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Unique Challenges of Remediation of Complex Sites

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2021 Global Summit
on Environmental Remediation
#REMPLEX

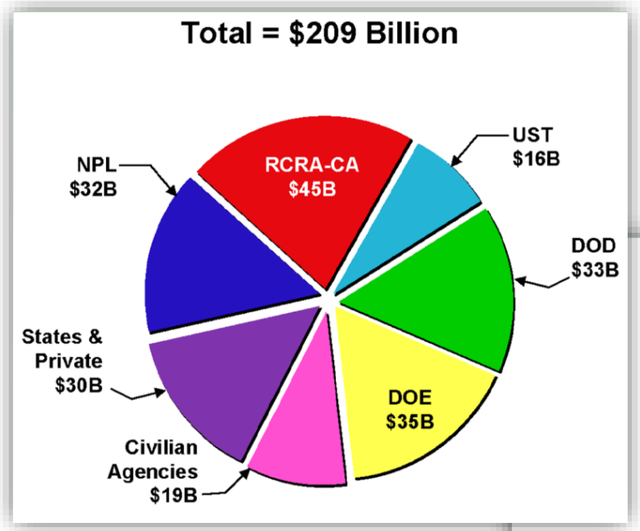
U.S. DEPARTMENT OF ENERGY BATTELLE

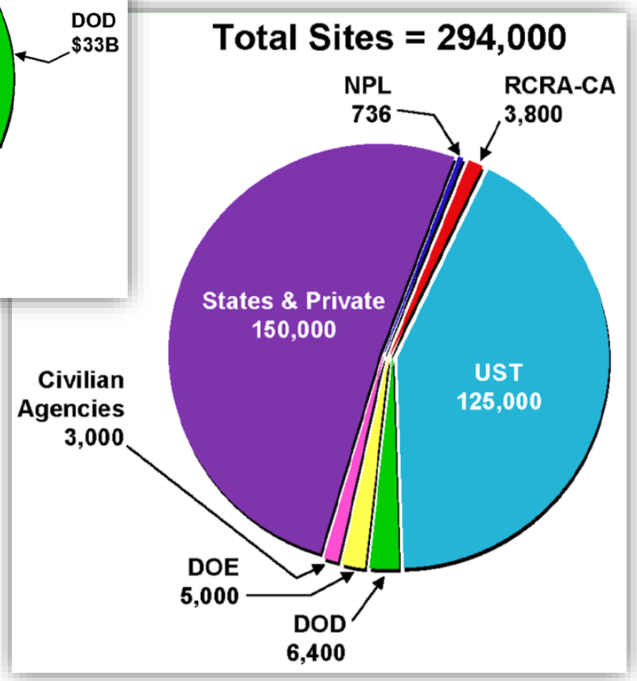
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Complex Site Challenges





