LUST Site Corrective Action in Ozark Karst - Yellville, Arkansas

ASTSWMO Mid-Year Meeting
North Little Rock, Arkansas
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ADEQ LUST Case #45-0008 – involved the release of a relatively minor volume of gasoline into a "karst" bedrock environment, resulting in:

- **Acute exposure to human receptors by hydrocarbon vapor intrusion, with perceived threat of explosion and fire,**
- **Concern for potential chronic vapor intrusion impact to human health,**
- **Confirmed ground water impact by LNAPL and dissolved hydrocarbons, threatening endangered subsurface organisms and a nearby surface stream, and**
- **Civil action, resulting in the largest third-party settlement (to date) by the Arkansas Petroleum Storage Tank Trust Fund.**

Today's discussion will focus on corrective action responses to the release by the impacted third party, the Responsible Party and ADEQ RST Division.

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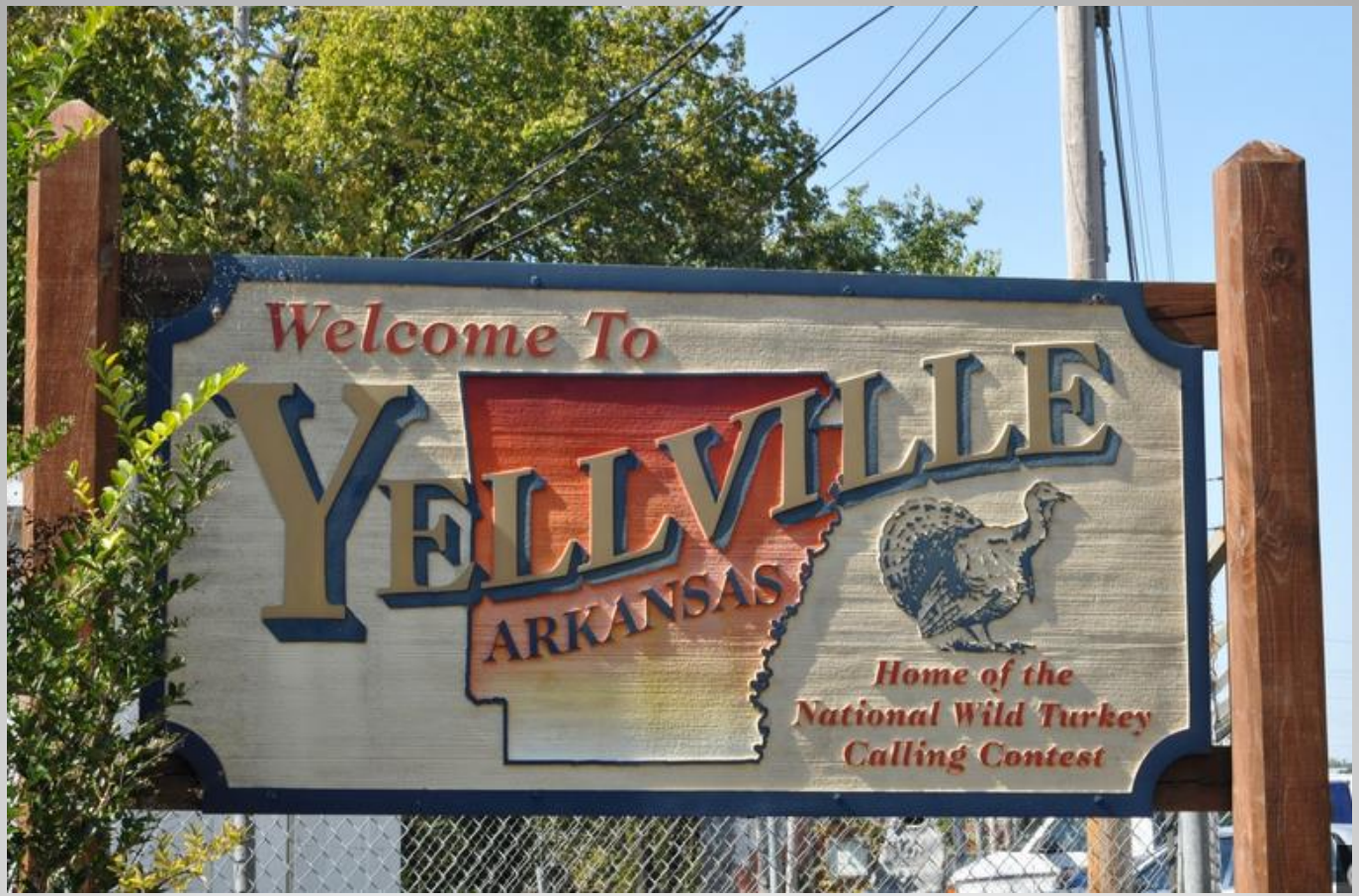

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Yellville, Arkansas

2010 population: 1,204 - County seat of Marion County

Named for Archibald Yell, 2nd Governor of Arkansas

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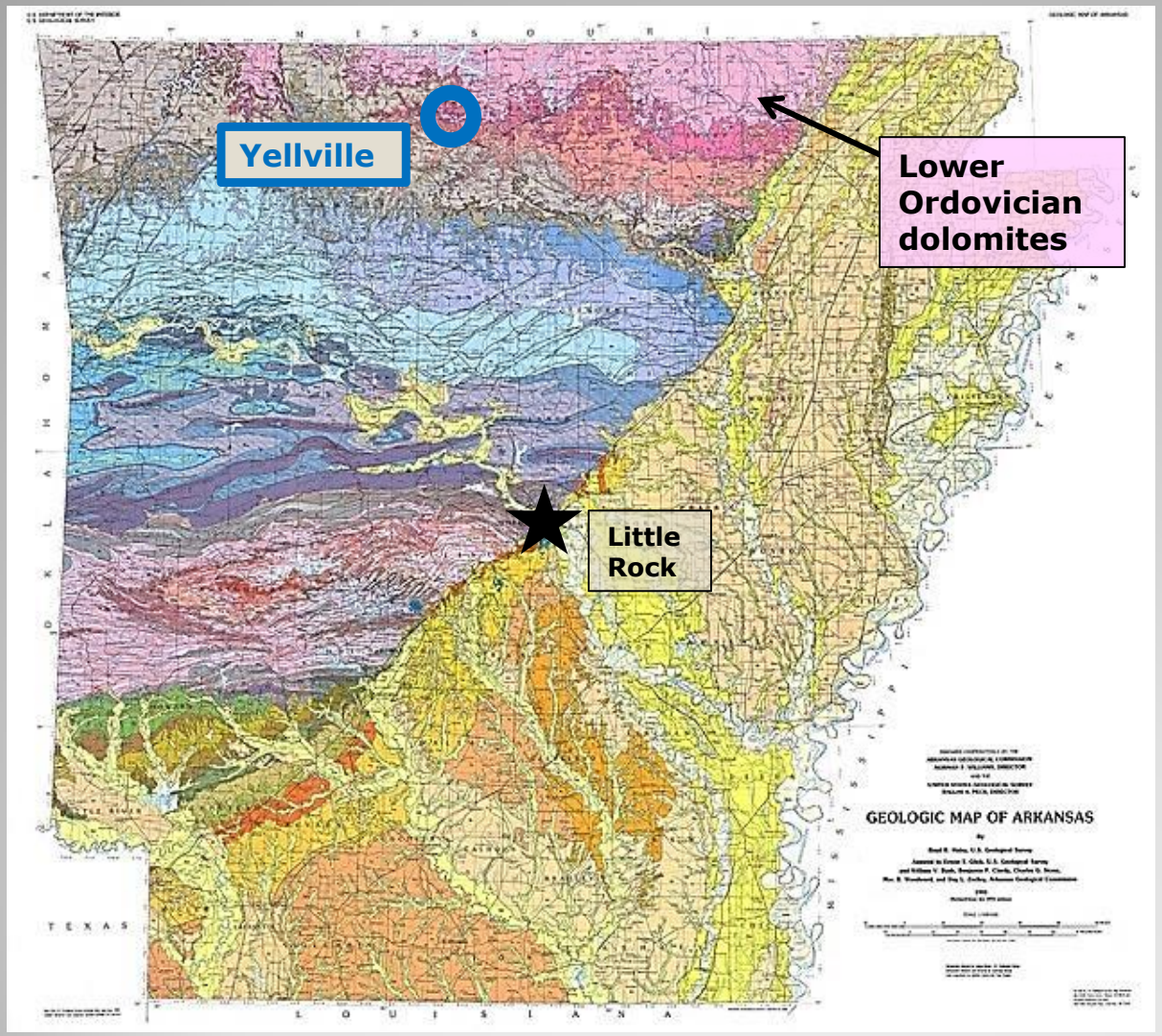

Geology:

Yellville is located in the Ozarks of northern Arkansas, within an outcrop belt of Lower Ordovician "karst" dolomite bedrock.

