Chapter 5: Environmental Surveillance Monitoring Programs – Agricultural Products, Wild Game, Soil, and Direct Radiation

This chapter summarizes the results of the environmental surveillance monitoring of agricultural products, wild game, soil, and direct radiation on and around the INL Site during 2025. Program details are provided in the "Idaho National Laboratory Site Environmental Monitoring Plan" (DOE-ID 2023). Surveillance of soil, vegetation, biota, and direct radiation is conducted both onsite and offsite to meet applicable U.S. Department of Energy (DOE) requirements. These media have the potential to accumulate contaminants released from INL Site operations. To improve readability, only data exceeding three sigma (3σ) thresholds or background upper tolerance limits (UTLs) are included in tables.

5.1 Agricultural Products and Biota Sampling

Agricultural products and game animals are monitored by the INL contractor because they represent a potential pathway for radionuclides to reach the public through food chains. In accordance with NE O 458.1A requirements to evaluate ingestion pathways, sampling includes milk, leafy greens (such as lettuce), alfalfa, potatoes, grains, and select wild game.

5.1.1 Sampling Design

Agricultural products may be impacted by radionuclides transported offsite by wind and deposited on soil and vegetation. Approximately 45% of land surrounding the INL Site is agricultural (DOE-ID 1995), and many residents maintain home gardens. Animals may also consume contaminated vegetation and transfer radionuclides to humans through meat and milk.

Agricultural product sampling began in the vicinity of the INL Site in the 1960s with milk and wheat as part of the routine environmental surveillance monitoring program. Currently, the program focuses on milk, leafy greens, alfalfa, potatoes, and grains.

As specified in DOE-HDBK-1216-2015 (DOE 2015), representative samples of the pathway-significant agricultural products grown within 16 km (10 miles) of the INL Site should be collected and analyzed for radionuclides that potentially could be present from INL Site operations. These samples should be collected in at least two locations: (1) the place of expected maximum radionuclide concentrations, and (2) a "background" location unlikely to be affected by radionuclides released from the INL Site.

Sample design was primarily guided by wind direction and frequencies, as well as from farming practices. Using CALPUFF and INL Site meteorological data measured from 2006 through 2008, air-dispersion modeling was performed to develop data quality objectives for radiological air surveillance monitoring for the INL Site using the methodology documented in Rood and Sondrup (2014). Then, this same methodology was used to discern the dispersion and deposition patterns resulting from these sources, which reflect wind patterns typical of the INL Site. Prevailing winds at most INL Site locations are from the southwest during daytime hours. During evening hours, the winds will sometimes shift direction and blow from the north or northeast but at a lower velocity. Model results show the maximum offsite deposition location is between the southwest INL Site boundary and the Big Southern Butte. Because there are no agricultural activities in this region, sampling is focused on other agricultural areas west and northeast of the INL Site. In addition, the sampling design considers locations of interest to the public, as well as those of historical interest, which is why some samples are collected at extended distances from the INL Site.

5.1.2 Sampling Methods

Fresh produce and milk are purchased from local farmers when available. In addition, lettuce is grown by the INL contractor in several locations where local gardens are not feasible.

5.1.3 Sampling and Analysis

Milk

Milk is sampled to monitor the pathway from potentially contaminated, regionally grown feed to cows, and then to milk, which is afterward ingested by humans. During 2025, the INL contractor collected 207 milk samples, including duplicates and controls, at various locations off the INL Site and purchased milk commercially produced outside the state of Idaho, which served as the control sample. The number and location of the dairies can vary from year to year as farmers enter and leave their businesses. Milk samples were collected weekly from dairies in Rigby and Terreton, Idaho, as well as monthly at other locations around the INL Site.

