Superfund Project: PFAS Investigations in a cold environment*

Lake Superior College – Emergency Response Training Center

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Bio and Disclaimer



I’m one of Barr’s PFAS experts and practice leads for AFFF sites. My 28-years of experience includes managing site investigation and remediation for impacts to soil, groundwater, surface water, soil vapor, sediment and biosolids. Contaminants managed have included petroleum, brine, SVOCs, coal combustion residuals, chlorinated solvents, dioxin/furans, and PFAS.

Kevin Eisen, PE (MN, WI, IA, SD, ND, MT)

Sr. Geological Engineer

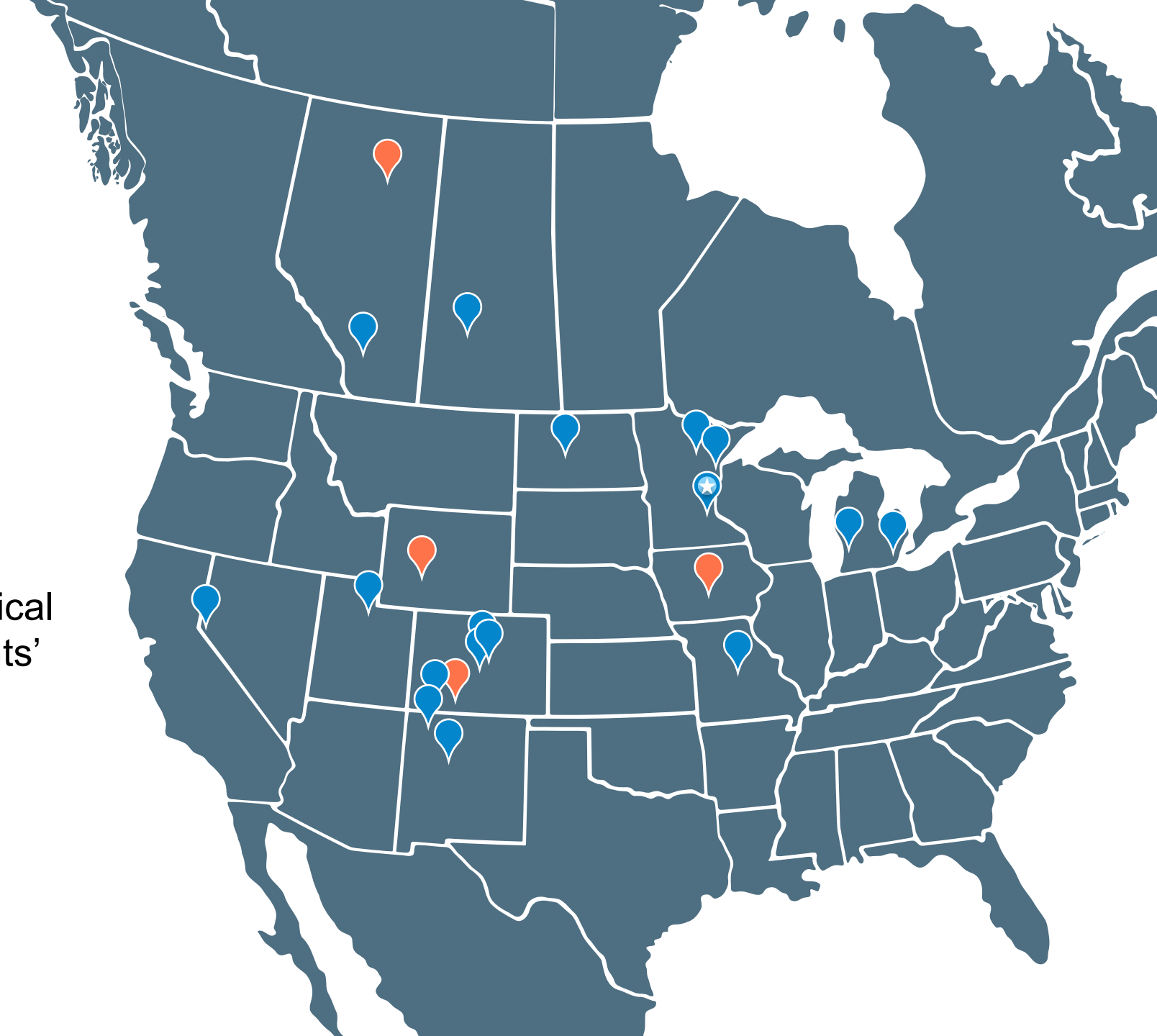
The views and opinions offered during this presentation are mine, and do not represent those of my employer, Barr Engineering Co., my client, nor the host of this event, Environmental Services Association of Alberta.

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21 OFFICES

in the U.S. and Canada

Our engineers, scientists, and technical specialists focus on solving our clients' problems as if they were our own.



