

A Comprehensive Design Approach to a Multi-Contaminant, Multi-Receptor Site

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Presentation Outline

Site Conditions

Delineation of Contamination

Treatment Approach

Conclusions/Summary of Findings

Path Forward

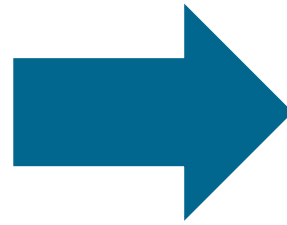
Site Location

The Site is a 3.52-ac parcel located in a commercial and industrial area of Elizabeth, NJ



Project History

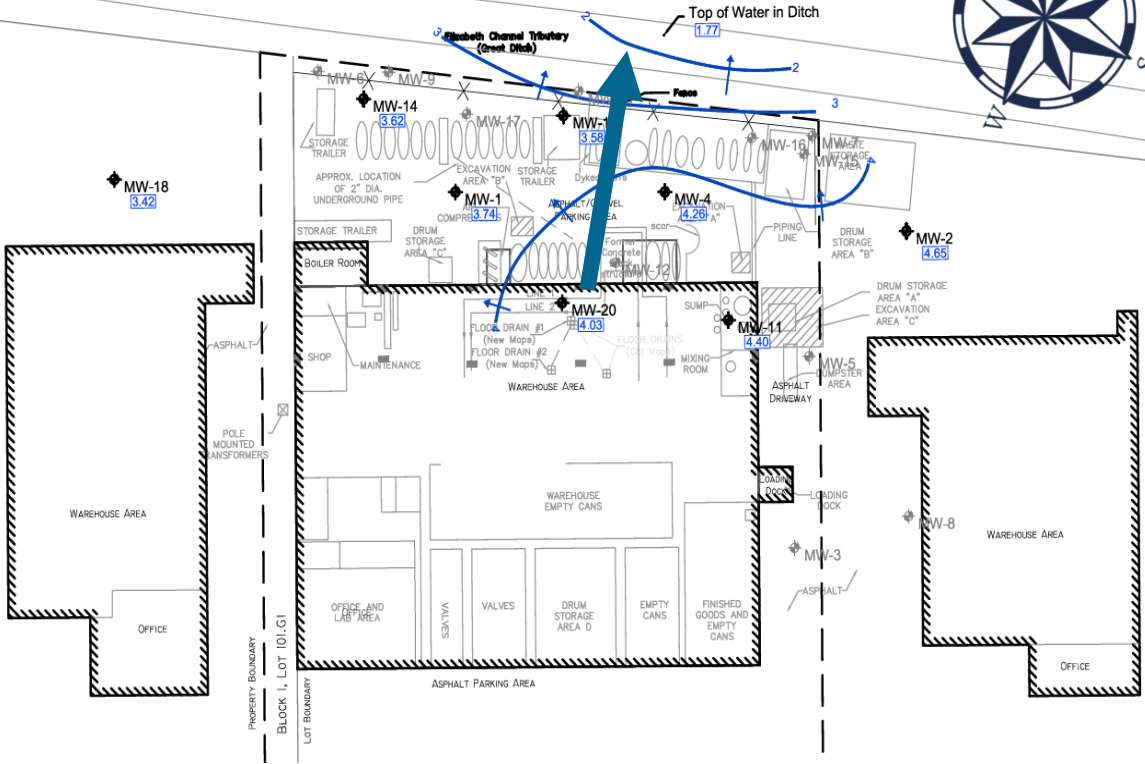
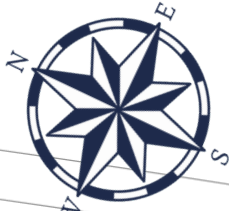
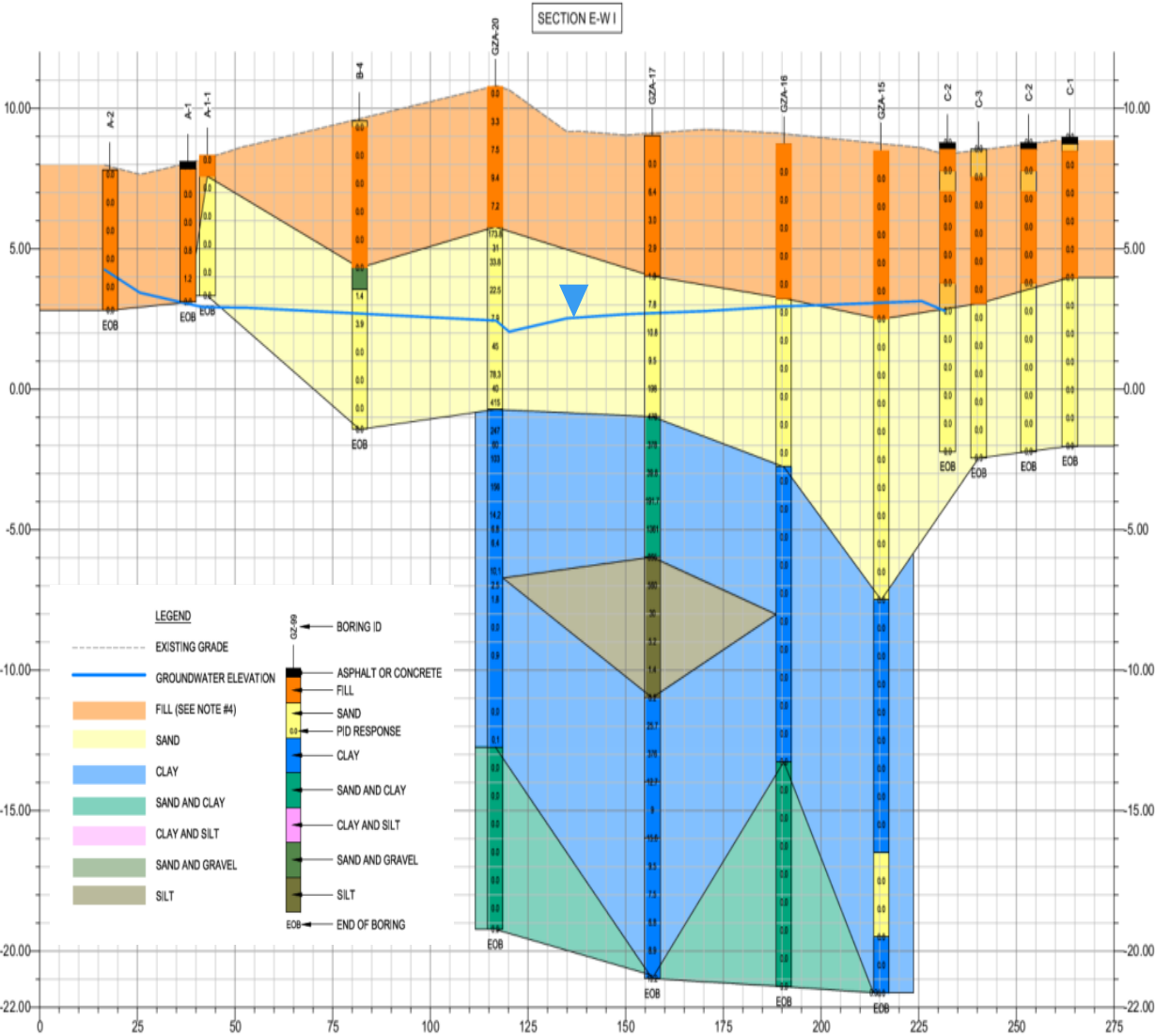
SAFEGUARD CHEMICAL
FACILITY (1964 - 2008)



