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Effective Treatment of a CVOC Plume Beneath and Active Manufacturing Facility Using Deep Horizontal Wells



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CH2M is now Jacobs

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Agenda

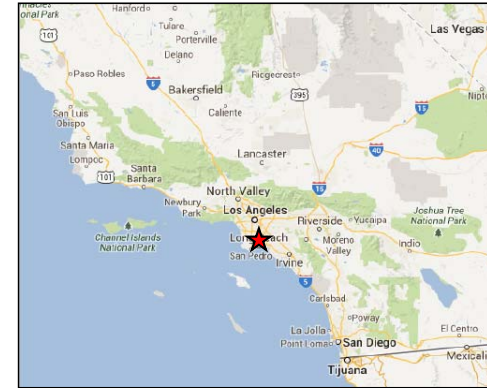
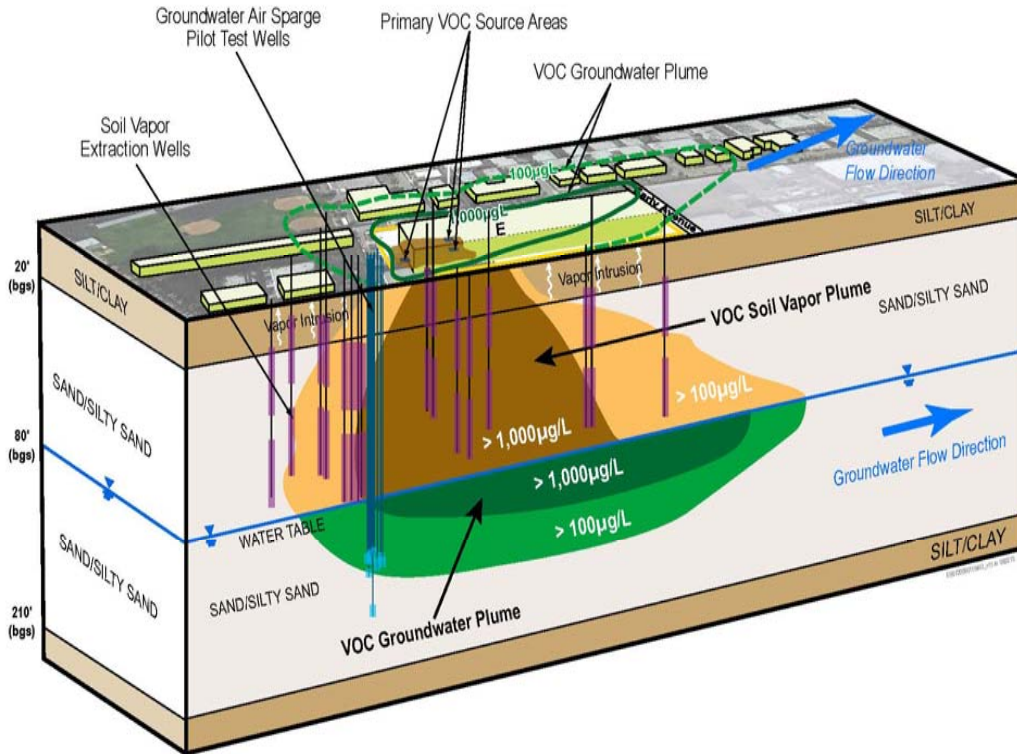


- Site Background and Conceptual Model
- Directional Drilling Methodology
- Results and Discussion

