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The Remedial Investigation:

Site Characterization and Treatability Studies

This fact sheet is the second in a series of four that describes the remedial investigation/feasibility study (RI/FS) process. Included within this fact sheet is a summary of Chapters 3 and 5 of the *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (October 1988, OSWER Directive No. 9355.3-01). These chapters discuss site characterization and treatability studies, respectively. Also included is information on how to manage these aspects of the remedial investigation (RI).

The RI builds on activities initiated during scoping and includes implementation of the work plan (WP), the sampling and analysis plan (SAP), and the health and safety plan (HSP). Field data are collected and analyzed to determine the problems posed by a site and to support the identification of potential remedial actions. For sampling efforts to be better focused, it may be desirable to conduct iterative, and increasingly focused, field investigation rounds. Thus, the RI objectives may be better balanced with time and resource constraints. A schematic of the major components that comprise the RI is presented in Figure 1.

Treatability studies provide data on remedial technologies and their effectiveness on the specific waste found at a site. Ideally, the need for these investigations is identified during scoping, while the testing program is developed and implemented during the RI.

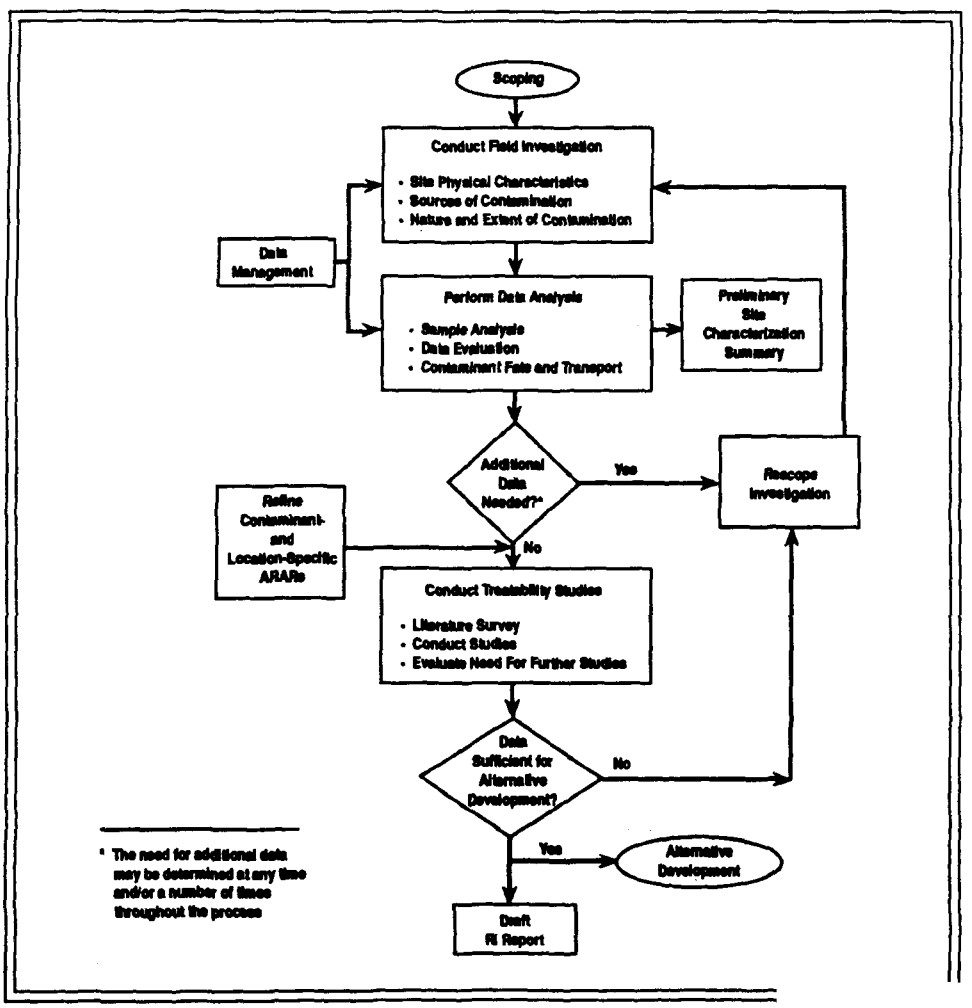

Figure 1. Major Components of the Remedial Investigation

Remedial Investigation Activities

Conduct Field Investigations

Field investigations define a site's physical characteristics as well as its sources, nature, and extent of contamination. In addition to characterizing a site, these activities may also be conducted to gather data on required design/operation parameters for the technologies being considered for remedial action. Because the RI and FS are interactive processes that are conducted concurrently, field investigation activities will be ongoing during the development and screening of remedial action alternatives. Sampling methods for obtaining site data are outlined in the *Compendium of Superfund Field Operations Methods* (September 1987, OSWER Directive No. 9355.0-14); relevant chapters from this compendium are noted on Table 3-1 of the *RI/FS Guidance*.

