



# Remediation Management of Complex Sites

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# About ITRC



## ► ITRC Purpose

To advance innovative environmental decision making

## ► ITRC Mission

Develop information resources and help break down barriers to the acceptance and use of technically sound innovative solutions to environmental challenges through an active network of diverse professionals

ITRC develops guidance documents and training courses



Since 1995:  
109 documents  
71 training courses

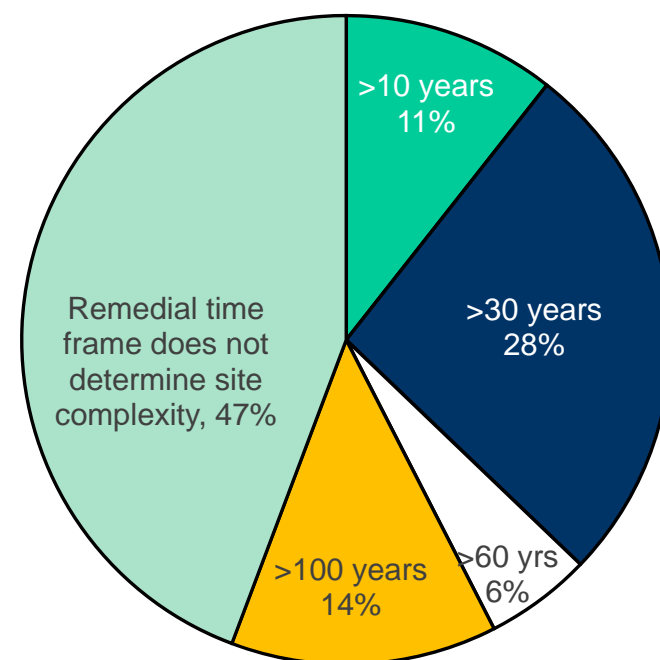
## The Challenge – Complex Sites Nationwide

### ► Complex site definition

- Remediation progress is uncertain and remediation may not achieve closure or even long-term management within a reasonable time frame

### ► National Research Council (2013) reported contaminant levels at 126,000 sites inhibit site closure

- Roughly 10% are “complex”
- Cost to complete = \$127 billion



*An ITRC team survey found a diversity of responses regarding reasonable remedial time frame (RMCS-1, Table 1)*

# The Solution – ITRC Guidance

- ▶ Recommended process for complex sites
  - Adaptive site management
- ▶ Consolidates existing guidance, best practices, tools, and technologies
- ▶ Stakeholder perspectives
- ▶ 16 case studies - real-world applications



<http://rmcs-1.itrcweb.org>

# Case Studies

1. Koppers Oroville Wood Treatment, CA
2. Moffett-MEW Regional Plume, CA
3. Rocky Flats Solar Ponds Plume, CO
4. Rocky Mountain Arsenal, CO
5. Naval Air Station Jacksonville OU 03, FL
6. U.S. DOE Test Area North, INEEL, ID
7. Joliet Army Ammunition Plant, IL
8. Tri-State Mining District, KS/OK/MO
9. Paducah Gaseous Diffusion Plant Groundwater, KY
10. Velsicol Chemical, MI
11. Onondaga Lake, NY
12. UGI Columbia Manufactured Gas Plant, PA
13. Savannah River Site (SRS) F-Area Seepage Basins Groundwater, SC
14. Former Naval Weapons Industrial Reserve Plant, MacGregor, TX
15. Hanford 200 Area, WA
16. Industrial site, Australia



★ Australian Site

WWW.ITRC.ORG/US/2017-INTERIOR-GEOSCIENCE-SURVEY-RESTORATION/2017

## The Challenge – Meeting Site Objectives at Complex Sites



Aerial view of the Rocky Flats Site, Colorado  
ITRC RMCS-1 Figure 15  
(DOE1995)

Delineating TCE plume in a residential area near  
Middlefield-Ellis-Whisman (MEW) Site, California  
ITRC RMCS-1 Figure 12 (CPEO 2016b)





