Department of the Air Force

One Team, One Fight!

Air Force PFAS Fingerprint and Background Studies

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PFAS Fingerprint and Background Study

- **The DAF is working to proactively address PFAS impacts associated with previous installation activities to protect human health and the environment.**
- **Addressing PFAS impacts presents many challenges, including**
  - rapidly-changing regulatory landscape
  - frequent advances in PFAS understanding
  - the large number of potential PFAS sources and their ubiquitous nature in the environment

Project Team

- **Project Team Members bring multiple disciplines including engineers, geologists, chemists, safety professionals, program and project management expertise, technical subject matter experts, and a thorough understanding of each installation**
- **Department of the Air Force (AFCEC and Air National Guard)**
  - Program/Project Management
  - Chemistry, Hydrogeology, and fingerprint/background study subject matter experts
  - Remedial Project Managers at the installations
  - Support Contractors for technical document review
- **U.S. Army Corps of Engineers**
  - Contract Management
  - Program/Project Management
  - Technical Support
  - Regional USACE District Office Support and installation expertise
- **Prime Contractor Oneida/Sustainment and Restoration Services**
  - Project Management and Field Sampling Expertise
- **SRS's Teaming Partner Battelle**
  - Concept Development, Chemistry Support

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ONEIDA Sustainment and Restoration Services

One Team, One Fight!

Regulatory Partnerships

- **Regulatory Partnerships**
  - Regulatory leadership engaged at Tier I, II, and III levels
  - USEPA Federal Facilities Restoration and Reuse Office (FFRRO) reviewed programmatic documents
  - USEPA, State, and local regulatory stakeholders engaged for project planning document review and input

What is PFAS?

- **A group of man-made chemicals used to make fluoropolymer coatings and products that resist heat, oil, stains, grease, and water**
  - Used since the 1940s in a wide variety of consumer products
    - Commercial household products: stain- and water-repellent fabrics, nonstick products (e.g., Teflon™), polishes, waxes, paints, cleaning products
    - Food packaged in PFAS-containing materials
  - Production facilities or industries (e.g., chrome plating, electronics manufacturing, and oil recovery)
  - Development of these chemicals increased after a deadly fire aboard the Navy aircraft carrier USS Forrestal in 1967
    - Aqueous film-forming foams (AFFF) commonly used starting circa 1970 for petroleum fires at airports and military bases for firefighting/training

USS Forrestal; 1967 onboard fire

Air Force AFFF Usage

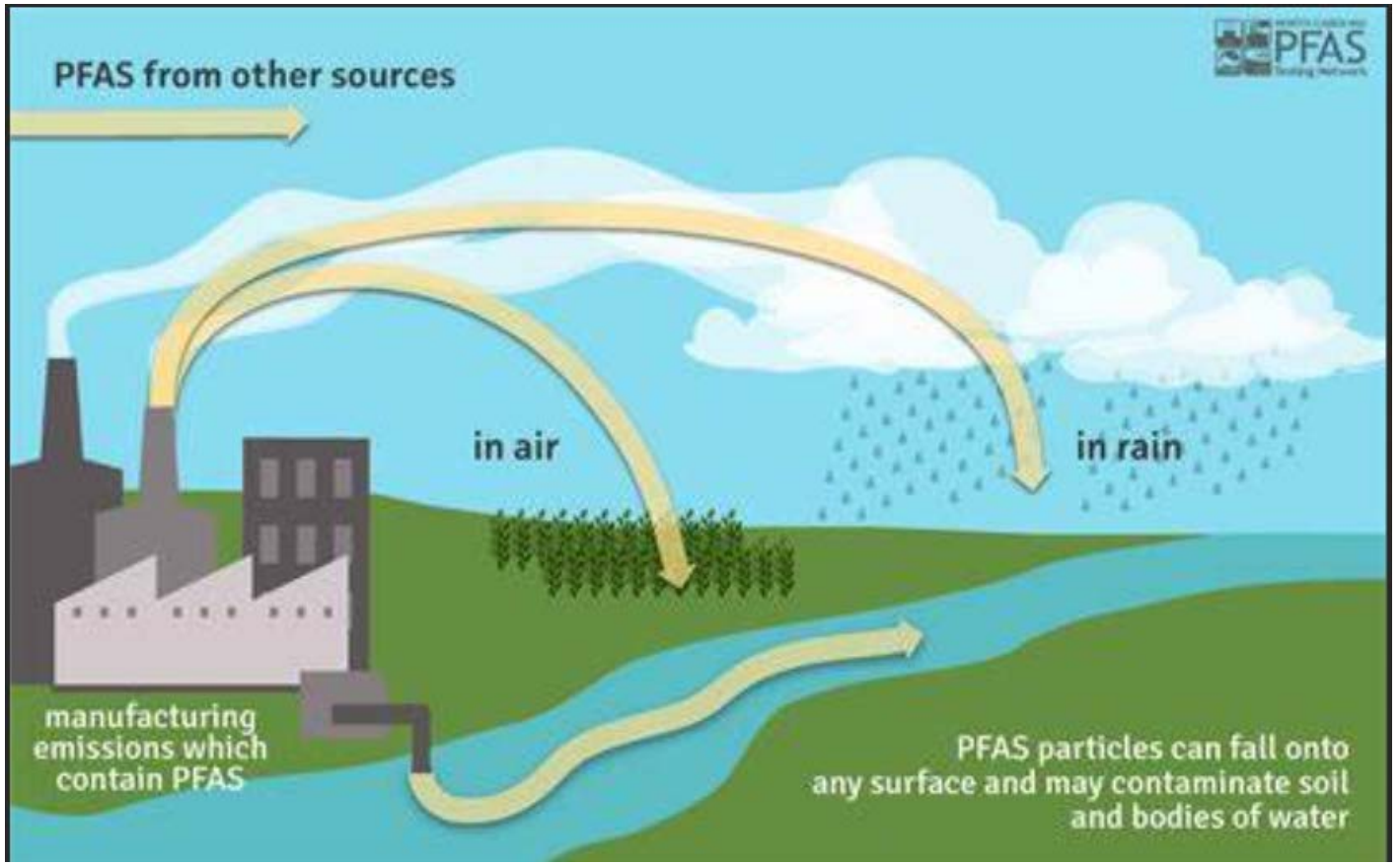
- **U.S. DoD Class B (i.e., fuel) fire protection**
  - Before 1970: protein-based foams
  - After 1970: AFFF (C-8)
  - After late 2010's: AFFF (C-6)
- **Fire Fighting (petroleum fires) with associated equipment testing**
- **All installations with a flying mission contain at least one fire training area**
  - Before ~1990: unlined infrastructure
  - After ~1990: engineered facilities
- **Hangars were designed with automatic fire suppression systems that used AFFF; majority transitioned to water in the past ± 2 years**

