EM Engineering & Technology: Groundwater and Soils Remediation Program

EM-20 Roadmap Projects

Terri Stewart, Mark Freshley, Dawn Wellman,
Mike Truex, and John Fruchter

January 8, 2009

Office of Engineering and Technology Program Objectives, Risks, and Uncertainties

- **Objective** is to reduce technical risk and uncertainty in the DOE EM clean-up mission
  - **Risks** are known technical issues that could prevent project success
  - **Uncertainties** are indefinite or unpredictable technical aspects of a project
- **DOE-EM Engineering & Technology Program** will provide:
  - Technical solutions where none exist
  - Improved solutions that enhance safety and operating efficiency, or
  - Technical alternatives that reduce programmatic risks (cost, schedule, or effectiveness)
- **Supported by DOE National Laboratories**

Role of the DOE National Laboratories

- National Laboratory Advisory Group (NLAG)
  - Led by SRNL (EM's lead laboratory)
  - PNNL, INL, and ORNL
- Initiative Development Teams (IDT's)
  - Groundwater and Soils Remediation Program – PNNL lead, SRNL co-lead with INL, ORNL participation
  - Waste Processing SRNL lead with PNNL and INL leading initiatives
  - D&D – ORNL lead with SRNL, INL, and PNNL participation

Office of Engineering and Technology Program - Approach

- Identify technical risks
  - **By Federal projects** – per DOE Order 413.3A, technical risks and uncertainties affecting each cleanup project are identified early in the project life-cycle
  - **By programmatic, external technical reviews and technology readiness assessments** - DOE-EM utilizes experts, including NAS panels (2007), to review the progress of its major cleanup projects and to assess the maturity of evolving technologies.
  - **By the sites** - DOE-EM periodically asks the DOE sites to identify technical risks and uncertainties in the form of “technical needs.”
  - **Most recently completed at a workshop in October 2006**
- Generate Engineering and Technology Roadmap
  - **Roadmap planning based on $100M/y investment (includes all areas – waste processing, D&D, soil and groundwater)**

Sorting Needs and Setting Priorities

- Sorted needs by
  - Technical assistance
  - Basic science
  - ✓ **Applied research and engineering**
- Considered
  - Common needs
    - By contaminant – Tc-99 and U are common constituents
    - By problem – soils, groundwater, *in situ, ex situ*
  - Schedule for technical insertion
  - Potential for cost or risk reduction
  - Opportunities to leverage
    - Site field activities
    - Office of Science
    - National Laboratory investments, e.g., LDRD
    - Other Federal agencies

Roadmap to Strategic Initiatives

Need Categories	Common Technical Challenges Across Complex	Strategic Initiatives
Sampling & Characterization Technology	➢Low-cost field characterization & monitoring techniques acceptable to regulators ➢Characterization in and around piping/storm drains	**Improve Sampling & Characterization Strategies**
Modeling	➢Improved conceptual models and incorporation of science into modeling ➢Fate & transport models that account for unique subsurface characteristics and reactive processes	**Advanced Predictive Capabilities**
In Situ Technology	➢Costs-effective techniques during remedial action and post-closure ➢Monitored natural attenuation (MNA)	**Enhanced Remediation Methods**
Long-Term Monitoring	➢Low-cost monitoring tools to reduce lifecycle costs ➢Long-term monitoring for MNA and barrier performance	**Enhanced Long-Term Monitoring Strategies**

FY09 Program
$5M/yr out of $30M/yr total EM-20 program

Current Focus: Enhanced Remediation

- *In situ* treatment of metals and radionuclides in deep vadose zone
  - BC Cribs “field research site”
  - Focus on Tc-99
- Attenuation Based Remedies for Metals and Radionuclides
  - SRS F Area Seepage Basins “field research site”
- Chlorinated Solvent Remediation
  - 200 Area vadose zone, address long-term impact on groundwater
  - Enhanced attenuation at SRS T Area
- Mercury Characterization and Remediation
  - OR Poplar Creek “field research site”

