Executive Summary

Since 1959, the U.S. Department of Energy (DOE) has prepared an annual Hanford Site environmental report in accordance with DOE Order (O) 231.1B, *Environment, Safety and Health Reporting* and DOE O 458.1, *Radiation Protection of the Public and the Environment*. The purpose of the *Hanford Site Environmental Report for Calendar Year 2015* is to inform the public, regulators, employees, and other stakeholders of environmental and operating performance during the year. This report summarizes environmental data; environmental management performance; compliance with applicable federal, state, and local regulations; and radiological releases and doses to the public resulting from site operations.

All previous annual Hanford Site environmental reports are available online through Mission Support Alliance, LLC (MSA) at http://msa.hanford.gov/page.cfm/enviroreports. The following sections summarize this year's annual report.

Section 1, Introduction

The approximately 580 square mile (mi^2; 1,502 square kilometer [km^2]) Hanford Site is located along the Columbia River north of the City of Richland in southeastern Washington State. Situated within the semiarid Pasco Basin of the Columbia Plateau, the Hanford Site was established in 1943 to produce plutonium for nuclear weapons. The site has restricted public access and provides a buffer for areas used for former nuclear materials production, waste storage, and waste disposal. Beginning in 1989, the primary mission of the Hanford Site has been to clean up the extensive contamination on the site as a result of plutonium production. The current mission focuses on environmental restoration of the site, focusing on remediation of contaminated areas, facility decontamination and decommissioning, waste management activities and operations, and scientific and environmental research and development. With the late 2015 establishment of the Manhattan Project National Historical Park, within which the Hanford B Reactor and other Hanford Site structures lie, added mission objectives include historic preservation and public education.

The Richland Operations Office (RL) and Office of River Protection (ORP) jointly manage the Hanford Site through several contractors and subcontractors. RL serves as the property owner and is responsible for cleaning up the river corridor (a 51-mi [82 km] stretch of the Columbia River) and the Central Plateau as well as remediating groundwater sitewide. Additionally, RL oversees environmental management operations and landlord services that support the site. RL, the U.S. Fish and Wildlife Service, and the Washington Department of Fish and Wildlife (WDFW) all manage portions of the Hanford Reach National Monument. Uniquely located in three states (Tennessee and New Mexico in addition to Washington state's Hanford Site), the Manhattan Project National Historical Park partners DOE with its oversight and management of the three sites with the National Park Service for visitor services and historical interpretation and preservation.

ORP manages the retrieval, treatment, and disposal of approximately 56 million gallons (gal; 213 million liters [L]) of radioactive tank waste currently stored in 177 underground tanks in Hanford's Central Plateau. ORP is responsible for safely operating the Hanford tank farms, and constructing and operating the Waste Treatment and Immobilization Plant (WTP).

Section 2, Compliance Summary

To ensure the protection of human health and the environment through safe operations, DOE implements compliance programs designed to fulfill requirements of applicable federal, state, and local environmental laws and regulations, and DOE orders, directives, policies, and guidelines. In addition, the Hanford Site operates under permits required under specific environmental protection regulations. Several federal, state, and local regulatory agencies are responsible for monitoring and enforcing compliance, including the U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), Washington State Department of Health (WDOH), and the Benton Clean Air Agency. EPA is the primary federal regulatory agency that develops, promulgates, and enforces environmental regulations and standards as directed in statutes enacted by Congress. In addition, the *Hanford Federal Facility Agreement and Consent Order* (also called the Tri-Party Agreement [TPA]) commits DOE to comply with the remedial-action provisions of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) as well as the *Resource Conservation and Recovery Act of 1976* (RCRA) treatment, storage, and disposal (TSD) unit regulations and corrective-action provisions.

Tri-Party Agreement. From 1989 through December 31, 2015, a total of 1,265 TPA milestones were completed, and 336 target dates were met. During 2015, 40 specific cleanup milestones were scheduled for completion; of those, 30 milestones were completed on time, no milestones were missed, 5 were in negotiation, and 5 were in dispute resolution. In addition, 4 target dates were met.

Federal Facility Compliance Act. DOE met the annual requirement to report mixed waste information to EPA and the states (*Calendar Year 2014 Hanford Site Mixed Waste Land Disposal Restrictions Full Report*).

Regulatory Inspections. During calendar year (CY) 2015, 86 regulatory agency inspections were conducted at DOE facilities on the Hanford Site: Ecology conducted 48, WDOH 26, EPA (Region 10) 5, City of Richland 2, and DOE 5. There were 27 regulatory agency compliance actions (54 concerns and 72 compliance actions) resulting from inspections that contributed to $169,722 in fines and penalties for CY 2015.

