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Welcome – Thanks for joining this ITRC Training Class

Project Risk Management for Site Remediation

ITRC Technical & Regulatory Guidance Document: *Project Risk Management for Site Remediation* (RRM -1, 2011)

Sponsored by: Interstate Technology and Regulatory Council (www.itrcweb.org)
Hosted by: US EPA Clean Up Information Network (www.cluin.org)

Remediation Risk Management (RRM) is a course of action through which all risks related to the remediation processes (site investigations, remedy selection, execution, and completion) are holistically addressed in order to maximize the certainty in the cleanup process to protect human health and the environment. Remediation decisions to achieve such a goal should be made based on threshold criteria on human health and ecological risks, while considering all the other potential project risks. Through this training course and associated ITRC Technical and Regulatory Guidance Document: Project Risk Management for Site Remediation (RRM-1, 2011), the ITRC RRM team presents tools and processes that can help the site remediation practitioner anticipate, plan for, and mitigate many of the most common obstacles to a successful site remediation project. Examples of project risks include remediation technology feasibility risks; remedy selection risks; remedy construction, operation and monitoring risks; remedy performance and operations risks; environmental impacts of systems during their operation; worker safety risk, human health and ecological impacts due to remedy operation; as well as costs and schedules risks including funding and contracting issues. You should learn: the principles and elements of Remediation Risk Management (RRM); the importance and benefits of RRM; how to implement RRM based on a discussion of case studies: how RRM can help you achieve more successful remediation; and how to use the ITRC RRM information to your benefit.

ITRC (Interstate Technology and Regulatory Council) www.itrcweb.org

Training Co-Sponsored by: US EPA Technology Innovation and Field Services Division (TIFSD) (www.clu-in.org)

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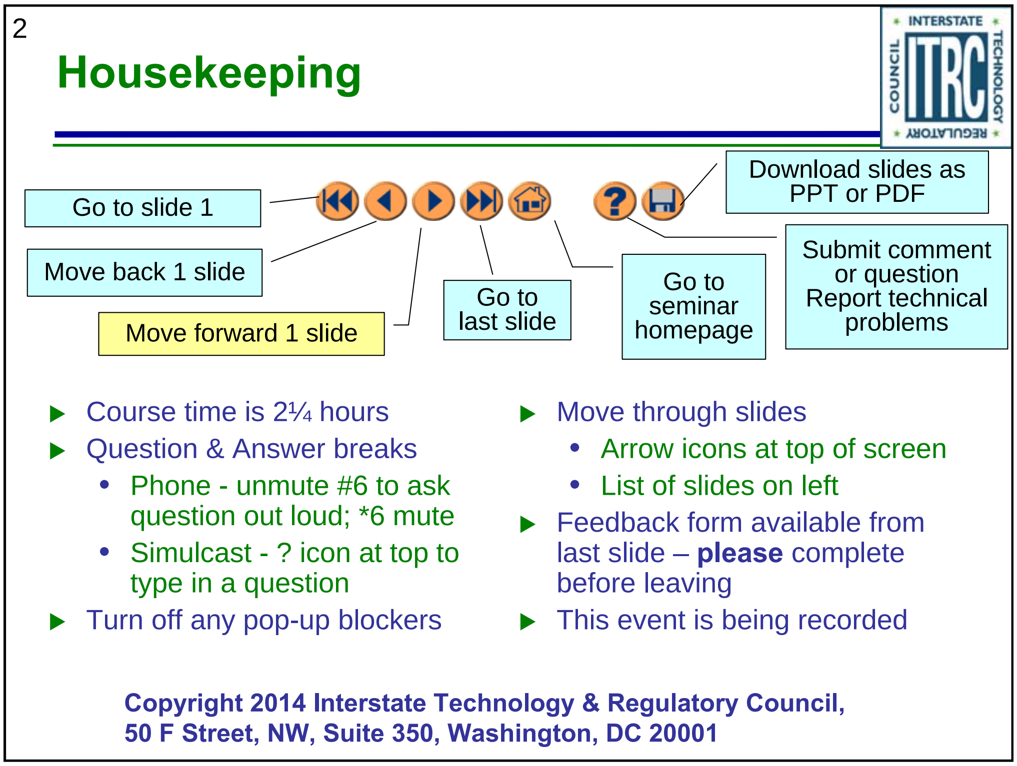

Although I'm sure that some of you are familiar with these rules from previous CLU-IN events, let's run through them quickly for our new participants.

We have started the seminar with all phone lines muted to prevent background noise. Please keep your phone lines muted during the seminar to minimize disruption and background noise. During the question and answer break, press *6 to unmute your lines to ask a question (note: *6 to mute again). Also, please do NOT put this call on hold as this may bring unwanted background music over the lines and interrupt the seminar.

You should note that throughout the seminar, we will ask for your feedback. You do not need to wait for Q&A breaks to ask questions or provide comments using the ? icon. To submit comments/questions and report technical problems, please use the ? icon at the top of your screen. You can move forward/backward in the slides by using the single arrow buttons (left moves back 1 slide, right moves advances 1 slide). The double arrowed buttons will take you to 1st and last slides respectively. You may also advance to any slide using the numbered links that appear on the left side of your screen. The button with a house icon will take you back to main seminar page which displays our presentation overview, instructor bios, links to the slides and additional resources. Lastly, the button with a computer disc can be used to download and save today's presentation slides.

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ITRC (www.itrcweb.org) – Shaping the Future of Regulatory Acceptance

- Host organization
- Network
  - State regulators
    - All 50 states, PR, DC
  - Federal partners

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  - ITRC Industry Affiliates Program
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The Interstate Technology and Regulatory Council (ITRC) is a state-led coalition of regulators, industry experts, citizen stakeholders, academia and federal partners that work to achieve regulatory acceptance of environmental technologies and innovative approaches. ITRC consists of all 50 states (and Puerto Rico and the District of Columbia) that work to break down barriers and reduce compliance costs, making it easier to use new technologies and helping states maximize resources. ITRC brings together a diverse mix of environmental experts and stakeholders from both the public and private sectors to broaden and deepen technical knowledge and advance the regulatory acceptance of environmental technologies. Together, we're building the environmental community's ability to expedite quality decision making while protecting human health and the environment. With our network of organizations and individuals throughout the environmental community, ITRC is a unique catalyst for dialogue between regulators and the regulated community.

For a state to be a member of ITRC their environmental agency must designate a State Point of Contact. To find out who your State POC is check out the "contacts" section at www.itrcweb.org. Also, click on "membership" to learn how you can become a member of an ITRC Technical Team.

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Meet the ITRC Trainers

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Dr. Ning-Wu Chang is a Senior Hazardous Substances Engineer with the Department of Toxic Substances Control (DTSC) of the California Environmental Protection Agency, located in Cypress, California. He joined the DTSC in 2001 as a remedial project manager for a major military facility overseeing a variety of remedial projects at the facility. He is currently with the Engineering Service Unit for engineering supports and technical lead for various projects thru out the programs. Prior to joining the State, Dr. Chang has worked for private consultant companies for more than 15 years. Dr. Chang has extensive experience in municipal water and wastewater treatment system evaluation and design, industrial water and wastewater treatment system evaluation and design, soil and groundwater remedial investigation, remedial system evaluation and design, landfill leachate treatment system evaluation and design, industrial waste minimization, and RCRA/SDWA permitting and compliance. He has contributed to ITRC since 2003 as a team member for the ITRC Remediation Process Optimization (RPO) team and is currently the team leader for the ITRC Remediation Risk Management (RRM) team. He earned his bachelor's degree in Civil Engineering from Chung Yuan College in 1975 and a master's in sanitary engineering from the National Taiwan University in 1977 in Taiwan, and also received a master in 1982 and a Ph.D. degree in 1986 in environmental engineering from the University of North Carolina at Chapel Hill, North Carolina.

Dr. Samuel L Brock is the Air Force Subject Matter Expert for environmental risk assessment and toxicology. In this capacity, Dr. Brock is responsible for providing technical consultation to the field, determining functional requirements for risk reduction, authoring articles and technical reports and assisting in developing educational and training programs. He has represented the Air Force on working groups developing National and DOD guidance on remediation risk management, vapor intrusion and bioavailability of contaminants in soil and sediments. Dr. Brock participated in development of the Air Force Center for Environmental Excellence Guidance for Contract Deliverables for Risk Assessment as well as guidance for determining requirements for small arms firing ranges. Dr. Brock currently provides technical leadership on a number of Environmental Security Technology Certification Program projects developing electronic sensors for vapor measurement in air, passive soil vapor sampling devices and biological treatment of N-Nitrosodimethylamine. He serves as a subject matter expert to DoD Materials of Emerging Regulatory Interest (MERIT) working groups and Military Family Housing Privatization Initiative activities addressing pesticides in soil. He developed a new approach to treat chlorinated pesticides using biological materials to destroy highly persistent contaminants in place. Dr. Brock is responsible for developing Air Force criteria and implementing guidance for a wide range of technical development, implementation, interpretation and problem resolution concerning environmental risk assessment. He is a member of the ITRC Remediation Risk Management Team and the ITRC Green and Sustainable Remediation Team. Dr. Brock earned a doctoral degree in Veterinary Medicine from Purdue University in West Lafayette, Indiana, in 1970; and a master's degree in Public Health, Epidemiology, from University of North Carolina at Chapel Hill, North Carolina in 1976.

Dave Becker is a geologist with the Environmental and Munitions Center of Expertise (EMCX) of the US Army Corps of Engineers (USACE) in Omaha, Nebraska. Since coming to the EM CX in 1991, Dave has been involved with providing technical consultation, teaching, review of environmental restoration-related documents, and preparation of guidance relevant to field studies and *ion situ* remediation. He has strong interests in optimization of remediation systems and long-term monitoring programs, site characterization techniques, and *in situ* remediation technologies. Before coming to the EMCX in 1991, Dave was Chief, Geology Section at the USACE Omaha District between March 1989 and December 1990. For five years prior to becoming a supervisor, Dave was a project geologist in Omaha District actively involved in many environmental restoration projects. Dave has been an active member of the ITRC Remediation Process Optimization and Remediation Risk Management teams (essentially since the inception of both) and has taught numerous Internet and live seminars for ITRC and EPA. He is a member of the Geological Society of America, the American Geophysical Union, the American Association of Petroleum Geologists, and the Nebraska Geological Society. Dave is also an adjunct professor of geology at the University of Nebraska at Omaha where he has taught hydrogeology and environmental geology for the past ten years. Dave earned a bachelor's degree in geology from the University of Nebraska at Omaha in 1981 and a master's degree in geophysics from Southern Methodist University in Dallas, Texas in 1985. He is a registered professional geologist in Nebraska.

