An Industry Perspective: Enabling Effective Contaminated Land Management

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Effective Contaminated Land Management (CLM) – Lessons Learned

- **Protective** - human health & environment, but fit for purpose & sustainable
- **Supported** – scientifically sound, stakeholder buy in = expanded participation
- **Practical** – flexibility to provide management options to contain costs & timelines
- **Predictable** – understand the expectations – clear objectives
- **Timely** – regulatory pace can support business objectives
- **Certain** – there is a definite end to the process

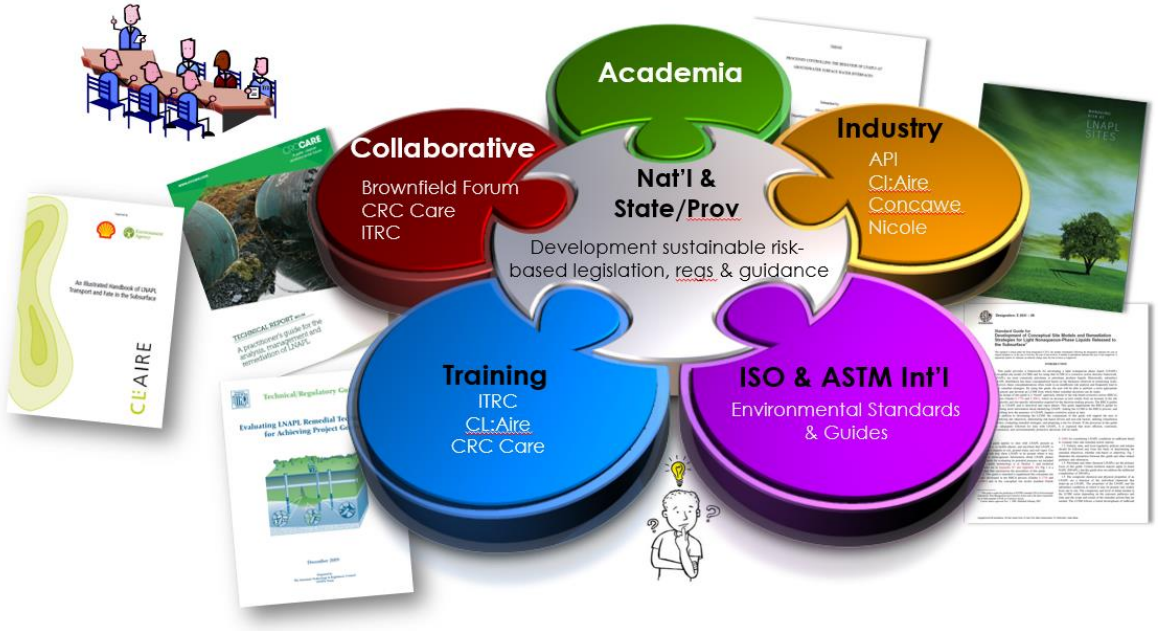
Collaboration

What we have learned

Global CLM Challenge → Sound Science Leads to Better Decisions, Practical Approaches Foster Compliance

National:

- Australia – CRC Care
- UK – National Brownfield Forum
- US - Interstate Technology & Regulatory Council



Local:

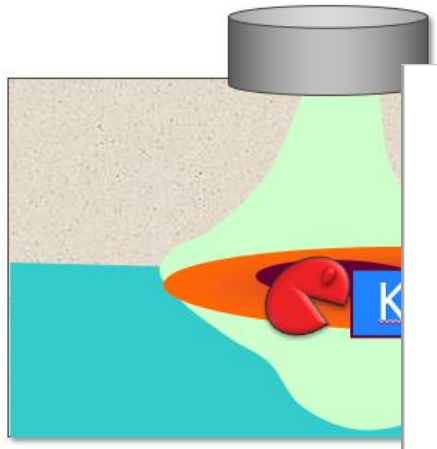
- California- UST Program Review, Low-Threat UST Case Closure Policy, Vapor Intrusion Workgroup
- Texas - Texas Risk Reduction Program Steering Committee
- Kansas – TPH & LNAPL
- Michigan – UST Program Review

People tend to support what they help build.

Setting the Stage: Petroleum Fuel Hydrocarbon Releases

What have we learned?

