Appendix – Glossary

Aquatic ecosystem: Ecological system containing species that live in water.

Aquifer: A water-bearing, geologic formation below the surface of the earth that can supply water for a well or spring.

Assessment: An analysis, examination, or investigation that predicts the behavior of a system under a given set of conditions and events.

Biota: Living organisms.

Biotic: Referring to living organisms and their products.

Carbon tetrachloride: Nonflammable manmade chemical that is produced as a liquid but evaporates easily in the environment and is commonly found as a gas; used for decades as a cleaning fluid and solvent, including for degreasing equipment and machinery parts at facilities on the Hanford Site; also used in the refining process during the separation of plutonium. At the Hanford Site, the carbon tetrachloride used in the Plutonium Finishing Plant at the central part of the site was eventually discharged to the soil and has since reached the underlying groundwater.

CERCLA: *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (42 USC 9601 et seq. as amended); federal law, enacted in 1980 and amended in 1986, that governs the cleanup of hazardous, toxic, and radioactive substances.

Cesium-137: Radionuclide in spent nuclear fuel, high-level radioactive waste resulting from the processing of spent nuclear fuel, and radioactive waste associated with the operation of nuclear reactors and fuel reprocessing plants; present in soil around the world largely as a result of fallout from past atmospheric nuclear weapons tests; generally less mobile in the environment. At Hanford, the highest concentrations of cesium-137 are in areas that contain waste from processing irradiated fuel, such as in the tanks in the Central Plateau.

Chemical separation: Process for extracting uranium, plutonium, and other radionuclides from dissolved spent nuclear fuel and irradiated targets.

Chemicals (carcinogenic): Chemicals that cause or promote cancer.

Chemicals (toxic): Noncarcinogenic chemicals that are poisonous.

Chromium: Element found naturally in rocks, soil, plants, and animals, including people; because it is an element, chromium does not degrade nor can it be destroyed; found naturally in three forms: metal ore, trivalent chromium (Cr III), and hexavalent chromium (Cr VI); found at Hanford where sodium dichromate solutions (hexavalent) were used to prevent corrosion in piping.

Ci: Curie, see definition under "curie."

Confined aquifer: An aquifer bounded above and below by less-permeable layers. Groundwater in the confined aquifer is under a pressure greater than atmospheric pressure. Aquifers within the Columbia River Basalt underlying the Hanford Site are confined aquifers.

CRCIA: Columbia River Comprehensive Impact Assessment.

Crib: Underground chambers used to dispose of large volumes of low level, radioactive liquid waste, usually constructed of loosely spaced timbers several feet below ground level, creating a chamber of more than 1000 cubic feet; the liquid would percolate through the chamber to the underlying soil; numerous cribs exist in the 100, 200, and 300 Areas.

Curie: Unit of radioactivity corresponding to 3.7 x 1010 (37 billion) disintegrations per second; 1 curie = 3.7 x 1010 Becquerel.

Decay: The decrease in the amount of any radioactive material with the passage of time, as a result of the spontaneous emission from the atomic nuclei of nucleons or either alpha or beta particles, often accompanied by gamma radiation. When a radioactive material decays, the material may be converted to another radioactive species (decay product) or to a nonradioactive material.

Deterministic analysis: Single calculation performed with a single value selected for each parameter, such as a concentration value of a contaminant entering the river; in contrast, see stochastic analysis.

Deterministic value: Single value used in a calculation; for example, 20 miles per gallon is used to estimate the fuel efficiency of a car; actual gas mileage varies considerably but averages to be this value so it is the one used in calculations.

Distribution coefficient: The quantity of the solute, chemical, or radionuclide sorbed by the solid per unit weight of the solid divided by the quantity dissolved in the water per unit volume of water. The distribution coefficient is often referred to as a K_d value and is used to calculate a retardation factor for contaminants. The retardation factor indicates the mobility of the contaminant compared to the water moving through the vadose zone and/or the aquifer.

Dose: Specific amount of ionizing radiation or of a toxic substance absorbed by a living being.

Exposure (external): Contact with materials on the outside of the body, as from submersion in water or immersion in air.

Exposure (internal): Contact with materials taken into the body through inhalation or ingestion.

Food web: Network of foraging relationships among species in a community.

Groundwater: Groundwater is water that occurs below the Earth's surface. It is found within the pores of sand and gravel or the cracks of fractured rock beneath the land and is invisible to the naked eye. Gravity causes groundwater under the Hanford Site to move toward the Columbia River. In this manner, groundwater may carry contamination from Hanford into the river.

Half-life: Time required for an initial number of radioactive atoms to be reduced to half that number by radioactive decay; each isotope has its own characteristic half-life; they range from fractions of a second to billions of years.

