
# Best Practices for PFAS Sampling and Data Evaluation

**Nicolette Andrzejczyk, PhD, NAVFAC EXWC**
**John Kornuc, PhD, NAVFAC EXWC**
**Ramona Iery, PhD, NAVFAC EXWC**

Summer 2023

# Disclaimer

This seminar is intended to be informational and does not indicate endorsement of a particular product(s) or technology by the Department of Defense of NAVFAC EXWC, nor should the presentation be construed as reflecting the official policy or position of any of those Agencies. Mention of specific product names, vendors, or source or information, trademarks, or manufacturers is for informational purposes only and does not constitute an endorsement or recommendation by the Department of Defense or NAVFAC EXWC. Although every attempt is made to provide reliable and accurate information, there is no warranty or representation as to the accuracy, adequacy, efficiency, or applicability of any product or technology discussed or mentioned during the seminar, including the suitability of any product or technology for a particular purpose.

# Speaker Introduction

**Nicolette Andrzejczyk, PhD**
**Toxicologist**

- NAVFAC EXWC
- PhD, Environmental Toxicology, University of California, Riverside

**John Kornuc, PhD**

- NAVFAC EXWC
- PhD, Biochemistry, University of California, Los Angeles

**Ramona Iery, PhD**
**Environmental Engineer**

- NAVFAC EXWC
- PhD, Environmental Engineering, Clemson University

# Past Related RITS Topics

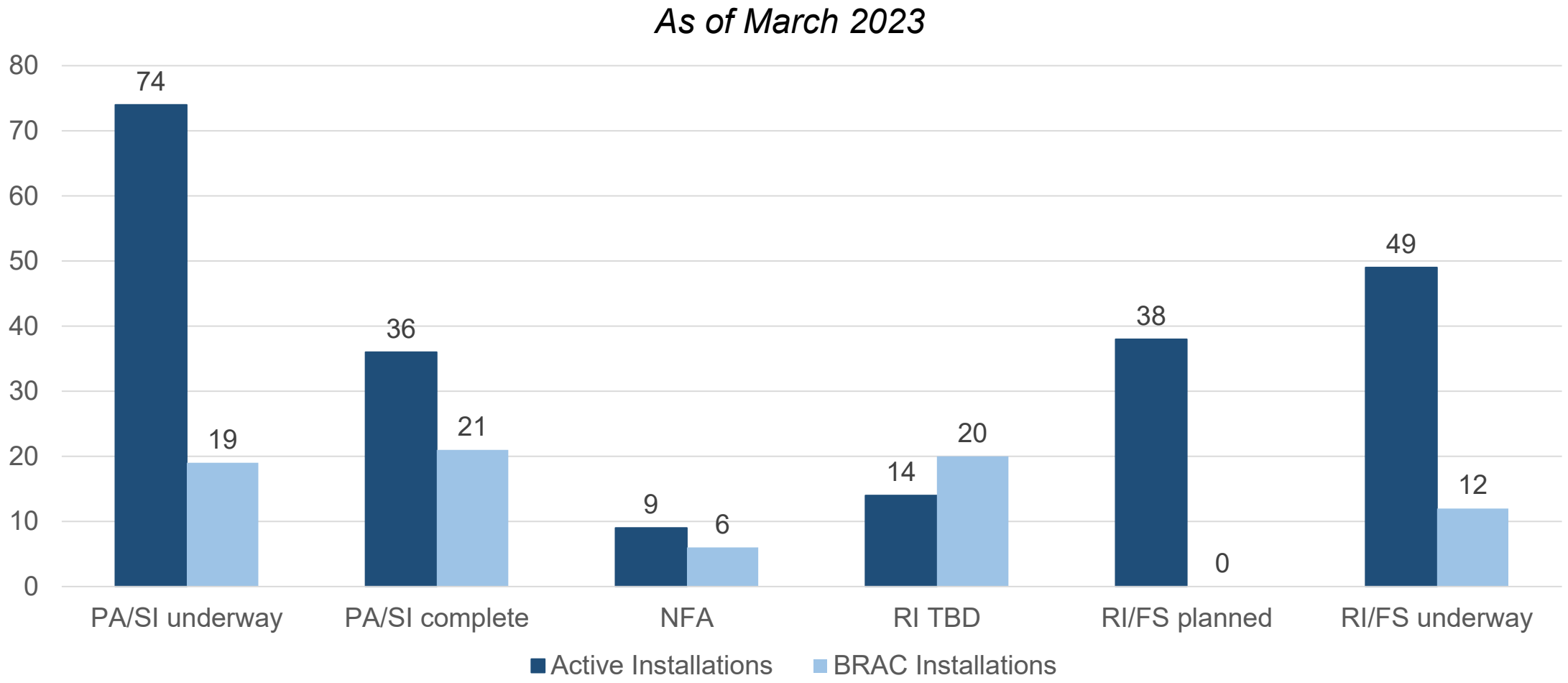
| | |
|---|---|
| 2015 | • Emerging Information on Emerging Contaminants |
| 2016 | • Emerging Contaminants: PFAS |
| 2017 | • Risk Communication for PFAS Sites |
| 2018 | • Remediating PFAS-Impacted Sites |
| 2019 | • Managing Emerging Contaminants at CERCLA Sites |
| 2019 | • PFAS Site Characterization |
| 2021 | • Best Practices for Conducting PFAS Remedial Investigations |
| 2022 | • Navigating the 2021 US EPA PFAS Strategic Roadmap and DoD's Related Priorities in Addressing PFAS |

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DoD: Department of Defense
PFAS: per- and polyfluoroalkyl substances
US EPA: United States Environmental Protection Agency

# Presentation Overview

- Department of the Navy PFAS Investigations
- PFAS Investigation Planning
- PFAS Sampling
  - Sampling Considerations
  - Field Best Practices
  - Analytical Best Practices
- Site Inspection Data Evaluation
- Key Points

# Snapshot of DON PFAS Investigations




BRAC: base realignment and closure
DON: Department of the Navy
FS: feasibility study
NFA: no further action
PA: preliminary assessment
RI: remedial investigation
SI: site inspection
TBD: to be determined

# What Makes PFAS Sites Unique

- PFAS are chemicals of emerging concern which have only recently been investigated
  - Navy releases may have occurred as early as the 1960s
  - Plumes may have developed and migrated without detection for many decades
- Treatment systems may result in additional transport pathways and chemical transformation
- AFFF formulations varied by manufacturer and by manufacture date, and multiple formulations may have been released at the same site
- PFAS detected at low levels may not be indicative of a CERCLA/RCRA release

***Early foam testing at Naval Research Laboratory – DC***

AFFF: aqueous film-forming foam
RCRA: Resource Conservation and Recovery Act

# Sampling-related Policies and Guidance

## Policies

- DON February 8, 2002 – *Policy on Sediment Site Investigation and Response Action*
  - Requires that all sediment investigations and response actions be directly linked to Navy CERCLA/RCRA releases (BRAC and/or ER,N eligible)
- DON June 20, 2016 – *Perfluorinated Compounds/Perfluoroalkyl Substances (PFC/PFAS) – Identification of Potential Areas of Concern (AOCs)*
  - Requires the identification and inventory of areas at all DON installations where releases of PFAS were known or suspected to have occurred
  - Requires the identification of PFAS releases that may impact downgradient off-base drinking water