RCRA. The Ecology and EPA inspections focused on TSD unit compliance with the *Hanford Facility Dangerous Waste Permit* (1994) and WAC 173-303, "Dangerous Waste Regulations." Waste accumulation and universal waste management areas were also inspected.

CERCLA. Field inspections of institutional controls were conducted in 2015 at waste sites on the Hanford Site. No public trespass events occurred and all approved excavation permits were in place for all active remediation activities. Site contractors provide an annual update on the effectiveness of the institutional controls to EPA and Ecology at the Area Unit Managers Meetings conducted every September.

Hanford Site Emission Sources. The WDOH inspections focused on compliance of major and minor stack air emission units with the Air Operating Permit and Radioactive Air Emissions License FF-01. EPA inspections focused on asbestos management under 40 Code of Federal Regulations (CFR) Part 61, Subpart M "National Emission Standards for Hazardous Air Pollutants (NESHAPs) for Asbestos." City of Richland inspections are limited to the 300 Area of the Hanford Site and involve implementation of the terms and conditions of the Industrial Wastewater Permit and discharges to the publicly owned treatment works.

Environmental Occurrences. Environmental releases of radioactive and regulated materials from the Hanford Site are reported as legally required under the following categories: Operational Emergency;

Recurring; Category 1 (significant impact); Category 2 (moderate impact); Category 3 (minor impact); and Category 4 (some impact). In 2015, there were no events for Category 1, 2, and 3; however, 46 Category 4 events occurred as a result of the discovery of legacy contamination at the Hanford Site.

Emergency Planning and Community Right to Know Act. The *2015 Hanford Site Toxic Chemical Release Inventory* report was submitted to EPA and Ecology before the annual July 1 deadline. During CY 2015, the Hanford Site exceeded activity thresholds for lead, naphthalene, propylene, toluene, and xylene.

Pollution Prevention Program. In 2015, over 2,248 tons (2,040 metric tons [MT]) of non-hazardous (plastic, aluminum, cardboard, paper, wood, and metal) and hazardous (antifreeze, batteries, bulbs, and oils) wastes were recycled through Hanford Site programs administered through the Mission Support Contract. Along with material recycling and diversion, greenhouse gas (GHG) emissions for FY 2015 decreased from FY 2014, largely due to a decrease in fleet diesel fuel use. In addition, the site reflected a 39% reduction in Scope 3 GHG emissions in FY 2015 from the FY 2008 baseline. Contractors at the Hanford Site continued to divert construction and demolition from landfill disposal, diverting approximately 980% (1,902 MT) of debris from the inert landfill.

Section 3, Environmental Management System

Environmental management performance measures objectives for 2015 included fleet management, alternative fuel use, potable and non-potable water use, electricity use, facility fuel use, facility energy use, electronic product environmental assessment tool, sanitary waste reduction, and regulated waste reduction. Objectives for 2015 were achieved for all performance measures, except for the target objective for standard electricity not met in FY 2015. The alternative fuel use target and electronic product environmental assessment tool were exceeded in 2015.

Section 4, Radiological Protection and Doses

Hanford Site radiation protection program staff conduct ongoing monitoring of external radiation sources; perform environmental radiological surveys; and evaluate potential radiological doses to the public. Results of 2015 monitoring efforts are provided below.

External Radiation Monitoring. Sources of external radiation at the Hanford Site include waste materials associated with former plutonium production and processing facilities; radioactive waste handling, storage, and disposal; and cleanup and remediation activities. In 2015, external radiation fields were monitored at 115 locations near Hanford Site facilities and operations, including the 100-K Area, 100-N Area Shoreline (N Springs), 200 Area, 300 Area, 400 Area, Environmental Restoration Disposal Facility (ERDF), 618-10 Burial Ground, and Integrated Disposal Facility (IDF).

In early 2015, the Hanford External Dosimetry Program's (HEDP) laboratory was relocated from its long-time location near the 300 Area and to between the 200 East and 200 West areas. This relocation introduced two substantial variances for 2015 data: first, approximately 50% higher background dose rate levels were attributable to elevated radon levels inherent in the new HEDP facility, producing artificially decreased dose rate values for 2015 compared to previous years' values. Second, the material used for shielding dosimeters was changed from lead (pre-2015), a substantially better material than the steel shielding used for 2015. The effect of this change was exposing dosimeters to significantly higher background levels and ultimately causing higher dose rate readings. Thus, due to complexities and

uncertainties imparted on 2015 data by these HEDP facility changes, annual data comparisons are impractical and were not reported. Comparative data reporting will resume once the HEDP laboratory background and shielding values are stable.

