

# Summary of Historical Environmental Monitoring



A Supplement to the  
***INL Site Environmental Report for 20172018***

## Summary of Historical Environmental Monitoring

This summary of Idaho National Laboratory (INL) Site historical environmental monitoring has been adapted from the *Idaho National Engineering Laboratory Historical Dose Evaluation* (DOE-ID 1991), which contains more detailed information on early environmental monitoring efforts and results.

Environmental monitoring has been performed at the INL Site by the Department of Energy Idaho Operations Office (DOE-ID) and its predecessors, the Atomic Energy Commission and Energy Research and Development Administration, as well as by other federal agencies, various contractors, and state agencies since its inception in 1949. The organization of environmental monitoring programs has remained fairly constant throughout much of the history of the INL Site. The Atomic Energy Commission's Health Services Laboratory, later named the DOE-ID's Radiological and Environmental Sciences Laboratory, was responsible for conducting most environmental surveillance tasks from the early 1950s to 1993 both on and off the INL Site. Contractors operating the various facilities were responsible for monitoring activities performed within the facility boundaries, including effluent monitoring.

Early monitoring activities focused on evaluating the potential for exposing the general public to a release of radioactive materials from INL Site facilities. Radionuclides were the major contaminants of concern because the INL Site was heavily involved in testing nuclear facilities. DOE-ID and its predecessors sampled and analyzed environmental media that could be affected by atmospheric releases. During those early years, the various INL Site contractors sampled liquid and airborne effluents from facilities to develop waste inventory information.

Throughout the INL Site's history, DOE-ID has maintained agreements with two other federal agencies to perform specific monitoring activities on and around the INL Site. The U.S. Geological Survey has monitored groundwater quantity and quality in the Eastern Snake River Plain Aquifer, emphasizing the portion of the aquifer beneath the INL Site. The National Oceanic and Atmospheric Administration (NOAA) has monitored weather conditions at the INL Site since 1948.

In 1993, the DOE-ID Environmental Monitoring Program was divided into separate programs for on and off the INL Site. Responsibility for the INL onsite program was transferred to the INL contractor. Currently, the INL and Idaho Cleanup Project (ICP) Core contractors conduct monitoring on the INL Site. During 2017, Battelle Energy Alliance, LLC was the INL contractor, managing nuclear research facilities and sitewide functions. The Idaho Cleanup Project (ICP) Core involves the safe environmental cleanup of the INL Site managing waste management facilities and related monitoring activities. The lead contractor on the project recently transitioned from CH2M-WG Idaho, LLC, to Fluor Idaho, LLC.

The Environmental Surveillance, Education, and Research Program, which is currently managed by Veolia Nuclear Solutions, Federal Services, is contracted by DOE-ID to conduct monitoring primarily off the INL Site.

**Table 1.** Historical Low-Volume Radiological Air Sampling Locations and Dates of Operations.

<b>Sampling Location</b>	<b>Dates of Operation</b>
<b>Off INL Site Locations</b>	
Aberdeen	1952 – 1957, 1960 – 1970
American Falls	1970
Blackfoot	1968 – 2001
Blackfoot Community Monitoring Station	1996 – present
Carey	1961 – 1970
Craters of the Moon <sup>b</sup>	1973 – present
Dubois	2001 – present
Dietrich	1961 – 1970
Idaho Falls	1953 – 1955, 1956 – present
Jackson <sup>c</sup>	2001 – 2015, 2017-present
Minidoka	1961 – 1970
Pocatello	1969 – 1980
Rexburg Community Monitoring Station	1996 – 2013
Sugar City	2013 – present
Spencer	1953 – 1956
<b>Boundary Locations</b>	
Arco	1968 – present
Atomic City	1953 – 1957, 1960 – 1970, 1973 – present
Butte City	1953 – 1957, 1960 – 1973
Blue Dome	2001 – present
Federal Aviation Administration Tower	1981 – present
Howe	1958 – present
Montevieu	1958 – present
Mud Lake	1958 – present
Reno Ranch/Birch Creek	1958 – 2001
Roberts	1960 – 1970
Terreton	1953 – 1956, 1964 – 1965
<b>INL Site Locations</b>	
Aircraft Nuclear Propulsion Program	1953 – 1955, 1961 – 1963
Auxiliary Reactor Area	1966 – present
Central Facilities Area	1953 – present
Critical Infrastructure Test Range Complex/Power Burst Facility	1958 – present
East Butte	1953 – 1955
Experimental Breeder Reactor No. 1	1952 – 1956, 1958 – present
Experimental Field Station	1972 – present
Fire Station #2	1958 – 1963
Gas-Cooled Reactor Experiment	1961 – 1963
Gate 4	2004 – present
Idaho Nuclear Technology and Engineering Center <sup>d</sup>	1953 – 1956, 1958 – 1970, 1981 – present
Main Gate	1976 – present,
Materials and Fuels Complex <sup>e</sup>	1961 – present
Mobile Low Power Reactor No. 1	1961 – 1963
Naval Reactors Facility	1956, 1958 – present
Organic Moderated Reactor Experiment	1957 – 1963
Radioactive Waste Management Complex	1973 – present
Advanced Test Reactor Complex <sup>f</sup>	1953 – 1956, 1958 – present
Rest Area, Highway 20	2000 – present
Specific Manufacturing Capability	2004 – present
Stationary Low-Power Reactor No. 1	1961 – 1963
Test Area North	1953 – 1955, 1956 – present
Van Buren Gate	1976 – present