Solution Paradigm: Research & Big Empirical Data Studies, Collaborative Guidance, Collaborative Outreach & Training



Groundwater Pet
Remediation due

"…significant reductions in benzene concentrations can oc with time, even without active Remediation"

California Leaking Underground Fuel Tank (LUFT) Historical Case Analysis
(Rice et al., 1995)
- *plume length* - *temporal trends*
- *impact of remediation*
- *drinking water impact*

217 sites

Extent, Mass, and Duration of Hydrocarbon Plumes from Lea Petroleum Storage Tank Sites
(Mace et al., 1997)
- *plume length* - *temporal trends*
- *impact of remediation*

217 sites

"We found no difference in plum between different remediation te and sites with no remedial actio

Concawe
Environmental Science for European Refining

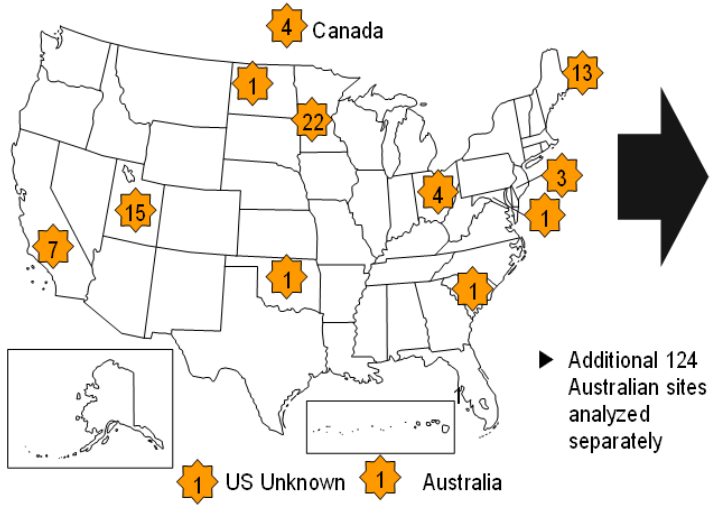
Report

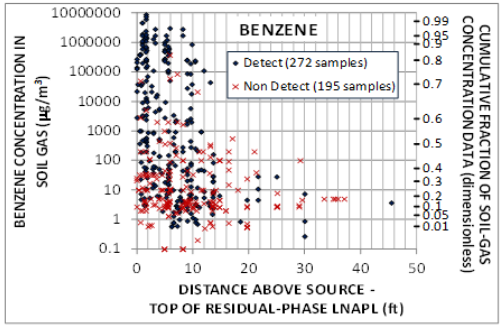
Report no. 10/18

Survey of natural attenuation of petroleum hydrocarbon plumes in groundwater in Europe

requirements

Petroleum Vapors Biodegrade





Lahvis et al., 2013

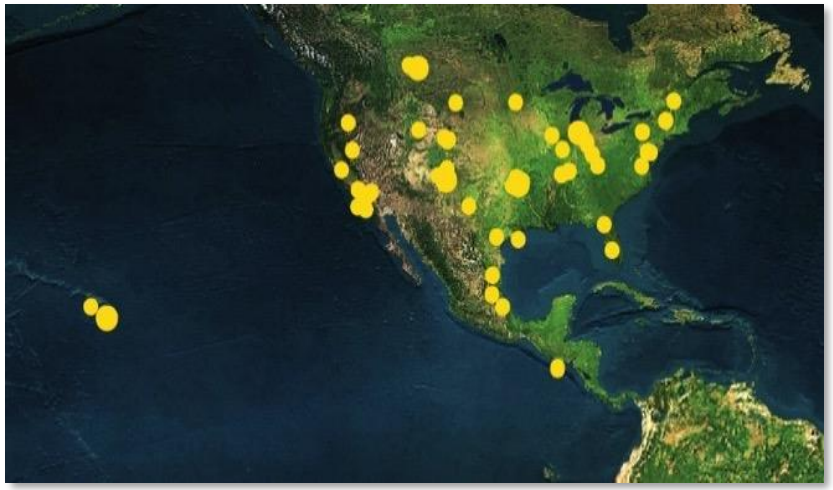
USEPA, 2013 Slide: Courtesy Matt Lahvis

- Fuel PHC LNAPLs distribute quickly, stabilize, then deplete naturally
- Dissolved PHC plumes are typically small and biodegrade
- PHC vapors biodegrade
- Bulk LNAPL recovery does not decrease dissolved-plume longevity
- LNAPL thickness is not a good metric of LNAPL recoverability

NSZD Rates can be Significant!

NSZD Study	Site-wide NSZD Rate (gallons/ acre /year)
Six refinery & terminal sites (McCoy et al., 2012)	2,100 – 7,700
1979 Crude Oil Spill (Bemidji) (Sihota et al., 2011)	1,600
Two Refinery/Terminal Sites (LA LNAPL Wkgrp, 2015)	1,100 – 1,700
Five Fuel/Diesel/Gasoline Sites (Piontek, 2014)	300 - 3,100
Eleven Sites, 550 measurements (Palaia, 2016)	300 – 5,600

Garg, S. et.al., 2017. Overview of Natural Source Zone Depletion: Processes, Controlling Factors, and Composition Change. GWM&R, 37:3, p. 62-81.