Note: Support activities are required before conducting field investigations and may take several months to be completed. Activities may include:

- **Obtaining access to areas of investigation**
- **Procuring subcontractors, equipment, and supplies**
- **Selecting and coordinating with an analytical laboratory**
- **Procuring onsite facilities for RI activities**
- **Providing for storage/disposal of contaminated materials generated during the RI**

Define Site Physical Characteristics

Data on the site's physical characteristics and the surrounding areas are collected to: (1) define potential transport pathways and receptor populations and (2) provide sufficient engineering data to develop and evaluate remedial action alternatives. Information used to define a site's physical characteristics includes:

- Site surface features
- Site geology
- Soil and vadose-zone characteristics
- Site hydrogeology
- Surface water hydrology
- Meteorological data
- Human population, land, and water use data
- Ecological information

These data may be obtained from a variety of sources including, but not limited to: historical photographs, topographic surveys, site operational records, sampling/monitoring results, demographic information, USGS and zoning maps, and interviews with present/past site owners and employees.

Characterize Sources of Contamination

Source characterization includes defining: (1) facility characteristics that identify source locations; (2) the quantity of wastes that are either contained in, or have been released in, the environment; and (3) the physical and chemical characteristics of wastes present in the sources. As a part of source characterization, the location, type, and integrity of waste containment structures (e.g., drums) are evaluated to determine the potential for substance release and its magnitude. The data required for source characterization are typically obtained through site inspections, mapping, remote sensing, and sampling and analysis. Quantities of wastes are estimated either from verifiable inventories of containerized waste, from sampling and analysis, or from physical dimensions of the source.

Characterize Nature and Extent of Contamination

The final objective of the field investigation performed during the RI is to investigate the extent of contaminant migration, including the volume of contamination and any changes in its physical and chemical characteristics. This process involves using the information on physical site data and source location for a preliminary estimate of the locations of contaminants that may have migrated into the environment. An iterative monitoring program is then implemented so that, using increasingly accurate analytical techniques, the locations and concentrations of contaminants that have migrated can be defined. The final step is to ensure that the extent of contamination is confirmed with adequate data of sufficient quality to support risk assessment and the analysis of remedial alternatives.

The sampling and analysis approach used to determine the extent of contamination is discussed in Section 4.5.1 of U.S. EPA's *Data Quality Objectives for Remedial Response Activities* (March 1987, OSWER Directive No. 9335.0-7B).

Note: Because of the inherent uncertainties associated with Superfund sites, it is impossible to definitively characterize the nature and extent of contamination at a site. Adequate site characterization requires data that meet DQOs, define the risks posed by a site, demonstrate clearly the need for remedial action, and support the rationale for selecting a remedial action alternative.

Perform Data Analysis

Laboratory Analyses

The type of laboratory chosen to analyze the site characterization samples may include a mobile laboratory, a laboratory with whom the EPA has contracted under the contract laboratory program, (CLP), or a non-CLP laboratory. The type of laboratory selected will depend on the analytical services required, the number of samples to be analyzed, and the desired turnaround time. In many cases, it may be appropriate for more than one type of laboratory to be used. For example, mobile or non-CLP laboratories may be used for the quick analysis of screening level samples, while selected duplicate and/or split samples may be sent to CLP laboratories to confirm and validate the initial estimation of the nature and extent of contamination.

Note: A combination of laboratory services, adequate to achieve the established DQOs, results in more effective use of time and money.

Data Evaluation

The results of the RI are typically presented as an analysis of site physical characteristics, sources of contamination, the nature and extent of contamination, and the risk associated with the contamination. Defining the risks to human health and the environment is a function of the baseline risk assessmen The baseline risk assessment is addressed in a separate fact sheet entitled, *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual.* This fact sheet is being prepared by the Hazardous Site Evaluation Division in the Office of Emergency and Remedial Response.

Data Management

The quality and validity of information generated during the RI must be effectively tracked by a data management system to allow it to be used to support remedy selection and any legal or cost recovery actions. The RI data management system should include:

- Field Logs–to document field investigation activities and observations, field measurements, and any unusual circumstances or occurrences.
- Laboratory and QA/QC Reports–to provide chain-of-custody and sample shipment records, analytical results, adherence to prescribed protocols, nonconformity events, correcti measures, and data deficiencies.