Additional Sources of PFAS in the Environment

- **PFAS originate from many sources, including:**
  - Production/application of waterproof, stain-proof, and grease-proof coatings
  - Agricultural use (pesticide and herbicide formulations; biosolids)
  - Painting Stations
  - Metal/chrome plating, electroplating, and etching facilities
  - Landfills
  - The list goes on…..
- **Many PFAS compounds may be used in different products and processes**
  - Because there are so many (>4000) different PFAS compounds, it is challenging to identify sources of observed PFAS

Anthropogenic Background

- **PFAS are man-made chemicals**
  - Do not naturally occur in the environment
  - Presence based on anthropogenic sources associated with atmospheric deposition
  - Focusing on soil background only during this project



Study Locations

- **A Fingerprint and Background Study project was awarded in September 2023 that includes the following installations:**
  - Des Moines ANGB, Iowa
  - Dover AFB, Delaware
  - Eielson AFB, Alaska
  - Stewart ANGB, New York
  - Travis AFB, California
  - Wright Patterson AFB, Ohio
  - Tucson Area, including Morris ANGB and Air Force Plant 44, Arizona

Project Approach

- **Installation-specific kick off calls**
- **On-site scoping meetings**
  - Conceptual Site Model (CSM) Development
  - Identify and ground truth sample locations
- **Planning documents (Combined WP/QAPP)**
  - Programmatic UFP-QAPP with Installation-specific UFP-QAPP Addenda
  - Programmatic Accident Prevention Plan with Installation-specific Site Safety and Health Plans
  - Regulatory stakeholder engagement
- **Installation Planning and Coordination**
  - Right of Entry/Access Agreements for off-installation sample locations
  - Flightline access, waivers, driving requirements, escorts
  - Cultural/natural resource teams for sample location and monitoring requirements
- **Continuous schedule coordination with Installation and laboratory**