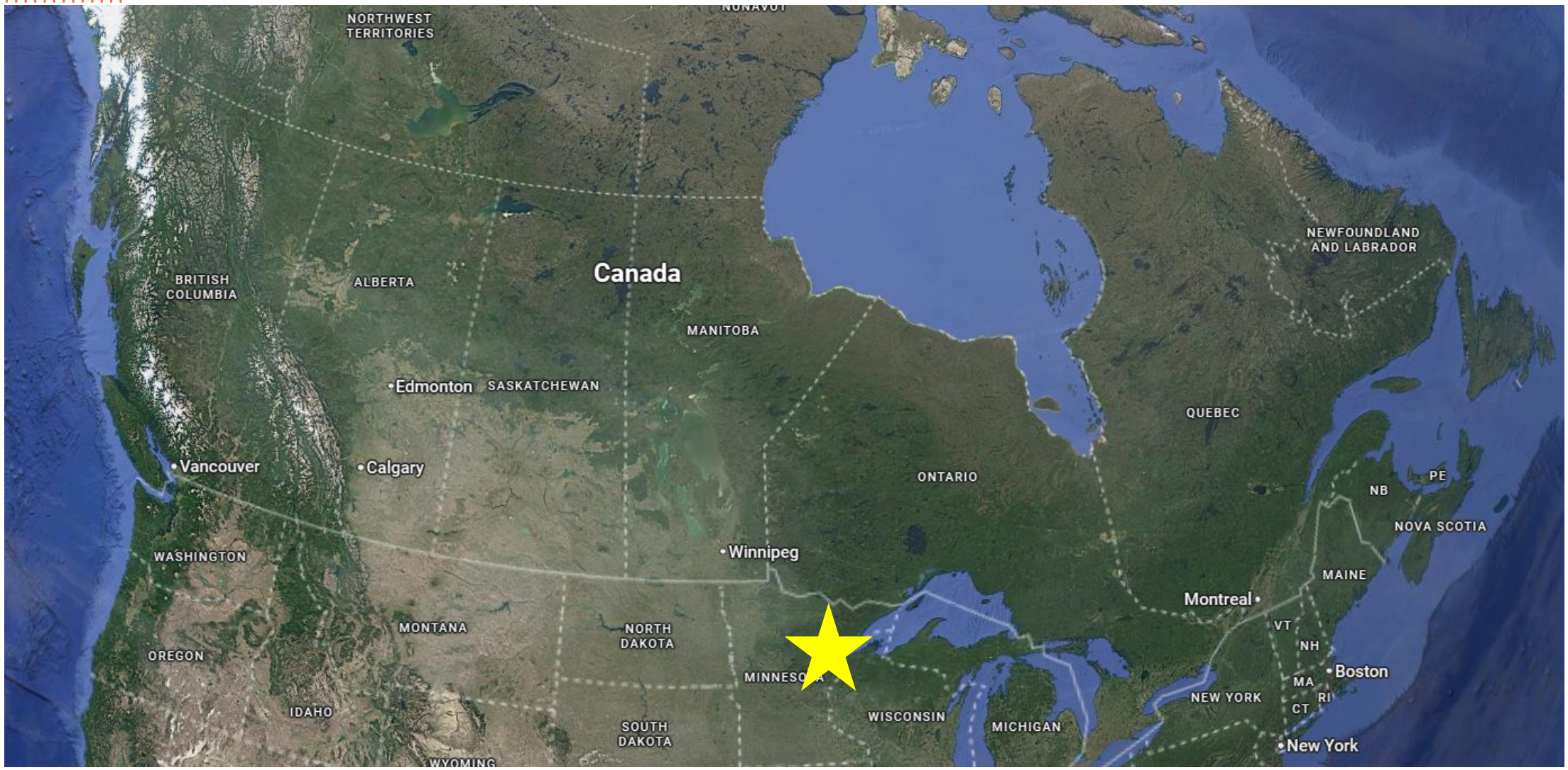
Office Project office

Agenda

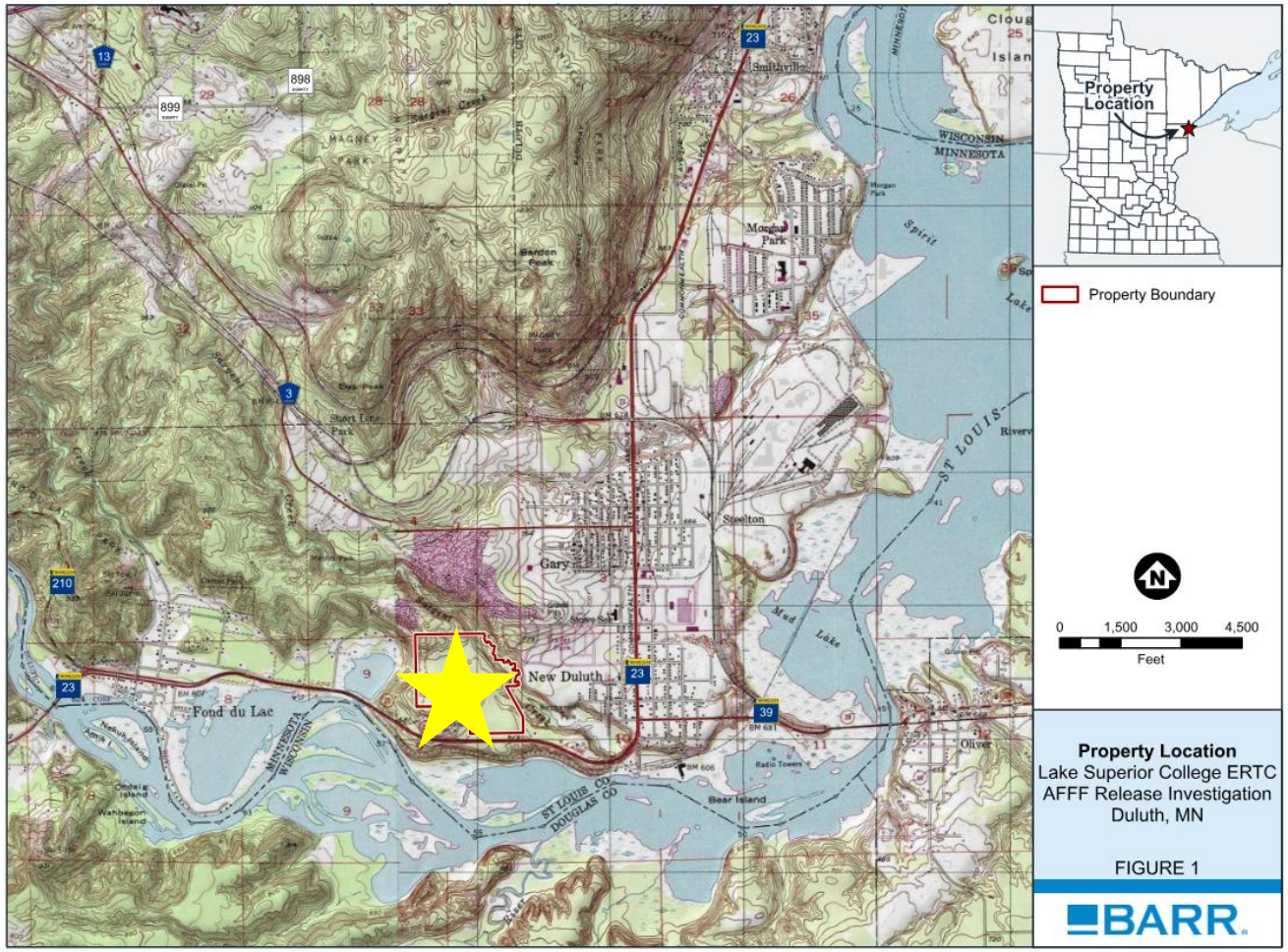
1. LSC Location, History and Key Site Features
2. Prior Investigation Observations
3. 2026 Goals and Approaches
4. Look Ahead
5. Q&A



Project Location – Duluth, Minnesota



Site Setting



- 40 hectare site
- 2.4 hectare Fire Training Area
- Adjacent to residences with private wells
- Near St. Louis River
- St. Louis River flows into Lake Superior (water supply for many lakeshore communities).
- Onsite tributary to a DNR trout stream

- Temperatures: High/Low
  - January: -5 / -13 C (20 / 4 F)
  - July: 25 / 15 C (77 / 59 F)
- Winter: 3.5 months
- Summer: 3.4 months

Property Development and Early Use





U.S. AIR FORCE



Lake Superior College



MINNESOTA STATE

1990 US Representative Oberstar leads legislation to develop the ERTC with grant funding from the FAA.

1994 ERTC opens - $15.8 million investment to **train aircraft rescue firefighters** in the Great Lakes Region (ND, SD, MN, WI, IA, IL, IN, MI, OH).

1995 Fire training begins at ERTC using PFAS-containing foam **as required per industry and certification standards.**

2013 Fire fighting training using PFAS-containing foam ends.

2015+ Ongoing training at the facility including **structural fire fighter certification, EMT, and truck driving** programs for students and regional emergency response agencies.

Historical AFFF Training





Note: multiple ARFF truck configurations

Site layout

Administration Building and Fire Engine Garage

Fire Training Area & Equalization Basin



Key Features: Fire Training Area (FTA) and Equalization Basin (EQB)

- FTA Features:
- Inner Ring: geomembrane underlying – drains to EQB
- Outer Ring: underlain by granular import and polystyrene, then soils
- Drain tile bisects area, with discharge to unnamed tributary to Sargent Creek
- Stormwater pond – overflow to discharge on surface to southeast
- Elevation 680’ amsl



Key Features Equalization Basin (EQB)

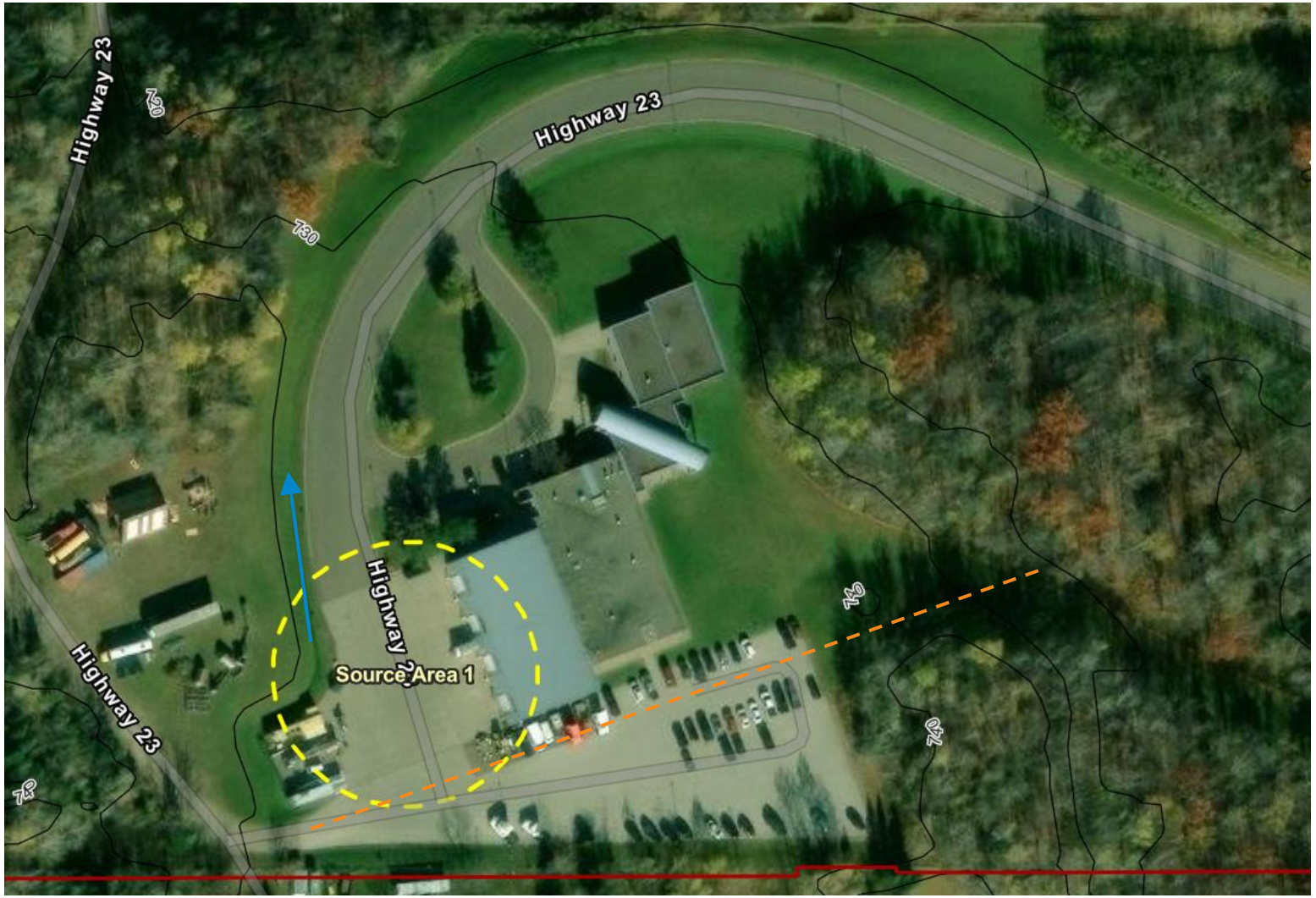
- 500,000 L capacity (150,000 gal)
- Concrete walls
- Connected to sanitary sewer
- Historical aeration system use
- Drain tile around EQB foundation discharges to unnamed creek





