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Office of Emergency and
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October 1987

Superfund

EPA

# Expanded Site Inspection

## Transitional Guidance For Fiscal Year 1988

# EXPANDED SITE INSPECTION (ESI) TRANSITIONAL GUIDANCE FOR FY 1988

OSWER Directive 9345.1-02

U.S. Environmental Protection Agency
Office of Emergency and Remedial Response
401 M Street, SW
Washington, DC 20460

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# NOTICE

The information in this document has been funded, wholly or in part, by the United States Environmental Protection Agency under Contract No. 68-01-7347 to Ecology and Environment, Inc. It has been subject to peer and administrative review and has been approved for publication as an EPA document.

This document is intended to present guidance on the conduct of expanded site investigations to obtain data to determine if there has been a release or potential for release of contaminants to the environment serious enough to warrant expenditure through the national Superfund.

# PREFACE

This Expanded Site Inspection (ESI) - Transitional Guidance manual is designed to provide the reader with a consolidated ready reference of general methodologies and activities for conducting site inspection work on sites projected to make the National Priorities List (NPL). The manual has been compiled, with substantial input from EPA Regional pre-remedial staff, and contains procedures that have been used successfully to execute EPA site investigation work nationwide.

The "new" pre-remedial program under the Superfund Amendments and Reauthorization Act (SARA) is evolving and in a state of flux. It will remain in flux until final promulgation of both the revised Hazard Ranking System (HRS) and the "new" National Contingency Plan (NCP). As discussed in Chapter 1, the ESI concept first proposed in Fall 1986 is being modified; hence the term "transitional" in the title of this manual. Progress is being made, however, to establish a more standardized and efficient program for evaluating hazardous waste sites throughout the country. This guidance, is applicable for FY 1988 and will be superseded when final guidance is issued on conducting SIs under the revised HRS.

When following document guidelines, the reader must realize that every hazardous waste site is unique and every work assignment is different. Not all methodologies and activities discussed in this guidance will be applicable to all sites. In addition, many of the described procedures will undoubtedly vary somewhat from region to region.

CONTENTS

## ACKNOWLEDGMENTS

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| | |
|---|---|
| Amy Brochu | (Region 2) |
| Carol Bronick | (OWPE) |
| DeCarlo Ciccel | (Region 6) |
| Steve Hooper | (OERR) |
| Bob Jourdan | (Region 4) |
| Ken Kryszczun | (Region 3) |
| Mike Nalipinski | (Region 1) |
| Carole Petersen | (Region 2) |
| Jeff Rosenbloom | (Region 9) |
| Dave Schutz | (OWPE) |

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| | |
|---|---|
| Paul Clay | (NUS Corporation) |
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| Bob Stecik | (NUS Corporation) |
| Neil Teamerson | (NUS Corporation) |

# CHAPTER 1 SUMMARY

**WHAT IS THE PURPOSE OF THIS GUIDANCE? WHAT ARE THE OBJECTIVES AND BENEFITS OF CONDUCTING EXPANDED SITE INSPECTIONS (ESIs)?**

- ESI - NEW COMPONENT OF THE PRE-REMEDIAL PROGRAM
  - Provides additional support to HRS scoring
  - Supports scoping of remedial investigation (RI) and development of RI work plan
  - Shortens remedial planning process

- CHANGES TO THE ESI CONCEPT
  - "New" pre-remedial approach encompasses a two-tiered SI process
    * Medium priority equivalent to Screening SI (SSI)
    * High priority equivalent to Listing SI (LSI)
  - FY 1988 ESIs equivalent to LSIs under the revised HRS and NCP
  - Principal LSI objective - score site under the revised HRS; secondary objective - provide scoping support to the RI program

- ESI VERSUS "TRADITIONAL" SI
  - Collects more comprehensive site background and chemical contamination data
  - Uses more resources (i.e., LOE hours, sample dollars) on high priority sites
  - Uses field analytical screening methods, soil borings, monitoring wells, and surface geophysical techniques to characterize sites

- ESI - RECOMMENDED LEVEL OF RESOURCES
  - Total level of effort: 1500 hours
  - Number of Contract Laboratory Program samples: 20-30[a]
  - Number of monitoring well installations: 3-6[a]

[a]Predicted averages. Actual numbers will vary on a site-specific basis.

# 1.0 INTRODUCTION

## 1.1 PURPOSE AND USE

This transitional guidance describes the goals, scope, procedures, and desired results of expanded site inspections (ESIs) conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended in 1986 by the Superfund Amendments and Reauthorization Act (SARA). The document is intended for use by EPA, its Field Investigation Team (FIT) contractors, and State agencies in planning for and preparing ESIs in FY 1988. New screening SI (SSI) and Listing SI (LSI) guidance will be prepared and distributed at the beginning of FY 1989 (Section 1.2).

EPA has developed a structured process to determine what, if any, cleanup actions are appropriate for potential hazardous waste sites included in CERCLIS, EPA's national inventory of such sites. The process is in two major phases: the first phase leads to proposal of sites for the National Priorities List (NPL). This "pre-remedial phase" previously consisted of four activities--discovery, preliminary assessment (PA), site inspection (SI), and scoring on the Hazard Ranking System (HRS). ESIs are a new component of the pre-remedial phase.

The second or "remedial" planning phase involves detailed evaluation of a site to identify the precise magnitude and extent of contamination and the most technically sound and cost-effective alternatives for correcting problems at the site. This remedial planning phase includes two activities--a remedial investigation (RI) and a feasibility study (FS).

PAs and SIs are limited to determining if a site ever handled hazardous substances and/or if there has been a release or potential for release of contaminants into the environment serious enough to warrant expenditure through the national Superfund. They are not intended to determine the exact magnitude or extent of contamination. A simple estimate of the magnitude of release is made when the site is scored under the HRS, and a more comprehensive estimate is made during the RI.

ESIs are intended to help narrow the data gap and reduce the elapsed time between pre-remedial activities and the start of RI field work. With the more detailed ESI data available, the remedial contractor can begin timely remedial action at sites which pose more serious health and environmental threats. ESIs will not only yield HRS scores and proposals for the NPL, they will also provide the remedial contractor with a more complete overview of the site and waste characteristics, expediting the remedial planning process. Finally, ESIs will provide data to bring enforcement action or initiate negotiations with potentially responsible parties (PRPs).

## 1.2 CHANGES TO THE ESI CONCEPT

The pre-remedial process has been modified since the initial proposal of the ESI concept (Expanded Site Inspection Concept Paper, 1986). Hence, ESI selection procedures have changed. These changes are best illustrated in a discussion of the "new" pre-remedial program to support the revised HRS.

Guidance is being prepared for the revised preliminary assessment (PA) which will require collecting more data following guidelines of a PA Checklist, off-site reconnaissance for most sites, and application of the Site Screening Analysis technique, a standardized method for calculating probable HRS scores. The revised PA will average 75-80 hours versus 40 hours for the "old" PA, and result in better screening of sites on which SI resources will be expended.

PAs will be used to establish priorities for subsequent SIs:

- o <u>High priority</u> - This recommendation will generally comprise those sites that are highly likely to score above the cut-off upon application of the current HRS at the end of an SI. Sites in this category are the most likely to be placed on the NPL. All high priority sites will receive an LSI after final promulgation of the revised HRS.

- o <u>Medium priority</u> - This recommendation will generally comprise those sites that have some, but not high, likelihood to score above the cut-off upon application of the current HRS at the end of an SI. Sites in this category, expected to be the largest category, will receive Screening SIs under the new HRS. Screening SIs will be roughly equivalent to today's standard SI.

- o <u>No further action</u> - This recommendation represents all other sites and will generally include (1) sites that never received CERCLA hazardous substances; (2) sites where the CERCLA hazardous substances are clearly not releasing, and have no potential to release into the environment and no removal action is required; and (3) sites with no potential to score 28.5 or higher upon application of the current HRS at the end of an SI.

Only in rare instances will sufficient cause or information be available for a site to go directly from a PA to an LSI. Generally, a site will undergo an SSI before an LSI.

The SI process under the revised HRS will be two tiered and include components of the present ESI concept. The vast majority of sites will receive a screening SI (SSI) to:

- o Collect additional data to calculate a better preliminary HRS score.

- o Establish priorities among sites most likely to qualify for the NPL.

- o Identify the most critical data requirements for an LSI, the top tier.

An SSI will not have rigorous data quality objectives (DQOs). Based on the refined preliminary HRS score, the SSI will drop out of the Federal CERCLA purview (i.e., NFA), be referred to another applicable Federal program, or to top tier, LSI status.

Sites most likely to qualify for the NPL are candidates for LSIs which will address all data requirements of the revised HRS and satisfy NPL-type DQOs. Formal HRS packages will be prepared only for LSI sites. LSIs will also provide data to support scoping of the RI and development of the remedial work plan.

The major objective of the tiered SI process is to ensure that limited LSI resources are applied only to the highest priority sites bound for the NPL. The difference between the tiered SI approach and the ESI concept discussed in this transitional guidance is mainly one of emphasis:

- ESIs support HRS scoring and RI scoping/work plan development. The two tiered SI process under the revised HRS and NCP will emphasize the HRS support objective.
- ESI efforts under the current HRS in support of the remedial planning process are similar to LSI efforts under the revised HRS (i.e., "HRS 2" will emphasize more thorough source and site characterization; collection of monitoring well data; consideration of the "new" on-site pathway).
- Total level of effort (LOE) is similar. An ESI averages 1,300-1,500 hours, versus 1,500 hours for the combination of an SSI (average 500) and LSI (average 1,000).

New SI guidance, concerning both SSIs and LSIs, will be issued in early FY 1989. Until that time, the terminology SI and ESI will continue to be used. In the interim, this guidance will serve as the foundation for planning and conducting ESIs. Today's ESI sites could represent the first generation of LSI sites to be addressed under the revised HRS.

## 1.3 ESI OBJECTIVES FOR FY 1988

ESIs are intended to:

- Provide additional data in support of revised HRS scoring.
- Provide the first generation of information for sites evaluated using the revised HRS.
- Identify situations requiring removal action.
- Provide more information on site characteristics, contaminant sources (waste type and volume), and migration pathways to the remedial contractor for timely development of the RI work plan.
- Shorten the remedial planning process.
- Encourage better communication and transfer of information between pre-remedial and remedial contractors.

## 1.4 COMPARISON OF SIs AND ESIs

The ESI differs from the traditional SI in a number of ways. ESIs:

- Collect more comprehensive site background information.
- Collect additional chemical contamination data--for example, increased sampling, surface geophysics, field analytical screening, and installation of monitoring wells.
- Formalize transfer of data from the pre-remedial contractor to the remedial contractor.
- Use more resources in terms of:
  - average LOE - 1,500 hours (FIT and EPA)
  - approximate number of Contract Laboratory Program (CLP) samples - 20 to 30
  - approximate number of monitoring well installations - 3 to 6.

Table 1-1 compares the overall approach of conducting SIs to ESIs. The major difference, the increased scope of the field investigation in an ESI, is highlighted in Table 1-2. Differences in approach are reflected by the increased use of field screening techniques (i.e., field gas chromatograph analysis and geophysical surveys), collection and analysis of additional CLP samples, drilling of boreholes for subsurface sampling, and installation of ground water monitoring wells. Table 1-3 estimates LOEs for the various components of a typical ESI, as well as subcontractor and equipment expenditures.

Field screening procedures can help obtain the most from ESI resources by targeting sampling efforts, supporting CLP data, and shortening the period between sample collection and data evaluation.

Field screening procedures include:

- Visual observation, which is valuable in characterizing waste sources and providing evidence of contamination, especially in soils, sediments, surface water, and ground water.
- Geophysical screening techniques, which can obtain information on:
  - hydrogeologic features
  - existence and general direction of subsurface contamination
  - boundaries of buried trenches and lagoons
  - location of buried drums and tanks.

## TABLE 1-1

## COMPARISON OF OVERALL SI AND ESI APPROACHES

| SI APPROACH | ESI APPROACH |
|---|---|
| 1. Review of PA/background information | 1. Same as SI |
| | 1a. Consideration of information requirements of PA Checklist |
| | 1b. Completion of off-site reconnaissance |
| | 1c. Prescoring of site and selection for ESI |
| | 1d. Collection of additional background information |
| 2. Site reconnaissance | 2. Same as SI |
| 3. Preparation of project plans | 3. Same as SI |
| 4. Field investigation | 4. Increased scope over SI. More field analytical screening, geophysical surveys, sample collection, and monitoring well installations |
| 5. Report and HRS scoring | 5a. Increased detail over SI report. Summary of background information, data interpretation, and recommendations |
| | 5b. Formalized transfer of information from ESI personnel to RI/FS personnel |

## TABLE 1-2

## COMPARISON OF FIELD INVESTIGATIONS UNDER SI AND ESI APPROACHES

| | SI APPROACH | ESI APPROACH |
|---|---|---|
| Sampling principles | Demonstrate that release has occurred | Same as SI plus determination of general extent of contamination |
| | Focus sampling to determine maximum population exposed or proximity to sensitive environments | Same as SI |
| | Collect sufficient background samples to identify contributions from other sources | Same as SI |
| | Minimize and prioritize on-site sampling | Sample on-site to provide location and preliminary characterization of all waste sources |
| | Sample air releases | Same as SI plus preliminary determination of extent of release |
| Field screening | Limit use of field screening techniques | Maximize use of field screening techniques to characterize sources and make preliminary determination of extent of contamination |
| Approximate number of samples for Contract Laboratory Program | 10-15[a] | 20-30[a] |
| Monitoring well installation | Rely largely on existing wells. Focus on aquifer of concern | Install 3-6 wells.[a] Focus on one or more aquifers to make preliminary determination of extent of contamination |

[a]Predicted averages. Actual numbers will vary on a site-specific basis.

## TABLE 1-3

## ESTIMATED LEVEL OF EFFORT FOR ESI

| TASK | AVERAGE LOE (hours) | AVERAGE SUBCONTRACT & EQUIPMENT ($)[a] |
|---|---|---|
| Review of existing data/ site reconnaissance | 100 | - - |
| Work plan development | 160 | |
| Field sampling/screening | | |
| Air | 50 | 1,000 |
| Geophysical | 150 | 20,000 |
| Surface water | 40 | - - |
| Ground water (≤ 8 wells) | 500 | 40,000 |
| Off-site sampling | 80 | 3,000 |
| Data validation | 100 | - - |
| Data evaluation | 80 | - - |
| HRS scoring | 120 | - - |
| Report preparation | 120 | - - |
| | 1,500 | 64,000 |

[a]Excluding laboratory costs.

