2019 Highlight

Effluent Releases
Nonradiological and radiological air effluent releases for calendar year 2019 were similar to calendar year 2018 releases and below permit limits and applicable standards.

Surveillance Program
Air sampling was conducted at 97 stations either on the Hanford Site or at offsite locations. For the year, the operational availability for all stations was approximately 98% and approximately 97% of all scheduled samples were collected.

6.0 Air Monitoring

CJ Perkins, DL Dyekman

Air quality is monitored using stack sampling at the sources and air monitoring at receptor locations. The specific objectives are to measure airborne radionuclides to calculate the doses to humans, plants, and animals. Measured and calculated results are compared with the U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), and/or Washington State Department of Health standards. This report presents 2019 results.

6.1 Air Effluent Monitoring

DL Dyekman

DOE contractors monitor airborne pollutants from site facilities to quantify emissions, determine compliance with federal and state regulatory requirements, monitor the effectiveness of emission control equipment, and assess environmental impacts. Most facility radioactive air emission point sources are actively ventilated stacks sampled prior to the point of release to the environment. Airborne emissions with potential to contain radioactive materials are sampled for gross alpha, gross beta and radionuclides specified in the Hanford Site Air Operating Permit (AOP) [Ecology 2019]. Nonradioactive air pollutants are sampled or estimated based on material and chemical use.

Quantified emissions estimates are documented in annual reports available to the public through the Tri Party Agreement Administrative Record Public Information Repository website (http://pdw.hanford.gov/arpir/). The DOE annually prepares and submit reports of Hanford Site radionuclide air emissions and non-radioactive chemical emissions as required per the Hanford Site AOP.

6.1.1 Radioactive Airborne Emissions

Small quantities of radionuclides are emitted to the environment through radioactive emission point sources (i.e., stacks and vents) during routine operations. The federal and state permit requirements contained in the AOP define which stacks require sampling, how and how often to collect the samples, and the isotopes to be measured. The commonly measured isotopes include: tritium (i.e., hydrogen-3), strontium-90, iodine-129, cesium-137, plutonium-238, plutonium-239/240, and americium-241. Emission points are sampled and monitored continuously if they have the potential to emit

radionuclides that exceeds 1% of the 40 CFR 61, Subpart H public dose limit of 10 mrem/yr or 100 microsievert (µSv)/yr. Continuous sampling is defined and described in more detail in the American National Standards Institute N13.1, *Sampling and Monitoring Releases of Airborne Radioactive Substances From the Stacks and Ducts of Nuclear Facilities* (ANSI 1999). For other release points, periodic confirmatory measurements are made to verify low emissions.

Offsite radiological dose assessments related to stack releases are ideally based on direct measurements of radionuclide concentrations in specific environmental media such as air, water, and food measured at offsite locations. However, amounts of many radioactive materials released to the atmosphere from Hanford Site sources are too small to be measured in media after they are released from stacks and diluted through miles of dispersion in the environment. Radioactive air emissions from the Hanford Site have been generally decreasing over time because the production and processing of nuclear materials ceased more than 30 years ago. For the radionuclides present in measurable amounts, it can be difficult to distinguish the small contribution of Hanford Site stacks from other contributions caused by fallout from historical nuclear weapons testing and naturally occurring radionuclides such as uranium and its decay products. As a result, the dose assessment process incorporates conservative assumptions to ensure that calculated doses are likely to be overestimated. For more information on doses due to radiological releases (Section 4.2).

Radioactive air emission points are located on the Hanford Site in the 100, 200, 300, and 400 Areas. Table 6-1 lists the 42 stacks that operated on the Hanford Site during calendar year (CY) 2019. Table 6-2 shows the curies released from these stacks in CY 2019.

The quantity of radionuclide air emissions reported in 2019 were similar in magnitude to those reported in 2018. Table 6-2 summarizes Hanford Site radioactive airborne emissions in 2019.

Table 6-1. Hanford Site Stack Locations and Sample Analyses. (2 Pages)

Stack ID	Facility	Individual Sample Analyses	Additional Sample Analyses
105-KW	KW Fuel Storage Basin	Alpha, Beta	^{137}Cs, ^{90}Sr, ^{239}Pu, ^{238}Pu, ^{241}Pu, ^{241}Am
105-KW Annex	KW Fuel Storage Basin	Alpha, Beta	^{137}Cs, ^{90}Sr, ^{239}Pu, ^{238}Pu, ^{241}Pu, ^{241}Am
291-A-1	PUREX	Alpha, Beta	^{129}I, ^{90}Sr, ^{137}Cs, ^{238}Pu, ^{239}Pu, ^{241}Am
296-A-18	241-AY-101 Annulus	Alpha, Beta	None
296-A-19	241-AY-102 Annulus	Alpha, Beta	^{137}Cs
296-A-20	241-AZ Tank Farm Annuli	Alpha, Beta	None
296-A-21A	242A Building Vent	Alpha, Beta	None
296-A-22	242A Evaporator Vessel Vent	Alpha, Beta	^{137}Cs, ^{90}Sr, ^{239}Pu, ^{238}Pu, ^{241}Am
296-A-28	241-AW Tank Farm Annuli	Alpha, Beta	None
296-A-30	241-AN Tank Farm Annuli	Alpha, Beta	None
296-A-41	241-AP Tank Farm Annuli	Alpha, Beta	None
296-A-42	241-AY/AZ Tank Farm	Alpha, Beta	^{137}Cs, ^{90}Sr, ^{238}Pu, ^{239}Pu, ^{241}Am
296-A-43	702AZ Building Exhauster	Alpha, Beta	None
296-A-44	241-AN Tank Farm	Alpha, Beta	^{90}Sr, ^{137}Cs, ^{154}Eu, ^{238}Pu, ^{239}Pu, ^{241}Am, ^{241}Pu

Table 6-1. Hanford Site Stack Locations and Sample Analyses. (2 Pages)

Stack ID	Facility	Individual Sample Analyses	Additional Sample Analyses
296-A-45	241-AN Tank Farm	Alpha, Beta	^{90}Sr, ^{137}Cs, ^{154}Eu, ^{238}Pu, ^{239}Pu, ^{241}Am, ^{241}Pu
296-A-46	241-AW Tank Farm	Alpha, Beta	^{90}Sr, ^{137}Cs, ^{154}Eu, ^{238}Pu, ^{239}Pu, ^{241}Am, ^{241}Pu
296-A-47	241-AW Tank Farm	Alpha, Beta	^{90}Sr, ^{137}Cs, ^{154}Eu, ^{238}Pu, ^{239}Pu, ^{241}Am, ^{241}Pu
296-A-48	241-AP Tank Farm	Alpha, Beta	^{90}Sr, ^{137}Cs, ^{154}Eu, ^{238}Pu, ^{239}Pu, ^{241}Am, ^{241}Pu
296-A-49	241-AP Tank Farm	Alpha, Beta	^{90}Sr, ^{137}Cs, ^{154}Eu, ^{238}Pu, ^{239}Pu, ^{241}Am, ^{241}Pu
296-B-1	B Plant	Alpha, Beta	^{137}Cs, ^{90}Sr, ^{238}Pu, ^{239}Pu, ^{241}Am
296-B-10	WESF	Alpha, Beta	^{137}Cs, ^{90}Sr, ^{238}Pu, ^{239}Pu, ^{241}Am
296-E-1	Effluent Treatment Facility	Alpha, Beta	None
FFTF-CB-EX	FFTF	None	Emissions estimated by calculation
437-MN&ST	FFTF MASF	Alpha, Beta	None
437-1-61	FFTF MASF	Alpha, Beta	None
296-H-212	CSB	Alpha, Beta	^{137}Cs, ^{90}Sr, ^{238}Pu, ^{239}Pu, ^{241}Am
296-P-22	241-SY Tank Farm Annuli	Alpha, Beta	None
296-P-23	241-SY Tank Farm	Alpha, Beta	None
296-P-45	241-T-111 Tank Exhauster	Alpha, Beta	^{137}Cs, ^{90}Sr, ^{238}Pu, ^{239}Pu, ^{241}Am
296-P-49	241-AX Tanks Exhauster	Alpha, Beta	^{137}Cs, ^{90}Sr, ^{238}Pu, ^{239}Pu, ^{241}Am
296-P-50	241-AX Tanks Exhauster	Alpha, Beta	^{137}Cs, ^{90}Sr, ^{238}Pu, ^{239}Pu, ^{241}Am
296-P-107	241-C Tanks Exhauster	Alpha, Beta	^{137}Cs, ^{90}Sr, ^{238}Pu, ^{239}Pu, ^{241}Am
291-S-1	S Plant	Alpha, Beta	None
296-S-16	219-S	Alpha, Beta	None
296-S-21	222-S	Alpha, Beta	^{137}Cs, ^{90}Sr, ^{238}Pu, ^{239}Pu, ^{241}Am
296-S-25	241-SY Tank Farm	Alpha, Beta	None
291-T-1	T Plant	Alpha, Beta	^{137}Cs, ^{90}Sr, ^{238}Pu, ^{239}Pu, ^{241}Am
296-T-7	2706T	Alpha, Beta	^{137}Cs, ^{90}Sr, ^{238}Pu, ^{239}Pu, ^{241}Am
296-W-4	WRAP	Alpha, Beta	90Sr, 137Cs, 238Pu, 239Pu, 241Am^{137}Cs, ^{90}Sr, ^{238}Pu, ^{239}Pu, ^{241}Am
EP-324-01-S	324 Building	Alpha, Beta	^{137}Cs, ^{90}Sr, ^{238}Pu, ^{239}Pu, Am^{241}
EP-325-01-S	325 Building	Alpha, Beta	Tritium, Radon, numerous additional isotopes
EP-331-01-S	331 Building	Alpha, Beta	^{137}Cs, ^{90}Sr, ^{238}Pu, ^{239}Pu, ^{241}Am
EP-331-01-09-S	331 Building	Alpha, Beta	^{14}C

