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Research for Managing Risks from Leaking Underground Storage Tanks

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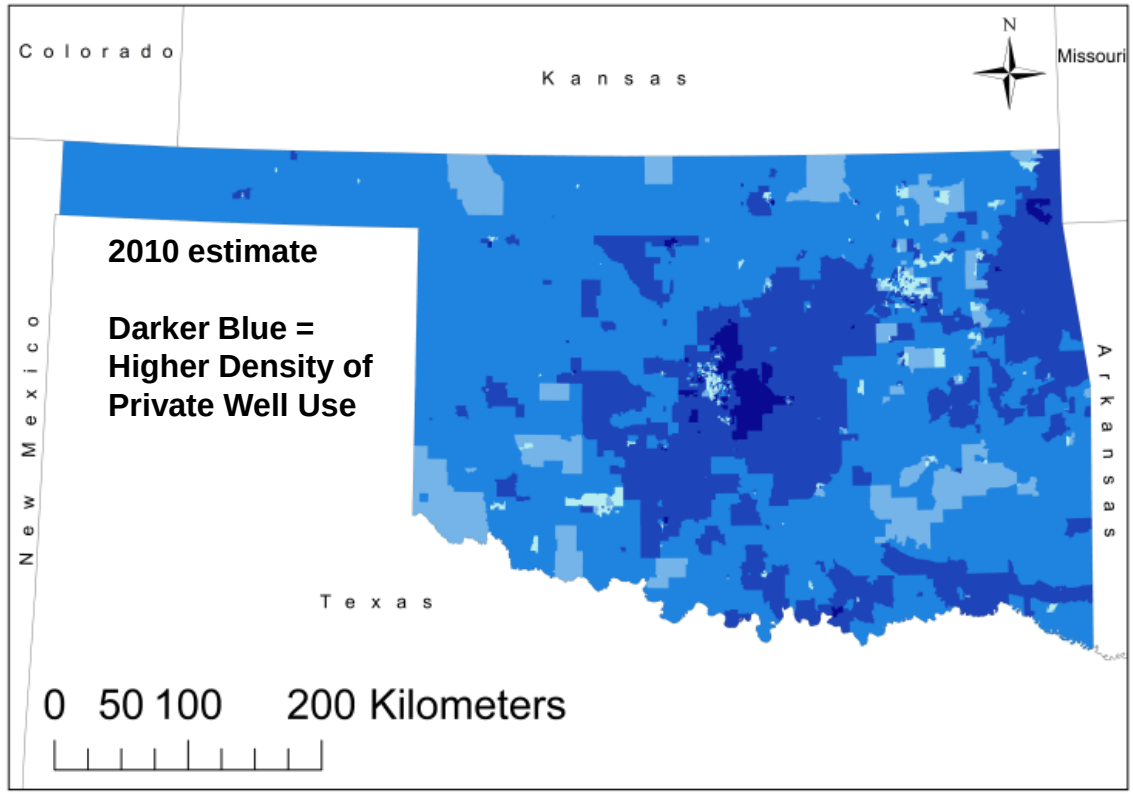
Leaking Underground Storage Tanks

- **Historically 500,000+ reported releases**
- **Projected ~ 3,000 per year**
- **Major impacts are groundwater contamination and possible vapor intrusion**
  - **Drinking water wells**
    - **What is the relationship between private wells and underground storage tanks?**
      - First: Where are the private wells?
  - **Vapor Intrusion**
    - **How can we improve site assessment and mitigation?**

Pilot Project in Oklahoma

First: Where are the private wells?

