Groundwater Remediation

Potential for Science and Technology Contributions

Outline

- Introduction
- Short Hanford History
- Remediation Plans and Ongoing Activities
- Identification of Some Science and Technology Needs

Introduction

Remediation Strategies

Activities

Characterization

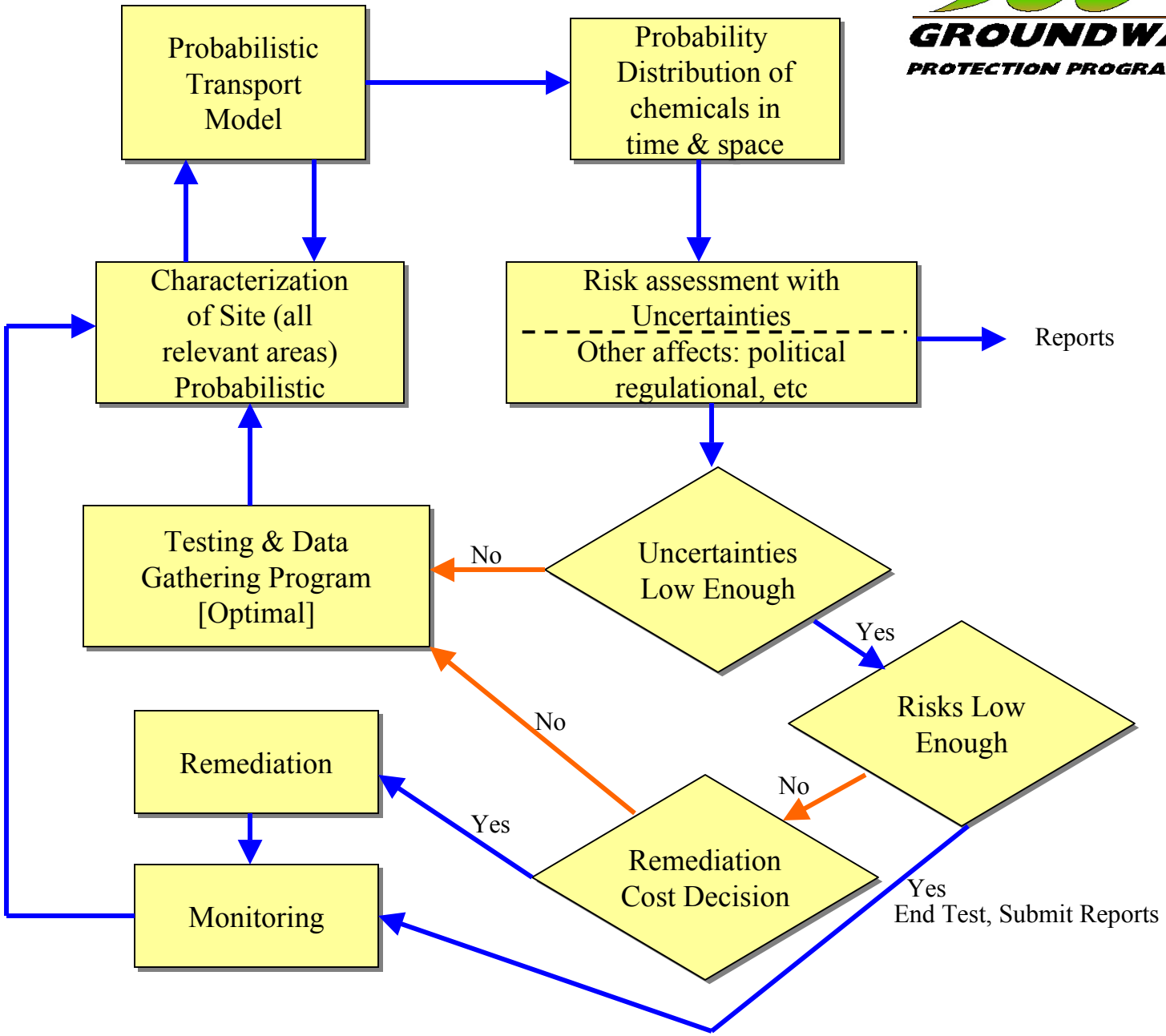
Remediation

Monitoring

Minimize

$\sum$ Costs of all Activities (Present, Probable)