FY09 Program, con't

Current Focus

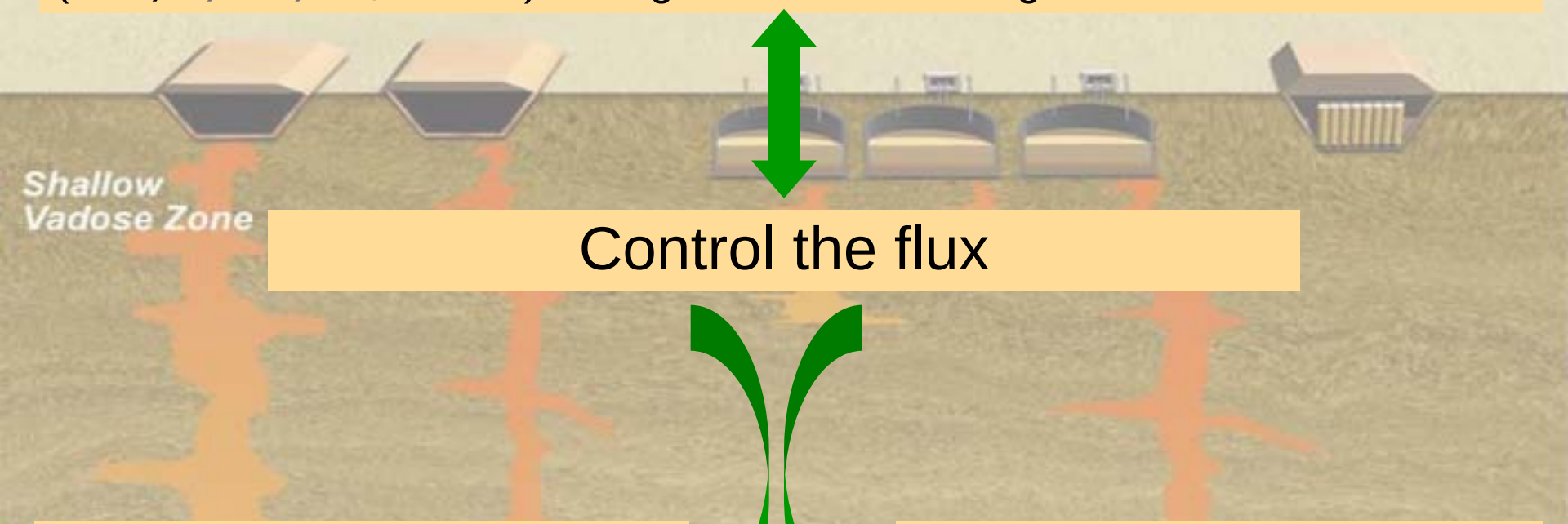
- Advanced Predictive Capabilities
  - Integrated into enhanced remediation projects
  - Lead technical forum on modeling and coordinate use of new capabilities from DOE Office of Science
- Improved Sampling and Characterization Strategies
  - Integrated into enhanced remediation
- The Center for Sustainable Groundwater and Soil Solutions at SRNL

Future Focus (FY10)

- Life-Cycle Monitoring
  - Draft Scope
  - February Technical Forum

In situ Treatment of Metals and Radionuclides in Deep Vadose Zone

Objective: Generate scientific information and cost-effective *in situ* remediation approaches to mitigate migration of metals and radionuclides (**^{99}Tc, U,^{90}Sr,** Pu, and Cr) through vadose zone to groundwater