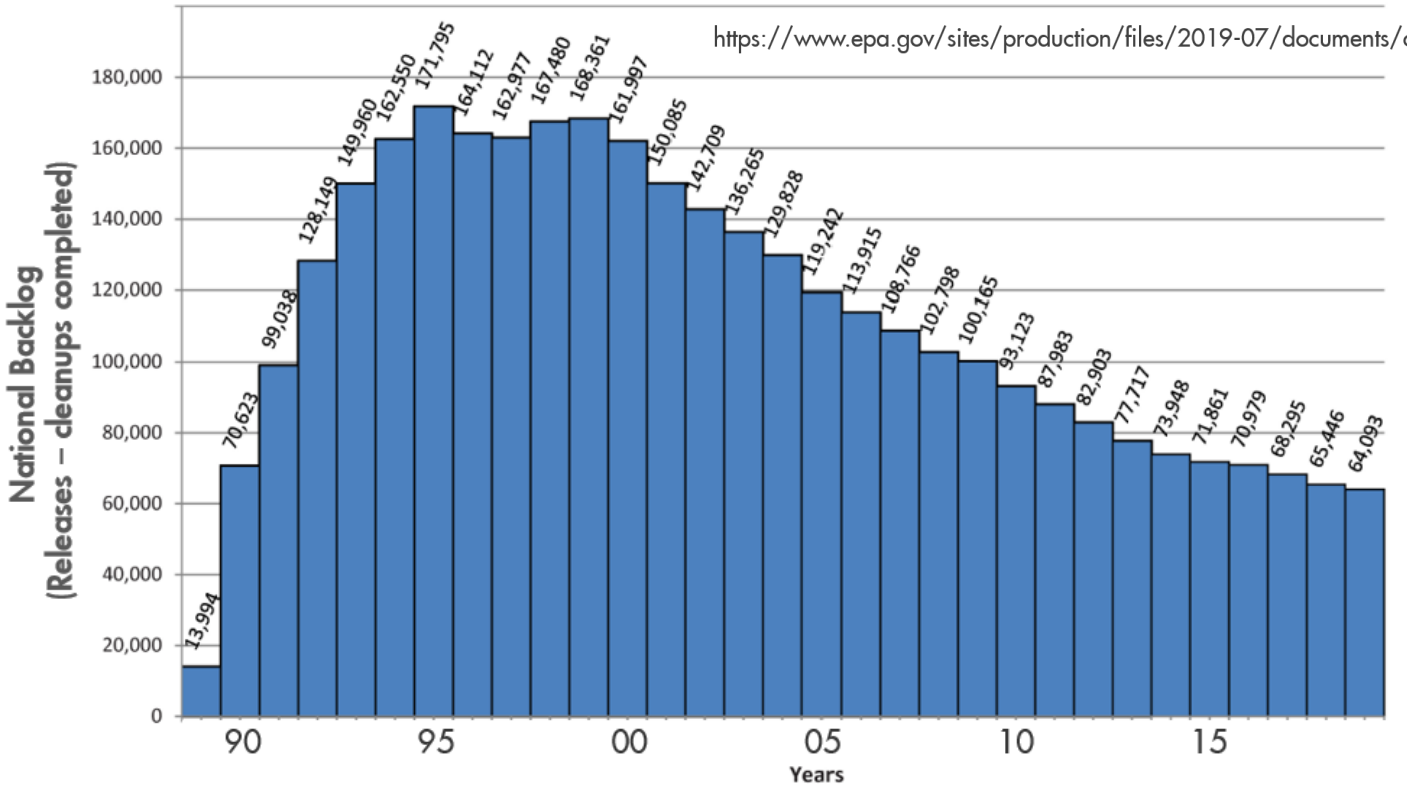
Locations where carbon traps have been used to measure NSZD rates (E-Flux, 2015).

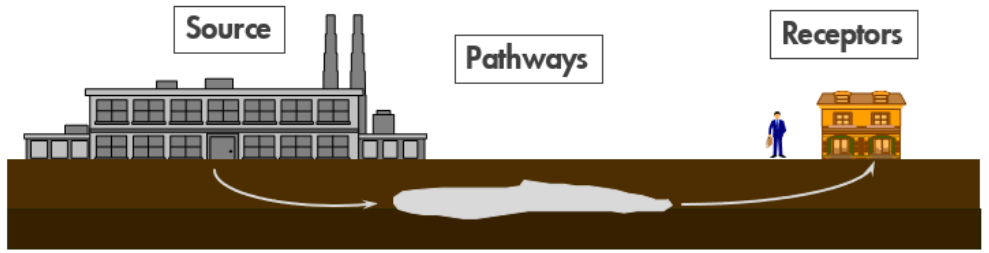
KEY POINT | NSZD rates are in the range of 100s to 1000s of gallons/acre/year

