



Science Applications International Corporation

**CHARACTERIZATION METHDOLOGY
FOR
CERCLA INACTIVE DISPOSAL SITES**

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CHARACTERIZATION METHODOLOGY FOR CERCLA INACTIVE DISPOSAL SITES

1.0 APPROACH TO DEVELOPING SITE CHARACTERIZATION METHODOLOGY

Requirements for characterizing the CERCLA sites derive from CERCLA and SARA regulations, particularly "applicable or relevant and appropriate regulations" (ARARs, see Task 2.0 report) and the need for collecting site-specific information for ensuring that implemented remedial actions are capable of achieving and maintaining ARARs. Such information includes identification and quantification of contaminants (i.e., the source), identification and characterization of probable pathways of transport, and identification and characterization of probable receptors. This information is used to define the site and the problems caused by the site and to predict the effects of potential remedial action alternatives. Site-specific information is generally obtained through the use of multiple investigation techniques. The approach to developing the site characterization methodology integrates regulatory requirements, contaminant transport pathways of concern, and potentially applicable site characterization methods to establish a framework for planning the investigation of each of the 62 CERCLA sites. The steps involved in developing the approach are summarized in the following subsections and the overall approach is summarized in Section 2.0.

The methodology for characterizing the CERCLA sites is designed to provide necessary and sufficient data to allow definition of the sites and their problems; and to support the evaluation, selection, and implementation of appropriate remedial actions for meeting regulatory requirements and providing protection of public health and the environment. The methodology, which will guide and focus the development of site characterization plans in Task 4.0, consists of the following steps:

- o Step 1 - Identify requirements for site characterization.
"Requirements", as used herein, refers to the regulatory requirements of EPA and the State of Washington and directives issued by DOE.

Regulations and directives have been evaluated in this Task for their applicability to the Hanford CERCLA sites; the specific requirements in each regulation will be identified in the preparation of site characterization plans in Task 4.0.

- o Step 2 - Identify pathways for each site. "Pathways" refers to the route(s) that contaminants could follow in transport from the source (the site) to receptors (human populations and/or plant and animal species). Pathways can consist of one or more environmental media. Potential pathways have been identified in this task for each site on using available information on the nature and environmental settings of the sites; pathways of primary concern for each site will be further defined during the planning effort in Task 4.0.
- o Step 3 - Determine methods for characterizing sites. "Methods" refers to those activities that could be conducted to provide definition of the sites, the site problem, and the site setting. Site characterization methods are generally considered to consist of on-site investigation of the site using existing data and through the collection and evaluation of new data for sites for which relatively little data are available. Potentially applicable site investigation techniques have been identified in this task for the potential transport pathways. Specific methods of site characterization will be selected as part of the planning effort in Task 4.0.

During the site characterization activity information must be obtained on the following topics:

- o Waste source -- physical and chemical aspects of the waste materials (solubility, persistence, quantity, toxicity) and the media in which they are contained.
- o Geology -- structures influencing groundwater movement, geologic properties of aquifers and confining units (porosity, permeability, geochemistry).

- o Groundwater -- direction and rate of flow, seasonal/temporal variations, aquifer properties, recharge/discharge areas.
- o Surface Water -- drainage patterns, runoff, seasonal variations, sediment pathways.
- o Pedology -- characteristics of surface soils and soils in the vadose zone, porosity, soil chemistry.
- o Air -- climatic data, wind speed and direction.
- o Public health -- demography, public use of groundwater surface water, and exposed animals/plants, contaminant toxicity.
- o Plant and animal species -- bioaccumulation of contaminants, populations of plant/animal species.

1.1 Identification of Remedial Action Requirements

The site characterization process has three primary purposes. First, site characterization should define the nature and extent of contamination (waste type, concentration, and distribution). Second, it should allow data quality objectives (DQOs) to be refined. Finally, it should assess the need for treatability studies. This process is required for collection of data to determine the need for, and extent of, remedial action.

