

CHLORINATED SOLVENT DAUGHTER PRODUCT MANAGEMENT AND REMEDIATION USING AN ACTIVATED CARBON BASED INJECTATE

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**2024 Chlorinated
Conference**

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Technology Description

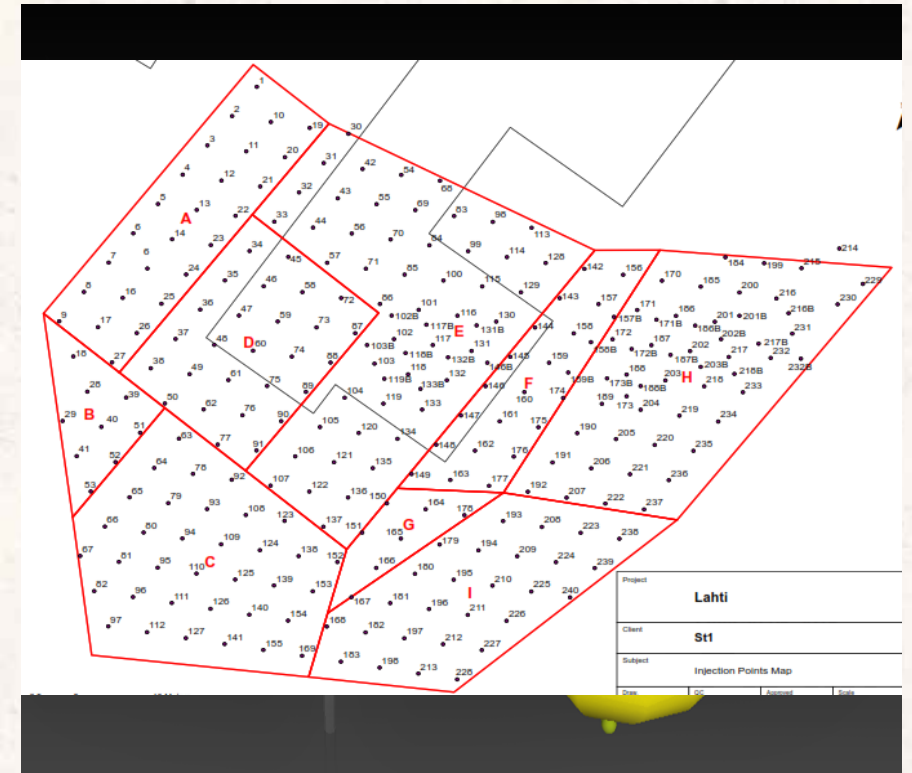
- Key Elements
 - Granular activated carbon (GAC) impregnated with metallic iron (abiotic degradation) – known commercially as BOS 100®
 - Electron donor – food grade starch or chitin
 - One set of microorganisms designed to degrade CVOCs
 - Second set of microorganisms designed to break down the electron donor
 - Nutrients
- Combination known as CAT 100
 - Quantities are tailored for each project site

Daughter Product Generation

- Daughter products are generated where an electron donor is introduced or where sufficient natural organic carbon is present in the aquifer
- For sites where either perchloroethylene (PCE) or trichloroethylene (TCE) is the parent compound, the degradation products are primarily cis-1,2-dichloroethylene (DCE) and/or vinyl chloride (VC)
- For source areas, significant daughter product concentrations can be generated and can persist for extended periods of time

Remedial Design Characterization (RDC)

- Detailed understanding of vertical and horizontal distribution of speciated AND total mass
- Collaborative process used to fine tune the CSM, fill data gaps, and optimize the remedial design
 - Dense soil vertical profiles (e.g. 1-2 ft)
 - Nested wells for groundwater (e.g. < 5 ft)
- RPI Project Support Lab (Denver) runs pro bono soil and water analytical pre and post project



Let's Dig Into Some Project Examples

- All sites to be discussed:
 - Source area treatment
 - Unconsolidated, shallow (<50 ft) DPT slurry injection
 - Pre-injection high density sampling (RDC) was performed
 - Most had some level of microbiological assessment work performed
 - Abiotic degradation PRB downgradient of treatment area(s)



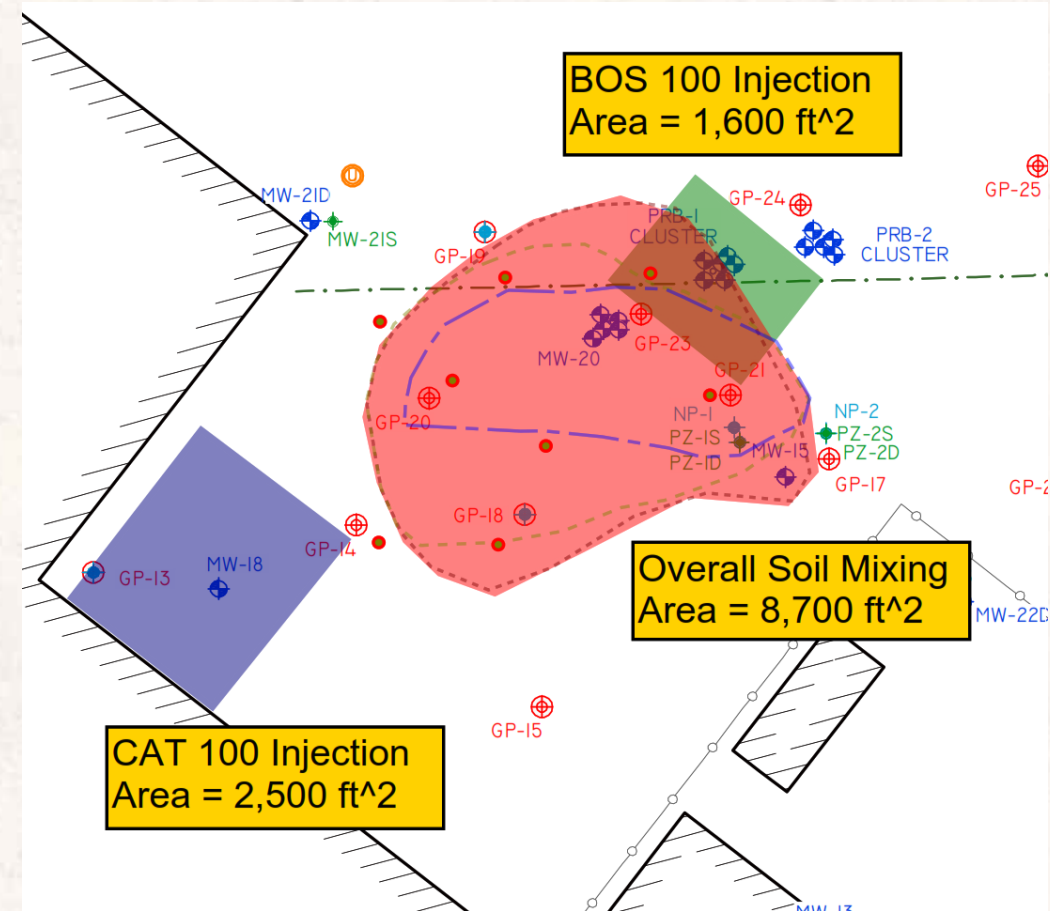
Project #1 – Source Area (USA)

