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EPA

Establishing Areas of Observed Contamination

Office of Emergency and Remedial Response | Quick Reference Fact Sheet

Abstract

This fact sheet addresses the use of analytical data to establish *areas of observed contamination* at hazardous waste sites when evaluating the soil exposure pathway under the Hazard Ranking System (HRS) (40 CFR Part 300). 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 based on analytical data. Factors that are critical to determine observed contamination include the concentration levels of contaminants, and the area of contamination. An integrated sampling approach under the Superfund Accelerated Cleanup Model (SACM) should be considered when planning the sampling strategy to establish observed contamination.

Introduction

The Hazard Ranking System (HRS) Final Rule (40 CFR Part 300, App. A) establishes general criteria to document an *observed release* of hazardous substances to media (e.g., ground water, surface water, air) and to document *observed contamination* in the soil exposure pathway. An observed release is based on evidence that contaminants have migrated away from a site through a medium. In contrast, observed contamination is based on evidence that targets (e.g., human populations, resources, and sensitive environments) have come into direct contact with the contaminants.

Unlike other pathways, the soil exposure pathway can be evaluated based only on current site conditions, with only limited exceptions. (See *The Revised Hazard Ranking System: Evaluating Sites After Waste Removals*, October 1991, OSWER Directive 9345.1-03FS, for information on exceptions.)

The HRS criteria for documenting an observed release and observed contamination are: 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 at least partial attribution of the hazardous substance to a release from the site (see Figure 1). (For more information on observed releases, refer to the fact sheet *Establishing an Observed Release*, September 1995, OSWER Directive 9285.7-20FS.)

Resource Considerations

An integrated sampling approach under the Superfund Accelerated Cleanup Model (SACM) should be considered when planning the sampling strategy to establish observed contamination. The data quality objective (DQO) process provides a logical framework for planning multiple field investigations, thereby fulfilling the integrated site assessment goal of cross-program response planning and allowing optimal cross-program data usability. (See *Data Quality Objectives Process for Superfund*, September 1993, OERR Directive 9355.9-01 for further details on the DQO process.)

The data gathered from the Site Inspection (SI) may be useful later in the overall site strategy, especially where it appears that a response action may be required. In such cases, site managers may consider a broader sampling strategy. For instance, such efforts might