a. Source: DOE-ID (1991).

b. Designated as a boundary location 1973 – 1981.

c. The Jackson location was not in operation during 2016 because a new location was being constructed.

d. Formerly referred to as the Idaho Chemical Processing Plant.

e. Formerly referred to as Argonne National Laboratory-West.

f. Formerly referred to as Test Reactor Area and as Reactor Technology Complex.

## Air Monitoring

Low-volume air samplers have been operating on and near the INL Site since 1952. Table 1 lists these sampling locations and their dates of operation (derived from DOE-ID 1991 and current program documentation). Before 1960, radiation detection devices, such as a Geiger-Müller tube, were used to measure radioactivity on air filters. Gross beta measurements started in 1960, and by 1967, the present measurements were being taken. High-volume air samplers operated at the Experimental Field Station and Central Facilities Area from 1973 until October 1996, when operations were suspended after a cost-benefit analysis was performed. Also in 1973, the Environmental Protection Agency began operating a high-volume sampler in Idaho Falls as part of the nationwide Environmental Radiation Ambient Monitoring System, now known as RadNet. The Idaho Falls sampler still operates.

Tritium in atmospheric moisture has been measured at a minimum of two locations since at least 1973. Some limited monitoring may have been performed before then. Currently, the INL contractor operates two atmospheric moisture stations onsite (EFS and Van Buren) and two offsite (Craters of the Moon and Idaho Falls). The ESER contractor also operates three stations offsite (Atomic City, Howe, and Idaho Falls) and one onsite (EFS).

Precipitation was monitored opportunistically since at least 1968. Like atmospheric moisture monitoring, some limited monitoring may have been before then. Tritium is now measured in precipitation from three offsite locations (Atomic City, Howe, and Idaho Falls) and one onsite location (EFS) by the ESER contractor. Sampling is currently performed at the same locations as the atmospheric moisture stations. This is to compare concentrations between the two media.

One monitoring location at the Central Facilities Area collected samples of noble gases, with specific interest in krypton-85, from approximately 1984 until 1992. This station monitored krypton-85 releases from the Idaho Nuclear Technology and Engineering Center (INTEC) when spent nuclear fuel was being reprocessed.

Nitrogen dioxide and sulfur dioxide were first monitored for a nine-week period at five locations on the INL Site in 1972. A nitrogen dioxide sampling station operated from 1983 to 1985 to monitor waste calcining operations at INTEC. A sulfur dioxide sampler also was used from 1984 to 1985. Nitrogen dioxide sampling resumed from 1988 to 2003, and one sulfur dioxide sampler operated from 1989 through 2001. Nitrogen dioxide was sampled using a continuous emissions monitoring system at the INTEC main stack, as well as ambient air samplers downwind of the facility. This sampling was performed to comply with the air permit to operate the INTEC calciner. The calciner ceased operations in 2000.

The National Park Service, in cooperation with other federal land management agencies, began the Interagency Monitoring of Protected Visual Environments (IMPROVE) Program in 1985. This program was an extension of an earlier Environmental Protection Agency program to measure fine particles of less than 2.5 µm in diameter (PM<sub>2.5</sub>). These particles are the major cause of degraded visibility. In May 1992, one IMPROVE sampler was established at the Central Facilities Area on the INL Site, and a second was located off the INL Site at Craters of the Moon National Monument as part of the nationwide network. Each sampler collected two 24-hr PM<sub>2.5</sub> samples a week. Analyses were performed for particulate mass, optical absorption, hydrogen,

carbon, nitrogen, oxygen, and the common elements from sodium through lead on the periodic table. The Central Facilities Area sampler ceased operation in May 2000 when the Environmental Protection Agency removed it from the nationwide network. The Craters of the Moon National Monument sampler ceased operation in 2008 when an Interagency Agreement between DOE-ID and the National Park Service expired. Emissions from the calciner at INTEC had potential to impact visibility at the Monument. The calciner ceased operations in 2000.