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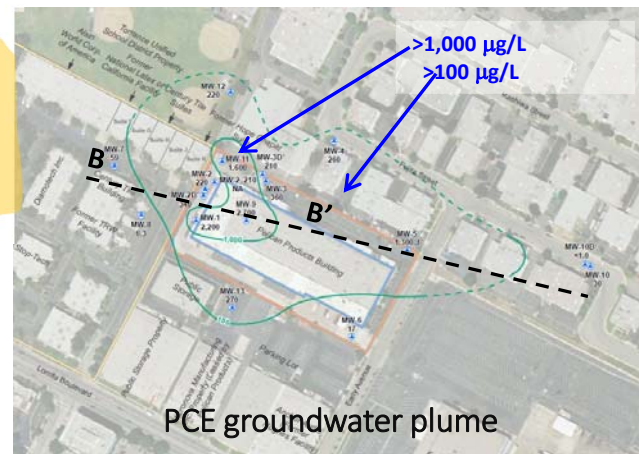
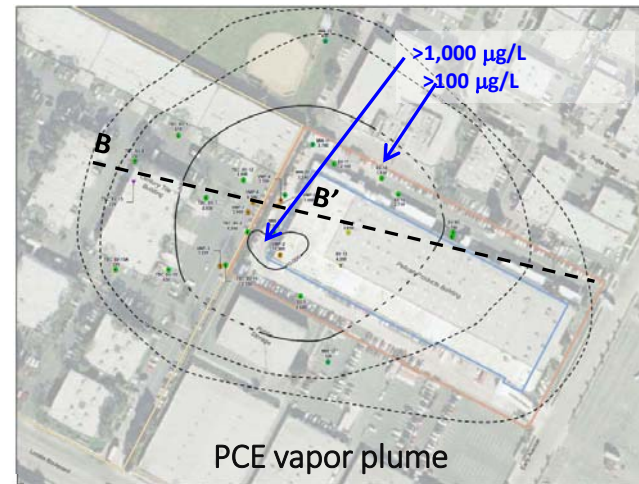
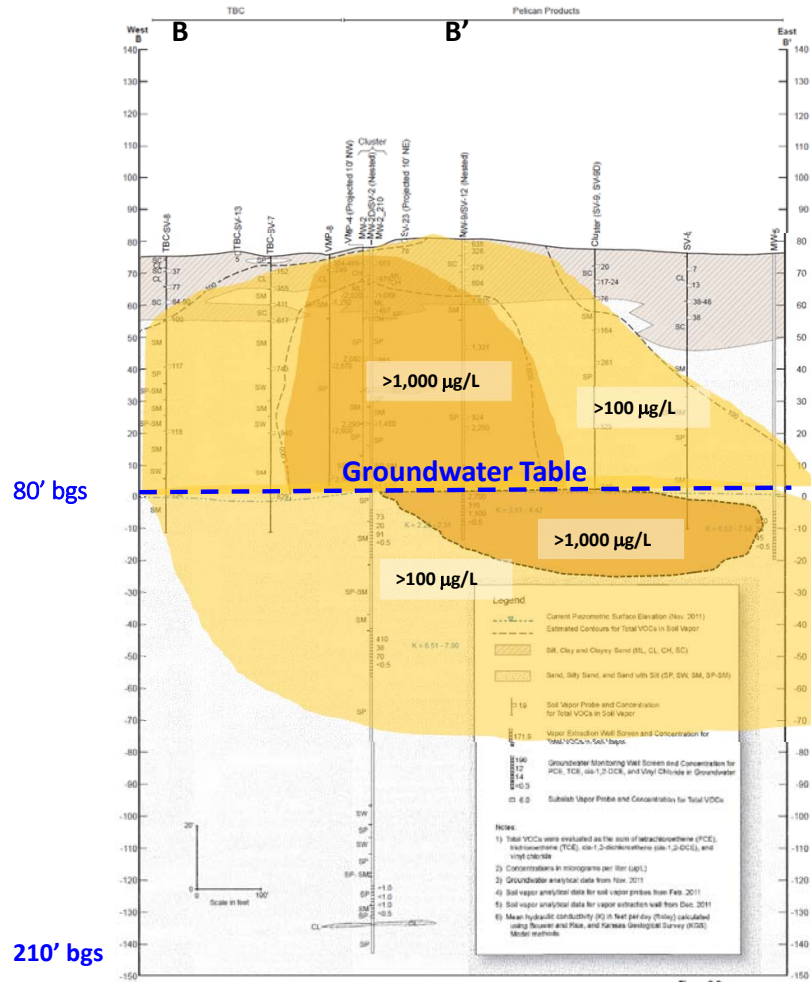
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Site Background and Conceptual Model