Site Background Info

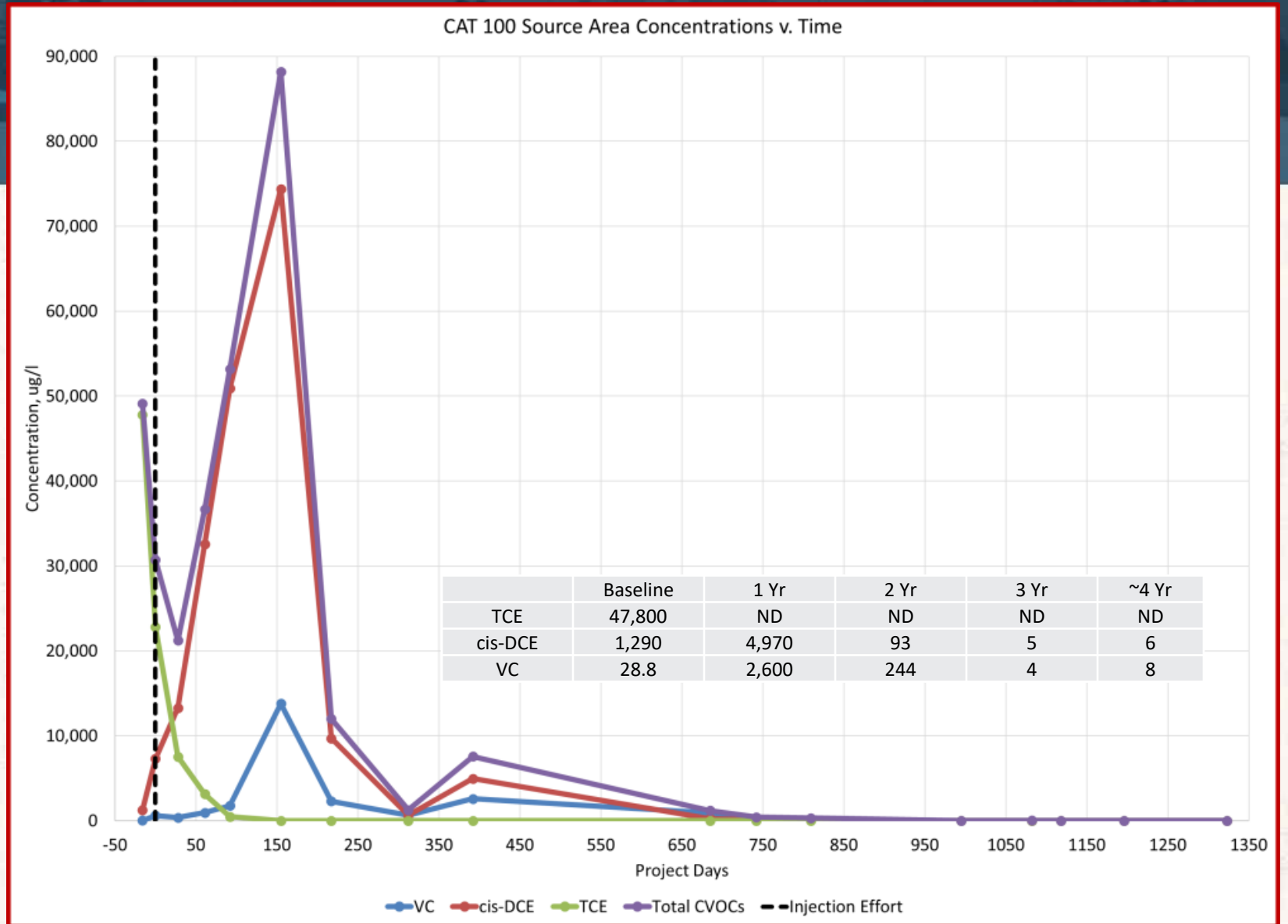
- Confidential Site in central Kentucky
- Historical Industrial Property that utilized chlorinated solvents for equipment maintenance from the 1950's to 1970's
- Materials are suspected to have been discharged to drainpipes which allowed for the contaminant migration
- Site is still active with existing utilities and various structures
- The site geology consist of interbedded sands, silts and clays associated with river sedimentation

