the winter months of the second year following the fire of 1984 (Johansen et al. 1993). The recovery time required by soil microbiota following construction is no exception.

Although microbiotic crusts may tolerate shallow burial, deep burial such as would result from construction described in the HSW EIS will kill crusts (Shields et al. 1957). Re-colonization of Area C and the areas identified for the additional CWC facilities and the New Waste Processing Facility would undoubtedly require several years following construction, the speed of which may largely depend on the availability of nearby sources (Belnap 1993). Consequently, a temporary loss of benefits derived from microbiotic crusts would ensue.

I.3 Impacts to Columbia River Aquatic and Riparian Resources Resulting from Future Contaminant Releases

Potential adverse impacts posed by future releases of contaminants to aquatic and terrestrial species known to occur in the Columbia River and its riparian corridor were analyzed in an ecological risk assessment framework. The risk assessments conducted for this analysis of impacts generally follow U.S. Environmental Protection Agency (EPA) guidance for conducting such assessments (EPA 1992, 1998) and the corresponding Hanford Site risk assessment methodology (DOE-RL 1995b).

These risk assessments emphasize the analysis and risk characterization phases of the EPA risk assessment paradigm, in order to characterize the relative magnitude of potential impacts between the alternative groups. The problem formulation phase of the EPA risk assessment framework is not well represented in these risk assessments because the inventory, location, release, and migration of contaminants of interest to the Columbia River are covered elsewhere in the EIS.

The risk of future adverse effects was analyzed using the Ecological Contaminant Exposure Model (ECEM) (Eslinger et al. 2002) developed for the Columbia River Comprehensive Impact Assessment (DOE-RL 1998).

I.3.1 Assumptions Regarding Contaminants

Contaminant concentrations used in the risk assessment consisted of predicted peak concentrations of key radionuclides at a hypothetical well along the Columbia River during any given year within 10,000 years of 2046 (see Appendix G). These well concentrations were assumed to apply also to pore water (water in the interstitial spaces of the substrate that forms the bottom of the Columbia River, such as groundwater in springs between rocks). Predicted peak concentrations of key radionuclides in the river also were used. These were derived from maximum amounts of radionuclides entering the river within the affected area in any 10-year period within 10,000 years of 2046 (see Appendix G). River concentrations were derived by diluting the maximum amount of a radionuclide by the average volume of river flow within a generic 10-year period (based on an average annual flow rate of 3300 m^3/sec).

The 10,000 years were divided into two time periods, early and late. An individual risk assessment was performed for each time period within each alternative group. The early time period applies to the

radionuclides with a distribution or partition coefficient (K_d) of zero—technetium-99 and iodine-129—whose arrival times at the river well and river are less than 2500 years. The late time period applies to the radionuclides with a K_d greater than zero—carbon-14 and the uranium isotopes—whose arrival times are from 2500 to 10,000 years.

Concentrations of individual radionuclides were summed over the 200 West Area and 200 East Area source areas and over all waste categories within each time period and alternative group. Concentrations of technetium-99 and iodine-129 in grouted Category 3 LLW and ungrouted Category 1 LLW within each alternative group were combined if their arrival times were within the same time period.

Concentrations of radionuclides often were separated temporally within a given time period and alternative group. For example, arrival times of the same radionuclide at a given location—that is, at the well or river—varied depending on the source area and waste stream (see Appendix G). Further, the same radionuclide from the same source area and waste stream arrived later at the river than at the well (see Appendix G), generally on the order of decades.

Concentrations of radionuclides also were separated spatially within a given time period and alternative group. For example, well concentrations represented a single location whose position varied depending on the radionuclide, source area, or waste stream. In contrast, river concentrations represented the entire length of the river in the affected area downstream from the point of entry.

The assumptions just described in the five foregoing paragraphs underly the radionuclide concentrations used in the risk assessments. These assumptions render the assessments extremely conservative by assuming simultaneous exposure to maximum contaminant concentrations that, based on groundwater modeling (see Appendix G), do not always occur concurrently in time and space. Thus, the risk assessments estimate maximum possible exposure and risk for receptors.

I.3.2 Assumptions Regarding Partitioning of Contaminants to Abiotic Media

Two exposure scenarios were evaluated—Hanford contribution (hereafter expressed as Hanford) and Hanford plus background. The assumptions used to derive the abiotic media concentrations used in these two scenarios are summarized in Table I.5.

In both scenarios, radionuclide concentrations in the well are released from groundwater into shoreline seeps, and the background groundwater contribution is assumed to be zero (Table I.5). Because seeps are located below the high water mark and river water levels fluctuate substantially, seep concentrations are based on mixing groundwater and surface water at a ratio of approximately 0.48:0.52, respectively (Table I.5) (Bryce et al. 2002). Background surface water concentrations for iodine-129, technetium-99, and uranium-234, -235, -236, and -238 were obtained from Kincaid et al. (2000). Background surface water concentrations for carbon-14 were obtained from DOE (1998). Soil concentrations were calculated by multiplying seep concentrations by partition coefficients (K_d). Background pore water concentrations were assumed equal only to background surface water concentrations (Table I.5) because the background groundwater contribution is assumed to be zero.

Table I.5. Summary of Assumptions Used to Derive Abiotic Media Concentrations Used in Hanford and Hanford Plus Background Exposure Scenarios

Exposure Scenario	
Hanford Contribution	**Hanford Contribution Plus Background**
Groundwater = peak concentrations of key radionuclides in well water (Appendix G)	Groundwater = peak concentrations of key radionuclides in well water (Appendix G)
Seep water = mix of 48% groundwater and 52% surface water	Seep water = mix of 48% groundwater and 52% surface water (including background surface water concentrations)
Soil = Seep water × K_d	Soil = Seep water × K_d
Pore water = groundwater	Pore water = groundwater + background surface water concentrations
Sediment = pore water × K_d	Sediment = pore water × K_d
Surface water = maximum concentrations entering the river (Appendix G) diluted by average river flow volume within a generic 10-year period	Surface water = maximum concentrations entering the river (Appendix G) + background surface water concentrations diluted by average river flow volume within a generic 10-year period

Sediment concentrations were calculated by multiplying pore water concentrations by partition coefficients (K_d). Best estimates were used for soil and sediment K_d values. These were obtained from Table G.1 in Appendix G.

Hanford and Hanford plus background radionuclide and total uranium concentrations in the various abiotic media, as calculated, are presented for each time period and alternative group in Tables I.6 and I.7.

I.3.3 Ecological Contaminant Exposure Model

The Ecological Contaminant Exposure Model, or ECEM, consists of two parts, terrestrial and aquatic (Eslinger et al. 2002). The terrestrial portion estimates wildlife exposures to contaminants in air through inhalation, in water through dermal exposure and ingestion, in soil through dermal exposure and ingestion, and in foods. The aquatic portion estimates exposures to contaminants in surface water and pore water via gill or respiratory uptake, in sediment via dermal exposure and ingestion, and in foods.

The ECEM was developed earlier for other more complex risk assessments of Columbia River biota (DOE-RL 1998; Bryce et al. 2002) and thus is based on a food web architecture that is specific to the Hanford Site. The ECEM estimates exposures for 57 terrestrial and aquatic animal and plant receptors (Table I.8). One of the ECEM's aquatic receptors, the generic salmon, serves as a surrogate for the steelhead (*Oncorhynchus mykiss* [federal endangered species, Washington State candidate species]) because its conceptual exposure to contaminated abiotic media and prey are essentially the same.

Table I.6. Hanford and Hanford Plus Background Radionuclide Concentrations in Well Water, Pore Water, Sediment, Soil, and River Water for Each Time Period and Alternative Group. Values were calculated based on the assumptions presented in Sections I.3.1 and I.3.2.

Constituent	EIS Alternative Group and Waste Volume	Time Period (y)	Hanford Concentrations					Hanford plus Background Concentrations				
			Well Water (pCi/L)	Pore Water (pCi/L)	Sediment (pCi/kg)	Soil (pCi/kg)	River Water (pCi/L)	Well Water (pCi/L)	Pore Water (pCi/L)	Sediment (pCi/kg)	Soil (pCi/kg)	River Water (pCi/L)
C-14	A -- Hanford Only	10,000	0.265890795	0.265890795	0	0	1.69752E-06	0.265890809	1.46589	0	0	1.2
C-14	A -- Lower Bound	10,000	0.265890923	0.265890923	0	0	1.69752E-06	0.26589092	1.46589	0	0	1.2
C-14	A -- Upper Bound	10,000	0.267090409	0.267090409	0	0	1.69828E-06	0.267090405	1.46709	0	0	1.2
C-14	B -- Hanford Only	10,000	0.266099826	0.266099826	0	0	3.33669E-06	0.266099837	1.4661	0	0	1.2
C-14	B -- Lower Bound	10,000	0.266119354	0.266119354	0	0	9.15302E-06	0.266119349	1.46612	0	0	1.20001
C-14	B -- Upper Bound	10,000	0.267447286	0.267447286	0	0	7.90261E-05	0.267447287	1.46745	0	0	1.20008
C-14	C -- Hanford Only	10,000	0.265890795	0.265890795	0	0	1.69752E-06	0.265890809	1.46589	0	0	1.2
C-14	C -- Lower Bound	10,000	0.265890923	0.265890923	0	0	1.69752E-06	0.26589092	1.46589	0	0	1.2
C-14	C -- Upper Bound	10,000	0.266063574	0.266063574	0	0	1.69828E-06	0.266063588	1.46606	0	0	1.2
C-14	D1 -- Hanford Only	10,000	0.266233177	0.266233177	0	0	1.70191E-06	0.266233174	1.46623	0	0	1.2
C-14	D1 -- Lower Bound	10,000	0.266298743	0.266298743	0	0	1.70268E-06	0.266298733	1.4663	0	0	1.2
C-14	D1 -- Upper Bound	10,000	0.269832422	0.269832422	0	0	1.63511E-05	0.269832434	1.46983	0	0	1.20002
C-14	D2 -- Hanford Only	10,000	0.266562402	0.266562402	0	0	1.69936E-06	0.266562411	1.46656	0	0	1.2
C-14	D2 -- Lower Bound	10,000	0.266705953	0.266705953	0	0	1.69976E-06	0.266705963	1.46671	0	0	1.2
C-14	D2 -- Upper Bound	10,000	0.274228089	0.274228089	0	0	1.72075E-06	0.274228085	1.47423	0	0	1.2
C-14	D3 -- Hanford Only	10,000	0.265827158	0.265827158	0	0	1.69716E-06	0.265827166	1.46583	0	0	1.2
C-14	D3 -- Lower Bound	10,000	0.265827158	0.265827158	0	0	1.69716E-06	0.265827166	1.46583	0	0	1.2
C-14	D3 -- Upper Bound	10,000	0.265979635	0.265979635	0	0	1.69781E-06	0.265979627	1.46598	0	0	1.2
C-14	E1 -- Hanford Only	10,000	0.266562402	0.266562402	0	0	1.69936E-06	0.266562411	1.46656	0	0	1.2
C-14	E1 -- Lower Bound	10,000	0.266705953	0.266705953	0	0	1.69976E-06	0.266705963	1.46671	0	0	1.2
C-14	E1 -- Upper Bound	10,000	0.274228089	0.274228089	0	0	1.72075E-06	0.274228085	1.47423	0	0	1.2
C-14	E2 -- Hanford Only	10,000	0.266233177	0.266233177	0	0	1.70191E-06	0.266233174	1.46623	0	0	1.2
C-14	E2 -- Lower Bound	10,000	0.266298743	0.266298743	0	0	1.70268E-06	0.266298733	1.4663	0	0	1.2
C-14	E2 -- Upper Bound	10,000	0.269832422	0.269832422	0	0	1.74291E-06	0.269832434	1.46983	0	0	1.2
C-14	E3 -- Hanford Only	10,000	0.26584615	0.26584615	0	0	1.69728E-06	0.265846151	1.46585	0	0	1.2
C-14	E3 -- Lower Bound	10,000	0.265849217	0.265849217	0	0	1.69729E-06	0.265849232	1.46585	0	0	1.2
C-14	E3 -- Upper Bound	10,000	0.266159853	0.266159853	0	0	1.69891E-06	0.266159844	1.46616	0	0	1.2
C-14	No Action -- Hanford Only	10,000	0.162687826	0.162687826	0	0	2.50048E-06	0.162687835	1.36269	0	0	1.2
C-14	No Action -- Lower Bound	10,000	0.162784028	0.162784028	0	0	2.50107E-06	0.162784036	1.36278	0	0	1.2
I-129	A -- Hanford Only	2,500	0.11974949	0.11974949	0.078838274	0.038081593	1.07402E-06	0.119749488	0.11975	0.0788383	0.0380816	1.09543E-06
I-129	A -- Lower Bound	2,500	0.120316062	0.120316062	0.079211283	0.038261793	1.07992E-06	0.120316063	0.120316	0.0792113	0.0382618	1.10133E-06
I-129	A -- Upper Bound	2,500	0.130782178	0.130782178	0.086101755	0.041590093	1.12433E-06	0.130782177	0.130782	0.0861018	0.0415901	1.14574E-06
I-129	B -- Hanford Only	2,500	0.119800368	0.119800368	0.07887177	0.038097793	1.05129E-06	0.119800378	0.1198	0.0788718	0.0380978	1.07269E-06
I-129	B -- Lower Bound	2,500	0.120378129	0.120378129	0.079252145	0.038281493	1.05221E-06	0.120378138	0.120378	0.0792522	0.0382815	1.07362E-06
I-129	B -- Upper Bound	2,500	0.128094982	0.128094982	0.084332613	0.040735593	1.10064E-06	0.128094979	0.128095	0.0843326	0.0407356	1.12204E-06
I-129	C -- Hanford Only	2,500	0.11974949	0.11974949	0.078838274	0.038081593	1.07402E-06	0.119749488	0.11975	0.0788383	0.0380816	1.09543E-06
I-129	C -- Lower Bound	2,500	0.120316062	0.120316062	0.079211283	0.038261793	1.07992E-06	0.120316063	0.120316	0.0792113	0.0382618	1.10133E-06
I-129	C -- Upper Bound	2,500	0.104448373	0.104448373	0.068764631	0.033215793	1.12433E-06	0.104448374	0.104448	0.0687646	0.0332158	1.14574E-06
I-129	D1 -- Hanford Only	2,500	0.11974949	0.11974949	0.078838274	0.038081593	1.07402E-06	0.119749488	0.11975	0.0788383	0.0380816	1.09543E-06
I-129	D1 -- Lower Bound	2,500	0.120316062	0.120316062	0.079211283	0.038261793	1.07992E-06	0.120316063	0.120316	0.0792113	0.0382618	1.10133E-06
I-129	D1 -- Upper Bound	2,500	0.127864635	0.127864635	0.084180961	0.040662293	1.12433E-06	0.127864649	0.127865	0.084181	0.0406623	1.14574E-06
I-129	D2 -- Hanford Only	2,500	0.11974949	0.11974949	0.078838274	0.038081593	1.07402E-06	0.119749488	0.11975	0.0788383	0.0380816	1.09543E-06
I-129	D2 -- Lower Bound	2,500	0.120316062	0.120316062	0.079211283	0.038261793	1.07992E-06	0.120316063	0.120316	0.0792113	0.0382618	1.10133E-06
I-129	D2 -- Upper Bound	2,500	0.127864635	0.127864635	0.084180961	0.040662293	1.12433E-06	0.127864649	0.127865	0.084181	0.0406623	1.14574E-06

