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Los Alamos NATIONAL LABORATORY

Dual-Axis Radiographic Hydrodynamic Test Facility Mitigation Action Plan Annual Report for Fiscal Year 2025

Los Alamos
NATIONAL LABORATORY

National Nuclear Security Administration

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Executive Summary

In fiscal year (FY) 2025, the majority of radionuclides, inorganic elements, dioxins, and furans in soil and sediment collected from around the perimeter of the Dual-Axis Radiographic Hydrodynamic Test (DARHT) Facility at Los Alamos National Laboratory were either not detected—similar to baseline statistical reference level (mean plus three standard deviations of chemicals in soil or sediment during the DARHT Facility pre-operations monitoring phase)—or below ecological screening levels that are protective of biota. No high explosives were detected in soil and sediment samples.

In 2025, the majority of per- and polyfluoroalkyl substances (PFAS) chemicals detections in soil and sediment was observed on the south and eastern sides of the DARHT Facility. Some concentrations of PFAS chemicals near the DARHT Facility in 2025 exceeded their regional statistical reference levels (mean plus three standard deviations of chemicals in soil samples collected at regional background locations); however, most were below available ecological screening levels. The majority of concentrations of PFAS chemicals observed here is within the range of global observations of concentrations in soil collected from nonpolluted sites.

Radionuclides, inorganic elements, and organic chemicals were assessed in honey collected from a bee hive located northeast of the DARHT Facility. No radionuclides, dioxins, or furans were detected. The majority of inorganic elements was not detected; five inorganic elements that were detected also exceeded the regional statistical reference levels. Two PFAS compounds commonly observed in the environment were observed in the honey sample. Both compounds were detected above the regional statistical reference level; however, the concentrations overall are very low, do not indicate point-source contamination, and are not of ecological concern. Two nonviable avian egg samples were also collected and analyzed for PFAS compounds. Both egg samples contained detectable PFAS, but all concentrations were below the regional statistical reference levels.

In FY 2025, radionuclide and chemical levels were not detected at concentrations detrimental to human health or the environment; however, measurable amounts of depleted uranium were detected in the soil and sediment. Historically, depleted uranium levels in all media increased over time until 2006, then decreased in 2007. The changes in these levels could correspond to the success of employing steel containment vessels. Uranium can linger in soils for some time; therefore, monitoring of these media will continue until the concentrations are similar to baseline statistical reference levels. Overall, foam mitigation has significantly reduced the amount of blast residues released into the environment compared with open-air detonations, and the use of steel containment vessels further reduced those amounts over foam mitigation.

1 Introduction

This “Mitigation Action Plan Annual Report” (MAPAR) was prepared by the U.S. Department of Energy (DOE)/National Nuclear Security Administration (NNSA) as part of implementing the “Dual-Axis Radiographic Hydrodynamic Test Facility Final Environmental Impact Statement Mitigation Action Plan” (MAP; DOE 1996). This MAPAR provides status on specific Dual-Axis Radiographic Hydrodynamic Test (DARHT) Facility operations–related mitigation actions implemented to fulfill DOE commitments under the DARHT Environmental Impact Statement (EIS) Record of Decision (ROD; DOE 1995), the DARHT MAP (DOE 1996), and the “2008 Site-Wide Environmental Impact Statement” (SWEIS) MAP (DOE 2008).

In January 2009, the SWEIS MAP was finalized; it includes outstanding 1999 SWEIS MAP commitments, all continuing mitigations from National Environmental Policy Act (NEPA) decisions made since the 1999 SWEIS, and those made in the September 2008 and June 2009 SWEIS RODs. Although no new commitments were identified for DARHT, some of the earlier commitments were completed; for example, the need to continue the archaeological monitoring of Nake’muu Pueblo, which is the only ancestral pueblo at Los Alamos National Laboratory (LANL) that has retained its original standing walls.

The DOE/NNSA Los Alamos Field Office (Field Office) is responsible for implementing the DARHT MAP, which is now included in the 2008 SWEIS MAP. In June 2004, DOE provided stakeholders with the first MAPAR, complete with the full scope of commitments and action plans implemented under the DARHT MAP during fiscal year (FY) 2003.

This MAPAR reports on the full scope of actions implemented during FY 2025 (October 1, 2024, through September 30, 2025) and represents the 21st year of DARHT Facility operations-related mitigation measures and action plans. All construction-related mitigation measures and action plans were completed during FY 1999 (LANL 1999).

1.2 Background

DOE issued the final EIS on the DARHT Facility (DOE/EIS-0228) at LANL in August 1995 and published the ROD in the Federal Register (60 FR 53588) on October 16, 1995. The DARHT MAP is being implemented consistent with DOE regulations under the NEPA, as stated in DOE’s Final Rule and Notice for Implementing NEPA (Title 10 Code of Federal Regulations [CFR] 1021, Section 331(a), revised July 9, 1996).

The ROD on the DARHT Final EIS states that DOE decided to complete and operate the DARHT Facility at LANL while implementing a program to conduct most tests inside steel containment vessels, with containment to be phased in over 10 years (the Phased Containment option of the Enhanced Containment alternative). In general, open-air detonations occurred from 2000 to 2002, and detonations within a foam medium occurred from 2003 to 2006. A containment vessel qualification shot was conducted at the Technical Area (TA) 39 Firing Point 6 in 2006, and shots within steel containment vessels at the DARHT Facility occurred in May 2007 through present day. In April 2020, the DARHT weather enclosure was completed. The new structure encloses the DARHT firing point, thereby protecting equipment while also creating a predictable environment for experimentation. The DARHT weather enclosure also creates another barrier to protect soil, water, and biological and cultural resources that could be affected by DARHT operations.

The ROD further states that DOE will develop and implement several mitigation measures to protect soil, water, and biological and cultural resources potentially affected by the DARHT Facility construction and operation (DOE 1995). In addition, DOE agreed to an ongoing consultation process with affected American Indian Tribes to ensure protection of resources of cultural, historic, or religious importance to the Tribes. As discussed in Section 5.11, Volume 1, of the DARHT Final EIS, DOE also committed to taking special precautions to protect the Mexican spotted owl (*Strix occidentalis lucida*) by preparing and implementing a LANL-wide habitat management plan (Hathcock, Keller, and Thompson 2017) for all threatened and endangered species. The DARHT MAP describes those commitments in detail (DOE 1996).

In December 1995, LANL biologists completed a biological assessment (BA) and a floodplain/wetland assessment for the DARHT Facility in compliance with the Endangered Species Act of 1973 (Keller and Risberg 1995) and 10 CFR 1022, Compliance with Floodplain and Wetland Environmental Review Requirements, respectively. The BA includes mitigation measures expected to prevent any likely adverse effect to any threatened or endangered species or modification to critical habitat. The mitigation measures identified in the BA were the basis for U.S. Fish and Wildlife Service concurrence with a finding of "may affect, but not likely to adversely affect" and have been used as the basis for establishing mitigation commitments and action plans. Through implementation of the DARHT MAP, these BA mitigation measures have established some of the guidelines under which the DARHT Facility was constructed and will be operated to mitigate the identified potential impacts.

1.3 MAP Function and Organization

The functions of the DARHT MAP are to

- document potentially adverse environmental impacts of the Phased Containment option delineated in the final DARHT EIS,
- identify commitments made in the Final EIS and ROD to mitigate those potential impacts, and
- establish action plans to carry out each commitment (DOE 1996).

The DARHT MAP is divided into eight sections: Sections I through V provide background information regarding the NEPA review of the DARHT Facility project and an introduction to the associated MAP. Section VI references the Mitigation Action Summary Table, which summarizes the potential impacts and mitigation measures; indicates the type of mitigation (design, construction, or operations); summarizes the organization responsible for the mitigation measure; and summarizes the projected or actual completion date for each mitigation measure. Sections VII and VIII discuss the MAPAR commitment and the potential impacts, commitments, and action plans.

Under Section VIII, potential impacts are categorized into the following five areas of concern:

- general environment, including impacts to air and water;
- soil, especially impacts that affect soil loss and contamination;
- biological resources, especially impacts that affect threatened and endangered species;
- cultural/paleontological resources, especially impacts that affect the archaeological site known as Nake'muu Pueblo; and

- human health and safety, especially impacts that pertain to noise and radiation.

Each category includes a brief statement of the nature of the impact and its potential cause(s). The commitment made to mitigate the potential impact is identified. The action plan for each commitment is described in detail, including a description of actions to be taken, pertinent time frames for the actions, verification of mitigation activities, and identification of agencies/organizations responsible for satisfying the requirements of the commitment.

1.4 MAP Duration and Closeout

The DARHT MAP will be implemented for the anticipated operational life (approximately 30 years) of the DARHT Facility (DOE 1996). Within the DARHT MAP, each DOE commitment and action plan specifies a time frame, verification strategy, and responsible agency or organization. The MAP also includes a summary of mitigation actions that identifies the projected or actual period of mitigation action completion. Each mitigation action time frame correlates with one or more of the following DARHT Facility project stages: design, construction, and operations. This information generally refers to when an individual action will be initiated and completed. All construction-related mitigation measures were completed during FY 1999 (LANL 1999).

1.5 DARHT Facility Schedule and Status

The court-ordered injunction on DARHT Facility construction was lifted on April 16, 1996, and DOE authorized resumption of construction activities on April 26, 1996. The DARHT Facility construction contractor was fully mobilized on August 23, 1996, and full-scale construction was authorized and began on September 30, 1996. In July 1999, with the appropriate DOE authorization, the DARHT Project Office initiated DARHT Facility operations.

During the late summer of 2000, two high-explosive shots using 16 pounds of 2,4,6-trinitrotoluene were performed. The purpose of these two experiments was to acquire accelerometer data on the building at the Nake'muu Pueblo archaeological site. In the late fall of 2000, the first major hydrotest was performed, fragment mitigation measures were in place, and post-shot cleanup was conducted to minimize the release of contaminants to the environment.

In the summer of 2001, one major system checkout experiment and three major hydrotests were performed. Fragment mitigation measures were in place, and post-shot cleanup was conducted to minimize the release of contaminants to the environment. Each of the four experiments returned state-of-the-art quantitative radiographic information. The final three hydrotests illuminated the complex hydrodynamics of stockpiled system mockups.

In the fall of 2002, hydrotesting continued, with two major experiments that again returned state-of-the-art quantitative radiographic information of stockpiled system mockups. Fragment mitigation measures were in place, and post-shot cleanup operations were conducted. An aqueous-foam containment method of particulate containment and blast mitigation was tested at another firing site for implementation at the DARHT Facility.

In 2003, the construction of the Vessel Preparation Building (VPB) was completed. One hydrotest was conducted in the fall of 2003, returning state-of-the-art quantitative radiographic information of a stockpile system mockup. This experiment was the initial implementation of aqueous-foam mitigation for a hydrotest experiment at the DARHT Facility. The aqueous-foam mitigation method achieved at least a 5 percent reduction in material released to the open air, as prescribed for Phase I of the Phased Containment option. Steel plates and concrete replaced surface gravel at the firing pad to enhance cleanup activities following the experiments.

Two major hydrotests were conducted during FY 2004. Aqueous-foam particulate mitigation was implemented during these experiments to moderate blast effects. One of these experiments was the first foam-mitigated experiment to use a new fabric tent configuration for containing the foam during these experiments.

Hydrotesting continued during FY 2005, with three major hydrotest experiments. To mitigate blast effects, fragmentation, and aqueous-foam particulate, the fabric tent configuration was again employed.