All records should be maintained throughout the RI/FS to ensure that only final and approved analytical data are used in the site analyses. Precautions should be taken to prevent the introduction of errors or the loss or misinterpretation of data. A data security system should be created to safeguard and prevent free access to project records.

Note: In some cases, the use of nonvalidated data is warranted to prepare internal review documents, to begin data analysis, and to continue refining remedial action alternatives. Preliminary data, however, can lead to improper conclusions and are, therefore, considered unofficial. These data must be updated upon receipt of QA/QC comments.

Define Contaminant Fate and Transport

Results of the site physical characterization, source characterization, and extent of contamination analyses are combined to determine and project contaminant

fate and transport. This involves determining the actual and potential magnitude of releases from the sources and the mobility and persistence of source contaminants.

If information on contaminant release is available, the observed extent of contamination may be used in assessing the transport pathway's rate of migration and the fate of contaminants over the time span between release and monitoring. Contaminant fate and transport may also be estimated on the basis of site physical and source characteristics. Either type of analysis may be based on semi-analytical, analytical, or numerical models. While field data generally best define the extent of contamination, models can interpolate among, and extrapolate from, isolated field samples to areas and times not sampled.

Note: Modeling techniques to determine contaminant fate and transport may not be necessary if site conditions are well understood and if the potential effectiveness of different remedial actions can be easily evaluated.

Define Contaminant- and Location-Specific ARARs

Identification of potential applicable or relevant and appropriate requirements (ARARs) is initiated during scoping and continues throughout site characterization activities. During the RI, as a better understanding is gained of site conditions and contaminants, identification of contaminant- and location-specific ARARs continues to: (1) better plan future field activities, including identifying the scale of any required treatability studies, and (2) identify remedial action alternatives. *The CERCLA Compliance with Other Laws Manual* (Part I - August 1988 and Part II - August 1989, OSWER Directive Nos. 9234.1 and 9234.1-02) contains detailed information on identifying and complying with ARARs.

Evaluate Additional Data Needs

As data are collected, and a better understanding of the site and the risks that it poses is obtained, the preliminary remedial action alternatives, initially identified during scoping, should be further refined. The available data should then be evaluated to determine if: (1) the DQOs have been met, (2) the risks posed by the site have been adequately defined, (3) the need (or lack of need) for remedial action is documented, and (4) the data necessary for the development and evaluation of remedial action alternatives have been obtained. Site characterization is complete when these criteria have been met.

Conduct Treatability Studies

The need for treatability testing should be identified during project scoping to avoid delays in the RI/FS schedule. During scoping, a literature survey should be conducted to gather information on a technology's applicability, performance, implementability, relative costs, and operation and maintenance requirements. If practical candidate technologies have not been sufficiently demonstrated or cannot be adequately evaluated on the basis of available information (e.g., characterization of a waste alone is insufficient to predict treatment performance or the size and cost of treatment units) treatability testing should be performed. The treatability testing program will be designed and implemented during the RI, while other field activities are under way. Design and implementation of a testing program will include:

- Preparation of a WP, SAP, and HSP
- Performance of field sampling, if required
- Implementation of a testing program
- Evaluation of test results and documentation in a report

If the project plans developed for the RI/FS do not adequately define the activities to be performed during the treatability studies, a WP, SAP, and HSP must be developed before beginning the testing program. The required contents of these plans are listed in Appendix B of the *RI/FS Guidance*.

The decision to use a bench- versus a pilot-scale test is affected by a number of factors, including the level of development of the technology, the composition of the waste, and the nature and representativeness of the desired data. For a technology that is well developed and tested, bench studies may be sufficient to evaluate performance on new waste types. Pilot tests may be necessary if information needed to operate the technology at full scale is limited, if there is a need to investigate secondary effects of the process, or if the waste being tested is complex or unique.

Following the treatability testing program, an evaluation report will be prepared that analyzes and interprets the test results considering the technology's effectiveness, implementability, environmental impacts, and cost. Full-scale application of the technology will be evaluated and should include the identification of key parameters and unknowns that can affect full-scale operations.

Additional information on treatability studies can be found in a document entitled, *Guide to Conducting Treatability Studies under CERCLA*. This guide is currently being developed by the Office of Research and Development in their Risk Reduction and Engineering Laboratory in Cincinnati, Ohio.

