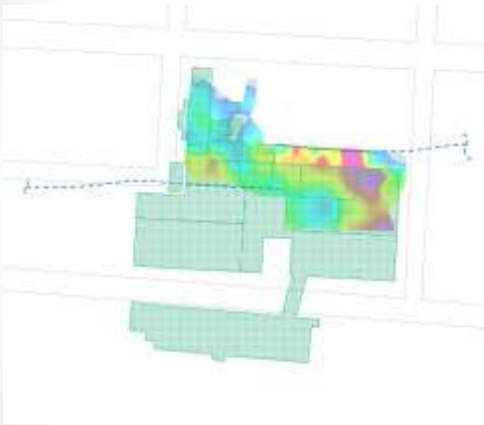
TCE VI Case Studies

Not always what you might expect.

Southern VT case study

Manufacturing facility that used a TCE vapor degreaser for many years with concrete as secondary containment.

Southern VT case study



- Accidental releases of TCE and likely PCE occurred on site due to past industry wide standard practices
- 2006-2007 SI found TCE and PCE in the shallow soil gas as well as contaminated groundwater and deep soils

Southern VT case study

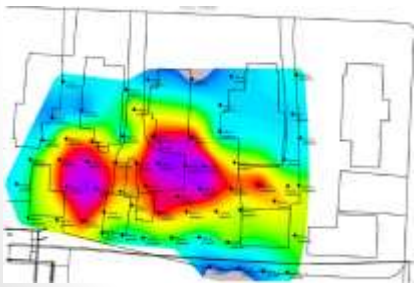
- VT DEC required an assessment of soil gas and potential VI in residential buildings located adjacent to the portion of the facility
- Off site PCE and TCE, but primarily PCE was identified in soil gas
- A potential TCE and PCE VI pathway into the homes was also identified
- Historical Data initially led VT DEC to conclude the factory was responsible

Southern VT case study

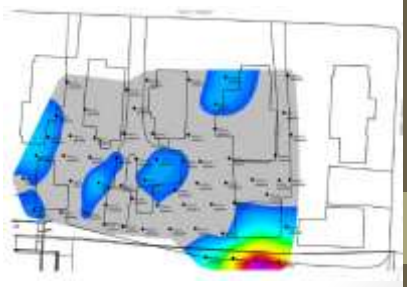
- Consultant requested further investigation as source was not completely clear
  - There were elevated concentrations of both PCE and TCE in indoor air
    - TCE concentrations were often higher in first floors
    - PCE concentrations were often higher in basement
- The on-site shallow groundwater contamination had significantly higher concentrations of TCE than PCE.

Southern VT case study

- Further studies demonstrated:
  - Elevated PCE in shallow soils or soil gas surrounding residences
  - Minimal TCE in shallow soils or soil gas near residences
  - Elevated TCE in soil gas near factory
  - Lower PCE in soil gas near factory



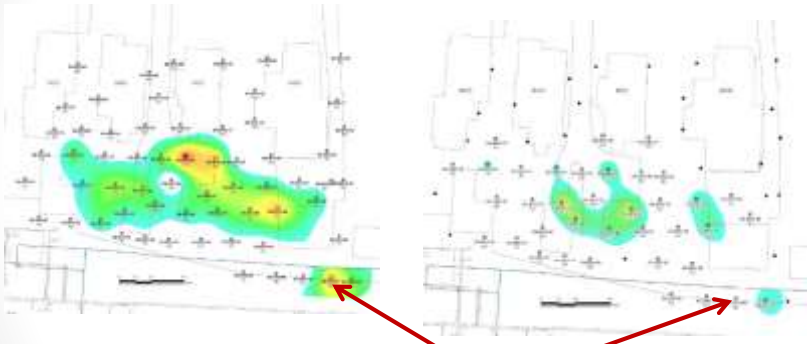
PCE in soil gas: Hot spots near residence



TCE in soil gas: hot spot near factory

Southern VT case study

PCE > 100 µg/kg in soils 0-2 ft bgs PCE > 100 µg/kg in soils 2 ft and greater

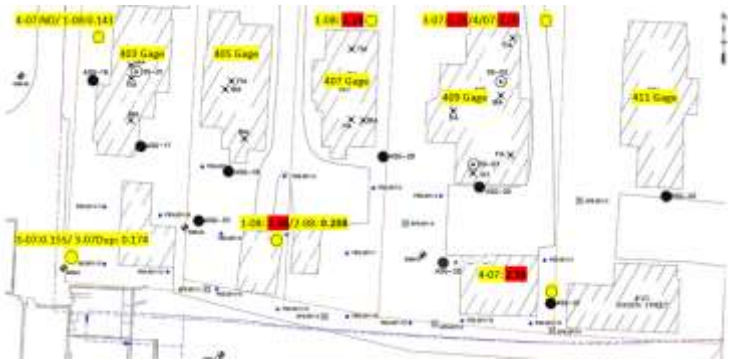


TCE below detection limits: **EXCEPT for high concentrations (50,000 - 400,000 µg/kg) in this area** which extended onto factory property. Roughly matches soil gas distribution.