- o Analytical screening procedures, which can be used for both inorganic and organic compounds to:
  - identify contaminants present
  - provide quantitative or semiquantitative estimates of contaminant levels
  - provide preliminary determination of the extent of contamination in soils, air, and water
  - optimize CLP sampling efforts.

Analytical screening procedures utilize portable monitors and instrumentation such as photo and flame ionization detectors, field gas chromatographs, and x-ray fluorescence.

## 1.5 REFERENCES

Existing guidance or information on the status of evolving guidance can be obtained from EPA Headquarters, Site Assessment Branch, Hazardous Site Evaluation Division, Office of Emergency and Remedial Response (OERR).

Contacts: Penny Hansen (FTS-475-8103)
Jim Jowett (FTS-475-8195)


- o Expanded Site Inspection Concept Paper, September 1986, Document Control No.: 999-PM1-RT-DCLQ-1.
- o Pre-remedial Strategy for Implementing SARA (Draft), August 1987.

## CHAPTER 2 SUMMARY

**WHAT ARE DATA QUALITY OBJECTIVES (DQOs) FOR AN ESI? HOW WILL CONSIDERATION OF DQOs BENEFIT PREPARATION OF WORK PLANS, SAMPLE PLANS, AND HEALTH AND SAFETY PLANS?**

o DEVELOP DQOs

- Three DQO stages: (1) identify decision types; (2) identify data uses/needs; (3) design data collection program.

o IDENTIFY DECISION TYPES

- Identify major decisions: (1) propose for NPL; (2) scope of RI work plan.
- Identify and involve data users: (1) EPA Regional Project Officers; (2) FIT and State project managers and staff; (3) EPA enforcement personnel; (4) State agency personnel; (5) Agency for Toxic Substances and Disease Registry; (6) remedial staff and contractors.
- Evaluate available information confirmed by off-site reconnaissance during the PA and on-site reconnaissance prior to SI or ESI field work. Update assessment of site conditions.
- Develop a conceptual model which illustrates probable contaminant(s), migration pathway(s) and potential route(s) of exposure.

o IDENTIFY DATA USES/NEEDS

- Identify data uses: (1) HRS documentation; (2) general site characterization; (3) RI work plan development; (4) preliminary risk assessment; and (5) enforcement support.
- Identify data types: (1) matrix (air, soil, water); (2) concentration (high, medium, environmental); (3) field screening vs. CLP quality; (4) quality assurance; (5) grab versus composite samples; and (6) geophysical data.
- Identify data quality needs: (1) appropriate analytical levels; (2) contaminants of concern; and (3) required detection limits.
- Identify data quantity needs: (1) satisfy confidence levels desired; (2) satisfy QA/QC requirements; (3) satisfy HRS requirements; and (4) satisfy the general site characterization objective.
- Evaluate sampling/analysis options. Consider the "phased" sampling approach - use field screening data to target CLP samples.

o DESIGN DATA COLLECTION PROGRAM (Chapter 3).

# 2.0 ESI DATA QUALITY OBJECTIVES

## 2.1 INTRODUCTION

Data quality objectives (DQOs) must be developed for each ESI based on proposed end uses of data generated from sampling and analytical activities. These DQOs are qualitative and quantitative statements which outline the decision-making process and specify the data required. ESIs have two objectives:

- o Support an HRS score that allows proposing the site for the NPL.
- o Expedite the remedial planning process.

## 2.2 DQO DEVELOPMENT PROCESS

Site-specific DQOs are identified during project scoping and development of sampling and analysis plans. They are established to ensure that data of sufficient quantity and quality are collected to satisfy ESI objectives. Data conforming to the DQO process described in this guidance can be used to assess the uncertainty associated with each of the primary objectives of the ESI program. ESI DQOs are addressed in more detail in Data Quality Objectives (DQOs) for Pre-remedial Response Activities (draft). In addition, remedial DQOs are discussed in Data Quality Objectives (DQOs) for Remedial Response Activities (1987).

DQOs are developed through a three-stage process (Figure 2.1). The first two -- identification of decision types and identification of data uses/needs -- are discussed in this chapter. Stage 3 -- design of data collection program -- is the basis for Chapter 3.

ESIs are undertaken at sites having probable contaminant problems identified during PAs and SIs. With careful phasing of sampling and site characterization activities, valid data from one phase can help guide subsequent phases. Field screening-type analyses, including geophysics, soil vapor measurements, and certain chemical analyses, provide rapid turnaround of results and help target more costly and time-consuming sampling efforts (i.e., well placement and CLP sampling decisions).

It may not be possible to identify at the outset all the data needed to complete an ESI. A phased approach to sampling, however, will help identify data gaps as field work progresses, and provide control to the complex sequence of investigative activities. Application of the DQO process to a phased investigation should improve data validity.

## 2.3 ESI DQO STAGE 1 - IDENTIFICATION OF DECISION TYPES

Stage 1 of the DQO approach is an inherent part of the project scoping effort and guides development of ESI work plans. The major elements include:

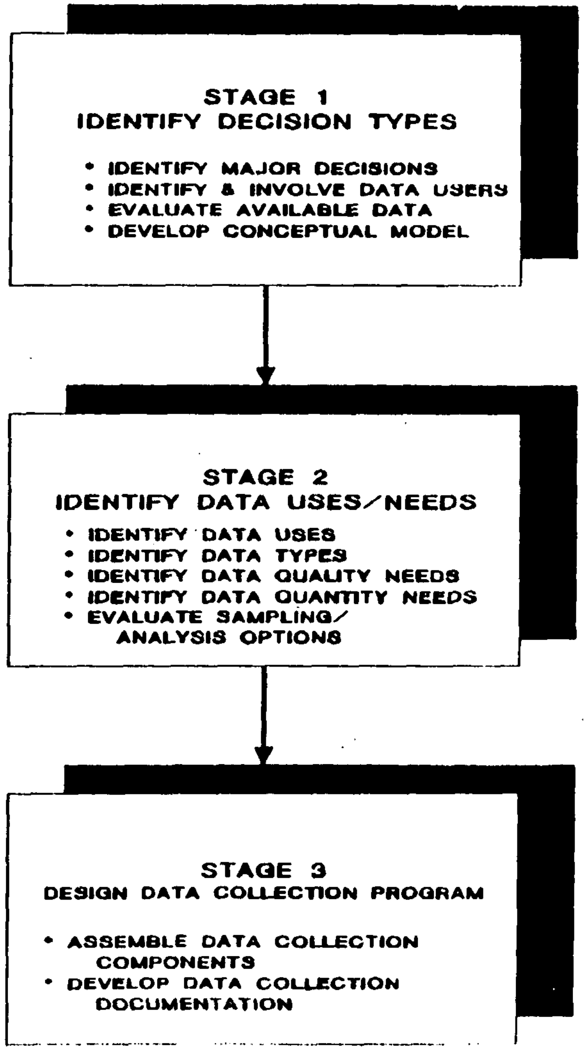


**FIGURE 2-1**
**ESI DQO THREE-STAGE PROCESS**
**(Modified from Data Quality Objectives for Remedial Response Activities, U.S. EPA, March 1987)**

- Identification of major decisions
- Identification of and involvement of data users
- Evaluation of available information
- Development of a conceptual model

### 2.3.1 Identification of Major Decisions

The two major factors affected by the outcome of an ESI are the NPL decision and the RI scoping/support decision. The more rigorous of these two factors, with respect to DQOs, is the NPL decision. HRS-quality data must support:

- Determination of an observed release to ground water, surface water, soil, or air. Under the existing HRS, EPA has established general guidelines to demonstrate an observed release by comparing background contaminant concentrations to release concentrations:

  - order of magnitude (10-fold) for a single contaminant

  - two to three fold for multiple contaminants

  - three times the instrument detection limit when undetected in background

- Determination of waste quantity, waste characteristics, and site characteristics to calculate an HRS score based on route characteristics.

While quantitative assessment of the data is required for an observed release, a qualitative assessment may suffice for a route score.

The ESI DQO process as it affects RI scoping involves determining how to judiciously focus RI/FS resources. It is not to make public, NPL determinations, but rather to assist with internal management decisions.

### 2.3.2 Identification and Involvement of Data Users

A list of potential data users should be developed at the outset of the DQO process (Figure 2-2). The primary data users are those involved in ongoing ESI activities, for example, the EPA Regional Project Officer and the FIT or State ESI project manager and staff.

Secondary data users include all those who rely on ESI output to support programmatic activities. They provide input to the RPO and other primary data users during DQO development by establishing generic needs and, on occasion, site-specific data needs. A typical list of secondary data users for an ESI might include EPA enforcement personnel, State agency personnel, the Agency for Toxic Substances and Disease Registry (ATSDR), and most importantly, EPA's remedial staff and the RI/FS contractor.

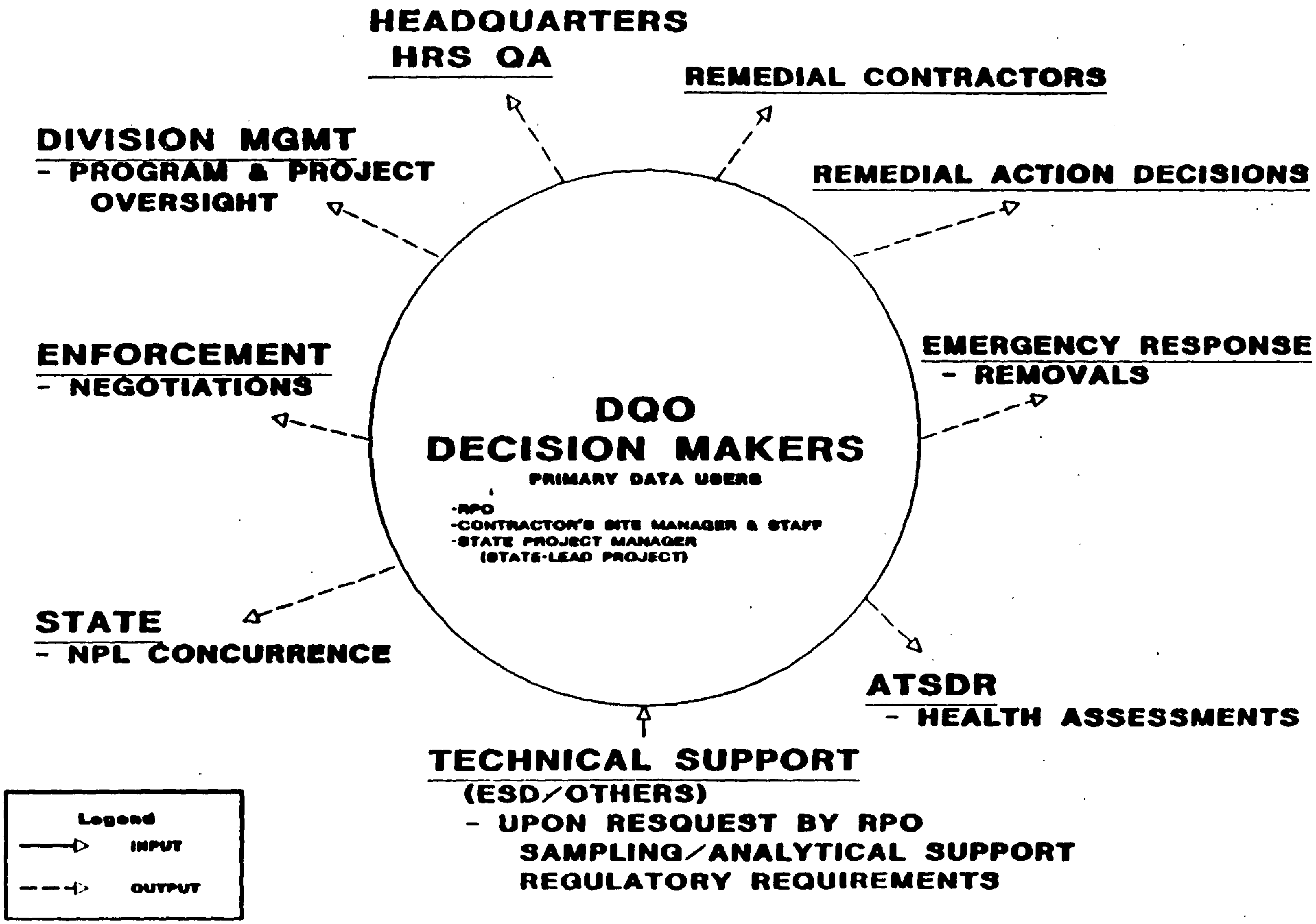


FIGURE 2-2
DECISION MAKER DATA INTERACTION
(Modified from Data Quality Objectives for Remedial Response Activities, U.S. EPA, March 1987)

### 2.3.3 Evaluation of Available Information

Review and evaluation of information available for a site is an early step in the ESI process. This review provides the basis for additional on-site activities and serves as the foundation for ESI scoping and work plan preparation. Following the initial evaluation, data are confirmed by on-site reconnaissance which:

- Uses field instruments to obtain data on any volatile chemical, radioactive, or explosive hazards on-site and to determine site-specific health and safety concerns.
- Determines if site conditions pose an imminent danger to public health.
- Confirms information contained in previous documents.
- Records observable data missing in previous documents.
- Updates site conditions.
- Inventories possible off-site sources of contamination.
- Obtains data such as location of access routes and sampling points, and identifies logistical considerations for the field investigation.

Aerial photographs and detailed maps (i.e., topographic, geologic, potentiometric surface) of the site are useful to the initial reconnaissance. Photos and maps should provide a scaled compilation of the best available information about the site and include:

- Site topography.
- Pertinent physical site features, (e.g., buildings, water bodies, water courses, wetland areas, access points, property boundaries, wooded or vegetated areas).
- Identification and delineation, as possible, of the areas of waste storage or contamination, both historic and existing.

