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PB95-963213
April 1994

INTRODUCTORY SITE INSPECTION TRAINING MANUAL

Office of Emergency and Remedial Response
U.S. Environmental Protection Agency
Washington, DC

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Regional Center for Environmental Information
US EPA Region III
1650 Arch St.
Philadelphia, PA 19103

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FOREWORD

This manual is for reference use of students enrolled in scheduled training courses of the U.S. Environmental Protection Agency (EPA). While it will be useful to anyone who needs information on the subjects covered, it will have its greatest value as an adjunct to classroom presentations, involving discussions among the students and the instructional staff.

This manual has been developed with a goal of providing the best available current information; however, individual instructors may provide additional material to cover special aspects of their presentations.

Because of the limited availability of the manual, it should not be cited in bibliographies or other publications.

References to products and manufacturers are for illustration only; they do not imply endorsement by EPA.

Constructive suggestions for improvement of the content and format of the manual are welcome.

INTRODUCTORY SITE INSPECTION TRAINING
2 Days

This course provides participants with an introduction to the Superfund site assessment process and the fundamentals of the site inspection phase of this process. The site assessment process is used to screen hazardous waste sites for inclusion on the EPA National Priorities List and to prioritize sites for further investigation and remediation. Participants will receive the background necessary to evaluate preliminary assessments and to develop and implement site inspection strategies. The course is designed for individuals with little experience in the initial evaluation of hazardous waste sites.

The course format is based on the EPA document entitled *Guidance for Performing Site Inspections Under CERCLA*. The focus is on implementing EPA site inspection guidance rather than on emphasizing the mechanics of scoring sites using the Hazard Ranking System.

Topics to be discussed include an overview of the site assessment process; the fundamentals of the Hazard Ranking System; data collection strategies; site reconnaissance and documentation procedures; site, source, and waste characterization techniques; groundwater, surface water, air, and soil exposure pathway analyses; site inspection approaches; media-specific planning and sampling strategies; data evaluation and review; and reporting requirements.

After completing this course, participants will be able to:

- Describe how the outcome of the site assessment process affects the placement of a hazardous waste site on the National Priorities List.
- Define key phrases related to site inspections.
- Review a preliminary assessment document and develop a site reconnaissance plan.
- Develop site sampling strategies that will test preliminary assessment hypotheses and will provide adequate data for performing Hazard Ranking System calculations.

Note: Calculators are highly recommended.

Continuing Education Units: 1.35

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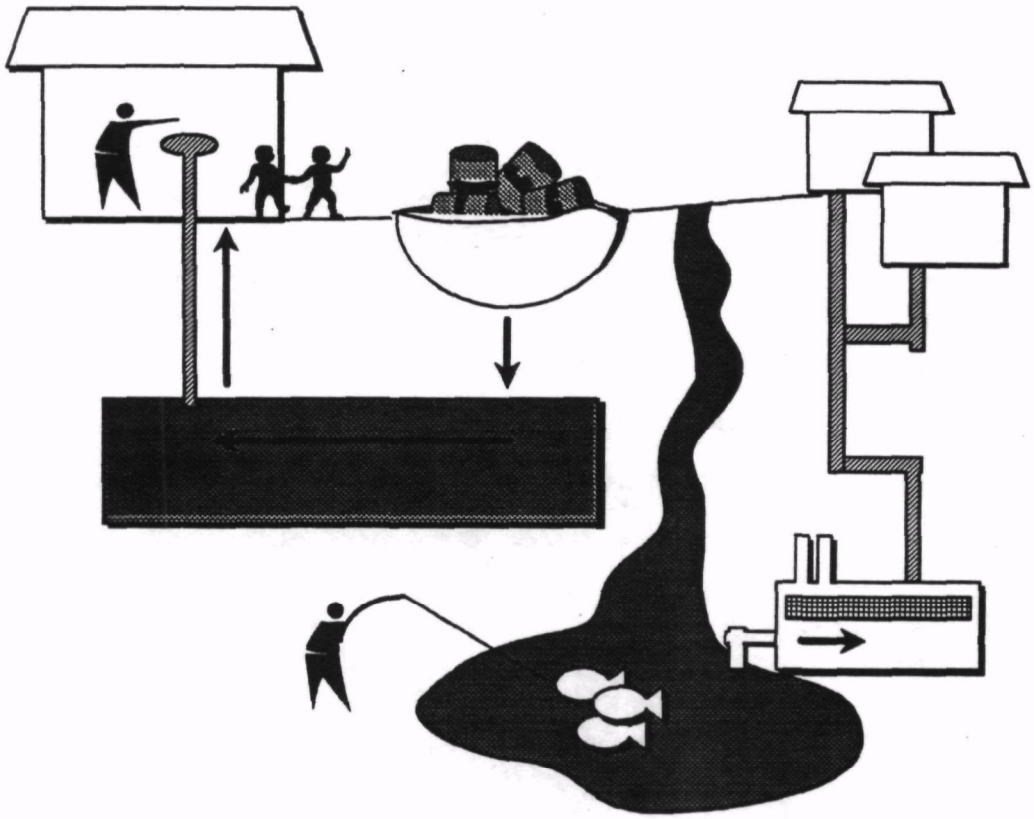
Section 1:
Introduction



Course Overview

This course...

- Focuses on the role of the site inspection (SI) in the site assessment process
- Examines the relationship of the SI to the preliminary assessment
- Demonstrates that the SI process is flexible and dynamic
- Describes the activities necessary to develop pathway-specific sampling strategies
- Emphasizes the importance of sampling smart
- Introduces the concept of "integrated assessments"

This course will not provide...

- Detailed SI standard operating guidelines or procedures
- Hazard Ranking System (HRS) training

OH • 1

SI Guidance Goals

Assist SI investigators in:

- Conducting efficient, high-quality assessments
- Making correct site recommendations
- Achieving national consistency in performing SIs

SI Guidance, chapter 1

OH • 2

SI Guidance Structure

- Chapter 1 • Introduction
- Chapter 2 • SI Approaches
- Chapter 3 • Planning
- Chapter 4 • Sampling Strategies
- Chapter 5 • SI Evaluation
- Chapter 6 • Reporting Requirements
- References
- Glossary
- Appendixes

SI Guidance, chapter 1

OH • 3

SARA Mandate

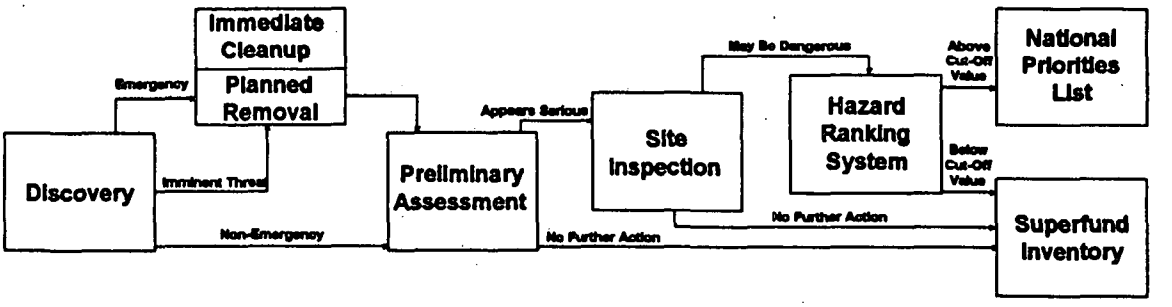
"...assess the relative degree of risk to human health and the environment posed by sites."

SI Guidance, section 1.1

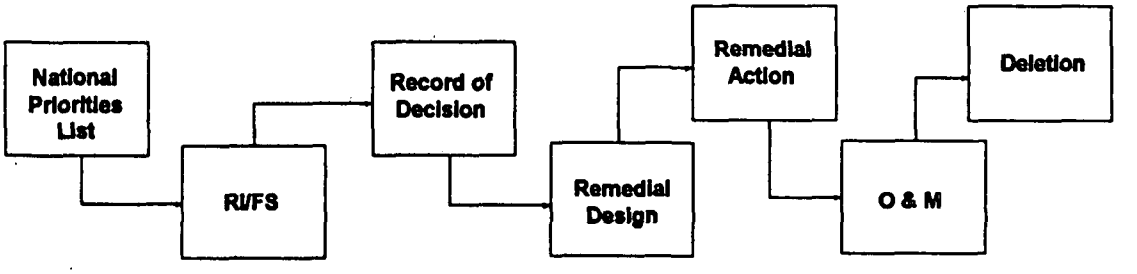
OH • 4

Superfund Tackles Hazardous Waste Emergencies and the Nation's Most Serious Sites

Site Discovery and Study: Finding the Most Serious Sites



Long-Term Cleanup: Fixing the Most Serious Sites



OH • 5

The Site Assessment Process: Preliminary Assessment (PA)

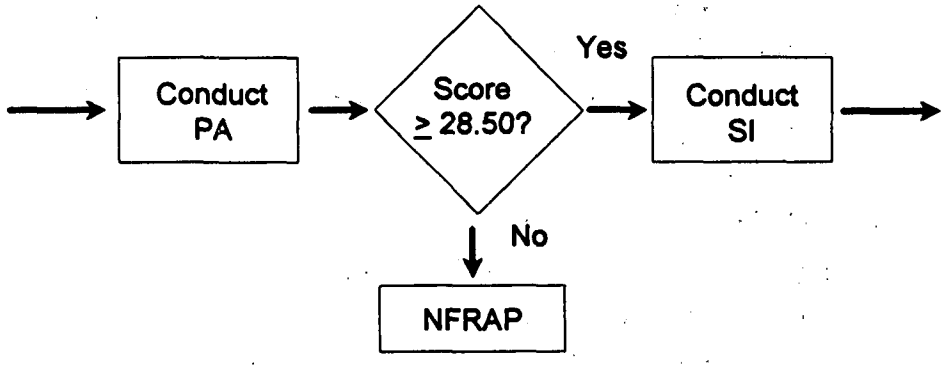
The PA identifies...

- Historical waste generation and disposal practices
- Hazardous substances associated with site
- Potential sources of hazardous substances
- Important migration pathways and affected media
- A comprehensive survey of targets
- Critical sample locations for SI

SI Guidance, section 1.1.1

OH • 6

Site Assessment in Superfund



OH • 7

The Site Assessment Process

Site inspection (SI)

- Intended to test PA hypotheses
- Includes collection of environmental samples
- Involves more detailed data collection
- Results in a decision to recommend for HRS scoring or no further remedial action planned (NFRAP)

SI Guidance, section 1.1.2 **OH • 8**

The Site Assessment Process

Primary SI objectives

- Identify substances present
- Determine whether hazardous substances are being released to the environment
- Determine whether hazardous substances have impacted specific targets

Additional objectives

- Support potential removal activities
- Support enforcement actions
- Collect data to support the remedial investigation/feasibility study (RI/FS)

SI Guidance, section 1.1.2 **OH • 9**

The Site Assessment Process

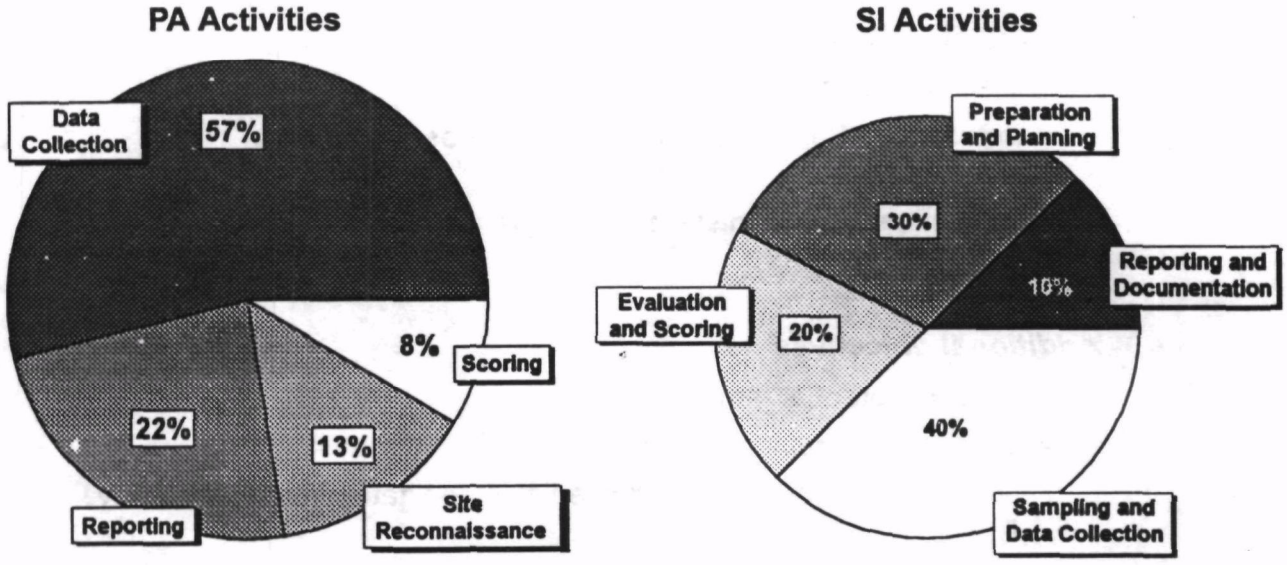
Major SI activities

- Review available information
- Organize project team and develop plans
- Perform field work
  - Visually inspect site
  - Collect data samples
- Evaluate all data and prepare site score
- Establish defensible documentation

SI Guidance, section 1.1.2

OH • 10

The Site Assessment Activities



OH • 11

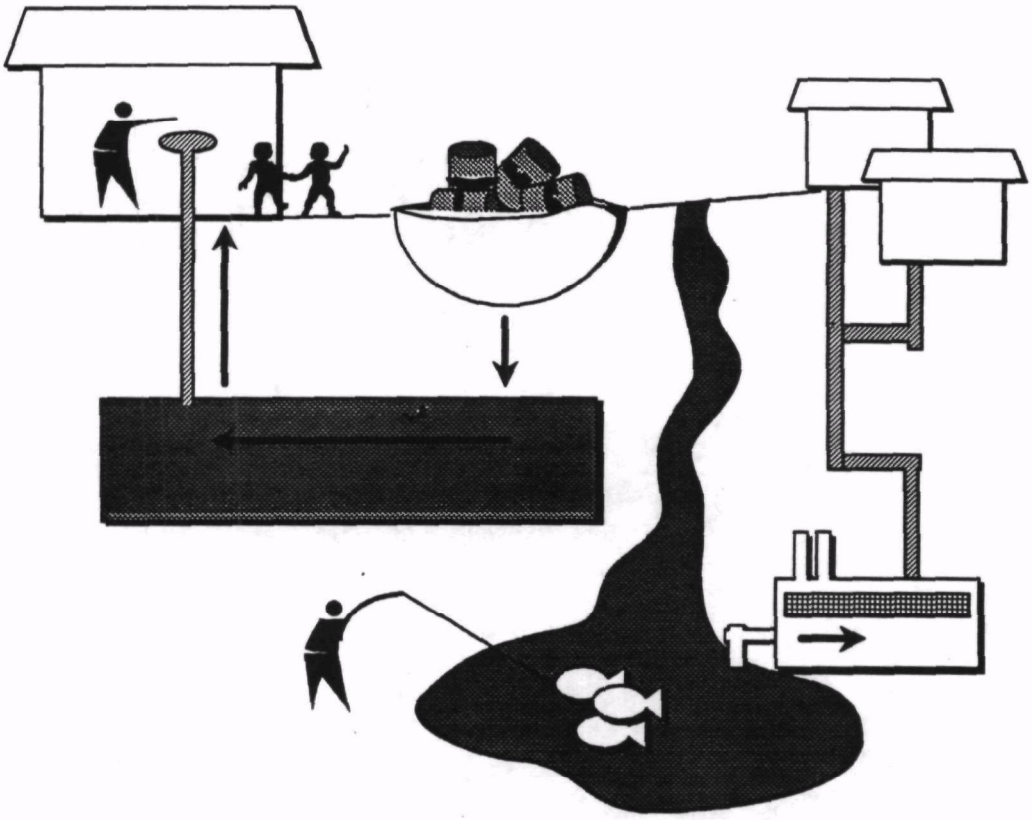
Comparison of PA and SI

PA	SI
• Limited scope	• Limited scope
• Nonsampling investigation	• Biased sampling investigation
• Step-by-step evaluation	• Flexible and dynamic evaluation
• Comprehensive target survey	• Sampling strategy and data collection to satisfy HRS criteria
• Conservative assumptions and professional judgment	• Additional information to test critical assumptions and hypotheses

OH • 12

Notes:

Section 2:
Integrated Assessments



Lecture Overview: Integrated Assessment

Integrated Assessments and SACM

↓

Introduction to the Removal Program

↓

Integrated Assessments Approach

OH • 1

Integrated Assessments

Integrated Assessments and SACM

↓

Introduction to the Removal Program

↓

Integrated Assessments Approach

OH • 2

Integrated Assessments

- Integrating removal and remedial site assessment investigation to achieve increased efficiency and shorter response times
- One of many programs associated with the implementation of the Superfund Accelerated Cleanup Model (SACM)

OH • 3

SACM History

- Developed to increase efficiency of the Superfund program by streamlining cleanup efforts at all Superfund sites
- Designed to combine immediate action with continuing study as necessary
- Should restore public confidence in Superfund process

Hazard Ranking System Guidance Manual, EPA 540-R-92-026, November 1992

OH • 4

Traditional Approaches

- Removal assessments are traditionally based on whether site conditions meet National Contigency Plan (NCP) criteria for a removal action
- Remedial site assessments are focused on collecting data for HRS
- The need to integrate these programs is based on the assumption that there is duplication of effort between the programs

EPA Directive 9345.1-16FS (Fact Sheet), Integrating Removal and Remedial Site Assessment Investigations, September 1993

OH • 5

Integrated Assessments

Integrated Assessments and SACM

↓

Introduction to the Removal Program

↓

Integrated Assessments Approach

OH • 6

What is the Removal Program?

Federal response capability for releases or threatened releases of:

- Hazardous substances that present a threat to public health, welfare, or the environment
- Oil spills into or on navigable waters and shorelines
- Petroleum releases from underground storage tanks

OH • 7

What are the Removal Program Authorities?

Statutory

- Clean Water Act (CWA) as amended by the Oil Pollution Act of 1990
- Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA)
- Superfund Amendments and Reauthorization Act (SARA)
- Oil Pollution Act

Regulatory

- NCP

OH • 8

Initiating Removal Actions

Authority to approve a removal is generally based on estimated cost

- Less than 50K - onscene coordinator (OSC)
- $50K to $2M - regional administrator
- Over $2M - assistant administrator, OSWER

PRP search

- NCP requirement

Action memorandum

- Criteria for qualifying site
- Proposed removal action
- Estimated cost

Note: Cost criteria are under revision

OH • 9

What are Removal Actions?

Near-term response actions taken to prevent, minimize, or mitigate threats to public health, welfare, or the environment including, but not limited to:

- Collection and analysis of samples
- Provision of alternate water supplies
- Onsite treatment
- Source control/stabilization
- Offsite storage, treatment, destruction, or disposal
- Temporary relocation of threatened individuals
- Installation of security fencing/guards

OH • 10

Classification of Removal Actions

Classic emergency

- 33 percent of removal actions since 1985
- Immediate action required

Time critical

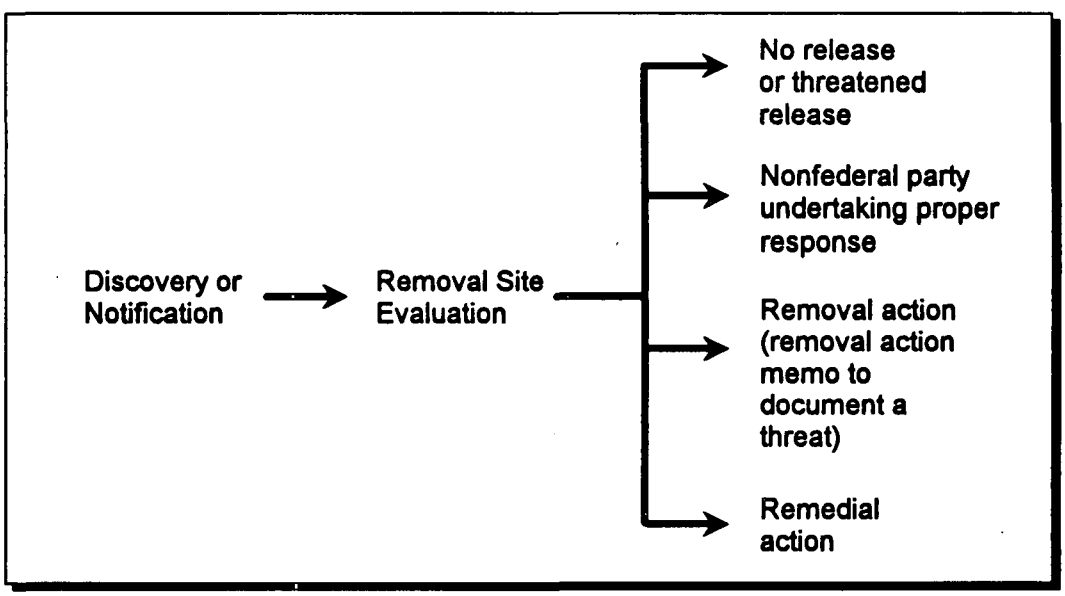
- Planning period of less than 6 months

Nontime critical

- Planning period of greater than 6 months is available
- Agency conducts an engineering evaluation/cost analysis (EE/CA)

OH • 11

How is the Appropriate Response Selected?



OH • 12

The Removal Evaluation

Removal preliminary assessments and site inspections are conducted to determine and evaluate:

- Presence and magnitude of threat to health or environment
- Source and nature of the release
- Activities required to mitigate threat
- Ability of nonfederal party(ies) to undertake response
- Need for CERCLA-funded removal

OH • 13

Removal Criteria

- Actual or potential human or animal food chain exposure
- Actual or potential drinking water contamination
- Fire or explosion threat
- Hazardous substance in containers that pose a threat of release
- Highly contaminated soils at the surface — direct contact threat
- Weather conditions that may cause substances to migrate
- Unavailability of other response or enforcement mechanisms

OH • 14

How are Removals Implemented?

Technical response support

- Technical Assistant Team (TAT) - contractor
- U.S. Coast Guard (USCG)
- Environmental Response Team (ERT)

Mitigation/cleanup response

- Regional Emergency Response Cleanup Services (ERCS) - contractor
- Site-specific contracts

Cooperative agreements (CAs) with states

OH • 15

ERCS

- Analytical services
- Containment and countermeasures
- Cleanup, mitigation, and disposal
- Site restoration

OH • 16

EPA Emergency Notification Procedures

- The National Response Center (NRC; 1-800-424-8802) alerts regional EPA or USCG OSC about most spill notifications

OH • 17

Integrated Assessments

Integrated Assessments and SACM

↓

Introduction to the Removal Program

↓

Integrated Assessments Approach

OH • 18

Removal and Remedial Assessments

Similarities in programs' goals

- Evaluate potential for human exposure to drinking water, soil, and airborne contaminants
- Evaluate threats to sensitive environments (e.g., wetlands)

Similarities in activities

- Telephone and file investigations
- Site visits or PA recons
- Sampling visits

Fact sheet, page 3

OH • 19

SACM Goals: Integrated Assessment

- Eliminate duplication of effort
- Expedite the process
- Minimize the number of site visits and other steps in the process
- Collect only the data needed to assess the site appropriately

Fact sheet, page 3

OH • 20

Integrated Assessment Approach

Important features

- Combined notification/site discovery/screening function
- Single site visit for both programs
- Phased file searches
- Integrated sample planning and inspection

See Figure 2, Integrated Assessment, Integrating Removal and Remedial Site Assessment Investigations Fact Sheet, EPA 540-F-93-038, September 1993

Fact sheet, page 4 **OH • 21**

Integrated Assessment Approach

Notification/site discovery/screening

- "One door" notification process
- All sites screened for emergency response
- Determine whether there is enough time for a file search before initial site visit

Classic emergency

- Respond immediately
- Little or no time for file search or telephone investigation

Fact sheet, page 3 **OH • 22**

Integrated Assessment Approach

File search

- Includes all elements of a removal assessment file search
- Table 1, File Search and Telephone Investigation, lists elements
- Document all elements for both programs

Fact sheet, page 3

OH • 23

Integrated Assessment Approach

Initial field investigation/PA reconnaissance:

- Combines elements from removal field visit and remedial PA reconnaissance
- Documentation procedures for removal assessment may require revision to meet remedial assessment needs
- Would require onsite reconnaissance at all sites
- Table 2, Data Elements of the Site Visit, lists data needs for both programs

Fact sheet, page 5

OH • 24

Integrated Assessment Approach

Sample (optional)

- Should follow current removal assessment approach
- Should consider HRS data needs

Review data and decide further action

- Both programs meet to decide next step(s)
- May continue removal assessment, PA, or both concurrently
- May expedite PA to determine whether remedial site assessment requirements should be included in sampling plans

Fact sheet, page 5

OH • 25

Integrated Assessment Approach

Complete the PA

- Collect additional information needed to complete PA
- Calculate preliminary HRS score
- Prepare PA report
- Table 3, Data Elements Needed to Complete the PA, should be consulted
- Refer site to regional decision team if score is greater than or equal to 28.5

Fact sheet, pages 5 and 6

OH • 26

Integrated Assessment Approach

Integrated sampling plan

- Combines screening level SI plans and remaining removal sampling activities
- For sites going to NPL, remedial project manager (RPM) should be consulted
- Could include sampling for long-term objectives

SI/removal assessment sampling

- One event
- Meet needs of both programs

See Table 4, Integrating Removal and Remedial Site Assessment Investigations, Fact Sheet, EPA 540-F-93-038, September 1993

Fact sheet, page 6

OH • 27

Integrated Assessment Approach

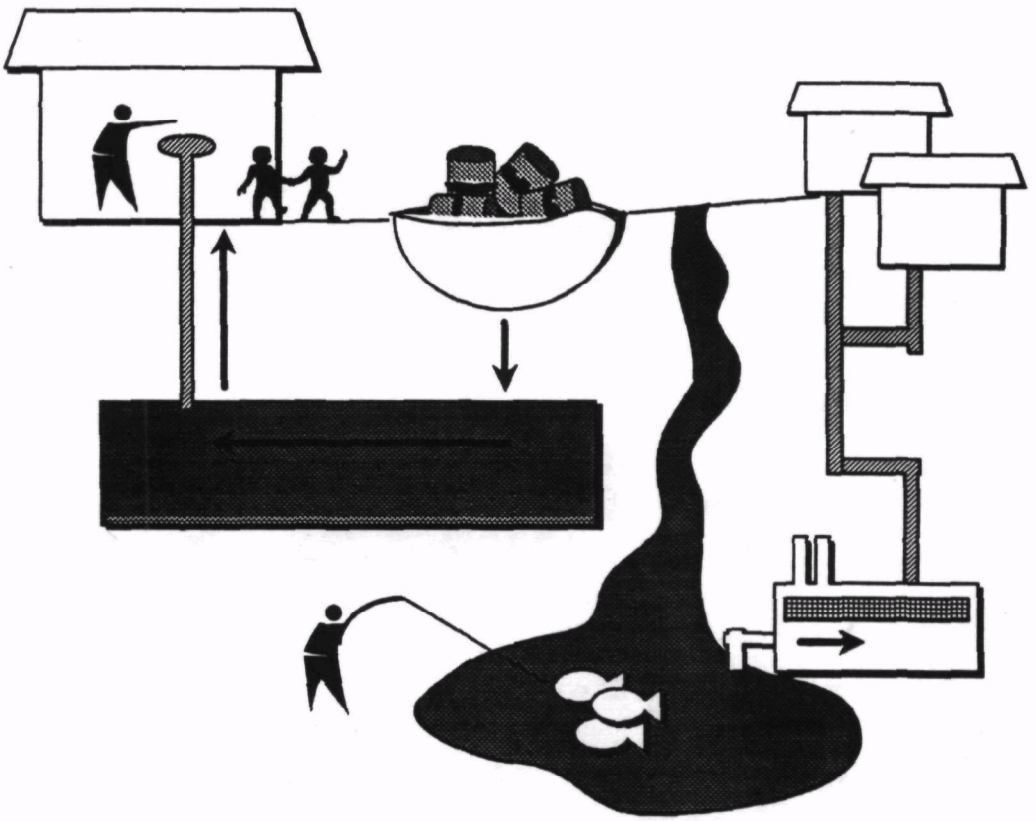
Expanded site inspection/remedial investigation

- Option allowing RI to start as soon as site appears to qualify for NPL
- NPL listing needs and RI needs can be incorporated into single sampling plan

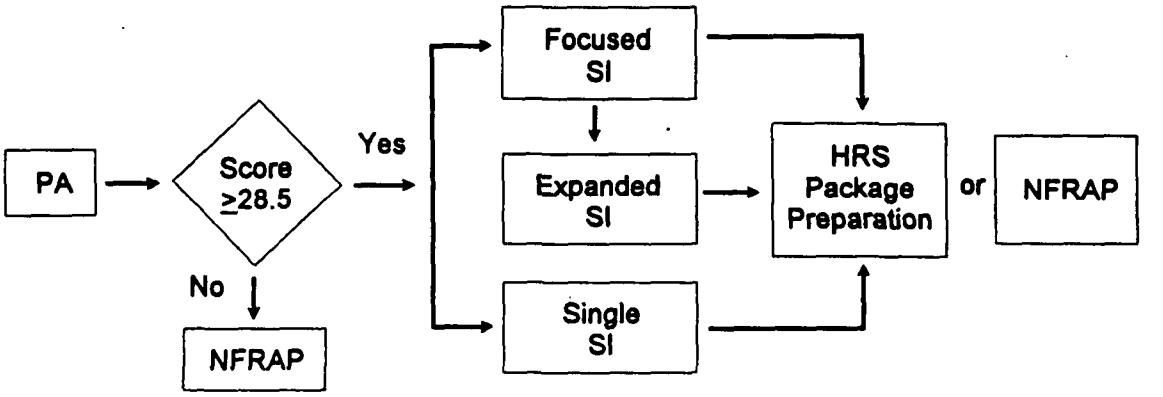
Fact sheet, page 6

OH • 28

Section 3:
SI Approaches



SI Approaches



SI Guidance, chapter 2

OH • 1

Focused SI: Goals

- Obtain and analyze critical samples
- Investigate human and environmental exposure to hazardous substances
- Test PA hypotheses that affect further action recommendations

SI Guidance, section 2.1

OH • 2

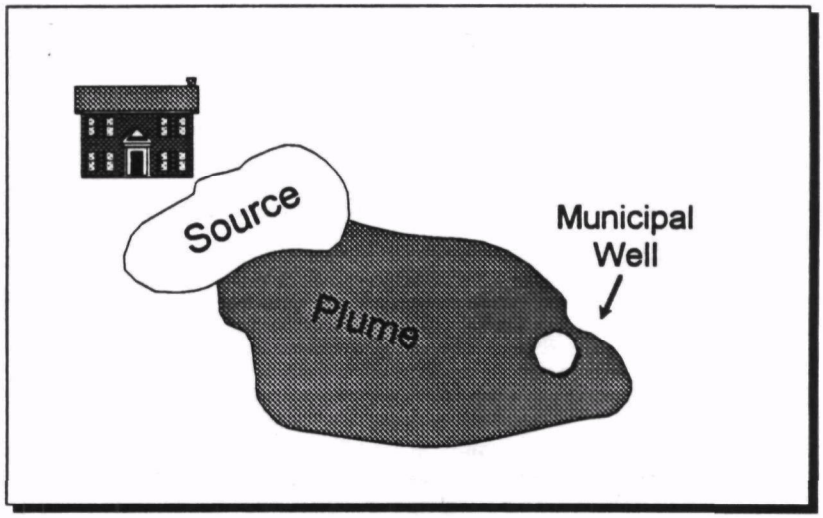
Focused SI

There are several types of PA hypotheses that would result in a further action decision

SI Guidance, section 2.1

OH • 3

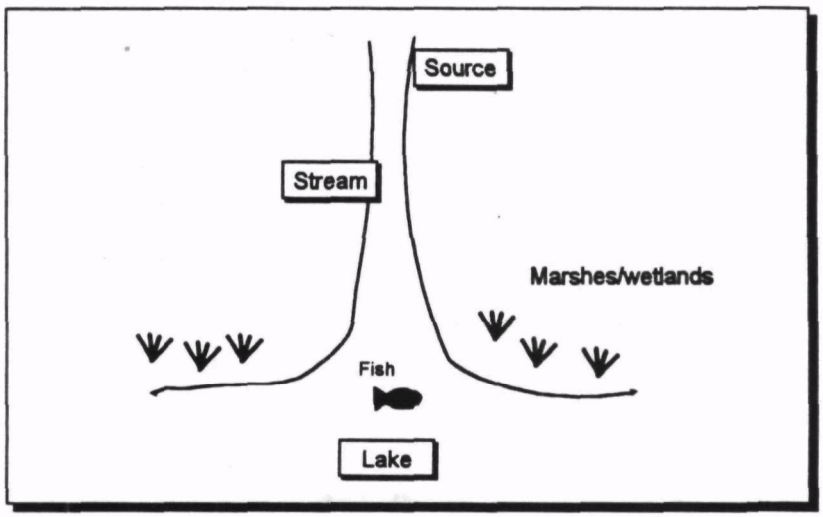
Focused SI:
Further Action Hypotheses



SI Guidance, section 2.1

OH • 4

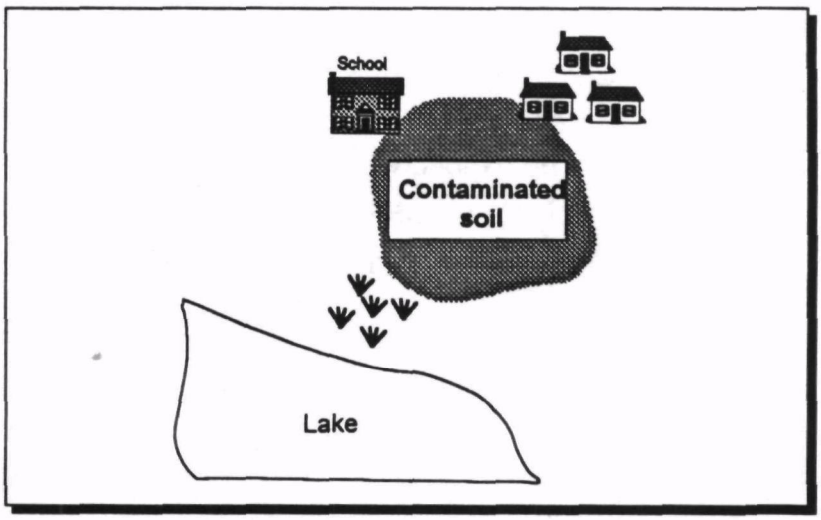
Focused SI:
Further Action Hypotheses



SI Guidance, section 2.1

OH • 5

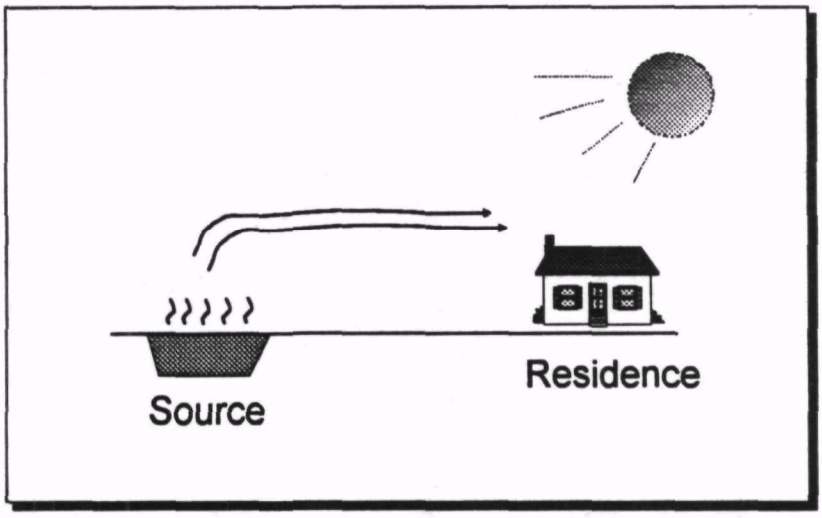
Focused SI:
Further Action Hypotheses



SI Guidance, section 2.1

OH • 6

Focused SI:
Further Action Hypotheses



SI Guidance, section 2.1

OH • 7

Focused SI: Emphasis

- Additional screening to test "critical" PA hypotheses and assumptions
  - Targets that may be exposed to contamination
  - Suspected release of hazardous substances
  - Source characterization and identification of hazardous substances
- Seeks to distinguish between NFRAP and National Priorities List (NPL) candidate site

SI Guidance, section 2.1

OH • 8

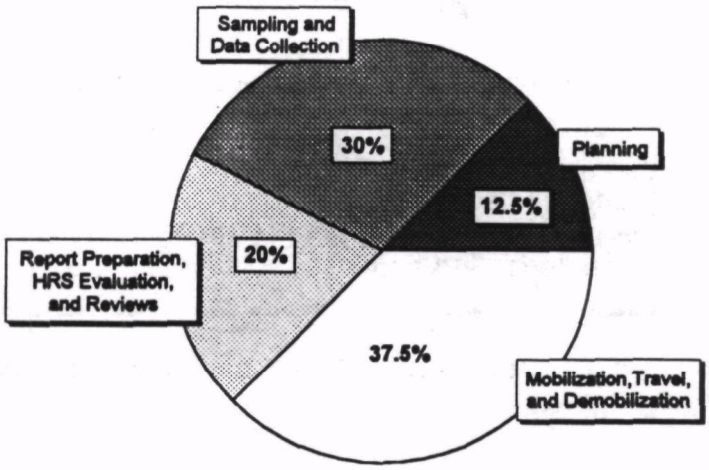
Focused SI: Scope

- Average 400 technical hours; typically 350 to 450 hours
- Average 16 samples; typically 12 to 20 samples
- Does not need to satisfy all HRS requirements
- Can reduce number of background samples to control costs
- Number of quality control (QC) and background samples depends on pathways being sampled

SI Guidance, section 2.1

OH • 9

Focused SI Activities

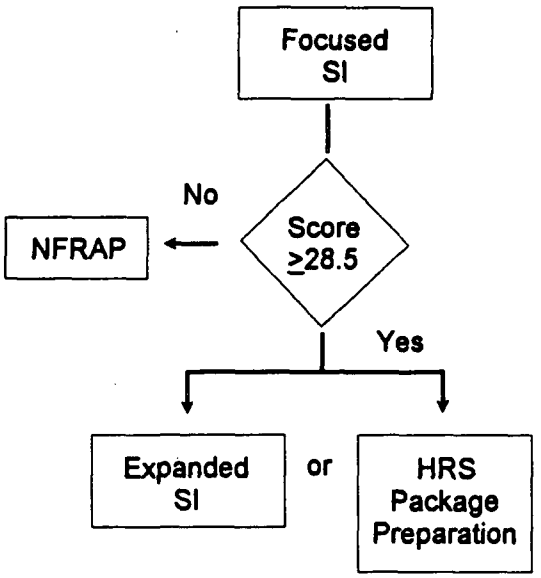


Total Focused SI Hours: 400

SI Guidance, section 2.1

OH • 10

Focused SI Results



OH • 11

Expanded SI: Goal

"...collect all data necessary to prepare an HRS scoring package to propose the site to the NPL."

SI Guidance, section 2.2

OH • 12

Expanded SI: Emphasis

- Hypotheses or conclusions not adequately documented during focused SI
- Collect samples necessary to attribute hazardous substance contamination to site operations
- Collect samples to establish background/quality control
- Collect missing data for significant pathways
- Collect all remaining nonsampling data
- Establish thorough and defensible documentation

SI Guidance, section 2.2 **OH • 13**

Expanded SI: Expanded SI Sampling

Design to support HRS requirements

- "Observed release" of hazardous substances relative to background
- "Observed contamination"
- "Levels of contamination"

May require special field activities

- Monitoring well installation
- Air sampling
- Geophysical studies
- Drum/tank sampling
- Borehole installation
- Background sampling studies

SI Guidance, section 2.2 **OH • 14**

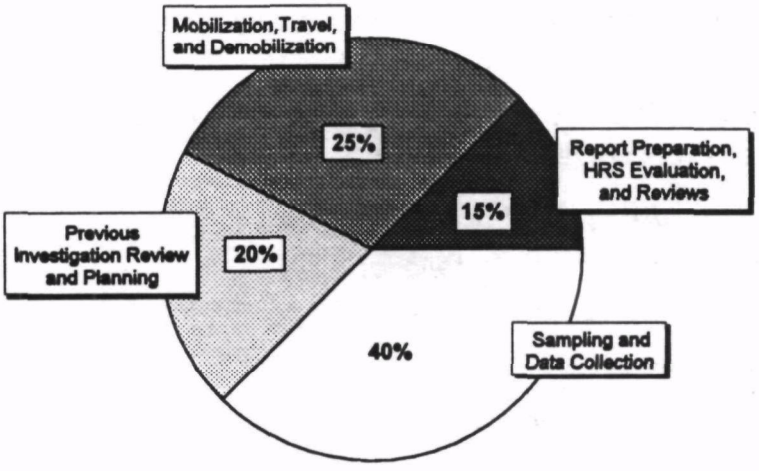
Expanded SI: Scope

- Average 600 hours; typically 550 to 650 hours
- Average 30 samples; typically 25 to 35 samples
- Adequate QC and background samples
- Satisfy HRS requirements

SI Guidance, section 2.2

OH • 15

Expanded SI Activities



Total Expanded SI Hours: 620

SI Guidance, section 2.2

OH • 16

SI Approaches: Typical Data Collection Activities

Activity	Focused SI	Expanded and Single SI
Nonsampling data collection	✓ (minor activity)	✓
Target sampling	✓✓ (major activity)	✓✓
Source sampling	✓✓	✓✓
Release sampling	✓	✓✓
Background sampling	✓	✓✓
Attribution sampling	—	✓✓
QA/QC sampling	✓	✓✓
Special data collection or sampling tasks	—	if necessary

SI Guidance, section 2.2, table 2-3

OH • 17

Single SI

Eligibility for single SI

- Sites with available analytical data
  - If previous analytical data are of sufficient quality and indicate site is a likely NPL candidate
- "Simple" sites
- "Remote" sites
- "Potential contamination" sites

SI Guidance, section 2.3

OH • 18

Single SI: Activities

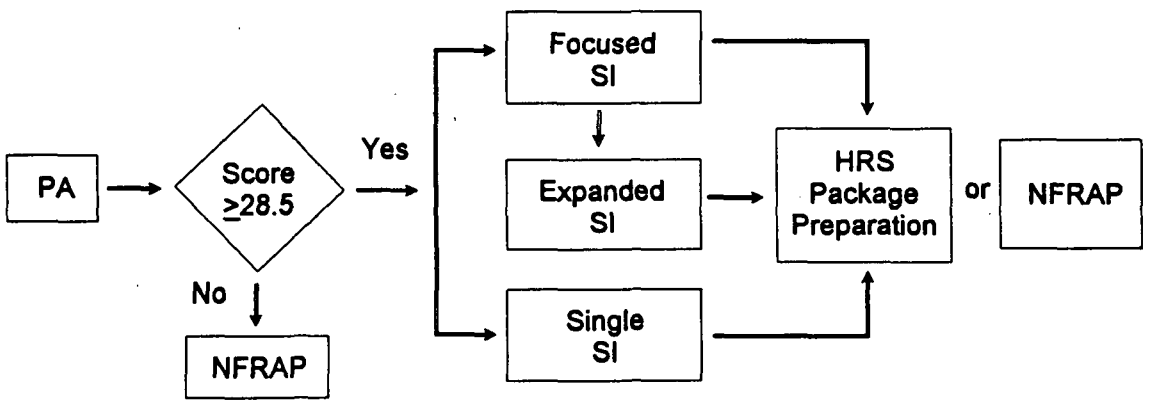
Scope varies

- Collect data to satisfy HRS requirements
- Obtain adequate QC and background samples
- Collect missing nonsampling information for significant pathways
- Document thoroughly

SI Guidance, section 2.3

OH • 19

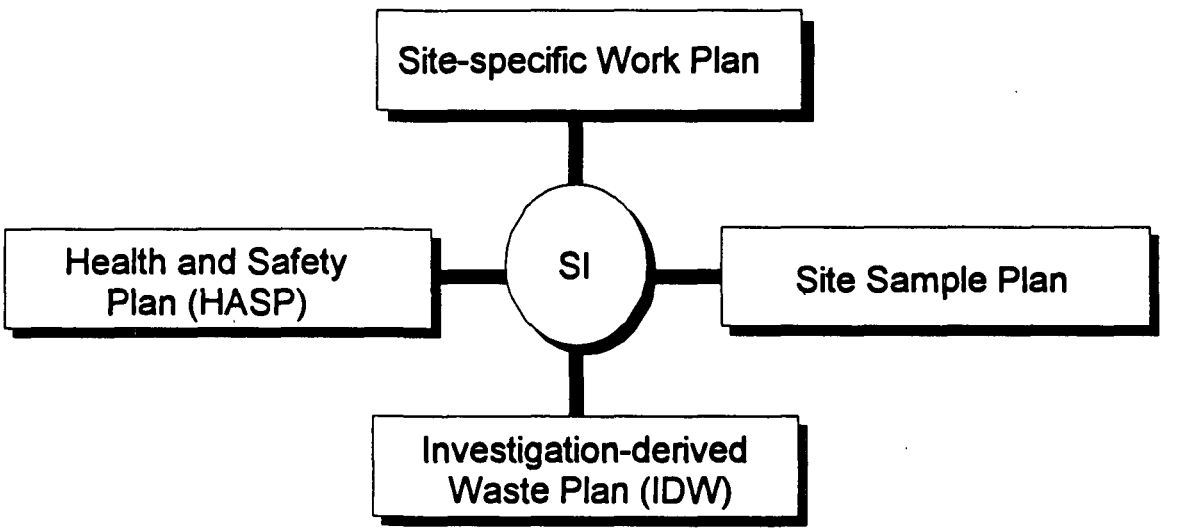
SI Approaches



SI Guidance, chapter 2

OH • 20

Section 4:
Site Investigation Planning



Planning - Overview

Four plans are needed to:

- Refine investigation objectives
- Ensure activities proceed efficiently
- Ensure safety
- Address investigation - derived waste

SI Guidance, chapter 3, pages 15 and 30

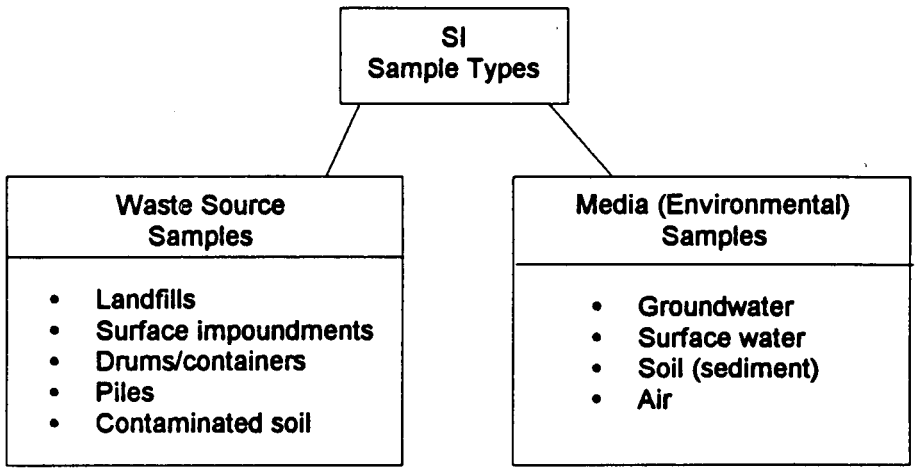
OH • 1

Sample Collection Issues

- Demonstrate that hazardous substances are present
- Determine whether they have migrated from their original locations

SI Guidance, section 3.1

OH • 2



Further discussion of sample types is found in Table 3-1, Types of Samples, page 16 of the SI Guidance

SI Guidance, section 3.1.1

OH • 3

Notes:

TABLE 3-1: TYPES OF SAMPLES

SAMPLE TYPE	ADVANTAGES	DISADVANTAGES
Biased (non-random, judgmental)	Promotes timeliness Uses knowledge of site Focuses sampling effort	Decreases representativeness Increases chance of false negatives
Unbiased (random, systematic grid)	Increases representativeness Reduces chance of false negatives Allows limited site knowledge	Increases cost Increases time required
Grab	Increases representativeness and variability	Requires more samples Requires careful placement
Composite	Reduces cost Increases area of investigation Reduces chance of false positives	Provides average concentrations only Allows substances to interact
Media	Supports releases Supports target contamination	May require off-site access permits Subject to temporal variation
Waste	Optimizes contaminant identification Supports attribution	May result in elevated concentrations May require sample dilution May require special procedures and equipment
Filtered	Allows comparison with drinking water benchmarks	Comparison with surface water environmental benchmarks not valid May increase sample handling errors
Unfiltered	Allows comparison with surface water environmental benchmarks	Comparison with drinking water benchmarks not valid

Guidance for Performing Site Inspections Under CERCLA, USEPA, Sept. 1992

Sample Variability: Factors

- Sample collection and handling techniques
- Spatial variability
- Temporal variability
- Media variability

SI Guidance, section 3.1.2, pages 17-21

OH • 4

Sample Variability: Media-specific Sampling

- Surface and ground water
- Soil/sediment
- Air vapors or particulates
- Tissue
- Containerized materials

Turn to SI Guidance, Table 3-4, Sampling Issues Affecting Confidence in Analytical Results, page 19, for media-specific sampling issues

SI Guidance, section 3.1.2, pages 19-21

OH • 5

TABLE 3-4: SAMPLING ISSUES AFFECTING CONFIDENCE IN ANALYTICAL RESULTS

MAJOR SAMPLING ISSUES	SOIL/ SEDIMENT	GROUND WATER	SURFACE WATER	AIR	AQUATIC ANIMAL TISSUE	SOURCE MATERIAL
Hazardous Substance Migration	✓✓	—	✓	✓	—	✓✓
Temporal Variation	—	✓	✓✓	✓✓	✓	—
Spatial Variation	✓✓	—	✓✓	✓	—	✓✓
Topographic and Geological Features	✓✓	✓✓	—	✓	—	—
Hot Spots	✓✓	—	—	—	—	✓✓
Sample Collection	✓	✓	✓✓	✓✓	✓✓	✓
Sample Preparation and Handling	✓✓	✓✓	✓✓	✓✓	✓✓	✓
Sample Storage	—	✓✓	✓✓	✓✓	✓✓	—
Sample Preservation	—	✓✓	✓✓	—	✓✓	—

Key: ✓✓= Likely source of significant sampling problem
✓ = Potential source of sampling problem
Source: Modified from Keith, 1990

Guidance for Performing Site Inspections Under CERCLA, USEPA, Sept. 1992

Field Quality Assurance and Quality Control (QA/QC) Considerations

- Help evaluate quality of analytical results and quality of field methods
- QC samples treated in same manner as site samples
- Consult EPA regional guidelines for number and type of QC samples to be collected

SI Guidance, section 3.2, page 21

OH • 6

Notes:

QC Sample Types

Co-located or Duplicates	Two samples collected at the same time and location.
Replicates or Splits	One sample that is divided and sent to the same or separate laboratories.
Field Blanks	Samples of contaminant-free medium that are either transferred from one container to another or are exposed to field conditions.
Trip Blanks	Samples prepared from contaminant-free medium and placed in sample containers prior to the SI. They are kept unopened with site samples throughout the investigation.
Field Rinsates (Equipment Blanks)	Deionized water flushed through sampling equipment after decontamination and before resampling to monitor decontamination procedures.
Field Matrix Spikes	Field samples prepared by adding a known amount of contaminants to selected site samples.