(The TCE contaminated soils have been excavated)

Southern VT case study

Outdoor ambient air testing demonstrated elevated concentrations of TCE in ambient air but not PCE.



TCE concentrations in ambient air: month-year: concentration in µg/m3

Southern VT case study

To help us assess the source of the TCE in the indoor air, we compared ratios of PCE to TCE in soil gas close to houses, the sub-slab soil gas, the basements, and first floor living space where possible.

- In **Soil Gas**, the mean ratio of PCE to TCE was:
  - 315 (PCE > TCE)
- In the houses, the mean ratio of PCE to TCE:
  - First Floor: 0.95 (PCE < TCE)
  - Basements: 2.12 (PCE > PCE)
  - Sub Slab: 29.9 (PCE > TCE)

Ratios of PCE to TCE are significantly different in the soil gas to the basement and reversed in the first floor air

Southern VT case study

- The data allowed us to improve our site conceptual model:
  - PCE but **not TCE** is present in shallow soil gas and soils near residences
  - There are two clear PCE soil hot spots near residences
  - Comparison of concentration ratios of PCE and TCE in indoor air between basements and first floor:
    - PCE often higher concentrations in basement air
    - TCE often in higher concentrations in first floor air
  - The likely source of elevated of TCE is the ambient air

Southern VT case study

We have concluded

- The primary source of the PCE in indoor air is likely the shallow soil vapor
- The primary source of TCE in indoor air is likely the ambient air
- **The likely source of the two PCE soil hot spots is not related to the PRP**

Remedial activities are being planned that will address the shallow PCE contamination

Southern VT case study

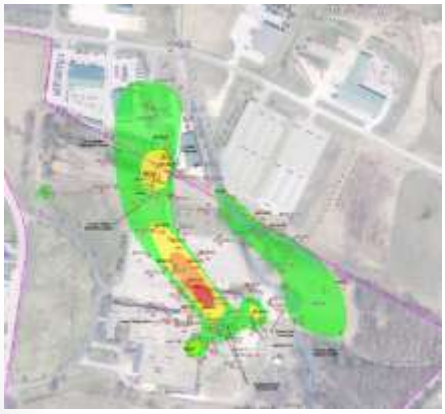
We have concluded that the weight of evidence indicates that the TCE in the indoor air is not due to soil or groundwater contamination including:

- Elevated TCE concentrations in ambient air but not PCE
- Higher concentrations of TCE than PCE in First Floor
- PCE in shallow groundwater near houses but not TCE
- High concentrations of PCE in soil gas samples taken near houses but TCE concentrations low to ND
- High concentrations of TCE in groundwater near factory but minimal PCE

Northern VT case study

- Factory in Northern VT which operated from 1947 through September 2013.
- TCE was used in the manufacturing process throughout the time the facility was in operation.
- Numerous releases (metals & VOC's) occurred on site during the early years
- Numerous SI's & remedial activities since the late 1970's

Northern VT case study



- Although we knew TCE was present in soils below the building, the focus on TCE remediation was on the groundwater
- TCE in indoor air at the facility was regulated by VOSHA

HOWEVER

Northern VT case study

When the factory ceased operations and the owner wanted to sell the building, the facility needed to go through formal RCRA Closure

- The DEC at this point determined that it needed to assess indoor air quality and the potential for vapor intrusion from subsurface soil contamination

Northern VT case study

As we suspected, we found elevated TCE concentrations in both sub-slab soil gas and indoor air that need to be addressed prior to a new building use.

(No vapor issues were identified in Former office areas).

HOWEVER

Northern VT case study

Based on experience at another factory in VT, we were concerned after so many years of using TCE, the building materials themselves as well as the sub-slab contamination could be a source of TCE vapors.

Testing of concrete cores demonstrated elevated concentrations of TCE in the concrete floor in some portions in the former manufacturing and TCE storage areas

Northern VT case study

Flux chambers also were used to confirm that the concrete is adding TCE vapor to the indoor air in portions of the former TCE storage and manufacturing areas

Northern VT case study

The consultant also used a portable GC/MS to assess preferential pathways in real time. Several were clearly identified

Northern VT case study

TCE Vapor Sources & Pathways:

- Vapor Intrusion Sources:
  - Sub-slab soils
  - Subslab soil gas
- Vapor Intrusion Pathways
  - Identified Preferential Pathways
  - Unidentified Preferential pathways
- Interior Sources
  - Concrete Floors

Northern VT case study

Remedial Strategies:

- ✓Sub-slab depressurization in "hot" areas
- ✓Seal known Preferential pathways
- ✓Maintain positive pressure in building with respect to sub-slab
- ✓Confirmatory sampling

If these actions do not succeed in lowering concentrations of TCE below action levels options may include:

? Seal Flooring $$$

? Build false floor with sub-floor vapor collection $$$$

Conclusions:

- Vapor intrusion of indoor air can be caused by contaminated soils and/or groundwater

BUT

- Don't forget there are other potential indoor air contaminant sources such as:
  - **Outdoor Ambient Air**
  - **Contaminated Building Materials**
  - **Other?**

Therefore

- Insure Site Investigation is complete and Conceptual Site Model considers adequate VI potential pathways