Technologies Selected

- BOS 100® (RPI)
 - Activated carbon impregnated with metallic iron (6.5% w/w)
 - Abiotic β -elimination pathway
 - Objective = 5 ppb at property boundary
- Sodium Permanganate (RemOx-L® Carus)
 - Delivered as 40% w/w liquid and diluted onsite
 - Objective = 125 mg/kg TCE soil
- CAT 100 (RPI)
 - BOS 100 + Electron Donor + Nutrients + Bacteria
 - Objective = Mass reduction

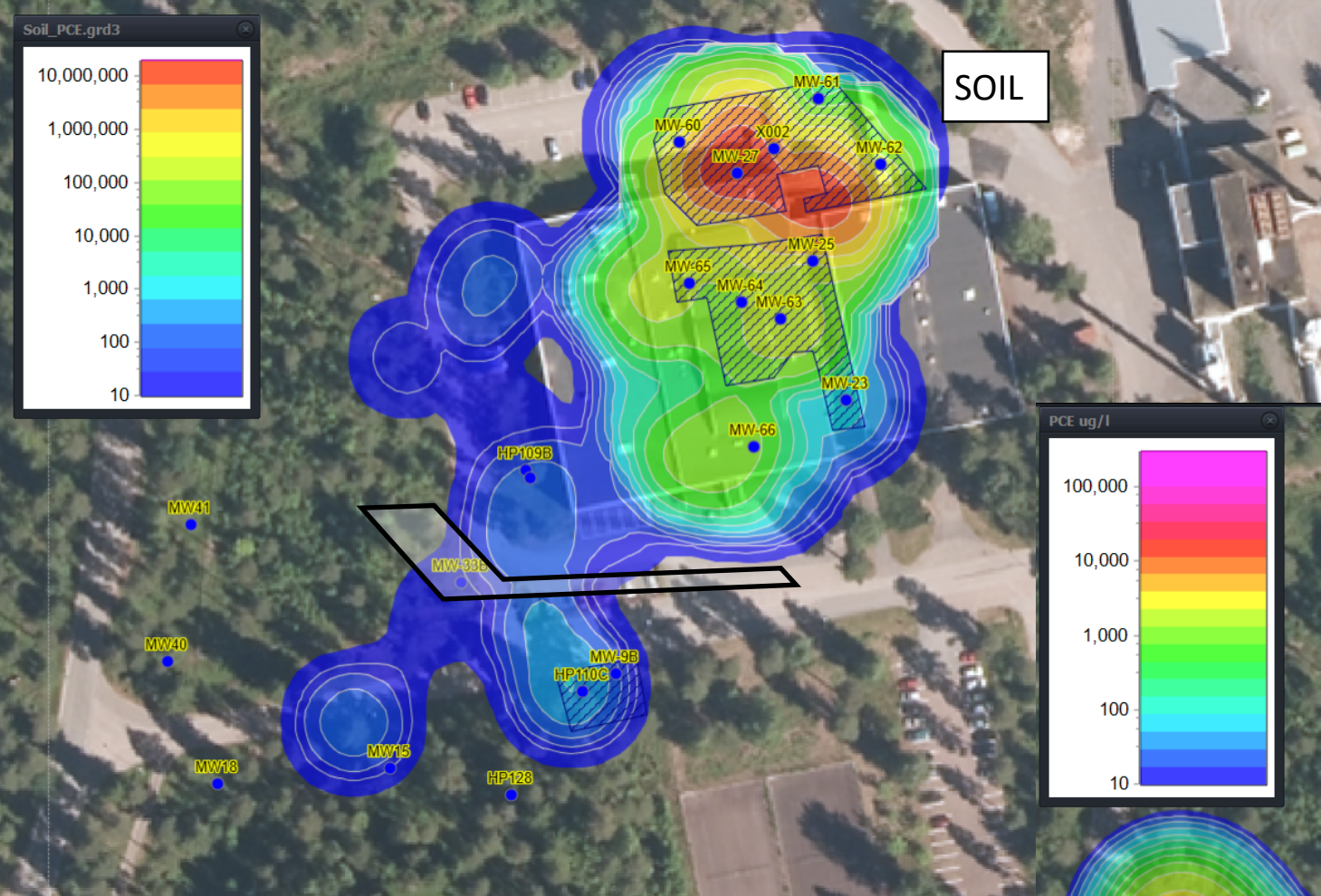


CAT 100 Results