HRS Sampling Considerations

Several HRS elements require sample data

- Site and source characterization
  - Identify hazardous wastes
  - Determine hazardous waste quantity
  - Delineate source boundaries
- Observed release and areas of observed contamination
  - Provide direct evidence of an "observed release" to affected media
  - Demonstrate "significant" contamination
  - Estimate area of contamination
  - Demonstrate "attribution"

SI Guidance, section 3.3, pages 22-23 **OH • 7**

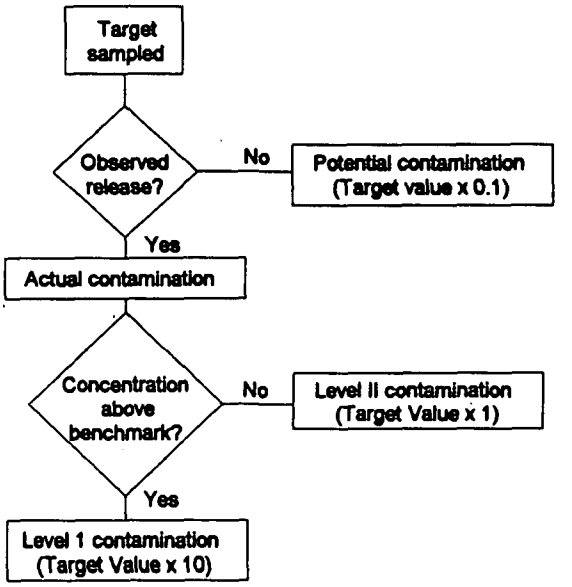
HRS Sampling Considerations

Additional HRS elements requiring sample data

- Levels of contamination at specific targets
  - Document "actual contamination"
  - Targets include drinking water wells, surface water intakes, residential/school properties, and sensitive environments
  - Support "potential contamination"
  - Define levels of contamination
- Target distances
  - Establish target distance limits

SI Guidance, section 3.3 **OH •8**

HRS Sampling Considerations: Levels of Contamination



SI Guidance, section 3.3

OH • 9

HRS Sampling Considerations: What are Benchmarks?

- Health- or ecological-based reference concentrations that reflect relative risk (for example, cancer risk)
- Media- and threat-specific
- Any threat may involve more than one benchmark
- Found in look-up table (for example, SCDM)
- Default to Level II if no benchmark applies

Benchmarks are presented in Table 3-6, Media-specific Benchmarks, SI Guidance, page 23

SI Guidance, section 3.3

OH • 10

TABLE 3-6: MEDIA-SPECIFIC BENCHMARKS

HRS PATHWAY/THREAT	BENCHMARKS[1]
Ground Water	Maximum Contaminant Levels Maximum Contaminant Level Goals Screening concentrations[2,3]
Surface Water	
Drinking Water Threat	Maximum Contaminant Levels Maximum Contaminant Level Goals Screening concentrations[2,3]
Human Food Chain Threat	Food and Drug Administration Action Levels Screening concentrations[2,3]
Environmental Threat	Ambient Water Quality Criteria Ambient Aquatic Life Advisory Concentrations
Soil Exposure	Screening concentrations[2,3]
Air	National Ambient Air Quality Standards National emissions standards for hazardous air pollutants Screening concentrations[2,3]

[1]See Superfund Chemical Data Matrix (SCDM)
[2]Screening concentrations for cancer corresponding to concentrations for the 10^{-6} individual cancer risk for oral exposure (inhalation exposure for the air pathway)
[3]Screening concentration for noncancer toxicological responses corresponding to RfDs for oral exposure (inhalation exposure for the air pathway)

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Sample Analysis Options

Contract Laboratory Program (CLP)

- Standardized analytical services provided by laboratories under contract to U.S. Environmental Protection Agency (EPA)
  - Organics/inorganics
  - Water or solid samples
  - Broad spectrum analysis
    - target compound list (TCL)
    - target analyte list (TAL)

SI Guidance, section 3.4, page 24 **OH • 11**

Sample Analysis Options

Non-CLP services

- May provide data of similar quality to CLP
- Analytical protocols must be selected

Field Analytical Screening Program (FASP)

- Use "portable" analytical instruments
- Applications:
  - Screen many samples
  - Select sample locations
  - Design soil sampling
  - Determine extent of waste migration
  - Reduce CLP costs
  - Determine monitoring well locations
  - Estimate hazardous waste quantity (HWQ)
  - Fast turnaround time

SI Guidance, section 3.4, page 25 **OH • 12**

Review Information for SI Planning

- Compile all relevant and available site data
  - Hazardous waste sources
  - Migration pathways
  - Human and environmental targets
  - Existing analytical data
- Review PA (or focused SI) reports
  - Examine hypotheses
  - Look for changes in site conditions

SI Guidance, section 3.5

OH • 13

Review Information for SI Planning

- Review data to determine additional work needed
  - Data gaps
  - Data quality
  - Nonsampling information
- Identify sampling objectives
  - Focused vs. expanded SI
  - Test critical hypotheses

SI Guidance, section 3.5

OH • 14

Review Information for SI Planning

Other sources of information

- Previous investigations by other parties
- Investigations at nearby sites
- Removal actions and reports
- EPA or other federal agencies
- State agencies
- Health departments
- Academic studies
- Owner/operator records

SI Guidance, section 3.5

OH • 15

Existing Analytical Data Review

- Use data to support design of sampling and analysis program
- Refer to SI Guidance, Table 3-7, Types of Analytical Data for applications of existing data
- SI Guidance, Table 3-8, Review of Previous Analytical Data, sets forth a procedure for data review
- SI Guidance, Exhibit 3-1, Checklist for Usability of Previous Analytical Data, should be applied to existing data

SI Guidance, section 3.5.2

OH • 16

TABLE 3-7: TYPES OF ANALYTICAL DATA

TYPE OF DATA	APPLICATION
CLP	No specific limitations; used as necessary for all SI activities
Qualified CLP	Some general limitations depending on types of data qualifiers and bias (e.g., unknown, low, high) associated with the data
Non-CLP	Few limitations if non-CLP data are shown to be equivalent to CLP data (e.g., level of QA/QC documentation, level of laboratory performance, level of data quality, independent data quality review) Limitations if non-CLP data cannot be shown to be comparable to CLP data
Field screening	Augments SI samples, especially to investigate area of contamination
Owner/operator	Few limitations; used as necessary for all SI activities

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TABLE 3-8: REVIEW OF PREVIOUS ANALYTICAL DATA

PROCEDURE	CONSIDERATIONS
Determine what data are available	What are the types of previous data: CLP, non-CLP, field screening, full TCL analysis, partial TCL analysis, owner/operator, State?
Evaluate purpose and scope of previous investigations	Why were data collected? What type of investigation: State or Federal facility investigation, enforcement action, emergency response, RCRA facility inspection, general assessment of ground water quality, environmental property assessment, NPDES permit requirements?
Review sampling locations, dates, depths, and sample descriptions	Was the design of the sampling program similar to the SI sampling strategy? Did it include background samples and field QC samples? Are a sample plan and sample location map available? Is a field notebook available that describes all sampling activities?
Evaluate the sampling results and hazardous substance concentrations	What hazardous substances were detected? What are the range of concentrations, background levels, data qualifiers and codes attached to data, and detection limits?
Review field preparation and collection techniques for previous samples	Were appropriate SOPs used for sample collection and handling?
Review available laboratory documentation	Are QA/QC procedures or data validation procedures available? What are the name of the laboratory, the type of analyses performed, and the performance results?
Assess usability of previous data	What is the overall usability of the data set?

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EXHIBIT 3-1: CHECKLIST FOR USABILITY OF PREVIOUS ANALYTICAL DATA

1. Have samples been taken at the appropriate location, depth, or stratum to confidently test site hypotheses? ☐ Yes ☐ No

If the answer is "no," additional sampling will likely be needed to fully test hypotheses and provide a basis for the site disposition decision. The data may nevertheless be useful in developing sampling and analysis plans and identifying hazardous substances of concern.

2. Is documentation available to support the analytical procedures used to derive the data (e.g., laboratory QA/QC procedures, type of analyses, detection limits, and data review)? ☐ Yes ☐ No

3. Are representative background levels available for targets exposed to actual contamination and hazardous substances that may demonstrate releases? ☐ Yes ☐ No

4. If background samples are available, are they temporally and spatially comparable to samples indicating releases and exposure of targets to actual contamination? ☐ Yes ☐ No

If the answer to questions 2, 3, or 4 is "no," the data may not support HRS documentation requirements and further review is needed to determine usability. However, the data may support testing of site hypotheses and development of a sampling strategy.

5. Do data provide evidence that attributes the hazardous substances detected in various media and waste samples to the site? ☐ Yes ☐ No

If the answer to question 5 is "no," additional samples will be needed to fully support releases and targets exposed to actual contamination.

If the answers to questions 1 through 5 are all "yes," the previous analytical data may support testing PA hypotheses, identification of hazardous substances of concern, development of a sampling strategy, and HRS documentation requirements, including releases and targets exposed to actual contamination.

Guidance for Performing Site Inspections Under CERCLA, USEPA, Sept. 1992

Site Assessment Team

- Site assessment manager
- Health and safety officer
- Field team
- Chemist/data evaluator
- Hydrogeologist
- Subcontracts officer/procurement officer

OH • 17

Work Plan

Work plans should:

- Summarize site background and hazards present
- Identify SI objectives
- Set work schedule
- Identify personnel and training needs
- Determine equipment/laboratory requirements
- Include provisions to secure contract services

SI Guidance, section 3.6.1

OH • 18

A Sample Plan Includes:

- Field operations—sequence for conducting field activities
- Sample locations and rationale—sample type, volume, number, and sample map
- Analytical requirements and sample handling—sample equipment, container types, preservation techniques, and filtering
- Sample delivery—laboratory locations, special storage, and transport requirements

Refer to SI Guidance, Exhibit 3-2,
SI Sample Plan Outline, pages 31-32

SI Guidance, section 3.6.2

OH • 19

Health and Safety Plan (HASP)

Goal: To establish requirements and procedures to protect the health and safety of investigative personnel and nearby public

- Routine operations—describe hazards, list key safety personnel, levels of protection by task, designate work areas, security, environmental monitoring, training requirements, and weather-related problems
- Emergencies—communication alternatives, contact procedures for emergency response units, emergency equipment, route to hospital map, transport vehicles, worker evacuation, and decontamination

SI Guidance, section 3.6.3

OH • 20

EXHIBIT 3-2: SI SAMPLE PLAN OUTLINE

INTRODUCTION

- Briefly state the authority and purpose for conducting the SI and the scope of the investigation. Discuss the objectives and goals of the SI.

SITE DESCRIPTION AND REGULATORY AND OPERATIONAL HISTORY

- Describe the site location. Identify the type of facility, whether it is active or inactive, and years of operation. Describe its physical characteristics and setting (e.g., local land use, climate, topography, geology, hydrology, hydrogeology). Include a map showing the location. Include a site plan or sketch showing features on and around the site.

- Describe historical site operations, including all past and current operations and conditions. Identify current and former owners/operators, types of site activities, wastes generated, and waste disposal practices. Identify all sources and source types. Provide the hazardous waste quantity disposed in each source, if possible, and provide volume or area of the sources. Identify hazardous substances associated with or detected in the sources. Describe source containment. Describe any spills that have occurred at the site.

- Specify whether any sources are regulated by RCRA. Describe past regulatory activities, including permits, permit violations, and inspections by local, State, or Federal agencies. If applicable, provide emergency response and waste removal information. Summarize analytical results of earlier investigations. Specify type of data (e.g., CLP, non-CLP, owner/operator).

COLLECTION OF NON-SAMPLING DATA

- Describe additional non-sampling information to be collected (e.g., aquifer boundaries, interconnections, and discontinuities; resources; drainage area; soil group; particulate migration factors) and the rationale for collecting this information. Discuss any field activities needed to obtain this information.

SAMPLING ACTIVITIES

- Discuss objectives of planned field activities. Describe procedures and necessary resources. Discuss the rationale for these tasks.

- Provide explicit instructions for all field activities, including field observations, sampling, environmental monitoring for health and safety purposes, and field QA/QC protocols. Reference appropriate Standard Operating Procedures (SOPs). Discuss purpose of both onsite and offsite reconnaissances and observations (e.g., to verify the selection of sample locations, to evaluate the degree of containment at site sources, to measure source dimensions, to verify distances to nearby targets, and to characterize additional sources of contamination not identified during previous investigations).

- Justify proposed sample locations. Discuss methods to more fully characterize wastes and sources. Identify specific targets to be sampled (e.g., drinking water wells or intakes, fisheries, sensitive environments) to test or substantiate target contamination hypotheses. Describe sampling strategy to test or substantiate observed release hypotheses and presence of media contamination (e.g., soil, ground water, sediment, air, surface water).

EXHIBIT 3-2: SI SAMPLE PLAN OUTLINE (concluded)

- Include a map or site sketch showing previous and proposed sample locations.
- Summarize sample plan in a table, identifying sample types, sample numbers, sample locations, and sample-selection criteria. Describe methods of sample collection and preservation, field measurements, and analytical methods. Refer to Standard Operating Guidelines (SOGs) or provide a table or checklist describing the SOGs.
- Describe investigation-derived wastes (IDW) that may result from field activities. Reference the IDW plan that describes the management approach for non-hazardous and hazardous IDW.

PROJECT MANAGEMENT

- Identify all persons who will be involved in the field activities and discuss their specific responsibilities. Identify all safety and sampling equipment and supplies. Describe any contractual services needed to accomplish field activities. Summarize all transportation and shipping information.
- Describe community relations plans and meetings.
- Provide information on SI costs (e.g., number of technical hours; number of CLP, field screening, or other samples; subcontracting costs). Provide schedule for SI activities and deliverables. Summarize any special requirements that impact the SI (e.g., special safety considerations, special analytical services (SAS), or special equipment).
- Reference the work plan.

ATTACHMENTS

- Sample summary table
- Sample location sketch
- List of references cited in this plan
- Health and safety plan
- Appropriate SOPs and SOGs

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Investigation-Derived Wastes (IDW) Management Plan

- Minimize quantity of wastes generated
- Remove wastes that pose an immediate threat to human health or the environment
- Must comply with applicable federal and state requirements

Refer to Directive 9345.3-02, Management of Investigation-Derived Wastes During Site Inspections

SI Guidance, section 3.6.4

OH • 21

Site Reconnaissance

- Verify site conditions
- Verify sample locations
- Locate and identify all sources
- Determine physical state of wastes
- Evaluate source containment and migration
- Identify overland flow paths
- Determine distance from sources to targets
- Refine site sketch
- Evaluate need for emergency response

SI Guidance, section 3.7

OH • 22

Site Access

"Legal access must be obtained from site owner before conducting an SI"

- Voluntary entry—consent to entry by notifying owner in writing of activities to be conducted (sample collection, photography)
- Conditional entry—consent to entry with restrictions (limit area of reconnaissance, employee interviews, records)
- Entry with a warrant—SI must be conducted in strict accordance with warrant
- Consult with EPA Office of Regional Counsel

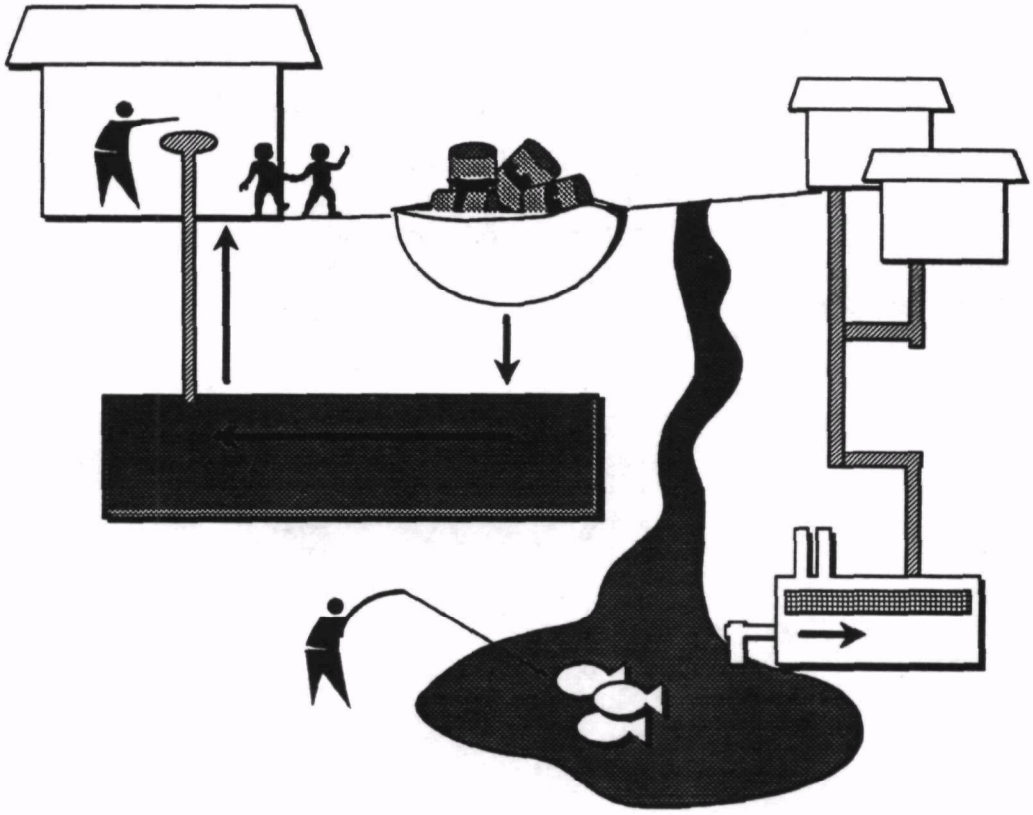
SI Guidance, section 3.7.3 **OH • 23**

Community, Neighborhood, and Government Contacts

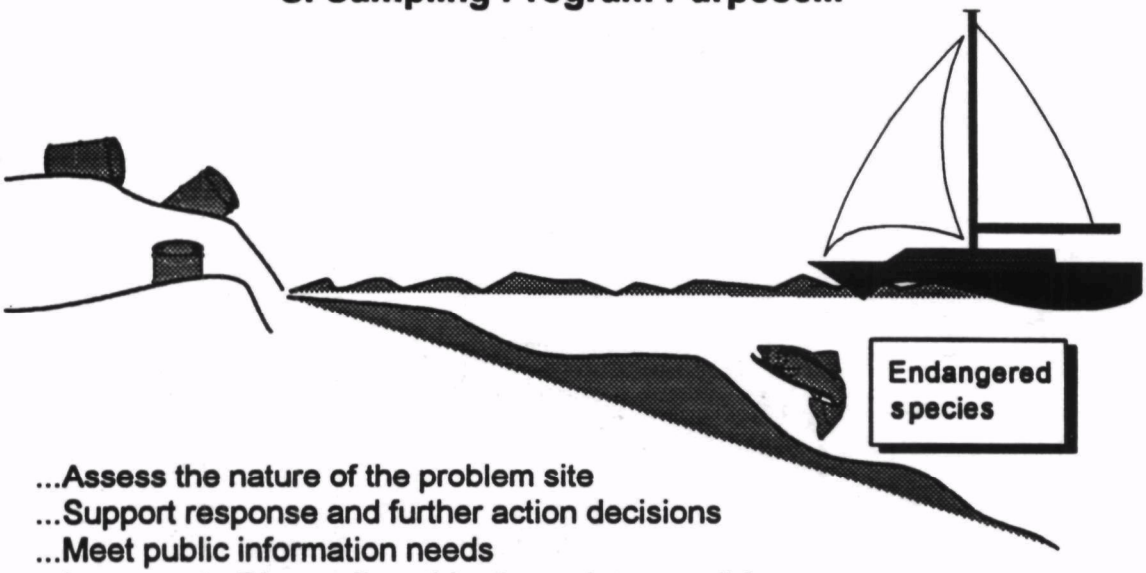
- Contact local representatives in advance
- Explain purpose of SI
- Explain tasks to be performed
- Identify contact for further information (regional site assessment manager—SAM)
- Determine routing of SI results and other information
- Consult *Community Relations in Superfund: A Handbook*; Section 4.1, OSWER Directive 9230.0-03C, January 1992
- Contact appropriate municipal, county, state, and federal officials before SI

SI Guidance, sections 3.7.4 and 3.7.5 **OH • 24**

Section 5:
Sampling Strategies



SI Sampling Program Purpose...



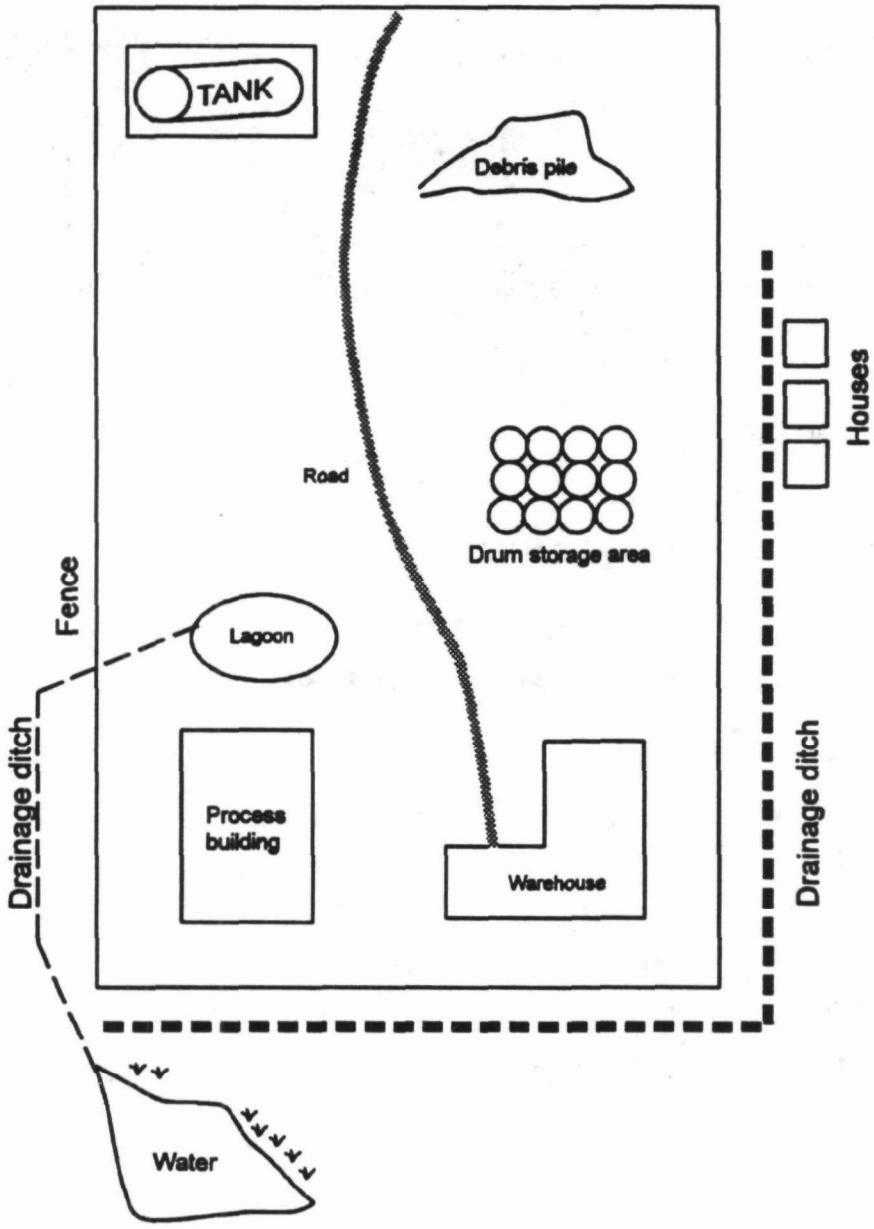
...Assess the nature of the problem site
...Support response and further action decisions
...Meet public information needs
...Incorporate RI sampling objectives when possible

SI Guidance, chapter 4

OH • 1

Notes:

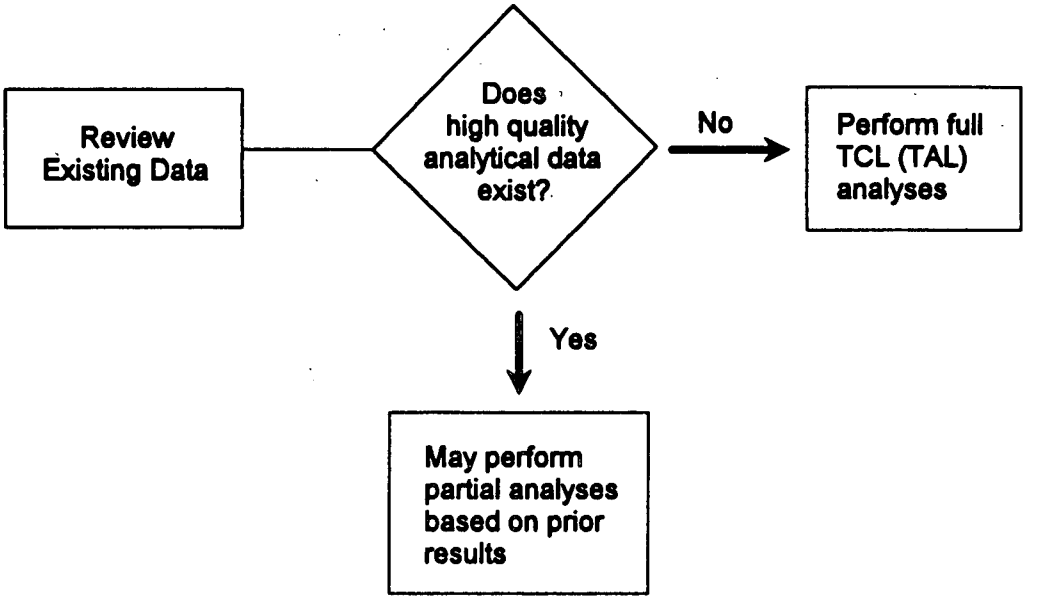
Bias sampling locations toward areas with potential for hazardous substance concentrations higher than background



SI Guidance, chapter 4

OH • 2

Selecting Analytical Parameters



SI Guidance, chapter 4

OH • 3

General SI Sampling Principles

Sample to:

- Identify targets exposed to actual contamination
- Identify all hazardous substances present
- Demonstrate a release
- Support attribution
- Establish representative background concentrations
- Ensure appropriate QA/QC

SI Guidance, chapter 4.1.1

OH • 4

Focused SI Sampling Principles

Collect analytical data to test PA hypotheses

- Identify hazardous substances present
- Determine whether a release has occurred
- Determine impact on targets

Determine need for further investigations

SI Guidance, chapter 4.1.2

OH • 5

Focused SI Sampling Considerations

- Concentrate samples on major pathways affecting the score
- Use previous analytical data
- Limit collection of background and QA/QC samples

SI Guidance, chapter 4.1.2

OH • 6

TABLE 4-2: PRIORITIES FOR FOCUSED SI SAMPLES

SAMPLE BUDGET CATEGORY	PRIORITIES
Number of pathways to evaluate with samples	Sample pathways critical to PA further action recommendation If multiple pathways are critical to screening decision, plan sampling to test all critical hypotheses
Number of targets sampled	Sample primary drinking water wells and intakes suspected of exposure to site-related contamination (see glossary: Primary Target) Sample nearest targets or targets most likely to be exposed to site-related contamination for critical pathways if contamination suspected during PA If sample budget permits, take more than one sample at surface water and soil target locations that are critical to the site decision
Number of sources sampled	Sample sources to identify hazardous substances present at site If multiple sources exist, sample each different source type
Number of release samples	Sample to test if a release has occurred for critical pathways. When possible, test release hypotheses in conjunction with target samples If the magnitude of potentially contaminated targets is responsible for screening decision, limit number of release samples
Number of background and QA/QC samples	Limit collection of background and QA/QC samples to those needed to screen site. Background or QA/QC samples may not be necessary
Other criteria	Use previous analytical data to plan sample locations Do not resample at locations where reliable previous analytical data detected a hazardous substance

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Expanded and Single SI Sampling Principles

Collect fully documented data to prepare HRS package

- Document observed releases
- Document observed contamination
- Document levels of target exposure

Collect field data for the RI when appropriate

Conduct field activities beyond the scope of focused SI

Turn to SI Guidance, Section 4.1.3, page 49, for list of expanded SI activities

SI Guidance, chapter 4.1.3 **OH • 7**

Expanded and Single SI Considerations

- Collect samples to improve documentation for factors that significantly affect scoring
- Collect adequate background and QA/QC samples

SI Guidance, chapter 4.1.3 **OH • 8**

TABLE 4-3: PRIORITIES FOR EXPANDED SI SAMPLES

SAMPLING CRITERIA	PRIORITIES
Number of pathways sampled	Sample pathways critical to site score If multiple pathways are critical to site score, sample to fully document all remaining site hypotheses
Number of targets sampled	Sample targets (e.g., drinking water wells and intakes, residential and school properties, surface water sensitive environments and wetlands) most likely to be exposed to site-related contamination Resample targets where previous analytical results are questionable, or where background concentrations are needed to document contamination of targets
Number of sources sampled	Sample sources to attribute hazardous substances to site Sample to more fully describe areas of observed surficial contamination If multiple source types exist at site, at a minimum, sample each different source type
Number of release samples	Sample to document a release for critical pathways. When possible, collect samples to document an observed release in conjunction with a target exposed to actual contamination Limit number of release samples to critical pathways
Number of background and QA/QC samples	Collect background and QA/QC samples necessary to confidently document site score
Other criteria	Use previous analytical data to optimize sample locations Do not resample at locations where reliable previous analytical data fully documented a hazardous substance or a release unless samples are needed to pair those with background samples taken at the same time

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Comparison of SI Data Collection Activities

Activity	Focused SI	Expanded and Single SI
Nonsampling data collection		
Source sampling		
Target sampling		
Release sampling		
Background sampling		
Attribution sampling		
QA/QC sampling		
Special data collection or sampling tasks		

SI Guidance, chapter 4.1.3

OH • 9

QA/QC Samples

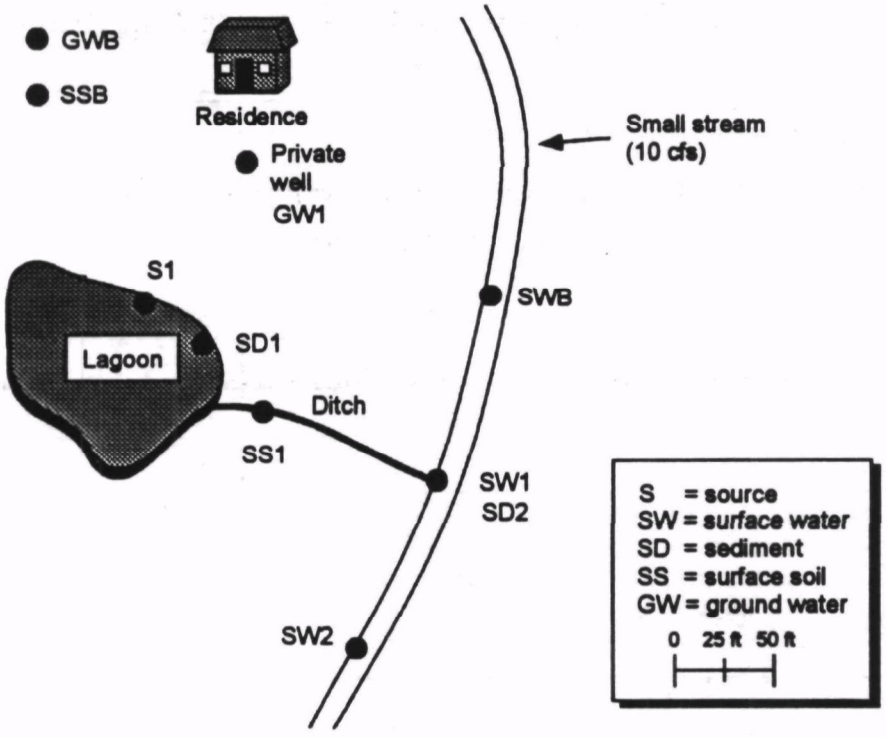
- Collected to confirm precision and accuracy of data
- QA/QC samples for focused SIs are limited
  - One aqueous trip blank
  - One equipment rinsate blank for each medium collected
- Suggested QA/QC sample guidance for expanded and single SIs is found in Table 4-6 (Note: EPA regional guidance may differ)

Turn to Table 4-6, Guidance for Minimum QA/QC Samples: Expanded SI or Single SI, page 56, SI Guidance

SI Guidance, chapter 4.3

OH • 10

Mini Exercise: QA/QC Samples



Sampling Plan	
Sampled	**Rationale**
SDI	Sediment from lagoon
SD2	Sediment from probable point of entry (PPE)
SS1	Surface soil from ditch
SSB	Surface soil background
SW1	Surface water at PPE
SW2	Surface water downstream of PPE
SWB	Surface water background
S1	Source (aqueous)
GW1	Ground water from private well
GWB	Ground water background

QA/QC Samples	
Focused SI	**Expanded SI**

OH • 11

Demonstrating a Release: HRS Requirements

An observed release can be documented by:

- Direct observation
- Chemical analysis

SI Guidance, chapter 4.4.1

OH • 12

Demonstrating a Release by Sampling

Key Factor: To demonstrate a release by chemical analysis for a pathway, at least one sample must show contamination significantly above the background level for a hazardous substance

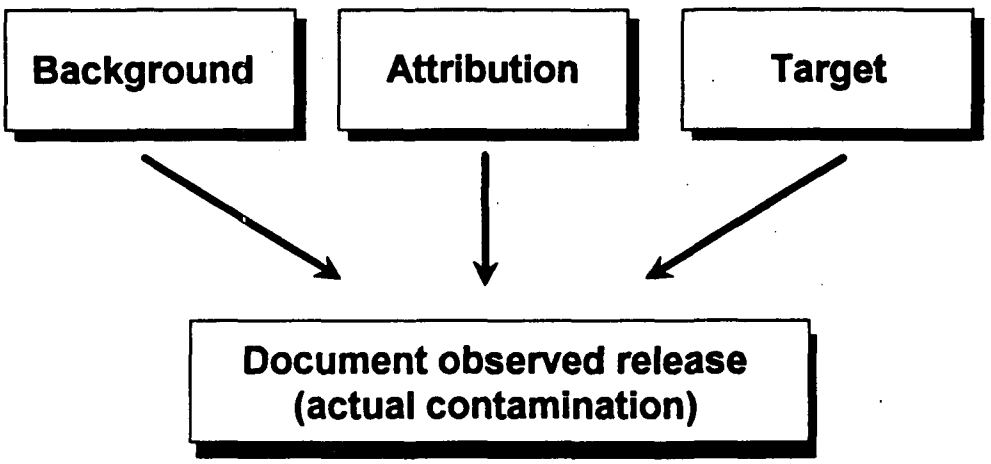
See SI Guidance, page 59, for a discussion of the term "significance"

SI Guidance, chapter 4.4.1

OH • 13

Demonstrating a Release by Sampling

Three Primary Factors



SI Guidance, chapter 4.4.1

OH • 14

Demonstrating a Release by Sampling: Background

Considerations

- Naturally occurring vs. man-made concentrations
- Chemical analytical data vs. published data
- Comparability of background and release samples
- Background sampling locations

SI Guidance, chapter 4.4.1

OH • 15

Demonstrating a Release by Sampling: Attribution

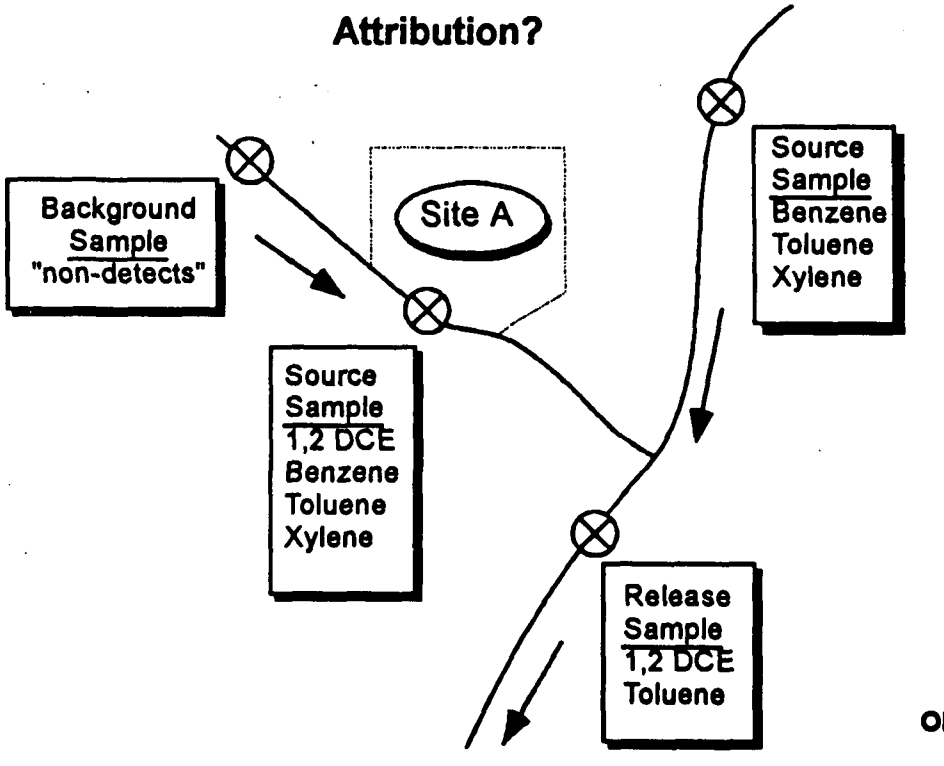
Considerations

- Some portion of the release must be attributable to one or more sources
- Can use a unique hazardous substance from a site to differentiate it from other sites
- May be addressed by source characterization

SI Guidance, chapter 4.4.1

OH • 16

Attribution?



OH • 17

Demonstrating a Release by Sampling: Targets

Evaluate target factors

- Nearest individual
- Population
- Sensitive environments, including wetlands

Evaluate on the basis of:

- Actual contamination
- Potential contamination

SI Guidance, chapter 4.4.1 **OH • 18**

Demonstrating Actual Contamination

- Must first demonstrate observed release
- Targets exposed to concentrations meeting observed release criteria are evaluated as actually contaminated
- Two degrees of actual contamination
  - Level I = concentration $\geq$ applicable benchmark(s)
  - Level II = concentration < applicable benchmark(s)

SI Guidance, chapter 4.4.1 **OH • 19**

Actual Contamination?

Concentrations (in μg/L)

Analyte	Site	Background	Intake	Benchmark
Compound x	25	5U	20	15

U = nondetect

OH • 20

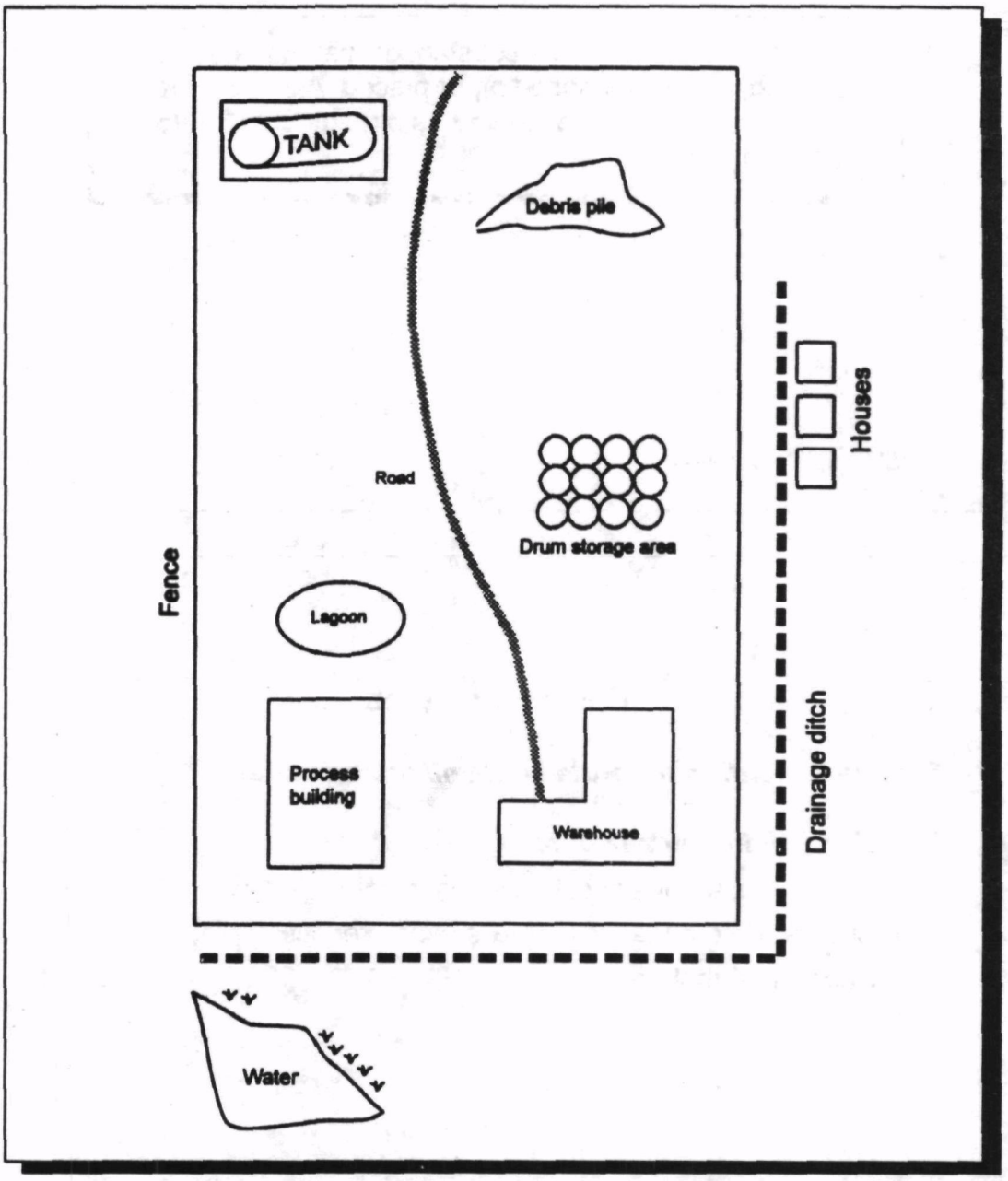
Sampling Strategies: Conclusions

The key to any successful SI: sample smart

- Conserve resources
- Set sampling priorities
- Emphasize dual-purpose sampling
- Use previous analytical data to augment scope
- Tailor sampling to meet SI objectives
- Consider HRS math when planning samples
  - Focus on major pathway(s)
  - Focus on critical HRS factors

OH • 21

Section 6:
Source Characterization



Source Definition

"An area where hazardous substances may have been deposited, stored, disposed of, or placed. Also, soil that may have become contaminated as a result of hazardous substance migration."

SI Guidance, glossary, page 121

OH • 1

Basic Principles

Sample to confirm or refute contamination at site

Sample to characterize sources

- Identify hazardous substances present
- Support determination of waste characteristics
- Support attribution

SI Guidance, section 4.2

OH • 2

Guidelines

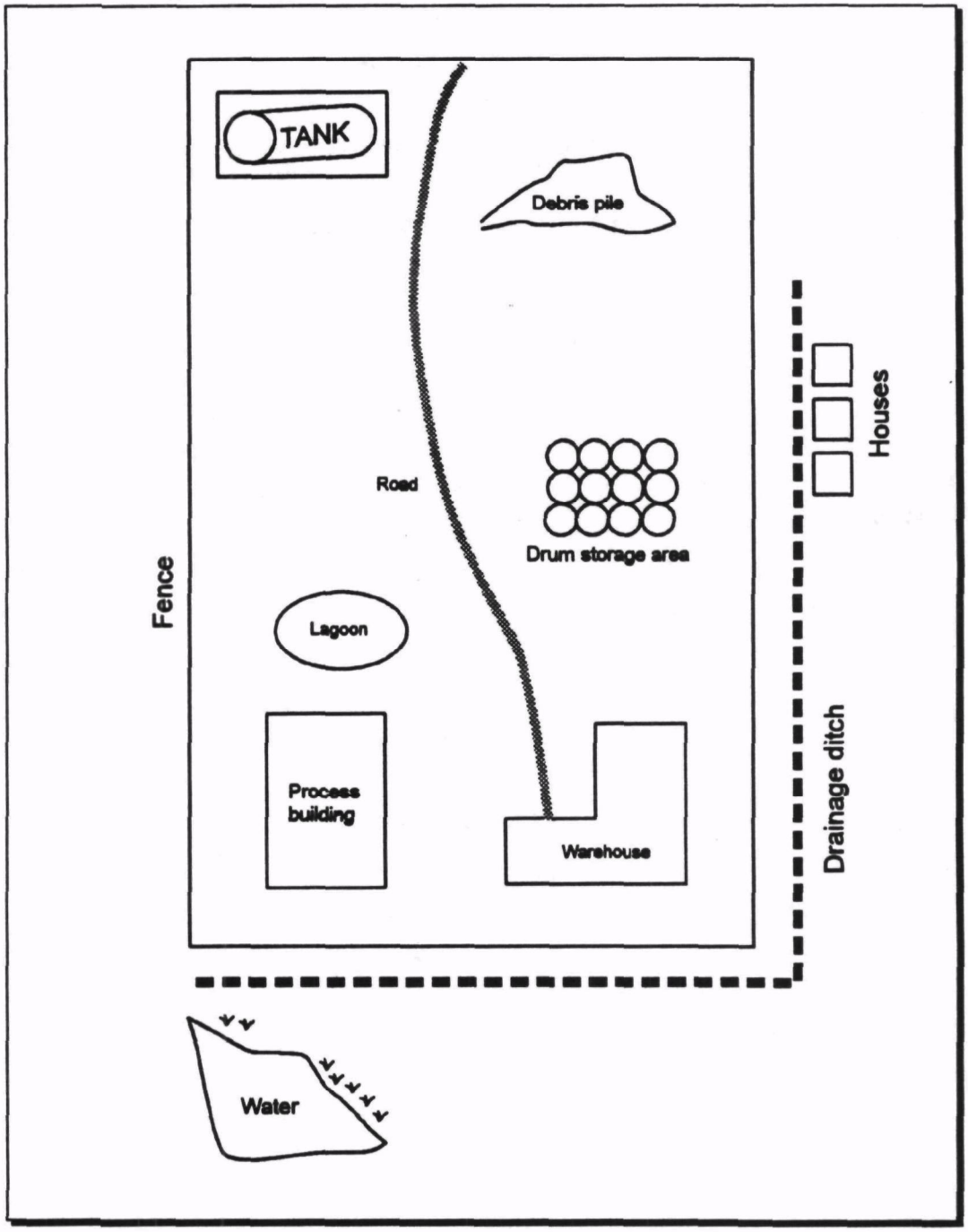
- Sample as many different types of sources as possible
- Sample visibly contaminated soil near drums or containers—do not sample drums or containers themselves
- Sample within 2 feet of ground surface (soil exposure pathway considerations)
- Sample where wastes are likely to collect or be concentrated
- Collect background sample for selected sources (for example, contaminated soil)
- Use composite samples carefully

SI Guidance, section 4.2

OH • 3

Notes:

Source Characterization



OH • 4

Focused SI Strategy

- Primary objective is identifying hazardous substances present at the site
- Should not attempt to establish degree of containment of source(s)
- Source area, volume, and hazardous constituent estimates are beyond the scope of focused SI

SI Guidance, section 4.2.1

OH • 5

Expanded and Single SI Strategy

- Emphasis is on HRS documentation requirements
- May not need further characterization after focused SI
- May collect samples to document containment
- Generally, do not collect samples to document extent of hazardous waste contamination

SI Guidance, section 4.2.2

OH • 6

TABLE 4-4: SOURCE SAMPLING STRATEGIES

CRITERION	FOCUSED SI	EXPANDED SI AND SINGLE SI
Primary objective	To identify hazardous substances associated with site sources; to confirm substances known or suspected To refine target distance limits	To verify inconclusive data collected during focused SI In limited situations, to help quantify hazardous waste quantity
Data quality	All DUCs	DUC-I for hazardous constituent quantity DUC-I and DUC-II to establish heterogeneity or homogeneity of wastes All DUCs for other hazardous waste quantity measures and to identify hazardous substances associated with site sources
Samples to help demonstrate observed contamination	Generally limited to samples used to test a site hypothesis regarding soil contamination within 2 feet of surface	Samples to further describe the areas of observed contamination in the direction of targets for the soil exposure pathway
Samples to help evaluate source containment or source type	Generally not collected	Generally only collected when the containment factor value for a migration pathway is not 10; sometimes collected to demonstrate a biogas release if air pathway is significant pathway
Samples to help describe source boundaries and estimate hazardous waste quantity	Generally limited to surficial samples within 2 feet of surface Generally limited to contaminated soil sources	In certain situations, samples to estimate the depth of a source or to further describe the area of sources other than contaminated soil (e.g., landfill, land treatment, buried surface impoundment) In certain situations, samples to estimate hazardous constituent quantity or hazardous waste volume quantity

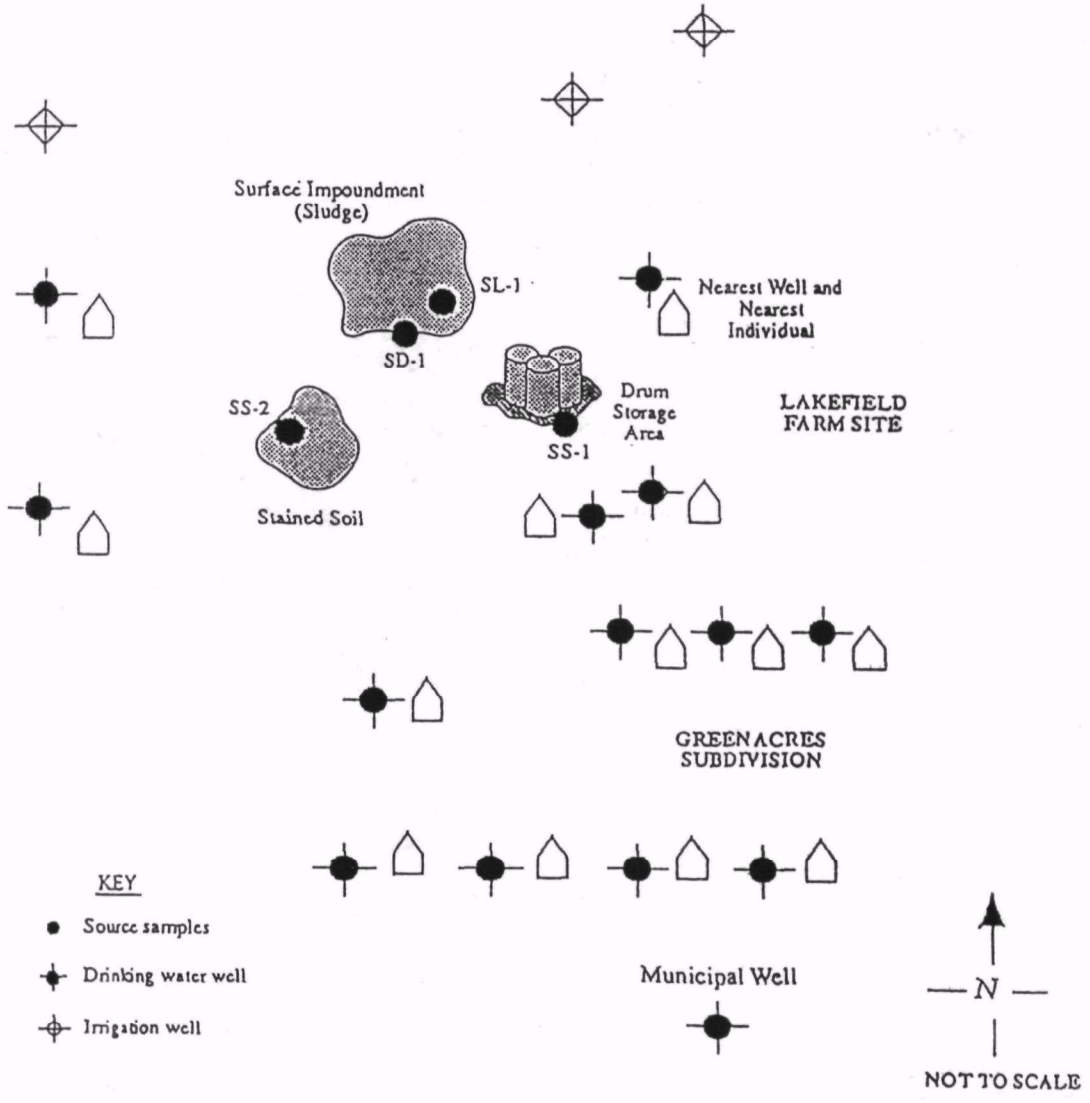
Guidance for Performing Site Inspections Under CERCLA, USEPA, Sept. 1992

CASE STUDY

EXAMPLE OF SOURCE SAMPLING STRATEGY

Located near a town of 10,000 people, the Lakefield Farm Site is an abandoned strawberry farm that was used for various types of waste activities for an unknown period (see Lakefield Farm Site Sketch #1). During the preliminary assessment, three potential sources were identified: a wet surface impoundment with a volume of approximately 45,000 cubic feet of electroplating sludge; a drum storage area containing about 30 leaking drums (contents unknown) at the southeast corner of the site; and an area of stained soil near the site's western boundary.