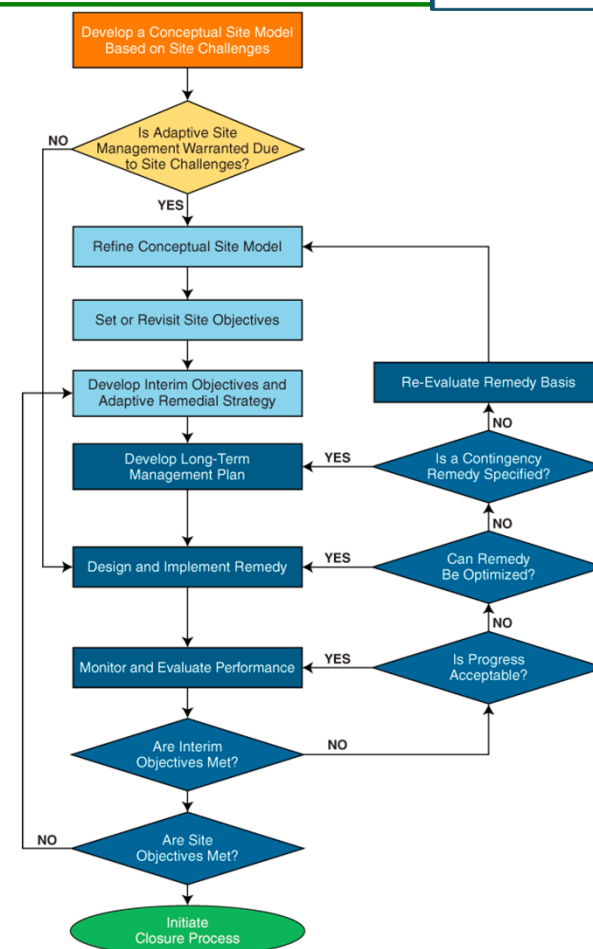
# Adaptive Site Management

Chapter 2. Site Challenges

Chapter 3. Remediation Potential Assessment

Chapter 4. Adaptive Remedy Selection

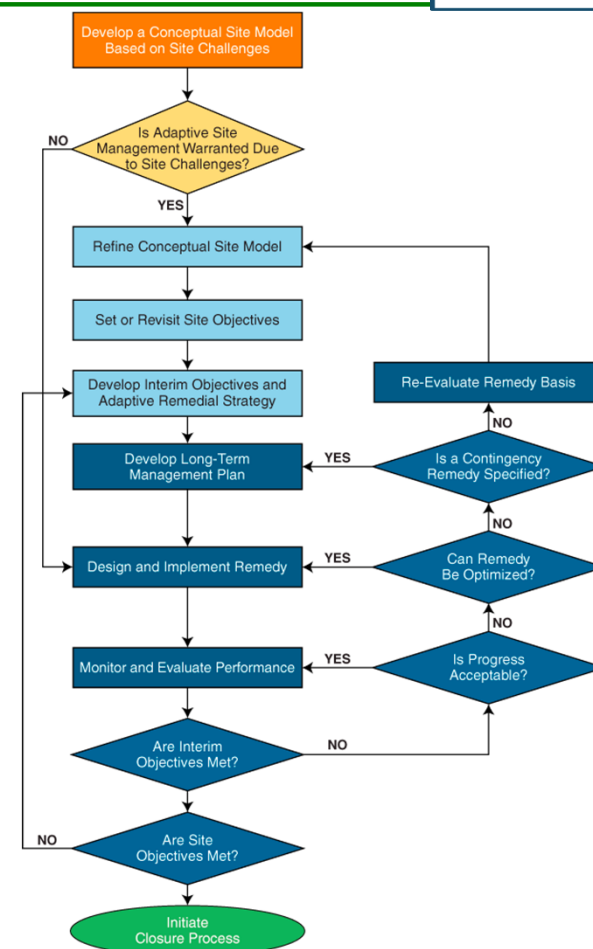
Chapter 5. Long-Term Management



# Adaptive Site Management

## Multiple Benefits

- ▶ Maintain protection of human health and the environment and fulfill regulatory obligations
- ▶ Base decisions on robust conceptual site models
- ▶ Streamline decision making and save costs
- ▶ Demonstrate interim progress that leads to long-term results
- ▶ Reduce barriers to using available remedial approaches
- ▶ Return sites to beneficial reuse