Milk Monitoring Results

All milk samples were analyzed for gamma-emitting radionuclides, including iodine-131 (^{131}I) and cesium-137 (^{137}Cs). During the second and fourth quarters, samples were analyzed for strontium-90 (^{90}Sr) and tritium as well. Iodine is an essential nutrient and is readily assimilated by cows or goats eating plants containing the element. Iodine-131 (^{131}I) is of particular interest because it is produced by reactor operations or nuclear weapons testing, is readily detectable, and, along with ^{134}Cs and ^{137}Cs, can dominate the ingestion dose regionally after a severe nuclear event, such as what occurred after the Chernobyl accident (Kirchner 1994) in Ukraine and the 2011 accident in Fukushima, Japan. The ingestion pathway of milk is the main route of internal ^{131}I exposure for people. Iodine-131 has a short half-life of just 8 days; therefore, it does not persist in the environment. Past releases from experimental reactors at the INL Site and fallout from atmospheric nuclear weapons tests and the Chernobyl accident are no longer present. Iodine-131 was not detected in any of the air samples collected at or beyond the INL Site boundary (see Chapter 2), nor was it detected in any milk sample collected during 2025.

Cesium-137 is chemically analogous to potassium in the environment and behaves similarly by accumulating in many types of tissue, most notably in muscle tissue. With a half-life of about 30 years, ^{137}Cs tends to persist in soil. If in a soluble form, it can readily enter the food chain through plants. It is widely distributed throughout the world from historic nuclear weapons detonations, which occurred between 1945 and 1980, and has been detected in all environmental media at the INL Site. Potential sources of ^{137}Cs include releases from INL Site facilities and the resuspension of previously contaminated soil particles. Cesium-137 was not detected in any milk sample collected in 2025.

Strontium-90 is an important radionuclide because it behaves like calcium and can deposit in bones. Like ^{137}Cs, ^{90}Sr is produced in high yields either from nuclear reactors or from the detonation of nuclear weapons. It has a half-life of about 29 years and can persist in the environment. Strontium tends to form compounds that are more soluble than ^{137}Cs and, therefore, are comparatively mobile in ecosystems. Strontium was not detected in any milk sample collected in 2025.

Tritium is a radioactive isotope of hydrogen with a half-life of approximately 12 years. Because it readily combines with oxygen to form tritiated water, it behaves similarly to ordinary water in the environment. As a result, tritium can be found in surface water, precipitation, and atmospheric moisture. It is produced naturally in the upper atmosphere and can also be generated through reactor operations and historical nuclear weapons testing.

Tritium enters the food chain primarily through surface water consumed by people and animals, as well as through plants that naturally contain water. Tritium concentrations were detected in samples collected on November 17, 2025, measuring 115.0 ± 27.6 pCi/L in Deitrich, Idaho, and 83.0 ± 24.9 pCi/L in Terreton, Idaho. For comparison, the derived concentration standard for tritium in milk is 12,000,000 pCi/L.

Lettuce

Lettuce is sampled as part of environmental monitoring because radionuclides present in the air can settle onto soil and plant surfaces, where they may be ingested by people. Plants can take up radionuclides in two ways: through their roots from the soil and through material deposited directly on their leaves. For many radionuclides, contamination of foliage is the primary pathway (Amaral et al. 1994). As a result, leafy greens such as lettuce often show higher soil-to-plant concentration ratios compared with other types of plants.

Each year, the INL contractor collects lettuce samples from locations on and near the INL Site. Because the availability of lettuce from home gardens varied from year to year, portable lettuce planters have replaced traditional gardens at several monitoring locations. These planters allow sampling in areas where public gardening is not feasible, including on the INL Site and near air sampling stations. The planters remain in place throughout the growing season, enabling natural deposition of airborne radionuclides on the soil and plant surfaces. In the spring, the planters are filled with locally sourced soil mixed with potting soil, seeded with lettuce, and maintained using a self-watering reservoir.

Lettuce Monitoring Results

During 2025, nine lettuce samples were collected from southeast Idaho, including a duplicate from Howe, Idaho. For comparison, a control sample was also purchased outside the state of Idaho from a local grocery store. Eight of the nine samples were grown in portable planters located in Atomic City, Blackfoot, the Experimental Field Station, Howe, Idaho Falls, Monteview, and Sugar City. One sample was collected from a farm in Pocatello. Collection of samples at Atomic City and the Experimental Field Station yielded insufficient amounts of lettuce for analysis. The remaining samples were analyzed for the gamma-emitting radionuclide ^{137}Cs and for ^{90}Sr.