### **Agricultural Products Monitoring**

Milk was the first agricultural product to be monitored, beginning in at least 1957. The number of samples collected per year has been relatively constant since about 1962. Because of improvements in counting technology, the detection level for iodine-131 has decreased from about 1,500 pCi/L in early sampling to the current detection level of about 1 pCi/L.

Grain, including wheat and barley, was first sampled as part of the radioecology research program in about 1962. The current monitoring program dates back to 1963.

Potatoes were first collected in 1976 as part of an ecological research project. Regular potato sampling resumed in 1994 in response to public interest. Starting in 1999, potatoes grown in other states were collected for comparison to those collected from growers adjacent to the INL Site.

Lettuce has been collected since 1977. Lettuce was collected randomly from home gardens around the INL Site. To make this sampling more deliberate, the Environmental Surveillance, Education, and Research contractor added lettuce planters in conjunction with other locations on and off the INL Site in 2003. These planters were relatively remote and had no access to water, and, therefore, required a self-watering system. The self-watering method allowed for the placement and collection of lettuce at areas previously unavailable to the public (i.e., on the INL Site). This new method also allowed for the accumulation of deposited radionuclides on the plant surface throughout the growth cycle. Currently, there are four locations offsite (Atomic City, FAA Tower, Howe, and Montevue) and one onsite (EFS).

Alfalfa samples were added to the program in 2010. This was in response to the DOE Headquarters Independent Oversight Assessment of the Environmental Monitoring program at the INL Site conducted during that year. The assessment team commented, with reference to the milk sampling program, that the ESER contractor should consider sampling locally-grown alfalfa offsite.

### **Animal Tissue Monitoring**

Monitoring of game animals has focused on research concerning the movement of radionuclides through the food chain. Rabbit thyroids and bones were first sampled in 1956. In 1973, routine sampling of game animal tissues began. The following year, the first studies on waterfowl that were using wastewater disposal ponds containing various amounts of radionuclides were conducted. Waterfowl studies have covered the periods 1974 – 1978, 1984 – 1986, and 1994 – present. In 1998, waterfowl collection became part of the routine monitoring activities.

In 1998, periodic sampling of yellow-bellied marmots was added. During 1998, 2000, 2002 and 2003, 15 marmots were collected from the Radioactive Waste Management Complex and 11 from

control areas and analyzed for specific radionuclides. Measured radionuclide concentrations in 2002 and 2003 were well below those in other wildlife species collected historically at the Radioactive Waste Management Complex, as well as in control animals collected in previous studies. As a result, routine monitoring of marmots ceased.

Monitoring of livestock grazing on and near the INL Site began in 1975. Sheep that grazed on the INL Site were routinely monitored from 1975 through 2006. Sheep sampling was discontinued because (1) radionuclide concentrations remained unchanged since 2002, (2) results were statistically equal to background levels, and (3) game animals theoretically indicate releases to the environment better because they may graze near INL Site facilities. Beef cattle grazing near the Radioactive Waste Management Complex were monitored biennially from 1978 to 1986. Monitoring of beef cattle ceased when grazing near the Radioactive Waste Management Complex was discontinued due to drought conditions.

Bat activity and species occurrence on the INL Site have been monitored since 2012. Bat carcasses have been collected at INL Site facilities since 2015 for radiochemical analyses. The bats are composited and analyzed for gamma-emitting radionuclides, strontium-90, and actinides (plutonium isotopes and americium-241).

### **Direct Radiation Monitoring**

Radiation in the environment has been measured on the INL Site since 1958. The technology for measuring radiation at fixed locations has evolved from film badges to thermoluminescent dosimeters and optically stimulated luminescent dosimeters. In addition to these fixed locations, surveys using hand-held and vehicle-mounted radiation instruments have been conducted since at least 1959. Aerial radiological surveys also were performed in 1959, 1966, 1974, 1982, and 1990.