Figure 1: Flowchart for Establishing Observed Contamination

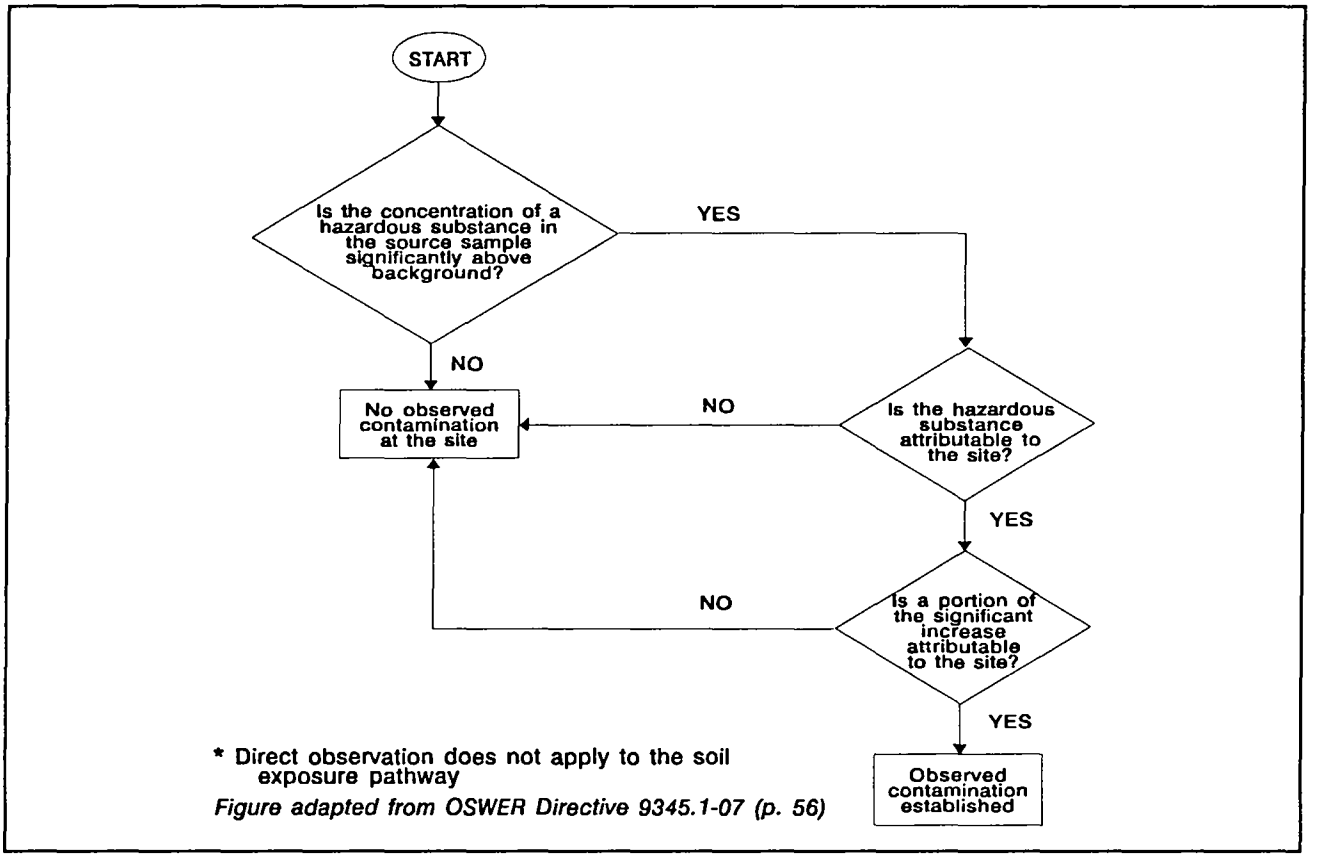


Figure adapted from OSWER Directive 9345.1-07 (p. 56)

include collection of the necessary site information for development and use of Soil Screening Levels (SSLs) for use during the Remedial Investigation/Feasibility Study (RI/FS). It is appropriate to use data gathered during the SI for the RI, especially to develop the Conceptual Site Model.

SSLs are not appropriate for use at the SI stage because the objectives of the SI and SSLs are different. The objective of the SI is to obtain information on "worst case" or "hot spot" contamination. It is not intended to be a detailed analysis of the extent of contamination, nor a risk assessment. Based on the results of the SI, EPA decides whether the site qualifies for possible inclusion on the National Priorities List or elimination from further Superfund consideration. SSLs are used in the RI to screen out potential contaminants and exposure areas for remedial action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Draft *Soil Screening Guidance*, December 1994, OSWER Directive 9355.4-14FS).

Establishing Observed Contamination

The soil exposure pathway can be evaluated only if there are documented areas of observed contamination. The source samples are compared to a background level. Most samples consist of soil, but leachate, waste, sediment, and other surficial samples also may be used (*Guidance for Performing Site Inspections Under CERCLA*, September 1992, OSWER Directive 9345.1-05).

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

- The release of the hazardous substance must be at least partially attributable to a source at the site.
- The source sample concentration must be greater than or equal to the appropriate and properly determined detection limit.

- 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 background levels are greater than or equal to the detection limit, the source sample concentration must be at least three times the background concentration.

- 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) (*Hazard Ranking System Guidance Manual*, November 1992, OSWER Directive 9345.1-07).

Sampling to Meet the HRS Sampling Objective

Unlike the other HRS pathways, contamination in the soil exposure pathway must be based on actual exposure. The potential for contamination is not evaluated in the soil exposure pathway. Thus, strategic sampling is critical. 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 within 200 feet of a residence, school, day care center, or workplace, and also lies on the property. Evaluate sensitive environments and resources under the HRS "resident population threat" only if the area of observed contamination lies within the boundaries of a terrestrial sensitive environment or resource. Evaluate targets beyond 200 feet but within one mile travel distance of the area of observed contamination under the HRS "nearby population threat" (40 CFR Part 300, App. A). 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 (OSWER Directive 9345.1-07). Since surficial contamination is not limited to soil, sampling of other surface media, such as leachate or waste, should be considered.

Contamination may be attributed to a site by collecting appropriate background samples outside the influence of sources. Obtain source samples from locations where the substances are suspected to have been deposited (e.g., contaminated soil along the flood plain of a contaminated surface water body) (OSWER Directive 9345.1-07). Exhibit 1 suggests appropriate locations for background samples by source type.

Estimating Waste Quantity by Defining Areas of Observed Contamination

The following criteria are important to consider when evaluating the soil exposure pathway under the HRS:

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

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

- 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 have its own targets.

