

The In Situ Treatment of Dissolved BTEX and Gasoline Residues Using Micro Activated Carbon

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InSitu Remediation Services

Battelle 2023

Background

In Situ Current Approaches

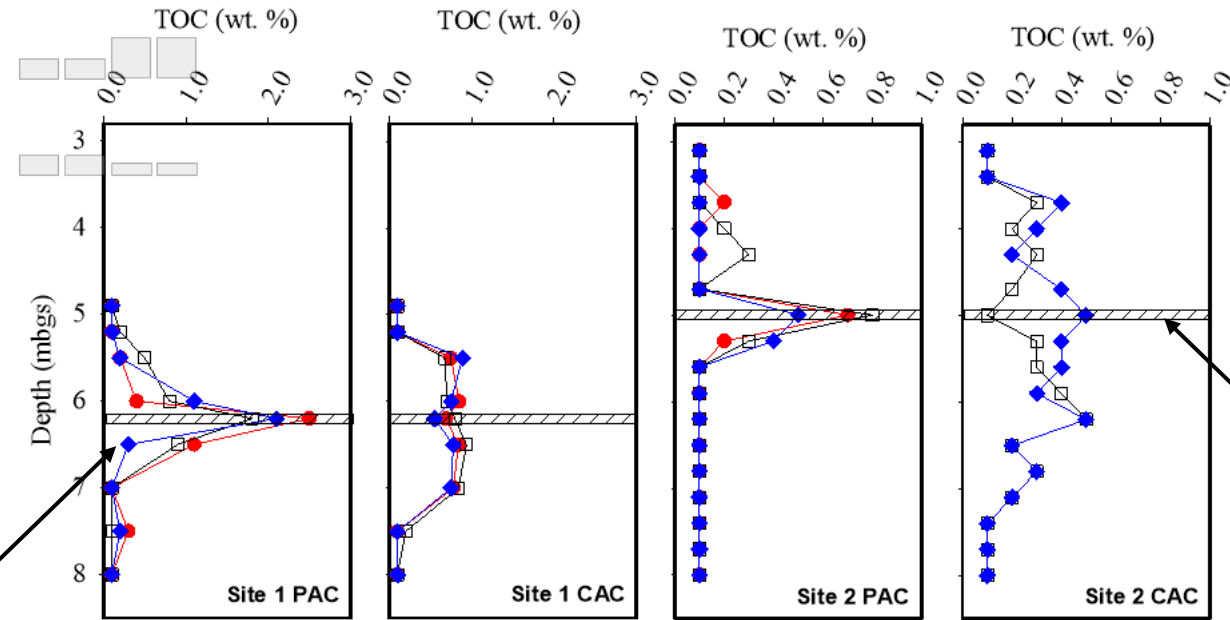
– Proven

- Sorptive
 - Colloidal, micro, powdered
- Bioremediation
 - Anaerobic & aerobic
- Chemical oxidation
- Volatization
 - Sparging and vapor extraction
- Surfactant & co-solvent



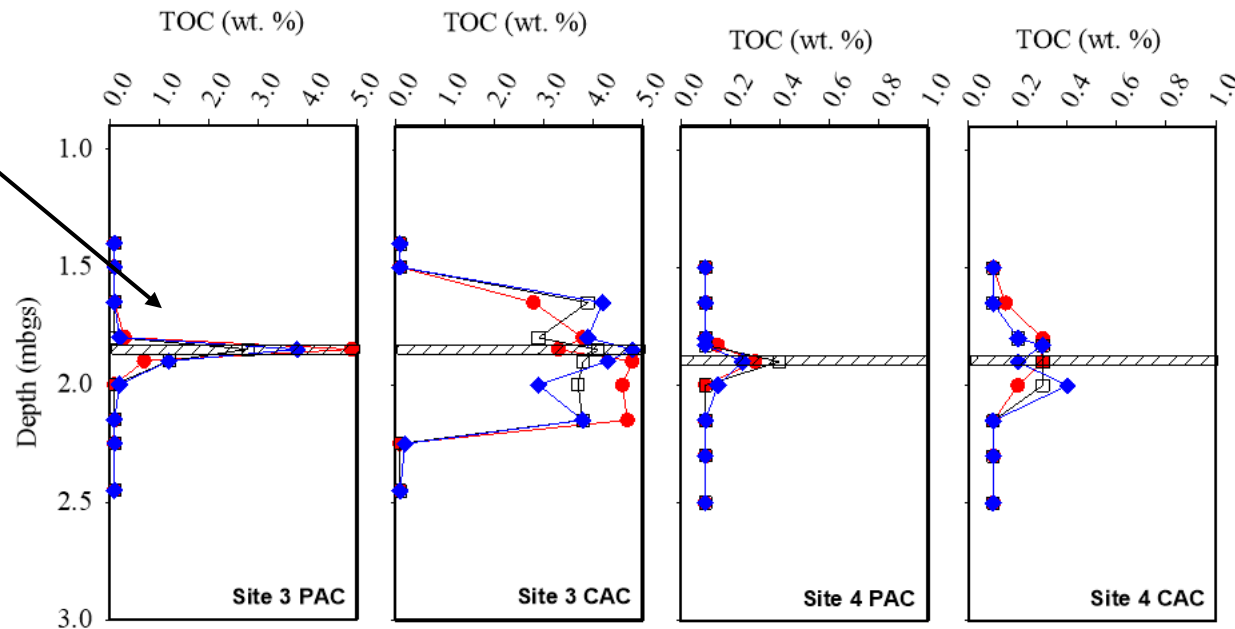
Source: Xiao et al., 2017

Background



High K Lens

Target Injection Zones



CAC - detected in 94.4% of samples
 PAC - detected in 42.4% of samples

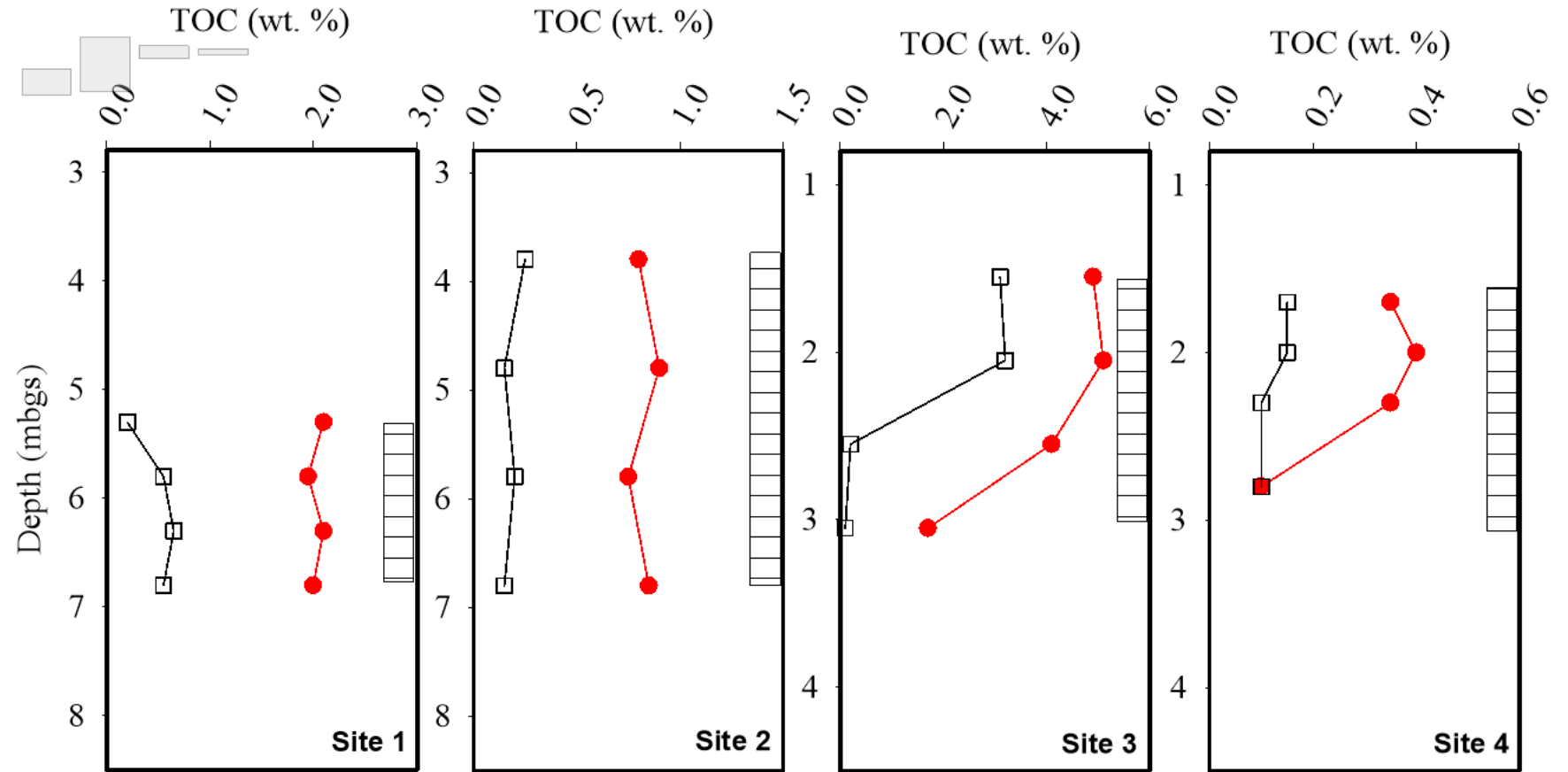
CAC - homogeneous distribution
 PAC - thin fracture distribution