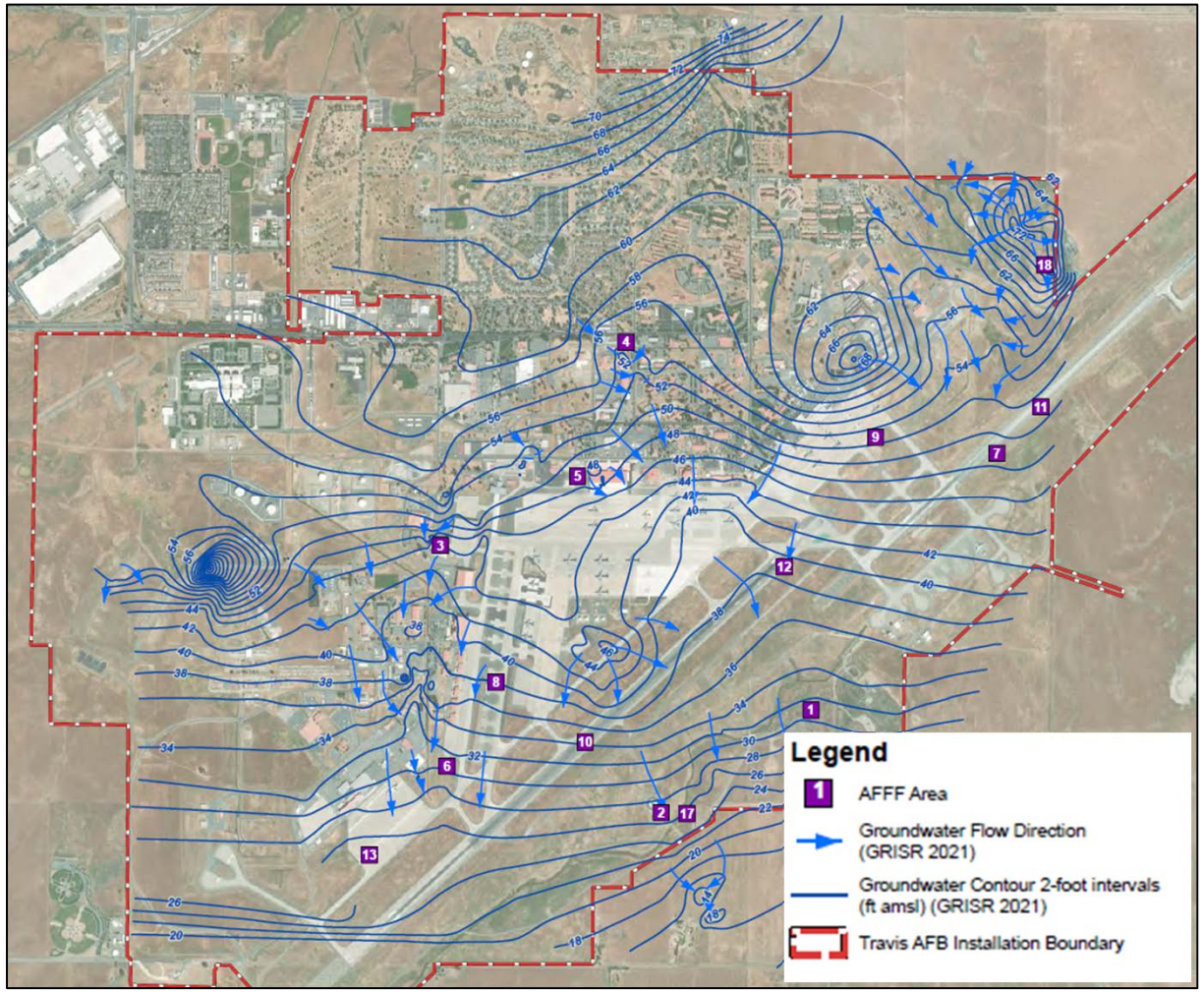
Air Force, Oneida SRS, and Battelle representatives evaluating sample locations at an on-site scoping meeting at Wright Patterson AFB. Photo Credit: Oneida SRS

Project Approach

- **Background Study**
  - Sampling soil
  - Testing for 40 PFAS compounds using EPA Method 1633 and for 520 PFAS compounds using PFAS Signature®
  - Develop anthropogenic background levels
- **Fingerprint Study**
  - Sampling soil, groundwater, and surface water
  - Testing for 40 PFAS compounds using EPA Method 1633 and for 520 PFAS compounds using PFAS Signature®
  - Comparison against database of PFAS sources
  - Select samples testing for TOC and metals to support additional lines of evidence
- **Data validation (EPA Method 1633), review, and evaluation**
- **Installation-specific reports**