The maps and/or photos should include a reasonable area outside known site boundaries to illustrate land use on adjacent properties and to identify potentially sensitive off-site receptors. Along with the project log book, they provide an efficient tool to confirm existing site conditions, record field notes and instrument measurements, and identify potential future sampling locations.

Tasks such as geophysical surveys and limited field screening and analysis may be performed during an initial site visit if an approved health and safety plan is in place. This initial 'sampling' may help determine the variability of contaminants, provide background information, or determine changes in site conditions. Confirmatory activities which may be undertaken during the initial visit include locating, numbering, labeling, photographing, securing, and recording the condition of on-site stored waste and ground-water monitoring wells; identifying the number of occupied residences in the vicinity of the site; and determining the adequacy and condition of the site security system.

### 2.3.4 Development of Conceptual Model

A conceptual model describes an uncontrolled hazardous waste site and its environs, presenting hypotheses regarding the contaminants present on-site, their routes of migration, and their potential impact on sensitive receptors. Hypotheses presented (based on PA, preliminary HRS score, and REP score information) are tested, redefined and modified during the ESI. The basic elements of a conceptual model (Figure 2-3) should be expanded to prepare a general description of the site and its environs. An illustration of site conditions (Figure 2-4) should accompany the written description.

The conceptual model developed during the ESI work plan will be expanded on and become more detailed as field work and sampling progress. A final version should be part of the ESI report and should incorporate the following factors:

- Population and environments at risk.
- Known and potential routes of exposure.
- General spatial distribution of contaminants.
- Atmospheric dispersion potential and proximity of targets.
- Amount, concentration, hazardous properties, and form of contaminants as deposited versus as dispersed.
- Hydrogeological factors (i.e., soil permeability, depth to saturated zone, hydraulic gradient).
- Climate (rainfall, seasonal variations, etc.).
- Extent to which the source can be adequately identified and characterized.
- General extent to which the substances have migrated or are expected to migrate from their area of origin and whether migration poses a threat to public health, welfare, or the environment.

## 2.4 ESI DQO STAGE 2 - IDENTIFICATION OF DATA USES/NEEDS

Stage 2 of the ESI DQO process defines specific data uses, identifies the necessary quality and quantity of data required to support the ESI, and designates appropriate sampling and analytical methods. The major elements of State 2 are identification of:


VARIABLES:

| SOURCE | PATHWAY | RECEPTORS |
| --- | --- | --- |
| CONTAMINANTS | MEDIA | TYPE |
| CONCENTRATION | RATE OF MIGRATION | SENSITIVITY |
| TIME OF DISPOSAL | TIME SINCE DISPOSAL | POTENTIAL EXPOSURE |
| LOCATION | PERSISTENCE/MOBILITY OF CONTAMINANTS | CONCENTRATION |

FIGURE 2-3
ELEMENTS OF A CONCEPTUAL MODEL
(Modified from Data Quality Objectives for Remedial Response Activities, U.S. EPA, March 1987)

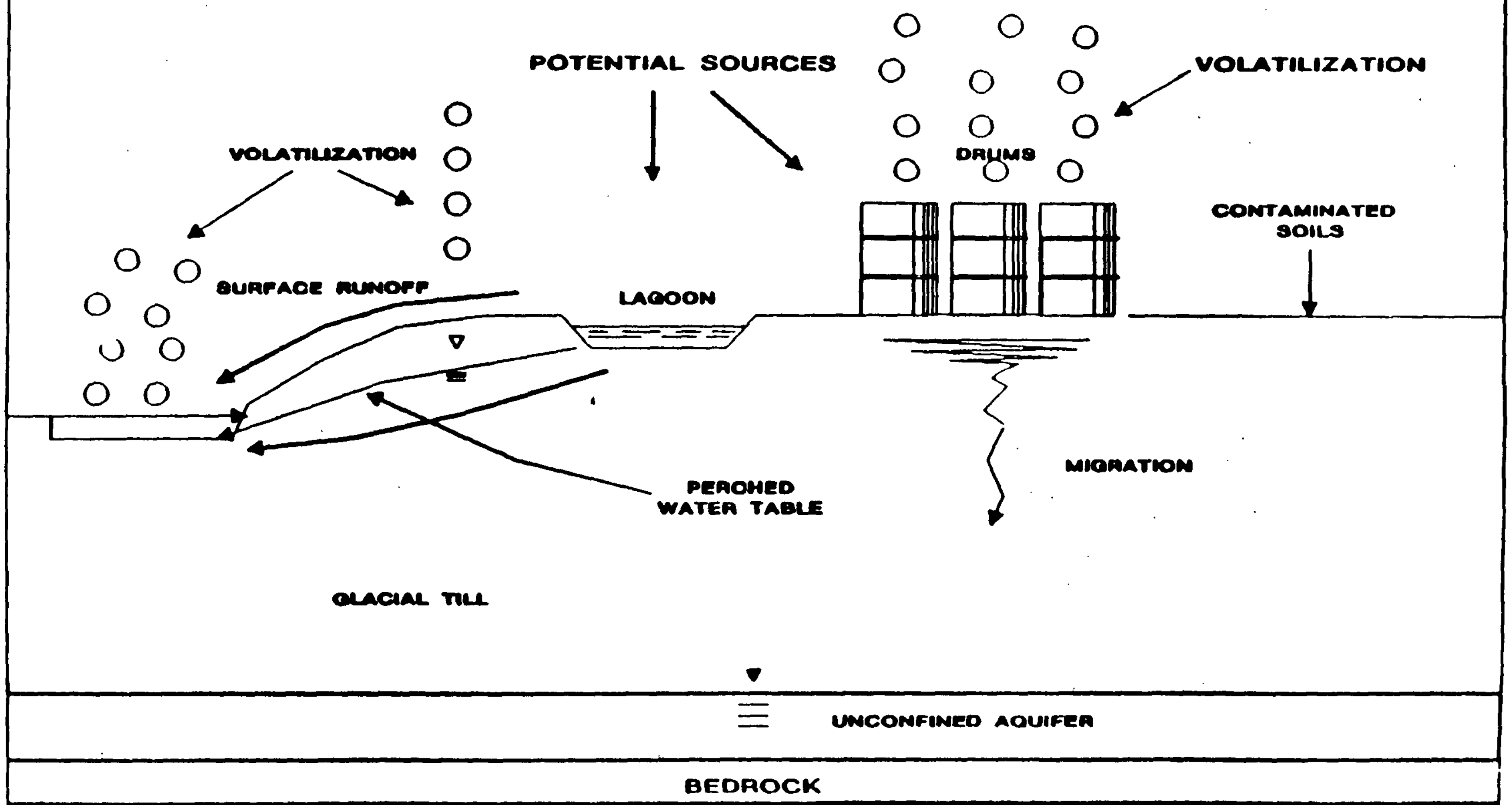


FIGURE 2-4
EXAMPLE CONCEPTUAL MODEL
ILLUSTRATION
(Modified from Data Quality Objectives for Remedial Response Activities, U.S. EPA, March 1987)

- o Data uses
- o Data types
- o Data quality needs
- o Data quantity needs
- o Evaluation of sampling/analysis options

### 2.4.1 Data Uses

Data developed during an ESI will be used for:

- o HRS documentation. Data require a comparison of background contaminant concentrations with release concentrations to determine an observed release. HRS documentation will generally require Levels IV and V CLP data (analytical levels are defined in Section 2.4.3.1).

- o Site characterization. Data are used to determine the general nature and extent of contamination at the site. They are generated through the sampling and analysis of waste sources and environmental media. This effort will usually be Level I or Level II combined with some CLP data (Level IV).

- o Development of RI work plan. Data help the remedial contractor develop the work plan. Data needs will depend on the unique source, pathway, and receptor characteristics of each site. Less rigorous levels of data (i.e., Levels I-III) are adequate, but all Levels of data may be useful for this purpose.

- o Preliminary risk assessment. Data are used to evaluate the risk posed by a site to public health and the environment. Some of the data must be qualitative, describing chemical/physical properties, toxicity, persistence, and mobility of contaminants. The data must also be quantitative (Level II) so that they may be compared with health risk criteria set by ATSDR.

- o Enforcement support. Data are used to help the enforcement program identify potentially responsible parties (PRPs). For known PRPs, data are used to link their wastes to those found on-site and to pollutants released off-site. For unknown PRPs, site wastes can be compared to pollutant profiles of their waste streams. Identifying PRPs will, in most instances, require Levels IV and V CLP data.

### 2.4.2 Data Types

The general purposes for which data will be collected during the ESI are defined early in the scoping process. Then, data quality needs can be defined and sampling and analysis options systematically evaluated. Data types include:

- o Matrix (air, soil, water)
- o Concentration (high, medium, environmental)
- o Parameters (field screening versus CLP analysis)

- Quality assurance (blanks, replicates and spike samples)
- Grab versus composite samples
- Geophysical data

The data types specified in Stage 2 should not be limited to chemical parameters, but may also include, as appropriate, physical parameters such as permeability, porosity, conductivity, resistivity, electromagnetic properties, magnetic response, and acoustic impedance. These physical parameters are needed to better evaluate the location of contaminants and the extent of, or potential for, migration.

### 2.4.3 Data Quality Needs

Data quality should be considered as the uses and types of data are determined. Important factors in defining data quality include:

- Appropriate analytical levels
- Contaminants of concern
- Required detection limits

EPA FIT and other EPA contractor personnel review all field procedures used by site inspection teams and all analytical results generated by CLP. This review assesses compliance with standard operating (i.e., chain-of-custody) and CLP procedures. Data validation is described in more detail in User's Guide to the Contract Laboratory Program (1984).

#### 2.4.3.1 Appropriate Analytical Levels

EPA has set various analytical levels (Table 2-1) for determining data quality:

- Level I. Field screening or analysis using portable instruments. Results are often not compound-specific and not quantitative but can indicate "hot" and "not so hot" spots. Results available immediately.

- Level II. Field screening or analysis using more sophisticated portable instruments. The quality of data generated is highly variable, depending on the use of suitable calibration standards, reference materials, sample preparation equipment, and the training of the operator. Results available almost immediately.

- Level III. All analyses performed in an off-site laboratory that may or may not follow CLP procedures. QA/QC and documentation are less rigorous than CLP protocols. Results delayed.

- Level IV. CLP Routine Analytical Services (RAS). All analyses are performed in an off-site CLP laboratory following CLP procedures. QA/QC protocols and documentation are rigorous. Results delayed.

TABLE 2-1
ANALYTICAL LEVELS APPROPRIATE TO DATA USES

| ANALYTICAL LEVEL | DATA USES | TYPE OF ANALYSIS | LIMITATIONS | DATA QUALITY |
|---|---|---|---|---|
| LEVEL I | • SITE CHARACTERIZATION | • TOTAL ORGANIC/INORGANIC VAPORS USING PORTABLE INSTRUMENTS | • INSTRUMENTS RESPOND TO NATURALLY OCCURRING COMPOUNDS | • IF INSTRUMENTS CALIBRATED AND DATA INTERPRETED CORRECTLY CAN INDICATE CONTAMINATION |
| LEVEL II | • SITE CHARACTERIZATION<br>• EVALUATION OF ALTERNATIVES<br>• ENGINEERING DESIGN | • VARIETY OF ORGANICS BY PORTABLE GAS CHROMATOGRAPHY (GC); INORGANICS BY PORTABLE ATOMIC ABSORPTION (AA) AND X-RAY FLUORESCENCE (XRF)<br>• TENTATIVE IDENTIFICATION CHEMICAL-SPECIFIC<br>• DETECTION LIMITS VARY FROM LOW ppm TO LOW ppb | • TENTATIVE IDENTIFICATION<br>• TECHNIQUES/INSTRUMENTS LIMITED MOSTLY TO VOLATILES, METALS | • DEPENDENT ON QA/QC STEPS USED<br>• DATA TYPICALLY REPORTED IN CONCENTRATION RANGES |
| LEVEL III | • RISK ASSESSMENT<br>• PRP DETERMINATION<br>• SITE CHARACTERIZATION<br>• EVALUATION OF ALTERNATIVES<br>• ENGINEERING DESIGN | • ORGANICS/INORGANICS USING EPA PROCEDURES OTHER THAN CLP; CAN BE CHEMICAL-SPECIFIC<br>• UNDER RCRA CHARACTERISTIC TESTS | • TENTATIVE IDENTIFICATION IN SOME CASES<br>• CAN PROVIDE DATA OF SAME QUALITY AS LEVELS IV AND V | • SIMILAR DETECTION LIMITS TO CLP<br>• LESS RIGOROUS QA/QC |
| LEVEL IV | • RISK ASSESSMENT<br>• PRP DETERMINATION<br>• EVALUATION OF ALTERNATIVES<br>• ENGINEERING DESIGN | • HAZARDOUS SUBSTANCE LIST (HSL) ORGANICS/INORGANICS BY CLP GC/MS; AA AND XRF<br>• LOW ppb DETECTION LIMIT | • TENTATIVE IDENTIFICATION OF NON-HSL PARAMETERS<br>• SOME TIME MAY BE REQUIRED FOR VALIDATION OF DATA PACKAGES | • GOAL IS DATA OF KNOWN QUALITY<br>• RIGOROUS QA/QC |
| LEVEL V | • RISK ASSESSMENT<br>• PRP DETERMINATION | • NON-CONVENTIONAL PARAMETERS<br>• METHOD - SPECIFIC DETECTION LIMITS<br>• MODIFICATION OF EXISTING METHODS | • MAY REQUIRE METHOD DEVELOPMENT/MODIFICATION<br>• REQUIRES SPECIAL LEAD TIME | • METHOD-SPECIFIC |

(Modified from Data Quality Objectives for Remedial Response Activities, U.S. EPA, March 1987.)

- Level V. Analysis by Non-Standard (NS) methods. All analyses are performed in an off-site laboratory that may or may not be a CLP laboratory. CLP Special Analytical Services (SAS) are level V. Results delayed.

2.4.3.2 Contaminants of Concern

Most ESIs require identifying the contaminants posing the most serious health and environmental threat in terms of toxicity, persistence, and mobility. This identification is key to preparing an HRS package and supporting an ATSDR preliminary health assessment.

To increase the likelihood of detecting a release, the analyses requested should be as broad as possible while still reflecting knowledge gained from any previous field work. Typically, CLP RAS organics and metals are requested and a CLP SAS may be requested for nonroutine hazardous substances.

