2023 Global Summit

Hanford Case Study Agenda

The Use of Geophysics to Support Site Characterization, Remedy Implementation, and Monitor Performance at the Hanford Site	
~~9:00 – 9:15 am~~	Geophysics of Old - Historical uses of geophysics methods at the Hanford Site *Doug Hildebrand, Argonne Associate / Retired DOE-RL Soil and Groundwater Division*
~~9:20 – 9:40 am~~	Utilizing Geophysical Methods in Remedial Decision Making at the Hanford Site *Sarah Springer, CERCLA Integration Manager*
~~9:45 – 10:00 am~~	Geophysical method selections, investigations, and translation for characterization and monitoring goals *Fred Day-Lewis, PNNL Chief Geophysicist and Lab Fellow*
~~10:05 – 10:20 am~~	Stratigraphic structure identification using electrical resistivity tomography (ERT) and seismic methods *Judy Robinson, PNNL Geophysicist*
10:25 – 10:40 am	**BREAK**
10:40 – 10:55 am	Source Characterization at the B-Complex and BC-Cribs and Trenches *Tim Johnson, PNNL Geophysicist*
11:00 – 11:15 am	Remedy Monitoring Using ERT at the 100-K Soil Flushing Site *Tim Johnson, PNNL Geophysicist*
11:20 – 11:40 am	Long term monitoring of low moisture and flux conditions in the vadose zone using multiple geophysical methods *Chris Strickland, PNNL Physicist*
11:45 – 12:00 pm	Predicting Remediation Technology Longevity using Spectral Induced Polarization *Jim Szecsody, PNNL Geochemist*

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IAEA International Atomic Energy Agency
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Source Characterization at the B-Complex and BC-Cribs and Trenches

Nov. 14, 2023

Tim Johnson, Judy Robinson, Jon Thomle, Jack Cambeiro, Kelsey Peta, Rob Mackley

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on Environmental Remediation
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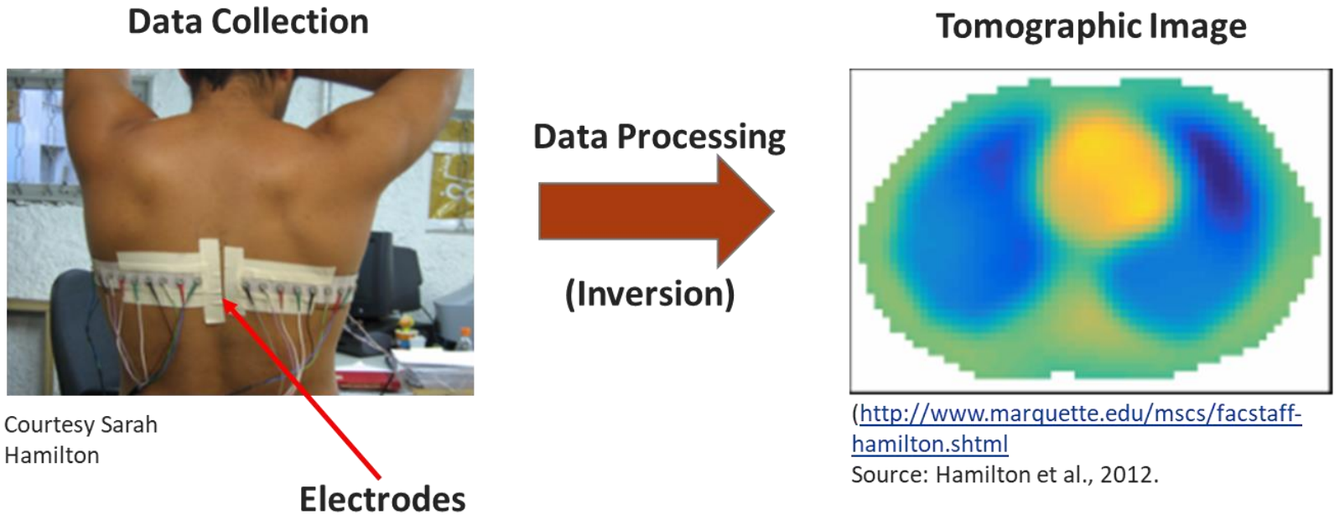
U.S. DEPARTMENT OF ENERGY BATTELLE

PNNL is operated by Battelle for the U.S. Department of Energy

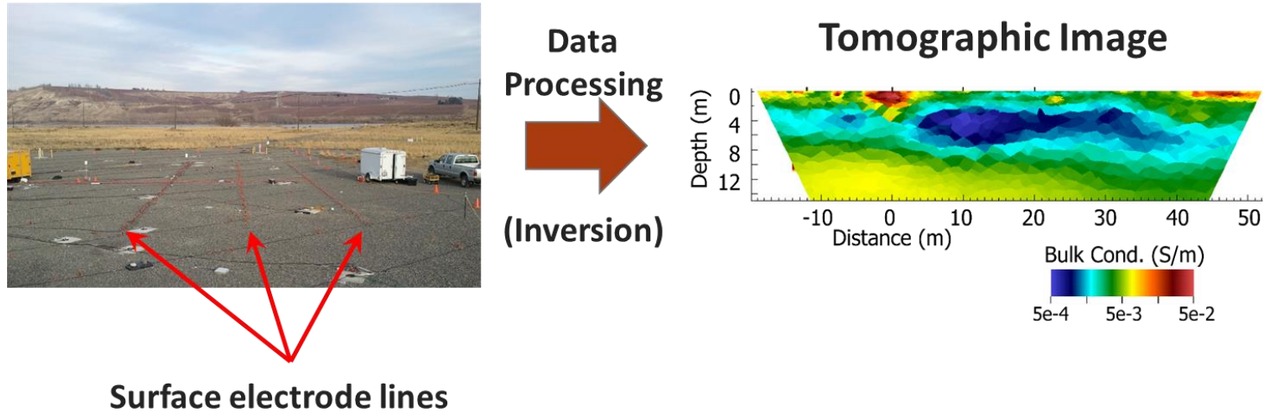
Electrical Resistivity Tomography

- Images electrical conductivity of the subsurface
  - Porosity
  - Saturation
  - Pore fluid chemistry
  - Grain size distribution
  - Mineralogy

