



# **A Roadmap to Long Term Monitoring Optimization and Tools**

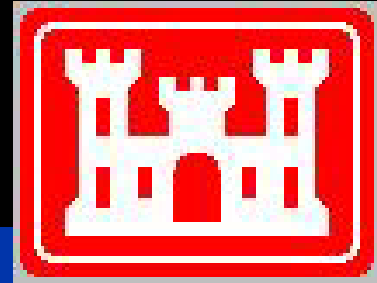
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# Brought to you by...



- US EPA Office of Superfund Remediation and Technology Innovation
- US Army Corps of Engineers Hazardous, Toxic, and Radioactive Waste Center of Expertise

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# What's the Point?



## A Roadmap for Long Term Monitoring

**Optimization** is being developed to assist managers, regulators, scientists and engineers tasked with reviewing monitoring programs to

- *Determine if optimization is appropriate for their existing monitoring program, and,*
- *If so, what methods are available and appropriate for their programs*

# Outline

- Background and Motivation
- Roadmap Purpose & Scope
- Long Term Monitoring Optimization Steps
- Summary
- Status & Next Steps



# Background and Motivation

- Long term monitoring represents a significant, persistent, and growing burden
- Often yields “wrong” level of information
- LTMO provides opportunity to identify:
  - Substantial cost savings
  - Identify inadequacies & avoid inefficiencies
  - Prevent potential impacts to public & environment

# So, LTMO's the way to go...

## Now what?

- Multiple LTMO tools and methods exist
- Unclear which are most cost and technically effective

**PARSONS**  
3-Tiered LTMO



**Navy and Marine Corps Working Group**

Optimizing Remedial Action Operations  
and Long Term Monitoring

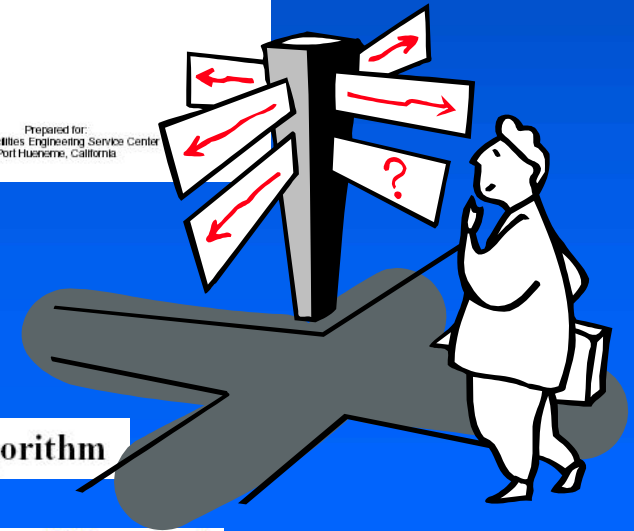
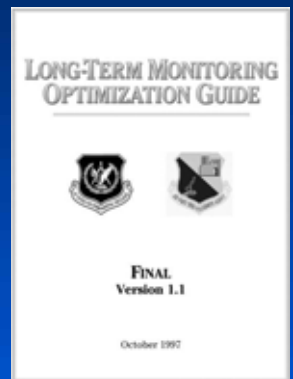
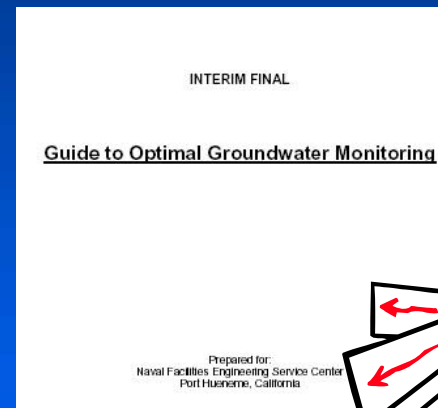
*Long-Term Monitoring (COMING SOON!!)*  
Cost-Effective Sampling (Subterranean Research,

**Geostatistical Temporal/Spatial (GTS) Optimization Algorithm**

**Long-Term Groundwater Monitoring: The State of the Art**



**MAROS Decision Support System**  
for Optimizing LTM Programs





# LTMO Roadmap Purpose

- **Audience:** managers, regulators, scientists and engineers tasked with reviewing monitoring programs
- **Goals:**
  - Understand the steps involved
  - Determine if a LTMO assessment is appropriate
  - Evaluate which LTMO methods and techniques are appropriate
  - Access more information and resources about LTMO tools





# LTMO Roadmap Scope

- Many LTMO Opportunities...
  - Sampling & analytical methods
  - Field protocol
  - Data management
- Established Monitoring Programs
  - Groundwater
  - Long term monitoring
- Focus on Physical Program Optimization
  - Monitoring frequency
  - Spatial distribution of wells
- 15 Pages!





# Roadmap Outline: Steps Involved in an LTMO

1. Review/Develop Objectives for Monitoring Program
2. Examine Existing Data
3. Determine if Site is a LTMO Candidate
4. Determine the Type of Evaluation
5. Select the Methods/Tools
6. Perform Optimization
7. Assess & Implement Results

# Review/Develop Objectives for Monitoring Program

- Establishing a Baseline...
  - What are you measuring?
  - How often and where?
    - What is the current monitoring program?
    - How much does it cost?
  - Why are you measuring?
    - Regulatory drivers?
    - Points of compliance?
    - Remedy performance evaluation?

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# Examine Existing Data

- LTMO Data Requirements Checklist
  - Lists data needed, source(s) & purpose
  - Examine the amount and types of available data
  - Discover data gaps
  - Determine what types of analyses will be feasible.

