RCRA Corrective Action Training Program: Getting to YES!

Strategies for Meeting the 2020 Vision

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Module 5

Achieving Success: Practical Solutions to Corrective Action Challenges

Module Overview

- Identify general principles for implementing practical solutions
- Review practical approaches to
  - Remedy selection and implementation
  - Field investigations and assessment

General Principles for Implementing Practical Solutions

1. Science and engineering are the solutions; reports document them.
2. The process is not linear.
3. EPA encourages practical approaches.
4. Regulatory approval is not necessary for every decision.
5. The “traditional” process is a guide, not a list of requirements.

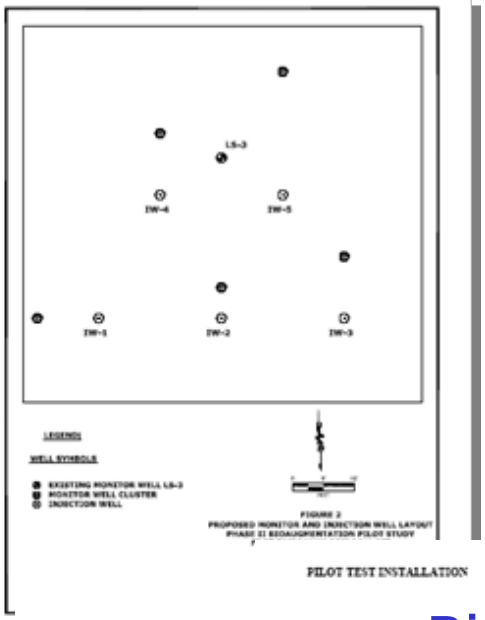
1. Science and Engineering are the Solutions

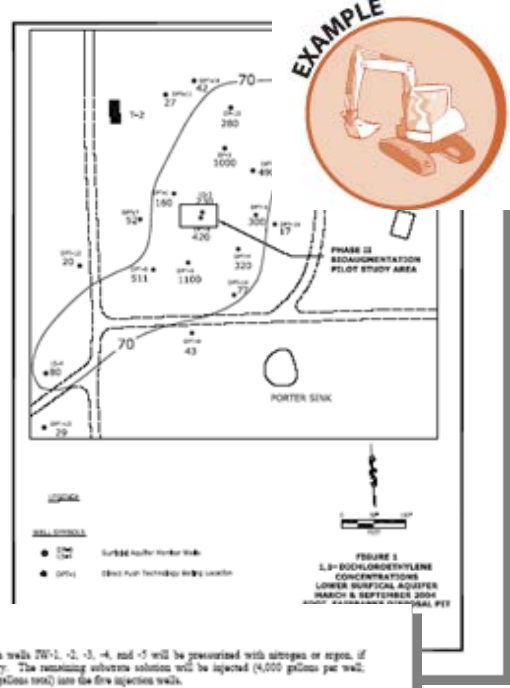
- Primary goal of CA program is remedies in place, not generating reports.
- Progress more important than process.
- Reports & regulatory reviews at key points.
- Challenge for PMs – balance info needs & reporting with maintaining progress.

Effective Documentation/ Reporting

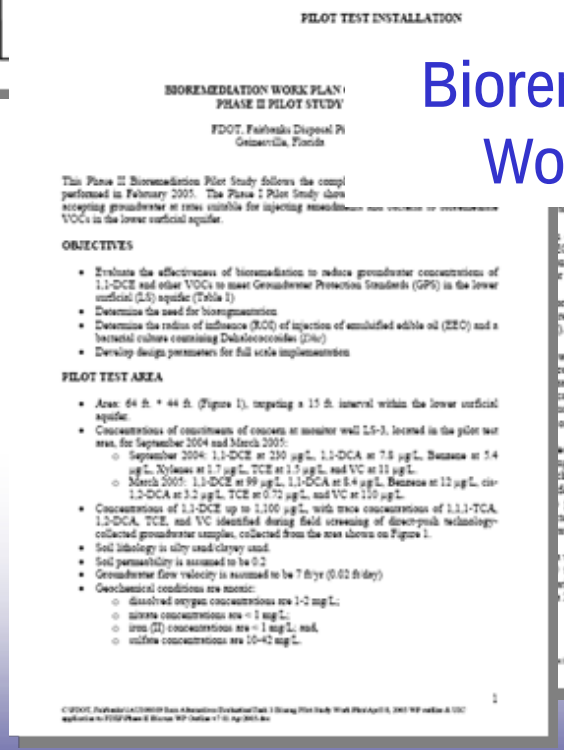
- **Purpose**
  - Establish and track schedule
  - Certify technical soundness, safety, QA/QC
  - Document decisions
- **Content and design**
  - Dynamic: for real-time decisions
  - Informal: e-mail or teleconference with minutes
  - Short: Tables and figures: minimal text
  - Clear: Decision matrices
  - Certified: Registered or licensed professional