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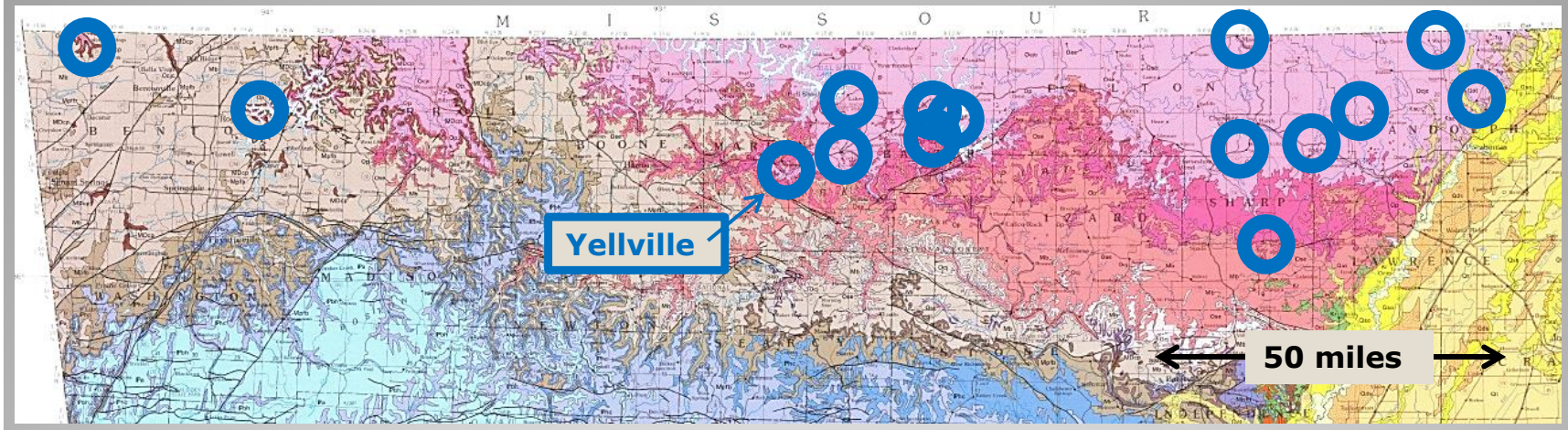

- Major LUST/LAST case sites in Lower Ordovician "karst" dolomites, Northern Arkansas Ozarks, 1985-2015

- Significant off-site impact was noted at all sites, with contamination of springs, surface waters and/or drinking water supply wells

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"Karst is a terrain with distinctive landforms and hydrology created from the dissolution of soluble rocks, principally limestone and dolomite. Karst terrain is characterized by springs, caves, sinkholes, and a unique hydrogeology that results in aquifers that are highly productive but extremely vulnerable to contamination." – US Geological Survey

Bull Shoals Caverns – developed in Lower Ordovician dolomite, 12 miles north of Yellville, AR

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White Oak Station #3

102 East US Highway 62 - Yellville, Arkansas

ADEQ RST Division Facility ID #45001606

View to northeast at intersection of US Highway 62 and Arkansas Highway 14

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Aerial Photo of White Oak #3 LUST site and adjoining properties, May 2014

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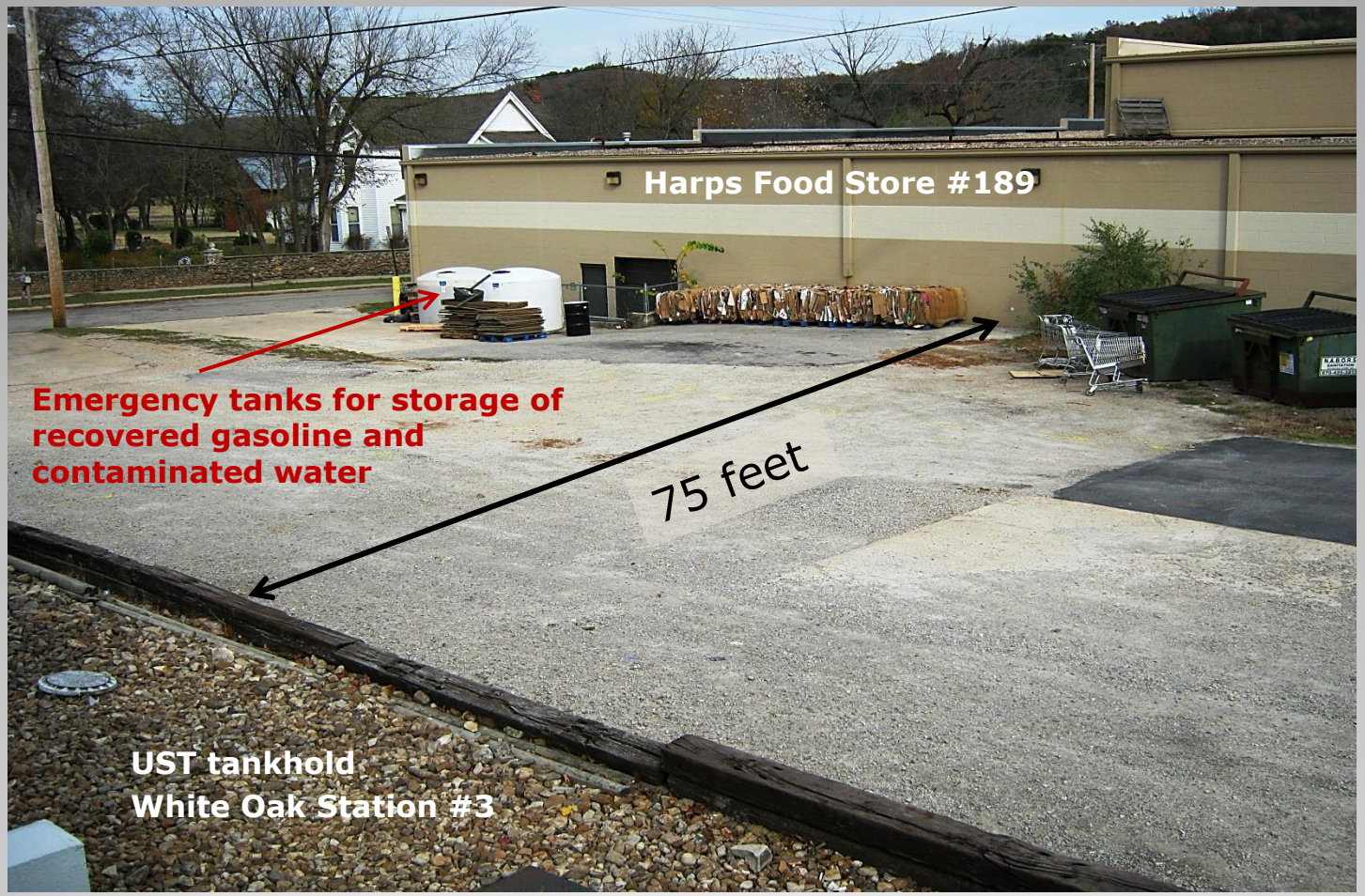

Rear of Harps Food Store #189 from UST tankhold at White Oak #3, November 13, 2011, during emergency response.

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Harps Food Store #189 – November 13, 2011 - Store had been closed by Yellville Fire Department on November 8th, after acute gasoline vapor impact.

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Ground water sump at base of access shaft, inside Harps #189, November 13, 2011. On afternoon of November 8th, following a heavy rainfall event, sump had filled with free product gasoline and contaminated ground water, with ensuing vapor impact throughout the grocery.

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Interior of Harps #189 on November 13, 2011. On November 10th, the Arkansas Department of Health had ordered the removal and landfill disposal of all consumable food items.

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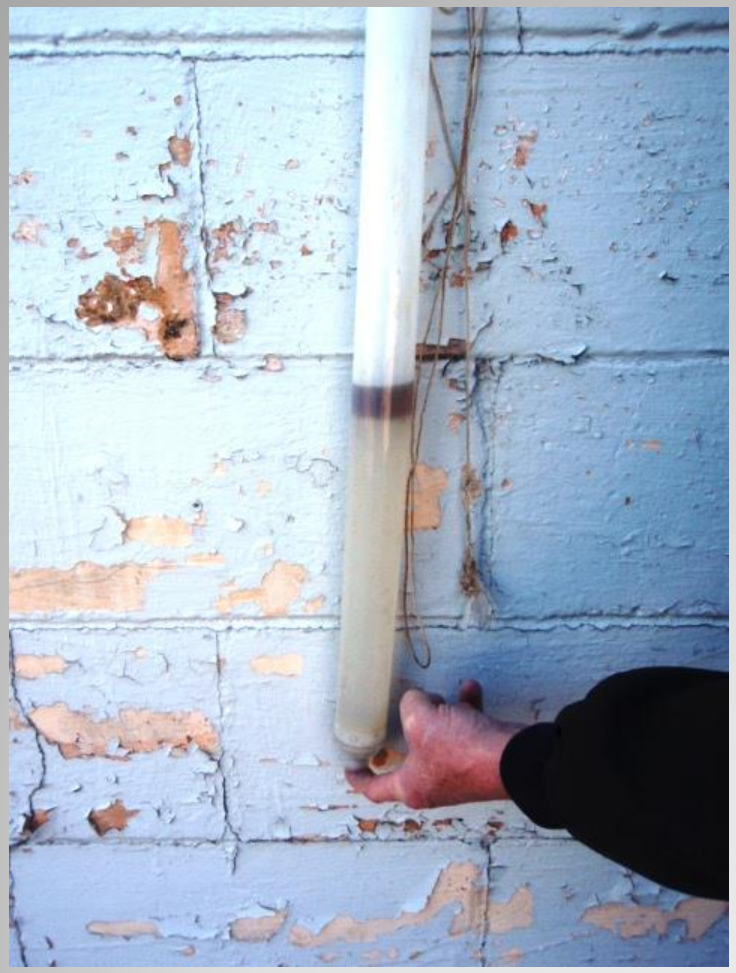

Source of the release: On November 9, 2011, RST Enforcement checked the two observation wells in the UST tankhold at White Oak Station #3 and confirmed the presence of free product gasoline in both wells.

Inventory records did not indicate a recent system release and the USTs and lines passed pressure tests conducted on November 10th.

Product losses during fuel deliveries are now suspected to have been the source of the release.

