Appendix F

Methods for Evaluating Impacts on Health from Radionuclides and Chemicals

Appendix F

Methods for Evaluating Impacts on Health from Radionuclides and Chemicals

This appendix describes details of the methodology used to evaluate health impacts for the alternatives considered in the Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement (HSW EIS). Unless otherwise specified, the data used for the analysis are provided in the *Hanford Site Solid Waste Management, Environmental Impact Statement Technical Information Document* (FH 2004); the Solid Waste Information Tracking System (SWITS) database from Anderson and Hagel (1996), Hagel (1999), and FH (2004); or the *Solid Waste Integrated Forecast Technical (SWIFT) Report* (Barcot 1999, 2002).

F.1 Normal Operation Impact Assessment Methods

Under normal waste management operations, atmospheric releases of radionuclides and chemicals could occur. This section describes methods used to estimate annual quantities released, atmospheric transport, exposure scenarios, and a health impacts assessment of these releases.

The methods used are based on source and waste stream information presented in Volume I, Section 3 and on the affected environment from Volume I, Section 4. The atmospheric transport and health impacts were evaluated using the Multimedia Environmental Pollutant Assessment System (MEPAS) computer program, Version 4.0 (Droppo and Buck 1996; Strenge and Chamberlain 1995). This version is an enhancement of earlier versions (for instance, Version 3.1 [Buck et al.1995] and Version 3.2 [Buck et al. 1997]) and is designed to operate under the Framework for Risk Analysis in Multimedia Environmental Systems (FRAMES) described by Whelan et al. (1997). The MEPAS program was selected because it is capable of evaluating health impacts from radionuclides and chemicals, and it can model time-varying releases, deposition, and accumulation in soil. Doses to hypothetical maximally exposed individuals are intended to bound potential impacts but not to reflect an expected set of typical circumstances.

The atmospheric dispersion models in the MEPAS program provide nearly identical results to those generated using the U.S. Environmental Protection Agency (EPA) CAP88 program, as verified in a benchmarking study performed on the MEPAS, MMSOILS, and RESRAD computer programs (Mills et al. 1997). The RESRAD program uses the CAP88 program for atmospheric transport calculations (Cheng et al.1995).

F.1.1 Pollutant Releases to the Atmosphere

Pollutant releases to the atmosphere may occur from any of the facilities handling or containing any of the several waste streams identified for this HSW EIS, as described in Volume I, Section 2. The release rate must be evaluated as a function of time during the period of operation because the volumes of waste processed vary by year. For a given facility and year, the annual release is determined by the quantity of waste processed or stored in the facility during the year, the average concentration of each pollutant in the waste while in the facility, and the fraction of the pollutant that is released to the atmosphere. The annual release from a given facility can be expressed as in Equation F.1.

$$R_i = \sum_{i=1}^{n} V\, C_i\, F_i \qquad \text{(F.1)}$$

where R_i = release rate of pollutant i from a facility during a given year (Ci/yr or kg/yr)
V = volume of waste stream processed in a facility (m^3/yr)
C_i = average concentration of pollutant i in a waste stream (Ci/m^3 or kg/m^3)
F_i = release fraction for pollutant i from a waste stream processed in a given facility (dimensionless)
n = number of waste streams processed in the facility.

The waste stream volumes are described in Volume I, Section 2 and in Appendixes B and C. Table F.1 is a cross reference for Tables F.2 through F.18, which provide concentration data for each waste stream for each alternative group. The presumed average concentration of constituents in each waste stream also is provided in Tables F.2 through F.18. Waste stream designations are given in Appendix B. The radionuclides included in each waste stream are those that contribute greater than 0.1 percent to inhalation or ingestion dose based on the concentration in the given waste stream. Short-lived radionuclides that are generated from a longer-lived radionuclide (for example, yttrium-90 from strontium-90) in the inventory are not included in the lists because their contributions are included with the parent radionuclide in the dose analysis.

The analysis of health impacts is performed for each facility using the facility release characteristics (for example, stack height and exit velocity) and annual release rates as inputs to the atmospheric transport analysis. The transport and exposure pathway analyses evaluate downwind transport, deposition, soil resuspension, soil accumulation, and transfer through exposure pathways to the exposed individuals.

The release fractions were defined for each facility and pollutant using information and methods from past analyses. Facilities not included in the list are not expected to release contaminants under normal operating conditions.

Release fractions were estimated for each facility managing wastes that are evaluated within the scope of this HSW EIS. These facilities and the waste streams associated with each facility are described in Volume I, Section 2 and Appendixes B and C. Generally, the release fraction estimation is based on previous studies involving the existing facilities or on values for similar facilities. Guidance from 40 CFR 61, Appendix D (consistent with WAC 246-247), also is used for release fraction estimates for

the Waste Receiving and Processing Facility (WRAP), the T Plant Complex, the new waste processing facility, and leachate treatment by pulse driers. That guidance includes the following conventions:

- Radioactive materials in sealed packages that remain unopened and have not leaked during the assessment period were not included in the calculation.
- The release fraction for gaseous material is 1.
- The release fraction for liquids and particulate solids is 1.0E-03.
- The release fraction for solids is 1.0E-06.
- Credit can be taken for particulate filtration installed between the place of use and the point of release (except for gaseous radionuclides).

Table F.1. Summary of Waste Stream Concentration Tables

Stream No.[a]	Waste Stream Description[b]	Table Number
1	LLW Cat 1	F.2
2	LLW Cat 3	F.3
1 and 2	LLW from Offsite Sources	F.4
2C2	LLW Cat 3 for T Plant Processing from Offsite	F.5
4	TRU-RH Waste from Trenches	F.6
4	TRU-CH Waste from Trenches	F.7
5	TRU-RH Waste from Caissons	F.8
8	TRU – Commingled PCB Waste	F.9
9	TRU – Newly Generated and Existing CH Standard Containers	F.10
10A	TRU – Newly Generated and Existing CH Non-Standard Containers	F.10
10B	TRU – Newly Generated and Existing RH Waste	F.11
11	MLLW Treated and Ready for Disposal	F.12
12	RH and Non-Standard Packages	F.13
13	CH Organic and Inorganic Solids and Debris	F.14
14	Elemental Lead	F.15
15	Elemental Mercury	F.16
17	TRU – K Basins Sludge	F.17
18	MLLW Trench Leachate	F.18

(a) Waste stream designations are as described in Appendix B.
(b) Cat = Category; CH = contact-handled; LLW = low-level waste; MLLW = mixed low-level waste; PCB = polychlorinated biphenyl; RH = remote-handled; TRU = transuranic.

Table F.2. Stream 1: Low-Level Waste Category 1

Constituent	Concentration, Ci/m^3
Americium-241	6.4E-06
Cobalt-60	1.0E-03
Cesium-137	1.0E-04
Iron-55	2.4E-03
Manganese-54	3.2E-03
Nickel-63	8.6E-04
Plutonium-238	2.2E-06
Plutonium-239	3.1E-05
Plutonium-240	7.8E-06
Plutonium-241	2.1E-04
Strontium-90	1.2E-04
Tritium	4.4E+00

Table F.3. Stream 2: Low-Level Waste Category 3

Constituent	Concentration, Ci/m^3
Americium-241	7.9E-03
Curium-244	1.0E-03
Cesium-137	9.8E+00
Plutonium-238	2.0E-03
Plutonium-239	9.4E-03
Plutonium-240	3.7E-03
Plutonium-241	2.2E-01
Strontium-90	1.2E+01
Tritium	1.6E-03
Uranium-234	1.8E-02
Uranium-235	5.4E-04
Uranium-236	2.4E-03
Uranium-238	3.0E-02

Table F.4. Streams 1 and 2: Low-Level Waste from Offsite Sources

Radionuclide	Source Site[(a)] and Waste Stream Concentrations, Ci/m^3											
	BNL	**GE VAL**	**GJPO**	**INEEL**	**ITRI**	**LLNL**	**ORR**	**PNTX**	**RFETS**	**SNL**	**SPRU**	**WV**
Tritium	9.6E-05	NR	NR	6.6E+01	1.7E-02	7.0E-03	8.6E+0	5.8E-04	2.4E-05	1.1E+0	1.4E-04	4.8E-01
Carbon-14	NR	NR	NR	2.3E-03	2.9E-03	1.7E-06	4.3E-05	NR	NR	4.0E-04	1.3E-11	4.0E-04
Cobalt-60	1.4E-06	6.2E-04	NR	8.2E+01	NR	NR	3.2E-02	NR	NR	9.5E-01	7.0E-05	9.5E-01
Nickel-59	NR	NR	NR	4.4E-01	NR	NR	1.4E-07	NR	NR	4.7E-03	8.7E-08	4.7E-03
Nickel-63	NR	NR	NR	1.6E+01	NR	NR	5.8E-01	NR	NR	2.1E-01	3.8E-06	2.1E-01
Strontium-90	3.4E-04	3.1E-03	NR	1.1E-02	NR	NR	2.2E-03	NR	4.7E-11	2.5E-01	4.2E-04	2.5E-01
Technetium-99	NR	NR	NR	1.4E-05	NR	NR	2.6E-07	NR	NR	4.2E-05	9.6E-10	4.2E-05
Cesium-137	5.5E-04	2.2E-03	5.5E-14	2.2E-01	NR	NR	2.2E-01	NR	1.7E-08	1.6E-01	6.8E-04	1.6E-01
Uranium-234	7.5E-08	NR	NR	3.0E-06	NR	NR	1.6E-04	7.4E-06	3.2E-07	1.4E-04	3.6E-06	1.4E-04
Uranium-235	2.6E-08	NR	NR	4.4E-05	NR	NR	7.2E-04	1.2E-06	9.4E-11	7.1E-06	1.6E-07	7.1E-06
Uranium-238	5.8E-08	NR	NR	1.8E-03	5.84E-04	4.96E-04	7.8E-05	7.8E-05	2.6E-07	3.2E-04	1.2E-05	3.2E-04

(a) BNL = Brookhaven National Laboratory
GE VAL = General Electric – Vallecitos
GJPO = Grand Junction Project Office
INEEL = Idaho National Engineering and Environmental Laboratory
ITRI = Inhalation Toxicology Research Institute
LLNL = Lawrence Livermore National Laboratory
ORR = Oak Ridge Reservation
PNTX = Pantex Facility
RFETS = Rocky Flats Environmental Technology Site
SNL = Sandia National Laboratories
SPRU = Separations Process Research Unit
WV = West Valley Nuclear Services

NR = none reported.

Table F.5. Stream 2C2: Low-Level Waste Category 3 for T Plant Processing from Offsite Sources

Radionuclide	Source Site[(a)] and Waste Stream Concentrations, Ci/m^3											
	BNL	**GE VAL**	**GJPO**	**INEEL**	**ITRI**	**LLNL**	**ORR**	**PNTX**	**RFETS**	**SNL**	**SPRU**	**WV**
Tritium	3.0E-05	NR	NR	2.1E+01	5.4E-03	2.2E-03	2.7E+0	1.8E-04	7.8E-06	3.6E-01	4.6E-05	1.5E-01
Carbon-14	NR	NR	NR	7.3E-04	9.2E-04	5.4E-07	1.4E-05	NR	NR	1.2E-04	4.2E-12	1.2E-04
Cobalt-60	4.4E-07	2.0E-04	NR	2.6E+01	NR	NR	1.0E-02	NR	NR	3.0E-01	2.2E-05	3.0E-01
Nickel-59	NR	NR	NR	1.4E-01	NR	NR	4.4E-08	NR	NR	1.4E-03	2.8E-08	1.4E-03
Nickel-63	NR	NR	NR	4.9E+0	NR	NR	1.8E-01	NR	NR	6.7E-02	1.2E-06	6.7E-02
Strontium-90	1.0E-04	9.9E-04	NR	3.6E-03	NR	NR	7.2E-04	NR	1.5E-11	8.0E-02	1.3E-04	8.0E-02
Technetium-99	NR	NR	NR	4.4E-06	NR	NR	8.1E-08	NR	NR	1.3E-05	3.0E-10	1.3E-05
Cesium-137	1.8E-04	6.8E-04	5.5E-14	7.0E-02	NR	NR	6.8E-02	NR	5.4E-09	5.3E-02	2.2E-04	5.3E-02
Uranium-234	2.4E-08	NR	NR	9.7E-07	NR	NR	5.0E-05	2.3E-06	10E-08	4.4E-05	1.1E-06	4.4E-05
Uranium-235	8.4E-09	NR	NR	1.4E-05	NR	NR	2.2E-06	4.0E-07	3.0E-11	2.2E-06	5.2E-08	2.2E-06
Uranium-238	1.8E-08	NR	NR	6.0E-04	1.8E-04	1.6E-04	2.4E-05	2.5E-05	8.4E-08	1.0E-04	3.6E-06	1.0E-04

(a) BNL = Brookhaven National Laboratory
GE VAL = General Electric – Vallecitos
GJPO = Grand Junction Project Office
INEEL = Idaho National Engineering and Environmental Laboratory
ITRI = Inhalation Toxicology Research Institute
LLNL = Lawrence Livermore National Laboratory
ORR = Oak Ridge Reservation
PNTX = Pantex Facility
RFETS = Rocky Flats Environmental Technology Site
SNL = Sandia National Laboratories
SPRU = Separations Process Research Unit
WV = West Valley Nuclear Services

NR = none reported.

Table F.6. Stream 4: TRU-RH Waste from Trenches

Constituent	Concentration	Units
Americium-241	6.4E+01	Ci/m^3
Plutonium-238	1.4E+01	Ci/m^3
Plutonium-239	5.5E+01	Ci/m^3
Plutonium-240	3.1E+01	Ci/m^3
Plutonium-241	1.2E+03	Ci/m^3
Beryllium	5.0E-01	kg/m^3
Sodium hydroxide	5.0E-01	kg/m^3
Xylene	4.8E+00	kg/m^3

Table F.7. Stream 4: TRU-CH Waste from Trenches

Constituent	Concentration, Ci/m^3
Americium-241	2.6E-01
Plutonium-238	1.0E+00
Plutonium-239	5.6E-01
Plutonium-240	2.2E+01

Table F.8. Stream 5: TRU-RH Waste from Caissons

Constituent	Concentration, Ci/m^3
Americium-241	5.6E+00
Cesium-137	5.0E+01
Cobalt-60	9.1E+00
Plutonium-238	9.0E-01
Plutonium-239	1.3E+01
Plutonium-240	3.2E+00
Plutonium-241	2.6E+01
Plutonium-242	1.2E-03
Strontium-90	4.6E+01
Uranium-233	1.0E-02
Uranium-234	1.3E-03
Uranium-235	3.9E-05
Uranium-238	9.6E-04

Table F.9. Stream 8: TRU – Commingled Polychlorinated Biphenyl Waste

Constituent	Concentration	Units
Americium-241	3.2E+00	Ci/m^3
Plutonium-238	7.2E-01	Ci/m^3
Plutonium-239	2.7E+00	Ci/m^3
Plutonium-240	1.5E+00	Ci/m^3
Plutonium-241	5.8E+01	Ci/m^3
Beryllium	5.0E-01	kg/m^3
Polychlorinated biphenyls (PCBs)	1.8E+00	kg/m^3
Sodium hydroxide	5.0E-01	kg/m^3
Xylene	4.8E+00	kg/m^3

Table F.10. Streams 9 and 10A: TRU – Newly Generated and Existing CH Standard and Non-Standard Containers

Constituent	Concentration	Units
Americium-241	3.2E+00	Ci/m^3
Plutonium-238	7.2E-01	Ci/m^3
Plutonium-239	2.7E+00	Ci/m^3
Plutonium-240	1.5E+00	Ci/m^3
Plutonium-241	5.8E+01	Ci/m^3
Acetone	7.7E-04	kg/m^3
Beryllium	5.0E-01	kg/m^3
Carbon tetrachloride	1.3E-01	kg/m^3
Dichloromethane	5.7E-03	kg/m^3
Hydraulic fluid	2.3E-01	kg/m^3
Mercury	4.8E-03	kg/m^3
Sodium hydroxide	5.0E-01	kg/m^3
1,1,1-Trichloroethane	7.8E-04	kg/m^3
Xylene	4.0E-03	kg/m^3

Table F.11. Stream 10B: TRU – Newly Generated and Existing RH Waste

Constituent	Concentration	Units
Cesium-137	7.4E+00	Ci/m^3
Cobalt-60	3.1E-01	Ci/m^3
Iron-55	2.8E+00	Ci/m^3
Strontium-90	2.4E+00	Ci/m^3
Tritium	3.9E-03	Ci/m^3
Acetone	7.7E-04	kg/m^3
Beryllium	5.0E-01	kg/m^3
Carbon tetrachloride	1.3E-01	kg/m^3
Dichloromethane	5.7E-03	kg/m^3
Hydraulic fluid	2.3E-01	kg/m^3
Mercury	4.8E-03	kg/m^3
Sodium hydroxide	5.0E-01	kg/m^3
1,1,1-Trichloroethane	7.8E-04	kg/m^3
Xylene	4.0E-03	kg/m^3

Table F.12. Stream 11: MLLW Treated and Ready for Disposal

Constituent	Concentration	Units
Americium-241	3.1E-05	Ci/m^3
Cesium-137	3.5E-03	Ci/m^3
Cobalt-60	6.3E-01	Ci/m^3
Curium-244	5.6E-04	Ci/m^3
Iron-55	1.1E-01	Ci/m^3
Neptunium-237	2.4E-06	Ci/m^3
Nickel-63	1.2E+0	Ci/m^3
Plutonium-238	2.9E-04	Ci/m^3
Plutonium-239	1.2E-04	Ci/m^3
Plutonium-240	2.1E-05	Ci/m^3
Plutonium-241	7.4E-04	Ci/m^3
Radium-224	1.6E-02	Ci/m^3
Strontium-90	1.0E-02	Ci/m^3
Tritium	3.9E-03	Ci/m^3

Table F.12. (contd)

Constituent	Concentration	Units
Thorium-228	4.8E-05	Ci/m^3
Thorium-232	1.4E-06	Ci/m^3
Thorium-234	2.4E-02	Ci/m^3
Uranium-234	2.8E-04	Ci/m^3
Uranium-235	4.6E-06	Ci/m^3
Uranium-236	5.4E-06	Ci/m^3
Uranium-238	7.2E-05	Ci/m^3
Acetone	2.0E-01	kg/m^3
Beryllium	5.3E+00	kg/m^3
Bromodichloromethane	1.2E-03	kg/m^3
Carbon tetrachloride	4.2E-01	kg/m^3
Hydraulic fluid	3.6E-01	kg/m^3
Toluene	3.4E-01	kg/m^3
Formic acid	9.4E-01	kg/m^3
Dichloromethane	2.0E-01	kg/m^3
Diesel fuel	1.6E-01	kg/m^3
Methyl ethyl ketone (MEK)	1.6E-01	kg/m^3
Mercury	4.9E-02	kg/m^3
Nitric acid	6.7E+00	kg/m^3
Polychlorinated biphenyls (PCBs)	5.8E-01	kg/m^3
p-chloroaniline	5.6E-01	kg/m^3
Sodium hydroxide	9.6E+00	kg/m^3
1,1,1-Trichloroethane	7.4 E-01	kg/m^3
Xylene	6.2E-02	kg/m^3

Table F.13. Stream 12: RH and Non-Standard Packages

Constituent	Concentration	Units
Cesium-137	7.4E+00	Ci/m^3
Cobalt-60	3.1E-01	Ci/m^3
Iron-55	2.8E+00	Ci/m^3
Strontium-90	2.4E+00	Ci/m^3
Tritium	3.9E-03	Ci/m^3
Acetone	2.0E-01	kg/m^3
Beryllium	5.3E+00	kg/m^3
Nitric acid	6.7E+00	kg/m^3
Sodium hydroxide	9.6E+00	kg/m^3
Toluene	1.0E+01	kg/m^3
Xylene	1.0E+00	kg/m^3

Table F.14. Stream 13: CH Organic and Inorganic Solids and Debris

Constituent	Concentration	Units
Americium-241	3.1E-05	Ci/m^3
Cesium-137	3.5E-03	Ci/m^3
Cobalt-60	6.3E-01	Ci/m^3
Curium-244	5.6E-04	Ci/m^3
Iron-55	1.1E-01	Ci/m^3
Nickel-63	1.2E+00	Ci/m^3
Neptunium-237	2.4E-06	Ci/m^3
Plutonium-238	2.9E-04	Ci/m^3
Plutonium-239	1.2E-04	Ci/m^3
Plutonium-240	2.1E-05	Ci/m^3
Plutonium-241	7.4E-04	Ci/m^3
Radium-224	1.6E-02	Ci/m^3
Strontium-90	1.0E-02	Ci/m^3
Thorium-228	4.8E-05	Ci/m^3
Thorium-232	1.4E-06	Ci/m^3
Thorium-234	2.4E-02	Ci/m^3

Table F.14. (contd)

Constituent	Concentration	Units
Tritium	3.9E-03	Ci/m^3
Uranium-234	2.8E-04	Ci/m^3
Uranium-235	4.6E-06	Ci/m^3
Uranium-236	5.4E-06	Ci/m^3
Uranium-238	7.2E-05	Ci/m^3
Acetone	2.0E-01	kg/m^3
Beryllium	5.3E+00	kg/m^3
Bromodichloromethane	1.2E-03	kg/m^3
Carbon tetrachloride	4.2E-01	kg/m^3
Dichloromethane	2.0E-01	kg/m^3
Diesel fuel	1.6E-01	kg/m^3
Formic acid	9.4E-01	kg/m^3
Hydraulic fluid	3.6E-01	kg/m^3
Methyl ethyl ketone (MEK)	1.6E-01	kg/m^3
Mercury	4.9E-02	kg/m^3
Nitrate	2.3E-01	kg/m^3
Nitric acid	6.7E+0	kg/m^3
Polychlorinated biphenyls (PCBs)	5.8E-01	kg/m^3
p-chloroaniline	5.6E-01	kg/m^3
Sodium hydroxide	9.6E+00	kg/m^3
Toluene	3.4E-01	kg/m^3
1,1,1-Trichloroethane	7.4E-01	kg/m^3
Xylene	6.2E-02	kg/m^3

Table F.15. Stream 14: Elemental Lead

Constituent	Concentration	Units
Americium-241	6.1E-05	Ci/m^3
Cerium-144	3.0E-03	Ci/m^3
Cesium-134	4.6E-05	Ci/m^3
Cesium-137	1.2E-02	Ci/m^3
Cobalt-60	1.2E-03	Ci/m^3
Neptunium-237	9.5E-07	Ci/m^3
Plutonium-238	9.3E-06	Ci/m^3
Plutonium-239	9.4E-05	Ci/m^3
Plutonium-240	4.0E-04	Ci/m^3
Plutonium-241	6.4E-04	Ci/m^3
Radium-224	4.2E-05	Ci/m^3
Radium-226	1.9E-04	Ci/m^3
Ruthenium-106	8.2E-04	Ci/m^3
Strontium-90	8.6E-03	Ci/m^3
Thorium-228	1.9E-03	Ci/m^3
Thorium-232	1.1E-06	Ci/m^3
Tritium	2.1E-05	Ci/m^3
Uranium-234	6.9E-06	Ci/m^3
Uranium-238	1.0E-05	Ci/m^3
Lead	9.8E+02	kg/m^3

Table F.16. Stream 15: Elemental Mercury

Constituent	Concentration	Units
Americium-241	5.3E-06	Ci/m^3
Cerium-144	4.6E-04	Ci/m^3
Cesium-134	3.6E-06	Ci/m^3
Cesium-137	8.4E-04	Ci/m^3
Cobalt-60	4.6E-05	Ci/m^3
Plutonium-238	5.6E-06	Ci/m^3
Plutonium-239	2.7E-03	Ci/m^3
Plutonium-240	1.0E-05	Ci/m^3
Plutonium-241	4.0E-04	Ci/m^3
Ruthenium-106	1.6E-04	Ci/m^3
Strontium-90	1.2E-04	Ci/m^3
Thorium-232	1.2E-05	Ci/m^3
Tritium	7.0E-07	Ci/m^3
Mercury	1.3E+02	kg/m^3

Table F.17. Stream 17: K Basins Sludge

Constituent	Concentration	Units
Americium-241	1.6E+01	Ci/m^3
Cesium-134	2.0E-01	Ci/m^3
Cesium-137	2.7E+02	Ci/m^3
Cobalt-60	5.4E-01	Ci/m^3
Neptunium-237	1.6E-03	Ci/m^3
Plutonium –238	2.6E+00	Ci/m^3
Plutonium-239	9.0E+00	Ci/m^3
Plutonium-240	5.0E+00	Ci/m^3
Strontium-90	2.7E+02	Ci/m^3
Technetium-99	4.2E-01	Ci/m^3
Uranium-234	3.4E-02	Ci/m^3
Uranium-235	1.2E-03	Ci/m^3
Uranium-236	4.0E-03	Ci/m^3
Uranium-238	2.5E-02	Ci/m^3
Polychlorinated biphenyls (PCBs)	1.6E-02	kg/m^3

Table F.18. Stream 18: MLLW Trench Leachate

Constituent	Concentration, Ci/m^3
Americium-241	1.4E-11
Cesium-137	3.6E-11
Cobalt-60	6.5E-09
Curium-244	2.6E-10
Iron-55	1.2E-09
Neptunium-237	1.1E-12
Nickel-63	1.2E-08
Plutonium –238	1.3E-10
Plutonium-239	5.6E-11
Plutonium-240	9.8E-12
Plutonium-241	3.4E-10
Radium-224	7.7E-09
Strontium-90	1.0E-10
Thorium-228	2.0E-11
Thorium-232	6.6E-13
Thorium-234	1.1E-08
Tritium	4.0E-11
Uranium-234	1.3E-10
Uranium-235	2.1E-12
Uranium-236	2.4E-12
Uranium-238	3.2E-11

F.1.1.1 Release Fractions for the Waste Receiving and Processing Facility

Potential releases from the WRAP have been characterized in the Notice of Construction (NOC) reports for hazardous chemicals (DOE-RL 1993a) and radionuclides (DOE-RL 1993b). Release fractions for radionuclides are based on 40 CFR 61, Appendix D (consistent with WAC 246-247). Releases of particulate solids from the WRAP gloveboxes include a factor of 1.0E-03, with an additional 5.0E-07 reduction for double high-efficiency particulate air (HEPA) filtration efficiency. The net release fraction is then 5.0E-10 for particulate material and 1.0 for volatile radionuclides (such as tritium and carbon-14).

Release fractions for non-radioactive volatile organic compounds (VOCs) were based on the vapor pressure and molecular weight of the chemical (DOE-RL 1993a, Appendix A). The releases were postulated to occur when a container was opened (within a glovebox) and the volatile chemicals were

emptied onto a holding pan with a diameter of 0.5 m (1.6 ft). The theoretical vaporization rate from this geometry was used to estimate the release rate over a one-year period. If the theoretical release rate indicated a greater release than the total inventory processed in a year, the chemical was assumed to be totally released (release fraction is 1.0).

The analysis presented in the WRAP NOC included consideration of the total mass fraction of each chemical in the annual processing inventory. A similar approach was used in the current analysis, except that the mass fraction was set to 1.0, representing a case where the chemical is the only one in the container emptied onto the holding pan. Also, the WRAP NOC analysis assumed the chemical would remain on the holding pan for the entire year. In the current analysis, the time was set to one day, and the theoretical release was divided by the amount of the chemical in one drum (average value). This process is in contrast to the NOC analysis that compared the release over a year to the total amount processed in a year. The net difference between the two analyses is that the current analysis is based on one drum, and the NOC analysis is based on a year of operation. The current analysis was based on one drum because the processing rates may change for each alternative group and the analysis could be performed in a more straightforward manner if the processing rate were not involved in the release fraction estimation. A summary of the release fraction evaluation for the WRAP is shown in Table F.19. The release fraction for volatile chemicals indicates the dependence on physical properties. Gases represent chemicals that have a vapor pressure above one atmosphere at ambient conditions.

Release fractions for specific VOCs are presented in Table F.20. As previously discussed, the release fraction is dependent on the waste stream because the release is based on the total amount of a chemical in one drum. The release fractions are based on total glovebox throughput of the waste type in the WRAP. For example, if a waste stream of transuranic (TRU) waste is defined as going to the gloveboxes, the release fraction does not include the processing fraction (0.1), and the release fraction for most VOCs would be 1.0. If the throughput is defined as the amount going to the WRAP, the release fraction must include the processing fraction (0.1). The processing fraction is multiplied by the listed release fraction in Table F.20 to find the correct release fraction for total throughput of the WRAP.

Table F.19. Release Fraction Values for the WRAP

Constituents Type	Form	Release Fraction
Radioactive material	Gases	1.0
	Particulates	5.0E-10
Chemicals	Gases	1.0
	VOCs[(a)]	0.12 VM/drum amount[(b)]
	Inorganic chemicals	5.0E-10

(a) VOCs = volatile organic compounds.
(b) Average amount in one drum expressed in kg/drum, vapor pressure (V) in atmospheres, and molecular weight (M) in g. The release fraction is limited to a maximum value of 1.0.

Table F.20. Release Fractions for Volatile Organic Compounds from the WRAP

Chemical Name	Waste Stream Description	
	TRU Waste, New and Stored	MLLW
1,1,1-Trichloroethane	1.0	1.0
Acetone	1.0	1.0
Bromodichloromethane	1.0	1.0
Carbon tetrachloride	1.0	1.0
p-chloroaniline	1.0	2.6E-03
Dichloromethane	None Reported	1.0
Diesel fuel	None Reported	3.4E-02
Formic acid	1.0	1.0
Hydraulic fluid	1.1E-04	7.5E-05
Mercury	6.4E-02	6.3E-03
Methyl ethyl ketone (MEK)	1.0	1.0
Polychlorinated biphenyls (PCBs)	4.0E-05	3.0E-05
Toluene	1.0	1.0
Xylene	1.0	1.0

The total estimated releases from the WRAP for each alternative group are given in Tables F.21 and F.22 for radionuclides and chemicals, respectively. The tables present releases for the Lower Bound and Upper Bound waste volumes for Alternative Groups A and B. The releases of radionuclides for the Hanford Only waste volume are just slightly smaller than those for the Lower Bound waste volume and are not shown. For chemicals, the releases for the Hanford Only waste volume are essentially identical to the Lower Bound waste volume because processing of MLLW for the two cases is nearly identical. The releases for Alternative Groups C, D, and E are essentially the same as those for Alternative Group A and are not shown.

F.1.1.2 Release Fractions for the Existing T Plant Complex

The release fractions are based on the value in 40 CFR 61, Appendix D (consistent with WAC 246-247), for particulate and solid contamination modified to include HEPA filtration. The 2706-T facility has single HEPA filtration and the 221-T facility has double HEPA filtration. The HEPA filtration efficiency for the 2706-T single HEPA filter is set to 99.95 percent. The analyses for releases from the existing T Plant Complex are based on all processing being done in the 2706-T facility. A summary of the release fractions for the T Plant Complex is given in Table F.23. The release fractions for specific VOCs are the same as for the WRAP (see Table F.20).

Table F.21. Airborne Radionuclide Releases from the WRAP

Radionuclide	Total Release, Ci				
	Alternative Group A		Alternative Group B		No Action
	Lower Bound Volume	Upper Bound Volume	Lower Bound Volume	Upper Bound Volume	
Americium-241	2.2E-06	2.2E-06	2.2E-06	2.2E-06	2.2E-06
Cesium-137	1.9E-08	1.3E-07	1.9E-08	2.2E-08	1.9E-08
Cobalt-60	1.2E-08	9.3E-08	1.2E-08	9.3E-08	1.2E-08
Curium-244	3.5E-11	2.0E-10	3.5E-11	2.0E-10	3.5E-11
Iron-55	7.1E-10	4.4E-09	7.1E-10	4.4E-09	7.1E-10
Manganese-54	1.3E-13	1.3E-13	1.3E-13	1.3E-13	1.3E-13
Nickel-63	1.1E-07	6.3E-07	1.1E-07	6.3E-07	1.1E-07
Neptunium-237	2.6E-13	1.4E-12	2.6E-13	1.4E-12	2.6E-13
Plutonium-238	6.9E-07	6.9E-07	6.9E-07	6.9E-07	6.9E-07
Plutonium-239	2.9E-06	2.9E-06	2.9E-06	2.9E-06	2.9E-06
Plutonium-240	1.7E-06	1.7E-06	1.7E-06	1.7E-06	1.7E-06
Plutonium-241	3.3E-05	3.3E-05	3.3E-05	3.3E-05	3.3E-05
Radium-224	2.4E-13	1.2E-12	2.4E-13	1.2E-12	2.4E-13
Strontium-90	2.4E-08	1.7E-07	2.4E-08	2.8E-08	2.4E-08
Thorium-234	1.0E-10	6.2E-10	1.0E-10	1.4E-10	1.0E-10
Tritium	1.4E+02	2.7E+02	1.4E+02	2.7E+02	1.4E+02
Uranium-234	1.2E-10	5.5E-10	1.2E-10	2.5E-10	1.2E-10
Uranium-235	2.2E-12	1.7E-11	2.2E-12	8.3E-12	2.2E-12
Uranium-236	8.3E-12	4.9E-11	8.3E-12	1.1E-11	8.3E-12
Uranium-238	1.0E-10	6.2E-10	1.0E-10	1.4E-10	1.0E-10

The total estimated releases from the T Plant Complex for the alternative groups are shown in Tables F.24 and F.25 for radionuclides and chemicals, respectively. The releases shown for Alternative Group A are for wastes processed in existing facilities and do not include releases in the modified T Plant. Releases from the modified T Plant are described in the following section. The tables present releases for the Lower Bound and Upper Bound waste volumes for Alternative Groups A and B. The releases of radionuclides for the Hanford Only waste volume are just slightly smaller than those for the Lower Bound waste volume and are not shown. For chemicals, the releases for the Hanford Only waste volume are essentially identical to the Lower Bound waste volume because processing MLLW for the two waste volumes is nearly identical. The releases for Alternative Groups C, D, and E are essentially the same as those for Alternative Group A and are not shown.

Table F.22. Total Chemical Atmospheric Releases from the WRAP

Chemical Name	Total Release, kg				
	Alternative Group A		Alternative Group B		No Action
	Lower Bound Volume	Upper Bound Volume	Lower Bound Volume	Upper Bound Volume	
Acetone	4.5E+01	2.3E+02	4.5E+01	2.3E+02	4.5E+01
Beryllium	7.7E-07	3.2E-06	7.7E-07	3.2E-06	7.7E-07
Bromodichloromethane	2.5E-01	1.3E+0	2.5E-01	1.3E+0	2.5E-01
Carbon tetrachloride	1.9E+02	5.7E+02	1.9E+02	5.7E+02	1.9E+02
Dichloromethane	4.9E+01	2.4E+02	4.9E+01	2.4E+02	4.9E+01
Diesel fuel	1.2E+0	6.1E+0	1.2E+0	6.1 E+0	1.2E+0
Formic acid	2.0E+02	1.1E+03	2.0E+02	1.1E+03	2.0E+02
Hydraulic fluid	2.6E-02	5.0E-02	2.6E-02	4.9E-02	2.6E-02
Mercury (elemental)	3.1E-01	5.9E-01	3.1E-01	5.7E-01	3.1E-01
Methyl ethyl ketone (MEK)	3.4E+01	1.8E+02	3.4E+01	1.8E+02	3.4E+01
Nitrate	2.3E-08	2.3E-08	2.3E-08	2.3E-08	2.3E-08
Nitric acid	7.2E-07	3.8E-06	7.2E-07	3.8E-06	7.2E-07
Polychlorinated biphenyls (PCBs)	3.8E-03	1.9E-02	3.7E-03	1.9E-02	3.7E-03
p-chloroaniline	3.1E-01	1.6E+00	3.1E-01	1.6E+00	3.1E-01
Sodium hydroxide	1.2E-06	5.6E-06	1.2E-06	5.6E-06	1.2E-06
Toluene	7.4E+01	3.9E+02	7.4E+01	3.9E+02	7.4E+01
1,1,1-Trichloroethane	1.6E+02	8.3E+02	1.6E+02	8.3E+02	1.6E+02
Xylene	1.6E+01	7.3E+01	1.6E+01	7.3E+01	1.6E+01

Table F.23. Release Fraction Values for the 2706-T Facility in the T Plant Complex

Operation	Form	Release Fraction	Filter Factor	Net Release Fraction
2706-T Facility	Gases	1.0E+00	1.0E+00	1.0E+00
	Particulates	1.0E-03	5.0E-04	5.0E-07
	Solids	1.0E-06	5.0E-04	5.0E-10

Table F.24. Total Radionuclide Atmospheric Release from the T Plant Complex

Radionuclide	Total Release, Ci				
	Alternative Group A		Alternative Group B		No Action
	Lower Bound Volume	Upper Bound Volume	Lower Bound Volume	Upper Bound Volume	
Americium-241	8.8E-07	8.9E-07	8.8E-07	8.9E-07	8.8E-07
Cesium-137	4.5E-04	4.6E-04	4.5E-04	4.6E-04	4.5E-04
Cobalt-60	4.2E-06	5.4E-05	4.2E-06	5.4E-05	4.2E-06
Curium-244	4.6E-08	1.0E-07	4.6E-08	1.0E-07	4.6E-08
Iron-55	2.6E-07	1.5E-06	2.6E-07	1.5E-06	2.6E-07
Manganese-54	4.1E-10	4.1E-10	4.1E-10	4.1E-10	4.1E-10
Neptunium-237	8.7E-11	4.5E-10	8.7E-11	4.5E-10	8.7E-11
Nickel-63	3.8E-05	2.7E-04	3.8E-05	2.7E-04	3.8E-05
Plutonium-238	1.3E-07	1.7E-07	1.3E-07	1.7E-07	1.3E-07
Plutonium-239	7.0E-07	7.2E-07	7.0E-07	7.2E-07	7.0E-07
Plutonium-240	2.7E-07	2.8E-07	2.7E-07	2.8E-07	2.7E-07
Plutonium-241	6.5E-06	6.6E-06	6.5E-06	6.6E-06	6.5E-06
Strontium-90	5.7E-04	5.7E-04	5.7E-04	5.7E-04	5.7E-04
Thorium-228	8.1E-11	4.1E-10	8.1E-11	4.1E-10	8.1E-11
Thorium-232	5.2E-11	2.7E-10	5.2E-11	2.7E-10	5.2E-11
Thorium-234	2.2E-06	2.2E-06	2.2E-06	2.2E-06	2.2E-06
Tritium	6.4E+02	1.1E+03	6.4E+02	1.1E+03	6.4E+02
Uranium-234	1.4E-06	1.4E-06	1.4E-06	1.4E-06	1.4E-06
Uranium-235	4.0E-08	4.1E-08	4.0E-08	4.1E-08	4.0E-08
Uranium-236	1.8E-07	1.8E-07	1.8E-07	1.8E-07	1.8E-07
Uranium-238	2.2E-06	2.2E-06	2.2E-06	2.2E-06	2.2E-06

Table F.25. Total Chemical Atmospheric Releases from the T Plant Complex

Chemical Name	Total Release, kg				
	Alternative Group A		Alternative Group B		No Action
	Lower Bound Volume	Upper Bound Volume	Lower Bound Volume	Upper Bound Volume	
Acetone	1.5E+01	7.7E+01	1.5E+01	7.6E+01	1.5E+01
Beryllium	1.9E-04	9.9E-04	1.9E-04	9.8E-04	1.3E-05
Bromodichloromethane	8.3E-02	4.3E-01	8.3E-02	4.3E-01	8.3E-02
Carbon tetrachloride	3.0E+01	1.6E+02	3.0E+01	1.6E+02	3.0E+01
Dichloromethane	1.5E+01	7.8E+01	1.5E+01	7.7E+01	1.5E+01
Diesel fuel	3.9E-01	2.0E+00	3.9E-01	2.0E+00	3.9E-01
Formic acid	6.8E+01	3.5E+02	6.8E+01	3.5E+02	6.8E+01
Hydraulic fluid	2.0E-03	1.0E-02	2.0E-03	1.0E-02	2.0E-03
Mercury (elemental)	2.2E-02	1.2E-01	2.2E-02	1.2E-01	2.2E-02
Methyl ethyl ketone (MEK)	1.2E+01	6.0E+01	1.2E+01	5.9E+01	1.2E+01
Nitrate	7.8E-06	7.8E-06	7.8E-06	7.8E-06	7.8E-06
Nitric acid	2.4E-04	1.3E-03	2.4E-04	1.2E-03	1.6E-05
Polychlorinated biphenyls (PCBs)	1.2E-03	6.5E-03	1.2E-03	6.4E-03	1.2E-03
p-chloroaniline	1.0E-01	5.4E-01	1.0E-01	5.3E-01	1.0E-01
Sodium hydroxide	3.5E-04	1.8E-03	3.5E-04	1.8E-03	2.3E-05
Toluene	2.5E+01	1.3E+02	2.5E+01	1.3E+02	2.5E+01
1,1,1-Trichloroethane	5.3E+01	2.8E+02	5.3E+01	2.7E+02	5.3E+01
Xylene	4.5E+00	2.3E+01	4.5E+00	2.3E+01	4.5E+00

F.1.1.3 The New Waste Processing Facility and Modified T Plant Complex

Handling wastes in the new waste processing facility and the modified T Plant Complex would be conducted in a manner similar to that in the WRAP except that some operations would be performed remotely. Therefore, the release fractions applicable to the WRAP were also used to estimate releases from waste processed in the new waste processing facility and the modified T Plant Complex. Double HEPA filtration was assumed for these facilities. Because some mixed waste may be processed in these facilities, the release fractions for hazardous chemicals are also needed. The release fractions are summarized in Table F.26. The release fractions for specific VOCs are the same as those presented for the WRAP (see Table F.20).

Table F.26. Release Fraction Values for the New Waste Processing Facility and the Modified T Plant Complex

Constituent Type	Form	Release Fraction
Radioactive material	Gases	1.0
	Particulates	5.0E-10
Chemicals	Gases	1.0
	VOCs[(a)]	0.12VM/drum amount[(b)]
	Inorganic chemicals	5.0E-10

(a) VOCs = volatile organic compounds.
(b) Average amount in one drum expressed in kg/drum, vapor pressure (V) is in atmospheres and molecular weight (M) is in g. The release fraction is limited to a maximum value of 1.0.

The total estimated releases from the modified T Plant Complex for Alternative Group A are given in Tables F.27 and F.28 for radionuclides and chemicals, respectively. Total releases of radionuclides for the new waste processing facility for Alternative Group B are shown in Table F.29. Chemical releases for the new waste processing facility for Alternative Group B are shown in Table F.30. Releases are estimated to be the same for the Lower and Upper Bound waste volume estimates because waste stream processing in these facilities are the same for both options. The releases for Alternative Groups C, D, and E are essentially the same as those for Alternative Group A and are not shown.

Table F.27. Total Radionuclide Atmospheric Release from the Modified T Plant Complex for Alternative Group A (Lower Bound and Upper Bound Waste Volumes)

Radionuclide	Total Release, Ci
Americium-241	3.1E-04
Cesium-134	4.2E-11
Cesium-137	2.3E-05
Cobalt-60	3.8E-08
Iron-55	1.3E-08
Plutonium-238	4.0E-05
Plutonium-239	1.9E-04
Plutonium-240	1.1E-04
Plutonium-241	1.2E-03
Strontium-90	1.6E-05
Technetium-99	2.9E-08
Tritium	4.4E+02
Uranium-234	5.7E-09
Uranium-235	8.3E-11
Uranium-236	2.8E-10
Uranium-238	1.8E-09

Table F.28. Total Chemical Atmospheric Releases from the Modified T Plant Complex for Alternative Group A

Chemical Name	Total Release, kg
Acetone	5.8E+02
Beryllium	1.0E-05
Carbon tetrachloride	4.3E+02
Dichloromethane	1.9E+01
Hydraulic fluid	8.3E-02
Mercury (elemental)	1.0E+00
Nitric acid	9.7E-06
Polychlorinated biphenyls (PCBs)	6.8E-03
Sodium hydroxide	1.6E-05
Toluene	3.1E+04
1,1,1-Trichloroethane	2.6E+00
Xylene	3.7E+04

Table F.29. Atmospheric Radionuclide Releases from the New Waste Processing Facility for Alternative Group B

Radionuclide	Total Release, Ci
Americium-241	2.3E-04
Cerium-144	5.9E-15
Cesium-134	7.9E-12
Cesium-137	1.8E-05
Cobalt-60	1.0E-06
Curium-244	4.8E-09
Iron-55	2.9E-08
Neptunium-237	1.6E-10
Plutonium-238	2.9E-05
Plutonium-239	1.4E-04
Plutonium-240	8.1E-05
Plutonium-241	7.7E-04
Strontium-90	1.4E-05
Technetium-99	2.9E-08
Thorium-234	3.1E-09
Tritium	5.1E+01
Uranium-234	1.0E-08
Uranium-235	1.7E-10
Uranium-236	3.7E-10
Uranium-238	3.1E-09

Table F.30. Total Chemical Atmospheric Releases from the New Waste Processing Facility for Alternative Group B

Chemical Name	Total Release, kg
Acetone	7.9E+03
Beryllium	1.0E-04
Bromodichloromethane	4.2E+01
Carbon tetrachloride	4.3E+02
Dichloromethane	7.5E+03
Diesel Fuel	2.0E+02
Formic Acid	3.4E+04
Hydraulic fluid	1.0E+03
Lead	4.8E-04
Mercury (elemental)	4.2E+01
Methyl ethyl ketone (MEK)	5.8E+03
Nitrate	4.2E-06
Nitric acid	1.3E-04
Polychlorinated biphenyls (PCBs)	6.3E-01
p-chloroaniline	5.2E+01
Sodium hydroxide	1.8E-04
Toluene	3.4E+04
1,1,1-Trichloroethane	2.7E+04
Xylene	4.6E+03

F.1.1.4 Pulse Drier Operation

The treatment of trench leachate would be performed in the Effluent Treatment Facility until that facility is decommissioned in 2025. Starting in 2026, the plan is to treat leachate using pulse driers installed near the trenches. Releases from drier operations are estimated using a release fraction of 0.001 (40 CFR 61, Appendix D) and a HEPA filtration factor of 5.0E-04. The net release fraction of 5.0E-07 is applied to radionuclides in the leachate from the trenches except for tritium and carbon-14, which are assumed to be totally released. The leachate is not expected to contain substantial amounts of volatile hazardous chemicals. The total annual release from leachate treatment using pulse driers is given in Table F.31 for Alternative Groups A and B. Releases for Alternative Groups C and D and for the No Action Alternative are given in Table F.32. Releases for Alternative Group E are expected to be the same as those for Alternative Group D and are not shown.

Table F.31. Atmospheric Radionuclide Release from Pulse Drier Leachate Treatment—Alternative Groups A and B

Radionuclide	Total Release, Ci					
	Alternative Group A			Alternative Group B		
	Hanford Only	Lower Bound	Upper Bound	Hanford Only	Lower Bound	Upper Bound
Americium-241	4.6E-13	1.1E-12	1.5E-12	3.4E-12	4.0E-12	6.7E-12
Cesium-137	3.0E-13	6.8E-13	9.9E-13	2.2E-12	2.6E-12	4.3E-12
Cobalt-60	9.8E-13	2.3E-12	3.3E-12	7.3E-12	8.5E-12	1.4E-11
Curium-244	1.2E-12	2.7E-12	3.9E-12	8.7E-12	1.0E-11	1.7E-11
Iron-55	2.5E-15	5.7E-15	8.2E-15	1.8E-14	2.1E-14	3.6E-14
Neptunium-237	2.2E-14	5.1E-14	7.5E-14	1.7E-13	1.9E-13	3.3E-13
Nickel-63	1.8E-10	4.2E-10	6.1E-10	1.4E-09	1.6E-09	2.7E-09
Plutonium-238	2.0E-12	4.5E-12	6.6E-12	1.5E-11	1.7E-11	2.9E-11
Plutonium-239	1.1E-12	2.6E-12	3.8E-12	8.5E-12	9.9E-12	1.7E-11
Plutonium-240	2.1E-13	4.8E-13	7.0E-13	1.6E-12	1.8E-12	3.0E-12
Plutonium-241	1.1E-12	2.5E-12	3.6E-12	7.9E-12	9.3E-12	1.6E-11
Strontium-90	8.6E-13	2.0E-12	2.9E-12	6.4E-12	7.5E-12	1.3E-11
Tritium	1.9E-07	4.3E-07	6.3E-07	1.4E-06	1.6E-06	2.7E-06
Uranium-234	2.7E-12	6.1E-12	8.9E-12	2.0E-11	2.3E-11	3.9E-11
Uranium-235	4.2E-14	9.8E-14	1.4E-13	3.2E-13	3.7E-13	6.2E-13
Uranium-236	5.0E-14	1.1E-13	1.7E-13	3.7E-13	4.3E-13	7.2E-13
Uranium-238	6.6E-13	1.5E-12	2.2E-12	4.9E-12	5.8E-12	9.6E-12

Table F.32. Atmospheric Radionuclide Release from Pulse Drier Leachate Treatment—Alternative Groups C and D and the No Action Alternative

Radionuclide	Total Release, Ci						
	Alternative Group C			Alternative Group D			No Action
	Hanford Only	Lower Bound	Upper Bound	Hanford Only	Lower Bound	Upper Bound	
Americium-241	4.6E-13	4.8E-13	9.6E-13	1.2E-12	1.3E-12	3.0E-12	1.5E-13
Cesium-137	3.0E-13	3.1E-13	6.2E-13	7.6E-13	8.4E-13	1.9E-12	1.2E-13
Cobalt-60	9.8E-13	1.0E-12	2.1E-12	2.5E-12	2.8E-12	6.3E-12	5.8E-13
Curium-244	1.2E-12	1.2E-12	2.4E-12	3.0E-12	3.3E-12	7.5E-12	4.9E-13
Iron-55	2.5E-15	2.6E-15	5.1E-15	6.3E-15	7.0E-15	1.6E-14	1.8E-15
Neptunium-237	2.2E-14	2.3E-14	4.7E-14	5.7E-14	6.4E-14	1.4E-13	7.6E-15
Nickel-63	1.8E-10	1.9E-10	3.8E-10	4.7E-10	5.2E-10	1.2E-09	6.5E-11
Plutonium –238	2.0E-12	2.1E-12	4.1E-12	5.1E-12	5.6E-12	1.3E-11	7.0E-13
Plutonium-239	1.1E-12	1.2E-12	2.4E-12	2.9E-12	3.3E-12	7.3E-12	3.9E-13
Plutonium-240	2.1E-13	2.2E-13	4.3E-13	5.3E-13	5.9E-13	1.3E-12	7.0E-14
Plutonium-241	1.1E-12	1.1E-12	2.2E-12	2.7E-12	3.1E-12	6.9E-12	4.7E-13
Strontium-90	8.6E-13	9.0E-13	1.8E-12	2.2E-12	2.5E-12	5.6E-12	3.3E-13
Tritium	1.9E-07	2.0E-07	3.9E-07	4.8E-07	5.4E-07	1.2E-06	8.5E-08
Uranium-234	2.7E-12	2.8E-12	5.6E-12	6.8E-12	7.6E-12	1.7E-11	9.0E-13
Uranium-235	4.2E-14	4.4E-14	8.9E-14	1.1E-13	1.2E-13	2.7E-13	1.4E-14
Uranium-236	5.0E-14	5.2E-14	1.0E-13	1.3E-13	1.4E-13	3.2E-13	1.7E-14
Uranium-238	6.6E-13	6.9E-13	1.4E-12	1.7E-12	1.9E-12	4.3E-12	2.2E-13

F.1.2 Release Point Characteristics

The atmospheric transport analysis requires definition of release point characteristics for each facility that has a release to air. The characteristics are presented in Table F.33 for the WRAP, 2706-T facility, the modified T Plant Complex, and pulse driers. Values for the WRAP were taken from the NOC (DOE-RL 2001a); for the 2706-T facility, from Meyer (1998); for the modified T Plant Complex, from the NOC (DOE-RL 2001b) and Rokkan et al. (2001); and pulse drier characteristics were taken from FH (2004). For all facilities, the temperature of outside air is set to the annual average value of 12°C (53.6°F).