McGregor, 2020)

Background

PAC - enriched well packs,
+224% mean TOC

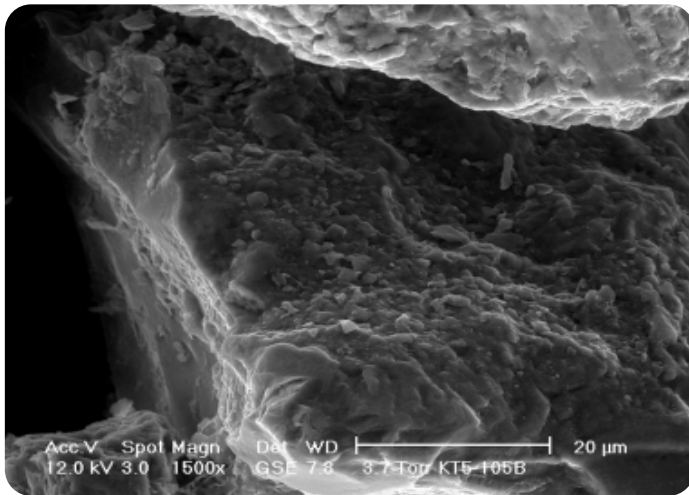
CAC - no pack enrichment, -
35% mean TOC



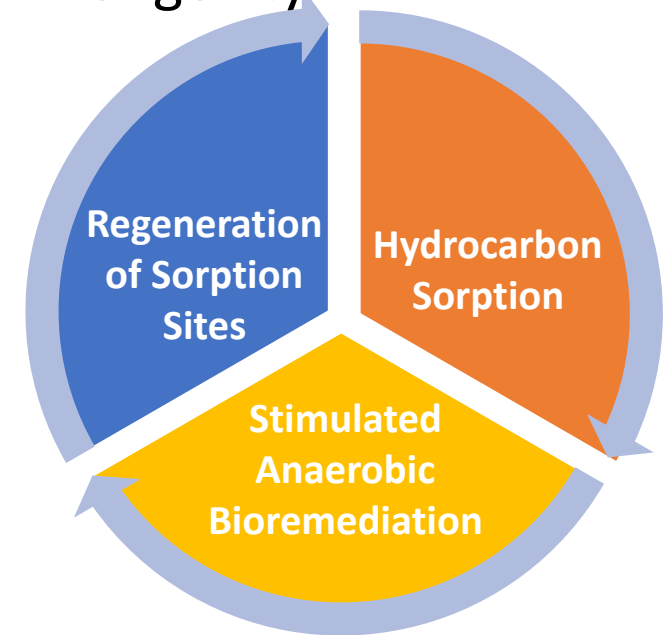
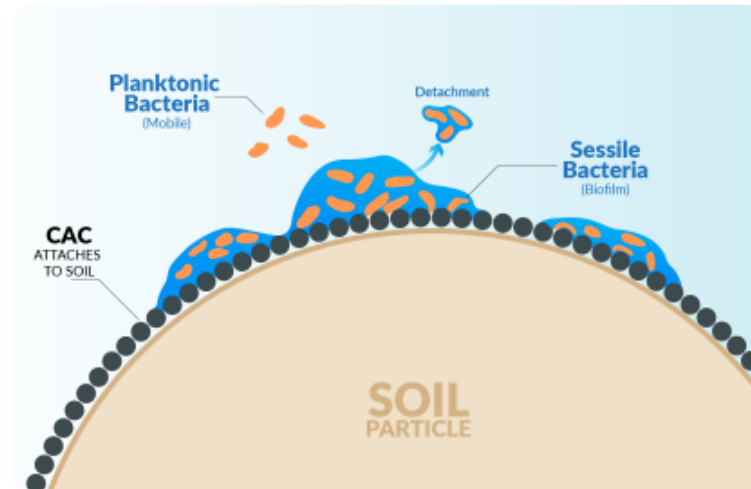
McGregor, 2020)

Background

- PetroFix coats soils in flux zones with a micrometer thick layer
- Longevity – flux from upgradient or back-diffusion captured over time
- $\text{NO}_3 + \text{SO}_4$ kick-start bioremediation = biofilm formation
- *In situ* carbon regeneration = contaminant destruction and > longevity