Medical Imaging Analog: Electrical Impedance Tomography



Subsurface Electrical Impedance/Resistivity Tomography



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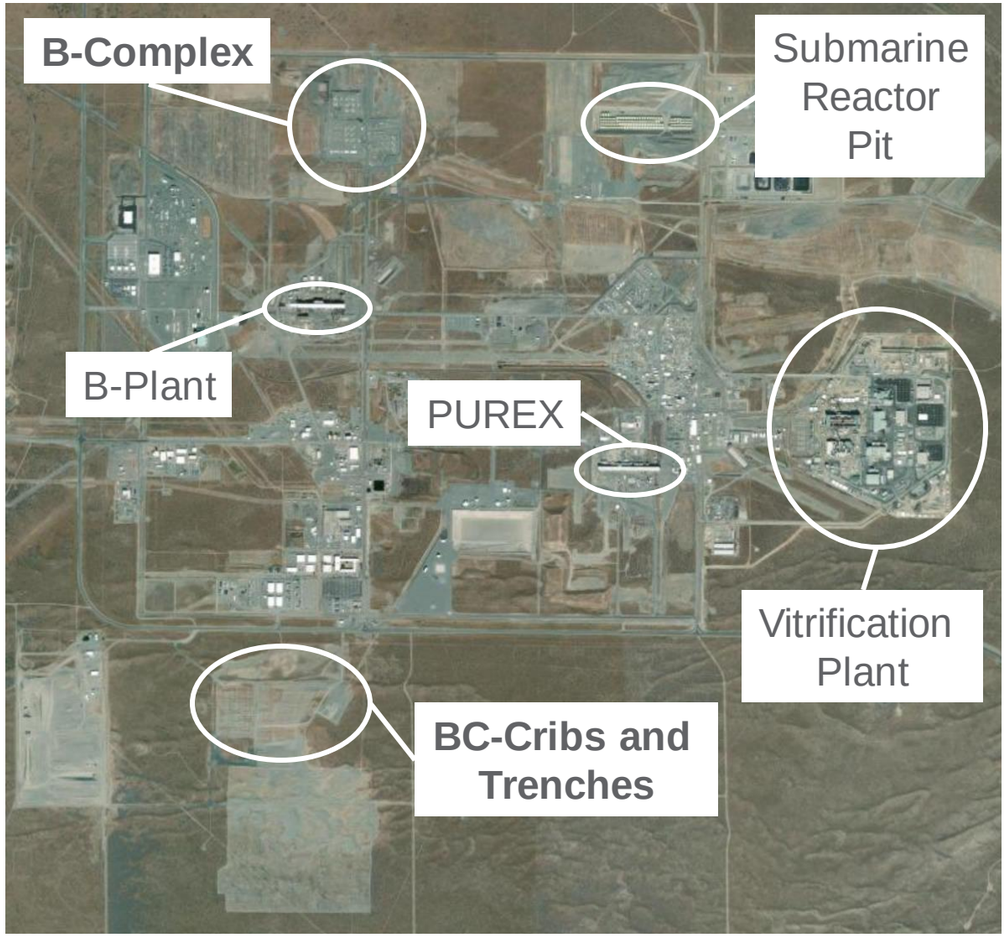
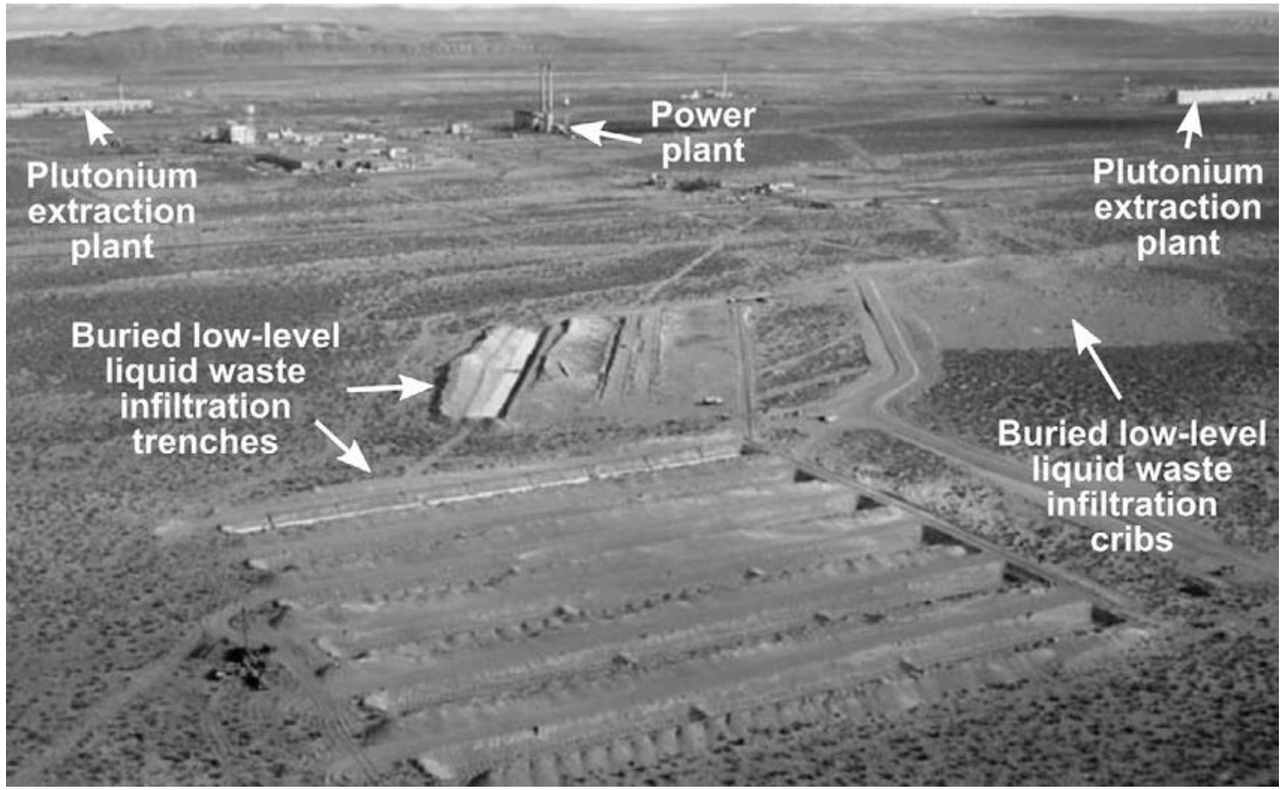
Hanford BC Cribs and Trenches Disposal History