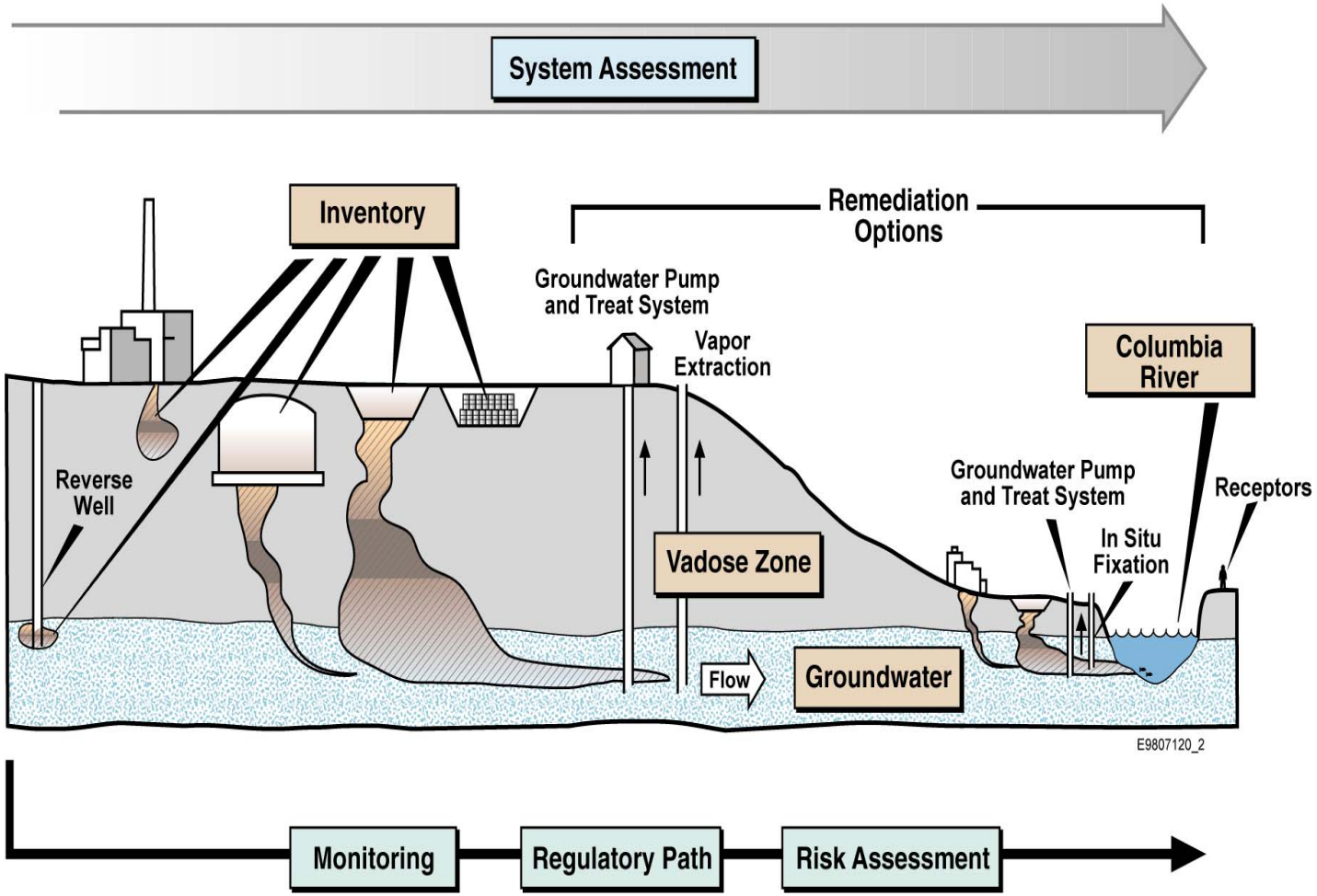
Subject to Constraints from Risks, Regulator, Uncertainties, Agency Requirements, - - -


Probabilistic Transport Model
Probability Distribution of chemicals in time & space
Characterization of Site (all relevant areas) Probabilistic
Risk assessment with Uncertainties
Other affects: political regulational, etc
Reports
Testing & Data Gathering Program [Optimal]
No
Uncertainties Low Enough
Yes
Risks Low Enough
No
Remediation
No
Yes
Remediation Cost Decision
Monitoring
Yes
End Test, Submit Reports

Uncertainties Drive Assessments

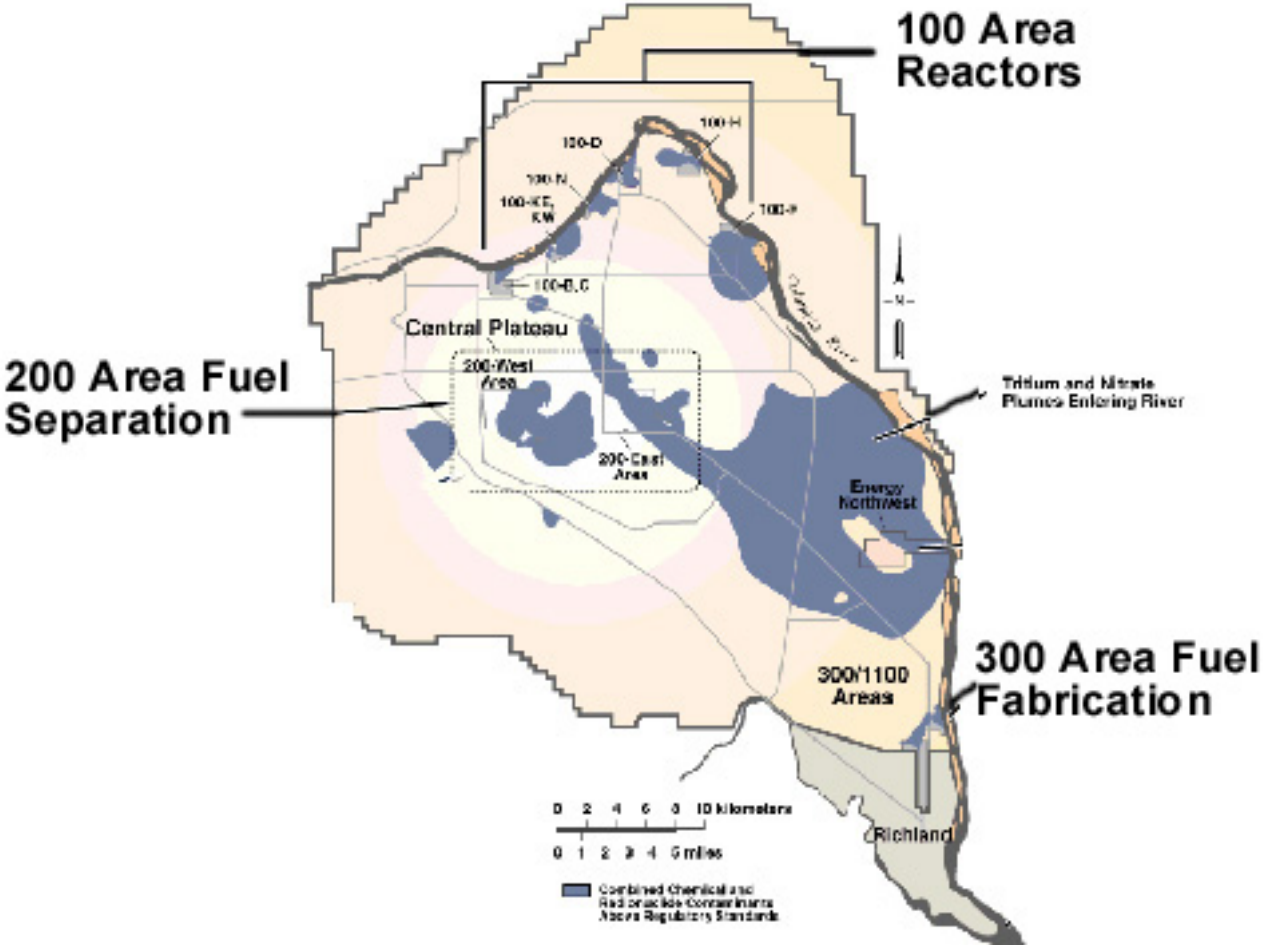
- Uncertainties in data
- Uncertainties in data give uncertainties in flow
- Uncertainties in flow and transport give uncertainties in contaminant concentrations
- Uncertainties in contamination concentrations give uncertainties in risk assessments
- Cost is minimized over project life (present value used)