Strontium-90 was not detected in any of the lettuce samples collected in 2025. This radionuclide persists in the environment from historic above-ground nuclear weapons testing conducted between 1945 and 1980. Cesium-137 was also not detected in the 2025 samples. Although ^{137}Cs from the past fallout can be measured in soils, its uptake into lettuce and other vegetation is generally much lower than that of strontium (Fuhrmann et al. 2003; Ng, Colsher, and Thompson 1982; Schulz 1965). The movement of ^{137}Cs into plants depends strongly on soil characteristics, including clay content and alkalinity. Soils in southeast Idaho tend to be moderately to highly alkaline, which can further limit the availability of ^{137}Cs for plant uptake. No other human-made radionuclides were detected in any lettuce samples.

Grain

Grain, including wheat and barley, are sampled because they are widely grown in the region and serve as an important local food and feed source.

Grain Monitoring Results

In 2025, the INL contractor collected grain samples at eleven locations from areas surrounding the INL Site, including a duplicate sample from Arco, Idaho. A control sample was purchased from outside the state of Idaho for comparison. Sampling locations may vary from year to year as growers rotate their crops, but they are generally chosen from areas that are part of the air surveillance monitoring network.

No human-made radionuclides were detected in any of the grain samples collected. Agricultural products, such as fruits and grains, typically contain lower levels of radionuclides than leafy greens, which more readily accumulate airborne deposition (Pinder et al. 1990).

Potato

Potatoes are collected for monitoring because they are one of the primary crops grown in the region and are of particular interest to the public. Since potatoes grow underground and are not exposed to airborne contaminants, they typically play a lesser role in the ingestion pathway.

Potato Monitoring Results

In 2025, the INL contractor collected nine potatoes samples from eight locations near the INL Site, along with a duplicate sample from American Falls, Idaho. A control sample was purchased from outside the state of Idaho. None of the potato samples collected during 2025 contained detectable concentrations of human-made radionuclides. Similar to grain crops, potatoes are generally less-efficient at taking up radioactive materials from the soil than leafy greens, such as lettuce, which can more readily accumulate airborne disposition.

Alfalfa

In addition to analyzing milk, the INL contractor began collecting alfalfa data in 2010 because alfalfa is an important feed source for dairy cows and can serve as an indicator of potential radionuclide deposition.

Alfalfa Monitoring Results

In 2025, the INL contractor collected fifteen alfalfa samples from four locations in areas surrounding the INL Site, including duplicate samples from Howe, Idaho Falls, and Mud Lake, Idaho. Mud Lake is an agricultural area with a relatively high potential for offsite airborne deposition. (Note: The highest offsite air concentration used for estimating public dose was detected southeast of the INL Site's east entrance; however, there is limited agriculture near that location.) No ^{90}Sr or gamma-emitting radionuclides were detected in the alfalfa samples collected during 2025.

Big Game Animals

Since big game historically have been documented to uptake some level of radioactive contaminants, the opportunistic sampling of road-killed game animals is important to ascertain the potential impacts of these contaminants on the animals, as well as the humans potentially consuming them (INL 2022a).

Big Game Monitoring Results

Various tissue samples were collected from three elk and a pronghorn under a scientific collection permit. Muscle, liver, and thyroid samples were collected from two of the elk. Only muscle samples were collected from the remaining elk and the pronghorn because the livers were damaged due to vehicular strikes. The muscle and liver samples were analyzed for ^{137}Cs because it is an analog of potassium and is readily incorporated into muscle and organ tissues. Thyroids are analyzed for ^{131}I because the isotope accumulates selectively in the thyroid gland of many animals when ingested, making them an ideal bio-indicator of atmospheric releases. Iodine-131 was not detected in the thyroid samples. No ^{137}Cs or other human-made, gamma-emitting radionuclides were found in any of the muscle or liver samples.

Because no human-made radionuclides were detected in big game tissues, an evaluation using the maximum radionuclide concentrations at the INL Site was completed, and the result was below the DOE-STD-1153-2019 (DOE-2019) criteria.

Waterfowl

Waterfowl are collected each year from ponds on the INL Site and from offsite locations under scientific collection permits issued by the Idaho Department of Fish and Game and the U.S. Fish and Wildlife Service. Samples are collected only when waterfowl are present, and additional opportunistic salvage of deceased birds may occur elsewhere on the INL Site when conditions allow. Results from these samples are used to estimate the potential radiation dose to the waterfowl and to individuals who may consume them.