ER,N: Environmental Restoration, Navy

# Sampling-related Policies and Guidance

## Policies (continued)

- DoD December 7, 2021 – *Update for Establishing a Consistent Methodology for the Analysis of Per- and Polyfluoroalkyl Substances in Media Other than Drinking Water*
  - Requires all new contracts and task orders after December 31, 2021, to use US EPA Draft Method 1633 for the analysis of PFAS in matrices other than drinking water
- DoD July 6, 2022 – *Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program* (supersedes and cancels Sept 15, 2021 memo)
  - Consistent with CERCLA, the May 2022 RSLs for the 6 PFAS should be used to determine if an RI or if no further action is warranted
    - PFOS, PFOA, PFNA, PFHxS, HFPO-DA, PFBS

PFOA: perfluorooctanoic acid
PFOS: perfluorooctane sulfonate
PFNA: perfluorononanoic acid
PFHxS: perfluorohexane sulfonate
HFPO-DA: hexafluoropropylene oxide dimer acid
PFBS: perfluorobutane sulfonate
RSL: regional screening levels

# Sampling-related Policies and Guidance

## Guidance

- NAVFAC November 24, 2020 – *Interim Per and Polyfluoroalkyl Substances Site Guidance for NAVFAC RPMs/November 2020 Update*
  - Assists RPMs with programmatic and technical issues related to PFAS
- NAVFAC January 14, 2022 – *Decision Framework Regarding Surface Water and Sediment Media during a Site Inspection*
  - Assists RPMs with determining whether surface water and/or sediment samples should be collected during the SI

RPM: remedial project manager

# Presentation Overview

- Department of the Navy PFAS Investigations
- PFAS Investigation Planning
- PFAS Sampling
  - Sampling Considerations
  - Field Best Practices
  - Analytical Best Practices
- Site Inspection Data Evaluation
- Key Points

# Site Inspection vs Remedial Investigation

| Site Inspection | Remedial Investigation |
|---|---|
| Generate preliminary CSM | Continue to refine CSM |
| Determine whether PFAS are present at levels that may result in unacceptable risk to human health and the environment and/or that warrant further investigation or action | Determine PFAS nature & extent and fate & transport<br>Assess risks to human health and the environment |
| SI recommendations include:<br>• No additional action at this time<br>• *Data Gap SI or SI Addendum*<br>• Remedial Investigation | RI recommendations include:<br>• No additional action at this time<br>• FS or EE/CA<br>• Pre-FS investigation to support Remedial Action development |

CSM: conceptual site model
EE/CA: engineering evaluation/cost analysis

# PFAS SI and RI Planning and Documentation

## SAP

- Scoping session(s) with regulators
- Draft, draft final, final
- Engage SMEs early (PFAS, hydrogeologist, risk assessors, etc.)
- RPM review
- QAO review of draft required (2 months)
- PFAS SME review of draft currently optional, but recommended; can be concurrent review with QAO
- Regulatory Review
- Can take up to 9–12 months from initiation to final

## Accident Prevention Plan and Site Health and Safety Plan

- Draft, draft final, final
- RPM review
- NMCPHC review (1 month)
- Can take up to 6 months from initiation to final

## SI or RI Report

- Draft, draft final, final
- RPM review
- SME review recommended
- Regulatory Review
- Can take up to 1–2 years from initiation to final (once fieldwork is complete)

NMCPHC: Navy and Marine Corps Public Health Center
QAO: quality assurance officer
SAP: sampling and analysis plan
SME: subject matter expert

# Watershed Contaminated Source Document (WCSD)

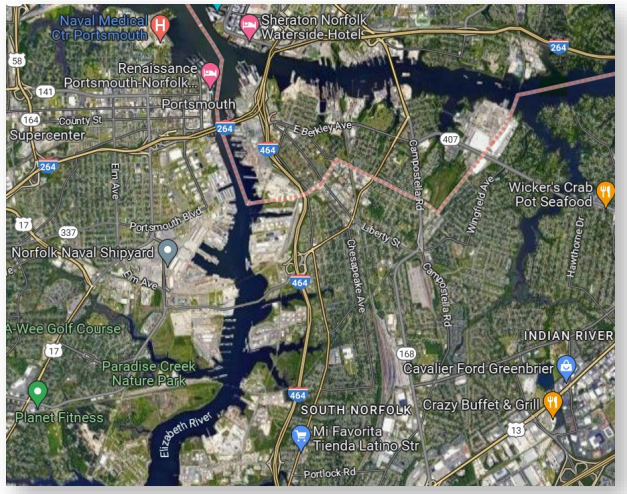
- Implements DON sediment policy
- Identifies Navy and non-Navy sources, transport mechanisms, exposure routes, and receptors to refine the CSM
- If needed, typically prepared before or during the RI, after a release has been identified and linked to a Navy site

*Norfolk Naval Shipyard (1995)*

# Is a WCSD required?

- The sediment policy does not require a WCSD
- WCSD determination is project-specific
  - Use professional judgment
  - Engage technical support early and often IMPORTANT
  - May not be needed if waterbody is within Navy property, does not receive discharge or runoff from non-Navy property, and only Navy sources are likely
  - Likely needed if waterbody receives discharge or runoff from multiple areas and non-Navy sources may be present

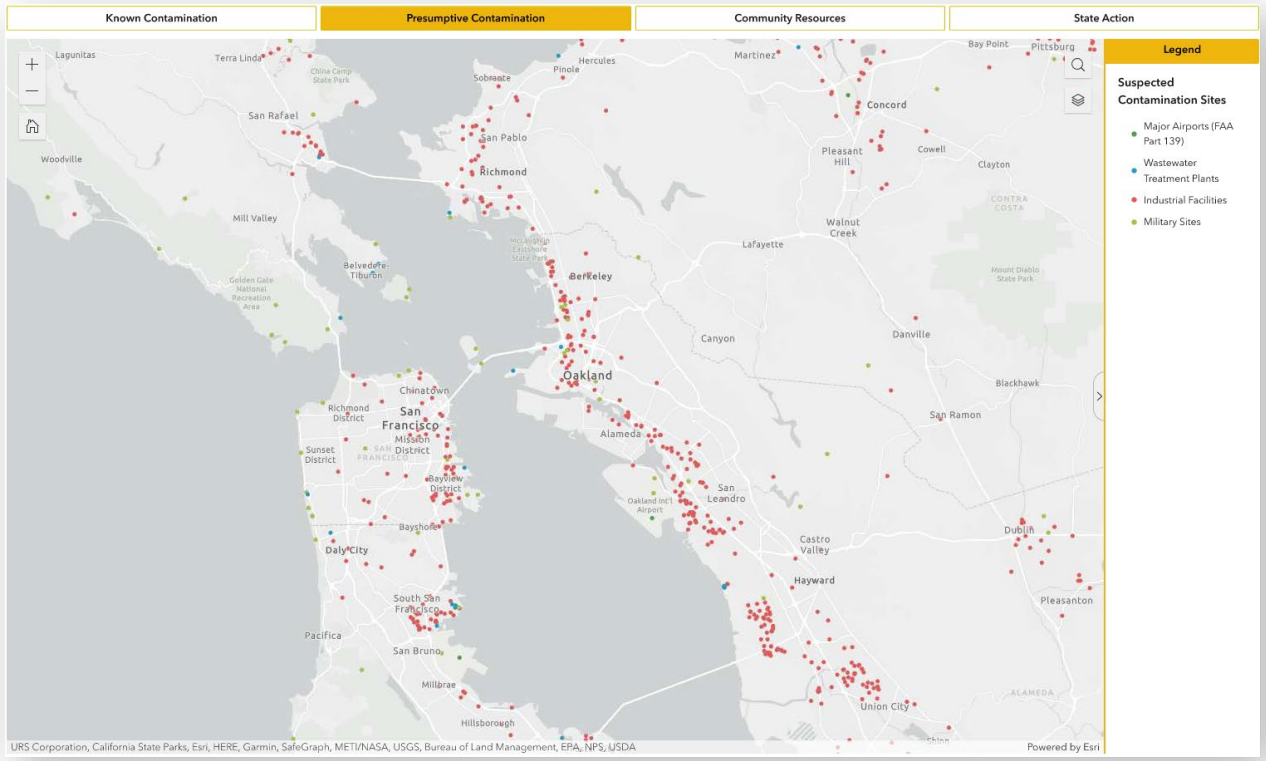

(Google Maps)