### **Meteorological Monitoring**

In 1948, a U.S. Weather Bureau Research Station was established at the INL Site. The station was used to develop a basic understanding of the regional meteorology and climate, with a specific focus on protecting the health and safety of Site workers and nearby residents. The first meteorological monitoring site was installed at the Central Facilities Area in 1949. During the 1950s, a small network of meteorological monitoring sites was deployed. To understand the complex wind flows in the area, the station developed innovative technologies that went beyond basic tower measurements. These included special balloons (called tetrons) that were tracked by radar and the use of tracer chemicals to track the movement of air parcels over time.

During the 1960s, the meteorological network was expanded at the INL Site. The more frequent, closely spaced data available from this network allowed local researchers to develop one of the earliest puff dispersion models. Such models are now commonly used worldwide for regulatory and emergency response applications. The Weather Bureau underwent reorganizations over time, and meteorological activities now fall under NOAA. The original Research Station at the INL Site is now the Field Research Division of the NOAA Air Resources Laboratory.

The NOAA/INL meteorological tower network (called the NOAA/INL Mesonet) has been upgraded several times since the 1960s, with the most significant modernization and consolidation

occurring in the early 1990s. At that time, most of the towers were replaced, and the towers off the INL Site, which the DOE-ID management and operating contractor had previously operated, were integrated into the NOAA system. Although components have been upgraded since then, the basic Mesonet configuration and data reporting have remained largely unchanged since the 1990s modernization.

## Soil Monitoring

Soil sampling has been part of the routine monitoring program since the early 1970s, although some soil was collected around various facilities as far back as 1960. Soil was sampled at distant and boundary locations off the INL Site annually from 1970 to 1975. The collection interval was extended to every two years starting in 1978. Soil samples in 1970, 1971, and 1973 represented a composite of five cores of soil 5 cm (2 in.) in depth from an approximately 0.9-m<sup>2</sup> (10-ft<sup>2</sup>) area. In all other years, the five cores were collected from two depths, 0 – 5 cm (0 – 2 in.) and 5 – 10 cm (2 – 4 in.), within a 100-m<sup>2</sup> (~1,076-ft<sup>2</sup>) area.

Soil sampling around INL Site facilities began in 1973. Soils at each facility were sampled every seven years. ESER personnel have collected soil samples on a biennial basis, primarily outside the INL Site boundary, since 2001.

The INL contractor began in situ analyses of gamma-emitting radionuclides in surface soils primarily within the INL Site in 2001, using a field-based gamma spectroscopy system. A reassessment of the INL soil analysis task was conducted in 2016. Based on the results, the INL contractor currently completes soil sampling on a five year rotation at the INL Site.

The Idaho Cleanup Project Core contractor collects soil samples at the Radioactive Waste Management Complex on a triennial basis.

## Water Monitoring

The U.S. Geological Survey has studied groundwater at the INL Site since its inception in 1949. The U.S. Geological Survey initially was assigned to characterize area water resources. They have since maintained a groundwater quality and water level measurement program to support research and monitor the movement of radioactive and chemical constituents in the Eastern Snake River Plain Aquifer. The first well, USGS 1, was completed and monitored in December 1949. The U.S. Geological Survey has maintained an INL Project Office since 1959 (Knobel et al. 2005). The U.S. Geological Survey released a report documenting their monitoring programs from 1949 to 2001 (Knobel et al. 2005).

In 1993, DOE-ID initiated integrating all the groundwater monitoring programs at the INL Site. This resulted in the development of the Sitewide Groundwater Monitoring Plan (DOE-ID 1993a) and the *Groundwater Protection Management Plan* (DOE-ID 1993b). The Groundwater Monitoring Plan describes historical conditions and monitoring programs and includes an implementation plan for each facility. The *Groundwater Protection Management Plan* establishes policy and identifies programmatic requirements.

Sampling and analysis of drinking water both on and off the INL Site began in 1958. Analysis for tritium began in 1961. Up to 28 locations were sampled until knowledge of groundwater movement beneath the INL Site increased and, as a result, the number of sampling locations decreased. In 1988, a central drinking water program was established. The Drinking Water Program was established to monitor drinking water and the production wells that supply drinking water; these are multiple-use wells for industrial use, fire safety, and drinking water. Drinking water is monitored to ensure it is safe for consumption and to demonstrate that it meets federal and state regulations. The Idaho Rules for Public Drinking Water Systems (IDAPA 58.01.08) and the federal Safe Drinking Water Act (42 USC § 300f – 300j-26) establish requirements for the Drinking Water Program.

The Environmental Surveillance, Education, and Research contractor began sampling drinking and surface water in 1994 (except from May 2007 to November 2010). They also sample the Big Lost River during years when it is flowing through the INL.



## References

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