CSB = Canister Storage Building
FFTF = Fast Flux Test Facility
MASF = Material and Storage Facility
PUREX = Plutonium Uranium Extraction Facility
WESF = Waste Encapsulation and Storage
WRAP = Waste Receiving and Processing

Table 6-2. Hanford Site Radioactive Airborne Emissions in Calendar Year 2019.

Radionuclide	100 Area (Ci)	200-East Area (Ci)	200-West Area (Ci)	300 Area (Ci)	400 Area (Ci)	Totals (Ci)
Actinium-227	NA	NA	NA	2.1E-10	NA	2.1E-10
Americium-241	4.9E-06	5.6E-07	6.8E-08	5.4E-09	NA	5.5E-06
Americium-243	NA	NA	NA	5.3E-08	NA	5.3E-08
Carbon-14	NA	NA	NA	1.1E-04	NA	1.1E-04
Cesium-137	9.8E-06	3.7E-06	3.9E-07	1.3E-07	1.1E-11	1.4E-05
Cobalt-60	ND	7.1E-08	ND	5.9E-08	NA	1.3E-07
Curium-243/244	NA	NA	NA	5.6E-11	NA	5.6E-11
Europium-152	ND	ND	ND	2.1E-09	NA	2.1E-09
Europium-154	ND	ND	ND	3.1E-08	NA	3.1E-08
Gadolinium-153	NA	NA	NA	9.1E-11	NA	9.1E-11
Gross Alpha	2.2E-05	2.3E-06	1.1E-06	1.2E-07	1.9E-07	2.6E-05
Gross Beta	3.2E-05	1.2E-05	1.9E-06	4.8E-06	1.6E-06	5.2E-05
Iodine-129	NA	1.2E-03	NA	NA	NA	1.2E-03
Krypton-85	NA	NA	NA	1.2E-02	NA	1.2E-02
Neptunium-237	NA	NA	NA	1.4E-08	NA	1.4E-08
Plutonium-238	8.0E-07	ND	ND	3.5E-08	NA	8.4E-07
Plutonium-239/240	6.5E-06	3.3E-07	6.5E-07	2.6E-09	2.3E-13	7.5E-06
Plutonium-241	2.8E-05	ND	1.7E-07	ND	NA	2.8E-05
Radium-226	NA	NA	NA	3.7E-10	NA	3.7E-10
Radon-220	NA	NA	NA	5.20E+02	NA	5.20E+02
Ruthenium-106	ND	ND	ND	1.4E-08	NA	1.4E-08
Sodium-22	NA	NA	NA	NA	2.1E-10	2.1E-10
Strontium-90	7.4E-06	1.7E-06	3.2E-07	8.0E-08	NA	9.5E-06
Technicium-99	NA	NA	NA	4.3E-06	NA	4.3E-06
Tritium (elemental)	NA	NA	NA	9.20E+01	NA	9.20E+01
Tritium (tritiated water vapor)	NA	NA	NA	1.63E+02	NA	1.63E+02
Uranium-232	NA	NA	NA	8.5E-09	NA	8.5E-09
Uranium-233	NA	NA	NA	1.9E-08	NA	1.9E-08

Ci = curies
NA = Not applicable
ND = Not detected

6.1.2 Criteria Air Pollutants

Typical Hanford Site facility operations emit non-radioactive air pollutants. The emissions of non-radioactive air pollutants fall under two general categories: criteria pollutants and hazardous or toxic air pollutants (TAPs). The *Clean Air Act Amendment of 1990* (CAA) requires EPA to establish National Ambient Air Quality Standards criteria for six air pollutants commonly found all over the U.S. The EPA regulation 40 CFR 50, "National Primary and Secondary Ambient Air Quality Standards," defines

allowable concentrations in the ambient air for carbon monoxide, lead, nitrogen dioxide, particulate matter, sulfur dioxide, and ozone. Ground level ozone is not typically emitted directly into the air but is created by chemical reactions between oxides of nitrogen and volatile organic compounds. The ozone creation occurs when pollutants emitted by cars, boilers, and other sources chemically react in the presence of sunlight. As a precursor to ozone creation, volatile organic compounds are often regulated instead of ozone. Given the nature of Hanford Site operations and relative small quantity of criteria pollutants emitted, sampling or monitoring the ambient air for chemical compounds is not required. Some Hanford Site facilities and projects do have source specific sampling and monitoring requirements specified in individual Washington State Department of Ecology (Ecology) air permit approval orders. See Section 6.1.3 for more information on source specific sampling and monitoring. See Section 6.1.4 for more information on reported emissions of pollutants during CY 2019.

6.1.3 Hazardous and Toxic Air Pollutants

Hazardous air pollutants (HAPs) and TAPs are defined in federal and state regulations as chemicals, compounds, and substances known or suspected to be dangerous to human health or the environment. Under the CAA, EPA is required to regulate emissions of HAPs. The original CAA listed 189 substances but has since been modified through rulemaking to a reduced list of 187 HAPs. In addition to the federal HAP list, the *Washington Administrative Code* establishes a list of TAPs that includes 142 of the federal HAPs, excludes 45 federal HAPs, and adds 296 chemicals for a total of 438 regulated substances.

The EPA oversees HAP emissions through a series of regulations promulgated as "New Source Performance Standards" and "National Emissions Standards for Hazardous Air Pollutants." These EPA regulations are applicable to specific source categories and work activities (e.g., working with asbestos during building renovation and demolition). Ecology has adopted a broader approach and regulates all TAP emissions without regard to source categories. Any new or modified source of TAP air emissions in Washington State is potentially subject to Ecology regulation.

As required by WAC 173-460-080, "First Tier Review," projects and individual sources with estimated emissions of TAPs that exceed *de minimis* levels listed in WAC 173-460-150, "Table of Acceptable Source Impact Level, Small Quantity Emission Rate and De Minimis Emission Values," are required to submit a notice of construction (NOC) application. These NOC applications quantify project emissions, perform computer-based dispersion modeling analyses, and are subject to Ecology review and approval. Ecology issues NOC approval orders specifying emission limits and sampling or monitoring requirements, which are subsequently incorporated in the Hanford Site AOP (Ecology 2019).

Pursuant to WAC 173-460-090, "Second Tier Review," if dispersion modeling shows any TAP exceeding the acceptable source impact levels, a second tier review or health impact assessment must be performed to demonstrate the estimated emissions represent an acceptable health risk to members of the public. In previous Hanford Site NOC applications, dispersion modeling demonstrated dimethyl mercury (DMM) emissions as the only TAP above the acceptable source impact level values. The source of DMM emissions is the future planned tank waste retrieval, transfer, and treatment processes within the Hanford Site tank farms and the Waste Treatment and Immobilization Plant. The current DMM health impact assessment completed in 2015 (RPP-ENV-59016) was approved by Ecology (Ecology 2016). Consistent with the Ecology publication 08-02-025, "Guidance Document: First, Second, and Third Tier Review of Toxic Air Pollution Sources," (Ecology 2015), the health impact assessment includes eight additional TAPs. The additional TAPs exhibit neurotoxic health effects similar to DMM and emissions

estimates exceeded their respective WAC 173-460-150 Small Quantity Emission Rate values. The eight additional TAPs were included to produce a more comprehensive assessment of risk.

