Implementing High Resolution Site Characterization

United States
Environmental Protection
Agency

Thanks to:
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Overview

- **Review of Data Quality Objective (DQO) Process**
  - Step 1 – State the problem
  - Step 2 – Identify the decision
  - Step 3 – Identify the inputs to the decision
  - Step 4 – Define the boundaries of the studies
  - Step 5 – Develop a decision rule
  - Step 6 – Specify tolerable limits on decision errors
  - Step 7 – Optimize the design
- **Explain the Triad Approach**
  - Systematic Planning
  - Dynamic Work Strategies
  - Real-Time Measurement Technologies
- **High Resolution Site Characterization (HRSC)**

What are DQOs?

- **Data Quality Objectives (DQOs) are quantitative and qualitative criteria that:**
  - **Clarify study objectives**
  - **Define appropriate types of data to collect**
  - **Specify the tolerable levels of potential decision errors**

The 7 Steps of DQO Process

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Stating the Problem

- What is the problem?
- What resources are available?
- What time is available?
- What important social / political issues have an impact on the decision?

Identifying the Decision

- **Identify the principal study question**
  - *Clarify the main issue to be resolved*
- **Specify the alternative actions that would result from each resolution**
  - *Associate a course of action with each possible answer*
- **Define the decision statement that must be resolved to address the problem**
  - *Combine the principal study question and the alternative actions into a specific decision statement*

Identifying Inputs for the Decision

- Focus on what information is needed for the decision
- Identify the variables / characteristics to be measured
- Identify the information needed to establish the action level

Defining the Boundaries

- **Define the spatial boundary for the decision**
  - *Define the geographical area within which decisions apply*
  - *Define the media of concern*
  - *Divide each medium into homogeneous strata*
- **Define the temporal boundary of the decision**
  - *Determine the time frame to which the study results apply*
  - *Determine when to study*
- **Define a scale of decision making**
- **Identify practical constraints on data collection**

Develop a Decision Rule

- **Develop an “If…, then…" statement that incorporates:**
  - *The population parameter of interest (e.g., mean, maximum, percentile)*
  - *The scale of decision making (e.g., residential lot size)*
  - *The action-triggering value*
  - *The alternative actions*

Specify Limits on Decision Errors

- **Determine the possible range of the parameter of interest**
- **Determine baseline condition (null hypothesis)**
- **Determine consequences of each decision error. Consequences may include:**
  - » *Health risks*
  - » *Ecological risks*
  - » *Political risks*
  - » *Social risks*
  - » *Resource risks*

Optimize the Design

- **Develop general data collection design alternatives**
- **For each design, develop cost formula, select a proposed method of data analysis, develop method for estimating sample size to correspond to method for data analysis**
- **Select the most resource-effective design**
  - *Consider cost, human resources, other constraints*
  - *Consider performance of design*

DQO Process Output

- **Qualitative and quantitative framework for a study**

- **Feeds directly into the Quality Assurance Project Plan (QAPP) which is essential for ensuring quality in environmental data collection activities**

Develop Conceptual Site Model

- **Develop a mental picture of the site and how it interacts in the environment (sources, hydrogeology)**
  - *Review site information and data to identify preliminary Conceptual Site Model (CSM)*
  - *Concept of CSM may be different for different team members*
- **CSM helps identify data gaps**
- **CSM is dynamic over project lifecycle**
- **Data collected should be focused on adding certainty to CSM**
- **CSM leads to common understanding of where the site is today**

Conceptual Site Model

- **Minimum components:**
  - *Source*
  - *Environmental setting*
    - *Topography, surface water hydrology, geology, hydrogeology, land use*
  - *Release mechanism*
  - *Migration pathways*
  - *Exposure routes*
  - *Receptors*

Identify Data Needs

- **Data Types**
  - *Locations of municipal wells*
  - *Stratigraphy*
  - *Depth to water*
  - *Soil permeability*
  - *Location of waste*
  - *Ground water concentrations*
- **Data Amount**
  - *Function of uncertainty, resources*
  - *Statistical analysis may be appropriate*
- **Data Location**
- **Data Quality**
  - *screening vs. definitive*
  - *qualitative vs. quantitative*