Courtesy: Regenesis



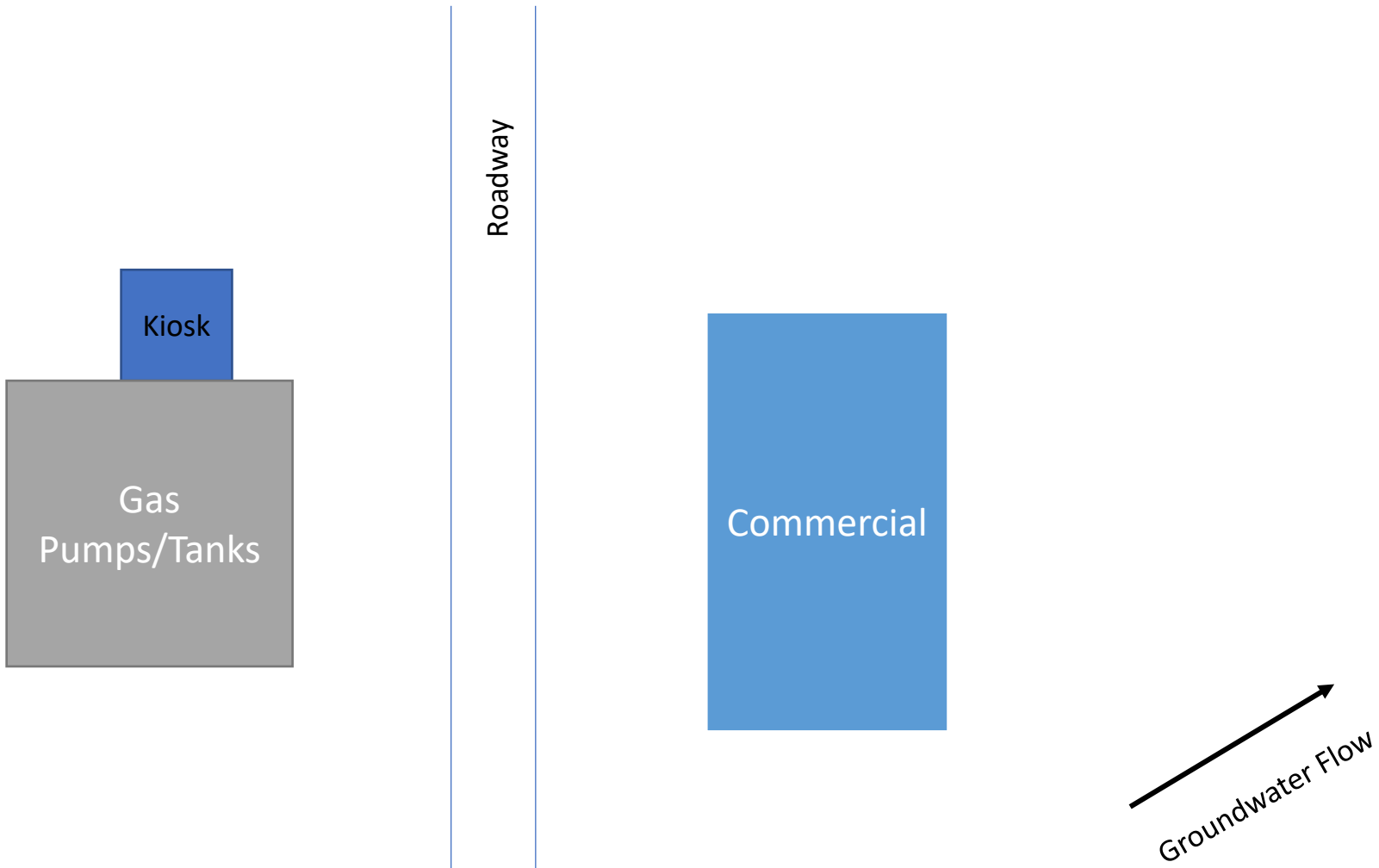
Study Site

- Commercial Facility
 - Downgradient of gas station
 - BTEX up to 9.5 mg/L
 - GRO up to 16.5 mg/L
 - Trace NAPL
- Previous remedial efforts
 - MPE for removal of LNAPL
 - AS/SVE
 - Angled wells
 - Upgradient aerobic barrier
 - Waterloo Emitters
- Geology
 - Dense sand with some silt
- Hydrogeology
 - Unconfined aquifer
 - Water table ~70 ft below surface
 - K: 5×10^{-6} to 6.3×10^{-4} m/sec
 - Groundwater velocity ~ 9 m/year
- Geochemistry
 - Iron & sulfate reducing

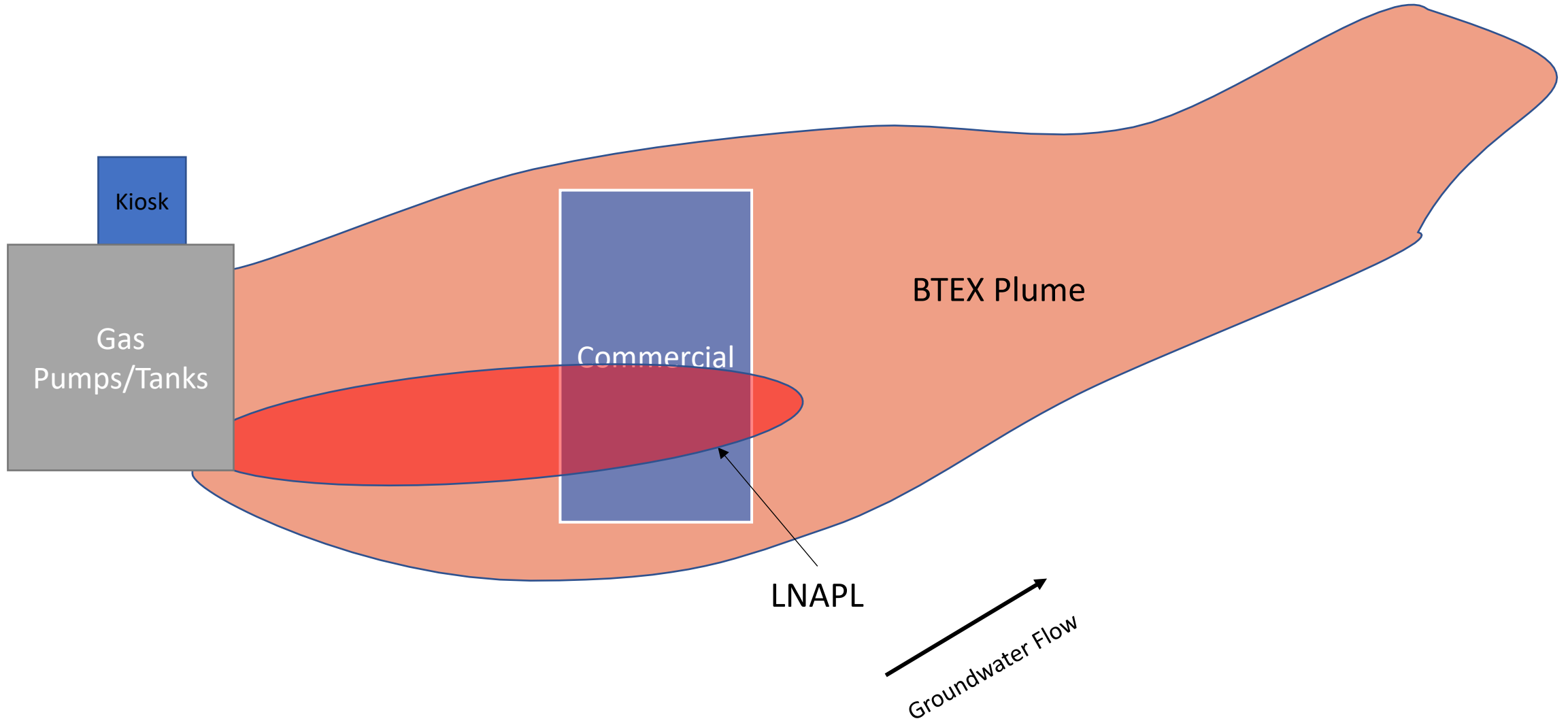
Study Site - Monitoring

- Groundwater Monitoring
 - Combination of 2" wells (3)
 - GRO-DRO, BTEX, inorganics, general chemistry
 - Microbiological analyses
 - CSIA
 - Groundwater
 - Pre-injection (2 events),
 - Post-injection Days 122, 248, 362, 547, & 724
- Aquifer Solids
 - Continuous cores for TOC, pre- & post injection