Table F.33. Release Point Characteristics

Parameter	Units	WRAP and New Waste Processing Facility	2706-T Facility	Modified T Plant Complex	Pulse Driers
Stack height	m	14	8.5	61	5
Exit area	m^2	0.5	0.39	1.8	0.20
Exit velocity	m/s	15.4	15[(a)]	8.3	1.5
Exit air temperature	°C	32.2	25.6	23.9	74
Height of building	m	7	7.62	25	4.3
(a) The average exit velocity was set to one half the maximum value for the 2706-T facility.					

F.1.3 Atmospheric Transport

The transport and deposition of material released to the atmosphere was evaluated using the atmospheric transport component of MEPAS Version 4.0. This component implements the models from earlier versions of MEPAS, as described by Droppo and Buck (1996). The models are similar to and consistent with the models recommended by EPA in the Industrial Source Complex dispersion model (EPA 1995). Also, the atmospheric dispersion models in the MEPAS program provide nearly identical results to those generated using the EPA CAP88 program, as verified in a benchmarking study performed on the MEPAS, MMSOILS, and RESRAD computer programs (Mills et al. 1997). The RESRAD program uses the CAP88 program for atmospheric transport calculations (Cheng et al.1995).

The MEPAS model uses a data set of the annual joint frequency of occurrence of wind speed, wind direction, and atmospheric stability from the 200 Area Hanford Meteorology Station. The data set used for the present analysis was the 14-year average for the years 1983 through 1996 (Hoitink and Burk 1997) as presented in Tables F.34 and F.35. This data set is used in the atmospheric transport and deposition model to evaluate the air concentration and deposition rate as a function of direction and downwind distance. The pollutant concentrations in air and deposition rates are expressed as annual average values. The annual joint frequency data set is based on heights of 9.1 m (30 ft) and 60 m (197 ft) for Tables F.34 and F.35, respectively. The MEPAS code adjusts the data to represent the actual release height defined in Table F.33.

The population dose values were estimated from the calculated individual doses by multiplying by a conversion factor relating the population weighted χ/Q value to the χ/Q value at the location of the offsite maximally exposed individual (7.0E+04 person-s/m^3). This conversion factor also was used to estimate population health impacts from carcinogenic chemicals. The population distribution is given in Table F.36 as extracted from the 2000 Census (Census 2002, 2003a, 2003b) for the current analysis.

Table F.34. Joint Frequency Distributions for the 200 Areas at 9.1-m (30-ft) Towers, 1983–1996 Historical Data

Average Wind Speed (m/s)	Atmospheric Stability Class	Percentage of Time Wind Blows from the 200 Area Toward the Direction Indicated															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.89	A	0.28	0.31	0.34	0.25	0.23	0.22	0.18	0.13	0.11	0.1	0.08	0.07	0.1	0.1	0.16	0.21
	B	0.14	0.15	0.16	0.11	0.11	0.09	0.08	0.05	0.05	0.04	0.04	0.04	0.05	0.07	0.09	0.12
	C	0.15	0.15	0.14	0.1	0.09	0.09	0.09	0.06	0.04	0.04	0.05	0.05	0.06	0.07	0.1	0.13
	D	0.87	0.76	0.72	0.55	0.6	0.65	0.64	0.42	0.36	0.31	0.35	0.38	0.49	0.59	0.77	0.83
	E	0.4	0.29	0.27	0.26	0.3	0.35	0.46	0.41	0.36	0.35	0.44	0.49	0.55	0.66	0.65	0.57
	F	0.25	0.16	0.15	0.15	0.15	0.2	0.25	0.24	0.26	0.29	0.35	0.36	0.43	0.45	0.42	0.33
	G	0.1	0.09	0.1	0.07	0.08	0.08	0.1	0.1	0.1	0.1	0.14	0.11	0.14	0.15	0.17	0.15
2.65	A	0.64	0.45	0.35	0.32	0.35	0.37	0.34	0.23	0.17	0.2	0.27	0.2	0.17	0.26	0.6	0.7
	B	0.26	0.17	0.11	0.1	0.1	0.12	0.1	0.07	0.06	0.06	0.09	0.07	0.07	0.14	0.29	0.31
	C	0.22	0.13	0.1	0.08	0.08	0.09	0.1	0.05	0.05	0.05	0.06	0.06	0.06	0.1	0.25	0.28
	D	0.64	0.46	0.3	0.27	0.31	0.36	0.43	0.29	0.23	0.24	0.3	0.39	0.55	1.05	1.72	1.12
	E	0.29	0.16	0.11	0.1	0.21	0.28	0.35	0.41	0.31	0.29	0.53	0.98	1.68	2.09	1.71	0.77
	F	0.15	0.07	0.05	0.06	0.09	0.11	0.3	0.33	0.31	0.37	0.65	1.23	1.74	1.89	1.57	0.59
	G	0.04	0.03	0.02	0.02	0.04	0.04	0.13	0.18	0.19	0.2	0.32	0.65	0.68	0.78	0.69	0.19
4.7	A	0.19	0.22	0.11	0.04	0.04	0.03	0.04	0.04	0.05	0.13	0.31	0.36	0.21	0.23	0.61	0.3
	B	0.04	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.04	0.06	0.1	0.08	0.09	0.22	0.09
	C	0.04	0.03	0.02	0.01	0	0	0.01	0.01	0.02	0.04	0.05	0.08	0.07	0.08	0.2	0.09
	D	0.14	0.13	0.06	0.04	0.05	0.04	0.07	0.09	0.11	0.19	0.34	0.52	0.57	1.11	1.45	0.37
	E	0.07	0.06	0.04	0.02	0.02	0.02	0.06	0.1	0.11	0.15	0.37	0.66	1.09	1.95	1.78	0.25
	F	0.02	0.01	0.01	0.01	0.01	0.01	0.04	0.09	0.04	0.03	0.08	0.3	0.33	0.53	0.72	0.11
	G	0	0	0	0	0	0	0.02	0.04	0.01	0.02	0.04	0.18	0.1	0.16	0.32	0.03
7.15	A	0.03	0.06	0.04	0.01	0	0	0.01	0.01	0.02	0.06	0.23	0.33	0.15	0.17	0.44	0.11
	B	0.01	0.01	0.01	0	0	0	0	0	0.01	0.03	0.06	0.08	0.03	0.05	0.12	0.02
	C	0.01	0.01	0.01	0	0	0	0	0	0.01	0.02	0.04	0.07	0.03	0.03	0.08	0.02
	D	0.03	0.05	0.03	0.01	0	0	0.01	0.03	0.06	0.16	0.38	0.35	0.24	0.6	0.85	0.11
	E	0.01	0.05	0.02	0	0	0	0	0.02	0.05	0.11	0.25	0.23	0.15	0.47	0.93	0.06
	F	0	0	0	0	0	0	0	0.01	0	0	0.01	0.02	0.01	0.01	0.02	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table F.35. Joint Frequency Distributions for the 200 Areas at 60-m (197-ft) Aboveground Level, 1983–1996 Historical Data

Average Wind Speed m/s	Atmospheric Stability Class	Percentage of Time Wind Blows from the 200 Area Toward the Direction Indicated															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.89	A	0.11	0.13	0.15	0.11	0.11	0.12	0.07	0.05	0.03	0.02	0.04	0.03	0.05	0.03	0.05	0.07
	B	0.09	0.09	0.08	0.07	0.07	0.06	0.06	0.03	0.02	0.03	0.02	0.02	0.02	0.03	0.05	0.07
	C	0.09	0.08	0.1	0.08	0.07	0.06	0.06	0.04	0.02	0.02	0.02	0.02	0.03	0.04	0.04	0.08
	D	0.58	0.53	0.51	0.43	0.45	0.49	0.52	0.35	0.24	0.22	0.22	0.2	0.27	0.35	0.44	0.54
	E	0.29	0.22	0.2	0.18	0.22	0.28	0.32	0.25	0.18	0.17	0.17	0.17	0.23	0.25	0.31	0.32
	F	0.2	0.13	0.12	0.11	0.14	0.14	0.19	0.14	0.13	0.12	0.13	0.12	0.17	0.19	0.23	0.21
	G	0.07	0.05	0.05	0.05	0.06	0.07	0.1	0.07	0.07	0.06	0.08	0.09	0.09	0.11	0.12	0.1
2.65	A	0.61	0.5	0.46	0.41	0.43	0.41	0.43	0.3	0.2	0.18	0.18	0.17	0.12	0.16	0.43	0.58
	B	0.25	0.2	0.16	0.12	0.14	0.13	0.12	0.1	0.07	0.06	0.07	0.05	0.06	0.09	0.22	0.27
	C	0.23	0.16	0.13	0.09	0.1	0.1	0.12	0.07	0.05	0.06	0.06	0.05	0.04	0.08	0.21	0.28
	D	0.79	0.56	0.39	0.32	0.39	0.37	0.5	0.34	0.22	0.23	0.24	0.25	0.35	0.63	1.29	1.1
	E	0.37	0.23	0.18	0.16	0.22	0.23	0.34	0.34	0.18	0.18	0.25	0.34	0.5	0.8	0.95	0.66
	F	0.28	0.13	0.11	0.08	0.1	0.12	0.22	0.23	0.18	0.17	0.23	0.3	0.53	0.79	0.81	0.6
	G	0.09	0.05	0.04	0.03	0.04	0.03	0.08	0.11	0.1	0.1	0.13	0.19	0.33	0.41	0.32	0.23
4.7	A	0.32	0.29	0.18	0.08	0.08	0.06	0.09	0.09	0.09	0.15	0.28	0.27	0.14	0.19	0.64	0.41
	B	0.09	0.08	0.04	0.03	0.03	0.02	0.02	0.03	0.03	0.04	0.08	0.09	0.05	0.09	0.28	0.15
	C	0.06	0.05	0.03	0.02	0.02	0.01	0.02	0.02	0.02	0.04	0.05	0.07	0.05	0.07	0.21	0.13
	D	0.2	0.16	0.09	0.06	0.08	0.08	0.13	0.14	0.12	0.16	0.26	0.31	0.31	0.83	1.55	0.48
	E	0.21	0.1	0.09	0.06	0.09	0.08	0.15	0.21	0.13	0.15	0.27	0.54	0.95	1.72	1.52	0.45
	F	0.14	0.06	0.04	0.02	0.04	0.03	0.09	0.2	0.08	0.06	0.15	0.35	0.78	1.34	1.41	0.49
	G	0.04	0.01	0	0	0	0	0.03	0.05	0.03	0.03	0.06	0.15	0.33	0.47	0.64	0.27

Table F.35. (contd)

Average Wind Speed m/s	Atmospheric Stability Class	Percentage of Time Wind Blows from the 200 Area Toward the Direction Indicated															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
7.15	A	0.05	0.11	0.07	0.02	0.01	0	0.01	0.02	0.02	0.09	0.29	0.37	0.15	0.16	0.48	0.11
	B	0.02	0.02	0.02	0.01	0	0	0	0.01	0.01	0.03	0.05	0.09	0.04	0.06	0.14	0.03
	C	0.01	0.01	0.01	0	0	0	0	0.01	0.01	0.03	0.05	0.07	0.04	0.05	0.12	0.02
	D	0.06	0.08	0.04	0.02	0.01	0.01	0.04	0.08	0.08	0.17	0.34	0.46	0.39	0.85	1.18	0.15
	E	0.07	0.05	0.04	0.02	0.02	0.01	0.05	0.1	0.09	0.14	0.31	0.64	0.9	2.11	1.71	0.15
	F	0.04	0.03	0.03	0.01	0.01	0	0.03	0.08	0.03	0.03	0.06	0.23	0.39	0.88	1.3	0.15
	G	0	0	0	0	0	0	0.02	0.04	0.01	0	0.01	0.05	0.08	0.2	0.61	0.1
9.8	A	0.01	0.03	0.04	0.01	0	0	0	0	0.01	0.03	0.16	0.21	0.06	0.1	0.31	0.03
	B	0	0.01	0	0	0	0	0	0	0	0.01	0.05	0.05	0.01	0.03	0.08	0.01
	C	0	0	0	0	0	0	0	0	0	0.01	0.04	0.04	0.02	0.03	0.05	0.01
	D	0.02	0.03	0.02	0.01	0	0	0	0.02	0.04	0.11	0.29	0.28	0.15	0.51	0.68	0.04
	E	0.02	0.04	0.02	0	0	0	0.01	0.02	0.04	0.09	0.24	0.28	0.2	0.78	1.04	0.03
	F	0	0	0	0	0	0	0	0.01	0.01	0	0.02	0.03	0.04	0.08	0.19	0.01
	G	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0.03	0.08	0
12.7	A	0	0	0.01	0	0	0	0	0	0	0.02	0.09	0.1	0.02	0.02	0.16	0.01
	B	0	0.01	0	0	0	0	0	0	0	0.01	0.04	0.03	0.01	0.01	0.05	0
	C	0	0	0	0	0	0	0	0	0	0.01	0.02	0.02	0	0.01	0.04	0
	D	0.01	0.02	0.01	0.01	0	0	0	0.01	0.01	0.1	0.23	0.12	0.04	0.24	0.48	0.01
	E	0	0.02	0.01	0	0	0	0	0	0.02	0.07	0.13	0.08	0.04	0.19	0.39	0
	F	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table F.35. (contd)

Average Wind Speed m/s	Atmospheric Stability Class	Percentage of Time Wind Blows from the 200 Area Toward the Direction Indicated															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
15.6	A	0	0	0	0	0	0	0	0	0	0	0.02	0.02	0	0	0.02	0
	B	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0.01	0
	C	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0.01	0
	D	0	0	0	0	0	0	0	0	0	0.04	0.08	0.03	0.01	0.03	0.06	0
	E	0	0	0	0	0	0	0	0	0	0.03	0.04	0.01	0.01	0.03	0.05	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0.01	0.03	0.01	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table F.36. Population Within 80 km (50 mi) of the 200 Areas

Downwind Sector	Distance Interval, mi					
	0–10	10–20	20–30	30–40	40–50	Total
S	0	959	790	175	4281	6205
SSW	0	180	12,966	293	298	13,737
SW	0	33	30,654	3205	95	33,987
WSW	1	53	2309	23,398	7055	32,816
W	7	37	188	10,558	118,630	129,420
WNW	0	1365	33	10	6178	7586
NW	11	3358	933	92	2336	6730
NNW	4	320	751	1713	7123	9911
N	0	170	2980	438	3018	6606
NNE	0	29	1085	4150	27,277	32,541
NE	0	115	10821	3651	670	15,257
ENE	0	347	1184	1705	220	3456
E	0	548	2387	1953	325	5213
ESE	0	305	1851	514	1301	3971
SE	0	213	51,919	96,942	1250	150,324
SSE	0	2316	17,659	905	7655	28,535
Total	23	10,348	138,510	149,702	187,712	486,295

F.1.4 Exposure Scenarios

Two exposure scenarios have been used to evaluate the potential impacts to humans from the waste remediation activities: industrial and resident gardener (agricultural). For waterborne pathways, an additional analysis was performed for the resident gardener scenario to include a sauna/sweat lodge exposure pathway (indicated in the result tables of this appendix as the hypothetical resident gardener with sauna/sweat lodge). These scenarios were chosen to represent a range of habits and conditions for potential exposures. The industrial and resident gardener scenarios are based on the recommendations presented in the *Hanford Site Risk Assessment Methodology* (HSRAM) (DOE-RL 1995) as adopted by the Tri-Party Agreement (Ecology et al. 1989). These scenarios are based on the concept of reasonable maximum exposure as recommended by EPA (EPA 1989) for which the most conservative parameter is not always used. The resident gardener with a sauna/sweat lodge scenario also includes exposure to waterborne contamination used in a sweat lodge (Harris and Harper 1997; DOE-RL 1998) or sauna. The resident gardener with a sauna/sweat lodge scenario is only applied to waterborne pathways because the airborne pathways do not contribute to the sauna/sweat lodge exposure pathways.

The present analysis has used the HSRAM scenarios and exposure parameter values as published (DOE-RL 1995). These scenarios and parameters provide a conservative estimate of potential exposures of individuals living on or near the Hanford Site. When the annual radiation dose is evaluated, the HSRAM scenarios are modified to reflect exposure for a one-year period instead of an extended exposure duration. The lifetime impacts can be estimated by multiplying the annual values by the exposure duration for the scenario (20 years for the industrial scenario and 30 years for the resident gardener scenario).

Exposure assessments are performed for atmospheric releases (from normal operations) and for long-term transport via groundwater. For normal operations, the exposure assessment uses the results from the atmospheric transport analysis as the starting point for evaluation of pollutant concentrations in exposure media (for example, air, soil, and foods). The analysis begins with the first release from a facility and continues until the releases have stopped and the individuals have been exposed for the prescribed duration for the specific exposure scenario. The operating and waste-handling periods for the facility being considered determine the release period. During the release period, the transported material may be deposited into soil resulting in a gradual increase over time in concentrations of pollutants in soil. The accumulation in soil is evaluated explicitly by the MEPAS program and is used to determine the annual maximum radiation dose and the exposures for each of the exposure scenarios.

For long-term transport via groundwater, the exposure assessment uses the estimated water concentration at the point of exposure (for example, a point of analysis 1 kilometer from the 200 East Area, a point of analysis 1 kilometer from the 200 West Area, a point of analysis 1 kilometer from the ERDF site, and another point of analysis near the Columbia River). This water is used as the source of domestic water for irrigation of food crops, animal product feed, and animal drinking water (for the resident gardener scenario).

Two exposure scenarios are summarized in the following sections. The scenarios are described for exposure pathways involving atmospheric releases as well as releases resulting in groundwater contamination. The atmospheric pathways are evaluated to estimate health impacts for releases to air from normal operations; waterborne pathways are evaluated to estimate health impacts from releases to soil and transport via groundwater to the environment. A discussion of each exposure pathway follows the scenario descriptions.

F.1.4.1 Industrial Scenario

The industrial scenario is intended to represent potential exposures to workers in a commercial or industrial setting. The scenario primarily involves indoor activities, but outdoor activities (such as soil contact) also are included. The workers are assumed to wear no protective clothing. The scenario is not intended to represent exposure of remediation workers. For atmospheric releases, the worker is assumed to be located 100 m (328 ft) east of the release point. The specific exposure pathways included in the industrial scenario are listed in Table F.37 for radionuclides, chemicals, and the atmospheric transport medium. Parameter values for the pathways are presented in Table F.38.

Table F.37. Industrial Scenario Exposure Pathways

Transport Medium	Exposure Pathway	Chemical	Radionuclide
Air (with deposition to soil)	Ingestion	Yes	Yes
	External	No	Yes
	Dermal absorption	Yes	No
	Soil suspension – inhalation	Yes	Yes
	Air inhalation	Yes	Yes

Table F.38. Industrial Scenario Parameter Values

Exposure Parameters[a]					
Source	**Exposure Pathway**	**Intake Rate**	**Exposure Frequency, d/yr**	**Conversion Factors**	**Other Factors**
Air (with deposition to soil)	Soil ingestion	50 mg/d	146	1.0E-06 kg/mg	NA
	Soil external	8 hr/d	146	NA	0.8[b]
	Soil dermal absorption	0.2 mg/cm^2/d	146	1.0E-06 kg/mg	5000 cm^2[c]
	Soil suspension – inhalation	20 m^3/d	250	1.0E-09 kg/µg	50 µg/m^3 [d]
	Air inhalation	20 m^3/d	250	NA	NA

(a) For all cases, the body weight is 70 kg (155 lb). The exposure period is 1 year for annual dose estimates and 20 years for other analyses.
(b) Average shielding factor for external exposure to contaminated soil.
(c) Skin surface area contacted with soil by the worker.
(d) Average particulate loading in air.
NA = not applicable.

F.1.4.2 Resident Gardener Scenario

The resident gardener scenario is intended to represent potential exposures to an individual living near the Hanford Site and raising food and animal products for home consumption. The agriculture scenario from the HSRAM is applied to atmospheric and groundwater transport pathways. This scenario is the same as the agricultural scenario representing the point of maximum offsite air concentration for routine releases. The specific exposure pathways for radionuclides and chemicals that are included in the resident gardener scenario are listed in Table F.39. Parameter values for each exposure pathway are presented in Table F.40.

Several different exposure pathways are considered in the health impacts analyses. The pathways included in a specific analysis depend on the transport medium, scenario, and pollutant type (that is, chemical or radionuclide), as indicated in the previous section. Details of each exposure pathway are presented here by transport medium. In general, the parameter values for a pathway are taken from DOE-RL (1995), Harris and Harper (1997), and DOE-RL (1998) for the sauna/sweat lodge pathway.

Table F.39. Resident Gardener Scenario Exposure Pathways

Transport Medium	Exposure Pathway	Chemical	Radionuclide
Soil (air deposition)	Ingestion	Yes	Yes
	External	No	Yes
	Dermal absorption	Yes	No
	Biota – dairy	Yes	Yes
	Biota – meat	Yes	Yes
	Biota – game (deer)	Yes	Yes
	Biota – fruit	Yes	Yes
	Biota – vegetables	Yes	Yes
	Suspension – inhalation	Yes	Yes
Air	Inhalation	Yes	Yes
	Biota – dairy	Yes	Yes
	Biota – meat	Yes	Yes
	Biota – game (deer)	Yes	Yes
	Biota – fruit	Yes	Yes
	Biota – vegetables	Yes	Yes
Groundwater	Ingestion	Yes	Yes
	Dermal absorption (bathing)	Yes	No
	Biota – dairy	Yes	Yes
	Biota – meat	Yes	Yes
	Biota – game (deer)	Yes	Yes
	Biota – fruit	Yes	Yes
	Biota – vegetables	Yes	Yes
	Inhalation indoor	Yes	Yes

Table F.40. Resident Gardener Scenario Parameter Values

Exposure Parameters[a]					
Source	**Exposure Pathway**	**Intake Rate**	**Exposure Frequency, d/yr**	**Conversion Factors**	**Other Factors**
Soil	Ingestion	100 mg/d	365	1.0E-06 kg/mg	NA
	External	24 hr/d	365	NA	0.8[b]
	Dermal absorption	0.2 mg/cm^2/d	180	1.0E-06 kg/mg	5000 cm^2[c]
	Inhalation	20 m^3/d	365	1.0E-09 kg/µg	50 µg/m^3[d]
Air	Inhalation	20 m^3/d	365	NA	NA
Groundwater	Ingestion	2 L/d	365	NA	NA
	Inhalation (sauna or sweat lodge)	20 m^3/d	365	NA	1.9 L/m^3[e] VOC 0.3 L/m^3[f] non-volatile 1 hr/d[g] 4 L/d
	Dermal absorption	0.17 hr/d	365	1.0E-03 L/cm^3	20,000 cm^2[f]
Biota	Dairy	300 g/d	365	1.0E-03 kg/g	NA
	Meat	75 g/d	365	1.0E-03 kg/g	NA
	Game	15 g/d	365	1.0E-03 kg/g	NA
	Fruit	42 g/d	365	1.0E-03 kg/g	NA
	Vegetable	80 g/d	365	1.0E-03 kg/g	NA

(a) For all cases the body weight is 70 kg (155 lb). The exposure period is for 1-year annual dose estimates and 30 years for other analyses.
(b) Average shielding factor for external exposure to contaminated soil.
(c) Skin surface area contacted with soil by the worker.
(d) Average particulate loading in air.
(e) The sauna or sweat lodge transfer factor (1.9 L/m^3) for VOCs assumes 4 L/d water use in a hemisphere of a 2-m (6.6-ft) diameter with complete suspension of all contaminants.
(f) Skin surface area contacted during bathing with domestic water.
(g) Ratio of indoor air concentration to water concentration for volatilization from indoor water uses.
NA = not applicable.

F.1.4.3 Soil (Air or Irrigation Water Deposition) Transport Medium

Deposition of airborne activity on soil would result in exposure to individuals who come in contact with the soil, breathe resuspended particles from the soil, or eat foods grown in the soil. The contamination deposited onto soil is modeled as a pollutant concentration per unit area of soil. Some of the soil exposure pathways require concentration to be expressed in units of soil mass (mg/kg or pCi/kg dry soil). For these pathways, the conversion to soil mass is made using the conversion factor 60 kg/m^2 that is based on uniform distribution of the contaminant in the top 4 cm (1.6 in) of soil having a density of

1.5 g/cm^3. This thickness is representative of the distribution of contaminants in residential soil (such as lawns) for deposition occurring over extended periods (for instance, several years). For agricultural pathways, the conversion is based on uniform distribution in 15 cm (6 in) of soil (plow layer) with a conversion factor of 225 kg/m^2.

The parameter values for each exposure pathway related to soil as a medium were presented in Tables F.38 and F.40 for the two exposure scenarios. Notes on the exposure pathways follow.

Soil Ingestion. The individual is assumed to inadvertently ingest contaminated soil as part of daily activities defined for the scenarios. The resident gardener ingests soil at 100 mg/day for the entire year, while the industrial worker ingests 50 mg/day while on the job for 146 days per year. It is assumed the worker is exposed to soil for only 146 of the 250 workdays per year.

Soil External Exposure. Radionuclides deposited onto soil may cause external radiation exposure to individuals near the contamination. The industrial worker is assumed to be exposed 8 hours per day for 146 days per year. The resident gardener is assumed to be exposed 24 hours per day for 365 days per year.

Soil Dermal Contact. The dermal contact pathway is evaluated only for chemicals (as recommended in DOE-RL1995). The individuals are assumed to have 1 contact event per day (a 12-hour period) with soil adhering to the skin at a surface density of 0.2 mg/cm^2 of skin for the industrial and resident gardener scenarios. The area of skin contacted is assumed to be 5000 cm^2 for all scenarios. The industrial worker is assumed to be exposed 146 days per year; the resident gardener is assumed to be exposed 180 days per year.

Soil Resuspension Inhalation. Material deposited on the ground is assumed to be available for resuspension and inhalation by individuals in proximity to the contamination. The industrial worker and resident gardener scenarios assume the individual inhales 20 m^3 (706 ft^3) of contaminated air per day. The airborne concentration of soil is evaluated using the mass loading factor approach with a particulate air concentration to 50 μg/m^3 of soil in air.

Food Crops. Food crops are evaluated as fruits and vegetables for the resident gardener scenario. The crops are contaminated when soil contamination (from airborne deposition or irrigation water application) transfers to the edible parts of the plant by root uptake. The resident gardener is assumed to eat food crops at a rate of 42 g/day (1.48 oz/day) of fruit and 80 g/day (2.82 oz/day) of vegetables throughout each year of the 30-year exposure period. The soil concentration is based on a soil mixing depth of 15 cm (5.9 in.) and a soil density of 1.5 g/cm^3, which is equivalent to an areal soil density of 225 kg/m^2.

Game (Deer). For the resident gardener scenario, the individual is assumed to hunt and kill one deer during the year. The deer becomes contaminated when foraging on plants grown in contaminated soil. The HSRAM scenario applies a hunter success rate of 19 percent for a season. This percentage is appropriate when the exposure duration is many years (30 years for HSRAM), but is not appropriate when considering a one-year period. The annual dose analysis must assume the hunter is successful

(a success rate equal to 100 percent for the year of exposure). Also, the HSRAM intake rate for deer meat is based on the amount of animal fat in the consumed meat. Although this assumption may be appropriate for organic chemical pollutants that are lipophilic, it is not generally appropriate for radionuclides. Also, the exposure pathway models for radionuclides evaluate the activity in the edible meat, not fat. The intake rate for deer meat, therefore, must be adjusted to represent the amount of meat ingested. This value is 15 g/day (0.53 oz/d), as calculated and reported for the recreational scenario of the Columbia River Comprehensive Impact Assessment (CRCIA) project (DOE-RL 1998).

Meat and Milk Ingestion. Individuals in the resident gardener scenario are assumed to ingest 75 g/day (2.65 oz/day) of meat (other than game) and 300 g/day (10.6 oz/day) of dairy products (represented as milk). The animal product becomes contaminated when the animal eats feed crops contaminated by root uptake from contaminated soil.

F.1.4.4 Air Transport Medium

Airborne activity may result in inhalation exposure plus direct transfer to plant surfaces, resulting in intake of contaminated food crops and animal products (from animals that eat contaminated feed crops). The parameter values for each exposure pathway related to air as a medium were presented in Tables F.37 through F.40 for the two exposure scenarios. Notes on the exposure pathways follow.

Inhalation. For the two HSRAM scenarios, the individual inhales 20 m^3 (706 ft^3) of air during the time the individual is present. For the industrial worker, this volume of air is inhaled during an 8-hour period, during which the individual is engaged in enhanced physical activity. For the resident gardener, the air is inhaled during a 24-hour period at average daily inhalation rates. The industrial worker is exposed 250 days per year; the resident gardener is exposed 365 days per year.

Food Crops. Food crops are evaluated as fruits and vegetables for the resident gardener scenario. The crops are contaminated when airborne contamination transfers directly to the plant surface and is incorporated into edible parts of the plant. Parameters for this pathway are defined in Section F.1.4.3.

Game (Deer). For the resident gardener scenario, the individual is assumed to hunt and kill one deer during the year. The dose for this pathway is evaluated as described under Section F.1.4.3. Deer are potentially contaminated for the air transport medium when they eat plants contaminated from direct air deposition onto plant surfaces plus root uptake of airborne deposition onto soil.

Meat and Milk Ingestion. The animals are exposed from eating feed crops that may be contaminated by direct air deposition plus root uptake of airborne deposition onto soil. Parameters for these pathways are defined in Section F.1.4.3.

F.1.4.5 Waterborne Transport Medium

Waterborne activity may result in exposure from domestic water uses and irrigation water uses. Groundwater used to supply drinking water for domestic water for residences can result in exposure via water ingestion, inhalation of volatile chemicals released during showering and washing, and dermal

contact during bathing. The parameter values for each exposure pathway related to groundwater as a medium were presented in Table F.39. Notes on the exposure pathways follow.

Ingestion of Drinking Water. The resident gardener consumes 2 L/day (0.53 gal/day) during each day of the year.

Indoor Air Inhalation. Individuals may be exposed to contaminated indoor air from volatilization of chemicals from indoor uses of domestic water. This exposure includes air inhalation while showering. The resident gardener is exposed daily with a breathing rate of 20 m^3 (706 ft^3) per day.

Sauna or Sweat Lodge Air Inhalation. Individuals who participate in sauna or sweat lodge activity may be exposed to contaminated air from the contaminants in water used to generate humidity. The amount of a pollutant transferred to air from the water is dependent on the physical properties (volatility) of the pollutant and the amount of water used. The typical use of water is 4 L (1.01 gal) over a 1-hour period. Volatile chemicals could be totally transferred to the air. Using a sauna or sweat lodge volume based on a 2-m (6.6-ft) diameter hemisphere (Harris and Harper 1997), the transfer factor is 1.9 L/m^3 (4 L [1.01 gal]) water per volume of 2-m (6.6-ft) diameter hemisphere. This value relates the air concentration inside the sauna or sweat lodge to the water concentration used to generate the humidity.

The transfer of non-volatile compounds (and most radionuclides) is determined by the amount of water vapor that can be held in the air. Excess water vapor (and associated non-volatile pollutants) would condense and be removed from the air. The estimated transfer factor of 0.3 L/m^3 is based on recommendations of Harris and Harper (1997) and is intended to maximize the concentration of non-volatile compounds in the air.

Water Dermal Contact. Individuals may be exposed to contaminated water while bathing. Dermal absorption of chemicals in shower water is evaluated using methods recommended by the EPA (EPA 1992). Residents are exposed each day of the year.

Food Crops, Game (Deer), Meat, and Milk Ingestion. Parameter values for these exposure pathways are as defined in Section F.1.4.3.

F.1.5 Soil Accumulation Model

The accumulation of pollutants in soil is represented using a box model with loss rate constants to represent radioactive decay, leaching, and volatilization of volatile and semi-volatile compounds.

The losses from volatilization are represented by a loss rate constant that was evaluated based on physical properties of the chemical. The loss rate constants were evaluated using the volatilization model of Streile et al. (1996) with soil parameters defined for Hanford agricultural soil (Sandy Loam). The evaluation was performed using the MEPAS 4.0 source term component under the FRAMES operating system (Whelan et al. 1997). The estimated half-times are presented in Table F.41.

Table F.41. Volatilization Half-Times for Soil

Chemical	Soil Half-Time Volatilization (Days)
Acetone	4.0E+02
Bromodichloromethane	3.8E+02
Carbon tetrachloride	1.2E+02
Dichloromethane	5.1E+01
Diesel fuel	8.5E+03
Hydraulic fluid	8.7E+03
Methyl ethyl ketone	8.4E+02
Polychlorinated biphenyls (PCBs)	4.4E+04
p-chloroaniline	1.4E+04
Toluene	2.7E+02
1,1,1 Trichloroethane	2.3E+02
Xylene	2.2E+02

The losses from radioactive decay (and progeny generation) are evaluated using the general decay algorithm of Strenge (1997).

The leaching losses from the surface soil layer are evaluated from the distribution coefficient (K_d) value, as shown in Equation F.2.

$$\lambda_i = \frac{I}{h\,\theta\,(1 + \frac{\beta_d}{\theta} k_{di})} \qquad \text{(F.2)}$$

where λ_i = loss rate constant for pollutant i from surface soils (1/yr)
I = total infiltration rate (cm/yr)
h = thickness of the surface-soil layer (cm)
θ = moisture content of the surface-soil layer (fraction)
β_d = bulk density of the surface-soil layer (g/cm^3)
k_{di} = distribution coefficient for pollutant i (mL/g).

Evaluation of the leach rate constant requires an estimate of the K_d for each contaminant. The following paragraphs describe the method used to evaluate the K_d values for radionuclides and chemicals.

Values used for the distribution coefficient were selected to give low leach rate constants (high retention times). This selection would result in a conservative (high) estimate of radiation dose or chemical intake for those exposure pathways that involve accumulation in soil. The parameters for

agricultural soil are used for all exposure pathways, as a simplification to the analysis and a further conservatism for the residential exposure pathways. Residential soil would be expected to involve mixing in a smaller depth (represented in Equation F.2 by parameter h). A smaller value for soil depth would result in a faster leach rate and lower equilibrium concentrations. Residential and industrial soils are assumed to be subject to the same infiltration rate as agricultural lands because of lawn watering.

F.1.5.1 Evaluation of Distribution Coefficient for Organic Chemicals

The general algorithm for estimation of K_d values for organic chemicals is taken from Strenge and Peterson (1989), as shown in Equations F.3 and F.4:

$$K_d = 0.0001 K_{oc} S_d \tag{F.3}$$

where K_d = distribution coefficient (mL/g)
K_{oc} = carbon matter water distribution coefficient (mL/g)
S_d = soil distribution coefficient (dimensionless)
0.0001 = empirical coefficient.

The soil distribution coefficient is evaluated based on soil properties as follows:

$$S_d = 57.735\ (\%\ organic\ matter) + 2.0\ (\%\ clay) + 0.4\ (\%\ silt) + 0.005\ (\%\ sand) \tag{F.4}$$

where the empirical coefficients have units of 1 percent.

As this equation indicates, the soil composition is important to the evaluation of the K_d. For the present analysis, the soil type is based on an agricultural soil composed of typical Hanford soil, with the carbon matter composition based on typical agricultural soils. Surface soils of Hanford are dominated by Rupert Sand, Ephrata Sandy Loam, and Burbank Loamy Sand (see Section 4.3.4). The approximate composition of these soils is indicated in Table F.42.

The properties of Sandy Loam provide higher estimates of K_d than the other two soil types because clay results in a higher contribution to the soil distribution coefficient than sand or silt. Typical agricultural soils contain about 1.2 percent organic carbon (Connor and Shacklette 1975). Assuming the weight of organic carbon is about half of the weight of the organic matter, the total content of organic matter is about 2.4 percent.

Table F.42. Soil Classification Composition

Soil Classification	% Sand	% Silt	% Clay
Sand	92	5	3
Loamy Sand	83	11	6
Sandy Loam	65	25	10

The estimate of S_d and K_d is based on Sandy Loam with a carbon matter content of 2.4 percent, with the carbon matter percent value replacing sand. The net composition is 62.6 percent sand, 25 percent silt, 10 percent clay, and 2.4 percent carbon matter. This soil composition results in a value of 169 for S_d.

The K_{oc} values are taken from the MEPAS chemical database. Evaluation of K_d values is indicated in Table F.43 for the hazardous chemicals in the waste stream inventories.

Table F.43. Soil-Related Properties of Hazardous Chemicals

Chemical	K_{oc}	K_d
Beryllium	--	1.0E+02
Nitric acid	--	1.0E+01
Sodium nitrate	--	1.0E+01
Sodium hydroxide	--	1.0E+01
1,1,1 trichloroethane	1.5E+02	2.6E+0
Polychlorinated biphenyls	6.1E+05	1.0E+04
p-chloroaniline	4.2^{E}+01	7.0E-01
Carbon tetrachloride	5.0E+02	8.4E+0
Hydraulic fluid	1.4E+04	2.4E+02
Toluene	3.0E+02	5.0E+00
Formic acid	1.8E-01	3.0E-03
Dichloromethane	8.8E+00	1.4E-01
Acetone	5.8E-01	9.7E-02
Methyl ethyl ketone (MEK)	4.5E+00	7.6E-02
Diesel fuels	4.5E+03	7.6E+01
Xylene	2.4E+02	4.0E+00
Mercury	--	8.0E+04
Bromodichloromethane	1.0E+02	1.8E+00
-- = A K_{oc} value is not needed for inorganic chemicals.		

F.1.5.2 Evaluation of Distribution Coefficients for Radionuclides and Inorganic Chemicals

The distribution coefficient values for radionuclides and inorganic chemicals were selected based on a literature review of values for the inorganic chemicals and radionuclide elements in the waste stream inventories. The selected K_d values are listed in Table F.44.

The K_d value for sodium nitrate, sodium hydroxide, and nitric acid are based on the value used for potassium-40; the value for mercury is the same as the value for lead. The values are based primarily on chemical similarity and solubility. The value for beryllium is a default value set to cause very little leaching (a conservative estimate for impacts).

Table F.44. Distribution Coefficients of Radionuclides and Inorganic Chemicals

Analyte Name[(a)]	Distribution Coefficient (mg/g)
Americium	5,000
Beryllium	100
Bismuth	900
Cesium	100
Cobalt	100
Curium	1,500
Iron	100
Lead	80,000
Manganese	2,400
Mercury	80,000
Neptunium	1,500
Nickel	2,400
Nitrate	10
Nitrite	10
Plutonium	5,000
Polonium	1,100
Protactinium	3,600
Radium	500
Radon	0.1
Sodium hydroxide	10
Strontium	180
Thorium	600,000
Tritium	0.7
Uranium	7
Yttrium	15,00

(a) The distribution coefficient applies to all isotopes of the listed element.

F.1.6 Health Impacts

The evaluation of annual radiation dose is based on radiation dose conversion factors as published in Federal Guidance Reports (FGRs) 11 and 12 (Eckerman et al.1988; Eckerman and Ryman 1993). These dose factors are based on recommendations of the International Commission on Radiological Protection (ICRP) as given in ICRP Publication 30 (ICRP 1979, 1980, 1981, 1988). The resulting doses represent the effective dose equivalent received over a commitment period of 50 years following intake in the first year.

For non-carcinogenic chemicals, the health endpoint is the hazard quotient defined by EPA as the average daily intake of a chemical divided by the reference dose (RfD) for that chemical. The hazard

quotient is evaluated for both inhalation exposures and ingestion exposures with RfD determined for each route. For carcinogenic chemicals, the health endpoint is the lifetime cancer incidence from the defined total intake.

The evaluation of radiation dose as the endpoint in the analysis is a deviation from the guidance in the HSRAM report (DOE-RL 1995). The HSRAM report describes evaluation of the lifetime cancer incidence risk from radionuclides using slope factors. The slope factors relate intake (pCi) to the lifetime cancer incidence risk. However, the present analysis requires evaluation of annual radiation dose. The use of slope factors has, therefore, been replaced in the present analysis by use of radiation dose conversion factors.

F.1.7 Basis for Radiological Health Consequences

Estimates of consequences from radiological exposures to workers and the public are based on recommendations of the EPA, as presented in FGR 13 (Eckerman et al. 1999). The consequences in terms of latent cancer fatalities (LCFs) and total detrimental health effects are presented in Table F.45 for both adult workers and the general population. The total incidence of detrimental health effects includes both fatal and non-fatal cancers and severe hereditary effects.

Table F.45. Summary of Basis for Health Consequences from Radiological Exposures from Federal Guidance Report 13 (from Eckerman et al. [1999])

Type of Health Effect	Effects per Unit Radiation Dose[(a)]	Radiation Dose to Produce 1 Effect[(a)]
Latent Cancer Fatality – All Individuals	6×10^{-4} /person-rem	1700 person-rem
Total Detriment[(b)] All individuals	8.5×10^{-4} /person-rem	1200 person-rem

(a) To convert person-rem to person-Sv, multiply by 0.01.
(b) Total detriment includes fatal and non-fatal cancers and severe hereditary effects.

The EPA recommendations are similar to those of the ICRP (1991), which are shown in Table F.46. Again, the total incidence of detrimental health effects includes both fatal and non-fatal cancers and severe hereditary effects. The higher rates for health effects in the general population account for the presence of more sensitive individuals, such as children, compared to the relatively homogeneous population of healthy adults in the workforce. These health effects coefficients are used to estimate the number of LCFs in populations, or the risk of an LCF to an individual, for the purposes of comparing the alternatives and activities discussed in this HSW EIS. The ICRP health effects coefficients have been adopted by the National Council on Radiation Protection and Measurements (NCRP 1993) and are similar to those developed by other organizations (for example, UNSCEAR 1988; Eckerman et al. 1999). Use of the health effects coefficients developed by these other organizations would result in conclusions regarding health effects similar to those presented in this HSW EIS.

Table F.46. Basis for Health Consequences from Radiological Exposures (from ICRP [1991])

Type of Health Effect	Effects per Unit Radiation Dose[(a)]	Radiation Dose to Produce 1 Effect[(a)]
Latent Cancer Fatality		
Adult Workers	4×10^{-4} /person-rem	2500 person-rem
General Population	5×10^{-4} /person-rem	2000 person-rem
Total Detriment[(b)]		
Adult Workers	5.6×10^{-4} /person-rem	1800 person-rem
General Population	7.3×10^{-4} /person-rem	1400 person-rem

(a) To convert person-rem to person-Sv, multiply by 0.01.
(b) Total detriment includes fatal and non-fatal cancers and severe hereditary effects.

The health effects coefficients are based on radiation exposures to specific populations and for different doses, dose rates, and pathways than those normally encountered in the environment. As a result, the health effects coefficients in Table F.46 are subject to substantial uncertainty when applied to very low or very high doses, and when extrapolated to estimate health effects in populations different from those used to develop them. The NCRP (1997) has estimated the range (90 percent confidence interval) of these health effects coefficients to be approximately a factor of two above and below the median values presented in Table F.46.

For some hypothetical radiological accidents discussed in this HSW EIS, the estimated doses to onsite or offsite individuals may be greater than the doses to which these health effects coefficients were intended to apply. Depending upon the radionuclides involved and the exposure pathways considered, the LCF risk may be as much as twice that listed in Table F.45 for doses greater than 20 rem but less than a few hundred rem. For doses greater than a few hundred rem, there is a potential for short-term health effects other than cancer and hereditary effects (again, depending upon the radionuclides and exposure pathways associated with a particular accident scenario). For a further discussion of uncertainties, see Section 3.5 in Volume I of this EIS.

The estimation of health effects in a given population is determined by applying the health effects coefficients to the collective dose for that population. Collective dose is defined as the sum of doses to all individuals in the population who may exhibit a wide range of susceptibility to radiation-induced health effects. The health effects coefficients are, therefore, associated with substantial uncertainty when applied to dose estimates for individuals whose sensitivity may differ from the population average. However, as stated in ICRP (1991), assumptions used to develop the health effects coefficients were intended to be sufficiently conservative that they would be "…unlikely to underestimate the risks."

F.1.8 Comparison of Radiation Risk Results for Children—Estimated Using Federal Guidance Reports 11 and 13

All dose results in this HSW EIS have been estimated using the internal radiation dose conversion factors recommended in FGR 11 (Eckerman et al.1988). As an approximation, radiation risks were estimated using an individual dose-to-risk conversion factor of 0.0006 risk of induction of a latent cancer

fatality per rem of dose, as recommended by EPA (Eckerman et al. 1999). All estimates presented in this HSW EIS are based on exposure of adults.

Radiation doses and risks to children are different from those to adults for the same concentrations of contaminants in the environment because children generally eat and drink less than adults (except possibly for milk) so their bodies metabolize contaminants differently than adults, and their organs have different masses than adult organs. In addition, children may have different sensitivities than adults to radiation for a given radiation dose. Eckerman et al. (1999) provides tables of ingestion dose and risk to children for a unit intake of radionuclides that may be used to evaluate the potential differences in dose and risk to children and adults for given groundwater concentrations of radionuclides of interest in this HSW EIS.

The radiation risks for adults in this HSW EIS are estimated using predicted radionuclide concentrations in waster, assumed drinking rates, radionuclide-specific radiation dose conversion factors, and a dose-to-risk conversion. A similar calculation can be done using a drinking rate appropriate for children and the radionuclide-specific risk conversion factor. The ratios of annual dose and risks estimated for children, using a 1 L/day drinking water intake rate, to the annual risk for adults, as calculated in this HSW EIS, are presented in Table F.47.

The HSW EIS approach would over-estimate the risk to children from ingestion of iodine-129, but slightly underestimate the dose. Doses and risks to children from carbon-14 would be about twice as high as those for adults; however, carbon-14 was found to be a minor contributor to dose for all the alternative groups. Risks to children from technetium-99 would be an order of magnitude greater, and doses would be a factor of 6 greater. Technetium-99 was found to be a major contributor to drinking water dose for several millennia, and, although the risk to children would be higher, the annual dose was found to not exceed the DOE 4 mrem/yr drinking water standard using the higher factor. The methods used for adults were approximately the same as those for children for isotopes of uranium.

Table F.47. Ratios of Dose and Risk to Children over Dose and Risk to Adults from 1-Year Ingestion of Contaminated Drinking Water

Radionuclide	Dose Ratio (Child/Adult)	Risk Ratio (Child/Adult)
Carbon-14	1.4	2.3
Technetium-99	6.0	11
Iodine-129	1.4	0.2
Uranium-233	0.88	1.1
Uranium-234	0.87	1.1
Uranium-235	0.90	1.2
Uranium-236	0.87	1.1
Uranium-238	0.88	1.1

F.2 Accident Impact Assessment Methods

In this HSW EIS, estimates of accident consequences for Hanford waste management facilities and operations are based on analyses of accident scenarios identified in existing Hanford nuclear facility safety analyses, including Bushore (2001), Tomaszewski (2001), Vail (2001a, 2001b, 2001c), and WHC (1991). Details of the accident analyses are presented in these documents and are summarized in Volume I, Section 5.11.

The accident consequences presented in this HSW EIS differ from those in the Hanford safety documents because of differences and calculation adjustments that are described in the following paragraphs. Adjustments were made to the analysis results to update calculations and to meet the needs of the environmental impact analysis rather than those of the safety analyses for which the analyses were originally prepared. Except for those changes and adjustments specifically noted, all calculations and assumptions remain the same.

Changes and adjustments to safety document calculations include the following:

- Updated Hanford meteorological data were used to estimate atmospheric dispersion factors. Composite joint frequency data, including the years 1983 through 1996, were used for this HSW EIS analysis.

- The environmental impact analysis used 95th percentile atmospheric dispersion factors, whereas safety analyses typically use 99.5 percentile atmospheric dispersion factors. (Building wake and plume meander factors used in the safety analyses remain incorporated in this HSW EIS consequence estimates.)

- The locations of the maximally exposed individual (MEI) member of the public and the MEI non-involved worker were changed from those in the safety analyses. For this HSW EIS analysis, the MEI was located at the nearest publicly accessible location on U.S. State Route 240 (generally a 3- to 5-km [1.9- to 3.1-mi] distant), and the MEI non-involved worker was located 100 m (109 yd) away. For the safety analyses, the MEI member of the public was located at the Hanford Site boundary, typically a distance of 12 km (7.4 mi), and the co-located worker was at the nearest facility, typically a distance of 800 m (872 yd). The difference in the locations of hypothetically exposed individuals is the most important reason for differences in the dose estimates between this HSW EIS and the Hanford safety analyses.

- Only the period of plume passage was considered for exposure pathways and doses in this HSW EIS analysis. Thus, inhalation is the most important exposure pathway, particularly for TRU waste radio-nuclides with much smaller contributions from immersion and ground deposition.