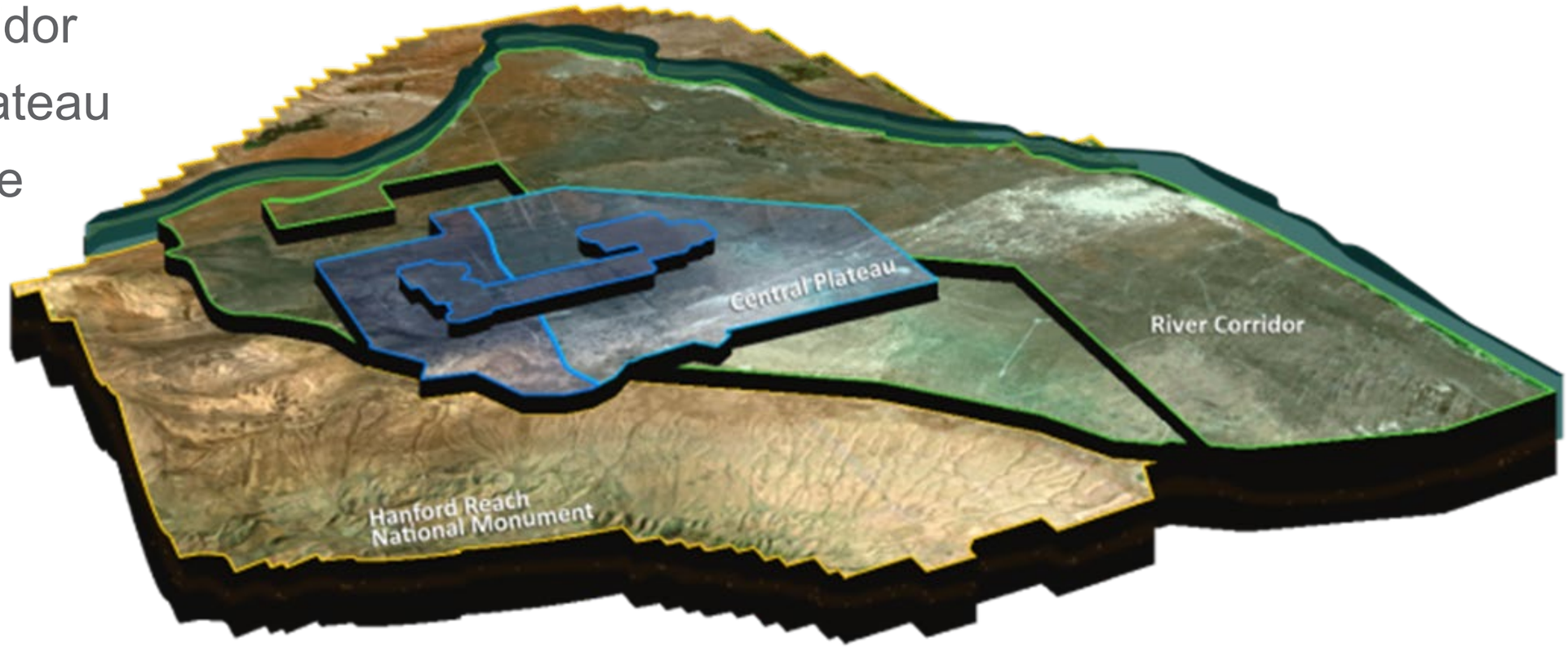
- Environmental Protection Agency, 2004
  - Technical complexities limiting remediation and closure of ~300,000 sites and ~$200B
- National Research Council, 2013
  - Technical complexities preventing closure of ~13,000 sites over 50-100 years
  - "*…extensive groundwater contamination, heterogeneous geology, large releases and/or source zones, multiple and/or recalcitrant contaminants, heterogeneous contaminant distribution in the subsurface, and long time frames since releases occurred.*"
- Interstate Technology & Regulatory Council, 2017
  - "*Sites where remediation progress is uncertain, and remediation is not anticipated to achieve closure or even long-term management within a reasonable timeframe.*"

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Hanford Cleanup: A Model Case Study in Complexity

Three Components

- River Corridor
- Central Plateau
- Tank Waste



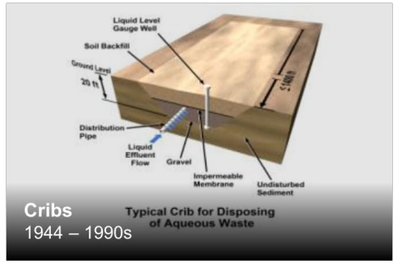
Shrink to the extent practical from 586 square miles to about 10 square miles – or 98 percent (Inner Area)

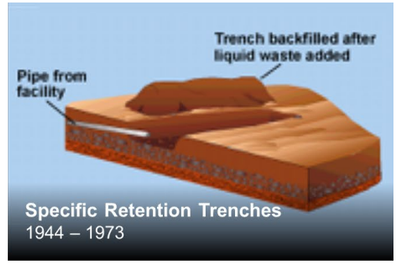
Complexities of Environmental Remediation

