Tales of Alhambra: Vapor Intrusion

By Lenny Siegel
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Beginning in the 13th Century Moorish Sultans built the Alhambra Palace in Granada Spain, celebrating the abundance of water with fountains, cascades, and reflecting pools. Like other communities in the San Gabriel Valley, Alhambra, California, an inland suburb of Los Angeles, is known for its contaminated groundwater.

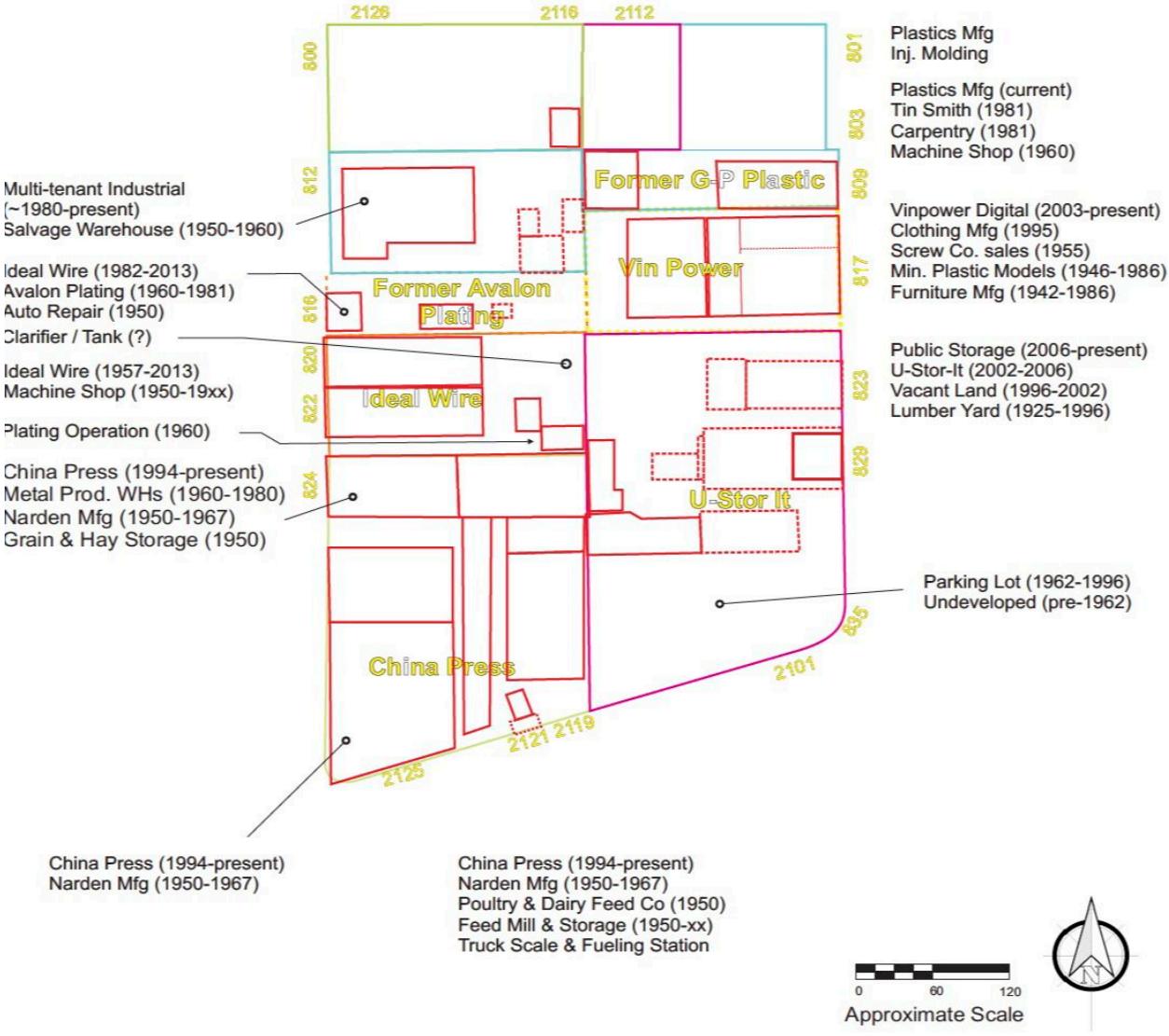
In some ways Alhambra resembles my community of Mountain View. Both are industrial suburbs of about 80,000 residents. They both are rife with subsurface contamination, solvents such as trichloroethylene (TCE) and tetrachloroethylene (PCE) from post-World War II industrial expansion. Both are experiencing significant redevelopment of contaminated properties. And reputedly, both have many good restaurants.