Control the flux

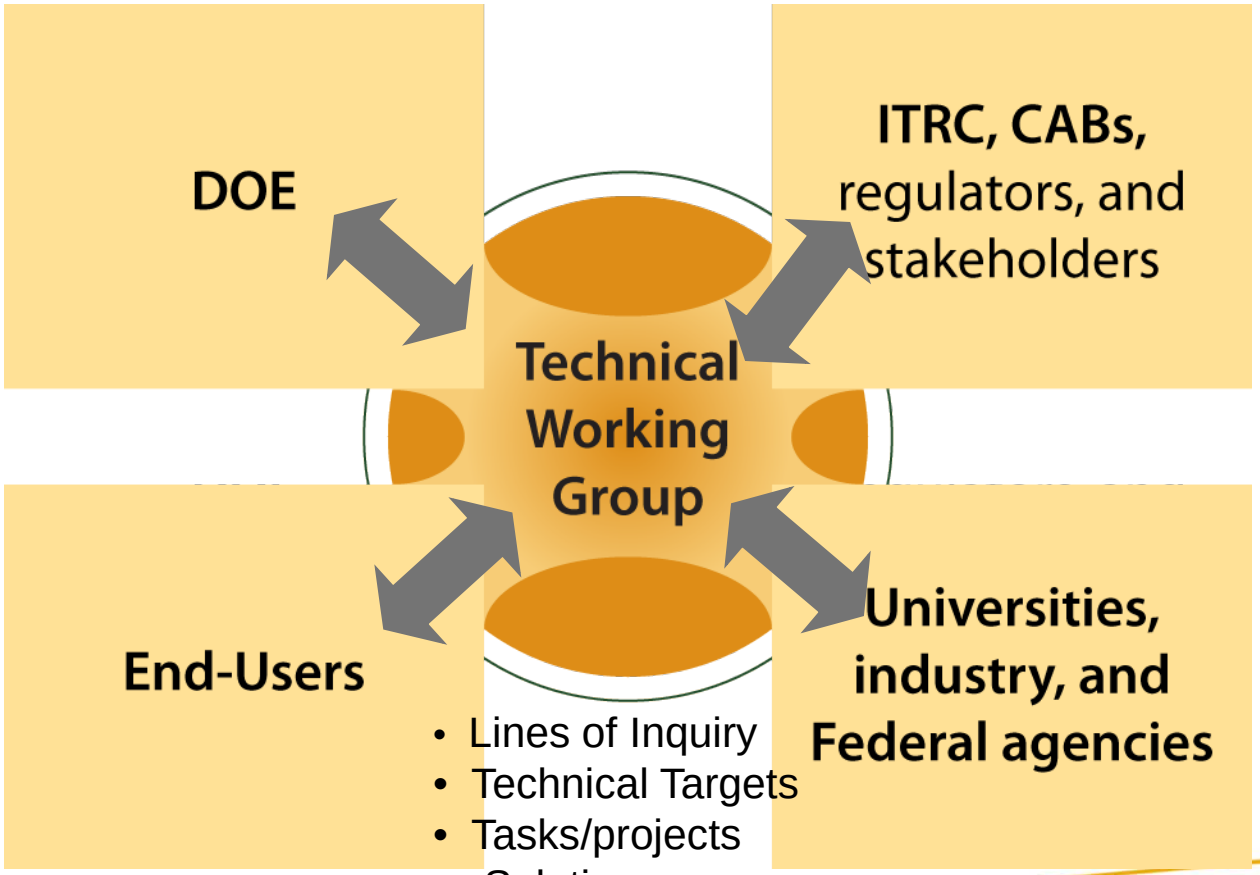
Regulatory

Communication to gain regulatory acceptance of in situ treatment, enhanced attenuation, and MNA in the vadose zone

Technical

Improved methods to control, reduce, and/or remove troublesome metals and radionuclides in the vadose zone

Technical Working Group at the Core of the Initiatives
National Laboratory and Other Experts

