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EPA

# The Feasibility Study: Detailed Analysis of Remedial Action Alternatives

Office of Emergency and Remedial Response
Hazardous Site Control Division OS-220
Quick Reference Fact Sheet

This is the fourth and final in a series of fact sheets describing the remedial investigation/feasibility study (RI/FS) process. This fact sheet is a synopsis of Chapter 6 of the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (October 1988, OSWER Directive No. 9355.3-01), which addresses the detailed analysis of remedial action alternatives. Additionally, this fact sheet provides Remedial Project Managers (RPMs) with information on how to manage this phase of the FS efficiently and effectively.

The purpose of the detailed analysis of alternatives is to provide decisionmakers with adequate information to permit selection of an appropriate remedy for a site or operable unit. The detailed analysis of remedial action alternatives follows the development and screening process, which is described in detail in Chapter 4 of the *RI/FS Guidance* and summarized in the third FS fact sheet (OSWER Directive No. 9355.3-01FS3). The development, screening, and detailed analysis of alternatives may overlap, with one phase beginning before another is completed. Also, the activities may vary in level of detail based on the complexity or scope of the problem at a site. The extent to which alternatives are analyzed during the detailed analysis is influenced by the available data, the number and types of alternatives being evaluated, and the degree to which alternatives were analyzed during their development and screening. The results of the detailed analysis provide the basis for identifying a preferred alternative and preparing the proposed plan. Upon completion of the detailed analysis, the FS report, along with the proposed plan (and the RI report if not already released) is issued for public review and comment. The results of the detailed analysis support the final selection of a remedy and provide the foundation for the Record of Decision (ROD). The major components of the detailed analysis process are presented in Figure 1.

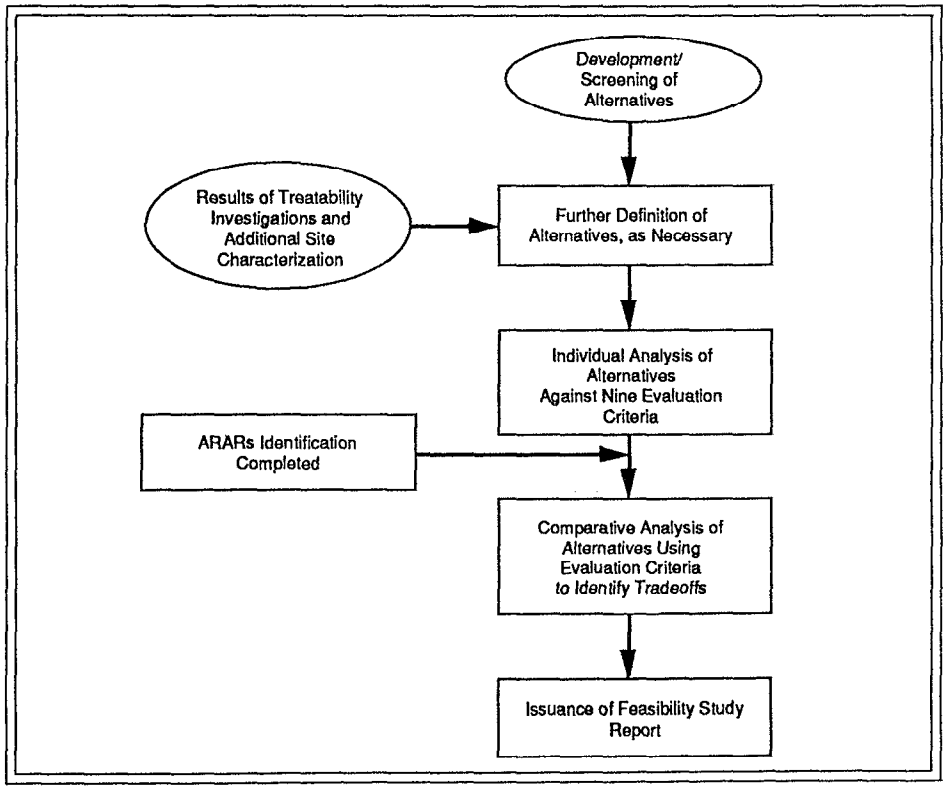



**Figure 1. Major Components of the Detailed Analysis Process**

The detailed analysis, like other phases of the RI/FS process, should be tailored to the scope and complexity of the site or operable unit. The level of detail can be expected to vary from site to site, although all major components discussed here and in the RI/FS guidance must always be addressed.

