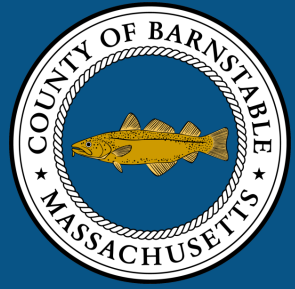


Barnstable County

REGIONAL GOVERNMENT OF CAPE COD

FORMER MUNICIPAL FIRE TRAINING FACILITY (MFTF)
RELEASE TRACKING NUMBER (RTN) 4-26179
PFAS RELEASE RESPONSE PROGRESS UPDATE
NOVEMBER 12, 2024

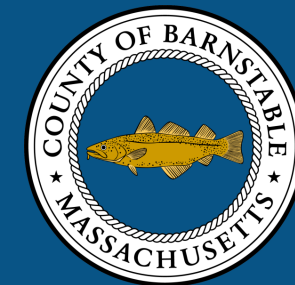
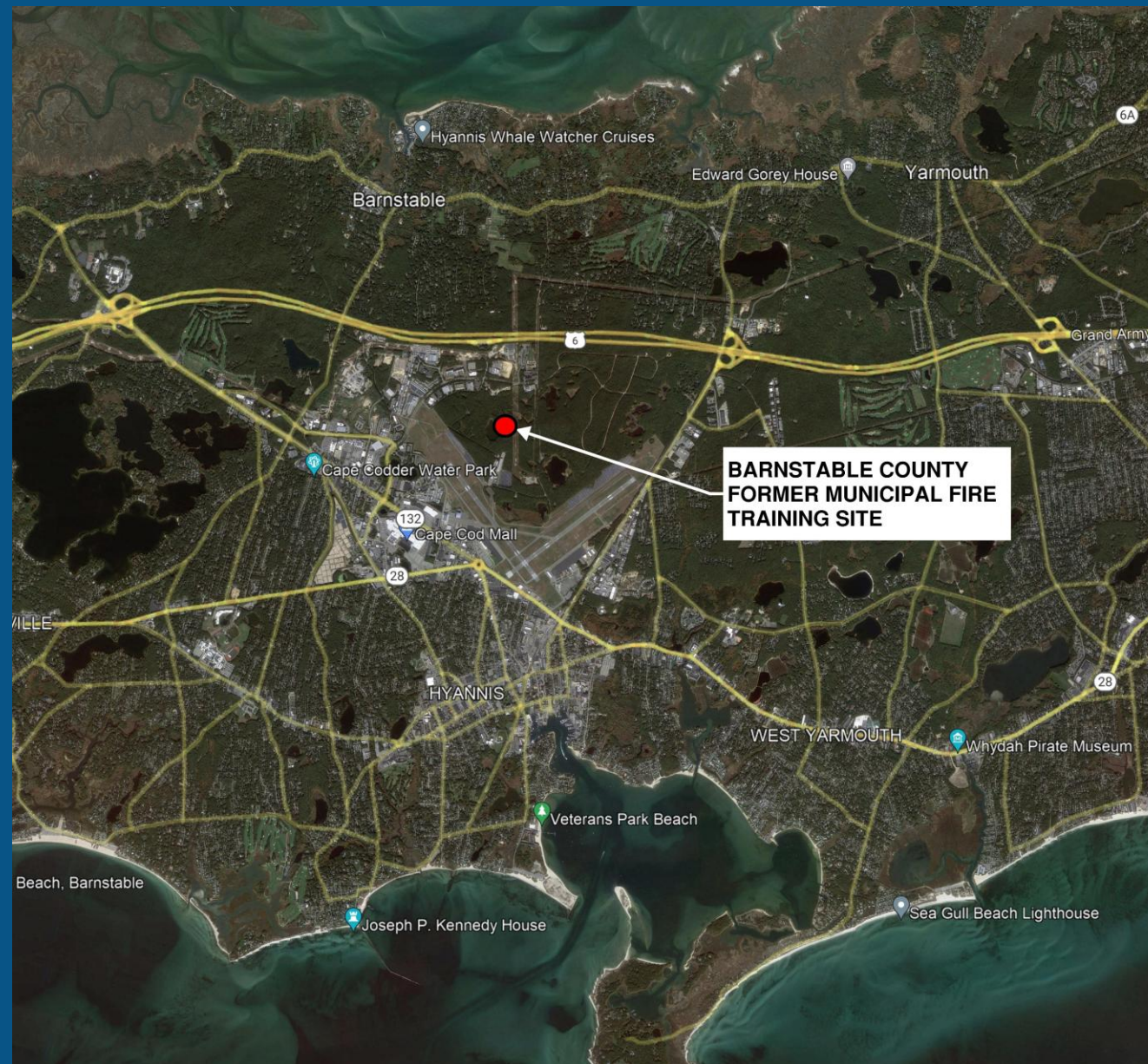


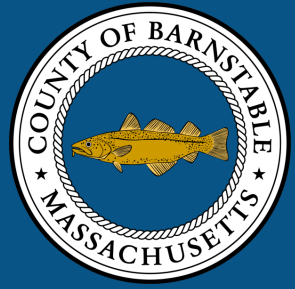
Agenda

- Site Overview
- Site Assessment Updates
- Conceptual Site Model
- Remediation Updates
- Next Steps
- Discussion / Questions

Site Locus

- 155 South Flint Rock Road, Hyannis, MA





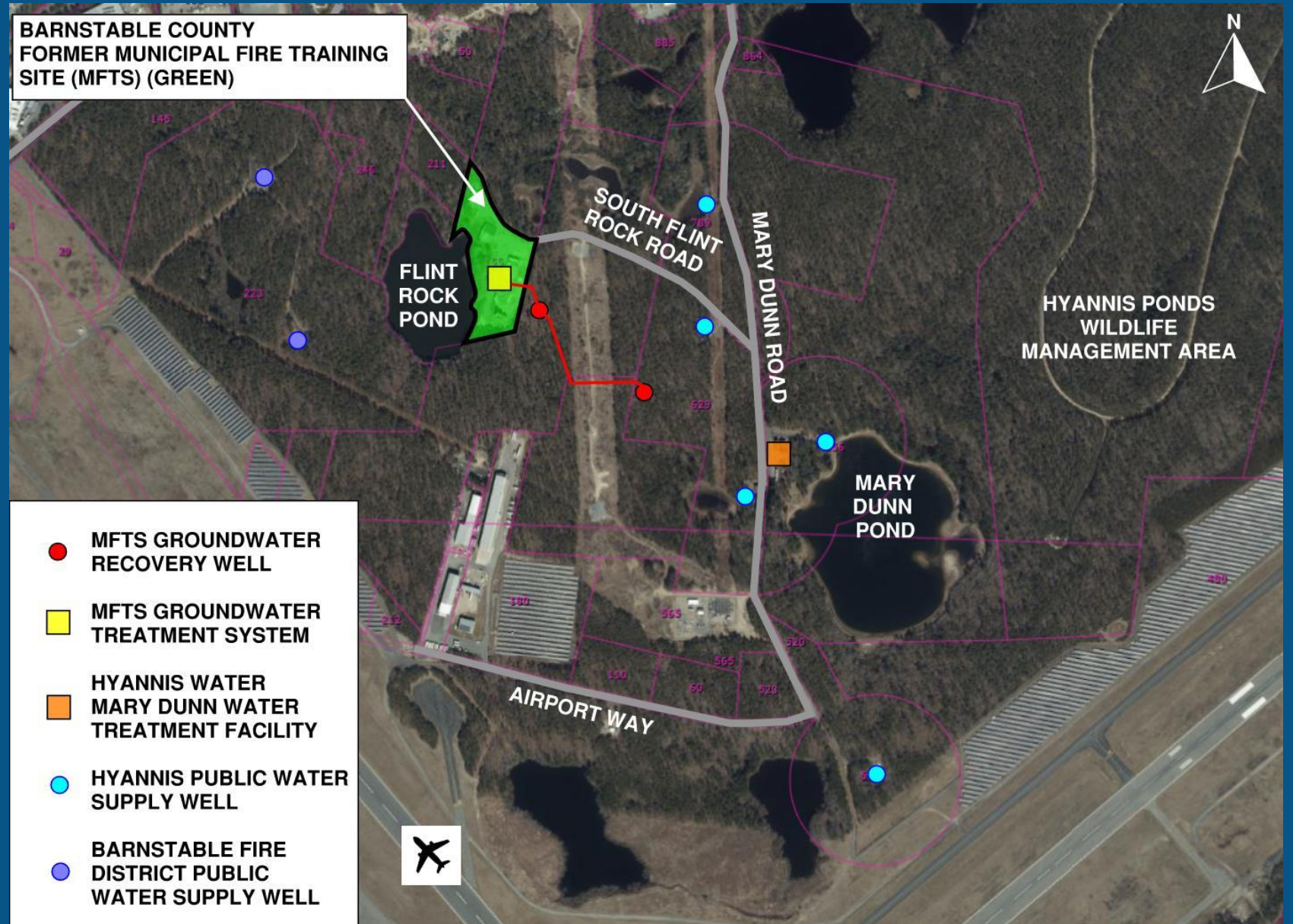
Former Municipal Fire Training Facility History

- 1959 to 1983 owned by others and operated by Hyannis Fire Department.
- 1987 to 2019 made available to towns by the County.
- Utilized by all Cape Cod Fire Departments for critical and necessary life-saving training exercises.
- The Towns participated in education and essential training that they otherwise could not afford.
- Trained with AFFF (aqueous film forming foams) from 1959-2009, provided by individual Fire Departments (i.e., the County did not purchase foam and has no Site usage records).
- Water training exercises ceased in 2019.



Project History

- Public water supply wells impacted by PFAS
- Hot spot soil removed (200 tons of soil)
- Site capped
- Groundwater treatment system in operation





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GZA Progress Update

Former Municipal Fire Training Facility (MFTF)





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Overall Project Approach

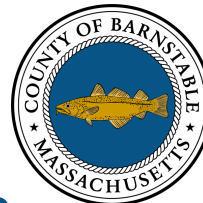
- GZA engaged in May 2024
- MCP compliance
- Holistic / Regional approach (MFTF / Airport / Wellfields)
- Community Involvement / Transparency
 - General Public; and
 - Meetings with Community Leaders (Town, Airport, BFD, MassDEP, USGS, Tom Cambareri, and others)
 - Information sharing and cooperation



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Project Approach



PRINCIPAL-IN-CHARGE / PROJECT COORDINATOR

John R. Paquin, P.G.