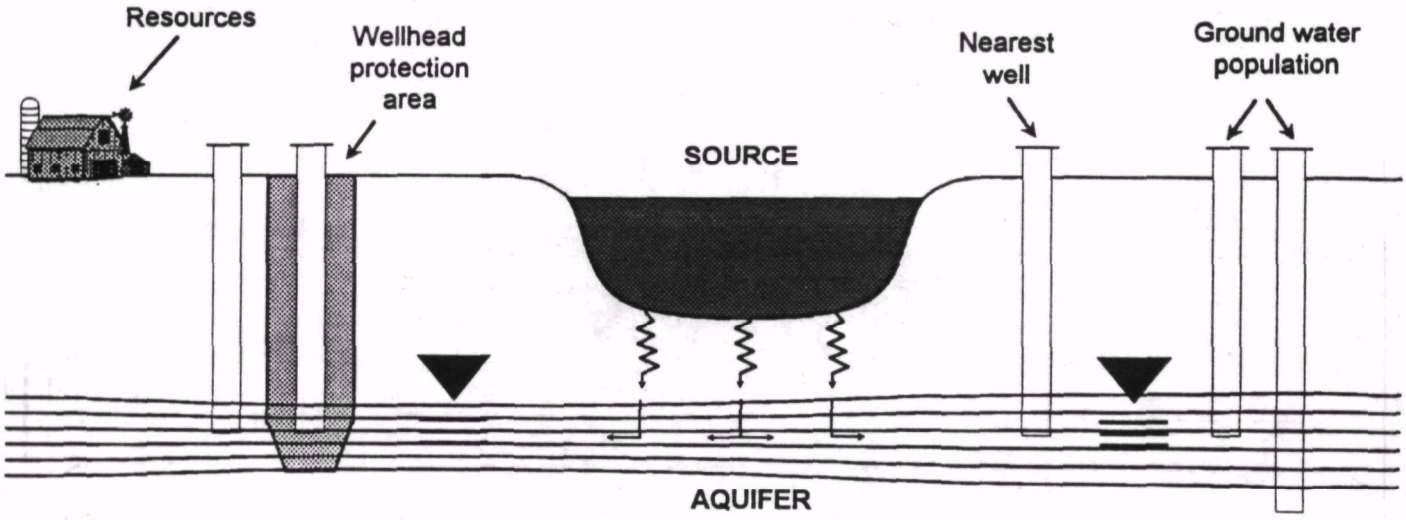
Lakefield Farm Site Sketch 1



SOURCE SAMPLING STRATEGY FOR EXAMPLE SITE

Potential Waste Source Area	Focused SI Sampling Strategy	HRS Considerations	Nonsampling Data Collection
Wet surface impoundment	Collect one composite source sample of impoundment sediments (SD-1) plus one sludge sample (SL-1) to evaluate hazardous substances present	More than 675,000 cubic feet is needed to increase HWQ factor to next category value	Obtain physical dimensions of source: evaluate containment, consider using aerial photographs
Drum storage area	Collect one composite surficial soil sample (SS-1) from beneath drums to determine hazardous substances present	More than 1,000 drums are needed to increase HWQ factor value to next category value	Verify number of drums, evaluate containment, look for container markings, examine area around drums
Stained soil	Collect one composite surficial soil sample (SS-2) to determine whether area is contaminated and to identify hazardous substances	More than 78 acres of contaminated soil are needed to increase HWQ factor value to next category value	Obtain physical dimensions of area, evaluate containment

Section 7:
Ground Water Pathway



Ground Water Pathway

Basis for pathway score

- Number of people served by each aquifer
- Likelihood of release to each aquifer
- Likelihood that drinking water wells are contaminated by site

SI Guidance, section 4.5

OH • 1

Ground Water Pathway: Review PA Information

Determine whether major pathway of concern is based on:

- Suspected release
- Primary targets
- Number of secondary targets

Has contamination already been demonstrated?

- Previous sampling
- Reports of suspected release
- Number of secondary targets

OH • 2

Ground Water Pathway: Review PA Information

- Identify specific information concerning primary targets
  - Type of well/population served
  - Distance from sources
  - Depth of screened interval
- Identify wellhead protection areas
- Identify relevant hydrogeological information
- Identify potentially affected resources
- Where do you expect hazardous substances to be found? (sinkers vs. floaters)

OH • 3

Ground Water Pathway

Compile existing analytical and nonsampling information

SI data summary document can be used to:

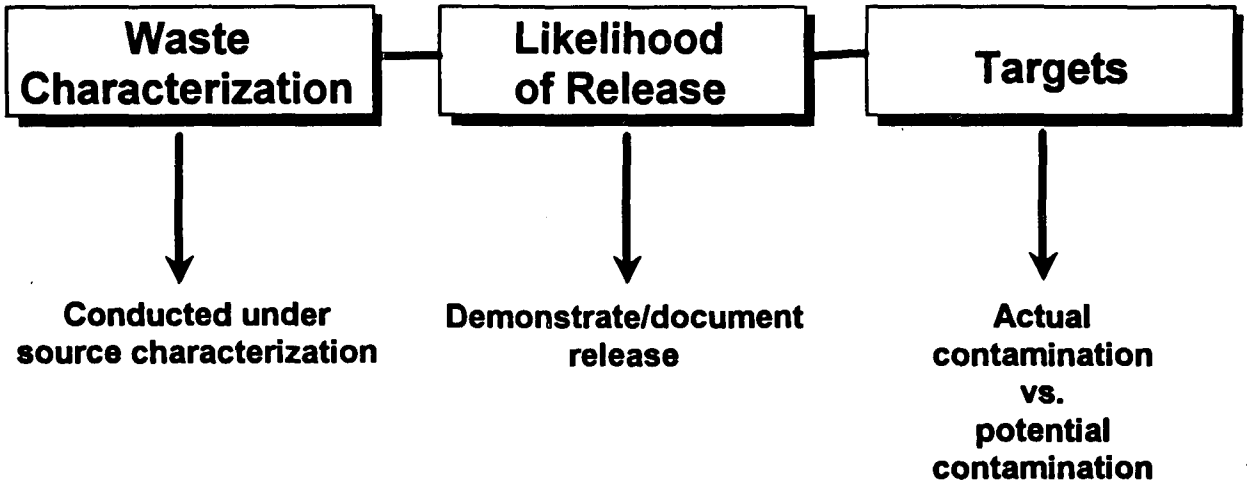
- Summarize existing information
- Identify factors not fully evaluated
- Focus additional data collection efforts

Turn to SI Guidance, Appendix B, SI Data Summary

SI Guidance, appendix B

OH • 4

Ground Water Pathway: HRS Considerations



OH • 5

Ground Water Pathway: Likelihood of Release

Document an observed release by:

- Direct observation
- Chemical analysis

Chemical analysis is preferred

SI Guidance, section 4.5

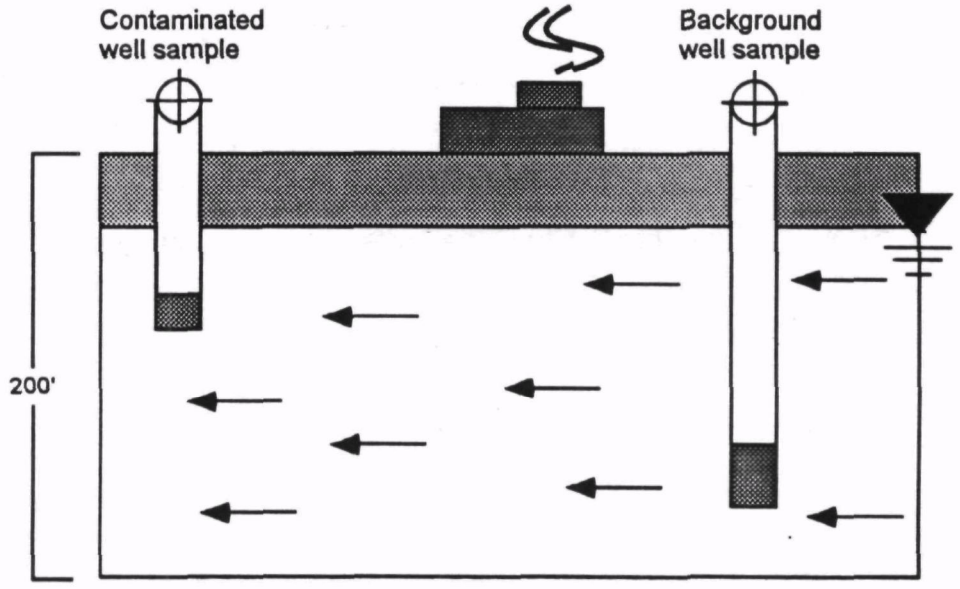
OH • 6

Ground Water Pathway: Likelihood of Release

- ***At least two groundwater samples are needed to document an observed release***
  - Background sample
  - Release sample
- ***Well samples should be from same aquifer and comparable screened intervals***
- ***Wells should be of similar construction***

OH • 7

Ground Water Pathway: Likelihood of Release Observed Release?



OH • 8

Ground Water Pathway: Likelihood of Release

- Sample nearest well expected to be contaminated
- Background well should be out of influence of site
- Sample both wells within 1-3 days
- Samples should be similar
  - sample analyses
  - filtered or unfiltered

SI Guidance, Section 4.5

OH • 9

Ground Water Pathway: Targets

- PA primary targets are sampled to establish "actual contamination"
- PA secondary targets become "potential contamination"

OH • 10

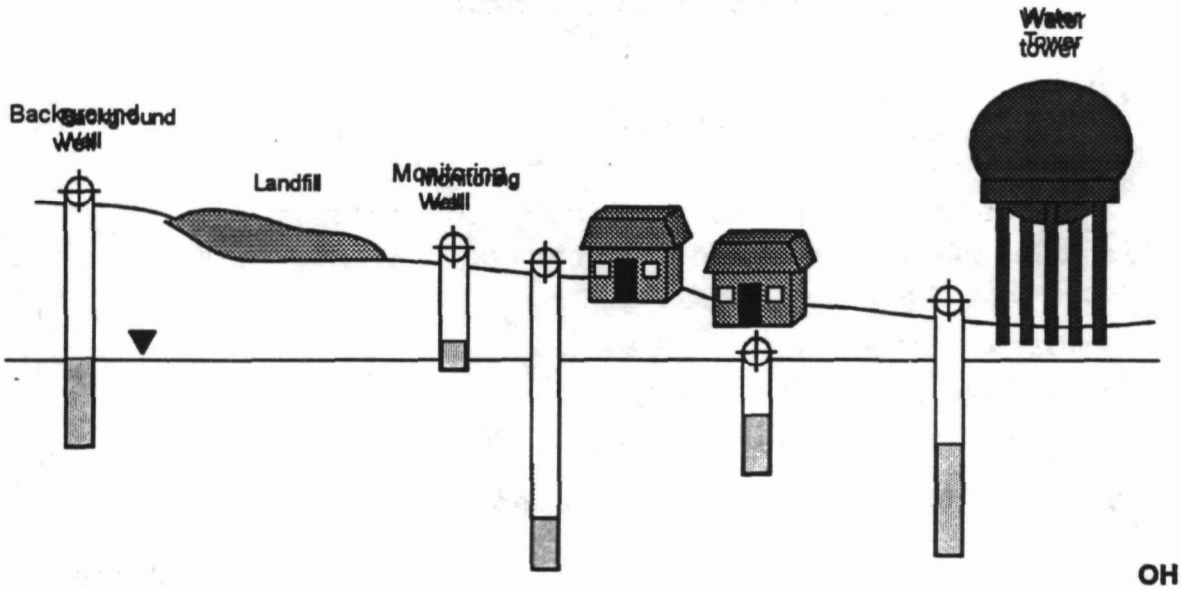
Ground Water Pathway: Targets

- Ground water pathway targets
  - Municipal drinking water wells
  - Private drinking water wells
  - Public drinking water wells
- Always sample nearest target well
- Attempt to sample all primary targets
- Cannot infer contamination between wells for actual contamination

SI Guidance, section 4.5

OH • 11

Ground Water Pathway: Ground Water Sampling Considerations



OH • 12

Ground Water Sampling

Type of Well	Background	Observed Release	Actual Contamination
Monitoring			
Private			
Municipal			
Industrial			
Irrigation			
Standby			

OH • 13

Ground Water Pathway: Focused SI Strategy–Release

If PA hypothesized release to groundwater

- Sample to test hypotheses
- Sample nearest drinking water well

Sampling to establish and document an observed release not necessarily in scope of focused SI

- Background wells may not be available
- Wells near source(s) may not exist
- Monitoring wells are an expanded SI activity

Can use other sources to establish background if necessary

SI Guidance, section 4.5.1

OH • 14

Ground Water Pathway: Focused SI Strategy–Targets

- Not every primary target well must be sampled
- Sample wells where detection of hazardous substances is likely
- Sample critical well locations
- Target well = drinking water well
  Background well = any type of well
- Some wells can serve as their own background wells if continuous monitoring data are available

SI Guidance, section 4.5.1

OH • 15

Ground Water Pathway: Focused SI Strategy–Actual Contamination

If "actual contamination" is hypothesized

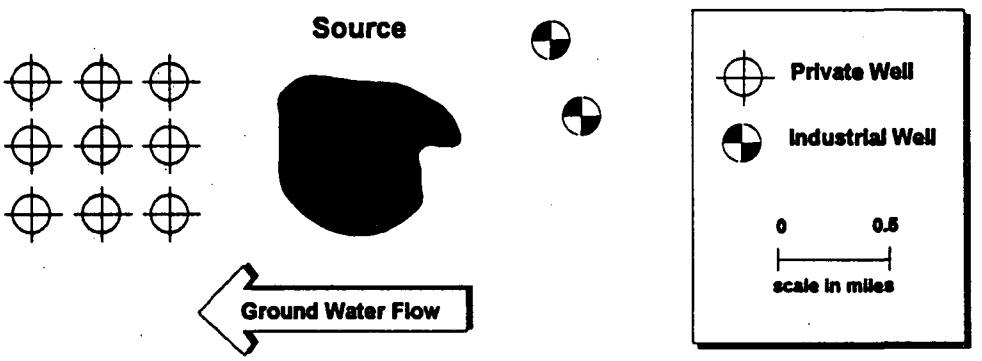
- Drinking water wells should be sampled
- If all wells cannot be sampled, sample nearby and municipal wells
- Sample remaining wells during expanded SI

Can use samples from target wells to demonstrate observed release and actual contamination

SI Guidance, section 4.5.1

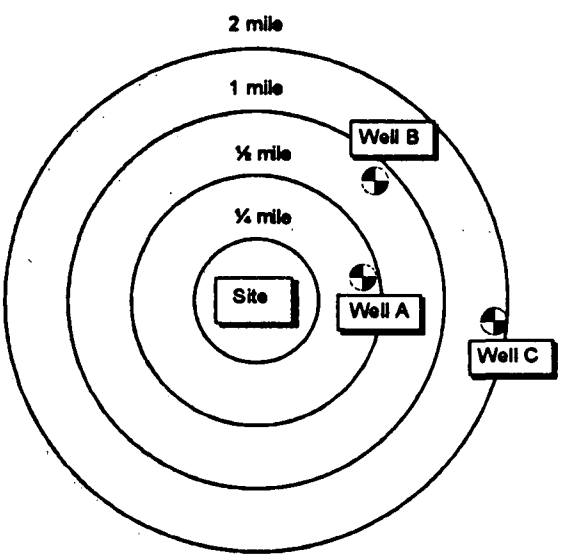
OH • 16

Which Wells Should Be Sampled to Test for Actual Contamination?



OH • 17

Ground Water Pathway: Focused SI Strategy–Blended Systems



Wells A, B, and C are part of a blended system. Which wells should be sampled.

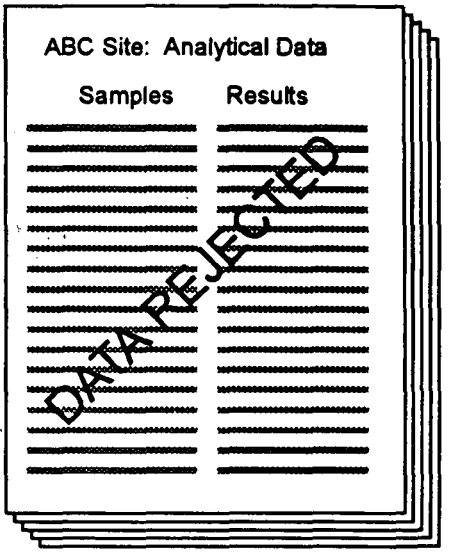
SI Guidance, section 4.5.1

OH • 18

Expanded SI and Single SI Strategy

Review existing analytical data from wells in the vicinity of the site

- Check for abnormalities
- Determine need for resampling



SI Guidance, section 4.5.2

OH • 19

Expanded SI and Single SI Activity: Document Observed Release

- Resample wells as needed
- Sample wells not tested during focused SI
- Collect background samples
- Install monitoring wells
- Collect QC samples

OH • 20

Expanded SI and Single SI Activity: Ground Water Target Sampling Considerations

- "Actual contamination" requires an observed release, attribution, and presence of hazardous substance at target
- Collect QC samples
- Base well selection on ground water flow direction
- Background well should be upgradient or at least outside of the influence of sources
- Focus on targets

SI Guidance, section 4.5.2

OH • 21

Expanded SI and Single SI Activity: Monitoring Well Installation

- Done only on sites expected to score because of observed release
- May not be necessary if ground water pathway is not critical site score
- Do not install wells in karst aquifers

SI Guidance, section 4.5.2

OH • 22

TABLE 4-8: GROUND WATER SAMPLING STRATEGIES

CRITERION	FOCUSED SI	EXPANDED SI AND SINGLE SI
Primary objective	To test hypotheses regarding a suspected release or targets suspected to be exposed to actual contamination When possible, test release hypothesis in conjunction with target sampling	To demonstrate a release based on HRS documentation requirements To demonstrate targets exposed to actual contamination and determine levels of exposure
Data quality (see section 5.2)	Less rigorous (e.g, DUC-II) to rigorous	Rigorous (e.g., DUC-I)
Average number of samples	0 to 6 depending on site hypotheses and number of existing wells to sample	0 to 14 based on HRS documentation requirements
Types of activities	Sample existing wells Install drive points or shallow boreholes if there are no nearby wells	Resample existing wells if previous data did not conclusively demonstrate a release or targets exposed to actual contamination Sample wells not yet sampled Collect multiple samples from drinking-water wells where hazardous substance concentrations are likely to be near benchmarks Install monitoring wells as needed
Background samples	Limited, 1 background per 3 release samples May rely on published regional data	2 background per 3 release samples Install background monitoring wells, if necessary Generally should not rely on published data
Attribution samples	Limited to testing release hypotheses	Those necessary to attribute a share of a release to the site
QA/QC samples	Limited to testing release hypotheses	Those necessary to obtain precise and accurate data

Guidance for Performing Site Inspections Under CERCLA, USEPA, Sept. 1992

Ground Water Pathway

- After sampling and analysis have been completed, compile new information
- Complete SI data summary sheets pertaining to ground water

Turn to SI Guidance, Appendix B, SI Data Summary

OH • 23

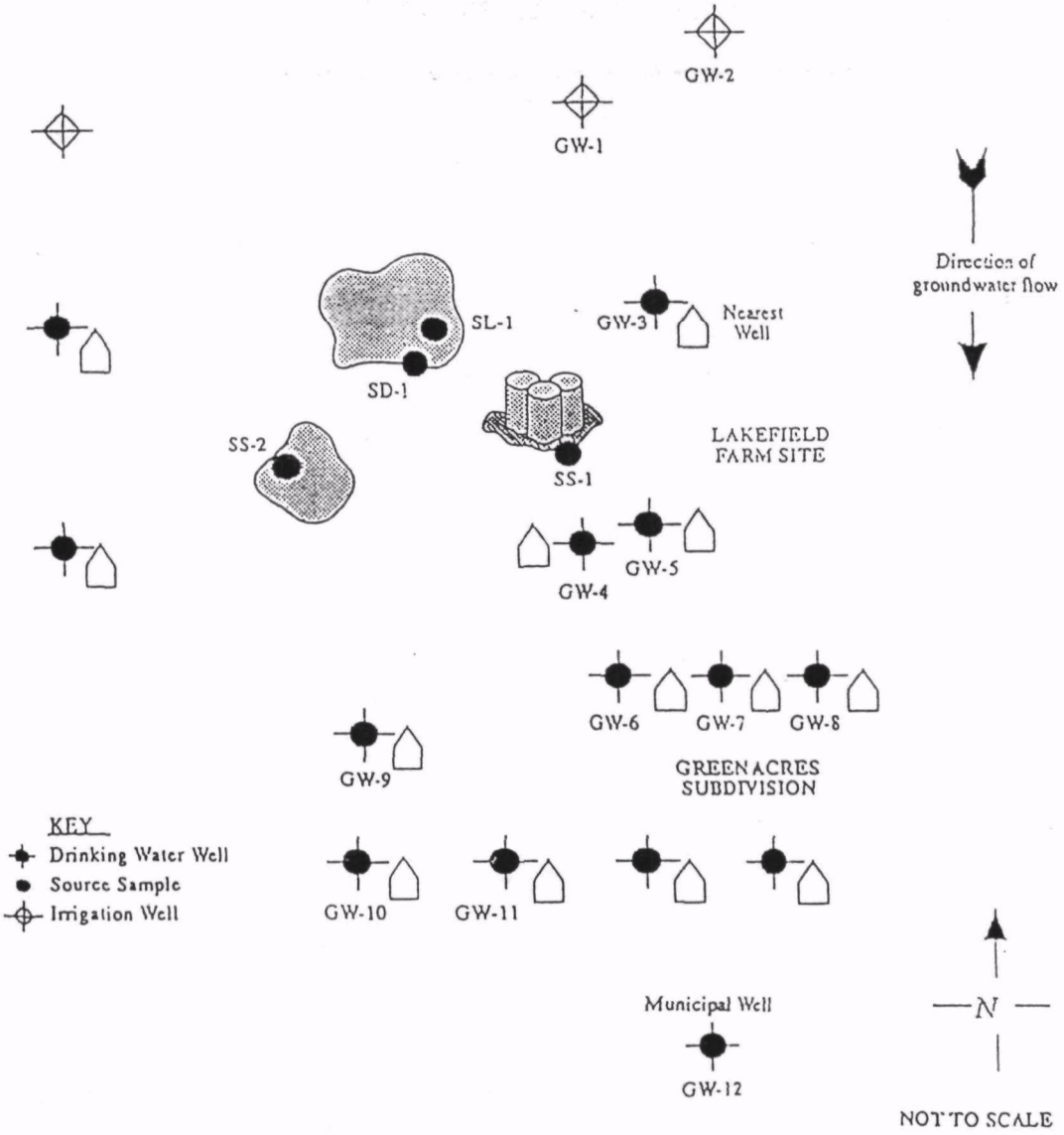
Notes:

CASE STUDY

EXAMPLE OF GROUND WATER SAMPLING STRATEGY: FOCUSED SI

During the PA it was determined that residents near the Lakefield Farm Site rely on shallow domestic wells for drinking water (see Lakefield Farm Site Sketch 2). A municipal well that provides drinking water to about 10,000 people is located 0.5 miles southeast of the site. The municipal well and several nearby irrigation wells are screened in the deep aquifer, which appears to be interconnected with the shallow aquifer. The PA identified the primary targets as all domestic wells within 0.25 miles of the site and the municipal well. The focused SI indicated ground water flows to the south. Several domestic wells appear to be downgradient from the site.

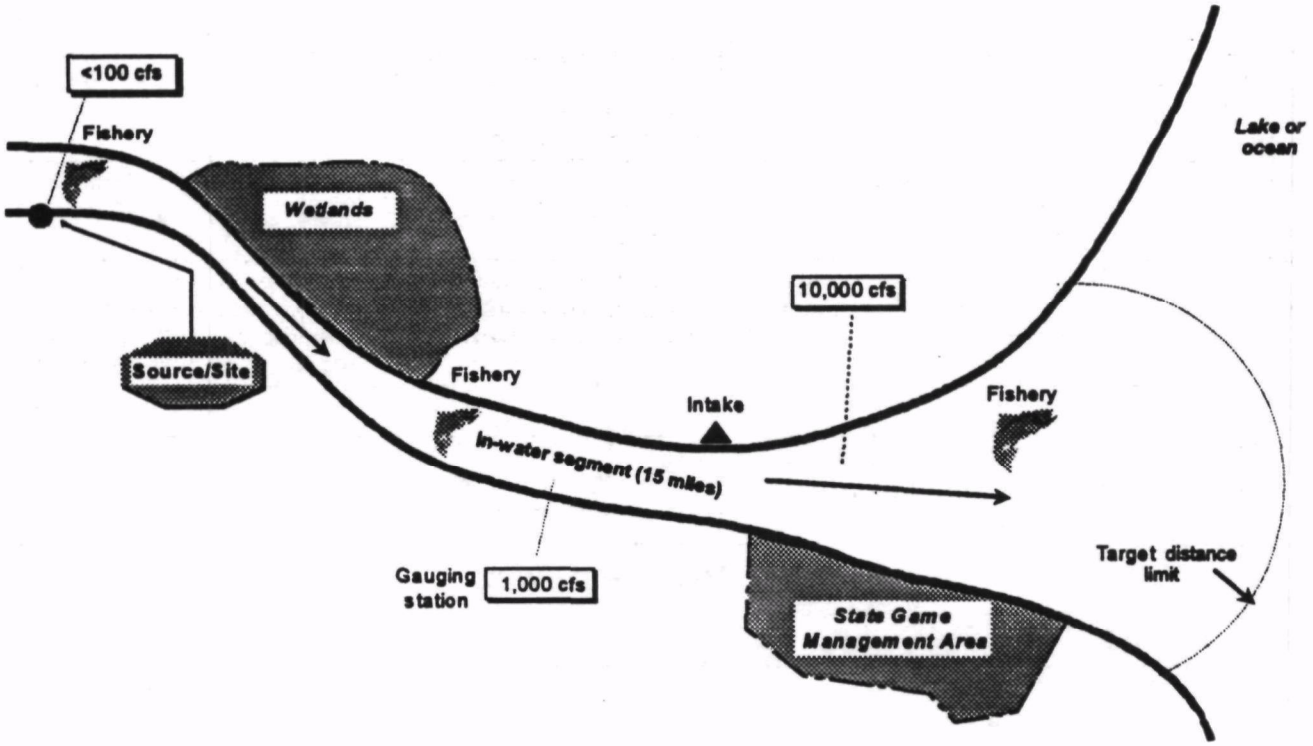
Lakefield Farm Site Sketch 2



GROUND WATER SAMPLING STRATEGY FOR EXAMPLE SITE FOCUSED SI

Samples	Focused SI Sampling Strategy	HRS Considerations	Nonsampling Data Collection
Municipal well (GW-12)	Collect sample prior to treatment; sample to document contamination, identify hazardous substances, and determine level of contamination	Determine municipal well contamination, which is critical to protecting public health and the screening decision	Verify aquifer from which well draws; verify population served
Domestic wells (GW-3, GW-4, GW-5, GW-6, GW-7, GW-8, GW-9, GW-10, GW-11)	Sample nearest domestic drinking water wells suspected of exposure to contamination	Determine domestic well contamination, which is critical to protecting public health and the screening decision	Verify aquifer from which wells draw; verify population served
Background (GW-1, GW-2)	Sample drinking water aquifer; limit number of background samples	Sample to determine concentrations of hazardous substances	Verify aquifer from which well draws
Sources (SD-1, SL-1, SS-1, SS-2)	Collect grab or composite soil samples to identify hazardous substances present at site	Do not sample to increase hazardous waste quantity (amounts are not close to HWQ factor value breakpoints)	Obtain physical dimensions of surface impoundment and estimate area of contaminated soil; verify number of drums and look for drum labels
Quality control (Q-1, Q-2) (not shown)	Monitor sample collection and decontamination procedures; one rinsate and one field blank		

Section 8:
Surface Water Pathway



Surface Water Pathway

Score based on:

- Likelihood of release to a surface water body
- Likelihood that surface water is contaminated by the site
- Number of people exposed to contaminated drinking water or contaminated food items
- Sensitive environments exposed to contaminated water

SI Guidance, section 4.6 **OH • 1**

Surface Water Pathway

Key Factor: If there are no surface waters within 2 miles of the site, the surface water pathway need not be evaluated

SI Guidance, section 4.6 **OH • 2**

Surface Water Pathway

Examples of surface water bodies

- Perennially flowing ditches, streams, and rivers
- Isolated but perennial ponds or lakes (excludes man-made used for industrial purposes)
- Intermittent streams only in areas with less than 20 inches mean annual precipitation
- Natural and man-made wetlands

SI Guidance, section 4.6

OH • 3

How Contaminants Reach Surface Water

- Overland flow

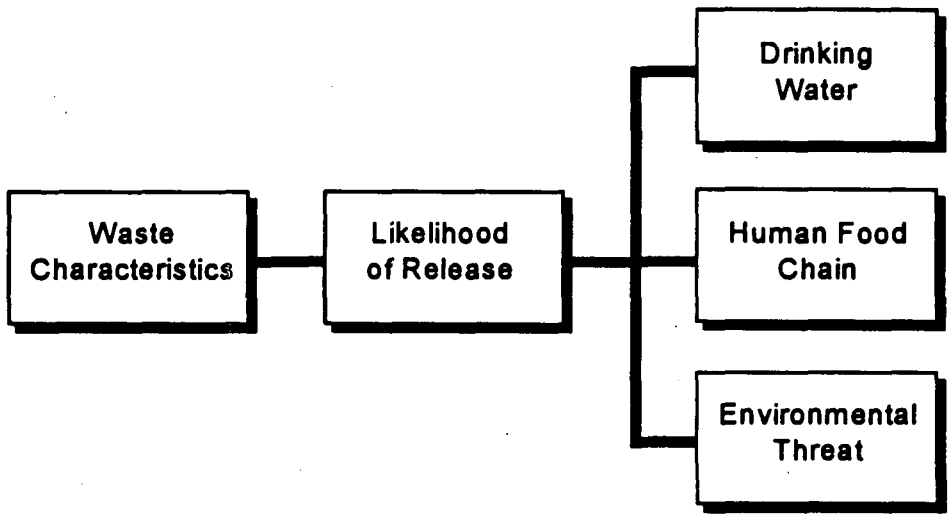
- Flood

- Ground water discharge to surface water

SI Guidance, section 4.6

OH • 4

Surface Water: Multiple Targets



SI Guidance, section 4.6

OH • 5

Surface Water Pathway Investigation

Complete the SI Data Summary Surface Water section using available data

See SI Guidance, Appendix B, Surface Water Information Section, pages B-12 through B-15

SI Guidance, appendix B

OH • 6

Review PA Information

Determine whether major pathway of concern is based on:

- Suspected release
- Primary targets
- Number of secondary targets

SI Guidance, section 4.6

OH • 7

Review PA Information

Identify physical characteristics of surface water migration route

- Is overland segment greater than 2 miles?
- Are there multiple watersheds?
- Location of PPE(s)
- Tidal influence
- Flow rate for each segment of migration path

SI Guidance, section 4.6

OH • 8

Review PA Information

Identify locations of primary targets

- Drinking water intakes
- Fisheries
- Wetlands and other sensitive environments

SI Guidance, section 4.6

OH • 9

Surface Water Sampling Considerations

- Are sources actively discharging contamination to surface water?
- How old is the site?
- What are surface water flow characteristics?
- What are the chemical properties of hazardous substances of concern (for example, persistence and bioaccumulation potential)?

SI Guidance, section 4.6

OH • 10

Sample Type Considerations

Sediment, Aqueous, or Tissue

- Sediment samples typically detect contamination more often than other sample types
- Consider adding aqueous samples for intakes or sensitive environments
- Tissue samples are generally not recommended

SI Guidance, section 4.6

OH • 11

Likelihood of Release: Observed Release By Direct Observation

Hazardous substance seen entering or known to have been deposited into perennial surface water

- Sample effluent discharge, source runoff, or leachate (no background required)

or

- Rely on existing analytical data indicating effluent contains hazardous substance
- Must sample discharge, runoff, or leachate to show they contain hazardous substance

SI Guidance, section 4.6

OH • 12

Likelihood of Release: Observed Release By Direct Observation

Source area flooded and hazardous substances in direct contact with flood waters

- Must rely on historical "source" data and flood information
- No SI sampling necessary

SI Guidance, section 4.6

OH • 13

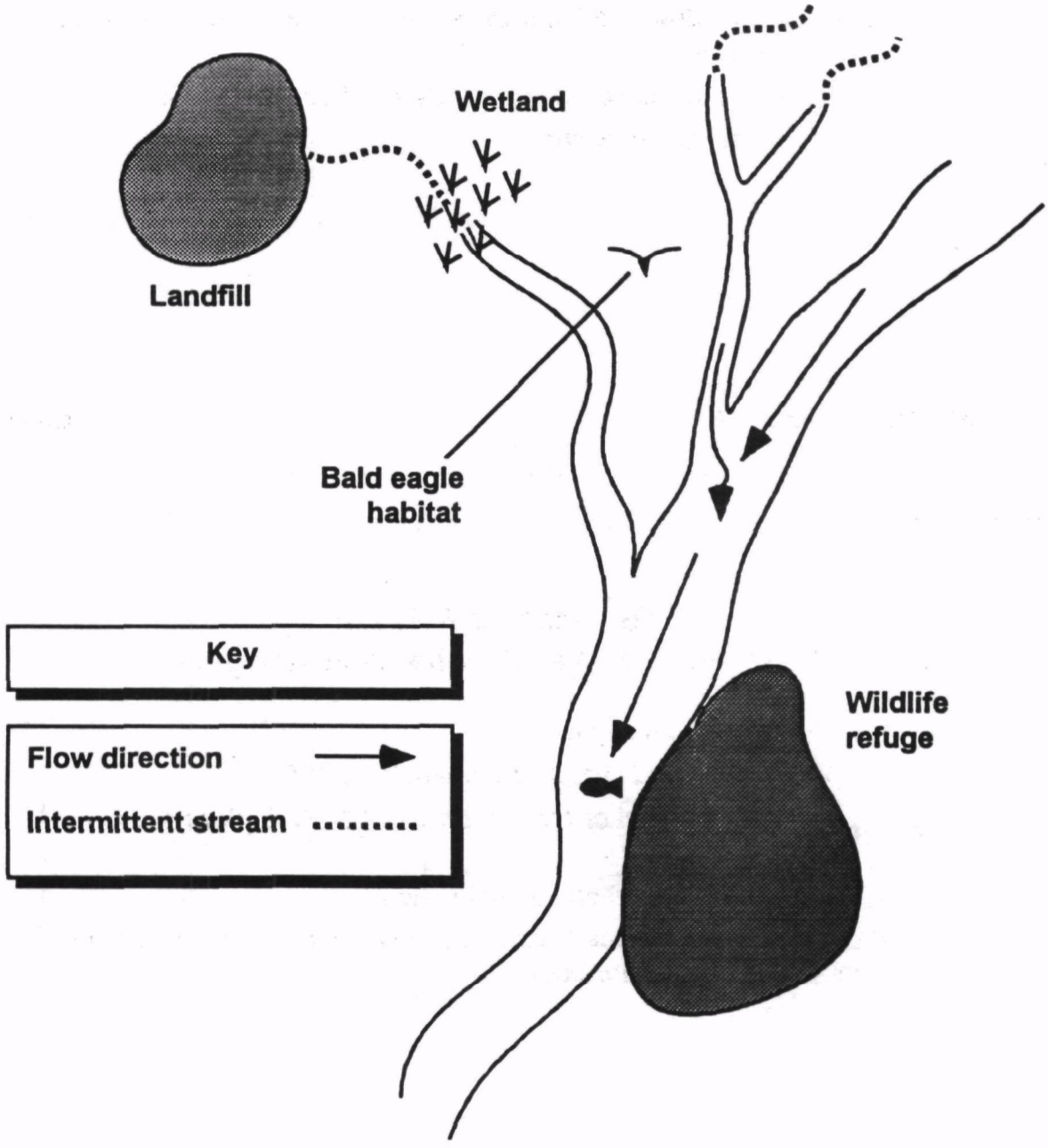
Likelihood of Release: Observed Release By Chemical Analysis

- Minimum of two samples
  - One background sample upstream from PPE
  - Second sample at or reasonably close to PPE (downstream sample)
- If multiple PPEs present, sample each
- Background and release samples must be same type and from same or similar water body

SI Guidance, section 4.6

OH • 14

Sample to Establish Background



OH • 15

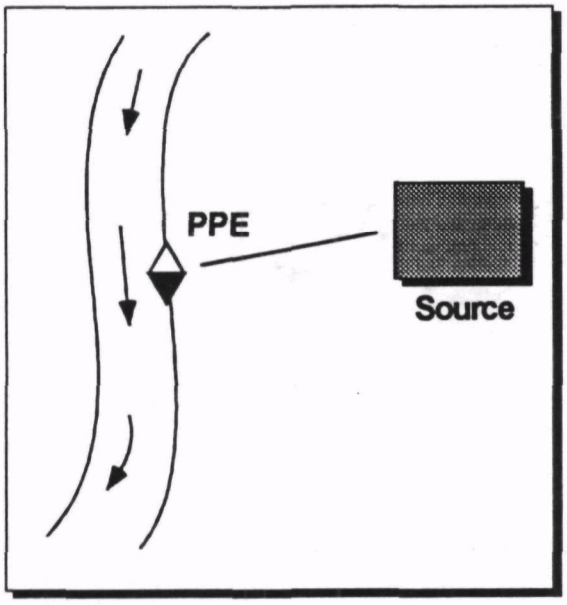
Likelihood of Release: Observed Release By Chemical Analysis

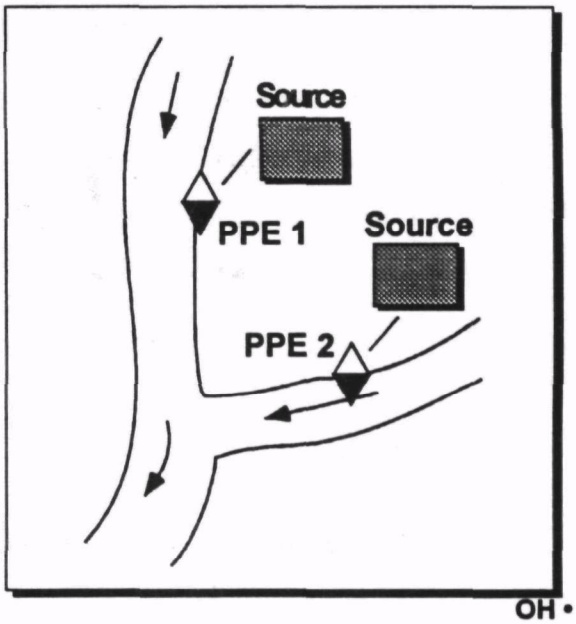
- Comparable sampling and analytical procedures
- Collect most downstream samples first
- Collect aqueous samples before sediment samples at same location

SI Guidance, section 4.6

OH • 16

Sample to Test Suspected Release





OH • 17

Targets

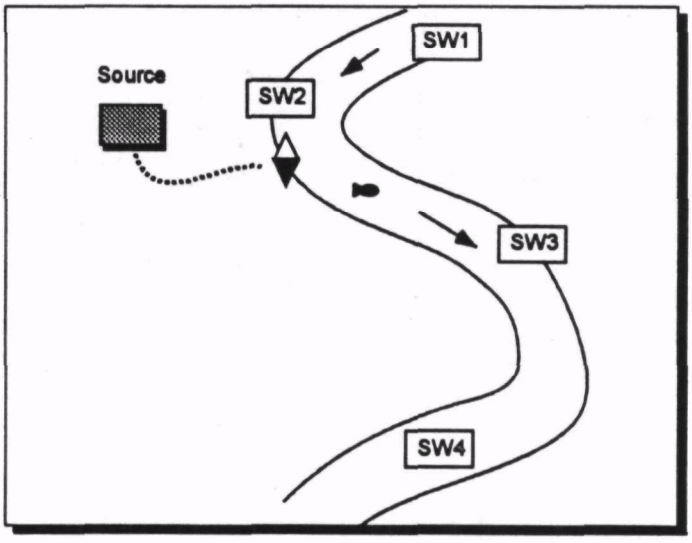
Sampling considerations for actual contamination

- Must establish observed release first
- Can infer contamination between "hits"
  - No need to sample each target
  - Can sample adjacent to or beyond (downstream of) target locations
- Sample for human health considerations, regardless of score
  - Always sample nearest drinking water intake if contamination is suspected

SI Guidance, section 4.6

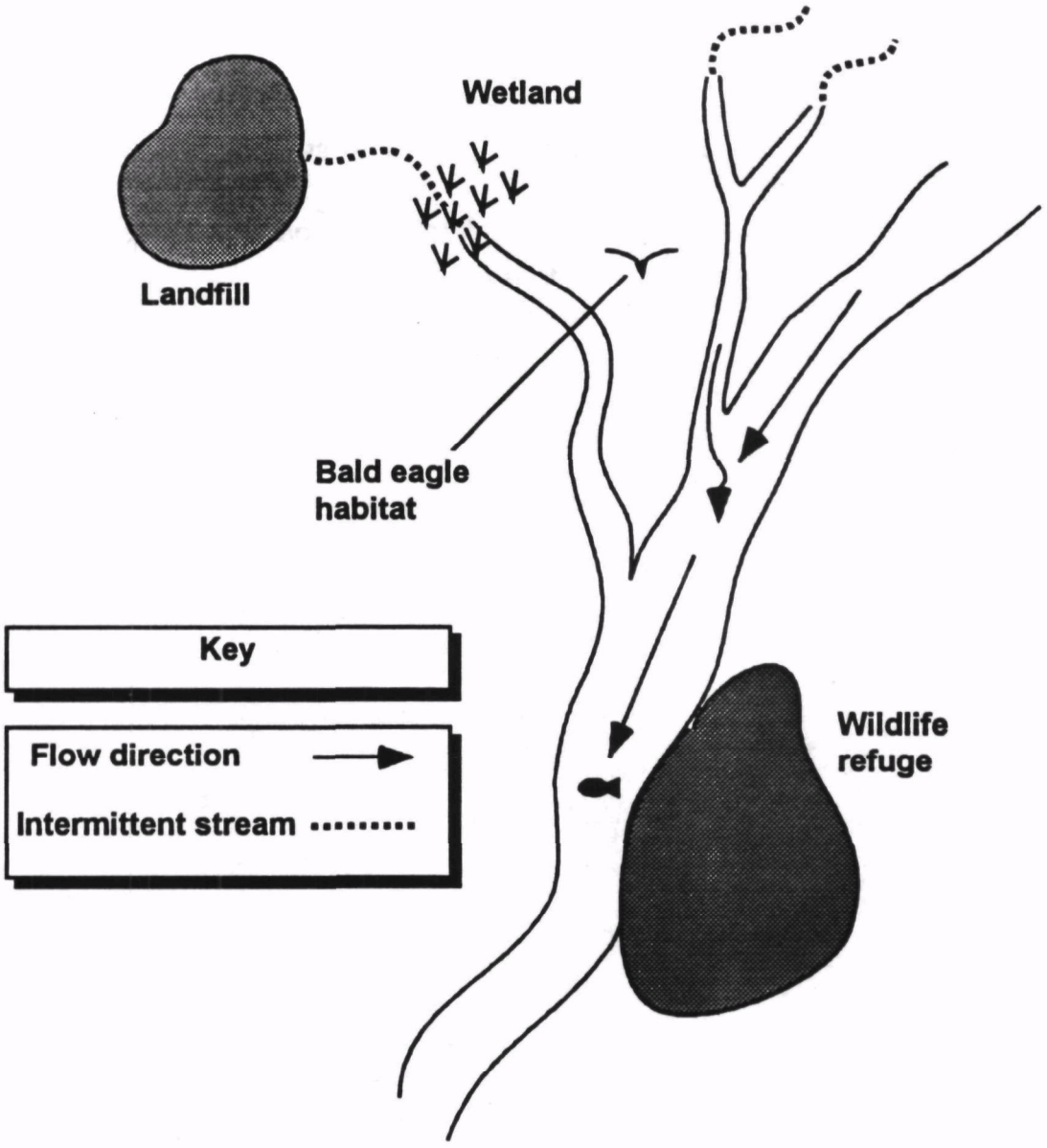
OH • 18

Targets: Inferring Contamination



OH • 19

Inferring Contamination



OH • 20

Targets: Drinking Water Threat

To demonstrate actual contamination:

- Sample types
  - Aqueous
  - Sediment
  - Sessile benthic
- Collect samples at or downstream of target (intake)
- Compare analytical results to benchmarks
- Only aqueous samples can be used to score Level I targets
- Level II can be established with any sample type

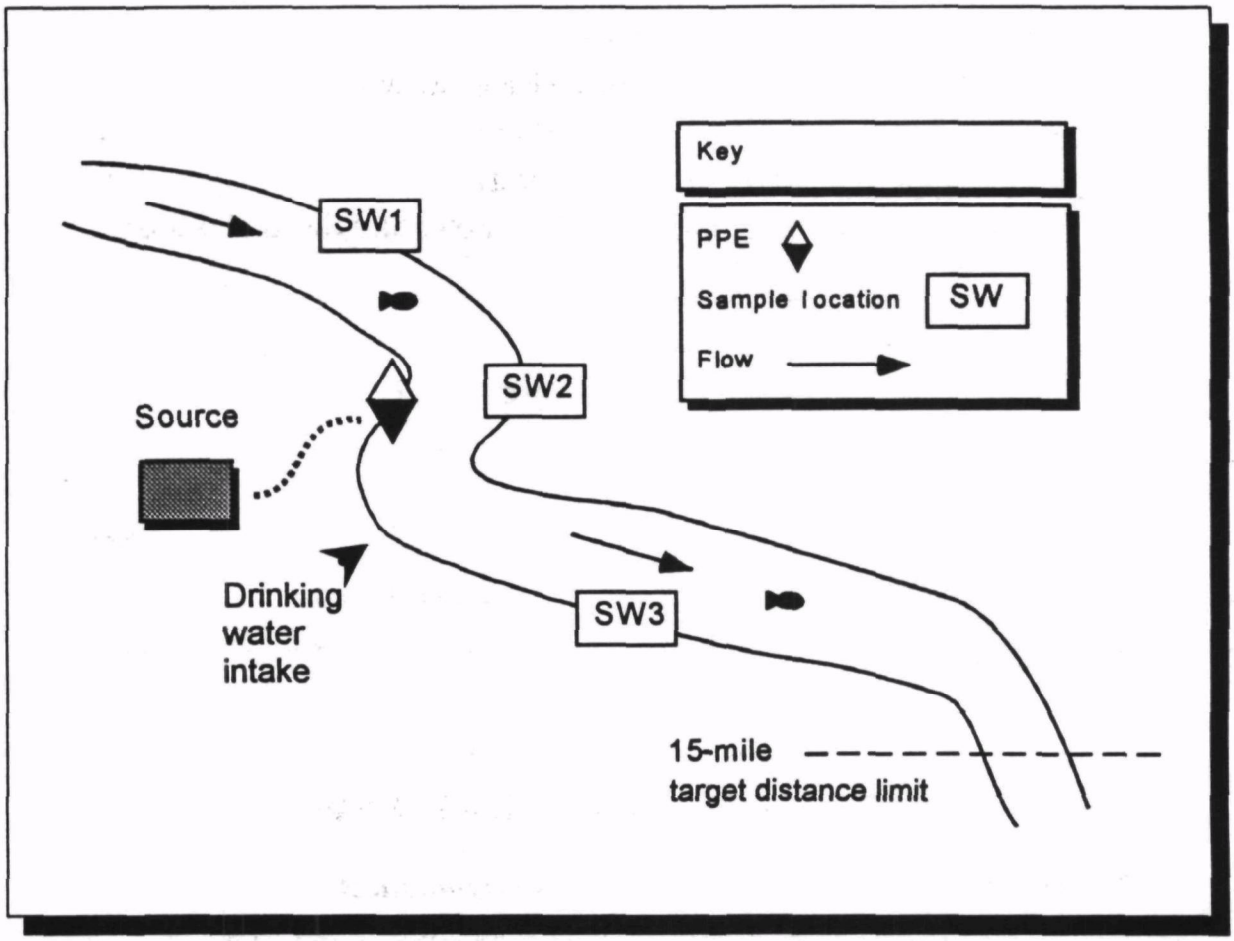
SI Guidance, section 4.6 **OH • 21**

Surface Water Benchmarks

SW Threat	Benchmark	Sample Type
Drinking water	MCL MCLG Screening concentrations	Aqueous
Environmental	AWQC AALAC	Aqueous
Human food chain	FDAAL Screening concentrations	Tissue

SI Guidance, section 4.6 **OH • 22**

Actual Contamination?
Level of Contamination?