But there are important differences. The water table in industrial Alhambra is much deeper. In Alhambra, the regulation of subsurface investigation and remediation is fragmented; in Mountain View it is more centralized. While Alhambra operates a treatment system to treat groundwater so it meets drinking water standards, city officials are only just beginning to become aware of the threat of vapor intrusion. Alhambra has no program for informing the public on vapor intrusion and water contamination. Mountain View, on the other hand, is a national model for public oversight and for local partnering with regulators to protect building occupants from vapor intrusion.

International Extrusion site on Meridian Ave., awaiting redevelopment, from northwest

Fragmented Oversight

Back in the 1980s, U.S. EPA placed much of the San Gabriel Valley on the "Superfund" National Priorities List. While in nearby South El Monte, U.S. EPA is leading a vapor intrusion investigation, in most of the western Valley, known as Area 3—including Alhambra—EPA focuses its oversight and action to the groundwater. EPA has identified 31 properties where groundwater contamination likely originated, dividing them into three operable units within Area 3. All of the twelve facilities that have installed monitoring wells have detected chlorinated volatile organic compounds (CVOCs) above drinking water standards. The largest cluster of potential source facilities is in Alhambra's Southwest Operable Unit (SWOU), where EPA counts 13 such properties. Eleven of those potential sources are regulated by the Los Angeles Regional Water Quality Control Board, while one overseen by the Chatsworth Office of the California Department of Toxic Substances Control (DTSC), and one is overseen by EPA.



Industrial history of one block within Alhambra's Southwest Operable Unit near W. Mission Rd. and Date Ave., from the VinPower Digital Site Assessment Workplan

EPA and the State are doing their best to hold the original polluters responsible for groundwater cleanup in San Gabriel Valley. However, with few exceptions, protecting building occupants against vapor intrusion is largely the responsibility of building developers or operators who moved in after releases occurred or lie over groundwater plumes originating elsewhere. That is, though they are located in a Superfund area, for the purpose of addressing known or potential vapor intrusion, many are essentially brownfields. Regulators evaluate the threat to human health on a site-by-site basis

Both state agencies have made available an enormous amount of information, in the form of workplans, investigative reports, and correspondence, about these sites on their respective web-based databases, DTSC's Envirostor (www.dtsc.ca.gov/envirostor) and the state Water Board's Geotracker (www.geotracker.waterboards.ca.gov). There is a great deal of data available on groundwater, soil, and soil vapor contamination. Contaminated soil has been excavated, soil vapor extraction systems have been installed, and *in situ* cleanups have been conducted. The regulators seem to be doing a good job, but the Water Board is understaffed, with individual project managers responsible for several sites.

In particular, the vapor intrusion response is uneven. There is no uniform conceptual site model. There has been little, if any indoor air sampling. And I've found no evidence of an evaluation of the potential for vapor intrusion on the other side of the railroad tracks and Mission Road.

Corner Company property on W. Mission Rd. at Date Ave., awaiting redevelopment

Some sites, such as the International Extrusion property on Meridian and the Corner property on Mission, promise passive mitigation for new construction, such as a large home-and-garden store and office buildings at the former and multi-family residential at the latter. Under California guidance, passive mitigation means vapor barriers and sub-slab passive venting, with the option of adding fans if indoor vapor levels exceed inhalation exposure standards after construction.