Hanford Reach: Segment of the Columbia River that extends 85 kilometers (51 miles) downstream from Priest Rapids Dam to the head of the McNary Pool near the city of Richland, Washington.

Hanford Site Disposition Baseline: Description of the disposal and remedial actions that will occur as the Hanford Site moves toward closure.

Hazard quotient: Ratio of an organism's estimated exposure to contaminants to the level of contaminants that produce adverse effects on similar organisms in experimental tests.

Heavy metals: Metallic elements with high atomic weights (for example, arsenic, lead, mercury, plutonium, and uranium) that can damage living organisms at low concentrations and tend to accumulate in the food chain.

HEIS: Hanford Environmental Information System; an electronic database that consolidates the data gathered during environmental monitoring and restoration of the Hanford Site.

Herbivore: Organism that feeds on plants.

History Matching: Comparison of model results to field observations to evaluate how well the model represents the real system.

Hyporheos: Region of riverbed where groundwater and surface water mix.

ICRP: International Commission on Radiological Protection.

Impact: An adverse effect or change.

Interim Remedial Measures: Corrective actions taken at Hanford Site operable units under CERCLA or RCRA prior to initiation of final remedial actions; examples are pumping and treating contaminated groundwater, excavating contaminated soil, or restricting access to contamination via warning signs and fences.

Inventory: Inventory is the total quantity of radiological and chemical constituents used and created at the Hanford Site, and their distribution in facilities, waste disposal sites, the vadose zone, groundwater, and the Columbia River ecosystem.

Iodine-129: Radionuclide present in spent nuclear fuel, high-level radioactive waste resulting from processing spent nuclear fuel, and radioactive waste associated with the operation of nuclear reactors and fuel reprocessing plants; present in soil around the world as a result of fallout from past atmospheric nuclear weapons tests; mobile in soil and can move downward with percolating water to groundwater. Iodine-129 represents one of the largest groundwater plumes at the Hanford Site, extending from the 200 Area to the Columbia River.

Isotopes: Different forms of the same chemical element that are distinguished by different numbers of neutrons in the nucleus. A single element may have many isotopes; some may be radioactive and some may be nonradioactive (stable). For example, the three isotopes of hydrogen are protium, deuterium, and tritium.

Kd: The quantity of the solute, chemical, or radionuclide sorbed by the solid per unit weight of the solid divided by the quantity dissolved in the water per unit volume of water and is used to calculate a retardation factor for contaminants. The retardation factor indicates the mobility of the contaminant relative to the water moving through the vadose zone and/or the aquifer.

Lognormal distribution: Data distribution where the logarithms of the data form a normal distribution.

Mathematical model: Mathematical representation of a conceptual model for a physical, chemical, and/or biological system by mathematical expressions designed to aid in understanding and/or predicting the behavior of the system under specified conditions.

Mean (arithmetic): Average value of a set of numbers.

Median: Middle value in a series of values arranged in order of size.

Monte Carlo analysis: A technique that obtains a probabilistic approximation to the solution of a problem by using statistical sampling techniques. The method requires continued sampling of values of a large number of events by the application of the mathematical theory of random variables. Monte Carlo methods are used to represent parameter variability in an uncertainty analysis.

mrem: Millirem, one-thousandth of a rem.

Natural uranium: Naturally occurring mixture of uranium (0.7 % uranium-235 and 99.3 % uranium-238).

NCRP: National Council on Radiation Protection and Measurement.

NEPA: National Environmental Policy Act of 1969 (42 USC 4321 et seq. as amended); federal law requiring the federal government to consider the environmental impacts of and alternatives to major proposed actions in its decision making process.

pCi: Picocurie, one-trillionth of a curie or 10-12.

pH: Term used to indicate the acidity and alkalinity of a solution; pH 7, the value for pure water, is regarded as neutral; pH values from 0-7 indicate acidity and pH values from 7-14 indicate alkalinity.

Plume: Volume of air, soil, or water containing contaminants.

Plutonium: Fabricated fissile element; pure plutonium is a silvery metal heavier than lead; material rich in plutonium-239 isotope is preferred for manufacturing nuclear weapons; the half-life of plutonium-239 is 24,000 years.

Pore water: Water in the minute spaces of the substrate that forms the bottom of the Columbia River; for example, groundwater in springs between rocks.

Predator (fish) - first-order: Fish that consume primarily herbivorous species; includes perch, crappie, punkinseed, and bluegill.

Predator (fish) - second-order: Fish that consume other fish-eating species; includes bass, trout, and squawfish.

Probabilistic analysis: A statistical analysis technique for studying the expected behavior of a system with parameters whose values are uncertain, with events whose occurrences are random, and with features which may or may not be present.

rad: Radiation absorbed dose, unit of measurement used to describe absorbed dose.