System Model



Short History of What Has Been Done at the Hanford Site

Groundwater Contaminants



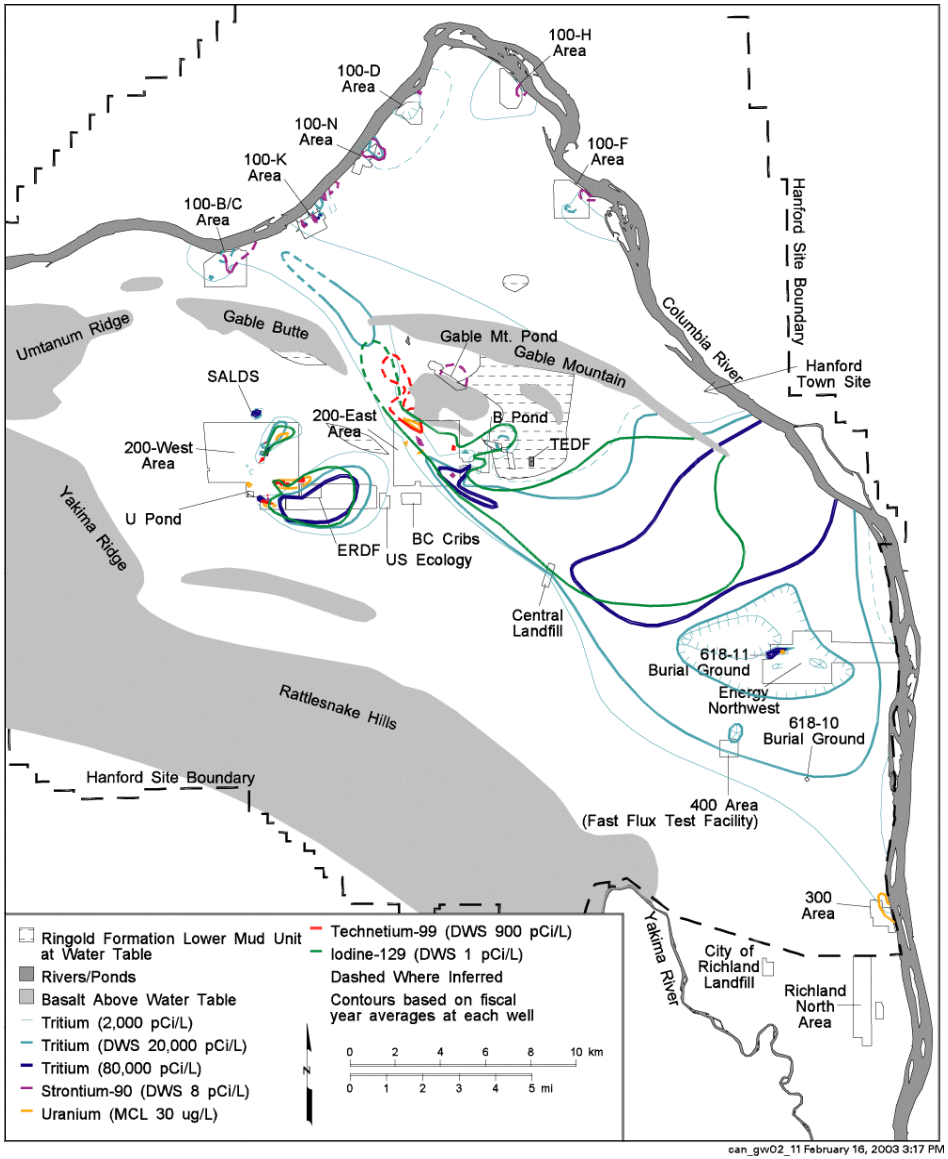
Radioactive Groundwater Contaminants

Radionuclides in groundwater at concentrations above MCLs or Drinking Water Standards in 2002

H-3
I-129
Sr-90
Tc-99
<u>Uranium</u> (various isotopes)
C-14
Cs-137
Plutonium

Radionuclides identified as potential contributors to risk in the future.