Minimal, Dynamic Work Plan





Bioremediation Work Plan



PILOT TEST INSTALLATION

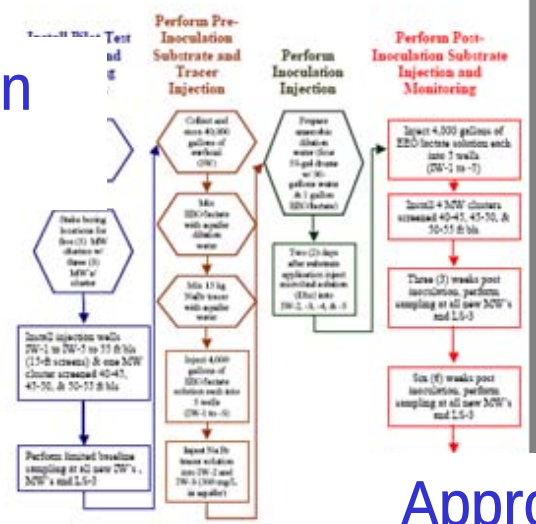
BIOREMEDIATION WORK PLAN
PHASE II PILOT STUDY

OBJECTIVES

- Evaluate the effectiveness of bioremediation to reduce groundwater concentrations of 1,1-DCE and other VOCs to meet Groundwater Protection Standards (GPS) in the lower surficial (LS) aquifer (Table 1)
- Determine the need for bioaugmentation
- Determine the radius of influence (ROI) of injection of emulsified edible oil (EEO) and a bacterial culture containing Dehalococcoides (*Dhc*)
- Develop design parameters for full scale implementation

PILOT TEST AREA

- Area: 64 ft. * 44 ft. (Figure 1), targeting a 15 ft. interval within the lower surficial aquifer.
- Concentrations of constituents of concern at monitor well LS-3, located in the pilot test area, for September 2004 and March 2005:
  - September 2004: 1,1-DCE at 230 µg/L, 1,1-DCA at 7.8 µg/L, Benzene at 5.4 µg/L, Xylenes at 1.7 µg/L, TCE at 1.5 µg/L, and VC at 11 µg/L.
  - March 2005: 1,1-DCE at 99 µg/L, 1,1-DCA at 8.4 µg/L, Benzene at 12 µg/L, cis-1,2-DCA at 3.2 µg/L, TCE at 0.72 µg/L, and VC at 110 µg/L.
- Concentrations of 1,1-DCE up to 1,100 µg/L, with trace concentrations of 1,1,1-TCA, 1,2-DCA, TCE, and VC identified during field screening of direct-push technology-collected groundwater samples, collected from the area shown on Figure 1.
- Soil lithology is silty sand/clayey sand.
- Soil permeability is assumed to be 0.2
- Groundwater flow velocity is assumed to be 7 ft/yr (0.02 ft/day)
- Geochemical conditions are anoxic:
  - dissolved oxygen concentrations are 1-2 mg/L;
  - nitrate concentrations are < 1 mg/L;
  - iron (II) concentrations are > 1 mg/L; and,
  - sulfate concentrations are 10-42 mg/L.



- Injection wells IW-1, -2, -3, -4, and -5 will be pressurized with nitrogen or argon, if necessary. The remaining substrate solution will be injected (4,000 gallons per well; 20,000 gallons total) into the five injection wells.

PILOT TEST PERFORMANCE MONITORING

- Groundwater samples will be periodically collected from the pilot test monitor wells, monitor well clusters, and LS-3.
  - Limited baseline sampling will be performed at the injection wells, one cluster of monitor wells, and LS-3 prior to substrate injection.
  - Samples will be analyzed for VOCs, bromide, and total organic carbon (TOC), as well as periodically for sulfate, dissolved hydrocarbon gases, and *Dhc* bacteria. Field analysis of DO, pH, and oxidation-reduction potential (ORP) will also be conducted.
- The proposed sample schedule is shown below, subject to modification based on pilot test performance.