Table I.6. (contd)

Constituent	EIS Alternative Group and Waste Volume	Time Period (y)	Hanford Only Concentrations					Hanford Only plus Background Concentrations				
			Well Water (pCi/L)	Pore Water (pCi/L)	Sediment (pCi/kg)	Soil pCi/kg)	River Water (pCi/L)	Well Water (pCi/L)	Pore Water (pCi/L)	Sediment (pCi/kg)	Soil (pCi/kg)	River Water (pCi/L)
I-129	D3 -- Hanford Only	2,500	0.11974949	0.11974949	0.078838274	0.038081593	1.07402E-06	0.119749488	0.11975	0.0788383	0.0380816	1.09543E-06
I-129	D3 -- Lower Bound	2,500	0.120316062	0.120316062	0.079211283	0.038261793	1.07992E-06	0.120316063	0.120316	0.0792113	0.0382618	1.10133E-06
I-129	D3 -- Upper Bound	2,500	0.127864635	0.127864635	0.084180961	0.040662293	1.12433E-06	0.127864649	0.127865	0.084181	0.0406623	1.14574E-06
I-129	E1 -- Hanford Only	2,500	0.11974949	0.11974949	0.078838274	0.038081593	1.07402E-06	0.119749488	0.11975	0.0788383	0.0380816	1.09543E-06
I-129	E1 -- Lower Bound	2,500	0.120316062	0.120316062	0.079211283	0.038261793	1.07992E-06	0.120316063	0.120316	0.0792113	0.0382618	1.10133E-06
I-129	E1 -- Upper Bound	2,500	0.127864635	0.127864635	0.084180961	0.040662293	1.12433E-06	0.127864649	0.127865	0.084181	0.0406623	1.14574E-06
I-129	E2 -- Hanford Only	2,500	0.11974949	0.11974949	0.078838274	0.038081593	1.07402E-06	0.119749488	0.11975	0.0788383	0.0380816	1.09543E-06
I-129	E2 -- Lower Bound	2,500	0.120316062	0.120316062	0.079211283	0.038261793	1.07992E-06	0.120316063	0.120316	0.0792113	0.0382618	1.10133E-06
I-129	E2 -- Upper Bound	2,500	0.127864635	0.127864635	0.084180961	0.040662293	1.12433E-06	0.127864649	0.127865	0.084181	0.0406623	1.14574E-06
I-129	E3 -- Hanford Only	2,500	0.11974949	0.11974949	0.078838274	0.038081593	1.07402E-06	0.119749488	0.11975	0.0788383	0.0380816	1.09543E-06
I-129	E3 -- Lower Bound	2,500	0.120316062	0.120316062	0.079211283	0.038261793	1.07992E-06	0.120316063	0.120316	0.0792113	0.0382618	1.10133E-06
I-129	E3 -- Upper Bound	2,500	0.127864635	0.127864635	0.084180961	0.040662293	1.12433E-06	0.127864649	0.127865	0.084181	0.0406623	1.14574E-06
I-129	No Action -- Hanford Only	2,500	0.125311105	0.125311105	0.082499819	0.039853593	1.0798E-05	0.125311109	0.125311	0.0824998	0.0398536	1.08194E-05
I-129	No Action -- Lower Bound	2,500	0.126560891	0.126560891	0.083322628	0.040250993	1.08115E-05	0.126560887	0.126561	0.0833226	0.040251	1.08329E-05
Tc-99	A -- Hanford Only	2,500	27.15197489	27.151995	0	0	0.0003222	27.15197489	27.1819	0	0	0.0302272
Tc-99	A -- Lower Bound	2,500	27.39874461	27.398695	0	0	0.000325	27.39874461	27.4286	0	0	0.03023
Tc-99	A -- Upper Bound	2,500	29.93080273	29.930795	0	0	0.000345	29.93080273	29.9607	0	0	0.03025
Tc-99	B -- Hanford Only	2,500	28.00434551	28.004395	0	0	0.0003209	28.00434551	28.0343	0	0	0.0302259
Tc-99	B -- Lower Bound	2,500	27.91135856	27.911395	0	0	0.002927	27.91135856	27.9413	0	0	0.032832
Tc-99	B -- Upper Bound	2,500	30.31284024	30.312795	0	0	0.002949	30.31284024	30.3427	0	0	0.032854
Tc-99	C -- Hanford Only	2,500	27.15197489	27.151995	0	0	0.0001392	27.15197489	27.1819	0	0	0.0300442
Tc-99	C -- Lower Bound	2,500	27.39874461	27.398695	0	0	0.000142	27.39874461	27.4286	0	0	0.030047
Tc-99	C -- Upper Bound	2,500	27.68929441	27.689295	0	0	0.000159	27.68929441	27.7192	0	0	0.030064
Tc-99	D1 -- Hanford Only	2,500	23.21149495	23.211495	0	0	0.0003192	23.21149495	23.2414	0	0	0.0302242
Tc-99	D1 -- Lower Bound	2,500	23.43689509	23.436895	0	0	0.0003266	23.43689509	23.4668	0	0	0.0302316
Tc-99	D1 -- Upper Bound	2,500	25.71971436	25.719695	0	0	0.0003435	25.71971436	25.7496	0	0	0.0302485
Tc-99	D2 -- Hanford Only	2,500	38.78891164	38.788895	0	0	0.0003529	38.78891164	38.8188	0	0	0.0302579
Tc-99	D2 -- Lower Bound	2,500	39.1579924	39.157995	0	0	0.0003562	39.1579924	39.1879	0	0	0.0302612
Tc-99	D2 -- Upper Bound	2,500	41.44685661	41.446895	0	0	0.0003762	41.44685661	41.4768	0	0	0.0302812
Tc-99	D3 -- Hanford Only	2,500	26.1322235	26.132195	0	0	0.0003212	26.1322235	26.1621	0	0	0.0302262
Tc-99	D3 -- Lower Bound	2,500	26.37732699	26.377295	0	0	0.0003241	26.37732699	26.4072	0	0	0.0302291
Tc-99	D3 -- Upper Bound	2,500	28.66097581	28.660995	0	0	0.0003441	28.66097581	28.6909	0	0	0.0302491
Tc-99	E1 -- Hanford Only	2,500	38.78891164	38.788895	0	0	0.0003529	38.78891164	38.8188	0	0	0.0302579
Tc-99	E1 -- Lower Bound	2,500	39.1579924	39.157995	0	0	0.0003562	39.1579924	39.1879	0	0	0.0302612
Tc-99	E1 -- Upper Bound	2,500	41.44685661	41.446895	0	0	0.0003775	41.44685661	41.4768	0	0	0.0302825
Tc-99	E2 -- Hanford Only	2,500	23.21149495	23.211495	0	0	0.0003192	23.21149495	23.2414	0	0	0.0302242
Tc-99	E2 -- Lower Bound	2,500	23.43689509	23.436895	0	0	0.0003223	23.43689509	23.4668	0	0	0.0302273
Tc-99	E1 -- Upper Bound	2,500	25.71971436	25.719695	0	0	0.0003435	25.71971436	25.7496	0	0	0.0302485
Tc-99	E3 -- Hanford Only	2,500	26.16809347	26.168095	0	0	0.0003216	26.16809347	26.198	0	0	0.0302266
Tc-99	E3 -- Lower Bound	2,500	26.42107155	26.421095	0	0	0.0003246	26.42107155	26.451	0	0	0.0302296
Tc-99	E3 -- Upper Bound	2,500	28.48323888	28.483195	0	0	0.0003458	28.48323888	28.5131	0	0	0.0302508
Tc-99	No Action -- Hanford Only	2,500	26.47523623	26.475195	0	0	5.43E-05	26.47523623	26.5051	0	0	0.0299593
Tc-99	No Action -- Lower Bound	2,500	26.8241731	26.824195	0	0	5.76E-05	26.8241731	26.8541	0	0	0.0299626
U-233	A -- Hanford Only	10,000	0.019239124	0.0192391	0.0115435	0.00743482	8.71298E-07	0.019239124	0.0192391	0.0115435	0.00743482	8.71298E-07
U-233	A -- Lower Bound	10,000	0.019239124	0.0192391	0.0115435	0.00743482	8.71298E-07	0.019239124	0.0192391	0.0115435	0.00743482	8.71298E-07
U-233	A -- Upper Bound	10,000	0.019240732	0.0192407	0.0115444	0.00743544	8.71309E-07	0.019240732	0.0192407	0.0115444	0.00743544	8.71309E-07
U-233	B -- Hanford Only	10,000	0.020020185	0.0200202	0.0120121	0.00773664	8.71166E-07	0.020020185	0.0200202	0.0120121	0.00773664	8.71166E-07
U-233	B -- Lower Bound	10,000	0.020102212	0.0201022	0.0120613	0.00776986	4.55143E-06	0.020102212	0.0201022	0.0120613	0.00776986	4.55143E-06
U-233	B -- Upper Bound	10,000	0.021904117	0.0219041	0.0131425	0.00846809	9.2312E-06	0.021904117	0.0219041	0.0131425	0.00846809	9.2312E-06

