrity of the associated analytical data may be affected.

2.1.4 PPE and Disposable Sampling Equipment

Visibly soiled PPE and disposable sampling equipment shall be segregated from non-visibly soiled PPE and sampling equipment. Where investigation involves potentially hazardous waste or other regulated wastes, visibly soiled PPE and disposable sampling equipment may require decontamination. The Field Manager shall use best professional judgment to determine if decontamination is appropriate. This determination should be included in the approved WP, FSP, or WMP. If decontamination is performed, PPE and disposable sampling equipment generated in the decontamination process may be double-bagged and disposed of as non-hazardous waste.

2.1.5 Liners

Bucket liners can be used in the decontamination process to reduce the volume of solid IDW-generated and reduce costs on larger projects. The plastic bucket liners can be crushed into a smaller volume than the buckets, and only a small number of plastic decontamination buckets are required for the entire project. Larger, heavy-duty, 55-gallon drum liners can be used for heavily contaminated IDW to provide secondary containment, and reduce the costs of disposal and drum recycling. Drum liners may extend the containment life of the drums in severe climates and will reduce the costs of cleaning out the drums prior to recycling.

2.1.6 Segregation of non-IDW

All waste materials generated in the support zone are considered non-IDW trash. To minimize the total volume of IDW, all trash shall be separated from IDW, sealed in garbage bags, and properly disposed of offsite as municipal waste.

2.1.7 Monitoring Well Construction

Excess cement, sand, and bentonite grout prepared for monitoring well construction shall be kept to a minimum. Well construction shall be observed by Field Managers to ensure that a sufficient, but not excessive, volume of grout is prepared. Some excess grout may be produced. Unused grout that has not come in contact with potentially contaminated soil or ground water shall be considered non-hazardous trash and shall be disposed of offsite by the drilling subcontractor. Surplus materials from monitoring well installation, such as scrap PVC sections, used bentonite buckets, and cement/sand bags that do not come in contact with potentially contaminated soil, shall be considered non-IDW trash and shall be disposed of offsite by the drilling subcontractor.

2.1.8 Field Analytical Test Kits

IDW generated from the use of field analytical test kits consists of those parts of the kit that have been used and/or come into contact with potentially contaminated site media, or excess extracting solvents and other reagents. Potentially contaminated solid test kit IDW shall be contained in plastic bags and stored with PPE or disposable sampling equipment IDW from the same source area as soil material used for the analyses. The small volumes of waste solvents, reagents, and water samples used in field test kits should be segregated, and disposed of accordingly (based upon the characteristics of the materials, MSDS sheets, and as described in the WMP). Most other test kit materials should be considered non-IDW trash, and be disposed of as municipal waste.

2.2 SEGREGATION OF IDW BY MATRIX AND LOCATION

To facilitate subsequent IDW screening, sampling, classification and/or disposal, IDW shall generally be segregated by matrix and source location at the time it is generated. Each drum of solid IDW shall be completely filled, when possible. For liquid IDW, drums should be left with headspace of approximately 5% by volume to allow for expansion of the liquid and potential volatile contaminants. IDW from each distinct matrix shall be stored in a single drum (e.g., soil, water or PPE shall not be mixed in one drum). In general, IDW from separate sources should not be combined in a single drum.

It is possible that monitoring well development and purge water will contain suspended solids, which will settle to the bottom of the storage drum as sediment. Significant observations on the turbidity or sediment load of the development or purge water shall be included in the logbook and reported in attachments to the quarterly drum inventory report (see SOP III-D, *Logbooks* and Section 2.5). To avoid having mixed matrices in a single drum (i.e., sediment and water), it may be necessary to decant the liquids into a separate drum, after the sediments have settled out. This segregation may be accomplished during subsequent IDW sampling activities or during consolidation in a holding tank prior to disposal. Disposal of liquid IDW into the sanitary sewer shall only occur if approved by the appropriate regulatory agencies, municipal entities, and Naval installation. Appropriate precautions per the approved Health and Safety Plan (HASP) shall be implemented to ensure worker protection during these activities.

Potentially contaminated well construction material shall be placed in separate containers. Soil, sediment, sludge, or liquid IDW shall be segregated from potentially contaminated waste well construction materials. Potentially contaminated well construction materials from different monitoring wells shall not be commingled.

Potentially hazardous PPE and disposable sampling equipment shall be segregated from other IDW. PPE from generally clean field activities, such as water sampling, shall be segregated from visibly soiled PPE, double-bagged and disposed of offsite as municipal waste. Disposable sampling equipment from activities such as soil, sediment, and sludge sampling includes plastic sheeting used as liner material in containment areas around drilling rigs and waste storage areas; disposable sampling equipment; and soiled decontamination equipment. Where investigation involves potentially hazardous waste, visibly soiled PPE and disposable sampling equipment may require decontamination. The Field Manager shall use best professional judgment to determine if decontamination is appropriate. If decontamination is performed, PPE and disposable sampling equipment generated in the decontamination process may be double-bagged and disposed of as non-hazardous waste. PPE and disposable sampling equipment generated on separate days may be commingled.

Decontamination fluids shall be stored in drums separate from other IDW. If practical, decontamination fluids generated from different sources should not be stored in the same drum. If decontamination fluids generated over several days or from different sources are stored in a single container, information regarding dates of generation and sources shall be recorded in the field notebook, on the drum label (Section 2.3.2), and in the drum inventory (Section 2.5).

Liquid and sediment portions of the equipment decontamination fluid in the containment unit used by the drilling or excavation field crew should be separated. The contents of this unit normally consist of turbid decontamination fluid above a layer of predominantly coarse-grained sediment. When the contents of the containment unit are to be stored in IDW containers, the Field Manager shall direct the placement of as much liquid into drums as possible and transfer the remaining solids into separate drums. Observations of the turbidity and sediment load of the liquid IDW should be noted in the field notebook, on the drum label (Section 2.3.2), and in attachments to the drum inventory (see Section 2.5). It is likely that decontamination fluids will contain minor amounts of suspended solids that will settle out of suspension to become sediment at the bottom of IDW storage drums. As noted above, it may be necessary to segregate the drummed water from sediment during subsequent IDW sampling or disposal activities.

2.3 DRUM HANDLING AND LABELING

Drum handling consists of those actions necessary to prepare an IDW drum for labeling. Drum labeling consists of those actions required to legibly and permanently identify the contents of an IDW drum. Specific handling, storage, and labeling requirements may differ with the Naval installation or oversight entity. Specific requirements should be determined at the planning stage and documented in the WMP. General requirements are provided in the following sections.

2.3.1 Drum Handling

The drums used for containing IDW shall be approved by the United States Department of Transportation (DOT, 49 CFR 172). The drums shall be made of steel or plastic, have a 55-gallon capacity, be completely painted or opaque, and have removable lids (i.e., 1A1 or 1A2). New steel drums are preferred over recycled drums. For short-term storage of liquid IDW prior to discharge, double-walled bulk steel or plastic storage tanks may be used. Consideration must be given to scheduling and cost-effectiveness of bulk storage, treatment, and discharge system versus longer-term drum storage.

For long-term IDW storage, the DOT-approved drums with removable lids are recommended. The integrity of the foam or rubber sealing ring located on the underside of some drum lids shall be verified prior to sealing drums containing IDW liquids. If the ring is only partially attached to the drum lid, or if a portion of the ring is missing, a drum lid with sealing ring that is in good condition must be used. At some facilities, drums containing liquid IDW will be required to be stored in protective overpacks.

To prepare IDW drums for labeling, the outer wall surfaces and drum lids shall be wiped clean of all material that may prevent legible and permanent labeling. If potentially contaminated material adheres to the outer surface of a drum, that material shall be wiped from the drum, and the paper towel or rag used to remove the material shall be segregated with visibly soiled PPE and disposable sampling equipment.

2.3.2 Drum Labeling

Proper labeling of IDW drums is essential to the success and cost-effectiveness of subsequent waste screening and disposal activities. Labels shall be permanent and descriptive to facilitate correlation of field analytical data with the contents of individual IDW drums.

2.3.2.1 Preprinted Labels

A preprinted drum label as required by the appropriate Naval installation and/or regulatory agency shall be completed. The label will be affixed to the outside of the drum (or overpack if required) with the label easily readable for inspections and inventory. Label requirements may vary based on the site.

The requested information shall be printed legibly on the drum labels in black, indelible ink. Instructions for entering the required drum-specific information for each label field are provided by the Naval installation.

Painted Labels

An alternative method for labeling drums, if acceptable for the project, is to paint label information directly on the outer surface of the drum. At a minimum, the information placed on the drum shall include the contract/delivery order number, a drum number, the source identification type and number, the type of IDW, the generation date(s), and the government point of contact and telephone number. The drum surface shall be dry and free of material that could prevent legible labeling. Label information shall be confined to the upper two-thirds of the total drum height. The printing on the drum shall be large enough to be easily legible. Yellow, white, or red paint markers (oil-based enamel paint) that are non-photodegradable are recommended to provide maximum durability and contrast with the drum surface.

2.3.2.2 Regulatory Marking and Labeling

Federal and State regulations may require specific labeling for IDW generated (i.e., RCRA, TSCA, NESHAPs). Pre-printed labels shall be used as appropriate and completed in accordance with the specific regulatory requirement. These requirements will be identified in the approved project plans. Once determined to be hazardous, weekly inspections must also be conducted to ensure that labels and markings are in good conditions and to ensure the integrity of containers.

In addition, prior to off-site transportation USDOT requirements for marking and labeling of regulated DOT materials must be complied with. These requirements will be identified in the approved project plans or otherwise coordinated with the Field Manager after the IDW has been characterized and off-site disposition is being planned. Note that personnel (i.e., contractors or subcontractors) who perform USDOT functions must be properly trained in accordance with 49 CFR 172, Subpart G.

2.4 DRUM STORAGE

Drum storage procedures shall be implemented to minimize potential human contact with the stored IDW and prevent extreme weathering of the stored drums. Waste accumulation areas will be pre-designated by NAVFAC NW prior to the start of site work. IDW drums should be placed on pallets. Good management practices should be used in storing drums which include: containers shall be in good condition and closed during storage; wastes must be compatible with containers; where liquids are stored, storage areas should have secondary containment; and spill or leaks should be removed as soon as possible. These good management practices are mandatory requirements where RCRA hazardous wastes are stored.

Waste accumulation areas shall be maintained as prescribed by local regulatory entities and the appropriate Naval installation. In general, drums of IDW shall be stored within the Area of Concern (AOC) so that the site can utilize RCRA regulatory flexibility (i.e., administrative requirements, such as 90-day storage, may not be triggered; and LDRs will not be triggered if IDW is placed back in AOC). If IDW is determined to be RCRA hazardous waste, then RCRA storage, transportation and disposal requirements must be met.

Drums shall be stored at identified waste accumulation areas. All IDW drums generated during field activities at a single AOC shall be placed together, in a secure, fenced onsite area to prevent access to the drums by unauthorized personnel. When a secure area is not available, drums shall be placed in an area of the site with the least volume of human traffic. Plastic sheeting (or individual drum covers) and yellow caution tape shall be placed around the stored drums. Drums from projects involving multiple AOCs should remain at the respective source areas where the IDW was generated. IDW should not be transferred offsite for storage elsewhere, except under rare circumstances, such as the lack of a secure storage area onsite.

Proper drum storage practices shall be implemented to minimize damage to the drums from weathering and possible exposure to humans or the environment. When possible, drums shall be stored in dry, shaded areas and covered with impervious plastic sheeting or tarpaulin material. Every effort shall be made to protect the preprinted drum labels from direct exposure to sunlight, which causes ink on the labels to fade. In addition, drums shall be stored in areas that are not prone to flooding. The impervious drum covers shall be appropriately secured to prevent dislodging by the wind. It may be possible to obtain impervious plastic covers designed to fit over individual drums; however, the labeling information shall be repeated on the outside of these opaque covers.

Drums in storage shall be placed with sufficient space between rows of drum pallets and shall not be stacked, such that authorized personnel may access all drums for inspection. Proper placement will also render subsequent IDW screening, sampling, and disposal more efficient. It is recommended that IDW drums be segregated in separate rows/areas by matrix (i.e., soil, liquid or PPE/other).

If repeated visits are made to the project site, the IDW drums shall be inspected to clear encroaching vegetation, check the condition and integrity of each drum, check and replace labels as necessary, and replace or restore protective covers.

2.5 DRUM INVENTORY

Accurate preparation of an IDW drum inventory is essential to all subsequent activities associated with IDW drum tracking and disposal. An inventory shall be prepared for each project in which IDW is generated, stored, and disposed of. Naval installations and local regulatory authorities may have specific requirements associated with waste inventory and these requirements should be included in the planning process and documented in the WP, FSP, and WMP.

The drum inventory information shall include 11 elements that identify drum contents and indicate their fate.

2.5.1 Navy Activity (Generator)/Site Name

Inventory data shall include the Navy activity and the site name where the IDW was generated (e.g., NASWI, NBK Bangor, etc.).

2.5.2 DO Number

Inventory data shall include the contract and delivery order number associated with each drum (e.g., 0089).

2.5.3 Drum Number

The drum number assigned to each drum shall be included in the inventory database.

2.5.4 Storage Location Prior to Disposal

The storage location of each drum prior to disposal shall be included in the inventory (e.g., Building 394 Battery Disassembly Area, or Adjacent to West end of Building 54).

2.5.5 Origin of Contents

The source identification of the contents of each IDW drum shall be specified in the inventory (e.g., soil boring number, monitoring well number, sediment sampling location, or the multiple sources for PPE- or rinse water-generating activities).

2.5.6 IDW Type

Inventory data shall include the type of IDW in each drum (e.g., soil, PPE, disposable sampling equipment, sludge, sediment, development water, steam cleaning water, decontamination rinse water).

2.5.7 Waste Volume

The amount of waste in each drum shall be specified in the inventory as a percentage of the total drum volume or an estimated percentage-filled level (e.g., 95% maximum for liquid IDW).

2.5.8 Recommended Analytical Methods and Test Results Compared with Applicable Regulatory Standards

The recommended EPA analytical methods that adequately characterize IDW contained in each drum will be summarized in a tabular format and attached to the quarterly IDW drum inventory report (see Attachment I-A-7-1). The methodology for sampling and characterizing IDW shall be specified in the appropriate project plans.

2.5.9 Recommended or Actual Disposition of IDW Drum Contents

The recommended means of IDW disposal for each drum shall be summarized in a tabular format (e.g., Offsite, Encapsulated Onsite, Treatment/Sewer, Offsite Incinerator) and attached to the quarterly IDW drum inventory report (see Attachment I-A-7-1). Additional narrative discussion of the rationale for the recommended disposal option shall be attached to the quarterly IDW drum inventory report as data become available.

2.5.10 Generation Date

Inventory data shall include the date IDW was placed in each drum. If a drum contains IDW-generated over more than one day, the start date for the period shall be specified in dd-month-yy format. This date is not to be confused with an RCRA hazardous waste accumulation date (40 CFR 262). The accumulation start date, if required for RCRA wastes, shall be included on the hazardous waste drum label (Section 2.3.2.2).

2.5.11 Expected Disposal Date

The expected date each drum is to be disposed of shall be specified as part of the inventory in month-yy format. This date is for informational purposes only for the Navy, and shall not be considered contractually binding.

2.5.12 Actual Disposal Date

The actual drum disposal date occurs at the time of onsite disposal, or acceptance by the offsite treatment or disposal facility. It shall only be entered in the drum inventory database when such a date is available in dd-month-yy format.

In order to provide information for all 11 of the inventory elements of the quarterly inventory report described above, the main source of information will be provided by RPMs, or their designees, and summarized in Attachment I-A-7-1.

The recommended analytical test methods and actual test results (compared to applicable regulatory standards) will be provided to the appropriate Navy groups, by the RPM, or their designees, when such data are available. Testing methods shall be documented in the associated project plans. Recommended disposal options or actual disposition of the IDW drum contents will also be provided by RPMs as data become available. The NAVFAC Northwest RPM will forward all IDW data to the appropriate Navy authority as attachments to the quarterly IDW drum inventory report. This information constitutes the results of preparing and implementing an IDW screening, sampling, classification, and disposal program for each site.

3.0 DOCUMENTATION

The RPM or designee is responsible for completing and updating the site-specific IDW drum inventory spreadsheet and submitting it as needed. The RPM is also responsible for submitting backup documentation to the U.S. Navy Program Management Office (PMO) about the analytical methods recommended to adequately characterize the IDW in each drum (Section 2.5.8). In addition, actual site or drum sampling results shall be forwarded to the PMO, along with a comparison to the applicable regulatory standards, for inclusion as attachments to the quarterly IDW drum inventory. As necessary, the backup documentation to the quarterly IDW drum inventory report shall also include the recommended means for IDW disposal for each drum (Section 2.5.9). After disposal, the actual means and/or location of disposal shall be indicated in tabular format with supporting narrative.

Field Managers and designates are responsible for documenting all IDW-related field activities in the field notebook, including most elements of the IDW drum inventory spreadsheet. The correct methods for developing and maintaining a field notebook are presented in SOP III-D, *Logbooks*.

Upon receipt of analytical data from the investigation, the information will be forwarded to the appropriate Naval authority for comparison to regulatory waste criteria. The Navy will designate the IDW and disposal options will be assessed based on the waste designation, approved transport/disposal facilities, and schedule for disposal. Naval installations may have additional requirements for reviewing analytical data, characterizing waste materials, transporting and off-site disposal. The RPM shall coordinate with the Naval installation early in the planning process to ensure that these requirements are properly identified, incorporated into the approved project plans, as available, and implemented in the field.

The disposal of IDW must be approved by the Navy and, in some cases, pertinent regulatory agencies. The disposal must be documented.

4.0 REFERENCES

Department of Transportation (DOT), Hazardous Materials Transportation Regulations, 49 CFR Parts 171 – 179.

EPA. 1998. EPA530-F-98-026, Management of Remediation Waste Under RCRA

EPA. 1991. Management of Investigative-Derived Wastes During Site Inspections. U.S. Environmental Protection Agency/540/G-91/009. May.

EPA. 1992. Guide to Management of Investigative-Derived Wastes. Quick Reference Guide. U.S. Environmental Protection Agency: 9345.3-03FS. January.

5.0 ATTACHMENTS

Attachment IA71	Example Format – Quarterly IDW Drum Inventory Updates

Attachment I-A-7-1
Quarterly IDW Drum Inventory Updates

Navy Activity / Site Name (Generator Site)	DO Number (0bbb)	Drum Number (xxxx-AA-Dzzz)	Drum Storage Location	Origin of Contents (Source ID #)	IDW Type	Waste Volume (Fill level %)	Waste Generation Date (dd-mm-yy)	Expected Disposal Date (mm-yy)	Actual Disposal Date (dd-mm-yy)
NSC Pearl Harbor/ Landfill	0068	0068-LF-D001	NSC, Bldg 7	SB-1	Soil Cuttings	100	16-Dec-92	Dec-93	Na
		0068-LF-D002	NA	MW-1	Purge Water	75	20-Dec-92	Jul 93	26-Jul-93
				MW-2					
				MW-3					
		0068-LF-D003	NA	MW-1	Decon Water	95	20-Dec-92	Jul-93	26-Jul-93
				MW-2					
				MW-3					
		0068-LF-D004	NSC, Bldg.16	SB-1	PPE	50	16-Dec-92	Oct-93	NA
				SB-2					
				SB-3					
				SB-4					
				MW-1					
				MW-2					
				MW-3					
NAVSTA Guam/ Drum Storage	0047	0047-DS-001	Hazmat Storage Area	SB-1	Soil Cuttings	100	18-Feb-93	Sep-93	NA
				SB-2					

NA = Not Applicable

GENERAL FIELD OPERATION

1.0 PURPOSE

This standard operating procedure (SOP) defines the general field organization and the field structure of sample collection, sample identification, record keeping, field measurements, and data collection. These SOPs are used to ensure the activities used to document sampling and field operations provide standardized background information and identities.

2.0 PROCEDURES

2.1 MOBILIZATION/DEMOBILIZATION

The SM or designee ensures that all purchase requests have been reviewed and approved by the PM. Then, the SM and PM assemble the project team in order to review the scope of work, disseminate the project plans, and complete the field equipment checklist (provided as Attachment I-A-9-1). After review by the project team, if additional items are required, additional purchase requests are prepared and approved by the PM.

The SM and project team upon arrival at the site inspects all equipment. Packing slips, bills of lading, or other documentation received with the shipment are initialed and returned to the purchasing department and a copy placed into the field file. Quantities, types, and makes of items received are checked against the original purchase requests to validate the shipment. Prior to validation of the shipping receipt, equipment is inspected to ensure all components are present and that the equipment calibrates and is fully functional. Any equipment received that is not fully functional is returned immediately and the vendor contacted to arrange a replacement.

The SM provides copies of the appropriate SOPs to the project team prior to the start of field activities. The most current versions of the SOPs are brought to the field. Any revisions to the SOPs must be approved by the PM and recorded in the field logbook.

It is imperative that rental equipment be cleaned (decontaminated), packaged, and returned immediately following the completion of a task. If any problems occurred on site with any equipment, the problems should be noted in detail in the field logbook and the SM notified. The SM will forward this information to the purchasing department and the vendor.

2.2 SHIPPING

If it is possible and /or practical, equipment and supplies should be shipped directly to the field site. If sensitive field equipment is to be shipped to the site, care shall be taken to ensure the equipment is not damaged en route. All original packaging material should be retained for return shipment of the equipment. Additional packing material (e.g., bubble wrap, bubble bags) may be required to provide additional protection for the shipped items. Equipment should always be shipped in its original carrying case. Each piece being shipped must have an address label on the shipping container separate from the shipping air bill.

2.3 CHAIN OF COMMAND

Chain of command protocols are implemented by the PM. These protocols should be strictly followed while performing field tasks. All decisions concerning priorities, project team assignments, sampling procedures, equipment management, and task approach are made by the PM, the SM, or an approved appointee. The SM or an approved designee will conduct a daily meeting prior to the start of field activities to discuss individual responsibilities. The meeting will also address potential contaminants that may be encountered, safety items (such as use of heavy equipment or protection against noise), special sampling requirements, and site control(s) to be employed to prevent injuries or exposure.

2.4 SAMPLING ORGANIZATION

The SM ensures the sampling design, outlined in project plans, is followed during all phases of the sampling activities at the site. For each sampling activity, field personnel record the information required by the applicable SOPs in their logbooks and on the exhibits provided in the SOPs.

2.5 REVIEW

The PM, SM, and, on occasion, the QAO or an approved designee checks field logbooks, daily logs, and all other documents that result from field operations for completeness and accuracy. Any discrepancies on these documents are noted and returned to the originator for correction. The reviewer acknowledges that review comments have been incorporated into the document by signing and dating the applicable reviewed documents.

3.0 DOCUMENTATION

Project activities shall be recorded in the field logbooks. The logbooks shall be kept current for the daily activities including documentation of all samples collected and the information relevant to the sample collection. All project required field forms shall be completed within a timely manner upon completion of the field task. All required field forms and specific logbook notations should be detailed in the field sampling plan.

4.0 REFERENCES

None.

5.0 ATTACHMENTS

Attachment IA91	Field Equipment Checklist.

Attachment I-A-9-1

Field Equipment Checklist

General

___ 1. Health and Safety Plan

___ 2. Site base map

___ 3. Hand calculator

___ 4. Brunton compass

___ 5. Personal clothing and equipment

___ 6. Personal Protective Equipment (First Aid kit)

___ 7. Cell or radio telephone

Environmental Monitoring Equipment

___ 1. Shovels

___ 2. Keys to well caps

___ 3. pH meter (with calibrating solutions)

___ 4. pH paper

___ 5. Thermometer

___ 6. Conductivity meter (with calibrating solution)

___ 7. Organic vapor analyzer or photoionization detector with calibration gas

___ 8. H2S, O2, combustible gas indicator

___ 9. Draeger tubes

Shipping Supplies

___ 1. Sample preservatives (nitric, hydrochloric, sulfuric acid/sodium hydroxide)

___ 2. Heavy-duty aluminum foil

___ 3. Coolers

___ 4. Ice packs

___ 5. Large zipper locking plastic bags

___ 6. Heavy-duty garbage bags

___ 7. Duct tape

___ 8. Strapping tape

___ 9. Paper towels

___ 10. Bubble pack, foam pellets, or shredded paper

___ 11. Vermiculite

___ 12. Cooler labels (“This Side Up,” “Hazardous Material,” “Fragile”)

___ 13. Federal Express/DHL labels

Sampling Equipment

___ 1. Tool box with assorted tools (pipe wrenches, screwdrivers, socket set and driver, open and box end wrenches, hacksaw, hammer, vice grips)
___ 2. Geologic hammer
___ 3. Trowel
___ 4. Stainless steel and/or Teflon spatula
___ 5. Hand auger
___ 6. Engineer's tape
___ 7. Steel tape
___ 8. Electric water level sounder
___ 9. Petroleum Interface Probe
___ 10. Batteries
___ 11. Bailers (Teflon, stainless steel, acrylic, PVC)
___ 12. Slug test water displacement tube
___ 13. Vacuum hand pump
___ 14. Electric vacuum pump
___ 15. Displacement hand pump
___ 16. Mechanical pump (centrifugal, submersible, bladder)
___ 17. Portable generator
___ 18. Gasoline for generator
___ 19. Hose
___ 20. Calibrated buckets
___ 21. Stop watch
___ 22. Orifice plate or equivalent flow meter
___ 23. Data logger and pressure transducers
___ 24. Strip chart recorders
___ 25. Sample bottles
___ 26. 0.45-micron filters (prepackaged in holders)
___ 27. Stainless steel bowls
___ 28. SW scoop
___ 29. Peristaltic pump/tubing
___ 30. Sample tags
___ 31. SOPs, HAZWOPER training certificates, MSDs, FSP, QAPP

Decontamination Equipment

___ 1. Non-phosphate laboratory-grade detergent
___ 2. Selected high purity, contaminant free solvents
___ 3. Long-handled brushes
___ 4. Drop cloths (plastic sheeting)
___ 5. Trash container
___ 6. Galvanized tubs or equivalent (e.g., baby pools)
___ 7. Tap Water
___ 8. Contaminant free distilled/deionized water
___ 9. Metal/plastic container for storage and disposal of contaminated wash solutions
___ 10. Pressurized sprayers, H_2O
___ 11. Pressurized sprayers, solvents
___ 12. Aluminum foil
___ 13. Sample containers
___ 14. Emergency eyewash bottle
___ 15. Documentation Supplies

Documentation Supplies

___ 1. Weatherproof, bound field logbooks with numbered pages
___ 2. Daily Drilling Report forms

___ 3. Field Borehole Log forms

___ 4. Monitoring Well Installation Log forms

___ 5. Well Development Data forms

___ 6. Groundwater Sampling Log forms

___ 7. Aquifer Test Data forms

___ 8. Sample Chain-of-Custody forms

___ 9. Custody seals

___ 10. Communication Record forms

___ 11. Documentation of Change forms

___ 12. Camera and film

___ 13. Paper

___ 14. Permanent/indelible ink pens

___ 15. Felt tip markers (indelible ink)

___ 16. Munsell Soil Color Charts

MONITORING/SAMPLING LOCATION RECORDING

1.0 PURPOSE

This standard operating procedure (SOP) describes the guidelines for generating the descriptions and information to be recorded for each physical location where monitoring, or sampling is conducted.

2.0 PROCEDURES

2.1 SAMPLING LOCATION MARKING

Sampling locations are based on criteria presented in the SAP. Whenever possible, each sampling location will be marked by a wooden lathe stake, directly marking the surface with marking paint, or with surveyors flagging. Each should be labeled with the location identifier outlined in the SAP. This should be done during the site visit or as soon as is feasible during field activities. This is to give the utility locators a better idea of the specific area to be cleared. Having the locations marked will also assist the field crew gain a better perspective of the locations to be worked

2.2 PHOTOGRAPHIC DOCUMENTATION

Site photographs showing monitoring/sampling locations with respect to structures or the site in general are encouraged. At certain installations, photography must be approved by the Navy. Prior to commencing work, the Navy must be notified to determine if cameras are allowed at the installation. The Note that the Navy will likely inspect your camera and may purge/delete some pictures if they feel there is a security issue. When possible, a menu board included in the photograph can be used to give relative information regarding the project and location.

For each photograph, record the following information in the field logbook:

- Photo number
- Date and time of the photo
- Orientation of the photo (direction facing)
- Subject-a description of what is contained within the photo. Others may be using the photos that are unfamiliar with the site and locations.

A detailed description of field logbook entries can be found in SOP III-D, *Logbooks*.

2.3 MONITORING/SAMPLING LOCATION INFORMATION FORM

A Monitoring/Sampling Location Information form must be filled out to establish each new sampling location. This form must be provided to the Navy for inclusion into the NAVFAC NW NIRIS Database. Established locations should not be re-established unless new information (such as survey information) is recorded about a location. A location description may be provided about a sampling location. It should contain detailed information regarding the physical features surrounding the location, including relevant site information (i.e., obvious contamination, measurements to physical features, topographical relief, etc.). This description may be a copy of the field logbook or notes on project plan maps. These descriptions shall be attached to the field form. The PM is responsible for insuring that the project personnel have and use consistent terminology and descriptions as established in the SAP. The reverse of the field form contains a brief discussion of the form and descriptions of the information requested on the front.

3.0 DOCUMENTATION

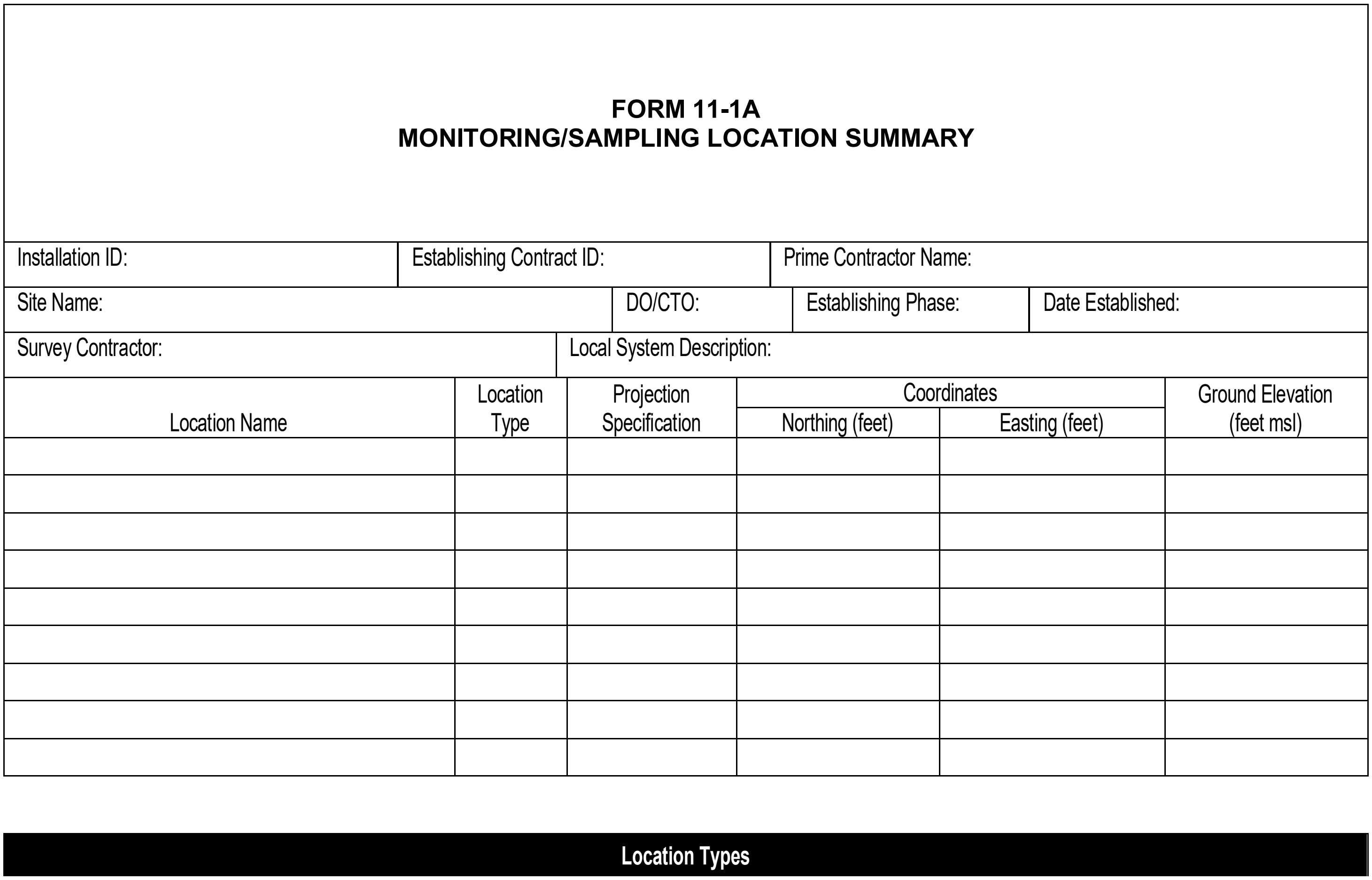
None.

4.0 REFERENCES

SOP III-D, *Logbooks*

5.0 ATTACHMENTS

Attachment IA101 Example Monitoring/Sampling Location Information Form



FORM 11-1A
MONITORING/SAMPLING LOCATION SUMMARY

Installation ID: Establishing Contract ID: Prime Contractor Name:
Site Name: DO/CTO: Establishing Phase: Date Established:
Survey Contractor: Local System Description:

Location Name	Location Type	Projection Specification	Coordinates		Ground Elevation (feet msl)
			Northing (feet)	Easting (feet)	

Location Types

ACID	Acid Pit
ADIT	Adit
AGT	Above ground tank
AIR	Air (not inside a building - ambient conditions)
AMB	Ambient drinking water aquifer monitoring well
AOVM	Ambient organic vapor monitor
ASBTS	Asbestos-Containing Area
BAY	Bay
BF	Backfill
BH	Borehole/Soil boring
BIN	Roll-off bin
BIOL	Biological (plant or animal)
BLDG	Building (includes building air and building materials)
BULK	Bulk sample
BURN	Burn pit
CB	Concrete boring
CENT	Location surveyed at the center of a UST field
CLGP	Canal Level Gauging Point
CPT	Cone penetrometer
CY	Cryopile
DCON	Decontamination pad
DITCH	Channel/Ditch
DP	Direct Push/Geoprobe
DRN	Drain
DRUM	Drum/Container contents
DRW	Drywell
DU	Decision Unit
DW	Domestic well
D_RIG_W	Drill Rig Fluid Container
EC	Electrode
ECT	Electrode
EF	System effluent
EVAP POND	EVAPORATION
EXCV	Excavation
FAGT	Former above ground tank location
FL	Fuel line
FLOOD	Flood Plain
FLOOD_GATE	Flood Control Gate
FLOOR	Floor
FLOOR_SCRP	Floor scrapings
FW	Faucet/Tap/Spigot
GAGE	Gaging station (not USGS)
GW	Geoprobe well
GWTH	Groundwater Test Hold
HA	Hand auger
HDPCH	Hydropunch
HOLE	Hole
HP	Holding pond/Lagoon
ID	Indoors
IMP	Import material
IN	System influent
IT	Intertidal
LAGOON	Lagoon
LENTIC	Freshwater, lentic
LF	Landfarm
LGV	Landfill Gas Vent
LH	Leachate (Landfill)
LK	Lake/pond/open reservoir
LOTIC	Freshwater, lotic
LYS	Lysimeter
MH	Manhole/Catch basin
MS	Sediment e.g., Marine Sediment
NQ	Quality Control sample
ON	Ocean, open water (not bay)
OTHER	Other
OUTFALL	Outfall
OW	Oil-Water Separator
PARK	Plantation/park/forest
PC	Paint chip
PIPE	Pipeline
PUBW	Public drinking water well
PUMP_STATN	Pumping station
RAIN_STATN	Rainfall station
REF	Reference
RES	Residential garden/yard
RV	River/stream
RW	Recovery well
SBAG	Soil bag
SE	Seep
SG	Soil Gas Probe
SIDEW	Side Wall
SLAG	Slag heap
SND_BLST	Sandblast material pile
SP	Spring/Seep
SPT	Septic tank
SR	Sewer System
SS	Ground surface
STEAM_LN	Steam Line
STKP	Stockpile
STRM_DRN	Storm drain
STRM_MH	Storm drain manhole
SUBS	Ground, sub-surface
SUBSLAB	Subslab
SUBT	Subtidal
SUMON	Survey monument
SUMP	Sump
SV	Soil vapor extraction system
SWS	Surface water body - nonspecific
SWSD	Surface Water/Sediment
SWWP	Wipe
SYSTEM	Treatment system air or water
T	Trench
TAA	Temporary accumulation area
TAIL	Mine tailings pile
TK	Tank
TMPM	Temperature Monitoring Point
TP	Test Pit
TRANS	Transformer
TUNNEL	Steam tunnel sampling location
TWP	Temporary well point
UGA	Geophysical anomaly
UNK	Unknown
USGS	USGS gauging station
UST	Underground storage tank
UXO	UXO
UXO_G	UXO grid
UXO_P	UXO point
VAULT	Vault
VPB	Vertical profile boring
WALL	Wall
WEEP	Weep hole
WF	Waste water treatment facility
WL	Well
WLAM	Alluvial Monitoring Well
WLBM	Bedrock Monitoring Well
WLE	Extraction well
WLEA	Alluvial Extraction Well
WLEB	Bedrock Extraction Well
WLHM	Hybrid Monitoring Well
WLI	Injection well
WLIA	Alluvial Injection Well
WLIM	Interface Monitoring Well
WLL	Leaching Well
WLM	Monitoring well
WLS	Sparge well
WLSG	Soil gas probe/Well
WRP	Waste rock pile
WSFI	Water system facility intake
WT	Wetlands
WW	Waste water

Recorder: ______________________________ Date: ____________

Checker: ______________________________ Date: ____________

SAMPLE NAMING

1.0 PURPOSE

This standard operating procedure (SOP) describes the naming convention to be used for samples collected, analyzed, and reported for the U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) projects. Unique sample identifiers are used to facilitate tracking by laboratory and project personnel and for purposes of storing, sorting, and querying data in the NAVFAC NW NIRIS database.

2.0 PROCEDURES

The contractor is responsible for assigning a unique sample ID to every individual sample collected. The contractor may use his or her own designations as long as the sample ID does not already exist in the NIRIS database. The contractor must also clearly identify which samples are field duplicates. This applies to both historical and planned sampling events. The used sampling identification scheme shall be identified and outlined in the field sampling plan.

3.0 DOCUMENTATION

All sample collection information must be recorded within the field logbook. Each sample collected will be clearly associated with the sample location (installation, site, and well or sample point location), matrix type, sample type (i.e. environmental, field duplicate, equipment rinsate), collection date and time, sampling method, and sampling depth (if appropriate). Only data codes and location IDs associated with NIRIS and NAVFAC NW's electronic deliverables SOP (NAVFAC NW 2015) shall be used.

Any sample submitted for analysis shall be documented using a completed chain-of-custody (COC) form that must accompany the shipment and a copy retained for the project records.

Samples submitted to an EPA laboratory shall also include a completed EPA analysis request form. The COC/analytical request form must be used to track all sample IDs.

4.0 REFERENCES

NAVFAC NW. 2015. Navy Environmental Data Transfer, Version 5.0.

5.0 ATTACHMENTS

None.

MONITORING WELL AND PIEZOMETER INSTALLATION

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to outline the methods by which all U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) personnel and their contractors will conduct monitoring well and piezometer installation. This procedure establishes the protocols and necessary equipment for installation of groundwater monitoring wells and piezometers.

2.0 PROCEDURES

2.1 EQUIPMENT

The following is an equipment list:

- Drill rig capable of installing wells to the desired depth in the expected formation material and conditions
- Well casing and well screen
- Bentonite pellets
- Filter pack sand
- Bentonite Grout or Portland Type I or II cement and powdered bentonite for grouting
- Protective well casing with locking cap
- High-pressure steamer/cleaner
- Long-handled bristle brushes
- Wash/rinse tubs
- Appropriate decontamination supplies as specified in the SOP for decontamination procedures
- Location map
- Plastic bags (re-sealable)
- Self-adhesive labels
- Weighted tape measure
- Water level probe
- Deionized water
- Logbook

- Boring log sheets
- Well construction form
- Plastic sheeting
- Drums for containment of cuttings and decontamination and/or development water (if necessary)

2.2 DECONTAMINATION

Before drilling or well installation begins, all drilling and well installation material should be decontaminated according to the protocols in SOP III-I, *Equipment decontamination*. Drilling equipment should be decontaminated between well locations.

2.3 INSTRUMENT CALIBRATION

Before going into the field, the sampler should verify that field instruments are operating properly. Calibration times and readings should be recorded in a notebook to be kept by the field sampler. Specific instructions for calibrating the instruments are provided in the respective SOPs.

2.4 DRILLING AND WELL INSTALLATION PROCEDURES

2.4.1 Drilling Technique

If soil sampling is required by project plans, all soil samples should be collected according to the subsurface soil sampling procedures. The hole should be logged according to the methods specified in the project plans.

Boreholes should be advanced via conventional continuous-flight hollow-stem auger, sonic, air rotary, or mud rotary drilling methods and a drill rig capable of completing the monitor well(s) to the depth(s) specified in the project plans. Before drilling begins, well locations should be numbered and staked. The necessary permits and utility clearances shall be obtained in accordance with permits and utility clearance procedures. The permits and clearances will conform to specific Naval installation procedures or SOP 1-A-6 for utility location procedures.

During the drilling operation, the cuttings from the boring shall be placed into 55-gallon drums or roll-off container as specified in the project plans. Disposal of cuttings should be in accordance with the project plans and follow the specific Naval installation procedures or SOP l-A-7 for investigation-derived waste (IDW) management procedures.

2.4.2 Well Bore Drilling Operations

The procedure for well bore drilling is as follows:

- Set up drilling rig at previously staked and borehole location cleared for utilities.
- Record location, date, time, and other pertinent information in the field logbook.
- Drill hole of appropriate size using the project specified drilling method.
- Collect split-spoon samples at the predetermined intervals, if appropriate, for sample description and/or chemical analysis as specified in the project plans.
- Complete the borehole to the depth specified in the project plans.

- Document any difficult drilling conditions and ensures taken in response to such conditions (such as the addition of clean water to control heave).