***Aerial Elizabeth River Watershed***
(Google Maps)

# WCSD Research – Potential Resources

- Google Earth
- Internet search – news articles, fire department incident reports
- State and federal environmental databases
  - Several states manage known contaminated sites databases
- Commercial environmental databases, such as EDR, Inc.
- Publicly available online databases
  - PFAS Sites and Community Resources Esri GIS Platform




***Presumptive Contamination Map – PFAS Sites and Community Resources Esri GIS Platform*** (pfasproject.com)

EDR: Environmental Data Resources, Inc.
GIS: geographic information system

# Background PFAS – Research Summary

- Atmospheric and rainwater transport of PFAS may result in background levels of PFAS in groundwater and soil at levels greater than plantwide applicability limits (Pike et al, 2021)
  - Atmospheric transport associated with stack and other air emissions
  - Concentrations of PFAS in rainwater ranging from 50–850 ng/L
- In a compiled dataset of > 30,000 samples collected from > 2,500 sites worldwide, PFAS were present in almost all soil samples, even in remote regions far from potential PFAS sources (Brusseau et al. 2020)
- A meta-analysis of 21,000 data points compiled from 96 publications indicated presence of PFAS in groundwater, surface water, soil, and precipitation in all regions tested, including areas far removed from PFAS sources (Johnson et al. 2022)
- PFAS were detected extensively in Vermont soils with PFOS detected in 100% of background soil samples ranging from 0.1 to 9.7 µg/kg (Zhu et al., 2019)

KEY POINT

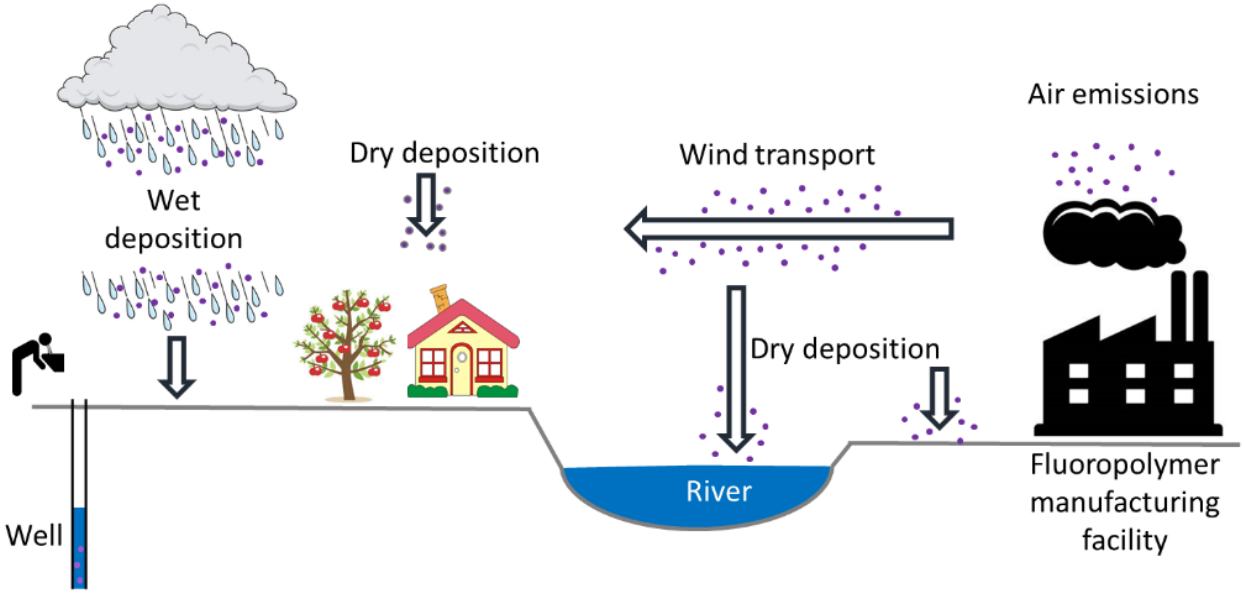
**Evidence from the peer-reviewed literature indicates existence of background PFAS concentrations in all media types, even in remote areas far removed from potential PFAS sources.**

µg/kg: microgram(s) per kilogram
ng/L: nanogram(s) per liter

# Identifying Background and Off-site Sources for PFAS

- No PFAS background investigations completed at DON installations
- A basewide PFAS background study may be valuable if there are release areas potentially impacted by non-Navy sources
  - These studies may help with determining remediation goals
- Engage technical support early and often

IMPORTANT




(EPA 2023)

# Presentation Overview

- Department of the Navy PFAS Investigations
- PFAS Investigation Planning
- PFAS Sampling
  - Sampling Considerations
  - Field Best Practices
  - Analytical Best Practices
- Site Inspection Data Evaluation
- Key Points