## Detailed Analysis Activities

### Alternative Definition

The alternatives progressing from the development and screening phase of the FS may need to be better defined in order to adequately evaluate them during the detailed analysis. If available, additional site characterization and treatability study data should be utilized at this time. These data may not have been available during the development and screening of remedial action alternatives due to the interactive nature of the RI and FS.

Necessary refinements to the remedial alternatives may include:

- Modification of contaminated media volume estimates
- Revision of sizing requirements of process options
- Selection of a more suitable "representative" process option
- Addition of other possible unit process options to be considered.

## Individual Analysis of Alternatives

Once the remedial action alternatives are sufficiently defined to allow for further evaluation, each alternative is assessed against nine evaluation criteria. These criteria have been designed to enable the analysis of each alternative to address the statutory requirements and considerations, and the technical and policy considerations important for selecting among remedial alternatives. These evaluation criteria, listed in Figure 2, provide the framework for conducting the detailed analysis and for subsequently selecting an appropriate remedial action. Also included within this figure are the specific factors to be considered under each of the criteria. The individual analysis of alternatives should profile the performance of each alternative against the evaluation criteria, highlighting the specific strengths and weaknesses of a particular alternative relative to each evaluation criterion.

The evaluation criteria have been divided into three groups based on the function of the criteria in remedy selection. The threshold criteria relate to statutory requirements that each alternative must satisfy in order to be eligible for selection and include:

- Overall protection of human health and the environment
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs).

The primary balancing criteria are the technical criteria upon which the detailed analysis is primarily based and include:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost.

The third group is made up of the modifying criteria and includes:

- State/Support agency acceptance
- Community acceptance.

These last two criteria are assessed formally after the public comment period, although to the extent they are known, they are factored into the identification of the preferred alternative. Based on this formal consideration, the lead agency may modify aspects of the preferred alternative or decide that another alternative is more appropriate. The RPM should try to develop and maintain a thorough understanding of State and community concerns throughout the RI/FS process. This understanding is essential to prevent issues from arising that could fundamentally change the alternatives being considered after completion of the RI/FS and proposed plan.

**Note: Risks associated with alternatives are considered during the detailed analysis. The evaluation of the long-term effectiveness and permanence afforded by alternatives assesses the effectiveness an alternative will have in eliminating exposure pathways or reducing levels of exposure identified in the baseline risk assessment. During the evaluation of short-term effectiveness, exposures associated with implementation of alternatives, such as short-term health effects from release of volatiles during excavation of soils are addressed. This may require assistance from the risk assessor.**

The level of detail in which each alternative is analyzed relative to the evaluation criteria will depend upon the type and complexity of the site, the types of technologies and alternatives being considered, the level of information available on the alternatives, and other project-specific considerations. The analysis should

