



RCRA Corrective Action Training Program: Getting to YES! *Strategies for Meeting the 2020 Vision*



This training and training documents do not create any legally binding requirements on the U.S. Environmental Protection Agency (EPA), states, or the regulated community, and do not create any right or benefit, substantive or procedural. The training and documentation are not a complete representation of the Resource Conservation and Recovery Act or of EPA's regulations and views.





Module 11

Maintaining Effective Remedy Performance



Module Overview

- ❖ Remedy Construction Definition
- ❖ Performance Metrics
- ❖ Facility and Agency responsibilities during system operation
- ❖ Remedial System Optimization
- ❖ Monitoring Institutional Controls
- ❖ Effective Reporting



Remedy Construction Defined

- ❖ **Remedy Constructed (RC):**
 - Construction is complete
 - Remedy is fully functional

- ❖ **No Remedy Constructed (NR):**
 - CA already complete
 - No construction necessary



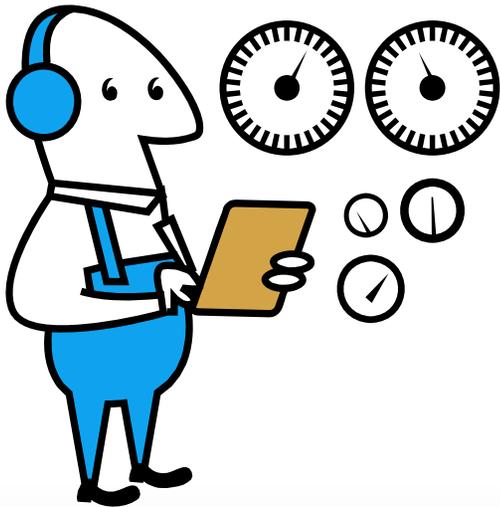
Documenting Remedy Construction Decision

- ❖ Options
 - Letter or memorandum
 - Decision document
- ❖ Getting to the remedy – not the event code
 - is what counts!



Performance Metrics

- ❖ Metrics must be
 - **S**pecific
 - **M**easurable
 - **A**ttainable
 - **R**ealistic
 - **T**imely



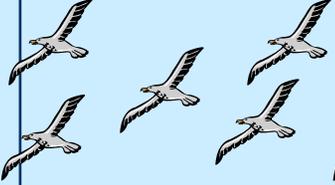
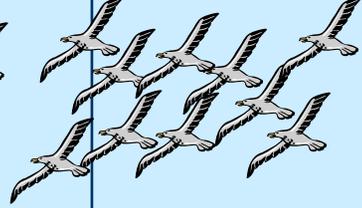


Examples of Performance Metrics

- ❖ Treatment System
 - % Removal
 - Rate of Removal (Mass / Time)
 - Energy Consumption / Mass Removal
 - Unit Cost / Mass Removal
 - % Utilization (actual versus available)
- ❖ Site Control
 - Hydraulic control
 - Groundwater quality trends



Facility and Agency Responsibilities in Perspective

	Regulatory Mechanism Negotiation	Assessment and Interim Measures	Remedy Selection/ Construction	Remedy Operation
Agency Staff Time				
Facility Costs	\$\$\$	\$\$\$\$\$\$	\$\$\$\$\$\$\$\$ \$\$\$\$	\$\$\$\$\$\$\$\$ \$\$\$\$\$\$\$\$
Public Participation				
Human Health & Environmental Benefit				



Agency Oversight During Operations

Results-based Concepts:

- ❖ Holistic Approach
- ❖ Tailored Oversight
- ❖ Targeted Data Collection
- ❖ Performance Criteria

Benefits:

- ❖ Focus on goals
- ❖ Faster results
- ❖ Resource savings to facility and agency



O&M and Site Sampling Activities

- ❖ Routine Maintenance
- ❖ Unexpected Maintenance
- ❖ Performance Monitoring and Reporting
- ❖ Cost Monitoring and Control
 - Proper maintenance
 - System optimization
 - Targeted data collection



Targeted Data Collection

- ❖ Sampling Frequency
 - Site-specific factors should dictate
- ❖ Analytical Tests
 - Focus on chemicals of concern
- ❖ Sampling Locations
 - May change over time, as cleanup occurs



Performance Criteria



- ❖ A facility has multiple recovery wells and treatment systems
- ❖ The RCRA permit requires agency approval to shut down recovery wells and treatment systems after cleanup criteria are met

(continued)