Summary on Project Planning

- Project planning involves all team members, including stakeholders and regulators
- Agreement on conceptual site model and site closeout statement is critical
- Data needs are governed by project objectives and conceptual site model
- Sampling program is designed to obtain data by most efficient means and is well documented

Sampling Selection Criteria

- **Method Selection**
  - » *Sample matrices*
  - » *Contaminant type*
  - » *Sample representativeness*
  - » *Practicality / simplicity*
  - » *Cost*
  - » *Safety*

- **Location Selection**
  - » *Objectives*
  - » *Site history and disposal practices*
  - » *Hydrogeology*
  - » *Contaminant behavior*
  - » *Receptor location*
  - » *Statistical significance*
  - » *Safety*

The Triad Approach

Systematic Planning

Dynamic Work Strategies

Real-Time Measurement Technologies

Synthesizes practitioner experience, successes, and lessons learned into an institutional framework

Site Cleanup Process

	Phase of Work	Triad Component
Site Assessment	◆ Property Acquisitions and Brownfields Sites » Phase I Environmental Site Assessment (ESA) » Phase II ESA ◆ Superfund Program » Preliminary Assessment / Site Inspection (PA/SI) » Remedial Investigation / Feasibility Study	◆ Preliminary Conceptual Site Model (CSM) ◆ Systematic Planning ◆ Dynamic Work Strategy (DWS) Sampling ◆ Real-Time Measurements ◆ Characterization CSM
Site Remediation	◆ Remedial Action Plan ◆ Cleanup & Development ◆ Long Term O&M	◆ Design Stage CSM ◆ Dynamic Remediation using Real Time Measurements ◆ Remediation / Mitigation CSM ◆ Post-Remediation CSM
Post-Remediation	◆ Redevelopment Activities ◆ Property Management	

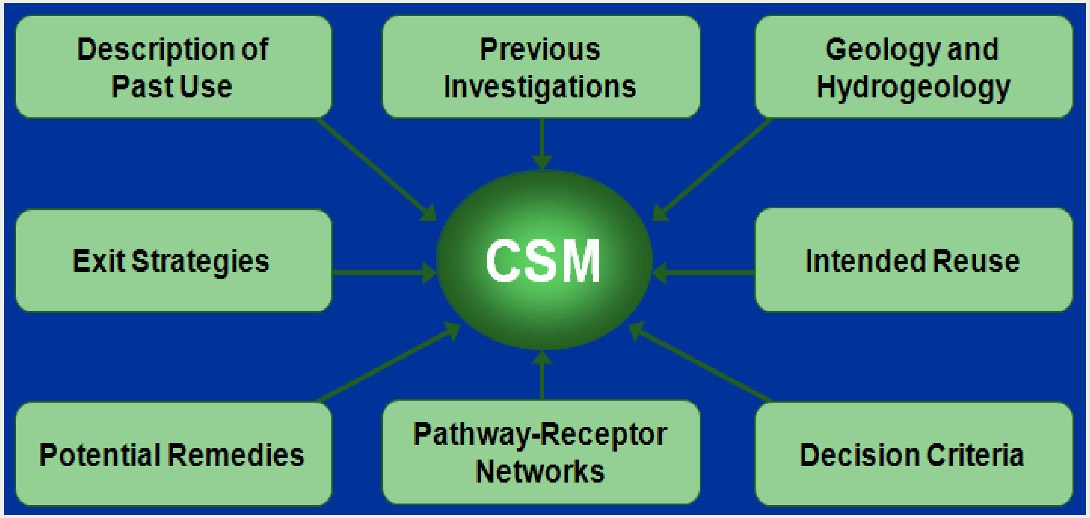
What is Systematic Planning?