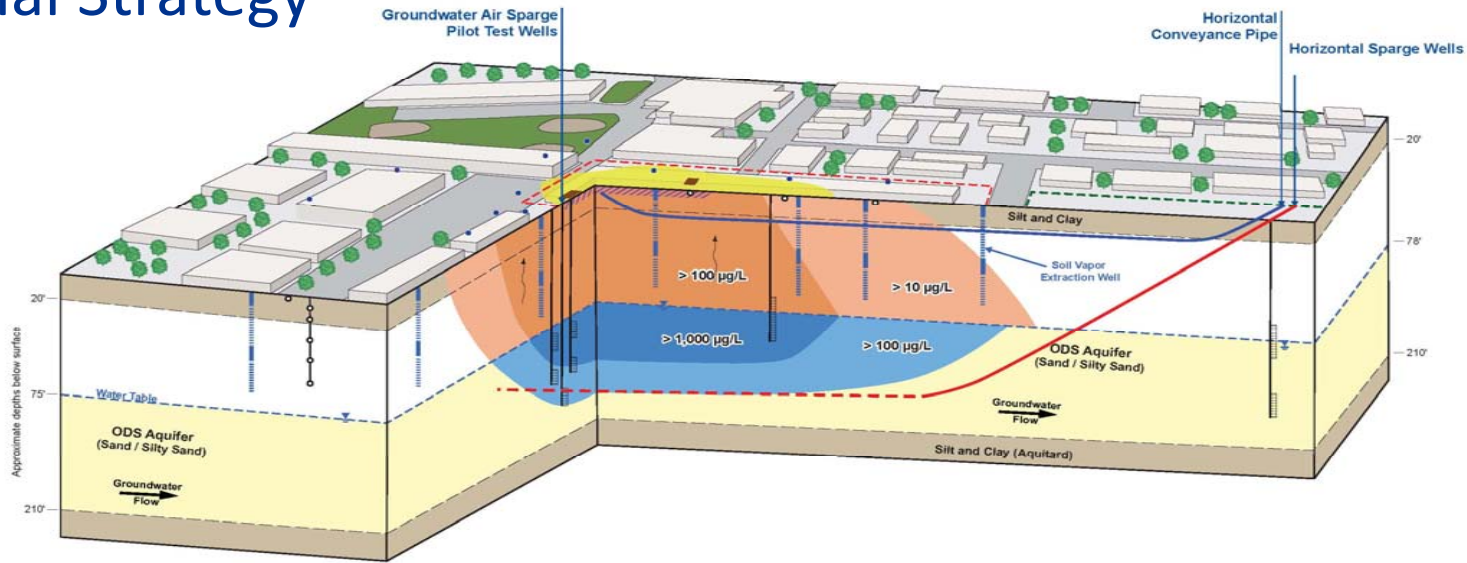


- **Site Description:** 5-acres, mixed commercial/industrial. Plume underlies 109,000 ft² manufacturing facility which operates 24/7
- **COCs:** Primarily PCE, with some TCE. Target 1,000 ug/L VOC plume extends 25 ft below water table. Depth to water 75-80 ft bgs
- **Geology:** Fine sand with interbedded layers of dense silty sand

Example Plume Cross Section (VOCs, primarily PCE)

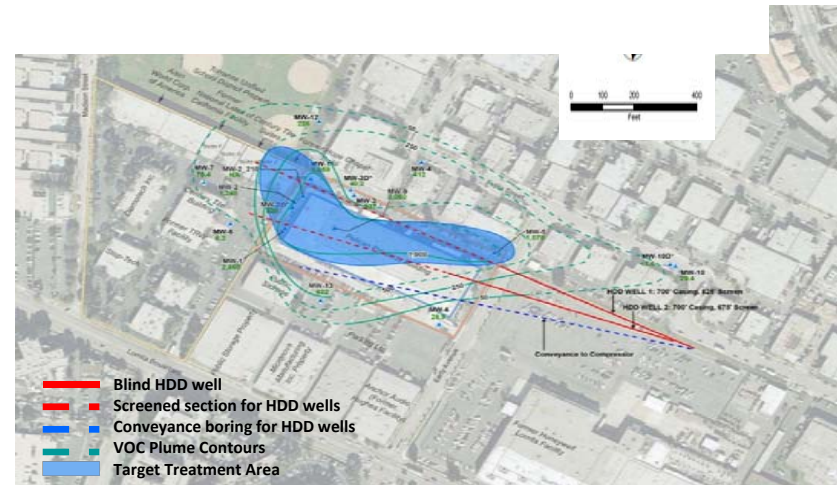


Remedial Strategy



Vadose zone: 14 multi-depth SVE wells
(installed early 2014)

Saturated zone: 2 horizontal AS wells ~ 130
ft bgs (installed late 2015)