The Site is currently
used as a warehouse
distribution facility



Site Geology & Hydrology



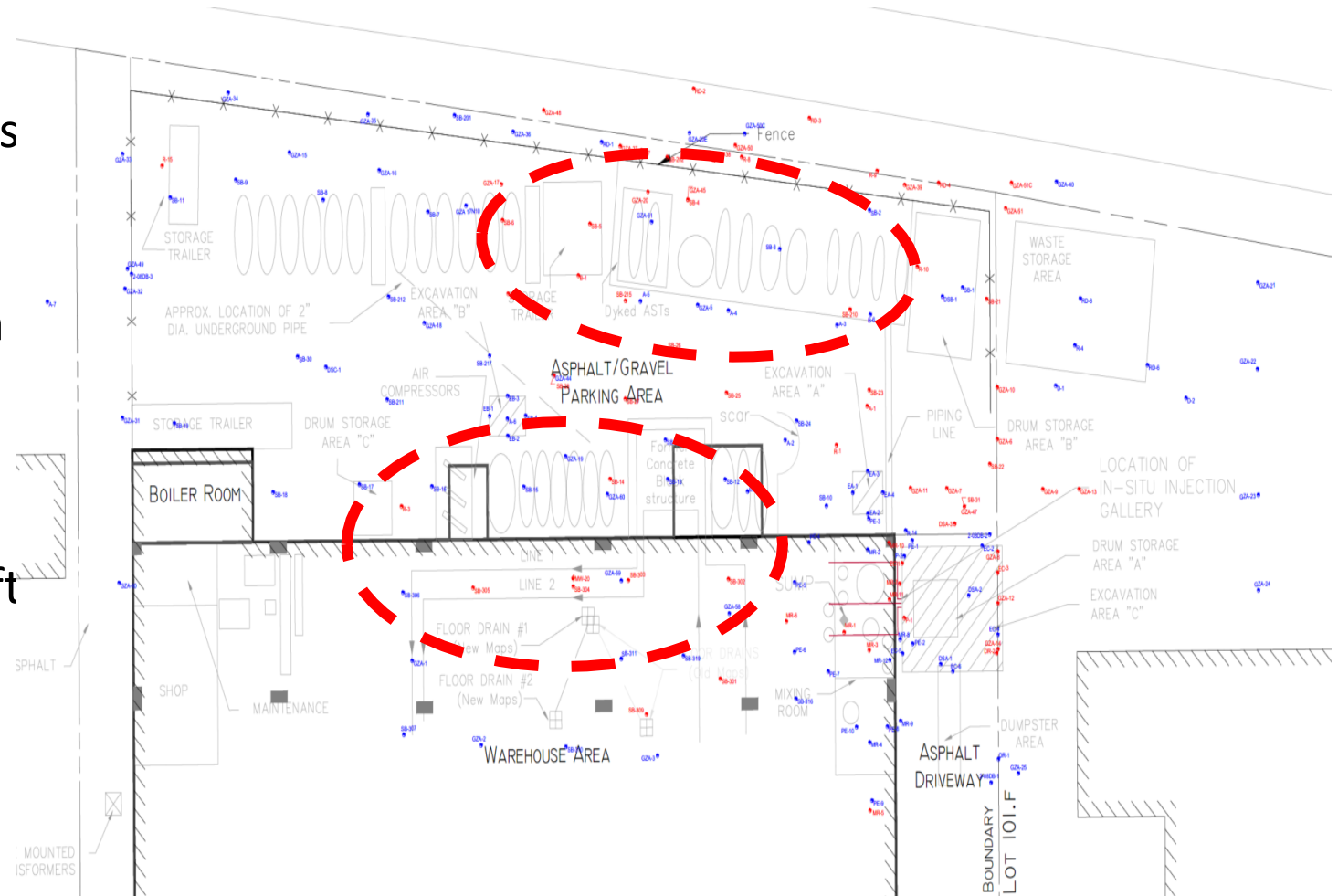
Delineation of

Chlorinated/Volatile Organic Compounds (C/VOCs)

- Detected in clay layer, ~6-18 ft bgs and groundwater
- Delineated four source zones (Areas A-D) at levels ranging from 228 to **3,000,000 ppm**

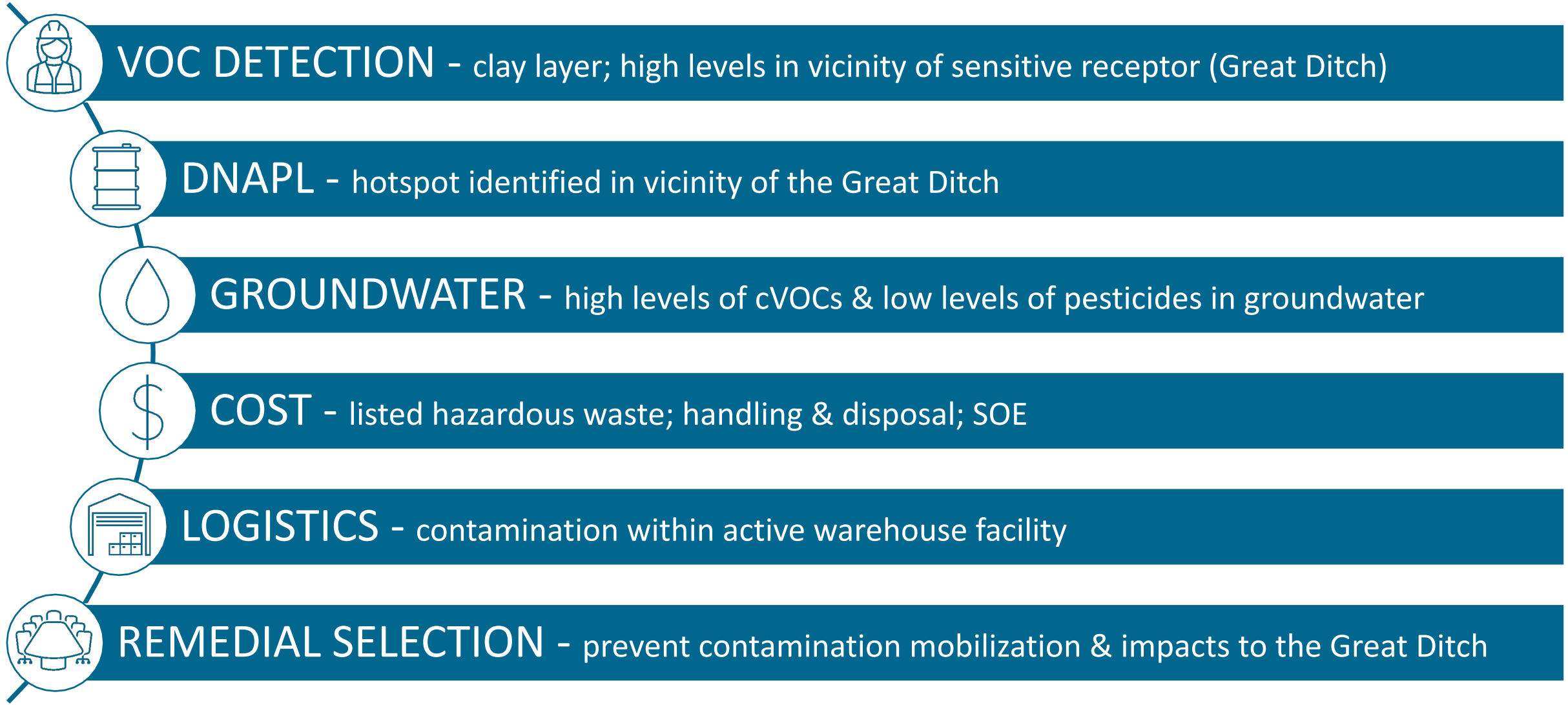
Pesticides

- Detected in shallow soils, ~0-5.5 ft bgs and groundwater
- Located throughout the Site