Note: The need for treatability studies will result from initiating the alternative development process during scoping. A Technical Advisory Committee (TAC) should be used to achieve early consensus on potential remedial alternatives. Once the need for treatability testing has been identified, TAC support should continue with oversight of the development and implementation of the testing program as well as evaluation and interpretation of test results. (See *Scoping Fact Sheet*, OSWER Directive No. 9355.3-01FS1, for additional information on the TAC.)

Remedial Investigation Deliverables

Preliminary Site Characterization Summary

The preliminary site characterization summary is a concise summary of site data. This summary is developed after initial field efforts and: (1) provides a vehicle for the early sharing of ARARs with the support agency, (2) allows for early refinement of remedial alternatives, and (3) can be transmitted to the Agency for Toxic Substances and Disease Registry so that they may begin their required health assessment.

The format of the preliminary site characterization summary will be determined by the Region. The summary may be nothing more than a list of contaminants of concern and the affected media, or it

may be more extensive and review the investigative activities that have taken place.

Draft RI Report

The RPM reviews and approves the draft RI report after completion of RI activities. This report summarizes the results of the field activities to characterize the nature and extent of contamination, the fate and transport of contaminants, and the results of the baseline risk assessment. Table 3-13 in the *RI/FS Guidance* provides a suggested RI report format.

RPM Responsibilities

The RPM is responsible for managing the project to meet the RI/FS objectives within the time and cost constraints. These responsibilities include ensuring that adequate technical support is provided, as well as schedule maintenance and financial control of the project.

Technical Support

Techniques to assist in ensuring that adequate technical support is provided to the project during the RI include:

- Incorporate TAC participation throughout the RI to identify and resolve technical issues. When treatment is being considered for complex or difficult to treat waste, it is appropriate for ORD's START team to be included on the TAC. See the *Scoping Fact Sheet* (OSWER Directive No. 9355.301FS1) for additional information on the START team and other technical experts.
- Communicate on a regular basis with all involved parties (support agencies, consultants, TAC members) to reach a consensus on issues of concern and/or additional site work.
- Carefully consider the choice of analytical services to minimize the time required to process samples while maintaining the needed data quality level. Consider the contractor's ability to perform or subcontract analytical services.
- Ensure that contractors performing treatability studies have adequate experience and the necessary permits.

Schedule and Cost Control

The management techniques listed under technical support also assist in controlling schedule and cost. Other schedule and cost control techniques include:

- When possible, provide conditional approval to portions of the work plan to begin field activities early.
- Be aware that Basic Ordering Agreements can be used by consultants to expedite the procurement of subcontractors.
- Consider weather conditions when scheduling field activities; extreme weather conditions may delay the schedule and/or increase costs.
- Ensure that field contractors are trained in CLP procedures, including sample collection, shipment, and chain-of-custody requirements, to minimize the need to resample.
- Consider directing contractors to validate field data.
- Hold review meetings with all involved parties to expedite review of deliverables.
- Review monthly financial statements from consultants and make sure that all costs are justifiable.
- Understand the components of labor hour costs and verify that activities are conducted by appropriate personnel at the most effective level.
- Learn to anticipate cost and schedule problems based on the contactor's previous month's performance and take actions to minimize cost overruns and schedule delays.

Enforcement Considerations

Potentially responsible parties (PRPs) may conduct all RI activities, including any required treatability studies. It should be noted, however, that EPA reserves the right to conduct any aspect of the RI. As an example, EPA may conduct the baseline risk assessment since it serves as a primary means for supporting enforcement decisions. Both the administrative order (AO) and approved WP represent the negotiated agreement between EPA and the PRPs on how the RI is to be conducted. Modifications to the scope of work must be approved by EPA before implementation.

As required by SARA, EPA will oversee all PRP activities with the assistance of a qualified third party. The objectives of such oversight include verifying that: (1) the RI/FS complies with CERCLA, NCP, and relevant Agency guidance; the work complies with the AO, Statement of Work, WP, and SAP; (3) all work is performed in accordance with acceptable scientific and engineering methods; and (4) an adequate data base is developed to support subsequent decisions and actions, either in the case of litigation or the development of the Record of Decision. Additional information on PRP participation in the RI/FS and PRP oversight 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

- Initiate field support activities early and allow enough time in the schedule to complete them.
- Use DQOs to determine the quality of data needed from each field activity.
- Create a data management system for all RI activities.
- Minimize the need to mobilize/demobilize contractors.
- Use field-screening techniques and mobile laboratories, where appropriate.
- Turn data over to contractors for pre-analysis before data validation.
- Develop and implement the treatability testing program during the RI.
- Continue the identification of contaminant- and location-specific ARARs.
- Communicate regularly with all involved parties.
- Incorporate TAC participation throughout the RI.