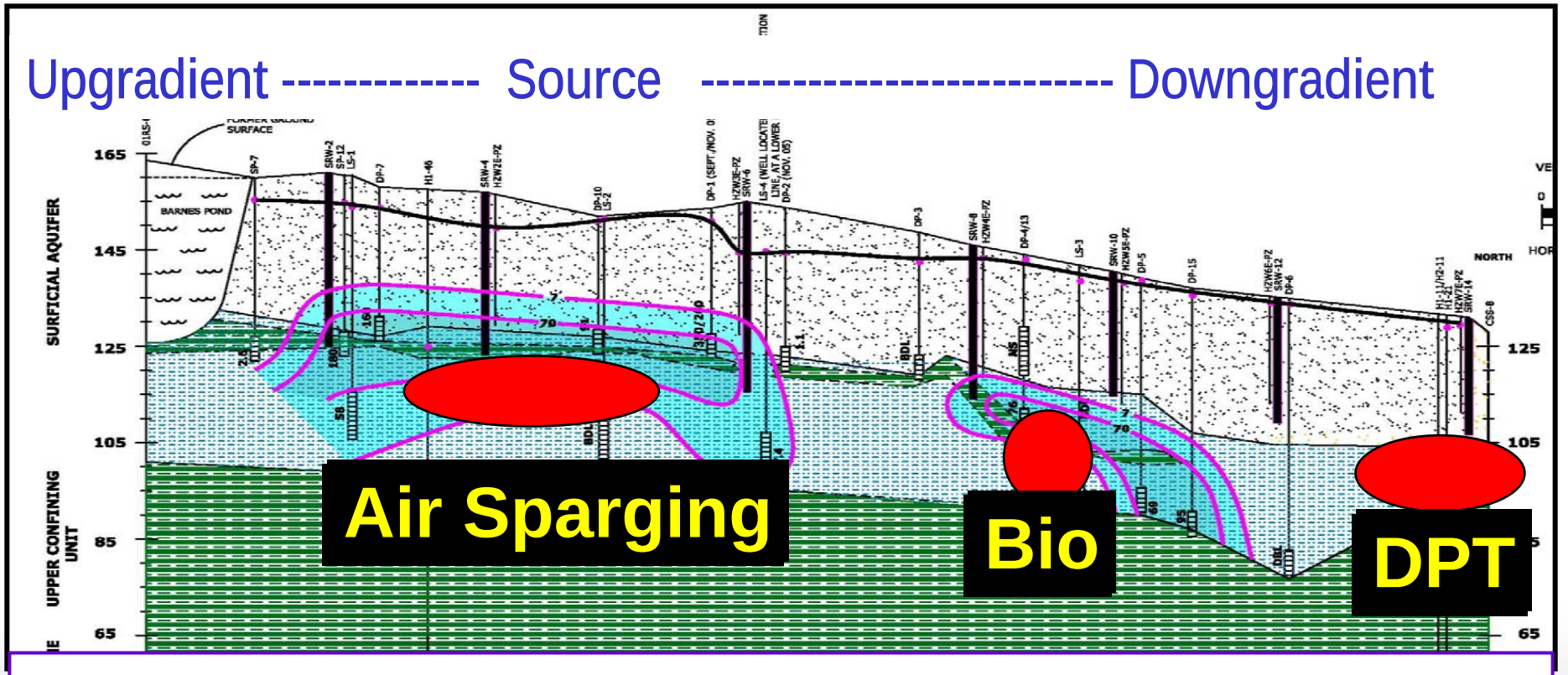
Parameter	Baseline (performed March 2004)	Prior to Inoculation	Within First Week after Inoculation	Three (3) Weeks Post-Inoculation	Six (6) Weeks Post-Inoculation	Twelve (12) Weeks Post-Inoculation
VOCs	X	X		X	X	X
Bromide	X	X	X	X	X	X
TOC	X	X		X	X	X
Sulfate	X			X		X
Dissolved						X
						X
						X

Approved in 48 Hours

2. Process Should Not be Linear

- Implement short-term, focused remediation (e.g., IMs) before assessment completed.
- Combine documents – such as Remedial Facility Investigation (RFI) Report & Corrective Measures Study (CMS) Report
- Evaluate exposure pathways & potential risks early to focus assessment & remedy planning on most significant risks.

CA as a Non-Linear Process



Remediation Can Begin Before Assessment is Completed

3. EPA Encourages Practical Approaches

- Tailored oversight
- Facility-lead agreements
- Performance-based permits

Be creative

Spectrum of Approaches

AGENCY

- **Performance-based standards**
- **Fewer approvals**
- **Low oversight**

- **More prescriptive standards**
- **More approvals**
- **High oversight**

OWNER/OPERATOR

- **Better track record**
- **More trustworthy**
- **Less controversy**

- **Worse track record**
- **Less trustworthy**
- **More controversy**

Tailored Oversight

DECLARATION OF RESTRICTIVE COVENANT

THIS DECLARATION OF RESTRICTIVE COVENANT (hereinafter "Declaration") is made this _____ day of _____, 200 __, by {{*property owne*
-.}} {{*a corporation authorized to conduct business in the State of Florida, -- if applicable*
(hereinafter GRANTOR) and the Florida Department of Environmental Protection (hereinafter "FDEP")

Facility-Lead Agreement University of VA

- Facility Lead Agreement took only 2 months to develop
- UVA conducted RFI in 16 months; EPA conducted verification sampling
- Statement of Basis: 2003
- CA Complete without Controls: 2004