During FY 2006, hydrotesting continued, with three major hydrotest experiments. Aqueous-foam particulate mitigation using a fabric tent configuration for containing the foam was again implemented during these experiments to mitigate blast effects. The VPB underwent a Phase II readiness review during FY 2006 and was approved to begin operations, including the staging, preparation, and decontamination of containment vessels.

During FY 2007 through current day, single-walled steel containment vessels were used for all hydrotest experiments to mitigate the fragments and particulate emissions associated with the experiments. These steel containment vessels achieved at least a 40 percent reduction in material released to the open air, as prescribed for Phase II of the Phased Containment option. The steel vessels were transported to the VPB, where they were decontaminated and prepared for the next experiment. Since 2007, hydrodynamic test shots have been conducted within steel containment vessels at DARHT. In addition, detonations have been conducted within a closed, steel containment vessel and inside a weather enclosure since 2021.

2 MAP Implementation

The DARHT MAP is implemented on an annual basis through the yearly monitoring of soil, water, and biological and cultural resources; the results are published in the annual DARHT MAPAR (this document). The DARHT MAPAR is published in coordination with the federal fiscal year cycle. Typically, the information provided in the DARHT MAPAR is compiled from the previous fiscal year cycle.

The function of the MAPAR is to fulfill DOE’s commitment to the stakeholders to report the general status and critical information regarding activities associated with implementation of the DARHT MAP. The MAPAR reflects new information or changed project and environmental circumstances and changes in mitigation actions or changes to the MAP. To ensure that the public has full access to this information, the DARHT MAPAR is published each year for the continued operations at LANL and is available in LANL’s electronic public reading room.

The organization of the MAPAR is intended to provide the reader with a clear understanding of the scope and status of mitigation actions implemented under the DARHT MAP.

3 DARHT MAP Scope, Schedule, and Status

This FY 2025 MAPAR documents the scope and results of mitigation action tasks implemented throughout FY 2025. Table 3-1 provides a summary of the scope of potential impacts and commitments addressed in this MAPAR.

Table 3-1. FY 2025 MAPAR potential impacts and commitments addressed

DARHT MAP Potential Impacts/Commitments	DARHT Phase	MAPAR Section
A. General Environment		
1. Contamination of the environment surrounding DARHT Facility with radioactive or hazardous materials: Commitments (b–e)	Operations	3.1
2. Contamination of the environment with various types of wastes as a result of cleaning out the containment vessels		
3. Contamination of the environment with various types of hazardous materials as a result of spills within the DARHT Facility		
4. Contamination of the environment with hazardous levels of various substances as a result of discharges of contaminated water from the DARHT Facility		
B. Soil		
1. Loss of soil and vegetation could occur during construction and operation of the DARHT Facility as a result of severe stormwater runoff: Commitments (a–c).	Operations	3.2
2. Soil erosion and damage to plants caused by additional construction and operations activities, especially off-road and groundbreaking activities: Commitments (a–e)		
C. Biological Resources		
1. DARHT Facility construction and operations could impact threatened and endangered species as a result of impacts from firings and other operations and activities at the firing sites: Commitments (b–d).	Operations	3.3
2. DARHT Facility construction and operation could impact the Mexican spotted owl (*Strix occidentalis lucida*) as a result of noise from firings and other operations, as well as other activities at the firing sites: Commitments (n–x).		
3. DARHT Facility construction and operation could impact the American peregrine falcon (*Falco peregrinus anatum*) as a result of noise from firings and other operations, as well as other activities at the firing sites: Commitments (a, b).		
4. DARHT Facility construction and operation could impact the northern goshawk (*Accipiter gentilis*) as a result of noise from firings and other operations, as well as other activities at the firing sites: Commitments (a–c).	Operations	3.3
5. DARHT Facility construction and operation could impact the spotted bat (*Euderma maculatum*) as a result of noise from firings and other operations, as well as other activities at the firing sites.		

DARHT MAP Potential Impacts/Commitments	DARHT Phase	MAPAR Section
6. DARHT Facility construction and operation could impact the New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) as a result of noise from firings and other operations, as well as activities at the firing sites.		
7. DARHT Facility construction and operation could impact the Jemez Mountains salamander (*Plethodon neomexicanus*) as a result of noise from firings and other operations, as well as other activities at the firing sites: Commitments (a, b).		
8. DARHT Facility construction and operation could impact the bald eagle (*Haliaeetus leucocephalus*) as a result of noise from firings and other operations, as well as other activities at the firing sites: Commitments (a, b).		
9. DARHT Facility construction and operation could impact the Townsend's big-eared bat (*Corynorhinus townsendii*) as a result of noise from firings and other operations, as well as other activities at the firing sites: Commitments (a, b).		
10. DARHT Facility construction and operation could impact the wood lily (*Lilium philadelphicum* var. *andinum*) as a result of firings and other operations, as well as other activities at the firing sites: Commitments (a, b).		
D. Cultural/Paleontological Resources		
1. Blast effects, such as shock waves and flying debris, from shots using high-explosive charges could affect nearby archaeological sites, especially Nake'muu Pueblo, and the immediately surrounding environment: Commitments (b, e–g). (See MAP Section VIII.D.1(e) for update.	Operations	3.4
2. Structural or other damage to as-yet-unknown Native American cultural resources within the area of potential effects for the DARHT Facility site. Damage could occur as a result of DOE's lack of knowledge of these resources in the DARHT Facility area: Commitments (a, b).	Construction/ Operations	
E. Human Health and Safety		
1. Adverse health effects on workers and the general public from high noise levels associated with the DARHT Facility, especially construction and test firings: Commitment (a)	Construction/ Operations	3.5
2. Adverse health effects on workers from radiation from DARHT Facility operations: Commitments (a–c)	Operations	

3.2 Mitigation Actions for the General Environment

3.2.1 *Summary of Potential Impacts*

MAP Section VIII.A.1(b–e)

The DARHT MAP identifies the potential for hazardous and radioactive materials to be released to the general environment surrounding the DARHT Facility. Hazardous and radioactive materials could be released to the general environment through the following mechanisms:

- a structural failure of containment vessels,

- release of various types of waste as a result of cleaning out the containment vessels,
- release of various hazardous materials as a result of spills within the DARHT Facility, and
- release of hazardous levels of various substances as a result of discharges of contaminated water from the DARHT Facility.

3.2.2 *Mitigation Action Scope*

The operational mitigation actions (MAP Section VIII.A.1 (b–e) associated with these potential impacts are as follows:

(b) Environmental Protection and Compliance-Environmental Stewardship (EPC-ES) will monitor potential contaminants once per year by sampling soil and sediment and at least one biota such as vegetation, mammals, birds, and/or honey or honey bees (*Api mellifera*) at baseline locations and, following the start of operations, within the potential impact area of DARHT. Note: Starting in FY 2014, soil plus one biota component (on a rotating basis) will be collected in accordance with the MAP.

(c) Other site monitoring and evaluation will consist of periodic soil, water, and other environmental analyses for solid, hazardous, mixed, and radioactive wastes should spills or other unplanned events occur.

(d) Double- and single-walled steel containment vessels will be used appropriately.

(e) Vessels will be decontaminated.

3.2.3 *Status*

MAP Section VIII.A.1(b)

Since 1996, soil, sediment, vegetation, honey bees, and small mammal samples have been collected from around the DARHT Facility and analyzed during the construction phase (1996–1999) for baseline conditions. The four years of DARHT sample results are summarized in a composite report (Nyhan et al. 2001) and were used to calculate baseline statistical reference levels—the concentrations of radionuclides and other chemicals (mean plus 3 standard deviations = 99% confidence level) around the DARHT Facility before the startup of operations, according to the DARHT MAP (DOE 1996). Baselines for potential contaminants, populations, and species diversity in birds were developed at a later date (Fresquez, Hathcock, and Keller 2007). Bird abundance and diversity were not negatively impacted at DARHT Facility based on long-term data (Keller et al. 2015). Avian population monitoring was replaced with avian nest-box monitoring in 2014. Yearly avian breeding surveys around the DARHT Facility started in 2017 and are conducted three times throughout the summer months each year (May through July).

During FY 2000, operations-phase environmental monitoring was initiated by collecting a suite of samples like those collected during the construction phase. Future monitoring of environmental media will continue by documenting accumulations of constituents in environmental media to assess the cumulative impact.

Monitored constituents in soil and sediment include radionuclides, beryllium (and other metals), and organic chemicals such as high explosives, dioxins, and furans. In 2020, monitoring for PFAS in environmental media began. Routine biological samples collected around DARHT have included overstory branches and leaves, small mammals, honey bees and honey, and nonviable bird eggs and nestlings that have died due to natural causes. Samples of soil, sediment, and one type of biota are collected annually. Vegetation, small mammals, and honey are rotated annually so that each sample type is collected once during a 3-year period. Bird samples are collected opportunistically when abandoned or when nonviable eggs or deceased nestlings are found in local nest boxes.

In 2025, soil, sediment, honey, and bird egg samples were collected around the perimeter of the DARHT Facility (Figure 3-1). For soil samples, we collect five surface soil subsamples at a depth from 0 to 2 inches and mix them to prepare a composite soil sample at each location. The soil samples were collected in April 2025 on the north, east, south, and west sides of the DARHT Facility perimeter along the fence line. An additional composite soil sample was collected about 75 feet north of the firing point along the side of the protective berm. We collected sediment grab samples in April 2025 at depths from 0 to 6 inches on the north, east, south, and southwest sides within drainages around the facility. All soil and sediment samples were analyzed for the following:

- the radionuclides americium-241, cesium-137, plutonium-238, plutonium-239/240, strontium-90, tritium, uranium-234, uranium-235/236, and uranium-238;
- inorganic elements including aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc;
- PFAS compounds; and
- high explosives.

In addition, a duplicate sample nearest to the firing point was also analyzed for dioxins and furans.

In June 2025, we collected one honey sample from the beehive located northeast of the DARHT Facility (Figure 3-1); it was analyzed for radionuclides, inorganic elements, PFAS, and dioxin and furan congener analyses. In July 2025, we collected western bluebird (*Sialia mexicana*) eggs that did not hatch from a nest box and an abandoned nest near the DARHT Facility and analyzed them for PFAS compounds.