# Identify Site Challenges

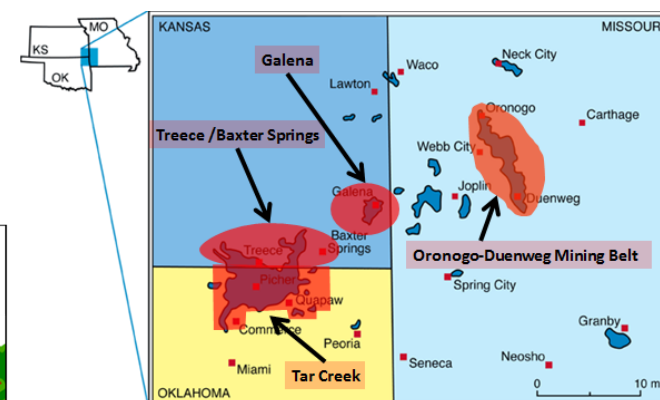
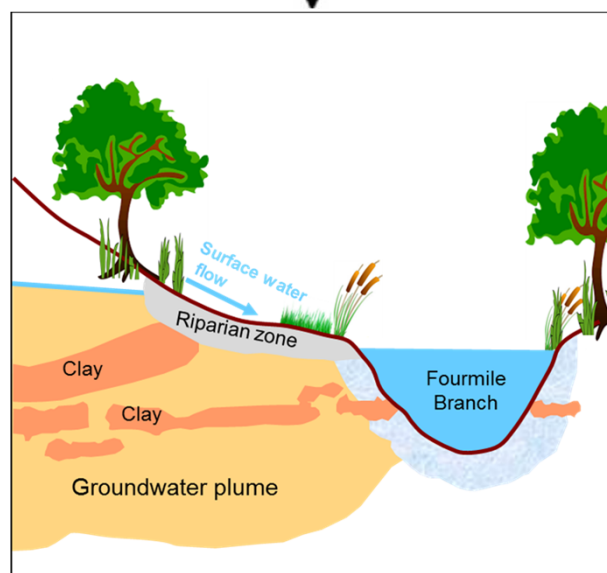
## ► Technical

- Geologic
- Hydrogeologic
- Geochemical
- Contaminant-related
- Large-scale

## ► Non-technical

- Site objectives
- Managing changes over long time frames
- Regulatory
- Institutional controls
- Land use
- Funding

Develop a Conceptual Site Model  
Based on Site Challenges



ITRC RMCS-1, Table 2 and 3; ITRC GSR-2

# Remediation Potential Assessment

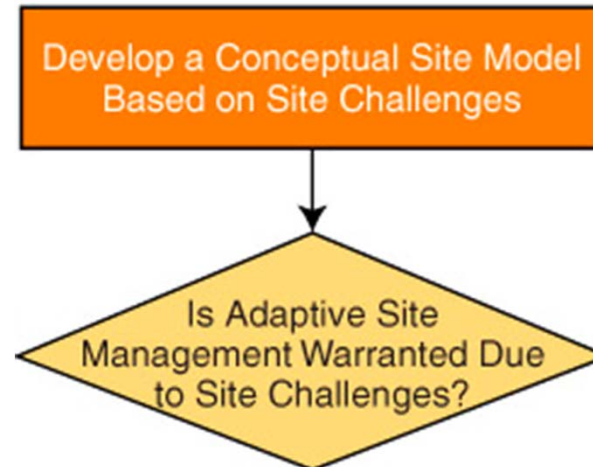
## *Process and Outcome*

### Process

- ▶ Screening tool uses weight-of-evidence approach to assess if site is likely to achieve remedial objectives in a reasonable time frame
- ▶ Basis for aligning expectations with actual remediation potential
- ▶ Promotes effective and transparent interaction