2.4.3 Well Design Specifications

The general specifications for wells are as follows:

Boring Diameter. The boring should be of sufficient diameter to permit at least 2 inches of annular space between the boring wall and all sides of the centered riser and screen. The boring diameter should be of sufficient size to allow for the accurate placement of the screen, riser, filter pack, seal, and grout.

Well Casing. The well riser should consist of new, flush-threaded, PVC or stainless steel. The well diameter and thickness should be specified in the project plans. The risers should extend approximately 2 feet above the ground surface, except in the case of flush-mount surface casings. The tops of all well casings should be fitted with plugs or caps in locking monuments and locking caps in non-locking monuments.

Well Screens. The screen length for each well should be specified in the project plans. Well screens should consist of new threaded pipe with factory-machine slots or wrapped screen with an inside diameter equal to or greater than that of the well casing. The slot size should be indicated in the project plans and designed to be compatible with aquifer and sand pack material. The schedule thickness of PVC screen should be the same as that of the well casing. All screen bottoms should be fitted with a cap or plug of the same composition as the screen and should be within 0.5 foot of the open part of the screen. Traps may be used.

2.4.4 Well Installation Procedure

The following procedure should be initiated within 12 hours of well bore completion for uncased holes or partially cased holes and within 48 hours for fully cased holes. Once installation has begun, if no unusual conditions are encountered, there should be no breaks in the installation procedure until the well has been completed and the drill casing has been removed.

The procedure for monitoring well installation is as described below.

1. Decontaminate all well materials according to the SOP for decontamination procedures. After decontamination, all personnel who handle the casing should put on a clean pair of rubber or surgical gloves.
2. Measure each section of casing and screen to nearest 0.10 foot.
3. Assemble screen and casing as it is lowered into the open boring or drill casing (augers, when auger drilling is used) the hollow-stem augers.
4. Lower screen and casing to about 6 inches above the bottom of the boring.
5. Record the level of top of casing and calculate the screened interval. Adjust screen interval by raising assembly to desired interval, if necessary, and add selected filter sand to raise the bottom of the boring.
6. Begin adding filter pack sand around the annulus of the screen and casing a few feet at a time while withdrawing the drill casing or augers. Repeated depth soundings should be taken to monitor the level of the sand.

7. Allow sufficient time for the filter sand to settle through the water column outside the casing before measuring the sand level.
8. Extend the filter pack sand to at least 2 to 5 feet above the top of the well screen.
9. After placing the sand filter pack, install a seal at least 3 to 5 feet thick of bentonite pellets or chips. Add the bentonite pellets or chips slowly through the drill casing to avoid bridging. The thickness of the completed bentonite seal should be measured before the pellets have been allowed to swell. The completed bentonite seal should be allowed to hydrate before proceeding with the grouting operations.
10. Grout the remaining annulus from the top of the bentonite seal to near the ground surface as measured after the drill casing has been removed. The grout should be tremied into the borehole until the annulus is completely filled. The base of the tremie pipe should be placed approximately 5 feet above the bentonite seal. Bentonite chips or pellets may be used to backfill the well borehole.
11. After the grout sets for 24 hours it should be checked for settlement. If necessary, additional grout should be added to top off the annulus. This procedure may not be an option in high traffic or unsecured areas.
12. The steel monument, concrete pad and bollards, if required, should be installed according to the specifications in this SOP. The protective casing and posts should be painted a highly visible color.
13. Optional: Personnel should affix to the outer steel protective casing of each well a permanent, noncorrosive tag that clearly identifies the well number, the client's name, or the adjusted top of casing elevation. In some states, a state well identification number must be affixed to the monument.

2.4.5 Well Installation Specifications

Filter Pack. The annular space around the well screen should be backfilled with clean, washed silica sand sized to perform as a filter between the formation material and the well screen. The filter pack should extend a minimum 3 feet above the screen and may be tremied into place. The final depth to the top of the filter pack should be measured directly with the use of a weighted tape measure or rod and not by volumetric calculation methods. The grain size of the filter pack should be shown on the well construction log. The filter pack must be selected based on the grain size distribution of the native formation, and should be specified in the project plans.

Bentonite Seal and Grout. A minimum 2-foot-thick bentonite pellet/chip seal should be placed in the annulus above the filter pack. The thickness of the seal may vary slightly based on site conditions. The thickness of the seal should be measured immediately after placement, without allowance for swelling. Bentonite Grout or cement grout should then be placed from the top of the bentonite seal to the ground surface. Bentonite grout is preferred because of potential investigation derived waste issues if too much cement grout is prepared and due to heat generated from cement grout. Bentonite grout shall be "high solids" and prepared in accordance with the manufacturer's instructions. Cement grout should consist of a mixture of Portland cement (ASTM C150) and clean water, with a ratio of no more than 7 gallons of clean water per bag of cement (1 cubic foot or 94 pounds). Additionally, 3 percent by weight of bentonite powder should be added if permitted by state regulations. The grout should be prepared in a rigid aboveground container by first thoroughly mixing the cement with water, and then mixing in the bentonite powder. Grout mixtures should be placed, by pumping through a tremie pipe. The lower end of the tremie pipe should be kept within 5 feet of the top of the bentonite seal. Grout should be pumped through the tremie pipe until undiluted grout flows from the annular space at the ground surface. The tremie pipe should then be removed and more grout added to compensate for settling. After 24 hours, the drilling contractor should check the site for grout settlement and add more grout to fill any depression. This should be repeated until firm grout remains at the surface.

Protection of Well. Personnel should at all times during the progress of the work take precautions to prevent tampering with the wells or the entry of foreign material into them. Upon completion of a well, a suitable cap should be installed to prevent foreign material from entering the well. The wells should be enclosed in a protective steel casing. Steel casings should be, at a minimum, 6 inches in diameter and should be provided with locking caps and locks. All locks used at a site should be keyed alike. If the well is to be a stickup (i.e., an aboveground monument), as specified in the project plans, a 1/4-inch drainage hole should be drilled in the protective steel casing, centered approximately 1/8-inch above the internal mortar collar for drainage. The well designation should be painted on the protective casing with a brush or paint pen. Painting should be done prior to well development. If specified in the project plans, a concrete pad should be constructed around the protective casing at the final ground level elevation and sloping away from the well. The concrete pad should measure at least 2 by 2 feet, with a thickness of 6 to 8 inches. Three 3-inch-diameter or larger steel posts should be equally spaced around the well and embedded in separate concrete-filled holes just outside the concrete pad. The protective steel posts should extend approximately 1 foot above the well riser. Any well that is to be temporarily removed from service or left incomplete due to a delay in construction should be capped with a watertight cap and equipped with a "vandal-proof" cover, satisfying applicable state or local regulations or recommendations.

3.0 DOCUMENTATION

Observations and data acquired in the field during the drilling and installation of wells should be recorded to establish a permanent record. A boring log should be completed for each well bore.

Additional documentation of well construction in the field logbook will include the following:

- Top of Casing surveyed elevation to 0.01 feet relative to known benchmarks, control points, and coordinate systems as defined in the Survey Specifications of NAVFAC NW SOPs V5.0 (or more current)
- Date
- Time
- Personnel
- Weather
- Subcontractors
- Health and safety monitoring equipment and readings
- Description of well location and triangulation measurements from landmarks, or GPS readings.
- Quantity and composition of grout, seals, and filter pack actually used during construction

- Screen slot size (in inches), slot configuration, outside diameter, nominal inside diameter, schedule/thickness, composition, and manufacturer
- Coupling/joint design and composition
- Protective casing composition and nominal inside diameter
- Start and completion dates
- Discussion of all procedures and any problems encountered during drilling and well construction

In addition, the well installation details should be shown in a diagram drawn in the field logbook. Each well diagram should consist of the following (denoted in order of decreasing depth from the ground surface):

- Reference elevation for all depth measurements
- Project and site names
- Well number
- Date(s) of installation
- Depth at which the hole diameter changes (if appropriate)
- Depth of the static water level and date of measurement(s)
- Total depth of completed well
- Depth of any grouting or sealing
- Nominal hole diameter(s)
- Depth and type of well casing
- Description (to include length, internal diameter, slot size, and well screen material
- Any sealing off of water-bearing strata
- Static water level upon completion of the well and after development
- Drilling date(s)
- Other construction details of monitoring well including grain size of well filter pack material and location of all seals and casing joints

All entries in the field logbook should be printed in black ink and legible.

4.0 REFERENCES

SOP I-A-7, *IDW Management*

SOP III-I, *Equipment Decontamination*

5.0 ATTACHMENTS

None.

MONITORING WELL DEVELOPMENT

1.0 PURPOSE

This section describes the standard operating procedures (SOP) for monitoring well development to be used by all U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) personnel and their contractors.

2.0 PROCEDURE

2.1 INTRODUCTION

Well development procedures are crucial in preparing a well for sampling. Development enhances the flow of groundwater from the formation into the well and grades the well filter pack to reduce the movement of fine (clay and silt) particles into the well. The reduction in groundwater sample turbidity achieved by development improves the representation of chemical analyses performed on groundwater samples.

The goal of well development is to restore the area adjacent to a well to its natural condition by correcting damage to the formation during the drilling process. Well development should accomplish the following tasks:

- Remove any filter cake or any drilling fluid within the borehole that affects formation permeability.
- Grade the well filter pack to reduce the intrusion of fine formation particles.

Well development should not be performed sooner than 24 hours after the completion of well installation to allow the annular seal to fully set up.

2.2 FACTORS AFFECTING MONITORING WELL DEVELOPMENT

2.2.1 Type of Geologic Materials

Different types of geologic materials are developed more effectively by using certain development methods. Where permeability is greater, water moves more easily into and out of the formation and development is accomplished more quickly. Highly stratified deposits are effectively developed by methods that concentrate on distinct portions of the formation. If development is performed unevenly, a ground-water sample will likely be more representative of the permeable zones. In uniform deposits, development methods that apply powerful surging forces over the entire screened interval will produce satisfactory results.

2.2.2 Design and Completion of the Well

Because the filter pack reduces the amount of energy reaching the borehole wall, it must be as thin as possible if the development procedures are to be effective in removing fine particulate material from the interface between the filter pack and natural formation. Conversely, the filter pack must be thick enough to ensure a good distribution of the filter-pack material during emplacement and allow effective grading during development. Generally, filter pack material must be at least 2 inches thick. Variances from state agencies may be required for filter pack materials of less than 2 inches thick.

The screen slot size must be appropriate for the geologic material and filter pack material in order for development to be effective. If the slot size is too large, the filter pack and native material will enter the well, causing settlement of overlying materials and sediment accumulation in the casing. If the slot size is too small, full development may not be possible and the well yield will be below the potential of the formation. Additionally, incomplete development coupled with a narrow slot size can lead to blockage of the screen openings.

2.2.3 Drilling Method

The drilling method influences development procedure. Typical problems associated with specific drilling methods include the following:

- If a mud rotary method is used, a mudcake builds up on the borehole wall and must be removed during the development process.
- If drilling fluid additives have been used, the development process must attempt to remove all fluids that have infiltrated into the native formation.
- If driven casing or hollow-stem auger methods have been used, the interface between the casing or auger flights and the natural formation may have been smeared with fine particulate matter that must be removed during the development process.
- If an air rotary method has been used in rock formations, fine particulate matter is likely to build up on the borehole walls and may plug pore spaces, bedding planes, and other permeable zones. These openings must be restored during the development process.

2.3 PREPARATION

In preparing for monitoring well development, development logs for any other monitoring wells in the vicinity should be reviewed to determine the general permeability of the water-bearing formation, the associated likely groundwater yield from the well and the appropriate development method.

Depth to groundwater and information from the well construction log should be used in calculating of the required quantity of water to be removed. The distance between the equilibrated water level and the bottom of screen is the saturated section. The saturated section (feet) multiplied by the unit well volume per foot (gallons/linear foot) equals the gallons required to remove one total well volume of water. The unit well volume is the sum of the casing volume and the filter-pack pore volume, both of which depend upon casing and borehole diameter and the porosity of the filter pack material. Well volume for wells can be calculated using Table I-C-2-1 and Table I-C-2-2.

Table I-C-2-1*
Casing Volume

Casing Diameter (inches)	Volume (gallon/linear foot)
2	0.16
4	0.65
6	1.47

Table I-C-2-2*
Filter Pack Pore Volume

Casing Diameter (inches)	Borehole Diameter (inches)	Volume[a] (gallon/linear foot)
2	6	0.52
2	8	0.98
4	10	1.37
4	12	2.09
6	12	1.76

* The above two volumes must be added together to obtain one unit well volume.

[a] Assumes a porosity of 40% for filter pack.

2.4 DECONTAMINATION

The purpose of decontamination of development equipment is to prevent cross-contamination between monitoring wells. A steam-cleaner, if available, should be used to decontaminate development equipment. The equipment should be cleaned away from the monitoring well in such a fashion that decontamination effluent can be containerized.

A triple rinse decontamination procedure is acceptable for equipment such as bailers if access to a steam cleaner is not possible. See SOP III-I, *Equipment Decontamination*.

2.5 WELL DEVELOPMENT MONITORING

Throughout the well development process, a development record should be maintained in the field logbook. A well development field form presented in Attachment 1 (or similar) may be filled out in addition to the field logbook. The record should include the following information:

General

- Well name/number and location

- Date, time, and weather conditions
- Names of personnel involved

Development volume

- Initial and final water level
- Casing total depth and diameter
- Borehole diameter
- Casing volume, filter pack pore volume, total well volume
- Volume of water to be evacuated
- Method and rate of removal
- Appearance of water before and after development

Monitoring data for each sample point

- Date, time, elapsed time
- Cumulative gallons removed, removal method, removal rate
- Temperature, pH, specific conductance, turbidity, dissolved oxygen, and redox potential

Part of the well development procedure should consist of acquisition and analysis of general water quality parameters at periodic intervals, considering the total quantity of water to be removed and the removal rate. Depending on site conditions, the parameters specific conductance, pH, temperature, dissolved oxygen, turbidity, and redox potential may be measured. At a minimum the temperature, pH and turbidity should be monitored. Parameter measurements should be collected on a periodic basis during development. At a minimum, these parameters should be measured after removal of each well volume. The cumulative water volume of removed, the clock time, and the time elapsed during development should be recorded and a flow rate should be calculated. Development should continue until turbidity stabilizes at or below 10 nephelometric units or at least three well volumes have been removed. If three successive parameter measurements show stable values (values within 10% of each other) and turbidity is low, well development may cease. If stabilization has not been attained, if turbidity remains high, or if the well does not readily yield water, development should continue for a reasonable time as determined in the project plans or by the Project Manager.

The discussion of well development in special situations such as low yield formations is described in Section 2.7.

2.6 METHODS OF MONITORING WELL DEVELOPMENT

The methods available for the development of monitoring wells have been inherited from production well practices. Methods include (1) mechanical surging with a heavy, non-disposable bailer (stainless steel or PVC) surge block or swab, and (2) surge pumping. Development methods using air or jetting of water into the well are discouraged because of the potential for affecting water quality. In some circumstances, air or water jet development may be necessary and should be conducted under the supervision of a qualified hydrogeologist.

All development water must be containerized and appropriately labeled, unless it is permissible to discharge onsite. Development should generally utilize mechanical surging or surge pumping, followed by bailing or groundwater removal with a pump. More detailed descriptions of appropriate development methods are presented below.

2.6.1 Mechanical Surging and Bailing

For mechanical surging and bailing, a heavy bailer, surge block or swab is operated either manually or by a drill rig. The bailer, surge block, or swab should be of sufficient weight to free-fall through the water in the well and create a vigorous outward surge. The equipment lifting the tool must be strong enough to extract it rapidly. A bailer is then used to remove fine-grained sediment and groundwater from the well.

Methodologies:

1. Properly decontaminate all equipment entering well.
2. Record the static water level and the total well depth.
3. Lower the bailer, surge block or swab to top of the screened interval.
4. Operate in a pumping action with a typical stroke of approximately 3 feet.
5. Gradually work the surging downward through the screened interval during each cycle.
6. Surge for several minutes per cycle.
7. Remove surge block and attach bailer in its place.
8. Bail to remove fines loosened by surging until water appears clear.
9. Repeat the cycle of surging and bailing until turbidity is reduced and stabilization of water quality parameters occurs.
10. The surging should initially be gentle and the energy of the action should gradually increase during the development process.

The advantages (+) and disadvantages (–) of this method are listed below:

+ It reverses the direction of flow, reduces bridging between large particles; the inflow then moves the fine material into the well for withdrawal.
+ It affects the entire screened interval.
+ It effectively removes fines from the formation and the filter pack.
– It may cause upward movement of water in the filter pack that could disrupt the seal.
– Potential exists for damaging a screen with a tight-fitting surge block or with long surge strokes.

2.6.2 Surge Pumping

Methodologies:

1. Properly decontaminate all equipment entering well.
2. Record the static water level and the total well depth.
3. Lower a submersible pump or airlift pump without a check valve to a depth within 1 to 2 feet of the bottom of the screened section.
4. Start pumping and increase discharge rate causing rapid drawdown of water in the well.
5. Periodically stop and start pump, allowing the water in the drop pipe to fall back into the well and surge the formation (backwashing), thus loosening particulates.
6. The pump intake should be moved up the screened interval in increments appropriate to the total screen length.
7. At each pump position, the well should be pumped, over-pumped, and backwashed alternately until satisfactory development has been attained as demonstrated by reduction in turbidity and stabilization of water quality parameters.

The advantages (+) and disadvantages (–) of this method are listed below:

+ Reversing the direction of flow reduces bridging between large particles, and the inflow then moves the fine material into the well for withdrawal.

+ It effectively removes fines from the formation and filter pack.

– The pump position or suction line must be changed to cover the entire screen length.

– Submersible pumps suitable to perform these operations may not be available for small diameter (2 inches or less) monitoring wells.

– It is not possible to remove sediment from the well unless particle size is small enough to move through pump.

For additional information on well development, consult the references included in Section 4.0 of this SOP.

2.7 SPECIAL SITUATIONS

2.7.1 Development of Low Yield Wells

Development procedures for monitoring wells in low-yield (<0.25 gpm) water-bearing zones are somewhat limited. Due to the low hydraulic conductivity of the materials, surging of water in and out of the well casing is difficult. Also, when the well is pumped, the entry rate of water is inadequate to remove fines from the well bore and the gravel pack. Additionally, the process may be lengthy because the well can be easily pumped dry and the water level will be very slow to recover.

The procedures for mechanical surging and bailing should be followed for low yield wells. During surging and bailing, wells in low yield formations should be drawn down to total depth twice if possible.

Development can be terminated, however, if the well does not exhibit 80% recovery after 2 hours have passed.

3.0 DOCUMENTATION

Well development information should be documented in field logbooks in accordance with SOP III-D, *Logbooks* using indelible ink. In addition, well development monitoring forms (Attachment I-C-2-1 or similar) may be filled out in addition to the field logbook documentation. Copies of this information should be sent to the Project Manager and to the project files.

4.0 REFERENCES

Driscoll, F.G. 1987. Ground Water and Wells. Published by Johnson Division, St. Paul, Minnesota.

USEPA. 1992. RCRA, Ground Water Monitoring Technical Enforcement Guidance Document. U.S. Environmental Protection Agency/530/R-93/001. November.

U.S. EPA Environmental Response Team. 1988. Response Engineering and Analytical Contract Standard Operating Procedures. U.S. EPA, Research Triangle Park, NC.

SOP III-I, *Equipment Decontamination*

SOP III-D, *Logbooks*

5.0 ATTACHMENTS

Attachment I-C-2-1	Well Development Record

Attachment 1-C-2-1
Well Development Record

PROJECT		WELL NO.
JOB NO.	SITE	PREPARED BY

WELL DEVELOPMENT LOG

METHOD
OVERPUMPAGE __________
BAILER __________

SURGE
BLOCK __________
AIR LIFT __________
OTHER __________

INITIAL WATER LEVEL __________
FINAL WATER LEVEL __________

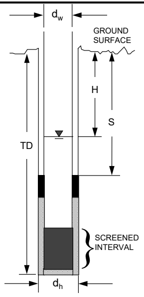
REMARKS:

CAPACITY OF CASING
(GALLONS/LINEAR FOOT)

2” = 0.16
4” = 0.65
6” = 1.47

VOLUME BETWEEN CASING AND HOLE
(GALLONS/LINEAR FOOT)
(ASSUMING 40% POROSITY)
2” CASING AND 6” HOLE - 0.52
2” CASING AND 8” HOLE - 0.98
4” CASING AND 10” HOLE = 1.37
4” CASING AND 12” HOLE - 2.09

Hole Diameter d_h =_____
Well Casing:
Inside Diameter d_wID =_____
Outside Diameter d_wOD =_____
Depth to Water: H =_____
Depth to Base of Seal: S =_____
Depth to Base of Well: TD =_____
Estimated Filter Pack Porosity: P =_____



WELL VOLUME CALCULATION :

$$\text{CASING VOLUME} = V_c = \Pi\left(\frac{d_w\text{ID}}{2}\right)^2(\text{TD}-\text{H}) = 3.14\left(\frac{\underline{\quad}}{2}\right)^2(\underline{\quad}-\underline{\quad}) = \underline{\qquad}$$

$$\text{FILTER PACK PORE VOLUME} = V_f = \Pi\left[\left(\frac{d_h}{2}\right)^2-\left(\frac{d_w\text{OD}}{2}\right)^2\right](\text{TD}-(\text{S or H}^*)(\text{P}) = \underline{\qquad}$$

$$(^*\text{if S} > \text{H, use S; if S} < \text{H, use H})$$

$$= 3.14\left[\left(\frac{\underline{\quad}}{2}\right)^2-\left(\frac{\underline{\quad}}{2}\right)^2\right](\underline{\quad}-\underline{\quad})(\underline{\quad}) = \underline{\qquad}$$

$$\text{TOTAL WELL VOLUME} = \text{VT} = \text{Vc}+\text{Vf} = \underline{\quad}+\underline{\quad} = \underline{\qquad}\ \text{ft.}^3 \times 7.48 = \underline{\qquad}\ \text{gal.}$$

DEVELOPMENT LOG:					CUMULATIVE WATER REMOVED	WATER QUALITY						COMMENTS
DATE	TIME BEGIN/END	METHOD	ELAPSED TIME	FLOW RATE (gpm)	GALLONS	pH	TEMP	CONDUC-TIVITY	D.O.*	REDOX	TURBID-ITY	

* = Dissolved Oxygen

LOW-FLOW GROUNDWATER PURGING AND SAMPLING

1.0 PURPOSE

This standard operating procedure (SOP) describes the conventional monitoring well sampling procedures to be used by all U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) personnel and contractors. Conventional monitoring well sampling procedures are provided in SOP I-C-4, *Groundwater Sampling from Temporary Wells (Piezometers)*.

2.0 PROCEDURE

2.1 PURPOSE

This procedure establishes the method for sampling groundwater monitoring wells for water-borne contaminants and general groundwater chemistry. The objective is to obtain groundwater samples with as little alteration of water chemistry as possible.

2.2 PREPARATION

2.2.1 Site Background Information

A thorough understanding of the purposes of the sampling event should be established prior to commencing field activities. A review of available data obtained from the site and pertinent to the water sampling should also be conducted. Copies of well logs or summary tables regarding well construction information should be available on-site if possible.

Previous groundwater development and sampling logs give a good indication of well purging rates and the types of problems that may be encountered during sampling, such as excessive turbidity and low well yield. They may also indicate where dedicated pumps are placed in the water column.

It is highly recommended that the field sampling team is familiar with the U.S. EPA recommended protocols for low-flow sampling outlined in the April 1996 Ground Water Issue *Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures* (U.S. EPA 1996).

2.2.2 Groundwater Analysis Selection

The requisite field and laboratory analyses should be established prior to performing water sampling. The types and numbers of quality assurance/quality control (QA/QC) samples to be collected (refer to SOP III-B, *Field QC Samples (Water, Soil)*) should be specified in the QA plan developed for the site.

2.3 GROUNDWATER SAMPLING PROCEDURES

Groundwater sampling procedures at a site should include: (1) measurement of depth to groundwater and total depth, (2) assessment of the presence or absence of an immiscible phase (if required by the project plan), (3) assessment of purge parameter stabilization, (4) purging of static water within the well and well bore, and (5) obtaining a groundwater sample. Each step is discussed in sequence below. Depending upon specific field conditions, additional steps may be necessary. As a rule, at least 24 hours should separate well development and well sampling events.

2.3.1 Measurement of Static Water Level Elevation

The depth to water and the total depth of the well should be measured to the nearest 0.01 foot to provide baseline hydrologic data, to calculate the volume of water in the well, and to provide information on the integrity of the well (e.g., identification of siltation problems). Dependent upon individual project requirements, synoptic water level collection may be required prior to groundwater sampling activities. In the event that synoptic water levels **are not** collected prior to sampling activities, total depth measurements should be collected **after** purging and sampling activities to prevent the suspension of fine-grained sediment that may be present at the bottom of the well. Each well should be marked with a permanent, easily identified reference point for water level measurements whose location and elevation have been surveyed.

An electronic water level meter accurate to 0.01 foot should be used to measure the water level surface and depth of the well. The presence of light, non-aqueous phase liquids (LNAPLs) and/or dense, non-aqueous phase liquids (DNAPLs) in a well requires measurement of the elevation of the top and the bottom of the product, generally using an interface probe. Water levels in such wells must then be corrected for density effects to accurately determine the elevation of the water table.

2.3.2 Decontamination of Equipment

Each piece of non-dedicated equipment should be decontaminated prior to entering the well. Decontamination should also be conducted prior to the start of sampling at a site, even if the equipment is known to be decontaminated subsequent to its last usage. This precaution is taken to minimize the potential for cross-contamination. In addition, each piece of equipment used at the site should be decontaminated prior to leaving the site. Dedicated sampling equipment need only be decontaminated prior to installation within the well. Clean sampling equipment should not be placed directly on the ground or other contaminated surfaces prior to insertion into the well. Dedicated sampling equipment that has been certified by the manufacturer as being decontaminated can be placed in the well without onsite decontamination.

Further details are presented in SOP III-I, *Equipment Decontamination*.

2.3.3 Detection of Immiscible Phase Layers

Unless specified in the project plans, groundwater samples should not be collected from wells with detectable amounts of LNAPL and DNAPL.

2.3.4 Purging Equipment and Use

To help minimize the potential for cross-contamination, well sampling should proceed from the least contaminated to the most contaminated. This order may be changed in the field if conditions warrant, particularly if dedicated sampling equipment is used. If decontamination of tubing is required by the project, Teflon® tubing is recommended. All groundwater removed from potentially contaminated wells should be handled in accordance with the investigation-derived waste (IDW) handling procedures described in SOP I-A-7, *IDW Management*.

Purging should be accomplished by removing groundwater from the well at low flow rates using a pump. According to the U.S. EPA (1996), the rate at which groundwater is removed from the well during purging ideally should be between than 0.1 to 0.5 L/min. The pump intake should be placed in the middle of the calculated saturated screened interval. The purge rate should be low enough that substantial drawdown (>0.3 foot) in the well does not occur during purging. If a stabilized drawdown in the well can't be achieved and the water level is approaching the top of the screened interval, reduce the flow rate or turn the pump off (for 15 minutes) and allow for recovery. It should be noted whether or not the pump has a check valve. A check valve is required if the pump is shut off. ***Under no circumstances should the well be pumped dry or otherwise over-purged***. Begin pumping at a lower flow rate, if the water draws down to the top of the screened interval again turn pump off and allow for recovery. If two tubing volumes (including the volume of water in the pump and flow cell) have been removed during purging then sampling can proceed next time the pump is turned on. This information should be noted in the field notebook or groundwater sampling log with a recommendation for a different purging and sampling procedure (USEPA, 2012).

Water level measurements should be collected to assess the water level effects of purging. A low purge rate also will reduce the possibility of stripping VOCs from the water, and will reduce the likelihood of mobilizing colloids in the subsurface that are immobile under natural flow conditions.

Water quality parameters should be collected and recorded on a regular basis (every 3-5 minutes) during well evacuation. Field parameters to be collected may include temperature, pH, specific conductance, salinity, dissolved oxygen, Redox potential, and turbidity. At least seven readings should be taken during the purging process unless the field parameters stabilize more quickly. These parameters are measured to demonstrate that the formation water, not stale well casing water, is being evacuated. Purging should be considered complete when the high and low values between three consecutive field parameter measurements stabilize within 10%. Turbidity may be considered stable if values are less than 10 nephelometric turbidity units (NTUs). The criterion for temperature may not be applicable if a submersible pump is used during purging due to the heating of the water by the pump motor. Field personnel should refer to the project-specific Sampling and Analysis Plan (SAP) for specific measurement requirements and well stabilization criteria.

All information obtained during the purging and sampling process should be entered into the field logbook. In addition to the field logbook, the data may be logged on a groundwater sampling log (Figure I-C-5-1 or equivalent). In special situations where LNAPL has been detected in the monitoring well and a groundwater sample is determined to be necessary by the Project Manager, a stilling tube should be inserted into the well prior to well purging. The stilling tube should be composed of a material that meets the performance guidelines for sampling devices. The stilling tube should be inserted into the well to a depth that allows groundwater from the screened interval to be purged and sampled. The bottom of the tube should be set below the upper portion of the screened interval where the LNAPL is entering the well screen. The goal is to sample the aqueous phase (groundwater) while preventing the LNAPL from entering the sampling device. To achieve this goal, the stilling tube must be inserted into the well in a manner that prevents the LNAPL from entering the stilling tube.

One method of doing this is to cover the end of the stilling tube with a membrane or material that will be ruptured by the weight of the pump. A piece of aluminum foil can be placed over the end of the stilling tube. The stilling tube is lowered slowly into the well to the appropriate depth and then attached firmly to the top of the well casing. When the pump is inserted, the weight of the pump breaks the foil covering the end of the tube, and the well can be purged and sampled from below the LNAPL layer. The membrane or material that is used to cover the end of the stilling tube must be fastened firmly so that it remains attached to the stilling tube when ruptured. Moreover, the membrane or material must retain its integrity after it is ruptured. Pieces of the membrane or material must not fall off of the stilling tube into the well. Although aluminum foil is mentioned in this discussion as an example of a material that can be used to cover the end of the tube, a more chemically inert material may be required, based on the site-specific situation. Stilling tubes should be thoroughly decontaminated prior to each use. Groundwater removed during purging should be collected and stored onsite until its disposition is determined based upon laboratory analytical results. Storage should be in secured containers such as DOT-approved drums. Containers of purge water should be labeled with NAVFAC NW approved labels or paint pens.

2.3.5 Groundwater Sampling Methodology

The well should be sampled when groundwater within it is representative of aquifer conditions and after it has recovered sufficiently to provide enough volume for the groundwater sampling parameters. A period of no more than 2 hours should elapse between purging and sampling to prevent groundwater interaction with the casing and atmosphere. This may not be possible with a slowly recharging well. The water level should be measured and recorded prior to sampling to demonstrate the degree of recovery of the well. Sampling equipment should never be dropped into the well, because this could cause aeration of the water upon impact. In addition, the sampling methodology utilized should allow for the collection of a groundwater sample in as undisturbed a condition as possible, minimizing the potential for volatilization or aeration. This includes minimizing agitation and aeration during transfer to sample containers.

2.3.6 Sample Handling and Preservation

Many of the chemical constituents and physiochemical parameters to be measured or evaluated during groundwater monitoring programs are chemically unstable; therefore, samples must be preserved. The U.S. Environmental Protection Agency document entitled *Test Methods for Evaluating Solid Waste – Physical/Chemical Methods (SW-846)* (U.S. EPA 1995), includes a discussion of appropriate sample preservation procedures. In addition, SW-846 specifies the sample containers that should be used for each constituent or common set of parameters. In general, check with specific laboratory requirements prior to obtaining field samples. In many cases, the laboratory will supply the necessary sample bottles and required preservatives. In some cases, the field team may add preservatives in the field.

Improper sample handling may alter the analytical results of the sample. Samples should be transferred in the field from the sampling equipment directly into the container that has been prepared specifically for that analysis or set of compatible parameters as described in the Quality Assurance Project Plan.

When sampling for VOCs, water samples should be collected in vials or containers specifically designed to prevent loss of VOCs from the sample. An analytical laboratory should provide these vials, preferably by the laboratory that will perform the analysis. Groundwater from the sampling device should be collected in vials by allowing the groundwater to slowly flow along the sides of the vial. Sampling equipment should not touch the interior of the vial. The vial should be filled above the top of the vial to form a positive meniscus with no overflow. No headspace should be present in the sample container once the container has been capped. The sample can be checked for headspace by inverting the sample bottle and tapping the side of the vial to dislodge air bubbles. Sometimes it is not possible to collect a sample without air bubbles, particularly water that is aerated or naturally carbonated. In these cases, the investigator should note the problem to account for possible error. Field logs and laboratory analysis reports should note any headspace in the sample container(s) at the time of receipt by the laboratory, as well as at the time the sample was first transferred to the sample container at the wellhead.

2.3.6.1 Special Handling Considerations

Samples requiring analysis for organics should not be filtered. Samples should not be transferred from one container to another because this could cause aeration or a loss of organic material onto the walls of the container.

Groundwater samples to be analyzed for total and dissolved metals should be obtained sequentially. The sample to be analyzed for total metals, should be obtained directly from the pump and be unfiltered. The second sample should be filtered through a 0.45-micron membrane in-line filter and transferred to a container to be analyzed for dissolved metals. Allow at least 500 ml of effluent to flow through the filter prior to sampling. Any difference in concentration between the total and dissolved fractions may be attributed to the original metallic ion content of the particles and adsorption of ions onto the particles.

2.3.6.2 Field Sampling Preservation

Samples should be preserved immediately upon collection. Ideally, sample jars contain preservatives of known concentration and volume during the initial filling of the jar to a predetermined final sample volume. For example, metals require storage in aqueous media at pH of 2 or less. Typically, 0.5 ml of 1:1 nitric acid added to 500 ml of groundwater will produce a pH less than 2.0. Certain matrices that have alkaline pH (greater than 7) may require more preservative than is typically required. An early assessment of preservation techniques, such as the use of pH strips after initial preservation, may therefore be appropriate. It should be noted that introduction of preservatives will dilute samples, and may require normalization of results. Guidance for the preservation of environmental samples can be found in the EPA "Handbook for Sampling and Sample Preservation of Water and Wastewater:" (U.S. EPA 1982).

3.0 DOCUMENTATION

Information collected during groundwater sampling should be documented in the field logbook in accordance with SOP III-D, *Logbooks*. In addition, groundwater sampling purge logs may be (Figure I-C-5-1 or equivalent) may be filled out in addition to the field logbook. Copies of this information should be sent to the Project Manager and to the project files.

A groundwater sampling log should be documented in the field logbook and contain the following information:

- Identification of well
- Well depth
- Static water level depth
- Presence of immiscible layers
- Purge volume and pumping rate
- Time that the well was purged
- Collection method for immiscible layers
- Sample IDs
- Well evacuation procedure/equipment
- Date and time of collection
- Parameters requested for analysis
- Field analysis data

- Field observations on sampling event
- Name of collector

Figure 1-C-5-1
Groundwater Sampling Log

Project Number: ____________________ Date: ____________________

Location: ____________________ Time: ____________________

Well Number: ____________________ Climatic Conditions: ____________________

Initial Measurements: Static Water Level: ____________
Total Depth: ____________

Well Purging: Length of Saturated Zone: ____________linear feet
Volume of Water to be Evacuated: ____________gals./linear ft. x
Linear feet of Saturation x Casing Volumes* = ____________gallons
Method of Removal: ____________________
Pumping Rate: ____________ gallons/minute

Well Purge Data:

DATE/ TIME	GALLONS REMOVED	pH	SP. COND.	D.O.	REDOX	TURBIDITY

Sample Withdrawal Method: ____________________
Appearance of Sample: Color ____________________
Turbidity ____________________
Sediment ____________________
Other ____________________

Laboratory Analysis Parameters and Preservatives: ____________________

Number and Types of Sample Containers Used: ____________________

Sample ID(s): ____________________

Decontamination Procedures:____________________

Notes: ____________________

Sampled by:____________________
Samples delivered to:____________________
Date/Time:____________________
Transporters: ____________________

* Capacity of casing (gallons/linear foot): 2”-0.16, 4”-0.65, 6”-1.47, 8”-2.61, 10”-4.08, 12”-5.87

4.0 REFERENCES

SOP I-A-7, IDW Management

SOP *-C-4, *Groundwater Sampling from Temporary Wells (Piezometers)*

SOP III-I, Equipment Decontamination

SOP III-B, Field QC Samples

SOP III-D, Logbooks

U.S. EPA. 1982. Handbook for Sampling and Sample Preservation of Water and Wastewater. EPA-600/4-82-029. September 1982.

U.S. EPA. 1986. RCRA Ground-Water Monitoring Technical Enforcement Guidance Document.

U.S. EPA. 1996. Ground Water Issue, Low-flow (Minimal Drawdown) Groundwater Sampling Procedures. EPA/540/S-95/504. April 1996

U.S. EPA. 1995 and as revised. Test Methods for Evaluating Solid Waste–Physical/Chemical Methods (SW-846). January 1995.

U.S. EPA. 2012. Standard Operating Procedure Low-Stress (Low Flow) / Minimal Drawdown Ground-Water Sample Collection, USEPA, Region 9, Management and Technical Services Division, April 2012.

5.0 ATTACHMENTS

None.

WATER LEVEL MEASUREMENTS

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish standard protocols for all U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) field personnel for use in making water level measurements.

2.0 PROCEDURE

2.1 EQUIPMENT

Equipment and materials used during liquid level and well-depth measurements:

- Electronic water level indicator with cable marked with 0.01-foot increments
- Electronic oil-water interface probe
- Engineers measuring tape with 0.01-foot increments may be used for water and petroleum reactive pastes as an alternative to an oil-water interface probe
- Weighted steel tape with 0.01-foot increments and chalk may be used as an alternative to a water level indicator
- Decontamination equipment
- Weatherproof, bound field logbook with numbered pages (see SOP III-D, *Logbooks*)
- Health and safety equipment appropriate for site conditions
- Keys for locked well covers
- Wire cutters if well has a security tag
- Turkey baster or hand pump in case flush-mount manhole is filled with water
- Bolt cutters for cutting “frozen” or rusted locks. HWD-40 is used to lubricate a rusted lock, but extreme care should be taken to avoid possible contamination to the well and equipment.
- Extra locks to replace cut locks

2.2 PRELIMINARY STEPS

Follow these steps prior to disturbing the liquid level in the well:

1. Locate the well and, confirm its label (if marked), and verify its position relative to other site features on the site map. Gain access to the top of the well casing.

2. Locate the permanent reference mark at the top of the well casing. This reference point shall be scribed, notched, or otherwise noted on the top of the casing. If no such marks are present, measure depth relative to the top of the highest point of the well casing and note this fact in the field logbook. Determine from the records and record the elevation of the permanent reference point and record it in the logbook.
3. Record any observations and remarks regarding the characteristics and condition of the well, such as evidence of cracked casing or surface seals, security of the well (locked cap), evidence of tampering, missing well cap, surface water entering the well casing, etc.

2.3 OPERATION

Follow these steps when taking depth to liquid level measurements in well suspected to have NAPL present.

1. Sample the air in the wellhead for gross organic vapors if required.
2. If non-aqueous phase liquid (NAPL) contamination is suspected, use an oil-water interface probe to determine the existence and thickness of the NAPL.
3. Open interface probe housing, turn probe on, and test the alarm. Ground the probe, because the slight electric charge from the probe could set off an explosion of highly flammable vapors. Slowly lower the probe into the well until the alarm sounds. A continuous alarm indicates light non-aqueous phase liquid (LNAPL), while an intermittent alarm indicates water. If LNAPL is detected, record depth of the initial (first) alarm. Mark the spot by grasping the cable with the thumb and forefingers at the top of the casing. Determine the depth to liquid relative to the permanent reference point on the well casing. Withdraw cable sufficiently to record the depth from the scale on the interface probe cable.
4. Continue to slowly lower the probe until it passes into the water phase (intermittent alarm). Slowly retract the probe until the NAPL continuous alarm sounds and record that level in the same manner as described above.
5. Record the depth to NAPL and the depth to water readings independently in the logbook. The thickness of the LNAPL can be calculated by subtracting depth to LNAPL reading from depth to water measurement.
6. Continue to slowly lower the interface probe through the water column to check for the presence of dense non-aqueous phase liquid (DNAPL) if suspected.
7. Measure and record the depths of the DNAPL layer (if any) as described above.
8. Slowly raise the interface probe, recording the depth to each interface as the probe is withdrawn. If there is a discrepancy in depths, clean the probe sensor and recheck the depth measurements.
9. Always lower and raise the interface probe slowly to minimize mixing of media.
10. Always perform a NAPL check in wells installed in areas with suspected NAPL contamination. Always perform a NAPL check if headspace test reveals presence of volatiles. Always perform a NAPL check the first time depth to liquid is measured in a well. If a well has been measured previously, with no NAPLs present, and none of the preceding conditions are met, the NAPL check may be omitted.

11. Decontaminate interface probe as appropriate.

For wells where NAPL is not suspected to be present, an electronic water level indicator or steel tape can be used as described below:

1. Remove the water level indicator probe from the case, turn on the sounder, and test the battery and sensitivity scale by pushing the test button. Adjust the sensitivity scale until you can hear the alarm.
2. Slowly lower the probe and cable into the well, allowing the cable reel to unwind. Continue lowering the probe until the alarm sounds. Very slowly raise and lower the probe until the point is reached where the meter just beeps. Mark the spot by grasping the cable with thumb and forefingers at the top of the casing. Record the depth to water relative to the permanent reference point. If no mark is present, use the highest point on the casing as a reference point. Withdraw the cable and record the depth.
3. Alternately, use a steel tape with an attached weight if the aquifer gradients are lower than 0.05 ft./ft. Due to the possibility of adding unknown contaminants from chalk colorants, only white chalk is permitted as a level indicator.
4. Rub chalk onto the end (first 1 foot) of the steel tape and slowly lower the chalked end into the well until the weighted end is below the water surface. (A small splash can be heard when the weighted end hits the water surface.)
5. Mark the spot on the tape by grasping the tape with the thumb and forefingers at the top of the casing as described in the subsection (2) above. Record this spot on the tape in the logbook as the "HOLD". Ensure not to retract the tape from the well until after the depth measurement (HOLD) is recorded.
6. Remove the steel tape from the well. The chalk will be wet or absent where the tape was below the water surface. Locate, read, and record this length in the logbook as the "CUT". Subtract the "CUT" length from the "HOLD" length and record the difference in the logbook. This is the depth to water table.
7. Decontaminate water level indicator or steel tape as appropriate

2.4 PRECAUTIONS

- Depending on the device used, correction factors may be required for some measurements. For example, if the water level indicator has been shortened during its repair.
- Check instrument batteries prior to each use.
- Exercise care not to break the seals at the top of the electric water level indicator probe.
- It is important to note that when measuring total well depth (bottom of casing), using an interface probe or water level indicator, the increments of measure are ticked off from the alarm sensor on the probe. On some meters there is a portion of the probe that sticks out beyond the alarm sensor. This needs to be accounted for when reading the bottom of casing measurement (i.e., added onto the reading). A potential problem arises if it is unknown whether this has been done on previous readings or not.