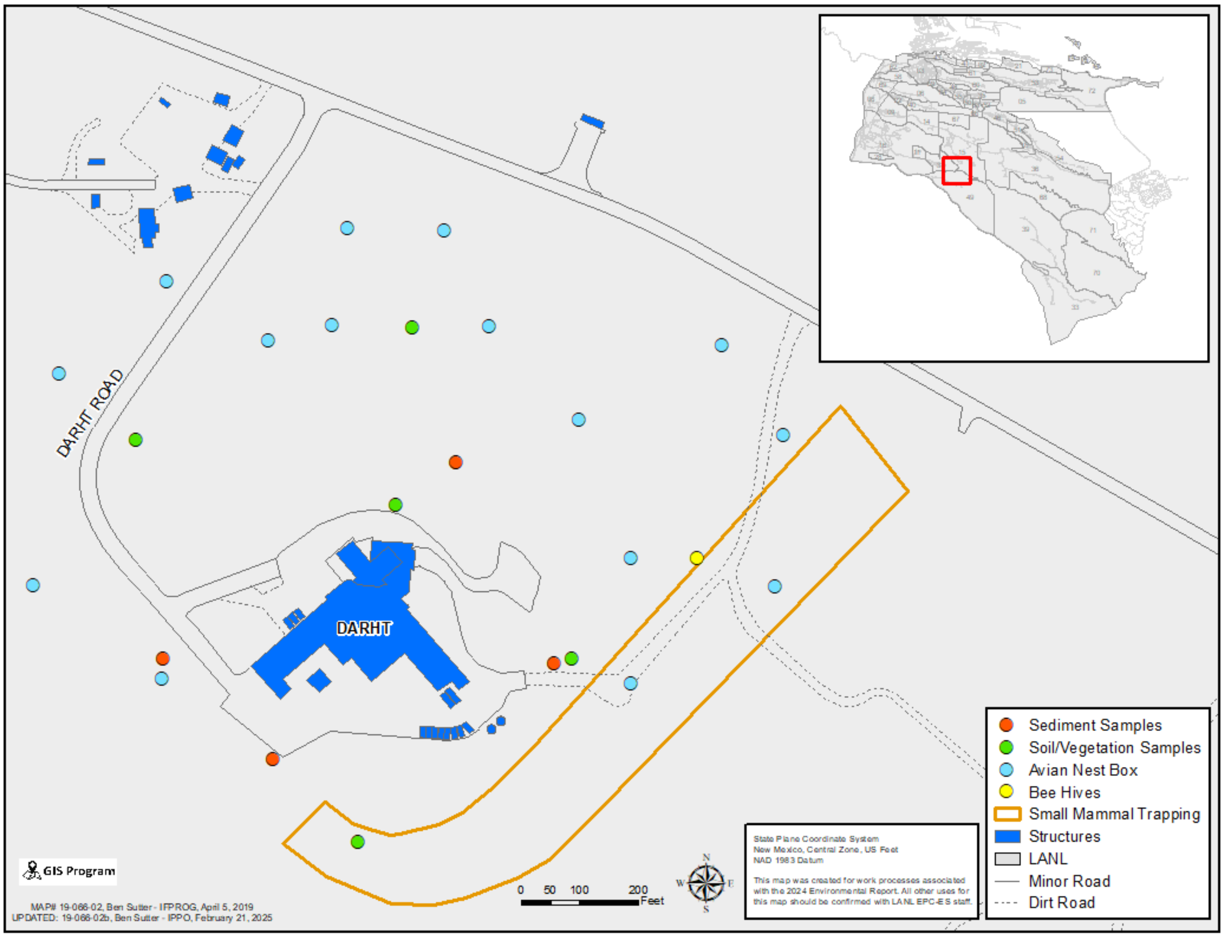

Figure 3-1. Soil, sediment, and biological sample locations at the DARHT Facility.

Constituent results in soil and sediment samples are compared with the baseline statistical reference levels. The baseline statistical reference levels for the DARHT Facility are based on samples collected at the facility from 1996 to 1999, before the beginning of firing-site operations. The baseline level for each constituent is the precise level below which 99 percent of samples from this time occurred (Nyhan et al. 2001). All constituents in soil and biota are compared with regional statistical reference levels. Soil results are compared with ecological screening levels (Intellus 2024), which are protective of biota, and with New Mexico Environmental Department soil screening levels, which are protective of human health.

3.2.4 *Soil and Sediment Radionuclide Results*

The 2025 soil and sediment results at the DARHT Facility are summarized as follows (also see Table A-1 in Appendix A:):

- Soil and sediment samples did not contain detectable levels of americium-241, plutonium-238, plutonium-239/240, or strontium-90.
- One soil sample contained cesium-137 that was above the baseline statistical reference level, and one sample from the firing site contained tritium that was above the baseline statistical reference level and the regional statistical reference level.

- Some samples had levels of uranium isotopes above the baseline statistical reference levels.
- Concentrations of all radionuclides were far below all ecological screening levels in soil.

In 2025, soil and sediment samples did not contain detectable levels of americium-241, plutonium-238, plutonium-239/240, or strontium-90 (Table A-1). In the duplicate soil sample collected at the firing site, one sample did not contain tritium, whereas the other contained 15.0 pCi/g, which exceeded both the baseline statistical reference level and the regional statistical reference level (Table A-1). Cesium-137 was detected at 0.408 pCi/g in soil on the north side of the DARHT Facility. This sample exceeded the baseline statistical reference level; however, the level was below the regional statistical reference level (Table A-1). The activities of detected radionuclides are far below all ecological screening levels (Table A-1).

Soil and sediment samples contained all three isotopes of uranium. This observation is consistent with previous years. Several samples contained activities of uranium that were higher than the regional statistical reference levels and the baseline statistical reference levels. The relative isotopic abundance of uranium-234, uranium-235, and uranium-238 activities indicates that the uranium in these samples is depleted uranium from testing activities rather than natural uranium (NRC 2019). The levels of uranium are far below all ecological screening levels (Table A-1, Intellus 2024).

Operations at the DARHT Facility have changed since 2007 to include the use of closed-containment vessels. Since 2008, uranium-238 activity near the firing point has mostly been similar to the baseline statistical reference level (see Figure 3-2). Uranium-238 in sediment on the north side is increasing over time (Kendall's Tau, $p < 0.05$). No other radionuclides in soil and sediment samples collected around the DARHT Facility are increasing over time (Kendall's Tau, $p > 0.05$). Trend analyses were not performed on uranium-235/236; see Chapter 7, Analytical Laboratory Quality Assessment, of the 2024 Annual Site Environmental Report for more information (LANL 2025).

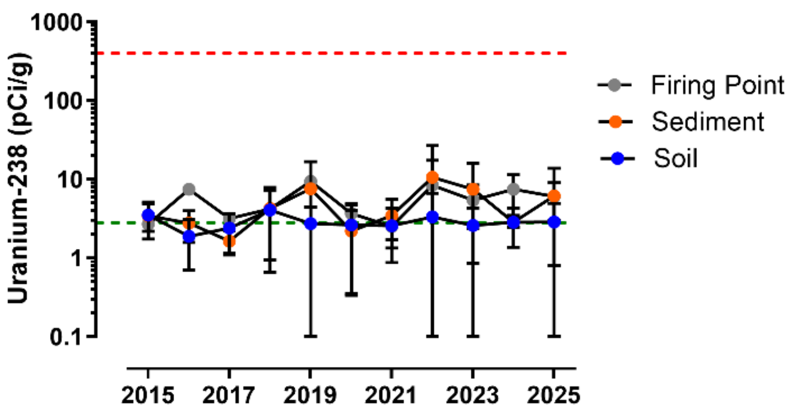

Figure 3-2. Uranium-238 activities in surface soil and sediment samples collected around the DARHT Facility and in the firing point soil sample from 2015 to 2025 compared with the baseline statistical reference level (mean plus three standard deviations of soil uranium-238 pre-operations; green dashed line) and the lowest no-effect ecological screening level (red dashed line). Note the logarithmic scale on the vertical axis. Points represent true values (firing point 2015–2019) or represent means (sediment and soil samples and the firing point 2020–2025), and error bars represent standard deviation. Bottom error bars are absent on some uranium-238 points because the error would have been a negative value; however, negative values cannot be shown on a logarithmic axis.

3.2.5 Soil and Sediment Inorganic Element Results

The 2025 soil and sediment inorganic element results at the DARHT Facility are summarized as follows (see Table A-2):

- Most inorganic elements were observed at detectable concentrations in all soil and sediment samples collected in 2025.
- Concentrations of most inorganic elements (aluminum, antimony, arsenic, beryllium, cadmium, calcium, chromium, cobalt, iron, magnesium, nickel, and potassium) were below all reference and screening levels.
- Like previous years, concentrations of nine inorganic elements (barium, copper, lead, manganese, mercury, selenium, thallium, vanadium, and zinc) exceeded the no-effect ecological soil screening level for plant, montane shrew (*Sorex monticolus*), or American robin (*Turdus migratorius*). Concentrations of selenium and vanadium also exceeded the low-effect soil ecological screening level for the montane shrew and American robin, respectively.
- The number of locations with concentrations potentially associated with adverse effects at an individual level are minimal, and no impacts to populations or communities of plants and animals are expected.

Consistent with observations in previous years, some soil and sediment samples contained concentrations of barium, copper, lead, manganese, mercury, selenium, thallium, vanadium, and zinc that exceeded the no-effect ecological soil screening level for plant, montane shrew, or American robin (see Table 3-2 and Table A-2). The regional statistical reference level of these elements (except for copper) is also above the no-effect ecological soil screening level. All concentrations of barium, manganese, mercury, thallium, and vanadium were below the regional statistical reference levels and the baseline statistical reference levels (when available). All detectable inorganic elements in soil and sediment collected around the DARHT Facility are below the New Mexico Environment Department soil screening levels for residential, industrial, and construction uses (Table A-2; NMED 2021).

Table 3-2. Percent of soil and sediment samples from the DARHT Facility in 2025 (n = 10) that exceeded an inorganic element screening level or reference level or that had an increasing trend over time and the location(s) of the sample(s)

Inorganic element	Exceedance				Percent of locations with increasing trend over time	Locations of exceedance and/or increasing trend
	No-effect ecological screening level[a]	Low-effect ecological screening level[b]	Baseline statistical reference level	Regional statistical reference level		
Barium	30%	0%	0%	0%	0%	Soil – W and N side; Sediment – SW side
Cadmium	0%	0%	–	0%	11%	Soil – W side
Calcium	–	–	–	0%	11%	Soil – firing point
Copper	10%	0%	–	10%	–	Sediment – E side
Lead	10%	0%	10%	0%	0%	Soil – N side
Manganese	60%	0%	–	0%	0%	Sediment – S and SW sides; Soil – N, E, S, and W sides
Mercury	60%	0%	0%	0%	0%	Sediment – S and E sides; Soil – N, W, E, and S sides

Inorganic element	Exceedance				Percent of locations with increasing trend over time	Locations of exceedance and/or increasing trend
	No-effect ecological screening level[a]	Low-effect ecological screening level[b]	Baseline statistical reference level	Regional statistical reference level		
Selenium	100%	100%	–	30%	0%	All
Silver	0%	0%	0%	10%	0%	Soil – firing point
Sodium	–	–	–	20%	11%	Sediment – E and S side;
Thallium	30%	0%	0%	0%	11%	Sediment – SW and E side; Soil – N and W sides
Vanadium	100%	100%	–	0%	11%	All
Zinc	30%	0%	–	30%	11%	Sediment – SW and E sides; Soil – W side

[a] Plant, montane shrew, or American robin
[b] Montane shrew or American robin
A dash (–) indicates that no ecological screening level or baseline statistical reference level is available.
N = north, W = west, E = east, S = south, and SW = southwest

Consistent with previous years, sodium concentrations are increasing over time in sediment samples collected from the east side (Kendall's Tau, $p < 0.05$). Zinc continues to increase over time in sediment collected from the southwest side of the DARHT Facility (Kendall's Tau, $p < 0.05$). Additional increases observed in 2025 include thallium in the sediment sample collected from the east side, vanadium in the soil sample collected from the south side, cadmium in the soil sample collected from the west side, and calcium in the soil sample collected from the firing site (Kendall's Tau, $p < 0.05$, Table 3-2). Some of these results are consistent with observations in previous years, and these trends will continue to be monitored in future sampling. To eliminate bias, trend analyses were conducted only on elements where the analytical method (inductively coupled plasma-optical emission spectrometry [ICP-OES] and inductively coupled plasma-mass spectrometry [ICP-MS]) is consistent over the time period of interest (e.g., past 10 years). Following this guidance, trend analyses on aluminum, antimony, beryllium, chromium, cobalt, copper, iron, magnesium, nickel, and silver were omitted.

