U.S. DEPARTMENT OF ENERGY





Scientific Opportunities for Monitoring of Environmental Remediation Sites (SOMERS)

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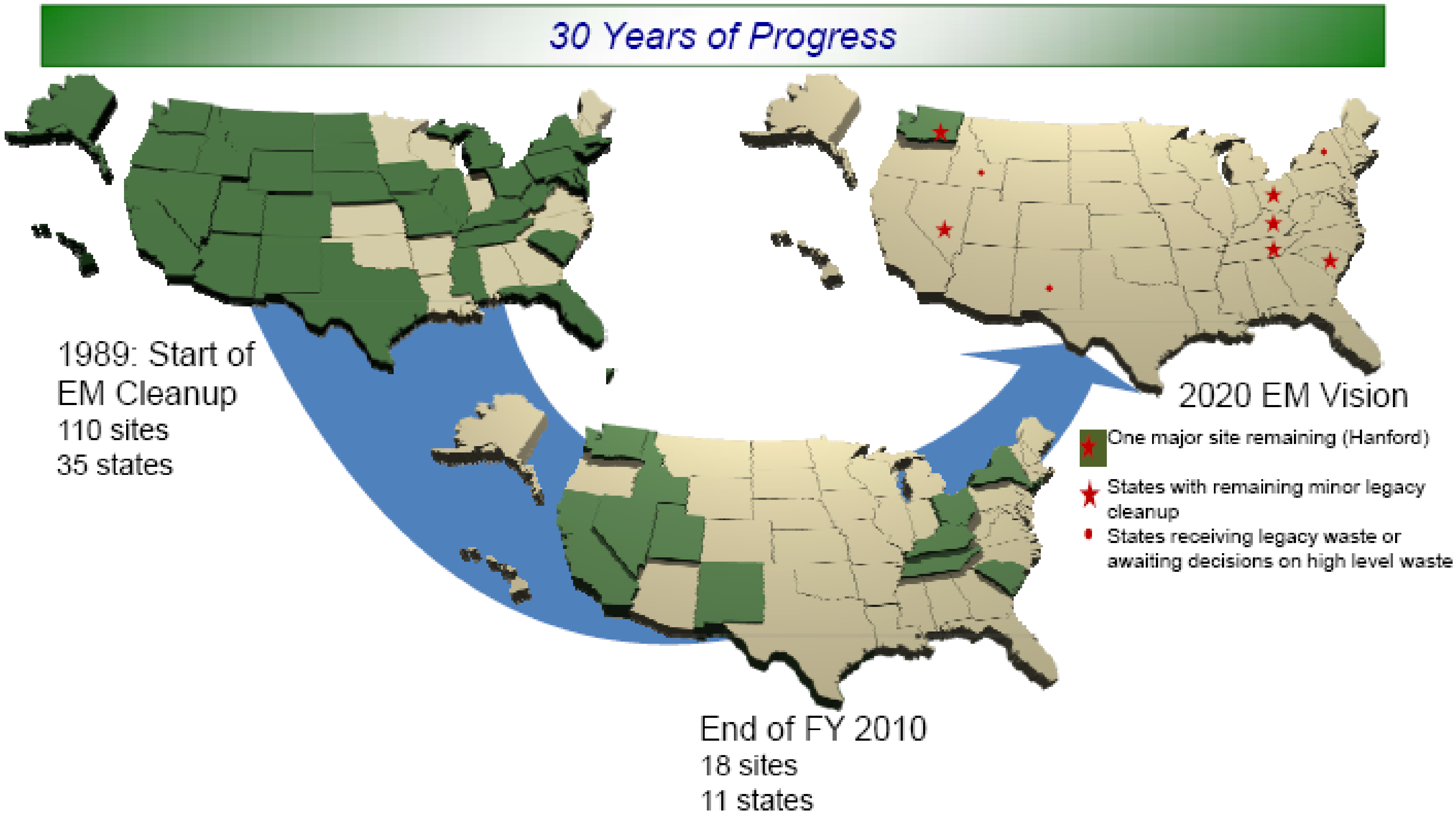
Perspective on Monitoring Needs within DOE's Office of Environmental Management