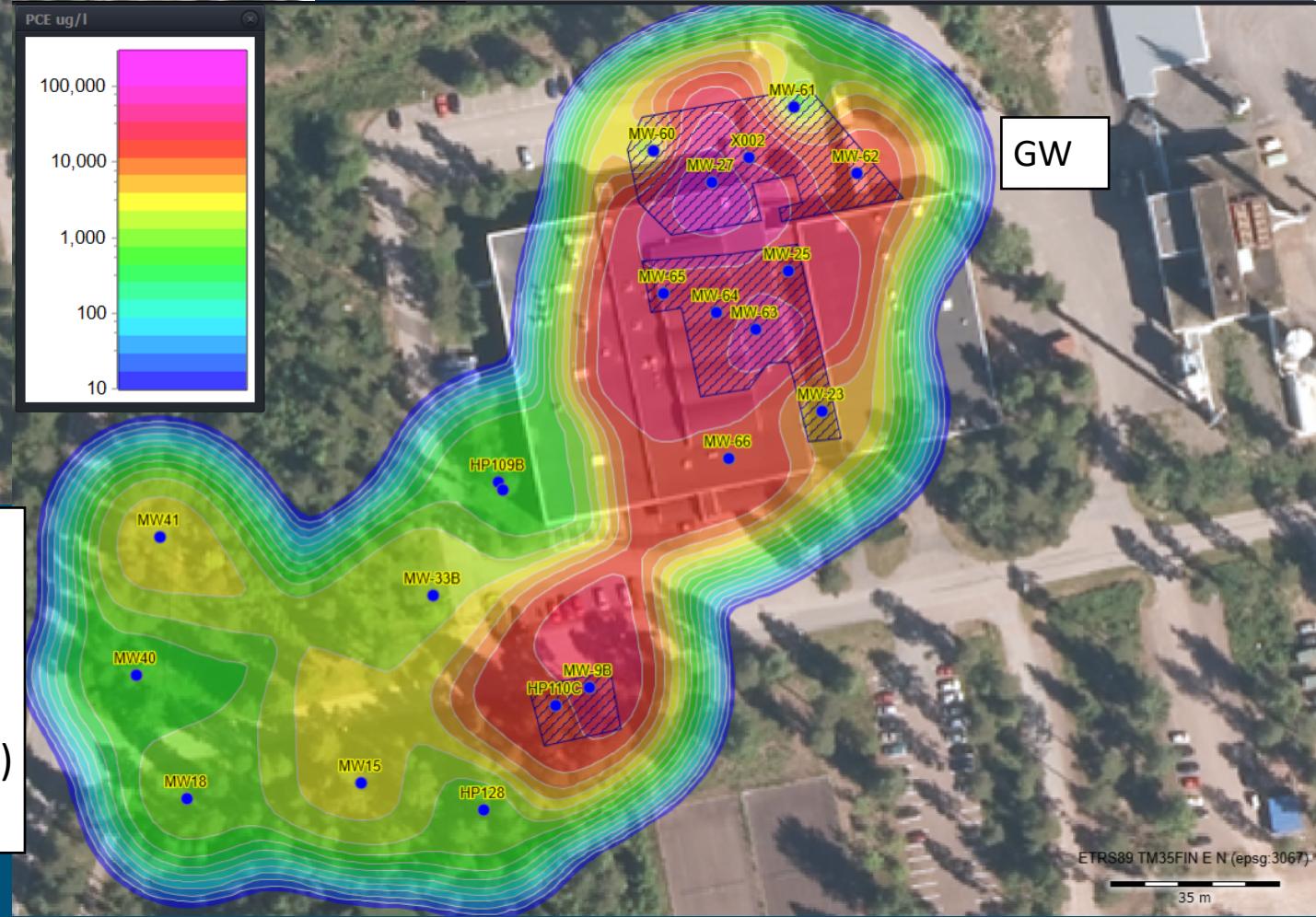




Project #2 – DNAPL Source Area (Europe)



<i>SUBAREA ID</i>	<i>AREAL EXTENT (m²)</i>	<i>PCE MASS (kg)</i>
AREA A	350	16,000
AREA B	500	250
AREA C	250	150
AREA D	800	1,000
AREA E	250	50



Injection works completed between April and August 2017. A total of 702 injection points were completed across subareas A through E.

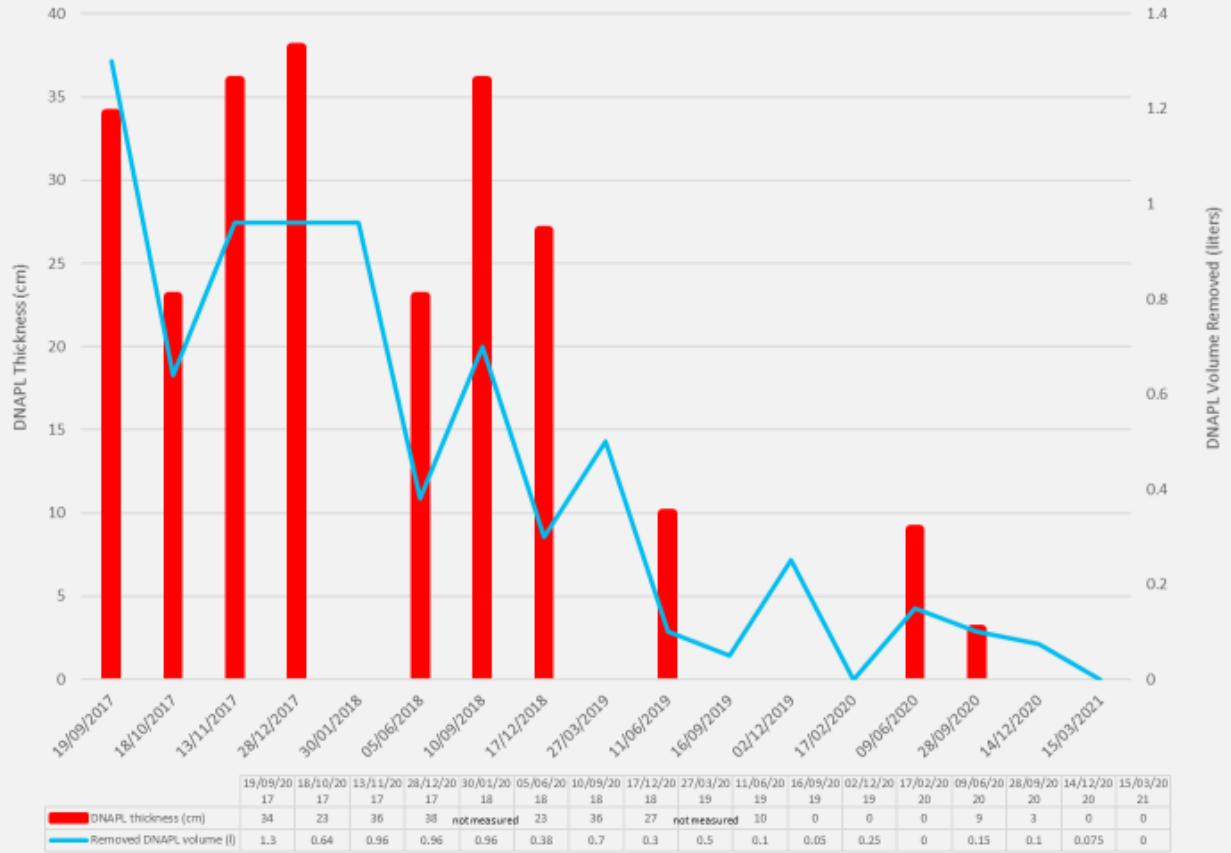
Approx. 52,000 Kg of CAT100 (incl. 3,800 kg of BOS100®) were installed