Effective Contaminated Land Management

Innovative Ideas to Increase Closures of Low Risk Sites

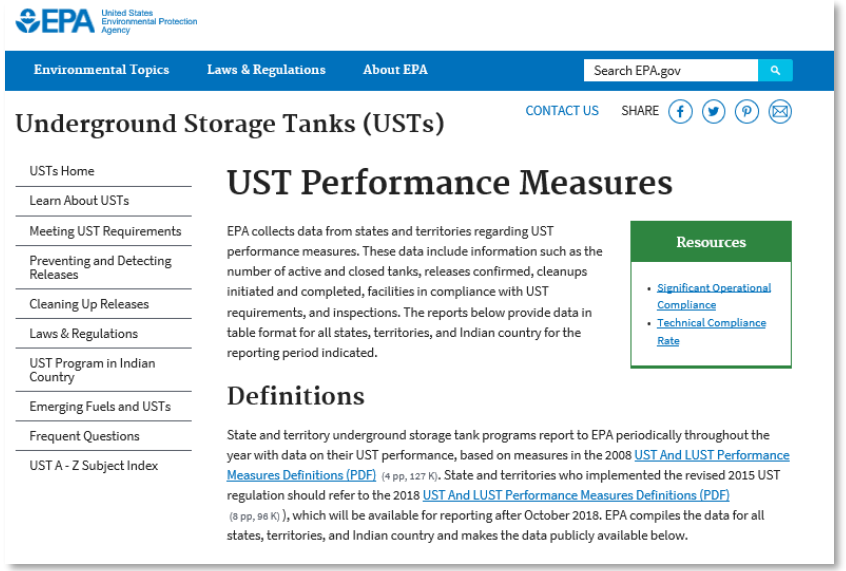
Huge UST CLM Challenge → Better Approach Required





RBM focus on breaking the S-P-R linkage:

Source treatment; pathway interception OR receptor modification all valid

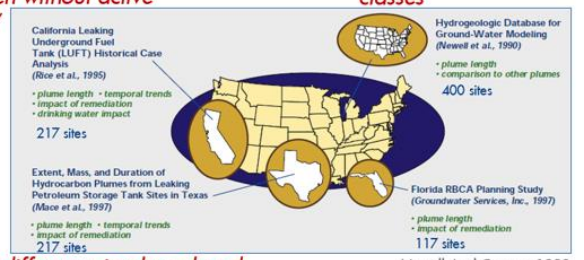


- 88% of confirmed LUST sites (479,026 of 542,209) have completed cleanup
- Fewer releases
- Risk Based Decision Making

Petroleum Plumes Degrade Screen Out Low Risk Sites

"…significant reductions in benzene concentrations can occur with time, even without active Remediation"

"BTEX plumes are significantly smaller than the other chemical classes"



Newell And Connor, 1998

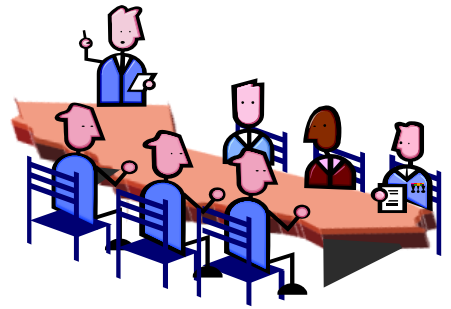
"We found no difference in plume length between different remediation techniques and sites with no remedial action"

"..soil removal would not significantly affect groundwater remediation requirements"

- **Texas Exit Criteria** – 1997
  - A series of flow charts with site conditions relative to plume concentrations and trends, and receptor distances, if meet qualify for immediate closure
  - Learnings from the 1997 Texas plumeathon
  - https://www.tceq.texas.gov/assets/public/comm_exec/pubs/rg/rg-523-pst-03.pdf

- **California Low-Threat UST Case Closure Policy** – 2012
  - Series of soil, groundwater and vapor scenarios that if match site conditions, or other condition determined low threat, qualify as low risk and thus for closure
  - Learnings from the 1995 California plumeathon and program reviews
  - https://www.waterboards.ca.gov/ust/lt_cls_plcy.html