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Project Risk?

What happened to my dozer?

“Project Risk is an uncertain event or condition that, if it occurs, has a positive or a negative effect on at least one project objective…” (Project Management Institute, A Guide to the Project Management Body of Knowledge, 2008)

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Has This Ever Happened at Your Site?

- Extent of excavation expanded significantly
- Remediation approach did not perform as designed
- Accident and incident during remediation
- Higher equipment costs due to social-economical changes

No associated notes.

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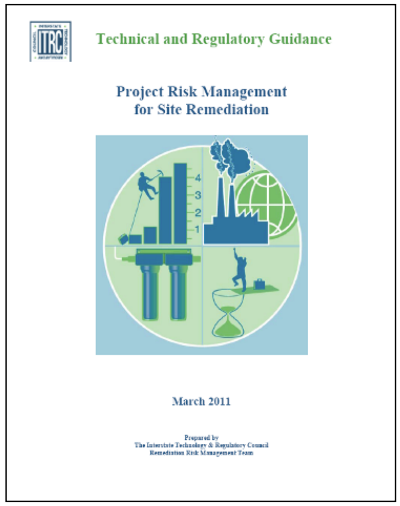
How Can We Avoid Negative Outcomes at Our Sites?

- Implement Remediation Risk Management (RRM)


Technical and Regulatory Guidance

Project Risk Management
for Site Remediation

March 2011

Prepared by
The Interstate Technology & Regulatory Council
Remediation Risk Management Team

Today’s presentation is based on the following document prepared by ITRC Remediation Risk Management Team:

Technical and Regulatory Guidance Document - “Project Risk Management for Site Remediation”

The term “RRM”, stands for remediation risk management, will be used through out this presentation for Project Risk Management for Site Remediation.

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What You Will Learn…

- Principles and elements of RRM
- Importance and benefits of RRM
- How to implement RRM through case studies
- To achieve a more successful remediation using RRM

The take home message.

What is RRM

Why RRM and how to apply it

Its benefits and examples to explain how it can be successfully used for better project management.

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What You Will Learn (continued)

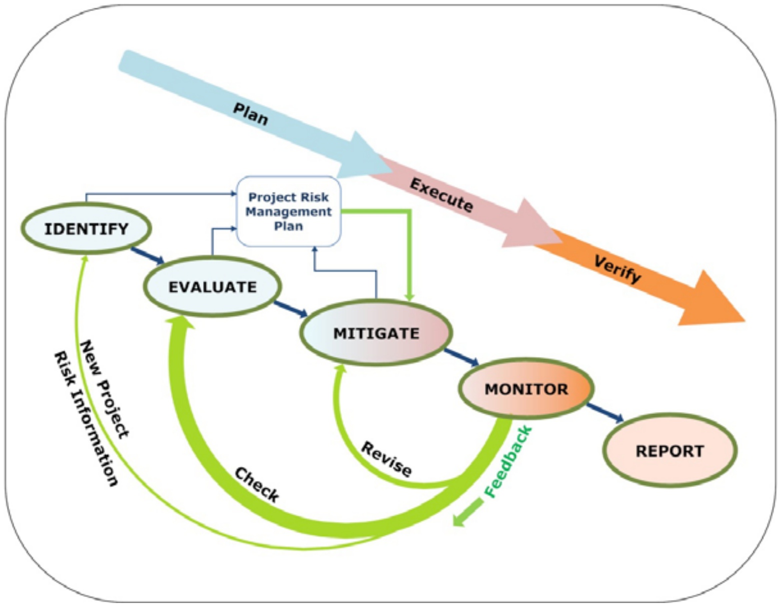

Figure 1-3

The take home message.

What is RRM

Why RRM and how to apply it

Its benefits and examples to explain how it can be successfully used for better project management.

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RRM Presentation Overview

Introduction

- Definition
- Benefits
- Evolution of RRM
- ITRC State Survey

RRM Overview & Roadmap

RRM Principles & Elements

Planning & Implementation

1st Question and Answer Break

Illustrative Example

Case Studies & Conclusion

2nd Question and Answer Break

Basic outline to follow throughout the presentation.

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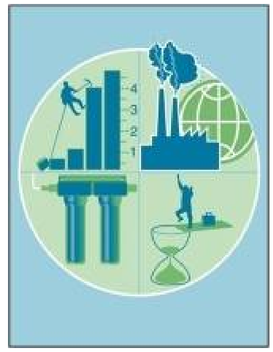
What is RRM?

- Application of risk management concepts to project risks associated with site remediation
- Course of action through which a broad set of project risks are holistically addressed in relation to
  - Site investigation
  - Remedy selection
  - Remedy implementation
  - Site closure



Overall philosophy and meaning of RRM

Throughout the life-cycle of a cleanup project, RRM can be applied by identifying and acting on remediation risks associated with project management

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RRM Helps You:

- Defend your project against *Murphy's Law*!
- Meet secondary project objectives while still achieving overall objectives (i.e., protecting human health and the environment)
- Assess and manage overall remediation project risks through
  - Planning
  - Executing
  - Verifying

"...and we can save 700 lira by not taking soil tests."

RRM is being done for 'site conditions' because of the complexities and not because we did not do it correct in the first place

As we gather more information through remedy implementation - we can make better decisions

Secondary objectives, especially the overall cumulative impact of all risks, can be substantial and need immediate counter actions

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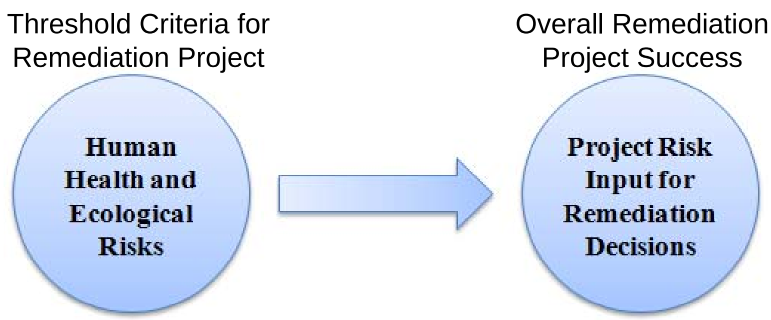
Project Risk ≠ Human Health and Ecological Risk

- Human health and ecological risks drive remediation
  - Reason for conducting remediation
  - Primary objective of remediation is protecting human health and environment



Part of Figure 1-1

Primary or the threshold criteria for conducting a remediation process.

Human health and ecological risks are the reason we conduct remediation at sites.

To start with, the Project risks are considered and appropriate decisions are made upon which the success of the overall project depends.

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Project Risk ➡ Project Decisions

- Project risks drive project decisions
  - How remediation is conducted
  - RRM focuses on secondary objectives of remediation, while still supporting primary objectives
- Examples of secondary objectives
  - Reducing remedial cost
  - Timeframe
  - Greenhouse gas emission footprint
  - Conducting remediation activities safely

Going beyond the risks of human health and ecological, what other risks can effect overall remediation?

These secondary risks, a variety of them based on site-specific conditions.

Some of these are more important than others for a given case and may influence the project at different levels.

Explain primary and secondary objectives

Project Risk ➡ Project Decisions

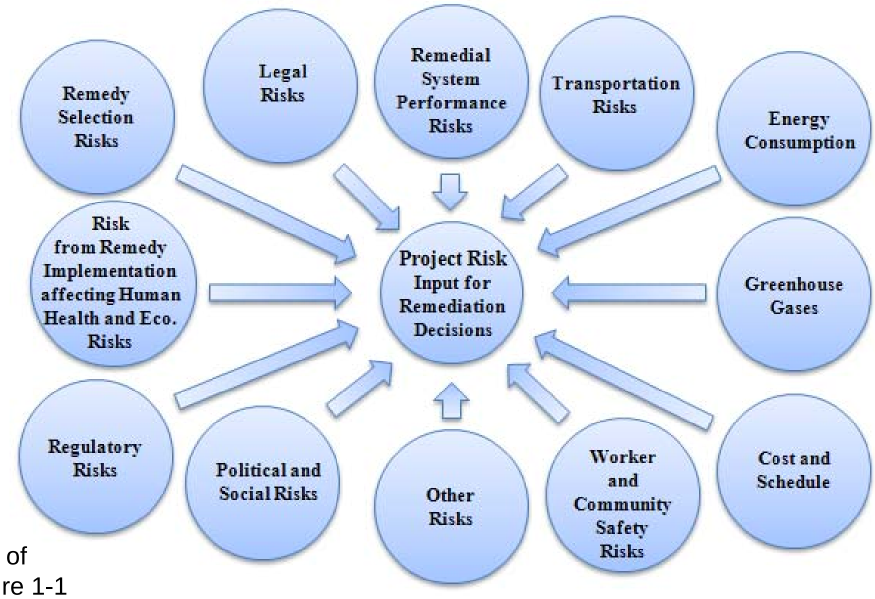

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Figure 1-1

Going beyond the risks of human health and ecological, what other risks can effect overall remediation?

These secondary risks, a variety of them based on site-specific conditions.

Some of these are more important than others for a given case and may influence the project at different levels.

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What are the Benefits of RRM?

- Reduce remediation project risks
- Avoid remedy failure
- Plan contingency response to avoid operating in crisis control mode
  - Resource-intensive
  - Constrained options
- Reduce uncertainties in remediation decision-making
- Ultimately protect human health and the environment while also achieve the secondary project objectives

Benefits of RRM are many.

Achieving the overall success of the remediation.

Successful cleanup complete and closure of the site.

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Where Does RRM Apply?

- All programs
  - CERCLA
  - RCRA
  - UST
  - Brownfields
- All sizes of project

Sump removal at a plating shop

Site 15, Vandenberg Air Force Base

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
RCRA = Resource Conservation and Recovery Act
UST = Underground Storage Tanks

Pretty much everywhere where there is a remediation process.

Scaling

Influencing the overall success.