LSP-OF-RECORD

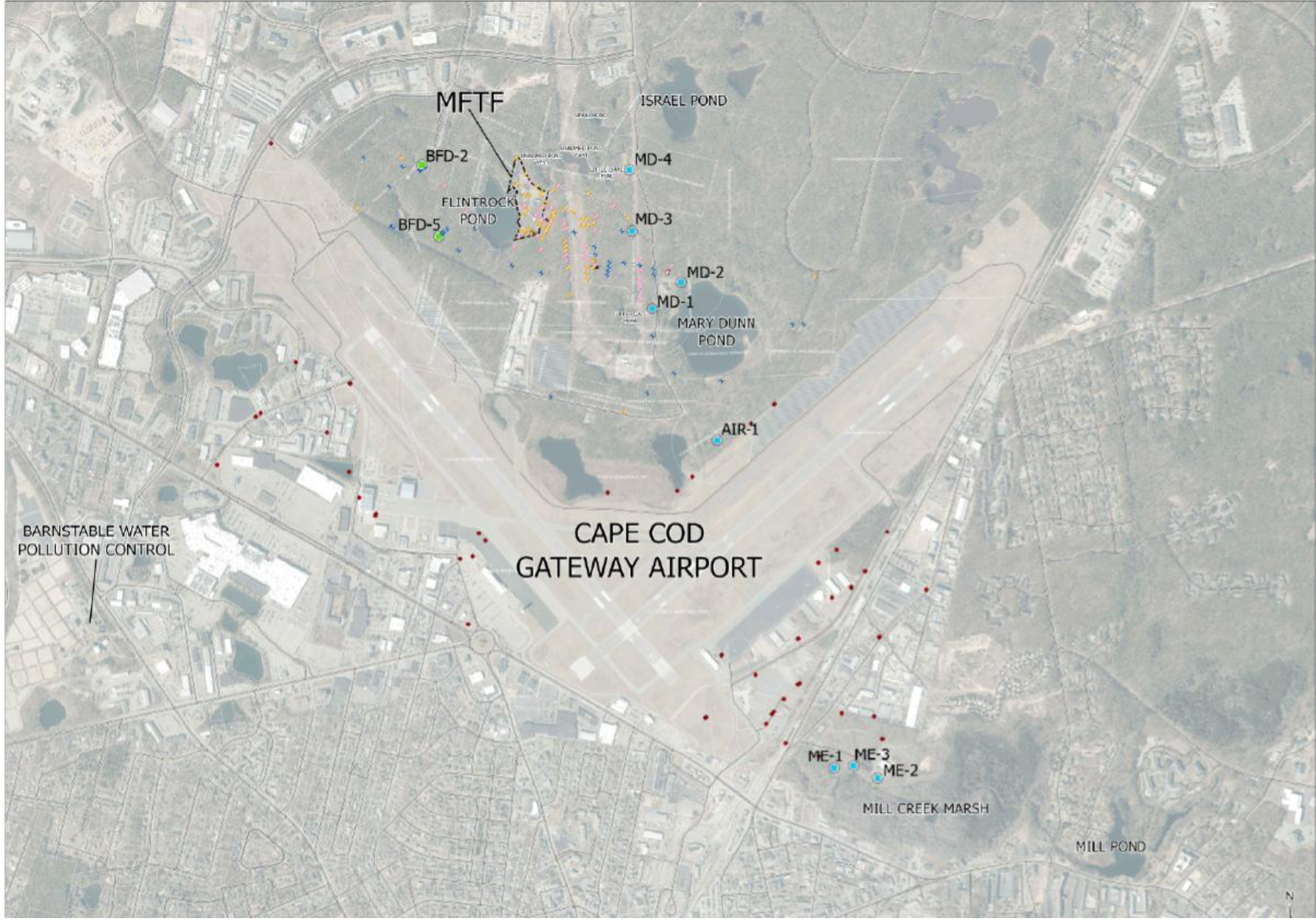
David E. Leone, LSP

Investigation
Compile Existing Data
Develop Conceptual Site Model
Data Gap Analysis
Groundwater Model
Jennifer McKechnie

Analysis and Forensics
Chemical Fingerprints
Plume Delineation
Jeremiah Duncan

Remediation / Groundwater Containment
CAC PRB Pilot Test
Evaluate Current Groundwater Treatment System
Daniel Scanlon

Multi-team, parallel approach





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Technical Approach - Investigation

- Compile comprehensive database of historical, current, and future data:
 - MFTF project data;
 - Hyannis Airport;
 - Barnstable Fire District (BFD);
 - Town (Water Supply Wells and WWTP); and
 - United States Geological Survey (USGS).
- The database allows for a deeper analysis of:
 - Nature and extent of contaminants;
 - Temporal trends; and
 - Forensics

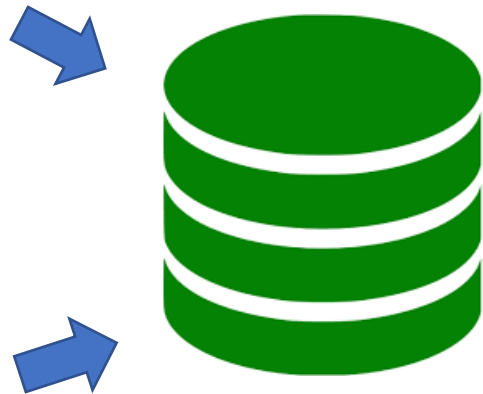
- > 42,000 results from >1,800 samples
- Taken on 258 sampling dates from 11/22/2012 to 07/12/2024
- From 616 unique locations
- Compiled in and loaded from >250 lab reports



Analytical Data



Historical Data



- 40 Different PFAS analyzed
- 31 detected at least once
- 17 detected in >10% of samples
- PFOS most common (85% of samples)



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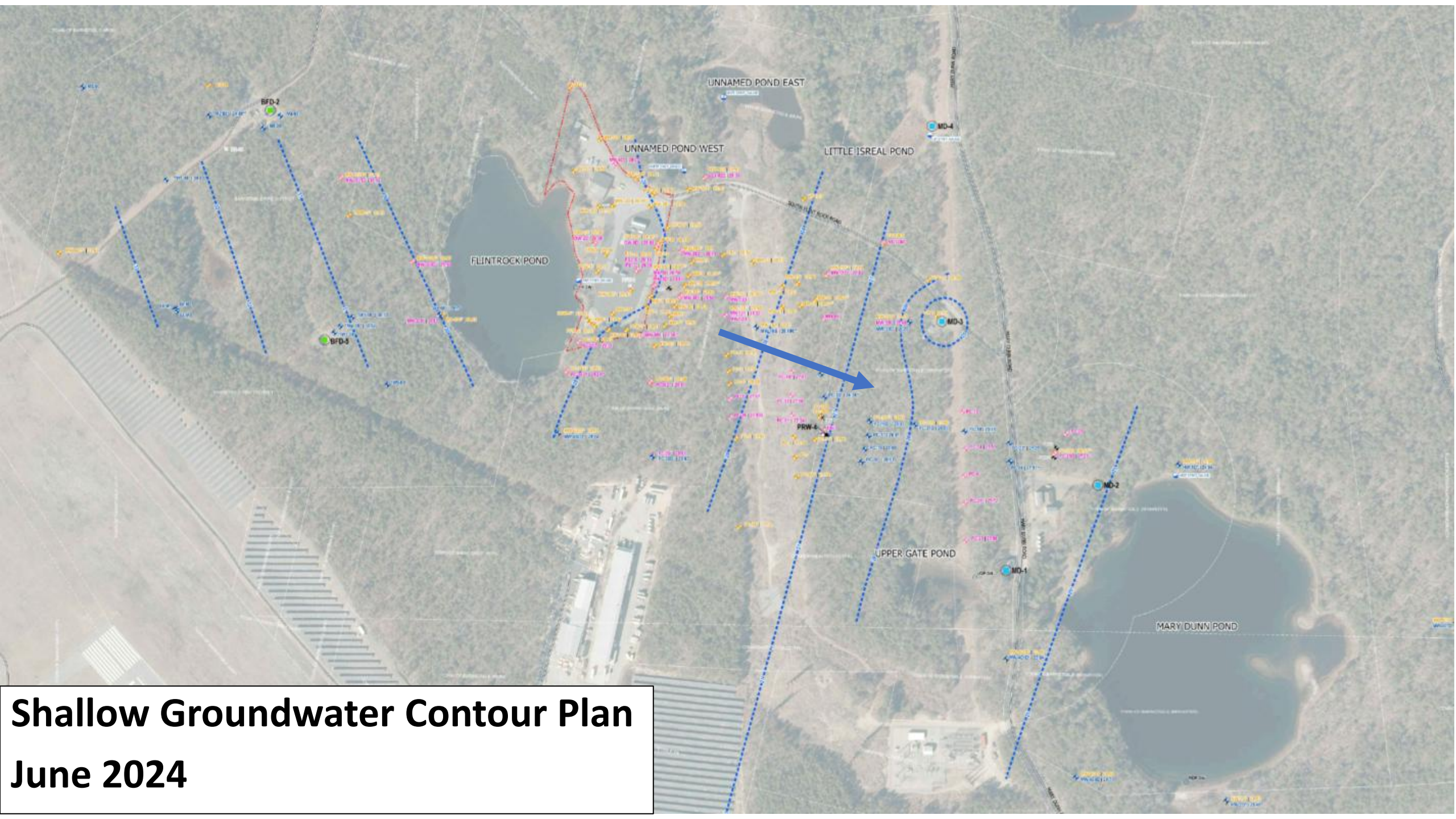