A process for building a
consensus vision
for conducting environmental
investigation and remediation

Conceptual Site Model (CSM)

- Written and graphical (2-D and 3-D) expression of site knowledge
- Primary basis for project design and execution
- Effective platform for maintaining stakeholder consensus
- Updated throughout project life cycle
- *Essential* to successful projects

Primary Anatomy of a CSM

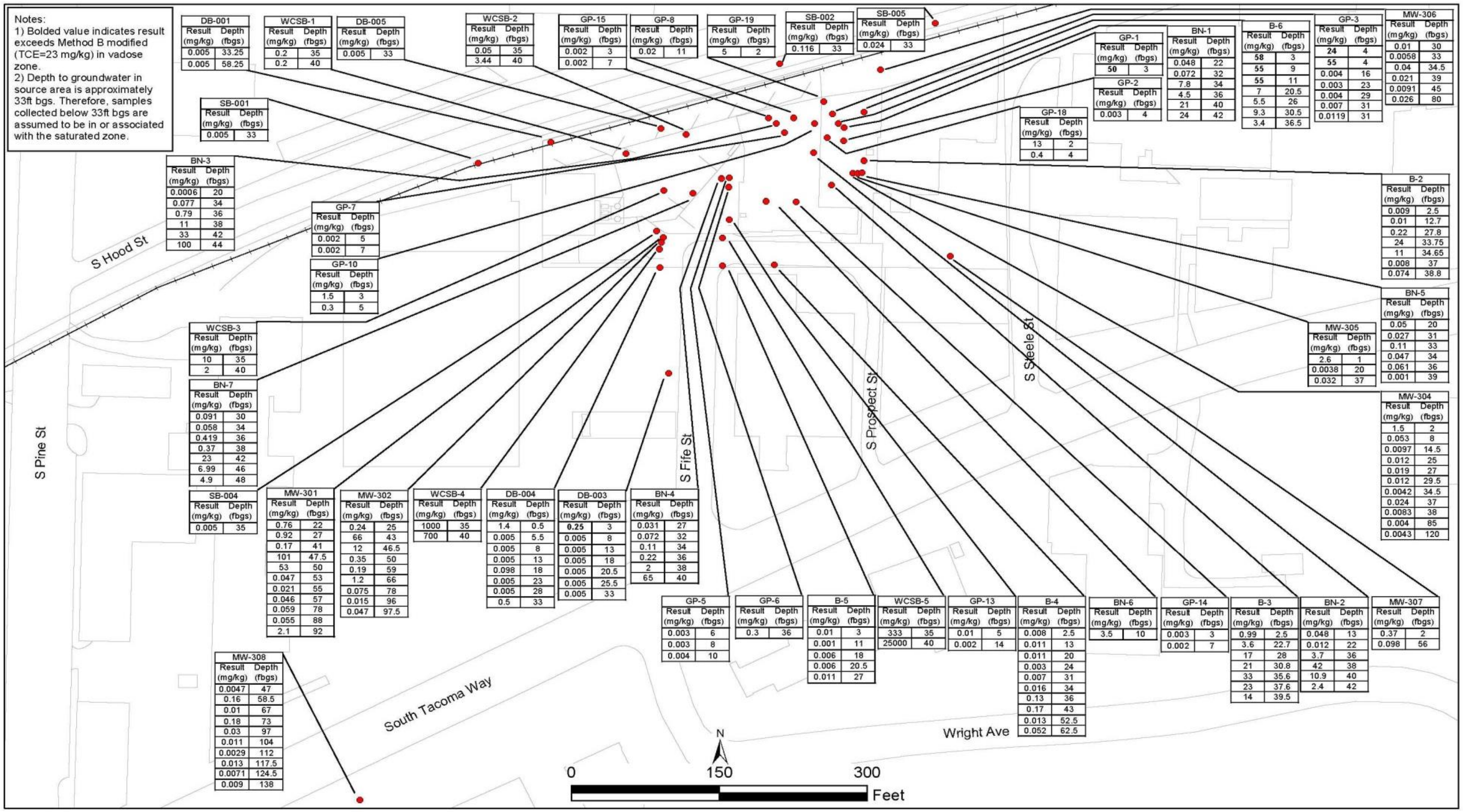


Project Life Cycle CSM Supports Project Phases

- **Preliminary CSM**
  - » Developed prior to systematic planning