Example of Cost Associated with Timing

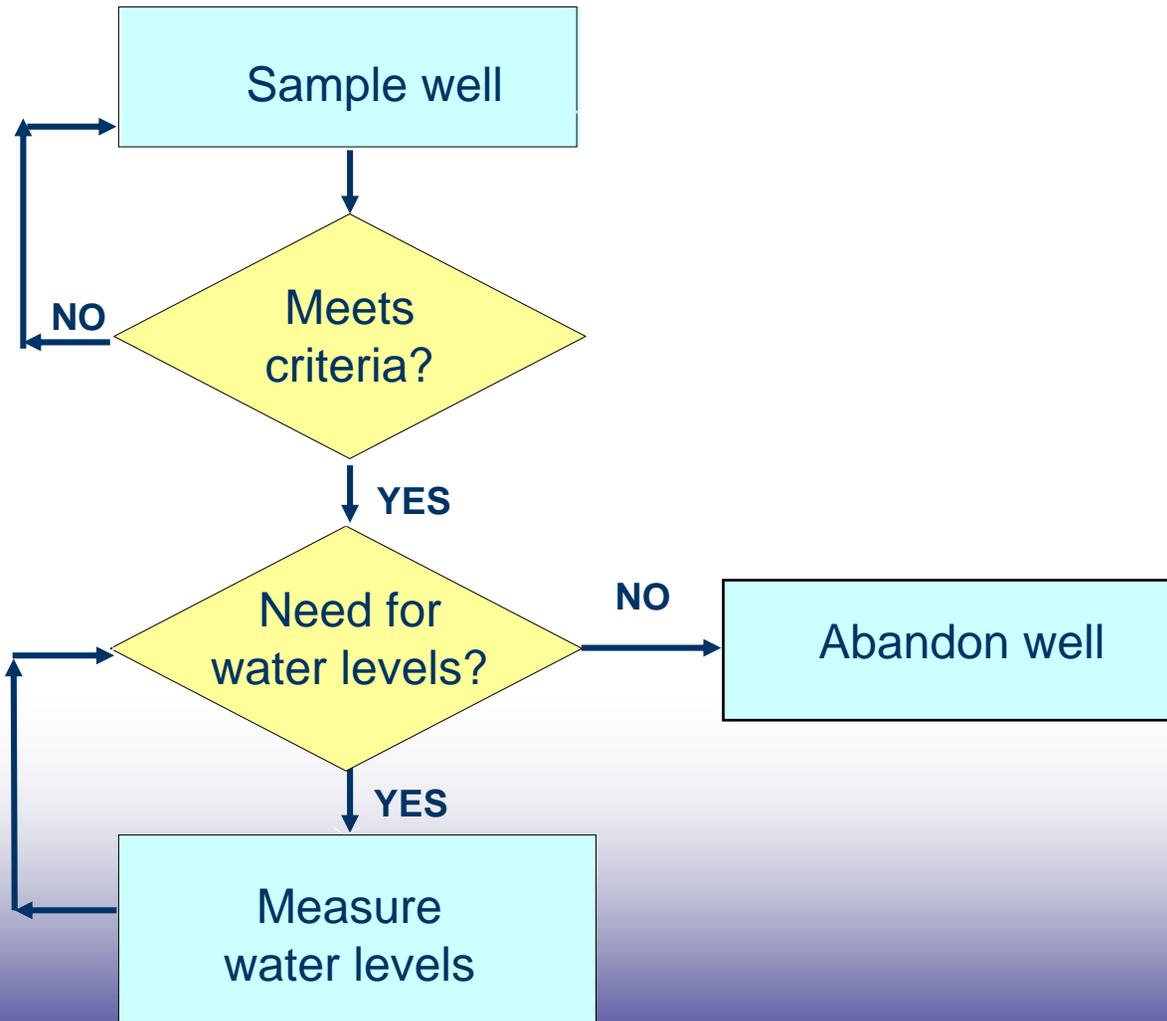


The facility requests agency approval to shut down a recovery well; assume the agency approves this request 8 months later.

- ❖ Cost of approval step:
 - \$15,000/yr X 2/3 yr = \$10,000 operational cost to facility
- ❖ Environmental benefit of approval step:
 - None; the facility has been treating clean water