TWA and Administration Building

- Simulates fire station
- Historical AFFF storage totes in Bay 1
- Historical AFFF distribution to ARFF trucks in Bay 3
- Truck wash area – outside of garage bays – to stormwater ditch
- Drain tile under parking lot
- Elevation 740’ amsl



Setting the table

Historical sampling starting in 2009:

- MPCA:
  - Private wells: 2010, 2018, 2023
  - Onsite surface water: 2010, 2019, 2022
  - Sediment: 2009

- MnDOT (Adjacent road work due diligence):
  - Soil samples: 2021

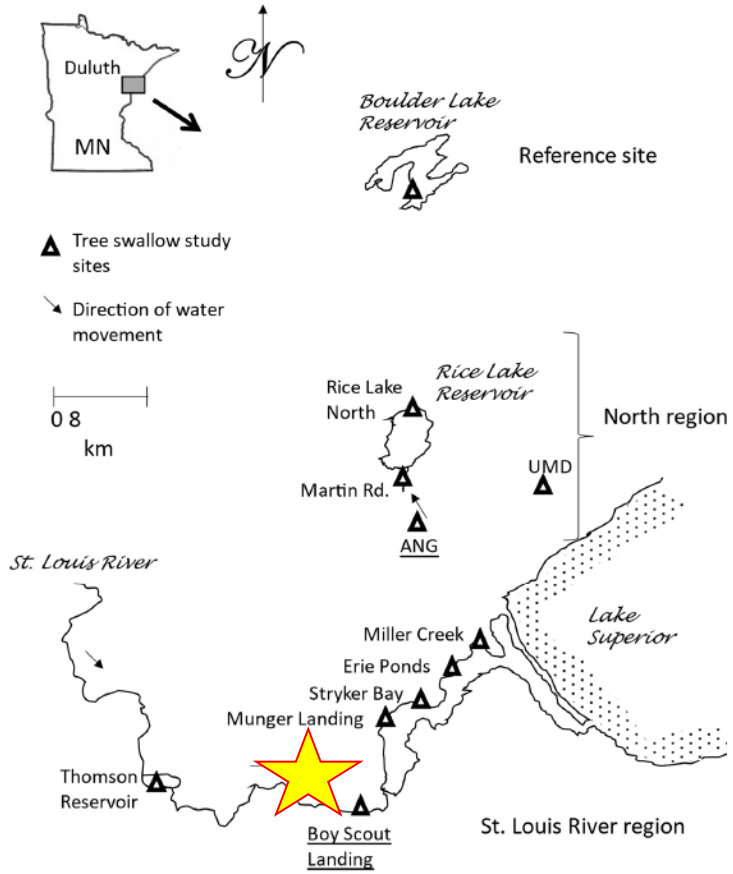
- Additional testing in the region (fish, birds)

- MPCA – 2023 Invitation to Superfund



Banff Gondola Sky Bistro, photo credit: Kevin Eisen

PFAS Wildlife Impact Investigations – MPCA, USGS and EPA

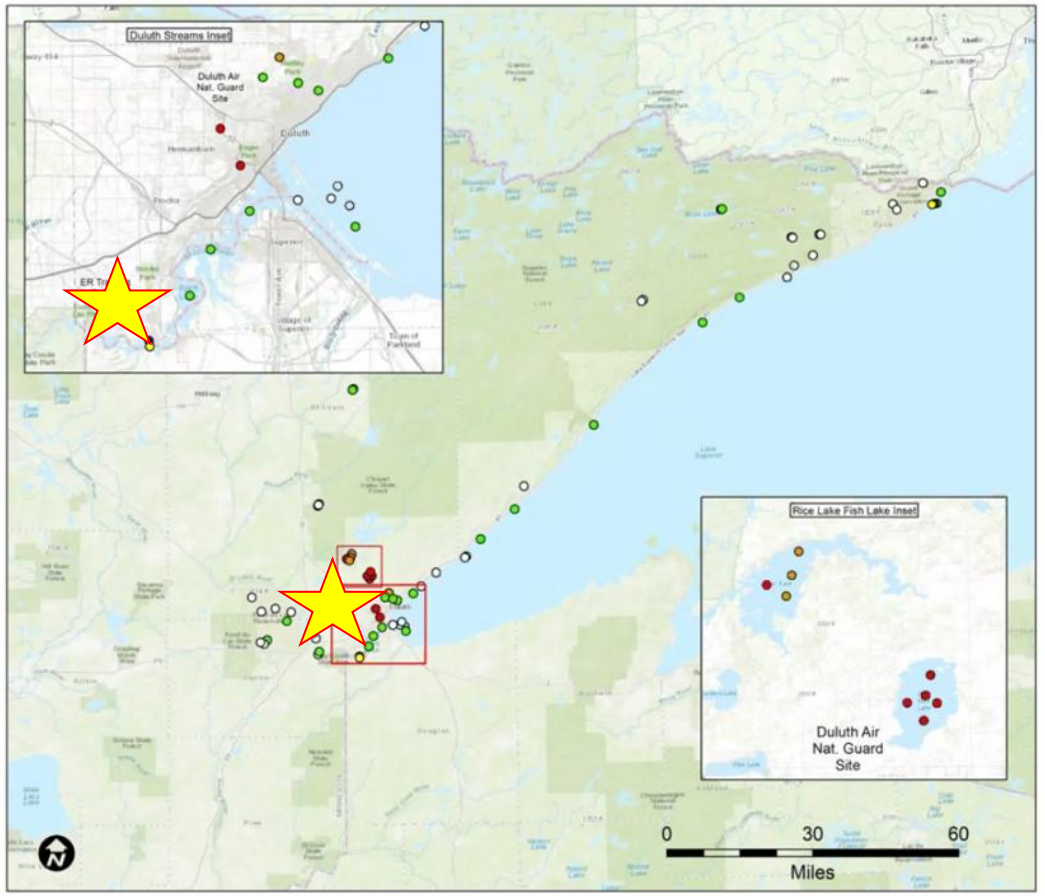


2019 USGS & EPA Tree Swallow Study (Left):

PFAS concentrations of tree swallow eggs and nestlings were 2-5x higher near the ERTC than a reference lake

2021 MPCA and EPA Lake Superior Fish Tissue Study (Right):

Creek chubs in Sargent Creek have highest PFOS concentration in Lake Superior and 2nd highest in state.



Funding, contracts and sequencing of LSC-performed work

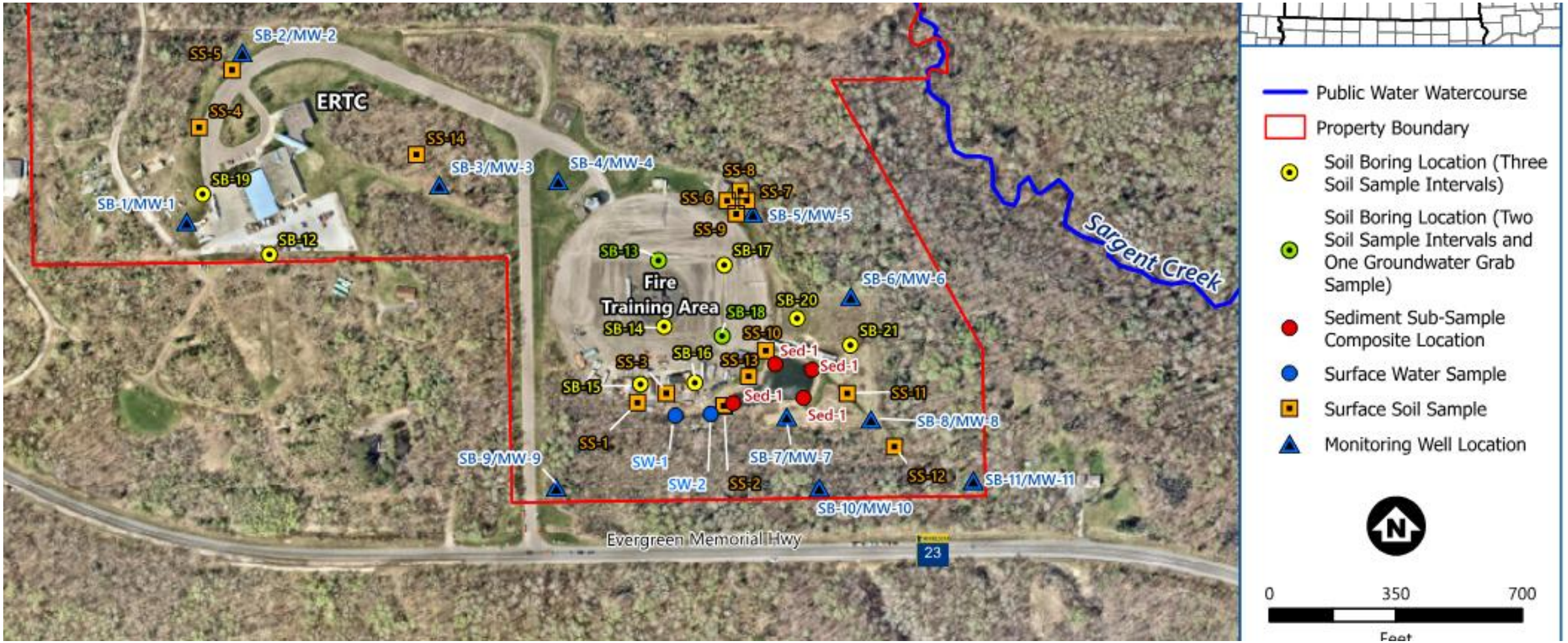
- Original 2023 sole-source funding: operating budget – limited resources available
  - Developed work plan
  - Performed 2024 Investigation
  - Created 2024 Investigation Report
  - Funded 2025 work plan – more expansive
  - 2025 work plan approved by MPCA

Funding Source Change

- MN State System funding
- Competitive RFP to perform 2025 work plan
- Awarded work – began after authorization July 2026.