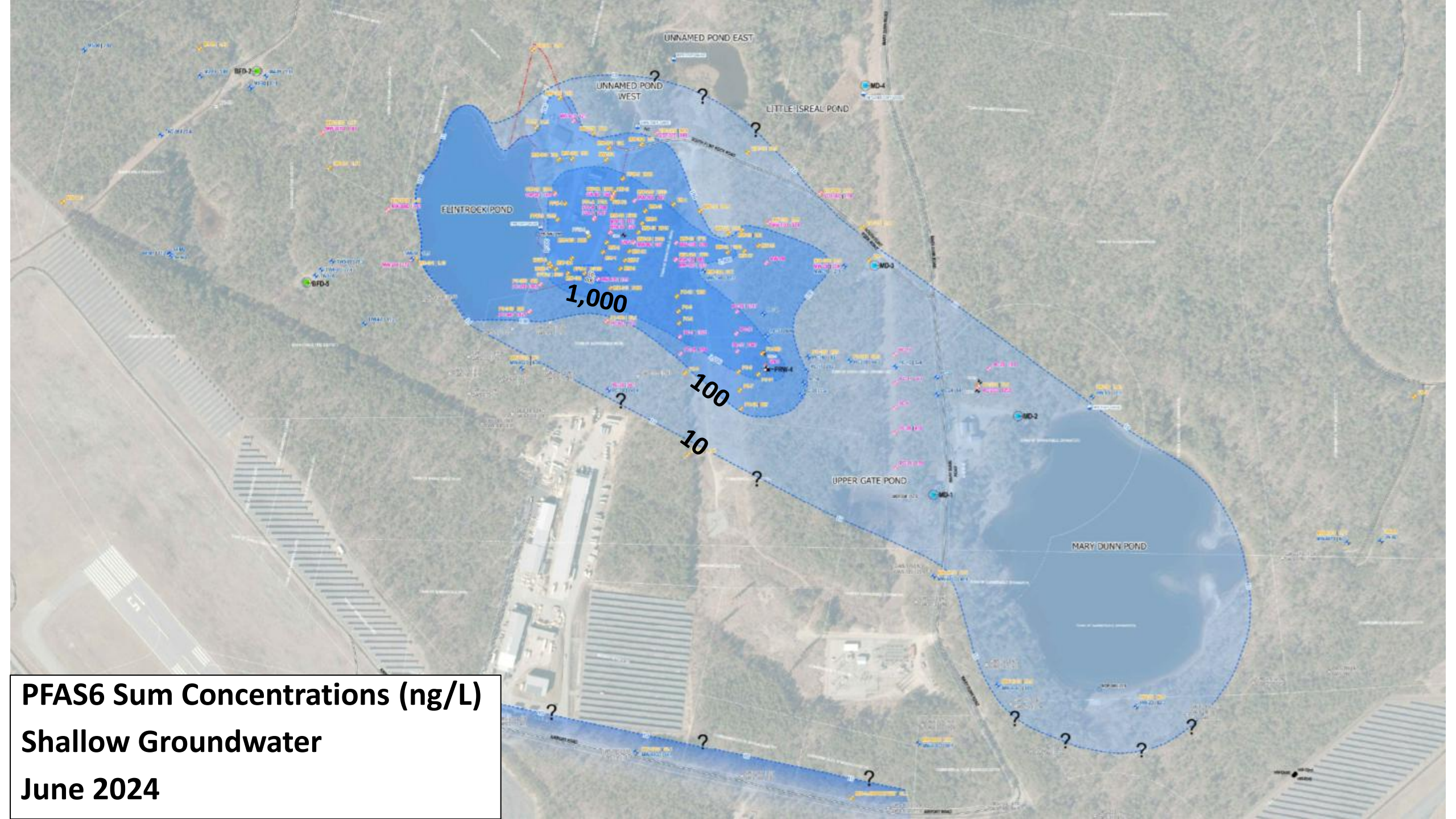
Technical Approach - Investigation

- Complete MCP Phase II Comprehensive Site Assessment (CSA)
- Performed Site-wide groundwater monitoring round (MFTF and BFD wells)
 - Groundwater monitoring well inventory and status;
 - Groundwater level gauging data (flow gradients, etc.); and
 - Groundwater quality testing
- Analyze existing data relative to:
 - Groundwater flow directions; and
 - Nature and extent of plume
- In-situ Hydraulic Conductivity Testing
 - Assess the physical properties of the underlying soil (aquifer) materials