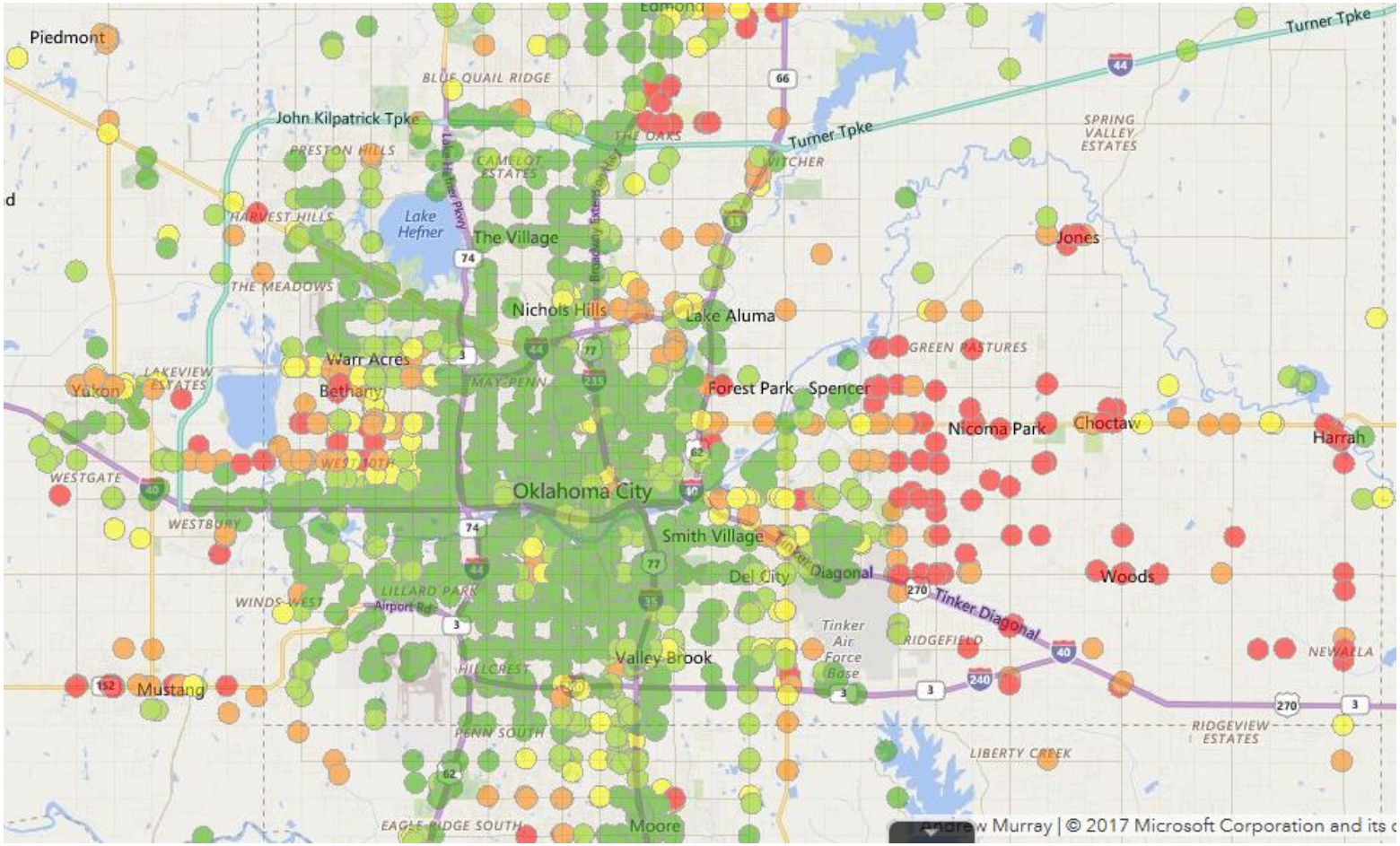
<u>All</u> data sources have limitations and gaps, our approach is based on the 1990 U.S. census and a forward projection using census housing and/or state well data



What did we learn? Areas of High Reliance of Private Wells

- Productive aquifers
- Rural without public water
- Cities with no public water (e.g. Nicoma Park)
- Coexistence
  - Major Lawn Areas
  - Expanding Cities (north and east of OKC, but not Tulsa)
  - Legacy areas