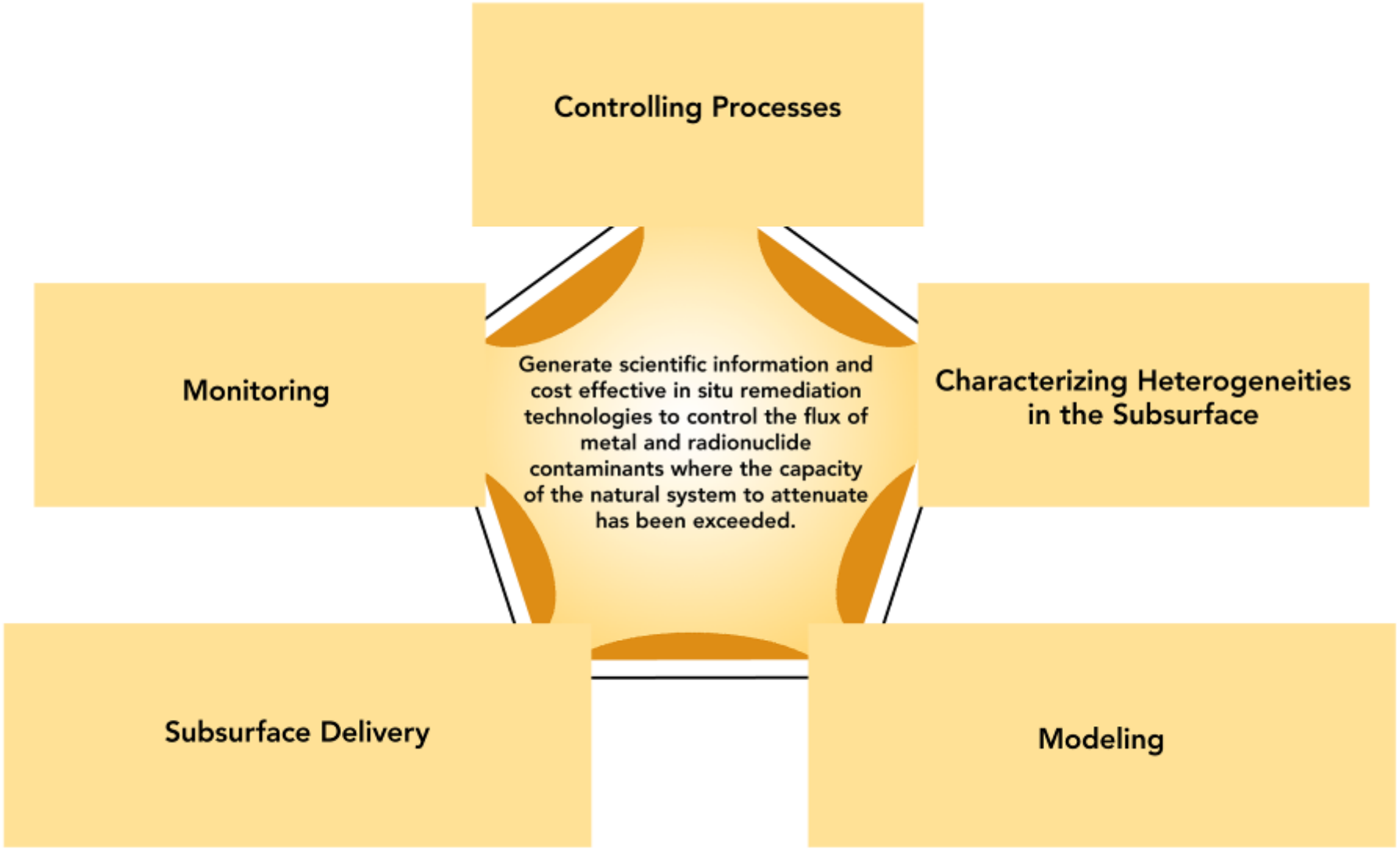


- Lines of Inquiry
- Technical Targets
- Tasks/projects
- Solutions
- Tech Transfer,

e.g., guidance documents

Pacific Northwest NATIONAL LABORATORY

Project Goal and Technical Targets



Reduce Transport of Chlorinated Organics through the Vadose Zone

Challenge

Soil vapor extraction, the baseline vadose zone remedy, is ineffective under certain conditions and a solution for persistent contamination in the vadose zone is needed for long-term groundwater protection.

Solution

Vadose zone evaluation, monitoring, remediation, and enhanced attenuation approaches will be developed to enhance the ability to reach remediation closure in the vadose zone.

Accomplishments

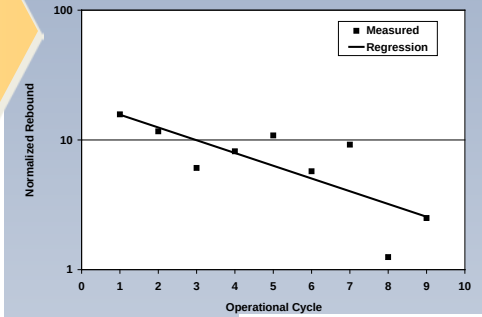
Initiated development of an improved methodology to quantify the strength and persistence of contamination in the vadose zone and its impact to groundwater to assist in determining the path to remediation closure in the vadose zone. Hanford site data is being used for this effort.

Assessing alternative monitoring and enhanced attenuation approaches for the vadose zone using the Savannah River Site T-Area as a field demonstration site.

Impact

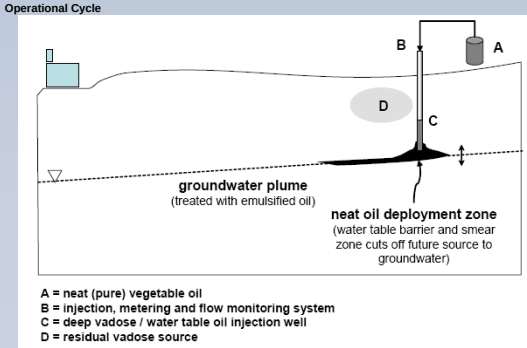
Methods to improve the ability to reach remediation closure for sites with persistent contamination in the vadose zone.