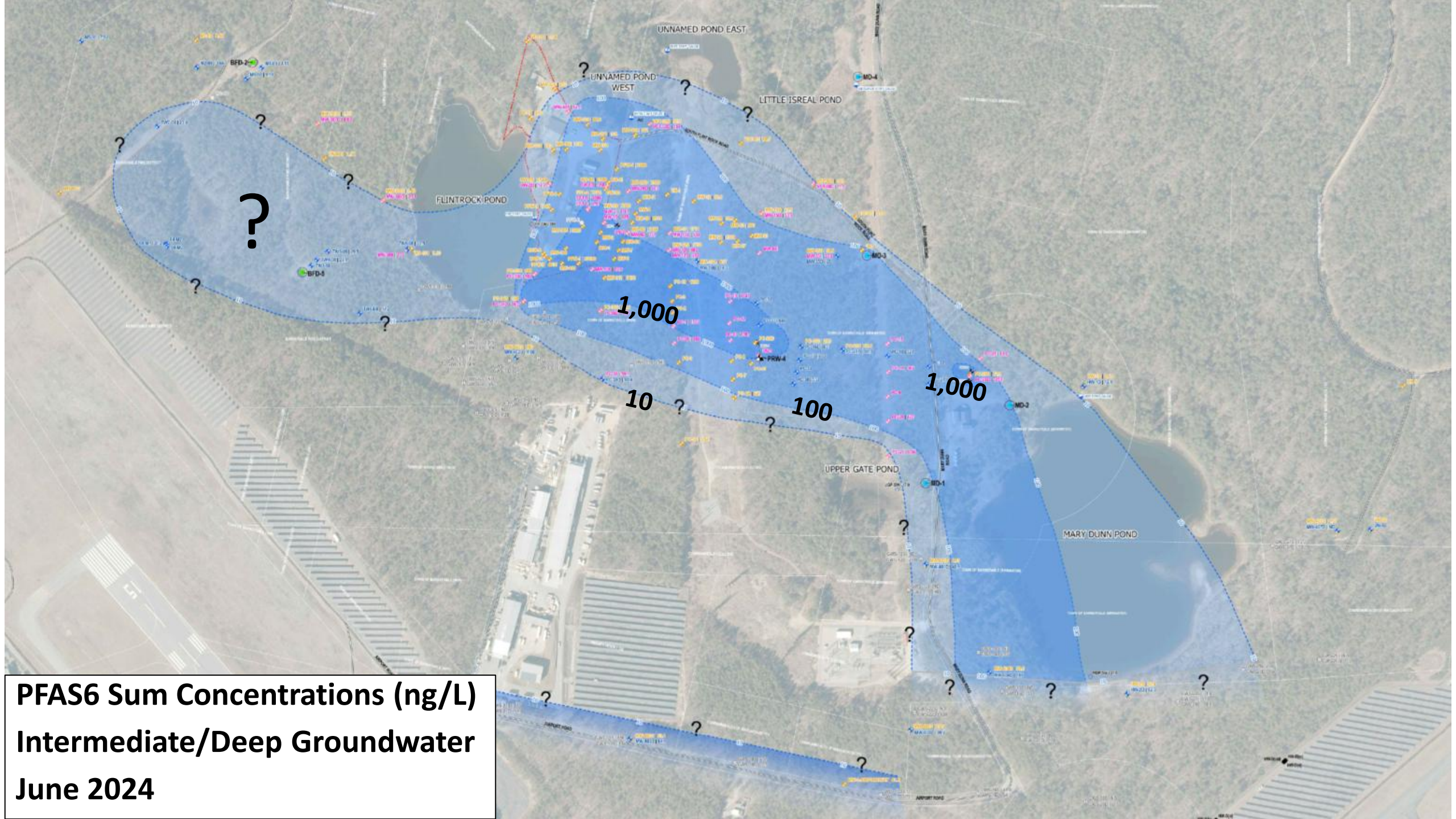
Shallow Groundwater Contour Plan

June 2024

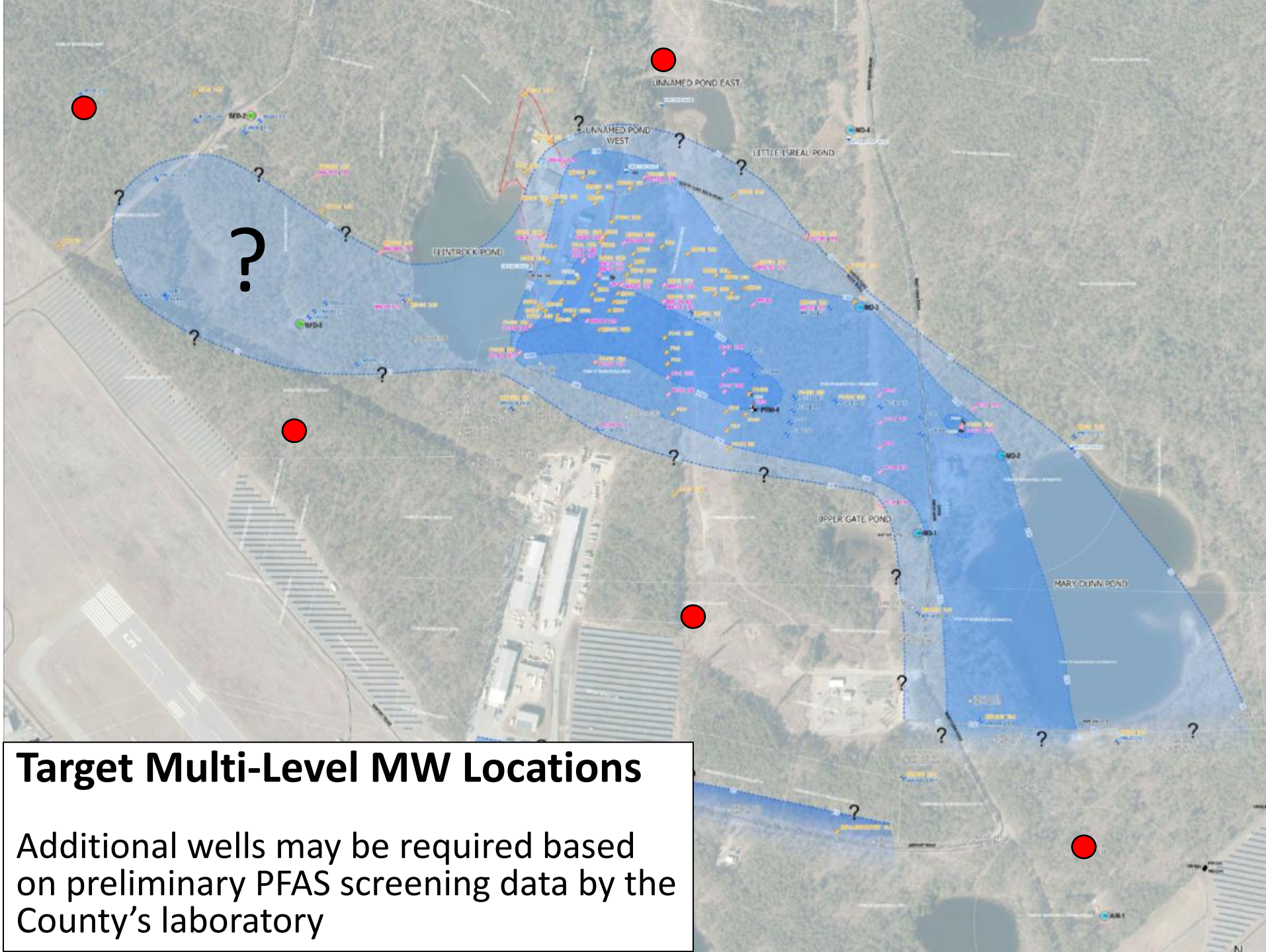




**PFAS6 Sum Concentrations (ng/L)
Shallow Groundwater
June 2024**



**PFAS6 Sum Concentrations (ng/L)
Intermediate/Deep Groundwater
June 2024**

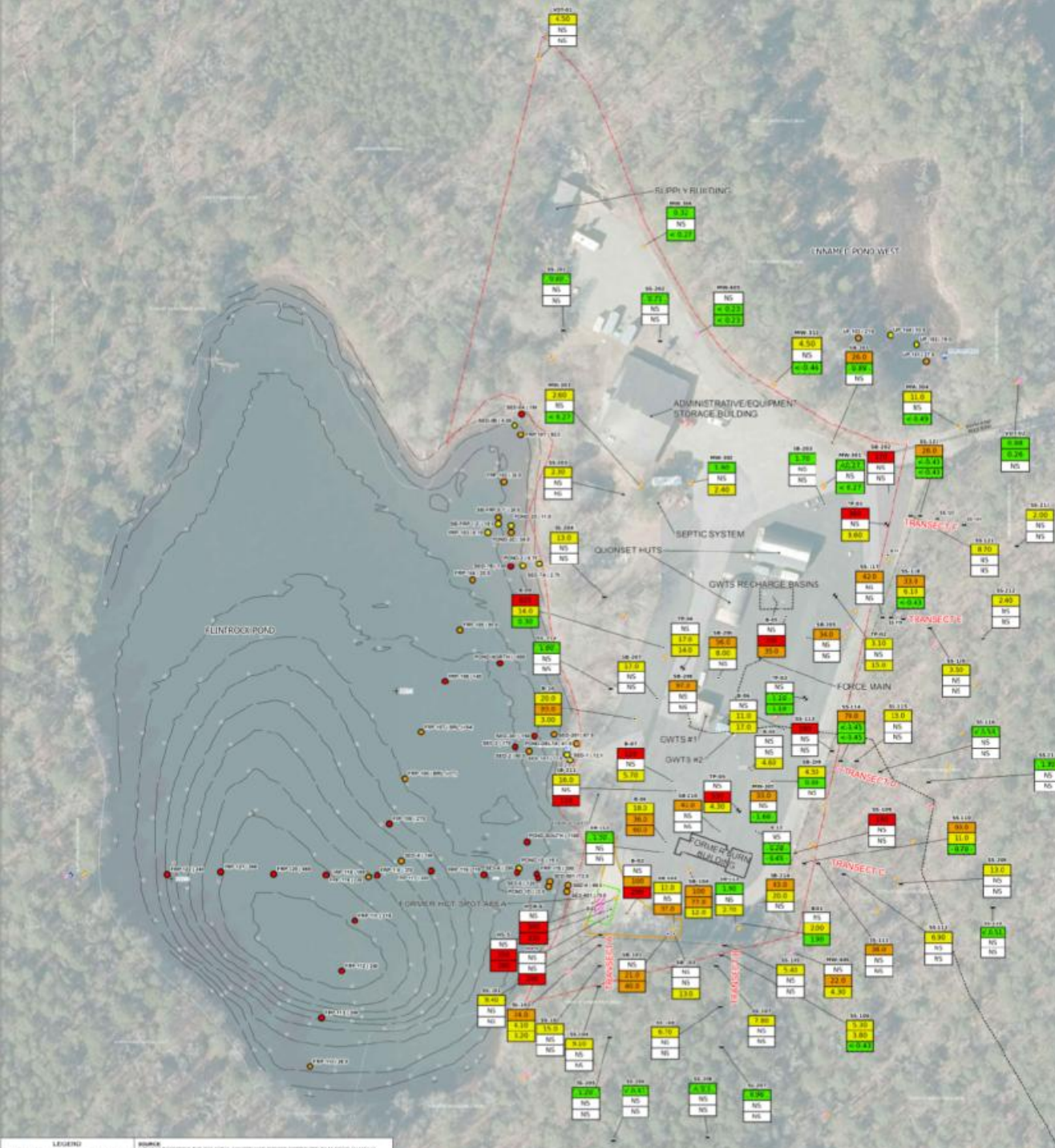


Target Multi-Level MW Locations

Additional wells may be required based on preliminary PFAS screening data by the County's laboratory

Additional Surficial Soil Sampling:

- Define Extent of Impacts
- Assess Ecological Risks

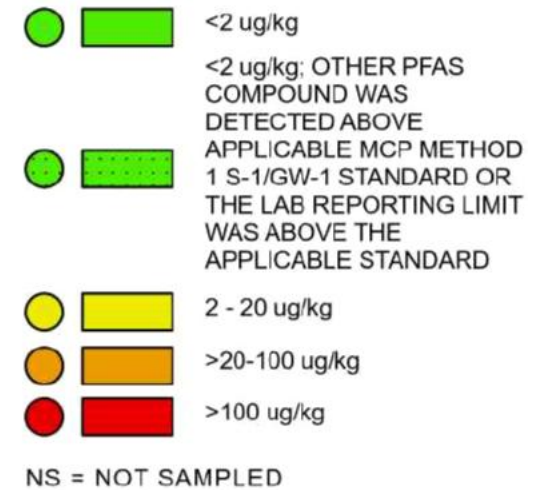


SAMPLE DEPTH KEY

0-3'
3-6'
6-15'

LEGEND

PFOS SAMPLE CONCENTRATION





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Technical Approach - Investigation

Numerical Groundwater Flow model

- Use as a tool to confirm and “test” (multiple lines of evidence approach):
 - Groundwater flow conditions; and
 - Contaminant fate and transport
- Factor in groundwater extraction (pumping wells) and injection
- Build on & refine the prior models by USGS and Tom Cambareri

Hydraulic Conductivity Testing

Shallow – 14 wells

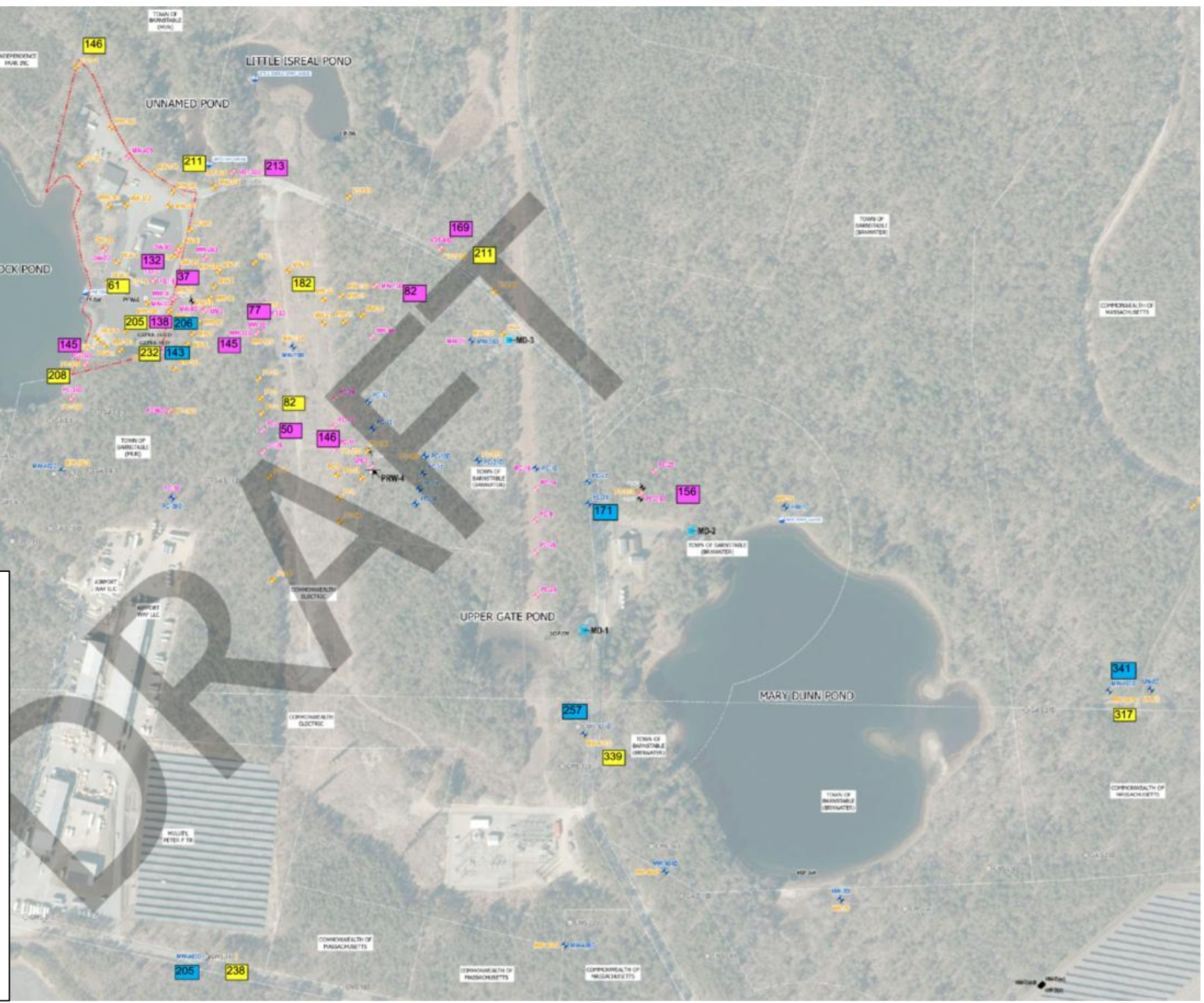
Intermediate – 15 wells

Deep – 9 wells

10 to 300 ft/day (10^{-1} to 10^{-3} cm/s)