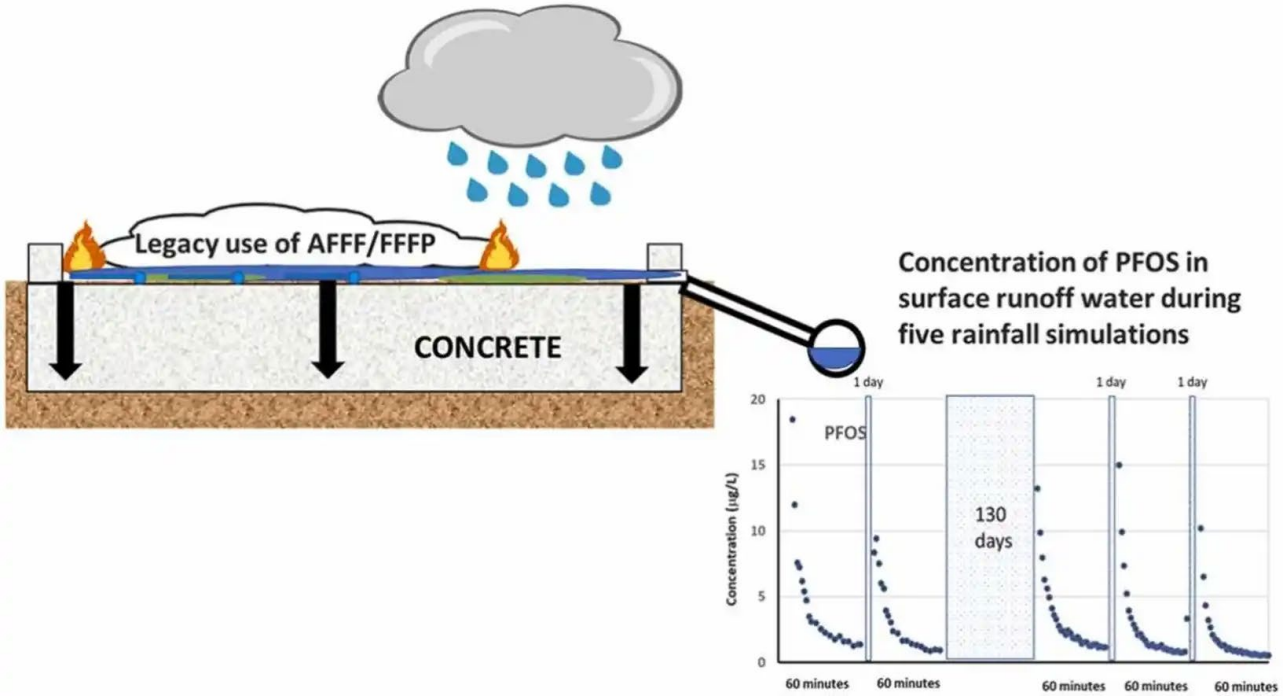
# Sampling Considerations: Groundwater

- Permanent Wells and Low Flow Sampling Methods
  - Preferred for use in risk assessments and for site management decisions
  - Surficial aquifer monitoring wells should be screened across the air-water interface
  - Samples should be collected from the middle of the saturated zone
  - If wells were installed prior to requirement for use of materials not containing PFAS, discuss uncertainties as needed
    - If many wells fall in this category and all have similar low levels of the same PFAS, consider the potential for cross contamination from well construction materials
- Direct Push Technology (DPT) Samples
  - DPT groundwater data may contain suspended particulate matter
  - Consider centrifuging samples prior to analysis
  - Useful for delineation purposes
  - Limitations on use of data must be clear in SAP

(Kermaida.com)

# Sampling Considerations: Groundwater

- Sample location selection considerations:
  - Evaluate potential impact of runoff and storm water conveyance systems
    - PFAS may be transported in surface water and infiltrate into groundwater
  - Environmental sequence stratigraphy may be useful to place wells at sites with evidence of geologic preferential pathways
- In addition to PFAS, the following data may support the CSM and assist in understanding migration and transformation potential
  - Dissolved oxygen
  - ORP
  - pH
  - TOD
  - Common anions and cations

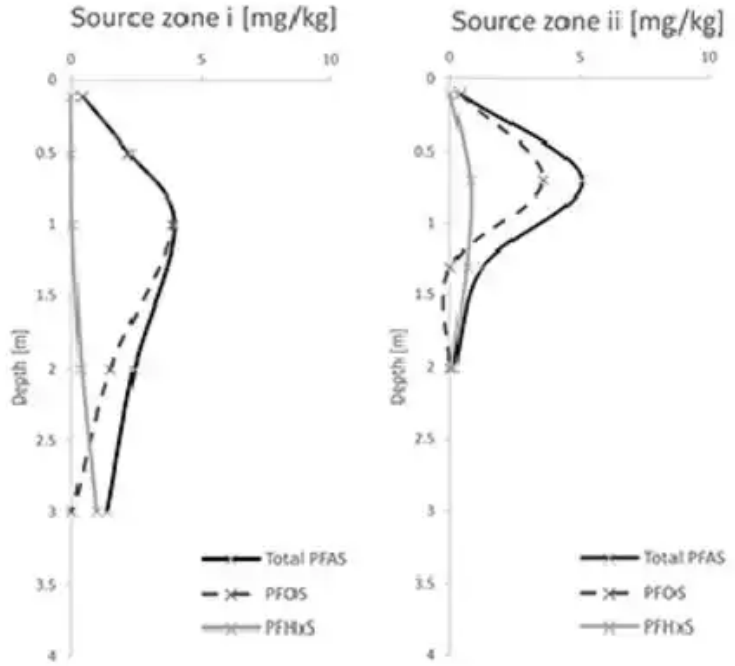



(Thai et al. 2022)

ORP: oxidation-reduction potential TOD: total oxygen demand

# Sampling Considerations: Soils

- Sample Location Selection Considerations
  - Sample different soil horizons may be beneficial in the RI to assess higher concentration strata and migration as well as vertical extent
  - Delineation should consider the extent of PFAS that pose unacceptable risk from direct exposure and the extent of PFAS which may leach to groundwater at levels of concern
- Site-specific leaching studies may assist in determining project action limits for use in delineation of soil
- Consider collecting concurrent pH, TOD, TOC, anion/cation exchange capacity (subset of samples), and redox measurements to address potential for desorption

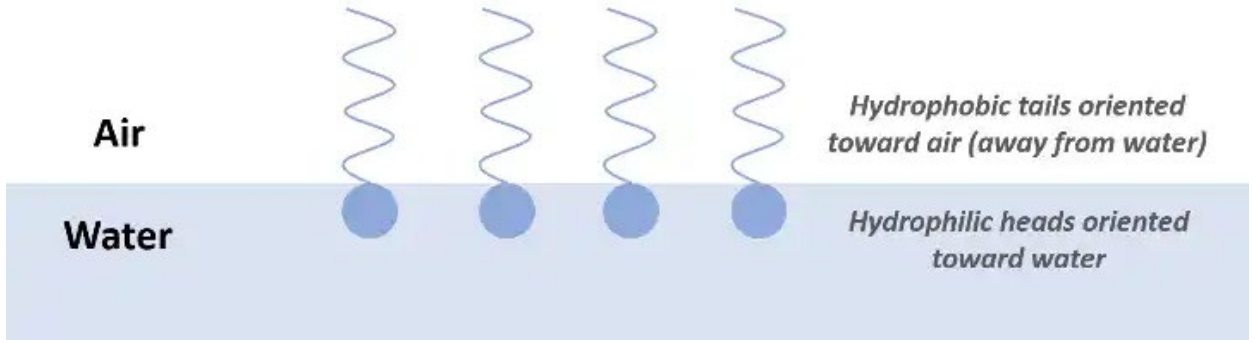



***PFAS Soil Depth Profiles***
(Wallis et al. 2022)

TOC: total organic carbon

# Sampling Considerations: Surface Water & Sediment

- Collect surface water samples prior to sediment samples to avoid introduction of particulates into sample
- Collection of samples from a stream, river, etc.
  - Sample downstream to upstream
  - Sampling recommended during base flow conditions (not during or within 48 hours after storm event)
- Surface water depth interval sampling dependent on the identified data quality objectives
  - Typically collected within the water column for risk assessment
  - Concentrations at the air-water interface could be higher and may be useful for some types of treatment planning




(GSI Environmental)

# Sampling Considerations: Biota Tissue

- Only consider biota sampling if there is a confirmed PFAS release to abiotic media AND there is complete pathway for biota exposure
- Consider previous aquatic biota sampling that may have been performed by State representatives for PFAS
- Before developing SAP, conduct a site survey to determine if fish/shellfish can be collected
- During analysis consider including the use of standard reference material (e.g., NIST standards) to add to the QA/QC of such sampling

KEY POINT

**RPMs should discuss potential need to sample biota with their ER Manager and HQ.**

ER: environmental restoration
HQ: headquarters
NIST: National Institute of Standards and Technology
QA/QC: quality assurance/quality control