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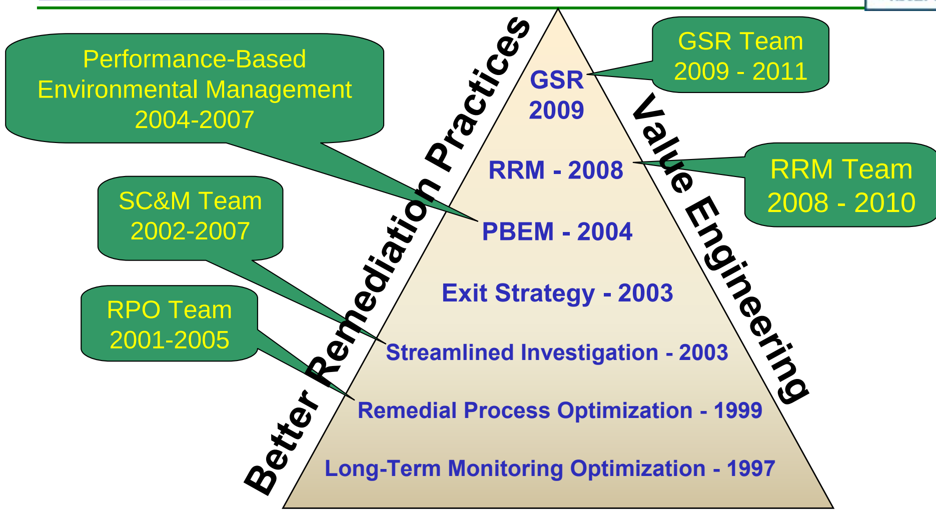
What is the Evolution of RRM?



ITRC Teams:

GSR – Green and Sustainable Remediation
RRM – Risk and Remediation Management
SC&M – Sampling, Characterization and Monitoring
RPO – Remediation Process Optimization

Evolution of RRM concept and how the ITRC helped in developing these concepts

From RPO in 2001 through GSR in 2011, the remediation (including investigation) process and how to effectively manage remediation project has come a long way.

Green boxes indicate documents, IBTs developed by respective ITRC teams.

ITRC documents are available at http://www.itrcweb.org/gd.asp. Information on ITRC Internet-based training is available at http://www.itrcweb.org/ibt.asp.

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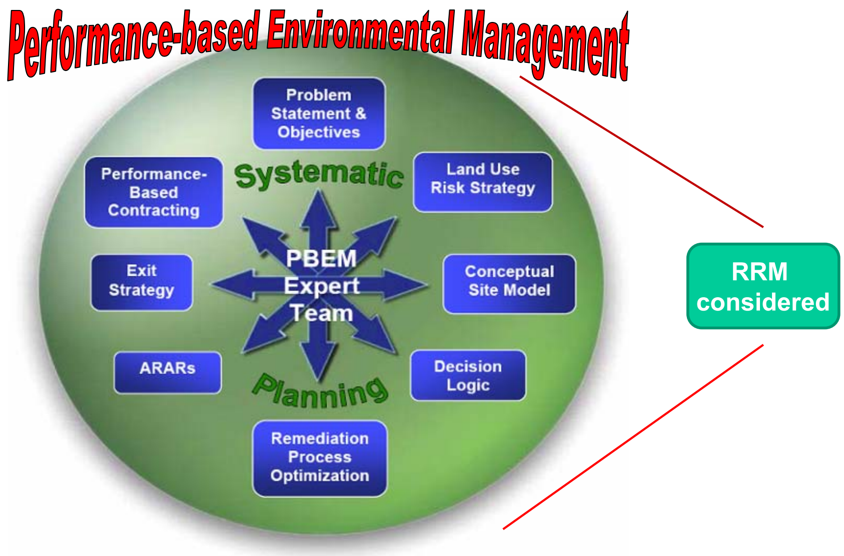
Connecting RRM to Performance-Based Environmental Management (PBEM)

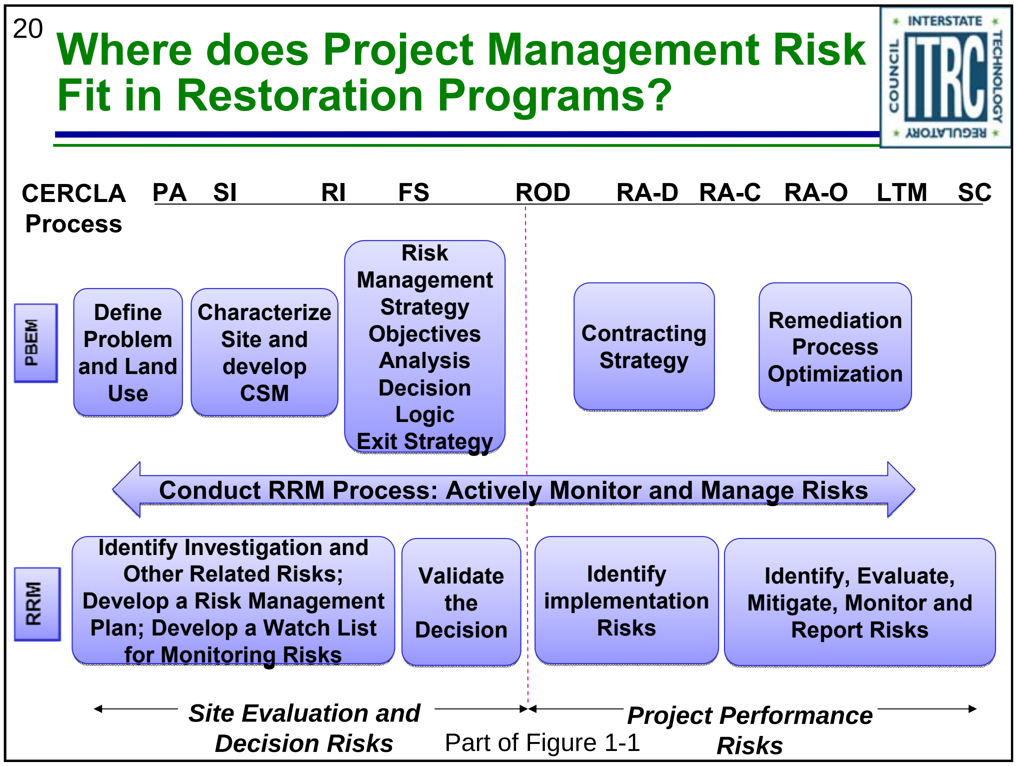


ITRC RPO-7 Figure 2-2

Performance-based environmental management (PBEM) is a strategic, goal-oriented methodology that is implemented through effective planning and decision logic to reach a desired end state of site cleanup.

ARARs = Applicable or Relevant and Appropriate Requirements

From ITRC's Improving Environmental Site Remediation Through Performance-Based Environmental Management (RPO-7, 2007). Figure 2-2. Relationships between the expert team, systematic planning, and the key components. Document available from http://www.itrcweb.org/guidancedocument.asp?TID=42



RRM versus PBEM.

Though example is for CERCLA language, the overall approach is the same for RCRA, UST, Brownfields, Voluntary Cleanup programs, etc.

PA – Preliminary Assessment

SI – Site Investigation

RI – Remedial Investigation

FS – Feasibility Study

ROD – Record of Decision

RA-D – Remedial Action – Design

RA-C – Remedial Action – Construction

RA-O – Remedial Action – Operation

LTM – Long Term Monitoring

SC – Site Closeout

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ITRC 2008 State Survey Results – Importance of Project Risk

Source: Aug/Sep 2008
RRM Team State Survey

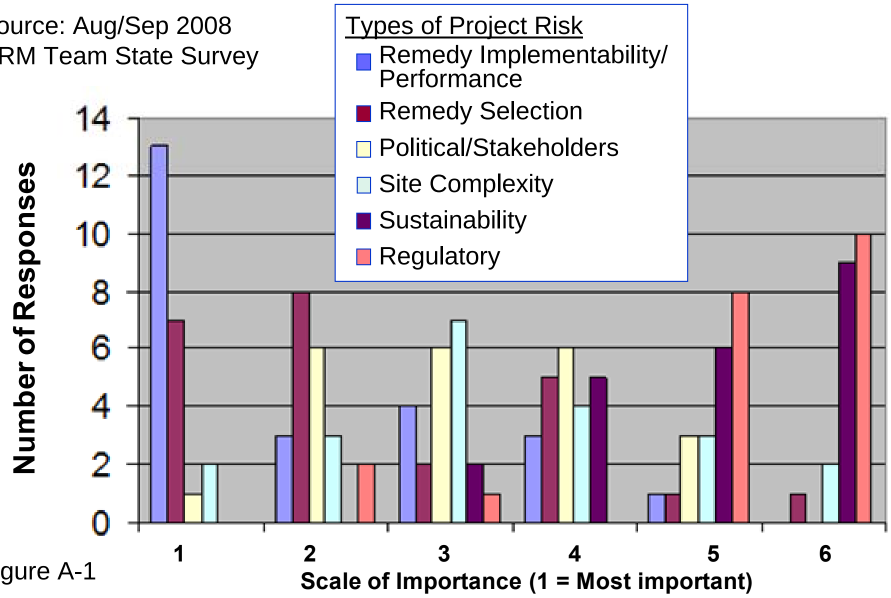

Figure A-1

Results of state survey.

Initially what are the risks important to your projects?

22 **ITRC 2008 State Survey Results – Alternative Approaches for Groundwater Remediation**

- Most states can use alternative approaches
  - Monitored Natural Attenuation (MNA) and Land Use Controls (LUCs) most popular
  - Alternate Concentration Limits (ACLs) least common

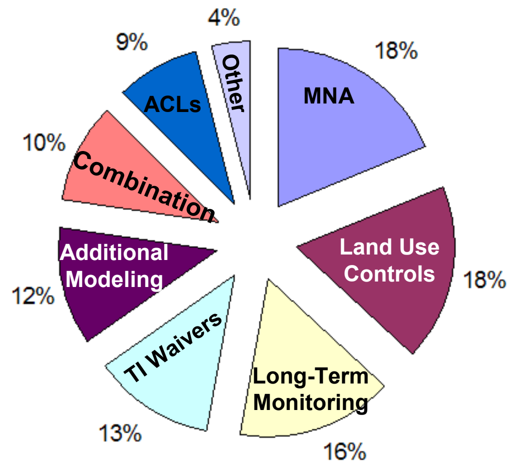

Figure A-2

Source: Aug/Sep 2008 RRM Team State Survey

Indicates the states preference for alternative approaches to remediation

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RRM Overview & Roadmap

- Introduction
- RRM Overview & Roadmap
  - Objectives and definition
  - Roadmap: When and how does RRM apply?
- RRM Principles & Elements
- Planning & Implementation
- 1st Question and Answer Break
- Illustrative Example
- Case Studies & Conclusion
- 2nd Question and Answer Break

No associated notes.

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What is RRM?

- The application of risk management concepts to project risks associated with site remediation
- A course of action through which a broad set of project risks related to site investigation, remedy selection, remedy implementation, and site closure are holistically addressed
- Manage unexpected outcomes (Murphy)

What's in it for me?

Nuts and bolts of RRM

What is RRM and how is it beneficial?

Not just another bureaucratic approach to slow things down but to ensure success of remedy implementation to reach cleanup goals successfully

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What are the RRM Objectives?