Project Approach

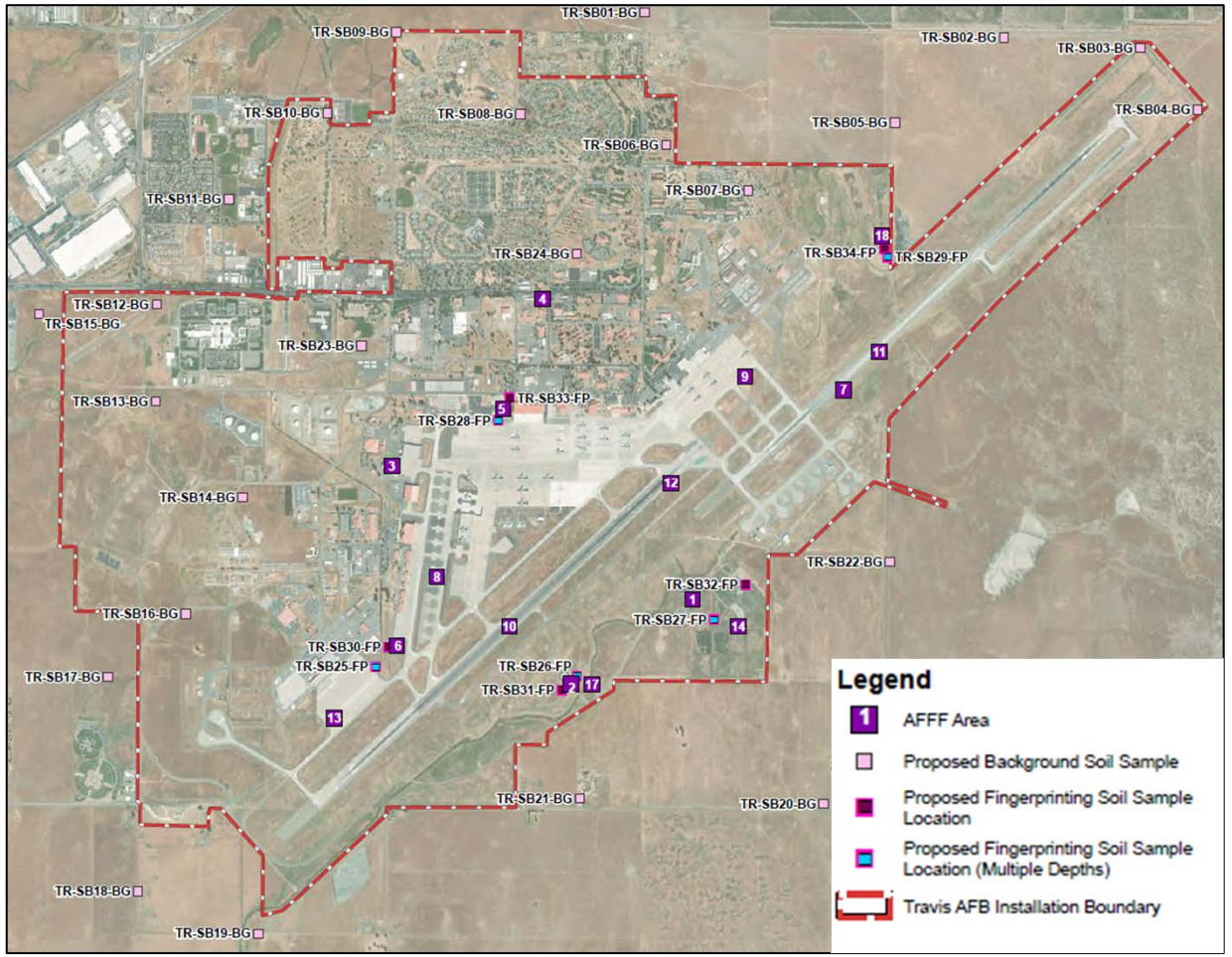
- **CSM Development**
  - Data compilation from multiple database sources, GIS, and documents
  - Evaluate PFAS and other analytical data available to date
  - Develop understanding of hydrogeologic framework evaluated using sequence stratigraphy
  - Current and past land uses and legacy contaminant sites, potential PFAS source areas, and installation infrastructure such as sanitary and storm water conveyance systems



Travis AFB Proposed Soil Sampling - UFP-QAPP Addendum (SRS, 2024)

Project Approach

- **Sampling location selection considers**
  - PFAS source area types
  - Known distribution of PFAS impacts including concentrations / relative proportions of PFAS constituents
  - Installation-wide CSM information
  - Suspected/potential PFAS source areas not investigated to date
  - Consideration of accessibility, sensitive resources or habitat areas, etc.
  - Background study samples collected in areas not expected to be impacted



Travis AFB Proposed Soil Sampling - UFP-QAPP Addendum (SRS, 2024)

Analytical Methods

- **Soil, groundwater, and surface water samples will be collected and analyzed to understand the types of PFAS constituents present**

Analytical Tool	Analytical Methods Included	PFAS Analytes
PFAS Fingerprinting Study (PFAS Signature®)	EPA 1633 Targeted analysis – Quantitative	40 target analytes
	High Resolution Mass Spectral Method – Suspect Screening Analysis -Qualitative	520 Suspect screening analytes
	Machine Learning Analysis using Suspect screening data	520 Suspect screening analytes
PFAS Background Study	EPA 1633 Targeted analysis – Quantitative	40 target analytes
	High Resolution Mass Spectral Method – Suspect Screening Analysis – Semi-Quantitative	520 Suspect screening analytes
	Multivariate Analysis using Quantitative and Semi-Quantitative analysis data	40 target analytes and 520 Suspect screening analytes