3.0 DOCUMENTATION

This section describes the documentation necessary for depth to liquid and well-depth measurements. All information shall be recorded in the field logbook using indelible ink in accordance with SOP III-D, *Logbooks*. At a minimum, the following information must be recorded:

- Date
- Time
- Weather
- Field personnel
- Well location and label
- Well condition
- Monitoring equipment type and readings
- Depth to Liquid measurements obtained
- Any other observations

All entries in the field logbook must be printed in black ink and legible. The actual readings measured should be recorded directly in the logbook. If calculations are necessary to determine the depth to liquid or liquid elevation, they should be performed using direct readings documented in the logbook.

Water level measurements must also be submitted electronically using the appropriate Naval Electronic Data Deliverable (NEDD) format for loading into NIRIS as defined in the NAVFAC NW SOPs (V5.0 or more current).

4.0 REFERENCES

SOP III-D, *Logbooks*

Thornhill, Jerry T. 1989. "Accuracy of Depth to Groundwater Measurements." In *EPA Superfund Groundwater Issue.* EPA/504/4-89/002.

5.0 ATTACHMENTS

None.

FIELD PARAMETER MEASUREMENTS

1.0 PURPOSE

This standard operating procedure (SOP) provides instructions for the calibration, use, and checking of instruments and equipment for field measurements.

2.0 PROCEDURES

2.1 WATER QUALITY MEASUREMENTS

All field water quality meters shall be calibrated daily following the manufacturers' specifications. Calibration shall be performed prior to using the instrument for collecting parameters. In addition, the meter's calibration should be checked at mid-day and the end of the day to determine if measurements have drifted from the original calibration numbers. These checks are not intended to be a recalibration of the instrument. All calibration and measurement data shall be recorded in the project logbook. Fluids used for calibration shall be changed at regular intervals to ensure its integrity. Since different fluids have different shelf lives and tolerances, manufacturers' specifications should be checked as appropriate.

Most multi-probe water quality meters utilize a flow-through cell. If the unit being used does not have a flow-through cell, a large enough vessel (i.e. polypropylene beaker) in which the probes will be submerged shall be used. The water to be measured will be pumped continuously through the beaker from the bottom, overflowing the top. The flow-through cells will usually allow for quicker stabilization of dissolved oxygen and oxidation-reduction potential readings.

Water shall be allowed to flow continuously through the cell or beaker with water quality measurements being collected at regular intervals, every three to five minutes, until stabilization of the parameters has occurred. A minimum number of seven sets of readings should be collected or as otherwise outlined in the field sampling plan. Stabilization is considered to have occurred when three consecutive readings meet the following guidelines:

pH	+ 0.2 Scientific Units
Specific Conductance	+ 3 % mS/cm
Turbidity	+ 10% or < 10 NTUs
Dissolved Oxygen	+ 10% mg/cm
Salinity	+ 10%
Oxidation-Reduction Potential	+ 10 mV
Temperature	+ 10% °C

In addition to recording the above listed parameters the following information shall also be documented: date, time of measurement, flow rates, purge volumes, total volume purged, and other relative information (i.e. odors, sheen, comments on turbidity, water color)

2.2 ORGANIC VAPORS

Various organic vapor monitors have differing requirements for equipment warm-up and operation. Ensure that all organic vapor monitors are calibrated and operated according to the manufacturer's specification.

For measuring vapors present in soils, expose the monitor to a sample of soil by collecting a sample in sealable plastic baggy and placing the probe tip into the closed bag. In cold weather, the soil may need to be warmed prior to testing.

For measuring breathing zone vapors, hold the probe tip in the area of the breathing zone while field activities are being conducted. Take representative measurements from each different work or sampling area.

For monitoring well head space, place the probe tip just inside of the monitoring well casing immediately after removing the cap.

All readings including calibration information shall be recorded in the field logbook.

3.0 DOCUMENTATION

Record all observations and analysis in the field logbook as defined in SOP III-D, *Logbooks*. If required by the SAP, also complete the Field Measurement Data Form.

Field measurements must also be submitted electronically using the appropriate Naval Electronic Data Deliverable (NEDD) format for loading into NIRIS as defined in the NAVFAC NW SOPs (V5.0 or more current).

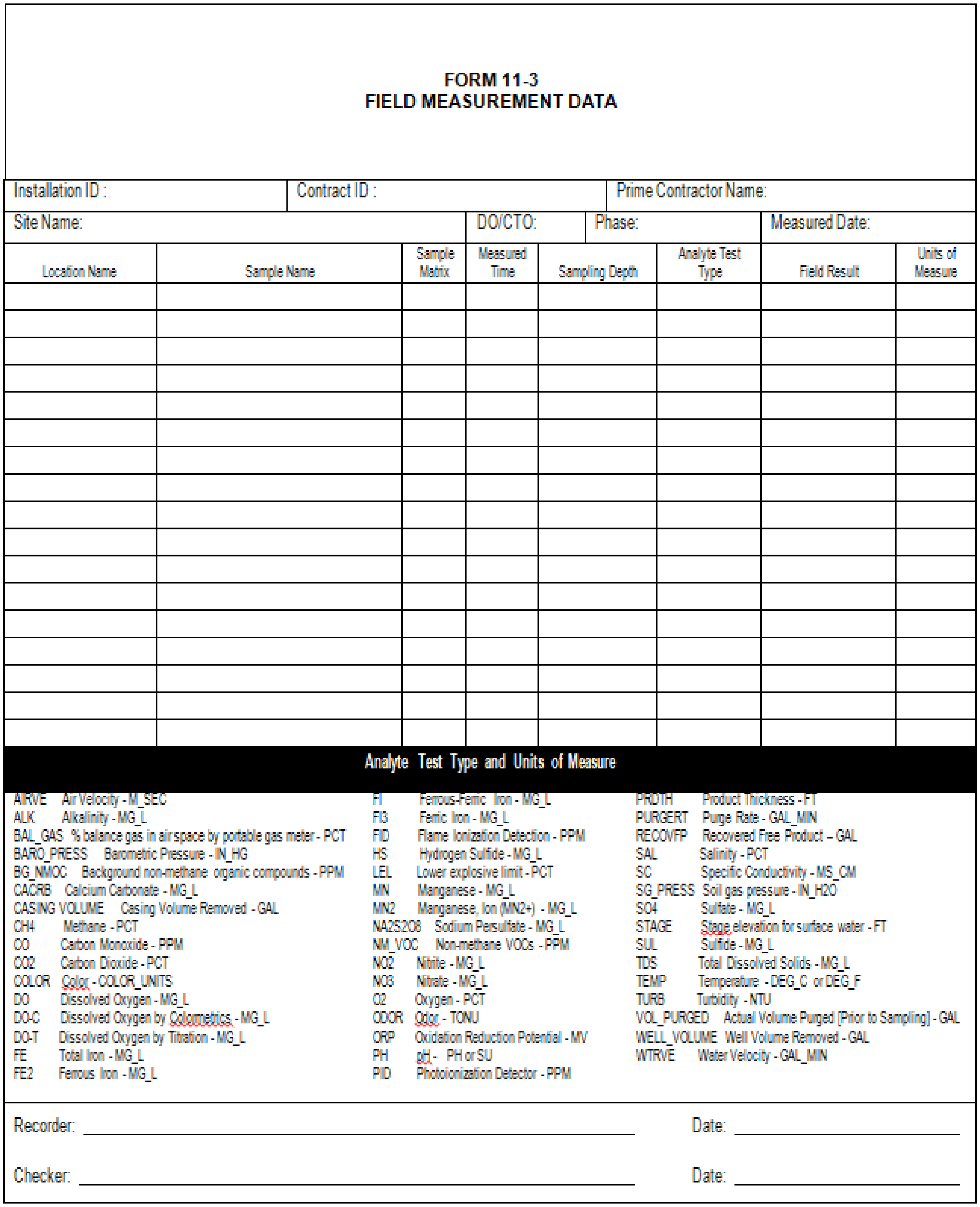
4.0 REFERENCES

ASTM International. 2003. D6771-02 Standard Practice for Low-flow Purging and Sampling Wells and Devices Used for Groundwater Quality Investigations

SOP III-D, *Logbooks*

5.0 ATTACHMENTS

Attachment I-D-7-1	Example Field Measurement Data form



FORM 11-3
FIELD MEASUREMENT DATA

Installation ID :
Contract ID :
Prime Contractor Name:
Site Name:
DO/CTO:
Phase:
Measured Date:

Location Name	Sample Name	Sample Matrix	Measured Time	Sampling Depth	Analyte Test Type	Field Result	Units of Measure

Analyte Test Type and Units of Measure

AIRVE	Air Velocity - M_SEC
ALK	Alkalinity - MG_L
BAL_GAS	% balance gas in air space by portable gas meter - PCT
BARO_PRESS	Barometric Pressure - IN_HG
BG_NMOC	Background non-methane organic compounds - PPM
CACRB	Calcium Carbonate - MG_L
CASING VOLUME	Casing Volume Removed - GAL
CH4	Methane - PCT
CO	Carbon Monoxide - PPM
CO2	Carbon Dioxide - PCT
COLOR	Color - COLOR_UNITS
DO	Dissolved Oxygen - MG_L
DO-C	Dissolved Oxygen by Colometrics - MG_L
DO-T	Dissolved Oxygen by Titration - MG_L
FE	Total Iron - MG_L
FE2	Ferrous Iron - MG_L
FI	Ferrous-Ferric Iron - MG_L
FI3	Ferric Iron - MG_L
FID	Flame Ionization Detection - PPM
HS	Hydrogen Sulfide - MG_L
LEL	Lower explosive limit - PCT
MN	Manganese - MG_L
MN2	Manganese, Ion (MN2+) - MG_L
NA2S2O8	Sodium Persulfate - MG_L
NM_VOC	Non-methane VOCs - PPM
NO2	Nitrite - MG_L
NO3	Nitrate - MG_L
O2	Oxygen - PCT
ODOR	Odor - TONU
ORP	Oxidation Reduction Potential - MV
PH	pH - PH or SU
PID	Photoionization Detector - PPM
PRDTH	Product Thickness - FT
PURGERT	Purge Rate - GAL_MIN
RECOVFP	Recovered Free Product – GAL
SAL	Salinity - PCT
SC	Specific Conductivity - MS_CM
SG_PRESS	Soil gas pressure - IN_H2O
SO4	Sulfate - MG_L
STAGE	Stage elevation for surface water - FT
SUL	Sulfide - MG_L
TDS	Total Dissolved Solids - MG_L
TEMP	Temperature - DEG_C or DEG_F
TURB	Turbidity - NTU
VOL_PURGED	Actual Volume Purged [Prior to Sampling] - GAL
WELL_VOLUME	Well Volume Removed - GAL
WTRVE	Water Velocity - GAL_MIN

Recorder: ______________________ Date: __________

Checker: ______________________ Date: __________

LAND SURVEYING

1.0 PURPOSE

This standard operating procedure (SOP) sets forth protocols for acquiring land surveying data to facilitate the location and mapping of geologic, hydrologic, geotechnical data, and analytical sampling points and to establish topographic control over project sites.

2.0 PROCEDURES

The procedures listed below shall be followed during land surveying conducted for NAVFAC Northwest.

- All surveying work shall be performed under the direct supervision of a land surveyor registered in the state or territory in which the work is being performed (i.e. a Professional Land Surveyor, PLS).
- Survey instruments shall be calibrated in accordance with the manufacturer's specifications regarding procedures and frequencies. At a minimum, instruments shall have been calibrated no more than 6 months prior to the start of the survey work.
- Standards for all survey work shall be in accordance with National Oceanic and Atmospheric Administration (NOAA) standards and at the minimum accuracy standards set forth below. The horizontal accuracy for location of all grid intersection and planimetric features shall be (±) 0.1 feet. The horizontal accuracy for boundary surveys shall be one in ten thousand feet (1:10,000). The vertical accuracy for ground surface elevations shall be (±) 0.1 feet. Benchmark elevation accuracy and elevation of other permanent features, including monitoring wellheads, shall be (±) 0.01 feet.
- Surveys shall be referenced to the local established coordinate systems and all elevations and benchmarks established shall be based on North American Vertical Datum of 1988.
- Surveyed points shall be referenced to Mean Sea Level (Mean Lower Low Water Level).
- Appropriate horizontal and vertical control points shall be jointly determined prior to the start of survey activities. If discrepancies in the survey (e.g., anomalous water level elevations) are observed, the surveyor may be required to verify the survey by comparison to a known survey mark. If necessary, a verification survey may be conducted by a qualified third party.
- All field notes, sketches and drawings shall clearly identify the horizontal and vertical control points by number designation, description, coordinates and elevations. All surveyed locations shall be mapped using a base map or other site mapping specified by the Project Manager.
- All surveys shall begin and end at the designated horizontal and vertical control points to determine the degree of accuracy of the surveys.

- Iron pins used to mark control points shall be made of reinforcement steel or an equivalent material and shall be 18 inches long with a minimum diameter of 5/8 inch. Pins shall be driven to a depth of 18 inches into the soil.
- Stakes used to mark survey lines and points shall be made from 3-foot lengths of 2-inch by 2-inch lumber and pointed at one end. They shall be clearly marked with brightly colored weatherproof flagging and paint.
- The point on a monitoring well casing that is surveyed shall be clearly marked by filing grooves into the casing on either side of the surveyed point.

3.0 DOCUMENTATION

Using generally accepted practices, field notes shall be recorded daily by the surveyor in paper or electronic format. The data shall be neat, legible and easily reproducible. Copies of the surveyor's field notes and calculation forms generated during the work shall be obtained and submitted to the Navy or designee.

Surveyor's field notes shall, at a minimum, clearly indicate:

- The date of the survey
- General weather conditions
- The name of the surveying firm
- The names and job titles of personnel performing the survey work
- Equipment used, including serial numbers
- Field book designations, including page numbers.

Drawings and calculations submitted by the surveyor shall be signed, sealed and certified by a land surveyor registered (PLS stamped) in the state or territory in which the work was done.

Dated records of land surveying equipment calibration shall be provided by the surveyor along with equipment serial numbers and calibration records.

4.0 REFERENCES

The detailed requirements in the Geographic Data, Survey Specifications subsection of the parent compendium (NAVFAC Northwest SOPs V5.0) also apply and are not repeated here in this field procedure. These should be consulted as part of any Land Surveying effort. In addition, NAVFAC Northwest Cadastral Team, Record of Survey or other requirements may apply to the project, an example of their requirements can be found with the Survey Specifications referenced above.

5.0 ATTACHMENTS

None.

FIELD QC SAMPLES (WATER, SOIL, SEDIMENT, TISSUE)

1.0 PURPOSE

This standard operating procedure (SOP) describes the number and types of field Quality Control (QC) samples that will be collected during U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) site field work. Quality control samples are controlled samples introduced into the analysis stream, whose results are used to review data quality and to calculate the accuracy and precision of the chemical analysis program. The purpose of each type of QC sample collection is described in this procedure. Collection and analysis frequency for quality control samples vary by project and are found in the project QA plan. Note that project-specific or contract requirements may supersede the requirements presented in this SOP.

2.0 PROCEDURES

The equipment required for the collection of QC samples is identical to the equipment required for the collection of environmental samples.

Field QC checks may include submission of trip blank, equipment rinsate, field blank, duplicate, and reference samples to the laboratory. Suggested frequency and types of QC check samples are discussed in the following guidance documents: *RCRA Technical Enforcement Guidance Document*, Section 4.6.1 (EPA 1986); the use and frequency of these field QC samples should be incorporated as appropriate. Types of field QC samples are discussed in general below. The frequency at which field QC samples should be collected for each QC level is provided in Table III-B-1.

The use of performance evaluation (PE) samples is discussed in SOP III-H, *Performance Evaluation Sample Procedures.*

2.1 TRIP BLANK

One trip blank is prepared off site by the laboratory using ASTM Type I organic-free water and included in each shipping container with samples scheduled for analysis of VOCs, regardless of the environmental medium. Trip blanks are placed in sample coolers by the laboratory prior to transport to the site so that they accompany the samples throughout the sample collection/ handling/ transport process. Once prepared, trip blanks remain unopened throughout the transportation and storage processes and are analyzed along with the associated environmental samples. Trip blanks are analyzed for VOCs and reported as water samples, even though the associated environmental samples may be from a matrix such as soil, tissue, or product.

One set of two 40 milliliter vials will constitute a trip blank and will accompany each cooler containing samples to be analyzed for volatile organics (VOCs) by methods such as CLP VOCs, 8010/601, 8020/602, 8240/624, modified 8015 (only if purge and trap analysis is performed, e.g., for gasoline, not for extraction and analysis for diesel fuel), and equivalent state-specific methods. Trip blanks will be analyzed for VOCs only (EPA 1987).

Trip banks are not typically analyzed in association with tissue samples and are therefore not required for tissue sampling programs.

Table III-B-1
Field QC Samples per Sampling Event

	Level C2		Level D2		Level E2	
Type of Sample	Metal	Organic	Metal	Organic	Metal	Organic
Trip blank (for volatiles only)	NA1	1/cooler	NA1	1/ cooler	NA[1]	1/cooler
Equipment rinsate[3]	1/day	1/day	1/day	1/day	1/day	1/day
Field blank	1/decontamination water source/event/for all QC levels and all analytes					
Field duplicates[4]	10%	10%	10%	10%	5%	5%

Background samples at least 1/sample media/sample event[5]

Notes:

[1] NA means not applicable.

[2] QC levels are discussed in Section 2.8, Quality Control (QC) Levels.

[3] Samples are collected daily; however, only samples from every other day are analyzed. Other samples are held and analyzed only if evidence of contamination exists.

[4] The duplicate must be taken from the same sample that will become the laboratory matrix/spike duplicate for organics or for the sample used as a duplicate in inorganic analysis.

[5] Sample event is defined from the time sampling personnel arrive at the site until they leave the site for more than a period of one week; the use of controlled-lot source water makes one sample per lot rather than per event an option.

Source: NFESC. 1999. Navy Installation and Restoration Chemical Data Quality Manual.

2.2 EQUIPMENT RINSATE SAMPLES

Equipment rinsate samples are collected by pumping organic-free, analyte-free water over and/or through the sampling equipment (such as a bailer, sampling pump, or mixing bowl) following its final decontamination rinse. This rinse water is collected into the sample containers directly or with the use of a funnel if necessary. The rinse water may be poured by use of an electric or hand submersible pump by tipping the jug of water upside down, or by use of a stopcock.

Equipment rinsate samples are collected daily for sampling equipment used repetitively to collect environmental samples. One equipment rinsate sample shall be collected per day per sampling technique utilized that day (NFESC 1999 and EPA 1986). At least one equipment rinsate sample is analyzed for each group of 20 samples of a similar matrix type and concentration. Equipment rinsate samples are preserved, handled, and analyzed in the same manner as all environmental samples. Analytical results of equipment rinsate samples are used to access equipment cleanliness and the effectiveness of the decontamination process.

When disposable or dedicated sampling equipment is utilized, only one equipment rinsate sample will be collected per equipment lot or project phase. Disposable and/or dedicated sampling equipment may include stainless steel bowls or trowels that will be used for collection of only one soil sample, disposable bailers for ground-water sampling, dedicated submersible pumps for ground-water sampling, or other such equipment. This disposable and/or dedicated sampling equipment is typically pre-cleaned and individually wrapped by the manufacturer prior to delivery to the site. In this case, the equipment rinsate sample is used to provide verification that contaminants are not being introduced to the samples via sampling equipment.

Sampling devices (e.g., gloved hands, dip nets, or traps) for collection of tissue samples are generally non-intrusive into the organisms collected, so equipment rinsate samples will not be collected as long as the devices have been properly cleaned following SOP III-I, *Equipment Decontamination*, and the devices appear clean.

2.3 FIELD BLANKS

Field blanks are generally prepared on site during the sampling event by pouring American Society for Testing and Materials (ASTM) Type I organic-free water into randomly selected sample containers. Commercially available distilled water may be a satisfactory substitute for the ASTM organic-free water depending specific project requirement. At least one field blank is analyzed for each group of 20 samples of a similar matrix type and concentration.

Field blanks, consisting of samples of the source water used as the final decontamination rinse water, will be analyzed to assess whether the wash or rinse water contained contaminants that may have been carried over into the site samples.

The final decontamination rinse water source, the field blank source water, and equipment rinsate source water should all be from the same purified water source. Tap water used for steam cleaning augers or used in the initial decontamination buckets need not be collected and analyzed as a field blank, because augers typically do not touch the actual samples and because the final decontamination rinse water should be from a purified source.

Field blanks are collected at a frequency of one per sampling event per each source of water for all levels of QC. A sampling event is considered to be from the time sampling personnel arrive at a site until they leave for more than a week. Field blanks will be analyzed for the same analyses as the samples collected during the period that the water sources are being used for decontamination. If the same lot of the water source is used, a field blank needs to be collected only once per lot.

2.4 FIELD DUPLICATE

At least one duplicate sample is analyzed from each group of 10 samples of a similar matrix type and concentration. Field duplicate samples should be collected from areas most likely to be contaminated and are preserved, handled, and analyzed in the same manner as all environmental samples. Field duplicates have the same location identification, sampling date and time, and depth interval as the associated environmental sample, but are assigned a unique sample number that is associated with the environmental sample number by virtue of the identical timestamp and location information.

Field duplicates for groundwater and surface water samples will generally consist of replicates. Field duplicates for soil samples will consist primarily of collocates. Soil field duplicates that are to be analyzed for volatile constituents will consist only of collocates; no soil samples that are to be analyzed for volatiles will be replicated (i.e., homogenized or otherwise processed or split) in the field. A separate sample will be collected to provide duplicates for non-volatile analyses. The sample may be homogenized and split in the field to form an original and duplicate (replicate) sample, or an additional volume into a separate sample container may be collected to form a duplicate (collocate) sample. Alternatively, replicates may be formed by homogenization in the laboratory. Duplicates will be analyzed for the same analytical parameters as their associated original sample.

Field duplicates for biological tissue samples will consist of splits of the original sample. Twice the required volume of organisms for one sample will be collected and placed into one food-grade self-sealing bag. The sample will later be homogenized in the laboratory and split, producing an original and a replicate sample. Replicates will be analyzed for the same analytical parameters as their associated original samples.

2.5 REFERENCE SAMPLES

There are two types of background levels of chemicals:

- Naturally occurring levels, which are concentrations of chemicals present in the environment that have not been influenced by humans (e.g., iron, aluminum)
- Anthropogenic levels, which are concentrations of chemicals that are present in the environment due to human-made, non-site sources (e.g., industry, automobiles)

Reference samples are samples taken from media similar to site media, but that are collected outside the zone of contamination, usually offsite.

Reference samples will be collected for each medium sampled at a site. Site-specific conditions will dictate the number of reference samples necessary to characterize background concentrations of contaminants of concern. However, at least one reference sample from each medium will be collected during each sampling event at a site. The samples will be analyzed for all the analytes for which site samples of that medium are analyzed. Background analysis, especially for metals, should be performed to assess the typical naturally occurring levels.

At least one reference sample will be collected for each biological species collected at a site. It may be difficult to find a nearby offsite location similar enough to the project site that has the same biological species available for offsite reference sample collection. Therefore, reference sample locations may need to be more distant from the site than for soil or water offsite reference samples. Collection methods will be identical for site and reference samples.

State-specific procedures may be required to establish background conditions for the site. This SOP is not intended to address such procedures and they should be consulted as necessary.

2.6 TEMPERATURE BLANKS

Temperature blanks are used to measure cooler temperatures upon receipt of the coolers at the laboratory. One temperature blank will be prepared and submitted to the project laboratory with each cooler. The temperature blank will consist of a sample jar containing water, which will be packed in the cooler in the same manner as the rest of the samples and labeled "temperature blank."

2.7 LABORATORY QUALITY CONTROL SAMPLES

The analytical laboratory uses a series of QC samples specified in each standard analytical method and laboratory SOP to assess laboratory performance. Analyses of laboratory QC samples are performed for samples of similar matrix type and concentration and for each sample batch. The types of laboratory QC samples are matrix spike/matrix spike duplicates, laboratory control standards, laboratory duplicates, method blanks, and surrogates. In addition, there may be other project-specific technical QC requirements.

2.7.1 Matrix Spike/matrix Spike Duplicate

Matrix spike/matrix spike duplicates (MS/MSDs) are used to assess sample matrix interferences and analytical errors, as well as to measure the accuracy and precision of the analysis. For MS or MSD samples, known concentrations of analytes are added to the environmental samples; the samples are then processed through the entire analytical procedure and the recovery of the analytes is calculated. Results are expressed as percent recovery of the known spiked amount for matrix spikes and the relative percent difference (RPD) for MS/MSDs. The MS/MSDs will be collected and analyzed at a rate of 5 percent of the field samples for each matrix and analytical method or at least one for each analytical batch, whichever frequency is greater.

Generally, a specific sampling location is used to collect field QC samples; however, it may not be possible to collect MS/MSD samples for all analyses at the same sampling location because of a limited volume of available material. In those instances, MS/MSD samples designated for various analyses will be collected from different locations (for example a MS/MSD for metals is collected at location X and an MS/MSD for PCBs is collected at location Y). Additionally, samples designated for MS/MSD analyses will not be collected from locations with potentially high concentrations of target analytes that may mask the added spike compounds. MS/MSD samples have the same location identification, sampling time, depth interval, and sample number as the associated environmental sample.

2.8 QUALITY CONTROL (QC) LEVELS

NAVFAC NW QC Levels III, IV are defined in SOP I-A-8 and Data Validation Procedure SOPs II-A through II-O. Level IV QC is appropriate to use for laboratory analysis for sites where cleanup decisions will be based on risk assessment. Sites on or eligible for the National Priorities List (NPL) will also have laboratory analyses conducted at Level IV QC. The QC level selected for laboratory analyses for many sites, therefore, will be NAVFAC NW Level IV. Other QC levels may be appropriate for certain types of samples or analyses; criteria for selection of the appropriate QC level for individual projects and field work activities are discussed in SOP I-A-8, *Data Validation Planning and Coordination*.

3.0 DOCUMENTATION

Records of the collection of field QC samples should be kept in the sample logbook by the methods discussed in SOPs III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody* and III-D, *Logbooks*.

4.0 REFERENCES

EPA. 1987. Data Quality Objectives for Remedial Response Activities: Development Process

NFESC. 1999. Navy Installation and Restoration Chemical Data Quality Manual.

EPA. 1992. RCRA Technical Enforcement Guidance Document.

SOP III-I, Equipment Decontamination

SOP, III-D, *Logbooks*

5.0 ATTACHMENTS

None.

LOGBOOKS

1.0 PURPOSE

This standard operating procedure (SOP) describes the activities and responsibilities of U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) personnel and/or their contractors pertaining to the identification, use, and control of logbooks and associated field data records. This SOP establishes a standard format for recording field observations and describes the methods for use and maintenance of field logbooks.

2.0 PROCEDURE

2.1 EQUIPMENT

- Waterproof hardbound field logbook (typically 4-inch by 7-inch to 8-inch by 10.5-inch) with numbered pages
- Waterproof/indelible marking pen
- Ruler/straight edge
- Clipboard

2.2 LOGBOOK MAINTENANCE

Prior to commencement of field work, logbooks will be assigned to field personnel by the Project Manager. If personnel changes must be made during a project, the successor may use the same logbook. In this case, the logbook cover page will indicate all persons who have made entries and the dates. This may be inappropriate if there are a large number of people involved.

The logbook user is responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature. The logbook user is also responsible for safeguard of the logbook while having custody of it.

Individuals performing specific tasks associated with a field project may keep a separate logbook; however, these logbooks must conform to this procedure and will become a permanent part of the central project file. The Project Manager is responsible for reviewing and signing all field logbooks associated with the project.

2.3 RECORDING FIELD ACTIVITIES

The field team provides a permanent record of daily activities, observations, and measurements through the use of a field logbook. All logbook entries will be made in indelible black or blue ink. No erasures are permitted. If an incorrect entry is made, the data will be crossed out with a single line and initialed and dated by the originator. Entries can be organized into easily understood tables if possible.

All logbook pages will be signed and dated at the bottom. Times will be recorded next to each entry. If a full page is not used during the course of a workday, a diagonal line will be drawn through the unused portion of the page and signed (in this case, it would not be necessary to sign the bottom of the page). If the project is completed and the logbook has not been completely filled, a diagonal line will be drawn across the first blank page after the last entry, and “no further entries” written before the page is signed and dated.

Daily entries will be made during field activities by, at a minimum, one field team member to provide daily records of all significant events, observations, and measurements during field operations. Notes will start at the beginning of the first blank page and extend through as many pages as necessary. All page numbers will be consecutively numbered as the logbook is filled.

The inside cover page of each logbook will contain the following information:

- Book number
- Project name
- Contract number
- Project number
- Navy Activity/Installation
- Site name
- Start date
- End date
- Person to whom the logbook is assigned
- Agency/Company name
- Agency/Company address
- Agency/Company phone number

The field logbook serves as the primary record of field activities. When possible, the field book should be dedicated to a singular Navy Activity/Installation to facilitate long-term records archiving. Entries shall be made chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct the applicable events. Individual data forms may be generated to provide systematic data collection documentation. Entries on these forms shall meet the same requirements as entries in the logbook and shall be referenced in the applicable logbook entry. Individual data forms shall reference the applicable logbook and page number. At a minimum, names of all samples collected shall be included in the logbook even if recorded elsewhere.

All field descriptions and observations are entered into the logbook, as described in Attachment III-D-1.

Typical information to be entered includes, but is not limited to, the following:

- Date and time of all onsite activities
- Site location and description
- Weather conditions
- Field work documentation
- Descriptions of and rationale for approved deviations from the Work Plan or Field Sampling Plan
- Field instrumentation readings
- Personnel present
- Photograph references
- Sample locations
- Sample identifications, as described in SOP I-A-11, Sample Naming
- Field QC sample information
- Field descriptions, equipment used, and field activities accomplished to reconstruct field operations
- Meeting information
- Daily health and safety meeting notes
- Important times and dates of telephone conversations, correspondence, or deliverables
- Field calculations
- PPE level
- Calibration records
- Subcontractors present
- Equipment decontamination procedures and effectiveness
- Procedures used for containerization of investigative-derived waste

Logbook page numbers shall appear on each page to facilitate identification of photocopies.

If a person's initials are used for identification, or if uncommon acronyms are used, these should be identified on a page at the beginning of the logbook.

At least weekly and preferably daily, the preparer shall photocopy and retain the pages completed during that session for backup. This will prevent loss of a large amount of information if the logbook is lost.

A technical review of each logbook shall be performed by a knowledgeable individual such as the Project Manager.

3.0 DOCUMENTATION

The field logbook shall be retained as a permanent project record. If a particular Task Order requires submittal of photocopies of logbooks, this shall be performed as required.

4.0 REFERENCES

SOP I-A-11, *Sample Naming*

5.0 ATTACHMENTS

Attachment III-D-1 Description of Logbook Entries

Attachment 1
Description of Logbook Entries

Logbook entries shall contain the following information, as applicable, for each activity recorded. Some of these details may be entered on data forms as described previously.

Name of Activity	For example, Asbestos Bulk Sampling, Charcoal Canister Sampling, Aquifer Testing.
Task Team Members and Equipment	Name all members on the field team involved in the specified activity. List equipment used by serial number or other unique identification, including calibration information.
Activity Location	Indicate location of sampling area as specified in the Field Sampling Plan. Record valid Navy Installation/Active and Site, at a minimum.
Weather	Indicate general weather and precipitation conditions.
Level of Personal Protective Equipment	The level of personal protective equipment (PPE), e.g., Level D, should be recorded.
Methods	Indicate method or procedure number employed for the activity.
Sample IDs	Indicate the unique identifier associated with the physical samples. Identify QC samples. Value can be numeric or alphanumeric and must not already exist in the database.
Sample Type and Volume	Indicate the medium, container type, preservative, and the volume for each sample.
Sample Collection Information	Indicate the location of sample, date and time of collection, sample matrix, sample depth interval, sample methods, sample handling, including filtration and preservation, analysis required and packaging and shipping information.
Time and Date	Record the time and date when the activity was performed (e.g., 0830/08/OCT/89). Use the 24-hour clock for recording the time and two digits for recording the day of the month and the year.
Analyses	Indicate the appropriate code for analyses to be performed on each sample, as specified in the Field Sampling Plan.
Field Measurements	Indicate measurements and field instrument readings taken during the activity.
Chain of Custody and Distribution	Indicate chain-of-custody for each sample collected and indicate to whom samples are transferred and the destination.
References	If appropriate, indicate references to other logs or forms, drawings or photographs employed in the activity.

Narrative (including time and location)	Create a factual, chronological record of the team's activities throughout the day, including the time and location of each activity. Include descriptions of any general problems encountered and their resolution. Provide the names and affiliations of non-field team personnel who visit the site, request changes in activity, impact to the work schedule, requested information, or observe team activities. Record any visual or other observations relevant to the activity, the contamination source, or the sample itself. It should be emphasized that logbook entries are for recording data and chronologies of events. The logbook author must include observations and descriptive notations, taking care to be objective and recording no opinions or subjective comments unless appropriate.
Recorded by	Include the signature of the individual responsible for the entries contained in the logbook and referenced forms.
Checked by	Include the signature of the individual who performs the review of the completed entries.

RECORD KEEPING, SAMPLE LABELING, AND CHAIN-OF-CUSTODY PROCEDURES

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish standard protocols for all U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) field personnel and their contractors for use in maintaining field and sampling activity records, writing sample logs, labeling samples, ensuring that proper sample custody procedures are utilized, and completing chain-of-custody/analytical request forms.

2.0 PROCEDURES

Standards for documenting field activities, labeling the samples, documenting sample custody, and completing chain-of-custody and analytical request forms are provided in this procedure. The standards presented in this section shall be followed to ensure that samples collected are maintained for their intended purpose and that the conditions encountered during field activities are documented.

2.1 RECORD KEEPING

The field logbook serves as the primary record of field activities. Entries shall be made chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct each day's events. Field logs such as soil boring logs and ground-water sampling logs will also be used. These procedures are described in SOP III-D, *Logbooks*.

2.2 SAMPLE LABELING

A sample label with adhesive backing shall be affixed to each individual sample container. Clear tape shall be placed over each label (preferably prior to sampling) to prevent the labels from tearing off, falling off, or being smeared, and to prevent loss of information on the label. The following information shall be recorded with a waterproof marker on each label:

- Project name or number (optional)
- Sample ID
- Date and time of collection
- Sampler's initials
- Matrix (optional)
- Sample preservatives (if applicable)
- Analysis to be performed on sample. This shall be identified by the method number or name identified in the subcontract with the laboratory. For water samples, a separate container is

typically used for each separate test method, whereas with soil samples, multiple analyses can be performed on the soil obtained from one sample container. In order to avoid lengthy lists on each container and confusion, soil sample containers may not list every analysis to be performed.

These labels may be obtained from the analytical laboratory or printed from a computer file onto adhesive labels. The adhesive glue used on the labels must be such that it does not contaminate the sample.

2.3 CUSTODY PROCEDURES

For samples intended for chemical analysis, sample custody procedures shall be followed through collection, transfer, analysis, and disposal to ensure that the integrity of the samples is maintained. Custody of samples shall be maintained in accordance with EPA chain-of-custody guidelines as prescribed in EPA's *NEIC Policies and Procedures*, National Enforcement Investigations Center, Denver, Colorado, revised May 1986; EPA *RCRA Ground Water Monitoring Technical Enforcement Guidance Document* (TEGD), *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA OSWER Directive 9355 3-01), Appendix 2 of the *Technical Guidance Manual for Solid Waste Water Quality Assessment Test (SWAT) Proposals and Reports*, and *Test Methods for Evaluating Solid Waste* (EPA SW-846). A description of sample custody procedures is provided below.

2.3.1 Sample Collection Custody Procedures

According to EPA's *NEIC Policies and Procedures*, a sample is considered to be in custody if:

- It is in one's actual physical possession or view
- It is in one's physical possession and has not been tampered with (i.e., it is under lock or official seal)
- It is retained in a secured area with restricted access
- It is placed in a container and secured with an official seal such that the sample cannot be reached without breaking the seal

Custody seals shall be placed on sample containers immediately after sample collection and on shipping coolers if the cooler is to be removed from the sampler's custody. Custody seals will be placed in such a manner that they must be broken to open the containers or coolers. The custody seals shall be labeled with the following information:

- Sampler's name or initials
- Date and time that the sample/cooler was sealed.

These seals are designed to enable detection of sample tampering. An example of a custody seal is shown in Attachment III-E-1.

Field personnel shall also log individual samples onto carbon copy chain-of-custody forms when a sample is collected. These forms may also serve as the request for analyses. Procedures for completing these forms are discussed in Section 2.4 indicating sample number, matrix, date and time of collection, number of containers, analytical methods to be performed on the sample, and preservatives added (if any). The samplers will also sign the COC form signifying that they were the personnel who collected the samples. The COC form shall accompany the samples from the field to the laboratory. When a cooler is ready for shipment to the analytical laboratory, the person delivering the samples for transport will sign and indicate the date and time on the accompanying COC form. One copy of the COC form will be retained by the sampler and the remaining copies of the COC form shall be placed inside a self-sealing bag and taped to the inside of the cooler. Each cooler must be associated with a unique COC form. Whenever a transfer of custody takes place, both parties shall sign and date the accompanying carbon copy COC forms, and the individual relinquishing the samples shall retain a copy of each form. One exception is when the samples are shipped; the delivery service personnel will not sign or receive a copy because they do not open the coolers. The laboratory shall attach copies of the completed COC forms to the reports containing the results of the analytical tests. An example COC form is provided in Attachment III-E-2. An example of a completed COC form is provided in Attachment III-E-3 and described in Section 2.4.

2.3.2 Laboratory Custody Procedures

The following are custody procedures to be followed by an independent laboratory receiving samples for chemical analysis; the procedures in their Laboratory Quality Assurance Plan (LQAP) must follow these same procedures. A designated sample custodian shall take custody of all samples upon their arrival at the analytical laboratory. The custodian shall inspect all sample labels and COC forms to ensure that the information is consistent, and that each is properly completed. The custodian will also measure the temperature of the samples in the coolers upon arrival. The custodian shall also note the condition of the samples including:

- If the samples show signs of damage or tampering.
- If the containers are broken or leaking.
- If headspace is present in sample vials.
- Proper preservation of samples (made by pH measurement, except VOCs and purgeable TPH). The pH of these samples will be checked by the laboratory analyst, after the sample aliquot has been removed from the vial for analysis.
- If any sample holding times have been exceeded.

All of the above information shall be documented on a sample receipt sheet by the custodian.

Any discrepancy or improper preservation shall be noted by the laboratory as an out-of-control event and shall be documented on an out-of-control form with corrective action taken. The out-of-control form shall be signed and dated by the sample control custodian and any other persons responsible for corrective action. An example of an out-of-control form is included as Attachment III-E-4.

The custodian shall then assign a unique laboratory number to each sample and distribute the samples to secured storage areas maintained at 4°C. The unique laboratory number for each sample, contractor sample ID, client name, date and time received, analysis due date, and storage details shall also be manually logged onto a sample receipt record and later entered into the laboratory's computerized data management system. The custodian shall also sign the shipping bill and maintain a copy.

Laboratory personnel shall be responsible for the care and custody of samples from the time of their receipt at the laboratory through their exhaustion or disposal. Samples should be logged in and out on internal laboratory COC forms each time they are removed from storage for extraction or analysis.

2.4 COMPLETING CHAIN-OF-CUSTODY/ANALYTICAL REQUEST FORMS

COC form/analytical request completion procedures are crucial in properly transferring the custody and responsibility of samples from field personnel to the laboratory. This form also is important for accurately and concisely requesting analyses for each sample; it is essentially a release order from the analysis subcontract.

Attachment III-E-2 is an example of a generic COC/analytical request form that may be used by field personnel. Multiple copies may be tailored to each project so that much of the information described below need not be handwritten each time. Attachment III-E-3 is an example of a completed site-specific COC/analytical request form, with box numbers identified and discussed in text below.

Box 1 Project Manager: This name shall be the name that will appear on the report. Do not write the name of the Project Coordinator or point of contact for the project instead of the Project Manager.

Project Name: Write it, as it is to appear on the report.

Project Number: Write it as it is to appear on the report. It shall include the project number, task number, and general ledger section code. The laboratory subcontract number should also be included.

Box 2 Bill to: List the name and address of the person/company to bill only if it is not in the subcontract with the laboratory.

Box 3 Sample Disposal Instructions: These instructions will be stated in the Basic Ordering Agreement (BOA) or each Task Order statement of work with each laboratory.

Shipment Method: State the method of shipment, e.g., hand carry; air courier via FEDEX, AIRBORNE, DHL or equivalent.

Comment: This area shall be used by the field team to communicate observations, potential hazards, or limitations that may have occurred in the field or additional information regarding analysis. For example: a specific metals list, explanation of Mod 8015, Mod 8015 + Kerosene, samples expected to contain high analyte concentrations.

Box 4 Cooler Number: This will be written somewhere on the inside or outside of the cooler and shall be included on the COC. Some laboratories attach this number to the trip blank identification, which helps track VOC samples. If a number is not on the cooler, field personnel shall assign a number, write it on the cooler, and write it on the COC.

QC Level: Enter the reporting/QC requirements, e.g., NAVFAC NW QC Level C, D, or E.

Turnaround time (TAT): TAT for contract work will be determined by a sample delivery group (SDG), which may be formed over a 14-day period, not to exceed 20 samples. Standard turnaround time once the SDG has been completed is 35 calendar days from receipt of the last sample in the SDG. Entering NORMAL or STANDARD in this field will be acceptable. If quicker TAT is required, it shall be in the subcontract with the laboratory and reiterated on each COC to remind the laboratory.

Box 5 Type of containers: The type of container used, e.g., 1-liter glass amber, for a given parameter in that column.

