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A Perspective on DOE Challenges and Opportunities for Alternative End States

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Pacific Northwest National Laboratory

Definitions

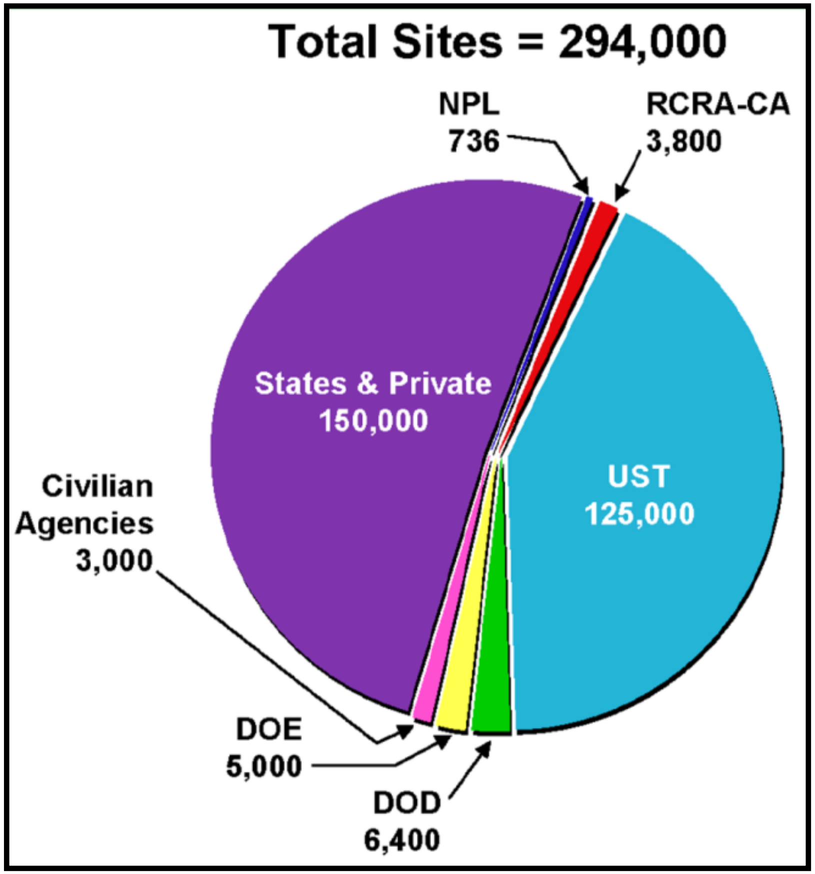
End States – final remedial goals that are permitted by regulations and are protective of human health and the environment

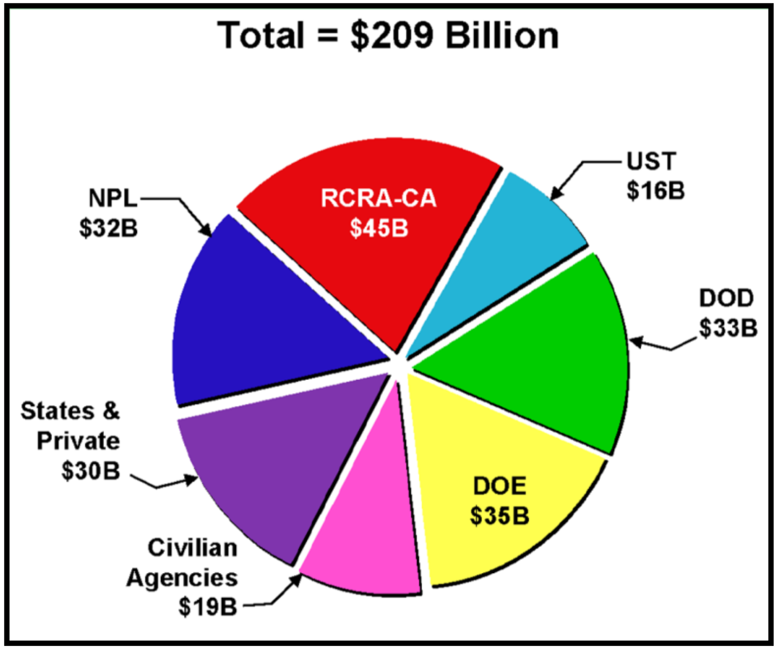
Risk-based – decision process based on analysis of the potential of a contaminant to cause immediate and long-term harm to a receptor resulting from exposure and the likelihood of occurrence

Scientifically based/ technically defensible – systematic, objective understanding of a problem based on, objective approaches and independently reproducible results that provide a sound understanding and justification for decision making.