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- EPA 1633 is the “standard” PFAS analytical method in widespread use for measuring PFAS concentrations in soil and water matrices
- EPA 1633 generates a concentration (numerical value) for each PFAS compound that it measures
- All samples collected for the Background and Fingerprinting Study will be analyzed using EPA 1633

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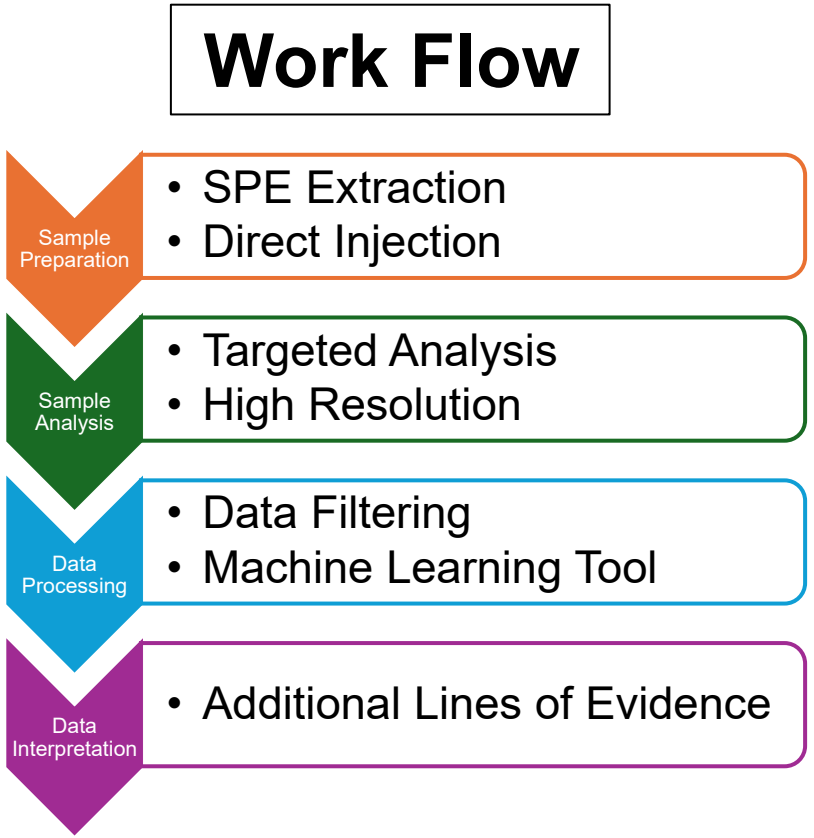
- Battelle's PFAS Signature® is a new forensic analytical approach that has two steps:
  - High resolution mass spectrometry to determine precise makeup ("fingerprint") of 520 different PFAS in a sample
  - Machine learning ("AI") to compare each sample's fingerprint against a database of known PFAS compositions from different sources
- The background study samples will also be analyzed using the high-resolution mass spectrometry analysis followed by multivariate analysis to compare the background data with the on-site concentrations