- Approx. hot spot locations
- Sample not exceeding standards
- Sample exceeding standards

Treatment Approach



Remediation Approach

Evaluated field parameters to design injections



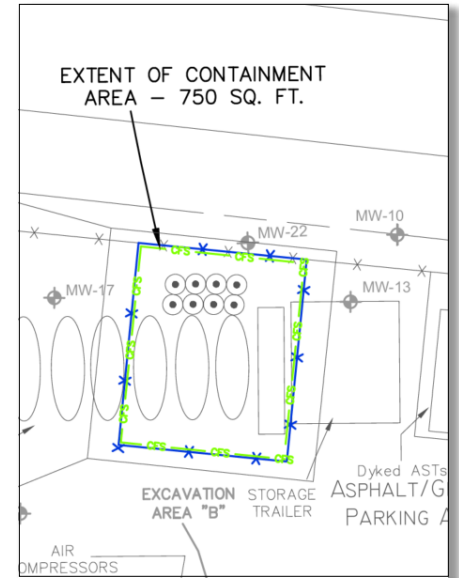
Bench Scale studies to select appropriate amendments



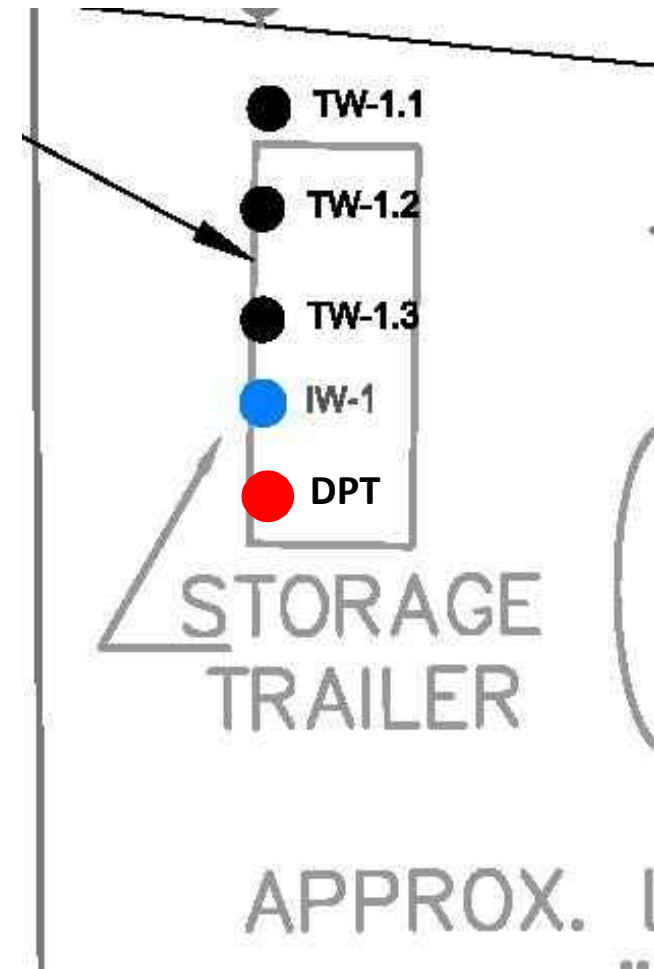
Implementation of remedial action [ISCO]



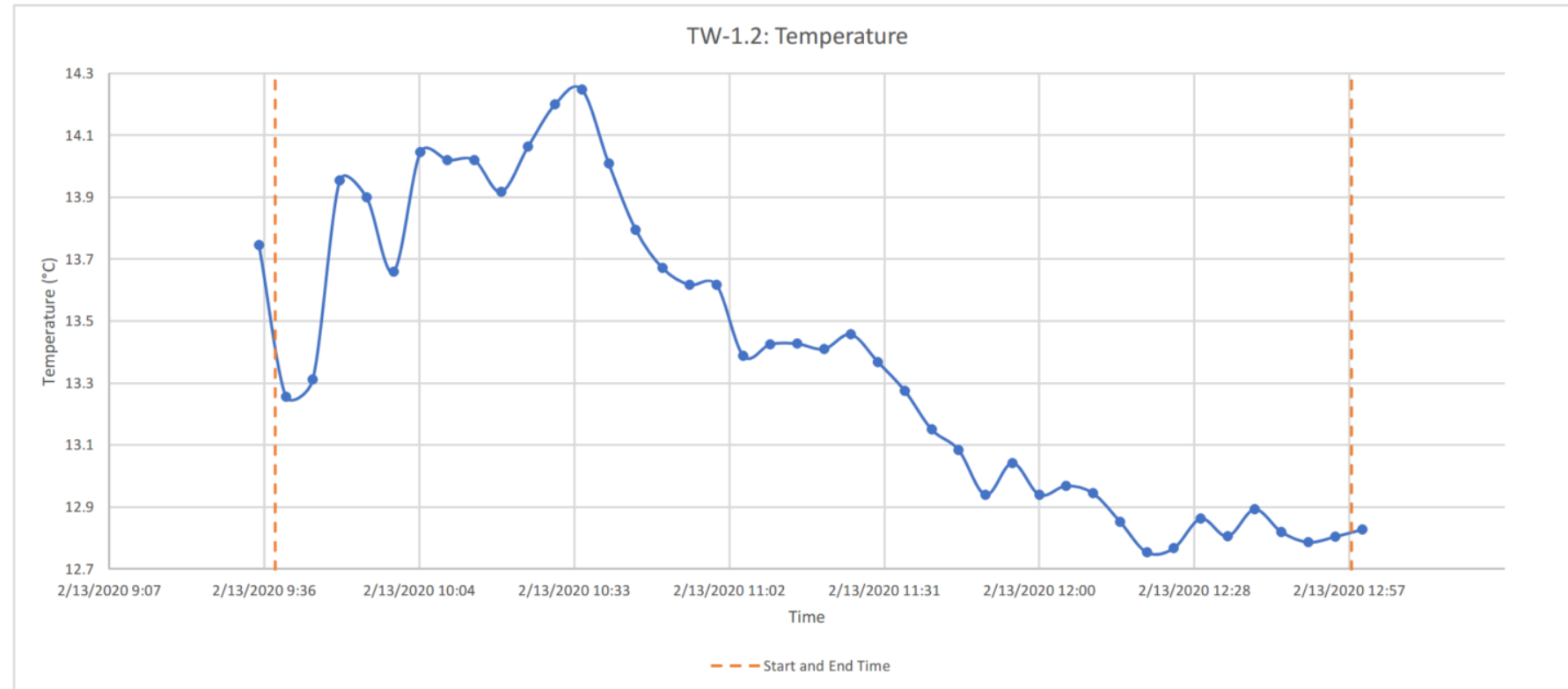
Limited excavation using caisson rigs to address DNAPL