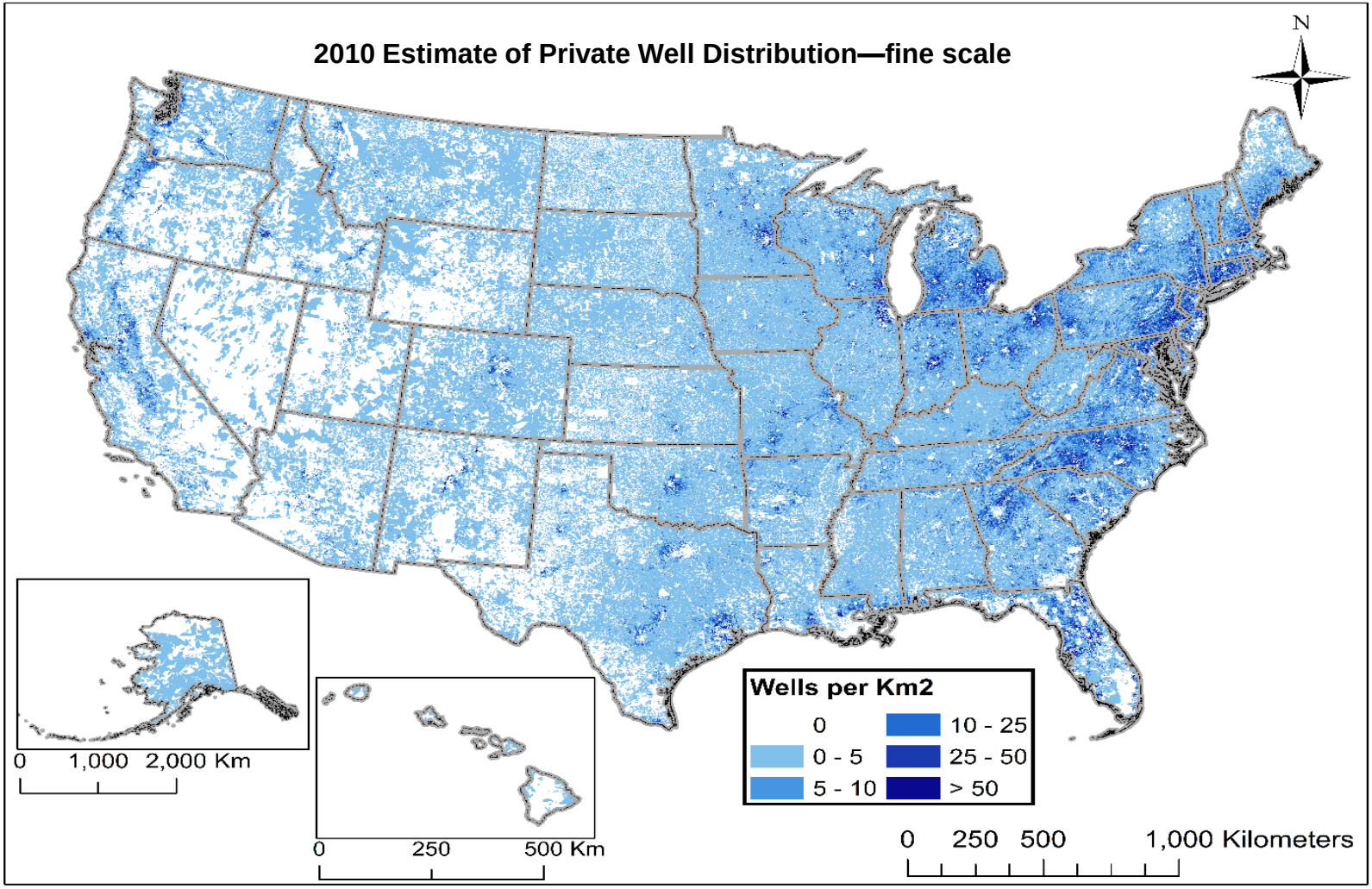
Private Domestic Wells and Underground Storage Tanks – Oklahoma City



Circles indicate 1,500 ft radius around tank locations – colors indicate potential numbers of private wells (green – low, yellow - moderate, red – high)

Estimated that 27% of tanks in Oklahoma have private well(s) within 1,000 ft

Private Wells in the U.S.