From presentation by Dr. Ines Triay, Assistant Secretary, DOE Office of Environmental Management, to 2011 Congressional Nuclear Cleanup Caucus, February 17, 2011, *Environmental Management FY 2012 Budget Overview*

Monitoring Challenge

RCRA/CERCLA

Preliminary Assessment / Site Inspection

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Remedial Investigation / Feasibility Study

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Treatability Testing

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Corrective Action Decision / Record of Decision

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Remedial Action

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Site Closure

Screening Characterization

- Estimation of contaminant loading & attenuation mechanisms
- Conceptual model development
- Identification of data required for preliminary remediation approach

Decision Characterization

- Define extent & scope of preferred remediation objectives
- Identify expected performance envelope
- Estimation of timetable and contingency planning

Process Monitoring

- Data intensive with multiple lines of evidence
- Refine conceptual model
- Short-term, 1-5 years
- Can be concurrent with remedial actions
- Verify remediation effectiveness
- Establish baseline for LTM with identification of individual parameters

- Monitoring represents largest legacy cost to the Department of Energy
- Effect of a remedial action with respect to risk to human health and the environment is determined from information gathered through monitoring activities
- Phased approach to cover changing goals as sites transition from remediation into long-term surveillance and maintenance
- Current monitoring approaches use point-source based groundwater monitoring well sampling and laboratory analyses
  - –Inefficient, costly, labor-intensive

Performance Monitoring

- Information on condition of site, goals
- Set forth in remediation or restoration plans
- Understanding of site processes
- Relies on the decreased frequency and distribution of monitoring observations for changes from baselin

Long-Term Monitoring

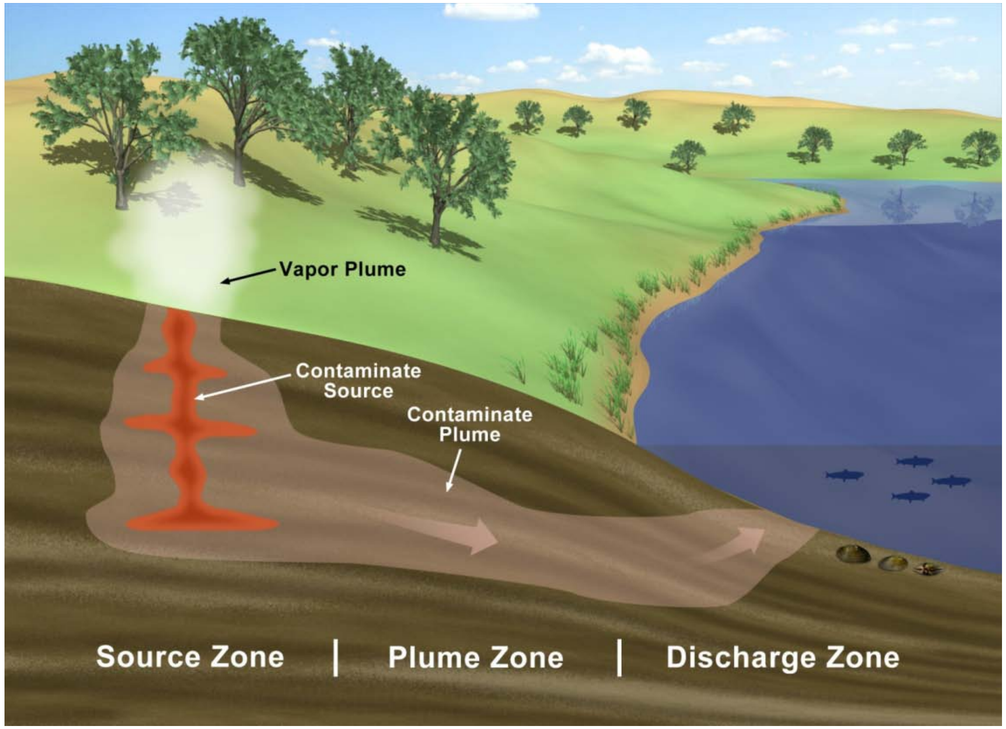
- Flexible to handle new technology
- Linked to ecological health
- Track performance over site lifetime
- Detect change from baseline
- Passive
- Robust
- Low maintenance
- Low cost
- Able to use leading indicators