Why do we NEED alternate end states?

Remaining sites are ***complex***-
- contaminant (radionuclides and metals)
- location (deep, fractured rock)
- cost





~ 300,000 sites

~$ 200 billion

Source: Cleaning Up the Nation's Waste Sites: Markets and Technology Trends, 2004 Edition, EPA 542-R-04-015

What is an acceptable End State?

Tradeoffs must be carefully considered among the competing influences of cost, scientific defensibility, and the amount of acceptable uncertainty in meeting remediation decision objectives

Increased Scientific and Technical Defensibility

Decreased Regulatory Acceptability

High risk, complexity, and cost with little to no regulatory acceptance *e.g. Enhanced attenuation*	Scientific and technically defensible with minimal risk but costly and limited regulatory acceptance *e.g. Pump-and-Treat*
High risk and complexity but less costly and regulatory acceptable *e.g. Permeable reactive barriers*	**Scientifically and technically defensible with minimal risk or cost and regulatory acceptable** *e.g. Surface barrier; in situ bioremediation*

Increased Cost

Decreased Uncertainty/Risk

What are currently ‘acceptable’ End States?

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- *Change for final cleanup standards (MCLs, pre-contaminant conditions)*

Attenuation (Monitored Natural Attenuation, Enhanced Attenuation): Long-term monitoring and/or limited action (~100 years)

Adaptive Site Management: Iterative approach; altered over time in response to site conditions

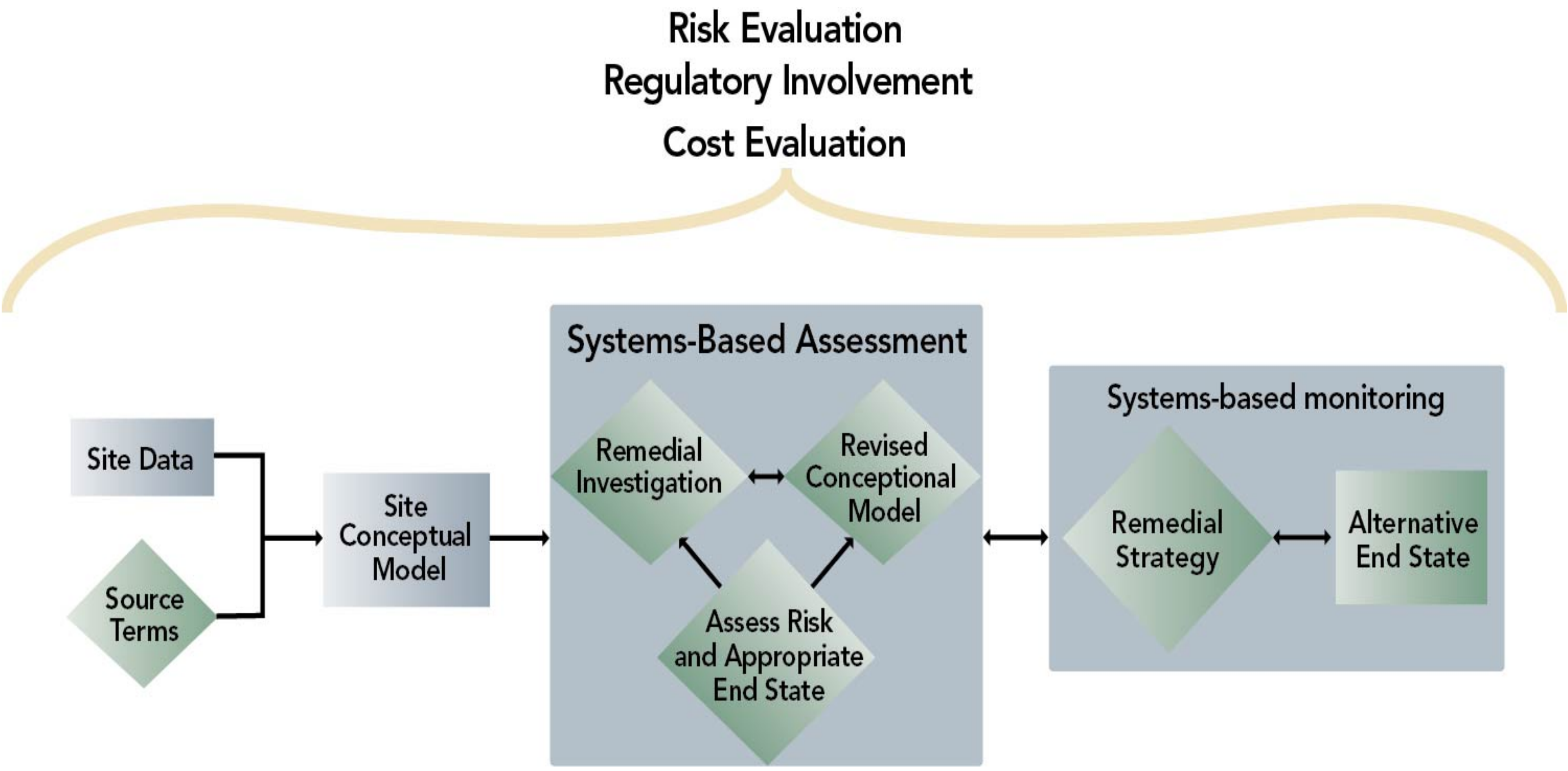
Groundwater Reclassification: Changes state regulations so groundwater is no longer classified as drinking water