Performance-Based Permit

Facility with accelerated cleanup to allow recreational land use

Sports Complex 2015

Long-Term Stewardship

Corrective Action Complete

Restrictive Covenant

Risk-based Criteria

Parcel Transfers

STRUCTURAL SUPPORT: Stakeholder buy-in

Chemical Oxidation

Optimize P&T

AS/SVE

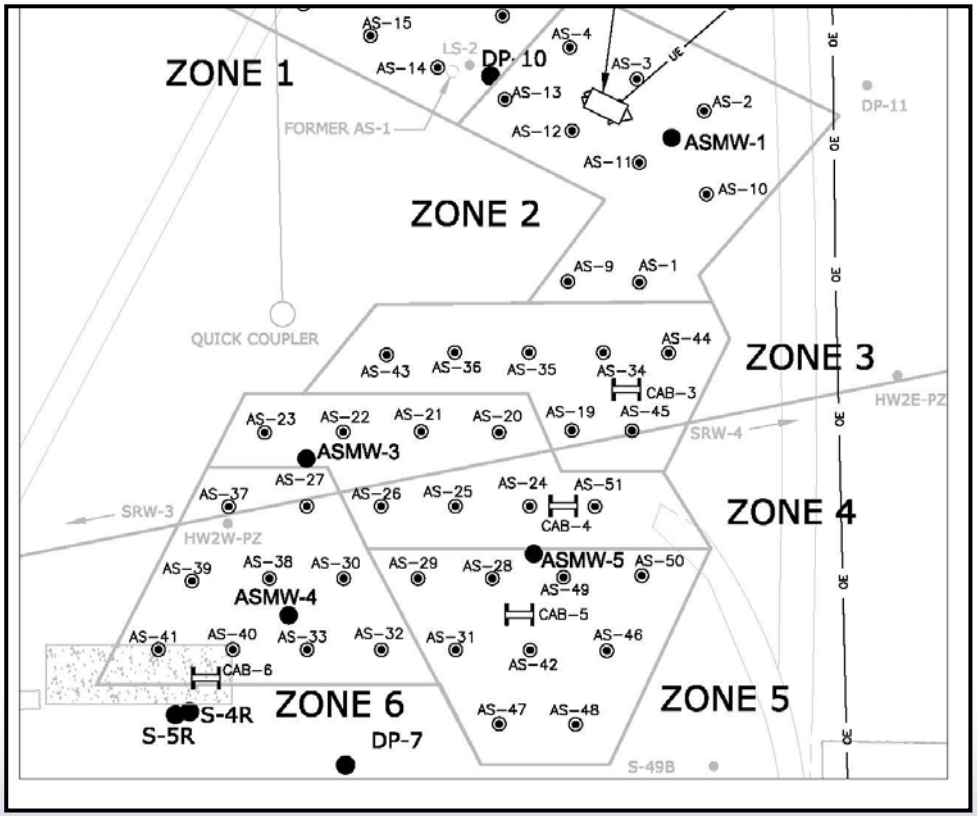
Bio-augmentation

FOUNDATION: FLEXIBLE, PERFORMANCE-BASED PERMIT

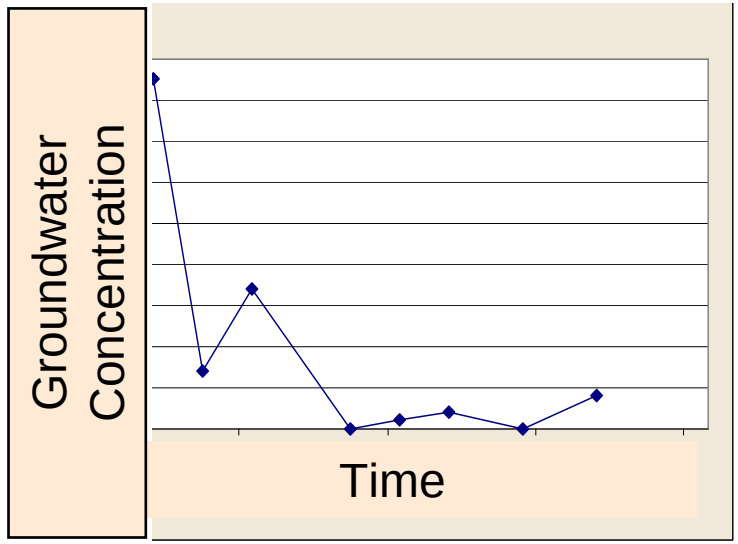
Assessment & Remediation Performance Standards

Menu of Remedial Technologies

Successes Achieved through Performance-Based Permit



Modular Air Sparge System



Effective Bioremediation

4. Regulatory Approval not Necessary for Every Decision

- Reserve regulatory approval for major milestones.
- Facilities make decisions regarding wells and system operations based on performance standards.
- Licensed or registered professionals should document findings and decisions.

Performance Standards Provide Flexibility

- Groundwater Monitoring Program:
  - Evaluate CA program effectiveness
  - Determine compliance with cleanup criteria
  - *Facility selects wells, parameters, frequency*
- Remediation Technologies:
  - Protect human health and the environment (HH&E)
  - Attain cleanup criteria
  - Achieve source control
  - *Facility selects technology and O&M data*

(continued)

Performance Standards Save Time and Reduce Costs

- Modified injection/recovery rates
- Adjusted sampling program
- Applied additional technologies

5. Traditional CA Process is a Guide, not a List of Requirements

- Focus on the goal (protect HH&E) but be flexible on how achieved:
  - Risk management
  - Site characterization
  - Remedy design and implementation
- Document decisions but maintain progress.