Table I.6. (contd)

Constituent	EIS Alternative Group and Waste Volume	Time Period (y)	Hanford Concentrations					Hanford plus Background Concentrations				
			Well Water (pCi/L)	Pore Water (pCi/L)	Sediment (pCi/kg)	Soil (pCi/kg)	River Water (pCi/L)	Well Water (pCi/L)	Pore Water (pCi/L)	Sediment (pCi/kg)	Soil (pCi/kg)	River Water (pCi/L)
U-233	C -- Hanford Only	10,000	0.019239124	0.0192391	0.0115435	0.00743482	8.71298E-07	0.019239124	0.0192391	0.0115435	0.00743482	8.71298E-07
U-233	C -- Lower Bound	10,000	0.019239124	0.0192391	0.0115435	0.00743482	8.71298E-07	0.019239124	0.0192391	0.0115435	0.00743482	8.71298E-07
U-233	C -- Upper Bound	10,000	0.019240732	0.0192407	0.0115444	0.00743544	8.71298E-07	0.019240732	0.0192407	0.0115444	0.00743544	8.71298E-07
U-233	D1 -- Hanford Only	10,000	0.019277384	0.0192774	0.0115664	0.0074496	8.71744E-07	0.019277384	0.0192774	0.0115664	0.0074496	8.71744E-07
U-233	D1 -- Lower Bound	10,000	0.019284664	0.0192847	0.0115708	0.00745242	8.71829E-07	0.019284664	0.0192847	0.0115708	0.00745242	8.71829E-07
U-233	D1 -- Upper Bound	10,000	0.019234761	0.0192348	0.0115409	0.00743313	8.72232E-07	0.019234761	0.0192348	0.0115409	0.00743313	8.72232E-07
U-233	D2 -- Hanford Only	10,000	0.019300122	0.0193001	0.0115801	0.00745839	8.71405E-07	0.019300122	0.0193001	0.0115801	0.00745839	8.71405E-07
U-233	D2 -- Lower Bound	10,000	0.019310109	0.0193101	0.0115861	0.00746225	8.71448E-07	0.019310109	0.0193101	0.0115861	0.00746225	8.71448E-07
U-233	D2 -- Upper Bound	10,000	0.019311717	0.0193117	0.011587	0.00746287	8.71675E-07	0.019311717	0.0193117	0.011587	0.00746287	8.71675E-07
U-233	D3 -- Hanford Only	10,000	0.019217548	0.0192175	0.0115305	0.00742648	8.71047E-07	0.019217548	0.0192175	0.0115305	0.00742648	8.71047E-07
U-233	D3 -- Lower Bound	10,000	0.019217548	0.0192175	0.0115305	0.00742648	8.71047E-07	0.019217548	0.0192175	0.0115305	0.00742648	8.71047E-07
U-233	D3 -- Upper Bound	10,000	0.021744197	0.0217442	0.0130465	0.00840284	8.71057E-07	0.021744197	0.0217442	0.0130465	0.00840284	8.71057E-07
U-233	E1 -- Hanford Only	10,000	0.019314552	0.0193146	0.0115887	0.00746397	8.71317E-07	0.019314552	0.0193146	0.0115887	0.00746397	8.71317E-07
U-233	E1 -- Lower Bound	10,000	0.019330398	0.0193304	0.0115982	0.00747009	8.7136E-07	0.019330398	0.0193304	0.0115982	0.00747009	8.7136E-07
U-233	E1 -- Upper Bound	10,000	0.019405028	0.019405	0.011643	0.00749893	8.71587E-07	0.019405028	0.019405	0.011643	0.00749893	8.71587E-07
U-233	E2 -- Hanford Only	10,000	0.02250883	0.0225088	0.0135053	0.00869962	4.0334E-06	0.02250883	0.0225088	0.0135053	0.00869962	4.0334E-06
U-233	E2 -- Lower Bound	10,000	0.023094958	0.023095	0.013857	0.00892635	4.59661E-06	0.023094958	0.023095	0.013857	0.00892635	4.59661E-06
U-233	E2 -- Upper Bound	10,000	0.024828055	0.0248281	0.0148968	0.00959675	6.26212E-06	0.024828055	0.0248281	0.0148968	0.00959675	6.26212E-06
U-233	E3 -- Hanford Only	10,000	0.019218308	0.0192183	0.011531	0.00742678	8.71229E-07	0.019218308	0.0192183	0.011531	0.00742678	8.71229E-07
U-233	E3 -- Lower Bound	10,000	0.019218308	0.0192183	0.011531	0.00742678	8.71229E-07	0.019218308	0.0192183	0.011531	0.00742678	8.71229E-07
U-233	E3 -- Upper Bound	10,000	0.019219916	0.0192199	0.0115319	0.0074274	8.71239E-07	0.019219916	0.0192199	0.0115319	0.0074274	8.71239E-07
U-233	No Action -- Hanford Only	10,000	0.019314758	0.0193148	0.0115889	0.00746375	1.48031E-07	0.019314758	0.0193148	0.0115889	0.00746375	1.48031E-07
U-233	No Action -- Lower Bound	10,000	0.0193303	0.0193303	0.0115982	0.00746975	1.4804E-07	0.0193303	0.0193303	0.0115982	0.00746975	1.4804E-07
U-234	A -- Hanford Only	10,000	0.000817116	0.000817117	0.00049027	0.00031625	1.19975E-06	0.000817116	0.000826629	0.000495977	0.000320184	0.000010712
U-234	A -- Lower Bound	10,000	0.000817117	0.000817117	0.00049027	0.00031625	1.19975E-06	0.000817117	0.000826629	0.000495977	0.000320184	0.000010712
U-234	A -- Upper Bound	10,000	0.163744407	0.163744488	0.098246593	0.063275666	2.22165E-06	0.163744407	0.163754	0.0982523	0.0632796	1.17339E-05
U-234	B -- Hanford Only	10,000	0.437474418	0.437474488	0.262484293	0.169051066	1.24315E-06	0.437474418	0.437484	0.26249	0.169055	1.07554E-05
U-234	B -- Lower Bound	10,000	0.448669574	0.448669488	0.269201293	0.175305066	0.004661618	0.448669574	0.448679	0.269207	0.175309	0.00467113
U-234	B -- Upper Bound	10,000	0.621507956	0.621507488	0.372904293	0.244577066	0.010667488	0.621507956	0.621517	0.37291	0.244581	0.010677
U-234	C -- Hanford Only	10,000	0.000817116	0.000817117	0.00049027	0.00031625	1.19975E-06	0.000817116	0.000826629	0.000495977	0.000320184	0.000010712
U-234	C -- Lower Bound	10,000	0.000817117	0.000817117	0.00049027	0.00031625	1.19975E-06	0.000817117	0.000826629	0.000495977	0.000320184	0.000010712
U-234	C -- Upper Bound	10,000	0.163744407	0.163744488	0.098246593	0.063275266	1.19985E-06	0.163744407	0.163754	0.0982523	0.0632792	1.07121E-05
U-234	D1 -- Hanford Only	10,000	0.000887535	0.000887535	0.000532521	0.000343461	1.20065E-06	0.000887535	0.000897047	0.000538228	0.000347395	1.07129E-05
U-234	D1 -- Lower Bound	10,000	0.000899636	0.000899636	0.000539782	0.000348137	1.20075E-06	0.000899636	0.000909148	0.000545489	0.000352071	0.000010713
U-234	D1 -- Upper Bound	10,000	0.16373658	0.163736488	0.098241893	0.063272666	2.22375E-06	0.16373658	0.163746	0.0982476	0.0632766	0.000011736
U-234	D2 -- Hanford Only	10,000	0.000918869	0.000918869	0.000551322	0.000355569	1.20015E-06	0.000918869	0.000928381	0.000557029	0.000359503	1.07124E-05
U-234	D2 -- Lower Bound	10,000	0.000935462	0.000935462	0.000561278	0.000361981	1.20025E-06	0.000935462	0.000944974	0.000566985	0.000365915	1.07125E-05
U-234	D2 -- Upper Bound	10,000	0.163898492	0.163898488	0.098339093	0.063335266	2.22265E-06	0.163898492	0.163908	0.0983448	0.0633392	1.17349E-05
U-234	D3 -- Hanford Only	10,000	0.000805163	0.000805163	0.000483098	0.00031163	1.19965E-06	0.000805163	0.000814675	0.000488805	0.000315564	1.07119E-05
U-234	D3 -- Lower Bound	10,000	0.000805163	0.000805163	0.000483098	0.00031163	1.19965E-06	0.000805163	0.000814675	0.000488805	0.000315564	1.07119E-05
U-234	D3 -- Upper Bound	10,000	0.168912953	0.168912488	0.101347293	0.065272966	2.22145E-06	0.168912953	0.168922	0.101353	0.0652769	1.17337E-05
U-234	E1 -- Hanford Only	10,000	0.000965755	0.000965755	0.000579454	0.000373687	1.20015E-06	0.000965755	0.000975267	0.000585161	0.000377621	1.07124E-05
U-234	E1 -- Lower Bound	10,000	0.000992088	0.000992088	0.000595253	0.000383863	1.20015E-06	0.000992088	0.0010016	0.00060096	0.000387797	1.07124E-05
U-234	E1 -- Upper Bound	10,000	0.164112626	0.164112488	0.098467593	0.063417966	2.22265E-06	0.164112626	0.164122	0.0984733	0.0634219	1.17349E-05
U-234	E2 -- Hanford Only	10,000	0.006310399	0.006310398	0.003786243	0.002441176	6.48925E-06	0.006310399	0.00631991	0.00379195	0.00244511	1.60015E-05
U-234	E2 -- Lower Bound	10,000	0.00725084	0.007250838	0.004350503	0.002804956	7.39255E-06	0.00725084	0.00726035	0.00435621	0.00280889	1.69048E-05
U-234	E2 -- Upper Bound	10,000	0.175947854	0.175947488	0.105568293	0.068060566	0.000169494	0.175947854	0.175957	0.105574	0.0680645	0.000179006
U-234	E3 -- Hanford Only	10,000	0.000805575	0.000805575	0.000483345	0.00031179	1.19975E-06	0.000805575	0.000815087	0.000489052	0.000315724	0.000010712
U-234	E3 -- Lower Bound	10,000	0.000805575	0.000805575	0.000483345	0.00031179	1.19975E-06	0.000805575	0.000815087	0.000489052	0.000315724	0.000010712