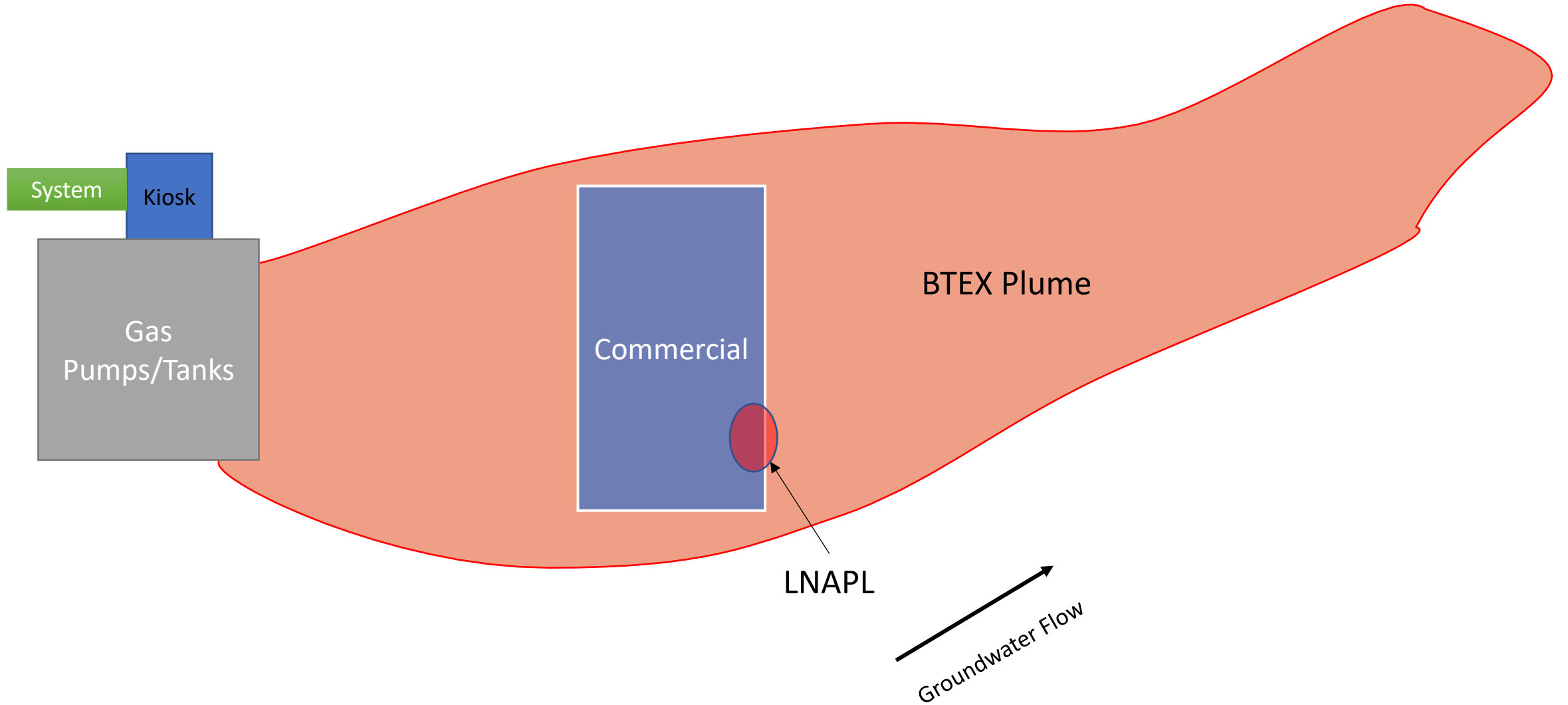
Study Site Layout



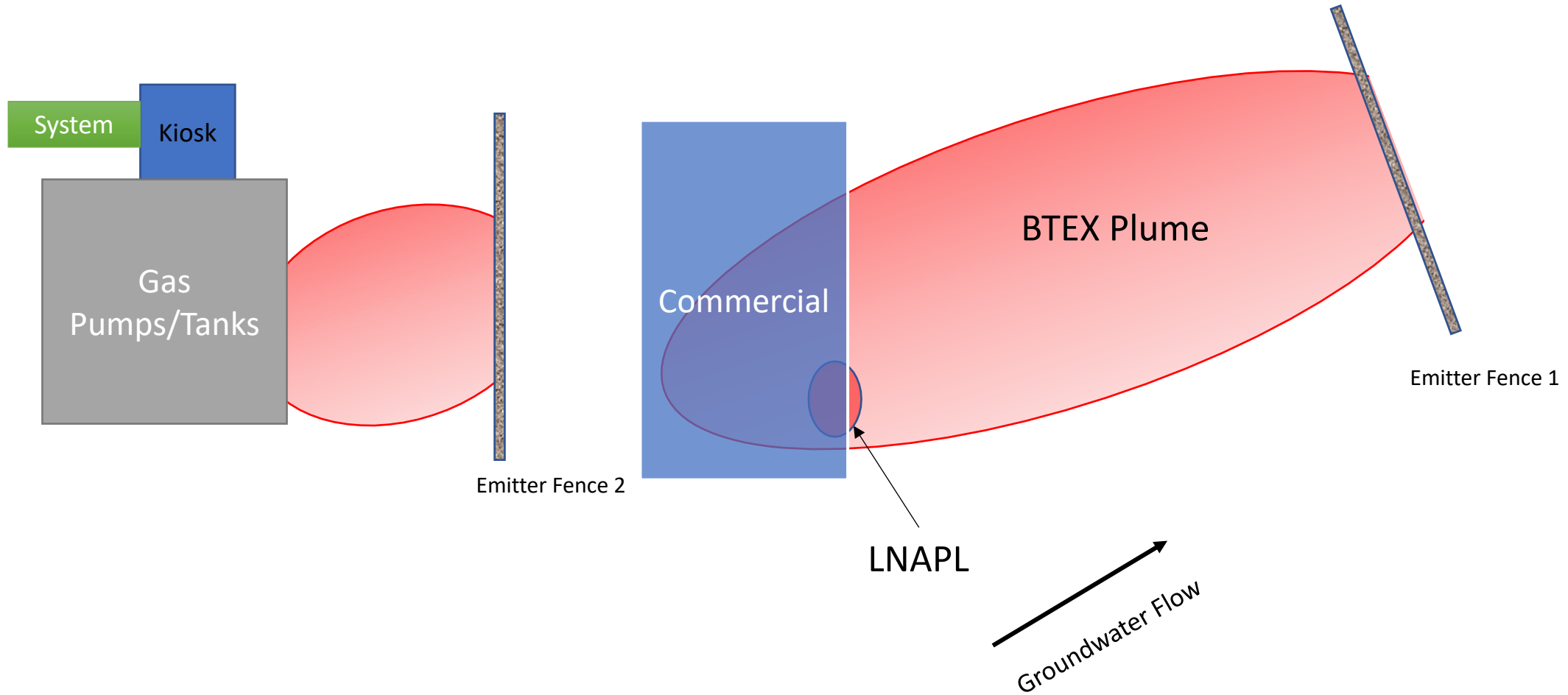
Remedial Progress: Pre Remedial



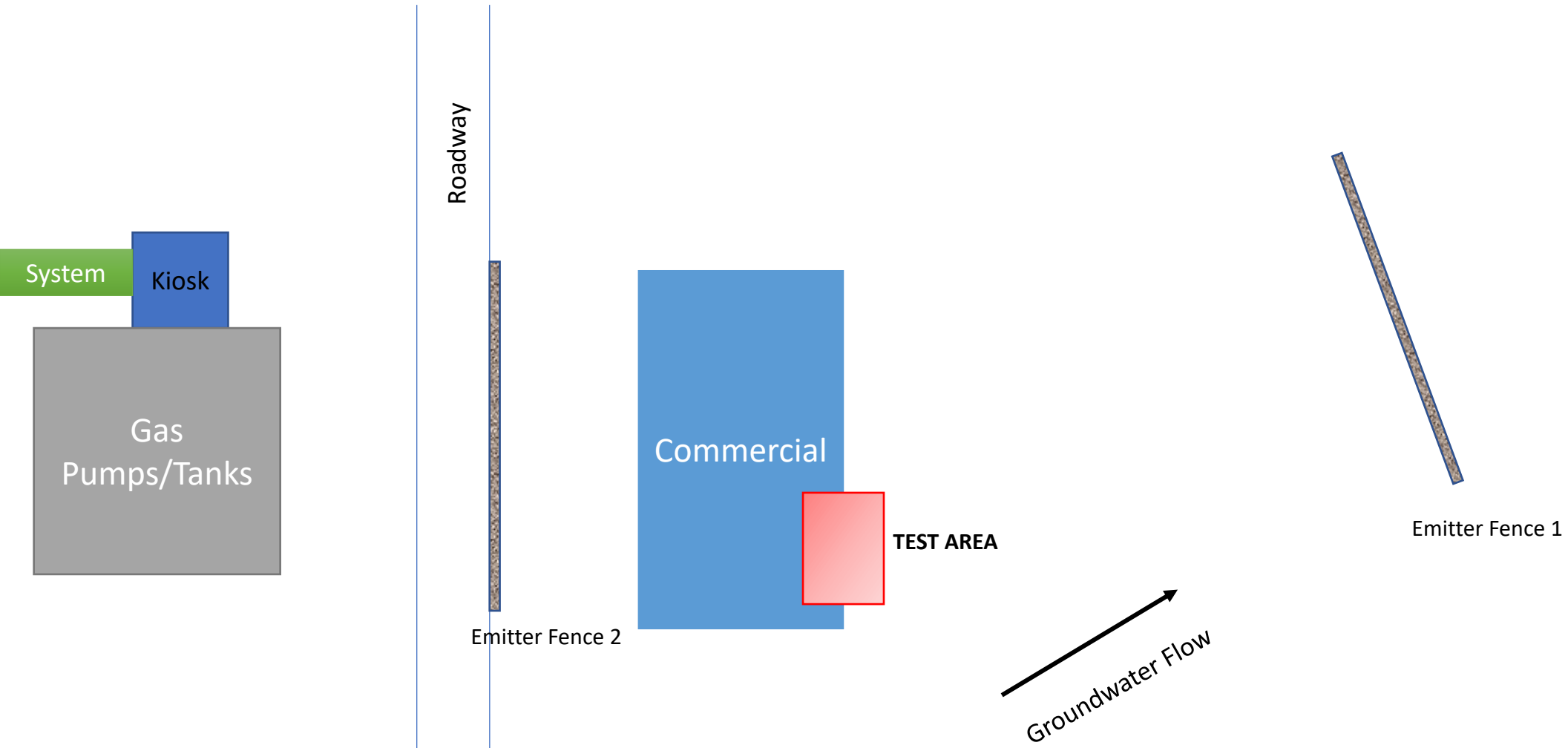
Remedial Progress: Post MPE



Remedial Progress: Post Emitter



Study Site Layout

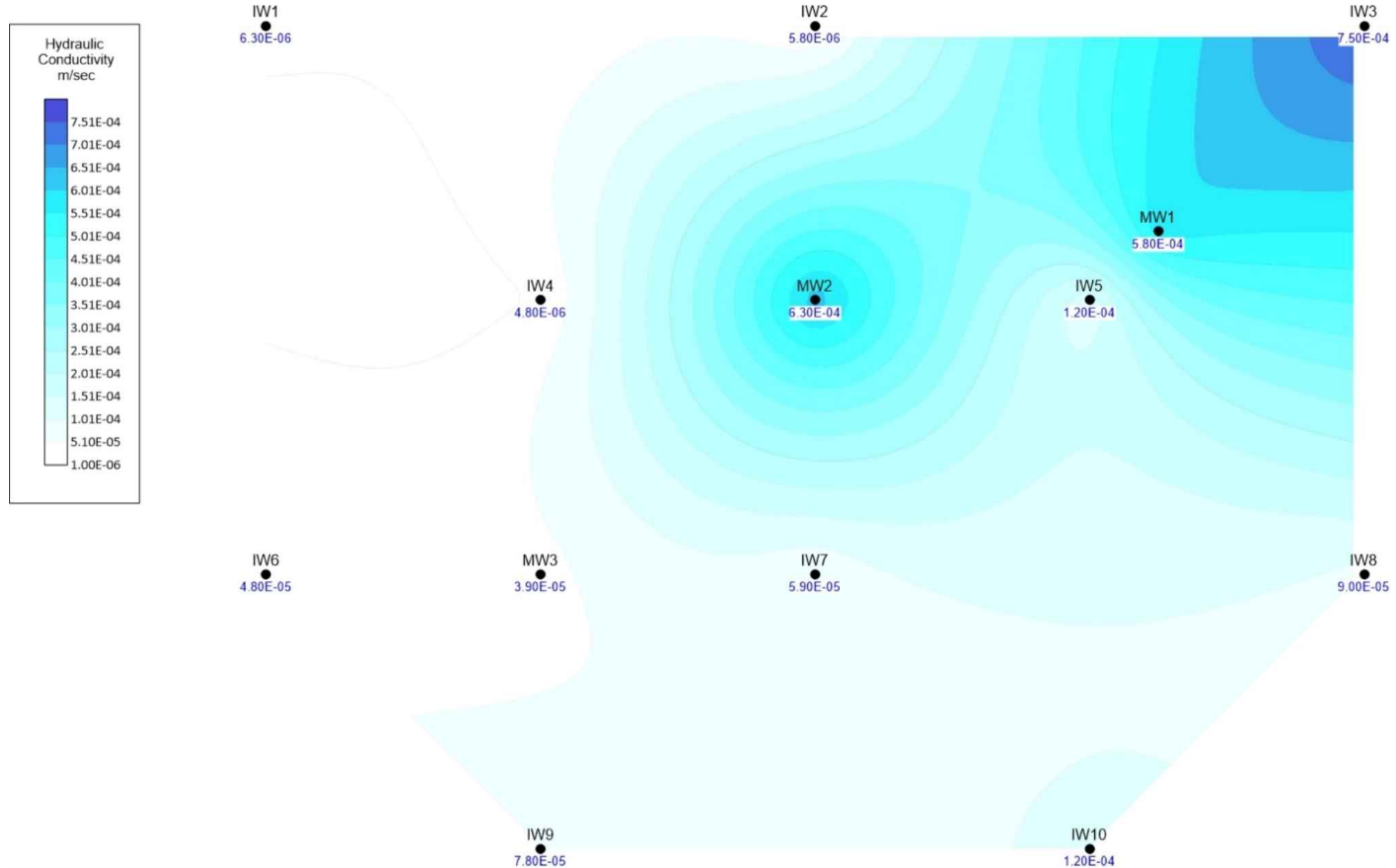