Performance Criteria





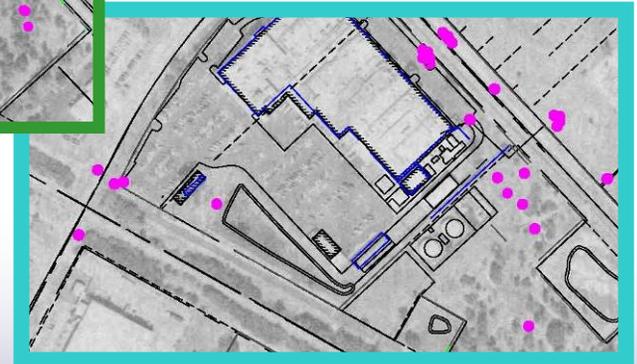
Goal: Close Out Site



1999: 60 wells



2005: 53 wells



2006: 21 wells

2008: 10 wells

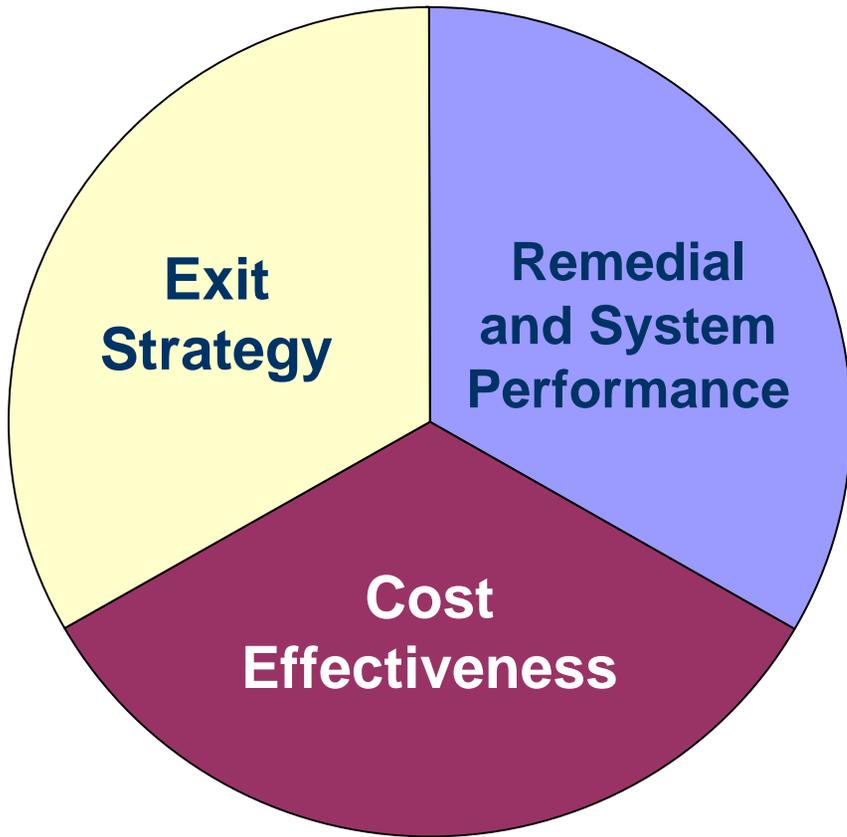


Remedial System Optimization

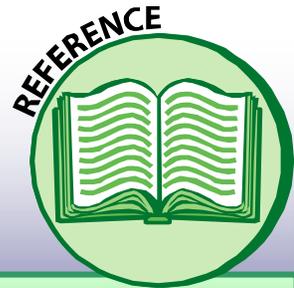
- ❖ Systematic evaluation of technologies:
 - Remedy performance
 - Cost effectiveness
- ❖ Considers technological advances
- ❖ Leads to system modifications/technology changes
- ❖ Regulatory mechanism should allow efficient implementation



Remediation System Evaluations



- ❖ USACE and EPA have guidance
- ❖ Tools and resources are available



<http://www.frtr.gov/optimization/general.htm>



RSEs - Exit Strategy

- ❖ Continued use or revitalization (residential or industrial?)
- ❖ Cleanup timeframe, including milestones
- ❖ Cleanup criteria (soil, groundwater)
- ❖ Are cleanup goals the same for the entire facility?

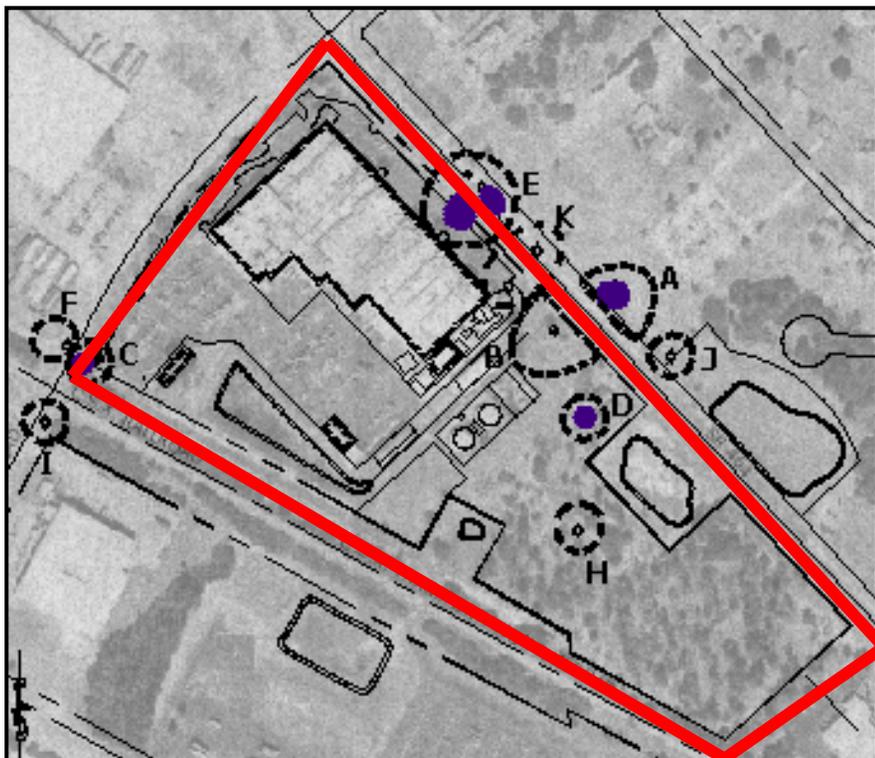


Remedial and System Performance

- ❖ Site Remedial Effectiveness
 - Concentrations in groundwater decreasing?
 - Plume contained?
- ❖ Treatment System Effectiveness
 - Meeting design expectations?
 - Maintenance issues such as biofouling?
- ❖ Should new technologies be introduced?