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 levels (OSWER Directive 9345.1-07). A minimum of three samples showing site contamination 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 (OSWER Directives 9345.1-05 and 9345.1-07). However, the following sub-areas are excluded:

- 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 (Refer to specific examples

Exhibit 1: Possible Locations of 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 OSWER Directive 9345.1-07 for additional considerations. [a]For these source types, the indicated sample is likely to be the most appropriate background. *Note: Do not evaluate intact containers.* *Figure adapted from Highlight 9-1 of OSWER Directive 9345.1-07 (p. 344)*	

in Highlights 9-3 through 9-6 in OSWER Directive 9345.1-07).

Points and linear strips of observed contamination may be evaluated as areas of observed contamination for the soil exposure pathway, even though it may not be possible to delineate an actual "area." 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. When possible, however, establishing an area of observed contamination is preferred.

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 been properly documented. Select sampling locations that will allow efficient use of inferred areas of observed contamination.

It is likely that with this strategy, more targets may be identified 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, avoid using non-grid horizontal composite samples to infer areas of observed contamination (OSWER Directives 9345.1-05 and 9345.1-07).

Additionally, 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. Avoid inferring an area of observed contamination between soils in the floodplain of a contaminated surface water body and those soils contaminated from other modes of transportation and deposition.

Determining Levels of Actual Contamination

Finding positive evidence of observed contamination is a prerequisite for evaluating actual contamination at targets. Actual contamination at targets indicates a high likelihood of exposure to hazardous substances. Note that the presence of contamination at targets is not in itself sufficient to establish observed contamination or actual contamination. The level of actual contamination is determined by comparing the release sample concentration to substance-specific benchmark values, where applicable (OSWER Directive 9345.1-07).

Samples taken to find observed contamination 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 (OERR Directive 9355.9-01).

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 all 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; refer to OERR Directive 9355.9-01.)

- The verified analytical data meet the HRS definition of observed contamination as defined in section 2.3 of the *Hazard Ranking System, Final Rule* (40 CFR Part 300, App. A).

Contaminated grid cells are those with identified hazardous substances that meet HRS criteria for depth, attribution to the site, and significance above background level. For SI sampling purposes, the grid size need not be standardized. The grid size can be site-specific depending upon contaminant locations. However, the grid size should be standardized when statistical sampling may be necessary, especially where it appears that a response action may be required. The area within these grid cells may be used to define an area of observed contamination when the appropriate sampling criteria for observed contamination are met.

Contamination can be inferred at grid cells that have not been sampled if they lie between contaminated grid cells. Areas lying within inferred contaminated cells are themselves inferred to be contaminated. The area within inferred contaminated grid cells may be included as part of an area of observed contamination. (Refer to Highlight 9-4 of OSWER Directive 9345.1-07)

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

- Uncontaminated grid cells, and unsampled grid cells that do not lie between contaminated or inferred contaminated ones, should be excluded from the area of observed contamination.

- Any grid cells or sub-areas which are covered with impervious materials, or meet other criteria for exclusion, should be subtracted from the defined area of observed contamination (OSWER Directive 9345.1-07).

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

Determining an Area of Observed Contamination for Sources Other Than Soil

Section 5.0.1 of the HRS states "...for all sources except contaminated soil, if observed contamination from the site is present at any sampling location within the source, consider that entire source to be an area of observed contamination." For example, a dry, buried, or backfilled surface impoundment should be evaluated as an area of observed contamination. An area of observed contamination is determined as follows:

- For dry surface impoundments, landfills, and land treatment units—the surface area of the source is used;
- For piles—the land surface area under the pile is used;
- For tanks, drums, and other containers—the volume of the container is used.

Determining the Hazardous Waste Quantity Factor Value for the Soil Exposure Pathway

Assign a source hazardous waste quantity value for each area of observed contamination. Sum the source hazardous waste quantity values assigned to each area of observed contamination to determine the hazardous waste quantity factor value. Table 5-2 in the *HRS Final Rule* provides equations for assigning hazardous waste quantity values for all types of sources in the soil exposure pathway (40 CFR Part 300, App. A).

Example Site

The following example from an Expanded Site Inspection (ESI) illustrates some of the challenges encountered in the field, and EPA's approach to resolve the issues.