6.1.4 Reporting

The EPA promulgated the Air Emissions Reporting Rule (AERR) as implemented in federal regulation 40 CFR 51 Subpart A, "Air Emissions Reporting Requirements." The AERR requires state and local air pollution control agencies to submit emissions inventories for criteria pollutants to EPA's Emissions Inventory System. The EPA uses these submittals, to build the National Emissions Inventory. Ecology implements this AERR as a reporting requirement through WAC 173-400-105, "Records, Monitoring, and Reporting," and the Hanford Site AOP Section 5.9. Every year, facilities that have an AOP must send their Air Emissions Inventory (AEI) to Ecology electronically through the Washington Emissions Inventory Reporting System. Reporting TAP compounds in the AEI is not required unless explicitly specified in project-specific Ecology air permit approval orders. One exception to this TAP reporting exclusion is ammonia. Ammonia, included in the state list of TAPs but excluded from the federal list of HAPs, is specifically requested in the federal and state reporting regulations.

Hanford Site facilities use a combination of measurements and calculations to estimate emissions for the annual AEI report. Calculated emission estimates use published EPA formulae and emission factors (*Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources* [EPA 1995]). The AEI report organizes the emissions from across the Hanford Site into 19 reporting categories called "Emission Points." Each Emission Point can include data from a single source or multiple sources. The most significant source of emissions is combustion of fossil fuels diesel, gasoline, natural gas, and propane. Routine operations burn fossil fuels to produce steam and provide a local source of light and electricity. The largest fraction of emissions and sources in 2019 were:

- Oxides of nitrogen (15 tons); sitewide combustion of diesel fuel contributed 66% of this total
- Carbon monoxide (8 tons); boilers operating in the 300 Area contributed 74% of this total
- Volatile organic compounds (7 tons); the onsite gasoline vehicle fuel station contributed 80% of this total
- Ammonia (2 tons); the double shell tanks storing mixed radioactive and hazardous waste in the Tank Farms contributed 92% of this total.

Figures 6-1 and 6-2 show locations for sources contributing the largest fractions of non-radiological effluents. Table 6-3 summarizes the reported Hanford Site emissions of nonradioactive air pollutants discharged to the atmosphere in CY 2019. See the 2019 AEI report for more information (DOE 2020).

Figure 6-1. Sources Contributing to Volatile Organic Compounds and Ammonia Effluents.

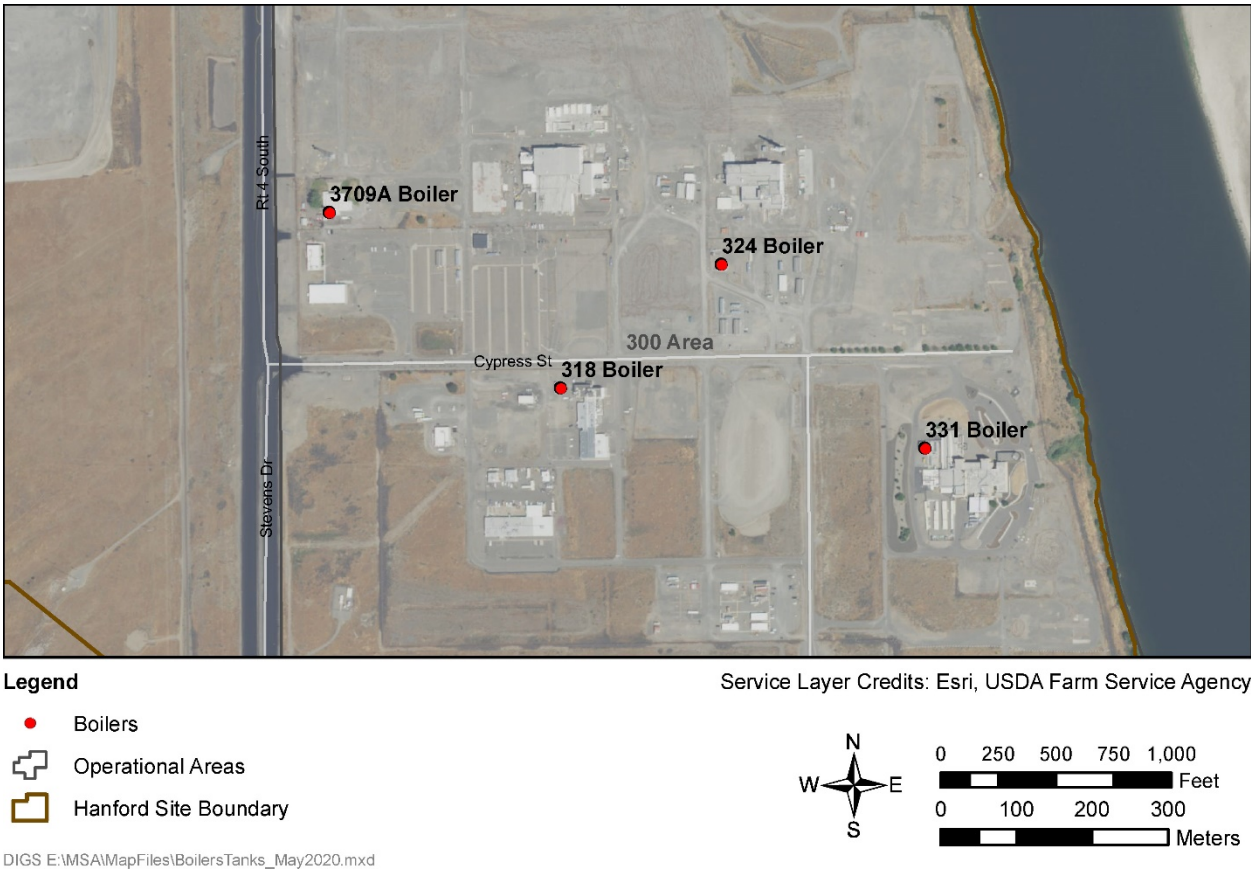


Figure 6-2. Sources Contributing to Carbon Monoxide Effluents.

Table 6-3. Calendar Year 2019 Hanford Site Air Emissions Inventory (DOE/RL-2020-07).

Pollutant	2019 Releases		
	Ton	lb	Kg
Particulate matter	1.0	2,057	933
Lead	0	0	0
Nitrogen oxides	14.7	29,625	13,438
Sulfur oxides	0.6	1,274	578
Carbon monoxide	8.5	16,980	7,702
Volatile organic compounds	6.5	12,961	5,879
Ammonia	2.0	3,911	1,774

6.2 Radioactive Air Monitoring

CJ Perkins

Atmospheric releases of radioactive materials from Hanford Site facilities and operations to the surrounding region are potential sources of exposure to humans. Radioactive constituents in air are monitored at Hanford Site facilities and operations at locations away from site facilities, offsite around

the perimeter, as well as in nearby and distant communities. Information about these air-monitoring efforts, including detailed descriptions of air sampling and analysis techniques, is provided in DOE/RL-91-50, *Hanford Site Environmental Monitoring Plan*.

Comparing measured radionuclide concentrations from locations on and around the Hanford Site, with those at upwind locations assumed to be uninfluenced by Hanford Site operations, provides an evaluation of the impact of radionuclide air emissions from the Hanford Site on surrounding air.

6.2.1 Hanford Site Air Monitoring

A network of continuously operating samplers at 78 locations across the Hanford Site was used during 2019 to monitor radioactive airborne materials in air near Hanford Site facilities and operations (Table 6-4). Most air samplers were located at or within approximately 1,640 ft (500 m) of sites and facilities, having the potential for or a history of environmental releases. The samplers were primarily located in the prevailing downwind direction. Samples were collected according to a schedule established before the 2019 monitoring year. Airborne particle samples were collected at each location by drawing air through a cellulose filter. The filters were collected biweekly, field-surveyed for gross radioactivity, held for at least 5 days, and then analyzed for gross alpha and beta activity. The 5-day holding period is necessary to allow for the decay of naturally occurring, short-lived radionuclides that would otherwise obscure the detection of longer-lived radionuclides associated with emissions from nuclear facilities. The gross radioactivity measurements were used to indicate changes in trends in the onsite facility environment.