Sieve/Hydrometer Analysis of Silty Clay

0.001 ft/day; 10^{-6} cm/s

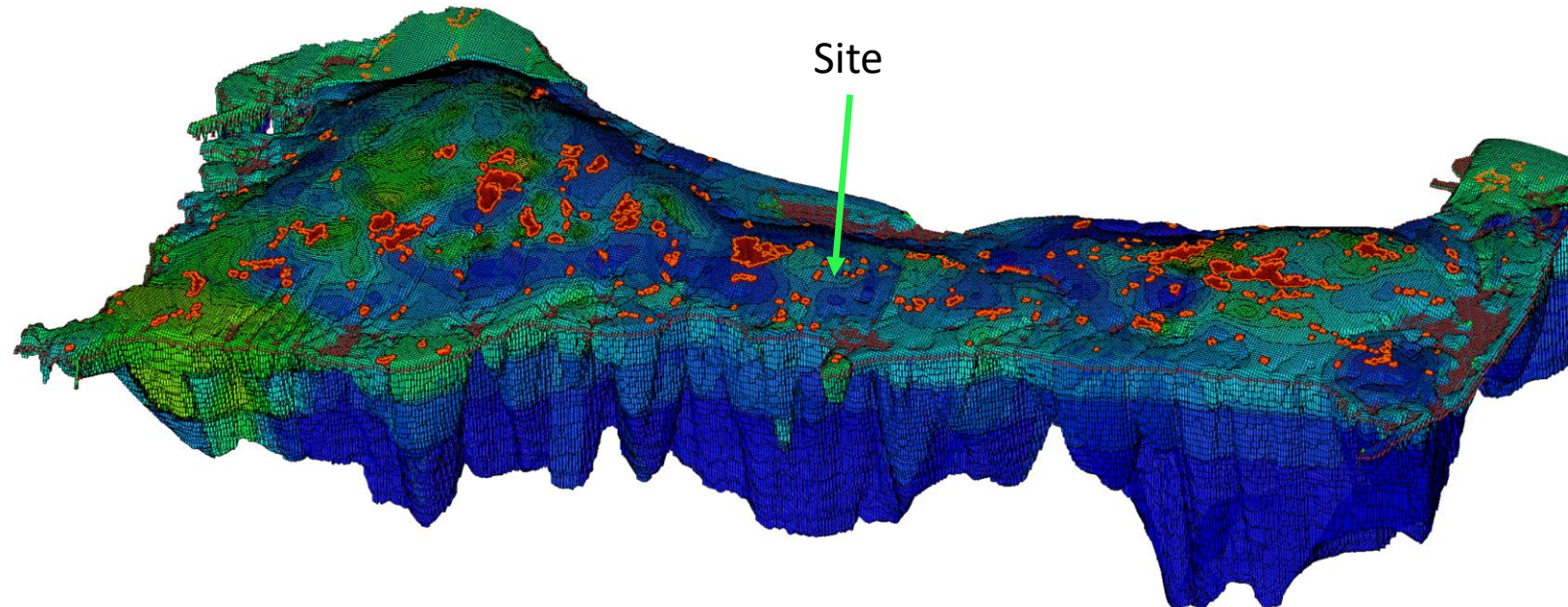
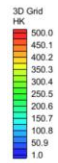




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USGS 2019 MODFLOW Model

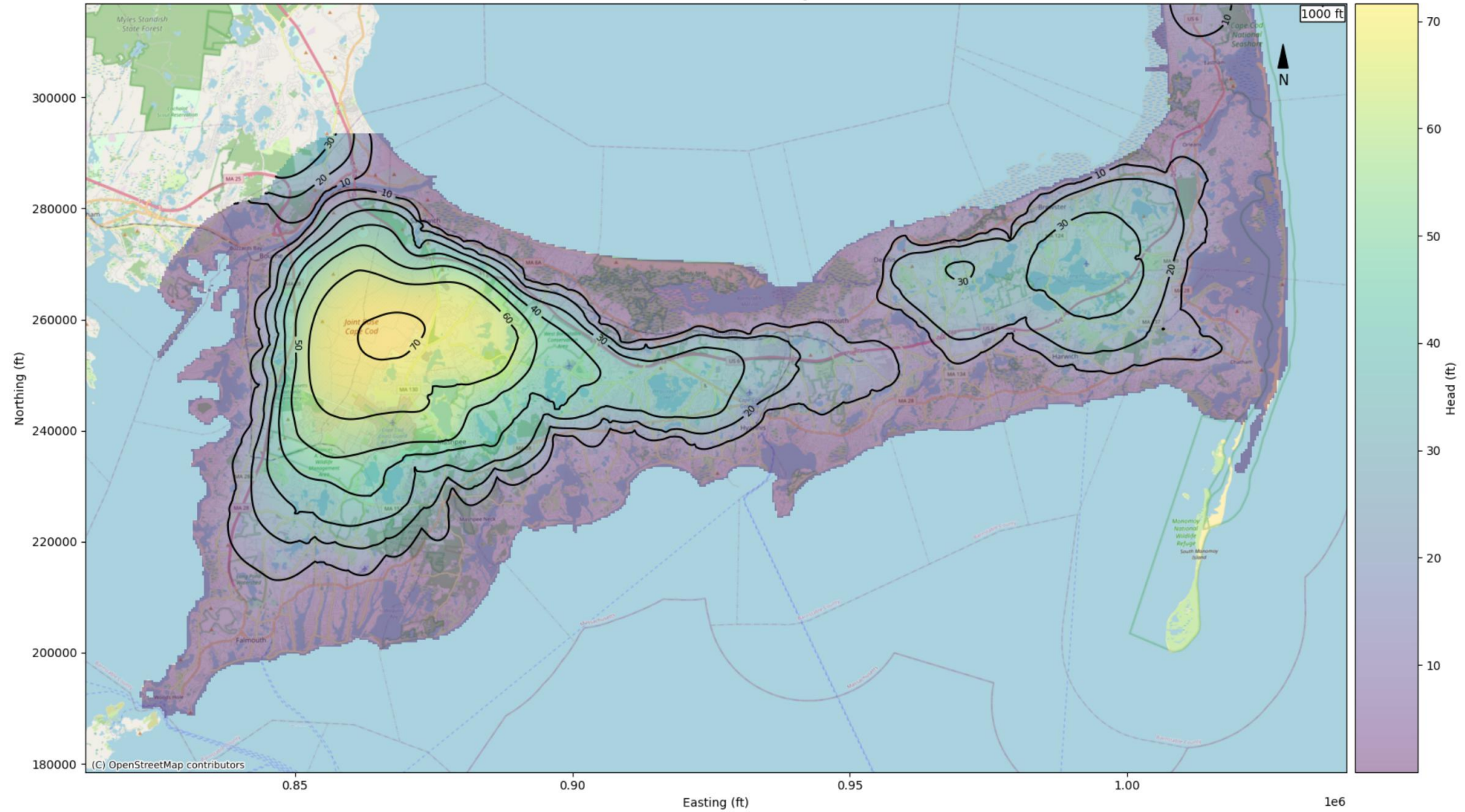




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Groundwater Head - Layer 1



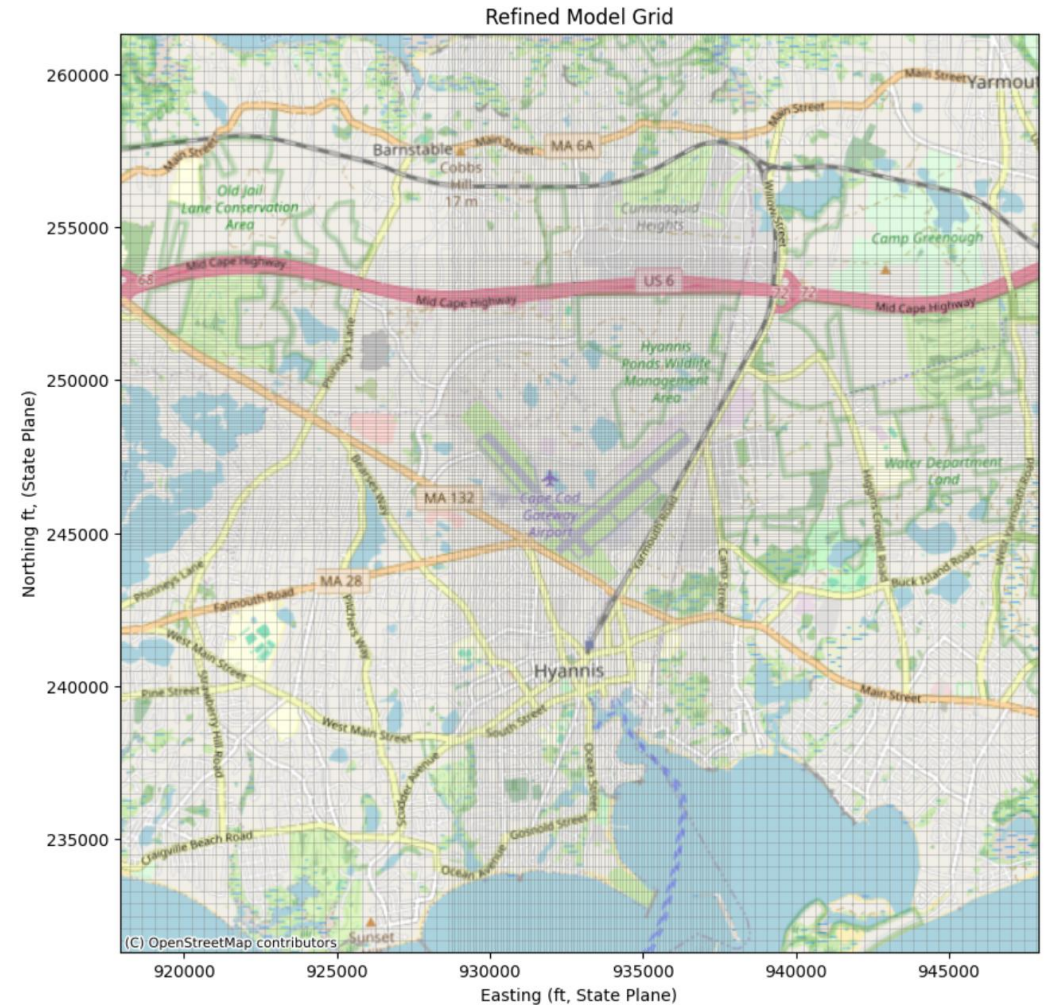


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Current Work

- Converted model from MODFLOW2005 to MODFLOW 6 (most current version)
- Refine grid in area of interest
 - Allows for better understanding of groundwater flow
 - Clearer picture of contaminant transport