Radiological Release of Hanford Site Property. No property with detectable residual radioactivity above authorized limits was released from the Hanford Site in 2015.

Radiological Clearance for Potentially Contaminated Personal Property with Hard-to-Detect Radionuclides. More than 19,000 items of personal property were unconditionally released from radiological areas on the Hanford Site; however, the majority of the items did not leave the site. These items primarily consisted of small articles such as flashlights, hard hats, radios, cameras, pens, pencils, respiratory protection, radiological control instruments, and industrial hygiene instruments.

Radiological Clearance for Granular Activated Carbon for Off-site Shipment and Regeneration. A granular activated carbon canister from a soil-vapor extraction system was removed from the system and shipped to an off-site facility for regeneration and reuse. As an estimated value from variance over time with the exact volume processed, approximately 150,000 pounds (lbs; 68,000 kilograms [kg]) of granular activated carbon was shipped off site in 2015 for regeneration.

Potential Radiological Doses to the Public. In 2015, scientists evaluated potential radiological dose to the public and biota resulting from exposure to Hanford Site liquid effluents and airborne emissions to determine compliance with pertinent regulations and limits. The primary sources of radionuclide contamination evaluated in the dose assessment included gaseous emissions from stacks and ventilation exhausts, contaminated groundwater seeping into the Columbia River, and fugitive emissions from areas of contaminated soil and operating facilities. Potential radiological doses from 2015 Hanford Site operations were evaluated in detail to determine compliance with pertinent regulations and limits. Radiological doses were assessed in terms of the following:

- Dose to a hypothetical maximally exposed individual (MEI) at an off-site location
- Collective dose to the population residing within 50 mi (80 km) of Hanford Site operation areas
- Doses for air pathways calculated using regulation-specified EPA methods for comparison to the Clean Air Act standards in 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities"
- Doses from recreational activities, including hunting and fishing
- Dose to a worker consuming drinking water on the Hanford Site
- Dose to a visitor of the Manhattan Project National Historical Park
- Doses from non-DOE industrial sources on and near the Hanford Site
- Absorbed dose received by biota exposed to radionuclide releases to the Columbia River and to radionuclides in on-site surface water bodies.

The MEI is a hypothetical person whose location and assumed exposures are modeled in such a protective manner that it is highly unlikely any actual off-site individual would have received a higher Hanford-related dose. The dose to the MEI calculated in 2015 from Hanford Site operations was 0.21 mrem (2.1 mSv), which is 0.21% of the 100 mrem (1000 mSv)/yr public dose limit specified in DOE O 458.1. Many different exposure pathways are included in the dose calculations, but ingestion of food containing tritium from 300 Area air emissions was the single largest contributor. Based on the 50-mi (80-km) radius

population exposed to air emissions and the surrounding population exposed to water pathways releases to the Columbia River, the average individual dose from Hanford Site operations in 2015 was protectively estimated to be 0.0058 mrem (0.058 mSv). Doses calculated for recreational activities based on game and fish tissue samples (0.012 mrem (0.12 mSv)/yr), ingestion of Hanford Site drinking water from a 400 Area well (0.021 mrem (0.21 mSv)/yr), and visitors of the Hanford Townsite and White Bluffs Bank locations of the Manhattan Project National Historical Park (0.00034 mrem (0.0034 mSv)/yr) were likewise far below the public dose limit. To place this information into perspective, these doses may be compared with those received from other routinely encountered sources of radiation. A 2009 National Council on Radiation Protection and Measurements report estimated that the overall average exposure to ionizing radiation for the average American is 620 mrem (6,200 mSv)/yr, approximately half of which is related to natural sources and the other half attributable primarily to medical procedures.

Section 5, Environmental Restoration and Waste Management

Below is a waste summary for environmental restoration and waste management activities, including Hanford Site River Corridor closure, cleanup and remediation, facility decommissioning, waste management operations, underground waste storage tank status, construction of the Waste Treatment and Immobilization Plant and its associated facilities, and research activities related to waste cleanup. The following describes important 2015 cleanup and remediation activities at the Hanford Site.

River Corridor. The River Corridor includes the Hanford Site 100 and 300 areas that border the Columbia River. Through 2015, transitions are complete for 190 of 220 mi^2 (492 of 570 km^2) of the River Corridor.