Study Site Injection Plan

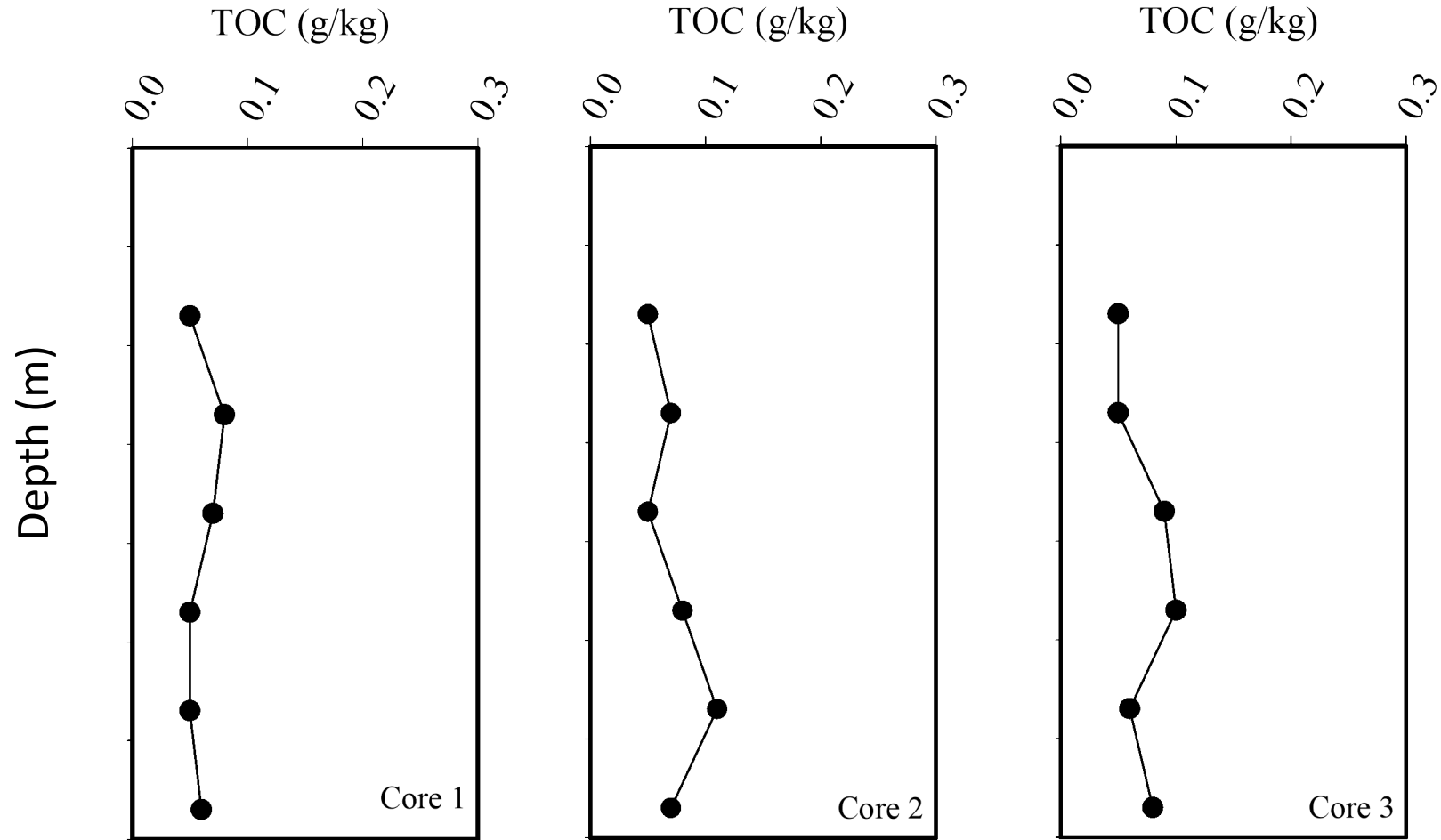
- Test Area:
 - 4000 ft² area
 - Targeting plume underneath facility
- Reagents
 - Micro activated carbon (Petrofix™)
 - Gypsum
 - Oxygen Releasing Compound™
- Injection
 - 8 angled injection wells (2" PVC)
 - 5 direct push points