- 2-in. injection point installed with direct push technology (DPT)
- Temporary injection monitoring points:
 - Installed downgradient 3-, 5-, 10-, and 15-ft. from DPT location
 - Constructed to 17-ft. bgs
- Transducers used to record water level, pressure, and temperature
- ~100 gal of cold water (4 °C) injected



- No significant changes in water level and pressure
- Observed decrease in groundwater temperature at locations 5- and 10-ft. from DPT location
- Estimated ROI ranges from 5-to-10 ft. at a pressure of 0-to-5 psi

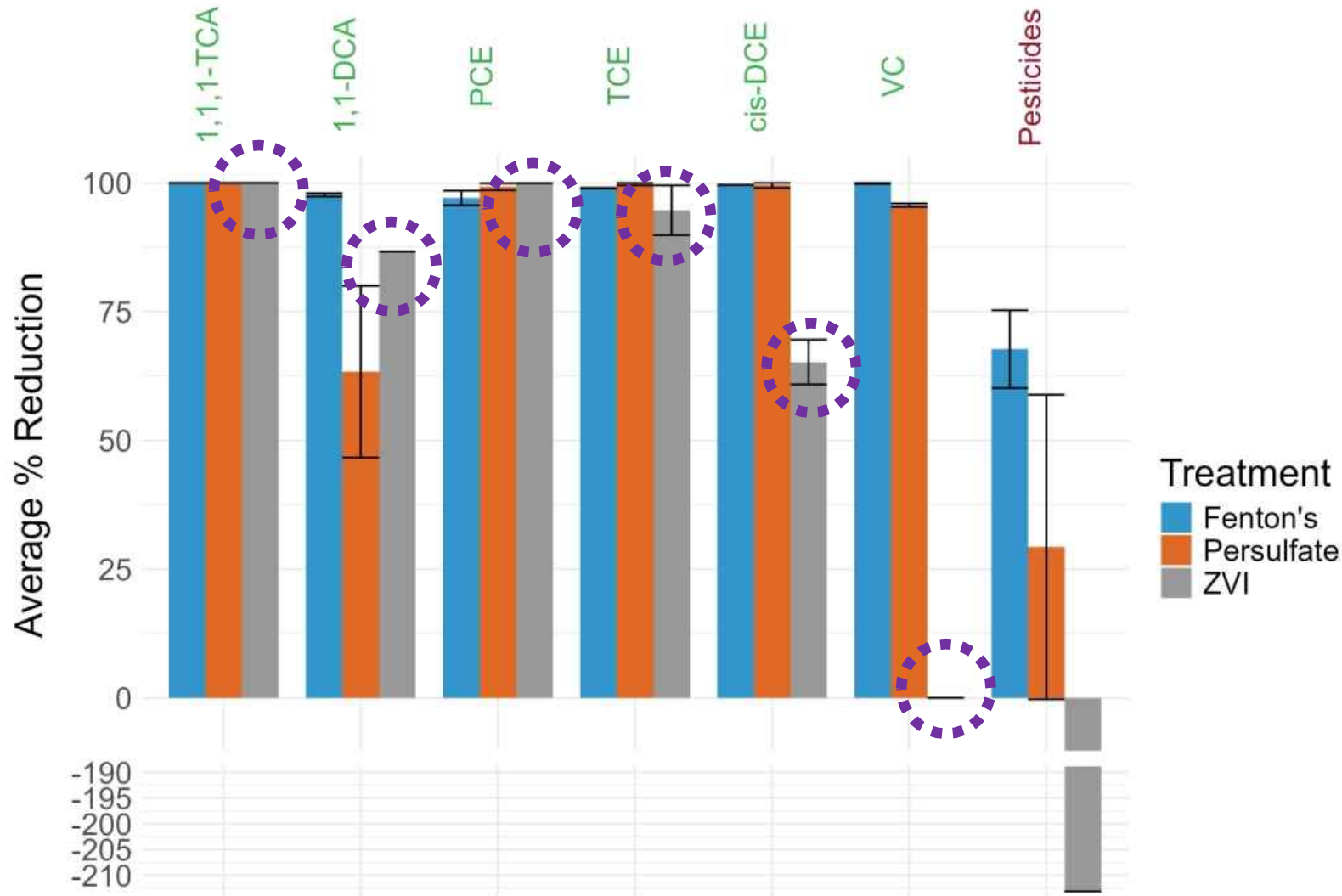


Treatability Study: Amendments

Hydrogen Peroxide (Fenton's Reagent - Modified)		Sodium Persulfate (Carbohydrate, NaOH activated)		EZVI w/ Bioaugmentation (ISCR)	
Low	High	Low	High	Low	High
50 g/L H ₂ O ₂	75 g/L H ₂ O ₂	50 g/L Persulfate	75 g/L Persulfate	10 g/L ZVI	20 g/L ZVI
250 mg/L Fe- EDTA	250 mg/L Fe- EDTA	2.5 g/L Glucose 0.5:1 mol NaOH	3.75 g/L Glucose 0.5:1 mol NaOH	18 g/L soybean oil TSI-DC culture	36 g/L soybean oil TSI-DC culture
14 days	14 days	14 days	14 days	28 days	28 days