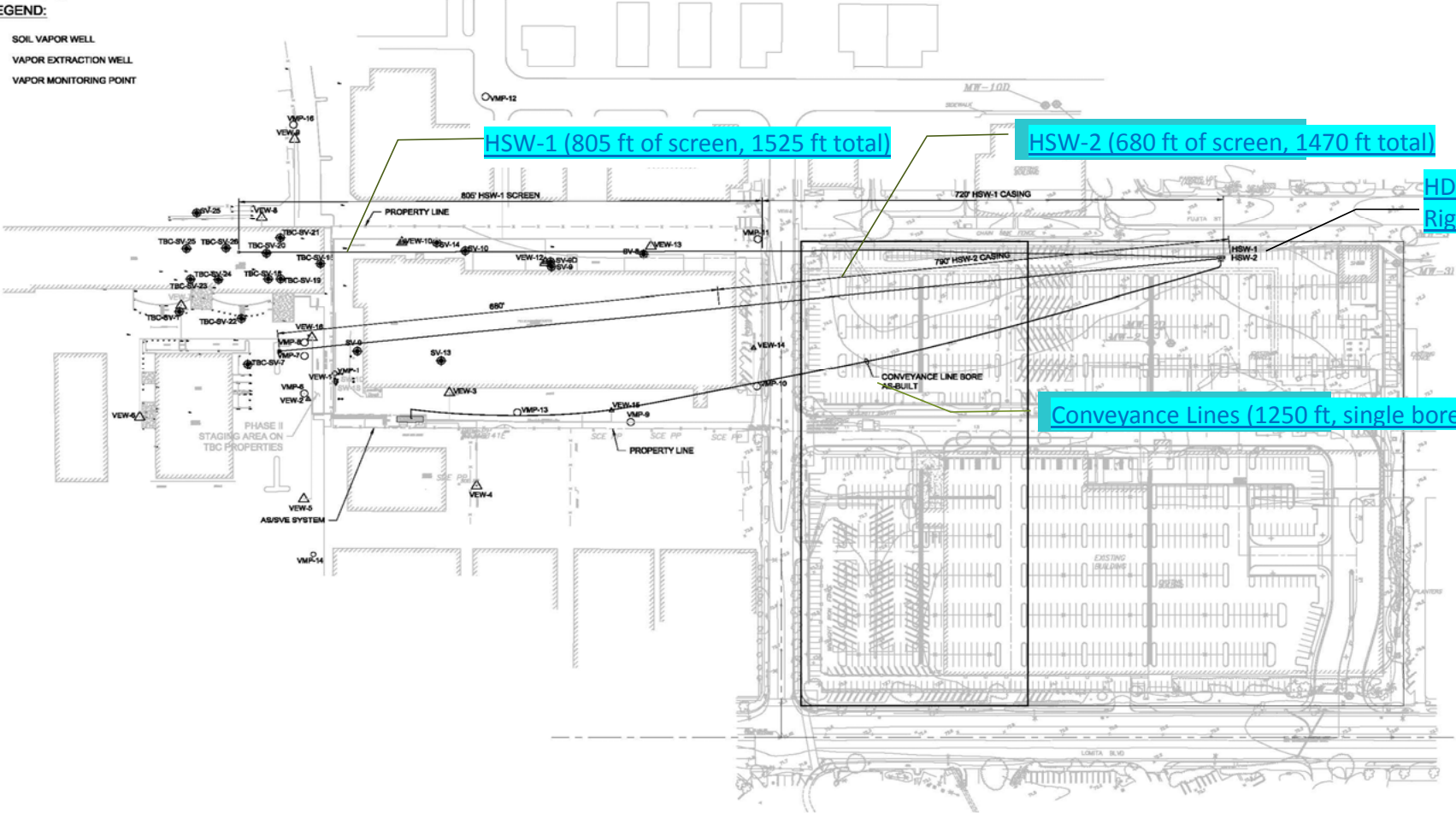


Site Plan



LEGEND:

- SOIL VAPOR WELL
- △ VAPOR EXTRACTION WELL
- VAPOR MONITORING POINT



HSW-1 (805 ft of screen, 1525 ft total)

HSW-2 (680 ft of screen, 1470 ft total)

HDD
Rig Staging Area

Conveyance Lines (1250 ft, single bore)

Directional Drilling



90,000# Drill Rig

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Blind Well Installation Methodology

- Blind wells > 800 ft in sands generally require a cased well installation methodology, which shields well materials from partial borehole collapse/pipe seizure.
- DTD (directional driller) developed a method Jacobs has successfully implemented on multiple sites. This technique uses oversized drill rods with an expendable, de-latching drill bit that remains in the formation.
- Once pilot bore is drilled (Phase 1), the well materials are inserted inside the drill rods and used to de-latch or “knock off” the drill head. The drill rods are subsequently extracted, leaving the well materials in place.



