CASE STUDY

TYPE: Surfactant-Enhanced NAPL Recovery
COMPONENTS: Biosurfactant & Nutrients

SURFACTANT-ENHANCED LNAPL RECOVERY
PETROSOLV™ SURFACTANT

Type of Project:	Pilot-scale and Full-scale
Contaminants Treated:	Light non-aqueous phase liquid (LNAPL) diesel fuel
Concentration:	NAPL layer ranging from 0.4 to 2.01 feet in thickness
Technology Applied:	Three surfactant injection/extraction events using injection pumps and mobile high-vacuum extraction system
Geology:	Red-brown SILTY CLAY transitioning to FRACTURED BEDROCK
Treatment Interval:	GW and smear zone at 13-17 feet bgs
Average % Reduction:	95% - reduced NAPL to less than 0.05 feet across the site
Timeframe:	3 surfactant-enhanced recovery events over a 12-month period
Project Reference:	Available on request.

SITE DISCUSSION: A diesel release from USTs occurred at a fueling facility in Georgia, resulting in floating non-aqueous phase liquid (NAPL) in the UST cavity and surrounding shallow groundwater. Subsequent delineation activities identified a NAPL area measuring approximately 60 ft. x 80 ft., as defined by four monitoring wells, including OW-1, OW-2, MW-3, and MW-5. Recommendations in the subsequent site investigation summary report (SISR) included installation of four (4) injection wells and one (1) extraction well for use during a soil-flushing pilot study. After regulatory approval of the SISR, the injection and extraction wells were installed, and the soil-flushing pilot study was performed in late 2007. Based on the favorable pilot study results (see below), a corrective action plan (CAP) for installation of 3 additional extraction wells and 3 full-scale surfactant-enhanced soil-flushing events was submitted and subsequently approved by state regulators.

SOIL-FLUSHING PILOT STUDY: The 24-hour soil-flushing pilot test was conducted at monitoring wells MW-3 and MW-5, injection wells IW-1 through IW-4, and recovery well RW-1. Baseline and post-injection gauging data is presented in the table below.

	OW-1	MW-3	MW-5	RW-1	IW-2
Baseline NAPL Thickness	0.5 ft.	0.58 ft.	1.37 ft.	2.01 ft.	ND
Post-injection NAPL Thickness (4 weeks after pilot test)	0.05 ft.	ND	0.07 ft.	0.14 ft.	0.10 ft.

FULL-SCALE SOIL FLUSHING EVENTS: Two 72-hour soil-flushing events were performed in 2008 to remove remaining NAPL at the site. Flushing procedures included the following:

- 12 hours of active extraction from all site wells containing NAPL
- 12 hours of extraction from RW-1 and MW-5 with simultaneous injection of 2,000 gallons of PetroSolvÊ surfactant solution into IW-1, IW-2, IW-3, and IW-4
- 12 hours of extraction from RW-1, MW-3, and RW-3 with simultaneous injection of 2,000 gallons of PetroSolvÊ surfactant solution into MW-4, IW-1, IW-2, RW-2, and RW-4.
- 12 hours of active extraction from OW-1 and OW-2 (adjacent to UST cavity)
- 12 hours of active extraction from OW-2 with simultaneous injection of 2,000 gallons of PetroSolvÊ surfactant solution into OW-1 and RW-1.
- Injection of 4,000 gallons of nutrient solution (400 lbs. CBNÊ nutrients) into OW-1, OW-2, RW-1, RW-2, RW-3, RW-4, IW-1, IW-2, IW-3, IW-4, MW-3, and MW-5

