Cleanup of a Day-Lighted Gasoline Release In A Sand Filled Tank Hold Utilizing Total Fluid Recovery Surfactant Enhanced Extraction (SEE)

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GST
GEOLOGIC SCIENCE & TECHNOLOGY

WRIGHT
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Drinking Water Reservoir Serving 2.4 Million (25%) Dallas, TX Residence.

Approximately 330 m (1083 ft) to Reservoir

Underground Storage Tank (UST) Pit with ~4.69 ft. (1.43 m) LNAPL measured in observation wells.

A corrosion pit in a flex hose fitting leaked ~1,100 gallons (4,164 L) of gasoline into the tank pit.

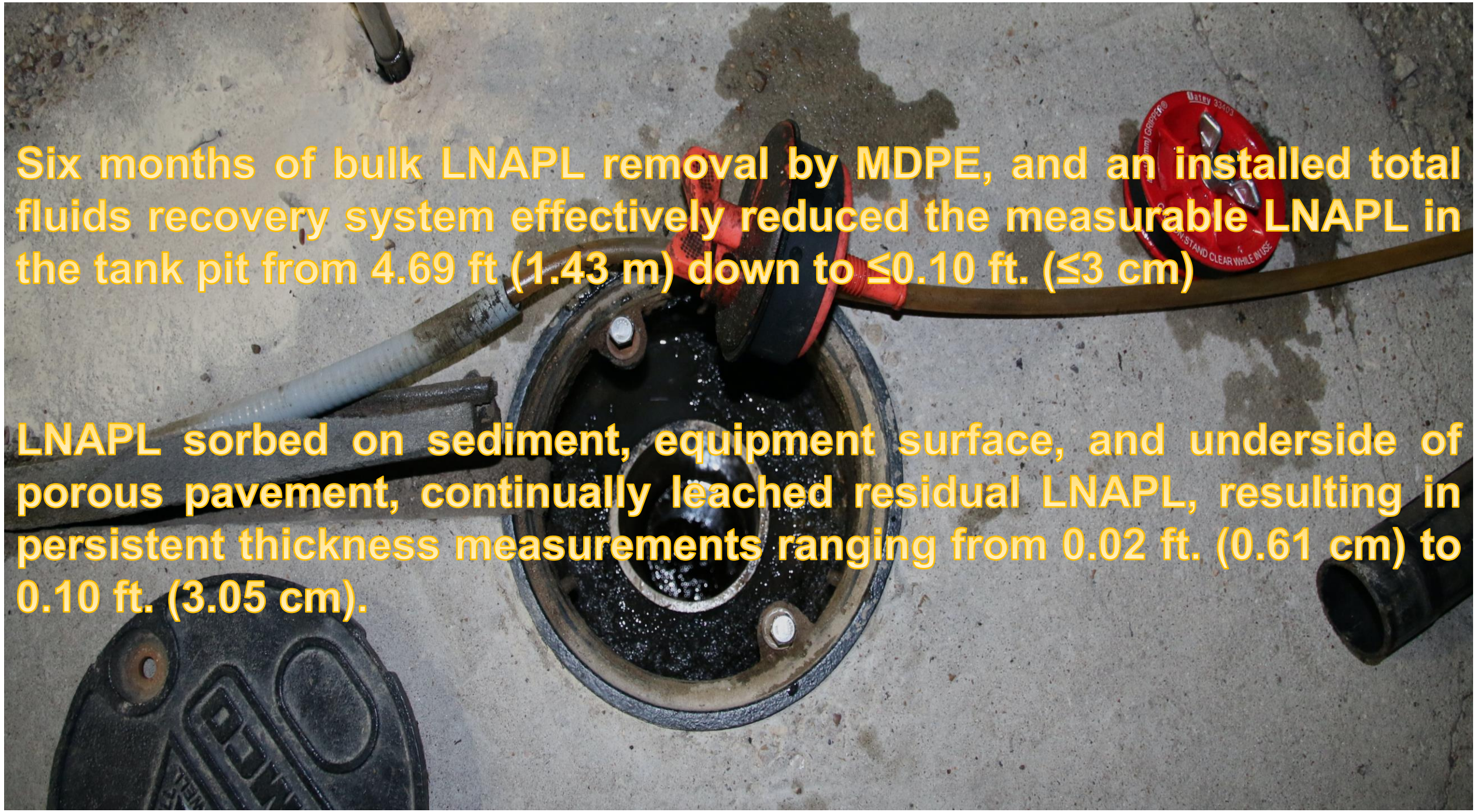

Upon detection of the release, the State of Texas TX Commission on Environmental Quality (TCEQ) immediately dispatched the State Lead Emergency Response contractor to prevent/minimize impacts to the nearby drinking water reservoir.
The State's objective was to maintain control of the tank pit fluid levels, to prevent additional LNAPL from reaching the reservoir and to abate the remaining LNAPL in the tank pit area.