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# Data Requirements Checklist Illustration

## Required Information

Required Information		
Description of current monitoring program	Monitoring program plan, recent monitoring report	Establish baseline conditions, purpose of monitoring program and rationale for monitoring wells
Well locations/ coordinates	Database; well construction information; site Maps	Determine spatial distribution of monitoring points
Historical COC analyses/results	Database; monitoring reports; site investigation reports	Define concentrations of COCs in space and time; Confirm primary COCs
Configuration of potentiometric surface: Groundwater flow direction, velocity and gradient	Remedial investigation report (RI report), RCRA Facility Investigation report (RFI report), or similar document providing facility/site information; database	Evaluate direction and rate of groundwater movement and contaminant migration
Hydrogeologic conditions	RI/RFI report or similar document providing facility/site information	Identify geologic or other controls on occurrence and movement of groundwater and dissolved COCs
Well completion intervals/ hydrogeologic zone	Database; well construction diagrams	Determine depth of sample collection in groundwater system and potential zones
Cleanup goals/regulatory limits	RI/RFI, Record of Decision (ROD); decision document	Establish cleanup limits and areas of concern requiring monitoring
Locations of potential receptors/compliance points	RI report, RFI report, or ROD; Site map	Identify areas and/or migration directions of concern

# Determine if Site is Candidate for LTMO (Threshold Check)

- Established Monitoring Objectives?
- “Long Term Monitoring” Program & Adequately Characterized Site?
- Cost and Size of Current Program Justify Optimization?
- Expected Future Status of Remedy?
- Available Resources?
- Adequate Data Availability?
- Flexible Regulatory Environment?

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# Determine the Type of Evaluation

- Qualitative
  - Qualitative evaluation most important, verified and support by quantitative evaluations
- Quantitative
  - Temporal:
    - Monitoring results over time
    - >4 minimum rounds of sampling data required
  - Spatial
    - Monitoring results across a region
    - >15 wells with results in similar timeframe

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# Select the LTMO Methods/Tools: Frequency Optimization

- Qualitative

- Quantitative

**MONITORING FREQUENCY DECISION LOGIC**

Reasons for Increasing Sampling Frequency	Reasons for Decreasing Sampling Frequency
Groundwater velocity is high	Groundwater velocity is low
Change in contaminant concentration would significantly alter a decision or course of action	Change in contaminant concentration would not significantly alter a decision or course of action
Well is necessary to monitor source area or operating remedial system	Well is distal from source area and remedial system
Cannot predict if concentrations will change significantly over time	Concentrations are not expected to change significantly over time, or contaminant levels have been below groundwater cleanup objectives for some prescribed period of time

- Rule Based

- CES/MAROS
- Three-Tiered

- Temporal Variograms

- GTS

- Mathematical Optimization

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# Select the LTMO Methods/Tools: Spatial Distribution Optimization

- Qualitative

- Quantitative

- Geostatistics

- Weighting schemes
- Mathematical optimizations

## MONITORING NETWORK OPTIMIZATION DECISION LOGIC

Reasons for Retaining a Well in Monitoring Network	Reasons for Removing a Well From Monitoring Network
Well is needed to further characterize the site or monitor changes in contaminant concentrations through time	Well provides spatially redundant information with a neighboring well (e.g., same constituents, and/or short distance between wells)
Well is important for defining the lateral or vertical extent of contaminants.	Well has been dry for more than 2 years
Well is needed to monitor water quality at compliance point or receptor exposure point (e.g., water supply well)	Contaminant concentrations are consistently below laboratory detection limits or cleanup goals
Well is important for defining background water quality	Well is completed in same water-bearing zone as nearby well(s)

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# LTMO Methods & Tools

- Monitoring and Remediation Optimization System (MAROS 2.0)
- PARSONS 3-Tiered Method
- Geostatistical Temporal/Spatial (GTS) Algorithm
- Multi-objective LTM Optimizer (M-LTMO)



# Roadmap Presentation of LTMO Methods and Tools

- How Qualitative and Quantitative Analyses are Implemented
- Limitations
- What Types of Sites Suited for
- Time & Cost Required
- Resources/Skills Required (Don't try this at home!)
- Other Resources and Approaches:
  - Guidance documents
  - Current Research

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# Perform Optimization

- Contact/reference Information for Implementing Tools
- Case Study Discussion & References
- What to Expect: Range of Performance Results
- Other Considerations
  - Sampling methods
  - Analytical methods & list of analytes
  - Data management & reporting

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# Assess & Implement Results

- Reality Check Results
- Stakeholder Involvement
  - Review & buy in: early involvement critical
- Implementing Recommendations
  - Checklist of Actions
  - Cost to implement
  - Benefits of flexibility
  - Periodic program evaluation

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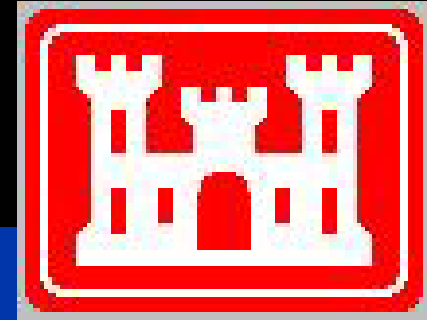
# Summary

- Long Term Monitoring: essential & costly
- Long Term Monitoring Optimization
  - Potential cost savings
  - Improve understanding of site
- But should you?? If so, how...???
- LTMO Roadmap
  - Outlines steps, methods & tools
  - Access to additional resources & information





# Status & Next Steps



- LTMO Roadmap
  - Draft in August, then out for expert review
- USEPA TIO 3-Tiered & MAROS LTMO Demonstration Project Report
  - Final report expected summer, 2004.
- Internet Seminars & Outreach
  - Fall, 2004
  - Announced on TechDirect & *www.clu-in.org*



**Thank you! Questions?**

# **A Roadmap to Long Term Monitoring Optimization and Tools**

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