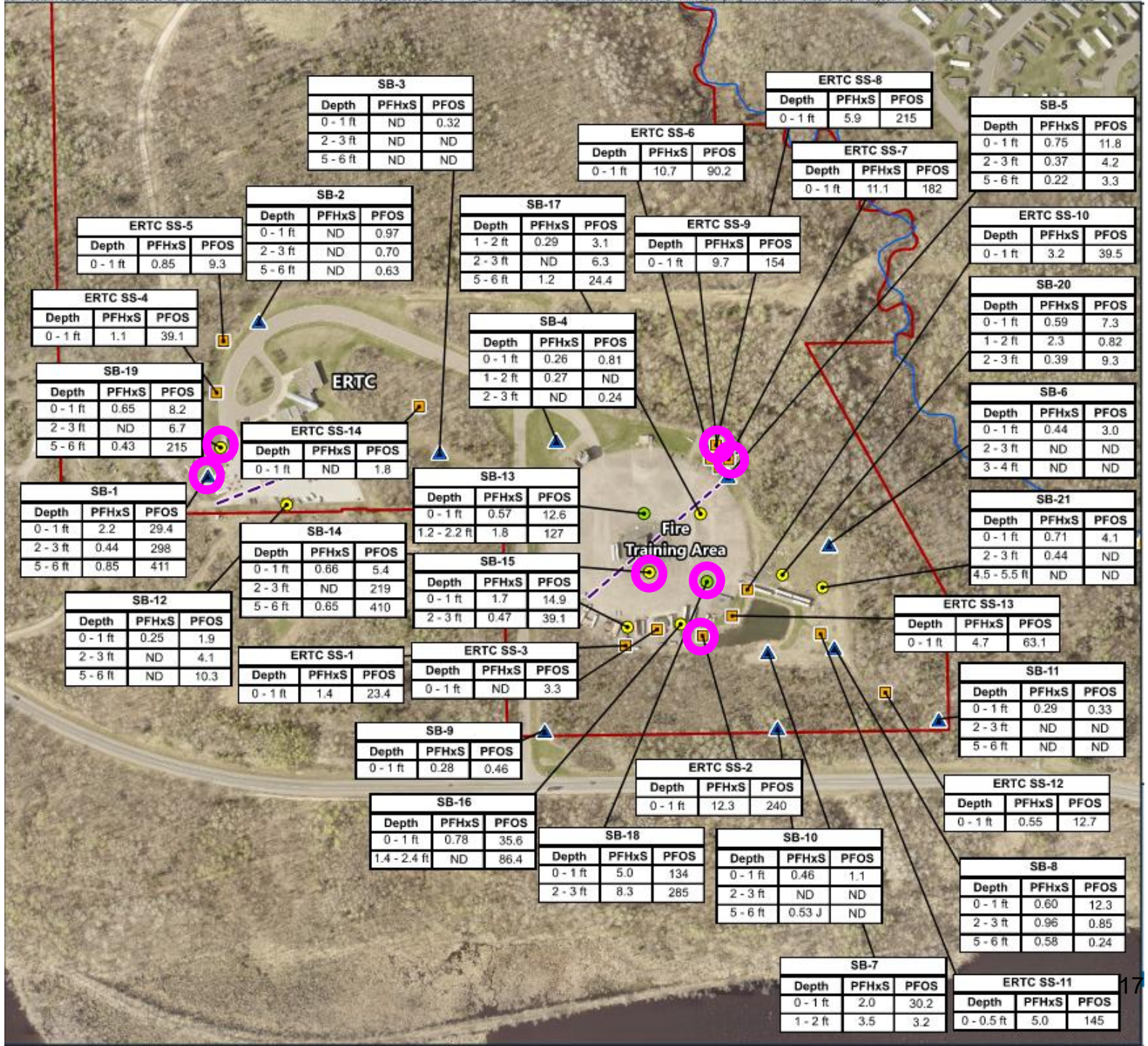


2024 Investigation

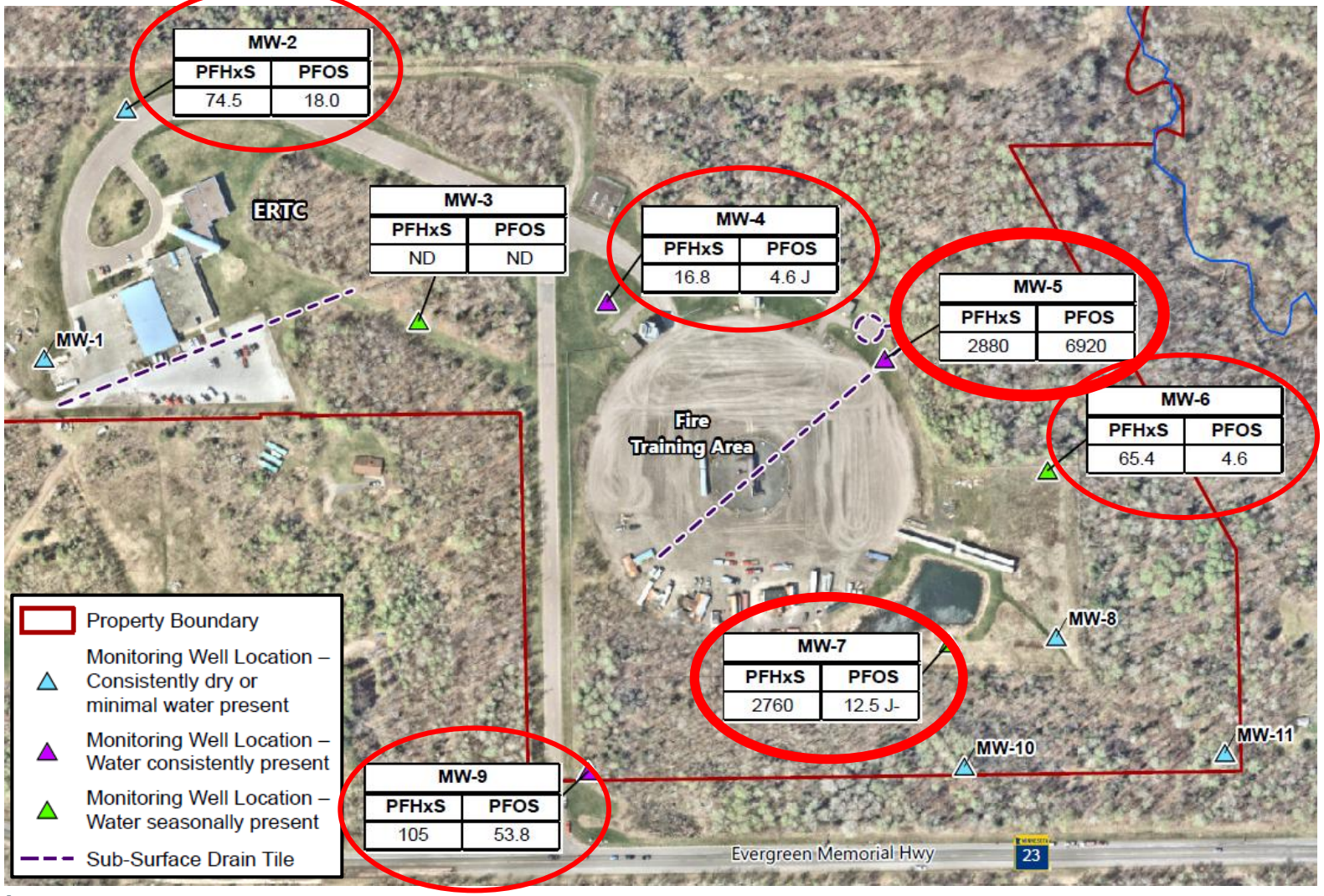


2024 Investigation Summary – Soils

- All depths shown
- PFOS concentrations exceed 2026 Industrial SRVs* at 7 locations in TWA, EQB, and FTA
- No exceedances of 2026 Industrial SRV for PFHxS
- Current scoping effort acknowledges additional considerations beyond SRVs for contributions to groundwater