Two phase directional drilling program Gyro steering tool and walkover navigation

Gyroscopic Steering Tool (GST)

- Wireline powered
- Accuracy and precision equal to or superior to other wireline methods
- Surface access above borepath not required
- Not subject to electromagnetic interference
- Unlimited depth

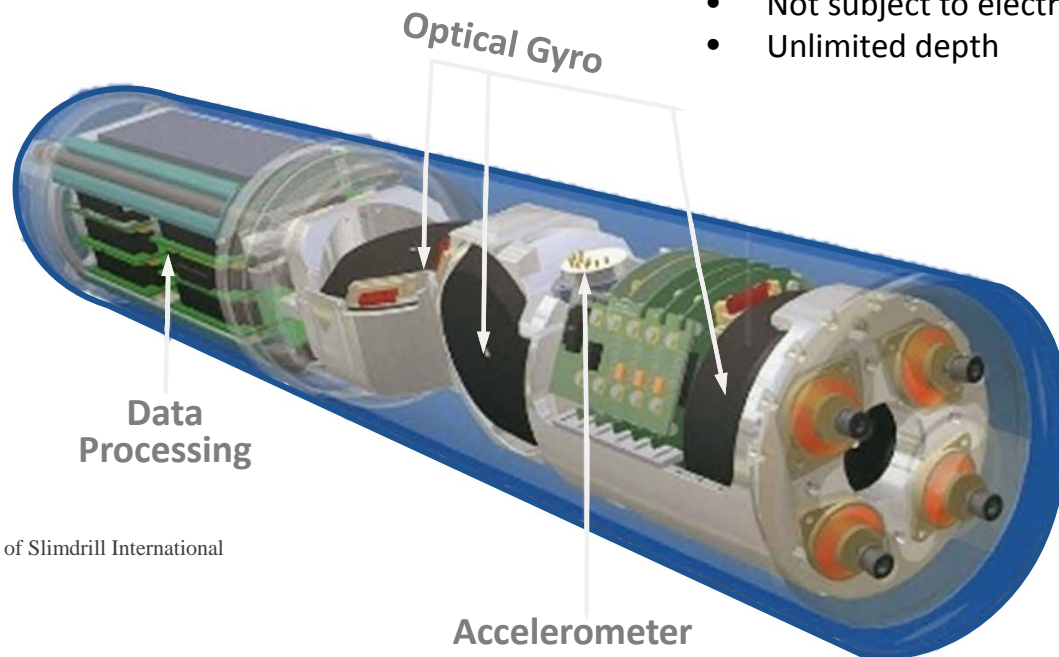


Diagram courtesy of Slimdrill International



Source: Directed Technologies Drilling, Inc.