- Manage/control inherent project risks
- Increase the likelihood of project success
- Reduce secondary impacts of remediation projects
- Minimize the time and cost to achieve cleanup
- Facilitate better planning and better communication

What do we expect to gain from RRM?

When Does RRM Apply?

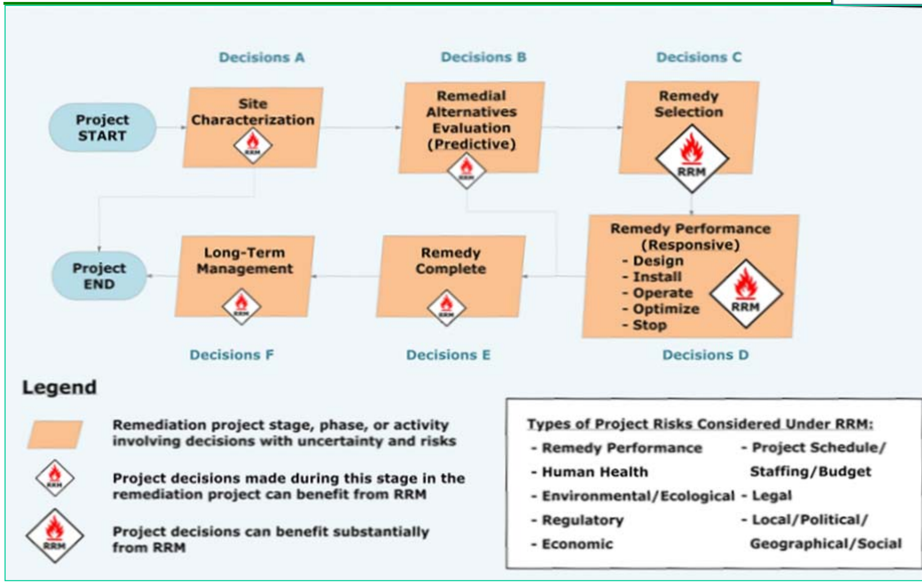

Figure 1-2. RRM Roadmap

Key decision- points

Analysis of remedial alternatives (predictive)

Implementation of remedy (responsive)

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RRM Adapts to All Programs

Stage	Site Characterization	Remedial Alternatives Evaluation	Remedy Selection	Remedy Performance	Remedy Complete	Long-Term Management
CERCLA/ Superfund	Remedial Investigation	Feasibility Study or EE/CA	ROD	Remedial Action	Response Complete	LTM/LTMgt/ LTMO
RCRA	RCRA Facility Investigation	Corrective Measures Study	RCRA Permit	Corrective Measures Implementation	Certification of Remedy Completion or Construction Complete	Post Closure Care
UST/ LUST	Varies by Regulatory Authority					
State	Varies by State					

Figure 1-2. RRM Roadmap (continued)

Another look how RRM fits with all program areas.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act

RCRA = Resource Conservation and Recovery Act

UST = Underground Storage Tanks

LUST = Leaking Underground Storage Tank

EE/CA = Engineering Evaluation/Cost Analysis

LTM = Long-Term Monitoring

LTMgt = Long Term Management (See also ITRC's Using Remediation Risk Management to Address Groundwater Cleanup Challenges at Complex Sites (RRM-2, 2012) at http://www.itrcweb.org/guidancedocument.asp?TID=71)

LTMO = Long-Term Monitoring Optimization

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RRM Roadmap: How does RRM Apply?

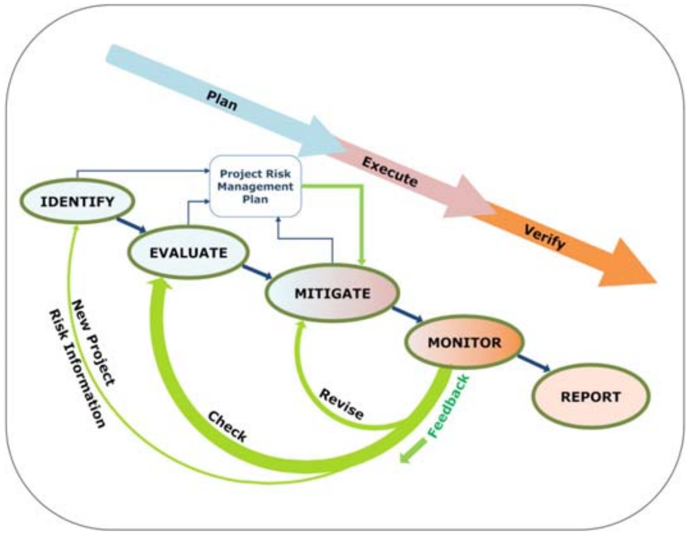

Figure 1-3. A systematic incorporation of RRM elements into project management

Iterative process

Follows plan, execute, verify steps

Conducting Identify, Evaluate, Mitigate, Monitor and Report process iteratively till the remediation is completed and site is closed out.

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Incorporating RRM into Projects

- Written Project Risk Management Plan
  - Your project's Early Warning System
  - Set the stage for planning/contingencies
  - Prepare a written plan
  - Implement the plan!
- Involve stakeholders throughout the process
  - Project team, external stakeholders, technical experts
- Integrate RRM with existing project management and reporting
  - Tools, decision documents, permits, reviews, communication plans

Practical way of controlling the Project Management risks

When Identifying and evaluating project risks, develop a written plan

The plan describes how risks will be monitored and reported to result in the appropriate response action when needed

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RRM Principles & Elements

No associated notes.

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What are Key RRM Principles?

- RRM is used to identify and address key project risks
  - Five steps: project risk identification, evaluation, mitigation, monitoring and reporting
  - Prepare a written project risk management plan
    - Keep a record of decisions made and why (risk register)
- RRM helps with compliance, performance objectives
- Integrate RRM into existing project activities
  - Management structure, project meetings, outreach, permits, plans and documents

Some basic principles of RRM

Five steps

Iterative till the project is completed.

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Key RRM Principles (continued)

- Many remedies fail to accomplish cleanup goals
- Factors influencing successful site remediation
- Systematically approaching lessons learned
- Remedial Process Optimization (RPO) experiences
  - ITRC RPO Team
  - Training audience requests
- Concept applied in other areas
  - Department of Energy
  - Department of Defense
  - Environmental Protection Agency

AFCEE = Air Force Center for Engineering and the Environment

Experience and common sense – we are doing these BMPs anyway to some extent

Begin with the end in mind (Exit Strategy)

Objective of RRM is to systematically evaluate anticipated obstacles for successful cleanups sooner than later

In planning for events we anticipate, we can also develop contingency responses for unexpected consequences of events not previously encountered or not expected

Remedy failure – AFCEE Environmental Restoration Program–Optimization (ERP-O) indicates many systems underperform, cleanup is slower and project costs understate actual expense

Factors – good site characterization, appropriate remedy monitored and adjusted to perform effectively

Objective of RRM is to systematically evaluate anticipated obstacles for successful cleanups sooner than later

RPO team provided the systematic approach to optimize systems

ERP-O evaluations expanded this concept to optimizing overall programs (all systems at a facility)

When conducting training, audience responses reflected common experience and consistently requested a systematic approach to leverage lessons learned and best practices.

RRM guidance is developed on experiences of other entities in bringing risk management practices adapted to environmental projects

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What are the RRM Elements?

- Project risk identification
- Evaluation
- Mitigation
- Monitoring
- Reporting

Project Risk

You will see these 5 steps several times and this is on purpose

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What is Project Risk Identification?

- Objectives
  - Compile a list of potential project risk events which might affect the project
  - Consider general, site-specific, and project-specific risks

- Tools and approaches
  - Checklists – customize for each project
  - Brainstorming (manager, project team, subject matter experts)
    - Site-specific experience
    - Professional considerations
  - Itemize activities using Work Breakdown Structure

Want to capture input from a mix of perspectives
Be systematic

Know what is important for your project

Capture the experience from the hands on live training as an example

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Project Risk Identification (continued)

Consider the following categories of project risks:

- Remedy/technology performance
  - Prior to remedy selection
  - Post-remedy implementation
- Human health
- Environmental/ecological
- Regulatory
- Economic
- Project schedule, staffing, financials
- Legal
- Political, geographic, and social

See Section 3.0, Project Risk Management for Site Remediation (RRM-1)

Remedy/technology performance includes:

a. Prior to remedy selection (Predictive)

b. Post-remedy implementation (Responsive)

Strong CSM is needed to identify and later mitigate key project risks related to remedy/technology performance.

What are uncertainties in site conditions?

Sources, hydrology, geochemistry, fate and transport pathways, etc.

The Tech Reg provides tools to help risk identification

Inappropriate cleanup approach might be a problem

At complex sites, use emerging technologies vs. outdated technologies

Might have selected an inappropriate technology for actual site conditions or have made incorrect assumptions about technology performance

Post remedy implementation examples of technology performance risks:

Improper design

Remediation may be too slow

Identification of new sources

What is Project Risk Evaluation?

- Objectives
  - Determine which project risks are important
  - Assign each a risk level ranging from low to high
- Tools and approaches
  - To rate overall risk, assess probability and consequences (site-specific analysis)
    - Likelihood (probability) of risk event occurring
    - Adverse consequences (e.g., impact on primary objective? Secondary impacts?)
  - Qualitative or quantitative analysis
    - Risk register
    - Models (e.g., cost estimates, duration, accident risks)

What are important risks in the successful implementation of a remedy for specific site conditions

Could be one person, a project team or an expert team

Models are only as accurate as the data input and the logic used

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Project Risk Evaluation (continued)

- Score the likelihood of occurrence for each project risk event:

Likelihood of Occurrence	Guideline for Qualitative Assessment
Very Unlikely	You would be surprised if this happened.
Unlikely	Less likely to happen than not.
Likely	More likely to happen than not.
Very Likely	You would be surprised if this did not happen.