Table I.6. (contd)

Constituent	EIS Alternative Group and Waste Volume	Time Period (y)	Hanford Concentrations					Hanford plus Background Concentrations				
			Well Water (pCi/L)	Pore Water (pCi/L)	Sediment (pCi/kg)	Soil (pCi/kg)	River Water (pCi/L)	Well Water (pCi/L)	Pore Water (pCi/L)	Sediment (pCi/kg)	Soil (pCi/kg)	River Water (pCi/L)
U-234	E3 -- Upper Bound	10,000	0.163727573	0.163727488	0.098236593	0.063269166	2.22155E-06	0.163727573	0.163737	0.0982423	0.0632731	1.17338E-05
U-234	No Action -- Hanford Only	10,000	0.063315922	0.063315888	0.037989593	0.025317566	0.002057138	0.063315922	0.0633254	0.0379953	0.0253215	0.00206665
U-234	No Action -- Lower Bound	10,000	0.065050382	0.065050388	0.039030193	0.025987766	0.002057138	0.065050382	0.0650599	0.0390359	0.0259917	0.00206665
U-235	A -- Hanford Only	10,000	3.24189E-05	3.242E-05	0.000019451	0.000012567	9.43958E-08	3.24189E-05	0.00127766	0.000766595	0.000527568	0.00124533
U-235	A -- Lower Bound	10,000	3.24189E-05	3.242E-05	0.000019451	0.000012567	9.43958E-08	3.24189E-05	0.00127766	0.000766595	0.000527568	0.00124533
U-235	A -- Upper Bound	10,000	0.007244668	0.00724467	0.004346796	0.002799569	1.3963E-07	0.007244668	0.00848991	0.00509394	0.00331457	0.00124538
U-235	B -- Hanford Only	10,000	0.012640731	0.01264076	0.007584436	0.004884719	9.56152E-08	0.012640731	0.013886	0.00833158	0.00539972	0.00124534
U-235	B -- Lower Bound	10,000	0.012982447	0.01298246	0.007789466	0.005072009	0.000133661	0.012982447	0.0142277	0.00853661	0.00558701	0.0013789
U-235	B -- Upper Bound	10,000	0.025609443	0.02560946	0.015365656	0.010021299	0.000302795	0.025609443	0.0268547	0.0161128	0.0105363	0.00154803
U-235	C -- Hanford Only	10,000	3.24189E-05	3.242E-05	0.000019451	0.000012567	9.43958E-08	3.24189E-05	0.00127766	0.000766595	0.000527568	0.00124533
U-235	C -- Lower Bound	10,000	3.24189E-05	3.242E-05	0.000019451	0.000012567	9.43958E-08	3.24189E-05	0.00127766	0.000766595	0.000527568	0.00124533
U-235	C -- Upper Bound	10,000	0.007244668	0.00724467	0.004346796	0.002799549	9.43981E-08	0.007244668	0.00848991	0.00509394	0.00331455	0.00124533
U-235	D1 -- Hanford Only	10,000	4.76617E-05	4.766E-05	0.000028597	0.000018457	9.45735E-08	4.76617E-05	0.0012929	0.000775741	0.000533458	0.00124533
U-235	D1 -- Lower Bound	10,000	5.01931E-05	5.019E-05	0.000030116	0.000019435	9.46029E-08	5.01931E-05	0.00129543	0.00077726	0.000534436	0.00124533
U-235	D1 -- Upper Bound	10,000	0.007244331	0.00724433	0.004346596	0.002799439	1.40001E-07	0.007244331	0.00848957	0.00509374	0.00331444	0.00124538
U-235	D2 -- Hanford Only	10,000	5.3649E-05	5.365E-05	0.000032189	0.000020771	9.44844E-08	5.3649E-05	0.00129889	0.000779333	0.000535772	0.00124533
U-235	D2 -- Lower Bound	10,000	5.71201E-05	5.712E-05	3.4272E-05	0.000022112	9.44993E-08	5.71201E-05	0.00130236	0.000781416	0.000537113	0.00124533
U-235	D2 -- Upper Bound	10,000	0.007271502	0.0072715	0.004362896	0.002809939	1.39823E-07	0.007271502	0.00851674	0.00511004	0.00332494	0.00124538
U-235	D3 -- Hanford Only	10,000	3.19318E-05	3.193E-05	1.9159E-05	1.2379E-05	9.43902E-08	3.19318E-05	0.00127717	0.000766303	0.00052738	0.00124533
U-235	D3 -- Lower Bound	10,000	3.19318E-05	3.193E-05	1.9159E-05	1.2379E-05	9.43902E-08	3.19318E-05	0.00127717	0.000766303	0.00052738	0.00124533
U-235	D3 -- Upper Bound	10,000	0.008184418	0.00818442	0.004910646	0.003162709	1.39623E-07	0.008184418	0.00942966	0.005765779	0.00367771	0.00124538
U-235	E1 -- Hanford Only	10,000	6.54069E-05	6.541E-05	3.9244E-05	0.000025314	9.44824E-08	6.54069E-05	0.00131065	0.000786388	0.000540315	0.00124533
U-235	E1 -- Lower Bound	10,000	7.09157E-05	7.092E-05	4.2549E-05	0.000027443	9.44974E-08	7.09157E-05	0.00131616	0.000789693	0.000542444	0.00124533
U-235	E1 -- Upper Bound	10,000	0.007313104	0.0073131	0.004387866	0.002826019	1.39821E-07	0.007313104	0.00855834	0.00513501	0.00334102	0.00124538
U-235	E2 -- Hanford Only	10,000	0.001176579	0.00117658	0.000705946	0.000455153	1.1942E-06	0.001176579	0.00242182	0.00145309	0.000970154	0.00124643
U-235	E2 -- Lower Bound	10,000	0.001379792	0.00137979	0.000827876	0.000533759	1.38946E-06	0.001379792	0.00262503	0.00157502	0.00104876	0.00124663
U-235	E2 -- Upper Bound	10,000	0.009362415	0.00936246	0.005617446	0.003621609	9.06002E-06	0.009362415	0.0106077	0.00636459	0.00413661	0.0012543
U-235	E3 -- Hanford Only	10,000	3.19489E-05	0.00003195	0.000019169	1.2385E-05	9.43942E-08	3.19489E-05	0.00127719	0.000766313	0.000527386	0.00124533
U-235	E3 -- Lower Bound	10,000	3.19489E-05	0.00003195	0.000019169	1.2385E-05	9.43942E-08	3.19489E-05	0.00127719	0.000766313	0.000527386	0.00124533
U-235	E3 -- Upper Bound	10,000	0.007243963	0.00724396	0.004346376	0.002799299	1.39627E-07	0.007243963	0.0084892	0.00509352	0.0033143	0.00124538
U-235	No Action -- Hanford Only	10,000	0.006186834	0.00618683	0.003712096	0.002588319	0.000477735	0.006186834	0.00743207	0.00445924	0.00310332	0.00172297
U-235	No Action -- Lower Bound	10,000	0.00624078	0.00624078	0.003744466	0.002609169	0.000477735	0.00624078	0.00748602	0.00449161	0.00312417	0.00172297
U-236	A -- Hanford Only	10,000	1.44967E-05	1.44967E-05	8.69801E-06	5.60296E-06	2.64836E-09	1.44967E-05	1.44967E-05	8.69801E-06	5.60296E-06	2.64836E-09
U-236	A -- Lower Bound	10,000	1.44967E-05	1.44967E-05	8.69802E-06	5.60297E-06	2.64836E-09	1.44967E-05	1.44967E-05	8.69802E-06	5.60297E-06	2.64836E-09
U-236	A -- Upper Bound	10,000	4.96879E-05	4.96879E-05	2.98127E-05	1.92018E-05	2.86907E-09	4.96879E-05	4.96879E-05	2.98127E-05	1.92018E-05	2.86907E-09
U-236	B -- Hanford Only	10,000	0.056462085	0.0564621	0.0338772	0.0218183	7.88492E-09	0.056462085	0.0564621	0.0338772	0.0218183	7.88492E-09
U-236	B -- Lower Bound	10,000	0.05789853	0.0578985	0.0347391	0.0226226	0.000602494	0.05789853	0.0578985	0.0347391	0.0226226	0.000602494
U-236	B -- Upper Bound	10,000	0.042325324	0.0423253	0.0253952	0.0169238	0.0013741	0.042325324	0.0423253	0.0253952	0.0169238	0.0013741
U-236	C -- Hanford Only	10,000	1.44967E-05	1.44967E-05	8.69801E-06	5.60296E-06	2.64837E-09	1.44967E-05	1.44967E-05	8.69801E-06	5.60296E-06	2.64837E-09
U-236	C -- Lower Bound	10,000	1.44967E-05	1.44967E-05	8.69802E-06	5.60297E-06	2.64837E-09	1.44967E-05	1.44967E-05	8.69802E-06	5.60297E-06	2.64837E-09
U-236	C -- Upper Bound	10,000	4.96879E-05	4.96879E-05	2.98127E-05	1.92017E-05	2.64837E-09	4.96879E-05	4.96879E-05	2.98127E-05	1.92017E-05	2.64837E-09
U-236	D1 -- Hanford Only	10,000	1.61736E-05	1.61736E-05	9.70415E-06	6.25096E-06	2.66792E-09	1.61736E-05	1.61736E-05	9.70415E-06	6.25096E-06	2.66792E-09
U-236	D1 -- Lower Bound	10,000	1.64687E-05	1.64687E-05	9.88122E-06	0.000006365	2.67135E-09	1.64687E-05	1.64687E-05	9.88122E-06	0.000006365	2.67135E-09
U-236	D1 -- Upper Bound	10,000	4.96515E-05	4.96515E-05	2.97909E-05	1.91877E-05	2.90786E-09	4.96515E-05	4.96515E-05	2.97909E-05	1.91877E-05	2.90786E-09
U-236	D2 -- Hanford Only	10,000	1.69772E-05	1.69772E-05	1.01863E-05	6.56151E-06	2.65594E-09	1.69772E-05	1.69772E-05	1.01863E-05	6.56151E-06	2.65594E-09
U-236	D2 -- Lower Bound	10,000	1.7382E-05	0.000017382	1.04292E-05	6.7179E-06	2.65768E-09	1.7382E-05	0.000017382	1.04292E-05	6.7179E-06	2.65768E-09
U-236	D2 -- Upper Bound	10,000	5.2613E-05	0.000052613	3.15678E-05	2.03321E-05	2.88712E-09	5.2613E-05	0.000052613	3.15678E-05	2.03321E-05	2.88712E-09
U-236	D3 -- Hanford	10,000	1.40597E-05	1.40597E-05	8.43584E-06	5.43411E-06	2.64329E-09	1.40597E-05	1.40597E-05	8.43584E-06	5.43411E-06	2.64329E-09
U-236	D3 -- Lower Bound	10,000	1.40597E-05	1.40597E-05	8.43584E-06	5.43411E-06	2.64329E-09	1.40597E-05	1.40597E-05	8.43584E-06	5.43411E-06	2.64329E-09

Table I.6. (contd)