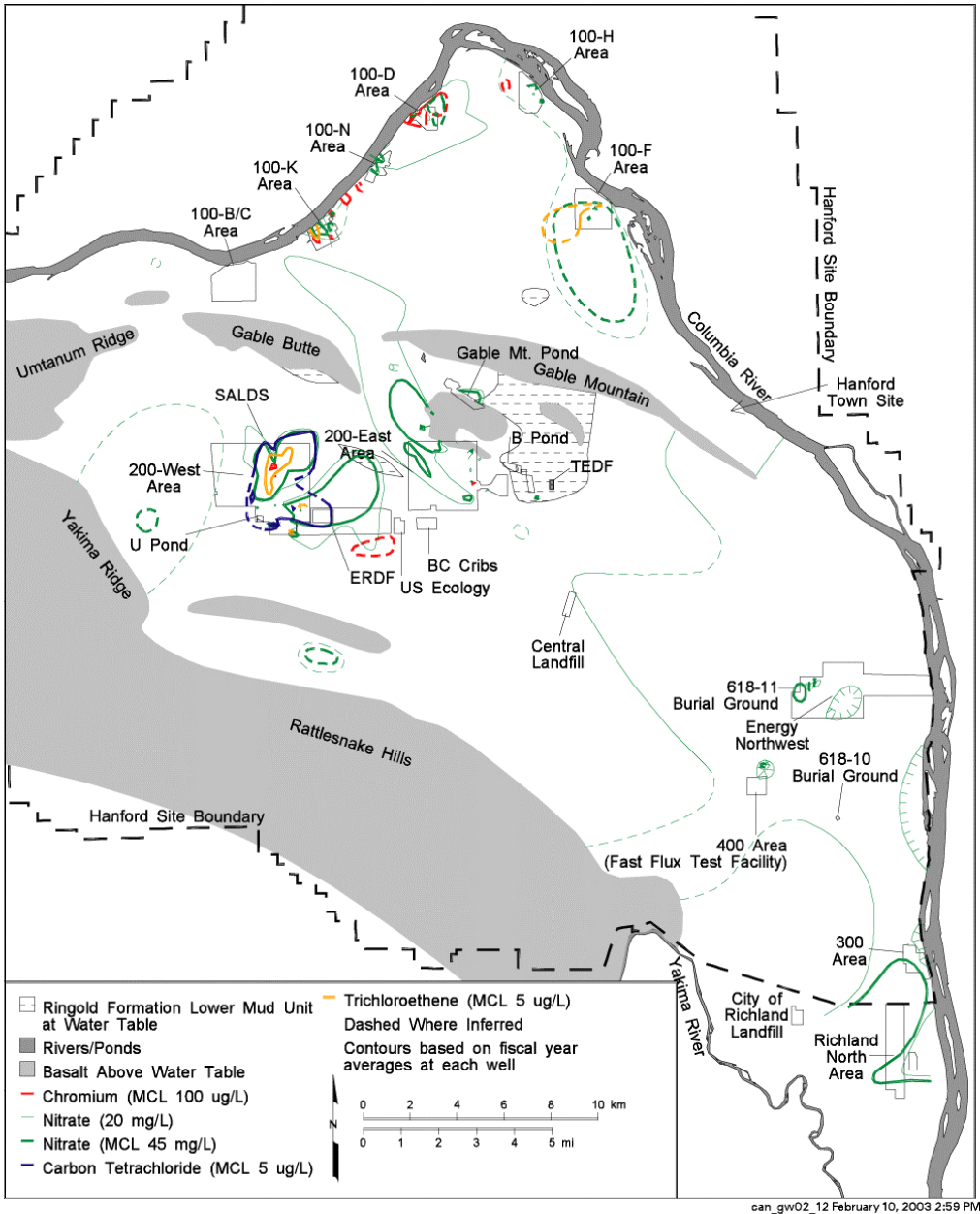
Np-237
Se-79
Cl-36



Non-Radioactive Groundwater Contaminants

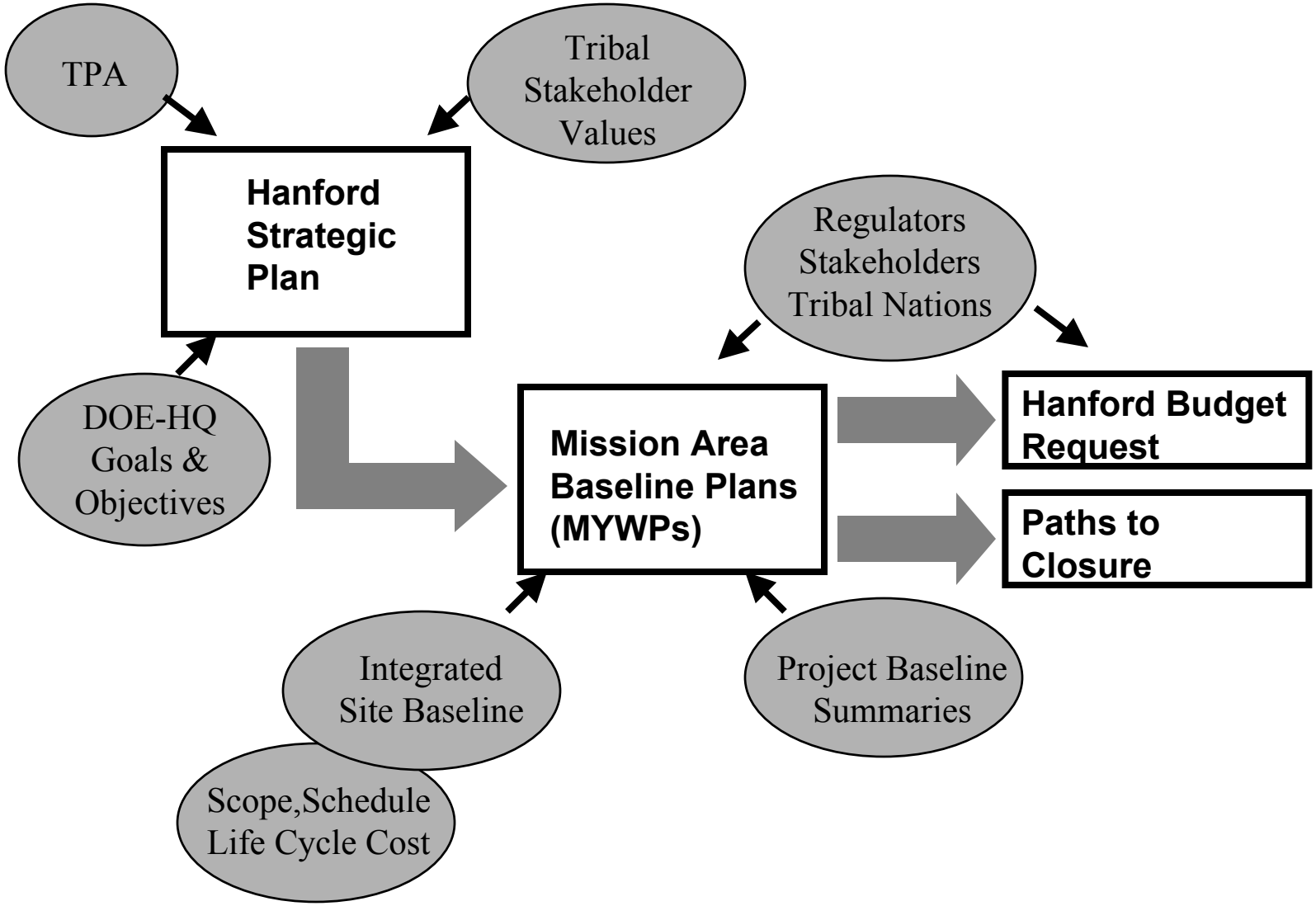
Hazardous chemicals in groundwater at concentrations above MCLs or Drinking Water Standards in 2002