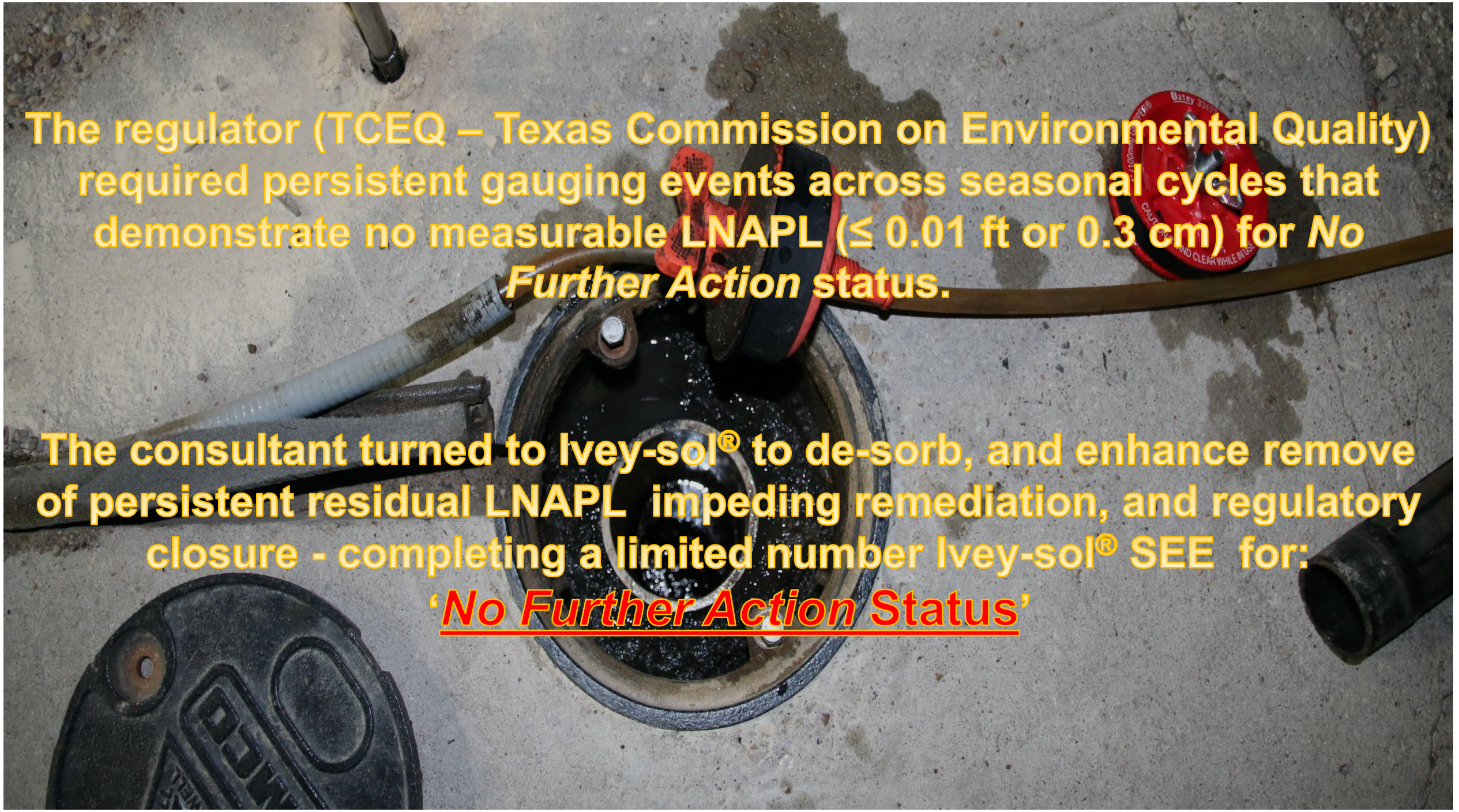

Heavy Rain Entering Tank Lifted LNAPL up Through Pavement
Surfaced LNAPL Ran Short Distance Downhill Toward Reservoir
(Oil Absorbent Booms and Pads Deployed Along Overland Pathway)

A large Mobile Dual-Phase Extraction (MDPE) System Was Immediately Engaged To Remove The Bulk Of LNAPL

Elevated VOC Levels In The Vapor (VOC) Stream Exceeded The Thermal Oxidizer Vapor Scrubber's Capacity

MDPE Was Replaced With A Permanent Total Fluids Extraction System Incorporating Peristaltic Pump Recovery


Six months of bulk LNAPL removal by MDPE, and an installed total fluids recovery system effectively reduced the measurable LNAPL in the tank pit from 4.69 ft (1.43 m) down to ≤0.10 ft. (≤3 cm)
LNAPL sorbed on sediment, equipment surface, and underside of porous pavement, continually leached residual LNAPL, resulting in persistent thickness measurements ranging from 0.02 ft. (0.61 cm) to 0.10 ft. (3.05 cm).



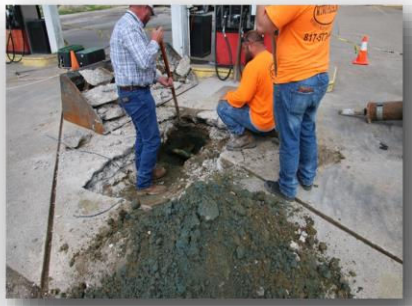
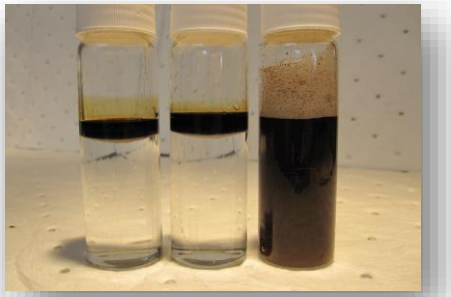
The regulator (TCEQ – Texas Commission on Environmental Quality) required persistent gauging events across seasonal cycles that demonstrate no measurable LNAPL (≤ 0.01 ft or 0.3 cm) for *No Further Action* status.

The consultant turned to Ivey-sol® to de-sorb, and enhance remove of persistent residual LNAPL impeding remediation, and regulatory closure - completing a limited number Ivey-sol® SEE for:

'*No Further Action* Status'

Project Summary:



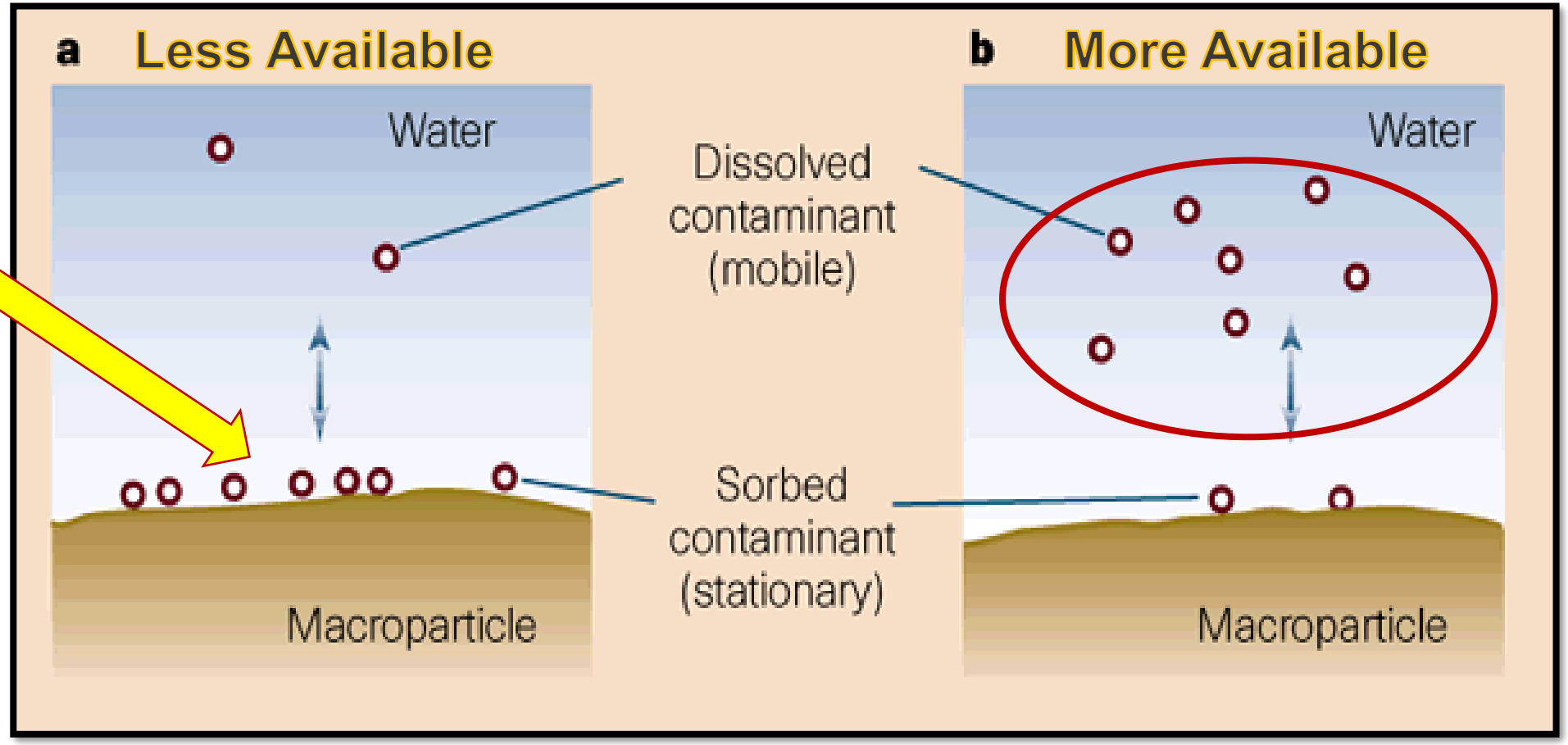



- A tandem use of total fluid recovery paired with a targeted Ivey-sol® surfactant flood was utilized for abatement of a gasoline release 4,164 L at the site;
- The release of gasoline PSH (LNAPL), which came to grade, threatened a large regional water supply reservoir 330 m (1083 ft.) down gradient;
- State of Texas (TCEQ) emergency response crews stabilized the release;
- Wright Environmental Services (WES) assumed control and continued manual fluid recovery until a Site-specific total fluid system was installed (*Team: WES & GST*);
- Total fluid recovery was conducted for 4 months, reducing the PSH (LNAPL);
- Continuous total fluid recovery was very successful; however it left significant gasoline mass trapped in fine sandy-clay native fill below the normal water level in tank pit;
- 3 Targeted Ivey-sol® SEE '*Push-Pulls*' left no significant PSH in the tank hold, with fluids being recovered by the total fluid recovery system, in just 2 days; a
- **SEE PSH mass removal allowed standard risk-based closure of the site!**

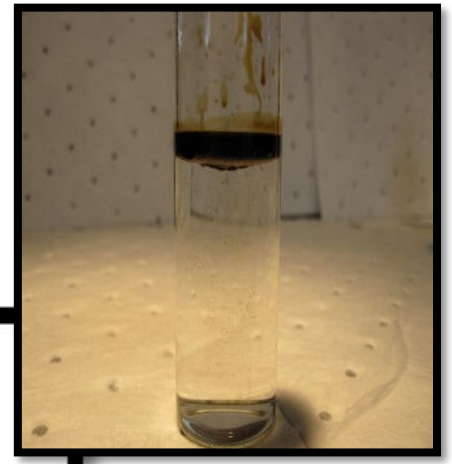
Sorption - Phase Partitioning

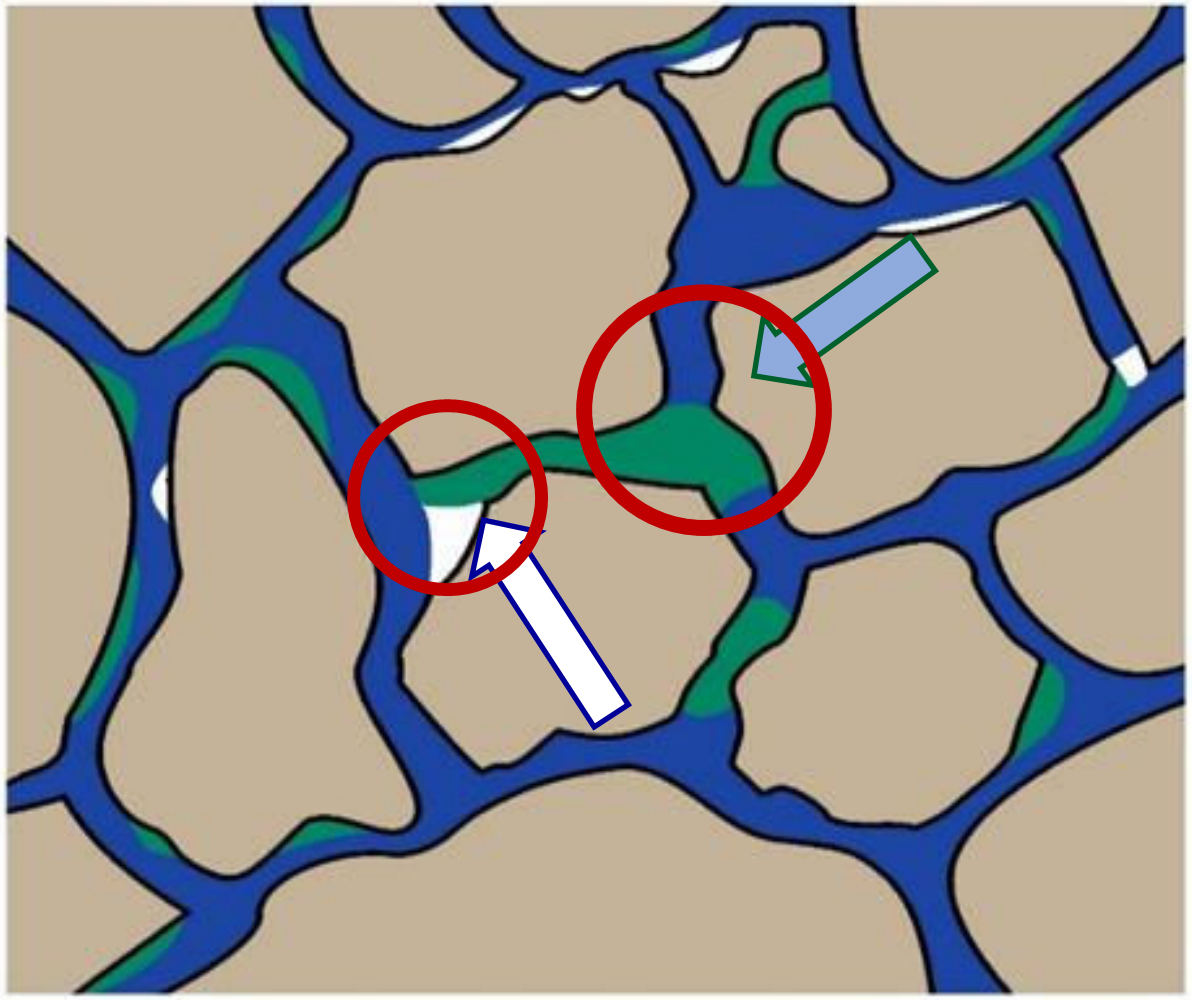
Petroleum has limited solubility in groundwater.
Hence the contaminants will Sorb onto the Soil Surfaces, aggregate to form Globules, or LNAPL = Reducing their '*Availability*' for Remediation.