2.4.3.3 Required Detection Limits

The detection limits selected must be compatible with the data quality requirements for each ESI objective, and the sampling and analysis methods selected must be capable of accurate measurement at the level of concern. The analytical options are:

- HRS/enforcement support. Levels IV and V detection limits may be optimal but are not always required.

- General site characterization. Levels I and II for sample analysis, and adherence to standard operating procedures for geophysical and well installation work, should be adequate.

- Preliminary risk assessment. Level II and Level IV and V data should be adequate.

2.4.4 Data Quantity Needs

The confidence levels desired and cost limitations imposed should help determine data quantity and sampling needs. Data to substantiate an HRS score have the most rigorous DQOs, generally requiring three or more samples, including background and release, for each migration pathway. In addition, one or more samples of the waste source should be collected to link waste constituents with contaminants detected as observed releases. Necessary duplicates and blanks should also be considered when determining data quantity needs.

For general site characterization, the investigator might consider the sampling requirements illustrated in Figure 2-5. Field analytical screening and geophysical survey results (i.e., portable gas chromatography, soil gas monitoring) will be maximized by establishment of a sampling grid. The size of the grid selected is based on the site-to-target-area ratio, and the probability of target detection (Figure 2-5(1) and Table 1). Figures 2-5(2) and 2-5(3) illustrate how

# FIGURE 2-5
# DATA QUANTITY NEEDS AND SPATIAL SAMPLING REQUIREMENTS

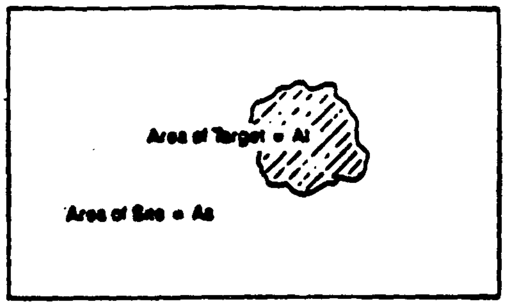


FIGURE 1: Illustrates Site to Target Area Ratio As/Ai ≅ 10 in this case

| Probability of Detection | As/Ai = 10 | As/Ai = 100 | As/Ai = 1000 |
|---|---|---|---|
| 100 | 16 | 160 | 1600 |
| 95 | 13 | 130 | 1300 |
| 90 | 10 | 100 | 1000 |
| 75 | 8 | 80 | 800 |
| 50 | 5 | 50 | 500 |
| 40 | 4 | 40 | 400 |
| 30 | 3 | 30 | 300 |

TABLE 1: Number of Sample points Required for Various As/Ai ratios and Probability of Detection

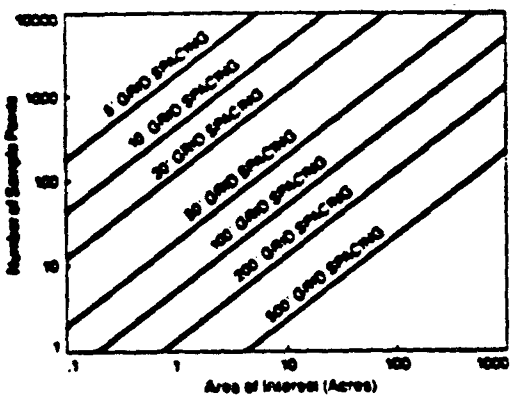


FIGURE 2. Approximate Sample Point Spacing

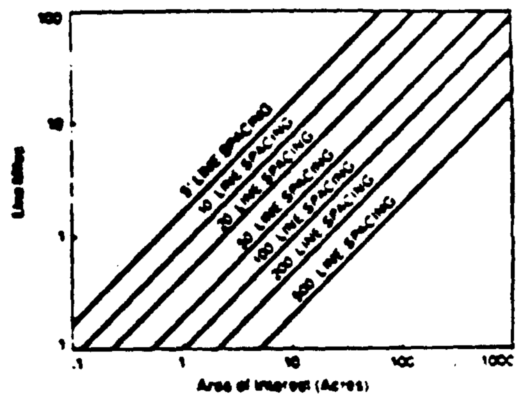


FIGURE 3 Approximate Line Miles of Continuous Profiling

The anomaly shown in Figure 1 may represent a buried trench, a group of buried drums, a ground water contaminant plume or a natural geologic feature. The number of samples necessary to detect an anomaly is shown in Table 1. The table provides a convenient means of estimating the number of samples required if a level of confidence is established and the size of the anomaly and the search area can be estimated.

The samples may be soil samples, ground water samples or any other localized means of sampling.

To estimate sample requirements and site coverage required:

1) Establish the overall area of interest.
2) Estimate the minimal size of anomaly to be detected - determine the site to target area ratio.
3) Determine the confidence level desired considering cost limitations.
4) Establish the number of sample points using Table 1.
5) Knowing the number of samples and the area of interest use Figure 2 to establish approximate sample grid spacing. A rectangular sample grid is assumed.
6) If continuous coverage is employed, use the spacing obtained in Pirgure 2 and the overall area of interest to find the number of line miles of continuous profiling from Figure 3.

(Modified from Technos Inc., Application Guidelines - Selected Contemporary Techniques for Subsurface Investigations) to select grid or line spacing depending on whether station data or continuous line profile data are to be collected. The sampling logic implied in Figure 2-5 should help guide development of the ESI sample plan.

### 2.4.5 Evaluation of Sampling/Analysis Options

Following identification of data users, data types, and data quality needs, sampling and analysis options can be evaluated. Sampling strategies to support the HRS are presented in Site Inspection Sampling Strategy for Supporting Hazard Ranking System Scoring (1985).

The evaluation should consider:

- Sampling and analysis components
- Sampling and analysis approach (phasing).

#### 2.4.5.1 Sampling and Analysis Components

The project site manager must involve technical personnel familiar with analytical techniques during this stage of the DQO process. Analytical approaches to be considered consist of Levels I - V variable as to cost, time required for analysis, and quality of resulting analytical data.

All sampling activities should be conducted and documented so that sound decisions concerning HRS and RI work plan development can be made. If sufficient data are collected using appropriate protocols, and the data are valid for NPL decisions, then they should be admissible as evidence in future litigation.

#### 2.4.5.2 Sampling and Analysis Approach (Phasing)

Data collection activities for each uncontrolled hazardous waste site must be designed to maximize use of available and collected data. A phased ESI approach, with field screening and geophysical techniques to direct sample collection, will ensure adequate sampling and analysis. Subdividing the data collection program into several phases enables use of data collected during one phase to direct data collection in subsequent phases (i.e., geophysical surveys to select monitoring well locations; field analytical indicators to select CLP samples). The time required to receive analytical data from laboratories often results in delays in additional sampling. Using field techniques for assessing contaminant concentrations or media characteristics allows the ESI to proceed more efficiently.

Direct reading instruments which should be considered for evaluating a sampling/analysis approach include:

- Organic vapor analyzer (OVA)/HNU
- Portable gas chromatograph (GC)
- Portable x-ray fluorescence (XRF)

- o Portable atomic absorption spectrometer (AA)
- o Hydrogen sulfide analyzers
- o Mercury vapor analyzers
- o Respirable particulate meters
- o Radiation detectors
- o pH and conductivity meters

Other field techniques which can assess site conditions without extensive laboratory support include:

- o Soil gas monitoring
- o Ground-penetrating radar surveys
- o Electromagnetic surveys
- o Magnetometer surveys
- o Seismic refraction surveys
- o Resistivity surveys

The phased sampling approach can be conceived of as a large "inverted funnel" whereby large numbers of samples are initially analyzed quickly and inexpensively in the field, with smaller numbers of samples analyzed further in a laboratory at a higher level of sophistication. If parameters are selected for screening purposes, a percentage of samples should be analyzed completely to verify assumptions made for chemicals present or of concern. The type and design of the analytical approach are determined by how data will be used. Strategic selection of samples for analysis at each level provides a higher degree of certainty for the overall data set without sacrificing either the quantity of samples to be analyzed or the quality of data collected.

## 2.5 REFERENCES

Existing guidance or information on the status of evolving guidance can be obtained from EPA Headquarters Site Assessment Branch, Hazardous Site Evaluation Division, Office of Emergency and Remedial Response (OERR).

Contacts: Penny Hansen (FTS-475-8103)
Jim Jowett (FTS-475-8195)


- o Data Quality Objectives for Pre-remedial Response Activities, in preparation, FY 1988.

- o Data Quality Objectives (DQOs) for Remedial Response Activities - Volumes 1 and 2, OSWER Directive 9335.0-7B, March 1987.

- o Site Inspection Sampling Strategy to Support HRS Scoring (Draft), OSWER Directive 9345.1-01, January 1986.

- o User's Guide to the Contract Laboratory Program, OSWER Directive 9240.0-01, July 1984.

## CHAPTER 3 SUMMARY

**WHAT IS THE FORMAT AND CONTENT OF ESI WORK PLANS, SAMPLING PLANS, AND HEALTH AND SAFETY PLANS?**

o WORK PLAN

- Major objectives:
  * Provide specific guidance for all field work
  * Provide a mechanism for planning site activities and obtaining EPA approvals

- Background:

  * Summarize existing site data
  * Describe site
  * Discuss data gaps

- General considerations:

  * Investigation procedures
  * Personnel requirements
  * Equipment requirements
  * Subcontractor procurements
  * Waste disposal procedures
  * Special training requirements

o SAMPLING PLAN

- Determine contaminants of interest

- Discuss sampling rationale and frequency

- Develop operational plans for sampling. Identify:

  * Team members
  * Sample report/documentation requirements
  * Analytical and sample handling requirements
  * Sampling equipment
  * QA samples
  * Decontamination procedures

o HEALTH AND SAFETY PLAN

- Describe known site hazards

- List key personnel

- Identify levels of protective gear required

- Evaluate hazards (i.e., toxicological assessment of known or suspected contaminants)

- Outline site monitoring program (i.e., survey instruments needed)
- Identify field work areas and outline site access control procedures
- Prescribe personnel decontamination procedures
- Compile emergency information

# 3.0 PREPARATION OF ESI WORK PLANS, SAMPLING PLANS, AND HEALTH AN SAFETY PLANS

## 3.1 INTRODUCTION

Work plans, sampling plans, and health and safety plans are prepared after the necessary data have been collected at the PA stage and the site has been prescored to determine potential data gaps. These plans document procedures to be used, resources needed, and the rationale behind the tasks to be undertaken during the ESI, thus ensuring that all necessary planning and review have been completed before field activities begin. The plans also provide the basis for later interpretation of the results of the ESI, and documentation of the procedures and technical approach used for eventual remedial work and possible future enforcement actions.

## 3.2 WORK PLAN

The ESI work plan establishes the level of effort and specific field activities. The plan:

- Provides specific guidance for all field work.
- Provides a mechanism for planning site activities and obtaining EPA approval.
- Provides a basis for estimating field costs.
- Targets sampling activities to those that are necessary and sufficient.
- Provides a common point of reference for all parties to coordinate site activities.

The work plan must outline site-specific data needed to:

- Support the HRS.
- Characterize the site (sources, migration pathways, and receptors).
- Support health studies conducted by ATSDR.
- Develop preliminary risk assessments.
- Support enforcement actions.

At a minimum, the ESI work plan should include sections outlined in Table 3-1. During the ESI, the work plan may require revision to reflect the need for more detailed information or greater focus on a particular problem.

TABLE 3-1
SUGGESTED FORMAT FOR ESI WORK PLAN

Introduction

- Objectives
- Site background
- General work plan considerations
- Evaluation of existing data (PA information)

ESI Data Quality Objectives (Chapter 2)

- DQO Stage 1 - Identification of decision types
- DQO Stage 2 - Identification of data uses/needs

Sampling Plan (Section 3.3)

- Chemicals of potential interest (based on disposal records and known industry feedstocks)
- Sample types to be taken
- Map of preliminary sample, well installation, and geophysical survey locations (based on file information and reconnaissance)
- Sample locations and frequency
- Analytical and standard operating procedures
- Sample QA/QC
- Sample decontamination
- Sampling reports/documentation
- Sample delivery

Health and Safety Plan[a] (Section 3.4)

- Description of known hazards and risks
- List of key personnel
- Levels of protective gear required
- Hazard evaluation
- Site monitoring program
- Field work areas/access control points
- Decontamination
- Emergency information

Field Investigation Procedures (Chapter 4)

- Sampling
- Geophysical surveys
- Installation of monitoring wells
- Mobilization and demobilization considerations

Community Relations Plan

Project Schedule and Costs

[a]Often a stand-alone document completed once Work/Sampling Plans are approved.

### 3.2.1 Objectives

Work plan objectives describe the precise reasons for field investigation and sampling efforts, as well as the ultimate use of the data.

### 3.2.2 Site Background

The site background is described based on existing file information and on data compiled during the PA. Background information should consist of:

- A description (cultural, topographic, geologic) of the site and surrounding area, including any limitations on conducting field activities.
- A discussion of known and suspected contamination sources and a listing of probable transport pathways.
- A list of information sources.
- A discussion of data gaps.

### 3.2.3 General Considerations

The work plan provides for efficient scheduling of resources such as manpower, equipment, and laboratory services. The "general" section should include material on the following subjects, which may be further detailed in subsequent sections:

- Investigation procedures. Outlines specific standard operating procedures (SOPs) and field quality control procedures during the ESI.
- Personnel requirements. Identifies all persons needed to conduct field activities, including support personnel, and their specific responsibilities.
- Equipment requirements. Identifies all safety and sampling equipment and supplies.
- Subcontractor procurements. Describes any contractual services needed to accomplish field work (i.e., drilling).
- Waste disposal procedures. Requires that all wastes generated during field activities be disposed of in accordance with Resource Conservation and Recovery Act (RCRA) regulations. In many cases, it may be possible to dispose of wastes on-site assuming the owner/operator grants permission.
- Special training requirements. Specifies training required if new equipment or procedures are to be used.