Progress to Date

- Previous efforts tackled a specific set of questions or challenges
- Identified and prioritized specific goals, technical targets, informative tools and cost-effective approaches for characterization, monitoring cleanup activities and monitoring to transition sites to closure and long-term stewardship

What's the Need?

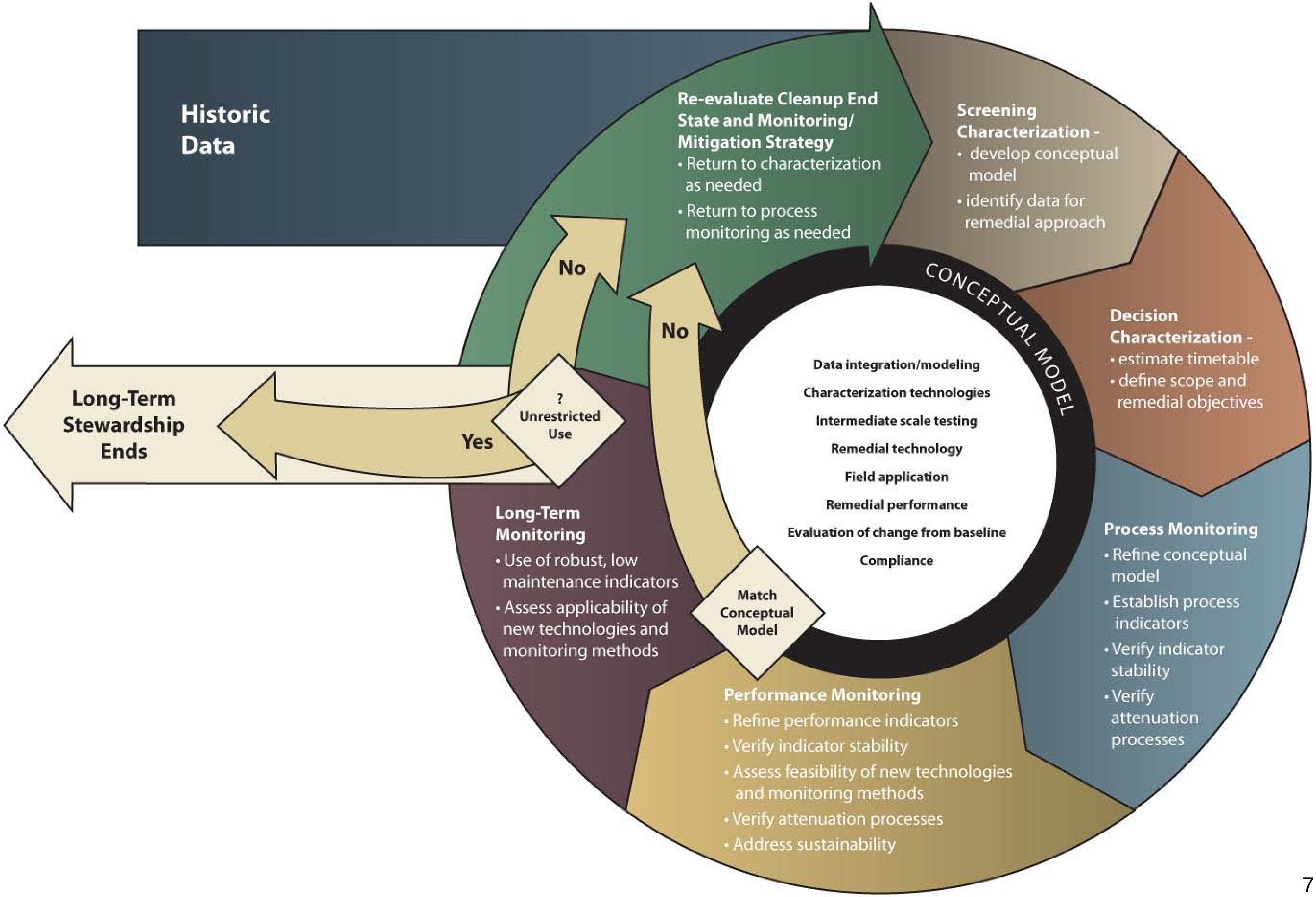
- Remaining sites are far more complex than those addressed in the past
- Strategic framework that addresses ***how*** technologies or approaches would be applied for site-specific challenges to advance from point-source monitoring technologies to flux-based monitoring strategies/systems