Hanford 200 East Area



BC Cribs and Trenches



23 Million kg of nitrate
411 Ci tech-99
4426 Ci Sr-90
5003 Ci Cs-137

1.25 Ci U-238
26 Ci Co-60
118 Ci Pu-239/240

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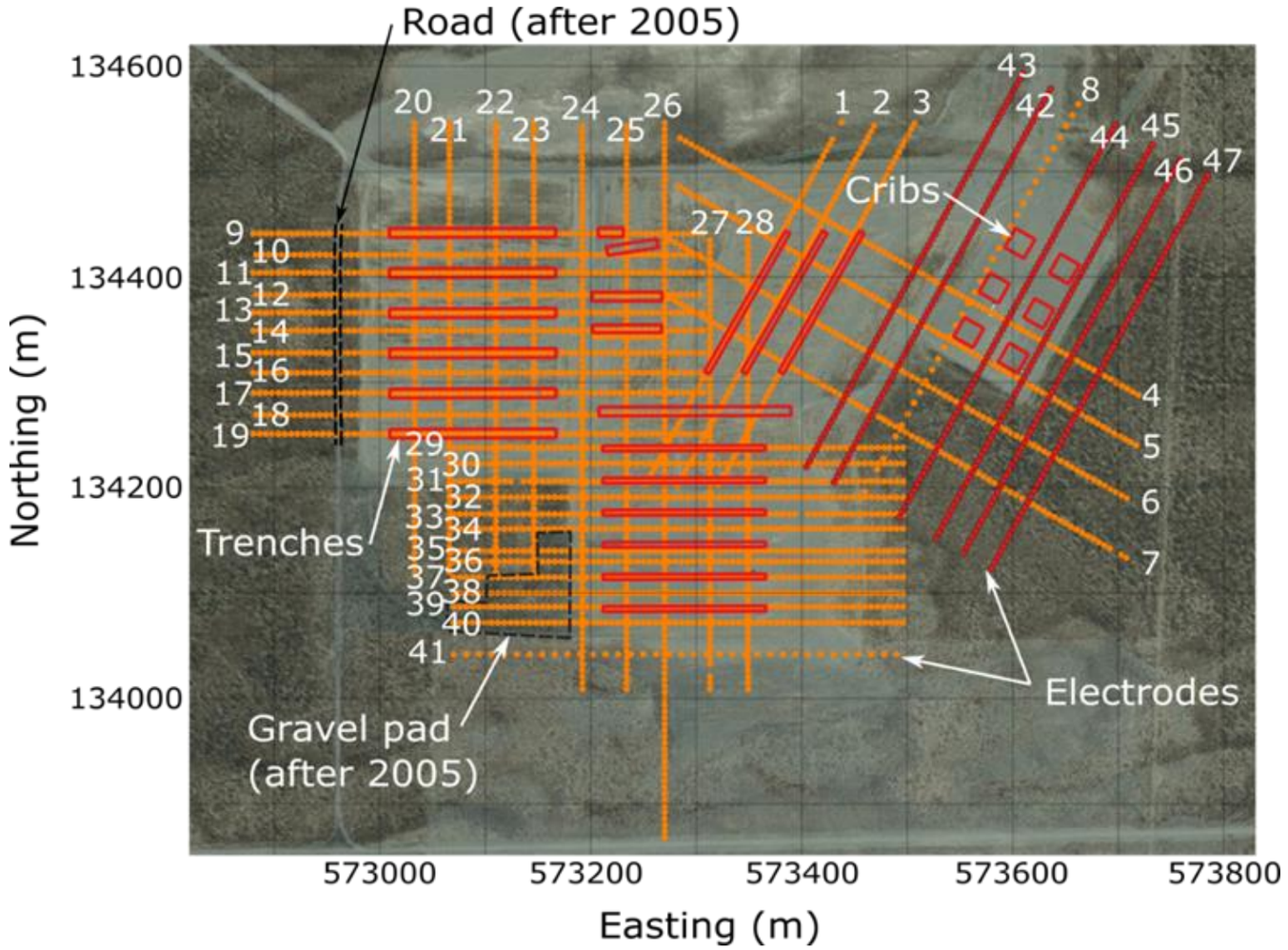
2005 and 2022 ERT Imaging Campaigns

2005

- 41 surface ERT lines
- > 5000 electrode positions at 3m spacing
- 2998 electrodes positions @ 6m spacing
- 15,249 pole-pole measurements inverted
- 2.84 M tetrahedral elements

2022

- Exact repeat of 2005 (approximately)
- Dipole-Dipole data also collected
- Processed on same mesh as 2005 data



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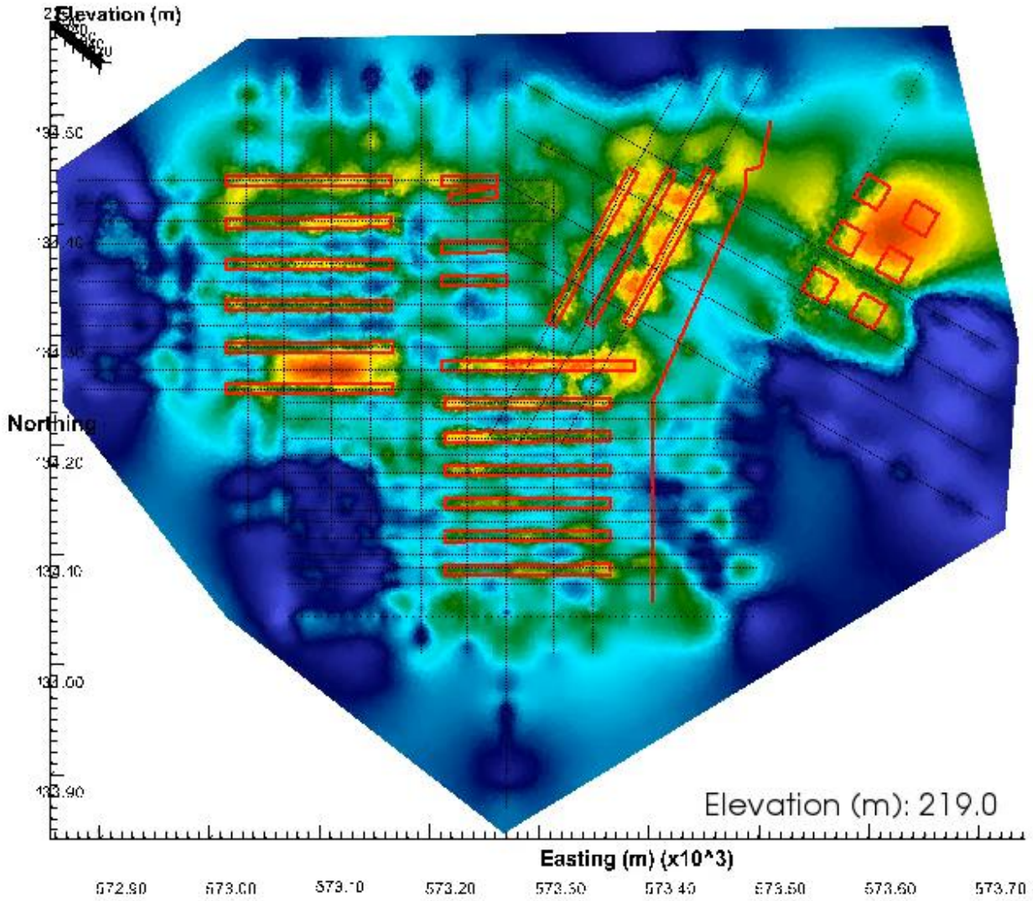
BC-Cribs and Trench ERT Characterization



Bulk Conductivity (S/m)