### 3.2.3 Evaluation of Existing Data

Existing data should be evaluated for quality and reliability before field work begins to develop effective work and sampling plans. In most instances, little quantitative information will be available unless SIs, Technical Assistance Team (TAT) responses, or emergency removals have been conducted at the site. If analytical data exist, the following information should be available for HRS documentation purposes:

- Sampling date
- Sampling team or person in charge
- Sampling location and description
- Collection technique
- Field preparation technique
- Chain-of-custody procedures
- Laboratory preparation techniques
- Laboratory analytical method
- Laboratory detection limits
- QA/QC samples taken
- Field replicates taken
- Rinsate data

## 3.3. SAMPLING PLAN

The ESI sample plan is incorporated into the overall work plan and identifies sampling locations, rationale, logistics, and frequency. To meet the objectives of the ESI, it should define the number of samples for each matrix necessary to support the HRS and characterize the site. The sample plan should also consider data sensitivity, which potentially involves application of statistical techniques to determine confidence levels in data collected. Extensive statistical analysis, however, is inappropriate for general pre-remedial work.

### 3.3.1 Contaminants of Interest

The waste constituents known or likely to be found at each site and in surrounding environmental media need to be identified (Table 3-2). They may be determined from site data, including records identifying wastes deposited, site history, site operations, and generators of wastes deposited at the site. Field screening methods may also be appropriate to determine the contaminants of interest.

## TABLE 3-2

## POTENTIAL INDUSTRY-SPECIFIC CONTAMINANTS

### MINING
#### Metal and Coal Mining Industries

| | | |
|---|---|---|
| pH | Zinc | Magnesium |
| Sulfate | Tin | Silver |
| Nitrate | Vanadium | Manganese |
| Chloride | Radium | Calcium |
| Total dissolved solids | Phenol | Potassium |
| Phosphate | Selenium | Sodium |
| Copper | Iron | Aluminum |
| Nickel | Chromium | Gold |
| Lead | Cadmium | Fluoride |
| | Uranium | Cyanide |

### PAPER AND ALLIED PRODUCTS
#### Pulp and Paper Industry

| | | |
|---|---|---|
| Chemical Oxygen Demand (COD)/ Biological Oxygen Demand (BOD) | Phenols | Nitrogen |
| Total Organic Carbon (TOC) | Sulfite | Phosphorus |
| pH | Color | Total dissolved solids |
| Heavy metals | Biocides | |

### CHEMICALS AND ALLIED PRODUCTS
#### Organic Chemicals Industry

| | | |
|---|---|---|
| COD/BOD | Alkalinity | Phenols |
| pH | TOC | Cyanide |
| Total dissolved solids | Total phosphorus | Total nitrogen |
| Heavy metals | | |

#### Inorganic Chemicals, Alkalies, and Chlorine Industry

| | | |
|---|---|---|
| Acidity/alkalinity | Chlorinated benzenoids & polynuclear aromatics | Chromium |
| Total dissolved solids | Phenols | Lead |
| Chloride | Fluoride | Titanium |
| Sulfate | Total phosphorus | Iron |
| COD/BOD | Cyanide | Aluminum |
| TOC | Arsenic | Boron |
| Mercury | | |

TABLE 3-2 (Continued)

POTENTIAL INDUSTRY-SPECIFIC CONTAMINANTS

CHEMICALS AND ALLIED PRODUCTS
Plastic Materials and Synthetics Industry

| | | |
|---|---|---|
| COD/BOD | Phosphorus | Ammonia |
| pH | Nitrate | Cyanide |
| Phenols | Organic nitrogen | Zinc |
| Total dissolved solids | Chlorinated benzenoids and polynuclear aromatics | Mercaptans |
| Sulfate | | |

Nitrogen Fertilizer Industry

| | | |
|---|---|---|
| Ammonia | Sulfate | COD |
| Chloride | Organic nitrogen compounds | Total iron |
| Chromium | Zinc | pH |
| Total dissolved solids | Sodium | Phosphate |
| Nitrate | | |

Phosphate Fertilizer Industry

| | | |
|---|---|---|
| Calcium | Acidity | Mercury |
| Dissolved solids | Aluminum | Nitrogen |
| Fluoride | Arsenic | Sulfate |
| pH | Iron | Uranium |
| Phosphorus | Cadmium | Vanadium |
| | | Radium |

PETROLEUM AND COAL PRODUCTS
Petroleum Refining Industry

| | | |
|---|---|---|
| Ammonia | Chloride | Nitrogen |
| Chromium | Color | Odor |
| COD/BOD | Copper | Total phosphorus |
| pH | Cyanide | Sulfate |
| Phenols | Iron | TOC |
| Sulfide | Lead | Turbidity |
| Total dissolved solids | Mercaptans | Zinc |

PRIMARY METALS
Steel Industry

| | | |
|---|---|---|
| pH | Cyanide | Chromium |
| Chloride | Phenols | Zinc |
| Sulfate | Iron | |
| Ammonia | Nickel | |

TABLE 3-2 (Continued)

**POTENTIAL INDUSTRY-SPECIFIC CONTAMINANTS**

ELECTRIC, GAS, AND SANITARY SERVICES
Power Generation Industry

| | | |
|---|---|---|
| COD/BOD | Copper | Phosphorus |
| Polychlorinated biphenyls | Zinc | Orgnaic biocides |
| Total dissolved solids | Chromium | Sulfur dioxide |
| Oil and grease | Other corrosion inhibitors | Heat |

Municipal Sewage Treatment

| | | |
|---|---|---|
| pH | Nitrate | Sulfate |
| COD/BOD | Ammonia | Copper |
| Alkalinity | Chloride | Tin |
| Detergents | Sodium | Zinc |
| Total dissolved solids | Potassium | Various organics |

(From NEIC Manual, Ground Water/Subsurface Investigations at Hazardous Waste Sites, July 1981)

3.3.2 Sample Types

The sampling plan should identify the number of each sample type to be collected, describe collection methods, and specify each sampling location with a brief rationale for the selected location. The plan should differentiate between analyses performed in the field using screening techniques, and those performed at a contract lab.

Samples are generally taken to:

- Define background conditions
- Characterize the source
- Characterize transport pathways in a preliminary fashion
- Define receptor impacts and effects

Figure 3-1 presents an ESI sample form.

3.3.3 Sampling Locations and Frequency

A site map should be prepared pinpointing and describing sample locations, as well as sample type (soil, sediment, water), volume, and number. General criteria for determining locations are:

- Select enough locations to delineate source, background, general spatial extent of contamination, actual (or potential) pathways, and impact on susceptible receptors, as well as to support simplified modeling needs.
- Minimize the number of samples according to the "necessary and sufficient" philosophy while still meeting ESI objectives.

The sampling plan should clearly state levels of confidence considered adequate. These levels are determined in part by the ESI objectives (i.e., HRS support and remedial contractor support) and by the guidelines in Chapter 2.

Sampling frequency depends on site environment and the most probable pathways for transport. Pathways or receptors affected by seasonal variations or weather patterns may require multiple sampling (i.e., ESI investigator can recommend further sampling to the remedial contractor).

For a more detailed discussion on sampling preparation, see Site Inspection Sampling Strategy to Support HRS Scoring (Draft) (1986).

3.3.4 Operational Plans

Clearly specified responsibilities and procedures contribute to safe and cost-effective field sampling. A sampling operations plan should contain:

- List of team members to ensure availability of required expertise.

FIGURE 3-1
ESI SAMPLE FORM

1. SITE NAME ____ EPA REGION ____
LOCATION ____
NUMBER ____

| 2. MEDIA (Circle One) | SOIL | GW | SW/SED | AIR | BIO | OTHER ____ |
|---|---|---|---|---|---|---|

| 3. USE (Circle all that apply) | SITE CHARAC. | HRS SUPPORT | PRP DETER. | OTHER ____ |
|---|---|---|---|---|

4. OBJECTIVE ____

5. SITE INFORMATION
AREA ____ DEPTH TO GROUND WATER ____
GROUND WATER USE ____
SOIL TYPES ____
SENSITIVE RECEPTORS ____

6. DATA TYPES (Circle as appropriate)

A. ANALYTICAL DATA

| | | |
|---|---|---|
| pH | PESTICIDES | |
| CONDUCTIVITY | PCB | TOC |
| VOA | METALS | BTX |
| ABN | CYANIDE | COD |
| TCLP | ____ | ____ |

B. PHYSICAL DATA

| | |
|---|---|
| POROSITY | HYDRAULIC HEAD |
| GRAIN SIZE | HARDNESS |
| BULK DENSITY | ____ |
| ____ | ____ |

7. SAMPLING METHOD (Circle as appropriate)

| | | | | |
|---|---|---|---|---|
| ENVIRONMENTAL | BIASED | GRAB | NON-INTRUSIVE | PHASED |
| SOURCE | GRID | COMPOSITE | INTRUSIVE | ____ |

8. ANALYTICAL LEVELS (Circle as appropriate)

LEVEL 1 FIELD SCREENING - EQUIPMENT ____
LEVEL 2 FIELD ANALYSIS - EQUIPMENT ____
LEVEL 3 NON-CLP LABORATORY - METHODS ____
LEVEL 4 CLP/RAS - METHODS ____
LEVEL 5 NON-STANDARD ____

9. SAMPLING PROCEDURES

BACKGROUND - 2 PER EVENT OR ____
CRITICAL (LIST) ____
PROCEDURES ____
PRESERVATION TECHNIQUES ____

10. QUALITY CONTROL SAMPLES (Confirm or set standard)

A. FIELD
COLLOCATED - 5% OR ____
REPLICATE - 5% OR ____
FIELD BLANK - 5% OR ____
TRIP BLANK - 1 PER DAY OR ____

B. LABORATORY
REAGENT BLANK - 1 PER ANALYSIS BATCH OR ____
REPLICATE - 1 PER ANALYSIS BATCH OR ____
MATRIX SPIKE - 1 PER ANALYSIS BATCH OR ____
OTHER ____

11. BUDGET REQUIREMENTS
BUDGET ____ SCHEDULE ____
STAFF ____
CONTRACTOR ____ PRIME CONTRACTOR ____
SITE MANAGER ____ DATE ____

(Modified from Data Quality Objectives for Remedial Response Activities, U.S. EPA, March 1987)

- Sampling reports/documentation describing all sampling forms to be completed (i.e., log books, chain-of-custody, sample receipt forms, sample traffic reports, sample tags, custody seals).

- Analytical and sample handling requirements. Discusses analyses to be run on each sample (volatile organics, metals, PCBs, etc.), specific levels of sample quality (i.e., Level I-V), appropriate preservation techniques and materials, tools needed for sample collection, and containers for storage. Much of this information can be referenced to SOPs for field sampling procedures. Figure 3-1 is a useful format for documenting the above information on a sample-specific basis.

- Lists of equipment required and procedures for use.

- Collection plan with a map of sample locations and sample types. The phased approach to sampling should be strongly considered (i.e., geophysics to target monitoring well locations and field screening to target CLP samples). In addition, the specific sampling duties of each field team member should be discussed--who will take samples, maintain the logbook, monitor the site for releases, etc.

- QA sample plan. Identifies the number and type of QA samples (i.e., number of blanks, duplicates, and spikes).

- Decontamination procedures and equipment. Disposal permits may be necessary to dispose of the waste generated in field activities.

- Sample delivery. Identifies final disposition of all samples (i.e., lab analysis locations, if known, and persons to whom any splits are to be delivered).

## 3.4 HEALTH AND SAFETY (H & S) PLAN

A major concern in pre-remedial investigations is the protection of the health and safety of the investigative team, as well as the general public. EPA, corporate, and State health and safety programs and written site-specific safety plans are a means for assuring overall safe operations. All parties must implement the applicable regulations to protect workers and the general public.

### 3.4.1 Regulatory Overview

The Occupational Safety and Health Administration (OSHA) published an interim final rule (December 1986) governing employees engaged in "hazardous waste operations" (29 CFR 1910.120). The rule explicitly applies to pre-remedial activities, as well as RIs. Other regulations protect the health and safety of hazardous waste response workers and the general public:

- U.S. Department or Transportation (DOT) regulations (49 CFR 171-178).

- o Resource Conservation and Recovery Act (RCRA) regulations governing the storage, transport, and disposal of investigation-derived wastes.

- o State occupational safety and health rules, which may be more stringent than Federal regulations. State rules should be consulted to determine applicability to site activities.

For an in-depth discussion of hazardous waste site health and safety considerations see the NIOSH/OSHA/USCG/USEPA publication entitled Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (October 1985).

### 3.4.2 Site-Specific Health and Safety Plans

A written H & S plan is prepared for each ESI. It assesses site hazards and outlines specific procedures to protect workers, as well as limitations on activities. The plan is often prepared after the work plan and sample plan are completed. Early preparation of the H & S plan helps identify potential problems, including the availability of adequately trained personnel and equipment.

All H & S plans should be prepared in accordance with EPA's Standard Operating Safety Guide Manual, November 1984, and then approved by the H & S director. The H & S plan should include:

- o Description of known hazards and risks. Describes location, topography, climate, current status of wastes and other materials on-site, legal status, site security, and waste types, quantities, locations, etc. (Much of this information can be incorporated by reference to other portions of the work plan or PA report). Reviews resources such as roads, water supply, electricity, and telephone. Also states the purpose of the ESI, lists planned actions and dates, and forms the basis for the prescribed protective strategies.

- o List of key personnel. Describes the H & S responsibilities of each team member, including the Project Team Leader and Site Safety Officer. The H & S Director approves personnel to help ensure that they have the proper medical and training certifications (i.e., first aid and cardiopulmonary resuscitation (CPR)).

- o Identification of levels of protective gear required. Specifies level (A, B, C, or D) for each activity (i.e., sampling, drilling, decontamination) and describes the modifications required for initial site entry. Criteria should be set, based on preliminary monitoring data, for changing the level as needed. When the types and amounts of chemicals are not known, a worst-case scenario should be assumed.

- o Evaluation of hazards. Summarizes toxicological data on wastes known or suspected to be present. Particularly important is an analysis of exposure routes and information regarding permissible exposure levels, such as the threshold limit values (TLVs) or OSHA permissible exposure limits (PELs). Synergistic or additive effects should be analyzed. Physical factors such as potential heat stress, frostbite, radiation, falls, electrical shock, unstable ground or structures, barriers, and heavy equipment (i.e., drill rig) use should be examined.