Additional Lines of Evidence and Work Flow

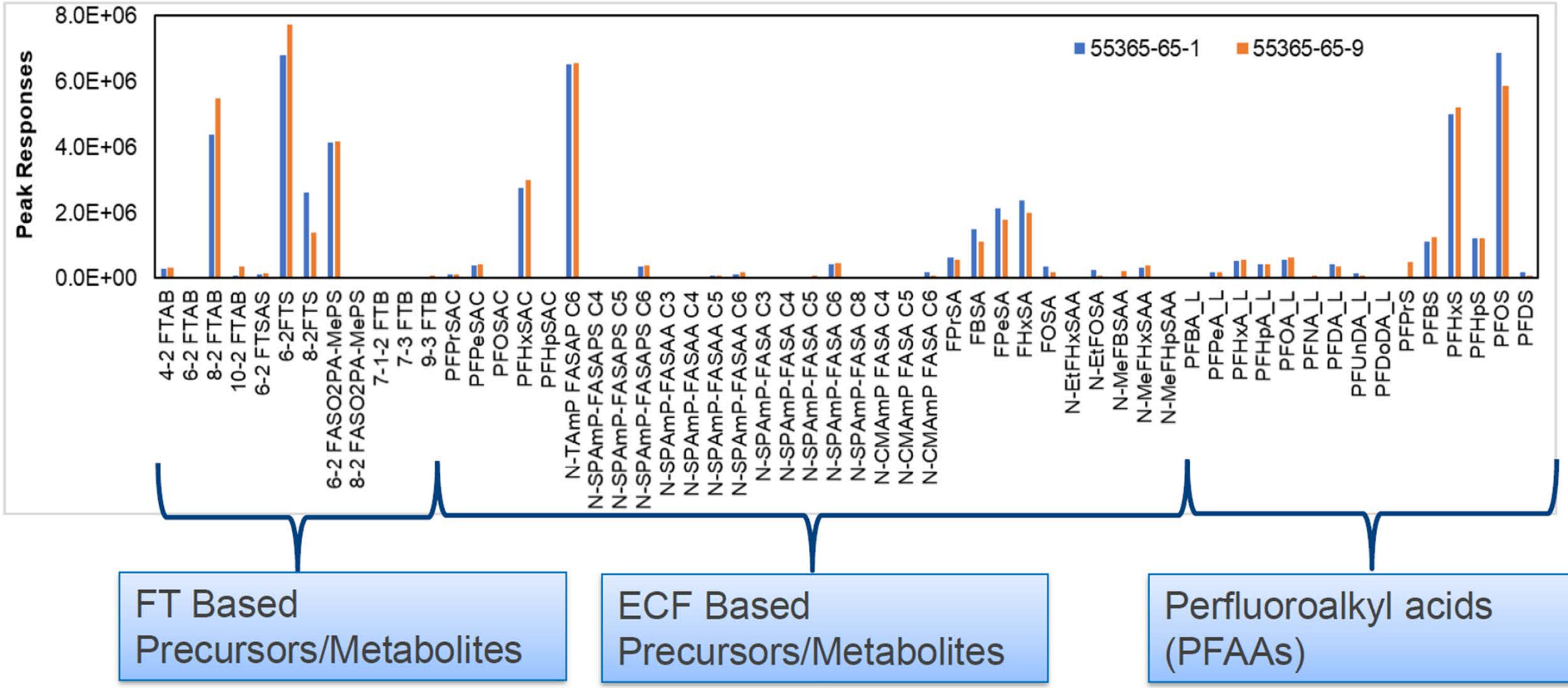
- **Multiple Lines of Evidence**
  - Site history
  - Source knowledge
  - Understanding the Fate & Transport
  - Database and patent searches
  - Conceptual site models
  - Data gap analysis
  - Due diligence investigations



PFAS Signature® Step 1 High Resolution Mass Spectrometry

- **Identifies up to 520 different PFAS compounds (versus 40 with traditional EPA 1633 analytical method)**
- **Step 1 will be used to support both the Fingerprinting and Background Studies**
  - Background Study: Provides a more detailed understanding of types and relative amounts of the PFAS compounds present at background (ambient) levels in the environment
  - Fingerprinting Study: Provides a more detailed understanding of types and relative amounts of the PFAS compounds present in areas with known PFAS impacts

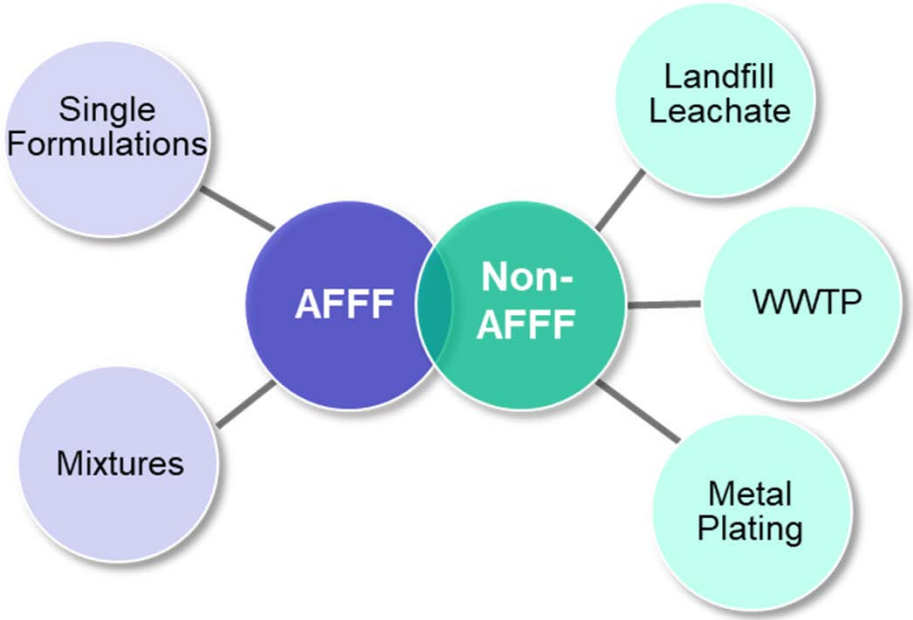
PFAS Signature® Step 1
High Resolution Mass Spectrometry



Example mass spectrometer output. Courtesy of Battelle.