Practical Approaches to Remedy Selection and Implementation

- Risk management
  - Eliminate unacceptable exposures early
  - Ensure adequate monitoring and reliable controls to prevent exposure over time
- Cleanup timeframes can vary
  - Consider redevelopment and reuse
  - Accommodate facility operations

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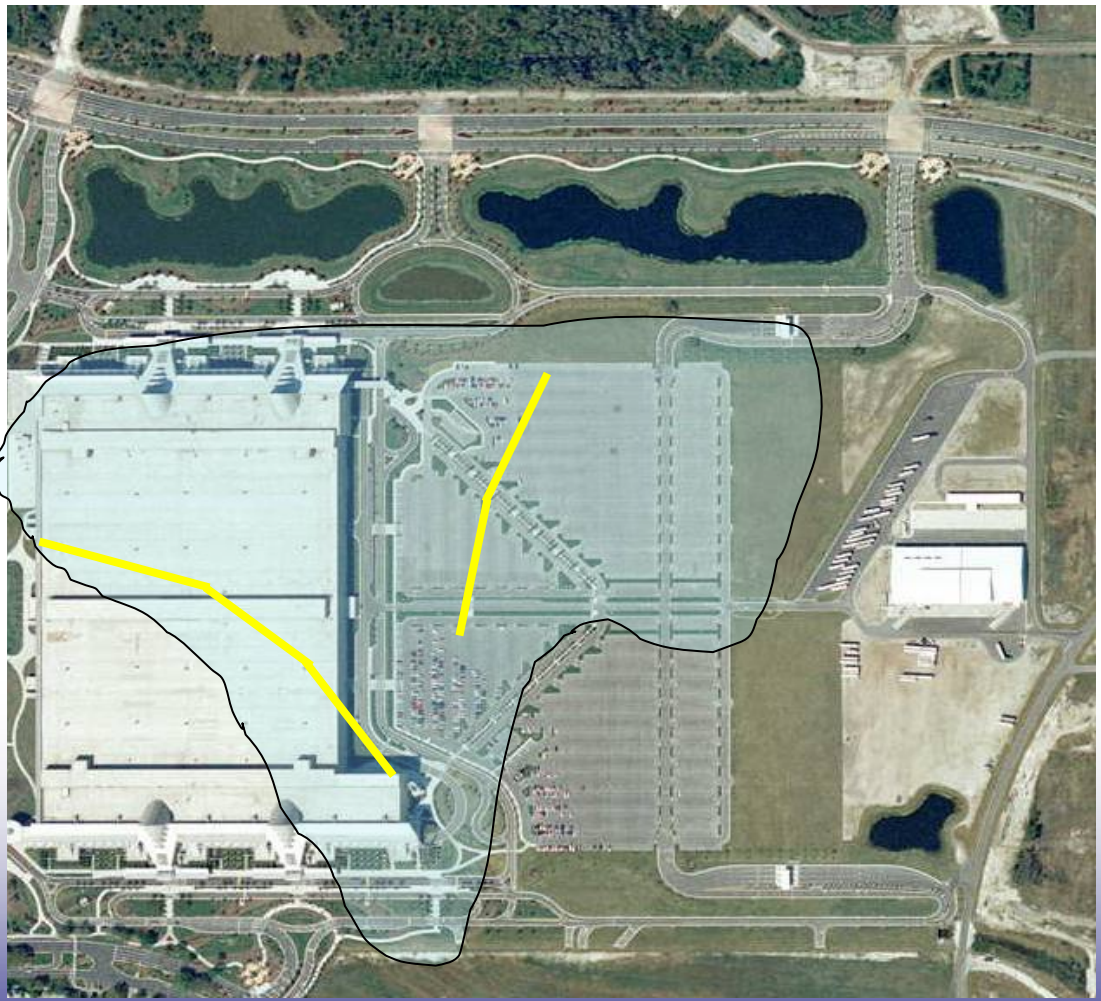
Stabilization Approach to Remedy Implementation



- Operating facility
- Long-term cleanup

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Flexible Timeline for Remedy Implementation