100 Area Waste Sites. The 100 Area waste sites vary in complexity and waste type. Typical waste sites include waste burial grounds, liquid effluent waste sites, burn pits, retired septic systems, piping systems, and miscellaneous waste sites. In 2015, remediation activities focused on hexavalent chromium release sites, pipeline sites, and miscellaneous waste sites. A total of 884,500 tons (802,400 MT) of contaminated soil and debris were removed from 100 Area remediation activities and were disposed of at the ERDF.

100-K Area. The 105-KE Reactor Building continued interim safe storage, reactor penetration sealing engineering, and safe storage enclosure; construction activities on the 100-K Annex in support of sludge removal operations; groundwater pump-and-treat operations; and testing of systems and components to be used to remove K Basins sludge to the Maintenance and Storage Facility in the 400 Area. The K West Basin is the only remaining operating nuclear facility undergoing cleanout that involves removing radioactive contaminated sludge and debris as a precursor to facility deactivation and demolition.

100 Areas Facilities Decommissioning. As of 2015, all deactivation, decommissioning, decontamination, and demolition activities in the 100 Area have been completed.

200 Area (Central Plateau) Facilities Decommissioning. Central Plateau facilities include buildings and associated waste sites in the 200 East, 200 West, and 200 North areas and those on the adjoining Rattlesnake Unit. At the Plutonium Finishing Plant in 2015, the Low-level Waste Treatment Facility, 296Z015 Stack, Low-level Waste Sump Facility, and Closed Loop Cooling System all were demolished and removed from the complex. The 234-5Z Plutonium Finishing Plant removed materials at the following completion milestones: 98% of all gloveboxes and hoods, 77% of all asbestos, and 55% of ducting. The Plutonium Reclamation Plant completed size reduction and seal out of the remaining pencil tanks during 2015.

300 Area Facilities Decommissioning. Deactivation, decommissioning, decontamination, and demolition activities in the 300 Area included completion of the 309 SP-100, MO-391, and MO-868 facilities.

400 Area Facilities – Fast Flux Test Facility Deactivation. The FFTF remains in long-term surveillance and maintenance, and routine surveillances are performed annually.

Solid Waste Management. Solid waste management includes the treatment, storage, and disposal of solid waste produced as a result of Hanford Site operations or received from off-site sources authorized to ship waste to the site. Active on-site solid waste facilities as of 2015 are described below.

Central Waste Complex. Located in the 200 West Area, the CWC receives waste from Hanford Site sources and any off-site sources authorized by DOE to ship waste to the site for treatment, storage, and disposal. Waste received includes low-level, transuranic, or mixed waste, and radioactive waste contaminated with polychlorinated biphenyls. Currently, the volume of waste stored in the CWC Outside Storage Areas is approximately 176,900 ft^3 (5,010 m^3), with the remaining enclosed area storage totaling approximately 211,600 ft^3 (5,992 m^3).

Canister Storage Building. Located in the 200 East Area, this 42,000-ft^2 (3,902-m^2) facility stores about 2,300 tons (2,086 MT) of spent nuclear fuel packaged in approximately 400 multi-canister overpacks from the 100-K Basins, 100-N Reactor, and T Plant.

Low-level Burial Grounds. This area consists of eight burial grounds located in the 200 East and 200 West areas that are used to dispose of low-level waste and mixed waste. In 2015, a total of 9,455 ft^3 (268 m^3) of waste was disposed of in Trenches 31 and 34. Trench 94 (218-E-12B Burial Ground) received no defueled U.S. Navy reactor compartments in 2015, with the total number of reactor compartments received into Trench 94 to date remaining 127.

Environmental Restoration Disposal Facility. ERDF began operations in 1996 and serves as the central disposal site for contaminated waste removed during Hanford Site CERCLA cleanup operations. The largest disposal facility in the DOE complex, ERDF has received 17.5 million tons (15.9 million MT) of contaminated material from DOE and its contractors, with a slight facility expansion approved during 2015.

Liquid Waste Management. The facilities described below are operated on the Hanford Site to store, treat, reduce, and dispose of various types of liquid effluent generated by site cleanup activities. In addition, remediation systems pump and treat contaminated groundwater in the 100-D, 100-H, and 200 West areas.

200 Area Effluent Treatment Facility. Located in the 200 East Area, the ETF treats liquid w to remove toxic metals, radionuclides, and ammonia, in addition to destroying organic compounds. The treated waste is stored in tanks, sampled and analyzed, and discharged to the State-approved Land Disposal Site (616-A Crib). This facility did not operate in 2015 due to a failed heat exchanger.