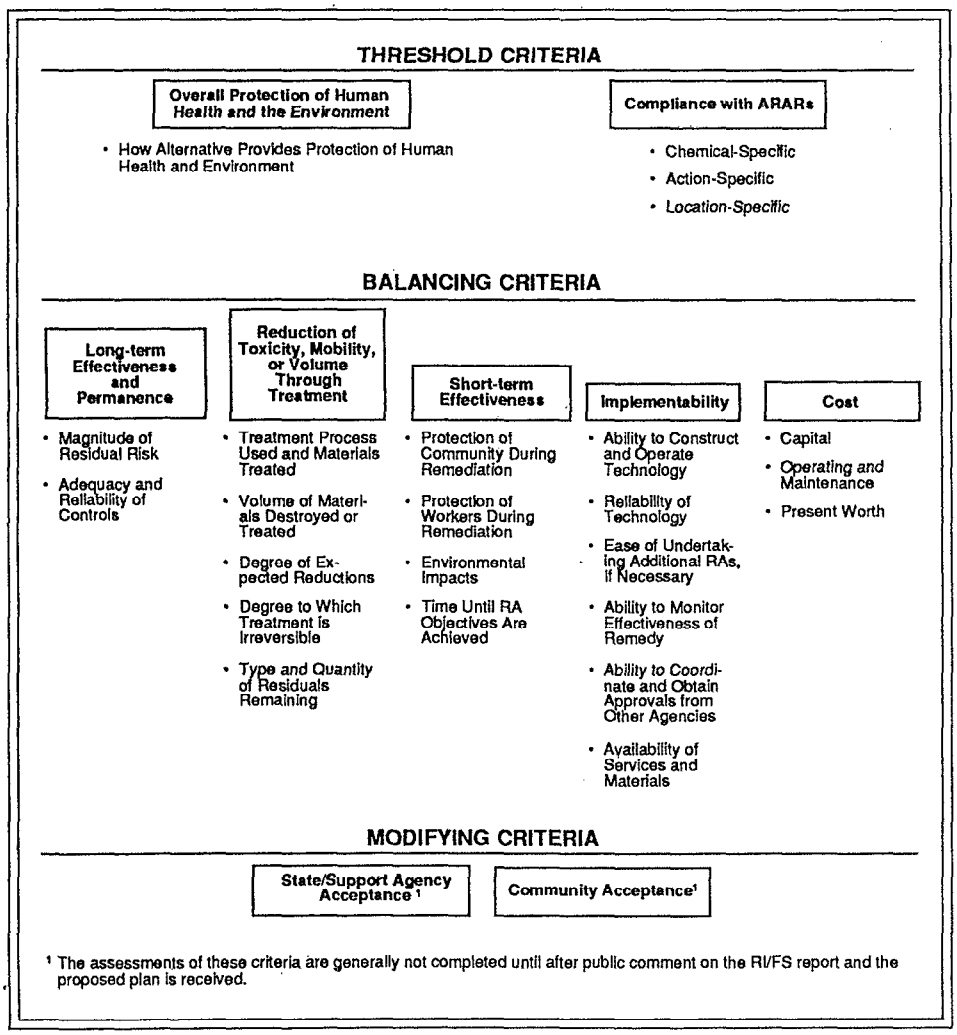



**Figure 2. Criteria for Detailed Analysis of Alternatives**

be conducted in sufficient detail to enable decisionmakers to understand the significant and/or controversial aspects of each alternative and any uncertainties associated with the anticipated performance or evaluation of the remedies.

**Note: All alternatives may not need to be evaluated with respect to all of the subcriteria presented in Figure 2. The key is to identify the subcriteria by which the alternatives vary significantly and to focus the evaluation on those factors.**

### Comparative Analysis

Once the alternatives have been fully described and individually assessed against the nine criteria, a comparative analysis should be conducted to evaluate the relative performance of the alternatives in relation to each specific evaluation criterion. The purpose of the comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another so the tradeoffs that will have to be balanced to select a remedy are fully understood. The comparative analysis generally will focus on the differences between alternatives with respect to the primary balancing criteria since these factors play the major role in determining which options are cost-effective and which remedy utilizes permanent solutions and treatment to the maximum extent practicable.

### Next Steps

The detailed analysis develops information used in selecting an appropriate remedy based on statutory requirements under CERCLA, as amended by SARA. As illustrated in Figure 3, the nine criteria have been developed to organize the evaluation which supports the determination that these statutory requirements are met. Further information on remedy selection will be provided in a subsequent fact sheet.

## Detailed Analysis Deliverables

Table 6-5 of the *RI/FS Guidance* presents a suggested format for the final FS report. The major elements to be included in the FS report are:

- Description of alternatives and individual analysis (narrative and table)
- Comparative analysis of the alternatives with respect to each evaluation criterion (narrative)
- Documentation of ARARs.

### Individual Analysis Presentation

The presentation of the individual analysis in the FS should include a narrative description of each alternative and a discussion of the evaluation of each alternative against the nine criteria. The narrative descriptions of alternatives should include:

- Technology components (identifying any innovative technologies)
- Quantities of materials handled
- Scale of process options
- Time required for implementation
- Implementation requirements
- Major ARARs
- Assumptions, uncertainties, and limitations.