Human Exposures EI CA 725 *YES*

Interim Measures – P&T, AS

Final Remedy - P&T, AS, MNA, 2-yr reviews

2-Yr Final Monitoring

GW EI CA750 conditional *YES*

GW EI *YES*

CMS

Final Remedy Selected CA 400 *YES* Construction Complete CA 550 *YES* Permit Mod

Meet Cleanup Goals

Terminate Permit

2000 2002 2004 2005 2007 2008 2035 2037

Interim Measures (IM) Approach to Remedy Implementation

- Horizontal wells installed as IM

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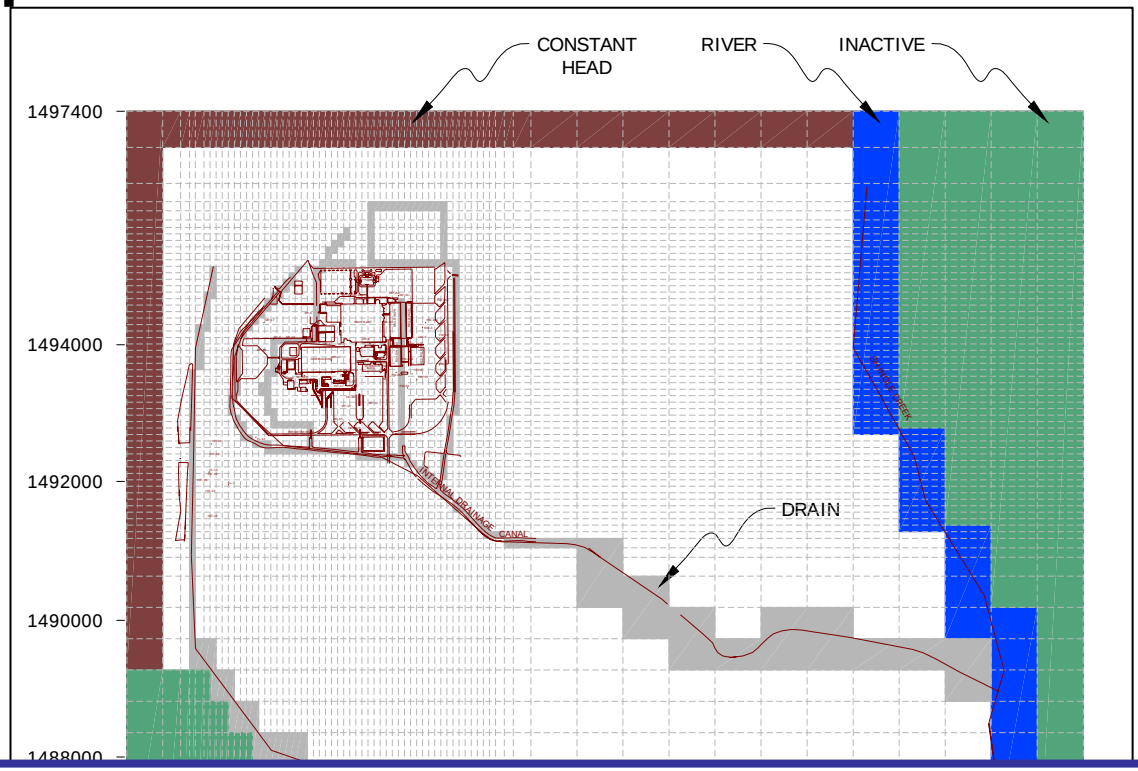
IM Approach to Remedy Implementation

IM

Final Remedy Verification



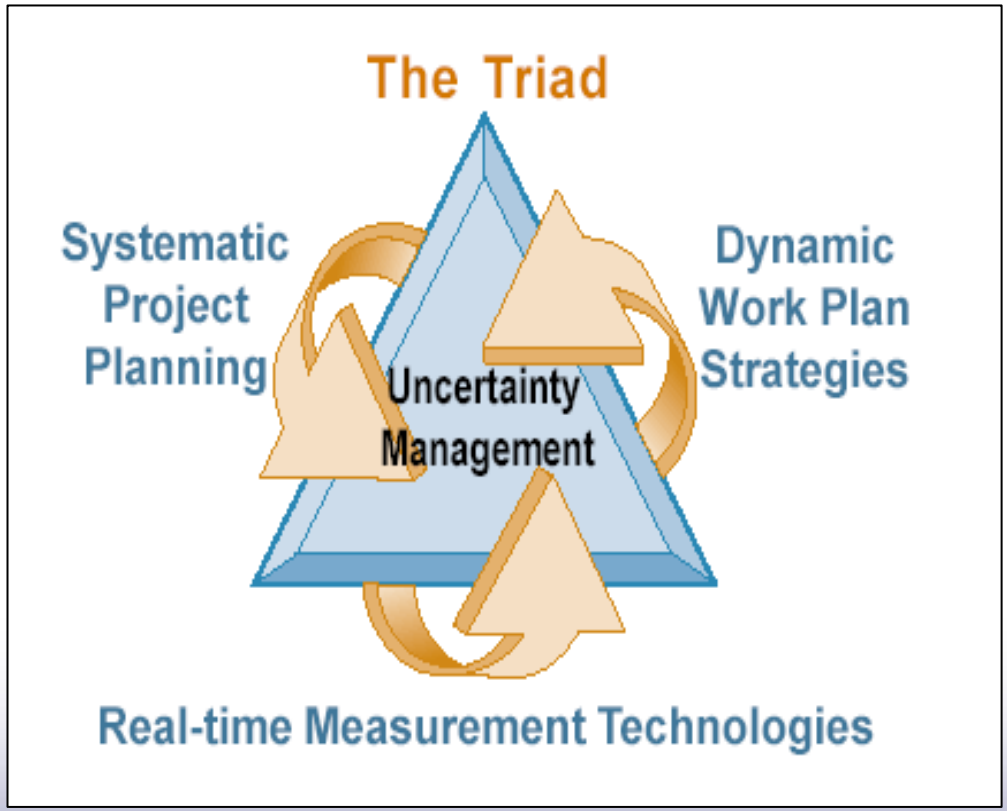
- **IM + MNA = CMS Not Necessary**
- **Permit modification required for IM to become final remedy**

Practical Approaches to Field Investigations

- Triad approach to support field planning across technology types
- Field screening and real-time data acquisition can guide further sampling for laboratory analysis