Since the information gathered in the remedial investigation is then used to proceed to the feasibility study, the process of selecting appropriate remedial action activities requires that the concentration and distribution of contaminants be determined. In order to accomplish this goal, it is necessary to identify the requirements as stated in Federal and State regulations and guidance. Table 1 identifies the specific regulations containing the requirements applicable to site characterization. In the matrix, the specific sections of each source which provides the requirement are noted. These sources contain very specific requirements which will be identified in Task 4.0 for the CERCLA sites as part of the development of the site characterization plan.

1.2 Identification of Site-Specific Contaminant Transport Pathways of Concern

In order to identify appropriate investigation techniques for the CERCLA sites, the likely pathways of contaminant transport to be investigated must first be identified. Available information on waste disposal methods, the types of wastes disposed, and the environmental settings of the locations of the sites (see Task 1.0 report) were evaluated and possible pathways of transport were identified for each site. The pathways, which include media that are both direct and intermediate pathways to receptors, that were considered include:

- o Groundwater
- o Surface soils
- o Vadose zone
- o Air
- o Surface water
- o Sediments
- o Waste source
- o Plant uptake
- o Animal uptake

Table 2 presents a preliminary evaluation of pathways for each site. As indicated, virtually every pathway is in a potential pathway for the majority of the sites. However, the relatively few pathways of primary concern are indicated for each site on Table 2 by a "P" entry. In general, these primary pathways are through the vadose zone and groundwater. The remaining, secondary pathways (indicated by an "S" entry) may also need to be investigated in order to characterize the sites; this determination will be made as part of the development of site-specific characterization plans in Task 4.0. The entries on Table 2 will serve as a guide for focusing this planning effort.

TABLE 1. THE REMEDIAL ACTION REQUIREMENTS TO SUPPORT THE SITE CHARACTERIZATION METHODOLOGY FOR CERCLA SITES

Remedial Action Activities	Sources for Remedial Action Requirements			
	Federal	State	Regulations	Policy/Guidance
<u>Remedial Investigation</u>	40 CFR 300.67	Title 1 Sec.120	DOE 5480.14 EPA Directive 9355.0-19 DOE 5480.14	DOE 5480.14 EPA Directive 9355.0-19 DOE 5480.14
Site Characterization				--
Pathways Characterization				--
Receptors Characterization				--
Problem Definition				--
				WAC 173-304-490
<u>Feasibility Study</u>	40 CFR 300.68		DOE 5480.14	
Cleanup Criteria	40 CFR 116.4 117.3 141.11 141.12 141.15 141.16 141.50 141.61 143.3	Title 1 Sec.120	EPA Directive 9355.0-19	WAC 173-201 173-303 173-304 -9901
Evaluation factors	10 CFR 61.41- 61.44	Title 1 Sec.121 Title 1 Sec.121		--
Cost-effectiveness				--
Selection/documentation	40 CFR 300.70 300.69			--
<u>Implementation</u>				
Permitting		Title 1 Sec.121		WAC 173-216 173-303 173-304
Compliance with other laws	10 CFR 61.41 61.43 61.44			--

TABLE 2. POTENTIAL SITE-SPECIFIC CONTAMINANT TRANSPORT PATHWAYS (continued)