- Doses are presented only as total effective dose equivalent (TEDE) in this HSW EIS.

- This HSW EIS presents estimates of dose and radiological impact (as the probability of LCFs) to exposed individuals, whereas the safety analyses present only estimates of dose.

- This HSW EIS presents estimates of collective dose and radiological impact (as the postulated number of LCFs) to the exposed population of the general public from an accident scenario. Safety analyses do not present this information.

- The environmental impact analysis used an updated list of temporary emergency exposure limits (TEELs) to evaluate potential impacts from exposure to non-radiological hazardous chemicals. Additional information on TEELs is presented in Section F.2.3.

- This HSW EIS presents estimated impacts from industrial and occupational accidents. Safety analyses do not present this information. Additional information for each alternative group is presented in Volume I, Section 4.10 and in the industrial accidents sections of Volume I, Section 5.11.

F.2.1 Adjustment Method

The method for adjusting dose results presented in the safety analyses for the environmental impact analysis is shown in the following equations. It is a simple ratio of acute release atmospheric dispersion factors (E/Q) and the calculated doses. The E/Q is a measure of atmospheric dispersion for short-term (acute) atmospheric releases using Gaussian dispersion plume modeling, with units of s/m^3. For a given point or location at some distance from the source, it represents the time-integrated air concentration ($Ci \cdot s/m^3$) divided by the total release from the source (Ci). E/Qs are typically used for releases lasting no longer than 8 to 24 hours. The effective dose equivalent (EDE) used in the safety analyses is equivalent to the TEDE used in the environmental impact analysis.

$$\frac{TEDE_{EIS}}{EDE_{SA}} = \frac{E/Q_{EIS}}{E/Q_{SA}} \tag{F.5}$$

or

$$TEDE_{EIS} = EDE_{SA} * \frac{E/Q_{EIS}}{E/Q_{SA}} \tag{F.6}$$

where EIS = used in this EIS
SA = used in the safety analyses.

A similar method was used for estimating collective dose to the population within 80 km (50 mi), except that a population-weighted atmospheric dispersion factor was used instead of the single-point dispersion factor. Collective dose estimates were based on the atmospheric dispersion and dose to the MEI member of the public presented in the safety analyses.

$$TEDE_{pop,EIS} = EDE_{MEI,SA} * \frac{E/Q_{pop,EIS}}{E/Q_{MEI,SA}} \quad (F.7)$$

where pop,EIS = population-weighted atmospheric factor used in this EIS
MEI,SA = maximally exposed individual member of the public used in the safety analyses.

A similar method was used for adjusting air concentrations at the point of exposure of individuals to non-radiological hazardous chemicals. These adjusted air concentrations were then compared to the revised TEELs list,

$$C_{EIS} = C_{SA} * \frac{E/Q_{pop,EIS}}{E/Q_{MEI,SA}} \quad (F.8)$$

where C is the air concentration of a particular hazardous chemical at the point of exposure.

Table F.46 presents the atmospheric dispersion parameters used in the accident analysis for the onsite non-involved worker and offsite locations of the exposed individuals and population.

F.2.2 Accident Frequency

As the first step in the safety analysis process, a preliminary hazard analysis is performed to identify the range of potential accident scenarios applicable to each facility. Each accident scenario in the complete suite of events is then assigned to one of several relative frequency and consequence categories. For this purpose, accident scenarios are often binned into one of three frequency ranges: "anticipated" (events having an expected frequency between 0.01 and 1.0 per year), "unlikely" (events having an expected frequency between 1×10^{-4} and 1×10^{-2} per year), and "extremely unlikely" (events having an expected frequency between 1×10^{-6} and 1×10^{-4} per year). Events having an expected frequency less than 1×10^{-6} per year are considered "incredible" and are typically not evaluated in detail for safety analyses. From the set of accident scenarios, one or more are selected from each frequency range for further detailed analysis. The accidents selected for detailed evaluation include the events that are considered to have the highest potential consequences for each frequency category, although other accidents in each frequency category may be analyzed to better represent the range of potential impacts and types of accident scenarios (such as fires, handling accidents, or external events such as earthquakes).

As noted previously in this section, the accident analyses presented in the HSW EIS are based on safety analysis reports for existing waste management facilities, or on preliminary evaluations prepared for proposed facilities. Frequencies reported in the HSW EIS for specific accidents are taken directly from those evaluations, where available. However, this HSW EIS presents the accident consequences without regard to frequency of occurrence, and estimated accident frequencies were not incorporated into the reported consequences or risk estimates.

F.2.3 Non-Radiological Impact Endpoints

Estimates of consequences of exposure to potentially hazardous chemicals were based on one-hour exposures, consistent with the assumptions of the Emergency Response Planning Guidelines (ERPGs). Also used were TEELs that are interim, temporary, or equivalent exposure limits for chemicals for which official ERPGs have not yet been developed. At its April 1996 meeting in Knoxville, Tennessee, the DOE Subcommittee on Consequence Assessment and Protective Actions (SCAPA) adopted the term TEEL. These exposure limits must be regarded as dynamic; if new concentration limits are issued (for example, ERPG, permissible exposure level, or threshold limit value) or if new or additional toxicity data are found, the TEEL would be revised. At the time of this analysis, TEEL values were provided for over 1340 additional chemicals. ERPGs adopted through January 1, 2000, are located on the SCAPA Internet Web site (DOE 2002). The most recent TEELs list revision is *ERPGs and TEELs for Chemicals of Concern: Rev 19* (Craig 2002).

Potential consequences of exposure to hazardous materials are evaluated by comparing them to the air concentrations of the applicable ERPG or TEEL. Definitions for the different TEEL levels are based on those for ERPGs that follow:

- ERPG-1 – The maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor

- ERPG-2 – The maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action

- ERPG-3 – The maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.

- TEEL-1 – The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor

- TEEL-2 – The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action

- TEEL-3 – The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing life-threatening health effects.

It is recommended that, for the application of TEELs, the concentration at the receptor point of interest be calculated as the peak 15-minute, time-weighted average concentration. It should be emphasized that TEELs are default values, following the published methodology on the SCAPA web page (DOE 2002) explicitly.

F.2.3.1 Impacts from Industrial Accidents

Impacts of potential industrial and occupational accidents were predicted using five-year average statistics for the DOE, Richland Operations Office, reported in Computerized Accident/Incident Reporting System, or CAIRS, for the years 1996 to 2000 (DOE 2001). The baseline statistics, applied separately for construction and operations activities, are presented in Volume I, Section 4.10. Impacts are presented as the predicted number of total recordable cases, lost workday cases, lost workdays, and fatalities for construction and operation activities, based on the number of worker-years for that activity. A full-time worker is assumed to work 2000 hours per year.

F.3 Intruder Impact Assessment Methods

In the assessment of intruder impacts, inadvertent intrusion is defined as an inadvertent activity that results in direct contact with the waste from a LLW disposal facility. Two types of inadvertent intrusions are considered: 1) excavation of a basement for construction of a dwelling and 2) drilling a well. In each case, the waste would be extracted from the disposal facility and the extracted waste, with the exception of activated metal and concrete (or grout), is assumed to be indistinguishable from soil. Pathways by which an intruder might be exposed to radiation from the exhumed waste include the following:

- ingestion of vegetables grown in the contaminated soil
- ingestion of soil
- inhalation of radionuclides on dust suspended in the air by gardening activities or wind
- external exposure to direct radiation from contaminated soil while working in the garden or residing in the house built on top of the waste disposal facility.

Calculations were performed via a spreadsheet using dose rate per unit concentration conversion factors contained in performance assessments for the disposal of LLW in the LLBGs and peak radionuclide concentrations (WHC 1995, 1998). Peak radionuclide concentrations are shown in Table F.48 along with a short description of the waste origin. The peak concentration values are based on information extracted from the Solid Waste Information Tracking System, or SWITS, database (Anderson and Hagel 1996; Hagel 1999) and decay corrected to 2046. These radionuclides would not all occur within the same waste container or even within the same disposal facility. Therefore, the peak values represent a hypothetical maximum waste package.

Table F.48. Peak Radionuclide Concentrations in Disposal Facilities (Year 2046)

Radionuclide	Peak Waste Concentration, Ci/m^3	Probable Waste Description
Tritium	6.9E+02	Failed tritium targets
Carbon-14[(a)]	4.2E+0	Naval core basket
Cobalt-60[(a)]	5.1E-01	Naval core basket
Nickel-59[(a)]	5.9E+0	Naval core basket
Nickel-63[(a)]	4.9E+02	Naval core basket
Strontium-90	1.0E+03	B Plant filters during encapsulation of strontium fluoride
Technetium-99	7.9E-02	Discarded uranium oxide
Iodine-129	5.2E-03	PUREX debris
Cesium-137	4.1E+02	B Plant filters during encapsulation of cesium chloride
Uranium-234	2.4E-01	Discarded uranium oxide
Uranium-235	6.0E-02	Discarded uranium oxide
Uranium-236	2.5E-01	Discarded uranium oxide
Uranium-238	1.5E-01	Discarded uranium oxide
(a) The activity is in activated metal.		

F.3.1 Human Intrusion Exposure Scenarios

Estimation of impacts from inadvertent human intrusion that were considered in this analysis included the following hypothetical scenarios: well drilling, post-well drilling gardening, excavation, post-excavation gardening, and the deep-root garden. The parameters and values employed for radiation dose and associated impacts are presented as follows:

- Well Drilling – A 30-cm (12-in) diameter well is driven through the waste.

- Post-Well Drilling Gardening – Waste from the well hole is mixed with topsoil in which vegetables are grown. The vegetables are consumed as well as incidental soil.

- Excavation – 300 m^3 (11,000 ft^3) of waste is exhumed during construction of a nominal 139-m^3 (1500-ft^2) house with a basement.

- Post-Excavation Gardening – Waste from the basement excavation is mixed with soil in which vegetables are grown. The vegetables are consumed as well as incidental soil.

- Deep-Root Garden – Crop roots, including fruit and nut trees or other natural plant roots (such as alfalfa), penetrate the waste zone, thereby contaminating crops or fodder that are consumed in the human food chain.

For Category 1 LLW, waste is buried at a depth of about 3 m (10 ft) and would be accessible by excavation, drilling, or root penetration of fruit and nut trees and alfalfa. Thus, all five scenarios apply.

For Category 3 LLW, waste is buried at a sufficient depth of 5 m (16 ft) or more to eliminate excavation for a dwelling house. However, root penetration by fruit and nut trees would still be possible as a feasible, albeit minor, means of interacting with the waste. (WAC 173-340 states that for soil cleanup levels based on human exposure via direct contact, the point of compliance is established in the soils throughout the site from the ground surface to 3.8 m [15 ft] below the ground surface. This estimate represents a reasonable depth of soil that could be excavated and distributed at the soil surface as a result of site development activities.) Thus, only the drilling and post-drilling scenarios are applicable based on depth of the waste. However, Category 3 LLW is contained within concrete high-integrity containers (HICs) and it is considered highly improbable that drilling through HICs would occur. Regardless, this scenario was selected to reasonably bound consequences of intrusion impacts from wastes under consideration in this HSW EIS.

Evaluation of this intrusion scenario was performed for 100, 500, and 1000 years after 2046. No allowance was given for the Modified RCRA Subtitle C Barrier to be used in capping HSW disposal facilities in Alternative Groups A and B. Thus the drilling scenario, as evaluated, applies to all alternative groups under consideration.

In the well drilling operation, 0.35 m^3 (12 ft^3) of waste (from a 0.3-m [12-in.] diameter well assumed to be drilled through 5 m [16 ft] of waste) is brought to the surface and spread over a 2500-m^2 (0.6-ac) garden. The resulting redistribution factor results in a value of 1.4E-04 m^3 of waste per m^2 (4.6E-04 ft^3 of waste per ft^2). It is assumed the exhumed soil is thoroughly mixed to a depth of 15 cm (6 in).

The area of the garden is a size that would reasonably supply the resident's vegetable diet (Napier et al. 1984) and has been used in other assessments (for example, Kincaid et al. 1995). The mixing depth of 15 cm (6 in) is considered a typical plowing depth for most farming practices. An attempt was made to be reasonably conservative in the selection of values so that the dose estimates would be bounding.

Inhalation and external exposures are based on the following exposure times: the gardener is assumed to spend 1800 hr/yr outside in the garden and 4380 hr/yr inside. The remaining 2580 hr/yr are spent elsewhere on the property.

A mathematical model was used to calculate the amount of each radionuclide that would be brought to the surface by human intrusion. Estimates of annual frequencies of yearly probabilities for borehole drilling into the disposal facility with the highest consequence impacts were calculated. The annual probabilities were derived by multiplying the annual borehole frequency per square kilometer, 0.01/km/yr, by the surface area occupied by the waste container. This value is more than three times higher than the number recommended by EPA in 40 CFR 191. For example, in 1976, a 48.9 m^3 box containing 100,000 Ci of cesium-137 was disposed of in the 218-E-10 LLBG for a concentration of 2040 Ci/m^3 in HEPA filters from the B Plant. That concentration of cesium-137 would physically decay to a concentration of about 410 Ci/m^3 by 2046. This box was assumed to be cubical in shape and, therefore, approximately 3.66 m (12 ft) on a side. This provides an estimate of 13.4 m^2 (1.3E-05 km^2) of surface area for the container into which the borehole can be drilled. Thus the probability of randomly drilling into and hitting the container holding the highest radioactivity concentration of cesium-137 would be roughly 1.3E-07 per year.

F.3.2 Radiological Analysis

The dose-rate-per-unit waste concentration factors (mrem/yr per Ci/m^3) for 13 radionuclides are given in Table F.49 for the post-well drilling scenario and in Table F.50 for the excavation scenario. The analysis used the Kennedy and Strenge (1992) concentration ratios and assumed the intrusion to begin at 100, 500, and 1000 years after 2046. The dose-rate-per-unit waste concentration factors were evaluated by setting the initial concentration (that is, at year 2046) of a radionuclide in the waste to 1 Ci/m^3 and then evaluating the intruder scenario at the specified time. The evaluation was based on the amount of the radionuclide present at the specified time (and any progeny radionuclides that may have grown in from the parent radionuclide). The dose-rate-per-unit waste concentration factors were evaluated for all radionuclides assumed to be present in the waste streams contributing to disposal facility activity. The dose-rate-per-unit waste concentration factors were then multiplied by the given initial concentration of radionuclides of interest to estimate the final dose results. For given radionuclides, doses were calculated as a function of time, using the assumption of leaching or not leaching of radionuclides from the soil during crop growth. For each radionuclide, the exposure pathway providing the largest dose is also shown in the tables.

The dose-rate-per-unit waste concentration factors change with time because of decay of the parent radionuclide and leaching of radionuclides from the surface soil. The unit dose factors given in Tables F.49 and F.50 in the "Without Soil Leaching" column are impacted only by radioactive decay and progeny ingrowth. These dose factors generally decrease with time as the parent decays, although progeny ingrowth may cause an increase with time. For example, the uranium-235 dose-rate-per-unit waste concentration factors increase with time because of the ingrowth of protactinium-231. The dose-rate-per-unit waste concentration factors for *with soil leaching* are impacted by decay and leaching and are less than or equal to the corresponding value for no leaching.

Table F.49. Dose-Rate-per-Unit Waste Concentration Factors (mrem/yr per Ci/m^3) for the Post-Well Drilling Scenario, Time Since Year 2046

Radionuclide	Without Soil Leaching			Dominant Exposure Pathway
	100 yr	300 yr	500 yr	
Tritium	5.1E-06	6.4E-11	8.0E-16	Soil Ing.
Carbon-14	5.1E+00	5.0E+00	4.8E+00	Vegetable
Cobalt-60	6.2E-03	2.4E-14	9.0E-26	External
Nickel-59	1.2E-01	1.2E-01	1.2E-01	External
Nickel-63	7.8E-02	2.0E-02	4.9E-03	Vegetable
Strontium-90	3.0E+01	2.4E-01	1.8E-03	Vegetable
Technetium-99	2.0E+01	2.0E+01	2.0E+01	Vegetable
Iodine-129	5.4E+01	5.4E+01	5.4E+01	Vegetable
Cesium-137	8.4E+01	8.5E-01	8.6E-03	External
Uranium-234	5.2E+01	5.2E+01	5.2E+01	Inhalation
Uranium-235	1.7E+02	1.8E+02	2.0E+02	External
Uranium-236	4.9E+01	4.9E+01	4.9E+01	Inhalation
Uranium-238	8.2E+01	8.2E+01	8.2E+01	Inhalation

Table F.50. Dose-Rate-per-Unit Waste Concentration Factors (mrem/yr per Ci/m^3) for the Excavation Scenario, Time Since Year 2046

Radionuclide	Without Soil Leaching			Dominant Exposure Pathway
	100 yr	300 yr	500 yr	
Tritium	1.0E-03	1.4E-08	1.7E-13	Soil Ing.
Carbon-14	1.1E+03	1.0E+03	1.0E+03	Vegetable
Cobalt-60	1.3E+00	5.0E-12	1.9E-23	External
Nickel-59	2.5E+03	2.5E+01	2.5E+01	External
Nickel-63	1.6E+01	4.2E+00	1.0E+00	Vegetable
Strontium-90	6.4E+03	5.0E+01	4.0E-01	Vegetable
Technetium-99	4.2E+03	4.2E+03	4.2E+03	Vegetable
Iodine-129	1.2E+04	1.2E+04	1.2E+04	Vegetable
Cesium-137	1.8E+04	1.8E+02	1.8E+00	External
Uranium-234	1.1E+04	1.1E+04	1.1E+04	Inhalation
Uranium-235	3.6E+04	3.9E+04	4.2E+04	External
Uranium-236	1.0E+04	1.0E+04	1.0E+04	Inhalation
Uranium-238	1.8E+04	1.8E+04	1.8E+04	Inhalation

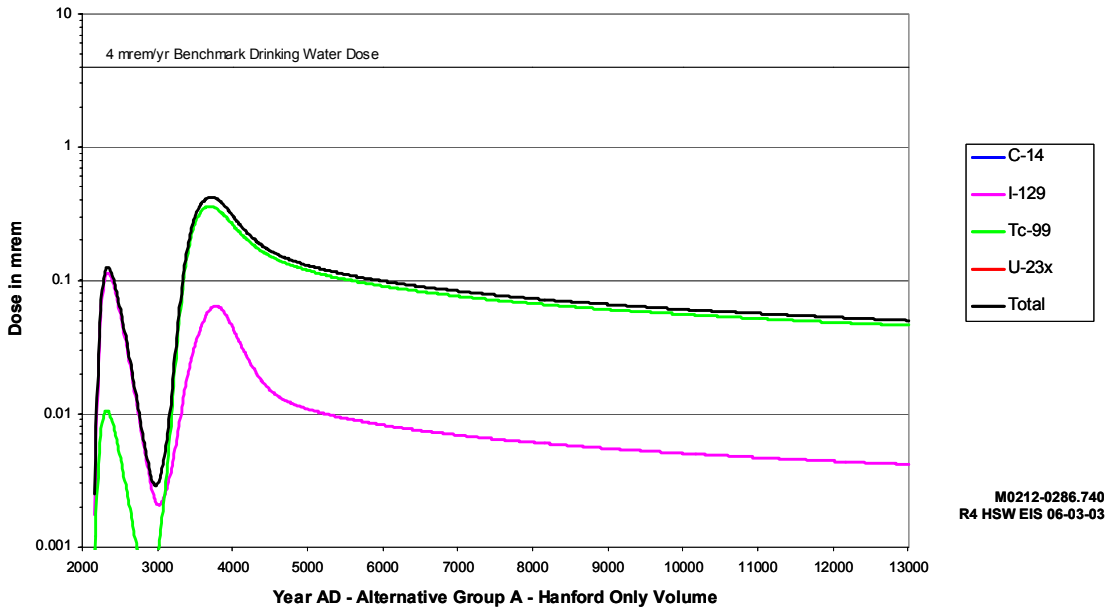
F.4 Impacts from Waterborne Pathways

This section presents results in addition to those presented in Volume I, Section 5.11 for the groundwater analyses, including examples of contributions to impacts by waste type and radionuclide and summaries of potential impacts to the resident gardener at the 1-km points of analysis and the Columbia River point of analysis for all alternative groups.

Graphs of contributions to drinking water dose by radionuclide are presented in the following figures for all alternative groups and for the Hanford Only and Upper Bound waste volumes. For the No Action Alternative, the results are presented only for the Hanford Only waste volume because the results are very similar to those for the Lower Bound waste volume. The content for each figure is indicated in Table F.51.

Table F.51. Content of Figures for Groundwater Analysis Results

Alternative Group	Line of Analysis				
	200 West	**ERDF**	**200 East NW**	**200 East SE**	**Columbia River**
Group A	F.1	NA	F.2	F.3	F.4
Group B	F.5	NA	F.6	NA	F.7
Group C	F.8	NA	F.9	F.10	F.11
Group D_1	F.12	NA	F.13	F.14	F.15
Group D_2	F.16	NA	F.17	NA	F.18
Group D_3	F.19	F.20	F.21	NA	F.22
Group E_1	F.23	F.24	F.25	NA	F.26
Group E_2	F.27	F.28	F.29	F.30	F.31
Group E_3	F.32	F.33	F.34	F.35	F.36
No Action	F.37	NA	F.38	NA	F.39
NA = not applicable.					



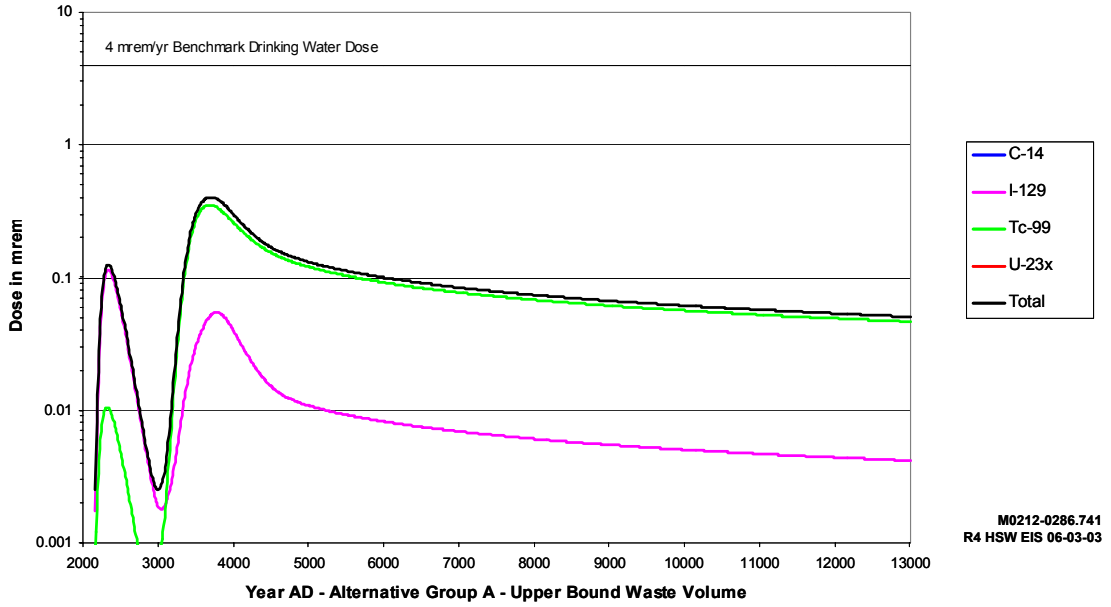
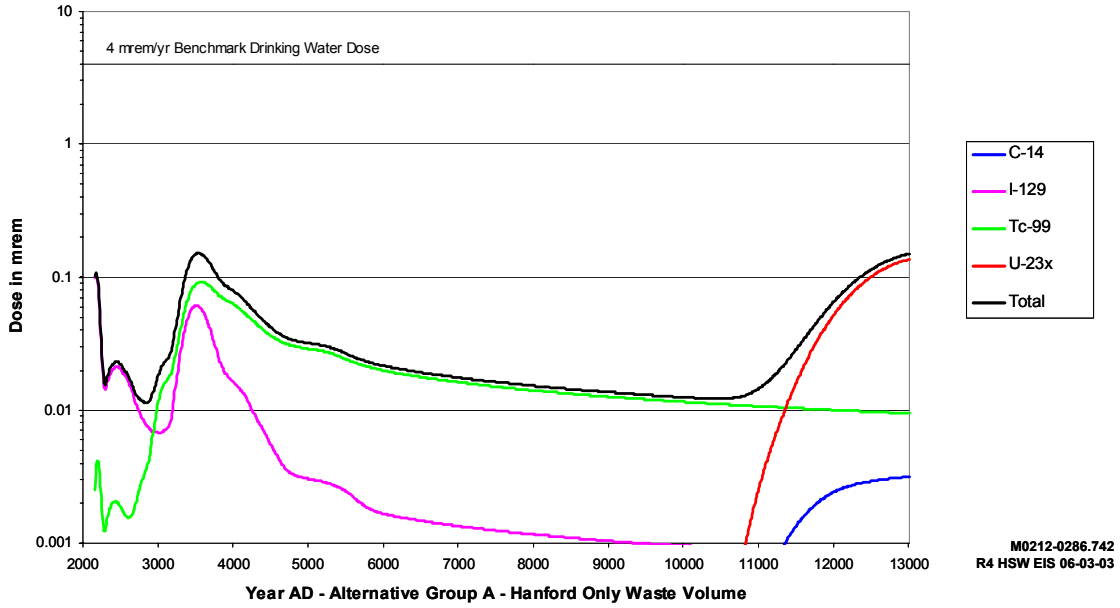


Figure F.1. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient from the 200 West Area, Alternative Group A



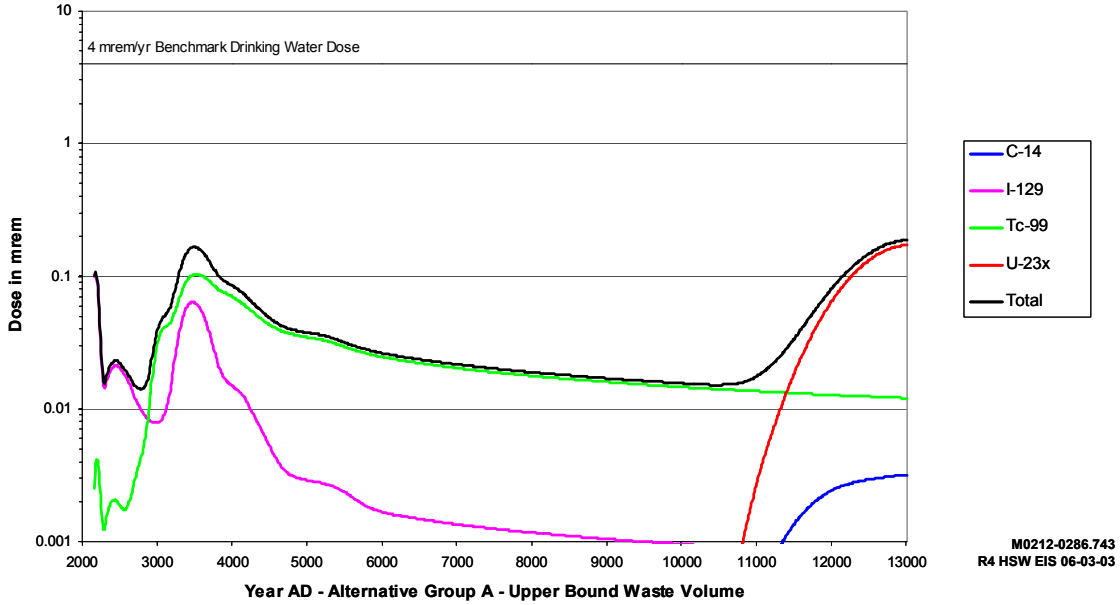
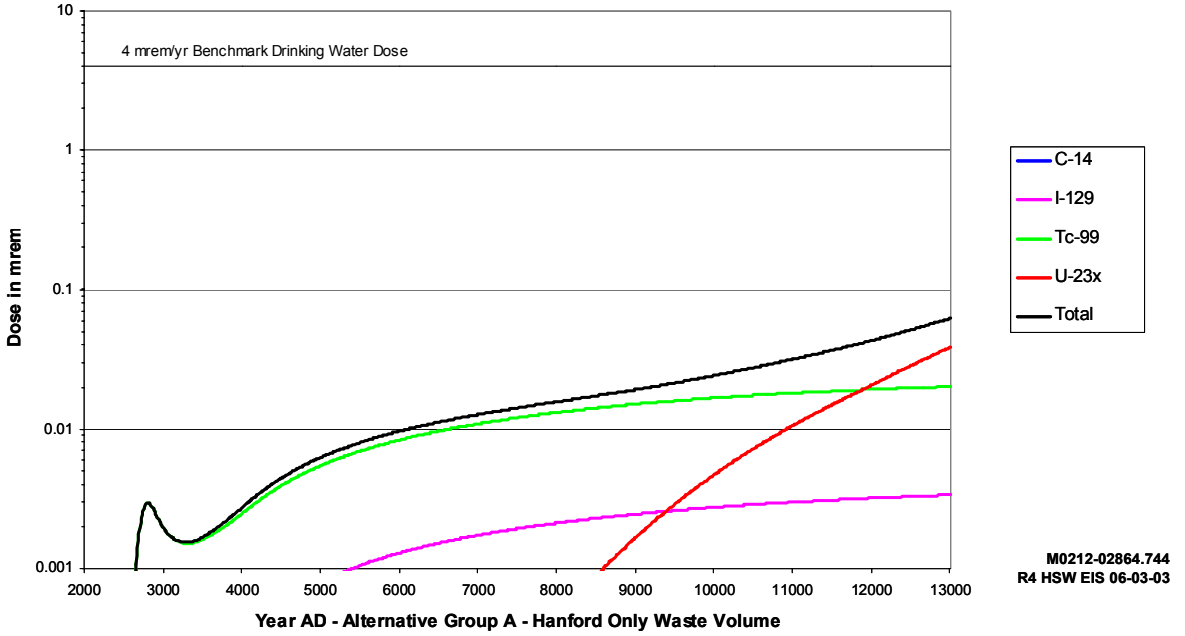


Figure F.2. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient Northwest of 200 East Area, Alternative Group A



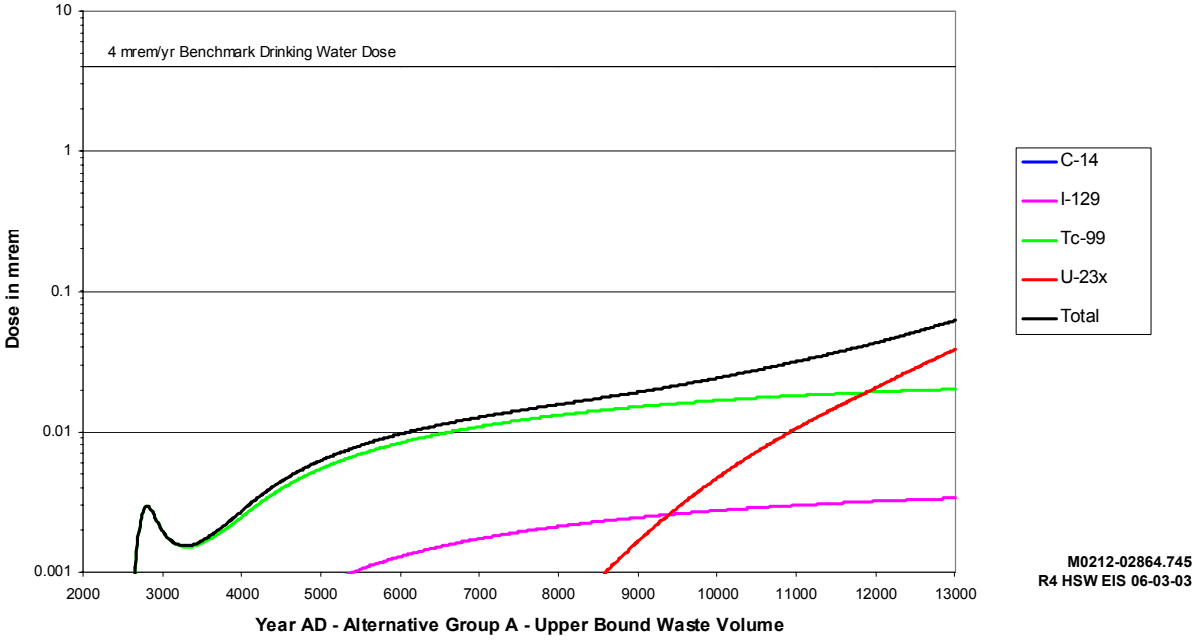
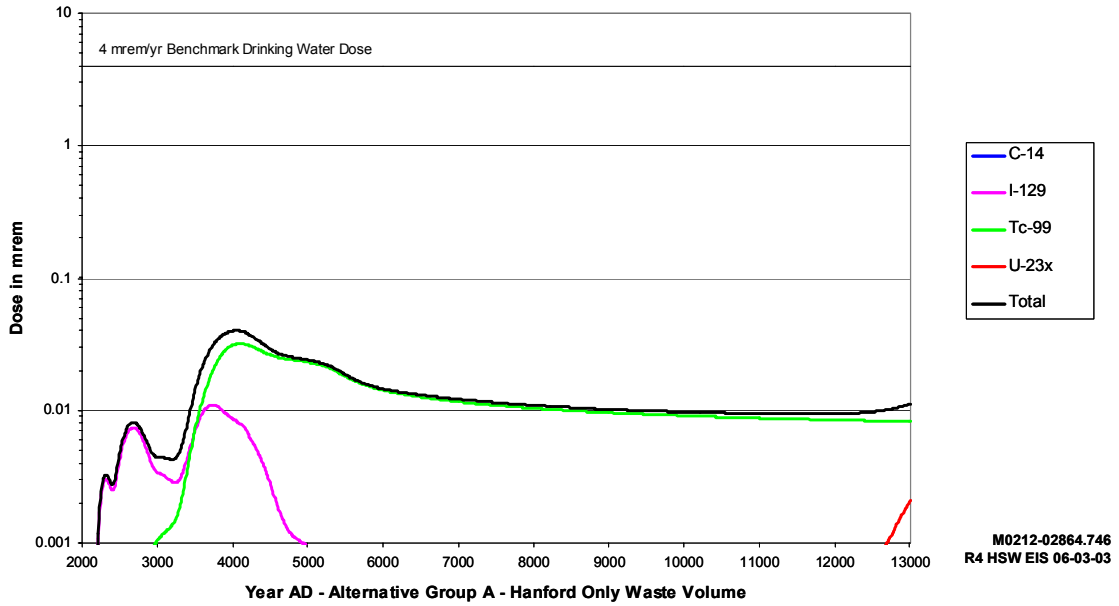


Figure F.3. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient Southeast of 200 East Area, Alternative Group A



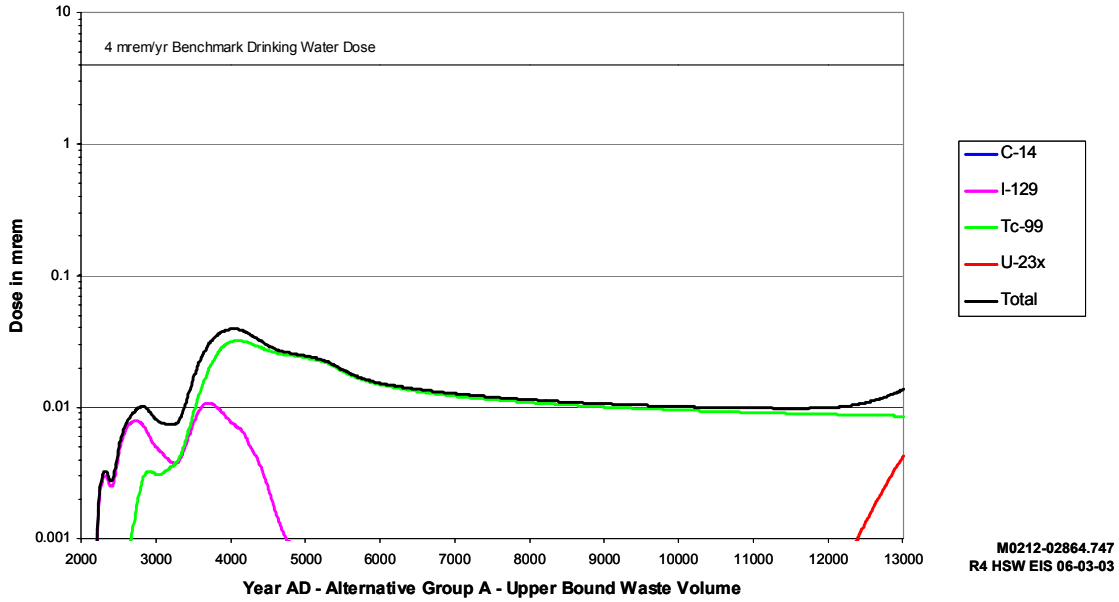
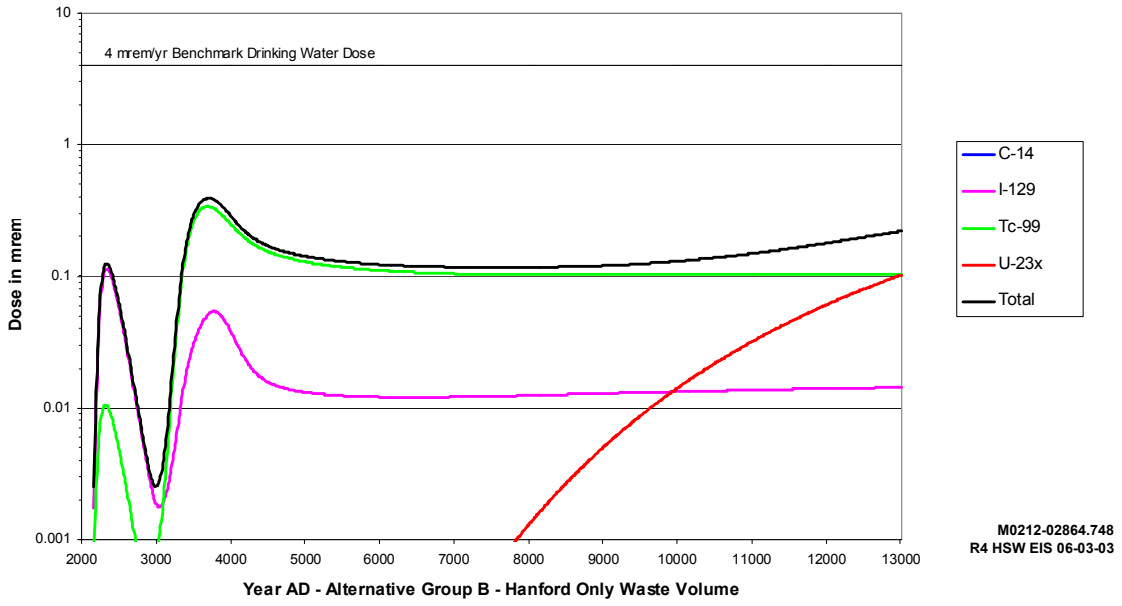


Figure F.4. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River Alternative Group A



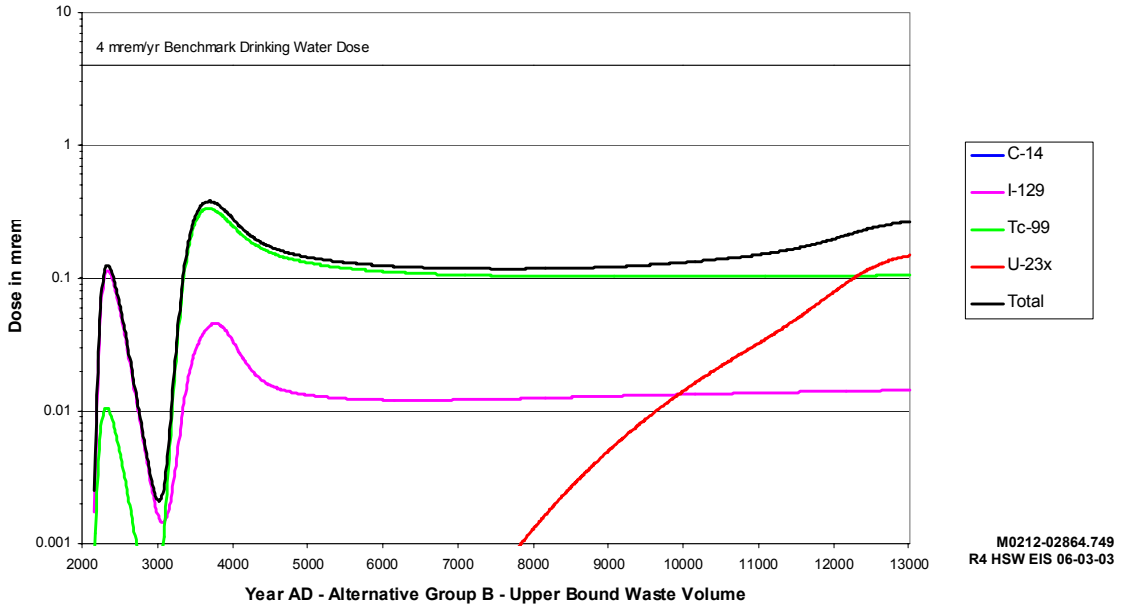
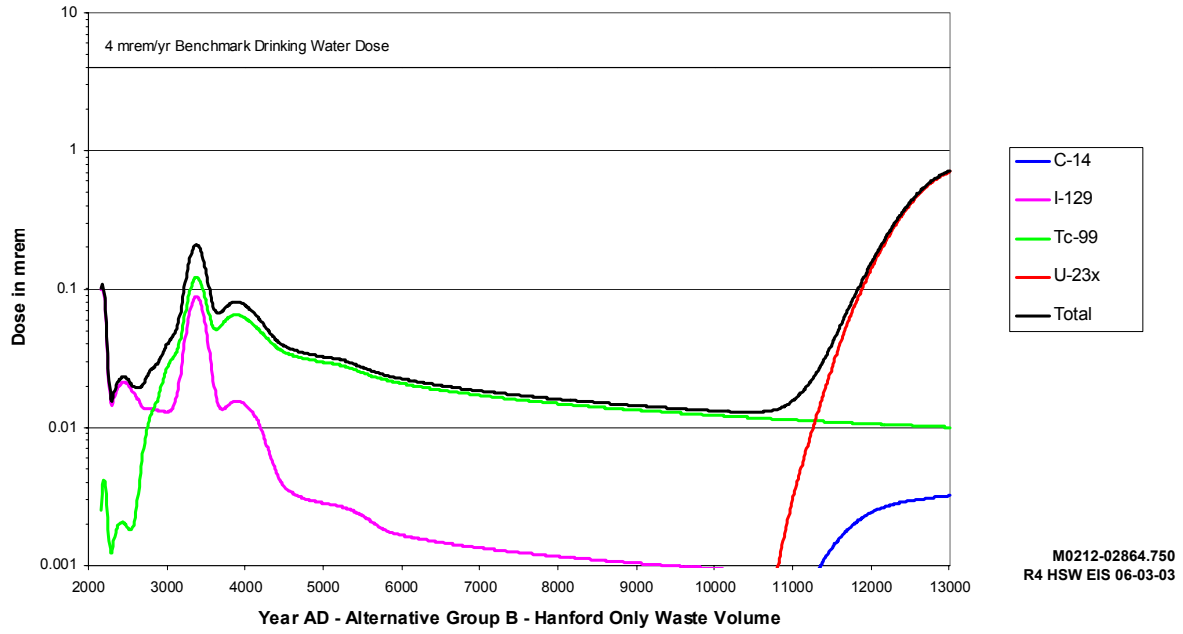


Figure F.5. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient from 200 West Area, Alternative Group B



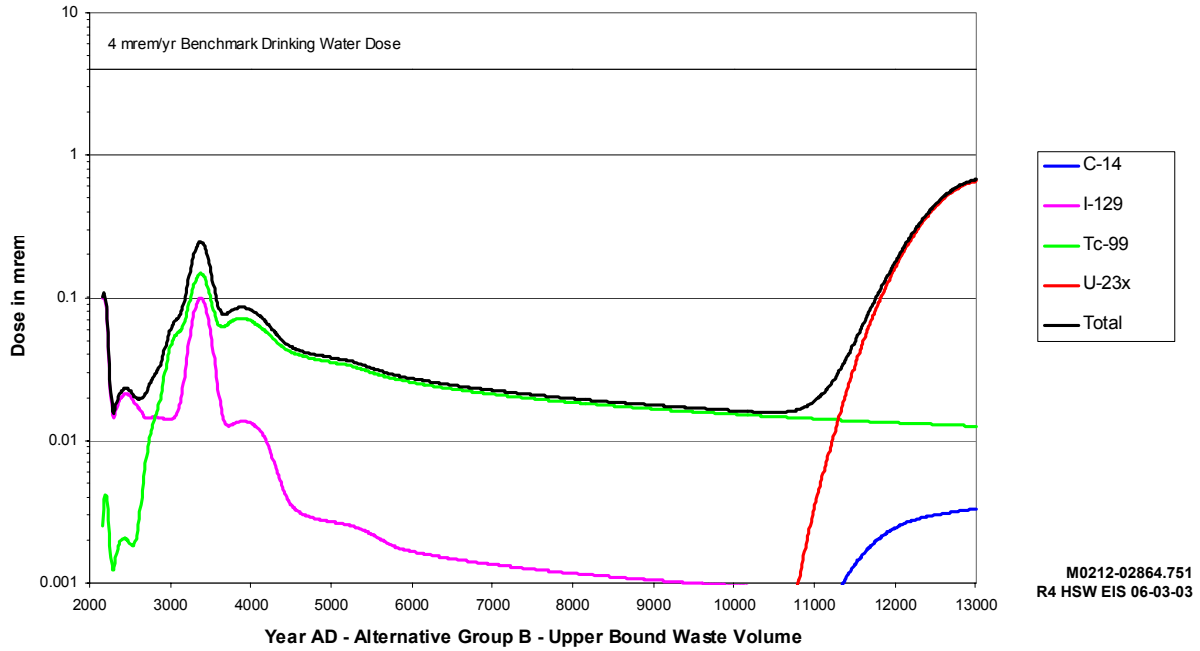
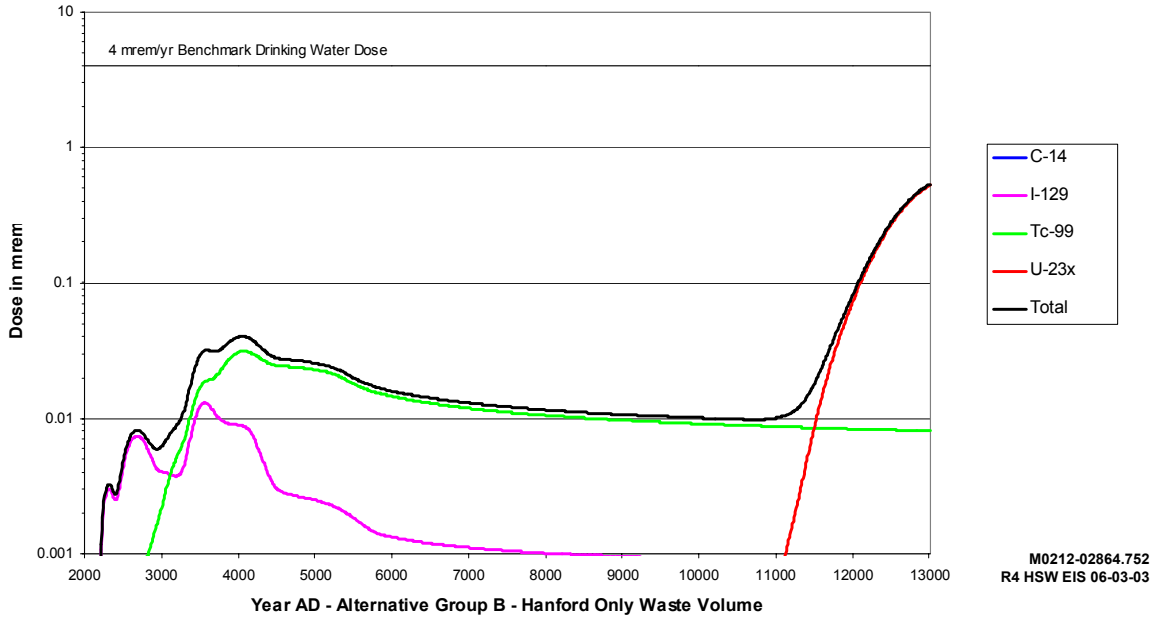


Figure F.6. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient Northwest of 200 East Area, Alternative Group B