Soil Gas Screening Levels

At other properties, such as the Alhambra Communities site on Fremont, consultants have developed unprotective soil gas screening levels that would require no mitigation. I've seen this elsewhere in California, which has protective indoor air targets but low default attenuation factors, such as 1/1000 for indoor air to soil gas for future residential use. That leads to a residential soil gas screening level of 480 µg/m^3 (micrograms per cubic meter). Since PCE soil gas readings there reach 3,400 µg/m^3, they conducted additional site-specific calculations to come up with a soil gas screening level of 9,500 µg/m^3 at 5 feet beneath the surface and 16,000 µg/m^3 at 10 feet for Site A, which makes up the bulk of the property.

Alhambra Communities site

At the Mercury Die site, on West Mission Road in the western section of the SWOU, the Water Board sent a no further action letter in 2000 in which it acknowledged TCE soil gas readings as high as 17,000 µg/m^3 at a depth of 25 feet. This was before most regulatory agencies began looking for vapor intrusion, but to my knowledge this site has not been revisited, despite EPA's 2014 measurement of TCE in nearby groundwater at 340 parts per billion at 70 to 90 feet beneath the surface and 450 parts per billion slightly deeper. Indeed, EPA reports no groundwater sampling directly on this large property.

At the International Extrusion property, consultants actually proposed setting soil gas screening levels based on excess lifetime cancer risk targets of one in 10,000 for commercial/industrial uses and one in 100,000 for residential scenarios. In general, I and other community activists strongly prefer one in a million for both, and California and Federal regulators suggest one in a million as a starting point. But for TCE, the less protective cancer-risk targets are particularly inappropriate, because the recommended non-cancer inhalation exposure standard is lower (more protective) than the one in 100,000 cancer level. Fortunately, for the purpose of requiring risk management, the soil gas results at the property were still high enough to trigger plans for mitigation.

China Press at W. Mission Rd. and Date Ave.

Indoor Air

Where there are buildings, indoor air sampling—not soil vapor sampling—is the best measure of potential exposures to intruding vapors, and it's the best way to inform building occupants of their level of risk. It is of course conceivable that indoor concentrations of solvents such as TCE and PCE are coming from sources inside buildings, or even outside, but once vapors are found there are many ways to determine whether they are coming from below. See http://www.cpeo.org/pubs/SGVI/EmergingStrategies.pdf. Furthermore, if indeed there are indoor sources, then those need to be addressed as well.