Mass Removal vs. Biological Evidence



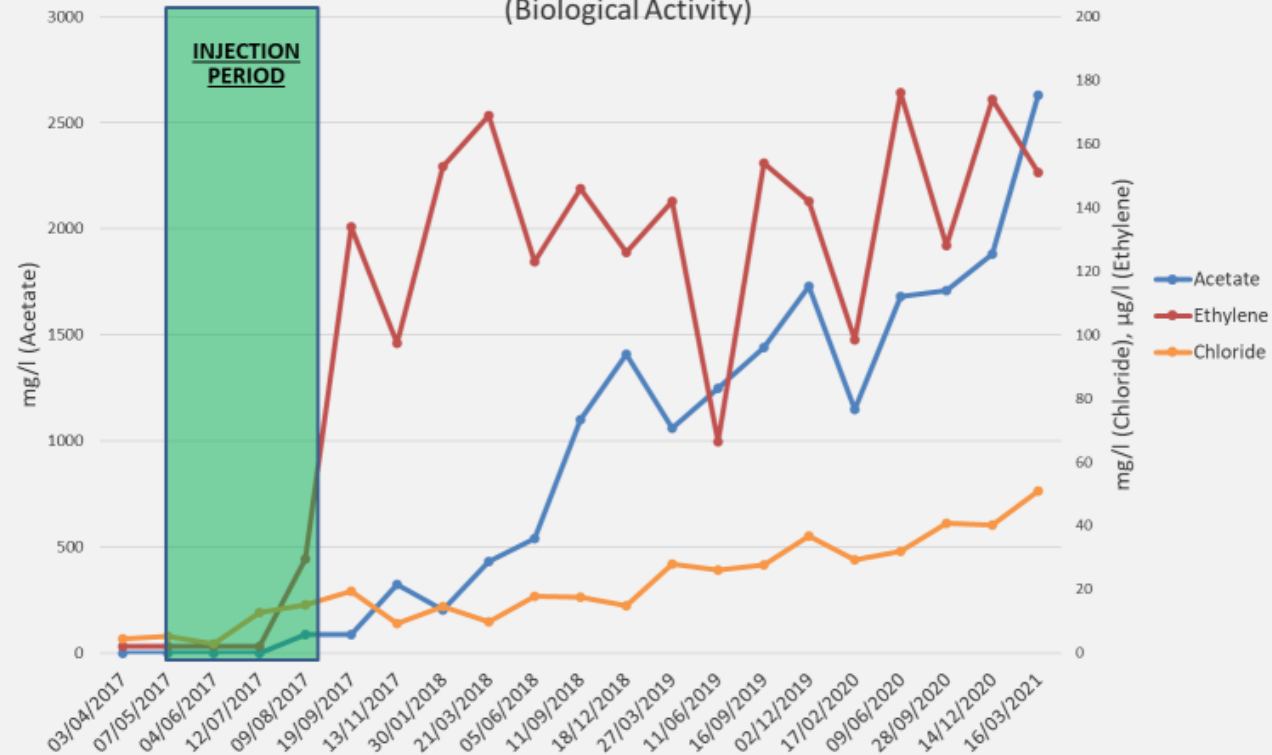
DNAPL evidence
MW27 soil core

DNAPL Trends - MW27