2024-2026 Investigation Summary - Groundwater



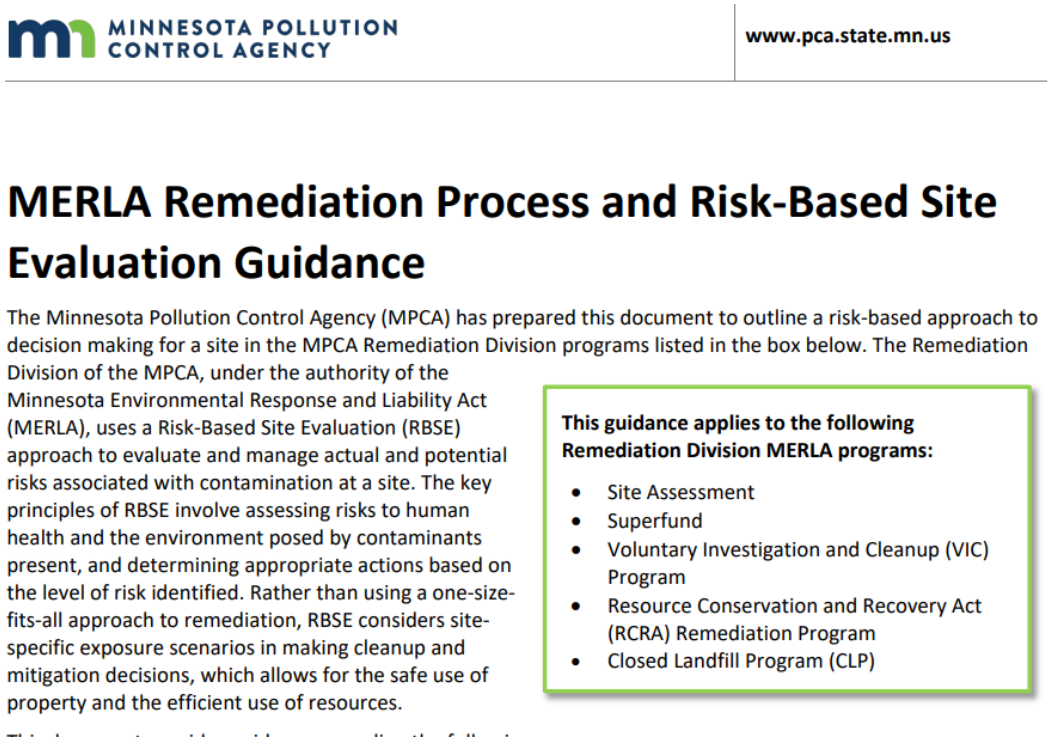
- Concentrations shown are Maximum of data to date
- Have been able to sample 7 of the 11 original monitoring wells
- PFOS and PFHxS exceedances of MCLs observed in all sampled wells except MW-3
- Criteria: MN and EPA
  - PFOS: 2.3 ppt / 4 ppt
  - PFHxS: 47 ppt / 10 ppt

2025 Work Plan Goals

- Delineate Extent and Magnitude of PFAS onsite
- Evaluate total potential PFAS mass
- Evaluate PFAS flux offsite in surface water
- Evaluate PFAS flux offsite in groundwater
- Continue interim water treatment

- Support remedial action planning and implementation
- Evaluate additional data collection offsite

- Iterative and non-linear process



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MERLA Remediation Process and Risk-Based Site Evaluation Guidance

The Minnesota Pollution Control Agency (MPCA) has prepared this document to outline a risk-based approach to decision making for a site in the MPCA Remediation Division programs listed in the box below. The Remediation Division of the MPCA, under the authority of the Minnesota Environmental Response and Liability Act (MERLA), uses a Risk-Based Site Evaluation (RBSE) approach to evaluate and manage actual and potential risks associated with contamination at a site. The key principles of RBSE involve assessing risks to human health and the environment posed by contaminants present, and determining appropriate actions based on the level of risk identified. Rather than using a one-size-fits-all approach to remediation, RBSE considers site-specific exposure scenarios in making cleanup and mitigation decisions, which allows for the safe use of property and the efficient use of resources.

This guidance applies to the following Remediation Division MERLA programs:

- Site Assessment
- Superfund
- Voluntary Investigation and Cleanup (VIC) Program
- Resource Conservation and Recovery Act (RCRA) Remediation Program
- Closed Landfill Program (CLP)

2026 approach

2025 work plan provided flexibility

Required regulatory coordination

Field work started August 2026:

- CPT, with porewater dissipation tests

October 2026

- Soil sampling and monitoring well installations
  - Sonic drilling
  - Geoprobe
- Surface water monitoring (monthly)
- Groundwater monitoring (quarterly)
- Private well sampling (annually)

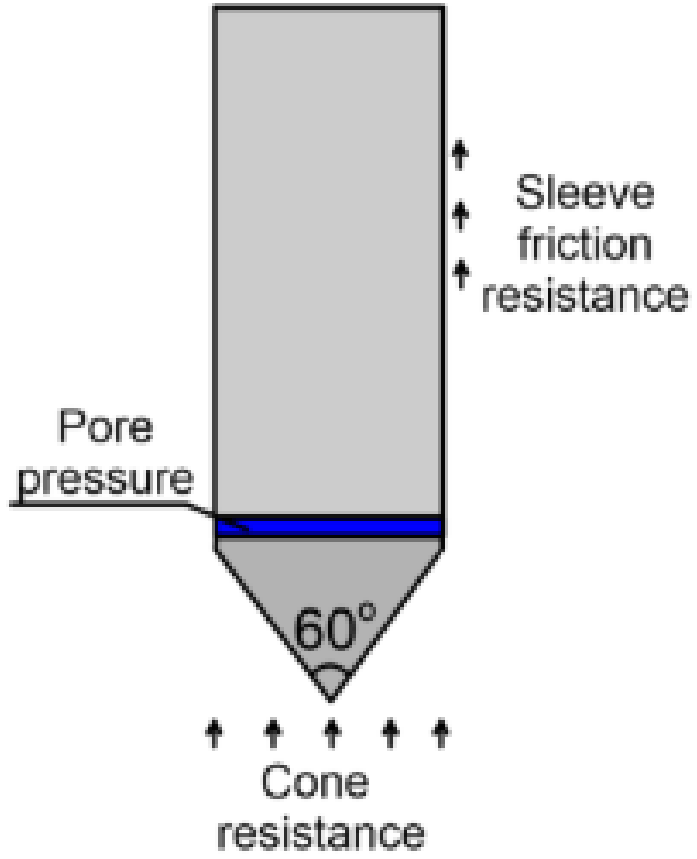


Image source: https://newcastle.pressbooks.pub/fundamentals-of-foundation-engineering