Extension to U.S. and finer scale:

- Rings around some cities
- Areas of high private well use in heavily populated east/midwest

Expected Impacts

- **L.U.S.T. Site investigation—are there wells in the vicinity that could be impacted? Legacy areas within cities?**
- **A component of remediation prioritization—which sites have the most potential to impact private well users?**
- **A component of inspection planning: are there areas to focus on for inspection?**

Example of legacy private well use:

Brown Palace Hotel,
Denver, CO

Uses private well in center of downtown Denver

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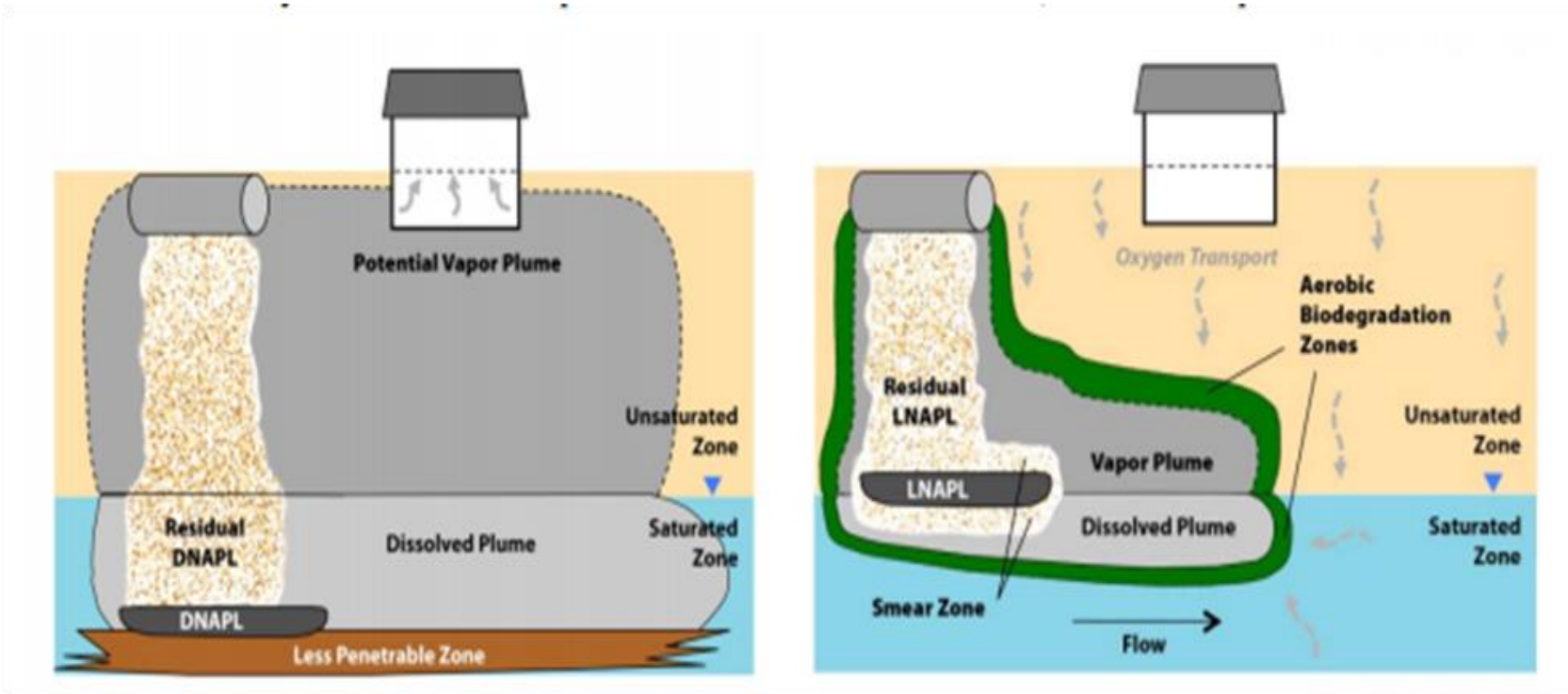
Contrast Solvent Vapor Intrusion and Petroleum Vapor Intrusion



Chlorinated Solvent (left) petroleum (right) are distinguished by prospects for biodegradation