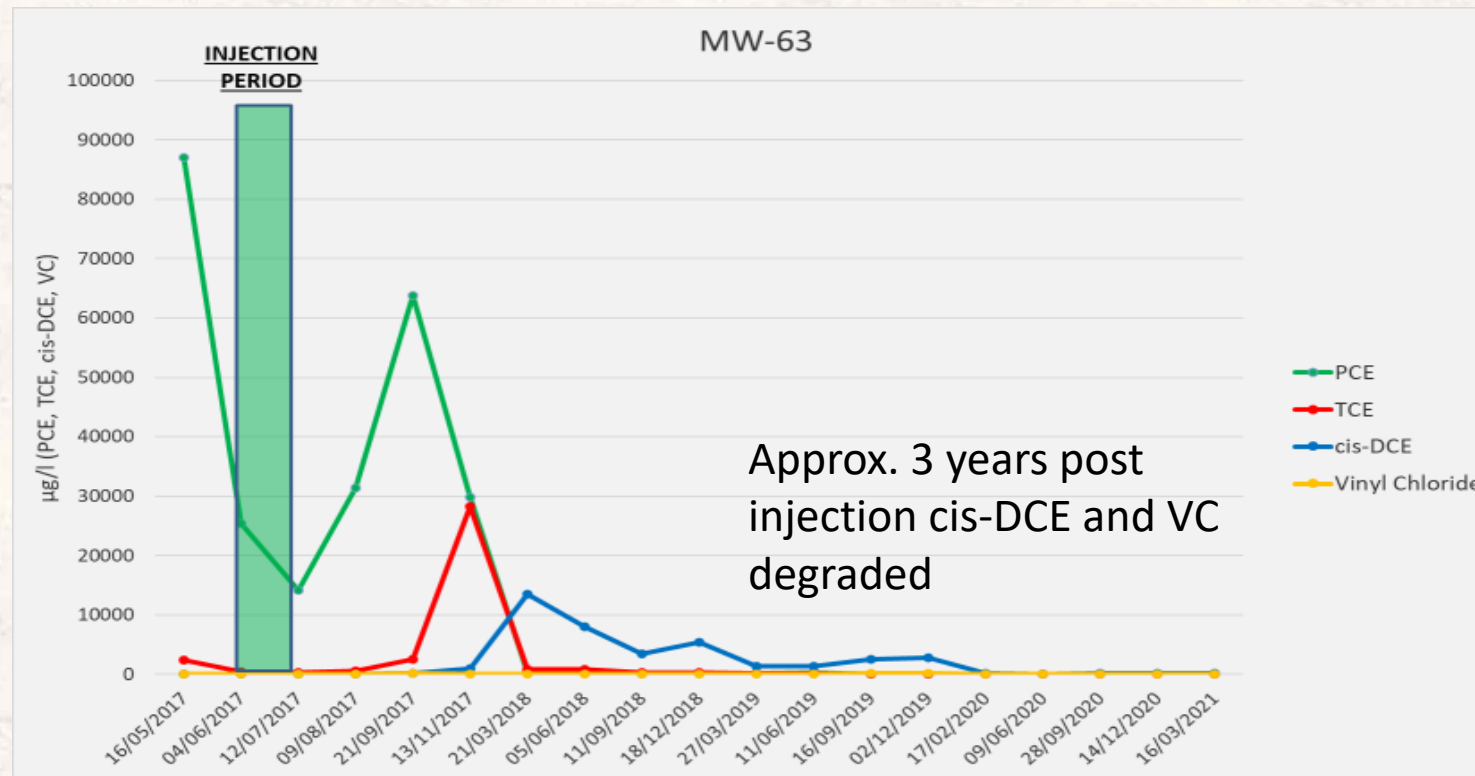


PCE Concentrations found in
Soil at 50-60,000 mg/kg

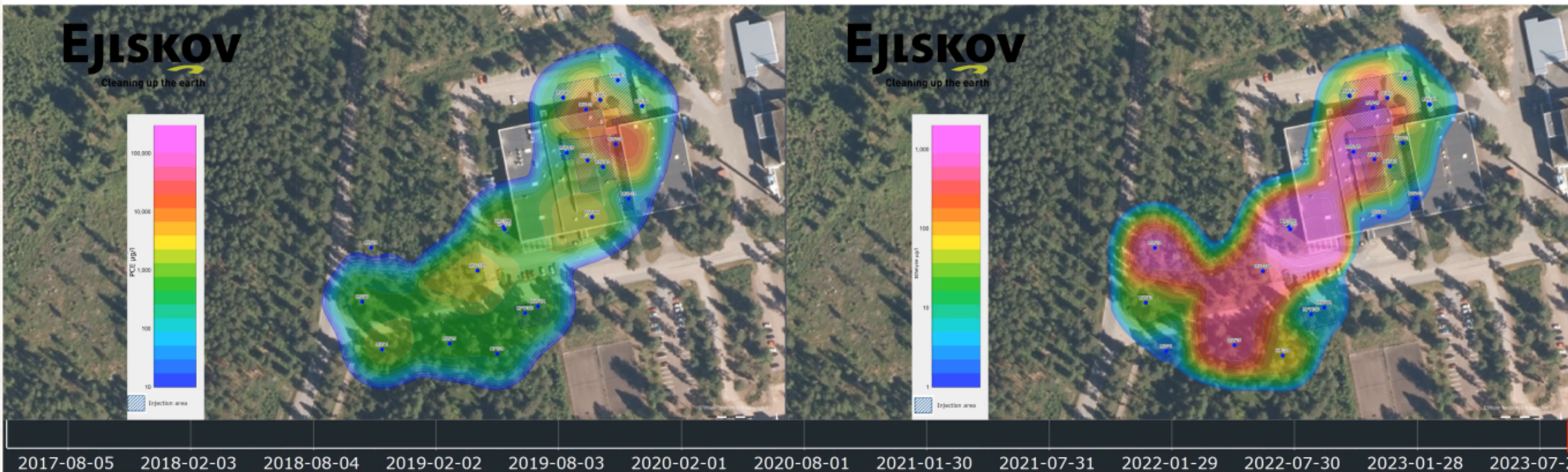
MW27
(Biological Activity)



