



## 4.0 ENVIRONMENTAL SURVEILLANCE INFORMATION

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The following sections describe results of the Hanford Site Surface Environmental Surveillance and Drinking Water Surveillance Projects for 2002 and include, where applicable, information on both radiological and non-radiological constituents. The objectives, criteria, design, and description of these projects are summarized below and provided in detail in the Hanford Site environmental monitoring plan (DOE/RL-91-50). Radiological doses associated with the surveillance results are discussed in Chapter 5. The quality assurance and quality control programs developed to assure the value of surveillance data are described in Chapter 9.

Many samples are collected and analyzed for the Hanford Site environmental surveillance project, and the resulting data are compiled in a large database (Hanford Environmental Information System [HEIS 1994]). Only summary information is reported here emphasizing those radionuclides and chemicals of Hanford Site origin that are important to the environment or human health and safety. Supplemental data for some sections can be found in Appendix B. More detailed results for specific surface environmental surveillance sampling locations are contained in *Hanford Site Environmental Surveillance Data Report for Calendar Year 2002* (PNNL-14295, APP. 1). The intent of these sections (4.1 through 4.6) is to provide current surveillance data, to compare 2002 data to past data and appropriate standards, and to present a general overview of Hanford Site surveillance activities.

In addition to Hanford Site environmental surveillance, environmental monitoring is conducted at or near facilities on the site. These near-facility monitoring efforts are discussed in Section 3.2 of this report.

### 4.0.1 SURFACE ENVIRONMENTAL SURVEILLANCE

The Pacific Northwest National Laboratory's Surface Environmental Surveillance Project measures the concentrations of radionuclides and chemicals in environmental media and assesses the potential effects of these materials on the environment and the public. Samples of agricultural products, air, fish, sediment, soil, surface water, vegetation, and wildlife are collected routinely or periodically. The samples are then analyzed for radionuclides, at very low environmental levels, and chemicals, including metals and anions. In addition, ambient external radiation is measured.

The project focuses on routine releases from U.S. Department of Energy (DOE) facilities on the Hanford Site; however, the project also responds to unplanned releases and releases from non-DOE operations on and near the site. Surveillance results are provided to DOE and the public annually through this report series. Unusually high results are reported to the DOE Richland Operations Office and the appropriate facility managers when they occur. Whereas effluent and near-facility environmental monitoring are conducted by the facility operating contractor or designated subcontractor, environmental surveillance is conducted under an independent program that reports directly to the DOE Richland Operations Office, Closure Division.

#### 4.0.1.1 SURVEILLANCE OBJECTIVES

The general requirements and objectives for environmental surveillance are to monitor routine and non-routine

releases to the environment from DOE facilities, to assess doses to members of the public, and to monitor potential impacts to biota (DOE Orders 450.1 and 5400.5; DOE/EH-0173T).

The surveillance objectives include the following:

- Determining compliance with applicable environmental quality standards, public exposure limits, and applicable laws and regulations; the requirements of DOE Orders; and the environmental commitments made in environmental impact statements, environmental assessments, safety analysis reports, or other official DOE documents. Additional objectives include conducting pre-operational assessments, assessing radiological doses to the public and environment, assessing doses from other local sources, reporting alarm levels and potential doses exceeding reporting limits.
- Determining background levels and site contributions of contaminants in the environment.
- Determining long-term accumulation of site-related contaminants in the environment and predict trends.
- Characterizing and defining trends in the physical, chemical, and biological conditions of environmental media.
- Determining the effectiveness of treatment and controls in reducing effluent and emissions.
- Determining the validity and effectiveness of models to predict concentrations of pollutants in the environment.
- Detecting and quantifying unplanned releases.
- Identifying and quantifying new environmental quality problems.

Subsidiary objectives for surveillance should also be considered (DOE/EH-0173T). Subsidiary objectives applicable to the site include the following:

- Obtaining data and maintaining the capability to assess the consequence of accidents.
- Providing public assurance; addressing issues of concern to the public, stakeholders, regulators, and business community.
- Enhancing public understanding of site environmental issues, primarily through public involvement and by providing public information.
- Providing environmental data and assessments to assist the DOE in environmental management of the site.