# Sampling Considerations: Air

- US EPA currently developing air method OTM 50
- Method will be finalized summer 2023
- Labs will have to be accredited for OTM 50

KEY POINT

**Air sampling is not currently recommended.**

# Presentation Overview

- Department of the Navy PFAS Investigations
- PFAS Investigation Planning
- PFAS Sampling
  - Sampling Considerations
  - Field Best Practices
  - Analytical Best Practices
- Site Inspection Data Evaluation
- Key Points

# PFAS in Sampling Materials

| Category | Material | Target PFAS (µg/m²) | Total PIGE (F/m²) |
|---|---|---|---|
| Prestaging | First Aid packaging and adhesive wrapper | PFBA - 0.88, PFHxA 0.68 PFHpA 0.22, 0.40 PFBS 1.1, PFOS 0.19,0.32, PFOA 0.09, 3.9 | 660,000 ± 83,000 |
| Staging | PTFE tape | PFOA 4.4 and 27 | 56,000,000 ± 11,000,000 |
| | Aluminum Foil (non-stick only) | PFOA 4.4 PFBS 4.5 | |
| | Label backing | 6:2 FTS - 2.7 8:2 FTS - 5.7 | 63,000 ± 13,000 |
| | Paper towel | PFOS 1.1, 3.8 | |
| | Lab notebook | PFHxA 1.4 PFOS 2.2,1.7 | |
| Sample Collection | PVC liner | | 10,000 ± 3,300 |
| | Nitrile glove packaging | | 160,000 ± 33,000 |
| Shipping | Marker | PFOA 83 | 16,000 ± 5,700 |
| | Cold pack | | 250,000 ± 33,000 |
| | Tape (duct) | PFBS 0.77 | |

*Dryer sheets, nitrile gloves, caulk, resin, white glue, core bag, plastic bags, resin were all nondetect.*

KEY POINT

**Although there were detects, these materials must come into direct contact with the sample for there to be cross contamination. It is advised to avoid PFAS-containing materials as much as reasonably possible and prevent cross contamination.**

(Rodowa 2020)

µg/m²: microgram(s) per square meter
F/m²: fluorine per square meter
PFBA: perfluorobutanoic acid
PFHxA: perfluorohexanoic acid
PFHpA: perfluoroheptanoic acid
PIGE: particle-induced gamma-ray emission
PTFE: polytetrafluoroethylene
PVC: polyvinyl chloride

# Cross-Contamination Avoidance

| PROHIBITED Materials and Equipment |
|---|
| Teflon®-containing materials, when possible, should be avoided (e.g., tubing, bailers, tape, and plumbing paste). In cases where Teflon®-containing materials are unavoidable, ensure adequate purging is performed prior to sampling (e.g., in-well pumps) and/or rinse blanks are collected prior to sampling. |
| LDPE-containing materials (e.g., bags or containers used to transport samples) |
| Paper products such as waterproof field books, plastic clipboards, binders, spiral hard cover notebooks, sticky notes or glue materials |
| Markers |
| Chemical (blue) ice packs |
| Decontamination soaps containing fluoro-surfactants such as Decon 90 |
| Water that is not verified to be “PFAS-free” to be used for trip and decontamination blanks and decontamination processes |
| Water-resistant, waterproof, stain-treated clothing or shoes including Gore-Tex™ and Tyvek® materials |


LDPE: low-density polyethylene

# Recommended Materials and Equipment

| Recommended Materials and Equipment |
|---|
| HDPE and silicon – Materials include: tubing, bailers, tape, plumbing paste |
| Acetate liners for direct push technologies |
| Nitrile gloves – Change often |
| Loose paper with Masonite or aluminum clipboards |
| Pens |
| Bags of ice |
| Alconox® or Liquinox® |
| Laboratory supplied and verified "PFAS-free" water to be used for trip and decontamination blanks and decontamination processes |
| Cotton construction is recommended for field clothing and should be well-laundered from time of purchase due to possible PFAS-related treatments. Fabric softener must be avoided. Rain gear should be made from polyurethane and wax-coated materials. |

KEY POINT

**Refer to the ITRC PFAS Sampling and Analytical Methods for specifics on acceptable and prohibited material and equipment for PFAS sampling.**

HDPE: high-density polyethylene
ITRC: Interstate Technology and Regulatory Council

# Equipment Selection

- When possible, field teams should:
  - Thoroughly decontaminate sampling equipment with hinges and difficult-to-access cavities
  - Pay special attention to areas where particles can become trapped
- Field teams should be briefed on the importance of extremely thorough decontamination and should bring a flashlight to inspect smaller diameter hand augers
- SI and RI reports should include all results for field and equipment blanks

*Thoroughly decontaminate before/after sample collection*

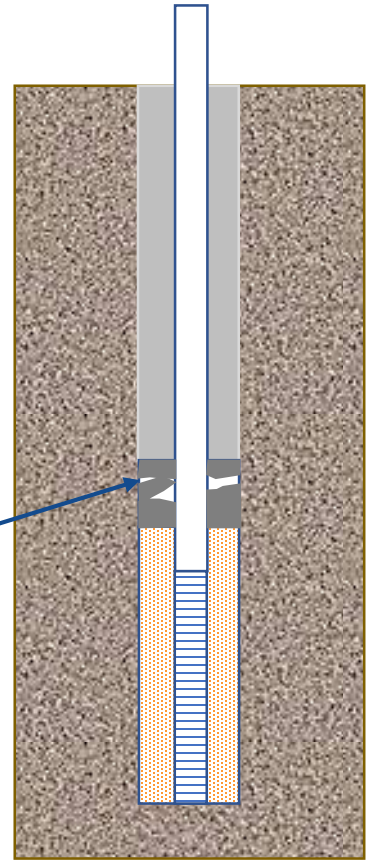
# Greases and Teflon Tape

- Greases and thread compounds may be composed of fluorinated chemicals
  - Can result in equipment blank detections and rejected data
  - SAPs/SOPs should specifically prohibit use of all fluorine-containing greases and specify use of vegetable-based greases such as Biolube
  - Field teams should check all drilling supplies upon arrival onsite
- Drillers often use Teflon tape or other similar tapes on threading to make it easier to break split spoons and rods
  - Not permitted – especially problematic on split spoons and hand augers which come in direct contact with samples


SOP: Standard Operating Procedure

# Bentonite Formulations

- Uncoated bentonite chips are used to seal wells during installation
- Coated bentonite pellets are used to prevent bridging of bentonite in the annular space around well casing
- NAVFAC/Jacobs/Battelle study indicated presence of PFAS in bentonite pellets



# NAVFAC/Jacobs/Battelle Bentonite Study Results

- Pellet samples were leached for 24 hours, and leachate was analyzed
  - One or more PFAS were detected in all samples
  - Control sample and uncoated pellets contained PFBA at comparable concentrations
  - Coated pellet leachate results indicated the presence of PFBA, PFPeA, and PFHxA at higher concentrations than the control and uncoated pellets
  - Triple coated pellet concentrations were roughly triple the concentration of the single coated pellets, supporting the premise that the pellet coating was the source of PFAS
  - Resultant groundwater concentration increases in the immediate vicinity of wells based on a 2-foot seal were estimated to be ~0.5 ng/L (PFBA, triple coated pellets)
- NAVFAC EXWC currently completing additional leaching studies using bentonite pellets from multiple suppliers
  - Preliminary TOF results also indicate the presence of fluorinated organic compounds in coated bentonite pellets