Sample	Result	Benchmark
SW1	Nondetect	
SW2	100 ppb	10 ppb
SW3	50 ppb	

OH • 23

Targets: Human Food Chain Threat

Demonstrate actual contamination

- Only attempt if this threat is essential to site score
- Use sediment samples (not organisms)
- Tissue sampling is expanded SI activity
- If fishery is closed for fishing, surface water sample can be used to establish threat
- Collect multiple samples

OH • 24

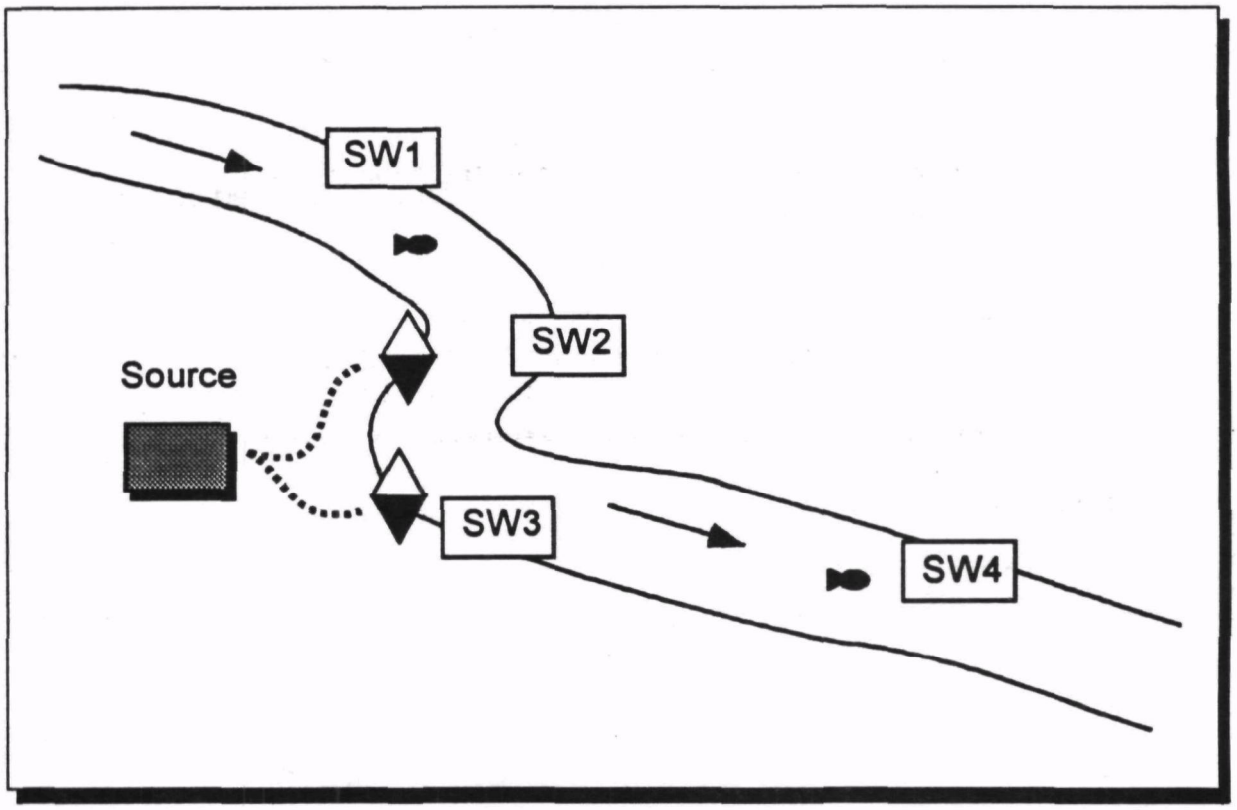
Targets: Human Food Chain Threat

Sampling considerations for actual contamination

- Observed release at target + bioaccumulation potential factor value (BCFV) considerations
- Sediment, aqueous, and effluent samples – require substance within BCFV $\geq$ 500
- Tissue samples – no BCFV requirement

OH • 25

Actual Contamination?



Sample	Arsenic
SW1	2
SW2	175
SW3	190
SW4	80

Key

PPE

Sample location SW

Flow

OH • 26

Targets: Environmental Threat

Determine actual contamination

- Only aqueous samples can be used to score Level I contamination
- Collect at or downstream of sensitive environment
- For wetlands
  - Sample near PPE
  - Two samples from wetland (at least 0.1 miles from PPE into surface water)
- Collect unfiltered surface water

Sensitive environments for this pathway are found in PA table 5 in the PA scoresheets

SI Guidance, section 4.6

OH • 27

Notes:

PA TABLE 5: SURFACE WATER AND AIR PATHWAY SENSITIVE ENVIRONMENTS VALUES

Sensitive Environment	*Assigned Value*
Critical habitat for Federally designated endangered or threatened species	100
Marine Sanctuary	
National Park	
Designated Federal Wilderness Area	
Ecologically important areas identified under the Coastal Zone Wilderness Act	
Sensitive Areas identified under the National Estuary Program or Near Coastal Water Program of the Clean Water Act	
Critical Areas identified under the Clean Lakes Program of the Clean Water Act (subareas in lakes or entire small lakes)	
National Monument (air pathway only)	
National Seashore Recreation Area	
National Lakeshore Recreation Area	
Habitat known to be used by Federally designated or proposed endangered or threatened species	75
National Preserve	
National or State Wildlife Refuge	
Unit of Coastal Barrier Resources System	
Federal land designated for the protection of natural ecosystems	
Administratively Proposed Federal Wilderness Area	
Spawning areas critical for the maintenance of fish/shellfish species within a river system, bay, or estuary	
Migratory pathways and feeding areas critical for the maintenance of anadromous fish species in a river system	
Terrestrial areas utilized for breeding by large or dense aggregations of vertebrate animals (air pathway) or semi-aquatic foragers (surface water pathway)	
National river reach designated as Recreational	
Habitat known to be used by State designated endangered or threatened species	50
Habitat known to be used by a species under review as to its Federal endangered or threatened status	
Coastal Barrier (partially developed)	
Federally designated Scenic or Wild River	
State land designated for wildlife or game management	25
State designated Scenic or Wild River	
State designated Natural Area	
Particular areas, relatively small in size, important to maintenance of unique biotic communities	
State designated areas for protection/maintenance of aquatic life under the Clean Water Act	5
Wetlands	See PA Table 6 (Surface Water Pathway) or PA Table 9 (Air Pathway)

PA TABLE 6: SURFACE WATER PATHWAY WETLANDS FRONTAGE VALUES

Total Length of Wetlands	*Assigned Value*
Less than 0.1 mile	0
0.1 to 1 mile	25
Greater than 1 to 2 miles	50
Greater than 2 to 3 miles	75
Greater than 3 to 4 miles	100
Greater than 4 to 8 miles	150
Greater than 8 to 12 miles	250
Greater than 12 to 16 miles	350
Greater than 16 to 20 miles	450
Greater than 20 miles	500

Focused SI Strategy

If PA hypothesized release to surface water and targets are present:

- Sample locations at or near PPE and background
- Sample effluent discharge (no background needed)
- Sample all drinking water intakes suspected to be exposed (primary targets)
- If multiple primary target threats are present, collect sediment samples

SI Guidance, section 4.6.1

OH • 28

Focused SI Strategy

To establish background

- Background and release/target samples must be same sample type
- Background samples include:
  - Sediments upstream of PPE (and out of site influence)
  - Aqueous samples upstream of PPE (only if drinking water targets are threatened)

SI Guidance, section 4.6.1

OH • 29

Expanded and Single SI Strategy

- Determine whether aqueous samples are needed to demonstrate a release
- Collect surface water samples at targets that were not sampled earlier
- Sample to expand fishery and wetland boundaries if these are important

SI Guidance, section 4.6.2

OH • 30

Notes:

TABLE 4-10: SURFACE WATER SAMPLES TO SUPPORT A RELEASE AND TARGET CONTAMINATION

HRS Factors	Sediment[1]	Aqueous	Effluent[2]	Sessile Benthic Organisms	Non-sessile Benthic Organisms	Finfish, Amphibians, and Reptiles
Observed release	Yes	Yes	Yes	Yes	No	No
Level I drinking water	No	Yes	No	No	No	No
Level II drinking water	Yes	Yes	Yes	Yes	No	No
Level I sensitive environments	No	Yes	No	No	No	No
Level II sensitive environments	Yes	Yes	Yes	Yes	No	No
Level I fisheries	No	No	No	Yes[3]	Yes[3,4]	Yes[3,4]
Level II fisheries	Yes[5]	Yes[5]	Yes[5]	Yes[3]	No	No

[1] No benchmarks available; evaluate as Level II contamination.
[2] Does not require comparison to background to document a release.
[3] Sample only tissues of edible species to evaluate human food chain level of contamination.
[4] Can be used to score Level I targets, but not an observed release; must be collected within boundaries of surface water contamination.
[5] Targets can be evaluated if hazardous substance has a bioaccumulation factor value of 500 or greater.

Guidance for Performing Site Inspections Under CERCLA, USEPA, 1992

Surface Water Sampling Strategies

- SI Guidance, Table 4-11, Surface Water Sampling Strategies, presents focused, expanded, and single SI sampling criteria and strategies
- Prior to sampling, carefully plot sample locations using information gathered during the site reconnaissance and the nonsampling investigation
- Photodocument sample locations to aid in data evaluation and to resample locations if necessary

SI Guidance, section 4.6.3

OH • 31

Notes:

TABLE 4-11: SURFACE WATER SAMPLING STRATEGIES

CRITERION	FOCUSED SI	EXPANDED SI AND SINGLE SI
Primary objectives	To test hypotheses regarding a suspected release and primary targets When possible, sample at or beyond targets to test release hypotheses	To document a release based on HRS requirements To document targets exposed to actual contamination and determine levels of exposure
Data quality	Less rigorous (e.g, DUC-II) to rigorous (e.g., DUC-I)	Rigorous (e.g., DUC-I)
Average number of samples	0 to 6 depending on site hypotheses and number of surface water targets to sample	0 to 14 based on HRS documentation requirements
Types of activities	Sample easily accessible surface water locations Sample sediments at or beyond targets most likely to indicate contamination	Resample surface water locations if previous data did not document a release or targets exposed to actual contamination Sample surface water targets not yet sampled, particularly sensitive environments and wetlands Collect multiple aqueous samples from drinking water intakes where hazardous substance concentrations are likely to be near surface water benchmarks
Background samples	1 background per 3 release samples May rely on published data	2 background per 3 release samples Should not rely on published data
Attribution samples	Limited to testing release hypotheses	Those necessary to attribute a portion of a release to the site
QA/QC samples	Enhance confidence in sample results	Those necessary to obtain precise and accurate data within the SI scope

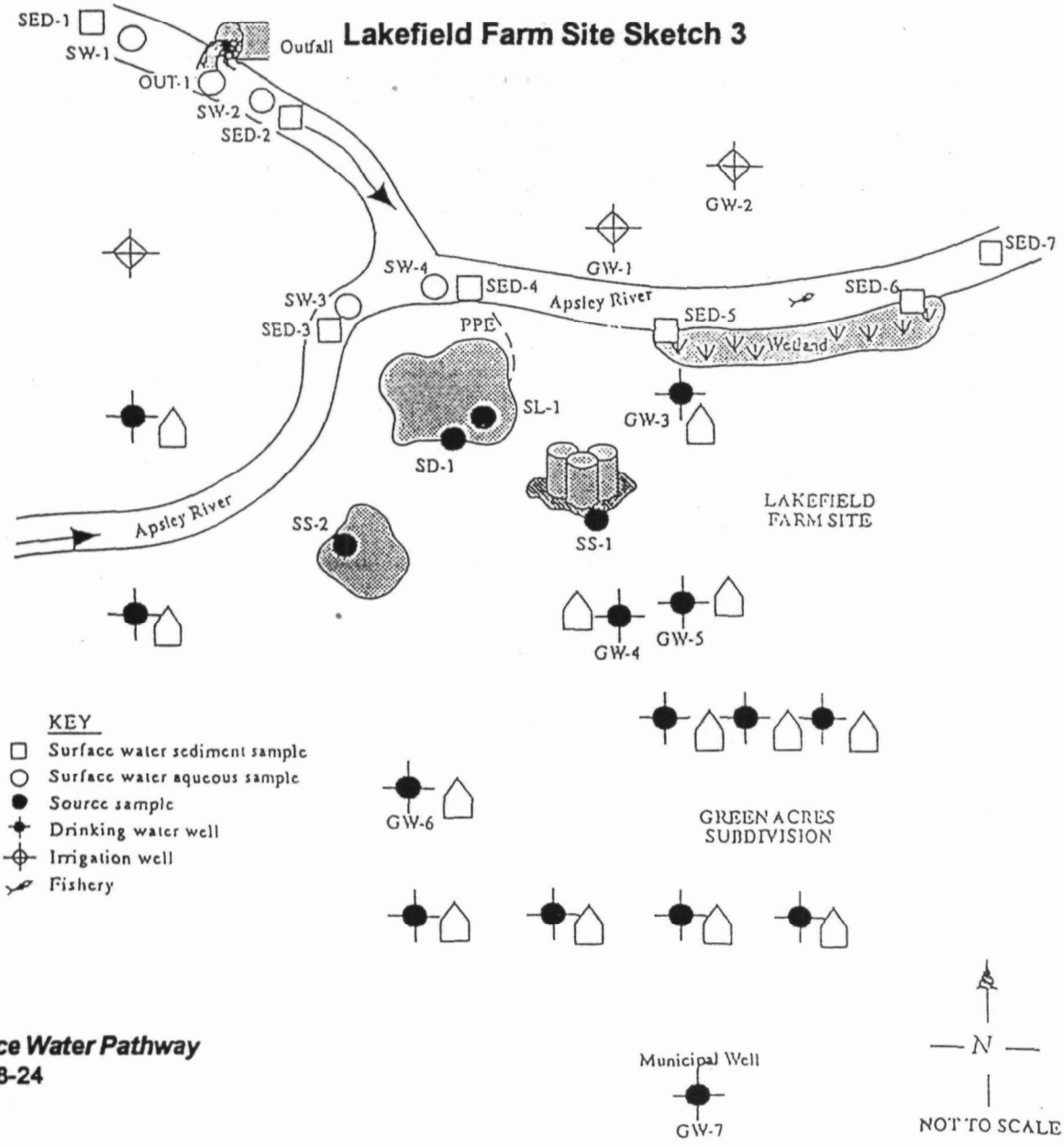
Guidance for Performing Site Inspections Under CERCLA, USEPA, 1992

CASE STUDY

EXAMPLE OF SURFACE WATER SAMPLING STRATEGY: FOCUSED SI

Returning to the Lakefield Farm Site example, the site description now includes the Apsley River, a moderate-to-large water body (streamflow 900 cfs) approximately 200 feet north of the surface impoundment (see Lakefield Farm Site Sketch 3). A recreational fishery is located within the river, and a 10-acre wetland lies 1 mile downstream from the PPE. An unnamed creek flows into the Apsley River about 750 feet upstream of the PPE, and an outfall to this creek is 1 mile upstream of this confluence. During the PA, the investigator suspected a release to the Apsley River from the Lakefield Farm and a release to ground water.

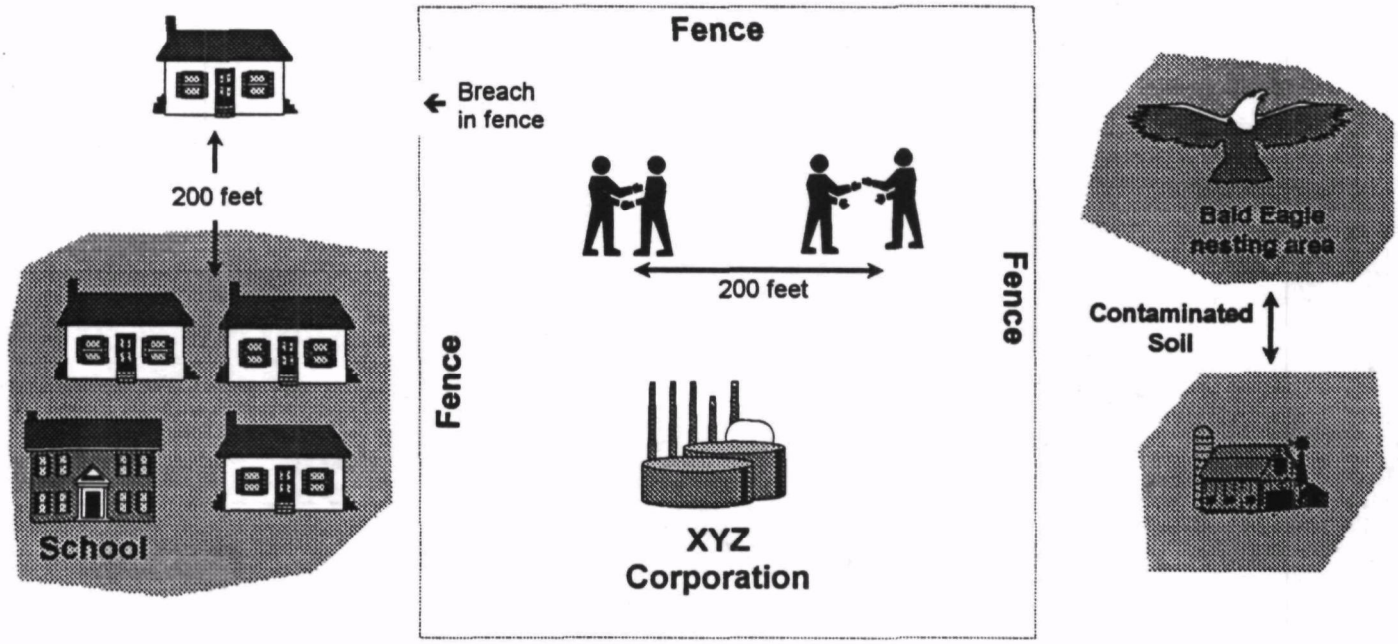
Because of significant threats to both ground water and surface water and because attribution is a problem, a focused SI is planned with an expanded SI to be performed if necessary. Focused SI sampling will test whether ground water and surface water targets are exposed to contamination.



SURFACE AND GROUND WATER SAMPLING STRATEGY FOR EXAMPLE SITE: FOCUSED SI

Samples	Approach	Rationale	Nonsampling Data Collection
Municipal well (GW-7)	Sample drinking water prior to treatment; sample to document contamination, identify hazardous substances, and determine level of contamination	Determining municipal well contamination is critical to protecting public health and to the site screening decision	Verify aquifer from which well draws; verify population served
Domestic wells (GW-3 through GW-6)	Sample nearest domestic wells suspected to be exposed to actual contamination	Determining domestic well contamination is critical to protecting public health and to the site screening decision	Verify aquifer from which wells draw; verify population served
Background for ground water	Sample drinking water aquifer; limit number of background samples	Sample to determine relative concentrations of hazardous substances in ambient conditions	Verify aquifer from which wells draw
Surface water target locations	Sample sediments to determine if contamination is present in the fishery (SED-4) or wetland (SED-5, SED-6)	Human food chain or sensitive environment contamination is vital to screening decision	Verify linear footage of wetland exposed to actual contamination
Background for surface water (SW-1, SED-1)	Limit number of background samples	Sample to determine levels of hazardous substances	Collect information about background sample location, including setting, flow, and physical characteristics (e.g., sediment grain size)
Sources (SD-1, SL-1, SS-1, SS-2)	Identify hazardous substances present at the site through composite samples	Do not sample to increase hazardous waste quantity if amounts are not close to HWQ factor value breakpoints	Obtain physical dimensions of surface impoundment and estimate area of contaminated soil; verify number of drums and look for drum labels
Quality control (Q-1 through Q-4) (not shown)	Monitor collection and decontamination procedures; one rinsate for ground water equipment, one rinsate for surface water equipment, one trip and one field blank		

Section 9:
Soil Exposure Pathway



Soil Exposure Pathway

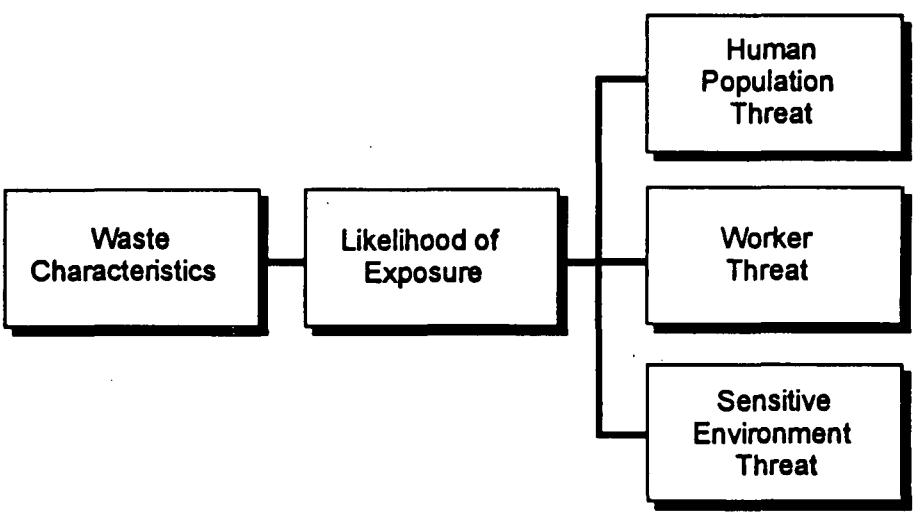
Pathway score based on:

- Likelihood that residential, school, or workplace properties are contaminated
- Likelihood that residents, students, or workers are exposed to site contaminants

SI Guidance, section 4.7

OH • 1

Soil Exposure Pathway: HRS Considerations



SI Guidance, section 4.7

OH • 2

Review PA Information

Determine whether a major pathway of concern is based on:

- Resident individuals (onsite residents, students)
- Workers
- Terrestrial sensitive environments

SI Guidance, section 4.7

OH • 3

Review PA Information

- Identify number and location of primary targets
- Identify areas of suspected surficial contamination
- Identify property boundaries
- Has contamination already been demonstrated?

SI Guidance, section 4.7

OH • 4

Soil Exposure Pathway Investigation

Complete SI data summary soil section using available information

See SI Guidance, Appendix B, "SI Data Summary"

SI Guidance, section 4.7

OH • 5

Most Important Analytical Data

- Establishing observed contamination
- Establishing level of contamination

SI Guidance, section 4.7

OH • 6

Establishing Observed Contamination

- Must use analytical evidence
- Should demonstrate:
  - Attribution
  - Contamination present at significant levels
- Need to collect two soil samples
  - Background
  - Area of contamination
- If observed contamination cannot be established, do not evaluate soil pathway

SI Guidance, section 4.7

OH • 7

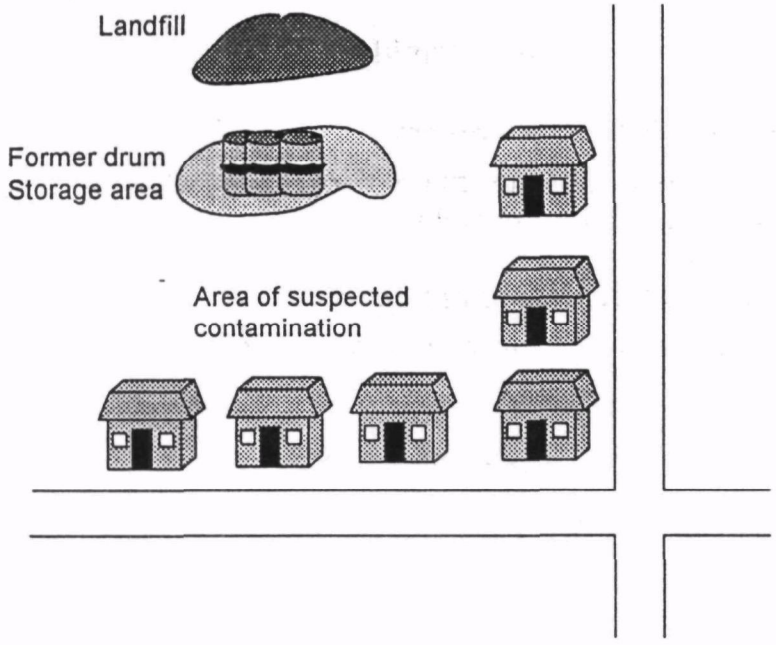
Sampling Criteria for Observed Contamination

- Must meet criteria for observed contamination (similar to observed release for migration pathways), and samples must be collected within 2 feet of surface
- Cannot collect sample beneath impenetrable cover
- Can infer contamination within a source, not between sources
- For all sources except soil, one observed contamination sample demonstrates an area of surficial contamination for entire source

SI Guidance, section 4.7

OH • 8

Sample for Observed Contamination (Sources)



SI Guidance, section 4.7

OH • 9

Sampling Considerations

Sample to identify targets exposed to surficial contamination

- Resident individuals most heavily weighted
- Workers
- Terrestrial sensitive environment
- Resources

Sample in direction of targets only

- Do not sample to delineate total extent of surficial contamination

SI Guidance, section 4.7

OH • 10

Target Considerations

Resident individuals and workers

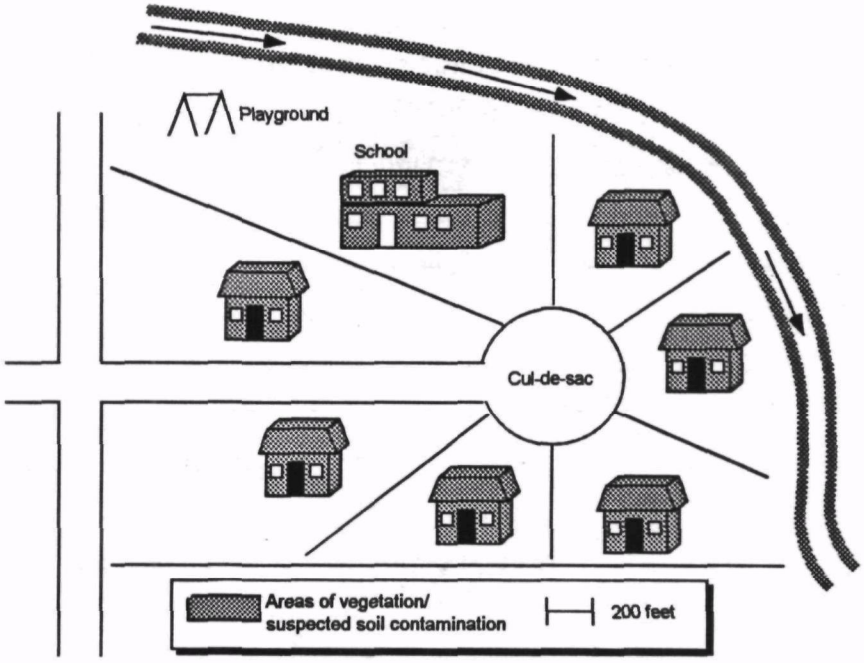
- Demonstrate contamination on property and within 200 feet of residence, school, or workplace

Sensitive environments and resources

- Demonstrate contamination within boundary

OH • 11

Sample to Define Resident Individuals



OH • 12

Estimating Areas of Observed Contamination

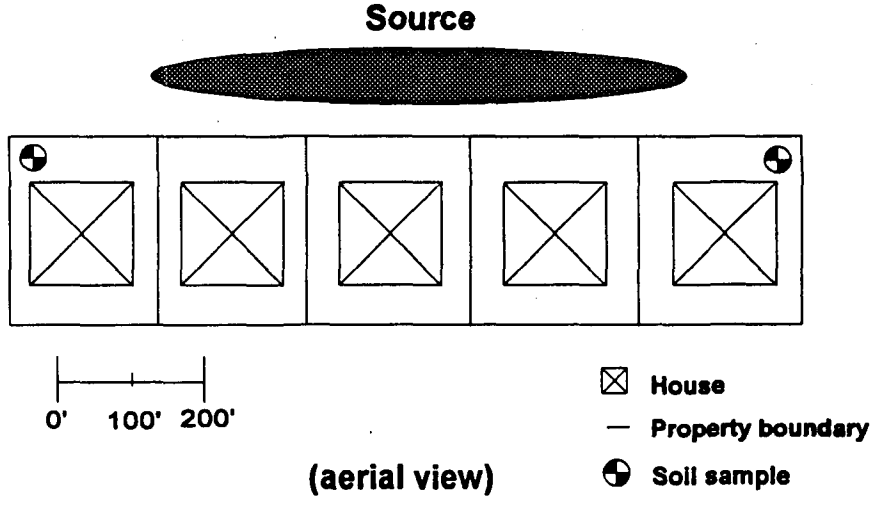
- Sample to identify resident population threat targets
- Three soil samples (minimum) needed
- Two soil samples for critical targets that lie along a line
- One nonsoil source sample can designate an entire source as area of observed contamination

SI Guidance, section 4.7

OH • 13

Area of Inferred Contamination

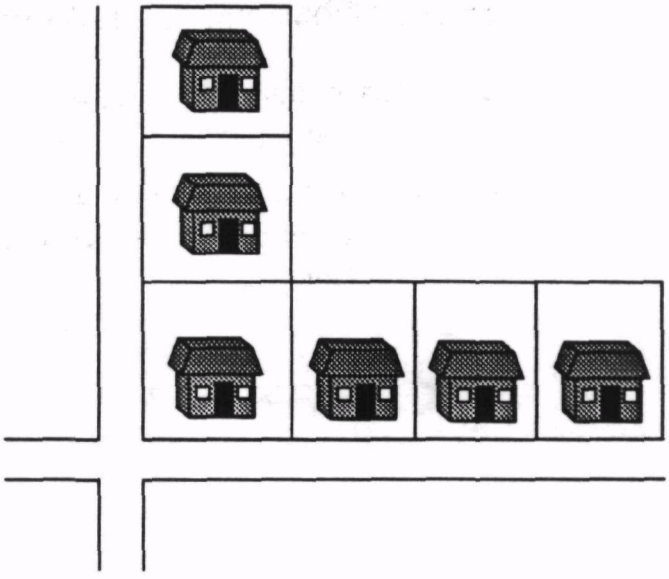
- Established between two points of observed contamination



SI Guidance, section 4.7

OH • 14

Inferring Contamination



OH • 15

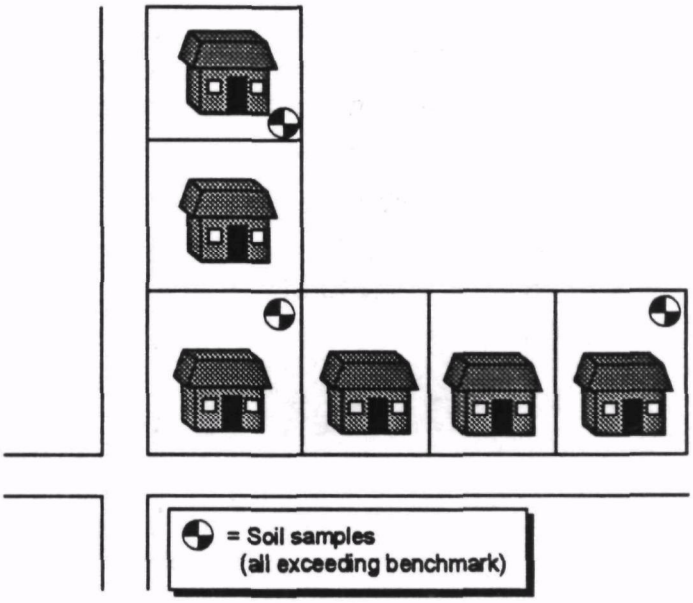
Evaluating Level of Contamination

- Analytical results are compared with benchmarks
- Populations associated with areas of inferred contamination can only be evaluated as Level II resident threat targets

SI Guidance, section 4.7

OH • 16

Levels of Contamination



OH • 17

Additional Sampling Considerations

- ***Soil samples collected for comparison should be similar***
  - Soil type
  - Same soil horizon
  - Mineralogy
  - Composition
- ***For background, observed contamination, and metals analysis samples, need similar:***
  - Texture
  - Color
  - Grain size
- ***For HRS purposes, grab samples are preferred***

SI Guidance, section 4.7

OH • 18

Establishing Background

Background samples should:

- Represent uncontaminated conditions
- Be collected from undisturbed areas
- Not be collected from drainage channels
- Be collected within 1-3 days of release sample (can use results from nearby sites for focused SI)

SI Guidance, section 4.7

OH • 19

Focused SI Strategy

- Review PA hypotheses concerning suspected observed surficial contamination and exposed targets
- Establish areas of observed contamination
- Target resident individual exposures
- Can use inferred contamination areas
- Less rigorous data quality

SI Guidance, section 4.7.1

OH • 20

Expanded and Single SI Strategy

- Focus on documentation of target exposure
- Sample locations not sampled during earlier investigations
- Establish and document background
- Rigorous quality control

SI Guidance, section 4.7.1

OH • 21

Soil Sampling Strategy

SI Guidance, Table 4-14, Soil Sampling Strategies, compares criteria and activities associated with focused, expanded, and single SIs

SI Guidance, section 4.7.1

OH • 22

TABLE 4-14: SOIL SAMPLING STRATEGIES

CRITERIA	FOCUSED SI	EXPANDED SI AND SINGLE SI
Primary objectives	To test hypotheses regarding suspected observed surficial contamination and targets exposed to actual contamination	To document target exposure to hazardous substances related to site sources
Data quality	Less rigorous (DUC-II) to rigorous (DUC-I); depends on objectives	Rigorous (DUC-I); depends on objectives
Average number of samples	0 to 10 depending on site hypotheses and resident population to investigate	0 to 20 based on documentation requirements and number of sources and targets
Types of activities	Sample source and target areas indicating possible surficial contamination, exposed or within 2 feet of surface	Resample locations if previous data did not demonstrate areas of observed contamination or targets exposed to actual contamination Sample other resident target properties not yet sampled Collect multiple samples from properties where hazardous substance concentrations are likely to be near benchmarks
Background samples	Limited May not be necessary for some organics May rely on published data	As many as necessary; research natural soil concentrations as well as development history in the area to select critical background sample locations; use aerial photographs.
Attribution samples	Limited	Those necessary to attribute substances to the site being evaluated
QA/QC samples	As approved by Regional guidelines	Minimum 1 split and 1 blank or per Regional guidelines

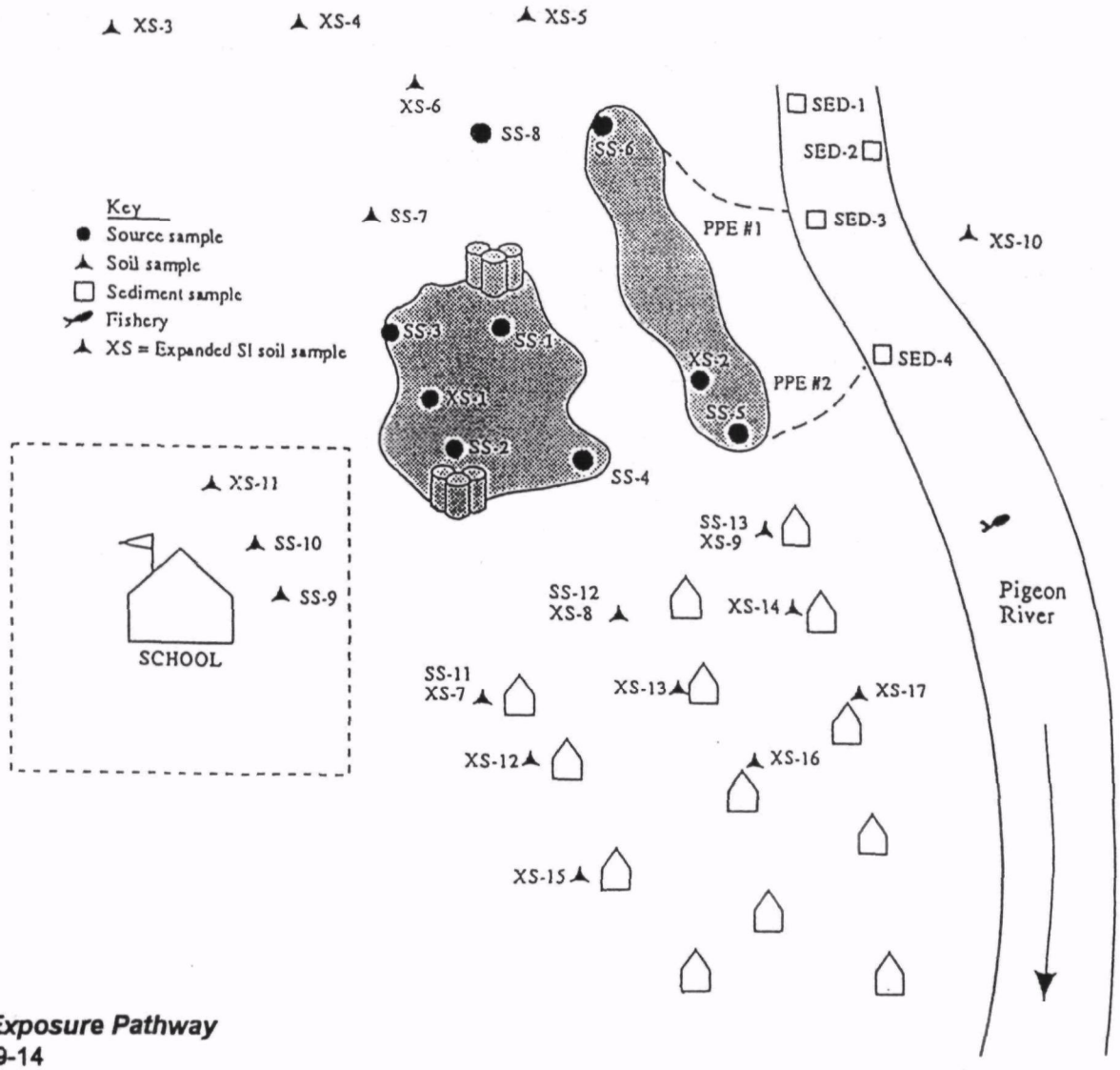
Guidance for Performing Site Inspections Under CERCLA, USEPA, 1992

CASE STUDY

EXAMPLE OF SOIL SAMPLING STRATEGY: FOCUSED SI

The Carveth Landing site is a dump near a residential neighborhood and elementary school (see Carveth Landing site sketch). The PA reported that dumping occurred for an unknown period of time and allegedly included paints, organic and inorganic substances, and construction debris. The area is devoid of vegetation. Sources at the site include several piles of 5-gallon containers and two poorly defined areas of stained soil. Pigeon River, which flows at 1,600 cubic feet per second and is located 400 feet east of the site, has flooded twice in the past 7 years. Commercial and recreational oyster beds are downstream of two PPEs to surface water. The PA concluded that flooding may have carried hazardous substances into the surface water and onto adjacent school and residential properties. Hazardous substances associated with the site are not known, but could involve metals typically found in paints.

Carveth Landing Site Sketch



SOIL AND SURFACE WATER SAMPLING STRATEGY FOR EXAMPLE SITE FOCUSED SI

Samples	Approach	Rationale	Nonsampling Data Collection
Surface water locations (SED-3, SED-4)	Sample sediments to demonstrate a release; determine if contamination is present and level of contamination	Investigate release to surface water and determine if fishery is exposed to actual contamination	Document use of river for fishing; estimate annual commercial food chain production for oysters
Residential soil samples	Sample to determine if nearby residential properties (SS-11, SS-12, SS-13) and the school yard (SS-9, SS-10) are exposed to surficial contamination	Investigate population exposure to hazardous substances	Determine number of people per residence and number of students attending school
Background soil (SS-7, SS-8)	Limited	Sample to determine relative levels of hazardous substances under ambient conditions and to better define effects of flooding at site	If available, obtain historical aerial photographs and FEMA maps; research natural background levels of metals
Background surface water (SED-1, SED-2)	Collect sediment samples upstream of PPEs; ensure samples are beyond tidal influence of hazardous substance migration	Sample to determine relative levels of hazardous substances under ambient conditions	Research other potential sources of hazardous substances
Sources (SS-1 through SS-6)	Identify hazardous substance present at the site; sample to test hypothesis of surficial contamination	Do not sample to increase hazardous waste quantity because amounts are not close to HWQ factor value breakpoints	Estimate physical dimensions of stained soil; count paint pails and look for drum labels
Quality control (Q-1 through Q-3)	Monitor sample collection and decontamination procedures; two rinsates and one trip blank		

CASE STUDY

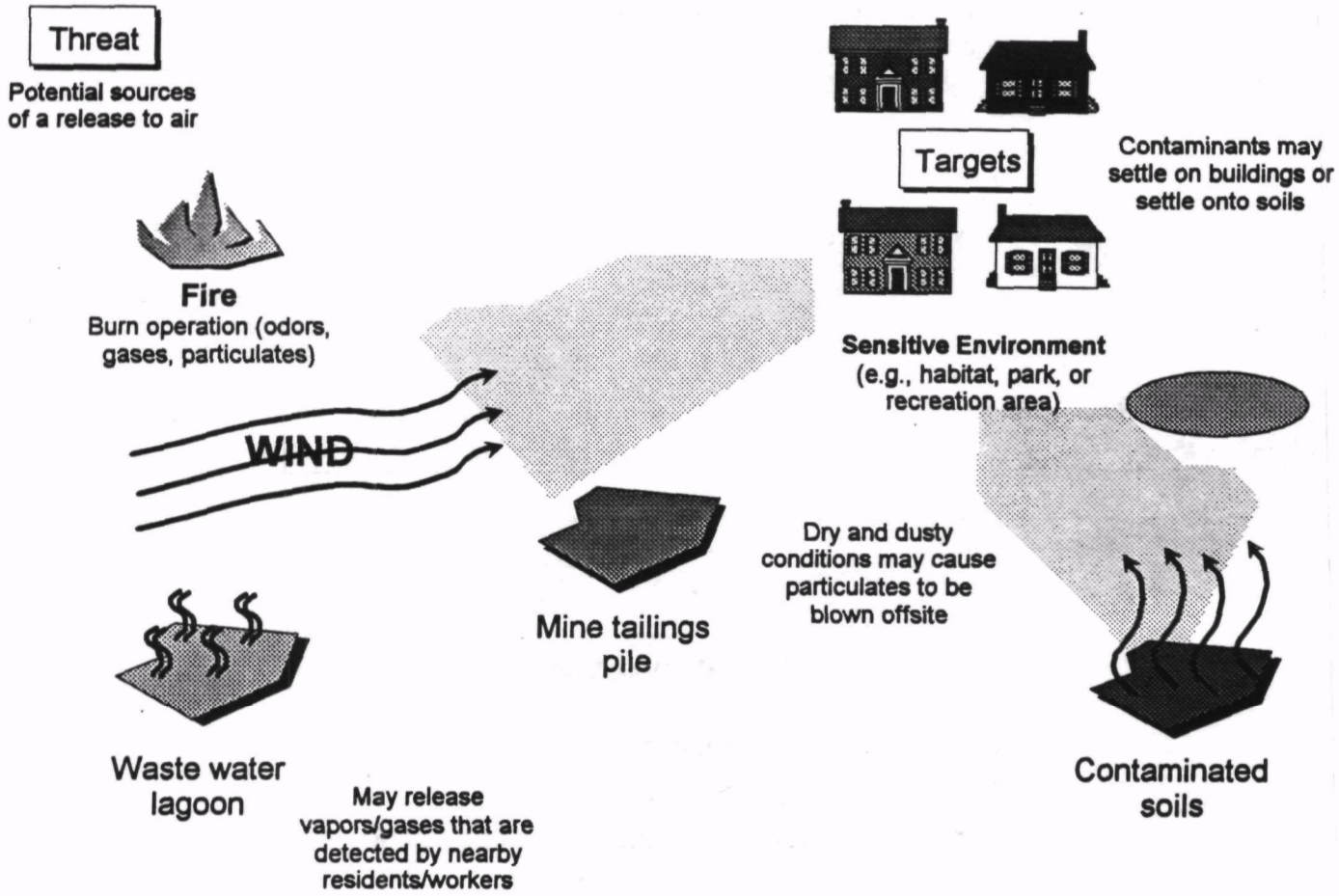
EXAMPLE OF SOIL SAMPLING STRATEGY: EXPANDED SI

An expanded SI was performed at the Carveth Landing site using the following sampling strategy.

SOIL SAMPLING STRATEGY FOR EXAMPLE SITE EXPANDED SI

Samples	Approach	Rationale	Nonsampling Data Collection
Resident samples (XS-7, XS-8, XS-9, XS-11 through XS-17)	Sample to document resident targets and levels of actual contamination	To establish observed contamination on residential and school properties, target samples must be 3 or more times the ambient background levels	Determine number of residents, property boundaries, and number of students
Background (XS-3 through XS-6, XS-10)	Sample areas less influenced by site; document contamination attributable to site	Show that target contamination is attributable to the site, rather than other potential sources of lead; ensure sufficient background samples for HRS documentation	
Quality control (Q-1 through Q-6)	Monitor sample collection and decontamination procedures; transport and handling procedures; two equipment rinsates, two duplicates, one field blank, one replicate	Ensure sufficient QA/QC samples for HRS documentation	

Section 10:
Air Pathway



Air Pathway Evaluation

Pathway score based on:

- Likelihood that airborne contaminants are migrating from site
- Likelihood of detecting contaminants at human and sensitive environment targets

SI Guidance, section 4.8

OH • 1

Review PA Information

- Was air pathway significant to preliminary score?
- Identify sources (source areas)
- Identify primary targets and primary target populations
- Identify most dispersible substances

SI Guidance, section 4.8

OH • 2

Air Pathway Investigation

Complete the SI data summary air section using available information.

This information may help determine whether to evaluate the pathway.

See SI Guidance, Appendix B,
SI Data Summary, pages B-19 through B-21

SI Guidance, appendix B

OH • 3

When Is Air Sampling Appropriate?

Is air the only significant pathway?