## 4.0.1.2 SURVEILLANCE DESIGN

The DOE Orders require that the content of surveillance programs be determined on a site-specific basis by the DOE site offices. The surveillance programs must reflect facility characteristics; applicable regulations; hazard potential; quantities and concentrations of materials stored or released; extent and use of affected air, land, and water; and specific local public interests and concerns. Environmental surveillance at the Hanford Site is designed to meet the listed objectives while considering the environmental characteristics of the site and potential and actual releases from site operations, surface contamination areas, former waste disposal sites, current waste disposal and storage facilities, and ongoing remediation efforts. Knowledge gained from more than 50 years of environmental surveillance and studies at the Hanford Site provides valuable technical background information for planning the surveillance design and managing the site.

The Hanford Site environmental surveillance project historically focused on radionuclides in various media and non-radiological water quality parameters. However, surveillance for non-radiological constituents, including hazardous chemicals, in selected media is also conducted. A detailed chemical pathway and exposure analysis for the Hanford Site was completed during 1995 (PNL-10714). The analysis helped guide the selection of chemical surveillance media, sampling locations, and chemical constituents.

Each year, a radiological pathway analysis and exposure assessment is performed. The 2002 pathway analysis was based on 2002 source-term data and on the comprehensive pathway and dose assessment methods included in the Generation II (GENII) computer code (PNL-6584) used to estimate radiation doses to the public from Hanford Site operations. The Radiological-Biota Concentration Guide (RAD-BCG) Calculator, a spreadsheet program developed by DOE, was used to screen doses to animals. The results of the pathway analysis and exposure assessment (discussed in Chapter 5) serve as a basis for future years' surveillance program design.

Exposure is defined as the interaction of an organism with a physical or chemical agent of interest. Thus, exposure can be quantified as the amount of chemical or physical agent available for absorption or uptake at the organism's exchange boundaries (i.e., skin contact, lungs, gut). An exposure pathway is identified based on (1) examination of the types, location, and sources (contaminated soil, raw effluent) of contaminants; (2) principal release mechanisms; (3) probable environmental fate and transport (including persistence, partitioning, and intermediate transfer) of contaminants of interest; and, most important, (4) location and activities of the potentially exposed populations. Mechanisms that influence the fate and transport of a chemical through the environment and influence the amount of exposure a person might receive at various receptor locations are listed below.

Once a radionuclide or chemical is released into the environment, it may be:

- Transported (e.g., migrate downstream in solution or on suspended sediment, travel through the atmosphere, or be carried off the site by wildlife).
- Physically or chemically transformed (e.g., deposition, precipitation, volatilization, photolysis, oxidation, reduction, hydrolysis, or radionuclide decay).
- Biologically transformed (e.g., biodegradation).
- Accumulated in the receiving media (e.g., sorbed strongly in the soil column, stored in organism tissues).

The primary pathways for movement of radioactive materials and chemicals from the site to the public are the atmosphere and surface water. Figure 4.0.1 illustrates these and other potential routes and exposure pathways to humans.