Nitrate
Carbon Tetrachloride
Trichloroethylene
<u>Chromium</u>
Cyanide

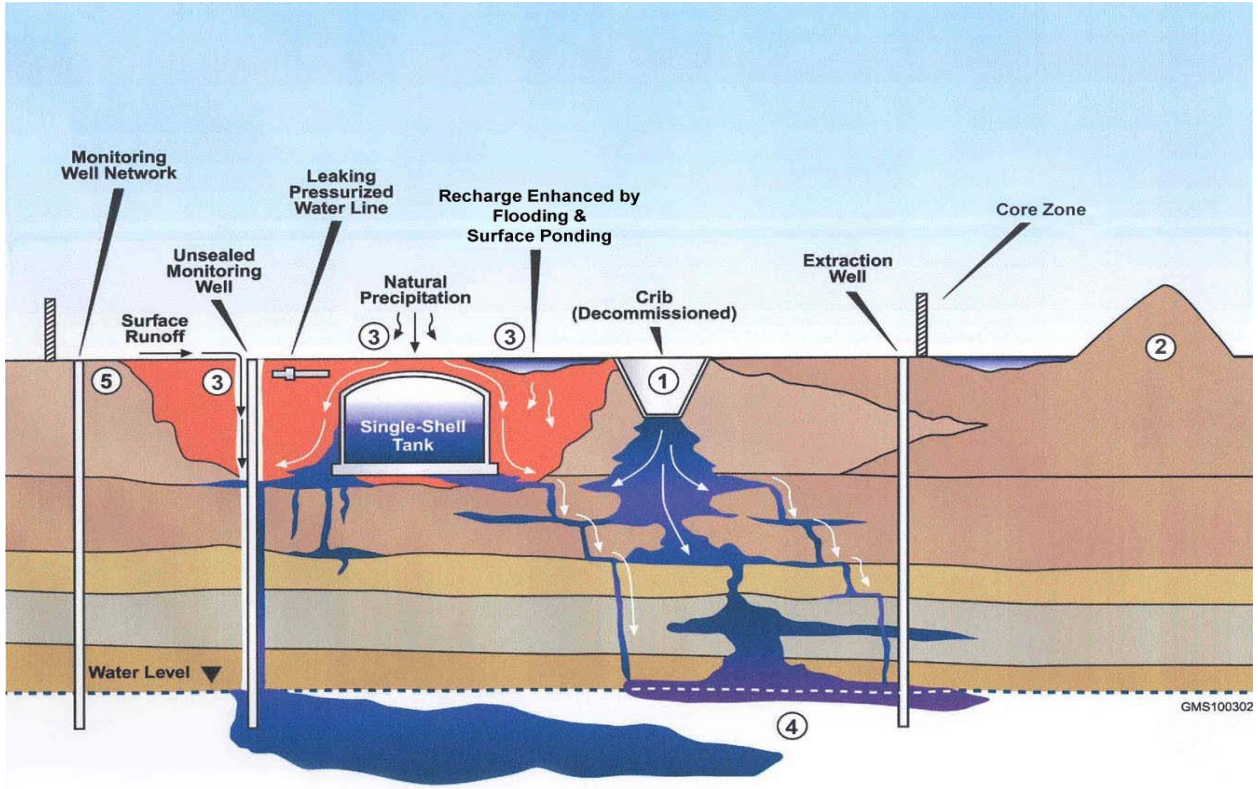


Remediation Plans

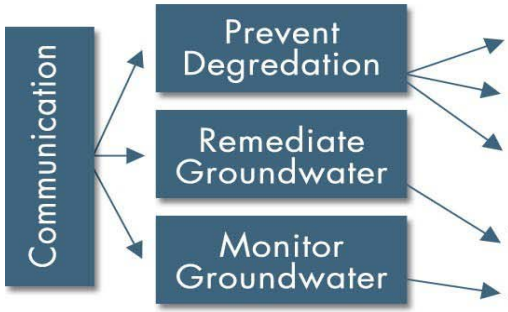
Hanford Paths to Closure



GROUNDWATER PROTECTION PROGRAM



Program Elements



Groundwater Protection Functional Areas:

1 – Remediate high-risk waste sites.

2 – Shrink the contaminated areas.

3 – Reduce natural and artificial recharge.

4 – Implement final groundwater remedies.