Constituent	EIS Alternative Group and Waste Volume	Time Period (y)	Hanford Concentrations					Hanford plus Background Concentrations				
			Well Water (pCi/L)	Pore Water (pCi/L)	Sediment (pCi/kg)	Soil (pCi/kg)	River Water (pCi/L)	Well Water (pCi/L)	Pore Water (pCi/L)	Sediment (pCi/kg)	Soil (pCi/kg)	River Water (pCi/L)
U-236	D3 -- Upper Bound	10,000	0.000150066	0.000150066	9.00398E-05	5.79904E-05	2.864E-09	0.000150066	0.000150066	9.00398E-05	5.79904E-05	2.864E-09
U-236	E1 -- Hanford Only	10,000	1.79822E-05	1.79822E-05	1.07893E-05	6.94985E-06	2.65418E-09	1.79822E-05	1.79822E-05	1.07893E-05	6.94985E-06	2.65418E-09
U-236	E1 -- Lower Bound	10,000	1.86244E-05	1.86244E-05	1.11747E-05	7.19802E-06	2.65592E-09	1.86244E-05	1.86244E-05	1.11747E-05	7.19802E-06	2.65592E-09
U-236	E1 -- Upper Bound	10,000	5.67534E-05	5.67534E-05	0.000034052	2.19321E-05	2.88535E-09	5.67534E-05	5.67534E-05	0.000034052	2.19321E-05	2.88535E-09
U-236	E2 -- Hanford Only	10,000	0.000148445	0.000148445	8.90672E-05	5.74173E-05	1.31765E-07	0.000148445	0.000148445	8.90672E-05	5.74173E-05	1.31765E-07
U-236	E2 -- Lower Bound	10,000	0.000171572	0.000171572	0.000102943	6.63632E-05	1.5398E-07	0.000171572	0.000171572	0.000102943	6.63632E-05	1.5398E-07
U-236	E2 -- Upper Bound	10,000	0.000277881	0.000277881	0.000166729	0.000107486	2.56146E-07	0.000277881	0.000277881	0.000166729	0.000107486	2.56146E-07
U-236	E3 -- Hanford Only	10,000	1.4075E-05	0.000014075	8.44498E-06	0.00000544	2.64693E-09	1.4075E-05	0.000014075	8.44498E-06	0.00000544	2.64693E-09
U-236	E3 -- Lower Bound	10,000	1.4075E-05	0.000014075	8.44498E-06	0.00000544	2.64693E-09	1.4075E-05	0.000014075	8.44498E-06	0.00000544	2.64693E-09
U-236	E3 -- Upper Bound	10,000	4.92661E-05	4.92661E-05	2.95597E-05	1.90388E-05	2.86765E-09	4.92661E-05	4.92661E-05	2.95597E-05	1.90388E-05	2.86765E-09
U-236	No Action -- Hanford Only	10,000	0.005351044	0.00535104	0.00321063	0.00206862	2.05972E-06	0.005351044	0.00535104	0.00321063	0.00206862	2.05972E-06
U-236	No Action -- Lower Bound	10,000	0.005572981	0.00557298	0.00334379	0.00215439	2.05982E-06	0.005572981	0.00557298	0.00334379	0.00215439	2.05982E-06
U-238	A -- Hanford Only	10,000	0.000810499	0.000810499	0.000486	0.0003136	8.61969E-07	0.000810499	0.172506	0.103503	0.0713225	0.171696
U-238	A -- Lower Bound	10,000	0.000810499	0.000810499	0.000486	0.0003136	8.61969E-07	0.000810499	0.172506	0.103503	0.0713225	0.171696
U-238	A -- Upper Bound	10,000	0.169530834	0.169530826	0.101719	0.0655121	1.92015E-06	0.169530834	0.341226	0.204736	0.136521	0.171697
U-238	B -- Hanford Only	10,000	0.70126166	0.701261672	0.420757	0.2709851	9.27096E-07	0.70126166	0.872957	0.523774	0.341994	0.171696
U-238	B -- Lower Bound	10,000	0.719300064	0.719300074	0.43158	0.2810471	7.47675E-03	0.719300064	0.890995	0.534597	0.352056	0.179172
U-238	B -- Upper Bound	10,000	0.912198317	0.912198288	0.547319	0.3595301	1.70092E-02	0.912198317	1.08389	0.650336	0.430539	0.188704
U-238	C -- Hanford Only	10,000	0.000810499	0.000810499	0.000486	0.0003136	8.61969E-07	0.000810499	0.172506	0.103503	0.0713225	0.171696
U-238	C -- Lower Bound	10,000	0.000810499	0.000810499	0.000486	0.0003136	8.61969E-07	0.000810499	0.172506	0.103503	0.0713225	0.171696
U-238	C -- Upper Bound	10,000	0.169530834	0.169530826	0.101719	0.0655111	8.62022E-07	0.169530834	0.341226	0.204736	0.13652	0.171696
U-238	D1 -- Hanford Only	10,000	0.00098345	0.00098345	0.00059	0.0003804	8.63985E-07	0.00098345	0.172678	0.103607	0.0713893	0.171696
U-238	D1 -- Lower Bound	10,000	0.001012394	0.001012394	0.000607	0.0003916	8.64321E-07	0.001012394	0.172707	0.103624	0.0714005	0.171696
U-238	D1 -- Upper Bound	10,000	0.169523881	0.169523868	0.101714	0.0655091	1.92478E-06	0.169523881	0.341219	0.204731	0.136518	0.171697
U-238	D2 -- Hanford Only	10,000	0.00105326	0.00105326	0.000632	0.0004074	8.62946E-07	0.00105326	0.172748	0.103649	0.0714163	0.171696
U-238	D2 -- Lower Bound	10,000	0.001092949	0.001092949	0.000656	0.0004227	8.63117E-07	0.001092949	0.172788	0.103673	0.0714316	0.171696
U-238	D2 -- Upper Bound	10,000	0.169868924	0.169868923	0.101921	0.0656421	1.92253E-06	0.169868924	0.341564	0.204938	0.136651	0.171697
U-238	D3 -- Hanford Only	10,000	0.000800013	0.000800013	0.00048	0.0003095	8.61847E-07	0.000800013	0.172495	0.103497	0.0713184	0.171696
U-238	D3 -- Lower Bound	10,000	0.000800013	0.000800013	0.00048	0.0003095	8.61847E-07	0.000800013	0.172495	0.103497	0.0713184	0.171696
U-238	D3 -- Upper Bound	10,000	0.181192852	0.181192838	0.108716	0.0700181	1.92E-06	0.181192852	0.352888	0.211733	0.141027	0.171697
U-238	E1 -- Hanford Only	10,000	0.001182977	0.001182977	0.00071	0.0004575	8.62904E-07	0.001182977	0.172878	0.103727	0.0714664	0.171696
U-238	E1 -- Lower Bound	10,000	0.001245964	0.001245964	0.000748	0.0004819	8.63074E-07	0.001245964	0.172941	0.103765	0.0714908	0.171696
U-238	E1 -- Upper Bound	10,000	0.170376505	0.170376502	0.102226	0.0658381	1.92248E-06	0.170376505	0.342072	0.205243	0.136847	0.171697
U-238	E2 -- Hanford Only	10,000	0.013893758	0.013893757	0.008336	0.0053745	1.34427E-05	0.013893758	0.185589	0.111353	0.0763834	0.171708
U-238	E2 -- Lower Bound	10,000	0.01621504	0.016215039	0.009729	0.0062724	1.56731E-05	0.01621504	0.18791	0.112746	0.0772813	0.171711
U-238	E2 -- Upper Bound	10,000	0.196173591	0.196173579	0.117704	0.0758841	1.88596E-04	0.196173591	0.367869	0.220721	0.146893	0.171884
U-238	E3 -- Hanford Only	10,000	0.000800381	0.000800381	0.00048	0.0003097	8.61935E-07	0.000800381	0.172495	0.103497	0.0713186	0.171696
U-238	E3 -- Lower Bound	10,000	0.000800381	0.000800381	0.00048	0.0003097	8.61935E-07	0.000800381	0.172495	0.103497	0.0713186	0.171696
U-238	E3 -- Upper Bound	10,000	0.169515166	0.169515162	0.101709	0.0655051	1.92008E-06	0.169515166	0.34121	0.204726	0.136514	0.171697
U-238	No Action -- Hanford Only	10,000	0.290101165	0.29010116	0.174061	0.1209931	2.14981E-02	0.290101165	0.461796	0.277078	0.192002	0.193193
U-238	No Action -- Lower Bound	10,000	0.292909003	0.292908983	0.175745	0.1220781	2.14981E-02	0.292909003	0.464604	0.278762	0.193087	0.193193

Table I.7. Hanford and Hanford Plus Background Total Uranium Concentrations in Well Water, Pore Water, Sediment, Soil, and River Water for Each Time Period and Alternative Group. Values were calculated based on the assumptions presented in Sections I.3.1 and I.3.2.

EIS Alternative Group and Waste Volume	Time Period (y)	Hanford Concentrations					Hanford plus Background Concentrations				
		Well Water (ug/L)	Pore Water (ug/L)	Sediment (ug/kg)	Soil (ug/kg)	River Water (ug/L)	Well Water (ug/L)	Pore Water (ug/L)	Sediment (ug/kg)	Soil (ug/kg)	River Water (ug/L)
A – Hanford Only	10,000	0.002426657	0.002426657	0.001455994	0.000939	2.60629E-06	0.002426657	0.513391	0.308034	0.212261	0.510967
A -- Lower Bound	10,000	0.002426657	0.002426657	0.001455994	0.000939	2.60629E-06	0.002426658	0.513391	0.308034	0.212261	0.510967
A -- Upper Bound	10,000	0.507332782	0.507332782	0.304399669	0.196048	5.77296E-06	0.5073328	1.0183	0.610978	0.40737	0.51097
B -- Hanford Only	10,000	2.091388031	2.091388031	1.254832818	0.808168	2.80054E-06	2.091388069	2.60235	1.56141	1.01949	0.510967
B -- Lower Bound	10,000	2.145191708	2.145191708	1.287115025	0.838178	0.022297551	2.145191729	2.65616	1.59369	1.0495	0.533262
B -- Upper Bound	10,000	2.72423406	2.72423406	1.634540436	1.073688	0.05072523	2.724234264	3.2352	1.94112	1.28501	0.561689
C -- Hanford Only	10,000	0.002426657	0.002426657	0.001455994	0.000939	2.60629E-06	0.002426657	0.513391	0.308034	0.212261	0.510967
C -- Lower Bound	10,000	0.002426657	0.002426657	0.001455994	0.000939	2.60629E-06	0.002426658	0.513391	0.308034	0.212261	0.510967
C -- Upper Bound	10,000	0.507332782	0.507332782	0.304399669	0.196047	2.60645E-06	0.5073328	1.0183	0.610978	0.407369	0.510967
D1 -- Hanford Only	10,000	0.002947869	0.002947869	0.001768721	0.001141	2.61237E-06	0.002947869	0.513912	0.308347	0.212463	0.510967
D1 -- Lower Bound	10,000	0.003035085	0.003035085	0.001821051	0.001174	2.61338E-06	0.003035084	0.513999	0.308399	0.212496	0.510967
D1 -- Upper Bound	10,000	0.507311939	0.507311939	0.304387164	0.19604	5.7869E-06	0.507311938	1.01828	0.610966	0.407362	0.51097
D2 -- Hanford Only	10,000	0.003158176	0.003158176	0.001894906	0.001222	2.60924E-06	0.003158176	0.514122	0.308473	0.212544	0.510967
D2 -- Lower Bound	10,000	0.003277771	0.003277771	0.001966662	0.001268	2.60975E-06	0.00327777	0.514242	0.308545	0.21259	0.510967
D2 -- Upper Bound	10,000	0.508350307	0.508350307	0.305010184	0.196442	5.78012E-06	0.508350297	1.01931	0.611589	0.407764	0.51097
D3 -- Hanford Only	10,000	0.002395252	0.002395252	0.001437151	0.000927	2.60593E-06	0.002395252	0.513359	0.308016	0.212249	0.510967
D3 -- Lower Bound	10,000	0.002395252	0.002395252	0.001437151	0.000927	2.60593E-06	0.002395252	0.513359	0.308016	0.212249	0.510967
D3 -- Upper Bound	10,000	0.542436875	0.542436875	0.325462125	0.209613	5.7725E-06	0.542436851	1.0534	0.632041	0.420935	0.51097
E1 -- Hanford Only	10,000	0.003549238	0.003549238	0.002129543	0.001373	2.60911E-06	0.003549238	0.514513	0.308708	0.212695	0.510967
E1 -- Lower Bound	10,000	0.003739038	0.003739038	0.002243423	0.001446	2.60962E-06	0.003739038	0.514703	0.308822	0.212768	0.510967
E1 -- Upper Bound	10,000	0.509878497	0.509878497	0.305927098	0.197032	5.77999E-06	0.509878475	1.02084	0.612505	0.408354	0.51097
E2 -- Hanford Only	10,000	0.041850761	0.041850761	0.025110456	0.016189	4.05159E-05	0.041850761	0.552815	0.331689	0.227511	0.511005
E2 -- Lower Bound	10,000	0.048845622	0.048845622	0.029307373	0.018895	4.72369E-05	0.048845624	0.55981	0.335886	0.230217	0.511011
E2 -- Upper Bound	10,000	0.587517291	0.587517291	0.352510375	0.227265	0.000564848	0.58751732	1.09848	0.659089	0.438587	0.511529
E3 -- Hanford Only	10,000	0.002396352	0.002396352	0.001437811	0.000928	2.60619E-06	0.002396352	0.51336	0.308016	0.21225	0.510967
E3 -- Lower Bound	10,000	0.002396352	0.002396352	0.001437811	0.000928	2.60619E-06	0.002396352	0.51336	0.308016	0.21225	0.510967
E3 -- Upper Bound	10,000	0.507285879	0.507285879	0.304371527	0.19603	5.77277E-06	0.507285904	1.01825	0.61095	0.407352	0.51097
No Action -- Hanford Only	10,000	0.87369709	0.87369709	0.524218254	0.364139	0.064127245	0.873697104	1.38466	0.830797	0.575461	0.575091
No Action -- Lower Bound	10,000	0.87369709	0.87369709	0.524218254	0.364139	0.064127245	0.873697104	1.38466	0.830797	0.575461	0.575091