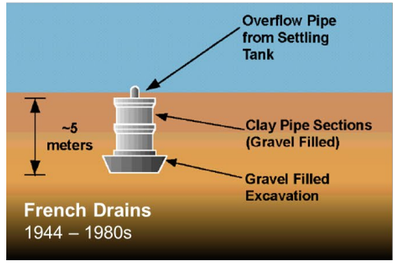
Source Terms and Waste Sites

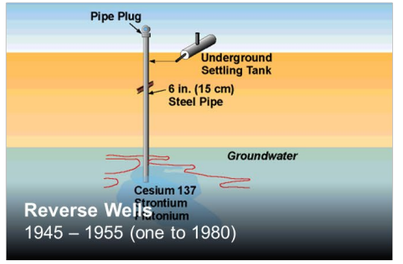
- Continuing sources
  - Many waste sites pose the potential for continuing contamination sources to groundwater, potentially over long time periods.
- Adjacent waste sites
  - Remedy evaluation and implementation must consider waste site “complexes” where multiple discharge sites of differing volume and contaminants are adjacent to each other and are adjacent to facilities or tank farms.

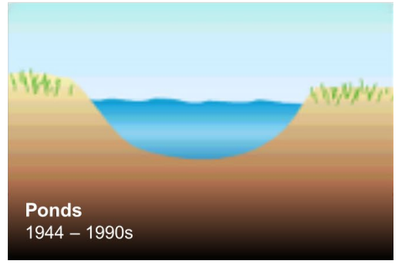


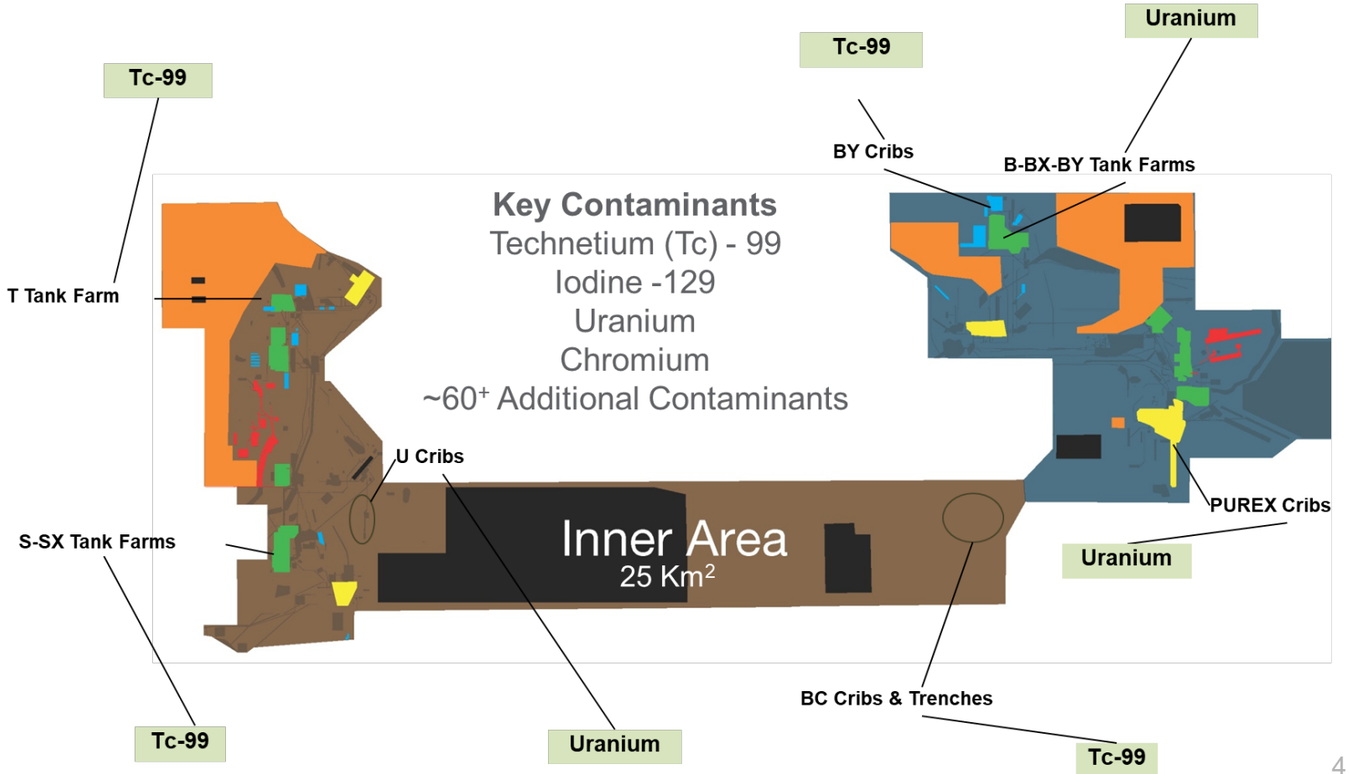








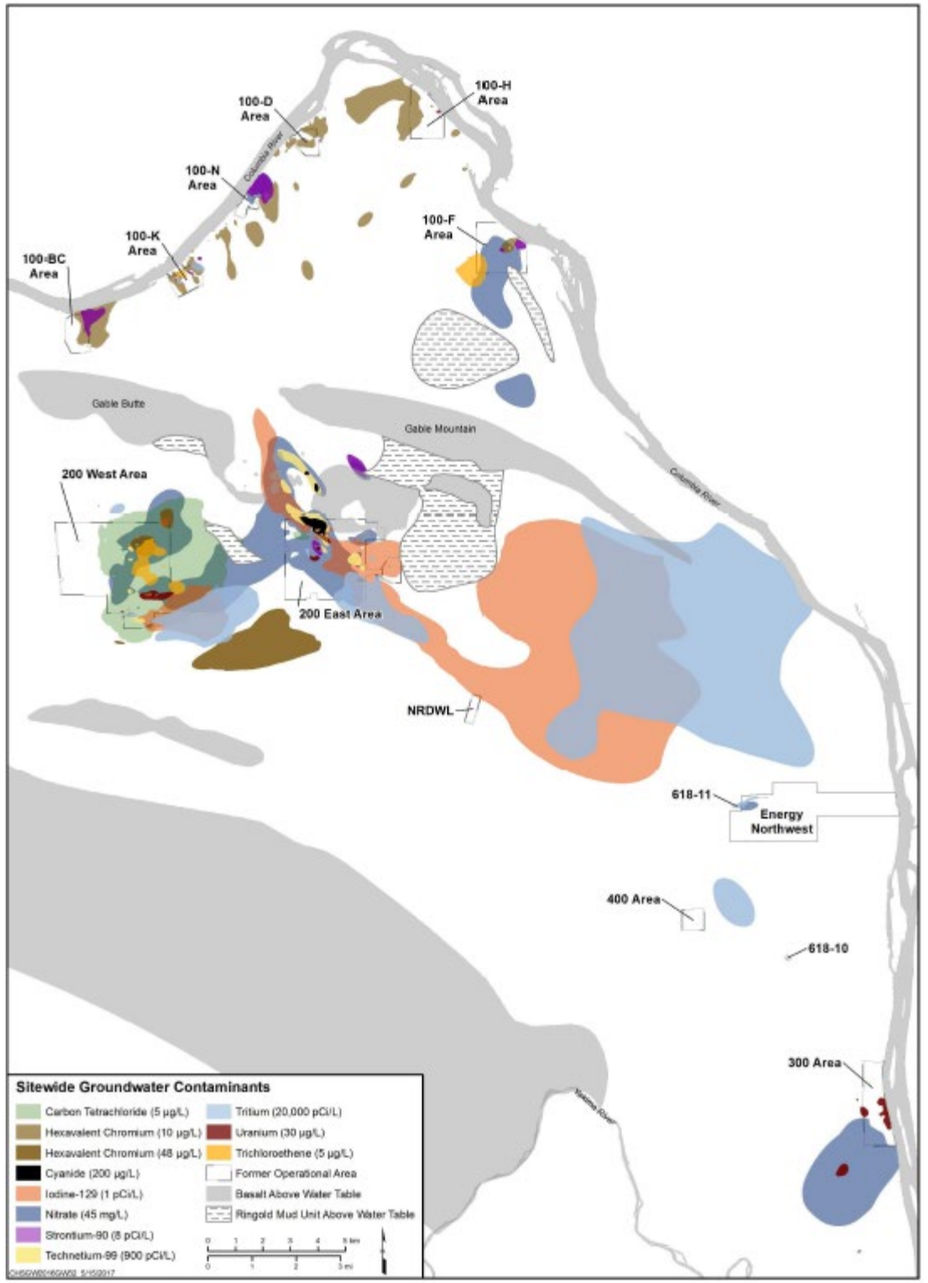




Complexities of Environmental Remediation

Scale and Co-contaminants

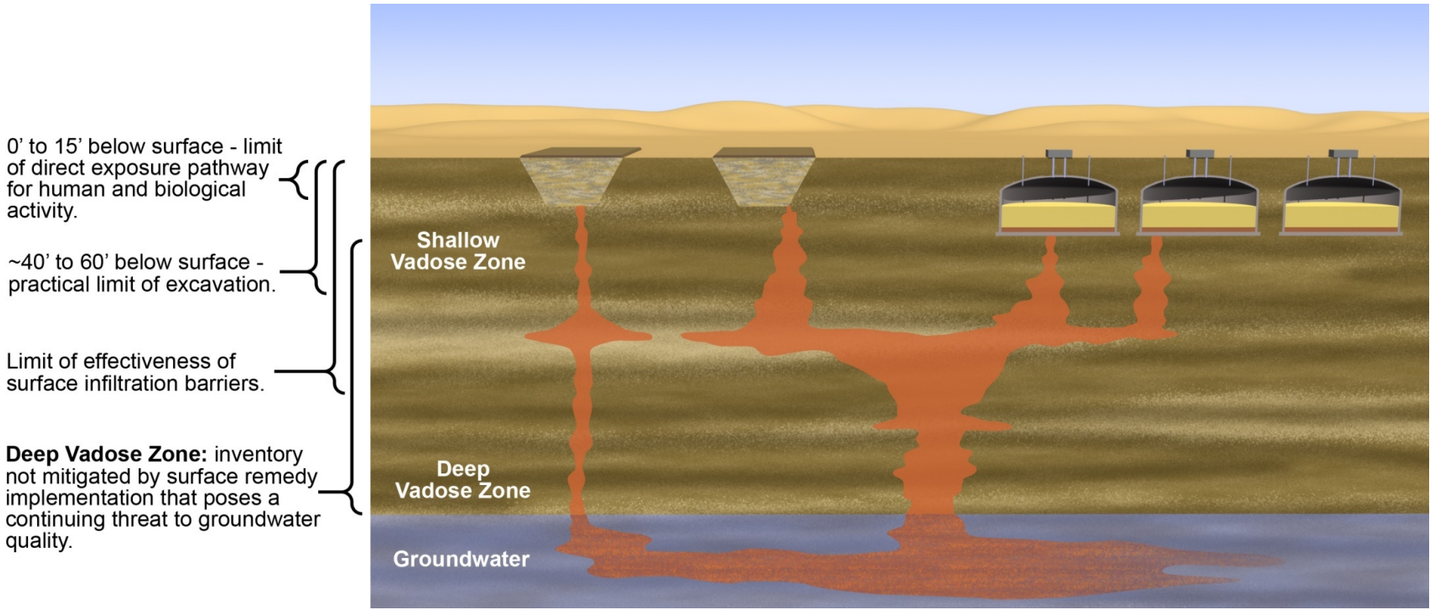
- Scale
  - Many plumes are large (square kilometer scale) and the Central Plateau vadose zone is 100 m thick – a scale that is large for many types of remedies.
- Mixed contaminants
  - Remedy evaluation and implementation must consider the presence of multiple contaminants having different characteristics and potential use of multiple remedy technologies.