Scientific Opportunities for Monitoring of Environmental Remediation Sites (SOMERs)

- Identify scientific, technical, and practical challenges that currently impede informative, timely and cost-effective monitoring.
- Provide prioritized scientific and technology strategies that meet current needs for the most challenging environments.
- Developing a scientific framework that combines regulatory drivers, point- and volume-averaged strategies, and techniques into an advanced characterization and monitoring program that includes flux- and risk-based approaches and transitions throughout the monitoring life of the facility

Goal of SOMERS



Outline

Executive Summary

1.0 **Introduction**

- 1.1. Need for Monitoring
- 1.2. Monitoring Summary
- 1.3. Historic Perspective of Monitoring
- 1.4. Framework for Advanced Monitoring Strategies within DOE
- 1.5. Integration of Advanced Monitoring Strategies into Long Term Surveillance and Maintenance at DOE Closure Sites

2.0 **Challenges and Opportunities in Monitoring**

3.0 **Environmental Monitoring Scenarios**

Scientific, Technical, and Practical Challenges and Opportunities in Monitoring

2.1. **Multiple lines of evidence**

“Quorum of evidence”

- Responsive characterization process based on conditional rules (i.e., no need to measure reduced gases at sites with measurable dissolved oxygen). Includes spatial process mapping and other items highlighted in the National Academy of Sciences review of the previous protocol.

2.2. **Monitoring system configuration and flux monitoring**

Interfacial monitoring and designed or identified monitoring points - weak points that would serve as indicators of performance throughout the system

Scientific, Technical, and Practical Challenges and Opportunities in Monitoring (cont'd.)

2.3. **Surrogate measures to reduce costs**

Indicator species, bulk and master variable properties

2.4. **Remote sensing, geophysics**

Instrumentation, interpretation and deployment options (horizontal wells, LiDAR, remote sensing, and others). Examine lessons from agriculture and soil science ("smart farming") and potential for cross over applicability

2.5. **State-of-the-art sensors**

Sensors in characterization and monitoring MNA/EPR systems. Examine need for sensors that provide high frequency data; passive vs. cumulative sensors that would act similarly to bioconcentration; and alternative configurations that use on-off sensor signals rather than concentration signals as a way to reduce costs.

Scientific, Technical, and Practical Challenges and Opportunities in Monitoring (cont'd.)