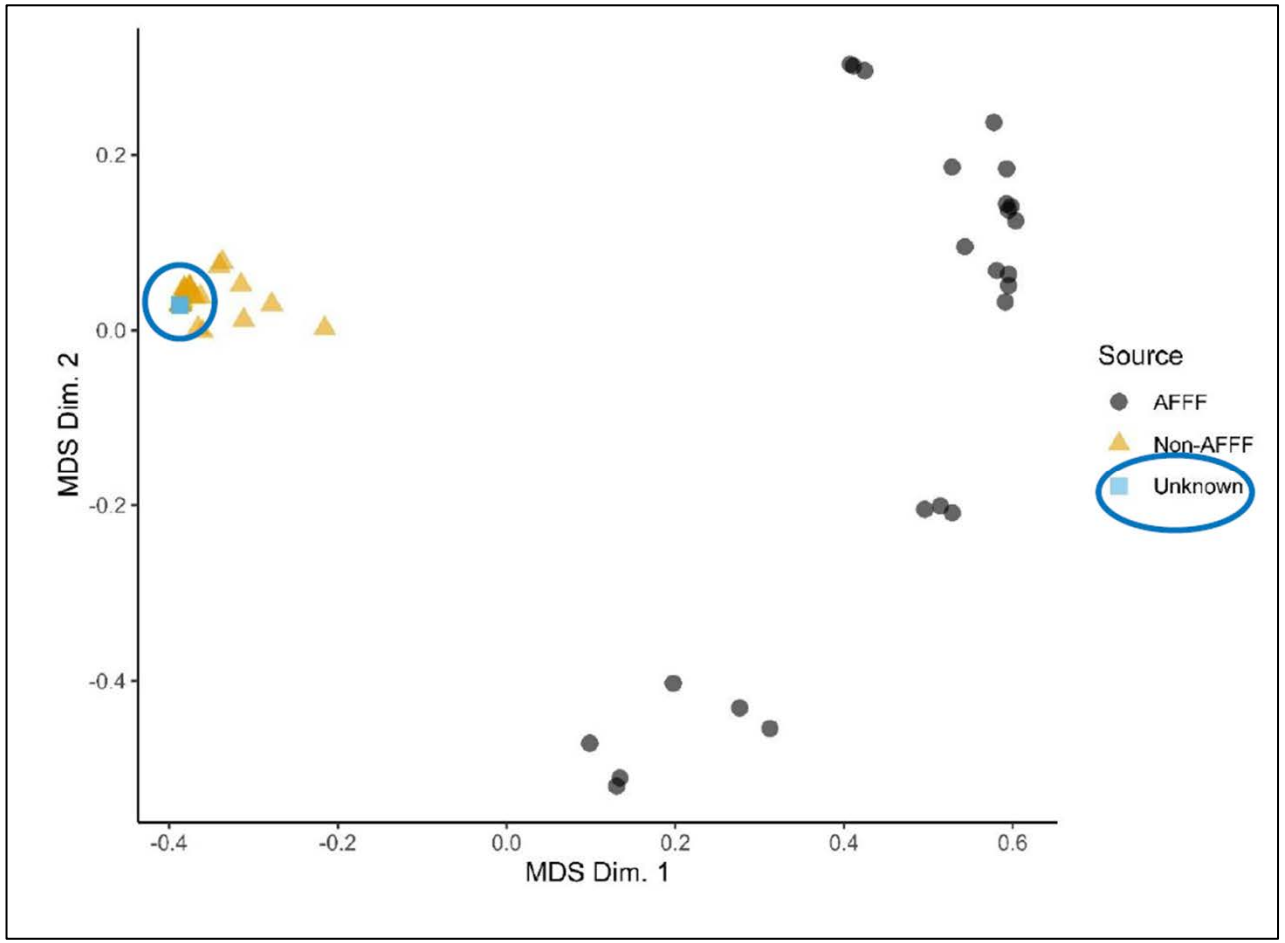
PFAS Signature® Step 2 Machine Learning

- **Step 2 will be used to support the Fingerprinting Study only**
- **Dataset generated from Step 1 is compared against a database of known PFAS source compositions, including (but not limited to):**
  - AFFF Formulations and AFFF-impacted Sites
  - Waste Water treatment plants (WWTP)
  - Biosolid applied soils
  - Landfill Leachate
  - Paper/Textile Manufacturing and Products
  - Septic
  - Commercial Products
  - Metal Plating
- **Database is continually updated as more source data is generated**