Vapor Intrusion

- **EPA's actions on Vapor Intrusion since 2002 resulted in two major documents**
  - **For Chlorinated Solvents:**
    - Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air, EPA, OSWER Publication 9200.2-154
  - **For Petroleum Hydrocarbons:**
    - Technical Guide For Addressing Petroleum Vapor Intrusion at Leaking Underground Storage Tank Sites, EPA 510-R-15-001, 2015
    - Developed with input from state/federal/industry input

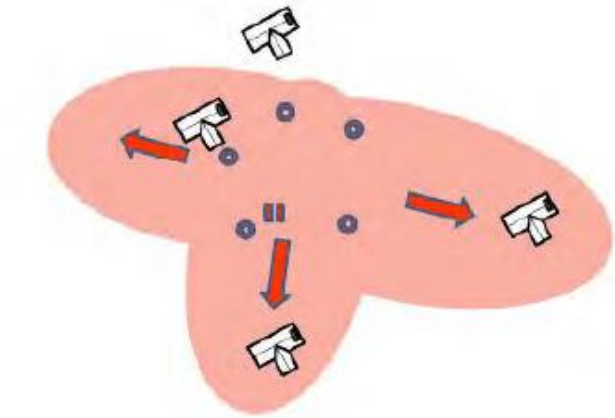
- **Specific focus here:**
  - Establish the role for models in the context of site assessment
  - All parameters of models are not/can not be measured at sites
    - How to account for uncertainties, yet still use model results?
    - To that end we developed a model "PVIScreen"

Assessment Strategy
(from the EPA PVI Guide)

- Address and mitigate immediate threats to safety
- Site Investigation and Develop Conceptual Site Model
- Delineate Lateral Inclusion Zone
- Delineate Vertical Inclusion Zone