Complexities of Environmental Remediation

Coupled-systems and Time

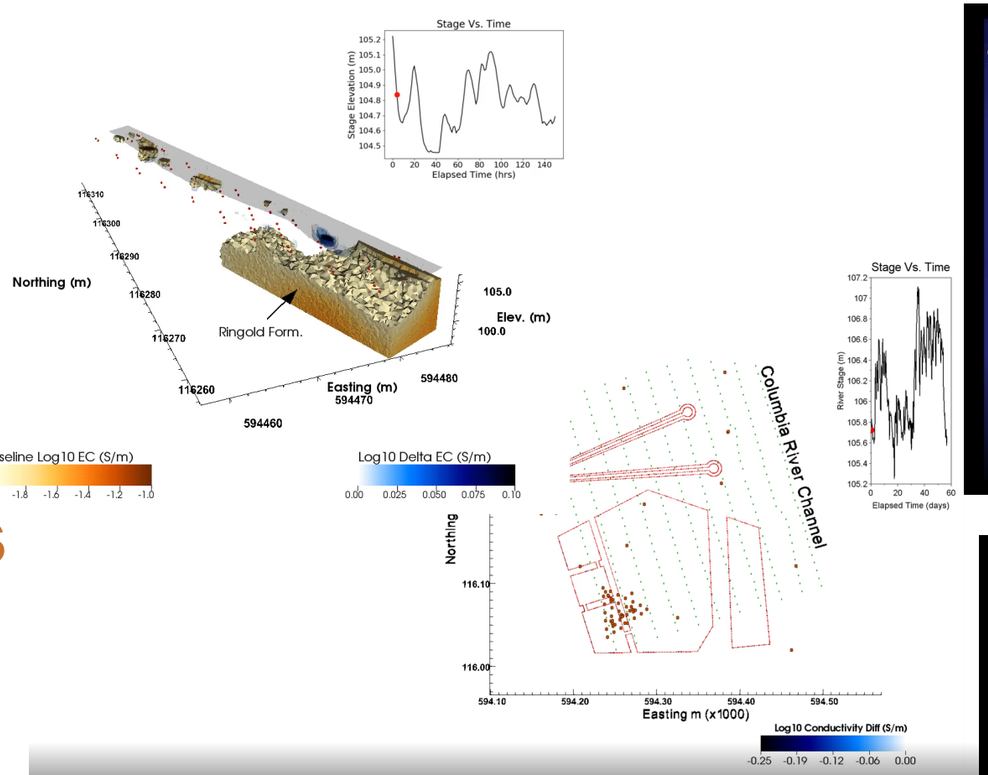
- Coupled-system understanding
  - Multiple discharges into a thick vadose zone resulted in a complex distribution of contaminants with some in groundwater and some as potential continuing sources in the vadose zone.
- Timeframe
  - Long-lived radionuclides, large scale, and slow rate of transport in the vadose zone and groundwater lead to long remediation timeframes.