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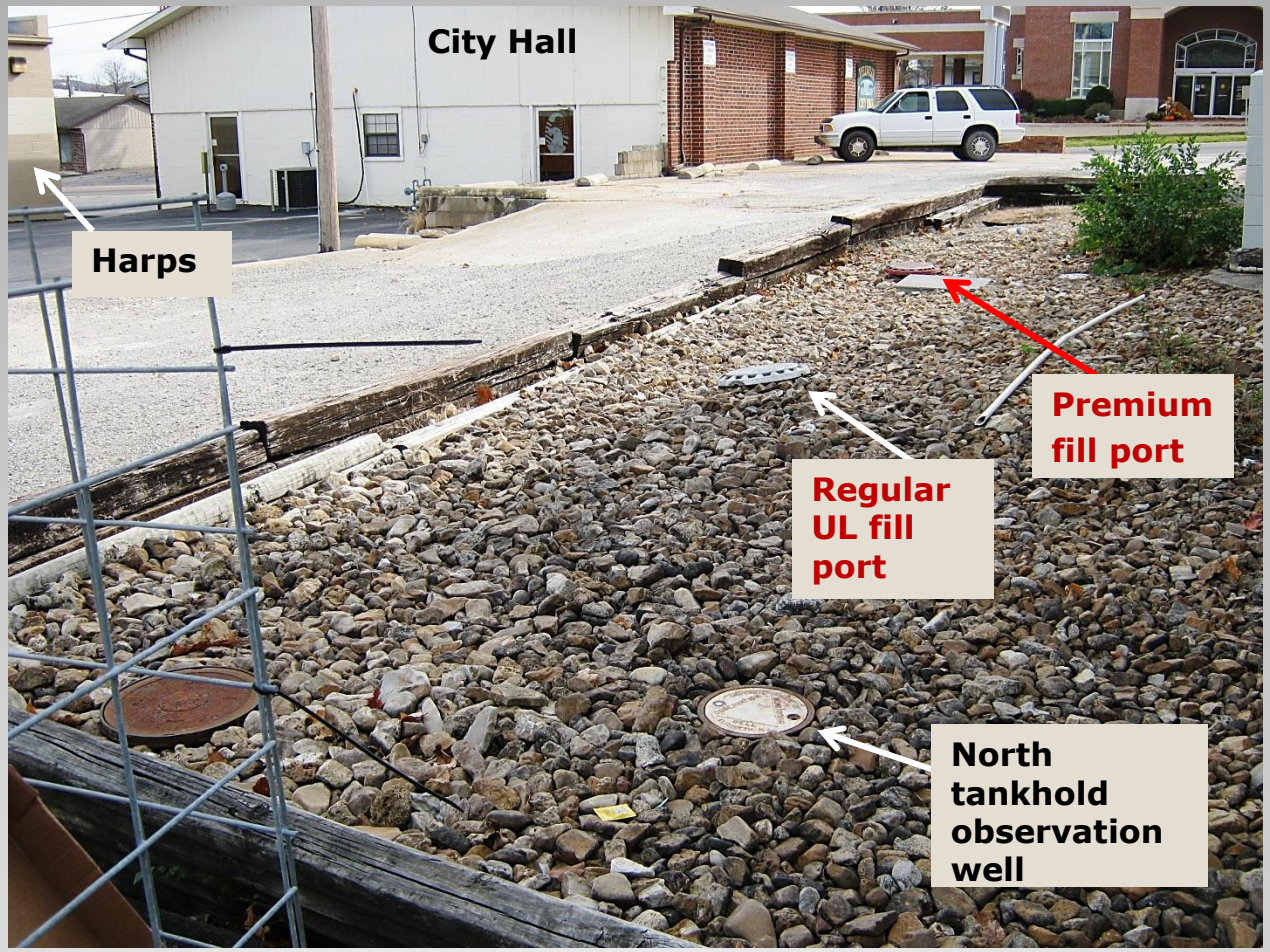

UST tankhold at White Oak #3, November 13, 2011. Note lack of an impermeable cover over gravel backfill.

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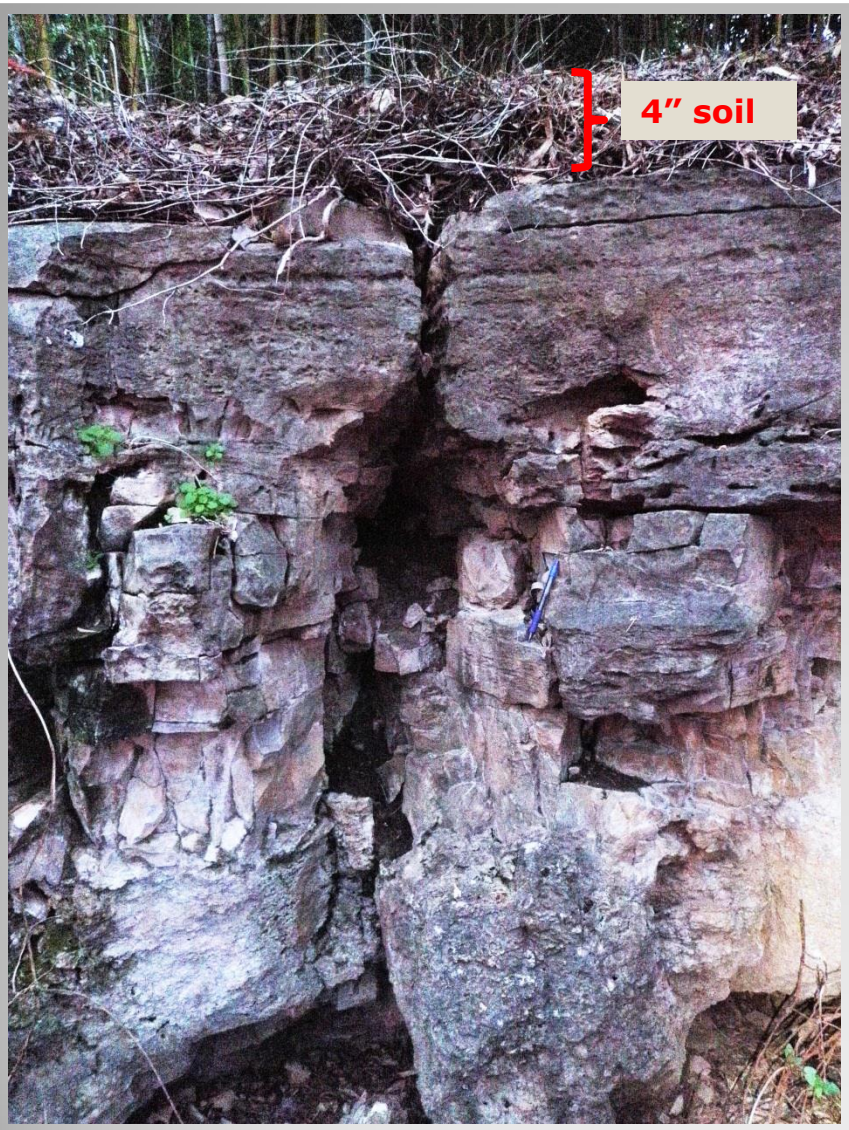

“Karst” bedrock exposure in Lower Ordovician Cotter Dolomite Formation, Yellville, AR.

Location is at top of a bluff, 600 feet south of White Oak #3 site. Dissolution of carbonate bedrock has occurred along vertical fractures and horizontal bedding planes.

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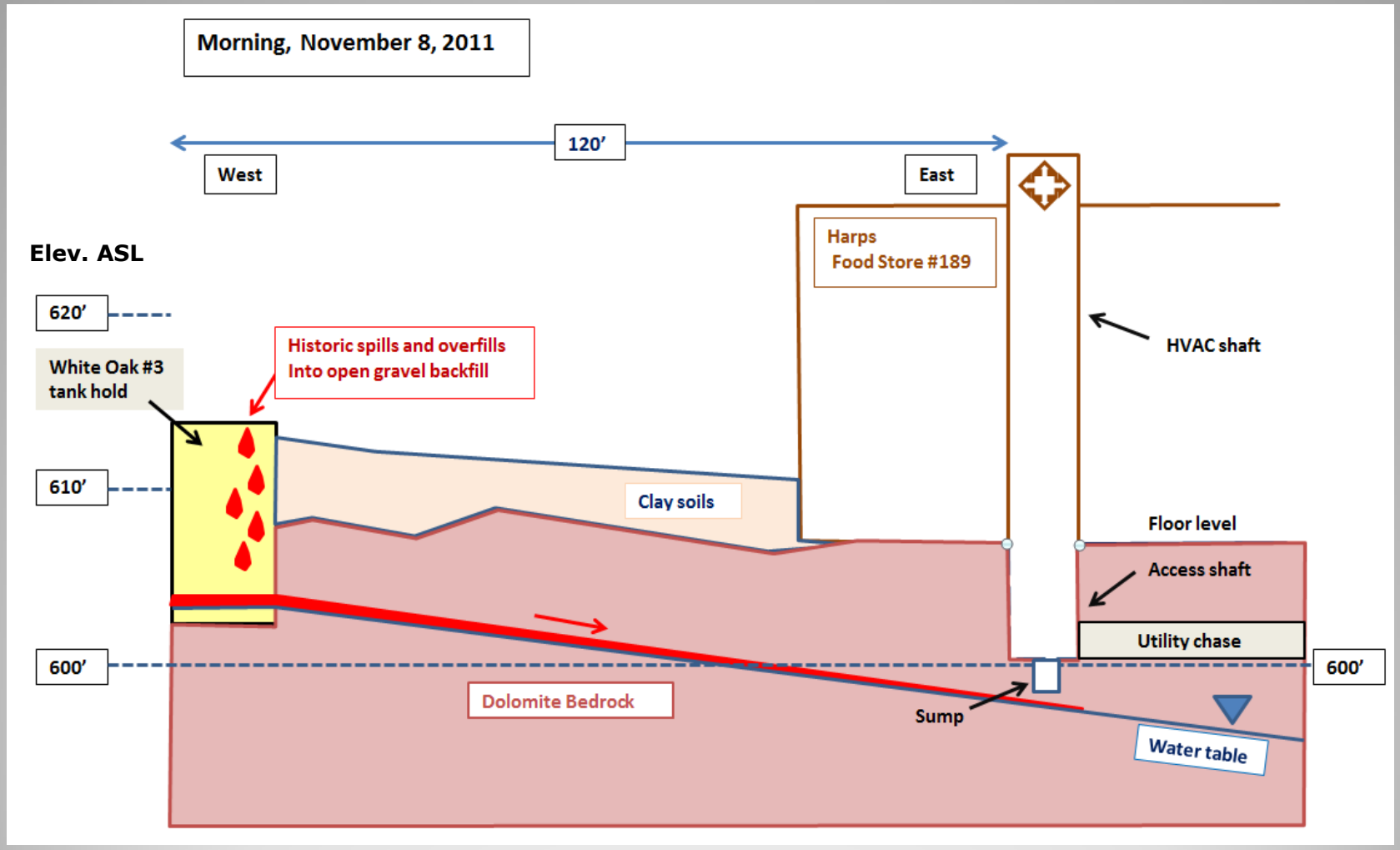