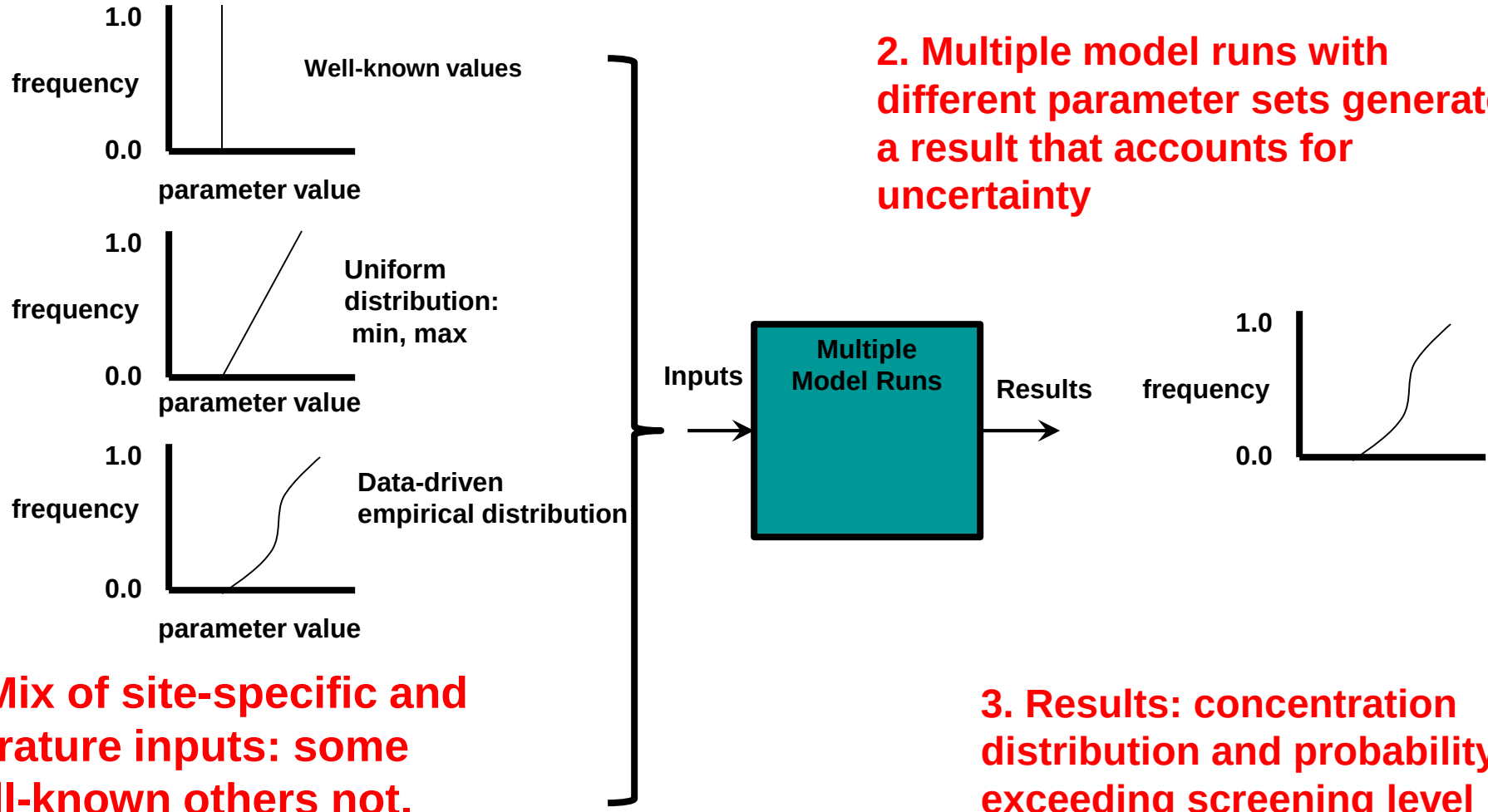
See EPA 600-R-13-047

- Evaluate Vapor Source and Attenuation of Vapors
  - Use a model as one line of evidence – PVIScreen
- Mitigate as appropriate



Technical Guide For Addressing Petroleum Vapor Intrusion at Leaking Underground Storage Tank Sites, EPA 510—R-15-001, 2015, see pages 4-6

PVIScreen Concept



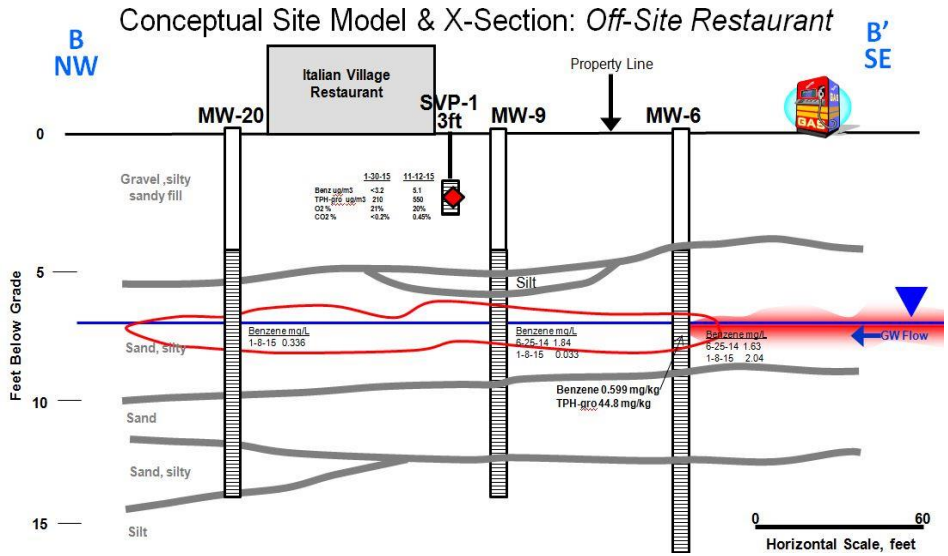
1. Mix of site-specific and literature inputs: some well-known others not.