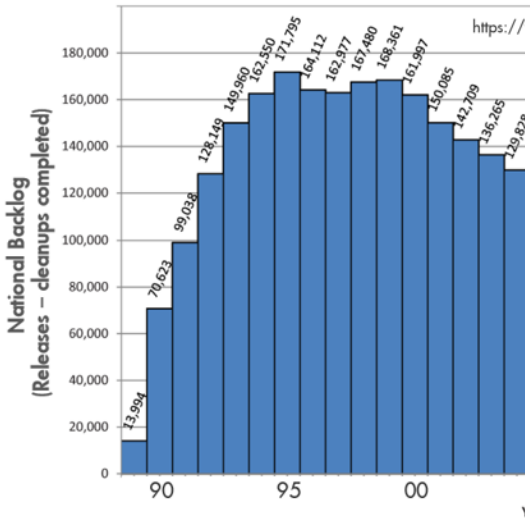
California Low-Threat UST Case Closure Policy (Background)



Evolution:

- **issues (low UST case closure rate - average case open 17 yrs)**
  - cleanup to background, irrespective of site risk
  - limited consideration of probable future groundwater use
  - residual LNAPL difficult to remediate; natural attenuation occurring, but slow; VI sites not effectively screened
  - lots of data collection/reg negotiation/remedy selection
- **Few petroleum UST cases w/ impacts**
  - domestic wells: 32/6423 sites (< 0.5%) or 54/250,000 to 600,000 = < 0.02%)
  - municipal wells: 42/6423 sites (< 0.7%)
- **Stakeholder group initiated to:**
  - review existing regs (adopted over 25 yrs), industry practice, science
  - recommend improvements to UST Cleanup program
  - risk-based (focus on low-risk sites)

Benefits of Screening Out Low Risk Sites Texas and California Example



COC concentrations are attenuating, conditions are improving!

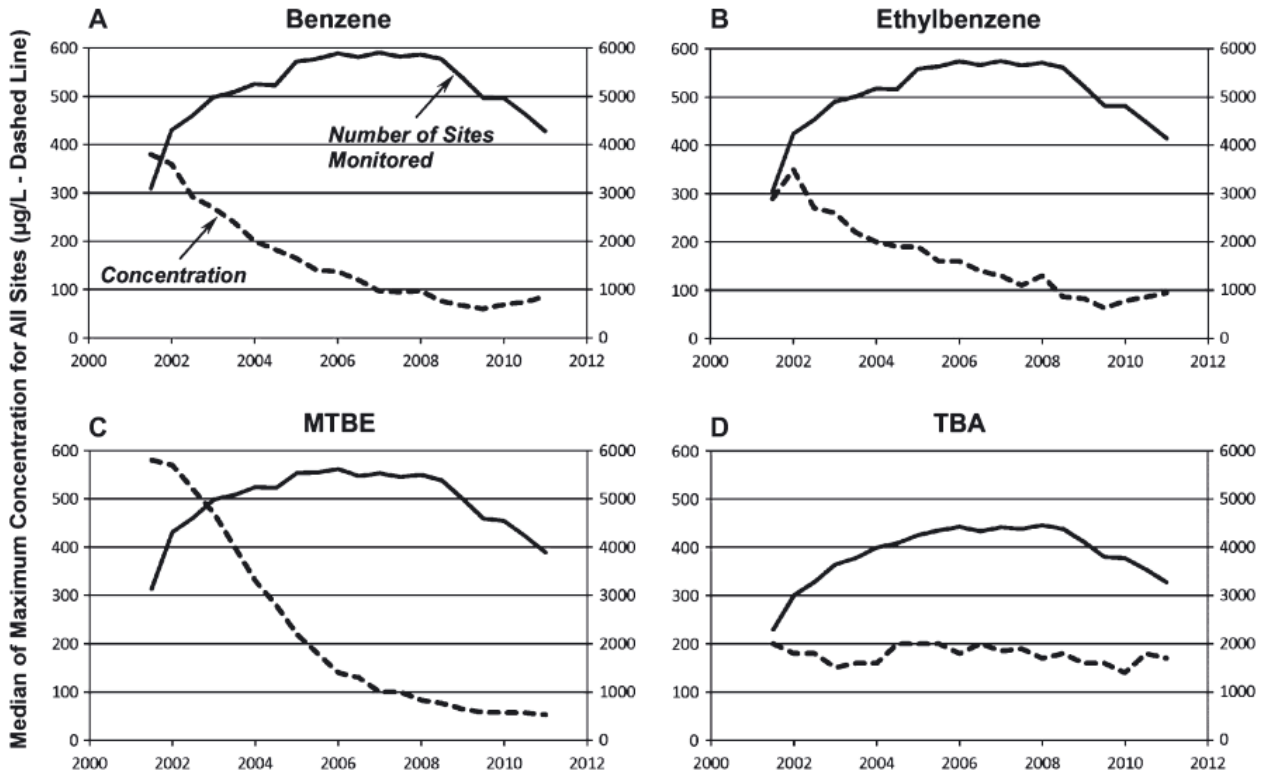


Figure 1. Maximum site concentration vs. time for all sites with any groundwater monitoring data.