The discussion of the evaluation of alternatives should focus on how, and to what extent, each alternative performs in terms of the key factors under each criterion. This includes an analysis of the possible effect of any change in assumptions on the alternative. The analysis should include a summary table highlighting the assessment of each alternative with respect to each of the nine criteria to assist the public and decisionmakers in understanding the options. A sample presentation of an individual analysis is provided in Appendix F of the *RI/FS Guidance*.

### Comparative Analysis Presentation

The presentation of the comparative analysis in the FS should describe the strengths and weaknesses of the alternatives relative to one another with respect to each criterion. An effective way to organize this section is to discuss for each individual criterion the alternative(s) that performs best overall under that criterion, with other alternatives then discussed in the order of their performance. Significant subcriteria should be highlighted and the possible effect of a change in assumptions should be noted. The differences among alternatives may be measured either qualitatively or quantitatively, as appropriate. Quantitative information used to assess the alternatives, such as cost estimates and the time until response objectives would be achieved, should be included in the presentation of the analysis. A sample

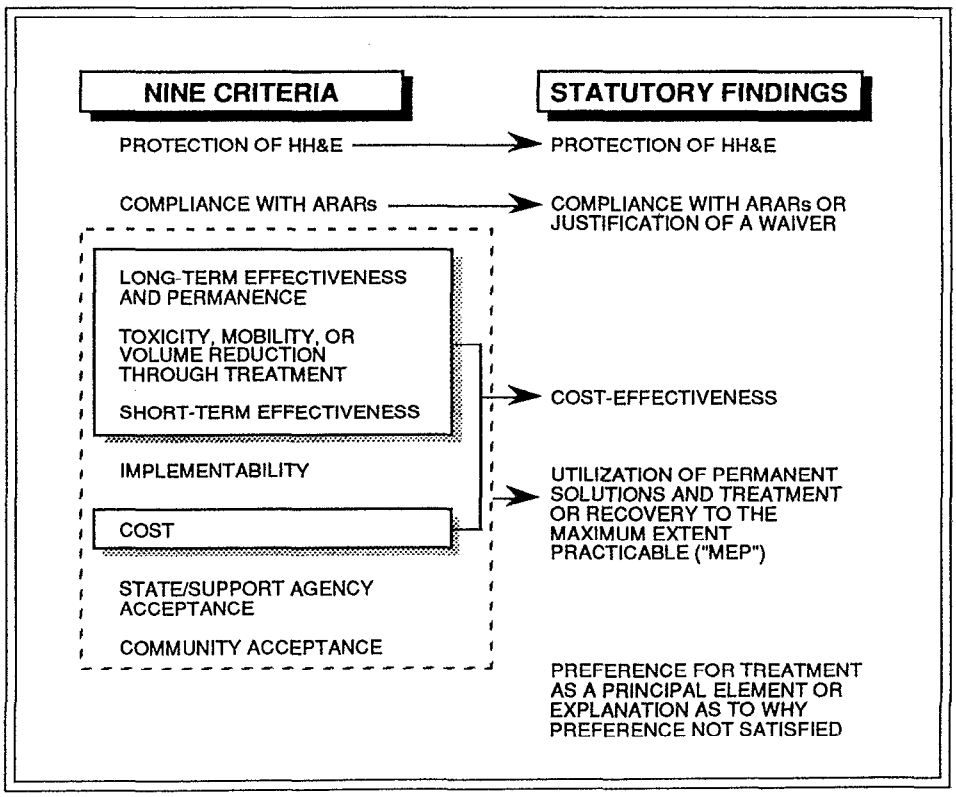



**Figure 3. The Relationship of the Nine Criteria to the Statutory Findings**

presentation of a comparative analysis is given in Appendix F of the *RI/FS Guidance*.