Site conditions prior to vapor impact at Harps Food Store, November 8, 2011

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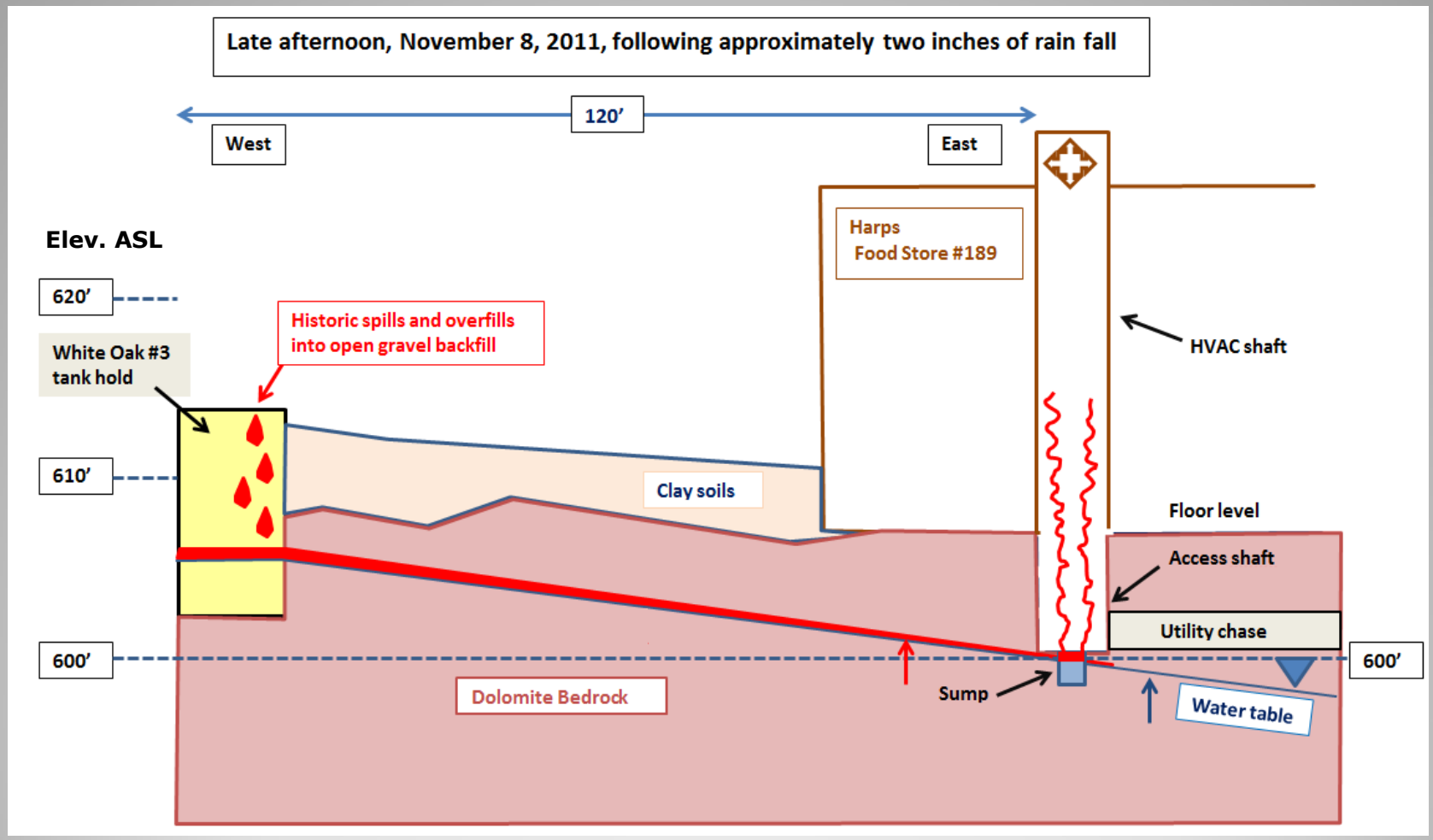

Site conditions following water table rise and vapor impact at Harps Food Store, November 8, 2011

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LUST release response by Harps Food Stores and contractors:

1) Within 12 hours of the initial vapor impact, environmental firms hired by Harps had begun ventilation of the building and pumping of free product and contaminated water from the sump. Approximately 1,200 gallons of liquid (mostly water) were recovered from the sump.

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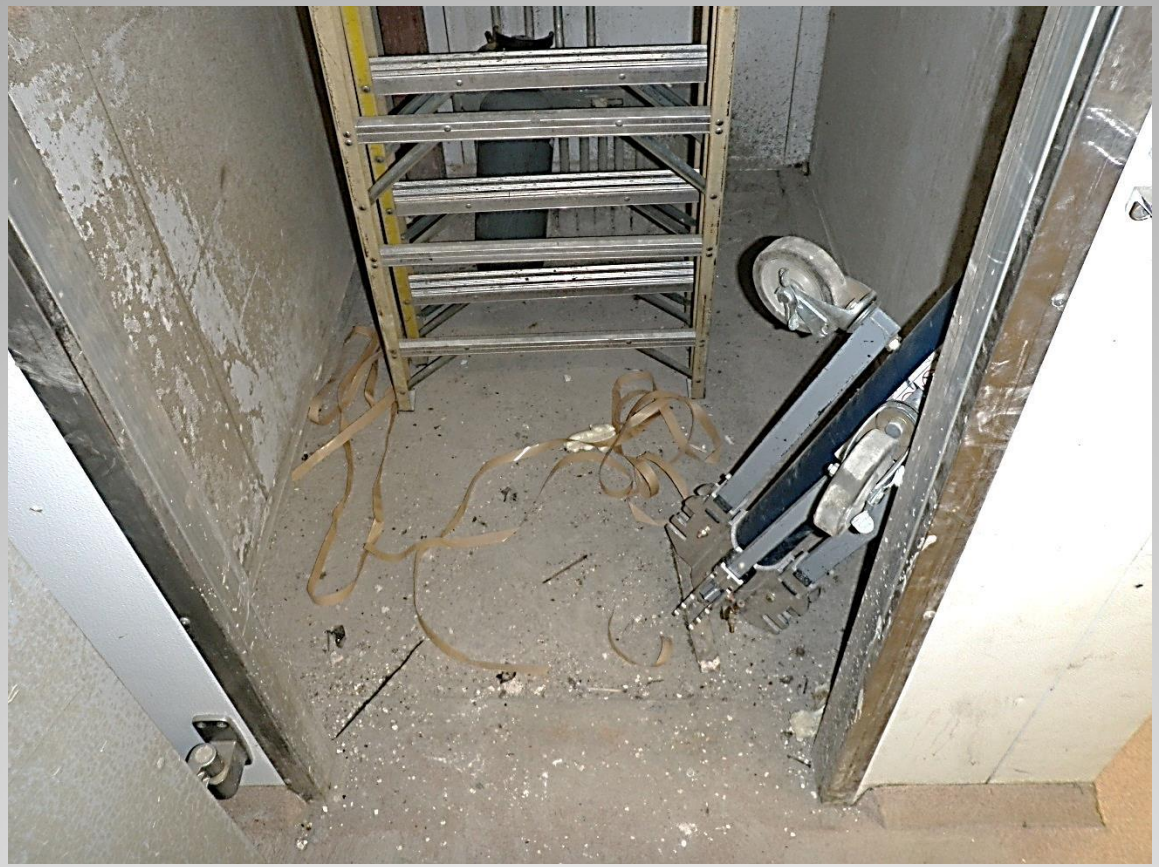

LUST response by Harps Food Stores and contractors:

2) On 11/14/11, Harps plugged the ground water sump and adjacent utility chase with approximately 90 yards of concrete, effectively eliminating the acute vapor impact.

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After re-stocking the shelves and completing utility repairs and replacement, Harps #189 re-opened on the morning of November 21, 2011.

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MW-1 – 2.53’ free product by interface probe on 11/21/11

LUST response by the Responsible Party (Petromark, Inc.) and contractor (Jones Environmental, Inc.) during November, 2011 consisted of the drilling of three groundwater monitoring wells at the White Oak #3 site and the recovery of free product from the UST tankhold and the three new wells, through bailing and Mobile Dual Phase Extraction.

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Vacuum extraction from monitoring well MW-1 during 11/21/11 MDPE event

An 8-hour Mobile Dual Phase Extraction event on November 21, 2011 recovered 300 gallons of free product, 2,052 gallons of dissolved-phase contaminated water and approximately 47 gallons of vapor equivalent gasoline.

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Drilling MW-15,
January, 2012

LUST response since 2011 has included the drilling of 33 additional groundwater monitoring wells, with quarterly sampling, and the performance of 14 additional MDPE events. A surface stream down-gradient from the LUST site has also been sampled quarterly and a sub-slab vapor monitoring event was performed in 2012.