- Typically expanded or single SI activity

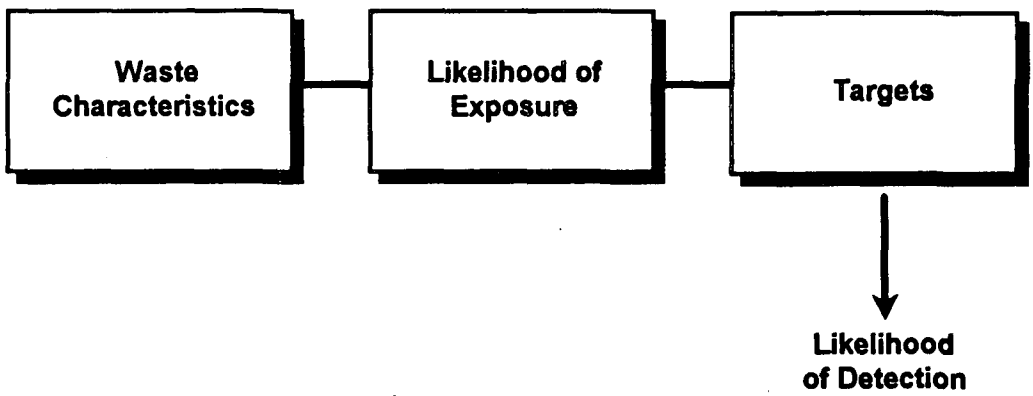
Evaluating air pathway during focused SI

- Generally sample air only if immediate human health threat exists
- Monitor to better assess release potential

SI Guidance, section 4.8

OH • 4

Air Pathway: HRS Considerations



SI Guidance, section 4.8

OH • 5

Air Pathway: Likelihood of Release

Depends on nature of source

- Chemical properties
- Thickness of cover

Affected by atmosphere

- Wind direction
- Temperature

SI Guidance, section 4.8

OH • 6

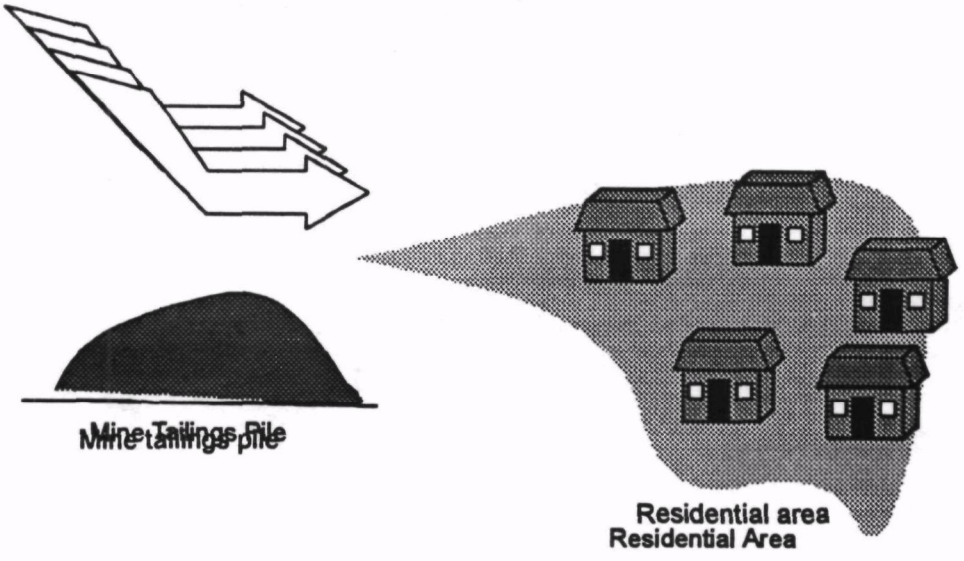
Observed Release by Direct Observation

- Particulate emission seen entering atmosphere directly
- Use photographs to document emissions
- Need information supporting that emission material contains hazardous substance
  - Existing analytical data
  - Manifests
  - Soil or source samples
- Sample source to document direct observation

SI Guidance, section 4.8

OH • 7

Observed Release by Direct Observation



OH • 8

Air Pathway: Observed Release

Background and release samples should be similar

- Collection and analysis
- Same time frame

Background sample locations should be outside influence of site to ensure attribution

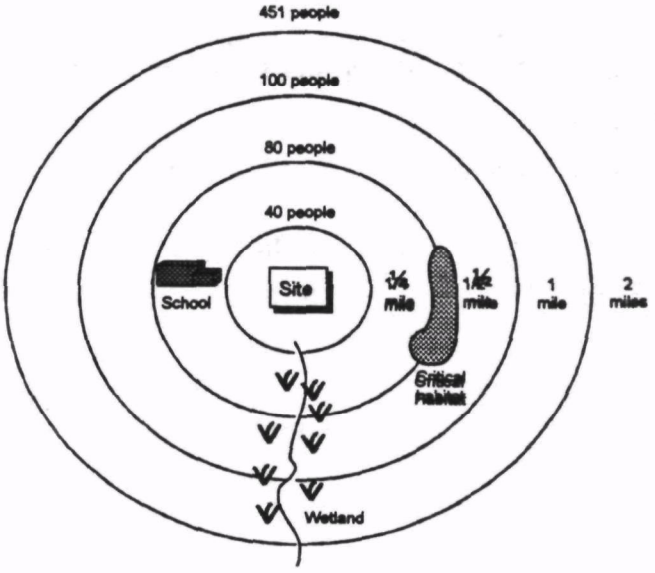
OH • 9

Air Pathway: Targets

- Do not need to sample air targets directly
- Observed release can demonstrate actual contamination of targets within the distance category

OH • 10

Air Targets



OH • 11

Air Sampling Considerations

- Sample targets within a 0.25-mile target distance limit
- Conduct before or after other sampling activities (not during)
- May require more than one sampling event
- Should not be conducted near facilities discharging into air
- Monitoring stations should be located near sources

SI Guidance, section 4.8.3

OH • 12

Focused SI Strategy

Air sampling for CLP analysis should not be conducted during focused SI

Ambient air screening may be appropriate

- Health and safety
- Release detection

SI Guidance, section 4.8.1

OH • 13

Expanded and Single SI Strategy

- Single SI option is selected if air is only pathway of concern
- Conduct sampling:
  - If air pathway is of concern
  - If public health is threatened
- Minimum 12-hour sampling time to reduce variability
- Determine predominant wind direction
- Rigorous quality control

SI Guidance, section 4.8.2

OH • 14

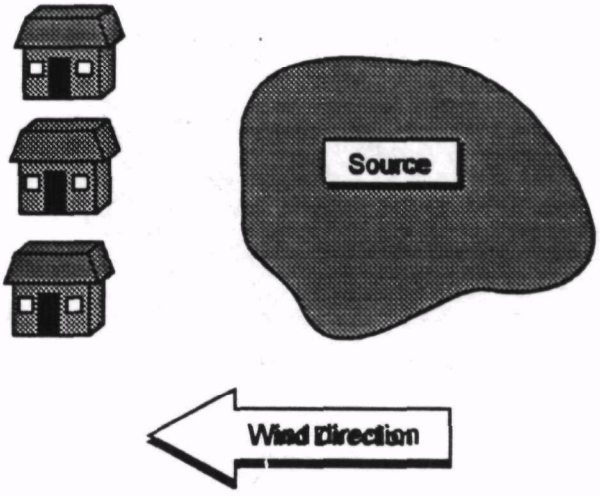
Expanded and Single SI Strategy: Establishing Background

- Necessary at this stage
- Upwind or cross-wind samples acceptable
- Multiple samples preferred

SI Guidance, section 4.8.2

OH • 15

Establishing Background



OH • 16

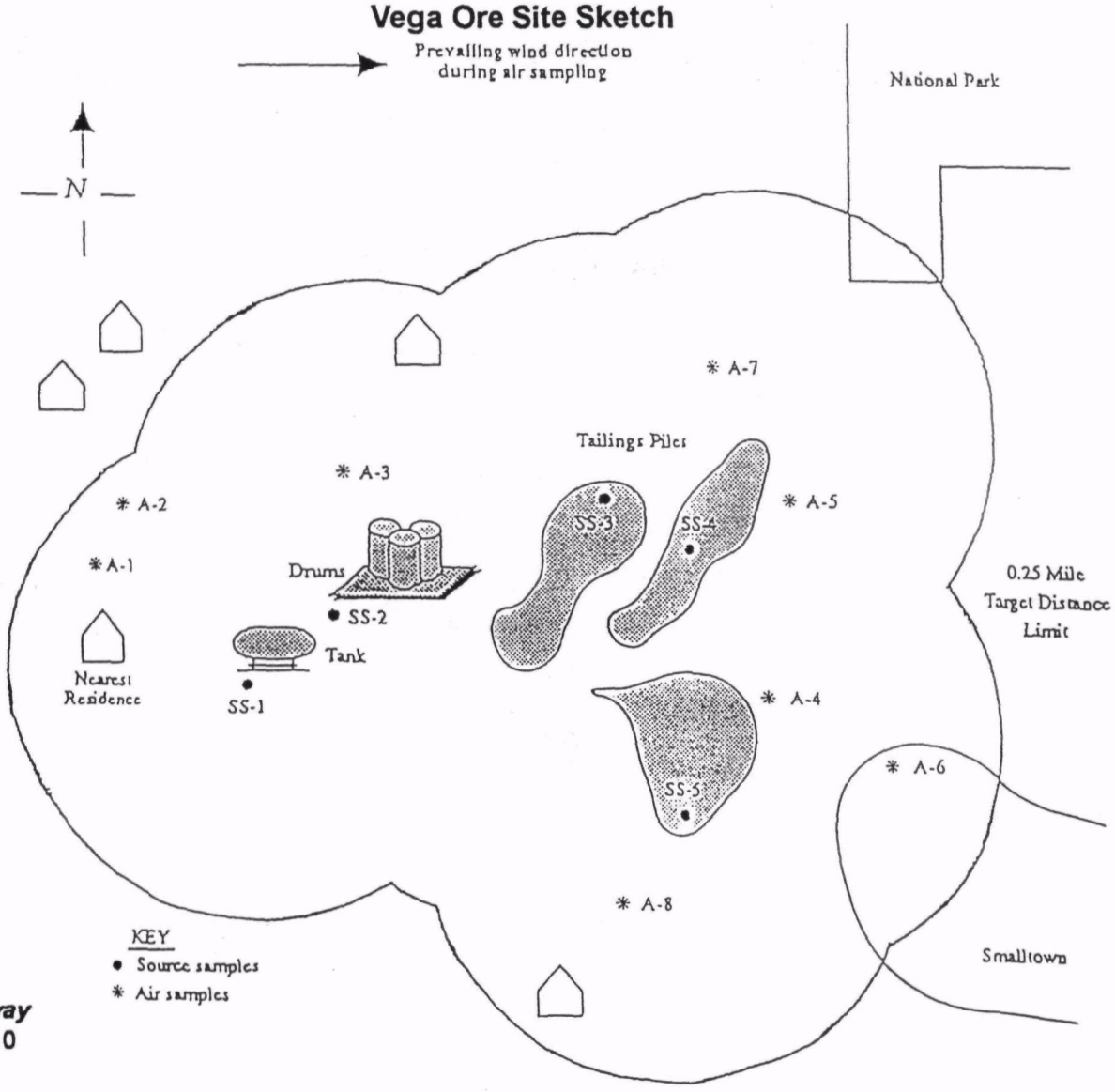
CASE STUDY

EXAMPLE OF AIR SAMPLING STRATEGY

Vega Ore is a remote site near Smalltown where ore is processed for the extraction of lead, zinc, and silver (see Vega Ore site sketch). The site has been operating since 1930, and current activities are very limited. Waste sources include three tailings piles, a drum storage area for acids, and an aboveground tank.

The nearest residence is 1,000 feet from a tailings pile. Smalltown relies on drinking water from an intake 3 miles away. A national park is located 900 feet from the site. A total of six ranches within 0.25 miles of the site rely on bottled water and cisterns for drinking water. Based on PA research, the significant threats posed by Vega Ore involve suspected migration of hazardous substances through air that may impact people and sensitive environments. No ground water targets exist, and the nearest surface water body is more than 2 miles from the site.

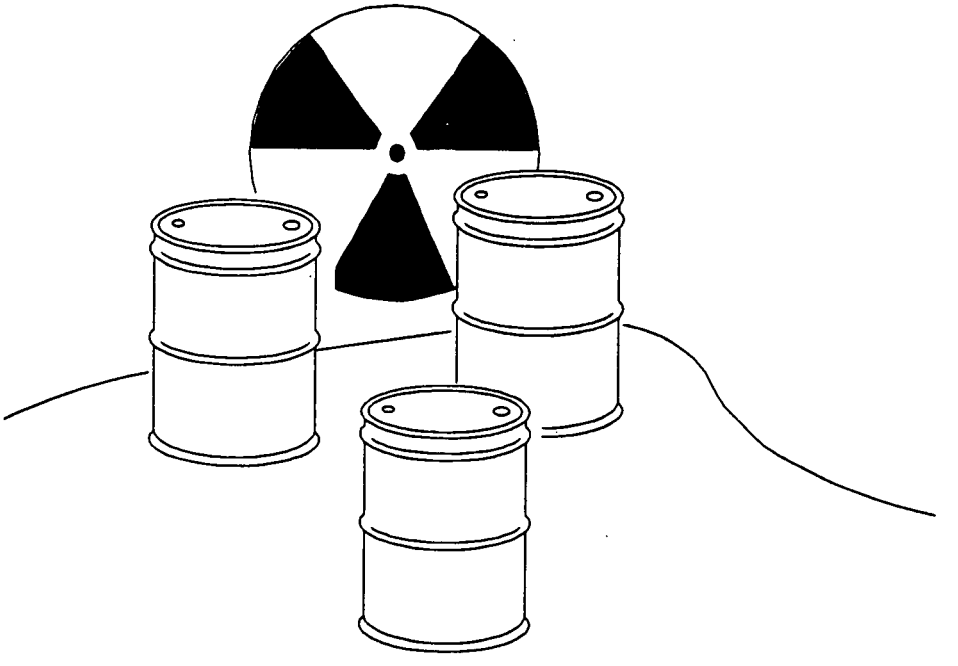
Vega Ore Site Sketch



AIR SAMPLING STRATEGY FOR EXAMPLE SITE

Samples	Approach	Rationale	Nonsampling Data Collection
Release and air targets (A-4 through A-6)	Sample to test if contamination is present and determine level of actual contamination Monitor wind speed, direction, and other atmospheric conditions	Determining whether the 0.25-mile target distance category is exposed to actual air contamination is vital to investigating the public health and the screening and listing decisions	Determine population of Smalltown lying within the 0.25-mile target distance category from site sources Determine number of workers at Vega Ore Determine boundaries of national park
Support for release and air targets (A-7, A-8)	Sample to test if other sources of air contamination exist in the site vicinity, or if wind direction changes during the sampling event; establish cross-wind sample stations	Support determining whether the 0.25-mile target distance category is exposed to actual contamination	
Background (A-1 through A-3)	Sample to collect background levels of ambient air concentrations Sample to determine background soil levels	Sample to determine relative levels of particulate hazardous substances in ambient conditions Ensure sufficient background samples for listing purposes	Identify other sources of particulate emissions in area Collect descriptive information for all background sample locations
Sources (SS-1 through SS-5)	Identify hazardous substances present at the site through surficial soil samples and tailing samples	Do not sample to increase hazardous waste quantity (amounts are not close to HWQ factor value breakpoints)	Obtain physical dimensions of tanks, drums, and tailings piles, and estimate area of contaminated soil; verify number of drums and look for drum labels
Quality control (Q-1 through Q-4) (not shown)	Monitor sample collection and decontamination procedures; 2 trip blanks and 2 duplicates	Ensure sufficient QA/QC samples for listing purposes	

Section 11:
Radiation



Definitions

1. **Radioactive Substance**—Solid, liquid, or gas containing atoms of a single radionuclide or multiple radionuclides.

2. **Radionuclide/radioisotope**—Isotope of an element exhibiting radioactivity. For HRS purposes, "radionuclide" and "radioisotope" are used synonymously.

3. **Radioactivity**—Property of those isotopes of elements that exhibit radioactive decay and emit radiation.

4. **Radiation**—Particles (alpha, beta, neutrons) or photons (X- and gamma-rays) emitted by radionuclides.

HRS Final Rule, section 1.1, page 51586

OH • 1

Radioactive Substances Are:

- Hazardous substances under CERCLA and should be considered in HRS scoring
- Treated as additional wastes with special properties under the HRS

Special analytical data requirements apply

HRS Final Rule, section 7.0, page 51663

OH • 2

Three Groups of Radionuclides

1. Naturally occuring or ubiquitous in the environment
2. Man-made radionuclides not ubiquitous in the environment (elements beyond atomic number 92: uranium)
3. Gamma radiation

HRS Final Rule, section 7.1.1, page 51663;
SI Guidance, section 4.9.4, page 89

OH • 3

Radiation Measurement

Radiation is measured in activity units (**curies**)

Curie (Ci): Measure used to quantify radioactivity. One curie equals 37 billion nuclear transformations per second and one picocurie (pCi) equals 10^{-12} Ci.

Media	Unit Measurement
Soil	pCi/kg
Ground/surface water	pCi/L
Air	pCi/m^3

HRS Final Rule, section 7.1.1, page 51663

OH • 4

CERCLA Exclusions

Section 101(22) of CERCLA excludes a limited category of radioactive materials, making them ineligible for CERCLA response or the NPL.

1. Excludes releases of source uranium or thorium..., by-product or material made radioactive by exposure to radiation from the use or production of special nuclear material (plutonium, ^{233}U, enriched ^{233}U, ^{235}U) or any material that the NRC determines to be special nuclear material subject to section 170 of the AEC Act.

2. Any release of source, by-products, or special nuclear material from any processing site specifically designated under the Uranium Mill Tailings Radiation Control Act of 1978.

HRS Guidance, page 19

OH • 5

Potential Radioactive Waste Sites

- Pose special hazards for field investigators (gamma radiation)
- Less than 2 percent of CERCLIS sites involve radioactive materials
- Detailed investigations and information are handled by EPA's Office of Radiation Programs (ORP)

PA Guidance, section 2.7, page 34

OH • 6

Facilities That Contain Radioactive Materials

- DOD/DOE research labs, contractors, and suppliers
- Public/private energy production and research labs
- Ore mining, milling, and processing industries
- Deep well injection sites
- Aircraft, submarine, and shipbuilding companies
- Businesses that manufacture, use, store, or dispose of radiopharmaceuticals
- Industrial radiography (X-rays)

PA Guidance, section 2.7, page 34

OH • 7

Evidence of Radioactive Materials

- Presence of drums and containers with radiation symbols
- Permits, manifests, and records of radioactive materials
- Above-background readings on a radiation meter

(EPA action guideline: readings ≥ 1milliroentgen/hour for gamma radiation; evacuate area!)

PA Guidance, section 2.7, page 34

OH • 8

Radiation Sampling* Goals

- Identify radionuclides and activity concentrations *in situ*, both onsite and offsite
- Locate elevated sources of radioactivity and external radiation exposure rates
- Estimate areal extent of contamination and major migration pathways
- Confirm radiation releases
- Determine site-specific background radioactivity and exposure rates
- Document Level I and Level II contamination
- Support QA/QC requirements (samples require CLP SAS)

* *After consultation with a health physicist*

SI Guidance, section 4.9.1, pages 86-88

OH • 9

Factors That Are Evaluated Differently under HRS in All Four Pathways

- Observed release
- Toxicity
- Persistance
- HWQ

Refer to HRS Final Rule, section 7, for specific information

HRS Final Rule, table 7-1, page 51663

OH • 10

Observed Release

- Direct observation for each migration pathway except soil
- Measured concentration in activity units in all four pathways

SI Guidance, section 4.9.4, pages 89-90

OH • 11

Observed Release

1. Observed release for naturally occurring radionuclides

- Concentrations that exceed upper limit of regional background for a specific nuclide and media type
- Must be attributable to site

2. Observed release for man-made radionuclide without ubiquitous background concentrations in the environment

- Measure concentrations that equal or exceed the SQL* for that nuclide in a specific media
- Must be attributable to site

** If CLP-generated data, use CRQL in place of SQL; if non-CLP-generated data, use IDL in place of SQL*

SI Guidance, section 4.9.4, pages 89-90

OH • 12

Observed Release for Soil Exposure Pathway

- Must be present at surface or covered by 2 feet or less of cover material
- Exceeds the upper-limit value of the range of regional background concentration values for that specific radionuclide in that type of sample
- Must be attributable to the site
- Excludes gamma radiation

SI Guidance, section 4.9.4, page 89;
HRS Final Rule, section 7.1.1, page 51664

OH • 13

For Observed Release with Gamma Radiation

- Concentration equals or exceeds 2 times the site-specific background gamma radiation exposure rate
- Must be attributable to the site
- Does *not* have to be within 2 feet of the surface

HRS Final Rule, section 7.1.1, page 51664

OH • 14

Hazardous Waste Quantity (HWQ)

- Use activity units (curies) to evaluate sources
- Need source area and depth (volume in cubic yards or gallons)
- Need net activity concentration of each nuclide (after subtracting background concentration)
- Evaluate radionuclide constituent quantity (tier A) or wastestream quantity (tier B)

SI Guidance, section 4.9.2, pages 88-89

OH • 15

HWQ

Tier A: Based on activity content. Convert from curies to equivalent pounds of nonradioactive hazardous substances by multiplying the activity estimate or area of observed contamination by 1,000. Assign the product as a constituent quantity value.

Tier B: Based on activity content. Estimate total volume (cubic yards or gallons); divide cubic yards by 0.55 and gallons by 110 to obtain equivalent pounds of noradioactive hazardous substances. Assign resulting value as radionuclide quantity value.

Select the higher value for HWQ

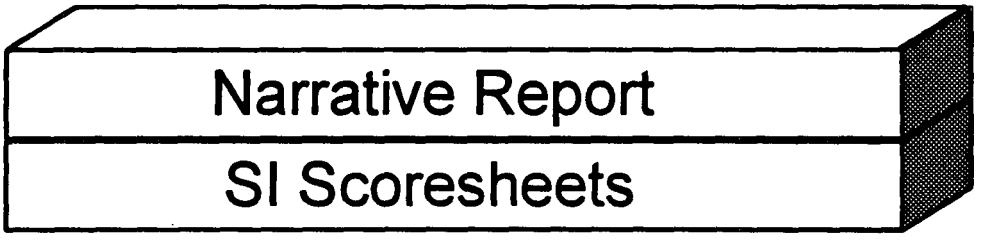
HRS Final Rule, section 7.2.5.7, pages 51665-51666

OH • 16

Section 12:
Site Inspection Evaluation and Reporting

$$\frac{WC \times LR \times T}{82{,}500} = S$$

$$\text{Site Score} = \sqrt{\frac{S_{gw}^2 + S_w^2 + S_s^2 + S_a^2}{4}}$$



SI Evaluation: Overview

Review and Validate Analytical Data

↓

Identify Analytical Data for Scoring

↓

Review Nonsampling Information

↓

Score Site

SI Guidance, chapter 5

OH • 1

SI Evaluation: Data Review

- Compile all data
  - Existing
  - New SI data
- Include sampling and nonsampling information
- Evaluate existing analytical data using procedures outlined in chapter 3 of the SI guidance
- Evaluate new analytical data against performance criteria in SI work plan

SI Guidance, section 5.1

OH • 2

SI Evaluation: Data Review

- Review should be conducted by the site investigator and project chemist
- SI Guidance, table 5-1, provides data review considerations

SI Guidance, section 5.1

OH • 3

Notes:

TABLE 5-1: DATA REVIEW CONSIDERATIONS

- ☐ Review data reports for transcription and typographical errors (e.g., 0.5 v. .05; ppb v. ppm)
- ☐ Determine if sampling protocols were appropriate
- ☐ Compare data against field and trip blanks to detect cross-contamination
- ☐ Compare field replicates samples
- ☐ Review laboratory QC (e.g., laboratory blanks, method standards, spike recovery, duplicates)
- ☐ Summarize detection limits for non-detectable results
- ☐ Review detection limits for positive but non-quantifiable data
- ☐ Review sampling program design for assessing media variability
- ☐ Review background concentrations to help identify site-specific contamination
- ☐ Delete unusable data, attach qualifiers to usable data, and explain limitations of qualified data

Guidance for Performing Site Inspections Under CERCLA, USEPA, 1992

SI Evaluation: Data Review

- Scope of data review reflects use requirements
- Problems with data packages should be resolved with laboratory

SI Guidance, section 5.1

OH • 4

SI Evaluation: Identify Data for Scoring

HRS aspects that depend on analytical data

- Observed releases
- Observed contamination (soil pathway)
- Targets exposed to actual contamination
- Levels of target contamination
- Hazardous waste quantity

Can use CLP and non-CLP data deemed suitable for SI objectives

SI Guidance, section 5.2

OH • 5

SI Evaluation: Identify Data for Scoring

Criteria for establishing acceptable minimum data quality:

- Intended use of data
- Specific site hypothesis being tested
- Particular HRS factor being examined
- Levels of target contamination
- Hazardous waste quantity

SI Guidance, section 5.2

OH • 6

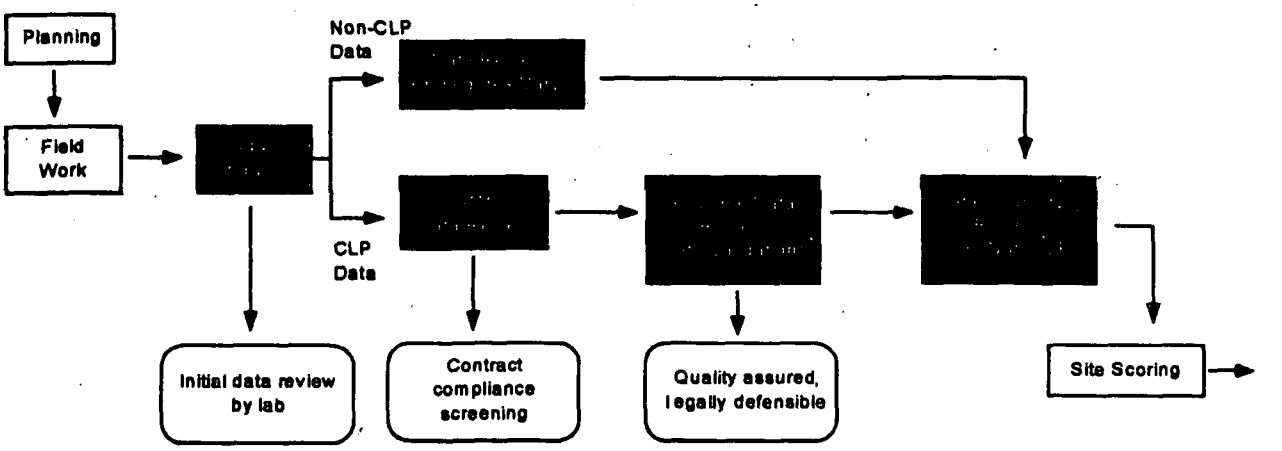
SI Evaluation: Identify Data for Scoring

- Determine usability of qualified data
- Qualifiers are added to data during laboratory analysis or data validation

SI Guidance, section 5.2

OH • 7

Analytical Data Review Process



OH • 8

SI Evaluation: Identify Data for Scoring

Qualified Analytical Data

- Data with attached letter code or "flag" indicates QA/QC problems or questions concerning chemical identity or concentration
- Flag assigned by analyzing laboratory or person validating data

OH • 9

SI Evaluation: Identify Data for Scoring

Example of Qualifed Data

Samples	1	2	3	4
Trichloroethylene	40J	160	120	30J
Tetrachloroethylene	25U	150J	100R	45
Phenol	330U	390	19,000J	490

Concentrations (ppb)

OH • 10

SI Evaluation: Identify Data for Scoring

Common Qualifiers in CLP Data

- J-flag: Concentrations are estimated; identification of hazardous substances certain
- U-flag: Compound analyzed for but not detected
- R-flag: QC indicates data are unusable
- Specific meaning of a qualifier may vary

OH • 11

SI Evaluation: Nonsampling Information

- Review SI data summary sheets
- Update with new information if needed
  - Changes in site conditions (e.g., a removal)
  - Changes in targets
- Assess quality of nonsampling information

SI Guidance, section 5.3

OH • 12

SI Evaluation: Site Score

General Strategy

- Characterize sources
- Focus on significant pathways

SI Guidance, section 5.4

OH • 13

SI Evaluation: Site Score

- SI worksheet
- PREscore software program
- HRS scoresheets
- Other evaluation tools developed by EPA regional or state offices

See SI Guidance, Appendix C, Site Inspection Worksheets

SI Guidance, section 5.4

OH • 14

SI Reporting Requirements

Narrative Report

Score Sheets

OH • 15

SI Reporting: Narrative Report

Report should:

- Describe history and nature of waste handling at site
- Describe known hazardous substances
- Describe pathways of concern
- Identify and describe targets
- Present SI analytical results

SI Guidance, section 6.1

OH • 16

SI Reporting: Narrative Report

- Can be letter report or stand-alone document
- Factual statements should be supported by references
- References not generally available should be attached
- Structure and format should follow format in Exhibit 6-1, SI Narrative Report Format

SI Guidance, section 6.1

OH • 17

EXHIBIT 6-1: SI NARRATIVE REPORT FORMAT

INTRODUCTION

- State that an SI was performed, the name of the agency performing it, and the authority under which it was conducted (e.g., CERCLA as amended by SARA, and EPA contract or cooperative agreement).
- State the site name, CERCLIS identification number, and location (street address, city, county, State, latitude/longitude coordinates). If necessary, provide brief directions to the site.
- State the purpose, scope, and objectives of the SI.

SITE DESCRIPTION AND REGULATORY HISTORY

- Identify the type of site (e.g., plating facility, chemical plant, municipal landfill), whether it is active or inactive, and years of operation. Describe its physical setting (e.g., topography, local land uses). Include the appropriate portion of a USGS 7.5-minute topographic map locating the site and showing a 1-mile radius. On the map, identify the surface water drainage route; nearest well, drinking water intake, and residence; and wetlands and other sensitive environments. Include a drafted sketch showing site layout, source areas, and features on and around the site.
- Briefly summarize dates and scope of previous investigations.
- Describe prior land use and past regulatory activities including the site's RCRA status, permits, permit violations, and inspections by local, State, or Federal authorities. Discuss any citizen complaints.

OPERATIONAL HISTORY AND WASTE CHARACTERISTICS

- Provide an operational history of the site. Identify current and former owners and operators, and describe site activities. Identify and describe wastes generated, waste disposal practices, waste source areas, waste source containment, and waste quantities. Indicate source areas on the site sketch.
- Discuss any previous sampling at the site; provide dates of sampling events and sample types. Summarize analytical results in a table. Include a site map of all previous sample locations.
- Discuss SI source sampling results. List in a table each waste source sample and summarize analytical results. Include a site map of all waste source and pathway sample locations.
- Identify hazardous substances associated with sources.
- Describe accessibility to source areas.

GROUND WATER

- Describe the local geologic and hydrogeologic setting (e.g., stratigraphy, formations, aquifers, karst features, confining layers, depth and permeability to each aquifer).

Guidance for Performing Site Inspections Under CERCLA, USEPA, 1992

EXHIBIT 6-1: SI NARRATIVE REPORT FORMAT (continued)

GROUND WATER (continued)

- Discuss ground water use within a 4-mile radius of the sources. Identify the nearest private and municipal drinking water wells and state the distance from sources. Quantify drinking water populations served by wells within 4 miles, differentiating between private and municipal wells and specifying aquifers. Identify any municipal wells that are part of a blended system; state number of wells, locations, pumping rates, and aquifer from which water is drawn. Identify wells in karst aquifers.

- Identify designated wellhead protection areas (WHPA) and specify location.

- Discuss any previous ground water sampling results; provide dates of sampling events and the depths and names of sampled aquifers.

- List in a table each well or spring sampled during the SI, provide the depth from which it draws drinking water and the screened interval, quantify the population associated with it, and identify its distance from site sources. Discuss SI ground water sampling results. List in a table each sample and summarize analytical results. Include a site map of sample locations. Identify drinking water wells exposed to hazardous substances and quantify the drinking water populations served by each.

SURFACE WATER

- Describe the local hydrologic setting, including site location with respect to floodplains, and the overland and in-water segments of the surface water migration path. State the distance from the site to the probable point of entry (PPE) into surface water. Identify the water bodies within the in-water segment, and state the length of reach and flow or depth characteristics of each; describe tidal influence. Include a drafted sketch of the surface water migration path. Describe upgradient drainage areas, onsite drainage (including storm drains, ditches, culverts, etc.), facility discharges into surface water, permits, and historical information, including floods, fish kills, fishery closures, and other events.

- Indicate whether surface water within the target distance limit supplies drinking water. Identify the location and state the distance from the PPE to each drinking water intake. Quantify the drinking water population served by surface water and identify blended systems.

- Indicate whether surface water within the target distance limit contains fisheries. Identify and state the distance from the PPE to each fishery; briefly characterize each fishery.

- Indicate whether sensitive environments are present within or adjacent to the in-water segment. Identify and state the distance from the PPE to each sensitive environment. Describe each sensitive environment and state the frontage length of wetlands on surface water.

- Discuss any previous surface water sampling results, dates, locations, and types of samples.

- Discuss SI surface water sampling results. List in a table each sample and summarize analytical results. Identify surface water intakes exposed to hazardous substances and quantify the drinking water populations served by each. Identify fisheries exposed to hazardous substances and quantify the food chain population associated with each. Identify sensitive environments and wetlands exposed to hazardous substances; quantify the frontage of exposed wetlands.

Guidance for Performing Site Inspections Under CERCLA, USEPA, 1992

EXHIBIT 6-1: SI NARRATIVE REPORT FORMAT (continued)

SOIL EXPOSURE

- State the number of workers on properties with site-related contamination.
- State the number of people who live on properties with site-related contamination and within 200 feet of an area of observed contamination. State the hazardous substance concentration and compare to health based benchmarks.
- Identify schools and day care facilities within 200 feet from an area of observed contamination on the school property and state the number of attendees.
- Identify terrestrial sensitive environments and resources in an area of observed contamination.
- State the number of people who live within 1 mile travel distance of the site.
- Discuss any previous sampling results of sources of surficial materials, including dates and locations.
- Discuss SI surficial source samples. List each sample in a table and summarize analytical results.

AIR

- Identify the location of, and state the distance to, the nearest individual. State the population within 4 miles of the site, including students and workers. Identify sensitive environments on sources and within 4 miles.
- Discuss any previous air sampling results, including dates, locations, sampling procedures, and meteorological conditions.
- Discuss SI air sampling procedures and results. Identify sample locations on a map. List in a table each sample and summarize analytical results.

SUMMARY AND CONCLUSION

- Briefly summarize the major aspects of the site and its history that relate to the release or threatened release of hazardous substances and the exposure of targets. Briefly summarize principal pathways and targets of concern.
- Summarize sampling results, including substances detected in site sources and in environmental media.

PHOTODOCUMENTATION LOG

- As an attachment, provide photographs of the site taken during the SI depicting pertinent site features such as waste source areas, containment conditions, stained soil, stressed vegetation, drainage routes, and sample locations. Describe each photograph in captions or accompanying text. Key each photo to its location on the site sketch.

Guidance for Performing Site Inspections Under CERCLA, USEPA, 1992

EXHIBIT 6-1: SI NARRATIVE REPORT OUTLINE (concluded)

APPENDICES

- Analytical results reports
- QA Report
- Other attachments

REFERENCES

- List, in bibliographic citation format, all references cited in the SI report.
- Attach copies of references cited in the SI report. Include complete copies of site-specific references (e.g., USGS topographic maps, records of communication, drinking water population apportionment and calculation worksheets, GEMS and other database printouts, waste handling records or shipping manifests). Include only the title page and pertinent excerpts of publicly available references (e.g., geologic reports).

Guidance for Performing Site Inspections Under CERCLA, USEPA, 1992

SI Reporting: Score and Documentation

During SI scoring, investigator should:

- Start at beginning of package and work through systematically
- Document all assumptions
- Develop references

Evaluate SI Results

- Use Table 6-1, Additional Evaluation of SI Results, to aid in decisions

SI Guidance, section 6.2 **OH • 18**

SI Reporting: Reviews

SI reports and scoresheets undergo three separate reviews

- SI investigator conducts detailed review of SI report and scoresheets for completeness and internal consistency
- Independent reviewer reviews analytical data and internal consistency
- EPA regional officials and state personnel review reasonableness and whether SI objectives were met

SI Guidance, section 6.3 **OH • 19**

Site Disposition Decision

Recommendation based on site score

- No further remedial action planned (NFRAP)
- Expanded SI (if focused SI conducted initially)
- HRS package preparation

EPA makes final decision

OH • 20

Notes:

APPENDIX A

Fact Sheets

PB93-963341

United States Environmental Protection Agency | Office of Solid Waste and Emergency Response | Directive 9345.1-16FS EPA540-F-93-038 September 1993

EPA

Integrating Removal and Remedial Site Assessment Investigations

Office of Emergency and Remedial Response
Hazardous Site Evaluation Division (5204G)

Quick Reference Fact Sheet

Increased efficiency and shorter response times are the primary objectives of integrating removal and remedial site assessment investigations under the Superfund Accelerated Cleanup Model (SACM). This is based on the assumption that there is duplication of effort between the programs. A critical element of SACM is a continuous and integrated approach to assessing sites. The concept of integrating removal and remedial site assessment activities was introduced in *Assessing Sites Under SACM—Interim Guidance* (OSWER Publication 9203.1-05I, Volume 1, Number 4, December 1992). This fact sheet examines areas of duplication and key differences between the two types of investigations, and describes some approaches for integrating assessments. The primary audience for this information is the site assessment community which includes EPA On-Scene Coordinators (OSCs) and Site Assessment Managers (SAMs), their counterparts in state or other federal agencies, and assessment contractors.

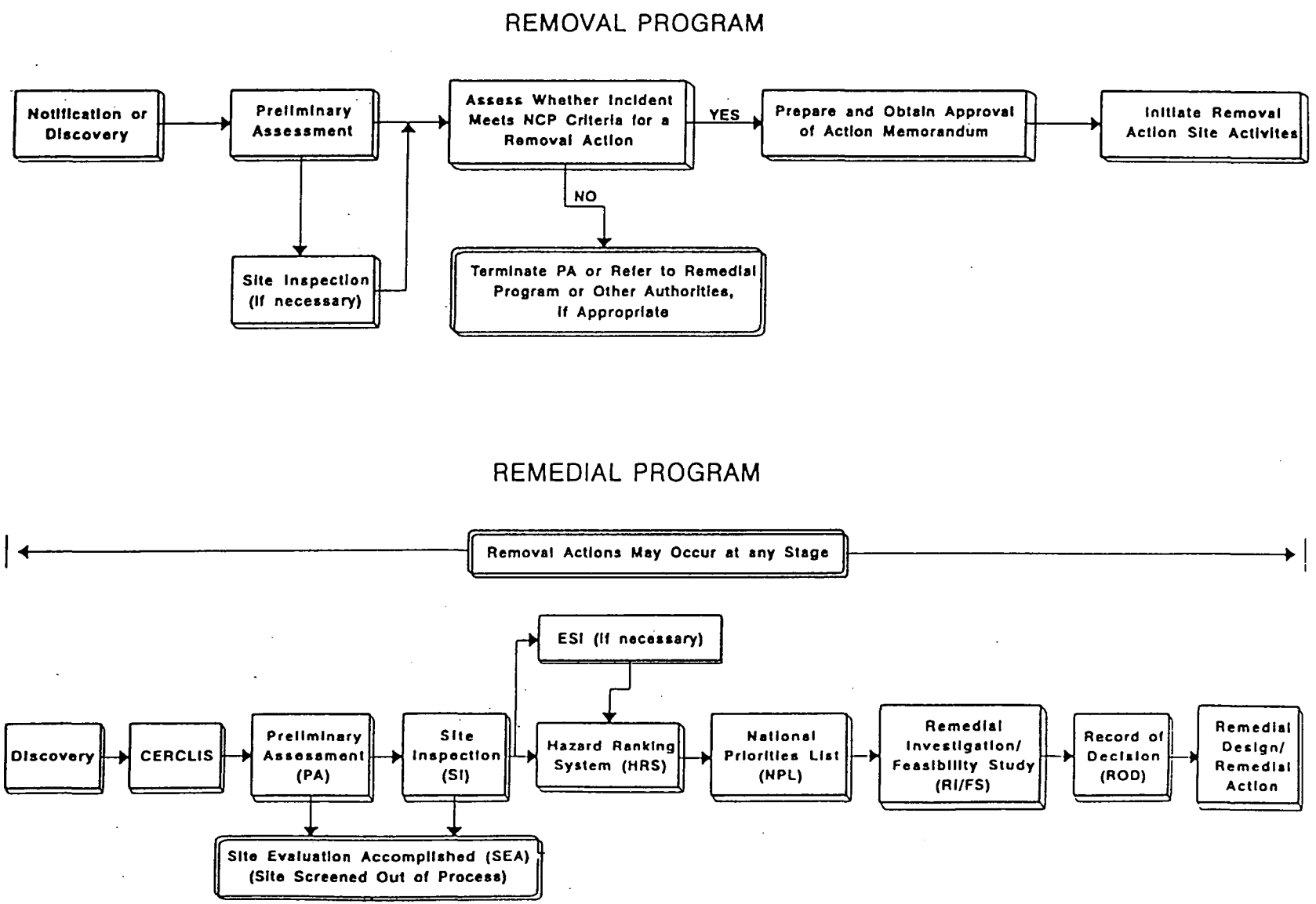
REMOVAL ASSESSMENTS AND REMEDIAL SITE ASSESSMENTS

Figure 1 illustrates traditional assessment activities of the removal and remedial programs prior to SACM. Typically, when EPA is notified of a possible release (under CERCLA Section 103), the removal program determines whether there is a need for emergency response by EPA. If a response is deemed necessary, an OSC and/or a removal program contractor will visit the site. If circumstances allow, a file and telephone investigation should be initiated prior to the site visit. The OSC may decide to take samples during this initial visit or may postpone sampling. EPA can initiate a removal action at any point in the assessment process. If the OSC determines that the site does not warrant a removal action, he may refer the site to remedial site assessment or the State for further evaluation, or recommend no further federal response action.

The remedial site assessment process is similar to that of the removal program. Once a site has been discovered and entered into the CERCLIS data base, the SAM directs that a preliminary assessment (PA) be performed at the site. The focus of PA data collection is the set of Hazard Ranking System (HRS) factors that can be obtained without sampling (e.g., population within 1/4 mile). The PA includes a file and telephone investigation, as well as a site visit (the PA reconnaissance, or "recon"). The PA recon differs from the typical removal site visit because samples are not collected and observations are often made from the perimeter of the site (although some Regions prefer on-site PA recons). From the PA information, the SAM determines if a site inspection (SI) is needed (i.e., whether the site could score greater than the 28.5 needed to qualify for inclusion on the National Priorities List (NPL)). The SI would include sufficient sampling and other information to allow the SAM to determine whether the score is above 28.5. Even in cases where SI data are adequate for this decision, it may be necessary to conduct an expanded site inspection (ESI) to obtain legally defensible documentation.

In general, the remedial site assessment process is more structured than the removal assessment and operates on a less intensive schedule. The remedial site assessment process is focused on collecting data for the HRS, while Removal assessments are based on whether site conditions meet National Contingency Plan (NCP) criteria for a removal action.

Figure 1: Traditional Assessment Processes



INTEGRATING ASSESSMENT ACTIVITIES

While there are differences in objectives between removal and remedial assessments (i.e., NCP removal criteria versus HRS), many of the same factors are important to both programs: the potential for human exposure through drinking water, soils, and air pollution; and threats to sensitive environments such as wetlands. Similarities in the activities required by both assessments—telephone and file investigations, site visits or PA recons, removal or SI sampling visits—suggest that the activities can be consolidated. The challenge of integrating assessments is to organize the activities to enhance efficiency.

The basic goals of an integrated assessment program under SACM are:

- Eliminate duplication of effort.
- Expedite the process. At a minimum, avoid delays for time-critical removal actions or early actions (see *Early Action and Long-Term Action Under SACM— Interim Guidance*, OSWER Publication 9203.1-05I, Volume 1, Number 2, December 1992, for details on early and long-term actions).
- Minimize the number of site visits and other steps in the process.
- Collect only the data needed to assess the site appropriately.

The last point is critical to enhancing efficiency since not all sites need to be assessed in depth for both removal and remedial purposes. Integrating assessments does not mean simply adding together the elements of both assessments for all sites—efficient decision points must be incorporated into the integration process. The elements deemed necessary for an integrated assessment depend on the particular needs of a specific site and could involve similar, additional, or slightly different activities from traditional removal or remedial site assessments.

Figure 2 shows an approach for integrating the two assessments and indicates ways to eliminate unnecessary data collection. The most important features of the approach are the combined notification/site discovery/screening function; the single site visit for both programs; phased file searches as appropriate; and integrated sample planning and inspection. This approach is detailed below.

Notification/Site Discovery/Screening

This "one door" notification process is a combination of the current removal and remedial program notification/discovery. All remedial and removal program discovered sites are screened for possible emergency response. The screening step would determine whether there is time for a file search prior to the initial site visit.

(Classic) Emergency

If an emergency is identified, the response would be implemented immediately. Emergency responses require immediate sampling and removal actions and allow little or no time for file or telephone investigations prior to site activity.

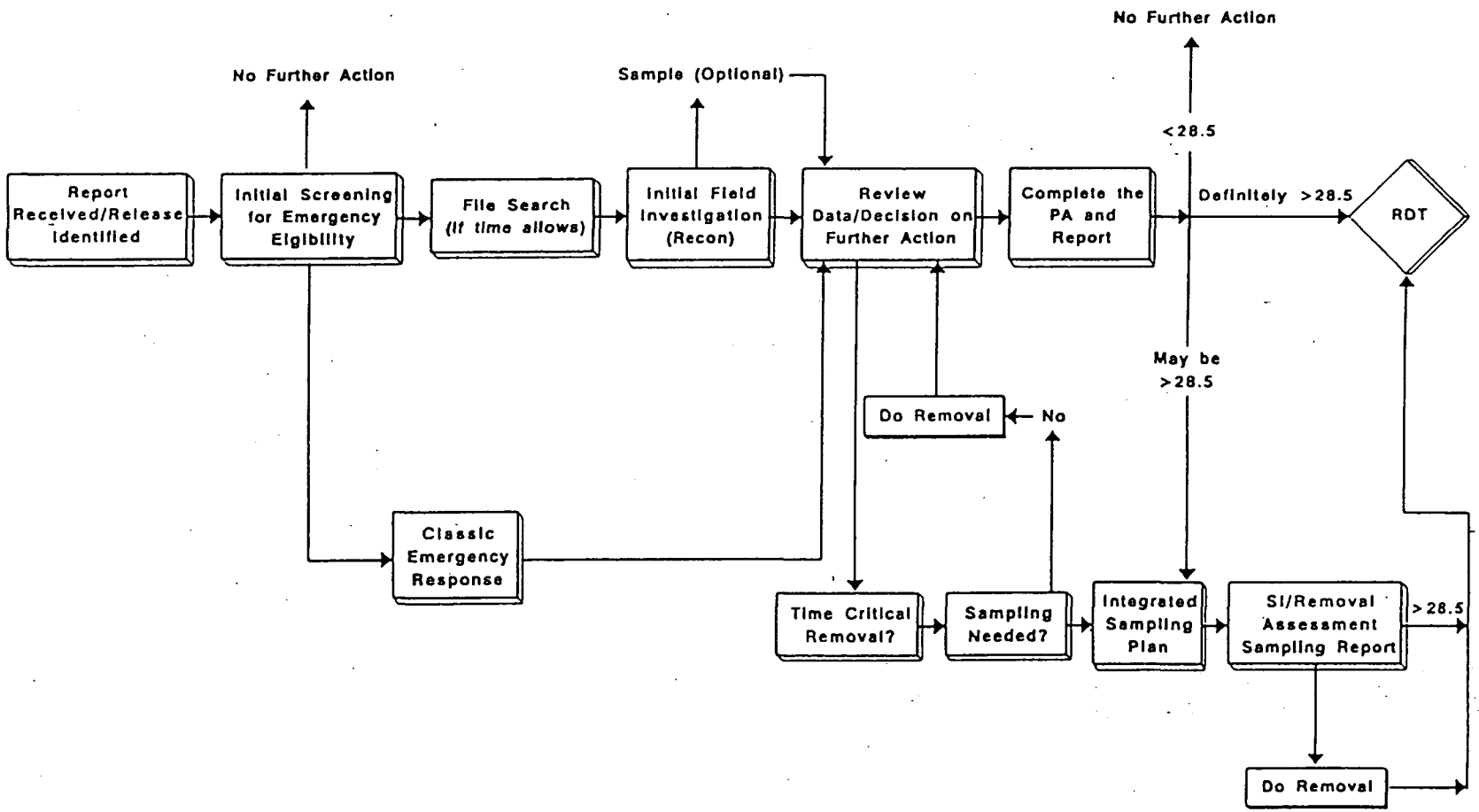
File Search

The integrated file search includes all elements of the current removal assessment file search. All file search elements should be thoroughly documented to serve the needs of both programs. Table 1 lists data elements that are commonly a part of the file search. The timing of the file search relative to the initial site visit would be determined during the notification/screening step.

Table 1: File Search and Telephone Investigation

Elements Common to Both Programs
• Regulatory program file search (e.g., RCRA, water, state) • Site access information and property ownership • Site history, industrial processes • Substances used at site • Past releases (substances, locations, impacts) • Latitude and longitude • Topographic maps
Generally Removal Assessment Only
• Potentially responsible party (PRP) search • Treatment technology review

Figure 2: Integrated Assessment



Initial Field Investigation/PA Recon

The integrated site visit combines elements of both the removal assessment field visit and the remedial PA recon. Because removal and remedial program site visit activities are similar, only a small increase in effort would be required to meet the needs of both programs. Documentation needs of remedial site assessment might require slight revision of removal assessment procedures. For example, one might need to document the distance to the nearest residence, in addition to locating any contaminated residential properties; for removal assessment needs, one might need to assess the extent of contamination. The assessment team will need to gain site access approval for the site visit, in contrast with current remedial PA recons performed from the perimeter in some Regions. Table 2 lists elements that are commonly part of the screening site visit.

Sample (Optional)

Integrated assessment sampling should follow the current removal assessment approach, except that HRS data needs should be considered in selecting sample locations and laboratory analyses. The emphasis, however, is on removal assessment needs.

Review Data/Decide Further Action

Both removal and remedial programs would jointly recommend a course of action, taking into consideration any previous removal actions. A site might undergo either a continuation of the removal assessment, a remedial site assessment PA, or both concurrently. Alternatively, a time-critical removal action could be performed prior to deciding whether the site should undergo a PA. Completing the PA might be expedited in order to determine early in the process whether remedial site assessment requirements should be included in sampling plans. When planning the site inspection, the Region may also want to consider the effect of a removal action on the HRS score (see *The Revised Hazard Ranking System: Evaluating Sites After Waste Removals*, OSWER Publication 9345.1-03FS, October 1991).

Complete the PA

Collect any information needed for the remedial site assessment that was not part of the earlier file search, and calculate the preliminary HRS score. For sites assigned the SEA (site evaluation accomplished) designation, also complete the PA report. Depending on circumstances and the Region's approach, the PA report might be included as part of a comprehensive PA/SI report for sites scoring above 28.5. Table 3 lists typical data elements of this activity. If after the PA it is evident that a site is likely to qualify for the NPL, the site would be referred to the Regional Decision Team (RDT). (See *SACM Regional Decision Teams—Interim Guidance*, OSWER Publication 9203.1-05I, Volume 1, Number 5,

Table 2: Data Elements of the Site Visit

Elements Common to Both Programs
• Current human exposure identification • Sources identification, including locations, sizes, volumes • Information on substances present • Labels on drums and containers • Containment evaluation • Evidence of releases (e.g., stained soils) • Locations of wells on site and in immediate vicinity • Runoff channels or pathways • Location of site or sources relative to surface waters • Nearby wetlands identification • Nearby land uses (e.g., residential, schools, parks, industrial) • Distance measurements or estimates for wells, land uses (residences and schools), surface waters, and wetlands • Public accessibility (e.g., site fence) • Blowing soils and air contaminants • Photodocumentation • Site sketch
Generally Removal Assessment Only
• Petroleum releases (eligible) • Fire and explosion threat • Urgency of need for response • Response and treatment alternatives evaluation • Greater emphasis on specific pathways (e.g., direct contact) • Sampling
Generally Remedial Site Assessment Only
• Perimeter survey (in some Regions) • Number of people within 200 feet • Some sensitive environments (e.g., endangered species habitats) • Review all pathways

Table 3: Data Elements Needed to Complete the PA

- Population within 1 and 4 miles
- All private and municipal wells within 4 miles
- Depth to ground water (sometimes also collected for removal assessment)
- Local or regional geology and climate
- Distance to surface water measured (removal assessment only estimates distance)
- Fisheries along a 15-mile surface water migration pathway
- Sensitive environments along a 15-mile surface water migration pathway
- Size of wetlands
- Preliminary HRS score

December 1992, for details on the composition and role of the RDT.)

Integrated Sampling Plan

This combines planning for the current screening level SI (see section 2.1 of the *Guidance for Performing Site Inspections Under CERCLA*, OSWER Directive 9345.1-05, 1992) and any removal sampling activities not already addressed by the initial visit. When it appears that a remedial action will be appropriate, and the site looks like a candidate for NPL listing, a Remedial Project Manager (RPM) should join the OSC and SAM in sample planning to incorporate the objectives of any potential long-term actions at the site. For applicable sites, this will enhance the efficiency of progressing from assessment to remediation, or starting a remedial investigation prior to NPL proposal. Likewise, sample planning should anticipate the needs of any possible engineering evaluation/cost analysis (EE/CA) that might be needed for subsequent non-time-critical removal actions.

SI/Removal Assessment Sampling

This is a single sampling event designed to meet the needs of both programs, where appropriate. Along with the site visit and the file search, integrating sampling would improve efficiency. Table 4 describes differences in emphasis between removal and remedial site assessment sampling approaches which need to be considered when developing a joint sampling plan.

RDT Decisions

The RDT determines the course of action needed to address a site, based on the outcome of the site assessment PA, SI/removal assessment, and any time-critical removal actions. This can include proposing to list the site on the NPL; conducting an early action; starting the remedial investigation (RI) early; or combining the RI with the data collection needed for listing.

ESI/RI

One option open to the RDT is to start the RI as soon as it is apparent that the site will qualify for the NPL (e.g., after a PA), even if further documentation is needed for NPL rulemaking. The needs of NPL listing and the RI can be integrated into a single sampling plan to give a headstart to a long-term action.

Flexibility in Approach

Figure 2 addresses the most likely approaches for screening site assessments; in fact, the approach will vary according to the site and other factors. Time-critical removal actions can occur at any time. Enforcement, community relations, and remedial planning considerations can be factored into data collection as needed at any point along the process.

OTHER CONSIDERATIONS

Methods of recording or documenting information vary between programs. Documentation is a major consideration for both programs, but the HRS requires a specific data set. In order for a common data element to be used by both programs, HRS documentation needs to be addressed.

Timing and duration of the activities also need to be considered by Regional personnel who are setting up integrated assessments. One critical timing consideration involves the step "complete the PA." At some sites this can proceed on a routine schedule, but if a Region decides that sampling is needed to

Table 4: Site Inspection/Removal Assessment Sampling

Remedial Site Assessment Emphasis
• Attribution to the site • Background samples • Ground water samples • Grab samples from residential soils • Surface water sediment samples • HRS factors related to surface water sample locations (e.g., floodplains, watershed area) • Fewer samples on average (10-30) than removal assessment • Strategic sampling for HRS • Contract Laboratory Program (CLP) usage (no separate funding for analytical services) • Full screening organics and inorganics analyses • Definitive analyses • Documentation, including targets and receptors (e.g., maps, census data) • Computing HRS scores • Standardized reports
Removal Assessment Emphasis
• Sampling from containers • Physical characteristics of wastes • Treatability and other engineering concerns • On-site contaminated soils • Composite and grid sampling • Rapid turnaround on analytical services • Field/screening analyses • PRP-lead removal actions • Goal of characterizing site (e.g., defining extent of contamination) • Focus on NCP removal action criteria

determine whether to undertake a time-critical removal action, the PA should be completed before developing the integrated sampling plan. Otherwise, the remedial site assessment sampling needs may not be appropriately factored into the sampling plan. By collecting enough data to develop a preliminary HRS score, the Region can determine whether the site may be eligible for the NPL and whether it is worthwhile to collect HRS-related samples. The PA report can be combined with an SI report at a later time, if appropriate.