The ECEM was run deterministically (single calculation using a single value for each input parameter—radionuclide concentration, partition coefficient, species uptake rates, and so on). Model output consisted of estimated equilibrium exposures for receptors (Table I.8) potentially affected by the (1) combined radiological toxicity of individual radionuclides (see Section I.3.4) and (2) chemical toxicity of total uranium (Labrot et al. 1999; Domingo 2001) (see Section I.3.5).

Table I.8. Ecological Contaminant Exposure Model Receptors

Common Name	Scientific Name
Terrestrial Animals	
American coot	*Fulica americana*
American kestrel	*Falco sparverius*
American white pelican	*Pelecanus erythrorhynchos*
Beaver	*Castor canadensis*
bald eagle	*Haliaeetus leucocephalus*
bufflehead	*Bucephala albeola*
California quail	*Callipepla californica*
Canada goose	*Branta canadensis*
cliff swallow	*Petrochelidon pyrrhonota*
Common snipe	*Gallinago gallinago*
Coyote	*Canis latrans*
Forster's tern	*Sterna forsteri*
great blue heron	*Ardea herodias*
harvest mouse	*Reithrodontomys megalotis*
lizards (generic)[(a)]	
Mallard	*Anas platyrhynchos*
mule deer	*Odocoileus hemionus*
Muskrat	*Ondatra zibethica*
Northern harrier	*Circus cyaneus*
Raccoon	*Procyon lotor*
Terrestrial arthropods (generic)	
Western aquatic garter snake	*Thamnophis elegans*
Weasel	*Mustela* spp.
Woodhouse's toad (adult)	*Bufo woodhousei*
Terrestrial Plants	
black cottonwood	*Populus trichocarpa*
Columbia yellowcress	*Rorippa columbiae*
dense sedge	*Carex densa*
fern (generic)	
fungi (generic)	
Mulberry	*Morus alba*
reed canarygrass	*Phalaris arundinacea*
Rushes	*Juncus* spp.
Tule	*Scirpus* spp.

(a) generic = not specific to a species or genus. Thus, none provided under "scientific name".

Table I.8. (contd)

Aquatic Animals	
carp	*Cyprinus carpio*
channel catfish	*Ictalurus punctatus*
clams (generic)	
Columbia pebblesnail	*Flumicola columbiana*
crayfish (generic)	
water flea	*Daphnia magna*
fresh-water shrimp	*Hyallela* spp.
largescale/mountain sucker	*Catostomus macrocheilus*/*C. platyrhynchus*
mayfly (generic)	
mountain whitefish	*Prosopium williamsoni*
mussels (generic)	
Pacific lamprey (juvenile)	*Entosphenus tridentatus*
rainbow trout (adult)	*Salmo gairdneri*
rainbow trout (eggs)	*Salmo gairdneri*
rainbow trout (juvenile)	*Salmo gairdneri*
salmon (generic) (adult)	*Oncorhynchus* spp.
salmon (generic) (eggs)	*Oncorhynchus* spp.
salmon (generic) (juvenile)	"
smallmouth bass	*Micropterus dolomieui*
Woodhouse's toad (tadpole)	*Bufo woodhousei*
white sturgeon	*Acipenser transmontanus*
Aquatic Plants	
periphyton (generic)	
phytoplankton (generic)	
water milfoil	*Myriophyllum* spp.

I.3.4 Combined Radiological Toxicity

Estimated equilibrium exposures for terrestrial and aquatic animal and plant receptors consisted of total radiological dose (rad/day). Risk is assessed via calculation of environmental hazard quotients (EHQs). The EHQ, or level of risk, is indicated by the ratio of the estimated exposure to a measurement (effect) endpoint such as a radiological dose limit or standard.

Radiological risk EHQs are calculated by dividing the estimated total radiological dose by the applicable DOE dose limit or standard. These dose limits and standards are 1 rad/day for native aquatic animals (DOE 1993), 0.1 rad/day for terrestrial animals, and 1 rad/day for aquatic and terrestrial plants (DOE 2002). An EHQ greater than 1 indicates a potential risk of radiotoxic effects.

Environmental hazard quotients based on total dose from all radiological constituents are provided for the Hanford and Hanford plus background exposure scenarios for the one receptor in Table I.8 that was at maximal risk in each alternative group and time period. These receptors were the mayfly for all

alternative groups in the 0- to 2500-year time period (Figure I.8) and Woodhouse's toad tadpole for all alternative groups in the 0- to 10,000-year time period (Figure I.9).

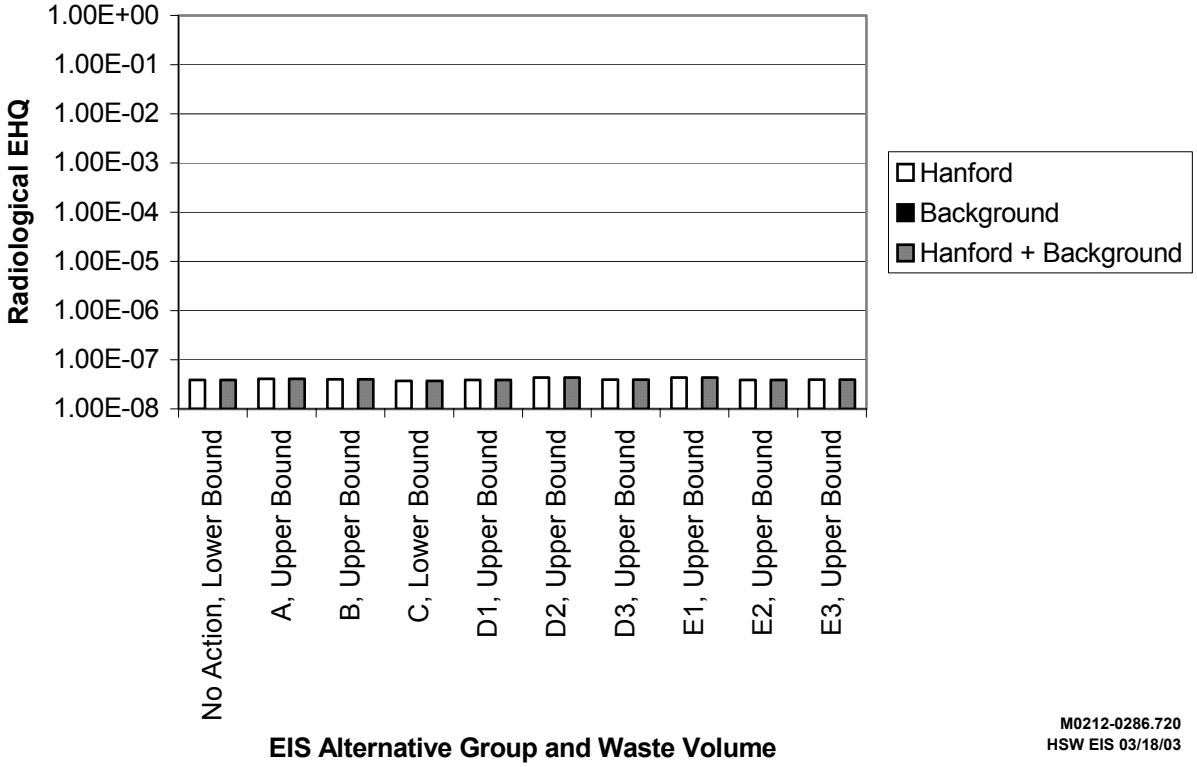

Figure I.8. Mayfly Radiological EHQs for Each Alternative Group in the 0- to 2500-Year Time Period for Background Compared to the Hanford and Hanford Plus Background Scenarios

Results are provided for only those waste volumes that yielded maximal risk (i.e., Lower Bound waste volumes for the No Action Alternative and Upper Bound waste volumes for Alternative Groups A, B, D_1, D_2, D_3, E_1, E_2, and E_3 for the 0- to 2500-year and the 2500- to 10,000-year time periods, as well as Lower and Upper Bound waste volumes for Alternative Group C for the 0- to 2500-year and 2500- to 10,000-year time periods, respectively).

The discussion below covers three points of interest: (1) Hanford's contribution to risk relative to the background contribution, (2) risk as a discriminator among the alternative groups, and (3) the magnitude of risk under each alternative group relative to a minimal level of concern (EHQ of 1).