Alternate Concentration Limits (ACL): Replace or modify groundwater cleanup standard at sites where contaminated groundwater discharges to surface water; risk-based value

ARAR (Applicable or Relevant and Appropriate Requirements) Waivers

TI waivers: Compliance with requirement is technically improbable from an engineering perspective

How do we get there? … Framework



How do we get there … risk considerations

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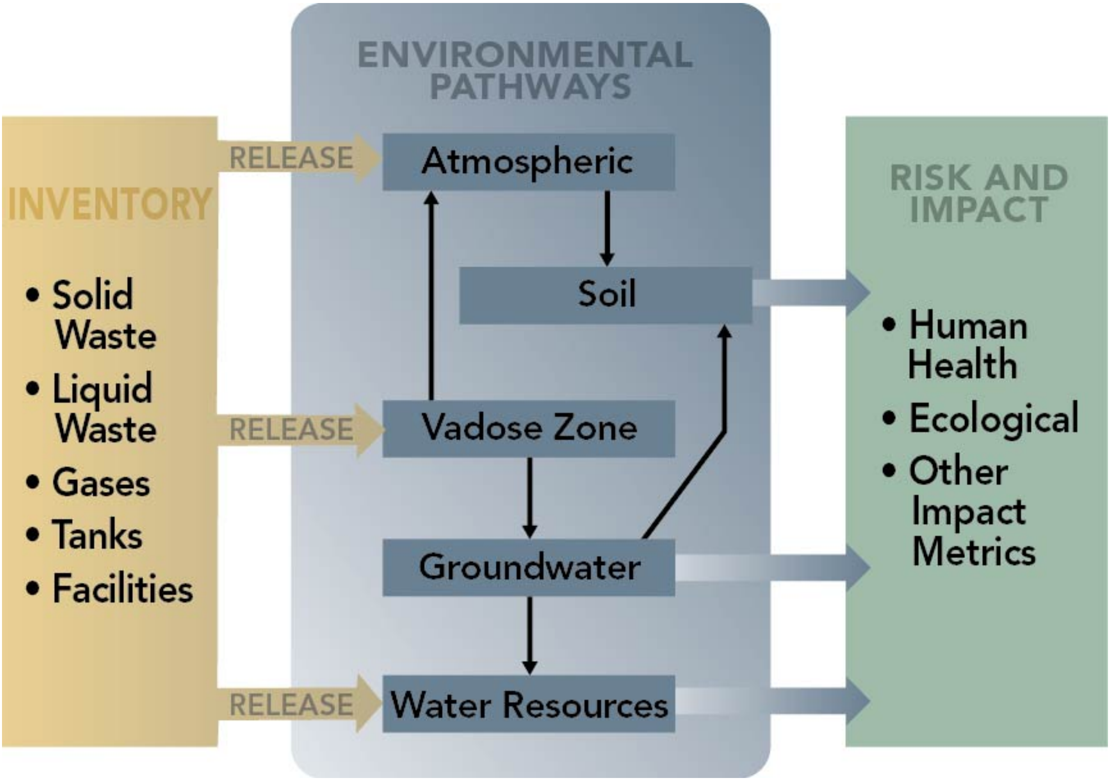
- Risk needs to be evaluated at multiple levels and integrated for a holistic view of choosing alternate end state
  - Human Health
  - Ecological
- Balance current needs and drivers with future land use
- Cognizant of dollars saved versus risk reduction
- Are there high-consequence hazards where risk is always too great