An integrated sampling approach implies the need for a coherent approach to sample analysis. Some general principles should be followed to avoid major problems. Analytical data must be suitable for NPL purposes. Analytical services should include the appropriate reporting requirements to allow for data validation at a later date, if necessary. Table 5 lists some data quality considerations for analytical data used to support an HRS score.

The focus of this fact sheet is on the technical integration of assessments at sites where there is a potential for no action, early actions, or long-term actions. In some cases, the Region will rule out the need for one of those, and the assessment process under SACM will be similar to a traditional removal or remedial site assessment.

Integration of assessments under SACM will reduce duplication of effort at sites by addressing them with a single assessment approach which incorporates the objectives of both programs as applicable to each site. Integration of assessments is an efficient blending of similar procedures which may be appropriate at some sites and meets the objectives and needs of both programs.

Table 5: Analytical Data Quality Needs For HRS Observed Releases

- Sampling procedures, location, and conditions documented in field log.
- Chain of custody.
- Field blanks for each parameter for each day of sampling. The concentration of contaminants detected must be at least one order of magnitude below corresponding sample results.
- Initial 2-point calibration. Low level standard at or below concentration level of concern. High concentration standard no more than 2 orders of magnitude above the low concentration standard.
- Continuing calibration using low level concentration standard after 10 to 15 sample analyses, or at the end of the day/sampling event, whichever occurs first. (This step ensures consistent instrument response.)
- Blanks run after high level samples to avoid cross contamination.

Specific examples of acceptable field methods:

- X-ray fluorescence (XRF) for metals with site-specific standard matrix or with 10 percent lab confirmation by accepted EPA atomic absorption (AA) method.
- Field headspace or vadose zone VOC analysis with site specific standards, coupled with previous site information such as spill composition, 10 percent split for verification by an accepted EPA method, or successful field analysis of a PE or reference sample.

Additional copies can be obtained from:

Public		EPA Employees
National Technical Information Service (NTIS)	or	Superfund Documents Center
U.S. Department of Commerce		U.S. Environmental Protection Agency
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Office of Solid Waste and Emergency Response

Directive 9285.7-14FS
PB94-963311
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EPA

Using Qualified Data to Document an Observed Release

Office of Emergency and Remedial Response
Hazardous Site Evaluation Division (5204G)

Quick Reference Fact Sheet

Abstract

Data validation checks the accuracy of analytical data, and qualifies results that fall outside performance criteria of the Contract Laboratory Program (CLP). Results qualified with a "J" are estimated concentrations that may be biased, but may be used to determine an observed release in Hazard Ranking System (HRS) evaluation. This fact sheet explains the conditions for use of "J"-qualified data, and introduces factors which compensate for variability and enable their use in HRS evaluation.

Why Qualify Data?

Chemical concentration data for environmental decision-making are generated using analytical methods. EPA analytical chemistry methods are designed to provide the definitive analyte identification and quantitation needed to establish an observed release under the Hazard Ranking System (HRS). Routine operational variations in sampling and analysis inevitably introduce a degree of error into the analytical data. Data validation checks the usability of the analytical data for HRS evaluation and identifies the error (bias) present. The validation process qualifies the biased data. Certain types of qualified data for release and background samples may be used to determine an observed release.

EPA Data Qualifiers

EPA analytical methods (e.g., SW-846 and Contract Laboratory Program [CLP]) introduce a number of Quality Assurance/Quality Control (QA/QC) mechanisms during the course of sample analysis to measure qualitative and quantitative accuracy.[3,4,8,9] Such mechanisms include matrix spikes, matrix spike duplicates, laboratory control samples, surrogates, blanks, laboratory duplicates, and quarterly blind performance evaluation (PE) samples. Surrogates and spikes are chemically similar to the analytes of interest and thus behave similarly during the analytical process. They are introduced or "spiked" at a known concentration into the field samples before analysis. Comparison of the known concentrations of the surrogates and spikes with their analytical results measures accuracy, and may indicate bias caused by interferences from the sample medium (matrix effect).[1,2,9] Laboratory control samples contain known concentrations of target analytes and are analyzed in the same batch as field samples. Their results are used to measure laboratory accuracy. Blanks are analyzed to detect any extraneous contamination introduced either in the field or in the laboratory. Laboratory duplicates consist of one sample that undergoes two separate analyses; the results are compared to determine laboratory precision. Quarterly blind PE samples also evaluate lab precision.

CLP and other EPA analytical methods include specifications for acceptable identification, and minimum and maximum percent recovery of the target analytes and QA/QC compounds. Data are validated according to guidelines which set performance criteria for instrument calibration, analyte identification, and identification and recovery of the QA/QC compounds.[3,4,9] The *National Functional Guidelines for Data Review* used in EPA validation were designed for data generated under the CLP organic and inorganic analytical protocols.[1,2,3,4] The guidelines do not preclude the validation of field and non-CLP data; many EPA Regions have adapted the *National Functional Guidelines for Data Review* to validate non-CLP data. Data which do not meet the

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guidelines' performance criteria are qualified to indicate bias or QC deficiencies. The data validation report usually explains why the data were qualified and indicates the direction of bias when it can be determined. Most EPA validation guidelines use the data qualifiers presented below. [1,2] (Other data qualifiers besides these are in use; always check the validation report for the exact list of qualifiers and their meanings.)

- **"U" qualifier** -- the analyte was analyzed for, but was not detected above the reported sample quantitation limit. For practical purposes, "U" means "not detected"; the result is usable for characterizing background concentrations for HRS evaluation. [5]

- **"J" qualifier** -- the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample. "J" data are biased, but provide definitive analyte identification, and are usually reliable. They may be used to determine an observed release under conditions specified later in this fact sheet. [5]

- **"N" qualifier** -- the analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification." "N" data are not sufficiently definitive for HRS evaluation.

- **"NJ" qualifier** -- the analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration. "NJ" data are not sufficiently definitive for HRS evaluation.

- **"UJ" qualifier** -- the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. "UJ" non-detects are not definite; the analyte may be present. The result can be used to document non-detects in background samples under certain conditions.

- **"R" qualifier** -- the sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified. EPA does not use "R" data because they are considered unreliable. [5]

Validated data that are not qualified are unbiased, and can be used at their reported values for HRS evaluation.

Criteria for Determining an Observed Release with Chemical Data

Chemical data demonstrate an observed release when all of the following are true:

1. The release of a hazardous substance is at least partially attributable to the site under investigation.

2. The release sample concentration is greater than or equal to the appropriate detection limit (e.g., sample quantitation limit [SQL]).

3. If background levels are below detection limits, the release sample concentration must be greater than its detection limit, or, if background levels are greater than or equal to detection limits, the release sample concentration must be at least three times the background concentration. [7]

Direction of Bias in "J"-Qualified Data

It is important to understand the bias associated with "J"-qualified data when using them for HRS evaluation. "J" data may have high, low, or indeterminate bias. A low bias means that the reported concentration is most likely an underestimate of the true concentration. For example, data may be biased low when sample holding times for volatile organic compounds (VOCs) are exceeded or when the recovery of QA/QC compounds is significantly less than the true amount originally introduced into the sample. A high bias means that the reported concentration is most likely an overestimate of the true concentration. A bias is indeterminate when it is impossible to ascertain whether the concentration is an overestimate or an underestimate. For example, an indeterminate bias could result when matrix effects obscure QA/QC compounds.

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Qualified Data and Direction of Bias

Qualified data may be used when it can be demonstrated that the data meet the HRS rule for determining an observed release despite the bias in the reported concentrations. This condition depends on the direction of bias: low bias data may be used for release samples, and high bias data may be used for background samples. Low bias release samples are underestimates of true concentration. Underestimated release concentrations that still meet the HRS criteria (e.g., they are still three times background level) clearly establish an observed release. High bias background samples are overestimates of background level. If the concentration of unbiased release samples still significantly exceeds an overestimated background level according to HRS criteria, an observed release is clearly established. Similarly, an observed release is established when low bias release concentrations significantly exceed high bias background concentrations according to the HRS criteria.

These scenarios show that low bias "J-"qualified data may be used for release samples at their reported concentrations, and that high bias "J-"qualified data may be used for background samples at their reported concentrations.

High bias release samples may not be used at their reported concentrations because they are an overestimate of true concentration; the true concentration might be less than the HRS criteria for an observed release. The reported concentration for low bias background concentrations may not be compared to release samples because it is most likely an underestimate of background level; the release sample concentration might not significantly exceed the background concentration. However, high bias release data and low bias background data may be used with factors which compensate for the variability in the data. The factors will enable these types of biased data to meet HRS criteria for determining an observed release.

Factors for Biased Data: Tables 1 through 4 (pages 6-13) present analyte-specific factors to address the uncertainty when determining an observed release using high bias release data and low bias background data. The factors are derived from percent recoveries of matrix spikes, surrogates, and laboratory control samples in the CLP Analytical Results Database (CARD) from January 1993 to March 1994.

The range of CARD data for each analyte includes 95 percent of all percent recoveries. Discarding outliers left 95 percent of the CARD data available for calculating factors. The factors are ratios of percent recovery values at the 97.5 and 2.5 percentiles. The ratios generally show a consistent pattern.

An attempt to "convert" a biased value to its true concentration is not recommended because the CARD data do not differentiate and quantify individual sources of variation. The factors are applied as "safety factors" to ensure that biased data can be used to meet HRS criteria for determining an observed release. Dividing a high bias value by a factor effectively deflates it from the high end of the range to the low end (low bias value). Multiplying a low bias value by the factor effectively inflates it to a high bias value. Use of the ratio of percentiles is a "worst-case" assumption that the data are biased by the extent of the range of CARD data considered. The factors either inflate the values to the high end of the range, or deflate the data to the low end, and thus compensate for the apparent variability when comparing a high bias value to a low bias value (see Exhibit 1).

Factors have been selected for all analytes in the CLP Target Compound List (organic analytes) and Target Analyte List (inorganic analytes). Some organic factors were derived from matrix spike percent recoveries, and some from surrogate percent recoveries, depending on availability of data. When both matrix spike and surrogate data were available for the same compound, the larger value (representing more extreme high and low percent recoveries) was used. Laboratory control samples were used to calculate some of the inorganic factors. A default factor of 10 was used for analytes when percent recovery data were unavailable.

Application of the Factors: Exhibit 1 shows how to apply the factors to "J" qualified data. High bias background data, low bias release data, and unbiased data may be used at their reported concentrations. Multiply low bias background sample data by the analyte-specific factor to bring them to their new value. The new background value effectively becomes a high bias value that may be used to determine an observed release. Divide high bias release sample data by the analyte-specific factor to bring them to their new value. The new release sample value effectively becomes a low bias result that may be used

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Exhibit 1: Use of Factors for "J"-Qualified Data		
Type of Sample	Type of Bias	Action Required
Background Sample	No Bias	None: Use concentration without factor
	Low Bias	Multiply concentration by factor
	High Bias	None: Use concentration without factor
	Unknown Bias	Multiply concentration by factor
Release Sample	No Bias	None: Use concentration without factor
	Low Bias	None: Use concentration without factor
	High Bias	Divide concentration by factor
	Unknown Bias	Divide concentration by factor

to determine an observed release. *Note: Adjusted release and background values must still meet HRS criteria (e.g., release concentration must be at least three times background level) to determine an observed release.*

Examples Using Trichloroethene in Soil:

1. Release sample data biased low, background sample data biased high.

Release sample value: 30 μg/kg (J) *low bias*
Background sample value: 10 μg/kg (J) *high bias*

In this instance, the direction of the bias indicates that the release sample concentration exceeds background by more than three times, so an observed release is established (provided all other HRS criteria are met). Use of the factors is not needed.

2. Release sample data unbiased, background sample data biased low.

Release sample value: 30 μg/kg *no bias*
Background sample value: 10 μg/kg (J) *low bias*

To use the data to establish an observed release, multiply the background sample value by factor given for trichloroethene (1.8). No factor is needed for the release sample.

New background sample value:
(10 μg/kg) x (1.8) = 18 μg/kg (J) *high bias*

The release sample concentration does not exceed the new background level by a factor of three, so an observed release is not established.

3. Release sample data biased high, background sample data unbiased.

Release sample value: 75 μg/kg (J) *high bias*
Background sample value: 15 μg/kg *no bias*

To use the data to establish an observed release, divide the release sample value by the factor for trichloroethene (1.8). No factor is needed for the background sample.

New release sample value:
(75 μg/kg) ÷ (1.8) = 42 μg/kg (J) *low bias*

The new release sample concentration does not exceed background concentration by a factor of three, so an observed release is not established.

4. Release sample data biased high, background sample data biased low.

Release sample value: 100 μg/kg (J) *high bias*
Background sample value: 10 μg/kg (J) *low bias*

To use the data to establish an observed release, divide the release sample value and multiply the background sample value by the factor given for trichloroethene in soil (1.8).

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New release sample value:
(100 μg/kg) ÷ (1.8) = 56 μg/kg (J) *low bias*

New background sample value:
(10 μg/kg) x (1.8) = 18 μg/kg (J) *high bias*

The new release sample concentration is three times the new background concentration, so an observed release is established, provided all other HRS criteria are met.

Documentation Requirements for Use of Qualified Data: When using "J"-qualified data to determine an observed release, include the "J"-qualifier commentary from the data validation report in the HRS package. This step will ensure that the direction of bias is documented.

Use of Other Factors: EPA Regions may substitute higher factor values other than the ones in this fact sheet on a case-by-case basis when technically justified. For example, other factors may be applied to conform with site-specific Data Quality Objectives (DQOs) or with Regional Standard Operating Procedures (SOPs).[10]

Detection Limit Restrictions: Factors may only be applied to "J" data with concentrations above the CLP Contract Required Quantitation Limit (CRQL) or Contract Required Detection Limit (CRDL). "J"-qualified data with concentrations below CLP detection limits cannot be used to document an observed release.

Use of "UJ"-Qualified Data

A combination of the "U" and "J" qualifiers indicates that the reported value may not accurately represent the concentration necessary to detect the analyte in the sample. Under limited conditions, "UJ" data can be used to represent background when determining an observed release. These conditions include instances when there is confidence that the background concentration has not been detected and the sample measurement that establishes the observed release equals or exceeds the SQL or other appropriate detection limit. This reasoning is based on the presence of a high bias in the background sample. Thus, UJ data can be used only when all of the following conditions apply:

- The "UJ" value applies to the background sample and represents the detection limit,
- The "UJ" value is biased high, and
- The release sample concentration exceeds the SQL (or applicable detection limit) and is unbiased or biased low.

Summary

Data validation checks the usability of analytical data and identifies certain errors (bias). "J"-qualified data identify that analytes are present, but the reported values represent estimated concentrations associated with bias. Low bias release data and high bias background data may be used at the reported values. High bias release data and low bias background data may not be used at their reported concentrations because they do not establish an observed release with certainty. Application of factors introduced in this fact sheet compensate for this uncertainty, and enable "J" data to be used to determine an observed release.

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Table 1: Factors for Volatile Organic Analytes				
VOLATILE ORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
1,1,1-TRICHLOROETHANE	--	10.0	--	10.0
1,1,2,2-TETRACHLOROETHANE	11144	1.5	9180	1.2
1,1,2-TRICHLOROETHANE	--	10.0	--	10.0
1,1-DICHLOROETHANE	11144	1.4	9179	1.3
1,1-DICHLOROETHENE	2064	2.4	1484	2.0
1,2-DICHLOROETHANE	11144	1.4	9179	1.3
1,2-DICHLOROETHENE (TOTAL)	11144	1.4	9179	1.3
1,2-DICHLOROPROPANE	--	10.0	--	10.0
2-BUTANONE	11144	1.4	9179	1.3
2-HEXANONE	11144	1.5	9180	1.2
4-METHYL-2-PENTANONE	11144	1.5	9180	1.2
ACETONE	11144	1.4	9179	1.3
BENZENE	2060	1.7	1482	1.5
BROMODICHLOROMETHANE	--	10.0	--	10.0
BROMOFORM	--	10.0	--	10.0
BROMOMETHANE	11144	1.4	9179	1.3
CARBON DISULFIDE	11144	1.4	9179	1.3

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Table 1: Factors for Volatile Organic Analytes (continued)				
VOLATILE ORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
CARBON TETRACHLORIDE	--	10.0	--	10.0
CHLOROBENZENE	2058	1.6	1480	1.4
CHLOROETHANE	11144	1.4	9179	1.3
CHLOROFORM	11144	1.4	9179	1.3
CHLOROMETHANE	11144	1.4	9179	1.3
CIS-1,3-DICHLOROPROPENE	--	10.0	--	10.0
DIBROMOCHLOROMETHANE	--	10.0	--	10.0
ETHYLBENZENE	11144	1.5	9180	1.2
METHYLENE CHLORIDE	11144	1.4	9179	1.3
STYRENE	11144	1.5	9180	1.3
TETRACHLOROETHENE	11144	1.5	9180	1.2
TOLUENE	2029	2.0	1468	1.4
TRANS-1,3-DICHLOROPROPENE	--	10.0	--	10.0
TRICHLOROETHENE	2046	1.8	1452	1.5
VINYL CHLORIDE	11144	1.4	9179	1.3
XYLENE (TOTAL)	11144	1.5	9180	1.2

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Table 2: Factors for Semivolatile Organic Analytes				
SEMIVOLATILE ORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
1,2,4-TRICHLOROBENZENE	1978	3.5	1375	2.9
1,2-DICHLOROBENZENE	11899	3.8	7951	4.0
1,3-DICHLOROBENZENE	11899	3.8	7951	4.0
1,4-DICHLOROBENZENE	1980	3.8	1373	3.0
2,2'-OXYBIS(1-CHLOROPROPANE)	11899	3.8	7951	4.0
2,4,5-TRICHLOROPHENOL	11889	8.9	7952	3.6
2,4,6-TRICHLOROPHENOL	11889	8.9	7952	3.6
2,4-DICHLOROPHENOL	11896	4.0	7949	2.5
2,4-DIMETHYLPHENOL	11896	4.0	7949	2.5
2,4-DINITROPHENOL	11889	8.9	7952	3.6
2,4-DINITROTOLUENE	1979	3.4	1375	2.6
2,6-DINITROTOLUENE	11889	8.9	7952	3.6
2-CHLORONAPHTHALENE	11889	8.9	7952	3.6
2-CHLOROPHENOL	1930	3.2	1376	2.9
2-METHYLNAPHTHALENE	11896	4.0	7949	2.5
2-METHYLPHENOL	11899	3.8	795[illegible]	4.0
2-NITROANILINE	11889	8.9	7952	3.6
2-NITROPHENOL	11896	4.0	7949	2.5
3,3'-DICHLOROBENZIDINE	11898	4.3	7951	6.0
3-NITROANILINE	--	10.0	--	10.0
4,6-DINITRO-2-METHYLPHENOL	--	10.0	--	10.0
4-BROMOPHENYL-PHENYL ETHER	--	10.0	--	10.0
4-CHLORO-3-METHYLPHENOL	1927	3.6	1375	3.5
4-CHLOROANILINE	11896	4.0	7949	2.5
4-CHLOROPHENYL-PHENYL ETHER	11899	8.9	7952	3.6
4-METHYLPHENOL	11899	3.8	7951	4.0

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Table 2: Factors for Semivolatile Organic Analytes (continued)				
SEMIVOLATILE ORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
4-NITROANILINE	11889	8.9	7952	3.6
4-NITROPHENOL	1905	4.8	1368	4.5
ACENAPHTHENE	1965	3.1	1361	3.0
ACENAPHTHYLENE	11889	8.9	7952	3.6
ANTHRACENE	--	10.0	--	10.0
BENZO(A)ANTHRACENE	11898	4.3	7951	6.0
BENZO(A)PYRENE	--	10.0	--	10.0
BENZO(B)FLUORANTHENE	--	10.0	--	10.0
BENZO(G,H,I)PERYLENE	--	10.0	--	10.0
BENZO(K)FLUORANTHENE	--	10.0	--	10.0
BIS(2-CHLOROETHOXY)METHANE	11896	4.0	7949	2.5
BIS(2-CHLOROETHYL)ETHER	11899	3.8	7951	4.0
BIS(2-ETHYLHEXYL)PHTHALATE	11898	4.3	7951	6.0
BUTYLBENZYLPHTHALATE	11898	4.3	7951	6.0
CARBAZOLE	--	10.0	--	10.0
CHRYSENE	11898	4.3	7951	6.0
DI-N-BUTYLPHTHALATE	--	10.0	--	10.0
DI-N-OCTYLPHTHALATE	--	10.0	--	10.0
DIBENZ(A,H)ANTHRACENE	11889	8.9	7952	3.6
DIBENZOFURAN	11889	8.9	7952	3.6
DIETHYLPHTHALATE	11889	8.9	7952	3.6
DIMETHYLPHTHALATE	11889	8.9	7952	3.6
FLUORANTHENE	--	10.0	--	10.0
FLUORENE	11889	8.9	7952	3.6
HEXACHLOROBENZENE	--	10.0	--	10.0
HEXACHLOROBUTADIENE	11896	4.0	7949	2.5
HEXACHLOROCYCLOPENTADIENE	11889	8.9	7952	3.6

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Table 2: Factors for Semivolatile Organic Analytes (continued)				
SEMIVOLATILE ORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
HEXACHLOROETHANE	11899	3.8	7951	4.0
4-NITROPHENOLINDENO(1,2,3-CD)PYRENE	--	10.0	--	10.0
ISOPHORONE	11896	4.0	7949	2.5
N-NITROSO-DI-N-PROPYLAMINE	1966	3.7	1345	3.7
N-NITROSODIPHENYLAMINE (1)	--	10.0	--	10.0
NAPHTHALENE	11896	4.0	7949	2.5
NITROBENZENE	11896	4.0	7949	2.5
PENTACHLOROPHENOL	1895	18.8	1359	3.7
PHENANTHRENE	--	10.0	--	10.0
PHENOL	1924	3.2	1368	3.5
PYRENE	1901	8.3	1369	4.9

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Table 3: Factors for Pesticide/PCB Analytes				
PESTICIDE/PCB ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
4,4'-DDD	--	10.0	--	10.0
4,4'-DDE	--	10.0	--	10.0
4,4'-DDT	1801	7.4	1353	4.6
ALDRIN	1870	7.9	1350	4.8
ALPHA-BHC	--	10.0	--	10.0
ALPHA-CHLORDANE	--	10.0	--	10.0
AROCLOR-1016	--	10.0	23305	8.7
AROCLOR-1221	--	10.0	23305	8.7
AROCLOR-1232	--	10.0	23305	8.7
AROCLOR-1242	--	10.0	23305	8.7
AROCLOR-1248	--	10.0	23305	8.7
AROCLOR-1254	--	10.0	23305	8.7
AROCLOR-1260	--	10.0	23305	8.7
BETA-BHC	--	10.0	--	10.0
DELTA-BHC	--	10.0	--	10.0
DIELDRIN	1886	6.2	1350	2.8

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Table 3: Factors for Pesticide/PCB Analytes (continued)				
PESTICIDE/PCB ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
ENDOSULFAN I	--	10.0	--	10.0
ENDOSULFAN II	--	10.0	--	10.0
ENDOSULFAN SULFATE	--	10.0	--	10.0
ENDRIN	1866	8.5	1348	3.4
ENDRIN ALDEHYDE	--	10.0	--	10.0
ENDRIN KETONE	--	10.0	--	10.0
GAMMA-BHC (LINDANE)	1872	4.5	1350	3.1
GAMMA-CHLORDANE	--	10.0	--	10.0
HEPTACHLOR	1877	4.5	1351	3.6
HEPTACHLOR EPOXIDE	--	10.0	--	10.0
METHOXYCHLOR	--	10.0	--	10.0
TOXAPHENE	--	10.0	--	10.0

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Table 4: Factors for Inorganic Analytes				
INORGANIC ANALYTES	SOIL MATRIX		WATER MATRIX	
	Number of CARD Samples Reviewed	Factor	Number of CARD Samples Reviewed	Factor
ALUMINUM	1147	1.5	1686	1.2
ANTIMONY	1153	1.8	1688	1.2
ARSENIC	1208	1.6	1701	1.2
BARIUM	1149	3.3	1686	1.1
BERYLLIUM	1150	1.2	1686	1.2
CADMIUM	1148	1.3	1685	1.2
CALCIUM	1163	1.2	1685	1.1
CHROMIUM	1148	1.2	1686	1.2
COBALT	1153	1.2	1685	1.2
COPPER	1154	1.1	1683	1.2
CYANIDE	884	1.4	--	10.0
IRON	1149	1.2	1687	1.2
LEAD	1331	1.3	1727	1.2
MAGNESIUM	1143	1.2	1686	1.1
MANGANESE	1151	1.2	1685	1.2
MERCURY	1563	1.7	--	10.0
NICKEL	1150	1.2	1685	1.2
POTASSIUM	--	10.0	--	10.0
SELENIUM	1190	2.3	1695	1.3
SILVER	1152	1.6	1684	1.3
SODIUM	--	10.0	--	10.0
THALLIUM	1197	1.7	1691	1.2
VANADIUM	1152	1.2	1685	1.1
ZINC	1154	1.3	1689	1.2

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Establishing Background Levels

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Office of Emergency and Remedial Response
Hazardous Site Evaluation Division (5204G)

Quick Reference Fact Sheet

Abstract

The Hazard Ranking System (HRS) establishes criteria for documenting an observed release and observed contamination. There must be evidence of a hazardous substance in the medium of concern at a concentration significantly above the background level, and some portion of the release and the hazardous substance must be attributable to the site. This fact sheet defines background, describes background level determination, and emphasizes the necessity of strategic, efficient sampling. Background considerations for each HRS pathway are presented.

Introduction

Background level is "the concentration of a hazardous substance that provides a defensible reference point that can be used to evaluate whether or not a release from the site has occurred. The background level should reflect the concentration of the hazardous substance in the medium of concern for the environmental setting on or near a site. Background level does not necessarily represent pre-release conditions, nor conditions in the absence of influence from source(s) at the site." [1] Background levels do not have to reflect pristine conditions; they define concentrations of contaminants outside the influence of a release.

Background level determination, usually by chemical analysis, is necessary to document an observed release and to establish attribution of contaminants where multiple sources or contaminant contributors exist. When evaluating a release, the background level of a substance is compared with the concentration of the release sample(s). Background and release samples generally should be collected during the same sampling event and from the same geologic stratum or medium of concern. Time differences between release and background samples become critical when analytical holding times are short (e.g., volatile organic analysis and hexavalent chromium). Collect release and background samples within the shortest time period possible, preferably on the same day. Obtaining suitable background samples can be challenging because of varying media compositions and potentially false assumptions regarding data representativeness. Consult the *Guidance for Performing Site Inspections Under CERCLA*, 1992, OSWER Directive 9345.1-05, for further information on establishing background levels.

Resource Considerations

Determining a background level is important for evaluating an observed release and attribution. Only a few background samples are usually necessary. The selection of strategic sampling locations is critical to the success of the Site Inspection (SI), which is a limited-scope biased sampling event. Evaluate the benefits of sampling at specific locations and assess the validity of available data to meet SI objectives and conserve resources (see exhibits 1 and 2).

Background Level Determination Without Sampling

Establishing background level requires determining the concentration level of a hazardous substance; it does not always require sampling. Often, the contaminant of concern is ubiquitous (e.g., lead), and sampling is required to establish a background level. However, some man-made hazardous substances (e.g., chlorinated organic solvents, pesticides, short-lived radioactive substances) can be attributed only to a contaminant source. In areas that are isolated or where no other sources can be identified, the presence of these substances in release samples is sufficient documentation of contamination; a background sample is not needed. [2] (However, certain low-level chlorinated organic com-

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Exhibit 1: Direct Observation and Chemical Analysis

The HRS documents an observed release in one of two ways: by direct observation, or by chemical analysis.

Direct Observation: Material containing a hazardous substance from the site is observed entering or is known to have been deposited directly into or otherwise has come to be located in the medium (e.g., an effluent discharge from the site to surface water). No background sampling is required if direct observation is documented. However, the presence of a hazardous substance in the release must be documented, preferably by chemical analysis. A demonstrated adverse effect also may be used to document an observed release by direct observation in the air and surface water pathways.

Chemical Analysis: There is analytical evidence of a hazardous substance in a medium, at a concentration significantly above the background level, and attributable wholly or in part to the site or source.

Criteria for observed release by chemical analysis (Refer to Table 2-3 in the *Hazard Ranking System, Final Rule,* 40 CFR Part 300):

- "If the background concentration is not detected (or is less than the detection limit), an observed release is established when the sample measurement equals or exceeds the sample quantitation limit."
- "If the background concentration equals or exceeds the detection limit, an observed release is established when the sample measurement is 3 times or more above the background concentration."

-pounds in aqueous samples may be associated with drinking water chlorination.)

In some cases, a sample location may serve as its own background location.[2] For example, a ground water well or surface water intake may have associated historical analytical data. A release can be demonstrated when historical data from a contaminated well or intake show that it was previously uncontaminated or less contaminated. Detailed historical data are useful to define encroachment of a contaminant plume. Often, historical data are available for wells and surface water intakes at industrial sites or municipal water facilities which have a regular monitoring program.[1]

Exhibit 2: Reasons for Collecting Background Samples

- A release cannot be determined by direct observation
- The source consists of contaminated soil
- Historical data are unavailable or insufficient
- The substance of interest is ubiquitous

Some substances, such as metals in soils, may have published background levels that can be applied to the site locally. Consult the following published data sources:

- Background sample results from other nearby CERCLA site investigations
- Local surveys by other Federal or State agencies (e.g., U.S. Geological Survey (USGS), Soil Conservation Service (SCS))
- University studies (e.g., graduate theses)
- Tables or databases with natural concentration ranges and averages in local or regional soils[2]

Note that in many cases published information may be inappropriate. Published data may not account for regional variations or unique site-specific characteristics.[2] Background levels may vary with regional and local geology (e.g., ore veins, soils with naturally high metals content). It is difficult to demonstrate comparability using published data because of the difficulty of duplicating sample method and analysis. To be similar, published or existing data should be generated under quality assurance/quality control (QA/QC) measures equivalent to EPA requirements for release samples. Published data may be useful when selecting background sampling locations. If published data are used, multiple sources of information help to support a comparison determination. The use of background level data without sampling (e.g., published data) may be acceptable for SI or HRS scoring activities. The analytical package for the published data should be obtained whenever possible.[2]

Background Sample Selection Considerations

Collect at least one background sample per pathway or medium collected outside the area believed to be influenced by the site. The activities of the investigation team should not introduce any non-attributable contaminants to a release or background sample. Sampling methodology can minimize this error.

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Smart Sampling Example: Advantages of GIS

For ground water contamination with multiple sources or very large areas of contamination, computer-based Geographic Information Systems (GIS) are often used to store and manage large quantities of water quality data, as well as hydrogeologic and geographic data and Potentially Responsible Party (PRP) information. The advantage of a GIS over a standard database management system is the ability to relate data spatially. Sample data in the GIS may contain historical background concentrations or aid in the selection of background sampling locations. In conjunction with GIS, use existing data from CERCLA sites.

It is often necessary to collect more than one background sample. The location and number of background samples depend upon:

- Hazardous substances present at the site and expected concentrations
- Availability and quality of existing information and analytical data
- Objectives of the investigation
- Site hypotheses to be tested
- Media variability
- Size of the site, number, and type of sources
- Pathway-specific considerations (e.g., geologic formations, types of surface water bodies)
- Other potential sources of contamination in the vicinity of the site [2]

The number of background samples collected may also depend upon the type of investigation performed. At times, a contaminated background sample can be compared with a release sample to demonstrate that the site under investigation contributes at least part of the contamination in the release sample (refer to chapter 4 of the *Guidance for Performing Site Inspections Under CERCLA*, for more information).

In general, the highest background sample concentration can be used as a background level. In a non-industrial area, average background concentrations may be used when sufficient background samples are collected in a relatively homogeneous environment and there are no alternative sources of contamination nearby. Qualified analytical data may also be used for background level determination (refer to *Using Qualified Data to Document an Observed Release*, 1994, OSWER Directive 9285.7-14FS, for more information).

In all evaluations, release and background samples must be similar for comparison. In some situations, collection of a comparable background sample is not possible (e.g., when there is no surface water sample similar to an isolated pond, or when a surface water body originates from a spring). [2] If background sampling is not possible, substitute published data, as available.

Exhibit 3: Examples of Factors Affecting Comparability

- Filtered versus unfiltered aqueous samples, including preservative added before or after filtering
- Depth of the ground water sample (i.e., screened interval). Note: Data may not be available for household wells
- Density of contaminants (floater or sinker)
- Geologic strata, sorptive capacities, and soil types
- Plants that bioaccumulate certain substances (consider cover vegetation types and density between surface soil sample locations)
- Factors within a water body
  - thermal or chemical stratification
  - sediments versus aqueous samples
  - coarse grain sediments in riffle or scouring zones versus fine grain sediments in depositional zones
  - mixing zones
- Age, species, and gender (tissue samples and portions analyzed)
- Date, time, and weather conditions
- Sample handling procedures[1,2]

Factors which determine sample similarity include location, type, depth, medium, sampling method, preservation, handling, timing, and weather conditions during sampling (see exhibit 3). Variability introduced by sampling methods can be much greater than that introduced by the analytical laboratory. Consider variability factors for each HRS pathway under investigation. The following are specific considerations when selecting background samples for each HRS pathway.

Ground Water Pathway

A direct observation of a release to ground water can be documented if it is observed or known that a hazardous substance has been deposited, or the source lies below the water table of the aquifer of concern (e.g., injection well, buried waste). A direct observation of a release to ground water does not require establishing a background level, but the presence of a hazardous substance in the

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release should be documented by manifest data or chemical analysis. [1,2]

When establishing an observed release by chemical analysis, background samples generally are needed. Collect background samples from nearby wells that are not expected to be influenced by the source of contamination or by other sites. If there are other sites or potential local sources of ground water contamination, collect additional background samples, where possible, to differentiate their contribution from that of the site under investigation (refer to the *Guidance for Performing Site Inspections Under CERCLA,* for more information).

Similarity of Aquifers

Where possible, aqueous release and background samples should be collected during the same sampling event but must be collected from comparable zones in the same aquifer. Interconnected aquifers should not be considered as one aquifer when comparing samples for an observed release. When collecting background samples, it is preferable not to use samples from a well screened in two or more aquifers. [2]

Evaluate aquifer characteristics before selecting wells for sampling, especially in areas of complex or variable geology. Be aware of the existence of mines, faults, or other aquifer intrusions which may affect sample representativeness. (Note: Section 7.1 of the *Hazard Ranking System Guidance Manual,* 1992, OSWER Directive 9345.1-07, provides detailed guidance on determining aquifers and aquifer boundaries.)

Note information on ground water flow direction if it is known or can be easily determined. This information may also be useful in selecting monitoring well installation locations for Expanded Site Inspection (ESI) and Remedial Investigation (RI) work. Obtain information on flow direction by using piezometers, by comparing static water levels in existing wells in the same aquifer, and by using data from published reports. The well used for background sampling should be out of the influence of the site. [2]

Comparability of Wells

Samples from any two wells can be considered comparable if both are collected from the same aquifer and if the sample preparation is the same (i.e., compare filtered release samples to filtered background samples, and unfiltered release samples to unfiltered background samples). Ideally, well completion techniques and usage of background wells should be similar to those of the well under investigation. It is best if sample methodology is the same for both release and background wells. Sampled wells generally should be screened at similar zones within the same aquifer, depending on the site hydrogeologic setting, because different depths may have different contaminant levels and water chemistry. Measure depth as elevation relative to a reference (e.g., mean sea level) instead of below ground surface for data consistency. Where possible, duplicate purge parameters and method, sampling method, and sampling equipment for all well samples. Sample release and background samples on the same day, if possible, but not more than three days apart. [2]

In cases where a background well is not available, sample a spring before it reaches the surface by inserting a pipe or well point near the location where ground water discharges at the spring.[2] Thoroughly document this type of sampling in a field logbook. Sampling data may be supplemented with applicable published data. Springs may be used for background sampling of surficial aquifers only.

Surface Water Pathway

Direct observation of a release to surface water may be documented if material containing a hazardous substance is seen entering surface water; is known to have entered surface water through direct deposition; or is present in a source which is in contact with surface water through flooding. Direct observation of a release to surface water eliminates the need for background sampling, but the presence of a hazardous substance in the release should be documented analytically. No background sample is required when sampling an effluent discharge from the site into surface water, because the effluent is considered a direct observation.

In non-tidal surface water bodies, sample downstream to upstream. Background sediment samples should be from a location comparable to that of the release samples (e.g., fine sediments from quiescent zones).[2] Sediment samples are generally preferred over aqueous samples for evaluation of the surface water pathway because sediments are more likely to retain contaminants. In general, aqueous samples might represent current release conditions, whereas sediment samples might exhibit historical release conditions.

Background tissue samples from essentially sessile, benthic organisms (e.g., sponges, oysters) can be used in support of similar (same species) release tissue samples. Individuals selected for background tissue sampling should be the same gender and approximate age, wherever possible, of those selected for release tissue sampling.[2]

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Special Considerations for Tidal Water Bodies

Determine the need to collect aqueous and sediment samples in cases where the surface water body is tidally influenced. One approach for background sampling is to collect outside of the zone of tidal influence (this can be gauged by the level of the highest tide). Beware of tidal flow picking up additional sources upstream. Consider the effect of the tides on contaminant concentration (upstream concentrations would be highest during the rising tide and lowest at falling tide). Consider collecting release and background samples at the same tidal level.[1]

Comparability of Water Bodies

Collect release and background samples from the same type of water body. (Use flow characteristics to determine similar water bodies.) For example, a background sample from a small tributary usually is not comparable to a release sample from a river. Consider physical and chemical properties of the surface water, such as lack of mixing in large, slow-flow segments of rivers, physical transport mechanisms, and biological influences. Where possible, collect release and background samples during the same time period, since thermal stratification and salt/freshwater stratification vary with the time of year. Consider the thermoclines of a pond or lake or measure them in the field prior to sampling.[1,2]

Simple surface water pathway sampling generally consists of a minimum of one Probable Point of Entry (PPE) release sample and one upstream background sample. If the surface water pathway has multiple PPEs, multiple background samples may be needed. The number of background samples collected depends on the complexity of the path of the surface water body. The presence of multiple tributaries upstream with multiple potential sources requires multiple background samples because of the potential contribution of contamination from other off-site sources.[1,2]

For ponds and lakes, background samples may be collected near the inflow to the water body if it is not influenced by the source. A pond near the site may be selected for background sampling if it exhibits similar physical characteristics to the pond on site. For large ponds and lakes, background samples may be collected from the water body itself but as far away as possible from the influence of the PPE and other potential sources. [1]

Air Pathway

Direct observation of release to the air pathway can be documented in two ways: a release containing hazardous substances is seen entering the atmosphere directly (e.g., visually observing dust blowing off a pile known to contain hazardous substances), or an adverse effect is demonstrated (e.g., a documented health effect from a reaction of incompatible substances). Background levels need not be established when an observed release by direct observation is documented.

Weather conditions are critical for evaluating the air pathway. Throughout the sampling period, determine the predominant wind direction and speed. Consider lack of air movement, effects of low temperatures, existence of flat, open terrain, and any atmospheric instability. Perform background sampling upwind of site sources, although cross-wind samples may be acceptable. Always consider multiple samples for this pathway and collect them from the same height and at the same time. (Samples from great heights such as rooftops generally are not useful because they do not represent target conditions; very low heights are subject to potential interference from particulates introduced by field activities.) Dust, wipe, soil, and soil gas samples are not acceptable for background sampling in the air pathway, but these types of samples may be used, along with field air monitoring equipment, to select release and background sample locations. Always sample release and background concurrently. A minimum 12-hour monitoring period is recommended for sampling the air pathway, particularly during hot and dry weather conditions. [1,2]

Wind roses may be used to determine predominant wind direction, or to document changes in wind direction; this is important when selecting sample stations. [1] The "rose" diagrams consist of bars on a compass face indicating the frequency of each wind direction during the selected time period, as well as the average high wind speed for the period. If wind roses are utilized, determine the elevation for which the wind rose was calculated; this elevation should be representative of target exposure. Weather stations and airports may provide information on local wind direction at ground level and at various elevations.

Soil Exposure Pathway

There is no direct observation of contamination in the soil exposure pathway. Establishing background levels for this pathway can be difficult, particularly if the hazardous substances attributed to the site are naturally occurring substances. Where possible, collect on-site background soil samples from surficial soils not likely to be affected by the source. Collect off-site background soil samples from shallow soils which ideally should not be affected by other sources and sites in the area. However, if there are alternative sources of contamination in the area, background levels should account for these contributions. When possible, sample release and background samples on the same day, or not more than three days apart. (See Highlight 9-1 of the

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HRS Guidance Manual for information on background samples for non-soil sources in the soil exposure pathway).

Carefully document location, depth, and appearance of all soil samples. If depths and thicknesses of soil strata vary with location, ensure that release and background samples are from a similar stratum and soil type. Samples should have similar texture, color, and grain size. [2] During an SI, grab samples (as opposed to composite) are preferred for determining soil contamination. Obtain the background sample from an undisturbed, unfilled area, because fill may have contaminants which are not representative of background conditions. If a site is located on fill, obtain the background samples from a similarly filled area (where the fill is not considered one of the areas of observed contamination at the site).[1]

Select more than one background sample and location for the soil exposure pathway. Do not collect background soil samples from a drainage channel which receives water from off site. [1] Where possible, collect background samples from a higher elevation than the sources to avoid the effect of potential surface drainage. Avoid background sample locations that are subject to airborne contamination from the site or other sources. [1,2]

Determining Background Levels in Industrial, Mining, and Radioactive Areas

Industrial areas pose a special challenge to determining background levels. Ambient conditions may include elevated concentrations of common contaminants from alternative sources not associated with the site. Common contaminants in background samples in industrial and urban areas include:

- Metals in soils (e.g., lead)
- Trichloroethene (TCE) and perchloroethene (PCE) in urban aquifers
- Organic substances in harbor sediments [2]

In industrial areas, the investigator often needs to document that a release sample is above background sample variability. Where potential alternative sources exist and possibly interfere with background or release samples, assess whether the interference affects background samples and the site significantly, or whether bias can be determined. Because industrial areas are affected by increased levels of contaminants and greater local variability, additional background samples may be required to establish surrounding off-site conditions. Be sure to collect a sufficient number of samples between the site and all other potential sources of contamination in order to attribute the increase to the site. [2] In general, it is inappropriate to average background samples in an industrial area where more than one type of industry existed. This probably will lead to unacceptable levels of local variability (see *Establishing Areas of Observed Contamination*, 1994, OSWER Directive 9285.7-18FS, for more detailed information).

Mining areas, like industrial areas, pose a challenge to determining background levels. Often the contaminants associated with the mine are naturally occurring elements. Surface water may originate from the mine, presenting no upstream location for background sampling. Surface water may pass through the mined watershed; its nearest upstream location away from the influence of the site may be in a different geologic formation, with different water chemistry, producing uncertainty about comparability. Mines are often located in areas with aquifers that are highly fractured or influenced by mine drainage tunnels. It is difficult to find undisturbed areas in which to locate ground water wells. Because it may be difficult to determine background levels in mining areas, it is preferable to determine an observed release by direct observation (e.g., evidence of mining below the water table of the aquifer of concern, tailings observed in surface water). Mine tailings generally have a high concentration of minerals and are considered waste; collecting background samples is not necessary if tailings are analyzed and the mineral concentrations are shown to be elevated well beyond what might be expected under natural conditions.

When surface water originates in the source or when no similar upstream location exists, select a water body with similar physical characteristics (e.g., a similar stream on the other side of a mined hill) for background sampling. The similar water body should not be directly affected by the site. Release concentrations may be so significantly elevated (this is common with large-scale mining sites) that published data may provide a more reasonable background level for comparison. Establishing background conditions at mining sites should be addressed on a site-by-site basis.

To sample sites with radioactive wastes, follow sampling strategies similar to those for other hazardous substances. Criteria to establish an observed release through chemical analysis for radioactive substances are available for the following three groups:

- Radionuclides that occur naturally, or ubiquitous man-made radionuclides
- Non-ubiquitous man-made radionuclides
- External gamma radiation (soil exposure pathway only)

Some portion of the release sample concentration must be attributable to the site. For each group, compare release concentrations against known background radionuclide concentrations or against sample quantitation limits for a sample medium. Section 4.9.4 of the *Guidance for Performing Site Inspections Under*

CERCLA provides details on establishing an observed release for each group.

Summary

Collect samples to improve documentation for factors that significantly affect HRS evaluation. If demonstrating a release or establishing actual contamination is critical to evaluating a site, do not limit background or QA/QC samples unduly because of budgetary considerations —collecting these samples may prevent having to return to the site. Thorough documentation of the locations of the background samples and potential alternative sources is necessary to assess the adequacy of the background levels and to evaluate release and attribution. Evaluate the benefits of sampling at specific locations and assess the validity of existing analytical data. Meet SI objectives while conserving Superfund resources when feasible. Direct observation of a release does not require background sampling if detectable concentrations of hazardous substances are documented to be present in the source. Background samples may not be necessary for certain man-made compounds.

To establish background levels by chemical analysis, thoroughly review on-site and off-site sources and their locations. Collect background and release samples from similar locations and media. Ground water samples are similar when they come from the same zone within an aquifer and undergo similar sample preparation. Collect background samples for surface water upstream of the PPE. Additional site reconnaissance and review are often needed to select sampling locations in industrial and mining areas and at complex sites.

References

1. U.S. Environmental Protection Agency, 1992. *Hazard Ranking System Guidance Manual*. Office of Solid Waste and Emergency Response. Directive 9345.1-07.

2. U.S. Environmental Protection Agency, 1992. *Guidance for Performing Site Inspections Under CERCLA*. Office of Solid Waste and Emergency Response. Directive 9345.1-05.

3. U.S. Environmental Protection Agency, *Hazard Ranking System, Final Rule*. 40 CFR Part 300.

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Establishing an Observed Release

DRAFT

Office of Emergency and Remedial Response
Hazardous Site Evaluation Division (5204G)

Quick Reference Fact Sheet

Abstract

The Hazard Ranking System (HRS) establishes criteria for documenting an *observed release* and *observed contamination*. This fact sheet describes an observed release and the data required to substantiate it for National Priorities List (NPL) rule-making purposes. This fact sheet further describes the process documenting an observed release and emphasizes strategic, efficient sampling.

Introduction

Three categories of sampling generally are performed during a Site Inspection (SI):

- Source sampling to establish the presence of hazardous substances at a site
- Sampling in the media of concern to establish an observed release, with background sampling corresponding to the source to establish attribution
- Quality Assurance/Quality Control (QA/QC) sampling (e.g., field blanks) to ensure data integrity

This fact sheet addresses the second category of sampling, although each category is dependent upon the others for site assessment.

Determining an Observed Release

An observed release is evidence that contaminants have migrated from a site to a pathway or medium. Ground water, surface water, and air constitute the migration pathways for observed releases. The Hazard Ranking System (HRS) establishes general criteria to document an observed release: there must be evidence of a hazardous substance in the medium of concern at a concentration significantly above the background level, and the release and the hazardous substance must be at least partially attributable to the site under investigation.[1,2,3] In contrast, the soil exposure pathway is evaluated for *observed contamination*, where targets (human populations, resources, and sensitive environments) may come into direct contact with contaminants. For more information on the soil exposure pathway, refer to the fact sheet *Establishing Areas of Observed Contamination*, 1994, OSWER Directive 9285.7-18FS.

An observed release can be determined either by chemical analysis of samples, or by directly observing the release of the hazardous substance (to be documented) into the medium of concern (see figure 1).

Documenting an observed release by chemical analysis cannot be accomplished without determining background level and attribution. Determine background level by sampling or by using other acceptable information such as published or existing sample data. For example, a ground water well or surface water intake with historical monitoring data may show a change in contaminant levels over time. If the change is attributable to the site or source, the data may serve both as background and release levels. Attribution requires documentation that the hazardous substance detected in a medium resulted from site activities. Background samples or existing data should be as similar as possible to the release samples for comparison.[2] For more information on establishing background levels, refer to the fact sheet *Establishing Background Levels*, 1994, OSWER Directive 9285.7-19FS.

Documenting an observed release is a prerequisite for evaluating actual contamination at targets. Actual contamination is evidence that targets have contact with the hazardous substance(s) resulting from an observed release. The level of actual contamination is determined by comparing the release sample concentration to health-based or ecological benchmark values, where available. Level I contamination is at or above media-specific benchmarks; level II is a concentration less than benchmark values. Note that the detection of contamination at targets is not in itself sufficient to

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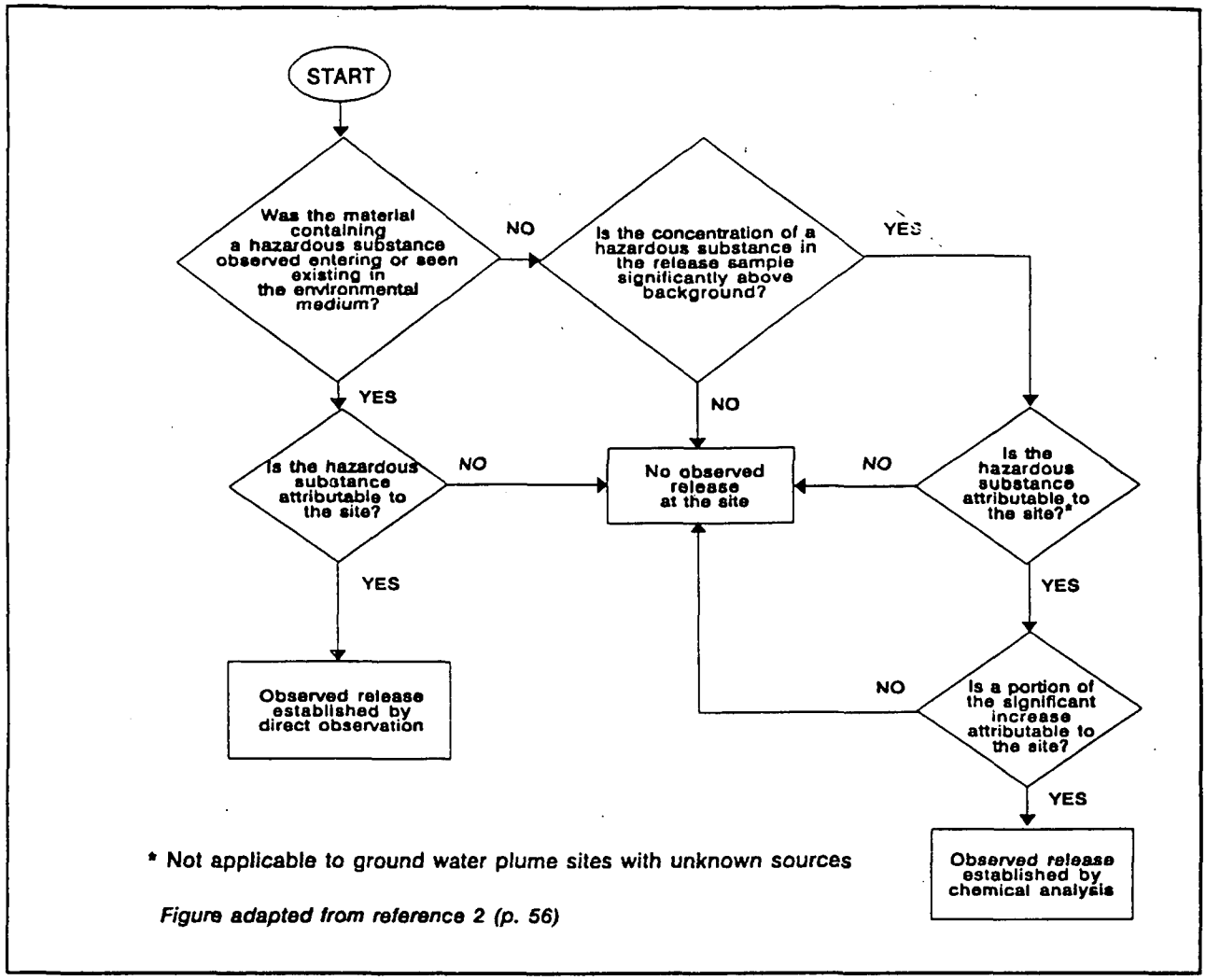
Figure 1: Flowchart for Establishing an Observed Release



establish an observed release or actual contamination.[2] Samples can be strategically collected to establish an observed release and to include one or more targets (dual purpose sampling). Analytical data with appropriate and adequate quality assurance/quality control (QA/QC) are needed, since benchmarks are expressed in concentration units.