Site	Location	Potential Environmental Pathways									
		Groundwater	Surface Soils	Vadose Zone	Air	Surface Water	Sediments	Direct Contact	Plant Uptake	Animal Uptake	
216-A-9	200 East	P	(2)	P	(4)	(E)	(E)			X	(6)
216-A-21	200 East	P	(2)	P	(4)	(E)	(E)			X	(6)
216-A-27	200 East	P	(2)	P	(4)	(E)	(E)			X	(6)
216-A-28	200 East	S	(2)	P	(4)	(E)	(E)			X	(6)
216-A-36A	200 East	S	(2)	P	(4)	(E)	(E)			X	(6)
216-B-5	200 East	P	(2)	P	(4)	(E)	(E)			X	(6)
216-B-6	200 East	S	(2)	P	(4)	(E)	(E)			X	(6)
216-B-7 A&B	200 East	P	(2)	P	(4)	(E)	(E)			X	(6)
216-B-10A	200 East	S	(2)	P	(4)	(E)	(E)			X	(6)
216-B-16	200 East	P	(2)	P	(4)	(E)	(E)			X	(6)
216-B-43	200 East	P	(2)	P	(4)	(E)	(E)			X	(6)
216-B-44	200 East	P	(2)	P	(4)	(E)	(E)			X	(6)
216-B-45	200 East	P	(2)	P	(4)	(E)	(E)			X	(6)
216-B-46	200 East	P	(2)	P	(4)	(E)	(E)			X	(6)
216-B-48	200 East	P	(2)	P	(4)	(E)	(E)			X	(6)
216-B-49	200 East	P	(2)	P	(4)	(E)	(E)			X	(6)
216-B-50	200 East	S	(2)	P	(4)	(E)	(E)			X	(6)
216-C-1	200 East	P	(1,2)	P	(3,4)	(E)	(E)			X	(6)
216-C-10	200 East	S	(1,2)	P	(3,4)	(E)	(E)			X	(6)

TABLE 2. POTENTIAL SITE-SPECIFIC CONTAMINANT TRANSPORT PATHWAYS (continued)

Potential Environmental Pathways

Site	Location	Groundwater	Surface Soils	Vadose Zone	Air	Surface Water	Sediments	Direct Contact	Plant Uptake	Animal Uptake
216-S-1&2	200 West	P	(1,2)	P	(4)	(E)	(E)		X	(6)
216-S-7	200 West	P	(1,2)	P	(4)	(E)	(E)		X	(6)
216-S-9	200 West	P	(1,2)	P	(4)	(E)	(E)		X	(6)
216-S-20	200 West	P	(2)	P	(4)	(E)	(E)		X	(6)
216-S-21	200 West	S	(2)	P	(4)	(E)	(E)		X	(6)
216-T-2	200 West	S	(2)	P	(4)	(E)	(E)		X	(6)
216-T-3	200 West	P	(2)	P	(4)	(E)	(E)		X	(6)
216-T-7	200 West	P	(2)	P	(4)	(E)	(E)		X	(6)
216-T-8	200 West	S	(2)	P	(4)	(E)	(E)		X	(6)
216-T-19	200 West	P	(2)	P	(4)	(E)	(E)		X	(6)
216-T-28	200 West	S	(2)	P	(4)	(E)	(E)		X	(6)
216-U-1&2	200 West	P	(2)	P	(4)	(E)	(E)		X	(6)
216-U-3	200 West	S	(2)	P	(4)	(E)	(E)		X	(6)
216-U-4	200 West	S	(2)	P	(4)	(E)	(E)		X	(6)
216-U-4A	200 West	S	(1,2)	P	(3,4)	(E)	(E)		X	(6)
216-U-4B	200 West	S	(2)	P	(4)	(E)	(E)		X	(6)
216-U-11	200 West	S	(1,2)	P	(3,4)	(E)	(E)	X	X	(6)
216-Z-1&2	200 West	P	(2)	P	(4)	(E)	(E)		X	(6)
216-Z-7	200 West	P	(1,2)	P	(3,4)	(E)	(E)		X	(6)

TABLE 2. POTENTIAL SITE-SPECIFIC CONTAMINANT TRANSPORT PATHWAYS (continued)

Site	Location	Potential Environmental Pathways								
		Groundwater	Surface Soils	Vadose Zone	Air	Surface Water	Sediments	Direct Contact	Plant Uptake	Animal Uptake
216-Z-10	200 West	S	(2)	P	(4)	(E)	(E)		X	(6)
316-1	300 Area	P	(1,2)	P	(3,4,5)	X	X	X	X	(6,7)
316-2	300 Area	P	(1,2)	P	(3,4,5)	X	X	X	X	(6,7)
316-3	300 Area	P	(2)	P	(3,4,5)	X	X		X	(6,7)

Notes to Table 2:

- (1) Waste was disposed at a depth of less than 5' below land surface.
- (2) Surface soil is potentially contaminated by plants which bioaccumulate waste and subsequently become mobile.
- (3) Waste is potentially released into air when contaminants contained in surface soils volatilize or are adsorbed to wind-blown particulates.
- (4) Burning of contaminated plant material may result in an air release.
- (5) Volatilization of contaminants in surface water may result in an air release.
- (6) Animals are potential pathways through contact with contaminated surface soils and/or vegetation.
- (7) Aquatic organisms are potential pathways through contact with contaminated surface water.
- (E) Contaminated surface water and sediment may potentially occur in ephemeral streams.
- (P) Primary pathway of concern.
- (S) Secondary pathway of concern.
- (X) Potential pathways considered to be approximately equal in importance (not of primary or secondary importance).

2.0 SITE CHARACTERIZATION METHODOLOGY

The primary purpose of site characterization is to define the sites, site problems, and settings to support the development, screening, evaluation and selection of remedial action alternatives in the feasibility study and the implementation of the selected remedial action. Site information should be sufficient to determine the necessity, extent, and feasibility of remedial actions, evaluate costs of potential remedial action alternatives, allow for the prioritization of sites based on threat to human health and the environment, and perform any required risk assessments.

The site characterization methodology consists of evaluation of existing data and collection and evaluation of additional data. Additional data may need to be collected and evaluated in more than one round in order to provide data on the sites and site problems sufficient to allow the evaluation, selection, and implementation of remedial actions.

2.1 Evaluation of Existing Data

The first step in site characterization is to locate, compile, and evaluate data available for each site. Investigators will, to the extent allowed by the available data, compile a site description, history, and chronology of significant events that will aid in planning subsequent detailed characterization efforts. Existing data will be evaluated to determine the following:

- o Locations, quantities, concentrations, and characteristics of hazardous waste disposed at each site. The investigators will evaluate results of previous sampling, results of chemical and physical testing, and records of disposal practices and operating procedures to characterize the properties of the hazardous waste disposed at each site.
- o Pathways and extent of contaminant migration. The investigators will evaluate existing monitoring data (water, soil, sediment, air, biota) and regional and site-specific information pertaining to site geology, pedology, hydrogeology, meteorology, and biology to identify

the pathways and extent of contaminant migration at the site. (The potential pathways of concern for the 62 CERCLA sites have been preliminarily evaluated and are presented in matrix form in Table 2.)

- o Human and environmental receptors. The investigators will evaluate demographic and land use information, surface water/groundwater use adjacent and downstream/downgradient of the site, regional and site ecology, and the results of biological testing to identify the human populations and environmental species potentially impacted by the site.
- o The impact of the site on human and environmental receptors. The investigators will evaluate the site with respect to waste characteristics and probable transport pathways to determine the site's impact on humans and the environment.
- o Factors that must be considered in future field investigations (e.g., site-specific health and safety requirements, limitations in conducting field activities, extreme weather, or difficult terrain).

2.2 Collection and Evaluation of Additional Data

If existing information is not sufficient to meet the data needs of the feasibility study, additional information must be obtained. The collection and evaluation of additional data will serve two purposes. First, additional data will verify the information gathered from existing sources (e.g., pathways, receptors, contaminants of concern). Second, additional investigations will provide an opportunity to collect data that will support the development and screening of remedial action alternatives. The various media/pathways/receptors that the investigator should monitor and characterize to acquire additional information on contaminant concentration, quantity, migration, etc., are presented in Table 2; methods for monitoring and of various pathways are presented below.

2.2.1 Identification of Potentially Applicable Site Characterization Methods.

Site investigation methods appropriate to the environmental setting of the CERCLA sites and the identified potential pathways of concern were identified for consideration in the development of site-specific characterization plans in Task 4.0. The methods, each of which was determined to be potentially applicable to the sites, include:

- o Soil borings and sampling and analysis/testing of the soil column.
- o Test pit excavation, direct observation of subsurface conditions, and sampling and analysis/testing of excavated material.
- o Groundwater monitoring well installation, sampling and analysis of groundwater, monitoring groundwater levels.
- o Piezometer installation and monitoring groundwater levels.
- o Probe driving and sampling and analysis of soil gases in the vadose zone.
- o Sampling and analysis/testing of biota (terrestrial and aquatic plants and animals).
- o Sampling and analysis of air for emission of gases and/or volatile compounds.
- o Grab sampling and analysis of wastes, surface soils, surface water, and/or sediments.