Mayfly EHQs for the Hanford scenario are much larger than for background (Figure I.8), indicative of miniscule background concentrations of technetium-99 and iodine-129. Mayfly EHQs for both the Hanford and Hanford plus background scenarios were at least seven orders of magnitude below the minimal level of concern (EHQ of 1) (Figure I.8). Consequently, there is essentially no risk of adverse radiological impacts under any of the alternative groups for the 0- to 2500-year time period. Further,

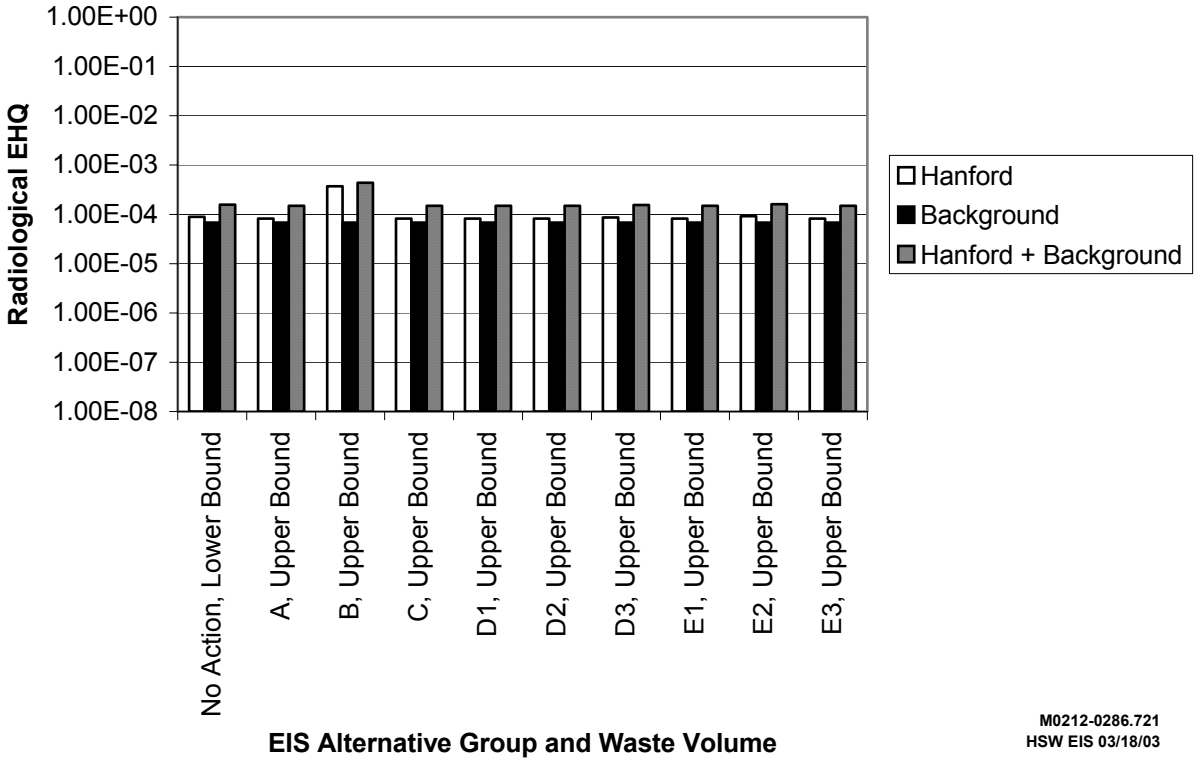

Figure I.9. Woodhouse's Toad Tadpole Radiological EHQs for Each Alternative Group in the 2500- to 10,000-Year Time Period for Background Compared to the Hanford and Hanford Plus Background Scenarios

radiological risk does not appear to be an important discriminator among the alternative groups in the0- to 2500-year time period because the mayfly EHQs were essentially the same for all the alternative groups (Figure I.8).

Woodhouse's toad tadpole EHQs for the Hanford scenario are slightly larger than for background under the Alternative Groups A, C, D_1, D_2, D_3, E_1, E_2, and E_3 (Figure I.9). Woodhouse's toad tadpole EHQs for the Hanford scenario are slightly higher relative to those for background for the No Action Alternative (Figure I.9) and substantially higher for Alternative Group B (Figure I.9). This is indicative of uranium levels elevated above background in all the alternative groups, particularly in Alternative Group B. Nonetheless, Woodhouse's toad tadpole EHQs for both the Hanford and Hanford plus background scenarios were at least three orders of magnitude below the minimal level of concern (EHQ of 1) (Figure I.9). Consequently, there is essentially no risk of adverse radiological impacts under any of the alternative groups for the 2500- to 10,000-year time period. Further, except for Alternative Groups A and B, radiological risk does not appear to be an important discriminator among the other alternative groups in the 2500- to 10,000-year time period because the Woodhouse's toad tadpole EHQs were essentially the same for these other alternative groups (Figure I.9).

I.3.5 Chemical Toxicity of Total Uranium

Terrestrial Receptors. Estimated equilibrium exposures for terrestrial receptors consisted of absorbed daily dose (µg/kg/day). Chemical toxicity EHQs for terrestrial animal receptors were calculated by dividing the estimated absorbed daily dose by the lowest dose known to produce a clinically toxic response in any member of a population (i.e., the lowest observed effects level or LOEL). The LOEL, based on chronic exposure, was selected because it was deemed to be most representative of effects that might occur during a long-term contaminant release.

Few data are available for assessing the toxic effects of non-pesticide chemicals on wildlife (Suter 1993). Consequently, it is generally necessary to use toxicity data for domestic animals that differ taxonomically (often widely so) from the species of interest. Also, the endpoint (e.g., LOEL) of a toxicity test may not apply to the exposure conditions of interest (e.g., mortality endpoint, such as an LD_{50} [median lethal dose, typically based on a 96-hour test] used to assess risk of lowest adverse effects to terrestrial animals under chronic exposure conditions). Such situations often require extrapolation of toxicity data across taxa and endpoints using uncertainty factors.

The chemical toxicity data used in calculating EHQs for terrestrial animal exposure to total uranium were as follows. Only two suitable uranium toxicity values were available. A LOEL of 6.13 mg/kg/day based on toxicity to mice (*Mus* spp.) (Opresko et al. 1995) was used. This value falls well within the range of doses known to cause reproductive and developmental effects in mice and rats (Domingo 2001). The mouse LOEL was extrapolated for use with all other terrestrial animal receptors by dividing it by an uncertainty factor of 10 (0.613 mg/kg/day). This extrapolation between taxa is consistent with DOE (1998).

In addition, a no observed adverse effects level (NOAEL) of 16 mg/kg/day, based on toxicity to black ducks (*Anas rubripes*) (Opresko et al. 1995) was used. The black duck NOAEL was multiplied by a factor of 10 to derive a LOEL (160 mg/kg/day) for use with all other terrestrial animal receptors. This extrapolation between endpoints is based on Dourson and Stara (1983) and is consistent with DOE (1998).

Because neither the derived black duck nor the derived mouse LOEL was considered more reliable, the former was used to calculate low and the latter high EHQs for all terrestrial animal receptors.

Low and high EHQs for total uranium, based on the derived black duck and mouse LOELs, respectively, are provided for the Hanford scenario and background (Figure I.10) and the Hanford plus background scenario (Figure I.11) for the one terrestrial animal receptor in Table I.8 that is at maximal risk in each alternative group in the 2500- to10,000-year time period—the American coot. Results are provided only for those waste volumes that yielded maximal risk (i.e., Hanford Only and Lower Bound waste volumes for the No Action Alternative and the Upper Bound waste volume for all other alternative groups).

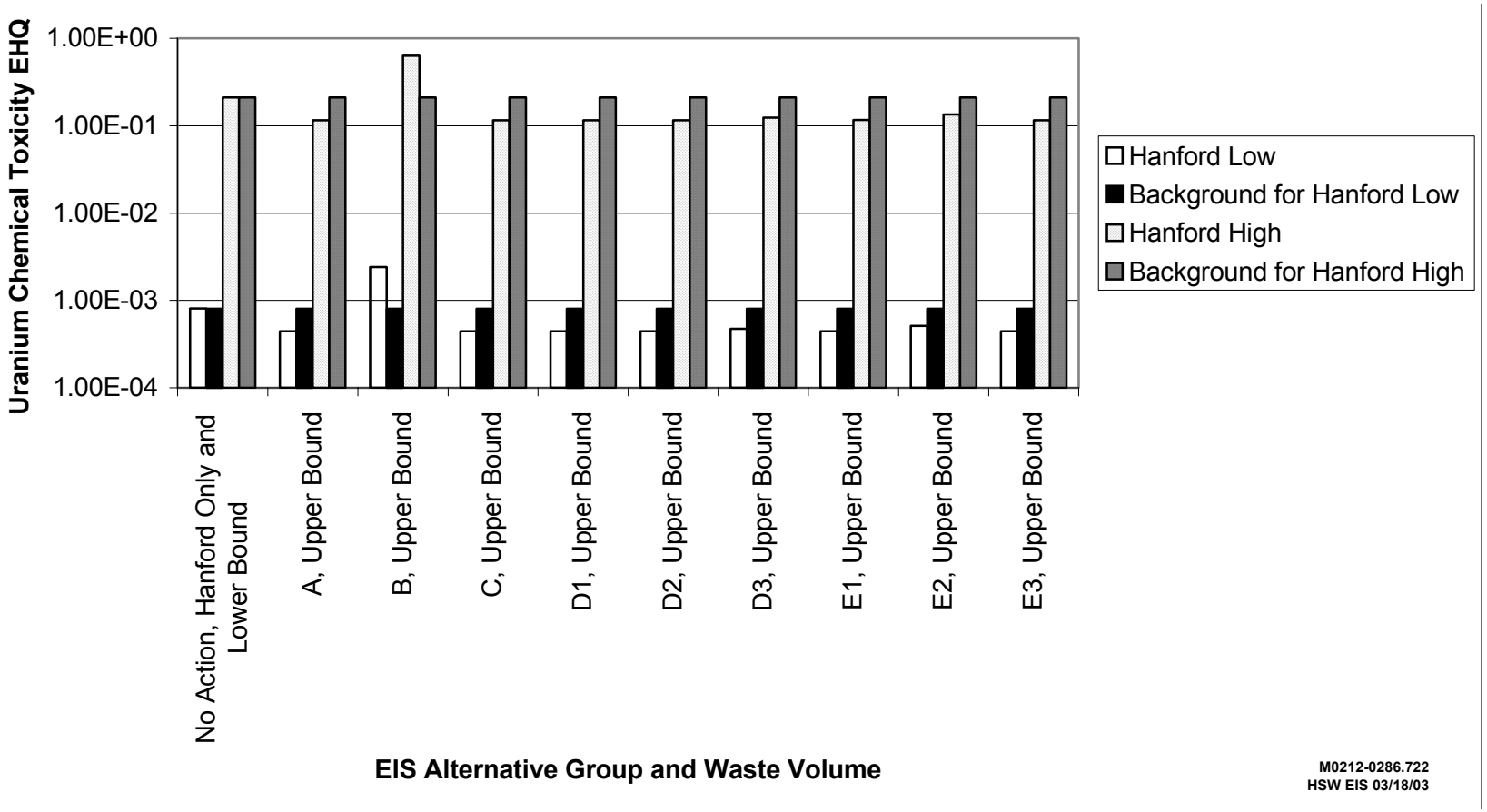

Figure I.10. American Coot Low and High Uranium Chemical Toxicity EHQs for Each Alternative Group in the 2500- to 10,000-Year Time Period for Background and the Hanford Scenario