Resource Considerations

The SI is a limited-scope biased sampling event, and selecting strategic sampling locations is critical to its success. Evaluate the benefits of sampling at specific locations. Use available data when possible to meet SI objectives and conserve resources (see exhibit 1).

Observed Release by Direct Observation

To establish an observed release by direct observation, a hazardous substance must be observed or known to have been released into the medium of concern. Use existing analytical data or other references, such as manifests, to document that the hazardous substance is present or known to have been released.[2] See exhibit 2 for examples of an observed release by direct observation.

For the ground water pathway, an observed release by direct observation may be documented with information that hazardous materials have come to be located or deposited in the aquifer of concern.[2]

For the surface water pathway, direct observation to establish an observed release can be documented by:

- Documented hazardous substances seen entering the water body through migration or known to have entered through direct deposition
- Flooding of a source area so that hazardous substances come in direct contact with the water
- Documented adverse effects (e.g., fish kill) associated with the release of a hazardous substance to surface water. Note that inference requires extensive documentation and verified attribution.[2]

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Exhibit 1: Questions to Consider when Determining the Need for Sampling

1. *Is there an imminent or current threat to human health or the environment? Is a removal action warranted?* Sample at targets if human or environmental exposure to contaminants is suspected. Sample for public health concerns, where possible.
2. *Does the pathway critically affect the site Hazard Ranking System (HRS) score (≥ 28.50)? If yes, must an observed release be documented for that pathway to achieve that site score?* If no, evaluating the pathway for potential contamination may be sufficient (particularly for less critical pathways).
3. *What are the constraints of the pathway? Are targets nearby?* Each HRS pathway has certain criteria for determining and limiting target distance with respect to contaminants. For example, for the soil exposure pathway, contamination must be documented within a zero to 2 foot depth of the surface, and contamination must be on the property and within 200 feet of targets. For the surface water pathway, the surface water body must be within two overland miles of the site or source.[2] If release samples cannot meet the pathway constraints, do not collect samples.
4. *What are the objectives of the SI?* Table 4-7 in *Guidance for Performing Site Inspections Under CERCLA* provides guidelines on the number of samples recommended for a focused, expanded, or single SI as part of an observed release sampling strategy.[1]

For an observed release by direct observation from flooded contaminated soils to surface water, the presence of a hazardous substance significantly above background prior to flooding must be demonstrated.[2] Historical data may be sufficient to document flood levels, the presence of a hazardous substance, and its direct contact with flooded waters.

For the air pathway, direct observation may be established by demonstrating adverse effects from a release.[2]

Observed Release by Chemical Analysis

An observed release can be documented when samples from the media of concern exhibit contamination significantly above background levels, and the contaminants are attributable to the source. Since concentrations of contaminants usually decrease with distance from a source, sampling near to sources will better establish an observed release and attribution.[1] At minimum, one validated sample and a background level are required to document a release, even if earlier or later sampling fails to show a release. Varying results could be due in part to intermittent releases.[2] Background level determination usually is required to attribute an observed release to the site.

To document an observed release by chemical analysis, the following criteria must be met (except for radionuclides, which are discussed later in this fact sheet):

1. The release of a hazardous substance must be at least partially attributable to a source at the site. (Note: This does not apply to ground water plume sites with unknown sources.)

2. The release sample concentration must be greater than or equal to the appropriate detection limit (e.g., sample quantitation limit [SQL]).[1,3]

3. If the background level is below its detection limit, the release sample concentration must be greater than or equal to the background detection limit, or, if the background level is greater than or equal to its detection limit, the release sample concentration must be at least three times the background concentration.[2]

4. The detection limits must be calculated or determined properly. The detection limit used for comparison often depends on the source of the analytical data. The SQL is the preferred HRS measure, but other limits such as those provided by the Contract Laboratory Program (CLP) may be used.[2] Note that detection limits may be different for release and background samples.

Observed release sampling issues vary according to the medium, or pathway. These issues include temporal and spatial variation, hazardous substances present, and documentation of location and collection conditions. The surface water pathway may use aqueous, effluent, sediment, and tissue samples from sessile, benthic organisms to document an observed release. The other pathways generally are more limited (e.g., aqueous samples for ground water, soil samples for soil exposure, and air samples for the air pathway). Establishing an observed release in the ground water pathway could be further complicated by uncertainties about ground water flow direction, and the resultant uncertainty about background and attribution.

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Exhibit 2: Examples of an Observed Release by Direct Observation

- Ground water pathway--Hazardous substances placed into an old quarry where the water table has been reestablished above the level of the deposited materials.
- Surface water pathway--An impoundment leachate seep seen entering a stream. (Collect a sample from the leachate to document hazardous substances.) Also, effluent known to contain hazardous substances (through manifests) seen entering a surface water body.
- Air pathway--A field logbook entry and photodocumentation of a dust cloud originating from a tailings pile. A sample of the fine particulate matter from the pile showing the presence of hazardous substances will verify the release. [1,2]

Ground Water Pathway

For the ground water pathway, certain types of wells, including monitoring, irrigation, or drinking water wells, may be used to establish an observed release, although the same well may not necessarily serve to document actual contamination of targets. For a target population, actual contamination should be documented using a drinking water well. To establish an observed release, sample the well(s) closest to the contamination source, where possible. Select background well(s) outside the influence of a source and in the same aquifer being evaluated. Either cross-gradient or upgradient background sample locations are preferred when flow gradient information is available. (Ground water flow gradient is not required for HRS purposes.) Be cautious about using wells that are close to the site as background, because some sources (e.g., landfills and impoundments) interfere with natural ground water flow. Pumping also may affect ground water direction and plume movement. If available, pumping rates of nearby wells (including those sampled) may serve as a useful source of information for addressing both sample comparability and contaminant effect.

Consider characteristics of suspected contaminants in water when selecting sample locations and depths. Contaminants in water may not be evenly dispersed. Oils and organic substances lighter than water (light non-aqueous phase liquids [LNAPLs]) tend to float on top of the water table. Contaminants heavier than water (dense non-aqueous phase liquids [DNAPLs]) sink to the bottom of the water column. [1,2]

Smart Sampling Example: Using Springs to Gather Ground Water Data

Experience at several sites indicates that springs are an underutilized source of ground water quality data, which are usually obtained from monitoring wells. Springs are common, occur in most geological settings, and are found at, or near, many hazardous waste sites. They require no installation or purging, and may be used to gather rapid screening data upon site discovery and/or later as part of an established sampling or monitoring program. The spring sample must be documented as ground water rather than surface water. When properly documented, spring sampling successfully has identified surficial aquifer contamination when well sampling did not. It also has located reaches of streams into which contaminated ground water plumes discharge. Consider using springs as surficial aquifer sampling points for documenting either a background level or an observed release.

Surface Water Pathway

A minimum of two samples (aqueous or sediment) generally is required for documenting a release in the surface water pathway: a background sample slightly upstream of the Probable Point of Entry (PPE) for contaminants from the site or source, and a release sample at or slightly downstream of the PPE. Beware of tidal flow picking up additional sources upstream. Exceptions to the two sample minimum are when the surface water body originates at the site (no upstream background exists) or when multiple PPEs exist. In the first case, one sample may be sufficient to document a release. In the second case, it may be advisable to sample at or downstream of each PPE to establish an observed release; similar background sample(s) should be included.[1,2]

Proper sampling methods and sample handling are critical for documenting an observed release, particularly for the surface water pathway. Aqueous samples may be used to document current releases to a surface water body. Collect the downstream sample first, and aqueous samples before sediments, to avoid the introduction of any contaminants not associated with the site or medium.

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Minimize aeration of a sample to prevent reducing the concentration of contaminants such as volatile organic chemicals.

Consider seasonal and other potential variations such as irrigation and flooding when sampling in this pathway. Deep, slow-moving surface water bodies often exhibit some chemical or thermal stratification. Stratification also occurs where two streams converge. The absorption or dilution of substances is affected by stream movement, and depositional conditions vary within the riffles or close to stream edges.[2]

Sediment samples may be used to document historical releases to the water body. Ideally, the characteristics of the suspected contaminant(s) should be known to select the best sample medium, location, and sampling method. Grain size, organic content, and structure can affect adsorbance of substances to sediments. For example, trichloroethylene (TCE) adsorbs to certain particles, which may bias a sample. [2] Sediments are scoured and deposited in bends of streams and other flowing surface water bodies. Sample from like areas (e.g., inside bend deposition areas) for comparability.

Distinguish sediments from soils, especially when sampling along the edge of a water body. Note that in arid or semiarid locations (less than 20 inches mean annual precipitation), "sediments" include areas with intermittently flowing waters as well as contiguous intermittently flowing ditches. Contamination in these areas should be evaluated in the surface water pathway.[3]

Tissue sampling poses challenges for comparability because of differences between members of the same species, differences between species, variations within a study population, species mobility, and tissue differentiation. The target sample species should be examined for type of organism, approximate age, gender, size of population, migratory nature, and seasonal, feeding, spawning, or other periodic activities that influence concentration of substances within the organism. [2] Tissue samples can be used to determine an observed release only under limited circumstances; they are more readily used to document actual contamination. It is prudent to collect tissue samples in concert with other sampling activities when documenting an observed release.

For tissue sampling, document both the rationale for the tissue selection, and the accuracy of measurement. Edible tissues from sessile, benthic organisms are preferred for HRS evaluation. (Non-sessile benthic organisms, finfish, amphibians, and reptiles generally should not be used.)

Air Pathway

It is important to consider temporal variability in air sampling because large variations in substance concentration can occur over a very short time. Emissions characteristics depend upon topography and changeable atmospheric conditions, including temperature, pressure, wind speed and direction, precipitation, and atmospheric stability.

Monitoring wind direction is prudent to document migration of hazardous substances from the source. Wind roses, which detail the percentage of predominant wind direction, should be developed for the sampling period to document shifts in wind direction. [2]

For the air pathway, an air sample may be used to document both an observed release and actual contamination of targets within a certain radius from the source. (In contrast, the ground water pathway requires sampling at the target; the surface water pathway requires sampling at or beyond the target to establish actual contamination.)

An observed release by chemical analysis is not easy to establish for the air pathway because of the difficulty of obtaining comparable and verifiable samples. The HRS evaluates outdoor ambient air conditions only; indoor air samples are not evaluated for this pathway.[2]

Partial Attribution and Multiple Source Sites

Sources of contamination other than those found at the site under investigation are often present. Where attribution is questionable, sampling should produce analytical data demonstrating that the contamination is at least partially attributable to the site. Contributions from sites sometimes can be isolated by identifying hazardous substances unique to the site under investigation. This may require special analytical services and close evaluation of data. Knowledge of the nearby facilities' disposal practices and wastes is helpful. [1]

Attribution may be established through the use of manifests, labels, records, oral or written statements, or other information regarding hazardous substances present at the site or at alternative sources. If these references confirm the presence of a hazardous substance in release samples, attribution generally can be established even if specific sources where the substance was deposited cannot be documented. [2]

Establishing background levels is important when attributing hazardous substances to varied sources. Background and release sample data should be from the same medium using similar sampling and analytical methods. Background samples should be collected from

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outside the influence of contamination from the site under investigation, but do not have to be free of contamination. The data need only support that the release sample concentration is beyond a reasonable background level. Thoroughly review and document the location of potential alternative sources so that the appropriate background sampling locations can be selected. Many hazardous substances may be widespread in the vicinity of the site. Substances may originate from non-point sources such as pesticides and lead. Background levels for ubiquitous substances should account for local variability; several samples may be required to establish this variability. [2]

Obtain sufficient samples from the site under investigation and from other known potential sources (or other adjacent sites) to demonstrate that an increase in contaminant levels is attributable to the site. Additional information beyond analytical samples may be required if the other sites release intermittently. To attribute contamination sufficiently, collect the following data:

- Concentration gradients (e.g., establish an observed release and attribution with samples from multiple wells or a series of samples between the site and alternative sources)
- Flow gradients and other information about the media of concern
- Data that associate the site with a unique substance or unique ratios of different substances [2]

Complex factors affecting attribution (e.g., soil contamination in an industrial area) may require conducting an expanded SI. In many cases, attribution concerns may be addressed by fully characterizing all sources at a site and those of neighboring sites. [1]

To establish attribution for the ground water pathway, sample wells located between site sources and alternative sources. Three wells generally are needed to define flow direction and to verify the source versus an alternative source(s). For surface water, a release sample may be collected downstream of or at the confluence. Sample background and attribution along each tributary if multiple sources are located upstream. [2]

Transformation Products

Transformation products are substances found when a hazardous substance is changed in the environment by physical, chemical, or biological processes. Most transformation products at hazardous waste sites are the result of degradation.[2]

An observed release for transformation products must be documented by chemical analysis and the transformation product must be a hazardous substance.[2]

Document the presence of a transformation product in a release sample at levels significantly above background level to attribute the parent substance(s) and the transformation product to the site. The following references may be useful for documenting the parent substance and transformation product relationship:

- Site-specific studies on the transformation process by qualified research organizations (e.g., U.S. Government agencies, universities)
- Technical reports on transformation from EPA's Office of Research and Development
- Databases containing EPA-reviewed information
- Articles from peer-reviewed journals
- Textbooks on soil, environmental microbiology, biotechnology, and biotreatment processes and their effectiveness [2]

For determining an observed release, conditions at the site must be conducive to, or must not impede, transformation, and at least one source must be able to release the substance to the pathway. [2]

Smart Sampling Example: Minimizing Investigation Derived Wastes (IDW)

Solvents, equipment, and other materials used in site investigation and cleanup may themselves end up as hazardous waste. Disposal of IDW at an approved facility increases site costs and adds to the overall waste disposal burden. Take precautions to minimize waste generated on site. Solvents should be recycled rather than incinerated, whenever feasible. In many instances, drums may be cleaned and reconditioned instead of sent to a landfill. A series of treatment steps may reduce the final volume of hazardous waste for disposal. Consider pollution prevention when planning response actions.

Radionuclide Sites

The criteria for documenting an observed release by direct observation apply to radionuclides. Table 7-1 in the *Hazard Ranking System, Final Rule* provides the HRS factor categories that are evaluated differently when radionuclides are present. [3]

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For documenting an observed release by chemical analysis, radionuclide sites are divided into three groups:

1. Radionuclides that exist naturally and ubiquitous radionuclides.
2. Man-made radionuclides which are not ubiquitous.
3. External gamma radiation (for the soil exposure pathway only).

Observed releases from a combination of radionuclides and hazardous wastes (mixed waste) should be documented separately.

Establishing an observed release requires:

- Identification of the radionuclide of concern and the physical and chemical properties of the radionuclide
- On-site and background activities for that radionuclide
- SQL or other detection limit for the radionuclide

For gamma radiation, measure the exposure rate at one meter above ground for the soil exposure pathway.

Specific requirements for establishing an observed release for each of the three groups of radionuclides can be found in Section 7.1 of the *Hazard Ranking System, Final Rule*.

Summary

Documenting an observed release for NPL rule-making purposes requires evidence that the concentration of the hazardous substance of concern significantly exceeds the background level. The hazardous substance must be attributable at least in part to the site under investigation (except for ground water plume sites with unknown sources). Establishing an observed release requires thorough documentation. The sampling design should attempt to meet multiple HRS data needs with a limited number of samples.

References

1. U.S. Environmental Protection Agency, 1992. *Guidance for Performing Site Inspections Under CERCLA*. Office of Solid Waste and Emergency Response. Directive 9345.1-05.

2. U.S. Environmental Protection Agency, 1992. *Hazard Ranking System Guidance Manual*. Office of Solid Waste and Emergency Response. Directive 9345.1-07.

3. U.S. Environmental Protection Agency, *Hazard Ranking System, Final Rule*. 40 CFR Part 300.

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Establishing Areas of Observed Contamination

DRAFT

Office of Emergency and Remedial Response
Hazardous Site Evaluation Division (5204G)

Quick Reference Fact Sheet

Abstract

This fact sheet addresses the use of analytical data to establish *areas of observed contamination* at a hazardous waste site when evaluating the soil exposure pathway under the Hazard Ranking System (HRS). The data may also be used to evaluate hazardous waste quantity for some HRS source types. The soil exposure pathway is evaluated only if *observed contamination* is established. Establishing observed contamination, defining the area of observed contamination, and identifying areas of differing levels of contamination are critical in evaluating the soil exposure pathway.

Introduction

The Hazard Ranking System (HRS) establishes general criteria to document an *observed release* of hazardous substances to the migration pathways (ground water, surface water, air) and to document *observed contamination* in the soil exposure pathway. An observed release is evidence that contaminants have migrated away from a site to a migration pathway. In contrast, observed contamination is evidence that targets (human populations, resources, and sensitive environments) have come into direct contact with the contaminants. Unlike the migration pathways, the soil exposure pathway is evaluated based on current, rather than historical, site conditions. An exception occurs when a removal action is performed under EPA oversight during or after a Site Inspection (SI). In such a case, the soil exposure pathway could be evaluated based on conditions prior to the removal action (see the fact sheet "The Revised Hazard Ranking System: Evaluating Sites After Waste Removals," OSWER 9345.1-03FS, for more information on removal actions performed during or after an SI).

The HRS criteria for documenting an observed release and observed contamination are: there must be evidence of a hazardous substance in the medium of concern at a concentration significantly above the background level and at or above the appropriate detection limit, and the hazardous substance must be at least partially attributable to a release from the site under investigation (see figure 1). (For more information on observed releases, refer to the fact sheet "Establishing an Observed Release," OSWER Directive 9285.7-20FS.)

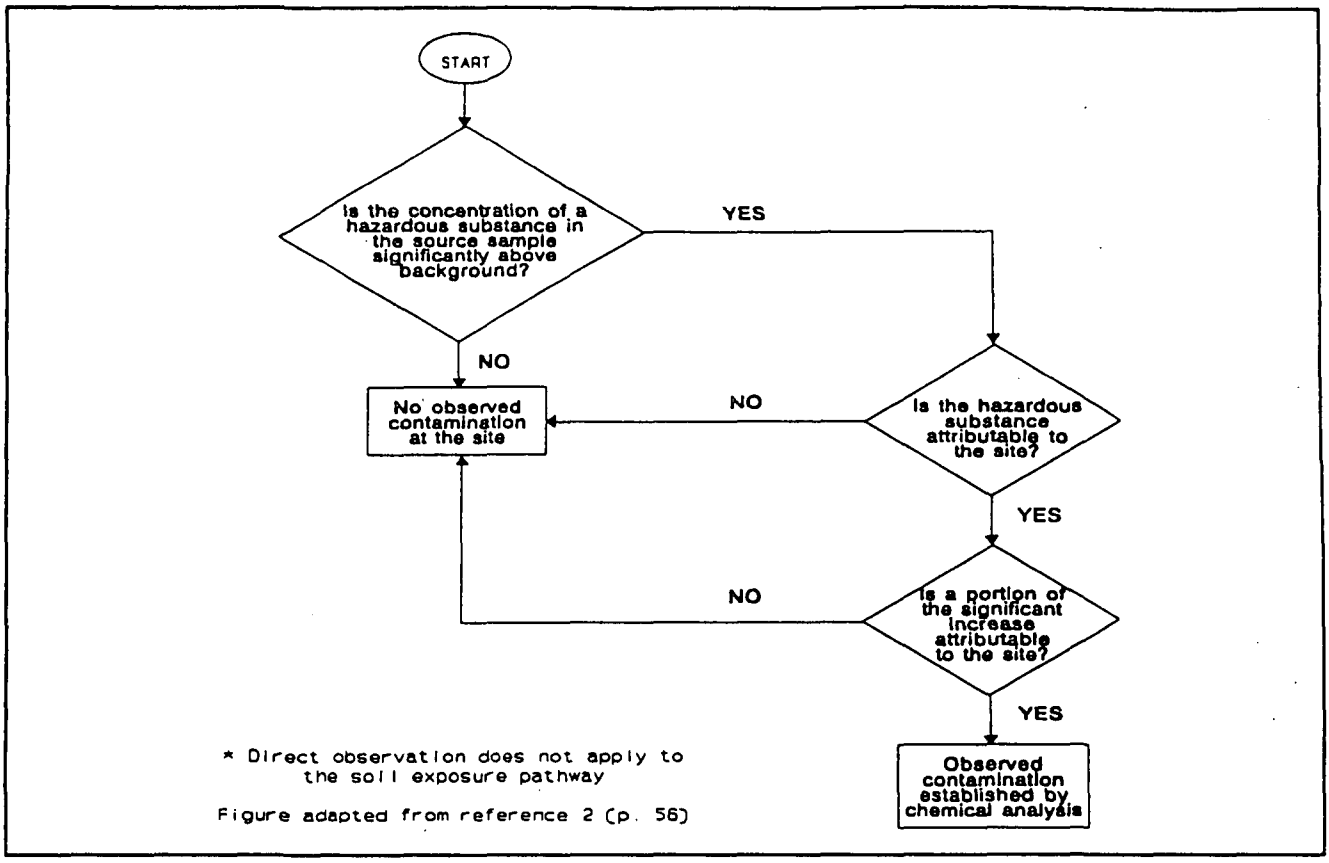
Establishing Observed Contamination

When evaluating the soil exposure pathway, observed contamination must be documented by chemical analysis of samples from contaminated areas. The source samples are compared to a background level. Most samples consist of soil, but leachate, waste, sediment, and other surficial samples may be collected. [1] In comparison, an observed release in the migration pathways may be documented either by direct observation or by chemical analysis of release samples compared to a background level.

Three criteria must be met in order to document observed contamination by chemical analysis:

1. The source sample concentration must be greater than or equal to the appropriate detection limit (e.g., sample quantitation limit [SQL]). The detection limit must be properly determined.

Figure 1: Flowchart for Establishing Observed Contamination



2. If the hazardous substance of concern is not detected in the background samples (or its concentration is less than the detection limit), the source sample concentration must be greater than or equal to its detection limit, if both detection limits are the same. If background levels are greater than or equal to the detection limit, the source sample concentration must be at least three times the background level. Note that detection limits may be different for source and background samples.

3. The hazardous substance is present at the surface or is covered by no more than two feet of penetrable material (except for gamma radiation emitters, which have no depth restriction).[2]

Sampling to Meet the HRS Sampling Objective

In the soil exposure pathway, there is no acceptable documentation of observed contamination based on direct observation, and the potential for contamination is not evaluated. Consider both the types and locations of targets when selecting sampling locations. Establish an area of observed contamination as close to targets as possible. Evaluate targets under the HRS resident population threat when an area of observed contamination lies on the site property and within 200 feet of a residence, school, day care center, or workplace. Evaluate sensitive environments and resources in the resident population threat only if the area of observed contamination lies within site boundaries. Evaluate targets beyond 200 feet but within one mile of the area of observed contamination under the HRS nearby population threat.[4] Collect samples no deeper than two feet below the surface. Document the absence of a maintained, essentially impenetrable cover material (e.g., asphalt, concrete) over any portion of an area of observed contamination.[2] Since surficial contamination is not limited to soil, sampling of other surface media, such as leachate or waste, should be considered.

Attribute contamination to a site by collecting appropriate background samples outside the influence of sources. Obtain source samples from locations where the

Exhibit 1: Background Samples for Areas of Observed Contamination	
Source	**Background Sample**
Contaminated soil	Soil in vicinity of the site[1]
Tanks/Drums filled with contaminated soil	Same as for the soil at the site
Tanks/Drums containing liquid or solid wastes	Background is zero
Landfill[a]	Soil in vicinity of the site
Piles[a]	Soil in vicinity of the site
Surface impoundment (liquid)[a]	Aqueous samples from vicinity of the site; background may be zero
Surface impoundment (sludges or backfilled)[a]	Soil in the vicinity of the site
Other sources	Review on a site-specific basis

[1]See sections 5.1 and 5.2 of reference 2 for additional considerations.
[a]For these source types, the indicated sample is likely to be the most appropriate background.
Figure adapted from Highlight 9-1 of reference 2 (p. 344)

substances are suspected to have been deposited (e.g., contaminated soil along the flood plain of a contaminated surface water body).[2] Exhibit 1 suggests appropriate locations for background samples by source type.

Evaluating Waste Quantity by Defining Areas of Observed Contamination

Identify and delineate areas of observed contamination for the following reasons:

1. The soil exposure pathway can be evaluated only if there are areas of observed contamination.

2. Target values are assigned based on the distance of targets from the area of observed contamination.

3. Waste quantity can be calculated based on the area of observed contamination.

A site may have more than one area of observed contamination. Each area of observed contamination may be associated with its own targets. Assign a source hazardous waste quantity value for each area. Sum the source hazardous waste quantity values assigned to each area of observed contamination to determine the waste quantity factor value for the soil exposure pathway.[2]

Some soil areas cannot be included in evaluating an area of observed contamination. Exclude the following sub-areas:

- Areas covered by permanent or otherwise maintained and essentially impenetrable material (e.g., asphalt, concrete)

- Areas of higher ground not influenced by runoff from the site, if contamination results from runoff

- Areas where the types of operations at a facility preclude the presence of hazardous substances (e.g., contamination at loading docks but not elsewhere on site)

- Contaminated areas covered by more than two feet of fill or other material[2]

(Refer to specific examples in Highlights 9-3 through 9-6 in the *Hazard Ranking System Guidance Manual*, 1992, OSWER Directive 9345.1-07.)

Areas of observed contamination can be established with sampling locations and analytical data that meet the HRS criteria for observed contamination, including determination of background level[2]. A minimum of three contaminated samples is sufficient to establish an area of observed contamination for soil. The area of

observed contamination includes the three sampling points and the area within them, except excluded sub-areas.[1,2]

Points and linear strips of observed contamination may be evaluated as areas of observed contamination for the soil exposure pathway, even though an actual "area" cannot be delineated. For soils, one contaminated sample denotes a point of observed contamination. Two contaminated soil samples denote a linear strip of observed contamination. Either a point or a linear strip can be used to identify other targets and to demonstrate a hazardous waste quantity value greater than zero. This method, however, should not be used indiscriminately to calculate waste quantity.

For non-soil sources, such as waste piles, observed contamination at a single point generally is sufficient to establish the entire source as an area of observed contamination.

Inferring an Area of Observed Contamination

For contaminated soil, an area of observed contamination may be inferred within sampling locations that meet the observed contamination criteria and have proper documentation. Select sampling locations that will allow maximum use of inferred areas of observed contamination. This strategy may identify more targets with fewer samples. Consider the following when inferring an area of observed soil contamination:

- Density of sampling points
- Physiography
- Topography and drainage patterns
- Operational history
- Transport and deposition of hazardous substances, such as wind dispersion
- Contamination in the downgradient portion of a well-defined migration route
- Data derived from other investigations (e.g., geophysical surveys)
- Soil staining
- Stressed vegetation patterns
- Aerial and ground photography
- Infrared satellite imagery indicating soil anomalies
- Use of composite samples (Samples within one grid cell may be combined; vertical samples from a single point within a zero to two foot depth may be combined. In general, do not use non-grid horizontal composite samples to infer areas of observed contamination.)[1,2]

Consider the modes of contaminant transportation and deposition when inferring an area of observed contamination. Contaminants dispersed by air would be distributed differently than those transported by water; take this into account when planning sampling. Do not infer an area of observed contamination between soils in the floodplain of a contaminated surface water body and those contaminated from other modes of transportation and deposition.

Determining Levels of Actual Contamination

Documentation of observed contamination is a prerequisite for evaluating actual contamination at targets. Actual contamination is evidence that targets have contact with the hazardous substance(s) from observed contamination. The level of actual contamination is determined by comparing the release sample concentration to media-specific benchmark values, where available. Level I contamination is at or above benchmarks; level II is below benchmarks. Note that the presence of contamination at targets is not in itself sufficient to establish observed contamination or actual contamination.[2] Observed contamination samples can be strategically located to establish an area of contamination and to include one or more targets (dual purpose sampling). Analytical data with appropriate and adequate quality assurance/quality control (QA/QC) are needed since benchmarks are expressed in concentration units. Analytical data should provide definitive identification of the hazardous substances.[3]

Level I actual contamination concentrations cannot be inferred between contaminated soil sampling points. The inferred area of observed contamination is evaluated as Level II, even if Level I concentrations are found at sampling points.[2]

Use of Grid Samples

Grid samples may consist of grab samples (from a single point) or composite samples (from multiple points). Either grab or composite grid samples may be used to evaluate the area of observed contamination if the following conditions apply:

- Samples are obtained from a depth of two feet or less from the source or soil surface, and the source is not covered by impervious material

- The available analytical data verify analyte identity and quantitation with adequate QA/QC (this may

consist of confirming 10 percent of screening analyses by definitive methods)[3]

- The verified analytical data meet the HRS definition of observed contamination as defined in section 2.3 of the *Hazard Ranking System, Final Rule*

Contaminated grid cells are those with identified hazardous substances that meet HRS criteria for depth, attribution to the site, and significance above background level. The area within these grid cells may be used to define an area of observed contamination.

Contamination can be inferred at grid cells not sampled if they lie between contaminated grid cells. Grid cells lying within inferred contaminated cells are themselves considered inferred contaminated cells. The area within inferred contaminated grid cells may be included as part of an area of observed contamination. (Refer to Highlight 9-4 in the *Hazard Ranking System Guidance Manual*, 1992, OSWER Directive 9345.1-07.)

The following guidelines should be used when considering grid sampling data:

- Exclude from the area of observed contamination uncontaminated grid cells and unsampled grid cells that do not lie between contaminated or inferred contaminated ones.

- Subtract from the defined area of observed contamination any grid cells or sub-areas which are covered with impervious materials, or meet other criteria for exclusion.[2]

- Use the same methods to define both the excluded sub-areas and areas of observed contamination. All samples should be of the same quality, and analyzed by similar procedures. Exclude sub-areas from the inferred area of observed contamination on a case-by-case basis.

- Composite grid samples may establish Level II actual contamination; specific grab samples are required to establish Level I actual contamination.

Determining an Area of Observed Contamination for Sources Other Than Soil

Sources other than contaminated soil, such as waste piles, impoundments, and containers, can be evaluated for the soil exposure pathway. The entire source is considered an area of observed contamination if a sample collected from it meets the criteria for observed contamination.[2] Determine an area of observed contamination as follows:

- Impoundment, landfill, and land treatment — Use the surface area of the source[2,4]

- Pile — Use the surface area of the pile

- Ruptured tanks, drums, and other containers — Use the surface area of the container or the land area under the container (Note: Do not evaluate containers which have not leaked.)

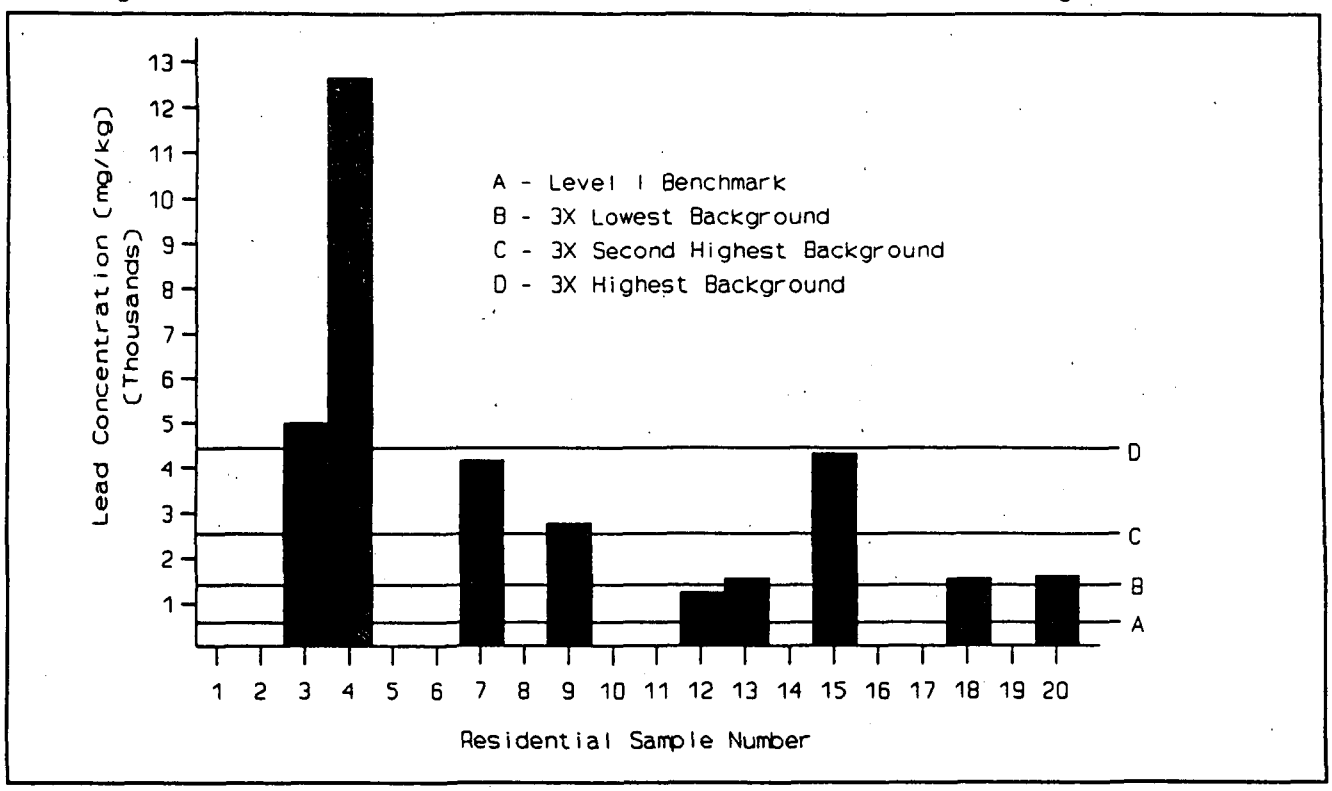
Example Site

EPA conducted an Expanded Site Inspection (ESI) at a scrap metal yard in an industrial area to assess inorganic soil contamination. For a number of years, reclamation of automotive batteries had taken place at the scrap yard, which was surrounded by a residential area. A prior removal action mitigated severe soil contamination and secured the site from public access, but did not generate enough data to allow HRS evaluation.

The removal action uncovered extensive lead contamination within the property boundaries of the scrap yard, but had not evaluated the residential area. Eleven residences were situated on a tract adjacent to the site; six residences abutted the scrap yard boundary. The proximity of the residential area raised the possibility that inhabitants could be exposed to lead from sources at the scrap yard. A study of the area revealed that lead could be deposited on the residential tract from surface runoff, dispersion of particulates from wind, and vehicular movement. EPA hypothesized that these modes of soil transport created an area of observed contamination in the residential tract.

EPA collected soil samples at each residence and at border areas to demonstrate attribution of lead contamination by areal contiguity. Background samples were collected at nearby areas that were outside the influence of sources at the scrap yard. In an industrial area, it is always possible that background concentration is inflated from various sources. To account for this possibility, seven spatially divergent sample locations were selected within the background area to ensure provision of at least one representative background level. Soils in all sample locations were classified so that release samples could be compared to background samples of similar soil composition. All samples were

Figure 2: Lead Concentrations in Residential Soils Related to Various Background Levels



collected within six inches of the ground surface. Analytical results from the area of suspected lead contamination revealed lead concentrations ranging from 740 to 12,600 mg/kg (see figure 2). Lead concentrations from the background area ranged from 448 to 1,410 mg/kg. Observed and actual contamination were clearly established, since three residences had lead concentrations greater than or equal to three times the highest background level, and the lead was attributable to the scrap yard. Data from local and regional health agencies indicated that the highest background level, which is usually the one selected for HRS evaluation, was inflated. If this were the case, the number of residences with actual contamination would be underestimated. EPA decided to examine the background data more closely.

According to data from the health agencies, background levels of lead in area soils ranged from 500 to 1000 mg/kg. Statistical analysis of the background levels showed that the highest value, 1,410 mg/kg, was not an outlier, but did lie well above the upper quartile of the data distribution. EPA suspected that the highest background value was not a representative level, and considered using a statistically derived concentration. The use of the mean concentration was immediately rejected because it was subject to inflation from the highest value. In such a skewed data set, the median would be a more stable estimator of typical background value. The median background level of 625 mg/kg was consistent with published data. It was, however, only an inference of typical background level, not a real sample concentration. The second highest background concentration, 856 mg/kg, fell within the range of the published data. EPA chose this value because a single background sample is a sufficient, defensible determination of background level under the HRS. Use of the lowest background concentrations was not considered because it could erroneously indicate observed contamination in areas where lead concentrations were below three times the reasonable background level. The lowest concentration is not defensible in HRS evaluation when there are higher background values obtained from sampling.

Samples from seven residences had lead concentrations in excess of three times background level (i.e., 3 x 856 mg/kg = 2,568 mg/kg). The health-based benchmark for lead in soil is 500 mg/kg. The ESI therefore established an area of observed contamination beyond the facility's boundaries and found seven residences with Level I actual contamination.

Smart Sampling Example: Use of Aerial Photographs

The use of aerial photographs during early site screening can provide valuable information for optimal selection of sampling locations. Further, photos can facilitate potentially responsible party (PRP) searches and enforcement activities. Recent aerial photography may reveal burial outlines, staining, or stressed vegetation. In one instance, aerial photos of a landfill pinpointed locations of buried drums more precisely than did borings. In another instance, aerial photos of two adjacent oilfield-related sites revealed the possibility of buried waste pits. Subsequent samples from the locations confirmed the existence of the waste pits. Whenever possible, use aerial photographs to help delineate site contamination, aid in enforcement, and save money by narrowing the areas that must be sampled.

Summary

Surficial soil and other source samples may be used to establish observed contamination for the soil exposure pathway. Observed contamination can be documented only by chemical analysis. Direct observation and the potential for observed contamination are not evaluated for this pathway. Sample on the property, within 200 feet of targets, and within two feet of the source surface. Multiple samples which meet the HRS criteria for observed contamination may be used to delineate an area of observed contamination by inferring contamination between sampling points. The scope of the Site Inspection generally does not warrant fully delineating areas that are not subject to observed contamination. The primary objective is to identify targets that may come in contact with hazardous substances at the site. Whenever possible, select sampling locations which serve the dual purpose of establishing observed contamination and identifying targets.

References

1. U.S. Environmental Protection Agency, 1992. *Guidance for Performing Site Inspections Under CERCLA*. Office of Solid Waste and Emergency Response. Directive 9345.1-05.

2. U.S. Environmental Protection Agency, 1992. *Hazard Ranking System Guidance Manual*. Office of Solid Waste and Emergency Response. Directive 9345.1-07.

3. U.S. Environmental Protection Agency, 1993. *Data Quality Objectives Process for Superfund, Interim Final Guidance*. Office of Emergency and Remedial Response. Directive 9355.9-01.

4. U.S. Environmental Protection Agency, 1990. *Hazard Ranking System, Final Rule*. 40 CFR Part 300.

Additional copies can be obtained from:

National Technical Information Service (NTIS)
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
(703) 487-4650
Order #94-963312

United States
Environmental Protection Agency
5204G
Washington, DC 20460

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APPENDIX B

Acronym List
and
Glossary

ACRONYM LIST

AALAC	ambient aquatic life advisory concentration
AOC	area of observed contamination
AWQC	ambient water quality criteria
BCF	bioconcentration factor
BCFV	bioconcentration factor value
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BPF	bioaccumulation potential factor
BPFV	bioaccumulation potential factor value
BTAG	Biological Technical Assistance Group
CA	cooperative agreement
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CERI	Center for Environmental Research Information
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CRDL	contract-required detection limit
CRQL	contract-required quantitation limit
CWA	Clean Water Act
DDD	dichloro-diphenyl-dichloro-ethane
DDE	dichloro-diphenyl-ethane
DDT	dichloro-diphenyl-trichloroethane
DL	detection limit
DNAPL	dense nonaqueous phase liquid
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EECA	engineering evaluation/cost analysis
EIS	environmental impact statement
EP	extraction procedure
EPA	U.S. Environmental Protection Agency
ERCS	Emergency Response Cleanup Services
ERD	Emergency Response Division
ERT	Environmental Response Team
FDAAL	Food and Drug Administration advisory level
FRDS	Federal Data Reporting System
FWRS	Fish and Wildlife Reference Service
GIS	Geographic Information System
GW	ground water
HASP	health and safety plan
HFC	human food chain
HRS	Hazard Ranking System
HRSGM	Hazard Ranking System Guidance Manual
HWQ	hazardous waste quantity
IAG	interagency agreement
IDL	instrument detection limit
IDW	investigation-derived waste
LNAPL	light nonaqueous phase liquid
LR	likelihood of release

ACRONYM LIST

MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MDL	method detection limit
MMS	Minerals Management Service
NAAQS	National Ambient Air Quality Standards
NAWDEX	National Water Data Exchange
NCP	National Contingency Plan
NESHAP	National Emission Standard for Hazardous Air Pollutants
NFRAP	no further remedial action planned
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NRC	Nuclear Regulatory Commission
NRT	National Response Team
NSFF	National Sport Fishing Federation
NWI	National Wetlands Inventory
ORP	EPA Office of Radiation Programs
OSC	Onscene Coordinator
OSM	Office of Surface Mining
OSWER	Office of Solid Waste and Emergency Response
OVA	organic vapor analyzer
OWRS	Office of Water Regulations and Standards
PA	preliminary assessment
PCB	polychlorinated biphenyl
PPE	probable point of entry
PRP	potentially responsible party
QA	quality assurance
QC	quality control
RA	removal action
RAS	Routine Analytical Services
REAC	Regional Engineering Analytical Contract
RCRA	Resource Conservation and Recovery Act
RDT	Regional Decision Team
RI/FS	remedial investigation/feasibility study
RREL	Risk Reduction Engineering Laboratory
RRT	Regional Response Team
SACM	Superfund Accelerated Cleanup Model
SARA	Superfund Amendments and Reauthorization Act
SAS	Special Analytical Services
SAV	submerged aquatic vegetation
SC	screening concentration
SCDM	Superfund Chemical Data Matrix
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act
SF	slope factor
SI	site inspection
SMO	sample management officer
SQL	sample quantitation limit
SW	surface water
SWDA	Solid Waste Disposal Act

ACRONYM LIST

TAL	target analyte list
TAT	Technical Assistance Team
TCL	target compound list
TCLP	Toxic Characteristic Leaching Procedure
TDL	target distance limit
TSCA	Toxic Substances Control Act
TSDF	treatment, storage, or disposal facility
USC	U.S. Code
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UV	ultraviolet
WC	waste characteristics
WHPA	wellhead protection area

GLOSSARY

Apportioned population: In the evaluation of drinking water target populations associated with a blended system, that portion of the population evaluated as being served by an individual well or intake within the system.

Aquifer: A saturated subsurface zone from which drinking water is drawn.

Blended system: A drinking water supply system which can or does combine (e.g., via connecting valves) water from more than one well or surface water intake, or from a combination of wells and intakes.

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act of 1980.

CERCLA Information System: CERCLIS, EPA's computerized inventory and tracking system for potential hazardous waste sites.

CERCLIS: CERCLA Information System.

Coastal tidal waters: Surface water body type that includes embayments, harbors, sounds, estuaries, back bays, etc. Such water bodies are in the interval seaward from the mouths of rivers and landward from the 12-mile baseline marking the transition to the ocean water body type.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980: Legislation that established the Federal Superfund for response to uncontrolled releases of hazardous substances to the environment.

Contaminated soil: Soil onto which available evidence indicates that a hazardous substance was spilled, spread, disposed, or deposited.

Depth to aquifer: The vertical distance between the deepest point at which hazardous substances are suspected and the top of the shallowest aquifer that supplies drinking water.

Distance to surface water: The shortest distance that runoff would follow from a source to surface water.

Drinking water population: The number of residents, workers, and students who drink water drawn from wells or surface water intakes located within target distance limits.

Drums: Portable containers designed to hold a standard 55-gallon volume of wastes.

Emergency response: See "removal."

Factor: The basic element of site assessment requiring data collection and evaluation for scoring purposes.

Factor category: A set of related factors. Each pathway consists of three factor categories -- likelihood of release or exposure, targets, and waste characteristics.

Federal Register: Daily publication of the Government Printing Office; contains public notices, rules, and regulations issued by the Federal Government. Cited as "<volume> FR <page>."

FEMA: Federal Emergency Management Agency.

Fishery: An area of a surface water body from which food chain organisms are taken or could be taken for human consumption on a subsistence, sporting, or commercial basis. Food chain organisms include fish, shellfish, crustaceans, amphibians, and amphibious reptiles.

FR: Federal Register.

GEMS: Geographical Exposure Modeling System.

Geographical Exposure Modeling System: Population database maintained by EPA's Office of Toxic Substances; provides residential populations in specified distance rings around a point location.

Hazard Ranking System: EPA's principal mechanism for placing sites on the NPL.

Hazardous constituent: Hazardous substance.

Hazardous substance: Material defined as a hazardous substance, pollutant, or contaminant in CERCLA Sections 101(14) and 101(33).

Hazardous waste: Any material suspected to contain a hazardous substance, pollutant, or contaminant that is or was in a source.

HRS: Hazard Ranking System.

Karst: A kind of terrain with characteristics of relief and drainage arising from a high degree of rock solubility. The majority of karst conditions occur in limestone areas, but karst may also occur in areas of dolomite, gypsum, or salt deposits. Features associated with karst terrain may include irregular topography, abrupt ridges, sinkholes, caverns, abundant springs, disappearing streams, and a general lack of a well-developed surface drainage system of tributaries and streams.

Lake: A type of surface water body which includes:

- Natural and artificially-made lakes or ponds that lie along rivers or streams (but excluding the Great Lakes).
- Isolated but perennial lakes, ponds, and wetlands.
- Static water channels or oxbow lakes contiguous to streams or rivers.
- Streams or small rivers, without diking, that merge into surrounding perennially-inundated wetlands.
- Wetlands contiguous to water bodies defined as lakes are considered to be part of the lake.

Landfill: An engineered (by excavation or construction) or natural hole in the ground into which wastes have been disposed by backfilling, or by contemporaneous soil deposition with waste disposal, covering wastes from view.

Land treatment: Landfarming or other land treatment method of waste management in which liquid wastes or sludges are spread over land and tilled, or liquids are injected at shallow depths into soils.

National Contingency Plan: Regulation that establishes roles, responsibilities, and authorities for responding to hazardous substance releases. The NCP established the HRS as the principal mechanism for placing sites on the NPL.

National Priorities List: Under the Superfund program, the list of releases and potential releases of hazardous substances, pollutants, and contaminants that appear to pose the greatest threat to public health, welfare, and the environment.

NCP: National Oil and Hazardous Substances Pollution Contingency Plan, commonly known as the National Contingency Plan.

NFRAP: No further remedial action planned; site disposition decision that further response under the Federal Superfund is not necessary.

No suspected release: A professional judgement conclusion based on site and pathway conditions indicating that a hazardous substance is not likely to have been released to the environment. (No suspected release is the PA term analogous to the HRS "potential to release.")

NPL: National Priorities List.

Ocean: A type of surface water body which includes:

- Ocean areas seaward from a baseline distance of 12 miles from shore.
- The Great Lakes, along with wetlands contiguous to them.

PA: Preliminary assessment.

PA-Score: EPA's computer program that automates PA site scoring.

Pathway: The environmental medium through which a hazardous substance may threaten targets. The PA evaluates the migration and threat potential through the ground water, surface water, air, and soil exposure pathways.

Pile: Any non-containerized accumulation above the ground surface of solid, non-flowing wastes; includes open dumps. Some types of piles are: Chemical Waste Pile -- consists primarily of discarded chemical products, by-products, radioactive wastes, or used or unused feedstocks; Scrap Metal or Junk Pile -- consists primarily of scrap metal or discarded durable goods such as appliances, automobiles, auto parts, or batteries, composed of materials suspected to contain or have contained a hazardous substance; Tailings Pile -- consists primarily of any combination of overburden from a mining operation and tailings from a mineral mining, beneficiation, or processing operation; Trash Pile -- consists primarily of paper, garbage, or discarded non-durable goods which are suspected to contain or have contained a hazardous substance.

PPE: Probable point of entry.

Preliminary assessment: Initial stage of site assessment under Superfund; designed to distinguish between sites that pose little or no threat to human health and the environment and sites that require further investigation.

PREscore: EPA's computer program that automates site scoring with the Hazard Ranking System.

Primary target: A target which, based on professional judgement of site and pathway conditions and target characteristics, has a relatively high likelihood of exposure to a hazardous substance. (Primary target is the PA term analogous to the HRS target exposed to Level I or Level II actual contamination.)

Probable point of entry: The point at which runoff from the site most likely enters surface water.

RCRA: Resource Conservation and Recovery Act of 1976.

Removal: An action taken to eliminate, control, or otherwise mitigate a threat posed to the public health or environment due to release or threatened release of a hazardous substance. Removals are relatively short-term actions to respond to situations requiring immediate action.

Resident: A person whose place of residence (full- or part-time) is within the target distance limit.

Resident individual: Under the soil exposure pathway, a resident or student within 200 feet of any area of suspected contamination associated with the site.

Resident population: Under the soil exposure pathway, the number of residents and students within 200 feet of any area of suspected contamination associated with the site.

Resource Conservation and Recovery Act of 1976: Legislation that established cradle-to-grave accountability for hazardous wastes, from point of generation to point of ultimate disposal.

SARA: Superfund Amendments and Reauthorization Act of 1986.

Secondary target: A target which, based on professional judgement of site and pathway conditions and target characteristics, has a relatively low likelihood of exposure to a hazardous substance. (Secondary target is the PA term analogous to the HRS target exposed to potential contamination.)

Sensitive environment: A terrestrial or aquatic resource, fragile natural setting, or other area with unique or highly-valued environmental or cultural features.

SI: Site inspection.

Site: The area consisting of the aggregation of sources, the areas between sources, and areas that may have been contaminated due to migration from sources; site boundaries are independent of property boundaries.

Site inspection: Second stage of site assessment under Superfund, conducted on sites that receive a further action recommendation after the PA; builds on PA information and typically includes sampling to identify hazardous substances, releases, and contaminated targets; identifies sites that pose the greatest threats to human health and the environment.

Source: An area where a hazardous substance may have been deposited, stored, disposed, or placed. Also, soil that may have become contaminated as a result of hazardous substance migration. In general, however, the volumes of air, ground water, surface water, and surface water sediments that may have become contaminated through migration are not considered sources.