Waterfowl Monitoring Results

Three waterfowl samples were collected from wastewater ponds located at the Sewage Lagoons, two control waterfowl samples were collected from the South Fork of the Snake River. These samples were analyzed for gamma-emitting radionuclides (^{90}Sr) and actinides (americium-241, plutonium-238, plutonium-239/240). These radionuclides were selected because they have been measured historically in liquid effluents from some INL Site facilities. Each sample was divided into the following three subsamples: (1) edible tissue (e.g., muscle, gizzard, heart, liver); (2) the external portion (e.g., feathers, feet, head); and (3) all remaining tissue.

Cesium-137 was detected in a remainder subsample collected at the Sewage Lagoons on October 31, 2025. The concentration was similar to historical results for waterfowl subsamples. No additional human-made, gamma-emitting radionuclides were found in the collected edible, external, or remainder subsamples.

Tissue data was evaluated in conjunction with maximum radionuclide concentrations measured in soil and water across the INL Site to estimate dose to waterfowl. The resulting dose estimate was well below the criteria established in DOE-STD-1153-2019 (DOE 2019).

5.2 Soil Sampling

Soil sampling provides long-term insight into the accumulation of radionuclides in the environment and is recommended in DOE-HDBK-1216-2015 (DOE 2015) for evaluating deposition trends over time. As an integrating medium, soil reflects contaminants introduced through atmospheric deposition, resuspension of onsite materials, or irrigation with impacted water. Although soil sampling is valuable for assessing long-term accumulation of airborne radionuclides, it typically plays a supplementary role in environmental surveillance programs because large natural variability and sampling uncertainties limit its usefulness for detecting small, short-term changes in deposition (Gallegos 1995; Hardy and Krey 1971; EML 1997).

NE O 458.1A supports this type of monitoring by requiring environmental surveillance programs to include direct measurements, where practical, to characterize exposures and potential pathways, ensuring that radionuclide deposition and long-term environmental conditions are adequately assessed. This provides regulatory value and justification for maintaining soil sampling as part of the INL environmental monitoring program.

The INL contractor conducts soil sampling on a five-year rotation, with the next sampling scheduled for 2027. Historical results show declining concentrations of human-made radionuclides such as ^{137}Cs, with no evidence of detectable deposition from ongoing INL Site releases (INL 2017).

5.3 Environmental Direct Radiation

Environmental direct radiation is monitored across the INL Site and within the surrounding 50-mile area to document potential external exposure to the public and non-involved workers. This monitoring aligns with NE O 458.1A, which requires the use of direct measurements, where practical, to characterize exposures and to ensure that radiological conditions are adequately assessed to demonstrate compliance.

5.3.1 Sampling Design

An array of optically stimulated luminescent dosimeters (OSLDs) are distributed throughout the eastern Snake River Plain and on the INL Site) to measure environmental radiation. Neutron dose monitoring is also conducted in areas where neutron radiation may be present, including around facilities and buildings. On the INL Site, OSLDs are positioned at facility perimeters, particularly in locations most likely to detect elevated gamma readings, as well as near radioactive material storage areas and along roadways. Neutron dosimeters are similarly placed at facility perimeters and in locations where neutron emissions could occur.

5.3.2 Sampling Methods

Environmental OSLDs and neutron dosimeters are deployed in the field for six months, after which each dosimeter is collected and returned to the supplier for analysis. Dosimeter exchanges occur twice annually, corresponding to the November 2024–April 2025 and May 2025–October 2025 sampling periods. Background radiation levels are highly variable; therefore, historical information establishes localized regional trends to identify variances. If a single measurement is greater than the background dose, it does not necessarily mean that an unusually high amount of radiation exists in that area. When a measurement exceeds the background dose, the measurement is compared to other values in the area and to historical data to determine whether the results may require further action as described in the report, “Data Quality Objectives Supporting the Environmental Direct Radiation Monitoring Program for the Idaho National Laboratory” (INL 2022b). The method for computing the background value as the UTL is described in EPA (2009) and EPA (2016). ProUCL Version 5.1 software (EPA 2016) has been used to compute the OSLD UTL for these locations, given all available data in the area since 2012. The UTL is the value such that 95% of all the doses in the area are less than that value with 95% confidence. It is anticipated that 5% of the measurements will exceed the background dose. For neutron doses, the background is considered to be zero, and the dosimeters currently in use have a detection threshold of 10 mrem. Therefore, any measured neutron dose is considered present due to sources located within the facility or building.