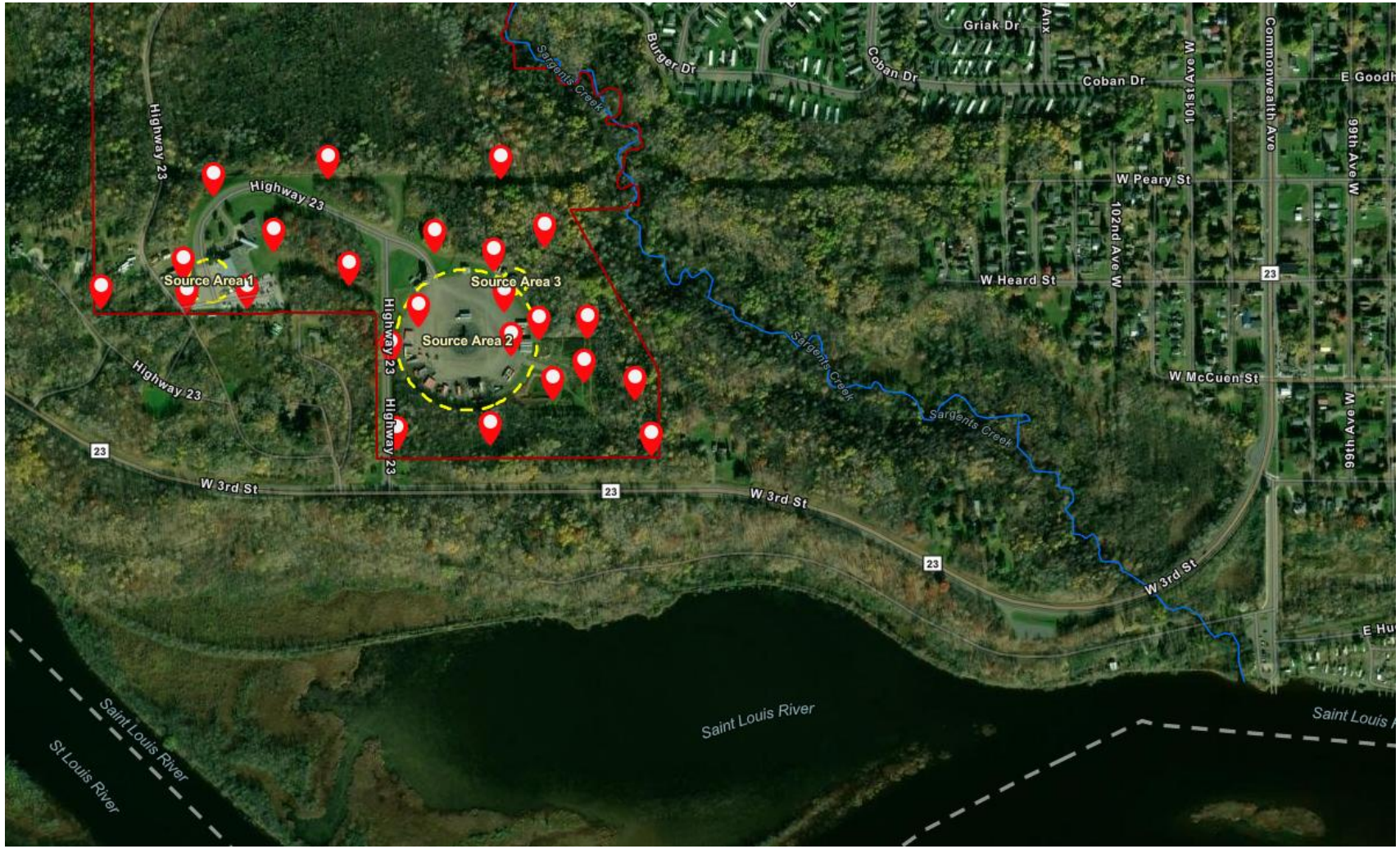
CPT locations

- Goal : ID lithology
- ID groundwater level

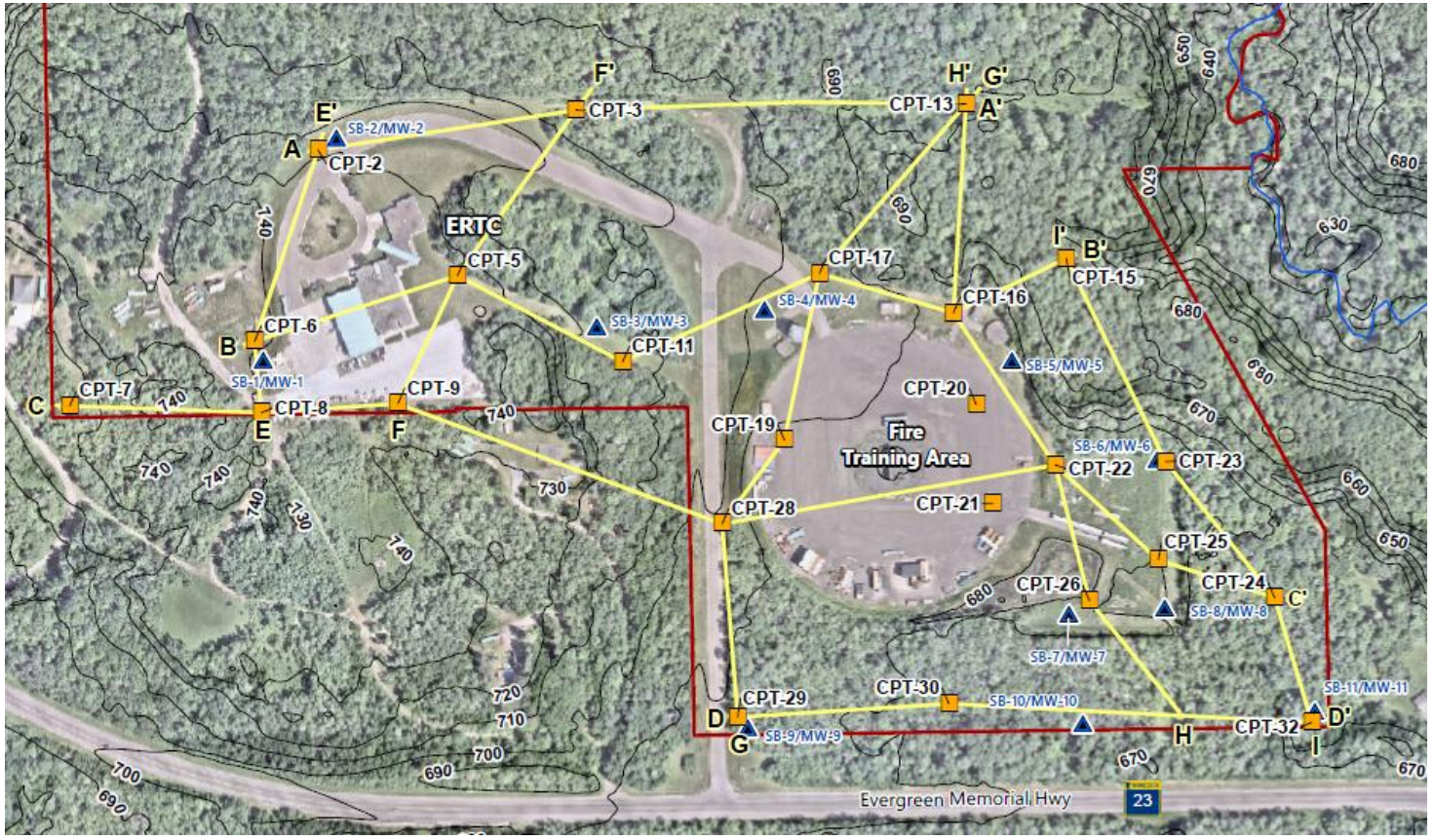
- 32 proposed
- 24 completed

- Cross Sections and MPCA walk through

- Developed plan for soil borings, monitoring wells, soil sampling



2026 CPT Investigation Summary



Completed 24 CPT soundings

Developed cross-sections A-A' through I-I'

West/TWA Observations:

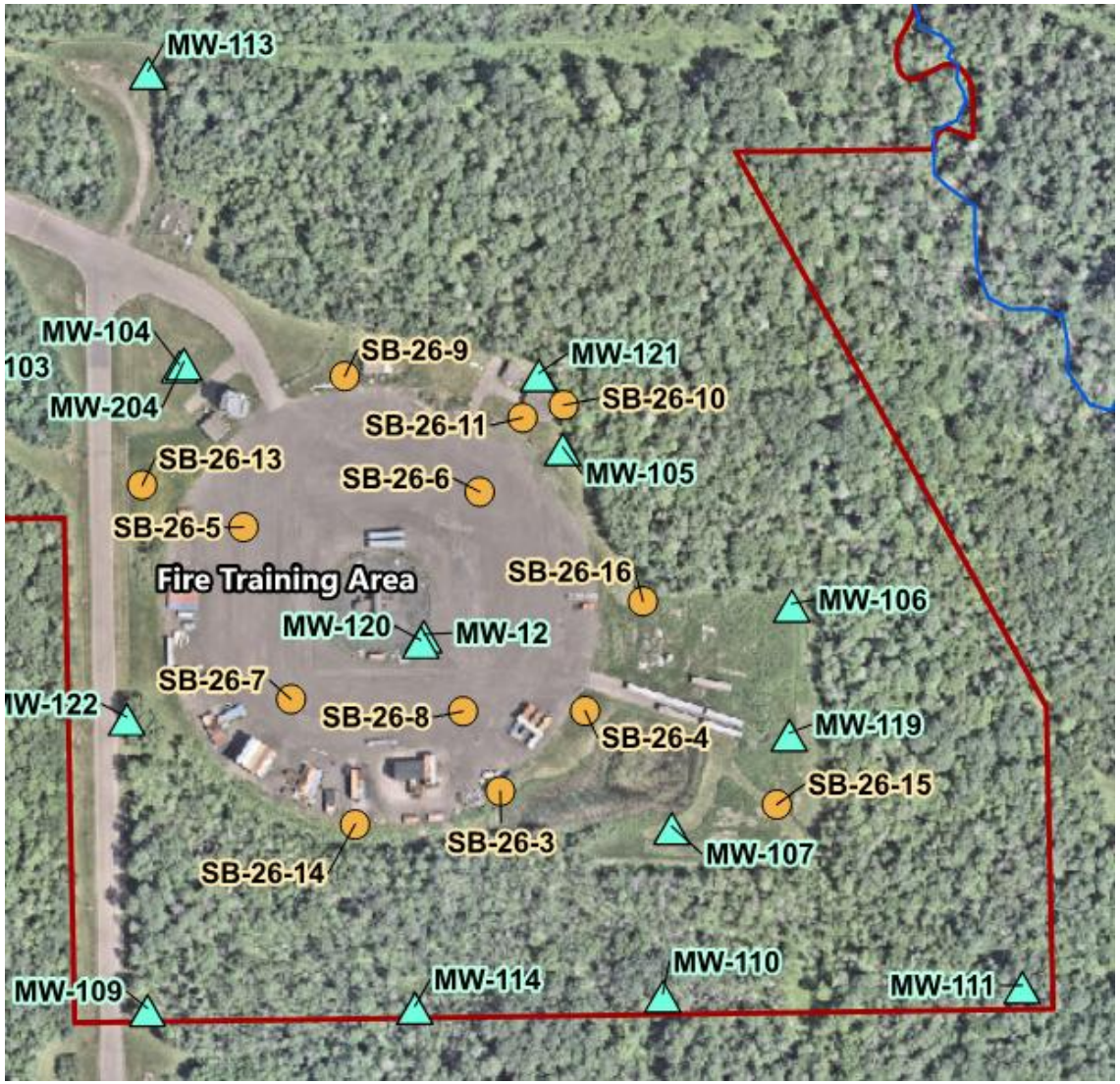
- Generally granular layer over clay
- Apparent clay valley SW of admin building – trending W/NW to E/SE
- Water table is less certain: field identified at approximately between 620' – 650'

East/FTA Observations:

- Apparent clay ridge along entry road
- Mixed soil profile/thinner vadose zone
- Identified the water table at 3 locations, at approximately 645'

