# FISCAL YEAR 1991 RECORD OF DECISION FORUM

## REGION VIII

APRIL 18, 1991

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF EMERGENCY AND REMEDIAL RESPONSE
OFFICE OF WASTE PROGRAMS ENFORCEMENT
401 M STREET S.W.
WASHINGTON, D.C. 20460

# FY'91 RECORD OF DECISION
# REGION VIII
# FORUM AGENDA
**April 18, 1991**

| | | |
|---|---|---|
| 1. | INTRODUCTION | 1:00 - 1:15 |
| 2. | FY'90 ROD ANALYSIS | 1:15 - 2:15 |
| 3. | SITE RISKS | 2:15 - 2:45 |
| 4. | RISK ASSESSMENT REVIEW | 2:45 - 3:00 |
| | Break | 3:00 - 3:15 |
| 5. | SPECIAL RODs | 3:15 - 4:00 |
| 6. | DEFINITIONS | 4:00 - 4:30 |

# TABLE OF CONTENTS


**FY'90 ROD ANALYSIS** Tab 1

a. Overview of FY'90 ROD Analysis Findings

1. National and Regional Findings

**SITE RISKS** Tab 2

a. Risk Assessment Briefing

**SPECIAL RODs** Tab 3

a. Development and Documentation For No Action RODs, Interim Action RODs, and Contingency RODs Briefing

**LAND DISPOSAL RESTRICTIONS** Tab 4

a. RCRA/LDR Update Briefing

**DEFINITIONS** Tab 5

a. Principal Threat and Low Level Threat Wastes Briefing
b. Innovative Treatment Technologies Briefing
c. Innovative Treatment Technologies Fact Sheet
d. Immobilization as Treatment Briefing
e. Immobilization as Treatment Fact Sheet

**EXAMPLE ROD** Tab 6

Guide to Developing Superfund No Action, Interim Action, and Contingency Remedy RODs Fact Sheet — Front Pocket
Guide to Addressing Pre-ROD and Post-ROD Changes Fact Sheet — Front Pocket

Checklists — Back Pocket
Toolbox — Back Pocket

FY '90 ROD
ANALYSIS

ROD ANALYSIS

FY'91 FORUM

# FY'90 RECORD OF DECISION ANALYSIS FINDINGS

## Region VIII

Office of Emergency and Remedial Response
Office of Waste Programs Enforcement

# CONTENTS

| | | Page No. |
|---|---|---|
| 1. | Overview of FY'90 ROD Analysis | 1 |
| 2. | National Findings | |
| | • Core/Essential ROD Content Areas | 4 |
| | - Declaration and Decision Summary documentation | 5 |
| | • Quality of ROD Documentation: Five Key Areas | 6 |
| | - Applicable or relevant and appropriate requirements (ARARs) | 7 |
| | - Principal and low-level threats | 10 |
| | - Site risks - human health | 12 |
| | - Rationale for remedy selection | 15 |
| | - Key components of the selected remedy | 18 |
| | • Consistency with Program Expectations | 21 |
| | • FY'91 Baseline Information | 25 |
| 3. | Regional Comparison: Region VIII Findings | 30 |
| 4. | Conclusions and Recommendations for FY'91 RODs | 41 |

## 1. OVERVIEW:
## ANALYSIS PURPOSE

- Provide Regions with feedback on National and Regional trends in ROD quality
  - Strengths
  - Areas in need of improvement
- Provide an assessment of the extent to which final remedial actions are consistent with the six program expectations
- Identify areas needing improved guidance or clarification
- Provide a National baseline of information against which Regions can view their own performance (i.e., this comparison was not performed by Headquarters)
- Collect data on areas of new guidance to measure improvement in FY'91 RODs

# 1. OVERVIEW: ANALYSIS APPROACH

- FY'90 RODs were categorized as follows (See Exhibit 1):

| | Number of RODs |
|---|---|
| Final Source Control | 97 |
| Interim Source Control | 15 |
| Final Ground Water | 77 |
| Interim Ground Water | 12 |
| No Action | 7 |

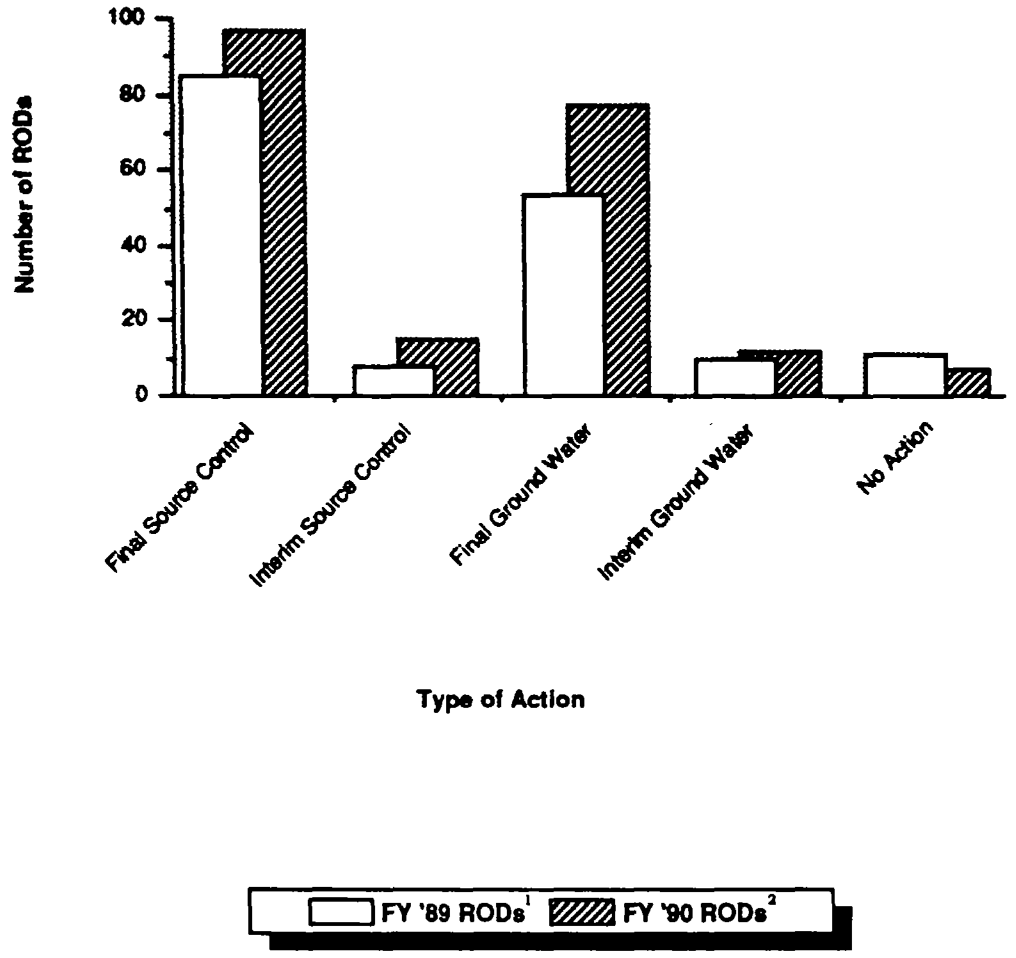
- Five evaluation forms were developed and applied to each ROD by FY'90 ROD review teams comprised of personnel from EPA Headquarters, Regions 1 through 10, and selected States

- FY'90 data were compiled and compared with FY'89 and FY'88 data (where available)

- FY'90 data were quality assured more rigorously than in previous years

- Analyses were conducted to:
  - Determine adequacy and quality of ROD documentation in: (1) Core/essential ROD content areas; and (2) Five key areas
  - Determine consistency of remedial actions with program expectations
  - Collect baseline data on areas of new guidance

**Exhibit 1**
**FY'89 AND FY'90 RECORD OF DECISION ANALYSIS UNIVERSE**




[1] FY'89 Record of Decison (ROD) Analysis evaluated 131 RODs out of 143 RODs entered into CERCLIS; an additional 4 RODs were not received by Headquarters and 8 RODs covering multiple sites were evaluated only once.

[2] FY'90 Record of Decision (ROD) Analysis evaluated 150 RODs out of 168 RODs entered into CERCLIS; an additional 2 RODs were not receieved by Headquarters, 2 RODs covering multiple sites were counted only once, and 8 federal facility RODs that followed an alternate format were not reviewed. Six ROD amendments also were excluded.

## 2. NATIONAL FINDINGS:
## CORE/ESSENTIAL CONTENT AREAS - BACKGROUND

Declaration and Decision Summary Components:

- Documentation of core site information is essential in providing an overview of site-specific factors considered to select the best remedy for or site
- Documentation of core components and model language lead to logical, consistent RODs

## 2. NATIONAL FINDINGS:
## CORE/ESSENTIAL ROD CONTENT AREAS

Declaration and Decision Summary Documentation:

- Strengths include:
  - Declaration (model language)
  - Site description
  - Site history and enforcement activities
  - Highlights of community participation
  - Scope and role
  - Summary of site characteristics
  - Summary of the comparative analysis of alternatives

- Descriptions of alternatives generally are in need of improvement, including:

Final Source Control:
- Closure
- Treatment levels and basis
- Residuals management
- Degree of hazard remaining

Final Ground Water:
- Ground water classification
- Remediation goals
- Estimated time frame for restoration

## 2. NATIONAL FINDINGS:
# QUALITY OF ROD DOCUMENTATION: FIVE KEY AREAS - BACKGROUND

- Applicable or relevant and appropriate requirements (ARARs): Targeted as needing improvement in FY'89 ROD Analysis
- Principal and low-level threats:*
  - Lack of guidance has lead to inconsistencies in interpreting NCP terms
  - Identification of types of threats at each site is essential to assess whether the remedial action is consistent with the program expectations provided in the NCP
- Site risks:* Summary of results of baseline risk assessment targeted as needing improvement in FY'89 ROD Analysis
- Rationale for remedy selection: Ensure that the rationale clearly summarizes how the selected remedy satisfies the mandates outlined in SARA and the NCP in terms of the five balancing criteria
- Key components of the selected remedy:
  - Streamline the transition between the ROD and remedial design
  - Clearly document remediation goals, risk levels corresponding to remediation goals, points of compliance, and management of residuals

* Additional guidance is being developed; these topics will be presented during the FY'91 Forum.

## 2. NATIONAL FINDINGS :
## QUALITY OF ROD DOCUMENTATION: FIVE KEY AREAS (cont'd)

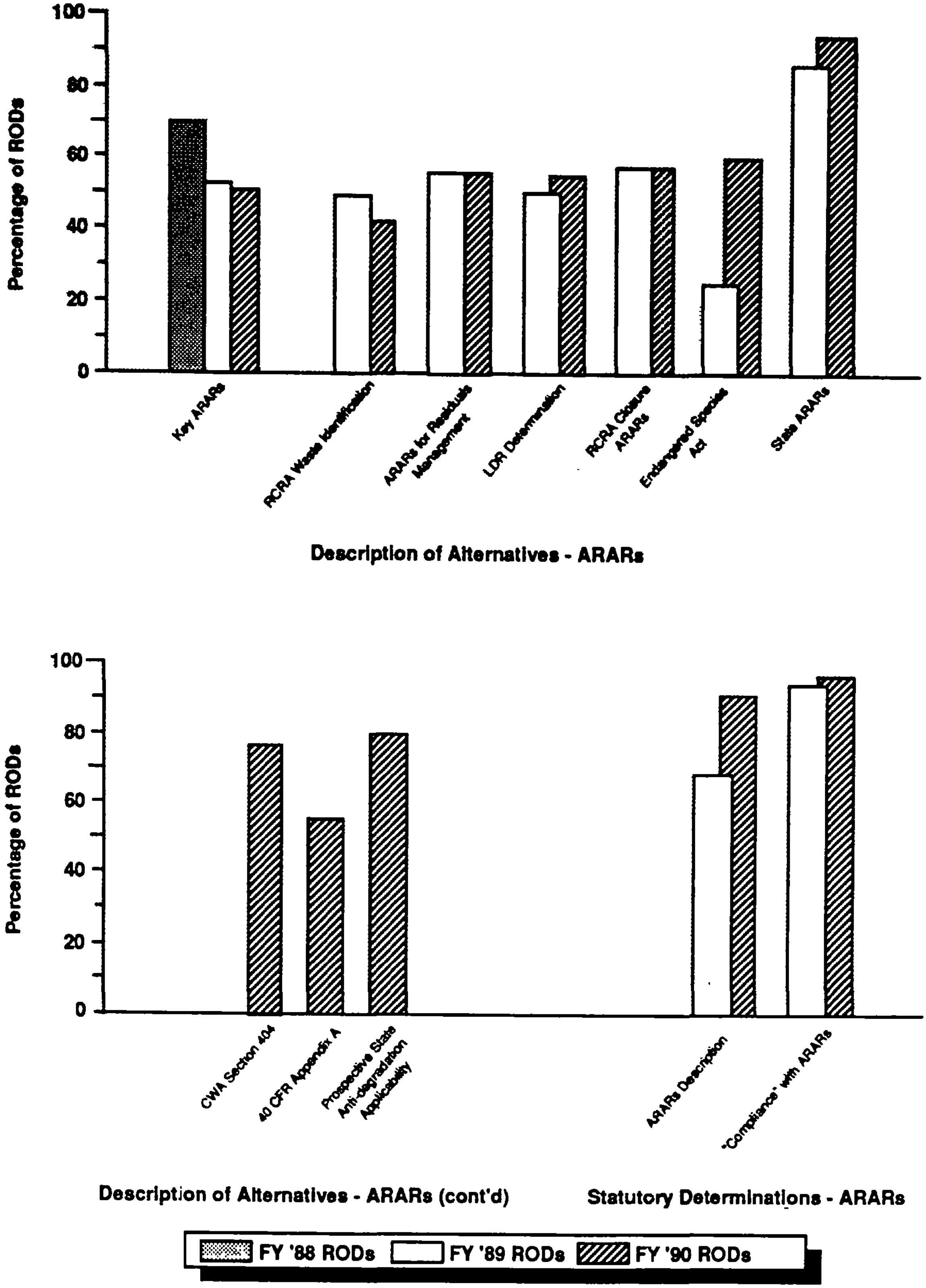
**<u>Documentation of ARARs</u>: (See Exhibit 2 and Exhibit 3)***

- Strengths/improvements over last year in:
  - Compliance with ARARs as a statutory finding
  - Describing ARARs for the selected remedy in the "Statutory Determinations" section
  - Addressing State ARARs
  - Documenting wetland ARARs and Endangered Species Act
  - Documenting MCLs and non-zero MCLGs (or waiver)

- Improvement needed in:
  - Documenting key ARARs for each alternative
  - Identifying RCRA waste
  - Identifying closure ARARs
  - Documenting ARARs for residuals
  - Making LDR determinations

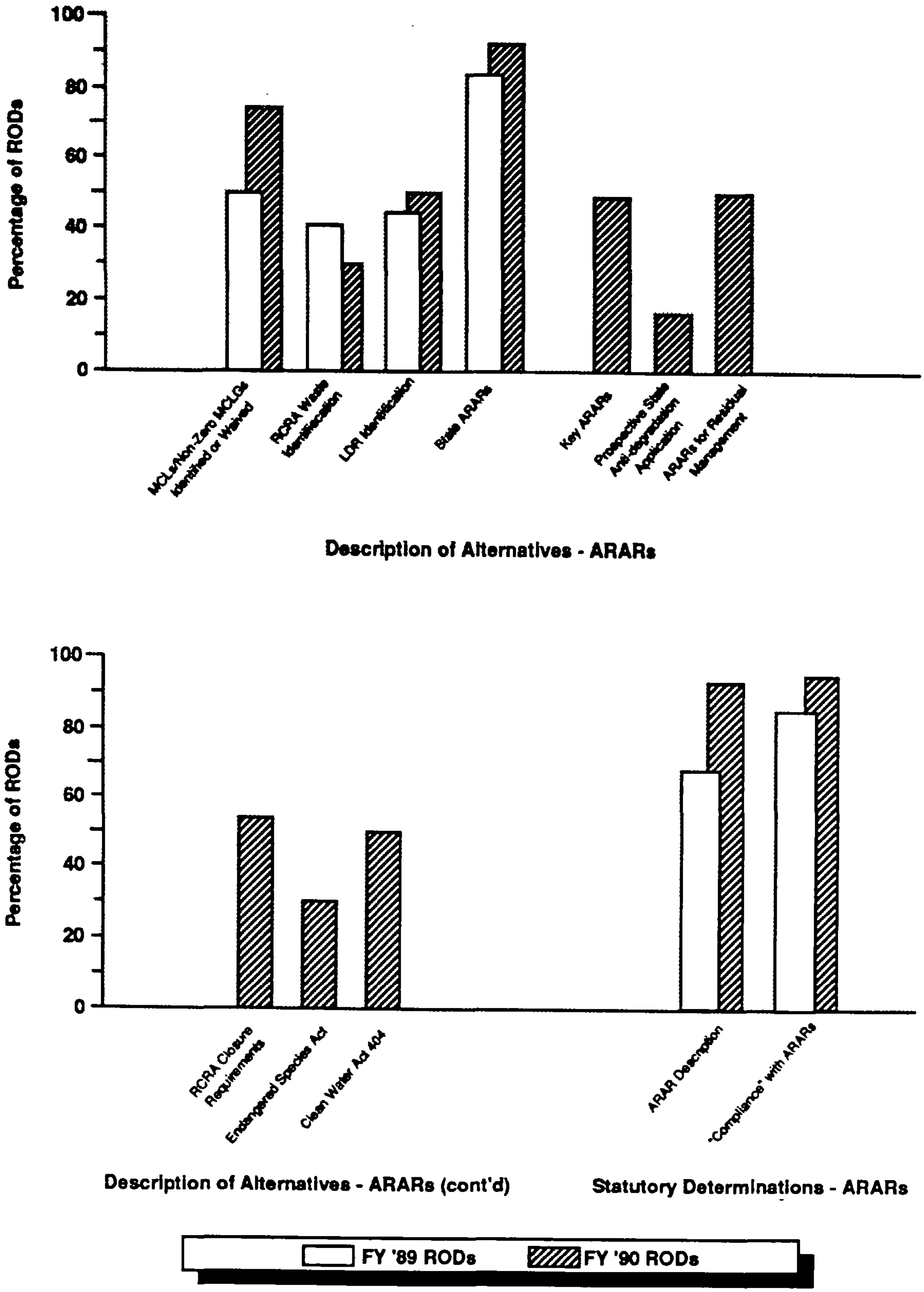
* Please note important footnote on each exhibit.

**Exhibit 2**
**FY '90 ROD ANALYSIS NATIONAL RESULTS AND COMPARISON: DOCUMENTATION OF ARARs IN FINAL SOURCE CONTROL RODs***




*The percentage of RODs presented is directly dependent upon the total number of applicable RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

**Exhibit 3**
**FY'90 ROD ANALYSIS NATIONAL RESULTS AND COMPARISONS: DOCUMENTATION OF ARARs IN GROUND WATER RODs***




*The percentage of RODs presented is directly dependent upon the total number of applicable RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

FY'91 FORUM

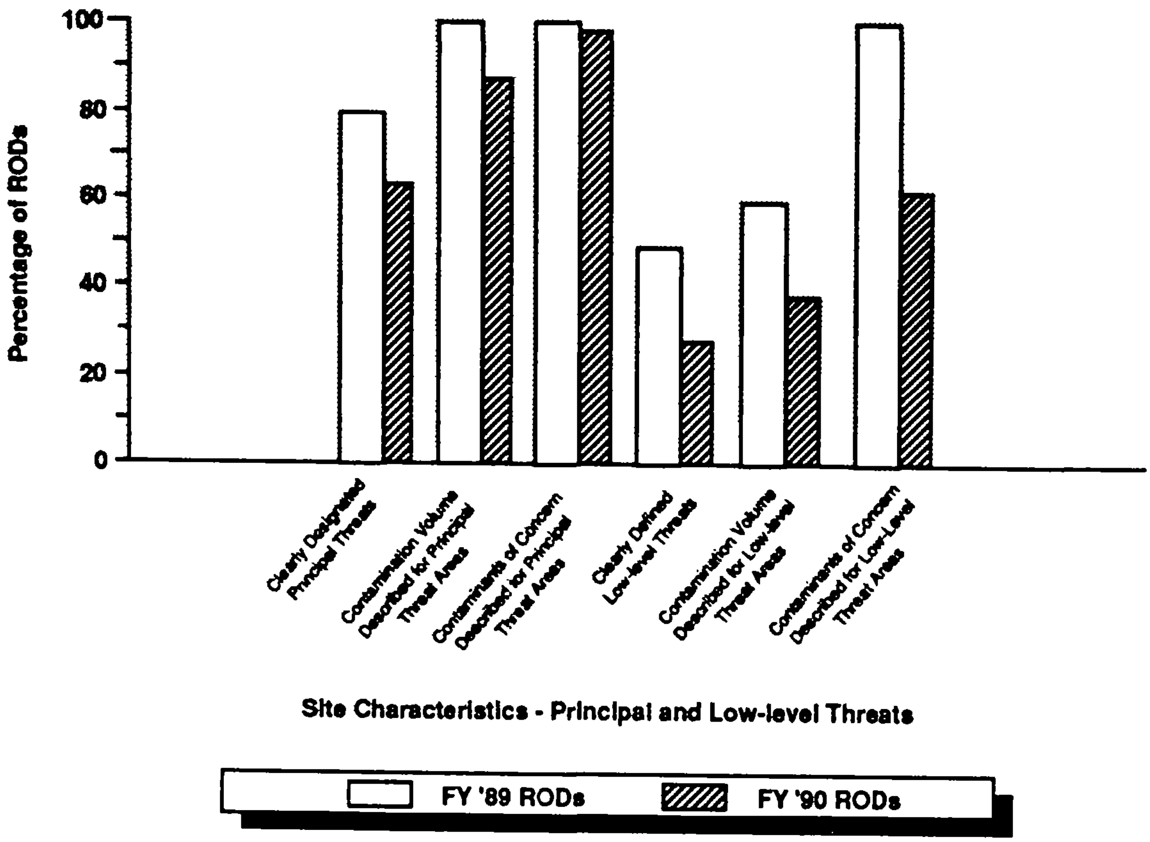
## 2. NATIONAL FINDINGS :
## QUALITY OF ROD DOCUMENTATION: FIVE KEY AREAS (cont'd)

Documentation* of Principal and Low-Level Threats: (See Exhibit 4)

- Improvement needed in designating principal and low-level threats
  - Principal threats are clearly defined in 64% of final source RODs; compared to 80% in FY'89
  - Areas and contaminants are provided in 83% and 94% of these final source RODs, respectively; compared to 100% in FY'89
  - Low-level threat material is clearly defined in 29% of final source RODs; compared to 49% in FY'89
  - Areas and contaminants are provided in 37% and 65%, of these final source RODs, respectively (compared to 49% and 60% in FY'89)
- Additional guidance is being developed.

* This analysis evaluated the description of site threats. The evaluation of how the threats were addressed is discussed on page 21 under Consistency with Program Expectations.

**Exhibit 4**
**FY'90 ROD ANALYSIS NATIONAL RESULTS AND COMPARISONS: DEFINING PRINCIPAL AND LOW-LEVEL THREATS IN FINAL SOURCE CONTROL RODs***




*The percentage of RODs presented is directly dependent upon the total number of applicable RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

## 2. NATIONAL FINDINGS :
## QUALITY OF ROD DOCUMENTATION: FIVE KEY AREAS (cont'd)

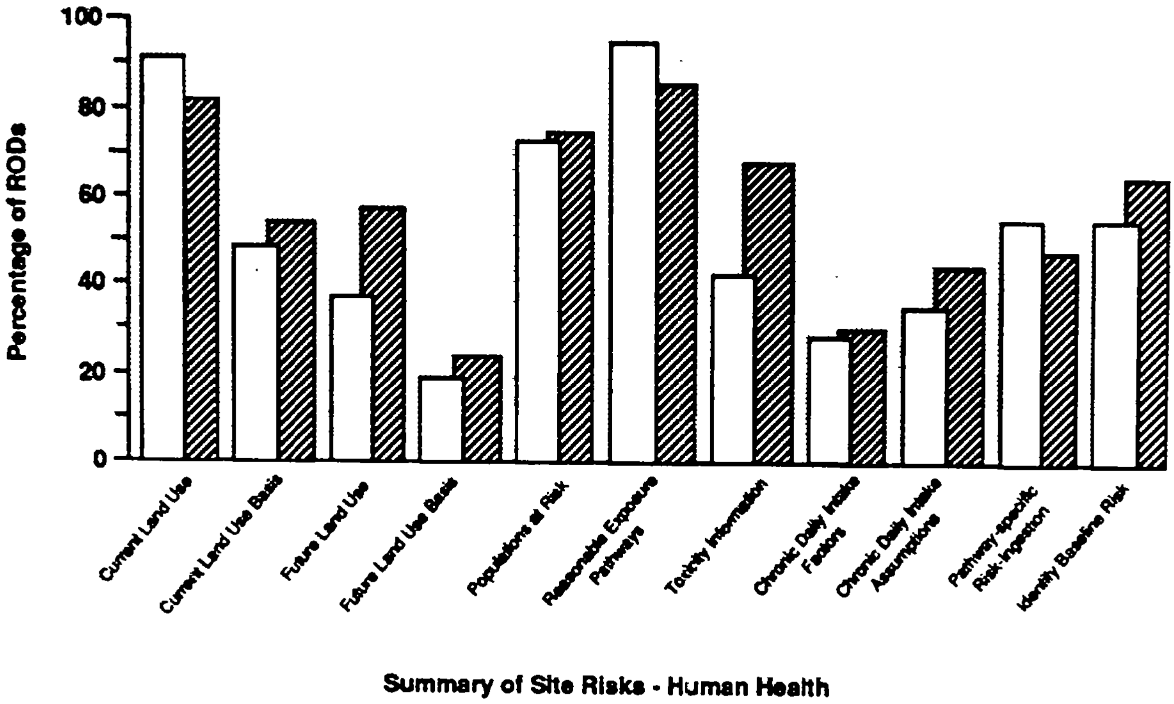
**Documentation of Site Risks - Human Health***: (See Exhibit 5 and Exhibit 6)

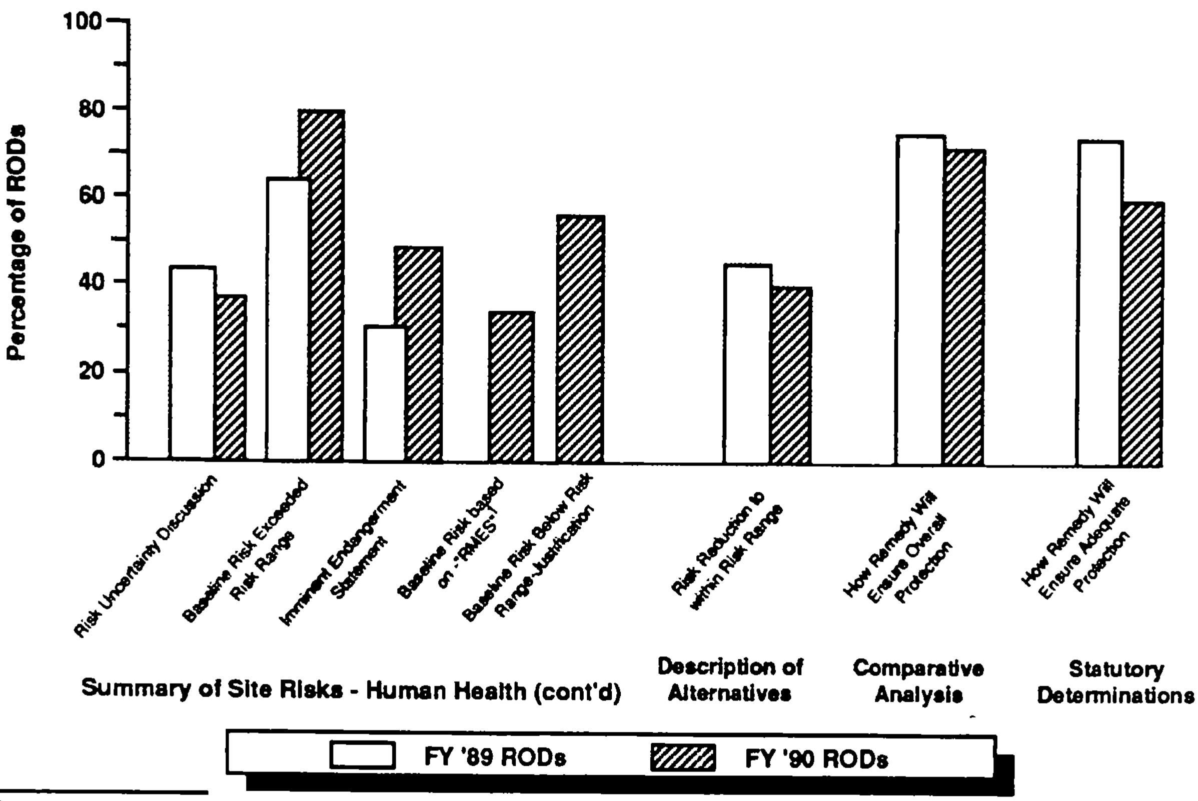
- **Remains a priority area for improvement; focus on:**
  - Current and future land use and basis
  - Potential beneficial use of ground water
  - Populations at risk
  - Chronic daily intake factors and assumptions
  - Pathway-specific risks
  - Baseline risk (basis and comparison to risk range)
- **Additional guidance is being developed.**

* Environmental risks are discussed on page 27 under Baseline Information.

**Exhibit 5**

**FY'90 ROD ANALYSIS NATIONAL RESULTS AND COMPARISONS: DOCUMENTATION OF SITE RISKS IN FINAL SOURCE CONTROL RODs***

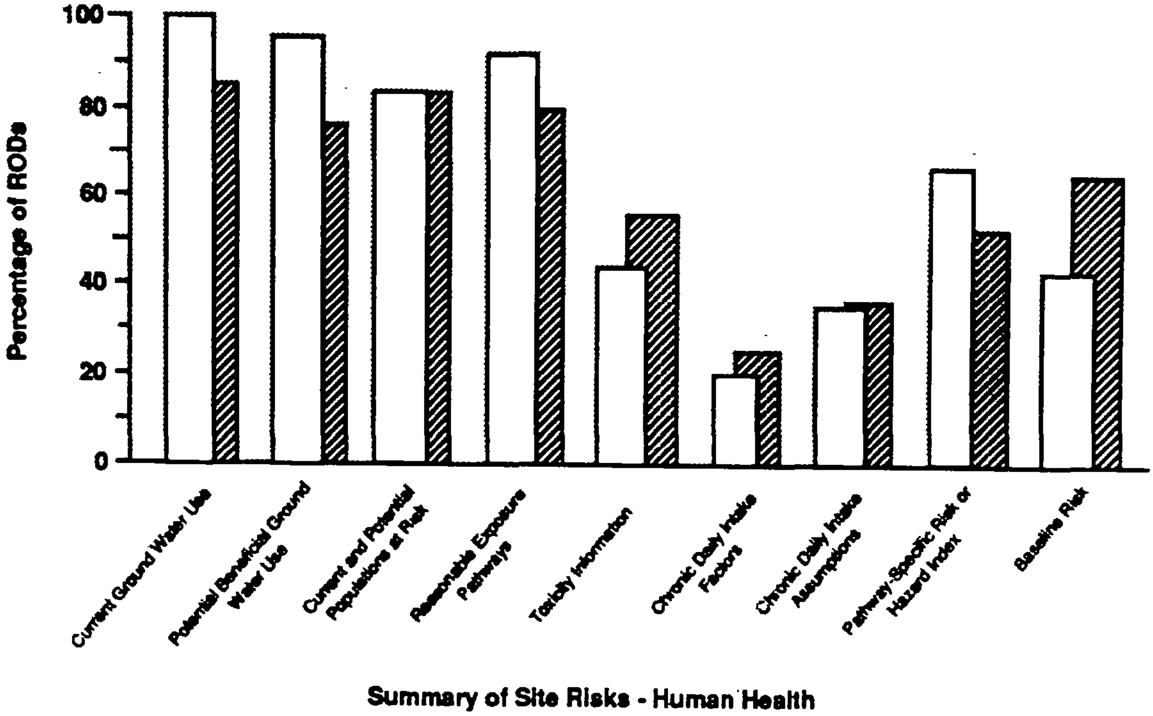


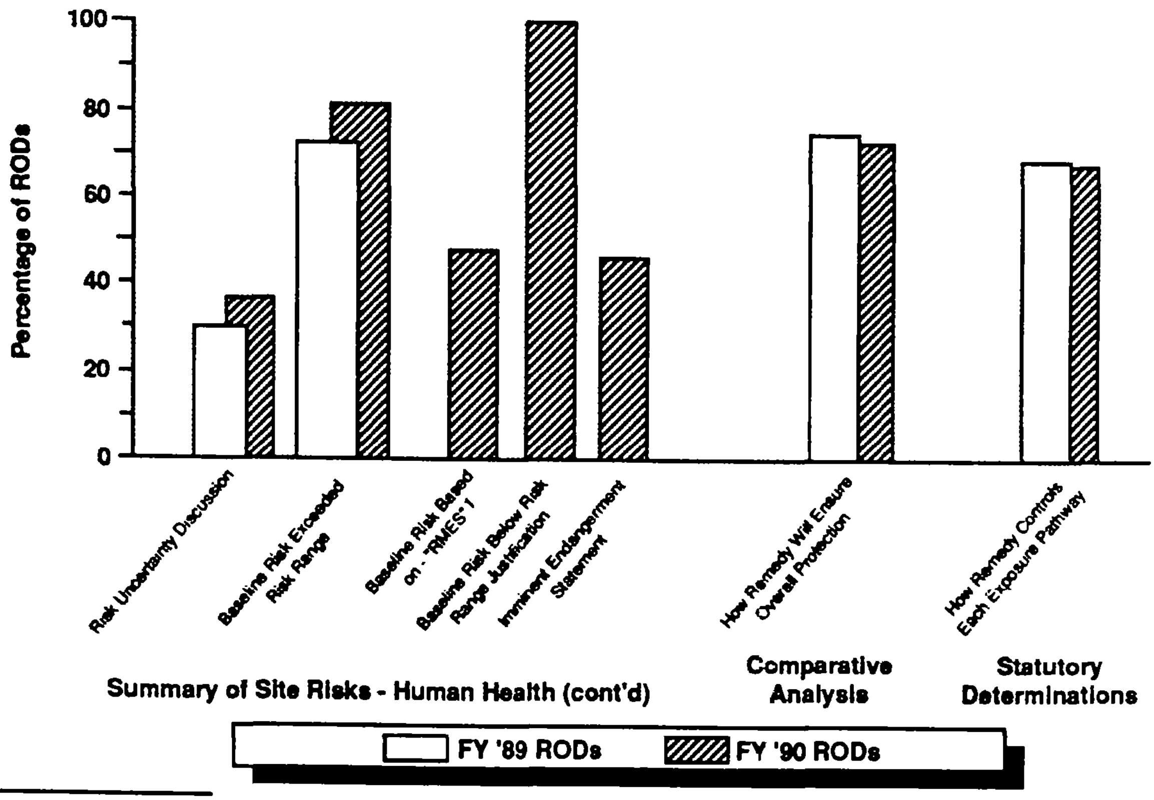




[1] RMES - Reasonable Maximum Exposure Scenario.