** Bench Scale study conducted with site-representative soil and groundwater samples*

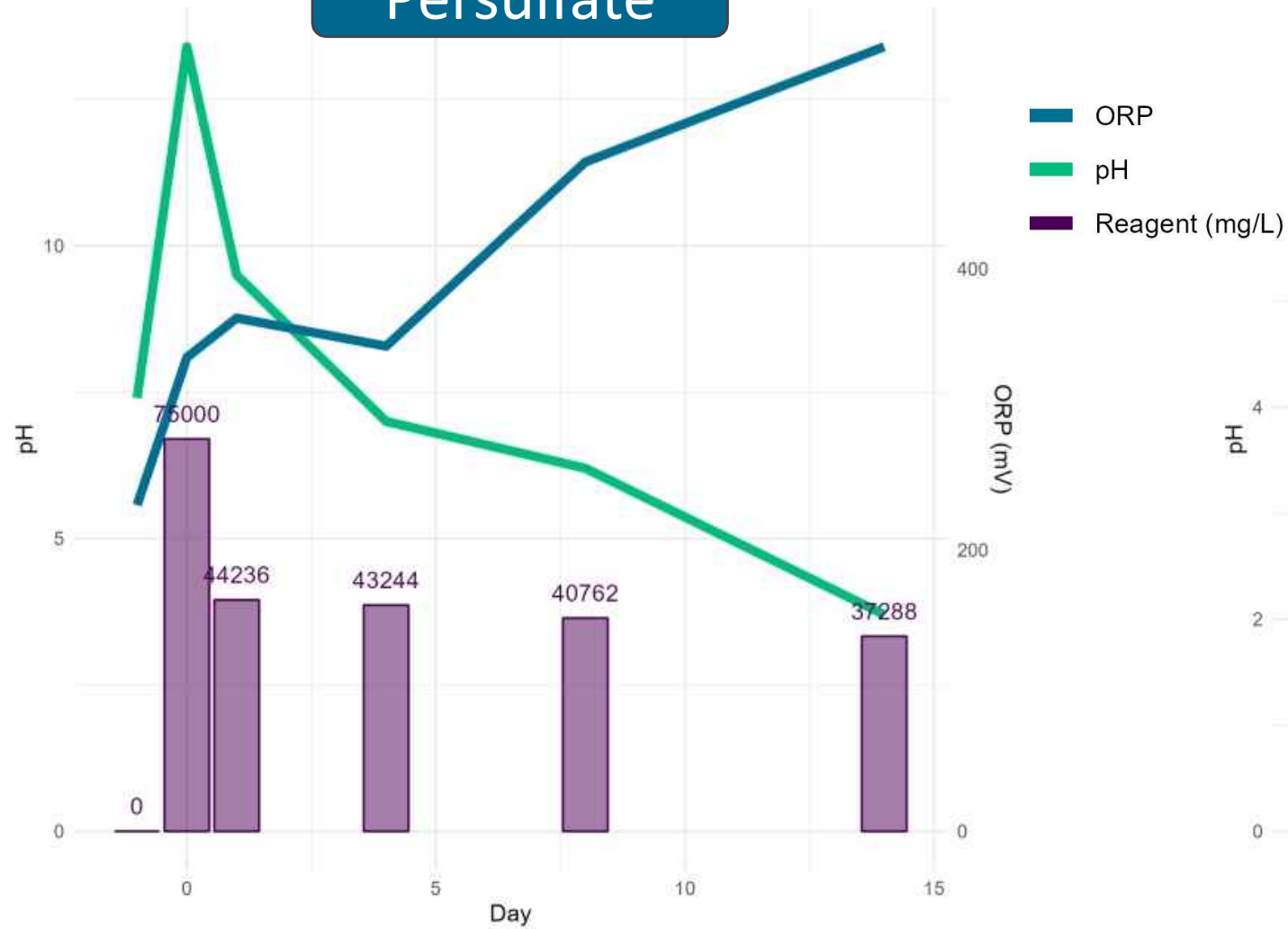
Treatability Study: COC Reductions



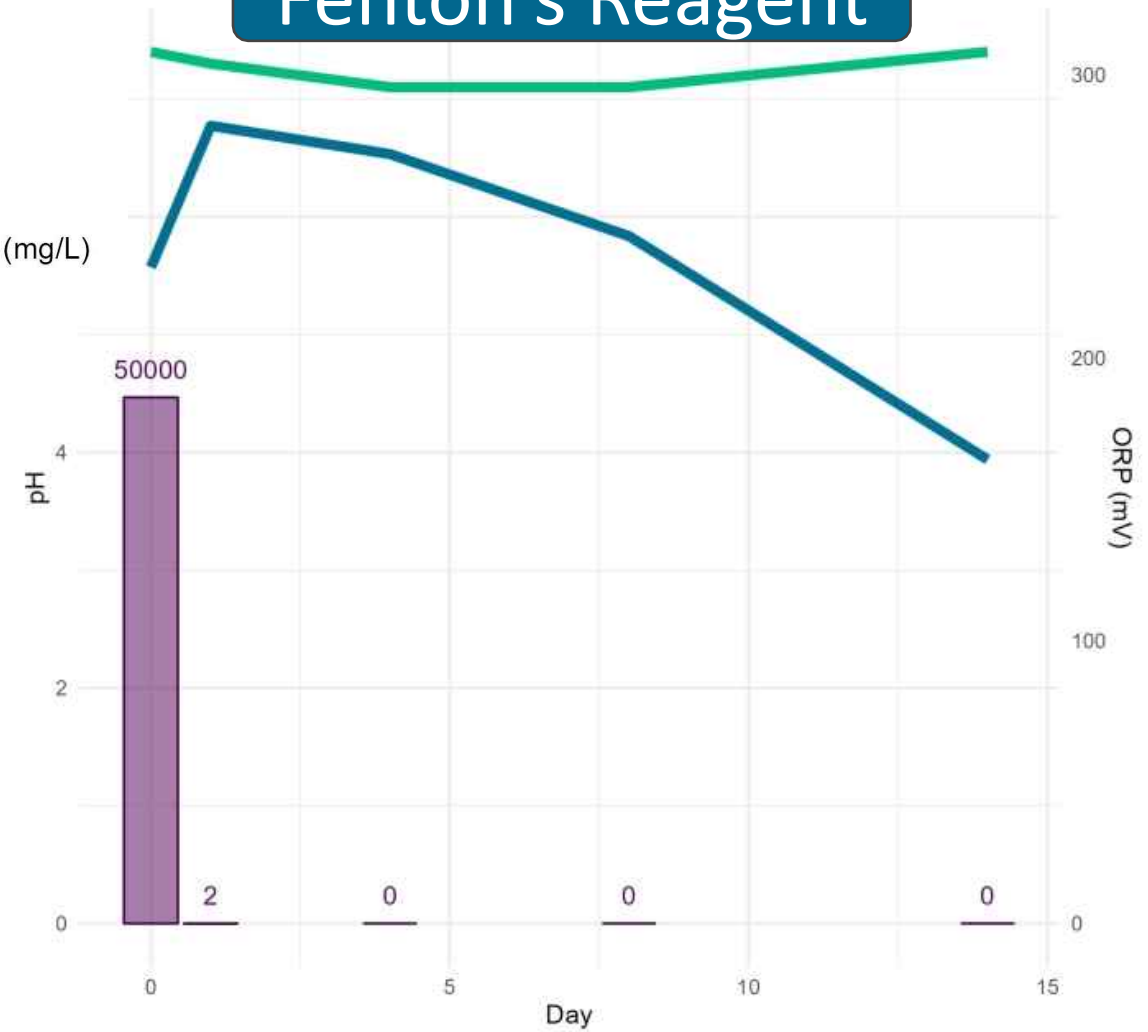
- ZVI was not as effective for chlorinated ethenes
- Organochlorine pesticides:
 - Fenton's reduced 60.2% - 75.3%
 - Persulfate reduced 0.3% - 58.9%
 - ZVI increased