Adding Technologies: Air Sparge

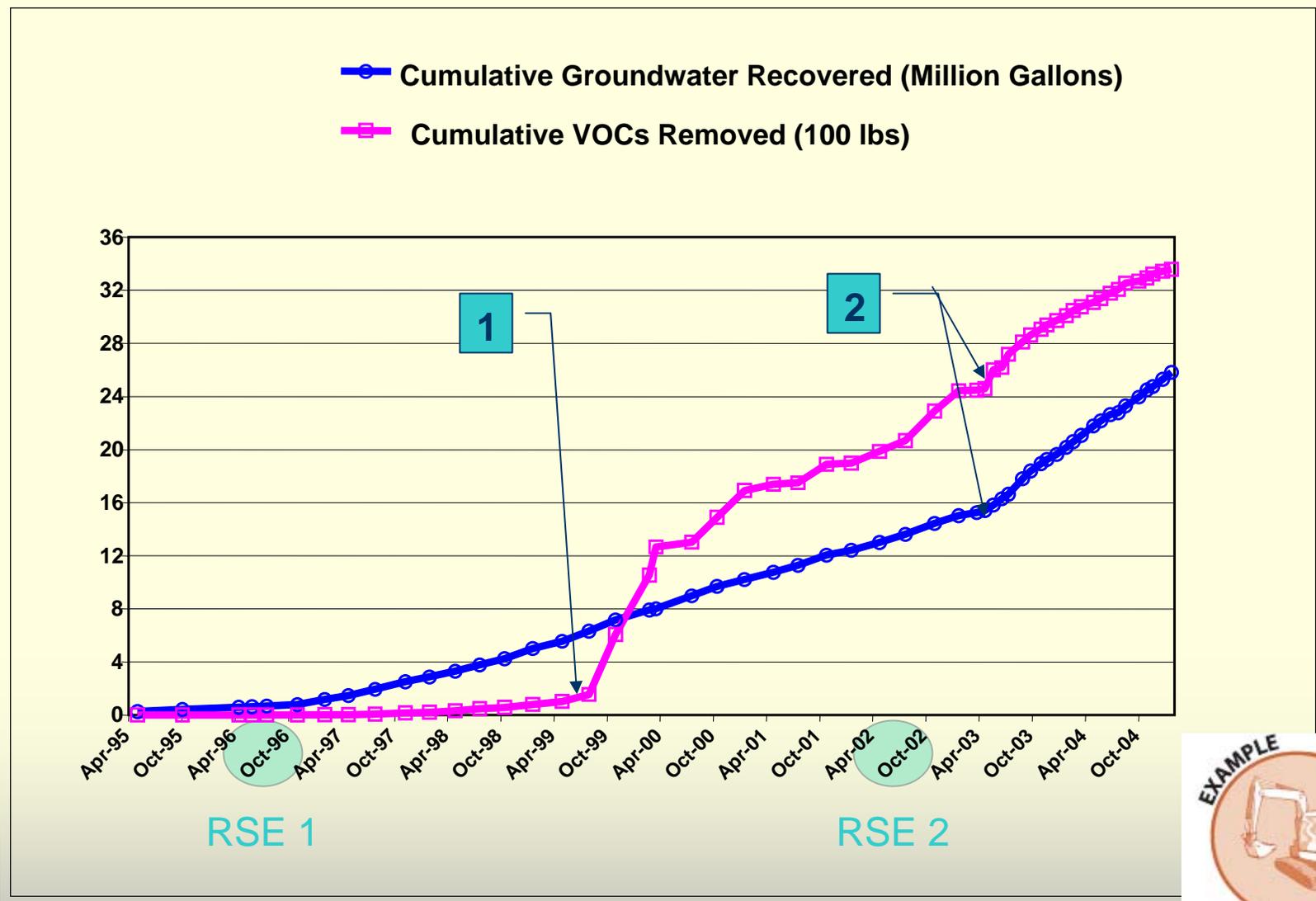


- ❖ Initially one large plume; successful P&T reduced size, then progress stalled
- ❖ Air sparge unit added as a polishing step