KEY POINT

**Given the low screening levels for PFAS, coated bentonite formulations should be avoided as much as possible – SAPs/SOPs/SOWs should specify avoidance of coated bentonite.**

PFPeA: perfluoropentanoic acid
SOW: scope of work
TOF: total organofluorine

# Concrete Formulations

- Fluorinated surfactants are used in shrink- and crack-resistant concrete formulations (Kissa, 1994)

KEY POINT

**SAPs/SOPs/SOWs should prohibit use of these fluorinated surfactant formulations in well pad construction.**

(Hawkston Drilling 2023)

# Drilling and Decontamination Water

- Potable water is used during drilling events:
  - To minimize impacts of running sands which can inundate hollow stem augers
  - For cooling core barrels
  - For steam decontamination of heavy equipment (augers, rigs, sonic coring equipment)

| | Unit | MRL | Maximum Concentration | Range |
|---|---|---|---|---|
| PFOA | ppt | 2.0 | 4.3 | < 2.0–4.3 |
| PFOS | ppt | 2.0 | 5.9 | 3.1–5.9 |
| Total PFAS | ppt | 2.0 | 9.1 | 4.4–9.1 |

Example of municipality water results where use of water for drilling would not be recommended

- Project teams should demonstrate potable water source is free of PFAS to the greatest extent practicable
- Recent sampling results as part of UCMR 3
  - Publicly available recent sampling results collected for other purposes
  - Detections should be less than current RSLs based on a hazard quotient of 0.1
  - Results for municipal water sources may vary from round to round, so check all recent rounds
  - Collect a project-specific source water blank if no appropriate data are available

MRL: minimum reporting limit  UCMR 3: Fifth Unregulated Contaminant Monitoring Rule
ppt: part(s) per trillion

# Drilling and Decontamination Water

- Collection of source blank samples
  - Include source blank sample in SAP
  - Arrange for sampling of source water with sufficient time to receive results before field mobilization
  - Contractor will need to work with drilling subcontractor to agree on possible water sources prior to sampling/SAP development
  - Analyze using US EPA Draft Method 1633 (no need to use drinking water method)
  - If concentrations exceed RSLs based on a hazard quotient of 0.1, use another source of water
- Regardless of the water source used, the volume added to the formation during drilling plus standard development volume (typically three well volumes) should be evacuated during development

# Drilling Methods

- DPT sampling
  - Good for undisturbed soil samples – depth and soil type limited
  - Groundwater samples may be turbid
- Hollow stem auger
  - Generates more IDW than sonic drilling methods
  - Soil samples typically undisturbed
  - Borehole can be converted to a well; less turbid groundwater samples due to development and purging
- Sonic drilling
  - Generates less IDW than hollow stem auger
  - Field geologist must be more cognizant of centralizing PVC screen and casing because annular space is often slightly less than what is achieved with hollow stem auger
- Rotary drilling and rock coring
  - Appropriate for bedrock aquifers

IDW: investigation-derived waste

# Presentation Overview

- Department of the Navy PFAS Investigations
- PFAS Investigation Planning
- PFAS Sampling
  - Sampling Considerations
  - Field Best Practices
  - Analytical Best Practices
- Site Inspection Data Evaluation
- Key Points

# US EPA Draft Method 1633 v3

- US EPA and DoD's SERDP partnered to produce Draft Method 1633, *Analysis of Per- and Polyfluoroalkyl Substances in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS*
- Method addresses up to 40 PFAS (including PFBA and fluorotelomers) in wastewater, surface water, groundwater, soil, biosolids, sediment, landfill leachate, and fish tissue
- DoD December 7, 2021 *Update for Establishing a Consistent Methodology for the Analysis of Per- and Polyfluoroalkyl Substances in Media Other than Drinking Water*:

  "All new contracts and task orders after December 31, 2021, shall require the use of Draft Method 1633 for the analysis for PFAS in matrices other than drinking water using a laboratory accredited to the method/matrix/analyte by the DoD Environmental Laboratory Accreditation Program (ELAP). All existing projects are encouraged to use Draft Method 1633 for PFAS analysis in matrices other than drinking water when ELAP-accredited laboratories become available."

KEY POINT

**New contracts and task orders after December 2021 to use US EPA Draft Method 1633. Once finalized, all existing contracts required to use US EPA Method 1633.**

LC-MS/MS: liquid chromatography-mass spectrometry/mass spectrometry
SERDP: Strategic Environmental Research and Development Program

# US EPA Draft Method 1633 v3

- Older “modified” method, LC-MS/MS Compliant with QSM Table B-15 being phased out
- Must use DoD ELAP accredited laboratory under **QSM 5.4 Table B-24**
  - Confirm lab is accredited for all of the analytes and environmental media needed: https://www.denix.osd.mil/edqw/accreditation/accreditedlabs/
- Fourth draft due Summer 2023
  - “Will incorporate the final QC acceptance criteria for all aqueous matrices (surface water, groundwater, and wastewater), derived from multi-lab validation study” (US EPA, 2023)
- Final due by end of 2023
  - “Will include the final QC acceptance for all eight environmental matrices (wastewater, surface water, groundwater, soil, biosolids, sediment, landfill leachate, and fish tissue), derived from the multi-lab validation study” (US EPA, 2023)

QSM: quality systems manual

# US EPA Method 537.1

- Applicable to drinking water only
  - Includes 18 PFAS
  - Cannot expand list without method modification
  - Does not include PFBA or fluorotelomer sulfonates
- Use for finished, raw, and mid-point treatment system drinking water samples for installation, public, and private drinking water wells, systems, or other drinking water sources

KEY POINT

**DoD policy requires use of this method for drinking water.**

# Analytical Methods Not Currently in Use (as of April 2023)

- US EPA Method 533: drinking water
- SW-846 Method 8327: surface water, groundwater, and wastewater screening method for 24 analytes

# US EPA Methods 537.1, 533, and 1633 Analyte Comparison

| Analyte | EPA 533 | EPA 537.1 | EPA 1633 |
|---|---|---|---|
| 11Cl-PF3OUdS | x | x | x |
| 9Cl-PF3ONS | x | x | x |
| ADONA | x | x | x |
| HFPO-DA | x | x | x |
| PFBS | x | x | x |
| PFDA | x | x | x |
| PFDoA | x | x | x |
| PFHpA | x | x | x |
| PFHxA | x | x | x |
| PFHxS | x | x | x |
| PFNA | x | x | x |
| PFOA | x | x | x |
| PFOS | x | x | x |
| PFUnA | x | x | x |
| 4:2FTS | x | | x |
| 6:2FTS | x | | x |
| 8:2FTS | x | | x |
| NFDHA | x | | x |
| PFBA | x | | x |
| PFEESA | x | | x |

| Analyte | EPA 533 | EPA 537.1 | EPA 1633 |
|---|---|---|---|
| PFHpS | x | | x |
| PFMBA | x | | x |
| PFMPA | x | | x |
| PFPeA | x | | x |
| PFPeS | x | | x |
| NEtFOSAA | | x | x |
| NMeFOSAA | | x | x |
| PFTeDA or PFTA | | x | x |
| PFTrDA | | x | x |
| NEtFOSA | | | x |
| NMeFOSA | | | x |
| NEtFOSE | | | x |
| NMeFOSE | | | x |
| 3:3FTCA | | | x |
| 5:3FTCA | | | x |
| 7:3FTCA | | | x |
| PFOSA | | | x |
| PFDoS | | | x |
| PFDS | | | x |
| PFNS | | | x |