The Triad Approach

- Conceptual Site Model development
- Dynamic work strategies
- Real-time decisions



Triad - Field Technologies

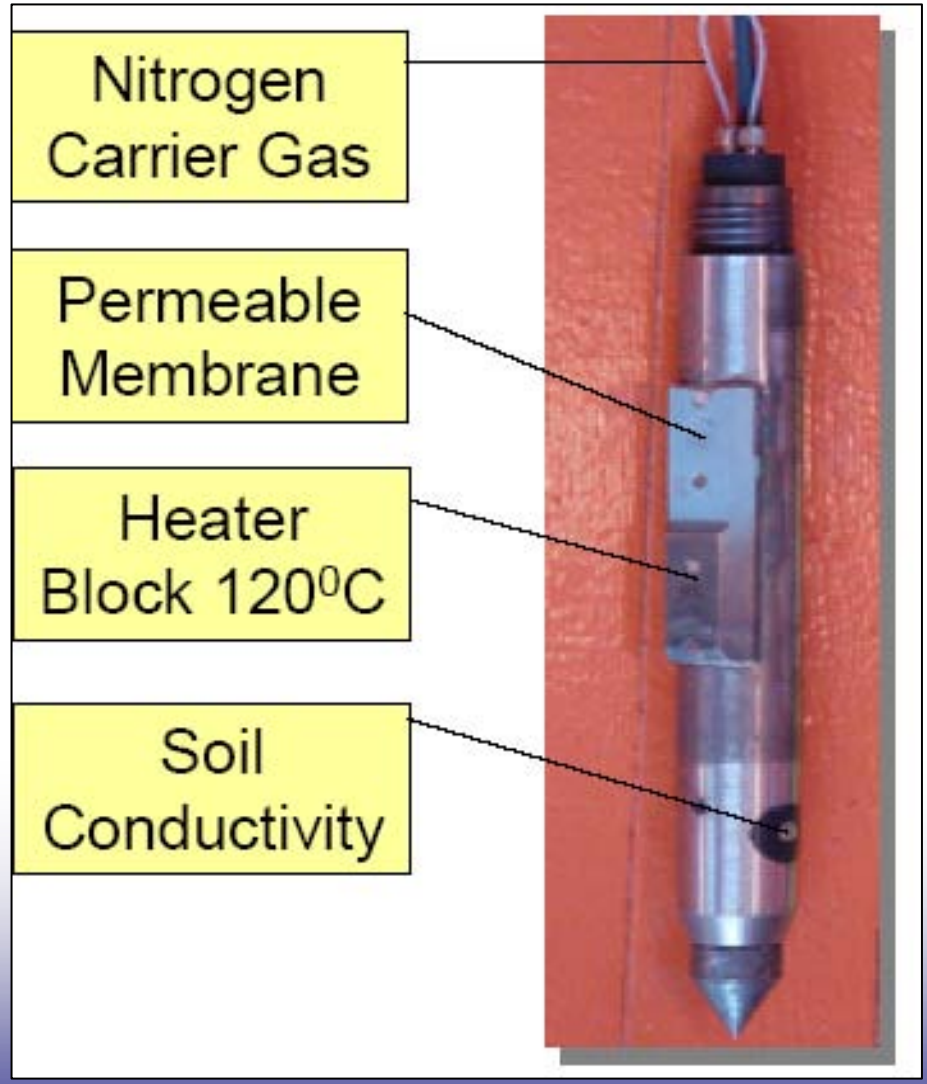
- Field analyses make dynamic work plan strategies possible
- Real-time decisions are made using real-time data
- Field-based methods are cost effective
- Laboratory data are not replaced, but supplemented