* The percentage of RODs presented is directly dependent upon the total number of <u>applicable</u> RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

# Exhibit 6
# FY'90 ROD ANALYSIS NATIONAL RESULTS AND COMPARISONS: DOCUMENTATION OF SITE RISKS IN FINAL GROUND WATER RODs*






---

1 "RMES" - reasonable maximum exposure scenario.

* The percentage of RODs presented is directly dependent upon the total number of <u>applicable</u> RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

2. NATIONAL FINDINGS:

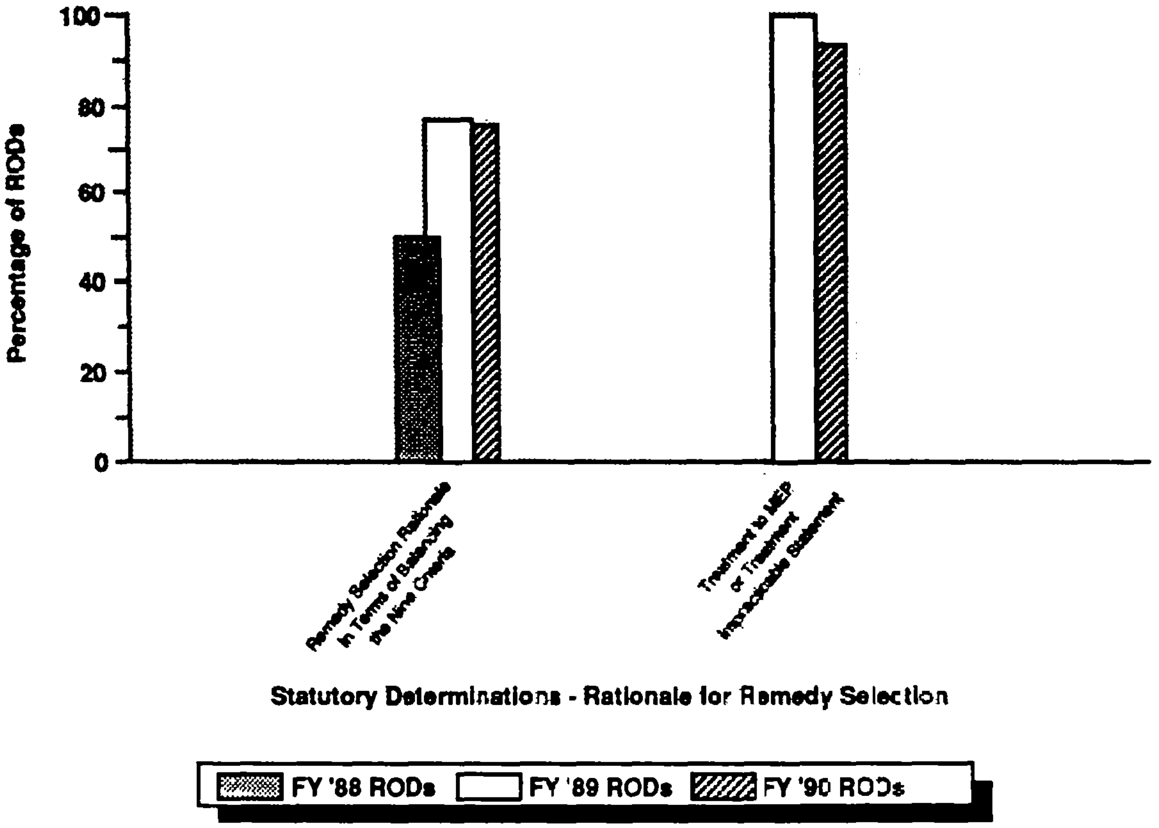
# QUALITY OF ROD DOCUMENTATION: FIVE KEY AREAS (cont'd)

Rationale for Remedy Selection: (See Exhibit 7 and Exhibit 8)

- Documentation of remedy selection rationale in terms of the five balancing criteria in final source control RODs has improved over last two years (50% in FY'88 vs. 77% in FY'89 vs. 76% in FY'90)
- Treatment to the maximum extent practicable statement was included in 93% of final source control RODs and 89% of the final ground water RODs compared to more than 95% in FY'89

**Exhibit 7**

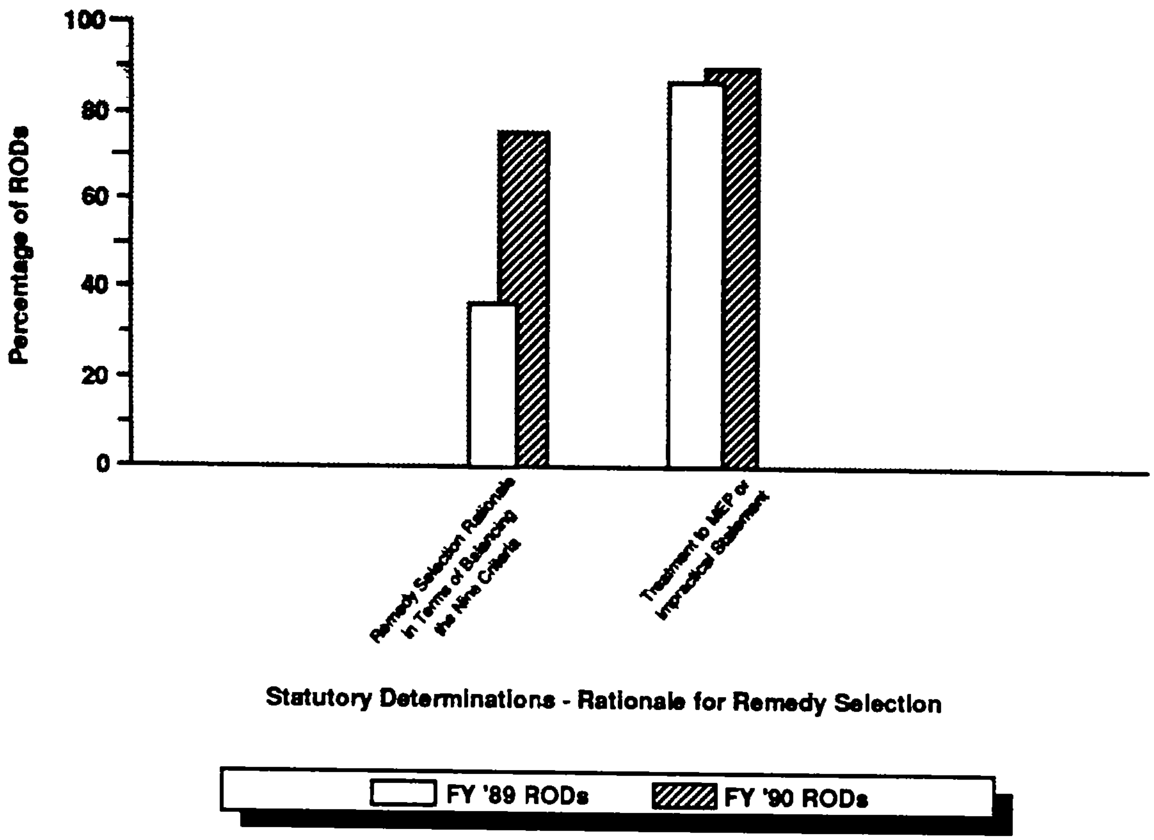
**FY'90 ROD ANALYSIS NATIONAL RESULTS AND COMPARISONS: DOCUMENTATION OF RATIONALE FOR REMEDY SELECTION IN FINAL SOURCE CONTROL RODs***




*The percentage of RODs presented is directly dependent upon the total number of applicable RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

**Exhibit 8**

**FY'90 ROD ANALYSIS NATIONAL RESULTS AND COMPARISONS: DOCUMENTATION OF RATIONALE FOR REMEDY SELECTION IN FINAL GROUND WATER RODs***




*The percentage of RODs presented is directly dependent upon the total number of applicable RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

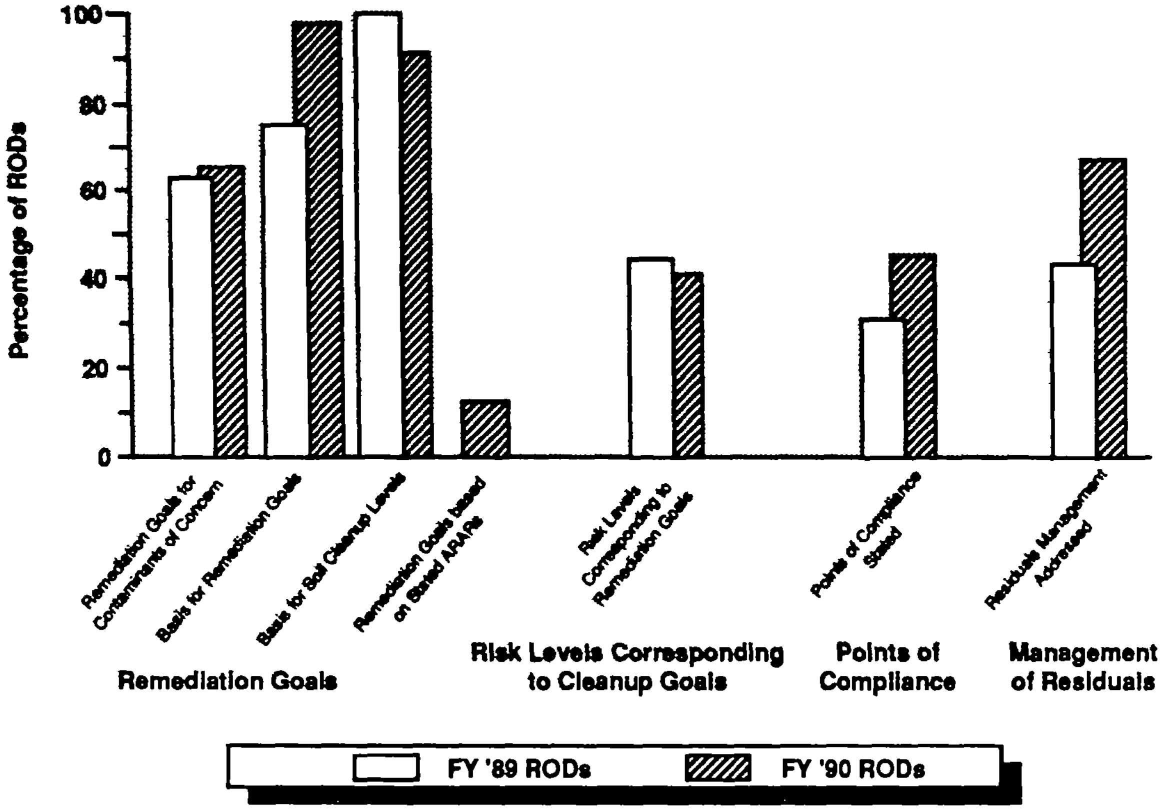
## 2. NATIONAL FINDINGS:

# QUALITY OF ROD DOCUMENTATION: FIVE KEY AREAS (cont'd)

Key Components of the Selected Remedy: (See Exhibit 9 and Exhibit 10)

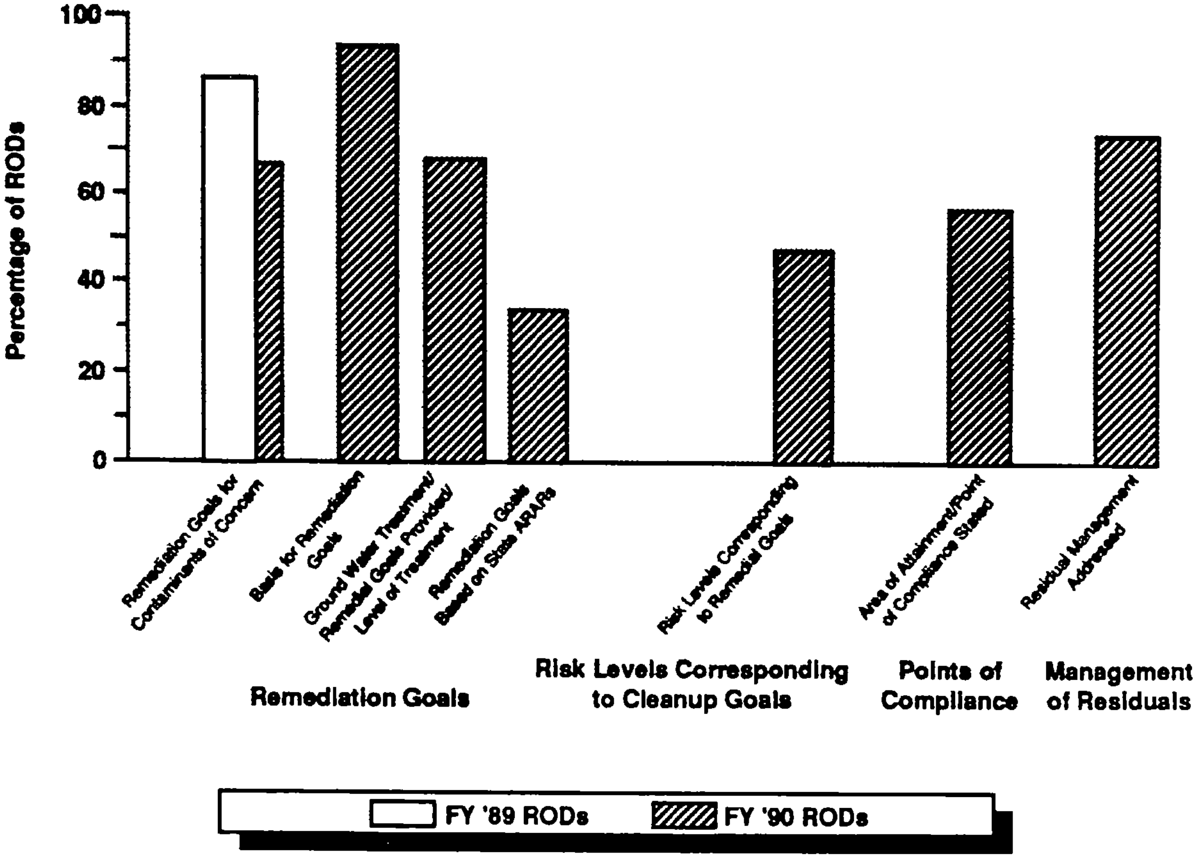
- Some improvement over last year, but needs further improvement
  - 66% of final source RODs and 68% of final ground water RODs provided remediation goals; compared to 62% and 85% in FY'89
  - Risks corresponding to remediation levels were documented in 41% of final source and 49% of final ground water actions; compared to 44% in FY'89
  - Points of compliance documentation increased from 33% in FY'89 to 49% in FY'90
  - Area of attainment was provided in 58% of final ground water actions
  - 68% of final source RODs and 73% of final ground water RODs and documented the method for managing residuals; compared to 48% in FY'89

## Exhibit 9
## FY'90 ROD ANALYSIS NATIONAL RESULTS AND COMPARISONS: DOCUMENTATION OF KEY COMPONENTS OF THE SELECTED REMEDY IN FINAL SOURCE CONTROL RODs*




*The percentage of RODs presented is directly dependent upon the total number of applicable RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

**Exhibit 10**
**FY'90 ROD ANALYSIS NATIONAL RESULTS AND COMPARISONS: DOCUMENTATION OF THE KEY COMPONENTS OF THE SELECTED REMEDY IN FINAL GROUND WATER RODs***




*The percentage of RODs presented is directly dependent upon the total number of applicable RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

## 2. NATIONAL FINDINGS: CONSISTENCY WITH PROGRAM GOAL AND EXPECTATIONS - BACKGROUND

Program Goal: Select remedies that are protective of human health and the environment that maintain protection over time, and that minimize untreated waste

Summary of Program Expectations:

- Perform treatment of principal threat materials (i.e., liquids, high concentrations of toxic compounds that are several orders of magnitude above health-based levels, highly mobile materials)
- Implement engineering controls for materials that pose a low-level threat (i.e., materials that exhibit low mobility, materials above health-based levels) or where treatment is impracticable
- Include institutional controls for mitigation of short-term impacts and/or as a supplement to engineering controls
- Combine treatment and containment as appropriate
- Employ innovative technologies where there is a reasonable belief that they may perform as well as or better than conventional technologies
- Return ground water to its beneficial uses within a reasonable time frame

FY'91 FORUM

## 2. NATIONAL FINDINGS:
# CONSISTENCY WITH PROGRAM EXPECTATIONS

| PROGRAM EXPECTATIONS | TOTAL NUMBER OF OCCURRENCES | | NCP EXPECTATIONS ADDRESSED | |
|---|---|---|---|---|
| | Source Control | Ground Water | Source Control | Ground Water |
| • Principal Threats - Total | 72 | - | 100% | - |
| - Treatment | 60 | - | 83% | - |
| - Containment (treatment is impracticable) | 12 | - | 17% | - |
| • Low-Level Threats - Total | 68 | - | 100% | - |
| - Containment | 52 | - | 76% | - |
| - Treatment (in conjunction with principal threat waste or to control migration) | 16 | - | 24% | - |
| • Waste On-site Above Health-Based Levels - Total | 70 | 67 | - | - |
| - Institutional Controls (for short-term impacts or engineering control supplement) | 56 | 40 | 80% | 60% |
| - Institutional Controls (as the primary remedy) | 0 | 0 | 0% | 0% |
| • Treatment Selected - Total | 64 | 77 | - | - |
| - Innovative Treatment Technologies Selected | 39 | 7 | 61% | 9% |
| • Ground Water Actions - Total | - | 77 | - | - |
| - Ground Water Restoration | - | 76 | - | 99% |
| TOTAL FY'90 FINAL ACTION RODs REVIEWED | 97 | 77 | | |

## 2. NATIONAL FINDINGS:
## CONSISTENCY WITH PROGRAM EXPECTATIONS (cont'd)

- Principal threats were addressed consistently with program expectations
  - Treatment of principal threats 83% (100% in FY'89)
  - Containment of principal threats 17% where it is impracticable to treat the wastes

- Low-level threats were addressed consistently with expectations
  - Containment of low-level threats 76% (67% in FY'89)
  - Treatment of low-level threats 24%; these RODs also are treating principal threats, or are treating the low-level threat to prevent migration to ground water

- Institutional controls will supplement engineering controls
  - Source control actions 80% (58% in FY'89)
  - Ground water actions 60% (72% in FY'89)
  - No final actions exclusively employed institutional controls

- Combinations of treatment of principal threats with engineering and institutional controls for treatment residuals and low-concentrated waste
  - Twofold increase since FY'89 (80% in FY'90; 41% in FY'89)

## 2. NATIONAL FINDINGS:
## CONSISTENCY WITH PROGRAM EXPECTATIONS (cont'd)

- Ground water remedies intend to <u>restore ground water to its beneficial use</u> within a reasonable time frame
  - Restoration in 99% of the RODs (97% in FY'89)
- <u>Innovative technologies</u> are being used for sites employing treatment
  - 61% (39/64) of final source control RODs (51% in FY'89; 40% in FY'88; 26% in FY'87)
  - 9% (7/77) of final ground water RODs (8% in FY'89)

## 2. NATIONAL FINDINGS:
# FY'91 BASELINE INFORMATION - PURPOSE

- **Provide a baseline for measuring the effectiveness of new policy/guidance in future RODs**
- **Increase awareness of program changes**
- **Improve implementation efficiency**

## 2. NATIONAL FINDINGS:
## FY'91 BASELINE INFORMATION (cont'd)

**Principal and Low-Level Threats:**

- Status:
  - Clarification and standardization of NCP terms
  - Expected to be issued in summer 1991
  - Should see improvement in FY'92 RODs

- Findings:
  - Provide a clearer rationale for waste management strategies based on toxicity, mobility, or volume of contaminants
  - Ground water should not be described as a principal or low-level threat

**Consistency with PCB Guidance:**

- Status:
  - "Guidance on Remedial Actions for Sites Contaminated with PCBs" (OSWER Directive #9355.4-01) and a short sheet was issued August 1990
  - Not a "strict recipe" but should be used as a guide

- Findings:
  - Guidance generally followed
  - Provide additional site-specific justification for use of other standards

## 2. NATIONAL FINDINGS:
## FY'91 BASELINE INFORMATION (cont'd)

Application of Standard Default Exposure Factors:

- Status:
  - Some factors included in "Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual" (EPA/540/1-89/002), December 1989
  - Additional factors being issued currently
- Findings:
  - Default exposure assumptions currently are being used in many cases
  - Clearly document alternate values

Documenting Environmental Risks:

- Status:
  - "Risk Assessment Guidance for Superfund: Volume II - Environmental Evaluation Manual" (EPA/540/1-89/001), March 1989
  - Describes framework for considering environmental effects
  - Guidance on documenting results of ecological assessments in the ROD has not been issued
- Findings:
  - Guidance needed on documenting environmental risks
  - Improvement needed in comparing surface water samples to WQC or WQS
  - Provide documentation of terrestrial surveys, aquatic toxicity tests, bioassays, or benthic surveys for species diversity, as appropriate

## 2. NATIONAL FINDINGS:
## FY'91 BASELINE INFORMATION (cont'd)

**Application of Ground Water Uncertainty Language:**

- **Status:**
  - "Suggested ROD Language for various Ground Water Remediation Options" (OSWER Directive #9283.1-03) was issued October 1990
  - Suggests ROD "uncertainty language"
  - Recommends approaches to planning and implementing ground water remediation

- **Findings:**
  - Increased usage expected
  - Provide basis for uncertainty, provisions for modifying the action, and alternative actions
  - Contingencies should include provisions for ARAR waivers, institutional and engineering controls if needed, and evaluations of innovative technologies
  - Interim RODs should provide basis and time frame

## 2. NATIONAL FINDINGS:
## FY'91 BASELINE INFORMATION (cont'd)

Use of Treatability Studies:

- Status:
  - "Guide for Conducting Treatability Studies Under CERCLA" (EPA/540/2-89/058) and a short sheet was issued December 1989
  - Provides information to facilitate planning and execution of treatability studies
  - Describes approach and protocol
- Findings:
  - Treatability studies often are planned for during the RD rather than the RI; this leads to elimination of many innovative technologies

## 3. REGIONAL COMPARISON:
## REGION VIII FINDINGS

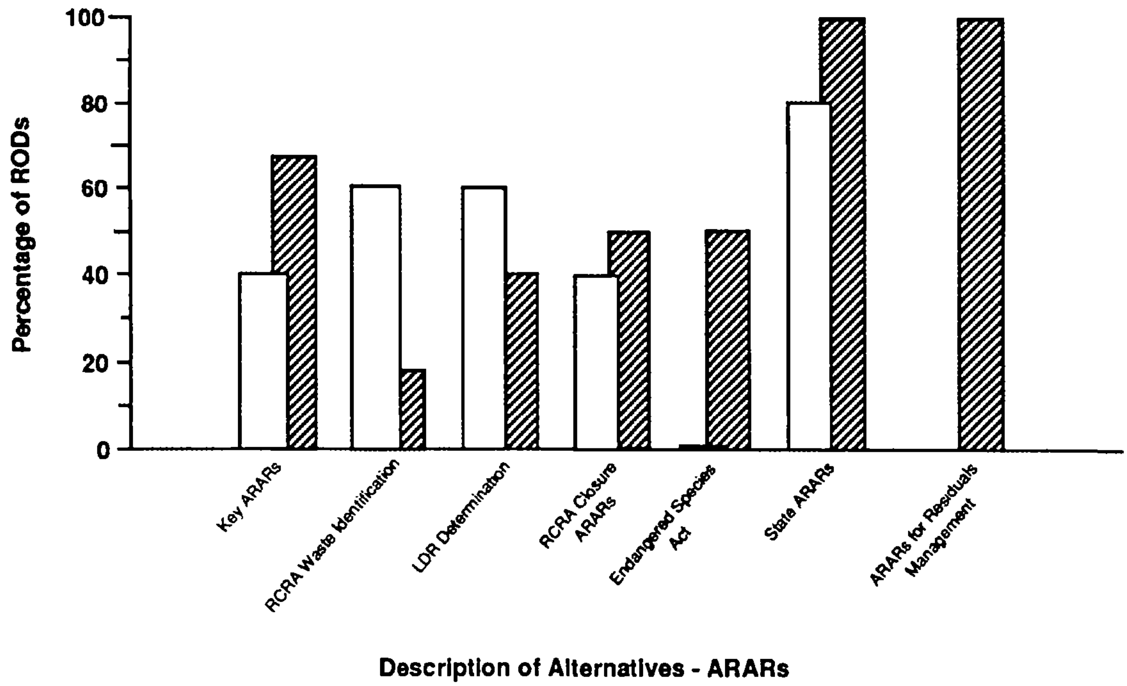
- 9 RODs were reviewed (5 in FY'89) and divided into 5 categories, including:

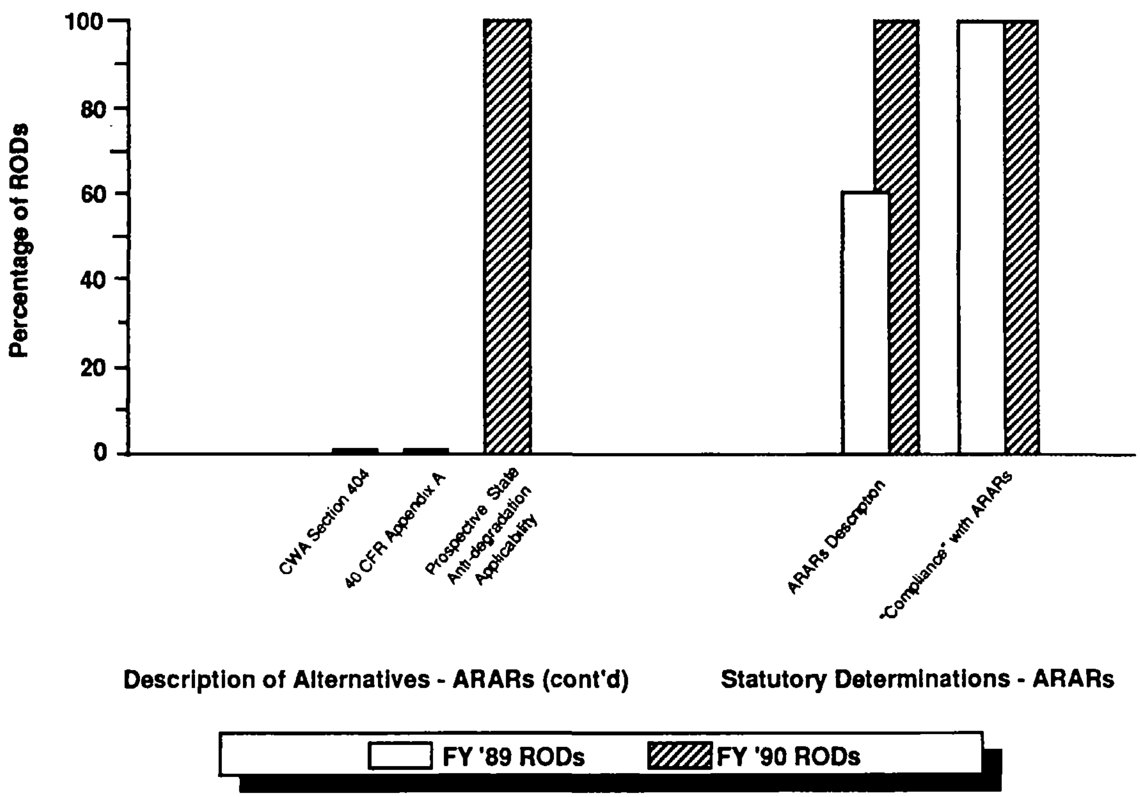
| | 1990 | 1989 |
|---|---|---|
| - Final Source Control | 6 | 4 |
| - Interim Source Control | 2 | 1 |
| - Final Ground Water | 3 | 2 |
| - Interim Ground Water | 1 | 0 |
| - No Action | 0 | 0 |

- Graphics that follow show trends in ROD documentation for Region VIII from FY'89 and FY'90 in:
  - Five key areas
  - Consistency with expectations

- Core documentation will be presented qualitatively

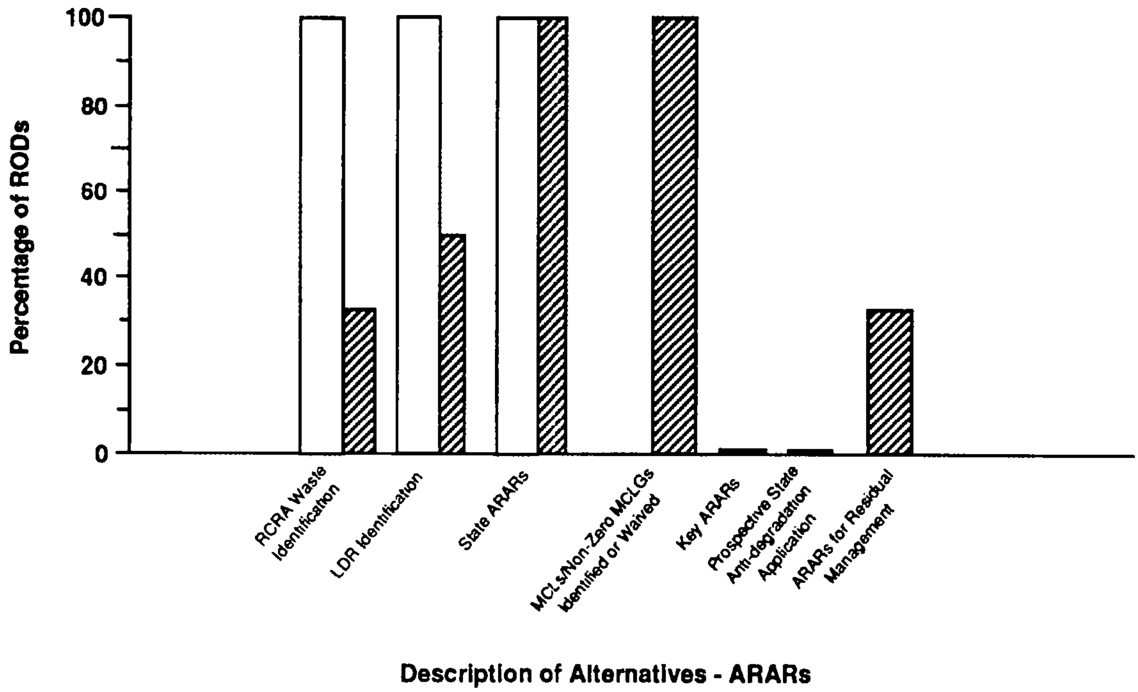
**Exhibit 11**
**FY '90 ROD ANALYSIS REGION VIII RESULTS AND COMPARISON: DOCUMENTATION OF ARARs IN FINAL SOURCE CONTROL RODs***

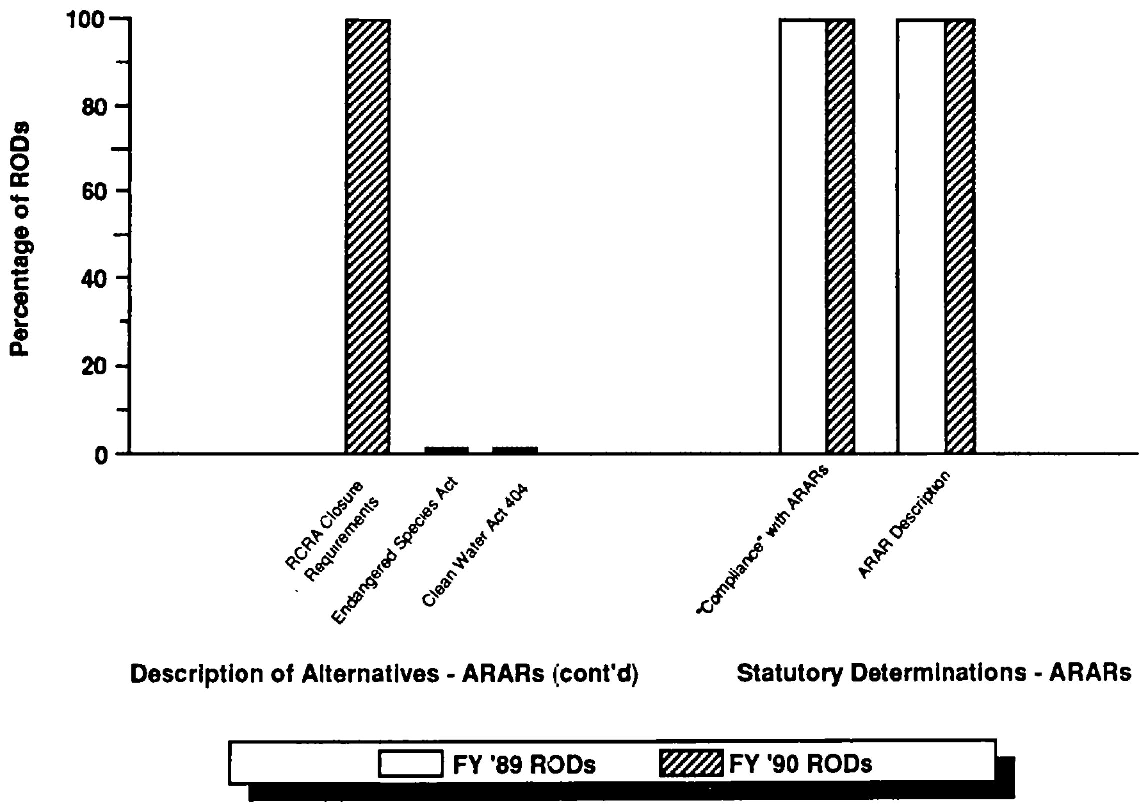



*The percentage of RODs presented is directly dependent upon the total number of applicable RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