MDPE #6,
March, 2012

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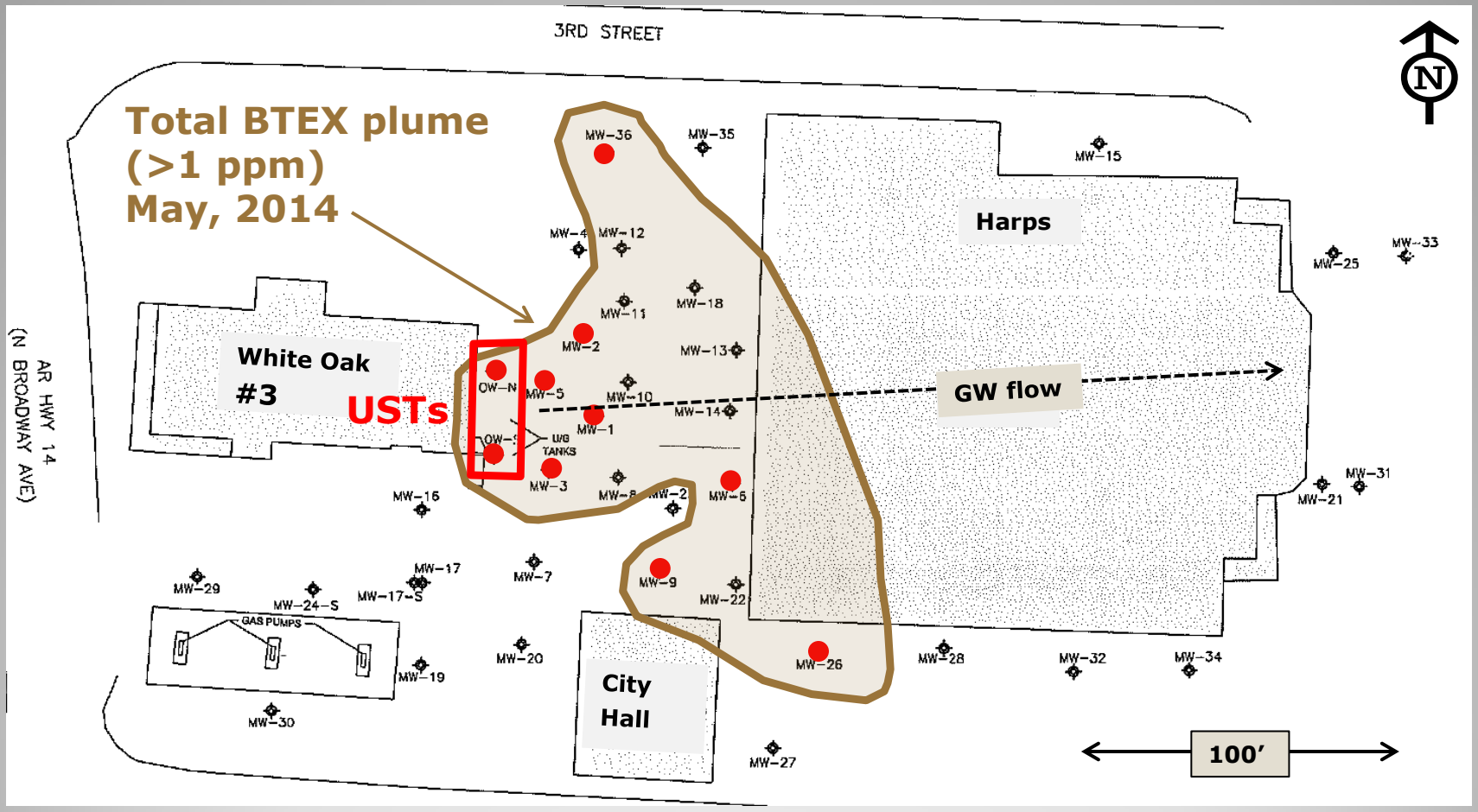

Monitoring well location map
White Oak #3 - LUST #45-0008
(All wells installed by 9/7/12)

● **- Free Product wells in bedrock aquifer**

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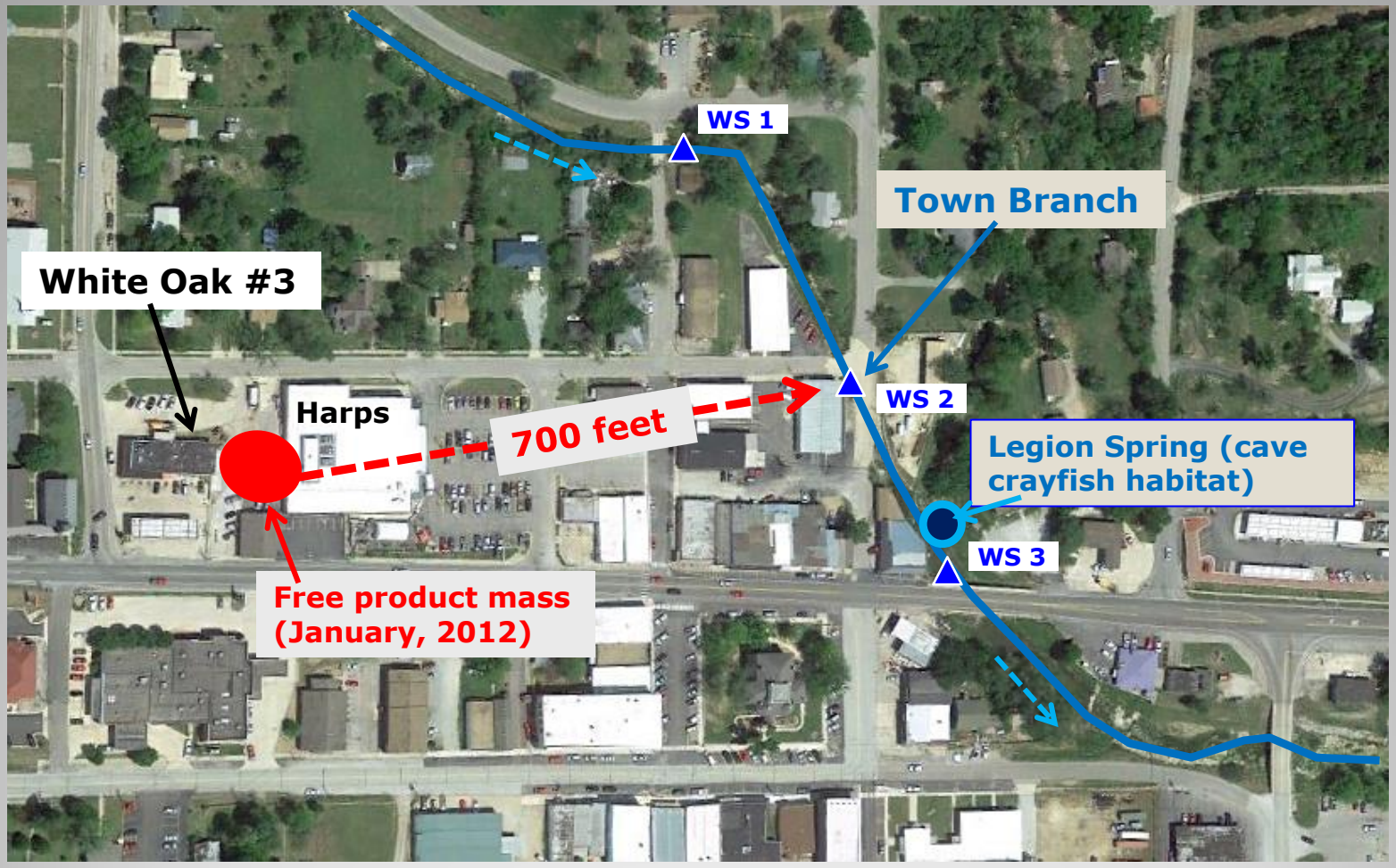

▲ Surface water sampling points along Town Branch

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Surface water samples were taken from Town Branch at three locations from September, 2012 through May, 2014.

All samples have tested "non-detect" for dissolved hydrocarbons.

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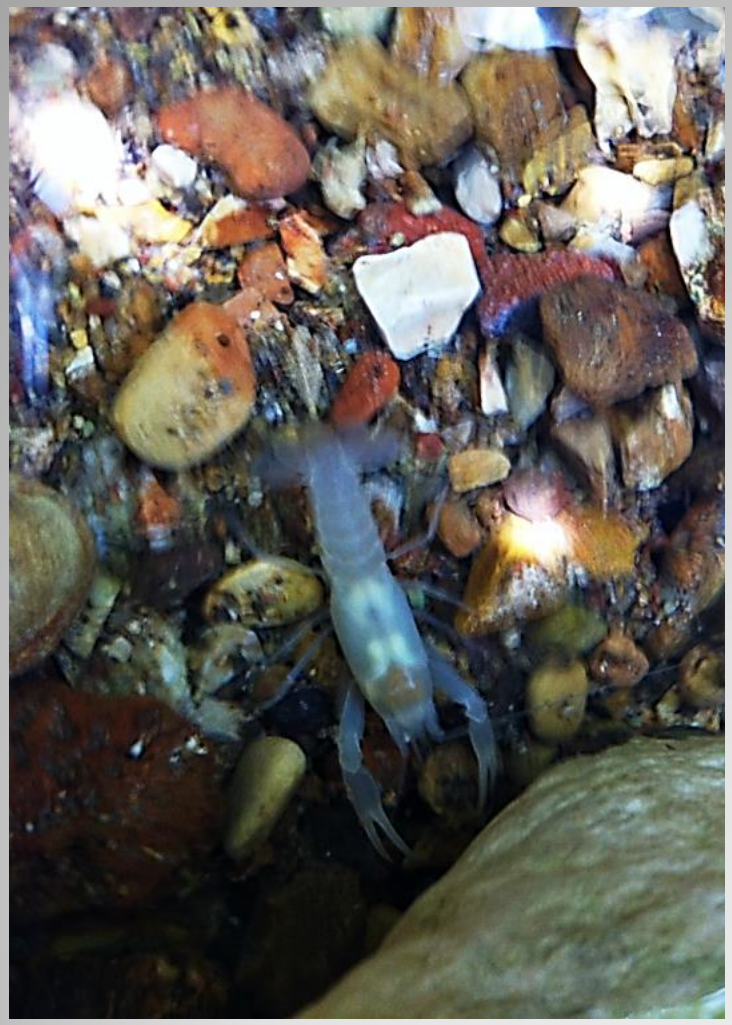

Cave crayfish (*Cambarus zophonastes*), photographed in Town Branch, immediately below Legion Spring, Yellville, Arkansas, by Ozark Underground Laboratory, April 3,2012.