Improving Mass Removal Rate



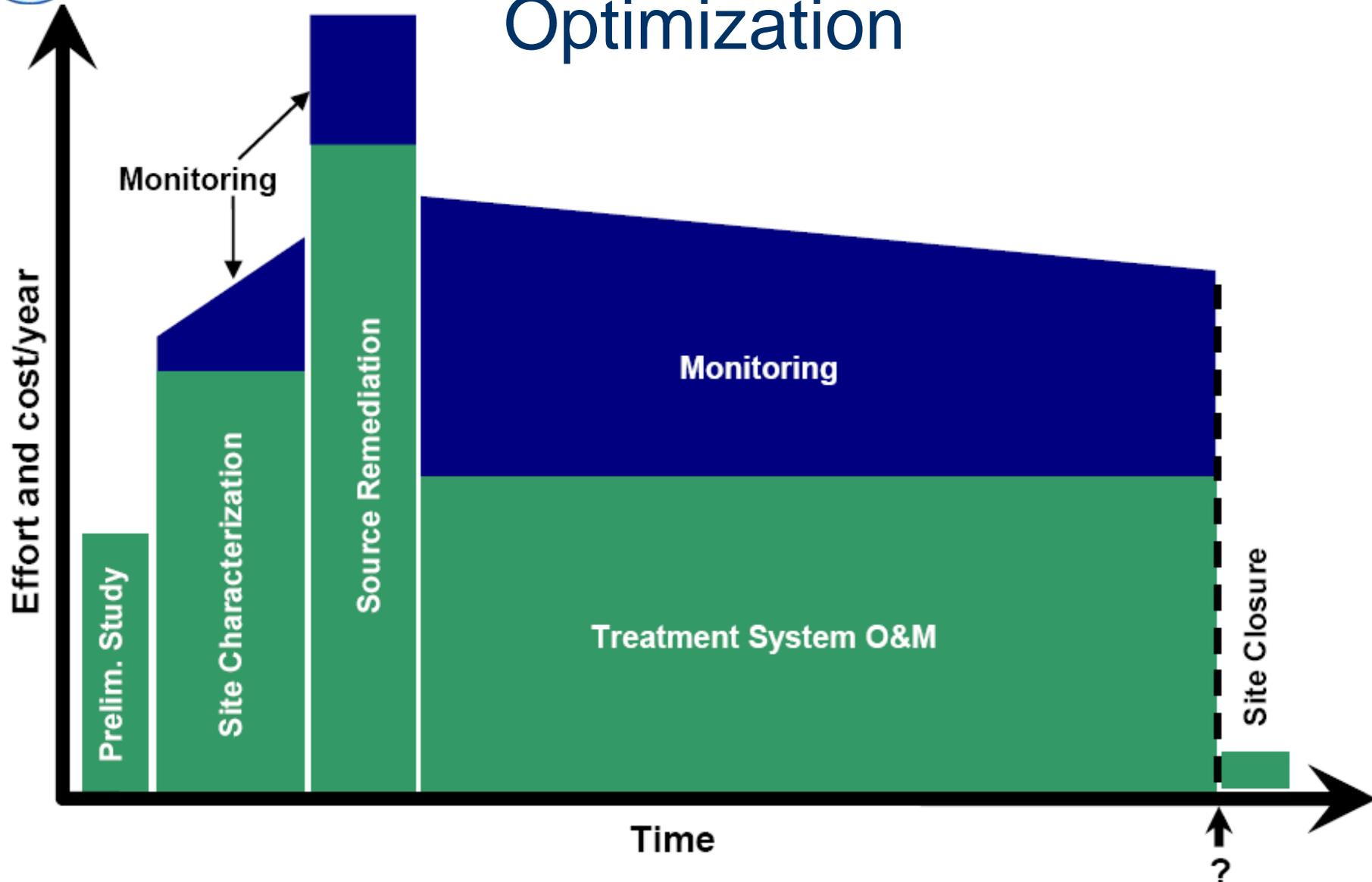


Site Changes Drive Optimization

- ❖ Contaminant concentrations
- ❖ Hydraulic recovery
- ❖ Zones of influence not as expected
- ❖ Source areas delineated and removed
- ❖ Natural degradation occurring