Sorbed Petroleum With Limited Availability For Remediation



VOC Sorbed and NAPL Behavior A Closer Look





Interfacial Tension

Soil

Vapor

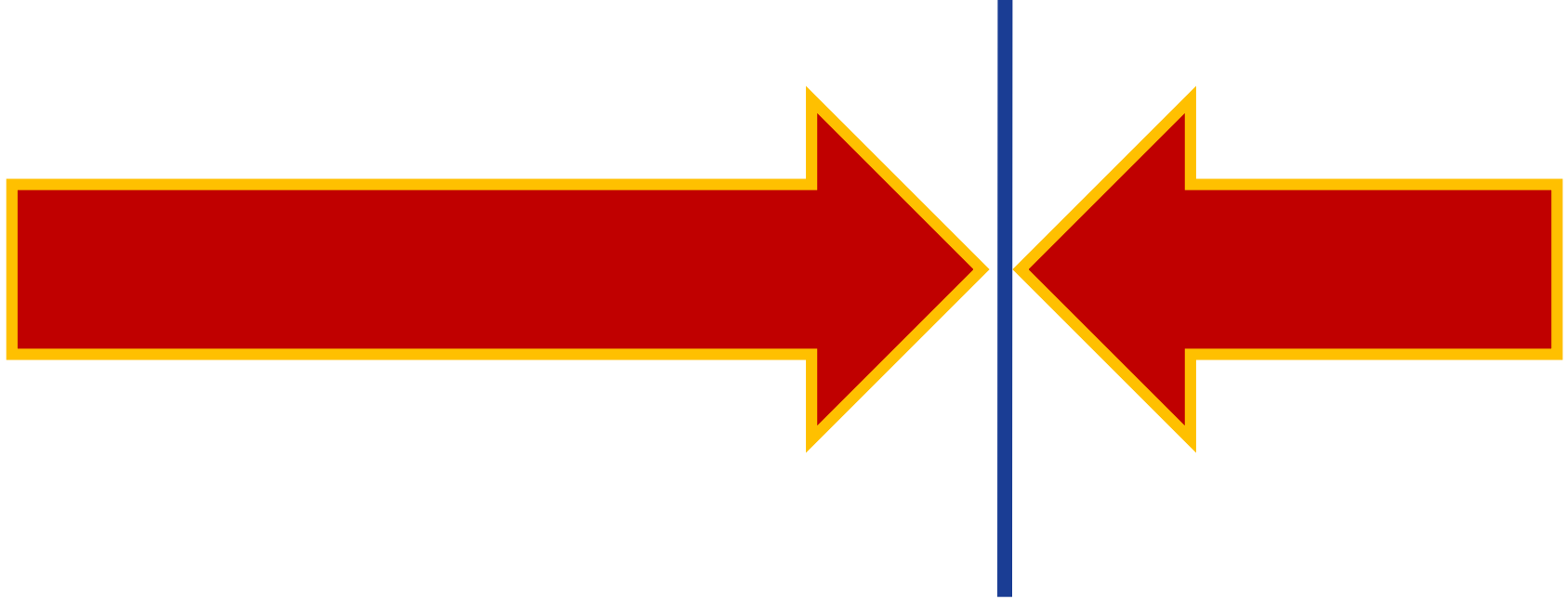
Water

Contamination

Interfacial Tension Between Phases

Water *Clusters* Have Interfacial Tension of ~73 Dynes

LNAPL and DNAPL Interfacial Tension of ~21 to 23 Dynes



NAPL molecules at molecular interface between the 2 phases actually reorganize to cause a net increase in NAPL Interfacial Tension to >>30 Dynes!!

Contaminant Aggregation

Contaminant **aggregation** is the 'sticking' (cohesive or adhesive forces) of organic molecules to one another, onto surfaces (Sorption), can increase in thickness….a natural phenomenon.

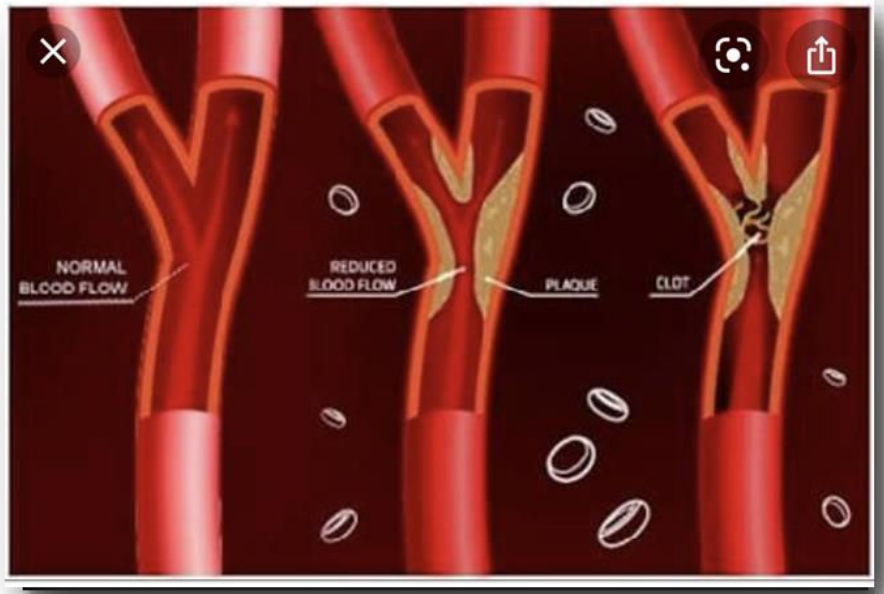
(like dissolves like & like attracts like)