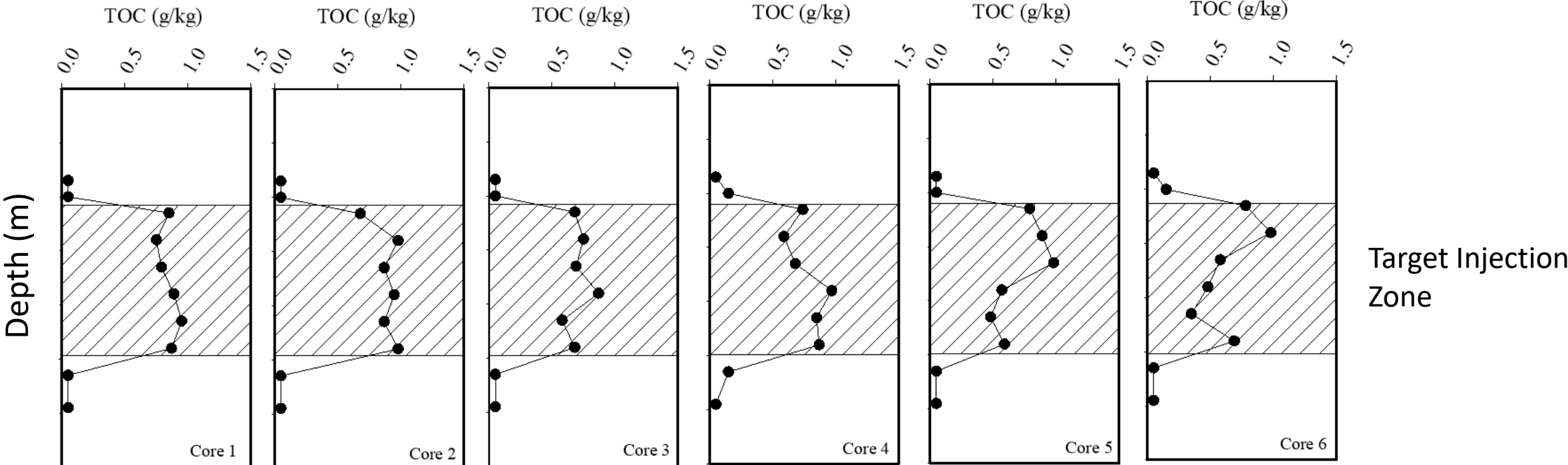
Study Site Horizontal K



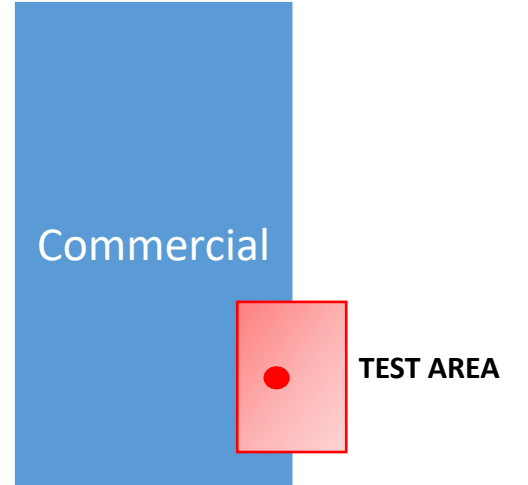
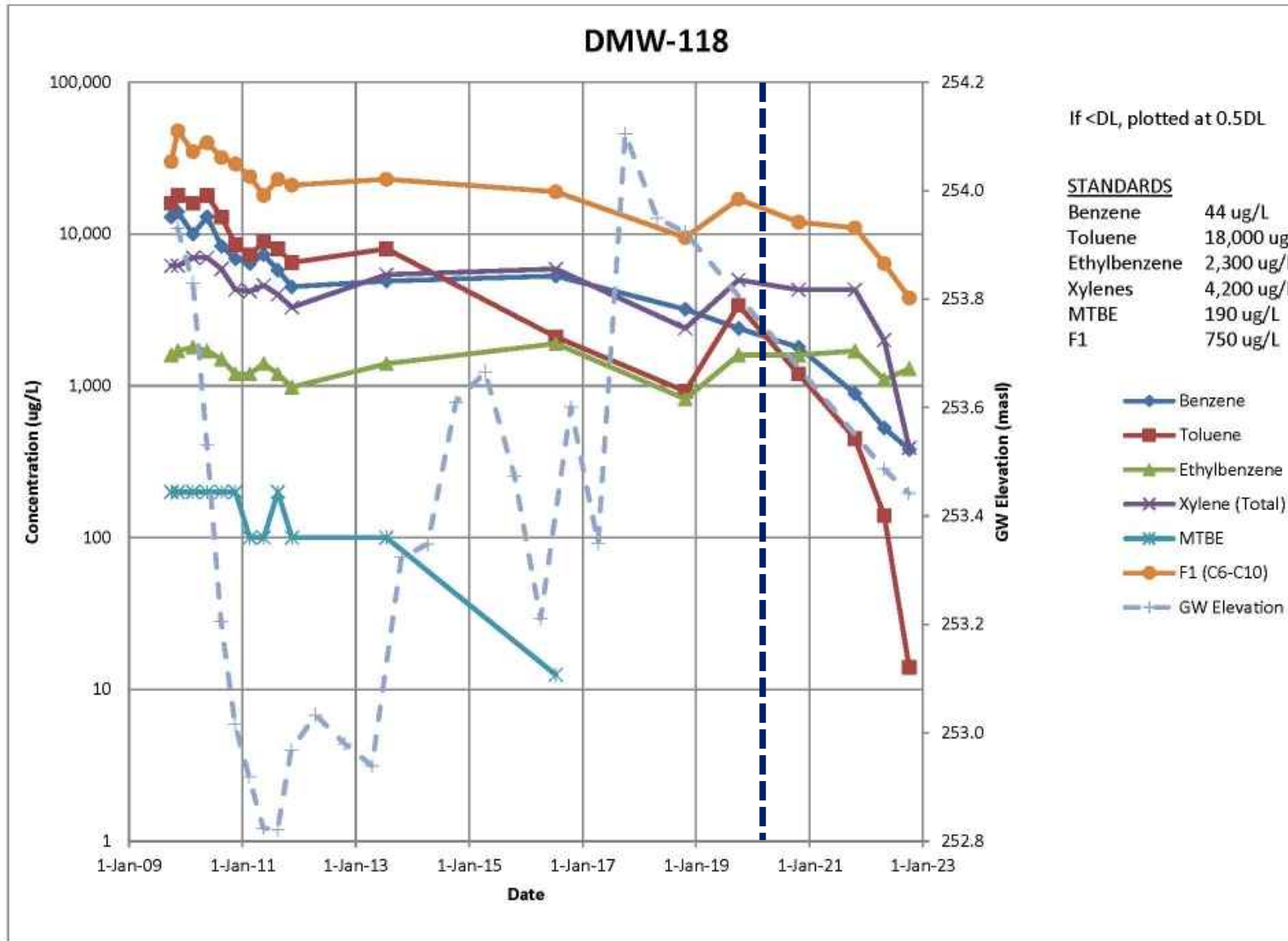