5.0e-04 1.0e-03 5.0e-03 1.0e-02 5.0e-02

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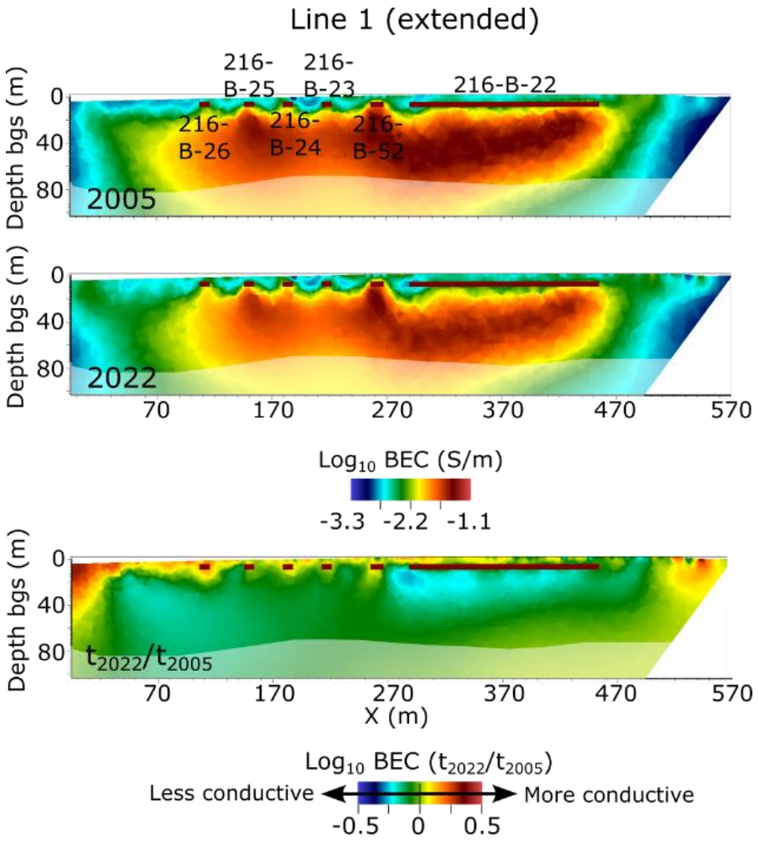
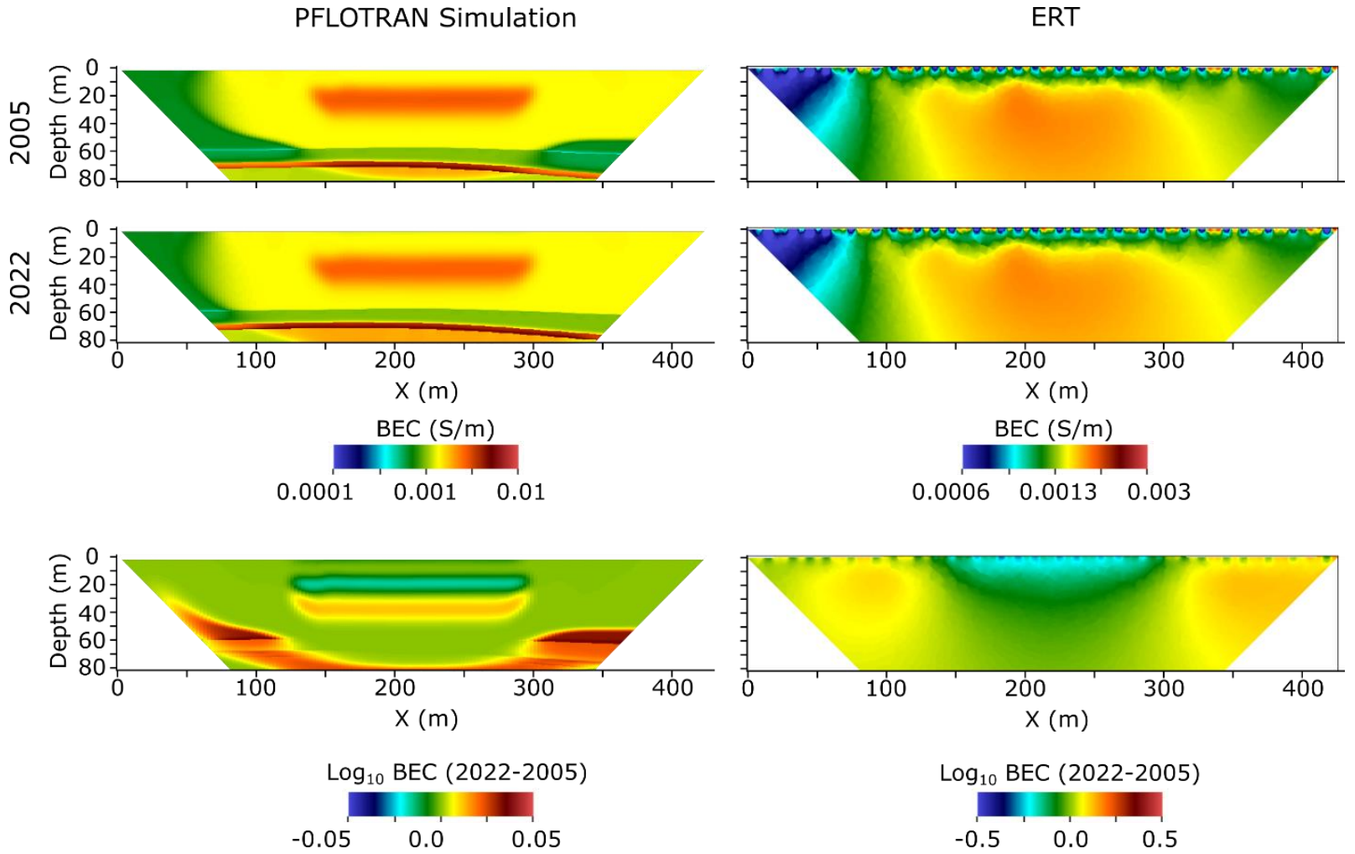
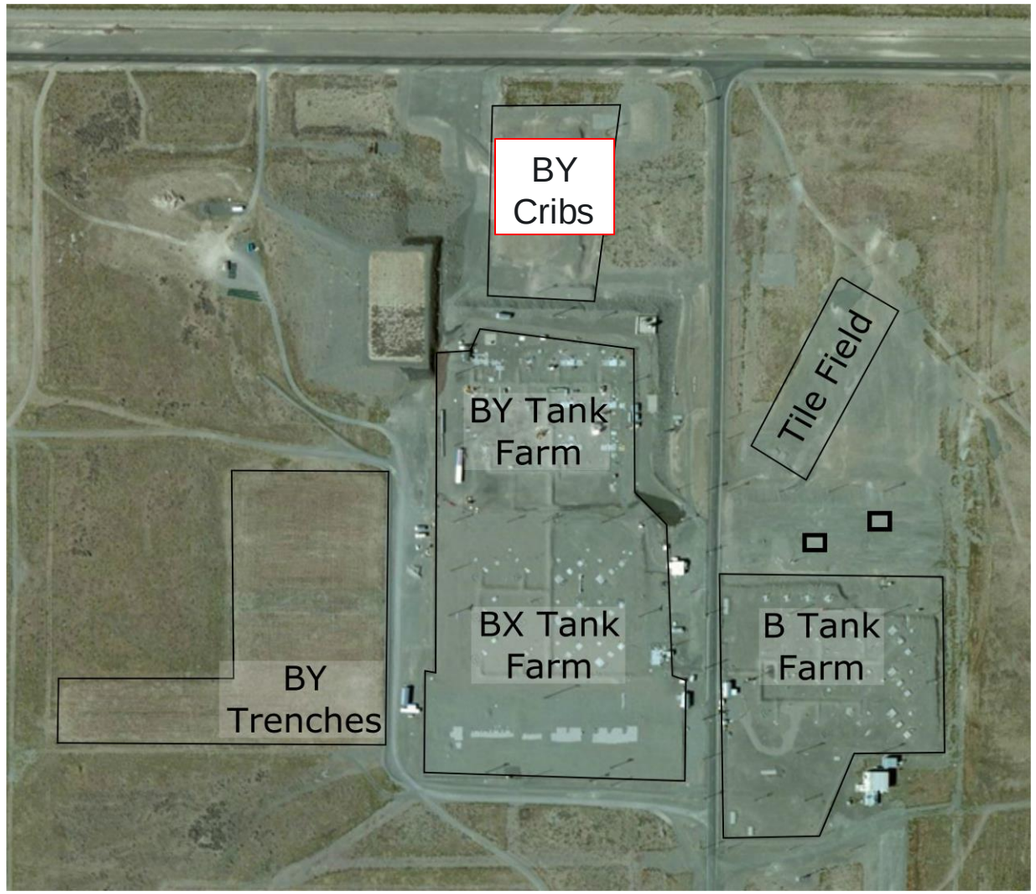
2005-2022 Time-Lapse Analysis