### Outcome

- ▶ Site objectives are attainable OR
- ▶ Remediation potential is low – consider adaptive site management



# Remediation Potential Assessment

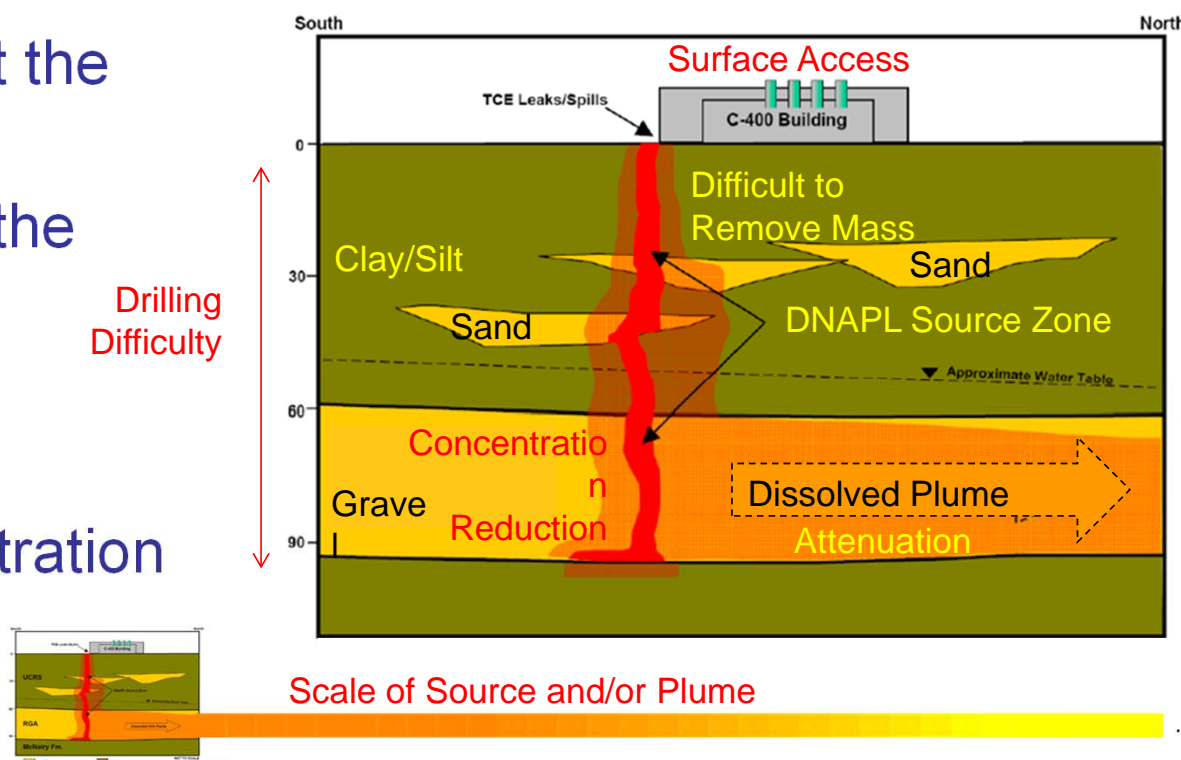
## Key Criteria (Pre-Remedy)

### 8 Questions...

1. How difficult is it to work at the surface of the site?
2. How difficult is it to drill at the site?
3. What is the scale of the source zone or plume?
4. What contaminant concentration reduction is needed?

90%?