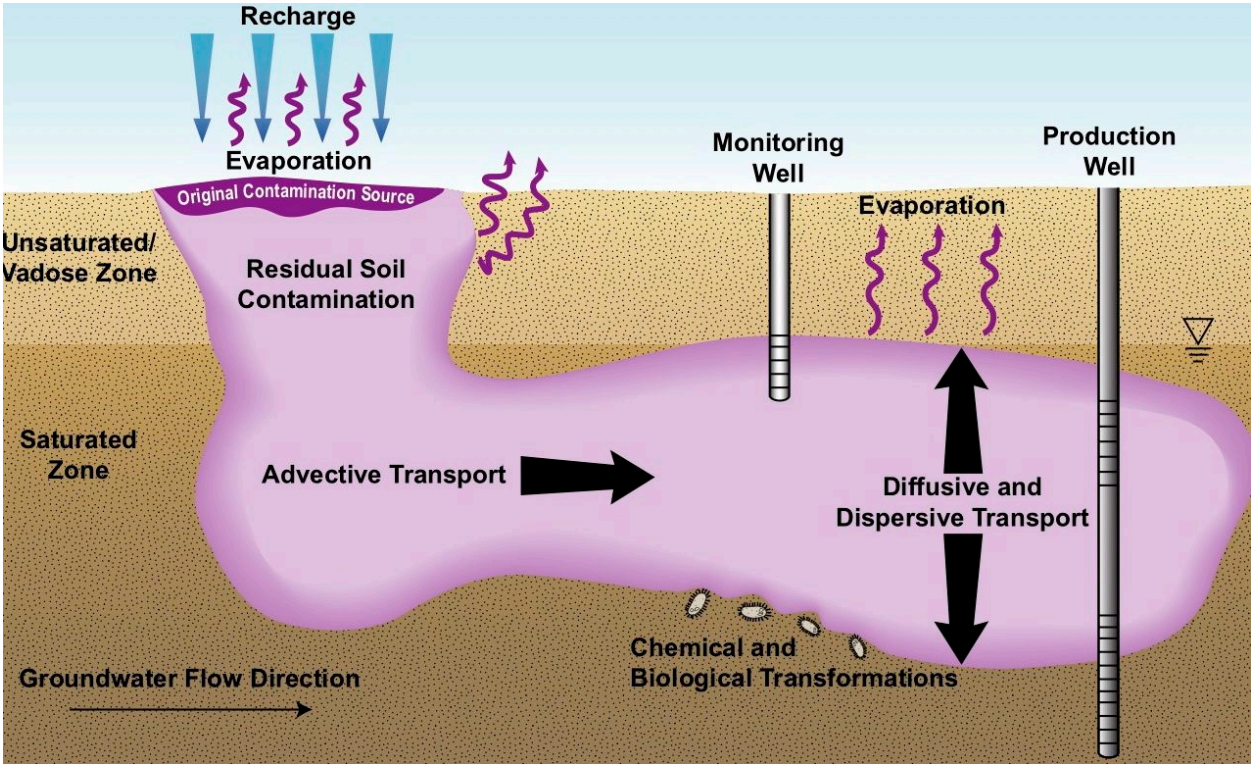
Despite the presence of occupied buildings on most of the SWOU properties, I have found no results of any indoor air sampling anywhere in Alhambra. Though the Water Board's July 2013 Cleanup and Abatement Order for the LSI/Agere site on Chestnut required an indoor air sampling plan, that requirement has been delayed until after the implementation of the Remedial Action Plan. This June, consultants proposed to collect two indoor air samples at the Vinpower building on Palm Ave., but as far as I know the workplan containing this proposal has not yet been approved by the Water Board.

Conceptual Site Model

Perhaps the greatest missing element of all the soil and soil-vapor studies is a clear, area-wide sense of the sources of soil vapor contamination. Almost all of the studies blame off-site sources. For example, a consultant for LSI/Agere identified Southern California Edison's property across Raymond Avenue as a potential source of its solvent contamination, while

Edison's consultants suggested that LSI/Agere was a source of its contamination. One exception is the Corner Company consultant's acceptance of responsibility for contamination at the contiguous Alhambra Communities land. But there's an explanation. The two properties were formerly under common ownership, and they have the same consultant.

Soil gas contamination is found throughout the Southwest Operable Unit at multiple depths. Even if one accepts less conservative screening levels, it's still important to refine the regional conceptual site model—portrayed in EPA's graphic below—to understand exactly where it's coming from, and where it's going.



Conceptual Site Model from EPA's area-wide Remedial Investigation

EPA explained the *possible* fate and transport of CVOCs in its area-wide Remedial Investigation, but it did not conclude which pathways predominated:

> the detection of Key COPCs in soil and soil vapor beneath numerous facilities in Area 3 indicates the occurrence of releases of contaminants to the vadose zone. Key COPCs released from a source at the ground surface could evaporate; dissolve in surface water and migrate in surface water runoff; infiltrate into the subsurface by migration through permeable layers; or undergo a combination of the three processes.
>
> A contaminant that migrates downward through the vadose zone could remain in the form of a free-phase liquid or could dissolve in water. Tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and carbon tetrachloride might volatilize within the vadose zone and migrate to the atmosphere.

There are three possible, non-exclusive explanations of the wide distribution of CVOCs in the soil gas:

1) Chlorinated volatile organic compounds, such as PCE, TCE, and their breakdown products, are moving laterally through the vadose zone (the soil above the water table). Given the widespread distribution, this seems unlikely. Experts say that it's unusual for CVOC vapors to migrate more than 100 feet unless there is a preferential pathway, such as a sewer line or the disturbed earth or gravel surrounding underground utilities. In some of the sites I've visited, such as the Stanford Research Park in Palo Alto, California (see http://www.cpeo.org/pubs/SRP.pdf) and the Modine Manufacturing site in Camdenton, Missouri (see http://www.cpeo.org/pubs/Modine.pdf), investigators have checked for such preferential pathways. In Alhambra, with its extensive industrial development, subsurface preferential pathways are quite possible, but they do not adequately explain the widespread distribution of CVOC vapors at depths exceeding 100 feet.