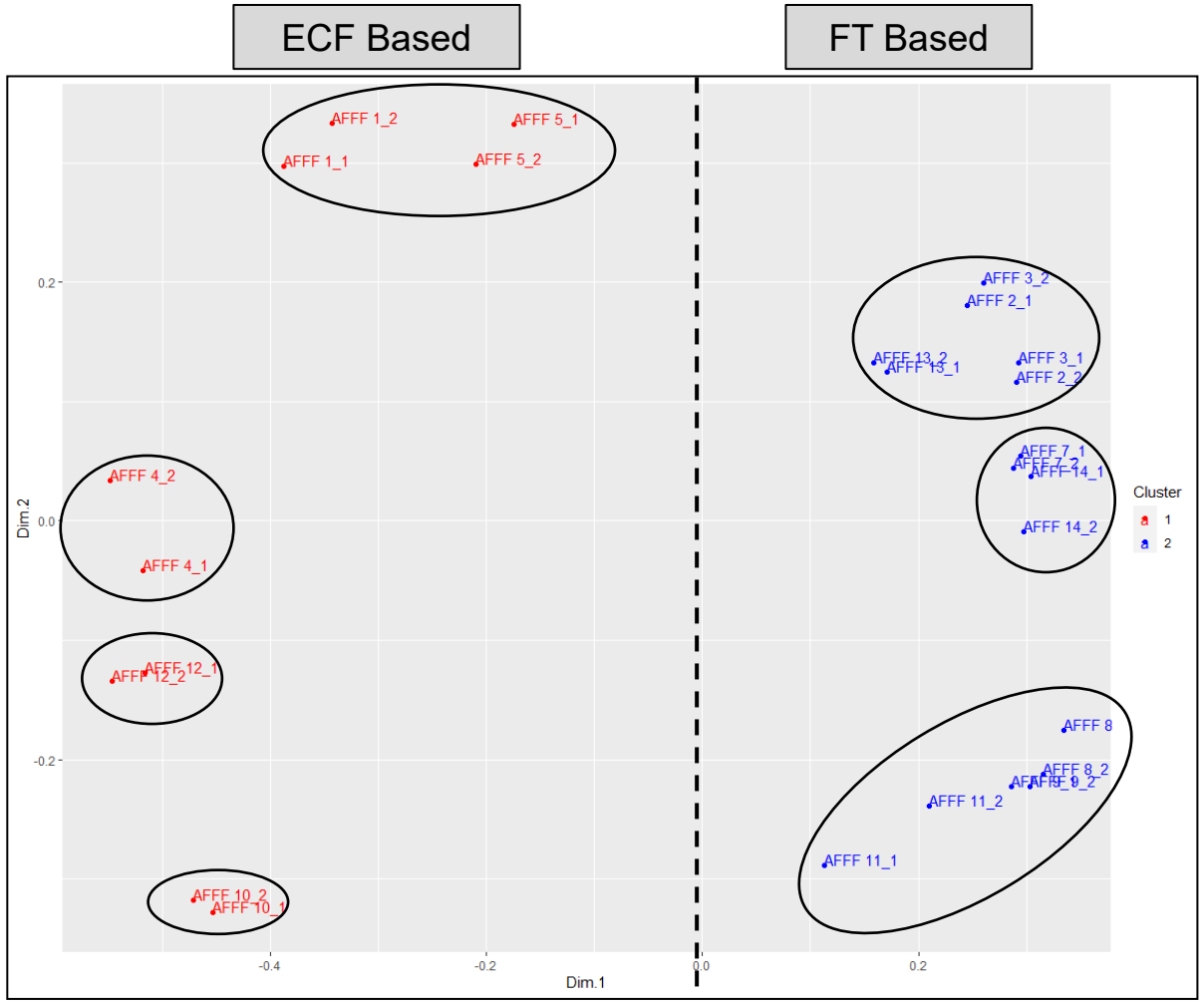
Battelle PFAS Signature® Step 2 Machine Learning

- **Machine learning ("AI") is used to determine a likely match/matches of the measured PFAS composition in a sample vs. the known PFAS compositions included in the database**
  - This step assesses how the unknown sample compares to the database to understand the similarities and differences between unknown and known sources



Courtesy of Battelle

Battelle PFAS Signature® Step 2 Machine Learning



Courtesy of Battelle

- Discriminates AFFF chemistry and formulations
- Not only discriminates FT-based and ECF chemistries, but also AFFF formulations from different vendors.
- Identification of unknown manufacturing source

Partnering for Success

- **Project success lies within strong communication and partnering**
  - Continuous coordination and communication programmatically and with each unique installation program
  - Respectful document review and comment resolution for progress
  - Project teams working together with RI contractor, CSM projects, or other ongoing installation studies to coordinate data exchange and field activities
  - Overcoming challenges of respecting installation and regulatory-specific policies while maintaining programmatic consistency
  - Working between field and laboratory teams to deploy new and exciting analytical tool with so many varied installation considerations and stakeholders

Questions

Questions?

Thank you!