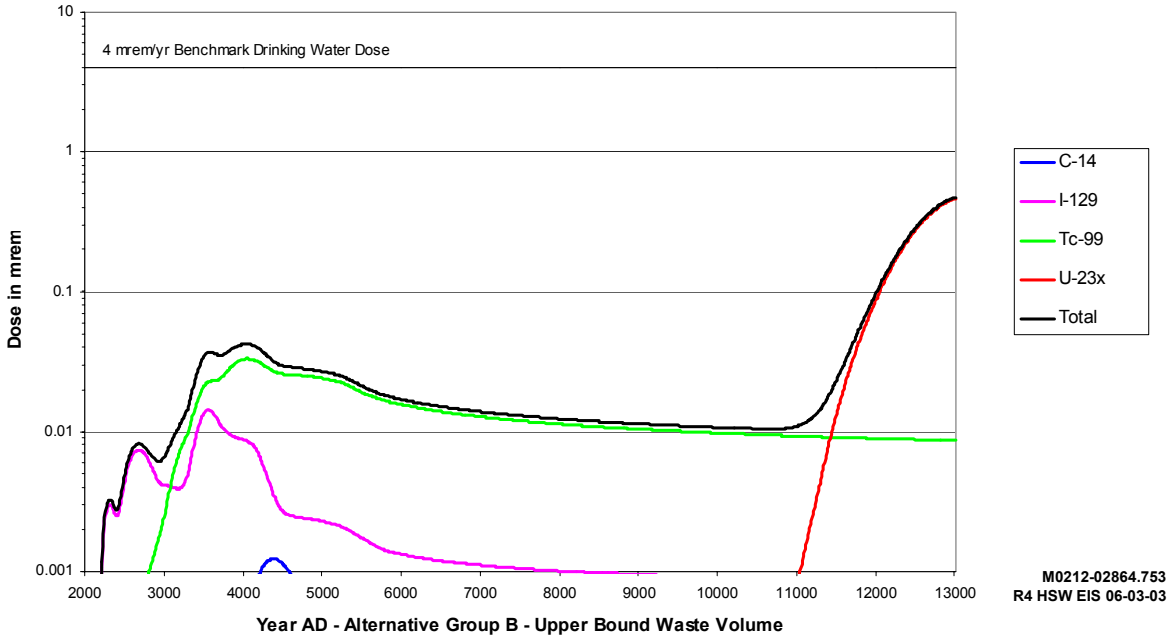
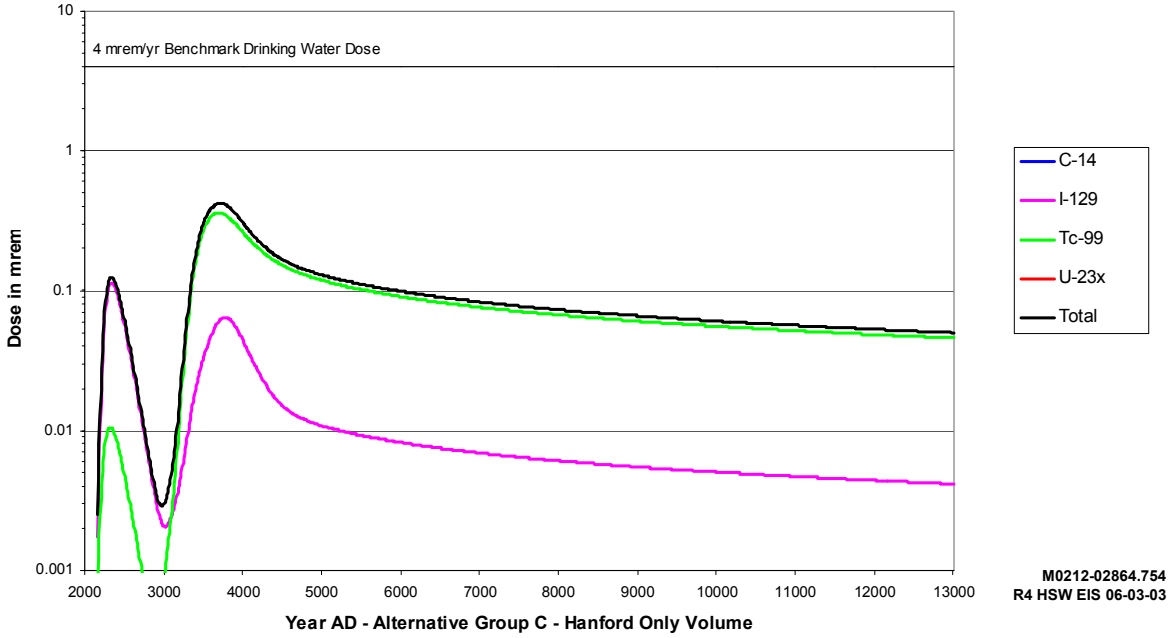


Figure F.7. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, Alternative Group B



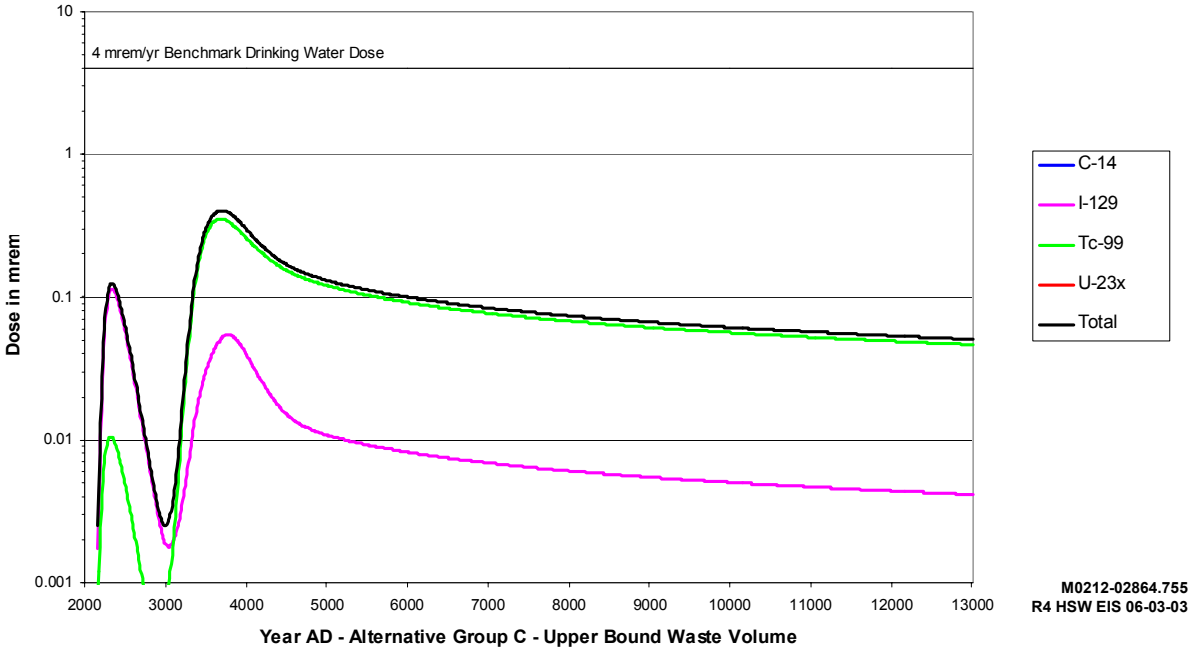
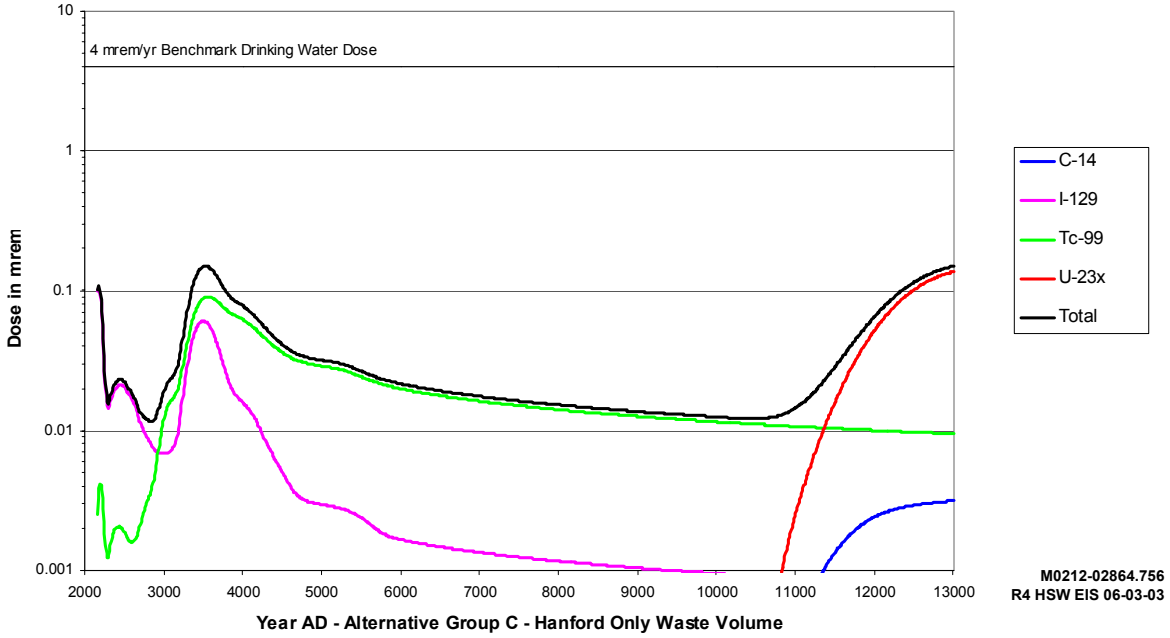


Figure F.8. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient from 200 West Area, Alternative Group C



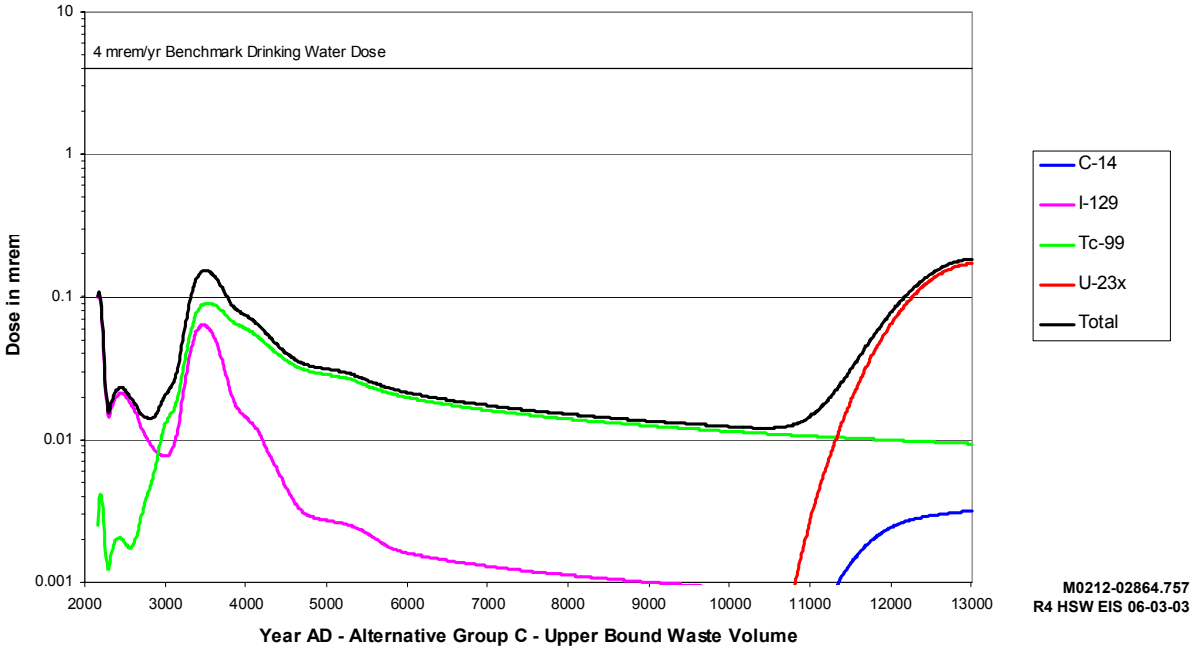
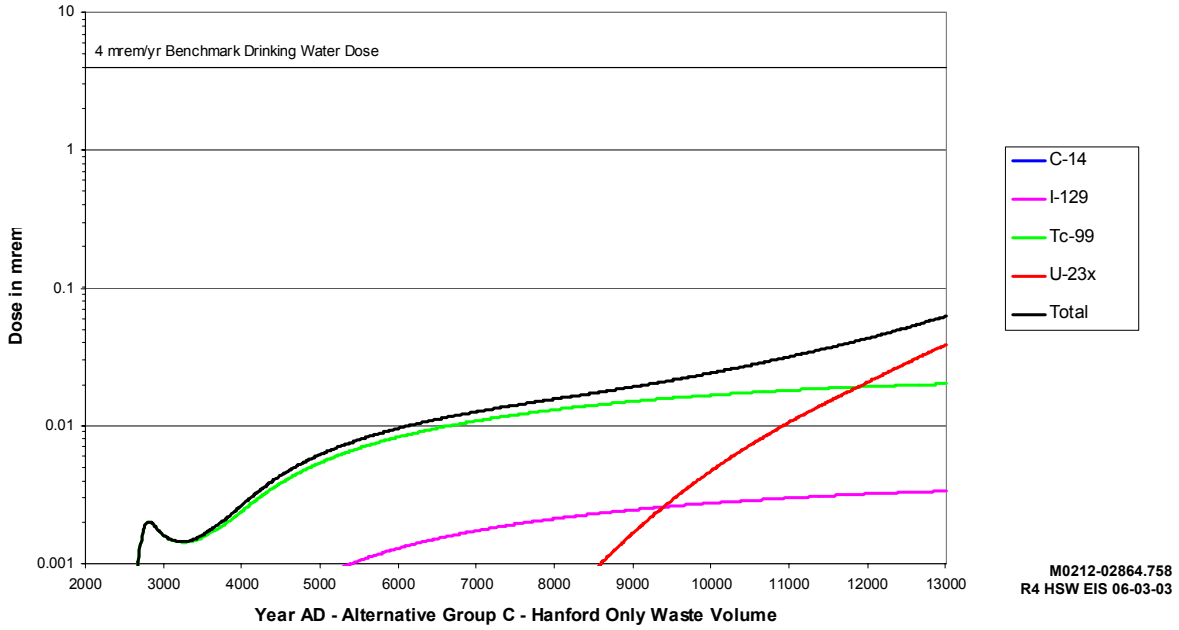


Figure F.9. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient Northwest of 200 East Area, Alternative Group C



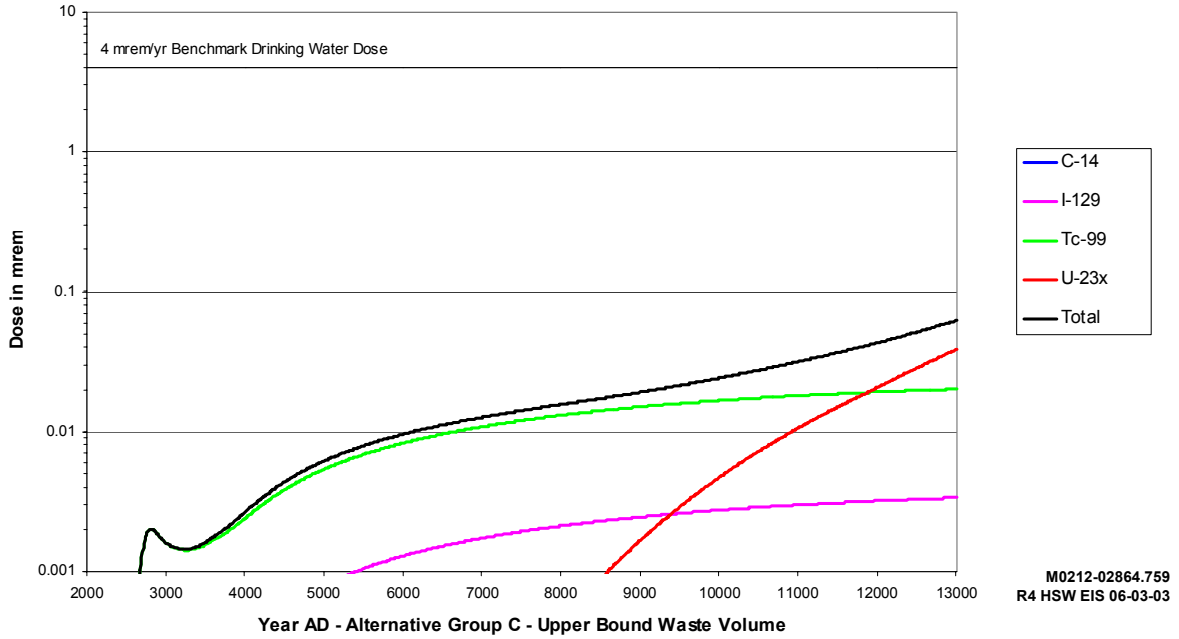
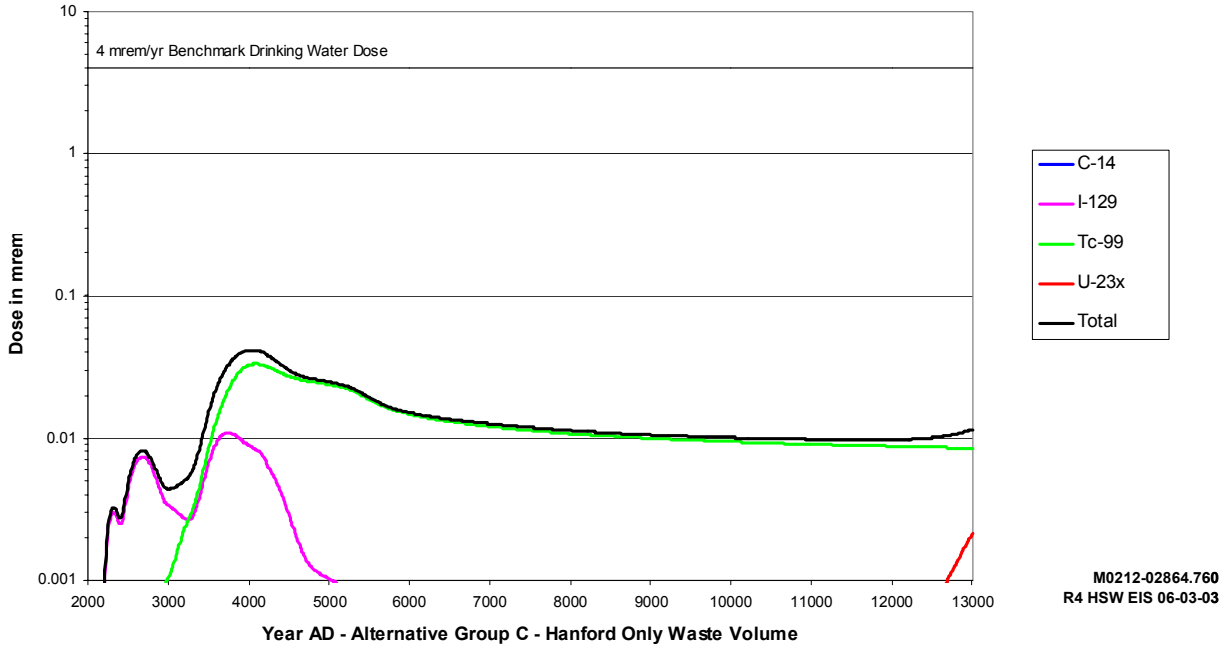


Figure F.10. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient Southeast of 200 East Area, Alternative Group C



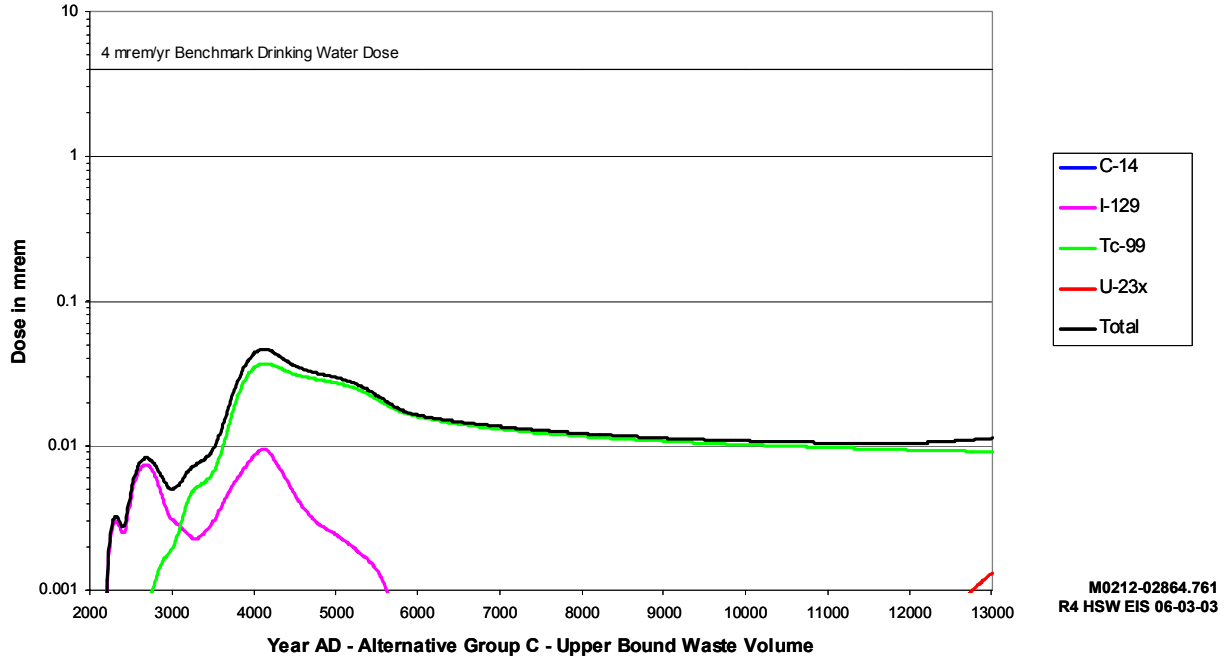
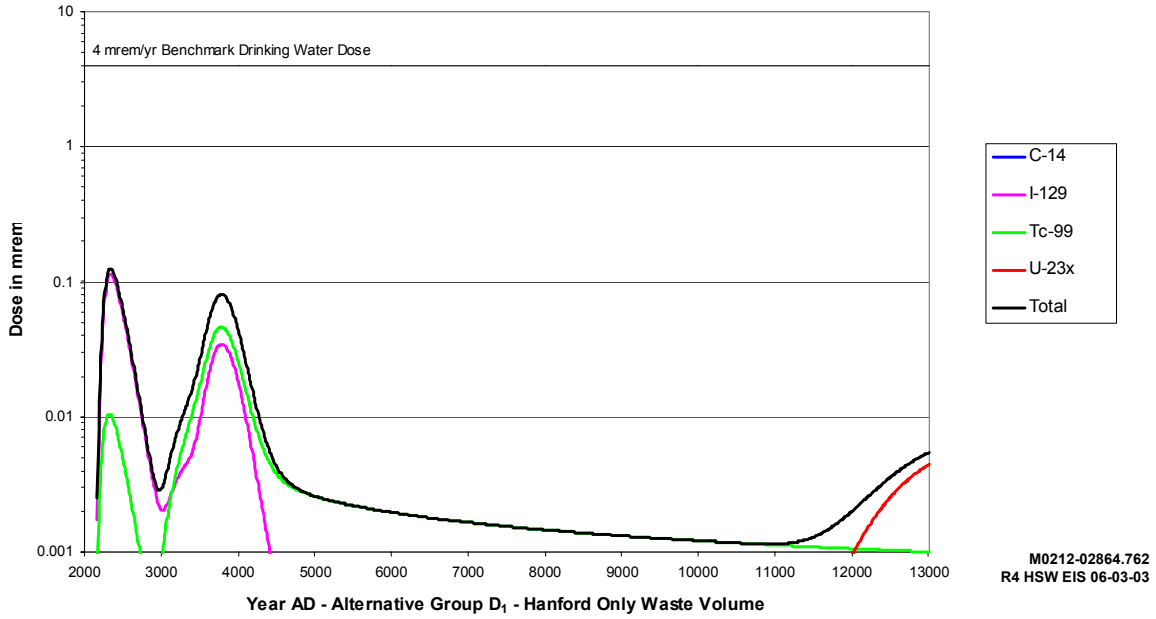


Figure F.11. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, Alternative Group C



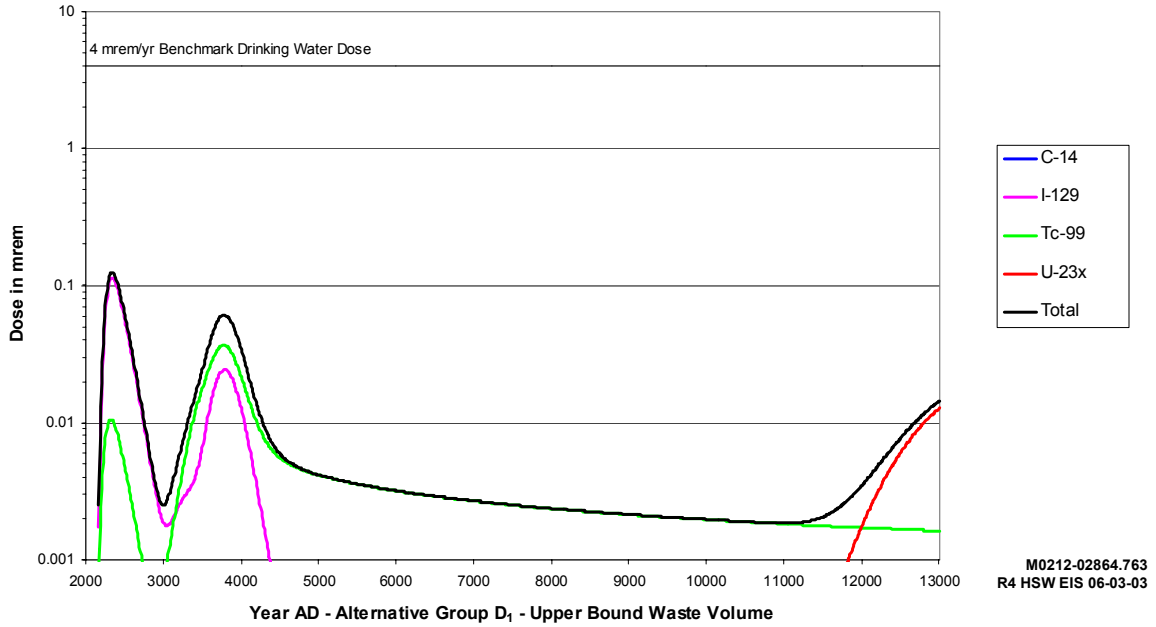


Figure F.12. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient from 200 West Area, Alternative Group D_1

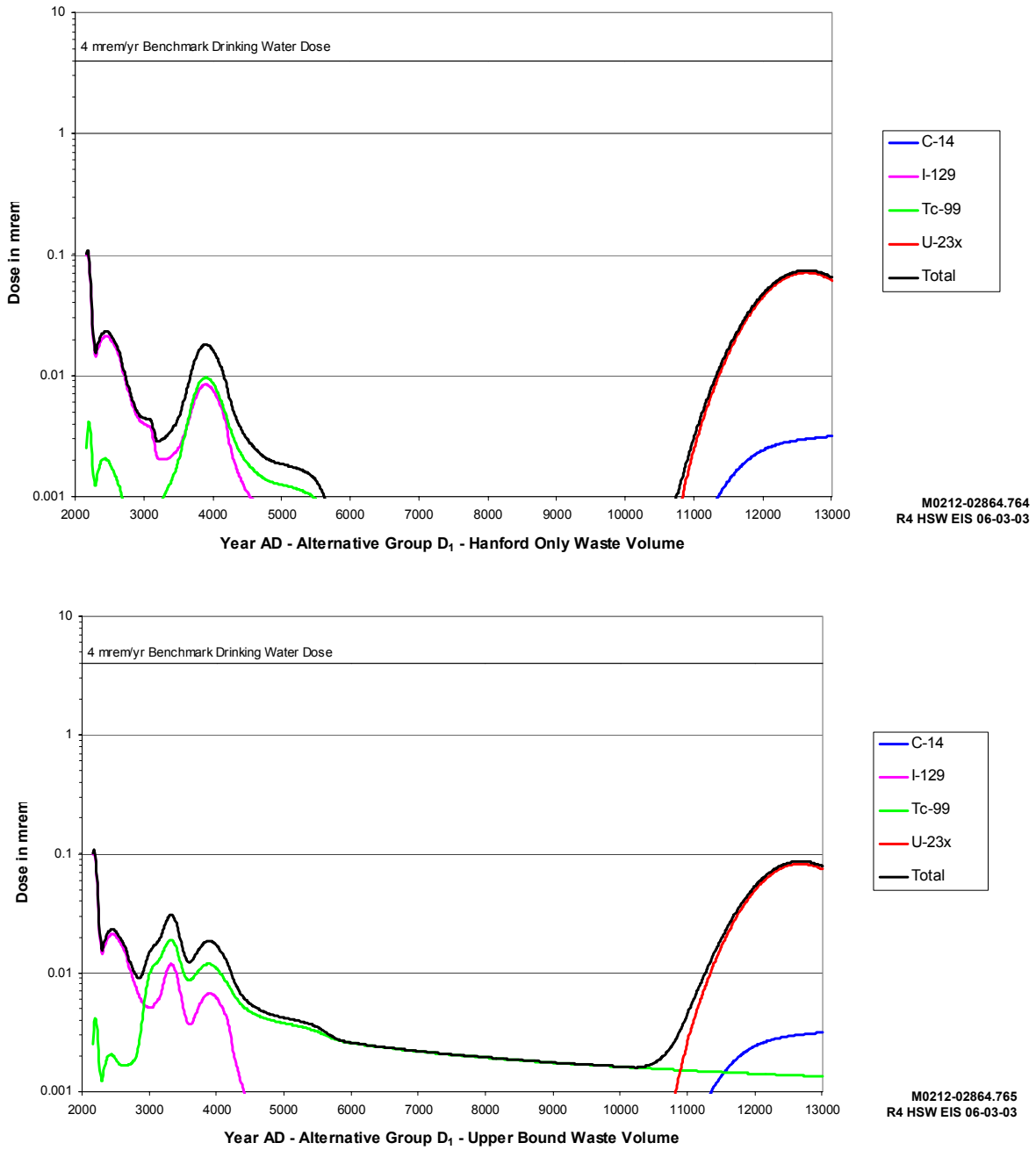
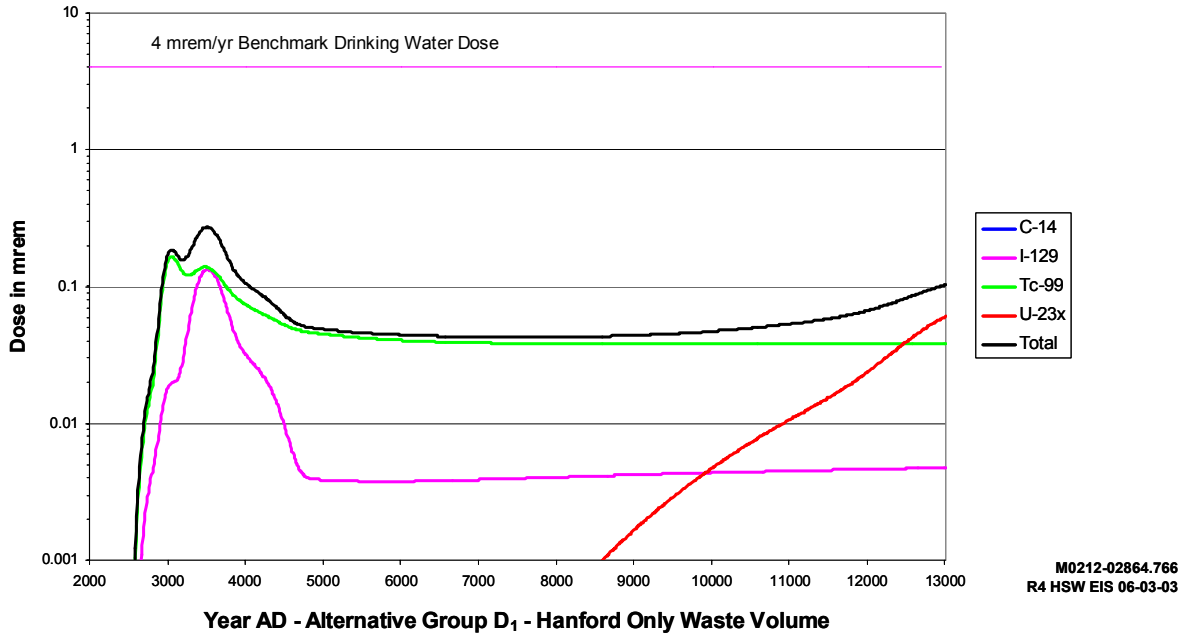


Figure F.13. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient Northwest of 200 East Area, Alternative Group D_1



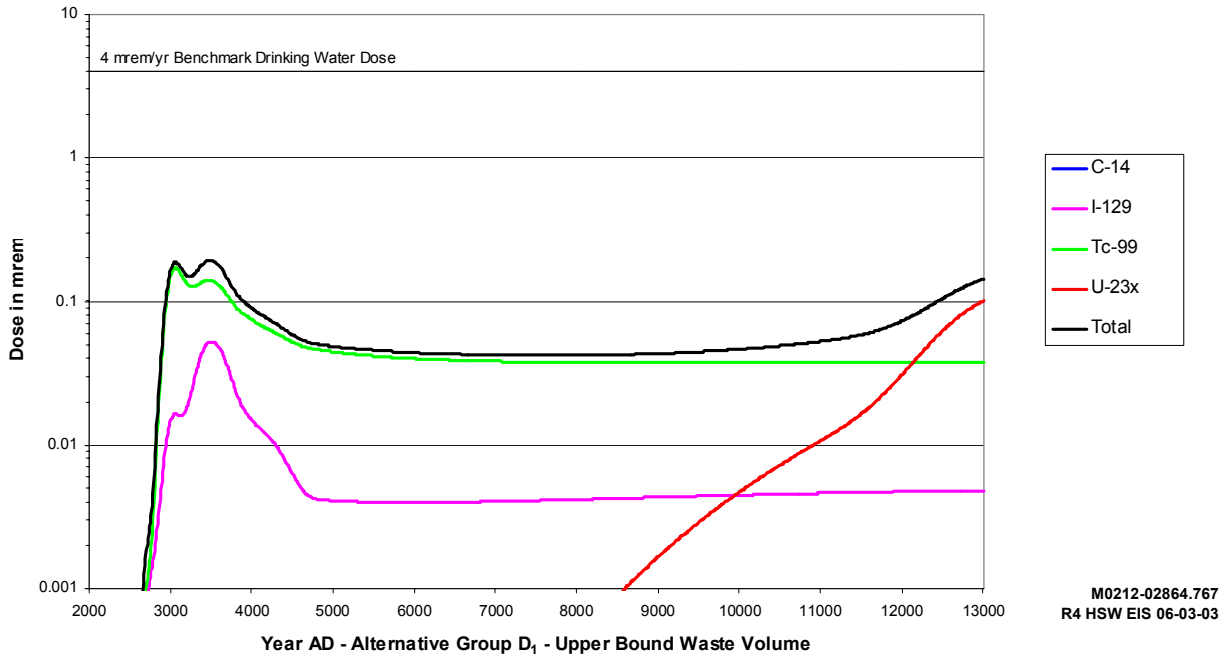
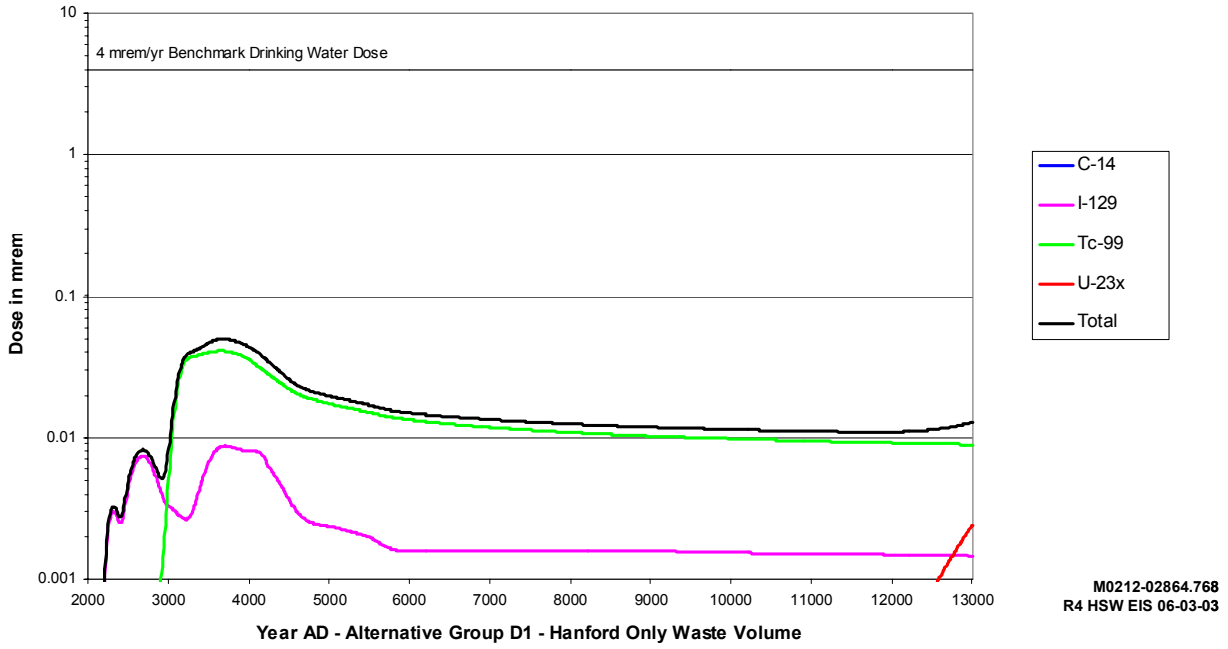


Figure F.14. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient Southeast of 200 East Area, Alternative Group D_1



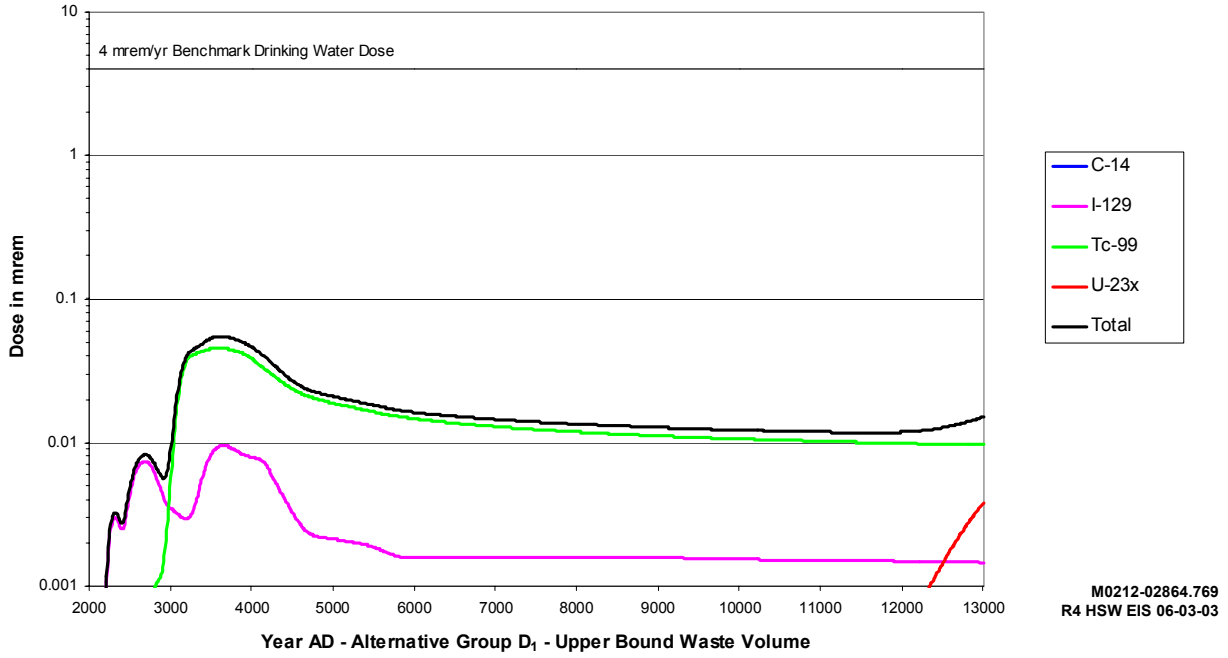
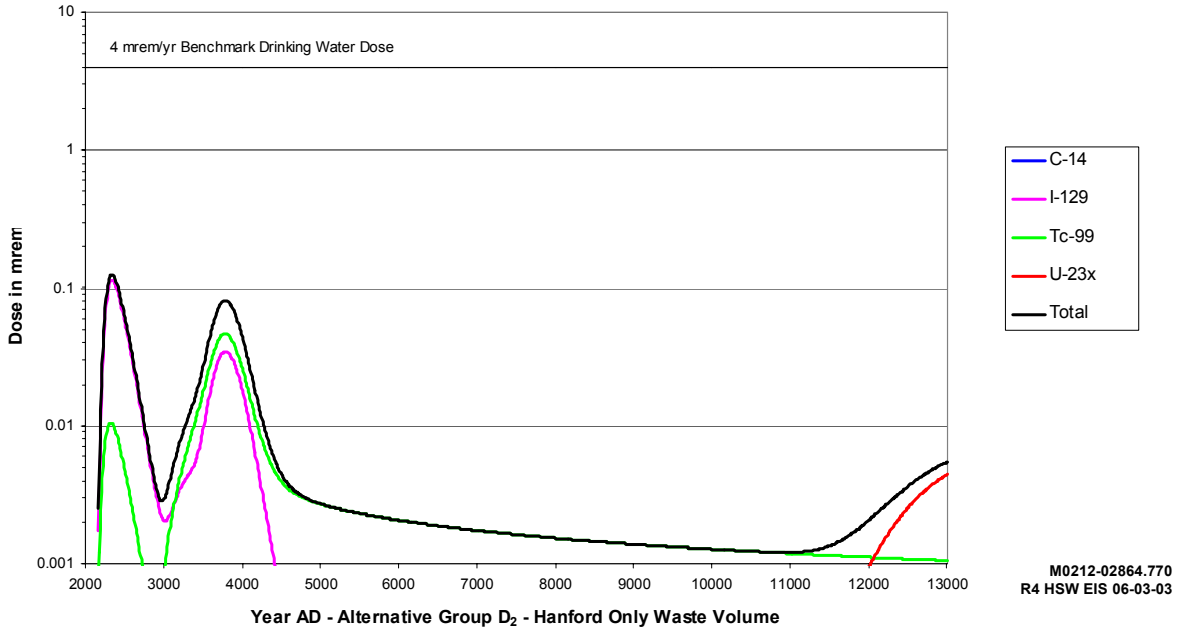


Figure F.15. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, Alternative Group D_1



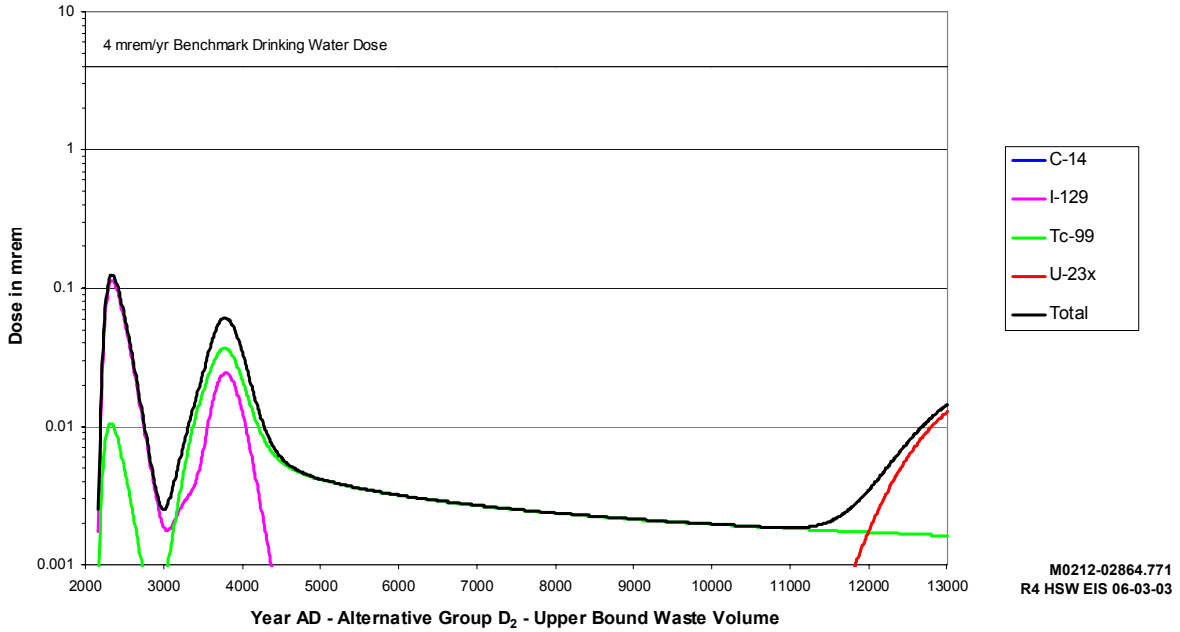
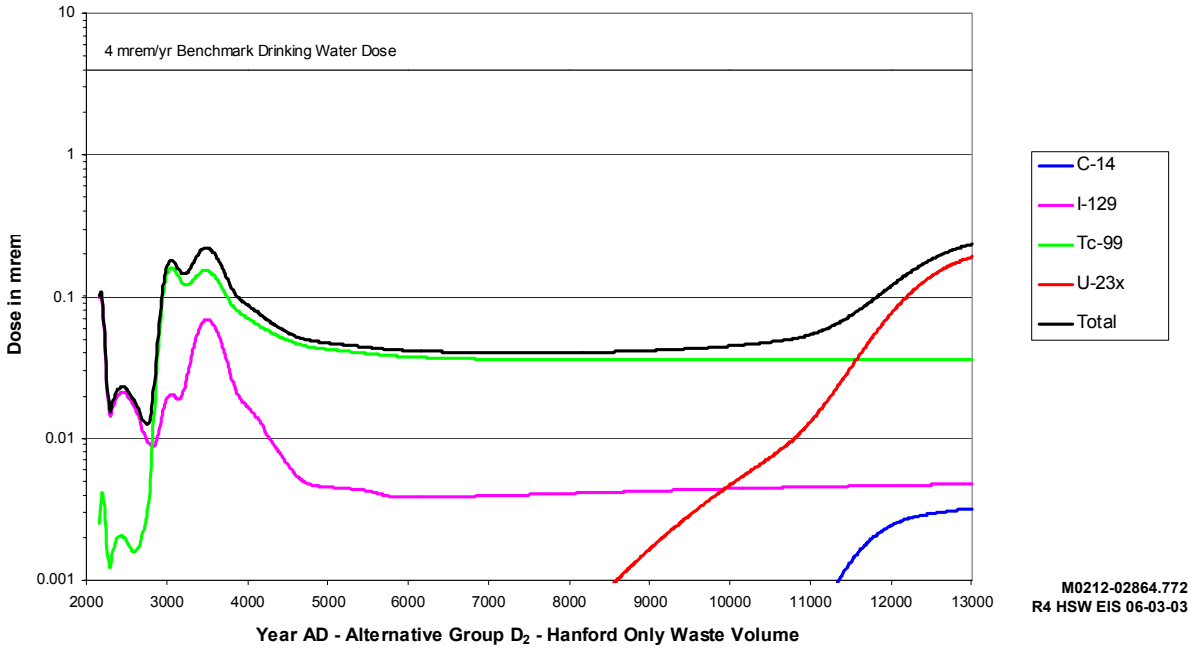


Figure F.16. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient from 200 West Area, Alternative Group D_2



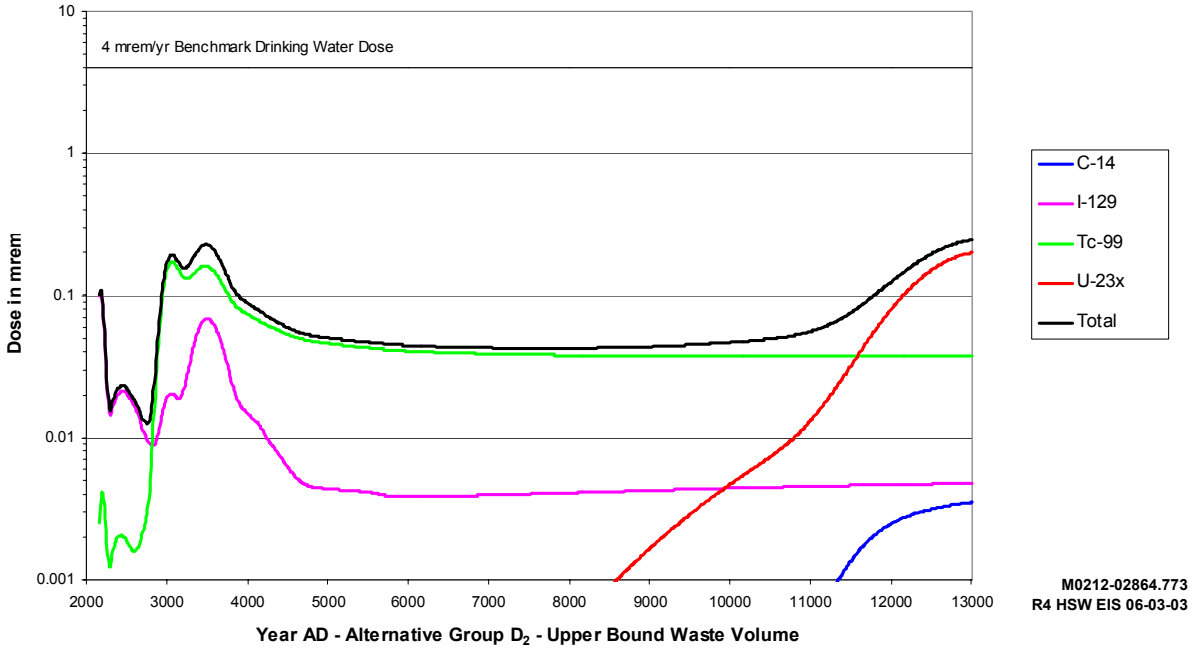
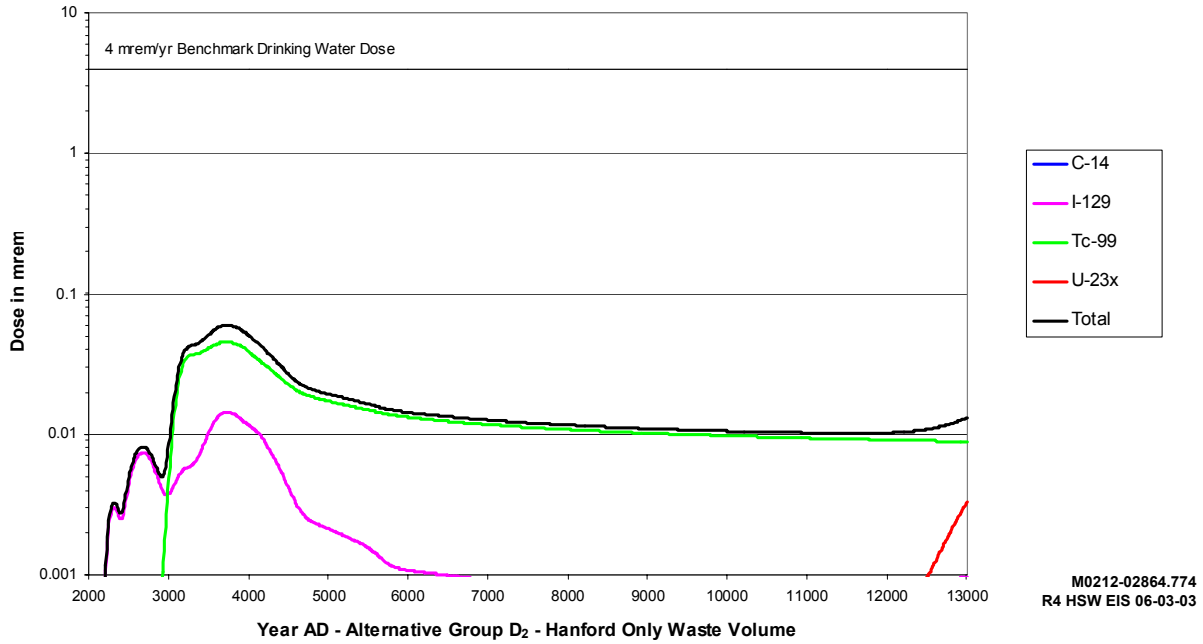