***C. zophonastes* is a federally-listed endangered species and is known to exist at only two other sites in the Arkansas Ozarks. A contract study of the Legion Spring site and its recharge area (including the White Oak #3 LUST site), was conducted by Ozark Underground Laboratory in 2011-2012, on behalf of The Nature Conservancy.**

No evidence of adverse impact to the *C. zophonastes* population as a result of the White Oak #3 release has been reported.

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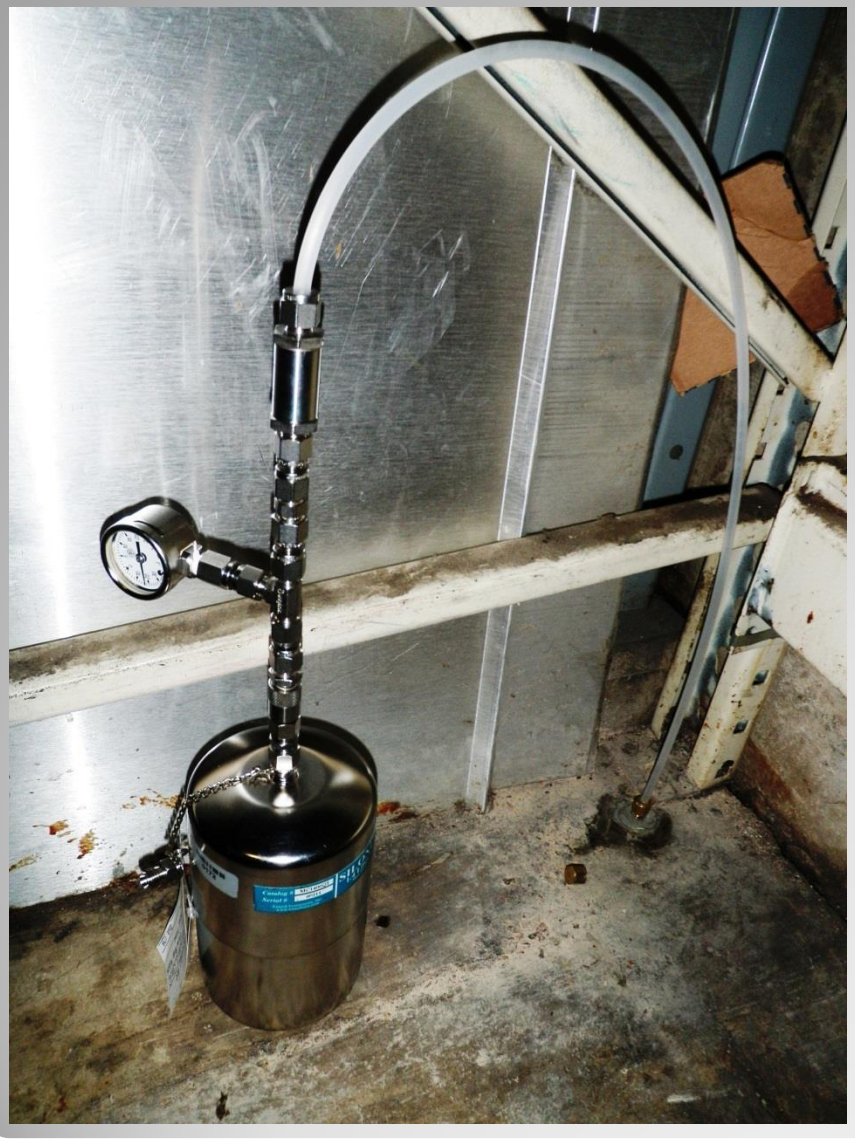

Six sub-slab vapor monitoring points were installed and sampled at the Harps store and at City Hall in September, 2012. Analyses for Benzene did not exceed the RST risk-based screening value of 49.3 ug/m^3 in any of the air samples.

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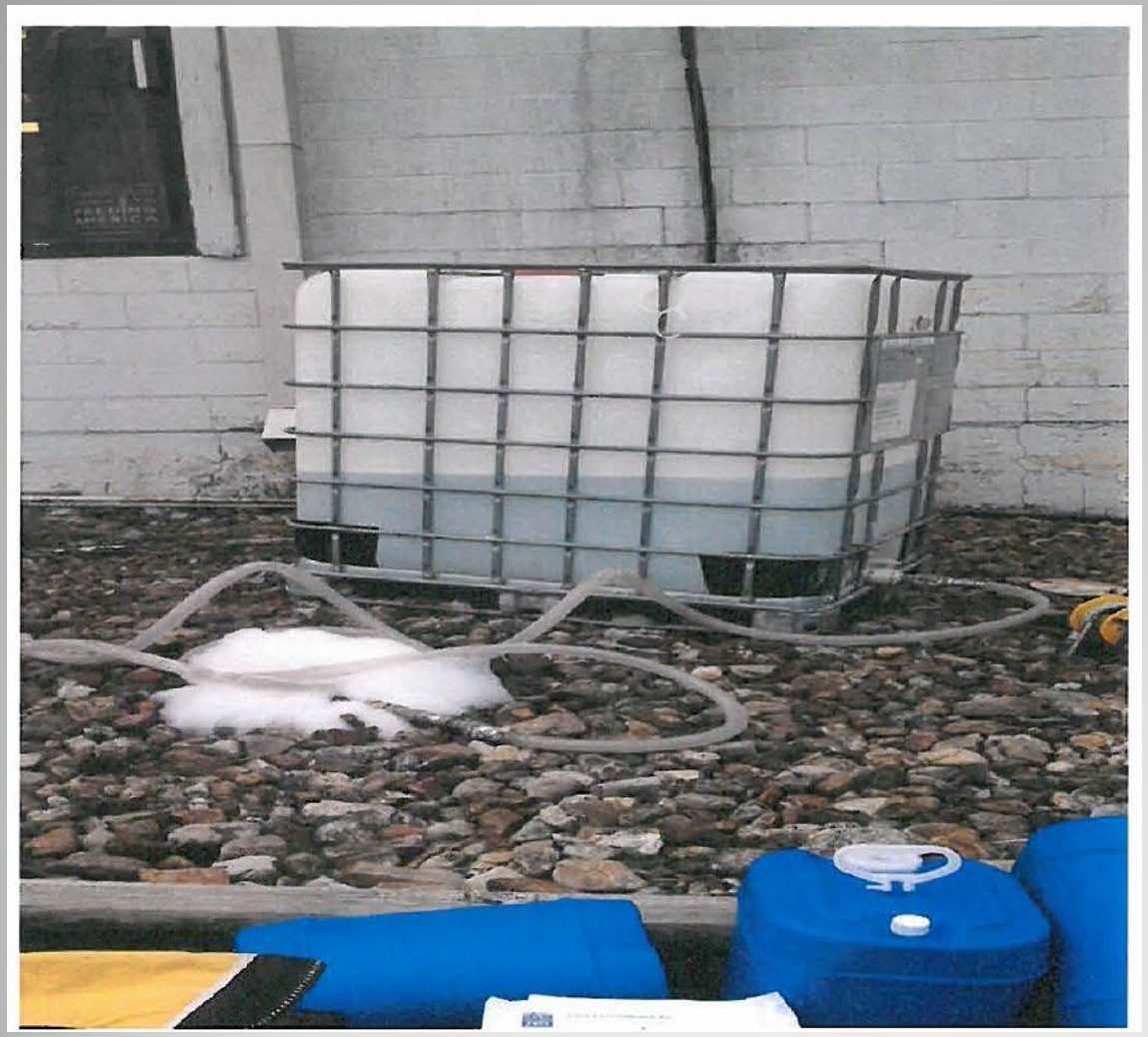

In November, 2013, the UST tankhold and four nearby monitoring wells were flushed with surfactant, in an effort to remove residual LNAPL. The spent surfactant and mobilized NAPL were then removed by vacuum extraction.

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In April, 2014, a concrete cover was installed over the UST tankhold, minimizing rain water infiltration and further flushing of residual contaminants.