2. Multiple model runs with different parameter sets generate a result that accounts for uncertainty

3. Results: concentration distribution and probability of exceeding screening level

Example 1 from Utah

- **Worked with Utah DEQ to test the model**
- **Restaurant located over contaminated ground water**
- **PVIScreen indicated no likelihood of impact**
- **Adds evidence to no further action needed**



benzene risks/hazards

0.0 % Exceed the ScreeningLevel of 0.5 (0.5 ug/m3)

"L" indicates screening level

Probability That Chosen Risk Level(s) Are Exceeded

High model probability of exceedence

Low or moderate model probability of exceedence

Probability

Most Probable Individual Result: 9.35E-6 ug/m3

(which is exceeded by 6.71 % of simulations)

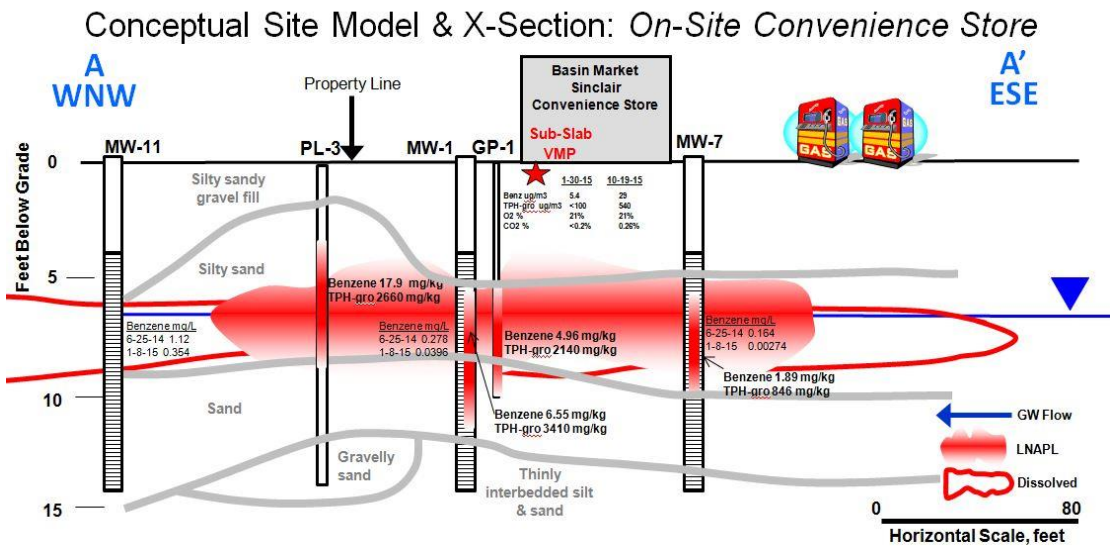
Averaged-Parameter Result: 8.28E-13 ug/m3

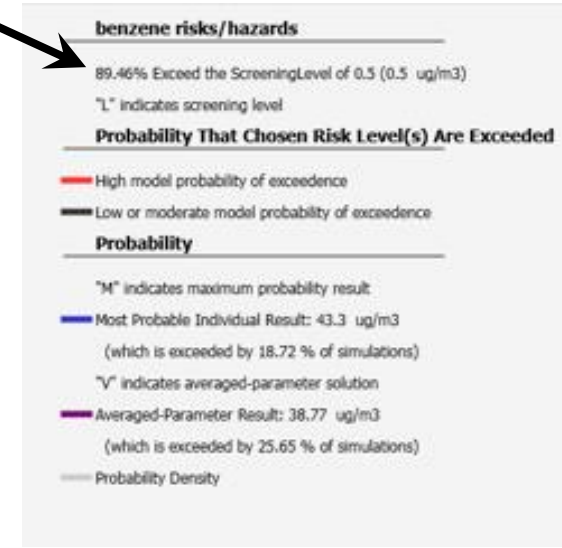
(which is exceeded by 80.43 % of simulations)

Probability Density

Example 2 from Utah

- **Convenience store located over leaked gasoline**
- **PVIScreen indicated high likelihood of impact above screening level**
- **More investigation warranted**





PVIScreen outcomes

- **Available field data have shown that most petroleum releases do not result in vapor intrusion.**
  - **Generally, strong petroleum source must be near the bottom of the foundation to create a problem**
- **PVIScreen accounts for variable factors (depth to source, source strength, soil type, etc.) allowing site-specific application of generalized knowledge.**
- **The model will help identify where problems exist and help focus resources to those sites.**

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Acknowledgements: Oklahoma Water Resources Board, Utah Department of Environmental Quality, Association of State and Territorial Solid Waste Management Officials.