**Note: If innovative technologies are being considered, their potential advantages in cost or performance and the degree of uncertainty associated with these advantages (as compared with the conventional technologies being considered) should be discussed.**

### ARAR Documentation

Major ARARs associated with alternatives that undergo detailed analysis should be integrated into the description of alternatives in the Detailed Analysis chapter of the FS. In addition, the FS should include in an appendix a table that summarizes all Federal and State requirements determined to be ARARs for those alternatives. The table should cite the ARAR, indicate which alternatives meet the ARAR, and identify any waiver and its justification. The specific requirement should be stated in addition to (not instead of) the appropriate regulatory reference, (for example, CWA MCL of 5 ppb TCE). Appendix E of the *RI/FS Guidance* presents a suggested format for documenting the identified ARARs.

**Note: Other available information that is not an ARAR (e.g., advisories, criteria, and guidance) may be considered in the analysis if it helps to evaluate the alternatives' effectiveness or protectiveness and if the lead and support agencies agree that its inclusion is appropriate. This "to be considered" (TBC) information is utilized in the detailed analysis along with ARARs.**

## RPM Responsibilities

Ensuring that adequate technical supervision is being provided during the detailed analysis as well as oversight of the RI/FS schedule and budget are the responsibilities of the RPM. Communication with appropriate technical experts and, in particular, the contractor during this phase of the FS will help the RPM fulfill these responsibilities.

### Technical Support

The detailed analysis is a technical evaluation and should not contain conclusions about remedy selection. Sources of technical support include the Technical Advisory Committee (TAC); ORD's Risk Reduction Engineering Laboratory and Technical Support Project; and the Alternative Treatment Technology Information Center (ATTIC), an automated information system (contact Miles Morse at FTS-475-7161). See the *Scoping Fact Sheet* [OSWER Directive No. 9355.3-01FS1] for further information on appropriate technical experts to utilize during this phase.

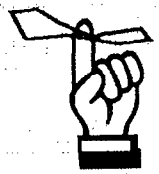
### Schedule and Cost Control

To complete this phase of the FS in a cost-effective and timely manner, the RPM should ensure that the key participants have been involved in all the previous phases of the FS. These participants include personnel from the lead and support agencies, contractor personnel, members of the TAC, PRPs, and community representatives, as appropriate. Other schedule and cost control techniques include:

- Briefing lead and support agency decisionmakers prior to the detailed analysis to obtain firm agreement on which alternatives will be evaluated in detail.
- Holding frequent (e.g., monthly) progress meetings or conference calls with contractors to review progress and to set schedules for completing upcoming tasks.
- Reviewing monthly financial statements from consultants and making sure that all costs are justifiable.
- Anticipating cost and schedule problems based on the previous month's activities, and taking actions to avoid or minimize unnecessary cost increases and schedule delays.

## Enforcement Considerations

In an RI/FS project conducted by PRPs, all aspects of the detailed analysis of alternatives are typically performed by the PRPs. The RPM should meet with the PRP representatives before they initiate the detailed analysis to ensure agreement on alternatives, including process options, that will be evaluated. EPA should oversee all aspects of the detailed analysis. In addition, ARARs identified by the PRPs should be reviewed and approved by both the lead and support agencies. Additional information on PRP participation in the RI/FS and EPA's oversight role can be found in Appendix A of the *RI/FS Guidance* and in OWPE's *Model Statement of Work for PRP-Conducted Remedial Investigations and Feasibility Studies* (June 2, 1989).



### Points to Remember

- **Limit the evaluation to viable, distinctive alternatives.**
- **Focus the evaluation on the strengths and weaknesses of each alternative relative to the others with respect to each criterion.**
- **Include sufficient detail to enable decisionmakers to understand distinctive features of each alternative.**
- **Continue seeking to identify major public concerns during the FS, and if possible, prior to issuance of the proposed plan.**
- **Ensure lead and support agencies discuss and agree upon ARARs and TBCs.**
- **Use sources of information consistently throughout the FS, such as vendors, contractor process/design engineers, and members of the TAC.**
- **Use tables and figures effectively in the presentation of the detailed analysis. They will be helpful when preparing briefings, the proposed plan, and the ROD.**
- **Present alternatives analysis in a level of detail that makes the differences clear, but is not as detailed as design specifications.**