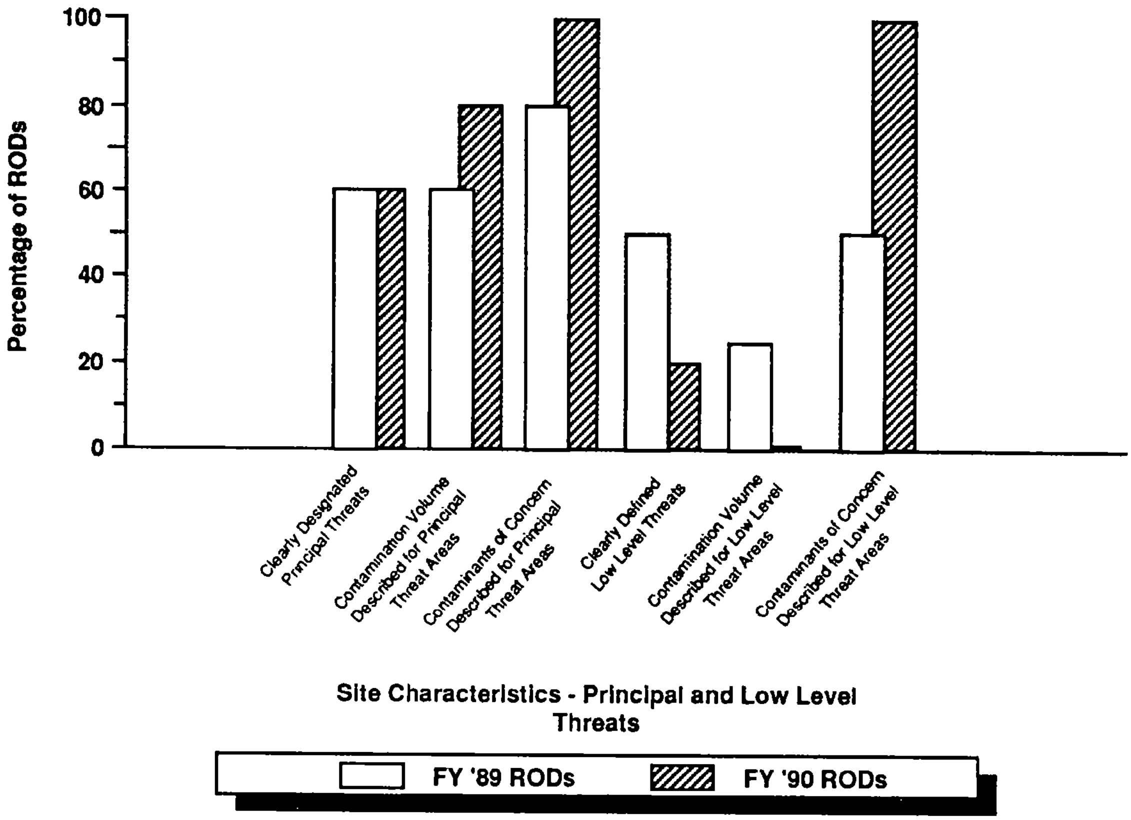
## Exhibit 12
## FY'90 ROD ANALYSIS REGION VIII RESULTS AND COMPARISONS: DOCUMENTATION OF ARARs IN GROUND WATER RODs*



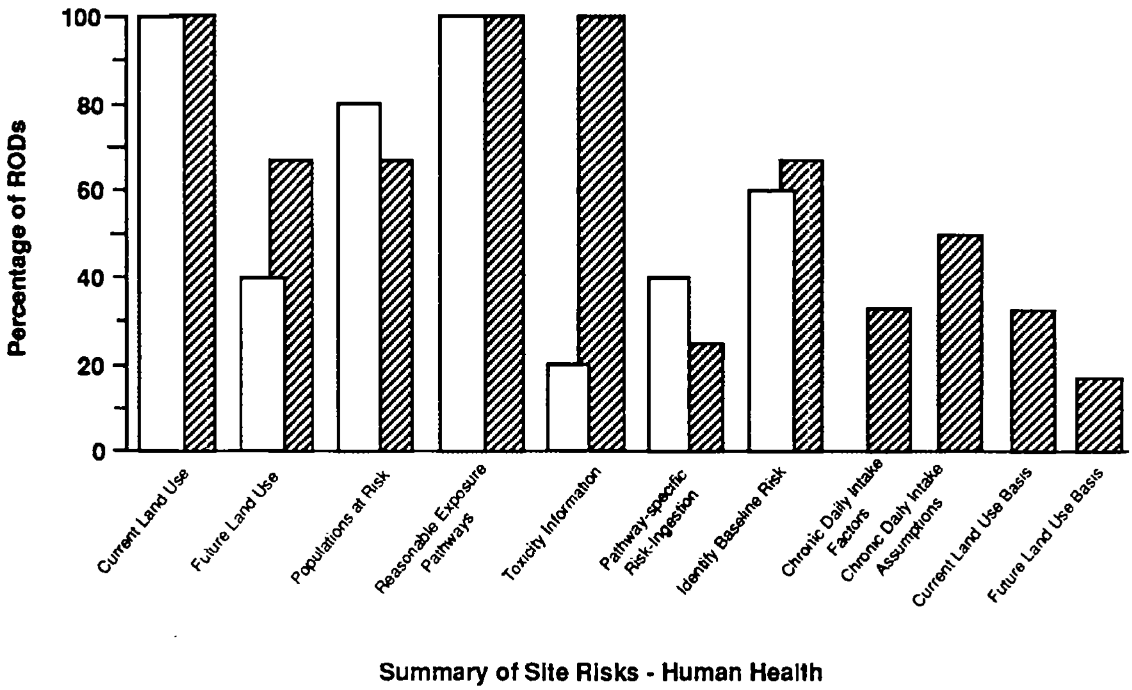

*The percentage of RODs presented is directly dependent upon the total number of applicable RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

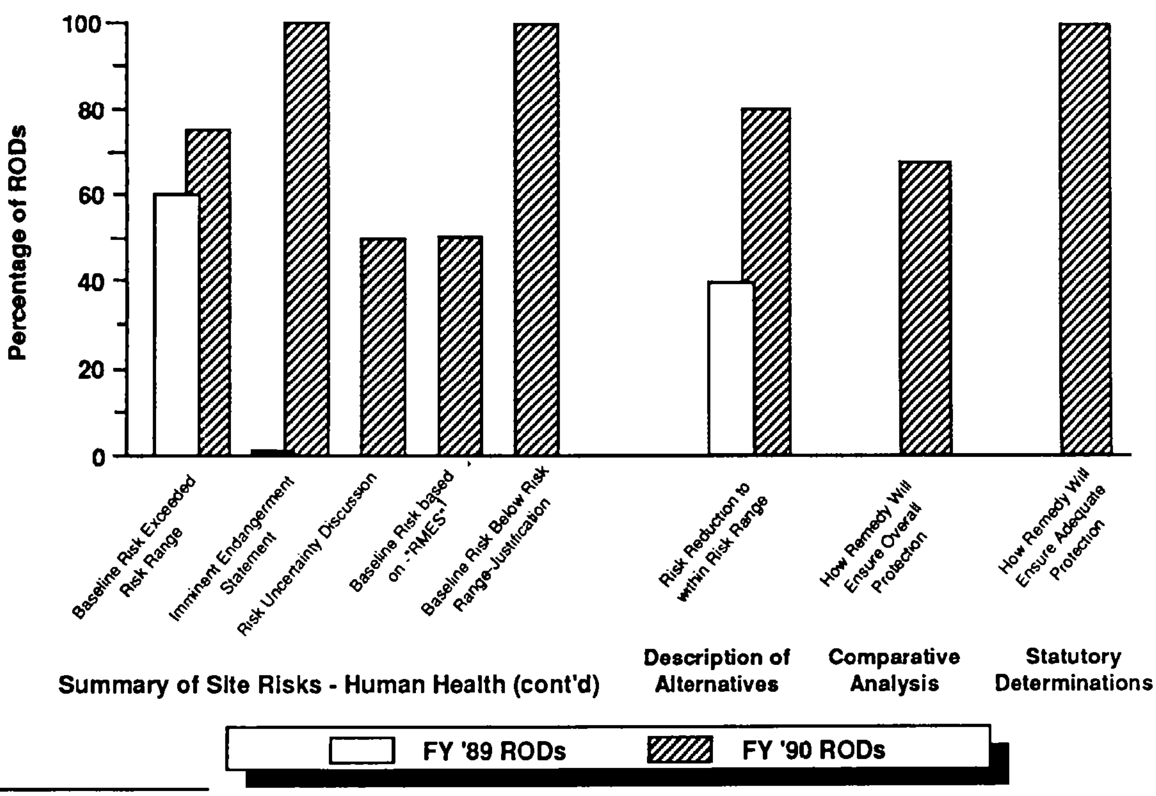
**Exhibit 13**
**FY'90 ROD ANALYSIS REGION VIII RESULTS AND COMPARISONS: DEFINING PRINCIPAL AND LOW LEVEL THREATS IN FINAL SOURCE CONTROL RODs***




*The percentage of RODs presented is directly dependent upon the total number of applicable RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

## Exhibit 14
## FY'90 ROD ANALYSIS REGION VIII RESULTS AND COMPARISONS: DOCUMENTATION OF SITE RISKS IN FINAL SOURCE CONTROL RODs*

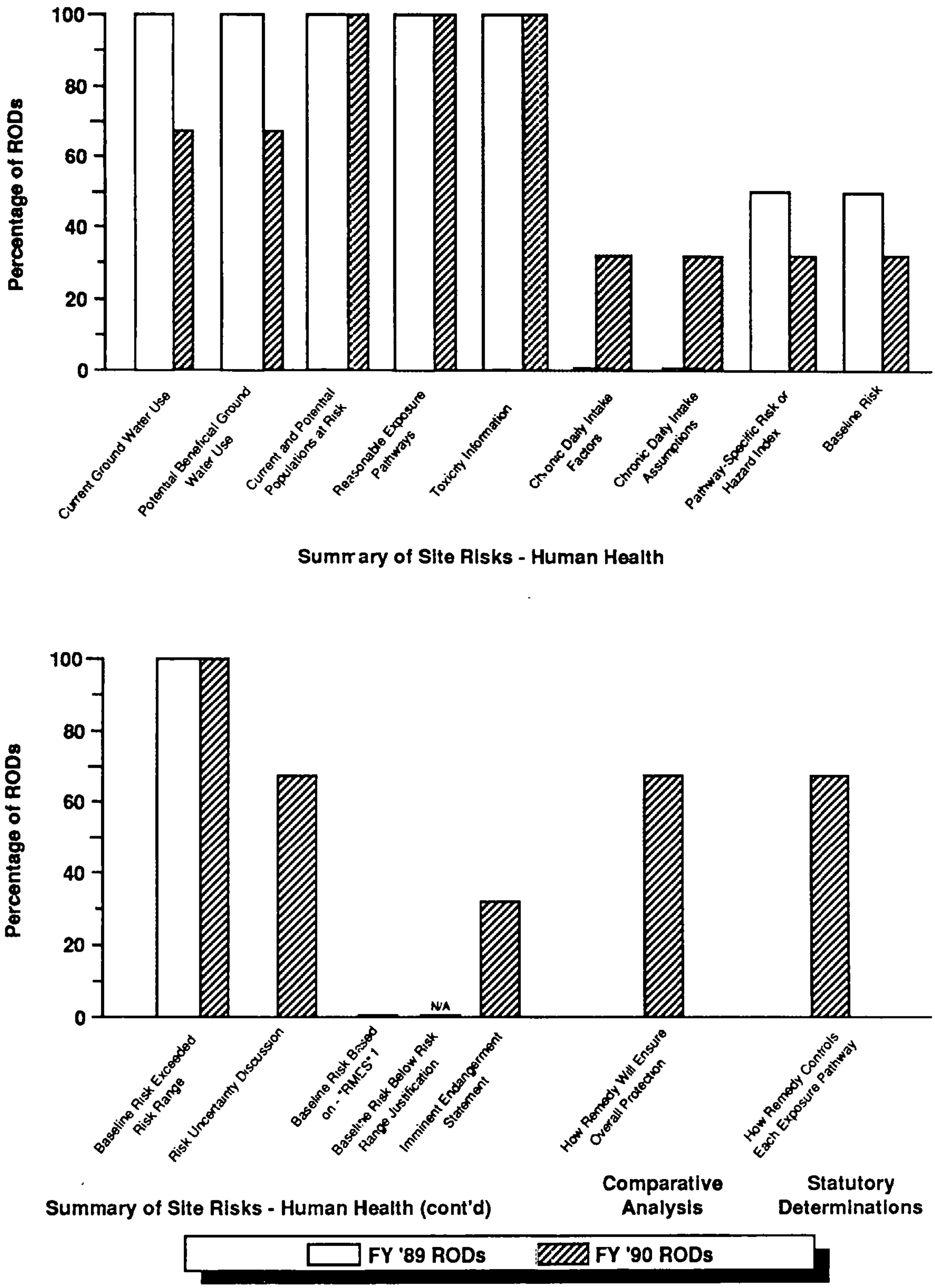



[1] RMES - Reasonable Maximum Exposure Scenario.

* The percentage of RODs presented is directly dependent upon the total number of applicable RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

**Exhibit 15**
**FY'90 ROD ANALYSIS REGION VIII RESULTS AND COMPARISONS: DOCUMENTATION OF SITE RISKS IN FINAL GROUND WATER RODs***

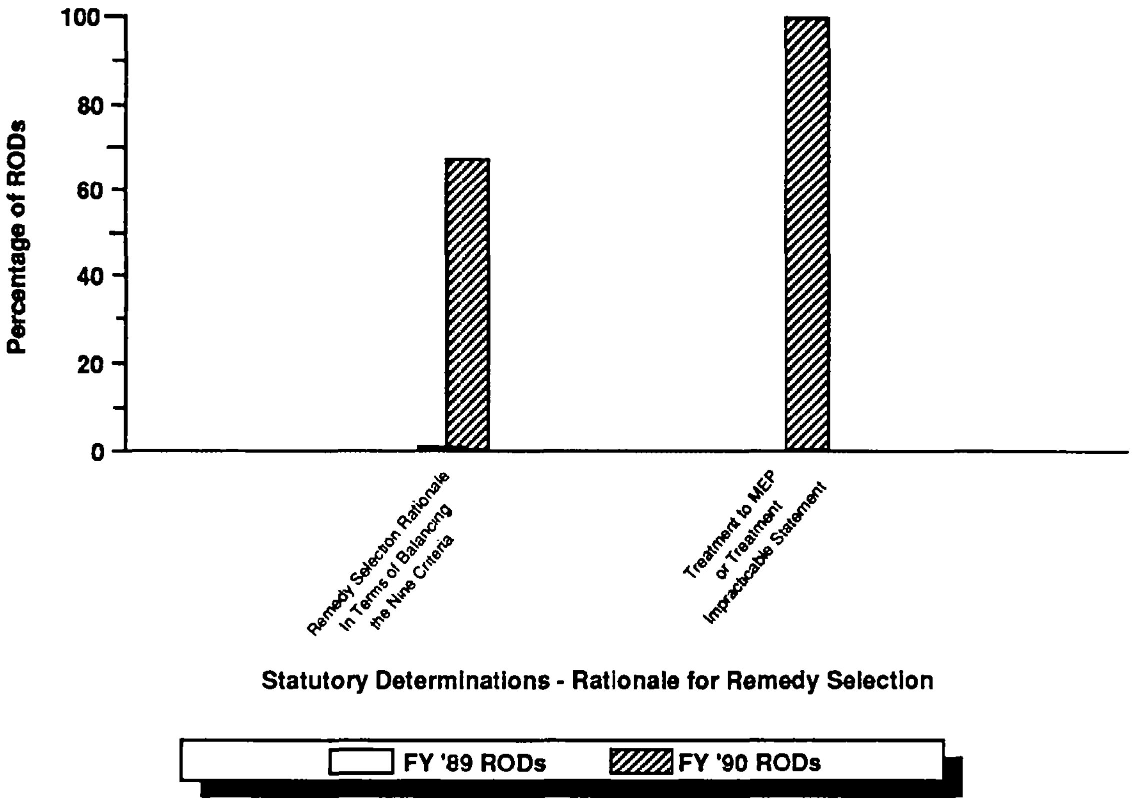





1 "RMES" - reasonable maximum exposure scenario.

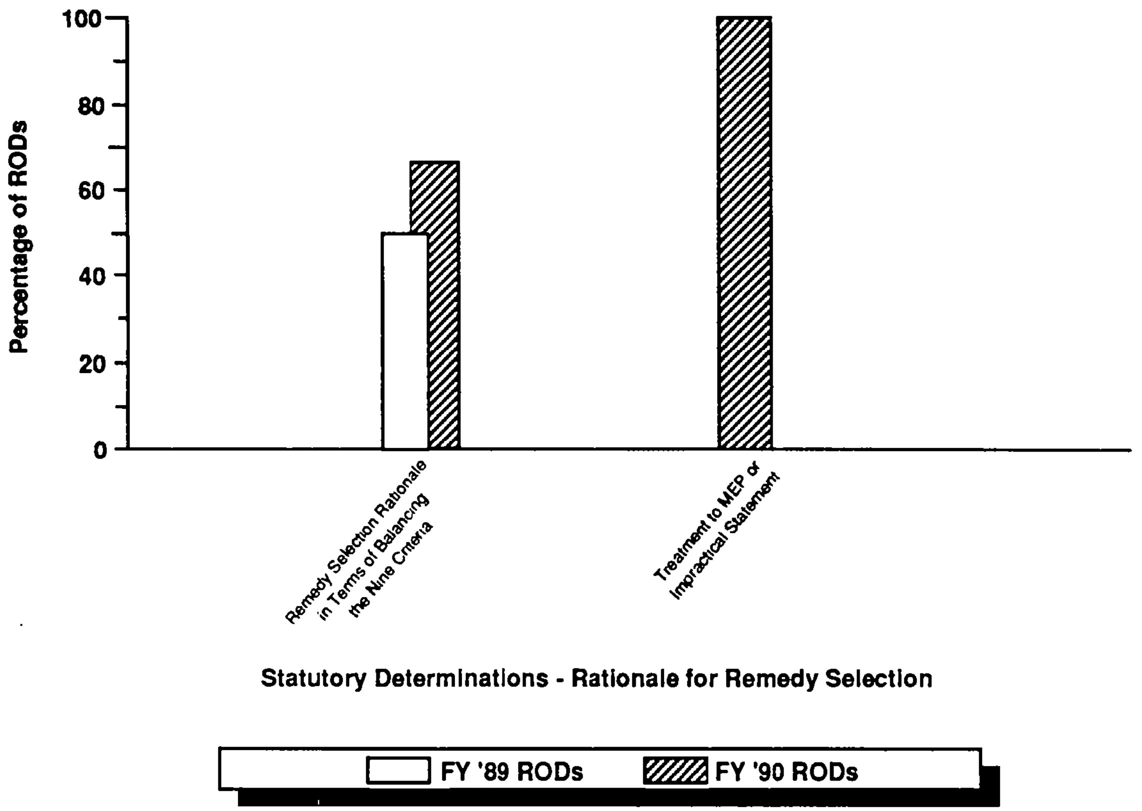
* The percentage of RODs presented is directly dependent upon the total number of applicable RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

**Exhibit 16**
**FY'90 ROD ANALYSIS REGION VIII RESULTS AND COMPARISONS: DOCUMENTATION OF RATIONALE FOR REMEDY SELECTION IN FINAL SOURCE CONTROL RODs***




*The percentage of RODs presented is directly dependent upon the total number of applicable RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

**Exhibit 17**
**FY'90 ROD ANALYSIS REGION VIII RESULTS AND COMPARISONS: DOCUMENTATION OF RATIONALE FOR REMEDY SELECTION IN FINAL GROUND WATER RODs***

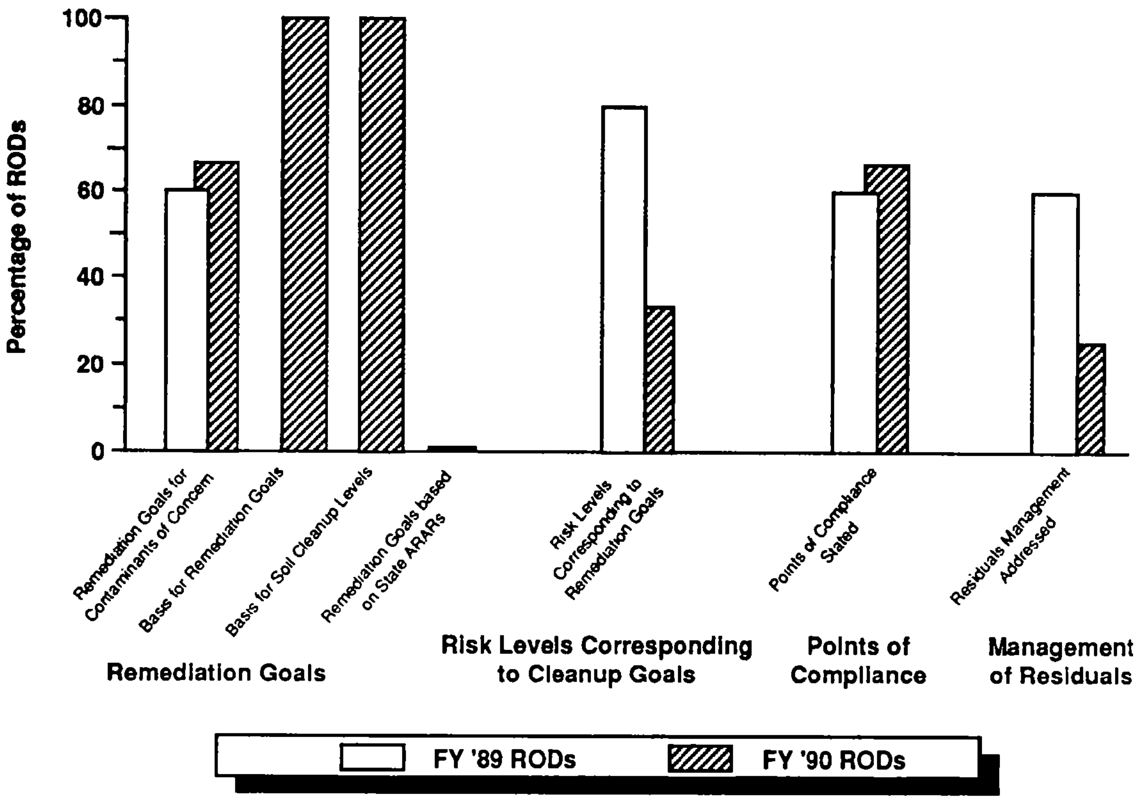



*The percentage of RODs presented is directly dependent upon the total number of applicable RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

-37-

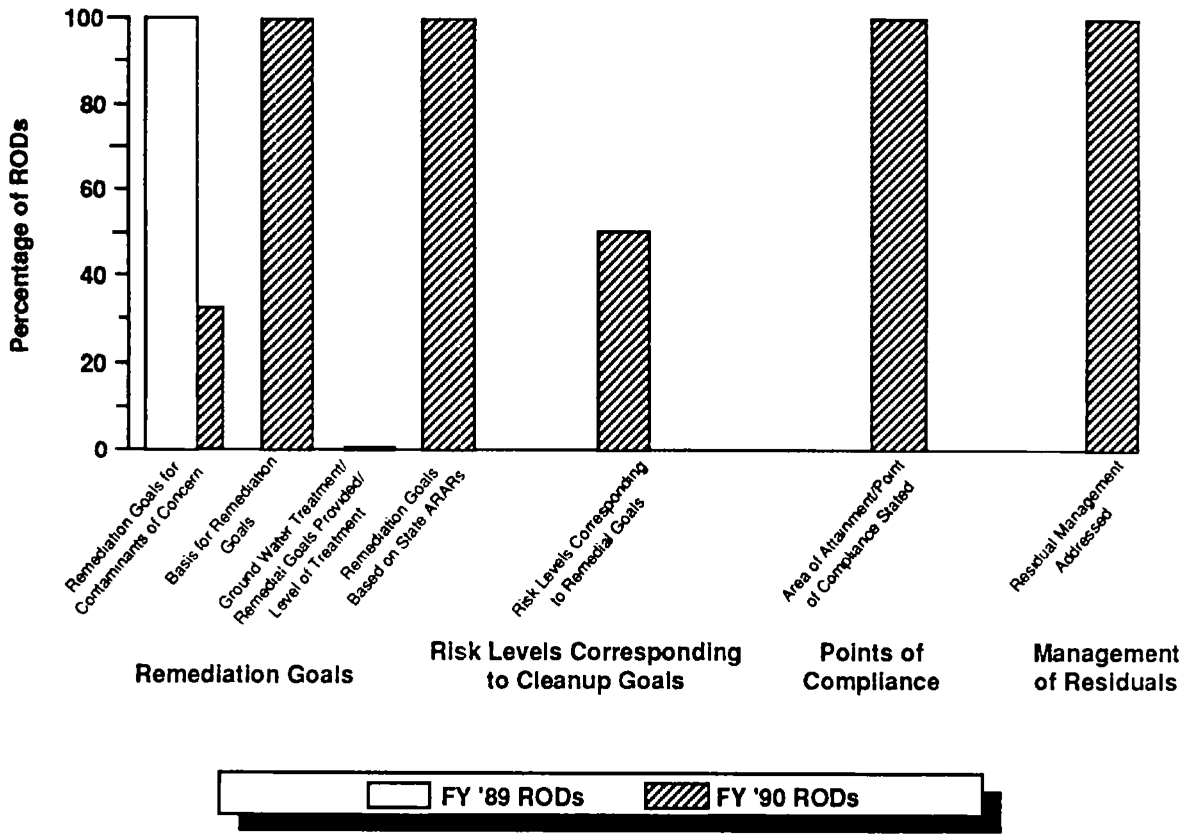
**Exhibit 18**

**FY'90 ROD ANALYSIS REGION VIII RESULTS AND COMPARISONS: DOCUMENTATION OF KEY COMPONENTS OF THE SELECTED REMEDY IN FINAL SOURCE CONTROL RODs***




*The percentage of RODs presented is directly dependent upon the total number of applicable RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

**Exhibit 19**
**FY'90 ROD ANALYSIS REGION VIII RESULTS AND COMPARISONS: DOCUMENTATION OF THE KEY COMPONENTS OF THE SELECTED REMEDY IN FINAL GROUND WATER RODs***




*The percentage of RODs presented is directly dependent upon the total number of <u>applicable</u> RODs evaluated; therefore, the number of RODs used to calculate the percentages will vary among findings.

## Exhibit 20
## FY'90 ROD ANALYSIS REGION VIII RESULTS: CONSISTENCY WITH PROGRAM EXPECTATIONS

| PROGRAM EXPECTATIONS | TOTAL NUMBER OF OCCURRENCES | | NCP EXPECTATIONS ADDRESSED | |
|---|---|---|---|---|
| | Source Control | Ground Water | Source Control | Ground Water |
| • Principal Threats - Total | 6 | - | 100% | - |
| - Treatment | 4 | - | 67% | - |
| - Containment (treatment is impracticable) | 2 | - | 33% | - |
| • Low-Level Threats - Total | 5 | - | 100% | - |
| - Containment | 4 | - | 80% | - |
| - Treatment (in conjunction with principal threat waste or to control migration) | 1 | - | 20% | - |
| • Waste On-site Above Health-Based Levels - Total | 6 | 3 | | - |
| - Institutional Controls (for short-term impacts or engineering control supplement) | 5 | 3 | 83% | 100% |
| - Institutional Controls (as the primary remedy) | 0 | 0 | 0% | 0% |
| • Treatment Selected - Total | 4 | 3 | | - |
| - Innovative Treatment Technologies Selected | 3 | 0 | 75% | 0% |
| • Ground Water Actions - Total | - | 3 | - | - |
| - Ground Water Restoration | - | 3 | - | 100% |
| **TOTAL FY'90 RODs REVIEWED** | **6** | **3** | | |

# 4. CONCLUSIONS AND RECOMMENDATIONS FOR FY'91 RODs

Conclusions:

- The results of the FY'90 ROD Analysis show continued improvement in our efforts to produce high-quality RODs
- Significant improvement and/or strengths in ROD documentation quality and in consistency of remedies with program expectations are seen in the following areas:
  - Identification and description of ARARs in the "Statutory Determinations"
  - Rationale for Remedy Selection
  - Documentation of MCLs and non-zero MCLGs for ground water alternatives
  - Documentation of essential components of the ROD
  - Consistency of remedies selected with Superfund program expectations

# 4. CONCLUSIONS AND RECOMMENDATIONS FOR FY'91 RODs (cont'd)

Recommendations:

- Improvement in FY'90 RODs should be focused on the following areas:
  - Identification of key ARARs for each alternative, including residuals management, especially LDR and closure
  - Documentation of site risks
  - Designation of principal and low-level threats
  - Documentation of key components of the selected remedy (i.e., remediation goals, risk levels corresponding to remediation goals, points of compliance, and management of residuals)
  - Application of new policy and guidance

# SITE RISKS

RISK ISSUES

FY'91 FORUM

# RISK ASSESSMENT

Office of Emergency and Remedial Response
Office of Waste Programs Enforcement

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

FY'91
FORUM

# RISK ASSESSMENT AND RISK MANAGEMENT ISSUES

- Risk Documentation in ROD
- Baseline Risk Memorandum
- Risk Management Initiatives

# RISK DOCUMENTATION IN RODS

- Chemicals of Concern
- Exposure Assumptions
- Toxicity Information
- Risk Characterization
- Ecological Risks

# CHEMICALS OF CONCERN

ROD Should:

- List Chemicals of Concern
- Indicate Why Other Chemicals Found On-Site Were Not Selected as Contaminants of Concern (e.g., Background, Contaminated Blanks, Concentrations Below Levels of Concern)

# EXPOSURE ASSUMPTIONS

ROD Should:

- Indicate Current and Future Land Use
- Reasonable Maximum Exposure Scenario
- Indicate Exposure Pathways
- Indicate Primary Assumptions Used to Calculate Exposure
- Justify Use of Non-Standard Exposure Assumption

# TOXICITY INFORMATION

ROD Should Indicate:

- Toxicity Information for Contaminants of Concern (e.g., Carcinogenic Slope Factor, RfD)
- The Source of the Toxicity Information (e.g., IRIS, HEAST)

# RISK CHARACTERIZATION

ROD Should:

- Indicate Actual or Potential Carcinogenic Risks
- Indicate Hazard Index for Noncarcinogens
- Discuss Uncertainty in Risk Assessment Results

FY'91 FORUM

# ECOLOGICAL RISKS

ROD Should:

- Indicate Endangered Species and Critical Habitats Were Considered, Whether Found or Not
- Discuss any Sampling and Investigations Based on Environmental Concerns
- Identify Risks or Threats to the Environment and the Basis for the Determination

# ROLE OF BASELINE RISK ASSESSMENT IN SUPERFUND REMEDY SELECTION DECISIONS

FY'91 FORUM

# RISKS WARRANTING REMEDIAL ACTION

- Baseline risk assessment provides basis for taking action under CERCLA 104 and 106.
- Unacceptable risk generally defined as:
  - risk greater than $10^{-4}$ cancer risk
  - exposure exceeds levels associated with no adverse effects for noncarcinogens

# RISK WARRANTING REMEDIAL ACTION (cont'd)

- Action is warranted if
  - chemical-specific standard that defines acceptable risk (e.g., MCLs, MCLGs) is exceeded or
  - if there are adverse environmental impacts
- Threshold for action is generally the same for sections 104 and 106.

# NO-ACTION DECISIONS

- If the baseline risk assessment indicates site presents no unacceptable risk, remedial action not required and section 121 requirements are not triggered.

FY'91 FORUM

# RISK RANGE

- EPA Strives to Manage Risks Within the $10^{-4}$ to $10^{-6}$ cancer risk range
- Upper end of risk range (i.e.,$10^{-4}$) is not discrete point; generally, $1 \times 10^{-4}$ is used in Risk Management decisionmaking

FY'91 FORUM

# CONSISTENT RISK ASSESSMENT METHODOLOGY

- Use standardized exposure assumptions (found in RAGS: HHEM and others as developed)
- Different assumptions should be justified in the ROD.
- Institutional controls and fences should not be factored into the baseline assessment, although they may be a component of remedial alternatives in Feasibility Study.

FY'91 FORUM

# DOCUMENTATION IN THE ROD

- Include standard language indicating that the site presents an unacceptable risk to human health and the environment.
- Summary of Site Risks section should also include a discussion of current and future risk.
- Include how remedial alternatives will reduce risks
  - include the cleanup level (and the level of residual risk, if quantifiable).

FY'91 FORUM

# NATIONAL SUPERFUND RISK MANAGEMENT WORKGROUP INITIATIVES

- Post-ROD Toxicity Information and ARAR changes
  - likely to be addressed in five-year review
- Definition of Principal Threats and Low-Level Threats

FY'91 FORUM

# NATIONAL SUPERFUND RISK MANAGEMENT WORKGROUP INITIATIVES

- Scope of Risk Assesments at partially remediated sites
  - recommending risk assessments based on operable units
- Role of risk targets and ARARs in setting remediation goals
- Land Use Restrictions should be noted in ROD
  - should be determined to be implementable at the site

ROD GUIDANCE

FY'91
FORUM

# DEVELOPMENT AND DOCUMENTATION FOR NO ACTION RODs, INTERIM ACTION RODs, AND CONTINGENCY RODs

Office of Emergency and Remedial Response
Office of Waste Programs Enforcement

# STANDARD ROD FORMAT

1. Declaration

   - Site Name and Location
   - Statement of Basis and Purpose
   - Assessment of the Site
   - Description of Selected Remedy
   - Statutory Determinations
   - Signature and Support Agency Acceptance of the Remedy

2. Decision Summary

   - Site Name, Location, and Description
   - Site History and Enforcement Activities
   - Highlights of Community Participation
   - Scope and Role of Operable Unit
   - Site Characteristics
   - Summary of Site Risks
   - Description of Alternatives
   - Summary of Comparative Analysis of Alternatives
   - Selected Remedy
   - Statutory Determinations
   - Explanation of Significant Changes

3. Responsiveness Summary

FY 91 FORUM

# NO ACTION RODs

- "No Action" RODs may be warranted under the following circumstances:
  - The site or operable unit poses no current or potential threat to human health and the environment.
  - CERCLA does not provide the authority to take remedial action.
  - A previous response eliminated the need for further remedial response.

# NO ACTION RODs (cont'd)

- "No Action" alternative may include monitoring
- Alternatives that include components designed to reduce/prevent exposure (e.g., fence, institutional controls) are considered "limited action" alternatives.

FY 91 FORUM

## NO ACTION ROD FORMAT

1. Declaration

- Site Name and Location
- Statement of Basis and Purpose
- ~~Assessment of the Site~~
- Description of Selected Remedy
- ~~Statutory Determinations~~
- Declaration Statement
- Signature and Support Agency Acceptance of the Remedy

## NO ACTION RODs

Description of Selected Remedy

- The ROD should state that no action is necessary for the site/OU.
- Monitoring may be authorized.

Declaration Statement

- If action is not necessary for protection, the ROD should state that no remedial action is necessary to ensure protection of human health and the environment.

- If no action is taken because there is no CERCLA authority to take action, the ROD should explain that EPA doesn't have authority under CERCLA 104 or 106 to address the problems posed by the site/OU. If a problem has been referred to other authorities, this should be explained.

- If taking "no further action," the ROD should explain that previous response(s) eliminated the need to conduct additional remedial action. The ROD should also state whether a 5 year review is required. CERCLA requires a 5 year review of earlier remedies that eliminated the need to take further action (i.e. institutional controls) but left hazardous substances, pollutants or contaminants on site.