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Directional Drilling

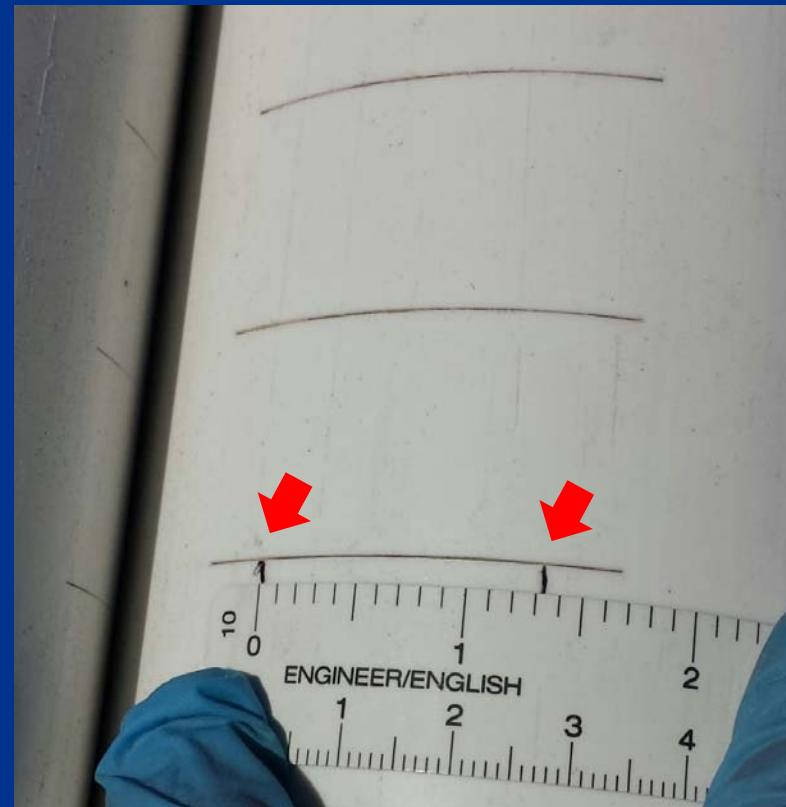
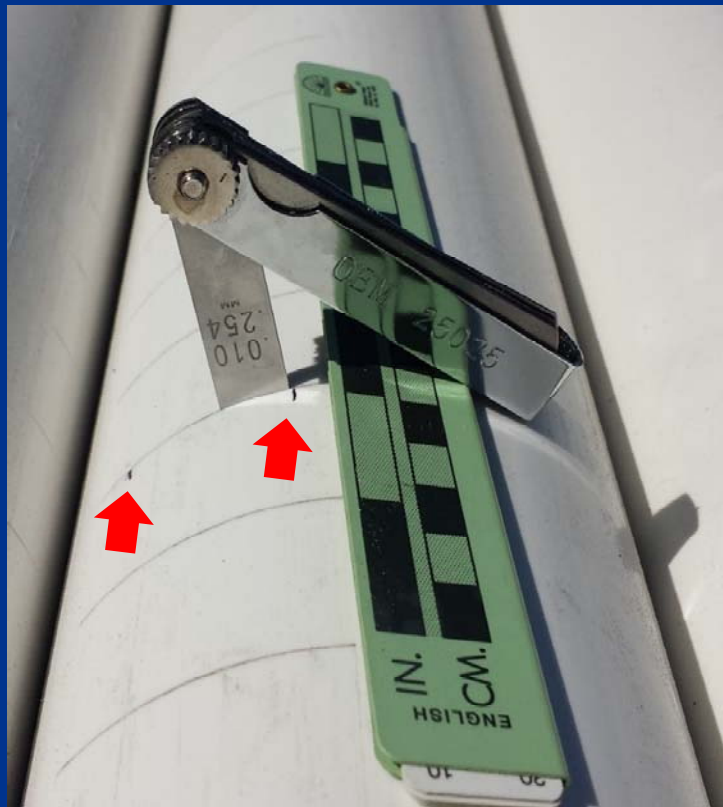


Installing PVC
Casing and Screen

Completed Access Vault
(both AS wellheads)



Well Screen Quality Control Checks (Open Area ~ 0.13%, Slot Width 0.012", Inside Length 1.3")