Table 6-4. Hanford Site Monitoring Locations and Analyses for Air Monitoring Samples. (2 Pages)

Air Monitoring Locations	EDP Codes	Bi-Weekly	Semi-Annual Composite
Onsite			
100-K Area	N476, N534, N535, N575, N576[a], N578, N900[b]	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, ^{241}Pu, ^{241}Am, GEA
100-B Area	N588[a]	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, GEA, ^{241} Am
200-East Area	N019, N158, N498, N499[a], N582, N957, N967, N968, N969, N970, N972, N973, N976, N977[a], N978, N984, N985[a], N999, N931[b], N932	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, GEA
WTP (200-East Area)	N583, N584, N920[b], N924	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, GEA, ^{241} Am
CSB (200-East Area)	N480, N481	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, ^{241}Pu, ^{241}Am, GEA
IDF (200-East Area)	N532, N559	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, GEA
200-West Area	N161, N168, N304, N441, N442, N449, N456, N457, N956, N963, N965, N966, N974, N987, N994, N901	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, GEA
Plutonium Finishing Plant (200-West Area)	N155, N165, N433, N554[a], N555[a], N964, N975[a]	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, ^{241}Pu, ^{241}Am, GEA
300 Area	N130[a, b], N557, N902[b], N903[a, b], N904[b], N905[a, b], N918[b]	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, GEA

Table 6-4. Hanford Site Monitoring Locations and Analyses for Air Monitoring Samples. (2 Pages)

Air Monitoring Locations	EDP Codes	Bi-Weekly	Semi-Annual Composite
400 Area	N911, N912[b]	Alpha, Beta	^{90}Sr, Pu-iso, GEA
600 Area	N928, N929, N930, N587[a]	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, GEA
ERDF	N482[a], N517, N518	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, GEA
Wye Barricade	N906, N981[a]	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, GEA
LIGO	N589[a]	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, GEA
Perimeter			
Ringold Met Tower	N933[b]	Alpha, Beta	Pu-iso, GEA, ^{241}Am
W End of Fir Road	N934[a, b]	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, GEA, ^{241}Am
Dogwood Met Tower	N935[b]	Alpha, Beta	^{90}Sr, U-iso, GEA, ^{241} Am
Byers Landing	N936[b]	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, GEA, ^{241}Am
Battelle Complex	N937[a, b]	Alpha, Beta	U-iso, GEA, ^{241} Am
Horn Rapids Substation	N938	Alpha, Beta	^{90}Sr, Pu-iso, GEA, ^{241}Am
Prosser Barricade	N939[a, b]	Alpha, Beta	^{90}Sr, Pu-iso, GEA, ^{241}Am
Yakima Barricade	N907[a]	Alpha, Beta	^{90}Sr, Pu-iso, GEA, ^{241}Am
Rattlesnake Springs	N940	Alpha, Beta	^{90}Sr, Pu-iso, GEA
Wahluke Slope	N941[b]	Alpha, Beta	^{90}Sr, Pu-iso, GEA, ^{241}Am
S End Vernita Bridge	N942	Alpha, Beta	^{90}Sr, Pu-iso, GEA, ^{241}Am
Offsite Nearby Community			
Basin City School	N943[b]	Alpha, Beta	Pu-iso, U-iso, GEA, ^{241}Am
Leslie Groves-Richland	N944[b]	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, GEA, ^{241}Am
Pasco	N945	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, GEA, ^{241}Am
Kennewick-Ely Street	N946	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, GEA
Benton City	N947	Alpha, Beta	GEA, ^{241}Am
Mattawa	N948	Alpha, Beta	GEA
Othello	N949	Alpha, Beta	U-iso, GEA, ^{241}Am
Offsite Distant Community			
Yakima	N909[b]	Alpha, Beta	^{90}Sr, Pu-iso, U-iso, GEA, ^{241}Am

[a] Collocated sampling location with WDOH
[b] Tritium air sampler
CSB = Container Storage Building
EDP Code = environmental data point code = sampler location code
ERDF = Environmental Restoration Disposal Facility
GEA = Gamma Energy Analysis
IDF = Integrated Disposal Facility
LIGO = Laser Interferometer Gravitational-Wave Observatory
WTP = Waste Treatment Plant
WDOH = Washington State Department of Health

For most specific radionuclide analyses, radioactive material collected on a single filter during a 2-week period was too small to be measured accurately. Individual samples collected at each location were combined into semiannual, location-specific composite samples (Table 6-4) to increase accuracy.

Composite samples were routinely analyzed for gamma-emitting isotopes, strontium-90, uranium-234, uranium-235, plutonium-238, uranium-238, and plutonium-239/240. Americium-241 and plutonium-241 were analyzed at locations associated with spent nuclear fuel processing.

Atmospheric water vapor was collected for tritium analysis at 20 locations in 2019 by continuously drawing air through multi-column samplers containing adsorbent silica gel. The water-vapor samplers were exchanged every 4 weeks to prevent sample loss as a result of breakthrough (i.e., oversaturation). The collection efficiency of the silica gel adsorbent is discussed in "Ambient Air Sampling for Tritium-Determination of Breakthrough Volumes and Collection Efficiencies for Silica Gel Adsorbent" (Patton et al. 1997). The collected water was distilled from the silica gel and analyzed for its tritium content.

Figure 6-3 shows the annual average air concentrations of selected radionuclides in the 100, 200, and 600 Areas compared to EPA concentration values and air concentrations measured in distant communities. EPA concentration values (40 CFR 61, Appendix E, Table 2) are dose-based reference values that would result in a dose of 10 mrem (100 µSv)/yr under conditions of continuous exposure. The 2019 data indicate a large degree of variability by location. Air samples collected from locations at or directly adjacent to Hanford Site facilities had higher radionuclide concentrations than samples collected farther away. In general, analytical results for most radionuclides were at or near Hanford Site background levels, which are much less than EPA concentration values but greater than those measured offsite. Data also show that concentrations of certain radionuclides were higher and widely variable within different Hanford Site operational areas. Appendix C, Table C-3 shows the annual average and maximum concentrations of radionuclides in air samples collected during 2019.

6.2.1.1 Monitoring Results

100-K Area. Air was monitored in 2019 at seven locations in the 100-K Area, and analytical results showed radionuclide concentrations at or below typical Hanford Site levels. Cesium-137 and uranium-238 were detected in approximately 15% of the samples. All other radionuclides of concern were below analytical detection limits.

200-East Area. Air sampling was conducted at 28 locations in the 200-East Area during 2019. Generally, radionuclide levels measured were similar to those in previous years. Cesium-137 was detected in approximately 10% of the samples. Uranium-234 and uranium-238 were detected in approximately 20% of the samples.

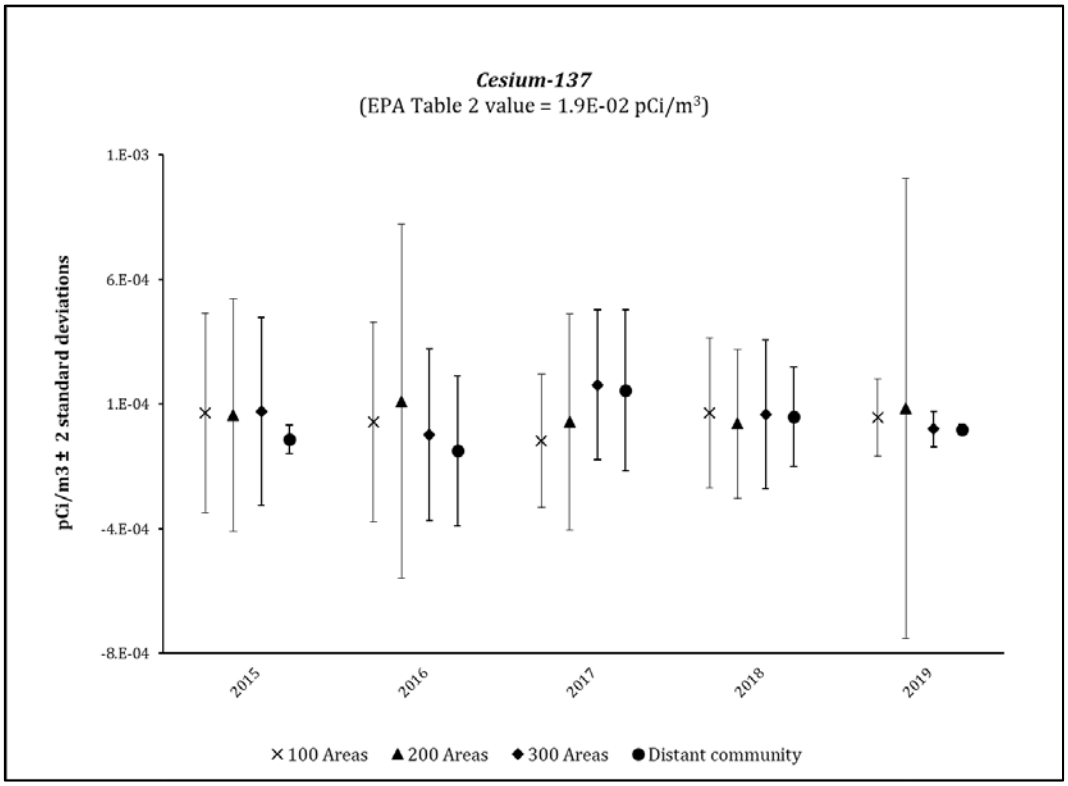
200-West Area. Air sampling was conducted at 23 locations in the 200-West Area during 2019. Radionuclide levels measured were, in general, similar to results for previous years. Uranium-234 and uranium-238 were detected in less than 10% of the samples. Plutonium-239/240 and americium-241 were detected in approximately 17% of the samples.