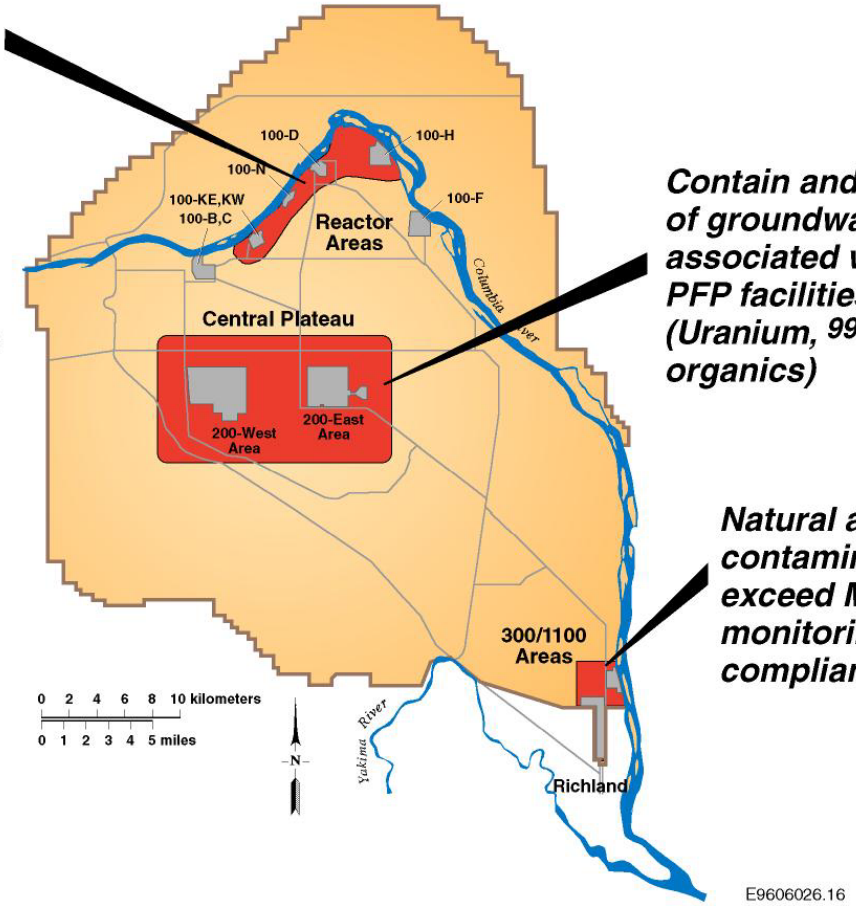
5 – Integrate groundwater monitoring needs.

Hanford Site Groundwater Remediation Strategy Objectives

Interim groundwater actions to be protective of the Columbia River.

- *Hydraulic control with treatment prior to reinjection for for ^{90}Sr at N Reactor*
- *Intercept chromium at H, D & K Reactors upwelling into potential salmon nesting areas.*

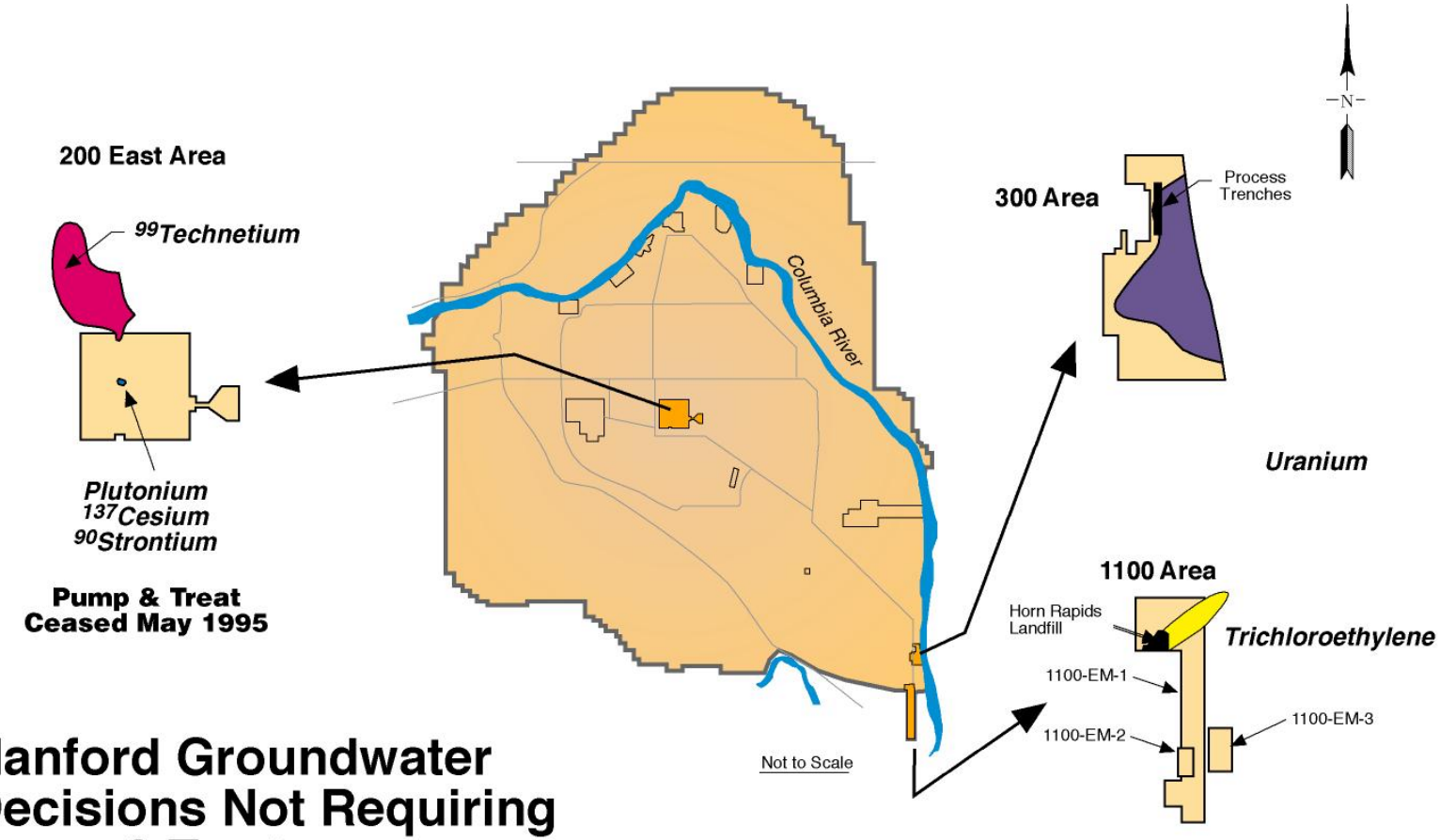
Assess alternative treatment methods for final remedial actions.