Treatability Study: Geochemical

Persulfate



Fenton's Reagent



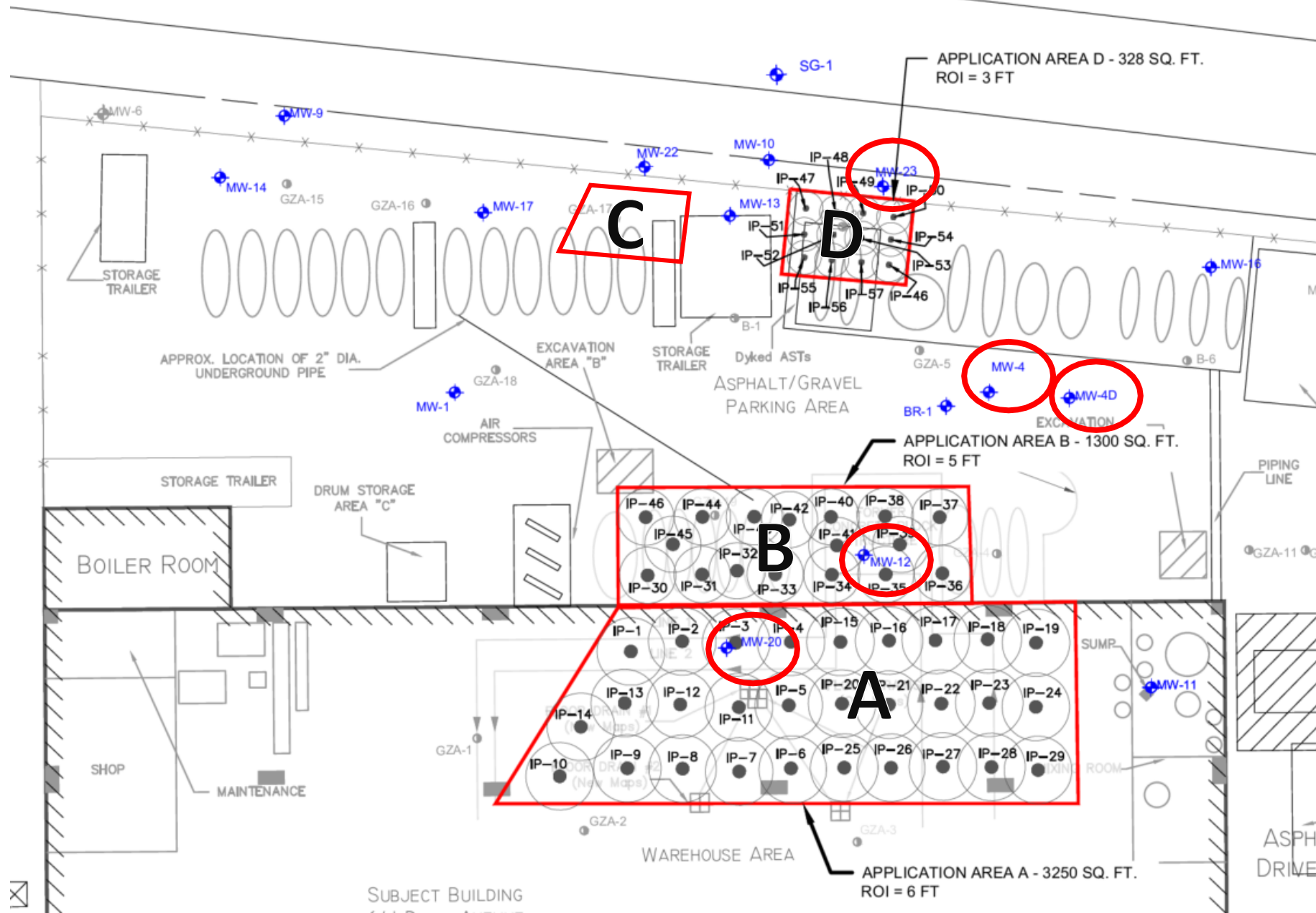
A combination of activated sodium persulfate with glucose and sodium hydroxide, along with Fenton's Reagent, are most effective at the Site

- Based upon the treatability study, EZVI was not selected for final remedy
- MFR (hydrogen peroxide and chelated iron) to mobilize adsorbed contamination from the clay layer at a low pressure
- Carbohydrate activated sodium persulfate (CHASP) to treat the mass mobilized from groundwater
- Large volumes of amendment were estimated for treatment, therefore injection volume divided into two events. Targeted 27 to 30% pore volume replacement in each event

Event 1: ~26,710 gal of amendments

Event 2: ~22,880 gal of amendments

Remediation Areas



Legend

MW-22 Monitoring Well

Injection Point

ROI

Injection Application Area

Injection Performance Monitoring Well

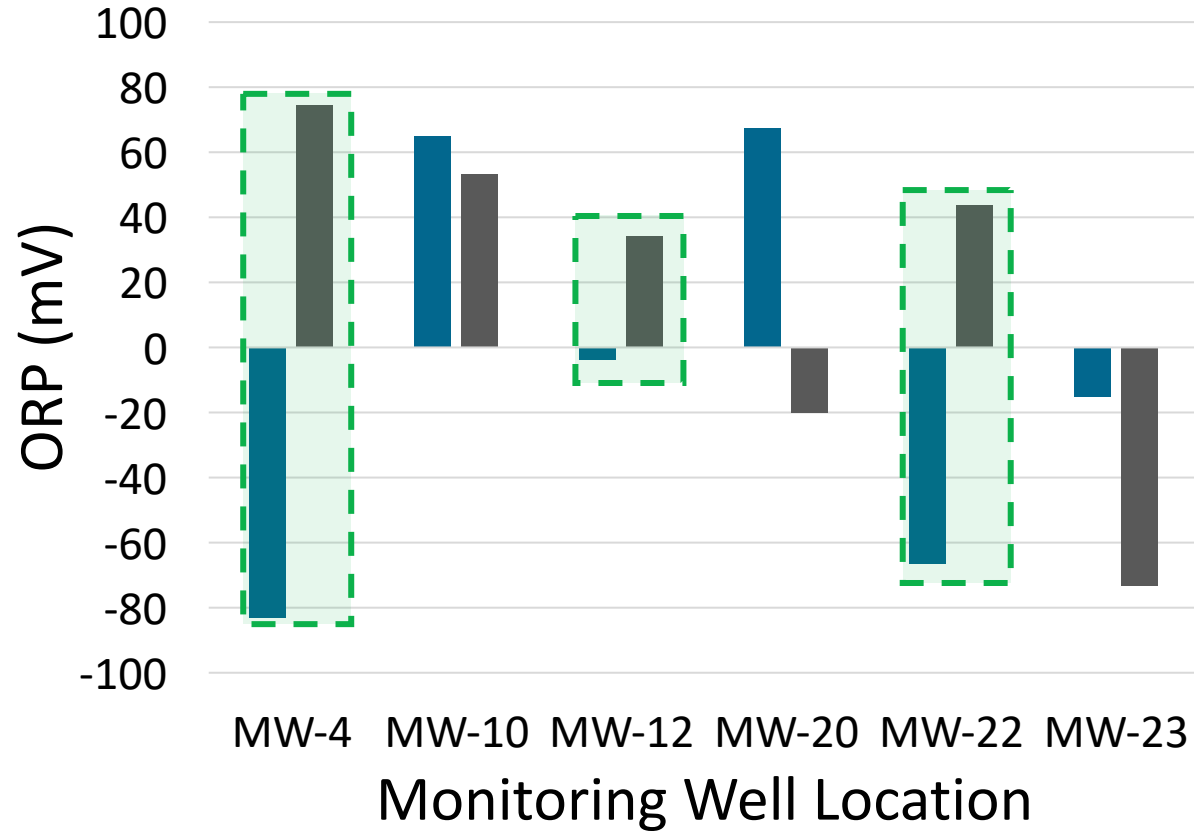
Limited Excavation Area



- 2 injection events, each lasting ~4-5 weeks in duration, separated by 2 months
- MFR and CHASP injected in a sequential manner in 3 injection areas at minimal pressure
- Target depths of 6-to-16 ft. bgs
- Field observations:
 - Surfacing
 - Pressure monitoring
 - Geochemical parameters
 - Subsurface acceptance of reagents to modify injection quantities