Preservatives: Field personnel must indicate on the COC the correct preservative used for the analysis requested. Indicate the pH of the sample (if tested) in case there are buffering conditions found in the sample matrix.

Box 6 Sample number: Five-character alpha-numeric identifier to be used by the laboratory to identify samples. The use of this identifier is important since the labs are restricted to the number of characters they are able to use. See SOP I-A-11, Sample Naming.

Description (sample identification): This name will be determined by the location and description of the sample, as described in SOP I-A-11, Sample Naming. This sample identification should not be submitted to the laboratory, but should be left blank. If a computer COC version is used, the sample identification can be input but printed with this block black. A cross-referenced list of sample number and sample identification must be maintained separately.

Date Collected: Collection date must be recorded in order to track the holding time of the sample. Note: For trip blanks, record the date it was placed in company with samples.

Time Collected: When collecting samples, record the time the sample is first collected. Use of the 24-hour military clock will avoid a.m. or p.m. designations; e.g., 1815 instead of 6:15 p.m. Record local time; the laboratory is responsible for calculating holding times to local time.

Lab Identification: This is for laboratory use only.

Box 7 Matrix and QC: Identify the matrix: e.g., water, soil, air, tissue, fresh water sediment, marine sediment, or product. If a sample is expected to contain high analyte concentrations, e.g., a tank bottom sludge or distinct product layer, notify the laboratory in the comment section. Mark an "X" for the sample(s) that have extra volume for laboratory QC matrix spike/matrix spike duplicate (MS/MSD) purposes. The sample provided for MS/MSD purposes is usually a field duplicate.

Box 8 Analytical Parameters: Enter the parameter by descriptor and the method number desired. When requesting metals that are modifications of the standard lists, define the list in the comment section. This would not be necessary when requesting standard list metals such as priority pollutant metals (PPM), target compound list from ILM03.0, and Title 22 metals which are groups of metals commonly requested and should not cause any confusion as to what metals are being analyzed. Whenever possible, list the parameters as they appear in the laboratory subcontract to maintain consistency and avoid confusion.

In the boxes below the analytical parameter, indicate the number of containers collected for each parameter by marking an "X". If more than one container is used for a sample, write a number in the desired box to indicate a request for analysis and to indicate the number of containers sent for that analysis.

Box 9 Sampler's Signature: The person who collected samples must sign here.

Relinquished By: This space shall contain the signature of the person who turned over the custody of the samples to a second party other than an express mail carrier such as FEDEX, DHL or Air Borne Express.

Received By: Typically, this is a written signature by a representative of the receiving laboratory, or a field crewmember who delivered the samples in person from the field to the laboratory. A courier such as FedEx or DHL does not sign because they do not open the coolers. It must also be used by the prime contracting laboratory when samples are sent to a subcontractor.

Relinquished By: In the case of subcontracting, the primary laboratory will sign the Relinquished By space and fill out an additional COC to accompany the samples being subcontracted.

Received By (Laboratory): This space is for the final destination (e.g., at a subcontracted laboratory).

Box 10 Lab Number and Questions: This box is to be filled in by the laboratory only.

Box 11 Control Number: This number is the "COC" followed by the first sample number in a cooler, or contained on a COC. This control number must be unique and never used twice. Record the date the COC is completed. It should be the same date the samples are collected.

Box 12 Total No. of Containers/row: Sum the number of containers in that row.

Box 13 Total No. of Containers/column: Sum the number of containers in that column.

Because COC forms contain different formats based upon who produced the form, not all of the information listed in items 1 to 13 may be recorded. However, as much of this information as possible shall be included.

COC forms tailored to each Task Order can be drafted and printed onto multi-ply forms. This eliminates the need to rewrite the analytical methods column headers each time. It also eliminates the need to write the project manager, name, and number; QC Level; TAT; and the same general comments each time.

Complete one COC form per cooler. Whenever possible, reduce the number of trip blanks by placing all samples to be analyzed for VOA, gasoline, and BTEX compounds into one cooler. Complete all sections and be sure to sign and date the COC form. One copy of the COC form must remain with the field personnel.

3.0 DOCUMENTATION

The COC/analytical request form shall be faxed daily, if possible, to the Task Order Laboratory Coordinator for accuracy verification. Following the completion of sampling activities, the sample logbook and COC forms will be transmitted to the Project Manager for storage in project files. The Project Manager shall review COC forms on a monthly basis at a minimum. The data validators shall also receive a copy. Along with the data delivered, the original COC/analytical request form shall be submitted by the laboratory. Any changes to the analytical requests that are required shall be made in writing to the laboratory. A copy of this written change shall be sent to the data validators and placed in the project files. The reason for the change shall be included in the project files so that recurring problems can be easily identified.

4.0 REFERENCES

SOP I-A-11, *Sample Naming*

SOP III-D, *Logbooks*

State of California Water Resources Control Board. 1988. Technical Guidance Manual for Solid Waste Water Quality Assessment Test (SWAT) Proposals and Reports.

USEPA. 1986. EPA NEIC Policies and Procedures, National Enforcement Investigations Center, Denver, Colorado.

USEPA. 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA OSWER Directive 9355 3-01).

USEPA. 1992. RCRA Ground Water Monitoring Technical Enforcement Guidance Document (TEGD).

USEPA. 1995 and as updated. Test Methods for Evaluating Solid Waste (SW-846), Third edition.

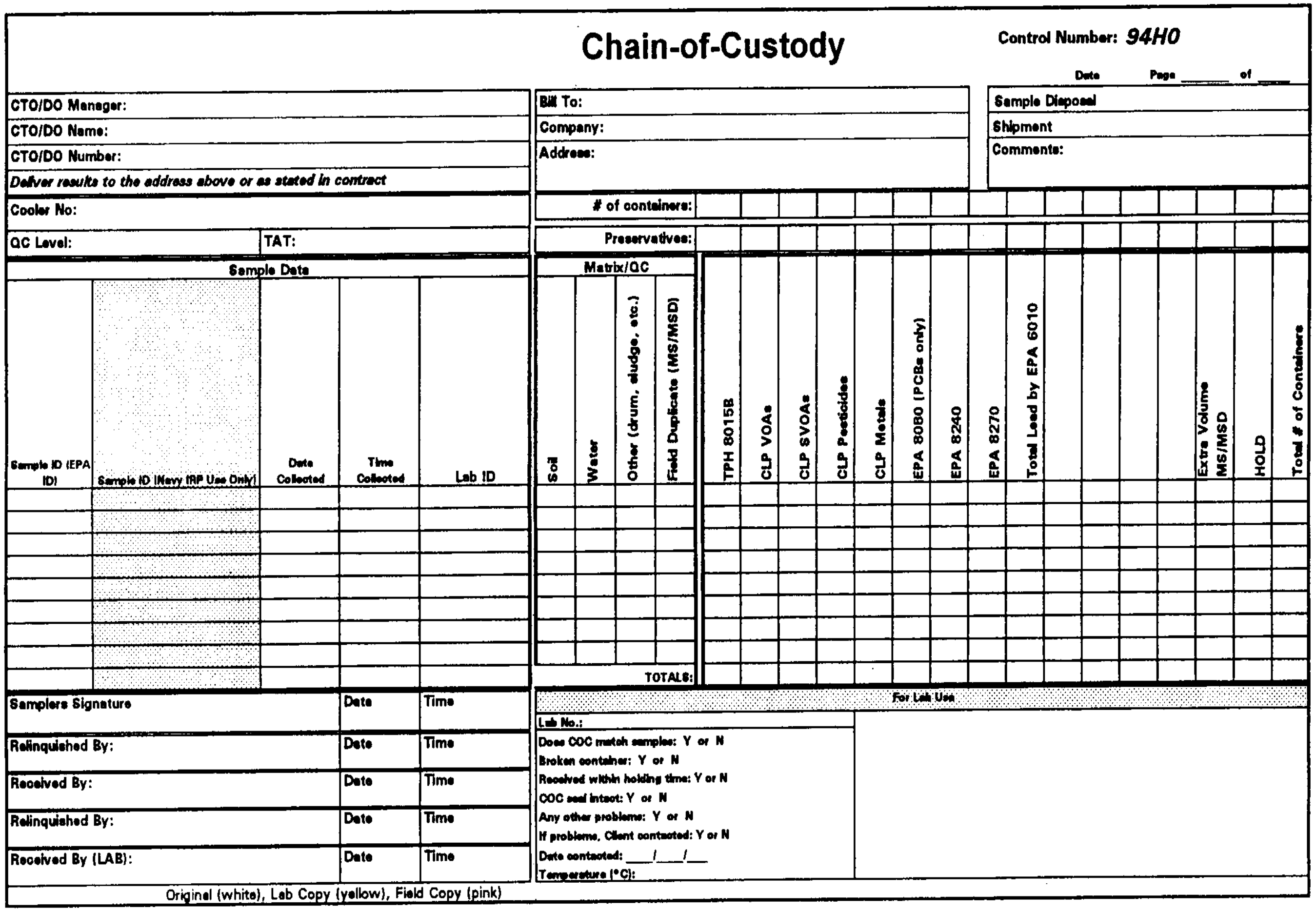
5.0 ATTACHMENTS

Attachment III-E-1	Chain-of-Custody Seal
Attachment III-E-2	Generic Chain-of-Custody/Analytical Request Form
Attachment III-E-3	Sample Completed Chain-of-Custody/Analytical Request Form
Attachment III-E-4	Sample Out-of-Control Form

Attachment III-E-1
Chain-of-Custody Seal

[LABORATORY]	SAMPLE NO.	DATE	SEAL BROKEN BY
	SIGNATURE		DATE
	PRINT NAME AND TITLE (Inspector, Analyst or Technician		

Attachment III-E-2
Generic Chain-of-Custody/Analytical Request Form



Chain-of-Custody

Control Number: 94H0

Date Page ____ of ____

CTO/DO Manager:
CTO/DO Name:
CTO/DO Number:
Deliver results to the address above or as stated in contract
Cooler No:
QC Level: **TAT:**

Bill To:
Company:
Address:

Sample Disposal
Shipment
Comments:

Sample Data

Sample ID (EPA ID)	Sample ID (Navy (RP Use Only)	Date Collected	Time Collected	Lab ID

	Matrix/QC																				
# of containers:																					
Preservatives:																					
	Soil	Water	Other (drum, sludge, etc.)	Field Duplicate (MS/MSD)	TPH 8015B	CLP VOAs	CLP SVOAs	CLP Pesticides	CLP Metals	EPA 8080 (PCBs only)	EPA 8240	EPA 8270	Total Lead by EPA 6010					Extra Volume MS/MSD	HOLD	Total # of Containers
TOTALS:																				

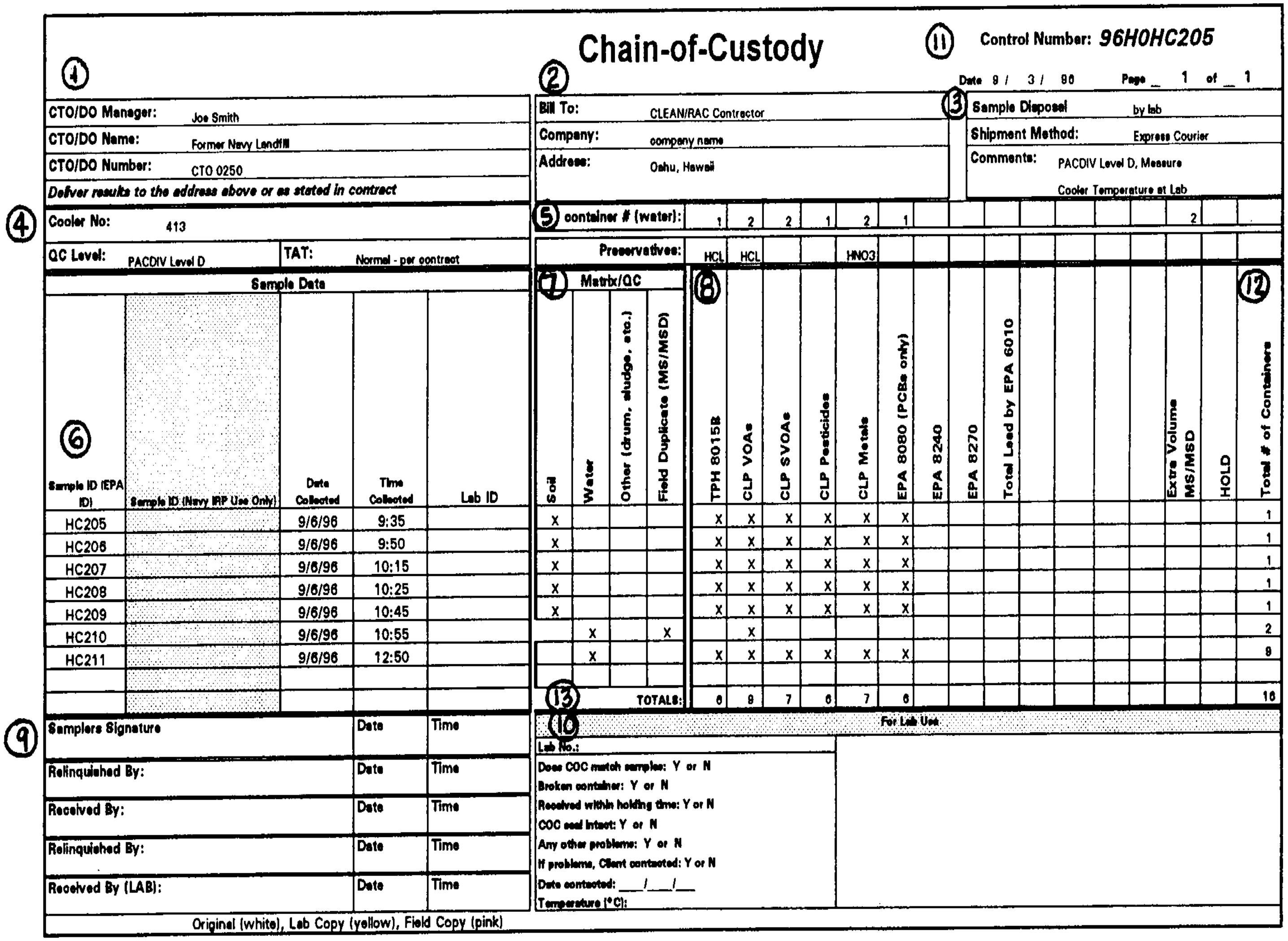
Samplers Signature	**Date**	**Time**
Relinquished By:	**Date**	**Time**
Received By:	**Date**	**Time**
Relinquished By:	**Date**	**Time**
Received By (LAB):	**Date**	**Time**

For Lab Use

Lab No.:
Does COC match samples: Y or N
Broken container: Y or N
Received within holding time: Y or N
COC seal intact: Y or N
Any other problems: Y or N
If problems, Client contacted: Y or N
Date contacted: ___/___/___
Temperature (°C):

Original (white), Lab Copy (yellow), Field Copy (pink)

Attachment III-E-3
Sample Completed Chain-Of-Custody/ Analytical Request Form



Chain-of-Custody

⑪ Control Number: 96H0HC205

Date 9 / 3 / 96 Page _ 1 of _ 1

①

CTO/DO Manager: Joe Smith

CTO/DO Name: Former Navy Landfill

CTO/DO Number: CTO 0250

Deliver results to the address above or as stated in contract

④ Cooler No: 413

QC Level: PACDIV Level D TAT: Normal - per contract

② Bill To: CLEAN/RAC Contractor

Company: company name

Address: Oahu, Hawaii

③ Sample Disposal by lab

Shipment Method: Express Courier

Comments: PACDIV Level D, Measure Cooler Temperature at Lab

									⑧														⑫
					⑤ container # (water):				1	2	2	1	2	1							2		
					Preservatives:				HCL	HCL			HNO3										
Sample Data					⑦ Matrix/QC																		
⑥ Sample ID (EPA ID)	Sample ID (Navy IRP Use Only)	Date Collected	Time Collected	Lab ID	Soil	Water	Other (drum, sludge, etc.)	Field Duplicate (MS/MSD)	TPH 8015B	CLP VOAs	CLP SVOAs	CLP Pesticides	CLP Metals	EPA 8080 (PCBs only)	EPA 8240	EPA 8270	Total Lead by EPA 6010				Extra Volume MS/MSD	HOLD	Total # of Containers
HC205		9/6/96	9:35		X				X	X	X	X	X	X									1
HC206		9/6/96	9:50		X				X	X	X	X	X	X									1
HC207		9/6/96	10:15		X				X	X	X	X	X	X									1
HC208		9/6/96	10:25		X				X	X	X	X	X	X									1
HC209		9/6/96	10:45		X				X	X	X	X	X	X									1
HC210		9/6/96	10:55			X		X		X													2
HC211		9/6/96	12:50			X			X	X	X	X	X	X									9
					⑬			TOTALS:	6	9	7	6	7	6									16

⑨ Samplers Signature	Date	Time
Relinquished By:	Date	Time
Received By:	Date	Time
Relinquished By:	Date	Time
Received By (LAB):	Date	Time

Original (white), Lab Copy (yellow), Field Copy (pink)

⑩ For Lab Use

Lab No.:

Does COC match samples: Y or N

Broken container: Y or N

Received within holding time: Y or N

COC seal intact: Y or N

Any other problems: Y or N

If problems, Client contacted: Y or N

Date contacted: ___/___/___

Temperature (°C):

Attachment III-E-4
Sample Out-Of-Control Form

OUT OF CONTROL FORM	Status	Date	Initial
	Noted OOC		
	Submit for CA*		
	Resubmit for CA*		
	Completed		

Date Recognized:	By:	Samples Affected (List by Accession AND Sample No.)
Dated Occurred:	Matrix	
Parameter (Test Code):	Method:	
Analyst:	Supervisor:	
1. Type of Event (Check all that apply)	2. Corrective Action (CA)* (Check all that apply)	

	Calibration Corr. Coefficient <0.995		Repeat calibration
	%RSD>20%		Made new standards
	Blank >MDL		Reran analysis
	Does not meet criteria:		Sample(s) redigested and rerun
	Spike		Sample(s) reextracted and rerun
	Duplicate		Recalculated
	LCS		Cleaned system
	Calibration Verification		Ran standard additions
	Standard Additions		Notified
	MS/MSD		Other (please explain)
	BS/BSD		
	Surrogate Recovery		
	Calculations Error		
	Holding Times Missed		
	Other (Please explain		Comments:

3. Results of Corrective Action	
	Return to Control (indicated with)
	Corrective Actions Not Successful - DATA IS TO BE FLAGGED with _____________.

Analyst:	Date:
Supervisor:	Date:
QA Department:	Date:

SAMPLE CONTAINERS AND PRESERVATION

1.0 PURPOSE

This standard operating procedure (SOP) describes the conventional containers used for sample collection and delivery to a laboratory for analysis. Additionally it will discuss sample preservation and holding times.

2.0 PROCEDURES

The purpose of sample preservation is to prevent or retard the degradation and modification of chemicals or to retard biological activity in samples during transit and storage. Efforts to preserve the integrity of the samples must be initiated as soon as possible after the time of sampling and continue until analyses are performed. Preservatives must be added to the sample container as soon as possible after the time of sample collection. The recommended procedure is to request that bottles be provided by the analytical laboratory and be pre-preserved.

Complete and unequivocal preservation of samples, domestic sewage, industrial wastes, or natural waters, is impossible in practice. Regardless of the nature of the sample, complete stability for every constituent is not likely to be achieved. At best, preservation techniques can retard the chemical and biological changes that inevitably continue after the sample is removed from the parent source. Degradation of the sample ceases only if it is preserved at a temperature of absolute zero (-273°C). However, freezing of a sample to extend hold times is not permitted. Therefore, as a general rule, it is best to analyze the samples as soon as possible after collection. This is especially true when the analyte concentration is expected to be in the low microgram per liter (mg/l) range.

Methods of preservation are relatively limited and are intended generally to perform the following:

- Retard biological action
- Retard hydrolysis of chemical compounds and complexes
- Reduce volatility of constituents
- Reduce absorption effects

Preservation methods are generally:

- pH control
- Chemical addition
- Refrigeration and/or chilling using ice

The recommended preservative for various constituents is given in the Exhibits at the end of this SOP. Preservation techniques for some analyses requiring more than simple refrigeration or filtering are discussed in Section 2.2. The exhibits also provide the estimated volume of sample required for the analysis, the suggested type of container, and the maximum recommended holding times for samples to be properly preserved.

When selecting preservation techniques and sample container type, always refer to the guidance provided in the documentation of the analytical methods to be used.

2.1 SAMPLE CONTAINERS

Select sample containers based on the analytical parameters of interest. Use containers made of materials that are non-reactive. Glass and polyethylene containers are the most commonly accepted, and both are used when sampling many constituents. When metals are the analytes of interest, however, polyethylene containers with Teflon-lined caps are preferred. When organics are the analytes of interest, use glass containers with Teflon-lined caps.

2.2 SAMPLE PRESERVATION

Utilize pre-preserved sample bottles whenever possible. If this is not possible or practical, perform appropriate chemical preservation in the field for various analytical parameters as soon as possible after the time of sample collection. Cool samples after collection and during shipment. All samples should be kept out of direct sunlight as much as possible and stored in the dark (e.g., in a cooler). Regardless of the method of preservation, analyses should be performed as soon after sampling as possible.

In some instances, the optimal method for sample preservation may be inappropriate due to the restrictions placed on the transport of certain chemicals by shippers. When shipping restrictions prevent the use of some reagents for sample preservation, use the most appropriate and permissible technique. The project chemist or laboratory should be able to assist in deciding the best alternative method of preservation.

2.3 MAXIMUM HOLDING TIME

Complete and unequivocal preservation of a sample for an extended period of time is a practical impossibility. Regardless of the nature of the sample, complete stability for every constituent is not likely to be achieved. Maximum holding times are assigned to each analyte and are designed for quality assurance purposes to minimize degradation effects on the analysis. Therefore, as a rule, it is better to analyze the sample as soon as possible after collection. This is especially true when low contaminant concentrations are expected.

2.4 REVIEW

The Field Manager or an approved designee shall check all sample control documentation to ensure that the samples, transport, and analysis events have met the criteria outlined in this SOP and the field sampling plan. Any discrepancies shall be noted and the documentation will be returned to the originator for correction or explanation. The reviewer will acknowledge that corrections have been incorporated by signing and dating each reviewed document.

3.0 DOCUMENTATION

All sample collection information must be recorded within the field logbook. Each sample collected will be clearly associated with a sample type (i.e. normal, field duplicate, equipment blank) sample location, matrix type, collection time, collection date, analysis and sampling depth if appropriate.

With every sample submitted for analysis, a completed chain of custody (COC) must accompany the shipment and a copy retained for the project records. The COC/analytical request form must be used to track all sample identifiers.

4.0 REFERENCES

None.

5.0 ATTACHMENTS

Attachment III-F-1	Example Sample Collection Form

Attachment III-F-1
Example Sample Collection Form

FORM 11-2
SAMPLE COLLECTION INFORMATION

Installation ID:	Establishing Contract ID:		Prime Contractor Name:
Site Name:	DO/CTO:	Establishing Phase:	Collection Date:

Location Name	Sample Name	Depth Range (feet bgs)		Collection Time	Sample Matrix	Sample Type	Sampling Equipment	Composite (Y/N)
		Start Depth	End Depth					

Sampling Equipment

2V	Double Van Veen Grab
AC	Air Canister
AP	Pump - Air Lift (bladder)
AS	Ashing
B	Bailer
BR	Brass (California) Ring
BS	Beach Seine
C	Continuous Flight Auger
CC	Continuous Core Sampler
CH	Charcoal Sampling Tube
CL	Clover Leaf Dredge Sampler
CN	Cone Penetrometer
CO	Core Sampler
CP	Pump - Centrifugal
DF	Diffusion Bag Samplers
DG	Drill Rig
DS	Dredge Sampler (brass, etc.)
DT	Driver Tube (geoprobe, direct push, CPT rig)
E2	Pump - Electric Submersible
EC	Encore Soil Sampler
FC	Cassette Filter
G	Grab
GP	Gas-Operated, Double Acting Piston Pump
H	Hollow Stem Auger
HA	Hand Auger
HB	Bucket Auger
HC	Hand Collected
HD	Hand Drill - Portable Powered
HK	Hook and Line
HP	Hydropunch
HU	Air Sampler - High Volume w/puf Resin
HV	Air Sampler - High Volume
HX	Air Sampler - High Volume w/XAD Resin
IF	Isolation Flux Chamber
LV	Air Sampler - Low Volume Continuous
LY	Lysimeter
MPPS	Micro Push Point Sampler
NC	Nickel Coated Brass Bomb Sampler
NX	NX Rock Coring
PP	Pump - Peristaltic
PS	Passive Soil Gas Sampling Probe
PU	Pump - Standard, Type not Recorded
RS	Hollow Glass Sampling Rod
SC	Scoop/Trowel
SD	Sediment Drag or Sled
SK	Skimmer
SS	Split Spoon
ST	Submersible Turbine Pump
SY	Syringe
T	Shelby Tube/ASTM-D1587
TB	Tedlar Bag
TL	Trawl
TR	Animal Trap
TS	Thief Sampler and/or Thief Type Sampler
UNK	Unknown
VC	Vacuum (gas)
VS	Van Dorn Sampler
VV	Van Veen
W	Swab or Wipe
WB	Westbay Sampling System

Recorder: ______________________________ Date: __________

Checker______________________________ Date: __________

Sample Matrix

AA	Ambient Air
AC	Composite Air Sample
ACS	Air - Crawlspace
AD	Air - Drilling
AI	Air - Indoor
AIN	Integrated Air Sample
AIR-ABS	Activity Based Sampling (ABS) Air Sample
AO	Air - Outdoor
AQ	Air Quality Control Matrix
AQS	Aqueous
ASB	Asbestos
ASBF	Asbestos-Fibrous
ASBNF	Asbestos-Non-Fibrous
AVE	Air-Vapor Extraction, Effluent
AX	Air Sample from Unknown Origin
BK	Brick
BS	Brackish Sediment
CA	Cinder Ash
CK	Caulk
CN	Container
CR	Carbon (usually for a remediation system)
DF	Dust/Fallout
DR	Debris/Rubble
DS	Storm Drain Sediment
DT	Trapped Debris
EF	Emissions Flux
EW	Elutriate Water
FB	Fibers
FL	Forest Litter
GE	Soil Gas Effluent - Stack Gas (from system)
GI	Soil Gas Influent (into system)
GL	Headspace of Liquid Sample
GQ	Gaseous or Headspace QC
GR	Gravel
GS	Soil Gas
GSS	Soil Gas - Subslab
GT	Grit
IC	IDW Concrete
IDD	IDW Solid
IDS	IDW Soil
IDW	IDW Water
IW	Interstitial Water
LA	Aqueous Phase of Multiphase Liquid/Soil
LF	Product (floating or free)
LQ	Organic Liquid Quality Control Matrix
MA	Mastic
MO	Mortar
MR	Marine Sediment
MS	Metal Shavings
NS	Near-Surface Soil
PA	Paper
PC	Paint Chips
PP	Precipitate
RE	Residue
RK	Rock
SB	Bentonite
SBS	Sub-Surface Soil (>6")
SC	Cement/Concrete
SD	Drill Cuttings - Solid Matrix
SE	Sediment
SEEP	Seep
SF	Filter Sandpack
SJ	Sand
SK	Asphalt
SL	Sludge
SM	Water Filter (solid material used to filter water)
SN	Miscellaneous Solid Materials - Building Materials
SO	Soil
SP	Casing (PVC, stainless steel, cast iron, iron pipe)
SQ	Soil/Solid Quality Control Matrix
SS	Scrapings
SSD	Subsurface Sediment
STKG	Stack Gas
STPM	Stripper Tower Packing Media
SU	Surface Soil (less than 6 inches)
SW	Swab or Wipe
SZ	Wood
TA	Animal Tissue
TP	Plant Tissue
TQ	Tissue QC
TX	Tissue
UNK	Unknown
W	Water (not groundwater, unspecified)
WA	Drill Cuttings - Aqueous Mix
WB	Brackish Water
WC	Drilling Water (used for well construction)
WD	Well Development Water
WF	Freshwater (not groundwater)
WG	Ground Water
WH	Equipment Wash Water (i.e. water used for washing equipment)
WI	Ground Water Influent (into system)
WL	Leachate
WM	Marine Water
WN	Porewater
WO	Ocean Water
WP	Drinking Water
WQ	Water for QC Samples
WR	Ground Water Effluent (from system)
WS	Surface Water
WT	Composite Ground Water Sample
WU	Storm Water
WW	Waste Water
XR	XRF Data

Sample Type

AB	Ambient Condition Blank
BIOCON	Bioassay Control Sample
BS	Blank Spike
BSD	Blank Spike Duplicate
EB	Equipment Blank
EBD	Equipment Blank/Rinsate Duplicate
FB	Field Blank
FD	Field Duplicate
FR	Field Replicate
FS	Field Spike
IDW	Purge and Rinseate Water
LB	Lab Blank
LR	Lab Replicate
MB	Material Blank
MIS	Multi-Incremental Sample
MS	Matrix Spike
N	Normal (Regular)
PE	Performance Evaluation
PURGE	Purge Water Sample
RD	Regulatory Duplicate
SB	Source Blank
SBD	Source Blank Duplicate
SCREEN	Screening Sample
SD	Matrix Spike Duplicate
SPLIT	Sample Split
SRM	Standard Reference Material
TB	Trip Blank
TBD	Trip Blank Duplicate
TBR	Trip Blank Replicate

Instructions
Form 11-2 (Sample Collection Information)

The purpose of this form is to collate sample collection information for data entry to serve as a quick reference for sample information. Every sample that is collected should be recorded on one of these forms. The information recorded on this form must come from the field logbook, which is the official record. This form must be filled out in its entirety; if a value or piece of information is unknown or not applicable, a horizontal line should be drawn through that field.

The information on this form must be checked against the field logbook for accuracy and completeness by a field staff member before the form is submitted for data entry. Data from this form will not be entered without the signature of the individual who checked the form for accuracy and completeness.

Installation ID: Unique identifier for installation associated with the location (example: WHIDBEY)

Establishing Contract ID: Unique contract ID assigned by Division Contraction Office
(example: D459559365800)

Prime Contractor Name: Name of company that established location (example: URS)

Site Name: Site name associated with the location (example: Site 11)

DO/CTO: Contract Task Order (CTO) or Delivery Order (DO) number assigned by the Navy. The format is NNNN (example: 0012)

Establishing Phase: Task Phase, Subtask Number or Annual Quarter (example: 1)

Collection Date: Date samples were collected

Location Name: Unique name used for the location (example: MW-2R)

Sample Name: Unique sample name assigned by the contractor and/or derived from historical data submittal (example: MW-1-11/02/98)

Depth Range (feet bgs): Start and end depth of sample collection, if applicable.

Collection Time: Time at which sample was collected

Sample Matrix: Matrix type code from options at the bottom of form (example: MR)

Sample Type: Sample type code from options at bottom of form (example: N)

Sampling Equipment: Sampling equipment code from options at bottom of form (example: G)

Composite: A Y/N field indicating whether or not the sample is a composite

Recorder: Signature of individual who completed form and date completed

Checker: Signature of individual who checked the data against the field logbook and date checked

SAMPLE HANDLING, STORAGE, AND SHIPPING

1.0 PURPOSE

This standard operating procedure (SOP) sets forth the methods for use by U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) field personnel and their contractors engaged in handling, storing, and transporting water, soil and/or sediment samples.

2.0 PROCEDURE

2.1 HANDLING AND STORAGE

Immediately following collection, all samples will be labeled according to the procedures in SOP III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures*. The lids of the containers shall not be sealed with duct tape, but may be covered with custody seals or placed directly into sealed plastic bags. The sample containers shall be placed in an insulated cooler with frozen gel packs (such as "blue ice") or ice in double, self-sealing bags. Samples should occupy the lower portion of the cooler, while the ice should occupy the upper portion. An absorbent material (e.g., proper absorbent cloth material) may be placed on the bottom of the cooler to contain liquids in case of spillage. All empty space between sample containers shall be filled with bubble wrap, Styrofoam "peanuts," or other appropriate material. Prior to shipping, glass sample containers should be wrapped on the sides, tops, and bottoms with bubble wrap or other appropriate padding and/or surrounded by packing material to prevent breakage during transport. Prior to shipment, the ice or cold packs in the coolers may require replacement to maintain samples as close to 4°C as possible during transport of the samples to the analytical laboratory. Samples shall be shipped as soon as possible to allow the laboratory to meet holding times for analyses. The procedures for maintaining sample temperatures at 4°C, pertains to all water, soil, and sediment field samples.

2.2 SHIPPING

All appropriate U.S. Department of Transportation (DOT) regulations (e.g., 49 Code of Federal Regulations (CFR), Parts 171-179) shall be followed in shipment of air, soil, water, and other samples.

2.2.1 Hazardous Materials Shipment

Field personnel must state whether any sample is suspected to be a hazardous material. A sample should be assumed to be hazardous unless enough evidence exists to indicate it is nonhazardous. If not suspected to be hazardous, shipments may be made as described in the Section 2.2.2 for non-hazardous materials. If hazardous, the procedures summarized below must be followed.

Any substance or material that is capable of posing an unreasonable risk to life, health, or property when transported is classified as hazardous. Hazardous materials identification should be performed by checking the list of dangerous goods for that particular mode of transportation. If not on that list, materials can be classified by checking the Hazardous Materials Table (49 CFR 172.102 including Appendix A) or by determining if the material meets the definition of any hazard class or division (49 CFR Part 173), as listed in Attachment III-G-2.

All persons offering for shipment any hazardous material must be properly trained in the appropriate regulations, as required by HM-126F, Training for Safe Transportation of Hazardous Materials. The training covers loading, unloading, handling, storing, and transporting of hazardous materials, as well as emergency preparedness in the case of accidents. Carriers such as commercial couriers must also be trained.

When shipping hazardous materials, including bulk chemicals or samples suspected of being hazardous, the proper shipping papers (49 CFR 172 Subpart C), package marking (49 CFR 172 Subpart D), labeling (49 CFR 172 Subpart E), placarding (49 CFR 172 Subpart F, generally for carriers), and packaging must be used. Attachment III-G-1 shows an example of proper package markings. A copy of 49 CFR should be referred to each time a hazardous material or potentially hazardous samples are shipped.

According to Section 2.7 of the International Air Transport Association (IATA) Dangerous Goods Regulations publication, very small quantities of certain dangerous goods may be transported without certain marking and documentation requirements as described in 49 CFR Part 172. However, other labeling and packing requirements must still be followed. Attachment III-G-2 shows the volume or weight for different classes of substances. A "Dangerous Goods in Excepted Quantities" label must be completed and attached to the associated shipping cooler (Attachment III-G-3). Certain dangerous goods are not allowed on certain airlines in any quantity.

As stated in item 4 of Attachment III-G-4, the Hazardous Materials Regulations do not apply to hydrochloric acid (HCl), nitric acid (HNO_3), sulfuric acid (H_2SO_4), and sodium hydroxide (NaOH) added to water samples if their pH or percentages by weight criteria are met. These samples may be shipped as non-hazardous materials as discussed below.

2.2.2 Nonhazardous Materials Shipment

If the samples are suspected to be nonhazardous, based on previous site sample results, field screening results, or visual observations, if applicable, then samples may be shipped as nonhazardous.

When a cooler is ready for shipment to the laboratory, copies of the chain-of-custody form shall be placed inside a sealed plastic bag and placed inside of an insulated cooler. The coolers will then be sealed with waterproof tape and labeled "Fragile," "This-End-Up" (or directional arrows pointing up), or other appropriate notices. Custody seals will be placed on the coolers as discussed in SOP III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures*.

2.2.3 Shipments from Outside the Continental United States

Shipment of sample coolers to the U.S. from locations outside the continental U.S. is controlled by the USDA and is subject to their inspection and regulation. Documentation is required to prove that the analytical laboratory receiving samples is certified. The laboratory must have certification by USDA to receive and properly dispose of soil; this is called a "USDA Soil Import Permit." In addition, all sample coolers must be inspected by a USDA representative, affixed with a label indicating that the coolers contain environmental samples, and shipping forms stamped by the USDA inspector prior to shipment. In addition, samples shipped from U.S. territorial possessions or foreign countries, must be cleared by the

U.S. Customs Service upon entry into the United States. As long as the commercial invoice is properly completed (see below), shipments typically pass through U.S. Customs without the need to open coolers for inspection.

Completion and use of proper paperwork will, in most cases, minimize or eliminate the need of the USDA and U.S. Customs to inspect the contents. Attachment III-G-5 shows an example of how paperwork may be placed on the outside of coolers for nonhazardous materials. For hazardous materials, refer to Section 2.2.1.

In summary, the paperwork listed below should be taped to the outside of the coolers to assist sample shipments. If a shipment is made up of multiple pieces (e.g., more than one cooler), the paperwork need be attached only to one cooler, provided that the courier agrees. All other coolers in the shipment need only be taped and have address and chain-of-custody seals affixed.

1. **Courier Shipping Form & Commercial Invoice** - See Attachments III-G-6, III-G-7, and III-G-8 for examples of the information to be included on these forms. Both forms should be placed inside a clear plastic adhesive-backed pouch, which adheres to the package (typically supplied by the courier) and placed on the cooler lid as shown in Attachment 5.
2. **Soil Import Permit and USDA Letter** (soil only) - See Attachments III-G-9 and III-G-10 for examples. The laboratory shall supply these documents prior to mobilization. The USDA in Hawaii often does stop shipments of soil without these documents. The 2" x 2" USDA label (described below), the USDA letter, and soil impact permit should be stapled together and placed inside a clear plastic pouch. Clear plastic and adhesive-backed pouches are typically supplied by the mailing courier.
3. The analytical laboratory should supply the Soil Import Permit. Although original labels are preferred, copies of this label, which are cut out to the 2" x 2" dimensions, are acceptable. Placing one label (as shown in Attachment III-G-5) covered with clear packing tape and one stapled to the actual permit is suggested.
4. The USDA does not control water samples, thus the requirements for soils listed above do not apply.
5. **Custody Seals**. Task Order personnel must sign and date custody seals. At least two seals should be placed in such a manner that they stick to both the cooler lid and body. The seals shall be placed so the cooler/container cannot be opened without breaking the seal. The custody seals are then covered with clear packing tape. This prevents the seal from coming loose and enables detection of tampering.
6. **Address Label**. A label stating the destination (the sending and laboratory, company, or location address) should be affixed to each cooler. The label should also include both telephone numbers.
7. **Special Requirements for Hazardous Materials** - see Section 2.2.1.

Upon receipt of sample coolers at the laboratory, the sample custodian shall inspect the sample containers as discussed in SOP III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures*. The samples shall then be immediately extracted and/or analyzed, or stored in a refrigerated storage area until they are removed for extraction and/or analysis. Whenever the samples are not being extracted or analyzed, they shall be returned to refrigerated storage.

3.0 DOCUMENTATION

Records shall be maintained as required by implementing these procedures.

4.0 REFERENCES

HM-126F, Training for Safe Transportation of Hazardous Materials

SOP III-E, Record Keeping, Sample Labeling, and Chain-of-Custody Procedures

5.0 ATTACHMENTS

Attachment III-G-1 Example Package Marking

Attachment III-G-2 Packing Groups

Attachment III-G-3 Label for Dangerous Goods in Excepted Quantities

Attachment III-G-4 SW-846 Preservative Exception

Attachment III-G-5 Sample Cooler Marking Figure

Attachment III-G-6 Example Courier Form

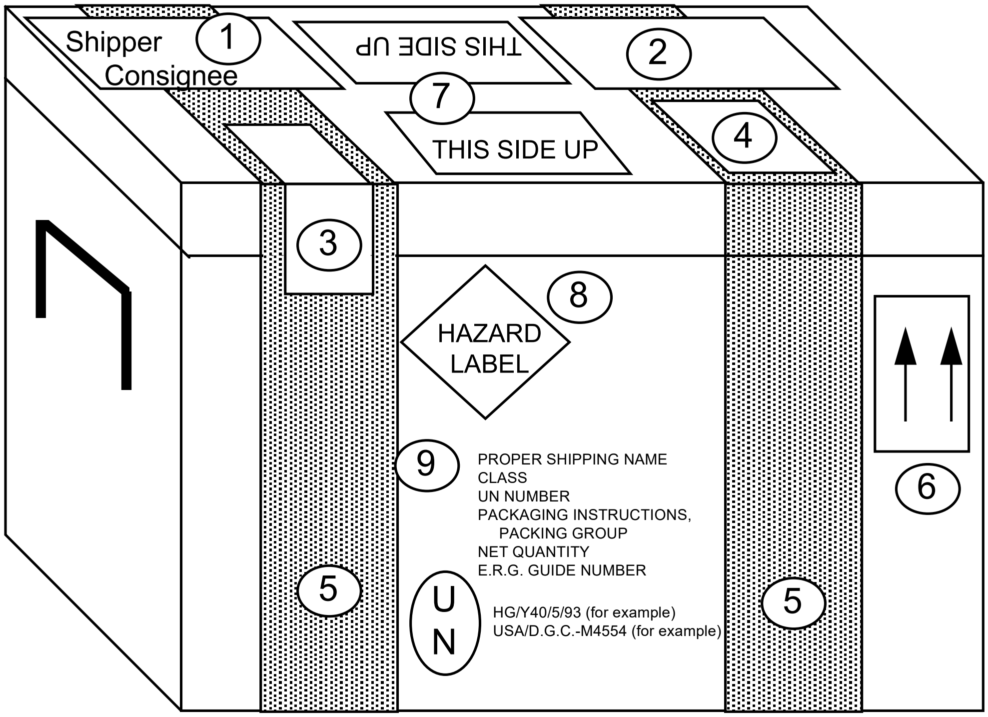
Attachment III-G-7 Commercial Invoice - Soil

Attachment III-G-8 Commercial Invoice - Water

Attachment III-G-9 Soil Import Permit

Attachment III-G-10 Soil Samples Restricted Entry Labels

Attachment III-G-1
Example Hazardous Material Package Marking



① **AIR BILL/COMMERCIAL INVOICE**

② **USDA PERMIT (Letter to Laboratory from USDA)**

③ **CUSTODY SEAL**

④ **USDA 2" X 2" SOIL IMPORT PERMIT**

⑤ **WATERPROOF STRAPPING TAPE**

⑥ **DIRECTION ARROWS STICKER - TWO REQUIRED**

⑦ **THIS SIDE UP STICKERS**

⑧ **HAZARD LABEL**

⑨ **HAZARDOUS MATERIAL INFORMATION**

⑩ **PACKAGE SPECIFICATIONS**

Attachment III-G-2
Packing Groups

Packing Group of the Substance	Packing Group I		Packing Group II		Packing Group III	
CLASS or DIVISION of PRIMARY or SUBSIDIARY RISK	Packagings		Packagings		Packagings	
	Inner	Outer	Inner	Outer	Inner	Outer
1: Explosives	-------------------- Forbidden (Note A) -------------------					
2.1: Flammable Gas	-------------------- Forbidden (Note B) -------------------					
2.2: Non-Flammable, non-toxic gas	----------------- See Notes A and B -----------------					
2.3: Toxic gas	-------------------- Forbidden (Note A) -------------------					
3. Flammable liquid	30 mL	300 mL	30 mL	500 mL	30 mL	1 L
4.1 Self-reactive substances	Forbidden		Forbidden		Forbidden	
4.1: Other flammable solids	Forbidden		30 g	500 g	30 g	1 kg
4.2: Pyrophoric substances	Forbidden		Not Applicable		Not Applicable	
4.2 Spontaneously combustible substances	Not Applicable		30 g	500 g	30 g	1 kg
4.3: Water reactive substances	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
5.1: Oxidizers	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
5.2: Organic peroxides (Note C)	See Note A		30 g or 30 mL	500 g or 250 mL	Not Applicable	
6.1: Poisons - Inhalation toxicity	Forbidden		1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.1: Poisons - oral toxicity	1 g or 1 mL	300 g or 300 mL	1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.1: Poisons - dermal toxicity	1 g or 1 mL	300 g or 300 mL	1 g or 1 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
6.2: Infectious substances	-------------------- Forbidden (Note A) -------------------					
7: Radioactive material (Note D)	-------------------- Forbidden (Note A) -------------------					
8: Corrosive materials	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L
9: Magnetized materials	-------------------- Forbidden (Note A) -------------------					
9: Other miscellaneous materials (Note E)	Forbidden		30 g or 30 mL	500 g or 500 mL	30 g or 30 mL	1 kg or 1 L

Note A: Packing groups are not used for this class or division.