5.3.3 Sampling and Analysis

The OSLD measured values at these field locations were primarily below the historic 6-month background UTL for the period from November 2024 to April 2025, except IF-675S O-34, which was slightly higher (64.7 ± 3.2 mrem) than the background UTL (63.0 mrem). This result showed similarity to historical data, suggesting that no further action was required.

A review of OSLD readings from dosimeters deployed across the eastern Snake River Plain and on the INL Site revealed measurements that were higher than anticipated for the May 2025 through October 2025 period.

When compared to historical data collected from these locations in previous years, the May 2025 through October 2025 data demonstrated a noticeable increase. Historically, OSLD measurements at these same monitoring locations have remained within typical background levels, exhibiting minimal variability. The sudden rise observed during this period was inconsistent with past data trends and prompted further evaluation. The investigation determined that the OSLDs were inadvertently exposed to an x-ray scanner during shipment, resulting in elevated readings unrelated to actual environmental conditions. This exposure led to artificially inflated dose values, rendering them invalid for reporting purposes.

The neutron dosimeters deployed from May 2025 through October 2025 were confirmed to be unaffected by x-ray scanning during shipment. This was determined based on the control dosimeter, which was reported as an “M” result. All neutron dosimeters collected in 2025 were also reported as “M,” which denotes that the dose equivalents are below the minimum measurable quantity of 10 mrem.

Table 5-1 summarizes the calculated effective dose a hypothetical individual would receive on the Snake River Plain from various sources of natural background radiation (e.g., cosmic and terrestrial). This table includes the latest recommendations of the National Council of Radiation Protection and Measurements (NCRP) in “Exposure of the Population in the United States and Canada from Natural Background Radiation” (NCRP 2009).

The terrestrial natural background radiation exposure estimate is based on the concentrations of naturally occurring radionuclides found in soil samples collected from 1976 to 1993, as summarized by Jessmore, Lopez, and Haney (1994).

Table 5-1. Calculated effective dose from natural background sources (2025).

SOURCE OF RADIATION DOSE	TOTAL AVERAGE ANNUAL DOSE	
	CALCULATED (mrem)	MEASURED[a] (mrem)
EXTERNAL IRRADIATION		
Terrestrial	72[b]	NA[c]
Cosmic	57[d]	NA
Subtotal	**129**	—[e]
INTERNAL IRRADIATION (PRIMARILY INGESTION)[f]		
Potassium-40	15	NM[g]
Thorium-232 and uranium-238	13	NM
Others (carbon-14 and rubidium-87)	1	NM
INTERNAL IRRADIATION (PRIMARILY INHALATION)[f]		
Radon-222 (radon) and its short-lived decay products	212	NM
Radon-220 (thoron) and its short-lived decay products	16	NM
TOTAL	**386**	

a. Calculated from the average annual external exposure at all offsite locations measured using OSLDs.
b. Estimated using concentrations of naturally occurring radionuclide concentrations in soils in the Snake River Plain.
c. NA indicates terrestrial and cosmic radiation parameters were not measured individually but were measured collectively using dosimeters located offsite and at the boundary of the INL Site.
d. Estimated from Figure 3.4 of NCRP Report No. 160 (2009).
e. — = Value not calculated due to OSLD readings for May–October 2025 being deemed invalid due to inadvertent x-ray exposure during shipment (See Subsection 5.3.3).
f. Values reported for the average American adult in Table 3.14 of NCRP Report No. 160 (2009).
g. NM = not measured.

Concentrations of naturally occurring radionuclides in the soil do not change significantly over this relatively short period. Data indicates the average concentrations of uranium-238 (^{238}U), thorium-232 (^{232}Th), and potassium-40 (^{40}K) were 1.5, 1.3, and 19 pCi/g, respectively. The calculated external dose equivalents received by a member of the public from ^{238}U plus decay products, ^{232}Th plus decay products, and ^{40}K based on the above-average area soil concentrations were 21, 28, and 27 mrem/yr, respectively, for a total of 76 mrem/yr (Mitchell et al. 1997). Because snow cover can reduce the effective dose that Idaho residents receive from the soil, a correction factor must be made each year to the estimated 76 mrem/yr. In 2025, this resulted in a reduction in the effective dose from the soil to a value of 72 mrem/yr.