Enhanced potential for incorporating attenuation-based approaches into long-term environmental stewardship decisions.



Quantifying Vadose Source Strength Over Time

SRS T-Area Vadose Treatment



Monitored Natural Attenuation/Enhanced Attenuation for Chlorinated Solvents

Challenge

Address fundamental challenges in reaching final closure for many DOE sites with contaminated soils and groundwater: transitioning costly source treatments and developing regulatory support.

Solution

Technical guidance, tools, and collaboration with state regulators to promote acceptance of natural attenuation/enhanced attenuation.

Accomplishments

New technologies and tools were developed and demonstrated to promote acceptance of attenuation-based remedies for chlorinated solvents.

Developed guidance with state and federal regulators for implementing technical products within regulatory frameworks and implemented web-based training on technical advances.

Impact

Technical developments enable transition from active, energy-intensive treatments to “green” treatments, minimizing our energy footprint on a national scale, while also saving money.

Publicly available training is resulting in technical advancements in the public/private sectors.

Retrieval of Passive Flux Monitor

Push-Pull Test

Attenuation-based Remedies for Metals and Radionuclides

Challenge
Environmental clean-up strategies at sites with metals and radionuclides often leave the contaminants in place, but they can pose a risk for 1000s of years.

Solution
Attenuation-based remedies can be implemented to demonstrate reduced risk through development of technical guidance and tools.

Accomplishments
Research to further understand natural attenuation processes in the subsurface is being conducted collaboratively by Savannah River and Lawrence Berkeley National Laboratories with extensive communications with the Environmental Protection Agency and state regulators.

Impact
Sustainable, low-energy approaches to cleaning up metals and rad-contaminated sites will minimize risk receptors.

Training in new technical developments and approaches will be made available first to DOE and to the broad stakeholder community.

Lawrence Berkeley researcher viewing soil samples from site

Savannah River scientist collecting water samples from wetlands

The Center for Sustainable Groundwater and Soil Solutions at SRNL

Focal point for technology transfer and research integration for the Office of Engineering and Technology Soils and Groundwater Remediation Program

- **Portal Search**
- **Ask the Expert**
- **Technical meetings**
- **Independent Expert Reviews/Technical Assistance**
- **Communication Plan**

PNNL FY 2006 - 2008 Columbia River Protection Projects funded by EM-22

Hexavalent Chromium in the 100-D & 100-K Areas

- Accelerated Bioremediation (Biostimulation)
- Geochemical/Mineralogical Study of Chromium in the Vadose Zone

Strontium-90 in the 100-N Area

- Sequestration of Sr-90 Subsurface Contamination in the Hanford 100-N Area by Surface Infiltration of an Apatite Solution
- 100-N Area Strontium-90 Treatability Demonstration Project: Phytoextraction along the 100-N Columbia River Riparian Zone
- Phytoextraction Food-Chain Study (funded 2007)

Uranium in the 300 Area

- 300 Area Uranium Plume Treatability Demonstration Project: Uranium Stabilization through Polyphosphate Injection
- 300 Area Uranium Stabilization by Vadose-Zone Infiltration of Polyphosphate (funded 2007)

Carbon Tetrachloride in the 200 Area

- Carbon Tetrachloride and Chloroform Attenuation Parameter Studies: Heterogeneous Hydrolytic Reactions

PNNL Columbia River Projects Selected by Fluor Hanford/CHPRC for Continued Funding in FY 2009

Uranium in the 300 Area

- 300 Area Uranium Stabilization by Vadose-Zone Infiltration of Polyphosphate

Strontium-90 in the 100-N Area

- Sequestration of Sr-90 Subsurface Contamination in the Hanford 100-N Area by Surface Infiltration of an Apatite Solution
- 100-N Area Strontium-90 Treatability Demonstration Project: Phytoextraction along the 100-N Columbia River Riparian Zone

Closing Thoughts

Goal

- EM-20 programs address problems unique to DOE
- National experts are tapped through the National Laboratories – PNNL, SRNL, ORNL, and INL
- Aim to leverage resources more effectively from other DOE programs, federal agencies, academia and private industry .
- Strive to improve communication of the EM-20 program both within and outside DOE

Status

- Early in the technical program startup
- High priority technical activities underway
- Initiating leveraging of programs and resources
- Establishing multiple ways EM-20 can help the site

Questions?