Note B: For inner packagings, the quantity contained in receptacle with a water capacity of 30 mL. For outer packagings, the sum of the water capacities of all the inner packagings contained must not exceed 1 L.

Note C: Applies only to Organic Peroxides when contained in a chemical kit, first aid kit or polyester resin kit.

Note D: See 6.1.4.1, 6.1.4.2 and 6.2.1.1 through 6.2.1.7, radioactive material in excepted packages.

Note E: For substances in Class 9 for which no packing group is indicated in the List of Dangerous Goods, Packing Group II quantities must be used.

Attachment III-G-3
Label For Dangerous Goods In Excepted Quantities

DANGEROUS GOODS IN EXCEPTED QUANTITIES

This package contains dangerous goods in excepted small quantities and is in all respects in compliance with the applicable international and national government regulations and the IATA Dangerous Goods Regulations.

____

Signature of Shipper

______________________ ____________________

Title Date

____

____

Name and address of Shipper

This package contains substance(s) in Class(es)
(check applicable box(es))

Class:	2	3	4	5	6	8	9
	☐	☐	☐	☐	☐	☐	☐

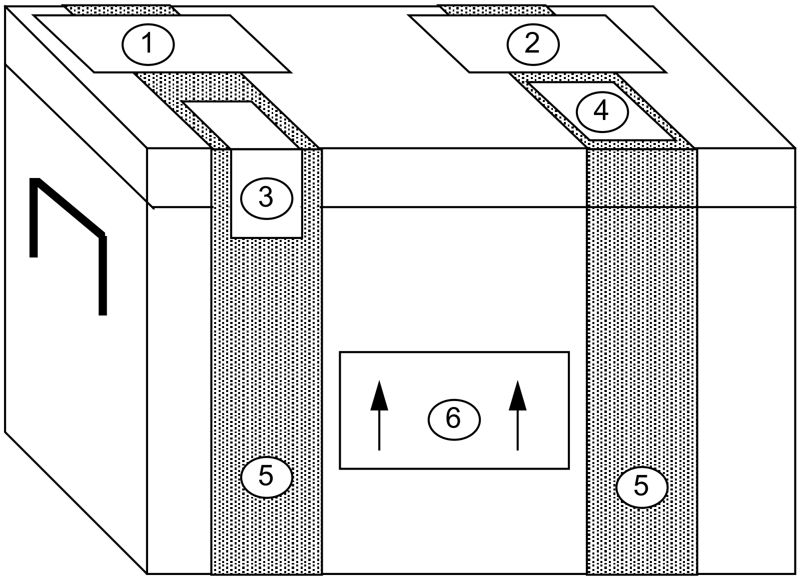
and the applicable UN Numbers are:

ATTACHMENT III-G-4
Preservative Exception

Measurement	Vol. Req. (mL)	Container[2]	Preservative [3,4]	Holding Time[5]
MBAS	250	P,G	Cool, 4ºC	48 Hours
NTA	500	P,G	Cool, 4ºC	24 Hours

1. More specific instructions for preservation and sampling are found with each procedure as detailed in this manual. A general discussion on sampling water and industrial wastewater may be found in ASTM, Part 31, p. 72-82 (1976) Method D-3370.
2. Plastic (P) or Glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.
3. Sample preservation should be performed immediately upon sample collection. For composite samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then samples may be preserved by maintaining at 4ºC until compositing and sample splitting is completed.
4. When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. for the preservation requirements of Table 1, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentration of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or grater); Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
5. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of sample under study are stable for the longer time, and has received a variance from the Regional Administrator. Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show this is necessary to maintain sample stability.
6. Should only be used in the presence of residual chlorine.

Attachment III-G-5
Non-Hazardous Material Cooler Marking Figure For Shipment From Outside the Continental United States



① **AIR BILL/COMMERCIAL INVOICE**

② **USDA PERMIT (Letter to Laboratory from USDA)**

③ **CUSTODY SEAL**

④ **USDA 2" X 2" SOIL IMPORT PERMIT**

⑤ **WATERPROOF STRAPPING TAPE**

⑥ **DIRECTION ARROWS STICKER - TWO REQUIRED**

Attachment III-G-6
Example Courier Form

FedEx USA Airbill FedEx Tracking Number 801704855619 0200 Form I.D. No. SPL11 **Sender's Copy**

1 From (please print and press hard)

Date ______ Sender's FedEx Account Number [redacted] Account Number

Sender's Name Joe Smith Phone (808) 545-2462

Company OGDEN ENVIRONMENTAL/CRC ACCT

Address 680 IWILEI RD STE 660 Dept./Floor/Suite/Room

City HONOLULU State HI ZIP 96817

2 Your Internal Billing Reference Information (Optional) (First 24 characters will appear on invoice)

3 To (please print and press hard)

Recipient's Name Sample Receipt Phone ( ) Lab Phone #

Company Lab Name

Address Lab Address

(To "HOLD" at FedEx location, print FedEx address here) (We Cannot Deliver to P.O. Boxes or P.O. ZIP Codes) Dept./Floor/Suite/Room

☐ Check here if residence (Extra charge applies for FedEx Express Saver)

City ______ State ______ ZIP ______

For HOLD at FedEx Location check here
☐ **Hold Weekday** (Not available with FedEx First Overnight)
☐ **Hold Saturday** (Not available at all locations) (Available for FedEx Priority Overnight and FedEx 2Day only)

For Saturday Delivery check here
☐ (Extra Charge. Not available to all locations) (Available for FedEx Priority Overnight and FedEx 2Day only)

4a Express Package Service *Packages under 150 lbs.* Delivery commitment may be later in some areas.
☐ FedEx Priority Overnight (Next business morning)
☐ FedEx Standard Overnight (Next business afternoon)
☐ FedEx 2Day* (Second business day)
☐ FedEx Express Saver* (Third business day)
☐ FedEx First Overnight (Earliest next business morning delivery to select locations) (Higher rates apply)

* FedEx Letter Rate not available. Minimum charge: One pound rate.

4b Express Freight Service *Packages over 150 lbs.* Delivery commitment may be later in some areas.
☐ FedEx Overnight Freight (Next business day)
☐ FedEx 2Day Freight (Second business day)
☐ FedEx Express Saver Freight (Up to 3 business days)

(Call for delivery schedule. See back for detailed descriptions of freight services.)

5 Packaging ☐ FedEx Letter ☐ FedEx Pak — Declared value limit $500. ☐ FedEx Box ☐ FedEx Tube ☐ Other Pkg.

6 Special Handling
Does this shipment contain dangerous goods? ☐ Yes (As per attached Shipper's Declaration) ☐ Yes (Shipper's Declaration not required)
☐ Dry Ice Dry Ice, 9, UN 1845 III ______ x ______ kg. 904 (Dangerous Goods Shipper's Declaration not required)
CA ☐ Cargo Aircraft Only

7 Payment
Bill to: ☐ Sender (Account no. in section 1 will be billed) ☐ Recipient ☐ Third Party ☐ Credit Card ☐ Cash/Check
(Enter FedEx account no. or Credit Card no. below)

FedEx Account No. ______
Credit Card No. ______ Exp. Date ______

Total Packages	Total Weight	Total Declared Value*	Total Charges
		$ .00	$

*When declaring a value higher than $100 per shipment, you pay an additional charge. See **SERVICE CONDITIONS, DECLARED VALUE, AND LIMIT OF LIABILITY** section for further information.

8 Release Signature *Sign to authorize delivery without obtaining signature.*

Your signature authorizes Federal Express to deliver this shipment without obtaining a signature and agrees to indemnify and hold harmless Federal Express from any resulting claims.

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Service Conditions, Declared Value, and Limit of Liability – By using this Airbill, you agree to the service conditions in our current Service Guide or U.S. Government Service Guide. Both are available on request. SEE BACK OF SENDER'S COPY OF THIS AIRBILL FOR INFORMATION AND ADDITIONAL TERMS. We will not be responsible for any claim in excess of $100 per package whether the result of loss, damage, or delay, non-delivery, misdelivery, or misinformation, unless you declare a higher value, pay an additional charge, and document your actual loss in a timely manner. Your right to recover from us for any loss includes intrinsic value of the package, loss of sales, interest, profit, attorney's fees, costs, and other forms of damage, whether direct, incidental, consequential, or special, and is limited to the greater of $100 or the declared value but cannot exceed actual documented loss. The maximum declared value for any FedEx Letter and FedEx Pak is $500. Federal Express may, upon your request, and with some limitations, refund all transportation charges paid. **See the FedEx Service Guide for further details.**

Questions?
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The World On Time

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Part #150364
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RETAIN THIS COPY FOR YOUR RECORDS

Attachment III-G-7
Commercial Invoice - Soil

DATE OF EXPORTATION 1/1/94	EXPORT REFERENCES (i.e., order no., invoice no., etc.) <CTO #>
SHIPPER/EXPORTER (complete name and address) Joe Smith Ogden c/o <hotel name> <hotel address>	CONSIGNEE Sample Receipt <Lab Name> <Lab Address>
COUNTRY OF EXPORT Guam, USA	IMPORTER - IF OTHER THAN CONSIGNEE
COUNTRY OF ORIGIN OF GOODS Guam, USA	
COUNTRY OF ULTIMATE DESTINATION USA	

INTERNATIONAL AIR WAYBILL NO. (NOTE: All shipments must be accompanied by a Federal Express International Air Waybill)

MARKS/ NOS	NO. OF PKGS	TYPE OF PACKAGING	FULL DESCRIPTION OF GOODS	QTY	UNIT OF MEASURE	WEIGHT	UNIT VALUE	TOTAL VALUE
	3	coolers	Soil samples for laboratory analysis only				$1.00	$3.00
	TOTAL NO. OF PKGS.					TOTAL WEIGHT		TOTAL INVOICE VALUE
	3							$3.00
								Check one ☐ F.O.B. ☐ C&F ☐ C.I.F.

THESE COMMODITIES ARE LICENSED FOR THE ULTIMATE DESTINATION SHOWN.

DIVERSION CONTRARY TO UNITED STATES LAW IS PROHIBITED.

I DECLARE ALL THE INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT

SIGNATURE OF SHIPPER/EXPORTER (Type name and title and sign)

Name/Title	Signature	Date
Joe Smith, Ogden	Joe Smith	1/1/94

ATTACHMENT III-G-8
Commercial Invoice - Water

DATE OF EXPORTATION 1/1/94	EXPORT REFERENCES (i.e., order no., invoice no., etc.) <CTO #>
SHIPPER/EXPORTER (complete name and address) Joe Smith Ogden c/o <hotel name> <hotel address>	CONSIGNEE Sample Receipt <Lab Name> <Lab Address>
COUNTRY OF EXPORT Guam, USA	IMPORTER - IF OTHER THAN CONSIGNEE
COUNTRY OF ORIGIN OF GOODS Guam, USA	
COUNTRY OF ULTIMATE DESTINATION USA	

INTERNATIONAL AIR WAYBILL NO.

(NOTE: All shipments must be accompanied by a Federal Express International Air Waybill)

MARKS/ NOS	NO. OF PKGS	TYPE OF PACKAGING	FULL DESCRIPTION OF GOODS	QTY	UNIT OF MEASURE	WEIGHT	UNIT VALUE	TOTAL VALUE
	3	coolers	Water samples for laboratory analysis only				$1.00	$3.00
	TOTAL NO. OF PKGS.					TOTAL WEIGHT		TOTAL INVOICE VALUE
	3							$3.00
								Check one ☐ F.O.B. ☐ C&F ☐ C.I.F.

THESE COMMODITIES ARE LICENSED FOR THE ULTIMATE DESTINATION SHOWN.

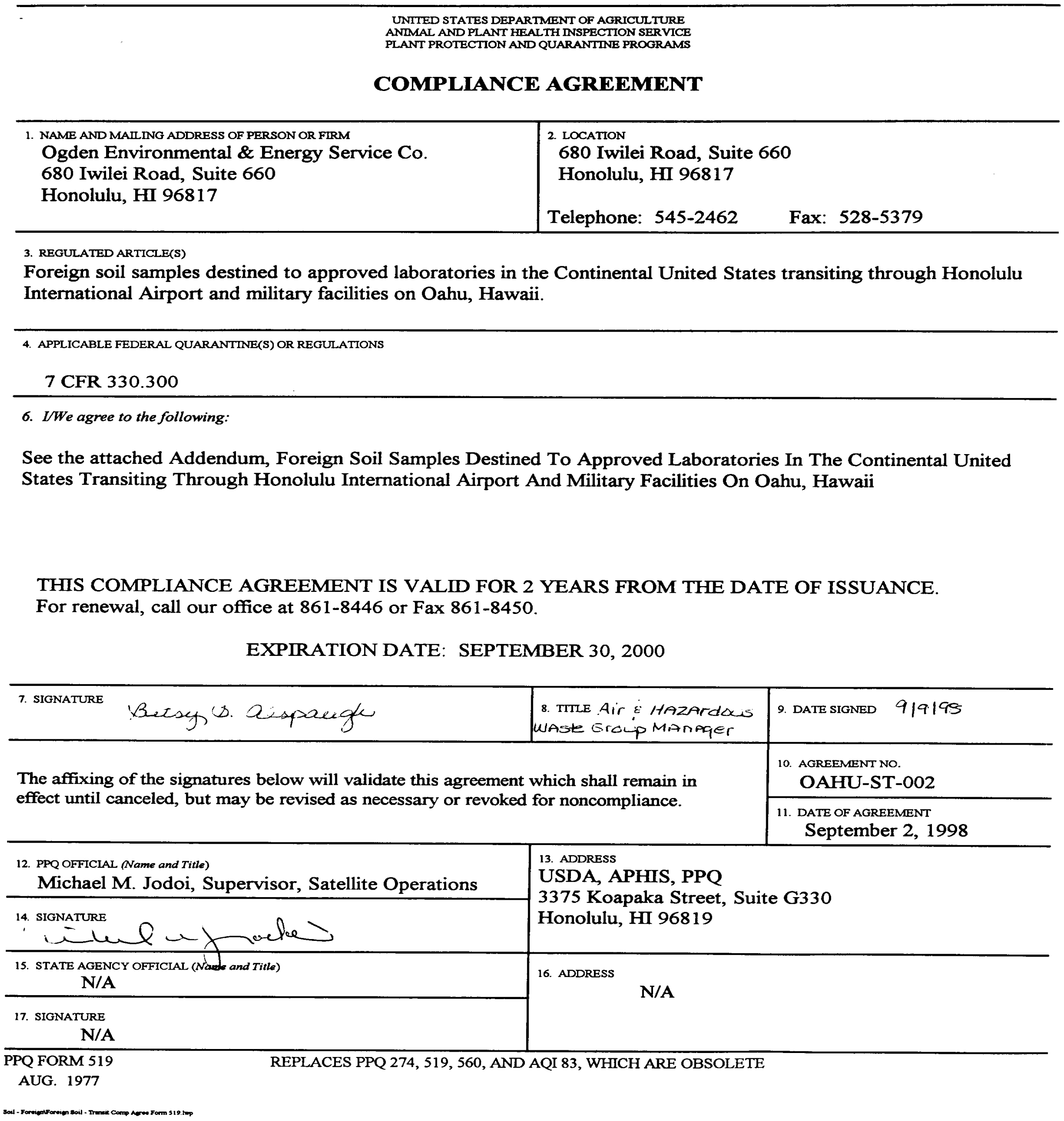
DIVERSION CONTRARY TO UNITED STATES LAW IS PROHIBITED.

I DECLARE ALL THE INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT

SIGNATURE OF SHIPPER/EXPORTER (Type name and title and sign)

Name/Title	Signature	Date
Joe Smith, Ogden	Joe Smith	1/1/94

Attachment III-G-9
Soil Import Permit



UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE PROGRAMS

COMPLIANCE AGREEMENT

1. NAME AND MAILING ADDRESS OF PERSON OR FIRM Ogden Environmental & Energy Service Co. 680 Iwilei Road, Suite 660 Honolulu, HI 96817	2. LOCATION 680 Iwilei Road, Suite 660 Honolulu, HI 96817 Telephone: 545-2462 Fax: 528-5379

3. REGULATED ARTICLE(S)

Foreign soil samples destined to approved laboratories in the Continental United States transiting through Honolulu International Airport and military facilities on Oahu, Hawaii.

4. APPLICABLE FEDERAL QUARANTINE(S) OR REGULATIONS

7 CFR 330.300

6. I/We agree to the following:

See the attached Addendum, Foreign Soil Samples Destined To Approved Laboratories In The Continental United States Transiting Through Honolulu International Airport And Military Facilities On Oahu, Hawaii

THIS COMPLIANCE AGREEMENT IS VALID FOR 2 YEARS FROM THE DATE OF ISSUANCE.
For renewal, call our office at 861-8446 or Fax 861-8450.

EXPIRATION DATE: SEPTEMBER 30, 2000

7. SIGNATURE Betsy D. Aispaugh	8. TITLE Air & HAZArdous WAste Group MAnager	9. DATE SIGNED 9/9/98

The affixing of the signatures below will validate this agreement which shall remain in effect until canceled, but may be revised as necessary or revoked for noncompliance.	10. AGREEMENT NO. OAHU-ST-002 11. DATE OF AGREEMENT September 2, 1998

12. PPQ OFFICIAL (*Name and Title*) Michael M. Jodoi, Supervisor, Satellite Operations 14. SIGNATURE	13. ADDRESS USDA, APHIS, PPQ 3375 Koapaka Street, Suite G330 Honolulu, HI 96819
15. STATE AGENCY OFFICIAL (*Name and Title*) N/A 17. SIGNATURE N/A	16. ADDRESS N/A

PPQ FORM 519
AUG. 1977

REPLACES PPQ 274, 519, 560, AND AQI 83, WHICH ARE OBSOLETE

Soil - Foreign\Foreign Soil - Transit Comp Agree Form 519.fwp

Attachment III-G-10
Soil Samples Restricted Entry Labels

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE
HYATTSVILLE, MARYLAND 20782
soil samples
restricted entry

The material contained in this package is imported under authority of the Federal Plant Pest Act of May 23, 1957.

For release without treatment if addressee is currently listed as approved by Plant Protection and Quarantine.

PPQ FORM 550 Edition of 12/77 may be used
(JAN 83)

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE
HYATTSVILLE, MARYLAND 20782
soil samples
restricted entry

The material contained in this package is imported under authority of the Federal Plant Pest Act of May 23, 1957.

For release without treatment if addressee is currently listed as approved by Plant Protection and Quarantine.

PPQ FORM 550 Edition of 12/77 may be used
(JAN 83)

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE
HYATTSVILLE, MARYLAND 20782
soil samples
restricted entry

The material contained in this package is imported under authority of the Federal Plant Pest Act of May 23, 1957.

For release without treatment if addressee is currently listed as approved by Plant Protection and Quarantine.

PPQ FORM 550 Edition of 12/77 may be used
(JAN 83)

EQUIPMENT DECONTAMINATION

1.0 PURPOSE

The standard operating procedure (SOP) describes general methods of equipment decontamination (decon) for use by U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) field personnel and their contractors during field sampling activities. Some sites may require additional steps (e.g. nitric rinses for metals, hexane for chlorinated pesticides) to insure equipment is properly deconned. These should be identified and addressed in the Work Plans and/or the Quality Assurance Project Plans (QAPPs)

2.0 PROCEDURES

Decontamination of equipment is necessary to prevent cross-contamination and to maintain the highest integrity possible in collected samples. Planning a decontamination program should include consideration of the following factors:

- The location where the decon procedures will be conducted
- The types of equipment requiring decon
- The frequency of equipment decontamination
- The cleaning technique and types of cleaning solutions appropriate to the contaminants of concern
- The method for containing the residual contaminants and wash water from the deconning process
- The use of a quality control measure to determine the effectiveness of the decontamination procedure (e.g. equipment rinsate samples)

This subsection describes standards for decontamination, including the techniques to be used, frequency of decontamination, cleaning solutions, and effectiveness.

2.1 DECONTAMINATION AREA

An appropriate location for the decontamination area at a site shall be selected on the basis of the ability to control access to the area, control residual material removed from equipment, the need to store dirty and clean equipment, and the ability to restrict access to the area being investigated. The decontamination area shall be located an adequate distance away and upwind from potential contaminant sources to avoid contamination of clean equipment.

2.2 TYPES OF EQUIPMENT

Examples of drilling equipment that must be deconned includes drill bits, auger sections, split spoon samplers, and hand tools. Decontamination of monitoring well development and ground-water sampling equipment includes submersible pumps, non-disposable bailers, interface probes, water level meters, bladder pumps, airlift pumps, and lysimeters. Other sampling equipment that may require decontamination includes, but is not limited to, hand trowels, hand augers, slide hammer samplers, shovels, stainless steel spoons and bowls, soil sample liners and caps, wipe sampling templates, COLIWASA samplers, and dippers. Equipment with a porous surface, such as rope, cloth hoses, and wooden blocks, cannot be thoroughly decontaminated and should be properly disposed of after one use.

2.3 FREQUENCY OF EQUIPMENT DECONTAMINATION

Down-hole drilling equipment and equipment used in monitoring well development and purging shall be decontaminated prior to initial use and between each borehole or well. However, down hole drilling equipment may require more frequent cleaning to prevent cross-contamination between vertical zones within a single borehole. When drilling through a shallow contaminated zone and installing a surface casing to seal off the contaminated zone, the drilling tools shall be decontaminated prior to drilling deeper. Groundwater sampling should be initiated by sampling ground water from the monitoring well where the least contamination is suspected. This is more important when not using disposable equipment. All groundwater, surface water, and soil sampling devices shall be decontaminated prior to initial use and between collection of each sample to prevent the possible introduction of contaminants into successive samples.

2.4 CLEANING SOLUTIONS AND TECHNIQUES

Decontamination can be accomplished using a variety of techniques and fluids. The preferred method of decontaminating major equipment such as drill bits, augers, drill string, pump drop-pipe, etc., is steam cleaning. Steam cleaning is accomplished using a portable, high-pressure steam cleaner equipped with a pressure hose and fittings. For this method, equipment shall be thoroughly steam washed and rinsed with potable tap water to remove particulates and contaminants.

A rinse decontamination procedure is acceptable for equipment such as bailers, water level meters, new and re-used soil sample liners, and hand tools. The decontamination procedure shall consist of the following: (1) wash with a non-phosphate detergent (Citrinox®, Liquinox®, or other suitable phosphate free detergent) and potable water solution, (2) rinse with potable water, and (3) rinses with deionized or distilled water. Equipment shall be disassembled as much as is practical, prior to cleaning. An initial gross wash scrub down and quick rinse should be completed at the beginning of the process if equipment is heavily soiled. After decontamination, care needs to be taken that the cleaned equipment does not become contaminated. This may require wrapping items in uncoated foil or plastic and storing the equipment in a specified “clean” area.

Decontaminating submersible pumps requires additional effort because internal surfaces become contaminated during usage. The pumps shall be decontaminated by circulating fluids through the pump while it is operating. This circulation can be done using a clean 4-inch or greater diameter pipe equipped with an end cap. The pipe shall be filled with enough decon fluid to submerge the pump, the pump placed within the capped pipe, and the pump operated while circulating the fluids within the pipe. The decontamination sequence shall include (1) detergent and potable water, (2) potable water rinse, and (3) deionized or distilled water rinse. The decontamination fluids shall be changed after each cycle. Changing of the fluids may include dumping of the detergent water, mixing detergent in the potable water rinse, using the deionized water as the potable rinse and renewing the distilled/deionized water. All decon water shall be disposed of as outlined in the field work plans.

Decontamination solvent(s) to be used during field activities will be specified in Project Work Plans or QAPPs. If solvents are used, sufficient time must be allowed to insure the solvent has evaporated from the equipment prior to reuse.

Equipment used for measuring field parameters such as pH, temperature, specific conductivity, and turbidity shall be rinsed with deionized or distilled water. New, unused soil sample liners and caps will be cleaned using the three step process, outlined above, to remove any dirt or cutting oils that may be on them prior to use.

2.5 CONTAINMENT OF RESIDUAL CONTAMINANTS AND CLEANING SOLUTIONS

Decontamination program for equipment exposed to potentially hazardous materials requires a provision for catchment and disposal of the contaminated material, cleaning solution, and wash water. This may require setting up a containment area with a system for pumping the water generated decontamination water into proper containers.

Clean equipment should be stored in a separate location to prevent recontamination. Decontamination fluids contained within the bermed area shall be collected and disposed of as outlined in the field sampling plan.

Containment of fluids from the decontamination of lighter-weight drilling equipment and hand-held sampling devices shall be accomplished using wash buckets or tubs. The decontamination fluids shall be collected and disposed of as outlined in the field sampling plan.

2.6 EFFECTIVENESS OF DECONTAMINATION PROCEDURES

A decontamination program must incorporate quality control measures to determine the effectiveness of cleaning methods. Quality control measures typically include collection of equipment rinsate samples or wipe testing. Equipment rinsates consist of analyte-free water that has been poured over or through the sample collection equipment after its final decontamination rinse. Wipe testing is performed by wiping a cloth over the surface of the equipment after cleaning. Further descriptions of these samples and their required frequency of collection are provided in SOP III-B, *Field QC Samples (Water, Soil)*. These quality control measures provide "after-the fact" information that may be useful in determining whether or not cleaning methods were effective in removing the contaminants of concern.

3.0 DOCUMENTATION

The decontamination process shall be recorded in the field logbook.

4.0 REFERENCES

SOP III-B, *Field QC Samples (Water, Soil).*

5.0 ATTACHMENTS

None.

EQUIPMENT CALIBRATION, OPERATION, AND MAINTENANCE

1.0 PURPOSE

This standard operating procedure (SOP) describes the activities and responsibilities of the U.S. Naval Facilities Engineering Command Northwest (NAVFAC NW) personnel pertaining to the operating, calibration, and maintenance of equipment used to collect environmental data. Reliable measurements of data required by the field sampling plan are necessary because the information recorded may be the basis for development of remedial action and responses.

2.0 PROCEDURES

2.1 EQUIPMENT CALIBRATION

All water quality monitoring equipment will be calibrated and adjusted to operate within the manufacturers' specifications. Water quality instruments and equipment that require calibration are to be calibrated to specifications prior to field use. In addition, a one-point calibration check is made at midday and at intervals outlined in the field sampling plan. A final check is conducted at the end of each field day. This is not a recalibration of the meter but a check of the calibration to ensure the continued accuracy of the meter. All calibration information shall be recorded in the project logbook.

Special attention shall be paid to instruments that may be affected by the change in the ambient temperature or humidity. Calibration checks should also be performed when sampling conditions change significantly, a change of sample matrix, and/or readings are unstable or there is a change of parameter measurements that appear unusual.

2.2 EQUIPMENT MAINTENANCE

All field monitoring equipment, field sampling equipment, and accessories are to be maintained in accordance with the manufacturer's recommendations and specifications and/or established field practices. All maintenance will be performed by qualified personnel and documented in the field logbook.

Equipment requiring battery charging shall be charged as recommended by the manufacturer. Backup batteries for meters requiring them shall be included as part of the meters accessories. Care must be taken to protect meters from adverse elements. This may involve placing the meter in a large plastic bag to shield it from the weather.

3.0 DOCUMENTATION

All field equipment calibration, maintenance, and operation information shall be recorded within the field logbook. This is to document that appropriate procedures have been followed and to track the equipment operation. All entries in the field logbook must be written accurately and legibly as outlined in the SOP III-D, *Logbooks*.

Logbook entries shall contain, but are not necessarily limited to, the following:

- Equipment model and serial numbers
- Date and time of calibration or maintenance performed
- Calibration standard used
- Calibration lot number and expiration date if listed on bottle
- Calibration procedure used if there are multiple options
- Calibration and calibration check readings including units used
- Problems and solutions regarding use, calibration or maintenance of the equipment
- And other pertinent information

4.0 REFERENCES

SOP III-D, *Logbooks*

5.0 ATTACHMENTS

None.

Appendix C
Department of Defense Environmental Laboratory Accreditation Program Accreditation Letter

PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

Battelle

141 Longwater Drive, Suite 202, Norwell, MA 02061

(Hereinafter called the Organization) and hereby declares that Organization has met the requirements of ISO/IEC 17025:2017) General Requirements for the competence of Testing and Calibration Laboratories and the United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP) requirements identified within the DoD/DOE Quality Systems Manual (DoD/DOE QSM) Version 5.3 May 2019 and is accredited is accordance with the:

United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP)

This accreditation demonstrates technical competence for a defined scope and the
operation of a laboratory quality management system
(as outlined by the joint ISO-ILAC-IAF Communiqué dated April 2017):

Environmental Testing

(As detailed in the supplement)

Accreditation claims for such testing and/or calibration services shall only be made from addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation body's duty to observe and comply with the said rules.

For PJLA:

Tracy Szerszen

Tracy Szerszen
President

Perry Johnson Laboratory
Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

Initial Accreditation Date:	*Issue Date:*	*Expiration Date:*
November 17, 2016	February 22, 2021	March 31, 2023

Accreditation No:	*Certificate No.:*
91667	L21-123

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: www.pjlabs.com

Certificate of Accreditation: Supplement

ISO/IEC 17025:2017 and DoD-ELAP

Battelle

141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Drinking Water	EPA 533	LC/MS/MS	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)
Drinking Water	EPA 533	LC/MS/MS	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)
Drinking Water	EPA 533	LC/MS/MS	4,8-dioxa-3H-perfluorononanoic acid (Adona)
Drinking Water	EPA 533	LC/MS/MS	Hexafluoropropylene oxide dimer acid (HFPO-DA)
Drinking Water	EPA 533	LC/MS/MS	Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-n-butanoic Acid (PFBA)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-1-butanesulfonic Acid (PFBS)
Drinking Water	EPA 533	LC/MS/MS	1H,1H,2H,2H-Perfluorodecane sulfonate (8:2FTS)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-n-decanoic Acid (PFDA)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-n-dodecanoic acid (PFDoA)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro(2-ethoxyethane)sulfonic Acid (PFEESA)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-1-heptanesulfonate (PFHpS)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-n-heptanoic Acid (PFHpA)
Drinking Water	EPA 533	LC/MS/MS	1H,1H,2H,2H-Perfluorohexane sulfonate (4:2FTS)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-1-hexanesulfonic Acid (PFHxS)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-n-hexanoic acid (PFHxA)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-3-Methoxypropanoic Acid (PFMPA)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-4-Methoxybutanoic Acid (PFMBA)
Drinking Water	EPA 533	LC/MS/MS	Perfluorononanoic acid (PFNA)
Drinking Water	EPA 533	LC/MS/MS	1H,1H,2H,2H-Perfluorooctane sulfonate (6:2FTS)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-1-octanesulphonic Acid (PFOS)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-n-octanoic Acid (PFOA)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-n-pentanoic acid (PFPeA)
Drinking Water	EPA 533	LC/MS/MS	Sodium perfluoro-1-pentanesulfonate (PFPeS)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-n-undecanoic acid (PFUnA)
Drinking Water	EPA 537.1.1	LC/MS/MS	4,8-dioxa-3H-perfluorononanoic acid (ADONA)
Drinking Water	EPA 537.1.1	LC/MS/MS	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)
Drinking Water	EPA 537.1.1	LC/MS/MS	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)
Drinking Water	EPA 537.1.1	LC/MS/MS	Hexafluoropropylene oxide dimer acid (HFPO-DA)

Certificate of Accreditation: Supplement

ISO/IEC 17025:2017 and DoD-ELAP

Battelle

141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-n-hexanoic acid (PFHxA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-n-heptanoic Acid (PFHpA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-n-octanoic Acid (PFOA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluorononanoic acid (PFNA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-n-decanoic Acid (PFDA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-n-undecanoic acid (PFUnA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-n-dodecanoic acid (PFDoA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-n-tridecanoic acid (PFTrDA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-n-tetradecanoic acid (PFTeDA)
Drinking Water	EPA 537.1.1	LC/MS/MS	N-methylperfluoro-1-octanesulfonamidoacetic acid (NMeFOSAA)
Drinking Water	EPA 537.1.1	LC/MS/MS	N-ethylperfluoro-octanesulfonamidoacetic acid (NEtFOSAA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-1-butanesulfonic Acid (PFBS)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-1-hexanesulfonic Acid (PFHxS)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-1-octanesulphonic Acid (PFOS)
Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	3-Perfluoropropyl propanoic Acid (3:3 FTCA)
Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	3-Perfluoropropyl propanoic acid (5:3 FTCA)
Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	3-Perfluoropropyl propanoic acid (7:3 FTCA)
Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-1-octanesulfonamide (PFOSA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	4,8-dioxa-3H-perfluorononanoic acid (Adona)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9CI-PF3ONS)

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11CI-PF3OUdS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Hexafluoropropylene oxide dimer acid (HFPO-DA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Sodium perfluoro-1-pentanesulfonate (PFPeS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-1-nonanesulfonate (PFNS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-1-heptanesulfonate (PFHpS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	N-ethylperfluoro-octanesulfonamidoacetic acid (NEtFOSAA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	1H,1H,2H,2H-Perfluorohexane sulfonate (4:2FTS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	1H,1H,2H,2H-Perfluorooctane sulfonate (6:2FTS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	1H,1H,2H,2H-Perfluorodecane sulfonate (8:2FTS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-butanoic Acid (PFBA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-pentanoic acid (PFPeA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-hexanoic acid (PFHxA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-heptanoic Acid (PFHpA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-octanoic Acid (PFOA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluorononanoic acid (PFNA)

Certificate of Accreditation: Supplement

ISO/IEC 17025:2017 and DoD-ELAP

Battelle

141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-decanoic Acid (PFDA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-undecanoic acid (PFUnA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-dodecanoic acid (PFDoA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-tridecanoic acid (PFTrDA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-tetradecanoic acid (PFTeDA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	N-methylperfluoro-1-octanesulfonamidoacetic acid (NMeFOSAA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-1-butanesulfonic Acid (PFBS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-1-hexanesulfonic Acid (PFHxS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-1-octanesulphonic Acid (PFOS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-1-decanesulfonate (PFDS)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ 128)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,3',4,5-Hexachlorobiphenyl (BZ 129)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ 180)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ 183)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ 138)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,4,4',6,6'-Heptachlorobiphen yl (BZ 184)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,4,5'-Pentachlorobiphenyl (BZ 87)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,5'-Tetrachlorobiphenyl (BZ 44)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ 153)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',4,5,5'-Pentachlorobiphenyl (BZ 101)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',4,5'-Tetrachlorobiphenyl (BZ 49)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',5,5'-Tetrachlorobiphenyl (BZ 52)

Certificate of Accreditation: Supplement

ISO/IEC 17025:2017 and DoD-ELAP

Battelle

141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',5-Trichlorobiphenyl (BZ 18)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,3,3',4,4'-Pentachlorobiphenyl (BZ 105)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,3,3',4',6-Pentachlorobiphenyl (BZ 110)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,3',4,4',5-Pentachlorobiphenyl (BZ 118)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,3',4,4'-Tetrachlorobiphenyl (BZ 66)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,4,4'-Trichlorobiphenyl (BZ 28)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,4'-DDD
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,4'-DDE
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,4'-DDT
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,4'-Dichlorobiphenyl (BZ 8)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ 169)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	3,3',4,4',5-Pentachlorobiphenyl (BZ 126)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	3,3',4,4'-Tetrachlorobiphenyl (BZ 77)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	4,4'-DDD
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	4,4'-DDE
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	4,4'-DDT
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Aldrin
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	alpha-BHC (alpha-Hexachlorocyclohexane)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	alpha-Chlordane
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	beta-BHC (beta-Hexachlorocyclohexane)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Chlorpyrifos
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	cis-Nonachlor
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Decachlorobiphenyl (BZ 209)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	delta-BHC
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Dieldrin
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Endosulfan II
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Endosulfan I
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Endosulfan sulfate
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Endrin
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Endrin aldehyde
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Endrin ketone
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	gamma-Chlordane
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Heptachlor
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Heptachlor epoxide
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Hexachlorobenzene

Battelle

141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Methoxychlor
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Mirex
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Oxychlordane
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	trans-Nonachlor
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	1,4-Dichlorobenzene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	1-Methylnaphthalene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	1-Methylphenanthrene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ 194)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ 207)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,4',6,6'-Octachlorobiphenyl (BZ 197)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ 171)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ 128)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ 208)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5,5',6-Octachlorobiphenyl (BZ 198)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ 199)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ 172)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ 200)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ 201)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ 173)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ 174)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ 175)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ 177)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5'-Hexachlorobiphenyl (BZ 130)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ 176)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,6-Hexachlorobiphenyl (BZ 131)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4-Pentachlorobiphenyl (BZ 82)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ 202)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ 178)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ 179)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',5,6-Hexachlorobiphenyl (BZ 134)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',5,6'-Hexachlorobiphenyl (BZ 135)

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Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',5-Pentachlorobiphenyl (BZ 83)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',6,6'-Hexachlorobiphenyl (BZ 136)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',6-Pentachlorobiphenyl (BZ 84)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3'-Tetrachlorobiphenyl (BZ 40)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ 203)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ 180)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ 183)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4',5-Hexachlorobiphenyl (BZ 137)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ 138)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ 184)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4',6-Hexachlorobiphenyl (BZ 139)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4',6'-Hexachlorobiphenyl (BZ 140)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4'-Pentachlorobiphenyl (BZ 85)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ 185)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4',5,5'-Hexachlorobiphenyl (BZ 146)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ 188)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4',5',6-Hexachlorobiphenyl (BZ 149)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,5',6-Hexachlorobiphenyl (BZ 144)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,5'-Pentachlorobiphenyl (BZ 87)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4',5'-Pentachlorobiphenyl (BZ 97)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4',6-Pentachlorobiphenyl (BZ 91)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4-Tetrachlorobiphenyl (BZ 41)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4'-Tetrachlorobiphenyl (BZ 42)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,5,5',6-Hexachlorobiphenyl (BZ 151)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,5,5'-Pentachlorobiphenyl (BZ 92)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,5',6-Pentachlorobiphenyl (BZ 95)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,5-Tetrachlorobiphenyl (BZ 43)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,5'-Tetrachlorobiphenyl (BZ 44)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,6'-Tetrachlorobiphenyl (BZ 46)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,6-Tetrachlorobiphenyl (BZ 45)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3-Trichlorobiphenyl (BZ 16)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ 153)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,4',5,6'-Hexachlorobiphenyl (BZ 154)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,4',5-Pentachlorobiphenyl (BZ 99)

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,4',6,6'-Hexachlorobiphenyl (BZ 155)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,4',6-Pentachlorobiphenyl (BZ 100)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,4'-Tetrachlorobiphenyl (BZ 47)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,5,5'-Pentachlorobiphenyl (BZ 101)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,5-Tetrachlorobiphenyl (BZ 48)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,5'-Tetrachlorobiphenyl (BZ 49)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,6,6'-Pentachlorobiphenyl (BZ 104)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,6'-Tetrachlorobiphenyl (BZ 51)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,6-Tetrachlorobiphenyl (BZ 50)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4-Trichlorobiphenyl (BZ 17)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',5,5'-Tetrachlorobiphenyl (BZ 52)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',5,6'-Tetrachlorobiphenyl (BZ 53)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',5-Trichlorobiphenyl (BZ 18)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',6,6'-Tetrachlorobiphenyl (BZ 54)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',6-Trichlorobiphenyl (BZ 19)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2'-Dichlorobiphenyl (BZ 4)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ 205)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ 189)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ 190)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ 191)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4,4',5-Hexachlorobiphenyl (BZ 156)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4,4',5'-Hexachlorobiphenyl (BZ 157)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4,4',6-Hexachlorobiphenyl (BZ 158)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4,4'-Pentachlorobiphenyl (BZ 105)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ 193)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4',5,6-Hexachlorobiphenyl (BZ 163)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4',5',6-Hexachlorobiphenyl (BZ 164)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4',6-Pentachlorobiphenyl (BZ 110)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4'-Tetrachlorobiphenyl (BZ 56)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4,4',5,5'-Hexachlorobiphenyl (BZ 167)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,4,4',5,6-Hexachlorobiphenyl (BZ 166)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,4,4',5-Pentachlorobiphenyl (BZ 114)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4,4',5-Pentachlorobiphenyl (BZ 118)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4,4',5'-Pentachlorobiphenyl (BZ 123)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,4,4',6-Pentachlorobiphenyl (BZ 115)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,4,4'-Tetrachlorobiphenyl (BZ 60)

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4,4'-Tetrachlorobiphenyl (BZ 66)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4',5,5'-Pentachlorobiphenyl (BZ 124)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4',5',6-Pentachlorobiphenyl (BZ 125)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,4',5-Tetrachlorobiphenyl (BZ 63)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4,5-Tetrachlorobiphenyl (BZ 67)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4',5-Tetrachlorobiphenyl (BZ 70)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,4',6-Tetrachlorobiphenyl (BZ 64)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4',6-Tetrachlorobiphenyl (BZ 71)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,4'-Trichlorobiphenyl (BZ 22)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4-Trichlorobiphenyl (BZ 25)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4'-Trichlorobiphenyl (BZ 33)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',5-Trichlorobiphenyl (BZ 26)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,5-Trimethylnaphthalene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,6-Trichlorobiphenyl (BZ 24)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',6-Trichlorobiphenyl (BZ 27)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3-Dichlorobiphenyl (BZ 5)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3'-Dichlorobiphenyl (BZ 6)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4,4',5-Tetrachlorobiphenyl (BZ 74)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4,4',6-Tetrachlorobiphenyl (BZ 75)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4,4'-Trichlorobiphenyl (BZ 28)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4,5-Trichlorobiphenyl (BZ 29)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4',5-Trichlorobiphenyl (BZ 31)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4,6-Trichlorobiphenyl (BZ 30)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4',6-Trichlorobiphenyl (BZ 32)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4'-DDD
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4'-DDE
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4'-DDT
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4-Dichlorobiphenyl (BZ 7)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4'-Dichlorobiphenyl (BZ 8)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,5-Dichlorobiphenyl (BZ 9)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,6-Dimethylnaphthalene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2-Chlorobiphenyl (BZ 1)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2-Chloronaphthalene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2-Methylnaphthalene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2-Methylphenanthrene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ 169)

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Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,3',4,4',5-Pentachlorobiphenyl (BZ 126)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,3',4,4'-Tetrachlorobiphenyl (BZ 77)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,3',4,5,5'-Pentachlorobiphenyl (BZ 127)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,3',5,5'-Tetrachlorobiphenyl (BZ 80)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,3'-Dichlorobiphenyl (BZ 11)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,4,4',5-Tetrachlorobiphenyl (BZ 81)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,4,4'-Trichlorobiphenyl (BZ 37)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,4-Dichlorobiphenyl (BZ 12)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,4'-Dichlorobiphenyl (BZ 13)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,6-Dimethylphenanthrene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	4,4'-Dichlorobiphenyl (BZ 15)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	4-Chlorobiphenyl (BZ 3)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Acenaphthene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Acenaphthylene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Anthracene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Benzo(a)anthracene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Benzo(a)pyrene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Benzo(b)fluoranthene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Benzo(b)thiophene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Benzo(e)pyrene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Benzo(k)fluoranthene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Biphenyl
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Chrysene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	cis-Decalin
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Decachlorobiphenyl (BZ 209)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Dibenz(a,h)anthracene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Dibenzofuran
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Dibenzothiophene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Fluoranthene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Fluorene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Indeno(1,2,3-cd)pyrene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Naphthalene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Perylene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Phenanthrene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Pyrene

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid/Tissue	EPA 8270DE MOD	GC-MS	trans-Decalin
Aqueous	EPA 3510 C	Separatory Funnel	Prep
Aqueous/Solid/Tissue	EPA 3640A MOD	Gel-permeation chromatography (GPC)	Cleanup
Aqueous/Solid/Tissue	EPA 3660B MOD	Sulfur Cleanup	Cleanup
Solids/Tissues	NOAA NOS ORCA 71	Orbital Shaker	Prep
Tissue	NOAA NOS ORCA 71	Tissuemizer	Prep

Appendix D
Laboratory Standard Operating Procedures

Sampling and Analysis Plan
Per- and Polyfluoroalkyl Substances Remedial Investigation
Outlying Landing Field Coupeville
Naval Air Station Whidbey Island
Oak Harbor, Washington

NOTIFICATION: APPENDIX D CONTAINS SENSITIVE BUT UNCLASSIFIED INFORMATION WHICH IS PROTECTED BY THE FREEDOM OF INFORMATION ACT

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Appendix B
Field Standard Operating Procedures

STANDARD OPERATING PROCEDURE

Logging of Soil Borings

I. Purpose and Scope

This SOP provides guidance to obtain accurate and consistent descriptions of soil characteristics during soil-sampling operations. The characterization is based on visual examination and manual tests, not on laboratory determinations.