Contain and reduce mass of groundwater plumes associated with UO3 and PFP facilities of 200 West (Uranium, ^{99}Tc, and volatile organics)

Natural attenuation of contaminants that exceed MCLs and monitoring for compliance

GROUNDWATER PROTECTION PROGRAM



Hanford Groundwater Decisions Not Requiring Pump & Treat

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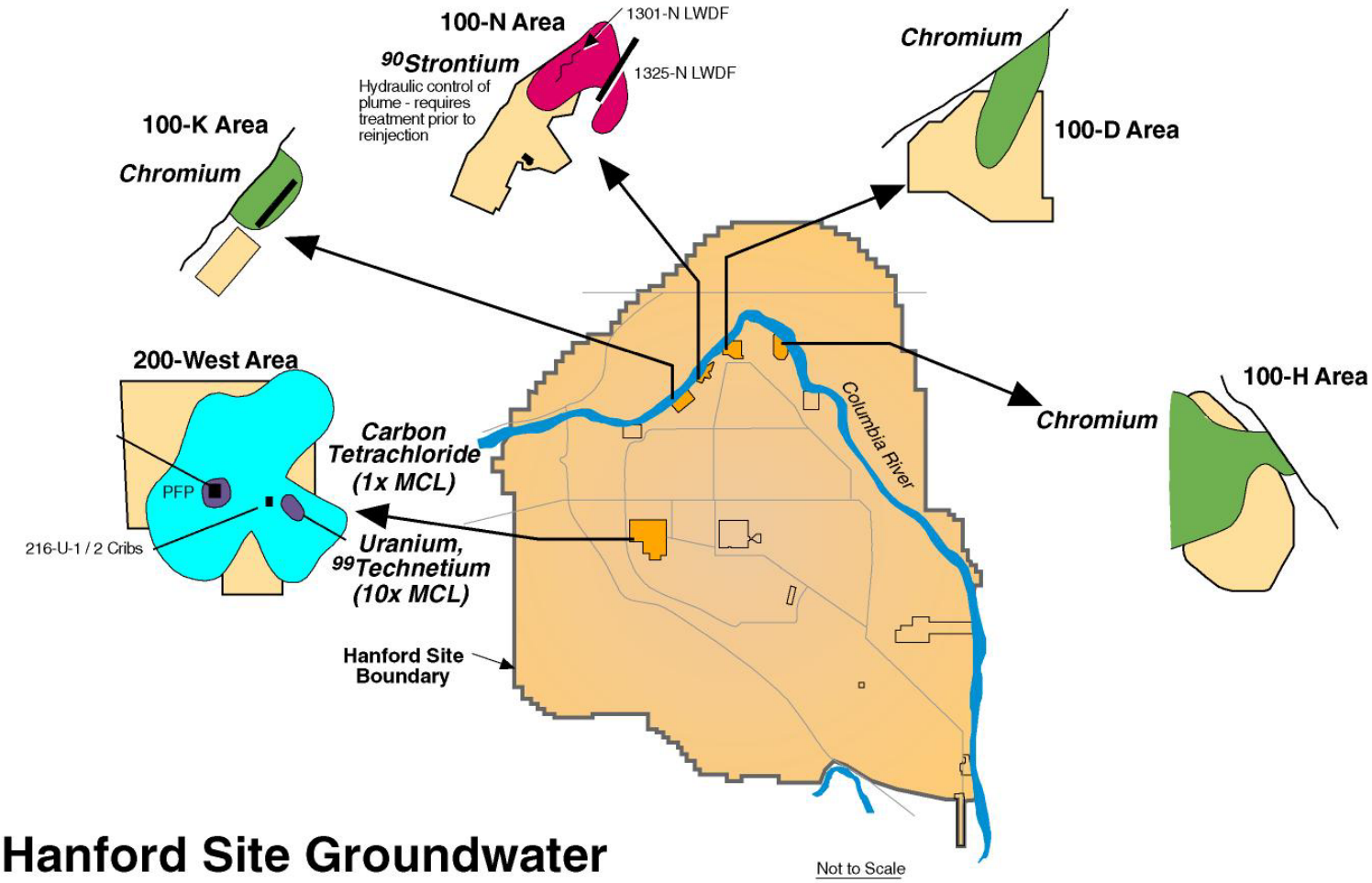
GROUNDWATER PROTECTION PROGRAM