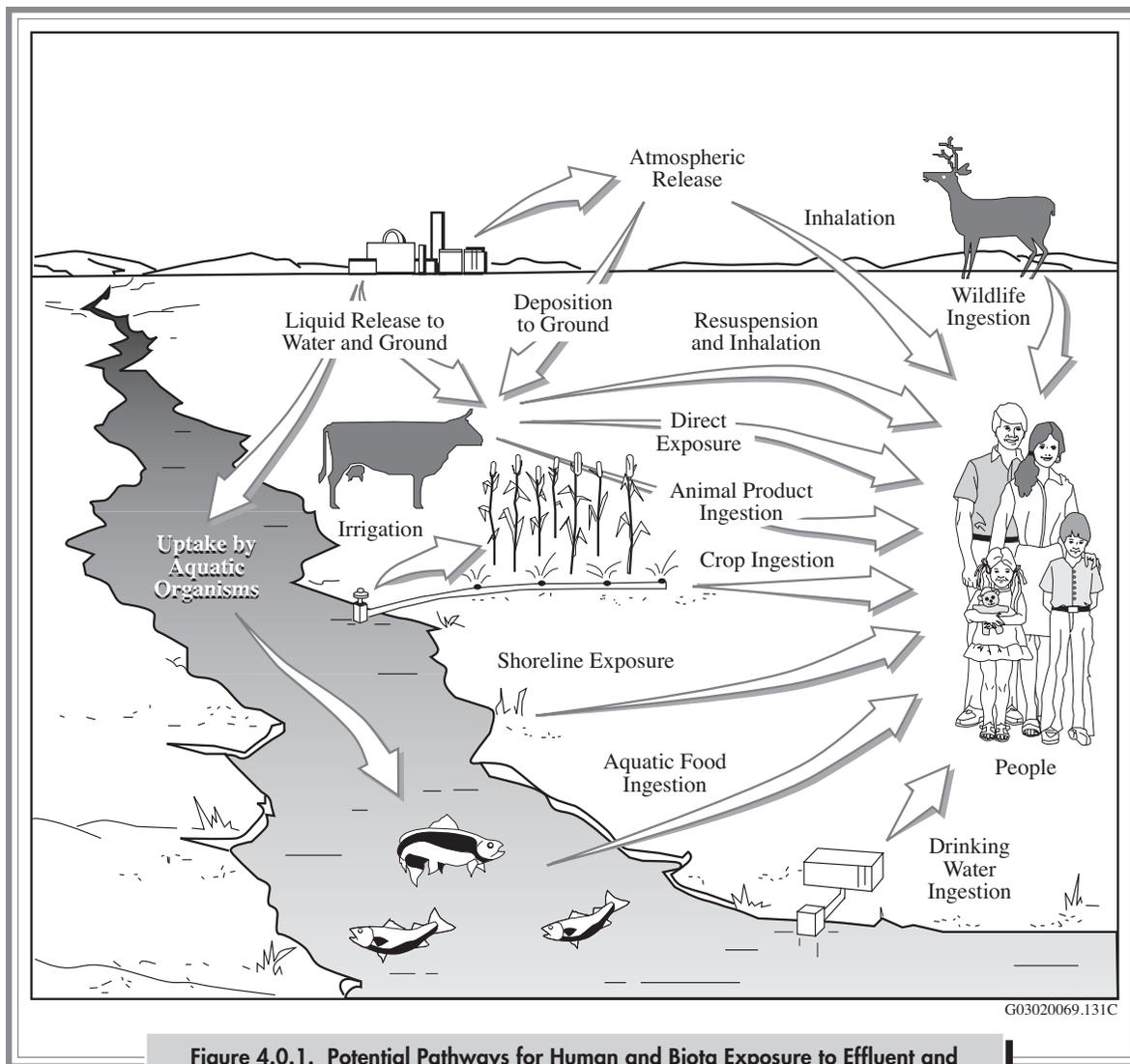
The significance of each pathway was determined from measurements and calculations that estimated the amount of radioactive material or chemical transported along each pathway and by comparing the concentrations or potential radiological doses to environmental and public health protection standards or guides. Pathways were also evaluated based on prior studies and observations of radionuclide and chemical movement through the environment and food chains. Calculations based on effluent data showed the expected concentrations off the Hanford Site, for all Hanford-produced radionuclides and chemicals, to be frequently below the levels that could be detected by

monitoring technology. To assure that radiological and chemical analyses of samples were sufficiently sensitive, minimum detectable concentrations of key radionuclides and chemicals were established at levels well below applicable health standards.

Environmental pathways were monitored near site facilities, locations, or operations with the potential to release contaminants. Food chain pathways were monitored at potential offsite receptor locations. Samples were collected, and radionuclide and chemical concentrations were measured in three general surveillance zones that extended from onsite facilities and operations to the offsite environs.