Rep

Year Reporting

McHugh, T.E., Kamath, R., Kulkarni, P.R., Newell, C.J., Connor, J.A., and S. Garg, 2013. Progress in remediation of groundwater at LUFT sites in California: Insights from the Geotracker Database. Groundwater, 52, 898-907. https://onlinelibrary.wiley.com/doi/abs/10.1111/gwat.12136

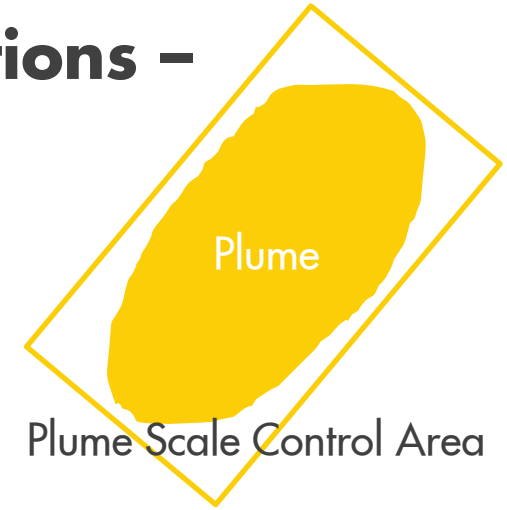
California
Texas
Florida
New Jersey

Low-Risk Groundwater Plume Management Options – Plume Scale

Site-specific plume scale – covered by institutional control to prohibit particular use.

Endpoint state, not an interim safeguard – final remedy

May require long-term monitoring – **situational, should serve a purpose**



Victoria, Aus and other states: Groundwater Quality Restricted Use Zones – recommended by the regulator or the environmental auditor after remediation attempt, reinforce with institutional control and registry https://www.epa.vic.gov.au/your-environment/land-and-groundwater/groundwater-pollution

Texas: Plume Management Zones – proposed by the person conducting the corrective action, reinforce with institutional control https://www.tceq.texas.gov/assets/public/comm_exec/pubs/rg/rg-366-trrp-29.pdf

Kansas: Risk Management Plan - enter into a RMP, receive a conditional closure, reinforce with institutional control http://www.kdheks.gov/redevelopment/euc/download/RMP_FactSheet.pdf

Petroleum Vapors Biodegrade
Low Risk Sites can be Screened Out

EPA United States Environmental Protection Agency

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Underground Storage Tanks (USTs)

- USTs Home
- Learn About USTs
- Meeting UST Requirements
- Preventing and Detecting Releases
- Cleaning Up Releases
- Laws & Regulations
- UST Program in Indian Country
- Emerging Fuels and USTs
- Frequent Questions
- UST A - Z Subject Index