Table 2-2. Likelihood of Occurrence Guidelines, Project Risk Management for Site Remediation (RRM-1)

- Similarly score adverse consequences
  - Range from negligible to significant to critical

Adverse consequences includes – inadequate source removal, incomplete source control and removal/recovery efficiency well below engineering assumptions

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Project Risk Evaluation (continued)

- Use qualitative scores to rate each potential risk event

Risk = Likelihood x Consequences

Likelihood of Occurrence	Impact or Consequence of Occurrence				
	Negligible	**Marginal**	**Significant**	**Critical**	**Crisis**
Very unlikely	Low risk	Low risk	Low risk	Low risk	High risk
Unlikely	Low risk	Low risk	Moderate risk	Moderate risk	High risk
Likely	Low risk	Moderate risk	High risk	High risk	High risk
Very likely	Low risk	Moderate risk	High risk	High risk	High risk

Table 2-3. Example Qualitative Evaluation of a Project Risk

Use the risk (likelihood and consequence) to determine which risks need to be managed

Project Risk Evaluation (continued)

Can use risk register to track analysis, ID key risks

- Risk ID #
- Risk title
- Risk event description
- Likelihood
- Project objective #1 (e.g., cost)
  - Impact
  - Risk level
- Project objective #2 (e.g., schedule)
  - Impact
  - Risk level

Risk ID #	Risk Title	Risk Event Description	Likelihood	Project Objective #1 (e.g., cost)		Project Objective #2 (e.g., schedule)	
				Impact	Risk Level	Impact	Risk Level
4	Release of contaminants above allowable levels	Vapor-phase carbon break-through occurs with release of contaminants above allowable levels. Regulatory agency fines could be assessed, perhaps tens of thousands of dollars. The credibility of remediation with nearby residents might then be diminished, resulting in project delays or increased community outreach costs.	Likely	Marginal	Moderate	Negligible	Low
5	In-situ chemical oxidation effectiveness	Incomplete contact may not reduce contaminant concentrations in the source area to target levels uniformly. Additional mobilizations to the site by the ISCO contractor or remedy changes might be needed.	Likely	Critical	High	Critical	High

Table 4-2. Example of a Completed Risk Registry, Project Risk Management for Site Remediation (RRM-1)

Define risk indicators (metrics)

4-5 Risk IDs: Critical: High, and Negligible

Identify key project risks

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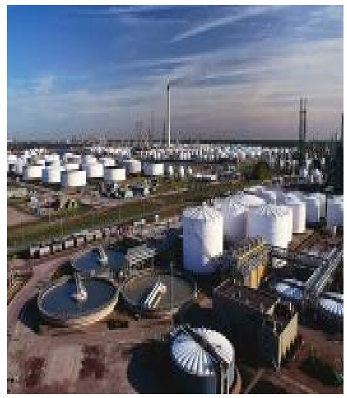
What is Project Risk Mitigation?

- Objectives
  - Address significant risks
  - Plan contingency responses and decision logic
- Tools and approaches
  - **Eliminate** – modify plans
  - **Reduce** – occurrence or impact
  - **Transfer** – reallocate impact
  - **Accept** – if impact is small



Objectives

Address all significant project risks

Plan contingency responses and decision logic

Tools and approaches

Eliminate – modify plans to eliminate / avoid risk e.g., change technology or approach

Reduce – reduce likelihood of occurrence or potential impact e.g., pilot studies, better characterization

Transfer – reallocate impact of risk e.g., insurance, performance-based contractor

Accept – if impact is small

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Project Risk Mitigation Example

- Key risk event - incomplete *in situ* chemical oxidation (ISCO) effectiveness
- Potential mitigation approaches
  - Technology objectives vs. long-term cleanup goals
  - Alternative approach*
  - Contingencies
  - Measure effectiveness - performance monitoring
  - Verify design assumptions
    - Injection tests
    - Aquifer studies

*See also: ITRC's **Using Remediation Risk Management to Address Groundwater Cleanup Challenges at Complex Sites** (RRM-2, 2012)

Alternative maximum contaminant levels (*MCL) or pilot testing are also potential mitigation approaches.*

Incomplete ISCO effectiveness determined to be a key risk event

Potential mitigation approaches:

Distinguish between technology objectives and long-term cleanup goals

Evaluate alternative endpoints

Evaluate contingencies

Develop performance monitoring, measure effectiveness

Verify design assumptions by injection tests, aquifer studies

Alternative approach such as using long-term management at complex GW cleanup site, while maintaining protectiveness. The long-term management may include:

- modifying remedial action objectives (RAOs)
- ARAR waiver
- alternative concentration limits
- groundwater management zone
- site management using phased approach

(See also ITRC's Using Remediation Risk Management to Address Groundwater Cleanup Challenges at Complex Sites (RRM-2, 2012) at http://www.itrcweb.org/guidancedocument.asp?TID=71)

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What is Project Risk Monitoring?

- Objectives
  - Identify changed conditions that impact project risk
  - Mitigate key risks
  - Cleanup objectives achieved as planned
- Tools and approaches
  - Observe indicators and performance measures
  - Use standard cost/schedule data
  - Earned value – cost/schedule vs. performance
  - Use appropriate tools to measure and quantify qualitative input from stakeholders
    - Statistical analysis tools
    - Roundtable approach with weighted input, etc.

Objectives

Identify changes in project conditions that could impact project risk analysis

Verify key project risks are successfully mitigated

Ensure cleanup is achieving objectives as planned

Tools and approaches

Observe indicators and performance measures

Use standard cost/schedule data

Earned value – relate schedule to technical performance

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What is Project Risk Reporting?

- Objectives
  - Communicate with stakeholders
    - Project risks and secondary impacts
    - Risk management
  - Inform decision-makers
  - Document risk analysis and basis for decisions
- Tools and approaches
  - Permits, decision documents, and reviews
  - Informal meetings and briefings
  - Risk management and communication plans
  - Scale appropriate to site complexity

Need to address the scale issue when addressing RRM?

Objectives

Communicate with stakeholders about project risks, secondary impacts, risk management

Help decision-makers make informed decisions

Document project risk analysis and basis for decisions

Tools and approaches

Informal meetings, briefings

Existing permits, decision documents, reviews, communication plans

Project risk management plan

Scale appropriately with site complexity

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Who are the Stakeholders?

- All groups and individuals impacted by project
  - Involve stakeholders early
  - Improve quality of decisions
- Methods for stakeholder involvement
  - Use existing cleanup program processes
    - Restoration Advisory Board/stakeholder meetings
    - Public outreach and community meetings
  - Identify roles and responsibilities during planning
  - Address concerns through the RRM Plan

Stakeholders include all groups and individuals potentially impacted by the project

Involve stakeholders early, build trust, foster respect and improve quality of decisions

Methods for stakeholder involvement

Identify roles and responsibilities during planning

Use existing cleanup program processes

Restoration Advisory Board/stakeholder meetings

Public outreach, community meetings

Address concerns through the RRM Plan

Different people

Issues about outreach

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Planning & Implementation

- Introduction
- RRM Overview & Roadmap
- RRM Principles & Elements
- Planning & Implementation
  - Project Risk Management Plan
  - Plan Purpose/Content
  - Tools
  - Key Aspects of Implementation
- 1st Question and Answer Break
- Illustrative Example
- Case Studies & Conclusion
- 2nd Question and Answer Break

We'll now discuss how to put all of these ideas together during planning and implementation,

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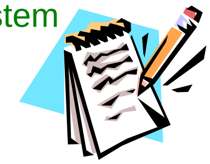
Project Risk Management Plan

- Prepare a written Project Risk Management Plan
  - Think of it as a project Early Warning System
  - Document
    - Identified potential risk events
    - Which are important and why
    - Strategies for mitigating/managing key project risks
    - Methods to monitor/track project risks
- Verify and review plan
- Implement plan (planning alone is not enough!)
- Plan can be part of other project planning documentation; simple short plan for simple, smaller sites



The Project Risk Management Plan documents much of what we have been talking about. The documentation is important as team composition changes over time, and the plan is a record that can be read by new team members. The plan is also the road map for the implementing the actions necessary to manage risks and for tracking and reporting the onset of risks. Note that the Risk Management Plan can be an appendix or component of other project management submittals.

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What is the Plan Purpose?

- Summarizes RRM process site/project-specific level
- Provides record of identifiable project risks and levels
- Documents basis for which project risks to manage
- Forms basis for implementing risk mitigation methods
- Specifies risk event owner for key project risks
- Documents selected mitigation strategies
- Identifies monitoring and tracking methods

As mentioned previously, the plan covers these specific goals.

It is the blue print for successful implementation of a project

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What is the Plan Content?

- Follow RRM elements

RRM Element	Key Questions/Analyses
Identification	Use checklist, register Consider multiple types of project risks Adapt to make analysis site-specific
Evaluation	Use risk analysis worksheet, register Which are key project risks? Which risks can be ignored?
Mitigation	How will key project risks be mitigated? Strategy development Document in risk register
Monitoring	How will mitigation strategy performance be tracked? Who is responsible for monitoring?
Reporting	How will monitoring results be shared? Who is responsible for reporting?

The discussion in the plan regarding the analysis, implementation, monitoring/tracking will follow the process we have discussed and is outlined in the ITRC Technical and Regulatory Guidance Document: Project Risk Management for Site Remediation (RRM-1, 2011).

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Plan Content (continued)

- Process to update strategy
  - How often and who will update RRM analysis?
- Identify roles and responsibilities
  - Who is responsible for updating RRM analysis?
  - Who is responsible for implementing mitigation strategy, monitoring and reporting?
  - What group of stakeholders are involved in different steps of the RRM process?
    - Will results be shared with all stakeholders?
    - Which stakeholders make decisions regarding acceptable project risks?

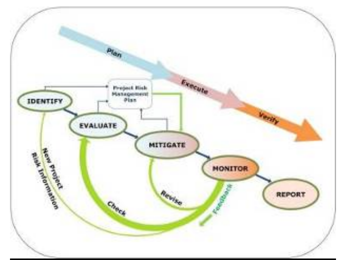

Figure 1-3

Key aspects of the plan include the definition of a process to revise the strategy as our understanding of the site evolves, even during construction/implementation. Any significant change in the understanding of remedy risk will likely trigger a need to notify certain parties. It is prudent to have thought this through before hand.

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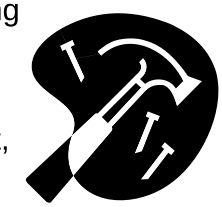
Plan Content (continued)

- Schedule for implementation
  - Identify RRM activities, milestones, and completion dates
- Recordkeeping of events and actions taken
- Tools for planning and documentation
  - Checklists, worksheets
    - Valuable tools for assessing and recording anticipated risks in systematic way
  - Risk register
    - Compile risks and consequences for cost, schedule, worker health, etc.
    - Updated over life of project



The project schedule should include the tasks related to remediation risk management, complete with milestones. Completion of the activities needs to be documented. The ITRC Technical & Regulatory Guidance Document: *Project Risk Management for Site Remediation* (RRM -1, 2011) has a number of tools for planning and documenting the RRM process, including checklists, worksheets.

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Tools: Risk Screening Checklist

Trigger question	Response (yes/no)	Comments
If technology fails to achieve project objectives, could there be:		
Potential health or safety concerns for on-site workers or the public?		
Potential threat to the environment or natural resources?		
Any laws violated?		
Any legally-required milestones threatened?		
Any threat to commitments made to the regulatory agencies or other stakeholders?		
Inadequate resources to address the risk event?		