2.6. **Bioassessment tools**

Key step in determining the presence, or potential, of a given site for MNA as well as tracking the presence and numbers of key microorganisms during the remediation process

2.7. **Information integration and modeling**

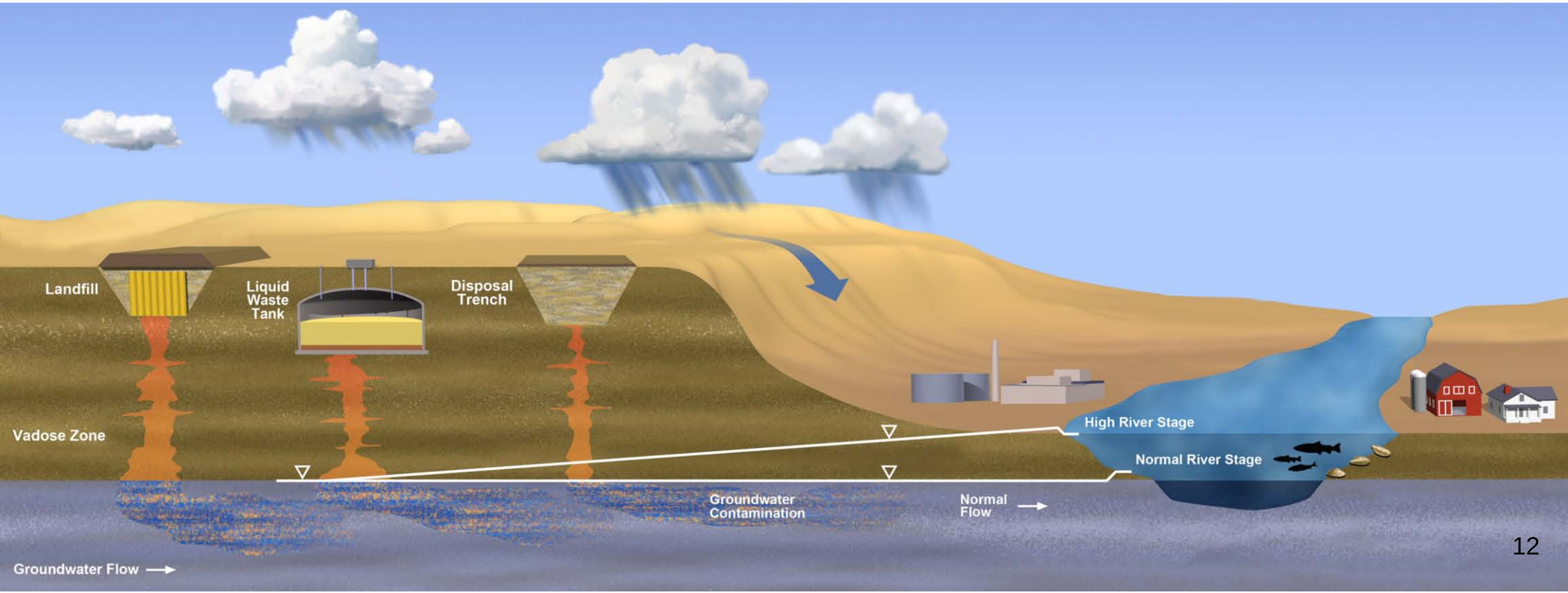
Active use of decision support tools and modeling to inform design and operation of monitoring systems to advance beyond traditional sampling of wells and chemical analyses.

Advanced monitoring systems (e.g., ecosystem monitoring, biological monitoring, and flux monitoring) require data integration and predictive modeling to effectively manage information and enable consideration of data pedigree and provenance, archival, accessibility, quality assurance, and data integration.

In order for data to become information, it must be processed, structured, and communicated. Predictive modeling includes processes to integrate data to construct valid conceptual models of a site, use of modeling for testing alternative conceptual models, model calibration and inverse modeling for interpretation, and use of predictive modeling to design and implement monitoring approaches with feedback mechanisms

Environmental Monitoring Scenarios: Systems-Based Monitoring for Challenging Environments

1. Vadose Zone
2. Ground Water
3. Groundwater-Surface Water Interface
4. Surface Water
5. Integrated Systems-based Monitoring



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