Stream flow: The average rate of flow of a water body, expressed in cubic feet per second (cfs).

Stream or river: A type of surface water body which includes:

- Perennially-flowing waters from point of origin to the ocean or to coastal tidal waters, whichever comes first, and wetlands contiguous to these flowing waters.
- Aboveground portions of disappearing rivers.
- Artificially-made ditches only insofar as they perennially flow into other surface water.
- Intermittently-flowing waters and contiguous intermittently-flowing ditches in areas where mean annual precipitation is less than 20 inches.

Student: A full- or part-time attendee of a daycare facility or educational institution located within the target distance limit.

Superfund Amendments and Reauthorization Act of 1986: Legislation which extended the Federal Superfund program and mandated revisions to the HRS.

Surface impoundment: A topographic depression, excavation, or diked area, primarily formed from earthen materials (lined or unlined) and designed to hold accumulated liquid wastes, wastes containing free liquids, or sludges that were not backfilled or otherwise covered during periods of deposition; depression may be dry if deposited liquid has evaporated, volatilized or leached, or wet with exposed liquid; structures that may be more specifically described as lagoon pond, aeration pit, settling pond, tailings pond, sludge pit, etc.; also a surface impoundment that has been covered with soil after the final deposition of waste materials (i.e., buried or backfilled).

Surface water: A naturally-occurring, perennial water body; also, some artificially-made and/or intermittently-flowing water bodies. See "water body type" and subsequent definitions for more detail.

Suspected release: A professional judgement conclusion based on site and pathway conditions indicating that a hazardous substance is likely to have been released to the environment. (Suspected release is the PA term analogous to the HRS "observed release.")

Tanks and non-drum containers: Any stationary device, designed to contain accumulated wastes, constructed primarily of fabricated materials (such as wood, concrete, steel, or plastic) that provide structural support; any portable or mobile device in which waste is stored or otherwise handled.

Target: A physical or environmental receptor that is within the target distance limit for a particular pathway. Targets may include wells and surface water intakes supplying drinking water, fisheries, sensitive environments, and resources.

Target distance limit: The maximum distance over which targets are evaluated. The target distance limit varies by pathway: ground water and air pathways -- a 4-mile radius around the site; surface water pathway -- 15 miles downstream from the probable point of entry to surface water; soil exposure pathway -- 200 feet (for the resident population threat) and 1 mile (for the nearby population threat) from areas of known or suspected contamination.

Target population: The human population associated with the site and/or its targets. Target populations consist of those people who use target wells or surface water intakes supplying drinking water, consume food chain species taken from target fisheries, or are regularly present on the site or within target distance limits.

Terrestrial sensitive environment: A terrestrial resource, fragile natural setting, or other area with unique or highly-valued environmental or cultural features.

USF&WS: U.S. Fish and Wildlife Service.

USGS: U.S. Geological Survey.

Water body type: Classification of a surface water body. Water body types include: streams and rivers; lakes; oceans (includes the Great Lakes); and coastal tidal waters. See the specific definition of each water body type for more detail.

Wetland: A type of sensitive environment characterized as an area that is sufficiently inundated or saturated by surface or ground water to support vegetation adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Worker: Under the soil exposure pathway, a person who is employed on a full- or part-time basis on the property on which the site is located. Under all other pathways, a person whose place of full- or part-time employment is within the target distance limit.

Guidance for Performing Preliminary Assessments Under CERCLA, USEPA, Sept. 1991

APPENDIX C

Case Studies

SOURCE SAMPLING EXERCISE: ACME MANUFACTURING COMPANY

OBJECTIVE:

Using available site information, develop a **source sampling** strategy implementing procedures established in the SI guidance manual.

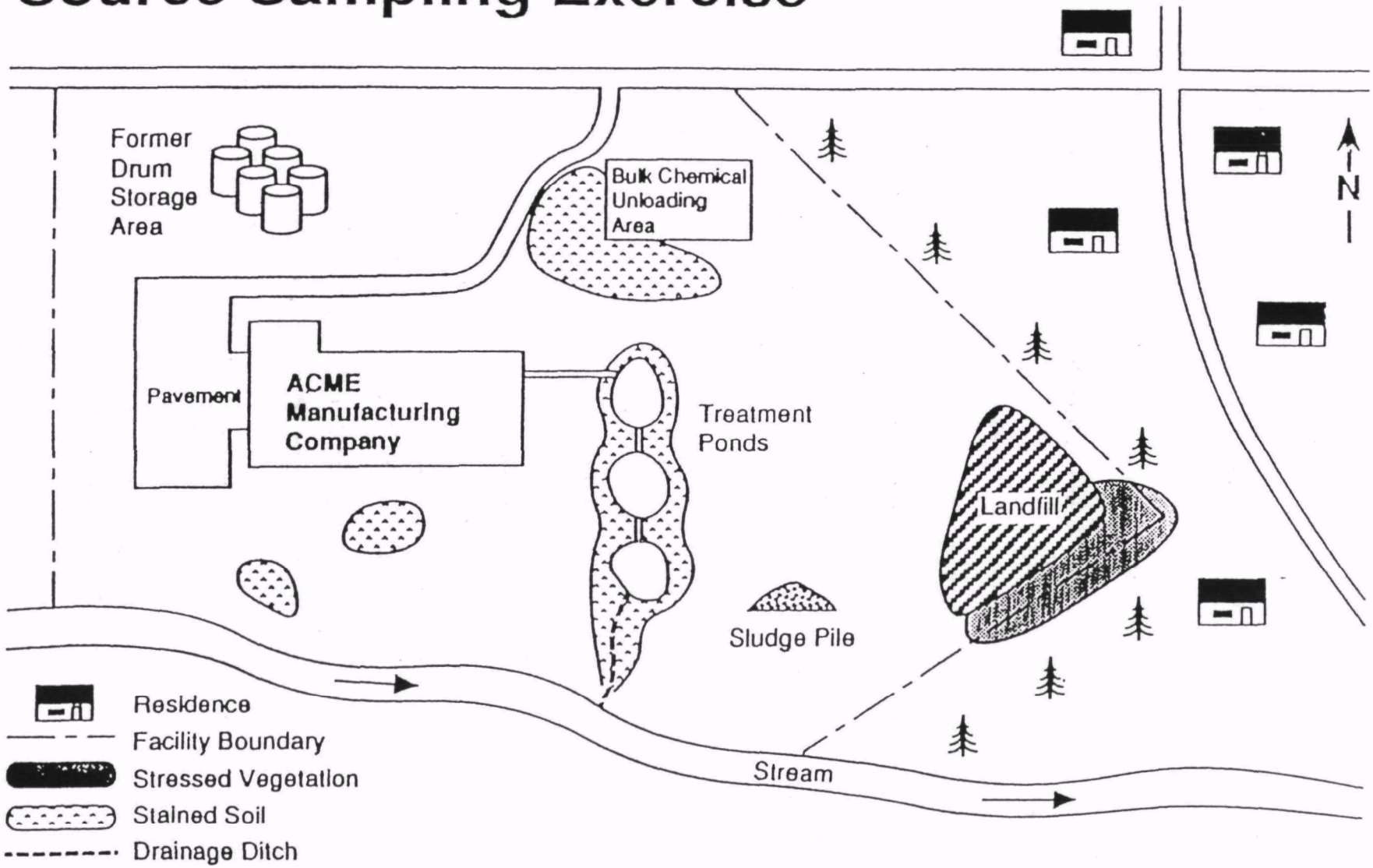
METHOD:

1. Review the general site information provided below.
2. Identify site sources on the map.
3. Develop a source sampling strategy that includes source characterization, background determination, and collection of quality control samples. You are limited to 20 samples. You do not need to use all available samples.
4. Record your sampling strategy on the table provided.
5. BONUS CHALLENGE: Complete this exercise using only 10 samples.

General Site Information:

- The ACME Manufacturing Company site is an inactive electroplating facility. The total acreage is about 10 acres (see site map).
- Rinsewater from the electroplating process was discharged to treatment ponds from 1907 until 1985.
- Drums, which were located in the former drum storage area found on the northwestern corner of the facility property, are believed to have contained waste solvents. They were held there prior to offsite removal.
- Stained soil was observed adjacent to the bulk chemical unloading area and manufacturing building.
- The waste pile appears to be dried sludge from the treatment ponds.
- The landfill reportedly received "off-spec" products, spent solvents, and treatment pond sludge.
- Leachate seeps were observed along the southeast corner of the landfill with stressed vegetation extending beyond the facility boundary.

Source Sampling Exercise



SOURCE SAMPLING STRATEGY

SITE NAME:

Sample ID	Sample Type	Rationale

Total Samples:

Special Sampling Considerations:

BONUS SOURCE SAMPLING STRATEGY

SITE NAME:

Sample ID	Sample Type	Rationale

Total Samples:

Special Sampling Considerations:

SURFACE WATER SAMPLING EXERCISE: R. R. ACME LANDFILL

OBJECTIVE:

Using available site information, develop a single SI sampling strategy to test a PA hypothesis of suspected contamination of surface water.

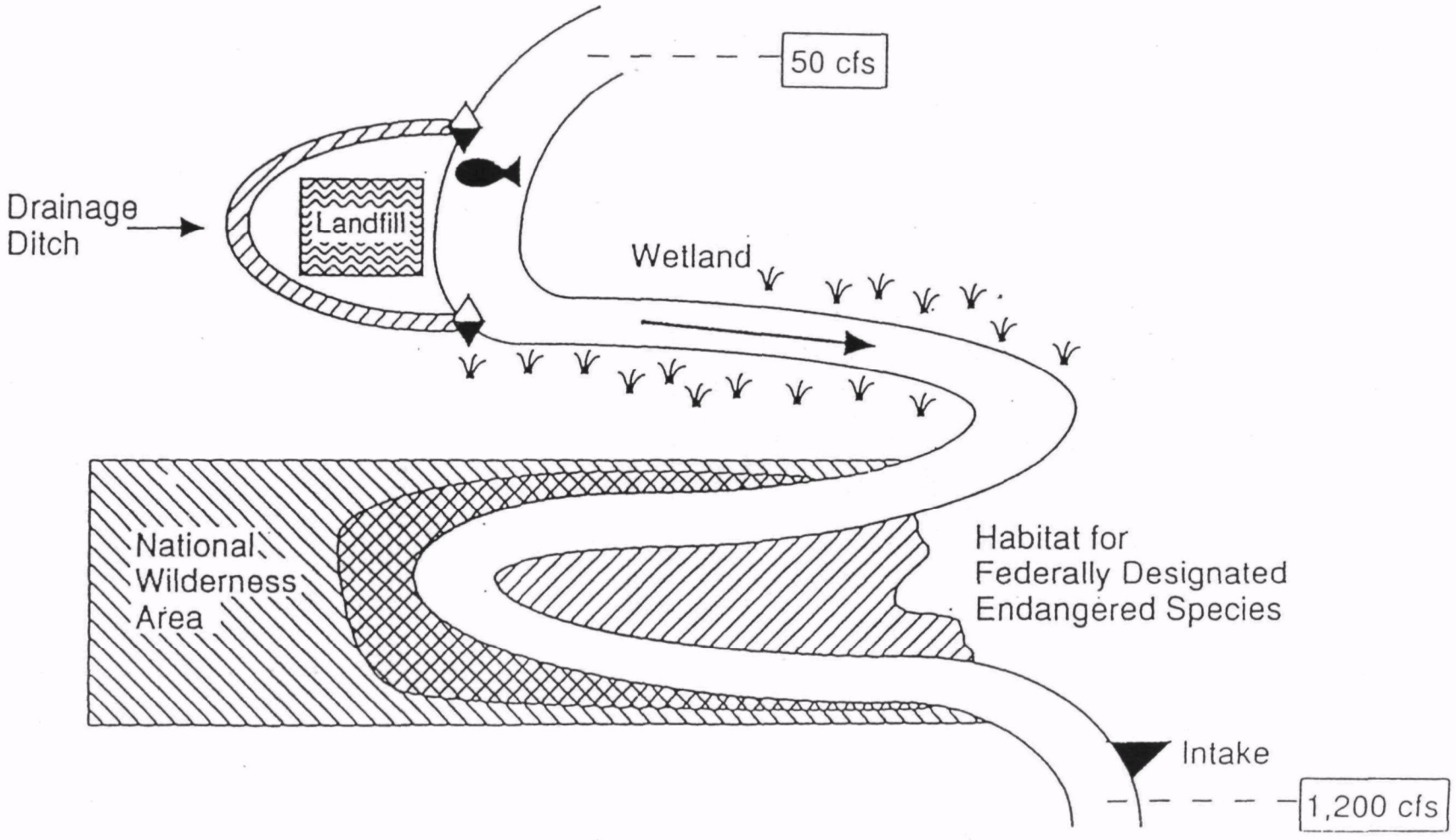
METHOD:

1. *Review the general site information and map below.*
2. Identify site sources on the map.
3. Identify probable points of entry (PPE).
4. Identify all primary and secondary targets.
5. Develop a sampling strategy to test the PA hypothesis of suspected release to surface water. You should use the procedures outlined in the SI guidance to demonstrate observed contamination. Because this is a single SI, all data must be sufficient to complete HRS scoring and documentation.
6. You are limited to 20 samples. You do not need to use all available samples.
7. Record your sampling strategy on the table provided.
8. BONUS CHALLENGE: Develop a sampling strategy to demonstrate actual contamination.

General Site Information:

- The R. R. Acme Landfill is a municipal landfill that was active between 1950 and 1980.
- The PA has determined that the surface water pathway is the major pathway of concern for this site.
- The PA has determined that the hazardous substances of concern are DDT, lead, and mercury.
- Critical distances:
  - PPE to wetland = 200 feet
  - PPE to wilderness area and habitat = 0.5 miles
  - PPE to intake = 5 miles

Sample to Test Suspected Contamination



SAMPLING STRATEGY

SITE NAME:

Sample ID	Sample Type	Rationale

Total Samples:

Special Sampling Considerations:

BONUS SAMPLING STRATEGY

SITE NAME:

Sample ID	Sample Type	Rationale

Total Samples:

Special Sampling Considerations:

CASE STUDY: SI SAMPLING STRATEGY

OBJECTIVE:

Using available site information for the Wolfram Industries site, develop a SI sampling strategy implementing procedures established in the SI guidance manual.

METHOD:

1. Review the site information provided with this case study. The information is derived from the preliminary assessment (PA).

2. Identify the following elements and label them on the appropriate maps:
   - Sources
   - Targets
   - Areas of suspected contamination
   - PPE
   - In-water portion of the surface water pathway

3. Develop a list of objectives for an SI sampling plan

4. Develop a sampling strategy to test the following hypotheses:
   - Suspected release to ground water, surface water, and air
   - Suspected soil contamination
   - Exposure of targets to contaminated ground water, surface water, soil, and air

5. Include the following elements in the sampling strategy:
   - Characterization of background
   - Demonstration of attribution
   - Quality control (minimal)

6. There is a limit of 20 samples for this exercise. You are not required to use all allocated samples.

7. Plot all sampling locations on the site map(s).

8. Complete the sampling strategy table.

SITE INSPECTION CASE STUDY: WOLFRAM INDUSTRIES

General Site Description

Wolfram Industries is a 12-acre site located within an industrial area in Harbor Hill County, Fairlawn, New York. It consists of a laboratory, a warehouse, and a refinery. The site was active from 1941 to 1989 and has since been abandoned. The Mosquito River is located east of the site and flows south into Harbor Hill Bay. There are several small wetlands along the banks of the Mosquito River. A potato farm occupies a piece of land to the east of the river. Rainfall for this area is approximately 28 inches per year, according to the local weather station records.

The GEMS data base provides the following population information for the region lying within 4 miles of the site.

Distance from Site	Population
Onsite	0
0 - ¼ mile	250
¼ - ½ mile	1,080
½ - 1 mile	4,520
1 - 2 miles	9,900
2 - 3 miles	35,400
3 - 4 miles	67,900

U.S. Census Bureau data for this region indicate an average 2.5 people per household.

Operational History

A review of site records indicates that this facility processed raw tungsten ore into tungsten metal via crushing and hydrochloric acid extraction and precipitation reactions. Processed tungsten was used for making lighting filaments and for making other tungsten compounds. Waste products include acidic metallic slag that contains high concentrations of hexavalent chromium, lead, zinc, manganese, iron, copper, and cyanide.

Information obtained during the PA revealed several possible source areas onsite (see Figure 1, Wolfram Industries site map). The slag is stored in stacked 55-gallon drums throughout the site. The outdoor portions of the site are not paved. Two large piles of fine-grained black ore tailings are adjacent to the refining facility. They are estimated to contain 375 cubic yards of waste within an estimated combined area of 416 square feet. A plastic-lined lagoon of unknown depth is found to the north of the refinery. It occupies an area of 2,000 square feet. The lagoon was reported to contain process waters and acidic solutions containing heavy metals and cyanide. Plants were observed growing out of a portion of the lagoon. Three monitoring wells that are 75 feet in depth are located around the lagoon. One downgradient monitoring well was reported to be vandalized and filled in with beer cans and gravel. The facility is fenced on three sides, but there is a large hole in the southern fence due to a recent automobile accident.

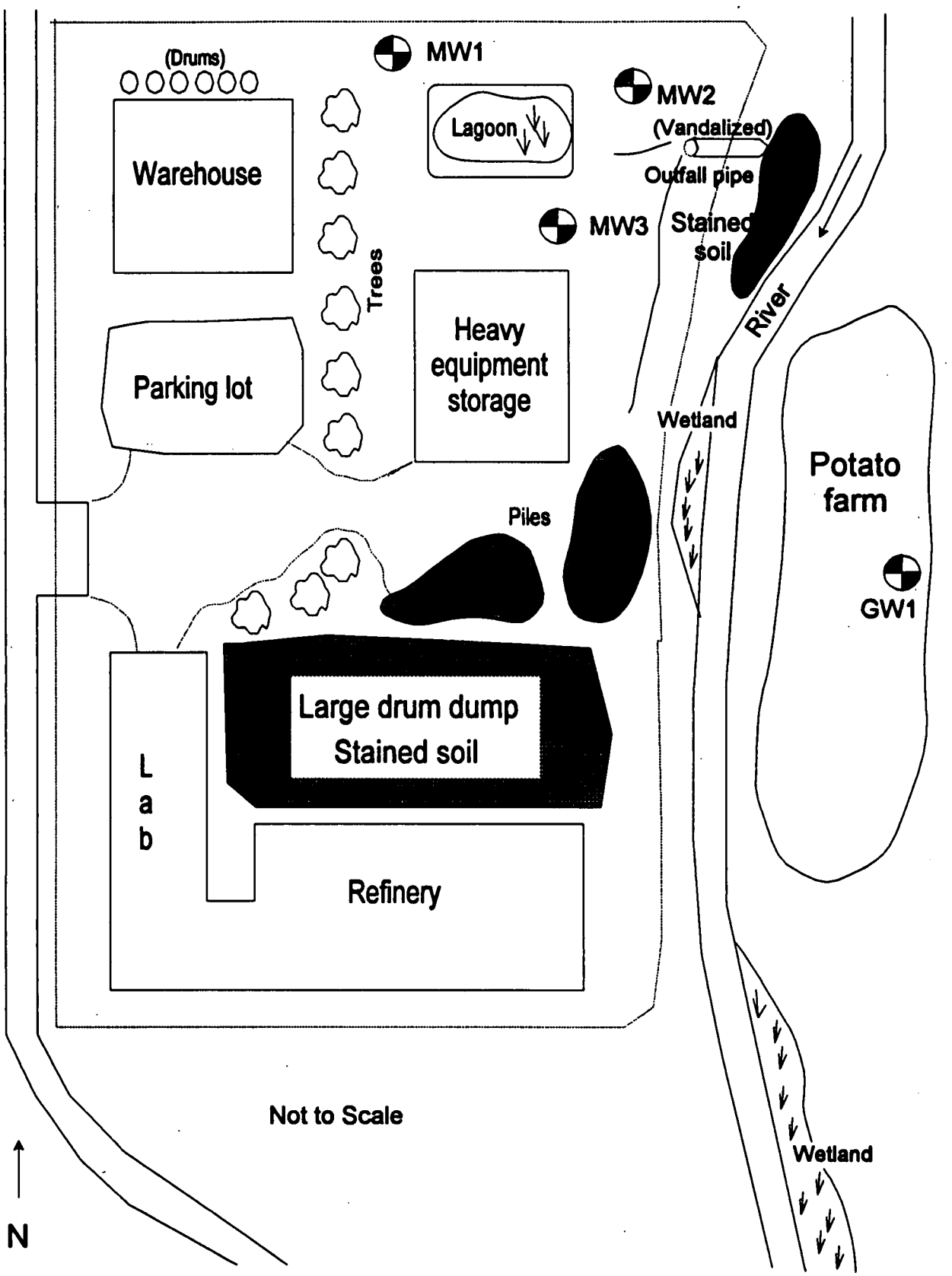
Probable Substances of Concern

Based on observations made during the offsite reconnaissance for the PA, the 55-gallon drums of slag are badly deteriorated and the contents of several drums are spilling black powdery slag onto the ground. Partially corroded drums were found on the north side of the warehouse; their contents are unknown. A topographic map of the area shows that the site slopes toward the northeast, and it is documented that runoff from the site is directed into the Mosquito River through an outfall pipe. The soil between the outfall pipe and the river was stained green and is devoid of vegetation. Aerial photographs of the site and information gathered during the PA indicate that there are 4,321 drums located outdoors. There is no containment and these drums are in contact with the unpaved ground. The area of stained soil adjacent to the drums is estimated to be 400 feet by 600 feet. The area of contaminated soil near the outfall is estimated to be 100 feet long by 10 feet wide. The estimated depth of the contaminated soil for both areas is 0.5 feet. The combined volume of the two tailings piles is estimated to be 375 cubic yards with a surface area of 416 square feet.

Geology and Ground Water

Based on information gathered from a United States Geological Survey (USGS) publication, the native soil for the site and surrounding area is a thin (0 to 2 feet thick) cover of loamy soil. Beneath this soil lies a thick formation of sand and gravel that is part of the Atlantic Coastal Plain from the Cretaceous Period. A water table aquifer occurs at a depth of 60 feet below the surface, although perched water tables exist over small and discontinuous clay lenses at shallow depths (about 10 feet) throughout the area. Ground water flow in the vicinity of the site is known to flow east-southeast or toward the Mosquito River.

Figure 1: Wolfram Industries Site Map



Ground Water Pathway

According to the municipal water authority, potable water for residents within 4 miles of the site comes from water reservoirs located 5 miles from the site. A wellhead protection area does not exist for this region. However, according to a USGS ground water data base, some residents have their own potable wells screened within a confined sand aquifer at a depth of 300 feet. Groundwater from a shallow perched water table aquifer is used for the irrigation of Mr. Spuds 4.5-acre potato farm. Some residents are supplied by ground water. They are eight homes located 0.3 miles from the site and 44 homes at 3.75 miles. This information was obtained from a USGS computer listing of wells within the county. No information is available on any well closures due to site contamination.

Surface Water Pathway

The Mosquito River was identified on the topographic map as the closest surface water body to the site. It lies within 100 feet of the site. Based on information gathered during the offsite reconnaissance, an outfall pipe from the facility and its associated stained soil area lie adjacent to the river bank. The bank of this river is located several feet below the grade of the site. The Federal Emergency Management Agency (FEMA) indicates that the site is located on the 10-year flood plain. On average, the Mosquito River flows at 1,500 cubic feet per second, according to the USGS Water Resource Atlas for this region. The state fish and wildlife bureau has confirmed that portions of this river serve as a fishery for catfish and small-mouth bass and as a habitat for the state-designated endangered species known as the "long-eared sunfish." In addition, many sport saltwater fish are caught in Harbor Hill Bay located 3 miles to the south. One unmapped wetland (0.1 miles in length) was observed along the river closest to the site and another (0.4 miles in length) was identified from published wetlands maps. No known drinking water intakes are located on the Mosquito River.

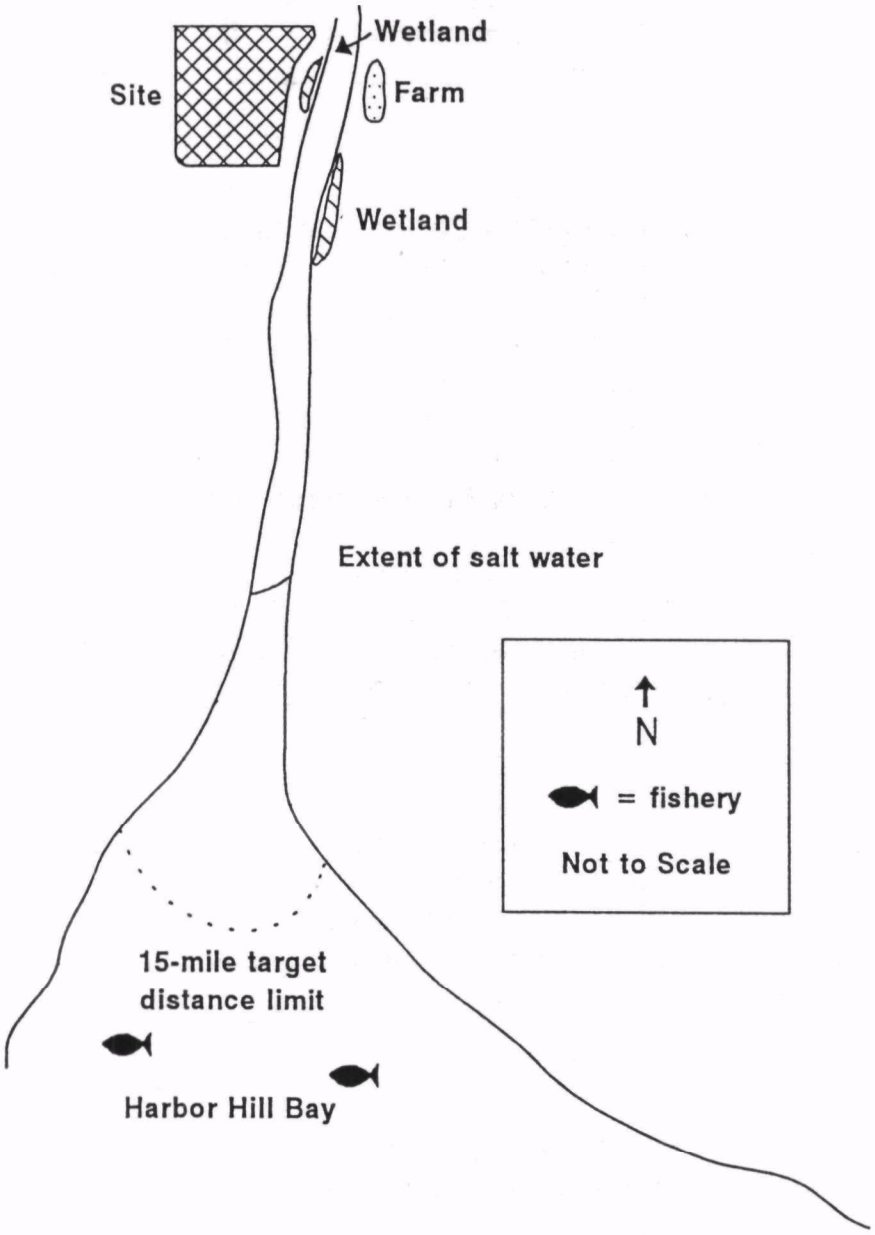
Soil Exposure Pathway

The PA states that there are no residents, schools, or day care centers located on or within 200 feet of an area of observed soil contamination. A hole in the fence of the facility allows unauthorized access by children or others. There are no terrestrial sensitive environments located on any areas of observed contamination. The total population within 1 mile of the site is 5,850 (based on GEMS data).

Air Migration Pathway

The nearest residence is located 0.24 miles west of the site and prevailing winds come from the west. No windbreak or covering is associated with the tailings piles.

Figure 2: Surface Water Pathway Map



SI SAMPLING STRATEGY

Sample ID	Sample Type	Rationale

Total Samples:

Special Sampling Considerations:

Requested Analyses:

SI SAMPLING STRATEGY

Sample ID	Sample Type	Rationale

Total Samples:

Special Sampling Considerations:

Requested Analyses:

APPENDIX D

SI Data Summary

SI DATA SUMMARY

The investigator may use the SI Data Summary to compile analytical data and non-sampling information concerning the site. The Data Summary can be a checklist to:

- Summarize previous and newly-collected information
- Identify factors that have not been fully evaluated
- Focus additional data collection efforts

A completed SI Data Summary may facilitate entering data into *PREscore* or other SI scoring and HRS documentation tools.

Responses on the SI Data Summary need not be typed; legible handwriting is acceptable.

The Data Summary is not a mandatory requirement for SI reporting; EPA Regional guidelines may recommend using other mechanisms to summarize information collected during the SI or to compile previous information about the site.

SI Data Summary entries marked with an asterisk (*) are optional during a focused SI. For pathways investigated during an expanded SI, all Data Summary entries should be completed.

If necessary, continuation pages to summarize additional analytical results should be photocopied and included with the Data Summary. A sample location map should be provided or referenced for all analytical results.

The last page of the Data Summary may be used to describe additional site information regarding a specific data element. In addition, this page may be used to describe or summarize site information that has not been collected, is not available, or is not well documented.

SI Data Summary Site Name _____

Site Name _____ EPA Region_____ Date _____

Contractor Name or State Office and Address _____

_____

GENERAL SITE INFORMATION

1. **CERCLIS ID No.** _____

   Address _____ City _____

   County _____ State _____ Zip Code _____ Congressional District _____

2. **Owner name** _____ **Operator name** _____

   Owner address _____ Operator address _____

   City _____ State _____ City _____ State _____

3. **Type of ownership** (check all that apply):
   ☐ Private ☐ Federal/Agency _____ ☐ State ☐ County ☐ Municipal
   ☐ Other _____ Reference(s) _____

4. **Approximate size of property:** _____ acres Reference(s) _____

5. **Latitude** ____°____'____.____" **Longitude** ____°____'____.____" Reference(s) _____

6. **Site status:** ☐ Active ☐ Inactive ☐ Unknown Reference(s) _____

7. **Years of operation:** From:_____ to: _____ ☐ Unknown Reference(s) _____

8. **Previous investigations:**

Type	Agency/State/Contractor	Date	
_____	_____	_____	Reference(s) _____
_____	_____	_____	Reference(s) _____
_____	_____	_____	Reference(s) _____
_____	_____	_____	Reference(s) _____
_____	_____	_____	Reference(s) _____
_____	_____	_____	Reference(s) _____

WASTE SOURCE INFORMATION

1. **Waste source types** (check all that apply)

   ☐ Constituent
   ☐ Wastestream (type) _____
   ☐ Landfill
   ☐ Drums
   ☐ Contaminated soil
   ☐ Land treatment
   ☐ Tanks or non-drum containers (type) _____
   ☐ Pile (type) _____
   ☐ Surface impoundment (buried)
   ☐ Surface impoundment (backfilled)
   ☐ Other _____

   Reference(s) _____

2. **Types of wastes** (check all that apply)

   ☐ Organic chemicals
   ☐ Inorganic chemicals
   ☐ Municipal wastes
   ☐ Radionuclides
   ☐ Metals
   ☐ Pesticides/Herbicides
   ☐ Solvents
   ☐ Other _____

   Reference(s) _____

3. **Summarize history of waste disposal operations:**

   _____
   _____
   _____
   _____
   _____
   _____
   _____

   Reference(s) _____

4. **Source characterization** (Attach pages to show quantity and calculations.)

Source 1 name: _____ Source type_____

Describe source: _____

Ground water migration containment: _____

Surface water migration containment: _____

Air migration (gas and migration) containment: _____

Physical state of wastes: ☐ Liquid ☐ Solid ☐ Sludge/Slurry ☐ Gas ☐ Unknown
Constituent quantity of hazardous substances: _____ (specify units)
Wastestream quantity containing hazardous substances: _____ (specify units)
Volume of source (yd^3): _____ Area of source (ft^2): _____

Hazardous substances associated with source 1:

_____ _____ _____
_____ _____ _____
_____ _____ _____

Reference(s) _____

Source 2 name: _____ Source type_____

Describe source: _____

Ground water migration containment: _____

Surface water migration containment: _____

Air migration (gas and migration) containment: _____

Physical state of wastes: ☐ Liquid ☐ Solid ☐ Sludge/Slurry ☐ Gas ☐ Unknown
Constituent quantity of hazardous substances: _____ (specify units)
Wastestream quantity containing hazardous substances: _____ (specify units)
Volume of source (yd^3): _____ Area of Source (ft^2): _____

Hazardous substances associated with source 2:

_____ _____ _____
_____ _____ _____
_____ _____ _____

Reference(s) _____

SI Data Summary Site Name _____

CONTINUATION PAGE FOR SOURCE CHARACTERIZATION

Source #____ Name_____ Source type _____

Describe source: _____

Ground water migration containment: _____

Surface water migration containment: _____

Air migration (gas and migration) containment: _____

Physical state of wastes: ☐ Liquid ☐ Solid ☐ Sludge/Slurry ☐ Gas ☐ Unknown
Constituent quantity of hazardous substances: _____ (specify units)
Wastestream quantity containing hazardous substances: _____ (specify units)
Volume of source (yd^3): _____ Area of source (ft^2): _____

Hazardous substances associated with source #_____:

_____ _____ _____
_____ _____ _____
_____ _____ _____

Reference(s) _____

Source #____ Name_____ Source type _____

Describe source: _____

Ground water migration containment: _____

Surface water migration containment: _____

Air migration (gas and migration) containment: _____

Physical state of wastes: ☐ Liquid ☐ Solid ☐ Sludge/Slurry ☐ Gas ☐ Unknown
Constituent quantity of hazardous substances: _____ (specify units)
Wastestream quantity containing hazardous substances: _____ (specify units)
Volume of source (yd^3): _____ Area of source (ft^2): _____

Hazardous substances associated with source #_____:

_____ _____ _____
_____ _____ _____
_____ _____ _____

Reference(s) _____

5. **Description of removal or remedial activities**

If a removal has occurred, identify the removal authority and describe the activities. Specify the date(s) of the removal.

Reference(s) _____

GROUND WATER INFORMATION

1. **Ground water drinking water use within 4 miles of site sources:**
   ☐ Municipal ☐ Private ☐ Both ☐ No Drinking Water Use

   Reference(s) _____

2. **Is ground water contaminated?**
   ☐ Yes ☐ No ☐ Uncertain but likely ☐ Uncertain but not likely
   ☐ Additional sampling required
   Is analytical evidence available? ☐ Yes ☐ No Reference(s) _____

3. **Is ground water contamination attributable to the site?**
   ☐ Yes ☐ No ☐ Additional sampling required Reference(s) _____

_____

_____

_____

4. **Are drinking water wells contaminated?**
   ☐ Yes ☐ No ☐ Uncertain but likely ☐ Uncertain but not likely
   ☐ Additional sampling required
   Is analytical evidence available? ☐ Yes ☐ No Reference(s) _____

5.* **Net precipitation** (HRS Section 3.1.2.2): _____ inches Reference(s) _____

6. **County average number of persons per residence:** _____ Reference(s) _____

7. **Discuss general stratigraphy underlying the site.** Attach sketch of stratigraphic column.

_____

_____

_____

_____

_____

_____

Reference(s) _____

8. **Using Table GW-1 (next page), summarize geology underlying the site** (starting with formation #1 as closest to ground surface). Indicate if formation is interconnected with overlying formation.

TABLE GW-1: SITE GEOLOGY

NAME OF FORMATION	INTER-CONNECT? (yes/no)	TYPE OF MATERIAL	AVERAGE THICKNESS (FEET)	HYDRAULIC CONDUCTIVITY (CM/SEC)	USED FOR DRINKING WATER?
1.					
2.					
3.					
4.					
5.					
6.					

Reference(s) _____

9. **Does a karst aquifer underlie any site source?**
☐ Yes ☐ No Reference(s) _____

10. **Depth to top of aquifer:** _____ feet **Elevation:** _____ Reference(s) _____

11. **In the table below, enter the number of people obtaining drinking water from wells located within 4 miles of the site.** For each aquifer, attach population calculation sheets. Key aquifer to formations listed in Table GW-1.

POPULATION SERVED BY WELLS WITHIN DISTANCE CATERGORIES BY AQUIFER

DISTANCE OF WELL(S) FROM SITE SOURCES	AQUIFER A: INCLUDES FORMATIONS _____	AQUIFER B: INCLUDES FORMATIONS _____	AQUIFER C: INCLUDES FORMATIONS _____
1/4 mile or less			
>1/4 to 1/2 mile			
>1/2 to 1 mile			
>1 to 2 miles			
>2 to 3 miles			
>3 to 4 miles			

Reference(s) _____

12. **Is ground water from multiple wells blended prior to distribution?**
☐ Yes ☐ No Reference(s) _____

13. **Is ground water blended with surface water?**
☐ Yes ☐ No Reference(s) _____

Briefly describe: _____

_____

14. **Distance from any incompletely contained source available to ground water to nearest drinking water well** (HRS Section 3.3.1): _____ feet Reference(s) _____

15. **Briefly describe standby drinking water wells within 4 miles of sources at the site:**

_____

_____

Reference(s) _____

16. **Using Table GW-2, summarize ground water analytical results for all sampling investigations.** Include and identify background ground water sample results.

17.* **Ground water resources within 4 miles of site sources** (HRS Section 3.3.3):
☐ Irrigation (5-acre minimum) of commercial food or commercial forage crops
☐ Commercial livestock watering
☐ Ingredient in commercial food preparation
☐ Supply for commercial aquaculture
☐ Supply for major or designated water recreation area, excluding drinking water use
☐ Water usable for drinking water but no drinking water wells are within 4 miles
☐ None of the above

Reference(s) _____

18. **Wellhead protection area (WHPA) within 4 miles of site sources** (HRS Section 3.3.4):
☐ Source with non-zero containment factor value lies within or above WHPA
☐ Observed ground water contamination attributable to site source(s) lies within WHPA
☐ WHPA lies within 4 miles of site sources
☐ None

Reference(s) _____

Additional ground water pathway description:

_____

_____

_____

References(s) _____

TABLE GW-2: ANALYTICAL RESULTS FOR GROUND WATER PATHWAY

SAMPLE ID & DATE	TYPE OF WELL	SCREENED INTERVAL	HAZARDOUS SUBSTANCE	CONCENTRATION (SPECIFY UNITS)	DETECTION LIMIT	REFERENCES
	☐ Irrigation ☐ Monitoring ☐ Drinking water People served _____ ☐ Other _____					
	☐ Irrigation ☐ Monitoring ☐ Drinking water People served _____ ☐ Other _____					
	☐ Irrigation ☐ Monitoring ☐ Drinking water People served _____ ☐ Other_____					
	☐ Irrigation ☐ Monitoring ☐ Drinking water People served _____ ☐ Other _____					
	☐ Irrigation ☐ Monitoring ☐ Drinking water People served _____ ☐ Other _____					
	☐ Irrigation ☐ Monitoring ☐ Drinking water People served _____ ☐ Other _____					
	☐ Irrigation ☐ Monitoring ☐ Drinking water People served _____ ☐ Other _____					
	☐ Irrigation ☐ Monitoring ☐ Drinking water People served _____ ☐ Other _____					

SURFACE WATER INFORMATION

Complete this section of the data summary for each watershed if there are multiple watersheds. Photocopy this page if necessary.

1. **Describe surface water migration path from site sources to at least 15 miles downstream.** Attach a sketch of the surface water migration route.

_____

_____

_____

_____

Reference(s) _____

2. **Is surface water contaminated?**
☐ Yes ☐ No ☐ Uncertain but likely ☐ Uncertain but not likely ☐ Additional sampling required
Is analytical evidence available? ☐ Yes ☐ No Reference(s) _____

3. **Is surface water contamination attributable to the site?**
☐ Yes ☐ No ☐ Additional sampling required Reference(s) _____

4. **Floodplain category in which site sources are located** (check all that apply):
☐ 1-year ☐ 10-year ☐ 100-year ☐ 500-year ☐ None Reference(s) _____

5. **Describe flood containment for each source** (HRS Section 4.1.2.1.2.2):

Source #1 _____ Flood containment _____

Source #2 _____ Flood containment _____

Source #3 _____ Flood containment _____

Source #__ _____ Flood containment _____

Source #__ _____ Flood containment _____

Source #__ _____ Flood containment _____

Source #__ _____ Flood containment _____

Reference(s) _____

6. **Shortest overland distance to surface water from any source** (HRS Section 4.1.2.1.2.1.3):
_____ feet Reference(s) _____

7.* **Size of drainage area** (HRS Section 4.4.3): _____ Acres Reference(s) _____

8.* **Describe predominant soil group within the drainage area** (HRS Section 4.1.2.1.2.1.2).

_____

_____

Reference(s) _____

9.* **2-year 24-hour rainfall** (HRS Section 4.1.2.1.2.1.2):
_____ inches Reference(s) _____

10.* **Elevation of the bottom of nearest surface water body:**
_____ feet above sea level Reference(s) _____

11.* **Elevation of top of uppermost aquifer:**
_____ feet above sea level Reference(s) _____

12. **Predominant type of water body between probable point of entry to surface water and nearest drinking water intake:**
☐ River ☐ Lake Reference(s) _____

13. **Identify all drinking water intakes, fisheries, and sensitive environments within 15 miles downstream.**

TARGET NAME/TYPE	WATER BODY TYPE	DISTANCE FROM PPE	FLOW (CFS)	TARGET CHARACTERISTICS[1]	TARGET SAMPLED?

[1]If target is a drinking water intake, provide number of people served by intake.
If target is a fishery, provide species and annual production of human food chain organisms (pounds per year).
If target is a wetland, specify wetland frontage (in miles). Attach calculation pages.

Reference(s) _____

14. **Is surface water drinking water blended prior to distribution?**
☐ Yes ☐ No Reference(s) _____

_____

_____

15. **Describe any standby drinking water intakes within 15 miles downstream.**

_____

_____

Reference(s) _____

16.*__Surface water resources within 15 miles downstream__ (HRS Section 4.1.2.3.3):

- ☐ Irrigation (5-acre minimum) of commercial food or commercial forage crops
- ☐ Commercial livestock watering
- ☐ Ingredient in commercial food preparation
- ☐ Major or designated water recreation area, excluding drinking water use
- ☐ Water designated by the state for drinking water use but is not currently used
- ☐ Water usable for drinking water but no drinking water intakes within 15 miles downstream
- ☐ None of the above

Reference(s) _____

17. **Using Table SW-1, summarize surface water analytical results for all sampling investigations.** Include and identify background sample results.

TABLE SW-1: SUMMARY OF ANALYTICAL RESULTS FOR SURFACE WATER PATHWAY

SAMPLE ID & DATE	SAMPLE TYPE	SAMPLE OBJECTIVE	TARGET NAME	HAZARDOUS SUBSTANCE	CONCENTRATION (SPECIFY UNITS)	DETECTION LIMIT	REFERENCES
	☐ Aqueous ☐ Sediment ☐ Other	☐ Release ☐ Fishery ☐ Drinking water ☐ Sensitive environment Distance from PPE					
	☐ Aqueous ☐ Sediment ☐ Other	☐ Release ☐ Fishery ☐ Drinking water ☐ Sensitive environment Distance from PPE					
	☐ Aqueous ☐ Sediment ☐ Other	☐ Release ☐ Fishery ☐ Drinking water ☐ Sensitive environment Distance from PPE					
	☐ Aqueous ☐ Sediment ☐ Other	☐ Release ☐ Fishery ☐ Drinking water ☐ Sensitive environment Distance from PPE					
	☐ Aqueous ☐ Sediment ☐ Other	☐ Release ☐ Fishery ☐ Drinking water ☐ Sensitive environment Distance from PPE					
	☐ Aqueous ☐ Sediment ☐ Other	☐ Release ☐ Fishery ☐ Drinking water ☐ Sensitive environment Distance from PPE					
	☐ Aqueous ☐ Sediment ☐ Other	☐ Release ☐ Fishery ☐ Drinking water ☐ Sensitive environment Distance from PPE					
	☐ Aqueous ☐ Sediment ☐ Other	☐ Release ☐ Fishery ☐ Drinking water ☐ Sensitive environment Distance from PPE					
	☐ Aqueous ☐ Sediment ☐ Other	☐ Release ☐ Fishery ☐ Drinking water ☐ Sensitive environment Distance from PPE					

SOIL INFORMATION

1. **Is surficial or soil contamination present at the site?**
   ☐ Yes ☐ No ☐ Uncertain but likely ☐ Uncertain but not likely
   ☐ Additional sampling required
   Is analytical evidence available? ☐ Yes ☐ No Reference(s) _____

2. **Is surficial or soil contamination attributable to the site?**
   ☐ Yes ☐ No ☐ Additional sampling required

3. **Is surficial contamination on the property and within 200 feet of a residence, school, daycare center, or workplace?**
   ☐ Yes ☐ No ☐ Uncertain but likely ☐ Uncertain but not likely
   ☐ Additional sampling required
   Is analytical evidence available? ☐ Yes ☐ No Reference(s) _____

4.* **Total area of surficial contamination** (HRS Section 5.2.1.2):
   _____ square feet Reference(s) _____

5.* **Attractiveness/accessibility of the areas of observed contamination** (HRS Section 5.2.1.1). Check all that apply:

   ☐ Designated recreational area
   ☐ Used regularly, or accessible and unique recreational area
   ☐ Moderately accessible with some use
   ☐ Slightly accessible with some use
   ☐ Accessible with no use
   ☐ Inaccessible with some use
   ☐ Inaccessible with no use

   Reference(s) _____

6. **Using Table SE-1, summarize analytical results detecting surficial contamination within 200 feet of a residence, school, daycare center, or workplace.** Include and identify background sample results.

7. **Using Table SE-2, summarize analytical results detecting surficial contamination within the boundary of a resource or a terrestrial sensitive environment.** Include and identify background sample results if not listed in Table SE-1.

8. **Population within 1-mile travel distance from site.** Do not include populations from Table SE-1.

DISTANCE FROM SITE SOURCES	POPULATION
1/4 mile or less	
>1/4 to 1/2 mile	
>1/2 to 1 mile	

Reference(s) _____

TABLE SE-1: ANALYTICAL RESULTS FOR SOIL EXPOSURE PATHWAY

SAMPLE ID & DATE	SAMPLE DEPTH	TYPE OF PROPERTY	POPULATION	HAZARDOUS SUBSTANCE	CONCENTRATION (SPECIFY UNITS)	DETECTION LIMIT	REFERENCES
		☐ Residence ☐ School ☐ Daycare center ☐ Workplace					
		☐ Residence ☐ School ☐ Daycare center ☐ Workplace					
		☐ Residence ☐ School ☐ Daycare center ☐ Workplace					
		☐ Residence ☐ School ☐ Daycare center ☐ Workplace					
		☐ Residence ☐ School ☐ Daycare center ☐ Workplace					
		☐ Residence ☐ School ☐ Daycare center ☐ Workplace					
		☐ Residence ☐ School ☐ Daycare center ☐ Workplace					
		☐ Residence ☐ School ☐ Daycare center ☐ Workplace					

TABLE SE-2: ANALYTICAL RESULTS FOR SOIL EXPOSURE PATHWAY

SAMPLE ID & DATE	SAMPLE DEPTH	TYPE OF TARGET	HAZARDOUS SUBSTANCE	CONCENTRATION (SPECIFY UNITS)	DETECTION LIMIT	REFERENCES
		☐ Terrestrial sensitive environment ☐ Resources* ☐ Commercial agriculture ☐ Commercial silviculture ☐ Commercial livestock production or grazing				
		☐ Terrestrial sensitive environment ☐ Resources* ☐ Commercial agriculture ☐ Commercial silviculture ☐ Commercial livestock production or grazing				
		☐ Terrestrial sensitive environment ☐ Resources* ☐ Commercial agriculture ☐ Commercial silviculture ☐ Commercial livestock production or grazing				
		☐ Terrestrial sensitive environment ☐ Resources* ☐ Commercial agriculture ☐ Commercial silviculture ☐ Commercial livestock production or grazing				

AIR INFORMATION

1. **Is air contamination present at the site?**
   ☐ Yes ☐ No ☐ Uncertain but likely ☐ Uncertain but not likely
   ☐ Additional sampling required
   Is analytical evidence available? ☐ Yes ☐ No Reference(s) _____

2. **Is air contamination attributable to the site?**
   ☐ Yes ☐ No ☐ Additional sampling required

3. **Are populations, sensitive environments, or wetlands exposed to airborne hazardous substances released from the site?**
   ☐ Yes ☐ No ☐ Uncertain but likely ☐ Uncertain but not likely
   ☐ Additional sampling required
   Is analytical evidence available? ☐ Yes ☐ No Reference(s) _____

4. **Evidence of biogas release from any of the following source types at the site:**
   ☐ Below-ground containers or tanks ☐ Landfill ☐ Buried surface impoundment
   Reference(s) _____

5.* **Particulate migration potential factor value:** _____ (HRS Figure 6-2)

6.* **Particulate mobility factor value:** _____ (HRS Figure 6-3)

7. **Distance from any incompletely contained source to nearest residence or regularly occupied area:** _____ miles Reference(s)_____

8. **Population within 4 miles of site sources.**

DISTANCE FROM SITE SOURCES	POPULATION
0 (within site sources)	
1/4 mile or less	
>1/4 to 1/2 mile	
>1/2 to 1 mile	
>1 to 2 miles	
>2 to 3 miles	
>3 to 4 miles	

Reference(s) _____

9.* **Resources within ½ mile of site sources** (HRS Section 6.3.3):
   ☐ Commercial agriculture
   ☐ Commercial silviculture
   ☐ Major or designated recreation area
   ☐ None of the above

   Reference(s) _____

10. **Sensitive environments and wetlands within 4 miles of the site.**

NAME/DESCRIPTION/LOCATION OF SENSITIVE ENVIRONMENT OR WETLAND	DISTANCE FROM SITE (MILES)	TYPE OF SENSITIVE ENVIRONMENT	WETLAND SIZE (ACRES)

Reference(s) _____

11. **Using Table Air-1, summarize air analytical results for all sampling investigations.** Include and identify background sample results.

TABLE AIR-1: SUMMARY OF ANALYTICAL RESULTS FOR AIR PATHWAY

SAMPLE ID & DATE	SAMPLE TYPE	DISTANCE FROM SITE (MILES)	TARGET(S) WITHIN DISTANCE CATEGORY	HAZARDOUS SUBSTANCE	CONCENTRATION (SPECIFY UNITS)	DETECTION LIMIT	REFERENCES
			☐ Number of people _____ ☐ Name of sens. environment _____ _____ ☐ Wetland acreage _____				
			☐ Number of people _____ ☐ Name of sens. environment _____ _____ ☐ Wetland acreage _____				
			☐ Number of people _____ ☐ Name of sens. environment _____ _____ ☐ Wetland acreage _____				
			☐ Number of people _____ ☐ Name of sens. environment _____ _____ ☐ Wetland acreage _____				
			☐ Number of people _____ ☐ Name of sens. environment _____ _____ ☐ Wetland acreage _____				
			☐ Number of people _____ ☐ Name of sens. environment _____ _____ ☐ Wetland acreage _____				
			☐ Number of people _____ ☐ Name of sens. environment _____ _____ ☐ Wetland acreage _____				

Site Name _____

ADDITIONAL INFORMATION AND COMMENTS

Reference(s) _____

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