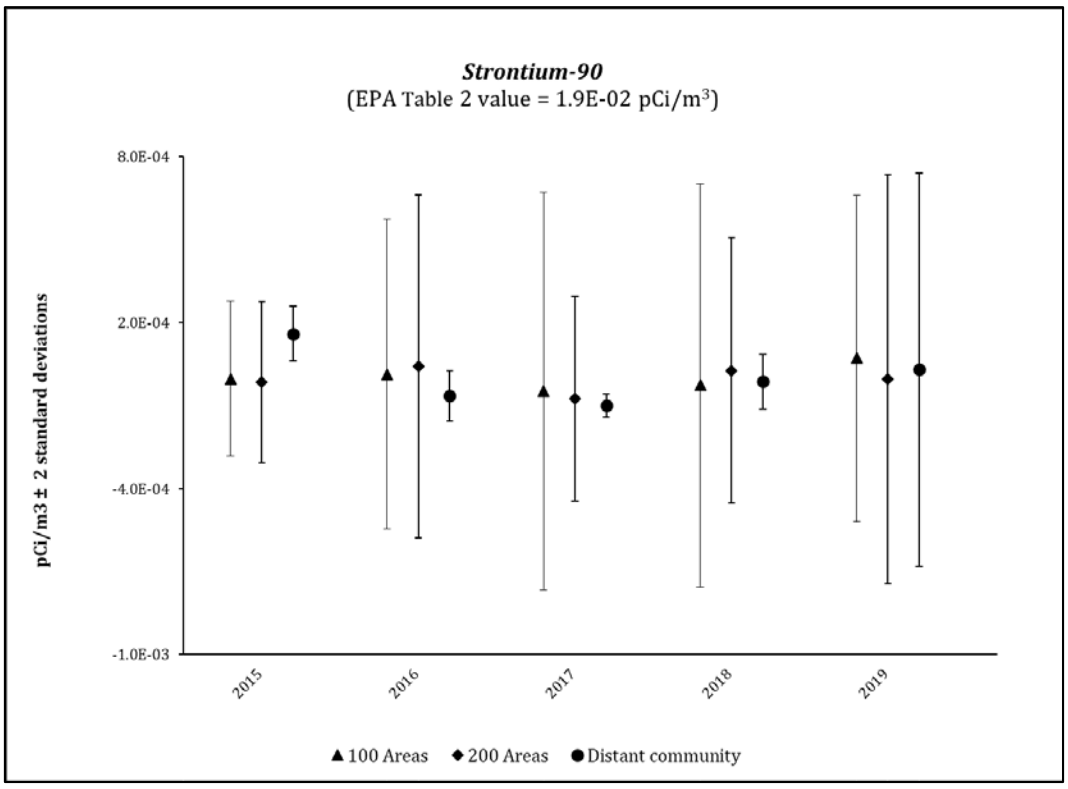
Plutonium Finishing Plant (200-West Area) Demolition. Low-risk clean-up activities continued at the Plutonium Finishing Plant during 2019 No airborne releases of radiological materials occurred during the year and air sample results obtained from seven sampling stations were at levels typically measured in the 200-West Area. Plutonium-239/240 was detected in approximately 50% of the samples and americium-241 was detected in approximately 30% of the samples.

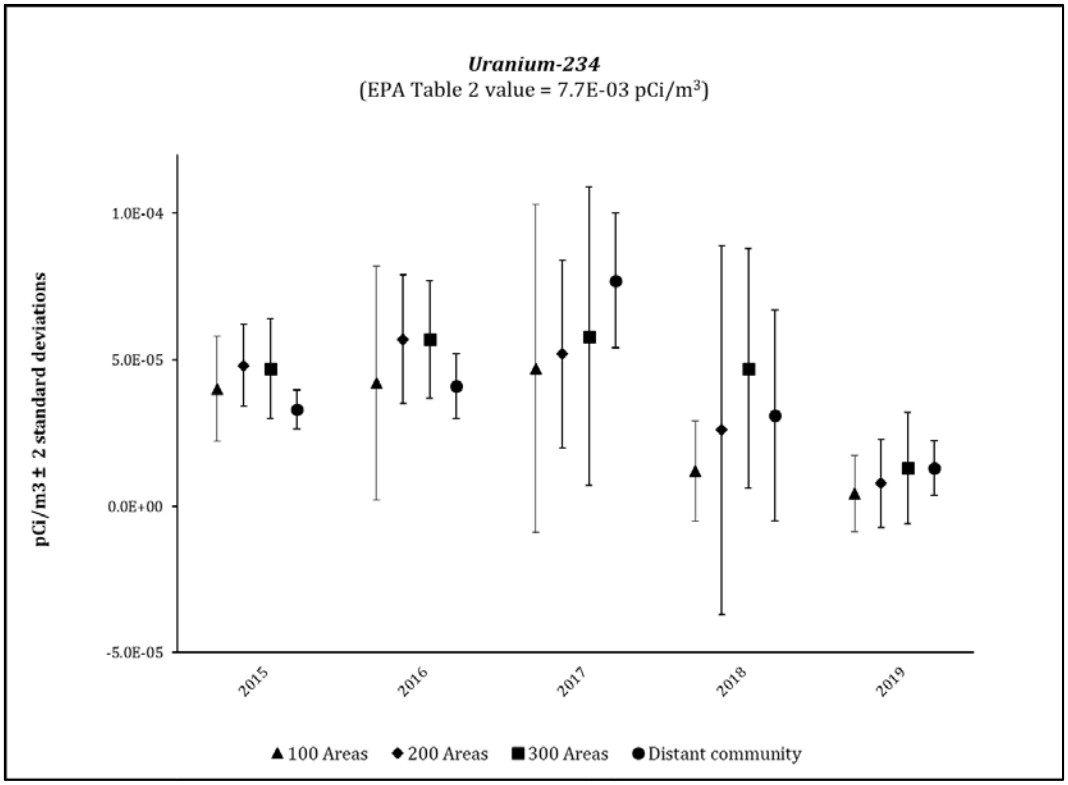
300 Area. Air sampling was conducted at seven locations in/near the 300 Area during 2019. At stations within the 300 Area, analytical results showed radionuclide concentrations similar to previous years'

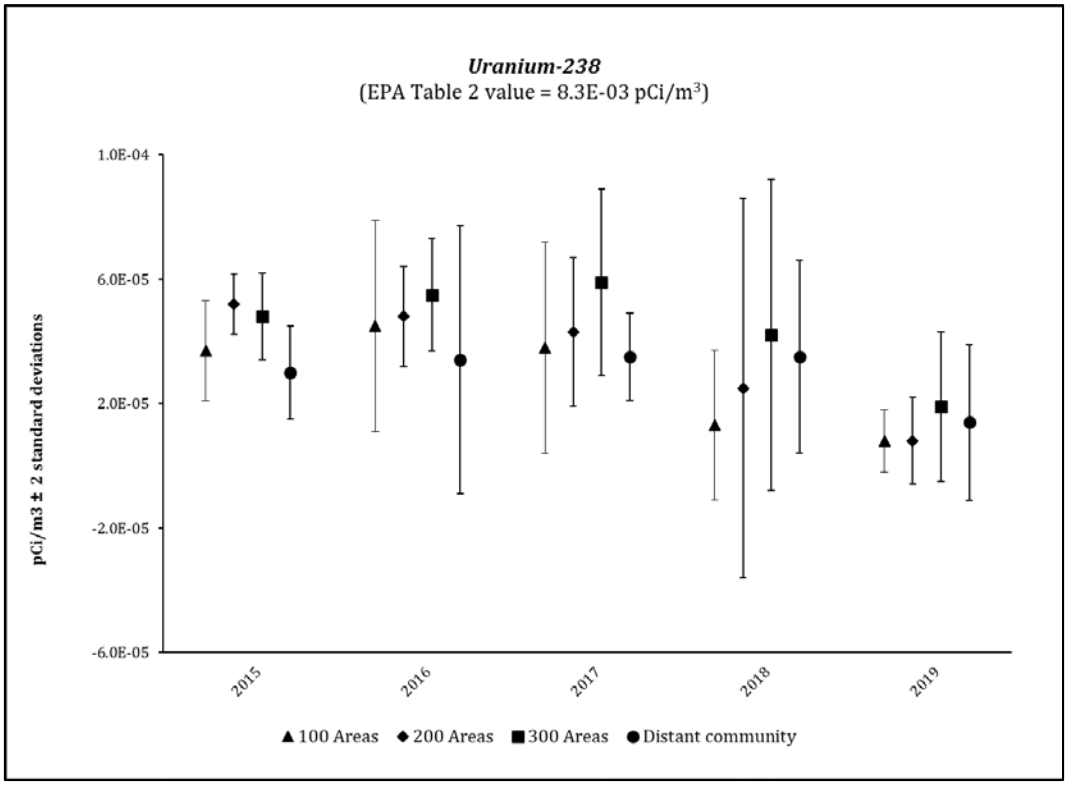
results. Uranium-234 and uranium-238 were detected in approximately 30% and 60% of the samples, respectively; tritium was detected in approximately 2% of the samples. All other radionuclides of concern were below analytical detection limits. At the 300 Treatment Effluent Disposal Facility station located just north of the 300 Area, air sample results were similar to those measured in previous years. Tritium was not detected in samples collected during 2019.