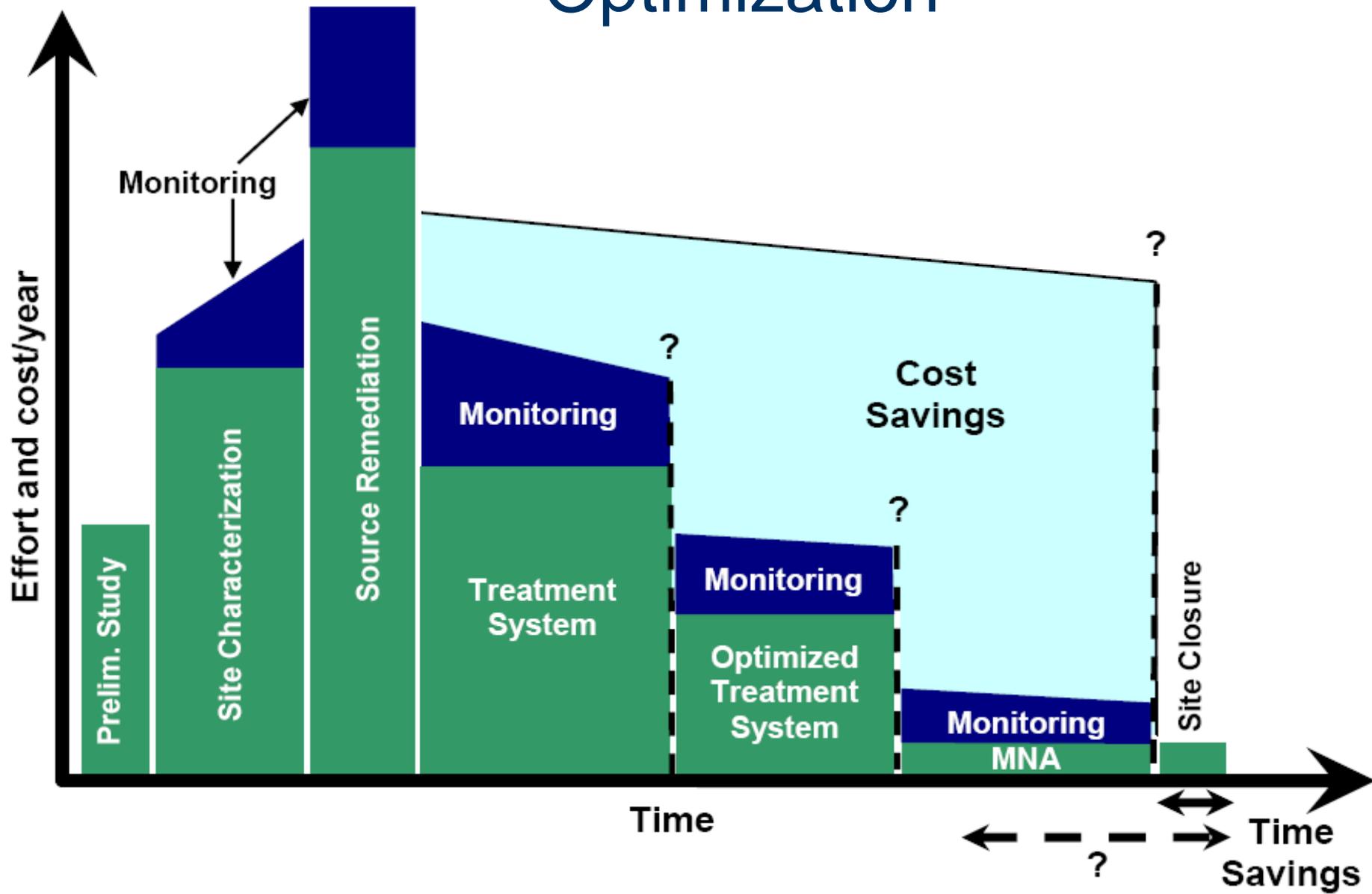


Remedial Process – Without Optimization





Remedial Process – With Optimization





Horizontal Well - Low Flow

- ❖ Why is flow declining?
 - Silt?
 - Iron fouling?
 - Slots clogged with drilling mud?
 - Slot size OK?
 - Biofouling?
 - Pumps?
 - Casing corrosion?



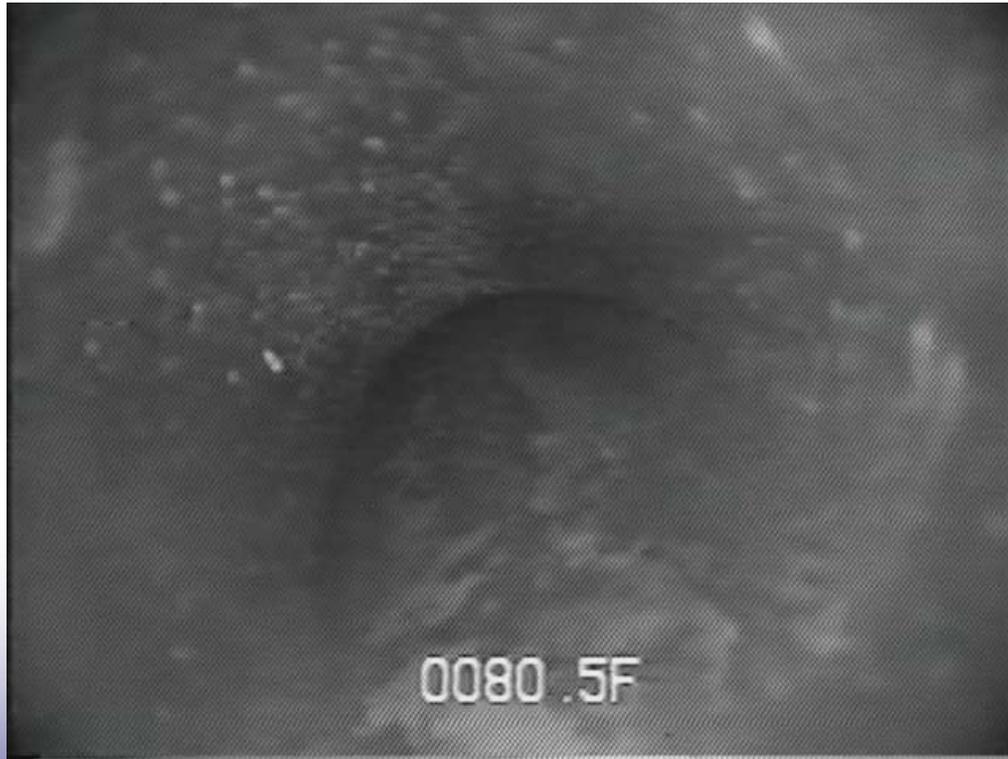
(continued)



Horizontal Well - Inspection



Decided to have the horizontal wells video inspected:



(continued)



Horizontal Well - Cleaning

No known method to mechanically clean such long horizontal wells.
Driller custom fabricated a wire brush and used citric acid to scrub the wells.



Wire bristles welded to drilling rod to specifically fit the well diameter.

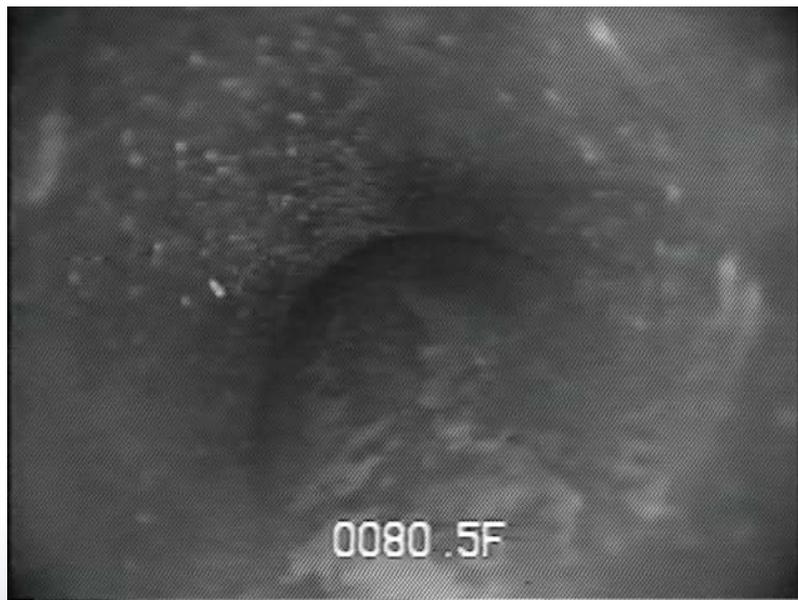


Wells were mechanically scrubbed, washed with citric acid, and then flushed with water.