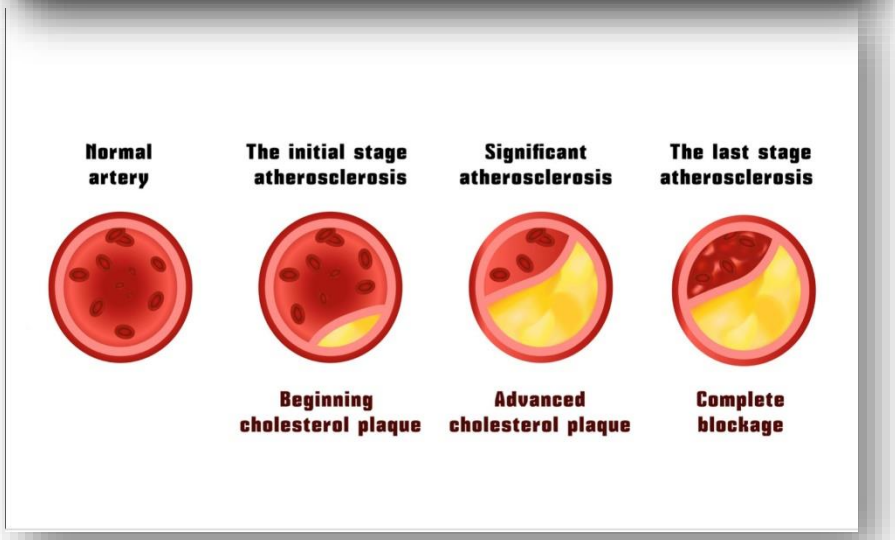
Aggregation may be viewed as unwanted surface Sorption, to amass forming Globules or Ganglia, to LNAPL and DNAPL layer formation.

(medical analogy - clogging of arteries)

Within geology, this causes caking, bridging, and/or blockage of effective pathways = '***Pathway Interference***' *(hence **delivery** or **extraction** issues!)*

Diameter of Soil < Diameter of Hair < Veins Diameter





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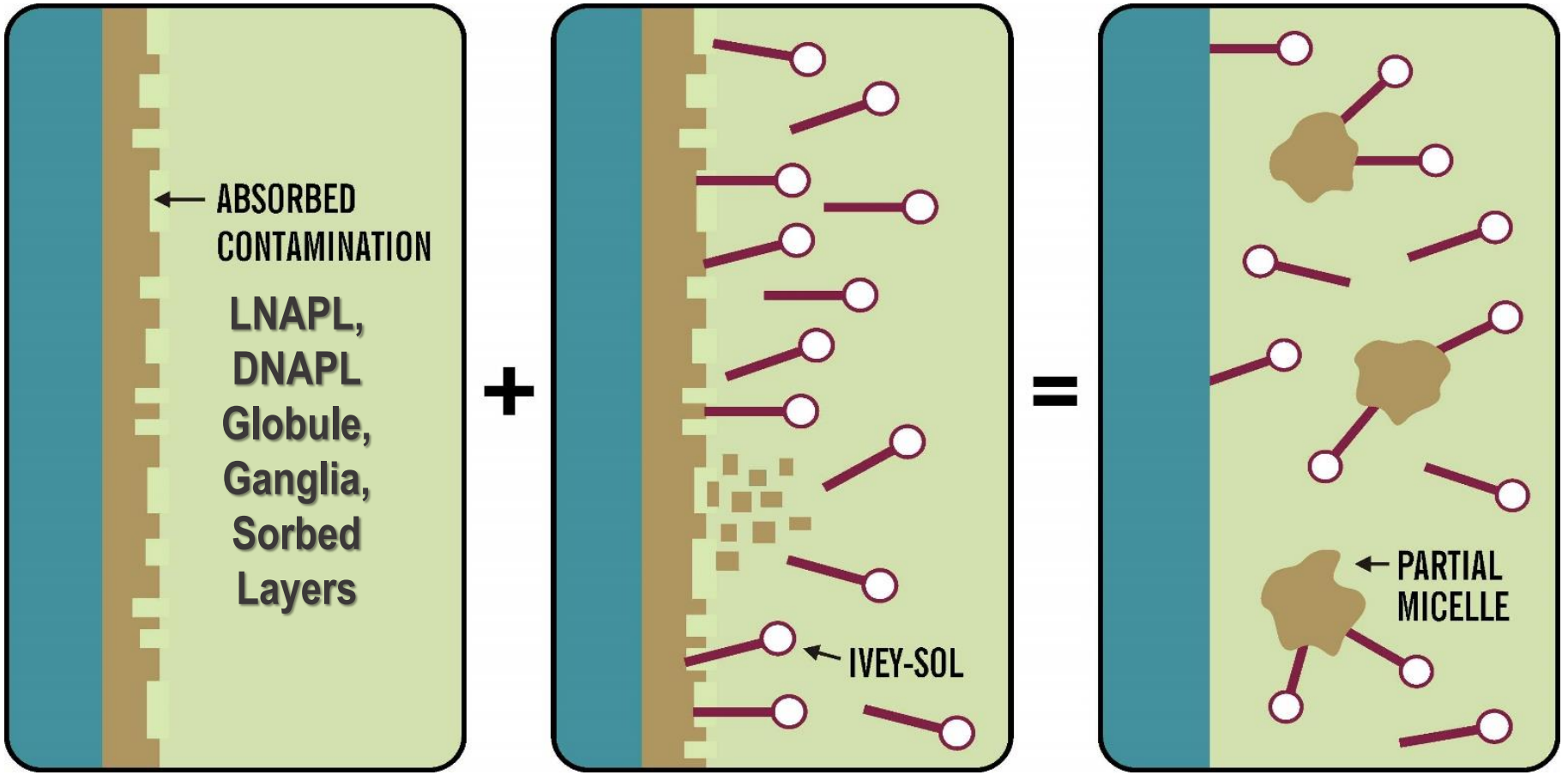
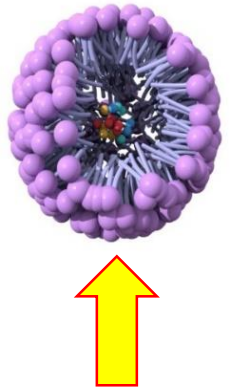
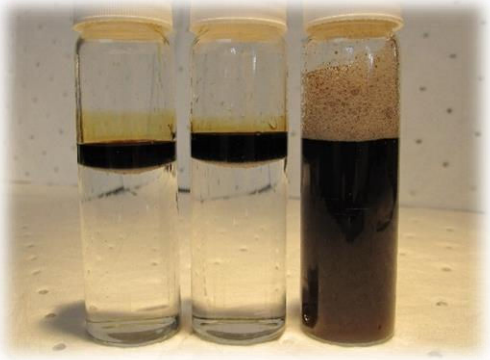




How >99% of surfactants work by encapsulating contaminants hindering their 'Availability' for remediation, and impedes waste water treatment .