II. Equipment and Materials

- Indelible pens
- Tape measure or ruler
- Field logbook
- Spatula
- HCL, 10 percent solution
- Squirt bottle with water
- Rock- or soil-color chart (e.g., Munsell)
- Grain-size chart
- Hand lens
- Unified Soil Classification System (USCS) index charts and tables to help with soil classification (attached)

III. Procedures and Guidelines

This section covers several aspects of soil characterization: instructions for completing the soil boring log form (attached), field classification of soil, and standard penetration test procedures.

A. Instructions for Completing Soil Boring Logs

Soil boring logs will be completed in the field log books or on separate soil boring log sheets. Information collected will be consistent with that required for ASTM D1586, a standard soil boring log form (attached), or an equivalent form that supplies the same information.

The information collected in the field to perform the soil characterization is described below.

Field personnel should review completed logs for accuracy, clarity, and thoroughness of detail. Samples also should be checked to see that information is correctly recorded on both sample jar labels and on the log sheets.

B. Heading Information

Boring/Well Number. Enter the boring/well number. A numbering system should be chosen that does not conflict with information recorded for previous exploratory work done at the site. Number the sheets consecutively for each boring.

Location. If station, coordinates, mileposts, or similar project layout information is available, indicate the position of the boring to that system using modifiers such as “approximate” or “estimated” as appropriate.

Elevation. Elevation will be determined at the conclusion of field activities through a survey.

Drilling Contractor. Enter the name of the drilling company and the city and state where the company is based.

Drilling Method and Equipment. Identify the bit size and type, drilling fluid (if used), and method of drilling (e.g., rotary, hollow-stem auger, sonic). Information on the drilling equipment (e.g., CME 55, Mobile B61) also is noted.

Water Level and Date. Enter the depth below ground surface to the apparent water level in the borehole. The information should be recorded as a comment. If free water is not encountered during drilling or cannot be detected because of the drilling method, this information should be noted. Record date and time of day (for tides, river stage) of each water level measurement.

Date of Start and Finish. Enter the dates the boring was begun and completed. Time of day should be added if several borings are performed on the same day.

Logger. Enter the first and last name.

C. Technical Data

Depth Below Surface. Use a depth scale that is appropriate for the sample spacing and for the complexity of subsurface conditions.

Sample Interval. Note the depth at the top and bottom of the sample interval.

Sample Type and Number. Enter the sample type and number. SS-1 = split spoon, first sample. Number samples consecutively regardless of type. Enter a sample number even if no material was recovered in the sampler.

Sample Recovery. Enter the length to the nearest 0.1-foot of soil sample recovered from the sampler. Often, there will be some wash or caved material above the sample; do not include the wash material in the measurement. Record soil recovery in feet.

Standard Penetration Test Results. In this column, enter the number of blows required for each 6 inches of sampler penetration and the "N" value, which is the sum of the blows in the middle two 6-inch penetration intervals. A typical standard penetration test involving successive blow counts of 2, 3, 4, and 5 is recorded as 2-3-4-5 and (7). The standard penetration test is terminated if the sampler encounters refusal. Refusal is a penetration of less than 6 inches with a blow count of 50. A partial penetration of 50 blows for 4 inches is recorded as 50/4 inches. Penetration by the weight of the slide hammer only is recorded as "WOH."

Samples should be collected using a 140-pound hammer and 2-inch diameter split spoons. Samples may be collected using direct push sampling equipment. However, blow counts will not be available. A pocket penetrometer may be used instead to determine relative soil consistency of fine grained materials (silts and clays).

Sample also may be collected using a 300-pound hammer or 3-inch-diameter split-spoon samples at the site. However, use of either of these sample collection devices invalidates standard penetration test results and should be noted in the comments section of the log. The 300-pound hammer should only be used for collection of 3-inch-diameter split-spoon samples. Blow counts should be recorded for collection of samples using either a 3-inch split-spoon, or a 300-pound hammer. An "N" value need not be calculated.

Soil Description. The soil classification should follow the format described in the "Field Classification of Soil" subsection below.

Comments. Include all pertinent observations (changes in drilling fluid color, rod drops, drilling chatter, rod bounce as in driving on a cobble, damaged Shelby tubes, and equipment malfunctions). In addition, note if casing was used, the sizes and depths installed, and if drilling fluid was added or changed. You should instruct the driller to alert you to any significant changes in drilling (changes in material, occurrence of boulders, and loss of drilling fluid). Such information should be attributed to the driller and recorded in this column.

Specific information might include the following:

- The date and the time drilling began and ended each day
- The depth and size of casing and the method of installation
- The date, time, and depth of water level measurements
- Depth of rod chatter
- Depth and percentage of drilling fluid loss
- Depth of hole caving or heaving
- Depth of change in material
- Health and safety monitoring data
- Drilling interval through a boulder

D. Field Classification of Soil

This section presents the format for the field classification of soil. In general, the approach and format for classifying soils should conform to ASTM D 2488, Visual-Manual Procedure for Description and Identification of Soils.

The Unified Soil Classification System is based on numerical values of certain soil properties that are measured by laboratory tests. It is possible, however, to estimate these values in the field with reasonable accuracy using visual-manual procedures (ASTM D 2488). In addition, some elements of a complete soil description, such as the presence of cobbles or boulders, changes in strata, and the relative proportions of soil types in a bedded deposit, can be obtained only in the field.

Soil descriptions should be precise and comprehensive without being verbose. The correct overall impression of the soil should not be distorted by excessive emphasis on insignificant details. In general, similarities rather than differences between consecutive samples should be stressed.

Soil descriptions must be recorded for every soil sample collected. The format and order for soil descriptions should be as follows:

1. Soil name (synonymous with ASTM D 2488 Group Name) with appropriate modifiers. Soil name should be in all capitals in the log, for example "POORLY-GRADED SAND."
2. Group symbol, in parentheses, for example, "(SP)."
3. Color, using Munsell color designation
4. Moisture content
5. Relative density (coarse grained) or consistency (fine grained)
6. Soil structure, mineralogy, or other descriptors

This order follows, in general, the format described in ASTM D 2488.

E. Soil Name

The basic name of a soil should be the ASTM D 2488 Group Name on the basis of visual estimates of gradation and plasticity. The soil name should be capitalized.

Examples of acceptable soil names are illustrated by the following descriptions:

- A soil sample is visually estimated to contain 15 percent gravel, 55 percent sand, and 30 percent fines (passing No. 200 sieve). The fines are estimated as either low or highly plastic silt. This visual classification is SILTY SAND WITH GRAVEL, with a Group Symbol of (SM).
- Another soil sample has the following visual estimate: 10 percent gravel, 30 percent sand, and 60 percent fines (passing the No. 200 sieve). The fines are estimated as low plastic silt. This visual classification is SANDY SILT. The gravel portion is not included in the soil name because the gravel portion was estimated as less than 15 percent. The Group Symbol is (ML).

The gradation of coarse-grained soil (more than 50 percent retained on No. 200 sieve) is included in the specific soil name in accordance with ASTM D 2488. There is no need to further document the gradation. However, the maximum size and angularity or roundness of gravel and sand-sized particles should be recorded. For fine-grained soil (50 percent or more passing the No. 200 sieve), the name is modified by the appropriate plasticity/elasticity term in accordance with ASTM D 2488.

Interlayered soil should each be described starting with the predominant type. An introductory name, such as "Interlayered Sand and Silt," should be used. In addition, the relative proportion of each soil type should be indicated (see **Table 1** for example).

Where helpful, the evaluation of plasticity/elasticity can be justified by describing results from any of the visual-manual procedures for identifying fine-grained soils, such as reaction to shaking, toughness of a soil thread, or dry strength as described in ASTM D 2488.

F. Group Symbol

The appropriate group symbol from ASTM D 2488 must be given after each soil name. The group symbol should be placed in parentheses to indicate that the classification has been estimated.

In accordance with ASTM D 2488, dual symbols (e.g., GP-GM or SW-SC) can be used to indicate that a soil is estimated to have about 10 percent fines. Borderline symbols (e.g., GM/SM or SW/SP) can be used to indicate that a soil sample has been identified as having properties that do not distinctly place the soil into a specific group. Generally, the group name assigned to a soil with a borderline symbol should be the group name for the first symbol. The use of a borderline symbol should not be used indiscriminately. Every effort should be made to first place the soil into a single group.

G. Color

The color of a soil must be given. The color description should be based on the Munsell system. The color name and the hue, value, and chroma should be given.

H. Moisture Content

The degree of moisture present in a soil sample should be defined as dry, moist, or wet. Moisture content can be estimated from the criteria listed on **Table 2**.

I. Relative Density or Consistency

Relative density of a coarse-grained (cohesionless) soil is based on N-values (ASTM D 1586 [attached]). If the presence of large gravel, disturbance of the sample, or non-standard sample collection makes determination of the in situ relative density or consistency difficult, then this item should be left out of the description and explained in the Comments column of the soil boring log.

Consistency of fine-grained (cohesive) soil is properly based on results of pocket penetrometer or torvane results. In the absence of this information, consistency can be estimated from N-values. Relationships for determining relative density or consistency of soil samples are given in **Tables 3 and 4**.

J. Soil Structure, Mineralogy, and Other Descriptors

Discontinuities and inclusions are important and should be described. Such features include joints or fissures, slickensides, bedding or laminations, veins, root holes, and wood debris.

Significant mineralogical information such as cementation, abundant mica, or unusual mineralogy should be described.

Other descriptors may include particle size range or percentages, particle angularity or shape, maximum particle size, hardness of large particles, plasticity of fines, dry strength, dilatancy, toughness, reaction to HCl, and staining, as well as other information such as organic debris, odor, or presence of free product.

K. Equipment and Calibration

Before starting the testing, the equipment should be inspected for compliance with the requirements of ASTM D 1586. The split-barrel sampler should measure 2-inch or 3-inch OD, and should have a split tube at least 18 inches long. The minimum size sampler rod allowed is “A” rod (1-5/8-inch OD). A stiffer rod, such as an “N” rod (2-5/8-inch OD), is required for depths greater than 50 feet. The drive weight assembly should consist of a 140-pound or 300-pound hammer weight, a drive head, and a hammer guide that permits a free fall of 30 inches.

IV. Attachments

Soil Boring Log (Sample Soil Boring Log.xls)

Soil Boring Log Form with a completed example (Soil_Log_Examp.pdf)

Tables 1 through 4 (Tables 1-4.pdf)

V. Key Checks and Preventive Maintenance

- Check entries to the soil-boring log and field logbook in the field; because the samples will be disposed of at the end of fieldwork, confirmation and corrections cannot be made later.
- Check that sample numbers and intervals are properly specified.
- Check that drilling and sampling equipment is decontaminated using the procedures defined in SOP *Decontamination of Drilling Rigs and Equipment*.

VI. References

ASTM D2488-17e1, Standard Practice for Description and Identification of Soils (Visual-Manual Procedures), ASTM International, West Conshohocken, PA, 2017, www.astm.org

ASTM D1586 / D1586M-18, Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils, ASTM International, West Conshohocken, PA, 2018, www.astm.org

JACOBS

PROJECT NUMBER	**BORING NUMBER**	

SOIL BORING LOG

PROJECT : LOCATION :

ELEVATION : DRILLING CONTRACTOR :

DRILLING METHOD AND EQUIPMENT USED :

ATD WATER LEVEL : START : END : LOGGER :

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS PID Readings: Breathing Zone: Above Hole:

CH2M HILL

PROJECT NUMBER	BORING NUMBER SHEET OF

SOIL BORING LOG

PROJECT ______ LOCATION ______

ELEVATION ______ DRILLING CONTRACTOR ______

DRILLING METHOD AND EQUIPMENT ______

WATER LEVELS ______ START ______ FINISH ______ LOGGER ______

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION

Figure 1
SOIL BORING LOG,
FORM D1586

REV 11/89 FORM D1586

CH2M HILL

PROJECT NUMBER DEN 22371.G5
BORING NUMBER BL-3
SHEET 1 OF 3

SOIL BORING LOG

PROJECT Howard Ave Landslide
LOCATION Howard & 24th Ave, Centennial, CO.
ELEVATION 5136 Feet
DRILLING CONTRACTOR Kendall Explorations, Ashcan, Colorado
DRILLING METHOD AND EQUIPMENT 4"-inch H.S. Augers, Mobil B-61 rotary drill rig
WATER LEVELS 3.2 Feet, 8/5/89
START August 4, 1989 FINISH August 8, 1989 LOGGER J.A.Michner

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0					Surface material consist of 4 inches AC underlain by 6 inches of 3/4 inch minus base rock	Start Drilling @ 3:00
	2.5					
	4.0	1-S	1.5	2-3-4 (7)	POORLY-GRADED SAND WITH SILT, (SP-SM), fine, light brown, wet, loose	Driller notes water at 4 feet
	5.0					Driller notes very soft drilling 4ft. dark grey, wet silty cuttings.
5	6.5	2-S	0.9	WOH/12"-1	ORGANIC SILT, (OL), very dark, gray to black, wet, very soft; strong H_2S odor, many fine roots up to about 1/4 inch	
	8.0					
	10.0	3-ST	1.3	—	ORGANIC SILT, similar to 2-S, except includes fewer roots (by volume)	
10	11.5	4-S	1.3	2-2-2 (4)	SILT, (ML), very dark gray to black, wet, soft	water level @ 3.2 feet on 8/5/89 @ 0730 Driller notes rough drilling action and chatter @ 13 ft
15	15.0 15.5	5-S	0.5	60/6"	SILTY GRAVEL, (GM), rounded gravel up to about 1 inch maximum observed size, wet, very dense	
20	20.0					Driller notes smoother, firm drilling @ 19 ft some angular rock chips @ bot tip of 6-S, poss boulders or rock
	21.0	6-S	1.0	12-50/6"	LEAN CLAY WITH SAND, (CL), medium to light green, moist, very stiff	Driller notes very hard, slow grinding, smooth drilling action from 21 to 23 ft, possibly bedrock
	23.0					
	23.1	7-S	-0-	50/1"	NO RECOVERY	
					END SOIL BORING @ 23.1 FEET SEE ROCK CORE LOG FOR CONTINUATION OF BL-3	

Figure 2
EXAMPLE OF COMPLETED LOG FORM

REV 11 89 FORM D1586

Table 1
EXAMPLE SOIL DESCRIPTIONS

POORLY GRADED SAND (SP), light brown, moist, loose, fine sand size

FAT CLAY (CH), dark gray, moist, stiff

SILT (ML), light greenish gray, wet, very loose, some mica, lacustrine

WELL-GRADED SAND WITH GRAVEL (SM), reddish brown, moist, dense, subangular gravel to 0.6 inches max

POORLY GRADED SAND WITH SILT (SP-SM), white, wet, medium dense

ORGANIC SOIL WITH SAND (OH), dark brown to black, wet, firm to stiff but spongy undisturbed, becomes soft and sticky when remolded, many fine roots, trace of mica

SILTY GRAVEL WITH SAND (GM), brownish red, moist, very dense, subrounded gravel to 1.2 inches max

INTERLAYERED SILT (60 percent) AND CLAY (40 percent): SILT WITH SAND (ML), medium greenish gray, nonplastic, sudden reaction to shaking, layers mostly 1.5 to 8.3 inches thick; LEAN CLAY (CL), dark gray, firm and brittle undisturbed, becomes very soft and sticky when remolded, layers 0.2 to 1.2 inches thick

SILTY SAND WITH GRAVEL (SM), light yellowish brown, moist, medium dense, weak gravel to 1.0 inches max, very few small particles of coal, fill

SANDY ELASTIC SILT (MH), very light gray to white, wet, stiff, weak calcareous cementation

LEAN CLAY WITH SAND (CL/MH), dark brownish gray, moist, stiff

WELL-GRADED GRAVEL WITH SILT (GW-GM), brown, moist, very dense, rounded gravel to 1.0 inches max

Table 2
CRITERIA FOR DESCRIBING MOISTURE CONDITION

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp, but no visible water
Wet	Visible free water, usually soil is below water table

Table 3
RELATIVE DENSITY OF COARSE-GRAINED SOIL
(Developed from Sowers, 1979)

Blows/Ft	Relative Density	Field Test
0-4	Very loose	Easily penetrated with ½-in. steel rod pushed by hand
5-10	Loose	Easily penetrated with ½-in. steel rod pushed by hand
11-30	Medium	Easily penetrated with ½-in. steel rod driven with 5-lb hammer
31-50	Dense	Penetrated a foot with ½-in. steel rod driven with 5-lb hammer
>50	Very dense	Penetrated only a few inches with ½-in. steel rod driven with 5-lb hammer

Table 4
CONSISTENCY OF FINE-GRAINED SOIL
(Developed from Sowers, 1979)

Blows/Ft	Consistency	Pocket Penetrometer (TSF)	Torvane (TSF)	Field Test
<2	Very soft	<0.25	<0.12	Easily penetrated several inches by fist
2-4	Soft	0.25-0.50	0.12-0.25	Easily penetrated several inches by thumb
5-8	Firm	0.50-1.0	0.25-0.5	Can be penetrated several inches by thumb with moderate effort
9-15	Stiff	1.0-2.0	0.5-1.0	Readily indented by thumb, but penetrated only with great effort
16-30	Very stiff	2.0-4.0	1.0-2.0	Readily indented by thumbnail
>30	Hard	>4.0	>2.0	Indented with difficulty by thumbnail

STANDARD OPERATING PROCEDURE

Water-Level Measurements

I. Purpose and Scope

The purpose of this procedure is to provide a guideline for the measurement of the depth to groundwater in piezometers and monitoring wells, even where a second phase of floating liquid (e.g., gasoline) is encountered, and on staff gauges in surface-water bodies. This SOP includes guidelines for discrete measurements of static water levels and does not cover the use of continuously recording loggers (see SOP *Use of Data Loggers and Pressure Transducers)*.

II. Equipment and Materials

- Electronic water-level meter (Solinst® or equivalent) with a minimum 100-foot tape; the tape should have graduations in increments of 0.01 feet or less
- Interface probe (Solinst® Model 122 Interface Meter or equivalent)

III. Procedures and Guidelines

Verify that the unit is turned on and functioning properly. Slowly lower the probe on its cable into the piezometer or well until the probe just contacts the water surface; the unit will respond with a solid tone or light signal. Note the depth from a reference point indicated on the piezometer or well riser. Typically, this is the top of the PVC casing. If no reference is clearly visible, measure the depth to water from the northern edge of the PVC casing. If access to the top of the PVC casing is difficult, sight across the top of the locking casing adjacent to the measuring point, recording the position of the cable when the probe is at the water surface.

Measure the distance from this point to the closest interval marker on the tape and record the water level reading in the logbook. Water levels will be measured to the nearest 0.01-foot. Also, when specified in the project plans, measure and record the depth of the piezometer or well. The depth of the piezometer or well may be measured using the water-level probe with the instrument turned off.

Free product light or dense nonaqueous phase liquid may be present in the piezometer or well. If the presence of free product is suspected, the thickness of the product should be determined using appropriate equipment (e.g., Solinst® Model 122 Interface Meter). The depth to water also is determined with this equipment and the water-level meter should not be used in the piezometer or well as long as product is present. Typically, a constant sound is emitted from the device when free product is encountered and an alternating on/off beep sound is emitted when water is encountered.

The apparent elevation of the water level in the well or piezometer is determined by measuring both the apparent depth to water and the thickness of free product. The corrected water-level elevation is calculated by the following equation:

$$WL_c = Wl_a + (\text{Free-product thickness} \times 0.80)$$

Where WL_c = Corrected water-level elevation

Wl_a = Apparent water-level elevation

0.80 = Typical value for the density of petroleum hydrocarbon products.

If free product is detected on the surface of the water in the piezometer or well, the value of sampling should be reconsidered because of the potential for contaminating the sampling equipment.

Staff gauges may be installed in some surface-water bodies. These facilities typically are constructed by attaching a calibrated, marked staff gage to a wood or metal post, driving the post into the bottom of the surface-water body, and surveying the elevation of the top of the post to a resolution or 0.01-foot. The elevation of the water in the surface-water body then can be determined by reading off the distance the water level is from the top of the post. A shield or other protection may be needed to calm the fluctuations in water level if the gauge is installed at a location exposed to wind or wave.

IV. Attachments

None.

V. Key Checks

- Before each use, verify that the battery is charged by pressing the test button on the water-level meter.
- Verify that the unit is operating correctly by testing the probe in distilled or de-ionized water. Leave the unit turned off when not in use.

STANDARD OPERATING PROCEDURE

Multi RAE Photoionization Detector (PID)

I. Purpose

The purpose of this SOP is to provide general reference information for using the Multi RAE PID in the field. Calibration and operation, along with field maintenance, will be included in this SOP.

II. Scope

This procedure provides information on the field operation and general maintenance of the Multi RAE PID. Review of the information contained herein will ensure that this type of field monitoring equipment will be properly utilized. Review of the owner's instruction manuals is a necessity for more detailed descriptions.

III. Definitions

Carbon Monoxide Sensor (CO) - Carbon Monoxide concentration in ppm.

Volatile Organic Compound (VOC) – VOC concentration in ppm

Lower Explosive Limit (LEL) - Combustible gas is expressed as a percent of the lower explosive limit.

Hydrogen Sulfide Sensor (H_2S) - Hydrogen Sulfide concentration in ppm.

Oxygen Sensor (OXY) - Oxygen concentration as a percentage.

ppm - parts per million: parts of vapor or gas per million parts of air by volume.

IV. Procedures

The PID operates on the principle that most organic compounds and some inorganic compounds are ionized when they are bombarded by high-energy ultraviolet light. The air sample is drawn across a UV lamp using a pump or a fan. The energy of the lamp determines whether a particular chemical will be ionized. Each chemical compound has a unique photoionization potential (PIP). When the UV light energy is greater than the ionization potential of the chemical, ionization will occur. All PID readings are relative to the calibration gas, usually isobutylene.

It is important to calibrate the PID in the same temperature and elevation that the equipment will be used, and to determine the background concentrations in the field before taking measurements. For environments where background readings are high, factory zero calibration gas should be used.

Note: For volatile and semi-volatile compounds, knowing the PIP is critical in determining the appropriate instrument to use when organic vapor screening. Consult the QAPP and manufacturer's manual to determine that the proper instrument has been selected for the contaminate vapors of interest. If an expected compound at a site has a PIP less than 11.7 eV, it is possible to use a PID. If the ionization potential is greater than 11.7eV, a flame-ionization detector is required.

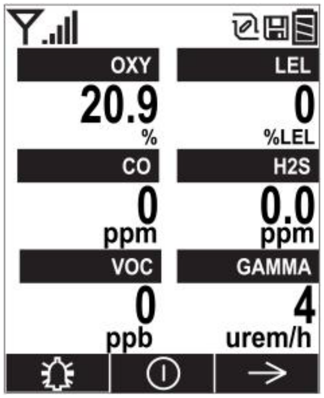
The following subsections will discuss Mini RAE calibration, operation, and maintenance. These sections, however, do not take the place of the instruction manual.

A. Calibration

For Multi RAE configured with O_2, LEL, H_2S, CO, sensors and a 10.6 eV PID Lamp.

Start up Instrument

- Press **Mode** button
- A RAE Systems logo (or a company name) should appear first. This is followed by a progression of screens that tell you the MultiRAE's current settings:
    - Product name and model number, air flow type, and serial number
    - Application firmware version, build date, and build time
    - Sensor firmware, build date, build time
    - Installed sensors (including serial number/production/expiration/calibration date and alarm limit settings)
    - Current date, time, temperature, and relative humidity
    - User mode and operation mode
    - Battery type, voltage, shutoff voltage
    - Alarm mode and alarm settings
    - Datalog period (if it is activated) and interval
    - Policy Enforcement settings (whether calibration and/or bump testing are enforced)
- Then the MultiRAE's main reading screen appears. It may take a few minutes for sensors to show a reading, so if any have not warmed up by the time the main screen is shown, you will see "- - -" instead of a numerical value until the sensor provides data (typically less than 2 minutes). Then it displays instantaneous readings similar to the following screen (depending on the sensors installed) and is ready for use.

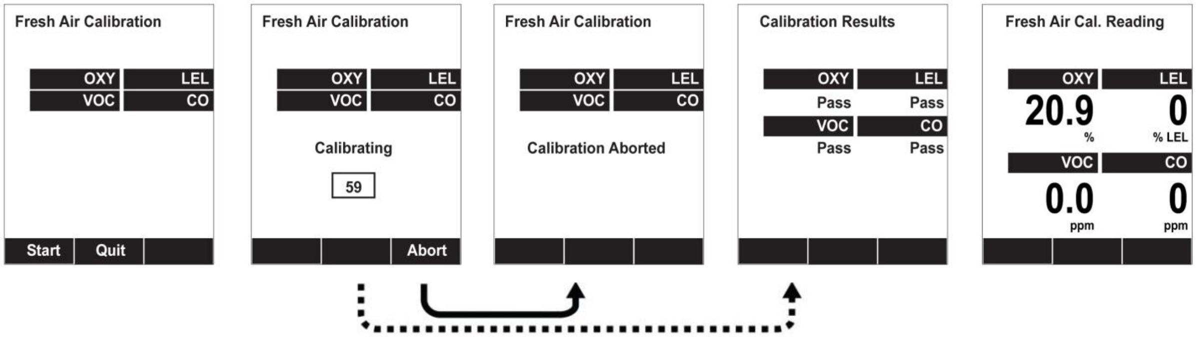

OXY 20.9 %
LEL 0 %LEL
CO 0 ppm
H2S 0.0 ppm
VOC 0 ppb
GAMMA 4 urem/h

Calibration Check and Adjustment

Zero Calibration

- At the Calibration Menu, select “Fresh Air.” Press [Y/+] once to enter the fresh air calibration sub-menu.

- Press **[Y/+]** to start fresh air calibration
- A countdown screen appears. You can abort the calibration at any time during the countdown by pressing [N/-].



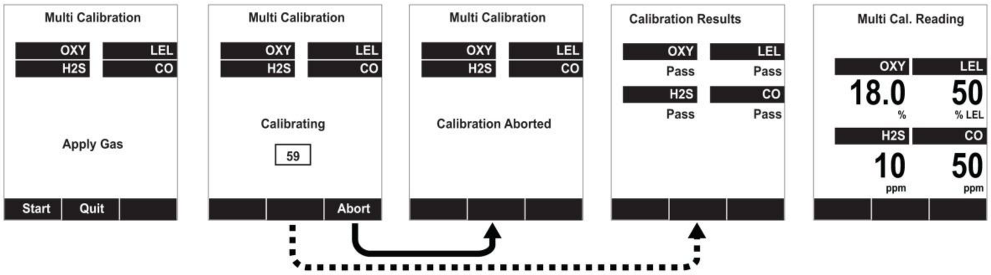
OXY Pass
LEL Pass
VOC Pass
CO Pass

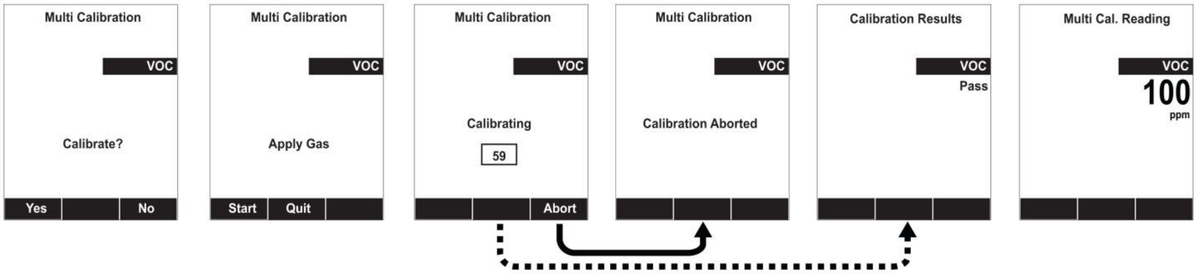
Fresh Air Cal. Reading
OXY 20.9 %
LEL 0 % LEL
VOC 0.0 ppm
CO 0 ppm

- Note: Dotted line indicates automatic progression
- If the calibration is not aborted, the display shows the sensor names and tells you whether the fresh air calibration passed or failed, followed by the sensors’ fresh air readings

Multi Sensor Span Calibration

- Depending on the configuration of your MultiRAE and span gas you have, you can perform a span calibration simultaneously on multiple sensors. You can define which sensors are calibrated together using the Multi Cal Select menu described in section 8.3.2.9.
- In case all sensors in the instrument cannot be calibrated with the same gas, the MultiRAE will intelligently split the span calibration process into several steps and will provide menu prompts accordingly.
- At the Calibration Menu, select "Multi Sensor Span."
- Install the calibration adapter and connect it to a source of calibration gas.
- Start the flow of calibration gas.
- Press **[Y/+]** to start calibrating or wait for calibration to start automatically.
- A countdown screen is shown. You can abort the calibration at any time during the countdown by pressing **[N/-]**.



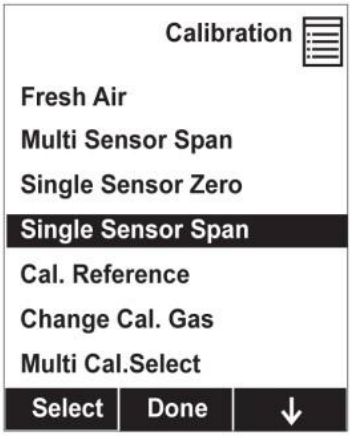


- Note: Dotted line indicates automatic progression
- If the calibration is not aborted, the display shows the sensor names and tells you whether the calibration passed or failed, followed by the sensor readings.

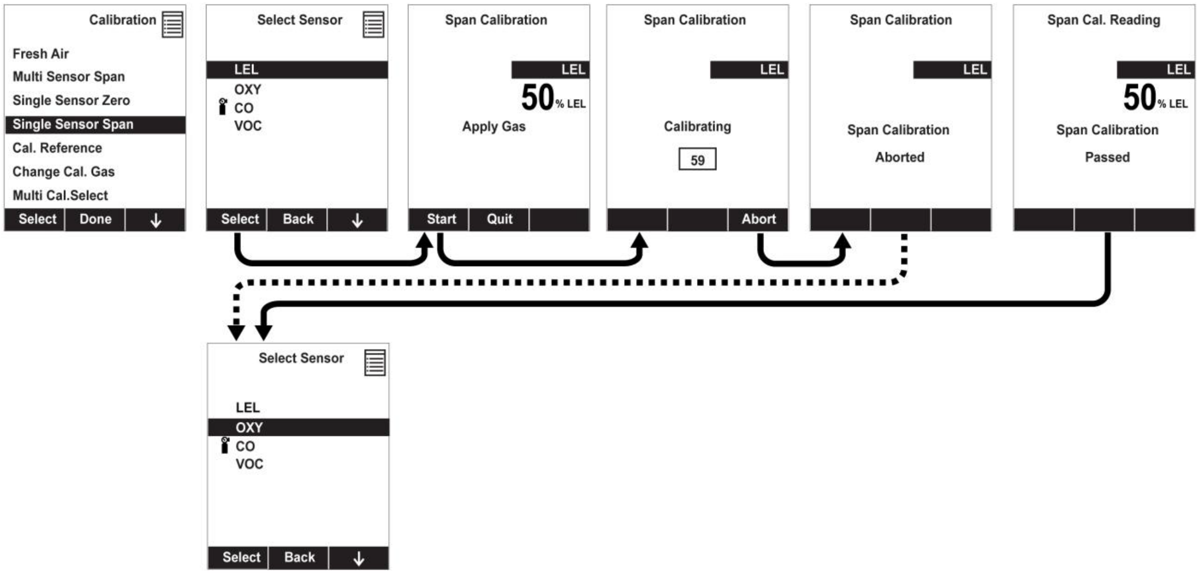
Single Sensor Span Calibration

- Instead of performing a span calibration on multiple sensors simultaneously, you can select a single sensor and perform a span calibration.
- To perform span calibration of an individual sensor, follow these steps:
- At the Calibration Menu, select "Single Sensor Span."
- Select a sensor to calibrate from the list.
- Install the calibration adapter and connect it to a source of calibration gas.
- Verify that the displayed calibration value meets the concentration specified on the gas cylinder.

- Start the flow of calibration gas.



- Press [Y/+] to start calibrating or wait for calibration to start automatically.
- A countdown screen appears. You can abort the calibration at any time during the countdown by pressing [N/-].



- Note: Dotted line indicates automatic progression
- Select the done button when calibration is complete.
- **CALIBRATION IS COMPLETE!**

B. Operation

Due to the Multi RAE having many functions in terms of operation, it is recommended that you follow the operational procedures as outlined in the instruction manual.

C. Site Maintenance

After each use, the meter should be recharged and the outside of the instruments should be wiped clean with a soft cloth.

D. Scheduled Maintenance

Function	Frequency
Check alarm and settings	Monthly/before each use
Clean screens and gaskets around sensors	Monthly
Replace sensors	Biannually or when calibration is unsuccessful

V. Quality Assurance Records

Quality assurance records will be maintained for each air monitoring event. The following information shall be recorded in the field logbook.

- Identification - Site name, date, location, CTO number, activity monitored, (surface water sampling, soil sampling, etc), serial number, time, resulting concentration, comments and identity of air monitoring personnel.
- Field observations - Appearance of sampled media (if definable).
- Additional remarks (e.g, Multi RAE had wide range fluctuations during air monitoring activities.)

VI. References

Multi RAE User's Guide, RAE Systems, Revision C, May 2013.

Groundwater Sampling for Per- and Polyfluoroalkyl Substances (PFAS)

I. Purpose and Scope

This SOP provides guidelines for groundwater sample collection for samples that will be analyzed for per- and polyfluoroalklyl substances (PFAS) via LC/MS/MS Compliant with the most recent version of the Quality Systems Manual (QSM) for which the lab is certified. This SOP should be used in conjunction with approved region-specific groundwater sampling SOPs which provide methods for general and low-flow groundwater sampling. In cases in which information in this SOP conflicts with region-specific groundwater sampling SOPs, this SOP will supersede the information in the general SOPs.

Standard techniques for collecting representative samples are summarized. These procedures are specific to the Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program. Materials, equipment, and procedures may vary; refer to the Sampling and Analysis Plan and operator’s manuals for specific details.

II. Equipment and Materials

A. Equipment and Materials Required

- If installing wells, ensure driller does not use polytetrafluoroethylene (PFTE)-containing drill lube or other drilling lubes containing PFAS. Biolube has been determined to be an acceptable drilling lube for installing wells where PFAS may be of concern. Additionally, Waterra surge blocks have been confirmed to not contain PFAS and may be used for development.
- Groundwater sampling equipment
  - PFAS-free tubing (avoid Teflon, Viton, PTFE and other fluorinated compounds)
    - High density polyethylene tubing (unlined)
    - If Masterflex tubing is needed for peristaltic pumps, Cole Parmer C-Flex (06424 series) and Tygon E-3603 (06509 series) are suitable options
  - PFAS-free Bailer (if using a bailer[1])

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[1] Geotech and Waterra offer PFAS free bailer options

  - PFAS-free Pump such as:
    - Geotech PFAS-free Portable Bladder Pump (note, most bladder pumps include a Teflon-lined bladder, but Geotech currently has one model which is Teflon-free).
    - Panacea P120 or P125. The P200 Stainless Steel Pump may also be used, but the standard model contains Teflon at the tube connection. If you are using this Panacea model, you must request one with the “PTFE-free thread sealant option.”
    - Waterra stainless foot-valve
    - QED Sample Pro
    - Monsoon or Mega Monsoon submersible pump
    - Grundfos Rediflo2 (this pump contains small Teflon components, but has not been shown to leach, it is less preferable than the other options)
    - Peristaltic pump (may be suitable for shallow locations)
- Groundwater sample containers (high density polyethylene [HDPE] bottle with HDPE screwcap), sample bottles should not be glass as glass may sorb PFAS. Sample bottle caps should not contain Teflon. Notify your project manager (PM) if bottles provided by the lab are glass or contain Teflon parts.
- Laboratory prepared deionized, certified PFAS-free water for field blank collection
- PFAS-free shipping supplies (labels [if available][2], coolers, and ice)
- Loose leaf paper without waterproof coating or a spiralbound notebook (not waterproof) or tablet (see tablet use notes below)
- Metal clip board (if using loose-leaf paper)
- Pen (not Sharpie)
- Nitrile or latex gloves

B. Equipment and Materials to Avoid During Sampling

Equipment and materials used to collect groundwater samples should not contain any fluorinated compounds, Teflon, or synthetic rubber with fluoropolymer elastomers (e.g., Viton).

Specifically, the following material should be avoided during sampling:

- Gore-Tex brand or similar high-performance outdoor clothing, clothing treated with ScotchGuard brand or similar water repellent, fluoropolymer-coated Tyvek, wrinkle-resistant fabrics, and fire-resistant clothing with fluorochemical treatment or anything advertised as water repellant.
- Weather-proof log books with fluorochemical coatings.
- New clothing that has been washed fewer than six times.

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[2] Efforts will be made to obtain PFAS-free labels; however, information on labels is scarce and labels are frequently mounted on PFAS-coated paper to allow for easy removal.

The sample collection area should be clear of the following items:

- Pre-packaged food wrappers (e.g., fast food sandwich wrappers, pizza boxes, etc.)
- Microwave popcorn bags
- Blue ice containers
- Non-Stick aluminum foil
- Kim-Wipes
- Sunscreen, insect repellant and other personal hygiene products that may contain PFAS

Research which has not yet been published has allowed us to generate a list of sunscreens and insect repellents which do not contain fluorine. Check with Bill Diguiseppi or Laura Cook on recommendations (because the research is not ours, it cannot be released externally at this time).

The use of electronics (e.g., cell phones and tablets) should be avoided without the implementation of precautionary measures outlined below:

- All devices should be used with clean, ungloved hands and an approved stylus (if desired).

Following the use of a device, hands must be washed with soap and water and clean gloves should be used prior to contact with sampling equipment (bottleware, tubing, etc.).

III. Procedures and Guidelines

Wash hands with dish detergent before sampling and don nitrile gloves. Do not use Kleen Guard powder free nitrile gloves which were shown in research to contain fluorine

Follow Navy CLEAN SOPs for low-flow or conventional groundwater sample collection, depending on site requirements.

A. Sample Collection

Once water quality parameters have stabilized for low-flow purging, samples can be collected. For conventional purging, if water quality parameters do not stabilize, a minimum of 3 well volumes must be purged prior to sample collection.