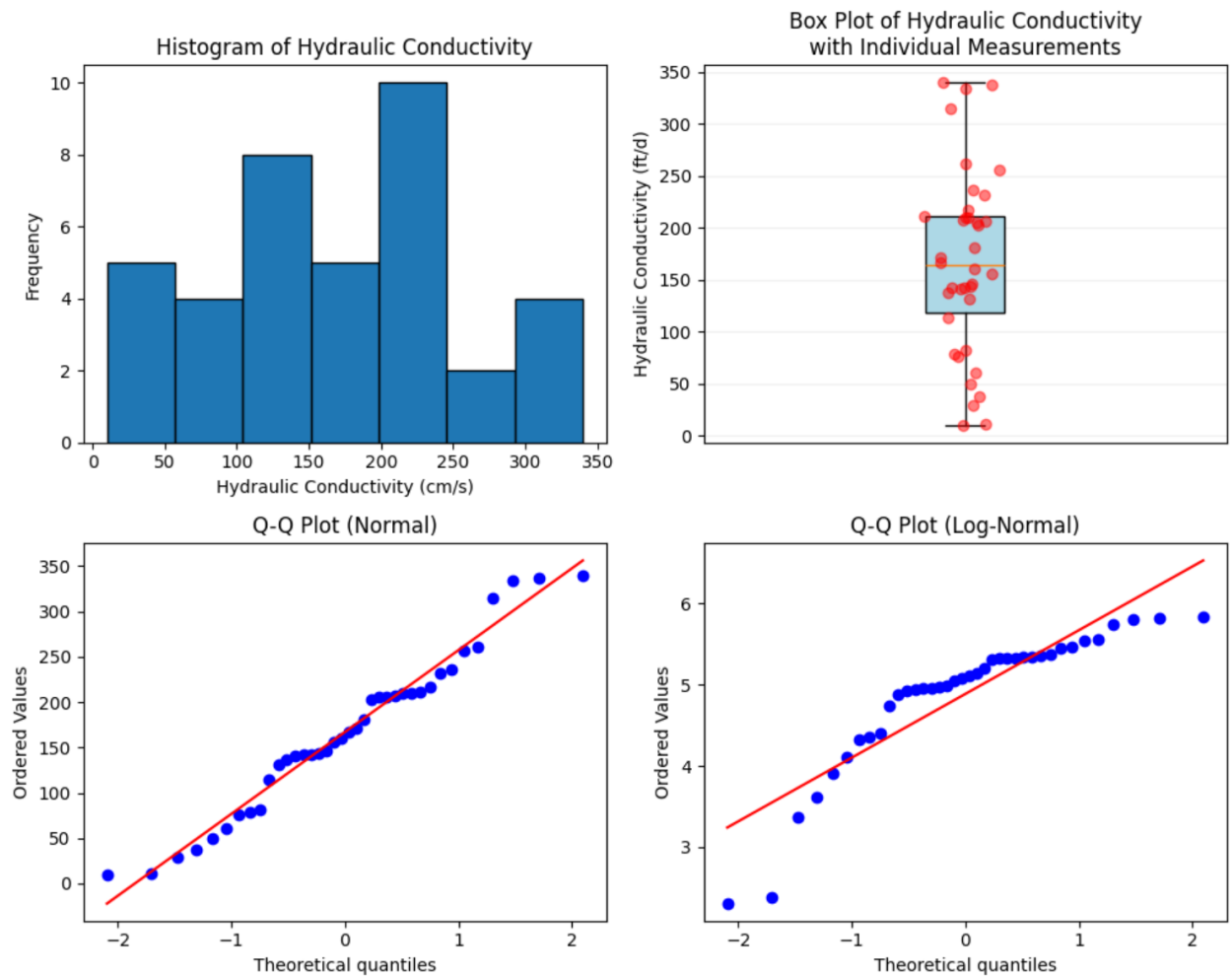


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Current Work

- Updated model with over 150 resurveyed groundwater elevations from 2024 for model calibration
- Updated using Site-specific geological information and hydraulic conductivity measurements
- **Model calibration in progress**



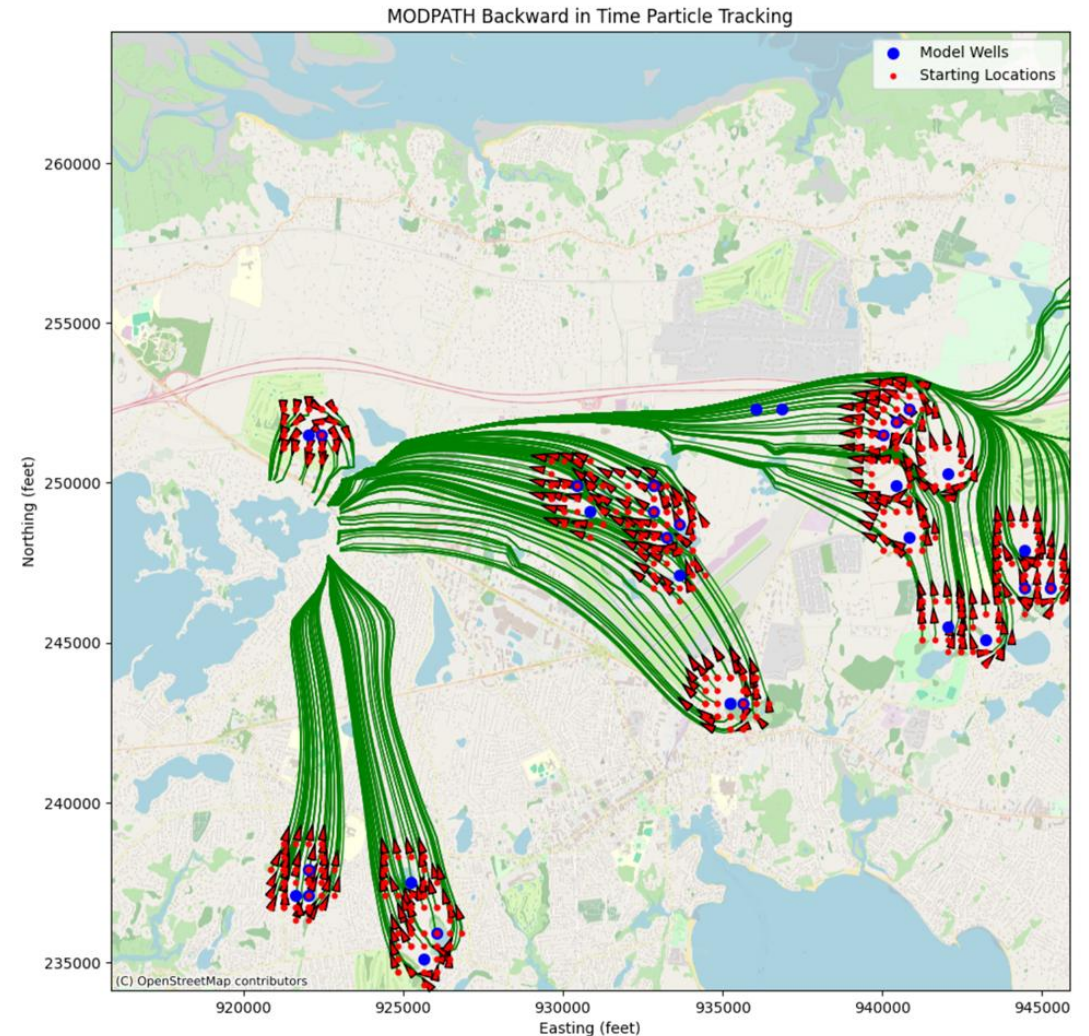


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Overall Model Objectives:

- Test the conceptual site model
- Evaluate potential remedial approaches
- Forecast contaminant migration
- Use particle tracking and other techniques to evaluate receptor source areas



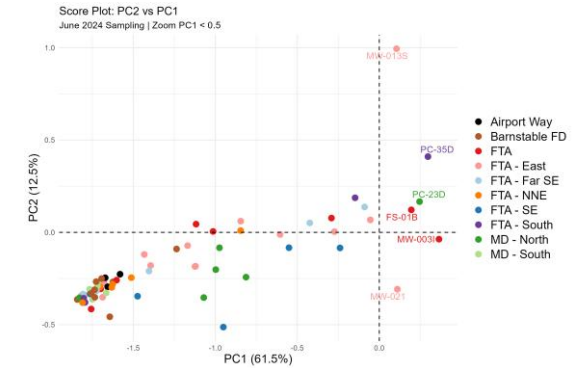
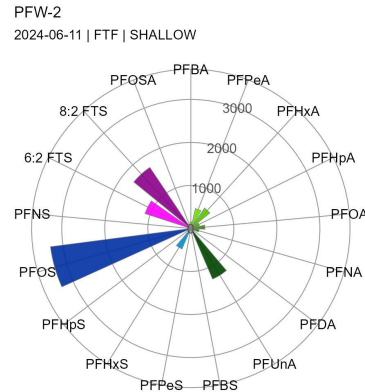
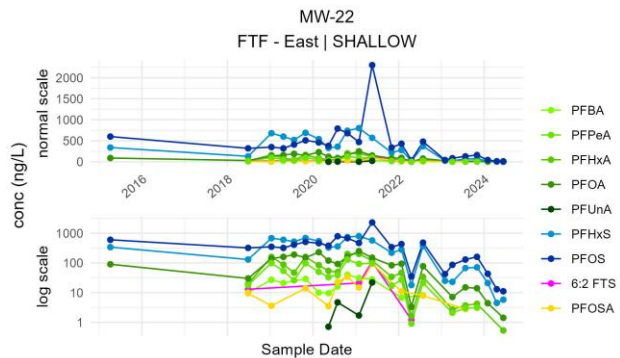


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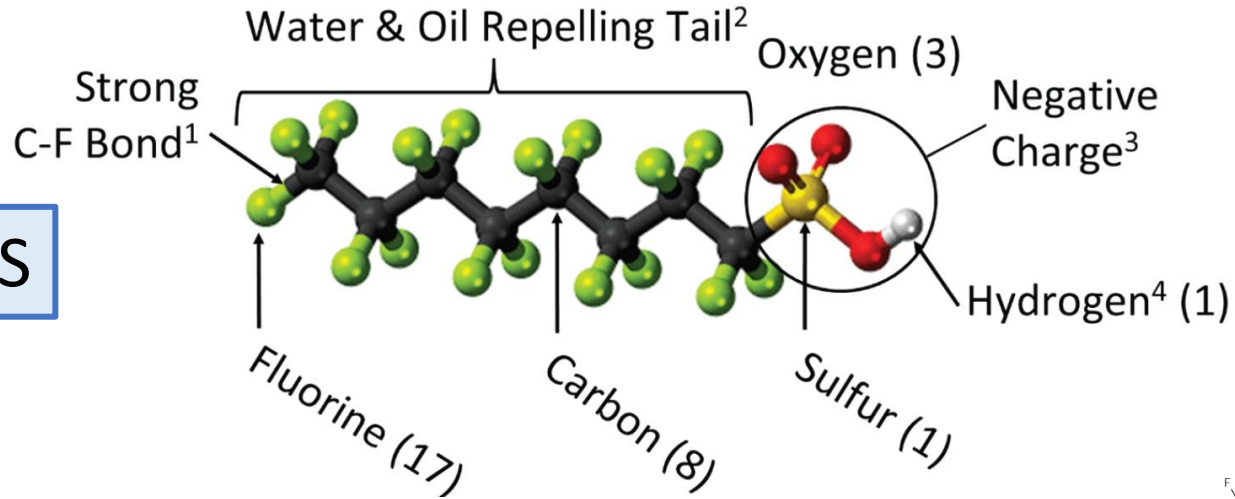


Project Approach - Forensics

- Investigation of potential source(s)
- Numerical and Statistical Analyses
- Data Visualization
- Provides lines of evidence
- Informed by and informs modeling and CSM