- **Baseline CSM**
  - » Product of systematic planning; documents stakeholder consensus
- **Characterization Stage**
  - » Guides investigation efforts and supports decision-making
- **Design Stage**
  - » Supports basis for remedy and redevelopment design
- **Remediation/Mitigation Stage**
  - » Guides efforts, meet objectives, and supports optimization
- **Post Remedy(ies) Stage**
  - » Documents attainment of remediation objectives and goals

Key CSM Paradigm

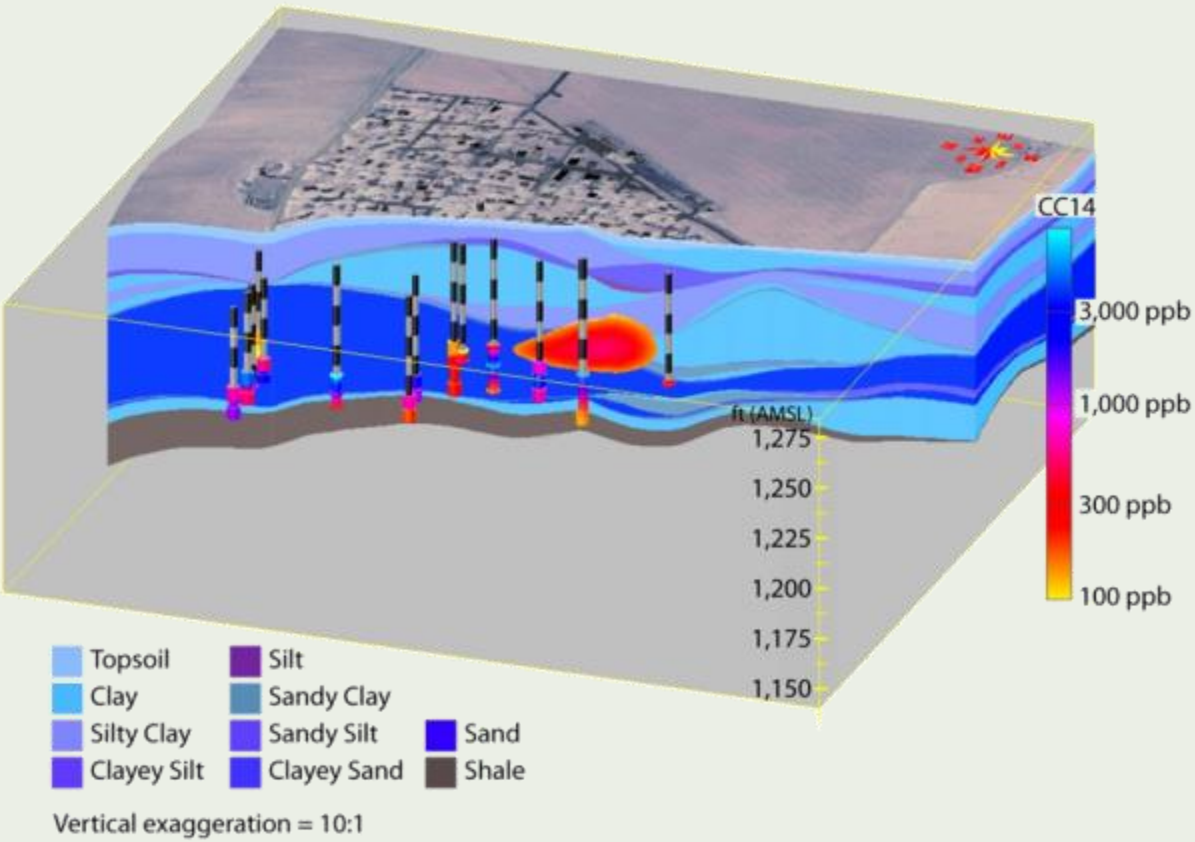
Are You Effectively Using Data or Confusing With Data?