(continued)



Horizontal Well - Cleaning Successful?



HW-1 = 5 gpm



HW-2 = 13 gpm



RSE - Cost Effectiveness Evaluation

- ❖ Identify Major Cost Categories
- ❖ Focus on the Highest Percentages
 - 40 to 60% of Costs: Energy Consumption
 - 20 to 40% of Costs: Sampling and Analysis
- ❖ Analyze for Cost Reduction Opportunities
 - Start with the largest costs first



Reducing Energy Costs



- ❖ Initial design for Vapor Recovery System based on 275 lbs/hr VOCs
- ❖ Actual now at 1.5 lbs/hr VOCs

Modifying system process cycle time realized annual energy savings of \$18,000.





Reducing Equipment Needs



- ❖ Air stripping system initially designed for 4 lbs/hr VOC – two towers in series
- ❖ Actual rate now at 1 lb/hr (continued)

Modifying system to use one tower and reducing blower size realized annual energy savings of \$10,000.





Evaluating Costs: A Different Perspective

- ❖ O&M Costs
 - Routine
 - Major Repairs / Replacements
- ❖ Capital Costs
 - Modifications
 - Upgrades
- ❖ Life Cycle Costs
- ❖ \$\$\$ per Unit Mass Removed

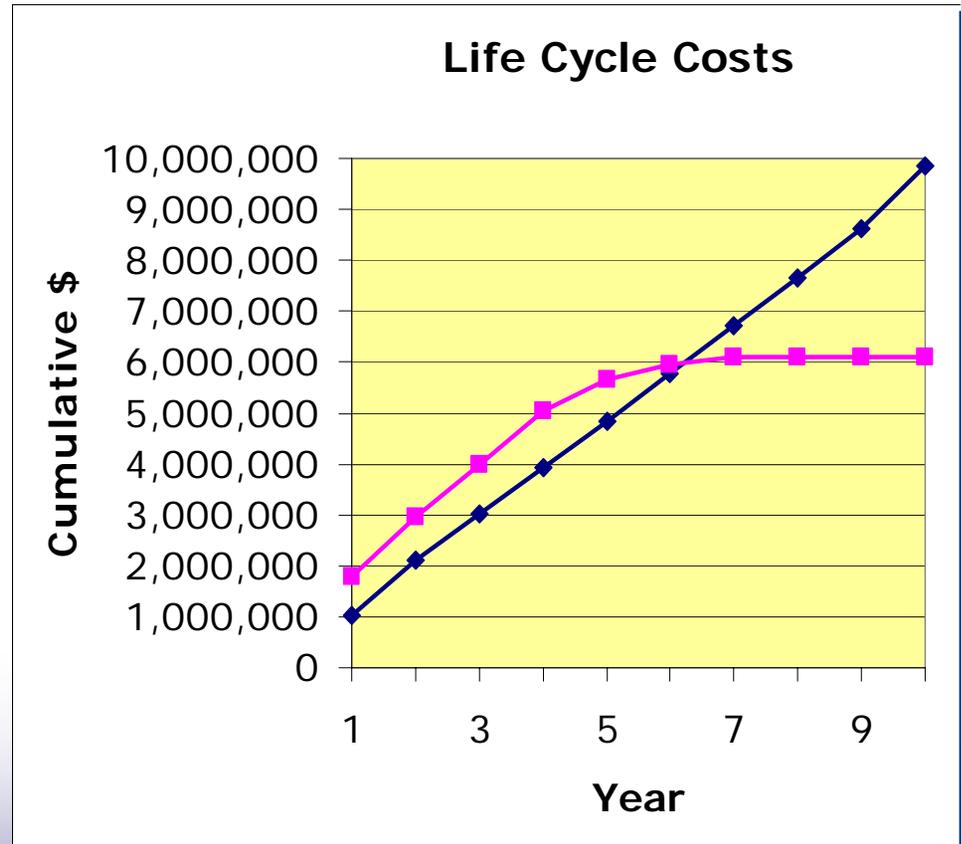


Savings on O&M and Sampling

EXAMPLE



- ❖ Sampling cost reduction of 57%
- ❖ O&M cost reduction of 77%
- ❖ Active remediation down by 4 years





Sampling Savings: Passive Diffusion Bags

- ❖ VOC sampling of groundwater
- ❖ Permeable bag containing deionized water
- ❖ Contaminants diffuse into DI water
- ❖ Bag retrieved from well and sampled





System Design Modification



- ❖ Initial design for 200 gpm, batch before disposal
- ❖ Actual now 25 gpm, direct injection

Capital costs recouped in two years, based on energy savings



Performance Standards

❖ Protective of human health and the environment



❖ Plume containment



❖ Source control



❖ Contaminant reduction



❖ Certified by a P.E.