Beryllium, listed as a chemical of potential concern before the start-up of operations at the facility (DOE 1995), was not detected above the regional statistical reference level (1.23 mg/kg [milligrams per kilogram]) in any of the soil or sediment samples during 2025. All beryllium concentrations observed in soil and sediment samples collected around the DARHT Facility are well below the lowest no-effect ecological screening level of 2.5 mg/kg (Table A-2). Additionally, all concentrations of beryllium in soil and sediment collected around the DARHT Facility were at least two orders of magnitude below the New Mexico Environment Department soil screening levels for residential, industrial, and construction uses (Table A-2; NMED 2021) and therefore do not trigger corrective actions.

3.2.6 *Soil and Sediment Organic Compound Results*

The 2025 soil and sediment organic compound results at the DARHT Facility are summarized as follows:

- No high explosives were detected in any of the soil or sediment samples.

- Dioxin and furan congeners that were detected at the firing point were at concentrations with toxic equivalency values orders of magnitude less than the montane shrew no-effect ecological screening level for 2,3,7,8-tetrachlorodibenzodioxin (TCDD).
- Some PFAS compounds exceeded their regional statistical reference levels; only one PFAS compound at one location was at the no-effect ecological screening level.

Like previous years, no high-explosives chemicals were detected in the soil or sediment samples collected within or around the perimeter of the DARHT Facility in 2025.

Dioxins and furans were evaluated in only the duplicate soil samples collected at the firing point. Most dioxins and furans were not detected. Like previous years, the detected dioxin and furan congeners were 1,2,3,7,8-pentachlorodibenzofuran at a concentration of 0.0000952 ng/g (nanograms per gram); 1,2,3,4,7,8-hexachlorodibenzofuran at a concentration of 0.000117 ng/g; and 1,2,3,4,6,7,8,9-octachlorodibenzodioxin at concentrations of 0.0174 ng/g.

No ecological soil screening levels exist for 1,2,3,7,8-pentachlorodibenzofuran; 1,2,3,4,7,8-hexachlorodibenzofuran; or 1,2,3,4,6,7,8,9-octachlorodibenzodioxin. However, toxic equivalent factors can be used to calculate the TCDD toxic equivalent for dioxin-like compounds. The toxic equivalent factor is 0.03 for 1,2,3,7,8-pentachlorodibenzofuran; 0.1 for 1,2,3,4,7,8-hexachlorodibenzofuran; and 0.0003 for 1,2,3,4,6,7,8,9-octachlorodibenzodioxin (Van den Berg et al. 2006). Multiplying the detectable concentrations of these congeners by their respective toxic equivalent factors yields values that are orders of magnitude less than the montane shrew no-effect ecological soil screening level for TCDD (0.00029 ng/g). Additionally, all detectable dioxins and furans in soil and sediment collected around the DARHT Facility are below the New Mexico Environment Department soil screening levels for residential, industrial, and construction uses (NMED 2021).

All locations sampled around the DARHT Facility contained detectable PFAS. Consistent with previous years, the sediment samples collected from the east and south sides of the DARHT Facility contained the greatest number of PFAS detections, with 21 compounds and 17 compounds detected, respectively (Table A-3). Soil collected from the east and south sides also contained numerous detectable PFAS compounds, with 16 and 13 compounds detected, respectively (Table A-3). The highest PFAS concentration detected was 1H,1H,2H,2H-perfluorooctane sulfonic acid at 20.0 ng/g in sediment from the east side (Table A-3).

Perfluoroactanesulfonic acid (PFOS) was the most frequently detected PFAS compound, occurring in all 10 of the soil and sediment samples with a range of 0.068 to 11.0 ng/g. Six samples exceeded the regional statistical reference level of 0.225 ng/g (Table A-3). The sediment sample on the east side, which contained PFOS at 11.0 ng/g, was at the no-effect ecological screening level for the America robin of 11 ng/g but was well below the low-effect ecological screening level for the American robin of 110 ng/g. All other concentrations were below the most sensitive ecological soil screening level for PFOS (Table A-3).

In 2025, some concentrations of PFAS compounds near the DARHT Facility exceeded their regional statistical reference levels; only one compound at one location was at the no-effect ecological screening level (Table A-3). The concentrations of some PFAS compounds observed here are within the range of global observations of concentrations in soil collected from nonpolluted sites (Brusseau et al. 2020). Additionally, all concentrations of detected PFAS compounds in soil and sediment collected around the DARHT Facility were at least two orders of magnitude below the New Mexico Environment Department soil screening levels for residential, industrial, and construction uses (Table A-3; NMED 2021) and therefore do not trigger corrective actions.

3.2.7 *Honey Results*

The 2025 honey results at the DARHT Facility are summarized as follows:

- No radionuclides, dioxins, or furans were detected in honey.
- The majority of inorganic elements were not detected; some detectable elements exceeded the regional statistical reference levels.
- Two commonly detected PFAS compounds were detected at low levels but exceeded the regional statistical reference levels.

The honey sample was analyzed for radionuclides, inorganic elements, PFAS, dioxins, and furans. No radionuclides, dioxins, or furans were detected. The majority of inorganic elements were not detected. A total of seven inorganic elements were detected in the honey sample, five of which exceeded the regional statistical reference levels (Table 3Table 3-3).

Honey bees are exposed to inorganic elements through several different sources, including soil, air (both through inhalation or matter bound to their bodies), water, and food. Metal concentrations bioavailable in pollen and nectar are influenced by the uptake of inorganic elements into plants, and plant uptake of inorganic elements can be influenced by numerous factors. Both soil properties and plant features (such as soil pH, particle size, presence of other minerals, soil microbial activity, plant taxonomy, plant morphology, and plant physiology) can influence plant uptake of constituents (Cataldo and Wildung 1978, Burger and Lichtscheidl 2019).

Honey bees can also act as biofilters and prevent the transfer of some metals into honey. Dżugan et al. observed that most metals, except for lead and aluminum, are higher in bees compared with honey (2018). Lead observed in the honey sample collected near the DARHT Facility contained lead concentrations that are comparable to lead concentrations in honey samples from rural areas in the United States (Godebo 2025). Honey bees also forage large distances and could be uptaking inorganic elements from locations outside of the DARHT Facility operational area.

These factors and interactions could explain the variability in inorganic elements concentrations in honey collected near the DARHT Facility compared with honey from background locations used to calculate the regional statistical reference levels. Furthermore, although aluminum, iron, lead, magnesium, and potassium in honey exceeded their respective regional statistical reference levels, these elements were also detected in all of the soil and sediment samples that were collected around the DARHT Facility in 2025 and were all below their respective regional statistical reference levels. The regional statistical reference level for honey is based on a small sample size of two to three honey samples (inorganic element dependent) from the same location. Further sampling of honey from the hive located near the DARHT Facility and from other background locations is needed to make robust comparisons.

Table 3-3. Inorganic element concentrations (mg/kg) detected in a honey samples collected from the beehive northeast of the DARHT Facility

Element (mg/kg)	Honey[a] SFB 25 367311	RSRL[b]
Aluminum	**160**	4.22
Copper	0.964	5.52
Iron	**43.2**	6.09
Lead	**0.261**	0.13

Magnesium	**280**	26.0
Manganese	2.73	3.70
Potassium	**874**	710

[a]A bold value indicates an element that was detected and above the regional statistical reference level.
[b]The RSRL is the upper limit background concentrations (mean + three standard deviations) for honey.

In 2025, 39 PFAS compounds were evaluated in the honey sample collected from the hive located northeast of the DARHT Facility. Perfluorobutanoic acid and perfluoropentanoic acid were the only two PFAS compounds detected. Perfluorobutanoic acid was detected at 2.2 ng/g, exceeding the regional statistical reference level of 0.22 ng/g, and perfluoropentanoic acid was detected at 0.79 ng/g, exceeding the regional statistical reference level of 0.10 ng/g. Both perfluorobutanoic acid and perfluoropentanoic acid are common PFAS compounds detected in the environment (Ghisi et al. 2019). Whereas the compounds detected in honey at the DARHT Facility exceeded the regional statistical reference levels, the concentrations overall are very low, do not indicate point-source contamination, and are not of ecological concern.

3.2.8 *Bird Egg Results*

In 2025, two nonviable western bluebird egg samples were collected near the DARHT Facility. Each sample was analyzed for 39 PFAS compounds. One egg sample contained five detectable PFAS compounds, and the other egg sample contained seven detectable PFAS compounds. All detectable PFAS concentrations in the avian eggs were below the regional statistical reference levels. See Stanek et al. 2026 for the full report.

3.3 Summary

Overall, monitoring results of these different types of environmental media around DARHT suggest that most constituents are similar to pre-operation or background levels, are below levels associated with adverse effects, and are not of ecological concern. However, because some constituents are increasing over time and uranium isotopes are often detected above background (and PFAS chemicals are being monitored and detected), continual monitoring is recommended.

MAP Section VIII.A.1(c)

For routine DARHT Facility operations, the sampling and analysis methodology used in the environmental baseline monitoring conducted under MAP Section VIII.A.1(b) was designed to include environmental monitoring requirements under this mitigation action. Should the DARHT Facility experience a substantial accidental spill or release of hazardous or radioactive materials, additional environmental monitoring, as necessary, would be conducted under this mitigation action. To date, no significant spills have occurred at the DARHT Facility that have reached the environment.

MAP Section VIII.A.1(d)

In accordance with the ROD for the DARHT Final EIS, DOE was operating the DARHT Facility while implementing a program to conduct tests inside single-walled steel containment vessels with containment (current DARHT nomenclature is confinement) to be phased in over 10 years (the Phased Containment option of the Enhanced Containment alternative; DOE 1995). In general, open-air detonations occurred during 2000 to 2006, and detonations within a foam medium occurred during 2002 to 2006. A containment vessel qualification shot was conducted at TA-39 Firing Point Six in 2006, and shots within single-walled steel containment vessels at the DARHT Facility were implemented in May 2007. That same year, three hydrodynamic test shots within single-walled, steel containment vessels at the DARHT Facility were conducted. In 2008, two hydrodynamic test shots were conducted within single-walled, steel containment vessels at the DARHT Facility. These steel containment vessels achieved at least a 40 percent reduction in material released into the open air, as prescribed for Phase II of the Phased Containment option.

Measurements that used a variety of sampling methodologies (e.g., air particulates, adhesive films, surface swipes, and video analysis) at the firing point and sites downwind at various distances (50, 135, and 200 meters) during open-air and foam detonations showed that the use of foam reduced the size of a plume generated from a hydrodynamic test and the dispersal of contaminants by an average of 80 percent (Duran 2008); this result is far above the 5 percent reduction required for Phase I of the Phased Containment option.

Similarly, potential contaminant releases during foam mitigation and the use of steel containment vessels were compared using surface swipes, particulate air sampling, and monitoring of detonation gases at the vessel and around the immediate work area. The use of steel containment vessels shows an additional 20 percent reduction over foam mitigation in potential emissions of uranium and beryllium as a result of a shot. In other words, the use of steel containment vessels reduced the amount of potential contamination by 99.9 percent and was far above the 40 percent reduction in material released to the open air as required for Phase II of the Phased Containment option.

MAP Section VIII.A.1(e)

The VPB, located at TA-15 near the DARHT Facility, underwent a Phase II readiness review during FY 2006, and the facility was approved to begin operations, including the staging, preparation, and decontamination of containment vessels. The containment vessel qualification shot conducted in 2006 provided baseline data and characterization of vessel debris that resulted from hydrodynamic testing and analysis of the generated gas byproducts to aid in the disposal of future material, to provide data for personnel safety, and to aid in the development of future cleanout procedures for the containment vessels.

Containment vessel decontamination operations began in FY 2007; during FY 2008, containment vessels continued to be decontaminated on the DARHT Facility firing point. Following decontamination, the vessels were transported to the VPB and prepared for the next experiment.