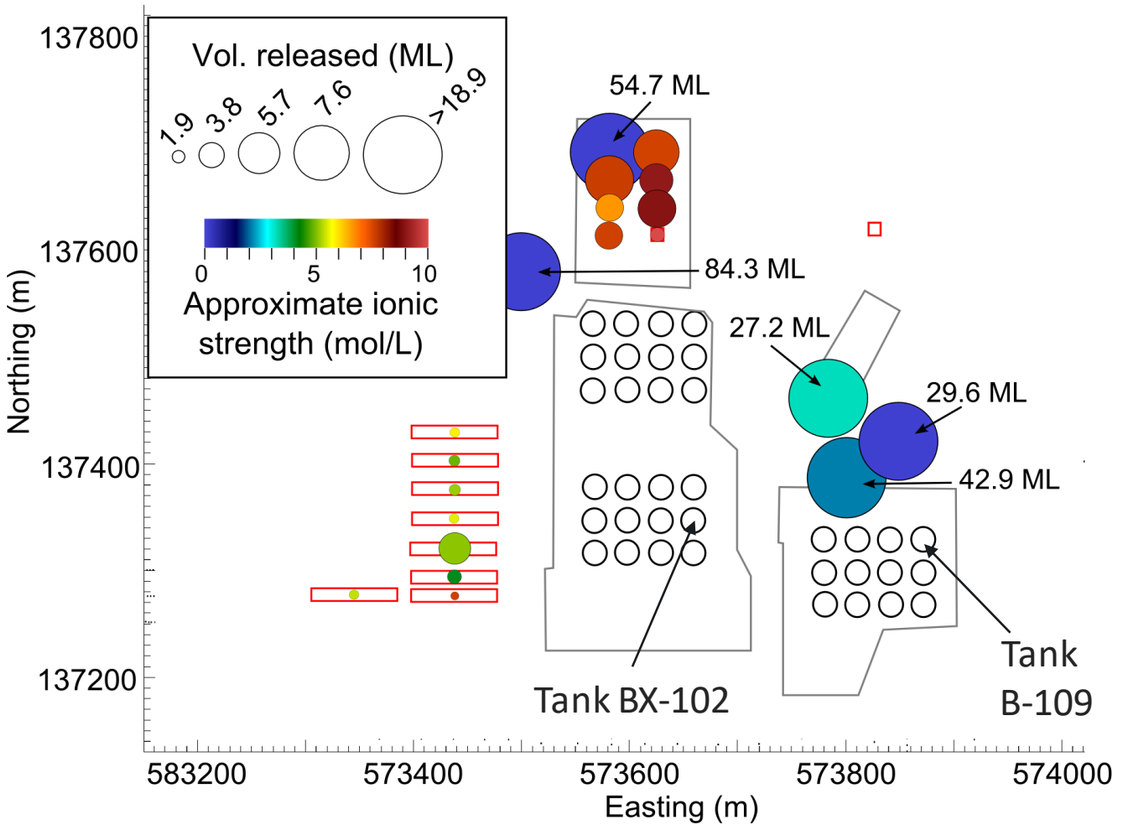


Hanford Site B-Complex Waste Release History

B-Complex Layout



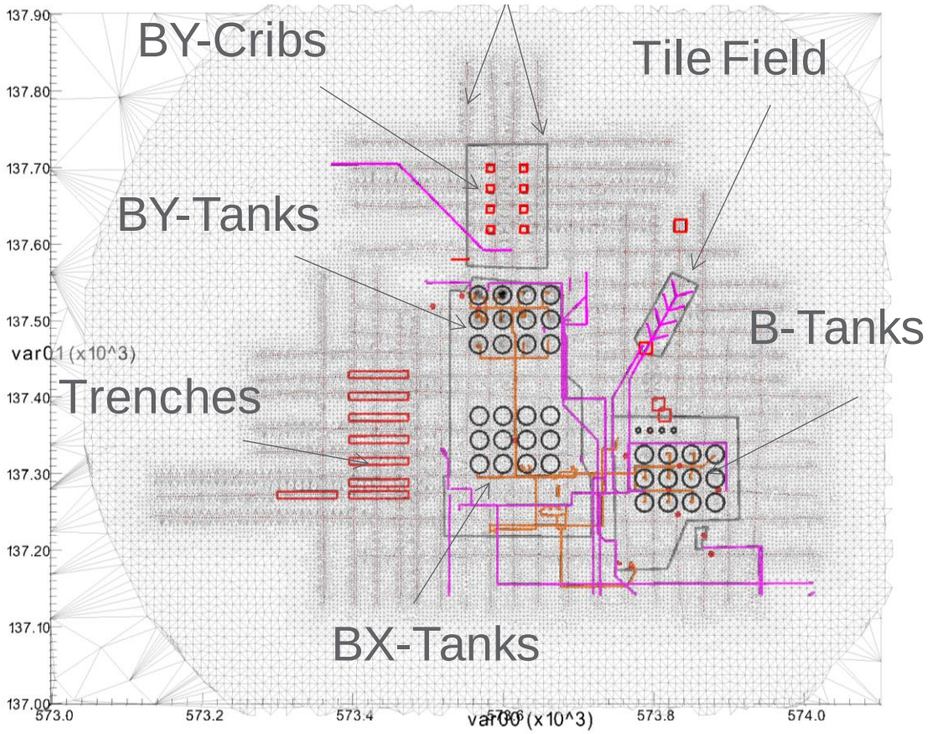
Waste Release Summary



2003 B-Complex ERT Survey

Computational Mesh: Plan view

Mesh refinement about electrode lines

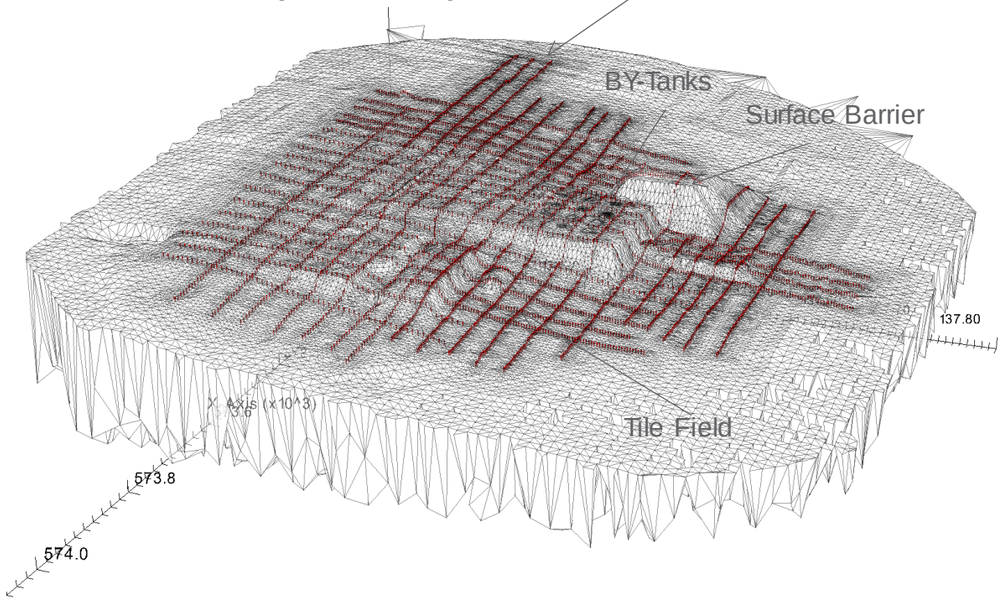


1 km

Computational Mesh: Oblique view

Topography extracted from LIDAR data (5x vertical expansion)