Implementing Institutional Controls (ICs)

- ❖ Overseeing agency approves
- ❖ Get the right information to the right people at the right time; consider layering ICs for effective outcomes
- ❖ Identify responsibilities of every party
- ❖ Identify costs and include in financial assurance



Monitoring of ICs

- ❖ Important to ensuring long-term effectiveness of remedy
- ❖ Used to determine whether ICs:
 - Remain in place
 - Provide the protection required by the remedy
- ❖ May be the responsibility of more than one party
- ❖ Monitoring opportunities



Effective Reporting

Lean Reporting:

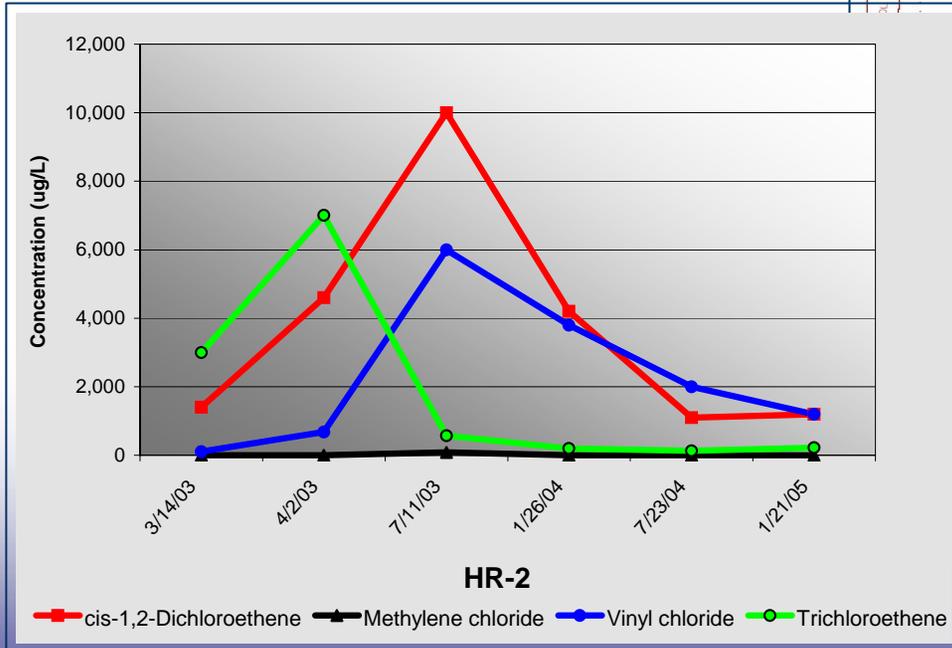
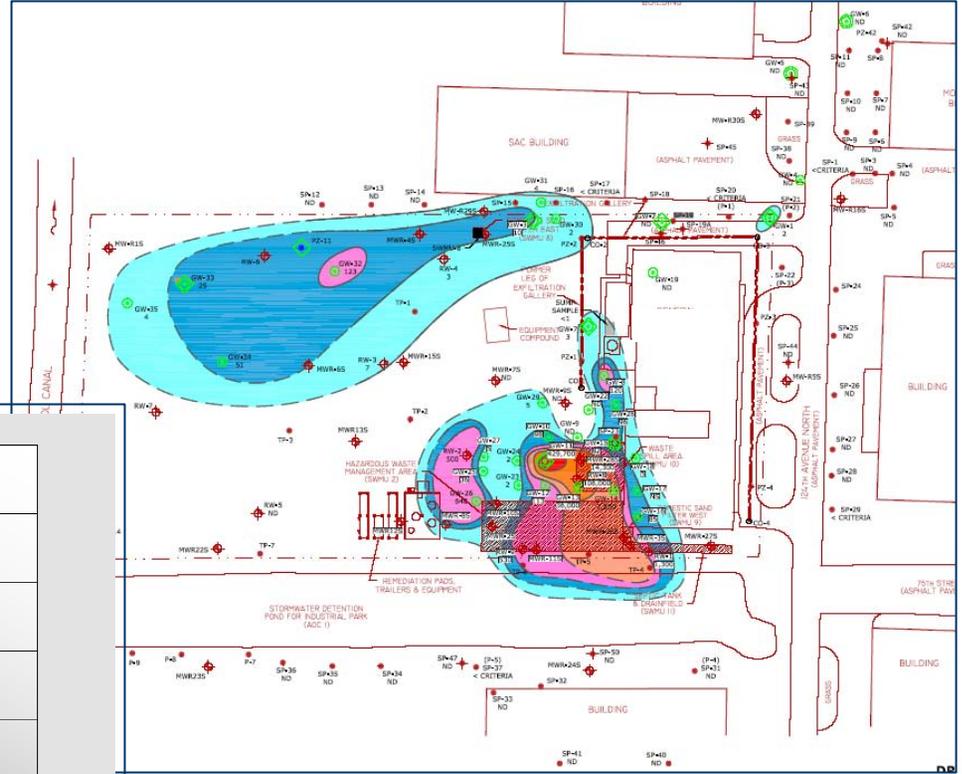
- ❖ Simple Reports
 - Think “bullets,” not paragraphs
- ❖ Reduced Frequency
 - Annual versus semi-annual
- ❖ Exception Reporting
 - Deviations from the norm



Effectively Reporting Effectiveness



- ❖ Keep it Simple & Direct
- ❖ Focus on Results
- ❖ Use Graphics
- ❖ Track Metrics



- ❖ Less May be More
- ❖ Draw Conclusions
- ❖ Make Recommendations



Summary

- ❖ Remediation does not end with Remedy Construction
- ❖ Facilities are responsible for adequately maintaining remedies, including ICs
- ❖ Remedies may change over time to reflect changing site conditions and optimize performance