Environmental Restoration Disposal Facility (ERDF). Air sampling in support of ERDF operations was conducted at five locations at ERDF. These locations included three project-specific stations and two upwind stations that are part of the 200-West Area monitoring network. Radionuclide levels measured at this site were lower than previous years. No radionuclides were detected in samples collected during 2019.




Strontium-90
(EPA Table 2 value = 1.9E-02 pCi/m3)
8.0E-04
2.0E-04
-4.0E-04
-1.0E-03
pCi/m3 ± 2 standard deviations
2015
2016
2017
2018
2019
100 Areas
200 Areas
Distant community


Uranium-234
(EPA Table 2 value = 7.7E-03 pCi/m3)
1.0E-04
5.0E-05
0.0E+00
-5.0E-05
pCi/m3 ± 2 standard deviations
2015
2016
2017
2018
2019
100 Areas
200 Areas
300 Areas
Distant community



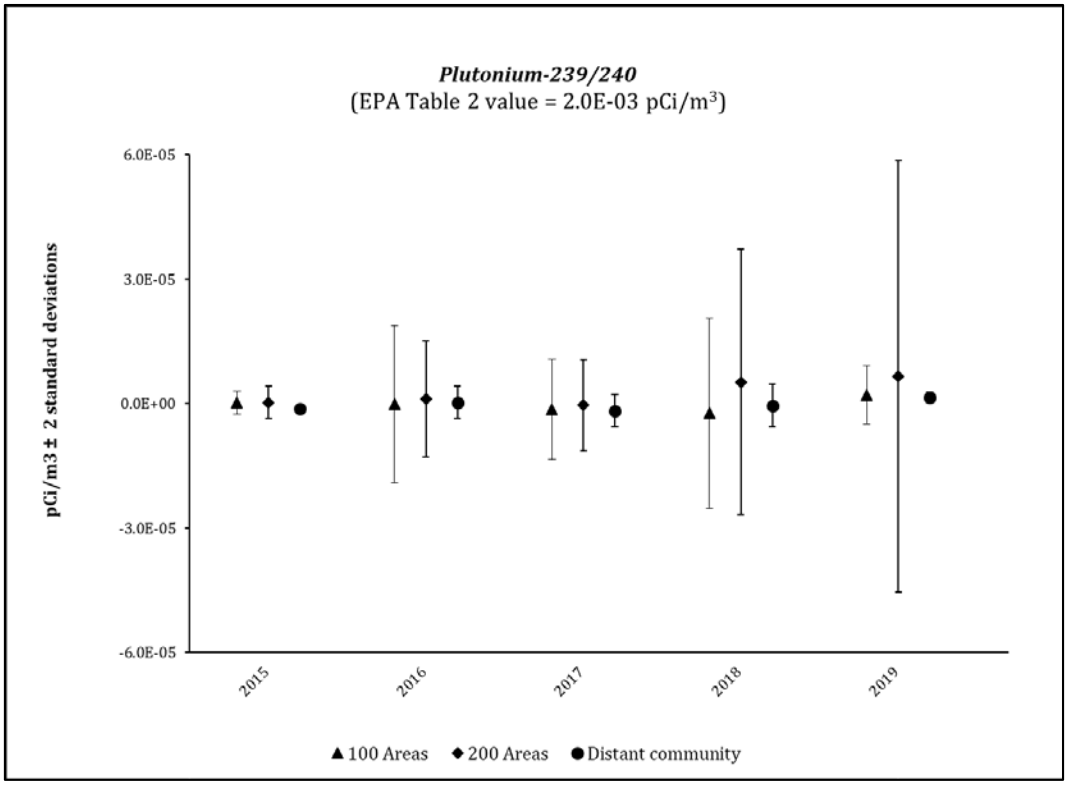


Figure 6-3. Hanford Site Average Radionuclide Concentrations in Air Samples Compared to Distant Community Samples.

NOTE: Because of figure scale, some uncertainties (error bars) are concealed by the point symbol

6.2.2 Perimeter and Offsite Air Monitoring

Airborne radionuclide samples were collected in 2019 by 19 continuously operating samplers in the vicinity of the Hanford Site. The stations were grouped into 3 proximity categories: perimeter (11 stations), nearby Hanford Site communities (7 stations), and distant community (1 station) (Figure 6-4; Appendix C, Table C-3). Perimeter samplers were located around the site boundary with emphasis on prevailing downwind directions to the south and east. Samplers located in Basin City, Benton City, Kennewick, Mattawa, Othello, Pasco, and Richland, Washington, provided data for the nearest population centers. A sampler in Yakima, Washington, provided background data from a community essentially unaffected by Hanford Site operations.

6.2.2.1 Monitoring Results.

Sample results in 2019 showed very low radiological concentrations in air. Gross alpha and gross beta concentrations in the air samples collected in 2019 from the perimeter and nearby Hanford Site communities were comparable to each other and slightly higher than samples from the distant community. Concentrations in 2019 were comparable to concentrations seen in the previous 5 years. Gross beta and gross alpha concentrations in air peak during the fall and winter months, exhibiting a pattern of natural radioactivity fluctuations (Eisenbud 1987). This fluctuation is seen in both Hanford Site and distant location concentrations.

Uranium-234 and -238 were both detected in approximately 50% of the air samples collected in 2019 from all locations. Uranium-234 and uranium-238 concentrations were at levels similar to those measured in previous years. The maximum concentrations measured in all locations were less than 10% of the EPA concentration values for both radionuclides.

Tritium, cesium-137, strontium-90, and plutonium isotopes were not detected in any of the offsite air samples collected during 2019. Annual average results from 2015 through 2019 for selected radionuclides are compared to onsite values in Figure 6-5.