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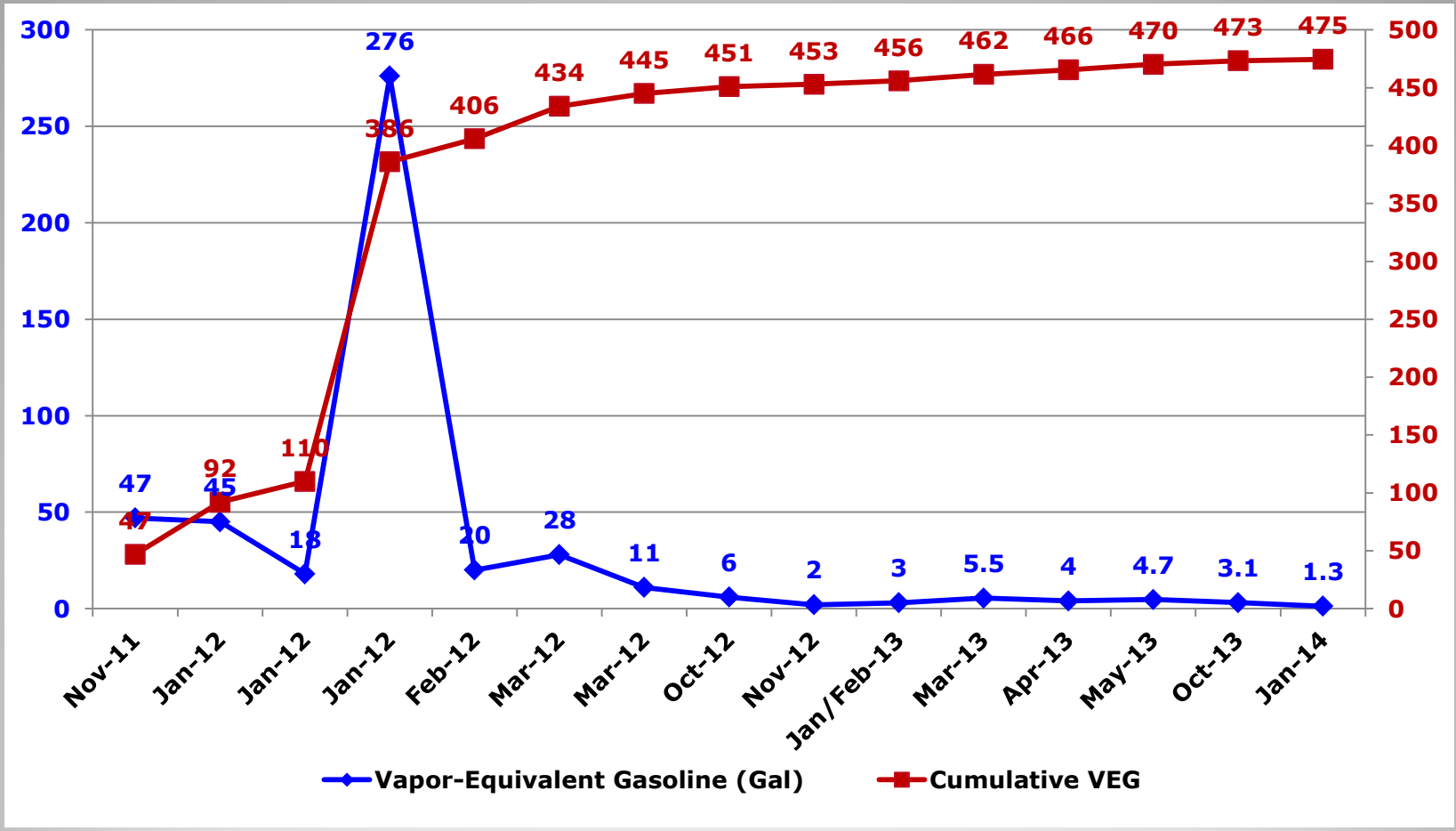
Remediation results: Free Product removal



Gasoline recovery (vapor-equivalent gallons per eight-hour event) by Mobile Dual Phase Extraction, 2011-2014

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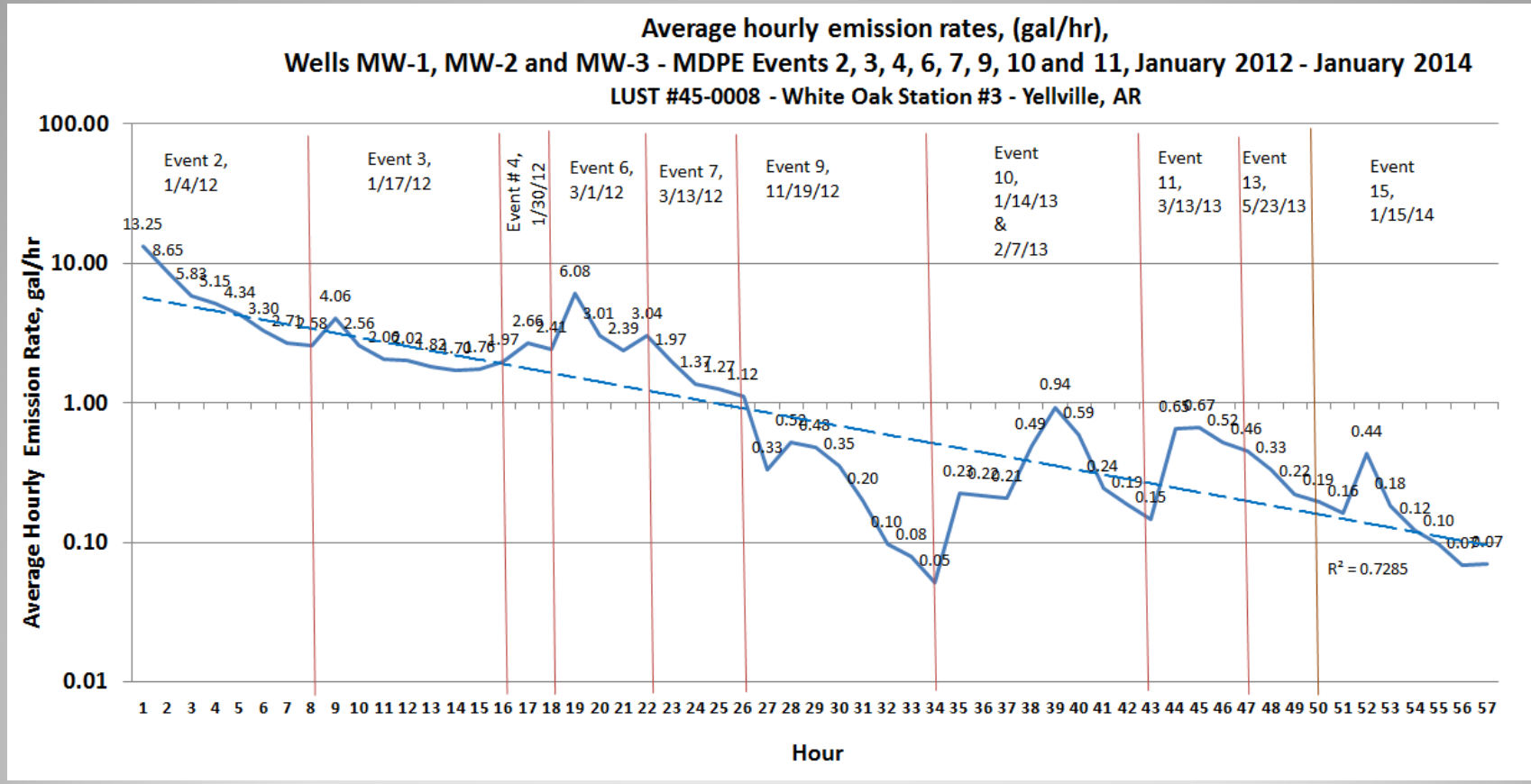
Remediation results: Free Product removal



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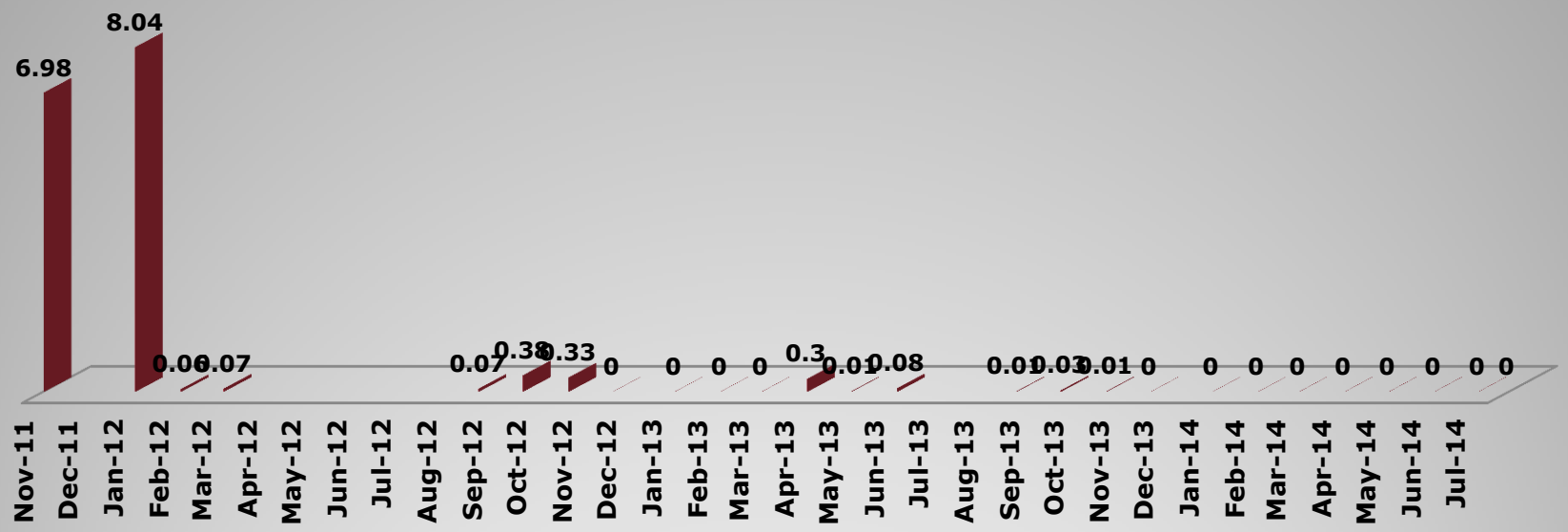
Remediation results: Free Product removal



Total Free Product thicknesses in feet (all wells), 2011-2014

White Oak Station #3 – LUST #45-0008

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Remediation results: Dissolved Phase contaminant reduction in ground water