Electrode lines

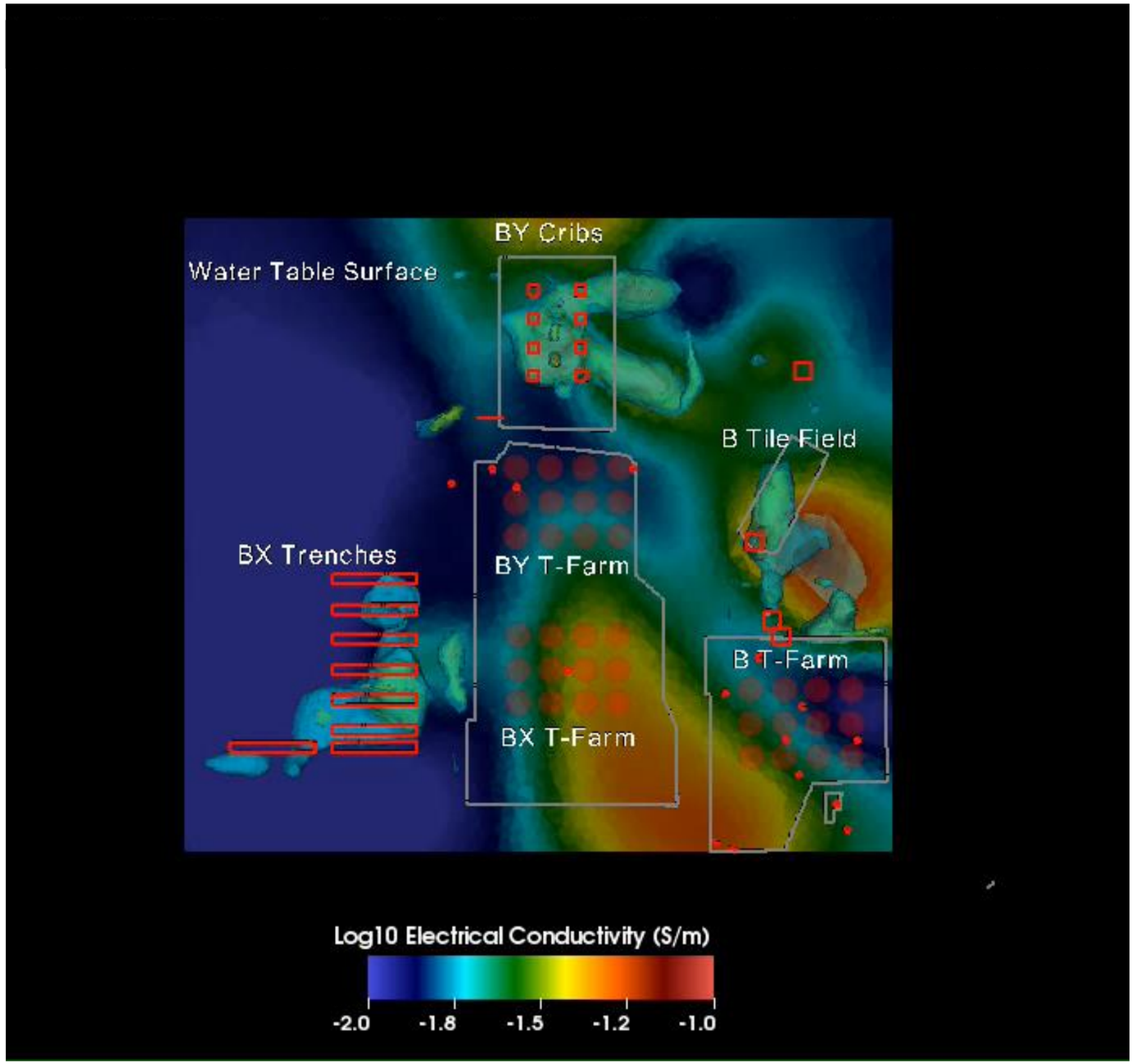


North

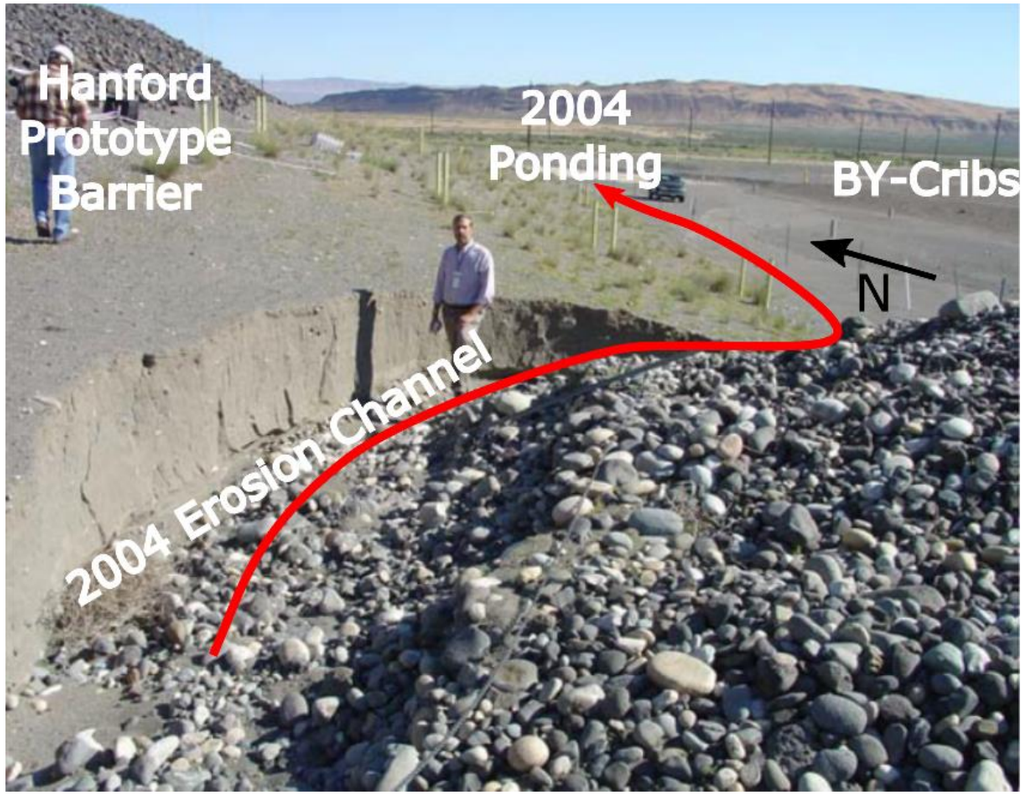
Data collected by HydroGeophysics Inc.