Resulting 2026 Investigation Scope





Left: Admin/Garage

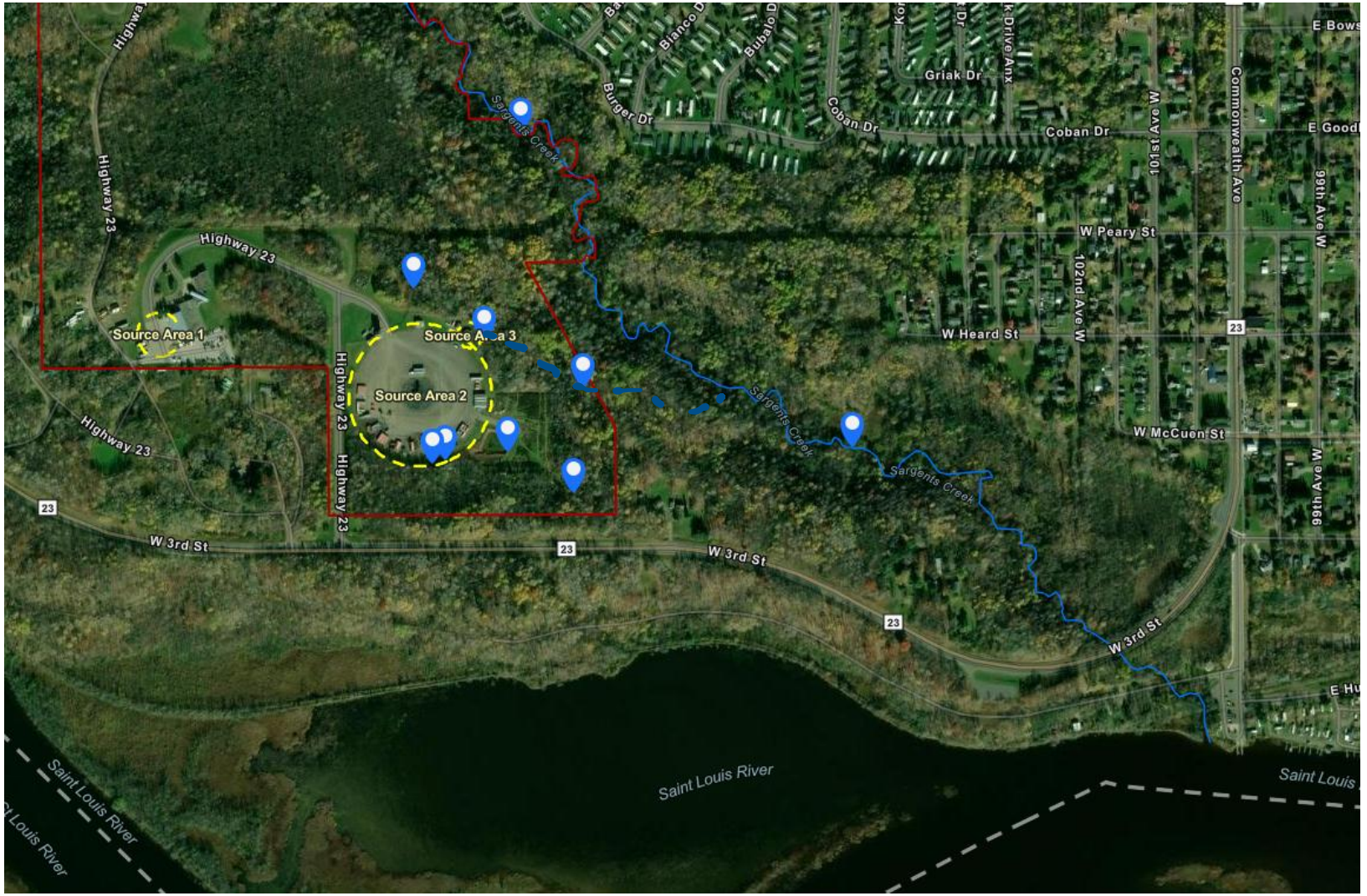
Right: Fire Training Area Equalization Basin

Surface water monitoring locations

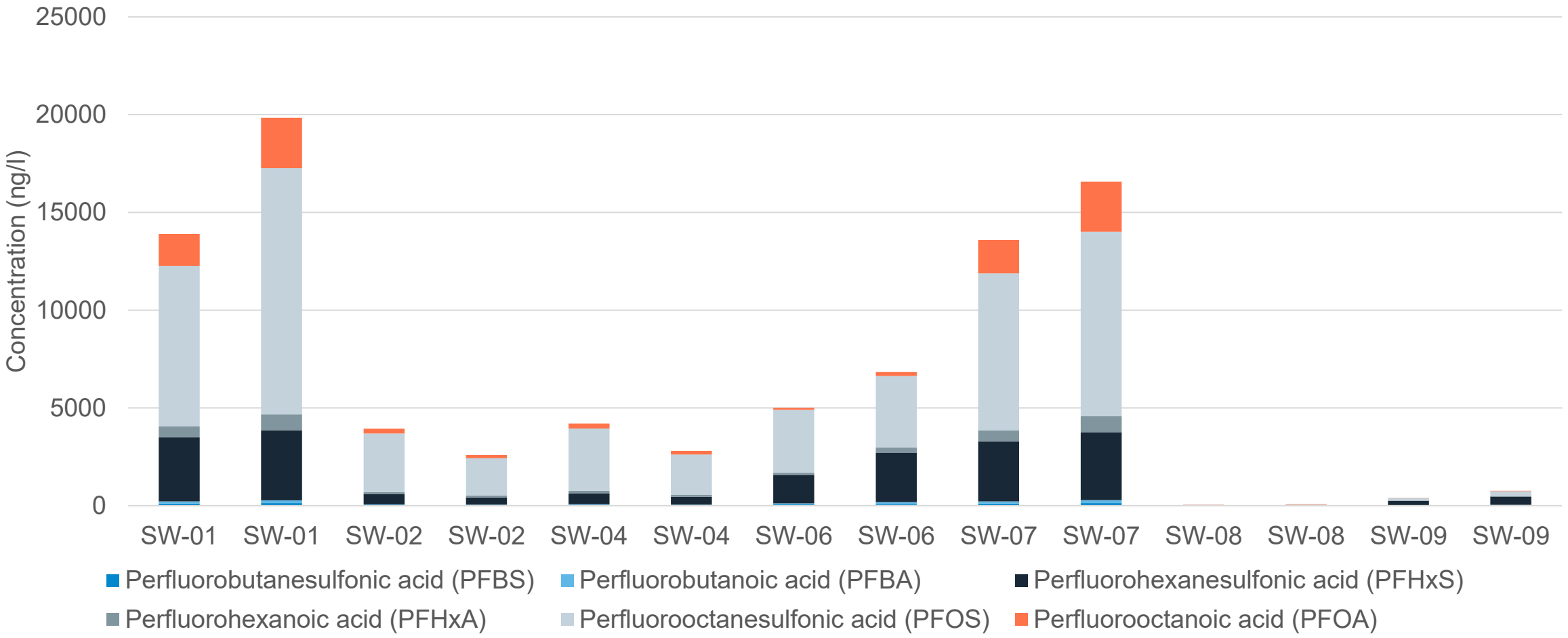
- Eleven locations
- Monthly frequency

- Flow measurement
- Analytical sampling

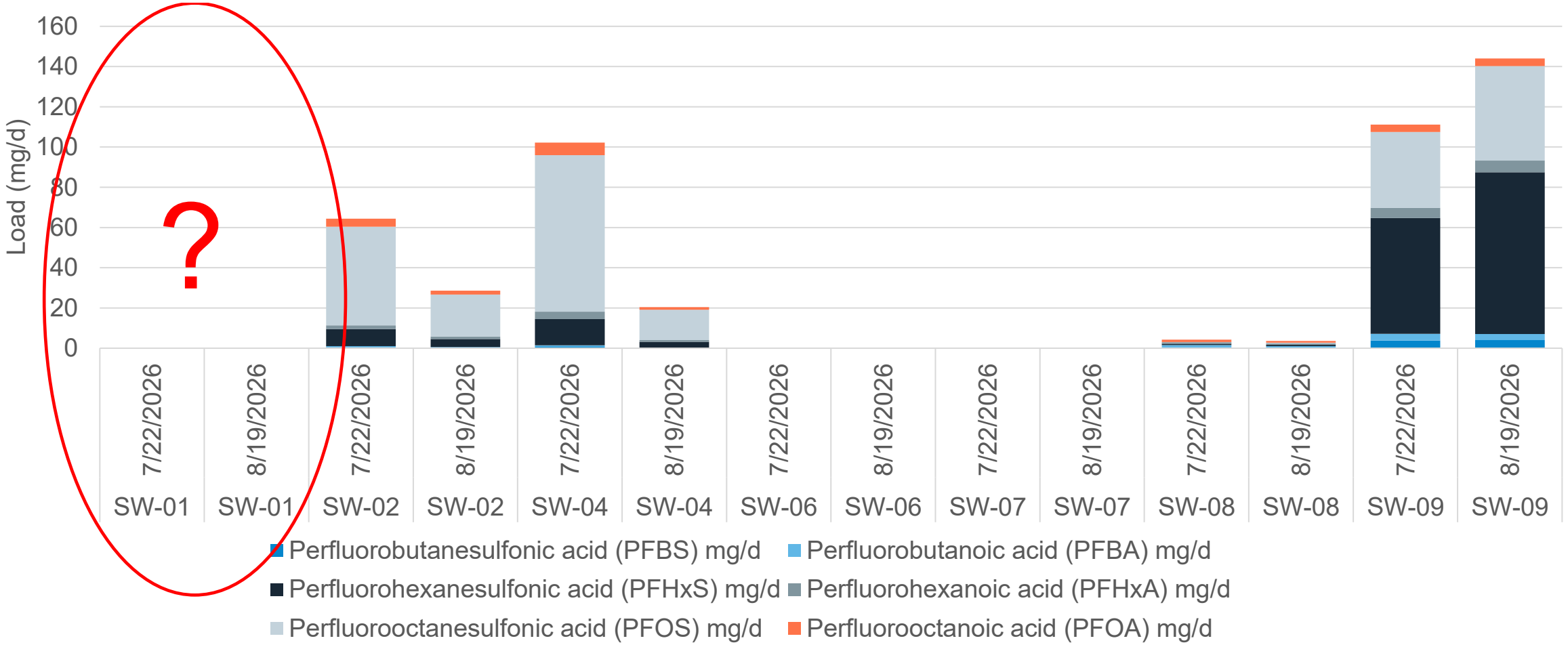
- Calculate flux of PFAS in each location