Containerized Air Sparge System



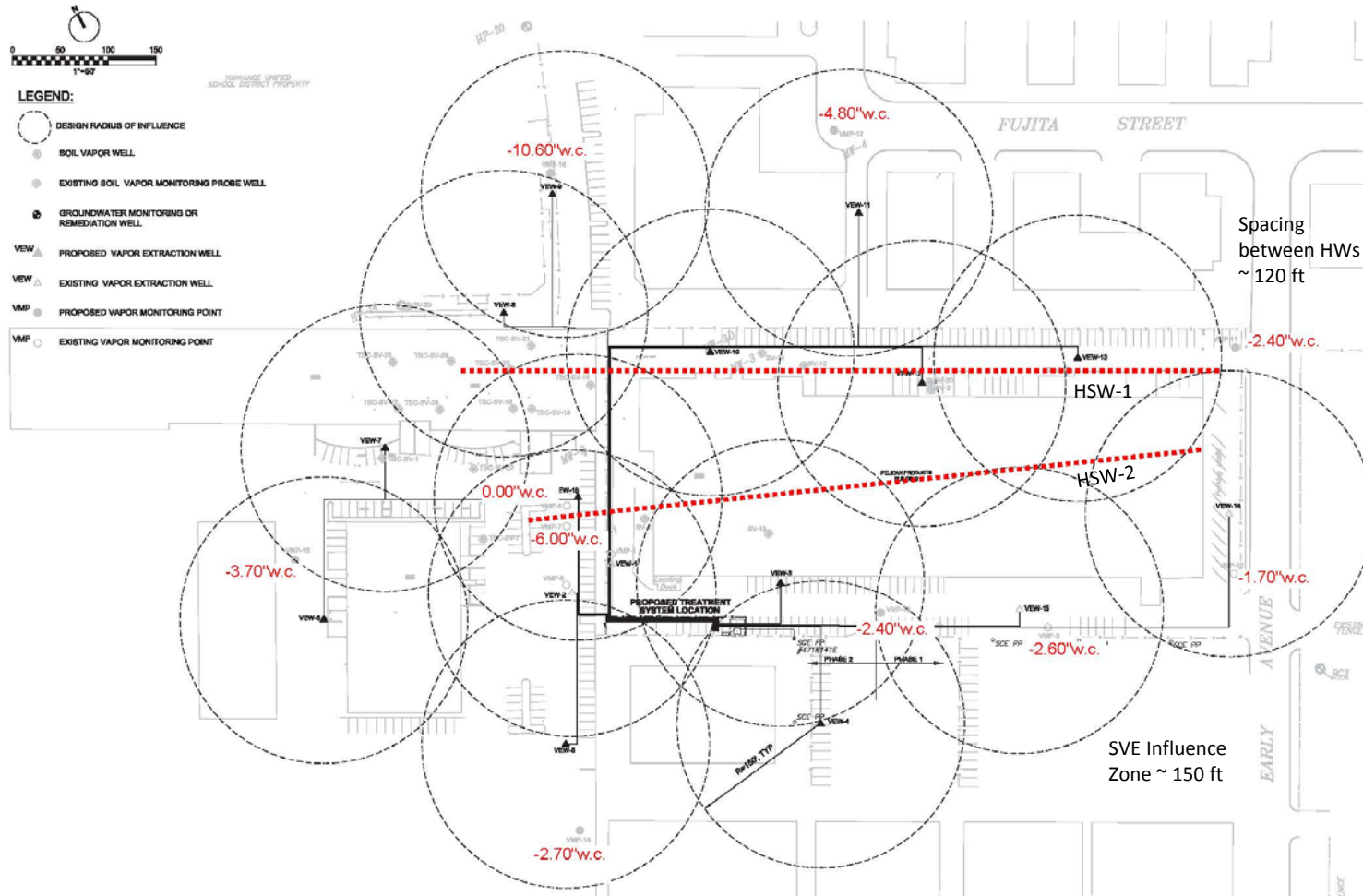
Soil Vapor Extraction System



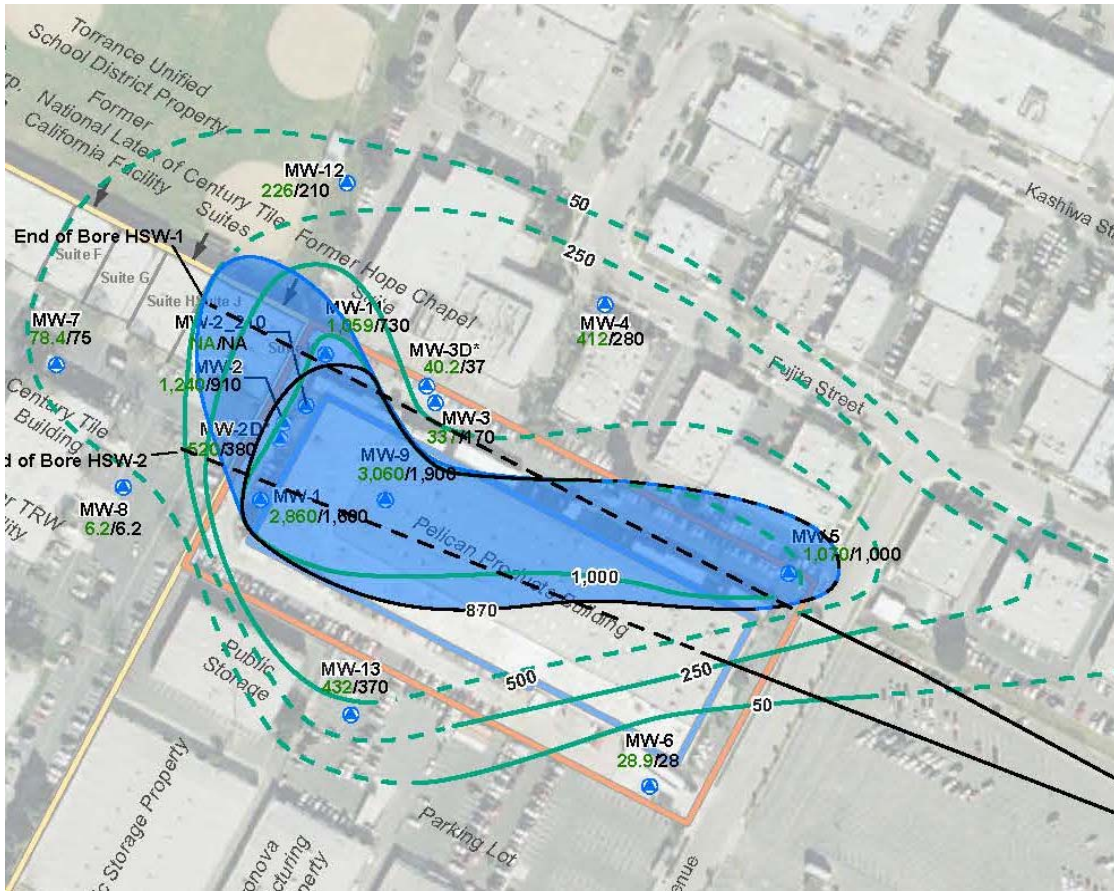
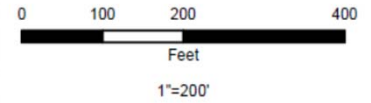
Operating Parameters