Hanford Site Groundwater Pump & Treat Contaminant Plumes

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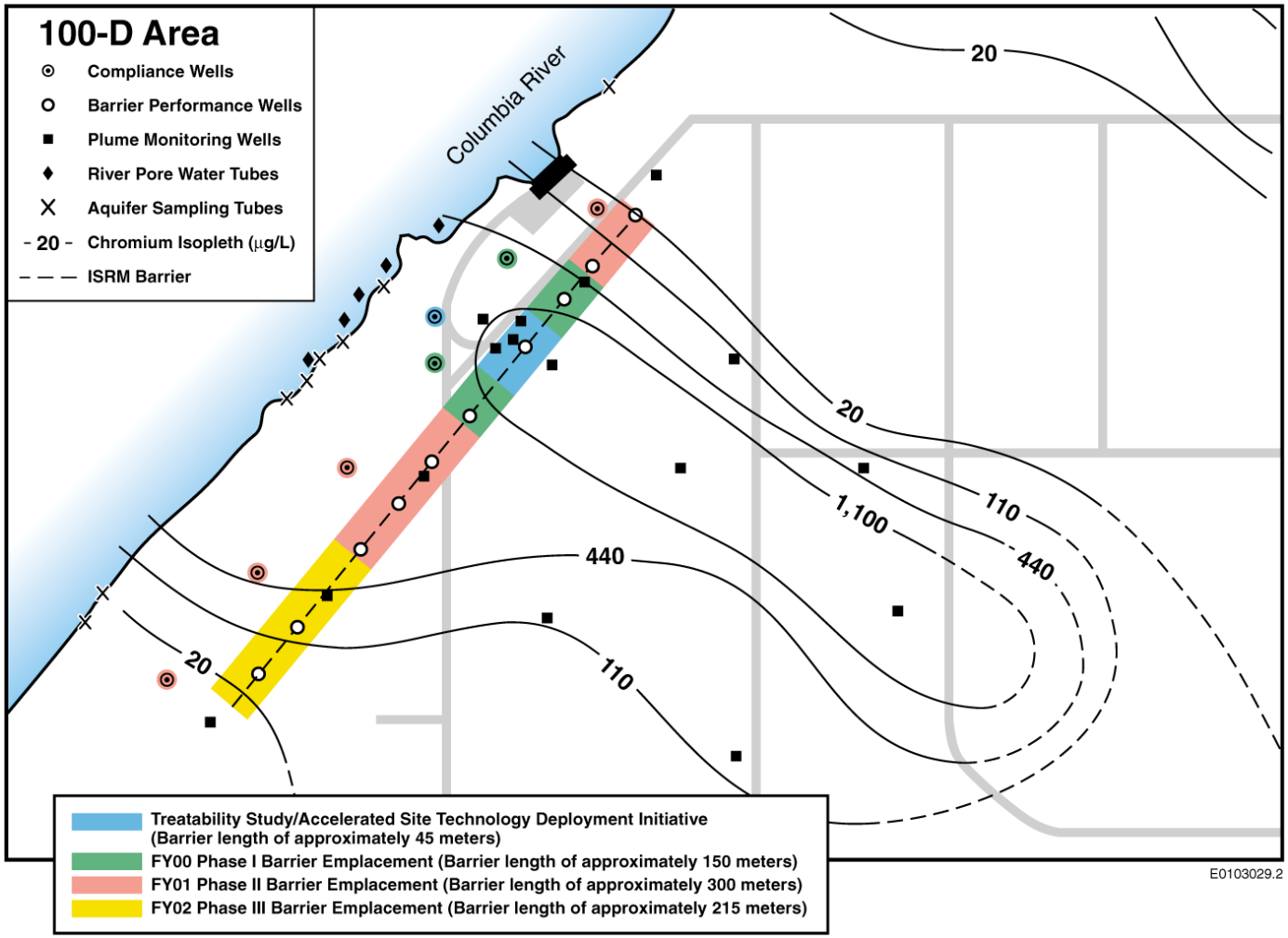
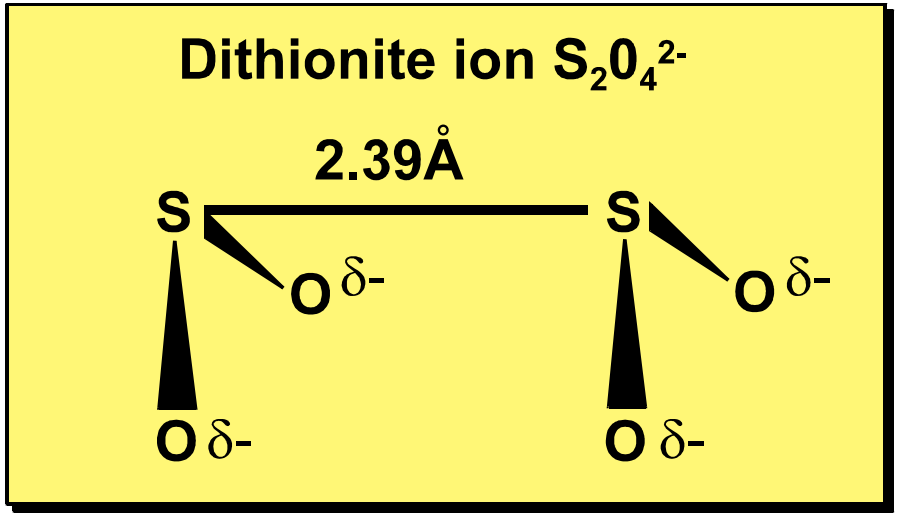
ISRM Construction Strategy



ISRM Reductant Characteristics

- Reduces Fe(III) in soil solids
- Reacts quickly
- Decomposes in absence of oxidants
- Benign reaction and decomposition products



Some Identified Science and Technology Needs Relative to Future Activities

- Characterization Issues
- Transport Issues
- Risk Issues
- Monitoring Issues
- Cost Issues
- Dissemination Issues

Characterization Issues

- Technetium – 99 – Difficult to analyze in radiation samples. Transport properties.
- Uranium – Transport properties. Chemical speciation.
- Carbon Tetrachloride – Inventory. Phase? Movement with water or without. Degradation questions. Transport properties.
- Access to locations in groundwater – limits numbers of samples and increases costs.
- Non intrusive hydro-geological characterization of larger areas.
- Scaling issues.
- Data integration, consistency, and presentation.

Transport Issues

- Uranium
- Carbon Tetrachloride
- Flow patterns of groundwater over time. Affects of pump and treat, etc.
- Recharge through barriers and how they degrade over time.
- Vadose zone fate and transport (comparison to groundwater).
- How to accurately predict concentrations for field from near field values. Particularly, technetium-99.
- Diffuse Chromium Plume. How to handle?

GROUNDWATER PROTECTION PROGRAM

Risk Issues

- What rad levels cause ecological damage to certain species.
- Understand and provide means to quantify the impact of river contaminants on receptors.
- Dilution factor for river or characterization of salmon fry uptake.
- Can a history match be done to quantify risks?

Monitoring Issues

- Optimization strategies for monitoring
- Unsaturated zone monitoring (better methodology).
  - What types of monitoring
  - Types of instrumentation, detection methods, etc.
- Monitoring in long-term stewardship mode.
- Reduce monitoring costs.

Cost Issues

- Cost risk evaluation and quantification.
- Optimization strategies for cleanup.
- Technologies to reduce cost.

Dissemination Issue

- How information gets to users.
- How results help DOE's efforts.
- Speed is of the essence.

Contact Information

Thomas W. Fogwell
509-373-3812

Thomas_Fogwell@rl.gov

http://www.hanford.gov/cp/gpp/