Groundwater Trends: Geochemical

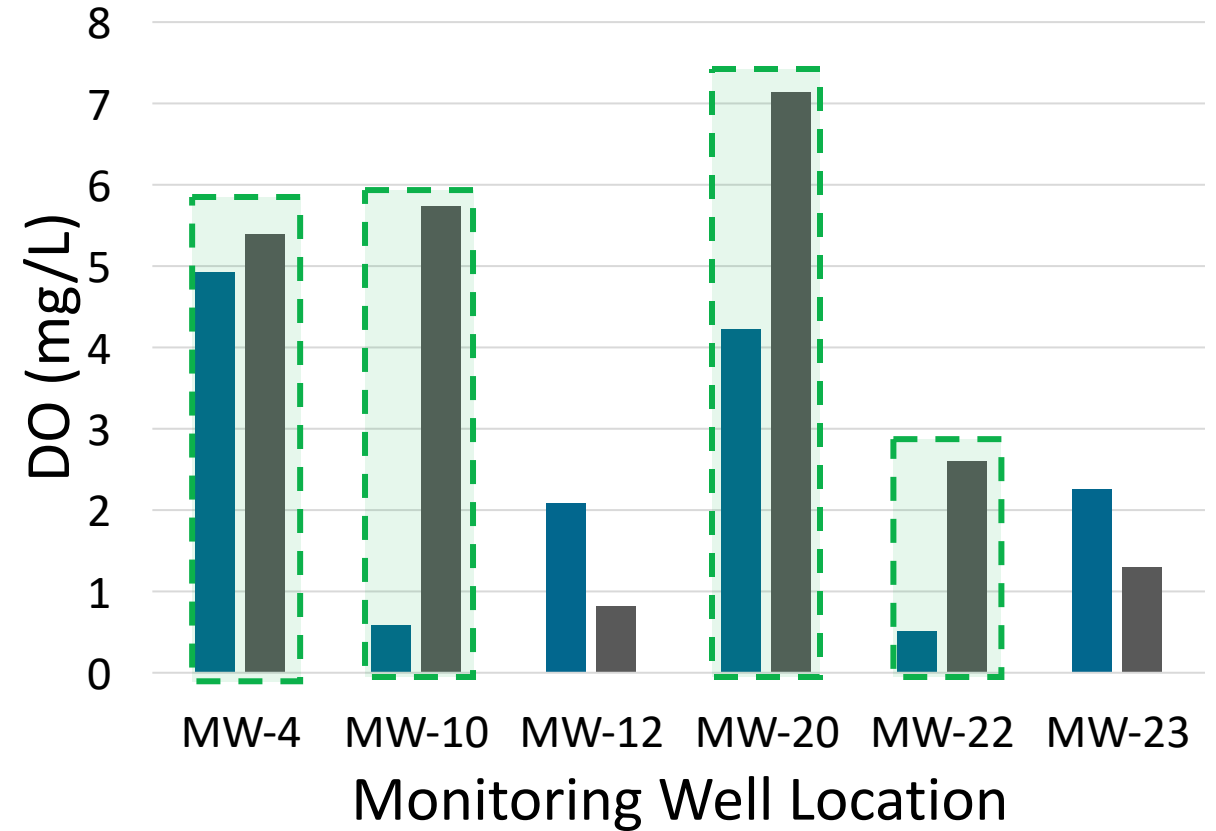
Oxidation-Reduction Potential (ORP)



■ Baseline: 10/25/2022

■ 90-Day Monitoring: 10/3/2023

Dissolved Oxygen (DO)

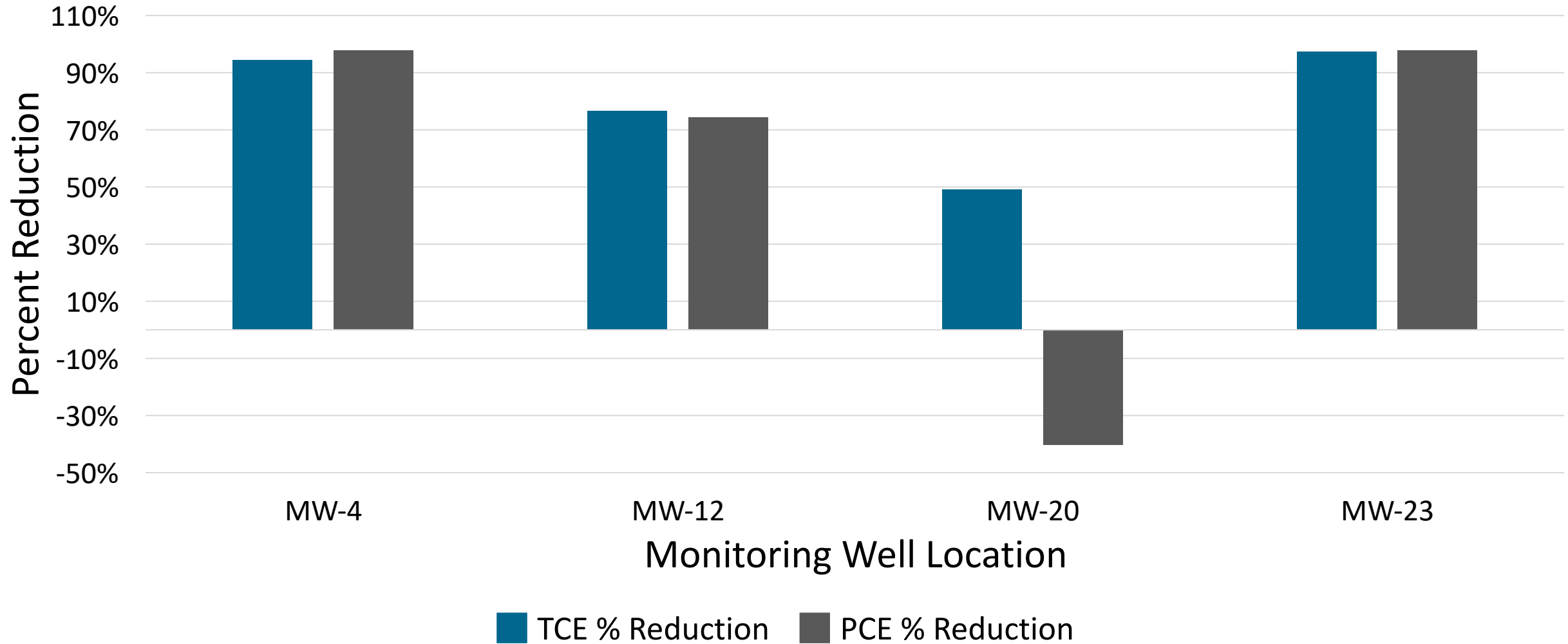


■ Baseline: 10/25/2022

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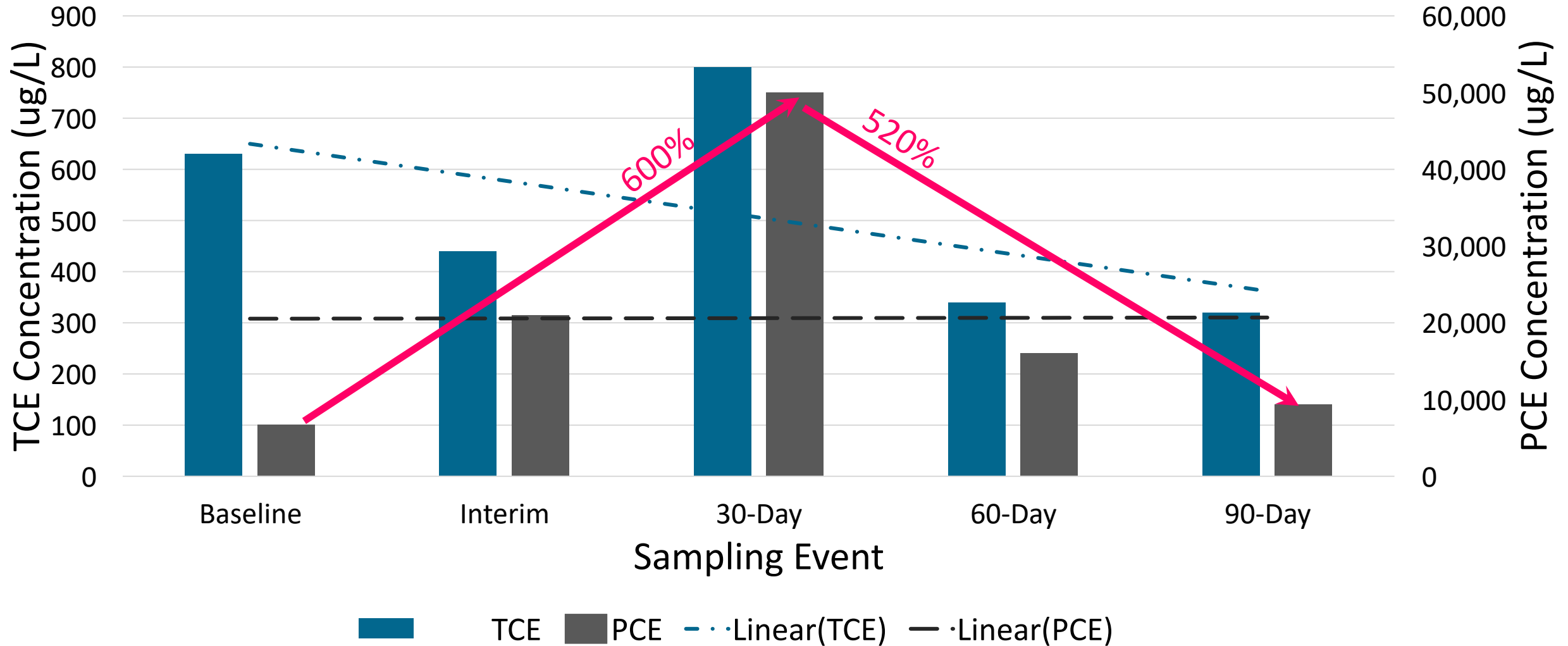
Groundwater Trends: TCE and PCE