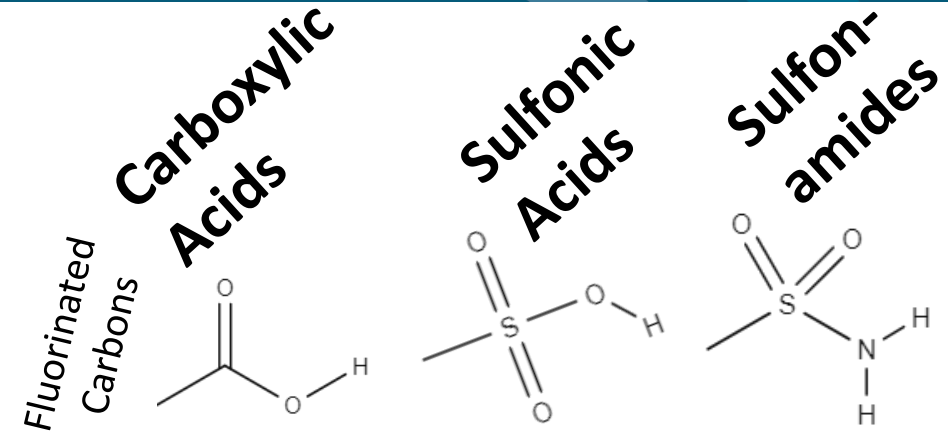
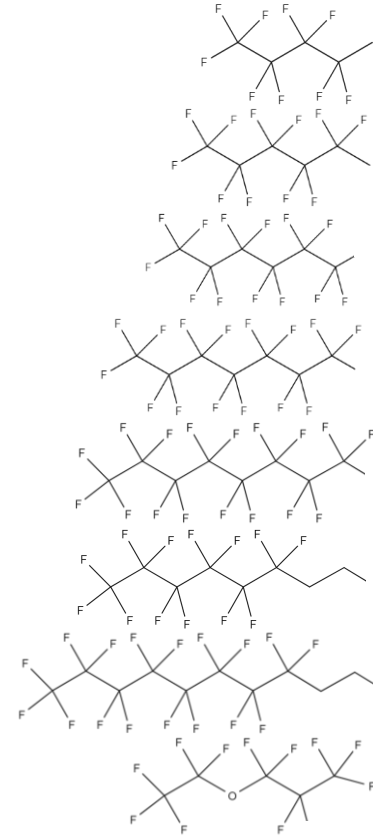


PFOS



- >10,000 compounds
- <100 can readily be quantified
 - Typically analyze for 30 – 40
- Many are surfactants
- Huge variety of fate and transport properties
- Regulations
 - Handful of PFAS
 - Ever evolving

**MA PFAS6
EPA MCLs
(+ PFDA)**



4	PFPeA	PFBS	
5	PFHxA	PFPeS	
6	PFHpA	PFHxS	
7	PFOA	PFHpS	
8	PFNA	PFOS	PFOSA
6	6:2 FTCA	6:2 FTS	
8	8:2 FTCA	8:2 FTS	
5	Gen-X		

K_d (Soil Adsorption coefficient)

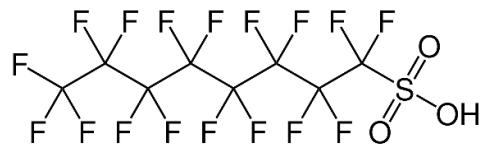
Larger = More strongly adsorbs to soil

Sulfonic Acids sorb more than Carboxylic Acids:

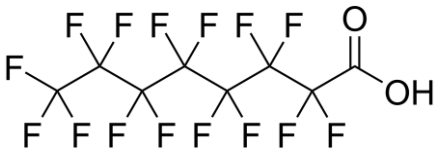
- PFOS transports slower than PFOA

Longer chain sorbs more:

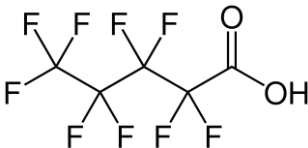
- PFOA transports slower than PFPeA



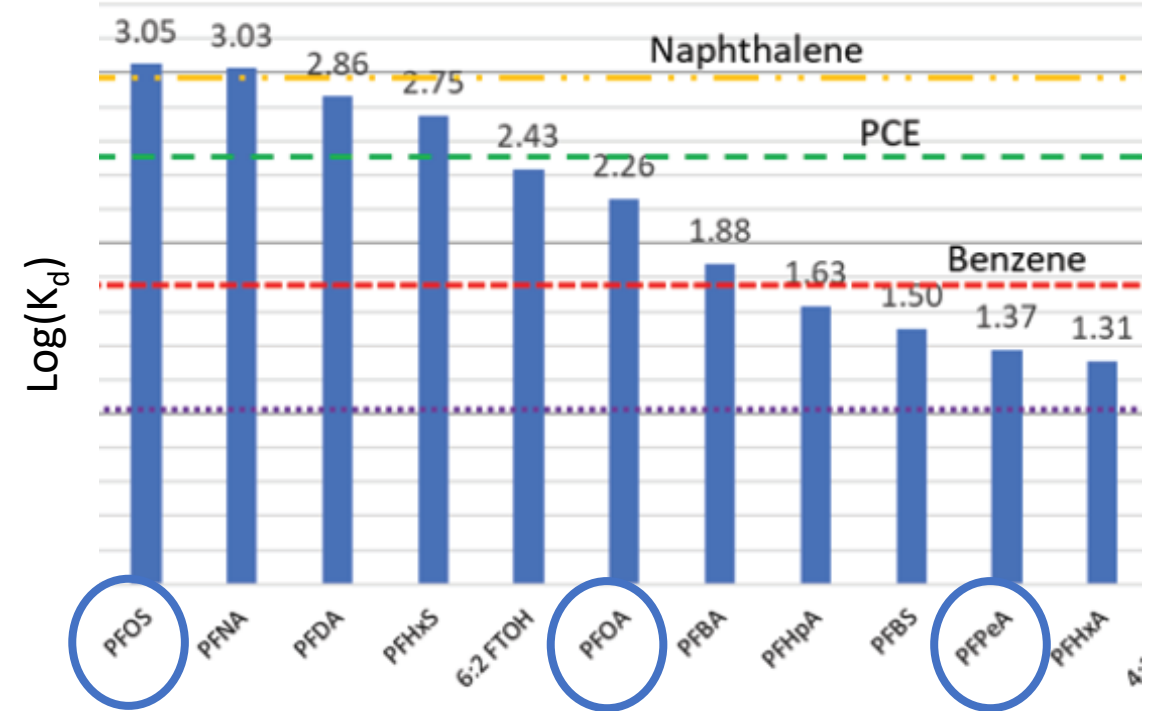
PFOS



PFOA



PFPeA

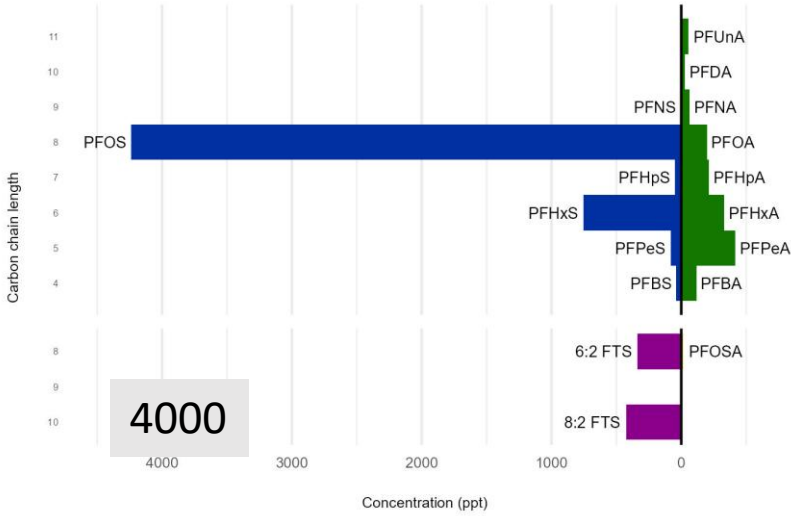


Example ratios: $\frac{\text{PFOS}}{\text{PFOA}}$ $\frac{\text{PFOA}}{\text{PFPeA}}$
 Expect ratios to decrease downgradient