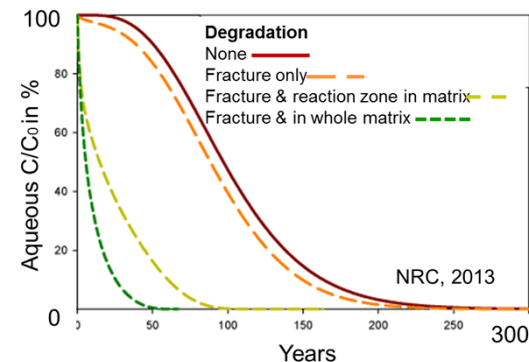
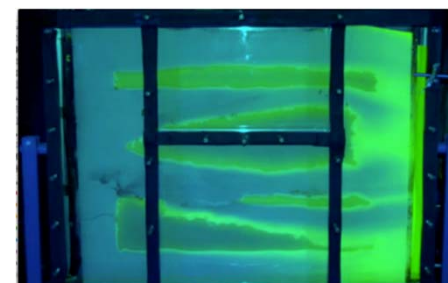
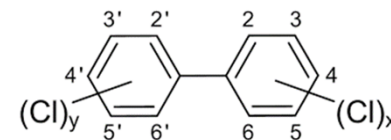
99.99%



# Remediation Potential Assessment

## Key Criteria (Pre-Remedy)

5. Do the key site constituents readily attenuate relative to the travel time to receptors?
6. Does difficult-to-remove mass exist at the site?
7. What is the predicted performance for available remedial technologies?
8. What is the predicted time frame for achieving interim and site objectives?



# Remediation Potential Assessment

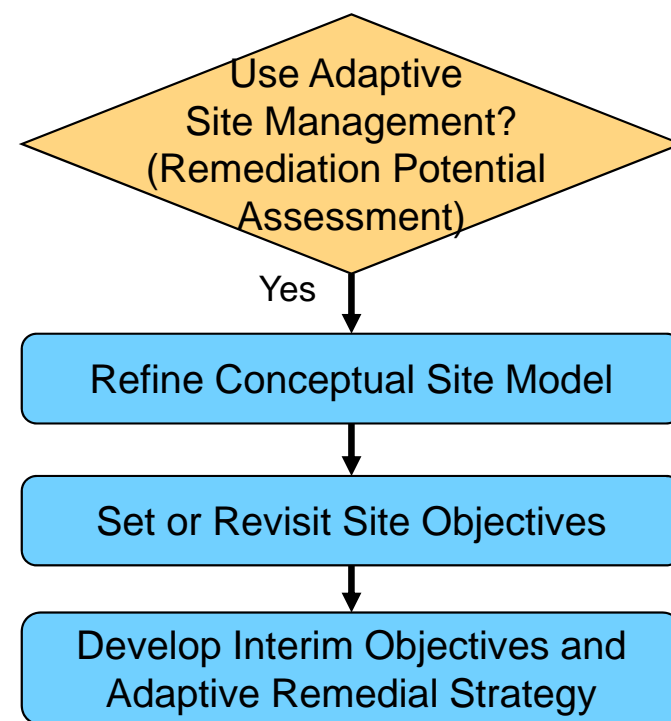
## Matrix of Evaluation Criteria

- ▶ Evaluate each criteria as
  - high
  - moderate
  - low
- ▶ Weight criteria to reflect relative importance
- ▶ Assess conclusion