Figure F.17. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient Northwest of 200 East Area, Alternative Group D_2



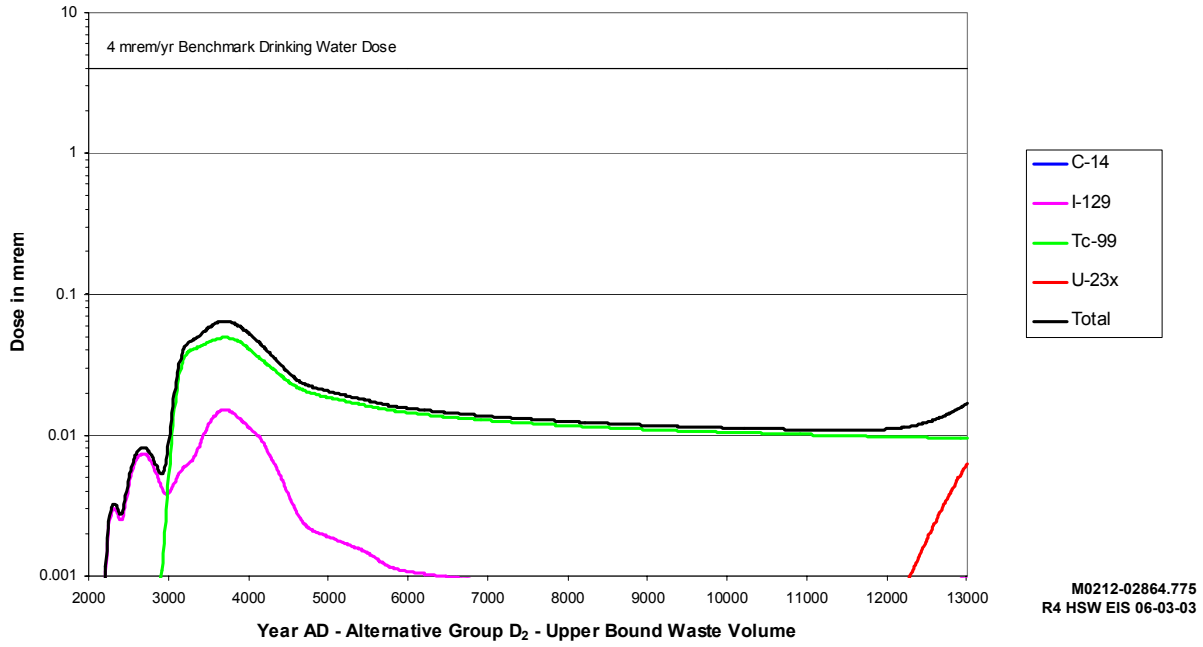
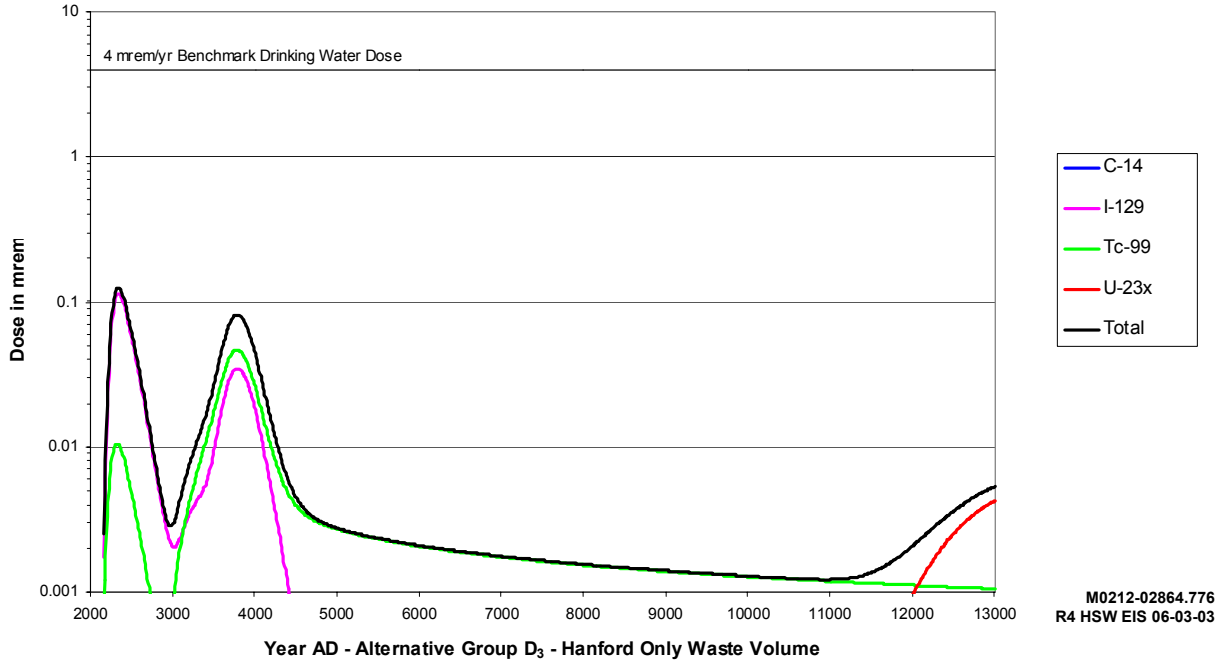


Figure F.18. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, Alternative Group D_2



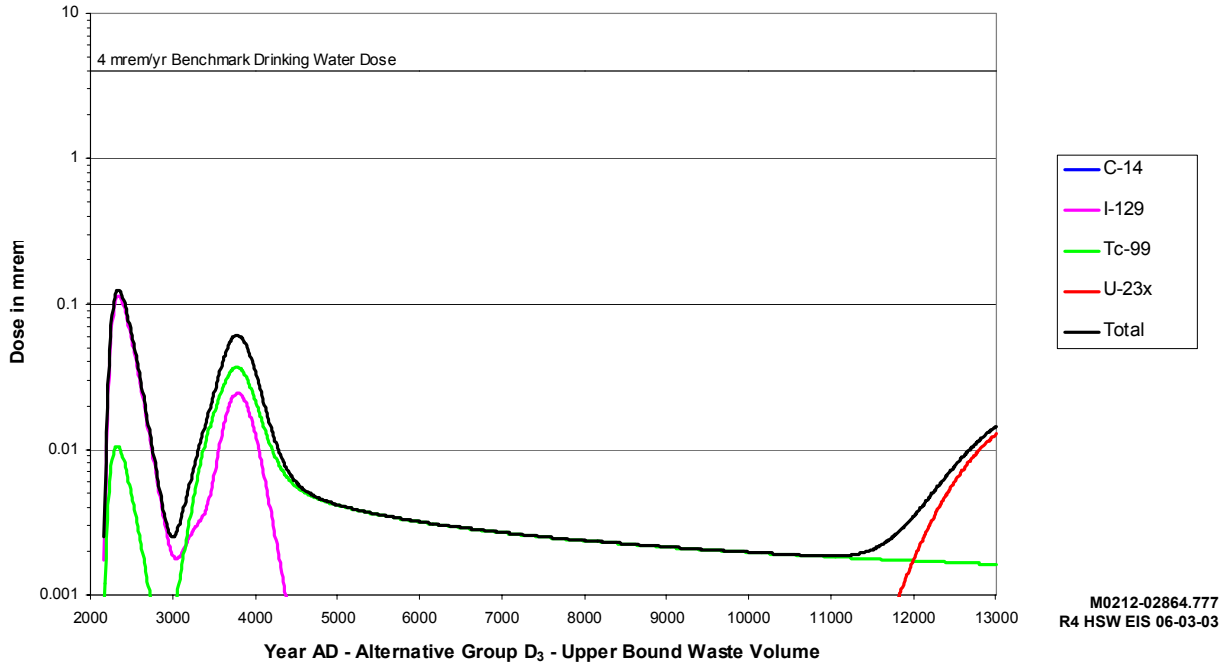
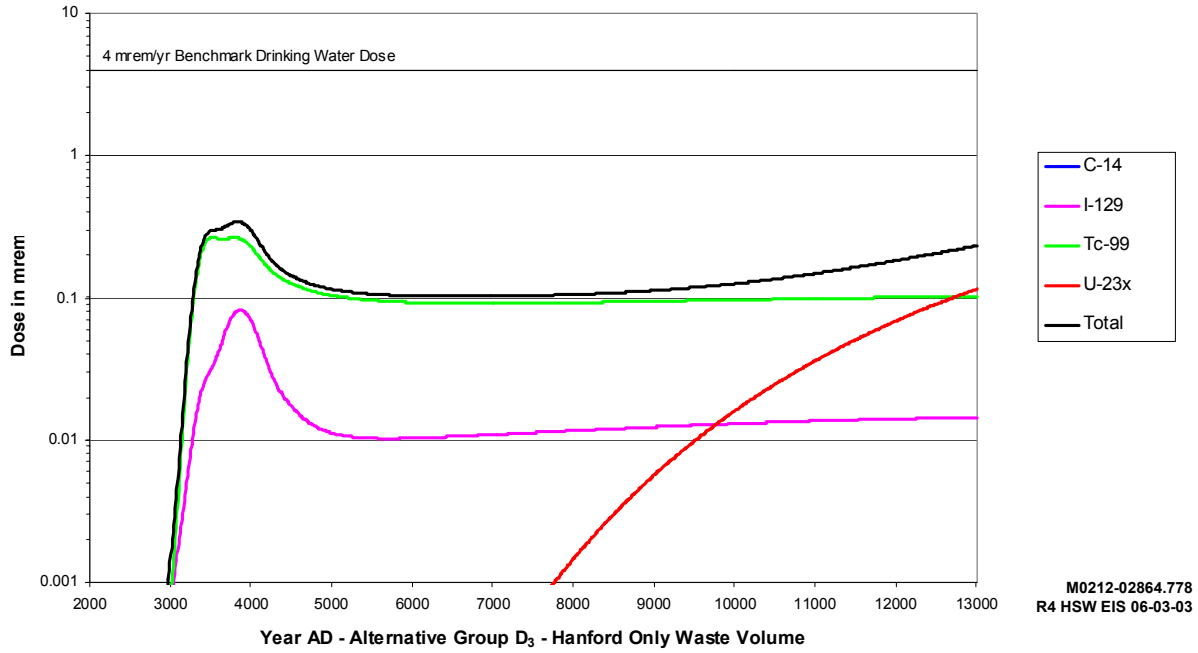


Figure F.19. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient from 200 West Area, Alternative Group D_3



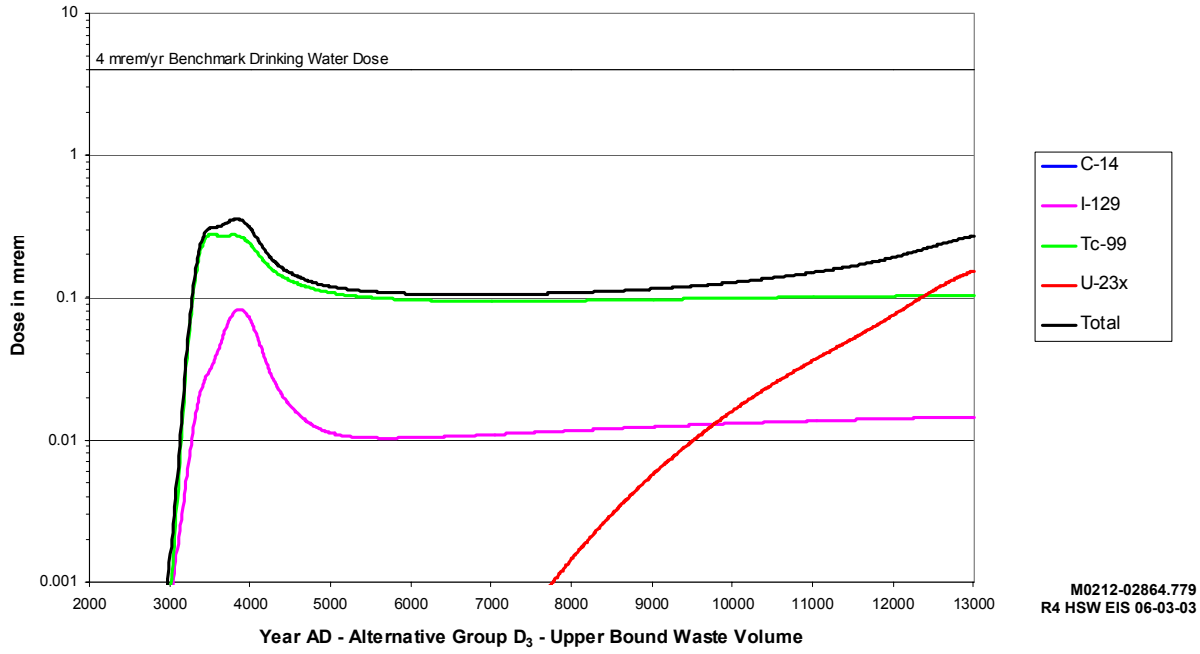


Figure F.20. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient from ERDF, Alternative Group D_3

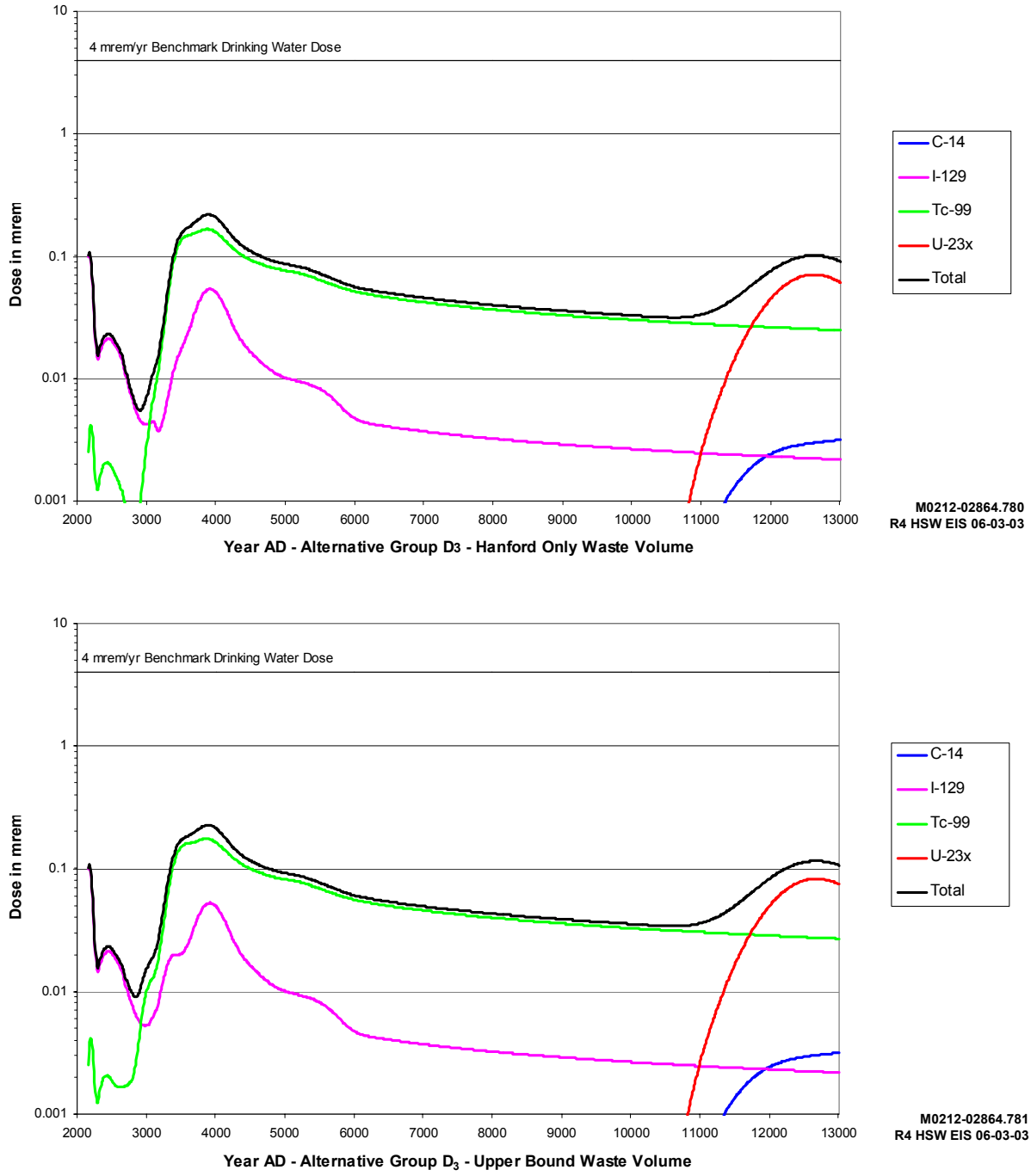
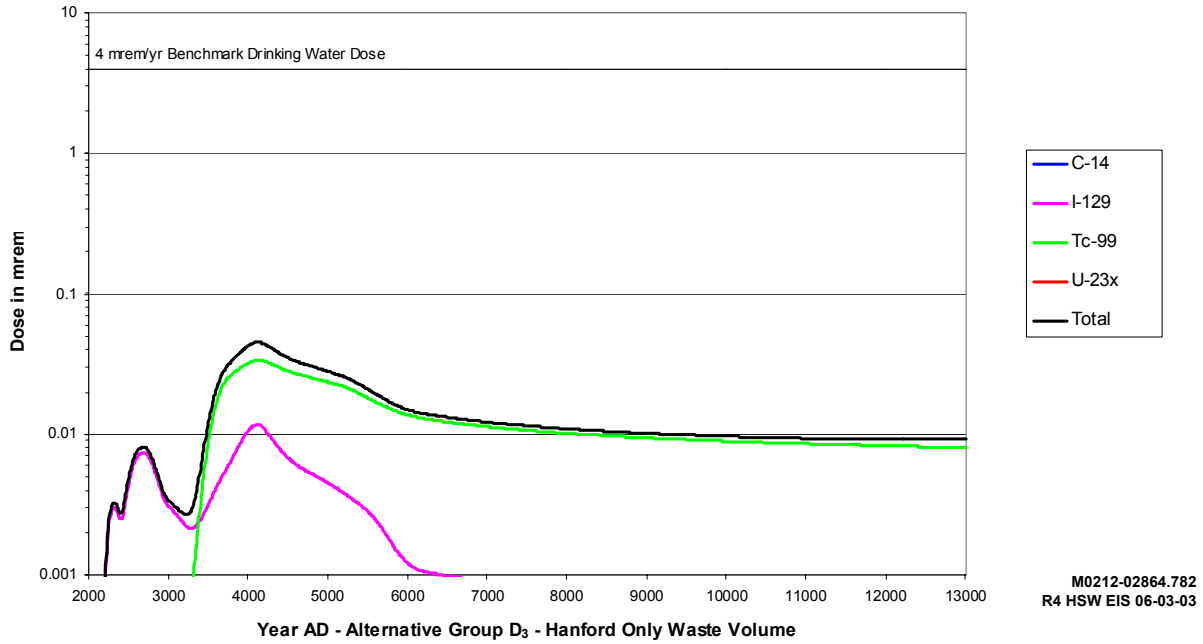


Figure F.21. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient Northwest of 200 East Area, Alternative Group D_3



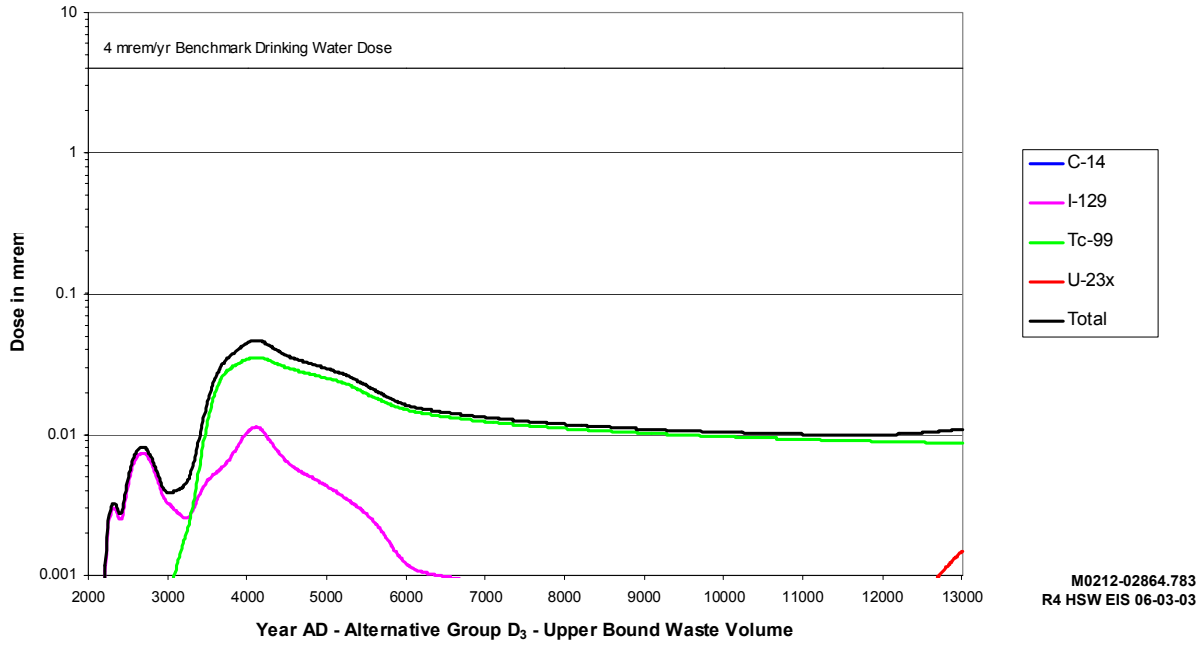
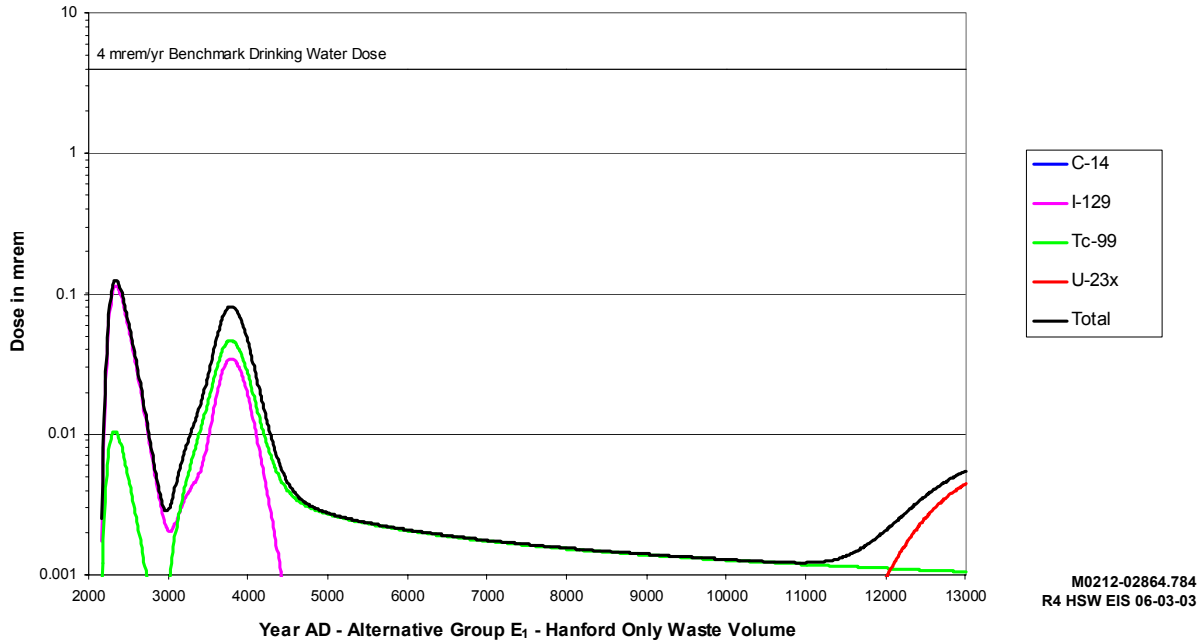


Figure F.22. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, Alternative Group D_3



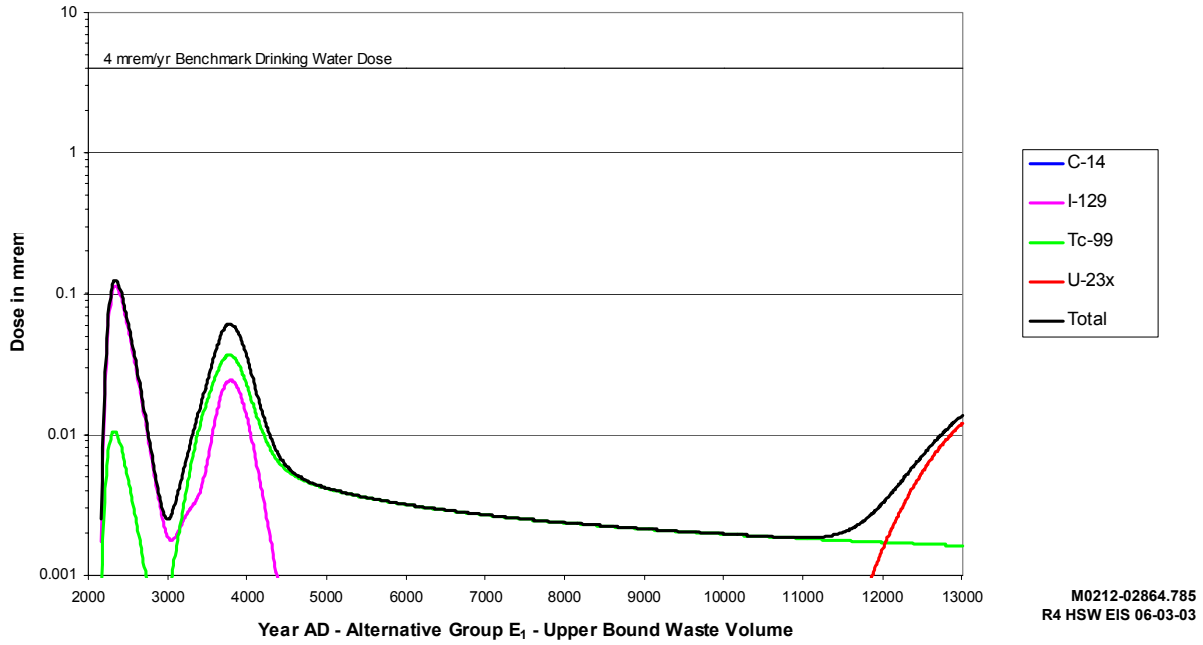
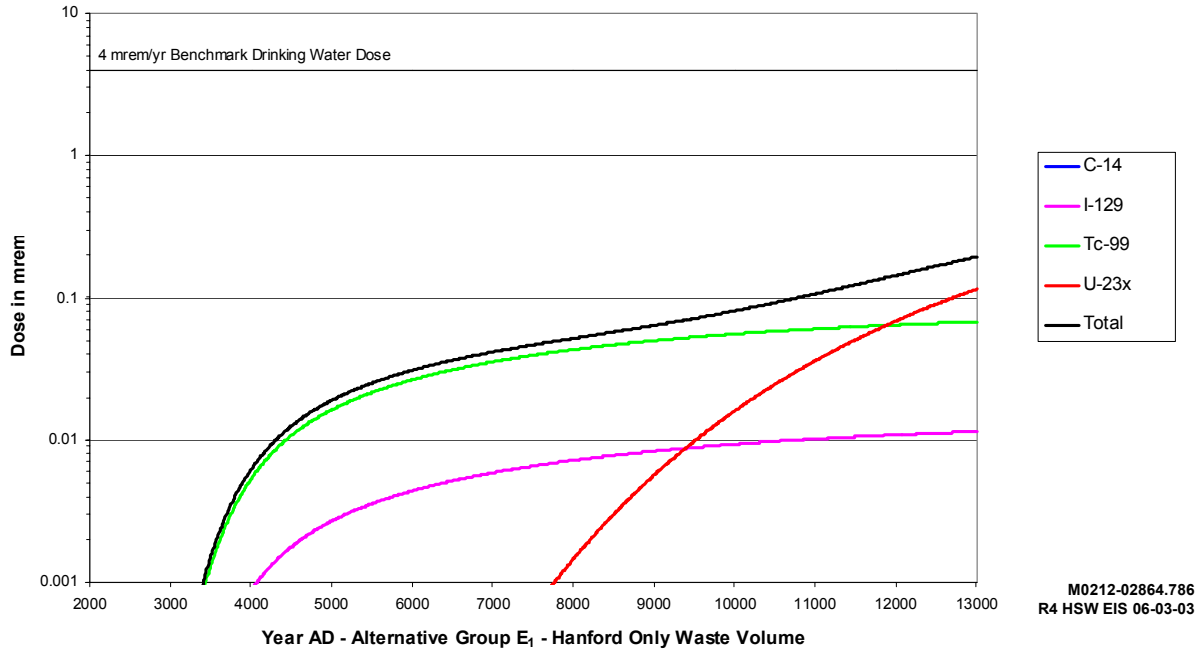


Figure F.23. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient from 200 West Area, Alternative Group E_1



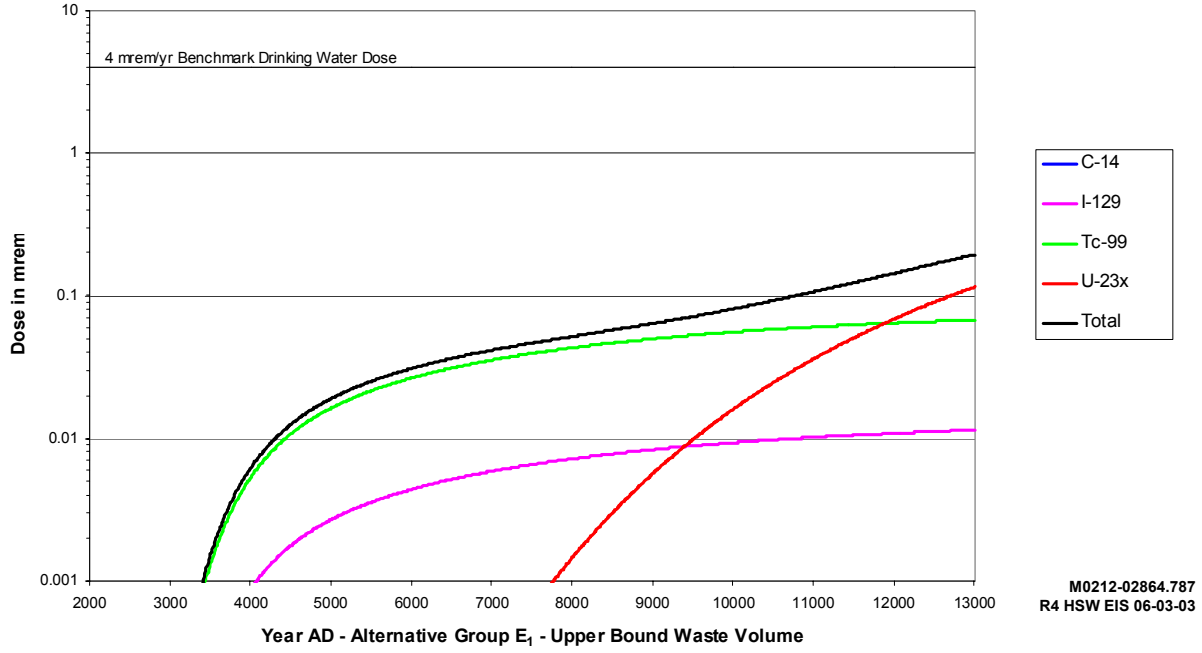
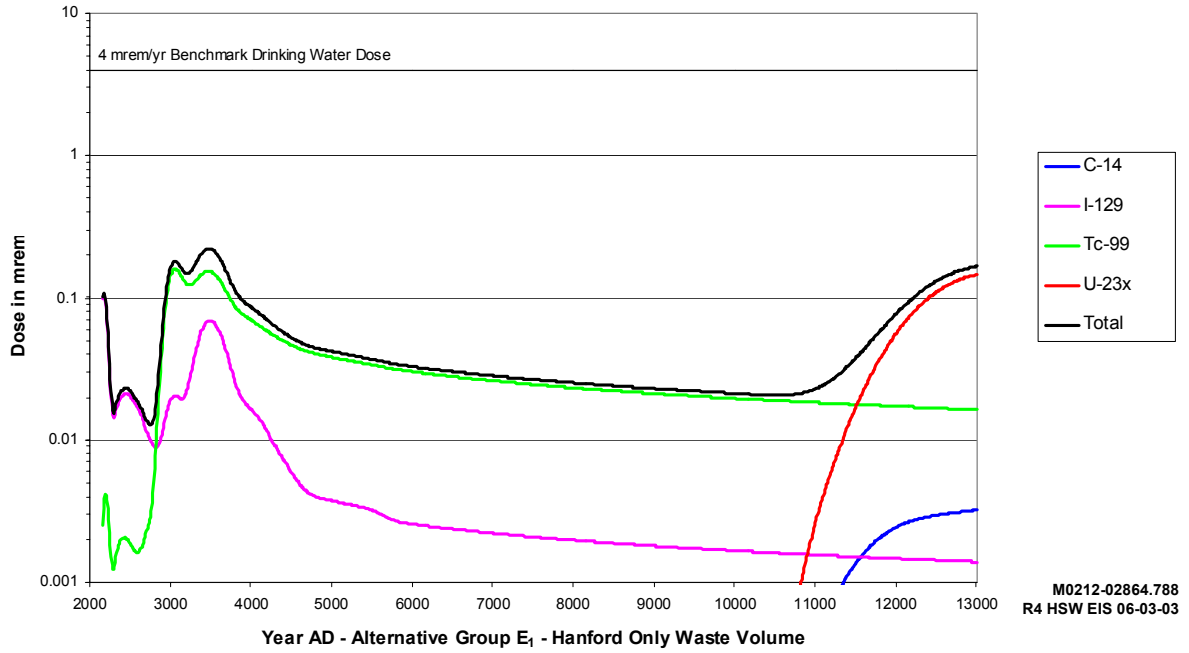


Figure F.24. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient from ERDF, Alternative Group E_1



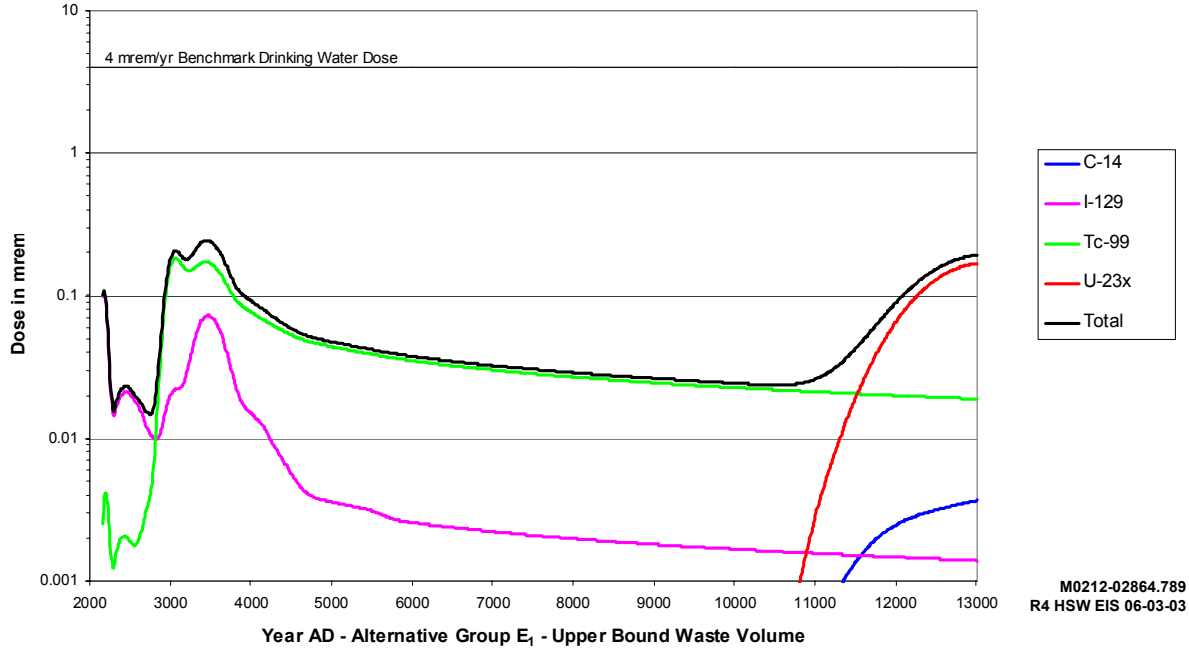
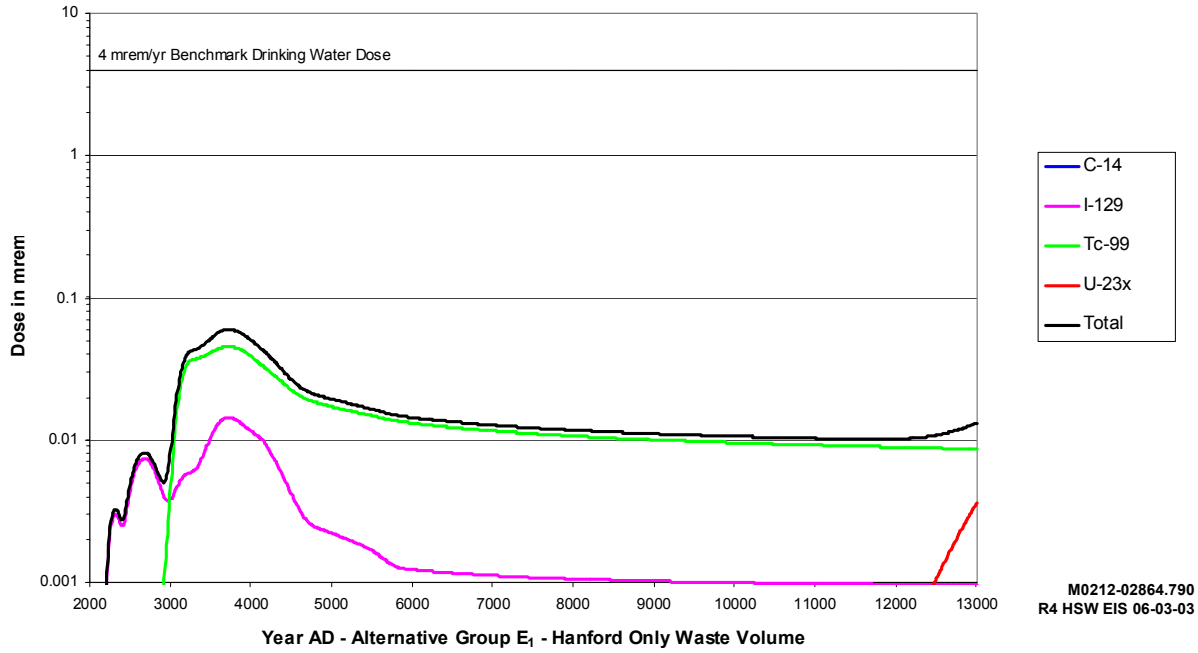


Figure F.25. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient Northwest of 200 East Area, Alternative Group E_1



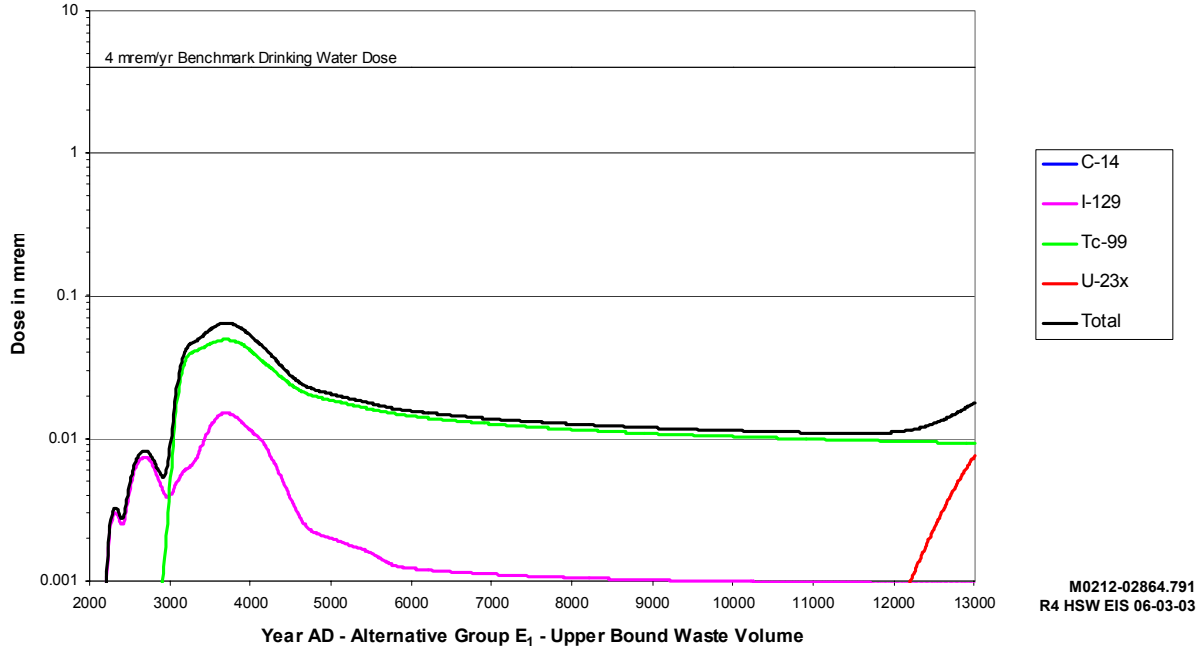
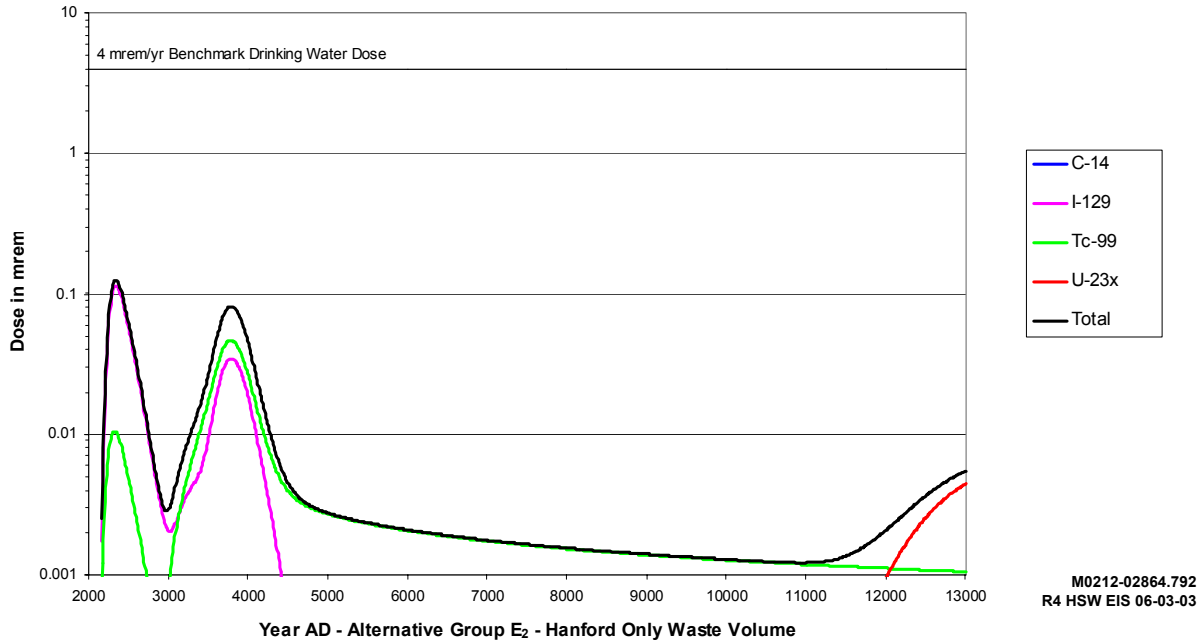


Figure F.26. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, Alternative Group E_1



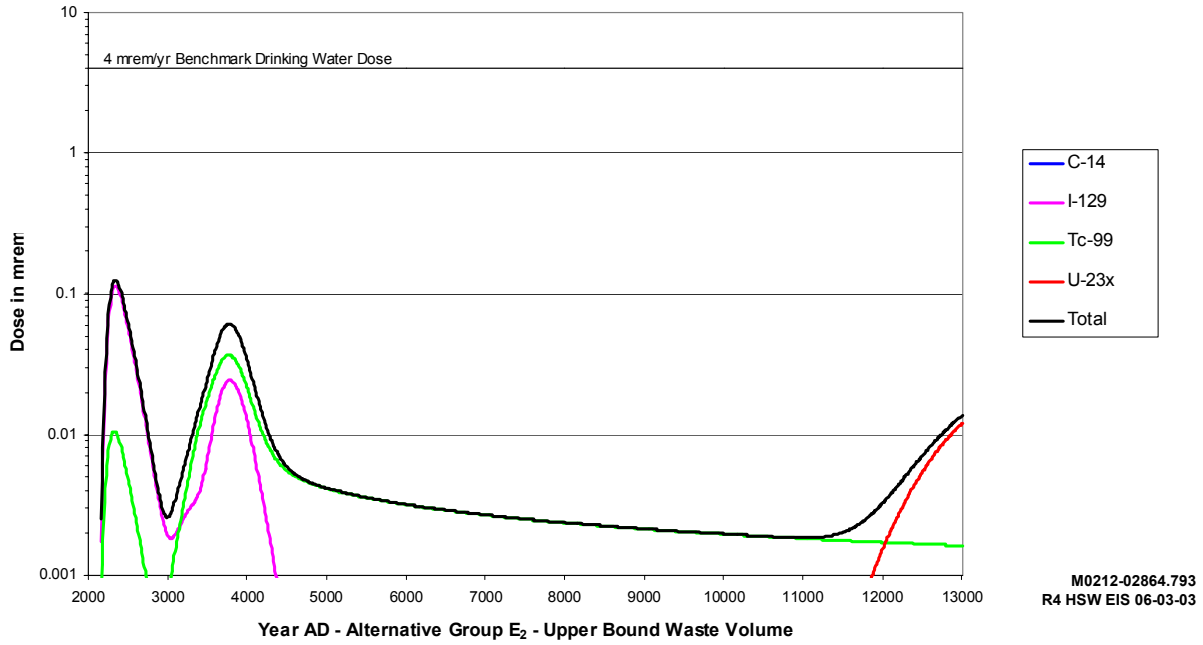
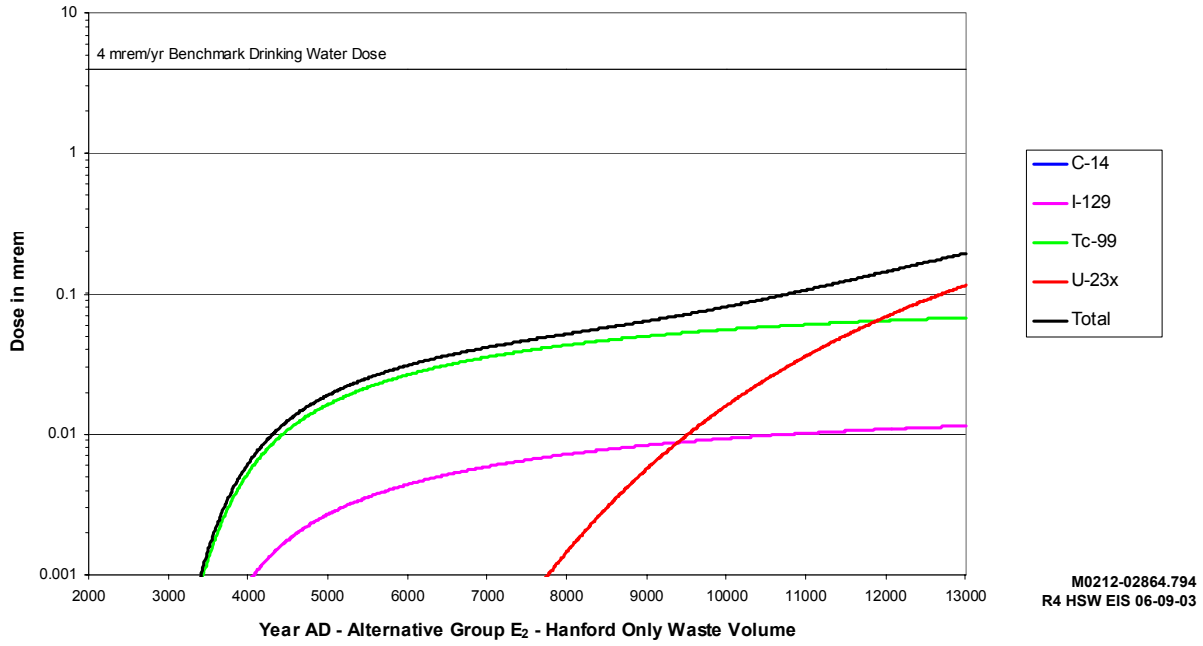