- o Remote sensing (i.e., geophysical surveys) of subsurface conditions, such as geologic anomalies and strata, contaminant distribution, and locations of underground structures:
 - ground-penetrating radar
 - electromagnetic induction
 - earth resistivity
 - borehole resistivity
 - borehole conductivity.

- o Aquifer tests for hydrogeologic properties such as transmissivity, storativity, and drawdown.

- o Modeling of groundwater flow to interpolate/extrapolate within/beyond areas of available data and to predict the effects of imposed subsurface conditions.

- o Aerial photography for identifying surface anomalies and historic surface changes (by comparison) and for supporting mapping of surface conditions.

- o Infrared imagery for identifying areas of vegetative stress and/or contamination.

These site characterization methods are the tools that are commonly used for defining the CERCLA sites and corresponding environmental problems. The applicability of these methods to characterizing and determining the presence and transport of contaminants in the aforementioned pathways of concern is shown in Table 3. This table, used in conjunction with the site-specific pathways identified in Table 2, will facilitate the selection of site characterization methods that are appropriate for consideration in planning the characterization of each site in Task 4.0.

Each medium in the column heading of Table 3 is a potential migration pathway for both radioactive and hazardous chemical contaminants. The amount and nature of the contaminants present in these media need to be

characterized in order to be able to assess the extent of existing contamination and the potential for future transport through that pathway. Chemical and radioactive analyses performed on samples obtained by the methods flagged by asterisks in the table, along with physical (i.e., hydrologic and structural) information obtained by using the other methods, provide the data necessary to perform this evaluation.

2.2.2 Compliance of Site Characterization Methods with Environmental Regulations

The sampling methods required for characterization are selected to satisfy the requirements of the regulations identified in Table 1. These regulations sometimes specify the methods to be employed, and otherwise allow the use of generally accepted and appropriate techniques. Table 5 presents a comparison of the identified site characterization methods with the applicable regulations.

TABLE 3. POTENTIALLY APPLICABLE SITE CHARACTERIZATION METHODS

Characterization Methods	Potential Environmental Pathways								
	Groundwater	Surface Soil	Vadose Zone	Air	Surface Water	Sediments	Waste Source	Plant Uptake	Animal Uptake
Borings*		X	X				X		
Test Pits*		X	X				X		
Well Installation/Sampling*	X	X	X				X		
Piezometer Installation*	X								
Hand Auger Samples*		X							
Soil Gas*	X	X	X						
Biological Samples*									
Air Monitoring*				X					
Grab Sample Collection*		X			X	X	X	X	X
Geophysical Surveys									
Ground Penetrating Radar	X		X				X		
Electromagnetic Induction	X		X				X		
Earth Resistivity	X		X				X		
Borehole Methods									
Resistivity	X		X				X		
Conductivity	X		X				X		
Aquifer Tests	X								
Models									
Aerial Photography		X	X	X	X	X	X	X	X
Infrared Imagery					X				X

* Samples obtained using these methods can be analyzed for a suite of organic chemical, inorganic chemical and radioactive contaminants.

TABLE 4. COMPLIANCE OF SITE CHARACTERIZATION METHODS WITH ENVIRONMENTAL REGULATIONS

Characterization Methods	Environmental Regulations			Local
	Federal Regulations	Federal Guidance	State Regulations	
Drilling/sampling/ analysis	40 CFR 264.90	RCRA		---
	40 CFR 147.2400	Groundwater Monitoring Technical		
Well installation/ sampling analysis	40 CFR 141.23	Enforcement	WAC173-304-490	---
	40 CFR 141.24	Guidance	173-160	
	40 CFR 141.25	Document		
Hand auger sampling/ analysis				---
Soil gas sampling/ analysis				---
Geophysical surveys				---