See Table D-1, Project Risk Management for Site Remediation (RRM-1)

This is an example of a tool provided in Appendix B of the ITRC Technical and Regulatory Guidance Document: Project Risk Management for Site Remediation (RRM-1, 2011). This checklist would help evaluate the significance of the consequences of a failure. See section 3 for more details of the checklist as well as the example case study in appendix D.

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Tools: Risk Analysis Worksheet

Element	Risk event information
Risk event tracking code:	UPS-5
Risk event title:	In situ Chemical Oxidation (ISCO) Effectiveness
Risk event description:	Incomplete contact may result in contaminant concentrations in the hot-spot area not being reduced uniformly to target levels, requiring additional mobilizations to the site by the ISCO contractor or remedy changes.
Date prepared:	July 25, 2008
Date last revised:	January 17, 2009
Risk event owner:	John Doe, Project Manager
Urgent response required?	No
Likelihood of cost impacts:	Likely
Cost impact:	Critical
Risk Level	High

See Table 4-1, Project Risk Management for Site Remediation (RRM-1)

Again, this is the example of a risk analysis worksheet for one of the remedy performance risk events that was identified.

For complex groundwater cleanup site, the risk event description may include the discussion of complex geological and hydrogeological settings, and contaminant-related challenges such as DNAPL dissolution/mobilization, matrix back-diffusion, etc. The evaluation of risk event associated with groundwater cleanup challenge at complex site is discussed in the ITRC's Using Remediation Risk Management to Address Groundwater Cleanup Challenges at Complex Sites (RRM-2, 2012) at http://www.itrcweb.org/guidancedocument.asp?TID=71.

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Tools: Risk Analysis Worksheet (continued)

Element	Risk event information
Cost risk level:	High
Likelihood of schedule impacts:	Likely
Schedule impacts:	Critical
Schedule risk level:	High
Risk mitigation strategy:	Ensure site characterization data are adequate to allow optimal oxidizing reagent injection design and implementation. Conduct treatability studies to refine remedial design. Drill test borings during and after injection to evaluate and verify penetration and coverage of reagent into the contaminated media. Develop realistic performance criteria.
Monitoring and reporting strategy:	Collect sufficient samples to allow evaluation of performance. Report evidence of failure to agencies
Risk status:	Active

See Table 4-1, Project Risk Management for Site Remediation (RRM-1)

This slide shows more of the worksheet, including the risk monitoring and reporting strategy.

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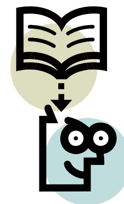
Tools: Risk Register

- List project risks
- Evaluate likelihood of occurrence, consequences
- Assign risk level
- If mitigation is warranted
  - Describe mitigation methods
  - List who's responsible
  - Specify monitoring and reporting methods
- If not
  - Specify how and when project risk analysis will be revisited if project conditions change



The risk register captures information about the compilation of risk events.

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Tools: Example of Project Risks Listed in Risk Register

Tracking Code	Risk Event Title	Project Team Discussions
UPS-1	Availability of Key Personnel	Unanticipated delays in obtaining approvals or reaching key decisions could occur. The project involves meetings, decision making and work product reviews by multiple personnel from the project team, ISCO and excavation contractors, stakeholders and regulatory/redevelopment agencies. The state's orphan site program has been struggling under recent staffing and funding limitations. Significant schedule delays may occur if critical path activities are impacted.
UPS-2	Excavation Uncertainty	The volume of contaminated soil that will be excavated is uncertain. Unanticipated drums or other debris may be encountered. Changes in current assumptions about excavation soil volumes or unanticipated materials will affect project cost and schedule. Excavation may be halted due to safety concerns if drums are encountered resulting in project delays.
UPS-3	In situ Chemical Oxidation Effectiveness	Incomplete contact may result in contaminant concentrations in the source area not being reduced uniformly to target levels, requiring additional mobilizations to the site by the ISCO contractor or remedy changes.

See Table D-3, Project Risk Management for Site Remediation (RRM-1)

This is an example of part of a risk register. There would be more events, and more detail in other rows/columns. Refer to section 4.2 in the ITRC Technical & Regulatory Guidance Document: *Project Risk Management for Site Remediation* (RRM -1, 2011) for a more complete example.

ISCO – *in situ* chemical oxidation

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Key Aspects of Implementation

- Integrate into existing project management framework
- Re-visit plan periodically
- Adapt RRM analysis to project stage (Remedial Investigation/Feasibility Study (RI/FS), Remedial Design (RD) or Remedial Action Operation (RA-O)) as project progresses
  - Resource planning
  - Planning costs, schedule
  - Remedy selection
  - Design parameters/design review
  - Remedy modification/optimization and change management
- Focus on performance metrics, contingency responses

The RRM plan would be part of the overall project management approach during the life-cycle of the project and the planning process needs to be revisited at the project moves forward and new activities with associated risks are identified. Planning will always consider what metrics will be monitored to assess the onset of a risk event. The contingent actions need to be identified in the planning process to the extent they can be.

RI/FS = Remedial Investigation/Feasibility Study

RD = Remedial Design

RA-O = Remedial Action Operation

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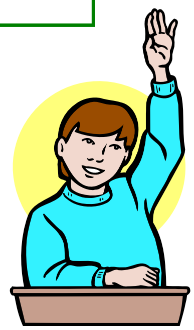
1st Question and Answer Session



No associated notes.

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Illustrative Example

- Introduction
- RRM Overview & Roadmap
- RRM Principles & Elements
- Planning & Implementation
- 1st Question and Answer Break
- Illustrative Example
  - Former Plating Facility
- Case Studies & Conclusion
- 2nd Question and Answer Break

We'll now illustrate some of the key points of the lecture so far with a hypothetical site that has many attributes and risks we encounter at real sites. The example is further developed in Appendix D of the ITRC Technical and Regulatory Guidance Document Project Risk Management for Site Remediation (RRM-1, 2011).

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What is the Site Setting?

- Former plating facility in urban light industrial area
  - Zoned for non-residential redevelopment
  - Nearby residential neighborhoods
- Historical waste practices
  - Metals, solvents discharged to on-site pond
  - Solid waste buried on site (paint, degreaser sludge)
- Hydrogeology
  - Alluvial sands, clay layers, over weathered shale
  - Groundwater at ~20 feet bgs
  - Downgradient 450-gpm production well

See Appendix D, Project Risk Management for Site Remediation (RRM-1)

A little background about this hypothetical site is given here. The site was a metal plating facility set in a light industrial area with nearby homes. The location is part of a non-residential Brownfield-like project scheduled for imminent redevelopment. The redevelopment will require some zoning changes. Not surprisingly, the historical operations included use and disposal of waste waters with solutions with toxic metals and spent solvents. Liquids were discharged to an on-site pond and waste paints, sludges were buried on-site early in the operations. The site is underlain by alluvial sands and clays resting on weathered shale bedrock at depths around 75 feet. A municipal well is located downgradient of the site within a mile of the site.

bgs = below ground surface

gpm = gallons per minute

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Initial Steps – Site Investigation/ Remedy Selection

- Site investigation
  - TCE, 1,1,1-TCA, Cr(VI) impacted groundwater, soils
  - Detected TCE in municipal well
- Remedy selection
  - Groundwater hot-spot treatment using *in situ* chemical oxidation (ISCO) with appropriate oxidant
  - Excavation of hot spot metals-contaminated soil
  - Wellhead treatment using air stripping, vapor-phase granular activated carbon (GAC)
  - Net present value ~ $0.63 million

Earlier investigations have identified solvents and hexavalent chromium in soils and solvents, particularly TCE, in groundwater threatening the municipal well. A recent decision document has identified the actions to clean up the site and protect the municipal well. The actions include hot-spot ground water treatment using *in situ* chemical oxidation (ISCO), excavation of hot-spot soils, and wellhead treatment at the municipal well using air stripping and vapor-phase carbon. The work has a projected net present value of $630,000.

ISCO – *in situ* chemical oxidation. GAC – granular activated carbon.

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Risk Identification – Hypothetical Site

- Let's think about the risks for this site:
  - Remedy performance risk (for ISCO, carbon adsorption, excavation, etc.)
  - Risks to community during remediation
  - Environmental risks
  - Regulatory project risks
  - Economic project risks
  - Project schedule/staffing/financial risks
  - Legal project risks
  - Political/public perception project risks
- Next slides show what the ITRC team thought

To set the stage for what are different risks we can think about, let us consider some potential risks that are associated with remedy performance and implementation..

Under a class room setting, these all can be developed using a brainstorming or discussion approach. Typically we encourage you all to use a kind of 'round-table' approach to identify what these risks are from different stakeholders perspective. The more input and more discussion is obtained earlier in the process., the better the results will be in understanding and mitigating remediation risks .

At a recent class room training, when we presented the hypothetical case study, we found that the audience members brought a variety of different issues to be addressed, based on their expertise and experiences.

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Step 1 – Project Risk Identification

- Remedy performance project risks
  - ISCO may not completely treat hot spot; contact may be incomplete between chemical oxidant and contaminants
  - During excavation of metals-contaminated soils, debris or drums may be encountered
  - Vapor-phase GAC breakthrough may occur, releasing contaminants above allowable levels
  - Well-head treatment may fail, delivering contaminated water

These are just some of the risks regarding the success of the cleanup that would be identified during the identification of risk step for a site such as this.

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Project Risk Identification (continued)

- Human health risks
  - Limited transportation of excavated soils through neighborhoods
  - Accident risk associated with excavation, ISCO
- Environmental/ecological project risks
  - Greenhouse gas emissions
    - Excavation equipment
    - ISCO equipment, chemical production
    - Wellhead treatment pumps
    - Project team commute trips
  - Consumption of landfill space

Other risks posed by actions at the site include these. These would also be compiled.

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Project Risk Identification (continued)

- Regulatory project risks
  - Regulatory agency staff/funding limitations
  - Change in cleanup goals
- Economic project risks
  - Redevelopment economics
- Project schedule/staffing/financial risks
  - No key risks identified
- Legal project risks
  - Legal challenges associated with changing zoning
- Political/public perception project risks
  - Disturbance to community – traffic, noise, dust

These categories of risks are discussed further in the ITRC Technical and Regulatory Guidance Document: Project Risk Management for Site Remediation (RRM-1, 2011). The risks due to regulatory agency staff/funding limitations and cleanup goal changes would have potential schedule and economic risk implications. The public perception concerns create potential project risks.