Figure F.27. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient from 200 West Area, Alternative Group E_2



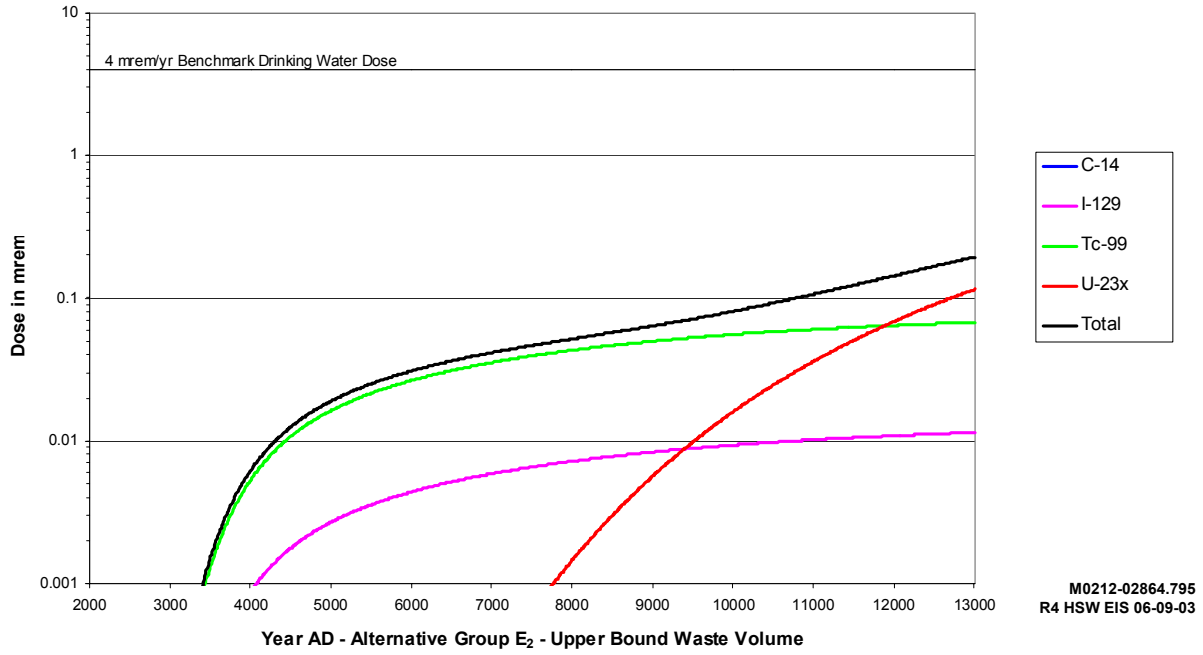
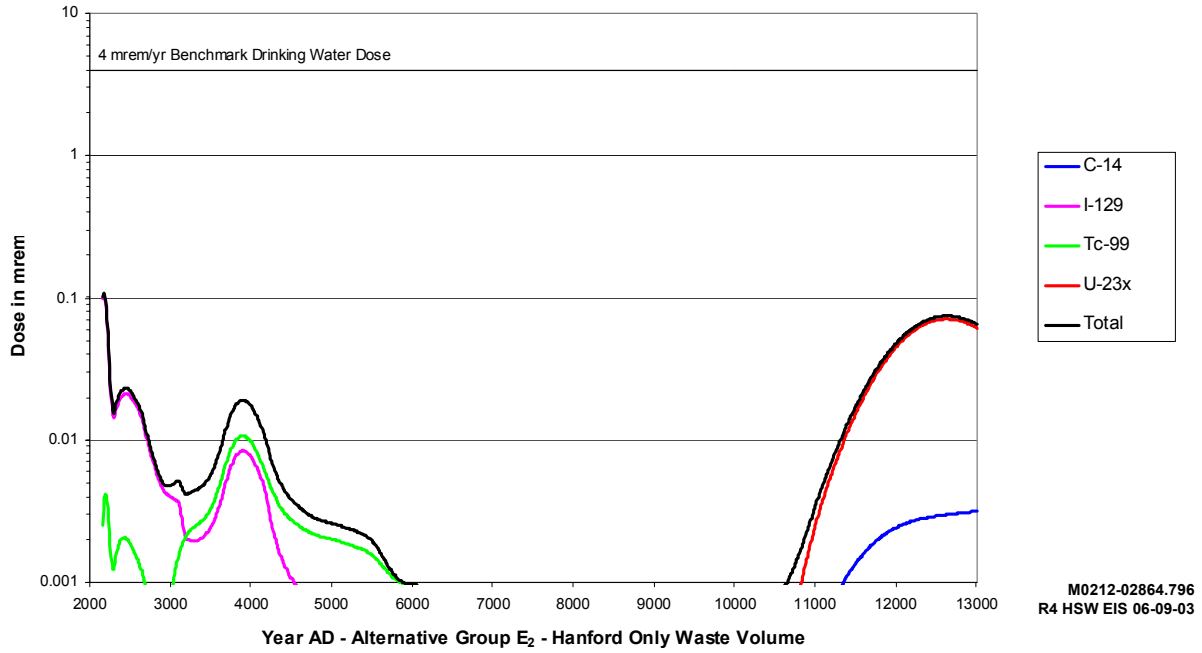


Figure F.28. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient from ERDF, Alternative Group E_2



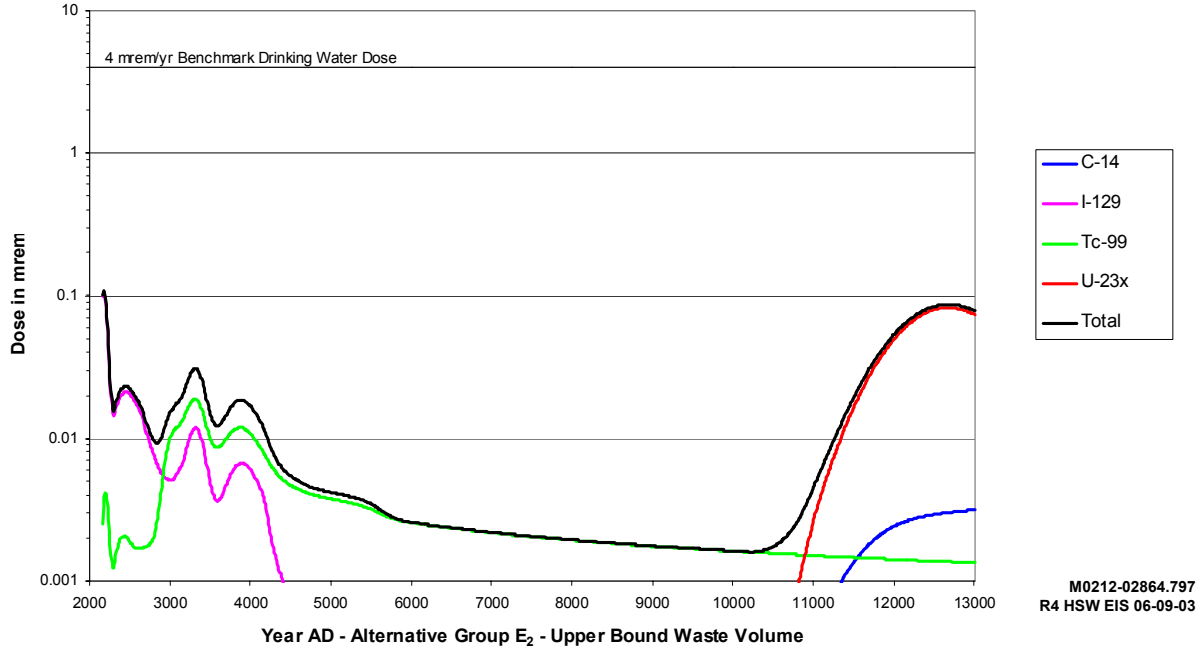
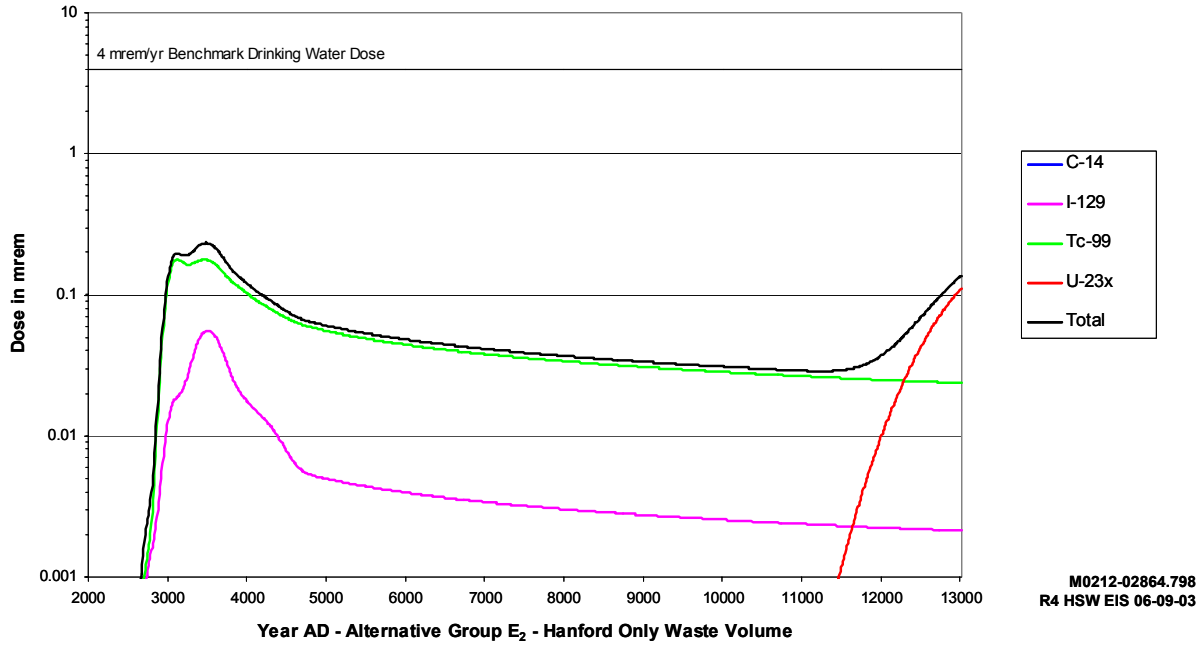


Figure F.29. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient Northwest of 200 East Area, Alternative Group E_2



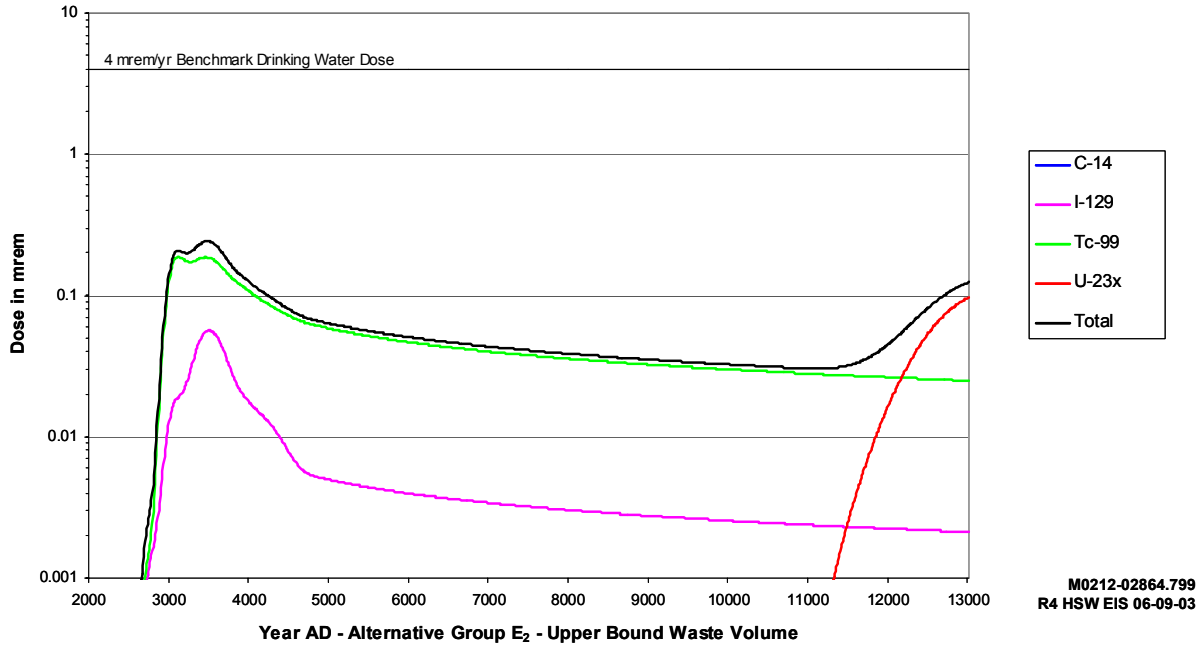
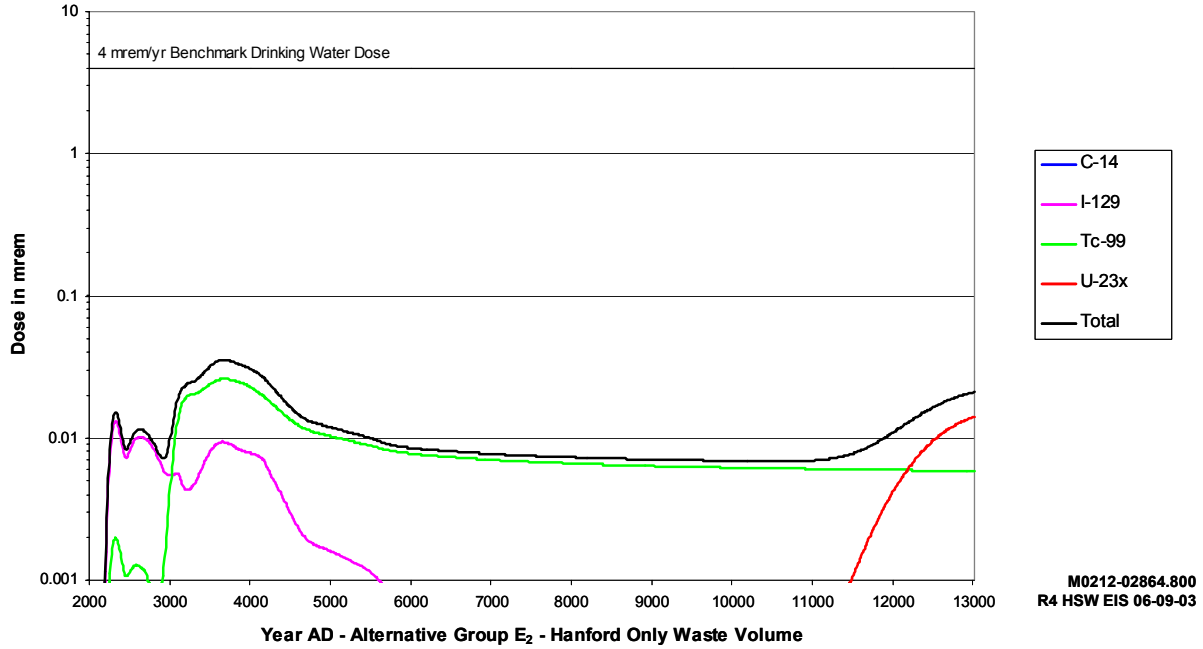


Figure F.30. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient Southeast of 200 East Area, Alternative Group E_2



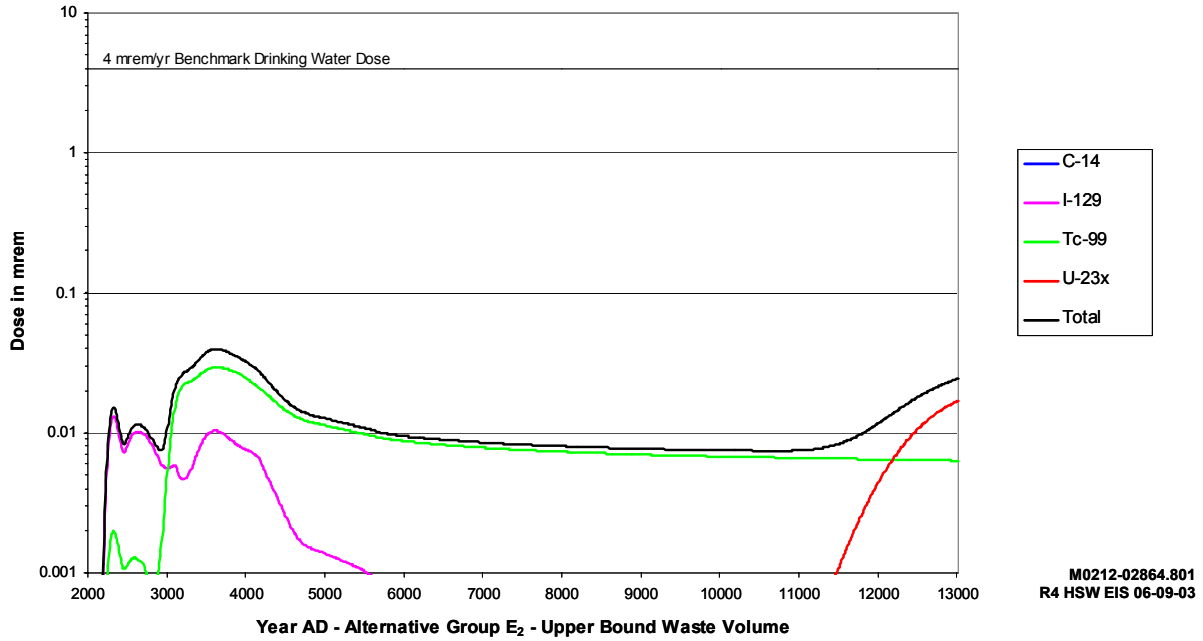
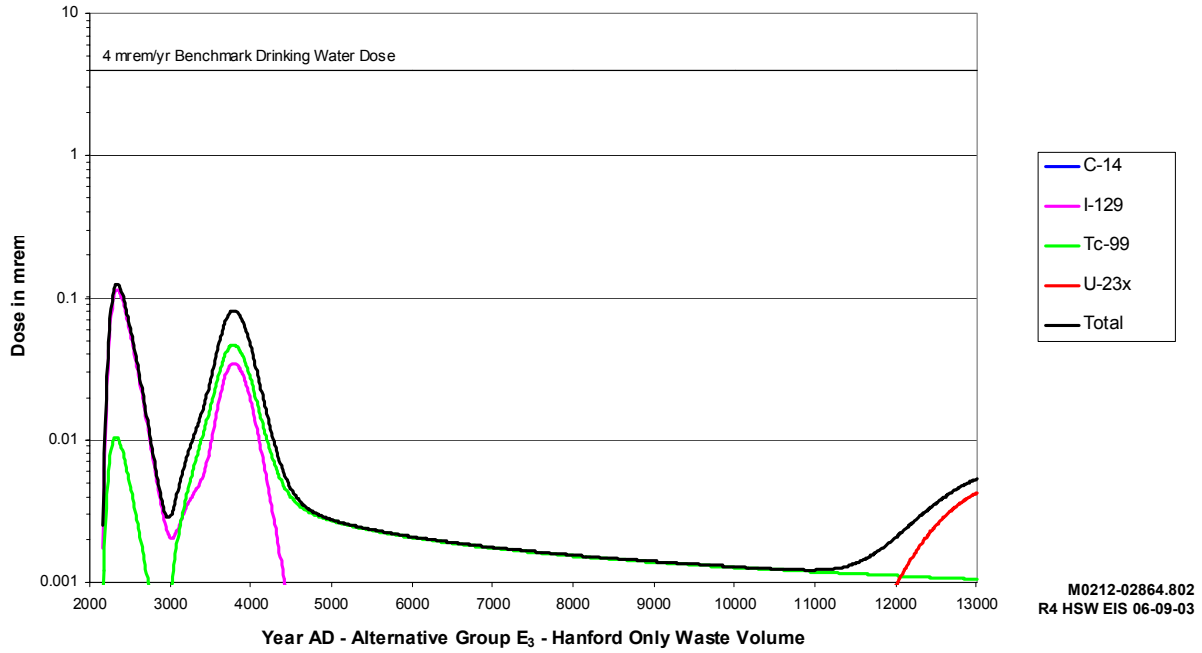


Figure F.31. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, Alternative Group E_2



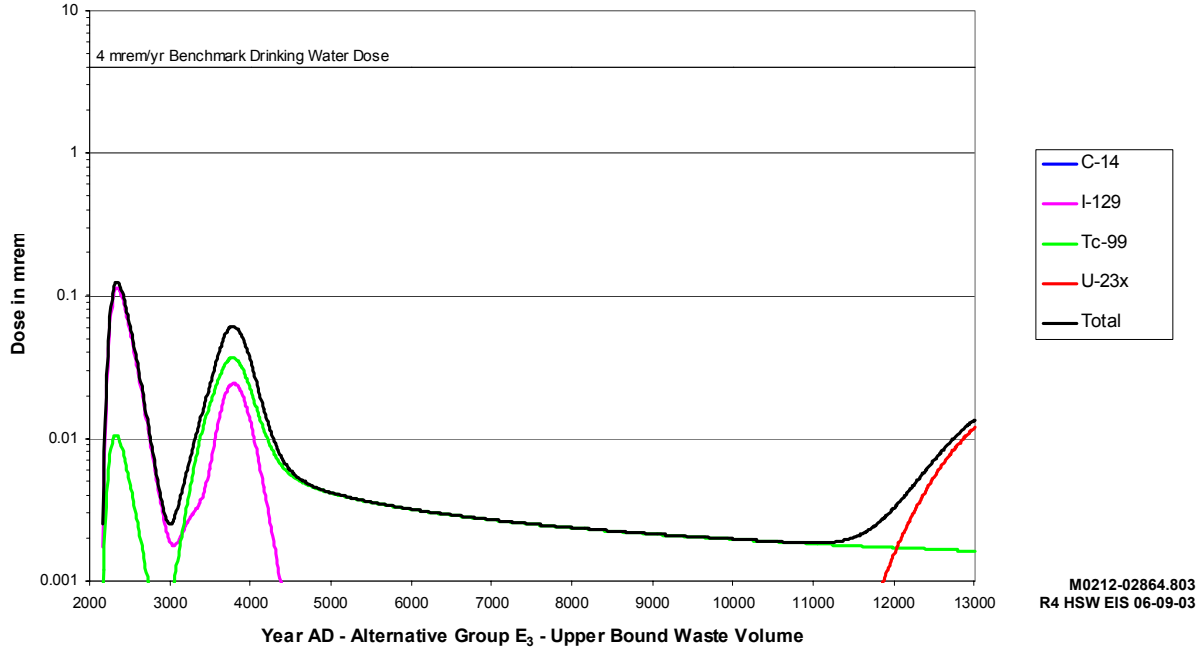
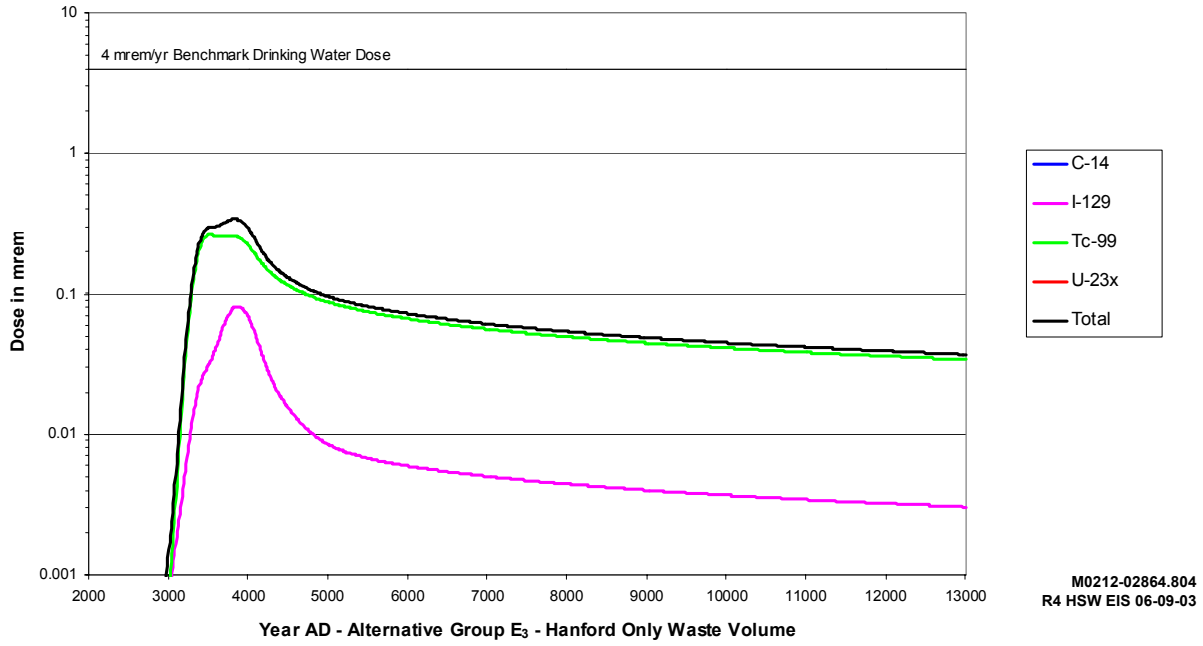


Figure F.32. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient from 200 West Area, Alternative Group E_3



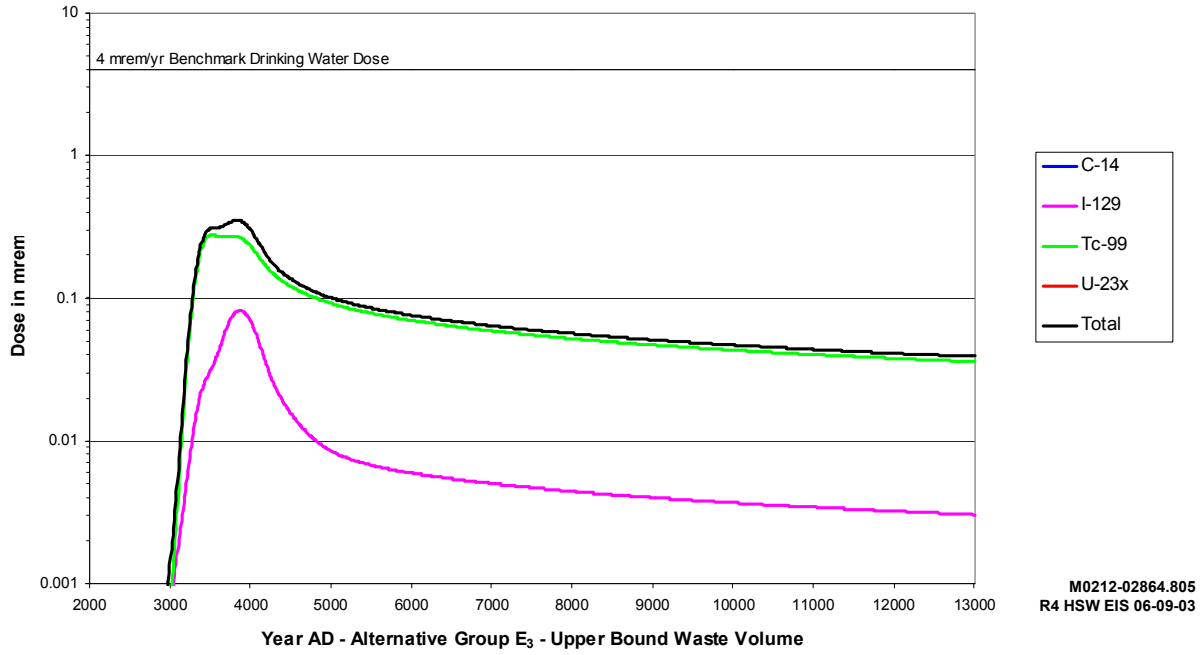
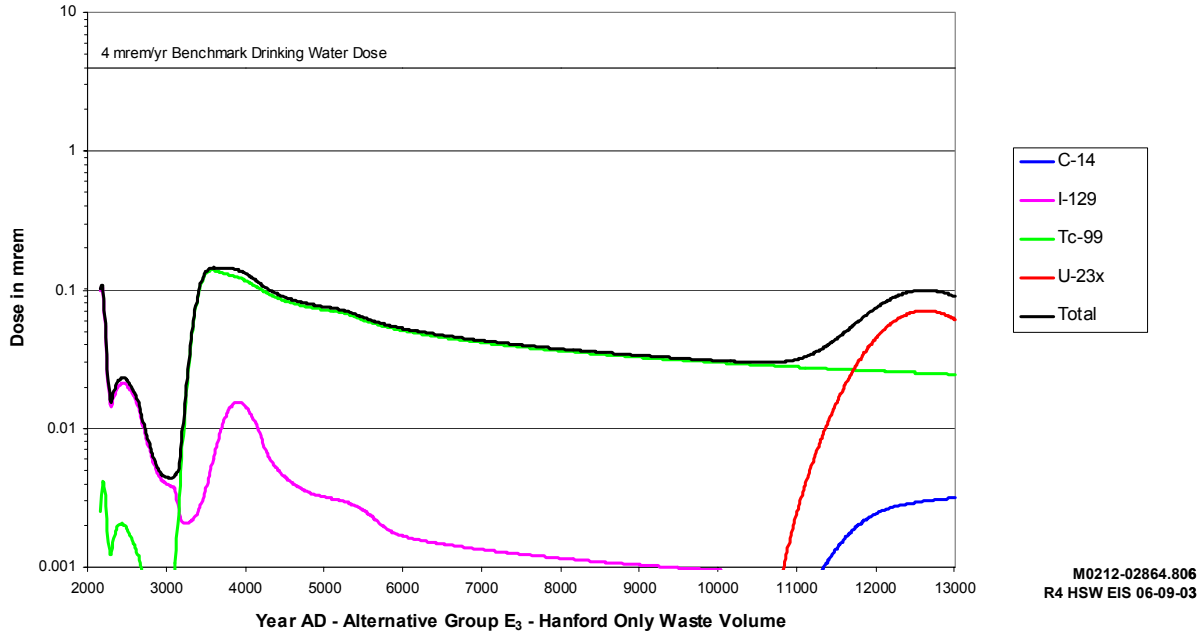


Figure F.33. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient from ERDF, Alternative Group E_3



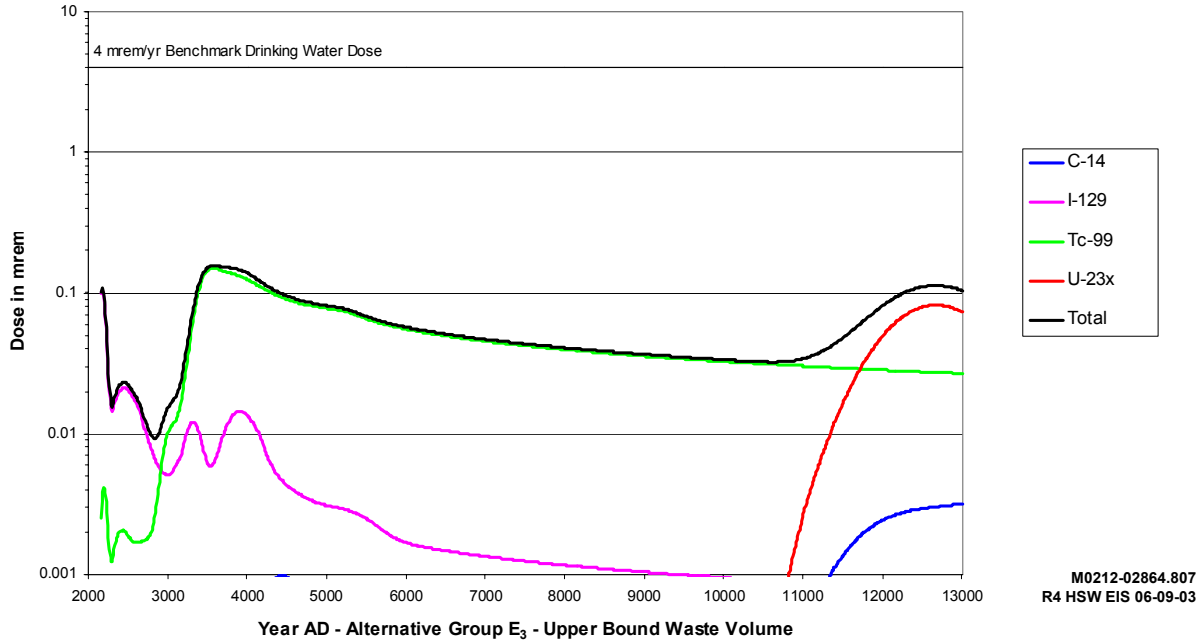
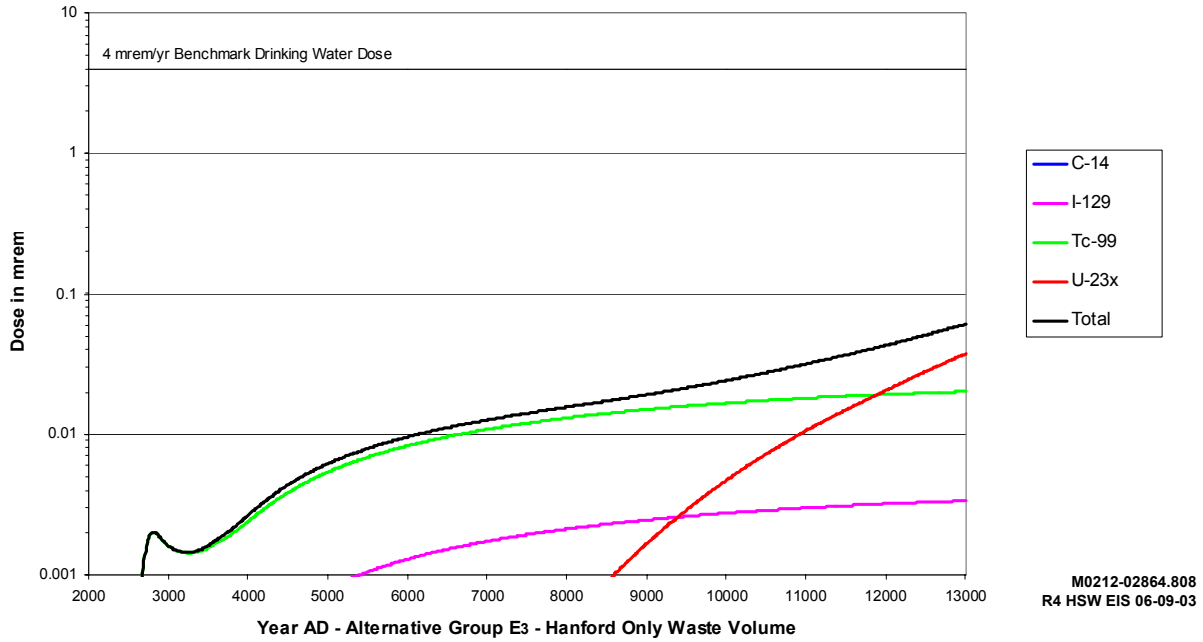


Figure F.34. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient Northwest of 200 East Area, Alternative Group E_3



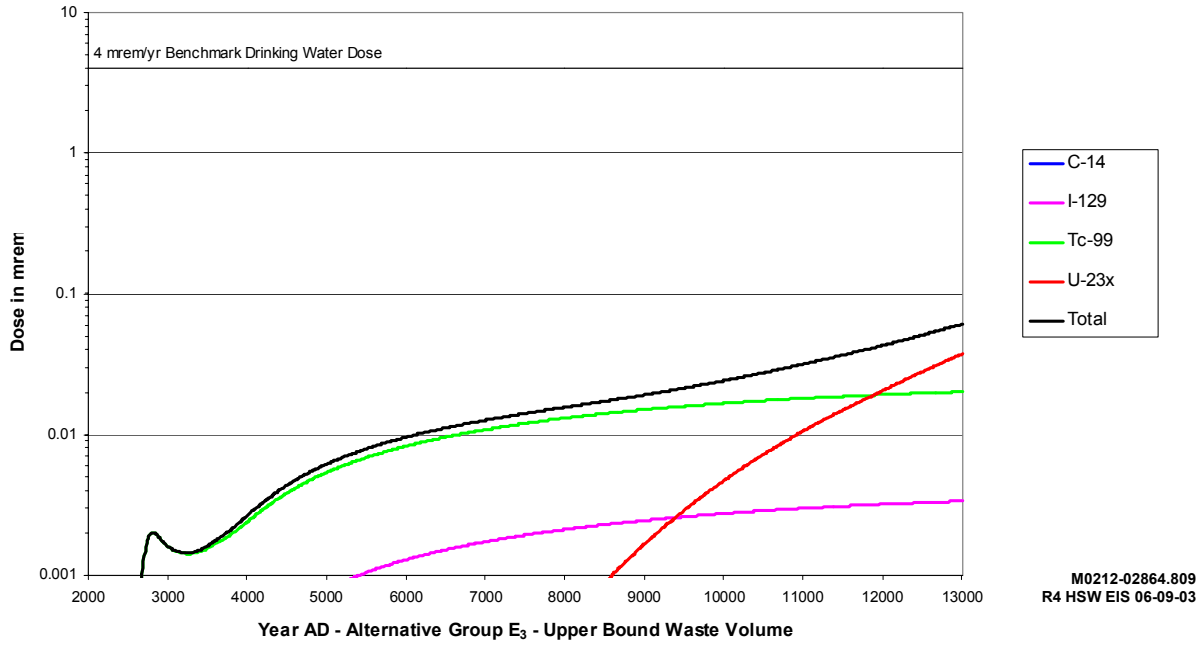
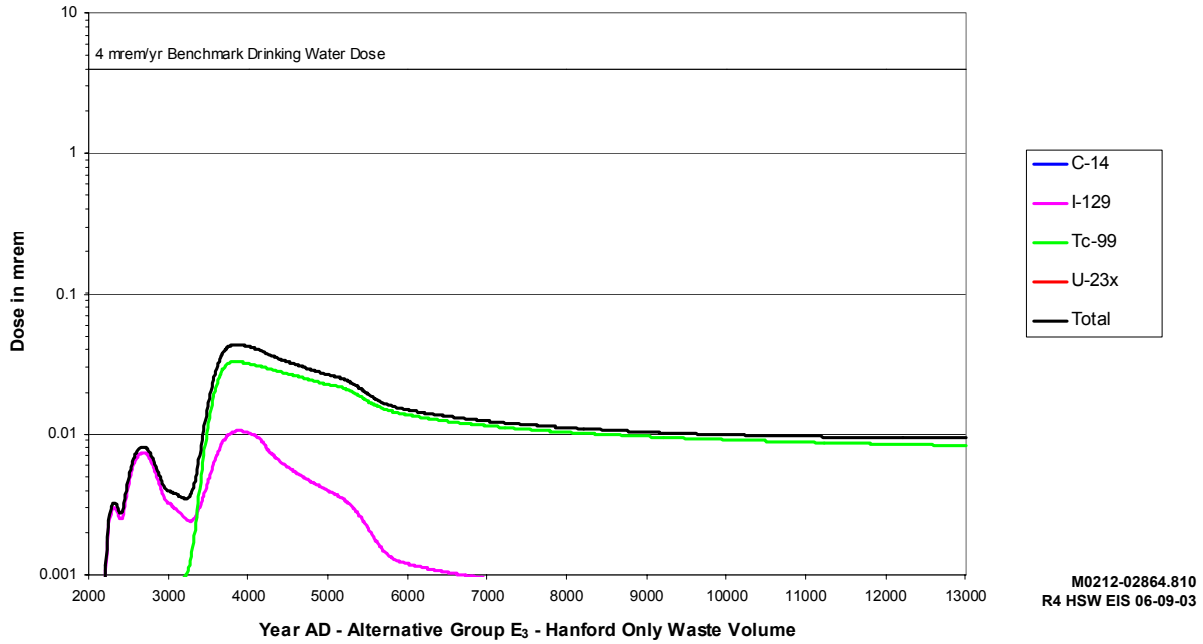


Figure F.35. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient Southeast of 200 East Area, Alternative Group E_3



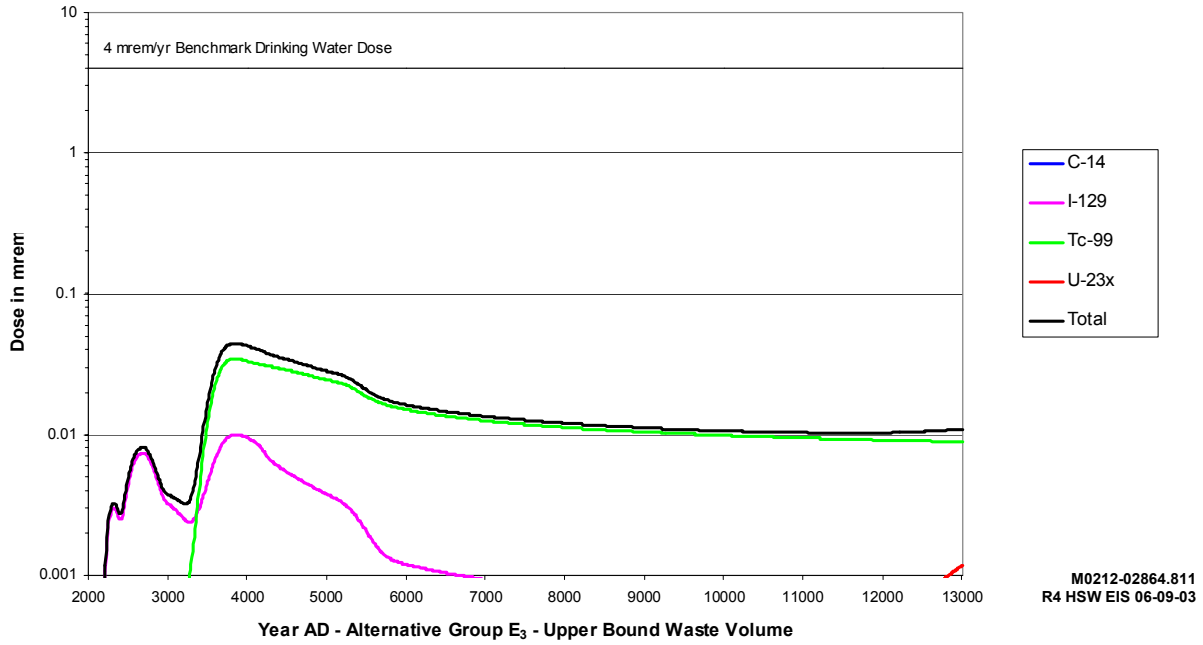


Figure F.36. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, Alternative Group E_3

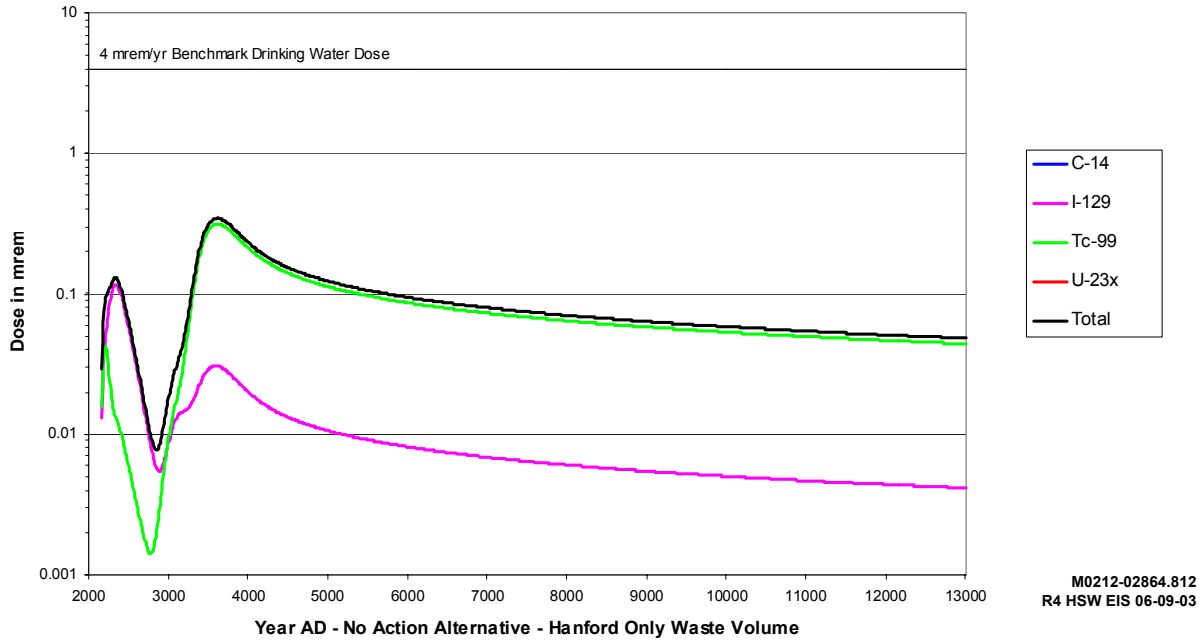


Figure F.37. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient from 200 West Area, No Action Alternative

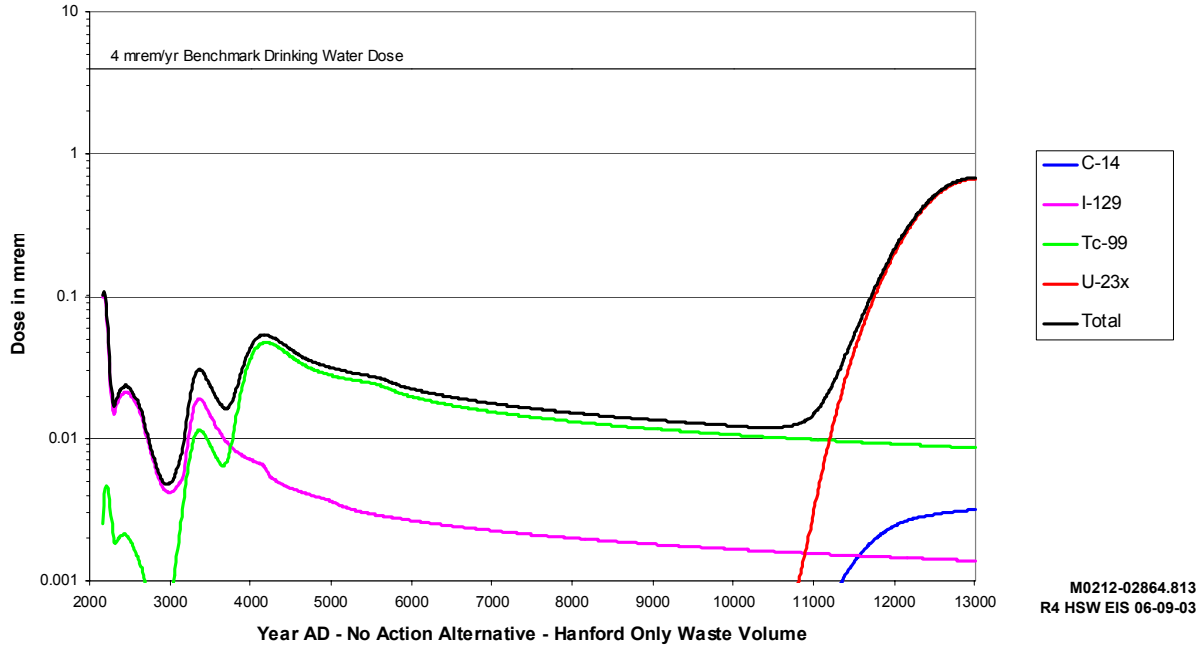


Figure F.38. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Downgradient Northwest of 200 East Area, No Action Alternative

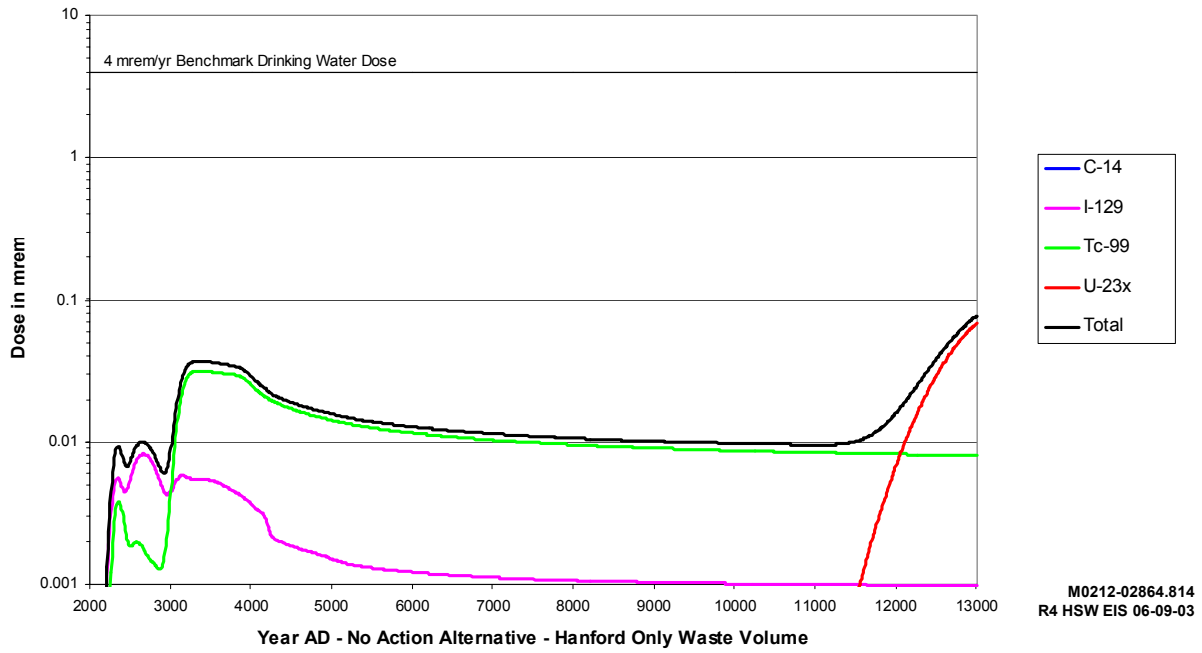


Figure F.39. Hypothetical Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, No Action Alternative

The radiation doses received from groundwater are evaluated using dose conversion factors specific to radionuclides and exposure scenarios. The dose factors used for drinking water ingestion, resident gardener, and resident gardener with sauna/sweat lodge are given in Table F.52.