Radiation: Energy transferred through space or other media in the form of particles or waves; certain radiation types are capable of breaking up atoms or molecules; splitting or decay of unstable atoms emits ionizing radiation.

Radioactivity: Spontaneous emission of radiation (alpha, beta, gamma rays, and/or neutrons) by some nuclides as they transform into other nuclides.

Radionuclide: Radioactive isotope of an element; for example, strontium-90 and tritium are radionuclides of elements of strontium and hydrogen, respectively.

RCRA: *Resource Conservation and Recovery Act of 1976* (42 USC 6901 et seq. as amended, Public Law 94-580); federal law enacted in 1976 to address the treatment, storage, and disposal of hazardous waste.

Redds: Nests fish make in gravel and/or small cobble in the riverbed to lay their eggs.

REDOX: Reduction Oxidation; a chemical separations plant (S Plant/202-S Building at the Hanford Site), which operated at the Hanford Site from 1952-1967.

Reference dose: Estimate established by the EPA for specific chemicals (with uncertainty spanning perhaps an order of magnitude) of the daily exposure of the human population to a potential hazard that is likely to be without risk of deleterious effects during a lifetime.

Release: Discharge of a substance into the environment.

rem: Roentgen equivalent man; unit of measurement used to describe dose equivalence; the amount of any type of radiation that produces the same biological effect as is obtained from an absorbed dose of 1 rad of 200 kilovolt potential X-rays.

RI/FS: Remedial investigation/feasibility study; an element of the CERCLA process.

Riparian ecosystem: Ecological system on banks of a body of water; in this report, the banks of the Columbia River.

Risk: Probability of an adverse effect as a consequence of exposure; measured for humans using either hazard index or lifetime risk.

Risk (lifetime): When applied to carcinogenic chemicals, the risk of cancer occurring; when applied to radionuclides, the risk of death from cancer.

Risk conversion factor: Converts an ingestion or inhalation rate of a contaminant into the probability of contracting cancer from the exposure.

Seeps: Discharge zones located above river water level where the flow rate is very low.

Stochastic analysis: Set of calculations performed using randomly selected values for each parameter; in contrast, see deterministic analysis.

Stochastic variability: Natural random variation of a measured quantity around a central value; for example, in a room full of people, there is an average height with some being taller and some shorter; the stochastic variability of that group is described by the differences between the individuals' heights and the average; see deterministic value.

Strontium-90: Radionuclide in spent nuclear fuel, high-level radioactive waste resulting from the processing of spent nuclear fuel, and radioactive waste associated with the operation of reactors and fuel reprocessing plants; present in surface soil around the world as a result of fallout from past atmospheric nuclear weapons tests; relatively mobile and can move down with percolating water to underlying layers of soil and into groundwater; highest concentrations of strontium-90 at the Hanford Site are in areas that contain waste from processing irradiated fuel, such as in tanks in the Central Plateau.

System Assessment Capability (SAC): An assessment tool to assess the cumulative impact of waste remaining at Hanford at the time of site closure.

Technetium-99: Radionuclide in spent nuclear fuel, high-level radioactive waste resulting from processing spent fuel, and radioactive waste associated with operating nuclear reactors and fuel reprocessing plants; present in soil due to fallout from past atmospheric nuclear weapons tests; very mobile in the environment, especially under aerobic conditions (i.e., where oxygen is present); can move rapidly downward with percolating water because most technetium compounds do not bind well to soil particles; highest concentrations of technetium-99 at Hanford are in areas that contain waste from processing irradiated fuel, such as in the tanks in the Central Plateau.

Tri-Party agencies: Three government agencies (U.S. Department of Energy, U.S. Environmental Protection Agency, and the Washington State Department of Ecology) that are signatories to the Tri-Party Agreement.

Tri-Party Agreement: Federal Facility Compliance Agreement signed in 1989 by the U.S. Department of Energy, the State of Washington, and the U.S. Environmental Protection Agency; commonly known as the Tri-Party Agreement. The agreement includes schedules and milestones for completion of the Hanford Site cleanup.

Tritium: The only radioactive isotope of hydrogen; produced in nuclear reactors and is three times heavier than ordinary hydrogen; tritium gas is used to boost the explosive power of most modern nuclear weapons; tritium has a half-life of approximately 12 years.

Uncertainty analysis: Attempts to describe the entire set of possible outcomes and their probability of occurrence.

Unconfined aquifer: An aquifer containing groundwater that is not confined above by relatively impermeable rocks. The pressure at the top of the unconfined aquifer is equal to that of the atmosphere. At Hanford, the unconfined aquifer is the uppermost aquifer and is most susceptible to contamination from site operations.

Vadose zone: The hydrogeologic region between the surface of the land and the water table.

Water table: Theoretical surface represented by the elevation of water surfaces in wells penetrating only a short distance into the unconfined aquifer.