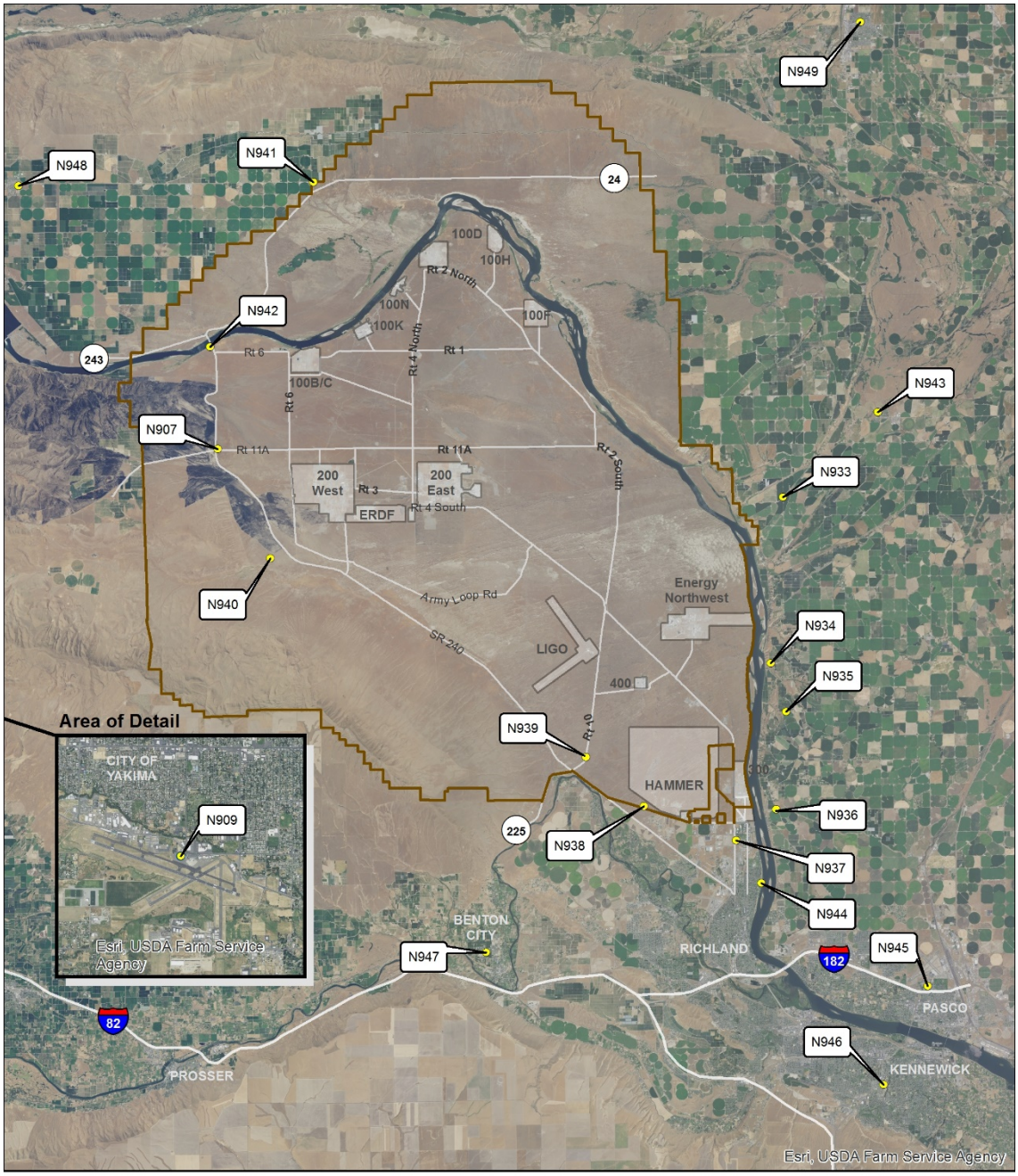
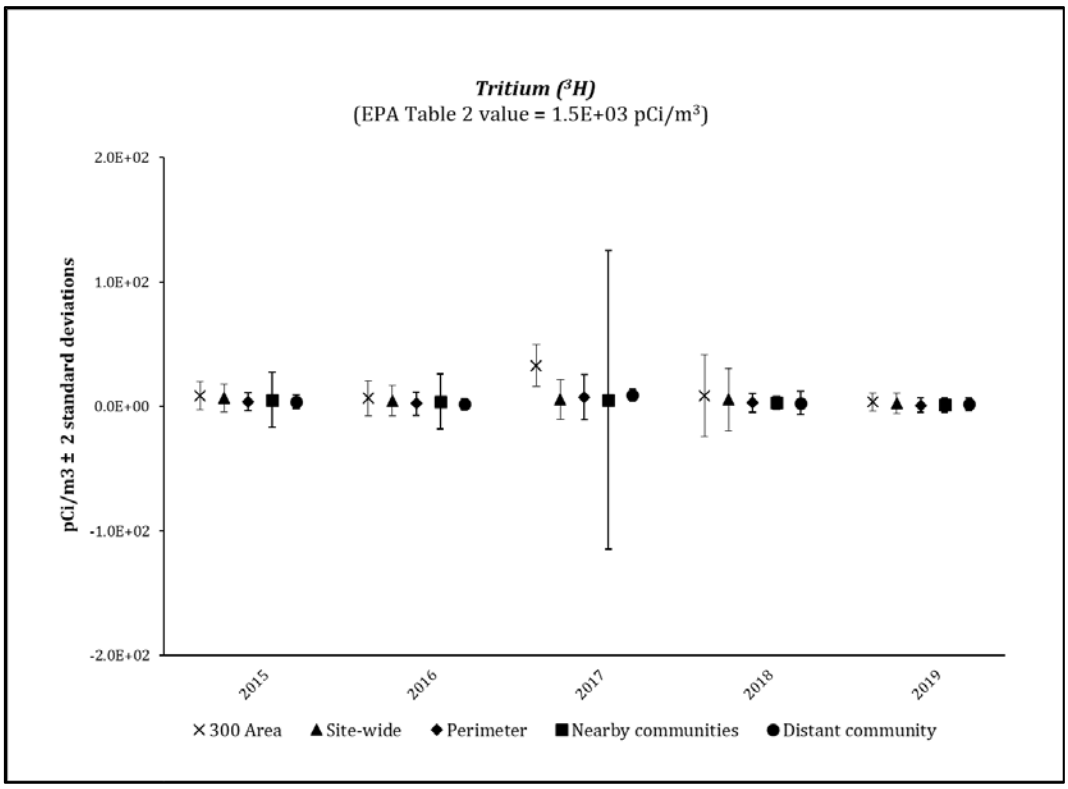
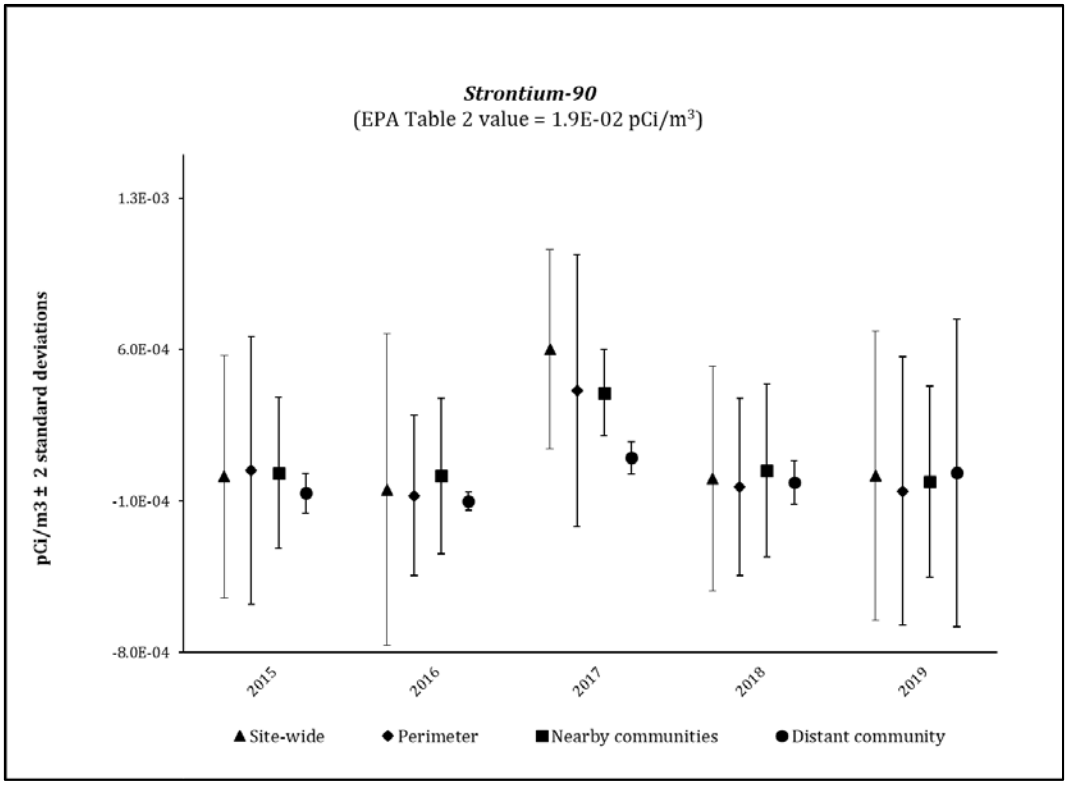
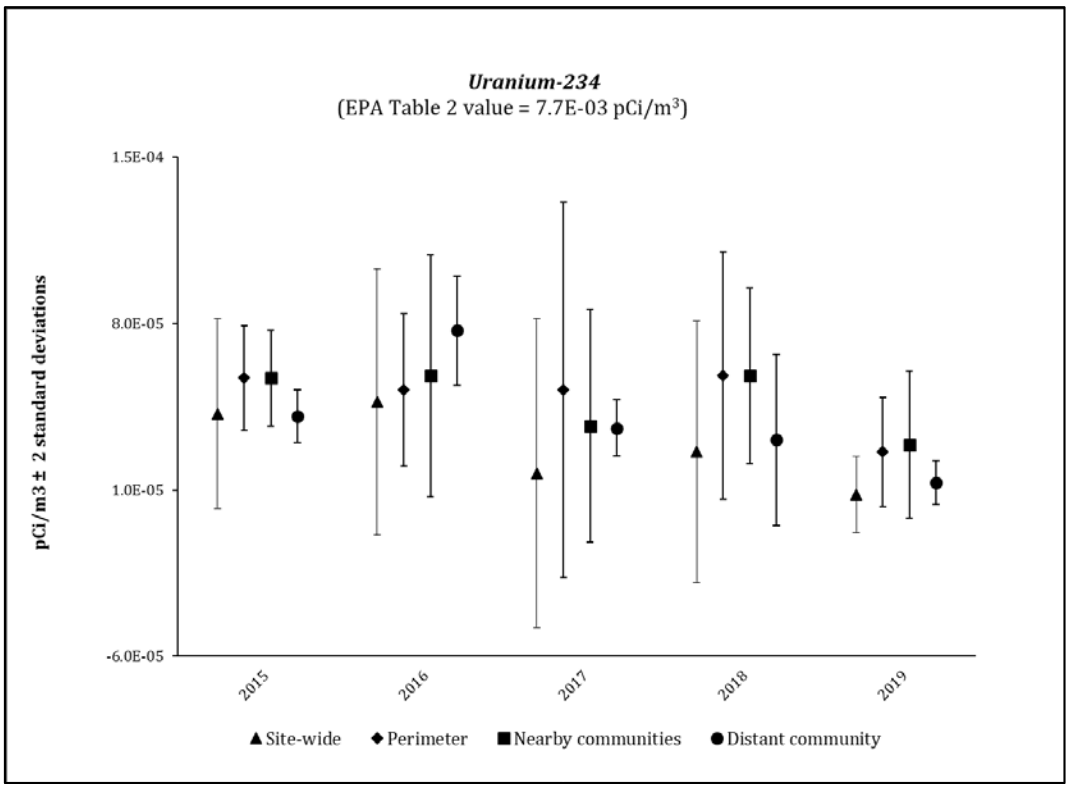
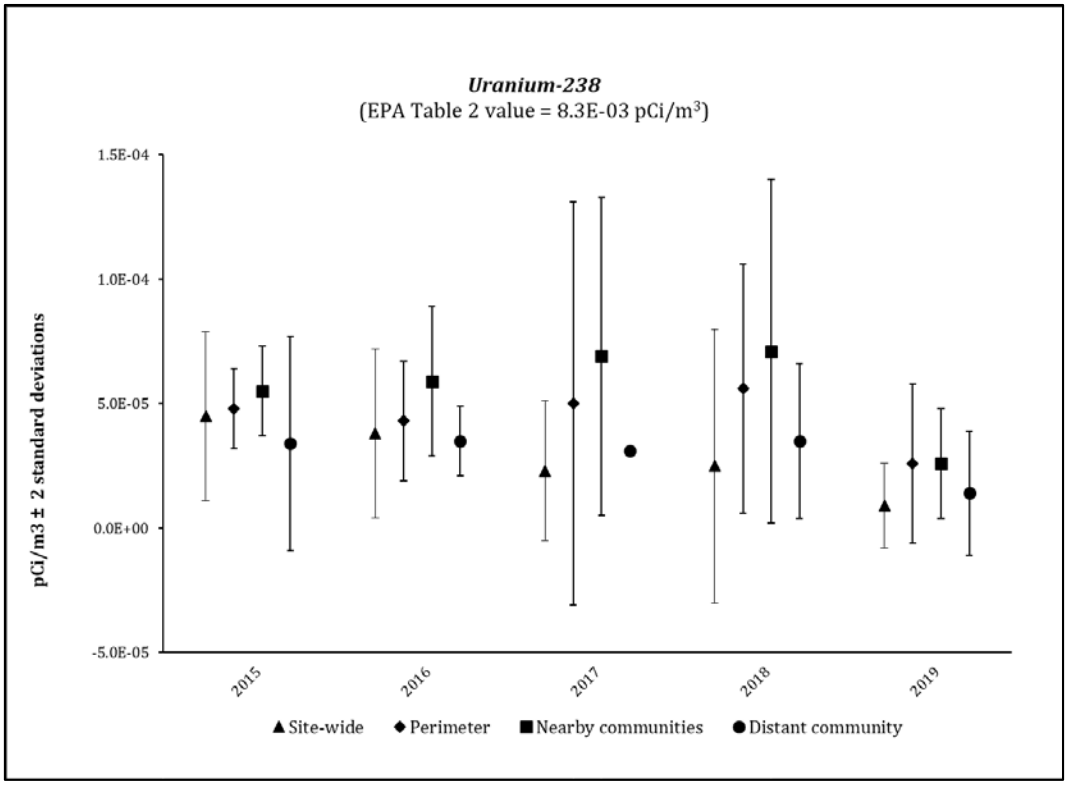