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Tools: Risk Analysis Worksheet

Element	Risk event information
Risk event tracking code:	UPS-5
Risk event title:	In situ Chemical Oxidation Effectiveness
Risk event description:	Incomplete contact may result in contaminant concentrations in the source area not being reduced uniformly to target levels, requiring additional mobilizations to the site by the ISCO contractor or remedy changes.
Date prepared:	July 25, 2008
Date last revised:	January 17, 2009
Risk event owner:	John Doe, Project Manager
Urgent response required?	No
Likelihood of cost impacts:	Likely
Cost impact:	Critical
Risk Level	High

See Tables D-2, Project Risk Management for Site Remediation (RRM-1)

Again, this is the example of a risk analysis worksheet for one of the remedy performance risk events that was identified.

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Step 2 – Project Risk Evaluation

- Use risk register to describe each project risk, rate the importance of each, and identify priority risks that need to be addressed

Remedy Performance Project Risks Description	Impact Severity on Cost/Schedule	Occurrence	Risk Level
Availability of key personnel slows approval time for key actions	Significant	Likely	High
Excavation volumes may be larger, debris/drums during excavation	Significant	Likely	High
Incomplete contact between oxidant, contaminant resulting in failure to achieve goals	Critical	Likely	High
Unexpected breakthrough of carbon, piping breaks	Marginal	Unlikely	Low
Public perception and legal challenges	Significant	Unlikely	Moderate

See Table D-3, Project Risk Management for Site Remediation (RRM-1)

The register allows the manager and stakeholders to easily identify those risks that have the greatest impact to the project. This puts each in perspective and allows realistic discussions of the need for risk management.

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Project Risk Mitigation Strategies: Hypothetical Site

- Now let's think about how to address the risks the ITRC team identified:
  - Remedy performance risk (for ISCO, carbon adsorption, excavation, etc.)
  - Risks to community during remediation
  - Environmental risks
  - Regulatory project risks
  - Economic project risks
  - Project schedule/staffing/financial risks
  - Legal project risks
  - Political/public perception project risks
- The next slides show what the ITRC team thought

At a recent class room training, when we presented the hypothetical case study, we found that the audience members brought a variety of different issues to be addressed, based on their expertise and experiences.

For regulators, the main concern was: risks with system performance, and effectiveness of the system to protect HH &E

For the PRPs, legal and cost-related risks ;

For the consultant who were working at the site, schedule and staffing was more of a concern.

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Step 3 – Project Risk Mitigation Strategies

- Remedy performance project risks
  - ISCO - incomplete contact with contaminant
    - Increase quantity injected
    - Decrease spacing on injection points
    - Additional characterization of contaminant extent, architecture
    - Financial contingencies for additional injection events
  - Excavation encountering drums, debris
    - Conduct pre-excavation geophysical survey
    - Have equipment/materials for debris removal on-site

For some typical project risks, we discuss options for managing the risks. These items would have to be accounted for in project risk management plans, project schedule, and project budget. We'll discuss the kind of mitigation that may be appropriate for the risks identified for this hypothetical site. Ideas for mitigation of the remedy performance risks are shown here.

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Project Risk Mitigation (continued)

- Remedy performance project risks (continued)
  - Treatment failure and breakthrough
    - Install larger carbon vessels
    - Monitor between vessels more frequently
    - Use virgin carbon
    - Install better piping supports or stronger materials

- Human health/public perception project risks
  - Traffic risk - Route planning with community, engineering controls
  - Accident risk - Engineering controls to reduce accident risk

Continue with risk mitigation strategies for any other key project risks. Many of the risk management actions are common sense and good engineering. Incorporating risk management should be easy. Addressing concerns raised by the public about risks associated with the remedy requires a combination of good engineering and public outreach.

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Project Risk Mitigation (continued)

- Environmental/ecological project risks
  - Greenhouse gas emissions
    - Consider using rail for transport
    - Use clean diesel, biofuels
    - Adequate characterization, pilot testing, to optimize use of oxidant
    - Proper equipment sizing, variable-speed drive motors
  - Landfill space consumption
    - Sufficiently define contaminant extent to better define amount of soil excavated and landfilled

These risks are relatively new issues for remediation, and the ITRC Green Remediation team is developing ITRC guidance document to help identify management options for remediation. Ideas for addressing the project contribution to these larger risks are shown here. Some of the mitigation actions have economic benefits as well.

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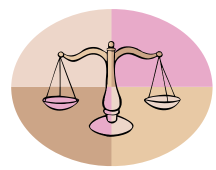
Project Risk Mitigation (continued)

- Regulatory
  - Coordinate early with regulators to streamline submittal and review process for plans and reports
  - Reimburse regulatory oversight costs
- Economic
  - Early involvement of municipal authorities regarding future zoning plans
  - Phasing of project to accelerate redevelopment of parts of the site

- Legal and public perception
  - Early outreach for education and Identification of community concerns



Some of the management strategies involve non-technical actions and can be assisted by community outreach specialists and legal help. Actions such as these may help avoid more expensive and time-consuming legal actions.

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What is Project Risk Monitoring and Reporting (Steps 4 and 5)?

- How will mitigation strategies be implemented, documented, and reported?
- Will it be part of existing project plan or report?
- When will each item be addressed?
- Who will conduct monitoring and prepare the report?
- Who will the results be reported to for each type of project risk?

- Document all this in the risk management plan

Again, the onset of risk events needs to be monitored as the project proceeds, with clear responsibilities for this and for reporting these indicators to the project management and stakeholders so timely contingent actions can be taken. The Risk Management Plan will have answers for each of these questions.

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Risk Monitoring: Example Finding

- Replacing monitoring well
  - Displaced by excavation
  - Separate-phase solvent (dense non-aqueous phase liquid) encountered at top of fractured/weathered rock
- Report occurrence to management, stakeholders
- Reconsider risk of remedy failure
  - Evaluate management options

As an example, here is an event with potentially serious consequences to the example project. It would be good to have considered the potential for this before it was encountered. The next section will discuss one management option for this situation that may be applicable to your most challenging sites. Refer to RRM-2 for more information on handling these challenging sites.

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Presentation Overview

- Introduction
- RRM Overview & Roadmap
- RRM Principles & Elements
- Planning and Implementation
- 1st Question and Answer Break
- Illustrative Example
- Case Studies & Conclusion
  - Remedy design: Industrial Facility in CA
  - Remedy selection: Hill Air Force Base
  - Remedy implementation: NPL Site
  - Remedy operation: LLNL Site 300
  - Conclusion
- 2nd Question and Answer Break

NPL = National Priorities List

LLNL = Lawrence Livermore National Laboratory

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RRM Case Studies

- Example case studies illustrating application of RRM elements
  - Objectives/ importance of RRM
  - Principle roadmap and elements
  - Planning and a example case study
  - We'll look at four actual cases
    - Simple to Complex Sites
    - Illustrate the range of applications of RRM
    - Different agencies

Many site examples can be provided

Document has several examples with detailed discussion

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Example for a Simpler Site (Facility in California)

- Site setting
  - Facility with on-site disposal operations
  - Chemicals of concern
    - VOCs in groundwater
- At the remedy design stage
  - Site conditions not favorable to any *in situ* treatment
  - Selected remedy: pump and treat for containment to prevent downgradient comingle plume
  - Low profile air stripper due to neighborhood settings
  - Hazard operation evaluation conducted.

Here is a simple example of other ways to conduct RMP

In this example we talk about a site where the

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Example for a Simpler Site (continued)

- Evaluation
  - Minor design issues were identified to verify flexibility/expandability to achieve the treatment goal
  - Several items identified to be included into O&M contingency plan
- Risk Management
  - A simple spreadsheet similar to the Risk Register in TechReg
  - Documentation for follow-up action items such as:
    - Design change made
    - Contingency incorporated into O&M plan

No associated notes.

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Example for a Simpler Site:
Risk Management Worksheet for Air Stripper

Air Strippers

Component	What If …	Hazard / Operability Concern	Consequence	Safeguard
Piping	Piping leaks	Reduced flow to treatment system; Worker exposure to contaminated water	System will need to operate more hours; worker health	Verify secondary containment pipe requirement. Install pipe as per manufacturer's instructions; worker personal protective equipment
	Piping is subjected to pressure surges	Pipe failure; Exposure to contaminated water; unnecessary pipe repairs	Worker health; additional maintenance labor and cost	Verify pipe that is rated for maximum pressure
	Piping material is incompatible with landfill leachate	Premature pipe failure; Exposure to contaminated water; unnecessary pipe repairs	Worker health; additional maintenance labor and cost	Verify appropriate pipe material of construction

Component: The components of treatment system (similar to PM's breakdown structure) each node are listed, including: Equipment, Valves, Piping, Instruments, Electrical and Other.

What if: questions will be formulated to identify and develop scenarios that will prompt a hazard analysis – essentially identifying the "risk event"

Hazard/Operability Concern: under each "risk event", what will happen or be observed during operation (a hazard or operating condition). Something that has the potential for causing harm to people, property, the environment or productivity.

Consequence: what will be consequence if "risk event" occurs or possible effects of each hazard are identified without regard to safeguards.

Safeguards: Measures taken to prevent or mitigate the risks of accidents will be identified.

Recommendations: Other follow up actions

Remarks: notes

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Tyson's Lagoon

- Site setting
  - Abandoned waste disposal site
  - Series of unlined lagoons
    - Liquid wastes were discharged
    - VOCs (Toluene, 1,2,3-Trichloropropane and Xylenes)
- At the remedy implementation stage
  - Site investigation/remediation
  - Selected remedy: excavation of lagoon materials and off-site disposal
  - Reconsidered remedy
    - Pilot studies for treating lagoon material, groundwater
    - Project risk evaluation

Consideration of site specific conditions to the potential risks.

Resulted in changing the selected remedy

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Tyson's Lagoon (continued)

- Evaluation
  - Greater potential for release of volatiles to the community
  - Alternatives – Innovative vacuum extraction studies
- Recommendations
  - Replace excavation with Soil Vapor Extraction (SVE)
  - Minimize risk to the community

Is solution worse than the problem

Can there be a better approach?