Ivey-sol® mechanism selectively desorbs NAPL below the CMC

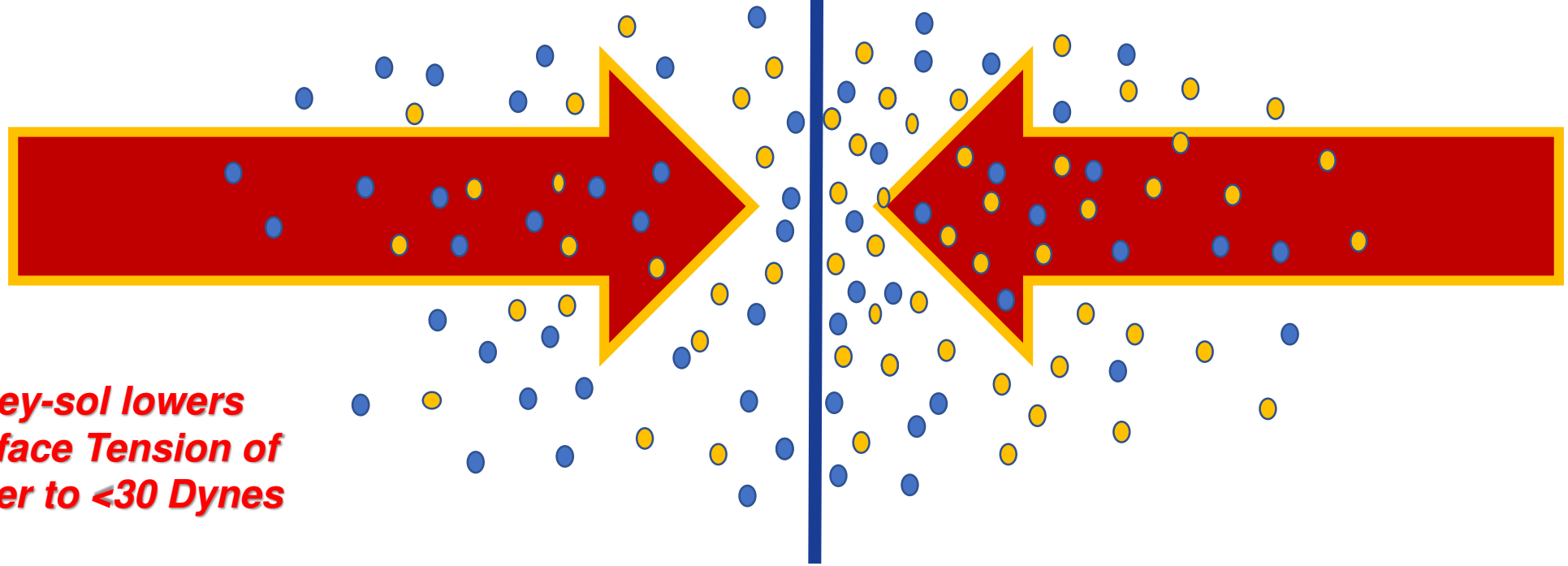
Increasing Physical, Biological and Chemical Availability For Enhanced Remediation



Overcoming Interfacial Tension

Water Has Interfacial Tension of 73 Dynes

LNAPL and DNAPL Have (On Average) Interfacial Tension of 21-23 Dynes

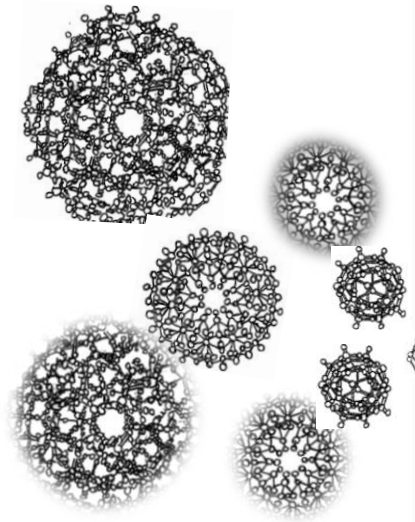


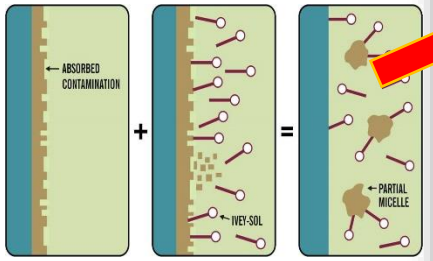
Ivey-sol lowers Surface Tension of Water to <30 Dynes