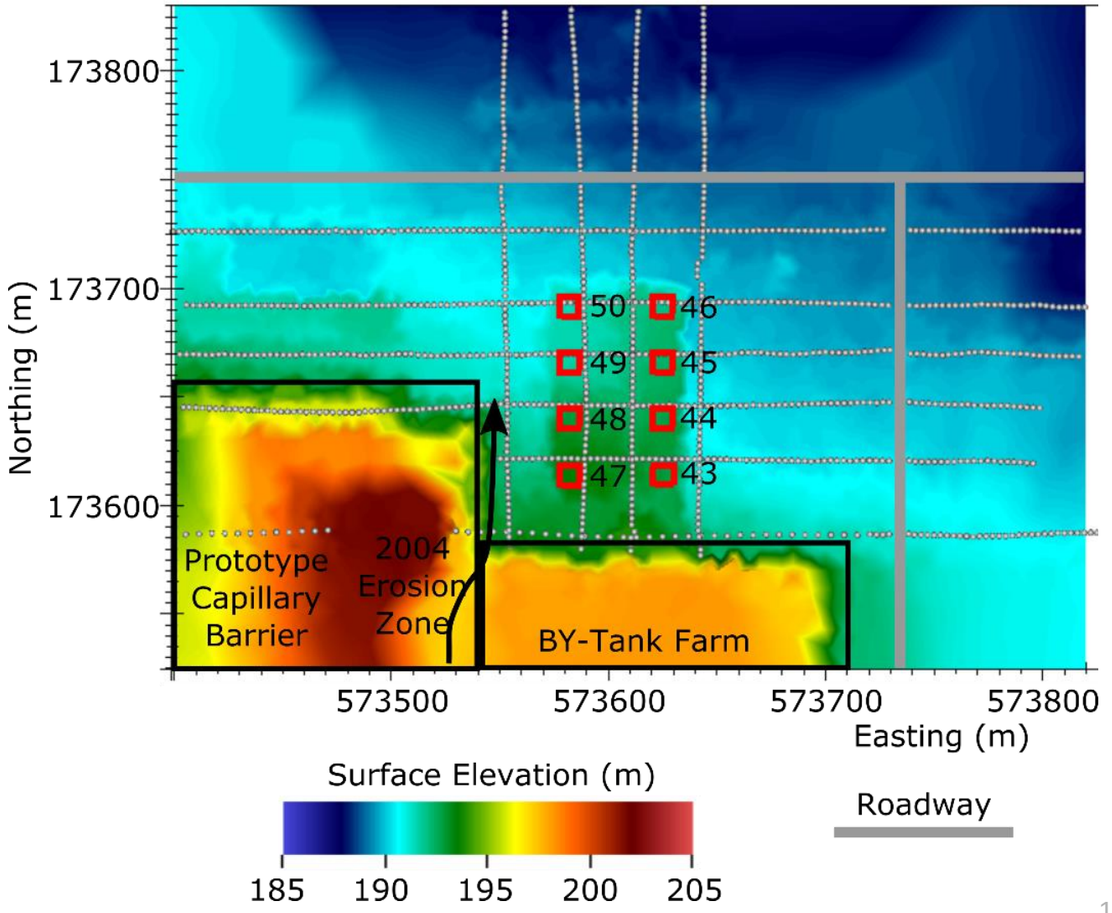
2003 B-Complex ERT Characterization Image

- Executed in 2012
- ~5250 electrode locations
- >25,000 measurements
- ~3M mesh elements
- Buried tanks and pipes explicitly simulated
- Inverted on ~5250 cores NERSC supercomputing facility (~6 hrs).



2004 Precipitation Event: BY-Cribs Impact





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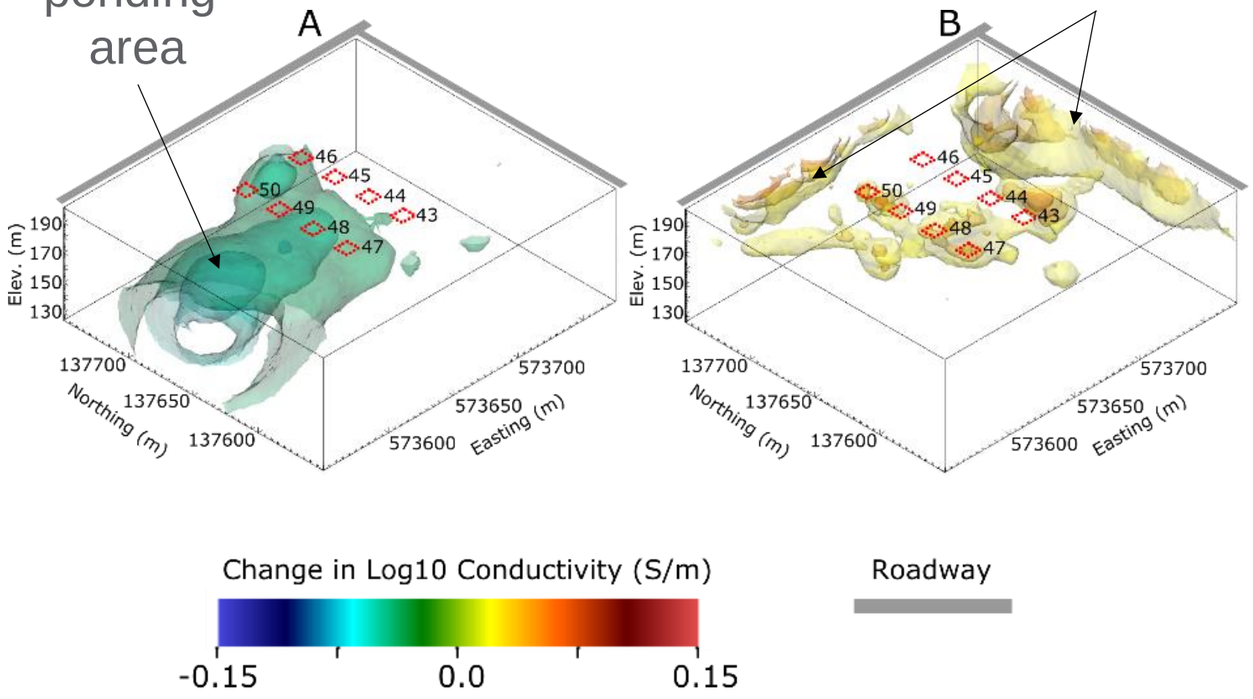
2003 to 2016 Change in Bulk Conductivity