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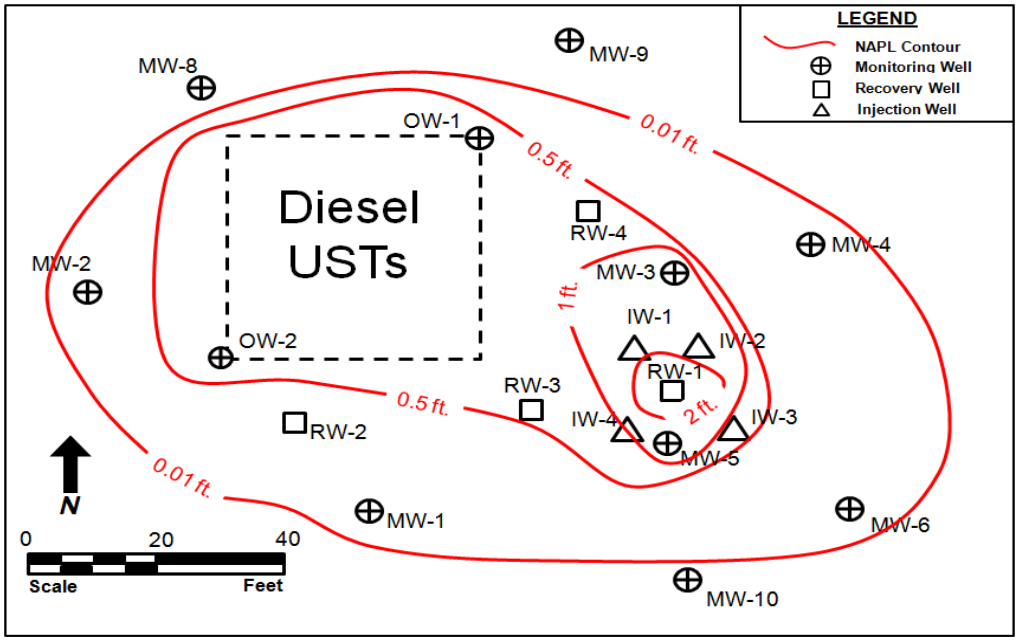
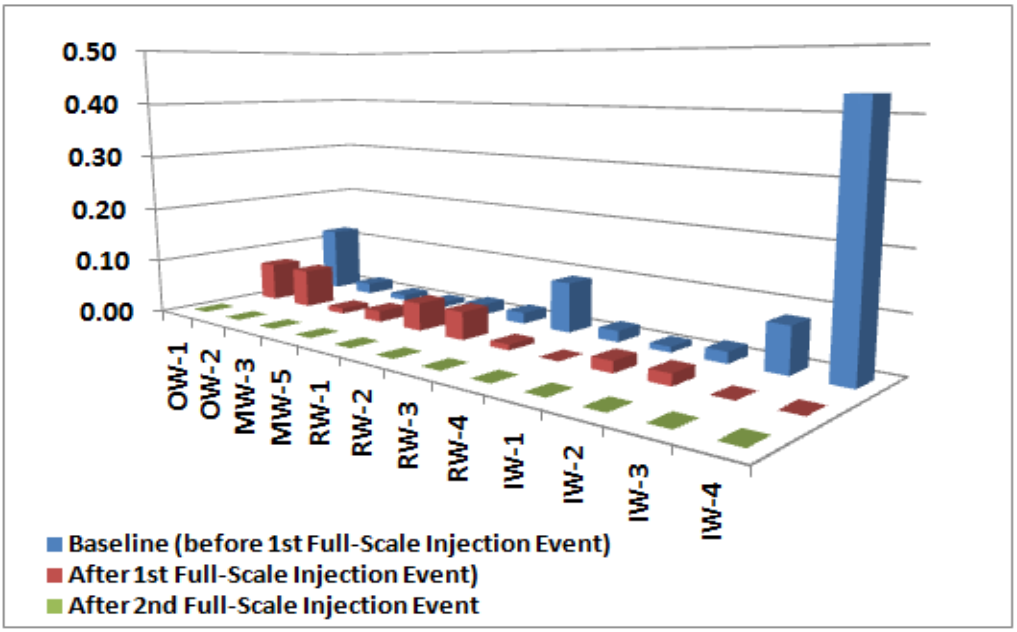
SITE PLAN:



RESULTS: After the second full-scale flushing event, ***no measurable NAPL thickness was detected*** in any of the site wells, including the UST observation wells OW-1 and OW-2. More importantly, throughout the surfactant injection events, dissolved-phase BTEX, MTBE, and PAH concentrations in groundwater remained below regulatory Maximum Contaminant Levels (MCLs).



COST: Approx. 450 gallons of PetroSolvÊ and 400 lbs. of CBN nutrients were used for the entire project, at a total cost of $17,000. Consultant labor/equipment costs were not available.

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