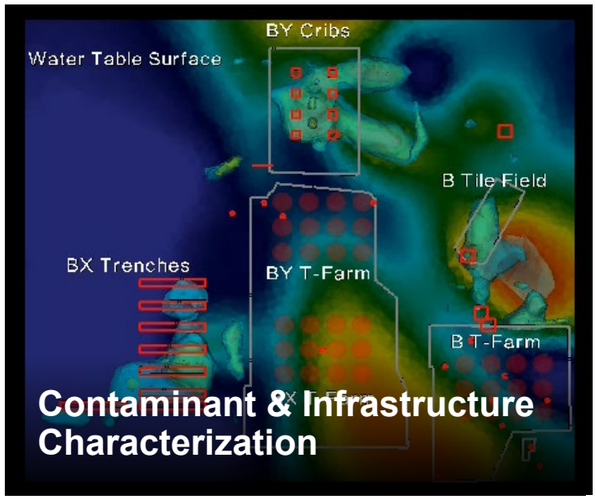


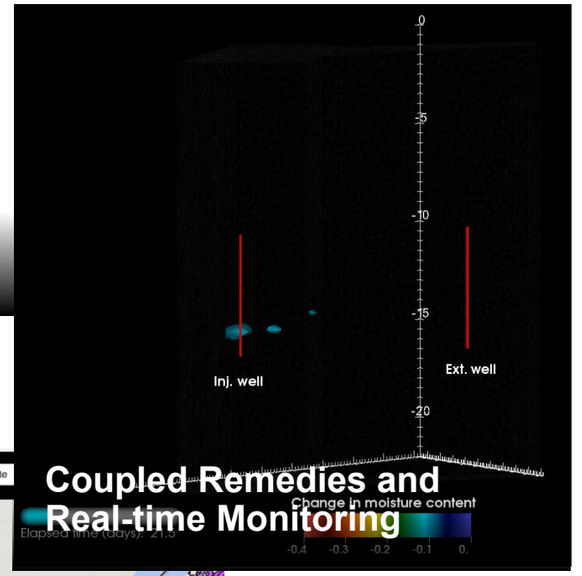
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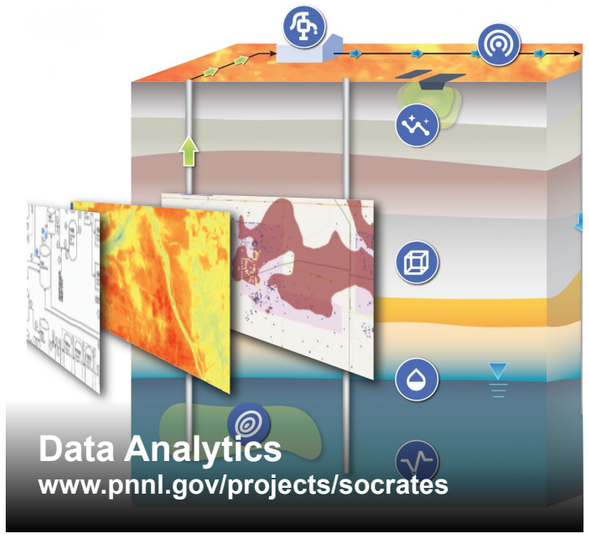
Collaborating for Innovative Solutions

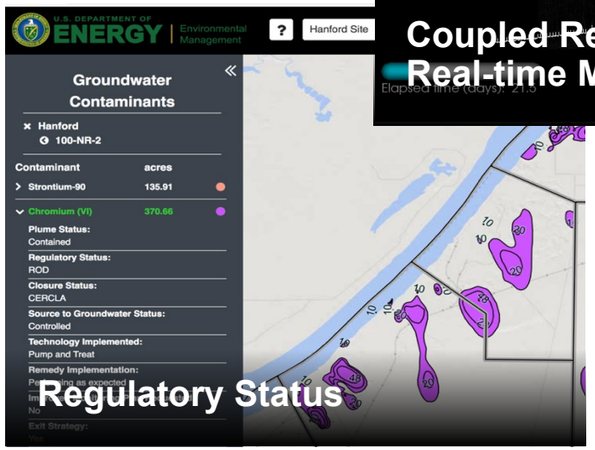
- Characterization & Monitoring
  - Limitations for large plumes, quantifying continuing sources, deep vadose zone contaminants…
- Coupled approaches
  - Multiple approaches, spatially and/or temporally











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CENTER FOR THE REMEDIATION
OF COMPLEX SITES
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Solution Development – Advanced solutions in adaptive remediation that enable risk-based remediation

Multi-institutional Collaborations – Integration and leveraging across federal and private partnerships to facilitate advancement

Technical Leadership – Independent technical resource for remediation and adaptive management of complex sites

Providing a global forum committed to fostering technical leadership, collaborative research, and professional development that facilitates the cost-effective remediation of complex sites.

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Thank you

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2. NRC: https://www.nap.edu/catalog/14668/alternatives-for-managing-the-nations-complex-contaminated-groundwater-sites