- Description of site monitoring program. Outlines in detail the monitoring requirements based on the hazard evaluation. For many sites, however, total organic vapor analyses, rather than analyses for specific compounds, are most practical. Survey instruments include: organic vapor analyzer (OVA), explosimeter, oxygen meter, draeger tubes, and radiation detectors. These tools should be used only as preliminary indicators, since expert judgment is required to interpret monitoring data and select optimal protection strategies.

- Identification of field work areas and access control procedures. Includes a map designating the exclusion area (control area), contamination reduction area, support area, and command post. In addition, access control points must be identified to regulate entry and exit from the exclusion area. Finally, the contamination reduction area or personnel decontamination station should be located upwind of the exclusion area to prevent contamination moving off-site.

- Decontamination procedures. Prescribes the requirements for decontamination, including equipment, solutions, and step-by-step procedures (may suffice to reference SOP documents). The problem of waste disposal of investigation-generated wastes should also be addressed. Certain waste streams may require RCRA permits.

- Emergency information. Provides telephone numbers for police, fire, ambulance, and hospital, and a map clearly outlining the fastest route to the hospital. Other useful emergency information includes telephone numbers of the PRP, EPA poison control center, and consulting physicians and toxicological experts. Standard procedures for reporting emergencies should also be included.

## 3.5 REFERENCES

Existing guidance or information on the status of evolving guidance can be obtained from EPA Headquarters Site Assessment Branch, Hazardous Site Evaluation Division, Office of Emergency and Remedial Response (EORR).

Contacts: Penny Hansen (FTS-475-8103)
Jim Jowett (FTS-475-8195)

- NIOSH/OSHA/USCG/USEPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, October 1985.

- Revised HRS/SI Bulletins, prepared periodically beginning Fall 1987.
- Site Inspection Sampling Strategy to Support HRS Scoring (Draft), OSWER Directive 9345.1-01, January 1986.
- Standard Operating Safety Guide Manual, OSWER Directive 9285.1-01B, November 1984.

# CHAPTER 4 SUMMARY

**WHAT ARE THE MAJOR OBJECTIVES OF THE ESI FIELD INVESTIGATION AND WHAT GENERAL SITE CHARACTERIZATION METHODS SUPPORT DATA COLLECTION REQUIREMENTS?**

o SITE INVESTIGATION OBJECTIVES

- Substantiate representative HRS Score
- Make preliminary identification of contaminant source(s), pathway(s), and potential receptors
- Generally determine area of contamination

o DATA COLLECTION REQUIREMENTS

- Contaminant source investigation - to determine toxicity, persistence, and mobility of pollutants
- Geologic investigation - to determine influence on water and contaminant transport
- Ground water investigation - to determine rate, general direction, and concentration of transported contaminants
- Surface water investigation - to identify potential surface water runoff pathways, and concentrations of contaminants
- Atmospheric investigation - to document an observed air release and to define the path and rate of dispersion of airborne contaminants

o GENERAL SITE CHARACTERIZATION METHODS

- Field analytical screening techniques
  * Organic vapor analyzer (OVA) and field gas chromatograph (GC) measure:

    (1) soil vapors in the vadose zone
    (2) headspace of water and soil samples
    (3) vapors from boreholes and monitoring wells
    (4) ambient air samples

- Surface geophysical techniques
  * Ground penetrating radar (GPR) - locate buried wastes and map stratigraphic horizons
  * Electromagnetics (EM) - characterize subsurface contaminant plumes and continuity of low-permeability layers
  * Resistivity - characterize contaminant plumes

* Seismic refraction - determine depth and thickness of soil and rock layers, depth to bedrock, and potential location of water table
* Magnetometry - locate buried wastes and map geological structure influencing waste migration

- Installation of monitoring wells

  * Wells can contribute to:

    (1) characterization of geology beneath the site
    (2) identification of ground water conditions
    (3) determination of depth and general extent of contamination

# 4.0 FIELD INVESTIGATION PROCEDURES

## 4.1 INTRODUCTION

The objectives of an ESI field investigation include those of a traditional SI (i.e., sampling to document an HRS score), in addition to collecting general data to help future contractors develop the RI work plan. Furthermore, ESIs will provide data to bring enforcement action or initiate negotiations with PRPs. Enough information must be collected and analyzed to:

- Substantiate a representative HRS score.
- Make a preliminary identification of contaminant source(s), pathway(s), and potential receptors.
- Generally determine the area of contamination.

Potential source types, release modes, migration modes, and routes of exposure associated with hazardous waste sites are illustrated in Figure 4-1. The wide range of waste effects and their interactions may necessitate further work to characterize wastes, geology, ground water and surface water hydrology, atmospheric conditions, and environmental and human health effects.

## 4.2 APPROACH TO SITE CHARACTERIZATION

To help the remedial contractor develop the RI work plan, the ESI must compile existing data to provide a clear picture of the overall problems at a site. Sources of existing data include the PA and information on any previous response/field activity. Much of this compilation and review should have been completed as part of preparing the ESI work plan and sample plan.

The site characterization effort should also screen potential sources, pathways, and receptors to provide the basis for subsequent RI field work and the preliminary evaluation of remedial alternatives.

### 4.2.1 Data To Be Collected

Data to be collected during an ESI include, but are not limited to, the following:

- Environmental setting: Description of the layout of the site and surrounding areas; topography; location of wastes; waste types; normal and unusual meteorological conditions; surface drainage patterns; geologic features; ground water occurrence, flow direction, and rate; and soils.
- Hazardous substances: Analytical data (mostly field screening data) characterizing wastes, including type, quantity, physical form, concentration, disposition, and conditions affecting release.

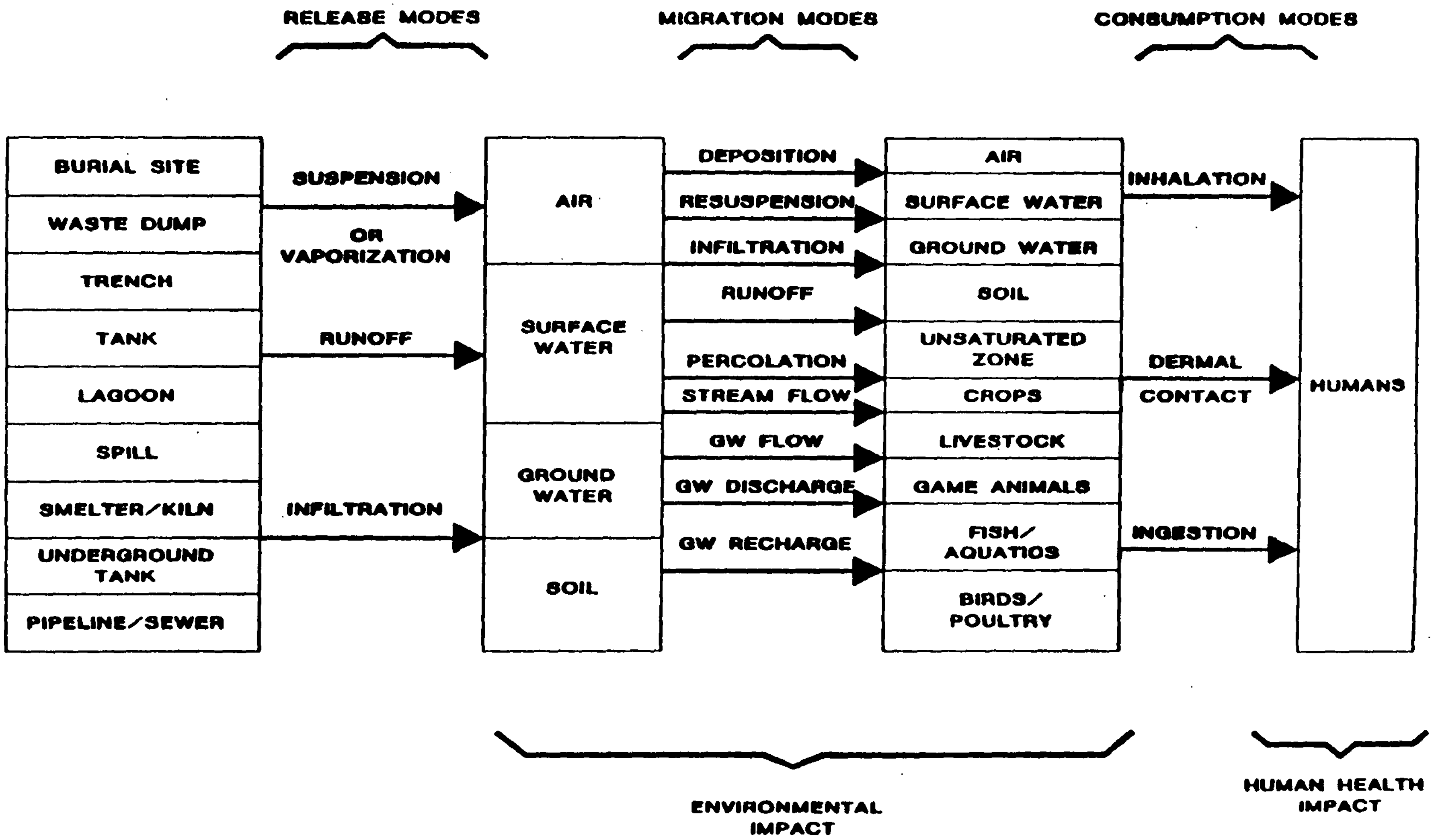


Figure 4-1. OVERVIEW OF EFFECTS AND INTERACTIONS AT A REPRESENTATIVE HAZARDOUS WASTE SITE
(From Guidance on Remedial Investigations under CERCLA, U.S. EPA, June 1985)

- Environmental concentrations: Analytical data on contamination of air, soil, surface water, and ground water both on and near the site. Should be sufficient to generally define the origin, extent, direction, and rate of movement of contaminants.

- Potential impact on receptors: Data describing the human populations and environmental systems susceptible to contaminant exposure via the transport pathways from a site. Permits ATSDR to generally assess potential exposures.

### 4.2.2 General Characterization Methods

ESIs imply use of technical approaches not necessarily part of the traditional SI including:

- Increased use of field screening techniques (i.e., portable GC), which can:

  - identify contaminants present
  - provide semiquantitative estimates of concentrations
  - determine the general extent of contamination in soils, air, and water
  - optimize CLP sampling efforts (i.e., minimize the number of "no-detection" samples).

- Surface geophysical surveys which:

  - delineate hydrogeologic features
  - determine subsurface contamination and general direction of flow
  - locate boundaries of buried trenches and lagoons
  - locate buried drums and tanks
  - delineate general site geology (i.e., depth to bedrock, lateral and vertical variations in soil and rock types).

- Installation of monitoring wells, which enable the investigator to:

  - collect ground water samples
  - conduct aquifer/aquitard tests
  - characterize all aquifers of concern
  - measure fluctuations in the water table
  - estimate direction of ground water flow
  - determine general subsurface stratigraphy
  - collect subsurface soil/sediment/bedrock samples.

- Careful visual observations (with photo documentation), which help to:

  - identify source/origin of contaminants
  - identify type/condition of containers
  - estimate migration potential
  - Prepare detailed site map (size, boundaries, buildings, etc.).

While these efforts are generally applicable to all sites, the scope of work should be developed on a a case-by-case basis.

## 4.3 TECHNICAL INVESTIGATIONS

ESI technical investigations should focus on characterizing waste sources, transport pathways, and receptors. These investigations can be categorized as studies of waste sources, geology, ground water hydrology, surface water hydrology, atmospheric conditions, and contaminants of concern.

### 4.3.1 Waste Sources

Characterizing waste sources involves collection of data describing the physical and chemical properties of waste materials and how they are contained. Relevant data can be grouped into two categories: (1) waste characteristics, such as the types and quantities of contaminants that have been or may be released to the environment and (2) facility data that characterize how these contaminants may be released (Table 4-1).

It may be necessary to collect data on the types of contaminants, location and volume (horizontal and vertical extent) of sources, and variation of concentrations within the sources. When extensive grid sampling is required over three dimensions, field screening techniques should be used, with a limited number of CLP samples collected in key locations.

Geophysical surveys (Section 4.3) can effectively map the location and extent of buried waste deposits and ground water contaminant plumes, as well as define site geologic conditions when correlated with a limited number of subsurface samples collected at key locations. Aerial photography and infrared imagery can aid in defining sources by documenting site activities over time and by providing the basis for interpreting ecological impacts resulting from stressed biota.

### 4.3.2 Geology

Site geology has a marked influence on release of contaminants, water movement, contaminant transport, and feasibility of remedial measures. Ground water flow and potential contaminant migration are influenced by folds, faults, joints, and fractures (Table 4-2). Stratigraphic information may be used to identify aquifers and confining formations so that the aquifers most likely to transport contaminants can be delineated.

### 4.3.3 Ground Water Hydrology

To characterize contaminant transport in ground water requires determining the hydrologic properties of aquifers (Table 4-3). The general direction of ground water flow can be estimated by comparing static water elevations in a series of wells completed in the same zone of an aquifer. The flow rate can be estimated using data on

**TABLE 4-1 SOURCE AND FACILITY INFORMATION NEEDED FOR ESIs**

| INFORMATION NEEDED | RATIONALE | APPROPRIATE COLLECTION METHODS: PRIMARY | APPROPRIATE COLLECTION METHODS: SECONDARY |
|---|---|---|---|
| **WASTE CHARACTERISTICS:** | | | |
| • Type | Determine contaminants | Site inspection, waste manifests | Sampling and analysis |
| • Form | Determine form of containment | Site inspection | Sampling and analysis, geophysical surveys |
| • Quantities | Determine magnitude of potential releases | Site inspection | Sampling and analysis, geophysical surveys |
| • Chemical and physical properties | Determine environmental mobility, persistence, and effects | Handbooks, CHEMTREC/OHMTADS, Chemical Information Service (CIS) | Laboratory analysis |
| • Concentrations | Determine quantities and concentrations potentially released to environmental pathways | Site inspection | Sampling and analysis |
| **FACILITY CHARACTERISTICS:** | | | |
| • Integrity of waste/ chemical containment | Determine probability of release and timing of response | Site inspection | Sampling and analysis, non-destructive testing |
| • Drainage control | Determine probability of release and timing of response | Site inspection, topographic maps | |
| • Security | Determine potential for release by direct contact; may dictate response | Site inspection | |
| • Known discharge points (outfalls, stacks) | Provide points for accidental or intentional discharge | Site inspection | |
| • Maps and Surveys | Locate existing structures and obstructions | Existing maps (USGS, county, land development) | Surveying (i.e., for well head elevations), analysis of air photos to delineate past operations and disposal practices |

(Modified from Guidance on Remedial Investigations Under CERCLA, U.S. EPA, June 1985).