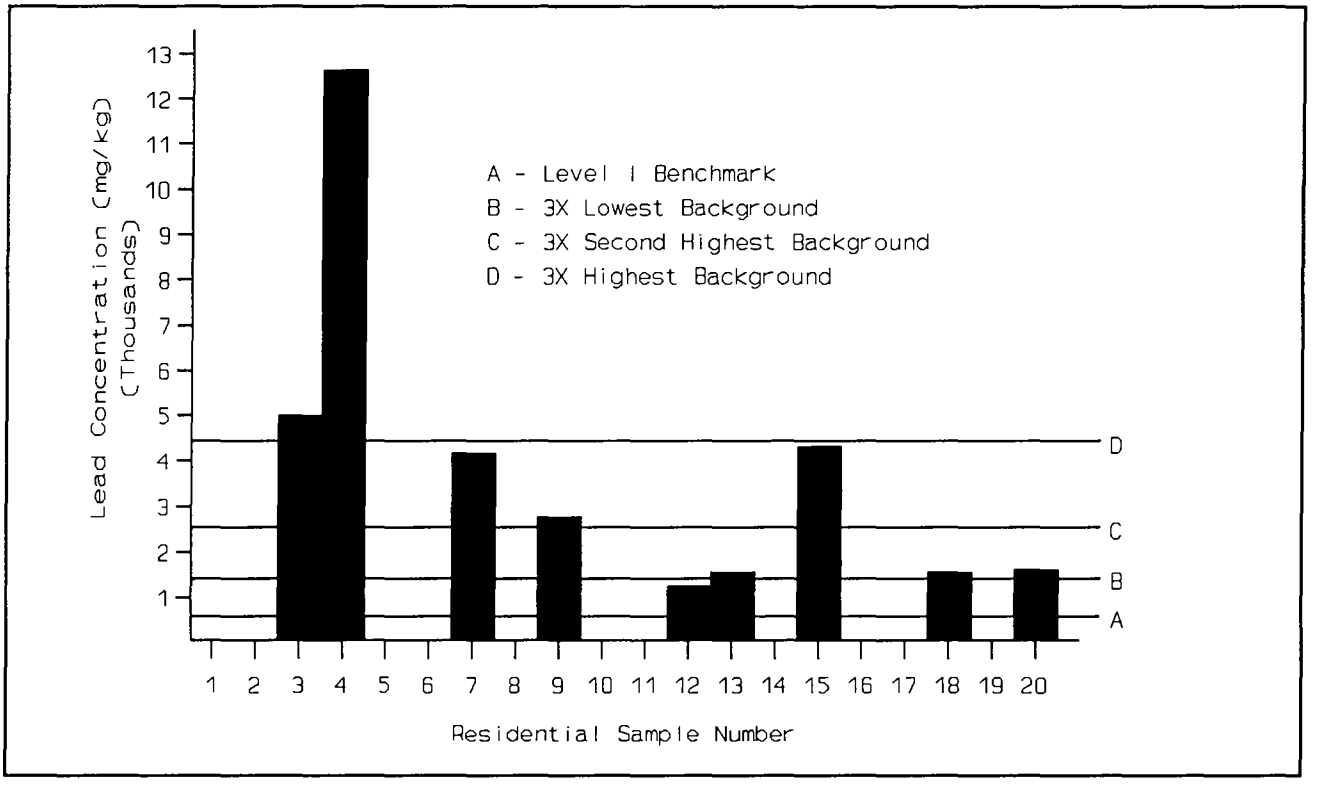
For a number of years, reclamation of automotive batteries occurred at a scrap metal yard, which was surrounded by a residential area. A prior removal action mitigated severe soil contamination and secured the site from public access, but did not generate enough data to allow HRS evaluation. As a result of the removal action, EPA discovered extensive lead contamination within the property boundaries of the scrap yard. However, EPA had not sampled 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 sampled the soil at each residence and at border areas to demonstrate attribution of lead contamination and contiguity of the contaminated area. 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 elevated 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 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 elevated. Because this was the case, the number of residences with actual contamination might have been 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 1,000 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

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



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. However, it was 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 determination of a 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. 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. (Note: Benchmarks are subject to revision.) Therefore the ESI established an area of observed contamination beyond the facility's boundaries and found seven residences with Level I actual contamination.

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. 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 (SI) generally should focus on delineating areas that are subject to observed contamination. The primary objective of the SI is to identify contaminants on the property and within 200 feet of a residence, school, or day care center. Samples should be collected within two feet of the source surface. Whenever possible, sampling locations which serve the dual purpose of establishing observed contamination and identifying targets should be selected.