200 Area Liquid Effluent Retention Facility. Across from the ETF, the LERF consists of three RCRA-compliant surface basins used to store aqueous waste. The volume of wastewater received for LERF basin storage in 2015 was approximately 3.95 million gal (15 million L), which includes pipeline-transported CERCLA-regulated ERDF wastewater (1.74 million gal [6.59 million L]), 242-A Evaporator process condensate (approximately 1.53 million gal [5.79 million L), and tanker truck wastewater from various other facilities (approximately 0.41 million gal [1.54 million L]). RCRA regulated waste is primarily contributed from 242-A Evaporator process condensate, with other minor contributors of RCRA

waste to include leachate from the mixed waste burial trench. The volume of wastewater being stored in the LERF at the end of 2015 was approximately 17.4 million gal (65.9 million L).

200 Area Treated Effluent Disposal Facility. Located east of the 200 East Area, the TEDF is a collection and disposal system for non-RCRA waste streams and consists of approximately 11 mi (18 km) of buried pipelines connecting three pumping stations, the 6653 Building (known as the disposal sample station), and a 5-acre (ac; 2-hectare [ha]) disposal ponds. The volume of unregulated effluent disposed to the TEDF in 2015 was approximately 238 million gal (901 million L).

242-A Evaporator. The 242-A Evaporator in the 200 East Area concentrates dilute liquid tank waste by evaporation, reducing the volume of liquid waste sent to double-shell tanks for storage and the potential need for other double-shell tanks. In 2015, four operating campaigns were completed at the 242-A Evaporator, creating nearly 2 million gal (7.6 million L) of available storage space in the double-shell tank system.

Underground Waste Storage Tanks. Most Hanford Site waste is stored in 149 large underground single-shell and 28 double-shell tanks grouped into 18 tank farms located on the Central Plateau.

Single-shell Tank System. This system is undergoing closure, as the radioactive and hazardous waste stored in single-shell tanks is being transferred to more safe, double-shell tanks. In 2015, progress continued in retrieving waste from the 16 tanks in C-Farm. Waste transfer is complete for 14 of the16 tanks, with the remaining two tanks at over 42% (tank C-105) and over 32% (tank C-105) at the end of 2015.

Double-shell Tank System. The double-shell tank system includes 28 double-shell tanks located in the 200 East and 200 West areas. At the end of 2015, approximately 25.8 million gal (97.7 million L) of waste were stored in the double-shell tanks.

Waste Treatment and Immobilization Plant. The WTP is being built on 65 ac (26 ha) on the Central Plateau to treat radioactive and hazardous waste currently stored in 177 underground tanks.

Pretreatment Facility. In 2015, work continued to resolve the remaining technical issues that have impacted design and construction since 2012. Significant progress on the technical issues was made in 2015, and procurement was completed to begin testing of the standard high-solids vessel in 2016.

High-level Waste Vitrification Facility. At this facility, high-level waste is combined with materials in high-temperature melters, poured into waste containers to form a solid, immobilized glass form. Construction in 2015 included the creation of 22 concrete placements.

Low-activity Waste Vitrification Facility. Similar to the high-level facility, low-activity waste is mixed with materials that form a solid, immobilized glass form. For 2015, construction continued on interior equipment and commodities installation.

Analytical Laboratory. Once operational, the laboratory will process about 10,000 waste samples a year to support glass formulation and waste-form compliance. In 2015, workers outfitted the facility with equipment and fixtures prior to a startup group that will test system working order.

Long-term Stewardship. This task focused on documenting completed cleanup actions and facilitating transition of surveillance and maintenance responsibilities within the River Corridor from the cleanup contractor to the site services contractor, MSA. Transition and turnover packages for IU-2/Segment 4a and 100 B/C Area were completed in 2015.

Scientific and Technical Contributions to Hanford Site Cleanup. Pacific Northwest National Laboratory's scientific and technical contributions to Hanford Site cleanup have focused on conducting fundamental engineering development to support resolution of mixing issues associated with the Waste Treatment Plant. Researchers teamed with Savannah River National Laboratory, Catholic University, and the Missouri University of Science and Technology to develop formulations capable of reducing low and high activity waste glass volumes. In addition, the Deep Vadose Zone Applied Field Research initiative led a multi-national laboratory effort to identify research and development needed to define and apply risk-informed remediation approaches successfully for complex sites such as Hanford.

Section 6, Air Monitoring

Hanford Site contractors monitor airborne emissions from site facilities to determine compliance with federal and state regulatory requirements and assess the effectiveness of emission control equipment and pollution management practices. The natural state of air in the outdoor environment, ambient air is also monitored at site facilities, away from facilities, and off site in nearby and distant communities.