FY 91 FORUM

## NO ACTION ROD FORMAT (cont'd)

2. <u>Decision Summary</u>

   - Site Name, Location, and Description
   - Site History and Enforcement Activities
   - Highlights of Community Participation
   - Scope and Role of Operable Unit or Response Action
   - Site Characteristics
   - Summary of Site Risks
   - ~~Description of Alternatives~~
   - ~~Summary of Comparative Analysis of Alternatives~~
   - ~~Selected Remedy~~
   - ~~Statutory Determinations~~
   - Explanation of Significant Changes

3. <u>Responsiveness Summary</u>

**NO ACTION ROD FORMAT**

<u>Summary of Site Risks</u>

- This section needs to support the decision for not taking an action. The conclusions of the baseline risk assessment need to be explained.

- Any previous responses conducted at the site/OU that eliminated the need for additional remedial action should be discussed.

- If any alternatives were developed in the FS, the FS should be referenced.

FY 91 FORUM

## INTERIM ACTION RODs

- **Interim actions:**
  - **are limited in scope**
  - **address only areas/media that will be <u>followed by a final ROD</u>**
  - **intent is to address problem more fully in a subsequent action**



### INTERIM ACTION RODS

<u>EXAMPLES OF INTERIM ACTION RODs</u>: (These Talking Points are for this slide and the next slide.)

- Install barrier wells to contain contaminant plume - remediation levels addressed in a subsequent ROD
- Provide temporary alternate water supply - management decisions addressed in subsequent ROD(s) for contamination source(s) and/or aquifer addressed in subsequent ROD(s)
- Construct temporary cap to control or reduce exposure - final waste management decision to address source (e.g. treatment) provided in subsequent ROD
- Temporarily consolidate contaminated material for storage - final waste management decision addressed in subsequent ROD.

# INTERIM ACTION RODs (cont'd)

- Interim actions may be necessary to:
  - protect human health and the environment from an imminent threat in the short term, while a final solution is being developed
  - temporarily stabilize the site/operable unit to prevent further contaminant migration and/or degradation

FY 91 FORUM

# INTERIM ACTION ROD FORMAT

1. Declaration

- **Site Name and Location**
- **Statement of Basis and Purpose**
- **Assessment of the Site**
- **Description of Selected Remedy**
- **Statutory Determinations**
- **Signature and Support Agency Acceptance of the Remedy**

## INTERIM ACTION ROD FORMAT

State that interim remedy:

- protects human health and the environment.
- complies with ARARs for the limited scope of the action.
- is cost effective.

Additionally:

- If the remedy does not employ treatment, state that the statutory preference for treatment will be addressed by the final response action.
- If the remedy does employ treatment, include language that says that the remedy is in furtherance of the statutory preference for treatment.
- The statutory preference for treatment will be addressed by the final response action.

FY'91 FORUM

## INTERIM ACTION ROD FORMAT (cont'd)

2. **Decision Summary**
   - **Site Name, Location, and Description**
   - **Site History and Enforcement Activities**
   - **Highlights of Community Participation**
   - **Scope and Role of Operable Unit**
   - **Site Characteristics**
   - **Summary of Site Risks**
   - **Description of Alternatives**
   - **Summary of Comparative Analysis of Alternatives**
   - **Selected Remedy**
   - **Statutory Determinations**
   - **Explanation of Significant Changes**
3. **Responsiveness Summary**

## INTERIM ACTION ROD FORMAT (cont'd)

### Scope and Role

- Describe what action is being performed at the site and state how the interim action will be consistent with any planned future actions.

### Site Characteristics

- Indicate description of site/OU characteristics to be addressed by the interim remedy.

### Site Risks

- Identify the risks addressed by the interim action and the rationale for the limited scope of action. Qualitative risk information may be presented if quantitative risk information is not yet available. This will often be the case.

### Description of Alternatives

- Describe the limited alternatives that were considered for the interim action.

### Comparative Analysis

- Evaluation criteria that are not relevant to the evaluation of interim actions do not have to be addressed in detail. Note their irrelevance to the decision.

### Statutory Determinations

- Focus only the ARARs specific to the interim action.
- State that the interim remedy is the best balance of tradeoffs among alternatives with respect to the pertinent criteria.
- The preference for treatment will be addressed in the final action.

FY'91 FORUM

## INTERIM VS. FINAL EARLY ACTIONS

- **Early remedial actions may be <u>either interim or final</u>.**
- **May not be sufficient time to prepare "formal" RI/FS.**
- **Analysis should be streamlined:**
  - **summary of site data**
  - **short analysis of considered remedial alternatives and basis for rejection/selection.**
- **Analysis/information can be provided in proposed plan/ROD**
- **ROD follows appropriate format (i.e., interim or final)**



**INTERIM VS. FINAL EARLY ACTIONS**

EXAMPLES OF EARLY ACTIONS

<u>Early Interim Action</u>

- Providing an alternate water supply and sealing wells that are pumping from a contaminated aquifer.

<u>Early final action</u>

- Complete removal of drums and surrounding contaminated soil to address imminent threat and further limit degradation.

FY91 FORUM

## RISK ASSESSMENTS FOR EARLY AND INTERIM ACTIONS

- **Completed baseline risk assessment not necessary**
- **Potential risk and the need to take an action must be demonstrated**
- **Contaminants of concern, concentrations and exposure information**



## RISK ASSESSMENTS FOR EARLY AND INTERIM ACTIONS

- A completed baseline risk assessment is not a requirement to take an interim or early action.
- ROD has to contain enough information to demonstrate the potential risk and the need to take action.
- This information can include a summary of contaminants of concern, concentrations and relevant exposure information.

FY'91 FORUM

## CONTINGENCY REMEDIES

- **Minimal use**
- **Treatability studies during RI/FS**
- **Ground water remedies**



## CONTINGENCY REMEDIES

- Contingency remedies should be used in limited circumstances because treatability studies should be performed before ROD is signed to ensure technology's performance.
- Appropriate when:
  - Significant uncertainty exists about the ability of remedial alternatives to achieve cleanup levels for ground water actions.
  - Either innovative technology is selected or a proven technology is used on a waste where performance data are not available.

FY'91
FORUM

# PRE-ROD AND POST-ROD CHANGES

Office of Emergency and Remedial Response
Office of Waste Programs Enforcement

## PRE-ROD CHANGES

- **Minor Changes**

  **Little or no impact on overall scope, performance, or cost of the alternative originally presented as the preferred remedy.**



**PRE-ROD CHANGES**

EXAMPLES OF PRE-ROD CHANGES

Minor Changes

- Altering the Selected Remedy to include a few more ground water extraction wells than were originally estimated in the Proposed Plan.

FY'91 FORUM

## PRE-ROD CHANGES (cont'd)

- Significant Changes

  Significant or fundamental effect on the scope, performance, and/or cost of the preferred remedy. Generally involve either:

  - selection of an RI/FS alternative other than the preferred alternative as the remedy; or
  - substantial modification of a component of the selected remedy.



**PRE-ROD CHANGES (cont'd)**

EXAMPLES OF PRE-ROD CHANGES

Significant Changes

- In response to comments, the final remedy combines one component of the preferred alternative (e.g., for ground water remediation) and a component of a different alternative presented in the RI/FS Report (e.g., soil remediation).

# PRE-ROD CHANGES (cont'd)
## DOCUMENTATION

- Minor Changes

  Document in Description of Alternatives section of the ROD Decision Summary

  - If logical outgrowth:
    - document in Decision Summary of the ROD in the Documentation of Significant Changes section.
  - If not logical outgrowth:
    - issue revised Proposed Plan;
    - document in Decision Summary of the ROD in the Documentation of Significant Changes section.

FY 91
FORUM

## LOGICAL OUTGROWTH

- Public could have reasonably anticipated the change based on available information
- Example: Change in components of the preferred alternative based on public comment.



## LOGICAL OUTGROWTH

- The public could have reasonably anticipated the change based on the information in the RI/FS, proposed plan, and comments submitted during public comment period.
- Example: Change in the preferred alternative's cost and implementation time based on public comment.

FY'91 FORUM

## POST-ROD CHANGES

- <u>Minor Changes</u>
  - Example: Amount of waste to be treated is slightly higher than expected and consequently increase in cost is minimal
  - Document in the <u>post-decision document file</u>.



## POST-ROD CHANGES

- The amount of a cost increase is not specific in order to give flexibility to regions.
- Difference ranging from 50% over cost to 30% under cost should be used as a guide.
- Call appropriate regional coordinator to assist in making determinations.

## POST-ROD CHANGES (cont'd)

- Significant Changes
  - Example: Wastes must be managed at a Subtitle C facility rather than a Subtitle D facility, as stated in the ROD.
  - Document in Explanation of Significant Differences.

FY 91 FORUM

# EXPLANATION OF SIGNIFICANT DIFFERENCES (ESD) DOCUMENTATION

- **Fact Sheet format**
- **Explain:**
  - **changes to remedy**
  - **information**
  - **statutory determinations**



## ESD DOCUMENTATION

- The ESD can be in a fact sheet format.
- The ESD should:
  - explain the changes to the remedy.
  - summarize information that lead to the decision to change the remedy.
  - affirm that statutory determinations of CERCLA 121 are met.

FY 91 FORUM

# POST-ROD CHANGES (cont'd)

- Fundamental Changes
  - Example: Selected remedy proves infeasible - a new remedy must be chosen.
  - Document in a ROD Amendment.

FY 91 FORUM

## ROD AMENDMENT DOCUMENTATION

Focus on:

- **Rationale for change**
- **Nine-criteria analysis**
- **Statutory requirements are satisfied**



## ROD AMENDMENT DOCUMENTATION

- Focus on documenting rationale for the ROD amendment.
- For the part of the ROD being amended, add the required new 9 criteria analysis. Cross-reference the original ROD where appropriate.
- Indicate that the remedy satisfies the statutory requirements.

# LAND DISPOSAL RESTRICTIONS

# RCRA/LDR UPDATE

- LDR SURVEY RESULTS
- LDR PROMULGATION SCHEDULE
- LDR COMPLIANCE STRATEGY
- MINIMUM TECHNOLOGY REQUIREMENTS
- AVAILABLE GUIDANCE

# LDR ROD SURVEY

- REVIEWED 581 RODs (FY '82 - FY '89)
- RESULTS:
  - 403 RODs - FURTHER ANALYSIS NOT REQUIRED (I.E., LDRs NOT ARARs)
  - 178 RODs - FURTHER ANALYSIS REQUIRED (I.E., LDRs ARE OR MAY BE ARARs)
- OF THE 178 RODs REQUIRING FURTHER ANALYSIS:
  - 53 - DESIGN START IN 1st Q FY '90 OR BEYOND
  - 97 - CURRENTLY IN RD
  - 28 - UNKNOWN WHETHER PLACEMENT OF RCRA WASTES WILL OCCUR

---

- The survey of RODs was needed to assess compliance of remedial actions with LDRs and to provide support to Regions.
- The results of the survey indicated that detailed analysis was required for the 178 sites at which the LDRs might be ARARs.
- For the FY '90 ROD Forums, fact sheets on the 53 sites with design start in the 1st Quarter of FY '90 were prepared.
- Largely because of the Third Third rule, the effective dates of wastes and treatment standards at many sites changed, and new provisions affected compliance status.
- OERR prepared fact sheets for the remaining 125 sites (i.e., those currently in Remedial Design or at which it was unknown if placement would occur).
- The original 53 fact sheets were updated, an additional fact sheet discussing relevant issues (including Third Third) was prepared, and changes from the TC rule were incorporated.

# LDR ROD SURVEY

- MOST SITES TAKING ACTION STILL IN COMPLIANCE WITH LDRs
- SOME SITES MAY REQUIRE ESDs OR REMEDY MODIFICATIONS
- SOME RODs DID NOT INCLUDE A COMPLETE LDR ANALYSIS

---

- Where sites are taking action that is still in compliance with the LDRs, fact sheets provide reminders about compliance requirements (e.g., notification, certifications).
- In some cases, an Explanation of Significant Differences or a Remedy Modification may be required. For example,
  - Hazardous waste is present at the site but the remedy involves excavation and disposal without treatment;
  - The selected technology is not appropriate to meet the LDR standard (e.g., incineration for metals) and the remedy mentions no other treatment.
- Where the ROD did not include a complete LDR analysis, fact sheets identify:
  - wastestreams or residuals not specifically mentioned in the ROD but potentially subject to LDRs;
  - any recommended compliance strategies developed by OERR (e.g, Treatability Variance for soil).

# PROMULGATED LDR REGULATIONS

| REGULATION | PROMULGATION DATE |
|---|---|
| SOLVENTS AND DIOXINS RULE | NOVEMBER 8, 1986 |
| CALIFORNIA LIST RULE | JULY 8, 1987 |
| FIRST THIRD RULE | AUGUST 8, 1988 |
| SECOND THIRD RULE | JUNE 8, 1989 |
| THIRD THIRD RULE | MAY 8, 1990 |

# UPCOMING LDR REGULATIONS

- COURT ORDERED K061 HIGH Zn (8/91 FINAL RULE)

- PHASE 1 POST-HSWA WASTES (5/92 FINAL RULE)
  - Contaminated debris
  - D004 - D017 that were not EP toxic

COURT ORDERED K061 HIGH Zn

- Court voided the No Land Disposal standard based on recycling and required EPA to establish a new treatment standard for K061 (electric arc furnace dust) in the high zinc subcategory.

- Automatic delisting proposed if waste conforms to all BDAT values and contains nondetectable levels for certain metals.

PHASE 1 POST-HSWA WASTES

- Contaminated debris has been separated out from soil and debris because standards are needed for debris wastes that are generated during normal manufacturing operations and because the existing national capacity variance for "inorganic solid debris" runs out in 5/92.

- Some new D004 - D017 wastes will pass EP but not TCLP and are therefore "newly identified." OSW expected to propose to extend the existing standards for the old EP wastes to all of these (based on TCLP standard).

# UPCOMING LDR REGULATIONS

- PHASE 2 POST-HSWA WASTES (4/93 FINAL RULE)
  - Contaminated soil
  - TC - 26 recently added organics (D018 - D043)
  - Remanded Bevill (K064 - K066, K090, K091) - (if relisted)

- PHASE 3 POST-HSWA WASTES (3/94 FINAL RULE)
  - Characteristic mineral processing wastes
  - Aluminum potliners
  - Wood preserving (F033 - F035)

===================================================================

PHASE 2 POST-HSWA WASTES

- Standards for contaminated soil will generally be numerical.
- There are 26 new TC organic chemicals that will require standards: D018 - D043.
- OSW expected to propose to transfer the standards that exist for multi-source leachate (F039) to the TC wastes.
- Wastewater standards for these TC constituents appear to be achievable by most existing conventional wastewater treatment systems.

PHASE 3 POST-HSWA WASTES

- Mineral processing wastes from over 20 industries are covered. Most of these are characteristic "D" wastes. BDAT for the 5 "deBevilled" wastes that were specifically listed as "K" wastes are expected to be covered in Phase 2.

# COMPLIANCE STRATEGY

| | ON-SITE: Applicable | ON-SITE: Relevant and Appropriate | OFF-SITE: Applicable |
|---|---|---|---|
| **Industrial Process Waste** | Meet BDAT <u>or</u><br>- Obtain Treatability Variance<br>- Delist waste<br>- Obtain No-Migration Petition | Meet BDAT <u>or</u><br>- Obtain Treatability Variance<br>- Delist waste<br>- Obtain No-Migration Petition | Meet BDAT <u>or</u><br>- Obtain Treatability Variance<br>- Delist waste<br>- Obtain No-Migration Petition <u>and</u><br>Comply with administrative requirements<br>- notification<br>- certification |
| **Soil and Debris** (Make case-by-case determination for sludges) | Obtain Treatability Variance | LDRs not relevant and appropriate;<br>Treat consistent with NCP expectations<br>- 90-99 percent reduction in concentration or mobility of waste | Obtain Treatability Variance <u>and</u> comply with administrative requirements<br>- notification<br>- certification |

- Major factors in evaluating compliance are:
  - -- Type of waste (industrial process vs. soil and debris)
  - -- Does action occur on- or off-site
  - -- Whether LDRs are applicable or relevant and appropriate
- Presumption is to comply with the LDRs for soil and debris through a Treatability Variance.

# INTERIM MEASURE WAIVER

- USE OF INTERIM MEASURE WAIVER FOR ON-SITE ACTIONS INVOLVING PLACEMENT OF WASTE PRIOR TO ACHIEVING STANDARD

- E.G., CONSOLIDATION OF WASTE FROM 2 OR MORE AOCs INTO A SINGLE AOC PRIOR TO TREATMENT

  - SOLIDIFICATION
  - IN-SITU VITRIFICATION
  - LANDFARMING

- NEED TO ENSURE STANDARDS WILL BE ATTAINED TO AVOID NEED FOR ADDITIONAL ACTION ON PLACED WASTES

# DISPOSAL REQUIREMENTS

- ONCE LDR STANDARDS ARE MET, PLACEMENT IS REQUIRED IN SUBTITLE C FACILITY, UNLESS:
  - WASTE IS DELISTED
  - WASTE IS RENDERED NON-CHARACTERISTIC
  - WASTE NO LONGER "CONTAINS"
  - NO MIGRATION SHOWING
- SUBTITLE C FACILITY MAY OR MAY NOT BE MIN. TECH. UNIT

# MINIMUM TECHNOLOGY REQUIREMENTS

- DOUBLE LINER, LEACHATE COLLECTION SYSTEM, GROUNDWATER MONITORING
- NECESSARY FOR
  - NEW UNITS
  - REPLACEMENT UNITS
  - LATERAL EXPANSIONS OF EXISTING UNITS
- APPLY DURING LDR NATIONAL CAPACITY EXTENSIONS

- A "new" unit is a unit that first receives waste after November 8, 1984.
- A "replacement" unit is an existing unit where:
  - the unit is taken out of service;
  - all or substantially all of the waste is removed; and
  - the unit is reused (which does not include removal and replacement of waste into the same unit).
- An "lateral expansion" is an expansion of the boundaries of an existing unit.

# MINIMUM TECHNOLOGY REQUIREMENTS

DO NOT APPLY WHEN:

- DISPOSAL (FOLLOWING TREATMENT TO ACHIEVE LDR STANDARDS) IN ORIGINAL AOC
- CONSOLIDATION OF WASTES FROM DIFFERENT AOCs (FOLLOWING TREATMENT) INTO EXISTING AOC

---

- If wastes are treated to meet the LDRs and replaced in the same unit (AOC), the unit is not a "new" or "replacement" unit nor is it a lateral expansion and therefore need not meet minimum technology requirements. (See memo on Plattsburgh Airforce Base, April 6, 1990).
- EPA believes that the references in the legislative history of RCRA to "replacement" unit refer to a unit that is actively managing hazardous waste, not where final disposal activities are occurring. (See memo on Moss American site, September 26, 1990.)

# SUPERFUND GUIDES CURRENTLY AVAILABLE

| NUMBER AND TITLE | | DATE | PUBLICATN NO. |
|---|---|---|---|
| 1: | Overview of RCRA LDRs | June 1989 | 9347.3-01FS |
| 2: | Complying With the California List Restrictions Under the LDRs | June 1989 | 9347.3-02FS |
| 3: | Treatment Standards and Minimum Technology Requirements Under LDRs | June 1989 | 9347.3-03FS |
| 4: | Complying With the Hammer Restrictions Under LDRs | June 1989 | 9347.3-04FS |
| 5: | Determining When LDRs are Applicable to CERCLA Response Actions | June 1989 | 9347.3-05FS |
| 6A: | Obtaining a Soil and Debris Treatability Variance for Remedial Actions (2nd Edition) | September 1990 | 9347.3-06FS |
| 6B: | Obtaining a Soil and Debris Treatability Variance for Removal Actions | September 1990 | 9347.3-06BFS |
| 7: | Determining When LDRs are Relevant and Appropriate to CERCLA Response Actions | December 1989 | 9347.3-08FS |
| 8: | Compliance with Third Third Requirements Under the LDRs | September 1990 | 9347.3-08FS |

# SUPERFUND GUIDES CURRENTLY AVAILABLE (Continued)

| NUMBER AND TITLE | DATE | PUBLICATN NO. |
|---|---|---|
| A Guide to Delisting of RCRA Wastes for Superfund Remedial Responses | September 1990 | 9347.3-09FS |
| Superfund Guidance for Obtaining No Migration Variances | March 1991 | 9347.3-10FS |
| CERCLA Compliance with the RCRA Toxicity Characteristics (TC) Rule: Part II | August 1990 | 9347.3-11FS |
| Superfund Guide to RCRA Management Requirements for Mineral Processing Wastes | January 1991 | 9347.3-12FS |

# SUPERFUND GUIDES UNDER DEVELOPMENT

- Management of Investigation-Derived Waste
- Identifying RCRA Hazardous Wastes
- POTW Discharge

FY 91 FORUM

# PRINCIPAL THREAT AND LOW LEVEL THREAT WASTES

# CURRENT STATUS

Office of Emergency and Remedial Response
Office of Waste Programs Enforcement

## PRINCIPAL THREAT AND LOW LEVEL THREAT WASTES

The need for guidance on the use of the terms principal threat and low level threat was identified during the FY'90 ROD Forums.

CURRENT STATUS:

Although the principal threat and low level threat policy is under development, the information presented today is expected to be very similar to that which will be issued.

STATUS:

- Draft policy provided to the National Risk Management Work Group for review.
- Revised policy will be provided to the Regions for review.
- Finalize policy fourth-quarter of FY'91.

FY 91
FORUM

## PRINCIPAL THREAT AND LOW LEVEL THREAT WASTES GUIDANCE

Purpose:

- To clarify and standardize use of terms

Content:

- Use of Terms
- NCP Expectations
- Definitions
- ROD Documentation



## PRINCIPAL THREAT AND LOW LEVEL THREAT WASTES GUIDANCE

PURPOSE:

Provide guidance on the use of these terms in the Superfund Program.

CONTENT:

- Use or role of these terms in the Superfund program.
- Relationship of NCP expectations to remedy selection.
- Definition of principal threat and low level threat wastes.
- ROD documentation requirements.

CURRENT STATUS

FY 91 FORUM

## USE OF TERMS

Purpose of Terms:

- Streamline the RI/FS process based on NCP expectations

Remedy Selection:

- Based on the nine evaluation criteria

3-

## USE OF TERMS

PURPOSE OF TERMS:

- Streamline RI/FS process based on NCP expectations.
- Designation of waste as a principal or low level threat does not dictate whether an action is necessary, but rather provides management expectations after a decision has been made to take action at a site.

REMEDY SELECTION:

- The baseline risk assessment and the chemical-specific standards that define the acceptable risk levels (e.g., non-zero MCLGs, MCLs) help to gauge whether remedial action is warranted.
- Once a decision is made that action is warranted, these terms serve primarily as tools to facilitate the consideration of the NCP expectations (40 CFR 300.430(a)(1)(iii)) on a site-specific basis.
- It should be stressed that a ROD may address only low level threat waste and still warrant remedial action.
- Remedy selection is based on the nine evaluation criteria.

FY'91 FORUM

## NCP EXPECTATIONS FOR SOURCE MATERIALS

- **Treatment of principal threat wastes**
- **Engineering controls for low level threat wastes**
- **Engineering controls where treatment is impracticable**
- **Use of a combination of methods**
- **Use of institutional controls to supplement engineering controls**

-4

## NCP EXPECTATIONS FOR SOURCE MATERIALS:

- The expectations are non-binding requirements.
- The expectations do not dictate the selection of the remedial alternative.
- The remedy selection decision is based on an evaluation of the alternatives in accordance with the NCP.
- There will be situations where based on the nine evaluation criteria the selected remedy does not meet the expectations (e.g., cost effectiveness).
- Treatment may not be selected for principal threat waste because of the following reasons: implementability, greater risk, or cross-media effects.
- Treatment may be selected for low level threat waste for the following reasons:
  - unreliable containment (e.g., technical difficulties)
  - sensitive environment
  - low volume

FY 91 FORUM

## DEFINING PRINCIPAL THREAT WASTES

Definition:

- Highly toxic or highly mobile wastes
- Cannot be reliably controlled
- Significant risk to human health or the environment

Includes:

- Liquids
- Solvents
- High concentrations of toxic compounds

Does not include:

- Contaminated ground water



## DEFINING PRINCIPAL THREAT WASTES:

- Principal threat is not solely determined by the degree of risk but also takes into consideration the physical state of the material (e.g., liquid) and the potential mobility of the wastes in the particular environmental setting.
- Wastes that present a significant risk generally will be deemed a principal threat.
- Wastes that significantly exceed ARARs or that present a significant non-carcinogenic health threat also will be deemed a principal threat.
- Ground water is not included in the definitions of principal threat or low level threat wastes; the NCP established expectations for ground water separately from other materials.
- Free products (NAPLs), sediments, lagoon materials, are generally considered source material, and therefore, may be principal threat waste.

FY 91 FORUM

## DEFINING LOW LEVEL THREAT WASTES

Definition:

- Low mobility wastes
- Can be reliably controlled
- Low risk in the event of exposure

Includes:

- Solids
- Moderate to low toxicity

Does not include:

- Contaminated ground water



## DEFINING LOW-LEVEL THREAT WASTES:

- Low level threat wastes are those wastes that are not principal threat wastes nor are they contaminated ground water.
- Risk is one measure of differentiating between principal threat and low level threat wastes.
- Wastes that pose a threat at the lower end of the risk range may be deemed a low level threat waste.
- Wastes that pose a risk in the middle of the extremes may either be characterized as principal threat or low level threat waste depending on the site-specific factors (e.g., uncertainty).

CURRENT STATUS

FY 91 FORUM

## ROD DOCUMENTATION

<u>Declaration</u>:

- **Characterize the wastes**
- **Discuss how the statutory preference for treatment is met**

<u>Decision Summary</u>:

- **Characterize the wastes as principal threat, low level threat waste, or contaminated ground water**
- **Provide supporting rationale**
- **Discuss how the preference for treatment is satisfied**



**ROD DOCUMENTATION:**

Declaration:

- The "Description of the Selected Remedy" section should identify the waste as principal threat, low level threat waste, or contaminated ground water and provide clear rationale.

- The "Statutory Determinations" section of the ROD Declaration should discuss how the selected remedy satisfies the statutory preference requirements of CERCLA section 121 to select remedial actions "in which treatment which permanently and significantly reduces the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants is a principal element . . ."

- The statutory determination is based on the degree that treatment is a principal element and <u>not whether the ROD selected treatment for the principal threat wastes</u>. (Fact Sheet will provide additional guidance)

- Preference for treatment would generally not be met if principal threat waste were the only materials treated but they were a very small portion of the site.

Decision Summary:

- The "Site Characteristics", "Description of Alternatives", and the "Selection of Remedy" sections should identify the wastes as principal threat, low level threat waste, or contaminated ground water and provide supporting rationale.

- The "Statutory Determinations" section, should include a discussion of how the preference for treatment is satisfied or explain why it is not satisfied.

- The statutory determination is based on the degree that treatment is a principal element and <u>not whether the ROD selected treatment for the principal threat wastes</u>.

INNOVATIVE

FY 91
FORUM

# INNOVATIVE TREATMENT TECHNOLOGIES

Office of Emergency and Remedial Response
Office of Waste Programs Enforcement

## INNOVATIVE TREATMENT TECHNOLOGIES

- Agency definition/policy on innovative treatment technologies was developed to standardize the use of terms and to enable the agency to communicate clearly with the public.

- Characterizing treatment as innovative or available in the ROD is important to allow program analyses on the elements. This effort also allows for the identification of those technologies which may need treatability studies.

- Agency policy was developed via work group meetings between OERR, ORD, and TIO (Technology Innovation Office). The policy represents state of the knowledge on immobilization.

- A draft fact sheet was developed and provided to the Regions in March for review and comment.

- The fact sheet is expected to be finalized in the third-quarter of FY'91.

## INNOVATIVE TECHNOLOGY GUIDANCE

**Purpose:**

- **Standardize use of terms.**

**Content:**

- **Agency policy**
- **Classification of Treatment Technologies**
- **Treatability studies**
- **ROD documentation**



## INNOVATIVE TECHNOLOGY GUIDANCE

PURPOSE: Provide guidance on innovative technologies such that the Agency can foster the use of such technologies and evaluate the progress of the program toward these ends.

CONTENT:

- Agency policy/definition of what constitutes innovative treatment technology(ies),
- Classification of Treatment Technologies,
- Agency policy on performance of treatability studies, and
- ROD documentation requirements.

INNOVATIVE

FY'91 FORUM

## AGENCY POLICY

Innovative Treatment Technologies:

- Limited data on performance or cost
- Most are source control technologies
- In-situ treatment technologies

Available Treatment Technologies:

- Available data on performance and cost
- Immobilization of most inorganics
- Incineration of most organics
- Most are wastewater treatment technologies

-3-

## AGENCY POLICY

Characterization of technologies as innovative or available will change over time as we gain experience.

INNOVATIVE TREATMENT DEFINITION:

- Innovative treatment technologies are those technologies where limited data on performance and/or cost inhibit their use for many Superfund types of applications. Innovative treatment technologies are based on the NCP expectations for these technologies (40 CFR 300.430(a)(1)(iii)(E)).
- Because of the general lack of available technologies we anticipate considering innovative technologies at many sites.
- Includes most source control technologies and in-situ treatment technologies.

AVAILABLE TREATMENT TECHNOLOGIES

- Currently includes incineration of organics, immobilization of inorganics, and most waste water treatment technologies.

## CLASSIFICATION OF TREATMENT TECHNOLOGIES

**Source Material - Grouped by primary function:**

- **Destruction/Detoxification**
- **Separation/Recovery**
- **Immobilization**
- **Other**

**Aqueous Material - Grouped by general use categories:**

- **Biological**
- **Chemical/Physical Treatment**
- **Other**

## CLASSIFICATION OF TREATMENT TECHNOLOGIES

TREATMENT TECHNOLOGIES:

- A partial list of innovative and available treatment technologies is provided in the draft Fact Sheet included in the handout that is entitled: "Innovative Treatment Technologies."

- Technologies have been grouped by primary function for source materials and by general categories used in the waste water treatment industry for aqueous materials.

- The category of "other" includes technologies involving multiple treatment functions (e.g., immobilization and thermal destruction) or those technologies that do not fit into a specific category.

- A treatment technology listed as innovative or available may not always fit that category in actual application. If a technology listed as innovative is used in a situation similar to that for which we have extensive data it may be available.

- Assistance on classification of technologies as innovative or available can be obtained through ORD or your Regional Coordinator.

- These categories also serve the purpose of providing some inclination as to the potential need for treatment trains (e.g., separation/recovery technologies will generally be followed by other technologies).

INNOVATIVE

FY91 FORUM

# TREATMENT TECHNOLOGY SYNONYMS

**A listing of preferred terms and commonly used synonyms is provided below.**

| Preferred Term | Synonym | Preferred Term | Synonym |
|---|---|---|---|
| **Destruction/Detoxification** | | **Extraction** | |
| Thermal Destruction | Thermal Treatment | Ex-Situ Thermal Desorption | Enhanced Volatilization<br>Low-Temperature Desorption<br>Low-Temperature Thermal Treatment<br>Thermal Aeration<br>Thermally Enhanced Volatilization |
| Solid-Phase/Bioremediation | Land Farming<br>Land Treatment<br>Land Application<br>Contained Solid-Phase | | |
| **Separation/Recovery** | | | |
| Solvent Extraction | Critical Fluid Extraction<br>Carbon Dioxide Solvent Extraction<br>Propane Solvent Extraction<br>Triethylamine Solvent Extraction | Soil Vapor Extraction (SVE) | Vapor Extraction<br>In-Situ Volatilization<br>Soil Venting |
| | | **Immobilization** | Fixation |

5

## TREATMENT TECHNOLOGY SYNONYMS

- This is a listing of preferred terms and those that have been used historically as synonyms.
- Some of the terms in the synonym column are specific examples of the preferred terms, while others are terms that are out-dated or do not present a clear indication of the technology.
- Thermal treatment is a term that does not clearly convey the technology. It is recommended that thermal destruction be used to mean incineration and thermal desorption be used for extractive type processes.
- The synonyms for solvent extraction are more specific examples of the technology.
- Passive soil venting is not considered treatment. This is similar to the situation on natural restoration.

INNOVATIVE

FY 91 FORUM

## TREATABILITY STUDIES

Treatability Studies

- Are to be conducted early in RI/FS when insufficient data are available
- Will generally be needed for innovative technologies

6

## TREATABILITY STUDIES

- Treatability studies of some scale are expected to be needed for innovative technologies.
- Since most technologies fall within this category, treatability studies should be planned for most sites involving treatment unless data are available to reference for the remedial decision.

INNOVATIVE

FY 91 FORUM

## ROD DOCUMENTATION

ROD Declaration should Include:

- Identification and characterization of treatment alternatives

ROD Decision Summary should Include:

- Identification and characterization of treatment alternative(s)
- Rationale for characterization
- Media/waste type and volume
- Treatability study performance
- Reference of treatability study(ies)

-7-

## ROD DOCUMENTATION

ROD DECLARATION:

- The "Selection Remedy" section should identify the treatment technologies as available or innovative.

ROD DECISION SUMMARY:

The following information should be discussed in the "Description of the Alternatives," "Summary of Comparative Analysis of Alternatives" and the "Selected Remedy" sections of the ROD:

- Identification of treatment alternative(s),
- Characterization of the treatment technology as innovative or available,
- Supporting justification for those situations where a technology is characterized differently from that provided in the examples above,
- Information on the type of media, waste constituents, and volume that will be treated by the treatment technology,
- Information on the performance and effectiveness of treatability studies, and
- References of treatability study(ies), if provided in lieu of a site-specific study.

**DRAFT**

United States Environmental Protection Agency | Office of Solid Waste and Emergency Response | Publication 9380.3-05FS February 1991

# INNOVATIVE TREATMENT TECHNOLOGIES

Office of Emergency and Remedial Response
Hazardous Site Control Division
OS-220W

Quick Reference Fact Sheet

The Environmental Protection Agency believes that it is important to foster the development and implementation of innovative treatment technologies, particularly those technologies which offer the potential for comparable or superior treatment performance or implementability, fewer adverse impacts, or lower cost for similar performance. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) promulgated on March 8, 1990 encourages the evaluation of innovative technologies in developing remedial alternatives. (40 CFR Section 300.430(a)(1)(iii)(E).)

The purpose of this guide is provide guidance on innovative technologies such that the Agency can direct efforts towards fostering the use of such technologies and can evaluate the progress of the program towards these ends. This guide provide a definition of "innovative treatment technology(ies)", examples, guidance on treatability studies, and ROD documentation requirements.