Table F.52. Exposure Scenario Dose Factors for Use of Groundwater

Radionuclide	Annual Dose Factor by Exposure Scenario (mrem/yr per pCi/L)		
	Drinking Water	Resident Gardener	Resident Gardener with Sauna
Carbon-14	1.5E-03	4.0E-02	4.4E-02
Technetium-99	1.0E-03	3.6E-03	1.7E-02
Iodine-129	2.0E-01	6.2E-01	9.0E-01
Uranium-233	2.1E-01	2.6E-01	2.2E+02
Uranium-234	2.0E-01	2.5E-01	2.2E+02
Uranium-235	1.9E-01	2.4E-01	2.0E+02
Uranium-236	2.0E-01	2.4E-01	2.0E+02
Uranium-238	1.8E-01	2.2E-01	1.9E+02

A summary of groundwater dose results as a function of time is presented in Volume I, Section 5.11.2 for each alternative group. This section of the appendix presents tables of the peak impacts and the time of peak impact by waste stream and period of disposal. These tables also present the health impact estimates for the resident gardener scenario with the sauna/sweat lodge included. The contents of Tables F.54 through F.140 are indexed in Table F.53.

Table F.53. Content of Tables for Groundwater Analysis Results

Alternative	200 East Area 1-km Point of Analysis			200 West Area 1- km Point of Analysis			Columbia River Point of Analysis		
	Waste Volume			Waste Volume			Waste Volume		
	Hanford	Lower	Upper	Hanford	Lower	Upper	Hanford	Lower	Upper
Group A	F.54	F.55	F.56	F.57	F.58	F.59	F.60	F.61	F.62
Group B	F.63	F.64	F.65	F.66	F.67	F.68	F.69	F.70	F.71
Group C	F.72	F.73	F.74	F.75	F.76	F.77	F.78	F.79	F.80
Group D_1	F.81	F.82	F.83	F.84	F.85	F.86	F.87	F.88	F.89
Group D_2	F.90	F.91	F.92	F.93	F.94	F.95	F.96	F.97	F.98
Group D_3	F.99	F.100	F.101	F.102	F.103	F.104	F.105	F.106	F.107
Group E_1	F.108	F.109	F.110	F.111	F.112	F.113	F.114	F.115	F.116
Group E_2	F.117	F.118	F.119	F.120	F.121	F.122	F.123	F.124	F.125
Group E_3	F.126	F.127	F.128	F.129	F.130	F.131	F.132	F.133	F.134
No Action	F.135	F.136	NA	F.137	F.138	NA	F.139	F.140	NA

NA = not applicable.

Table F.54. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group A, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	5.8E-06	1.7E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	7.3E-05	2.2E-03	1E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,810	1.6E-05	4.8E-04	3E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.6E-05	4.9E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	2.0E-04	5.9E-03	4E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,070	9.3E-06	2.8E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	1.7E-04	5.0E-03	3E-06
MLLW	200 East Area	Resident Gardener	1,370	4.8E-04	1.4E-02	9E-06
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
Melters	200 East Area	Resident Gardener	670	1.0E-05	3.0E-04	2E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,070	3.4E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	7.6E-04	2.3E-02	1E-05
MLLW	200 East Area	Resident Gardener + Sauna	10,000	1.4E-02	4.1E-01	3E-04
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1.0E-00	6E-04
Melters	200 East Area	Resident Gardener + Sauna	10,000	7.7E-04	2.4E-02	2E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.55. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group A, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	7.0E-06	2.1E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	5.0E-05	1.0E-03	8E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,810	2.0E-05	5.9E-04	4E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.6E-05	4.9E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	2.0E-04	5.0E-03	3E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,070	1.1E-05	3.4E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	1.7E-04	5.0E-03	3E-06
MLLW	200 East Area	Resident Gardener	1,810	5.0E-05	1.0E-03	8E-07
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
Melters	200 East Area	Resident Gardener	980	2.4E-06	7.1E-05	4E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,070	4.2E-05	1.3E-03	8E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	7.6E-04	2.3E-02	1E-05
MLLW	200 East Area	Resident Gardener + Sauna	10,000	2.0E-02	5.0E-01	3E-04
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1E-00	6E-04
Melters	200 East Area	Resident Gardener + Sauna	10,000	7.8E-04	2.3E-02	1E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.56. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group A, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	7.3E-06	2.2E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	3.1E-05	3.3E-03	2E-06
	200 East Area	Resident Gardener	1,230	1.1E-04	3.4E-03	2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,810	2.1E-05	6.2E-04	4E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.6E-05	4.9E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	1.1E-04	3.3E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	6.4E-03	1.9E-01	1E-04
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,070	1.1E-05	3.4E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	1.7E-04	5.0E-03	3E-06
MLLW	200 East Area	Resident Gardener	1,370	5.4E-04	1.6E-02	1E-05
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
Melters	200 East Area	Resident Gardener	670	1.0E-05	3.0E-04	2E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,070	4.2E-05	1.3E-03	8E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	7.6E-04	2.3E-02	1E-05
MLLW	200 East Area	Resident Gardener + Sauna	10,000	2.5E-02	7.4E-01	4E-04
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1.0E-00	6E-04
Melters	200 East Area	Resident Gardener + Sauna	10,000	7.7E-04	2.3E-02	1E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.57. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group A, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	2.7E-05	8.2E-04	5E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	7.6E-05	2.3E-03	1E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	7.4E-04	2.2E-02	1E-05
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1910	4.8E-05	1.5E-03	9E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	1.2E-03	3.5E-02	2E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1910	1.8E-04	5.4E-03	3E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.3E-03	1.6E-01	1E-04

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.58. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater Over 10,000 Years for Alternative Group A, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.3E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	700	9.3E-05	2.8E-03	2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	7.4E-04	2.2E-02	1E-05
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1910	5.9E-05	1.8E-03	1E-06
LLW Cat 3	200 West Area	Resident Gardener	1230	1.2E-03	3.5E-02	2E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1910	2.2E-04	6.5E-03	4E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.3E-03	1.6E-01	1E-04

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.59. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group A, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.4E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1700	1.5E-04	4.4E-03	3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	9.8E-05	3.0E-03	2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	5.2E-04	1.6E-02	9E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1910	5.9E-05	1.8E-03	1E-06
LLW Cat 3	200 West Area	Resident Gardener	1230	1.2E-03	3.5E-02	2E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1910	2.2E-04	6.6E-03	4E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.3E-03	1.6E-01	1E-04

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.60. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group A, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.4E-06	7.2E-05	4E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.9E-05	5.7E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	6.7E-06	2.0E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	6.4E-05	1.9E-03	1E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,260	4.5E-06	1.3E-04	8E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	8.2E-05	2.5E-03	2E-06
MLLW	200 East Area	Resident Gardener	1,590	6.4E-05	1.9E-03	1E-06
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
Melters	200 East Area	Resident Gardener	940	1.2E-06	3.7E-05	2E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,260	1.7E-05	5.0E-04	3E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	3.7E-04	1.1E-02	7E-06
MLLW	200 East Area	Resident Gardener + Sauna	10,000	2.9E-04	8.7E-03	5E-06
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	6E-05
Melters	200 East Area	Resident Gardener + Sauna	10,000	1.1E-05	3.2E-04	2E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.61. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group A, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.9E-06	8.7E-05	5E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.9E-05	5.7E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	8.1E-06	2.4E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	6.5E-05	1.9E-03	1E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,260	5.5E-06	1.6E-04	8E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	8.2E-05	2.5E-03	1E-06
MLLW	200 East Area	Resident Gardener	1,580	6.4E-05	1.9E-03	1E-06
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
Melters	200 East Area	Resident Gardener	940	1.2E-06	3.7E-05	2E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,260	2.0E-05	6.1E-04	4E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	3.7E-04	1.1E-02	7E-06
MLLW	200 East Area	Resident Gardener + Sauna	1,590	3.0E-04	9.0E-03	5E-06
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	6E-05
Melters	200 East Area	Resident Gardener + Sauna	10,000	1.1E-05	4.6E-04	3E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.62. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years for Alternative Group A, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	3.0E-06	9.1E-05	5E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.3E-05	3.9E-04	2E-07
	200 East Area	Resident Gardener	10,000	1.8E-05	3.9E-04	2E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	8.6E-06	2.6E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	4.6E-05	1.4E-03	8E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.9E-04	5.8E-03	4E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,260	5.5E-06	1.7E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,710	8.2E-05	2.5E-03	2E-06
MLLW	200 East Area	Resident Gardener	1,590	6.9E-05	2.1E-03	1E-06
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
Melters	200 East Area	Resident Gardener	940	1.2E-06	3.7E-05	2E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,260	2.0E-05	6.1E-04	4E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	3.7E-04	1.1E-02	7E-06
MLLW	200 East Area	Resident Gardener + Sauna	10,000	3.9E-04	2.3E+02	1E-01
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	6E-05
Melters	200 East Area	Resident Gardener + Sauna	10,000	1.1E-05	3.2E-04	2E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.63. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group B, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	5.5E-06	1.7E-04	1E-07
	200 East Area	Resident Gardener	1,230	8.5E-07	2.5E-05	2E-08
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.3E-06	1.0E-04	6E-08
	200 East Area	Resident Gardener	620	6.0E-06	1.8E-04	1E-07
MLLW	200 West Area	Resident Gardener	1,810	2.7E-05	8.0E-04	5E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,810	1.5E-05	4.6E-04	3E-07
	200 East Area	Resident Gardener + Sauna	10,000	3.0E-04	9.0E-03	5E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.6E-05	4.7E-04	3E-07
	200 East Area	Resident Gardener + Sauna	620	2.9E-05	8.6E-04	5E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	9.1E-05	2.7E-03	2E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,920	9.5E-06	2.8E-04	2E-07
	200 East Area	Resident Gardener	1,320	1.1E-06	3.2E-05	2E-08
LLW Cat 3	200 West Area	Resident Gardener	1,450	1.6E-04	4.9E-03	3E-06
	200 East Area	Resident Gardener	10,000	3.0E-04	9.1E-03	5E-06
MLLW	200 East Area	Resident Gardener	1,250	7.2E-04	2.1E-02	1E-05
Melters	200 East Area	Resident Gardener	680	2.6E-07	7.7E-06	5E-09
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,920	3.5E-05	1.1E-03	6E-07
	200 East Area	Resident Gardener + Sauna	1,320	3.9E-06	1.2E-04	7E-08
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	7.3E-04	2.2E-02	1E-05
	200 East Area	Resident Gardener + Sauna	10,000	2.4E-01	7.3E+00	4E-03
MLLW	200 East Area	Resident Gardener + Sauna	10,000	3.8E-02	1.1E+00	7E-04
Melters	200 East Area	Resident Gardener + Sauna	680	1.2E-06	3.6E-05	2E-08

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.64. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group B, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	6.8E-06	2.0E-04	1E-07
	200 East Area	Resident Gardener	1,230	1.0E-06	3.1E-05	2E-08
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.3E-06	1.0E-04	6E-08
	200 East Area	Resident Gardener	620	4.2E-07	1.3E-05	8E-09
MLLW	200 West Area	Resident Gardener	1,810	2.7E-05	1.3E+02	8E-02
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,810	1.9E-05	5.6E-04	3E-07
	200 East Area	Resident Gardener + Sauna	10,000	3.5E-04	1.0E-02	6E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.6E-05	4.7E-04	3E-07
	200 East Area	Resident Gardener + Sauna	10,000	2.3E-06	6.8E-05	4E-08
MLLW	200 West Area	Resident Gardener + Sauna	1,810	9.1E-05	1.3E+02	8E-02
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,920	1.2E-05	3.5E-04	2E-07
	200 East Area	Resident Gardener	1,320	1.3E-06	3.8E-05	2E-08
LLW Cat 3	200 West Area	Resident Gardener	1,450	1.6E-04	4.9E-03	3E-06
	200 East Area	Resident Gardener	10,000	3.1E-04	9.3E-03	6E-06
MLLW	200 East Area	Resident Gardener	10,000	7.6E-04	2.3E-02	1E-05
Melters	200 East Area	Resident Gardener	680	2.6E-07	7.7E-06	5E-09
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,920	4.3E-05	1.3E-03	8E-07
	200 East Area	Resident Gardener + Sauna	10,000	7.5E-04	2.2E-02	1E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	7.3E-04	2.2E-02	1E-05
	200 East Area	Resident Gardener + Sauna	10,000	2.5E-01	7.5E+00	5E-03
MLLW	200 East Area	Resident Gardener + Sauna	10,000	7.6E-02	2.3E+00	1E-03
Melters	200 East Area	Resident Gardener + Sauna	680	1.2E-06	3.6E-05	2E-08

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.65. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group B, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	6.3E-06	1.9E-04	1E-07
	200 East Area	Resident Gardener	1,230	3.9E-06	1.2E-04	7E-08
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.3E-06	1.0E-04	6E-08
	200 East Area	Resident Gardener	620	4.4E-07	1.3E-05	8E-09
MLLW	200 West Area	Resident Gardener	1,810	1.6E-05	4.7E-04	3E-07
	200 East Area	Resident Gardener	670	4.0E-05	1.2E-03	7E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,810	1.8E-05	5.4E-04	3E-07
	200 East Area	Resident Gardener + Sauna	10,000	5.5E-05	1.6E-03	1E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.6E-05	4.7E-04	3E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.7E-05	5.0E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	5.9E-05	1.8E-03	1E-06
	200 East Area	Resident Gardener + Sauna	670	2.2E-04	6.6E-03	4E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,920	1.0E-05	3.1E-04	2E-07
	200 East Area	Resident Gardener	1,210	6.1E-06	1.8E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	1.6E-04	4.9E-03	3E-05
	200 East Area	Resident Gardener	10,000	3.1E-04	9.4E-03	6E-06
MLLW	200 East Area	Resident Gardener	1,250	8.4E-04	2.5E-02	2E-05
Melters	200 East Area	Resident Gardener	680	2.6E-07	7.7E-06	5E-09
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,920	3.9E-05	1.2E-03	7E-07
	200 East Area	Resident Gardener + Sauna	1,210	2.3E-05	7.0E-04	4E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	7.3E-04	2.2E-02	1E-05
	200 East Area	Resident Gardener + Sauna	10,000	2.5E-01	7.6E+00	5E-03
MLLW	200 East Area	Resident Gardener + Sauna	1,810	5.1E-02	1.5E+00	9E-04
Melters	200 East Area	Resident Gardener + Sauna	680	1.2E-06	3.6E-05	2E-08

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.66. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group B, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1,700	2.6E-05	7.9E-04	5E-07
LLW Cat 3	200 West Area	Resident Gardener	1,230	2.3E-05	7.0E-04	4E-07
MLLW	200 West Area	Resident Gardener	1,700	1.3E-04	3.8E-03	2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,700	7.3E-05	2.2E-03	1E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	1.1E-04	3.3E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1,700	4.3E-04	1.3E-02	8E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,770	5.0E-05	1.5E-03	9E-07
LLW Cat 3	200 West Area	Resident Gardener	1,230	1.1E-03	3.4E-02	2E-05
ILAW	200 West Area	Resident Gardener	10,000	3.1E-04	9.2E-03	6E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,770	1.8E-04	5.5E-03	3E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	5.1E-03	1.5E-01	9E-05
ILAW	200 West Area	Resident Gardener + Sauna	10,000	1.1E-01	3.3E-00	2E-03

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.67. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group B, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1,700	3.2E-05	9.6E-04	6E-07
LLW Cat 3	200 West Area	Resident Gardener	1,230	2.3E-05	7.0E-04	4E-07
MLLW	200 West Area	Resident Gardener	1,700	1.3E-04	3.8E-03	2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,700	8.9E-05	2.7E-03	2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	1.1E-04	3.3E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1,700	4.3E-04	1.3E-02	8E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,770	6.1E-05	1.8E-03	1E-06
LLW Cat 3	200 West Area	Resident Gardener	1,230	1.1E-03	3.4E-02	2E-05
ILAW	200 West Area	Resident Gardener	10,000	3.1E-04	9.2E-03	6E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	2.4E-02	7.3E-01	4E-04
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	5.1E-03	1.5E-01	9E-05
ILAW	200 West Area	Resident Gardener + Sauna	10,000	1.1E-01	3.3E-00	2E-03

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.68. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group B, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1,700	3.0E-05	8.9E-04	5E-07
LLW Cat 3	200 West Area	Resident Gardener	1,230	2.3E-05	7.0E-04	4E-07
MLLW	200 West Area	Resident Gardener	1,700	7.4E-05	2.2E-03	1E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,700	8.5E-05	2.5E-03	2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	1.1E-04	3.3E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1,700	2.8E-04	8.3E-03	5E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,770	5.5E-05	1.6E-03	1E-06
LLW Cat 3	200 West Area	Resident Gardener	1,230	1.1E-03	3.4E-02	2E-05
ILAW	200 West Area	Resident Gardener	10,000	3.1E-04	9.2E-03	6E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	2.1E-02	6.2E-01	4E-04
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	5.1E-03	1.5E-01	9E-05
ILAW	200 West Area	Resident Gardener + Sauna	10,000	1.1E-01	3.3E-00	2E-03

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.69. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group B, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.3E-06	6.9E-05	4E-08
	200 East Area	Resident Gardener	1,400	1.4E-07	4.3E-06	3E-09
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.6E-06	4.9E-05	3E-08
	200 East Area	Resident Gardener	860	1.4E-06	4.2E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.1E-05	3.3E-04	2E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	6.4E-06	1.9E-04	1E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-05	3.7E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	7.7E-06	2.3E-04	1E-07
	200 East Area	Resident Gardener + Sauna	860	6.7E-06	2.0E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	3.8E-05	1.1E-03	7E-07
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,110	4.5E-06	1.4E-04	8E-08
	200 East Area	Resident Gardener	2,330	1.2E-05	3.5E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener	1,710	7.9E-05	2.4E-03	1E-06
	200 East Area	Resident Gardener	10,000	2.9E-04	8.6E-03	5E-06
MLLW	200 East Area	Resident Gardener	1,430	8.5E-05	2.5E-03	2E-06
ILAW	200 West Area	Resident Gardener	10,000	1.0E-05	3.0E-04	2E-07
Melters	200 East Area	Resident Gardener	940	3.2E-08	9.5E-07	6E-10
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,110	1.7E-05	5.0E-04	3E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.4E-04	1.9E-02	1E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	3.6E-04	1.1E-02	6E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.4E-01	7.3E+00	4E-03
MLLW	200 East Area	Resident Gardener + Sauna	10,000	5.4E-04	1.6E-02	1E-05
ILAW	200 West Area	Resident Gardener + Sauna	10,000	2.6E-05	7.8E-02	5E-05
Melters	200 East Area	Resident Gardener + Sauna	940	1.5E-07	4.5E-06	3E-09

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.70. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group B, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.8E-06	8.4E-05	5E-08
	200 East Area	Resident Gardener	1,400	1.7E-07	5.2E-06	3E-09
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.6E-06	4.9E-05	3E-08
	200 East Area	Resident Gardener	860	9.8E-08	2.9E-06	2E-09
MLLW	200 West Area	Resident Gardener	2,000	1.1E-05	3.4E-04	2E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	7.8E-06	2.3E-04	1E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.3E-05	3.9E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	7.7E-06	2.3E-04	1E-07
	200 East Area	Resident Gardener + Sauna	860	4.6E-07	1.4E-05	8E-09
MLLW	200 West Area	Resident Gardener + Sauna	2,000	3.8E-05	1.1E-03	7E-07
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,110	5.5E-06	1.7E-04	1E-07
	200 East Area	Resident Gardener	2,250	1.4E-05	4.2E-04	3E-07
LLW Cat 3	200 West Area	Resident Gardener	1,710	7.9E-05	2.4E-03	1E-06
	200 East Area	Resident Gardener	10,000	3.0E-04	8.9E-03	5E-06
MLLW	200 East Area	Resident Gardener	1,430	8.6E-05	2.6E-03	2E-06
ILAW	200 West Area	Resident Gardener	10,000	1.0E-05	3.0E-04	2E-07
Melters	200 East Area	Resident Gardener	940	3.2E-08	9.5E-07	6E-10
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,110	2.0E-05	6.1E-04	4E-07
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-04	2.2E-02	1E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	3.6E-04	1.1E-02	6E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.5E-01	7.5E+00	5E-03
MLLW	200 East Area	Resident Gardener + Sauna	10,000	1.0E-03	3.1E-02	2E-05
ILAW	200 West Area	Resident Gardener + Sauna	10,000	2.6E-05	7.8E-02	5E-05
Melters	200 East Area	Resident Gardener + Sauna	940	1.5E-07	4.5E-06	3E-09

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.71. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group B, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[(b)]
			Years Post-2046[(a)]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.6E-06	7.8E-05	5E-08
	200 East Area	Resident Gardener	1,400	6.6E-07	2.0E-05	1E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.6E-06	4.9E-05	3E-08
	200 East Area	Resident Gardener	860	9.8E-08	2.9E-06	2E-09
MLLW	200 West Area	Resident Gardener	940	6.6E-06	2.0E-04	1E-07
	200 East Area	Resident Gardener	1,400	5.1E-06	1.5E-04	9E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	7.4E-06	2.2E-04	1E-07
	200 East Area	Resident Gardener + Sauna	1,400	5.3E-05	1.6E-03	1E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	7.7E-06	2.3E-04	1E-07
	200 East Area	Resident Gardener + Sauna	860	6.4E-07	1.9E-05	1E-08
MLLW	200 West Area	Resident Gardener + Sauna	2,000	2.5E-05	7.5E-04	5E-07
	200 East Area	Resident Gardener + Sauna	940	3.1E-05	9.3E-04	6E-07
Projected New Waste (>2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	2,110	5.0E-06	1.5E-04	9E-08
	200 East Area	Resident Gardener	10,000	6.1E-06	1.8E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,710	7.9E-05	2.4E-03	1E-06
	200 East Area	Resident Gardener	10,000	3.0E-04	8.9E-03	5E-06
MLLW	200 East Area	Resident Gardener	1,430	9.9E-05	3.0E-03	2E-06
ILAW	200 West Area	Resident Gardener	10,000	1.0E-05	3.0E-04	2E-07
Melters	200 East Area	Resident Gardener	940	3.2E-08	9.5E-07	6E-10
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,110	1.9E-05	5.6E-04	3E-07
	200 East Area	Resident Gardener + Sauna	10,000	4.0E-03	1.2E-01	7E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	3.6E-04	1.1E-02	6E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.5E-01	7.6E+00	5E-03
MLLW	200 East Area	Resident Gardener + Sauna	10,000	7.5E-04	2.3E-02	1E-05
ILAW	200 West Area	Resident Gardener + Sauna	10,000	2.6E-05	7.8E-02	5E-05
Melters	200 East Area	Resident Gardener + Sauna	940	1.5E-07	4.5E-06	3E-09

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.72. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group C, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	5.8E-06	1.7E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,810	1.6E-05	4.8E-04	3E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.6E-05	4.9E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,700	7.4E-04	2.2E-02	1E-05
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,070	6.3E-06	1.9E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,460	1.7E-04	5.0E-03	3E-06
MLLW	200 East Area	Resident Gardener	1,370	4.8E-04	1.4E-02	9E-06
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
Melters	200 East Area	Resident Gardener	680	6.9E-06	2.1E-04	1E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,070	3.0E-05	9.0E-04	5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,460	7.6E-04	2.3E-02	1E-05
MLLW	200 East Area	Resident Gardener + Sauna	10,000	1.4E-02	4.1E-01	3E-04
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1.0E-00	6E-04
Melters	200 East Area	Resident Gardener + Sauna	10,000	7.7E-04	2.3E-02	1E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.73. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group C, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	7.0E-06	2.1E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,810	2.0E-05	5.9E-04	4E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.6E-05	4.9E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,700	7.4E-04	2.2E-02	1E-05
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,070	7.7E-06	2.3E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	1.7E-04	5.0E-03	3E-06
MLLW	200 East Area	Resident Gardener	1,370	4.8E-04	1.5E-02	9E-06
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
Melters	200 East Area	Resident Gardener	680	6.9E-06	2.1E-04	1E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,070	3.7E-05	1.1E-03	7E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	7.6E-04	2.3E-02	1E-05
MLLW	200 East Area	Resident Gardener + Sauna	10,000	1.5E-02	4.6E-01	3E-04
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1.0E-00	6E-04
Melters	200 East Area	Resident Gardener + Sauna	10,000	8.0E-04	2.4E-02	1E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.74. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group C, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	7.3E-06	2.2E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	4.1E-05	1.2E-03	7E-07
	200 East Area	Resident Gardener	10,000	2.6E-04	7.9E-03	5E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,810	2.1E-05	6.2E-04	4E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.6E-05	4.9E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	5.2E-04	1.6E-02	9E-06
	200 East Area	Resident Gardener + Sauna	10,000	6.4E-03	1.9E-01	1E-04
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,070	7.7E-06	2.3E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	1.7E-04	5.0E-03	3E-06
MLLW	200 East Area	Resident Gardener	1,370	5.4E-04	1.6E-02	1E-05
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
Melters	200 East Area	Resident Gardener	680	6.9E-06	2.1E-04	1E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,070	3.7E-05	1.1E-03	7E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	7.6E-04	2.3E-02	1E-05
MLLW	200 East Area	Resident Gardener + Sauna	10,000	2.5E-02	7.4E-01	4E-04
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1.0E-00	6E-04
Melters	200 East Area	Resident Gardener + Sauna	10,000	8.0E-04	2.4E-02	1E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.75. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group C, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	2.7E-05	8.2E-04	5E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	7.6E-05	2.3E-03	1E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	7.4E-04	2.2E-02	1E-05
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1910	4.8E-05	1.5E-03	9E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	1.2E-03	3.5E-02	2E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1910	1.8E-04	5.4E-03	3E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.3E-03	1.6E-01	1E-04

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.76. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group C, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.3E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	9.3E-05	2.8E-03	2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	7.4E-04	2.2E-02	1E-05
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1910	5.9E-05	1.8E-03	1E-06
LLW Cat 3	200 West Area	Resident Gardener	1230	1.2E-03	3.5E-02	2E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1910	2.2E-04	6.5E-03	4E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.3E-03	1.6E-01	1E-04

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.77. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group C, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.4E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1700	1.5E-04	4.4E-03	3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	9.8E-05	3.0E-03	2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	5.2E-04	1.6E-02	9E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1910	5.9E-05	1.8E-03	1E-06
LLW Cat 3	200 West Area	Resident Gardener	1230	1.2E-03	3.5E-02	2E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1910	2.2E-04	6.6E-03	4E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.3E-03	1.6E-01	1E-04

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.78. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group C, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.4E-06	7.2E-05	4E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.9E-05	5.7E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	6.7E-06	2.0E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	6.4E-05	1.9E-03	1E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,260	4.5E-06	1.3E-04	8E-08
LLW Cat 3	200 West Area	Resident Gardener	1,720	7.6E-05	2.3E-03	1E-06
MLLW	200 East Area	Resident Gardener	1,590	6.4E-05	1.9E-03	1E-06
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
Melters	200 East Area	Resident Gardener	820	7.5E-07	2.2E-05	1E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,260	1.7E-05	5.0E-04	3E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,720	3.6E-04	1.1E-02	7E-06
MLLW	200 East Area	Resident Gardener + Sauna	1,590	2.9E-04	8.7E-03	5E-06
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	6E-05
Melters	200 East Area	Resident Gardener + Sauna	10,000	1.3E-05	3.9E-04	2E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.79. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group C, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.9E-06	8.7E-05	5E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.9E-05	5.7E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	8.1E-06	2.4E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	6.5E-05	1.9E-03	1E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,260	5.5E-06	1.6E-04	8E-08
LLW Cat 3	200 West Area	Resident Gardener	1,720	7.8E-05	2.3E-03	1E-06
MLLW	200 East Area	Resident Gardener	1,580	6.4E-05	1.9E-03	1E-06
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
Melters	200 East Area	Resident Gardener	820	7.6E-07	2.3E-05	1E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,260	2.0E-05	6.1E-04	3E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,720	3.6E-04	1.1E-02	5E-06
MLLW	200 East Area	Resident Gardener + Sauna	1,590	3.0E-04	9.0E-03	5E-06
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	5E-05
Melters	200 East Area	Resident Gardener + Sauna	10,000	1.3E-05	3.9E-04	2E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.80. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group C, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	3.0E-06	9.1E-05	5E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.3E-05	3.9E-04	2E-07
	200 East Area	Resident Gardener	940	4.1E-06	1.2E-04	7E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	8.6E-06	2.6E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	4.6E-05	1.4E-03	8E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-04	4.4E-03	3E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,260	5.5E-06	1.7E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,710	7.8E-05	2.3E-03	1E-06
MLLW	200 East Area	Resident Gardener	1,590	6.9E-05	2.1E-03	1E-06
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
Melters	200 East Area	Resident Gardener	820	7.5E-07	2.2E-05	1E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,260	2.0E-05	6.1E-04	4E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	3.6E-04	1.1E-02	7E-06
MLLW	200 East Area	Resident Gardener + Sauna	1,590	3.9E-04	1.2E-02	7E-06
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	6E-05
Melters	200 East Area	Resident Gardener + Sauna	10,000	1.3E-05	3.9E-04	2E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.81. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_1, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	5.8E-06	1.7E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	4.6E-05	1.4E-03	8E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	3.5E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.7E-05	5.0E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	1.5E-04	4.6E-03	3E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1,380	3.4E-05	1.0E-03	6E-07
LLW Cat 3	200 East Area	Resident Gardener	620	5.4E-04	1.6E-02	1E-05
MLLW	200 East Area	Resident Gardener	1,380	6.3E-04	1.9E-02	1E-05
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
Melters	200 East Area	Resident Gardener	980	2.4E-06	7.1E-05	4E-08
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10,000	4.7E-03	1.4E-01	9E-05
LLW Cat 3	200 East Area	Resident Gardener + Sauna	620	2.4E-03	7.3E-02	4E-05
MLLW	200 East Area	Resident Gardener + Sauna	1,380	8.6E-03	2.6E-01	2E-04
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1.0E-00	6E-04
Melters	200 East Area	Resident Gardener + Sauna	10,000	5.6E-04	1.7E-02	1E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.82. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_1, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	7.1E-06	2.1E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	4.6E-05	1.4E-03	8E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	3.6E-05	1.1E-03	7E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.7E-05	5.0E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	1.5E-04	4.6E-03	3E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1,380	4.2E-05	1.3E-03	8E-07
LLW Cat 3	200 East Area	Resident Gardener	620	5.4E-04	1.6E-02	1E-05
MLLW	200 East Area	Resident Gardener	1,380	3.2E-04	9.6E-03	6E-06
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
Melters	200 East Area	Resident Gardener	980	2.4E-06	7.1E-05	4E-08
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10,000	5.5E-01	1.7E+01	1E-02
LLW Cat 3	200 East Area	Resident Gardener + Sauna	620	2.4E-03	7.3E-02	4E-05
MLLW	200 East Area	Resident Gardener + Sauna	10,000	7.6E-03	2.3E-01	1E-04
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1.0E-00	6E-04
Melters	200 East Area	Resident Gardener + Sauna	10,000	5.7E-04	1.7E-02	1E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.83. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_1, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	7.4E-06	2.2E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	3.1E-05	9.3E-04	6E-07
	200 East Area	Resident Gardener	10,000	1.1E-04	3.4E-03	2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	7.6E-05	2.3E-03	1E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.7E-05	5.0E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	1.1E-04	3.3E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	6.4E-03	1.9E-01	1E-04
Projected New Waste (>2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1,380	4.3E-05	1.3E-03	8E-07
LLW Cat 3	200 East Area	Resident Gardener	620	5.5E-04	1.6E-02	1E-05
MLLW	200 East Area	Resident Gardener	1,380	4.1E-04	1.2E-02	7E-06
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
Melters	200 East Area	Resident Gardener	980	2.4E-06	7.1E-05	4E-08
LLW Cat 1	200 East Area	Resident Gardener + Sauna	1,380	1.6E-04	4.7E-03	3E-06
LLW Cat 3	200 East Area	Resident Gardener + Sauna	620	2.4E-03	7.3E-02	4E-05
MLLW	200 East Area	Resident Gardener + Sauna	10,000	1.7E-02	5.1E-01	3E-04
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1.0E-00	6E-04
Melters	200 East Area	Resident Gardener + Sauna	10,000	5.7E-04	1.7E-02	1E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.84. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_1, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,700	2.9E-05	8.6E-04	5E-07
LLW Cat 3	200 West Area	Resident Gardener	1,230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1,700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-02	2E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	1.4E-04	4.2E-03	3E-06
MLLW	200 West Area	Resident Gardener + Sauna	1,700	7.4E-04	2.2E-02	1E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.85. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_1, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,700	3.5E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener	1,230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1,700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	1.4E-03	4.3E-02	3E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	1.4E-04	4.2E-03	3E-06
MLLW	200 West Area	Resident Gardener + Sauna	1,700	7.4E-04	2.2E-02	1E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.86. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_1, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.4E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1700	1.5E-04	4.4E-03	3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	9.8E-05	3.0E-03	2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	5.2E-04	1.6E-02	9E-06

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.87. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_1, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.4E-06	7.2E-05	4E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.9E-05	5.7E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	7.0E-06	2.1E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	6.4E-05	1.9E-03	1E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1,510	4.0E-06	1.2E-04	7E-08
LLW Cat 3	200 East Area	Resident Gardener	860	1.2E-04	3.6E-03	2E-06
MLLW	200 East Area	Resident Gardener	1,510	3.9E-05	1.2E-03	7E-07
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
Melters	200 East Area	Resident Gardener	10,000	1.9E-09	5.6E-08	3E-11
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10,000	6.3E-05	1.9E-03	1E-06
LLW Cat 3	200 East Area	Resident Gardener + Sauna	820	5.6E-04	1.7E-02	1E-05
MLLW	200 East Area	Resident Gardener + Sauna	1,510	2.2E-04	6.5E-03	4E-06
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	6E-05
Melters	200 East Area	Resident Gardener + Sauna	10,000	1.6E-06	4.8E-05	3E-08

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.88. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_1, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.9E-06	8.7E-05	5E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.9E-05	5.7E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	8.5E-06	2.6E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	6.4E-05	1.9E-03	1E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1,510	4.9E-06	1.5E-04	9E-08
LLW Cat 3	200 East Area	Resident Gardener	820	6.7E-05	2.0E-03	1E-06
MLLW	200 East Area	Resident Gardener	1,510	3.6E-05	1.1E-03	6E-07
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
Melters	200 East Area	Resident Gardener	850	1.4E-06	4.2E-05	3E-08
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10,000	7.3E-05	2.2E-03	1E-06
LLW Cat 3	200 East Area	Resident Gardener + Sauna	820	3.0E-04	9.0E-03	5E-06
MLLW	200 East Area	Resident Gardener + Sauna	1,510	2.0E-04	6.0E-03	4E-06
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	6E-05
Melters	200 East Area	Resident Gardener + Sauna	10,000	1.4E-05	4.1E-04	2E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.89. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_1, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	3.0E-06	9.1E-05	5E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.3E-05	3.9E-04	2E-07
	200 East Area	Resident Gardener	1,400	1.7E-05	5.0E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	8.6E-06	2.6E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	4.6E-05	1.4E-03	8E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.9E-04	5.7E-03	3E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1,510	4.9E-06	1.5E-04	9E-08
LLW Cat 3	200 East Area	Resident Gardener	820	6.7E-05	2.0E-03	1E-06
MLLW	200 East Area	Resident Gardener	1,510	1.1E-04	3.2E-03	2E-06
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
Melters	200 East Area	Resident Gardener	10,000	4.4E-08	1.3E-06	8E-10
LLW Cat 1	200 East Area	Resident Gardener + Sauna	1,510	1.8E-05	5.4E-04	3E-07
LLW Cat 3	200 East Area	Resident Gardener + Sauna	820	3.0E-04	9.0E-03	5E-06
MLLW	200 East Area	Resident Gardener + Sauna	1,510	5.3E-04	1.6E-02	1E-05
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	6E-05
Melters	200 East Area	Resident Gardener + Sauna	10,000	7.1E-06	2.1E-04	1E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.90. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_2, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[(b)]
			Years Post-2046[(a)]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	5.8E-06	1.7E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,450	3.8E-06	1.1E-04	7E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	3.5E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.7E-05	5.0E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,450	1.8E-05	5.4E-04	3E-07
Projected New Waste (>2007)[(c)]						
LLW Cat 1	200 East Area	Resident Gardener	1,320	2.8E-05	8.4E-04	5E-07
LLW Cat 3	200 East Area	Resident Gardener	620	5.4E-04	1.6E-02	1E-06
MLLW	200 East Area	Resident Gardener	1,370	4.8E-04	1.4E-02	9E-06
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
Melters	200 East Area	Resident Gardener	980	2.4E-06	7.1E-05	4E-08
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10,000	7.5E-03	2.3E-01	1E-04
LLW Cat 3	200 East Area	Resident Gardener + Sauna	620	2.4E-03	7.3E-02	4E-05
MLLW	200 East Area	Resident Gardener + Sauna	1,370	1.1E-02	3.3E-01	2E-04
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1.0E-00	6E-04
Melters	200 East Area	Resident Gardener + Sauna	10,000	9.0E-04	2.7E-02	2E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.91. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_2, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	7.1E-06	2.1E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	4.6E-05	1.4E-03	8E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	3.6E-05	1.1E-03	7E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.7E-05	5.0E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	1.6E-04	4.7E-03	3E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1,320	3.4E-05	1.0E-03	6E-07
LLW Cat 3	200 East Area	Resident Gardener	620	5.4E-04	1.6E-02	1E-05
MLLW	200 East Area	Resident Gardener	1370	4.8E-04	1.4E-02	9E-06
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
Melters	200 East Area	Resident Gardener	980	2.4E-06	7.1E-05	4E-08
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10,000	8.9E-03	2.7E-01	2E-04
LLW Cat 3	200 East Area	Resident Gardener + Sauna	620	2.4E-03	7.3E-02	4E-05
MLLW	200 East Area	Resident Gardener + Sauna	1,370	1.1E-02	3.3E-01	2E-04
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1.0E-00	6E-04
Melters	200 East Area	Resident Gardener + Sauna	10,000	9.0E-04	2.7E-02	2E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.92. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_2, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	7.4E-06	2.2E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	3.1E-05	9.3E-04	6E-07
	200 East Area	Resident Gardener	1,230	1.1E-04	3.4E-03	2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	1.1E-04	3.4E-03	2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.7E-05	5.0E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	1.1E-04	3.3E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	6.4E-03	1.9E-01	1E-04
Projected New Waste (>2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1,320	3.6E-05	1.1E-03	6E-07
LLW Cat 3	200 East Area	Resident Gardener	620	5.5E-04	1.7E-02	1E-05
MLLW	200 East Area	Resident Gardener	1,370	5.4E-04	1.6E-02	1E-05
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
Melters	200 East Area	Resident Gardener	980	2.4E-06	7.1E-05	4E-08
LLW Cat 1	200 East Area	Resident Gardener + Sauna	1,320	1.3E-04	3.8E-03	2E-06
LLW Cat 3	200 East Area	Resident Gardener + Sauna	620	2.5E-03	7.5E-02	5E-05
MLLW	200 East Area	Resident Gardener + Sauna	10,000	2.5E-02	7.5E-01	5E-04
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1.0E-00	6E-04
Melters	200 East Area	Resident Gardener + Sauna	10,000	8.9E-04	2.7E-02	2E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.93. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_2, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,700	2.9E-05	8.6E-04	5E-07
LLW Cat 3	200 West Area	Resident Gardener	1,230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1,700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-02	2E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1,700	7.4E-04	2.2E-02	1E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.94. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_2, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,700	3.5E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener	1,230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	1.4E-03	4.3E-02	3E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1,700	7.4E-04	2.2E-02	1E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.95. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_2, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.4E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1700	1.5E-04	4.4E-03	3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	9.8E-05	3.0E-03	2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	5.2E-04	1.6E-02	9E-06

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.96. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_2, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.4E-06	7.2E-05	4E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.8E-06	5.5E-05	3E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	7.0E-06	2.1E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,710	8.7E-06	2.6E-04	2E-07
Projected New Waste (>2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1,530	7.6E-06	2.3E-04	1E-07
LLW Cat 3	200 East Area	Resident Gardener	860	1.3E-04	3.8E-03	2E-06
MLLW	200 East Area	Resident Gardener	1,590	6.4E-05	1.9E-03	1E-06
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
Melters	200 East Area	Resident Gardener	2,110	6.5E-08	2.0E-06	1E-09
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10,000	8.7E-05	2.6E-03	2E-06
LLW Cat 3	200 East Area	Resident Gardener + Sauna	860	5.7E-04	1.7E-02	1E-05
MLLW	200 East Area	Resident Gardener + Sauna	1,590	2.7E-04	8.2E-03	5E-06
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	6E-05
Melters	200 East Area	Resident Gardener + Sauna	10,000	9.7E-06	2.9E-04	2E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.97. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_2, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.9E-06	8.7E-05	5E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.9E-05	5.7E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	8.5E-06	2.6E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	6.5E-05	1.9E-03	1E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1,530	9.3E-06	2.8E-04	2E-07
LLW Cat 3	200 East Area	Resident Gardener	860	1.3E-04	3.8E-03	2E-06
MLLW	200 East Area	Resident Gardener	1,580	6.4E-05	1.9E-03	1E-06
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
Melters	200 East Area	Resident Gardener	850	1.4E-06	4.2E-05	3E-08
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10,000	1.1E-04	3.3E-03	2E-06
LLW Cat 3	200 East Area	Resident Gardener + Sauna	860	5.7E-04	1.7E-02	1E-05
MLLW	200 East Area	Resident Gardener + Sauna	1,580	2.7E-04	8.2E-03	5E-06
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	6E-05
Melters	200 East Area	Resident Gardener + Sauna	10,000	8.1E-06	2.4E-04	2E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.98. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_2, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	3.0E-06	9.1E-05	5E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.3E-05	3.9E-04	2E-07
	200 East Area	Resident Gardener	1,400	1.7E-05	5.0E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	9.8E-06	2.9E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	4.6E-05	1.4E-03	8E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.9E-04	5.7E-03	3E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1,530	9.3E-06	2.8E-04	2E-07
LLW Cat 3	200 East Area	Resident Gardener	860	1.3E-04	3.8E-03	2E-06
MLLW	200 East Area	Resident Gardener	1,580	6.9E-05	2.1E-03	1E-06
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
Melters	200 East Area	Resident Gardener	2,110	6.5E-08	2.0E-06	1E-09
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10,000	1.2E-04	3.5E-03	2E-06
LLW Cat 3	200 East Area	Resident Gardener + Sauna	860	5.7E-04	1.7E-02	1E-05
MLLW	200 East Area	Resident Gardener + Sauna	1,590	3.9E-04	1.2E-02	7E-06
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	6E-05
Melters	200 East Area	Resident Gardener + Sauna	10,000	9.7E-06	2.9E-04	2E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.99. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_3, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	5.8E-06	1.7E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,450	3.8E-06	1.1E-04	7E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,810	1.6E-05	4.8E-04	3E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.6E-05	4.9E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,450	1.8E-05	5.3E-04	3E-07
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,800	2.7E-05	8.2E-04	5E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1,130	4.8E-04	1.4E-02	9E-06
MLLW	200 ERDF Site	Resident Gardener	1,800	2.7E-04	8.0E-03	5E-06
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
Melters	200 ERDF Site	Resident Gardener	1,130	5.3E-06	1.6E-04	1E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1,800	1.0E-04	3.0E-03	2E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1,130	2.1E-03	6.4E-02	4E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,800	9.3E-04	2.8E-02	2E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1,130	2.5E-05	7.6E-04	5E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.100. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_3, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[(b)]
			Years Post-2046[(a)]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	7.0E-06	2.1E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,450	3.8E-06	1.1E-04	7E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,810	2.0E-05	5.9E-04	4E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.6E-05	4.9E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,450	1.8E-05	5.3E-04	3E-07
Projected New Waste (>2007)[(c)]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,800	3.3E-05	1.0E-03	6E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1,130	4.8E-04	1.4E-02	9E-06
MLLW	200 ERDF Site	Resident Gardener	1,800	2.7E-04	8.0E-03	5E-06
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
Melters	200 ERDF Site	Resident Gardener	1,130	5.3E-06	1.6E-04	1E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1,800	1.2E-04	3.7E-03	2E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1,130	2.1E-03	6.4E-02	4E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,800	9.3E-04	2.8E-02	2E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1,130	2.5E-05	7.6E-04	5E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.101. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_3, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	7.4E-06	2.2E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	3.1E-05	9.3E-04	6E-07
	200 East Area	Resident Gardener	10,000	1.1E-04	3.4E-03	2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	1.3E-04	4.0E-03	2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.7E-05	5.0E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	1.1E-04	3.3E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	6.4E-03	1.9E-01	1E-04
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,800	3.3E-05	1.0E-03	6E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1,130	4.8E-04	1.4E-02	9E-06
MLLW	200 ERDF Site	Resident Gardener	1,790	2.9E-04	8.7E-03	5E-06
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
Melters	200 ERDF Site	Resident Gardener	1,130	5.3E-06	1.6E-04	1E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1,800	1.3E-04	3.8E-03	2E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1,130	2.1E-03	6.4E-02	4E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,790	1.0E-03	3.1E-02	2E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1,130	2.5E-05	7.6E-04	5E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.102. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area and 200 ERDF Site 1-km Wells from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_3, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1,700	2.7E-05	8.2E-04	5E-07
LLW Cat 3	200 West Area	Resident Gardener	1,230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1,700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,700	7.6E-05	2.3E-03	1E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1,700	7.4E-04	2.2E-02	1E-05
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,740	5.0E-05	1.5E-03	9E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1,070	8.9E-04	2.7E-02	2E-05
MLLW	200 ERDF Site	Resident Gardener	1,740	4.9E-04	1.5E-02	9E-06
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1,740	1.9E-04	5.6E-03	3E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1,070	4.0E-03	1.2E-01	7E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,740	1.7E-03	5.1E-02	3E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.103. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area and 200 ERDF Site 1-km Wells from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_3, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1,700	3.3E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener	1,230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1,700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,700	9.3E-05	2.8E-03	2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1,700	7.4E-04	2.2E-02	1E-05
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,740	6.1E-05	1.8E-03	1E-06
LLW Cat 3	200 ERDF Site	Resident Gardener	1,070	8.9E-04	2.7E-02	2E-05
MLLW	200 ERDF Site	Resident Gardener	1,740	4.9E-04	1.5E-02	9E-06
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1,740	2.3E-04	6.8E-03	4E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1,070	4.0E-03	1.2E-01	7E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,740	1.7E-03	5.2E-02	3E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.104. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area and 200 ERDF Site 1-km Wells from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_3, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1,700	4.0E-05	1.2E-03	7E-07
LLW Cat 3	200 West Area	Resident Gardener	1,230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1,690	1.5E-04	4.4E-03	3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	4.8E-03	1.5E-01	9E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1,690	5.2E-04	1.6E-02	9E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,740	6.1E-05	1.8E-03	1E-06
LLW Cat 3	200 ERDF Site	Resident Gardener	1,070	8.9E-04	2.7E-02	2E-05
MLLW	200 ERDF Site	Resident Gardener	1,740	5.3E-04	1.6E-02	1E-05
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10,000	1.0E-02	3.1E-01	2E-04
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1,070	4.0E-03	1.2E-01	7E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,740	1.9E-03	5.7E-02	3E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.105. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_3, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.4E-06	7.2E-05	4E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	1,710	1.8E-06	5.5E-05	3E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	6.7E-06	2.0E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,710	8.7E-06	2.6E-04	2E-07
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	2,010	4.4E-06	1.3E-04	8E-08
LLW Cat 3	200 ERDF Site	Resident Gardener	1,420	7.8E-05	2.3E-03	1E-06
MLLW	200 ERDF Site	Resident Gardener	2,010	4.3E-05	1.3E-03	8E-07
ILAW	200 ERDF Site	Resident Gardener	10,000	1.2E-05	3.5E-04	2E-07
Melters	200 ERDF Site	Resident Gardener	1,420	8.7E-07	2.6E-05	2E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	2,010	1.6E-05	4.9E-04	3E-07
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1,420	3.5E-04	1.1E-02	6E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	2,010	1.5E-04	4.6E-03	3E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	3.0E-05	9.0E-02	5E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1,420	4.1E-06	1.2E-04	7.0E-08

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.106. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_3, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.9E-06	8.7E-05	5E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.9E-05	5.7E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	8.1E-06	2.4E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	6.5E-05	1.9E-03	1E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	2,010	5.4E-06	1.6E-04	1E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1,420	7.8E-05	2.3E-03	1E-06
MLLW	200 ERDF Site	Resident Gardener	2,010	4.4E-05	1.3E-03	8E-07
ILAW	200 ERDF Site	Resident Gardener	10,000	1.2E-05	3.5E-04	2E-07
Melters	200 ERDF Site	Resident Gardener	1,420	8.7E-07	2.6E-05	2E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	2,010	2.0E-05	6.0E-04	4E-07
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1,420	3.5E-04	1.1E-02	6E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	2,010	1.5E-04	4.6E-03	3E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	3.0E-05	9.0E-02	5E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1,420	4.1E-06	1.2E-04	7E-08

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.107. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group D_3, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	3.0E-06	9.1E-05	6E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.3E-05	3.9E-04	2E-07
	200 East Area	Resident Gardener	10,000	1.7E-05	5.0E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	1.4E-05	4.3E-04	3E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,720	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	4.6E-05	1.4E-03	8E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.9E-04	5.7E-03	3E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	2,010	5.4E-06	1.6E-04	1E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1,420	7.8E-05	2.3E-03	1E-06
MLLW	200 ERDF Site	Resident Gardener	2,010	4.7E-05	1.4E-03	9E-07
ILAW	200 ERDF Site	Resident Gardener	10,000	1.2E-05	3.5E-04	2E-07
Melters	200 ERDF Site	Resident Gardener	1,420	8.7E-07	2.6E-05	2E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10,000	4.2E-03	1.2E-01	8E-05
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1,420	3.5E-04	1.1E-02	6E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	2,010	1.7E-04	5.1E-03	3E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	3.0E-05	9.0E-02	5E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1,420	4.1E-06	1.2E-04	7E-08