Air Emissions. Small quantities of particulate and volatilized forms of radionuclides and nonradioactive chemical pollutants are emitted to the environment from federal and state permitted emission sources. Most facility radioactive air emission units are monitored periodically or continuously if they have the potential to exceed 1% of the standard for public dose at 10 mrem (100 mSv)/yr. Non-radioactive constituents and parameters are monitored directly, sampled, and analyzed or estimated based on inventory usage. Air emission data collected in 2015 were comparable to those collected in 2014. DOE a report of Hanford Site radionuclide air emissions annually submits to EPA and the WDOH in compliance with 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities" and WAC 246-247, "Radiation Protection – Air Emissions."

Ambient Air Monitoring Near Facilities and Operations. A network of continuously operating samplers at 60 locations across the Hanford Site was used during 2015 to monitor radioactive airborne materials in air near site facilities and operations. 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 off site. Concentrations of certain radionuclides were higher and widely variable in different operational areas, and naturally occurring radionuclides, beryllium-7, and potassium-40 were routinely identified.

Hanford Site and Off-site Ambient Air Monitoring. During 2015, ambient air samples were collected from 40 continuously operating samplers in nearby, surrounding, and distant communities to provide background data. Airborne particle samples were collected biweekly at each location and analyzed for gross beta and, at some locations, gross alpha radiation. All sample results for 2015 showed very low concentrations in air, and all radionuclide concentrations were below the EPA standard of 10 mrem (100 mSv)/yr.

Section 7, Water Monitoring

In 2015, water samples were collected and analyzed from seven different sources as described below.

Hanford Site Drinking Water Monitoring. Routine chemical, physical, and microbiological monitoring of Hanford Site drinking water is performed regularly as mandated by EPA's Community Water System

(CWS) requirements. All DOE-owned Hanford Site systems were in compliance with drinking water standards for radiological, chemical, and microbiological contaminant levels for 2015. Contaminant concentrations measured during the year were similar to those observed in recent years.

Columbia River Water Monitoring. Columbia River water samples were collected in 2015 from fixed-location monitoring stations at Priest Rapids Dam and City of Richland drinking raw water intake facility and were analyzed for radionuclides. Cross-river transects near Vernita Bridge, 100-N Area, Hanford Townsite, 300 Area, and the City of Richland drinking water intake were collected in 2015 and analyzed for radionuclides, metals, and inorganic and organic compounds.

Columbia River Water – Fixed Location Samples. Radiological analyses of Columbia River water samples collected at the fixed locations showed individual radiological contaminant concentrations were below DOE-derived concentration standards.

Columbia River Water – Cross-river Transect Samples. Cross-river transect samples near the Vernita Bridge, 100-N Area, Hanford Townsite, 300 Area, and the City of Richland had higher tritium concentrations near the Benton County (Hanford Site) shoreline compared to the opposite (Grant-Franklin) shoreline. Stronium-90 concentrations in Hanford Reach transect samples were similar to upstream reference concentrations. Uranium concentrations in all transect samples were below the EPA drinking water standard.

Inorganic and organic analyses detected metals and anions in Columbia River transect samples upstream and downstream of the Hanford Site. Aluminum, copper, magnesium, sodium, uranium, and zinc were detected in most samples. All dissolved metal concentrations in river water transect samples were less than the Washington State ambient surface-water quality criteria for protection of aquatic life.

Columbia River Sediment Monitoring. Samples were collected from Columbia River sediments and analyzed for radionuclides and inorganic constituents. Radionuclides consistently detected in river sediment adjacent to and downstream of the Hanford Site during 2015 included cesium-137, uranium-234, uranium-235, uranium-238, plutonium-239/-240, and decay products from naturally occurring radionuclides. The concentrations of all other radionuclides, including strontium-90, were below the required detection limits for most samples.

Detectable amounts of most metals were found in all river sediment samples. Maximum and average concentrations of cadmium, chromium, copper, lead, mercury, nickel, thallium, and zinc were higher for sediment collected in the reservoir upstream of Priest Rapids Dam than in sediment from either the Hanford Reach or McNary Dam. Lead concentrations were detected at higher rates in White Bluffs sediment in comparison to all other sediment collection locations in 2015.

Columbia River Shoreline Seep Water. Samples of Columbia River shoreline seep water and two associated shoreline sediment samples were collected along the Hanford Reach in 2015 and analyzed for radiological, inorganic, and organic contaminants. Radiological contaminants of Hanford Site origin, including gross alpha, gross beta, carbon-14, strontium-90, tritium, and total uranium, were detected in seep water samples. Inorganic and organic contaminants originating from the Hanford Site, including metals and anions of interest (chloride, nitrate, and sulfate) were detected in seep water. Concentrations of volatile organic compounds were near or below the analytical laboratory's required detection limits in all samples. Constituents found above detection limits in the shoreline seep included cesium-137, uranium isotopes, and metals, particularly chromium and hexavalent chromium.