3.3.2 *Summary of Potential Impacts*

MAP Section VIII.A.2

The DARHT MAP identifies the potential for contamination of the environment with various types of waste that could result from cleaning out the containment vessels.

3.3.3 *Mitigation Action Scope*

MAP Section VIII.A.2

The cleaning operations will recycle materials as much as reasonably possible and use appropriate operations processes to limit discharges of waste into the environment. Waste minimization techniques will be applied to those materials that cannot be recycled, and they will be disposed of in permitted disposal facilities.

3.3.4 *Status*

MAP Section VIII.A.2

LANL completed construction of a permanent VPB to be operated at TA-15 near the DARHT Facility. This facility is approved to stage, prepare, and decontaminate (as appropriate) the vessels used in the DARHT hydrodynamic experiments. LANL developed containment vessel cleanout processes in support of the commitment to decontaminate vessels used in experiments.

Process equipment for managing debris from vessel shots was installed in the VPB. Procedures for vessel cleanout, decontamination, and stabilization of debris from vessel shots were developed to support containment vessel experiments. Waste minimization techniques are applied during the vessel cleanout and decontamination processes. Typically, nonrecyclable materials are placed into 55-gallon drums, fixed with cement, and disposed of at an appropriate disposal facility (M. Zumbro, personal communication, Los Alamos National Laboratory, May 10, 2010).

3.3.5 *Summary of Potential Impacts*

MAP Section VIII.A.3

The DARHT MAP identifies the potential for contamination of the environment with various types of hazardous material that could result from spills within the DARHT Facility.

3.3.6 *Mitigation Action Scope*

MAP Section VIII.A.3

Spill containment (physical barriers or sills) within the DARHT Facility will be provided by engineering design to contain all hazardous material spills that could occur. Additionally, a spill prevention control and countermeasures plan will be required before facility operation begins and will be maintained for the life of the facility. Also, a spill/emergency response team and equipment will be available for deployment in the event of an accidental spill.

3.3.7 *Status*

MAP Section VIII.A.3

Spill containment (physical barriers or sills) within the DARHT Facility is in place and is maintained to contain all hazardous material spills that could occur. A spill prevention control and countermeasures plan was completed and approved before DARHT Facility operations began. This plan will be maintained for the life of the facility consistent with the requirements under the LANL Integrated Safety Management System and Environmental Protection Agency Oil Pollution Prevention Regulation 40 CFR Part 112. The DARHT Facility has not experienced a substantial accidental spill of hazardous materials. Should an accidental spill occur at the DARHT Facility, appropriate emergency actions will be taken in accordance with existing operational procedures. These emergency actions would include deployment of the LANL

Hazardous Materials Response Team—on call full time to respond to all emergency spills within the LANL site and, as needed, the LANL region.

3.3.8 *Summary of Potential Impacts*

MAP Section VIII.A.4

The DARHT MAP identifies the potential for contamination of the environment with hazardous levels of various substances that could result from discharges of industrial water from the DARHT Facility cooling tower.

3.3.9 *Mitigation Action Scope*

MAP Section VIII.A.4

Water discharged from the DARHT Facility cooling tower will be monitored to ensure compliance with outfall permits as stated in the National Pollutant Discharge Elimination System (NPDES) permit for the DARHT Facility site. Should discharge levels exceed permit limits, LANL's Environmental Protection and Compliance-Compliance Programs (EPC-CP) will act to bring the facility into compliance.

3.3.10 *Status*

MAP Section VIII.A.4

Water flow from the DARHT Facility cooling tower was routinely monitored by EPC-CP to ensure compliance with the NPDES permit. An NPDES chlorine exceedance occurred at the DARHT Facility cooling tower (Outfall 03A185) during FY 2006. The compliance sample result of >2.2 mg/L exceeded the daily maximum permit requirement of 500 µg/L (0.5 mg/L). Corrective actions were taken to get the discharge back into compliance. Since 2010, the cooling tower discharges have been tied into the LANL sanitary wastewater treatment plant at TA-46. Consequently, Outfall 03A185 was removed from LANL's NPDES permit on October 10, 2012.

3.4 Mitigation Actions for Soil

3.4.1 *Summary of Potential Impacts*

MAP Section VIII.B.1(a–c), 2(a–e)

According to the DARHT MAP, loss of soil and vegetation could occur during construction and operation of the DARHT Facility as a result of severe storms and consequent severe stormwater runoff. In addition, off-road and groundbreaking activities caused by additional construction and operational activities could result in further soil erosion and damage to plants.

3.4.2 *Mitigation Action Scope*

MAP Section VIII.B.1(a–c)

The operational mitigation actions, MAP Section VIII.B.1 (a–c), associated with these potential impacts are as follows:

(a) Adherence to all soil erosion mitigation measures in accordance with the operational Stormwater Pollution Prevention Plan (SWPPP) to ensure that erosion and sedimentation are minimized and that drainage facilities are in place to control runoff. These measures will include temporary and permanent erosion control, sedimentation control, surface restoration and revegetation, stormwater attenuation in paved and unpaved areas, routine inspection, and best management practices, which include minimization of fuel and oil spills, good housekeeping practices, and control of stored material and soil stockpiles.

(b) Modification of the SWPPP if control measures are ineffective.

(c) Establishment and continuance of erosion/sediment control best management practices. The best management practices required by the SWPPP will be continually monitored and maintained.

3.4.3 *Status*

MAP Section VIII.B.1(a)

DARHT Facility operations are conducted in full compliance with an existing SWPPP. The SWPPP has been implemented to ensure that erosion and sedimentation are minimized and that measures are in place to control runoff. The plan covers required measures for temporary and permanent erosion control, sedimentation control, surface restoration and revegetation, stormwater attenuation in paved and unpaved areas, routine inspection, and a best management practices plan, which includes minimization of fuel and oil spills, good housekeeping practices, and control of stored material and soil stockpiles. The scope, implementation, and modification of the operational SWPPP are routinely reviewed by Weapons Facilities Operations-Facilities Operations Directorate (WFO-FOD) environmental personnel and EPC-CP.

MAP Section VIII.B.1(b)

If control measures prescribed in the SWPPP are determined to be ineffective, the scope and implementation of the operational SWPPP will be modified as necessary by WFO-FOD environmental personnel and EPC-CP.

MAP Section VIII.B.1(c)

Best management practices prescribed in the SWPPP are continually monitored and maintained by DARHT Facility representatives and WFO-FOD environmental personnel. Current control measures have proven appropriate and effective. If control measures are determined to be ineffective, the scope and implementation of the SWPPP will be modified as necessary by the WFO-FOD environmental personnel and EPC-CP.

3.4.4 *Mitigation Action Scope*

MAP Section VIII.B.2(a–e)

The operational mitigation actions, MAP Section VIII.B.2(a–e), associated with these potential impacts are as follows:

(a) Workers must avoid off-road activities and stay within approved rights-of-way.

(b) Any proposed activities that require the disturbance of mature trees and shrubs must first be approved by EPC-ES to avoid disturbance to threatened and endangered species and other wildlife species.

(c) EPC-ES must be notified before any new groundbreaking activities occur. EPC-ES will review all new sites and evaluate any potential impacts associated with the action. EPC-ES will also provide mitigation to minimize potential impacts, including revegetation as addressed in the SWPPP.

(d) The size of a vegetation buffer zone between the facilities and the edge of the mesa tops will be determined by EPC-ES based on topographic aspects and vegetation composition.

(e) Native vegetation for this elevation and forest type will be planted, as appropriate, for erosion control, landscaping, and additional wildlife habitat.

3.4.5 *Status*

MAP Section VIII.B.2(a)

DARHT Facility operations are conducted according to procedures that, in part, restrict facility workers to designated areas. Access to undesignated areas of the DARHT Facility is managed according to procedures that restrict access to authorized personnel on special work assignments, such as post-shot material recovery or fire-suppression operations. All other workers must avoid off-road activities and stay within approved rights-of-way.

MAP Section VIII.B.2(b-e)

In accordance with System Description (SD) 400, *Environmental Management System*, all new and modified planning, construction, and operations activities (excluding office, business, and administrative functions) must be reviewed for requirements and needed controls for the following:

- Air quality
- Biological resources
- Cultural resources
- NEPA
- Pollution prevention, including resource conservation and sustainable practices
- Potential release sites (Solid Waste Management Units and Areas of Concern)
- Waste and materials management
- Water quality

In addition to requiring full compliance with the above, SD400 requires full and effective implementation of the LANL Habitat Management Plan (Hathcock, Keller, and Thompson 2017). EPC-ES is the Office of Institutional Coordination for SD400 and is responsible for developing, revising, and maintaining the document, as well as technically assisting in its full and effective implementation

Under the LANL Five-Year Wildland Fire Management Plan (2016–2020; Hand, Moraga, and L'Esperance 2016) and weapons facilities procedure "Vegetation and Fuels Prescription Controls Requirements for Sited High Explosives Facilities" (WFO-OP-276), defensible space that surrounds the DARHT Facility has been maintained. The DARHT Facility site defensible space activities were reviewed by EPC-ES biologists and EPC-CP stormwater subject matter experts to ensure appropriate protection (such as vegetation buffer zones and erosion control) for the Mexican spotted owl and other wildlife habitat in the area. All applicable NEPA, biological resources, and cultural resources regulatory requirements, including MAP Section VIII.B.2(b–e) for DARHT Facility operations and other facility management activities around the DARHT Facility site, are fully addressed through the ongoing implementation of SD400.

3.5 Mitigation Actions for Biological Resources

3.5.1 *Summary of Potential Impacts*

MAP Section VIII.C.1(b–d); 2(n–x); 3(a, b); 4(a–c); 5(a); 6(a); 7(a, b); 8(a, b); 9(a, b); and 10(a, b)

According to the DARHT MAP, DARHT Facility construction and operation could impact federally protected threatened and endangered species such as the Mexican spotted owl because of noise from firings, other operations, and other activities at the firing site.

3.5.2 *Mitigation Action Scope*

MAP Section VIII.C.1(b–d); 2(n–x); 3(a, b); 4(a–c); 5(a); 6(a); 7(a, b); 8(a, b); 9(a, b); and 10(a, b)

These sections of the DARHT MAP commit DOE and LANL to implementing mitigation measures selected to protect threatened, endangered, and sensitive species in the DARHT Facility area. These mitigation measures collectively require DARHT Facility representatives to continue to coordinate with EPC-ES on all DARHT Facility threatened and endangered species issues through the ongoing implementation of the LANL Habitat Management Plan. LANL biologists will conduct the necessary species monitoring and habitat protection measures required for the DARHT Facility through the Habitat Management Plan (Hathcock, Keller, and Thompson 2017).

3.5.3 *Status*

MAP Section VIII.C.1(b–d); 2(n–x); 3(a, b); 4(a–c); 5(a); 6(a); 7(a, b); 8(a, b); 9(a, b); and 10(a, b)

Since January 1999, LANL has fully implemented the habitat management plan. During FY 2000, site-wide implementation of the habitat management plan was included as part of the institutional requirements in SD400. All applicable NEPA, biological resources, and cultural resources regulatory requirements (including MAP Section VIII.C.1 [b–d]; 2 [n–x]; 3 [a, b]; 4 [a–c]; 5 [a]; 6 [a]; and 7 [a, b]) for DARHT Facility operations are addressed through the ongoing implementation of SD400. The habitat management plan was last updated in 2017. The historic nest site adjacent to DARHT is still empty, and no new Mexican spotted owls were found around the DARHT Facility during FY 2025.