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.108. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_1, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	5.8E-06	1.7E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	4.6E-05	1.4E-03	8E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	3.5E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.7E-05	5.0E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	1.6E-04	4.7E-03	3E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,320	2.8E-05	8.4E-04	5E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	620	5.4E-04	1.6E-02	1E-05
MLLW	200 ERDF Site	Resident Gardener	1,370	4.8E-04	1.4E-02	9E-06
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
Melters	200 ERDF Site	Resident Gardener	1,130	5.3E-06	1.6E-04	1E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10,000	7.6E-03	2.3E-01	1E-04
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	620	2.4E-03	7.3E-02	4E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,370	1.1E-02	3.3E-01	2E-04
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1,130	2.5E-05	7.6E-04	5E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.109. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_1, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[(b)]
			Years Post-2046[(a)]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	7.1E-06	2.1E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	4.6E-05	1.4E-03	8E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	3.6E-05	1.1E-03	7E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.7E-05	5.0E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	1.6E-04	4.7E-03	3E-06
Projected New Waste (>2007)[(c)]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,320	3.4E-05	1.0E-03	6E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	620	5.4E-04	1.6E-02	1E-05
MLLW	200 ERDF Site	Resident Gardener	1,370	5.0E-04	1.5E-02	9E-06
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
Melters	200 ERDF Site	Resident Gardener	1,130	5.3E-06	1.6E-04	1E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10,000	9.0E-03	2.7E-01	2E-04
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	620	2.5E-03	7.4E-02	4E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	10,000	3.0E-02	8.9E-01	5E-04
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1,130	2.5E-05	7.6E-04	5E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.110. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_1, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	7.3E-06	2.2E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	3.1E-05	9.3E-04	6E-07
	200 East Area	Resident Gardener	10,000	1.1E-04	3.4E-03	2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	4.3E-05	1.3E-03	8E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.7E-05	5.0E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	1.1E-04	3.3E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	6.4E-03	1.9E-01	1E-04
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,320	3.4E-05	1.0E-03	6E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	620	5.4E-04	1.6E-02	1E-05
MLLW	200 ERDF Site	Resident Gardener	1,370	5.2E-04	1.6E-02	9E-06
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
Melters	200 ERDF Site	Resident Gardener	1,130	5.3E-06	1.6E-04	1E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10,000	1.4E-02	4.3E-01	3E-04
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	620	2.4E-03	7.2E-02	4E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,370	1.2E-02	3.5E-01	2E-04
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1,130	2.5E-05	7.6E-04	5E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.111. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area and 200 ERDF Site 1-km Wells from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_1, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,700	2.9E-05	8.6E-04	5E-07
LLW Cat 3	200 West Area	Resident Gardener	1,230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1,700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	1.3E-03	3.9E-02	2E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	1.4E-04	4.2E-03	3E-06
MLLW	200 West Area	Resident Gardener + Sauna	1,700	7.4E-04	2.2E-02	1E-05
Projected New Waste (>2007)[c]						
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.112. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area and 200 ERDF Site 1-km Wells from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_1, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,700	3.5E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener	1,230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1,700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	1.4E-03	4.3E-02	3E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1,700	7.4E-04	2.2E-02	1E-05
Projected New Waste (>2007)[c]						
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.113. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area and 200 ERDF Site 1-km Wells from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_1, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	**1.9E-02**	1E-05
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,700	3.7E-05	1.1E-03	7E-07
LLW Cat 3	200 West Area	Resident Gardener	1,230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1,230	4.0E-05	1.2E-03	7E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	2.2E-03	6.6E-02	4E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1,230	2.2E-04	6.5E-03	4E-06
Projected New Waste (>2007)[c]						
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.114. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_1, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.4E-06	7.2E-05	4E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.9E-05	5.7E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	7.0E-06	2.1E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	6.4E-05	1.9E-03	1E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,530	7.7E-06	2.3E-04	1E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	860	1.3E-04	3.8E-03	2E-06
MLLW	200 ERDF Site	Resident Gardener	1,580	6.4E-05	1.9E-03	1E-06
ILAW	200 ERDF Site	Resident Gardener	10,000	1.2E-05	3.5E-04	2E-07
Melters	200 ERDF Site	Resident Gardener	1,420	8.7E-07	2.6E-05	2E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10,000	1.4E-04	4.1E-03	3E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	860	5.7E-04	1.7E-02	1E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,580	2.7E-04	8.2E-03	5E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	3.0E-05	9.0E-02	5E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1,420	4.5E-06	1.3E-04	8E-08

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.115. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_1, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.9E-06	8.7E-05	5E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.9E-05	5.7E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	8.5E-06	2.6E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	6.5E-05	1.9E-03	1E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,530	9.3E-06	2.8E-04	2E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	860	1.3E-04	3.8E-03	2E-06
MLLW	200 ERDF Site	Resident Gardener	1,580	6.4E-05	1.9E-03	1E-06
ILAW	200 ERDF Site	Resident Gardener	10,000	1.2E-05	3.5E-04	2E-07
Melters	200 ERDF Site	Resident Gardener	1,420	8.7E-07	2.6E-05	2E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10,000	1.6E-04	4.8E-03	3E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	850	5.7E-04	1.7E-02	1E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,580	2.7E-04	8.2E-03	5E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	3.0E-05	9.0E-02	5E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1,420	4.5E-06	1.3E-04	8E-08

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.116. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_1, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	3.0E-06	9.1E-05	5E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.3E-05	3.9E-04	2E-07
	200 East Area	Resident Gardener	1,400	1.7E-05	5.0E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	9.0E-06	2.7E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	4.6E-05	1.4E-03	8E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.9E-04	5.7E-03	3E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,530	9.6E-06	2.9E-04	2E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	860	1.3E-04	3.8E-03	2E-06
MLLW	200 ERDF Site	Resident Gardener	1,570	6.9E-05	2.1E-03	1E-06
ILAW	200 ERDF Site	Resident Gardener	10,000	1.2E-05	3.5E-04	2E-07
Melters	200 ERDF Site	Resident Gardener	1,420	8.7E-07	2.6E-05	2E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10,000	3.4E-04	1.0E-02	6E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	860	5.7E-04	1.7E-02	1E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,570	3.9E-04	1.2E-02	7E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	3.0E-05	9.0E-02	5E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1,420	4.5E-06	1.3E-04	8E-08

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.117. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_2, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	5.8E-06	1.7E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	4.6E-05	1.4E-03	8E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	3.5E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.7E-05	5.0E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	1.6E-04	4.7E-03	3E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,380	4.1E-05	1.2E-03	7E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	620	1.6E-04	4.8E-03	3E-06
MLLW	200 ERDF Site	Resident Gardener	1,380	3.4E-04	1.0E-02	6E-06
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
Melters	200 ERDF Site	Resident Gardener	1,130	5.3E-06	1.6E-04	1E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10,000	4.8E-03	1.4E-01	9E-05
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	620	7.7E-04	2.3E-02	1E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	10,000	7.7E-03	2.3E-01	1E-04
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1,130	2.5E-05	7.6E-04	5E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.118. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_2, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[(b)]
			Years Post-2046[(a)]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	7.1E-06	2.1E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	4.6E-05	1.4E-03	8E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	3.6E-05	1.1E-03	7E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.7E-05	5.0E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	1.6E-04	4.7E-03	3E-06
Projected New Waste (>2007)[(c)]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,380	4.9E-05	1.5E-03	9E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	620	1.6E-04	4.8E-03	3E-06
MLLW	200 ERDF Site	Resident Gardener	1,380	3.5E-04	1.0E-02	6E-06
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
Melters	200 ERDF Site	Resident Gardener	1,130	5.3E-06	1.6E-04	1E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10,000	5.5E-03	1.7E-01	1E-04
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	620	7.7E-04	2.3E-02	1E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	10,000	7.7E-03	2.3E-01	1E-04
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1,130	2.5E-05	7.6E-04	5E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.119. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_2, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	7.3E-06	2.2E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	3.1E-05	9.3E-04	6E-07
	200 East Area	Resident Gardener	1,230	1.1E-04	3.4E-03	2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	4.3E-05	1.3E-03	8E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.7E-05	5.0E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	1.1E-04	3.3E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	6.4E-03	1.9E-01	1E-04
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,380	4.2E-05	1.3E-03	8E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	620	1.7E-04	5.0E-03	3E-06
MLLW	200 ERDF Site	Resident Gardener	1,380	3.8E-04	1.2E-02	7E-06
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
Melters	200 ERDF Site	Resident Gardener	1,130	5.3E-06	1.6E-04	1E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10,000	9.4E-03	2.8E-01	2E-04
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	620	8.0E-04	2.4E-02	1E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.7E-02	5.1E-01	3E-04
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1,130	2.5E-05	7.6E-04	5E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.120. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area and 200 ERDF Site 1-km Wells from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_2, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[(b)]
			Years Post-2046[(a)]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1,700	2.9E-05	8.6E-04	5E-07
LLW Cat 3	200 West Area	Resident Gardener	1,230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1,700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	1.3E-03	3.9E-02	2E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1,700	7.4E-04	2.2E-02	1E-05
Projected New Waste (>2007)[(c)]						
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.121. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area and 200 ERDF Site 1-km Wells from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_2, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1,700	3.5E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener	680	1.3E-05	3.8E-04	2E-07
MLLW	200 West Area	Resident Gardener	1,700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	1.3E-03	4.0E-02	2E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1,700	7.4E-04	2.2E-02	1E-05
Projected New Waste (>2007)[c]						
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.122. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area and 200 ERDF Site 1-km Wells from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_2, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1,700	3.7E-05	1.1E-03	7E-07
LLW Cat 3	200 West Area	Resident Gardener	1,230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1,690	1.5E-04	4.4E-03	3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10,000	2.2E-03	6.6E-02	4E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,230	1.3E-04	3.8E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1,690	5.2E-04	1.6E-02	9E-06
Projected New Waste (>2007)[c]						
ILAW	200 ERDF Site	Resident Gardener	10,000	3.5E-04	1.0E-02	6E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	1.2E-01	3.6E-00	2E-03

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.123. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_2, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.4E-06	7.2E-05	4E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.9E-05	5.7E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	7.0E-06	2.1E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	6.4E-05	1.9E-03	1E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	10,000	5.4E-06	1.6E-04	1E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	820	6.2E-05	1.9E-03	1E-06
MLLW	200 ERDF Site	Resident Gardener	1,500	3.9E-05	1.2E-03	7E-07
ILAW	200 ERDF Site	Resident Gardener	10,000	1.2E-05	3.5E-04	2E-07
Melters	200 ERDF Site	Resident Gardener	1,420	8.7E-07	2.6E-05	2E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10,000	4.7E-03	1.4E-01	9E-05
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	820	3.1E-04	9.3E-03	6E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,500	2.2E-04	6.5E-03	4E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	3.0E-05	9.0E-02	5E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1,420	4.1E-06	1.2E-04	7E-08

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.124. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_2, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.9E-06	8.7E-05	5E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.9E-05	5.7E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	8.5E-06	2.6E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	6.5E-05	1.9E-03	1E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	10,000	5.5E-03	1.7E-01	1E-04
LLW Cat 3	200 ERDF Site	Resident Gardener	820	6.7E-05	2.0E-03	1E-06
MLLW	200 ERDF Site	Resident Gardener	1,500	3.9E-05	1.2E-03	7E-07
ILAW	200 ERDF Site	Resident Gardener	10,000	1.2E-05	3.5E-04	2E-07
Melters	200 ERDF Site	Resident Gardener	1420	8.7E-07	2.6E-05	2E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10,000	5.6E-03	1.7E-01	1E-04
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	820	3.2E-04	9.7E-03	6E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,500	2.2E-04	6.5E-03	4E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	3.0E-05	9.0E-02	5E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1,420	4.1E-06	1.2E-04	7E-08

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.125. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_2, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	3.0E-06	9.1E-05	5E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.3E-05	3.9E-04	2E-07
	200 East Area	Resident Gardener	1,400	1.7E-05	5.0E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	9.0E-06	2.7E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	4.6E-05	1.4E-03	8E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.9E-04	5.7E-03	3E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	10,000	1.1E-05	3.2E-04	2E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	820	6.2E-05	1.9E-03	1E-06
MLLW	200 ERDF Site	Resident Gardener	1,500	4.2E-05	1.3E-03	8E-07
ILAW	200 ERDF Site	Resident Gardener	10,000	1.2E-05	3.5E-04	2E-07
Melters	200 ERDF Site	Resident Gardener	1,420	8.7E-07	2.6E-05	2E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10,000	9.2E-03	2.8E-01	2E-04
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	820	3.0E-04	9.0E-03	5E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,510	3.7E-04	1.1E-02	7E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10,000	3.0E-05	9.0E-02	5E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1,420	4.1E-06	1.2E-04	7E-08

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.126. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_3, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	5.8E-06	1.7E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	4.6E-05	1.4E-03	8E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,810	1.6E-05	4.8E-04	3E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.6E-05	4.9E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	1.6E-04	4.7E-03	3E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,800	5.5E-05	1.7E-03	1E-06
LLW Cat 3	200 ERDF Site	Resident Gardener	1,130	4.5E-04	1.4E-02	8E-06
MLLW	200 ERDF Site	Resident Gardener	1,450	2.2E-05	6.6E-04	4E-07
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
Melters	200 East Area	Resident Gardener	680	7.5E-06	2.3E-04	1E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1,800	1.3E-04	3.9E-03	2E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1,130	2.1E-03	6.3E-02	4E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,450	1.0E-04	3.1E-03	2E-06
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1.0E-00	6E-04
Melters	200 East Area	Resident Gardener + Sauna	10,000	5.6E-04	1.7E-02	1E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.127. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_3, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[(b)]
			Years Post-2046[(a)]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	7.0E-06	2.1E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	4.6E-05	1.4E-03	8E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,810	2.0E-05	5.9E-04	4E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.6E-05	4.9E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	1.6E-04	4.7E-03	3E-06
Projected New Waste (>2007)[(c)]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,800	6.7E-05	2.0E-03	1E-06
LLW Cat 3	200 ERDF Site	Resident Gardener	1,130	4.5E-04	1.4E-02	8E-06
MLLW	200 ERDF Site	Resident Gardener	1,450	2.2E-05	6.6E-04	4E-07
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
Melters	200 East Area	Resident Gardener	680	7.5E-06	2.3E-04	1E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1,800	1.6E-04	4.8E-03	3E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1,130	2.1E-03	6.3E-02	4E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,450	1.0E-04	3.1E-03	2E-06
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1.0E-00	6E-04
Melters	200 East Area	Resident Gardener + Sauna	10,000	5.6E-04	1.7E-02	1E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.128. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_3, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	4E-08
	200 East Area	Resident Gardener	10,000	7.0E-05	2.1E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	2E-07
	200 East Area	Resident Gardener + Sauna	10,000	6.1E-02	1.8E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	6E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	8E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.2E-03	3.7E-03	2E-06
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.6E-04	7.8E-03	5E-06
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,810	7.3E-06	2.2E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener	1,450	3.5E-06	1.0E-04	6E-08
MLLW	200 West Area	Resident Gardener	1,810	3.1E-05	9.3E-04	6E-07
	200 East Area	Resident Gardener	10,000	1.1E-04	3.4E-03	2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,810	2.1E-05	6.2E-04	4E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,450	1.6E-05	4.9E-04	3E-07
MLLW	200 West Area	Resident Gardener + Sauna	1,810	1.1E-04	3.3E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	6.4E-03	1.9E-01	1E-04
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,800	6.8E-05	2.0E-03	1E-06
LLW Cat 3	200 ERDF Site	Resident Gardener	1,130	4.5E-04	1.4E-02	8E-06
MLLW	200 ERDF Site	Resident Gardener	1,360	4.6E-05	1.4E-03	8E-07
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
Melters	200 East Area	Resident Gardener	680	6.9E-06	2.1E-04	1E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1,800	1.6E-04	4.8E-03	3E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1,130	2.1E-03	6.3E-02	4E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,360	2.2E-04	6.5E-03	4E-06
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1.0E-00	6E-04
Melters	200 East Area	Resident Gardener + Sauna	10,000	5.6E-04	1.7E-02	1E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.129. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area and 200 ERDF Site 1-km Wells from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_3, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[(b)]
			Years Post-2046[(a)]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	2.7E-05	8.2E-04	5E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	7.6E-05	2.3E-03	1E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	7.4E-04	2.2E-02	1E-05
Projected New Waste (>2007)[(c)]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1740	5.1E-05	1.5E-03	9E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1070	8.9E-04	2.7E-02	2E-05
MLLW	200 ERDF Site	Resident Gardener	1740	4.9E-04	1.5E-02	9E-06
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1070	1.9E-04	5.6E-03	3E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1070	4.0E-03	1.2E-01	7E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1740	1.7E-03	5.1E-02	3E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.130. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area and 200 ERDF Site 1-km Wells from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_3, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.3E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1700	2.2E-04	6.5E-03	4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	9.3E-05	2.8E-03	2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	7.4E-04	2.2E-02	1E-05
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1740	6.2E-05	1.9E-03	1E-06
LLW Cat 3	200 ERDF Site	Resident Gardener	1070	8.9E-04	2.7E-02	2E-05
MLLW	200 ERDF Site	Resident Gardener	1740	4.9E-04	1.5E-02	9E-06
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1740	2.3E-04	6.8E-03	4E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1070	4.0E-03	1.2E-01	7E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1740	1.7E-03	5.2E-02	3E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.131. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area and 200 ERDF Site 1-km Wells from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_3, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[(b)]
			Years Post-2046[(a)]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9E-07
1970–1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	5E-07
1988–1995	200 West Area	Resident Gardener	250	3.6E-04	1.1E-02	7E-06
	200 West Area	Resident Gardener + Sauna	250	6.3E-04	1.9E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.4E-05	1.0E-03	6E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4E-07
MLLW	200 West Area	Resident Gardener	1690	1.5E-04	4.4E-03	3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	9.8E-05	3.0E-03	2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2E-06
MLLW	200 West Area	Resident Gardener + Sauna	1690	5.2E-04	1.6E-02	9E-06
Projected New Waste (>2007)[(c)]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1740	6.2E-05	1.9E-03	1E-06
LLW Cat 3	200 ERDF Site	Resident Gardener	1070	9.0E-04	2.7E-02	2E-05
MLLW	200 ERDF Site	Resident Gardener	1740	5.3E-04	1.6E-02	1E-05
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1740	2.3E-04	6.9E-03	4E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1070	4.0E-03	1.2E-01	7E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1740	1.9E-03	5.7E-02	3E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.132. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_3, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.4E-06	7.2E-05	4E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.9E-05	5.7E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	6.7E-06	2.0E-04	1E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	6.4E-05	1.9E-03	1E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,660	4.6E-06	1.4E-04	8E-08
LLW Cat 3	200 ERDF Site	Resident Gardener	1,520	7.7E-05	2.3E-03	1E-06
MLLW	200 ERDF Site	Resident Gardener	1,650	4.2E-05	1.3E-03	8E-07
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
Melters	200 East Area	Resident Gardener	820	7.5E-07	2.2E-05	1E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1,660	1.7E-05	5.1E-04	3E-07
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1,420	3.5E-04	1.1E-02	6E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,650	1.4E-04	4.2E-03	3E-06
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	6E-05
Melters	200 East Area	Resident Gardener + Sauna	820	3.9E-06	1.2E-04	7E-08

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.133. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_3, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	2.9E-06	8.7E-05	5E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.9E-05	5.7E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	8.1E-06	2.4E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	6.5E-05	1.9E-03	1E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,660	5.7E-06	1.7E-04	1E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1,420	7.8E-05	2.4E-03	1E-06
MLLW	200 ERDF Site	Resident Gardener	1,650	4.5E-05	1.4E-03	8E-07
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
Melters	200 East Area	Resident Gardener	940	1.2E-06	3.7E-05	2E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1,660	2.1E-05	6.3E-04	4E-07
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1,420	3.5E-04	1.1E-02	6E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,650	1.6E-04	4.7E-03	3E-06
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	6E-05
Melters	200 East Area	Resident Gardener + Sauna	940	6.2E-06	1.9E-04	1E-07

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.134. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for Alternative Group E_3, Upper Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	6E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	8E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.4E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.2E-05	6.5E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	3E-08
	200 West Area	Resident Gardener + Sauna	600	3.2E-05	9.6E-04	6E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.5E-05	4.6E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2,000	3.0E-06	9.1E-05	5E-08
LLW Cat 3	200 West Area	Resident Gardener	1,710	1.7E-06	5.1E-05	3E-08
MLLW	200 West Area	Resident Gardener	2,000	1.3E-05	3.9E-04	2E-07
	200 East Area	Resident Gardener	10,000	1.6E-05	4.7E-04	3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2,000	8.6E-06	2.6E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,710	8.0E-06	2.4E-04	1E-07
MLLW	200 West Area	Resident Gardener + Sauna	2,000	4.6E-05	1.4E-03	8E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.8E-04	5.5E-03	3E-06
Projected New Waste (>2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1,660	5.7E-06	1.7E-04	1E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1,520	7.7E-05	2.3E-03	1E-06
MLLW	200 ERDF Site	Resident Gardener	1,660	4.9E-05	1.5E-03	9E-07
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
Melters	200 East Area	Resident Gardener	820	7.5E-07	2.2E-05	1E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1,660	2.1E-05	6.3E-04	4E-07
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1,420	3.5E-04	1.1E-02	6E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	1,660	1.8E-04	5.3E-03	3E-06
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	6E-05
Melters	200 East Area	Resident Gardener + Sauna	820	3.9E-06	1.2E-04	7E-08

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.135. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for the No Action Alternative, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.1E-06	6.4E-05	3E-08
	200 East Area	Resident Gardener	10,000	8.7E-05	2.6E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.8E-06	2.6E-04	1E-07
	200 East Area	Resident Gardener + Sauna	10,000	7.5E-02	2.3E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-03	5E-06
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.3E-03	3.8E-02	2E-05
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	9E-07
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.3E-03	2E-06
	200 East Area	Resident Gardener + Sauna	110	2.6E-02	7.8E-01	4E-04
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1,220	1.9E-05	5.7E-04	3E-07
	200 East Area	Resident Gardener	1,220	1.9E-05	5.7E-04	3E-07
LLW Cat 3	200 West Area	Resident Gardener	680	8.6E-04	2.6E-02	2E-05
	200 East Area	Resident Gardener	10,000	6.6E-04	2.0E-02	1E-05
MLLW	200 West Area	Resident Gardener	1,220	1.5E-05	4.4E-04	3E-07
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1,220	6.5E-05	1.9E-03	1E-06
	200 East Area	Resident Gardener + Sauna	10,000	1.6E-03	4.7E-02	3E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	680	4.0E-03	1.2E-01	7E-05
	200 East Area	Resident Gardener + Sauna	10,000	5.7E-01	1.7E+01	1E-02
MLLW	200 West Area	Resident Gardener + Sauna	1,220	5.0E-05	1.5E-03	9E-07
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1.0E-00	6E-04

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.136. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 East Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for the No Action Alternative, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.1E-06	6.4E-05	3E-08
	200 East Area	Resident Gardener	10,000	8.7E-05	2.6E-03	1E-06
	200 West Area	Resident Gardener + Sauna	350	8.8E-06	2.6E-04	1E-07
	200 East Area	Resident Gardener + Sauna	10,000	7.5E-02	2.3E+00	1E-03
1970–1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-03	5E-06
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7E-08
	200 East Area	Resident Gardener + Sauna	10,000	1.3E-03	3.8E-02	2E-05
1988–1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	9E-07
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.3E-03	2E-06
	200 East Area	Resident Gardener + Sauna	110	2.6E-02	7.8E-01	4E-04
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	360	2.9E-05	8.8E-04	5E-07
	200 East Area	Resident Gardener	110	1.1E-05	3.2E-04	2E-07
LLW Cat 3	200 West Area	Resident Gardener	1460	1.7E-04	5.0E-03	3E-06
	200 East Area	Resident Gardener	10,000	7.1E-04	2.1E-02	1E-05
MLLW	200 West Area	Resident Gardener	1,220	1.5E-05	4.4E-04	3E-07
ILAW	200 East Area	Resident Gardener	10,000	1.0E-04	3.0E-03	2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	360	1.0E-04	3.0E-03	2E-06
	200 East Area	Resident Gardener + Sauna	10,000	1.9E-03	5.8E-02	4E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1,460	7.4E-04	2.2E-02	1E-05
	200 East Area	Resident Gardener + Sauna	10,000	5.9E-01	1.8E+01	1E-02
MLLW	200 West Area	Resident Gardener + Sauna	1,220	5.0E-05	1.5E-03	9E-07
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.5E-02	1.0E-00	6E-04

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.137. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for the No Action Alternative, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[(b)]
			Years Post-2046[(a)]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	8E-07
1970–1988	200 West Area	Resident Gardener	250	2.4E-05	7.3E-04	4E-07
	200 West Area	Resident Gardener + Sauna	250	3.6E-05	1.1E-03	5E-07
1988–1995	200 West Area	Resident Gardener	210	5.2E-04	1.6E-02	8E-06
	200 West Area	Resident Gardener + Sauna	210	9.0E-04	2.7E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	210	2.0E-04	6.0E-03	4E-06
LLW Cat 3	200 West Area	Resident Gardener	1230	1.2E-03	3.5E-02	2E-05
MLLW	200 West Area	Resident Gardener	1070	9.6E-05	2.9E-03	2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	210	6.8E-04	2.0E-02	1E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.2E-03	1.6E-01	9E-05
MLLW	200 West Area	Resident Gardener + Sauna	1070	3.3E-04	9.8E-03	6E-06

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.

Table F.138. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the 200 West Area 1-km Well from Radionuclides in the Groundwater over 10,000 Years for the No Action Alternative, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[(b)]
			Years Post-2046[(a)]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	8E-07
1970–1988	200 West Area	Resident Gardener	250	2.4E-05	7.3E-04	4E-07
	200 West Area	Resident Gardener + Sauna	250	3.6E-05	1.1E-03	5E-07
1988–1995	200 West Area	Resident Gardener	210	5.2E-04	1.6E-02	8E-06
	200 West Area	Resident Gardener + Sauna	210	9.0E-04	2.7E-02	1E-05
Newly Generated Waste (1996–2007)						
LLW Cat 1	200 West Area	Resident Gardener	210	2.4E-04	7.3E-03	4E-06
LLW Cat 3	200 West Area	Resident Gardener	1230	1.2E-03	3.5E-02	2E-05
MLLW	200 West Area	Resident Gardener	1070	9.6E-05	2.9E-03	2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	210	8.3E-04	2.5E-02	2E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.2E-03	1.6E-01	9E-05
MLLW	200 West Area	Resident Gardener + Sauna	1070	3.2E-04	9.7E-03	6E-06

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.

Table F.139. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for the No Action Alternative, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.7E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	7E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	4E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.3E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.3E-05	7.0E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2E-08
	200 West Area	Resident Gardener + Sauna	10,000	4.9E-02	1.5E+00	7E-04
	200 East Area	Resident Gardener + Sauna	10,000	6.5E-04	0.0E+00	4E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	600	8.4E-06	2.5E-04	2E-07
	200 East Area	Resident Gardener	260	7.7E-07	2.3E-05	1E-08
LLW Cat 3	200 West Area	Resident Gardener	930	1.1E-04	3.3E-03	2E-06
	200 East Area	Resident Gardener	10,000	3.1E-05	9.4E-04	6E-07
MLLW	200 West Area	Resident Gardener	1,420	5.9E-06	1.8E-04	1E-07
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	600	3.0E-05	9.0E-04	5E-07
	200 East Area	Resident Gardener + Sauna	10,000	9.5E-05	2.8E-03	2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	940	4.9E-04	1.5E-02	9E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.3E-02	6.9E-01	4E-04
MLLW	200 West Area	Resident Gardener + Sauna	1,420	2.0E-05	6.0E-04	4E-07
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	6E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.140. Potential Individual Human Health Impacts to a Hypothetical Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater over 10,000 Years for the No Action Alternative, Lower Bound Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed of Low-Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1E-08
	200 East Area	Resident Gardener	260	6.7E-06	2.0E-04	1E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5E-08
	200 East Area	Resident Gardener + Sauna	10,000	4.5E-03	1.4E-01	7E-05
1970–1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	4E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3E-08
	200 East Area	Resident Gardener + Sauna	10,000	7.3E-05	2.2E-03	1E-06
1988–1995	200 West Area	Resident Gardener	600	2.3E-05	7.0E-04	4E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2E-08
	200 West Area	Resident Gardener + Sauna	10,000	4.9E-02	1.5E+00	7E-04
	200 East Area	Resident Gardener + Sauna	10,000	2.2E-05	6.5E-04	3E-07
Newly Generated Waste (1996–2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	600	1.0E-05	3.1E-04	2E-07
	200 East Area	Resident Gardener	260	9.4E-07	2.8E-05	2E-08
LLW Cat 3	200 West Area	Resident Gardener	930	1.1E-04	3.3E-03	2E-06
	200 East Area	Resident Gardener	10,000	2.9E-05	8.6E-04	5E-07
MLLW	200 West Area	Resident Gardener	1,420	5.9E-06	1.8E-04	1E-07
ILAW	200 East Area	Resident Gardener	10,000	1.3E-05	3.8E-04	2E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	600	3.6E-05	1.1E-03	7E-07
	200 East Area	Resident Gardener + Sauna	10,000	1.1E-04	3.4E-03	2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	940	4.9E-04	1.5E-02	9E-06
	200 East Area	Resident Gardener + Sauna	10,000	2.4E-02	7.2E-01	4E-04
MLLW	200 West Area	Resident Gardener + Sauna	1,420	2.0E-05	6.0E-04	4E-07
ILAW	200 East Area	Resident Gardener + Sauna	10,000	3.3E-05	9.8E-02	6E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.
(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of a LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.
(c) Results are not reported for cases that had no inventory reported for the waste.

F.5 Potential Health Impacts of West Valley TRU Wastes Processed or Stored at Hanford

This section presents the potential impacts of receiving TRU wastes from the West Valley Demonstration Project in New York State for processing and/or storage at Hanford before shipment to the Waste Isolation Pilot Project (WIPP) in New Mexico. DOE does not prefer to ship TRU wastes from West Valley to Hanford for processing and/or storage before shipment to WIPP (see Volume I, Section 1.5.2 and Volume II, Appendix C, Section C.1 for further discussion of West Valley waste). Nonetheless, potential health impacts to workers and to the public from atmospheric releases were estimated in the event that, at a later date, DOE needs to ship West Valley TRU wastes to be processed and certified at Hanford. The West Valley TRU wastes were estimated to consist of about 1130 cubic meters of contact-handled (CH) TRU waste and 250 cubic meters of remote-handled (RH) TRU waste (DOE 2003). The concentration of radionuclides in the West Valley TRU waste is indicated in Table F.141.

For purposes of this analysis, it was assumed that CH TRU waste would be processed through the WRAP facility and the RH TRU waste would be processed through the T-Plant complex. The wastes were assumed to be shipped to Hanford between 2004 and 2008. The routine impacts of processing the West Valley TRU wastes are presented in the following sections. Potential accident risks associated with managing West Valley TRU wastes at Hanford would be small and would not differ from the estimates presented in Volume I, Section 5.11.

Table F.141. West Valley TRU Wastes Radionuclide Concentrations (after DOE [2003], Appendix D, Table D.13)

Radionuclide	CH TRU (Ci/m3)	RH TRU (Ci/m3)
Co-60	2.1E-04	0
Sr-90	3.3E-03	1.8E+01
Cs-137	3.3E-03	1.9E+01
Th-228	0	5.5E-03
U-232	0	5.5E-03
Pu-238	3.1E+01[(a)]	1.2E+00
Pu-239	5.1E+00	3.4E-01
Pu-240	1.4E+00	2.5E-01
Pu-241	6.5E+01	7.4E+00
Pu-242	2.3E-04	0
Am-241	1.2E+00	4.1E-01
Am-242	0	2.9E-03
Am-242m	0	2.9E-03
Am-243	0	1.8E-02
Cm-244	0	3.7E-02

(a) The 330 Pu-238 value from DOE (2003) was reduced in the HSW EIS to agree with plutonium isotopic ratios found elsewhere in DOE (2003).

F.5.1 Worker Health Impacts

The estimate of occupational exposure from the West Valley TRU wastes was based on the relative increase in volume for the WRAP and T-Plant Complex over that calculated for the Upper Bound waste volume described earlier. Table F.142 summarizes these potential occupational impacts from the West Valley TRU wastes if shipped to Hanford for processing before shipment to WIPP. The workforce impacts from processing West Valley TRU wastes at Hanford are small compared to the range of total workforce impacts of 765 to 873 person-rem for the HSW EIS alternative groups (Volume I, Section 5.11.1)

Table F.142. Occupational Exposure from Processing West Valley TRU Wastes at Hanford

Waste Type	Facility	Workforce Dose, person-rem	Workforce LCF
CH TRU	WRAP	0.52	0 (3E-4)
RH TRU	T-Plant Complex	0.63	0 (4E-4)

F.5.2 Routine Atmospheric Release – Public Health Impacts

The specific health impacts to the non-involved worker and general public from the West Valley TRU wastes are shown in Table F.143, with contributions from these wastes only. As can be seen in Table F.143, radiological impacts on workers and the public in terms of dose would be small, and there would be no associated fatalities. These impacts, when combined with those for the HSW EIS alternative groups, would still result in small radiological impacts. For example, the maximum total population probability of an LCF is just 2E-4 (Alternative Group B, Upper Bound waste volume). The impacts from processing West Valley TRU wastes could increase that total by about 1 percent and would not change the conclusions presented for any of the HSW EIS alternative groups.

Table F.143. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Radionuclides—West Valley TRU Wastes Only

Exposed Group	Exposure Scenario[a]	Facility	Lifetime Dose[b] (mrem)	Probability of LCF[c]	Maximum Annual Dose	
					Year	mrem
Worker Onsite (non-involved)	Industrial	WRAP	1.1E-03	7E-10	2004	2.7E-04
		Modified T Plant Complex	1.7E-05	1E-11	2006	4.6E-06
MEI Offsite	Resident Gardener	WRAP	3.6E-05	2E-11	2004	9.1E-06
		Modified T Plant Complex	1.4E-06	8E-13	2004	3.2E-07
		Total	3.8E-05	2E-11	2004	9.5E-06
			(person-rem)	**Number of LCFs[d]**	**Year**	**(person-rem)**
Population[e]	Population within 80 km (50 mi)	WRAP	4.3E-03	0 (3E-6)	2004	8.3E-04
		Modified T Plant Complex	1.6E-04	0 (1E-7)	2004	2.9E-05
		Total	4.4E-03	0 (3E-6)	2004	8.6E-04

(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Volume II, Appendix F.
(b) The lifetime dose is the radiation dose received from intake during the exposure period and up to 50 years after exposure due to radionuclides deposited in the body during the exposure period.
(c) LCF = latent cancer fatality.
(d) The value in parentheses is the calculated value based on the population dose and the appropriate health effects conversion factor. The actual number of LCFs must be a whole number (deaths).
(e) The population lifetime impacts are based on exposure for the same exposure pathways impacting the resident gardener MEI.

F.6 References

40 CFR 61. "National Emission Standards for Hazardous Air Pollutants." Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_02/40cfr61_02.html

40 CFR 191. "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes." Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_01/40cfr191_01.html

Anderson, J. D. and D. L. Hagel. 1996. *Summary of Radioactive Solid Waste Received in the 200 Areas During Calendar Year 1995*. WHC-EP-0125-8, Westinghouse Hanford Company, Richland, Washington.

Barcot, R. A. 1999. *Solid Waste Integrated Forecast Technical (SWIFT) Report*. HNF-EP-0918, Rev. 5, Fluor Hanford, Inc., Richland, Washington.

Barcot, R. A. 2002. *Solid Waste Integrated Forecast Technical (SWIFT) Report*. HNF-EP-0918, Rev. 9, Fluor Hanford, Inc., Richland, Washington.

Buck, J. W., G. Whelan, J. G. Droppo, Jr., D. L. Strenge, K. J. Castleton, J. P. McDonald, C. Sato, and G. P. Streile. 1995. *Multimedia Environmental Pollutant Assessment System (MEPAS) Application Guidance: Guidelines for Evaluating MEPAS input Parameters for Version 3.1*. PNL-10395, Pacific Northwest National Laboratory, Richland, Washington.

Buck, J. W., D. L. Strenge, B. L. Hoopes, J. P. McDonald, K. J. Castleton, M. A. Pelton, and G. M. Gelston. 1997. *Description of Multimedia Environmental Pollutant Assessment System (MEPAS). Version 3.2. Modification for the Nuclear Regulatory Commission*. NUREG/CR-6566 (PNNL-11676), Nuclear Regulatory Commission Washington D.C.

Bushore, R. P. 2001. *Interim Safety Basis for Solid Waste Facilities (T Plant)*. HNF-SD-WM-ISB-006, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

Census. 2002. *Census 2000 Summary File 3 – Washington*. U.S. Census Bureau, Washington D.C. Online at: http://www2.census.gov/census_2000/datasets/Summary_File_3/Washington

Census. 2003a. *Glossary - Definition and Explanations–decennial census terms*. U.S. Census Bureau, Washington D.C. Online at: http://www.census.gov/main/www/glossary.html (Last revised February 11, 2003. Accessed September 5, 2003).

Census. 2003b. *Poverty 1999. Census 2000 Brief. C2KBR-19. Issued May 2003*. U.S. Census Bureau, Washington D.C. Online at: http://www.census.gov/prod/2003pubs/c2kbr-19.pdf (Accessed September 8, 2003)

Cheng, J. J., J. G. Droppo, E. R. Faillace, E. Granapragasam, R. Johns, G. Laniak, C. Lew, W. Mills, L. Owens, D. L. Strenge, J. F. Sutherland, G. Whelan, and C. Yu. 1995. *Benchmarking Analysis of Three Multimedia Models: RESRAD, MMSOILS, and MEPAS*. DOE/ORO-2033, U.S. Department of Energy, Washington, D.C. Online at: https://www.osti.gov/dublincore/doeecd/servlets/purl/192408-9sPZLn/webviewable/192408.pdf

Connor, J. J. and H. T. Shacklette. 1975. "Background Geochemistry of Some Rocks, Soils, Plants, and Vegetables in the Conterminous United States." Statistical Studies in Field Geochemistry. Geological Survey Professional Paper 574-F. U.S. Department of the Interior, Washington, D.C.

Craig, D. K. 2002. *ERPGs and TEELs for Chemicals of Concern, Rev. 19*. WSMS-SAE-02-0171, Westinghouse Safety Management Systems, Aiken, South Carolina. Online at: http://tis.eh.doe.gov/web/chem_safety/teel.html

DOE. 2001. *DOE Computerized Accident/Incident Reporting System (CAIRS)*. Online at http://tis.eh.doe.gov/cairs (data downloaded August 2001).

DOE. 2002. DOE Subcommittee on Consequence Assessment & Protective Actions (SCAPA). Brookhaven National Laboratory, Upton, New York. Online at: http://www.bnl.gov/scapa

DOE. 2003. *West Valley Demonstration Project Waste Management Environmental Impact Statement*. DOE/EIS-0337F, U.S. Department of Energy, West Valley Area Office, West Valley, New York. Online at: http://tis.eh.doe.gov/nepa/eis/eis0337/index.html

DOE-RL. 1993a. *Non-Radioactive Air Emissions Notice of Construction for the Waste Receiving and Processing Facility*. DOE/RL-93-18, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL. 1993b. *Radioactive Air Emissions Notice of Construction for the Waste Receiving and Processing Facility*. DOE/RL-93-15, U.S. Department of Energy, Richland Operations Office, Richland Operations Office, Richland, Washington.

DOE-RL. 1995. *Hanford Site Risk Assessment Methodology*. DOE/RL-91-45, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL. 1998. *Screening Assessment and Requirements for a Comprehensive Assessment: Columbia River Comprehensive Impact Assessment*. DOE/RL-96-16, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL. 2001a. *Radioactive Air Emissions Notice of Construction Application for the Waste Receiving and Processing Facility*. DOE/RL-2000-34, Rev 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL. 2001b. *Radioactive Air Emissions Notice of Construction for the T Plant Complex Fuel Removal Project*. DOE/RL-2000-64, Rev 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Online at: http://198.232.211.23/pdwdocs/fsd0001/osti/2001/I0000430.pdf

Droppo, J. G., Jr. and J. W. Buck. 1996. Supplemental Mathematical Formulations. Atmospheric pathway: *The Multimedia Environmental Pollutant Assessment System (MEPAS)*. PNNL-11080, Pacific Northwest National Laboratory, Richland, Washington.

Eckerman, K. F., A. B. Wolbarst, and A. C. B. Richardson. 1988. *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion. Federal Guidance Report No. 11*. EPA-520/1-88-020, U.S. Environmental Protection Agency, Washington, D.C.

Eckerman, K. F. and J. C. Ryman. 1993. *External Exposure to Radionuclides in Air, Water, and Soil, Federal Guidance Report No. 12*. EPA 402-R-93-081, U.S. Environmental Protection Agency, Washington, D.C.

Eckerman, K. F., R. W. Leggett, C. B. Nelson, J. S. Puskin, and A. C. B. Richardson. 1999. *Cancer Risk Coefficients for Environmental Exposure to Radionuclides*. Federal Guidance Report No. 13. EPA 402-R-99-001. Office of Radiation and Indoor Air, U.S. Environmental Protection Agency, Washington, D.C. Online at: http://riskassessment.ornl.gov/keydocs/fgr13.pdf

Ecology, EPA, and DOE. 1989. *Hanford Federal Facility Agreement and Consent Order*. 89-10 (As Amended). Washington State Department of Ecology, U.S. Environmental Protection Agency, U.S. Department of Energy, Richland, Washington. Online at: http://www.hanford.gov/tpa/tpahome.htm

EPA. 1989. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A) Interim Final*. EPA/540/1-89/002, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C. Online at: http://www.epa.gov/superfund/programs/risk/ragsa/index.htm

EPA. 1992. *Dermal Exposure Assessment: Principles and Applications*. EPA/600/8-91/011B, U.S. Environmental Protection Agency, Washington, D.C. Online at: http://www.epa.gov/NCEA/pdfs/dermalexp.pdf

EPA. 1995. *User's Guide for the Industrial Source Complex (ICS3) Dispersion Models. Volumes 1 & 2. User Instructions*. EPA-454/B-95-003a, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

FH. 2004. *Hanford Site Solid Waste Management, Environmental Impact Statement Technical Information Document*. HNF-4755, Rev. 2, Fluor Hanford, Richland, Washington.

Hagel, D. L. 1999. *Summary of Radioactive Solid Waste Received in the 200 Areas During Calendar Year 1998*. HNF-EP-0125-11, Fluor Hanford, Richland, Washington.

Harris, S. G. and B. L. Harper. 1997. "A Native American Exposure Scenario." *Risk Analysis* 17:6,789-795.

Hoitink, D. J. and K. W. Burk. 1997. *Climatological Data Summary 1996, with Historical Data*. PNNL-11471, Pacific Northwest National Laboratory, Richland, Washington. Online at: https://www.osti.gov/dublincore/doeecd/servlets/purl/656504-LW5BaO/webviewable/656504.pdf

ICRP. 1979. "Limits for Intakes of Radionuclides by Workers." (ICRP Publication 30, Part 1). *Annals of the ICRP*, Vol. 2, No. 3/4. International Commission on Radiological Protection, Pergamon Press, New York.

ICRP. 1980. "Limits for Intakes of Radionuclides by Workers." (ICRP Publication 30, Part 2). *Annals of the ICRP,* Vol. 4, No. 3/4. International Commission on Radiological Protection, Pergamon Press, New York.

ICRP. 1981. "Limits for Intakes of Radionuclides by Workers." (ICRP Publication 30, Supplement A to Part 3). *Annals of the ICRP*, Vol. 7, No. 1-3. International Commission on Radiological Protection, Pergamon Press, New York.

ICRP. 1988. "Limits for Intakes of Radionuclides by Workers: an addendum." (ICRP Publication 30, Part 4). *Annals of the ICRP,* Vol. 19, No. 4. International Commission on Radiological Protection, Pergamon Press, New York.

ICRP. 1991. "1990 Recommendations of the International Commission on Radiological Protection." *ICRP Publication 60. Annals of the ICRP*, Vol. 21, No. 1-3. International Commission on Radiological Protection. Pergamon Press, New York.

Kennedy, W. E., Jr. and D. L. Strenge. 1992. *Residual Radioactive Contamination from Decommissioning*. NUREG/CR-5512, Vol. 1. U.S. Nuclear Regulatory Commission, Washington, D.C.

Kincaid, C. T., J. W. Shade, G. A. Whyatt, M. G. Piepho, K. Rhoads, J. A. Voogd, J. H. Westsik, Jr., M. D. Freshley, K. A. Blanchard, and G. B. Lauzon. 1995. *Performance Assessment of Grouted Double-Shell Tank Waste Disposal at Hanford*. WHC-SD-WM-EE-004, Rev. 1, Volumes 1 & 2, Westinghouse Hanford Company, Richland, Washington.

Meyer, M. F. 1998. *Interim Safety Analysis for Solid Waste Facilities (T Plant)*. HNF-SD-WM-ISB-006, Rev. 1, Waste Management Federal Services of Hanford, Inc., Richland, Washington.

Mills, W. B., J. J. Cheng, J. G. Droppo, Jr., E. R. Faillace, E. K. Gnanapragasam, R. A. Johns, G. F. Laniak, C. S. Lew, D. L. Strenge, J. F. Sutherland, G. Whelan, and C. Yu. 1997. "Multimedia Benchmarking Analysis for Three Risk Assessment Models: RESRAD, MMSOILS, and MEPAS." *Risk Analysis,* 17(2):187-202.

Napier, B. A., R. A. Peloquin, W. E. Kennedy, Jr., and S. M. Neuder. 1984. *Intruder Dose Pathway Analysis for the Onsite Disposal of Radioactive Wastes: The ONSITE/MAXI1 Computer Program*. NUREG/CR-3620, U.S. Nuclear Regulatory Commission, Washington, D.C.

NCRP. 1993. *Limitation of Exposure to Ionizing Radiation: Recommendations of the National Council on Radiation Protection and Measurements*. NCRP Report No. 116, National Council on Radiation Protection and Measurements, Bethesda, Maryland.

NCRP. 1997. *Uncertainties in Fatal Cancer Risk Estimates Used in Radiation Protection: Recommendations of the National Council on Radiation Protection and Measurements*. NCRP Report No. 126, National Council on Radiation Protection and Measurements, Bethesda, Maryland.

Rokkan, D. J., K. Rhoads, and L. H. Staven. 2001. *Radionuclide Air Emissions Report for the Hanford Site, Calendar Year 2000*. DOE/RL-2001-32, Rev. 0, U.S. Department of Energy, Richland, Washington. Online at: http://198.232.211.23/pdwdocs/fsd0001/osti/2001/I0000483.pdf

Streile, G. P., K. D. Shields, J. L. Stroh, L. M. Bagaasen, G. Whelan, J. P. McDonald, J. G. Droppo, and J. W. Buck. 1996. *The Multimedia Environmental Pollutant Assessment System (MEPAS): Source-Term Release Formulations*. PNNL-11248, Pacific Northwest National Laboratory, Richland, Washington. Online at: http://www.osti.gov/dublincore/ecd/servlets/purl/435301-C3hEnq/webviewable/435301.pdf

Strenge, D. L. 1997. "A General Algorithm for Radioactive Decay with Branching and Loss from a Medium." *Health Physics,* 73(6): 953-957.

Strenge, D. L. and P. J. Chamberlain. 1995. *Multimedia Environmental Pollutant Assessment System (MEPAS): Exposure Pathway and Human Health Impact Assessment Models*. PNL-10523, Pacific Northwest Laboratory, Richland, Washington.

Strenge, D. L. and S. R. Peterson. 1989. *Chemical Data Bases for the Multimedia Environmental Pollutant Assessment System (MEPAS): Version 1*. PNL-7145, Pacific Northwest Laboratory, Richland, Washington.

Tomaszewski, T. A. 2001. *WRAP Final Safety Analysis Report*. HNF-SD-W026-SAR-002, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

UNSCEAR. 1988. *Sources, Effects, and Risks of Ionizing Radiation, United Nations Scientific Committee on the Effects of Atomic Radiation. Report to the General Assembly with Annexes*. United Nations Publications, New York.

Vail, T. S. 2001a. *Central Waste Complex Interim Safety Basis*. HNF-SD-WM-ISB-007, Rev. 1-E, Fluor Hanford, Inc., Richland, Washington.

Vail, T. S. 2001b. *Solid Waste Burial Grounds Interim Safety Basis*. HNF-SD-WM-ISM-002, Rev. 3-B, Fluor Hanford, Inc., Richland, Washington.

Vail, T. S. 2001c. *Solid Waste Burial Grounds Interim Safety Analysis*. HNF-SD-WM-SARR-028, Rev. 3-C, Fluor Hanford, Inc., Richland, Washington.

WAC 173-340. "Model Toxics Control Act – Cleanup." Washington Administrative Code, Olympia, Washington. Online at: http://www.leg.wa.gov/wac/index.cfm?fuseaction=Section&Section=173-340

WAC 246-247. "Radiation Protection – Air Emissions." Washington Administrative Code, Olympia, Washington. Online at: http://www.leg.wa.gov/wac/index.cfm?fuseaction=chapterdigest&chapter=246-247

WHC. 1991. *Hazard Classification and Preliminary Safety Evaluation for Waste Receiving and Processing (WRAP) Module 2 Project W100*. WHC-SD-W100-PSE-001, Rev 0, October 1991, Westinghouse Hanford Company, Richland, Washington.

WHC. 1995. *Performance Assessment for the Disposal of Low-Level Waste in the 200 West Area Burial Grounds*. WHC-EP-0645, Westinghouse Hanford Company, Richland, Washington.

WHC. 1998. *Performance Assessment for the Disposal of Low-Level Waste in the 200 East Area Burial Grounds*. WHC-SD-WM-TI-730, Westinghouse Hanford Company, Richland, Washington.

Whelan, G., K. J. Castleton, J. W. Buck, G. M. Gelston, B. L. Hoopes, M. A. Pelton, D. L. Strenge, and R. N. Kickert. 1997. *Concepts of a Framework for Risk Analysis in Multimedia Environmental Systems (FRAMES)*. PNNL-11748, Pacific Northwest National Laboratory, Richland, Washington.