Well 12A Superfund Site
Tacoma, Washington

Figure 2-6
Trichloroethylene in Soil

Emerging CSMs: 3-D Visualization and 4-D (Time) Visualization



Source: Sundance Environmental & Energy

What is a Dynamic Work Strategy (DWS)?

A work strategy that incorporates the flexibility to adapt to information generated by real-time measurement technlogies

How does DWS support Groundwater Characterization?

- Uses streamlined work plans with decision logic diagrams
- Sequences activities based on decisions to be made and a continuously updated CSM
- Generates collaborative data sets for multiple lines of evidence and controls uncertainties
- Provides real-time data management and communication
- Considers potential remedies and reuse

What is Meant by "Real-Time?"

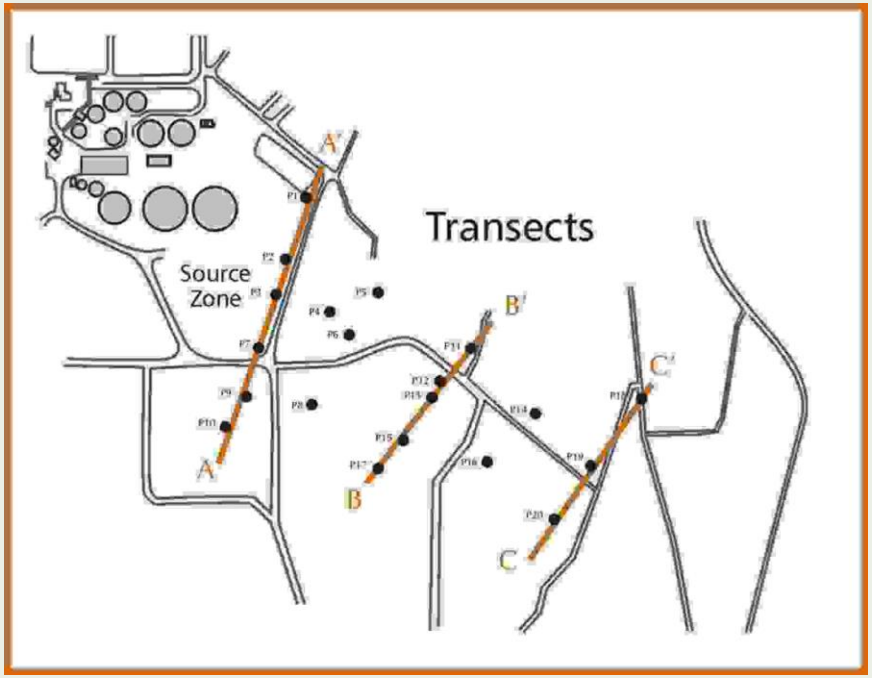
Real-time = within
a timeframe that allows the
project team to react to the
information while
in the field

How is Triad Data Collection Different?

- **Provides a greater density of measurements**
- **Uses collaborative data sets**
- **Employs strict field QA/QC**
  - Maximize usefulness of data
  - Target confirmatory or collaborative sample analysis where needed
- **Often uses field-based action levels or response factors with a margin of safety**
- **Uses real-time data management and communication strategies**
  - High volume of data gathered to capture, process, format for stakeholder decision-making

Implementing High Resolution Site Characterization

- Transect:
  - Line of vertical profiles oriented normal to the direction of the hydraulic gradient (Horizontal spacing)
- Short Sample Interval:
  - Vertical dimension of the sampled portion of the aquifer
- Close Sample Spacing:
  - Vertical distance between samples
- Real-time/Near Real-time Tools
- Dynamic/ Adaptive Approach



Implementing High Resolution Site Characterization

DQO Process

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Triad Approach

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HRSC

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Robust CSM

Questions?

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