## DEFINING INNOVATIVE TREATMENT TECHNOLOGIES

**Innovative Treatment Technologies** are those technologies where limited available data on the performance and/or cost inhibit their use for many Superfund types of applications. Innovative treatment technologies are considered based on the NCP expectations for these technologies (40 CFR 300.430(a)(1)(iii)(E)). That is to say, innovative technologies are generally considered when they offer the "potential for comparable or superior treatment performance or implementability, fewer or lesser adverse impacts than other available approaches, or lower costs for similar levels of performance than demonstrated technologies." Because of the general lack of available technologies we anticipate that at many sites we will consider innovative technologies.

**ANALYSIS OF DEFINITION AS IT APPLIES TO SUPERFUND**

The Superfund program's definition of innovative technologies includes the following:

- "New" technologies that have been demonstrated at the bench- or pilot-scale for a limited number of applications, and

- "Demonstrated" or "available" technologies used in various industries but for which limited data are available for Superfund site applications.

Since the types of materials encountered at Superfund sites (particularly soil and debris) differ from bulk waste generally treated at RCRA facilities, technologies that are commonly employed at a RCRA facility may be considered innovative for a Superfund application.

Although the Agency has selected diverse remedial alternatives for Superfund sites, our experience in the application of these technologies is limited. Immobilization of inorganics and incineration of organics are generally considered proven technologies for which we have extensive experience. However, we have limited experience with many other types of treatment technologies which may be utilized to treat source material. For these reasons, we consider all source control alternative technologies, with the exception of immobilization of most inorganics and incineration of most organics, to be innovative at the present time.

There will be occasions where a demonstrated or proven technology is used in a manner that constitutes an innovative application. For example, incineration of a complex waste containing materials for which we have limited experience (e.g., NOx generating compounds) or innovative applications or designs also may warrant the inclusion of these technologies into the category of innovative technology. The selection of an innovative design for thermal treatment or immobilization is expected to be an infrequent event. RODs should usually identify a generic type of technology (e.g., thermal destruction) rather than a specific design (e.g., rotary kiln) unless specific conditions warrant such as selection. Immobilization of some inorganic compounds (e.g., arsenic, hydrogen cyanide, chromium VI) is considered less proven and also would fall into the realm of innovative treatment.

With regard to ground-water remediation, most technologies selected for ex-situ treatment of ground water have found common usage in the waste water treatment industry and it is believed that these are generally "available technologies" for many Superfund applications. There are a few technologies, and hopefully there will be more in the future, which are or will be considered innovative technologies. In addition, treatment of waste water treatment residuals also may utilize many of the technologies applicable to source material, and these also may be considered innovative.

Conversely, all in-situ technologies for remediating ground water and source material are considered innovative at this time.

We anticipate that the list of remedial alternatives which are characterized as "innovative technologies" in the Superfund program will change over time. Technologies will graduate to the "available technology" category and new technologies will enter the "innovative technology" category. As a result, an annual analysis of Superfund progress will use a consistent definition but the list of technologies that comprise that category will change.

This definition does differ slightly from that which is used in the Agency's Superfund Innovative Technology Evaluation (SITE) program but we believe the differences are justified and should not affect analysis conducted by either program. The SITE program considers three stages of technology development:

(1) Available Alternative Technology - technologies that are fully proven and routinely used at hazardous waste sites.

(2) Innovative Alternative Technology - any fully developed technology for which cost or performance information is incomplete, thus hindering routine use. An innovative alternative technology requires field testing and evaluation before it is considered proven and available for routine use.

(3) Emerging Alternative Technology - a technology in an earlier stage of development. Documentation has involved laboratory testing, and the technology is being developed at pilot-scale prior to field testing at Superfund sites.

For purposes of the Superfund program we have grouped the last two categories under the term "innovative technology." While the Agency will primarily be selecting technologies which fall under the first two categories of the SITE program, there may be situations where an "emerging technology" may also be selected based on developmental efforts conducted at a site. Therefore, for purposes of the Superfund program there does not appear to be a reason for maintaining a separate category for emerging technologies for the Superfund program.

**EXAMPLES**

Table 1 provides a list of treatment technologies which are currently considered "innovative" or "available". The list is not intended to be exhaustive. Most of the technologies listed have been selected in Records of Decisions (RODs); a few additional technologies have been listed because they are believed to have a high potential of being applied to Superfund sites. Other technologies are under development and are innovative technologies. As these are selected as remedial alternatives for Superfund sites they will be added to the list.

Table 2 provides a listing of treatment technology synonyms which will aid in the use of Table 1.

Table 1

**CLASSIFICATION OF TREATMENT TECHNOLOGIES FOR TREATMENT OF SOURCE MATERIALS**[1]

Treatment technologies for source material are grouped based on the primary function for which they are generally used: destruction/detoxification, separation/recovery, immobilization, and other.

**INNOVATIVE**

**DESTRUCTION/DETOXIFICATION**

Bioremediation
- Composting
- Solid-Phase Bioremediation
- Slurry-Phase Bioremediation
- Soil Heaping
- Vacuum-Enhanced Bioremediation
- In-Situ Bioremediation

Chemical Destruction
- Dehalogenation
  - Dechlorination
- Chemical Oxidation
- Chemical Reduction

Thermal Destruction
- Incineration (Organics in the presence of inorganics[2])

---

[1] The list is not all inclusive.

[2] Thermal destruction technologies are generally considered available for most organic wastes. Thermal destruction of organic waste mixed with inorganics (e.g., metals, hydrogen cyanide, nitrous oxide generating compounds) may be innovative if it requires innovative engineering approaches to address emissions problems and/or concerns regarding residuals characteristics.

**Classification of Innovative Treatment Technologies for Treatment of Source Materials (Continued):**

**SEPARATION/RECOVERY**

Chemical/Physical Extraction

- Solvent Extraction
- Soil Washing
- In-Situ Vacuum Extraction
  - Soil Vapor Extraction (SVE)
  - Thermally-Enhanced Vacuum Extraction
- In-Situ Soil Flushing

Thermal Desorption

- Ex-Situ Thermal Desorption
- In-Situ Steam Stripping
- In-Situ Hot Air Stripping

**IMMOBILIZATION**[3]

- Solidification/Stabilization (Organics and select inorganics (e.g., Ar, HCN, Cr(VI))
- Stabilization (Organics and select inorganics (e.g., Ar, HCN, Cr(VI))
- In-Situ Solidification/Stabilization (All wastes)
  - In-Situ Stabilization (All wastes)

**OTHER**[4]

- Ex-Situ Vitrification
- In-Situ Vitrification

---

[3] Immobilization is generally considered innovative when it involves treatment of organics and/or treatment of inorganics which include arsenic, hydrogen cyanide, or chromium(VI). This is primarily due to uncertainty regarding the effectiveness of the technology for these waste types.

[4] The "Other" category includes technologies involving multiple treatment functions (e.g., destruction and immobilization), generally due to the presence of both organics and metals in the source material.

**Classification of Available Treatment Technologies for Treatment of Source Materials:**

**AVAILABLE**[5]

**DESTRUCTION/DETOXIFICATION**

Thermal Destruction

Incineration (Oganics)
- Rotary Kiln Incineration
- Fluidized Bed Incineration
- Liquid Injection Incineration
- Infrared Incineration

**IMMOBILIZATION** (Most inorganics and metals)

- Stabilization
- Solidification/Stabilization
- Sorbent Solidification

## CLASSIFICATION OF TREATMENT TECHNOLOGIES FOR TREATMENT OF AQUEOUS STREAMS[6]

Treatment technologies for aqueous streams are grouped based the categories commonly used in the waste water treatment industry: biological, chemical/physical treatment, and other.

**INNOVATIVE**

**BIOLOGICAL**

In-Situ Biodegradation for Ground Water

**OTHER**

All in-situ treatment methods applied to the saturated zone for ground water remediation.

---

[5] In some cases, modifications of available technologies may be considered innovative.

[6] The list is not all inclusive.

**Classification of Available Treatment Technologies for Treatment of Aqueous Streams:**

**AVAILABLE**[7]

**BIOLOGICAL**

Activated Sludge
Aerobic Treatment
Fixed-film Reactors
Rotating Biological Contactors
Sequencing Batch Reactors

**CHEMICAL/PHYSICAL TREATMENT**

Air Stripping
Carbon Adsorption
Chemical Precipitation
Ion Exchange
Reverse Osmosis
Steam Stripping
Ultrafiltration
UV/Oxidation

[7] In some cases, modifications of available technologies may be considered innovative.

Table 2

## TREATMENT TECHNOLOGY SYNONYMS

A listing of preferred terms and commonly used synonyms are provided below.

| PREFERRED TERM | SYNONYM |
|---|---|
| **Destruction/Detoxification** | |
| Thermal Destruction | Thermal Treatment[8] |
| Solid-Phase Bioremediation | Land Farming<br>Land Treatment<br>Land Application<br>Contained Solid-Phase |
| **Separation/Recovery** | |
| Solvent Extraction | Critical Fluid Extraction<br>Carbon Dioxide Solvent Extraction<br>Propane Solvent Extraction<br>Triethylamine Solvent |
| **Extraction** | |
| Ex-Situ Thermal Desorption | Enhanced Volatilization<br>Low-Temperature Desorption<br>Low Temperature Thermal Treatment<br>Thermal Aeration<br>Thermally Enhanced Volatilization |
| Soil Vapor Extraction (SVE) | Vapor Extraction<br>In-Situ Volatilization<br>Soil Venting[9] |
| **Immobilization** | Fixation |

[8] Thermal Treatment has been used in the past to mean either thermal destruction (e.g., incineration) or thermal desorption (e.g., steam stripping).

[9] Passive soil venting is also a means of ventilating subsurface gases or vapors (such as methane) in the absence of a vacuum. This type of soil venting is not considered treatment.

**TREATABILITY STUDIES**

It is Agency policy that treatability studies will be conducted during the remedial investigation/feasibility study (RI/FS) when there are insufficient data to support the evaluation choice of a treat remedy during the selection process. This policy was provided in the directive entitled: "Advancing the Use of Treatability Technologies for Superfund Remedies" (OSWER Directive No. 9355.0-26, Feb. 21, 1989). The directive points out the importance of treatability studies particularly for "innovative technologies." The importance and need for treatability studies was also identified in A Management Review of the Superfund Program (July 1989).

Treatability studies will be needed for the selection and implementation of innovative treatment technologies except for those situations where sufficient information is available for the treatment technology for similar waste and waste matrix. Currently this information does not exist for most treatment technologies termed innovative. Treatability studies may also be needed for the "available" treatment technologies where insufficient data are available to support the remedy evaluation and/or implementation.

Guidance for designing and executing treatability studies is provided in the Guide for Conducting Treatability Studies under CERCLA, Interim Final, EPA 540/2-89/058, December 1989 and in the Treatability Studies under CERCLA: An Overview, Quick Reference Fact Sheet, Directive 9380/3-02FS, December 1989.

**ROD DOCUMENTATION**

The characterization of a treatment alternative as "innovative" or "available" should be documented in the "Selected Remedy" section of the ROD Decision Summary. The information provided above together with knowledge about the technology and site-specific information should be used to characterize technologies.

The following information should be discussed in the "Description of the Alternatives", "Summary of Comparative Analysis of Alternatives" and the "Selected Remedy" sections of ROD:

- Identification of treatment alternative(s),
- Characterization of the treatment technology as innovative or available,
- Supporting justification for those situations where a technology is characterized differently from that provided in the examples above,
- Information on the media/waste type and volume which

will be treated by the treatment technology,

- Information on the performance and effectiveness of treatability studies, and
- References of treatability study(ies), if provided in lieu of a site-specific study.

**FOR FURTHER INFORMATION**

The appropriate Regional Coordinator for each Region located in the Hazardous Site Control Division/Office of Emergency and Remedial Response or the CERCLA Enforcement Division/Office of Waste Programs Enforcement should be contacted for additional information.

*****************************************************************

NOTICE: The policies set out in this memorandum are intended solely as guidance. They are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this memorandum, or to act at variance with the guidance, based on an analysis of specific site circumstances. The Agency also reserves the right to change this guidance at any time without public notice.

*****************************************************************

FY 91
FORUM

# IMMOBILIZATION AS TREATMENT

Office of Emergency and Remedial Response
Office of Waste Programs Enforcement

## IMMOBILIZATION AS TREATMENT

- Agency policy on the use of immobilization has been developed because of concerns regarding the short- and long-term protectiveness afforded by the immobilization of organic-containing wastes.

- Agency policy was developed via workgroup meetings between OERR, ORD, and OSW. The policy represents state of the knowledge on immobilization.

- A draft Fact Sheet entitled "Immobilization as Treatment" (Publication #9380.3-07 FS), was developed and provided to the Regions in March for review and comment.

- The Fact Sheet is expected to be finalized in third-quarter of FY 91.

FY 91 FORUM

## IMMOBILIZATION GUIDANCE

**Purpose:**

- **Provide guidance on the conditions under which immobilization is appropriate**

**Content:**

- **Definition of Immobilization**
- **Agency Policy**
- **Land Disposal Restrictions**
- **ROD Documentation Requirements**



## IMMOBILIZATION GUIDANCE

PURPOSE: Provide guidance on the conditions under which immobilization is an appropriate treatment technology to employ under the Superfund program.

CONTENT:

This guide provides:

- A definition of immobilization,
- Current Agency policy on the use of immobilization,
- Status of the immobilization as it relates to the RCRA Land Disposal Restrictions, and
- ROD documentation requirements.

FY 91 FORUM

## DEFINITION OF IMMOBILIZATION

Definition:

- **Technologies that limit solubility or mobility of contaminants**

Includes:

- **Stabilization**
- **Solidification/Stabilization**
- **Sorbent Solidification**

Does not include:

- **Solidification**



**DEFINITION OF IMMOBILIZATION:**

- The term "immobilization" is used to mean any of the technologies that limit the solubility or mobility of contaminants, including:
  - Stabilization
  - Solidification/Stabilization
  - Sorbent Solidification

- Solidification is not included as a treatment technology under Superfund.

  Solidification is solely intended to produce a monolith for purposes of structural integrity and does not satisfy the statutory preference for treatment to reduce the toxicity, mobility, or volume (TMV) under Superfund.

FY 91 FORUM

## SUPERFUND POLICY ON USE OF IMMOBILIZATION

- May be appropriate for inorganics, semi-volatile organics and/or non-volatile organics
- Not appropriate for volatile organics
- Pre-treatment required for volatile organics
- Treatability study is needed for semi-volatile and non-volatile organics
- Test method is total waste analysis (TWA)
- Demonstrate significant reduction in mobility



## SUPERFUND POLICY ON USE OF IMMOBILIZATION

Immobilization generally constitutes treatment of wastes to reduce toxicity, mobility, or volume (TMV) in the following circumstances:

- Immobilization of inorganics.
- Immobilization of semi-volatile and non-volatile organics where a treatability study was planned or performed. Treatability studies should generally achieve a 90 percent reduction or greater of the contaminant concentration or mobility (using TWA before and after treatment).
- Non-site specific treatability studies may be used to demonstrate effectiveness but should be referenced and discussed in the RI/FS and the ROD.

Immobilization is not deemed to constitute treatment to reduce TMV in the following circumstances:

- Immobilization of volatile organics. Immobilization cannot contain volatile organics during the treatment process or after the treatment process.
- Immobilization of semi-volatile and non-volatile organics where a treatability study producing data meeting the above criteria is not performed, planned and/or referenced.

FY 91 FORUM

## RCRA LAND DISPOSAL RESTRICTIONS

- **Immobilization is not BDAT for organics**
- **Immobilization may be appropriate for a treatability variance**
- **Treatability test method for a treatability variance employing immobilization of organics has changed**



**RCRA LAND DISPOSAL RESTRICTIONS:**

- RCRA land disposal restrictions (LDRs) are potential ARARs for Superfund waste management.
- While immobilization under Superfund may be treatment to reduce TMV, it may not be able to comply with the LDRs treatment standards.
- Immobilization generally is not appropriate for compliance with existing LDR best demonstrated available technology (BDAT) standards for organics (40 CFR section 268.43). Immobilization does not significantly lower the concentration of hazardous constituents present.
- Immobilization of organics does have a role in the treatability variance process for contaminated soil and debris. (See "Superfund LDR Guide #6A (2nd Edition) Obtaining a Soil and Debris Treatability Variance for Remedial Actions," Superfund Publication #9347.3-06FS, September 1990.)
- The evaluation method specified in Superfund LDR Guide #6A for the immobilization of organic waste (first footnote on page two) has changed since the issuance of the guidance -- Total Waste Analysis (TWA) should be used in lieu of TCLP for organics.

FY 91 FORUM

## ROD DOCUMENTATION

ROD Decision Summary:

- Type of waste
- Constituents in the waste
- Treatability study results

6

## ROD DOCUMENTATION:

The following information should be provided in the "Description of the Alternatives," "Summary of Comparative Analysis of Alternatives," and the "Selected Remedy" sections of ROD:

- Type of waste (i.e., non-volatile organics, semi-volatile organics, volatile organics, or inorganics).
- Constituents in the waste to be remediated by immobilization.
- Treatability study results (literature reference and/or results of site-specific studies) that demonstrate 90 percent reduction or greater in contaminant concentration or mobility using TWA.
- Treatability study results that demonstrate the effectiveness of immobilization to achieve remediation levels.

# DRAFT

United States Environmental Protection Agency | Office of Solid Waste and Emergency Response | Publication 9380.3-07FS February 1991

## IMMOBILIZATION AS TREATMENT

Office of Emergency and Remedial Response
Hazardous Site Control Division Quick Reference Fact Sheet

---

Section 121(b) of CERCLA mandates the EPA to select remedies that "utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable" and to prefer remedial actions in which treatment "permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances, pollutants, and contaminants as a principal element." Immobilization is one such treatment technology which may find application at Superfund sites to meet the CERCLA mandate for treatment. Since immobilization is not generally considered a destructive or removal treatment technology for which treatment effectiveness can most easily be defined, it is important that the Agency establish clear guidelines as to when and under what conditions immobilization satisfies the CERLA mandate.

The purpose of this guide is to provide guidance on the conditions under which immobilization is an appropriate treatment technology under the Superfund program. This guide provides: a definition of immobilization, the current Agency policy on the use of immobilization for Superfund applications, the status of the immobilization as it relates to the RCRA Land Disposal Restrictions, and ROD documentation requirements.

---

### DEFINITION OF IMMOBILIZATION

The term "immobilization" is used to mean any of the technologies which limit the solubility or mobility of contaminants. The term "fixation" has also been used as a synonym for immobilization. Technology types which fall within the realm of immobilization include:

Stabilization
Solidification/Stabilization
Sorbent Solidification

The various immobilization technologies limit solubility or mobility with or without a change in physical characteristics of the matrix. Immobilization may involve physical/chemical processes that do more than simply entrap the contaminants.

**Solidification alone is not included as a treatment technology under the Superfund definition of immobilization because it does not satisfy the statutory preference for treatment to reduce the toxicity, mobility, or volume (TMV) under Superfund.** The term "solidification" implies a treatment technology which is intended to produce a monolith for purposes of structural integrity. Since the principal purpose of solidification is structural integrity, it does not qualify as treatment under Superfund for purposes of reduction of TMV. Solidification performed in conjunction with stabilization (i.e., solidification/stabilization), however, would satisfy the preference for treatment under Superfund and falls within the Superfund program's definition of immobilization.

**IMMOBILIZATION AS A TREATMENT ALTERNATIVE**

Concerns have been raised regarding the types of immobilization that provide for adequate protection. The principal reason for these concerns rest on the fact that immobilization is not generally considered a destructive technique but rather prohibits or impedes the mobility of contaminants.

Although experts are in general agreement regarding the effectiveness of immobilization for most inorganics and metals, the effectiveness of immobilization for organics cannot be predicted without testing. Furthermore, the testing methods available (i.e., leachability tests) provide different types of information on the mobility of contaminants depending on the test. For these reasons, Superfund has developed general guidelines for evaluating and selecting immobilization taking into consideration the testing methods currently available, scientific understanding to date, and the NCP expectations regarding treatment.

The preamble to the NCP (55 FR Page 8701, March 8, 1990) provides the following guidance regarding treatment effectiveness:

> "...The Superfund program also uses as a guideline for effective treatment the range 90 to 99 percent reduction in the concentration or mobility of contaminants of concern....EPA believes that, in general, treatment technologies or treatment trains that cannot achieve this level of performance on a consistent basis are not sufficiently effective and generally will not be appropriate."

The use of any treatment technology, including immobilization, needs to be weighed against this policy and current knowledge regarding the technology application.

**SUPERFUND POLICY ON USE OF IMMOBILIZATION**

This guide provides Agency policy on the use of immobilization for treatment in view of concerns that have been raised regarding technology performance primarily for organics. The Superfund policy is as follows:

> **Immobilization** is generally appropriate as a treatment alternative only for material containing inorganics, semi-volatile and/or non-volatile organics. Based on present information, the Agency does not believe that immobilization is an appropriate treatment alternative for volatile organics. Selection of immobilization of semi-volatile and non-volatile organics generally requires the performance of a site-specific treatability study or non-site-specific treatability study data generated on waste which is very similar (in terms of type of contaminant, concentration, and waste matrix) to that to be treated and that demonstrates, through Total Waste Analysis (TWA), a significant reduction (i.e., a 90-99 percent reduction) in the concentration of chemical constituents of concern[1].

The need for treatability study data and the importance of conducting appropriate leachability tests as part of the study, are important parts of this policy statement. Treatability studies to demonstrate the effectiveness of treatment of organics is needed since we do not believe that we can predict the degree of performance which may be provided without such testing. Although immobilization has a long history of application for inorganics, treatability testing may also be advisable for site specific cases for both inorganics and organics constituents where we have insufficient data.

EPA believes that given the uncertainty associated with immobilization of organics, the most stringent leachability test available (i.e., TWA) should be used to demonstrated the effectiveness of the technology. A successful demonstration using TWA provides a measure of assurance regarding the leachability of the organics. TWA does not mirror environmental conditions, however, and does not provide information on the protectiveness under specific management scenarios for the immobilized product. One or more other leachability tests may

---

[1] The 90-99 percent reduction in contaminant concentration is a general guidance and may be varied within a reasonable range considering the effectiveness of the technology and the clean-up goals for the site. Although this policy represents EPA's strong belief that TWA should be used to demonstrate effectiveness of immobilization, other leachability tests may also be appropriate in addition to TWA to evaluate the protectiveness under a specific management scenario.

also be used in conjunction with TWA to ensure that the remedy is protective and can meet the remediation levels for the site-specific conditions.

Immobilization is not currently viewed as an effective treatment method for volatile organics since these compounds will be released during treatment as well as following treatment. Alternative treatment methods should be evaluated to destroy or remove the volatile organics to remediation levels either prior to or concurrently with immobilization. A treatability study will be needed to demonstrate the effectiveness of the destruction or removal treatment technology through measurement of emissions.

The Superfund policy on immobilization is based on current knowledge with regards to immobilization effectiveness. This policy may change in the future as we gain knowledge on the use of immobilization and leachability testing.

**POLICY ANALYSIS**

The immobilization policy focuses principally on the appropriate use of the technology as a treatment alternative. The performance of the technology against site specific remediation goals also needs to be considered in the evaluation of the treatment technology.

The policy is broken down into various components to clarify when immobilization will and will not be considered to constitute treatment to reduce TMV under Superfund:

**Immobilization generally constitutes treatment of wastes to reduce TMV in the following circumstances:**

- Immobilization of inorganics.[2]

- Immobilization of semi-volatile and non-volatile organics contaminants of concern where a treatability study was performed during the RI/FS or is planned during the RD/RA, and the performance achieved or performance goal is generally 90 percent reduction or greater of the contaminant concentration or mobility using TWA before and after treatment.

---

[2] Treatability tests for immobilization of inorganic wastes may be appropriate in situations where insufficient data is available to support remedy selection or implementation.

- Immobilization of semi-volatile and non-volatile organics where non-site-specific data (treatability or full scale operational data) are available for similar wastes (in terms of contaminants, concentration, and waste matrix), and the performance achieved was generally 90 percent reduction or greater in the concentration or mobility of contaminants of concern using a TWA before and after treatment. The reference for the treatability study report and a discussion of the data applicability at this site was provided.

**Immobilization is not deemed to constitute treatment to reduce TMV in the following circumstances:**

- Immobilization of volatile organics.[3]

- Immobilization of semi-volatile and non-volatile organics where a treatability study producing data meeting the above criteria is not performed, planned and/or referenced.

**ANTICIPATED APPLICATIONS OF IMMOBILIZATION**

Immobilization is most commonly accepted as an appropriate remedy for wastes which contain only inorganics or high levels of inorganics in combination with semi- and/or non-volatile organics which would not in themselves result in a waste being deemed a principal threat. For example, a waste may contain elevated levels of lead and a low-level concentration of a relatively immobile organic (e.g. PCBs). In such a case one could immobilize the waste for the metal but the organic might not be targeted for treatment since it is at levels at which engineering controls would be more appropriate. A treatability study for the organics would not be needed unless we were attempting to achieve a significant degree of treatment (e.g., 90 percent or greater reduction in mobility) for purposes of protectiveness. A treatability study would need to be conducted, if the organics were of concern and immobilization was being used to treat those constituents. A treatability study would also be needed for the inorganics if insufficient information is available to support the remedy decision for these constituents.

---

[3] This general statement does not apply to carbon adsorption of volatile emissions which is followed by carbon regeneration or treatment. Carbon adsorption has found wide acceptance for volatile organic control from air emission sources and waste water treatment facilities.

Although treatment of high levels of organics may be achievable with immobilization, the Agency is recommending that alternative treatment technologies be evaluated in addition to immobilization, or that treatment trains (which combine pre-treatment or concurrent treatment to destroy or remove the organics together with immobilization) be evaluated. Treatment technologies which have found application to organic wastes include destructive or removal technologies such as thermal destruction, thermal desorption, solvent extraction, etc. If pre-treatment or concurrent treatment is evaluated to address the organics, the technology should generally be able to achieve a significant reduction of the organics constituents (i.e., 90 percent reduction or greater or a level that is deemed protective under the reasonably expected use scenarios).

Since immobilization is not currently considered a viable treatment alternative for volatile organic materials, an alternative treatment method to immobilization (i.e., use of a pre-treatment or concurrent treatment method) should be used to remove or destroy the volatile organics to remediation levels. Treatability study data are required to demonstrate the destruction or removal of the volatile organics to these levels.

**EXAMPLES**

Examples of immobilization which constitute treatment:

- The waste matrix contains inorganics at concentrations that represent a principal threat and high molecular weight organics that are low-level threat wastes since they are near above unrestricted use levels and are relatively non-mobile under the current and future environmental conditions. The disposal of the treatment product would generally require engineering controls since the organics would generally be above levels of concern. Selection of immobilization would constitute treatment to reduce TMV for the inorganic if it met the remediation goals for the inorganics since the waste warrants treatment solely due to the presence of inorganics.

- The waste matrix contains mobile semi- and non-volatile organics at concentrations that represent a principal threat. A treatability study is conducted that shows that the concentration or mobility of the organics is reduced 90 percent or greater by using TWA before and after immobilization. The treatability study is documented in the ROD. Immobilization of the organics constitutes treatment to reduce TMV since a treatability study verified its probable performance which was documented in the ROD.

- o The waste matrix contains inorganics at levels deemed appropriate for treatment (i.e., principal threat) and semi- and non-volatile organic contaminants at levels deemed appropriate for containment (i.e., low-level threat). Treatment of the both types of wastes is selected based on economies of scale (cost effectiveness) and treatability study data which demonstrate a 90 percent reduction in the concentration or mobility for both inorganics and organics of concern. Immobilization of the organics and inorganics constitutes treatment to reduce TMV because a treatability study was conducted and documented showing effective treatment of the organics.

Examples of immobilizations which generally do not constitute treatment to reduce TMV:

- o The waste matrix contains inorganics that due to mobility and concentration result in the waste matrix being deemed a principal threat and volatile organics which result in emissions above levels that are protective. Immobilization would generally count as treatment to reduce TMV for the inorganics but not for the volatile organics which would volatilize during the immobilization process and may continue to volatilize after completion of the remedy. Pre-treatment to remove or destroy the volatile organics to remediation levels established in the ROD is generally required.

- o The waste matrix contains mobile semi- and non-volatile organics at levels which constitute a principal threat. A treatability study was not conducted, treatability study data of similar waste was not documented in the ROD, and a treatability study is not planned post-ROD. Immobilization would generally not constitute treatment to reduce TMV in this situation since the waste warrants treatment due to the presence of the organics and a treatability study was not performed, planned, or documented.

**RCRA LAND DISPOSAL RESTRICTIONS**

CERCLA remedial actions must comply with the requirements of the Resource Conservation and Recovery Act (RCRA) when they are determined to be applicable or relevant and appropriate requirements (ARARs) unless a waiver is justified. Potential ARARs for CERCLA responses include the RCRA land disposal restrictions (LDRs) established under the Hazardous and Solid Waste Amendments (HSWA). The LDRs prohibit the land disposal of restricted RCRA hazardous wastes unless these wastes meet treatment standards specified in 40 CFR Part 268, meet the minimum technology requirements during a national treatment capacity extension, or satisfy the requirements of one of the other available compliance options (i.e., treatability variance, equivalent treatment method, no migration demonstration, or delisting).

While immobilization may be treatment to reduce TMV, it may not be able to comply with the LDRs, which are based on best demonstrated available technology (BDAT). In setting BDAT, the Agency can decide that BDAT involves destroying or recovering the hazardous constituents, or that decreasing the mobility represents BDAT. To date, immobilization has been selected as BDAT only for metals. Immobilization is not generally appropriate for compliance with existing BDAT standards for organics (40 CFR Part 268.43) because it serves to dilute the waste, lower the effectiveness of the analytical method, and not significantly lower the amount of hazardous constituents present.

Immobilization of organics does have a role in the treatability variance process for contaminated soil and debris. The fact sheet entitled: Superfund LDR Guide #6A (2nd Edition) Obtaining a Soil and Debris Treatability Variance for Remedial Actions, Superfund Publication 9347.3-06FS, September 1990 should be consulted for guidance on applying this variance.

The evaluation method specified in Superfund LDR Guide #6A for the immobilization of organic waste (first foot-note on page two) has changed since the issuance of the guidance. The September 1990 guidance specified the "TCLP method" but should read TWA. The revised foot-note should read:

> "**TWA** should be used when evaluating wastes with relatively low levels of organics that have been treated through immobilization."

As stated previously, TWA is believed to provide a more stringent test of the immobilization and the potential degree of chemical interaction which may have occurred.

The treatability variance guidance for soil and debris (as modified above) will apply on a case-by-case basis until final LDR soil and debris standards are issued.

**ROD DOCUMENTATION**

The Record of Decision (ROD) should indicate clearly what materials are targeted for treatment by immobilization and the rationale that supports the selection of immobilization. The following information should be provided in the ROD for immobilization to be characterized as treatment to reduce TMV:

- Type of waste (i.e., non-volatile organics, semi-volatile organics, volatile organics, or inorganics),

- Constituents in the waste to be remediated by immobilization,

- Treatability study results (literature reference and results of site-specific studies) which demonstrate 90 percent reduction or greater in contaminant concentration or mobility using TWA.

- Treatability study results that demonstrate the effectiveness of immobilization to achieve remediation levels.

This information should be provided in the "Selected Remedy" section of the ROD Decision Summary to ensure that it is documented appropriately. This information also should be provided in the "Description of the Alternatives", "Summary of Comparative Analysis of Alternatives" and the "Selected Remedy" sections of ROD. Please refer to the Interim Final Guidance on Preparing Superfund Decision Documents (OSWER Directive 9355.3-02, November 1989) for additional information on ROD documentation.

**FOR FURTHER INFORMATION**

The appropriate Regional Coordinator for each Region located in the Hazardous Site Control Division/Office of Emergency and Remedial Response or the CERCLA Enforcement Division/Office of Waste Programs Enforcement should be contacted for additional information.

*****************************************************************
NOTICE: The policies set out in this memorandum are intended solely as guidance. They are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this memorandum, or to act at variance with the guidance, based on an analysis of specific site circumstances. The Agency also reserves the right to change this guidance at any time without public notice.

*****************************************************************

EXAMPLE ROD

## EXAMPLE ROD

The final ground water Record of Decision for the Mystery Bridge Site has been included in this portion of your handbook to serve as an example of a well-prepared decision document. It is not a "model ROD" (see ROD checklists for standard content and language) but represents a concise well-written document which clearly outlines the history of the site, current problems posed by site contamination, the options considered to address the problems, and the reason/rationale for selecting a particular alternative. Editorial notes/comments have been inserted throughout the text to highlight current program policies and guidance as it relates to ROD documentation.

## I. SITE NAME, LOCATION AND DESCRIPTION

The Mystery Bridge Road/U.S. Highway 20 (Mystery Bridge) Superfund site (Figure 1) is located in Section 5, Township 33N, Range 78W 6th P.M. in Natrona County, one mile east of Evansville, Wyoming. The site includes two residential subdivisions (Brookhurst and Mystery Bridge) and an industrial area to the south where certain hazardous materials have been used. The site is bordered on the north by the North Platte River, on the west by the Sinclair/Little America Refining Company (LARCO), and on the south by U.S. Highway 20. Mystery Bridge Road and the Mystery Bridge subdivision extend along the eastern perimeter of the site.

Topography of the area varies from flat or gently sloping to slightly rolling. The slope of the land surface is less than 2 percent but ranges between 7 and 25 percent along the banks of the North Platte River. The 100- and 500- year floodplains are within 50 to 100 feet of Elkhorn Creek and the North Platte River. Because of upstream reservoir regulation, the relatively large channel capacity of the river and rare heavy precipitation events, the North Platte River does not have an extensive history of flooding.

Drainage is mainly overland flow to man-made diversion structures and to Elkhorn Creek. Elkhorn Creek is a perennial stream that crosses the site and flows in a northeasterly direction into the North Platte River. Water from Elkhorn Creek is used for washing equipment at industrial facilities. During the summer, water is diverted for irrigation of nearby fields.

The Mystery Bridge site is underlain by an alluvial aquifer which previously served as a water supply to all of the homes in the area. After discovery of organic compounds in water from this aquifer, all but six of these homes began using other water sources. Currently only two wells in the residential area are being used to provide drinking water. The alluvial aquifer is also used for fire fighting by KNEnergy, Inc. (KN). The uppermost bedrock aquifer, the Teapot Sandstone formation, provides water to a number of industrial wells in the area of the site. Except for ground water, no other natural resources on the site are used. The North Platte River is used for recreational fishing.

The residential area, located on the northern two thirds of the site, consists of 125 lots which range in size from two to five acres. Houses were constructed on approximately 100 of these lots between 1973 and 1983. According to population data collected in 1987, approximately 400 people lived within the Brookhurst subdivision. In addition, approximately 250 people comprised the work force for the industrial properties bordering the residential area. Within a 1-mile radius of the study area, the total work daytime population is approximately 1000 people. The population within a 3-mile radius was approximately 3000 people, which included 2160 people in the community of Evansville.