Plume Downgradient of Source Zone



PCE conversion to Ethylene



PCE trends

Ethylene trends

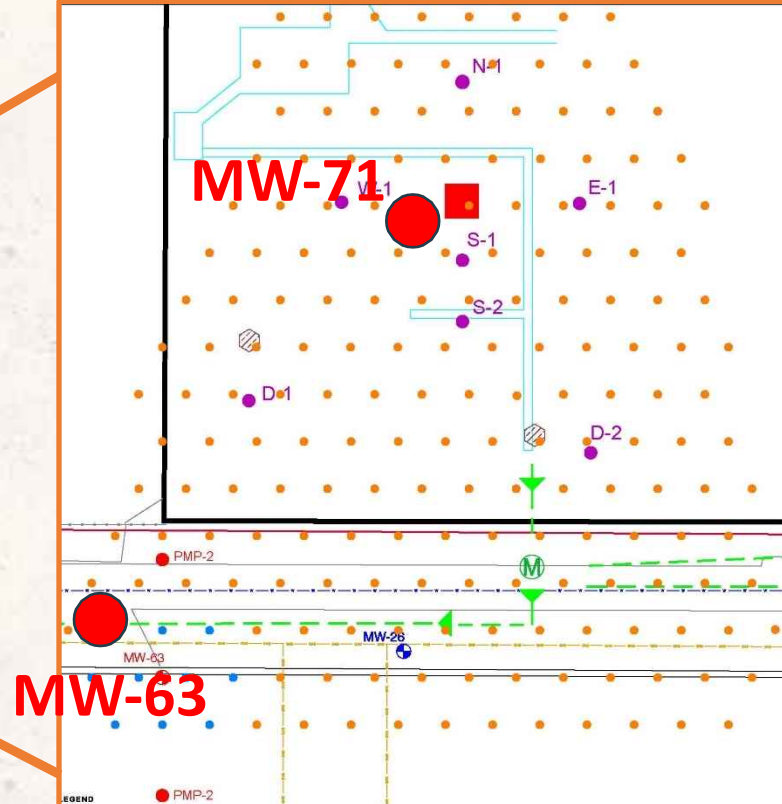
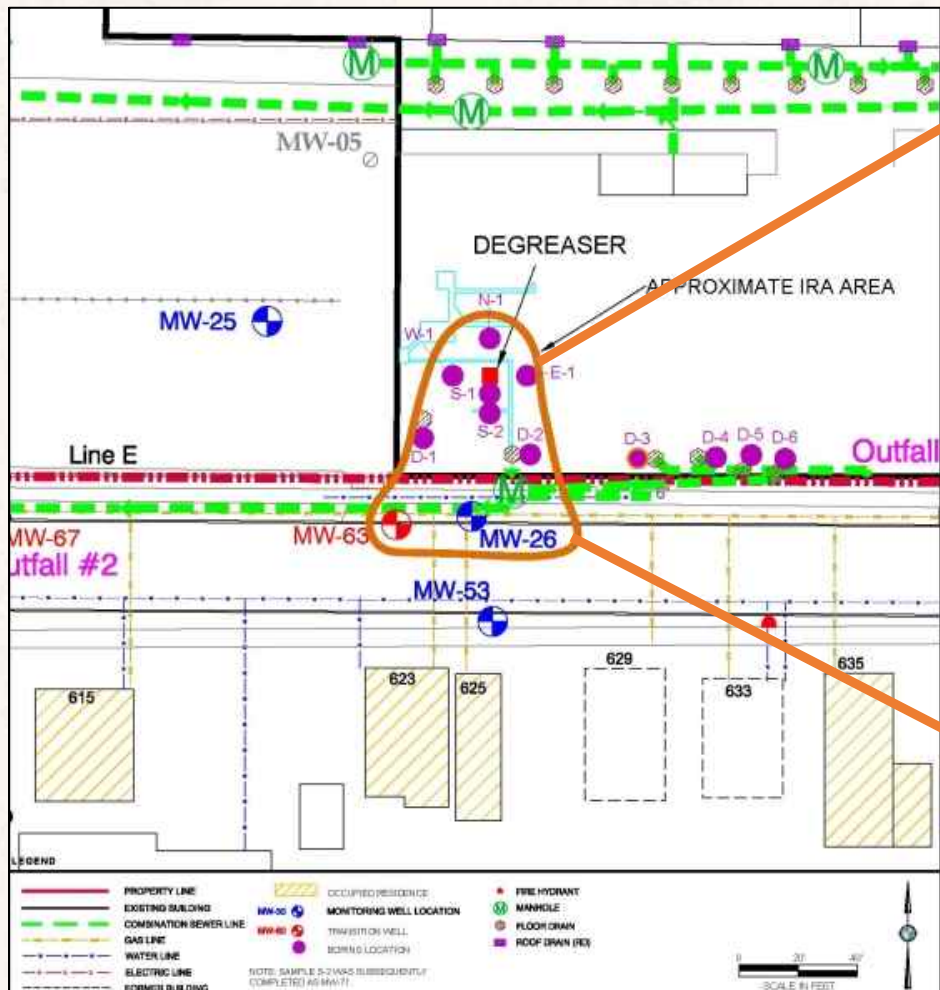


Project #3 – DNAPL Source Area (USA)

Site Background

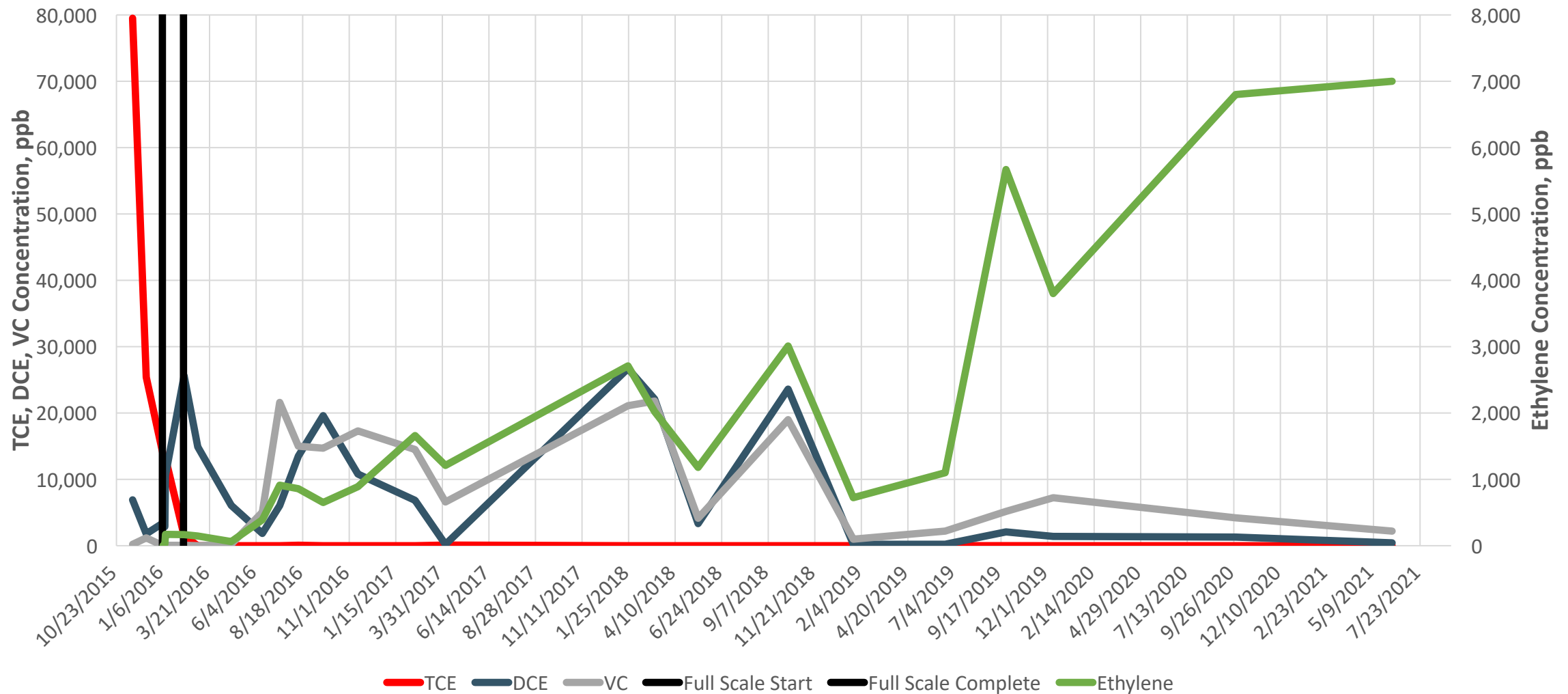
- Site in mid-western US
- Example of site with elevated parent products at baseline and significant daughter product saturated soil mass from previous ERD application
- CAT 100 part of multiyear phased approach
- BOS 100 applied as downgradient PRB
- First Quarter 2016 Application