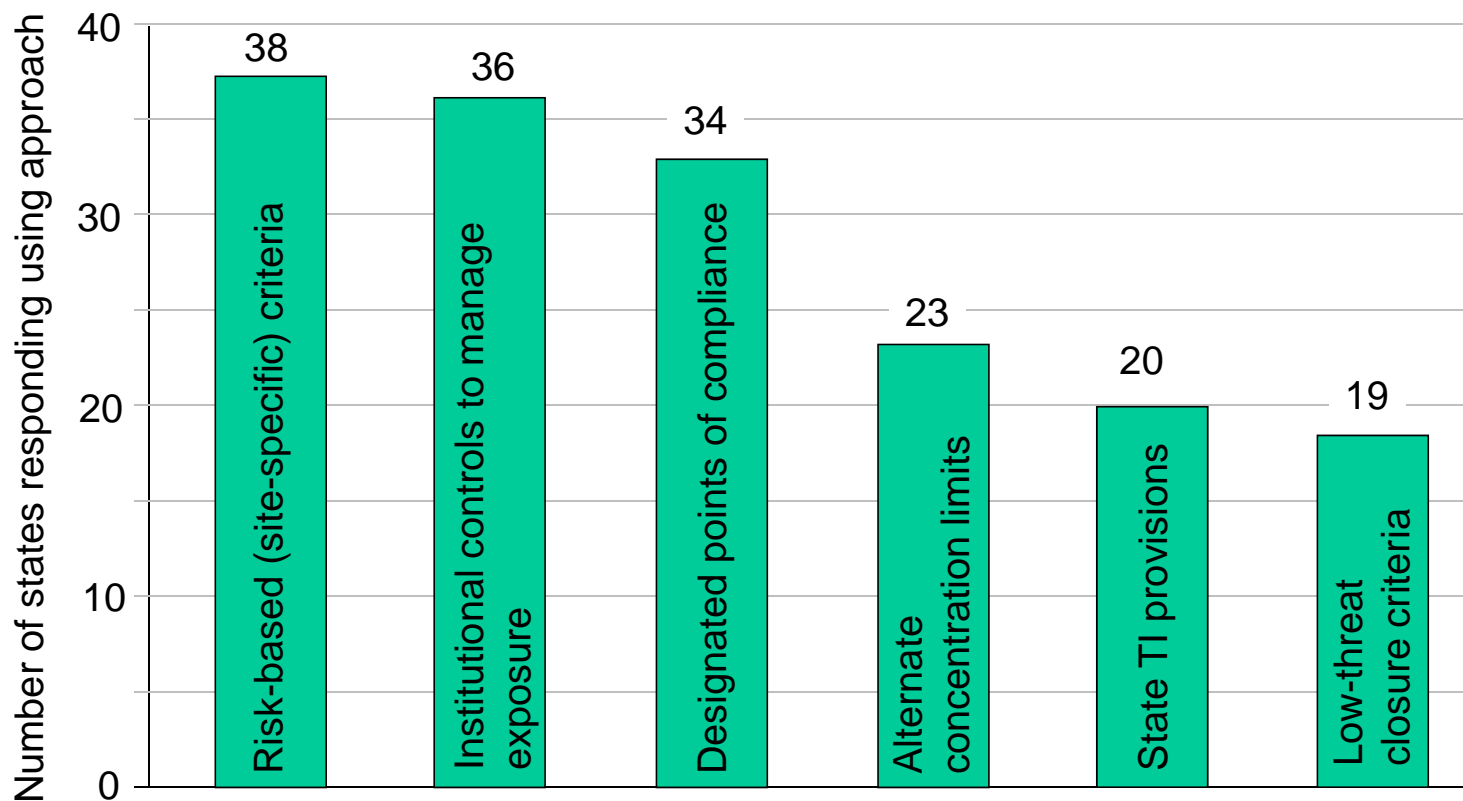
| Evaluation Criteria      | Likelihood of Achieving Remediation Objectives |          |     |
|--------------------------|--|----------|-----|
|                          | High   | Moderate | Low |
| Access                   |  | ✓        |     |
| Drilling feasibility     | ✓  |          |     |
| Scale                    |  | ✓        |     |
| Concentration reduction  |  |          | ✓   |
| Attenuation              |  | ✓        |     |
| Difficult-to-remove mass |  |          | ✓   |
| Technology performance   |  |          | ✓   |
| Time frame               |  |          | ✓   |
| Total checked:           | 1  | 3        | 4   |

# Adaptive Remedy Selection

- ▶ Refine conceptual site model
- ▶ Set or revisit site objectives
  - Site objectives are overall remedial expectations, including protecting public health and the environment
  - When setting objectives, consider complexities, different geologic units or operable units, source area and plume -- “site segments”
  - Revisit site objectives if progress is insufficient despite optimization