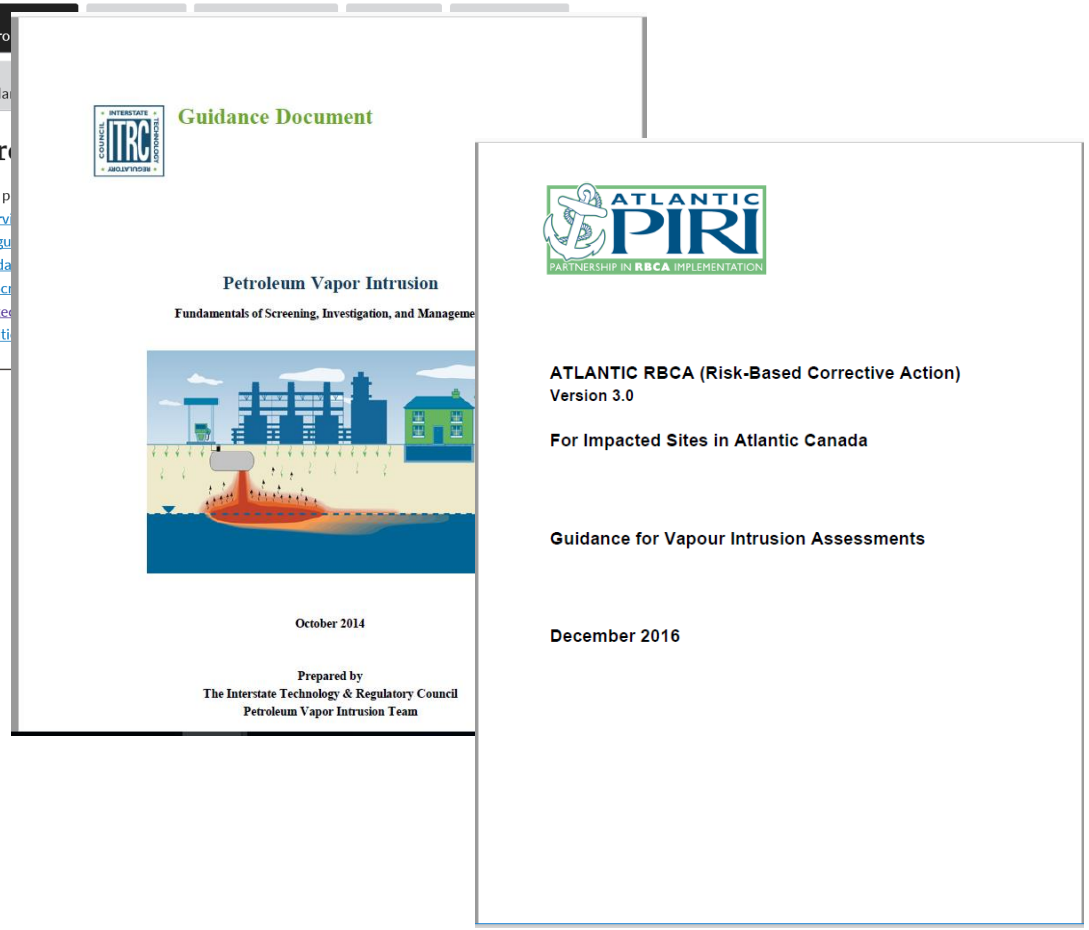
Petroleum Vapor Intrusion

Intro | Guida

Intr

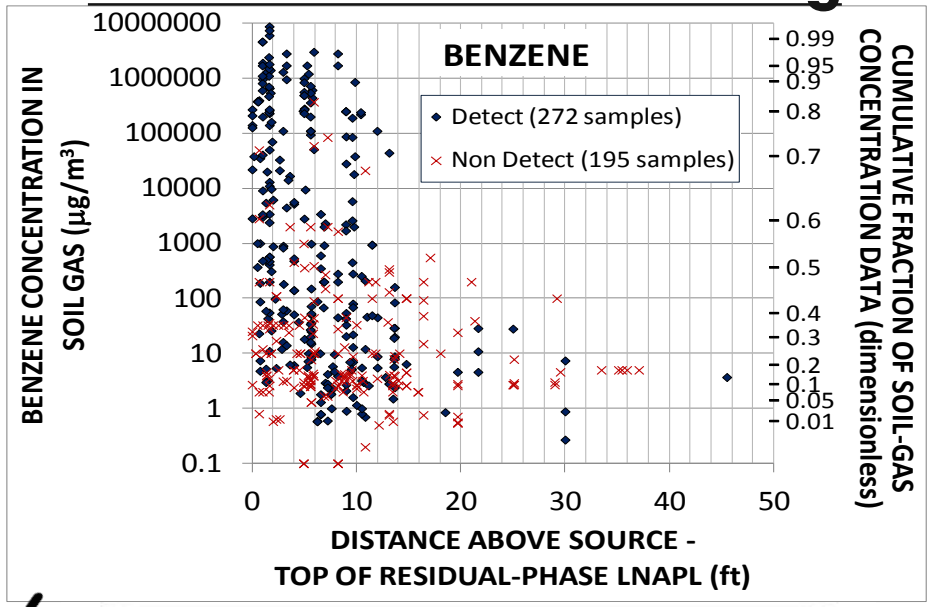
On this p

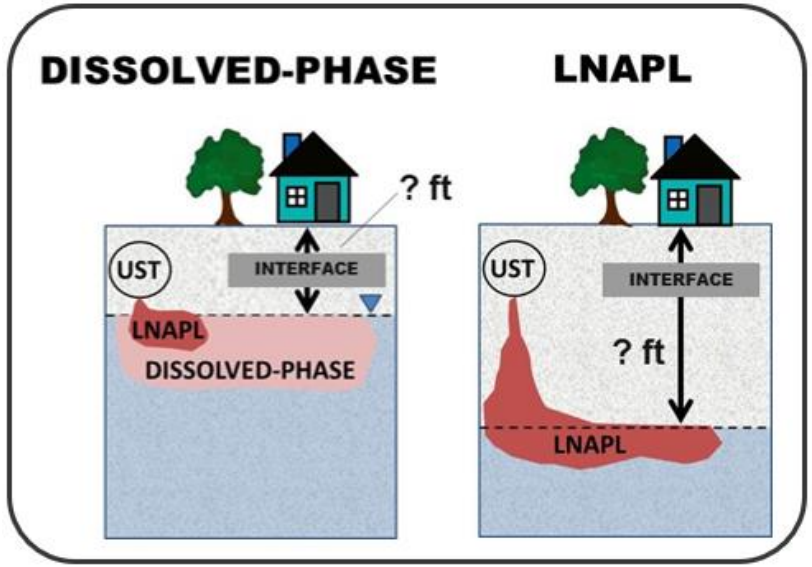
- Overv
- PVI gu
- PVI da
- PVIScr
- PVI tec
- Additi