3.6 Mitigation Actions for Cultural Resources

3.6.1 *Summary of Potential Impacts*

MAP Section VIII.D.1(b, e–g)

The DARHT MAP identifies potential impacts from blast effects, such as shock waves and flying debris, from shots that use high-explosives charges. These blast effects could affect nearby archaeological sites, especially Nake'muu Pueblo and the immediate surrounding environment.

3.6.2 *Mitigation Action Scope*

MAP Section VIII.D.1(b, e–g)

The operational mitigation actions, MAP Section VIII.D.1(b, e–g), associated with these potential impacts are as follows:

(b) For large high-explosives-charge experiments, temporary expendable fragment mitigation consisting of glass plates (to dissipate energy), a sandbag revetment, or other shielding material will be constructed on a case-by-case basis as necessary to mitigate blast effects.

(e) At Nake'muu Pueblo, a long-term monitoring program will be implemented using photographs or other means of recording to determine if activities at TA-15 are causing any structural changes to the cultural site over time.

(f) DOE will periodically arrange for Tribal officials to visit (at least once per year) cultural resource sites within TA-15 that are of particular interest to the Tribes. DOE is now conducting visits to cultural resource sites in TA-15, as well as Nake'muu Pueblo, when requested by Tribal officials.

(g) The DARHT Facility operator will periodically pick up metal fragments in the areas where fragments land and will invite local Tribes to participate (at least once a year) so that Tribal representatives can observe if damage has occurred to any cultural resource sites. DOE will periodically evaluate procedures/measures for mitigation. If damage is discovered, necessary changes will be implemented and reported in the MAPAR. Such changes will be implemented in consultation with the four Accord Pueblos (Cochiti, Jemez, Santa Clara, and San Ildefonso).

3.6.3 *Status*

MAP Section VIII.D.1(b)

In general, open-air detonations occurred 2000 through 2006, and detonations within foam medium and steel containment vessels occurred 2002 through 2006 and 2007 through 2008, respectively. None of the large explosive shots in 2002 or 2003 (two shots each year) required fragment mitigation for blast effects, and the employment of foam and steel containment vessels in the latter years significantly reduced the size of a plume and the dispersal of materials (Duran 2008). In 2021, detonations were performed within a closed steel containment vessel and inside a weather enclosure.

Therefore, regarding fragment mitigation measures, all future shots will be evaluated on a case-by-case basis to determine the need for additional fragment protection; however, the current use of steel containment vessels basically eliminates this mitigation concern.

MAP Section VIII.D.1(e)

The results of the 9-year-long annual assessment of physical conditions at Nake'muu Pueblo (1998–2006) indicated that the ambient environment (e.g., amount of annual snowfall) appears to be having a greater effect on the deterioration rate of the standing walled architecture at Nake'muu compared with the DARHT facility operations (Vierra and Schmidt 2006). As a result of this statistically quantitative study, additional annual monitoring at Nake'muu Pueblo for the purpose of the DARHT MAP was determined to not be required beginning in FY 2007. However, condition assessments, monitoring, and annual photography, as well as Tribal outreach, have continued at Nake'muu Pueblo since FY 2007 under "A

Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico" (LA-UR-19-21590).

MAP Section VIII.D.1(f)

LANL received requests for Tribal visits from Pueblo de San Ildefonso in FY 2021. In December 2022, LANL conducted a site visit of Nake'muu Pueblo with Tribal members from Pueblo de San Ildefonso. An additional site visit with Tribal members was also conducted in FY2024. No additional Tribal visits were requested or conducted in FY2025.

MAP Section VIII.D.1(g)

Fragment mitigation measures are implemented for experiments that have the potential to generate fragments. Mitigation measures for material releases to the environment include steel containment vessels implemented in FY 2007 and aqueous foam implemented before FY 2007. The post-shot operations for the experiments were conducted according to experiment-specific integrated work documents and established procedures.

These procedures were determined appropriate by DOE and are implemented under the LANL Integrated Safety Management System as an integral part of DARHT Facility operations and provide the operational basis and procedures for recovery of metal fragments dispersed during operational shots. In addition to the Integrated Safety Management System requirements, the procedures appropriately address DARHT MAP commitments that have been designed to minimize the short- and long-term release of contaminants (radioactive and hazardous materials) from the DARHT Facility.

3.6.4 *Summary of Potential Impacts*

MAP Section VIII.D.2(a, b)

The DARHT MAP identifies the potential for structural or other damage to as-yet-unknown Native American cultural resources within the area of potential effects at the DARHT Facility. Such damage could occur as a result of DOE's lack of knowledge of these resources at or around the DARHT Facility.

3.6.5 *Mitigation Action Scope*

MAP Section VIII.D.2(a, b)

The operational mitigation actions, MAP Section VIII.D.2(a, b), associated with this potential impact are as follows:

(a) Consultation with the four Accord Pueblos will continue to identify and protect any such cultural resources throughout the life of activities at the DARHT Facility.

(b) Evaluation of cultural resources in the vicinity of TA-15 will also be coordinated with the New Mexico State Historic Preservation Officer, as appropriate, for concurrence of eligibility determinations and potential effects.

3.6.6 *Status*

MAP Section VIII.D.2(a, b)

LANL received requests for Tribal visits from Pueblo de San Ildefonso in FY 2021. In December 2022, LANL conducted a site visit of Nake'muu Pueblo with Tribal members from Pueblo de San Ildefonso. No requests nor visits were conducted in FY 2025.

3.7 Mitigation Actions for Human Health and Safety

3.7.1 *Summary of Potential Impacts*

MAP Section VIII.E.1(a)

The DARHT MAP identifies potential adverse health effects on workers and the general public from high noise levels associated with the DARHT Facility, especially from construction and test firing.

3.7.2 *Mitigation Action Scope*

MAP Section VIII.E.1(a)

A commitment in the DARHT MAP provides for noise protection to workers in the form of earmuffs or ear plugs depending on the expected noise levels, according to Occupational Safety and Health Administration Act of 1972 requirements.

3.7.3 *Status*

MAP Section VIII.E.1(a)

Under the institutional implementation of the Integrated Safety Management System, DARHT Facility operations are managed according to specific procedures that collectively address a wide range of potential impacts to worker safety and health. These procedures fully address potential adverse health effects on workers from high noise levels associated with the DARHT Facility during test firing by requiring the use of appropriate personal protective equipment.

3.7.4 *Summary of Potential Impacts*

MAP Section VIII.E.2(a–c)

The DARHT MAP identifies the potential for adverse health effects on workers from radiation from DARHT Facility operations.

3.7.5 *Mitigation Action Scope*

MAP Section VIII.E.2(a–c)

The operational mitigation actions, MAP Section VIII.E.2(a–c), associated with this potential impact are as follows:

(a) Radiation shielding will be provided around the accelerators to limit radiation exposure to workers in the facility.

(b) DARHT Facility workers will be required to complete DOE-certified core radiological training (minimum Radiation Worker I level) and be enrolled in the LANL dosimetry program.

(c) Engineered controls will be installed as visual indicators to notify workers when the accelerators are operating.

3.7.6 *Status*

MAP Section VIII.E.2(a–c)

Under the institutional implementation of the Integrated Safety Management System, DARHT Facility operations are managed according to specific procedures that collectively address a wide range of potential impacts to worker safety and health. DARHT Facility accelerator operations are conducted in accordance with the DARHT Operations Standard AP-DARHT-014. This procedure requires appropriate training, radiation dosimetry program participation, and acceleration operations that collectively protect workers from exposure to unacceptable levels of radiation.

4 Conclusions

During FY 2025, the majority of radionuclides and chemicals in soil and sediment collected from around the perimeter of the DARHT Facility was either similar to the baseline statistical reference level or below screening levels protective of biota. No radionuclides, dioxins, or furans were detected in honey, and the majority of inorganic elements and PFAS compounds were either not detected or below regional statistical reference levels. The majority of PFAS compounds were not observed in the avian egg samples.

Although FY 2025 radionuclide and chemical levels were not at concentrations detrimental to human health (DOE 1999) or to the environment (DOE 2002), measurable amounts of depleted uranium still exist. Also, PFAS concentrations were detected in soil and sediment; therefore, continual annual monitoring is recommended.

The results of the 9-year-long annual assessment of physical conditions at Nake'muu Pueblo (1998–2006) indicated that the ambient environment (e.g., amount of annual snowfall) appears to be having a greater effect on the deterioration rate of the standing walled architecture at Nake'muu compared with the DARHT facility operations (Vierra and Schmidt 2006).

4.2 2025 MAP Implementation

In July 1999, all construction-related DARHT MAP mitigation commitments and action plans were completed. The FY 2025 DARHT MAP activities represent the 31st year of operation implementation.

The DARHT MAP activities implemented during FY 2025 were a continuation of DARHT Facility operations-phase MAP tracking and annual reporting. Should the scope of the DARHT Facility project change during the operations stage, as part of the appropriate NEPA review, the scope of the DARHT MAP could be changed by NNSA as necessary and as directed by the DOE/NNSA Field Office.

4.3 Recommendations

- Continue monitoring for constituents that are above baseline statistical reference levels or are on increasing trends.
- Continue tribal visits as requested at Nake'muu Pueblo (see Section VIII.D.1(f)).

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6 Acronyms

Acronym	Definition
BA	biological assessment
CFR	Code of Federal Regulations
DARHT	Dual-Axis Radiographic Hydrodynamic Test (Facility)
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
EPC-CP	Environmental Protection and Compliance-Compliance Programs
EPC-ES	Environmental Protection and Compliance-Environmental Stewardship
FY	fiscal year
LANL	Los Alamos National Laboratory
MAP	Mitigation Action Plan
MAPAR	Mitigation Action Plan Annual Report
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
PFAS	per- and polyfluoroalkyl substances
PFOS	perfluorooctanesulfonic acid
ROD	Record of Decision
SD	System Description (document)
SWEIS	Site-Wide Environmental Impact Statement
SWPPP	Stormwater Pollution Prevention Plan
TA	technical area
TCDD	2,3,7,8-tetrachlorodibenzodioxin
VPB	Vessel Preparation Building
WFO-FOD	Weapons Facilities Operations, Facilities Operations Directorate

Appendix A: DARHT Soil and Sediment Testing Results

Table A-1. Radionuclide concentrations (pCi/g) in soil (0- to 2-inch depth) and sediment (0- to 6-inch depth) collected around the perimeter of the DARHT facility in 2025.