Study Site Pre-Injection TOC



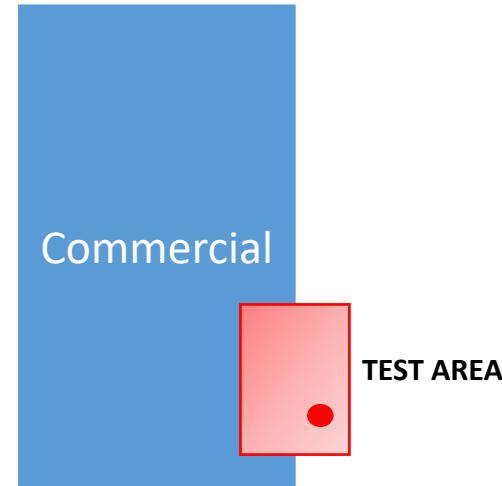
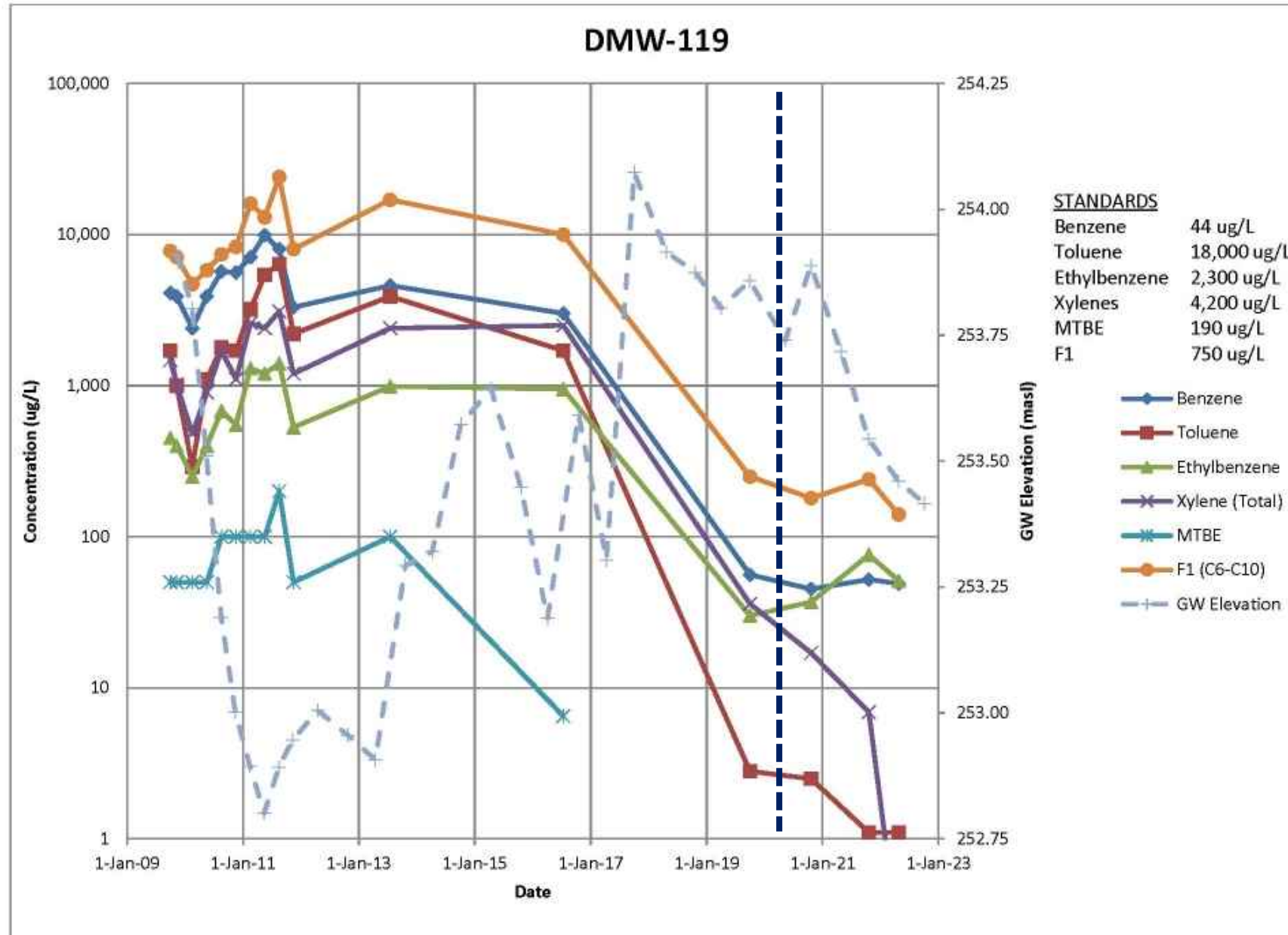
Study Site Post Injection TOC