Site Map

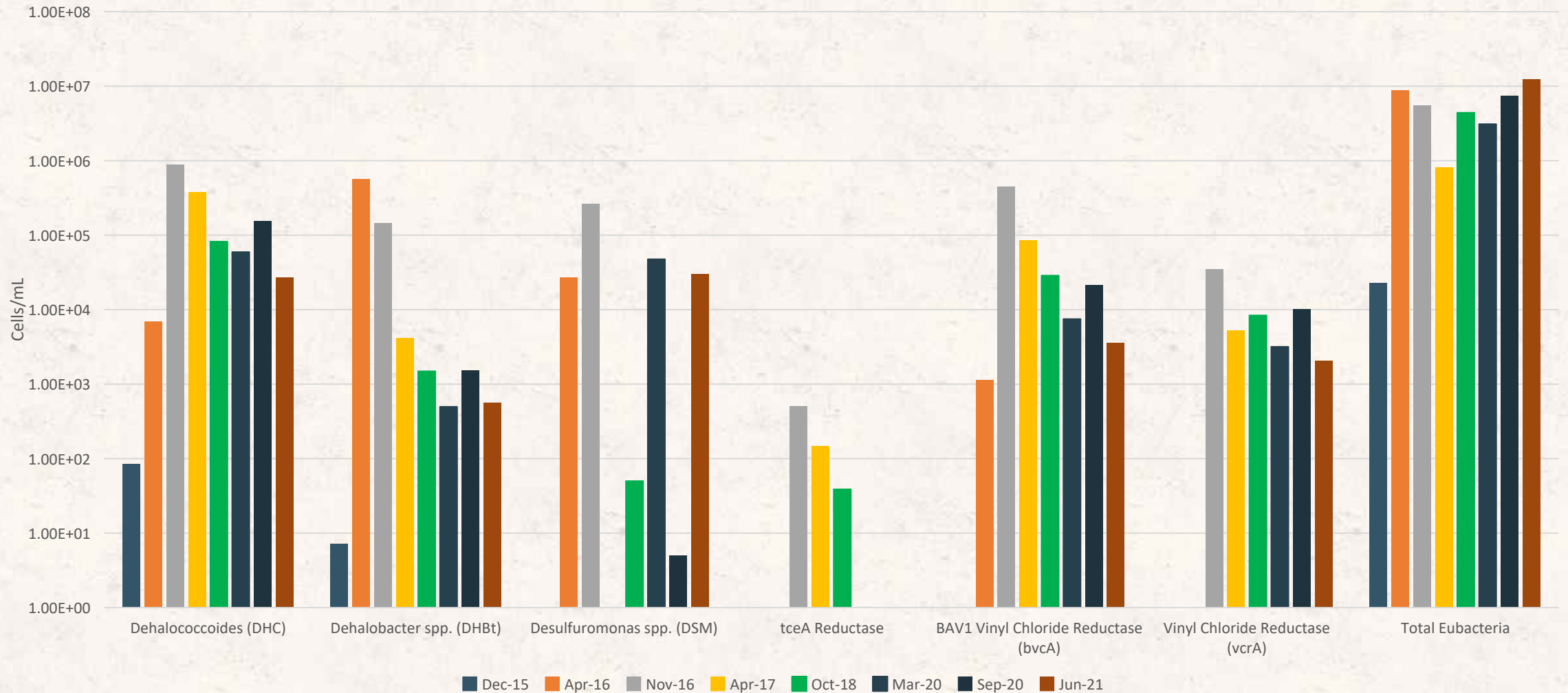


- ~5,400 ft²
- 11,300 lbs of CAT 100 installed in 215 injection points in January & February 2016

MW-71 – Degreaser Source Area



MW-71 Biological Signature



Summary

- Success starts with the RDC and accurate CSM
 - Guides dosing and expectations
- Application of synergistic technologies can:
 - Manage daughter products generated naturally or via ERD
 - Reduce source area parent compounds without long term daughter product issues
- In most instances, an abiotic PRB should be installed for downgradient control of daughter products

Thank you for your time. Questions?

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