- Total SVE flowrate = 1200 cfm
~ 120 cfm per well
- Three positive displacement blowers
- Spurge flowrate = 1000 cfm @ 45 psi,
0.8-1.0 cfm/ft of well
- “Wave” pulsing (~150 in one well, ~700
in the other)
- Single 200 hp rotary screw compressor

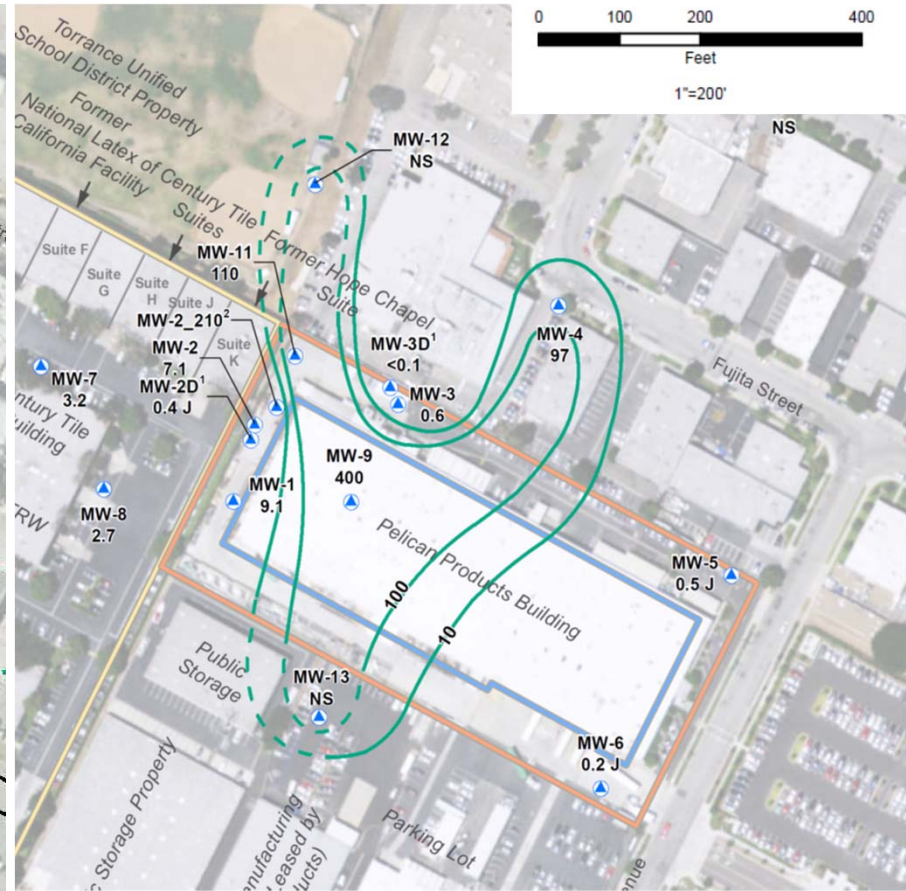
Site Plan with SVE Influence Zones



Remedial Action Status



May 2015



January 2016
to July 2017



Conclusions

Blind end HDD at these distances/depths requires GST navigation and specialized well installation methods

Low impact to site (one access vault), access to plume under active manufacturing facility

Low maintenance compressed air system

Estimated influence zone, based on PCE and TCE reductions, estimated to be ~70+ ft on both sides of the wells

Objectives largely achieved after two years within ZOI ,except MW-9

Delayed response at MW-9 appears related to geology

Based on dissolved oxygen monitoring, pulsed operation improves air distribution

Thank you!

Mark Strong, Jacobs

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