Distance – Based Screening

Lahvis et al., 2013





Effective Contaminated Land Management

Innovative Ideas to Increase Brownfield Participation

Voluntary Programs and "Innocent" Programs

Now in many US states (google "Voluntary Cleanup Program") to encourage Brownfield development

- Streamlined regulatory scheme
- Formal concurrence of remediation – e.g., "Certificates of Completion", "Conditional Certificate of Completion," "No Further Action"
- Some with releases of liability from regulator
- "Cleanup" not limited to numeric standard compliance, but includes risk-based management
- Pay to play – pay for regulatory oversight

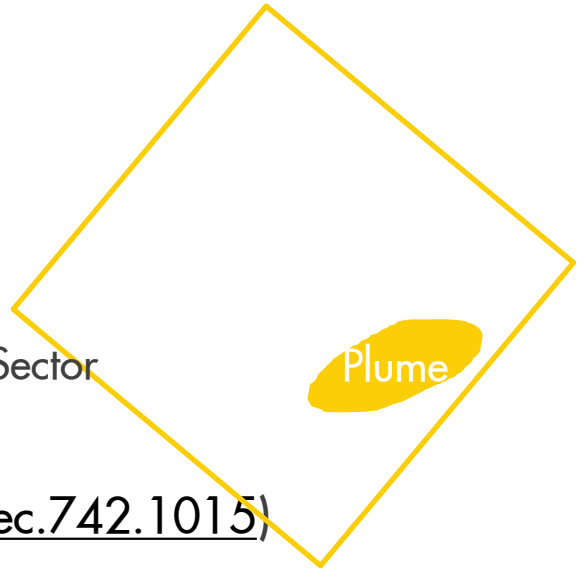
Texas: Innocent Owner/Operator Certificate, **Colorado:** No Action Determination

- Statement of "innocence" and regulatory liability release for soil and groundwater pollution if property affected by an off-site source, and did not cause or contribute to
- Encourages off-site landowner support for regulatory flexibility at on-site source property
- On-site source property owner can pursue for innocent off-site property

Prohibited Groundwater Use Ordinance – City or Sector-Scale

Municipal ordinance (i.e., bylaw) as an institutional control within City limit or portion of City limit

- Eliminate only groundwater ingestion exposure pathway
- Publicly provided potable water source, and not that groundwater
- To spark urban Brownfield redevelopment
- Legislation, but local government decides



- Illinois – Groundwater Use Ordinance (http://ilrules.elaws.us/iac/t35_pt742_sec.742.1015)
- Ohio – Urban Setting Designation (http://codes.ohio.gov/oac/3745-300-10, https://epa.ohio.gov/portals/30/vap/docs/fact8.pdf)
- Texas – Municipal Setting Designation (https://www.tceq.texas.gov/remediation/msd.html)
- Pennsylvania – Non-use Aquifer Area-Wide Certification (https://www.pacode.com/secure/data/025/chapter250/s250.303.html)

Timely Regulatory Review & Closure Documentation

Extending the regulatory base to the private sector to fill capacity and skill gaps.

- Licensed environmental professionals certify regulatory compliance
- US use for lower risk sites, Australia typically use for the higher risk, more complex sites
- Professionals subject to competency audits which tends to drive to regulatory conservatism
  - UK National Quality Mark Scheme - industry initiative https://www.claire.co.uk/projects-and-initiatives/nqms
  - AUS South Australia Site Contamination Auditor Program https://www.epa.sa.gov.au/environmental_info/site_contamination/assessment_and_remediation/the_audit_process
  - US Massachusetts Licensed Site Professionals https://www.mass.gov/orgs/board-of-registration-of-hazardous-waste-site-cleanup-professionals
  - BC Contaminated Sites Approved Professionals https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/approved-professionals

Sustainable Soils Re-Use

UK – Definition of Waste: Code of Practice (https://www.claire.co.uk/projects-and-initiatives/dow-cop)

- Industry developed, regulatory endorsed
- Self implementing environmental standards for property developers to work with local planning authority to define suitable approaches
- To determine if soils can be suitably reused for a designated purpose, to by pass "waste or contaminated" designations and thus remain outside a regulatory process. Developed to encourage investors to redevelop Brownfields
- More sustainable by not filling landfill space and limits soil use from green fields by re-use of recovered materials
- Projects are overseen by Qualified Professionals, and subject to audits to verify compliance