TABLE 4-2 GEOLOGIC INFORMATION NEEDED FOR RSIs

| INFORMATION NEEDED | RATIONALE | APPROPRIATE COLLECTION METHODS | |
|---|---|---|---|
| | | PRIMARY | SECONDARY |
| STRUCTURAL FEATURES: | | | |
| o Folds, faults | Determine natural flow barriers or controls | Existing geologic maps | Aerial photos, geophysical techniques |
| o Joints, fractures | Predict major boundaries, routes of ground water flow | Existing geologic profiles, pump tests | Geophysical techniques (limited) |
| STRATIGRAPHIC CHARACTERISTICS: | | | |
| o Thickness, extent (horizontal and vertical) of aquifers and confining layers, relationships among units | Determine geometry of aquifers/ confining layers, aquifer recharge/ discharge | Existing geologic maps, existing well logs | Geophysical techniques (limited) |
| o Soil/sediment/bedrock compositions, permeability and porosity, grain-size distribution | Determine ground water quality/ movement/occurrence/yield | Laboratory core/split spoon sample analysis, geologic literature | Geologic literature |

(Modified from Guidance on Remedial Investigations Under CERCLA, U.S. EPA, June 1985.)

TABLE 4-3 GROUND WATER INFORMATION NEEDED FOR ESIs

| INFORMATION NEEDED | RATIONALE | APPROPRIATE COLLECTION METHODS | |
|---|---|---|---|
| | | PRIMARY | SECONDARY |
| **GROUND WATER OCCURRENCE:** | | | |
| • Aquifer boundaries and locations | Define flow limits and degree of aquifer confinement | Existing literature, water resource atlases | Existing well logs, regional water-level measurements |
| • Aquifer ability to transmit water | Determine potential quantities and rates | Pumping and injection tests of monitoring wells | |
| **GROUND WATER MOVEMENT:** | | | |
| • Direction of flow | Identify most likely pathways of contaminant migration | Existing hydrologic literature | Water-level measurements in monitoring wells |
| • Rate of flow | Determine maximum potential migration rate and dispersion of contaminants | Existing hydrologic literature | Hydraulic gradient, permeability, effective porosity from water level contours, aquifer test results, laboratory analyses |
| **GROUND WATER QUALITY:** | | | |
| • pH, total dissolved solids, conductivity, specific contaminant concentrations | Determine exposure via ground water, define contaminant plume | Existing site data | Analysis of ground water samples from monitoring wells, geophysical techniques |

(Modified from Guidance on Remedial Investigations Under CERCLA, U.S. EPA, June 1985.)

ground water surface gradients, and hydraulic conductivity and porosity; the flow rate can be determined more precisely by aquifer tests, if necessary. The direction and extent of contaminated ground water plumes can often be identified by using geophysical surveys.

### 4.3.4 Surface Water Hydrology

If contaminants could be transported via surface water runoff, sampling should be performed to evaluate the types and levels of contaminants present. Surface water pathways depend greatly on weather conditions (Table 4-4). Therefore, data should be collected at specific locations under known meteorological conditions and through periods (if possible) representing natural cycles in ambient conditions.

### 4.3.5 Atmospheric Investigations

The HRS revisions will probably require more extensive characterization of the air pathway. Data on the characteristics of an observed or potential release and atmospheric conditions may be required to help define the path and dispersion of airborne contaminants (Table 4-5).

### 4.3.6 Contaminants of Concern

Before the potential for human or environmental exposure can be analyzed, the chemicals on which the analyses will focus must be selected. The goal is to choose chemicals that represent the most serious hazard in terms of prevalence, persistence, toxicity, and mobility. If enough information is available, the "indicator" chemical should be selected when the ESI sample plan is being prepared. Sampling data for contaminants of concern will be used by the ATSDR to conduct a Public Health Assessment before the remedial alternatives are selected.

## 4.4 INVESTIGATION TECHNIQUES

Traditional SIs encompass only sampling to score a site for the NPL. ESIs, however, have the added objective of providing the remedial contractor with the "big picture," so that RI/FS activities may begin in a timely fashion. A number of investigation techniques are available (Table 4-6) from which project managers can select to solve site-specific problems. To help determine the spatial sampling requirements for each technique, see Section 2.4.4.

For more detailed descriptions, including instrument calibration and operation procedures, see Quality Assurance/Field Operation Methods Manual (1986), contractor SOPs, and instrument user manuals.

No single technique/approach will solve every ESI problem. Combining SI sampling/analysis approaches does, however, provide a complete site picture with greater confidence levels and in a cost-effective manner.

TABLE 4-4 SURFACE WATER INFORMATION NEEDED FOR ESIs

| INFORMATION NEEDED | RATIONALE | APPROPRIATE COLLECTION METHODS: PRIMARY | APPROPRIATE COLLECTION METHODS: SECONDARY |
|---|---|---|---|
| **DRAINAGE PATTERNS:** | | | |
| o Overland flow, topography, channel flow pattern, tributary relationships | Determine if overland or channel flow can result in on-site or off-site flow and if patterns form contaminant pathways | Topographic maps, site inspection | Aerial photos, ground survey |
| **SURFACE WATER BODIES:** | | | |
| • Flow, stream widths/depths, channel elevations, flooding tendencies | Determine volume and velocity, transport times, dilution potential, potential spread of contamination | Public agency data and atlases; catalogs, maps, and handbooks for background data | Aerial photos, ground survey |
| • Structures | Determine effect on contaminant transport/mitigation | Public agency maps/records | |
| • Surface water/ground water relationships | Predict contaminant pathways for interceptive actions (i.e., slurry walls) | Public agency reports/surveys | Water level measurements |
| **SURFACE WATER QUALITY:** | | | |
| • pH, temperature, total suspended solids, conductivity, salinity specific contaminant concentrations | Determine capacity of water to carry contaminants, water/sediment partitioning | Public agency computerized data files, handbooks, literature | Sampling and analysis |

(Modified from Guidance on Remedial Investigations Under CERCLA, U.S. EPA, June 1985.)

TABLE 4-5 ATMOSPHERIC INFORMATION NEEDED FOR ESIs

| INFORMATION NEEDED | RATIONALE | APPROPRIATE COLLECTION METHODS: PRIMARY | APPROPRIATE COLLECTION METHODS: SECONDARY |
|---|---|---|---|
| LOCAL CLIMATE: | | | |
| • Precipitation | Define recharge, evaporation potential, probable transport direction | National Climate Center (NCC) National Oceanic and Atmospheric Administration, local weather bureaus | On-site measurements/observations |
| • Temperature | | | |
| • Wind speed/direction | | | |
| WEATHER EXTREMES: | | | |
| • Storms | Determine effect of weather extremes | NCC, State emergency planning offices | |
| • Floods | | | |
| • Winds | | | |
| RELEASE CHARACTERISTICS: | | | |
| • Direction/speed of plume movement | Determine dispersion characteristics of release | Information from source facility, weather services, air monitoring services | On-site air monitoring stations |
| • Contaminant concentrations | | | Field screening techniques |

(Modified from <u>Guidance on Remedial Investigations Under CERCLA</u>, U.S. EPA, June 1985.)

TABLE 4-6
SURFACE GEOPHYSICAL TECHNIQUES FOR HAZARDOUS WASTE SITE INVESTIGATIONS

(Modified from Technos Inc., Application Guidelines - Selected Contemporary Techniques for Subsurface Investigations).

| | GROUND-PENETRATING RADAR | ELECTRO-MAGNETICS | RESIS-TIVITY | SEISMIC REFRACTION | METAL DETECTOR | MAGNE-TOMETRY | ORGANIC VAPOR ANALYZERS |
|---|---|---|---|---|---|---|---|
| **EVALUATION OF NATURAL GEOLOGIC AND HYDROLOGIC CONDITIONS** | | | | | | | |
| - Depth and thickness of soil and rock layers and vertical variations | 1[a] | 2 | 1 | 1 | NA | NA | NA |
| - Mapping lateral variations in soil and rock (fractures, karst features, etc.) | 1[a] | 1 | 2 | 2 | NA | 3 | NA |
| - Depth of water table | 3 | 2 | 1 | 1 | NA | NA | NA |
| **EVALUATION OF SUBSURFACE CONTAMINATION AND POST CLOSURE MONITORING** | | | | | | | |
| Inorganics (high total dissolved solids (TDS) and electrically conductive)* | | | | | | | |
| - Early warning contaminant detection | 3 | 1 | 2 | NA | NA | NA | NA |
| - Detailed lateral mapping | 3 | 1 | 2 | NA | NA | NA | NA |
| - Vertical extent | 3 | 2 | 1 | NA | NA | NA | NA |
| - Changes of plume with time (flow direction and rate) | 3 | 1 | 2 | NA | NA | NA | NA |
| Organics (typically non-conductive)* | | | | | | | |
| - Early warning contaminant detection | 3 | 3 | 3 | NA | NA | NA | 1 |
| - Detailed lateral mapping | 2[a] | 2 | 3 | NA | NA | NA | 1 |
| - Vertical extent | 2[a] | 3 | 2 | NA | NA | NA | 2 |
| - Changes of plume with time (flow direction and rate) | 3 | 3 | 3 | NA | NA | NA | 1 |
| **LOCATION OF BURIED WASTES AND DELINEATION OF TRENCH BOUNDARIES** | | | | | | | |
| - Bulk waste trenches--without metal | 1 | 1 | 2 | 3 | NA | NA | NA[d] |
| - Bulk waste trenches--with metal | 1 | 1 | 2 | 3 | 1[c] | 1[b] | NA[d] |
| - Depth and lateral extent of trenches and landfills | 2 | 3 | 2 | 1 | NA | NA | NA[d] |
| - Detection of 55-gallon steel drums | 2[a] | 2 | NA | NA | 1[a] | 1 | NA[d] |
| - Estimates of depth and quantity of 55-gallon steel drums | 2[a] | 3 | 3 | NA | 2 | 1 | NA[d] |
| **LOCATION OF UTILITIES** | | | | | | | |
| - Buried pipes and tanks | 1 | 1[c] | NA | 3 | 1[c] | 1[b] | NA[d] |
| - Potential pathways of contaminant migration via conduits and permeable trench backfill | 1 | 2 | NA | NA | 2 | 2 | NA[d] |
| - Abandoned wells with metal casing | 3 | NA | NA | NA | 2 | 1[b] | NA[d] |

*The various approaches are in general equally applicable to both the saturated and unsaturated zones.

1 - primary choice
2 - secondary choice
3 - limited field application
NA - not applicable
a - shallow
b - assumes ferrous metal
c - assumes metals to be present
d - assumes no vapors present

NOTE: Many site-specific conditions may dictate the choice of a method rated 2 or 3 in preference to a 1.

ESI techniques include but are not limited to:

- o Field screening
  - organic vapor analyzers (OVA)
  - field gas chromatographs (GC)
  - soil/gas monitoring.
- o Surface geophysical techniques (Table 4-6). They can provide valuable information, but their use must be evaluated on a case-by-case basis. In most instances, complementary techniques should be used to confirm data and resulting interpretations. Geophysical techniques include:
  - ground-penetrating radar
  - electromagnetics
  - resistivity
  - seismic refraction
  - metal detection
  - magnetometry.
- o Installation of monitoring wells.

### 4.4.1 Portable Organic Vapor Analyzers (OVA/GC)

Portable field screening instruments can measure organic vapors to levels of low ppm to low ppb. Instrument response is a function of the organic chemicals' volatility and quantity. Typically, the OVA and GC are used at stations, but the OVA can also make continuous measurements along profile lines. Types of samples to be monitored include:

- o Soil vapors in the vadose zone (i.e., soil/gas monitoring)
- o Head space of water and soil samples
- o Vapors from boreholes and monitoring wells
- o Ambient air

The OVA/GC techniques are susceptible to interference from other airborne vapors. Instruments must be handled by experienced and qualified technical personnel to ensure reliable results. The techniques provide different analytical levels of data, with the OVA providing semiquantitative data on total organics (Level I), and the field GC providing qualitative and semiquantitative data on specific constituents (Level II).

### 4.4.2 Ground-Penetrating Radar (GPR)

The GPR instrument responds to changes in electrical properties, which are a function of soil and rock material and moisture content. Data are generally in the form of a picture-like display (continuous two-dimensional profiles). The unit can be pulled by hand or vehicle, at rates of 0.5 to 5 mph, and tens of acres or more can be surveyed in a day. In general, the instrument provides:

- o High resolution profiles (depending on antenna frequency).
- o Varying depths of penetration (depending on antenna frequency and soil moisture/clay content) -- typically less than 15 to 20 feet, and rarely in excess of 50 feet.

### 4.4.3 Electromagnetics (EM)

The EM instrument measures bulk electrical conductivity, which is a function of the soil and rock density, percent saturation, and conductivity of pore fluids. Depth of investigation varies depending on instrument coil spacing and configuration. Both station and continuous profile measurements can be made to depths of up to 180 feet.

In general, EM surveys provide excellent lateral resolution (profiling) but limited vertical resolution (sounding); as a result, EM methods are often combined with other geophysical investigations i.e., GPR). The technique is susceptible to interference from metal pipes, cables, fences, vehicles, and noise from power lines.

### 4.4.4 Resistivity

The resistivity instrument measures bulk electrical resistivity, which is a function of the soil and rock matrix, percentage of saturation, and conductivity of pore fluids. Resistivity surveys result in good vertical resolution to depths of 100 feet, and may also be used for lateral profiling. One drawback is that the instrument requires direct ground contact, allowing only station measurements to be made (less efficient than continuous profiles). The technique is susceptible to interference from metal pipes, fences, and cables.

### 4.4.5 Seismic Refraction

The seismic refraction technique measures seismic velocity of rock, which is a primary function of soil and rock density. Data output is in the form of two-dimensional cross sections, and information on the depth and thickness of soil and rock layers are obtained. Measurements can be made to depths of 100 feet or more but are station-specific. Collection of continuous profile data is time consuming because geophone arrays must be moved, but seismic data can provide a complete subsurface picture across a site. Seismic surveys are susceptible to acoustic noise and vibrations, although available equipment can filter much of this interference.