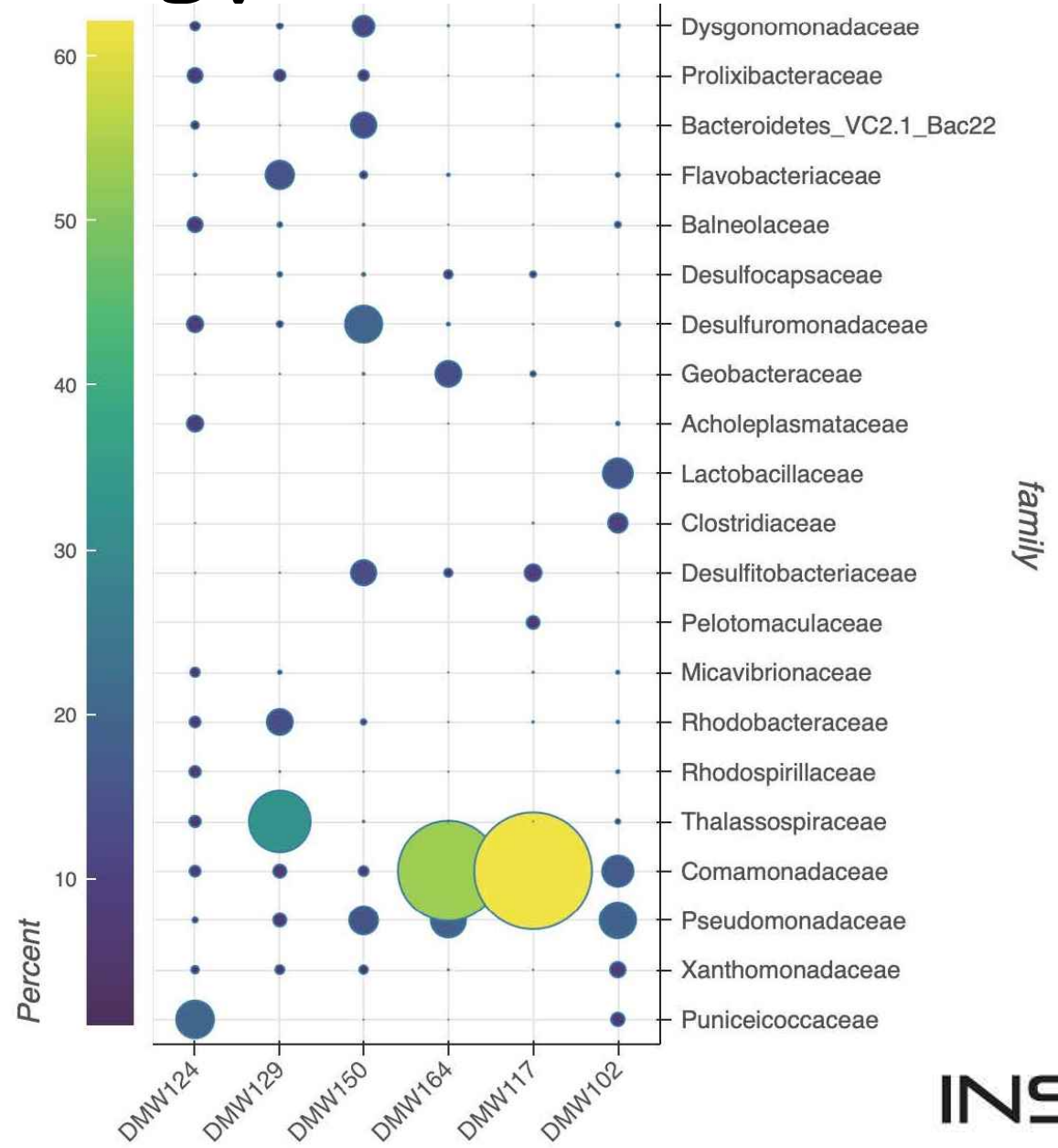
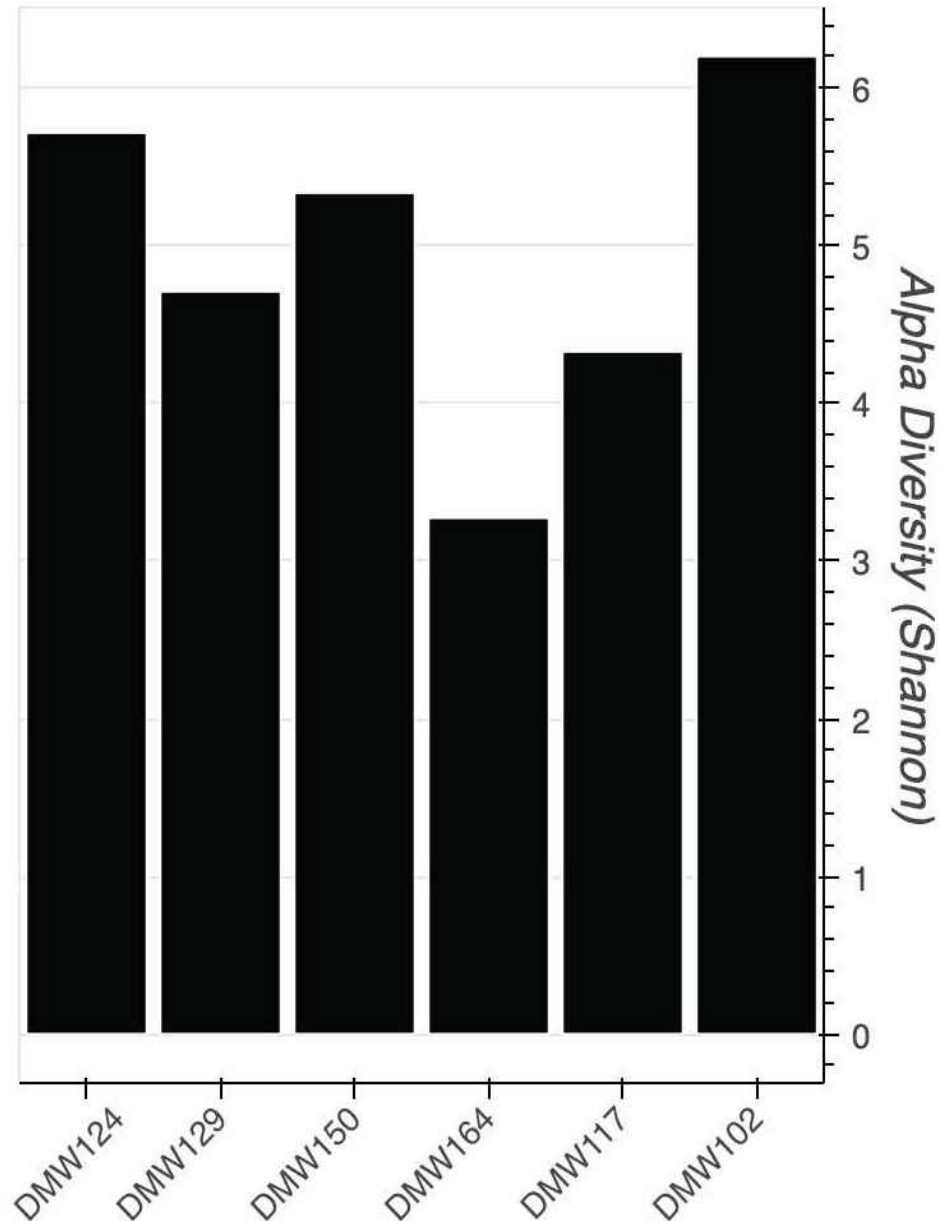
Study Site Treatment with Time



Study Site Treatment with Time



Study Site Microbiology



Study Site Summary

- Treatment with 3 months of application
 - Greater than 98% reduction in GRO and BTEX concentrations
 - Evidence of change of microbiological community following injection of Petrofix
- Removal of BTEX to below 200 $\mu\text{g/L}$ for greater than 2 years
- Greater than 99% of samples within target injection zone had Petrofix present