# Presentation Overview

- Department of the Navy PFAS Investigations
- PFAS Investigation Planning
- PFAS Sampling
  - Sampling Considerations
  - Field Best Practices
  - Analytical Best Practices
- Site Inspection Data Evaluation
- Key Points

# Data Validation Guidelines

## Non-Drinking Water

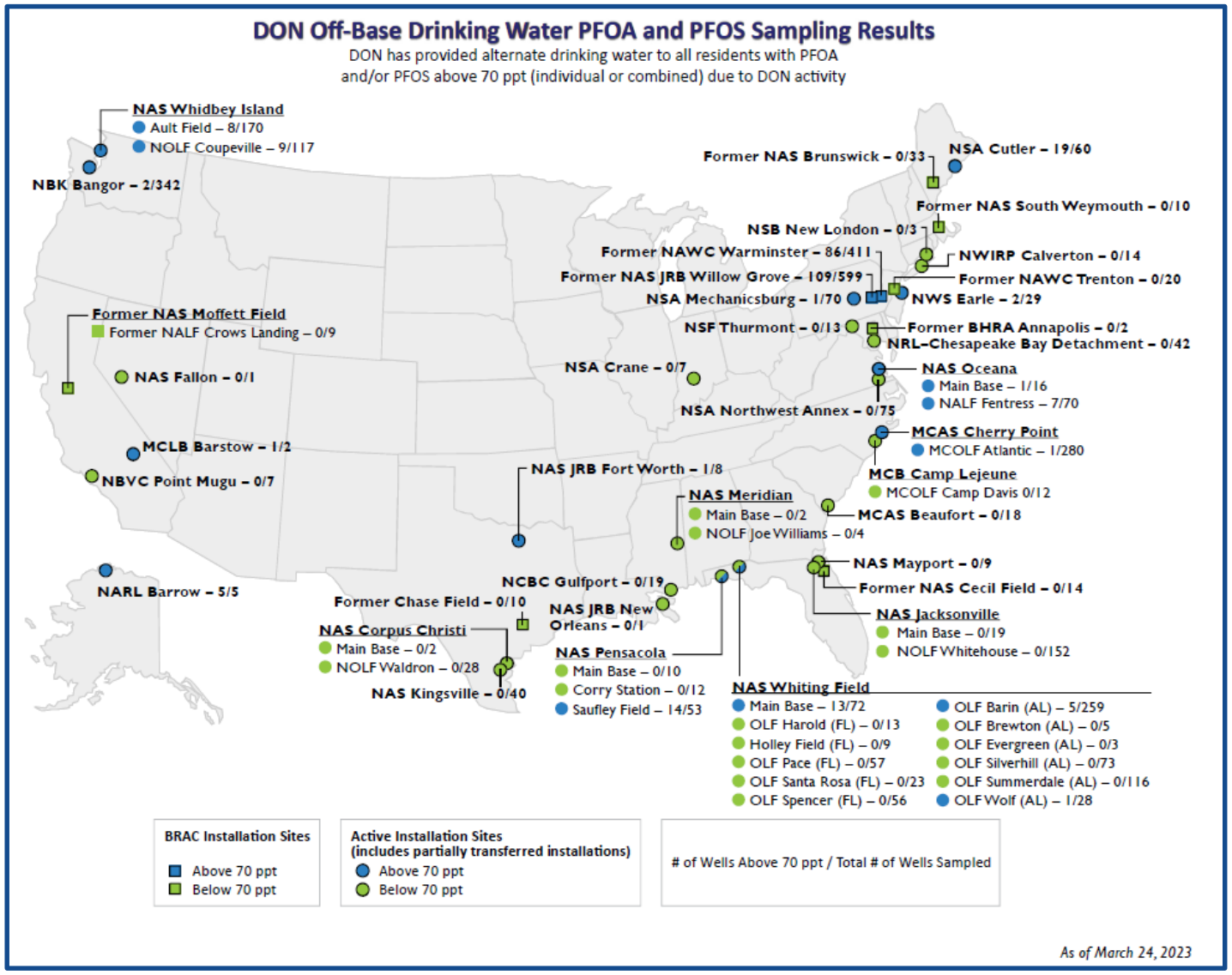
- *Data Validation Guidelines Module 6: Data Validation Procedure for Per- and Polyfluoroalkyl Substances Analysis by QSM Table B-24* (DoD, Oct 2022)
  - Covers data validation for US EPA Draft Method 1633
  - Can be found at https://www.denix.osd.mil/edqw/
  - Should be referred to in SAP Worksheets 34–36

## Drinking Water

- *Data Review and Validation Guidelines for Perfluoroalkyl Substances (PFASs) Analyzed Using EPA Method 537* (US EPA, Nov 2018)
  - Covers data validation for US EPA Method 537.1
  - Can be found at https://nepis.epa.gov
  - Should be referred to in SAP Worksheets 34–36

# DON Off-Base Drinking Water PFAS Sampling

- Planning for off-base drinking water sampling:
  - Outreach work plan
  - SAP
  - Outreach materials
    - Fact sheets
    - Posters
    - Mailings
  - Preparation session and public meeting
  - Engage NAVFAC Atlantic and NMCPHC early



# Off-Base Drinking Water Sampling for PFAS

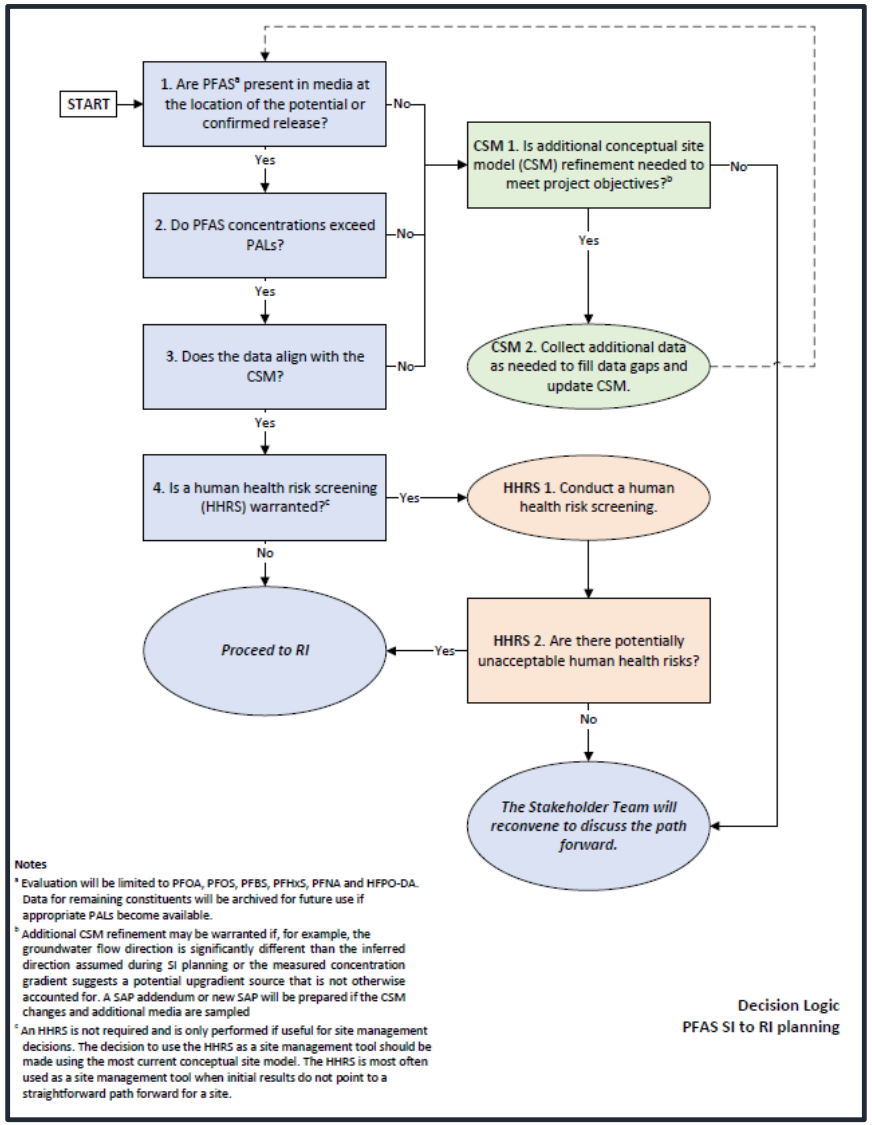
- "Priority 1" identification in 2016 in response to June 20, 2016, Navy policy
- Identification and evaluation of off-base drinking water sources in PFAS PA
- Continually re-evaluated
  - New information about off-base drinking water sources
  - New PFAS AOIs are identified
  - Groundwater flow understanding refined
  - New groundwater data; PFOA and PFOS compared to 70 ppt (individually or combined)
- Contractor should notify RPM immediately if there is evidence of off-base drinking water impacts