Pond Water and Sediment. West Lake is the only naturally occurring pond on the site, and the area has not received radioactive discharges for some time. Tritium concentrations were below the laboratory-reported detection limit; in addition, West Lake water was analyzed for tritium and uranium-234, -235, and -238. Detections of all radionuclides during 2015 were similar to previously reported measurements.

Off-site Irrigation Water. To assess the potential for Hanford Site-associated contaminants to affect food products irrigated with Columbia River downstream of the site, water samples were collected three times during the irrigation season from a canal east of the Columbia River and from the Horn Rapids irrigation pumping station. Unfiltered samples were analyzed for gross alpha, gross beta, gamma emitters, strontium-90, and tritium. Although tritium results were slightly higher than water collected from the Riverview irrigation system, all radionuclide concentrations were within the historical range, less than the respective DOE-derived concentration standards and Washington state ambient surface-water quality criteria.

Liquid Effluent Monitoring. Liquid effluent disposal is governed by applicable regulations and permits. When discharges occur, sampling and analyzing is performed to identify select radioactive parameters and nonradioactive hazardous materials. Discharge monitoring reports that contain contaminant data from these analyses are submitted to Ecology.

Section 8, Groundwater Monitoring

During Hanford Site operations, chemical and radioactive waste was released into the environment and contaminated soil and groundwater beneath portions of the site, mostly in the 200 East, 200 West, 300, and 100 reactor areas along the river. This section summarizes Hanford Site groundwater monitoring results, including those for RCRA TSD units, CERCLA groundwater operable units, and *Atomic Energy Act of 1954* requirements. DOE publishes details on CERCLA remediation activities (such as pump-and-treat operations) in separate documents that are summarized and referenced in this report. Along with information on well monitoring locations, construction details, and screened intervals, the monitoring data presented can be found through the DOE Environmental Dashboard Application at https://ehs.hanford.gov/eda/ or on the PNNL-Hanford Online ENvironmental Information eXchange (PHOENIX) website at http://phoenix.pnnl.gov. The data and additional groundwater monitoring details are available in the *Hanford Site Groundwater Monitoring Report for 2015*.

Section 9, Soil Monitoring

Soil samples are collected near facilities and operations on the Hanford Site to detect potential migration and deposition of facility emissions and evaluate long-term trends in the environmental accumulation of radioactive materials. A total of 79 samples was collected in 2015 and compared to concentrations of radionuclides measured in samples collected off site at various locations in Grant, Yakima, Walla Walla, Adams, Benton, and Franklin counties in 2015.

In general, radionuclide concentrations in soil samples collected from or adjacent to waste disposal facilities in 2015 were similar to or slightly elevated compared with the concentrations in samples collected in distant communities. Also, as expected, data showed that concentrations of certain radionuclides in 2015 were higher in different operational areas compared with concentrations measured in distant communities in previous years: historically, predominant radionuclides detected are activation and fission products in the 100 Areas, fission products in the 200 and 600 areas, and uranium in the 300 and 400 areas.

Section 10, Biota Monitoring

DOE conducted agricultural monitoring at several locations that vary annually near the Hanford Site to assess potential contaminant concentrations in food and farm products as a result of site activities. Plant and animal species on the site are also monitored to assess abundance, condition, and population distributions. Data collection and analysis are integrated with environmental monitoring of biotic and abiotic media, and analytical results are used to characterize potential risks or impacts.

Agricultural Monitoring. Samples of milk and several fruit, vegetable, and farm products as well as wine samples were collected in 2015 at eight different locations on and around the Hanford Site. Radionuclide concentrations in most samples were below levels that could be detected by analytical laboratories; however, some potential Hanford Site-produced contaminants (such as tritium) were found at low levels in some samples.

Animal Monitoring. In 2015, four fish and wildlife species were sampled and analyzed for potential Hanford Site contaminants: mountain whitefish, white sturgeon, Nuttall's cottontail rabbit, and Canada goose. All fish and wildlife samples were monitored for strontium-90 and a number of gamma emitters, including cesium-137. Trace metals associated with Hanford Site operations (e.g., copper, lead, and mercury) that have potential to accumulate in certain fish and wildlife tissues were also analyzed. Cesium-137 was found in all the white sturgeon filet samples, and strontium-90 was detected in rabbit bone samples collected in the 300 Area. Trace metals were found above detection limits in most of the tested animal tissues at variable but fairly low concentrations. At this time, no established federal or state criteria are available for trace-metal concentrations in fish tissue.