## States May Have Flexibility in Setting Objectives



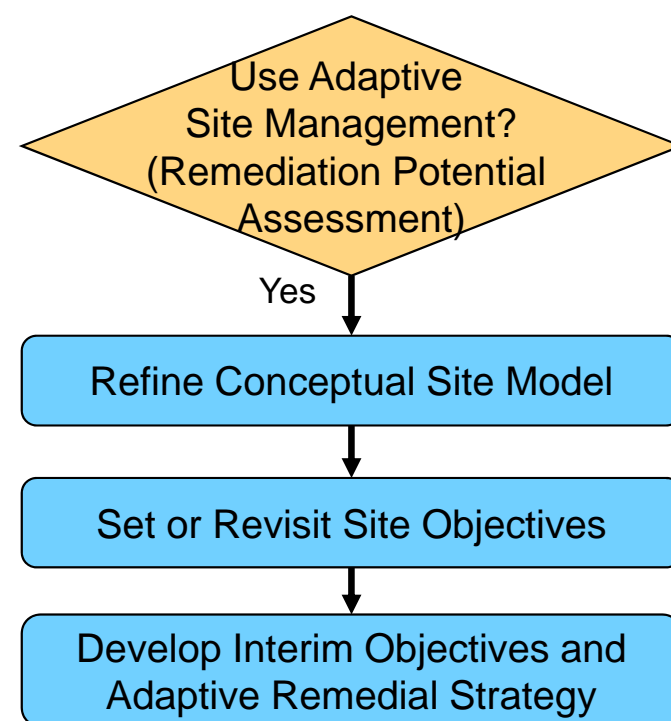


## Adaptive Remedy Selection, Cont'd

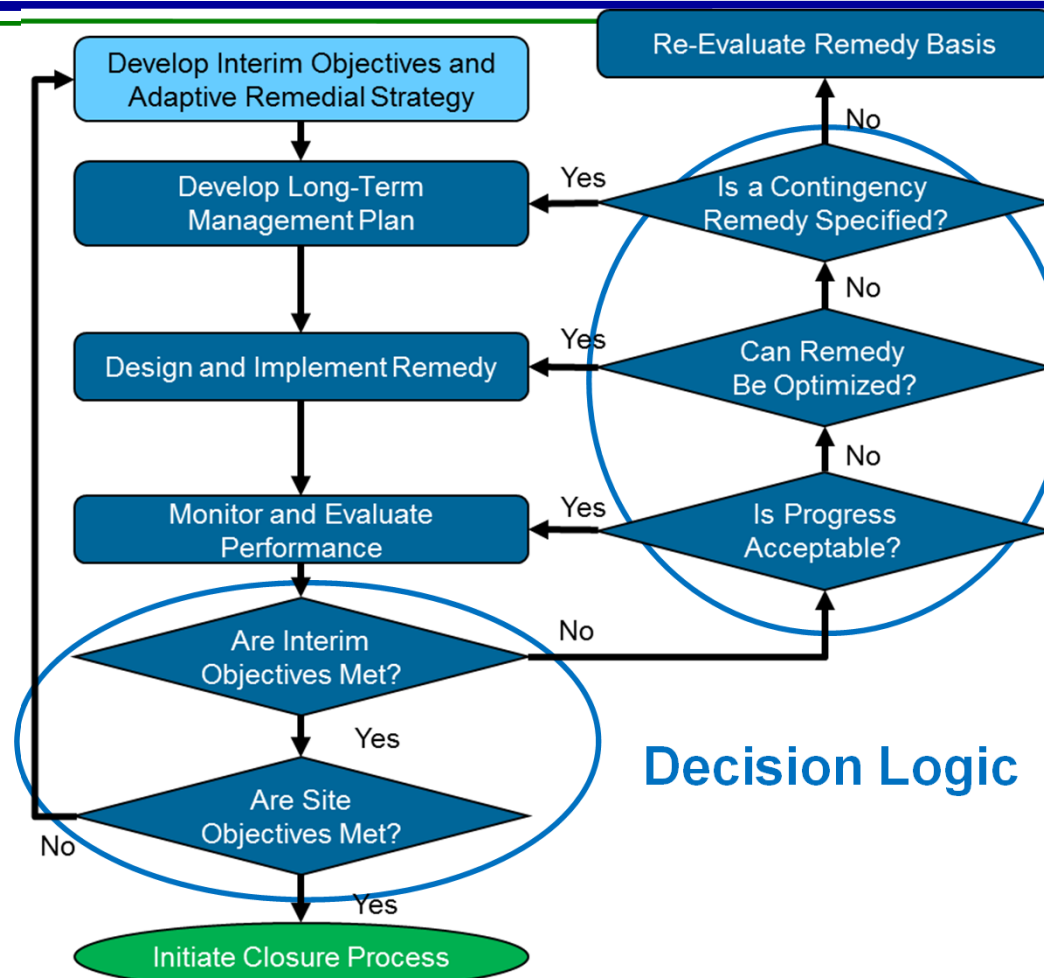
- ▶ Build adaptive remedial strategy – a combination of technologies and approaches to meet interim objectives
  - May need multiple technologies, phases for each site area
  - Set interim objectives: intermediary goals to guide remedial progress