# Off-Base Drinking Water: Proficiency Test (PT) Sample

- A PT sample is a deionized water sample spiked with known concentrations of chemicals of interest and sent blind to the lab with drinking water samples
- Include PT samples during off-base drinking water sampling
  - PT samples should include known concentrations of PFOA, PFOS, and PFBS
  - Spiked concentrations of the three PFAS should be within the same order of magnitude
  - The sum of PFOA and PFOS should be just above 70 ppt
  - Sent to analytical lab as blind sample

# SI to RI Strategy

- Review approved SI SAPs for decision logic and data evaluation, and/or
- Aim to have draft or final report submitted by September 30, 2023
- Final PA/SI reports should be submitted to regulators by December 27, 2023
  - Agree-to-disagree language available (approved by OSD)
- Upcoming OER2 webinar for PFAS RI planning in September 2023




OER2: Open Environmental Restoration Resource
OSD: Office of the Secretary of Defense

# Site Inspection Data Evaluation Considerations

- Questions to ask before moving AOI to the RI:
  - Are the highest concentrations on the upgradient edge of the AOI with lower concentrations in the suspected release area?
  - Could the detected concentrations be associated with another, upgradient Navy or non-Navy site?
  - Are all soil concentrations non-detect at an unpaved site?
  - Are concentrations consistent across the site/low levels, possibly consistent with background or well installation impacts?
  - How reliable are your data?
    - DPT or permanent wells?
    - PFAS-free construction?
- If a release associated with the area of interest cannot be confirmed based on the data collected, a second phase of SI or addressing the detections within a larger AOC of clustered release areas may be appropriate

AOC: area of concern
AOI: area of interest

# Human Health Risk Screening

Perform a human health risk screening in the SI only when needed for site management decisions

- If sample concentrations exceed the RSLs based on a hazard quotient of 1 and PFAS present are site-related, move to RI
- If sample concentrations exceed the RSLs based on a hazard quotient of 1, but PFAS may not be site-related, proceed to second phase of SI or address PFAS as part of more likely release area, if nearby
- If sample concentrations do not exceed the RSLs based on a hazard quotient of 1, but exceed based on a hazard quotient of 0.1 and are site-related, consider performing a human health risk screening and use results in conjunction with other site data to determine a path forward

# Presentation Overview

- Department of the Navy PFAS Investigations
- PFAS Investigation Planning
- PFAS Sampling
  - Sampling Considerations
  - Field Best Practices
  - Analytical Best Practices
- Site Inspection Data Evaluation
- Key Points

# Key Take Away Points

- Ensure all Navy guidance, policy, and sampling considerations are followed during site investigations
- RPMs should discuss potential need to sample biota with their ER Manager and HQ
- Air sampling is not currently recommended
- Avoid materials that contain PFAS when sampling
- DoD policy requires use of US EPA Method 537.1 for drinking water samples
- During off-base drinking water sampling include PT samples with known concentrations of PFOA, PFOS, and PFBS

# Points of Contact


**Katie Tippin (NAVFAC Atlantic)**

- kathryn.z.tippin.civ@us.navy.mil
- (757) 322-8425

**Laura Cook (NAVFAC Atlantic)**

- laura.j.cook@navy.mil
- (757) 322-4025

**Nicolette Andrzejczyk (NAVFAC EXWC)**

- nicolette.e.andrzejczyk.civ@us.navy.mil
- (805) 982-1934

**Kim Brown (NAVFAC HQ)**

- kim.p.brown4.civ@us.navy.mil
- (202) 685-0096

**Ramona Iery (NAVFAC EXWC)**

- ramona.iery.civ@us.navy.mil
- (805) 982-5575

**Dave Barclift (BRAC PMO)**

- david.j.barclift.civ@us.navy.mil
- (215) 897-4913


PMO: Program Management Office

# Resources

1. ITRC PFAS Factsheet: Sampling Precautions and Laboratory Analytical Methods https://pfas-1.itrcweb.org/wp-content/uploads/2022/09/Sampling_and_Lab_PFAS_Fact-Sheet_082522_508.pdf
2. ITRC PFAS Document: 11. Sampling and Analytical Methods https://pfas-1.itrcweb.org/11-sampling-and-analytical-methods/

# References


- Alix E. Rodowa, Emerson Christie, Jane Sedlak, Graham F. Peaslee, Dorin Bogdan, Bill DiGuiseppi, and Jennifer A. Field. 2020. Field Sampling Materials Unlikely Source of Contamination for Perfluoroalkyl and Polyfluoroalkyl Substances in Field Samples. *Environmental Science & Technology Letters* 2020, 7, 3, 156–163
- EPA. Community Multiscale Air Quality Modeling System (CMAQ). Simulating PFAS Fate and Transport in Air with CMAQ. Accessed May 2023. https://www.epa.gov/cmaq/simulating-pfas-fate-and-transport-air-cmaq
- Presumptive Contamination Map. PFAS Sites and Community Resources Esri GIS Platform. Accessed May 2023. https://pfasproject.com/pfas-sites-and-community-resources/
- Thai, P. K., McDonough, J. T., Key, T. A., Thompson, J., Prasad, P., Porman, S., & Mueller, J. F. 2022. Release of perfluoroalkyl substances from AFFF-impacted concrete in a firefighting training ground (FTG) under repeated rainfall simulations. *Journal of Hazardous Materials Letters*, *3*, 100050.
- Wallis, I., Hutson, J., Davis, G., Kookana, R., Rayner, J., & Prommer, H. 2022. Model-based identification of vadose zone controls on PFAS mobility under semi-arid climate conditions. *Water Research*, *225*, 119096.

NAVFAC
Naval Facilities Engineering Systems Command
EXWC Engineering and Expeditionary Warfare Center

# Questions