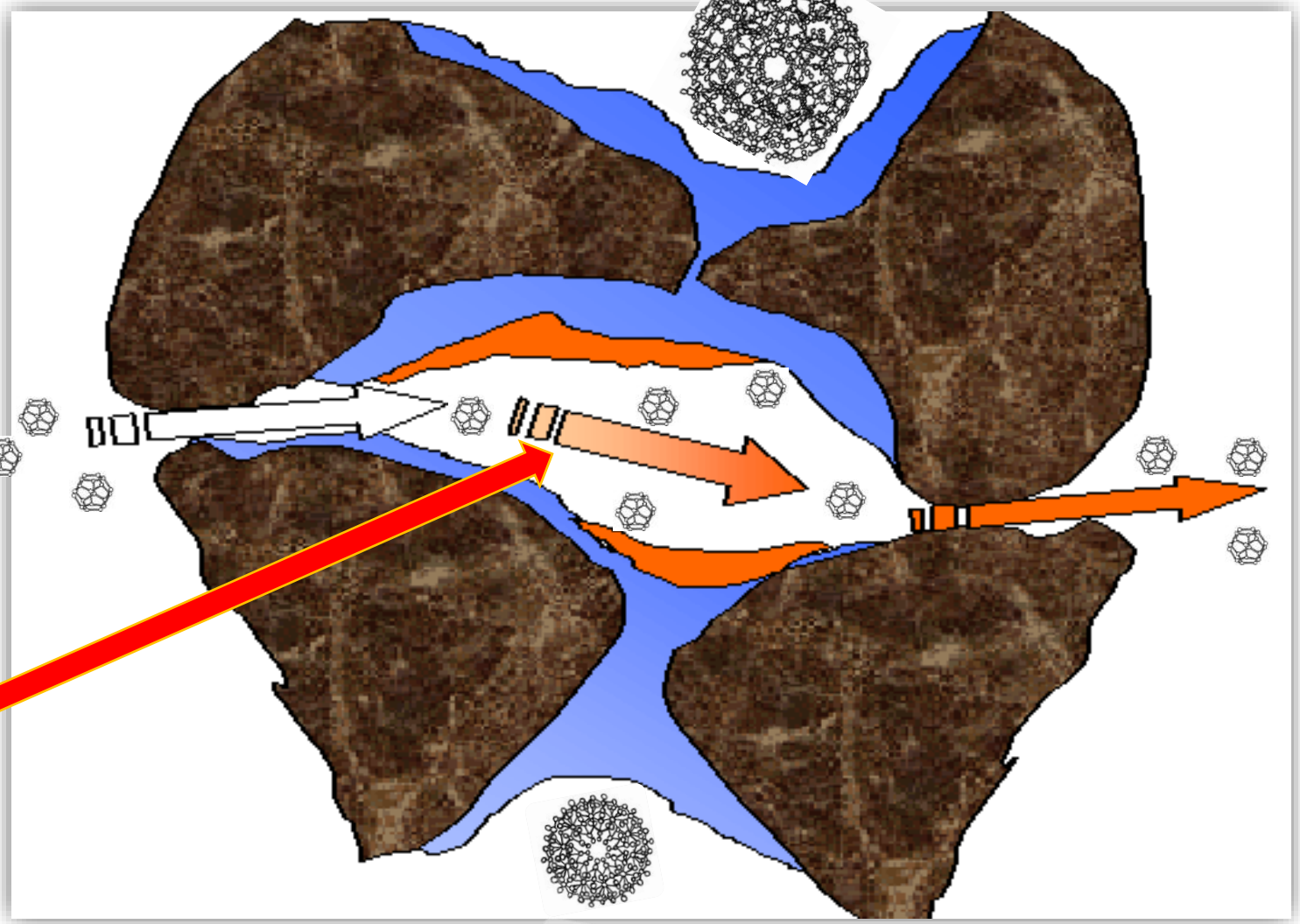
Overcoming Interfacial Tension & Increasing NAPL, Sorbed, Dissolved Contaminant '*Availability*' For Remediation

Ivey-sol® Overcomes Low K and Retardation In Finer Grain Soil Improving Access, Regress, and Remediation

ACCESS



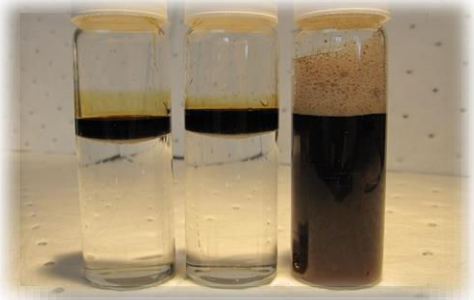


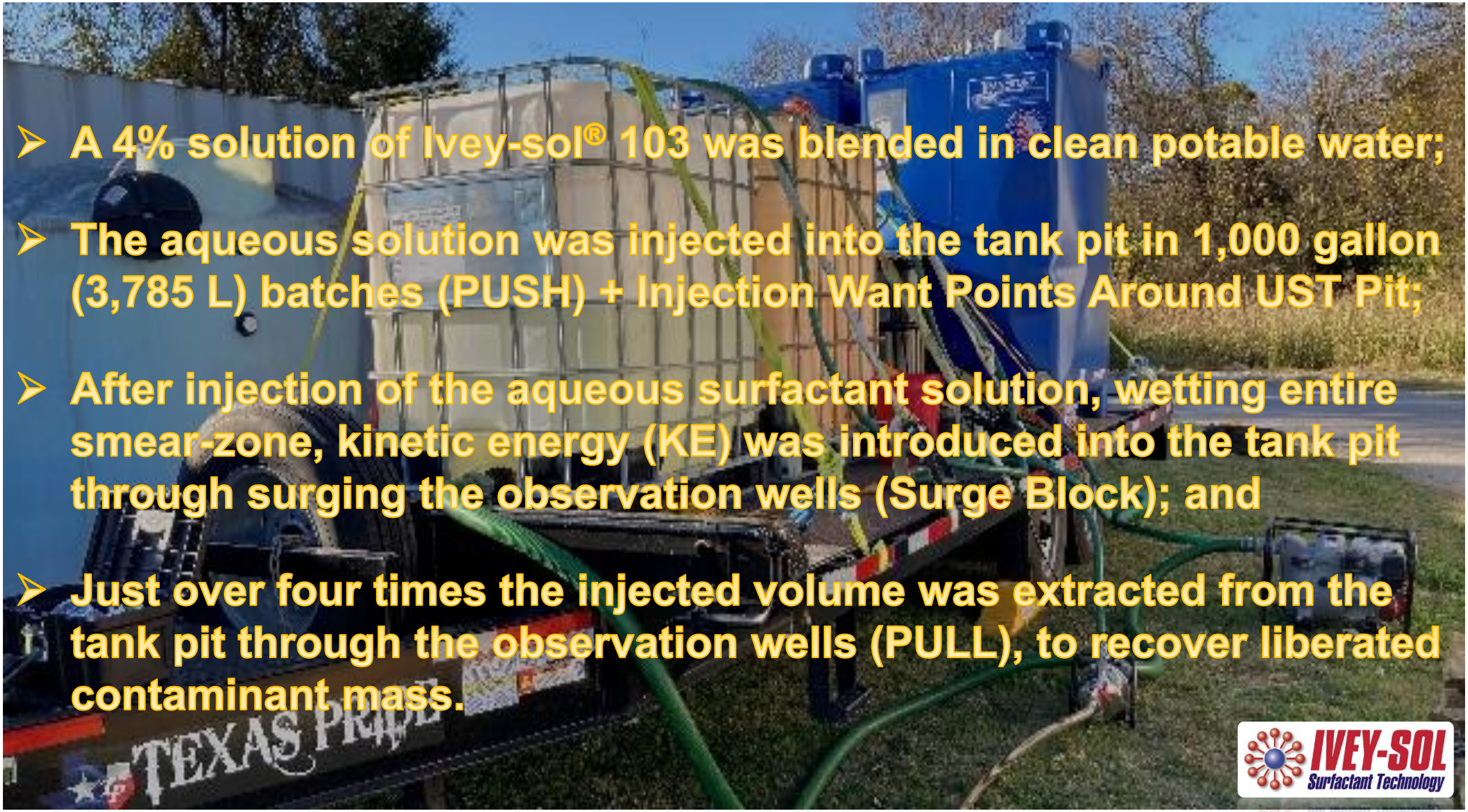


Interfacial Tension Will Effect NAPL Behaviors

More Available
(Physio-Bio-Chem)

REGRESS





- A 4% solution of Ivey-sol® 103 was blended in clean potable water;
- The aqueous solution was injected into the tank pit in 1,000 gallon (3,785 L) batches (PUSH) + Injection Want Points Around UST Pit;
- After injection of the aqueous surfactant solution, wetting entire smear-zone, kinetic energy (KE) was introduced into the tank pit through surging the observation wells (Surge Block); and
- Just over four times the injected volume was extracted from the tank pit through the observation wells (PULL), to recover liberated contaminant mass.