The first surveillance zone extended from near operational areas to the site perimeter. Environmental concentrations of contaminants released from facilities and fugitive sources (those released from other than monitored sources such as contaminated soil) generally would be the highest and, therefore, most easily detected in this zone. The second surveillance zone consisted of a series of perimeter sampling stations positioned near or just inside the site boundary, along State Highway 240, which runs through the site from Richland to the Yakima Barricade, and along the Columbia River (Figure 1.0.1). The third surveillance zone consisted of locations in and between communities within an 80-kilometer (50-mile) radius of the industrial areas on the site. Surveillance was conducted in communities to obtain measurements at locations where a large number of people potentially could be exposed to Hanford Site releases and to document that contaminant levels were well below standards established to protect public health. Table 4.0.1 lists the sample types and measurement locations in all three zones for 2002. A summary of the number and types of samples collected during 2002, and the number of analytical results obtained from those samples is provided in Table 4.0.2. Except for special studies, soil and vegetation samples are only collected every 3 to 5 years. Routine soil and vegetation samples were last collected in 2001.

Background concentrations were measured at distant locations and compared with concentrations measured on the site and at perimeter and community locations. Background locations were essentially unaffected by Hanford Site operations (i.e., these locations could be used to measure ambient environmental levels of chemicals and radionuclides). Comparing concentrations at these background



**Figure 4.0.1. Potential Pathways for Human and Biota Exposure to Effluent and Emissions from the DOE's Hanford Site**

locations to concentrations measured on or near the site indicated the impact, if any, of Hanford Site operations.

To the extent possible, radiological dose assessments should be based on direct measurements of dose rates and radionuclide activities in environmental media. However, the amount of most radioactive materials released from operations on the Hanford Site in recent years generally have been too small to be measured directly once dispersed in the offsite environment. For the measurable radionuclides, often it was not possible to distinguish levels resulting from worldwide fallout and natural sources from those

associated with Hanford Site releases. Therefore, offsite doses during 2002 were estimated using the following methods:

- Doses from monitored air emissions and liquid effluent released to the Columbia River were estimated by applying environmental transport and dose calculation models to measured effluent monitoring data and selected environmental measurements.
- Doses from fugitive air emissions (e.g., from unmonitored, resuspended, contaminated soil) were estimated from measured airborne concentrations at site perimeter locations.

**Table 4.0.1. Routine Environmental Surveillance Sample Types and Measurement Locations on and Around the Hanford Site in Washington State, 2002**

Type	Total Number	Sample Locations						
		Onsite <sup>(a)</sup>	Site Perimeter <sup>(b)</sup>	Nearby <sup>(c)</sup>	Distant <sup>(c)</sup>	Columbia River		
						Upstream <sup>(c)</sup>	Hanford Reach <sup>(b)</sup>	Downstream <sup>(c)</sup>
Air	45	24	11	8 <sup>(d)</sup>	2 <sup>(d)</sup>			
Spring water	8						8	
Spring sediment	6						6	
Columbia River water	7					2	4	1
Irrigation water	2		2					
Drinking water	4	4						
River sediment	6					1	3	2
Ponds	2	2						
Pond sediment	1	1						
Foodstuffs	7			5	2			
Wildlife	12	7				1	4	
External dose	80	33	38	7	2			
External shoreline radiation	14		14					
Exposure rate	4			3	1			

(a) Surveillance Zone 1 (near operational areas to the site perimeter).

(b) Surveillance Zone 2 (near or just inside the site boundary).

(c) Surveillance Zone 3 (in and between communities within an 80-kilometer (50-mile) radius of the site's industrial areas).

(d) Includes community-operated environmental surveillance stations.

**Table 4.0.2. Samples Collected for the Hanford Site Surface Environmental Surveillance Project and Analytical Results Obtained, 2002**

Media	Number of Samples Collected	Number of Analytical Results Obtained
Air	1,658	4,312
Biota	370	3,004
Soil and sediment	71	936
Surface water	426	4,039
Drinking water	20	69
External radiation	314	314
<b>Totals</b>	<b>2,859</b>	<b>12,674</b>

- Doses from unmonitored groundwater seeping into the Columbia River were estimated by evaluating differences in measured concentrations in Columbia River water upstream and downstream from the Hanford Site.

The surveillance design is reviewed annually based on the above considerations as well as an awareness of planned waste management and environmental restoration activities. The final sampling design and schedule are documented annually in the environmental surveillance master sampling schedule (e.g., PNNL-13749).