An industrial area is located along the southern perimeter of the site to the south of the Burlington Northern Railroad (BNRR) right-of-way and north of the highway. Present industrial operations at the site include companies which provide oil field services, bulk fuel storage for local delivery, natural gas processing and compressing, and supply commercial chemicals. Several petroleum refineries operate to the west of the site. Other businesses located along U.S. Highway 20 include truck sales, grading, moving and storage, and public utilities.

Past and present surface and subsurface storage units and other structures at the site include several underground and above ground storage tanks, abandoned drums, an unlined waste pond and a concrete lined waste pond. Although several of the units have been removed, these features have released contaminants from the industrial facilities at the site and are discussed in detail in the next section.

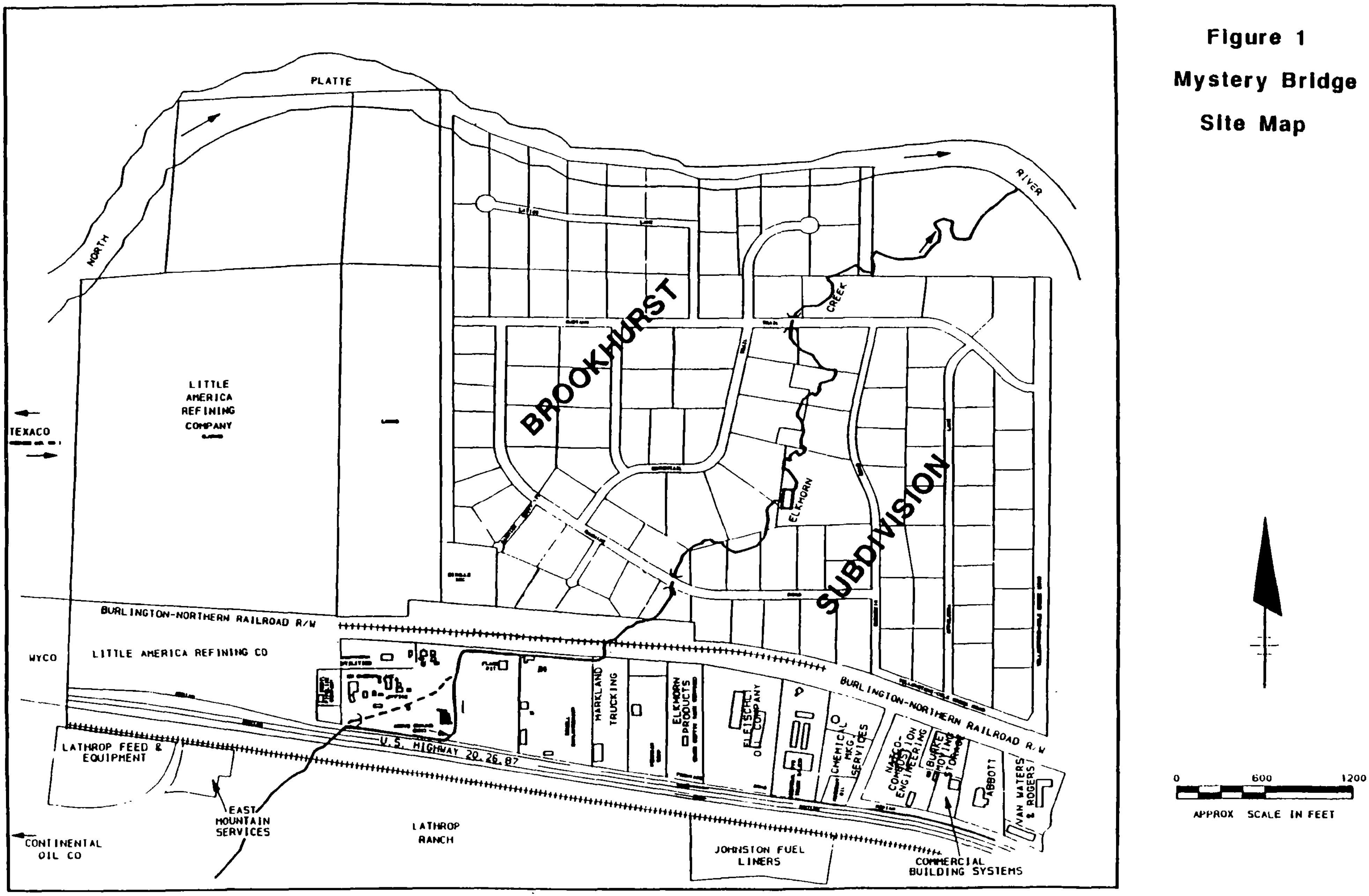



**Figure 1**

**Mystery Bridge**

**Site Map**

## II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

### Initial Investigations

In August of 1986, residents complained of poor air and water quality in and around the residential subdivisions. As a result, the Wyoming Department of Environmental Quality (WDEQ), the Natrona County Health Department and the Office of Drinking Water in EPA Region VIII began an investigation of the site. Results of early sampling activities indicated organic compounds in residential wells and tap water. Residents were advised not to use their well water for drinking or food preparation purposes. In the same year, the State of Wyoming began providing bottled water to residents. Under the Superfund Removal Program, EPA took over the lead responsibility for removal activities including providing bottled water. As part of the removal program, EPA also installed monitoring wells and conducted sampling programs to further investigate the release of contaminants and gather information to evaluate the need for further removal action.

The Agency for Toxic Substances and Disease Registry (ATSDR) assessed the public health risk posed by volatile organic compounds in the ground water at the site. ATSDR determined that there was an imminent and significant health threat to site residents and that if action were not taken within one year, the levels of contaminants would increase the lifetime cancer risk for individuals drinking well water from the area.

In March 1987, EPA began an Expanded Site Investigation (ESI) to further define the nature and extent of contamination in air, soil, surface water and ground water at the site and to respond to community concerns. The ESI delineated several potential plumes of ground water contamination and identified several potential sources of contaminants. Based on the findings of the ESI, the Mystery Bridge site was proposed for the National Priorities List (NPL) in June of 1988. Listing of the Mystery Bridge site on the NPL was finalized on August 28, 1990.

The ESI concluded that one or more contaminated ground water plumes originate near the Dow/DSI property, and that another ground water plume resulting from the release of aromatic hydrocarbons originates near the KN facility. The report also concluded that soils at the Dow Chemical Company and Dowell-Schlumberger Inc. (Dow/DSI) facility were contaminated and soils at KN could be contaminated. A third major plume was identified as entering the subdivision from the LARCO property to the west.

The LARCO facility is under the authority of the Resource Conservation and Recovery Act (RCRA) and was not investigated as part of the CERCLA activities at the Mystery Bridge site. The contamination associated with the LARCO facility is being addressed through a unilateral 3008(h) corrective action order issued on December 1, 1988 on which LARCO and EPA are negotiating a consent decree. The contaminated ground water (referred to as the RCRA plume) is believed to be made up of floating petroleum/hydrocarbon products.

Based on an imminent and substantial endangerment to public health revealed by the ESI, EPA decided to supply an alternative permanent water system for the subdivision. The water supply project was separated into two phases: Phase I included the design and construction of a water transmission line from the municipal water supply in Evansville to the site and a distribution system throughout the residential area; Phase II involved upgrading the Evansville water filtration facility and included the design and construction of a new water intake and its corresponding pump station, a new transmission line from the new intake to the Evansville water filtration facility, and a new sedimentation basin. Phase II was required because the existing intake was below the Casper wastewater treatment plant discharge and the water quality was unacceptable. The system was put into operation in January 1989.

Concurrent with the initial scientific studies, EPA also conducted research to identify potentially responsible parties (PRPs), parties who may be liable pursuant to CERCLA, for the clean up of contamination at the site. Notice letters regarding removal actions and remedial activities were sent in late 1986 and 1987 to various PRPs identified including Dow Chemical Company, Dowell-Schlumberger, Inc., and KNEnergy, Inc.

Pentachloraphenol (PCP) was detected in two soil samples and several wells located on the BNRR right-of-way. Over 60 abandoned 55-gallon drums were also found on the property. Analysis of samples from the drums indicated that 11 of the drums contained aromatic hydrocarbons and other chemical compounds. These drums were relocated to a BNRR freight building. The remaining drums were found to contain typical trash and were disposed of by WDEQ. In 1988, a soil contamination study conducted at the BNRR property concluded that soil underlying the drums was not contaminated.

**Removal Actions**

In December 1987, KN and Dow/DSI each entered into Administrative Orders on Consent to perform removal actions at their respective facilities. Dow/DSI and KN agreed to take immediate actions to control suspected sources of ground water contamination on their respective properties and to prevent further migration of contaminated ground water into the subdivision.

<u>Dow/DSI:</u> The Dow/DSI facility uses mobile mounted pumps, tanks and other associated equipment to perform oil and gas production enhancement services for the oil and gas industry. Dow/DSI performs its own truck repair and stores solvents in drums on site.

A gravel leach sump for disposal of truck wash water located on the western portion of the property had been in operation since shortly after the facility began operations. The wash water is believed to have contained chlorinated solvents. Also located on the western part of the property, a 1000-gallon underground oil/water separator tank was used to separate oil film and solids washed from trucks. Separated wash water left the separator and flowed through a vitreous tile drain to the leach sump system. A toluene storage area was located at the north end of the facility. Contaminants were released from both the wash water disposal system and toluene storage area.

Because of these releases and the resulting contamination, and in accordance with the Administrative Orders on Consent, Dow/DSI prepared an Engineering Evaluations/Cost Analysis (EE/CA) report to document the extent and nature of the releases of contaminants, and to propose expedited removal actions to control migration of contaminants and eliminate sources of contaminants beneath and adjacent to their property. As a result of drilling and sampling activities at the Dow/DSI facility in 1987, several volatile halogenated organic (VHO) soil contaminants were identified in the ground water and soil near the abandoned chlorinated sump area. The VHO group includes chlorinated organic compounds. The EE/CA prepared by Dow/DSI evaluated removal technologies and recommended a removal action that was then implemented.

Removal activities at the Dow/DSI facility began in January 1988. This removal included the excavation and off-site landfilling of approximately 440 cubic yards of contaminated surface soils from the chlorinated sump area. The oil/water separator, the decommissioned waste oil tank and portions of the vitreous tile drain were also removed from the site. A soil vapor extraction (SVE) system was used in the chlorinated sump area and removed over 300 pounds of contaminants from the soil. Almost 6,000 pounds of solvents were removed from soils from the toluene storage area using a SVE system.

KN: KN has operated a natural gas fractionation, compression, cleaning, odorizing, and transmission plant at the site since 1965. Operational maintenance activities are performed on-site.

Originally constructed as an earthen impoundment, a flare pit was used to collect spent material generated by the facility. Materials that may have been placed in the flare pit include: 1) crude oil condensate; 2) absorption oil; 3) emulsions, antifoulants, and anticorrosive agents; 4) liquids accumulated in the flare stack; 5) potassium hydroxide treater waste; and 6) lubrication oils and blowdown materials from equipment in the plant. In October 1984, the western half of the impoundment was backfilled and a new concrete lined flare pit was constructed on the eastern half. Use of the flare pit was discontinued and the pit was decommissioned in 1987. Waste streams formerly collected in the flare pit were rerouted into above storage tanks for temporary storage or recycling.

A catchment area, a low spot in the ground just west of Elkhorn Creek, collected surface run-off water containing contaminants from the plant area and steam condensate from the dehydration unit. Various activities were undertaken by KN to reroute materials away from this area in 1984.

In 1965, an underground pipe burst during facility start-up and 5,000 to 10,000 gallons of absorption oil were injected under pressure into the ground beneath the process area. Absorption oil is used at the KN processing facility to remove impurities from the natural gas stream. Other releases occurred between 1965 and 1987 in the form of small leaks and spills near the flare pit and catchment area.

Because of these releases and the resulting contamination, and in accordance with the Administrative Order on Consent, KN prepared an EE/CA report. An investigation was conducted as part of the EE/CA for removal actions at the KN facility. A soil vapor survey was conducted in the vicinity of the flare pit, and soil boreholes and ground water were sampled. Additional samples were collected from soils between the concrete flare pit and the flare stack, and also beneath the concrete flare pit. Several aromatic hydrocarbon contaminants were identified in the soils and ground water near the flare pit. Benzene, ethylbenzene, toluene and xylenes (BETX) are included in the aromatic hydrocarbons group. A floating layer of BETX contaminants was identified during subsequent ground water sampling at the KN facility. Based on additional drilling and sampling, aromatic hydrocarbons were identified within the boundaries of a section of soil that is stained by what is believed to be absorption oil from past releases in the process area and flare pit location. The stained soil on the KN property extends across the northeastern portion of the Dow/DSI property, through the railroad right-of-way and slightly into the residential area.

In November 1989, removal actions designed to remove BETX contaminants from the ground water and soil beneath the KN facility began. Pursuant to this removal action, volatile BETX contaminants are being removed from the ground water and soil using a SVE system and a ground water treatment system. As of July 31, 1990, the KN removal system had recovered approximately 6,000 gallons of BETX contaminants and has extracted approximately 135 pounds of benzene from the soils and ground water beneath the KN facility.

**Remedial Investigation/Feasibility Study (RI/FS)**

In December 1987, an Administrative Order on Consent was issued to Dow/DSI and KN requiring them to conduct a Remedial Investigation/Feasibility Study (RI/FS) to characterize the extent of contamination and identify alternatives for cleaning up the site. The RI/FS report, which was completed in June 1990, concluded that two plumes of contaminated ground water originate in the industrial area south of the subdivision and are migrating through the subdivision in a northeast direction. The first of these plumes is contaminated with VHO compounds (referred to as the VHO plume), and extends from the Dow/DSI facility to the North Platte River. The second plume is contaminated with BETX compounds (referred to as the BETX plume), and extends from the KN facility to the BNRR property and possibly into the subdivision directly north of the KN facility. In addition, a layer of BETX contaminants originating at the KN facility and extending slightly into the subdivision was found floating on the ground water.

PCP contamination near the BNRR property that was identified during the ESI was not detected in subsequent ground water sampling conducted for the RI/FS. However, EPA will further address the PCP contamination during activities conducted for the second operable unit for the site which will evaluate contaminant source areas as discussed in Section IV.

The RI/FS also identified areas of contaminated soils related to the industrial properties at the site including Dow/DSI, KN, Van Waters and Rogers, NATCO, Sivalls, Permian, and Mobile Pipeline. Much of this soil has been removed or cleaned up as part of the removal actions described above. However, some underground soil contamination remains in the industrial area of the site. This contamination will be addressed during the studies conducted for contaminant source areas of the Mystery Bridge site (see Section IV).

As part of the RI/FS, in September 1989, EPA prepared a baseline risk assessment (BRA) to estimate potential health and environmental risk which could result if no action were taken at the site. The BRA indicated that exposure to ground water could result in significant risks due to contaminants at the site. Details of the BRA are summarized later in Section VI.

The RI/FS, completed in June 1990, suggested that ground water plumes of VHO compounds emanating from the Dow/DSI property and BETX compounds emanating from the KN property are not commingled in the area downgradient from the Dow/DSI and KN facilities. The data also suggested the VHO plume could be commingled with the RCRA plume. Since the most recent data contained in the RI/FS was from ground water samples taken in September and October 1989, EPA requested the data be updated prior to issuing this ROD to determine if these conditions had changed.

In July 1990, ground water samples from 20 wells were collected by consultants for Dow/DSI (with split samples obtained by EPA and consultants for KN) and analyzed for selected VHO and BETX compounds. The primary objectives of this sampling were to further assess possible commingling of the contaminant plumes and to investigate the current degree of contamination as it may have been affected by the ongoing KN removal action. Results of the July sampling suggest that there is no current commingling of the VHO plume with the BETX plume nor the VHO plume with the RCRA plume. The July 1990 data are somewhat conflicting with historical data with respect to BETX compounds in the ground water northeast of the KN property line and the volume of the BETX plume appears to be greater than that estimated in the RI/FS.

## III. HIGHLIGHTS OF COMMUNITY INVOLVEMENT

Community interest in problems at the Mystery Bridge site became very intense in late 1986 when site contamination problems first surfaced and the ATSDR advisory was issued. Early public meetings, many of which were attended by as many as 100 people, often became highly emotional encounters between concerned residents and public officials. Media coverage was extensive, including coverage by local and State newspapers and television stations, as well as some national television coverage.

State legislators and Congressional staff members took a great interest in site activities. The community's letter-writing campaign extended to the White House.

Initial community involvement was coordinated by an EPA removal program community relations coordinator, as well as by an EPA field liaison, EPA's representative in Casper, and the Emergency Response Branch's On-Scene Coordinator for the site.

EPA's removal community relations coordinator prepared a Community Relation Plan in December 1986. The Plan was revised in November 1988 by the remedial community involvement coordinator.

Between December 1986 and July 1987, EPA held five public meetings. From December 1986 through October 1989, EPA issued five Fact Sheets and 14 Information Updates. In January 1990, EPA distributed a Fact Sheet on the risk assessment for the site. In addition, EPA provided for public comment on work plans, sampling plans, the Community Relations Plan, alternative water supply options, and other key documents throughout site activities. EPA issued responsiveness summaries for comments received during these comment periods.

From April 1987 through June 1988, EPA representatives participated in a Governor's Task Force and Oversight Committee on a regular basis. From June 1988 through October 1989, EPA worked with WDEQ and the Natrona County Health Department to continue a monthly forum for discussing issues with community members.

To further fulfill the requirements of CERCLA/SARA Section 113 (k)(2)(i-v) and Section 117, the Administrative Record file for the removal actions was established at EPA's Denver office and at EPA's Wyoming field office in Casper. EPA also provided a copy of the record to one community group who requested it under the Freedom of Information Act (FOIA). The Administrative Record for the remedial activities was established at the Natrona County Library in Casper and in EPA's Denver office.

The Proposed Plan for OU 1 was issued on July 3, 1990 with a one-quarter page advertisement placed in the *Casper Star Tribune* on July 1, 1990 outlining remedial alternatives and announcing the public comment period and public meeting. The public comment period was open from July 5 to August 3, 1990. The public meeting was held July 18, 1990 at the Casper City Council Chambers. A transcript of the public meeting is included in the Administrative Record.

Approximately five community members attended the Proposed Plan public meeting. Two oral comments were received at the public meeting and three sets of written comments were received during the public comment period.

Details of community involvement activities and responses to official public comment on the Proposed Plan are presented in the Responsiveness Summary attached to this ROD.

## IV. SCOPE OF ROLE OF OPERABLE UNIT WITHIN SITE STRATEGY

The Mystery Bridge site has been divided into two operable units: one to address ground water (OU 1) and the other to evaluate contaminant source areas (OU 2). The remedy selected in this ROD is for the first operable unit and addresses the contaminated ground water emanating from the Dow/DSI and KN facilities. This ground water poses the principal threat to human health and the environment due to ingestion of and contact with water from wells that contain contaminants above the Maximum Contaminant Levels (MCLs) established by the Safe Drinking Water Act.

use of the term "principal threat" should be [reser]ved for source material and as such, aids in concluding whether the statutory preference for [tre]atment as a principal element is met. Groundwater * is better portrayed as a "primary risk", although pools of contaminants such as the floating BETX layer are considered sources.

EPA will evaluate remaining source areas in OU 2 and, as necessary, will determine whether further action is required for contaminated subsurface soils in the vicinity of the industrial properties that were identified during the RI/FS and represent possible continuing sources of ground water contamination. Questions raised by comments received during the public comment period regarding the BNRR property will be further evaluated during OU 2.

EPA believes additional consideration of the contaminant source areas is necessary to ensure the long-term effectiveness of the ground water clean up. The RI focused primarily on contaminated ground water and did not address mechanisms which may transport contaminants from soils to water. Removal actions for the Dow/DSI and KN facilities prevent further migration from source areas into residents' ground water. Questions remain concerning the ability of the removal actions to eliminate sources of contamination. For example, the SVE and hydrocarbon recovery activities at the site may not be effective on soils below the ground water. There are also inherent technical difficulties in cleaning the stained soil areas above the ground water and the floating BETX contaminants.

## V. SITE CHARACTERISTICS

### Site Geology and Hydrology

The site is located within a narrow strip of Quaternary alluvial floodplain and terrace deposits along the North Platte River and Elkhorn Creek. The upper 1.5 to 13 feet of the alluvial deposit is a surficial soil layer which consists of a mixture of sandy silt and clayey silt. The remaining alluvium ranges in thickness from 13 to 68 feet. It is well-sorted coarse to medium sand with little fine sand and trace amounts of silt and gravel.

Bedrock crops out to the southeast and northwest of the site. In the uppermost 200 to 300 feet of bedrock the formations are in ascending order: 1) Teapot Sandstone, consisting of medium- to fine-grained sandstone with shale partings and 2) the Lewis Shale, consisting of thick bedded shale grading into brown sandstone.

The bedrock surface at the site is beneath a layer of alluvium. A clay layer indicating weathered bedrock was encountered at the contact between the alluvium and bedrock in almost every borehole. A valley in the bedrock surface that roughly parallels the present course of Elkhorn Creek was also identified. This valley was probably eroded by a former course of the North Platte River. Bedrock elevations increase on both flanks of the valley. To the east, this increase is part of a divide separating the site from an adjoining drainage. The alluvium pinches out in the east, restricting movement of ground water towards the residential area. The bedrock surface is less regular to the northwest. A comparison of bedrock surface topography to alluvial ground water flow directions shows that the shape of the bedrock valley significantly affects ground water movement in the alluvial aquifer. The low permeability layer at the bedrock surface also appears to confine the contaminants to the upper alluvial aquifer.

The horizontal component of ground water flow within the alluvial aquifer is consistently to the northeast with only minor and local variations. The flow direction appears to be controlled to a certain degree by the alignment of the valley in the bedrock surface. Although water level differences between the alluvium and underlying bedrock have been variable, they generally confirm the potential for ground water in the bedrock to flow into the alluvium in the valley from peripheral portions of the local area.

Based on the character of the alluvial materials at the site and on hydraulic tests conducted within the alluvium, the ground water seepage velocity for horizontal flow within the alluvium ranges from 0.21 to 4.9 feet per day, with an average value of 2.12 feet per day. The seepage velocity represents the rate at which dissolved contaminants would be transported with the ground water in the absence of hydrogeochemical factors such as adsorption onto sand grains in the aquifer.

There is potential discharge of contaminated ground water from the VHO plume to the North Platte River over the next few years. Data from the RI/FS indicate that the water quality criteria for the river will continue to be met because the volume of contaminants will be insignificant relative to the volume of water in the river.

**Nature and Extent of Contamination**

The scope of the RI at the Mystery Bridge site included studies for all media that may be contaminated. Soils in the residential area, surface water and sediments from Elkhorn Creek, and air quality at the site were investigated and determined not to be of concern with regard to contaminant pathways at the site.

Areas of contaminated soils were identified on the industrial properties at the site. This contamination will be evaluated more fully during the activities conducted for OU 2.

Sources of ground water contamination at the Dow/DSI and KN properties are discussed below. The pathway of migration for contaminants in both the VHO plume originating beneath the Dow/DSI facility and BETX plume originating beneath the KN facility is through the shallow alluvial aquifer moving in a northeasterly direction towards the North Platte River.

Dow/DSI: Potential sources of contaminants at Dow/DSI include 1) a 1000 gallon oil/water separator, 2) a vitreous drain line, 3) an empty waste oil tank, 4) chlorinated leach sump, and 5) toluene storage area. The first three were removed as part of the Dow/DSI removal action discussed above.

The ground water plume emanating from Dow/DSI is characterized by elevated levels of VHOs including the following chlorinated compounds:

1,1-dichloroethene (1,1 DCE);
trans-1,2-dichloroethene (t-1,2 DCE);
trichloroethene (TCE);
tetrachloroethene (PCE);
1,1,1-trichloroethane (1,1,1 TCA); and
1,1-dichloroethane (1,1 DCA).

MCLs and proposed MCLs were exceeded for TCE, t-1,2 DCE and PCE in wells sampled between 1987 and 1989. Table 1 summarizes data from the RI/FS and ESI reports, and recent July 1990 sampling for VHO concentrations in monitoring wells considered to be located within the VHO plume and their MCLs or proposed MCLs. These contaminants were released to the ground water from equipment washing operations at or near the chlorinated sump on the western portion of the Dow/DSI facility. A toluene and xylene plume apparently originates at the former toluene storage area, but is considered of minor importance as the concentrations are below MCLs.

Table 1: VHO Plume Contaminants

| Well ID | Current Date | Contaminants (ug/l) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | t-1,2 DCE | | | 1,1,1 TCA | | | TCE | | | PCE | | |
| | | Current | Average * | Maximum | Current | Average * | Maximum | Current | Average * | Maximum | Current | Average * | Maximum |
| MCL | | | 70 ** | | | 200 | | | 5 | | | 5 ** | |
| EPA 1-1 | 7/90 | 2 | 2.8 | 4 | 6 | 15 | 21 | 22 | 29 | 37 | 35 | 34 | 37 |
| EPA 1-2 | 4/89 | <1 | <1-<5 | <5 | 8 | 18 | 31 | 4 | 55 | 110 | 17 | 37 | 45 |
| EPA 1-6 | 4/89 | <1 | <1-<5 | <5 | 11 | 8.5 | 11 | 1 | 5.6 | 10 | 15 | 17 | 23 |
| EPA 1-7 | 4/89 | 5 | 3.9 | 5.0 | 23 | 73 | 99 | 180 | 138 | 190 | 77 | 87 | 110 |
| EPA 2-1 | 4/89 | <5 | <5 | <5 | 15 | 13 | 15 | 23 | 26 | 29 | 37 | 31 | 37 |
| EPA 2-2 | 4/89 | <5 | <5 | <5 | 15 | 14 | 21 | 25 | 36 | 52 | 39 | 36 | 40 |
| EPA 2-3 | 7/90 | <1 | <1-<5 | <5 | <1 | <1-<5 | <5 | 2 | 6.3 | 15 | 4 | 7.0 | 13 |
| EPA 2-8 | 4/89 | <5 | <5 | <5 | 7 | 6.8 | 11 | <1 | 2.3 | 4.0 | 10 | 8.7 | 12 |
| EPA 2-9 | 4/89 | <5 | <5 | <5 | 13 | 25 | 31 | 11 | 13 | 22 | 50 | 45 | 50 |
| EPA 2-10 | 4/89 | <5 | <5 | <5 | <1 | 1.7 | 2.5 | <1 | 49 | 130 | <1 | 7.5 | 15 |
| EPA 2-15 | 4/89 | 2 | 1.9 | 2.5 | 11 | 38 | 90 | 110 | 75 | 130 | 57 | 70 | 130 |
| MK MW-1 | 4/89 | 24 | 24 | 24 | 4 | 4 | 4 | 110 | 110 | 110 | 38 | 38 | 38 |
| PCMW-2 | 4/89 | <1 | 1.9 | 2.5 | 9 | 56 | 78 | 10 | 17 | 28 | 42 | 67 | 88 |
| PCMW-4 | 4/89 | <5 | <5 | <5 | 1 | 9.1 | 21 | <1 | 5.6 | 17 | 6 | 11 | 22 |
| MW87-2 | 9/89 | <1 | <1-<10 | <10 | <1 | 25 | 70 | <1 | <1-<10 | <10 | 16 | 27 | 89 |
| MW87-4 | 9/89 | <1 | <1-<15 | <15 | <1 | 40 | 150 | 2 | 20 | 71 | 7 | 87 | 320 |
| MW87-6 | 7/90 | <10 | <1-<500 | <500 | <10 | <1-<500 | <500 | <10 | 78 | 250 | <10 | 78 | 250 |
| MW87-7 | 9/89 | <1 | 47 | 180 | <1 | 56 | 140 | 220 | 172 | 340 | 7 | 75 | 150 |
| MW87-8 | 9/89 | <1 | <1-<10 | <10 | <1 | 26 | 100 | 5 | 57 | 220 | 23 | 142 | 540 |
| DSI MW-1 | 9/89 | <5 | <5 | <5 | 9 | 9 | 9 | 430 | 430 | 430 | 20 | 20 | 20 |
| DSI MW-3 | 9/89 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 20 | 20 | 20 |
| DSI MW-4 | 9/89 | <5 | <5 | <5 | <5 | <5 | <5 | 44 | 44 | 44 | 23 | 23 | 23 |
| DSI MW-6 | 7/90 | <100 | <5-<100 | <100 | <100 | <5-<100 | <100 | <100 | 34 | 50 | <100 | <5-<100 | <100 |

** Detection Limit/2 value used for averaging purposes*

*** Proposed MCL*

The shape and trend of the TCE ground water contamination has been found to be similar to the ground water plume for total VHO compounds, as TCE is the major constituent in the VHO group. VHO compounds are highly mobile in the aquifer and contamination from Dow/DSI has travelled with the northeasterly flow of ground water. The plume of contaminated ground water with levels exceeding MCLs or proposed MCLs extends below the residential area of the site as shown on Figure 2. Vertical extent of the VHO contamination is limited to the shallow alluvial aquifer. The volume of ground water at the site containing VHO contaminants above the MCLs or proposed MCLs was estimated in the RI/FS report to be 1096 acre-feet.

KN: Three sources of contamination have been identified on the KN property including: 1) the flare pit, 2) the catchment area and 3) the process area. High concentrations of BETX compounds have been found in monitoring wells near these sources. These compounds are believed to be components of absorption oil and other liquids associated with refining activities at the KN facility. A summary of data for BETX concentrations from the RI/FS and ESI reports, and recent July 1990 sampling in monitoring wells considered to be located within the BETX plume and their MCLs or proposed MCLs are provided in Table 2. Recent drought conditions have lowered the water table, and free hydrocarbons containing BETX compounds have been found floating on top of the water. Some of this material was recovered by KN as part of the removal action. A large area of stained soil below the surface remains on KN's property. Final remediation of this contamination and of the floating hydrocarbons will be addressed as part of the OU 2 activities.

BETX compounds are less mobile in the aquifer and are present in the ground water near the source at the KN facility. Migration of the BETX may be inhibited by preferential adsorption to the soil matrix as well as by biological degradation of adsorbed and dissolved residues. The contaminated plume of BETX compounds occurs under the KN facility and extends downgradient of the facility close to the northern property boundary as shown on Figure 3. A conservative approach to estimating the volume of ground water contaminated with BETX compounds would be to consider all wells where BETX compounds in excess of their MCLs or proposed MCLs have ever been detected. This would include several wells on the KN property, plus wells north of the property line. If the dissolved BETX plume is taken to include all of these wells, the estimated volume of contaminated ground water would be about 25 acre-feet rather than 10 acre-feet estimated in the RI/FS.

## VI. SUMMARY OF SITE RISKS

As part of the RI/FS, EPA prepared a Baseline Risk Assessment for the Mystery Bridge site in December 1989. This risk assessment was carried out to characterize, in the absence of remedial action (i.e., the "no-action" alternative), the current and potential threats to human health and the environment that may be posed by contaminants migrating in ground water or surface water, released to the air, leaching through the soil, remaining in the soil, or bioaccumulating in the food chain at the site. Figure 4 provides a glossary of the key risk terms from the BRA that are used in this section of the ROD.

Contaminants of Concern

The risk assessment began by compiling a list of contaminants from the results of the various sampling activities that were measured to be above detection limits or above natural background levels. Thirteen indicator contaminants were selected based on concentrations at the site, toxicity, physical/chemical properties that affect transport/movement in air, soil and ground water and prevalence/persistence in these media. These indicator contaminants were judged to represent the major potential health risks at the site.