2) The factories and other industrial buildings in the Southwest Operable Unit leaked like a sieve. That is, there were a large number of releases from sumps, pipes, storage tanks, and even direct dumping on the group. Normally, this possibility is reinforced by data showing higher concentrations of CVOCs near the surface and lower concentrations at depth. However, in my cursory review of soil gas data, I found the trends inconsistent. That is, in some places the concentrations increase with depth while at other spots they decrease. Conceivably release points account for a portion, but not all of the soil gas contamination.

3) CVOCs are volatilizing from groundwater and are rising toward the surface. This is common here in Mountain View, where groundwater is shallow. But the groundwater in Alhambra is generally one or two hundred feet down, though at the western edge of the SWOU it's closer to 70 feet. What's more, the CVOC concentrations in sampled groundwater have generally been measured in the tens or hundreds, not the thousands. Based on experience elsewhere, this pathway seems unlikely, but possible. Indeed, the consultant for the Corner Company's Mission Road parcel suggested:

> TCE results detected in vapor monitoring wells VMW-1, VMW-3, SVE-1D suggest that these results are from off-gassing from groundwater beneath the Site and the results detected in SVE well SVE-5D are a result of pulling contaminants from adjacent properties across Date Avenue.

I believe that the regulators and consultants need to conduct a consolidated review of the data from all the sites to better understand the fate and transport of CVOC vapors in the SWOU. This would not only help consider and design vapor mitigation strategies for future as well as existing buildings, but it may also lead to an expanded investigation.

If indeed groundwater is a source of CVOC vapors that may be pulled up into overlying buildings, this opens a new frontier for site characterization. The studies have shown that groundwater in the SWOU area generally flows to the southeast. The area to the southeast, beyond Mission Road and the railroad tracks, consists primarily of residential neighborhoods. However, despite elevated levels of PCE and TCE in groundwater just north of Mission, the only water sampling on the other side of the tracks has been centered around the Valley Cleaners site, at Valley Blvd. and Fremont Ave. The PCE concentration there reached 106 parts per billion.

To some degree, this reminds me of the Triples Site in Sunnyvale, California, where EPA is sampling homes and schools downgradient from a contaminated industrial area (see http://www.cpeo.org/pubs/TripleSite.pdf). If regulatory responsibility were consolidated in Alhambra, regulators would be much more likely to be looking for vapor intrusion in residences near the known contamination sites.