Figure 6-4. Offsite Air Sampling Locations for Calendar Year 2019.


Tritium (3H)
(EPA Table 2 value = 1.5E+03 pCi/m3)
2.0E+02
1.0E+02
0.0E+00
-1.0E+02
-2.0E+02
pCi/m3 ± 2 standard deviations
2015
2016
2017
2018
2019
300 Area
Site-wide
Perimeter
Nearby communities
Distant community


Strontium-90
(EPA Table 2 value = 1.9E-02 pCi/m3)
1.3E-03
6.0E-04
-1.0E-04
-8.0E-04
pCi/m3 ± 2 standard deviations
2015
2016
2017
2018
2019
Site-wide
Perimeter
Nearby communities
Distant community


Uranium-234
(EPA Table 2 value = 7.7E-03 pCi/m3)
pCi/m3 ± 2 standard deviations
1.5E-04
8.0E-05
1.0E-05
-6.0E-05
2015
2016
2017
2018
2019
Site-wide
Perimeter
Nearby communities
Distant community


Uranium-238
(EPA Table 2 value = 8.3E-03 pCi/m3)
pCi/m3 ± 2 standard deviations
1.5E-04
1.0E-04
5.0E-05
0.0E+00
-5.0E-05
2015
2016
2017
2018
2019
Site-wide
Perimeter
Nearby communities
Distant community

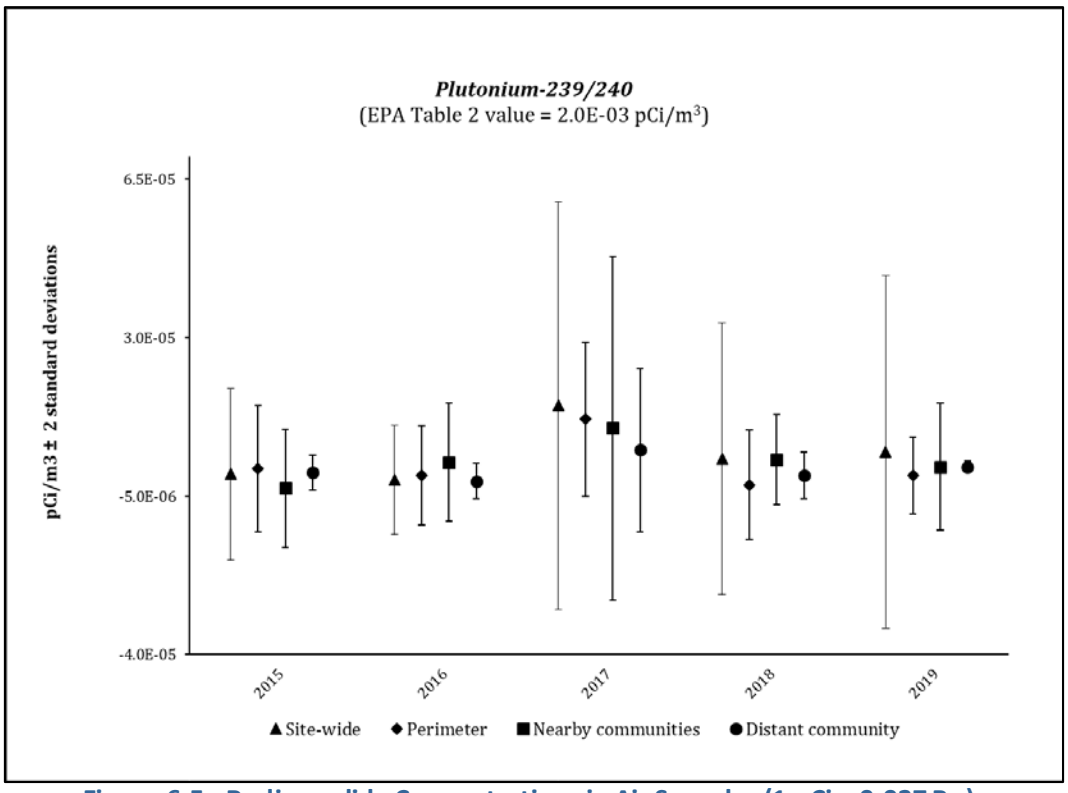


Figure 6-5. Radionuclide Concentrations in Air Samples (1 pCi = 0.037 Bq).

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