Percent Reduction of PCE and TCE in Groundwater



Groundwater Trends: MW-20

MW-20 TCE and PCE Concentrations



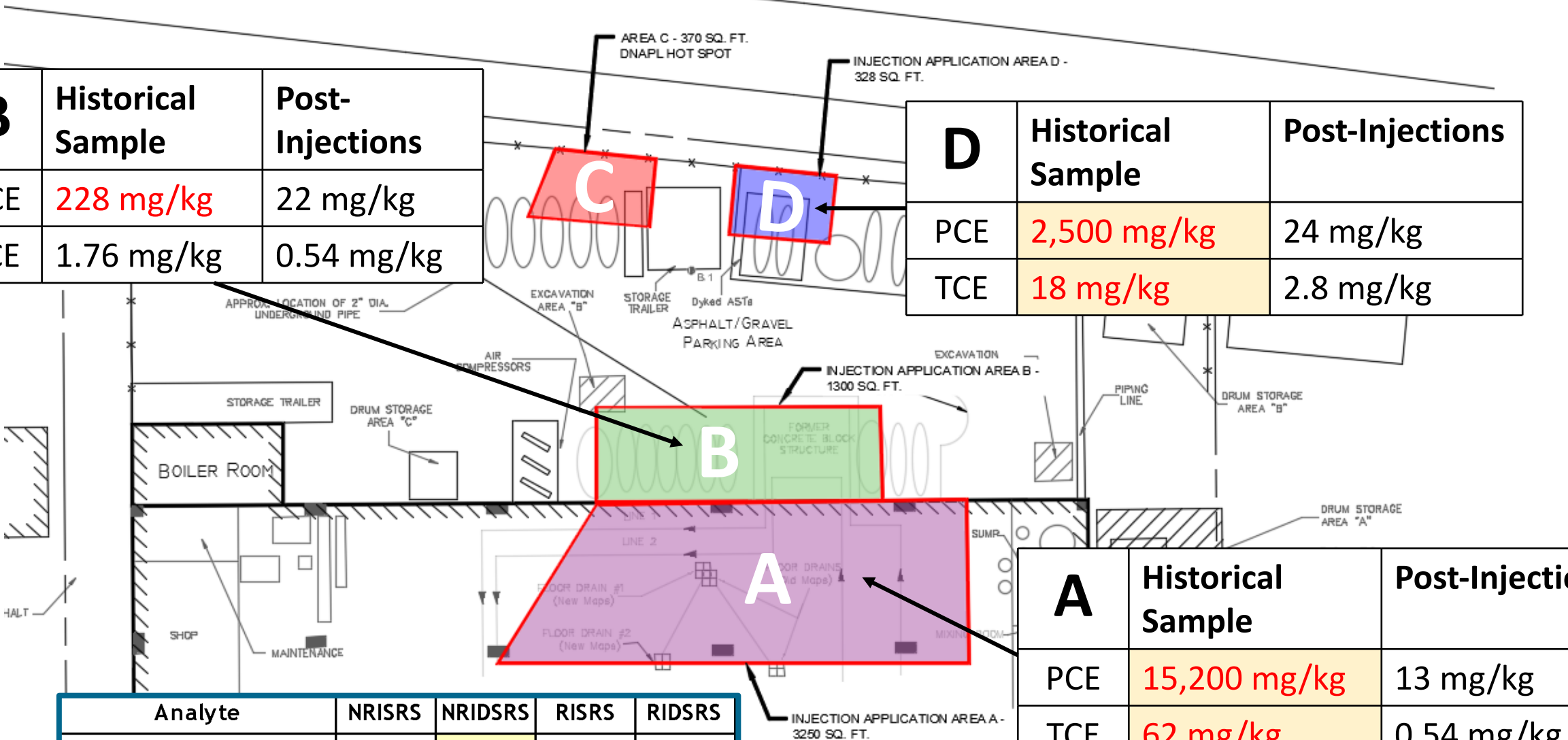
Soil Trends

B	Historical Sample	Post-Injections
PCE	228 mg/kg	22 mg/kg
TCE	1.76 mg/kg	0.54 mg/kg

D	Historical Sample	Post-Injections
PCE	2,500 mg/kg	24 mg/kg
TCE	18 mg/kg	2.8 mg/kg

A	Historical Sample	Post-Injections
PCE	15,200 mg/kg	13 mg/kg
TCE	62 mg/kg	0.54 mg/kg

Analyte	NRISRS	NRIDSRs	RISRS	RIDSRs
Tetrachloroethene (PCE)	NS	1,700	47	330
Trichloroethene (TCE)	14	79	3	15



Conclusions/Summary of Findings

Objective

- Successfully delineated high levels of contamination and targeted hotspots for injections
- Successfully desorbed mass from the clay layer and mobilized into groundwater
- Reduced the overall extent of excavation and disposal of listed hazardous waste
- Successfully implemented injections with minimal disruption to the facility

Geochemical Parameters

- Generally followed the expected trends
- Increase in DO and ORP

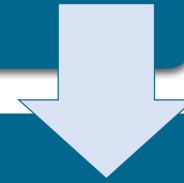
Groundwater Analytical Results

- Generally followed the expected trends
- Decreasing trend in overall contamination

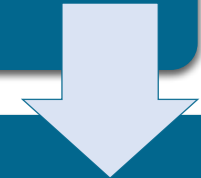
Mass Reductions

- Appxr. 30% removal of dissolved cVOCs in groundwater
- Upwards of 90% removal of PCE in soil

An additional round of injections to be implemented to treat demobilized mass in the groundwater



Excavation and off-site disposal of soils in Area C



Demonstrate MNA and switch to Long Term Monitoring (LTM)

Thank You!

GEOTECHNICAL ENVIRONMENTAL ECOLOGICAL WATER CONSTRUCTION MANAGEMENT

Questions?



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