Surface water draft results - concentrations



Surface water draft results - flux



SW-01



Discharge location (pre-sampling)

Existing discharge below water level

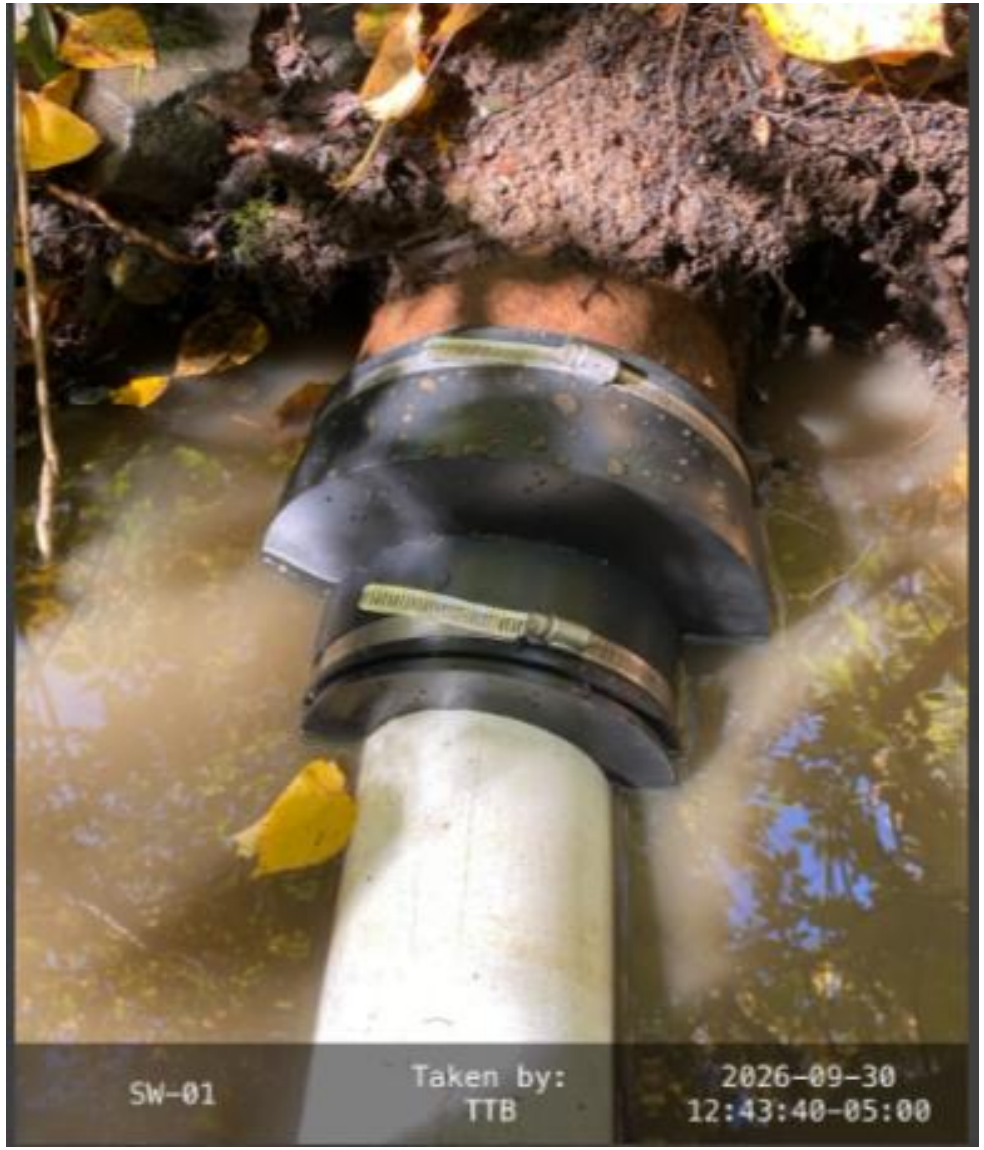
Initial efforts – leaky connection

Not representative flow measurements

If at first you don't succeed…

SW-01 – pond discharge structure





Next steps

Public engagement - open house

Summary report

Next work plan

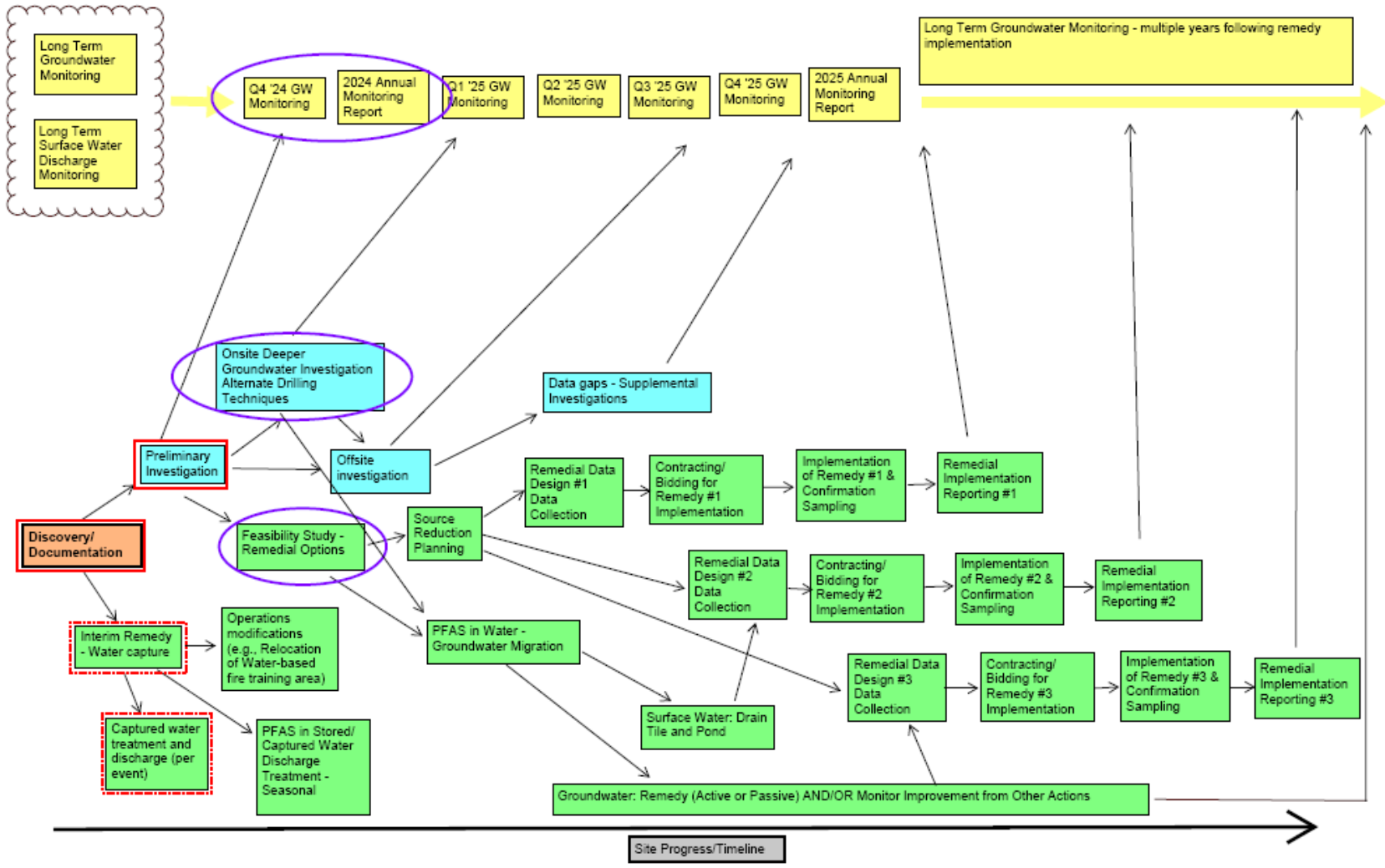
Iterative

Non-linear – parallel paths

Monitoring (yellow)

Investigation (blue)

Remediation (green)



Questions / Discussion

Thank you!

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