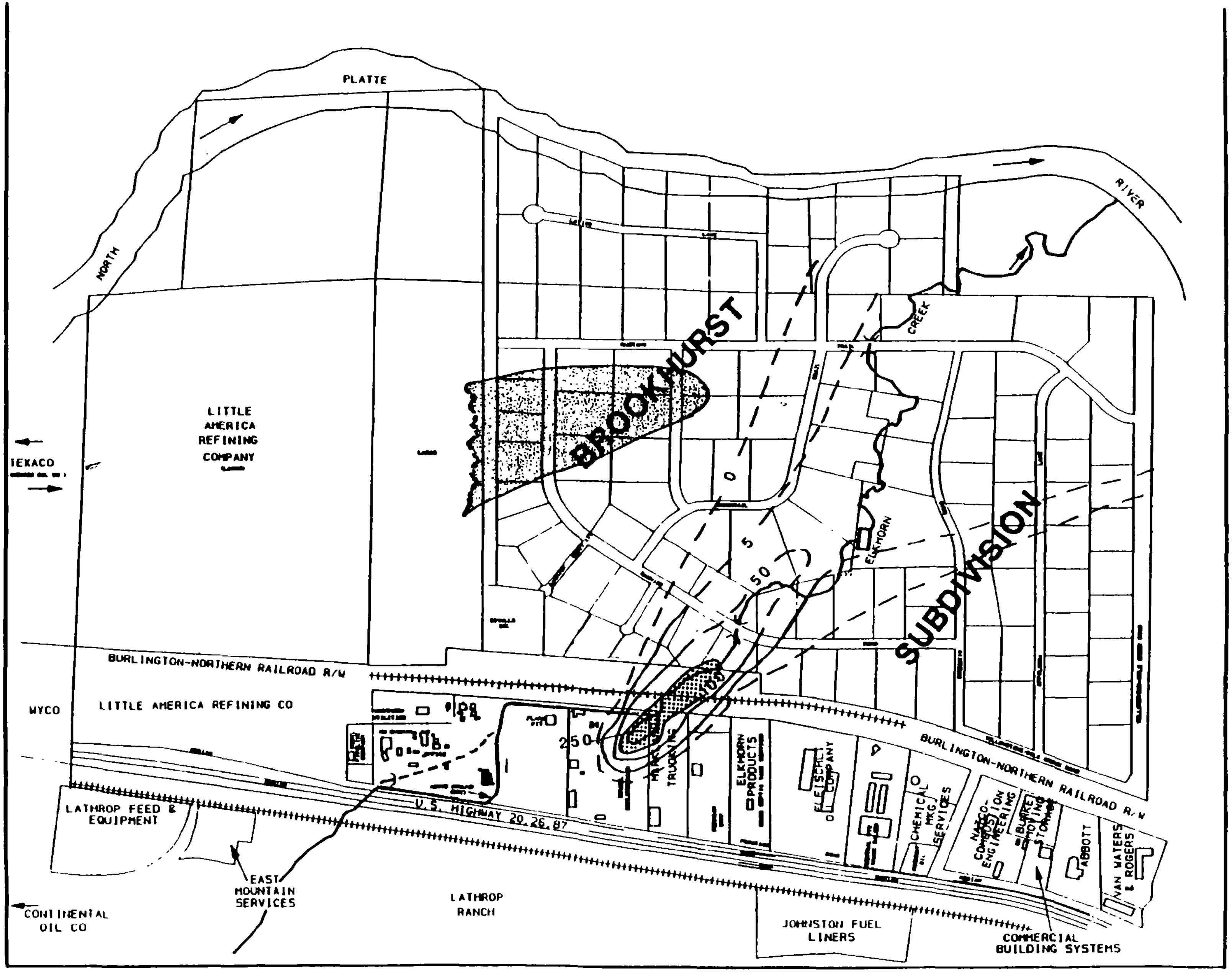



**Figure 2**

**Mystery Bridge**

**VHO Plume**

LEGEND

— — 50 TCE

Isoconcentration Contour (in ug/L)

Approximate Areal Extent of RCRA Plume in the Residential Area

Illustrative Example of Ground Water That Would be Treated

0 600 1200

APPROX. SCALE IN FEET

Table 2: BETX Plume Contaminants

| Well ID | Current Date | Contaminants (ug/l) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Benzene | | | Ethyl-benzene | | | Toluene | | | Total Xylenes | | |
| | | Current | Average * | Maximum | Current | Average * | Maximum | Current | Average * | Maximum | Current | Average * | Maximum |
| MCL | | | 5 | | | 700 ** | | | 2000 ** | | | 10000 ** | |
| EPA 1-9 | 7/90 | <1 | 2.4 | 4 | <1 | 1.7 | 3 | <1 | <1-<5 | <5 | <3 | <1-<5 | <5 |
| EPA 1-10 | 7/90 | <1 | 5.9 | 19 | 7 | 5 | 11 | <1 | 2.5 | 10 | <3 | 7.6 | 21 |
| EPA 2-11 | 7/90 | <5 | 22 | 70 | 4 | 22 | 82 | <5 | <1-<10 | <10 | 8 | 194 | 760 |
| EPA 2-11 (fp) | 7/90 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 1.0 | 1.0 | 1.0 |
| EPA 2-14 | 7/90 | <1 | <1-<5 | <5 | <1 | <1-<5 | <5 | <1 | <1-<5 | <5 | <3 | <1-<5 | <5 |
| KN MW-2 | 2/88 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 20 | 38 | <5 | <5 | <5 |
| KN MW-3 | 2/88 | <5 | <5 | <5 | 2 | 2.3 | 2.5 | <5 | <5 | <5 | 6 | 88 | 170 |
| KN MW-5 | 2/88 | <500 | <500 | <500 | <500 | <500 | <500 | <500 | <500 | <500 | 180 | 180 | 180 |
| KN MW-6 | 7/90 | <1 | 160 | 320 | <1 | <1-<500 | <500 | <1 | <1-<500 | <500 | <3 | 461 | 920 |
| KN MW-6 (fp) | 7/90 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.5 | 0 5 | 0.5 |
| KN MW-7 | 7/90 | <1 | <1-<250 | <250 | <1 | 70 | 140 | <1 | <1-<250 | <250 | <3 | 551 | 1100 |
| KN MW-7 (fp) | 7/90 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 1.7 | 1.7 | 1.7 |
| KN ABC-11 | 7/90 | <5 | 18 | 33 | <5 | 56 | 110 | <5 | 43 | 83 | 110 | 705 | 1300 |
| KN ABC-11 (fp) | 4/89 | <1000 | <1000 | <1000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 18000 | 18000 | 18000 |
| KN ABC-24 | 7/90 | <1 | <0.5-<5 | <5 | <1 | <0.5-<5 | <5 | <1 | <0.5-<10 | <10 | <3 | 2.7 | 7 |
| KN ABC-25 | 10/89 | <0.5 | 2.5 | 7 | <0.5 | <0.5-<1 | <1 | <0.5 | <0.5-<10 | <10 | 1 | 5.1 | 14 |
| KN ABC-26 | 10/89 | 220 | 180 | 220 | 790 | 513 | 790 | 520 | 191 | 520 | 6900 | 4083 | 6900 |
| KN ABC-26 (fp) | 10/89 | <100 | 100-<1000 | <1000 | 2000 | 1500 | 2000 | 3300 | 1900 | 3300 | 19000 | 18000 | 19000 |
| KN ABC-27 | 10/89 | <5 | <5 | <5 | <5 | <5 | <5 | 38 | 45 | 52 | 300 | 184 | 300 |
| KN ABC-27 (fp) | 10/89 | 9600 | 9600 | 9600 | 1400 | 1400 | 1400 | 9600 | 9600 | 9600 | 13000 | 13000 | 13000 |
| KNP-2 | 10/89 | <500 | 240 | 250 | 150000 | 75025 | 150000 | 390 | 390 | 390 | 1100000 | 550800 | 1100000 |
| KNP-2 (fp) | 10/89 | <100 | <100 | <100 | 2100 | 2100 | 2100 | 340 | 340 | 340 | 1400 | 1400 | 1400 |

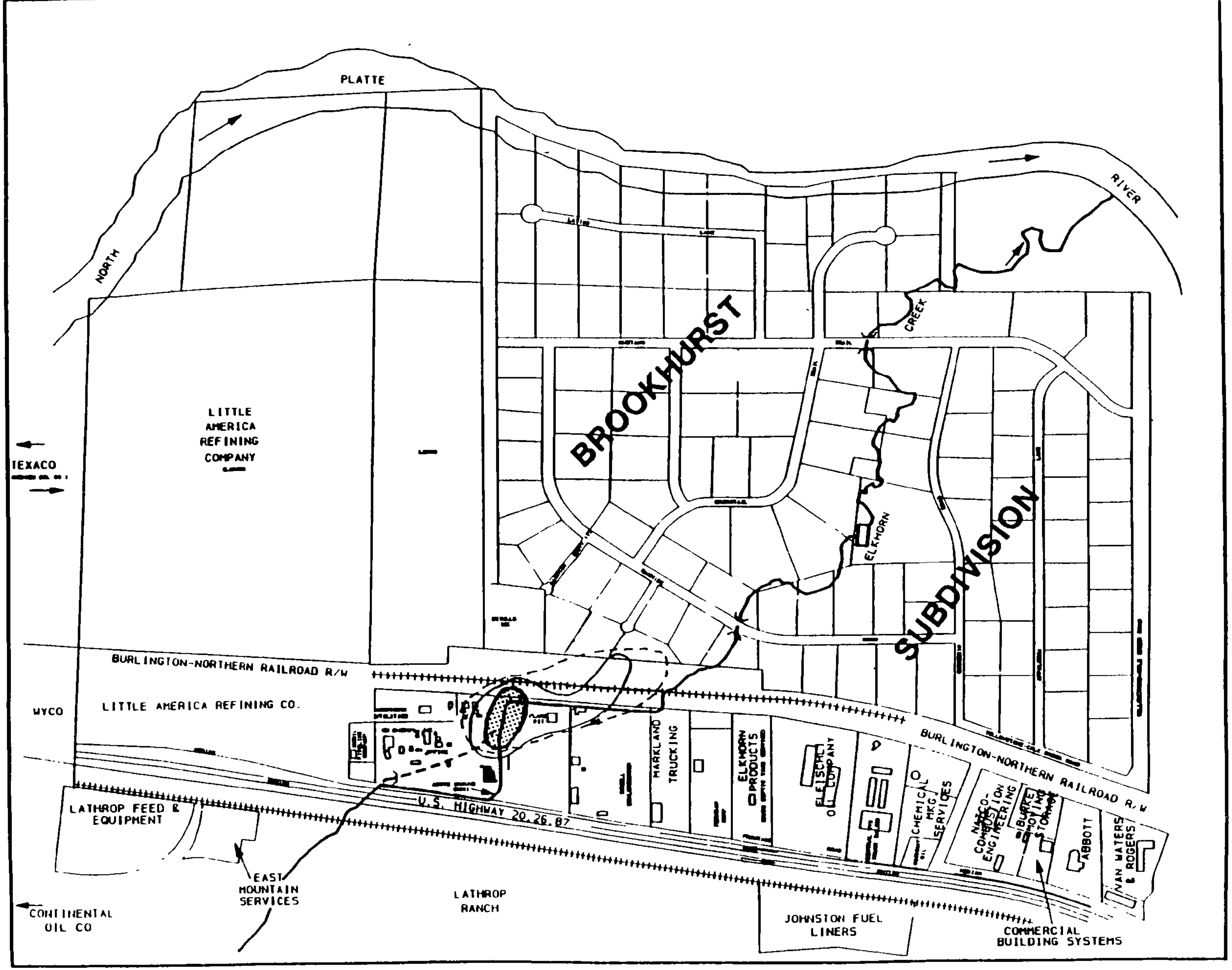
** Detection Limit/2 value used for averaging purposes*

*** Proposed MCL*

*(fp) = Floating Product in ppm*

# Figure 3

## Mystery Bridge BETX Plume

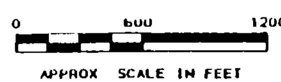



LEGEND

Approximate Areal Extent of Ground Water With BETX Concentration > MCLs or Proposed MCLs (Based on RI/FS Estimate)

Approximate Areal Extent of Floating Hydrocarbons Layer

Approximate Areal Extent of Stained Soil



## Figure 4
## Key Risk Terms

**Carcinogen**: A substance that increases the incidence of cancer.

**Chronic Daily Intake (CDI)**: The average amount of a chemical in contact with an individual on a daily basis over a substantial portion of a lifetime.

**Chronic Exposure**: A persistent, recurring, or long-term exposure. Chronic exposure may result in health effects (such as cancer) that are delayed in onset, occurring long after exposure ceased.

**Exposure**: The opportunity to receive a dose through direct contact with a chemical or medium containing a chemical.

**Exposure Assessment**: The process of describing, for a population at risk, the amounts of chemicals to which individuals are exposed, or the distribution of exposures within a population, or the average exposure of an entire population.

**Hazard Index**: An EPA method used to assess the potential noncarcinogenic risk. The ratio of the CDI to the chronic RfD (or other suitable toxicity value for noncarcinogens) is calculated. If it is less than one, then the exposure represented by the CDI is judged unlikely to produce an adverse noncarcinogenic effect. A cumulative, endpoint-specific HI can also be calculated to evaluate the risks posed by exposure to more than one chemical by summing the CDI RfD ratios for all the chemicals of interest exert a similar effect on a particular organ. This approach assumes that multiple subthreshold exposures could result in an adverse effect on a particular organ and that the magnitude of the adverse effect will be proportional to the sum of the ratios of the subthreshold exposures. If the cumulative HI is greater, than one, then there may be concern for public health risk.

**Reference Dose (RfD)**: The EPA's preferred toxicity value for evaluating noncarcinogenic effects.

**Risk**: The nature and probability of occurrence of an unwanted, adverse effect on human life or health, or on the environment.

**Risk Assessment**: The characterization of the potential adverse effect on human life or health, or on the environment. According to the National Research Council's Committee on the Institutional Means for Assessment of Health Risk, human health risk assessment includes: description on the potential adverse health effects based on an evaluation of results of epidemiologic, clinical, toxicologic, and environmental research; extrapolation from those results to predict the types and estimate the extent of health effect in humans under given conditions of exposure; judgements as to the number and characteristics of persons exposed at various intensities and durations; summary judgements on the existence and overall magnitude of the public-health program; and characterization of the uncertainties inherent in the process of inferring risk.

**Slope Factor**: The statistical 95% upper confidence limit on the slope of the dose response relationship at low doses for a carcinogen. Values can range from about 0.0001 to about 100,000, in units of lifetime risk per unit dose (mg/kg-day). The larger the value, the more potent is the carcinogen, i.e., a smaller dose is sufficient to increase the risk of cancer.

[illegible] use of the term/concept - "Reasonable maximum exposure" which can include future scenarios of residential settings where *none currently exist.

**Exposure Assessment**

Although exposure pathways were identified for ground water, surface water and sediments, residential soils, and air media at the site, the risk assessment indicated that only the ground water pathway could result in significant health risks. Of the 13 indicator contaminants studied in the BRA, PCE, TCE, 1,1 DCA and benzene were determined to be the primary contaminants of concern in the ground water pathway.

Because of the northeasterly flow of ground water in the alluvial aquifer at the site, contaminants introduced into the ground water below the sources at the southern section of the site could be transported across the residential areas. Thus, a significant potential exposure pathway involving ground water is likely to exist for the subdivision residences which currently use site ground water for domestic purposes. All but two of the residences now use a non-contaminated municipal water supply in place of ground water. The pathway for contaminants is intercepted for residents using the municipal water supply; however, potential risk of exposure to the ground water contaminants remains. In addition, considering the potential for future land development at the site, future residences could potentially be located on properties currently used by industries. The ground water pathway is therefore likely to be complete for these future hypothetical residences. Two important exposure scenarios, the Current Resident and *Future Hypothetical Resident, were developed based on the fact that ground water is the primary exposure medium at the site.

Intake of contaminants present in ground water could potentially occur via three routes: 1) ingestion of ground water; 2) dermal contact with water while bathing, showering, cooking or swimming (also ground water used for outdoor domestic and/or agricultural purposes); and 3) inhalation of indoor air contaminants volatilized while bathing, showering, or cooking, or that volatilized and directly accumulated in the living spaces. In addition, use of contaminated ground water in a home cooling unit (i.e., swamp cooler) could potentially lead to the inhalation of volatilized contaminants. The contaminant intake equations and values chosen for various intake parameters were derived from the standard intake equation and data presented in EPA guidance documents. Chronic daily intakes (CDIs) were estimated in the BRA. Representative exposure point concentrations were developed from the sampling data for contaminants measured in EPA monitoring wells in the residential area.

The Reference Dose values (RfD) for a substance represents a level of intake which is unlikely to result in adverse non-carcinogen health effects in individuals exposed for a chronic period of time. The RfDs (in mg/kg-day) for the contaminants include: 1,1 DCA = 0.01; 1,1,1 TCA = 0.09; 1,2 DCE = 0.02; PCE = 0.01; xylenes = 2; toluene = 0.3; and ethylbenzene = 0.1.

The slope factor represents the upper 95 percent confidence limit value on the probability of response per unit intake of a contaminant over a life time (70 years for the analysis in the BRA). Slope factors used in the BRA for the contaminants (in $(mg/kg\text{-}day)^{-1}$) include: TCE = 0.11; 1,1 DCA = 0.091; PCE = 0.051 and benzene = 0.029.

**Toxicity Assessment**

Indicator contaminants present in the ground water include VHO and BETX compounds. The following discussion comes from the toxicological profiles of these contaminants presented in the BRA.

VHOs TCE is classified as a group B2 carcinogen (a probable human carcinogen). TCE has been shown to cause pulmonary adenocarcinoma, lymphoma, and hepatocellular carcinoma in multiple strains of mice. Subchronic and chronic exposures of animals to TCE appears to result in liver and kidney toxicity. PCE has been classified as a group C carcinogen (a possible human carcinogen) based upon evidence that the chemical causes hepatocellular carcinoma in mice. Mouse and rat studies have indicated that PCE is a teratogen and a reproduction toxin. In addition, both oral and inhalation exposure of laboratory animals to PCE for intermediate and long-term exposure leads to liver, kidney and spleen toxicity. 1,1 DCA, t-1,2 DCE and 1,1,1 TCA are not demonstrated human carcinogens. 1,1 DCA appears to cause kidney damage in laboratory animals exposed subchronically via the inhalation route. Rats exposed to t-1,2 DCE via inhalation developed progressive damage to the lung and fatty changes in the liver. Chronic inhalation exposure of laboratory animals to 1,1,1 TCA resulted in hepatoxicity (fatty changes in the liver and increased liver weights).

BETX EPA considers benzene to be a group A carcinogen. This listing signifies that there is "Sufficient evidence from epidemiologic studies to support a causal association between exposure and cancer." In sensitive humans, alterations in bone marrow have been shown to form during short-term exposures to approximately 10 ppm benzene. Several studies have demonstrated an increased incidence of non-lymphocytic leukemia from occupational exposure. Intermediate and chronic exposure to benzene can adversely effect the hematopoietic and immune systems.

Ethylbenzene, toluene and xylenes are classified as non-carcinogens. Ethylbenzene is acutely toxic to the lung and central nervous system. However, subchronic and chronic exposures of laboratory animals to this compound cause liver and kidney damage, as well as testicular toxicity. The teratogenicity of ethylbenzene has also been indicated in rats. A primary target for toluene toxicity is the central nervous system. In humans acute exposures to 100 ppm of toluene via inhalation causes fatigue, sleepiness, decreased manual dexterity and decreased visual acuity. Exposure to high levels of toluene, as occurs in solvent abuse, can result in permanent central nervous system effects such as tremors, atrophy, and speech, hearing, and vision impairment. Animal studies indicate that toluene is also a development toxin causing growth inhibition and skeletal anomalies. Xylene orally administered to animals can result in central nervous system toxicity and has also been shown to cause ultra-structural liver changes (although these changes are not necessarily adverse effects). Xylene has also been shown to be a fetotoxin and a teratogen in mice at high oral doses.

**Risk Characterization**

The BRA evaluated the potential non-carcinogenic and carcinogenic risks posed by the indicator contaminants in the various exposure media at the Mystery Bridge site. Carcinogenic risk is presented as a probability value (i.e., the chance of contracting some form of cancer over a lifetime). The estimate of carcinogenic risk is conservative and may overestimate the actual risk due to exposure.

In the risk characterization, the aggregate carcinogenic risk due to ground water indicator contaminants at the site is compared to an acceptable target risk. The chance of one person developing cancer per one million people (or $10^{-6}$) is used as a target value or point of departure above which carcinogenic risks may be considered unacceptable. The $10^{-6}$ point of departure is used when ARARs are not available (i.e., no MCLs or proposed MCLs for the indicator contaminants) or are not sufficiently protective of human health and the environment.

* Should state clearly which approach ($10^{-6}$ vs MCLs) was used at this site & why.

Carcinogenic Risk. Carcinogenic risk is typically estimated by multiplying the CDI of an indicator contaminant by its slope factor. A summary of carcinogenic risks for residents living directly above and using contaminated ground water from the VHO and BETX plumes in the Current Resident scenario is provided in Table 3. The aggregate carcinogenic risk is $8.1 \times 10^{-5}$ for the VHO plume and $4.7 \times 10^{-5}$ for the BETX plume. Total carcinogenic risk due to ground water consumption exceeded $10^{-6}$ at both the VHO and BETX plumes. The primary source of risk posed by the VHO plume was PCE and TCE contamination. The major component of the risk values calculated for the BETX plume were based on the risk due to exposure to benzene.

Carcinogenic risks were also calculated for selected indicator contaminants for residents using ground water from wells at the Dow/DSI and KN properties in the Future Hypothetical Resident scenario. These risks, shown in Table 3, also exceeded $10^{-6}$. The aggregate carcinogenic risk for the VHO plume was $3.2 \times 10^{-4}$ and $1.7 \times 10^{-4}$ for the BETX plume.

risk posed by site (i.e., assessment of site - from Declaration)

Non-Carcinogenic Risks. The ratio of CDI to RfD was computed for each contaminant and the resulting ratios are summed to give the hazard index. Non-carcinogenic hazard indices were calculated for both the Current Resident and Future Hypothetical Resident scenarios. Results indicated the aggregate hazard indices do not exceed unity; therefore, EPA believes that there is no non-carcinogenic public health threat.

Risks Due to Indoor Air Contamination. There is a high likelihood that the residents who use contaminated well water are being exposed to indoor organic vapor contaminants that have volatilized from the well water. This exposure occurs through inhalation of volatilized contaminants while showering, bathing, or cooking, as well as volatilized contaminants from home cooling units. Quantitative risk calculations were not done for indoor air because there is a high degree of uncertainty associated with the generic (non site-specific) and inhalation risk factors. Although not quantified, this exposure to contaminated indoor air adds additional risk for subdivision residents using contaminated well water.

Another potential source of site-related indoor air contamination is the direct emanation and accumulation of volatilized plume water in the living spaces of residences located directly over the contaminated ground water plumes. The risks from this direct accumulation of indoor organic vapors is considered to be insignificant when compared to the risks from inhaling volatilized shower, bath or cooking water.

**Environmental Risks**

The ecological effects due to releases from industrial areas are not expected to be significant for three reasons: 1) these industrial areas do not provide habitat resources for wildlife ; 2) the sampling data for surface water and sediments at Elkhorn Creek indicates minor levels of contamination from the site; and 3) contamination of the North Platte River via ground water plume discharge is expected to be relatively insignificant due to the high rate of river flow as compared with the rate of ground water discharge.

## VII. DESCRIPTION OF ALTERNATIVES

A feasibility study was conducted to develop and evaluate remedial alternatives for OU 1 at the Mystery Bridge site. Remedial alternatives were assembled from applicable remedial technology process options and were initially evaluated for effectiveness, implementability, and cost. The alternatives meeting these criteria were then evaluated and compared to nine criteria required by the NCP. In addition to the remedial alternatives, the NCP requires that a no-action alternative be considered at every site. The no-action alternative serves primarily as a point of comparison for other alternatives.

Table 3: Carcinogenic Risk Characterization

**VHO Plume**

| Scenario/Pathway | Benzene | PCE | TCE | 1,1 DCA | Methylene Chloride | Pathway Total |
|---|---|---|---|---|---|---|
| Current Resident | | | | | | |
| Ingestion | 7.0E-07 | 2.5E-05 | 5.1E-05 | 2.3E-06 | 2.5E-07 | 7.9E-05 |
| Absorbtion | 1.3E-06 | 8.9E-08 | 1.9E-07 | 8.5E-09 | 9.0E-10 | 1.6E-06 |
| **Aggregate** | | | | | | **8.1E-05** |
| Future Hypothetical Resident * | | | | | | |
| Ingestion | - | 7.1E-05 | 2.5E-04 | - | - | 3.2E-04 |
| Absorbtion | - | 2.9E-07 | 1.0E-06 | - | - | 1.3E-06 |
| **ggregate** | | | | | | **3.2E-04** |

**BETX Plume**

| Scenario/Pathway | Benzene | PCE | TCE | 1,1 DCA | Methylene Chloride | Pathway Total |
|---|---|---|---|---|---|---|
| Current Resident | | | | | | |
| Ingestion | 1.4E-05 | 1.3E-06 | 2.8E-06 | 3.0E-06 | 8.3E-07 | 2.2E-05 |
| Absorbtion | 2.5E-05 | 4.8E-09 | 1.0E-08 | 1.1E-08 | 3.0E-09 | 2.5E-05 |
| **Aggregate** | | | | | | **4.7E-05** |
| Future Hypothetical Resident * | | | | | | |
| Ingestion | 5.8E-05 | - | - | - | - | 5.8E-05 |
| Absorbtion | 1.1E-04 | - | - | - | - | 1.1E-04 |
| **Aggregate** | | | | | | **1.7E-04** |

***selected contaminants only***

Each remedial alternative acknowledges the removal activities that have occurred or are currently taking place assumes continuation of the ongoing activities. While sources are being controlled by the removal actions, ground water remains contaminated with VHO and BETX compounds released from the sources. The remedial alternatives described in this ROD address this ground water contamination.

A ground water model has been developed to simulate transport of dissolved VHO compounds through the alluvial ground water system. The model incorporates a variety of physical, chemical, and biological factors which can affect the rate of contaminant migration through the aquifer. Known variability and expected uncertainty in these factors were incorporated into the model by performing 5,000 duplicate model runs with model parameters selected randomly from within their known or expected ranges. The resulting model runs provided an expected range of contaminant concentrations over time, from which statistically most-probable contaminant transport rates could be estimated. Contaminant transport rates were used to estimate time frames for the remedial alternatives developed in the RI/FS. This transport model was not applied to the BETX plume because downgradient migration of BETX compounds from the KN property to the BNRR property appears to be minimal.

The action levels for remediation are the MCLs and proposed MCLs for the contaminants of concern. Attainment of these levels will be protective of human health and the environment. However, EPA recently studied the effectiveness of ground water extraction systems in achieving specified goals and found that it is often difficult to predict the ultimate concentration to which contaminants in the ground water may be reduced. The study did find that ground water extraction is an effective remediation measure and can achieve significant mass removal of contaminants. Most of the remedial alternatives described in this section include ground water extraction systems and assume that it is technically feasible to achieve MCLs or proposed MCLs in the ground water.

Except for the no-action alternative which includes ground water monitoring only, each alternative includes the following common elements:

**Ground Water Monitoring.** Ground water monitoring during the remedial activities will be used to evaluate performance of the remedial action. Monitoring points are anticipated to be located upgradient of the plume (to detect contamination from other sources), within the plume (to track the plume movement during remediation), and downgradient (to detect plume migration). Monitoring points to the west of the VHO plume would be used to evaluate whether commingling with other plumes occurs in the future. Ground water samples would be analyzed for site indicator compounds as determined during remedial design. Existing monitoring wells and possibly additional monitoring wells to be installed would be used for ground water monitoring. The specific locations and frequency of ground water monitoring will depend on the remedial alternative selected and site conditions at the time of implementation. Monitoring would continue after remedial objectives are met to ensure residual contaminants desorbing into ground water will not exceed MCLs or proposed MCLs in the future.

**Temporary Institutional Controls.** Temporary restrictions on the construction and use of private water wells, such as well restrictions in property deeds, well construction permits, and/or deed notices during remediation would effectively restrict human consumption of ground water exceeding MCLs and proposed MCLs in the residential area until remediation goals for ground water are achieved. Actual institutional controls to be used will be determined during remedial design.

**VHO Plume**

Seven remedial alternatives for the VHO plume were considered for detailed evaluation and are described below. Table 4 provides a summary of the alternatives. Alternative V2 contemplated collection of VHO-impacted ground water and transport to an off-site RCRA treatment facility. This alternative was eliminated early in the evaluation process because it would be technically infeasible to implement and would involve costs that would be grossly excessive compared to its overall effectiveness.

**Alternative V1 - No-action with ground water monitoring.**

Under this alternative, EPA would take no further action to control the source of contamination. However, long-term monitoring of the site would be necessary to monitor contaminant migration. Monitoring using previously installed monitoring wells and residential wells can easily be implemented.

Because this alternative would result in contaminants remaining on-site, CERCLA requires that the site be reviewed every five years. If indicated by the review, remedial actions would be implemented at that time to remove or treat the wastes.

Alternative V1 relies on natural processes in the ground water to reduce VHO levels in the aquifer. Results of contaminant transport and fate modeling described previously indicated that the most-probable time required for natural processes to reduce contaminant concentrations by two orders of magnitude at the downgradient edge of the subdivision (i.e., at the North Platte River) would be approximately seven years. A two order of magnitude reduction would result in VHO concentrations below MCLs and proposed MCLs. Consequently, it is expected that VHO contaminants will have been effectively flushed out of the aquifer beneath the subdivision within seven years. The ground water would be restored to a Classification I aquifer suitable for drinking water purposes. There is a minimal chance that complete flushing would take as long as 19 years.

The present worth cost for Alternative V1 would be $71,000. Since the alternative requires "no-action", there would be no capital cost. However, operation and maintenance (O&M) costs are estimated to be $11,000 for ground water monitoring.

**Alternative V3 - Extraction of VHO-impacted ground water, aerobic biological treatment of extracted ground water, and discharge of treated ground water to the North Platte River.**

Extraction of ground water with VHO concentrations exceeding MCLs or proposed MCLs would be accomplished with an extraction well system. Assuming an extraction system of ten wells and a volume of impacted ground water of 1096 acre-feet, extraction would be completed in one to two years after initiation of the alternative. The actual number of wells could change as determined by remedial design. The time for remediation could vary depending on several factors including the pumping rate and the volume of impacted ground water.

A sequencing batch reactor system would provide aerobic biological treatment of extracted ground water and would facilitate destruction of organic constituents. The treatment system would be expected to volatilize some of the VHO contaminants which would be released to the atmosphere.

I would make some qualitative statement as to potential risk posed, if any, or State that no risk would be posed / also any ARARs associated with air release.

Aerobic biological treatment of ground water would produce a sludge that would require disposal. An estimated 170 tons of non-hazardous sludge per year would be generated. The sludge would be expected to meet all RCRA criteria for land disposal.

Table 4: Summary of VHO Plume Alternatives

| Component | | Alternatives | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | V1 | V3 | V4 | V4A | V5 | V6 | V6A | V7 |
| Common Elements | Ground Water Monitoring | X | X | X | X | X | X | X | X |
| | Institutional Controls | | X | X | X | X | X | X | X |
| Extent of Ground Water Extraction | Extraction of Ground Water with VHO Concentrations > MCLs | | X | X | X | X | | | |
| | Extraction of Upgradient Ground Water With VHO Concentrations > MCLs | | | | | | X | X | |
| Treatment Technology | Aerobic Biological Treatment of Extracted Ground Water | | X | | | | | | |
| | Air Stripping of Extracted Ground Water | | | X | | | X | | |
| | Carbon Adsorption of Extracted Ground Water | | | | X | | | X | |
| | Chemical Oxidation of Extracted Ground Water | | | | | X | | | |
| | Natural Attenuation of VHOs in Downgradient Plume | | | | | | X | X | |
| | In-situ Bioremediation of VHOs in Downgradient Plume | | | | | | (X) | (X) | |
| | In-situ Bioremediation of VHO Plume | | | | | | | | X |
| Disposition of Treated Water | Injection of Treated Water to Up/Downgradient Wells | | | | | | X | X | |
| | Discharge of Treated Water to North Platte River | | X | X | X | X | | | |
| | Discharge of Treated Water to Elkhorn Creek | | | | | | (X) | (X) | |

*(X) = Option or Contingency*

Treated ground water would be discharged to the North Platte River. For cost estimation purposes, it was assumed that a treatment facility would be located on industrial property. The discharge would be sampled as necessary to comply with National Pollutant Discharge Elimination System (NPDES) permit requirements.

Capital cost for Alternative V3 would be over $2 million with O&M costs of $165,000. The present worth cost would be almost $2.5 million.

<u>Alternative V4</u> - **Extraction of VHO-impacted ground water, air stripping of extracted ground water, and discharge of treated ground water to the North Platte River.**

This alternative is similar to Alternative V3, except that extracted ground water would be treated in an air stripping tower on-site to remove VHOs. In the air stripping process, VHOs are transferred from the water phase to the air phase and discharged to the atmosphere. Air stripper vapor discharge would be sampled as necessary to comply with Wyoming Air Quality Standards and Regulations.

Alternative V4 would involve capital costs of over $1 million and O&M costs of $129,000. The present worth cost would be approximately $1.3 million.

<u>Alternative V4A</u> - **Extraction of VHO-impacted ground water, carbon adsorption treatment of extracted ground water, and discharge of treated ground water to the North Platte River.**

This alternative is similar to alternatives V3 and V4, except that extracted ground water would be treated in a carbon adsorption system on-site to remove VHOs. In the carbon adsorption process, VHOs are adsorbed onto activated carbon, thereby removing them from the ground water. The spent carbon is typically thermally or chemically regenerated for reuse.

Present worth cost for this alternative would be almost $1.4 million. Capital cost would be $1.2 million with O&M costs of $128,000.

<u>Alternative V5</u> - **Extraction of VHO-impacted ground water, chemical oxidation of extracted ground water, and discharge of treated ground water to the North Platte River.**

This alternative is similar to alternatives V3, V4, and V4A, except the chemical oxidation of contaminants in extracted ground water would be implemented on-site using controlled reactor vessels. A retention time of approximately a few minutes should be sufficient to treat influent ground water VHO concentrations to the required levels.

Capital cost for Alternative V5 would be $1.1 million with O&M costs equal to $282,000. Present worth cost is $1.7 million.

<u>Alternative V6</u> - **Extraction in the upgradient portion of the plume which contains the highest VHO concentrations, air stripping of extracted ground water, discharge of treated ground water to Elkhorn Creek or reinjection upgradient or downgradient of the extraction well system, and natural attenuation in the downgradient portions of the plume.**

An extraction well system would remove ground water with VHO levels exceeding MCLs and proposed MCLs in the upgradient portion of the plume. Assuming one extraction well and a volume of VHO-impacted ground water in the upgradient portion of the plume of 57 acre-feet, extraction should be completed in about one year following implementation of the remedy. The actual number of extraction wells could change as determined by the remedial design.

Extracted ground water would be treated to remove VHOs in an air stripping tower on-site as described for Alternative V4. Concentrations of VHOs in the treated ground water would be reduced to MCLs or proposed MCLs.

Treated ground water would be reinjected upgradient or downgradient of the extraction well. Downgradient injection points could accomplish the following objectives: 1) provide additional hydraulic containment of the upgradient portion of the VHO plume being extracted; 2) minimize the possibility of any interaction related to VHO remediation efforts with nearby plumes and/or free BETX contaminants associated with the KN facility; and 3) assist remediation in the downgradient portion of the VHO plume. The final reinjection locations(s) would be determined during remedial design. Treated ground water would be sampled as necessary to comply with Wyoming Underground Injection Control (UIC) program requirements.

Alternative V6 relies on natural processes in the ground water to reduce VHO levels in downgradient portions of the aquifer. Concentrations of VHOs should decline two orders of magnitude, which would be sufficient to lower the VHO concentrations to MCLs and proposed MCLs, within about six years. An extraction well system in the upgradient portions of the plume would help prevent VHO concentrations in ground water leaving the northern Dow/DSI property boundary from exceeding MCLs or proposed MCLs. VHO concentrations throughout the aquifer would therefore meet MCLs and proposed MCLs within six years under Alternative V6. However, there is a minimal chance that a complete flushing could take as long as 18 years.

*In situ* bioremediation in the downgradient portion of the plume was considered as an additional component of Alternative V6. However, it was not incorporated for the following reasons: 1) this type of treatment is designed primarily for source control, not area control; 2) the uncertainties in remediation time associated with this treatment; 3) extraction and injection of treated water would cause nearby plumes to migrate further into the residential area; and 4) treatability studies would be required.

Costs for Alternative V6 would include capital cost of $183,000, O&M costs of $122,000, and present worth cost of $354,000.

<u>Alternative V6A</u> - **Extraction of the upgradient portion of the plume which contains the highest VHO concentrations, carbon adsorption treatment of extracted ground water, discharge of treated ground water to Elkhorn Creek or reinjection upgradient or downgradient of the extraction well system, and natural attenuation in the downgradient portions of the plume.**

This alternative is Similar to Alternative V6, except extracted ground water would be treated to remove VHOs in a carbon adsorption system on-site similar to Alternative V4A.

Alternative V6 costs would include $357,000 in capital cost, $114,000 for O&M, and a present net cost of $518,000.

<u>Alternative V7</u> - ***In situ* bioremediation of VHO-impacted ground water.**

*In situ* bioremediation of ground water with VHO concentrations exceeding MCLs and proposed MCLs would involve addition of an oxygen source, nutrients, and hydrocarbon feedstock, such as methane, to the aquifer to promote the activity of organisms which co-metabolize VHOs. An injection and extraction well circulation system would distribute oxygen, nutrients, and co-metabolites through the aquifer. Assuming the extraction and injection well system would consist of six extraction wells and four injection wells, VHO concentrations would be expected to be reduced to MCLs and MCLs in two to five years. The actual number of wells for the system could change as determined by remedial design. Treatability testing would be necessary to determine design parameters for *in situ* bioremediation.