### 4.4.6 Metal Detectors

Metal detector response is a function of object depth and surface area. Continuous profiles are obtainable, and both ferrous (iron) and non-ferrous metals may be detected. Instruments can be hand carried or vehicle mounted and detect single 55-gallon drums at depths up to 8 feet or large masses of drums up to 18 feet. Measurements are susceptible to interference from trash metal, nearby metal pipes, fences, etc.

### 4.4.7 Magnetometry

Magnetometer response is a function of an object's iron content and its depth and mass. Station or continuous profile measurements are possible, and magnetometers may be hand carried or vehicle mounted. Depth of resolution is greater than that of metal detectors; single 55-gallon drums can be identified at depths up to 18 feet and large masses of drums up to 60 feet. Measurements are susceptible to interference from steel pipes, fences, vehicles, and buildings.

### 4.4.8 Monitoring Well Installations

In the past, monitoring wells have not been routinely installed when gathering data for HRS scoring. Field teams will sample existing private and municipal wells; however, the ESI objective of supporting the RI could, in many instances, warrant installing monitoring wells.

Monitoring wells and aquifer tests can contribute to:

- o Characterization of geology beneath the waste site
  - depth to bedrock
  - correlation of stratigraphic units between soil/rock borings
  - core/interval sampling to identify the depth and extent of contamination
  - identification of the confining layer/formation
  - identification of zones of potentially high hydraulic conductivity
  - indication of unusual or unpredicted geologic features such as fault zones, facies changes, and buried stream deposits.
- o Identification of ground water conditions
  - depth to water table
  - direction of horizontal and vertical flow of ground water
  - seasonal/temporal, naturally and artificially induced variations in ground water flow
  - hydraulic conductivities of significant hydrogeologic units underlying the site
  - possibility of aquifer interconnections.
- o Determination of depth and extent of contamination
  - necessity for both ungradient and downgradient wells
  - field screening/CLP analysis of well samples.

Well placement decisions should be based on field screening and geophysical surveys. Wells upgradient of the site as well as downgradient are necessary to provide background information. At least three wells are required to estimate hydraulic head, flow gradients, and flow directions.

## 4.5 REFERENCES

Copies of existing guidance or information on the status of evolving guidance can be obtained from the EPA Headquarters Site Assessment Branch, Hazardous Site Evaluation Division, Office of Emergency and Remedial Response (OERR).

Contacts: Penny Hansen (FTS-475-8103)
Jim Jowett (FTS-475-8195)


- Geophysical Techniques for Sensing Buried Wastes, EPA Contract No. 68-03-3050
- Quality Assurance/Field Operations Methods Manual (Draft), Volumes 1-4, OSWER Directive 9355.0-14, March 1986

# CHAPTER 5 SUMMARY

## HOW WILL ESIs SUPPORT RI SCOPING AND DEVELOPMENT OF RI WORK PLANS?

- RI SUPPORT
  - Collect data to assess general nature and extent of contamination
  - Prepare ESI report in format compatible with RI work plan
- LIMITED FIELD INVESTIGATION (DATA COLLECTED BEYOND THE MINIMUM FOR HRS SCORING):
  - Conduct preliminary geophysical investigations
  - Install monitoring wells
  - Monitor air
  - Use screening techniques extensively
  - Prepare detailed site maps showing the locations of wastes, wells and samples; probable extent of contamination; and potential areas for further study.

## 5.0 ESI SUPPORT TO RI SCOPING AND DEVELOPMENT OF RI WORK PLAN

A principal ESI objective is to provide the remedial contractor with site information beyond that required for the HRS to facilitate development of the RI work plan. The ESI can:

- Collect and analyze existing and ESI data to assess the general nature and extent of contamination.
- Complete limited field investigation to characterize all three migration pathways. Activities include:
  - collection of analytical field screening data
  - installation of monitoring wells
  - application of surface geophysical techniques.
- Determine existing and potential impacts from the site on public health and the environment.
- Provide limited support to ATSDR, community relations, and enforcement.
- Organize information in a format compatible with RI work plans.

The RI scoping and work plan development process is described in EPA's revised RI/FS Guidance Document. ESIs are not designed to completely replace these preliminary RI/FS efforts, but they should both support and help shorten the remedial planning process.

### 5.1 EXISTING AND ESI DATA

ESI field work will help to understand site conditions through extensive site screening data, more CLP samples, monitoring well data, and geophysical survey data. The field work should:

- Investigate the hazardous wastes disposed of at a site. Sample results should be summarized in terms of physical and chemical characteristics, contaminants identified, and concentrations present.
- Review records of site disposal and operating procedures to identify wastes on-site, waste haulers and waste generators when waste records are unavailable, or waste products (which may be inferred from manufacturing processes used by identified waste generators).
- Summarize existing site-specific and regional information to help identify surface, subsurface, atmospheric, and biotic migration pathways. Information should include site geology, hydrogeology, meteorology, and ecology. Regional information can help to identify background soil, water, and air quality characteristics. Summarize results of ESI sampling and document soil, water, air, and/or biotic contamination.

- o Compile demographic and land use information to help identify potential human receptors. Locate residential, municipal, and industrial wells. Describe surface water uses surrounding and downstream of the site (upstream if the surface water body is tidally influenced).

- o Describe the ecology of the site and surrounding areas, identifying threatened, endangered, or rare species, or sensitive environments protected under both State and Federal statutes.

- o Summarize any community relations activities during the pre-remedial stage (i.e., lists of individuals and groups that have expressed concern about the site; appropriate Federal, State and local officials; locations for meetings; and media).

Existing data should be analyzed for a preliminary understanding of the nature and extent of contamination and the pathways, receptors, and existing or potential impacts of the site. QA information should be provided and data certainty assessed. The data analysis should consider:

- o Comparability of data (i.e., time of sampling).

- o Analytical methods used.

- o Detection limits.

- o Analytical labs used (if any).

- o Sample collection and handling procedures used.

The remedial contractor will benefit from the compilation of a site description and chronology of significant events, previous site visits, sampling, legal actions, regulatory violations, changes in ownership, and prior cleanup and removal actions.

The site description should include a detailed map delineating topography, geology, land use, waste locations, sampling locations, and other pertinent details. The general extent of contaminant migration should be illustrated for later investigation.

## 5.2 LIMITED FIELD INVESTIGATION

Collection of additional site-specific data beyond the minimum required for HRS scoring can help to increase understanding of a site and provide valuable support to the RI scoping process. Normally, an ESI is limited to easily obtainable data and rapid results. Examples of tasks are:

- o Preliminary geophysical investigations.

- o Limited sampling (both CLP and field screening data) and analysis of sources, soil, sediment, and surface water.
- o Sampling and analysis of residential wells.
- o Monitoring well installations, water-level measurements, aquifer testing, sampling, and analysis.
- o Air monitoring.
- o Preparation of a detailed site map.

If ESI data are later determined insufficient for satisfying RI scoping objectives, the remedial contractor may have to conduct additional sampling during development of the RI work plan. This should be possible using existing ESI Health and Safety and Sampling Plans. RI Quality Assurance Project Plans (QAPP) and Field Sampling Plans (FSP) may be unnecessary for this scoping effort.

## 5.3 PRELIMINARY EVALUATION OF POTENTIAL IMPACTS

A conceptual model (Section 2.3.4) based on limited information on waste sources, pathways, and receptors should be developed to evaluate the potential health and environmental impacts posed by a site. The initial version of the conceptual model, developed early during preparation of the ESI work plan, should be updated and improved once field work is complete.

Sample analysis, determination of the general extent of contamination, semiquantitative estimates of directions and rates of contaminant transport, and identification of potential receptors should produce a comprehensive data base useful to the RI contractor in planning the RI. Conceptual model results will help to:

- o Substantiate the level of health and environmental threat implied by the HRS score.
- o Establish the timing of remedial/removal response.
- o Improve RI sampling to determine the precise extent of contamination.
- o Identify preliminary remedial alternatives.
- o Support the RI contractor and ATSDR in evaluating potential health and environmental exposures.

## 5.4 COMMUNITY RELATIONS AND ENFORCEMENT SUPPORT

The final ESI report should include a section summarizing pre-remedial community relations activities. The section should present the issues and concerns of the community, the history of site community relations, citizens' preferences for site information, and a list of individuals, groups, and government officials who have participated in community relations activities.

Communication with enforcement personnel should be established early in the ESI process. Periodic updates concerning site history, site ownership, disposal practices, and waste generators and transporters should be provided to the Regional Office of Waste Programs Enforcement to help identify PRPs and support initial cost-recovery efforts.

## 5.5 REFERENCES

Existing guidance or information on the status of evolving guidance can be obtained from EPA Headquarters Site Assessment Branch, Hazardous Site Evaluation Division, Office of Emergency and Remedial Response (OERR).

Contacts: Penny Hansen (FTS-475-8103)
Jim Jowett (FTS-475-8195)


- Guidance on Remedial Investigations Under CERCLA, OSWER Directive 9355.0-06B, June 1985 (revisions per SARA due in Fall 1987).
- Superfund Exposure Assessment Manual (Draft), OSWER Directive 9285.5-01, January 1986.

# CHAPTER 6 SUMMARY

**WHAT INTERPRETATION AND REPORTING PROCEDURES SHOULD BE USED TO SUMMARIZE ESI DATA?**

- o DATA EVALUATION (PRELIMINARY SITE CHARACTERIZATION)
  - Prepare complete HRS package
  - Summarize source and pathway data:
    - * Detailed base map with supporting overlays of sample locations, well placements, geophysical survey lines, and interpretative comments
    - * Contour maps summarizing important geologic, hydrologic, and atmospheric data
    - * Summaries of sample results and supporting documentation
    - * Narrative summarizing findings most relevant to the RI scoping effort
    - * Supporting appendices of all data
- o FINAL ESI REPORT
  - Standardized presentation compatible with RI work plan format
  - Complete documentation of data for use in RI decision-making and enforcement support
- o TURNOVER MEETING
  - FIT contractor or State should compile all information for transfer to the remedial contractor
  - Meeting will focus on the key aspects of site data and significant ESI results

# 6.0 DATA EVALUATION OPTIONS AND ESI REPORT FORMAT

Data collected from various investigative activities must be evaluated to determine if they meet ESI objectives and presented in a format useful for making decisions during the RI.

## 6.1 DATA EVALUATION OPTIONS

Data evaluation or preliminary site characterization efforts determine the general extent of contamination and the probable severity of hazards at a site. The quantities, types, forms, and concentrations of contaminants at and around a site should be described, followed by a quantitative evaluation of observed and potential releases. Important outputs of the evaluation will be the completed HRS package and a thorough interpretation of all collected data.

The site characterization effort should include:

- o A description of the environmental setting, including important geologic, hydrologic, and atmospheric data. These data should be presented as contour maps illustrating important features of potential migration pathways and other information for development of the RI work plan. A base map (referenced to permanent benchmarks) of the site and surrounding region should be completed early in the ESI planning process. Subsequent overlays of sample locations, well placements, geophysical survey lines, etc., should be developed as the ESI progresses. Finally, a detailed site map highlighting results should be prepared.

- o A description of the hazardous substances found, including types, quantities, forms, and containment. Appropriate analytical detection limits and compliance with established data quality objectives should be described.

- o A description of contaminant levels found in media at and near the site. Concentration contour maps should be provided in an overlay format for comparison with pathway data.

- o A summary of findings most relevant to the objectives of site characterization and to development of RI work plans.

- o Supporting appendices of all data (i.e., raw sampling and geophysical survey data).

A model can be a valuable adjunct to site characterization efforts. However, it is an artificial representation of a physical system and is only an alternative way of characterizing and assessing a site. A model cannot replace field data, nor can it be more accurate than those data. A model can:

- o Improve the conceptual understanding of contaminant migration over time.

- o Help to define future RI sampling requirements by identifying inconsistencies and uncertainties in existing data.

- o Provide a structure for organizing, manipulating, and graphically presenting field data.

ESI models should be simplified analytical and semi-analytical models that estimate site conditions with relatively low accuracy and resolution. The objective is to provide general estimates of site conditions. More extensive (i.e., higher accuracy and resolution) modeling will be done in the remedial stage.

## 6.2 REPORT FORMAT

The final ESI report should be presented in a format that:

- o Ensures that all major ESI objectives are adequately addressed.

- o Produces comparable presentations nationwide.

- o Promotes high quality results.

- o Ensures adequate documentation and complete data for use in RI decision-making and enforcement support.

The suggested format (Table 6-1) is not intended as a compendium of site information, and not all of the identified sections will be relevant to a given ESI.

RI scoping and work plan development will be most efficient when the remedial contractor has all available information. Hence, the contractor should receive existing site file information along with the final ESI report (Table 6-2).

## 6.3 TURNOVER MEETING

EPA should ensure that all site data and ESI results are transferred to remedial contractors at the appropriate time. The FIT contractor or the State should compile all logbooks, data sheets, validation summaries, maps, file reports, geophysical survey results, and log borings. FIT or State personnel and remedial contractors should attend a "turnover" meeting to discuss key site data and important ESI results. The FIT or State budget for an ESI should provide hours for this meeting, including the preparation of the necessary materials. Similarly, work assignments for an RI/FS should, as the initial task, request attendance at a turnover meeting.

TABLE 6-1
ESI REPORT FORMAT

TABLE 6-2
SITE FILE INFORMATION

1. <u>Pre-remedial Response</u>

   o Discovery

   - Initial investigation reports
   - PA report
   - SI report (if applicable)
   - Sampling and analysis data

   o ESI Planning

   - ESI work plan
   - Sampling plan
   - Health and safety plan

   o Actions by State and Other Agencies

   - Correspondence

   o Community Relations

   - Correspondence
   - List of people to contact (i.e., local officials, civic leaders, environmental groups)

2. <u>Photos and Graphics</u>

   o Photographs

   o Maps and illustrations

   o Other graphics

3. <u>Enforcement</u>

   o Correspondence with OWPE

   o Preliminary identification of PRPs

4. <u>Contracts</u>

   o Site specific contracts

   o Procurement packages

   o Contract status notifications

   o List of contractors