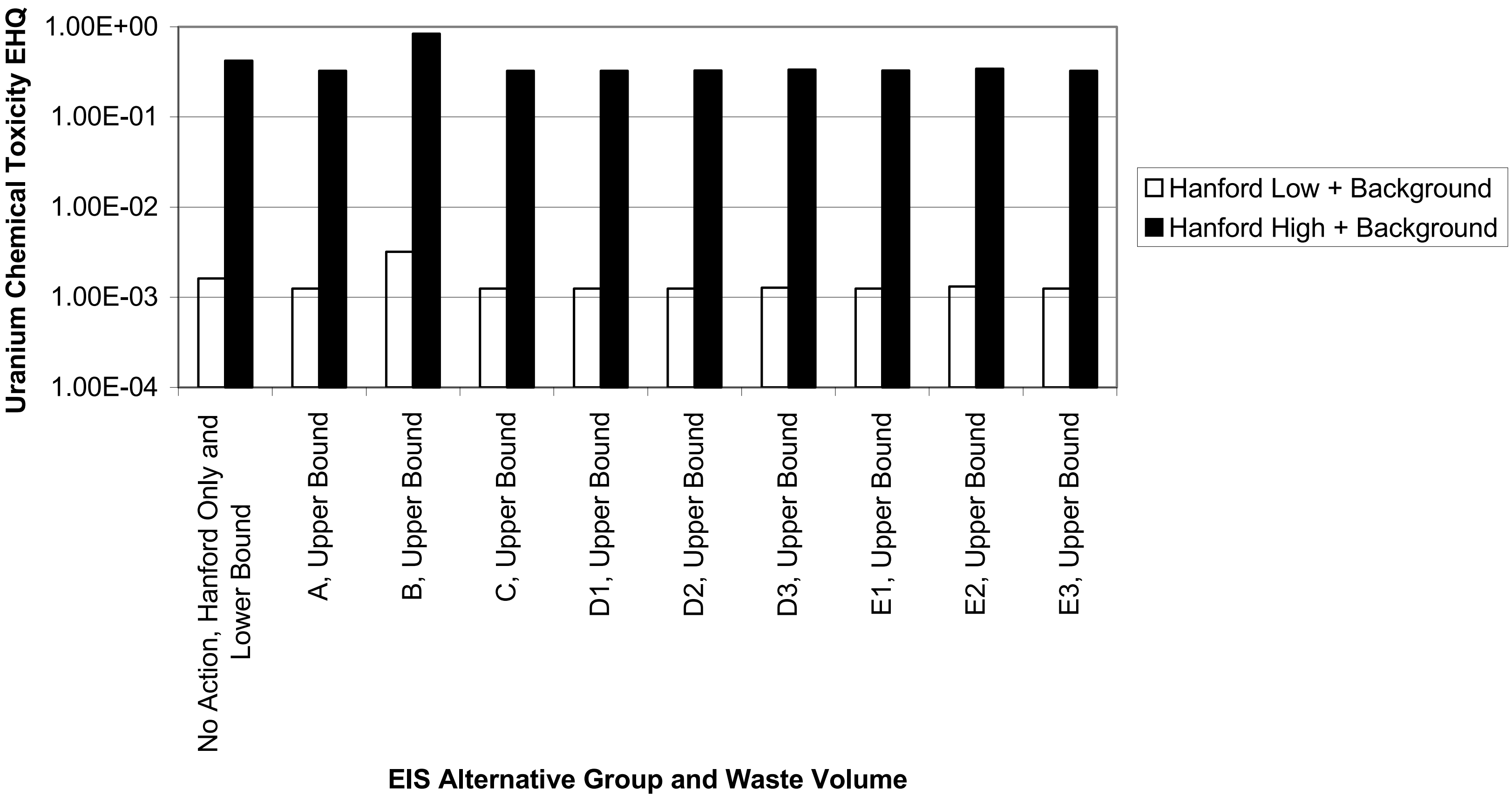

Figure I.11. American Coot Low and High Uranium Chemical Toxicity EHQs for Each Alternative Group in the 2500- to 10,000-Year Time Period for the Hanford Plus Background Scenario

The low and high coot EHQs for the Hanford scenario are less than for background under Alternative Groups A, C, D_1, D_2, D_3, E_1, E_2, and E_3 (Figure I.10). Coot EHQs for the Hanford scenario are equal to background for the No Action Alternative (Figure I.10) and substantially higher for Alternative Group B (Figure I.10), indicative of uranium levels elevated above background in Alternative Group B.

The high coot EHQs were approximately two to three orders of magnitude greater than the low EHQs (Figure I.10). Neither the low nor high coot EHQs exceeded the minimal level of concern (EHQ of 1) for either the Hanford (Figure I.10) or Hanford plus background (Figure I.11) scenarios. Because the entire range of coot EHQs was below an EHQ of 1 for both scenarios (Figures I.10 and I.11), only a negligible risk of uranium chemical toxicity to terrestrial receptors exists under all the alternative groups.

Except for Alternative Groups A and B, uranium chemical toxicity risk to terrestrial receptors does not appear to be an important discriminator among the other alternative groups because coot EHQs were essentially the same for these other alternative groups (Figure I.10).

Aquatic Receptors. Estimated equilibrium exposures for aquatic receptors are tissue concentrations expressed in terms of micrograms per kilogram (µg/kg). One way of calculating chemical toxicity EHQs for aquatic animal receptors is by dividing the estimated tissue concentration by the lowest tissue concentration known to produce a clinically toxic response (i.e., the lowest observed effects concentration, or LOEC), where such concentrations are available. The LOEC, based on chronic exposure, was selected because it was deemed to be most representative of effects that might occur during a long-term contaminant release.

LOECs or other tissue-concentration–based toxicity data were unavailable for aquatic animal receptors, so water-concentration–based toxicity data were used. EHQs thus were calculated by comparing the equivalent water concentration for the receptor with the lowest water concentration known to produce a clinically toxic response.

The equivalent water concentration in micrograms per liter (µg/L) is derived by dividing the receptor's estimated tissue concentration (µg/kg) by the bioconcentration factor (BCF) in liters per kilogram (L/kg). The BCF is the ratio of the tissue concentration of an aquatic organism to the water concentration where uptake is to limited to water alone, usually derived in an experimental setting. Thus, the equivalent water concentration is the water concentration that would result in the receptor's estimated tissue concentration via gill/respiratory uptake and dermal uptake alone (i.e., excluding uptake from foods, ingestion of sediment, and dermal uptake from sediment). The ratio of an equivalent water concentration to a water-concentration-based toxicity benchmark is equivalent to the ratio of a tissue concentration to a tissue-concentration-based toxicity benchmark such as a LOEC.

The BCF values used in deriving the equivalent water concentrations were those reported in conjunction with the aquatic toxicity data described below (i.e., 8.87E-03 for the teleost fish [of or belonging to a large group of fishes with bony skeletons] [*Brachydanio rerio*] and 55.67E-03 for the bivalve mollusk [*Corbicula fluminea*] [Labrot et al. 1999]). The teleost fish BCF was used to calculate equivalent water concentrations for fish, lamprey, and the Woodhouse's toad tadpole. The *Corbicula* BCF was used to calculate equivalent water concentrations for crayfish, mayfly, clams, mussels, and the Columbia pebble snail. In addition, more conservative BCFs from the literature (i.e., 50, the upper end of

a range of BCFs [2 to 50] for generic fish, and 1000, the upper end of a range of BCFs [100 to 1000] for generic aquatic invertebrates [Fellows et al. 1998]) were similarly used. Because neither the generic nor species-specific BCFs were considered more reliable, the former were used to calculate low EHQs and the latter high EHQs.

As is the case with toxicity data for terrestrial receptors, it is frequently necessary to extrapolate aquatic toxicity data across taxa and endpoints using uncertainty factors. The chemical toxicity data used in calculating EHQs for aquatic animal exposure to total uranium were as follows. Only two suitable uranium values were available. Because LOECs and tissue-concentration-based toxicity data were lacking for uranium, a uranium 96-hour LC_{50} (median lethal concentration) (3.05 mg/L) for the teleost fish (Labrot et al. 1999) was used. This value was divided by 10 to yield a LOEC (0.305 mg/L). The derived teleost fish LOEC was used to calculate EHQs for fish, lamprey, and the Woodhouse's toad tadpole. A uranium 96-hour LC_{50} (1,872.08 mg/L) for the bivalve mollusk (Labrot et al. 1999) was divided by 10 to yield a LOEC (187.208 mg/L). The derived *Corbicula* LOEC was used to calculate EHQs for crayfish, mayfly, clams, mussels, and the Columbia pebble snail. The above extrapolations from acute to chronic toxicity values are based on Dourson and Stara (1983) and are consistent with DOE (1998).

Low and high EHQs for total uranium, based on the generic and Labrot et al. (1999) BCFs, respectively, are provided for the Hanford scenario and background (Figure I.12) and the Hanford plus background scenario (Figure I.13) for the one aquatic animal receptor in Table I.8 that is at maximal risk in each alternative group in the 2500- to 10,000-year time period—Woodhouse's toad tadpole. Results are provided for only those waste volumes that yielded maximal risk (i.e., Hanford Only and Lower Bound waste volumes for the No Action Alternative and the Upper Bound waste volume for all other alternative groups).

The high and low Woodhouse's toad tadpole EHQs for the Hanford scenario are less than for background under Alternative Groups A, C, D_1, D_2, D_3, E_1, E_2, and E_3 (Figure I.12). Tadpole EHQs for the Hanford scenario are equal to background for the No Action Alternative (Figure I.12) and substantially higher than background for Alternative Group B (Figure I.12), indicative of uranium levels elevated above background in Alternative Group B.

The high Woodhouse's toad tadpole EHQs were approximately three to four orders of magnitude greater than the low EHQs (Figure I.12). The low and high EHQs were below or well above and EHQ of one, respectively, for the Hanford (Figure I.12) and Hanford plus background scenarios (Figure I.13) for all the alternative groups. Based on the range of the EHQs alone, it is inconclusive whether or not there would be a non-discountable uranium chemical toxicity risk to this receptor. Further, it is important to note that both the low and high tadpole EHQs are based on uptake parameters (BCFs) and a toxicity benchmark from fish, which have questionable applicability when evaluating risk in toad tadpoles. Consequently, the EHQs of fish receptors at maximal risk should be examined as well.

The carp had the next highest EHQs behind Woodhouse's toad tadpole. Because largescale/mountain sucker and smallmouth bass EHQs differed from those of the carp by no more than 0.01 in any alternative group and scenario, the three species are considered together.

Low and high EHQs for total uranium, based on the generic and Labrot et al. (1999) BCFs, respectively, are provided for the Hanford scenario and background (Figure I.14) and the Hanford plus background scenario (Figure I.15) for the carp (and largescale/mountain sucker and smallmouth bass) in each alternative group in the 2500- to 10,000-year time period. Results are provided for only those waste volumes that yielded maximal risk (i.e., Hanford Only and Lower Bound waste volumes for the No Action Alternative and the Upper Bound waste volume for all other alternative groups).

The high carp (and largescale/mountain sucker and smallmouth bass) EHQs were approximately three to four orders of magnitude greater than the low EHQs (Figure I.14). Neither the high nor the low carp EHQs exceeded 1 for the Hanford (Figure I.14), or the Hanford plus background (Figure I.15) scenarios, except for Alternative Group B, in which the high EHQ was just slightly above 1 (Figures I.14 and I.15). Consequently, only a negligible risk of uranium chemical toxicity to these fish receptors exists under all the alternative groups, except Alternative Group B, because the entire range of EHQs for these three species falls below 1. There may be a slight risk of chronic uranium chemical toxicity to these fish receptors under Alternative Group B, although this is unlikely for the following reasons. First, the groundwater modeling of contaminants in the hypothetical well along the river and in the river was conservative (see Appendix G). Second, simultaneous exposure to maximum contaminant concentrations that do not always occur concurrently in time and space was assumed for this risk assessment (see Section I.3.1).

Carp (and largescale/mountain sucker and smallmouth bass) EHQs were virtually the same for all alternative groups, except for Alternative Groups A and B, which were approximately one-third to three-quarters of an order of magnitude, respectively, higher than the other alternative groups (Figures I.14 and I.15). Consequently, except for Alternative Groups A and B, risk of uranium chemical toxicity to fish receptors does not appear to be an important discriminator among the other alternative groups.

All other aquatic animal receptors had EHQs that were less than those of carp, largescale/mountain sucker, and smallmouth bass. Therefore, only a negligible risk of uranium chemical toxicity to these receptors exists under all the alternative groups.

I.4 Consultations

DOE consults with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service regarding potential actions that may affect sensitive habitats or species on the Hanford Site. Copies of the DOE consultation letters and agency responses are included in Attachment B to this appendix.