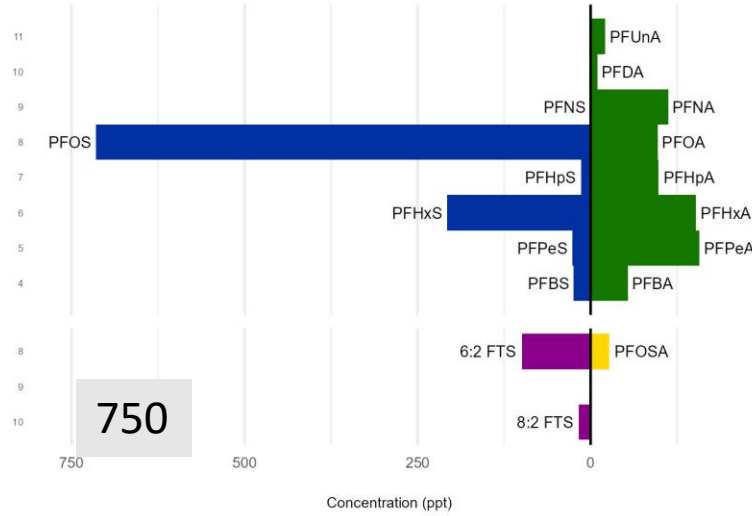


Data Analysis and Visualization

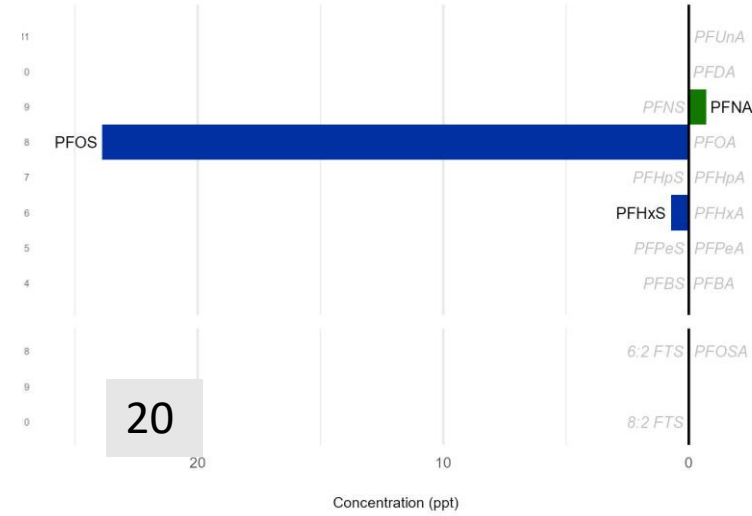
MW-311
2024-06-11 | FTF - SE | SHALLOW



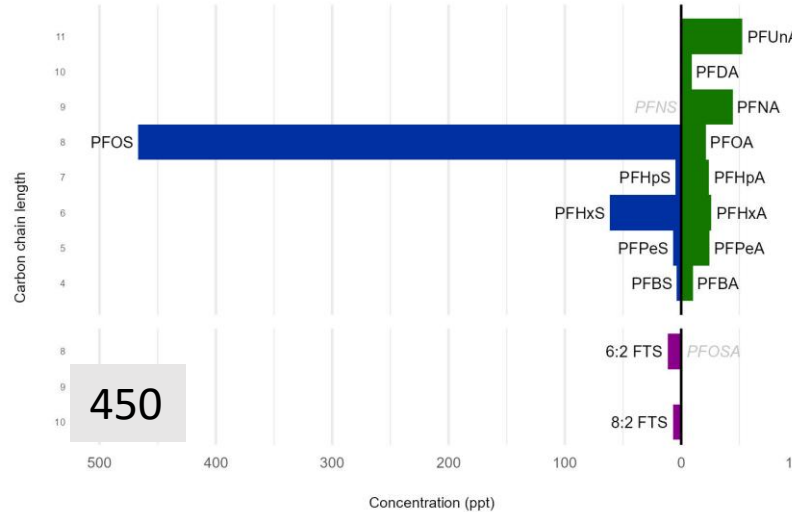
PC-13
2024-06-12 | FTF - SE | SHALLOW



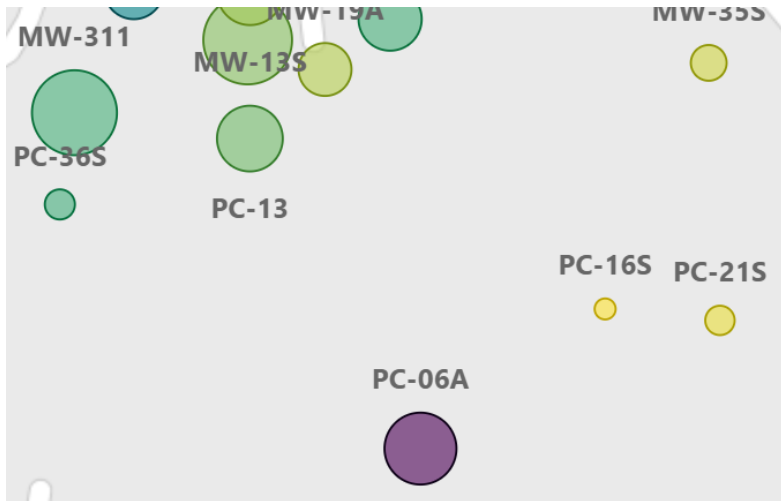
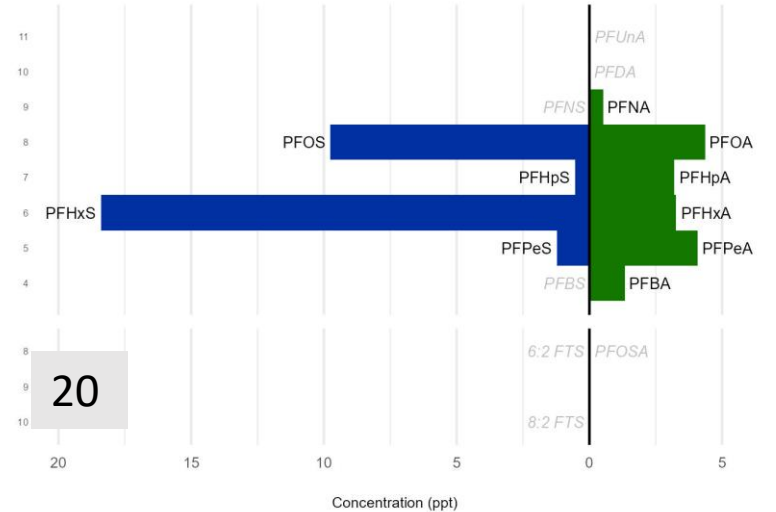
PC-16S
2024-06-12 | FTF - Far SE | SHALLOW



PC-6A
2024-06-13 | FTF - SE | SHALLOW



PC-21S
2024-06-13 | FTF - Far SE | SHALLOW





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Forensics - Ongoing

- “Fingerprint” figures have been generated
- Data from database now available in a dashboard for easier analysis
- Numerical and statistical analyses are ongoing
- Review of trends and pattern changes both temporally and spatially ongoing
- Comparison of results with modeling once model is more complete



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Project Approach - Remediation

- Assess and Improve on existing Groundwater Extraction and Treatment system
 - Groundwater extraction system
 - Assess need for additional extraction wells at different locations
 - Groundwater treatment system
 - Evaluate alternative treatment media / technology
- Continued Operation and Maintenance (O&M) of the existing groundwater extraction and treatment system including recovery well pump replacement, cleaning, and/or maintenance



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Project Approach - Remediation

- Permeable Reactive Barrier (PRB) using In-situ Colloidal Activated Carbon (CAC) Treatment
 - New and innovative approach
 - Involves injecting CAC into the subsurface
 - Contaminants sorb to the CAC and become “fixed” to the soil
 - Effectively creates an in-situ vertical treatment wall
 - Mitigates further downgradient contaminant migration



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PRB Pilot Test

- Performed to obtain design inputs for a full-scale PRB.
- Immediate Response Action (IRA) Plan Modification submitted to MassDEP
- Test area located downgradient of the PFAS “hot spot” (SW area of the MFTF)
- Additional monitoring wells installed to monitor the PRB pilot test effectiveness.
- Underlying clay layer is deeper than initially expected and may not be continuous.
- CAC injections initiated October 23, 2024. Completed November 1, 2024.

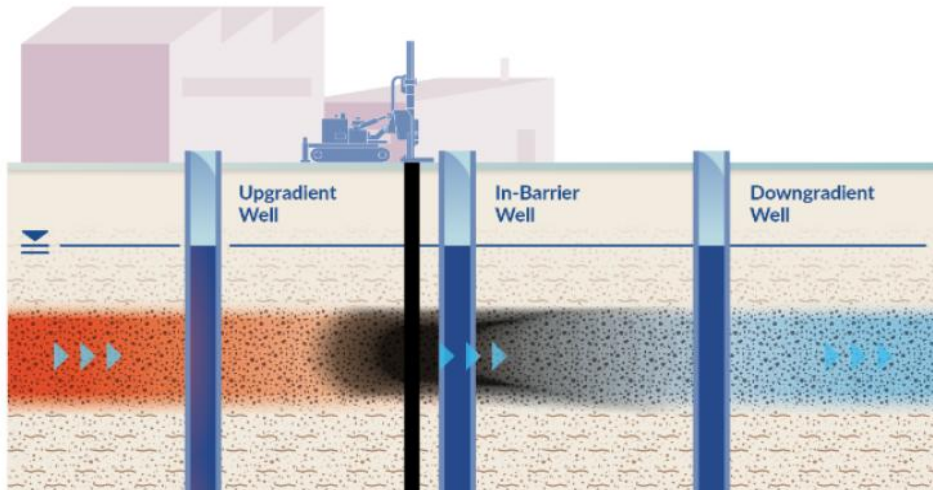


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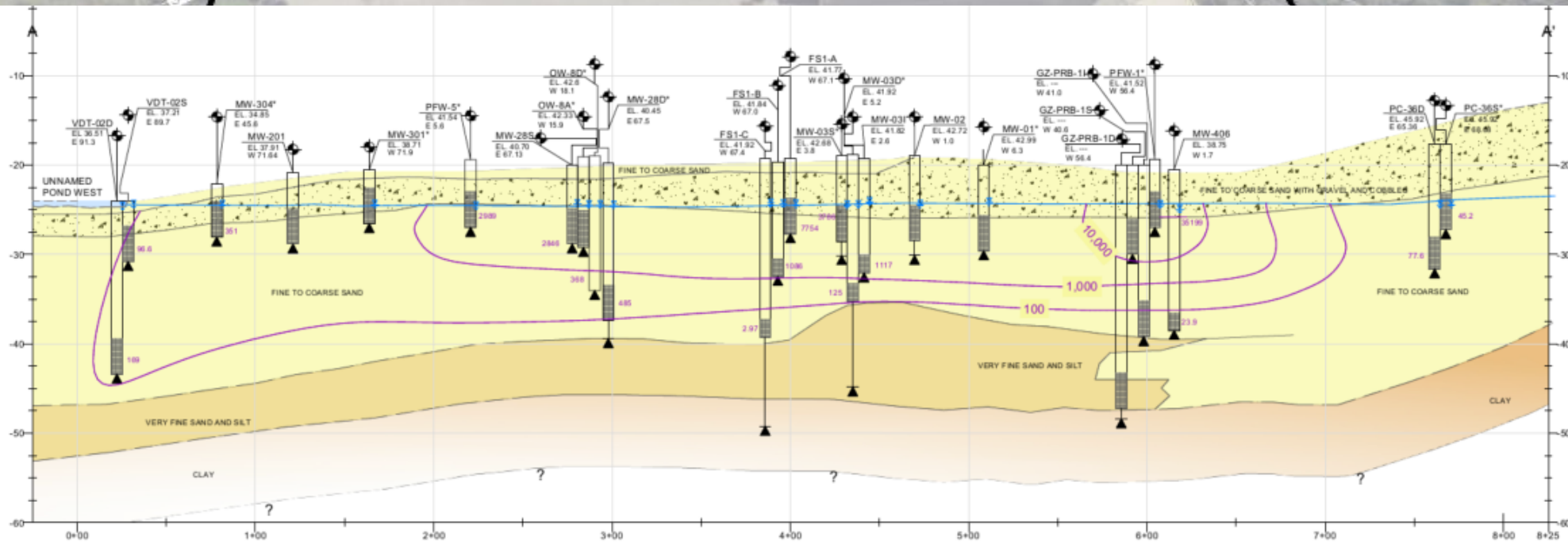


PRB Pilot Test

- CAC injected from deep aquifer (~top of silt/clay layer) up to water table
- PFAS sorbs to CAC



Geological Conditions





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Other On-going or Completed Assessment Tasks

- Site-wide elevation survey;
- Instrumentation of ponds to assess surface water/groundwater interactions
- Research, data compilation, review, and analysis for non-MFTF properties (on-going)
- Detailed hydrogeologic analysis (on-going)
- Numerical Groundwater Flow Model (on-going)
- PFAS Forensics (on-going)



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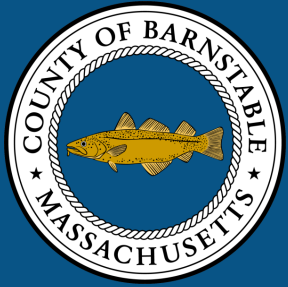


Upcoming Investigations

- Geophysical assessment (depth and topography of the lower silt/clay layer)
- Monitoring Well Installations (fill data gaps using Observational Approach)
- Surficial Soil Sampling (fill data gaps)
- Ecological Assessments of:
 - Flintrock Pond & Mary Dunn Pond
 - Potentially Wooded Areas surrounding MFTF (pending additional soil analyses)



Discussion & Questions



Thank You!

Paul Ruzala, P.E.

Barnstable County Assets and Infrastructure
Manager

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Michael Dutton

County Administrator

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