The steps to be followed for sample collection are as follows:

1. Ensure that the end of the tubing does not touch the ground or equipment. Remove the cap from the sample bottle. Position the sample bottle under the end of the tubing.
2. Fill the bottle. Do not fill the bottle past the middle of the bottle shoulder. Samples do not need to be collected headspace free.
3. Affix labels after bottles have been closed; collect only one sample at a time to avoid mislabeling. Pack the sample on ice immediately for shipment to the offsite laboratory. Avoid packing materials that may contain fluorine. Unpublished research has allowed us to generate a list of packing materials which do not contain fluorine. Please contact Bill Diguiseppi or Laura Cook for recommendations (because the research is not ours, it cannot be released externally at this time).

B. Equipment Decontamination

Whenever possible, use disposable equipment when collecting groundwater samples. If reusable equipment must be used, the equipment must be cleaned/decontaminated between uses. Alconox and Liquinox soap are acceptable for cleaning/decontaminating reusable equipment at PFAS sites. Any water used for cleaning/decontamination must be certified PFAS-free by a laboratory. Consider triple-rinsing. Once decontaminated, wrap equipment in plastic bags (such as Ziploc) or un-coated aluminum foil, and store away from potential PFAS sources.

Use of Water Quality Equipment and Water Level Indicators

Water quality meters typically do not contain PFAS. However, consistent with general sampling SOPs, disconnect the water quality meter prior to sampling. Some water level indicators do contain small polyvinylidene fluoride (a PFAS constituent for which we do not currently monitor) or less frequently, Teflon, components, but we have not noted cross contamination from water level indicators at any sites. The Durham Geoslope Water Level Indicators and the Solinst Model 101 with the P2 meter have been shown to be fluorine free.

IV. References

United States Environmental Protection Agency (USEPA), 2009. *Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/ Tandem Mass Spectrometry (LC/MS/MS).* September.

United States Navy, 2020. *Interim Per- and Polyfluoroalkyl Substances (PFAS) Site Guidance for NAVFAC Remedial Project Managers (RPMs)/November 2020 Update*. November.

United States Navy, 2015. *Navy Drinking Water Sampling Policy for Perfluorochemicals: Perfluorooctane Sulfonate and Perfluorooctanoic Acid.* September.

STANDARD OPERATING PROCEDURE
NAVY CLEAN PROGRAM

Surface Water Sampling for Per- and Polyfluoroalkyl Substances

I. Purpose and Scope

This SOP provides guidelines for surface water sample collection for samples that will be analyzed for per- and polyfluoroalklyl substances (PFAS) via LC/MS/MS Compliant with the most recent version of the Quality Systems Manual (QSM) for which the lab is certified at the time of analysis. Standard techniques for collecting representative samples are summarized. These procedures are specific to the Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program. Materials, equipment, and procedures may vary; refer to the Sampling and Analysis Plan and operator's manuals for specific details.

II. Materials and Equipment

A. Equipment and Materials Required

- Open tube sampler
- Dip sampler
- Weighted bottle sampler (no glass)
- Hand pump without Teflon components
- Van Dorn sampler (Kemmerer cannot be used as it has Teflon caps)
- Depth-integrating sampler
- Peristaltic pump and PFAS-free tubing
- High density polyethylene tubing (unlined)
- Masterflex tubing such as Cole Parmer C-Flex (06424 series) and Tygon E-3603 (06509 series) are suitable options
- Sample containers (high density polyethylene [HDPE] with HDPE screw cap [no Teflon caps])
- PFAS-free labels (if available[1]) and shipping materials
- Loose leaf paper or a wire-bound notebook without waterproof coating or tablet (see notes about tablet use below)

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[1] Efforts will be made to obtain PFAS-free labels; however, information on labels is scarce and labels are frequently mounted on PFAS-coated paper to allow for easy removal.

- Metal clipboard (if using loose leaf paper)
- Pen (not Sharpie)
- Nitrile or Latex gloves (Do not use Kleen Guard powder free nitrile gloves which were shown in research to contain fluorine)
- Meters for specific conductance, temperature, pH, and dissolved oxygen

Equipment and materials used to collect surface water samples should not contain any fluorinated compounds including Teflon or synthetic rubber with fluoropolymer elastomers (e.g. Viton). Neoprene and rubber waders should not be an issue, however, check with your PFAS subject matter expert (SME) during field preparation to ensure all equipment is free of fluorine-containing components.

B. Equipment and Materials to Avoid During Sampling

Equipment and materials used to collect groundwater samples should not contain any fluorinated compounds, Teflon, or synthetic rubber with fluoropolymer elastomers (e.g., Viton).

Specifically, the following material should be avoided during sampling:

- Gore-Tex brand or similar high-performance outdoor clothing, clothing treated with ScotchGuard brand or similar water repellent, fluoropolymer-coated Tyvek, wrinkle-resistant fabrics, and fire-resistant clothing with fluorochemical treatment or anything advertised as water repellant.
- Weather-proof log books with fluorochemical coatings.
- New clothing that has been washed fewer than six times.

The sample collection area should be clear of the following items:

- Pre-packaged food wrappers (e.g., fast food sandwich wrappers, pizza boxes, etc.)
- Microwave popcorn bags
- Blue ice containers
- Non-stick aluminum foil
- Kim-Wipes
- Sunscreen, insect repellant and other personal hygiene products that may contain PFAS

Contact your PFAS SME for an approved list of sunscreens and insect repellants.

The use of electronics (e.g., cell phones and tablets) should be avoided without the implementation of precautionary measures outlined below:

  - All devices should be used with clean, ungloved hands and an approved stylus (if desired).

Following the use of a device, hands must be washed with soap and water and clean gloves should be used prior to contact with sampling equipment (bottleware, tubing, etc.).

III. Procedures and Guidelines

Wash hands with dish detergent before sampling and don nitrile gloves. Do not use Kleen Guard powder free nitrile gloves which were shown in research to contain fluorine.

Before surface water samples are taken, all sampler assemblies and sample containers are cleaned and decontaminated as described in SOP *Decontamination of Personnel and Equipment* as well as this SOP (see below). Surface water samples collected from water bodies tidally influenced should be collected at low tide and under low flow conditions to minimize the dilution of potential contaminants. Once the area has been determined to be free of materials potentially containing PFAS, follow the methods for surface water sample collection described below.

Surface water samples are collected manually by submerging a clean stainless steel or polypropylene container into the water body. Samples may be collected at depth with a covered bottle that can be removed with a tripline provided the bottle or bottle cap does not contain Teflon. The most common sampler types are sealable bottles, pond samplers, peristaltic pumps, and weighted bottle samplers. Pond samplers have a fixed or telescoping pole attached to the sample container. Weighted bottle samplers are lowered below water surface, where the attached bottle is opened, allowed to fill, and pulled out of the water. When retrieved, the bottle is tightly capped and removed from the sampler assembly. A specific type of weighted bottle sampler is the Van Dorn and is acceptable in most instances. The Kemmerer weighted bottle sampler cannot be used for PFAS sampling due to the Teflon caps.

A sample is taken with the following specific steps:

1. The location and desired depth for water sampling are selected.
2. The sample site is approached from downstream in a manner that avoids disturbance of bottom sediments as much as possible. The sample bottle is gently submerged with the mouth pointed upstream and the bottle tilted slightly downstream. Bubbles and floating materials should be prevented from entering the bottle. If using a Peristaltic pump, lower the tubing into the water to the desired depth.
3. For weighted bottle samplers, the assembly is slowly lowered to the desired depth. The bottle stopper is unseated with a sharp tug and the bottle is allowed to fill until bubbles stop rising to the surface.
4. When the bottle is full, it is gently removed from the water. If sample transfer is required, it should be performed at this time. Fill all sample containers to the middle of the bottle shoulder. Do not fill bottles completely. Affix labels after sample containers are closed; collect only one sample at a time to avoid mislabeling.
5. Measure dissolved oxygen, specific conductance, temperature, and pH at the sampling location.

A. Equipment Decontamination

Whenever possible, use disposable equipment when collecting surface water samples. If reusable equipment must be used, the equipment must be cleaned/decontaminated between uses. Alconox and Liquinox soap are acceptable for cleaning/decontaminating reusable equipment at PFAS sites. Any water used for cleaning/decontamination must be certified PFAS-free by a laboratory. Consider triple-rinsing. Once decontaminated, wrap equipment in plastic bags (such as Ziploc) or un-coated aluminum foil, and store away from potential PFAS sources.

Use of Water Quality Equipment

Water quality meters typically do not contain PFAS. However, consistent with general sampling SOPs, disconnect the water quality meter prior to sampling.

IV. References

United States Environmental Protection Agency (USEPA), 2009. *Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS).* September.

United States Navy, 2015. *Navy Drinking Water Sampling Policy for Perfluorochemicals: Perfluorooctane Sulfonate and Perfluorooctanoic Acid.* September.

Sediment Sampling for Per- and Polyfluoroalkyl Substances

I. Purpose and Scope

This SOP provides guidelines for sediment sample collection and handling for samples that will be analyzed for per- and polyfluoroalklyl substances (PFAS) via LC/MS/MS Compliant with the most recent version of the Quality Systems Manual (QSM) for which the lab is certified at the time of analysis. Standard techniques for collecting representative samples are summarized. These procedures are specific to the Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program. Materials, equipment, and procedures may vary; refer to the Sampling and Analysis Plan and operator's manuals for specific details.

II. Equipment and Materials

A. Equipment and Materials Required

- Sample collection device (hand corer, scoop, dredge, grab sampler, or other suitable device). Check with your PFAS subject matter expert (SME) during field preparation to ensure all equipment is free of fluorine-containing components.
- Stainless steel spoon or spatula or fluorine-free plastic disposable scoop for media transfer
- Measuring tape
- GPS Unit
- PFAS-free labels (if available[1]) shipping materials
- Loose leaf paper or a wire-bound notebook without waterproof coating
- Metal clipboard (if using loose-leaf paper)
- Pen (not Sharpie)
- Personal protection equipment (rubber or latex gloves, boots, hip waders, etc.). Check with your SME prior to selecting PPE to ensure there are no fluorine-containing components.
- Materials for classifying soils, particularly the percentage of fines
- Sample jars (high density polyethylene [HDPE] with HDPE screw cap [no Teflon caps])
- Laboratory prepared deionized, certified PFAS-free water for field blank collection

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[1] Efforts will be made to obtain PFAS-free labels; however, information on labels is scarce and labels are frequently mounted on PFAS-coated paper to allow for easy removal.

B. Equipment and Materials to Avoid During Sampling

Equipment and materials used to collect soil samples should not contain any fluorinated compounds including Teflon or synthetic rubber with fluoropolymer elastomers (e.g. Viton).

Specifically, the following material should be avoided during sampling:

- Gore-Tex brand or similar high-performance outdoor clothing, clothing treated with ScotchGuard brand or similar water repellent, fluoropolymer-coated Tyvek, wrinkle-resistant fabrics, and fire-resistant clothing with fluorochemical treatment or anything advertised as water repellant.
- Weather-proof log books with fluorochemical coatings.
- New clothing that has been washed fewer than six times.

The sample collection area should be clear of the following items:

- Pre-packaged food wrappers (e.g., fast food sandwich wrappers, pizza boxes, etc.)
- Microwave popcorn bags
- Blue ice containers
- Non-Stick aluminum foil
- Kim-Wipes
- Sunscreen, insect repellant and other personal hygiene products that may contain PFAS

Contact your PFAS SME for an approved list of sunscreens and insect repellants.

The use of electronics (e.g., cell phones and tablets) should be avoided without the implementation of precautionary measures outlined below:

  - All devices should be used with clean, ungloved hands and an approved stylus (if desired).

Following the use of a device, hands must be washed with soap and water and clean gloves should be used prior to contact with sampling equipment (bottleware, tubing, etc.).

III. Procedures and Guidelines

Wash hands with dish detergent before sampling and don nitrile gloves. Do not use Kleen Guard powder free nitrile gloves which were shown in research to contain fluorine.

Once the area has been determined to be free of materials potentially containing PFAS, these steps can be followed to collect the sediment samples:

1. Field personnel will start downstream and work upstream to prevent contamination of unsampled areas. In surface water bodies that are tidally influenced, sampling will be performed at low tide and under low flow conditions to minimize the dilution of possible contaminants. Sediment sampling activities will not occur immediately after periods of heavy rainfall.
2. Make a sketch of the sample area that shows important nearby river features and permanent structures that can be used to locate the sample points on a map. Whenever possible, include measured distances from such identifying features. Also include depth and width of waterway, rate of flow, type and consistency of sediment, and point and depth of sample removal (along shore, mid-channel, etc.).
3. Note in the field book any possible outside sources of contamination; for example, the outlet to a drainage culvert in the water body near your sampling location.

4. Transfer sample into appropriate sample jars with a stainless steel utensil or plastic disposable scoop confirmed to be fluorine-free. Be especially careful to avoid the loss of the very fine clay/silt particles when collecting the sample. The fine particles have a higher adsorption capacity than larger particles. Minimize the amount of water that is collected within the sample matrix. Decant the water off the sample slowly and carefully to maximize retention of the very fine particles. The sampler's fingers should never touch the sediment. Classify the soil type of the sample using the Unified Soil Classification System, noting particularly the percentage of silt and clay. Affix the sample label to the container after the container has been closed; collect only one sample at a time to avoid mislabeling.
5. Rocks and other debris should be removed before placement in jars.
6. For channel sampling, be on the alert for submerged hazards (rocks, tree roots, drop-offs, loess silt and muck) which can make wading difficult.
7. Immediately upon collection, all samples are to be placed in a closed container on ice. Although unusual and uncommon, there may be instances where it is not possible to have containers with ice at the sample location. In these instances, the samples should be placed on ice as soon as practical and during the time between collection and placing the samples on ice, the samples should be kept as cool as possible.
8. Equipment Decontamination
    - Whenever possible, use disposable equipment when collecting sediment samples. If reusable equipment must be used, the equipment must be cleaned/decontaminated between uses. Alconox and Liquinox soap are acceptable for cleaning/decontaminating reusable equipment at PFAS sites. Any water used for cleaning/decontamination must be certified PFAS-free by a laboratory. Consider triple-rinsing. Once decontaminated, wrap equipment in plastic bags (such as Ziploc) or un-coated aluminum foil, and store away from potential PFAS sources.

IV. References

United States Environmental Protection Agency (USEPA), 2009. *Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS).* September.

United States Navy, 2015. *Navy Drinking Water Sampling Policy for Perfluorochemicals: Perfluorooctane Sulfonate and Perfluorooctanoic Acid.* September.

Appendix C

Department of Defense Environmental Laboratory Accreditation Program Accreditation Letter

PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc.
has assessed the Organization of:

Battelle
141 Longwater Drive, Suite 202, Norwell, MA 02061

(Hereinafter called the Organization) and hereby declares that Organization has met the requirements of ISO/IEC 17025:2017 General Requirements for the competence of Testing and Calibration Laboratories and the United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP) requirements identified within the DoD/DOE Quality Systems Manual (DoD/DOE QSM) Version 5.4 October 2021 and is accredited in accordance with the:

United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP)

This accreditation demonstrates the technical competence for the defined scope and the operation of a laboratory quality management system (as outlined by the joint ISO-ILAC-IAF Communiqué dated April 2017):

Environmental Testing

(As detailed in the supplement)

Accreditation claims for such activities shall only be made from the addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation Body's duty to observe and comply with the said rules.

Initial Accreditation Date:	*Issue Date:*	*Expiration Date*
November 17, 2016	February 22, 2021	March 31, 2023

Revision Date:
October 31, 2022

For PJLA

Tracy Szerszen
President

Accreditation No:	*Certificate No:*
91667	L21-123-R2

Perry Johnson Laboratory
Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: **www.pjlabs.com**

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
Draft EPA Method 1633 by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	10123429
Aqueous	
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	9490
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA, 3-Perfluoroheptyl Propanoic Acid)	9340
2H,2H,3H,3H-Perfluorooctanoic Acid (5:3 FTCA)	9338
4,4,5,5,6,6,6-Heptafluorohexanoi Acid (3:3 FTCA, 3-Perfluoropropyl Propanoic Acid)	9353
4,8-dioxa-3H-perfluorononanoic Acid (ADONA)	6951
4:2 Fluorotelomersulfonic Acid (4:2FTS)	6946
6:2 Fluorotelomersulfonic Acid (6:2FTS)	6947
8:2 Fluorotelomersulfonic Acid (8:2FTS)	6948
9-Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid (9-Cl-PF3ONS)	6952
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	9460
N-ethyl perfluorooctanesulfonamide (EtFOSA)	9395
N-ethyl perfluorooctanesulfonamidoacetic Acid (EtFOSAA)	4847
N-ethyl perfluorooctanesulfonamidoethanol (EtFOSE)	9431
N-methyl perfluorooctanesulfonamide (MeFOSA)	9433
N-methyl perfluorooctanesulfonamidoacetic Acid (MeFOSAA)	4846
N-methyl perfluorooctanesulfonamidoethanol (MeFOSE)	6949
Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)	6956
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	6957
Perfluoro-3-Methoxypropanoic Acid (PFMPA)	6965
Perfluoro-4-Methoxybutanoic Acid (PFMBA)	6966
Perfluorobutanesulfonic Acid (PFBS)	6918
Perfluorobutanoic Acid (PFBA)	6915
Perfluorodecanesulfonic Acid (PFDS)	6920
Perfluorodecanoic Acid (PFDA)	6905
Perfluorododecanesulfonic Acid (PFDoS)	6923
Perfluorododecanoic Acid (PFDoA)	6903
Perfluoroheptanesulfonic Acid (PFHpS)	9470
Perfluoroheptanoic Acid (PFHpA)	6908
Perfluorohexanesulfonic Acid (PFHxS)	6927
Perfluorohexanoic Acid (PFHxA)	6913
Perfluorononanesulfonic Acid (PFNS)	6929
Perfluorononanoic Acid (PFNA)	6906
Perfluorooctanesulfonamide (PFOSA)	6917
Perfluorooctanesulfonic Acid (PFOS)	6931
Perfluorooctanoic Acid (PFOA)	6912
Perfluoropentanesulfonic Acid (PFPeS)	6934

Certificate of Accreditation: Supplement

Battelle
141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn   Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
Draft EPA Method 1633 by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	10123429
Aqueous	
Perfluoropentanoic Acid (PFPeA)	6914
Perfluorotetradecanoic Acid (PFTeDA)	6902
Perfluorotridecanoic Acid (PFTrDA)	9563
Perfluoroundecanoic Acid (PFUnA)	6904
Solid	
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	9490
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA, 3-Perfluoroheptyl Propanoic Acid)	9340
2H,2H,3H,3H-Perfluorooctanoic Acid (5:3 FTCA)	9338
4,4,5,5,6,6,6-Heptafluorohexanoi Acid (3:3 FTCA, 3-Perfluoropropyl Propanoic Acid)	9353
4,8-dioxa-3H-perfluorononanoic Acid (ADONA)	6951
4:2 Fluorotelomersulfonic Acid (4:2FTS)	6946
6:2 Fluorotelomersulfonic Acid (6:2FTS)	6947
8:2 Fluorotelomersulfonic Acid (8:2FTS)	6948
9-Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid (9-Cl-PF3ONS)	6952
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	9460
N-ethyl perfluorooctanesulfonamide (EtFOSA)	9395
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Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)	6956
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	6957
Perfluoro-3-Methoxypropanoic Acid (PFMPA)	6965
Perfluoro-4-Methoxybutanoic Acid (PFMBA)	6966
Perfluorobutanesulfonic Acid (PFBS)	6918
Perfluorobutanoic Acid (PFBA)	6915
Perfluorodecanesulfonic Acid (PFDS)	6920
Perfluorodecanoic Acid (PFDA)	6905
Perfluorododecanesulfonic Acid (PFDoS)	6923
Perfluorododecanoic Acid (PFDoA)	6903
Perfluoroheptanesulfonic Acid (PFHpS)	9470
Perfluoroheptanoic Acid (PFHpA)	6908
Perfluorohexanesulfonic Acid (PFHxS)	6927
Perfluorohexanoic Acid (PFHxA)	6913
Perfluorononanesulfonic Acid (PFNS)	6929

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
Draft EPA Method 1633 by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	10123429
Solid	
Perfluorononanoic Acid (PFNA)	6906
Perfluorooctanesulfonamide (PFOSA)	6917
Perfluorooctanesulfonic Acid (PFOS)	6931
Perfluorooctanoic Acid (PFOA)	6912
Perfluoropentanesulfonic Acid (PFPeS)	6934
Perfluoropentanoic Acid (PFPeA)	6914
Perfluorotetradecanoic Acid (PFTeDA)	6902
Perfluorotridecanoic Acid (PFTrDA)	9563
Perfluoroundecanoic Acid (PFUnA)	6904
Tissue	
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	9490
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA, 3-Perfluoroheptyl Propanoic Acid)	9340
2H,2H,3H,3H-Perfluorooctanoic Acid (5:3 FTCA)	9338
4,4,5,5,6,6,6-Heptafluorohexanoi Acid (3:3 FTCA, 3-Perfluoropropyl Propanoic Acid)	9353
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6:2 Fluorotelomersulfonic Acid (6:2FTS)	6947
8:2 Fluorotelomersulfonic Acid (8:2FTS)	6948
9-Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid (9-Cl-PF3ONS)	6952
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	9460
N-ethyl perfluorooctanesulfonamide (EtFOSA)	9395
N-ethyl perfluorooctanesulfonamidoacetic Acid (EtFOSAA)	4847
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N-methyl perfluorooctanesulfonamidoacetic Acid (MeFOSAA)	4846
N-methyl perfluorooctanesulfonamidoethanol (MeFOSE)	6949
Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)	6956
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	6957
Perfluoro-3-Methoxypropanoic Acid (PFMPA)	6965
Perfluoro-4-Methoxybutanoic Acid (PFMBA)	6966
Perfluorobutanesulfonic Acid (PFBS)	6918
Perfluorobutanoic Acid (PFBA)	6915
Perfluorodecanesulfonic Acid (PFDS)	6920
Perfluorodecanoic Acid (PFDA)	6905
Perfluorododecanesulfonic Acid (PFDoS)	6923
Perfluorododecanoic Acid (PFDoA)	6903

Certificate of Accreditation: Supplement

Battelle
141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
Draft EPA Method 1633 by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	10123429
Tissue	
Perfluoroheptanesulfonic Acid (PFHpS)	9470
Perfluoroheptanoic Acid (PFHpA)	6908
Perfluorohexanesulfonic Acid (PFHxS)	6927
Perfluorohexanoic Acid (PFHxA)	6913
Perfluorononanesulfonic Acid (PFNS)	6929
Perfluorononanoic Acid (PFNA)	6906
Perfluorooctanesulfonamide (PFOSA)	6917
Perfluorooctanesulfonic Acid (PFOS)	6931
Perfluorooctanoic Acid (PFOA)	6912
Perfluoropentanesulfonic Acid (PFPeS)	6934
Perfluoropentanoic Acid (PFPeA)	6914
Perfluorotetradecanoic Acid (PFTeDA)	6902
Perfluorotridecanoic Acid (PFTrDA)	9563
Perfluoroundecanoic Acid (PFUnA)	6904
EPA 533 by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	10091619
Drinking Water	
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	9490
1H, 1H, 2H, 2H-Perfluorodecane Sulfonic Acid (8:2 FTS)	6948
1H, 1H, 2H, 2H-Perfluorohexane Sulfonic Acid (4:2 FTS)	6946
1H, 1H, 2H, 2H-Perfluorooctane Sulfonic Acid (6:2 FTS)	6947
9-Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid (9-Cl-PF3ONS)	6952
Ammonium 4,8-Dioxa-3H-Perfluorononanoate (ADONA)	6953
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA) – GenX	9460
Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)	6956
Perfluoro(2-Ethoxyethane)Sulfonic Acid (PFEESA)	6957
Perfluoro-3-Methoxypropanoic Acid (PFMPA)	6965
Perfluoro-4-Methoxybutanoic Acid (PFMBA)	6966
Perfluorobutanesulfonic Acid (PFBS)	6918
Perfluorobutanoic Acid (PFBA)	6915
Perfluorodecanoic Acid (PFDA)	6905
Perfluorododecanoic Acid (PFDoA)	6903
Perfluoroheptanesulfonic Acid (PFHpS)	9470
Perfluoroheptanoic Acid (PFHpA)	6908
Perfluorohexanesulfonic Acid (PFHxS)	6927
Perfluorohexanoic Acid (PFHxA)	6913
Perfluorononanoic Acid (PFNA)	6906

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 533 by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	10091619
Drinking Water	
Perfluorooctanesulfonic Acid (PFOS)	6931
Perfluorooctanoic Acid (PFOA)	6912
Perfluoropentanesulfonic Acid (PFPeS)	6934
Perfluoropentanoic Acid (PFPeA)	6914
Perfluoroundecanoic Acid (PFUnA)	6904
EPA 537.1.1 by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	10091642
Drinking Water	
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	9490
9-Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid (9-Cl-PF3ONS)	6952
Ammonium 4,8-Dioxa-3H-Perfluorononanoate (ADONA)	6953
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA) – GenX	9460
N-Ethylperfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	4846
N-Methylperfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	4847
Perfluorobutanesulfonic Acid (PFBS)	6918
Perfluorodecanoic Acid (PFDA)	6905
Perfluorododecanoic Acid (PFDoA)	6903
Perfluoroheptanoic Acid (PFHpA)	6908
Perfluorohexanesulfonic Acid (PFHxS)	6927
Perfluorohexanoic Acid (PFHxA)	6913
Perfluorononanoic Acid (PFNA)	6906
Perfluorooctanesulfonic Acid (PFOS)	6931
Perfluorooctanoic Acid (PFOA)	6912
Perfluorotetradecanoic Acid (PFTeDA)	6902
Perfluorotridecanoic Acid (PFTrDA)	9563
Perfluoroundecanoic Acid (PFUnA)	6904
EPA 8081 MOD (Battelle SOP 5-128) by Gas Chromatography Electron Capture Detector (GC/ECD)	10178402
Aqueous	
2,4'-DDD	8580
2,4'-DDE	8585
2,4'-DDT	8590
4,4'-DDD	7355
4,4'-DDE	7360
4,4'-DDT	7365
Aldrin	7025
alpha-BHC (a-BHC, alpha-Hexachlorocyclohexane)	7110
alpha-Chlordane (cis-Chlordane)	7240

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Battelle

141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn   Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8081 MOD (Battelle SOP 5-128) by Gas Chromatography Electron Capture Detector (GC/ECD)	10178402
Aqueous	
beta-BHC (b-BHC, beta-Hexachlorocyclohexane)	7115
Chlorpyrifos (Dursban)	7300
cis-Nonachlor	7925
delta-BHC (d-BHC)	7105
Dieldrin	7470
Endosulfan I	7510
Endosulfan II	7515
Endosulfan Sulfate	7520
Endrin	7540
Endrin Aldehyde	7530
Endrin Ketone	7535
gamma-BHC (γ-BHC, Lindane)	7120
gamma-Chlordane	7245
Heptachlor	7685
Heptachlor Epoxide	7690
Hexachlorobenzene	6275
Methoxychlor	7810
Mirex	7870
Oxychlordane	3890
PCB-101 (2,2’,4,5,5’-Pentachlorobiphenyl)	8980
PCB-105 (2,3,3',4,4'-Pentachlorobiphenyl)	8985
PCB-110 (2,3,3',4',6-Pentachlorobiphenyl)	8990
PCB-118 (2,3',4,4',5-Pentachlorobiphenyl)	8995
PCB-126 (3,3',4,4',5-Pentachlorobiphenyl)	9015
PCB-128 (2,2',3,3',4,4'-Hexachlorobiphenyl)	9020
PCB-129 (2,2',3,3',4,5-Hexachlorobiphenyl)	9118
PCB-138 (2,2',3,4,4',5'-Hexachlorobiphenyl)	9025
PCB-153 (2,2’,4,4’,5,5’-Hexachlorobiphenyl)	9040
PCB-169 (3,3',4,4',5,5'-Hexachlorobiphenyl)	9060
PCB-170 (2,2',3,3',4,4',5-Heptachlorobiphenyl)	9065
PCB-18 (2,2',5-Trichlorobiphenyl)	8930
PCB-180 (2,2',3,4,4',5,5'-Heptachlorobiphenyl)	9134
PCB-183 (2,2',3,4,4',5',6-Heptachlorobiphenyl)	9075
PCB-184 (2,2',3,4,4',6,6'-Heptachlorobiphenyl)	9139
PCB-187 (2,2',3,4',5,5',6-Heptachlorobiphenyl)	9080
PCB-195 (2,2',3,3',4,4',5,6-Octachlorobiphenyl)	9103

Certificate of Accreditation: Supplement

Battelle
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Contact Name: Jonathan Thorn Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8081 MOD (Battelle SOP 5-128) by Gas Chromatography Electron Capture Detector (GC/ECD)	10178402
Aqueous	
PCB-206 (2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl)	9095
PCB-209 (2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl)	9105
PCB-28 (2,4,4’-Trichlorobiphenyl)	9252
PCB-44 (2,2',3,5'-Tetrachlorobiphenyl)	8945
PCB-49 (2,2',4,5'-Tetrachlorobiphenyl)	8950
PCB-52 (2,2',5,5'-Tetrachlorobiphenyl)	8955
PCB-66 (2,3',4,4'-Tetrachlorobiphenyl)	8960
PCB-77 (3,3',4,4'-Tetrachlorobiphenyl)	8965
PCB-8 (2,4’-Dichlorobiphenyl)	9256
PCB-87 (2,2',3,4,5'-Pentachlorobiphenyl)	8975
trans-Nonachlor	7910
Solid	
2,4'-DDD	8580
2,4'-DDE	8585
2,4'-DDT	8590
4,4'-DDD	7355
4,4'-DDE	7360
4,4'-DDT	7365
Aldrin	7025
alpha-BHC (a-BHC, alpha-Hexachlorocyclohexane)	7110
alpha-Chlordane (cis-Chlordane)	7240
beta-BHC (b-BHC, beta-Hexachlorocyclohexane)	7115
Chlorpyrifos (Dursban)	7300
cis-Nonachlor	7925
delta-BHC (d-BHC)	7105
Dieldrin	7470
Endosulfan I	7510
Endosulfan II	7515
Endosulfan Sulfate	7520
Endrin	7540
Endrin Aldehyde	7530
Endrin Ketone	7535
gamma-BHC (γ-BHC, Lindane)	7120
gamma-Chlordane	7245
Heptachlor	7685
Heptachlor Epoxide	7690

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Battelle
141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn   Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8081 MOD (Battelle SOP 5-128) by Gas Chromatography Electron Capture Detector (GC/ECD)	10178402
Solid	
Hexachlorobenzene	6275
Methoxychlor	7810
Mirex	7870
Oxychlordane	3890
PCB-101 (2,2’,4,5,5’-Pentachlorobiphenyl)	8980
PCB-105 (2,3,3',4,4'-Pentachlorobiphenyl)	8985
PCB-110 (2,3,3',4',6-Pentachlorobiphenyl)	8990
PCB-118 (2,3',4,4',5-Pentachlorobiphenyl)	8995
PCB-126 (3,3',4,4',5-Pentachlorobiphenyl)	9015
PCB-128 (2,2',3,3',4,4'-Hexachlorobiphenyl)	9020
PCB-129 (2,2',3,3',4,5-Hexachlorobiphenyl)	9118
PCB-138 (2,2',3,4,4',5'-Hexachlorobiphenyl)	9025
PCB-153 (2,2’,4,4’,5,5’-Hexachlorobiphenyl)	9040
PCB-169 (3,3',4,4',5,5'-Hexachlorobiphenyl)	9060
PCB-170 (2,2',3,3',4,4',5-Heptachlorobiphenyl)	9065
PCB-18 (2,2',5-Trichlorobiphenyl)	8930
PCB-180 (2,2',3,4,4',5,5'-Heptachlorobiphenyl)	9134
PCB-183 (2,2',3,4,4',5',6-Heptachlorobiphenyl)	9075
PCB-184 (2,2',3,4,4',6,6'-Heptachlorobiphenyl)	9139
PCB-187 (2,2',3,4',5,5',6-Heptachlorobiphenyl)	9080
PCB-195 (2,2',3,3',4,4',5,6-Octachlorobiphenyl)	9103
PCB-206 (2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl)	9095
PCB-209 (2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl)	9105
PCB-28 (2,4,4’-Trichlorobiphenyl)	9252
PCB-44 (2,2',3,5'-Tetrachlorobiphenyl)	8945
PCB-49 (2,2',4,5'-Tetrachlorobiphenyl)	8950
PCB-52 (2,2',5,5'-Tetrachlorobiphenyl)	8955
PCB-66 (2,3',4,4'-Tetrachlorobiphenyl)	8960
PCB-77 (3,3',4,4'-Tetrachlorobiphenyl)	8965
PCB-8 (2,4’-Dichlorobiphenyl)	9256
PCB-87 (2,2',3,4,5'-Pentachlorobiphenyl)	8975
trans-Nonachlor	7910
Tissue	
2,4'-DDD	8580
2,4'-DDE	8585
2,4'-DDT	8590

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141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn   Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8081 MOD (Battelle SOP 5-128) by Gas Chromatography Electron Capture Detector (GC/ECD)	10178402
Tissue	
4,4'-DDD	7355
4,4'-DDE	7360
4,4'-DDT	7365
Aldrin	7025
alpha-BHC (a-BHC, alpha-Hexachlorocyclohexane)	7110
alpha-Chlordane (cis-Chlordane)	7240
beta-BHC (b-BHC, beta-Hexachlorocyclohexane)	7115
Chlorpyrifos (Dursban)	7300
cis-Nonachlor	7925
delta-BHC (d-BHC)	7105
Dieldrin	7470
Endosulfan I	7510
Endosulfan II	7515
Endosulfan Sulfate	7520
Endrin	7540
Endrin Aldehyde	7530
Endrin Ketone	7535
gamma-BHC (γ-BHC, Lindane)	7120
gamma-Chlordane	7245
Heptachlor	7685
Heptachlor Epoxide	7690
Hexachlorobenzene	6275
Methoxychlor	7810
Mirex	7870
Oxychlordane	3890
PCB-101 (2,2’,4,5,5’-Pentachlorobiphenyl)	8980
PCB-105 (2,3,3',4,4'-Pentachlorobiphenyl)	8985
PCB-110 (2,3,3',4',6-Pentachlorobiphenyl)	8990
PCB-118 (2,3',4,4',5-Pentachlorobiphenyl)	8995
PCB-126 (3,3',4,4',5-Pentachlorobiphenyl)	9015
PCB-128 (2,2',3,3',4,4'-Hexachlorobiphenyl)	9020
PCB-129 (2,2',3,3',4,5-Hexachlorobiphenyl)	9118
PCB-138 (2,2',3,4,4',5'-Hexachlorobiphenyl)	9025
PCB-153 (2,2’,4,4’,5,5’-Hexachlorobiphenyl)	9040
PCB-169 (3,3',4,4',5,5'-Hexachlorobiphenyl)	9060
PCB-170 (2,2',3,3',4,4',5-Heptachlorobiphenyl)	9065

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Battelle
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Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8081 MOD (Battelle SOP 5-128) by Gas Chromatography Electron Capture Detector (GC/ECD)	10178402
Tissue	
PCB-18 (2,2',5-Trichlorobiphenyl)	8930
PCB-180 (2,2',3,4,4',5,5'-Heptachlorobiphenyl)	9134
PCB-183 (2,2',3,4,4',5',6-Heptachlorobiphenyl)	9075
PCB-184 (2,2',3,4,4',6,6'-Heptachlorobiphenyl)	9139
PCB-187 (2,2',3,4',5,5',6-Heptachlorobiphenyl)	9080
PCB-195 (2,2',3,3',4,4',5,6-Octachlorobiphenyl)	9103
PCB-206 (2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl)	9095
PCB-209 (2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl)	9105
PCB-28 (2,4,4’-Trichlorobiphenyl)	9252
PCB-44 (2,2',3,5'-Tetrachlorobiphenyl)	8945
PCB-49 (2,2',4,5'-Tetrachlorobiphenyl)	8950
PCB-52 (2,2',5,5'-Tetrachlorobiphenyl)	8955
PCB-66 (2,3',4,4'-Tetrachlorobiphenyl)	8960
PCB-77 (3,3',4,4'-Tetrachlorobiphenyl)	8965
PCB-8 (2,4’-Dichlorobiphenyl)	9256
PCB-87 (2,2',3,4,5'-Pentachlorobiphenyl)	8975
trans-Nonachlor	7910
EPA 8270E MOD (Battelle SOP 5-157) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Aqueous	
1,4-Dichlorobenzene	4620
1-Methylnaphthalene	6380
1-Methylphenanthrene	9501
2,3,5-Trimethylnaphthalene	6852
2,6-Dimethylnaphthalene	6188
2-Chloronaphthalene	5795
2-Methylnaphthalene	6385
2-Methylphenanthrene	4953
3,6-Dimethylphenanthrene	5957
Acenaphthene	5500
Acenaphthylene	5505
Anthracene	5555
Benzo(a)Anthracene	5575
Benzo(a)Pyrene	5580
Benzo(b)Fluoranthene	5585
Benzo(b)Thiophene	NC
Benzo(e)Pyrene	5605

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Battelle
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Contact Name: Jonathan Thorn Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-157) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Aqueous	
Benzo(g,h,i)Perylene	5590
Benzo(k)Fluoranthene	5600
Chrysene	5855
cis-Decalin	4621
Dibenz(a,h)Anthracene	5895
Dibenzofuran	5905
Dibenzothiophene	5910
Fluoranthene	6265
Fluorene	6270
Indeno(1,2,3,cd)Pyrene	6315
Naphthalene	5005
Perylene	6608
Phenanthrene	6615
Pyrene	6665
trans-Decalin	9587
Solid	
1,4-Dichlorobenzene	4620
1-Methylnaphthalene	6380
1-Methylphenanthrene	9501
2,3,5-Trimethylnaphthalene	6852
2,6-Dimethylnaphthalene	6188
2-Chloronaphthalene	5795
2-Methylnaphthalene	6385
2-Methylphenanthrene	4953
3,6-Dimethylphenanthrene	5957
Acenaphthene	5500
Acenaphthylene	5505
Anthracene	5555
Benzo(a)Anthracene	5575
Benzo(a)Pyrene	5580
Benzo(b)Fluoranthene	5585
Benzo(b)Thiophene	NC
Benzo(e)Pyrene	5605
Benzo(g,h,i)Perylene	5590
Benzo(k)Fluoranthene	5600
Chrysene	5855

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-157) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Solid	
cis-Decalin	4621
Dibenz(a,h)Anthracene	5895
Dibenzofuran	5905
Dibenzothiophene	5910
Fluoranthene	6265
Fluorene	6270
Indeno(1,2,3,cd)Pyrene	6315
Naphthalene	5005
Perylene	6608
Phenanthrene	6615
Pyrene	6665
trans-Decalin	9587
Tissue	
1,4-Dichlorobenzene	4620
1-Methylnaphthalene	6380
1-Methylphenanthrene	9501
2,3,5-Trimethylnaphthalene	6852
2,6-Dimethylnaphthalene	6188
2-Chloronaphthalene	5795
2-Methylphenanthrene	4953
3,6-Dimethylphenanthrene	5957
Acenaphthene	5500
Acenaphthylene	5505
Anthracene	5555
Benzo(a)Anthracene	5575
Benzo(a)Pyrene	5580
Benzo(b)Fluoranthene	5585
Benzo(b)Thiophene	NC
Benzo(e)Pyrene	5605
Benzo(g,h,i)Perylene	5590
Benzo(k)Fluoranthene	5600
Chrysene	5855
cis-Decalin	4621
Dibenz(a,h)Anthracene	5895
Dibenzofuran	5905
Dibenzothiophene	5910

Accreditation is granted to the facility to perform the following testing:	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-157) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Tissue	
Fluoranthene	6265
Fluorene	6270
Indeno(1,2,3,cd)Pyrene	6315
Naphthalene	5005
Perylene	6608
Phenanthrene	6615
Pyrene	6665
trans-Decalin	9587
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Aqueous	
2,4'-DDD	8580
2,4'-DDE	8585
2,4'-DDT	8590
4,4'-DDD	7355
4,4'-DDE	7360
4,4'-DDT	7365
Biphenyl	5640
PCB-1 (2-Chlorobiphenyl, 2-Monochlorobiphenyl)	8915
PCB-100 (2,2',4,4',6-Pentachlorobiphenyl)	9177
PCB-101 (2,2’,4,5,5’-Pentachlorobiphenyl)	8980
PCB-104 (2,2',4,6,6'-Pentachlorobiphenyl)	9182
PCB-105 (2,3,3',4,4'-Pentachlorobiphenyl)	8985
PCB-11 (3,3'-Dichlorobiphenyl)	8925
PCB-110 (2,3,3',4',6-Pentachlorobiphenyl)	8990
PCB-114 (2,3,4,4',5-Pentachlorobiphenyl)	9005
PCB-115 (2,3,4,4',6-Pentachlorobiphenyl)	9219
PCB-118 (2,3',4,4',5-Pentachlorobiphenyl)	8995
PCB-12 (3,4-Dichlorobiphenyl)	9270
PCB-123 (2,3',4,4',5'-Pentachlorobiphenyl)	9000
PCB-124 (2,3',4',5,5'-Pentachlorobiphenyl)	9222
PCB-125 (2,3',4',5',6-Pentachlorobiphenyl)	9224
PCB-126 (3,3',4,4',5-Pentachlorobiphenyl)	9015
PCB-127 (3,3',4,5,5'-Pentachlorobiphenyl)	9260
PCB-128 (2,2',3,3',4,4'-Hexachlorobiphenyl)	9020
PCB-13 (3,4'-Dichlorobiphenyl)	9269
PCB-130 (2,2',3,3',4,5'-Hexachlorobiphenyl)	9117