Manage risk to the community

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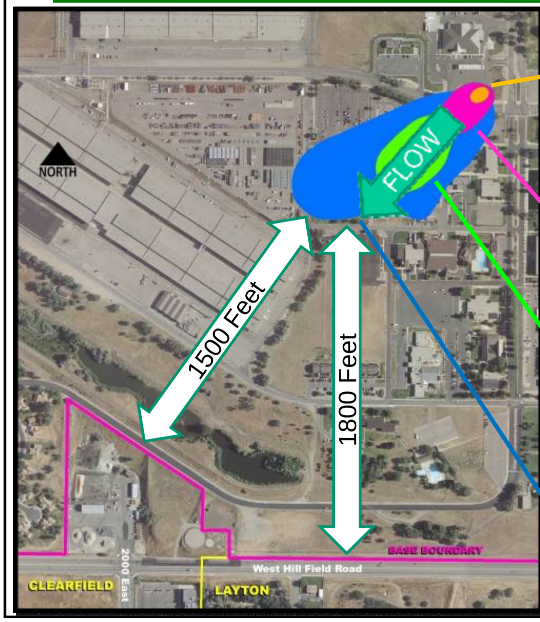
Hill Air Force Base OU11 Case Study - Site Setting



LNAPL (Free Product)
- **Manual recovery in-progress**
- **Plume appears to be shrinking**
- **Less than ~200 gallons remaining**

BTEXN
- **Upper 50 feet of shallow aquifer**
- **Plume appears to be shrinking**

TCE
- **At depths of 50 to 100 feet**
- **Plume appears to be shrinking**

MTBE
- **At depths of up to 185 feet in shallow aquifer**
- **Plume appears to be expanding – Principle of Non-Degradation**
- **Off-base migration unlikely**

Site setting

- OU11 plumes
- Characterization
- Activities so far

At the remedy selection stage

- Several remediation alternatives considered in Feasibility Study (FS)
- Need to address remedy goals and uncertainties
- Used Air Force Restoration Performance Risk Management (RPRM) process, similar to RRM

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Hill Air Force Base OU11 Case Study (continued)

- At the remedy selection stage
  - Several alternatives in Feasibility Study (FS)
  - Need to address remedy goals and uncertainties
  - Used Air Force Restoration Performance Risk Management (RPRM) process, similar to RRM
- Considered technical, political and regulatory project risks under RRM (39 events)
- Tools and approaches
  - Developed Project Risk Management Plan elements
  - Statistical analysis
  - Input from stakeholders to get combined score

Summary of the site conditions.

Consider technical, political and regulatory project risks under RRM

Site characterization (7 events)

Remedial action objectives (10 events)

Technical issues (9 events)

Sustainability (6 events)

Cost and schedule (7 events)

Tools and approaches

Developed Project Risk Management Plan elements

Statistical analysis

Input from stakeholders to get combined score

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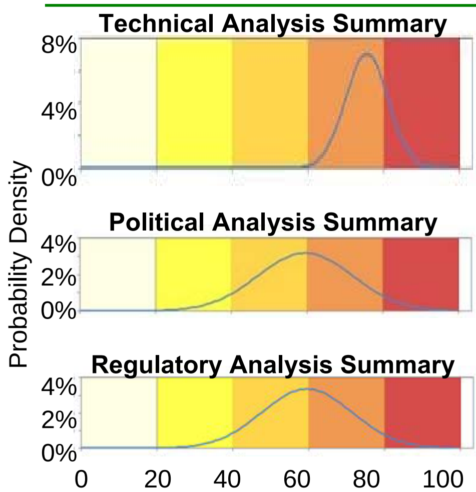
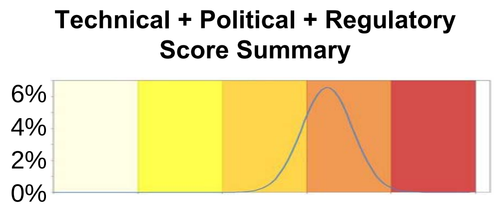
Hill Air Force Base OU11 Case Study (continued)





Probability of Occurrence	Response Level Confidence
0.00%	0.00%
0.00%	0.00%
18.95%	18.95%
80.28%	99.23%
0.77%	100.00%

Figure E-2

An expert team looked at different elements important to the success of the remedy

What re the different elements and how they are related

Cumulative risks are added into a numerical score

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Hill Air Force Base OU11 Case Study (continued)

- Evaluation
  - Relative importance of uncertainties
  - Trigger, consequence, mitigation, tracking
- Lessons learned/highlights
  - Considering biofouling
  - Oxygenation that reduces effectiveness of Enhanced Monitored Natural Attenuation (EMNA)
  - Limitations of other techniques
  - Need pilot studies before committing to pump and treat (P&T)
- Recommendations
  - P&T greater risk than Monitored Natural Attenuation/ Enhanced Monitored Natural Attenuation (MNA/EMNA) at Hill Air Force Base
  - MNA/EMNA is more effective

Some specific properties addressed in the site OU11 case

Evaluation of data/information to make appropriate decision

Create a Risk Management Plan (RMP)

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Lawrence Livermore National Laboratory (LLNL) Site 300 Case Study

- Site information
  - High explosive test facility
  - Radionuclides, TCE, dioxin metals, etc.
- Remedy operation stage
- Risk management program
  - Comprehensive site-wide
  - Potential risk screening checklist
  - Risk probability-consequence analysis
  - Risk analysis worksheet
  - Prioritize risk events

Summary of the site conditions.

LLNL has been doing this for a while managing risks from radioactive sites

The overall approach for RRM based on LLNL work

LLNL Site 300 Case Study (continued)

Risk Quantification for Risk Event ER/S300/R2

Probability	5%
Cost impacts	$47,053,000 (excavation, offsite disposal)
Schedule impacts	None
Expected value	$2,353,000 (= $47,053,000 x 0.05)
Urgent response	No
Risk event owner	Mike T.
Risk category	Logistical (Difficult to implement) Funding (Extremely expensive)

Note:

Assigned roles and responsibilities (event owner)

Urgency and impacts to schedule

Addresses impacts to site schedule and budgets and adequate resources for response

Judgment plus advanced modeling

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LLNL Site 300 Case Study (continued)

Risk Handling = Risk Mitigation + Risk Monitoring

- **Risk Mitigation**
  - **Implementation of risk control measures**
    - Adjusting schedules
    - Adopting a less complex process
    - Adding or reallocating resources
    - Conducting treatability studies to assess technologies
    - Considering alternative technologies
- **Risk Monitoring**
  - An ongoing, iterative process to ensure mitigation measures effectively manage the risk
    - Validate mitigation strategy assumptions
    - Ensure mitigation implemented as planned
    - Evaluate effectiveness mitigation measures
    - Identify unanticipated risks
    - Detect trends

Details of LLNL case

Handling the risk

Elements of mitigation and monitoring

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LLNL Site 300 Case Study Summary

- Qualitative risk identification/screening followed by quantitative analysis
- Develops risk mitigation and monitoring measures
- Analyses includes work plans and staff interviews
- Risk management activities included in the Work Plans
- Risk handling actions defined in the Risk Management Plan
- 20 risk events have been realized
- 18 risk events successfully mitigated by implementing the Risk Management Plan

Risk Summary:

- The EM Project risk management process employs a qualitative risk identification and screening process followed by quantitative analysis and development of risk mitigation and monitoring measures.
- Although risk and contingency are estimated, they are not included in the Baseline cost estimates. Neither the EM Project nor LLNL maintains a management reserve.
- The risk analysis was performed by reviewing all scopes of work and assumptions included in the Baseline Work Plans and by consulting project staff.
- Risk management activities are included in the Work Plans. To maintain flexibility, specific risk handling actions are defined in the Risk Management Plan.

Following information is updated from the latest information available.

- Eighty-nine risk events were identified for the EM Project.
- An example of a risk event that has been realized.
    - The R10 risk event (realized) is where the regulators imposed stricter discharge limits for a groundwater treatment system, resulting in supplemental treatment equipment be installed additional monitoring requirements.
- Two examples of risk events successfully mitigated by implementing the risk handling strategy presented in the Risk Management Plan.
    1) The first risk event successfully mitigated risk event addressed whether rad waste buried in the Pit 7 Landfill Complex would require excavation. Capping proved adequate and therefore the risk of required excavation is “mitigated.” Pit 7 is one of nine operable units at Site 300.
    2) The second mitigated risk event (R9) is also for Pit 7, the potential requirement to actively remediate a large tritium plume. Once the record of decision (ROD) was signed that didn't include excavation or active tritium remediation, this events became "mitigated".

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RRM Summary

- Risk is inherent in remediation programs
- A diverse RRM technical team to develop a RMP
- RRM assesses remediation project risks, dynamic planning, key risks, tracks and reports results
  - Better management practice
  - Uses proven methods to identify and mitigate risks (DoD, DOE, EPA, other federal and state programs)
- RRM is scalable – tailored for specific site conditions – from small to big sites
- RRM will benefit the environment through successful remediation of contaminated sites
- Use ITRC RRM Team as a resource

1. A strategy to identify and manage risks related to remediation process and exit strategy

Proven - other federal and state programs – NASA, DOTs, etc. use methods to identify and mitigate risks

Systematically understand problem statement and goals of remediation

Involve regulators and stakeholders earlier in the process when risks are identified

Develop a Risk Management Plan

Identify trigger points for predetermined actions

A better management practice

Use ITRC Team as a resource

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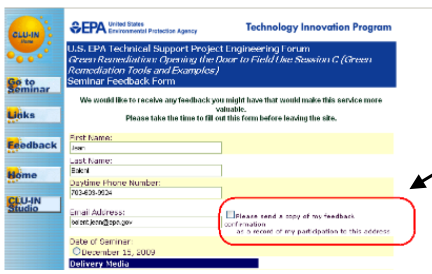
Thank You for Participating

- 2nd question and answer break
- Links to additional resources
  - http://www.clu-in.org/conf/itrc/RRM/resource.cfm
- Feedback form – *please* complete
  - http://www.clu-in.org/conf/itrc/RRM/feedback.cfm



Need confirmation of your participation today?

Fill out the feedback form and check box for confirmation email.

Links to additional resources:
http://www.clu-in.org/conf/itrc/RRM/resource.cfm

Your feedback is important – please fill out the form at:
http://www.clu-in.org/conf/itrc/RRM/feedback.cfm

The benefits that ITRC offers to state regulators and technology developers, vendors, and consultants include:

✓Helping regulators build their knowledge base and raise their confidence about new environmental technologies

✓Helping regulators save time and money when evaluating environmental technologies

✓Guiding technology developers in the collection of performance data to satisfy the requirements of multiple states

✓Helping technology vendors avoid the time and expense of conducting duplicative and costly demonstrations

✓Providing a reliable network among members of the environmental community to focus on innovative environmental technologies

How you can get involved with ITRC:

✓Join an ITRC Team – with just 10% of your time you can have a positive impact on the regulatory process and acceptance of innovative technologies and approaches

✓Sponsor ITRC's technical team and other activities

✓Use ITRC products and attend training courses

✓Submit proposals for new technical teams and projects