Practical Field Sampling and Analysis Methods

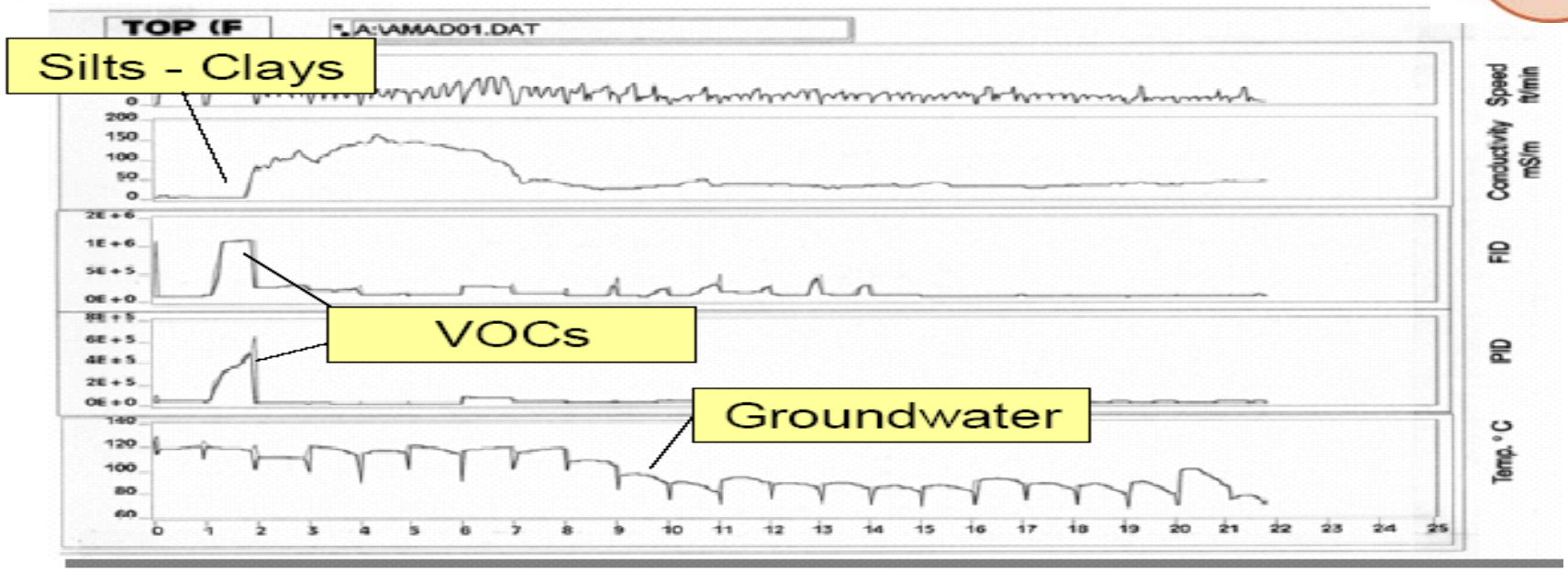
- Colorimetric Test Kits
- Immunoassay Methods
- Membrane Interface Probe (MIP)
- Direct Push Technology
- Mobile Laboratories
- Passive Diffusion Bags

Membrane Interface Probe

- Measures VOCs in soils and groundwater
- VOCs diffuse through heated permeable membrane
- Collected VOCs swept by carrier gas to land surface and measured by detectors



MIP Outputs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Conductivity mS/m
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FID
PID
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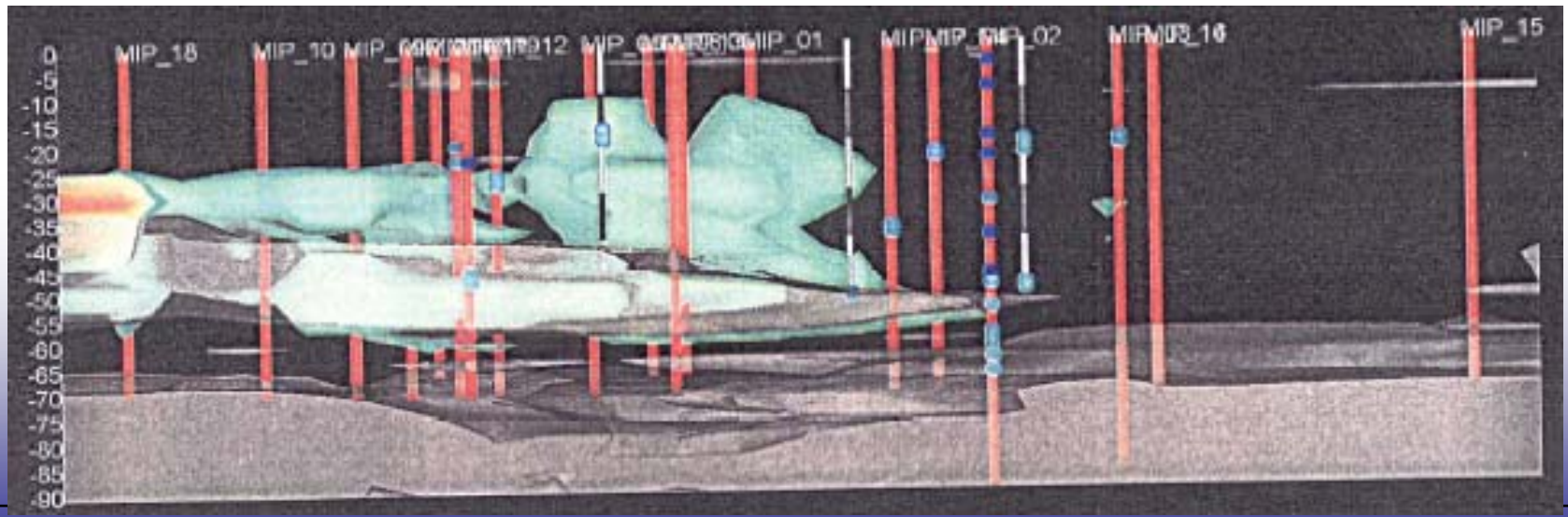
MIP_18
MIP_10
MIP_01
MIP_15

Advantages of Field Technologies

- Rapid sample turn-around (real time)
- Low cost
- Large number of samples collected
- Ease of use (varies)
- Little or no investigation derived waste (IDW)

Summary

- To achieve progress, focus on practical solutions that protect HH&E.
- Practical solutions consider current and reasonably anticipated uses.
- Triad and field-based investigation approaches are available to support progress.