Ground water monitoring would be performed during the two to five years of *in situ* ground water treatment and following completion of treatment to verify the reduction of VHO concentrations in the aquifer.

Capital cost for this alternative would be $425,000 and O&M costs would be $133,000. Present worth cost would be over $1 million.

**BETX Plume.**

For the BETX plume, five remedial alternatives (including the no-action alternative) remained following the screening analysis. Table 5 summarizes the alternatives for the BETX plume. Each of the remedial alternatives designed to address the BETX plume are described below. Alternative B2 contemplated collection of BETX-impacted ground water and transport to an off-site RCRA treatment facility. This alternative was eliminated early in the evaluation process because it would be technically infeasible to implement and would involve costs that would be excessive compared to its overall effectiveness.

**Alternative B1 - No-action with ground water monitoring.**

Similar to Alternative V1 for the VHO plume, Alternative B1 relies on presently occurring natural processes to reduce concentrations on the BETX compounds in the aquifer. The time frame for the ground water to be restored to a Classification I aquifer under the no-action alternative is unknown.

The costs associated with ground water monitoring for this alternative would be $11,000 in O&M. Present worth cost would be $137,000.

**Alternative B3 - Extraction of BETX-impacted ground water, aerobic biological treatment of extracted ground water, discharge of treated ground water to either injection wells located upgradient or downgradient of the extraction well system or to Elkhorn Creek**

Extraction of ground water with BETX concentrations above MCLs or proposed MCLs would be accomplished in Alternative B3 with an extraction well system. Assuming a volume of impacted ground water of ten acre-feet as estimated in the RI/FS, the time of aquifer remediation has been calculated to be approximately three months. If the volume of impacted ground water is assumed to be 25 acre-feet, based on a more conservative approach, the time for remediating the aquifer is extended to approximately eight months. Ground water extraction and treatment would continue until MCLs and proposed MCLs are permanently attained in the BETX plume.

Extracted ground water would be passed through an oil/water separator to remove free hydrocarbons. Recovered hydrocarbons would be recycled. It was assumed that the existing oil/water separator would be used for this purpose.

Following separation of aromatic hydrocarbons, a sequencing batch reactor system, similar to the system described for Alternative V3 for the VHO plume, would provide aerobic biological treatment of extracted ground water and would facilitate destruction of organic constituents. The treatment system would be expected to volatilize some of the BETX compounds which would be released to the atmosphere.

Table 5: Summary of BETX Plume Alternatives

| Component | | Alternatives | | | | |
|---|---|---|---|---|---|---|
| | | B1 | B3 | B4 | B5 | B6 |
| Common Elements | Ground Water Monitoring | X | X | X | X | X |
| | Institutional Controls | | X | X | X | X |
| | Soil Vapor Extraction of BETX Contaminated Soils | | X | X | X | X |
| | Hydrocarbons Recovery and Recycling | | X | X | X | X |
| Extraction | Extraction of Ground Water with BETX Concentrations > MCLs | | X | X | X | |
| Treatment Technology | Aerobic Biological Treatment of Extracted Ground Water | | X | | | |
| | Air Stripping of Extracted Ground Water | | | X | | |
| | Chemical Oxidation of Extracted Ground Water | | | | X | |
| | In-situ Bioremediation of BETX Plume | | | | | X |
| Disposition of Treated Water | Injection of Treated Water to Up/Downgradient Wells | | X | X | X | |
| | Discharge of Treated Water to Elkhorn Creek | | (X) | (X) | (X) | |

*(X) = Option or Contingency*

Aerobic biological treatment of ground water would produce an estimated 10 to 20 tons of sludge per year. The sludge would be expected to meet all RCRA criteria for land disposal.

Treated ground water would be discharged to injection wells upgradient or downgradient of the extraction well system or to Elkhorn Creek. Upgradient injection locations could facilitate movement of the contaminants toward extraction wells. Downgradient injection locations could serve to contain the plume and also provide hydraulic assistance in ground water collection. The discharge would be sampled as necessary to comply with NPDES and/or Wyoming UIC program requirements.

Costs for this alternative would include capital cost of $582,000, and O&M costs of $44,000. The present worth cost would be $750,000.

Alternative B4 - **Extraction of BETX-impacted ground water, air stripping of extracted ground water, and discharge of treated ground water to either injection wells located upgradient or downgradient of the extraction well system or to Elkhorn Creek.**

This alternative is similar to Alternative B3, except extracted ground water would be treated with an air stripper. It was assumed that the existing on-site air stripper would be used. In the air stripping process, BETX compounds are transferred from the water phase to the air phase and discharged to the atmosphere. Based on the best available control technology (BACT) analysis performed as part of the EE/CA for the KN current removal action, vapors emitted during air stripping and SVE treatment at the KN facility would be associated with an individual probability of cancer of $1 \times 10^{-7}$, which is within the acceptable limit established by the NCP. Based on this analysis, the WDEQ determined that the preferred approach for management of air stripper emissions for the KN removal action was venting the air stripper emissions at the top of the on-site flare stack, which raises the point of emissions to 110 feet above ground level, thereby decreasing the individual probability of cancer to $5 \times 10^{-9}$. Accordingly, this method of air emission management was implemented in connection with the current removal action and is included in Alternative B4. It was assumed that vapors emitted from the air stripping system would be vented from the flare stack and that risk levels similar to those for the current removal action would be associated with the system proposed. Discharge from the flare stack would be monitored as necessary to comply with Wyoming air quality standards.

The present worth cost for this alternative would be $248,000. The capital cost would be $73,000 with O&M costs of $51,000.

Alternative B5 - **Extraction of BETX-impacted ground water, chemical oxidation of extracted ground water, and discharge of treated ground water to either injection wells located upgradient or downgradient of the extraction well system or to Elkhorn Creek.**

This alternative is similar to alternatives B3 and B4, except chemical oxidation of extracted ground water would be implemented on-site using controlled reactor vessels similar to Alternative V5 for the VHO plume

Costs for this alternative would include $400,000 capital cost, $53,000 O&M costs, and a present worth cost of $577,000.

Alternative B6 - ***In situ* bioremediation of BETX-impacted ground water.**

*In situ* bioremediation of ground water would involve adding an oxygen source and nutrients to the aquifer in order to promote the activity of organisms which degrade contaminants in a manner similar to Alternative V7 for the VHO plume. The injection/extraction well system would consist of one extraction well and one injection well. It was assumed that one of the three existing aromatic hydrocarbons recovery wells would be used for extraction, and an existing on-site injection well would be used for injection. The actual number and location of wells for the system could change as determined by remedial design. Prior to mixing, extracted water would be passed through an oil/water separator to remove BETX contaminants extracted with ground water. Recovered BETX contaminants would be recycled. To the extent technically practicable, *in situ* bioremediation would continue until the ground water achieves MCLs and proposed MCLs which would be expected to be within two to five years. Treatability testing would be necessary to determine design parameters for *in situ* bioremediation.

This alternative would cost $87,000 in capital cost with $37,000 for O&M. The present worth would be $344,000.

> and at the completion of alternatives can be addressed under the short-term and long-term effectiveness criteria.

## VIII. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The remedial alternatives developed in the FS were analyzed in detail for both the VHO and BETX plumes using nine evaluation criteria. The resulting strengths and weaknesses of the alternatives were then weighed to identify the alternative for each plume providing the best balance among the nine criteria. These criteria are: 1) overall protection of human health and the environment; 2) compliance with applicable or relevant and appropriate requirements (ARARs); 3) reduction of toxicity, mobility, or volume through treatment; 4) long-term effectiveness and permanence; 5) short-term effectiveness; 6) implementability; 7) cost; 8) state acceptance; and 9) community acceptance. Each of these criteria is described below.

### VHO Plume

Criterion 1: Protection of Human Health and Environment

> under this criterion, i.e., simply state whether and how individual alternatives provide protection *

Overall protection of human health and the environment addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

All the treatment technologies employed by the alternatives are protective of human health and the environment by eliminating or reducing risk through the treatment of contaminants in ground water. In addition, the institutional controls and the existing municipal water supply would minimize further use of ground water and therefore reduce exposure to contaminants. As the no-action alternative does not include treatment or controls, it provides no reduction in risk and will no longer be discussed with regard to the VHO plume.

Alternatives V6 and V6A, which contemplate limited extraction of ground water, provide the greatest overall protection. Extraction and injection of ground water throughout the entire VHO plume, as considered in alternatives V3, V4, V4A, V5, and V7, would accelerate eastward migration of the RCRA plume. The approximate areal extent of the RCRA plume is shown in the residential area on Figure 2. The resulting movement of the RCRA plume would increase the areal extent of contamination in the aquifer from that plume, thereby increasing potential risk to residents in the subdivisions.

Criterion 2: Compliance with Applicable Relevant and Appropriate Requirements (ARARs)

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal or State environmental or facility siting law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal or State environmental siting law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

Compliance with ARARs addresses whether a remedy will meet all Federal and State environmental laws and/or provide basis for a waiver from any of these laws. These ARARs are divided into chemical specific, action specific, and location specific groups.

All the VHO alternatives would comply with ARARs. The ARARs evaluation is provided as Exhibit 1.

Criterion 3: Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to the ability of a remedy to maintain reliable protection of human health and the environment over time. This criterion includes the consideration of residual risk and the adequacy and reliability of controls.

The remedial alternatives all result in minimal residual risk. All the alternatives are expected to attain MCLs and proposed MCLs, thereby resulting in minimal risk from contaminant residuals in ground water. The institutional controls and the existing municipal water supply additionally mitigate residual risk by minimizing the use of ground water.

Alternatives V3, V5 and V7 result in no treatment residuals. Alternatives V4 and V6 release emissions to the atmosphere, but at negligible levels and minimal risk. Additional controls for these two alternatives include monitoring to ensure compliance with Wyoming air quality standards, and a BACT analysis to ensure emissions are minimized. Alternatives V4A and V6A require disposal or treatment of contaminated carbon filters, but pose minimal residual risk.

Criterion 4: Reduction of Toxicity, Mobility, or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the preference for a remedy that uses treatment to reduce health hazards, contaminant migration, or the quantity of contaminants at the site.

All the alternatives employ an irreversible treatment as a primary element to address the principal threat of contamination. Alternatives V6 and V6A treat a smaller volume of water than the other alternatives in order to avoid adverse effects to the RCRA plume.

Reduction in toxicity, mobility, and volume of contaminants in ground water is best accomplished by Alternative V5 through chemical oxidation. Alternatives V4 and V6 indirectly reduce toxicity and volume through photodegradation of contaminants. Photodegradation occurs when the contaminants, released to the atmosphere, are broken down by sunlight. Alternative V7 reduces toxicity and volume through treatment but would require treatability studies to evaluate its effectiveness. Alternatives V4A and V6A reduce mobility, but not volume or toxicity because these alternatives result in spent carbon filters containing the contaminants, requiring disposal or regeneration of the carbon. Alternative V3 reduces toxicity, mobility and volume of contaminants, but would produce 170 tons of non-hazardous sludge annually which would require disposal.

NOTE: an important point, i.e., decision to select a remedy will involve differences in the other criteria

best discussed under short-term effectiveness criteria

more discussed above under long-term effectiveness (i.e., residual mgmt) dynamics & interrelatedness would have been helpful for the layman.

mbrod6

any wrap up any comparative analysis, here discussion earlier (e.g. site characterization) regarding plume

Criterion 5: Short-Term Effectiveness

Short-term effectiveness refers to the period of time needed to complete the remedy and any adverse impacts on human health and the environment that may be posed during the construction and implementation of the remedy.

Alternatives V6 and V6A are not expected to pose any appreciable short-term risks to the community and workers during construction and implementation.

Alternatives V3, V4, V4A, V5, and possibly V7 are expected to cause adverse effects to the environment and human health by spreading the RCRA plume through the aquifer and possibly depleting the aquifer.

The high extraction volume in alternatives V3, V4, V4A, V5, and V7 are expected to attain remedial objectives in the shortest time, two years, with the exception of V7 which could take as long as five years. Alternatives V6 and V6A are expected to require six years to attain remedial objectives. These two alternatives would not result in the unacceptable effects on human health and the environment as are expected from the other alternatives through effects on the RCRA plume.

↑ This would be the time to discuss air emissions

Criterion 6: Implementability

Implementability refers to the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the chosen solution. It also includes coordination of Federal, State, and local governments to clean up the site.

Alternatives V6 and V6A are most easily technically implemented because these alternatives involve activities primarily on the Dow/DSI facility, requiring the least amount of construction and least difficulty with property access. Alternative V7, and possibly V5, would be less easily implemented because of the need for treatability studies to better understand the applicability of *in situ* bioremediation and chemical oxidation to the site. Alternatives V3, V4A, and V6A present no technical difficulties, but require the additional burden of disposing of or treating residual sludges and carbon filters.

All alternatives require ground water monitoring. Alternatives V6 and V6A additionally require air monitoring. Monitoring activities would be coordinated with the State of Wyoming.

Criterion 7: Cost

This criterion examines the estimated costs for each remedial alternative. For comparison, capital and annual O&M costs are used to calculate a present worth cost for each alternative.

Alternatives V6 and V6A have the lowest capital and O&M costs, resulting in present worth of $353,822 and $518,407, respectively. These alternatives are the least expensive because they incorporate scaled-down ground water extraction in comparison to the other alternatives. V7 is the next most costly, with a present worth of $1,011,288. Alternatives V4 and V4A, which are scaled-up versions of V6 and V6A, and V5, differ in treatment method, but are otherwise similar and so cost nearly the same. Present worth estimates for these three alternatives range from $1,351,883 to $1,673,488. V3 is the most costly because of very high capital expenses, and has a present worth of $2,482,675.

* use of a summary table often is helpful here.

Criterion 8: State Acceptance

EPA has involved the WDEQ in the RI/FS and remedy selection process. WDEQ was provided the opportunity to comment on the RI/FS document and the proposed plan, and took part in the public meeting held to inform the public of the proposed plan. WDEQ's statement in regard to the selected remedy, read at the public meeting, states in part "It is the position of the Department [WDEQ] that the proposed actions identified in alternatives B4 and V6 should be implemented as soon as possible". WDEQ went on to add that it concurs with the proposal to further investigate subsurface soil contamination sources as contemplated in OU 2.

WDEQ believes, however, that remedial actions taken under CERCLA should be integrated with the RCRA corrective action addressing the RCRA plume, forming a comprehensive effort to concurrently remediate all ground water contamination within the Brookhurst subdivision. WDEQ's comments are further addressed in the attached Responsiveness Summary.

Criterion 9: Community Acceptance

EPA solicited input from the community on the clean up methods proposed for the ground water at the Mystery Bridge site. Although public comments indicate no specific opposition to the preferred alternative, residents and their representatives did raise concerns about the methods and data used to reach that alternative. These issues are addressed in the attached Responsiveness Summary and some will be incorporated into OU 2 activities for the site.

**BETX Plume**

Criterion 1: Protection of Human Health and the Environment

All the treatment technologies employed by the remedial alternatives are protective of human health and the environment by eliminating or reducing risk through the treatment of contaminants in ground water. In addition, institutional controls and the municipal water supply would minimize further use of ground water and therefore reduce exposure to contaminants. As the no-action alternative does not include treatment or controls, it provides no additional reduction in risk and will no longer be discussed with regard to the BETX plume.

None of the alternatives is expected to adversely impact the RCRA plume as some of the VHO plume alternatives would.

Criterion 2: Applicable or Relevant and Appropriate Requirements (ARARs)

All the BETX alternatives would comply with ARARs. The ARARs evaluation is provided as Exhibit 1.

Criterion 3: Long-Term Effectiveness and Permanence

The remedial alternatives all result in minimal residual risk. All the alternatives are expected to attain MCLs or proposed MCLs, thereby resulting in minimal risk from contaminant residuals in ground water. The institutional controls and the existing municipal water supply additionally mitigate residual risk by minimizing the use of ground water.

Over the long term, each alternative will likely leave some residual BETX contaminants in subsurface soils on or near the KN facility. Problems related to these residuals will be addressed OU 2. Alternative B6, however, would help treat some of the residual BETX contaminants since *in situ* bioremediation would destroy contaminants with naturally occurring microorganisms in ground water and in subsurface soils.

Alternative B5 would result in no treatment residuals. Alternative B4 would release emissions to the atmosphere, but at negligible levels and minimal risk. The air stripper contemplated in Alternative B4 is currently operating as part of the KN removal action. Monitoring has demonstrated that air stripper emissions are within Wyoming air quality standards. Alternative B3 would result in 10 to 20 tons annually of non-hazardous residual sludge requiring off-site disposal.

Criterion 4: Reduction in Toxicity, Mobility, or Volume through Treatment

All the alternatives employ an irreversible treatment as a primary element to address the principal threat of contamination.

Reduction in toxicity, mobility, and volume of contaminants in ground water would best be accomplished by alternatives B5 and B6. Alternative B4 would remove contaminants from ground water and indirectly reduce toxicity and volume through photodegradation of the contaminants. Alternative B3 would reduce toxicity, mobility and volume of contaminants, but would produce 10 to 20 tons of non-hazardous sludge annually requiring disposal.

Criterion 5: Short-Term Effectiveness

None of the alternatives would result in adverse short-term effects for community and worker protection. However, Alternative B6 would require two to five years to achieve clean up, whereas alternatives B3, B4 and B5 are estimated to achieve clean up within one year.

Criterion 6: Implementability

Alternative B4 would most easily be implemented because the air stripper used in this alternative is currently in operation as part of the KN removal action. Alternative B5 would pose no undue problem with regard to this criterion. Alternative B3 would present no technical difficulties but requires the additional burden of disposing of residual sludge. Alternative B6 would be more difficult to implement because of the need for treatability studies to better understand the applicability of *in situ* bioremediation to the site.

All alternatives require ground water monitoring. Alternative B4 additionally requires air monitoring. Monitoring activities will be coordinated with the State of Wyoming.

Criterion 7: Cost

With the air stripper already in place, Alternative B4 has minimal capital costs. Its present worth of $247,917 is also the least among all alternatives. Alternative B6 is the next most expensive with a present worth of $334,553. Alternatives B5 and B3 are the most costly, with present worth estimates of $577,217 and $750,502, respectively.

Criterion 8: State Acceptance

State acceptance for this alternative is the same as described above for Alternative V6 for the VHO plume.

Criterion 9: Community Acceptance

Community acceptance for this alternative is the same as described above for Alternative V6 for the VHO plume.

## IX. SELECTED REMEDY

EPA has selected the combination of alternatives V6 and B4 as the remedy for the ground water operable unit for the Mystery Bridge site. This remedy is made up of the following components:

Common Elements

- Monitoring ground water, discharged treated water, and air; and
- Implementation of institutional controls.

VHO Plume: Alternative V6

- Extraction of ground water with concentrations of VHOs above MCLs or proposed MCLs in the upgradient portion of the plume (i.e., on and/or near the Dow/DSI facility);
- Treatment of contaminated ground water with an on-site air stripping facility;
- Reinjection of treated water into the aquifer to provide additional hydraulic containment of the upgradient portion of the VHO plume being extracted, minimize any impact from the VHO remediation efforts on the RCRA plume and BETX plume, and enhance the natural attenuation process in the downgradient portions of the VHO plume; and
- Reliance on natural processes for reduction of VHO levels in downgradient portions of the VHO plume.

BETX Plume: Alternative B4

- Extraction of ground water with concentrations of BETX compounds above MCLs or proposed MCLs throughout the plume;
- Treatment of contaminated ground water with an on-site air stripping facility; and
- Reinjection of treated water into the aquifer to provide additional hydraulic control of the BETX plume and minimize any potential impact from the BETX remediation efforts on the RCRA and VHO plumes.

Alternative B4 assumes continuation of the ongoing KN removal action. This removal action would be expanded, if necessary, to recover any hydrocarbons originating from the KN operation that may exist outside of KN's facility. In addition, since no ground water in the residential areas is believed to be contaminated with BETX originating from KN at concentrations above MCLs or proposed MCLs, this remedy requires that no ground water contaminated above such levels will be allowed to enter the subdivision from the KN property. Periodic monitoring will be used to evaluate compliance with this condition.

The remedial design will specify the appropriate number and location of wells and monitoring points, and system parameters such as flow rates for both the VHO and BETX ground water treatment systems. Some modifications or refinements may be made to the remedy during remedial design and construction. Such modifications or refinements, in general, would reflect results of the engineering design process. Estimated cost for the selected remedy is $600,739. Details of the costs for each of the VHO and BETX remedies are shown in Table 6.

mbrod8

The selection of this remedy is based upon the comparative analysis of alternatives presented above, and provides the best balance of tradeoffs with respect to the nine evaluation criteria. ARARs for the selected remedy are shaded in the table provided as Exhibit 1. As pointed out in the comparative analysis, the impact of each VHO plume alternative on the RCRA plume was carefully considered. The close proximity of these two plumes prescribes a remedy that would not adversely affect the extent of the RCRA plume. VHO plume alternatives which include limited ground water extraction and minimally disturb the aquifer down gradient of the source areas meet this need. Air stripping was chosen as the appropriate treatment technology applied to the extracted ground water by weighing the factors outlined in the comparative analysis. Natural attenuation was chosen over *in situ* bioremediation for the downgradient portion of the VHO plume in Alternative V6 because it would not adversely impact the RCRA plume in any way, does not require treatability studies, is effective at the existing level of contamination, and has less uncertainty than bioremediation with regard to remediation time frame. The selection of Alternative B4 as the remedy for the BETX plume was also based upon the comparative analysis. A particular strength of this alternative is that it is already in place and has been proven effective as part of the KN removal action.

Based on the findings in the BRA for the Current Resident and Future Hypothetical Resident scenarios (see Table 3), the remedial action objectives for this site are the following:

1) Prevent ingestion of water containing t-1,2 DCE, 1,1,1 TCA, TCE, PCE, benzene, toluene, ethylbenzene, or xylene at concentrations that either a) exceed MCLs or proposed MCLs, or b) present a total carcinogenic risk range greater than $1x10^{-4}$ -$1x10^{-6}$; and

2) Restore the alluvial aquifer to concentrations that both a) meet the MCLs or proposed MCLs for t-1,2 DCE, 1,1,1 TCA, TCE, PCE, benzene, toluene, ethylbenzene, and xylene, and b) present a total carcinogenic risk range less than $1x10^{-4}$ -$1x10^{-6}$.

Remedial ~~action~~ goals specifically delineate ~~action levels~~, area of attainment, and restoration time frame. The ~~action~~ levels are MCLs and proposed MCLs (as shown previously in tables 1 and 2). Attainment of these ~~action levels~~ will provide protectiveness of human health and the environment. The area of attainment shall be the entire VHO and BETX plumes, including those areas of the plumes within and outside the Dow/DSI and KN properties. Based on the contaminant transport modeling performed for the RI/FS, the restoration time frame for this remedial action shall be six years, with the expectation that remediation of the BETX plume should be no longer than one year, and with the acknowledgement that the restoration time frame may vary depending upon the outcome of OU 2 in addressing remaining sources, and other factors described below.

A further objective of this remedial action is to restore the ground water, with the exception of the area impacted by the RCRA plume, to its beneficial use, which is, at this site, a drinking water aquifer. Based on information obtained during the RI, and the analysis of all remedial alternatives, EPA and the State of Wyoming believe that the selected remedy will achieve this objective. It may become apparent, during implementation or operation of the ground water extraction system, that contaminant levels have ceased to decline and are remaining constant at levels higher than the remediation goal. In such a case, the systems' performance standards and/or the remedy may be reevaluated.

Table 6: Selected Remedy Costs



| VHO Plume | |
|---|---|
| Item | Cost |
| Direct Capital Costs | |
| Temporary Deed and/or User Restrictions | $15,000 |
| Extraction Well System Installation | $3,500 |
| Well Installation Supervision | $1,110 |
| Well Pumps | $2,500 |
| Influent and Discharge Piping | $5,000 |
| Piping Installation | $4,000 |
| Air Stripper System | $57,000 |
| Air Stripper System Installation | $14,000 |
| Discharge Pump | $2,500 |
| Mobilization | $7,000 |
| Equipment Decontamination | $5,000 |
| Health and Safety Program | $10,000 |
| Estimated Direct Capital Cost | $126,610 |
| Indirect Capital Costs | |
| Contingency Allowance (25%) | $31,653 |
| Engineering Fees (15%) | $18,992 |
| Legal Fees (5%) | $6,331 |
| Estimated Indirect Capital Cost | $56,975 |
| Total Estimated Capital Cost | $183,585 |
| Annual Operation and Maintenance Costs | |
| Ground Water Sample Collection | $2,600 |
| Ground Water Sample Analysis | $8,400 |
| Electricity (pumps, blower) | $4,320 |
| Air Stripper Operation | $23,360 |
| Air Stripper Maintenance | $13,440 |
| Air Stripper Cleaning Solution | $1,500 |
| Discharge Sampling (water) | $11,680 |
| Discharge Analysis (water) | $54,750 |
| Air Stripper Vapor Discharge Sampling | $1,664 |
| Vapor Sample Analysis | $1,200 |
| Estimated Annual Operation and Mainenance Cost | $122,914 |
| Present Worth of Annual Operation and Maintenance Costs (i=5%) | $170,237 |
| **Total Estimated Cost VHO Plume** | **$353,822** |

*From: RI/FS Report (June 1990)*

Table 6: Selected Remedy Costs



| BETX Plume | |
|---|---|
| Item | Cost |
| Direct Capital Costs | |
| Temporary Deed and/or User Restrictions | $15,000 |
| Influent and Discharge Piping | $4,000 |
| Piping Installation | $600 |
| SVE Wells | $10,500 |
| Product Recovery Well | $4,500 |
| Product Recovery Pump | $2,500 |
| Vacuum Pump | $7,500 |
| Well Installation Supervision | $1,850 |
| Mobilization | $3,000 |
| Equipment Decontamination | $500 |
| Health and Safety Program | $500 |
| Estimated Direct Capital Cost | $50,450 |
| Indirect Capital Costs | |
| Contingency Allowance (25%) | $12,613 |
| Engineering Fees (15%) | $7,568 |
| Legal Fees (5%) | $2,523 |
| Estimated Indirect Capital Cost | $22,703 |
| Total Estimated Capital Cost | $73,153 |
| Annual Operation and Maintenance Costs | |
| Ground Water Sample Collection | $2,600 |
| Ground Water Sample Analysis | $8,400 |
| Electricity (pumps, blower) | $6,000 |
| Air Stripper Operation | $6,400 |
| Air Stripper Maintenance | $3,200 |
| Air Stripper Cleaning Solution | $1,700 |
| Discharge Sampling (water) | $3,200 |
| Discharge Analysis (water) | $15,000 |
| SVE Vapor and Stack Discharge Sampling | $1,664 |
| Vapor Sample Analysis | $2,400 |
| Estimated Annual Operation and Mainenance Cost | $50,564 |
| Present Worth of Annual Operation and Maintenance Costs (i=5%) | $174,765 |
| **Total Estimated Cost BETX Plume** | **$247,917** |

*From: RI/FS Report (June 1990)*

The selected remedy will include ground water extraction for an estimated period of at least one year for the VHO plume and less than one year for the BETX plume, during which time the systems' performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. The operation monitoring period will be determined during remedial design. The operating system may include discontinuing operation of extraction wells in areas where cleanup goals have been attained, alternate pumping at wells to eliminate stagnation points, and pulse pumping to allow aquifer equilibration and encourage adsorbed contaminants to partition into ground water for extraction and treatment.

## X. STATUTORY DETERMINATIONS

EPA's primary responsibility at Superfund sites is to select remedial actions that are protective of human health and the environment. CERCLA also requires that the selected remedial action for the site comply with applicable or relevant and appropriate environmental standards established under Federal and State environmental laws, unless a waiver is granted. The selected remedy must also be cost-effective and utilize permanent treatment technologies or resource recovery technologies to the maximum extent practicable. The statute also contains a preference for remedies that include treatment as a principal element. The following sections discuss how the selected remedy for contaminated ground water at the Mystery Bridge site meets these statutory requirements.

### Protection of Human Health and Environment

In order to meet the remedial objectives outlined in the previous section, the risk associated with exposure to the contaminated ground water must fall within the acceptable risk for carcinogens. Attainment of MCLs and proposed MCLs will assure site risk falls within this range. The selected remedy protects human health and the environment by reducing levels of contaminants in the ground water through extraction and treatment, as well as through natural attenuation. EPA expects VHOs in ground water would be reduced to MCLs or proposed MCLs in six years and MCLs or proposed MCLs for BETX compounds would be attained within one to two years. However, there is a minimal chance that complete remediation may take as long as 18 years. Together with deed and/or user restrictions and the existing municipal water supply, the threat of exposure currently posed to residents from contaminated ground water would be significantly reduced if not eliminated. Of all the alternatives for both the VHO and BETX plumes, the selected alternatives provide the best protection to human health without significant adverse impact to the environment. No unacceptable short-term risks or cross-media impacts would be caused by implementing this remedy.

### Attainment of Applicable or Relevant and Appropriate Requirements of Environmental Laws

All ARARs would be met by the selected remedy.

Chemical Specific ARARs. The selected remedy would achieve compliance with chemical specific ARARs related to the downgradient ground water and ambient air quality at the site. The relevant and appropriate requirements include primary drinking water standards established by the Safe Drinking Water Act. Some contaminants of concern identified for the site have MCLs. MCLs have been proposed for the remaining contaminants of concern and are to be considered. Values for the MCLs and proposed MCLs are shown on Table 1 for the VHO compounds and on Table 2 for the BETX compounds. Concentrations of BETX compounds throughout the entire BETX plume would be reduced below MCLs or proposed MCLs by the Alternative B4 treatment system. Concentrations of VHO compounds in the while natural attenuation would reduce concentrations in the downgradient portion of the plume to below MCLs or proposed MCLs.

Benzene emissions from the air stripping treatment system will be monitored and if required, controls would be implemented to ensure would compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAP). At present it is not expected that constituents for which standards have been established by the Wyoming Air Quality Rules and Regulations will be produced in the treatment process. In the unlikely event that constituents are produced, the necessary controls would be implemented in order for the emissions to comply with the regulations.

Action Specific ARARs. The selected remedy would address and comply with action specific ARARs for injection of treated water back in to the ground according to Wyoming UIC program established by 40 CFR 147 and Wyoming Water Quality Rules and Regulations, Chapter IX. The ground water monitoring program which includes wells located upgradient, downgradient, and within the contaminated ground water would fulfill the requirements of the RCRA corrective action program.

Land disposal restrictions are not applicable to the selected remedy. Instead, RCRA section 3020 applies to reinjection of treated ground water into Class IV injection wells during CERCLA response actions. Since the goal is to clean up ground water to drinking water levels, health-based drinking water standards (MCLs), rather than land disposal restrictions, are the relevant and appropriate clean up standard.

RCRA requirements would be met as appropriate for owner and operators of hazardous waste treatment, storage, and disposal facilities. BACT analysis for construction, modification, and operation of the water treatment systems would comply with the requirements of Wyoming Air Quality Rules and Regulations and discharges would not be concealed. Similarly, BACT permit and data requirements for the ground water extraction/injection system would comply with Wyoming Water Quality Rules and Regulations.

Location Specific ARARs. The selected remedy would address and comply with all location specific ARARs for preservation and protection of the North Platte River floodplain according to the requirements of 40 CFR 6.302. RCRA location standards for treatment, storage and disposal facilities are relevant and appropriate for temporary storage tanks of recovered hydrocarbons.

**Cost Effectiveness**

EPA believes the selected remedy is cost-effective in mitigating the principal risk posed by contaminated ground water within a reasonable period of time. Section 300.430(f)(ii)(D) of the NCP requires EPA to evaluate cost-effectiveness by comparing all the alternatives which meet the threshold criteria: protection of human health and the environment, against three additional balancing criteria: long-term effectiveness and permanence; reduction of toxicity, mobility or volume through treatment; and short-term effectiveness. The selected remedy meets these criteria and produces the best overall effectiveness at the lowest reasonable cost. Therefore, the selected remedy is cost effective as defined in the NCP. The estimated cost for the selected remedy is over $600,000.

provides for

in proportion to its

more specific even though an estimate

**Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable**

EPA believes the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the Mystery Bridge site. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that the selected remedy provides the best balance of trade-offs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility or volume achieved through treatment; short-term effectiveness; implementability; and cost, and also considering the statutory preference for treatment as a principal element and considering State and community acceptance.

Alternative V6 complies with ARARs; and reduces the toxicity, mobility, and volume of the contaminants in the ground water equally as well as the other VHO plume alternatives. Short-term effectiveness and protection of human health and the environment were critical in choosing Alternative V6 with natural attenuation for the downgradient portion of the VHO plume in light of effects on the RCRA plume and trade-off with remediation time frame.

Alternative B4 provides long-term effectiveness equally as well as alternatives B3 and B5. Although Alternative B6 has potential to best provide protection, it would require a greater remediation time frame and cost more than Alternative B4. Alternative B5 would accomplish a greater reduction in toxicity, mobility and volume of contaminants than B4, but at over twice the cost. Alternative B4 removes contaminants from ground water and will indirectly reduce the toxicity and mobility through photodegradation. Alternative B3 requires the additional burden of disposing of 10 to 20 tons of non-hazardous sludge annually. Since Alternative B4 would be a continuation of the ongoing air stripping operation at the KN facility, it would be the easiest to implement and cost the least of the BETX plume alternatives.

The State of Wyoming is in concurrence with the selected remedy. The Proposed Plan for the Mystery Bridge site was released for public comment in July 1990. The Proposed Plan identified alternatives V6 and B4 as the preferred remedy. EPA reviewed all written and verbal comments submitted during the public comment period. Upon review of these comments, EPA determined that no significant change to the remedy originally identified in the Proposed Plan was necessary.

...ough okay, this information would be better presented under Selected Remedy Section

**Preference for Treatment as a Principal Element**

The selected remedy satisfies, in part, the statutory preference for treatment as a principal element. The principal threat to human health is from ingestion of and direct contact with contaminated ground water. The selected remedy reduces levels of BETX contaminants and the highest concentrations of VHO contaminants in ground water through treatment using air stripper systems. Natural attenuation of the downgradient portion of the VHO plume was selected over treatment because of the adverse effects on the nearby RCRA that would result from aquifer drawdown during pumping of that portion of the plume for treatment. If the downgradient portion of the plume is pumped, the RCRA plume could migrate further into the residential area and thus increase the risk of exposure to contaminated ground water.

As indicated earlier, "principal threats" concept pertains to source material. Therefore, satisfaction of treatment preference could have been put off to subsequent ROD dealing with sources. However, the pool of floating material can be viewed as a principal threat and treatment of it could be viewed as satisfaction, in part, of the statutory preference.