- ▶ Repeat process if remedy is not on track



# Long-Term Management

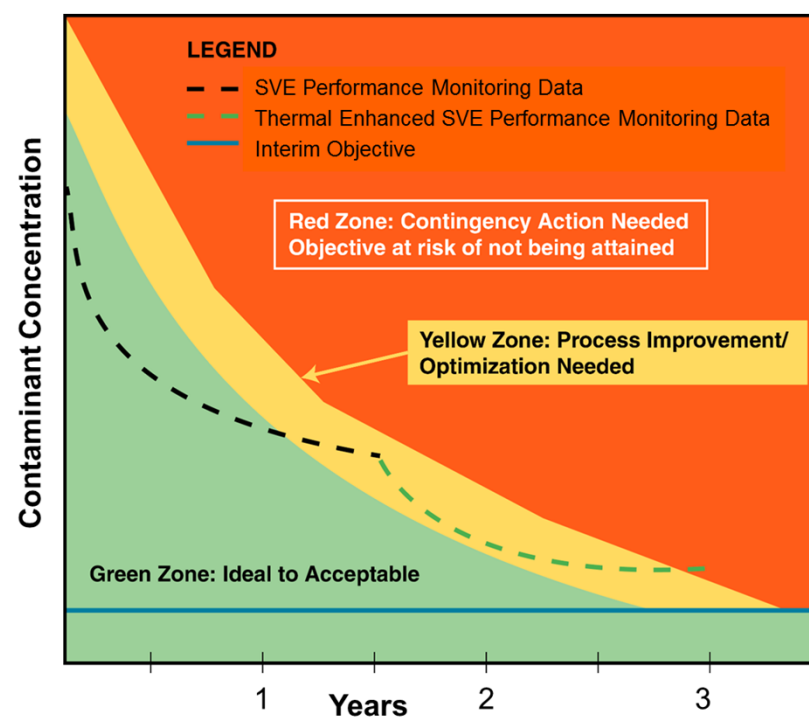


Decision Logic

# Develop Long-Term Management Plan

## Plan Components

- ▶ Completion strategy
- ▶ Description of the selected remedy
- ▶ Expected performance over time
  - Performance model predictions
  - Compare actual and predicted performance
- ▶ Timeline and criteria for monitoring and periodic evaluations
- ▶ Decision logic for remedy transitions
- ▶ Project risks and uncertainty



SVE – Soil vapor extraction

## Additional Resources

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- ▶ Remediation Management of Complex Sites  
<http://rmcs-1.itrcweb.org>
- ▶ Internet-based training
  - Clu-in training page at <http://www.clu-in.org/conf/itrc/rmcs/>
  - Under “Download Training Materials”
  - April 26, 2018 (Thursday) 1-3:15 PM EDT
  - June 19, 2018 (Tuesday) 1-3:15 PM EDT
  - October 23, 2018 (Tuesday) 1-3:15 PM EDT
- ▶ Additional resources  
<http://www.clu-in.org/conf/itrc/RMCS/resource.cfm>

# QUESTIONS?

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