What it IS NOT and IS

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- **Walk-away approach**
  Long-term management including regular review of site conceptual model (SCM) to address residual contamination and employ new technologies and approaches as they are available in out years

- **A quick or easy fix**
  Based on robust, holistic SCMs which provide platform for more accurate predictions and risk-informed decisions

- **Un-Protective of human health and environment**
  Considers all aspects of risk- present and future, re-evaluated within context of resource-use goals or other significant changes in model assumptions

- **Rigid and inflexible**
  Iterative approach providing transition of sites from active remediation or intensive characterization and monitoring into systems-based LTM strategies

How do we achieve these goals?

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- **What has been done at other sites**
- **Interagency collaboration**
- **Lessons Learned**
- **Technology/expertise transfer**

  Resources available include:

  Assessing Alternative Endpoints for Groundwater Remediation at Contaminated Sites
  EPA policy and guidance
  ITRC overview document and training
  Navy Alternative Restoration Technology Team workgroup
  AFCEE and Army initiatives
  ESTCPs' Alternative Endpoints and Approaches for Groundwater Remediation

- **Regulatory and stakeholder engagement**
- **Risk-informed understanding and defensibility**
- **Robust long-term management of residual contamination**

DOE goals for subsurface

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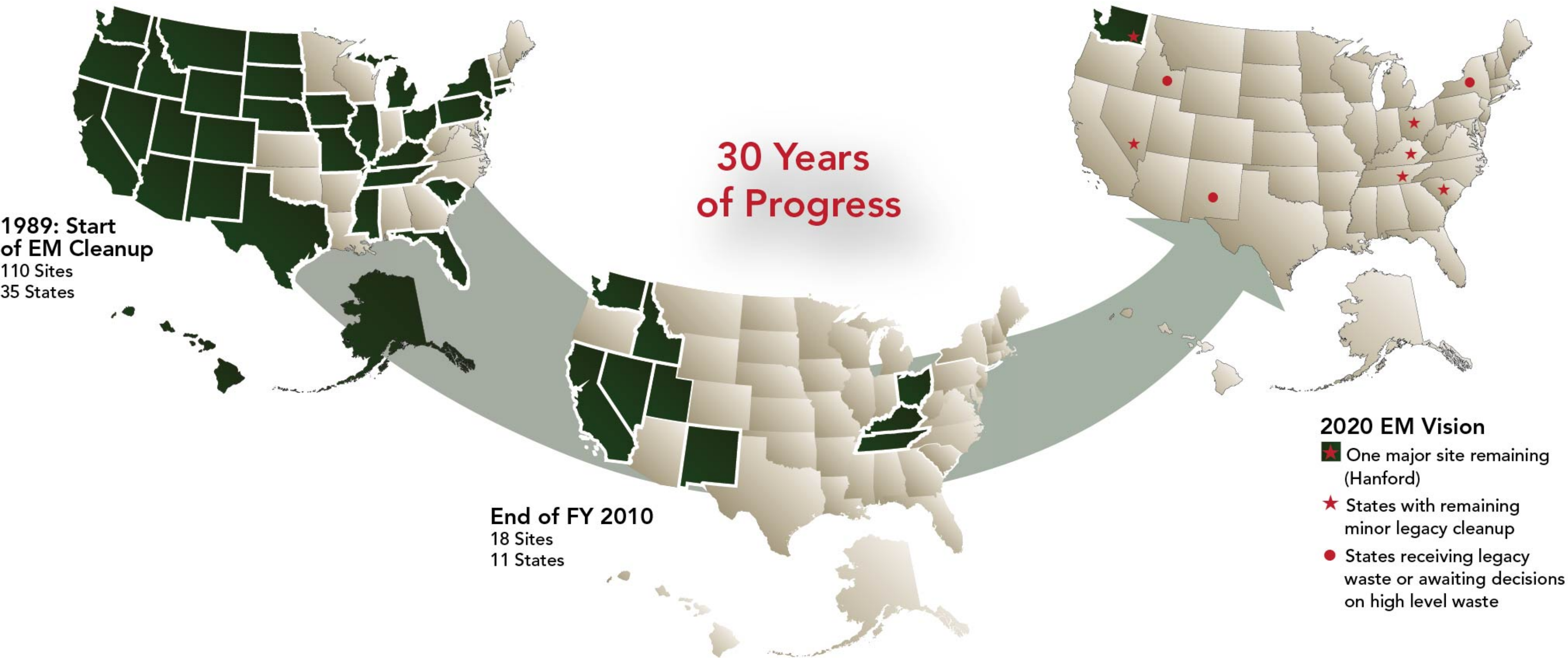

- **Reduce the life-cycle costs and accelerate the cleanup of the Cold War environmental legacy**
- **Reduce the EM legacy footprint by 40 percent by the end of 2011, leading to approximately 90 percent reduction by 2015**

Challenges	Key Issues	Opportunities