	Americium 241			Cesium 137[d]			Plutonium 238			Plutonium 239/240			Strontium 90			Tritium			Uranium 234			Uranium 235/236			Uranium 238		
Soil	pCi/g	Uncertainty	Detected	pCi/g	Uncertainty	Detected	pCi/g	Uncertainty	Detected	pCi/g	Uncertainty	Detected	pCi/g	Uncertainty	Detected	pCi/mL	Uncertainty	Detected	pCi/g	Uncertainty	Detected	pCi/g	Uncertainty	Detected	pCi/g	Uncertainty	Detected
East	0.006	0.004	N	0.137	0.041	Y	0.010	0.005	N	0.011	0.005	N	-0.149	0.096	N	3.06	1.58	N	**1.85**	0.125	Y	**0.233**	0.039	Y	**2.47**	0.156	Y
South	-0.010	0.010	N	0.033	0.032	N	0.006	0.008	N	0.006	0.006	N	0.031	0.091	N	0.153	1.38	N	0.821	0.068	Y	0.074	0.019	Y	0.831	0.068	Y
West	0.006	0.007	N	0.098	0.041	Y	0.005	0.006	N	0.009	0.007	N	0.042	0.060	N	1.73	1.49	N	**1.88**	0.187	Y	0.143	0.051	N	**2.43**	0.228	Y
North	-0.008	0.008	N	**0.408**	0.053	Y	0.004	0.005	N	0.026	0.009	N	-0.109	0.061	N	1.93	1.42	N	**4.84**	0.322	Y	**0.530**	0.073	Y	**5.74**	0.371	Y
North FS	-0.024	0.009	N	0.043	0.023	N	-0.025	0.008	N	0.000	0.004	N	-0.102	0.023	N	**15.0**	2.64	Y	**1.80**	0.131	Y	**0.159**	0.037	Y	**8.17**	0.461	Y
North FS	-0.002	0.008	N	0.000	0.018	N	0.006	0.004	N	0.000	0.003	N	0.052	0.084	N	-0.172	1.35	N	1.20	0.091	Y	0.125	0.026	Y	**3.90**	0.224	Y
Sediment	pCi/g	Uncertainty	Detected	pCi/g	Uncertainty	Detected	pCi/g	Uncertainty	Detected	pCi/g	Uncertainty	Detected	pCi/g	Uncertainty	Detected	pCi/mL	Uncertainty	Detected	pCi/g	Uncertainty	Detected	pCi/g	Uncertainty	Detected	pCi/g	Uncertainty	Detected
East	0.011	0.005	N	0.083	0.041	N	0.011	0.006	N	0.011	0.005	N	0.157	0.080	N	0.012	1.35	N	1.42	0.115	Y	**0.276**	0.047	Y	**4.34**	0.272	Y
Southwest	0.002	0.007	N	0.076	0.080	N	0.004	0.004	N	0.005	0.004	N	0.017	0.030	N	0.371	1.35	N	0.970	0.092	Y	**0.178**	0.037	Y	1.24	0.108	Y
South	0.009	0.005	N	0.044	0.033	N	0.009	0.004	N	0.007	0.004	N	0.082	0.120	N	0.272	1.39	N	1.26	0.103	Y	**0.168**	0.036	Y	**1.62**	0.123	Y
North	0.000	0.005	N	0.036	0.033	N	0.005	0.005	N	0.001	0.003	N	-0.108	0.063	N	1.00	1.41	N	**17.1**	1.12	Y	**1.89**	0.188	Y	**17.4**	1.14	Y
Screening Levels	pCi/g	Receptor		pCi/g	Receptor		pCi/g	Receptor		pCi/g	Receptor		pCi/g	Receptor		pCi/mL	Receptor		pCi/g	Receptor		pCi/g	Receptor		pCi/g	Receptor	
[a]BSRL - Soil	0.008	NA		0.270	NA		0.003	NA		0.017	NA		0.340	NA		0.530	NA		2.40	NA		NA	NA		2.20	NA	
[a]BSRL- Sediment	0.015	NA		0.510	NA		0.005	NA		0.026	NA		0.260	NA		0.90	NA		3.70	NA		NA	NA		3.3	NA	
[b]RSRL	0.027	NA		1.07	NA		0.032	NA		0.068	NA		0.481	NA		0.213	NA		1.49	NA		0.156	NA		1.50	NA	
[c]NE-ESL (Plant)	500	plant		1500	plant		1800	plant		1900	plant		1100	plant		36000	plant		440	plant		440	plant		400	plant	
[c]LE-ESL (Plant)	5000	plant		15000	plant		18000	plant		19000	plant		11000	plant		360000	plant		4400	plant		4400	plant		4000	plant	
[c]NE-ESL (A/I)	190	Earthworm		1400	American robin		820	Earthworm		870	Earthworm		340	American robin		48000	Earthworm		2200	Earthworm		1600	Earthworm		1100	Earthworm	
[c]LE-ESL (A/I)	1900	Earthworm		14000	American robin		8200	Earthworm		8700	Earthworm		3400	American robin		480000	Earthworm		22000	Earthworm		16000	Earthworm		11000	Earthworm	

[a]Baseline statistical reference level for soil and sediment; the upper limit background concentration (mean + 3 standard deviation) based on Nyhan et al. 2001. U-235/236 comparisons omitted; see *Analytical Laboratory Quality Assessment* section in Chapter 7 of LANL 2025.
[b]Regional statistical reference level; the upper-limit background concentration (mean + 3 standard deviation) for soil based on data from 2015 to 2024 (last 10 years; n=30). Due to discrepancies of uranium-235/236 values between analytical laboratories, uranium-235/236 regional statistical reference level is calculated on data from GEL only (currently used analytical laboratory; n=6).
[c]Ecological screening level; no effect (NE) level and lowest effect (LE) level for plants and animal/invertebrate (A/I; Intellus 2024).
[d]Bold values are radionuclides that were detected and above the BSRL and/or RSRL.

Table A-2. Total analyte list concentrations (mg/kg) in soil (0- to 2-inch depth) and sediment (0- to 6-inch depth) collected from within and around the perimeter of the DARHT Facility in 2025.

	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadmium		Calcium		Chromium		Cobalt		Copper		Iron		Lead	
Soil	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg[d]	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected
East	11500	Y	0.741	Y	2.40	Y	82.7	Y	0.848	Y	0.083	Y	3190	Y	6.51	Y	3.43	Y	5.86	Y	8730	Y	8.79	Y
South	9300	Y	1.09	Y	3.14	Y	86.1	Y	0.514	Y	0.053	Y	4710	Y	6.10	Y	3.17	Y	8.40	Y	8820	Y	7.62	Y
West	14500	Y	1.19	Y	2.38	Y	**121**	Y	0.730	Y	0.105	Y	2610	Y	7.03	Y	4.22	Y	7.30	Y	8950	Y	10.8	Y
North	12000	Y	0.696	Y	2.76	Y	**116**	Y	0.652	Y	0.118	Y	1770	Y	6.89	Y	5.83	Y	7.10	Y	8920	Y	**14**	Y
Firing Site	5140	Y	0.330	N	2.29	Y	65.4	Y	0.299	Y	0.081	Y	13500	Y	5.66	Y	2.98	Y	9.69	Y	6630	Y	4.98	Y
Firing Site	7830	Y	2.12	Y	1.87	Y	54.1	Y	0.433	Y	0.062	Y	14800	Y	4.90	Y	2.89	Y	8.01	Y	6930	Y	5.32	Y
Sediment	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg[d]	Detected
East	7440	Y	0.717	Y	2.00	Y	80.9	Y	0.550	Y	0.109	Y	1980	Y	8.39	Y	2.53	Y	**14.2**	Y	7490	Y	8.79	Y
Southwest	15900	Y	0.712	Y	2.12	Y	**126**	Y	0.860	Y	0.0350	Y	2730	Y	7.89	Y	4.17	Y	5.83	Y	9870	Y	9.73	Y
South	11300	Y	0.530	Y	2.50	Y	59.5	Y	0.677	Y	0.0813	Y	1660	Y	7.19	Y	3.19	Y	7.73	Y	8920	Y	9.07	Y
North	4110	Y	0.464	Y	1.35	Y	32.1	Y	0.246	Y	0.0187	N	788	Y	3.72	Y	1.98	Y	2.23	Y	6260	Y	4.70	Y
Screening Levels	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor
[a]BSRL - Soil	NA	NA	NA	NA	NA	NA	147	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	13.5	NA
[a]BSRL - Sediment	NA	NA	NA	NA	NA	NA	161	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	15.4	NA
[b]RSRL	28584	NA	2.60	NA	7.78	NA	345	NA	1.23	NA	0.301	NA	70601	NA	17.4	NA	9.8	NA	13.1	NA	19195	NA	22.0	NA
[c]NE-ESL (Plant)	NA	NA	11.0	plant	18.0	plant	110	plant	2.50	plant	32.0	plant	NA	NA	NA	NA	13.0	plant	70.0	plant	NA	NA	120	plant
[c]LE-ESL (Plant)	NA	NA	58.0	plant	91.0	plant	260	plant	25.0	plant	160	plant	NA	NA	NA	NA	130	plant	490	plant	NA	NA	570	plant
[c]NE-ESL (A/I)	NA	NA	2.30	Deer mouse	6.80	Earthworm	330	Earthworm	35.0	Montane shrew	0.270	Montane shrew	NA	NA	23.0	American robin	76.0	American robin	14.0	American robin	NA	NA	11.0	American robin
[c]LE-ESL (A/I)	NA	NA	23.0	Deer mouse	68.0	Earthworm	3200	Earthworm	350	Montane shrew	3.60	Montane shrew	NA	NA	73.0	American robin	170	American robin	43.0	American robin	NA	NA	23.0	American robin
[d]SSL (R C)	NA	NA	NA	NA	7.07	Human	NA	NA	64400	Human	85900	Human	NA	NA	96.6	Human	17200	Human	NA	NA	NA	NA	NA	NA
[d]SSL (R NC)	78000	Human	31.3	Human	13	Human	15600	Human	156	Human	70.5	Human	13000000	Human	45200	Human	23.4	Human	3130	Human	54800	Human	NA	NA
[d]SSL (I/O C)	NA	NA	NA	NA	35.9	Human	NA	NA	313000	Human	417000	Human	NA	NA	505	Human	83400	Human	NA	NA	NA	NA	NA	NA
[d]SSL (I/O NC)	1290000	Human	519	Human	208	Human	255000	Human	2580	Human	1110	Human	32400000	Human	314000	Human	388	Human	51900	Human	908000	Human	NA	NA
[d]SSL (C C)	NA	NA	NA	NA	216	Human	NA	NA	2710	Human	3610	Human	NA	NA	468	Human	722	Human	NA	NA	NA	NA	NA	NA
[d]SSL (C NC)	41400	Human	142	Human	41.2	Human	4390	Human	148	Human	72.1	Human	8850000	Human	134	Human	36.7	Human	14200	Human	248000	Human	NA	NA

	Magnesium		Manganese		Mercury		Nickel		Potassium		Selenium		Silver		Sodium		Thallium		Vanadium		Zinc	
Soil	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected
East	1640	Y	**229**	Y	**0.015**	Y	5.50	Y	1290	Y	**1.60**	Y	0.102	N	46.0	Y	0.139	N	**15.5**	Y	24.9	Y
South	2260	Y	**244**	Y	**0.016**	Y	5.84	Y	1020	Y	**2.11**	Y	0.091	N	79.2	Y	0.134	N	**17.1**	Y	32.1	Y
West	2160	Y	**280**	Y	**0.027**	Y	6.43	Y	1450	Y	**1.68**	Y	0.110	N	51.8	Y	**0.152**	Y	**14.7**	Y	**75.8**	Y
North	1540	Y	**339**	Y	**0.026**	Y	5.96	Y	1360	Y	**1.64**	Y	0.096	N	58.8	Y	**0.157**	Y	**19.9**	Y	22.8	Y
Firing Site	2240	Y	212	Y	0.008	Y	6.75	Y	767	Y	**1.25**	Y	**0.772**	Y	94.7	Y	0.143	N	**21.5**	Y	24.8	Y
Firing Site	1810	Y	193	Y	0.007	N	5.01	Y	916	Y	**1.44**	Y	0.148	Y	54.4	Y	0.135	N	**13.8**	Y	25.3	Y
Sediment	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected	mg/kg	Detected
East	1480	Y	184	Y	**0.025**	Y	5.52	Y	1150	Y	**2.05**	Y	0.107	N	**273**	Y	0.163	N	**13.9**	Y	**101**	Y
Southwest	2120	Y	**262**	Y	0.012	Y	7.28	Y	1710	Y	**1.44**	Y	0.110	N	60.2	Y	**0.164**	Y	**17**	Y	**73.8**	Y
South	1740	Y	**255**	Y	**0.020**	Y	6.36	Y	1380	Y	**1.99**	Y	0.091	N	**274**	Y	0.145	N	**18.7**	Y	41.6	Y
North	784	Y	202	Y	0.008	N	3.08	Y	566	Y	**1.12**	Y	0.089	N	36.8	Y	0.131	N	**19.5**	Y	31	Y
Screening Levels	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor	mg/kg	Receptor
[a]BSRL - Soil	NA	NA	NA	NA	0.040	NA	NA	NA	NA	NA	NA	NA	1.62	NA	NA	NA	0.400	NA	NA	NA	NA	NA
[a]BSRL - Sediment	NA	NA	NA	NA	0.040	NA	NA	NA	NA	NA	NA	NA	1.56	NA	NA	NA	0.300	NA	NA	NA	NA	NA
[b]RSRL	5641	NA	1264	NA	0.043	NA	16.1	NA	3841	NA	1.80	NA	0.609	NA	146	NA	0.486	NA	38.3	NA	48.0	NA
[c]NE-ESL (Plant)	NA	NA	220	plant	34.0	plant	38.0	plant	NA	NA	0.520	plant	560	plant	NA	NA	0.050	plant	60	plant	160	plant
[c]LE-ESL (Plant)	NA	NA	1100	plant	64.0	plant	270	plant	NA	NA	3.00	plant	2800	plant	NA	NA	0.500	plant	80	plant	810	plant
[c]NE-ESL (A/I)	NA	NA	450	Earthworm	0.013	American robin	10.0	Montane shrew	NA	NA	0.700	Montane shrew	2.60	American robin	NA	NA	0.420	Montane shrew	4.70	American robin	47	American robin