The cosmic component varies primarily with increasing altitude. Using Figure 3.4 in NCRP Report No. 160 (NCRP 2009), it was estimated that the annual cosmic radiation dose near the INL Site is approximately 57 mrem. Cosmic radiation may vary slightly because of solar cycle fluctuations and other factors.

Based on this information, the sum of the terrestrial and cosmic components of external radiation dose to a person residing on the Snake River Plain in 2025 was estimated to be 129 mrem/yr. Because the monitoring results for the May–October 2025 interval were deemed invalid, a definitive measured external radiation dose could not be established. Consequently, a comparison between the estimated external radiation dose and the measured external radiation dose was not possible.

The component of background dose that varies the most is inhaled radionuclides. According to NCRP, the major contributor of effective dose received by a member of the public from ^{238}U plus decay products are short-lived decay products of radon (NCRP 2009). The amount of radon in buildings and groundwater depends, in part, upon the natural radionuclide content of soil and rock in the area. The amount of radon also varies among buildings of a given geographic area depending on the materials each contains, the amount of ventilation and air movement, and other factors. The U.S. average of 212 mrem/yr was used in Table 5-1 for this component of the total background dose. NCRP also reports that the average dose received from thoron, a decay product of ^{232}Th, is 16 mrem.

Individuals also receive an internal dose from ingestion of ^{40}K and other naturally occurring radionuclides in environmental media. The average ingestion dose to an adult living in the U.S. was 29 mrem/yr (NCRP 2009).

With all these contributions, the total background dose to an average person living in southeast Idaho was estimated to be approximately 386 mrem/yr, as identified in Table 5-1. This value was used to calculate the background radiation dose to the population living within 50 miles of INL Site facilities (Table 6-2).

5.4 Waste Management Direct Surface Radiation Sampling

In compliance with DOE O 435.1, "Radioactive Waste Management," direct surface radiation was measured by the Idaho Cleanup Project (ICP) contractor at the Radioactive Waste Management Complex (RWMC) and the Idaho Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Disposal Facility (ICDF).

5.4.1 Surface Radiation Survey at the Radioactive Waste Management Complex and the Idaho CERCLA Disposal Facility

Surface radiation surveys were performed at ICDF and RWMC on July 24, 2025. These surveys aimed to characterize gamma radiation levels near the ground surface at each facility and to monitor changes related to ongoing waste management activities.

At ICDF, the gamma readings fluctuated from year to year. These variations are associated with disposal and burial of new CERCLA remediation wastes as prescribed by the ICDF waste placement plan. In 2025, the gross gamma measurements were found to be either at background levels or slightly above background levels, with readings averaging approximately 3,200 counts per second (CPS). This result is considered typical and is expected to persist until the facility undergoes closure and capping.

Measurements at RWMC indicated that gross gamma readings have remained consistently below 3,000 CPS, with a mean background value of 2,875 CPS. This stability in gamma readings reflects ongoing waste management operations and the effectiveness of control measures at the INL Site.

5.5 Quality Assurance

5.5.1 INL Contractor Quality Assurance

In 2025, the INL contractor implemented its quality control program to ensure environmental monitoring results were accurate and trustworthy. Quality assurance activities included the use of blanks, duplicates, and performance evaluation samples to verify the performance of the contracted analytical laboratory. When discrepancies were identified, the contractor collaborated with the laboratory to refine processes, procedures, and methods. Field sampling, laboratory measurements and performance evaluation samples were thoroughly reviewed. These measures ensure that monitoring data used to protect public health and the environment are valid, reliable, and defensible. All laboratory data presented by the INL contractor in this chapter meet these standards.

5.5.2 ICP Contractor Quality Assurance

The ICP contractor followed a similar approach in 2025 to maintain data integrity and reliability. Quality assurance activities associated with surface radiation readings included manufacturer-recommended calibration intervals and instrument maintenance to ensure accurate readings are collected.

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