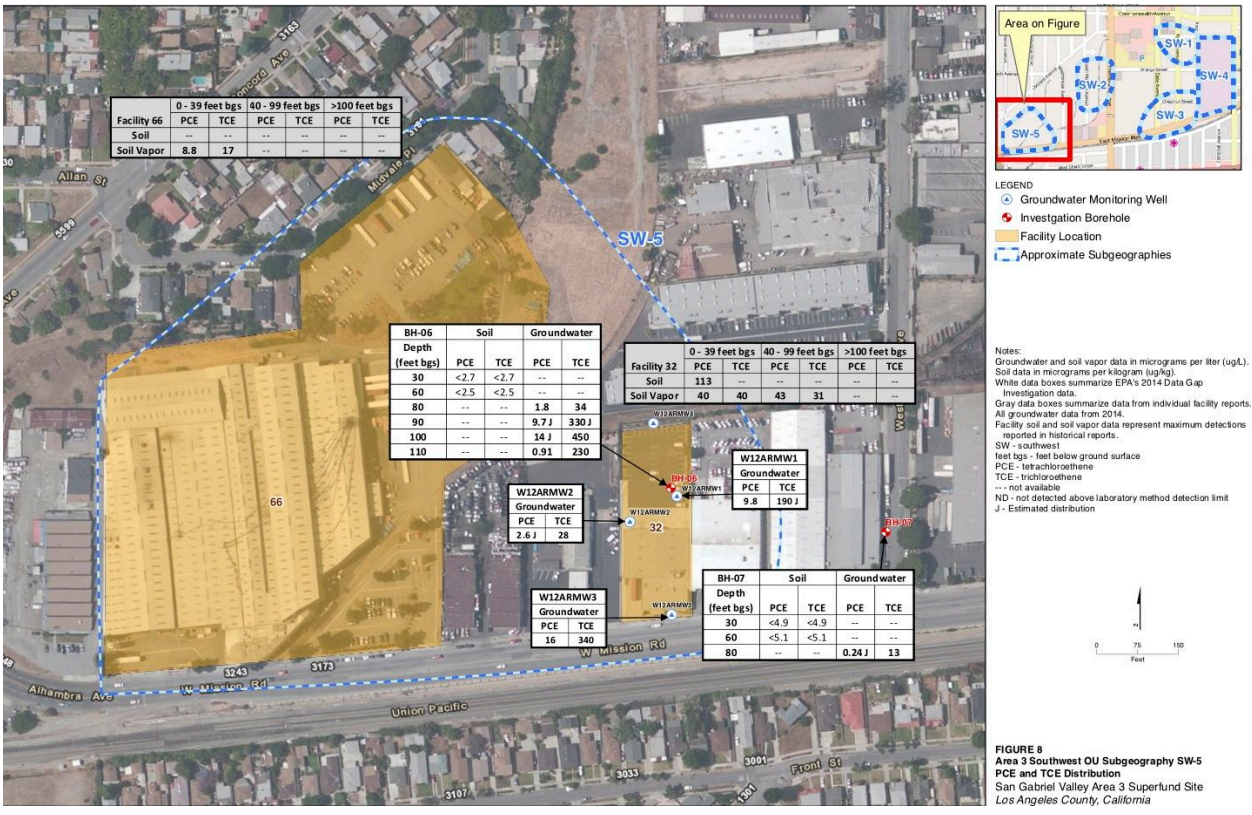


FIGURE 8
Area 3 Southwest OU Subgeography SW-5
PCE and TCE Distribution
San Gabriel Valley Area 3 Superfund Site
Los Angeles County, California

EPA's Data Gaps Investigation found high levels of TCE in groundwater near homes

The City's Role

The City of Alhambra has long been aware of the industrial contamination within its borders. In 2008, to protect its residents and other water customers from contamination, as well as reduce its dependence on imported water, the city of Alhambra opened a $13.8 million

Groundwater Treatment Plant capable of treating up to 7,000 gallons of water per minute. The plant uses both granular activated carbon and ion exchange to remove volatile organic compounds and nitrates from its water supply.

However, until very recently the city has not engaged directly in the management of vapor intrusion risks. Like most cities, it lacks the expertise and resources to evaluate the potential for vapor intrusion in new construction, so in approving developments it relies entirely on the actions of whichever regulatory agency, if any, has the lead for the property in question. But there are so many properties with CVOC contamination in the SWOU that it's difficult for the regulators to keep up. Furthermore, DTSC and the Water Board are constrained to apply attenuation factors that limit the conditions under which mitigation is mandated.