[c]LE-ESL (A/I)	NA	NA	4500	Earthworm	0.130	American robin	21.0	Montane shrew	NA	NA	1.00	Montane shrew	26.0	American robin	NA	NA	4.20	Montane shrew	9.50	American robin	120	American robin
[d]SSL (R C)	NA	NA	NA	NA	NA	NA	595000	Human	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
[d]SSL (R NC)	15600000	Human	10500	Human	23.8	Human	1560	Human	15600000	Human	391	Human	391	Human	7820000	Human	0.782	Human	394	Human	23500	Human
[d]SSL (I/O C)	NA	NA	NA	NA	NA	NA	2890000	Human	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
[d]SSL (I/O NC)	5680000	Human	160000	Human	112	Human	25700	Human	76200000	Human	6490	Human	6490	Human	37300000	Human	13	Human	6530	Human	389000	Human
[d]SSL (C C)	NA	NA	NA	NA	NA	NA	25000	Human	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
[d]SSL (C NC)	1550000	Human	464	Human	20.7	Human	753	Human	20800000	Human	1750	Human	1770	Human	10200000	Human	3.54	Human	614	Human	106000	Human

[a]Baseline statistical reference level for soil and sediment; the upper limit background concentration (mean + 3 standard deviation) based on Nyhan et al. 2001. Comparisons of current results with the baseline statistical reference level were omitted when the analytical methods differed; which prevented the comparison of antimony, arsenic, beryllium, chromium, copper, nickel, and selenium.

[b]Regional statistical reference level; the upper-limit background concentration (mean + 3 standard deviation) for soil based on data from 2015 to 2024 (last 10 years; n=30).

[c]Ecological screening level; no effect (NE) level and lowest effect (LE) level for plants and animal/invertebrate (A/I; Intellus 2024).

[d]SSL (Soil Screening Level) for cancerous (C) and noncancerous (NC) risk to humans from several exposure scenarios: residential (R), industrial/occupational (I/O), and construction (C) (NMED 2021).

[d]Bold values are inorganic elements that were detected and above the BSRL, RSRL, and/or ESL.

Table A-3. Select per- and polyfluoroalkyl substances (PFAS; ng/g) in soil (0- to 2-inch depth) and sediment (0- to 6-inch depth) collected from within and around the perimeter of the DARHT Facility in 2025.

	1H, 1H, 2H, 2H Perfluorodecane sulfonic acid		1H, 1H, 2H, 2H Perfluorooctane sulfonic acid		3 Perfluoroheptyl propanoic acid		3 Perfluoropentyl propanoic acid		3 Perfluoropropyl propanoic acid		Perfluoro 1 octanesulfonamide		Perfluorobutanoic acid		Perfluorodecane sulfonate		Perfluorodecanoic acid		Perfluorododecanoic acid		Perfluoroheptanoic acid		Perfluorohexane sulfonic acid		Perfluorohexanoic acid		Perfluorononanesulfonic acid		Perfluorononanoic acid	
Soil	[c]ng/g	Detected	[c]ng/g	Detected	ng/g	Detected	[c]ng/g	Detected	ng/g	Detected	ng/g	Detected	[c]ng/g	Detected	ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected
East	**3.80**	Y	**0.270**	Y	0.590	Y	0.260	Y	0.094	N	0.059	N	0.130	Y	0.047	N	**1.60**	Y	**0.180**	Y	**0.230**	Y	0.047	N	**0.150**	Y	0.047	N	**1.60**	Y
South	**0.580**	Y	0.090	N	0.420	Y	0.230	N	0.090	N	0.057	N	0.110	Y	0.045	N	**0.810**	Y	**0.081**	Y	0.062	Y	0.051	Y	0.054	Y	0.045	N	**1.80**	Y
West	0.086	N	0.086	N	0.220	N	0.220	N	0.086	N	0.054	N	0.086	N	0.043	N	**0.120**	Y	0.044	Y	0.043	N	0.043	N	0.043	N	0.043	N	0.120	Y
North	0.091	N	0.091	N	0.230	N	0.230	N	0.091	N	0.057	N	0.091	N	0.045	N	0.057	Y	0.045	N	0.045	N	0.045	N	0.045	N	0.045	N	0.180	Y
Firing site	0.095	N	0.095	N	0.240	N	0.240	N	0.095	N	0.060	N	0.095	N	0.047	N	**0.130**	Y	0.047	N	0.047	N	0.047	N	0.047	N	0.047	N	0.049	Y
Firing site	0.093	N	0.093	N	0.230	N	0.230	N	0.093	N	0.058	N	0.093	N	0.046	N	**0.150**	Y	0.046	N	0.046	N	0.046	N	0.046	N	0.046	N	0.063	Y
Sediment	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected
East	**12.0**	Y	**20.0**	Y	**8.00**	Y	**15.0**	Y	**1.00**	Y	**0.190**	Y	**0.640**	Y	**0.081**	Y	**1.80**	Y	**1.40**	Y	**1.70**	Y	**0.220**	Y	**1.90**	Y	**0.120**	Y	**1.50**	Y
Southwest	0.084	N	0.084	N	0.210	N	0.210	N	0.084	N	0.053	N	0.084	N	0.042	N	0.042	N	0.042	N	0.042	N	0.042	N	0.042	N	0.042	N	0.046	Y
South	**0.330**	Y	0.091	Y	0.940	Y	0.800	Y	0.087	N	0.055	N	**0.320**	Y	0.043	N	**0.900**	Y	**0.480**	Y	**0.400**	Y	**0.160**	Y	**0.300**	Y	0.043	N	**0.730**	Y
North	0.100	N	0.100	N	0.250	N	0.250	N	0.100	N	0.063	N	0.100	N	0.050	N	0.050	N	0.050	N	0.050	N	0.050	N	0.050	N	0.050	N	0.050	N
Screening Levels	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor
[a]RSRL	0.229	NA	0.229	NA	2.11	NA	1.92	NA	0.321	NA	0.057	NA	0.229	NA	0.065	NA	0.063	NA	0.057	NA	0.137	NA	0.057	NA	0.066	NA	0.071	NA	0.195	NA
[c]NE-ESL (Plant)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	640000	plant	NA	NA	51000	plant	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	46000	plant
[c]LE-ESL (Plant)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
[c]NE-ESL (A/I)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	48000	Deer mouse	NA	NA	NA	NA	NA	NA	1000	Earthworm	1000	Earthworm	170000	Gray fox	NA	NA	900	Montane shrew
[c]LE-ESL (A/I)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	120000	Deer mouse	NA	NA	NA	NA	NA	NA	100000	Earthworm	100000	Earthworm	350000	Gray fox	NA	NA	1100	Montane shrew
[d]SSL (R NC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1560	Human	NA	NA	NA	NA	235	Human
[d]SSL (I/O NC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	26000	Human	NA	NA	NA	NA	3890	Human
[d]SSL (C NC)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7080	Human	NA	NA	NA	NA	1060	Human

	Perfluorooctanesulfonic acid		Perfluorooctanoic acid		Perfluoropentanoic acid		Perfluorotetradecanoic acid		Perfluorotridecanoic acid		Perfluoroundecanoic acid	
Soil	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected
East	**0.890**	Y	**1.30**	Y	**0.240**	Y	0.056	Y	**0.067**	Y	**0.480**	Y
South	**8.80**	Y	**0.490**	Y	0.045	Y	0.052	N	0.045	N	**0.220**	Y
West	**0.260**	Y	0.053	N	0.043	N	0.050	N	0.043	N	**0.082**	Y
North	**0.230**	Y	0.066	Y	0.045	N	0.053	N	0.045	N	0.045	N
Firing site	0.074	Y	0.059	N	0.047	N	0.055	N	0.047	N	**0.059**	Y
Firing site	0.170	Y	0.057	N	0.046	N	0.054	N	0.046	N	**0.085**	Y
Sediment	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected	[c]ng/g	Detected
East	**11.0**	Y	**2.50**	Y	**2.00**	Y	**0.240**	Y	**0.320**	Y	**2.50**	Y
Southwest	0.068	Y	0.052	N	0.042	N	0.049	N	0.042	N	0.042	N
South	**1.50**	Y	**0.720**	Y	**0.590**	Y	**0.160**	Y	**0.230**	Y	**0.660**	Y
North	0.110	Y	0.062	N	0.050	N	0.058	N	0.050	N	0.050	N
Screening Levels	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor	ng/g	Receptor
[a]RSRL	0.225	NA	0.173	NA	0.121	NA	0.064	NA	0.057	NA	0.057	NA
[c]NE-ESL (Plant)	11000	plant	84	plant	NA	NA	NA	NA	NA	NA	NA	NA
[c]LE-ESL (Plant)	33000	plant	840	plant	NA	NA	NA	NA	NA	NA	NA	NA
[c]NE-ESL (A/I)	11	American robin	600	Gray fox	NA	NA	NA	NA	NA	NA	NA	NA
[c]LE-ESL (A/I)	110	American robin	1200	Gray fox	NA	NA	NA	NA	NA	NA	NA	NA
[d]SSL (R NC)	1560	Human	1560	Human	NA	NA	NA	NA	NA	NA	NA	NA

[d]SSL (I/O NC)	26000	Human	26000	Human	NA	NA	NA	NA	NA	NA	NA	NA
[d]SSL (C NC)	7080	Human	7080	Human	NA	NA	NA	NA	NA	NA	NA	NA

[a]Regional statistical reference level; the upper-limit background concentration (mean + 3 standard deviation) for soil analyzed by the same analytical method (EPA:1663) based on data from 2024 (n=6).
[b]Ecological screening level; no effect (NE) level and lowest effect (LE) level for plants and animal/invertebrate (A/I; Intellus 2024).
[c]Bold values are PFAS that were detected and above the RSRL.
[d]SSL (Soil Screening Level) for noncancerous (NC) risk to humans from several exposure scenarios: residential (R), industrial/occupational (I/O), and construction (C) (NMED 2021).
Note: PFAS chemicals listed in this table were detected in at least one sample. PFAS chemicals that were not detected in any soil samples were excluded from the table.