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Aqueous	
PCB-131 (2,2',3,3',4,6-Hexachlorobiphenyl)	9121
PCB-134 (2,2',3,3',5,6-Hexachlorobiphenyl)	9128
PCB-135 (2,2',3,3',5,6'-Hexachlorobiphenyl)	9127
PCB-136 (2,2',3,3',6,6'-Hexachlorobiphenyl)	9130
PCB-137 (2,2',3,4,4',5-Hexachlorobiphenyl)	9138
PCB-138 (2,2',3,4,4',5'-Hexachlorobiphenyl)	9025
PCB-139 (2,2',3,4,4',6-Hexachlorobiphenyl)	9141
PCB-140 (2,2',3,4,4',6'-Hexachlorobiphenyl)	9140
PCB-141 (2,2',3,4,5,5'-Hexachlorobiphenyl)	9030
PCB-144 (2,2',3,4,5',6-Hexachlorobiphenyl)	9150
PCB-146 (2,2',3,4',5,5'-Hexachlorobiphenyl)	9144
PCB-149 (2,2',3,4',5',6-Hexachlorobiphenyl)	9151
PCB-15 (4,4'-Dichlorobiphenyl)	9273
PCB-151 (2,2',3,5,5',6-Hexachlorobiphenyl)	9035
PCB-153 (2,2’,4,4’,5,5’-Hexachlorobiphenyl)	9040
PCB-154 (2,2',4,4',5,6'-Hexachlorobiphenyl)	9174
PCB-155 (2,2',4,4',6,6'-Hexachlorobiphenyl)	9176
PCB-156 (2,3,3',4,4',5-Hexachlorobiphenyl)	9050
PCB-157 (2,3,3’,4,4’,5’-Hexachlorobiphenyl)	9045
PCB-158 (2,3,3',4,4',6-Hexachlorobiphenyl)	9193
PCB-16 (2,2',3-Trichlorobiphenyl)	9173
PCB-163 (2,3,3',4',5,6-Hexachlorobiphenyl)	9199
PCB-164 (2,3,3',4',5',6-Hexachlorobiphenyl)	9201
PCB-166 (2,3,4,4',5,6-Hexachlorobiphenyl)	9217
PCB-167 (2,3',4,4',5,5'-Hexachlorobiphenyl)	9055
PCB-169 (3,3',4,4',5,5'-Hexachlorobiphenyl)	9060
PCB-17 (2,2',4-Trichlorobiphenyl)	9185
PCB-170 (2,2',3,3',4,4',5-Heptachlorobiphenyl)	9065
PCB-171 (2,2',3,3',4,4',6-Heptachlorobiphenyl)	9106
PCB-172 (2,2',3,3',4,5,5'-Heptachlorobiphenyl)	9110
PCB-173 (2,2',3,3',4,5,6-Heptachlorobiphenyl)	9113
PCB-174 (2,2',3,3',4,5,6'-Heptachlorobiphenyl)	9116
PCB-175 (2,2',3,3',4,5',6-Heptachlorobiphenyl)	9115
PCB-176 (2,2',3,3',4,6,6'-Heptachlorobiphenyl)	9119
PCB-177 (2,2',3,3',4,5',6'-Heptachlorobiphenyl)	9114
PCB-178 (2,2',3,3',5,5',6-Heptachlorobiphenyl)	9124

Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Aqueous	
PCB-179 (2,2',3,3',5,6,6'-Heptachlorobiphenyl)	9126
PCB-18 (2,2',5-Trichlorobiphenyl)	8930
PCB-180 (2,2',3,4,4',5,5'-Heptachlorobiphenyl)	9134
PCB-183 (2,2',3,4,4',5',6-Heptachlorobiphenyl)	9075
PCB-184 (2,2',3,4,4',6,6'-Heptachlorobiphenyl)	9139
PCB-185 (2,2',3,4,5,5',6-Heptachlorobiphenyl)	9143
PCB-187 (2,2',3,4',5,5',6-Heptachlorobiphenyl)	9080
PCB-188 (2,2',3,4',5,6,6'-Heptachlorobiphenyl)	9146
PCB-189 (2,3,3',4,4',5,5'-Heptachlorobiphenyl)	9085
PCB-19 (2,2',6-Trichlorobiphenyl)	9188
PCB-190 (2,3,3',4,4',5,6-Heptachlorobiphenyl)	9191
PCB-191 (2,3,3',4,4',5',6-Heptachlorobiphenyl)	9192
PCB-193 (2,3,3',4',5,5',6-Heptachlorobiphenyl)	9195
PCB-194 (2,2',3,3',4,4',5,5'-Octachlorobiphenyl)	9090
PCB-195 (2,2',3,3',4,4',5,6-Octachlorobiphenyl)	9103
PCB-197 (2,2',3,3',4,4',6,6'-Octachlorobiphenyl)	9104
PCB-198 (2,2',3,3',4,5,5',6-Octachlorobiphenyl)	9109
PCB-199 (2,2',3,3',4,5,5',6'-Octachlorobiphenyl)	9108
PCB-200 (2,2',3,3',4,5,6,6'-Octachlorobiphenyl)	9111
PCB-201 (2,2',3,3',4,5',6,6'-Octachlorobiphenyl)	9112
PCB-202 (2,2',3,3',5,5',6,6'-Octachlorobiphenyl)	9123
PCB-203 (2,2',3,4,4',5,5',6-Octachlorobiphenyl)	9133
PCB-205 (2,3,3',4,4',5,5',6-Octachlorobiphenyl)	9190
PCB-206 (2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl)	9095
PCB-207 (2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl)	9101
PCB-208 (2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl)	9107
PCB-209 (2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl)	9105
PCB-22 (2,3,4'-Trichlorobiphenyl)	9241
PCB-24 (2,3,6-Trichlorobiphenyl)	9247
PCB-25 (2,3',4-Trichlorobiphenyl)	9240
PCB-26 (2,3',5-Trichlorobiphenyl)	8935
PCB-27 (2,3',6-Trichlorobiphenyl)	9248
PCB-28 (2,4,4'-Trichlorobiphenyl)	9252
PCB-29 (2,4,5-Trichlorobiphenyl)	9253
PCB-3 (4-Chlorobiphenyl, 4-Monochlorobiphenyl)	9274
PCB-30 (2,4,6-Trichlorobiphenyl)	9254

Certificate of Accreditation: Supplement

Battelle
141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn   Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Aqueous	
PCB-31 (2,4',5-Trichlorobiphenyl)	8940
PCB-32 (2,4',6-Trichlorobiphenyl)	9255
PCB-33 (2,3',4'-Trichlorobiphenyl)	9239
PCB-37 (3,4,4'-Trichlorobiphenyl)	9266
PCB-4 (2,2'-Dichlorobiphenyl)	9189
PCB-40 (2,2',3,3'-Tetrachlorobiphenyl)	9132
PCB-41 (2,2',3,4-Tetrachlorobiphenyl)	9163
PCB-42 (2,2',3,4'-Tetrachlorobiphenyl)	9162
PCB-43 (2,2',3,5-Tetrachlorobiphenyl)	9169
PCB-44 (2,2',3,5'-Tetrachlorobiphenyl)	8945
PCB-45 (2,2',3,6-Tetrachlorobiphenyl)	9172
PCB-46 (2,2',3,6'-Tetrachlorobiphenyl)	9171
PCB-47 (2,2',4,4'-Tetrachlorobiphenyl)	9178
PCB-48 (2,2',4,5-Tetrachlorobiphenyl)	9181
PCB-49 (2,2',4,5'-Tetrachlorobiphenyl)	8950
PCB-5 (2,3-Dichlorobiphenyl)	8920
PCB-50 (2,2',4,6-Tetrachlorobiphenyl)	9184
PCB-51 (2,2',4,6'-Tetrachlorobiphenyl)	9183
PCB-52 (2,2',5,5'-Tetrachlorobiphenyl)	8955
PCB-53 (2,2',5,6'-Tetrachlorobiphenyl)	9186
PCB-54 (2,2',6,6'-Tetrachlorobiphenyl)	9187
PCB-56 (2,3,3',4'-Tetrachlorobiphenyl)	9207
PCB-6 (2,3'-Dichlorobiphenyl)	9249
PCB-60 (2,3,4,4'-Tetrachlorobiphenyl)	9221
PCB-63 (2,3,4',5-Tetrachlorobiphenyl)	9233
PCB-64 (2,3,4',6-Tetrachlorobiphenyl)	9236
PCB-66 (2,3',4,4'-Tetrachlorobiphenyl)	8960
PCB-67 (2,3',4,5-Tetrachlorobiphenyl)	9232
PCB-7 (2,4-Dichlorobiphenyl)	9257
PCB-70 (2,3',4',5-Tetrachlorobiphenyl)	9230
PCB-71 (2,3',4',6-Tetrachlorobiphenyl)	9237
PCB-74 (2,4,4',5-Tetrachlorobiphenyl)	9250
PCB-75 (2,4,4',6-Tetrachlorobiphenyl)	9251
PCB-77 (3,3',4,4'-Tetrachlorobiphenyl)	8965
PCB-8 (2,4’-Dichlorobiphenyl)	9256
PCB-80 (3,3',5,5'-Tetrachlorobiphenyl)	9264

Certificate of Accreditation: Supplement

Battelle

141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn   Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Aqueous	
PCB-81 (3,4,4',5-Tetrachlorobiphenyl)	8970
PCB-82 (2,2',3,3',4-Pentachlorobiphenyl)	9122
PCB-83 (2,2',3,3',5-Pentachlorobiphenyl)	9129
PCB-84 (2,2',3,3',6-Pentachlorobiphenyl)	9131
PCB-85 (2,2',3,4,4'-Pentachlorobiphenyl)	9142
PCB-87 (2,2',3,4,5'-Pentachlorobiphenyl)	8975
PCB-9 (2,5-Dichlorobiphenyl)	9258
PCB-91 (2,2',3,4',6-Pentachlorobiphenyl)	9160
PCB-92 (2,2',3,5,5'-Pentachlorobiphenyl)	9164
PCB-95 (2,2',3,5',6-Pentachlorobiphenyl)	9166
PCB-97 (2,2',3,4',5'-Pentachlorobiphenyl)	9154
PCB-99 (2,2',4,4',5-Pentachlorobiphenyl)	9175
Solid	
2,4'-DDD	8580
2,4'-DDE	8585
2,4'-DDT	8590
4,4'-DDD	7355
4,4'-DDE	7360
4,4'-DDT	7365
Biphenyl	5640
PCB-1 (2-Chlorobiphenyl, 2-Monochlorobiphenyl)	8915
PCB-100 (2,2',4,4',6-Pentachlorobiphenyl)	9177
PCB-101 (2,2’,4,5,5’-Pentachlorobiphenyl)	8980
PCB-104 (2,2',4,6,6'-Pentachlorobiphenyl)	9182
PCB-105 (2,3,3',4,4'-Pentachlorobiphenyl)	8985
PCB-11 (3,3'-Dichlorobiphenyl)	8925
PCB-110 (2,3,3',4',6-Pentachlorobiphenyl)	8990
PCB-114 (2,3,4,4',5-Pentachlorobiphenyl)	9005
PCB-115 (2,3,4,4',6-Pentachlorobiphenyl)	9219
PCB-118 (2,3',4,4',5-Pentachlorobiphenyl)	8995
PCB-12 (3,4-Dichlorobiphenyl)	9270
PCB-123 (2,3',4,4',5'-Pentachlorobiphenyl)	9000
PCB-124 (2,3',4',5,5'-Pentachlorobiphenyl)	9222
PCB-125 (2,3',4',5',6-Pentachlorobiphenyl)	9224
PCB-126 (3,3',4,4',5-Pentachlorobiphenyl)	9015
PCB-127 (3,3',4,5,5'-Pentachlorobiphenyl)	9260

Certificate of Accreditation: Supplement

Battelle
141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Solid	
PCB-128 (2,2',3,3',4,4'-Hexachlorobiphenyl)	9020
PCB-13 (3,4'-Dichlorobiphenyl)	9269
PCB-130 (2,2',3,3',4,5'-Hexachlorobiphenyl)	9117
PCB-131 (2,2',3,3',4,6-Hexachlorobiphenyl)	9121
PCB-134 (2,2',3,3',5,6-Hexachlorobiphenyl)	9128
PCB-135 (2,2',3,3',5,6'-Hexachlorobiphenyl)	9127
PCB-136 (2,2',3,3',6,6'-Hexachlorobiphenyl)	9130
PCB-137 (2,2',3,4,4',5-Hexachlorobiphenyl)	9138
PCB-138 (2,2',3,4,4',5'-Hexachlorobiphenyl)	9025
PCB-139 (2,2',3,4,4',6-Hexachlorobiphenyl)	9141
PCB-140 (2,2',3,4,4',6'-Hexachlorobiphenyl)	9140
PCB-141 (2,2',3,4,5,5'-Hexachlorobiphenyl)	9030
PCB-144 (2,2',3,4,5',6-Hexachlorobiphenyl)	9150
PCB-146 (2,2',3,4',5,5'-Hexachlorobiphenyl)	9144
PCB-149 (2,2',3,4',5',6-Hexachlorobiphenyl)	9151
PCB-15 (4,4'-Dichlorobiphenyl)	9273
PCB-151 (2,2',3,5,5',6-Hexachlorobiphenyl)	9035
PCB-153 (2,2’,4,4’,5,5’-Hexachlorobiphenyl)	9040
PCB-154 (2,2',4,4',5,6'-Hexachlorobiphenyl)	9174
PCB-155 (2,2',4,4',6,6'-Hexachlorobiphenyl)	9176
PCB-156 (2,3,3',4,4',5-Hexachlorobiphenyl)	9050
PCB-157 (2,3,3’,4,4’,5’-Hexachlorobiphenyl)	9045
PCB-158 (2,3,3',4,4',6-Hexachlorobiphenyl)	9193
PCB-16 (2,2',3-Trichlorobiphenyl)	9173
PCB-163 (2,3,3',4',5,6-Hexachlorobiphenyl)	9199
PCB-164 (2,3,3',4',5',6-Hexachlorobiphenyl)	9201
PCB-166 (2,3,4,4',5,6-Hexachlorobiphenyl)	9217
PCB-167 (2,3',4,4',5,5'-Hexachlorobiphenyl)	9055
PCB-169 (3,3',4,4',5,5'-Hexachlorobiphenyl)	9060
PCB-17 (2,2',4-Trichlorobiphenyl)	9185
PCB-170 (2,2',3,3',4,4',5-Heptachlorobiphenyl)	9065
PCB-171 (2,2',3,3',4,4',6-Heptachlorobiphenyl)	9106
PCB-172 (2,2',3,3',4,5,5'-Heptachlorobiphenyl)	9110
PCB-173 (2,2',3,3',4,5,6-Heptachlorobiphenyl)	9113
PCB-174 (2,2',3,3',4,5,6'-Heptachlorobiphenyl)	9116
PCB-175 (2,2',3,3',4,5',6-Heptachlorobiphenyl)	9115

Certificate of Accreditation: Supplement

Battelle

141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn   Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Solid	
PCB-176 (2,2',3,3',4,6,6'-Heptachlorobiphenyl)	9119
PCB-177 (2,2',3,3',4,5',6'-Heptachlorobiphenyl)	9114
PCB-178 (2,2',3,3',5,5',6-Heptachlorobiphenyl)	9124
PCB-179 (2,2',3,3',5,6,6'-Heptachlorobiphenyl)	9126
PCB-18 (2,2',5-Trichlorobiphenyl)	8930
PCB-180 (2,2',3,4,4',5,5'-Heptachlorobiphenyl)	9134
PCB-183 (2,2',3,4,4',5',6-Heptachlorobiphenyl)	9075
PCB-184 (2,2',3,4,4',6,6'-Heptachlorobiphenyl)	9139
PCB-185 (2,2',3,4,5,5',6-Heptachlorobiphenyl)	9143
PCB-187 (2,2',3,4',5,5',6-Heptachlorobiphenyl)	9080
PCB-188 (2,2',3,4',5,6,6'-Heptachlorobiphenyl)	9146
PCB-189 (2,3,3',4,4',5,5'-Heptachlorobiphenyl)	9085
PCB-19 (2,2',6-Trichlorobiphenyl)	9188
PCB-190 (2,3,3',4,4',5,6-Heptachlorobiphenyl)	9191
PCB-191 (2,3,3',4,4',5',6-Heptachlorobiphenyl)	9192
PCB-193 (2,3,3',4',5,5',6-Heptachlorobiphenyl)	9195
PCB-194 (2,2',3,3',4,4',5,5'-Octachlorobiphenyl)	9090
PCB-195 (2,2',3,3',4,4',5,6-Octachlorobiphenyl)	9103
PCB-197 (2,2',3,3',4,4',6,6'-Octachlorobiphenyl)	9104
PCB-198 (2,2',3,3',4,5,5',6-Octachlorobiphenyl)	9109
PCB-199 (2,2',3,3',4,5,5',6'-Octachlorobiphenyl)	9108
PCB-200 (2,2',3,3',4,5,6,6'-Octachlorobiphenyl)	9111
PCB-201 (2,2',3,3',4,5',6,6'-Octachlorobiphenyl)	9112
PCB-202 (2,2',3,3',5,5',6,6'-Octachlorobiphenyl)	9123
PCB-203 (2,2',3,4,4',5,5',6-Octachlorobiphenyl)	9133
PCB-205 (2,3,3',4,4',5,5',6-Octachlorobiphenyl)	9190
PCB-206 (2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl)	9095
PCB-207 (2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl)	9101
PCB-208 (2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl)	9107
PCB-209 (2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl)	9105
PCB-22 (2,3,4'-Trichlorobiphenyl)	9241
PCB-24 (2,3,6-Trichlorobiphenyl)	9247
PCB-25 (2,3',4-Trichlorobiphenyl)	9240
PCB-26 (2,3',5-Trichlorobiphenyl)	8935
PCB-27 (2,3',6-Trichlorobiphenyl)	9248
PCB-28 (2,4,4’-Trichlorobiphenyl)	9252

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Solid	
PCB-29 (2,4,5-Trichlorobiphenyl)	9253
PCB-3 (4-Chlorobiphenyl, 4-Monochlorobiphenyl)	9274
PCB-30 (2,4,6-Trichlorobiphenyl)	9254
PCB-31 (2,4',5-Trichlorobiphenyl)	8940
PCB-32 (2,4',6-Trichlorobiphenyl)	9255
PCB-33 (2,3',4'-Trichlorobiphenyl)	9239
PCB-37 (3,4,4'-Trichlorobiphenyl)	9266
PCB-4 (2,2'-Dichlorobiphenyl)	9189
PCB-40 (2,2',3,3'-Tetrachlorobiphenyl)	9132
PCB-41 (2,2',3,4-Tetrachlorobiphenyl)	9163
PCB-42 (2,2',3,4'-Tetrachlorobiphenyl)	9162
PCB-43 (2,2',3,5-Tetrachlorobiphenyl)	9169
PCB-44 (2,2',3,5'-Tetrachlorobiphenyl)	8945
PCB-45 (2,2',3,6-Tetrachlorobiphenyl)	9172
PCB-46 (2,2',3,6'-Tetrachlorobiphenyl)	9171
PCB-47 (2,2',4,4'-Tetrachlorobiphenyl)	9178
PCB-48 (2,2',4,5-Tetrachlorobiphenyl)	9181
PCB-49 (2,2',4,5'-Tetrachlorobiphenyl)	8950
PCB-5 (2,3-Dichlorobiphenyl)	8920
PCB-50 (2,2',4,6-Tetrachlorobiphenyl)	9184
PCB-51 (2,2',4,6'-Tetrachlorobiphenyl)	9183
PCB-52 (2,2',5,5'-Tetrachlorobiphenyl)	8955
PCB-53 (2,2',5,6'-Tetrachlorobiphenyl)	9186
PCB-54 (2,2',6,6'-Tetrachlorobiphenyl)	9187
PCB-56 (2,3,3',4'-Tetrachlorobiphenyl)	9207
PCB-6 (2,3'-Dichlorobiphenyl)	9249
PCB-60 (2,3,4,4'-Tetrachlorobiphenyl)	9221
PCB-63 (2,3,4',5-Tetrachlorobiphenyl)	9233
PCB-64 (2,3,4',6-Tetrachlorobiphenyl)	9236
PCB-66 (2,3',4,4'-Tetrachlorobiphenyl)	8960
PCB-67 (2,3',4,5-Tetrachlorobiphenyl)	9232
PCB-7 (2,4-Dichlorobiphenyl)	9257
PCB-70 (2,3',4',5-Tetrachlorobiphenyl)	9230
PCB-71 (2,3',4',6-Tetrachlorobiphenyl)	9237
PCB-74 (2,4,4',5-Tetrachlorobiphenyl)	9250
PCB-75 (2,4,4',6-Tetrachlorobiphenyl)	9251

Accreditation is granted to the facility to perform the following testing:	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Solid	
PCB-77 (3,3',4,4'-Tetrachlorobiphenyl)	8965
PCB-8 (2,4’-Dichlorobiphenyl)	9256
PCB-80 (3,3',5,5'-Tetrachlorobiphenyl)	9264
PCB-81 (3,4,4',5-Tetrachlorobiphenyl)	8970
PCB-82 (2,2',3,3',4-Pentachlorobiphenyl)	9122
PCB-83 (2,2',3,3',5-Pentachlorobiphenyl)	9129
PCB-84 (2,2',3,3',6-Pentachlorobiphenyl)	9131
PCB-85 (2,2',3,4,4'-Pentachlorobiphenyl)	9142
PCB-87 (2,2',3,4,5'-Pentachlorobiphenyl)	8975
PCB-9 (2,5-Dichlorobiphenyl)	9258
PCB-91 (2,2',3,4',6-Pentachlorobiphenyl)	9160
PCB-92 (2,2',3,5,5'-Pentachlorobiphenyl)	9164
PCB-95 (2,2',3,5',6-Pentachlorobiphenyl)	9166
PCB-97 (2,2',3,4',5'-Pentachlorobiphenyl)	9154
PCB-99 (2,2',4,4',5-Pentachlorobiphenyl)	9175
Tissue	
2,4'-DDD	8580
2,4'-DDE	8585
2,4'-DDT	8590
4,4'-DDD	7355
4,4'-DDE	7360
4,4'-DDT	7365
Biphenyl	5640
PCB-1 (2-Chlorobiphenyl, 2-Monochlorobiphenyl)	8915
PCB-100 (2,2',4,4',6-Pentachlorobiphenyl)	9177
PCB-101 (2,2’,4,5,5’-Pentachlorobiphenyl)	8980
PCB-104 (2,2',4,6,6'-Pentachlorobiphenyl)	9182
PCB-105 (2,3,3',4,4'-Pentachlorobiphenyl)	8985
PCB-11 (3,3'-Dichlorobiphenyl)	8925
PCB-110 (2,3,3',4',6-Pentachlorobiphenyl)	8990
PCB-114 (2,3,4,4',5-Pentachlorobiphenyl)	9005
PCB-115 (2,3,4,4',6-Pentachlorobiphenyl)	9219
PCB-118 (2,3',4,4',5-Pentachlorobiphenyl)	8995
PCB-12 (3,4-Dichlorobiphenyl)	9270
PCB-123 (2,3',4,4',5'-Pentachlorobiphenyl)	9000
PCB-124 (2,3',4',5,5'-Pentachlorobiphenyl)	9222

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Tissue	
PCB-125 (2,3',4',5',6-Pentachlorobiphenyl)	9224
PCB-126 (3,3',4,4',5-Pentachlorobiphenyl)	9015
PCB-127 (3,3',4,5,5'-Pentachlorobiphenyl)	9260
PCB-128 (2,2',3,3',4,4'-Hexachlorobiphenyl)	9020
PCB-13 (3,4'-Dichlorobiphenyl)	9269
PCB-130 (2,2',3,3',4,5'-Hexachlorobiphenyl)	9117
PCB-131 (2,2',3,3',4,6-Hexachlorobiphenyl)	9121
PCB-134 (2,2',3,3',5,6-Hexachlorobiphenyl)	9128
PCB-135 (2,2',3,3',5,6'-Hexachlorobiphenyl)	9127
PCB-136 (2,2',3,3',6,6'-Hexachlorobiphenyl)	9130
PCB-137 (2,2',3,4,4',5-Hexachlorobiphenyl)	9138
PCB-138 (2,2',3,4,4',5'-Hexachlorobiphenyl)	9025
PCB-139 (2,2',3,4,4',6-Hexachlorobiphenyl)	9141
PCB-140 (2,2',3,4,4',6'-Hexachlorobiphenyl)	9140
PCB-141 (2,2',3,4,5,5'-Hexachlorobiphenyl)	9030
PCB-144 (2,2',3,4,5',6-Hexachlorobiphenyl)	9150
PCB-146 (2,2',3,4',5,5'-Hexachlorobiphenyl)	9144
PCB-149 (2,2',3,4',5',6-Hexachlorobiphenyl)	9151
PCB-15 (4,4'-Dichlorobiphenyl)	9273
PCB-151 (2,2',3,5,5',6-Hexachlorobiphenyl)	9035
PCB-153 (2,2’,4,4’,5,5’-Hexachlorobiphenyl)	9040
PCB-154 (2,2',4,4',5,6'-Hexachlorobiphenyl)	9174
PCB-155 (2,2',4,4',6,6'-Hexachlorobiphenyl)	9176
PCB-156 (2,3,3',4,4',5-Hexachlorobiphenyl)	9050
PCB-157 (2,3,3’,4,4’,5’-Hexachlorobiphenyl)	9045
PCB-158 (2,3,3',4,4',6-Hexachlorobiphenyl)	9193
PCB-16 (2,2',3-Trichlorobiphenyl)	9173
PCB-163 (2,3,3',4',5,6-Hexachlorobiphenyl)	9199
PCB-164 (2,3,3',4',5',6-Hexachlorobiphenyl)	9201
PCB-166 (2,3,4,4',5,6-Hexachlorobiphenyl)	9217
PCB-167 (2,3',4,4',5,5'-Hexachlorobiphenyl)	9055
PCB-169 (3,3',4,4',5,5'-Hexachlorobiphenyl)	9060
PCB-17 (2,2',4-Trichlorobiphenyl)	9185
PCB-170 (2,2',3,3',4,4',5-Heptachlorobiphenyl)	9065
PCB-171 (2,2',3,3',4,4',6-Heptachlorobiphenyl)	9106
PCB-172 (2,2',3,3',4,5,5'-Heptachlorobiphenyl)	9110

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Tissue	
PCB-173 (2,2',3,3',4,5,6-Heptachlorobiphenyl)	9113
PCB-174 (2,2',3,3',4,5,6'-Heptachlorobiphenyl)	9116
PCB-175 (2,2',3,3',4,5',6-Heptachlorobiphenyl)	9115
PCB-176 (2,2',3,3',4,6,6'-Heptachlorobiphenyl)	9119
PCB-177 (2,2',3,3',4,5',6'-Heptachlorobiphenyl)	9114
PCB-178 (2,2',3,3',5,5',6-Heptachlorobiphenyl)	9124
PCB-179 (2,2',3,3',5,6,6'-Heptachlorobiphenyl)	9126
PCB-18 (2,2',5-Trichlorobiphenyl)	8930
PCB-180 (2,2',3,4,4',5,5'-Heptachlorobiphenyl)	9134
PCB-183 (2,2',3,4,4',5',6-Heptachlorobiphenyl)	9075
PCB-184 (2,2',3,4,4',6,6'-Heptachlorobiphenyl)	9139
PCB-185 (2,2',3,4,5,5',6-Heptachlorobiphenyl)	9143
PCB-187 (2,2',3,4',5,5',6-Heptachlorobiphenyl)	9080
PCB-188 (2,2',3,4',5,6,6'-Heptachlorobiphenyl)	9146
PCB-189 (2,3,3',4,4',5,5'-Heptachlorobiphenyl)	9085
PCB-19 (2,2',6-Trichlorobiphenyl)	9188
PCB-190 (2,3,3',4,4',5,6-Heptachlorobiphenyl)	9191
PCB-191 (2,3,3',4,4',5',6-Heptachlorobiphenyl)	9192
PCB-193 (2,3,3',4',5,5',6-Heptachlorobiphenyl)	9195
PCB-194 (2,2',3,3',4,4',5,5'-Octachlorobiphenyl)	9090
PCB-195 (2,2',3,3',4,4',5,6-Octachlorobiphenyl)	9103
PCB-197 (2,2',3,3',4,4',6,6'-Octachlorobiphenyl)	9104
PCB-198 (2,2',3,3',4,5,5',6-Octachlorobiphenyl)	9109
PCB-199 (2,2',3,3',4,5,5',6'-Octachlorobiphenyl)	9108
PCB-200 (2,2',3,3',4,5,6,6'-Octachlorobiphenyl)	9111
PCB-201 (2,2',3,3',4,5',6,6'-Octachlorobiphenyl)	9112
PCB-202 (2,2',3,3',5,5',6,6'-Octachlorobiphenyl)	9123
PCB-203 (2,2',3,4,4',5,5',6-Octachlorobiphenyl)	9133
PCB-205 (2,3,3',4,4',5,5',6-Octachlorobiphenyl)	9190
PCB-206 (2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl)	9095
PCB-207 (2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl)	9101
PCB-208 (2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl)	9107
PCB-209 (2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl)	9105
PCB-22 (2,3,4'-Trichlorobiphenyl)	9241
PCB-24 (2,3,6-Trichlorobiphenyl)	9247
PCB-25 (2,3',4-Trichlorobiphenyl)	9240

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	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Tissue	
PCB-26 (2,3',5-Trichlorobiphenyl)	8935
PCB-27 (2,3',6-Trichlorobiphenyl)	9248
PCB-28 (2,4,4’-Trichlorobiphenyl)	9252
PCB-29 (2,4,5-Trichlorobiphenyl)	9253
PCB-3 (4-Chlorobiphenyl, 4-Monochlorobiphenyl)	9274
PCB-30 (2,4,6-Trichlorobiphenyl)	9254
PCB-31 (2,4',5-Trichlorobiphenyl)	8940
PCB-32 (2,4',6-Trichlorobiphenyl)	9255
PCB-33 (2,3',4'-Trichlorobiphenyl)	9239
PCB-37 (3,4,4'-Trichlorobiphenyl)	9266
PCB-4 (2,2'-Dichlorobiphenyl)	9189
PCB-40 (2,2',3,3'-Tetrachlorobiphenyl)	9132
PCB-41 (2,2',3,4-Tetrachlorobiphenyl)	9163
PCB-42 (2,2',3,4'-Tetrachlorobiphenyl)	9162
PCB-43 (2,2',3,5-Tetrachlorobiphenyl)	9169
PCB-44 (2,2',3,5'-Tetrachlorobiphenyl)	8945
PCB-45 (2,2',3,6-Tetrachlorobiphenyl)	9172
PCB-46 (2,2',3,6'-Tetrachlorobiphenyl)	9171
PCB-47 (2,2',4,4'-Tetrachlorobiphenyl)	9178
PCB-48 (2,2',4,5-Tetrachlorobiphenyl)	9181
PCB-49 (2,2',4,5'-Tetrachlorobiphenyl)	8950
PCB-5 (2,3-Dichlorobiphenyl)	8920
PCB-50 (2,2',4,6-Tetrachlorobiphenyl)	9184
PCB-51 (2,2',4,6'-Tetrachlorobiphenyl)	9183
PCB-52 (2,2',5,5'-Tetrachlorobiphenyl)	8955
PCB-53 (2,2',5,6'-Tetrachlorobiphenyl)	9186
PCB-54 (2,2',6,6'-Tetrachlorobiphenyl)	9187
PCB-56 (2,3,3',4'-Tetrachlorobiphenyl)	9207
PCB-6 (2,3'-Dichlorobiphenyl)	9249
PCB-60 (2,3,4,4'-Tetrachlorobiphenyl)	9221
PCB-64 (2,3,4',6-Tetrachlorobiphenyl)	9236
PCB-66 (2,3',4,4'-Tetrachlorobiphenyl)	8960
PCB-67 (2,3',4,5-Tetrachlorobiphenyl)	9232
PCB-7 (2,4-Dichlorobiphenyl)	9257
PCB-71 (2,3',4',6-Tetrachlorobiphenyl)	9237
PCB-74 (2,4,4',5-Tetrachlorobiphenyl)	9250

Certificate of Accreditation: Supplement

Battelle

141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Tissue	
PCB-75 (2,4,4',6-Tetrachlorobiphenyl)	9251
PCB-77 (3,3',4,4'-Tetrachlorobiphenyl)	8965
PCB-8 (2,4’-Dichlorobiphenyl)	9256
PCB-80 (3,3',5,5'-Tetrachlorobiphenyl)	9264
PCB-81 (3,4,4',5-Tetrachlorobiphenyl)	8970
PCB-82 (2,2',3,3',4-Pentachlorobiphenyl)	9122
PCB-83 (2,2',3,3',5-Pentachlorobiphenyl)	9129
PCB-84 (2,2',3,3',6-Pentachlorobiphenyl)	9131
PCB-85 (2,2',3,4,4'-Pentachlorobiphenyl)	9142
PCB-87 (2,2',3,4,5'-Pentachlorobiphenyl)	8975
PCB-9 (2,5-Dichlorobiphenyl)	9258
PCB-91 (2,2',3,4',6-Pentachlorobiphenyl)	9160
PCB-92 (2,2',3,5,5'-Pentachlorobiphenyl)	9164
PCB-95 (2,2',3,5',6-Pentachlorobiphenyl)	9166
PCB-97 (2,2',3,4',5'-Pentachlorobiphenyl)	9154
PCB-99 (2,2',4,4',5-Pentachlorobiphenyl)	9175
PFAS by LC/MS/MS Compliant with Table B-15 of QSM 5.3 or Latest Version by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	90000451
Aqueous	
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	9490
1H, 1H, 2H, 2H-Perfluorodecane Sulfonic Acid (8:2 FTS)	6948
1H, 1H, 2H, 2H-Perfluorododecane Sulfonic Acid (10:2 FTS)	9616
1H, 1H, 2H, 2H-Perfluorohexane Sulfonic Acid (4:2 FTS)	6946
1H, 1H, 2H, 2H-Perfluorooctane Sulfonic Acid (6:2 FTS)	6947
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA, 3-Perfluoroheptyl Propanoic Acid)	9340
2H,2H,3H,3H-Perfluorooctanoic Acid (5:3 FTCA)	9338
4,4,5,5,6,6,6-Heptafluorohexanoi Acid (3:3 FTCA, 3-Perfluoropropyl Propanoic Acid)	9353
9-Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid (9-Cl-PF3ONS)	6952
Ammonium 4,8-Dioxa-3H-Perfluorononanoate (ADONA)	6953
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA) – GenX	9460
N-Ethyl Perfluorooctanesulfonamide (NEtFOSA)	9395
N-Ethyl Perfluorooctanesulfonamidoethanol (NEtFOSE)	9431
N-Ethylperfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	4846
N-Methylperfluorooctanesulfonamide (NMeFOSA)	6954
N-Methylperfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	4847
N-Methylperfluorooctanesulfonamidoethanol (MeFOSE)	6949

Certificate of Accreditation: Supplement

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	Code
Organic	
PFAS by LC/MS/MS Compliant with Table B-15 of QSM 5.3 or Latest Version by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	90000451
Aqueous	
Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)	6956
Perfluoro(2-Ethoxyethane)Sulfonic Acid (PFEESA)	6957
Perfluoro-1-Octanesulfonamide (PFOSA)	9665
Perfluoro-3-Methoxypropanoic Acid (PFMPA)	6965
Perfluoro-4-Methoxybutanoic Acid (PFMBA)	6966
Perfluorobutanesulfonic Acid (PFBS)	6918
Perfluorobutanoic Acid (PFBA)	6915
Perfluorodecanesulfonic Acid (PFDS)	6920
Perfluorodecanoic Acid (PFDA)	6905
Perfluorododecanesulfonic Acid (PFDoS)	6923
Perfluorododecanoic Acid (PFDoA)	6903
Perfluoroheptanesulfonic Acid (PFHpS)	9470
Perfluoroheptanoic Acid (PFHpA)	6908
Perfluorohexadecanoic Acid (PFHxDA)	6958
Perfluorohexanesulfonic Acid (PFHxS)	6927
Perfluorohexanoic Acid (PFHxA)	6913
Perfluorononanesulfonic Acid (PFNS)	6929
Perfluorononanoic Acid (PFNA)	6906
Perfluorooctadecanoic Acid (PFODA)	6916
Perfluorooctanesulfonic Acid (PFOS)	6931
Perfluorooctanoic Acid (PFOA)	6912
Perfluoropentanesulfonic Acid (PFPeS)	6934
Perfluoropentanoic Acid (PFPeA)	6914
Perfluorotetradecanoic Acid (PFTeDA)	6902
Perfluorotridecanoic Acid (PFTrDA)	9563
Perfluoroundecanoic Acid (PFUnA)	6904
Solid	
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	9490
1H, 1H, 2H, 2H-Perfluorodecane Sulfonic Acid (8:2 FTS)	6948
1H, 1H, 2H, 2H-Perfluorododecane Sulfonic Acid (10:2 FTS)	9616
1H, 1H, 2H, 2H-Perfluorohexane Sulfonic Acid (4:2 FTS)	6946
1H, 1H, 2H, 2H-Perfluorooctane Sulfonic Acid (6:2 FTS)	6947
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA, 3-Perfluoroheptyl Propanoic Acid)	9340
2H,2H,3H,3H-Perfluorooctanoic Acid (5:3 FTCA)	9338
4,4,5,5,6,6,6-Heptafluorohexanoi Acid (3:3 FTCA, 3-Perfluoropropyl Propanoic Acid)	9353

Certificate of Accreditation: Supplement

Battelle
141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
PFAS by LC/MS/MS Compliant with Table B-15 of QSM 5.3 or Latest Version by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	90000451
Solid	
9-Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid (9-Cl-PF3ONS)	6952
Ammonium 4,8-Dioxa-3H-Perfluorononanoate (ADONA)	6953
N-Ethyl Perfluorooctanesulfonamide (NEtFOSA)	9395
N-Ethyl Perfluorooctanesulfonamidoethanol (NEtFOSE)	9431
N-Ethylperfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	4846
N-Methylperfluorooctanesulfonamide (NMeFOSA)	6954
N-Methylperfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	4847
N-Methylperfluorooctanesulfonamidoethanol (MeFOSE)	6949
Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)	6956
Perfluoro(2-Ethoxyethane)Sulfonic Acid (PFEESA)	6957
Perfluoro-1-Octanesulfonamide (PFOSA)	9665
Perfluoro-3-Methoxypropanoic Acid (PFMPA)	6965
Perfluoro-4-Methoxybutanoic Acid (PFMBA)	6966
Perfluorobutanesulfonic Acid (PFBS)	6918
Perfluorobutanoic Acid (PFBA)	6915
Perfluorodecanesulfonic Acid (PFDS)	6920
Perfluorodecanoic Acid (PFDA)	6905
Perfluorododecanesulfonic Acid (PFDoS)	6923
Perfluorododecanoic Acid (PFDoA)	6903
Perfluoroheptanesulfonic Acid (PFHpS)	9470
Perfluoroheptanoic Acid (PFHpA)	6908
Perfluorohexadecanoic Acid (PFHxDA)	6958
Perfluorohexanesulfonic Acid (PFHxS)	6927
Perfluorohexanoic Acid (PFHxA)	6913
Perfluorononanesulfonic Acid (PFNS)	6929
Perfluorononanoic Acid (PFNA)	6906
Perfluorooctadecanoic Acid (PFODA)	6916
Perfluorooctanesulfonic Acid (PFOS)	6931
Perfluorooctanoic Acid (PFOA)	6912
Perfluoropentanesulfonic Acid (PFPeS)	6934
Perfluoropentanoic Acid (PFPeA)	6914
Perfluorotetradecanoic Acid (PFTeDA)	6902
Perfluorotridecanoic Acid (PFTrDA)	9563
Perfluoroundecanoic Acid (PFUnA)	6904

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
PFAS by LC/MS/MS Compliant with Table B-15 of QSM 5.3 or Latest Version by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	90000451
Tissue	
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	9490
1H, 1H, 2H, 2H-Perfluorodecane Sulfonic Acid (8:2 FTS)	6948
1H, 1H, 2H, 2H-Perfluorohexane Sulfonic Acid (4:2 FTS)	6946
1H, 1H, 2H, 2H-Perfluorooctane Sulfonic Acid (6:2 FTS)	6947
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA, 3-Perfluoroheptyl Propanoic Acid)	9340
2H,2H,3H,3H-Perfluorooctanoic Acid (5:3 FTCA)	9338
4,4,5,5,6,6,6-Heptafluorohexanoi Acid (3:3 FTCA, 3-Perfluoropropyl Propanoic Acid)	9353
9-Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid (9-Cl-PF3ONS)	6952
Ammonium 4,8-Dioxa-3H-Perfluorononanoate (ADONA)	6953
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA) – GenX	9460
N-Ethylperfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	4846
N-Methylperfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	4847
Perfluoro-1-Octanesulfonamide (PFOSA)	9665
Perfluorobutanesulfonic Acid (PFBS)	6918
Perfluorobutanoic Acid (PFBA)	6915
Perfluorodecanesulfonic Acid (PFDS)	6920
Perfluorodecanoic Acid (PFDA)	6905
Perfluorododecanoic Acid (PFDoA)	6903
Perfluoroheptanesulfonic Acid (PFHpS)	9470
Perfluoroheptanoic Acid (PFHpA)	6908
Perfluorohexanoic Acid (PFHxA)	6913
Perfluorononanesulfonic Acid (PFNS)	6929
Perfluorononanoic Acid (PFNA)	6906
Perfluorooctanesulfonic Acid (PFOS)	6931
Perfluorooctanoic Acid (PFOA)	6912
Perfluoropentanesulfonic Acid (PFPeS)	6934
Perfluoropentanoic Acid (PFPeA)	6914
Perfluorotetradecanoic Acid (PFTeDA)	6902
Perfluorotridecanoic Acid (PFTrDA)	9563
Perfluoroundecanoic Acid (PFUnA)	6904

Certificate of Accreditation: Supplement

Battelle

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Accreditation is granted to the facility to perform the following testing:

		Code
Preparation		
Aqueous		
EPA 3510C	Separatory Funnel Liquid-Liquid Extraction	
EPA 3640A MOD (Battelle SOP 5-191)	Gel-Permeation Cleanup	
EPA 3660B MOD (Battelle SOP 5-328)	Sulfur Cleanup	
Solid		
EPA 3640A MOD (Battelle SOP 5-191)	Gel-Permeation Cleanup	
EPA 3660B MOD (Battelle SOP 5-328)	Sulfur Cleanup	
NOAA NOS ORCA 71	Orbital Shaker	
Tissue		
EPA 3640A MOD (Battelle SOP 5-191)	Gel-Permeation Cleanup	
EPA 3660B MOD (Battelle SOP 5-328)	Sulfur Cleanup	
NOAA NOS ORCA 71	Tissuemizer Orbital Shaker	

Footnotes:

> Method codes are typically based on The NELAC Institute (TNI) Laboratory Accreditation Management System (LAMS) and are used to compare to the laboratory reported Performance Test (PT) results. Although the method code may not represent the specific method version, it is the method code used to represent the method/technology used to report PTs. (NC = No Code)