Iso-surface Views

2004 ponding area

Near-surface increases

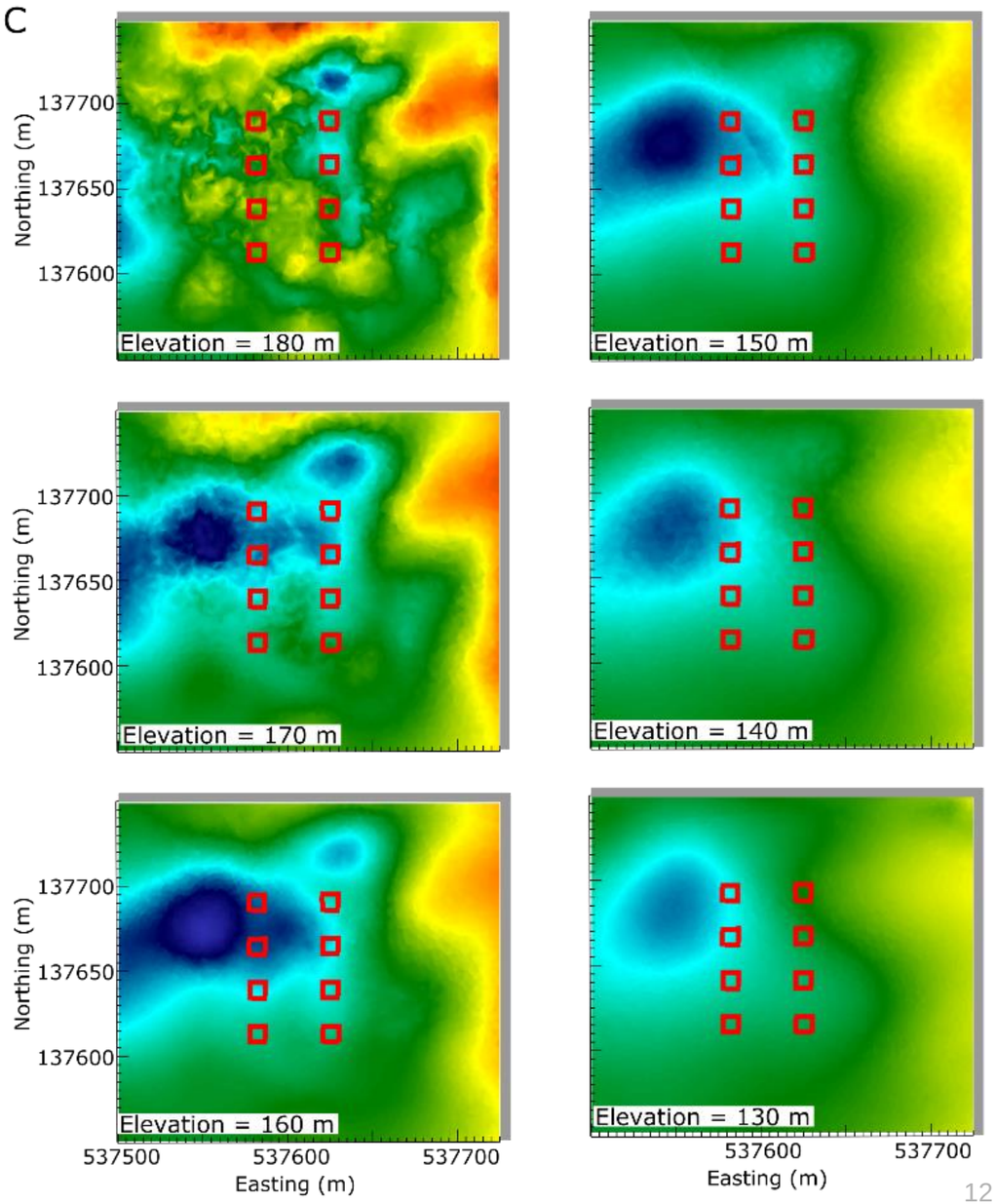


Change in Log10 Conductivity (S/m)

-0.15 0.0 0.15

Roadway

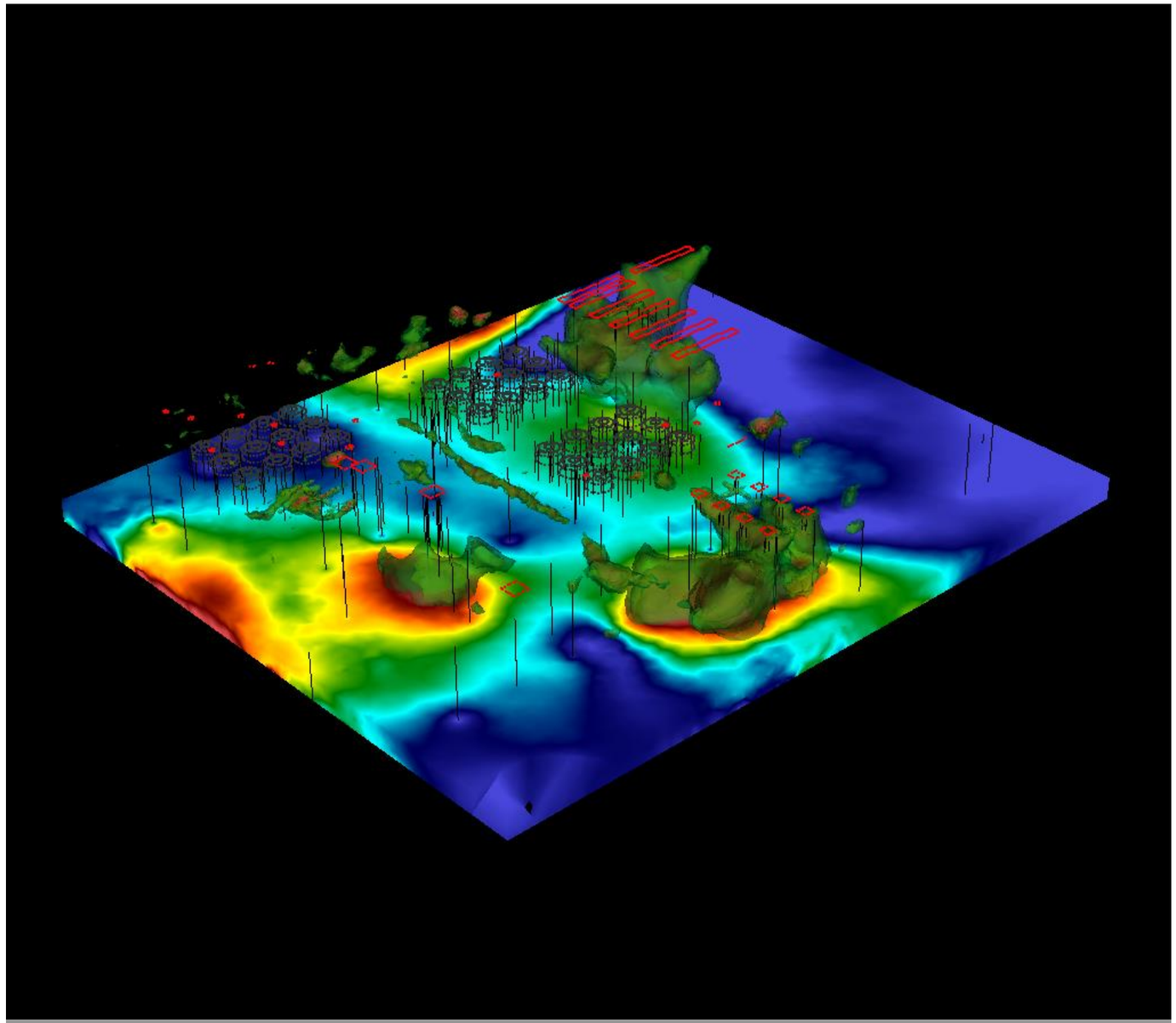
Depth-Section Views



Strong evidence that ponding event impacted BY-Cribs area

Summary

- ERT- Effective tool for imaging vadose zone contamination
  - Facilitated by high performance computing and infrastructure modeling
- Cost effective
- Impacts of anomalous events



B-Complex Wellbores and ERT Image

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Questions?

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