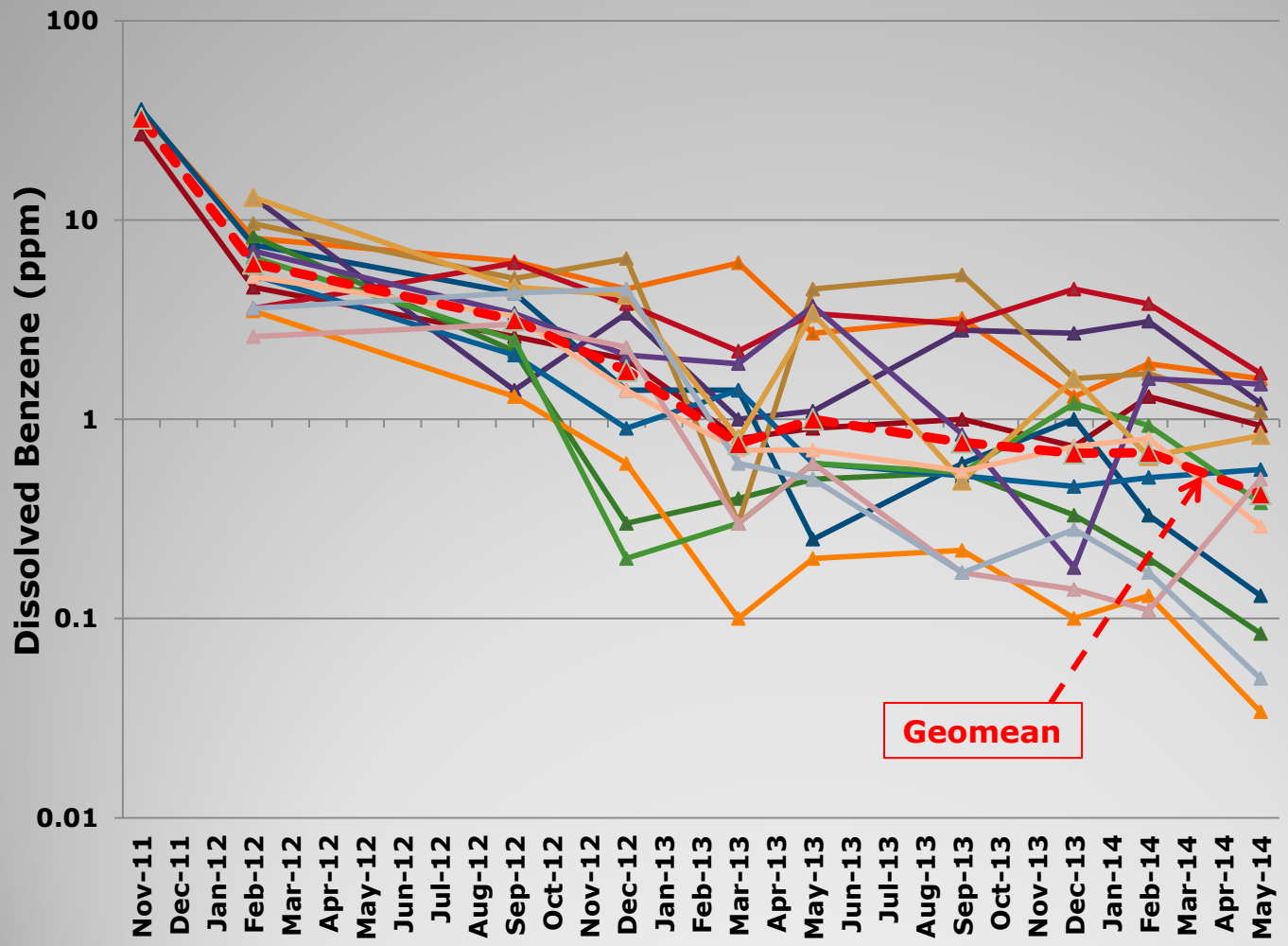

Chart depicts the reduction in dissolved Benzene in core monitoring wells at the White Oak #3 site during ten sampling events from November, 2011 through May, 2014.

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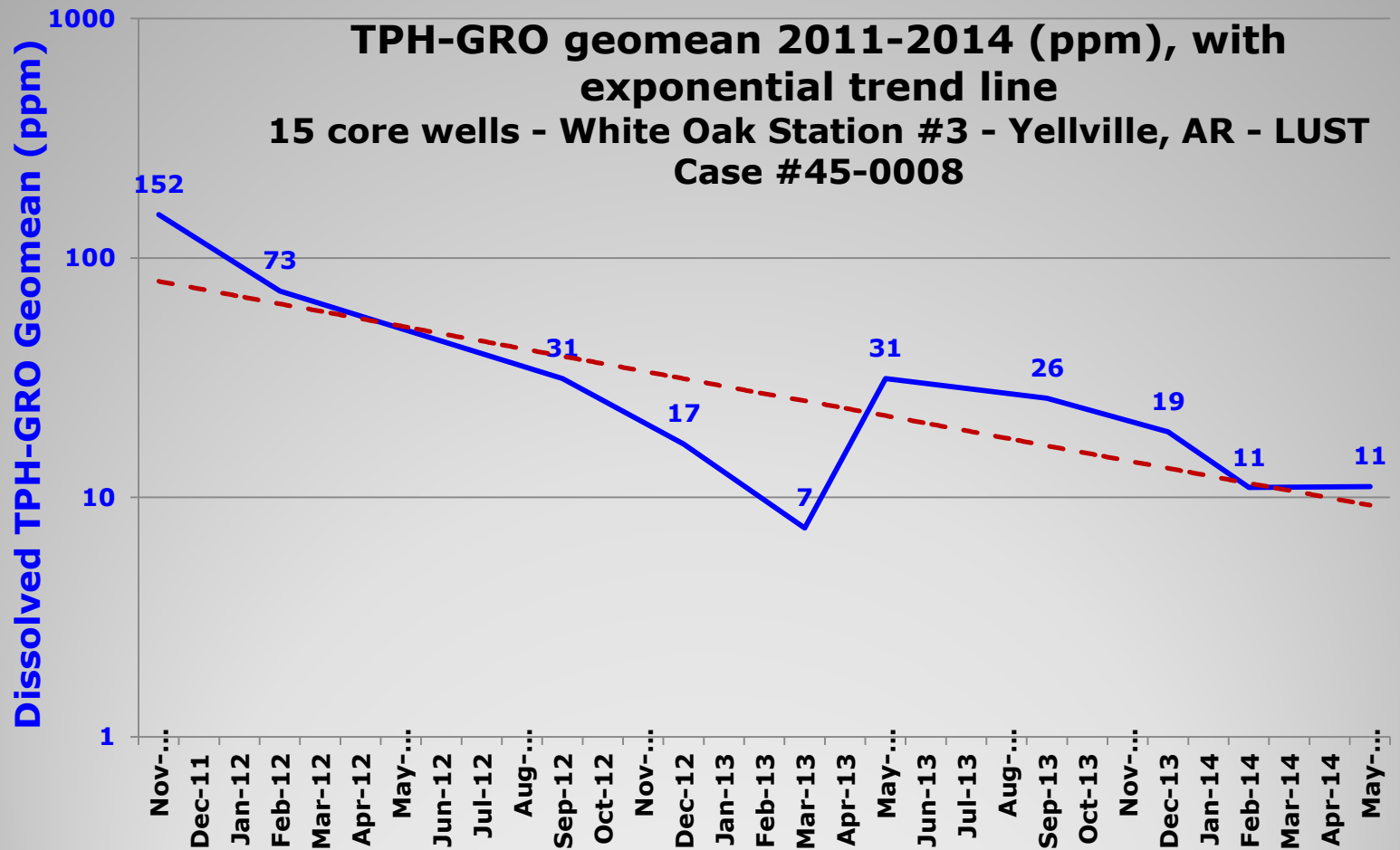
Remediation results: Dissolved Phase contaminant reduction in ground water



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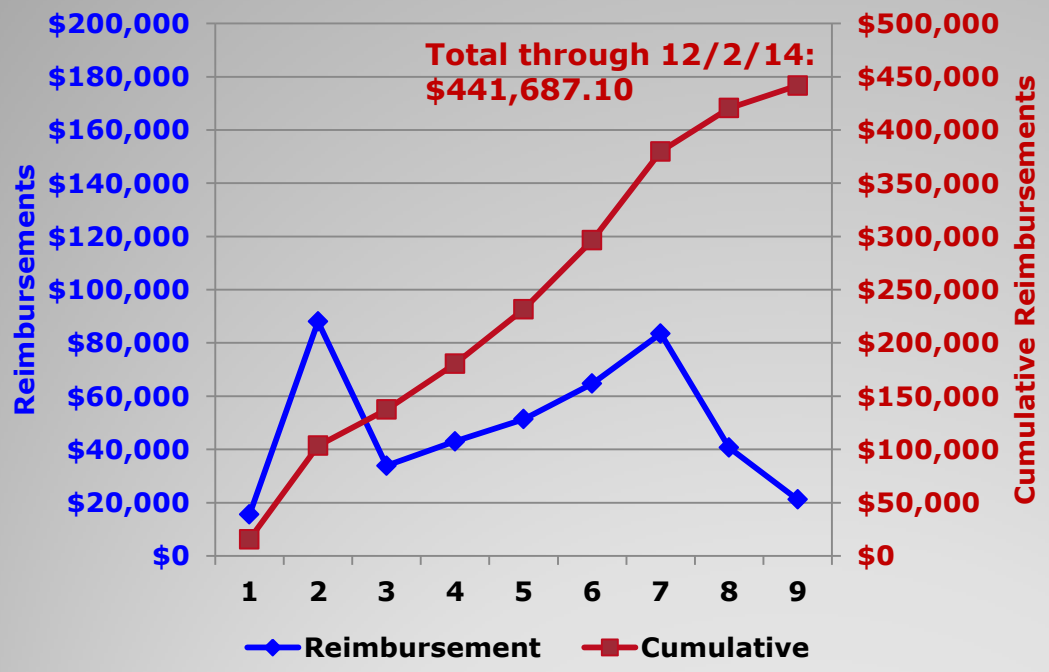
Arkansas Petroleum Storage Tank Trust Fund corrective action reimbursements:



In addition to corrective action reimbursements, the Arkansas Petroleum Storage Tank Trust Fund has issued a payment in the amount of $992,500 to partially settle a damages claim by Harps Food Stores against the RP for LUST case #45-0008 (February 3, 2013).

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LUST Case #45-0008 recap:

- **As at many similar vapor intrusion sites, acute impact was eliminated by identifying the point at which vapors were entering the structure and sealing off that point.**
- **Corrective action in karst – achieved through the drilling of a grid of closely-spaced wells, as soon as possible after release discovery, with concurrent and extended aggressive NAPL recovery by dual phase extraction.**
- **Site was monitored closely to assess the potential for chronic human health and ecological impacts, and to document "free product recovery to the maximum extent practicable".**

Administrative closure of LUST Case #45-0008 is anticipated later in 2015.

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