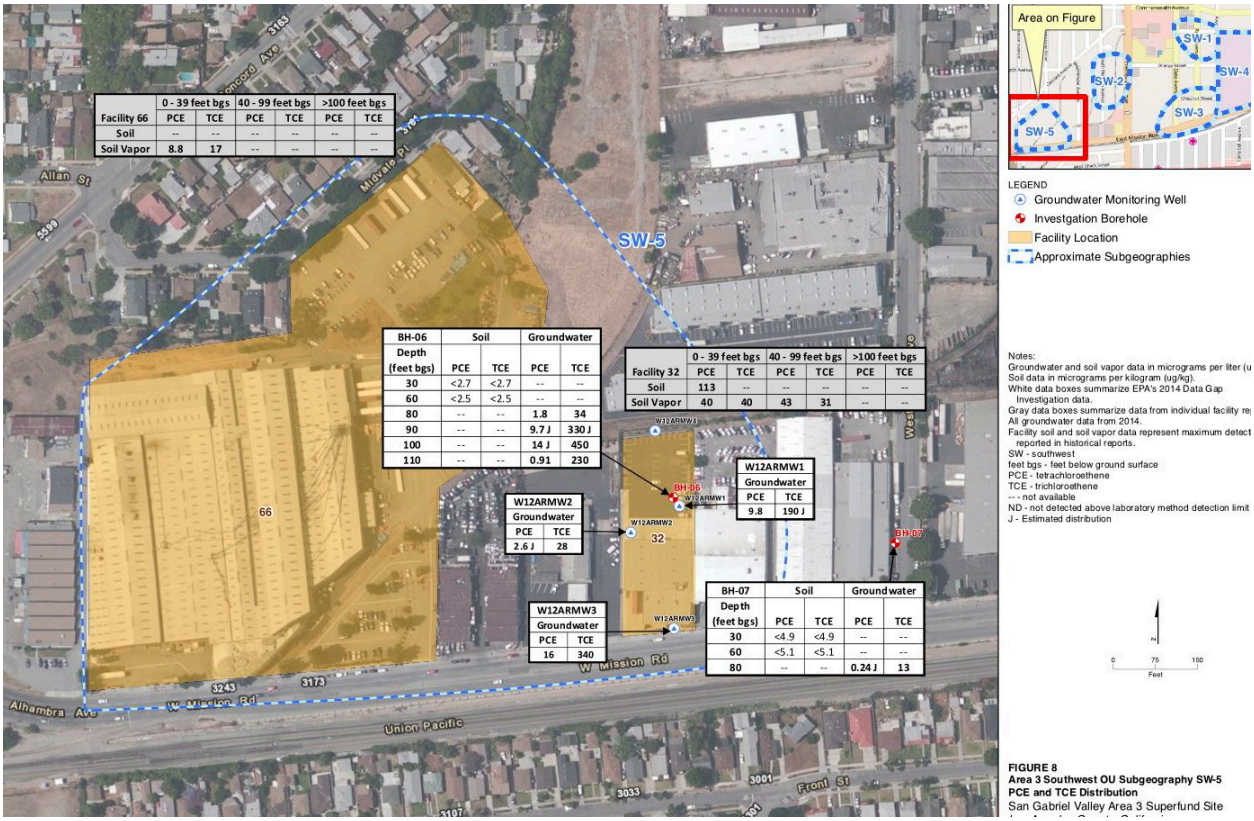


FIGURE 8
Area 3 Southwest OU Subgeography SW-5
PCE and TCE Distribution
San Gabriel Valley Area 3 Superfund Site

EPA's Data Gaps Investigation also found high levels of TCE in groundwater near homes further west

When I visited Alhambra at the end of August, I suggested that Alhambra adopt policies similar to my community Mountain View, California. Mountain View requires at least passive mitigation in new construction on properties with or near CVOC contamination. We use the California Environmental Quality Act to require compliance with conditions developed by regulatory agencies, and we require notification of property purchasers and occupants. Developers are happy to comply, because the cost of mitigation and monitoring is generally less than paying for the amount of sampling necessary to assure that future exposure risks are acceptable.

Since my visit, Alhambra circulated the Draft Mitigated Negative Declaration for the International Extrusion site. It includes a one-paragraph requirement for vapor mitigation:

> A vapor barrier and underlying passive vent system must be installed beneath the proposed buildings in the affected area where the vapors are remaining. The presence of vapor barriers combined with passive sub-slab venting and engineered air flow inside the buildings will minimize the potential exposure of workers to VOCs due to vapor intrusion to indoor air.

Ideally, the document would go into more detail, but clearly this is a step in the right direction.

In Mountain View, the city—and often I do it personally, as a member of the Mountain View City Council—assures the public that despite the widespread legacy of industrial contamination within our boundaries, the new buildings will be safe. Alhambra, facing a similar legacy, can also routinely reinforce the efforts of state and federal regulators. If it does, it can provide the same assurances.