Vegetation Monitoring. Plant populations and habitats occurring on the Hanford Site are surveyed and monitored to assess potential risks or impacts to biota. Hanford Site and off-site vegetation samples are analyzed for information about atmospheric deposition of contaminants in and around operational areas on site and in uncultivated areas off site. These data provide a baseline against which unplanned releases can be compared. In general, radionuclide concentrations in vegetation samples collected from or adjacent to waste disposal facilities in 2015 were higher than concentrations in samples collected farther away, including concentrations measured off site. Generally, the predominant radionuclides were activation and fission products in the 100 Areas, fission products in the 200 Areas and 600 Area, and uranium in the 300 and 400 areas.

Vegetation Control. Vegetation control activities help prevent, limit, or remove contaminated plants or undesirable plant species. Approximately 5,164 ac (2,090 ha) were treated with herbicides in 2015 on radiological waste sites, around operations areas, and along roadways to keep areas free of deep-rooted vegetation (e.g., Russian thistle, also known as tumbleweed). Follow-up treatments are included in the total treated acres; several areas received more than one herbicide application.

Waste Site Remediation and Revegetation. Waste sites in the 200 East and 200 West areas were designed and constructed with a cap of perennial grass. Integrated Biological Control has been actively restoring vegetative caps on other waste sites.

Section 11, Resource Protection

DOE is responsible for managing and protecting biological and cultural resources on the Hanford Site. Ecological and cultural resource monitoring are conducted to collect and track data needed to ensure compliance with an array of laws, regulations, and policies governing DOE activities.

Ecological Protection. Ecological monitoring data provide baseline information about the plants, animals, and habitats under DOE stewardship at Hanford that is required to make cleanup decisions. During 2015, DOE continued to monitor and evaluate species that are protected by federal or state laws and regulations or are of special interest to the public and stakeholders. Fall Chinook salmon redds, steelhead redds, and bald eagle nesting and night roosting activity were assessed because these species have the potential to be impacted by Hanford Site operations. Additional monitoring efforts included nesting raptors, migratory birds, ground squirrel habitat analysis, reptiles, burrowing owl, jackrabbits, and the American badger.

Endangered and Threatened Species. Two endangered and threatened fish species, spring-run Chinook salmon and steelhead, are known to occur regularly on the Hanford Site. One additional fish species (bull trout) was recorded at the site, but scientists believe that the species is transient. Umtanum desert buckwheat and White Bluffs bladderpod, federally listed as threatened plant species, also occur on the site. No other plants or animals known to occur on the Hanford Site are currently federally listed as threatened or endangered, though the Washington ground squirrel is a candidate for federal listing.

Cultural and Historic Resource Protection. DOE is responsible for managing and protecting the Hanford Site's cultural and historic resources in accordance with applicable federal cultural resources laws and regulations and DOE management plans. Hanford Site archaeologists reviewed 23 undertakings that had the potential to affect cultural resources, of which 9 were identified as No Historic Properties Affected, 11 were determined to have No Adverse Effects, and 3 were identified as having Adverse Effects that required mitigation measures. A total of 4,645 ac (1,880 ha) of new ground was surveyed for cultural resources in 2015.

The Hanford Collection comprises artifacts from the Manhattan Project and Cold War era. In 2015, 70 artifacts were delivered to the 4732-A Artifact Staging Facility, leaving approximately 3.5% of the items scheduled for collection between 2016 and 2048. Also in 2015, Washington State University Tri-Cities (WSU-TC) in Richland, WA was subcontracted to provide management, conservation, and interpretation of the Hanford Collection. A total of 40% of the Collection was moved from the artifact staging facility on the Hanford Site to the WSU-TC Consolidated Information Center curation facility, with the remaining 60% to be transitioned in 2016.

Section 12, Quality Assurance

Quality assurance and control programs for the Hanford Site and off-site environmental surveillance were documented through project-specific quality assurance plans and describe applicable quality assurance elements. Samples were collected and analyzed according to documented standard procedures. Analytical data quality was verified by a continuing program of internal laboratory quality control, participation in inter-laboratory crosschecks, duplicate sampling and analysis, submittal of blind standard samples and blanks, and splitting samples with other laboratories. No issues were identified that significantly affected the quality assurance and control for Hanford Site sampling and analytical activities during 2015.