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KE Surge Blocking Use At UST Tank Pit Observation Wells + Injection Wand

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- The Ivey-sol® SEE 'Push-Pull' process was repeated three (3) times over a two (2) day period;
- A total of 3,000 gallons (11,356 L) of 4% Ivey-sol® 103 solution was introduced. Approximately 12,500 gallons (47,318 L) of tank pit fluids were extracted;
- The Ivey-sol® SEE process required 2 Drums of Ivey-sol® 103 with a total material cost of <$10,000 USD delivered, taxes Included.

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- LNAPL was recovered from the extracted tank pit fluids in a separation tank for off-site disposal / recycling;
- The remaining recovered tank pit fluids were filtered through granular activated carbon (GAC) and discharged under Texas Pollutant Discharge Elimination System (TPDES) General Permit resulting in MINIMAL DISPOSAL COST
- Ivey-sol® does not impede waste-water treatment performance.

PROJECT RESULTS

- The PUSH – PULL remediation was completed within one week on site (August 2020) - *During COVID Protocols;*
- LNAPL was reduced well below the TXCEQ remedial goal;
- Gauging continued for 12 months to cover seasonal cycles;
- Measurable LNAPL did not return - *Not even a sheen*;
- Consultant and Contractor estimated, if not for Ivey-sol, easily 1-2 more years if stayed the course, and cost saving >$100,000.00
- The TCEQ has since granted *No Further Action* status for the site, and the case was closed.

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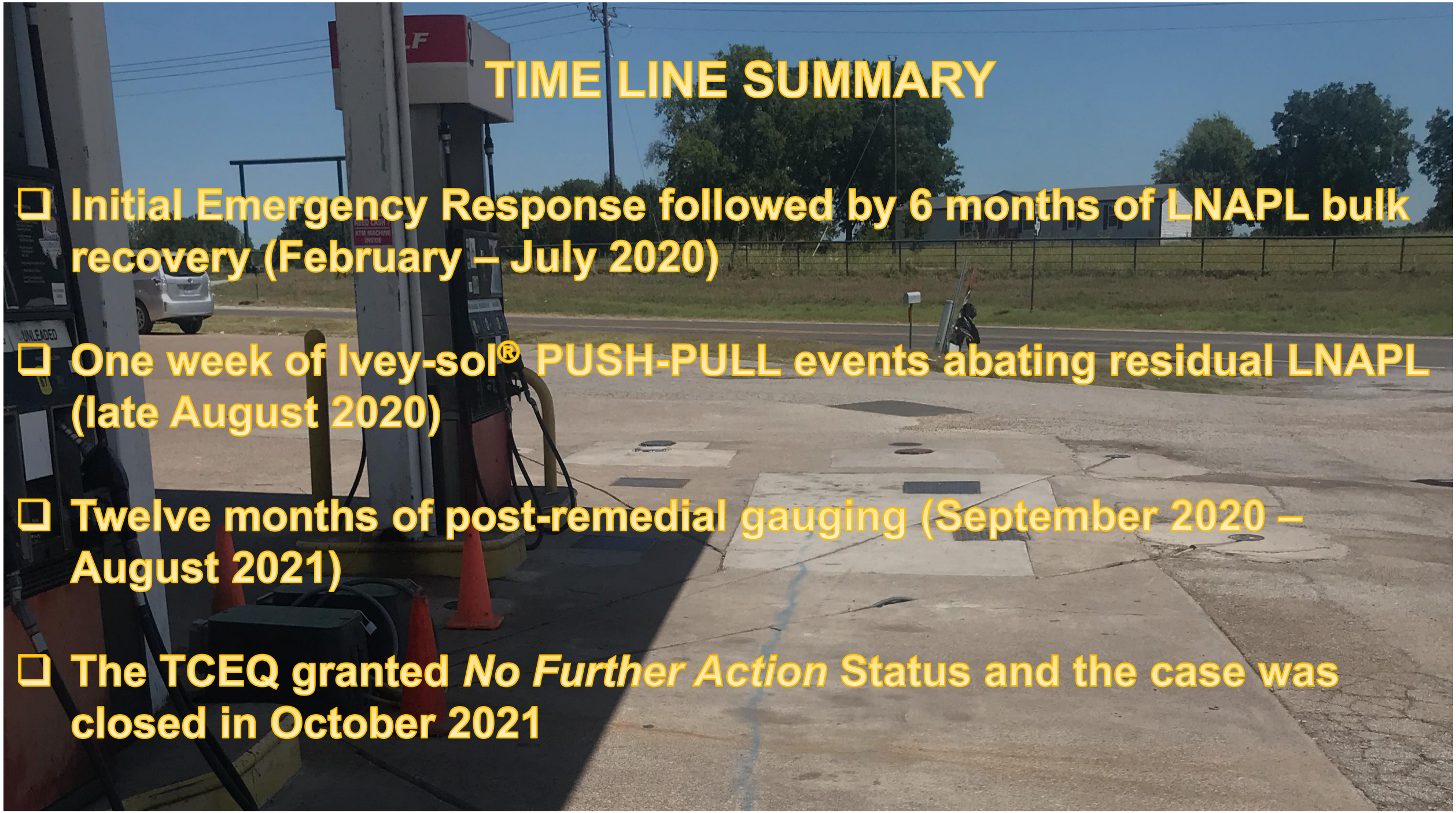

TIME LINE SUMMARY

- Initial Emergency Response followed by 6 months of LNAPL bulk recovery (February – July 2020)
- One week of Ivey-sol® PUSH-PULL events abating residual LNAPL (late August 2020)
- Twelve months of post-remedial gauging (September 2020 – August 2021)
- The TCEQ granted *No Further Action* Status and the case was closed in October 2021

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DECON-IT®

Omni Surface Decontaminator

PFAS SOLS

Our Products Are Free of Unwanted Impurities
PFOA & PFOS Free
1,4 Dioxane Free
Dioxins, Furans, and PCB Free
Tested and Free For USEPA Regulated Compounds

Our newest formulation called **PFAS-SOL®** is effective for enhancing in-situ PFAS remediation.

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