Scientific and Technical	Understand the nature and magnitude of problems to determine which risks are most critical and establish priorities for remediation needs and closure requirements	• Systems-based Approaches for Remediation and Decision Support • Characterization vs. Predictive Understanding (e.g. mass flux based conceptual models) • Technologies vs. Remedial Strategies • Point source vs. Systems-based Monitoring • Active/Passive Remediation Efforts–Transition and Exit Strategies.
Regulatory	Based on scientific and technical understanding, determine what must be accomplished through cleanup efforts	• Risk-informed definition of regulatory requirements • Priorities based on protection of human health and the environment
Institutional and Closure Management	Define what end state or condition would constitute progress or completion of cleanup	• Process to effectively define end states from scientifically and technically defensible understanding • Clearly defined and credible cleanup scope of work to achieve risk-based end states • Transition complex sites to LTM or MNA
Budget and Resource Allocation	Allocate limited resources (i.e., federal budget dollars) to provide benefit to society (e.g., reduced risk, recovered resources, etc.)	• Risk-informed choices to prioritize resources, drive 'cleanup demand' and complete site cleanup

Risk-Based Alternative End Point Strategies for Site Closure and/or Long-Term Management

Technically-based approaches to achieve alternative end point strategies, which are risk-based, cost-effective, sustainable, and protective of public health and environment

Benefits

- Set common expectations and acceptable terms (between agencies and contractors) for remedial performance
- Meet regulatory requirements despite technical challenges & limitations
- Leverage resources
- Define reliable ways to manage long-term residual contamination, cognizant of human health and environment
- Achieve risk-informed end states

Acknowledgments

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- **Department of Energy, Richland Office**

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- **Resource documents:**
  ***ESTCPs'* Alternative Endpoints and Approaches for Groundwater Remediation**
  Cleaning Up the Nation's Waste Sites: Markets and Technology Trends, EPA 542-R-04-015